• 15R1102B200 •

IRIS BLUE

AC DRIVE

Specific for Water, Fan and Compressor Applications

USER MANUAL

- Programming Instructions -

Issued on 11/09/17
R. 02
Software Version 4.13x

English

• This manual is integrant and essential to the product. Carefully read the instructions contained herein as they provide important hints for use and maintenance safety.
• This device is to be used only for the purposes it has been designed to. Other uses should be considered improper and dangerous. The manufacturer is not responsible for possible damages caused by improper, erroneous and irrational uses.
• Elettronica Santerno is responsible for the device in its original setting.
• Any changes to the structure or operating cycle of the device must be performed or authorized by the Engineering Department of Elettronica Santerno.
• Elettronica Santerno assumes no responsibility for the consequences resulting by the use of non-original spare-parts.
• Elettronica Santerno reserves the right to make any technical changes to this manual and to the device without prior notice. If printing errors or similar are detected, the corrections will be included in the new releases of the manual.

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REVISION INDEX

Modifications with respect to Programming Guide 15R1102B200, release R.00, SW version 4.06x dated 15/09/2015 and release R.01, SW version 4.11x dated 07/04/2016.

The following subjects covered in this Programming Guide R.02 (SW version 4.13x) have been added, changed or suppressed with respect to the previous version R.00 (SW version 4.06x) or R.01 (SW version 4.11x).

ENERTRONICA GROUP logo added.
The following parameters have been added to the [CFG] MOTOR CONFIGURATION MENU

- **C030** (Field Weakening Speed)
- **C030a** (Field Weakening Time Constant)

The following parameters have been added to the [CFG] DIGITAL INPUTS MENU

- **C151** (REVERSE)
- **C154a** (Enable Signal from Terminal Board only)
- **C159** (CW/CCW)
- **C179a**, **C179b** (Selection of Commands and References)

The picture related to the ENABLE control has been changed.
D74 selection added: kWh pulse in Table 46: List of the selectable digital inputs and analog outputs.
The description of custom PID Measurements **M023**/**023a**/**024**/**024a** has been rectified.
Measurement **M051** (Frequency Input) has been removed along with all the references to FINA and FINB inputs.
The MODBUS address of the Texas SW version has been rectified.
The MODBUS addresses in the [CFG] DATE AND TIME MENU have been rectified.
The VTC procedure has been integrated with a new procedure to get equal estimated torque and generated torque.
Table 57: List of the programmable measurements in P330 to P331 has been split from Table 23: List of the programmable measurements in P268, P268a, P268b, P268c, P268d, P268e.
The First Start Up section has been added to the MULTIMOTOR CONTROL (MMC) menu.
Alarms **A100** Illegal MDI6 Configuration and **A101** Illegal MDI8 Configuration have been removed.
Alarms **A110** Fieldbus Board Alarm, **A136** Dry Run Alarm and **A137** Pressure Loss Alarm have been added.
The “Side A” wording has been removed from the description of the alarms related to the IGBTs.
The **06h: Write Single Register** function has been added to the MODBUS-RTU Protocol.

USER MANUALS MENTIONED IN THIS PROGRAMMING GUIDE

The following User Manuals from Elettronica Santerno are mentioned throughout this Programming Guide:

- **15P0102B200** IRIS BLUE – Installation Guide
- **15W0102B300** Safe Torque Off Function – Application Manual
- **15G0010B1** PROFIdrive COMMUNICATIONS BOARD – User Manual
- **15G0851B100** DATA LOGGER ES851 – Programming Guide
- **15J1102B100** IrisControl – User Manual
- **15W0102B500** Motor Drives Accessories – User Manual
- **15J0901B100** Iris Control DRIVE REMOTE CONTROL – User Manual

0. TABLE OF CONTENTS

0.1. Chapters

0.2. Figures

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1. SCOPE OF THIS MANUAL

Elettronica Santerno is committed to update its User Manuals available for download from santerno.com with the latest software version officially released. Please contact Elettronica Santerno if you require technical documents related to previous software versions.

2. HOW THIS MANUAL IS ORGANISED

2.1. Overview

This User Manual (Programming Guide) provides any information required to setup and monitor the drives of the IRIS BLUE series manufactured by Elettronica Santerno S.p.A.

Setup/monitoring may be obtained using one of the following options:

- Display/keypad unit;
- Serial link through RS485 standard port or ES822 (isolated optional serial board) RS485/RS32;
- ES851 (optional Data Logger and communications board).

For the instructions on how to use and remote the keypad, please refer to the IRIS BLUE – Installation Guide / Motor Drives Accessories – User Manual.

IRIS Control

Any information sent to/from the drive via the display/keypad unit may be obtained also via serial link using the Iris Control software application offered by Elettronica Santerno. See the Iris Control DRIVE REMOTE CONTROL – User Manual.
This software allows the following functions: image acquisition, keypad simulation, oscilloscope functions and multifunction tester, data logger, table compiler including history data, parameter setup and data reception-transmission-storage from and to a computer, scan function for the automatic detection of the connected drives (up to 247 drives may be connected).

You can also create your own dedicated software via serial communication link. This manual provides any information concerning addressing (Address field) and scaling (Range field) for the drive interfacing.

2.2. Menus and Submenus

This User Manual (Programming Guide) is divided into different Menus. Their sequence is the same as their display sequence in the display/keypad and the Iris Control software.

Programming parameters and Measure parameters are divided into:

2.2.1. M Measurements

(read-only)

Mxxx	Description	
Range	Drive representation (integer)	Display on the display/keypad and the Iris Control (may be a decimal figure) plus unit of measure
Active	Type of control the measurement is related to	
Address	Modbus address which the measurement can be read from (integer)	
Function	Measurement description	

2.2.2. PARAMETERS P, R, I, C

Pxxx	Description	
Range	Drive representation (integer)	Display on the display/keypad and the Iris Control (may be a decimal figure) plus unit of measure
Default	Factory-setting of the parameter (as represented for the drive)	Factory-setting of the parameter (as displayed) plus unit of measure
Level	User level (BASIC / ADVANCED / ENGINEERING)	
Address	Modbus address which the parameter can be read from/written to (integer)	
Control	This optional field is displayed when a parameter is not active for all types of motor controls (IFD / VTC)	
Function	Parameter description	

Pxxx Parameters: Always read/write.

Cxxx Parameters: Parameters (Read Only when the drive is running and the motor is operating; R/W when the drive is in stand-by or in Run, but the motor is stopped: see **P003** in [PAR] PASSWORD AND USER LEVEL MENU**).**

Ixxx Inputs: These are not parameters, but inputs (the values allocated to these inputs are not stored to non-volatile memory. Ixxx value is always 0 when the drive is powered on).

Rxxx Parameters: Parameters (Read Only when the drive is in Run; R/W when the drive is in stand-by or in Run, but the motor is stopped: see **P003** Condition required for changing C parameters in the [PAR] PASSWORD AND USER LEVEL MENU).
Unlike **Cxxx** parameters, **Rxxx** parameters become active only after the drive has been switched off and switched on again, or after resetting its control board by pressing the **RESET** button for more than 5 seconds.

NOTE Use the **ESC** key to enter the value of an **Ixxx** input.
If the **SAVE/ENTER** key is used, **W17 SAVE IMPOSSIBLE** (warning) is displayed.

NOTE When changing a **Pxxx** or **Cxxx** parameter via the display/keypad, you may activate its new value immediately (flashing cursor) or when you quit the programming mode (fixed cursor). Typically, numeric parameters immediately come to effect, while alphanumeric parameters have a delayed effect.

NOTE When changing a **Pxxx** or **Cxxx** parameter via the IrisControl, the drive will immediately use the new parameter value.

2.2.3. ALARMS AND WARNINGS

The last part of this User Manual covers alarms **(Axxx)** and warnings **(Wxxx)** displayed by the drive:

Axxx	Description
Description	
Event	
Possible causes	
Solutions	

3. USING THE DISPLAY/KEYPAD UNIT

3.1. Overview

This section contains several examples about navigating in the display/keypad unit and the UPLOAD and DOWNLOAD functions of the programming settings of the drive when using the keypad.

More details about the keypad settings (contrast, backlight, etc.) are given in the section covering the display/keypad in the IRIS BLUE – Installation Guide**.** Details about custom navigation in the root page, the measures in the Keypad page and the Root page and the custom unit of measure of the PID controller are given in the [PAR] DISPLAY/KEYPAD MENU.

3.2. Menu Tree and Navigation Mode

```
      I N  V E R T E R   O K
 ->     + 1 5 0 0 . 0 0 r p m
 ->     +       0 . 0 0 r p m
[ M E A ] P A R   C F   I D P
```

The Root page is factory-set as the startup page to be displayed when the drive is powered on.
Line 4 in the display/keypad module shows the four main menus in the menu tree:

MEA: Contains the drive measurements and fault list.

PAR: Contains the programming parameters of the drive, that can be altered when the drive is running or stopped.

CF: Contains the configuration parameters of the drive that CANNOT be altered when the drive is on. These parameters can be altered only when the drive is stopped.

IDP: Product identification.

The selected menu is displayed in square brackets (MEA in the example above), use the ▲ and ▼ keys to select a different menu. Press the **ENTER** key to access the selected menu.

Navigation mode – By Menu
When **P264 = BY MENU**, the menu structure is the one given in the Menu Tree section.
The whole menu tree is given in the Navigation Mode section, although the actual menu structure depends on the user level set in **P001** and on the actual parameter adjustment.
The Navigation Mode section shows an example of how to use the navigation keys and how to alter a parameter value (**P264 = BY MENU**).

Navigation Mode - Linear
When **P264** = Linear (linear navigation), the parameters displayed are no longer grouped into menus, and you can scroll through all parameters using the ▲ and ▼ keys.

Navigation Mode – Modified Only
If the type of navigation **P264 = Modified only**, only the only the parameters having different values than the factory settings are displayed, and you can scroll through all parameters using the ▲ and ▼ keys.

The function keys and their functionality are described below.

3.3. Menu Tree

MEASURES	PARAMETERS	CONFIGURATION	PRODUCT IDENTIFIER
INVERTER OK M00=+0.00rpm M02=+ 0.00 rpm [MEA] PAR CF IDP	INVERTER OK M00=+0.00rpm M02=+ 0.00 rpm MEA [PAR] CF IDP	INVERTER OK M00=+0.00rpm M02=+ 0.00 rpm MEA PAR [CF] IDP	INVERTER OK M00=+0.00rpm M02=+ 0.00 rpm MEA PAR CF [IDP]
MEASURE MENU M Parameters Cannot be altered	PARAMETERS MENU P Par. that can be altered when the motor is running	CONFIGURATION MENU C-I-R Parameters can be altered when motor stopped	PRODUCT MENU Language Selection and Inverter Data
[MEA] MOTOR OPERATION TIME	[PAR] PASSWORD AND ACCESS LEVEL	[CFG] AUTOTUNE	[IDP] PRODUCT
[MEA] MULTIMOTOR MEASUREMENTS	[PAR] DISPLAY / KEYPAD	[CFG] MODULATION FREQUENCY	
[MEA] MOTOR MEASUREMENTS	[PAR] RAMPS	[CFG] MOTOR CONFIGURATION	
[MEA] PID REGULATOR	[PAR] INPUTS FOR REFERENCES	[CFG] MOTOR LIMITS	
[MEA] DIGITAL INPUTS	[PAR] MULTISPEED	[CFG] CONTROL METHOD	
[MEA] REFERENCES	[PAR] PID MULTI REFERENCES	[CFG] DIGITAL INPUTS	
[MEA] OUTPUTS	[PAR] PROHIBIT SPEED	[CFG] RAMP EXTENSION	
[MEA] TEMPERATURE MEASUREMENTS FROM PT100	[PAR] SPEED LOOP AND CURRENT BALANCE	[CFG] DC BRAKING	
[MEA] AUTODIAGNOSTICS	[PAR] VTC – VECTOR TORQUE CONTROL	[CFG] SPEED SEARCH	
[MEA] DATA LOGGER MEASUREMENTS	[PAR] ANALOG AND FREQUENCY OUTPUTS	[CFG] ALARM AUTORESET	
[MEA] DIGITAL INPUTS PROGRAMMING	[PAR] TIMERS	[CFG] THERMAL PROTECTION	

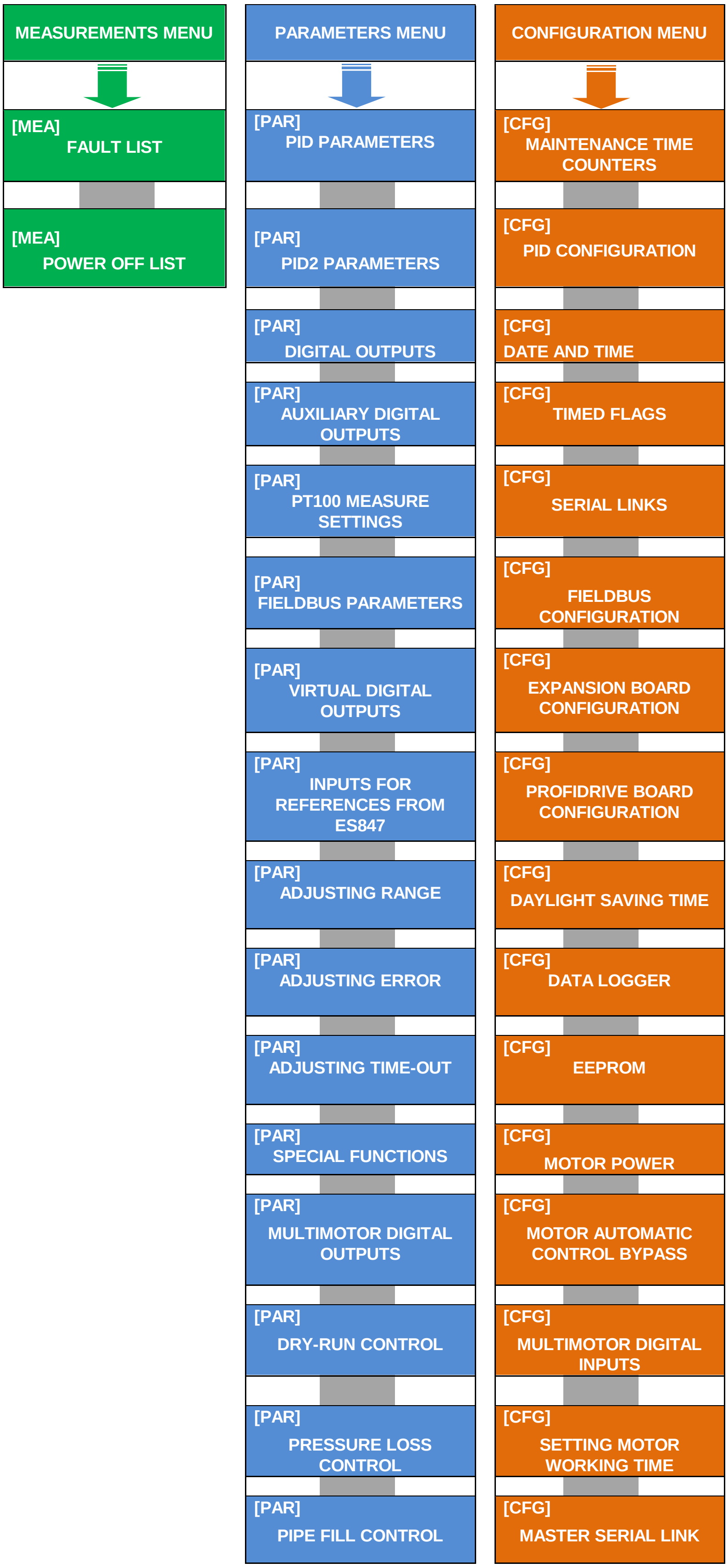


Figure 1: Menu tree

3.4. Navigation Mode

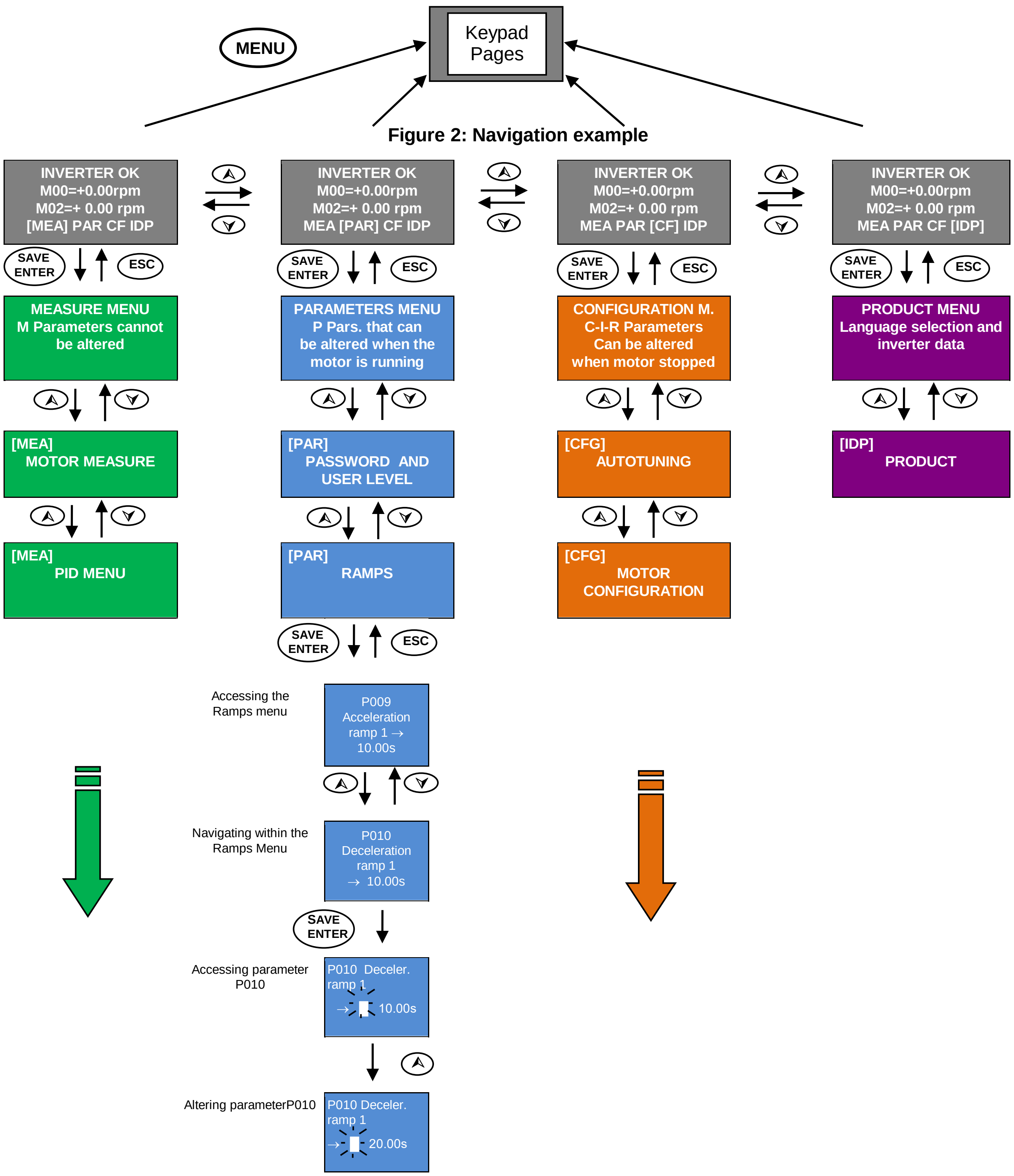


Figure 2: Navigation example

If the **ESC** key is pressed to quit, the new parameter value will be acknowledged but not saved to non-volatile memory, and will therefore be lost at power off. Press **SAVE/ENTER** to confirm parameter alteration.

3.5. Altering Parameter Values

Factory setting allows parameter modification. The parameters included in the Parameters Menu (**Pxxx** parameters) can be changed at any moment, whereas the parameters included in the Configuration Menu (**Cxxx**, **Rxxx**, **Ixxx** parameters) can be changed only when the motor is stopped.
For safer operating conditions, the configuration parameters must be changed only when the drive is disabled (the **ENABLE-A** and **ENABLE-B** commands are inactive): to do so, **P003** must be set to **0 (stand-by only)**.

To disable parameter changes, just change **P000** (write enable) and save its new setting. **P000** and **P002** (password) are both factory-set to 1. If **P000=0**, an inexpert user cannot change parameter values, but if **P000=1,** an advanced user will be able to change the parameter values.
For even safer operating conditions, you can change the password stored in **P002**; in that case, you must set **P000** accordingly.

NOTE Note down and keep at hand the value set in **P002**.

Press the **SAVE/ENTER** key for parameter modifications; when a flashing cursor appears, press ▲ and ▼ to change the parameter value. Do one of the following to quit the editing mode:

- Press **ESC** with **P269b** = 0: [No] → the parameter value used by the drive is changed and is maintained until the drive is shut down, then the value is lost when the drive is powered on again.
- Press **ESC** with **P269b** =1: [YES] → the previous value is restored.
- **Press SAVE/ENTER** → the parameter value is used by the inverter and stored to non-volatile memory and is not deleted when the drive is shut down.

Inputs (**Ixxx**) cannot be saved to non-volatile memory and are automatically set to their default values.
Rxxx parameters become active only when the drive control board has been reset by pressing the **RESET** key for a few seconds or by switching off the drive.

3.6. Programming the Root Page

When the drive is turned on, the Root page is displayed as the starting page. The Root page allows you to access the main menus (Measures, Parameters, Configuration, Product ID) or to shift to the Keypad pages using the **MENU** key.

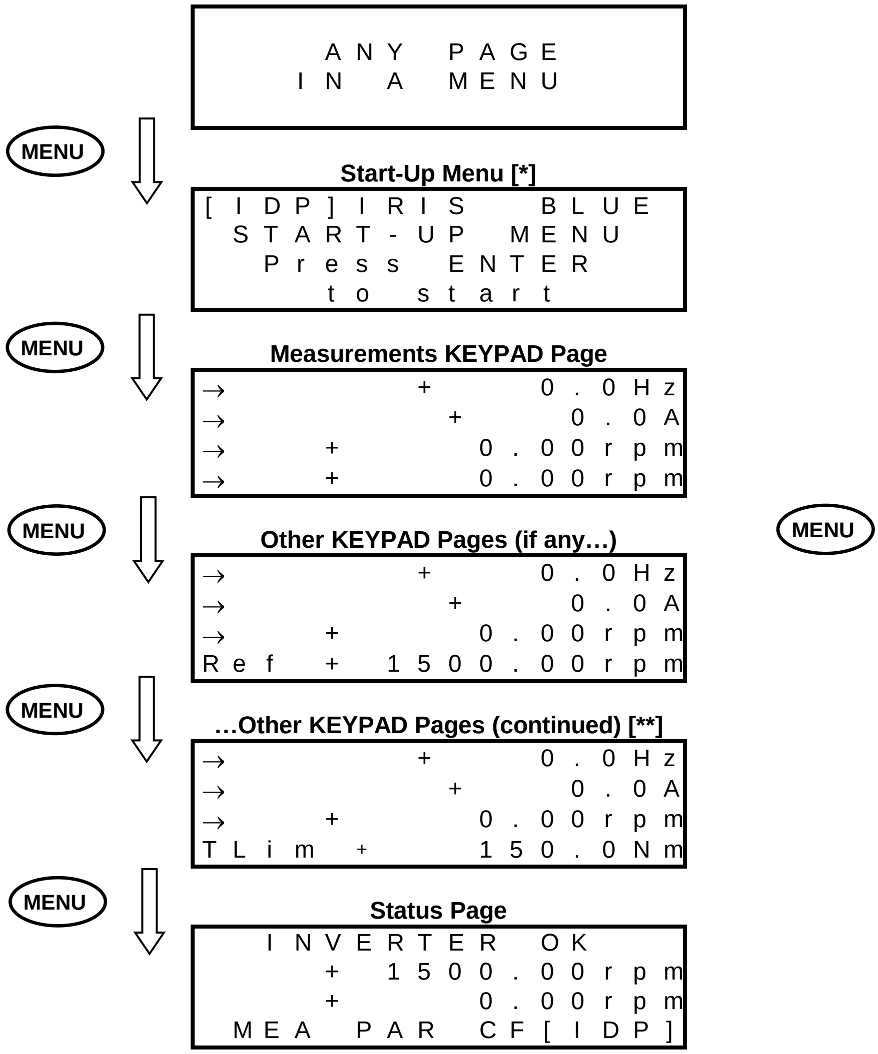
Root page

```
  I N V E R T E R   O K
      +   1 5 0 0 . 0 0 r p m
      +         0 . 0 0 r p m
M E A [ P A R ] C F   I D P
```

You can customise the root page using parameter **P265** (see the [PAR] DISPLAY/KEYPAD MENU).

3.7. MENU Key

The **MENU** key allows going to the next menu. From the Root page, press the MENU key to enable circular navigation.



NOTE [*] The Start-Up menu is available only if **P265**=3: Start-Up (see [PAR] DISPLAY/KEYPAD MENU).

NOTE [**] The other Keypad pages are available only if the relevant references / feedback / limits are activated (see the [CFG] CONTROL METHOD MENU and [CFG] PID CONFIGURATION MENU).

3.8. ESC Key

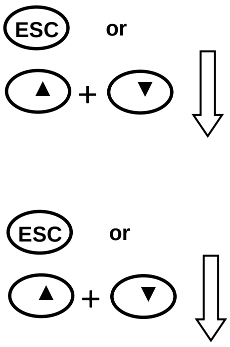
Press the **ESC** key and to do the following:

1. move up one level in the menu tree;
2. go to the next field when changing a parameter having multiple value fields;
3. quit the editing mode without storing the value to EEPROM, or go back to the previous value based on **P269b.**

1\. In the example below, starting from parameter **C015** in the [CFG] MOTOR CONFIGURATION MENU, inside the Configuration Menu, you can move up to the Root page by pressing the **ESC** key.

Page C015 Parameter of Motor Configuration Menu

```
C015 Rated
Frequency
Motor 1
→           50.0Hz
```



Root page of Motor Configuration Menu

```
[CFG]    C008–C042
     MOTOR
   CONFIGURATION
```

Status Page

```
  INVERTER  OK
    +  1500.00rpm
    +     0.00rpm
 MEA  PAR[CF] IDP
```

2\. When using the **SAVE/ENTER** key to change a parameter including multiple fields (ESC> is displayed for the **ESC** key) press **ESC** to move to the next field. In the example below, 2 programmable fields are displayed for **P226**:

```
P226 Timer on
digital inputs
MDI   1  2  3  4
ESC> T0 T0 T0 T0
```

Press "SAVE/ENTER" to enter the editing mode

```
P226 Timer on
digital inputs
MDI   1  2  3  4
ESC>■T0 T0 T0 T0
```

Press "▼"to change the parameter value

```
P226 Timer on
digital inputs
MDI   1  2  3  4
ESC>■T1 T0 T0 T0
```

Press "ESC" to move to the next field

```
P226 Timer on
digital inputs
MDI   1  2  3  4
ESC> T1■T0 T0 T0
```

3. Press the following keys to quit the last page displayed:
   - **ESC** without saving the value to EEPROM if **P226** = **T0** → press **ESC** to confirm the parameter, that will not be saved (the previous value will be restored at next power on);
   - **ESC** without saving the value to EEPROM if **P226** = **T1** → press **ESC** to restore the previous value;
   - **SAVE/ENTER** (new values are saved to EEPROM).

3.9. RESET Key (Alarm and Control Board Reset)

The **RESET** key is used to reset the drive after an alarm trips and the cause responsible for the alarm has been removed.
Press the **RESET** key for **more than 5 seconds to reset the control board and reinitiate it.** This procedure may be useful when changes made to **Rxxx** parameters (which activate only after resetting the equipment) must immediately come to effect, with no need to switch off the drive.

3.10.TX/RX Key (Download/Upload from/to the Keypad)

Use the keypad to perform the following functions:
1. UPLOAD (parameters stored in the drive are copied to the display/keypad);
2. DOWNLOAD (parameters stored in the keypad are copied to the drive).

Press the **TX/RX** key to go to the UPLOAD page; press the **TX/RX** key again to toggle between the UPLOAD and DOWNLOAD pages.

CAUTION

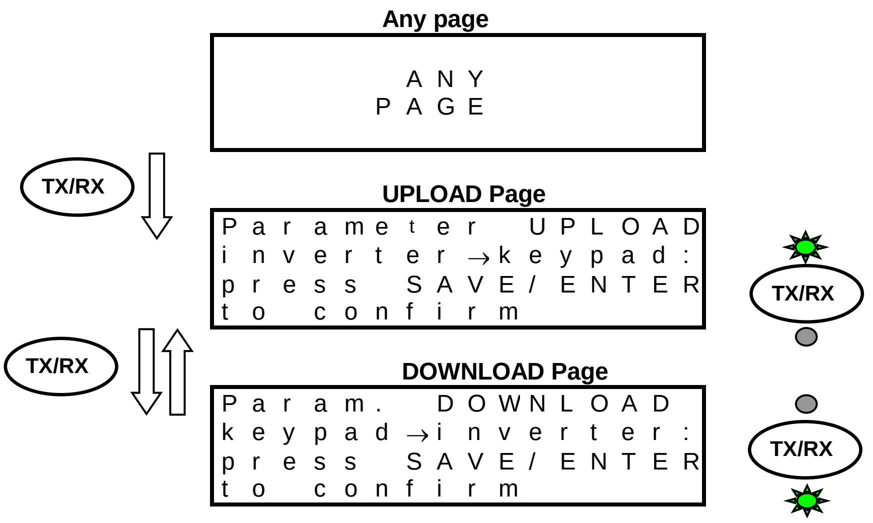
A Warning is displayed (one among **W41** to **W46**) when trying to DOWNLOAD parameters to a drive whose SW Version, IDP, PIN or current/voltage classes are different from those of the drive previously used for parameter UPLOAD. In that case, download is not allowed.

NOTE

The DOWNLOAD function allows the parameters stored in the keypad to be copied to the drive. However, parameters are not stored to the non-volatile memory of the drive.
To store the downloaded parameters to the non-volatile memory of the drive, go to the EEPROM menu and execute a “Save Work” command once the download procedure is complete. Otherwise, when power is lost, the parameters downloaded to the drive are lost. See the [CFG] EEPROM MENU.

The **TX/RX** key is disabled under the following conditions:
- no password is entered in **P000**
- the OPERATOR mode is activated with the **MENU** Key (**P264b** = OPERATOR)
- the drive is running.

In the example below, you can go to the UPLOAD page from any page (the upper LED starts flashing). If you then press the **TX/RX** key, you can go to the UPLOAD and DOWNLOAD pages.



Press **SAVE/ENTER** from the UPLOAD (/DOWNLOAD) page to confirm UPLOADING (/DOWNLOADING). The relevant LED will come on (fixed light).
If the **SAVE/ENTER** key is not pressed for confirmation within 10 seconds from the selection of the UPLOAD (/DOWNLOAD) page, the starting page is automatically displayed.

While UPLOADING, **W08 UPLOADING (**flashing warning) appears.
If parameters are successfully uploaded, the following warning appears:
W11 UPLOAD OK
If not, the **W12 UPLOAD KO** warning appears. Retry parameter upload.

While DOWNLOADING, **W07 DOWNLOADING** (flashing warning) appears.
If parameters are successfully downloaded, the following warning appears:
W09 DOWNLOAD OK
If not, alarm **A073** trips, and download must be retried before restarting the drive.

3.11.LOC/REM Key (Keypad Pages)

To enable the Local/Remote operating mode (Remote sources are command and/or reference sources other than the display/keypad) press the **LOC/REM** key in the display/keypad, or use a digital input configured as **Loc/Rem** (see **C180**).

NOTE

The **LOC/REM** key is enabled when no digital input is configured as **Loc/Rem**, or when a digital input is configured as a **Loc/Rem** button (see **C180a**).
The **LOC/REM** key is disabled when a digital input is configured as a **Loc/Rem** selector switch (see **C180a**).

C148 sets whether toggling between Remote mode and Local mode is activated only when the drive is disabled, or whether toggling from Remote to Local mode does not affect the drive running conditions (bumpless commands), but it does affect the reference. You can also choose to keep running conditions and reference unaffected (any command is bumpless). For more details, please refer to the description of parameter **C148** ([CFG] CONTROL METHOD MENU).

In LOCAL mode (the L-CMD and L-REF LEDs come on), when drive references and commands are sent via display/keypad, the Keypad page allows changing the given reference using the ▲ and ▼ keys (see **P266** in the [PAR] DISPLAY/KEYPAD MENU).
When not in LOCAL mode, press the **MENU** key to access the Keypad pages from the root page. Only the Keypad pages relating to the Keypad source will be displayed along with the Measure Keypad page.
Example: Parameter **C146** (Reference Selection) is set to Keypad. From the root page, press the **MENU** key once to display the Measure Keypad page, and press the **MENU** key twice to display the Keypad page relating to Reference Selection allowing changing the reference using the ▲ and ▼ keys.
The Keypad page allows entering custom measures (see parameters **P268b** to **P268e** in the ([PAR] DISPLAY/KEYPAD MENU).

From the Keypad pages, press the **SAVE/ENTER** key to access the Keypad Help page containing any details about the measures displayed in the Keypad page.

3.12.SAVE/ENTER Key

The **SAVE/ENTER** key allows selecting a lower level when navigating within the programming menus. It also allows changing a parameter value (to change a parameter value, press the **SAVE/ENTER** key from the page of the parameter you want to change). An example is given in Figure 2.
From the Keypad pages, the SAVE/ENTER key allows accessing the Keypad Help page containing any details about the measures displayed in the Keypad page.

3.13.START-UP Key

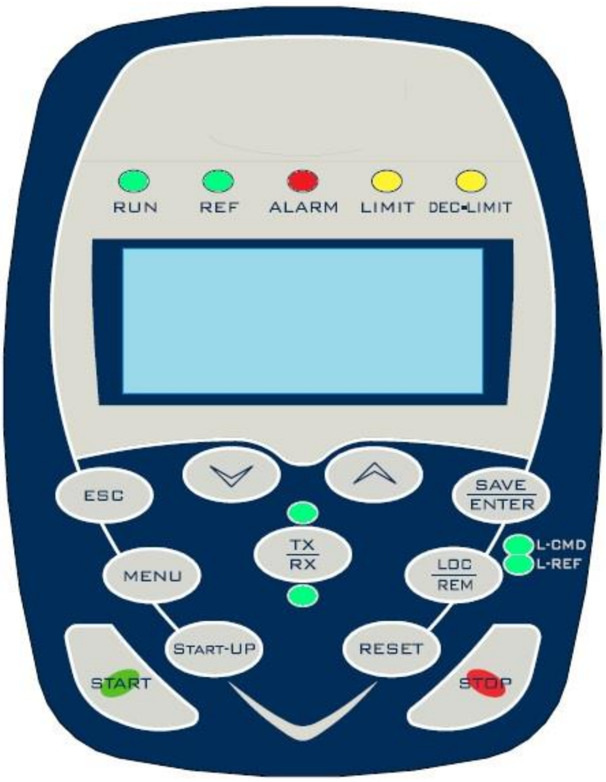
In order to make programming easier, the **START-UP** key allows reactivating the START-UP Menu at any time; this is a wizard to program the main parameters for the motor control and the PID control. See the START-UP MENU.

3.14.Indicator LEDs of the Display/Keypad

Nine LEDs are located on the keypad, along with a 4-line, 16-character LCD display, a buzzer and eleven function keys. The display shows the parameter values, the diagnostic messages and the variables processed by the drive.
The figure below shows the location of the indicator LEDs and their functionality.

RUN LED – GREEN		
	Motor not powered	
	Motor powered but null torque (idle)	
	Motor powered and running	
REF LED – GREEN		
	Reference for speed, frequency or torque=0	
	Motor accelerating or decelerating	
	Reference present	
ALARM LED – RED		
	Inverter OK	
	Alarm tripped	
LIMIT LED – YELLOW		
	No active limitation	
	Voltage or current limit active	
DEC-LIMIT LED – YELLOW		
	Normal operation	
	Decelerating	
TX and RX LEDs - GREEN		
TX	RX	
		No parameter transfer
		Download: waiting for confirmation
		Upload: waiting for confirmation
		Parameter downloading from keypad to inverter
		Parameter uploading from inverter to keypad
L-CMD LED - GREEN		
	Commands sent from sources other than keypad	
	Commands sent both from keypad and terminal board	
	Commands sent from keypad only	
L-REF LED - GREEN		
	Reference sent from sources other than keypad	
	Reference sent both from keypad and terminal board	
	Reference sent from keypad only	

Key	
	LED off
	LED flashing
	LED on (fixed)



NOTE See also the OPERATING AND REMOTING THE KEYPAD section in Motor Drives Accessories – User Manual.

Figure 3: Display/keypad

4. SERIAL LINKS

4.1. Overview

The IRIS BLUE drives may be connected to other devices through a serial link. This allows reading and writing the parameters accessed through the remotable display/keypad.

Elettronica Santerno also supplies the IrisControl software package allowing controlling the drive through a computer connected via serial link.
The IrisControl offers the following functionality: image copy, keypad emulation, oscilloscope functions and multifunction tester, data logger, history data table compiler, parameter setting and data reception–transmission–storage from and to a computer, scan function for the automatic detection of the connected inverters (up to 247 connected inverters).

4.2. MODBUS-RTU Protocol

Messages and data are sent by means of standard protocol MODBUS in RTU mode. This standard protocol performs control procedures using an 8–bit binary representation.
In RTU mode, a message begins with a silence interval equal to 3.5 times the transmission time of a character.
If the character transmission stops for a time equal to 3.5 times the transmission time of a character, the controller will consider this time interval as the end of the message. Similarly, a message starting with a shorter silence time is considered as part of the previous message.

Message beginning	Address	Function	Data	Error control	End of message
T1–T2–T3–T4	8 bits	8 bits	n x 8 bits	16 bits	T1–T2–T3–T4

Use parameter R004 (TimeOut) to increase the silence time interval up to max. 10000ms for the systems that do not recognize standard timeouts.

Address
The address field acknowledges any value ranging from 1 to 247 as the address of the slave peripheral device. The master device queries the peripheral device specified in the address field; the peripheral device will respond with a message containing its address to let the master device know which the slave source of the response is. A master device query with a 0 address is addressed to all slave devices, which will not respond at all (broadcast mode).

Function
The function related to the message may be chosen within the legal field ranging from 0 to 255. A response of the slave device to a message of the master device will simply return the function code to the master device if no error took place; otherwise, the most significant bit in this field is set to 1.
The only functions allowed are **03h: Read Holding Register, 06h Write Single Register** and **10h: Preset Multiple Register** (see below).

Data
The data field contains any additional information for the function being used.

Error Control
The error control is performed through the CRC (Cyclical Redundancy Check) method. The16–bit value of the relevant field is computed when the message is sent by the transmitter and is then re–computed and checked by the receiver.
CRC Register is computed as follows:
1. CRC Register is set to FFFFh
2. Exclusive OR is executed between CRC register and the first 8 bits of the message; the result is saved to a 16–bit register.
3. This register is right–shifted of one place.
4. If the right bit is 1, exclusive OR is executed between the 16–bit register and value 1010000000000001b.
5. Steps 3 and 4 are repeated until 8 shifts are performed.
6. Exclusive OR is performed between the 16–bit register and the next 8 bits of the message.
7. Steps 3 to 6 are repeated until all message bytes are processed.
8. The result is a CRC, that is attached to the message by sending the less significant byte as the first byte.

Supported Functions

03h: Read Holding Register

Allows reading the register state of the slave device. This function does not allow the broadcast mode (address 0).

QUERY	RESPONSE
Slave address	Slave address
03h Function	03h Function
Register address (high)	Byte number
Register address (low)	Data
Register N. (high)	…
Register N. (low)	Data
Error correction	Error correction

06h: Write Single Register

Sets the state of a register for the slave device. In broadcast mode (address 0) the status of the same register is set to all the connected slaves. The parameters used are the register address and the relevant value.

QUERY	RESPONSE
Slave address	Slave address
06h Function	06h Function
Register address (high)	Register address (high)
Register address (low)	Register address (low)
Data (high)	Data (high)
Data (low)	Data (low)
Error correction	Error correction

10h: Preset Multiple Register

Sets the state of multiple registers for the slave device. In broadcast mode (address 0), the state of those registers is set in all the connected slave devices. Additional parameters are the basic register address, the number of registers to be set, the relevant value and the number of bytes used for the data items.

QUERY	RESPONSE
Slave address	Slave address
10h Function	10h Function
Register 1 addr. (Hi)	Register 1 addr. (Hi)
Register 1 addr. (Lo)	Register 1 addr. (Lo)
Register N. (Hi)	Register N. (Hi)
Register N. (Lo)	Register N. (Lo)
Byte number	Error correction
Data (Hi)	
Data (Lo)	
…	
Data (Hi)	
Data (Lo)	
Error correction	

Error messages

If a message error is detected, the inverter will send a message to the master:

Slave address	Function (MSB = 1)	Error code	Error correction

The error code meaning is the following:

Code	Description	MEANING
0x01	ILLEGAL FUNCTION	The function sent by the Master is different from 03h (Read Holding Registers), 06h (Write Single Register) and from 10h (Preset Multiple Registers).
0x02	ILLEGAL ADDRESS	The Master wrote to or read from an illegal address.
0x03	ILLEGAL DATA VALUE	The numerical value the Master tried to write is not included in the correct range.
0x06	DEVICE BUSY	The drive refused the Master writing attempt (e.g. because it is running and a Cxxx parameter is activated).
0x07	ANOTHER USER WRITING	Other users are writing to the selected parameter when the Master is trying to write to this parameter (e.g. display/keypad in editing mode or Upload/Download to/from keypad).
0x09	BAD ACCESS LEVEL	The parameter the Master is trying to write to is not included in the selected User Level (e.g. it is trying to write an ADVANCED parameter when the BASIC user level is selected).

5. DESCRIPTION OF INPUT AND OUTPUT SIGNALS

The control board of the drives of the IRIS BLUE series is provided with the following inputs/outputs:

- **N.3 Analog Inputs** (single-ended REF input, differential AIN1 & AIN2 inputs) that can be programmed as voltage/current inputs via SW1 DIP-switch (see Configuration DIP-switches in IRIS BLUE – Installation Guide)
- **N.3 Analog Outputs** that can be programmed as voltage/current outputs via SW2 DIP-switch (see Configuration DIP-switches in the IRIS BLUE – Installation Guide)
- **N.8 MDI Multifunction Digital Inputs.**
- **N.4 MDO Multifunction Digital Outputs**; MDO1 is a Push-pull output, MDO2 is an Open Collector output and MDO3-4 are relay outputs.

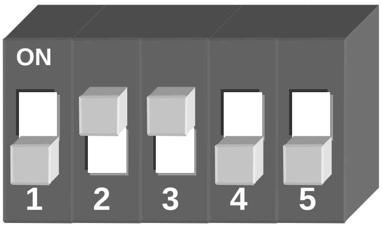
Electrical ratings of the control board inputs/outputs are given in the IRIS BLUE – Installation Guide.

When programming:
- **Analog inputs** see the [PAR] INPUTS FOR REFERENCES MENU
- **Analog outputs** see the [PAR] ANALOG AND FREQUENCY OUTPUTS MENU
- **Digital inputs** see the [CFG] DIGITAL INPUTS MENU
- **Multifunction digital outputs** see the [PAR] DIGITAL OUTPUTS MENU

CAUTION

The drive is factory-set with the REF input configured as 0-10V and AIN1-AIN2 inputs configured as 4-20mA.
SW1 dip-switches, which are located on the control board, must be set as follows:

SW1



6. REFERENCES AND FEEDBACK

The drive references are the following:
- Main speed reference
- PID reference
- PID feedback

6.1. Main Speed Reference

If a speed control (e.g. **C011 = Speed**) is used, the main reference is a speed reference, while if a torque control is used (e.g. **C011=Torque)**, but the digital input is closed for the Slave programmed with C170), the main reference of the drive is a torque reference.
The main reference can be one of the following:
- Analog/digital inputs programmed as sources (see parameters **C143-C146**).
- PID output if **C294** PID Action = Reference
- Digital inputs programmed as Multispeed (see [PAR] MULTISPEED MENU) only when the main reference is a speed reference.

6.2. PID Reference

If the internal PID regulator is enabled (**C291 different from Disabled**), its reference is given by default by the sum of the three sources programmed as references (see parameters **C285-C287** in the [CFG] PID CONFIGURATION MENU parameters **C285-C287**).
Different types of PID reference control (Two PIDs and 2-zone mode) are available based on the setting in parameter **C291a** (PID Control Mode).

6.3. PID Feedback

The PID feedback by default is the sum of the three sources programmed as feedback (see parameters **C288-C290** in the (see [CFG] PID CONFIGURATION MENU parameters **C288-C290**).
Different types of PID feedback control (Two PIDs and 2-zone mode) are available based on the setting in parameter **C291a** (PID Control Mode).

7. PROGRAMMABLE FUNCTIONS

7.1. Voltage/Frequency Pattern

When using the Volt/Freq IFD control algorithm (e.g. **C010 = IFD Volt/Freq**), you can select different types of V/f patterns (see the V/f Pattern (IFD only) section in the [CFG] MOTOR CONFIGURATION MENU).

7.2. Slip Compensation

When using the Volt/Freq IFD control algorithm (**C010 = IFD Volt/Freq**), you can set the slip compensation function for a more accurate speed control (see the Slip Compensation (IFD Only) in the [CFG] MOTOR CONFIGURATION MENU).

7.3. Speed Searching

When using the Volt/Freq IFD (e.g. **C010 = IFD Volt/Freq**) or the VTC VectorTorque control algorithm (**C010 = VTC VectorTorque**), you can set the speed searching function for the motor speed of rotation, which is useful when the drive controls a motor which is already running (as for motors connected to fans). See the [CFG] SPEED SEARCHING.

7.4. DC Braking

When using the Volt/Freq IFD or Vector Torque VTC control algorithm, you can set DC braking at start or at stop. The DCB Hold function can be set for the Volt/Freq IFD function. See the [CFG] MOTOR CONFIGURATION MENU.

7.5. Motor Thermal Protection

The Motor Thermal Protection function protects the motor against possible overloads. This function can be obtained via a PTC acquired in AIN2 analog input—up to 6 PTCs can be series-connected—or it can be a software protection implemented through an algorithm reproducing the motor thermal image.
See the [CFG] MOTOR THERMAL PROTECTION MENU for more details.
For more details about using AIN2 input, please refer to the IRIS BLUE – Installation Guide.

7.6. Prohibit Speeds

Prohibit speeds are speed ranges corresponding to mechanical resonance frequencies. They prevent the drive from running at the preset speed ranges.
See the [PAR] PROHIBIT SPEED MENU for more details.

7.7. PID Digital Regulator

The IRIS BLUE drive is provided with a digital PID (proportional, integral, derivative) regulator that can be used to implement the following:

- Analog output
- Main reference of the drive (Speed/Torque reference)
- Correction of the main reference
- Correction of the output voltage (only for Volt/Freq IFD control)

See the [PAR] PID PARAMETERS MENU and the [CFG] PID CONFIGURATION MENU.

7.8. Dry-Run Control

The Dry-run function detects when water is running out in the system o when cavitation is about to occur.
More details are given in the [PAR] DRY-RUN CONTROL MENU.

7.9. Pressure Loss Control

The Pressure Loss control detects losses or failures in the water system.
Using the PID pressure regulator is required. The pressure loss control detection is based on PID measurements, errors or feedback, depending on the parameter settings.

Please refer to [PAR] PRESSURE LOSS CONTROL MENU.

7.10.Pipe Fill Control

The Pipe Fill Control allows preventing water hammer in pipes, failures and faults in the hydraulic joints (such as watering nozzles), and limits the pipe filling rate.

Please refer to [PAR] PIPE FILL CONTROL MENU.

7.11.Multimotor Control

The Multimotor Control functionality integrated into the IRIS BLUE drive allows controlling multiple motors in parallel (maximum 5 motors). This function allows controlling motors in two different modes:

- Fixed speed: n.1 Master motor at variable speed and up to n.4 slave motors at fixed speed.
- Variable speed: up to n.5 variable speed motors (drive-controlled).

Please refer to the MULTIMOTOR CONTROL (MMC) section.

7.12.Setting Two Alternative Command Sources and Reference Sources

You can set a digital input as a selector switch allowing selecting two alternative control sources and reference sources.
Example:
A selector switch is required to select **control mode B** (the drive references and commands are sent via fieldbus) and **control mode A** (the drive reference is sent via AIN1 analog input and commands are sent via keypad).
The following parameters shall be set up accordingly:

C179 MDI for source selection= **MDI6**
C140 Selection of control source n. 1 = **Keypad**
C141 Selection of control source n. 2 = **Fieldbus**
C143 Selection of reference n. 1 = **AIN1**
C144 Selection of reference n. 2 = **Fieldbus**

When MDI6 digital input in the terminal board is open (terminal 19), the command sources and reference sources n. 1 are selected (Keypad and AIN1 analog input, control mode A). When MDI6 is closed, the command sources and reference sources n. 2 are selected (Fieldbus, control mode B).

CAUTION In the example above, if **C179 = Disable**, the OR logic for the Keypad and Fieldbus is considered, whereas the Fieldbus and AIN1 control sources are considered as summed up.

As an alternative to **C179**, it is possible to set, via parameters **C179a** and **C179b**, two digital inputs as independent selectors for the commands and the reference.
See also parameter **C179, C179a, C179b** in the [CFG] DIGITAL INPUTS MENU.

7.13. Fire Mode

When the digital input programmed as FIRE MODE is activated, all the protecting functions of the drive are ignored, so that no alarm trips when the drive is operating.

CAUTION

The Fire Mode function must be used only when it is strictly necessary, such as in fire pumps, to protect human lives.
This function must never be used to prevent alarms from tripping in domestic or industrial applications.

NOTE

To activate the parameters relating to the Fire Mode, enter the Password in the [IDP] PRODUCT MENU.
This Password is provided by Elettronica Santerno's Service Department. The drive Serial Number is required (see the Serial Number parameter in the [IDP] PRODUCT MENU).

The following parameters can be accessed only after entering the Password enabling the Fire Mode:

- **P032** Acceleration ramp in Fire Mode (see [PAR] RAMPS MENU)
- **P033** Deceleration ramp in Fire Mode (see [PAR] RAMPS MENU)
- **P099** Fire Mode speed (see [PAR] MULTISPEED MENU)
- **C186** MDI for Fire Mode enable (see [CFG] DIGITAL INPUTS MENU)

The Fire Mode is enabled when closing the MDI set through **C186**. The drive will use the speed reference set in **P099** and the ramp times set in **P032**, **P033.** All alarms will be ignored, except for the following:

A041	IGBT FAULT Side A	IGBT Hardware, general alarm
A044	OVERLOAD SW	Software Overcurrent
A048	OVER VOLTAGE	DC-bus voltage exceeding Vdc_max
A050	IGBT FAULT A	Hardware Fault from IGBT Converter
A051	OVERLOAD HW A	Hardware Overcurrent
A053	PWMA Not ON	Hardware Failure, IGBT cannot be fired
		Control Board Failure

When the Fire Mode is active, innumerable alarm autoresets are automatically enabled.

CAUTION

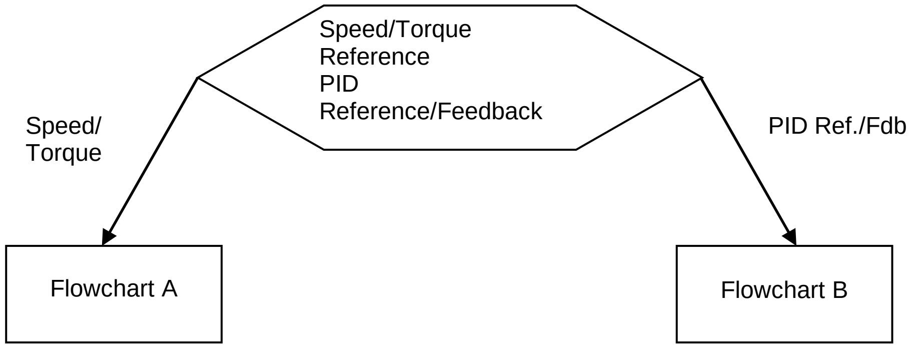
If an asterisk (*) appears next to INVERTER OK on the display, the product guarantee is no longer valid.
The asterisk appears if at least one condition requiring the activation of a protection feature occurs when the inverter is running in Fire Mode.

8. PROGRAMMING EXAMPLES

8.1. Overview

This section illustrates some programming examples for particular functions of the drive. Flowcharts are used for easier reference.
For any detail concerning individual parameters, see the relevant sections in this manual.

8.2. Programming a Reference



FLOWCHART A

Program the following:
P000= Write enable
P001= Eng (user level)

Selecting the Reference Sources

In the **Motor Control** menu, select the type of speed/torque reference (**C011**). The **Control Method** menu includes the parameters selecting the reference source.
You can set up to four sources, which are summed up to each other. For speed control, and if references are to be sent also from **digital inputs**, see the **Multispeed** menu**.**

Forcing the Reference Sources

Sources:

REF	Ref Analog Input
AIN1	AIN1 Analog Input
AIN2	AIN2 Analog Input
Pulse Input	Frequency Input (MDI8)
XAIN4	XAIN4 Analog Input
XAIN5	XAIN5 Analog Input

The reference scaling is obtained through the parameters included in the **Input Reference** menu. Each source is assigned to a parameter setting its min. value and max. value for the min./max. speed/torque reference of the connected motor (e.g. Motor speed reference: **C028** for min. speed, **C029** for max. speed.
Torque reference:
C047 for min. torque, **C048** for max. torque)

Sources:

Serial Link	Reference from serial link
Fieldbus	Reference from fieldbus
Keypad	Reference from Display/keypad
Preset Speed	Reference from digital input

No reference scaling is required. Speed references are expressed in rpm, torque references are expressed as a percentage of the motor rated torque. Saturation of the reference values depends on Min. Speed and Max. Speed parameters (speed control), and on Min. Torque and Max. Torque parameters (torque control). (E.g. Motor speed: **C028** for min. speed, **C029** for max. speed; Motor 1 torque: **C047** for min. torque, **C048** for max. torque)

FLOWCHART B

Program the following:
P000= Password enable
P001= Eng (user level)

Selecting the Ref/Feedback Sources

The **PID Configuration** menu includes the parameters selecting the reference/feedback source.

You can set up to three sources, which are summed up to each other.

Forcing the Reference/Feedback Sources

Sources:

REF	Ref Analog Input
AIN1	AIN1 Analog Input
AIN2	AIN2 Analog Input
Pulse Input	Frequency Input (MDI8)
XAIN4	XAIN4 Analog Input
XAIN5	XAIN5 Analog Input

The reference scaling is obtained through the parameters included in the **Reference** menu. Each source is assigned to a parameter setting its min. value and max. value for the min./max. PID Reference/Feedback value.
See the **PID Parameters** menu.
Reference **P245** Min., **P246** Max.
Feedback **P247** Min., **P248** Max.

Sources:

Serial Link	Reference from serial link
Fieldbus	Reference from fieldbus
Keypad	Ref. from display/keypad

Feedback reference only:

Iout	Output current
Vout	Output voltage
Vdc	DC bus voltage
Pout	Output power
Vout	Output voltage
Vout measured	Measured voltage
Tout	Output torque

No reference scaling is required. References are expressed as a percentage. As a feedback reference, output current (Iout), output voltage (Vout), DC bus voltage (Vdc) are available, which refer (as full-scale values) to the following:
Rated current of the selected motor (Mot.1 **C018**)
Rated voltage of the selected motor (Mot.1 **C019**)
DCb Bus 1500 V.

EXAMPLE:

The speed of a motor is to be controlled via a 0 ÷ 5 V analog input. Speed range is 0 ÷ 1500 rpm; two digital inputs are available to increase three speed values with steps of 100rpm.

Setting the min. and max. speed:
The parameters for the motor min./max. speed are **C028** = 0 rpm, **C029** = 1800 rpm.

Setting the analog reference:
Default setting: the analog reference is sent from REF input (**C143** = REF).
The speed range for the analog input must be 0 ÷ 1500 rpm.

Default setting in the [PAR] INPUTS FOR REFERENCES MENU for REF analog input:
P050 = 3: 0 –10 V Type of reference for REF input
P051 = 0.0 V Min. value for REF input
P052 = 10.0 V Max. value for REF input

P052 is the voltage value for REF input for a speed reference of 1800rpm (**C029**)
For a speed reference of 1500rpm with 5 V, **P052** is to be set as follows:
(Max. speed REF): (5 V) = (**C029**): (Vx)
Vx = 5 V *1800rpm /1500rpm = 6 V
If **P052** = 6V, a speed reference of 1500rpm is set for REF with 5V.

Setting the reference from digital inputs:

Default setting: two digital inputs for multispeed values.

[CFG] DIGITAL INPUTS MENU: **C155**= MDI4; **C156** = MDI5

Based on the status of digital inputs MDI4 and MDI5:

MDI4	MDI5	Multispeed
0	0	0
1	0	1
0	1	2
1	1	3

In the [PAR] MULTISPEED MENU set the speed steps as follows:

P080 = 1: Sum Speed
P081 = 100rpm Multispeed 1
P083 = 200rpm Multispeed 2
P085 = 300rpm Multispeed 3

P080 → Multispeed function: the selected multispeed is summed up to the reference for the analog input.
P081, **P083**, **P085** are the steps depending on the selected multispeed for digital inputs MDI4, MDI5.

8.3. Programming the Drive for PID Pressure Control

This section covers the quick programming procedure adopting the most common programming parameters for pump operation with pressure feedback control through PID regulator. A pressure sensor is required to be installed on an analog input of the drive. The PID regulator is to be used for pressure control.

Motor Configuration

A. From the **Motor Configuration Menu**:
  - a.1 Set **C010** = “0: IFD (Voltage/Frequency)” if not required otherwise,
  - a.2 Set **C013** = “0: Torque Constant” to define a linear V/f curve,
  - a.3 Set parameters **C015, C016, C017, C018, C019** based on the motor ratings (please refer to section “IFD” Control Algorithm).
  - a.4 Set **C028** = 0rpm. When in PID control mode, the minimum frequency is limited by **P237** and should not be limited by **C028**. Parameter **C028** may be set other than zero only if the minimum speed is to be limited in speed control mode.
  - a.5 Set **C029** as the rated motor synchronism speed (e.g. to limit frequency to 50Hz for a 2-pole 50Hz motor, set **C029**=3000rpm).

B. In the **Ramps Menu**, set the following:
  - b.1 **P009**, **P010** (acceleration and deceleration times 1) so that the speed ramps are not “slow” with respect to the pressure dynamics required. The dynamics of the speed ramp must not slow down the system with respect to the control dynamics required by the pressure PID regulator; otherwise, oscillations, limit cycles or pressure regulation instability may occur.

C. In the **Ramps Menu**, set the following:
  - c.1 **P018, P019** (start acceleration time, end deceleration time). Times **P018** and **P019** are to be set short (shorter than **P009/P010**).
  - c.2 Set the start/end ramp speed **P020**. Parameter **P020** may be set equal to or higher than the minimum frequency below which the pump cannot work due to lack of lubricant in the impeller (e.g. 30Hz for pumps with 50Hz rated frequency; please contact the pump manufacturer for details) i.e. at the minimum operating frequency of the pump. When operating at the frequency set in **P020**, the pump flow rate is expected to be low or negligible.

Control and I/Os Configuration

D. In the **References Menu**, configure analog channels (e.g. AIN1) for the acquisition of the pressure measurement from the sensor, and the channel (if any) for the acquisition of the analog reference (please refer to the [PAR] INPUTS FOR REFERENCES MENU for more details on the configuration of the analog inputs). When in pressure control mode, if loud noise occurs when the PID measurement feedback is operating (see measurements **M038**, **M038u**, etc.), the control action might be “jerky” and the desaturation control does not ensure that the minimum/maximum control action “PID Out Min/PID Out Max” **P237/P237** is steady. If this is not the case, increase the value in **P059** “Filter over AIN1 Input”.

E. In the **Control Method Menu,** set the speed reference and control sources **C140-C146** (for more details, please refer to the [CFG] CONTROL METHOD MENU or the Programming the References section).

F. In the **PID Configuration Menu**, set the following:
  - f.1 **C291**= “1: Normal” to enable the PID regulator
  - f.2 the sources for the PID pressure reference via **C285-C287**
  - f.3 the PID feedback (allocated to the analog input of the pressure sensor) via **C288** (e.g. in case of sensor on AIN1, **C288**=2: AIN1 [5-6]).
  - f.4 set the PID to adjust the pump speed with **C294**= “1: Reference”

G. In the **Digital Inputs Menu,** allocate **C171** (MDI for PID disable) to a digital input to switch from PID control (inactive allocated MDI) to the speed control (activated MDI).

Display Configuration

H. To display the pressure measurement expressed with the “physical” unit of measurement (e.g. in bars) on the Status Page or the Keypad Page, set parameters **P266d-P266i** (preset units of measurement AIN1 and AIN2) in the **Display/Keypad Menu.**

I. In the **Display/Keypad** menu, set the unit of measurements to display the PID reference and feedback via **P267/P267b** (consistently with the pressure measurements over the analog input).

J. In the **PID Parameters Configuration Menu**, set the gain for the scaling of the PID measurements **P257** (e.g. if the full-scale value of the pressure sensor is 5bars, so 100% of the PID feedback is 5bars, set **P257**=0.05).

K. In the **Display/keypad Menu**, set **P268-P268e** to select measurements **M038u, M039u** to be displayed on the Status Page and the Keypad Page. The user measurements over AIN1/AIN2 (**M038u, M039u**) are always kept updated, even when the PID is disabled.

L. If the configuration of the measurements and the scaling is correct, the pressure measurements expressed in bars (e.g. **M038u** if over AIN1) and the PID feedback expressed in bars (**M024**) must always match when the PID regulator is active.

PID Configuration

M. In the **PID Parameters Menu**, set the PID output range:

m.1 Set **P236**=100% for operation up to the rated pump frequency

m.2 Set **P237** equal to the minimum operating frequency of the pump. As a first trial, a value equalling **P020** may be set up (it should be greater than or equal to **P020**). The sleep function is based on parameters **P255a-P255d**, not on **P237**.
When the pump operates at its minimum frequency and the flow rate is null, the hydraulic head of the pump is expected to be lower than or equal to the allowable minimum reference pressure. This ensures that operation in Sleep Mode works properly. To check the pump hydraulic head, run the pump in speed control at minimum frequency, slowly close all the devices in the circuit and check the heading pump at constant flow rate from the pressure sensor by reading the values from **M038u, M039u**). For example, a motor with rated frequency 50Hz and P237=60% running at 30Hz with all the devices in the circuit closed will give 0.8bars pressure. In that case, the correct operation of the PID Sleep Mode is ensured by pressure references greater than 0.8bars.

N. **Adjusting the regulator via P240-P243** – Adjusting the proportional gain and integral time may be obtained when the PID regulator is active by varying the pressure reference and/or the flow rate of the devices in the circuit, or by activating and deactivating the PID control (by alternating the PID control with pressure feedback to speed control with fixed speed reference).

O. **Sleep Mode:** Parameters **P255a-P255d** may be adjusted by making two tests, one with a high pressure reference (equal to or close to the maximum allowable working pressure), one with a low reference (equal to or close to the minimum allowable working pressure), and null circuit flow rate.
For proper adjustment, the relation **P237**<**P255c**<**P255d**<**P236** must be true.
The test procedure is as follows:

o.1 With active PID control, set the pressure reference “high” (that value will be assigned to **P255a**)

o.2 Start the inverter delivering water to the circuit, wait until the system operation is smooth and at constant speed and that pressure reaches the pressure reference

o.3 Slowly close all the devices in the circuit until flow rate is zero, then wait until the measured pressure steadily reaches the pressure reference. Read the value of PID regulator output **M022**.

o.4 In **P255c**, set a value exceeding the PID regulator output **M022**. In **P255a**, set a “high” pressure reference

o.5 Do the same test by setting the PID Ref as “low” (to be set in **P255b** afterwards) for the adjustment of **P255d** (higher than the value at constant speed in **M022**).

o.6 After setting the parameters, set **P255** other than zero to enable the Sleep Mode. The Sleep Mode activation delay **P255** is to be set high enough to avoid false stops during the transients due to a variation of the pressure reference and/or a variation of the devices flow rate, but not too high to avoid delaying the pump stop in case of no pump delivery.

P. **Wake-up** (parameters **P237a/P237b**).

p.1 With a variable pressure reference, set **P237a**=Error>P237b

p.2 and **P237b** as the allowable error for the wake-up function (e.g. 1-2%). If set too high, the drive reactivation is delayed, while the PID regulator keeps integrating the error, so the output frequency might be high at start and pressure overshoot might occur.

p.3 Carry out some tries with a variable pressure reference between the minimum and maximum value, to check if the PID regulator deactivation and activation is smooth (e.g. deactivation not too delayed, no immediate stops and restarts). The sleep dynamic threshold in **M025** calculated in relation to PID reference **M023** must be greater than the PID output at constant speed **M022** throughout the whole adjusting range of the reference, when the flow rate is null, to ensure that the Sleep mode activates properly. The sleep mode is activated if the PID output **M022** is kept lower than **M025** for the time set in **P255** and—simultaneously— the wake-up condition is not true (**P237a**=Disable). The Sleep mode may be activated only if the PID output **M022** is equal to PID out min **P237**.

9. START-UP MENU

9.1. Overview

For easier startup of the IRIS BLUE drive, you can activate the Start-Up Menu. The Start-Up Menu is a wizard allowing programming the main parameters for the connected motor and the parameters for PID control.
The parameters in this menu are the same as described in the FIRST STARTUP section.

The Start-Up Menu is displayed when the IRIS BLUE drive is first started. The Start-Up Menu can be reactivated at any time pressing the START-UP key on the Display/Keypad or setting **P265** in “Start Up” mode (see the [PAR] DISPLAY/KEYPAD MENU) and power on the drive again.

The following is the root page of the Start-Up menu:

```
[IDP]  IRIS  BLUE
 START-UP  MENU
  Press  ENTER
   to  start
```

Press **ENTER** to enter the wizard.

Before entering the control parameters, you are asked to choose a dialogue language:

```
P263  Language


→@@@@@@@@@@@@@@@
```

Then you are asked to choose the display mode of the Start Up Menu:

Parameter	Description	Visible
C013	Type of motor V/f pattern	[only if IFD is active]
C015	Rated motor frequency	
C016	Rated motor rpm	
C017	Rated motor power	
C018	Rated motor current	
C019	Rated motor voltage	
C028	Min. motor speed	
C029	Max. motor speed	
P009	Acceleration ramp time	
P010	Deceleration ramp time	
P018	Start acceleration time	
P019	End acceleration time	
P020	Speed threshold for start and end ramp	
C043	Current limit while accelerating	[only if IFD is active]
C044	Current limit at constant speed	[only if IFD is active]
C045	Current limit while decelerating	[only if IFD is active]
C265	Motor thermal protection	
C267	Motor thermal time constant	[only if protection is active]

After setting the last parameter and moving the cursor forward, the following page will appear:

```
Press UP ARROW
to quit
DOWN ARROW
to continue
```

Press ▲ to quit the Start-up menu. The default page of the system will be displayed.

10. FIRST STARTUP

For the signal wiring and power wiring, please refer to the IRIS BLUE – Installation Guide.
Parameter programming is detailed in the START-UP MENU.

10.1. "IFD" Control Algorithm

The IRIS BLUE drives are factory set with the IFD (**C010**) control algorithm for the first startup of the equipment. The default functions of the drive terminals are given in the table below. For more details, please refer to the IRIS BLUE's IRIS BLUE – Installation Guide.

.

1) Wiring: Follow the instructions stated in the "Caution Statements" and "Installation" sections (IRIS BLUE – Installation Guide).

2) Power on: Power on the drive and do not close the link to the **ENABLE-A** and **ENABLE-B** inputs to prevent the motor from running. Check if the display/keypad turns on.

3) Parameter setting: The equipment startup is made easier by the START-UP MENU, which is a wizard for the setup of the main motor control parameters.

From the START-UP MENU, set the following:

1. The motor ratings by way of:

- **C015** (fmot1) rated frequency
- **C016** (rpmnom1) rated rpm
- **C017** (Pmot1) rated power
- **C018** (Imot1) rated current
- **C019** (Vmot1) rated voltage

The motor V/f pattern may be programmed in **C013**.

4) Autotune (motor stopped): In case of IFD motor control when slip compensation is inactive (**C039**=0%) no autotune is required. On the other hand, when slip compensation is active, it is recommended to compute stator resistance **C022**.

The steps to take to perform motor autotune are the following:
With the **ENABLE-A** and **ENABLE-B** commands open, access the [CFG] AUTOTUNE MENU and set **I073** = [1: Motor Tune] and **I074** = [0: All Ctrl no rotation]. Use the **ESC** key to accept changes.

Close the **ENABLE-A** and **ENABLE-B** commands and wait until tune is complete (Warning "**W32** Open Enable" is displayed). The drive has computed and saved the values for **C022** (stator resistance).

If alarm "**A097** Motor Wires KO" trips, check the motor wiring. If alarm "**A065** Autotune KO" trips, this means that the **ENABLE** command has opened before autotune was complete. In this case, reset the drive by sending a command from terminal MDI3, or press the **RESET** key in the display/keypad and perform the autotune procedure again.

5) Overload: Set parameters **C043**, **C044** and **C045** as the maximum desired overload current.

6) Startup: Activate the **ENABLE-A** input (terminal 15), **ENABLE-B** input (terminal S) and the **START** input (terminal 14) and send a speed reference: the **RUN** LED and **REF** LEDs will come on and the motor will start running. Make sure that the motor is rotating in the correct direction. If not, set parameter **C014** (Phase Rotation) to [1:Yes], or open the **ENABLE-A, ENABLE-B** and **START** inputs, remove voltage from the drive and, after waiting at least 20 minutes, swap two of the motor phases.

7) Possible failures: If no failure occurred, go to step 8. Otherwise, check the drive connections paying particular attention to supply voltages, DC link and input reference. Also check if alarm messages are displayed. In the [MEA] MEASUREMENTS MENU, check the reference speed (**M001**), the supply voltage to the control section (**M030**), the DC link voltage (**M029**), and the condition of control terminals (**M033**). Check to see if these readouts match with the measured values.

8) Additional parameter modifications: When parameter **P003** = Standby Only (condition required for changing C parameters), you can change **Cxxx** parameters in the CONFIGURATION menu only when the drive is DISABLED or STOPPED, whereas if **P003** = Standby + Fluxing, you can change **Cxxx** parameters when the motor is stopped but the drive is enabled.

9) Reset: If an alarm trips, find the cause responsible for the alarm and reset the drive. Enable input MDI3 (terminal 16) for some time, or press the **RESET** key on the display/keypad.

NOTE When the IFD control algorithm is used, only speed references can be set up.

NOTE The **ENABLE-A** and **ENABLE-B** inputs are allocated to the STO function. If this safety functionality is to be adopted, the control mode and the control circuit of these signals must be accomplished as per the Safe Torque Off Function – Application Manual**.**
That manual also includes a detailed validation procedure of the control configuration of the STO function to be executed upon first start-up and also periodically at yearly intervals.

10.2.“VTC” Control Algorithm

1) Wiring: Follow the instructions stated in the “Caution Statements” and “Installation” sections in the IRIS BLUE – Installation Guide.

2) Power on: Power on the drive and do not close the link to the **ENABLE-A** and **ENABLE-B** inputs to prevent the motor from running. Check if the display/keypad turns on.

3) Parameter setting: The equipment startup is made easier by the START-UP MENU, which is a wizard for the setup of the main motor control parameters.

From the START-UP MENU, set the following:

1. The control algorithm as VTC (Vector Torque Control) in **C010**;
2. The motor ratings by way of:

- **C015** (fmot1) rated frequency
- **C016** (rpmnom1) rated rpm
- **C017** (Pmot1) rated power
- **C018** (Imot1) rated current
- **C019** (Vmot1) rated voltage
- **C029** (Speedmax1) max. allowable speed

4) Setting no-load current C021 If the motor current is known, set **C021** (**I_0**) to the value of **I_0** expressed as a percentage of the rated motor current.
If the no-load current of the motor is not known but the motor can rotate freely without any connected load, start the motor in IFD mode at nominal rpm, read out the current value from the Motor Measurements Menu and use that value as the first trial value for **I_0**. For example, if the rated motor current is **C018** = 133A and **M026** = 36A, set **C021**= 36/133=27%.

NOTE: If the motor must run at a higher speed than the rated speed (field weakening mode) read out the no-load current value at rated speed in any case.
Lastly, if the no-load current of the motor is not known and the motor cannot rotate under no-load conditions, you can use the first **I_0** trial value automatically computed by the IRIS BLUE drive during the tuning procedure described in step 5).

NOTE: Each time the tuning procedure in step 5) is carried out with no-load current parameter **C021** (**I_0**) = 0, the IRIS BLUE drive will automatically enter a value based on the motor current ratings.

5) Autotune of motor parameters (motor stopped) With the **ENABLE-A** and **ENABLE-B** commands open, access the [CFG] AUTOTUNE MENU and set **I073**=[1: Motor Tune] and **I074**=[0: Motor Params]. Press **ESC** to confirm the new values.
Close the **ENABLE-A** and **ENABLE-B** commands and wait until tune is complete (Warning “**W32** Open Enable” is displayed).

The drive has now computed and saved the following parameter values:

- **C022** (stator resistance) through motor measurements
- **C023** (leakage inductance) through motor measurements
- If **C021**=0, a first trial value for no-load current **C021** is computed based on the motor ratings
- **C024** (mutual inductance)
- If **C025**=0, a first trial value for rotor time constant **C025** is computed based on the motor ratings

If alarm “**A097** Motor Wires KO” trips, check the motor wiring. If alarm “**A065** Autotune KO” trips, this means that the **ENABLE-A** and **ENABLE-B** commands have opened before autotune was complete. In that case, reset the drive sending a command from terminal MDI3, or press the **RESET** key in the display/keypad and perform the autotune procedure again.
If the motor can rotate with no connected load, carry out the autotune procedure for the rotor time constant and the current loop of the VTC regulator as detailed in step **6a**, otherwise carry out only the current loop tuning as detailed in step **6b** (in that case, the rotor time constant **C025** is not computed based on the motor measurements).

6a) Autotune for rotor time constant and current loop (rotor free)

CAUTION: This type of tuning requires that the motor is free to rotate with no connected load. During autotune, current is first applied to the motor when the rotor is not running, then the motor is operated to run at approx. 70% of its rated speed.

If the motor can rotate with no connected load, with the **ENABLE-A** and **ENABLE-B** commands open, access the [CFG] AUTOTUNE MENU and set **I073**= [1: Motor Tune] e **I074**= [2: Control YES rot]. Press **ESC** to confirm the new values.
Close the **ENABLE-A** and **ENABLE-B** commands and wait until tune is complete (Warning "**W32** Open Enable" is displayed).

The drive has now computed and saved the following parameter values:

- **C025** (rotor time constant) through motor measurements
- **P175t1** (proportional gain of the current control) and **P175u1** (integral time of the current control) through motor measurements.

If alarm "**A065** Autotune KO" trips, this means either that the **ENABLE-A** and **ENABLE-B** commands have opened before autotune was complete, or that the available timeout has elapsed. In either case, reset the drive sending a command from terminal MDI3, or press the **RESET** key on the display/keypad and perform the autotune procedure again.

NOTE: If autotune has not been interrupted by opening the **ENABLE-A** and **ENABLE-B** commands, decrease no-load current value **C021** by 5% before performing the autotune procedure again.

6b) Current loop autotune (motor stopped):

If the motor cannot rotate with any connected load, it is not possible to estimate the rotor time constant by way of the autotune procedure. Therefore, only the VTC current loop is tuned.

With the **ENABLE-A** and **ENABLE-B** commands open, access the [CFG] AUTOTUNE MENU and set **I073**= [1: Motor Tune] and **I074**= [1: Control NO rot]. Press **ESC** to confirm the new changes. Close the **ENABLE-A** and **ENABLE-B** commands and wait until tune is complete (Warning "**W32** Open Enable" is displayed).

The drive has now computed and saved the following parameter values:

- **P175t1** (proportional gain of the current control) through motor measurements.
- **P175u1** (integral time of the current control) through motor measurements.

If alarm "**A065** Autotune KO" trips, this means that the **ENABLE-A** and **ENABLE-B** commands have opened before autotune was complete or the autotune algorithm has failed within the preset timeout. In that case, reset the drive sending a command from terminal MDI3, or press the **RESET** key in the display/keypad and perform the autotune procedure again.

7) Overload:

Set parameter **C048** in the [CFG] LIMITS MENU based on the maximum torque that can be generated expressed as a percentage of the motor rated torque.

8) Start up:

Activate the **ENABLE-A** input (terminal 15), **ENABLE-B** (terminal S) and the **START** input (terminal 14) and send a speed reference. The **RUN** LED and **REF** LED will come on and the motor will start. Make sure that the motor is rotating in the correct direction. If not, set parameter **C014** (Phase Rotation) = [1:Yes], or open the **ENABLE-A**, **ENABLE-B** and **START** inputs, remove voltage from the drive and, after waiting at least 20 minutes, swap two of the motor phases.

9) Speed regulator adjustment:

If overshoot occurs when the speed setpoint is attained or if a system instability is detected (jerking), adjust the parameters relating to the speed loop ([PAR] SPEED LOOP AND CURRENT BALANCING MENU). Set the two parameters relating to integral time (**P125, P126**) as [Disabled] and set low values for the parameters relating to proportional gain (**P128, P129**). Set equal values for **P128** and **P129** and increase them equally until overshoot takes place when the setpoint is attained. Decrease **P128** and **P129** by approx. 30%, then decrease the high values set for integral time in **P125** and **P126** (keep both values equal) until an acceptable setpoint response is obtained. Check to see if the motor runs smoothly at constant speed.

10) Possible failures:

If no failure occurred, go to step 11. Otherwise, check the drive connections paying particular attention to supply voltages, DC link and input reference. Also check if alarm messages are displayed. In the [MEA] MEASUREMENTS MENU, check the reference speed (**M000**), the reference speed processed by the ramps (**M002**), the supply voltage of the control section (**M030**), the DC-link voltage (**M029**), the condition of the control terminals (**M033**). Check to see if these readouts match with the measured values.

11) Additional parameter modifications:

If the motor control is underperforming, make sure that the following measurements are consistent with the expected motor operation:

- estimated speed **M004** with respect to speed ramp **M002**,
- output frequency **M006**,
- generated torque **M012** and torque demand **M011**,
- output current **M026**,
- output voltage **M027**.

Proceed as follows:

Issue	What to do
Generation of weak torque or inaccurate torque delivery	Increase the flux boost at low frequency **P175h1** and adjust the frequency range for the boost to occur via parameters **P175i1** and **P175j1**. The magnetization current at low frequency with active current boost equals the no-load current value in **C021** increased by the value in **P175h1** (for example, if **C021**=27% and **P175h1**=30%, the magnetization current is 27%x1.3=35.1%). Up to the frequency value in **P175i1**, the magnetization current is **C021** x (1+**P175h1**); at a frequency higher than **P175j1**, the magnetization current is **C021**; at intermediate frequency values, the magnetization current follows a linear pattern. Too high magnetization current values may lead to saturation of the motor flux, lower efficiency due to greater no-load current, inaccurate torque adjustment or controller instability. It is suggested that **P175j1** be applied at its maximum value up to 50% of the rated frequency. Also, set **P175i1** in such a way so as to obtain a rather smooth pattern (for example, **P175i1** set to half the value in **P175j1**). In case **P175i1** and **P175j1** are not correctly adjusted, torque adjustment may be uneven or current variations may occur.
Generation of weak torque at high speed	If the motor is not capable of delivering high torque at high speed (close to rated torque or field weakening torque) or requires excessive current with respect to the expected current, it is possible to adjust rotor time constant **C025**.
Generation of weak torque at low speed or in regenerative mode	Change current distortion compensation parameters in VTC control **P175a**, **P175b**, **P175c**. Change current distortion compensation **P175b** first, then change positive and negative current split **P175c.** For high values in **P175b**, also increase the linear pattern threshold in **P175a**. If parameter **P175b** is set too high or **P175a** is set too low, rotor oscillations may occur, or it may happen that the rotor is not kept standstill even in no-load conditions. If this is the case, set lower values for the parameters above.
Low output voltage or weak torque in field weakening mode	Disable static field weakening by setting **C030** = Disable and enable automatic field weakening by setting **C030a** >0. In that way, the field weakening amplitude is automatically adjusted to ensure adjusting the required speed at the maximum allowable voltage fitting the rated motor voltage and the available DC voltage.

Torque demand (measurement **M011**) different from generated torque (measurement **M012**)	Certain applications require that the generated torque be as close as possible to the torque demand; this is due to the fact that the torque limit (parameters **C047** and **C048**) affects the torque demand, so it is important that the actual generated torque is correctly limited. To do so, proceed as follows: • Check **M011** and **M012** under normal operating conditions of the motor and, in any case, at at least 75% of the rated speed and at least 75% of the rated load. If the motor has to operate under field weakening conditions (higher speed than the nominal speed) also this condition is to be checked. • If **M011**>**M012**, gradually increase **C023** by steps of about 10%. • If **M011**<**M012**, gradually decrease **C023** by steps of about 10%. • In case start up is difficult when increasing **C023**, gradually decrease **C024** by steps of about 10% and find a new value for **C023** that makes **M011** and **M012** equal.

When parameter **P003** = Standby Only (condition required for changing **Cxxx** parameters), you can change **Cxxx** parameters only when the drive is DISABLED or STOPPED, whereas if **P003** = Standby + Fluxing, you can change **Cxxx** parameters when the motor is stopped but the drive is enabled.

Before changing any parameters, remember that the correct code for parameter **P000** must be previously set up.

12) Reset: If an alarm trips, find the cause responsible for the alarm and reset the drive. Enable input MDI3 (terminal 16) for some time, or press the **RESET** key on the display/keypad.

NOTE

The **ENABLE-A** and **ENABLE-B** inputs are allocated to the STO function. If this safety functionality is to be adopted, the control mode and the control circuit of these signals must be accomplished as per the Safe Torque Off Function – Application Manual**.**
That manual also includes a detailed validation procedure of the control configuration of the STO function to be executed upon first start-up and also periodically at yearly intervals.

11. [MEA] MEASUREMENTS MENU

11.1. Overview

The Measures Menu contains the variables measured by the drive that can be used by the user.
In the display/keypad, measures are divided into subgroups.

The measure subgroups are the following:

Motor Measurements Menu
This menu contains: the values of the speed reference at constant rpm, the values of the reference being used and the speed values of the connected motor expressed in rpm; the drive rated frequency;
the torque reference at constant rpm, the torque demand and the motor torque output, the torque limit reference at constant speed and the torque limit being used expressed both in Nm and as a percentage of the rated torque of the connected motor; the flux reference and the electrical variables measured by the drive mains side, the DC-bus and output.

Hydraulic Measurements Menu
This menu contains the measurements specific to water applications (dry-run detection, pressure loss control).

PID Controller Menu
This menu contains the values relating to the PID controller of the IRIS BLUE drive.

Digital Inputs Menu
This menu contains the state of the drive digital inputs and the indication of the functions programmed for the digital inputs of the IRIS BLUE drive.

References Menu
This menu contains the following values: the analog references and the frequency input references, the speed/torque or reference/feedback values of the PID coming from serial link or fieldbus.

Outputs Menu
This menu contains the state of the drive digital outputs, analog outputs and frequency outputs.

Temperatures from PT100 Menu
This menu contains the temperature values detected in the first four analog channels of ES847 I/O expansion board (this menu is available only if ES847 is fitted).

Autodiagnostics Menu
This menu contains the temperature values, the operation time counter and the supply time counter, the active alarm and the drive status.

Data Logger Measurements Menu
This menu contains the status of the type of connections (serial links, Ethernet and modem) supported by ES851 Data Logger board (this menu is available only if the Data Logger ES851 is fitted).

Digital Input Settings Menu
This menu contains the functions assigned to the digital inputs.

Fault List Menu
This menu contains the trip log of the last eight alarms tripped and the values of some measurements being used when the alarm trip was stored.

PowerOff Log Menu
This menu contains the value of some measurements being used at the drive power off.

Multimotor Measurements Menu
This menu contains the measurements specific to equipment operation in Multimotor mode (available motors, running motors, references to motors, serial communications status, power required to the plant, etc.).
This menu is active in Multimotor mode only.

Motor Running Time Menu
This menu displays the motors running time computed by the drive based on controlled duty cycles in Multimotor mode.
This menu is active in Multimotor mode only.

11.2.Motor Measurements Menu

This menu contains speed values, torque values and electrical variables measured by the drive on the mains side, DC bus and output.

M000-1	Speed Reference at Constant RPM	
Range	± 32000(integer part) ± 99 (decimal part)	± 32000.99 rpm Note: The actual range depends on the connected motor, because it is defined by the value set in the parameters for the motor max. speed and min. speed. (**C028**–**C029**).
Active	Active only when a speed reference is used for the connected motor.	
Address	1650 (integer part) 1651 (decimal part)	
Function	Value of the speed reference obtained when the motor rotates at constant speed, once the preset ramp time is over.	

M002-3	Speed Reference after Ramps	
Range	± 32000(integer part) ± 99 (decimal part)	± 32000.99 rpm Note: The actual range depends on the connected motor, because it is defined by the value set in the parameters for the motor max. speed and min. speed. (**C028**–**C029**).
Active	Active only when a speed reference is used for the connected motor.	
Address	1652 (integer part) 1653 (decimal part)	
Function	This is the measurement of the speed value processed with respect to the ramp time.	

M004-5	Motor Speed	
Range	± 32000(integer part) ± 99 (decimal part)	± 32000.99 rpm
Active	Always active.	
Address	1654 (integer part) 1655 (decimal part)	
Function	Motor speed value.	

M006	Drive Output Frequency	
Range	± 10000	± 1000.0 Hz (see Table 68)
Active	Always active.	
Address	1656	
Function	This is the measurement of the voltage frequency output of the drive.	

M008	Torque Demand (Nm)	
Range	± 32000	± 32000 Nm Note: The actual range depends on the rated torque and the torque limit values set for the connected motor (**C047**–**C048**).
Active	Active for VTC control only.	
Address	1658	
Function	With speed control: Torque demand of the speed regulator for the type of control used. With torque control: Torque reference processed with respect to the preset torque ramp time.	

M009	Torque Generated by the Motor (Nm)	
Range	± 32000	± 32000
Active	Active for VTC control only	
Address	1659	
Function	Approximate value of the torque produced by the connected motor.	

M011	Torque Demand (%)	
Range	± 500	± 500 % Note: The actual range depends on the torque limit values set for the selected motor (**C047–C048**).
Active	Active for VTC control only	
Address	1661	
Function	With speed control: Torque demand of the speed regulator expressed as a percentage of the motor rated torque. With torque control: Torque reference processed with respect to the preset torque ramp time and expressed as a reference of the motor rated torque.	

M012	Torque Generated by the Motor (%)	
Range	± 500	± 500
Active	Active for VTC control only TC	
Address	1662	
Function	Approximate value of the torque produced by the motor and expressed as a percentage of the rated torque of the connected motor.	

M017	Flux Reference	
Range	0 ÷ 500	0 ÷ 5.00 Wb
Active	Active for VTC control only	
Address	1667	
Function	Flux reference required and expressed in Weber (Wb).	

M026	Output Current	
Range	0 ÷ 65535	0 ÷ 6553.5 A Note: The actual range depends on the drive size.
Active	Always active	
Address	1676	
Function	Measurement of the RMS of the output voltage.	

M026a	Motor Thermal Capacity	
Range	0 ÷ 1000	0.0 ÷ 100.0%
Active	Always active	
Address	1728	
Function	Heating of the connected motor. This parameter indicates the current level of the motor heating following I2t pattern set in the [CFG] MOTOR CONFIGURATION MENU. This value is expressed as a percentage of the allowable asymptotic value.	

M027	Output Voltage	
Range	0 ÷ 65535	0 ÷ 65535 V Note: The actual range depends on the drive voltage class.
Active	Always active	
Address	1677	
Function	Measurement of the RMS of the output voltage.	

M027a	Power Factor (cosphi)	
Range	0 ÷ 1000	0.000 ÷ 1.000
Active	Always active.	
Address	1742	
Function	This is the measurement of the output power factor.	

M028	Output Power	
Range	–32768 ÷ +32767	–3276.8 ÷ +3276.7 kW Note: The actual range depends on the drive voltage class.
Active	Always active	
Address	1678	
Function	Measurement of the active power produced by the drive. A negative value indicates input power (the motor is regenerating energy).	

M028a	Energy Consumption	
Range	0 ÷ 1000000000	0 ÷ 10000000.00 kWh
Active	Always active	
Address	1723-1724 (LSWord, MSWord)	
Function	Counter of the drive energy consumption. This is a value expressed in 32 bits divided into two 16-bit words: the low part and the high part.	

M029	Bus-DC Voltage	
Range	0 ÷ 1400	0 ÷ 1400 V
Active	Always active	
Address	1679	
Function	Measurement of the voltage in the drive DC-link.	

M030	Output Voltage	
Range	0 ÷ 1000	0 ÷ 1000 V
Active	Always active	
Address	1680	
Function	Measurement of the RMS value of the drive supply voltage.	

11.3. Water Measurements Menu

This menu contains measurements specific to water applications.

M700	H2O Digital Outputs	
Range	Bit-controlled measurement	See Table 1
Active	Always active	
Address	1561	
Function	Status of digital water measurements - “Dry-run” is active only if the Dry-run condition has been detected - “Pressure-loss” is active only when the pressure loss condition has been detected.	

Table 1: Coding of M700

Bit n.	Digital Input	Bit n.	Digital Input
0	Dry-run	1	Pressure loss

M701	Dry-run Threshold	
Range	±32000	0.00kW-320.00kW or 0.00-1.00 Note: The actual range and the unit of measurement depend on the type of quantity set in **P710** to detect the dry run condition
Active	Always active	
Address	1562	
Function	This is the measurement for the detection of the dry-run condition. Based on the dry-run detection mode set in **P710** (electric power or power factor). **M701** is the threshold below which the pump is considered as running under dry-run conditions. **M701** is computed by way of linear interpolation with respect to frequency, based on parameters **P710a-P710d** and **P711**.	

11.4. PID Regulator Menu

This menu contains the measurements relating to the input and output values of the internal PID regulator.

M018	PID Reference at Constant RPM (%)	
Range	±10000	±100.00 % Note: The actual range depends on the max. value and the min. value of the PID reference set in parameters **P245–P246**
Active	Always active	
Address	1668	
Function	This is the measurement of the PID reference expressed as a percentage. Scaling is detailed in the [PAR] PID PARAMETERS MENU and the [CFG] PID CONFIGURATION MENU.	

M018a	PID2 Reference at Constant RPM (%)	
Range	±10000	±100.00 % Note: The actual range depends on the max. value and the min. value of the PID2 reference set in parameters **P445–P446**
Active	If enabled from **C291a**	
Address	1731	
Function	This is the measurement percent of the reference selected with **C286** for the PID2 or the 2-zone mode. Scaling is detailed in the [PAR] PID2 PARAMETERS MENU and [CFG] PID CONFIGURATION [PAR] PID2.	

M019	PID Reference after Ramps (%)	
Range	±10000	±100.00 % Note: The actual range depends on the max. value and the min. value of the PID reference set in parameters **P245–P246**
Active	Always active	
Address	1669	
Function	This is the measurement of the PID reference after the ramps expressed as a percentage. Scaling is detailed in the [PAR] PID PARAMETERS MENU and the [CFG] PID CONFIGURATION MENU.	

M019a	PID2 Reference after Ramps (%)	
Range	±10000	±100.00 % Note: The actual range depends on the max. value and the min. value of the PID reference set in parameters **P445–P446**
Active	If enabled from **C291a**	
Address	1732	
Function	This is the measurement percent of the current PID reference after the ramps selected with **C286** for the PID2 or the 2-zone mode. Scaling is detailed in the [PAR] PID2 PARAMETERS MENU and the [CFG] PID CONFIGURATION MENU.	

M020	PID Feedback (%)	
Range	±10000	±100.00 % Note: The actual range depends on the max. value and the min. value of the PID feedback set in parameters **P247–P248**
Active	Always active	
Address	1670	
Function	This is the measurement of the PID feedback expressed as a percentage. Scaling is detailed in the [PAR] PID PARAMETERS MENU and the [CFG] PID CONFIGURATION MENU.	

M020a	PID2 Feedback (%)	
Range	±10000	±100.00 % Note: The actual range depends on the max. value and the min. value of the PID2 feedback set in parameters **P447-P448**
Active	If enabled **C291a**	
Address	1733	
Function	This is the measurement percent of the PID2 feedback selected with **C286** for the PID2 or the 2-zone mode. Scaling is detailed in the [PAR] PID2 PARAMETERS MENU and [CFG] PID CONFIGURATION MENU.	

M021	PID Error (%)	
Range	±10000	±100.00 % Note: The actual range depends on the min. and max. saturation values of the reference and the feedback set in parameters **P245–P246** for the reference and in **P247–P248** for the feedback.
Active	Always active	
Address	1671	
Function	This is the measurement of the PID input error expressed as a percentage. See also the [PAR] PID PARAMETERS MENU and the [CFG] PID CONFIGURATION MENU.	

M021a	PID2 Error (%)	
Range	±10000	±100.00 % Note: The actual range depends on the min. and max. saturation values of the reference and the feedback set in parameters **P445-P446** for the reference and in **P447–P448** for the feedback.
Active	This measurement is active if enabled from **C291a**	
Address	1736	
Function	This is the measurement percent of the PID2 input error or the 2-zone mode input error (difference between the reference selected with **C286** and the feedback selected with **C289**). Please refer to the [PAR] PID2 PARAMETERS MENU and [CFG] PID CONFIGURATION MENU.	

M022	PID Output (%)	
Range	±10000	±100.00 % Note: The actual range depends on the min. and max. saturation values of the PID output set in parameters **P236–P237**.
Active	Always active.	
Address	1672	
Function	This is the measurement of the output produced by the PID regulator and expressed as a percentage. Please refer to the [PAR] PID PARAMETERS MENU and the [CFG] PID CONFIGURATION MENU for the scaling of the PID output**.**	

M022a	PID2 Output (%)	
Range	±10000	±100.00 % Note: The actual range depends on the min. and max. saturation values of the PID output set in parameters **P436–P437**.
Active	This measurement is active if enabled from **C291a**	
Address	1718	
Function	This is the measurement of the output produced by the PID2 regulator and expressed as a percentage. Scaling is detailed in the [PAR] PID2 PARAMETERS MENU and [CFG] PID CONFIGURATION MENU.	

M023	PID Reference after Ramps	
Range	±32000	Note: The actual range depends on the max. value and the min. value of the PID reference set in parameters **P245–P246** and on the gain level set in **P257**.
Active	Always active	
Address	1673	
Function	This is the measurement of the reference after the ramps being used for the PID regulator, as **M019** but multiplied by the gain level set in **P257** (see also the [PAR] PID PARAMETERS MENU and the [CFG] PID CONFIGURATION MENU). As for the display/keypad, the unit of measurement can be programmed with parameters **P267**, **P267a** in the [PAR] DISPLAY/KEYPAD.	

M023a	PID2 Reference after Ramps	
Range	±32000	Note: The actual range depends on the min. and max. values of the PID2 reference set in parameters **P445-P446** and on the gain level set in **P457**.
Active	This measurement is active if enabled from **C291a**	
Address	1737	
Function	This is the measurement of the reference being used for the PID2 or the 2-zone mode, as **M019a** but multiplied by the gain level set in **P457** (see also the [PAR] PID2 PARAMETERS MENU and [CFG] PID CONFIGURATION MENU). As for the display/keypad, the unit of measurement can be programmed with parameters **P267b**, **P267c** in the [PAR] DISPLAY/KEYPAD MENU.	

M024	PID Feedback	
Range	±32000	Note: The actual range depends on the max. value and the min. value of the PID feedback set in parameters **P247**–**P248** and on the gain level set in **P257**.
Active	Always active.	
Address	1674	
Function	This is the measurement of the feedback being used for the PID regulator, as **M020** but multiplied by the gain level set in **P257** (see also the [PAR] PID PARAMETERS MENU and the [CFG] PID CONFIGURATION MENU). As for the display/keypad, the unit of measurement can be programmed with parameters **P267**, **P267a** in the [PAR] DISPLAY/KEYPAD MENU**.**	

M024a	PID2 Feedback	
Range	±32000	Note: The actual range depends on the max. value and the min. value of the PID2 feedback set in parameters **P447**–**P448** and on the gain level set in **P457.**
Active	If enabled from **C291a**	
Address	1738	
Function	This is the measurement of the feedback being used for the PID2 regulator or the 2-zone mode as **M020a** but multiplied by the gain level set in **P457** (see also the [PAR] PID2 PARAMETERS MENU and the [CFG] PID CONFIGURATION MENU). As for the display/keypad, the unit of measurement can be programmed with parameters **P267b**, **P267c** in the [PAR] DISPLAY/KEYPAD MENU.	

M025	PID Disable Threshold	
Range	±32000	Note: The actual range depends on the max. value and the min. value of the PID2 feedback set in parameters **P247**–**P248** and on the gain level set in **P257**.
Active	Always active	
Address	3307	
Function	This is the measurement of the PID disable threshold (Sleep mode activation). For more details, please refer to the [PAR] PID2 PARAMETERS MENU and the [CFG] PID CONFIGURATION MENU).	

M025a	PID2 Disable Threshold	
Range	±32000	Note: The actual range depends on the max. value and the min. value of the PID2 feedback set in parameters **P447**–**P448** and on the gain level set in **P457**.
Active	If enabled from **C291a**	
Address	3308	
Function	This is the measurement of the PID disable threshold (Sleep mode activation). For more details, please refer to the [PAR] PID2 PARAMETERS MENU and [CFG] PID CONFIGURATION MENU).	

11.5.Digital Inputs Menu

This menu allows checking the state of the command sources for the digital inputs (local terminals, serial link and fieldbus), the terminal board resulting from their combination and the terminals which are actually used for the drive control. The terminals which are actually used to control the drive also consider any timers applied to the digital inputs.

M031	Delayed Digital Inputs	
Range	Bit-controlled measurement	See Table 2
Active	Always active	
Address	1681	
Function	Status of the control terminal board used by the drive. This is the terminal board resulting from the combination of the preset command sources (local terminal board, serial link and fieldbus), where: - Inputs MDI1 to MDI8 are the result of the OR between the different control sources. - The ENABLE (E) status is the result of the AND of inputs MDI2+S of the physical terminals and of MDI2 inputs of all the other programmed control sources. - The ENABLE SW (ESW) is the result of the AND of the inputs programmed as ENABLE SW (**C152**) of all the programmed command sources. See also the [CFG] CONTROL METHOD MENU and the [PAR] TIMERS MENU. Refer to Figure 49 for the ENABLE and ENABLE SW status.	

M032	Instant Digital Inputs	
Range	Bit-controlled measurement	See Table 2
Active	Always active	
Address	1682	
Function	Status of the virtual control terminal board upstream of the application of the timers to the digital inputs (if no timer is applied, it matches with **M031**). See the [CFG] CONTROL METHOD MENU and the [PAR] TIMERS MENU. Refer to Figure 50 for the **ENABLE** and **ENABLE SW** status.	

Table 2: Coding of M031, M032

Bit n.	Digital Input	Bit n.	Digital Input
0	MDI1	5	MDI6
1	MDI2	6	MDI7
2	MDI3(RESET)	7	MDI8
3	MDI4	8	ENABLE-SW
4	MDI5	9	ENABLE

M033	Local Control Terminal Board	
Range	Bit-controlled measurement	See Table 3
Active	Always active	
Address	1683	
Function	Status of the digital inputs in the drive physical terminal board. The status of **MDI2+S (S)** input is the result of a logic AND between **ENABLE-A** and **ENABLE-B** physical signals.	

Table 3: Coding of M033

Bit n.	Digital Input	Bit n.	Digital Input
0	MDI1	4	MDI5
1	MDI2+S (S)	5	MDI6
2	MDI3(RESET)	6	MDI7
3	MDI4	7	MDI8

M034	Control Terminals from Serial Link	
Range	Bit-controlled measurement	See Table 4
Active	Always active	
Address	1684	
Function	Status of the digital inputs in the terminal board controlled via serial link.	

M035	Control Terminal Board from Fieldbus	
Range	Bit-controlled measurement	See Table 4
Active	Always active	
Address	1685	
Function	Status of the digital inputs in the terminal board controlled via fieldbus.	

Table 4: Coding of M034, M035

Bit n.	Digital Input	Bit n.	Digital Input
0	MDI1	4	MDI5
1	MDI2	5	MDI6
2	MDI3(RESET)	6	MDI7
3	MDI4	7	MDI8

M036	Auxiliary Digital Inputs from Terminal Board	
Range	Bit-controlled measurement	See Table 5
Active	Always active	
Address	1686	
Function	Status of the auxiliary digital inputs in ES847 or ES870 terminal board.	

M036a	Auxiliary Digital Inputs from Serial Link	
Range	Bit-controlled measurement	See Table 5
Active	Always active	
Address	1713	
Function	Status of the auxiliary digital inputs from serial link.	

M036b	Auxiliary Digital Inputs from Fieldbus	
Range	Bit-controlled measurement	See Table 5
Active	Always active	
Address	1717	
Function	Status of the auxiliary digital inputs from fieldbus.	

Table 5: Coding of M036, M036a, M036b

Bit n.	Digital Input	Bit n.	Digital Input
0	XMDI1	4	XMDI5
1	XMDI2	5	XMDI6
2	XMDI3	6	XMDI7
3	XMDI4	7	XMDI8

11.6. References Menu

This menu contains the measurements of the possible reference sources for speed, torque or PID available in the terminal board (analog inputs and frequency inputs) and sent via serial link or fieldbus.

M037	REF External Analog Reference	
Range	Function of the preset type of reference (voltage/current).	Function of the type of reference (voltage/current) set in **P050**. The numerical value always includes two decimal figures; the unit of measurement is V or mA.
Active	Always active.	
Address	1687	
Function	Measurement of the voltage /current value detected by the drive in REF analog input.	

M038	AIN1 External Analog Reference	
Range	Function of the preset type of reference (voltage/current)	Function of the type of reference (voltage/current) set in **P055**. The numerical value always includes two decimal figures; the unit of measurement is V or mA.
Active	Always active	
Address	1688	
Function	Measurement of the voltage /current value detected by the drive in AIN1 analog input.	

M038u	User Measurement over AIN1	
Range	Function of the preset unit of measurement	Function of the unit of measurement programmed in **P266d** and function of **P266e**, **P266f**
Active	Always active	
Address	1559	
Function	Measurement of the value detected by the drive in AIN1 analog input, expressed with the unit of measurement set in **P266d** (if **P266d**=Disable, value expressed as a percentage). The values of the user measurement expressed with **P266d** corresponding to min. AIN1 **P056** and max. **P057** are defined in **P266e** and **P266f**. See [PAR] DISPLAY/KEYPAD MENU and [PAR] INPUTS FOR REFERENCES MENU.	

M039	AIN2 External Analog Reference	
Range	Function of the preset type of reference (voltage/current)	Function of the type of reference (voltage/current) set in **P060**. The numerical value always includes two decimals; the unit of measurement is V or mA.
Active	Always active	
Address	1689	
Function	Measurement of the voltage /current value detected by the drive in AIN2 analog input.	

M039u	User Measurement over AIN2	
Range	Function of the preset unit of measurement	Function of the unit of measurement programmed in **P266g** and function of **P266h**, **P266i**
Active	Always active	
Address	1560	
Function	Measurement of the value detected by the drive in AIN2 analog input, expressed with the unit of measurement set in **P266g** (if **P266g**=Disable, value expressed as a percentage). The values of the user measurement expressed with **P266g** corresponding to min. AIN2 **P058** and max. **P059** are defined in **P266h** and **P266i**. See [PAR] DISPLAY/KEYPAD MENU and [PAR] INPUTS FOR REFERENCES MENU.	

M039a	XAIN4 External Analog Reference	
Range	Function of the preset type of reference	Function of the type of reference (voltage) set in **P390**. The numerical value always includes two decimals; the unit of measurement is V.
Active	Active only if set via parameter **R023**	
Address	1729	
Function	Measure of the voltage value detected by the drive in XAIN4 analog input.	

M039b	XAIN5 External Analog Reference	
Range	Function of the preset type of reference	Function of the type of reference (current) set in **P395**. The numerical value always includes two decimals; the unit of measurement is mA.
Active	Active only if set via parameter **R023**	
Address	1730	
Function	Measurement of the current value detected by the drive in the XAIN5 analog input.	

M040	Speed Reference from Serial Link	
Range	± 32000 (integer part) ± 99 (decimal part)	± 32000.99 rpm Note: The actual range depends on the connected motor, because it is defined by the value set in the parameters for the max. speed and min. speed of the motor (**C028–C029**)
Active	Always active	
Address	1690 (integer part), 1691 (decimal part)	
Function	This is the value of the speed reference set via serial link.	

M042	Speed Reference from Fieldbus	
Range	± 32000 (integer part) ± 99 (decimal part)	± 32000.99 rpm Note: The actual range depends on the selected motor, because it is defined by the value set in the parameters for the max. speed and min. speed of the connected motor (**C028–C029**)
Active	Always active.	
Address	1692 (integer part), 1693 (decimal part)	
Function	This is the measurement of the speed reference set by the fieldbus.	

M044	Torque Reference from Serial Link	
Range	± 5000	± 500.0 % Note: The actual range depends on the torque limit value set for the connected motor (**C047–C048**).
Active	Always active	
Address	1694	
Function	This is the measurement of the torque reference set via serial link and expressed as a percentage of the rated torque of the selected motor.	

M045	Torque Reference from Fieldbus	
Range	± 5000	± 500.0 % Note: The actual range depends on the torque limit value set for the connected motor (**C047–C048**).
Active	Always active	
Address	1695	
Function	This is the measurement of the torque reference set by the fieldbus and expressed as a percentage of the rated torque of the selected motor.	

M046	PID Reference from Serial Link	
Range	±10000	±100.00 % Note: The actual range depends on the min. value and the max. value of the PID reference set in parameters: **P245–P246**
Active	Always active.	
Address	1696	
Function	This is the measurement of the PID reference set via serial link and expressed as a percentage.	

M047	PID Reference from Fieldbus	
Range	±10000	±100.00 % Note: The actual range depends on the min. value and the max. value of the PID reference set in parameters: **P245–P246**
Active	Always active.	
Address	1697	
Function	This is the measurement of the PID reference set by the fieldbus and expressed as a percentage.	

M048	PID Feedback from Serial Link	
Range	±10000	±100.00 % Note: The actual range depends on the min. value and the max. value of the PID feedback set in parameters: **P247–P248**
Active	Always active.	
Address	1698	
Function	This is the measurement of the PID feedback set via serial link and expressed as a percentage.	

M049	PID Feedback from Fieldbus	
Range	±10000	±100.00 % Note: The actual range depends on the min. value and the max. value of the PID feedback set in parameters: **P247**–**P248**
Active	Always active.	
Address	1699	
Function	This is the measurement of the PID feedback set by the fieldbus and expressed as a percentage.	

M051a	RMS Input from AIN1 and AIN2	
Range	0 ÷ 32000	0.00 ÷ 32.00 V
Active	This measurement is active only if one of parameters among **C288**, **C289** or **C290** = 13: Vout measured. Also, **P055**, **P060** = 0: ±10V.	
Address	3374	
Function	RMS voltage obtained from instantaneous values of **AIN1** and **AIN2** if they are two sinusoidal voltage values having equal amplitude and frequency phase displacement of 120˚.	

11.7. Outputs Menu

This menu allows checking the status of the digital outputs, the analog outputs and the frequency outputs located in the terminal board.

M056	Digital Outputs	
Range	Bit-controlled measurement	See Table 6
Active	Always active	
Address	1706	
Function	Status of digital outputs MDO1÷4 and status of the precharge contactor.	

Table 6: Coding of M056

Bit n.	Digital Output
0	MDO1/FOUT
1	MDO2
2	MDO3
3	MDO4
6	Status of the precharge contactor

M056a	Virtual Digital Outputs	
Range	Bit-controlled measurement	See Table 7
Active	Always active	
Address	1675	
Function	Status of virtual digital outputs MPL1÷4.	

Table 7: Coding of M056a

Bit n.	Digital Output
0	MPL1
1	MPL2
2	MPL3
3	MPL4

M056b	Timed Flags	
Range	Bit-controlled measurement	See Table 8
Active	Always active	
Address	1741	
Function	Status of timed flags TFL1 ÷ 4.	

Table 8: Coding of M056b

Bit n.	Timed Flag
0	TFL1
1	TFL2
2	TFL3
3	TFL4

M057	Frequency Output	
Range	10000 ÷ 100000	10000 ÷ 100000 Hz Note: The actual range depends on the min. value and the max. value of MDO1 digital output set as a frequency reference. Values are set in **P204** and **P205** (see [PAR] ANALOG AND FREQUENCY OUTPUTS MENU).
Active	Always active	
Address	1707	
Function	This is the frequency measurement produced by MDO1 digital output when set as a frequency output.	

M058	AO1 Analog Output	
Range	±100	±100 %
Active	Always active	
Address	1708	
Function	Value percent of analog output AO1, referred to the preset max. output value (maximum absolute value between **P182** and **P183**, see [PAR] ANALOG AND FREQUENCY OUTPUTS MENU).	

M059	AO2 Analog Output	
Range	±100	±100 % V
Active	Always active	
Address	1709	
Function	Value percent of AO2 analog output referred to the preset max. output value (maximum absolute value between **P190** and **P191**, see [PAR] ANALOG AND FREQUENCY OUTPUTS MENU).	

M060	AO3 Analog Output	
Range	±100	±100 % V
Active	Always active	
Address	1710	
Function	Value percent of AO3 analog output referred to the preset max. output value (maximum absolute value between **P198** and **P199**, see [PAR] ANALOG AND FREQUENCY OUTPUTS MENU).	

M061	Auxiliary Digital Outputs	
Range	Bit-controlled measurement	See Table 9
Active	Always active	
Address	1711	
Function	Status of the auxiliary digital outputs located on the expansion board.	

Table 9: Coding of M061

Bit n.	Digital Output	Bit n.	Digital Output
0	XMDO1	3	XMDO4
1	XMDO2	4	XMDO5
2	XMDO3	5	XMDO6

11.8. Temperature Measurements from PT100 Menu

This menu displays the temperatures detected in the first four analog channels of the expansion board.
Scaling complies with DIN EN 60751 for PT100: 100 ohm @ 0 °C and 0.385 ohm/°C.

ES847 Expansion Board must be fitted on the equipment.
See also the [CFG] EXPANSION BOARD CONFIGURATION MENU.

M069	PT100 Measurement in Channel 1	
Range	–500 ÷2600	–50.0 ÷260.0 °C
Active	This measurement is active only if programmed from parameter **R023**	
Address	1719	
Function	Temperature detected in analog channel 1.	

M070	PT100 Measurement in Channel 2	
Range	–500 ÷2600	–50.0 ÷260.0 °C
Active	This measurement is active only if programmed from parameter **R023**	
Address	1720	
Function	Temperature detected in analog channel 2.	

M071	PT100 Measurement in Channel 3	
Range	–500 ÷2600	–50.0 ÷260.0 °C
Active	This measurement is active only if programmed from parameter **R023**.	
Address	1721	
Function	Temperature detected in analog channel 3.	

M072	PT100 Measurement in Channel 4	
Range	–500 ÷2600	–50.0 ÷260.0 °C
Active	This measurement is active only if programmed from parameter **R023**.	
Address	1722	
Function	Temperature detected in analog channel 4.	

11.9. Autodiagnostics Menu

This menu allows the user to check the functioning times and the relevant counters (for maintenance purposes) of the IRIS BLUE drive; it also allows reading out the analog channels used for temperature sensors and the relevant temperature values, as well as the drive status.

M052/54	Functioning Times	
Range	0 ÷ 2147483647 (0 ÷ 7FFFFFFFh)	0 ÷ 429496729.4 sec
Address	Supply Time: 1702-1703 (LSWord, MSWord) Operation Time: 1704-1705 (LSWord, MSWord)	
Function	This screen displays the ST (supply time) and the OT (operation time). The Operation Time is the activation time of the drive IGBTs. Both values are expressed in 32 bits divided into two 16-bit words: the low part and the high part.	

Functioning times:

```
Supply         Time
M054=     53:25:01
Operation      Time
M052=     29:35:51
```

M062	Ambient Temperature Measurement	
Range	± 32000	± 320.0 °C
Active	Always active	
Address	1712	
Function	Ambient temperature measurement on the surface of the control board.	

M064	IGBT Heatsink Temperature Measurement	
Range	± 32000	± 320.0 °C
Active	Always active	
Address	1714	
Function	Measurement of the IGBT heatsink temperature. If the temperature readout is <–30.0 °C or >150.0 °C, warning **W50 NTC Fault** appears. Note: Not all models are provided with the NTC sensor (see Table 18 in [IDP] PRODUCT MENU). If this sensor is not provided, the measurement is forced to 32,000, corresponding to +320.0 °C.	

M065	Operation Time Counter	
Range	0÷65000 h	0÷65000 h
Active	Always active	
Address	1715	
Function	Time elapsed after resetting the operation time counter. The Operation Time is the activation time of the drive IGBTs.	

M066	Supply Time Counter	
Range	0÷65000	0÷650000h
Active	Always active	
Address	1716	
Function	Time elapsed after resetting the supply time counter.	

M089	Drive Status
Range	See Table 131
Active	Always active
Address	1739
Function	Describes the current condition of the drive.

M090	Active Alarm	
Range	See Table 128	See Table 128
Active	Always active	
Address	1740	
Function	Alarm tripped at the moment.	

11.10. Data Logger Measurement Menu

This menu displays the status of the types of connections (serial links, Ethernet and modem) supported by ES851 Data Logger board.

This menu can be viewed only if the Data Logger board is fitted.
See also the [CFG] DATA LOGGER MENU

M100 (line 3)	**Data Logger Status**	
Range	0 ÷ 2	0: NOT FITTED 1: OK not interlocked 2: OK interlocked
Active	This measurement is active only if programmed from parameter **R021**.	
Address	1336	
Function	**0: NOT FITTED**, ES851 is not installed on the IRIS BLUE drive. **1: OK not interlocked**, ES851 is operating independently of the drive where it is installed. To program ES851, a connection to a computer via the IrisControl software is required, or a special preset set via display/keypad is required (see the [CFG] DATA LOGGER MENU). **2: OK interlocked**, ES851 is ready to be configured even through the display/keypad of the drive where it is installed.	

M100 (Line 4)	**ES851 Fault (Line 4)**	
Range	0 ÷ 6, 99 ÷ 104	0: No alarm 1: Parameter save fault 2: Log write error 3: FBS configuration failure 4: RS232 Modbus configuration failure 5: RS485 Modbus configuration failure 6: TCP/IP stack configuration failure 99: Flash card lacking or inaccessible 100: Invalid stream access 101: TCP/IP socket fault 102: Dial out connection failure 103: Control board clock failure 104: Modem initialization failure
Active	This measurement is active only if programmed from parameter **R021**.	
Address	1340	
Function	This indicates a general alarm tripped for ES851. In case an alarm trips, please contact ELETTRONICA SANTERNO's CUSTOMER SERVICE and mention the alarm code and name.	

M101	Connection Status	
Range	Bit-controlled measurement	See Table 10
Active	This measurement is active only if programmed from parameter **R021**.	
Address	1338	
Function	Status of the connections supported by ES851. Note that the COM1 serial link is RS232 by default, whereas COM 2 is RS485 by default. For more details, please refer to the Programming Guide manual for the Data Logger ES851.	

Table 10: Data Logger connection status

Bit n.	Connection	Description
0-7	Type of modem connection failure	0: None 1: Dial KO 2: Connect KO 3: Authentication KO 4: IPCP KO* 5: Modem not yet initialized 6: Modem init KO 7: Modem not configured 8: Modem not dial out 16: Connect end (echo time out) 32: Connect end (idle time out) 64: Connect end (term expired)
8-10	Status of the connection via modem	0: No conn. 1: Dialing 2: Connecting 4: Connected 5: Attempt finished
11	COM1	0: No data exchange 1: Data exchanged
12	COM2	0: No data exchange 1: Data exchanged
13	Ethernet	0: No connection 1: Connection
14-15	Reserved	

* Internet Protocol Control Protocol (IPCP): network control protocol for establishing and configuring Internet Protocol over a Point-to-Point Protocol link. The IPCP configures, enables, and disables the IP protocol modules on both ends of the point-to-point link.

11.11.Digital Input Settings Menu

This menu allows checking the functions assigned to the digital inputs.

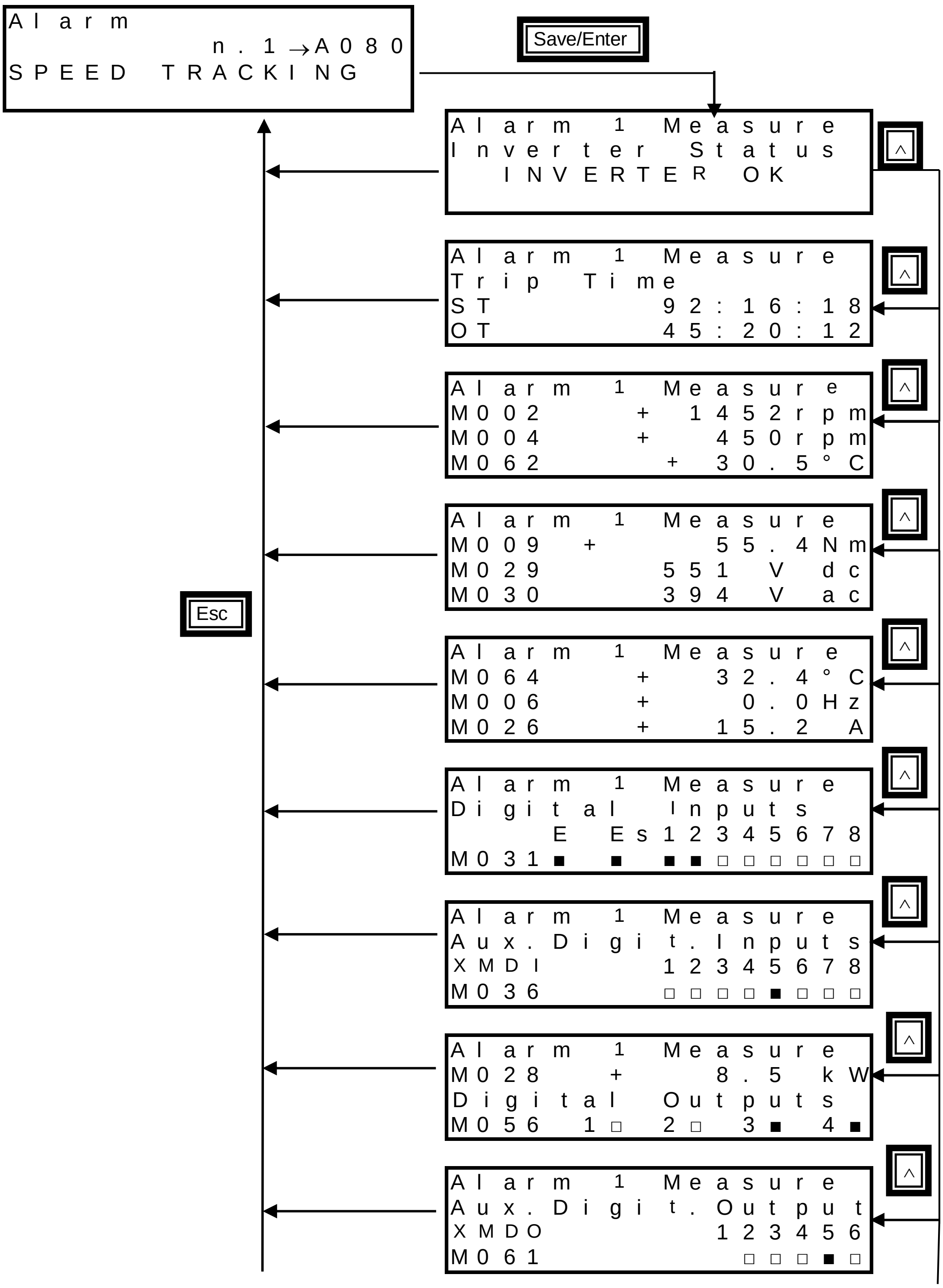
Table 11: Coding of the functions assigned to the digital inputs

Displayed Items	Function Allocated to the Digital Inputs
STOP	STOP function
EN-SW	ENABLE SW
DISABLE	Drive disable
Mvel0	Multispeed 0
Mvel1	Multispeed 1
Mvel2	Multispeed 2
DCB	DC braking
UP	Reference increase
DOWN	Reference decrease
UD Reset	Reset of speed setpoint due to UP/DOWN command
Alarm 1	Auxiliary trip 1
Alarm 2	Auxiliary trip 2
Alarm 3	Auxiliary trip 3
MRmp0	Multiramp 0
SLAVE	Selection of Slave Mode
Pid Dis	PID Disable
KpdLock	Display/keypad unit locked
Var 0	Reference Variation 0
Var 1	Reference Variation 1
Var 2	Reference Variation 2
PID UDR	PID Reference Reset due to UP/DOWN commands
LOCAL	Selection of Local mode
FireM	Fire Mode enable
Src.Sel	Reference/command source switch
PID Csl	PID control selection
START	START function
M2 OK	Input for Motor 2 ok
M3 OK	Input for Motor 3 ok
M4 OK	Input for Motor 4 ok
M5 OK	Input for Motor 5 ok
No DryRn	Dry Run alarm disable

11.12. Fault List Menu (Fault List)

Scroll the **Fault List Menu** to display the codes of the last eight alarms tripped.
Press the **SAVE/ENTER** key to access the alarm submenu and navigate to each value measured by the drive when the alarm tripped.
The diagram below shows a navigation example for the **Fault List Menu** (relating to alarm n.1 in particular). Note that n.1 is the last alarm tripped and n.8 is the first alarm tripped.
The measurements marked with **Mxxx** are the same measurements covered in this section.
If the Data Logger ES851 is installed (even the ES851 RTC version only) and parameter **R021** Data Logger is set to 2: ENABLE, the date and time when the alarm has tripped are displayed instead of the Supply Time (ST) and the Operation Time (OT) respectively.

Navigation example – Fault list menu:



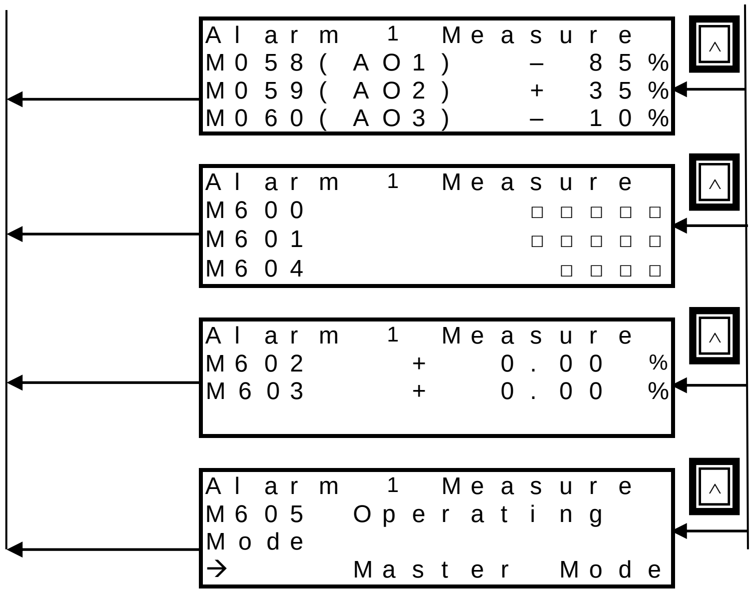

Alarm 1 Measure
M058(AO1) – 85%
M059(AO2) + 35%
M060(AO3) – 10%
Alarm 1 Measure
M600
M601
M604
Alarm 1 Measure
M602 + 0.00 %
M603 + 0.00 %
Alarm 1 Measure
M605 Operating
Mode
→ Master Mode

Table 12: Modbus base addresses in the Fault Lists

Fault List	MODBUS Address (BASE)
FL1	7712
FL2	7744
FL3	7776
FL4	7808
FL5	7840
FL6	7872
FL7	7904
FL8	7936

Table 13: List of the measurements in the Fault Lists

Measur.	Function	Range	Values	MODBUS Address (OFFSET)
M090	Active Alarm	See Table 128	-	0
M052	Supply Time	See measurement description	-	1: LSW 2: MSW
M054	Operation Time	See measurement description	-	3: LSW 4: MSW
M089	Inverter Status	See Table 131	-	5
M026	Output Current	0 ÷ 65535	0 ÷ 6553.5 A	6
M004	Motor Speed	±32000	±32000 rpm	7
M002	Speed Reference after Ramps	±32000	±32000 rpm	8
M008	Torque Demand	±32000	±32000 Nm	9
M009	Torque Generated by the Motor	±32000	±32000 Nm	10
M029	DC-bus Voltage	0 ÷ 1400	0 ÷ 1400 V	11
M030	Grid Voltage	0 ÷ 1000	0 ÷ 1000 V	12
M064	IGBT Heatsink Temperature	±32000	± 320.0 °C	13
M006	Inverter Output Frequency	±10000	±1000.0 Hz	14
M036	Instant Auxiliary Digital Inputs	See measurement description	-	15
M031	Delayed Digital Inputs	See measurement description	-	16
M058	AO1 Analog Outputs	±100	±100 %	17
M061	Auxiliary Digital Outputs	See measurement description	-	18
M028	Output Power	0 ÷ 65535	0 ÷ 6553.5 kW	19
M056	Digital Outputs	See measurement description		20
M062	Ambient Temperature	±32000	± 320.0 °C	21
M600	Available Motors	See measurement description	-	22
M601	Motors On	See measurement description	-	23
M602	Slave Motor Setpoint	0 ÷ 10000	0 ÷ 100.00%	24
M603	Master Motor Setpoint	0 ÷ 10000	0 ÷ 100.00%	25
M604	Status of the Serial Communications to the Slave Motors	See measurement description	-	26
M605	Status of the Multimotor Control	See measurement description	-	27
M059	AO2 Analog Output	±100	±100 %	28
M060	AO3 Analog Output	±100	±100 %	29

To get the Modbus address of a given measurement in a Fault List, sum up the base address to the measurement's offset.
Example:
The address of measure **M058** in Fault List **FL6** is as follows:
7872 + 17 = 7889

11.13. Power Off List Menu (Power Off List)

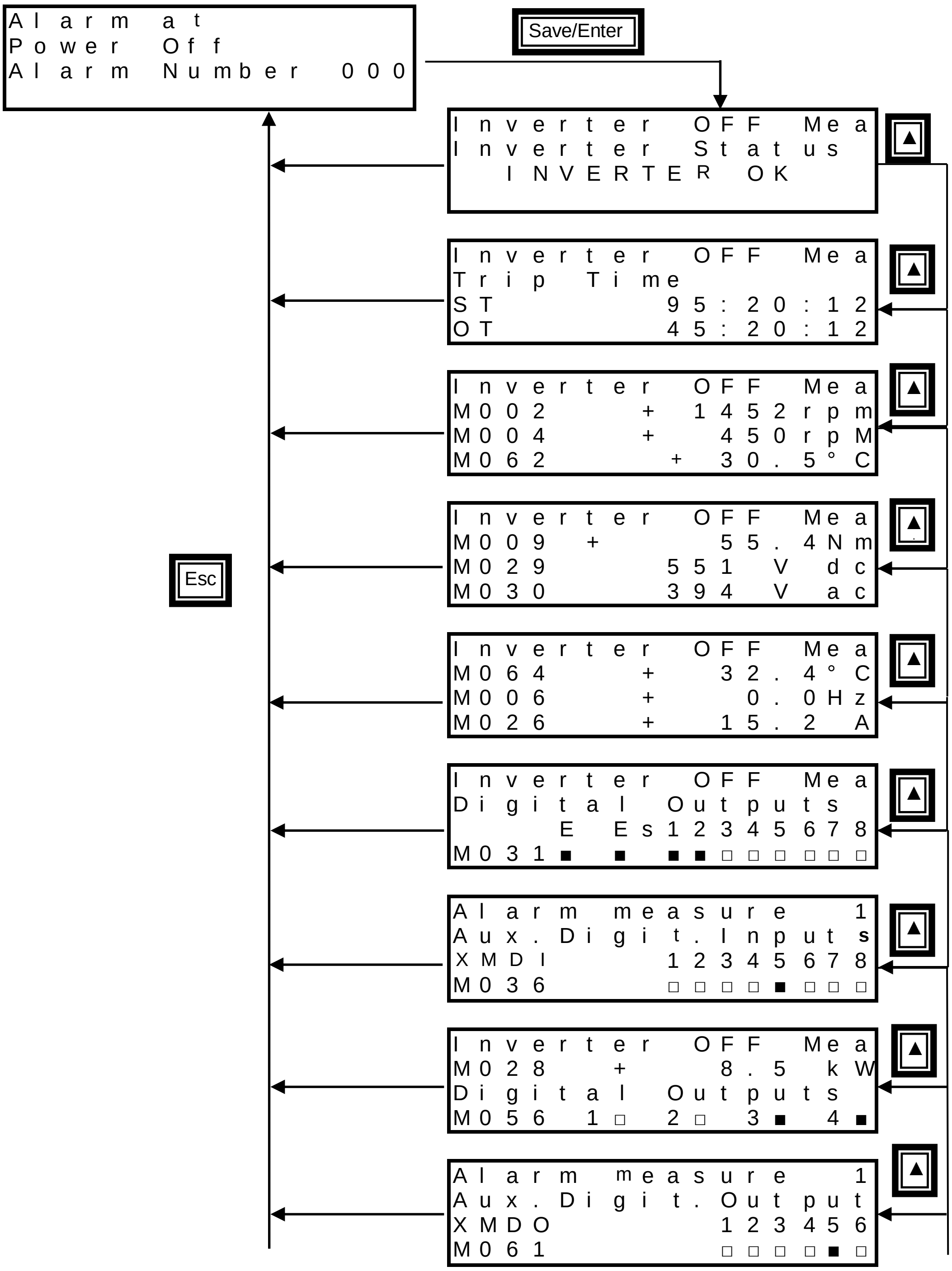
This menu contains the measurements of some characteristic variables detected at the drive power off, in conjunction with the alarm (if any) tripped at that moment.

Press the **SAVE/ENTER** key to access the submenu and navigate to the measurements detected by the drive when the alarm tripped. Measurements and codes are the same as the ones shown in the Fault List Menu (Fault List).

If the Data Logger ES851 is installed (even the ES851 RTC version only) and parameter **R021** Data Logger is set to 2: ENABLE, the date and time when the alarm has tripped are displayed instead of the Supply Time (ST) and the Operation Time (OT) respectively.

The diagram below shows a navigation example for the **Power Off List.**

Navigation example - Power Off List Menu



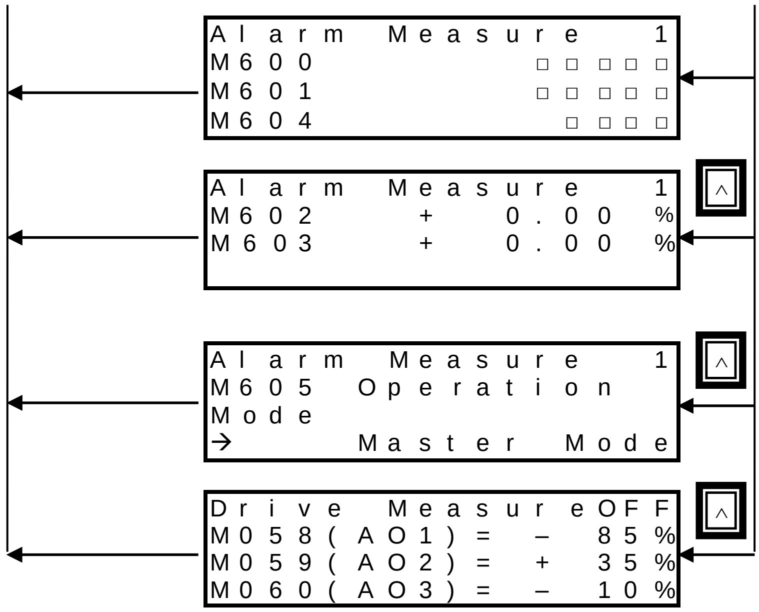

Alarm Measure 1
M600 □□□□□
M601 □□□□□
M604 □□□□
Alarm Measure 1
M602 + 0.00 %
M603 + 0.00 %
Alarm Measure 1
M605 Operation
Mode
→ Master Mode
Drive Measure OFF
M058(AO1) = – 85 %
M059(AO2) = + 35 %
M060(AO3) = – 10 %

Table 14: List of the measurements in the Power Off List

Measure-ment	Function	Range	Value	Modbus Address
M090	Active Alarm	See Table 128	-	5044
M052	Supply Time	See measurement description	-	5045: LSW 5046: MSW
M054	Operation Time	See measurement description	-	5047: LSW 5048: MSW
M089	Inverter Status	See Table 131	-	5049
M026	Output Current	0 ÷ 65535	0 ÷ 6553.5 A	5050
M004	Motor Speed	±32000	±32000 rpm	5051
M002	Speed Reference after Ramps	±32000	±32000 rpm	5052
M008	Torque Demand	±32000	±32000 Nm	5053
M009	Torque Generated by the Motor	±32000	±32000 Nm	5054
M029	DC-bus Voltage	0 ÷ 1400	0 ÷ 1400 V	5055
M030	Grid Voltage	0 ÷ 1000	0 ÷ 1000 V	5056
M064	IGBT Heatsink Temperature	±32000	± 320.0 °C	5057
M006	Inverter Output Frequency	±10000	±1000.0 Hz	5058
M036	Instant Auxiliary Digital Inputs	See measurement description	-	5059
M031	Delayed Digital Inputs	See measurement description	-	5060
M058	AO1 Analog Output	±100	±100 %	5061
M061	Auxiliary Digital Outputs	See measurement description	-	5062
M028	Output Power	0 ÷ 65535	0 ÷ 6553.5 kW	5063
M056	Digital Outputs	See measurement description		5064
M062	Ambient Temperature	±32000	± 320.0 °C	5065
M600	Available motors	See measurement description	-	5066
M601	Motors On	See measurement description	-	5067
M602	Slave Motors Setpoint	0 ÷ 10000	0 ÷ 100.00%	5068
M603	Master Motors Setpoint	0 ÷ 10000	0 ÷ 100.00%	5069
M604	Status of Serial Communications to Slave Motors	See measurement description	-	5070
M605	Status of Multimotor Control	See measurement description	-	5071
M059	AO2 Analog Output	±100	±100 %	5072
M060	AO3 Analog Output	±100	±100 %	5073

12. [IDP] PRODUCT MENU

12.1. Overview

The Product Menu includes parameter **P263 Language**, allowing the user to select a dialog language; it also contains the Fire Mode enabling Password and the following information (read-only) about the product:

- Product Name and Type
- SW Versions
- Serial Number
- Manufacturer

12.2. List of Parameters P263 and Fire Mode Enable Password

Table 15: List of Parameter P263 and Fire Mode Enable Password

Parameter	FUNCTION	User Level	DEFAULT	MODBUS Address
P263	Language	BASIC	1:ENGLISH	863
	Fire Mode Enable Password	BASIC	0	868

P263	**Language**				
Range	0 ÷ 4	0: ITALIANO 1: ENGLISH 2: ESPAÑOL 3: PORTUGUES 4: DEUTSCH (F1 version – standard)	0: DANISH 1: ENGLISH 2: NORWEGIAN 3: FINNISH 4: SWEDISH (F2 version – on demand)	0: RUSSIAN 1: ENGLISH 2: ESPAÑOL 3: PORTUGUES 4: DEUTSCH (F3 version – on demand)	0: ITALIANO 1: ENGLISH 2: ESPAÑOL 3: PORTUGUES 4: FRANÇAIS (F4 version – on demand)
Default	1	1: ENGLISH			
Level	BASIC				
Address	863				
Function	The dialog language is factory set to English. Use parameter **P263** to choose a different language. The software implemented in the display/keypad is called MMI (man/machine interface); its version is displayed in the SW screen of the Product Menu.				

CAUTION

The available language set is that of standard version F1.
Versions F2, F3 and F4 are to be explicitly requested at the time when ordering the drive.

Product Name and Type		
Range	Fan control: bits 0 to 3 Voltage class: bits 4 to 7 Drive size: bits 8 to 15	0 ÷ 7 – see Table 19 0 ÷ 1 – see Table 17 2 ÷ 61 – see Table 16
Address	1593	
Function	This screen displays the name of the product (IRIS BLUE) and the type of product (see example below).	

```
P r o d u c t   N a m e
I R I S   B L U E
T y p e   0 0 2 0   4 T   – – –
```

The product name (IRIS BLUE) appears in the second line of the display/keypad. The third line shows the voltage class, the size of the drive and the type of fan control.
In the case shown in the example, the voltage class is 4T (400V), the size of the drive is 0020 and the fan operation is not controlled by the drive (characters ---).

The numbers corresponding to the different models of the IRIS BLUE Drive are given in the table below:

Table 16: Indexes corresponding to the different models (sizes) of the IRIS BLUE Drive

Index	Model	Index	Model	Index	Model
2	**0005**	17	**0020**	37	**0067**
4	**0007**	20	**0023**	39	**0074**
5	**0008**	22	**0025**	41	**0086**
6	**0009**	23	**0030**	43	**0113**
7	**0010**	25	**0033**	44	**0129**
8	**0011**	26	**0034**	46	**0150**
10	**0013**	28	**0036**	47	**0162**
11	**0014**	29	**0037**	51	**0180**
12	**0015**	31	**0040**	55	**0202**
13	**0016**	33	**0049**	57	**0217**
14	**0017**	35	**0060**	61	**0260**

Table 17: Voltage classes

Index	Class
0	**2T**
1	**4T**

The type of fan control is marked by 3 characters:

Table 18: Fan control modes

Character	Description
F	The fan activation is controlled by the inverter.
S	The fan operation is correct: when a fan fault is detected, the relevant alarm trips.
N	A NTC sensor is fitted, that acquires the heatsink temperature. The fan activation threshold is set in parameter **C264**.

Table 19: Coding for fan activation

Code	Symbol	Fan control	Fan status	NTC
0	**---**	No	No	No
1	**-S-**	No	Yes	No
2	**F--**	Yes	No	No
3	**FS-**	Yes	Yes	No
4	**--N**	No	No	Yes
5	**-SN**	No	Yes	Yes
6	**F-N**	Yes	No	Yes
7	**FSN**	Yes	Yes	Yes

SW Application

Range	This screen displays the type of software application which is implemented in the drive (e.g. Regenerative). For the application software downloading instructions see the relevant user manual.

SW Versions

Range	0 ÷ 65535	0 ÷ 65.535
Address	Texas: 475 MMI: 1489 Motorola: 1487	
Function	This screen displays the SW versions implemented on the IRIS BLUE drive: **Texas** → **SW version of the Texas DSP** **MMI** → **SW version of the display/keypad** **Motorola** → **SW version of the Motorola microprocessor**	

Maximum Output Frequency

Range	0 ÷ 999	0 ÷ 999
Address	3327	
Function	This screen displays the maximum allowable output frequency (Hz) for the drive.	

Serial Number		
Range	0 ÷ 9999999	0 ÷ 9999999
Address	1827-1828 (LSWord, MSWord)	
Function	This is the serial number of the drive. The serial number is required when contacting ELETTRONICA SANTERNO's CUSTOMER SERVICE in order to activate the Fire Mode. This measurement is expressed in 32 bits divided into two 16-bit words: the low part and the high part.	

Fire Mode Enable Password		
Range	0 ÷ 9999	0 ÷ 9999
Default	0	0
Level	BASIC	
Address	868	
Function	To enable the Fire Mode, please contact ELETTRONICA SANTERNO's CUSTOMER SERVICE and give the Serial Number of the drive where the Fire Mode is to be activated. Enter the password given by the Customer Service.	

CAUTION The Fire Mode Enable Password is set to 0 when the Restore Default is performed.

Manufacturer	
Range	The name of Elettronica Santerno is displayed followed by Elettronica Santerno's website santerno.com.

You can also send a Modbus query message to read the product ID.

Product ID		
Range	1 ÷ 65535	1 ÷ 65535
Address	476	
Function	You can read the product ID from address 476. The eight high bits give the first character of the ID, the eight low bits give the second character of the product I. ES. for IB (IRIS BLUE): MODBUS value from the address 476: 18754d → 0x4942H 49H → 'I' Character 42H → 'B' Character	

13. [PAR] PASSWORD AND USER LEVEL MENU

13.1. Overview

The Password and User Level menu allows changing the programming parameters and sets their visibility.

- **P000** enables parameter modification
- **P001** sets the user level
- **P002** allows to change the password set in **P000**
- **P003** conditions required to change C parameters

13.2. List of Parameters P000 to P003

Table 20: List of Parameters P000 to P003

Parameter	FUNCTION	User Level	DEFAULT VALUE	MODBUS Address
P000	Write enable	BASIC	00001	513
P001	Programming level	BASIC	0:[Basic]	514
P002	Write enable password	ENGINEERING	00001	510
P003	Conditions required to change C parameters	ADVANCED	Stand by + Fluxing	509

Factory setting is **P000 = 1** (parameter write is enabled). To access parameter **P000** allowing parameter write, access the Password and User Level Menu from the Parameters Menu.

P000	**Write Enable**	
Range	00000÷32767	00000: [No] ÷32767
Default	00001	00001
Level	BASIC	
Address	Cannot be accessed via serial link. Parameter write via serial link is always enabled.	
Function	Set the correct value in **P000** to enable parameter write. The default password for **P000** is 00001. You can enter a custom password in **P002.**	

P001	User Level	
Range	0÷2	0: Basic 1: Advanced 2: Engineering
Default	0	0: Basic
Level	BASIC	
Address	514	
Function	The inverter programming parameters are grouped by access levels based on their functions (more or less complex functions). Some menus, or some parts of menus, are not displayed when a given access level is selected. When the BASIC access level is selected once the inverter parameterization is correct, navigation is easier, as only frequently accessed parameters are displayed. The User Level is stated for each parameter.	

P002	Password for Write Enable	
Range	00001 ÷ 32767	00001 ÷ 32767
Default	00001	
Level	ENGINEERING	
Address	510	
Function	Once write is enabled after entering the correct password in **P000**, you can use parameter **P002** to enter a custom password.	

CAUTION **The new password allowing parameter write is the value entered in P002. Note it down and keep it handy!**

P003	Conditions for C Parameter Modifications	
Range	0 ÷ 1	0:[Stand By only] ÷ 1:[StandBy+Fluxing]
Default	1	1:[StandBy+Fluxing]
Level	ADVANCED	
Address	509	
Function	Factory setting allows **C parameters** to be programmed even when the inverter is enabled. However, the motor must be stopped. If **P003=0: [Stand-by only]**, C parameters can be changed only when the inverter is disabled. This parameter also affects the behaviour of the digital inputs for **LOC/REM** and motor selection: when those inputs change, they produce their effect only when C parameters are allowed to be changed, according to the value in **P003**.	

CAUTION If **P003 = 1:[StandBy+Fluxing]** when changing a C parameter, the drive automatically disables (stops modulating) and the motor starts idling.

NOTE If **C010 = 0: IFD [Voltage/Frequency]**, C parameters may be set up when the **ENABLE-A** and **ENABLE-B** inputs are active and the motor is stopped independently of **P003**.

14. [PAR] DISPLAY/KEYPAD MENU

14.1. Overview

NOTE It is recommended that the "Operating and Remoting the Keypad" section in the Motor Drives Accessories – User Manual.

The Display/Keypad Menu contains programming parameters to do the following:

- Set the navigation mode within the drive menus;
- Select the Root Page;
- Select measurements from the Root Page and the Keypad Page;
- Select the type of Keypad Page displayed in Local mode;
- Set the custom units of measurement for analog inputs AIN1 and AIN2
- Set custom PID units of measurement;
- Disable the **LOC/REM** key in the keypad.

The Root Page, the Keypad Page and Local mode are detailed in the following sections.

14.2. Status Page

```
 I N V E R T E R   O K
→       +   1 5 0 0 . 0 0 r p m
→       +         0 . 0 0 r p m
 M E A   P A R   C F [ I D P ]
```

The Root page is factory-set as the startup page to be displayed when the drive is turned on.

NOTE

You can access the four main menus only from the root page:
MEA → Measurements;
PAR → Programming parameters;
CF → Configuration parameters;
IDP → Product identification.

Line 1 on this page displays the drive operating status (see the description of parameter **M089**).

Lines 2 and 3 display two measurements which may be selected with parameters P268, **P268a. These measurements can be scaled through parameters P268y and P268z.**

Line 4 displays the four main menus of the drive. The selected menu is displayed in square brackets: use the ▲ and ▼ keys to select a different menu. Press the **SAVE/ENTER** key to access the selected menu.

14.3.Keypad Page and Local Mode

Keypad

```
→           +       0 . 0 H z
→              +      0 . 0 A
→        +        0 . 0 0 r p m
R e f    +    1 5 0 0 . 0 0 r p m
```

SAVE/ ENTER

Keypad Help

```
→ M 0 0 6   M o t . F r e q .
→ M 0 2 6   I ( R M S )   O u t
→ M 0 0 4   M o t o r   S p d
R e f    +  1 5 0 0 . 0 0 r p m
```

To access the Keypad pages, press the **MENU key** from the Root Page or press the **LOC/REM key** after selecting the Local mode.
The measurements displayed on the Keypad page can be set up through parameters **P268b** to **P268e**. Press the **SAVE/ENTER** key to display the Keypad Help page for a few seconds; this page describes the measurements displayed.

NOTE If parameter **P264b** (Navigation mode via **MENU key)** is set to Operator, navigation is locked once the Keypad Page is displayed. Hold down the **ESC** key for a few seconds to resume navigation.

The following Keypad Pages are available:
Measurements only→ four lines displaying measures only
Speed → line 4 shows the speed reference, that can be changed with the ▲ and ▼ keys
PID → line 4 shows the PID reference, that can be changed with the ▲ and ▼ keys.

If the Local Mode is NOT selected, pressing the MENU key allows viewing only the pages containing the references sent via keypad (see the [CFG] CONTROL METHOD MENU and [CFG] PID CONFIGURATION MENU).

LOCAL MODE

In **LOCAL** mode (the L-CMD and L-REF LEDs come on when the Local mode is active), only the commands and references sent via keypad are enabled, while any other control source or reference source is disabled (see the [CFG] CONTROL METHOD MENU, [CFG] DIGITAL INPUTS MENU and [PAR] INPUTS FOR REFERENCES MENU). The keypad page displayed when the **LOC/REM** key is pressed depends on the setting of parameter **P266** (Type of Keypad Page in Local Mode):
P266 = Measurements Only → Page containing 4 preset measurements; no reference can be changed.

P266 = Ref.Activated → Line 4 in the Keypad Page enables changing the drive reference: the speed reference if a speed control is activated ("Ref" displayed), the torque reference if a torque control is activated ("TRef" displayed). If the drive reference is the PID output (**C294** PID Action = 1:[Reference]), the PID reference is given ("PRef" displayed).
Use the ▲ and ▼ keys to change the reference displayed in line 4 on the Keypad Page.

P266 = Ref.Activated+Spd → To be used only when the drive reference depends on the PID output when a speed control is used (**C294** PID Action = 1:[Reference]). When the **LOC/REM** key is pressed for the first time, "PRef" is displayed in line 4 and the PID reference may be adjusted; when the **LOC/REM** key is pressed twice, the PID is disabled and the speed reference can be changed ("Ref" displayed).
Use the▲ and ▼ keys to change the reference shown in line 4 on the Keypad Page.

14.4. List of Parameters P264 to P269b

Table 21: List of Parameters P264 to P269b

Parameter	FUNCTION	User Level	DEFAULT VALUE	MODBUS Address
P264	Navigation mode	ADVANCED	0:[A MENU]	864
P264a	Circular navigation	ADVANCED	1:[SI]	865
P264b	Navigation mode with the **MENU** key	ADVANCED	0:[STANDARD]	512
P265	Root page	ADVANCED	0:[STATUS]	866
P266	Type of Keypad page in Local Mode	ADVANCED	1:[Ref.Active]	511
P266d	Preset AIN1 units of measurement	ENGINEERING	0:[Disable]	968
P266e	Minimum value of custom measurement from AIN1	ENGINEERING	0 %	976
P266f	Maximum value of custom measurement from AIN1	ENGINEERING	100.0 %	977
P266g	Preset AIN2 units of measurements	ENGINEERING	0:[Disable]	969
P266h	Minimum value of custom measurement from AIN2	ENGINEERING	0 %	978
P266i	Maximum value of custom measurement from AIN2	ENGINEERING	100.0 %	979
P267	Preset PID units of measurement	ENGINEERING	0:[Disable]	867
P267a	Custom PID units of measurement	ENGINEERING	[%]	1851
P267b	Preset PID2 units of measurement	ENGINEERING	0:[Disable]	861
P267c	Custom PID2 units of measurement	ENGINEERING	[%]	1865
P268	Measurement n.1 on Status page	ADVANCED	**M004** Motor Spd	not accessible
P268a	Measurement n.2 on Status page	ADVANCED	**M000** Speed Ref.	not accessible
P268b	Measurement n.1 on Keypad page	ADVANCED	**M006** Mot.Freq.	not accessible
P268c	Measurement n.2 on Keypad page	ADVANCED	**M026** Motor Current	not accessible
P268d	Measurement n.3 on Keypad page	ADVANCED	**M004** Motor Spd	not accessible
P268e	Measurement n.4 on Keypad page	ADVANCED	**M000** Speed Ref.	not accessible
P269	Disable the LOC/REM key	ENGINEERING	[NO]	869
P269b	**ESC** key to restore previous value	ENGINEERING	[NO]	1051

P264	Navigation Mode	
Range	0 ÷ 2	0: By Menu 1: Changed Pars Only 2: Linear
Default	0	0: By Menu
Level	ADVANCED	
Address	864	
Function	Navigation by menu is factory-set and is activated whenever the IRIS BLUE drive is powered on. Set **P264**=1:[Changed Pars Only] to navigate only through the parameters whose default values have been changed. In that case, linear navigation becomes active: only the parameters that have been changed are displayed in sequence. Press the ▲ and ▼ keys to go to a different parameter. Navigation is slower if only few parameters have been changed. Set **P264**=2:[Linear] to display parameters in sequence using the ▲ and ▼ keys**.** If Linear navigation is selected, parameters are no longer divided into menus and submenus.	

NOTE This parameter cannot be saved. Navigation by menu is restored whenever the drive is powered on.

P264a	Circular Navigation	
Range	0 ÷ 1	0: [NO] 1: [YES]
Default	1	1: [YES]
Level	ADVANCED	
Address	865	
Function	Parameter **P264a** is factory set to 1:[YES]. This means that “wrap” navigation is activated: navigation starts from the first page of the selected menu. Press ▲ to go to the next page. When the last page is displayed, press ▲ again to <u>return to the first page of the selected menu</u>. From the first page of the selected menu, press ▼ to go to the last page of the active menu. If **P264a**=0: [NO], when the last page of the active menu is displayed, the ▲ key is disabled; you can only view the previous pages—up to the first page of the active menu—by pressing the ▼ key.	

P264b	Navigation Mode with the MENU Key	
Range	0 ÷ 1	0: [STANDARD] 1: [OPERATOR]
Default	0	0: [STANDARD]
Level	ADVANCED	
Address	512	
Function	Press the **MENU** key from any parameter to go to the access page of the menu containing that parameter; press the **MENU** key again to go to the Root page; press the MENU key again to go to the Keypad page. If factory setting is active (**P264b**=0: [STANDARD]) press the **MENU** key from the Keypad page to go to the Root page, then to the starting parameter. If **P264b**=1: [OPERATOR], navigation is locked once the Keypad Page is displayed. Hold down the **ESC** key for a few seconds to resume navigation. This prevents inexpert users from navigating through the parameters stored to the keypad. If the Keypad page is preset as the startup page (**P265**=1: [Measurements]) and **P264b**=1:[OPERATOR], navigation is always locked.	

P265	Root Page	
Range	0 ÷ 3	0: [Status] 1: [Measurements] 2: [Keypad] 3: [Start Up]
Default	3	3: [Start Up]
Level	ADVANCED	
Address	866	
Function	**P265** sets the page to be displayed when the drive is turned on. **P265** = 0: The Root page is the startup page. **P265** = 1: The Keypad Page displaying 4 measurements only is the startup page. **P265** = 2: The Keypad page displaying a reference in line 4 is the startup page. **P265** = 3: The START-UP MENU is the one in the START-UP MENU.	

P266	Type of Keypad Page in Local Mode	
Range	0 ÷ 2	0: [Measurements only] 1: [Ref.Activated] 2: [Ref.Activated+Speed]
Default	1	1: [Ref.Activated]
Level	ADVANCED	
Address	511	
Function	**P266** sets the type of keypad page to be displayed in Local mode. If **P266 = 0: [Measurements Only]** in Local mode, the reference cannot be changed. If **P266 = 1: [Ref.Activated]** in Local mode, the Keypad page containing the activated reference is displayed; for example, if a speed control is active, the Keypad page displayed in Local mode shows the speed in line 4. Use the ▲ and ▼ keys to change the speed reference. If a speed control is active and the drive reference is the PID output (**C294** PID Action = 1: [Reference]), when in Local mode, you should disable the PID regulator and send a speed reference from keypad (to do so, set **P266 = 2: [Ref.Activated+Speed]**). When pressing the **LOC/REM** key to enter the Local mode, the Keypad page containing the PID reference is displayed. Use the ▲ and ▼ keys to change the PID reference. Press the **LOC/REM** key once again (when the drive is disabled) to disable the PID control. The Keypad page containing the speed reference is displayed. Use the ▲ and ▼ keys to change the speed reference.	

P266d/g	Preset AIN1/AIN2 Units of Measurement	
Range	0 ÷ 39	See Table 22
Default	0	0: [Disable]
Level	ENGINEERING	
Address	968/969	
Function	Unit of measurement to be displayed for **M038u/M039u**. It is useful to allocate a physical meaning of a given range to the electrical measurement on the analog input. The range is defined by parameters **P266e/f** for AIN1 and **P266h/i** for AIN2. A typical example is a pressure sensor on an analog input, but the pressure PID is not to be (or may not be) activated by reading out its feedback measurement, rather a pressure measurement is to be used, that is always active independently of the operating conditions.	

P266e/h	Minimum Value of Custom Measurement from AIN1/AIN2	
Range	–32000 ÷ +32000	±3200.0
Default	0	0.0
Level	ENGINEERING	
Address	976 / 978	
Function	Physical value allocated to **P056/P061** (value over AIN1/AIN2 generating a minimum value). This is a read-only parameter only affecting measurement **M038u** for AIN1 or **M039u** for AIN2. Its interpretation is based on parameters **P266d/P266g**.	

P266f/i	Maximum Value of Custom Measurement from AIN1/AIN2	
Range	–32000 ÷ +32000	±3200.0
Default	1000	100.0
Level	ENGINEERING	
Address	977 / 979	
Function	Physical value allocated to **P057/P062** (value over AIN1/AIN2 generating a maximum value). This is a read-only parameter only affecting measurement **M038u** for AIN1 or **M039u** for AIN2. Its interpretation is based on parameters **P266d/P266g**.	

P267/ P267b	Preset PID/PID2 Units of Measurement	
Range	0 ÷ 39	See Table 22
Default	0	0: [Disable]
Level	ENGINEERING	
Address	867 / 861	
Function	The PID/PID2 reference and PID/PID2 feedback are expressed as a percentage of measurements **M019, M020, M019a, M020a.** Parameters **P257/P457** allow setting a gain value to “scale” the PID reference and PID feedback and to obtain the following measurements: **M023** = **P257** * **M019; M024** = **P257** * **M020**; **M023a** = **P457** * **M019a; M024a** = **P457** * **M020a** which are properly scaled. Parameters **P267/P267b** (see coding of **P267/P267b**) sets the unit of measure for the measures above; the unit of measure can also be entered in parameter **P267a/P267c** (only if **P267/P267b** = 0: [Disable]). Example: the PID reference is 100%; **M019** = 100% if **P257** = 0.04 and **P267** = 1: [bars], the scaled measurement for the PID reference is → **M023** = 4.00 bars.	

Table 22: Preset PID Units of Measurement

Unit of measurement	List	Display	Unit of measurement	List	Unit of measurement
Custom (for PID only, see **P267a/c**)	0: Disable	-	m	18: m	m
bar	1: bar	bar	ft	19: ft	ft
mbar	2: mbar	mbar	m/s	20: m/s	m/s
atm	3:atm	atm	ft/s	21: ft/s	ft/s
Pa	4: Pa	Pa	rpm	22: rpm	rpm
kPa	5: kPa	kPa	gal/s	23: GPS	GPS
PSI	6: PSI	PSI	gal/min	24: GPM	GPM
m^3/s	7: m3/s	m3/s	gal/h	25: GPH	GPH
m^3/min	8: m3/m	m3/m	ft^3/s	26: CFS	CFS
m^3/h	9: m3/h	m3/h	ft^3/min	27: CFM	CFM
l/s	10: l/s	l/s	ft^3/h	28: CFH	CFH
l/min	11: l/m	l/m	A	29: A	A
l/h	12: l/h	l/h	V	30: V	V
°	13: °	°	W	31: W	W
°C	14: °C	°C	kW	32: kW	kW
°F	15: °F	°F	kVA	35: kVA	kVA
Nm	16: Nm	Nm	ft-lbs	36: ftLb	ftLb
kgm	17: kgm	kgm	Polished Rod Speed	37: PRS	PRS
m	18: m	m	Polished Rod Torque	38: PRT	PRT
ft	19: ft	ft	stroke/min	39: SPM	SPM

P267a/ P267c	**Custom PID/PID2 Units of Measurement**	
Range	0x20 ÷ 0x8A (every byte)	ASCII 0x20 = blank ASCII 0x8A = □
Default	0x015D255B	ASCII 0x5D = [ASCII 0x25 = % ASCII 0x5B =] ⇒ [%]
Level	ENGINEERING	(32-bit data item) Characters have an 8-bit ASCII coding; there are N.3 characters, 8-bit each, starting from the least significant bit. Bit 24 is always to be set to 1.
Address	1851/1865	
Function	Parameter **P267a/P267c** is active only if **P267/P267b** = 0:[Disable] and it relates to the unit of measurement actually displayed in **M023**, **M024, M023a, M024a**. This parameter allows setting a 3-character string to display the units of measurement for the PID Measurements: **M023**, **M024, M023a, M024a**. Press the **SAVE/ENTER** key to edit each character: when a flashing cursor appears on the left of each character, press ▲ and ▼ to scroll all the characters displayed. Press the **ESC** key to go to the next character. Press **SAVE/ENTER** to store the new parameter value.	

NOTE See also parameter **P257/P457** in the [PAR] PID PARAMETERS MENU.

P268 / P268a	Measurement n.1 (n.2) on Root Page
Range	**M000** ÷ **M027a** (See [MEA] MEASUREMENTS MENU and Table 24)
Default	**P268** → **M004** Motor Spd **P268a** → **M000** Speed Ref.
Level	ADVANCED
Address	Cannot be accessed via serial link.
Function	These two parameters allow selecting two measurements to be displayed on the Root Page.

P268b / P268c / P268d / P268e	Measurement n.1 (n.2, n.3, n.4) on Keypad Page
Range	**M000** ÷ **M027a** (See [MEA] MEASUREMENTS MENU and Table 24)
Default	**P268b** → **M006** Mot.Freq. **P268c** → **M026** Motor Current **P268d** → **M004** Motor Spd **P268e** → **M000** Speed Ref.
Level	ADVANCED
Address	Cannot be accessed via serial link.
Function	These four parameters allow selecting four measurements to be displayed on the Keypad Pages.

NOTE Measurement n. 4 is available from the measurement Keypad page only. On the other pages, it will be replaced with the reference/feedback/active limit in that page.

Table 23: List of the programmable measurements in P268, P268a, P268b, P268c, P268d, P268e

Multimotor Control Measurements	M036 Aux. Dig.IN
M600 AvailMotor	M037 Analog In REF
M601 Work.Motor	M038 Analog In AIN1
M602 Setslave	M039 Analog In AIN2
M603 Setmaster	M040 Ser.SpdRef
M604 Ser.Comm.	M042 Fbus.SpdRef
M605 Oper.Mode	M044 Ser.TrqLimRef
M606 SysPwReq	M045 Fbus.TrqLimRef
M607 SysPwMastr	M046 SerPID Ref
M608 SysPwSlave	M047 FbusPID Ref
M609 PowerMastr	M048 SerPID Fbk
M038u AIN1user	M049 FbusPID Fbk
M039u AIN2user	M056 Digital Out
M700 H2ODigOUT	M057 Freq.Out
M701 DryRThresh	M058 Analog Out AO1
Iris Blue Measurements	M059 Analog Out AO2
M000 Speed Ref	M060 Analog Out AO3
M002 Ramp Out	M061 Aux. Dig.OUT
M004 Motor Speed	M062 Amb.Temp.
M006 Mot.Freq.	M036a Aux.Ser. Dig.IN
M008 Torq.Demand	M064 Hts.Temp.
M009 Torq.Out	M065 OT Counter
M011 Torq.Dem.%	M066 ST Counter
M012 Torq.Out %	M036b Aux.FBus. Dig.IN
M017 Flux Ref	M022a PID2 Out %
M018 PID Ref %	M069 PT100 Temp.1
M019 PID RmpOut %	M070 PT100 Temp.2
M020 PID Fbk %	M071 PT100 Temp.3
M021 PID Err %	M072 PT100 Temp.4
M022 PID Out %	M028a Energy (low)
M023 PID Ref	M026a I2t %
M024 PID Fbk	M039a Analog In XAIN4
M056a Virtual Dig.Out	M039b Analog In XAIN5
M026 Mot.Current	M018a PID2 Ref %
M027 Out Volt	M019a PID2 RmpOut %
M028 Power Out	M020a PID2 Fbk %
M029 Vbus-DC	M021a PID2 Err %
M030 V Mains	M023a PID2 Ref
M031 Delay.Dig.IN	M024a PID2 Fbk
M032 Istant.Dig.IN	M090 Alarm
M033 Term. Dig.IN	M056b Timed Flags TFL
M034 Ser. Dig.IN	M027a Power Factor
M035 Fbus. Dig.IN	

P269	Disable LOC/REM Key	
Range	0 ÷ 1	0:[NO] - 1:[YES]
Default	0	0:[NO]
Level	ENGINEERING	
Address	869	
Function	This parameter allows disabling the **LOC/REM.**	

P269b	ESC Key to Restore Previous Value	
Range	0 ÷ 1	0:[No] - 1:[YES]
Default	0	0:[No]
Level	ENGINEERING	
Address	1051	
Function	Effect of pressing the **ESC** key when changing a parameter after pressing **SAVE/ENTER:** **P269b** = **0:[No]** → press **ESC** to confirm the parameter value, which is not stored non-volatile memory (the previous value will be restored when the drive is next powered on). **P269b** = **1**:**[YES]** → press **ESC** to restore the previous value. In both cases, press **SAVE/ENTER** to confirm the new parameter value and store it to non-volatile memory (the new value is still effective when the drive is next powered on).	

15. [PAR] RAMPS MENU

15.1. Overview

An acceleration/deceleration ramp is a function allowing linear variations of the motor speed.
The ramp time is the time the motor takes to reach its max. speed when it starts from zero speed (or the time the motor takes to reach 0 speed when decelerating).
Two pairs of programmable values are available. Each pair defines the motor acceleration time and deceleration time. The unit of measurement of the basic time period is assigned to each pair of values.
For Fire Mode operation, two separate parameters with acceleration ramp time and deceleration ramp time are available.
From the Ramps menu, you can set quick initial acceleration ramps and final deceleration ramps specific to applications including pumps or compressors.
Those ramps allow quickly overriding critical working points and are dependent on the threshold set in **P020.** When accelerating and speed is lower than the threshold set in **P020,** ramp **P018** is adopted, while when decelerating and speed is lower than the threshold set in **P020**, ramp **P019** is adopted. Consequently, the pair of active ramps during normal operation is considered only when speed exceeds the threshold set in **P020**.

15.1.1. Description of the Speed Ramps

The two active ramps depend on the logic status of the digital input parametrized in **C167**.
Parameter **P014** enables setting a wider time range.

P009 Ramp Up Time 1
P010 Ramp Down Time 1
P012 Ramp Up Time 2
P013 Ramp Down Time 2
P014 Unit of Measurement for Ramp Times 1 and 2

The set ramp time corresponds to the time the speed reference takes to reach the max. speed (from 0 rpm) as an absolute value between min. speed and max. speed of the selected motor (**C028** and **C029** for motor 1, and so on). The time unit of measurement may have the following values:

0 → 0.01 s
1 → 0.1 s
2 → 1 s
3 → 10 s

The programmable range may be 0s – 327000s.

Example of a speed ramp:

Table 24: Example of a speed ramp

P014		Range P009 – P010	
Value	Coding	Min	Max
0	0.01 s	0	327.00 s
1	0.1 s	0	3270.0 s
2	1 s	0	32700 s
3	10 s	0	327000 s

The factory setting of the unit of measurement is 0.1 s; the ramp time is 10 sec.

15.2. List of Parameters P009 to P033

Table 25: List of Parameters P009 to P033

Parameter	FUNCTION	User Level	DEFAULT VALUE	MODBUS Address
P009	Speed ramp 1: acceleration time	BASIC	See Table 78	609
P010	Speed ramp 1: deceleration time	BASIC	See Table 78	610
P012	Speed ramp 2: acceleration time	ADVANCED	See Table 78	646
P013	Speed ramp 2: deceleration time	ADVANCED	See Table 78	647
P014	Speed ramps 1 and 2: time unit of measurement	ADVANCED	See Table 78	614
P018	Initial acceleration time	BASIC	1.00 s	618
P019	Final deceleration time	BASIC	1.00 s	619
P020	Speed threshold for initial and final ramps	BASIC	50.0%	670
P032	Fire Mode Ramp: acceleration time	ENGINEERING	See Table 78	648
P033	Fire Mode Ramp: deceleration time	ENGINEERING	See Table 78	649

P009	Speed Ramp 1: Acceleration Time	
Range	0 ÷ 32700	0 ÷ 327.00 s if **P014**=0 → 0.01 s 0 ÷ 3270.0 s if **P014**=1 → 0.1 s 0 ÷ 32700 s if **P014**=2→ 1 s 0 ÷ 327000 s if **P014**=3 → 10 s
Default	See Table 78	
Level	BASIC	
Address	609	
Function	Determines the time the reference takes to go from 0 rpm to the max. preset speed (considering the max. value between absolute values for max. speed and min. speed set for the connected motor). If the quick ramps are adopted (**P020**>0), ramp **P018** will activate first.	

P010	Speed Ramp 1: Deceleration Time	
Range	0 ÷ 32700	0 ÷ 327.00 s if **P014**=0 → 0.01 s 0 ÷ 3270.0 s if **P014**=1 → 0.1 s 0 ÷ 32700 s if **P014**=2→ 1 s 0 ÷ 327000 s if **P014**=3 → 10 s
Default	See Table 78	
Level	BASIC	
Address	610	
Function	Determines the time the reference takes to go from the max. preset speed (considering the max. value between absolute values for max. speed and min. speed set for the connected motor) to zero rpm. If the quick ramps are adopted (**P020**>0), ramp **P018** will activate first.	

P012	Speed Ramp 2: Acceleration Time	
Range	0 ÷ 32700	0 ÷ 327.00 s if **P014**=0 → 0.01 s 0 ÷ 3270.0 s if **P014**=1 → 0.1 s 0 ÷ 32700 s if **P014**=2 → 1 s 0 ÷ 327000 s if **P014**=3 → 10 s
Default	See Table 78	
Level	ADVANCED	
Address	646	
Function	Same as ramp 1 (see **P009**).	

NOTE Values for ramp 2 can be applied to the reference provided that multiramp digital inputs are set up and that ramp 2 is selected (see the [CFG] DIGITAL INPUTS MENU).

P013	Speed Ramp 2: Deceleration Time	
Range	0 ÷ 32700	0 ÷ 327.00 s if **P014**=0 → 0.01 s 0 ÷ 3270.0 s if **P014**=1 → 0.1 s 0 ÷ 32700 s if **P014**=2 → 1 s 0 ÷ 327000 s if **P014**=3 → 10 s
Default	See Table 78	
Level	ADVANCED	
Address	647	
Function	Same as ramp 1 (see **P010**).	

NOTE Values for ramp 2 can be applied to the reference provided that multiramp digital inputs are set up and that ramp 2 is selected (see the [CFG] DIGITAL INPUTS MENU).

P014	Speed Ramps 1 and 2: Time Unit of Measurement	
Range	0 ÷ 3	0 → 0.01 s 1 → 0.1 s 2 → 1 s 3 → 10 s
Default	See Table 78	
Level	ADVANCED	
Address	614	
Function	Defines the unit of measurement for the time periods for speed ramp 1 (**P009** and **P010)**, for speed ramp 2 (**P012** and **P013**), and for ramps in Fire Mode (**P032** and **P033**). The allowable programmable range may be extended from 0 s to 327000s. E.g. **P014**=1 then **P009**=100; this means **P009** = 100 x 0.1 s = 10 s **P014**=0 then **P009**=100; this means **P009** = 100 x 0.01 s = 1 s **P014**=3 then **P009**=100; this means **P009** = 100 x 10 s = 1000 s	

P018	Initial Acceleration Ramp	
Range	0 ÷ 32700	0 ÷ 327.00 s
Default	100	1.00s
Level	BASIC	
Address	618	
Function	Defines the time taken from the reference to go from zero rpm to the value corresponding to the speed threshold set in **P020**. Once the speed threshold in **P020** is exceeded, the active acceleration ramp for normal operation (**P009** or **P012**) is adopted.	

P019	Final Deceleration Time	
Range	0 ÷ 32700	0 ÷ 327.00 s
Default	100	1.00s
Level	BASIC	
Address	619	
Function	Defines the time taken from the reference to drop from **P020** to zero rpm. While decelerating, once the threshold in **P020** has been exceeded, the ramp defined in this parameter is adopted instead of the ramp set in **P010** or **P013** (normal operation ramp).	

P020	Speed Threshold for Initial and Final Ramps	
Range	0 ÷ 1500	0 ÷ 150.0 %fnom
Default	500	50.0 %fnom
Level	BASIC	
Address	670	
Function	Defines the speed threshold below which, while accelerating, ramp **P018** is adopted and, while decelerating, ramp **P019** is adopted. For values not ranging between the ranges above, acc./dec. ramps **P009/P010** or **P012/P013** will be adopted. This value is expressed as a percentage of the motor rated frequency (**C015**).	

P032	Acceleration Ramp in Fire Mode	
Range	0 ÷ 32700	0 ÷ 327.00 s if **P014**=0 → 0.01 s 0 ÷ 3270.0 s if **P014**=1 → 0.1 s 0 ÷ 32700 s if **P014**=2 → 1 s 0 ÷ 327000 s if **P014**=3 → 10 s
Default	See Table 78	
Level	ENGINEERING	
Address	648	
Function	Ramp adopted to accelerate the motor in Fire Mode.	

P033	Deceleration Ramp in Fire Mode	
Range	0 ÷ 32700	0 ÷ 327.00 s if **P014**=0 → 0.01 s 0 ÷ 3270.0 s if **P014**=1 → 0.1 s 0 ÷ 32700 s if **P014**=2 → 1 s 0 ÷ 327000 s if **P014**=3 → 10 s
Default	See Table 78	
Level	ENGINEERING	
Address	649	
Function	Ramp adopted to decelerate the motor Fire Mode.	

16. [PAR] INPUTS FOR REFERENCES MENU

16.1. Processing Speed/Torque References

The "**main reference**" is the value at constant rpm for the controlled physical variable required by the drive.
This reference is acquired by the drive only if the **START** command is active and the drive is **RUNNING**, otherwise it is ignored.
The **main reference** is the reference at constant rpm: when the drive is **RUNNING**, it will increment the **set-point** which will reach the main reference with a ramp (see the [PAR] RAMPS MENU).
The setup of the main reference is based on a number of parameters included in several menus:

Table 26: Parameters used for references

Parameters	Menus	Description of the Menu content
P050 ÷ P069	**References**	Scaling parameters for references sent from analog inputs REF, AIN1, AIN2. Parameters for changes made using the UP and DOWN keys. Parameter for drive disable in case of reference at min. value.
P390 ÷ P399	**References from option board**	Scaling parameters for references sent from analog inputs XAIN4, XAIN5.
P080 ÷ P090	**Multispeed**	Parameters setting preset multispeed values to be selected through digital inputs.
P105 ÷ P108	**Prohibit speed**	Parameters setting prohibit speed values.
C143 ÷ C146	**Control method**	Parameters setting the reference source.
C011, C028, C029	**Motor configuration**	Parameters setting the minimum and maximum speed.
C047, C048	**Motor limit**	Parameters setting the minimum and maximum torque.

Figure 4 shows the block diagrams illustrating how the speed references are processed. Menus and parameters used are also stated.

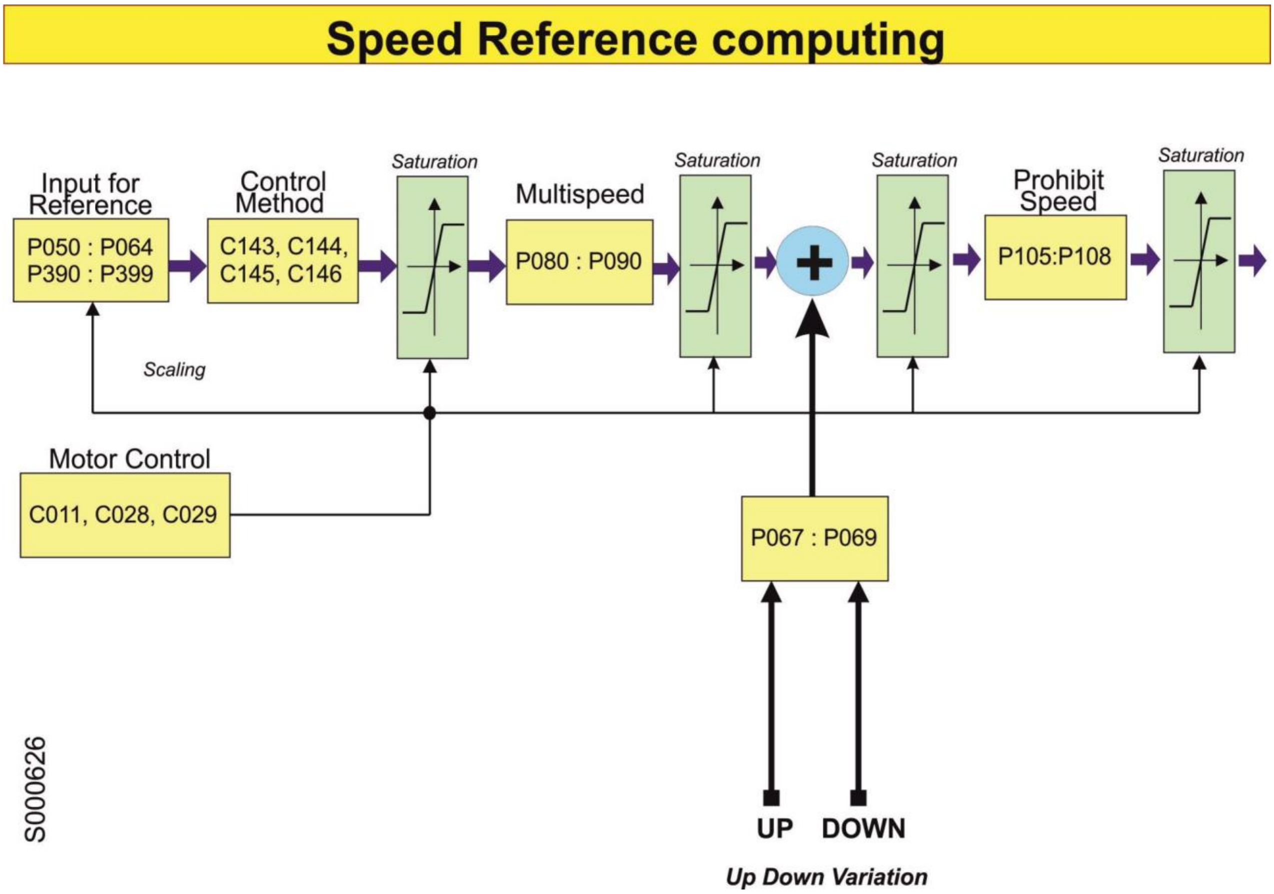


Figure 4: Speed Reference computing

16.2. Scaling Analog Inputs REF, AIN1, AIN2

NOTE Please refer to the IRIS BLUE – Installation Guide for hardware details about analog inputs.

Three analog inputs are available: REF, AIN1, AIN2.
They can be voltage inputs or current inputs (switching is made possible through hardware Dip–Switch **SW1** and software parameters) and are bipolar analog inputs (–10V ÷ +10V or –20mA ÷ +20mA).
REF input is single–ended; **AIN1** and **AIN2** inputs are differential inputs.
Factory setting is as follows: the **main speed reference** is given by **REF** analog input, **0V ÷ +10V** mode; the max. speed and min. speed are **C028**=**1500** rpm and **C029**=**0** rpm respectively.
For the 3 analog inputs, parameters **P050** ÷ **P064** allow setting the type of signal to be acquired, offset compensation (if any), scaling to obtain a speed reference the signal filtering time constant.
Parameter **P053** sets the offset of the input analog signal (if **P053**=0 offset is zero), while parameter **P054** defines the filtering time constant (factory setting: P054 = 5ms).
Type of input: for each analog input, DIP–Switch **SW1** allows setting the acquisition method of the input signal: voltage signal or current signal.
The voltage signal can be bipolar (–**10V** ÷ **+10V**) or unipolar (**0V** ÷ **+10V**).
The current signal can be bipolar (**–20mA** ÷ **+20mA**), unipolar (**0mA** ÷ **+20mA**) or can have a minimum offset (**4mA** ÷ **20mA**).
The user will set each analog input mode in parameters **P050**, **P055**, **P060**.

Table 27: Analog Input Hardware Mode

Type / Terminals	Name	Type	Dip–Switch	Parameter
Single-ended input/ 1,2	REF	±10V Input	SW1–1 off	**P050**
		0–20mA Input	SW1–1 on	
Differential input / 5,6	AIN1	±10V Input	SW1–2 off	**P055**
		0–20mA Input	SW1–2 on	
Differential input / 7,8	AIN2	±10V Input	SW1–3 off, SW1–4 5 off	**P060**
		0–20mA Input	SW1–3 on, SW1–4 5 off	
		PTC Input	SW1–3 off, SW1–4 5 on	See note

NOTE If AIN2 input is configured as PTC, refer to the [CFG] MOTOR THERMAL PROTECTION MENU or select the proper parameters. Its measurements are no longer valid.

NOTE Configurations different from the ones stated in the table above are not allowed.

CAUTION For each analog input (REF, AIN1, AIN2), make sure that the “mode” parameter setting (**P050**, **P055**, **P060**) matches with the setting of the relevant SW1 Dip–Switches.

Scaling is obtained by setting the parameters relating to the **linear function for the conversion** from the value read by the analog input to the corresponding speed/torque reference value.
The **conversion function** is a **straight line** passing through **2 points** in **Cartesian coordinates** having the values read by the analog input in the X-axis, and the speed/torque reference values multiplied by the reference percentage parameters in the Y-axis.

Each point is detected through its **two coordinates**.

The ordinates of the two points are the following:
the value of **Speed_Min** (or **Trq_Min** for the torque reference) multiplied by the percentage set through **P051a/P056a/P061a/P071a;** for the **first point**; the value of **Speed_Max** (or **Trq_Max** for the torque reference) multiplied by the percentage set through **P052a/P057a/P062a** for the **second point**.

Speed_Min is the value of parameter **C028**.
Trq_Min is the value of parameter **C047**.

Speed_Max is the value of parameter **C029**.
Trq_Max is the value of parameter **C048**.

The X-axis values of the two points depend on the analog input:
REF Input:
Parameter **P051** is the X-axis value of the **first point;** parameter **P052** is the X-axis value of the **second point.**
AIN1 Input:
Parameter **P056** is the X-axis value of the **first point;** parameter **P057** is the X-axis value of the **second point.**
Input **AIN2**:
Parameter **P061** is the X-axis value of the **first point;** parameter **P062** is the X-axis value of the **second point.**

The figure below illustrates how parameters set computing the signals for speed (or torque) analog reference.

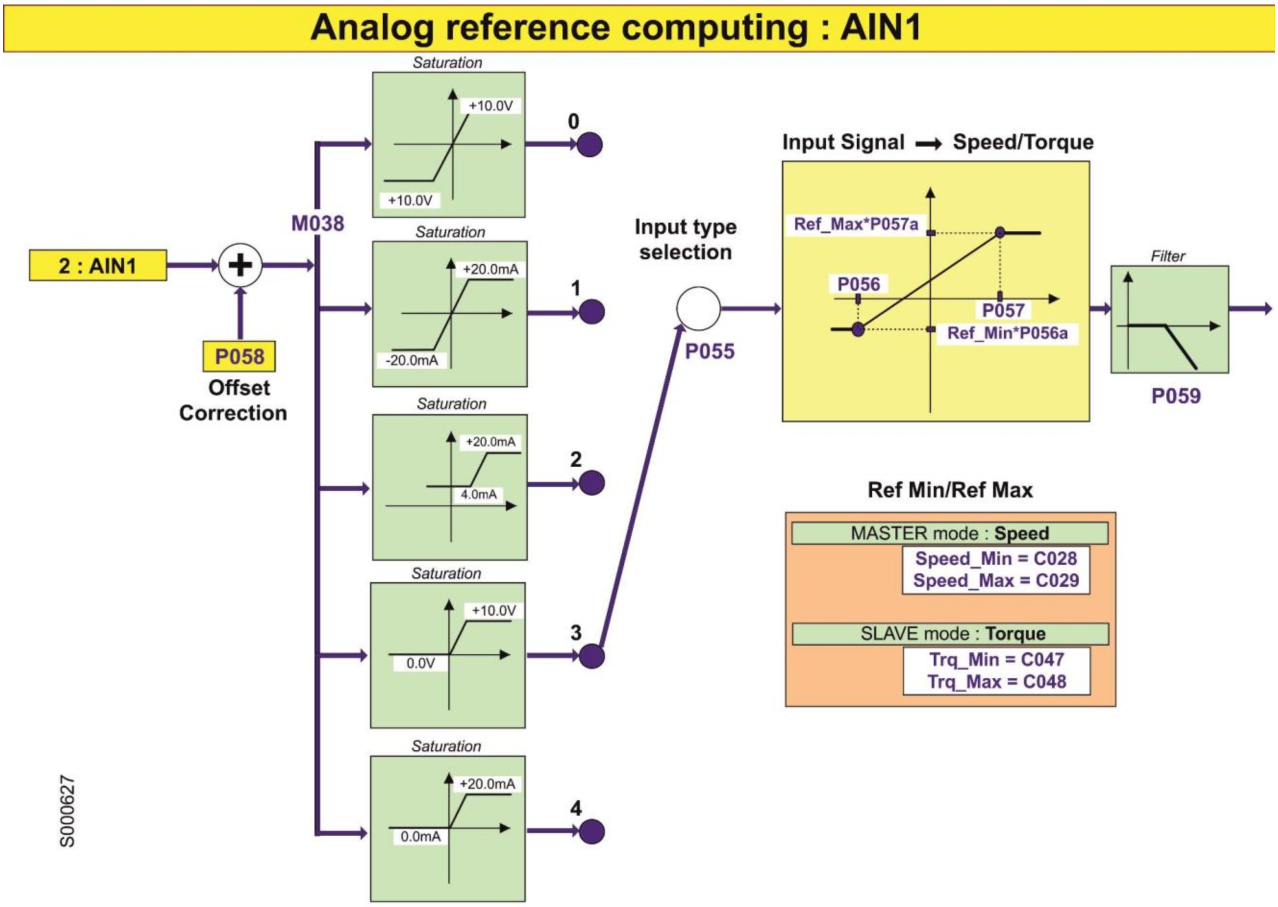


Figure 5: Computing Speed Analog Reference from terminal board: AIN1

The figures below illustrate programming examples for REF analog input in MASTER mode: speed reference.

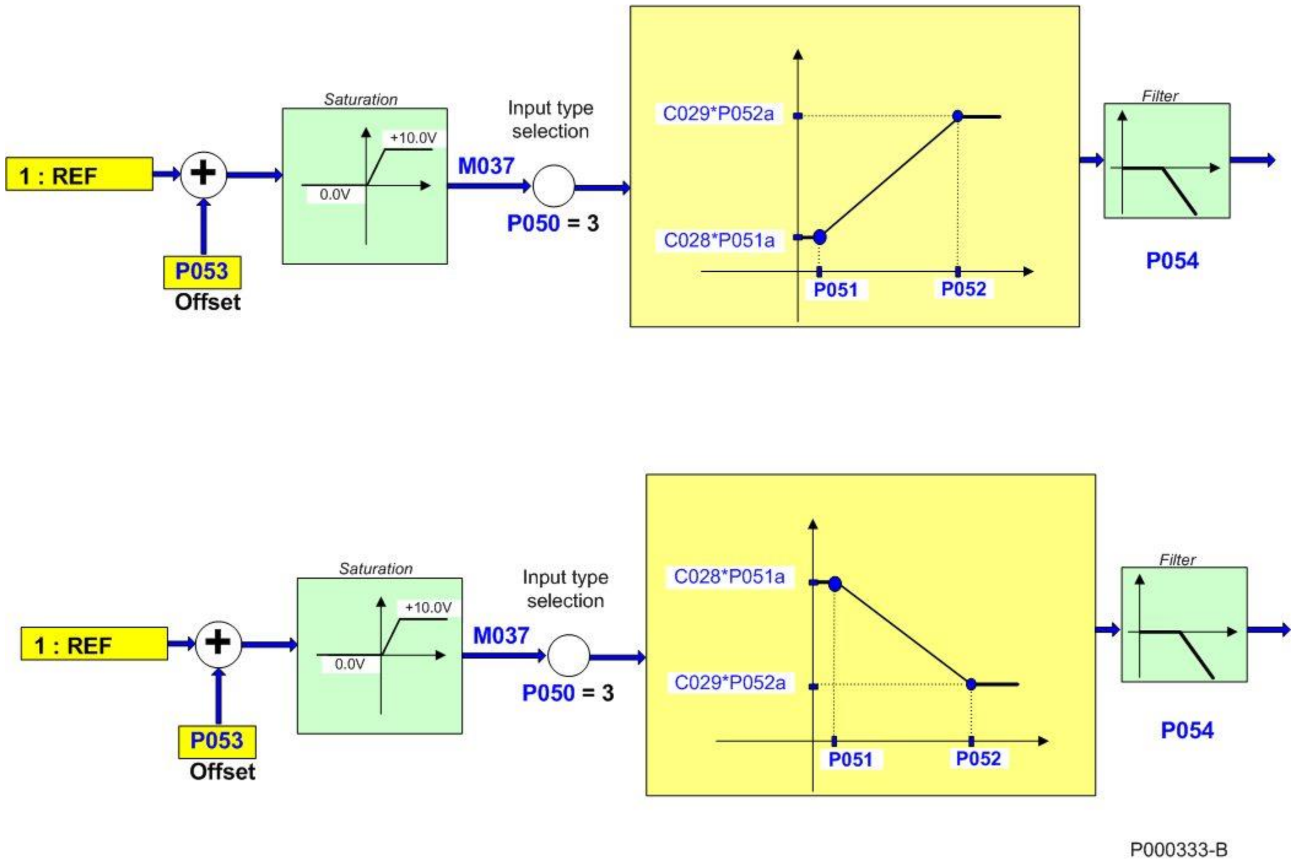


Figure 6: Computing Inputs REF (1) and (2) (examples)

The setup in the first part of the figure is as follows:
P050 = 3
P051 = 1V; **P051a** = 100%; **P052** = 10V; **P052a** = 100%
Speed_Min = **C028** = 100 rpm; **Speed_Max** = **C029** = 1100 rpm

The setup in the second part of the figure is as follows:
P050 = 3
P051 = 1V; **P051a** = 100%; **P052** = 10V; **P052a** = 100%
Speed_Min = **C028** = 1200 rpm; **Speed_Max** = **C029** = 400 rpm

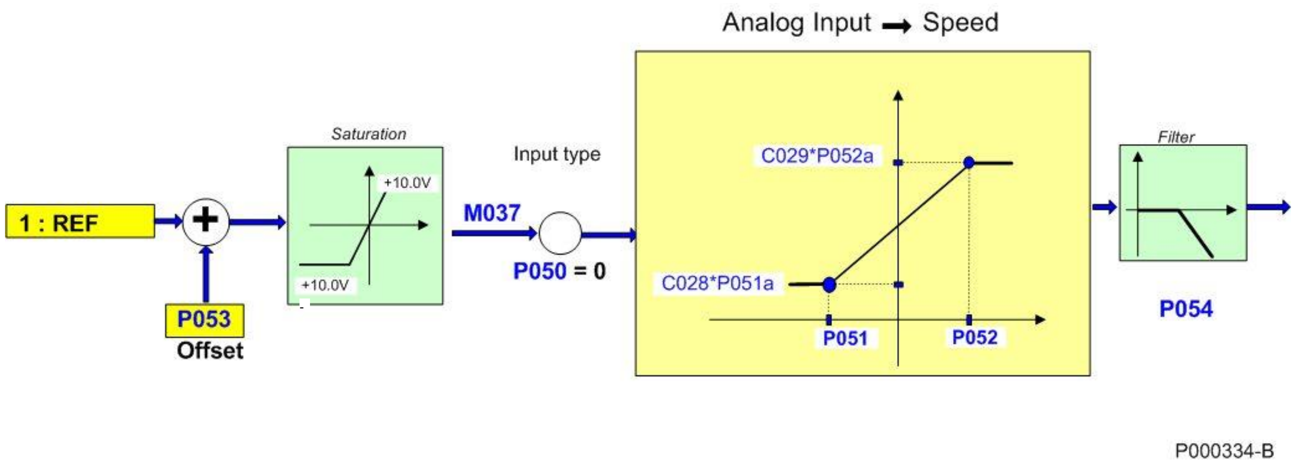


Figure 7: Computing REF Input (Example 3)

The setup in the figure above is as follows:
P050 = 0
P051 = –5V; **P051a** = 100%; **P052** = +8V; **P052a** = 100%
Speed_Min = **C028** = 300 rpm; **Speed_Max** = **C029** =1450 rpm

16.3. List of Parameters P050 to P069

Table 28: List of Parameters P050 to P069

Parameter	FUNCTION	User Level	DEFAULT VALUE	MODBUS Address
P050	Type of signal over REF input	ADVANCED	3: 0÷10V	650
P051	Value of REF input producing min. reference (X-axis)	ADVANCED	0.0V	651
P051a	Percentage of Speed_Min/Trq_Min producing min. reference (Y-axis related to **P051**)	ADVANCED	100.0%	675
P052	Value of REF input producing max. reference (X-axis)	ADVANCED	10.0V	652
P052a	Percentage of Speed_Max/Trq_Max producing max. reference (Y-axis related to **P052**)	ADVANCED	100.0%	676
P053	Offset over REF input	ADVANCED	0V	653
P054	Filtering time over REF input	ADVANCED	5ms	654
P055	Type of signal over AIN1 input	ADVANCED	2: 4÷20mA	655
P056	Value of AIN1 input producing min. reference (X-axis)	ADVANCED	4.0mA	656
P056a	Percentage of Speed_Min/Trq_Min producing min. reference (Y-axis related to **P056**)	ADVANCED	100.0%	677
P057	Value of AIN1 input producing max. reference (X-axis)	ADVANCED	20.0mA	657
P057a	Percentage of Speed_Max/Trq_Max producing max. reference (Y-axis related to **P057**)	ADVANCED	100.0%	678
P058	Offset over AIN1 input	ADVANCED	0mA	658
P059	Filtering time over AIN1 input	ADVANCED	5 ms	659
P060	Type of signal over AIN2/PTC input	ADVANCED	2: 4÷20mA	660
P061	Value of AIN2 input producing min. reference (X-axis)	ADVANCED	4.0mA	661
P061a	Percentage of Speed_Min/Trq_Min producing min. reference (Y-axis related to **P061**)	ADVANCED	100.0%	679
P062	Value of AIN2 input producing max. reference (X-axis)	ADVANCED	20.0mA	662
P062a	Percentage of Speed_Max/Trq_Max producing max. reference (Y-axis related to **P062**)	ADVANCED	100.0%	701
P063	Offset over AIN2/PTC input	ADVANCED	0mA	663
P064	Filtering time over AIN2/PTC input	ADVANCED	5 ms	664
P065	Minimum reference and START disabling threshold	ADVANCED	0	665
P066	START disable delay at **P065** threshold	ADVANCED	0 s	666
P067	Keypad and terminal board UP/DOWN ramp	ADVANCED	Quadratic	667
P068	Storage of UP/DOWN values at Power Off	ADVANCED	SI	668
P068b	Reset UP/DOWN PID at Stop	ADVANCED	0:[NO]	941
P068d	Reset UP/DOWN speed/torque at Source Changeover	ADVANCED	0:[NO]	943
P069	Range of UP/DOWN reference	ADVANCED	1: Unipolar	669

P050	Type of Signal over REF Input	
Range	0 ÷ 4	0: ± 10 V 1: ± 20 mA 2: 4 ÷ 20 mA 3: 0 ÷ 10 V 4: 0 ÷ 20 mA
Default	3	3:0÷10V
Level	ADVANCED	
Address	650	
Function	This parameter selects the type of single–ended, analog signal over the REF terminal in the terminal board. The signal can be a voltage signal, a current signal, a unipolar signal, or a bipolar signal. **0:** ± 10 V Bipolar voltage input between –10V and +10V. The detected signal is saturated between these two values. **1**: ± 20 mA Bipolar current input between –20mA and +20mA. The detected signal is saturated between these two values. **2**: 4 ÷ 20 mA Unipolar current input with min. threshold, between +4 mA and +20mA. The detected signal is saturated between these two values. Before being saturated, if the detected signal is lower than 4 mA or greater than 20 mA, alarms **A066** or **A102** trip. **3**: 0 ÷ 10 V Unipolar voltage input between 0V and +10V. The detected signal is saturated between these two values. **4**: 0 ÷ 20 mA Unipolar current input between +0 mA and +20mA. The detected signal is saturated between these two values.	

NOTE The value set in parameter **P050** must match with the status of **SW1–1** switch allowing selecting the proper electric circuit for the analog signal processing (voltage signal or current signal).

P051	Value of REF Input Producing Min. Reference (X-axis)	
Range	–100 ÷ 100, if **P050** = 0 –200 ÷ 200, if **P050** = 1 +40 ÷ 200, if **P050** = 2 0 ÷ 100, if **P050** = 3 0 ÷ 200, if **P050** = 4	–10.0 V ÷ 10.0 V, if **P050 =** 0: ± 10 V –20.0 mA ÷ 20.0 mA, if **P050** = 1: ± 20 mA +4.0mA ÷ 20.0 mA, if **P050** = 2: 4 ÷ 20 mA 0.0 V ÷ 10.0V, if **P050** = 3: 0 ÷ 10 V 0.0 mA ÷ 20.0 mA, if **P050** = 4: 0 ÷ 20 mA
Default	0	0.0V
Level	ADVANCED	
Address	651	
Function	This parameter selects the value for REF input signal for minimum reference, or better the reference set in **C028xP051a** (Master mode) or in **C047xP051a** (Slave mode).	

P051a	Percentage of Speed_Min/Trq_Min Producing Min. Reference (Y-axis related to P051)	
Range	0 ÷ 1000	100.0%
Default	1000	100.0%
Level	ADVANCED	
Address	675	
Function	This parameter represents the min. speed percentage (or the min. torque percentage for a torque reference) to be used for the minimum reference set with **P051.**	

P052	Value of REF Input Producing Max. Reference (X-axis)	
Range	–100 ÷ 100, if **P050** = 0 –200 ÷ 200, if **P050** = 1 +40 ÷ 200, if **P050** = 2 0 ÷ 100, if **P050** = 3 0 ÷ 200, if **P050** = 4	–10.0 V ÷ 10.0 V, if **P050 =** 0: ± 10 V –20.0 mA ÷ 20.0 mA, if **P050** = 1: ± 20 mA +4.0mA ÷ 20.0 mA, if **P050** = 2: 4 ÷ 20 mA 0.0 V ÷ 10.0V, if **P050** = 3: 0 ÷ 10 V 0.0 mA ÷ 20.0 mA, if **P050** = 4: 0 ÷ 20 mA
Default	100	+10.0V
Level	ADVANCED	
Address	652	
Function	This parameter selects the value for REF input signal for maximum reference, or better the reference set in **C029xP052a** (Master mode) or in **C048xP052a** (Slave mode).	

P052a	Percentage of Speed_Max/Trq_Max Producing Max. Reference (Y-axis related to P052)	
Range	0 ÷ 1000	100.0%
Default	1000	100.0%
Level	ADVANCED	
Address	676	
Function	This parameter represents the max. speed percentage (or the max. torque percentage for a torque reference) to be used for the maximum reference set with **P052.**	

P053	Offset over REF Input	
Range	–2000 ÷ 2000	–10.00 V ÷ +10.00 V, se **P050 =** 0 or 3 –20.00 mA ÷ +20.00 mA, se **P050** = 1,2,4
Default	0	0.00 V
Level	ADVANCED	
Address	653	
Function	This parameter selects the offset correction value of the REF analog signal that has been measured. The value set is added to the signal measured before saturation or conversion; its unit of measure is the same as the one of the signal selected for REF analog input.	

P054	Filtering Time over REF Input	
Range	0 ÷ +65000	0 ÷ +65000ms
Default	5	5 ms
Level	ADVANCED	
Address	654	
Function	This parameter selects the value of the filter time constant of the first command applied to the REF input signal when the signal saturation and conversion is over.	

P055	Type of Signal over AIN1 Input	
Range	0 ÷ 4	0: ± 10 V 1: ± 20 mA 2: 4 ÷ 20 mA 3: 0 ÷ 10 V 4: 0 ÷ 20 mA
Default	2	2: 4 ÷ 20 mA
Level	ADVANCED	
Address	655	
Function	This parameter selects the type of differential analog signal over terminals **AIN1+** and **AIN1–** in the terminal board. The signal can be a voltage signal, a current signal, a unipolar signal, or a bipolar signal. **0:** ± 10 V Bipolar voltage input between –10V and +10V. The detected signal is saturated between these two values. **1**: ± 20 mA Bipolar current input between –20mA and +20mA. The detected signal is saturated between these two values. **2**: 4 ÷ 20 mA Unipolar current input with min. threshold, between +4 mA and +20mA. The detected signal is saturated between these two values. Before being saturated, if the detected signal is lower than 4 mA or greater than 20 mA, alarms **A067** or **A103** trip. **3**: 0 ÷ 10 V Unipolar voltage input between 0V and +10V. The detected signal is saturated between these two values. **4**: 0 ÷ 20 mA Unipolar current input between +0 mA and +20mA. The detected signal is saturated between these two values.	

NOTE The value set in parameter **P055** must match with the status of switch **SW1–2** allowing selecting the proper electric circuit for the analog signal processing (voltage signal or current signal).

P056	Value of AIN1 Input Producing Min. Reference (X-axis)	
Range	–100 ÷ 100, if **P055** = 0 –200 ÷ 200, if **P055** = 1 +40 ÷ 200, if **P055** = 2 0 ÷ 100, if **P055** = 3 0 ÷ 200, if **P055** = 4	–10.0 V ÷ 10.0 V, if **P055 =** 0: ± 10 V –20.0 mA ÷ 20.0 mA, if **P055** = 1: ± 20 mA +4.0mA ÷ 20.0 mA, if **P055** = 2: 4 ÷ 20 mA 0.0 V ÷ 10.0V, if **P055** = 3: 0 ÷ 10 V 0.0 mA ÷ 20.0 mA, if **P055** = 4: 0 ÷ 20 mA
Default	40	+4.0mA
Level	ADVANCED	
Address	656	
Function	This parameter selects the value for AIN1 input signal for minimum reference, or better the reference set in **C028xP056a** (Master mode) or in **C047xP056a** (Slave mode).	

P056a	Percentage of Speed_Min/Trq_Min Producing Min. Reference (Y-axis related to P056)	
Range	0 ÷ 1000	100.0%
Default	1000	100.0%
Level	ADVANCED	
Address	677	
Function	This parameter represents the min. speed percentage (or the min. torque percentage for a torque reference) to be used for the minimum reference set with **P056.**	

P057	**Value of AIN1 Input Producing Max. Reference (X-axis)**	
Range	–100 ÷ 100, if **P055** = 0 –200 ÷ 200, if **P055** = 1 +40 ÷ 200, if **P055** = 2 0 ÷ 100, if **P055** = 3 0 ÷ 200, if **P055** = 4	–10.0 V ÷ 10.0 V, if **P055 =** 0: ± 10 V –20.0 mA ÷ 20.0 mA, if **P055** = 1: ± 20 mA +4.0mA ÷ 20.0 mA, if **P055** = 2: 4 ÷ 20 mA 0.0 V ÷ 10.0V, if **P055** = 3: 0 ÷ 10 V 0.0 mA ÷ 20.0 mA, if **P055** = 4: 0 ÷ 20 mA
Default	200	+20.0mA
Level	ADVANCED	
Address	657	
Function	This parameter selects the value for AIN1 input signal for maximum reference, or better the reference set in **C029xP057a** (Master mode) or in **C048xP057a** (Slave mode).	

P057a	**Percentage of Speed_Max/Trq_Max Producing Max. Reference (Y-axis related to P057)**	
Range	0 ÷ 1000	100.0%
Default	1000	100.0%
Level	ADVANCED	
Address	678	
Function	This parameter represents the min. speed percentage (or the min. torque percentage for a torque reference) to be used for the minimum reference set with **P057**.	

P058	**Offset over AIN1 Input**	
Range	–2000 ÷ 2000	–10.00 V ÷ +10.00 V, if **P055 =** 0 or 3 –20.00 mA ÷ +20.00 mA, if **P055** = 1,2,4
Default	0	0 mA
Level	ADVANCED	
Address	658	
Function	This parameter selects the offset correction value of AIN1 analog signal that has been measured. The value set is added to the signal measured before saturation or conversion; its unit of measure is the same as the one of the signal selected for AIN1 analog input.	

P059	**Filter over AIN1 Input**	
Range	0 ÷ +65000	0 ÷ +65000ms
Default	5	5 ms
Level	ADVANCED	
Address	659	
Function	This parameter selects the value of the filter time constant of the first command applied to AIN1 input signal when the signal saturation and conversion is over.	

P060	Type of Signal over AIN2/PTC Input	
Range	0 ÷ 4	0: ± 10 V 1: ± 20 mA 2: 4 ÷ 20 mA 3: 0 ÷ 10 V 4: 0 ÷ 20 mA
Default	2	2: 4 ÷ 20 mA
Level	ADVANCED	
Address	660	
Function	This parameter selects the type of differential analog signal over terminals **AIN2+** and **AIN2–** in the terminal board. The signal can be a voltage signal, a current signal, a unipolar signal, or a bipolar signal. **0:** ± 10 V Bipolar voltage input between –10V and +10V. The detected signal is saturated between these two values. **1**: ± 20 mA Bipolar current input between –20mA and +20mA. The detected signal is saturated between these two values. **2**: 4 ÷ 20 mA Unipolar current input with min. threshold, between +4 mA and +20mA. The detected signal is saturated between these two values. Before being saturated, if the detected signal is lower than 4 mA or greater than 20 mA, alarms **A068** or **A104** trip. **3**: 0 ÷ 10 V Unipolar voltage input between 0V and +10V. The detected signal is saturated between these two values. **4**: 0 ÷ 20 mA Unipolar current input between +0 mA and +20mA. The detected signal is saturated between these two values.	

NOTE The value set in parameter **P060** must match with the status of switches **SW1–3, SW1-4** and **SW1-5** allowing selecting the proper electric circuit for the analog signal processing (voltage signal or current signal).

NOTE If the PTC thermal protection (**C274**) is enabled, the reference from **AIN2** is automatically managed as a 0 ÷10V input. The only parameter enabled for the control of AIN2 is **P064**; **P060, P061, P061a, P062, P062a** and **P063** cannot be viewed and are not considered for calculations.

P061	Value of AIN2 Input Producing Min. Reference (X-axis)	
Range	–100 ÷ 100, if **P060** = 0 –200 ÷ 200, if **P060** = 1 +40 ÷ 200, if **P060** = 2 0 ÷ 100, if **P060** = 3 0 ÷ 200, if **P060** = 4	–10.0 V ÷ 10.0 V, if **P060 =** 0: ± 10 V –20.0 mA ÷ 20.0 mA, if **P060** = 1: ± 20 mA +4.0mA ÷ 20.0 mA, if **P060** = 2: 4 ÷ 20 mA 0.0 V ÷ 10.0V, if **P060** = 3: 0 ÷ 10 V 0.0 mA ÷ 20.0 mA, if **P060** = 4: 0 ÷ 20 mA
Default	40	4.0mA
Level	ADVANCED	
Address	661	
Function	This parameter selects the value for AIN2 input signal for minimum reference, or better the reference set in **C028xP061a** (Master mode) or in **C047xP061a** (Slave mode).	

P061a	Percentage of Speed_Min/Trq_Min Producing Min. Reference (Y-axis related to P061)	
Range	0 ÷ 1000	100.0%
Default	1000	100.0%
Level	ADVANCED	
Address	679	
Function	This parameter represents the min. speed percentage (or the min. torque percentage for a torque reference) to be used for the minimum reference set with **P061.**	

P062	Value of AIN2 Input Producing Max. Reference (X-axis)	
Range	–100 ÷ 100, if **P060** = 0 –200 ÷ 200, if **P060** = 1 +40 ÷ 200, if **P060** = 2 0 ÷ 100, if **P060** = 3 0 ÷ 200, if **P060** = 4	–10.0 V ÷ 10.0 V, if **P060 =** 0: ± 10 V –20.0 mA÷ 20.0 mA, if **P060** = 1: ± 20 mA +4.0mA ÷ 20.0 mA, if **P060** = 2: 4 ÷ 20 mA 0.0 V ÷ 10.0V, if **P060** = 3: 0 ÷ 10 V 0.0 mA ÷ 20.0 mA, if **P060** = 4: 0 ÷ 20 mA
Default	100	20.0 mA
Level	ADVANCED	
Address	662	
Function	This parameter selects the value for **AIN2** input signal for maximum reference, or better the reference set in **C029xP062a** (Master mode) or in **C048xP062a** (Slave mode).	

P062a	Percentage of Speed_Min/Trq_Min Producing Max. Reference (Y-axis related to P062)	
Range	0 ÷ 1000	0 ÷ 1000
Default	1000	1000
Level	ADVANCED	
Address	701	
Function	This parameter selects the value for **AIN2** input signal for maximum reference, or better the reference set in **C029xP062a** (Master mode) or in **C048xP062a** (Slave mode).	

P063	Offset over AIN2/PTC Input	
Range	–2000 ÷ 2000	–10.00 V ÷ +10.00 V, if **P060 =** 0 or 3 –20.00 mA ÷ +20.00 mA, if **P060** = 1,2,4
Default	0	0 mA
Level	ADVANCED	
Address	663	
Function	This parameter selects the offset correction value of AIN2 analog signal that has been measured. The value set is added to the signal measured before saturation or conversion; its unit of measure is the same as the one of the signal selected for AIN2 analog input.	

P064	Filtering Time over AIN2/PTC	
Range	0 ÷ 65000	0 ÷ 65000ms
Default	5	5 ms
Level	ADVANCED	
Address	664	
Function	This parameter selects the value of the filter time constant of the first command applied to AIN2 input signal when the signal saturation and conversion is over.	

P065	Minimum Reference and START Disabling Threshold	
Range	0 ÷ +32000	0 ÷ +32000 rpm
Default	0	0rpm
Level	ADVANCED	
Address	665	
Function	If this parameter is other than zero, the current speed reference computed when processing of all active source references is over, **it is saturated as an absolute value of this parameter's value**. Saturation implies an absolute value, i.e. this parameter determines a "prohibit range" of the reference approx. zero. Example: **P065** = 100 rpm and current speed reference is 500 rpm; if reference drops below 100 rpm, for example down to +50rpm, the value of the active reference is saturated to 100 rpm until reference exceeds 100 rpm again or is lower than -100 rpm; in that case, the preset value will be assigned to the reference. If also parameter **P066** is other than zero, the **drive disabling function is enabled**: if the absolute value of the current speed reference is kept in the "prohibit range" for a time longer than the time set in **P066**, reference is set to zero and the motor speed decreases following the active ramp up to zero rpm; when the motor speed is equal to zero, the drive will automatically deactivate. With **ENABLE-A** and **ENABLE-B** inputs closed, **the drive will automatically reactivate** if the reference exceeds the value set in parameter **P065** as an absolute value.	

NOTE Parameter **P065** is active in Master mode only, i.e. when the reference is a direct speed reference not sent from PID with **C294** PID Action = 1:[Reference]).

NOTE Parameter **P065** is active only when the Speed Searching function is disabled: **C245=0**.

P066	START Disable delay at P065 Threshold	
Range	0 ÷ 250	0 ÷ 250 sec
Default	0	0s
Level	ADVANCED	
Address	666	
Function	If this parameter is other than zero and if also parameter **P065** is other than zero, the **drive disabling function is enabled**: if the absolute value of the current speed reference is kept in the "prohibit range" for a time longer than the time set in **P066**, reference is set to zero and the motor speed decreases following the active ramp up to zero rpm; when the motor speed is equal to zero, the drive will automatically deactivate. See also the description of parameter **P065**.	

P067	Keypad and Terminal Board UP/DOWN Ramp	
Range	0 ÷ 6501	0 s ÷ 6500 s; Quadratic
Default	6501	Quadratic
Level	ADVANCED	
Address	667	
Function	Reference may be increased or decreased with input digital signals **UP** and **DOWN**, or using the ▲ and ▼ keys from the keypad (local mode). Reference increment or decrement is obtained by adding to the current reference a quantity which will be increased or decreased with a time ramp. Parameter **P067** indicates the ramp time to increase the reference from zero to the preset speed (or torque) maximum absolute value, i.e. the max. value between absolute values Spd_Min and Spd_Max (or Trq_Min and Trq_Max). That is the maximum value between absolute values of Spd_Min=**C028** and Spd_Max=**C029**, or between Trq_Min=**C047** and Trq_Max=**C048**.	

P068	Storage of UP/DOWN Values at Power Off	
Range	0 ÷ 1	0: Disabled, 1: Enabled
Default	1	1: Enabled
Level	ADVANCED	
Address	668	
Function	If **P068**=1, the Speed/Torque or PID references added through input digital signals **UP** and **DOWN** or with the **INC** and **DEC** keys (local mode), are stored at the drive power off and are added to the start reference when the drive is restarted. This function allows storing he reference value obtained with **UP** and **DOWN** signals.	

P068b	Reset Up–Down PID at Stop	
Range	0 ÷ 1	0: NO, 1: YES
Default	0	0: NO
Level	ADVANCED	
Address	941	
Function	If **P068b** =1: [Yes], the PID reference sent via the **UP**/**DOWN** digital signals or via the ▲ and ▼ keys in the keypad) is reset whenever the START command for the drive is disabled and the deceleration ramp is completed.	

P068d	Reset Up–Down PID at Source Changeover	
Range	0 ÷ 1	0: NO, 1: YES
Default	0	0: NO
Level	ADVANCED	
Address	943	
Function	If **P068d** =1: [Yes], the PID reference sent via the **UP/DOWN** digital signals or with the ▲ and ▼ keys in the keypad is reset whenever switching from the Remote mode to the Local mode and vice versa (using the **LOC/REM** key or the LOC/REM digital input, or when a control source switches to the other using the digital input programmed in **C179** or **C179a** - MDI for source selection, see the [CFG] DIGITAL INPUTS MENU).	

P069	Range of Up/Down Reference	
Range	0 ÷ 1	0: Bipolar, 1: Unipolar
Default	1	1: Unipolar
Level	ADVANCED	
Address	669	
Function	If **P069**=1, the quantity added via the **UP/DOWN** digital signals or with the ▲ and ▼ keys (Local mode) is unipolar, i.e. it is positive only and has a min. value equal to zero. For bipolar quantities, the added quantity may be negative.	

17. [PAR] MULTISPEED MENU

17.1. Overview

NOTE See also the [PAR] PID MULTIREFERENCES MENU and [CFG] DIGITAL INPUTS MENU.

The Multispeed menu allows defining the values for 7 **preset speed** (or **multispeed**) references set in parameters **P081** to **P090**. Their application method is set in **P080**.
The desired speed is selected through the digital inputs in the [CFG] DIGITAL INPUTS MENU).
The reference range may be programmed via these parameters:
± 32000 rpm if multispeed unit of measurement is → P100 = 1.00 rpm
± 3200.0 rpm if multispeed unit of measurement is → P100 = 0.10 rpm
± 320.00 rpm if multispeed unit of measurement is → P100 = 0.01 rpm

Use parameters **C155**, **C156**, **C157** to set the digital inputs in multispeed mode.
Parameter **P080** defines the functionality of the references set in the preset speed function and may have three different values: PRESET SPEED, SUM SPEED, EXCLUSIVE PRESET SPEED.
If **P080** = **PRESET SPEED**, the speed reference is the value set in the preset speed which is active at that moment. If digital inputs set as **multispeed** are all open (inactive), the speed reference is the reference coming from the sources selected in the **Control Method Menu** (**C143** to **C146**).
If **P080** = **EXCLUSIVE PRESET SPEED**, the speed reference is the value set in the multispeed which is active at that moment. If digital inputs set as **multispeed** are all open (inactive), no other reference source is considered; the speed reference is zero.
If **P080** = **SUM SPEED**, the speed reference value assigned to the **preset speed** which is active at that moment is summed up to the total amount of the speed references.

The reference obtained is always saturated by the parameters relating to the min. speed and the max. speed of the connected motor.

17.2. List of Parameters P080 to P100

Table 29: List of Parameters P080 to P100

Parameter	FUNCTION	User Level	DEFAULT VALUE	MODBUS Address
P080	Multispeed function	BASIC	0:Preset Speed	755
P081	Output speed Mspd1	BASIC	0.00 rpm	756
P083	Output speed Mspd2	BASIC	0.00 rpm	757
P085	Output speed Mspd3	BASIC	0.00 rpm	758
P087	Output speed Mspd4	ADVANCED	0.00 rpm	759
P088	Output speed Mspd5	ADVANCED	0.00 rpm	760
P089	Output speed Mspd6	ADVANCED	0.00 rpm	761
P090	Output speed Mspd7	ADVANCED	0.00 rpm	762
P099	Fire Mode speed	ENGINEERING	750.00 rpm	763
P100	Multispeed unit of measurement	ADVANCED	2: 1.0 rpm	764

P080	Multispeed Function	
Range	0 ÷ 2	0: Preset Speed, 1: Sum Speed, 2: Exclusive Preset Speed
Default	0	0: Preset Speed
Level	BASIC	
Address	755	
Function	Defines the functionality of the multispeed values for the global speed reference. Three functions are available: • 0: [Preset Speed] → the selected **multispeed** is the actual rpm value (upon limit due to min. and max. speed parameters for the selected motor) of the motor speed reference. If no **multispeed** is selected (*no digital input programmed for multispeed selection is activated, or all digital inputs programmed for multispeed selection are deactivated*), the speed reference is the reference for the sources set in the [CFG] CONTROL METHOD MENU**.** • 1: [Sum Speed] → the reference relating to the selected multispeed is considered as the sum of the references for the other reference sources selected in the [CFG] CONTROL METHOD MENU**.** • 2: [Exclusive Preset Speed] → the selected multispeed is the actual rpm value (upon saturation due to min. and max. speed parameters for the selected motor) of the motor speed reference. Unlike function 0 [Preset Speed], if no multispeed is selected (*no digital input programmed for multispeed selection is activated, or all digital inputs programmed for multispeed selection are deactivated*) **the speed reference is zero**.	

P081÷P090	Output Speed Mspd n.1(/7)	
Range	–32000 ÷ 32000	±32000rpm
Default	0	0.00 rpm
Level	**P081** to **P085** BASIC **P087** to **P090** ADVANCED	
Address	756÷762	
Function	This parameter sets the multispeed output speed selected through the relevant digital inputs Table 92). The multispeed value is scaled based on the unit of measurement set in **P100**. The reference resulting from the multispeed selected through the relevant digital inputs will be computed based on the setting of parameter **P080**.	

P099	Fire Mode Speed	
Range	–32000 ÷ 32000	±32000
Default	750	750.00 rpm
Level	ENGINEERING	
Address	763	
Function	Determines the value of the output speed in Fire Mode. The Fire Mode speed depends on the unit of measurement programmed in **P100**.	

P100	Multispeed Unit of Measurement	
Range	0÷2	0: [0.01rpm] ÷ 2: [1.0 rpm]
Default	2	2: [1.0 rpm]
Level	ADVANCED	
Address	764	
Function	Determines the unit of measurement considered for the 15 allowable multispeed values and the Fire Mode speed in **P099**. Function	

CAUTION When changing the unit of measurement of the multispeed values in **P100**, the preset speed values for the multispeed and Fire Mode values will be RECOMPUTED.

18. [PAR] PID MULTIREFERENCES MENU

18.1. Overview

The parameters for the utilisation and allocation of PID Multireferences from digital inputs.
The reference sources are based on the setup in parameters **C285** to **C287** (see the [CFG] PID CONFIGURATION MENU). The overall reference also depends on the multireferences that are already set (if any).

Configuration example:

PID Configuration Menu

C285 Source of PID reference 1 = 2: AIN1
C286 Source of PID reference 2 = 0: Disable
C287 Source of PID reference 3 = 0: Disable

Digital Inputs Menu

C188a Input for PID Multireference 1 = 7: MDI7
C188b Input for PID Multireference 2 = 8: MDI8
C188c Input for PID Multireference 3 = 0: Disable

PID Multireferences Menu

P081a PID Reference 1 (Mref 1) = 1.0 bars
P082a PID Reference 2 (Mref 2) = 1.5 bars
P083a PID Reference 3 (Mref 3) = 2.5 bars

PID Parameters Menu

P257 Gain for PID scaling = 0.1

When AIN1 analog input is set to 100%, the pressure reference is 10 bars
(100%***P257** =10.0).

Supposing that AIN1 is set to 43%, the references below are obtained based on the combination of the digital inputs configured as multireferences, and based on the function allocated to parameter **P080a**.

P080a = 0: Preset Ref. If both digital inputs configured as Multireferences are not activated, the overall reference is given from AIN1 analog input selected as the first PID reference (**C285**):

P080a	Multireference Function = 0: Preset Ref.	
MDI8	MDI7	Overall reference
0	0	4.3 bars
0	1	1.0 bars
1	0	1.5 bars
1	1	2.5 bars

P080a = 1: Sum Ref. If both digital inputs configured as Multireference are inactive, the overall reference is given from AIN1 analog input selected as the first PID reference (**C285**). For the combinations where at least one of the digital inputs configured as multireference is active, the resulting reference is the sum of the value for AIN1 plus the value for the selected multireference.

P080a	Multireference Function = 1: Sum Ref.	
MDI8	MDI7	Overall reference
0	0	4.3 bars
0	1	5.3 bars
1	0	5.8 bars
1	1	6.8 bars

P80a= 2: Exclusive Preset Ref. If no Multireference is activated, the overall reference is null.

P080a	**Multireference Function = 2: Exclusive Preset Ref.**	
MDI8	**MDI7**	**Overall Reference**
0	**0**	**0.0 bars**
0	**1**	**1.0 bars**
1	**0**	**1.5 bars**
1	**1**	**2.5 bars**

18.2. List of Parameters P080a to P099a

Table 30: List of Parameters P080a to P099a

Parameter	FUNCTION	User level	DEFAULT VALUE	MODBUS Address
P080a	PID Multireference function	ENGINEERING	0	948
P081a	PID Multireference 1 (Mref1)	ENGINEERING	0	949
P082a	PID Multireference 2 (Mref2)	ENGINEERING	0	953
P083a	PID Multireference 3 (Mref3)	ENGINEERING	0	954
P084a	PID Multireference 4 (Mref4)	ENGINEERING	0	957
P085a	PID Multireference 5 (Mref5)	ENGINEERING	0	958
P086a	PID Multireference 6 (Mref6)	ENGINEERING	0	959
P087a	PID Multireference 7 (Mref7)	ENGINEERING	0	963
P099a	PID Reference in Fire Mode	ENGINEERING	50%	964

P080a	**Multireference**	
Range	0 ÷ 2	0: Preset Ref 1: Sum Ref 2: Exclusive Preset Ref.
Default	0	0: [Preset Ref]
Level	ENGINEERING	
Address	948	
Function	This parameter sets if the PID reference resulting from the selection of a digital multireference is to be considered either as the unique active reference or as summed up to the other configured PID reference sources (see example above).	

P081a÷P087a	**Multireference 1 to 7 PID**	
Range	–1000 ÷ +1000	±1000
Default	0	0
Level	ENGINEERING	
Address	949, 953÷954, 957÷959, 963	
Function	This is the value of the PID reference selected with the corresponding combination of the digital inputs programmed as multireferences. The reference is expressed in the unit of measurement set with **P267** (see the [PAR] DISPLAY/KEYPAD MENU) and is based on parameter **P257** (Gain for PID Scaling). Example: The max. value for the PID feedback is 100%. This value corresponds to a level of 25m in a tank. When **P257** = 0.25, 100% of PID feedback corresponds to 25 metres. When setting a reference level of 15 meters, multireference 1 shall be set as **P081a** = 15.0 m.	

P099a	PID Reference in Fire Mode	
Range	–1000 ÷ 1000	±1000
Default	500	50.0 %
Level	ENGINEERING	
Address	964	
Function	This parameter sets the value of the PID reference when in Fire Mode. The value of the PID reference depends on the scale factor set in **P257**.	

19. [PAR] PROHIBIT SPEED MENU

19.1.Overview

This menu allows setting prohibit speed ranges that the motor cannot maintain at constant rpm due to mechanical resonance.
Three prohibit speed ranges are available: 3 intermediate values of the speed range and their semi-amplitude (one for all ranges).
In this way, the speed reference value is never included in one of the preset speed ranges; when decreasing, if the speed reference matches with the max. allowable value of a prohibit speed range, the value assigned to the reference is given by the min. allowable value of the speed range, and vice versa when the reference is increasing.
The discontinuity of the speed reference has no effect on the actual speed of the connected motor, because this will vary with continuity until it reaches the new rpm value of the speed reference.
The intermediate values of the prohibit speed ranges are to be intended as absolute values (independent of the reference sign, +/-).

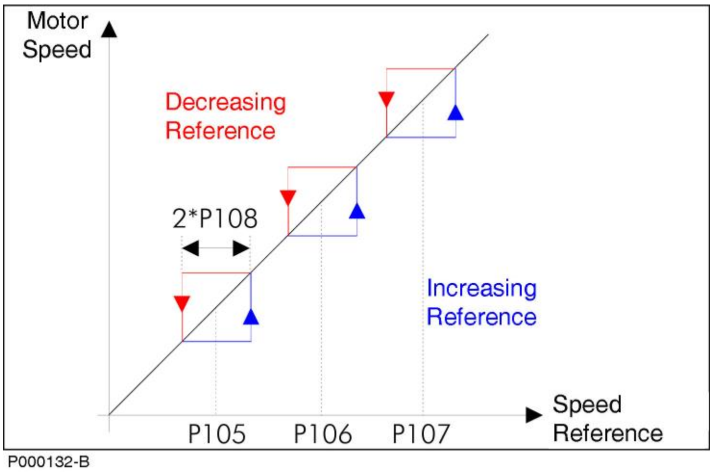


Figure 8: Prohibit speed ranges

Figure 8 illustrates different trends of the speed reference when it matches with the max. allowable value of a prohibit speed range when decreasing (red) or when it matches with the min. allowable value of a prohibit speed range when increasing (blue).

Example:

P105	=	500	rpm	Prohibit speed 1
P106	=	650	rpm	Prohibit speed 2
P107	=	700	rpm	Prohibit speed 3
P108	=	50	rpm	Semi-amplitude of prohibit speed ranges

Range Number	Min. Allowable Value	Max. Allowable Value
1	450 rpm	550 rpm
2	600 rpm	700 rpm
3	650 rpm	750 rpm

In this case, the second and third prohibit ranges partially match, because the max. allowable value of the second range (700 rpm) is higher than the min. allowable value of the third range (650 rpm), thus forming a prohibit speed range ranging from 600 rpm to 750 rpm.

19.2. List of Parameters P105 to P108

Table 31: List of Parameters P105 to P108

Parameter	FUNCTION	User Level	DEFAULT VALUE	MODBUS Address
P105	Prohibit speed 1	ADVANCED	0 rpm	705
P106	Prohibit speed 2	ADVANCED	0 rpm	706
P107	Prohibit speed 3	ADVANCED	0 rpm	707
P108	Hysteresis (band) of prohibit speed ranges	ADVANCED	0 rpm	708

P105, P106, P107	Prohibit Speed 1, (2, 3)	
Range	0 ÷ 32000	0 ÷ 32000 rpm
Default	0	0 rpm
Level	ADVANCED	
Address	705 706 707	
Function	Determines the intermediate value of the first prohibit speed range. This value is to be considered as an absolute value, i.e. independent of the speed reference sign (+/-).	

P108	Hysteresis (Band) of Prohibit Speed Ranges	
Range	0 ÷ 5000	0 ÷ 5000 rpm
Default	0	0 rpm
Level	ADVANCED	
Address	708	
Function	Sets the semi-amplitude of the prohibit speed ranges.	

20. [PAR] SPEED LOOP AND CURRENT BALANCING MENU

20.1. Overview

The [PAR] SPEED LOOP AND CURRENT BALANCING MENU for VTC control, allows setting the parameter values of the speed regulators for the three connected motors and to manually adjust the motor current balancing (see parameter **P152**).
The speed regulator for each motor has two parameterization functions: two integral terms, two proportional terms and two speed error thresholds (expressed as a percentage of the motor rated speed).
The response of the speed regulator can be dynamically linked with the speed error; in this way, the speed regulator will be more sensitive to remarkable speed errors and less sensitive to negligible speed errors.
Factory setting: because two identical error thresholds are set, only two parameters are used: **P126** (maximum integral time) and **P128** (minimum proportional constant).
The setup of min. integral time and max. proportional constant is enabled provided that two different error thresholds are used.

P125	100	[ms]	Minimum integral time for maximum error
P126	500	[ms]	Integral time for minimum error
P128	10.00		Proportional constant for minimum error
P129	25.00		Proportional constant for maximum error
P130	2	[%]	Minimum error threshold
P131	20	[%]	Maximum error threshold

<u>Error ≤ **P130**</u>
For speed errors lower than or equal to 2% of the motor rated speed, the speed regulator adopts parameters **P126** and **P128**.

<u>Error ≥ **P131**</u>
If the speed error exceeds the second error threshold, the speed regulator adopts parameters **P125** and **P129**.

<u>**P130**<Error<**P131**</u>
When the speed error is included between the two error thresholds, the speed regulator will use coefficients that are dynamically linked with the speed error (see figure below).

Integral coefficient = (1/**P126**) + [(err%–**P130**)* (1/**P125** – 1/**P126**) / (**P131** – **P130**)]
Proportional coefficient = **P128** + [(err%–**P130**)* (**P129** – **P128**) / (**P131** – **P130**)]

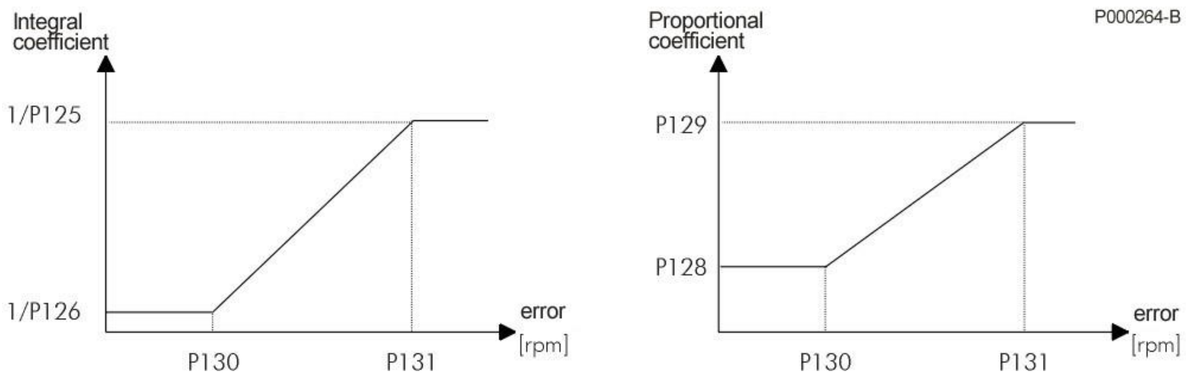


Figure 9: Dual Parameterization function (example)

20.2.List of Parameters P125 to P153

Table 32: List of Parameters P125 to P153

Parameter	FUNCTION	User Level	Default Values	MODBUS Address
P125	Integral time for maximum error	BASIC	500 ms	725
P126	Integral time for minimum error	BASIC	500 ms	726
P128	Prop. coefficient for minimum error	BASIC	10.00	728
P129	Prop. coefficient for maximum error	BASIC	10.00	729
P130	Minimum error threshold	BASIC	1.00%	730
P131	Maximum error threshold	BASIC	1.00%	731
P152	Symmetry regulation of three-phase current	ENGINEERING	0 %	752
P153	VTC Speed Error Filter Time Constant	ENGINEERING	10 ms	753

P125	**Integral Time for Maximum Error**	
Range	1÷ 32000	1÷ 32000 [Disable] ms
Default	500	500 ms
Level	BASIC	
Address	725	
Control	VTC	
Function	This parameter sets the min. integral time for the speed regulator. It may be accessed only if the min. and max. error thresholds are different (**P130≠P131**).	

P126	**Integral Time for Minimum Error**	
Range	1÷ 32000	1÷ 32000 [Disable] ms
Default	500	500 ms
Level	BASIC	
Address	726	
Control	VTC	
Function	This parameter sets the max. integral time for the speed regulator, applied when the error is lower than the minimum threshold. If the minimum and maximum error thresholds are exactly the same (**P130**=**P131**), this is the integral time of the speed regulator.	

P128	Proportional Coefficient for Minimum Error	
Range	0 ÷ 65000	0.00 ÷ 650.00
Default	1000	10.00
Level	BASIC	
Address	728	
Control	VTC	
Function	This parameter sets the proportional coefficient of the speed regulator applied when the error is lower than the minimum threshold. If the minimum and maximum error thresholds are exactly the same (**P130**=**P131**), this is the proportional coefficient of the speed regulator. Default value (10): if a speed error of 1% occurs, the regulator will require 10% of the motor rated torque.	

P129	Proportional Coefficient for Maximum Error	
Range	0 ÷ 65000	0.00 ÷ 650.00
Default	1000	10.00
Level	BASIC	
Address	729	
Control	VTC	
Function	This parameter sets the max. proportional coefficient for the speed regulator. Default value (10): if a speed error of 1% occurs, the regulator will require 10% of the motor rated torque. This parameter may be accessed only if the min. and max. error thresholds are different (**P130**≠**P131**).	

P130	Minimum Error Threshold	
Range	0 ÷ 32000	0.00 ÷ 320.00 %
Default	100	1.00%
Level	BASIC	
Address	730	
Control	VTC	
Function	This parameter determines the minimum error threshold expressed as a percentage of the rated motor speed. If **P130** = **P131** or for error thresholds lower than or equal to the minimum threshold, the regulator uses parameters **P126** and **P128**.	

P131	Maximum Error Threshold	
Range	0 ÷ 32000	0.00 ÷ 320.00 %
Default	100	1.00%
Level	BASIC	
Address	731	
Control	VTC	
Function	This parameter determines the maximum error threshold expressed as a percentage of the rated motor speed. For error thresholds lower than or equal to the minimum threshold, the regulator uses parameters **P125** and **P129**.	

P152	Symmetry Regulation of Three-phase Current	
Range	±100	±100%
Default	0	0%
Level	ENGINEERING	
Address	752	
Function	This parameter affects three-phase current balancing. It must be used when dissymmetry of the motor currents occurs, especially when no-load currents are delivered and the motor rotates at low rpm.	

P153	Speed Error Filter Time Constant	
Range	0 ÷ 32000	0 ÷ 32000 ms
Default	10	10 ms
Level	ENGINEERING	
Address	753	
Control	VTC	
Function	Input speed error filter time constant, in speed loop of VTC control.	

21. [PAR] VTC – VECTOR TORQUE CONTROL MENU

21.1. Overview

NOTE A comprehensive review of the [CFG] MOTOR CONFIGURATION MENU and FIRST STARTUP sections is recommended.

NOTE This menu may be accessed only if the VTC Control is set up (**C010**=1).

The sensorless VTC control algorithm is based on the field oriented control criterion, but instead of using the speed value read from the encoder, it exploits an estimated value of that speed value. Estimation is made possible via a dedicated status observer.
Two PI current regulators are available.
The first regulator adjusts the **torque current (Iq)**, whilst the second regulator adjusts the **flux current (Id)**.
Torque current Iq is computed based on the torque setpoint required.
In **Slave Mode** (torque reference), the torque setpoint is required by the external reference; in **Master Mode**, the set–point is given by the **speed regulator** (see [PAR] SPEED LOOP AND CURRENT BALANCING MENU) that adjusts the motor speed of rotation.
Flux current Id is given by the output of the **flux regulator**, that keeps the motor fluxing correct.
This menu includes the parameters of the current PI regulator and flux PI regulator for the VTC Control.

21.2. List of Parameters P175h to P175w

Table 33: List of Parameters P175h to P175w

Parameter	FUNCTION	User Level	DEFAULT VALUE	MODBUS Address
P175h	Low-Frequency Flux Increment Percentage	ENGINEERING	0.0 %	1259
P175i	Minimum Frequency for Motor Flux Increment	ENGINEERING	10.0 %	1268
P175j	Maximum Frequency for Motor Flux Increment	ENGINEERING	30.0 %	1271
P175t	Proportional Gain of Current Controller	ENGINEERING	500.0	1242
P175u	Integral Time of Current Controller	ENGINEERING	50 ms	1243
P175a	Current Distortion Threshold	ENGINEERING	5.00%	831
P175b	Current Distortion Compensation	ENGINEERING	80.00%	833
P175c	Current Distortion Compensation Allocation	ENGINEERING	50.00%	834
P175k	Extra-flux Percentage	ENGINEERING	110.0 %	727
P175l	Minimum Flux Percentage	ENGINEERING	10.0 %	616
P175o	Time Constant for Flux Reference Filter	ENGINEERING	300 ms	613
P175p	Field Weakening Time Constant	ENGINEERING	250 ms	644
P175w	Type of Control at Stop with Start Open	ENGINEERING	Speed	612

P175h	**Low-Frequency Flux Increment Percentage**	
Range	0 ÷ 1000	0.0 ÷ 100.0 %
Default	0	0.0 %
Level	ENGINEERING	
Address	1259	
Control	VTC	
Function	Percentage of the flux increment at low frequency. Indicates the increment percentage of the motor flux, in respect of its nominal value, adopted up to the frequency value displayed in **P175i**. The flux increment is dropped to 0 linearly with the frequency (flux equal to the nominal value) at the frequency value displayed in **P175j**.	

P175i	Minimum Frequency for Motor Flux Increment	
Range	0 ÷ 1000	0.0 ÷ 100.0 %
Default	250	25.0 %
Level	ENGINEERING	
Address	1268	
Control	VTC	
Function	Minimum frequency of the interpolation for the flux increment at low frequency. Indicates the frequency up to which a flux increment equal to the value set in parameter **P175h** is adopted. See the description for **P175h**.	

P175j	Maximum Frequency for Motor Flux Increment	
Range	0 ÷ 1000	0.0 ÷ 100.0 %
Default	500	50.0 %
Level	ENGINEERING	
Address	1271	
Control	VTC	
Function	Maximum frequency of the interpolation for the flux increment at low frequency. Indicates the frequency up to which a flux increment equal to the value set in parameter **P175h** is adopted. See the description for **P175j**.	

P175t	Proportional Gain of Current Controller	
Range	0 ÷ 32000	0.000 ÷ 3200.0
Default	5000	500.0
Level	ENGINEERING	
Address	1242	
Control	VTC	
Function	Proportional gain of the torque and flux current control (d and q axis).	

P175u	Integral Time of Current Controller	
Range	1 ÷ 32000	1 ÷ 32000 ms [Disabled]
Default	50	50 ms
Level	ENGINEERING	
Address	1243	
Control	VTC	
Function	Integral time constant of the torque and flux current control (d and q axis).	

NOTE Parameters **P175t**, **P175u** are automatically computed and saved by performing the autotune procedure **I074 = 1: Control NO rot]** or **I074= [2: Control YES rot]** if the active control is VTC.

P175a	**Current Distortion Threshold**	
Range	1 ÷ 10000	0.01 ÷ 100.00 %
Default	500	5.00 %
Level	ENGINEERING	
Address	831	
Control	VTC	
Function	Current threshold for the compensation of positive and negative current distortion. The positive current compensation equal to **P175b** x **P175c** is applied to positive current values exceeding the rated drive current multiplied by the threshold set in **P175a**. The negative current compensation **P175b** x (100% - **P175c)** is applied to negative current values having absolute values greater than the rated drive current multiplied by **P175a**. When lower currents than the threshold currents are applied, compensation is obtained via linear pattern. Null current means null compensation. For tuning criteria, please refer to the FIRST STARTUP section.	

P175b	**Current Distortion Compensation**	
Range	-30000 ÷ 30000	-300.00 ÷ 300.00 %
Default	8000	80.00 %
Level	ENGINEERING	
Address	833	
Control	VTC	
Function	Compensation to suppress current distortion due to dead times. That compensation activates when the positive current is greater than **P175a** (with respect to the rated drive current). See parameter **P175a** for a detailed description. For tuning criteria, please refer to the FIRST STARTUP section.	

P175c	**Current Distortion Compensation Allocation**	
Range	0 ÷ 10000	0 ÷ 100.00 %
Default	5000	50.00 %
Level	ENGINEERING	
Address	834	
Control	VTC	
Function	Allocation of the compensation to suppress current distortion due to dead times between positive and negative current. See parameter **P175a** for a detailed description. For tuning criteria, please refer to the FIRST STARTUP section.	

P175k	**Extra Flux Percentage**	
Range	1000 ÷ 1500	100.0 ÷ 150.0 %
Default	1100	110.0 %
Level	ENGINEERING	
Address	727	
Control	VTC	
Function	Extra-flux percentage, with respect to the nominal flux, used when decelerating to increase the motor resistor losses and to dissipate the incoming energy produced by the motor in order to limit the DC bus voltage.	

P175l	Minimum Flux Percentage	
Range	0 ÷ 1000	0 ÷ 1000
Default	100	100
Level	ENGINEERING	
Address	616	
Control	VTC	
Function	Minimum reference flux expressed as a percentage with respect of the nominal flux.	

P175o	Time Constant for Flux Reference Filter	
Range	1 ÷ 32000	1 ÷ 32000 ms
Default	300	300 ms
Level	ENGINEERING	
Address	613	
Control	VTC	
Function	Time constant of the filter adopted in the fluxing rate limiter.	

P175p	Field Weakening Time Constant	
Range	1 ÷ 32000	1 ÷ 32000 ms
Default	250	250 ms
Level	ENGINEERING	
Address	644	
Control	VTC	
Function	Time constant for setting field weakening dynamics.	

P175w	Type of Control at Stop with START Open	
Range	0 ÷ 1	0: Speed 1: Fluxing
Default	0	0: Speed
Level	ENGINEERING	
Address	612	
Control	VTC	
Function	Selects the type of control when the motor is stopped and the START input is open. It this parameter is worth 1: [Fluxing], when the START input is open and the motor is stopped, only the flux control is active, while the speed control is disabled. The excitation frequency of the motor is null (DC current injection). If load torque is applied, the motor may rotate at slip frequency. If 0:[Speed], both the speed control and the flux control are enabled, with zero speed reference.	

22. [PAR] ANALOG AND FREQUENCY OUTPUTS MENU

22.1. Overview

NOTE Please refer to the IRIS BLUE – Installation Guide for the hardware description of the analog output and the frequency output or for the configuration of the dip-switches for voltage/current outputs.

NOTE MDO1 digital output is used when the frequency output is enabled (**P200** other than Disabled). Any configuration set in the [PAR] DIGITAL OUTPUTS MENU will have no effect.

The IRIS BLUE drive allows configuring three programmable analog outputs as voltage outputs or current outputs, as well as one frequency output.

22.1.1. Factory-setting of the Analog Outputs

Analog outputs are factory set to voltage values ranging from ± 10V and the following variables are selected:

TERMINAL	OUTPUT	SELECTED VARIABLE	OUTPUT RANGE	MIN VALUE	MAX VALUE
10	AO1	Speed (speed of the connected motor)	±10V	–1500	1500
11	AO2	Speed Ref. (speed reference at constant rpm)	±10V	–1500	1500
12	AO3	Current of the connected motor	±10V	0	Imax *

* Depending on the inverter size.

22.1.2. Analog Outputs

As per the analog outputs, the [PAR] ANALOG AND FREQUENCY OUTPUTS MENU allows selecting the variable to be represented, its range, its acquisition mode (± or as an absolute value), the type of analog output (voltage/current) and the output values corresponding to the min. value and the max. value of the selected variable. An offset value and a filtering function may also be applied to the analog outputs. For the frequency output, this menu contains the parameters for the selection of the represented variable, its acquisition mode (± or as an absolute value), its min. value and max. value and the corresponding output frequency value, and a filtering function. The figure below shows the typical structure of the analog outputs; in particular, AO1 analog output and its parameter set are illustrated.

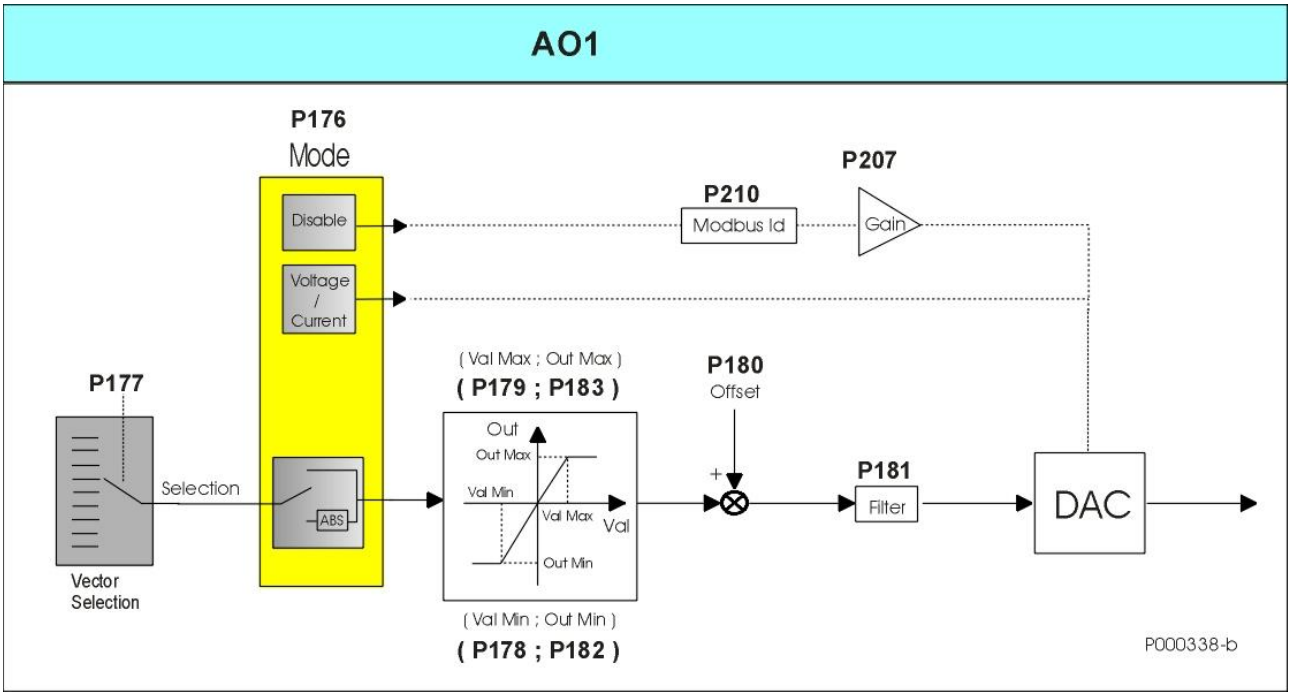


Figure 10: Typical structure of the Analog Outputs

- **Vector Selection** Selects the variable to be represented through the digital analog converter (DAC). **P177** is the selection parameter for AO1 analog output and **P185** and **P193** for AO2 and AO3 respectively.

- **Mode** Sets the acquisition mode of the selected variable (± or as an absolute value) and the type (voltage/current) for the analog output. If Mode = **Disable**, a different operating mode is activated for the analog output for which the represented variable is determined by the MODBUS address set in Address and the gain value set in Gain is applied:
P176 (Mode), **P207** (Gain), **P210** (Address) for AO1;
P184 (Mode), **P208** (Gain), **P211** (Address) for AO2;
P192 (Mode), **P209** (Gain), **P212** (Address) for AO3.

- **(Val Min; Out Min)** Defines the minimum saturation value of the variable to be represented and the corresponding value to be assigned to the analog output. For values equal to or lower than Val Min, Out Min will be assigned to the selected analog output. For analog outputs AO1, AO2, and AO3, the following parameters will be used: **(P178; P182)**, **(P186; P190)** and **(P194; P198)** for values **(Val Min; Out Min).**

- **(Val Max; Out Max)** Defines the maximum saturation value of the variable to be represented and the corresponding value to be assigned to the analog output. For values equal to or higher than Val Max, Out Max will be assigned to the selected analog output. For analog outputs AO1, AO2, and AO3, the following parameters will be used: **(P179; P183)**, **(P187; P191)** and **(P195; P199)** for values **(Val Max; Out Max).**

- **Offset** Defines the offset value applied to the analog output. Offset is set in parameter **P180** for AO1 analog output, in parameters **P188**, **P196** for AO2 and AO3 respectively.

- **Filter** Defines the filter time constant applied to the analog output. The filter time constant is set in parameter **P181** for AO1 analog output, in parameters **P189**, **P197** for AO2 and AO3 respectively.

22.1.3. FREQUENCY OUTPUT

When programming the frequency output, the setting of MDO1 in the [PAR] DIGITAL OUTPUTS MENU **is disabled**.
The figure below illustrates the structure of the frequency output. Parameterization is similar to the one used for the analog outputs.

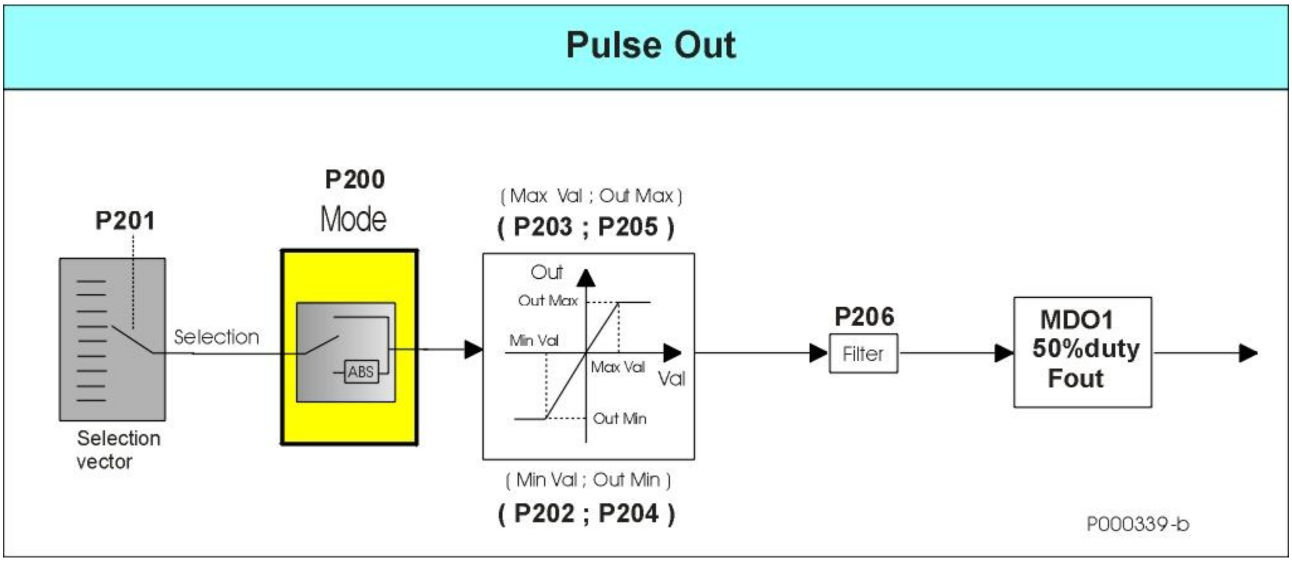


Figure 11: Structure of the Frequency Output

22.2. Variables

This section covers the variables that can be represented for the analog and frequency outputs.

Table 34: Selectable variables for the Analog and Frequency Outputs

SELECTION CODE		
Selection Value	**Full-scale Value**	**Description**
0: Ground		Analog 0 Volts
1: Speed	10000 rpm	Motor Speed
2: Speed Ref.	10000 rpm	Speed reference at constant speed
3: Ramp Out	10000 rpm	"Ramped" speed reference
4: Mot. Freq.	1000.0 Hz	Frequency produced by the drive
5: Mot. Curr.	5000.0 A	Current RMS
6: Out Volt	2000.0 V	Output voltage RMS
7: OutPower	5000.0 kW	Output power
8: DC Vbus	2000.0 V	DC-link voltage
10: Torq.Dem	10000 Nm	Demanded torque (Nm)
11: Torq.Out %	10000 %	Evaluation of the torque output
13: PID Ref %	100.00 %	Setpoint of the torque limit
14: PID RMP %	100.00 %	PID reference at constant speed
15: PID Err %	100.00 %	"Ramped" PID reference
16: PID Fbk %	100.00 %	Error between PID reference and feedback
17: PID Out %	100.00 %	Feedback to the PID
18: REF	100.00 %	Output of the PID
19: AIN1	100.00 %	Analog input REF
20: AIN2/PTC	100.00 %	Analog input AIN1
23: Flux Ref	1.0000 Wb	Flux reference at constant speed
24: Flux	1.0000 Wb	Current flux reference
25: iq ref.	5000.0 A	Current reference in axis q
26: id ref.	5000.0 A	Current reference in axis d
27: iq	5000.0 A	Current measurement in axis q
28: id	5000.0 A	Current measurement in axis d
29: Volt.Vq	2000.0 V	Voltage in axis q
30: Volt Vd	2000.0 V	Voltage in axis d
31: Cosine	100.00%	Cosine waveform
32: Sine	100.00%	Sine waveform
33: Angle	1.0000 rad	Electric angle of delivered Vu
34: +10V	10.000 V	Voltage level +10V
35: –10V	10.000 V	Voltage level –10V
36: Flux Current	5000.0 A	Flux Current
37: Square Wave	100.00 %	Square wave
38: Saw Wave	100.00 %	Saw wave
39: Heatsink Temp.	100.00 °C	Heatsink temperature
40: Ambient Temp.	100.00 °C	Ambient temperature
41: -10V	10.000 V	Voltage level -10V
42: -7.5V	10.000 V	Voltage level -7.5V
43: -5V	10.000 V	Voltage level -5V
44: -2.5V	10.000 V	Voltage level -2.5V
45: +2.5V	10.000 V	Voltage level +2.5V
46: +5V	10.000 V	Voltage level +5V
47: +7.5V	10.000 V	Voltage level 7.5V
48: +10V	10.000 V	Voltage level +10V
49: RESERVED		RESERVED
50: PT100_1	100.00 %	PT100 Channel 1
51: PT100_2	100.00 %	PT100 Channel 2
52: PT100_3	100.00 %	PT100 Channel 3
53: PT100_4	100.00 %	PT100 Channel 4
54: I2t%	100.00 %	Motor thermal capacity
55: XAIN4	100.00 %	XAIN4 Analog input
56: XAIN5	100.00 %	XAIN5 Analog input
57: OT Count	100000 h	Maintenance Operation Time Counter
58: ST Count	100000 h	Maintenance Supply Time Counter
59: PID2 Reference	100.00 %	Reference at constant speed of PID2

SELECTION CODE		
Selection Value	**Full-scale Value**	**Description**
60: PID2 Setpoint	100.00 %	“Ramped” reference of PID2
61: PID2 Feedback	100.00 %	PID2 Feedback
62: PID2 Error	100.00 %	Error between reference and feedback of PID2
63: PID2 Out	100.00 %	Output of PID2
64: Torque Demand %	100.00 %	Torque demand (value percent)
65: Actual Current Iv	5000 A	Output Current Iv
66: RESERVED		RESERVED
67: RESERVED		RESERVED
68: RESERVED		RESERVED
69: RESERVED		RESERVED

Table 34 provides a brief description of each variable and its full-scale value used to set the minimum and maximum value.

22.2.1. Operating Mode of Analog and Frequency Outputs

This section covers the different representation modes to be selected for the analog and frequency outputs.

The following modes can be used for **Analog Outputs**:

Value	Meaning	Description of Analog Outputs
0	**Disabled**	Disabled analog output (enables a RESERVED operating mode).
1	**± 10V**	The analog output is set as a voltage output and the possible min. and max. output values range from +/ – 10V. The selected variable has a positive or negative sign.
2	**0÷10V**	The analog output is set as a voltage output and the possible min. and max. output values range from 0 to 10V. The selected variable has a positive or negative sign.
3	**0÷20mA**	The analog output is set as a current output and the possible min. and max. output values range from 0 to 20mA. The selected variable has a positive or negative sign.
4	**4÷20mA**	The analog output is set as a current output and the possible min. and max. output values range from 4 to 20mA. The selected variable has a positive or negative sign.
5	**ABS 0÷10V**	As 0÷10V output mode, but the selected variable is considered as an absolute value.
6	**ABS 0÷20mA**	As 0÷20mA output mode, but the selected variable is considered as an absolute value.
7	**ABS 4÷20mA**	As 4÷20mA output mode, but the selected variable is considered as an absolute value.

NOTE Always check the min. and max. values of the outputs programmed in the relevant parameters.

Three operating modes can be selected for the **Frequency Output**:

Value	Description	Description of Frequency Outputs
0	**Disabled**	The output frequency is disabled.
1	**Pulse Out**	MDO1 Digital Output is programmed as a frequency output. The selected variable has a positive or negative sign.
2	**ABS Pulse Out**	As *Pulse Out*, but the selected variable is considered as an absolute value.

NOTE When **P200** is not set to DISABLE, MDO1 digital output is used as a frequency output and any MDO1 settings in the [PAR] DIGITAL OUTPUTS MENU are ignored.

22.2.2. Analog Output Programming Examples

This section contains a description of operating examples of the analog outputs obtained with different programming modes.

Example 1:

Table 35: Programming AO1 (0 ÷ 10V)

Parameterization of AO1 Analog Output		
Parameter	**Value**	**Description**
P176	0÷10V	AO1 Analog output
P177	1: Speed	Selected variable for AO1 analog output
P178	–500 rpm	Min. value of AO1 selected variable
P179	+500 rpm	Max. value of AO1 selected variable
P180	0.000 V	AO1 Analog output offset
P181	0 ms	Filter for AO1 analog output
P182	0.0 V	Min. AO1 output value with reference to **P178**
P183	10.0 V	Max. AO1 output value with reference to **P179**

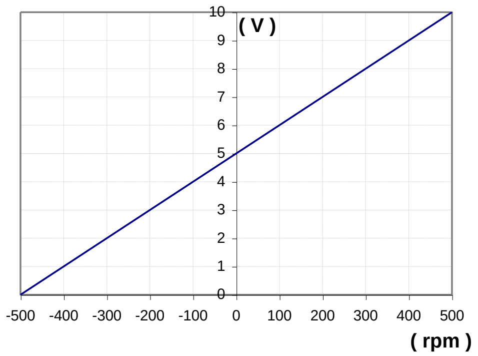


Figure 12: Curve (voltage; speed) implemented by AO1 (Example 1)

Example 2:

Table 36: Programming AO1 (ABS 0 ÷ 10V)

Parameterization of AO1 Analog Output		
Parameter	**Value**	**Description**
P176	ABS 0÷10V	AO1 Analog output
P177	1: Speed	Selected variable for AO1 analog output
P178	0 rpm	Min. value of AO1 selected variable
P179	+500 rpm	Max. value of AO1 selected variable
P180	0.000 V	AO1 Analog output offset
P181	0 ms	Filter for AO1 analog output
P182	0.0 V	Min. AO1 output value with reference to **P178**
P183	10.0 V	Max. AO1 output value with reference to **P179**

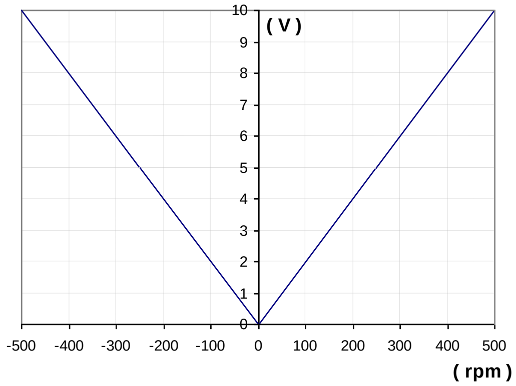


Figure 13: Curve (voltage; speed) implemented by AO1 (Example 2)

Example 3:

Table 37: Programming AO1 (ABS 0 ÷ 10V)

Parameterization of Analog Output AO1		
Parameter	**Value**	**Description**
P176	ABS 0÷10V	AO1 Analog output
P177	1: Speed	Selected variable for AO1 analog output
P178	–500 rpm	Min. value of AO1 selected variable
P179	+500 rpm	Max. value of AO1 selected variable
P180	0.000 V	AO1 Analog output offset
P181	0 ms	Filter for AO1 analog output
P182	0.0 V	Min. AO1 output value with reference to **P178**
P183	10.0 V	Max. AO1 output value with reference to **P179**

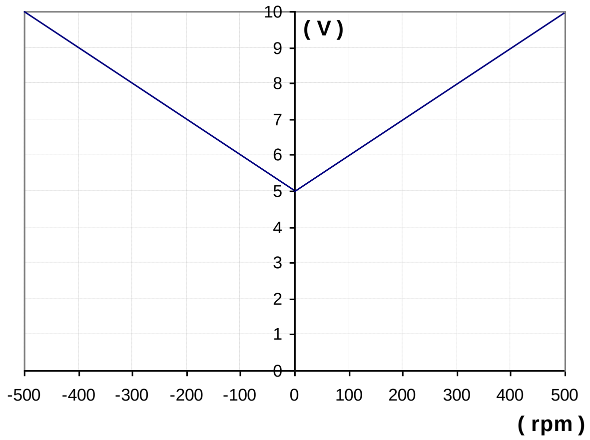


Figure 14: Curve (voltage; speed) implemented by AO1 (Example 3)

NOTE The programming mode above would imply a straight line passing through (–500rpm; 0V) and (+500rpm; 10V), but based on the selected mode and considering the variable as an absolute value, the min. point for output AO1 will be (0 rpm; 5 V).

Example 4:

Table 38: Programming AO1 (ABS 0 ÷ 10V)

Parameterization of Analog Output AO1		
Parameter	**Value**	**Description**
P176	ABS 0÷10V	AO1 Analog output
P177	1: Speed	Selected variable for AO1 analog output
P178	+100 rpm	Min. value of AO1 selected variable
P179	+500 rpm	Max. value of AO1 selected variable
P180	0.000 V	AO1 Analog output offset
P181	0 ms	Filter for AO1 analog output
P182	0.0 V	Min. AO1 output value with reference to **P178**
P183	10.0 V	Max. AO1 output value with reference to **P179**

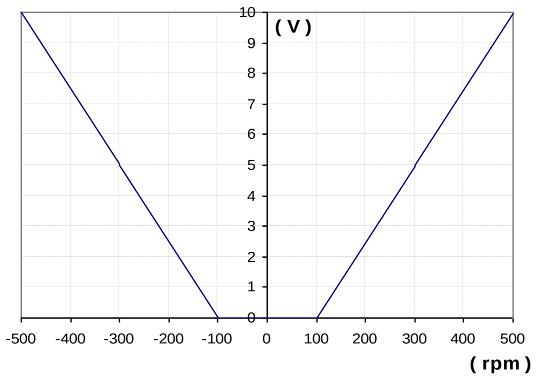


Figure 15: Curve (voltage; speed) implemented by AO1 (Example 4)

Example 5:

Table 39: Programming AO1 (± 10V)

Parameterization of Analog Output AO1		
Parameter	**Value**	**Description**
P176	±10V	AO1 Analog output
P177	1: Speed	Selected variable for AO1 analog output
P178	+500 rpm	Min. value of AO1 selected variable
P179	–500 rpm	Max. value of AO1 selected variable
P180	0.000 V	AO1 Analog output offset
P181	0 ms	Filter for AO1 analog output
P182	–10.0 V	Min. AO1 output value with reference to **P178**
P183	+10.0 V	Max. AO1 output value with reference to **P179**

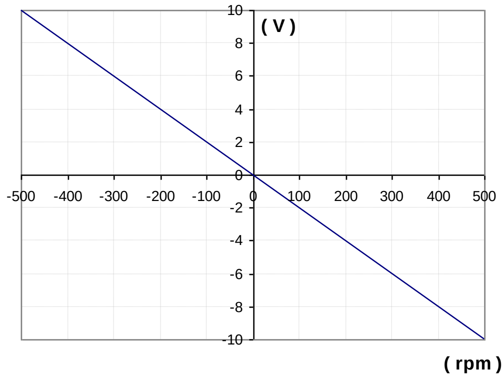


Figure 16: Curve (voltage; speed) implemented by AO1 (Example 5)

22.3. List of Parameters P176 to P214

Table 40: List of Parameters P176 to P214

Param.	Function	User Level	DEFAULT VALUES	Modbus Address
P176	AO1 Analog Output	ADVANCED	1: ± 10V	776
P177	Selected Variable for AO1 Analog Output	ADVANCED	1: Motor speed	777
P178	Min. Value of AO1 Selected Variable	ADVANCED	–1500 rpm	778
P179	Max. Value of AO1 Selected Variable	ADVANCED	+1500 rpm	779
P180	AO1 Analog Output Offset	ADVANCED	0.000 V	780
P181	Filter for AO1 Analog Output	ADVANCED	0 ms	781
P182	Min. AO1 Output Value with Reference to **P178**	ADVANCED	–10.0 V	782
P183	Max. AO1 Output Value with Reference to **P179**	ADVANCED	+10.0V	783
P184	AO2 Analog Output	ADVANCED	1: ± 10V	784
P185	Selected Variable for AO2 Analog Output	ADVANCED	2: Seed reference at constant rpm	785
P186	Min. Value of AO2 Selected Variable	ADVANCED	–1500 rpm	786
P187	Max. Value of AO2 Selected Variable	ADVANCED	+1500 rpm	787
P188	AO2 Analog Output Offset	ADVANCED	0.000 V	788
P189	Filter for AO2 Analog Output	ADVANCED	0 ms	789
P190	Min. AO2 Output Value with Reference to **P186**	ADVANCED	–10.0 V	790
P191	Max. AO2 Output Value with Reference to **P187**	ADVANCED	+10.0V	791
P192	AO3 Analog Output	ADVANCED	2: 0÷10V	792
P193	Selected Variable for AO3 Analog Output	ADVANCED	5: Output current	793
P194	Min. Value of AO3 Selected Variable	ADVANCED	0 A	794
P195	Max. Value of AO3 Selected Variable	ADVANCED	Inverter Imax	795
P196	AO3 Analog Output Offset	ADVANCED	0.000 V	796
P197	Filter For AO3 Analog Output	ADVANCED	0 ms	797
P198	Min. AO3 Output Value with Reference to **P194**	ADVANCED	0.0 V	798
P199	Max. AO3 Output Value with Reference to **P195**	ADVANCED	+10.0V	799
P200	FOUT Output In [MDO1] Frequency	ADVANCED	0: Disabled	800
P201	Selected Variable for FOUT Frequency Output	ADVANCED	1: Motor speed	801
P202	Min. FOUT Value of Selected Variable	ADVANCED	0	802
P203	Max. FOUT Value of Selected Variable	ADVANCED	0	803
P204	Min. FOUT Output Value with Reference to **P202**	ADVANCED	10.00 kHz	804
P205	Max. FOUT Output Value with Reference to **P203**	ADVANCED	100.00 kHz	805
P206	Filter for FOUT Frequency Output	ADVANCED	0 ms	806
P207	AO1: Gain	ADVANCED	RESERVED	807
P208	AO2: Gain	ADVANCED		808
P209	AO3: Gain	ADVANCED		809
P210	AO1: Variable MODBUS Address	ADVANCED		810
P211	AO2: Variable MODBUS Address	ADVANCED		811
P212	AO3: Variable MODBUS Address	ADVANCED		812
P213	Amplitude of Sinusoidal Analog Output Signal	ENGINEERING	100.0%	813
P214	Frequency of Sinusoidal Analog Output Signal	ENGINEERING	1.00 Hz	814

P176	AO1 Analog Output AO1	
Range	0 ÷ 7	0: Disabled, 1: ± 10V, 2: 0 ÷ 10V, 3: 0 ÷ 20mA, 4: 4 ÷ 20mA, 5: ABS 0 ÷ 10V, 6: ABS 0 ÷ 20mA, 7: ABS 4 ÷ 20mA
Default	1	1: ± 10V
Level	ADVANCED	
Address	776	
Function	Selects the operating mode of AO1 analog output.	

```
P176 Type of
Output Signal
AO1      SW2-1  -2
→    0-20mA  □   ■
```

In the example above, AO1 is set as a current input. Contact 1 of SW2 dip-switch is open, contact 2 is closed.

NOTE Analog outputs are set as voltage outputs by default. To set them as current outputs, see the DIP-switch configuration and follow the instructions displayed on the keypad, or refer to the IRIS BLUE – Installation Guide.

P177	Selected Variable for AO1 Analog Output	
Range	0 ÷ 69	See Table 34
Default	1	Motor speed
Level	ADVANCED	
Address	777	
Function	Selects the variable to be allocated to AO1 digital output.	

P178	Min. Value of AO1 Selected Variable	
Range	-32000 ÷ +32000 Depending on the value selected in **P177**	–320.00 % ÷ +320.00 % of the full-scale value See Table 34
Default	–1500	–15.00% of 10000 rpm = –1500 rpm
Level	ADVANCED	
Address	778	
Function	Minimum value of the variable selected via **P177,** corresponding to the min. output value of AO1 set in **P182**.	

P179	Min. Value of AO1 Selected Variable	
Range	-32000 ÷ +32000 Depending on the value selected in **P177**	- 320.00% ÷ + 320.00 % of the full-scale value See Table 34
Default	+1500	+15.00% of 10000 rpm = +1500 rpm
Level	ADVANCED	
Address	779	
Function	Maximum value of the variable selected via **P177**, corresponding to the max. output value of AO1 set in **P183**.	

P180	AO1 Analog Output Offset	
Range	–9999 ÷ +9999 Depending on the value selected in **P176**	–9.999 ÷ +9.999
Default	0	0.000 V
Level	ADVANCED	
Address	780	
Function	Offset value applied to AO1 analog output.	

P181	Filter for AO1 Analog Output	
Range	0 ÷ 65000	0.000 ÷ 65.000 sec
Default	0	0.000 sec
Level	ADVANCED	
Address	781	
Function	Value of the filter time constant applied to AO1 analog output.	

P182	Min. AO1 Output Value with Reference to P178	
Range	–100 ÷ +100 –200 ÷ +200 Depending on the value selected in **P176**	–10.0 ÷ +10.0 V –20.0 ÷ +20.0 mA
Default	–100	–10.0 V
Level	ADVANCED	
Address	782	
Function	Minimum output value obtained when the minimum value of the variable set in **P178** is implemented.	

P183	Max. AO2 Output Value with Reference to P179	
Range	–100 ÷ +100 –200 ÷ +200 Depending on the value selected in **P176**	–10.0 ÷ +10.0 V –20.0 ÷ +20.0 mA
Default	+100	+10.0 V
Level	ADVANCED	
Address	783	
Function	Maximum output value obtained when the maximum value of the variable set in **P179** is implemented.	

P184	AO2 Analog Output	
Range	0 ÷ 7	0: Disabled, 1: ± 10V, 2: 0 ÷ 10V, 3: 0 ÷ 20mA, 4: 4 ÷ 20mA, 5: ABS 0 ÷ 10V, 6: ABS 0 ÷ 20mA, 7: ABS 4 ÷ 20mA.
Default	1	1: ± 10V
Level	ADVANCED	
Address	784	
Function	Selects the operating mode of AO2 analog output.	

NOTE Analog outputs are set as voltage outputs by default. To set them as current outputs, see the DIP-switch configuration and follow the instructions displayed on the keypad, or refer to the IRIS BLUE – Installation Guide.

P185	Selected Variable for AO2 Analog Output	
Range	0 ÷ 69	See Table 34
Default	2	Reference at constant speed
Level	ADVANCED	
Address	785	
Function	Selects the variable to be allocated to AO2 digital output.	

P186	Min. Value for AO2 Selected Variable	
Range	–32000 ÷ +32000 Depends on the value selected in **P185**	–320.00 % ÷ +320.00 % of the full-scale value See Table 34
Default	–1500	–1500 rpm
Level	ADVANCED	
Address	786	
Function	Minimum value of the variable selected via **P185**, corresponding to the min. output value of AO2 set in **P190**.	

P187	Max. Value of AO2 Selected Variable	
Range	–32000 ÷ +32000 Depends on the value selected in **P185**	–320.00 % ÷ +320.00 % of the full-scale value See Table 34
Default	+1500	+1500 rpm
Level	ADVANCED	
Address	787	
Function	Maximum value of the variable selected via **P185**, corresponding to the max. output value of AO2 set in **P191**.	

P188	AO2 Analog Output Offset	
Range	–9999 ÷ +9999 Depends on the value selected in **P184**	-9.999 ÷ 9.999
Default	0	0.000 V
Level	ADVANCED	
Address	788	
Function	Offset value applied to AO2 analog output.	

P189	Filter for AO2 Analog Output	
Range	0 ÷ 65000	0.000÷65.000 sec.
Default	0	0.000 sec.
Level	ADVANCED	
Address	789	
Function	Value of the filter time constant applied to AO2 analog output.	

P190	Min. AO2 Output Value with Reference to P186	
Range	–100 ÷ +100 –200 ÷ +200 Depends on the value selected in **P184**	–10.0 ÷ +10.0 V –20.0 ÷ +20.0 mA
Default	–100	–10.0 V
Level	ADVANCED	
Address	790	
Function	Minimum output value obtained when the minimum value of the variable set in **P186** is implemented.	

P191	Max. AO2 Output Value with Reference to P187	
Range	-100 ÷ +100 –200 ÷ +200 Depends on the value selected in **P184**	–10.0 ÷ +10.0 V –20.0 ÷ +20.0 mA
Default	+100	+10.0 V
Level	ADVANCED	
Address	791	
Function	Maximum output value obtained when the maximum value of the variable set in **P187** is implemented.	

P192	AO3 Analog Output	
Range	0 ÷ 7	0: Disabled, 1: ± 10V, 2: 0 ÷ 10V, 3: 0 ÷ 20mA, 4: 4 ÷ 20mA, 5: ABS 0 ÷ 10V, 6: ABS 0 ÷ 20mA, 7: ABS 4 ÷ 20mA.
Default	2	2: 0 ÷ 10V
Level	ADVANCED	
Address	792	
Function	Selects the operating mode of AO3 analog output.	

NOTE Analog outputs are set as voltage outputs by default. To set them as current outputs, see the DIP-switch configuration and follow the instructions displayed on the keypad, or refer to the IRIS BLUE – Installation Guide.

P193	Selected variable for AO3 Analog Output	
Range	0 ÷ 69	See Table 34
Default	5	5: Motor current
Level	ADVANCED	
Address	793	
Function	Selects the variable to be allocated to AO3 analog output.	

P194	Min. Value of AO3 Selected Variable	
Range	–320.00 % ÷ +320.00 % of the full-scale value Depends on the value selected through **P193**	–320.00 % ÷ +320.00 % of the full-scale value See Table 34
Default	0	0 A
Level	ADVANCED	
Address	794	
Function	Minimum value of the variable selected via **P193**, corresponding to the min. output value of AO3 set in **P198**.	

P195	Max. Value of AO3 Selected Variable	
Range	–320.00 % ÷ +320.00 % Depends on the value selected through **P193**	–320.00 % ÷ +320.00 % of the full-scale value See Table 34
Default	Imax Inverter	Max. drive current depending on the drive size – see Table 77
Level	ADVANCED	
Address	795	
Function	Maximum value of the variable selected via **P193**, corresponding to the max. output value of AO3 set in **P199**.	

P196	AO3 Analog Output Offset	
Range	–9999 ÷ +9999 Depends on the value selected through **P192**	–9.999 ÷ +9.999
Default	0	0.000 V
Level	ADVANCED	
Address	796	
Function	Offset value applied to AO3 analog output.	

P197	Filter for AO3 Analog Output	
Range	0 ÷ 65000 sec.	0.000 ÷ 65.000 sec.
Default	0	0.000 sec.
Level	ADVANCED	
Address	797	
Function	Value of the filter time constant applied to AO3 analog output.	

P198	Min. AO3 Output Value with Reference to P194	
Range	–100 ÷ +100 –200 ÷ +200 Function according to the selection of **P192**	–10.0 ÷ +10.0 V –20.0 ÷ +20.0 mA
Default	0	00.0 V
Level	ADVANCED	
Address	798	
Function	Minimum output value obtained when the minimum value of the variable set in **P194** is implemented.	

P199	Max. AO3 Output Value with Reference to P195	
Range	–100 ÷ +100 –200 ÷ +200 Function according to selection of **P192**	–10.0 ÷ +10.0 V –20.0 ÷ +20.0 mA
Default	+100	+10.0 V
Level	ADVANCED	
Address	799	
Function	Maximum output value obtained when the maximum value of the variable set in **P195** is implemented.	

P200	FOUT Output in [MDO1] Frequency	
Range	0 ÷ 2	0: Disabled, 1: Pulse, 2: ABS Pulse
Default	0	0: Disabled
Level	ADVANCED	
Address	800	
Function	Selects the operating mode of FOUT frequency output.	

NOTE When **P200** is not set to DISABLE, MDO1 digital output is used as a frequency output and any settings for MDO1 in the [PAR] DIGITAL OUTPUTS MENU are ignored.

P201	Selected Variable for FOUT Frequency Output	
Range	0 ÷ 69	See Table 34
Default	1	Motor speed
Level	ADVANCED	
Address	801	
Function	Selects the variable to be allocated to FOUT frequency output.	

P202	Min. FOUT Value of Selected Variable	
Range	–32000 ÷ +32000 Depends on the value selected through **P201**	–320.00 % ÷ +320.00 % of the full-scale value See Table 34
Default	0	0
Level	ADVANCED	
Address	802	
Function	Minimum value of the selected variable.	

P203	Max. FOUT Value of Selected Variable	
Range	–32000 ÷ +32000 Depends on the value selected through **P201**	–320.00 % ÷ +320.00 % of the full-scale value See Table 34
Default	0	0
Level	ADVANCED	
Address	803	
Function	Maximum value of the selected variable.	

P204	Min. FOUT Output Value with Reference to P202	
Range	1000÷10000	10.00÷100.00 kHz
Default	1000	10.00 kHz
Level	ADVANCED	
Address	804	
Function	Minimum output value obtained when the minimum value of the variable set in **P202** is implemented**.**	

P205	Min. FOUT Output Value with Reference to P203	
Range	1000÷10000	10.00÷100.00 kHz
Default	10000	100.00 kHz
Level	ADVANCED	
Address	805	
Function	Maximum output value obtained when the maximum value of the variable set in **P203** is implemented.	

P206	Filter for FOUT Frequency Output	
Range	0 ÷ 65000	0.000 ÷ 65.000 sec
Default	0	0.000 sec
Level	ADVANCED	
Address	806	
Function	Value of the filter time constant applied to FOUT frequency output.	

P207 AO1: Gain **P208 AO2: Gain** **P209 AO3: Gain** **P210 AO1: Variable MODBUS Address** **P211 AO2: Variable MODBUS Address** **P212 AO3: Variable MODBUS Address**	**RESERVED**

P213	Amplitude of Sinusoidal Analog Output Signal	
Range	0 ÷ 1000	0 ÷ 100.0%
Default	1000	100.0%
Level	ENGINEERING	
Address	813	
Function	Amplitude of the sinusoidal analog output signal when Sine or Cosine variables are selected.	

P214	Frequency of Sinusoidal Analog Output Signal	
Range	0 ÷ 20000	0 ÷ 200.00Hz
Default	100	1.00Hz
Level	ENGINEERING	
Address	814	
Function	Frequency of the sinusoidal analog output signal when Sine or Cosine variables are selected.	

23. [PAR] TIMERS MENU

23.1.Overview

The Timers menu allows setting enable and disable delay times for digital inputs/outputs.

NOTE For the **ENABLE-A** and **ENABLE-B** digital inputs, no disable delay is allowed, because their logic status is utilized directly by the hardware activating IGBT switching; when no **ENABLE-A**, **ENABLE-B** command is sent, the output power stage is instantly deactivated.

NOTE The **ENABLE-A** and **ENABLE-B** inputs are allocated to the STO function. If this safety function is to be adopted, the control mode and the control circuit of these signals must be accomplished as per the Safe Torque Off Function – Application Manual**.**
That manual also includes a detailed validation procedure of the control configuration of the STO function to be executed upon first start-up and also periodically at yearly intervals.

NOTE The reset function for the alarms on the leading edges of MDI3 is not delayed.

NOTE Any auxiliary alarm set to the digital inputs is not delayed.

NOTE Five timers are available; the use can set an enabling/disable delay for each of them. The same timer may also be assigned to multiple digital inputs/outputs.

NOTE The ENABLE-SW function cannot be delayed.

Example 1:

The drive enable (**MDI1 START**) depends on a signal coming from a different source. An activation delay of 2 seconds and a deactivation delay of 5 seconds are needed. To do so, set two delay times for activation and deactivation for the same timer and assign it to **MDI1** (**START**) digital input. In the example below, timer 1 is used.

P216	2.0 sec	Activation delay T1
P217	5.0 sec	Deactivation delay T1
P226	0x0001	Timer assigned to **MDI1** (**START**)

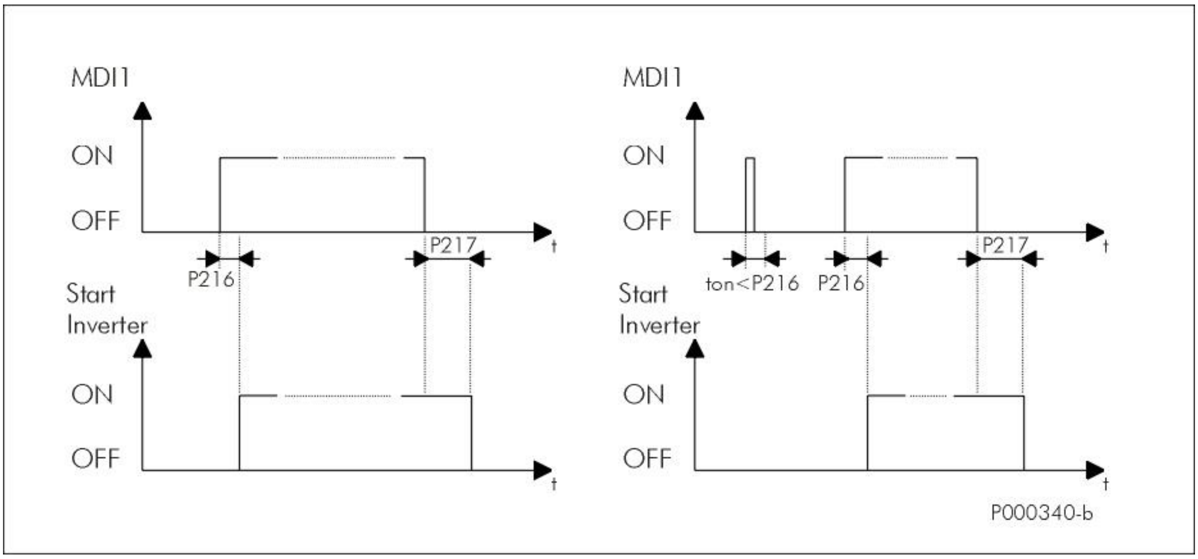


Figure 17: Using Timers (example)

The figure shows two possible operating modes:
- on the left: application of the delay times set for the drive enable/disable;
- on the right: the start signal persists for a shorter time than the delay set for enabling; in this case, the Start function is not enabled. The Start function will be enabled only when **MDI1** digital input is ON for a time longer than the time set in **P216**.

23.2.List of Parameters P216 to P229

Table 41: List of Parameters P216 to P229

Parameter	FUNCTION	User Level	DEFAULT VALUE	MODBUS Address
P216	T1 Enable delay	ENGINEERING	0.0 sec	816
P217	T1 Disable delay	ENGINEERING	0.0 sec	817
P218	T2 Enable delay	ENGINEERING	0.0 sec	818
P219	T2 Disable delay	ENGINEERING	0.0 sec	819
P220	T3 Enable delay	ENGINEERING	0.0 sec	820
P221	T3 Disable delay	ENGINEERING	0.0 sec	821
P222	T4 Enable delay	ENGINEERING	0.0 sec	822
P223	T4 Disable delay	ENGINEERING	0.0 sec	823
P224	T5 Enable delay	ENGINEERING	0.0 sec	824
P225	T5 Disable delay	ENGINEERING	0.0 sec	825
P226	Timer assigned to inputs MDI1÷4	ENGINEERING	0: no timer assigned	826
P227	Timer assigned to inputs MDI5÷8	ENGINEERING	0: no timer assigned	827
P228	Timer assigned to outputs MDO1÷4	ENGINEERING	0: no timer assigned	828
P229	Timer assigned to virtual outputs MPL1÷4	ENGINEERING	0: no timer assigned	829

P216	**T1 Enable Delay**	
Range	0 ÷ 60000	0.0 ÷ 6000.0 sec
Default	0	0.0 sec
Level	ENGINEERING	
Address	816	
Function	This parameter sets T1 enable time. Using **P226** or **P227**, if **timer T1** is assigned to a digital input having a particular function, P216 represents the delay occurring between the input closure and the function activation. Use **P228** to assign timer 1 to a digital output; in that case, the digital output energizing will be delayed according to the time set in **P216**.	

P217	**T1 Disable Delay**	
Range	0 ÷ 60000	0.0 ÷ 6000.0 sec
Default	0	0.0 sec
Level	ENGINEERING	
Address	817	
Function	This parameter sets T1 disabling time. Using **P226** or **P227**, if **timer T1** is assigned to a digital input having a particular function, this parameter represents the delay occurring between the input opening and the function deactivation. Use **P228** to assign timer 1 to a digital output; in that case, the digital output de-energizing will be delayed according to the time set in **P217**.	

P218	T2 Enable Delay	
Range	0 ÷ 60000	0.0 ÷ 6000.0 sec
Default	0	0.0 sec
Level	ENGINEERING	
Address	818	
Function	This parameter sets T2 enable time. (Operation as per **P216**.)	

P219	T2 Disable Delay	
Range	0 ÷ 60000	0.0 ÷ 6000.0 sec
Default	0	0.0 sec
Level	ENGINEERING	
Address	819	
Function	This parameter sets T2 disable time. (Operation as per **P217**.)	

P220	T3 Enable Delay	
Range	0 ÷ 60000	0.0 ÷ 6000.0 sec
Default	0	0.0 sec
Level	ENGINEERING	
Address	820	
Function	This parameter sets T3 enable time. (Operation as per **P216**.)	

P221	T3 Disable Delay	
Range	0 ÷ 60000	0.0 ÷ 6000.0 sec
Default	0	0.0
Level	ENGINEERING	
Address	821	
Function	This parameter sets T3 disable time. (Operation as per **P217**.)	

P222	T4 Enable Delay	
Range	0 ÷ 60000	0.0 ÷ 6000.0 sec
Default	0	0.0 sec
Level	ENGINEERING	
Address	822	
Function	This parameter sets T4 enable time. (Operation as per **P216**.)	

P223	T4 Disable Delay	
Range	0 ÷ 60000	0.0 ÷ 6000.0 sec
Default	0	0.0 sec
Level	ENGINEERING	
Address	823	
Function	This parameter sets T4 disable time. (Operation as per **P217**.)	

P224	T5 Enable Delay	
Range	0 ÷ 60000	0.0 ÷ 6000.0 sec
Default	0	0.0 sec
Level	ENGINEERING	
Address	824	
Function	This parameter sets T5 enable time. (Operation as per **P216**.)	

P225	T5 Disable Delay	
Range	0 ÷ 60000	0.0 ÷ 6000.0 sec
Default	0	0.0 sec
Level	ENGINEERING	
Address	825	
Function	This parameter sets T5 disable time. (Operation as per **P217**.)	

P226	Timers Assigned to Inputs MDI 1÷4	
Range	[0; 0; 0; 0] ÷ [5; 5; 5; 5]	0: No timer assigned 1 ÷ 5: T1 ÷ T5
Default	[0; 0; 0; 0]	0: No timer assigned
Level	ENGINEERING	
Address	826	
Function	The first group of four digital inputs may be assigned to any of the five timers and the same timer may be assigned to multiple inputs. Select “zero” to avoid delaying the digital inputs. Setting via serial link: see coding table below.	

Table 42: Coding of P226: Timers assigned to digital inputs MDI 1÷4

bit [15..12]	bit [11..9]	bit [8..6]	bit [5..3]	bit [2..0]
not used	MDI4	MDI3	MDI2	MDI1

Coding example for P226:
MDI1=Timer T2
MDI2=No timer assigned
MDI3=Timer T2
MDI4=Timer T5
⇒ value in **P226** 101 010 000 010 bin = 2690 dec

P227	Timers Assigned to Digital Inputs MDI 5÷8	
Range	[0; 0; 0; 0] ÷ [5; 5; 5; 5]	0: No timer assigned 1 ÷ 5: T1 ÷ T5
Default	[0; 0; 0; 0]	0: No timer assigned
Level	ENGINEERING	
Address	827	
Function	The second group of four digital inputs may be assigned to any of the five timers and the same timer may be assigned to multiple inputs. Select “zero” to avoid delaying the digital inputs. Setting via serial link: see coding in **P226**.	

P228	Timers Assigned to Digital Outputs MDO1÷4	
Range	[0; 0; 0; 0] ÷ [5; 5; 5; 5]	0: No timer assigned 1 ÷ 5: T1 ÷ T5
Default	[0; 0; 0; 0]	0: No timer assigned
Level	ENGINEERING	
Address	828	
Function	The digital outputs may be assigned to any of the five timers and the same timer may be assigned to multiple outputs. Select “zero” to avoid delaying the digital outputs. Setting via serial link: see coding in **P226**.	

P229	Timers Assigned to Virtual Outputs MPL 1÷4	
Range	[0; 0; 0; 0] ÷ [5; 5; 5; 5]	0: No timer assigned 1 ÷ 5: T1 ÷ T5
Default	[0; 0; 0; 0]	0: No timer assigned
Level	ENGINEERING	
Address	829	
Function	The virtual digital outputs may be assigned to any of the five timers and the same timer may be assigned to multiple outputs. Select “zero” to avoid delaying the virtual digital outputs. Setting via serial link: see coding in **P226**.	

24. [PAR] PID PARAMETERS MENU

24.1. Overview

This menu defines the parameters for the digital PID regulator integrated in the drive.
The PID regulator may be used to control a physical variable which is external to the drive; the variable measurement shall be available in the system and must be connected to the “feedback” input.

The PID regulator is used to keep the reference and the control variable constant (feedback); to do so, the PID regulator controls three internal variables, which are described below:

- ✓ Proportional term: this the variable detecting the instant difference between the reference and the measured value of the physical variable to be controlled (“error “);
- ✓ Integral term: this is the variable keeping track of the “history” of the detected errors (summation of all errors);
- ✓ Derivative term: this is the variable keeping track of the evolution of the error or the controlled variable (difference between two consecutive errors or between two consecutive values of the feedbacked variable);

The weighted summation of these terms represents the output signal of the PID regulator.
The weight of these three terms may be defined by the user with the parameters below.

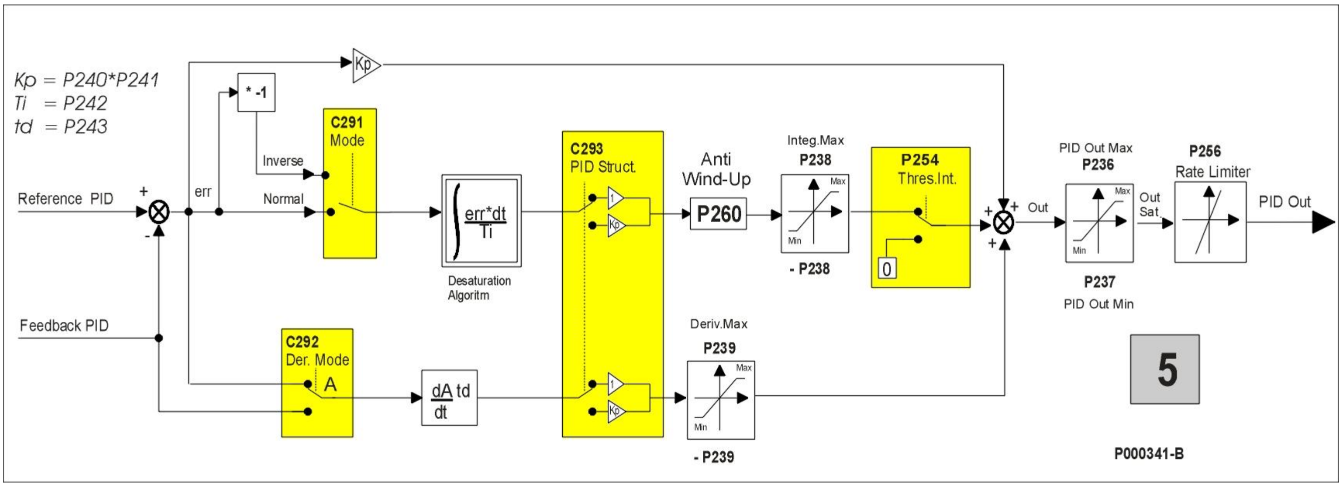


Figure 18: PID Block diagram

NOTE

In **LOCAL mode,** if the drive reference is the PID output **C294=Reference** and the Type parameter on the Keypad page in Local mode is **P266=Ref.Active+Spd**, the PID reference can be changed by activating the Local mode from the Keypad page. Press the **LOC/REM** key again when the drive is disabled (or the MDI LOC/REM key if it is programmed as a pushbutton: **C180a=Pushbutton**) to disable the PID and to set the speed reference directly from the Keypad page.

24.2. PID Regulator Tuning – Method of Ziegler and Nichols

Tuning a PID regulator consists in selecting and allocating values to PID parameters in order to adjust the operation of the system to the technical requirements of the process and to the equipment restrictions.
One of the possible PID tuning procedures is the ***Method of Ziegler and Nichols.***

This method implies the following steps:

1. Set the integral action and the derivative action to zero: Ti (**P242**) = 0, Td (**P243**) = 0.
2. Assign very low values to Kp (**P240**), then apply a little step to the reference signal (setpoint) selected with **C285**/**286**/**287.**
3. Gradually increase the value of Kp until **permanent oscillation** is attained in the PID loop.
4. Tune the parameters for a **P, PI** or **PID** regulator based on the table below—where Kp_c is the value of the proportional gain corresponding to the permanent oscillation (critical gain) and T_c is the period of the permanent oscillation:

	Kp (**P240**)	Ti (**P242**)	Td (**P243**)
P	0.5 Kp_c		
PI	0.45 Kp_c	T_c/1.2	
PID	0.6 Kp_c	T_c/2	T_c/8

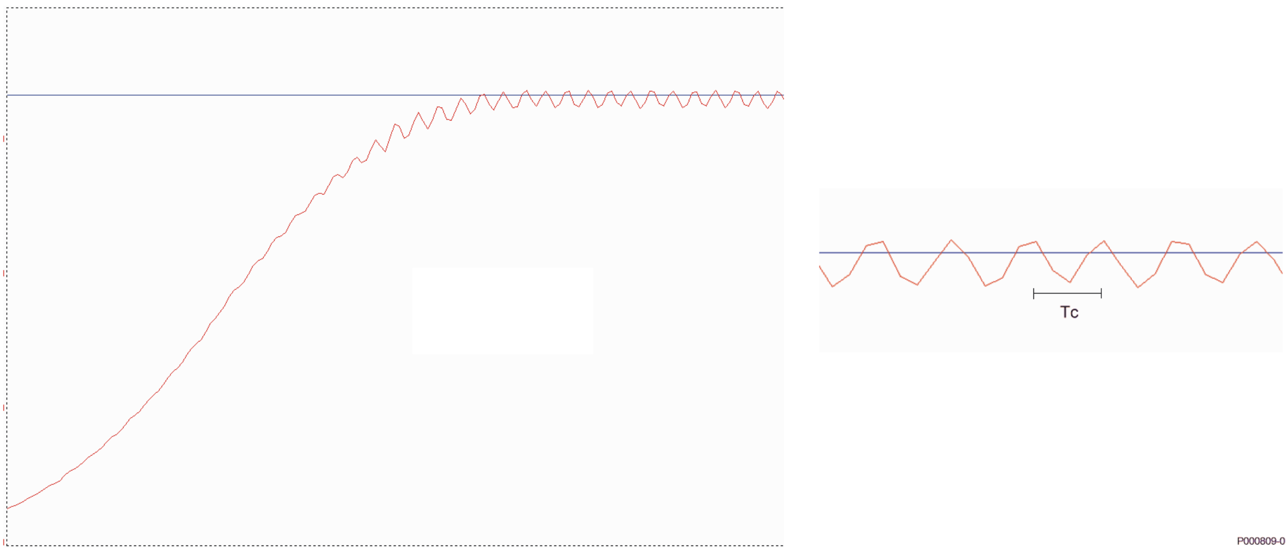


Figure 19: Permanent oscillation with Kp_c critical gain

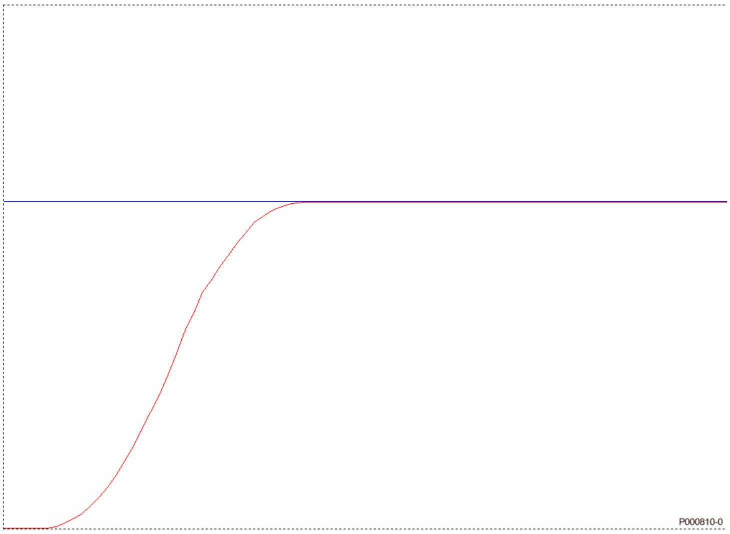


Figure 20: Response to a system tuned with the method of Ziegler and Nichols

NOTE The method of Ziegler and Nichols is not always applicable, because some systems do not produce any oscillations, even in presence of large proportional gains.
However, leading a system close to instability can be very dangerous.

24.3. Manual Tuning of the PI Regulator

The PI regulator can be manually tuned when the tuning method of Ziegler and Nichols is not applicable. The sections below cover the following:

- how the transient is affected from the proportional action when the integral action is kept constant in a PI regulator;
- how the transient is affected from the integral action when the proportional action is kept constant in a PI regulator;
- how the transient is affected from the derivative action in a PID regulator.

24.3.1. Proportional Action (P)

Symbol	Tuning function	Main goal
Kp	An input variance (error) produces an output variance proportional to the variance amplitude	Changes the tuning variable based on the variable being tuned

PI Regulator Ti=Constant	Response to the step	Response time
Small Kp	Overshoot	Longer
Optimum Kp	Optimum	Optimum
Large Kp	Undershoot	Shorter

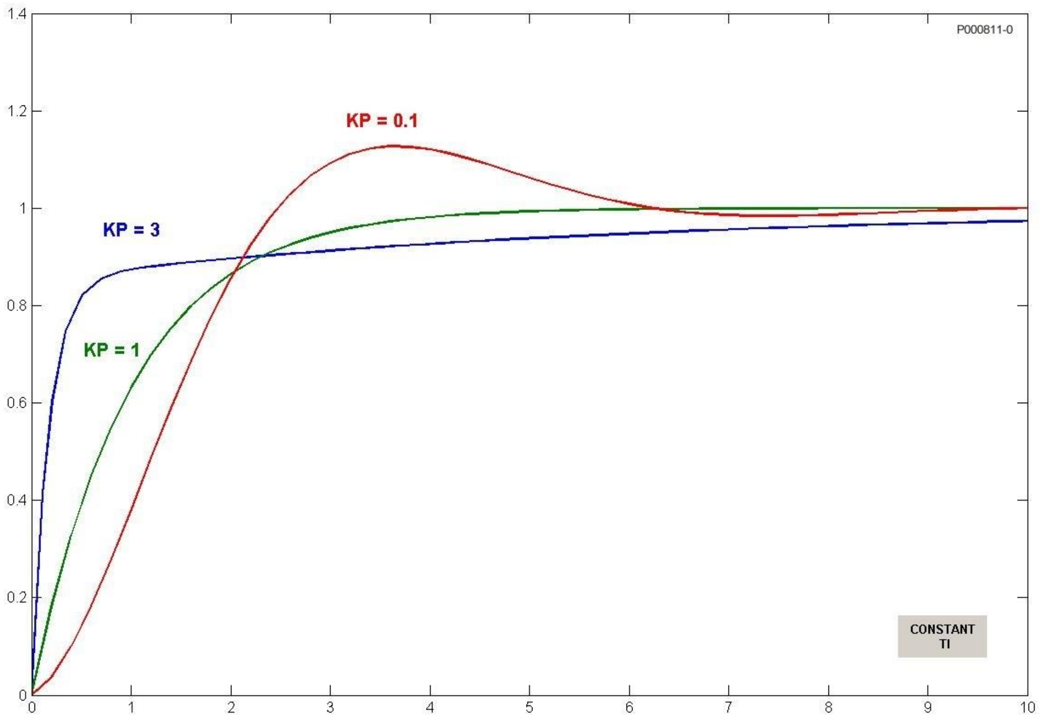


Figure 21: Response to the step based on the value of Kp when Ti is kept constant

When Kp is increased, the error is reduced at constant rate, but the transient can also be adversely affected. Adverse effects can be a longer transient with stronger oscillations due to the damping reduction, or even instability. This is shown in the figure below:

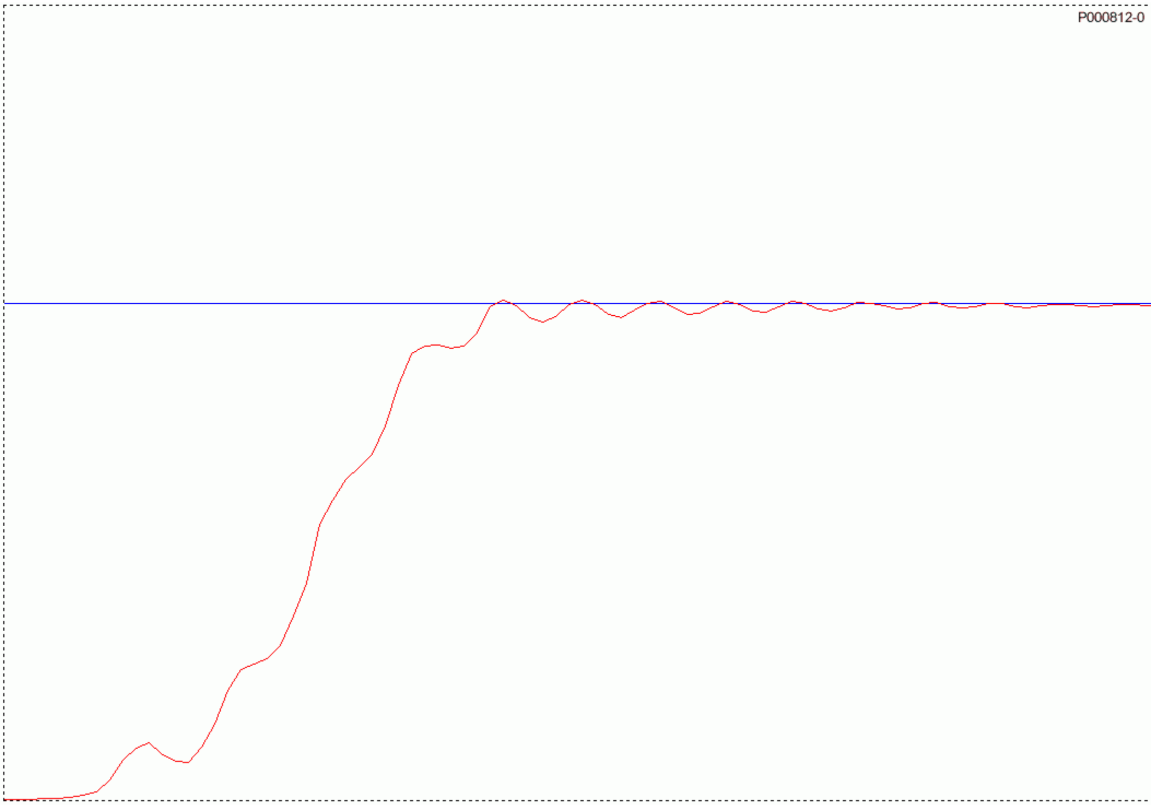


Figure 22: Response to the step when Kp is too large

24.3.2. Integral Action (I)

Symbol	Tuning function	Main goal
Ti	As soon as an input variance occurs (Error), an output variance occurs. The variation rate is proportional to the error magnitude.	Sets the tuning point (eliminates the offset from the proportional action).

PI Regulator	Response to the step	Response time
Small Kp	Overshoot	Shorter
Optimum Kp	Optimum	Optimum
Large Kp	Undershoot	Longer

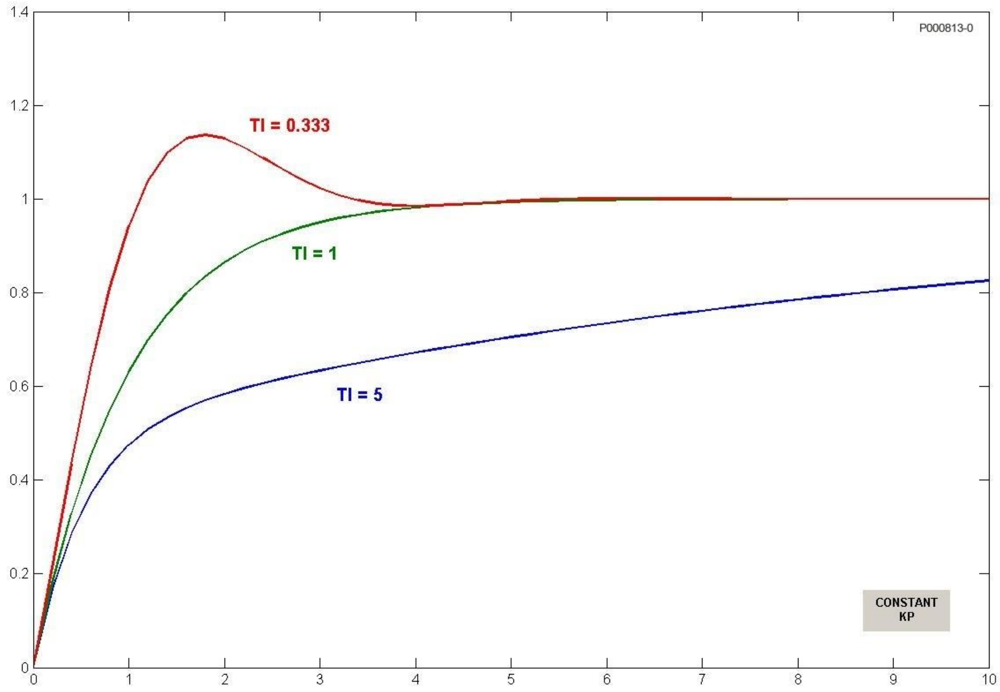


Figure 23: Response to the step based on the value of Ti when Kp is kept constant

The figure below represents the response of the PI regulator when the values for Kp and Ti are lower than the optimum value computed with the ***method of Ziegler and Nichols***.

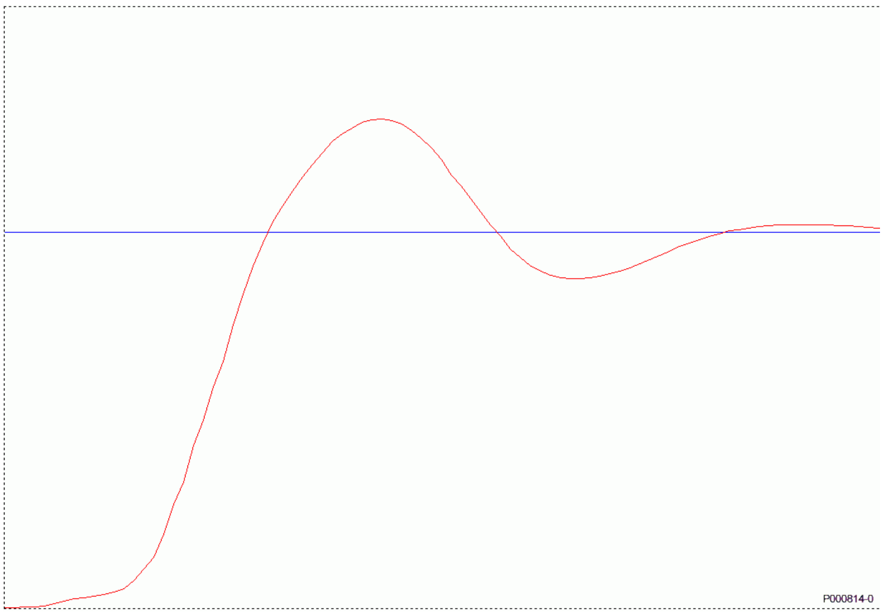


Figure 24: Response to the step when the values of Kp and Ti are too small

24.3.3. Derivative Action (D)

Symbol	Tuning function	Main goal
Td	An input variance (error) generates an output variance proportional to the variance rate	Decreases the response time for the return to the tuning point

The derivative action set with Td increases the stability of the system, thus increasing the transient response. The derivative action tends to get an earlier response, but it increases the system sensitivity to the disturbance overriding the error signal.

24.3.1. Tuning Actions at Constant Speed

When the system is operating at constant speed, the system response shall be the most accurate as possible (minimum error) and shall adjust any little reference variations.

When at constant speed, if the system does not promptly respond to little reference variations, a shorter integral time may solve this problem. Otherwise, when little and long-lasting oscillations affect the reference value, setting a longer integral time could be the right solution.

24.4. Anti Windup

The major benefit of the integral action is to ensure null errors at steady speed. However, just like the derivative action, the integral action shall be applied with caution to avoid worse performance.
A case in point is the output saturation occurring at the same time as an excessive integral action. When the output saturates, the control action is limited, so the error is still remarkable. If the error persists, the actuator will saturate, because the longer the time the error persists, the stronger the integral action is; this phenomenon is called “windup”.
In case of output saturation, the integral term can reach very high values; as a result, the error shall have opposite sign for a long period before exiting from saturation.

The PID regulator of the IRIS BLUE drive is provided with an Anti-windup function which compensates the effect described above. This Anti-windup action is described below (P=proportional term; I=integral term; D=derivative term).

The output is always calculated as follows:
OUT ← P + I + D

When output saturation occurs:
OUT ← OUTsat

The integral term is forced based on the following:
I ← OUTsat – P – D
(which is the Anti-windup function).

This prevents the integral term from reaching very high values; the integral term is then kept constantly in line with the saturated output value OUTsat that is present at each moment; any variations of the error (i.e. the P) that allows exiting from saturation have immediate effect to the output, without having to wait for a long time before discharging the integral term itself.
The effect of the Anti-windup can be adjusted with parameter **P260**; if **P260**<1, the effect is reduced and the system is less sensitive to error variations; if **P260**=0, the effect is cancelled.

The value of **P260**=1 is correct for the applications requiring to quickly exit from saturation.
On the other hand, reducing **P260** can be useful when output variations are to be avoided for negligible error variations.

24.5.Sleep and Wake-up Mode

The Sleep and Wake-up functionality reduces the electric power consumption by increasing the system efficiency and preventing motor wear and tear.

The Sleep and Wake-up functionality is useful in hydraulic systems characterized by pressure or level control when the flow rate required by the connected devices is low.

In case of pressure regulation by means of the PID regulator, the regulator output is allocated to the motor speed. When at constant speed, the motor output frequency depends both on the circuit pressure (e.g. static head and hydraulic drops in the circuit) and on the flow rate required by the devices in the circuit. If the pump delivery drops for a reasonably long time—even until the circuit closes and the flow rate becomes null—the PID regulator output decreases to the minimum PID output. In that case, the pump will operate at low rpm with null or low flow rate and the motor runs in no-load conditions. In order to avoid pump wear and tear and consumptions due to weak lubrication and cooling down, the Sleep Mode may be used, allowing temporarily stopping the PID regulator and the drive. The Wake-up mode will restart the system; for instance, when the flow rate of the devices increases and the system pressure drops below the setpoint, the drive is restarted to deliver the required flow rate.

SLEEP Mode:
When the PID regulator is operating, if **M022-PID** output is lower than **M025-PID Disable Threshold** for a time equal to **P255-PID Disable Delay for PIDout under Min.** (if other than [0: Disable]), the PID regulator and the drive will stop ("PID out under min." status).

M022 < M025 for the time in **P255** (if activated) => SLEEP MODE (drive and PID regulator stopped)

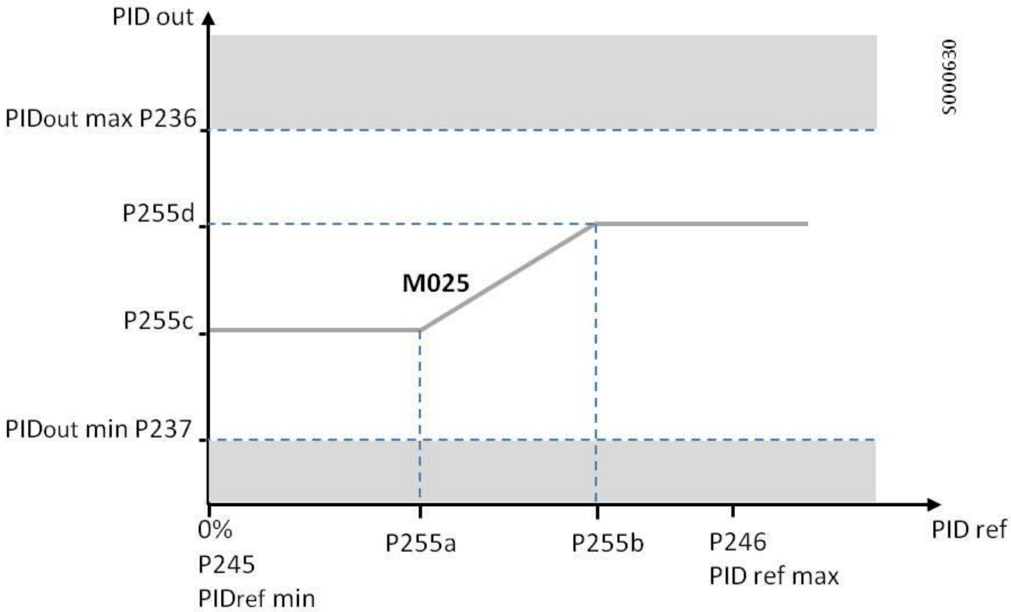


Figure 25: PID Disable threshold

As shown in Figure 25, **M025-PID Disable Threshold** is a variable dynamic threshold as a function of **M023-PID Reference** and computed based on parameters **P255a-P255d.**
Parameters **P255a-P255d** are the points of a linear function as follows:

- If the PID reference is lower than **P255a**, the threshold is equal to **P255c**
- If the PID reference is higher than **P255b**, the threshold is equal to **P255d**
- For intermediate values, the threshold is computed via linear interpolation with X-axes defined in **P255a**, **P255b** and Y-axes **P255c**, **P255d**.

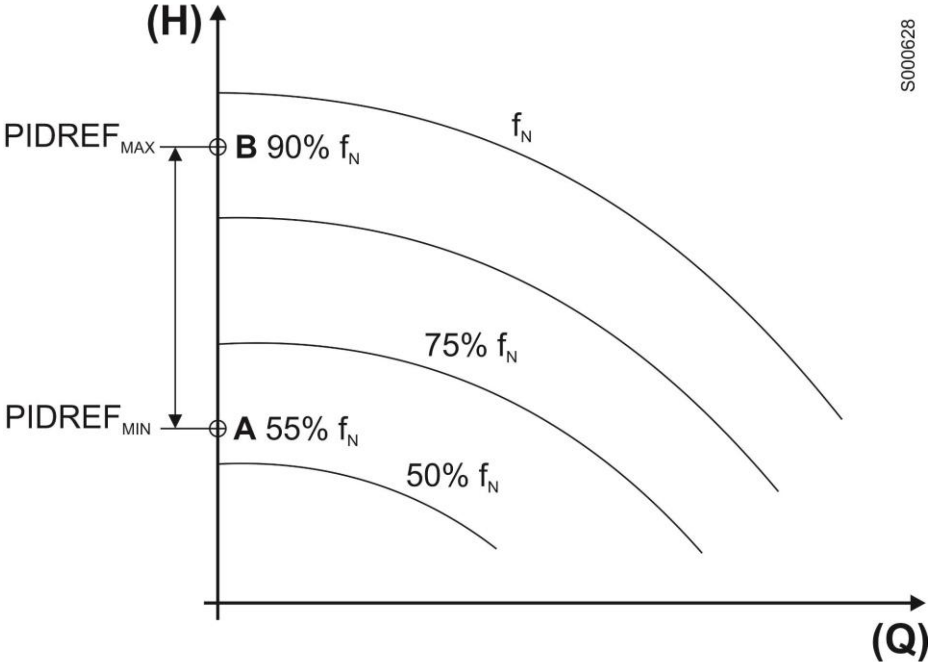
This is useful to define the PID disable threshold based on the variable PID reference, because the pump speed determining zero flow rate varies based on the hydraulic circuit pressure. In general, the pump head corresponding to the null flow rate increases when the pump speed increases, so when the allowable pressure reference ranges between a minimum and maximum value, when operating at high pressure values at constant rpm, the motor speed (PID output) at constant rpm corresponding to null flow rate is high, whilst at low pressure the flow rate is null at lower speeds.
The criterion adopted to adjust Sleep Mode parameters is as follows (see also Programming the Drive for PID Pressure Control):

A. In order to ensure that Operation in Sleep Mode is correct, it is required that when the pump operates at its minimum frequency (depending on **P237**) and the flow rate is null, the pump head is lower than or equal to the minimum allowable reference pressure. To check the pump hydraulic head, run the pump in speed control at minimum frequency, slowly close all the devices in the circuit and check the heading pump at constant flow rate from the pressure sensor by reading the values from **M038u, M039u**). For example, a motor with rated frequency 50Hz and P237=60% running at 30Hz with all the devices in the circuit closed will give 0.8bars pressure. In that case, the correct operation of the PID Sleep Mode is ensured by pressure references greater than 0.8bars. It is also possible to check if the PID output is greater than parameter **P237** when the PID regulator reference is equal to the minimum value and all the devices in the circuit are close.

B. Parameters **P255a-P255d** may be adjusted by two tests:
   - One with high pressure reference (equal to or close to the maximum allowable working pressure)
   - One with low pressure reference (equal to or close to the minimum allowable working pressure) and null flow rate in the circuit.

   For proper adjustment, the relation **P237**<**P255c**<**P255d**<**P236** must be true.
   The test procedure is as follows:

   b.1 With active PID control, set the pressure reference “high” (that value will be assigned to **P255a**)
   b.2 Start the inverter delivering water to the circuit, wait until the system operation is smooth and at constant speed and that pressure reaches the pressure reference
   b.3 Slowly close all the devices in the circuit until flow rate is zero, then wait until the measured pressure steadily reaches the pressure reference. Read the value of PID regulator output **M022**.
   b.4 In **P255c**, set a value exceeding the PID regulator output **M022**. In **P255a**, set a “high” pressure reference
   b.5 Do the same test by setting the PID Ref as “low” (to be set in **P255b** afterwards) for the adjustment of **P255d** (higher than the value at constant speed in **M022**).
   b.6 After setting the parameters, set **P255** other than zero to enable the Sleep Mode. The Sleep Mode activation delay **P255** is to be set high enough to avoid false stops during the transients due to a variation of the pressure reference and/or a variation of the devices flow rate, but not too high to avoid delaying the pump stop in case of no pump delivery.



A: PIDOUT = PIDREFmin; Q = 0; f = 55% fn
B: PIDOUT = PIDREFmax; Q = 0; f = 90% fn

Figure 26: Head/flow rate characteristic when varying the frequency and the Sleep mode parameters

Figure 26 shows the Head/frequency characteristic of a pump when varying the supply frequency. The possible parameter values are as follows from the examples above:
P236 = 50%
P237 =100%
P255a equal to minimum allowable value of PIDref
P255b equal to maximum allowable value for PIDref
P255c = 60%
P255d = 95%

During the Sleep mode, the operating conditions are monitored so that the drive may restart when the load is detected again, based on parameter **P237a** (restart). The Wake-up mode activates only when the conditions below are true:

- The PID output (updated when in Sleep mode as well) is greater than minimum output **P237**
- Based on parameter **P237a**, the feedback signal or the PID error and parameter **P237b** match.

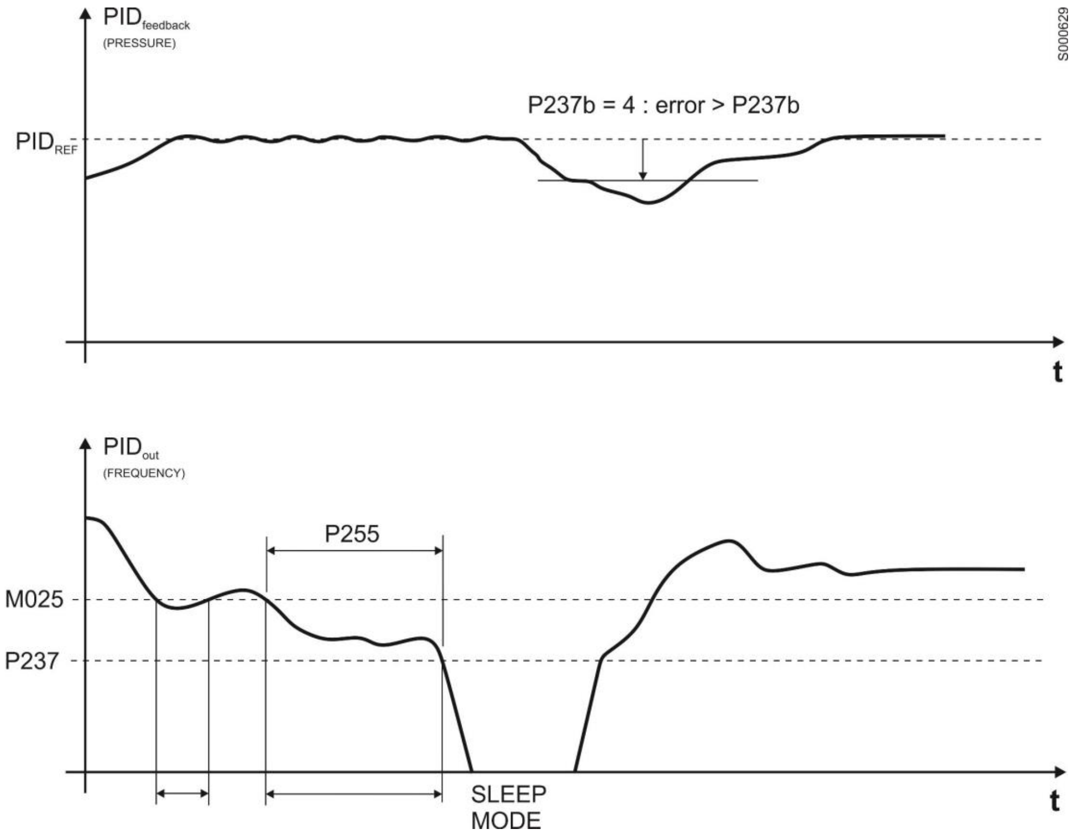


Figure 27: Sleep and Wake-up mode activation example

Figure 27 shows pressure and current patterns over time in case the PID regulator is used and the wake-up mode is activated.

24.6.List of Parameters P236 to P260

Table 43: List of Parameters P236 to P260

Parameter	FUNCTION	User Level	DEFAULT VALUES	MODBUS Address
P236	Max. Value of PID Output	ENGINEERING	+100.00%	836
P237	Min. Value of PID Output	ENGINEERING	0%	837
P237a	Wake-Up Mode for PID	ENGINEERING	0: [Disabled]	858
P237b	Wake-Up Level for PID	ENGINEERING	0.00%	859
P238	Max. Value of PID Integral Term	ENGINEERING	+100.00%	838
P239	Max. Value of PID Derivative Term	ENGINEERING	+100.00%	839
P240	PID Proportional Constant	ENGINEERING	1.000	840
P241	Multiplicative Factor of **P240**	ENGINEERING	0:1.0	841
P242	PID Integral Time (multiples of **P244**)	ENGINEERING	500*Tc (ms)	842
P243	PID Derivative Time (multiples of **P244**)	ENGINEERING	0*Tc (ms)	843
P244	Cycle Time of PID Regulator: Tc	ENGINEERING	5 ms	844
P245	Min. Value of PID Reference	ENGINEERING	0.00%	845
P246	Max. Value of PID Reference	ENGINEERING	+100.00%	846
P247	Min. Value of PID Feedback	ENGINEERING	0.00%	847
P248	Max. Value of PID Feedback	ENGINEERING	+100.00%	848
P249	PID Reference Ramp Up Time	ENGINEERING	0 s	849
P250	PID Reference Ramp Down Time	ENGINEERING	0 s	850
P251	Unit of Measure of PID Ramp	ENGINEERING	1: [0.1s]	851
P252	PID Ramp Start Rounding Off	ENGINEERING	1%	852
P253	PID Ramp End Rounding Off	ENGINEERING	1%	853
P254	PID Out Threshold Enabling Integral Action	ENGINEERING	0.00%	854
P255	PID Disable Delay for Low PIDout	ENGINEERING	0: [Disabled]	855
P255a	Low Reference for PID Disable	ENGINEERING	+100.00%	937
P255b	High Reference for PID Disable	ENGINEERING	+100.00%	938
P255c	PID Disable Threshold with Low Reference	ENGINEERING	+100.00%	939
P255d	PID Disable Threshold with High Reference	ENGINEERING	+100.00%	940
P256	PID Output Gradient Limit	ENGINEERING	1 ms	856
P257	Gain for PID Measure Scaling	ENGINEERING	1.000	857
P260	Gain for Anti-Windup	ENGINEERING	1.00	860

P236	Max. Value of PID Output	
Range	–10000 ÷ +10000	–100.00 ÷ +100.00 %
Default	+10000	+100.00 %
Level	ENGINEERING	
Address	836	
Function	This is the max. allowable value of PID regulator output. This value is expressed as a percentage; its allocation depends on parameter **C294**, defining PID action. Example: if **C294 = External Out**, the PID regulator delivers a reference obtained based on the controlled variable and its setpoint. In this case, the PID output can be brought outside through an analog output. The matching between **P236** and the output value (see the [PAR] ANALOG AND FREQUENCY OUTPUTS MENU). is user-defined. If **C294 = Reference**, the PID regulator output is the motor speed/torque reference (the system will ignore any other reference source), parameter **P236** is a percentage referring to the max. value, considered as an absolute value, between the max. and the min. speed/torque reference of the active motor.	

P237	Min. Value of PID Output	
Range	–10000 ÷ +10000	–100.00 ÷ +100.00 %
Default	0	0%
Level	ENGINEERING	
Address	837	
Function	This is the min. allowable value of PID regulator output. For the value percent of **P237**, see the description of parameter **P236**.	

P237a	Wake-Up for PID	
Range	0 ÷ 4	0: Disabled 1: Feedback < **P237b** 2: Feedback > **P237b** 3: Error < **P237b** 4: Error > **P237b**
Default	0	0: Disabled
Level	ENGINEERING	
Address	858	
Function	If this parameter is disabled, the PID control re-activates only when the PID output exceeds the value set in parameter **P237**. If this parameter is enabled, the PID control re-activates when the PID output exceeds the threshold set in parameter **P237** and: **P237a**=1: The Feedback value drops below the level set with **P237b;** **P237a**=2: The Feedback value exceeds the level set with **P237b;** **P237a**=3: The Error value drops below the level set with **P237b**; **P237a**=4: The Error value exceeds the level set with **P237b**.	

P237b	Wake Up for PID	
Range	–10000 ÷ +10000	–100.00 ÷ +100.00 %
Default	0	0.00 %
Level	ENGINEERING	
Address	859	
Function	Level of the Feedback or Error signal allowing re-activating the PID control (see **P237a**).	

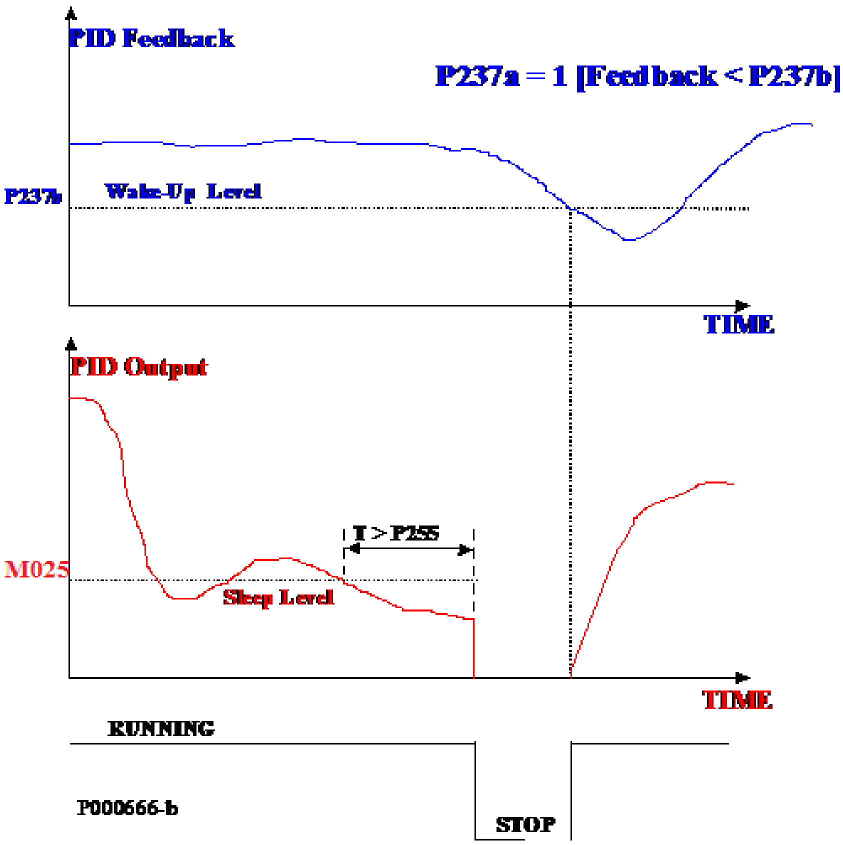


Figure 28: PID Sleep and Wake-up Mode when P237a is set to 1

P238	Maximum Value of PID Integral Value	
Range	0 ÷ 10000	0.00 ÷ +100.00 %
Default	10000	+100.00 %
Level	ENGINEERING	
Address	838	
Function	This is the max. allowable value of the integral term. It is to be considered as an absolute value; the output value resulting from the integral term ranges from ± **P238**.	

P239	Maximum Value of PID Derivative Term	
Range	0 ÷ 10000	0.00 ÷ +100.00 %
Default	10000	+100.00 %
Level	ENGINEERING	
Address	839	
Function	This is the max. allowable value of the derivative term; it is to be considered as an absolute value; the output value resulting from the derivative term ranges from ± **P239**.	

P240	PID Proportional Constant	
Range	0 ÷ 65000	0 ÷ 65.000
Default	1000	1.000
Level	ENGINEERING	
Address	840	
Function	his is the value of the proportional coefficient. The PID regulator will use Kp resulting from the product of **P240** multiplied by **P241** (multiplicative factor).	

P241	Multiplicative Factor of P240	
Range	0÷2	0: 1.0 1: 10.0 2: 100.0
Default	0	0: 1.0
Level	ENGINEERING	
Address	841	
Function	Multiplicative factor of the proportional coefficient. This is used to obtain a wider range for the proportional coefficient used in PID regulator and ranging from 0.000 to 6500.0. Supposing that the default values are used for **P240** and **P241**, the proportional coefficient used in the PID regulator is unitary: in case an error of 1% occurs between the reference and the controlled variable, the proportional term, representing one of the three values of the regulator output, will be 1%.	

P242	PID Integral Time (Multiples of P244)	
Range	0 ÷ 65000	0: [Disabled] ÷ 65000 * Tc (ms)
Default	500	500*Tc (ms)
Level	ENGINEERING	
Address	842	
Function	**Ti** constant dividing the integral term of PID regulator: **Ki** = 1/**Ti** = 1/(**P242***Ts) It is expressed in sampling time units **Ts** (see **P244**). If this parameter is set to zero, the integral action is cancelled.	

P243	PID Derivative Time (Multiples of P244)	
Range	0 ÷ 65000	0 ÷ 65.000 * Tc (ms)
Default	0	0*Tc (ms)
Level	ENGINEERING	
Address	843	
Function	Constant multiplying the derivative term of PID regulator. If this parameter is set to zero, the derivative action is disabled.	

P244	Cycle Time of PID Regulator: “Tc”	
Range	5 ÷ 65000	0 ÷ 65000 ms
Default	5	5 ms
Level	ENGINEERING	
Address	844	
Function	This parameter sets the cycle time of PID regulator. It is expressed in ms (multiples of 5 only). Example: if **P244** = 1000 ms, the PID regulator cycle will be executed every second, and the output will be refreshed every second as well.	

P245	Minimum Value of PID Reference	
Range	–20000 ÷ +20000	±200.00%
Default	0	0.00%
Level	ENGINEERING	
Address	845	
Function	This parameter defines the min. allowable value of the PID reference. The PID references are to be considered as percentage values. If analog references are selected, **P245** relates to the minimum value of the selected analog input. Example: Select AIN1 analog input as the PID reference and suppose that its max. and min. values are +10V and –10V respectively. If **P245** is –50%, this means that the PID reference will be saturated at –50% for voltage values lower than –5V.	

P246	Maximum Value of PID Reference	
Range	–20000 ÷ +20000	±200.00%
Default	+10000	+100.00%
Level	ENGINEERING	
Address	846	
Function	This parameter defines the max. allowable value of the PID reference. See the description of **P245**.	

P247	Minimum Value of PID Feedback	
Range	–20000 ÷ +20000	±200.00%
Default	0	0.00%
Level	ENGINEERING	
Address	847	
Function	This parameter defines the min. allowable value of the PID feedback. See the description of **P245**.	

P248	Maximum Value of PID Feedback	
Range	–20000 ÷ +20000	±200.00%
Default	+10000	+100.00%
Level	ENGINEERING	
Address	848	
Function	This parameter defines the max. allowable value of the PID feedback. See the description of **P245**.	

P249	PID Reference Ramp Up Time	
Range	0 ÷ 32700	Function of **P251**
Default	0	0 s
Level	ENGINEERING	
Address	849	
Function	This parameter defines the ramp up time of the PID regulator reference from 0% to the max. allowable absolute value (max {|**P245**|, |**P246**|}).	

P250	PID Reference Ramp Down Time	
Range	0 ÷ 32700	Function of **P251**
Default	0	0 s
Level	ENGINEERING	
Address	850	
Function	This parameter defines the ramp down time of the PID regulator reference, from max. allowable value (max. {|**P245**|, |**P246**|}) to 0%.	

P251	Unit of Measurement of PID Ramps	
Range	0 ÷ 3	0: 0.01 s 1: 0.1 s 2: 1.0 s 3: 10.0 s
Default	1	1: 0.1 s
Level	ENGINEERING	
Address	851	
Function	This parameter defines the unit of measurement for the PID reference ramp times. It defines the unit of measurement for the time of the third ramp of the PID reference **P249** and **P250**, so that the allowable range becomes 0s – 327000s.	

Example:

P251		Range P249 – P250	
Value	Coding	Min	Max
0	0.01s	0	327.00 s
1	0.1s	0	3270.0 s
2	1.0s	0	32700 s
3	10.0	0	327000 s

NOTE Factory-setting: the PID reference ramp is zero; if a given ramp time is set up, the ramp will be rounded off (50% at the beginning and at the end of the ramp). See parameters **P252** and **P253**.

P252	**PID S Ramp Start Rounding Off**	
Range	0 ÷ 100	0 % ÷ 100%
Default	1	1%
Level	ENGINEERING	
Address	852	
Function	This parameter sets the time period of the rounding off applied to the first stage of the ramps. It is expressed as a percentage of the ramp up/down time. Example: ramp up of 5sec.: **P252** = 50% means that the speed reference is limited in acceleration for the first 2.5 sec of the ramp up.	

NOTE When **P252** is used, the preset ramp time is increased by (**P252**%)/2.

P253	**PID Ramp End Rounding Off**	
Range	0 ÷ 100	0 % ÷ 100%
Default	1	1%
Level	ENGINEERING	
Address	853	
Function	As **P252**, but **P253** sets the rounding off applied at the end of the ramps.	

NOTE When **P253** is used, the preset ramp time is increased by (**P253%**)/2.

P254	**PIDout Threshold Enabling Integral Action**	
Range	0 ÷ 5000	0.0 % ÷ 500.0%
Default	0	0.0 %
Level	ENGINEERING	
Address	854	
Function	This parameter sets a threshold value below which the integrator is kept to zero. It has effect only when the PID regulator is used as a reference corrector or generator. In this case, the threshold percentage value refers to the max. speed (or torque) absolute value set for the active motor. The integral term is not calculated when the speed (or torque) percentage value expressed as an absolute value is lower than the value set in **P254**. If **P254** is set to zero, the integrator is always activated.	

P255	PID Disable Delay for Low PIDout	
Range	0 ÷ 60000	0: Disabled 1 s ÷ 60000 s
Default	0	0: Disabled
Level	ENGINEERING	
Address	855	
Function	This parameter sets the maximum time for the drive to operate when the PID regulator output is continuously under the PID Disable Threshold **M025**. See parameters **P255a**-**P55d** for details on the PID disable threshold. The counter is an up/down timer; this means that if the PID regulator output varies around **M025**, the counter is incremented or decremented (with no reset) depending on weather the threshold is respected or not. If the condition above is true for the time set in **P255**, the drive will automatically go on stand-by and will be kept on stand-by under the following conditions: 1) Until the PID output becomes greater than minimum **P237** (if **P237a**=Disabled); 2) When the PID Feedback or Error drops below the Wake-up level **P237b** (if **P237a**=1 or =3 respectively); 3) When the PID Feedback or Error exceeds the Wake-up level (if **P237a**=2 or =4 respectively). If the PID regulator action (**C294**) is set as External Out or **P255** is zero, <u>the functionality described above is inactive</u>.	

P255a	Low Reference for PID Disable	
Range	-10000 ÷ 10000	-100 % ÷ 100%
Default	10000	100%
Level	ENGINEERING	
Address	937	
Function	This is the value of the PID regulator reference corresponding to the PID Disable Threshold **P255c**. For intermediate PID reference values between **P255a** and **P255b**, the disable threshold is defined via linear interpolation with X-axes **P255a**, **P255b** and Y-axes **P255c**, **P255d**. For values exceeding **P255b**, the disable threshold is **P255d**.	

P255b	High Reference for PID Disable	
Range	-10000 ÷ 10000	-100 % ÷ 100%
Default	10000	100%
Level	ENGINEERING	
Address	938	
Function	This is the reference value corresponding to the PID Disable Threshold **P255d**. See the Description of **P255a** for details.	

P255c	PID Disable Threshold with Low Reference	
Range	-10000 ÷ 10000	-100 % ÷ 100%
Default	10000	100%
Level	ENGINEERING	
Address	939	
Function	See the Description of **P255a** for details.	

P255d	PID Disable Threshold with High Reference	
Range	-10000 ÷ 10000	-100 % ÷ 100%
Default	10000	100%
Level	ENGINEERING	
Address	940	
Function	See the Description of **P255a** for details.	

P256	PID Out Gradient Limit	
Range	1 ÷ 65000	1 ms ÷ 65000 ms
Default	1	1 ms
Level	ENGINEERING	
Address	856	
Function	This parameter limits the max. acceleration for the PID regulator output. The max. acceleration for the PID regulator output is equal to 100% / **P256** [%/msec].	

P257	Gain for PID Measurement Scaling	
Range	0 ÷ 65535	0.000 ÷ 65.535
Default	1	1.000
Level	ENGINEERING	
Address	857	
Function	Gain for the scaling of PID measurements **M023** ÷ **M024**. This gain has effect only on the measurements above. It does not affect the PID operation. This parameter allows scaling if you want to display PID measurements with a different unit of measurement: **M023** = **M020** * **P257** **M024** = **M021** * **P257**	

P260	Anti Wind-Up Gain	
Range	0 ÷ 100	0.00 ÷ 1.00
Default	100	1.00
Level	ENGINEERING	
Address	860	
Function	Value of the Anti Wind-Up coefficient that freezes the integral term of the PID when its output is being saturated (see Anti Windup). When leaving **P260**=1.00, Anti Wind-Up is complete (I ← OUTsat – P – D). If **P260**=0.00, Anti Wind-Up is inhibited (the integral term reaches the value of ±**P238** based on the error sign). Intermediate values for **P260** give intermediate effects.	

25. [PAR] PID2 PARAMETERS MENU

25.1.Overview

This menu defines the parameters of the digital regulator PID2 as well as the parameters used in 2-zone mode.

To activate the PID2 regulator, set **C291a = 7: 2 PID** (see [CFG] PID CONFIGURATION MENU).
Once activated, the PID2 regulator has the same functionality and operates in line with the standard PID (see [PAR] PID PARAMETERS MENU). The output of the standard PID regulator is algebraically summed with the output of the PID2 regulator.
Add "200" to the parameter codes pertaining to the standard PID to obtain the relevant parameter codes for PID2. Example: **P236** for standard PID corresponds to **P436** for PID2.

To enable the 2-zone mode, set **C291a = 5: 2-Zone MIN** or **6: 2-Zone MAX** ([CFG] PID CONFIGURATION MENU).
Once the 2-zone mode is enabled, the standard PID regulator operates on the system with the larger error (minimum feedback with respect to its reference, **2-Zone MIN**) or with the smaller error (maximum feedback with respect to its reference, **2-Zone MAX**).
In 2-zone mode, parameters **P236**..**P260** pertain to the system where the error results from the reference selected with **C285** and from the feedback selected with **C288**, whilst parameters **P436**..**P460** pertain to the system where the error results from the reference selected with **C286** and from the feedback selected with **C289.**

NOTE The PID2 regulator is disabled when operating in 2-zone mode.

Please refer to the block diagram in Figure 62.

25.2. List of Parameters P436 to P460

Table 44: List of Parameters P436 to P460

Parameter	FUNCTION	User Level	DEFAULT VALUES	MODBUS Address
P436	Max. value of PID2 output	ENGINEERING	+100.00%	1215
P437	Min. value of PID2 output	ENGINEERING	0.00%	1216
P437a	Wake-up Mode for PID2	ENGINEERING	0: [Disabled]	1237
P437b	Wake-up Level for PID2	ENGINEERING	0.00%	1238
P438	Max. value of PID2 integral term	ENGINEERING	+100.00%	1217
P439	Max. value of PID2 derivative term	ENGINEERING	+100.00%	1218
P440	PID2 proportional constant	ENGINEERING	1.000	1219
P441	Multiplicative factor of **P440**	ENGINEERING	0:1.0	1220
P442	PID2 Integral time (multiples of **P444**)	ENGINEERING	500*Tc (ms)	1221
P443	PID2 Derivative time (multiples of **P444**)	ENGINEERING	0*Tc (ms)	1222
P444	Cycle time of PID2 regulator: Tc	ENGINEERING	5 ms	1223
P445	Min. allowable value of PID2 reference	ENGINEERING	0.00%	1224
P446	Max. allowable value of PID2 reference	ENGINEERING	+100.00%	1225
P447	Min. allowable value of PID2 feedback	ENGINEERING	0.00%	1226
P448	Max. allowable value of PID2 feedback	ENGINEERING	+100.00%	1227
P449	PID2 reference ramp up time	ENGINEERING	0 s	1228
P450	PID2 reference ramp down time	ENGINEERING	0 s	1229
P451	Unit of measurement of PID2 ramp	ENGINEERING	1: [0.1s]	1230
P452	PID2 ramp start rounding off	ENGINEERING	1%	1231
P453	PID2 ramp end rounding off	ENGINEERING	1%	1232
P454	PID2 Out Threshold Enabling Integral Action	ENGINEERING	0.00%	1233
P455	PID2 Disable Delay for Low PID2 Output	ENGINEERING	0: [Disabled]	1239
P455a	Low Reference for PID2 Disable	ENGINEERING	+100.00%	944
P455b	High Reference for PID2 Disable	ENGINEERING	+100.00%	945
P455c	PID2 Disable Threshold with Low Reference	ENGINEERING	+100.00%	946
P455d	PID2 Disable Threshold with High Reference	ENGINEERING	+100.00%	947
P456	PID2 Output Gradient Limit	ENGINEERING	1 ms	1234
P457	Gain for PID2 Measurement Scaling	ENGINEERING	1.000	1235
P460	Gain for Anti Wind-Up	ENGINEERING	1.00	1236

NOTE Parameters **P437a**, **P437b** and **P455, P455a-P455d** are overridden if the Two PIDs mode is selected with “summed outputs” (**C291a** = **7: 2 PID** and **C171a** = **0: Disabled**).

NOTE For a detailed description of these parameters, please refer to the PID-related List of Parameters P236 to P260.

26. [PAR] DIGITAL OUTPUTS MENU

26.1. Overview

The Digital Outputs menu includes the parameters allowing configuring the drive digital outputs: MDO1, MDO2, MDO3 and MDO4.

NOTE The Digital Outputs Menu may be accessed only if the user level is set to ADVANCED or ENGINEERING.

NOTE Please refer to the IRIS BLUE – Installation Guide for the hardware description of the digital outputs.

NOTE Digital output **MDO1** may be programmed only if frequency output **P200** = Disable has not been set up (see [PAR] ANALOG AND FREQUENCY OUTPUTS MENU).

NOTE Auxiliary digital inputs XMDI (values from 13 to 20 in the parameters related to the control functions) may be programmed only after setting XMDI/O in parameter **R023**.

NOTE Digital outputs MDO1-4 via parameters **P270**, **P279**, **P288**, **P297** in the [PAR] DIGITAL OUTPUTS MENU may be programmed only if the configuration of the relevant output via **P630**, **P632**, **P634**, **P636** in the [PAR] Digital Outputs Menu for MMC is "**D600:** Function Mode". For example, if **P630** = "**D600:** Function Mode" MDO1 is configured via **P270**. Otherwise, for example with **P630** = "**D601:** Inverter OK", the configuration of MDO1 is determined by **P630**, not **P270**. In order to change the values in the MULTIMOTOR DIGITAL OUTPUTS MENU, the Multimotor mode is to be activated (see parameter **C600** "Number of motors in the system" from the [CFG] Motor Power Ratings Menu).

26.1.1. Factory Settings

The factory settings are as follows:
MDO1 is a zero speed relay (it energizes when a preset threshold is exceeded).
MDO2 is configured to indicate that the Speed Reference at constant rpm has been achieved.
MDO3 de-energizes (fail-safe logic) in case of "Inverter Alarm".
MDO4 energizes when the drive is running and is enabling the power stage ("Inverter Run OK" condition).

26.1.2. Structure of the Digital Outputs

A digital output is composed of two logic blocks allowing data processing before actuating the actual digital output. Block 2 depends on the settings in parameters **P277a** (**P286a, P295a, P304a**).

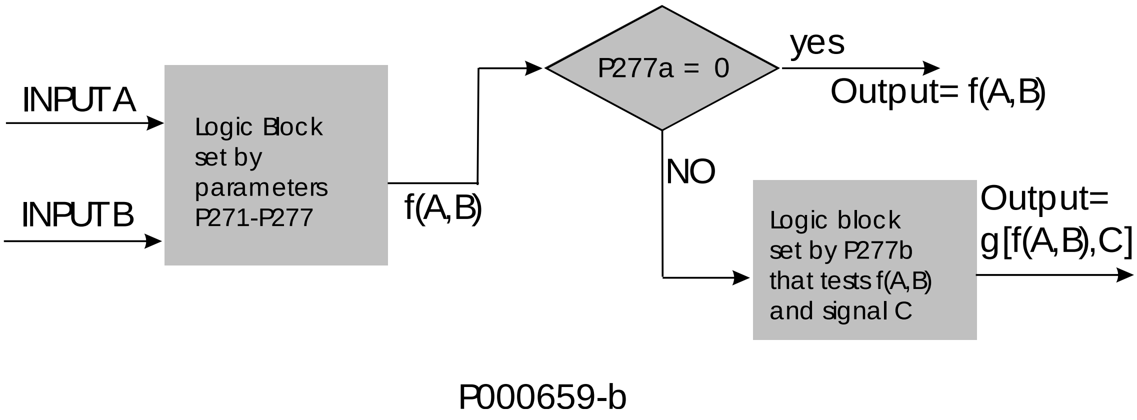


Figure 29: MDO block-diagram

Operating modes set in MDO1 (2,3,4) Digital Output: P270, (P279, P288, P297)

The user can select one of the following operating modes:

Table 45: Digital Output Mode

DISABLE	The selected digital output is disabled.
DIGITAL	The digital output depends on a selected digital signal and on the logic output function (True/False). See Examples 1 and 2.
DOUBLE DIGITAL	The digital output depends on 2 selected digital signals, on the logic function calculating the output value and on the logic output function (True/False).
ANALOG	The digital output depends on a selected analog variable, which is tested through Test A obtaining one digital signal; starting from its value, the selected logic function calculates the True/False end value. See Example 3.
DOUBLE ANALOG	The digital output depends on 2 selected analog variables: Test A is performed for variable A, whilst Test B is performed for variable B, thus obtaining 2 digital signals; starting from their value, the selected logic function calculates the output value, whereas the logic output function True/False calculates the end value.
DOUBLE FULL	As DOUBLE ANALOG or DOUBLE DIGITAL mode, but both digital signals and analog variables can be selected. If you select a digital signal, its value (TRUE or FALSE) is used to calculate the selected logic function. If you select an analog variable, the test selected for this variable is performed, and its result (TRUE or FALSE) is used to calculate the selected logic function.

Activation	Conditions to be considered in logic AND with the following programmed functions: • Drive accelerating • Drive running, no alarm triggered
Deactivation	Conditions to be considered in logic OR with the following programmed functions: • Drive not running or locked due to an alarm condition

Variable A Selected for MDO1 (2,3,4): P271, (P280, P289, P298)

This selects the digital signal or the analog variable used for Test A (set with **P273/P282/P291/P300**).
The whole list of the selectable items and their description appears at the end of this section (see Table 46).
If a digital signal is selected, Test A is not performed: therefore, the comparison value for Test A (set with **P275/P284/P293/P302**) has no meaning.

NOTE This parameter can be accessed only if the operating mode of the digital output concerned is other than zero. Example: MDO1 **P270**≠0.

Variable B selected for MDO1 (2,3,4): P272, (P281, P290, P299)

This selects a different digital signal or the analog variable used for Test B (set with **P274/P283/P292/P301**).
The whole list of the selectable items and their description appears at the end of this section (see Table 46).
If a digital signal is selected, Test B is not performed: therefore, the comparison value for Test B (set with **P276/P285/P294/P303**) has no meaning.

NOTE Parameter **P272** cannot be accessed when the digital output operating mode is 1: DIGITAL or 3: ANALOG.

Example: MDO1 **P270**=1 OR **P270**=3.

Table 46: List of the selectable digital inputs and analog outputs

Selectable digital signals (BOOLEAN):

Selectable Value	Description
D0: Disable	Always FALSE: 0
D1: Run Ok	Drive running (no standby)
D2: Ok On	Inverter ok: no alarms tripped
D3: Alarm	Drive alarm tripped
D4: Run ALR	Drive KO: alarm tripped when the drive is running
D5: FWD Run	Speed (measured or estimated) higher than +0.5 rpm
D6: REV Run	Speed (measured or estimated) lower than –0.5 rpm
D7: Lim.MOT	Drive in limiting mode operating as a motor
D8: Lim.GEN	Drive in limiting mode operating as a generator
D9: Limiting	Drive in limiting mode (generator or motor)
D10: Prec.Ok	Capacitor Precharge relay closure and command return test
D11: PID MAX	PID output max. saturation
D12: PID MIN	PID output min. saturation
D13: MDI 1	Selected MDI1digital input (remote OR physical)
D14: MDI 2	Selected MDI2 digital input (remote OR physical)
D15: MDI 3	Selected MDI3 digital input (remote OR physical)
D16: MDI 4	Selected MDI4 digital input (remote OR physical)
D17: MDI 5	Selected MDI5 digital input (remote OR physical)
D18: MDI 6	Selected MDI6 digital input (remote OR physical)
D19: MDI 7	Selected MDI7 digital input (remote OR physical)
D20: MDI 8	Selected MDI8 digital input (remote OR physical)
D21: Enable	ENABLE function (remote AND physical)
D22: Enable SW	ENABLE-SW function (remote AND physical)
D23: MDI 1 Delayed	MDI1 Digital input (remote OR physical) DELAYED by MDI timers
D24: MDI 2 Delayed	MDI1 Digital input (remote OR physical) DELAYED by MDI timers
D25: MDI 3 Delayed	MDI1 Digital input (remote OR physical) DELAYED by MDI timers
D26: MDI 4 Delayed	MDI1 Digital input (remote OR physical) DELAYED by MDI timers
D27: MDI 5 Delayed	MDI5 Digital input (remote OR physical) DELAYED by MDI timers
D28: MDI 6 Delayed	MDI6 Digital input (remote OR physical) DELAYED by MDI timers
D29: MDI 7 Delayed	MDI7 Digital input (remote OR physical) DELAYED by MDI timers
D30: MDI 8 Delayed	MDI8 Digital input (remote OR physical) DELAYED by MDI timers
D31: Enable Delayed	ENABLE function (remote AND physical) DELAYED by MDI timers
D32: Trk.Err	Speed tracking error: |SetPoint – Measurement| > Error_Par
D33: Fan Flt	Fault of the cooling fan
D34: Fbus c1	Command 1 from fieldbus

D35: Fbus c2	Command 2 from fieldbus
D36: Fbus c3	Command 3 from fieldbus
D37: Fbus c4	Command 4 from fieldbus
D38: FireMod	Fire Mode function
D39: Local	LOCAL Mode
D40: Speed OK	Constant speed reference reached
D41: Fan ON	Fan activation command
D42: XMDI1	XMDI1 Auxiliary digital input
D43: XMDI2	XMDI2 Auxiliary digital input
D44: XMDI3	XMDI3 Auxiliary digital input
D45: XMDI4	XMDI4 Auxiliary digital input
D46: XMDI5	XMDI5 Auxiliary digital input
D47: XMDI6	XMDI6 Auxiliary digital input
D48: XMDI7	XMDI7 Auxiliary digital input
D49: XMDI8	XMDI8 Auxiliary digital input
D50: MPL1 Delayed	Virtual digital input resulting from MPL1 output DELAYED from MPL Timers
D51: MPL2 Delayed	Virtual digital input resulting from MPL2 output DELAYED from MPL Timers
D52: MPL3 Delayed	Virtual digital input resulting from MPL3 output DELAYED from MPL Timers
D53: MPL4 Delayed	Virtual digital input resulting from MPL4 output DELAYED from MPL Timers
D54: OTM Elapsed	Maintenance Operation Time elapsed
D55: STM Elapsed	Maintenance Supply Time elapsed
D56: MDO1 Delayed	Virtual digital input resulting from MDO1 output DELAYED from MDO Timers
D57: MDO2 Delayed	Virtual digital input resulting from MDO2 output DELAYED from MDO Timers
D58: MDO3 Delayed	Virtual digital input resulting from MDO3 output DELAYED from MDO Timers
D59: MDO4 Delayed	Virtual digital input resulting from MDO4 output DELAYED from MDO Timers
D60: TFL1	Timed flag TFL1
D61: TFL2	Timed flag TFL2
D62: TFL3	Timed flag TFL3
D63: TFL4	Timed flag TFL4
D64: NTC Fault	NTC Fault (heatsink temperature measurement)
D65: Cumulative Warning	Logic OR of W40 (FAN FAULT), W50 (NTC FAULT), W48 (OT TIME OVER), W49 (ST TIME OVER)
D66: Dec to Stop	Deceleration due to START opening or STOP activation
D67: Reserved	
D68: Accelerating	Motor accelerating
D69: Decelerating	Motor decelerating
D70: DryRun	Dry-run detected
D71: PressureLoss	Pressure loss detected
D72: Reserved	
D73: Reserved	
D74: kWh pulse	A 500 ms pulse per kWh
D75: Reserved	
D76: Reserved	
D77: Reserved	
D78: Reserved	
D79: Reserved	

Selectable analog variables:

Selectable Value	Full-scale Value	Kri	Description
A00: GROUND			Analog 0 Volt
A01: Speed	10000 rpm	1	Motor speed
A02: Spd REF.	10000 rpm	1	Speed reference at constant speed
A03: RampOut	10000 rpm	1	Speed reference when ramps are over
A04: MotFreq	1000.0 Hz	10	Frequency produced by the drive
A05: MotCurr	5000.0 A	10	Current RMS
A06: OutVolt	2000.0 V	10	Output voltage RMS
A07: Out Pow	1000.0 kW	10	Output power
A08: DC Vbus	2000.0 V	10	DC-link voltage
A09: Reserved			
A10: Torq.DEM	100.00 %	100	Torque demand
A11: Torq.OUT	100.00 %	100	Estimation of the torque output
A12: Reserved			
A13: PID REF	100.00 %	100	PID reference at constant speed
A14: PID RMP	100.00 %	100	PID reference when ramps are over
A15: PID Err	100.00 %	100	Error between PID reference and PID feedback
A16: PID Fbk	100.00 %	100	PID feedback
A17: PID Out	100.00 %	100	PID output
A18: REF	100.00 %	100	Analog input REF
A19: AIN1	100.00 %	100	Analog input AIN1
A20: AIN2/Pt	100.00 %	100	Analog input AIN2/PTC
A21 ÷ A22: Reserved			
A23: Flux REF	1.0000 Wb	10000	Flux reference at constant speed
A24: Flux	1.0000 Wb	10000	Active flux reference
A25: Iq REF	5000.0 A	10	Current reference over axis q
A26: Id REF	5000.0 A	10	Current reference over axis d
A27: Iq	5000.0 A	10	Current measurement over axis q
A28: Id	5000.0 A	10	Current measurement over axis d
A29: Volt Vq	2000.0 V	10	Voltage over axis q
A30: Volt Vd	2000.0 V	10	Voltage over axis d
A31: Cosine	100.00 %	100	Waveform: Cosine
A32: Sine	100.00 %	100	Waveform: Sine
A33: Angle	100.00 %	100	Electric angle of delivered Vu
A34: +10V			Analog +10 Volt
A35: –10V			Analog –10 Volt
A36: Flux Current	5000.0 A	10	Flux current
A37: SqrWave	100.00 %	100	Square wave
A38: Saw Wave	100.00 %	100	Saw wave
A39: HtsTemp.	100.00 °C	100	Heatsink temperature
A40: AmbTemp.	100.00 °C	100	Ambient temperature
A41 ÷ A49: Reserved			
A50: PT100_1	320.00 °C	100	PT100 channel 1
A51: PT100_2	320.00 °C	100	PT100 channel 2
A52: PT100_3	320.00 °C	100	PT100 channel 3
A53: PT100_4	320.00 °C	100	PT100 channel 4
A54: I2t%	100.00 %	100	Motor thermal capacity
A55: XAIN4	100.00 %	100	XAIN4 analog input
A56: XAIN5	100.00 %	100	XAIN5 analog input
A57: OT Counter	320000 h	1	Maintenance Operation Time counter
A58: ST Counter	320000 h	1	Maintenance Supply Time counter
A59: PID2 REF	100.00 %	100	PID2 reference at constant speed
A60: PID2 RMP	100.00 %	100	PID2 reference when ramps are over
A61: PID2 Fbk	100.00 %	100	Error between PID2 reference and PID2 feedback
A62: PID2 Err	100.00 %	100	PID2 feedback
A63: PID2 Out	100.00 %	100	PID2 output
A64: Torque Demand %	100.00 %	100	Torque demand (percentage)
A65: Actual Current Iv	5000.0 A	10	Output current Iv
A66: Slave Ref	100.00 %	100	Slave motor set point
A67 ÷ A69: Reserved			
Minimum Value = –3.2 x Full-scale value **Maximum Value = 3.2 x Full-scale value** **MODBUS Value = Parameter value x Kri**			

Testing Variable A for MDO1 (2,3,4): P273, (P282, P291, P300)

If an analog variable is selected, a logic TEST is performed to obtain a TRUE/FALSE Boolean signal.
Seven different tests are available, that can be performed for selected variable A and its comparing value A:

Table 47: Test Functions

GREATER THAN	Selected variable > comparing value
GREATER THAN/EQUAL TO	Selected variable ≥ comparing value
LOWER	Selected variable < comparing value
LOWER THAN/EQUAL TO	Selected variable ≤ comparing value
ABS, GREATER THAN	Absolute value (selected variable) > comparing value
ABS, GREATER THAN/EQUAL TO	Absolute value (selected variable) ≥ comparing value
ABS, LOWER	Absolute value (selected variable) < comparing value
ABS, LOWER THAN/EQUAL TO	Absolute value (selected variable) ≤ comparing value

NOTE This parameter can be accessed only if the operating mode of the selected digital output is > 2. Example: MDO1 **P270**>2.

Testing Variable B for MDO1 (2,3,4): P274, (P283, P292, P301)

If an analog variable is selected, a logic TEST is performed to obtain a TRUE/FALSE Boolean signal.
Seven different tests are available, that can be performed for selected variable B and its comparing value B (see Table 47).

NOTE This parameter can be accessed only if the operating mode of the selected digital output is > 2 and < 9. Example: MDO1 2<**P270**<9.

Reference threshold for P271 (P280, P289, P298) in MDO1: P275, (P284, P293, P302)

This defines the comparing value of Test A with the first selected variable.

NOTE This parameter can be accessed only if the operating mode of the selected digital output is > 2. Example: MDO1 **P270**>2.

Reference threshold for P272 (P281, P290, P299) in MDO2 (3,4): P276, (P285, P294, P303)

This defines the comparing value of Test B with the first selected variable.

NOTE This parameter can be accessed only if the operating mode of the selected digital output is > 2. Example: MDO1 **P270**>2.

MDO1 (2, 3, 4): Function Applied to the Result of Tests A and B: P277, (P286, P295, P304)

A logic function is applied to the two Boolean signals obtained in order to obtain the output TRUE/FALSE Boolean signal.
Six different tests may be performed for variable (A) using the comparing value and variable (B).

(A) OR (B): The selected digital output is enabled when at least one of the two conditions below is true (this function also allows enabling the selected digital input based on one test only).

(A) OR (B)		
Test A	**Test B**	**Output**
0	0	**0**
1	0	**1**
0	1	**1**
1	1	**1**

(A) SET (B) RESET Rising Edge
(A) RESET (B) SET Rising Edge
(A) SET (B) RESET Falling Edge
(A) RESET (B) SET Falling Edge
The selected digital output is activated as the output of a Flip Flop Set Reset whose inputs are signal A and signal B. This function can be used in case of hysteresis.
The status of the input (Qn) depends on the previous value (Qn-1) and on the result of the two tests.
Signals A and B are considered only when passing from 0→1 (Rising Edge) or 1→0 (Falling Edge). Signal A and signal B may be used both as Set and Reset command.
Example: Suppose that the output enables only when the motor speed exceeds 50rpm and disables when the motor speed drops below 5 rpm. To do so, assign the first condition to Test A, representing the Set command for Flip Flop (**P271** = Motor Speed, **P273** >, **P275** = 50rpm), and assign the second condition to Test B, representing the Reset command (**P272** = Motor Speed, **P274** <=, **P276** = 5rpm). A more detailed example is given at the end of this section.

(A) SET (B) RESET Rising Edge		
Test A (Set)	**Test B (Reset)**	**Q_n**
0→1	X	**1**
X	0→1	**0**
In any other case		**Q_{n-1}**

(A) RESET (B) SET Rising Edge		
Test A (Reset)	**Test B (Set)**	**Q_n**
0→1	X	**0**
X	0→1	**1**
In any other case		**Q_{n-1}**

(A) SET (B) RESET Falling Edge		
Test A (Set)	**Test B (Reset)**	**Q_n**
1→0	X	**1**
X	1→0	**0**
In any other case		**Q_{n-1}**

(A) RESET (B) SET Falling Edge		
Test A (Reset)	**Test B (Set)**	**Q_n**
1→0	X	**0**
X	1→0	**1**
In any other case		**Q_{n-1}**

(A) AND (B): The selected digital output enables when both conditions are true.

(A) AND (B)		
Test A	**Test B**	**Output**
0	0	**0**
1	0	**0**
0	1	**0**
1	1	**1**

(A) XOR (B): The selected digital output enables when either one condition or the other is true (but not when both conditions are true at a time).

(A) XOR (B)		
Test A	**Test B**	**Output**
0	0	**0**
1	0	**1**
0	1	**1**
1	1	**0**

(A) NOR (B): The selected digital output enables when no condition is true. The NOR function between two variables corresponds to the AND of the same false variables, i.e. (A)NOR (B) = (/A) AND (/B).

A) NOR (B)		
Test A	**Test B**	**Output**
0	0	**1**
1	0	**0**
0	1	**0**
1	1	**0**

(A) NAND (B): The selected digital output enables when no condition is true or when only one of the two conditions is true. The NAND function between two variables corresponds to the OR of the same false variables, i.e. (A)NAND (B) = (/A) OR (/B).

(A) NAND (B)		
Test A	**Test B**	**Output**
0	0	**1**
1	0	**1**
0	1	**1**
1	1	**0**

NOTE This parameter can be accessed only if the operating mode of the selected digital output is > 2 and <9. Example: MDO1 2<**P270**<9.

unction applied to the result of f(A,B) C for MDO1 P277b, (P286b, P295b, P304b)

Once the Boolean signal resulting from f(A,B) is obtained, an additional logic function can be applied to obtain the output TRUE//FALSE Boolean signal.
If parameter **P277a** is disabled, the output of f(A,B) goes directly to the corresponding digital output; if parameter P277a is enabled, the output of the output of f(A,B) becomes one of the two inputs of the second programmed block.
The user can choose one of the six Boolean tests above for the first variable - f(A,B) – and for the second variable (C). See Example 6.

MDO1 (2,3,4): Logic applied to MDO1 (2,3,4): P278, (P287, P296, P305)

The logic of the Boolean signal can be reversed at the end of the processing chain.
The user can choose whether the logic level of the digital output is POSITIVE or NEGATIVE.
(0) FALSE = a logic negation is applied (NEGATIVE logic)
(1) TRUE = no negation is applied (POSITIVE logic)

NOTE This parameter can be accessed only if the operating mode of the selected digital output is other than zero. Example: MDO1 **P270**≠0.

26.2. Programmable Operating Modes (Diagrams)

The diagrams shown in the figures illustrate the operating structure of MDO1 digital output; the remaining digital outputs (MDO2, MDO3, and MDO4) will follow the same logics, as implemented in the relevant parameters.

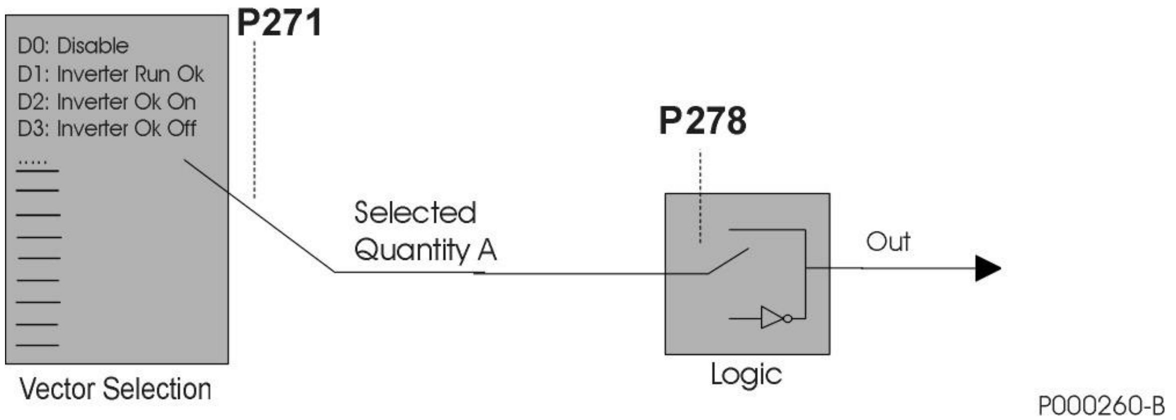


Figure 30: DIGITAL Mode

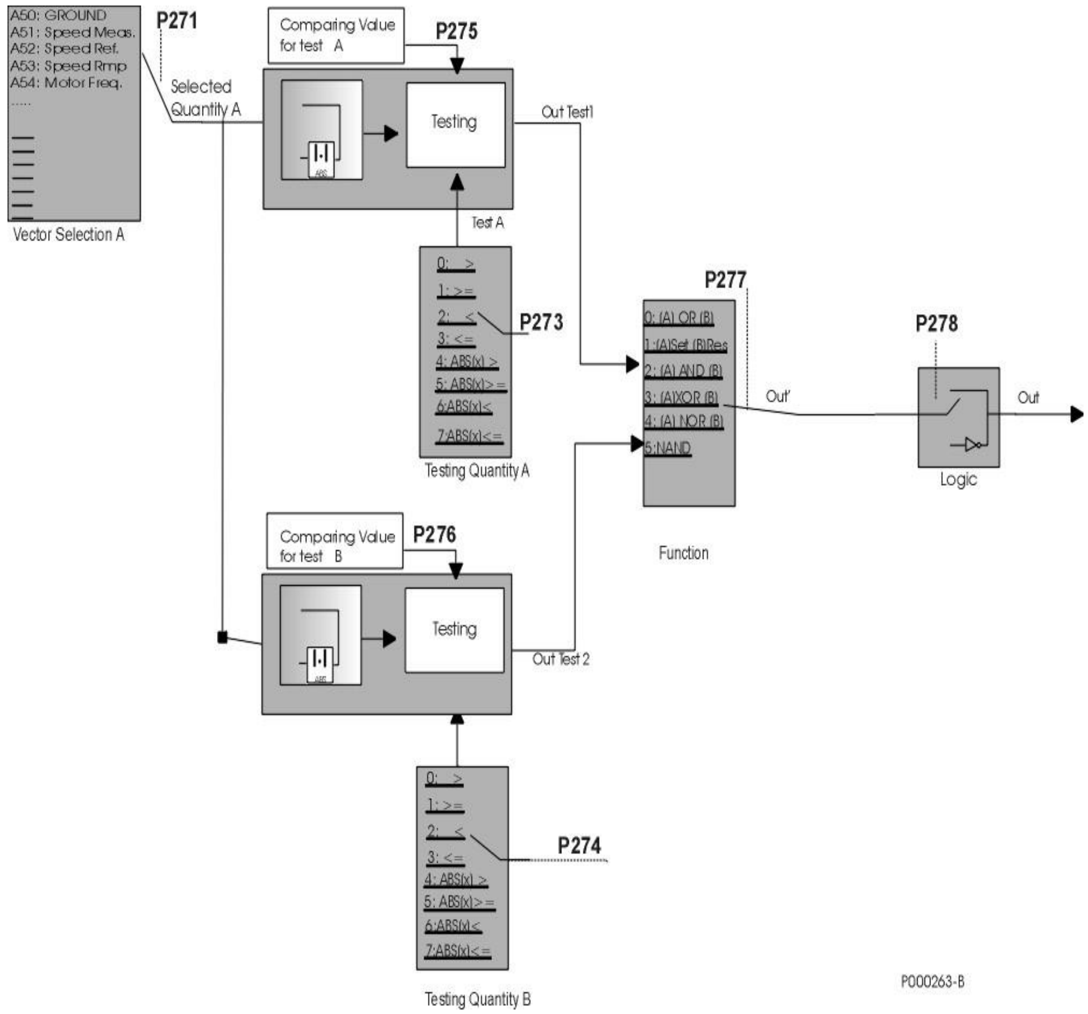


Figure 31: ANALOG Mode

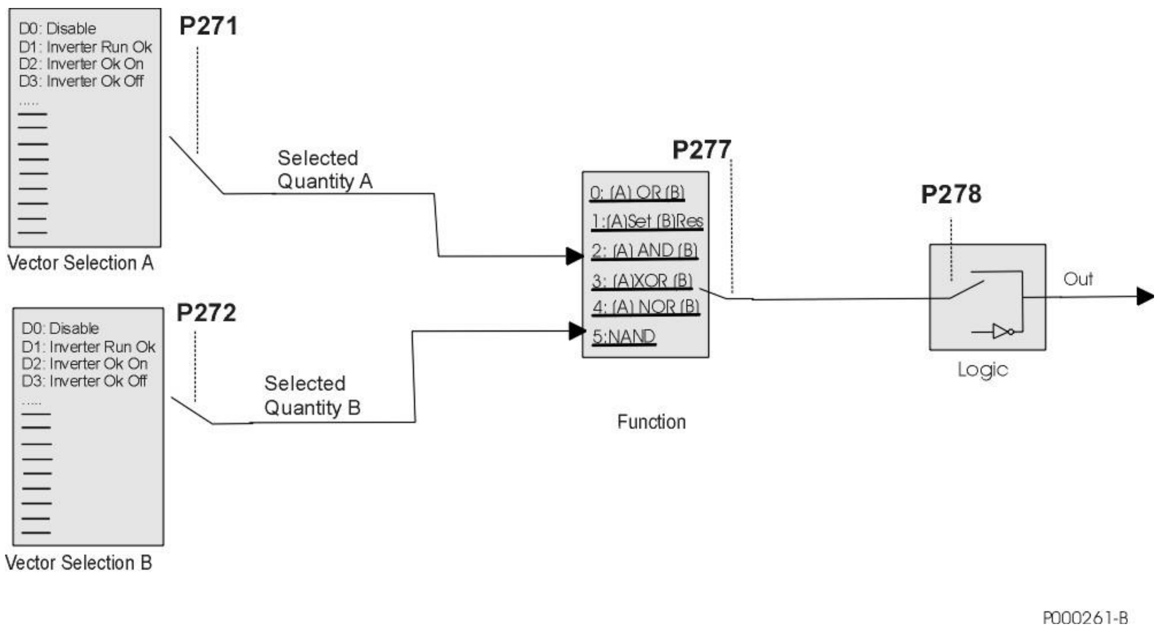


Figure 32: DOUBLE DIGITAL Mode

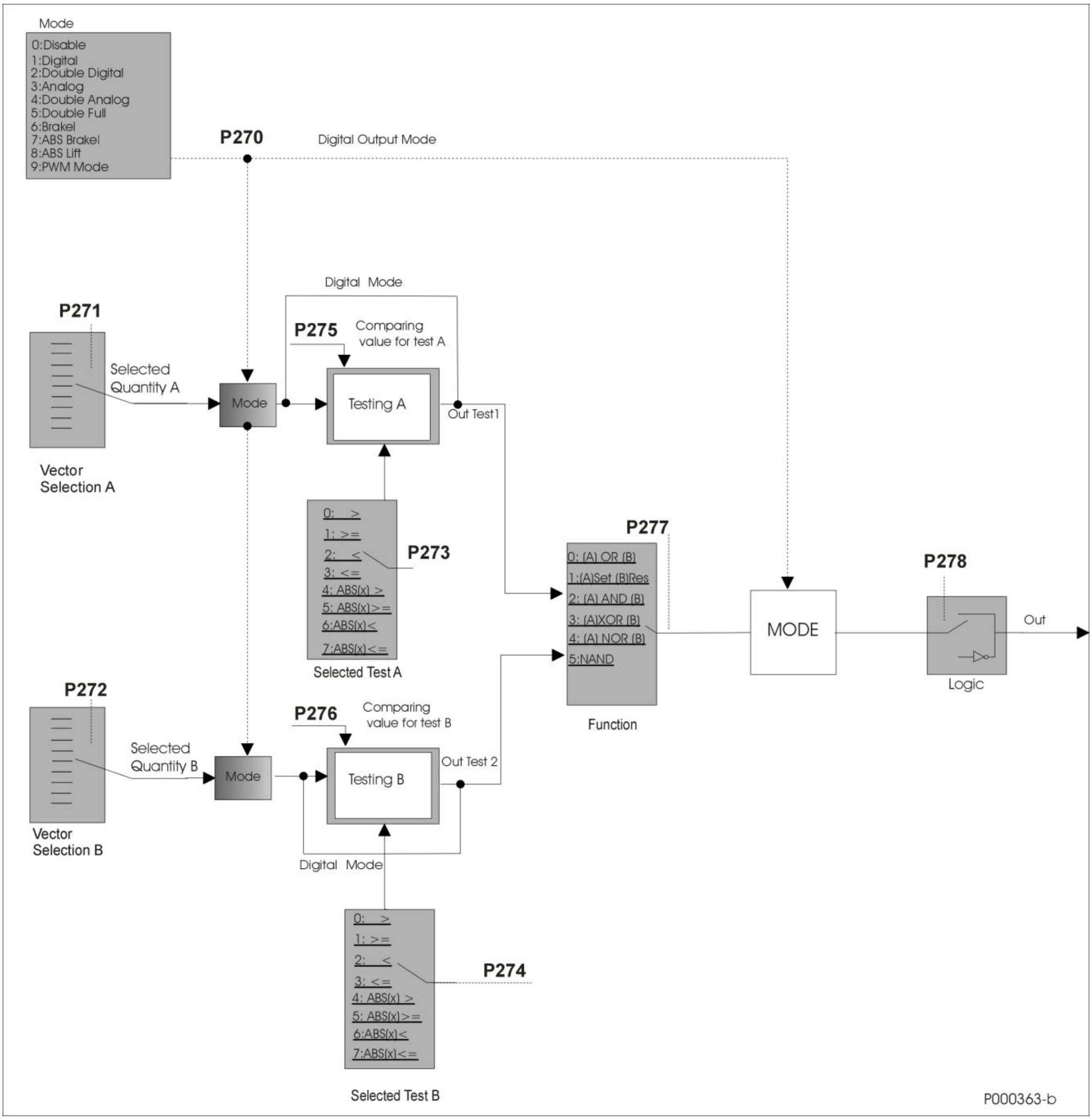


Figure 33: General structure of a digital output parameterization

26.3.Examples

This section illustrates some examples.
A table stating the setup of the parameters used is given for each example.
Parameters highlighted in grey have no effect due to their preset selection.

Example 1: Digital output for Inverter Alarm digital command (MDO3 digital output default setting).

Table 48: MDO parameterization for Drive Status OK

P288	MDO3: Digital output mode	DIGITAL
P289	MDO3: Variable A selection	D3: Inverter Alarm
P290	MDO3: Variable B selection	
P291	MDO3: Testing variable A	
P292	MDO3: Testing variable B	
P293	MDO3: Comparing value for Test A	
P294	MDO3: Comparing value for Test B	
P295	MDO3: Function applied to the result of the two tests	
P295a	MDO3: Variable C selection	D0: Disabled
P295b	MDO3: Function applied to the result of f(A,B) and C test	
P296	MDO3: Output logic level	FALSE

The digital output status depends on the Boolean variable “Inverter Alarm”, which is TRUE only when an alarm trips. This output is a fail-safe contact: the relay energizes if the drive is on and no alarms tripped.

Example 2: Digital output for Drive Run OK digital command (MDO4 digital output default setting)

Table 49: MDO parameterization for drive Run OK

P297	MDO4: Digital output mode	DIGITAL
P298	MDO4: Variable A selection	D1: Drive Run Ok
P299	MDO4: Variable B selection	
P300	MDO4: Testing variable A	
P301	MDO4: Testing variable B	
P302	MDO4: Comparing value for Test A	
P303	MDO4: Comparing value for Test B	
P304	MDO4: Function applied to the result of the two tests	
P295a	MDO3: Variable C selection	D0: Disabled
P295b	MDO3: Function applied to the result of f(A,B) and C test	
P305	MDO4: Output logic level	TRUE

The digital output status depends on the Boolean variable “Drive Run Ok”, which is TRUE only when the drive is modulating (IGBTs on).

Example 3: Digital output for speed thresholds

Suppose that a digital output energizes if the motor speed exceeds 100rpm as an absolute value, and de-energizes when the motor speed is lower than or equal to 20rpm (as an absolute value). Parameter P270 sets ABS mode, so that the selected variables are considered as absolute values. The condition "greater than" is selected for test A, and "lower than/equal to" is selected for test B.

Table 50: MDO parameterization for speed thresholds

P270	MDO1: Digital output mode	DOUBLE ANALOG
P271	MDO1: Variable A selection	A01: Speed
P272	MDO1: Variable B selection	A01: Speed
P273	MDO1: Testing variable A	ABS(x) >
P274	MDO1: Testing variable B	ABS (x) ≤
P275	MDO1: Comparing value for Test A	100.00 rpm
P276	MDO1: Comparing value for Test B	20.00 rpm
P277	MDO1: Function applied to the result of the two tests	(A) Set (B) Reset Rising Edge
P277a	MDO1: Variable C selection	D0: Disabled
P277b	MDO1: Function applied to the result of f(A,B) and C test	
P278	MDO1: Output logic level	TRUE

Both tests are performed over the motor speed; **P271**, **P272** are set to "motor speed". The values of reference for the two tests are 100rpm and 20rpm; the function applied is Flip Flop Set Reset and the output is considered as a true logic. Test A is the Set signal of the Flip Flop and Test B is the Reset signal.

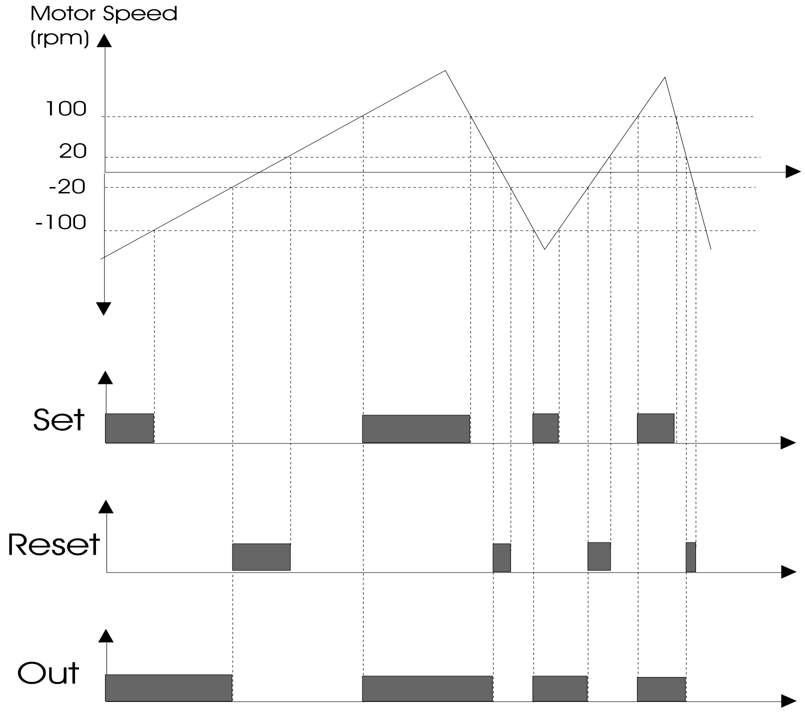


Figure 34: Digital output for speed thresholds (example)

Example 4: Digital output indicating the READY state to a PLC supervisor – using Inputs A, B, C

This example shows how to activate a digital output based on the logic AND of 3 conditions A,B,C—particularly the ENABLE input, the condition of constant speed reference achieved, and the "Inverter Ok On" condition.
An additional block applied to f(A,B) and C is used:

Table 51: MDO parameterization for the Ready state of a PLC supervisor

P270	MDO1: Digital output mode	DOUBLE DIGITAL
P271	MDO1: Variable A selection	D21: Enable
P272	MDO1: Variable B selection	D40: Speed OK
P273	MDO1: Testing variable A	
P274	MDO1: Testing variable B	
P275	MDO1: Comparing value for Test A	
P276	MDO1: Comparing value for Test B	
P277	MDO1: Function applied to the result of the two tests	(A) AND (B)
P277a	MDO1: Variable C selection	D2: Inverter Ok On
P277b	MDO1: Function applied to the result of f(A,B) and C test	f(A,B) AND (C)
P278	MDO1: Output logic level	TRUE

26.4. List of Parameters P270 to P305

Table 52: Lis of Parameters P270 to P305

Parameter	FUNCTION	User Level	DEFAULT VALUES	MODBUS Address
P270	MDO1: Digital output mode	ADVANCED	3: ANALOG	870
P271	MDO1: Selecting variable A	ADVANCED	A01: Speed	871
P272	MDO1: Selecting variable B	ADVANCED	A01: Speed	872
P273	MDO1: Testing variable A	ADVANCED	0: >	873
P274	MDO1: Testing variable B	ADVANCED	3: ≤	874
P275	MDO1: Comparing value for Test A	ADVANCED	50 rpm	875
P276	MDO1: Comparing value for Test B	ADVANCED	10 rpm	876
P277	MDO1: Function applied to the result of the 2 tests	ADVANCED	1: (A) SET (B) RESET	877
P277a	MDO1: Selecting variable C	ADVANCED	0: Disable	620
P277b	MDO1: Function applied to the result of f(A,B) C	ADVANCED	0: f(A,B) OR C	621
P278	MDO1: Output logic level	ADVANCED	1: TRUE	878
P279	MDO2: Digital output mode	ADVANCED	1: DIGITAL	879
P280	MDO2: Selecting variable A	ADVANCED	D40: Spd ok	880
P281	MDO2: Selecting variable B	ADVANCED	D0: Disable	881
P282	MDO2: Testing variable A	ADVANCED	0: >	882
P283	MDO2: Testing variable B	ADVANCED	3: ≤	883
P284	MDO2: Comparing value for Test A	ADVANCED	20%	884
P285	MDO2: Comparing value for Test B	ADVANCED	50 rpm	885
P286	MDO2: Function applied to the result of the 2 tests	ADVANCED	1: (A) SET (B) RESET	886
P286a	MDO2: Selecting variable C	ADVANCED	0: Disable	622
P286b	MDO2: Function applied to the result of f(A,B) C	ADVANCED	0: f(A,B) OR C	623
P287	MDO2: Output logic level	ADVANCED	1: TRUE	887
P288	MDO3: Digital output mode	ADVANCED	1: DIGITAL	988
P289	MDO3: Selecting variable A	ADVANCED	D3: Inverter Alarm	989
P290	MDO3: Selecting variable B	ADVANCED	D3: Inverter Alarm	990
P291	MDO3: Testing variable A	ADVANCED	0: >	991
P292	MDO3: Testing variable B	ADVANCED	0: >	992
P293	MDO3: Comparing value for Test A	ADVANCED	0	993
P294	MDO3: Comparing value for Test B	ADVANCED	0	994
P295	MDO3: Function applied to the result of the 2 tests	ADVANCED	0: (A) OR (B)	995
P295a	MDO3: Selecting variable C	ADVANCED	0: Disable	996
P295b	MDO3: Function applied to the result of f(A,B) C	ADVANCED	0: f(A,B) OR C	997
P296	MDO3: Output logic level	ADVANCED	0: FALSE	998
P297	MDO4: Digital output mode	ADVANCED	1: DIGITAL	698
P298	MDO4: Selecting variable A	ADVANCED	D1: Inverter Run Ok	699
P299	MDO4: Selecting variable B	ADVANCED	D1: Inverter Run Ok	700
P300	MDO4: Testing variable A	ADVANCED	0: >	715
P301	MDO4: Testing variable B	ADVANCED	0: >	716
P302	MDO4: Comparing value for Test A	ADVANCED	0	717
P303	MDO4: Comparing value for Test B	ADVANCED	0	718
P304	MDO4: Function applied to the result of the 2 tests	ADVANCED	0: (A) OR (B)	719
P304a	MDO4: Selecting variable C	ADVANCED	0: Disable	720
P304b	MDO4: Function applied to the result of f(A,B) C	ADVANCED	0: f(A,B) OR C	721
P305	MDO4: Output logic level	ADVANCED	1: TRUE	732

P270	MDO1: Digital Output Mode	
Range	0 ÷ 5	0: DISABLE 1: DIGITAL 2: DOUBLE DIGITAL 3: ANALOG 4: DOUBLE ANALOG 5: DOUBLE FULL
Default	3	3: ANALOG
Level	ADVANCED	
Address	870	
Function	This parameter defines the operating mode of **digital output 1**. The different operating modes are described at the beginning of this chapter. MDO1 digital output may be configured via **P270** if **P630**= “D600: Function Mode” in the [PAR] MMC Digital Outputs Menu, otherwise it is configured based on **P630**.	

NOTE MDO1 Digital output can be programmed only if the frequency output is not set up: **P200** = Disable (see [PAR] ANALOG AND FREQUENCY OUTPUTS MENU).

P271	MDO1: Selecting Variable A	
Range	0 ÷ 149	See Table 46
Default	81	A01: Speed
Level	ADVANCED	
Address	871	
Function	This parameter selects the digital signal used to calculate the value of **MDO1** digital output. It selects an analog variable used to calculate the value of **MDO1** digital output if one of the “analog” operating modes is selected. Digital signals and analog variables are detailed in Table 46.	

P272	MDO1: Selecting Variable B	
Range	0 ÷ 149	See Table 46
Default	81	A01: Speed
Level	ADVANCED	
Address	872	
Function	This parameter selects the second digital signal used to calculate the value of **MDO1** digital output. It selects an analog variable used to calculate the value of **MDO1** digital input if one of the “analog” operating modes is selected. Digital signals and analog variables are detailed in Table 46.	

P273	MDO1: Testing Variable A	
Range	0 ÷ 7	0: > 1: ≥ 2: < 3: ≤ 4: ABS(x) > 5: ABS(x) ≥ 6: ABS(x) < 7: ABS(x) ≤
Default	0	0: >
Level	ADVANCED	
Address	873	
Function	This parameter defines the test to be performed for the variable detected by **P271** using **P275** as a comparing value.	

P274	MDO1: Testing Variable B	
Range	0 ÷ 7	0: > 1: ≥ 2: < 3: ≤ 4: ABS(x) > 5: ABS(x) ≥ 6: ABS(x) < 7: ABS(x) ≤
Default	3	3: ≤
Level	ADVANCED	
Address	874	
Function	This parameter defines the test to be performed for the variable detected by **P272** using **P276** as a comparing value.	

P275	MDO1: Comparing Value for Test A	
Range	–32000 ÷ 32000	–320.00 % ÷ 320.00 % *% of the full-scale value of selected variable A*, see Table 46
Default	50	50 rpm
Level	ADVANCED	
Address	875	
Function	his parameter defines the comparing value with the selected variable for test A.	

P276	MDO1: Comparing Value for Test B	
Range	–32000 ÷ 32000	–320.00 % ÷ 320.00 % *% of the full-scale value of selected variable B*, see Table 46
Default	10	10 rpm
Level	ADVANCED	
Address	876	
Function	This parameter defines the comparing value with the selected variable for test B.	

P277	MDO1: Function Applied to the Result of the 2 Tests	
Range	0 ÷ 12	0: (A) OR (B) 1: (A) SET (B) RESET RISING EDGE 2: (A) AND (B) 3: (A) XOR (B) 4: (A) NOR (B) 5: (A) NAND (B) 6: (A\) OR (B) 7: (A) OR (B\) 8: (A\) AND (B) 9: (A) AND (B\) 10: (A) RESET (B) SET RISING EDGE 11: (A) SET (B) RESET FALLING EDGE 12: (A) RESET (B) SET FALLING EDGE
Default	1	1: (A) SET (B) RESET
Level	ADVANCED	
Address	877	
Function	This parameter determines the logic function applied to the result of the two tests allowing calculating the output value.	

P277a	MDO1: Selecting Variable C	
Range	0 ÷ 79	See Table 46
Default	0	D0: Disable
Level	ADVANCED	
Address	620	
Function	This parameter selects the digital signal used to calculate the value of **MDO1** digital output. The digital signals that can be selected are given in Table 46.	

P277b	MDO1: Function Applied to the Result of f(A,B) C	
Range	0 ÷ 12	0: f(A,B) OR (C) 1: f(A,B) SET (C) RESET RISING EDGE 2: f(A,B) AND (C) 3: f(A,B) XOR (C) 4: f(A,B) NOR (C) 5: f(A,B) NAND (C) 6: f(A,B)\ OR (C) 7: f(A,B) OR (C\) 8: f(A,B)\ AND (C) 9: f(A,B) AND (C\) 10: f(A,B) RESET (C) SET RISING EDGE 11: f(A,B) SET (C) RESET FALLING EDGE 12: f(A,B) RESET (C) SET FALLING EDGE
Default	0	0: f(A,B) OR (C)
Level	ADVANCED	
Address	621	
Function	This parameter determines the logic function applied to the result of the two tests allowing calculating the output value.	

P278	MDO1: Output Logic Level	
Range	0–1	0: FALSE 1: TRUE
Default	1	1: TRUE
Level	ADVANCED	
Address	878	
Function	MDO1 digital output logic function to apply a logic reversal (negation) to the calculated output signal: (0) FALSE = a logic negation is applied; (1) TRUE = no negation is applied.	

P279	MDO2: Digital Output Mode	
Range	0 ÷ 5	0: DISABLE 1: DIGITAL 2: DOUBLE DIGITAL 3: ANALOG 4: DOUBLE ANALOG 5: DOUBLE FULL
Default	1	1: DIGITAL
Level	ADVANCED	
Address	879	
Function	This parameter defines the operating mode of **digital output 2**. The different operating modes are described at the beginning of this chapter. MDO2 digital output may be configured via **P279** if **P632**= “D600: Function Mode” in the [PAR] MMC Digital Outputs Menu, otherwise it is configured via **P632**.	

P280	MDO2: Selecting Variable A	
Range	0 ÷ 149	See Table 46
Default	40	D40: Speed ok
Level	ADVANCED	
Address	880	
Function	This parameter selects the digital signal used to calculate the value of **MDO2** digital output. It selects an analog variable used to calculate the value of **MDO2** digital input if one of the “analog” operating modes is selected. Digital signals and analog variables are detailed in Table 46.	

P281	MDO2: Selecting Variable B	
Range	0 ÷ 149	See Table 46
Default	0	D0: Disable
Level	ADVANCED	
Address	881	
Function	This parameter selects the second digital signal used to calculate the value of **MDO2** digital output. It selects an analog variable used to calculate the value of **MDO2** digital input if one of the “analog” operating modes is selected. Digital signals and analog variables are detailed in Table 46.	

P282	MDO2: Testing Variable A	
Range	0 ÷ 7	0: > 1: ≥ 2: < 3: ≤ 4: ABS(x) > 5: ABS(x) ≥ 6: ABS(x) < 7: ABS(x) ≤
Default	0	0: >
Level	ADVANCED	
Address	882	
Function	This parameter defines the test to be performed for the variable detected by **P280** using **P284** as a comparing value.	

P283	MDO2: Testing Variable B	
Range	0 ÷ 7	0: > 1: ≥ 2: < 3: ≤ 4: ABS(x) > 5: ABS(x) ≥ 6: ABS(x) < 7: ABS(x) ≤
Default	3	3: ≤
Level	ADVANCED	
Address	883	
Function	This parameter defines the test to be performed for the variable detected by **P281** using **P285** as a comparing value.	

P284	MDO2: Comparing Value for Test A	
Range	–32000 ÷ 32000	–320.00 % ÷ 320.00 % *% of the full-scale value of selected variable A,* see Table 46
Default	2000	20%
Level	ADVANCED	
Address	884	
Function	This parameter defines the comparing value with the selected variable for test A.	

P285	MDO2: Comparing Value for Test B	
Range	–32000 ÷ 32000	–320.00 % ÷ 320.00 % *% of the full-scale value of selected variable B*, see Table 46
Default	50	50 rpm
Level	ADVANCED	
Address	885	
Function	This parameter defines the comparing value with the selected variable for test B.	

P286	MDO2: Function Applied to the Result of the 2 Tests	
Range	0 ÷ 12	0: (A) OR (B) 1: (A) SET (B) RESET 2: (A) AND (B) 3: (A) XOR (B) 4: (A) NOR (B) 5: (A) NAND (B) 6: (A\) OR (B) 7: (A) OR (B\) 8: (A\) AND (B) 9: (A) AND (B\) 10: (A) RESET (B) SET RISING EDGE 11: (A) SET (B) RESET FALLING EDGE 12: (A) RESET (B) SET FALLING EDGE
Default	1	1: (A) SET (B) RESET
Level	ADVANCED	
Address	886	
Function	This parameter determines the logic function applied to the result of the two tests allowing calculating the output value.	

P286a	MDO2: Selecting Variable C	
Range	0 ÷ 79	See Table 46
Default	0	D0: Disable
Level	ADVANCED	
Address	622	
Function	This parameter selects the digital signal used to calculate the value of **MDO2** digital output. The digital signals that can be selected are given in Table 46.	

P286b	MDO2: Function Applied to the Result of f(A,B) C	
Range	0 ÷ 12	0: f(A,B) OR (C) 1: f(A,B) SET (C) RESET RISING EDGE 2: f(A,B) AND (C) 3: f(A,B) XOR (C) 4: f(A,B) NOR (C) 5: f(A,B) NAND (C) 6: f(A,B)\ OR (C) 7: f(A,B) OR (C\) 8: f(A,B)\ AND (C) 9: f(A,B) AND (C\) 10: f(A,B) RESET (C) SET RISING EDGE 11: f(A,B) SET (C) RESET FALLING EDGE 12: f(A,B) RESET (C) SET FALLING EDGE
Default	1	1: (A) SET (B) RESET
Level	ADVANCED	
Address	623	
Function	This parameter determines the logic function applied to the result of the two tests allowing calculating the output value.	

P287	MDO2: Output Logic Level	
Range	0–1	0: FALSE 1: TRUE
Default	1	1: TRUE
Level	ADVANCED	
Address	887	
Function	MDO2 digital output logic function to apply a logic reversal (negation) to the calculated output signal: (0) FALSE = a logic negation is applied; (1) TRUE = no negation is applied.	

P288	MDO3: Digital Output Mode	
Range	0 ÷ 5	0: DISABLE 1: DIGITAL 2: DOUBLE DIGITAL 3: ANALOG 4: DOUBLE ANALOG 5: DOUBLE FULL
Default	1	1: DIGITAL
Level	ADVANCED	
Address	988	
Function	This parameter defines the operating mode of **digital output 3**. The different operating modes are described at the beginning of this chapter. MDO3 digital output may be configured via **P288** if **P634**= “D600: Function Mode” in the [PAR] MMC Digital Outputs Menu, otherwise it is configured based on **P634**.	

P289	MDO3: Selecting Variable A	
Range	0 ÷ 149	See Table 46
Default	3	D3: Inverter Alarm
Level	ADVANCED	
Address	989	
Function	This parameter selects the digital signal used to calculate the value of **MDO3** digital output. It selects an analog variable used to calculate the value of **MDO3** digital input if one of the “analog” operating modes is selected. Digital signals and analog variables are detailed in Table 46.	

P290	MDO3: Selecting Variable B	
Range	0 ÷ 149	See Table 46
Default	3	D3: Inverter Alarm
Level	ADVANCED	
Address	990	
Function	This parameter selects the second digital signal used to calculate the value of **MDO3** digital output. It selects an analog variable used to calculate the value of digital input **MDO3** if one of the “analog” operating modes is selected. Digital signals and analog variables detailed in Table 46.	

P291	MDO3: Testing Variable A	
Range	0 ÷ 7	0: > 1: ≥ 2: < 3: ≤ 4: ABS(x) > 5: ABS(x) ≥ 6: ABS(x) < 7: ABS(x) ≤
Default	0	0: >
Level	ADVANCED	
Address	991	
Function	This parameter defines the test to be performed for the variable detected by **P289** using **P293** as a comparing value**.**	

P292	MDO3: Testing Variable B	
Range	0 ÷ 7	0: > 1: ≥ 2: < 3: ≤ 4: ABS(x) > 5: ABS(x) ≥ 6: ABS(x) < 7: ABS(x) ≤
Default	0	0: >
Level	ADVANCED	
Address	992	
Function	This parameter defines the test to be performed for the variable detected by **P290** using **P294** as a comparing value.	

P293	MDO3: Comparing Value for Test B	
Range	–32000 ÷ 32000	–320.00 % ÷ 320.00 % *% of the full-scale value of selected variable A,* see Table 46
Default	0	0
Level	ADVANCED	
Address	993	
Function	This parameter defines the comparing value with the variable selected for test A.	

P294	MDO3: Comparing Value for Test B	
Range	–32000 ÷ 32000	–320.00 % ÷ 320.00 % *% of the full-scale value of selected variable B*, see Table 46
Default	0	0
Level	ADVANCED	
Address	994	
Function	This parameter defines the comparing value with the variable selected for test B.	

P295	MDO3: Function Applied to the Result of the 2 Tests	
Range	0 ÷ 12	0: (A) OR (B) 1: (A) SET (B) RESET 2: (A) AND (B) 3: (A) XOR (B) 4: (A) NOR (B) 5: (A) NAND (B) 6: (A\) OR (B) 7: (A) OR (B\) 8: (A\) AND (B) 9: (A) AND (B\) 10: (A) RESET (B) SET RISING EDGE 11: (A) SET (B) RESET FALLING EDGE 12: (A) RESET (B) SET FALLING EDGE
Default	0	0: (A) OR (B)
Level	ADVANCED	
Address	995	
Function	This parameter determines the logic function applied to the result of the two tests allowing calculating the output value.	

P295a	MDO3: Selecting Variable C	
Range	0 ÷ 79	See Table 46
Default	0	D0: Disable
Level	ADVANCED	
Address	996	
Function	This parameter selects the digital signal used to calculate the value of **MDO3** digital output. The digital signals that can be selected are given in Table 46.	

P295b	MDO3: Function Applied to the Result f(A,B) C	
Range	0 ÷ 12	0: f(A,B) OR (C) 1: f(A,B) SET (C) RESET RISING EDGE 2: f(A,B) AND (C) 3: f(A,B) XOR (C) 4: f(A,B) NOR (C) 5: f(A,B) NAND (C) 6: f(A,B)\ OR (C) 7: f(A,B) OR (C\) 8: f(A,B)\ AND (C) 9: f(A,B) AND (C\) 10: f(A,B) RESET (C) SET RISING EDGE 11: f(A,B) SET (C) RESET FALLING EDGE 12: f(A,B) RESET (C) SET FALLING EDGE
Default	1	1: (A) SET (B) RESET
Level	ADVANCED	
Address	997	
Function	This parameter determines the logic function applied to the result of the two tests allowing calculating the output value.	

P296	MDO3: Output Logic Level	
Range	0–1	0: FALSE 1: TRUE
Default	0	0: FALSE
Level	ADVANCED	
Address	998	
Function	MDO3 digital output logic function to apply a logic reversal (negation) to the calculated output signal: (0) FALSE = a logic negation is applied; (1) TRUE = no negation is applied.	

P297	MDO4: Digital Output Mode	
Range	0 ÷ 5	0: DISABLE 1: DIGITAL 2: DOUBLE DIGITAL 3: ANALOG 4: DOUBLE ANALOG 5: DOUBLE FULL
Default	1	1: DIGITAL
Level	ADVANCED	
Address	698	
Function	This parameter defines the operating mode of **digital output 4**. The different operating modes are described at the beginning of this chapter. MDO4 may be configured via **P297** if **P636**= “D600: Function Mode” in the [PAR] MMC Digital Outputs Menu, otherwise it is configured based on **P636**.	

P298	MDO4: Selecting Variable A	
Range	0 ÷ 149	See Table 46
Default	1	D1: Inverter Run Ok
Level	ADVANCED	
Address	699	
Function	This parameter selects the digital signal used to calculate the value of **MDO4** digital output. It selects an analog variable used to calculate the value of **MDO4** digital input if one of the “analog” operating modes is selected. Digital signals and analog variables are detailed in Table 46.	

P299	MDO4: Selecting Variable B	
Range	0 ÷ 149	See Table 46
Default	1	D1: Inverter Run Ok
Level	ADVANCED	
Address	700	
Function	This parameter selects the second digital signal used to calculate the value of **MDO4** digital output. It selects an analog variable used to calculate the value of **MDO4** digital input if one of the “analog” operating modes is selected. Digital signals and analog variables are detailed in Table 46.	

P300	MDO4: Testing Variable A	
Range	0 ÷ 7	0: > 1: ≥ 2: < 3: ≤ 4: ABS(x) > 5: ABS(x) ≥ 6: ABS(x) < 7: ABS(x) ≤
Default	0	0: >
Level	ADVANCED	
Address	715	
Function	This parameter defines the test to be performed for the variable detected by **P298** using **P302** as a comparing value**.**	

P301	MDO4: Testing Variable B	
Range	0 ÷ 7	0: > 1: ≥ 2: < 3: ≤ 4: ABS(x) > 5: ABS(x) ≥ 6: ABS(x) < 7: ABS(x) ≤
Default	0	0: >
Level	ADVANCED	
Address	716	
Function	This parameter defines the test to be performed for the variable detected by **P299** using **P303** as a comparing value.	

P302	MDO4: Comparing Value for Test A	
Range	–32000 ÷ 32000	–320.00 % ÷ 320.00 % *% of the full-scale value of selected variable A*, see Table 46
Default	0	0
Level	ADVANCED	
Address	717	
Function	This parameter defines the comparing value with the selected variable for test A.	

P303	MDO4: Comparing Value for Test B	
Range	–32000 ÷ 32000	–320.00 % ÷ 320.00 % *% of the full-scale value of selected variable B*, see Table 46
Default	0	0
Level	ADVANCED	
Address	718	
Function	This parameter defines the comparing value with the selected variable for test B.	

P304	MDO4: Function Applied to the Result of the 2 Tests	
Range	0 ÷ 12	0: (A) OR (B) 1: (A) SET (B) RESET 2: (A) AND (B) 3: (A) XOR (B) 4: (A) NOR (B) 5: (A) NAND (B) 6: (A\) OR (B) 7: (A) OR (B\) 8: (A\) AND (B) 9: (A) AND (B\) 10: (A) RESET (B) SET RISING EDGE 11: (A) SET (B) RESET FALLING EDGE 12: (A) RESET (B) SET FALLING EDGE
Default	0	0: (A) OR (B)
Level	ADVANCED	
Address	719	
Function	This parameter determines the logic function applied to the result of the two tests allowing calculating the output value.	

P304a	MDO4: Selecting Variable C	
Range	0 ÷ 79	See Table 46
Default	0	D0: Disable
Level	ADVANCED	
Address	720	
Function	This parameter selects the digital signal used to calculate the value of **MDO4** digital output. The digital signals that can be selected are given in Table 46.	

P304b	MDO4: Function Applied to the Result of f(A,B) C	
Range	0 ÷ 12	0: f(A,B) OR (C) 1: f(A,B) SET (C) RESET RISING EDGE 2: f(A,B) AND (C) 3: f(A,B) XOR (C) 4: f(A,B) NOR (C) 5: f(A,B) NAND (C) 6: f(A,B)\ OR (C) 7: f(A,B) OR (C\) 8: f(A,B)\ AND (C) 9: f(A,B) AND (C\) 10: f(A,B) RESET (C) SET RISING EDGE 11: f(A,B) SET (C) RESET FALLING EDGE 12: f(A,B) RESET (C) SET FALLING EDGE
Default	1	1: (A) SET (B) RESET
Level	ADVANCED	
Address	721	
Function	This parameter determines the logic function applied to the result of the two tests allowing calculating the output value.	

P305	MDO4: Output Logic Level	
Range	0–1	0: FALSE 1: TRUE
Default	1	1: TRUE
Level	ADVANCED	
Address	732	
Function	**MDO4** digital output logic function to apply a logic reversal (negation) to the calculated output signal: (0) FALSE = a logic negation is applied; (1) TRUE = no negation is applied.	

27. [PAR] AUXILIARY DIGITAL OUTPUTS MENU

27.1. Overview

This menu includes the parameters allowing allocating the control functions implemented by means of the digital inputs located on I/O expansion boards. This menu can be viewed only after enabling data acquisition from the expansion boards.

The digital signals that can be allocated to the auxiliary digital outputs are given in Table 46, whilst the digital signals related to the drive operation when in Multimotor mode are given in Table 53.

Table 53: List of the additional digital signals selectable for the auxiliary digital outputs

Selectable digital (BOOLEAN) signals:

Value	Description
D607: TIME OUT	Activation of the adjustment timeout (see [PAR] Adjusting Timeout)
D608: ALL Motors On	All motors on
D609: Motor 2 On	Start Command for Motor M2 (Motor 2 On)
D610: Motor 3 On	Start Command for Motor M3 (Motor 3 On)
D611: Motor 4 On	Start Command for Motor M4 (Motor 4 On)
D612: Motor 5 On	Start Command for Motor M5 (Motor 5 On)
D613: Master MMC	Multimotor Master drive signal. For systems comprising N.2 Multimotor drives, it determines which drive is the Master of the system (Master MMC Signal = On) and which drive is the Slave.
D614: SerComm KO	Serial communications signal when the slave drives are KO (set as 9:Serial Link in **C615** to **C618**). No drive programmed for the control via serial link responds to the drive queries.

27.2. List of Parameters P306 to P317

Table 54: List of Parameters P306 to P317

Parameter	FUNCTION	User Level	DEFAULT VALUES	MODBUS Address
P306	XMDO1: Signal Selection	ENGINEERING	D0: Disable	906
P307	XMDO1: Output Logic Level	ENGINEERING	1: True	907
P308	XMDO2: Signal Selection	ENGINEERING	D0: Disable	908
P309	XMDO2: Output Logic Level	ENGINEERING	1: True	909
P310	XMDO3: Signal Selection	ENGINEERING	D0: Disable	910
P311	XMDO3: Output Logic Level	ENGINEERING	1: True	911
P312	XMDO4: Signal Selection	ENGINEERING	D0: Disable	912
P313	XMDO4: Output Logic Level	ENGINEERING	1: True	913
P314	XMDO5: Signal Selection	ENGINEERING	D0: Disable	914
P315	XMDO5: Output Logic Level	ENGINEERING	1: True	915
P316	XMDO6: Signal Selection	ENGINEERING	D0: Disable	916
P317	XMDO6: Output Logic Level	ENGINEERING	1: True	917

P306	XMDO1: Signal Selection	
Range	0 ÷ 79	See Table 46 and Table 53
Default	0	D0: Disable
Level	ENGINEERING	
Address	906	
Function	Selects the digital signal used to calculate the value of **XMDO1** digital output. It selects an analog variable used to calculate the value of **XMDO1** digital input if one of the “analog” operating modes is selected. Digital signals and analog variables are detailed in Table 46 and Table 53.	

P307	XMDO1: Output Logic Level	
Range	0–1	0: FALSE 1: TRUE
Default	1	1: TRUE
Level	ENGINEERING	
Address	907	
Function	**XMDO1** digital output logic function to apply a logic reversal (negation) to the calculated output signal: (0) FALSE = a logic negation is applied; (1) TRUE = no negation is applied.	

P308	XMDO2: Signal Selection	
Range	0 ÷ 79	See Table 46 e Table 53
Default	0	D0: Disable
Level	ENGINEERING	
Address	908	
Function	Selects the digital signal used to calculate the value of **XMDO2** digital output. It selects an analog variable used to calculate the value of **XMDO2** digital input if one of the “analog” operating modes is selected. Digital signals and analog variables are detailed in Table 46 and Table 53.	

P309	XMDO2: Output Logic Level	
Range	0–1	0: FALSE 1: TRUE
Default	1	1: TRUE
Level	ENGINEERING	
Address	909	
Function	**XMDO2** digital output logic function to apply a logic reversal (negation) to the calculated output signal: (0) FALSE = a logic negation is applied; (1) TRUE = no negation is applied.	

P310	XMDO3: Signal Selection	
Range	0 ÷ 79	See Table 46 and Table 53
Default	0	D0: Disable
Level	ENGINEERING	
Address	910	
Function	Selects the digital signal used to calculate the value of **XMDO3** digital output. It selects an analog variable used to calculate the value of **XMDO3** digital input if one of the "analog" operating modes is selected. Digital signals and analog variables are detailed in Table 46 and Table 53.	

P311	XMDO3: Output Logic Level	
Range	0–1	0: FALSE 1: TRUE
Default	1	1: TRUE
Level	ENGINEERING	
Address	911	
Function	**XMDO3** digital output logic function to apply a logic reversal (negation) to the calculated output signal: (0) FALSE = a logic negation is applied; (1) TRUE = no negation is applied.	

P312	XMDO4: Signal Selection	
Range	0 ÷ 79	See Table 46 and Table 53
Default	0	D0: Disable
Level	ENGINEERING	
Address	912	
Function	Selects the digital signal used to calculate the value of **XMDO4** digital output. It selects an analog variable used to calculate the value of **XMDO4** digital input if one of the "analog" operating modes is selected. Digital signals and analog variables are detailed in Table 46 and Table 53.	

P313	XMDO4: Output Logic Level	
Range	0–1	0: FALSE 1: TRUE
Default	1	1: TRUE
Level	ENGINEERING	
Address	913	
Function	**XMDO4** digital output logic function to apply a logic reversal (negation) to the calculated output signal: (0) FALSE = a logic negation is applied; (1) TRUE = no negation is applied.	

P314	XMDO5: Signal Selection	
Range	0 ÷ 79	See Table 46 and Table 53
Default	0	D0: Disable
Level	ENGINEERING	
Address	914	
Function	Selects the digital signal used to calculate the value of **XMDO5** digital output. It selects an analog variable used to calculate the value of **XMDO5** digital input if one of the “analog” operating modes is selected. Digital signals and analog variables are detailed in Table 46 and Table 53.	

P315	XMDO5: Output Logic Level	
Range	0–1	0: FALSE 1: TRUE
Default	1	1: TRUE
Level	ENGINEERING	
Address	915	
Function	**XMDO5** digital output logic function to apply a logic reversal (negation) to the calculated output signal: (0) FALSE = a logic negation is applied; (1) TRUE = no negation is applied.	

P316	XMDO6: Signal Selection	
Range	0 ÷ 79	See Table 46 and Table 53
Default	0	D0: Disable
Level	ENGINEERING	
Address	916	
Function	Selects the digital signal used to calculate the value of **XMDO6** digital output. It selects an analog variable used to calculate the value of **XMDO6** digital input if one of the “analog” operating modes is selected. Digital signals and analog variables are detailed in Table 46 and Table 53.	

P317	XMDO6: Output Logic Level	
Range	0–1	0: FALSE 1: TRUE
Default	1	1: TRUE
Level	ENGINEERING	
Address	917	
Function	**XMDO6** digital output logic function to apply a logic reversal (negation) to the calculated output signal: (0) FALSE = a logic negation is applied; (1) TRUE = no negation is applied.	

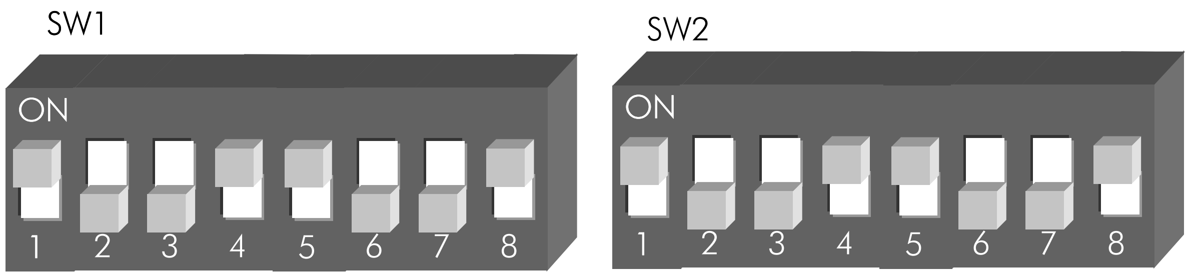
28. [PAR] MEASUREMENT CONTROL FROM PT100 MENU

28.1.Overview

This menu relates to ES847 control board. It can be viewed only if **R023** (I/O board setting) = PT100 (see the [CFG] EXPANSION BOARD CONFIGURATION MENU).

The analog inputs can be linked to measurement sensors.

NOTE Set DIP-Switches 1 and 2 as follows for proper data acquisition from PT100:



28.2.List of Parameters P318 to P325

Table 55: List of Parameters P318 to P325

Parameter	FUNCTION	User Level	DEFAULT VALUE	MODBUS Address
P320	Channel 1: Measurement Mode	ADVANCED	0: no input	920
P321	Channel 1: Measurement Offset	ADVANCED	0.0 °C	921
P322	Channel 2: Measurement Mode	ADVANCED	0: no input	922
P323	Channel 2: Measurement Offset	ADVANCED	0.0 °C	923
P324	Channel 3: Measurement Mode	ADVANCED	0: no input	924
P325	Channel 3: Measurement Offset	ADVANCED	0.0 °C	925
P326	Channel 4: Measurement Mode	ADVANCED	0: no input	926
P327	Channel 4: Measurement Offset	ADVANCED	0.0 °C	927

P320	**Channel 1: Measurement Mode**	
Range	0 ÷ 1	0: no input 1: val PT100
Default	0	0: no input
Level	ADVANCED	
Address	920	
Function	This parameter selects the type of analog signal available in terminals 27–28 in ES847 expansion board. **0:** no signal is used. The P parameter relating to the analog input disappears. **1**: val PT100. The acquired signal is transformed into degrees centigrade. See measurement **M069.**	
P321	**Channel 1: Measurement Offset**	

Range	–30000 ÷ 30000	–300.00 ÷ 300.00 °C
Default	0	0.0 °C
Level	ADVANCED	
Address	921	
Function	Value of the measurement offset for channel 1: an offset can be applied to the measure to correct possible errors.	

P322	**Channel 2: Measurement Mode**	
Range	0 ÷ 1	0: no input 1: val PT100
Default	0	0: no input
Level	ADVANCED	
Address	922	
Function	This parameter selects the type of analog signal available in terminals 29–30 in ES847 expansion board. **0:** no signal is used. The P parameter relating to the analog input disappears. **1**: val PT100. The acquired signal is transformed into degrees centigrade. See Measurement **M070.**	

P323	**Channel 2: Measurement Offset**	
Range	–30000 ÷ 30000	–300.00 ÷ 300.00 °C
Default	0	0.0 °C
Level	ADVANCED	
Address	923	
Function	Value of the measurement offset for channel 2: an offset can be applied to the measurement to correct possible errors.	

P324	**Channel 3: Measurement Mode**	
Range	0 ÷ 1	0: no input 1: val PT100
Default	0	0: no input
Level	ADVANCED	
Address	924	
Function	This parameter selects the type of analog signal available in terminals 31–32 in ES847 expansion board. **0:** no signal is used. The P parameter relating to the analog input disappears. **1**: val PT100. The acquired signal is transformed into degrees centigrade. See Measurement **M071.**	

P325	**Channel 3: Measurement Offset**	
Range	–30000 ÷ 30000	–300.00 ÷ 300.00 °C
Default	0	0.0 °C
Level	ADVANCED	
Address	925	
Function	Value of the measurement offset for channel 3: an offset can be applied to the measurement to correct possible errors.	

P326	**Channel 4: Measurement Mode**

Range	0 ÷ 1	0: no input 1: val PT100
Default	0	0: no input
Level	ADVANCED	
Address	926	
Function	This parameter selects the type of analog signal available in terminals 33–34 in ES847 expansion board. **0:** no signal is used. The P parameter relating to the analog input disappears. **1**: val PT100. The acquired signal is transformed into degrees centigrade. See Measurement **M072**.	

P327	**Channel 4: Measurement Offset**	
Range	–30000 ÷ 30000	–300.00 ÷ 300.00 °C
Default	0	0.0 °C
Level	ADVANCED	
Address	927	
Function	Value of the measurement offset for channel 4: an offset can be applied to the measurement to correct possible errors.	

29. [PAR] FIELDBUS PARAMETERS MENU

29.1. Overview

This menu allows selecting the Third measurement and the Fourth measurement from the Fieldbus.
The list of the selectable measurements is the same as the list in the [MEA] MEASUREMENTS MENU.
The First measurement and the Second measurement are fixed (Output Current and Motor Speed) (see exchanged parameters).

29.2. List of Parameters P330 to P331

Table 56: List of Parameters P330 to P331

Parameter	FUNCTION	User Level	DEFAULT	MODBUS Address
P330	Third measurement from the Fieldbus	ENGINEERING	22: M021 PidErr%	930
P331	Fourth measurement from the Fieldbus	ENGINEERING	23: M022 PID Out%	931

P330	**Third Measurement from the Fieldbus**	
Range	0 ÷ 93 99 ÷ 130	**NONE** ÷ **M027a** **M600** ÷ **M701** See Table 57
Default	22	**M021** PID Error %
Level	ENGINEERING	
Address	930	
Function	The third measurement exchanged via fieldbus may be customized among IRIS BLUE's measurements **M000** to **M027a** and the Multimotor Control measurements **M600** ÷ **M701** with **P330**.	

NOTE The unit of measurement and the scaling ratio are obtained from the Range row of the table describing the selected measurement.

P331	**Fourth Measurement from the Fieldbus**	
Range	0 ÷ 93 99 ÷ 130	**NONE** ÷ **M027a** **M600** ÷ **M701** See Table 57
Default	23	**M022** PID Output %
Level	ENGINEERING	
Address	931	
Function	The third measurement exchanged via fieldbus may be customized among IRIS BLUE's measurements **M000** to **M027a** and the Multimotor Control measurements **M600** ÷ **M701** with **P331**.	

Table 57: List of the programmable measurements in P330 to P331

Misure Controllo Multimotore	M036 Aux. Dig.IN
M600 AvailMotor	M037 Analog In REF
M601 Work.Motor	M038 Analog In AIN1
M602 Setslave	M039 Analog In AIN2
M603 Setmaster	M040 Ser.SpdRef
M604 Ser.Comm.	M042 Fbus.SpdRef
M605 Oper.Mode	M044 Ser.TrqLimRef
M606 SysPwReq	M045 Fbus.TrqLimRef
M607 SysPwMastr	M046 SerPID Ref
M608 SysPwSlave	M047 FbusPID Ref
M609 PowerMastr	M048 SerPID Fbk
M038u AIN1user	M049 FbusPID Fbk
M039u AIN2user	M056 Digital Out
M700 H2ODigOUT	M057 Freq.Out
M701 DryRThresh	M058 Analog Out AO1
Misure Iris Blue	M059 Analog Out AO2
M000 Speed Ref	M060 Analog Out AO3
M002 Ramp Out	M061 Aux. Dig.OUT
M004 Motor Speed	M062 Amb.Temp.
M006 Mot.Freq.	M036a Aux.Ser. Dig.IN
M008 Torq.Demand	M064 Hts.Temp.
M009 Torq.Out	M065 OT Counter
M011 Torq.Dem.%	M066 ST Counter
M012 Torq.Out %	M036b Aux.FBus. Dig.IN
M017 Flux Ref	M022a PID2 Out %
M018 PID Ref %	M069 PT100 Temp.1
M019 PID RmpOut %	M070 PT100 Temp.2
M020 PID Fbk %	M071 PT100 Temp.3
M021 PID Err %	M072 PT100 Temp.4
M022 PID Out %	M028a Energy (low)
M023 PID Ref	M026a I2t %
M024 PID Fbk	M039a Analog In XAIN4
M056a Virtual Dig.Out	M039b Analog In XAIN5
M026 Mot.Current	M018a PID2 Ref %
M027 Out Volt	M019a PID2 RmpOut %
M028 Power Out	M020a PID2 Fbk %
M029 Vbus-DC	M021a PID2 Err %
M030 V Mains	M023a PID2 Ref
M031 Delay.Dig.IN	M024a PID2 Fbk
M032 Istant.Dig.IN	M090 Alarm
M033 Term. Dig.IN	M056b Timed Flags TFL
M034 Ser. Dig.IN	M027a Power Factor
M035 Fbus. Dig.IN	

Measurements specific to Multimotor mode:

M600 AvailMotor
M601 Work.Motor
M602 Setslave
M603 Setmaster
M604 Ser.Comm.
M605 Oper.Mode
M606 SysPwReq
M607 SysPwMastr
M608 SysPwSlave
M609 PowerMastr
M610 ----------
M611 ----------
M612 ----------
M613 ----------
M614 ----------
M615 ----------
M616 ----------
M617 ----------
M618 ----------
M619 ----------
M620 ----------
M621 ----------
M622 ----------
M623 ----------
M624 ----------
M625 ----------
M626 ----------
M627 ----------
M038u AIN1user
M039u AIN2user
M700 H2ODigOUT
M701 DryRThresh
M702 ----------
M703 ----------
M704 ----------
M705 ----------
M706 ----------

30. [PAR] VIRTUAL DIGITAL OUTPUTS (MPL) MENU

30.1. Overview

The Virtual Digital Outputs menu includes the parameters allowing configuring the virtual digital outputs (MPL1..4) of the IRIS BLUE drive.
Virtual digital outputs are logic blocks (no hardware output is provided) allocating more complex logic functions to outputs MDO1..4: MPL virtual outputs can be feedbacked at the input of a new block (hardware or virtual block), thus allowing implementing more complex functionality.

NOTE The Virtual Digital Outputs menu may be accessed only if the user level is ADVANCED or ENGINEERING.

NOTE XMDI auxiliary digital outputs (values from 13 to 20 in the parameters relating to the control functions) can be set up only after setting XMDI/O in parameter **R023**.

30.1.1. Factory Setting

The four virtual digital outputs are disabled as a factory setting.

30.1.2. Structure of the Virtual Digital Outputs

A virtual digital output is composed of two logic blocks allowing data processing before actuating the actual digital output. Block 2 depends on the settings in parameters **P357a** (**P366a**, **P375a, P384a**).
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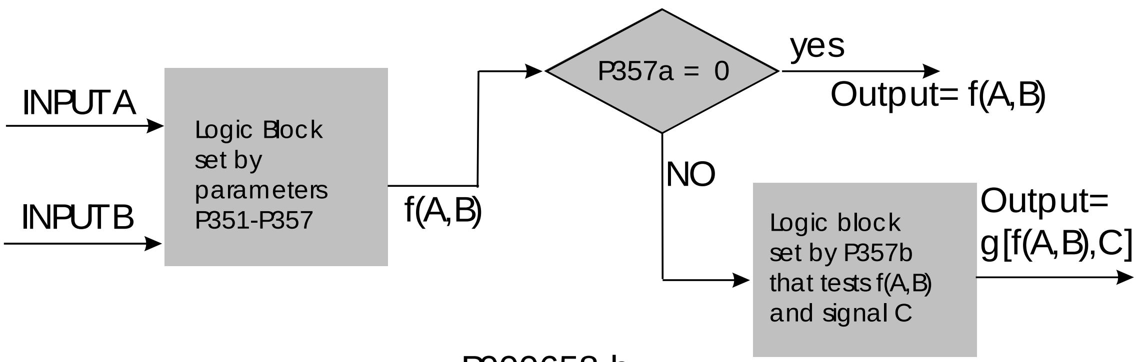


P000658-b

Figure 35: Block diagram of the virtual digital outputs (MPL)

<u>**Operating modes set in MPL1 (2, 3, 4): P350, (P359, P368, P377)**</u>

The user can select one of the following operating modes:

Table 58: Virtual digital output modes

DISABLE	The selected digital output is disabled.
DIGITAL	The digital output depends on a selected digital signal and on the logic output function (True/False).
DOUBLE DIGITAL	The digital output depends on 2 selected digital signals, on the logic function calculating the output value and on the logic output function (True/False).
ANALOG	The digital output depends on a selected analog variable, which is tested through Test A obtaining one digital signal; starting from its value, the selected logic function calculates the True/False end value.
DOUBLE ANALOG	The digital outputs depend on 2 selected analog variables: Test A is performed for variable A, whilst Test B is performed for variable B, thus obtaining 2 digital signals; starting from their value, the selected logic function calculates the output value, whereas the logic output function True/False calculates the end value.
DOUBLE FULL	As DOUBLE ANALOG or DOUBLE DIGITAL mode, but both digital signals and analog variables can be selected. If a digital signal is selected, its TRUE or FALSE value is adopted when computing the selected logic function. If an analog variable is selected, the selected test is executed and its TRUE or FALSE value is used when computing the selected logic function.

Activation	Conditions to be considered in logic AND with the following programmed functions: • Drive accelerating • Drive running, no alarm triggered
Deactivation	Conditions to be considered in logic OR with the following programmed functions: • Drive not running or locked due to an alarm condition

Variable A Selected for MPL1 (2, 3, 4): P351, (P360, P369, P378)

Selects the digital signal or the analog variable used for Test A (set with **P353** / **P362** / **P371** / **P380**).
The whole list of the selectable items and their description are stated in Table 46.
If a digital signal is selected, Test A is not performed: therefore, the comparison value for Test A (set with **P355** / **P364** / **P373** / **P382**) has no meaning.

NOTE This parameter can be accessed only if the operating mode of the digital output concerned is other than zero. Example: MPL1 **P350**≠0.

Variable B selected for MPL1 (2, 3, 4): P352, (P361, P370, P379)

This selects a different digital signal or the analog variable used for Test B (set with **P354** / **P363** / **P372** / **P381**).
The whole list of the selectable items and their description are stated in Table 46.

If a digital signal is selected, Test B is not performed: therefore, the comparison value for Test B (set with **P356** / **P365** / **P374** / **P383**) has no meaning.

NOTE Parameter **P352** cannot be accessed when the digital output operating mode is 1: DIGITAL or 3: ANALOG.

Example: MPL1 **P350**=1 OR **P350**=3.

Testing Variable A for MPL1 (2, 3, 4): P353, (P362, P371, P380)

If an analog variable is selected, a logic TEST is performed to obtain a TRUE/FALSE Boolean signal.
Eight different tests are available, that can be performed for selected variable A and its comparing value A:

Table 59: Test functions

GREATER THAN	Selected variable > comparing value
GREATER THAN/EQUAL TO	Selected variable ≥ comparing value
LOWER	Selected variable < comparing value
LOWER THAN/EQUAL TO	Selected variable ≤ comparing value
ABS, GREATER THAN	Absolute value (selected variable) > comparing value
ABS, GREATER THAN/EQUAL TO	Absolute value (selected variable) ≥ comparing value
ABS, LOWER	Absolute value (selected variable) < comparing value
ABS, LOWER THAN/EQUAL TO	Absolute value (selected variable) ≤ comparing value

NOTE This parameter can be accessed only if the operating mode of the selected digital output is > 2. Example: MPL1 **P350**>2.

Operation on variable B, digital output MPL1 (2, 3, 4): P354, (P363, P372, P381)

If an analog variable is selected, a logic TEST is performed to obtain a TRUE/FALSE Boolean signal.
Eight different tests are available, that can be performed for selected variable B and its comparing value B (see Table 59).

NOTE This parameter can be accessed only if the operating mode of the selected digital output is > 2 and < 9. Example: MPL1 2<**P350**<9.

Reference threshold for P351 (P360, P369, P378) in MPL1 (2, 3, 4): P355, (P364, P373, P382)

Defines the comparing value of Test A with the first selected variable.

NOTE This parameter can be accessed only if the operating mode of the selected digital output is > 2. Example: MPL1 **P350**>2.

Reference threshold for P352 (P361, P370, P379) in MPL1 (2, 3, 4): P356, (P365, P374, P383)

Defines the comparing value of Test B with the first selected variable.

NOTE This parameter can be accessed only if the operating mode of the selected digital output is > 2. Example: MPL1 **P350**>2.

MPL1 (2, 3, 4): Function applied to the result of Tests A and B: P357, (P366, P375, P384)

A logic function is applied to the two Boolean signals obtained in order to obtain the output TRUE/FALSE Boolean signal.

<u>(A) OR (B)</u>: The selected digital output is enabled when at least one of the two conditions below is true (this function also allows enabling the selected digital input based on one test only).

(A) OR (B)		
Test A	Test B	Output
0	0	**0**
1	0	**1**
0	1	**1**

<u>(A) SET (B) RESET Rising Edge</u>
<u>(A) RESET (B) SET Rising Edge</u>
<u>(A) SET (B) RESET Falling Edge</u>
<u>(A) RESET (B) SET Falling Edge</u>

The selected digital output is activated as the output of a Flip Flop Set Reset whose inputs are signal A and signal B. This function can be used in case of hysteresis.
The status of the input (Qn) depends on the previous value (Qn-1) and on the result of the two tests.
Signals A and B are considered only when passing from 0→1 (Rising Edge) or 1→0 (Falling Edge) and may be used both as Set and Reset command.
Example: Suppose that the output enables only when the motor speed exceeds 50rpm and disables when the motor speed drops below 5 rpm. To do so, assign the first condition to Test A, representing the Set command for Flip Flop (**P271** = Motor Speed, **P273** >, **P275** = 50rpm), and assign the second condition to Test B, representing the Reset command (**P272** = Motor Speed, **P274** ≤, **P276** = 5rpm). A more detailed example is given at the end of this section.

(A) SET (B) RESET Rising Edge		
Test A (Set)	**Test B (Reset)**	**Q_n**
0→1	X	**1**
X	0→1	**0**
In any other case		**Q_{n-1}**

(A) RESET (B) SET Rising Edge		
Test A (Reset)	**Test B (Set)**	**Q_n**
0→1	X	**0**
X	0→1	**1**
In any other case		**Q_{n-1}**

(A) SET (B) RESET Falling Edge		
Test A (Set)	**Test B (Reset)**	**Q_n**
1→0	X	**1**
X	1→0	**0**
In any other case		**Q_{n-1}**

(A) RESET (B) SET Falling Edge		
Test A (Reset)	**Test B (Set)**	**Q_n**
1→0	X	**0**
X	1→0	**1**
In any other case		**Q_{n-1}**

(A) AND (B): The selected digital output enables when both conditions are true.

(A) AND (B)		
Test A	**Test B**	**Output**
0	0	**0**
1	0	**0**
0	1	**0**
1	1	**1**

(A) XOR (B): The selected digital output enables when either one condition or the other is true (but not when both conditions are true at a time).

(A) XOR (B)		
Test A	**Test B**	**Output**
0	0	**0**
1	0	**1**
0	1	**1**
1	1	**0**

(**A) NOR (B)**: The selected digital output enables when no condition is true. The NOR function between two variables corresponds to the AND of the same false variables, i.e. (A) NOR (B) = (/A) AND (/B).

(A) NOR (B)		
Test A	**Test B**	**Output**
0	0	**1**
1	0	**0**
0	1	**0**
1	1	**0**

(A) NAND (B): The selected digital output enables when no condition is true or when only one of the two conditions is true. The NAND function between two variables corresponds to the OR of the same false variables, i.e. (A) NAND (B) = (/A) OR (/B).

(A) NAND (B)		
Test A	**Test B**	**Output**
0	0	**1**
1	0	**1**
0	1	**1**
1	1	**0**

NOTE This parameter can be accessed only if the operating mode of the selected digital output is > 2 and <9. Example: MPL1 2<**P350**<9.

Function applied to the result of f(A,B) C for MPL1: P357b, (P366b, P375b, P384b)

Once the Boolean signal resulting from f(A,B) is obtained, an additional logic function can be applied to obtain the output TRUE//FALSE Boolean signal.
If parameter **P357a** is disabled, the output of f(A,B) goes directly to the corresponding digital output; if parameter **P357a** is enabled, the output of the output of f(A,B) becomes one of the two inputs of the second programmed block.
The user can choose one of the six Boolean tests above for the first variable—f(A,B)—and for the second variable (C).

Logic applied to MPL1 (2, 3,4): P358, (P367, P376, P385)
The logic of the Boolean signal can be reversed at the end of the processing chain.
The user can choose whether the logic level of the digital output is POSITIVE or NEGATIVE.
(0) FALSE = a logic negation is applied (NEGATIVE logic).
(1) TRUE = no negation is applied (POSITIVE logic).

NOTE This parameter can be accessed only if the operating mode of the selected digital output is other than zero. Example: MPL1 **P350**≠0.

NOTE Please refer to the Programmable Operating Modes (Diagrams) of the digital outputs.

30.2. Operating Diagram of the Virtual Digital Outputs

Virtual digital outputs are software outputs that can be used as digital inputs from the following items:

- digital inputs
- digital outputs
- auxiliary digital outputs
- virtual digital outputs themselves.

They can be used for special functionality of the system, thus avoiding loop wiring on the same control board.

Example:

It can be necessary to control the status of the physical **ENABLE** contacts (**ENABLE-A** and **ENABLE-B**) of the system to cause an external alarm to trip when MPL1 is selected in parameter **C164** ([CFG] DIGITAL INPUTS MENU).

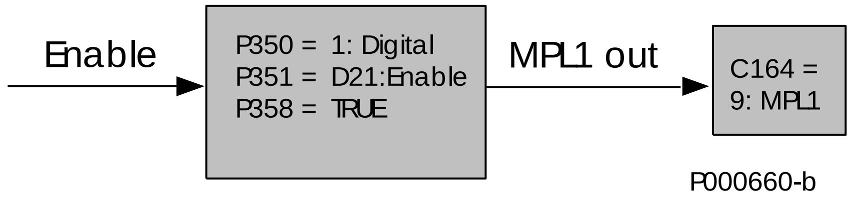


Figure 36: Example of MPL functionality

For more details about possible configurations of the virtual digital outputs, see Programmable Operating Modes (Diagrams).

30.2.1. List of Parameters P350 to P385

Table 60: List of Parameters P350 to P385

Parameter	FUNCTION	Access Level	DEFAULT VALUES	MODBUS Address
P350	MPL1: Digital output mode	ADVANCED	0: DISABLE	680
P351	MPL1: Selecting variable A	ADVANCED	D0: DISABLE	681
P352	MPL1: Selecting variable B	ADVANCED	D0: DISABLE	682
P353	MPL1: Testing variable A	ADVANCED	0: >	683
P354	MPL1: Testing variable B	ADVANCED	0: >	684
P355	MPL1: Comparing value for Test A	ADVANCED	0	685
P356	MPL1: Comparing value for Test B	ADVANCED	0	686
P357	MPL1: Function applied to the result of the 2 tests	ADVANCED	0: (A) OR (B)	687
P357a	MPL1: Selecting variable C	ADVANCED	0: DISABLE	624
P357b	MPL1: Function applied to the result of f(A,B) C	ADVANCED	0: f(A,B) OR C	625
P358	MPL1: Output logic level	ADVANCED	1: TRUE	688
P359	MPL2: Digital output mode	ADVANCED	0: DISABLE	689
P360	MPL2: Selecting variable A	ADVANCED	D0: DISABLE	690
P361	MPL2: Selecting variable B	ADVANCED	D0: DISABLE	691
P362	MPL2: Testing variable A	ADVANCED	0: >	692
P363	MPL2: Testing variable B	ADVANCED	0: >	693
P364	MPL2: Comparing value for Test A	ADVANCED	0	694
P365	MPL2: Comparing value for Test B	ADVANCED	0	695
P366	MPL2: Function applied to the result of the 2 tests	ADVANCED	0: (A) OR (B)	696
P366a	MPL2: Selecting variable C	ADVANCED	0: Disable	626
P366b	MPL2: Function applied to the result of f(A,B) C	ADVANCED	0: f(A,B) OR C	627
P367	MPL2: Output logic level	ADVANCED	1: TRUE	697
P368	MPL3: Digital output mode	ADVANCED	0: DISABLE	733
P369	MPL3: Selecting variable A	ADVANCED	D0: DISABLE	734
P370	MPL3: Selecting variable B	ADVANCED	D0: DISABLE	735
P371	MPL3: Testing variable A	ADVANCED	0: >	736
P372	MPL3: Testing variable B	ADVANCED	0: >	737
P373	MPL3: Comparing value for Test A	ADVANCED	0	738
P374	MPL3: Comparing value for Test B	ADVANCED	0	739
P375	MPL3: Function applied to the result of the 2 tests	ADVANCED	0: (A) OR (B)	740
P375a	MPL3: Selecting variable C	ADVANCED	0: Disable	628
P375b	MPL3: Function applied to the result of f(A,B) C	ADVANCED	0: f(A,B) OR C	629
P376	MPL3: Output logic level	ADVANCED	1: TRUE	741
P377	MPL4: Digital output mode	ADVANCED	0: DISABLE	742
P378	MPL4: Selecting variable A	ADVANCED	D0: DISABLE	743
P379	MPL4: Selecting variable B	ADVANCED	D0: DISABLE	744
P380	MPL4: Testing variable A	ADVANCED	0: >	745
P381	MPL4: Testing variable B	ADVANCED	0: >	746
P382	MPL4: Comparing value for Test A	ADVANCED	0	747
P383	MPL4: Comparing value for Test B	ADVANCED	0	748
P384	MPL4: Function applied to the result of the 2 tests	ADVANCED	0: (A) OR (B)	749
P384a	MPL4: Selecting variable C	ADVANCED	0: Disable	630
P384b	MPL4: Function applied to the result of f(A,B) C	ADVANCED	0: f(A,B) OR C	631
P385	MPL4: Output logic level	ADVANCED	1: TRUE	750

P350	MPL1: Digital Output Mode	
Range	0 ÷ 5	0: DISABLE 1: DIGITAL 2: DOUBLE DIGITAL 3: ANALOG 4: DOUBLE ANALOG 5: DOUBLE FULL
Default	0	0: DISABLE
Level	ADVANCED	
Address	680	
Function	This parameter defines the operating mode of **virtual digital output 1**. The different operating modes are described at the beginning of this chapter.	

P351	MPL1: Selecting Variable A	
Range	0 ÷ 149	See Table 46
Default	21	D21: Enable
Level	ADVANCED	
Address	681	
Function	This parameter selects the digital signal used to calculate the value of **MPL1** digital output. It selects an analog variable used to calculate the value of **MPL1** digital output if one of the "analog" operating modes is selected. Digital signals and analog variables are detailed in Table 46.	

P352	MPL1: Selecting Variable B	
Range	0 ÷ 149	See Table 46
Default	0	D0: Disable
Level	ADVANCED	
Address	682	
Function	This parameter selects the second digital signal used to calculate the value of **MPL1** digital output. It selects an analog variable used to calculate the value of **MPL1** digital input if one of the "analog" operating modes is selected. Digital signals and analog variables are detailed in Table 46.	

P353	MPL1: Testing Variable A	
Range	0 ÷ 7	0: > 1: ≥ 2: < 3: ≤ 4: ABS(x) > 5: ABS(x) ≥ 6: ABS(x) < 7: ABS(x) ≤
Default	0	0: >
Level	ADVANCED	
Address	683	
Function	This parameter defines the test to be performed for the variable detected by **P351** using **P355** as a comparing value.	

P354	MPL1: Testing Variable B	
Range	0 ÷ 7	0: > 1: ≥ 2: < 3: ≤ 4: ABS(x) > 5: ABS(x) ≥ 6: ABS(x) < 7: ABS(x) ≤
Default	0	0: >
Level	ADVANCED	
Address	684	
Function	This parameter defines the test to be performed for the variable detected by **P352** using **P356** as a comparing value.	

P355	MPL1: Comparing Value for Test A	
Range	–32000 ÷ 32000	–320.00 % ÷ 320.00 % *% of the full-scale value of selected variable A*, see Table 46
Default	0	0
Level	ADVANCED	
Address	685	
Function	This parameter defines the comparing value with the selected variable for test A.	

P356	MPL1: Comparing Value for Test B	
Range	–32000 ÷ 32000	–320.00 % ÷ 320.00 % *% of the full-scale value of selected variable B*, see Table 46
Default	0	0
Level	ADVANCED	
Address	686	
Function	This parameter defines the comparing value with the selected variable for test B.	

P357	MPL1: Function Applied to the Result of the 2 Tests	
Range	0 ÷ 12	0: (A) OR (B) 1: (A) SET (B) RESET 2: (A) AND (B) 3: (A) XOR (B) 4: (A) NOR (B) 5: (A) NAND (B) 6: (A\) OR (B) 7: (A) OR (B\) 8: (A\) AND (B) 9: (A) AND (B\) 10: (A) RESET (B) SET RISING EDGE 11: (A) SET (B) RESET FALLING EDGE 12: (A) RESET (B) SET FALLING EDGE
Default	0	0: (A) OR (B)
Level	ADVANCED	
Address	687	
Function	This parameter determines the logic function applied to the result of the tests allowing calculating the output value.	

P357a	MPL1: Selecting Variable C	
Range	0 ÷ 79	See Table 46
Default	0	D0: Disable
Level	ADVANCED	
Address	624	
Function	This parameter selects the digital signal used to calculate the value of **MPL1** digital output. The digital signals that can be selected are given in Table 46.	

P357b	MPL1: Function Applied to the Result of f(A,B) C	
Range	0 ÷ 12	0: f(A,B) OR (C) 1: f(A,B) SET (C) RESET RISING EDGE 2: f(A,B) AND (C) 3: f(A,B) XOR (C) 4: f(A,B) NOR (C) 5: f(A,B) NAND (C) 6: f(A,B)\ OR (C) 7: f(A,B) OR (C\) 8: f(A,B)\ AND (C) 9: f(A,B) AND (C\) 10: f(A,B) RESET (C) SET RISING EDGE 11: f(A,B) SET (C) RESET FALLING EDGE 12: f(A,B) RESET (C) SET FALLING EDGE
Default	0	0: f(A,B) OR (C)
Level	ADVANCED	
Address	625	
Function	This parameter determines the logic function applied to the result of the two tests allowing calculating the output value.	

P358	MPL1: Output Logic Level	
Range	0–1	0: FALSE 1: TRUE
Default	1	1: TRUE
Level	ADVANCED	
Address	688	
Function	MPL1 digital output logic function to apply a logic reversal (negation) to the calculated output signal: (0) FALSE = a logic negation is applied; (1) TRUE = no negation is applied.	

P359	MPL2: Digital Output Mode	
Range	0 ÷ 5	0: DISABLE 1: DIGITAL 2: DOUBLE DIGITAL 3: ANALOG 4: DOUBLE ANALOG 5: DOUBLE FULL
Default	0	0: DISABLE
Level	ADVANCED	
Address	689	
Function	This parameter defines the operating mode of **virtual digital output 2**. The different operating modes are described at the beginning of this chapter.	

P360	MPL2: Selecting Variable A	
Range	0 ÷ 149	See Table 46
Default	33	D33: Fan Fault
Level	ADVANCED	
Address	690	
Function	This parameter selects the digital signal used to calculate the value of **MPL2** digital output. It selects an analog variable used to calculate the value of **MPL2** digital input if one of the “analog” operating modes is selected. Digital signals and analog variables are detailed in Table 46.	

P361	MPL2: Selecting Variable B	
Range	0 ÷ 149	See Table 46
Default	0	D0: Disable
Level	ADVANCED	
Address	691	
Function	This parameter selects the second digital signal used to calculate the value of **MPL2** digital output. It selects an analog variable used to calculate the value of **MPL2** digital input if one of the “analog” operating modes is selected. Digital signals and analog variables are detailed in Table 46.	

P362	MPL2: Testing Variable A	
Range	0 ÷ 7	0: > 1: ≥ 2: < 3: ≤ 4: ABS(x) > 5: ABS(x) ≥ 6: ABS(x) < 7: ABS(x) ≤
Default	0	0: >
Level	ADVANCED	
Address	692	
Function	This parameter defines the test to be performed for the variable detected by **P360** using **P364** as a comparing value.	

P363	MPL2: Testing Variable B	
Range	0 ÷ 7	0: > 1: ≥ 2: < 3: ≤ 4: ABS(x) > 5: ABS(x) ≥ 6: ABS(x) < 7: ABS(x) ≤
Default	0	0: >
Level	ADVANCED	
Address	693	
Function	This parameter defines the test to be performed for the variable detected by **P361** using **P365** as a comparing value.	

P364	MPL2: Comparing Value for Test A	
Range	–32000 ÷ 32000	–320.00 % ÷ 320.00 % *% of the full-scale value of selected variable A,* see Table 46
Default	0	0
Level	ADVANCED	
Address	694	
Function	This parameter defines the comparing value with the selected variable for test A.	

P365	MPL2: Comparing Value for Test B	
Range	–32000 ÷ 32000	–320.00 % ÷ 320.00 % *% of the full-scale value of selected variable A,* see Table 46
Default	0	0
Level	ADVANCED	
Address	695	
Function	This parameter defines the comparing value with the selected variable for test B.	

P366	MPL2: Function Applied to the Result of the 2 Tests	
Range	0 ÷ 12	0: (A) OR (B) 1: (A) SET (B) RESET 2: (A) AND (B) 3: (A) XOR (B) 4: (A) NOR (B) 5: (A) NAND (B) 6: (A\) OR (B) 7: (A) OR (B\) 8: (A\) AND (B) 9: (A) AND (B\) 10: (A) RESET (B) SET RISING EDGE 11: (A) SET (B) RESET FALLING EDGE 12: (A) RESET (B) SET FALLING EDGE
Default	1	1: (A) SET (B) RESET
Level	ADVANCED	
Address	696	
Function	This parameter determines the logic function applied to the result of the two tests allowing calculating the output value.	

P366a	MPL2: Selecting Variable C	
Range	0 ÷ 79	See Table 46
Default	0	D0: Disable
Level	ADVANCED	
Address	626	
Function	This parameter selects the digital signal used to calculate the value of **MPL2** digital output. The digital signals that can be selected are given in Table 46.	

P366b	MPL2: Function Applied to the Result of f(A,B) C	
Range	0 ÷ 12	0: f(A,B) OR (C) 1: f(A,B) SET (C) RESET RISING EDGE 2: f(A,B) AND (C) 3: f(A,B) XOR (C) 4: f(A,B) NOR (C) 5: f(A,B) NAND (C) 6: f(A,B)\ OR (C) 7: f(A,B) OR (C\) 8: f(A,B)\ AND (C) 9: f(A,B) AND (C\) 10: f(A,B) RESET (C) SET RISING EDGE 11: f(A,B) SET (C) RESET FALLING EDGE 12: f(A,B) RESET (C) SET FALLING EDGE
Default	0	0: f(A,B) OR (C)
Level	ADVANCED	
Address	627	
Function	This parameter determines the logic function applied to the result of the two tests allowing calculating the output value.	

P367	MPL2: Output Logic Level	
Range	0–1	0: FALSE 1: TRUE
Default	1	1: TRUE
Level	ADVANCED	
Address	697	
Function	MPL2 digital output logic function to apply a logic reversal (negation) to the calculated output signal: (0) FALSE = a logic negation is applied; (1) TRUE = no negation is applied.	

P368	MPL3: Digital Output Mode	
Range	0 ÷ 5	0: DISABLE 1: DIGITAL 2: DOUBLE DIGITAL 3: ANALOG 4: DOUBLE ANALOG 5: DOUBLE FULL
Default	0	0: DISABLE
Level	ADVANCED	
Address	733	
Function	This parameter defines the operating mode of **virtual digital output 3**. The different operating modes are described at the beginning of this chapter.	

P369	MPL3: Selecting Variable A	
Range	0 ÷ 149	See Table 46
Default	38	D38: Fire Mode
Level	ADVANCED	
Address	734	
Function	This parameter selects the digital signal used to calculate the value of **MPL3** digital output. It selects an analog variable used to calculate the value of digital input **MPL3** if one of the “analog” operating modes is selected. Digital signals and analog variables are detailed in Table 46.	

P370	MPL3: Selecting Variable A	
Range	0 ÷ 149	See Table 46
Default	0	D0: Disable
Level	ADVANCED	
Address	735	
Function	This parameter selects the second digital signal used to calculate the value of **MPL3** digital output. It selects an analog variable used to calculate the value of digital input **MPL3** if one of the “analog” operating modes is selected. Digital signals and analog variables are detailed in Table 46.	

P371	MPL3: Testing Variable A	
Range	0 ÷ 7	0: > 1: ≥ 2: < 3: ≤ 4: ABS(x) > 5: ABS(x) ≥ 6: ABS(x) < 7: ABS(x) ≤
Default	0	0: >
Level	ADVANCED	
Address	736	
Function	This parameter defines the test to be performed for the variable detected by **P369** using **P373** as a comparing value.	

P372	MPL3: Testing Variable B	
Range	0 ÷ 7	0: > 1: ≥ 2: < 3: ≤ 4: ABS(x) > 5: ABS(x) ≥ 6: ABS(x) < 7: ABS(x) ≤
Default	0	0: >
Level	ADVANCED	
Address	737	
Function	This parameter defines the test to be performed for the variable detected by **P370** using **P374** as a comparing value.	

P373	MPL3: Comparing Value for Test A	
Range	–32000 ÷ 32000	–320.00 % ÷ 320.00 % *% of the full-scale value of selected variable A,* see Table 46
Default	0	0
Level	ADVANCED	
Address	738	
Function	This parameter defines the comparing value with the variable selected for test A.	

P374	MPL3: Comparing Value for Test B	
Range	–32000 ÷ 32000	–320.00 % ÷ 320.00 % *% of the full-scale value of selected variable B*, see Table 46
Default	0	0
Level	ADVANCED	
Address	739	
Function	This parameter defines the comparing value with the variable selected for test B.	

P375	MPL3: Function Applied to the Result of the 2 Tests	
Range	0 ÷ 12	0: (A) OR (B) 1: (A) SET (B) RESET 2: (A) AND (B) 3: (A) XOR (B) 4: (A) NOR (B) 5: (A) NAND (B) 6: (A\) OR (B) 7: (A) OR (B\) 8: (A\) AND (B) 9: (A) AND (B\) 10: (A) RESET (B) SET RISING EDGE 11: (A) SET (B) RESET FALLING EDGE 12: (A) RESET (B) SET FALLING EDGE
Default	0	0: (A) OR (B)
Level	ADVANCED	
Address	740	
Function	This parameter determines the logic function applied to the result of the two tests allowing calculating the output value.	

P375a	MPL3: Selecting Variable C	
Range	0 ÷ 79	See Table 46
Default	0	D0: Disable
Level	ADVANCED	
Address	628	
Function	This parameter selects the digital signal used to calculate the value of **MPL3** digital output. The digital signals that can be selected are given in Table 46.	

P375b	MPL3: Function Applied to the Result of f(A,B) C	
Range	0 ÷ 12	0: f(A,B) OR (C) 1: f(A,B) SET (C) RESET RISING EDGE 2: f(A,B) AND (C) 3: f(A,B) XOR (C) 4: f(A,B) NOR (C) 5: f(A,B) NAND (C) 6: f(A,B)\ OR (C) 7: f(A,B) OR (C\) 8: f(A,B)\ AND (C) 9: f(A,B) AND (C\) 10: f(A,B) RESET (C) SET RISING EDGE 11: f(A,B) SET (C) RESET FALLING EDGE 12: f(A,B) RESET (C) SET FALLING EDGE
Default	0	0: f(A,B) OR (C)
Level	ADVANCED	
Address	629	
Function	This parameter determines the logic function applied to the result of the two tests allowing calculating the output value.	

P376	MPL3: Output Logic Level	
Range	0–1	0: FALSE 1: TRUE
Default	1	1: TRUE
Level	ADVANCED	
Address	741	
Function	MPL3 digital output logic function to apply a logic reversal (negation) to the calculated output signal: (0) FALSE = a logic negation is applied; (1) TRUE = no negation is applied.	

P377	MPL4: Digital Output Mode	
Range	0 ÷ 5	0: DISABLE 1: DIGITAL 2: DOUBLE DIGITAL 3: ANALOG 4: DOUBLE ANALOG 5: DOUBLE FULL
Default	0	0: DISABLE
Level	ADVANCED	
Address	742	
Function	This parameter defines the operating mode of **virtual digital output 4**. The different operating modes are described at the beginning of this chapter.	

P378	MPL4: Selecting Variable A	
Range	0 ÷ 149	See Table 46
Default	0	D0: Disable
Level	ADVANCED	
Address	743	
Function	This parameter selects the digital signal used to calculate the value of **MPL4** digital output. It selects an analog variable used to calculate the value of **MPL4** digital input if one of the “analog” operating modes is selected. Digital signals and analog variables are detailed in Table 46.	

P379	MPL4: Selecting Variable B	
Range	0 ÷ 149	See Table 46
Default	0	D0: Disable
Level	ADVANCED	
Address	744	
Function	This parameter selects the second digital signal used to calculate the value of **MPL4** digital output. It selects an analog variable used to calculate the value of **MPL4** digital input if one of the “analog” operating modes is selected. Digital signals and analog variables are detailed in Table 46.	

P380	MPL4: Testing Variable A	
Range	0 ÷ 7	0: > 1: ≥ 2: < 3: ≤ 4: ABS(x) > 5: ABS(x) ≥ 6: ABS(x) < 7: ABS(x) ≤
Default	0	0: >
Level	ADVANCED	
Address	745	
Function	This parameter defines the test to be performed for the variable detected by **P378** using **P382** as a comparing value.	

P381	MPL4: Testing Variable B	
Range	0 ÷ 7	0: > 1: ≥ 2: < 3: ≤ 4: ABS(x) > 5: ABS(x) ≥ 6: ABS(x) < 7: ABS(x) ≤
Default	0	0: >
Level	ADVANCED	
Address	746	
Function	This parameter defines the test to be performed for the variable detected by **P379** using **P383** as a comparing value.	

P382	MPL4: Comparing Value for Test A	
Range	–32000 ÷ 32000	–320.00 % ÷ 320.00 % *% of the full-scale value of selected variable A*, see Table 46
Default	0	0
Level	ADVANCED	
Address	747	
Function	This parameter defines the comparing value with the selected variable for test A.	

P383	MPL4: Comparing Value for Test B	
Range	–32000 ÷ 32000	–320.00 % ÷ 320.00 % *% of the full-scale value of selected variable B*, see Table 46
Default	0	0
Level	ADVANCED	
Address	748	
Function	This parameter defines the comparing value with the selected variable for test B.	

P384	MPL4: Function Applied to the Result of the 2 tests	
Range	0 ÷ 12	0: (A) OR (B) 1: (A) SET (B) RESET 2: (A) AND (B) 3: (A) XOR (B) 4: (A) NOR (B) 5: (A) NAND (B) 6: (A\) OR (B) 7: (A) OR (B\) 8: (A\) AND (B) 9: (A) AND (B\) 10: (A) RESET (B) SET RISING EDGE 11: (A) SET (B) RESET FALLING EDGE 12: (A) RESET (B) SET FALLING EDGE
Default	0	0: (A) OR (B)
Level	ADVANCED	
Address	749	
Function	This parameter determines the logic function applied to the result of the two tests allowing calculating the output value.	

P384a	MPL4: Selecting Variable C	
Range	0 ÷ 79	See Table 46
Default	0	D0: Disable
Level	ADVANCED	
Address	630	
Function	This parameter selects the digital signal used to calculate the value of **MPL4** digital output. The digital signals that can be selected are given in Table 46.	

P384b	MPL4: Function Applied to the Result of f(A,B) C	
Range	0 ÷ 12	0: f(A,B) OR (C) 1: f(A,B) SET (C) RESET RISING EDGE 2: f(A,B) AND (C) 3: f(A,B) XOR (C) 4: f(A,B) NOR (C) 5: f(A,B) NAND (C) 6: f(A,B)\ OR (C) 7: f(A,B) OR (C\) 8: f(A,B)\ AND (C) 9: f(A,B) AND (C\) 10: f(A,B) RESET (C) SET RISING EDGE 11: f(A,B) SET (C) RESET FALLING EDGE 12: f(A,B) RESET (C) SET FALLING EDGE
Default	0	0: f(A,B) OR (C)
Level	ADVANCED	
Address	631	
Function	This parameter determines the logic function applied to the result of the two tests allowing calculating the output value.	

P385	MPL4: Output Logic Level	
Range	0–1	0: FALSE 1: TRUE
Default	1	1: TRUE
Level	ADVANCED	
Address	750	
Function	MPL4 digital output logic function to apply a logic reversal (negation) to the calculated output signal: (0) FALSE = a logic negation is applied; (1) TRUE = no negation is applied.	

NOTE

Although it is possible to program a digital output so that it reflects the drive status, this indication is not be considered “SIL rated” as per the safety standards the STO function relates to. The STO safety function is accomplished with a dedicated and redundant hardware circuit, assessed and certified with defined SIL and PL levels, whereas the control software and the outputs implementing hardware do not meet the requirements above.
For that reason, the output signals within safety functions of the system where the drive is installed must not be used.
For details on the STO function, consult the Safe Torque Off Function – Application Manual.

31. [PAR] INPUTS FOR REFERENCES FROM OPTION BOARD MENU

This menu relates to ES847 I/O expansion board. It can be viewed only if **R023** (I/O board setting) = XAIN (see the [CFG] EXPANSION BOARD CONFIGURATION MENU).
In addition to the analog inputs located on the control board, a current analog input and a voltage analog input can be acquired if ES847 is fitted.

31.1. Scaling Analog Inputs XAIN4, XAIN5

NOTE Please refer to the Motor Drives Accessories – User Manual for hardware details about analog inputs.

Two analog inputs (XAIN4, XAIN5) are located on ES847 control board.
XAIN4 is a current input and XAIN5 is a voltage input. They are both bipolar analog inputs (–10V ÷ +10V or –20mA ÷ +20mA).
For both analog inputs, parameters **P390** to **P399** allow setting the type of signal to be acquired, offset compensation (if any), scaling to obtain a speed reference or a torque reference, the signal filtering time constant.
Parameter **P393** sets the offset of the input analog signal (if **P393**=0 offset is zero), while parameter **P394** defines the filtering time constant (factory setting: **P394** = 100ms).
The voltage signal can be bipolar (**–10V** ÷ **+10V**) or unipolar (**0V** ÷ **+10V**).
The current signal can be bipolar (**–20mA** ÷ **+20mA**), unipolar (**0mA** ÷ **+20mA**) or can have a minimum offset (**4mA** ÷ **20mA**).
The user will set each analog input mode in parameters **P390**, **P395**.

Table 61: Analog input hardware mode

Type / Terminals	Name	Type	Parameter
Differential input / Pin 11,12	XAIN4	±10V Input	**P390**
Differential input / Pin 13,14	XAIN5	±20mA Input	**P395**

NOTE Configurations different from the ones stated in the table above are not allowed.

Scaling is obtained by setting the parameters relating to the **linear function for the conversion** from the value read by the analog input to the corresponding speed/torque reference value.
The **conversion function** is a **straight line** passing through **2 points** in **Cartesian coordinates** having the values read by the analog input in the X-axis, and the speed/torque reference values in the Y-axis. The speed/torque reference values are multiplied by the reference percent parameters.

Each point is detected through its **two coordinates**.

The ordinates of the two points are the following:
the value of **Speed_Min** (or **Trq_Min** for the torque reference) multiplied by the percentage set with **P391a/P396a** for the **first point**; the value of **Speed_Max** (or **Trq_Max** for the torque reference) multiplied by the percentage set with **P392a/P397a** for the **second point**.

Speed_Min is the value of parameter **C028**
Trq_Min is the value of parameter **C047**
Speed_Max is the value of parameter **C029**
Trq_Max is the value of parameter **C048**

The X-axis values of the two points depend on the analog input:

XAIN4 Input:
Parameter **P391** is the X-axis of the **first point;** parameter **P392** is the X-axis of the **second point.**

XAIN5 Input:
Parameter **P396** is the X-axis of the **first point;** parameter **P397** is the X-axis of the **second point.**

(see also Scaling Analog Inputs REF, AIN1, AIN2).

31.2. List of Parameters P390 to P399

Table 62: List of Parameters P390 to P399

Parameter	FUNCTION	Access Level	DEFAULT VALUE	MODBUS Address
P390	Type of signal over **XAIN4** input	ADVANCED	1:0÷10V	766
P391	Value of **XAIN4** input producing min. reference (X-axis)	ADVANCED	0.0V	767
P391a	Percentage of Speed_Min/Trq_Min producing min. reference (Y-axis related to **P391**)	ADVANCED	100.0%	704
P392	Value of **XAIN4** input producing max. reference (X-axis)	ADVANCED	10.0V	768
P392a	Percentage of Speed_Max/Trq_Max producing max. reference (Y-axis related to **P392**)	ADVANCED	100.0%	710
P393	Offset over **XAIN4** input	ADVANCED	0V	769
P394	Filtering time over **XAIN4** input	ADVANCED	100ms	770
P395	Type of signal over **XAIN5** input	ADVANCED	3: 4÷20mA	771
P396	Value of **XAIN5** input producing min. reference (X-axis)	ADVANCED	4.0mA	772
P396a	Percentage of Speed_Min/Trq_Min producing min. reference (Y-axis related to **P396**)	ADVANCED	100.0%	711
P397	Value of **XAIN5** input producing max. reference (X-axis)	ADVANCED	20.0mA	773
P397a	Percentage of Speed_Min/Trq_Min producing min. reference (Y-axis related to **P397**)	ADVANCED	100.0%	712
P398	Offset over **XAIN5** input	ADVANCED	0mA	774
P399	Filtering time over **XAIN5** input	ADVANCED	100 ms	775

P390	Type of Signal over XAIN4	
Range	0 ÷ 1	0: ± 10 V 1: 0 ÷ 10 V
Default	1	1: 0÷10V
Level	ADVANCED	
Address	766	
Function	This parameter selects the type of single–ended, analog signal over XAIN4 terminal in the terminal board. The signal can be a voltage signal, a unipolar signal, or a bipolar signal. **0:** ± 10 V Bipolar voltage input between –10V and +10V. The detected signal is saturated between these two values. **1**: 0 ÷ 10 V Unipolar voltage input between 0V and +10V. The detected signal is saturated between these two values.	

P391	Value of XAIN4 Input Producing Min. Reference (X-axis)	
Range	–100 ÷ 100, if **P390** = 0 0 ÷ 100, if **P390** = 1	–10.0 V ÷ 10.0 V, if **P390 =** 0: ± 10 V 0.0 V ÷ 10.0 V, if **P390** = 1: 0 ÷ 10 V
Default	0	0.0V
Level	ADVANCED	
Address	767	
Function	This parameter selects the value for XAIN4 input signal for minimum reference, or better the reference set in **C028 xP391a** (Master mode) or in **C047xP391a** (Slave mode).	

P391a	Percentage of Speed_Min/Trq_Min. Producing Min. Reference (Y-axis related to P391)	
Range	0 ÷ 1000	100.0%
Default	1000	100.0%
Level	ADVANCED	
Address	704	
Function	This parameter represents the min. speed percentage (or the min. torque percentage for a torque reference) to be used for the minimum reference set with **P391**.	

P392	Value of XAIN4 Input Producing Max. Reference (X-axis)	
Range	–100 ÷ 100, if **P390** = 0 0 ÷ 100, if **P390** = 1	–10.0 V ÷ 10.0 V, if **P390 =** 0: ± 10 V 0.0 V ÷ 10.0 V, if **P390** = 1: 0 ÷ 10 V
Default	100	+10.0V
Level	ADVANCED	
Address	768	
Function	This parameter selects the value for XAIN4 input signal for maximum reference, or better the reference set in **C029xP392a** (Master mode) or in **C048xP392a** (Slave mode).	

P392a	Percentage of Speed_Max/Trq_Max Producing Max. Reference (Y-axis related to P392)	
Range	0 ÷ 1000	100.0%
Default	1000	100.0%
Level	ADVANCED	
Address	710	
Function	This parameter represents the max. speed percentage (or the max. torque percentage for a torque reference) to be used for the maximum reference set with **P392.**	

P393	Offset over XAIN4 Input	
Range	–1000 ÷ 1000	–10.00 V ÷ +10.00 V
Default	0	0.00 V
Level	ADVANCED	
Address	769	
Function	This parameter selects the offset correction value of the **XAIN4** analog signal that has been measured. The value set is added to the signal measured before saturation or conversion; its unit of measurement is the same as the one of the signal selected for **XAIN4** analog input.	

P394	Filtering Time over XAIN4 Input	
Range	0 ÷ +65000	0 ÷ +65000ms
Default	100	100 ms
Level	ADVANCED	
Address	770	
Function	This parameter selects the value of the filter time constant of the first command applied to the XAIN4 input signal when the signal saturation and conversion is over.	

P395	Type of Signal over XAIN5 Input	
Range	3 ÷ 5	3: ± 20 mA 4: 4 ÷ 20 mA 5: 0 ÷ 20 mA
Default	3	3: 4 ÷ 20 mA
Level	ADVANCED	
Address	771	
Function	This parameter selects the type of differential analog signal over terminals **XAIN5+** and **XAIN5–** in the terminal board. The signal can be a current signal, a unipolar signal, or a bipolar signal. **3:** ±20 mA Bipolar current input between –20mA and +20mA. The detected signal is saturated between these two values. **4**: 4 ÷ 20 mA Unipolar current input with min. threshold, between +4 mA and +20mA. The detected signal is saturated between these two values. Before being saturated, if the detected signal is lower than 4 mA or greater than 20 mA, alarms **A069** or **A086** trip. **5**: 0 ÷ 20 mA Unipolar current input between +0 mA and +20mA. The detected signal is saturated between these two values.	

P396	Value of XAIN5 Producing Min. Reference (X-axis)	
Range	–200 ÷ 200, if **P395** = 3 +40 ÷ 200, if **P395** = 4 0 ÷ 200, if **P395** = 5	–20.0 mA ÷ 20.0 mA, if **P395** = 3: ± 20 mA +4.0 mA ÷ 20.0 mA, if **P395** = 4: 4 ÷ 20 mA 0.0 mA ÷ 20.0 mA, if **P395** = 5: 0 ÷ 20 mA
Default	40	+4.0mA
Level	ADVANCED	
Address	772	
Function	This parameter selects the value for XAIN5 input signal for minimum reference, or better the reference set in **C028xP396a** (Master mode) or in **C047xP396a** (Slave mode).	

P396a	Percentage of Speed_Min/Trq_Min Producing Min. Reference (Y-axis related to P396)	
Range	0 ÷ 1000	100.0%
Default	1000	100.0%
Level	ADVANCED	
Address	711	
Function	This parameter represents the min. speed percentage (or the min. torque percentage for a torque reference) to be used for the minimum reference set with **P396.**	

P397	Value of XAIN5 Input Producing Max. Reference (X-axis)	
Range	–200 ÷ 200, if **P395** = 3 +40 ÷ 200, if **P395** = 4 0 ÷ 200, if **P395** = 5	–20.0 mA ÷ 20.0 mA, if **P395**= 3: ± 20 mA +4.0 mA ÷ 20.0 mA, if **P395**= 4: 4 ÷ 20 mA 0.0 mA ÷ 20.0 mA, if **P395**= 5: 0 ÷ 20 mA
Default	200	+20.0mA
Level	ADVANCED	
Address	773	
Function	This parameter selects the value for XAIN5 input signal for maximum reference, or better the reference set in **C029xP397a** (Master mode) or in **C048xP397a** (Slave mode).	

P397a	Percentage of Speed_Max/Trq_Max Producing Max. Reference (Y-axis related to P397)	
Range	0 ÷ 1000	100.0%
Default	1000	100.0%
Level	ADVANCED	
Address	712	
Function	This parameter represents the max. speed percentage (or the max. torque percentage for a torque reference) to be used for the maximum reference set with **P397**.	

P398	Offset over XAIN5 Input	
Range	–2000 ÷ 2000	– 20.00 mA ÷ +20.00 mA
Default	0	0 mA
Level	ADVANCED	
Address	774	
Function	This parameter selects the offset correction value of XAIN5 analog signal that has been measured. The value set is added to the signal measured before saturation or conversion; its unit of measurement is the same as the one of the signal selected for XAIN5 analog input.	

P399	Filtering Time over XAIN5 Input	
Range	0 ÷ +65000	0 ÷ +65000ms
Default	100	100 ms
Level	ADVANCED	
Address	775	
Function	This parameter selects the value of the filter time constant of the first command applied to XAIN5 input signal when the signal saturation and conversion is over.	

32. [PAR] DRY-RUN CONTROL MENU

Thanks to the Dry-run detection function, the drive is capable of detecting when the pump is working under Dry-run conditions or when cavitation is about to occur.

The Dry-run Control algorithm is based on electrical measurements of the motor and does not require pressure measurements, as these are not always available and, moreover, are dependent on the application. This allows the Dry-run Control to be kept activated even in speed control only.

The reference variables for the Dry-run Control conditions may be selected via parameter **P710:**

- Electric power
- Power factor (*cos(*□□)

The latter guarantees greater sensitivity and accuracy.
The user may choose the most suitable measurement based on the type of application.
These values are computed and displayed runtime and are part of the custom measurements to be displayed on the keypad for easier calibration.

32.1.Calibration

The Dry-run zone is to be defined based on the plant and the characteristic curves of the connected pump.
As shown in the figure below, the zone is limited by 2 points at two different operating frequency values.

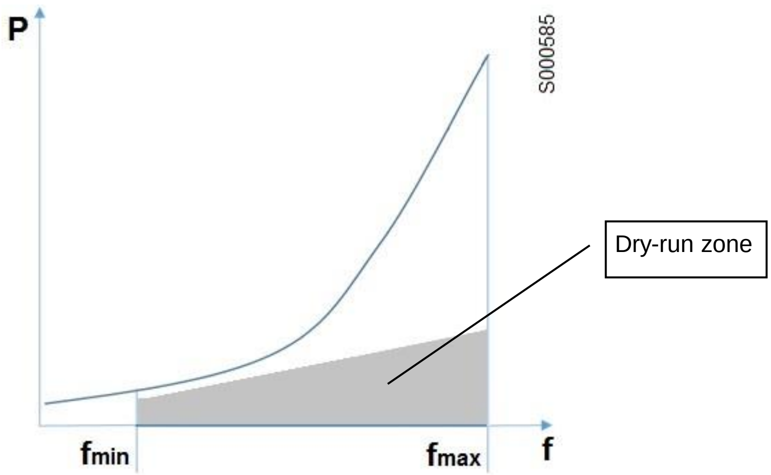


Figure 37: Dry-run zone

The two Dry-run points are set in parameters **P710a-P710b** and **P710c-P710d.**
Parameter **P711** inhibits the Dry-run detection below a preset operating frequency.

The calibration guidelines for two different applications are given below:

1) **Speed control, without pressure PID**
- Stop water flow from the plant (valve closure).
- Reach maximum speed and set **P710c**.
- Set **P710d** to a value lower than the selected Dry-run measurement (electric power or power factor).
- Repeat the steps above by adopting a low speed reference.

2) **When using active PID pressure**
- Stop water flow from the plant (valve closure).
- Set the pressure reference at maximum desired plant pressure.
- From the speed measurement, set **P710c**.
- Set **P710d** to a value lower than the selected Dry-run measurement (electric power or power factor).
- Repeat the steps above by adopting a low speed reference.

NOTE A simplified procedure, where the same value is entered (e.g. minimum power factor detected at low rpm reference) both in parameter **P710a** Low Frequency for Dry-run Threshold and in parameter **P710c** High Frequency for Dry-run Threshold, is generally acceptable for most applications.

32.2. Dry-run Activation

The Dry-run function activates if both the following conditions are true:

- Operation in Dry-run zone (see Figure 37)
- Speed reference greater than the minimum value between **P711** and **C029** (with suitable adjustment of the units of measurement controlled internally to the drive)

If the Dry-run condition persists for a time longer than **P712**, the action defined in **P716** is carried out.
To facilitate testing or expand activation logics, parameter **P715** is available, allowing allocating an MDI to the deactivation of the Dry-run function.

If the Dry-run function is active, resetting its activation is possible

- either manually (by pressing the reset button on the keypad)
- or automatically if the system quits the Dry-run detection mode for a time longer than **P713**. The automatic reset allows for the service re-activation without manual activation after a transient condition has occurred, such as a transient lower level of water in a well.

When **P716** is set as Alarm or Warning, the autoreset countdown is shown on the keypad.

32.3.List of Parameters P710 to P716

Table 63: List of Parameters P710 to P716

Parameter	FUNCTION	Access Level	DEFAULT VALUE	MODBUS Address
P710	Variable for Dry-run Detection	ADVANCED	Power Factor	888
P710a	Low Frequency for Dry-run Threshold	ADVANCED	0.00%fnom	889
P710b	Low Frequency Dry-run Threshold	ADVANCED	0	890
P710c	High Frequency for Dry-run Threshold	ADVANCED	100.00%fnom	891
P710d	High Frequency Dry-run Threshold	ADVANCED	0	892
P711	Min. Disable Frequency	ADVANCED	0.00%fnom	893
P712	Trip Time	ADVANCED	20.0 s	894
P713	Autoreset Time	ADVANCED	30 s	895
P714	Filter Time Constant for Variable	ADVANCED	300 ms	896
P715	Disable Digital Input	ADVANCED	0: Disable	897
P716	Trip Action	ADVANCED	0: Disable	898

P710	**Variable for Dry-run Detection**	
Range	0 ÷ 1	0: Electrical Power 1: Power Factor
Default	1	1: Power Factor
Level	ADVANCED	
Address	888	
Function	Defines the measurement for the Dry-run detection.	

P710a	**Low Frequency for Dry-run Threshold**	
Range	0 ÷ 10000	0 ÷ 100.00 %fnom
Default	0	0.00 %fnom
Level	ADVANCED	
Address	889	
Function	Speed for the first point defining the Dry-run function (fmin, see Figure 37). Expressed as a percentage of **C015**: nominal motor frequency.	

P710b	**Low Frequency Dry-run Threshold**	
Range	0 ÷ 10000 if **P710** = 0: Electrical Power 0 ÷ 100 if **P710** = 1: Power Factor (cosphi)	0 ÷ 100.00 if **P710** = 0: Electrical Power 0 ÷ 1.00 if **P710** = 1: Power Factor (cosphi)
Default	0	0.00 %fnom
Level	ADVANCED	
Address	889	
Function	Value of the measurement for the detection of the Dry-run function, selected in P710, at the speed of the first point **P710a** (fmin, see Figure 37).	

P710c	High Frequency for Dry-run Threshold	
Range	0 ÷ 10000	0 ÷ 100.00 %fnom
Default	10000	100.00 %fnom
Level	ADVANCED	
Address	891	
Function	Speed for the second point defining the operating range of the Dry-run function (fmax, see Figure 37). Expressed as a percentage of **C015**: nominal motor frequency.	

P710d	High Frequency Dry-run Threshold	
Range	0 ÷ 10000 if **P710** = 0: Electrical Power 0 ÷ 100 if **P710** = 1: Power Factor	0 ÷ 100.00 if **P710** = 0: Electrical Power 0 ÷ 1.00 if **P710** = 1: Power Factor
Default	0	0.00
Level	ADVANCED	
Address	892	
Function	Value of the measurement for the detection of the Dry-run function, selected in P710, at the speed of the second point **P710c** (fmax, see Figure 37).	

P711	Min. Disable Frequency	
Range	0 ÷ 10000	0 ÷ 100.00 %fnom
Default	0	0.00 %fnom
Level	ADVANCED	
Address	893	
Function	Frequency below which the Dry-run condition detection is kept disabled. Expressed as a percentage of **C015**: nominal motor frequency.	

P712	Trip Time	
Range	0 ÷ 32000	0 ÷ 3200.0 s
Default	200	20.0 s
Level	ADVANCED	
Address	894	
Function	Minimum time for the Dry-run condition to be true before triggering the function activation as per **P716**.	

P713	Autoreset Time	
Range	0 ÷ 3200	0 ÷ 3200 s
Default	30	30 s
Level	ADVANCED	
Address	895	
Function	Timeout for the latest detection occurrence of the Dry-run condition. If **P716** is set as Alarm or Warning, this value is the starting point of the reset countdown. - If alarm **A136** trips, autoreset is performed (if enabled via **C255**) once the time set in **P713** has elapsed starting from the time when the alarm tripped - If warning **W51** fires, parameter **P713** is the time when the warning indication is kept activated. In case of manual reset, the time in **P713** has no effect (it is possible to send a reset command also before the time **P713** is over).	

P714	Filter Time Constant for Variable	
Range	0 ÷ 32000	0 ÷ 32000 ms
Default	300	300 ms
Level	ADVANCED	
Address	896	
Function	First order filter time constant applied to the reference variable chosen in **P710.** Useful in case of electric noise affecting the variable.	

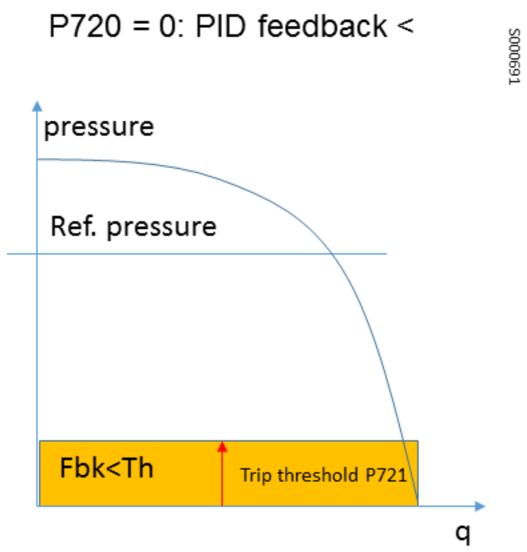
P715	Disable Digital Input	
Range	0 ÷ 24	0 ÷ 24:XMDI8
Default	0	0: Disable
Level	ADVANCED	
Address	897	
Function	If a digital input is set, when the signal is high, the Dry-run detection is disabled.	

P716	Trip Action	
Range	0 ÷ 3	0: Disable 1: Alarm 2: Warning 3: Only MDO
Default	0	0: Disable
Level	ADVANCED	
Address	898	
Function	When a Dry-run condition is detected for a time equal to at least the time set in **P712**, the selected action is executed. The default setting is “No action”. The possible options are: • the triggering of alarm **A136** (drive stop) or • warning **W51** signal (displayed on the keypad, but the drive is kept running). If an MDO for Dry-run detection set as **D70:** DryRun from the [PAR] DIGITAL OUTPUTS MENU is allocated to this function, the MDO status will be changed in cases 1, 2 and 3 (Alarm, Warning or Only MDO). Option 3 (Only MDO) is required to have only the MDO command without any additional signal.	

33. [PAR] PRESSURE LOSS CONTROL MENU

The Pressure Loss detection function is useful to identify water leakage or faults in the hydraulic system.
A pressure PID regulator is required.
The pressure loss condition is based on PID measurements, errors or feedback, according to what is set in **P720**:

- The function activation based on the error is required to enable the function for all the working points and is based on an offset percent with respect to the PID error.
- The logic based on the feedback PID measurement is required to prevent the system from operating below a given pressure threshold. This is very useful when the Pressure Loss function is adopted to fight cavitation, a phenomenon that could occur due to the excessive flow required to compensate for a fault leading to sudden pressure loss.



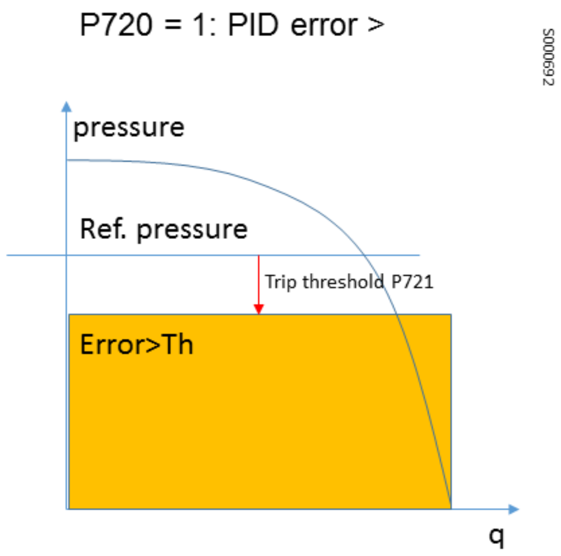


Figure 38: Setting P720 for pressure loss detection

The threshold parameter is **P721** and its meaning is dependent on the setting in **P720**.

33.1. List of Parameters P720 to P723

Table 64: List of Parameters P720 to P723

Parameter	FUNCTION	Access Level	DEFAULT VALUE	MODBUS Address
P720	Threshold Type Selector for Alarm Tripped	ADVANCED	1: PID error >	900
P721	Trip Threshold	ADVANCED	15.00 %err	901
P722	Trip Time	ADVANCED	30.0s	902
P723	Trip Action	ADVANCED	0: Disable	903

P720	**Threshold Type Selector for Alarm Tripped**	
Range	0 ÷ 1	0: PID feedback < 1: PID error >
Default	1	1: PID error >
Level	ADVANCED	
Address	900	
Function	Defines the measurement to be considered for the Pressure Loss logic between PID error greater than the threshold and PID smaller than the threshold. The threshold parameter is **P721**.	

P721	**Trip Threshold**	
Range	0 ÷ 32000	0 ÷ 320.00 %err
Default	1500	15.00 %err
Level	ADVANCED	
Address	901	
Function	Threshold value for the activation of the Pressure Loss function. The meaning of this parameter is dependent on the selector in **P720**. It is worth PID error percent (if exceeded, the Pressure Loss function activates) or PID feedback percent (if the PID feedback value drops below the preset threshold, the Pressure Loss function activates).	

P722	**Trip Time**	
Range	0 ÷ 32000	0 ÷ 3200.0 s
Default	300	30.0 s
Level	ADVANCED	
Address	902	
Function	Minimum time for the Pressure Loss condition to be true before triggering the function activation as per **P723**.	

P723	**Trip Action**	
Range	0 ÷ 3	0: Disable 1: Alarm 2: Warning 3: Only MDO
Default	0	0: Disable
Level	ADVANCED	
Address	898	
Function	When a Pressure Loss condition is detected for a time equal to at least the time set in **P722**, the selected action is executed. The default setting is “No action”. The possible options are: • the triggering of alarm **A137** (drive stop) or • warning **W52** signal (displayed on the keypad, but the drive is kept running). If an MDO for Dry-run detection set as **D71:** PressureLoss from the [PAR] DIGITAL OUTPUTS MENU is allocated to this function, the MDO status will be changed in cases 1, 2 and 3 (Alarm, Warning or Only MDO). Option 3 (Only MDO) is required to have only the MDO command without any additional signal.	

34. [PAR] PIPE FILL CONTROL MENU

The hydraulic systems are affected by the “water hammer” phenomenon, occurring in case of sudden changes in pressure and that may damage piping, thus adversely affecting the lifetime of the system.
The water hammer phenomenon may occur if pipes are filled in an abrupt way.
The Pipe Fill function has been developed to smoothly control pipe fill and avoid water hammer phenomena damaging hydraulic outlets (such as irrigation nozzles) by limiting the system filling rate.

The Pipe Fill logic is a general-purpose one to better meet the customer’s application requirements, i.e. vertical or horizontal systems:

- In vertical systems, the more pipes are full, the greater the pressure. In that case, the acceleration ramp must be slower and maintain constant flow rate for the time required for pressure stabilization.

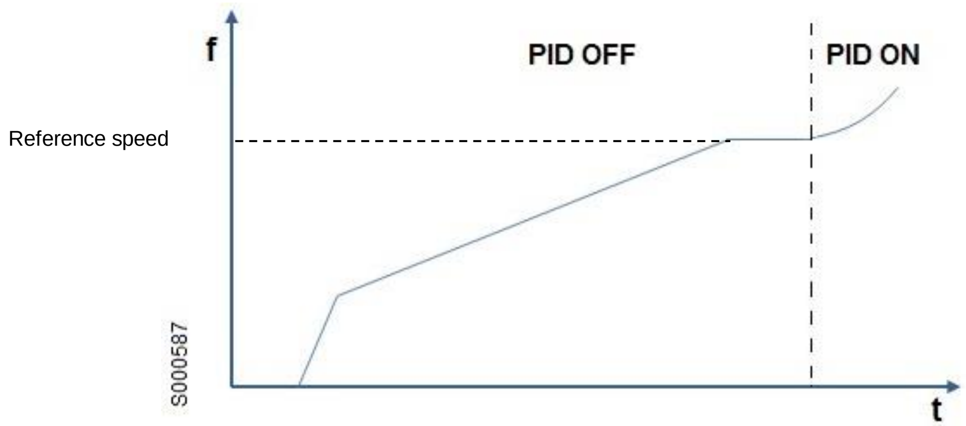


Figure 39: Ramp example – filling vertical pipes

- In horizontal systems, pressure does not increase during pipe fill, so the pipe fill rate may be attained quickly and can be kept constant for the time required to fill the whole pipe length.

The figure below shows the pipe fill rate trend over time in case of vertical and horizontal plant.

Figure 40: Ramp example – filling horizontal pipes

If the PID regulator is adopted, parameter **P734** allows choosing whether to stop pipe fill when the preset fill time is over, or even when the PID reference is attained.
When the PID is disabled, the Pipe Fill function will stop when the preset fill time is achieved and will be resumed to reach the reference fill rate via the active ramps.

34.1.List of Parameters P730 to P734

Table 65: List of Parameters P730 to P734

Parameter	FUNCTION	Access Level	DEFAULT VALUE	MODBUS Address
P730	Pipe Fill Ramp	ADVANCED	10.0 s	932
P731	Pipe Fill Rate	ADVANCED	30.00%fnom	933
P732	Pipe Fill Time	ADVANCED	5s	934
P734	Pipe Fill Enable Mode	ADVANCED	Disable	936

P730	**Pipe Fill Ramp**	
Range	0 ÷ 32000	0 ÷ 3200.0 s
Default	100	10.0 s
Level	ADVANCED	
Address	932	
Function	Determines the time taken to go from zero rpm to the value set in **P731**.	

P731	**Pipe Fill Rate**	
Range	0 ÷ 32000	0 ÷ 320.00 % Fnom
Default	3000	30.00 % Fnom
Level	ADVANCED	
Address	933	
Function	Determines the pipe fill rate for the reference during the Pipe Fill stage.	

P732	**Pipe Fill Time**	
Range	0 ÷ 32000	0 ÷ 32000 s
Default	5	5 s
Level	ADVANCED	
Address	934	
Function	Indicates the time when the pipe fill rate is kept at the value set in **P731**.	

P734	Pipe Fill Enable Mode	
Range	0 ÷ 2	0: Disabled 1: Enabled 2: Enabled + PID feedback
Default	0	0: Disabled
Level	ADVANCED	
Address	936	
Function	0: Disabled The Pipe Fill function is inactive and the active ramps are implemented. 1: Enabled The function is active; exiting the Pipe Fill mode is conditioned only when the preset times are over 2: Enabled + PID feedback The function is active; exiting the Pipe Fill mode is conditioned when the preset times are over or when the PID reference is attained.	

35. [CFG] AUTOTUNE MENU

35.1. Overview

NOTE See the FIRST STARTUP section for tuning based on the control algorithm to be used.

NOTE At the end of the Autotune procedure, the system automatically saves the whole parameter set of the drive.

NOTE Autotune must be performed only after entering the motor ratings.
Please refer to the [CFG] MOTOR CONFIGURATION MENU.

The motor may be tuned in order to obtain the machine ratings or the parameterization required for the correct functioning of the control algorithms.

The Autotune menu includes two programming inputs, **I073** and **I074**. Input **I073** allows enabling and selecting the type of autotune. Input **I074** - which can be programmed only if **I073** = Motor Tune - describes the type of autotune which is performed. Because the values set in **I073** and **I074** cannot be changed once for all and are automatically reset after autotune, the **ENABLE-A ENABLE-B** signals must be disabled and the **ESC** key must be used to accept the new value.

35.1.1. Motor Autotune and Adjusting Loops

Set **I073** as Motor Tune to enable autotune functions that can be selected with **I074**.

NOTE

For the correct operation of the tuning algorithms, enter the motor ratings.

If carrier frequency is changed via parameters **C001** and **C002**, the current control loop of the VTC regulator is to be adjusted again (see "VTC" Control Algorithm).

The autotune procedure computes the motor parameters and the regulators parameters regardless of the control algorithm selected via **C010**. Therefore, it is possible to perform the autotune procedure before selecting the type of motor control to be applied.

Please refer to the [CFG] MOTOR CONFIGURATION MENU.

Table 66: Type of programmable "Motor Tune" functions

Value of I074	Motor Rotation	Tuning executed
[0: Motor Params]	no	Motor parameter tuning through **automatic** estimation based on motor measurements or ratings. Tuning required for the correct operation of IFD and VTC control with slip compensation. The following parameters are computed: - Stator resistance **C022**, through automatic estimation - Leakage inductance **C023**, through automatic estimation - If **C021**=0, a first trial value for no-load current **C021** is computed based on the motor ratings (rated power in particular), otherwise, the value in **C021** is not changed. An accurate value for **C021** is required when using the VTC control algorithm, so it is recommended that it is measured by means of a special test as detailed in the FIRST STARTUP. - Mutual inductance **C024**, based on motor ratings and no-load current. - If **C025**=0, a first trial value for rotor time constant **C025,** otherwise the value in **C025** is not changed. Although a first trial value for the rotor time constant is computed, the correct operation of the VTC control algorithm requires that the rotor time constant is computed via the procedure **I074** =[2: Control YES rot] or is manually and properly entered.
[1: Control NO rot]	no	**Autotune** of the current loop for VTC control. For the correct operation of the VTC control algorithm, it is possible to perform this type of tuning if the motor shaft cannot rotate. During that procedure, current pulses are applied to the motor. The current amplitude of the current pulses is up to the rated current. Before performing this procedure, tune motor parameters through **I074** = [0: Motor Params]. For the VTC control, parameters **P175t** (proportional gain of the current gain) and **P175u** (integral time of the current control) through motor measurements are estimated. If frequency modulation is changed for the VTC regulator gain calibration, [1: Control NO rot] needs to be calibrated again.
[2: Control YES rot]	yes	**Autotune** of the rotor time constant (through motor measurements) and the VTC current loop. For the correct operation of the VTC algorithm, it is recommended to perform this type of tuning if the motor shaft can rotate with no connected load. If the motor cannot rotate, perform procedure **I074** = [1: Control NO rot], that does not automatically estimate the rotor time constant. During this procedure, current pulses are first applied to the motor when the rotor is standstill (current pulse amplitude is up to the rated current). Consequently, the motor is started with no connected load up 70% of the rated speed. If the VTC control is selected, the following parameters are estimated: **P175t1** (proportional gain of the current control) and **P175u** (integral time of the current control) by way of motor measurements. The procedure computes and saves the rotor time constant **C025** by way of motor measurements. If frequency modulation is changed for the VTC regulator gain calibration, [2: Control YES rot] needs to be calibrated again.

35.2.List of Inputs I073 to I074

Table 67: List of Inputs I073 to I074

Input	FUNCTION	User Level	MODBUS Address
I073	Type of Autotune	BASIC	1460
I074	Type of Motor Tune	BASIC	1461

I073	**Type of Autotune**	
Range	0 ÷ 1	0: Disable 1: Motor Tune
Default	This is not a programming parameter: the input is set to zero whenever the drive is powered on and whenever the command is executed.	
Level	BASIC	
Address	1460	
Function	**I073** selects the type of tune to perform. If you select [1: Motor Tune]: **I074** sets different types of tune for current loops, flux loops and speed loops and for the estimation of the motor ratings (see Motor Autotune and Adjusting Loops).	

I074	**Type of Motor Tune**	
Range	0 ÷ 2	0: Motor Params 1: Control NO rot 2: Control YES rot
Default	This is not a programming parameter: the input is set to zero whenever the drive is powered on and whenever the command is executed.	
Level	BASIC	
Address	1461	
Function	**I074** selects the type of autotune to perform if **I073** = [1: Motor Tune] (see section Motor Autotune and Adjusting Loops).	

NOTE No changes can be made to **I073** and **I074** when the **ENABLE-A** and **ENABLE-B** signals are present. If you attempt to change these values when the **ENABLE-A** and **ENABLE-B** signals are present, **“W34 ILLEGAL DATA”** warning appears. Remove the **ENABLE-A** and **ENABLE-B** signals to change these values and activate them again to begin the selected autotune process.

NOTE If **SAVE/ENTER** is pressed to store the changes made to **I073** and **I074**, **“W17 SAVE IMPOSSIBLE”** warning appears. Use the **ESC** key instead.

36. [CFG] CARRIER FREQUENCY MENU

36.1. Overview

The Carrier Frequency Menu makes it possible to set some of the PWM modulation characteristics based on the preset type of control.

It is possible to gain access to all the parameters included in the Carrier Frequency menu.
The user can set the minimum value and the maximum value of the switching carrier frequency and the number of pulses per period used to produce the output frequency when switching from min. carrier frequency to max. carrier frequency (synchronous modulation).

The silent modulation function can also be enabled (**C004**).

36.1.1. Example

Setting two levels of carrier frequency and the number of pulses used for synchronous modulation.
A lower value for carrier frequency ensures a better performance of the motor in terms of output torque but implies higher noise levels. Suppose that the connected motor has a rated speed equal to 1500rpm at 50Hz and that you need the best performance up to 200rpm and a “noiseless” carrier frequency at max. speed (3000rpm).
In this case, the max. speed of the drive will produce an output voltage with a frequency value equal to 100Hz; in proximity to this speed the carrier frequency should be at its maximum level. Suppose that a model implementing max. 16kHz carrier frequency is used.
Assign the following:
C001 = 1600Hz
C002 = 16000Hz
C003 ≥ (**C002** / 100Hz) = (160 pulses per period)

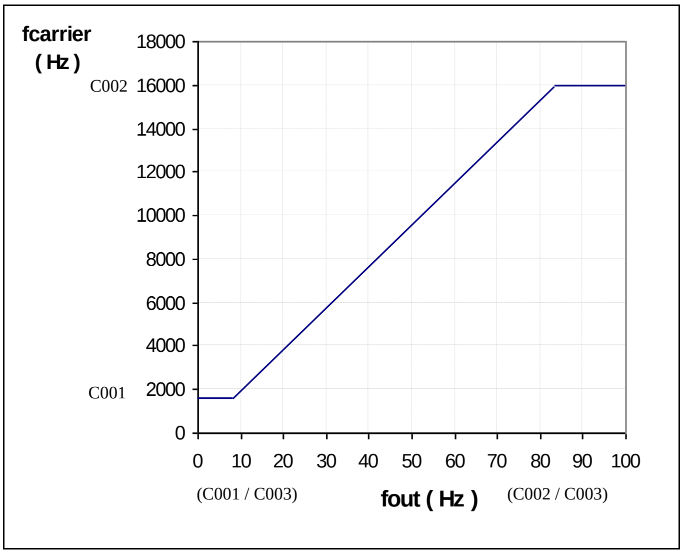


Figure 41: Carrier frequency (example)

Suppose that **C003** = 192np, so that **C002/C003** = 16000/192 = 83.33Hz. The max. carrier frequency is obtained with this output frequency. The min. frequency is kept constant until frequency **C001/C003** = 8.33 Hz is attained, corresponding to 250 rpm of the motor speed. In the output frequency range, ranging from 8.33 to 83.33Hz, synchronous modulation is obtained and the carrier frequency applied results from: f carrier = fout * **C003** [Hz].

36.1.2. Maximum Programmable Speed Value

The maximum preset carrier frequency value also limits the maximum speed value to be programmed:

Max. programmable speed → rated speed x (maximum output frequency/rated frequency)
where the maximum output frequency results from the following:

C002 > 5000Hz **fout_max = C002 / 16**
C002 ≤ 5000Hz **fout_max = C002 / 10**

Where **C002** is the maximum carrier frequency and the divisor is the min. allowable number of pulses per period.

Table 68: Maximum value of the output frequency depending on the drive size

Size	Max. output frequency (Hz) (*)
	2T/4T
0005 to 0129 (**)	599
0150 to 0260	500

(**) 625Hz on demand, except for 0005, 0007, 0009, 0011, 0014 and 0040 (1000Hz) and for 0049 (800Hz).

(*) NOTE The maximum output frequency is limited to the speed level programmed in parameters **C028, C029 [–32000 ÷ 32000]rpm.** This results in **$Fout_{max}$= (RPM_{max}xNPoles)/120.**

EXAMPLE:
When using a 4-pole motor and 30,000rpm are required, F_{out} will be 1000Hz, so the performance requirements are fulfilled.
On the other hand, if the same performance requirements are needed with an 8-pole system, 30,000rpm cannot be obtained, as F_{out} is 2000Hz. As a result, when using an 8-pole motor, the maximum allowable programmable speed is 15,000rpm[RPM_{outmax}=(F_{outmax}x120)/(number of motor poles)].

36.2. List of Parameters C001 to C004

Table 69: List of Parameters C001 to C004

Parameter	FUNCTION	User Level	MODBUS Address	DEFAULT VALUES
C001	Minimum carrier frequency	ENGINEERING	1001	See Table 77
C002	Maximum carrier frequency	ENGINEERING	1002	See Table 77
C003	Number of pulses	ENGINEERING	1003	1:[24]
C004	Silent modulation	ENGINEERING	1004	See Table 77

The default value and the max. value of carrier frequency (**C001** and **C002**) depend on the drive size.
To check those values, see Table 77.

C001	**Minimum Carrier Frequency**	
Range	1600 ÷ 16000 *Depending on the drive model*	1600 ÷ 16000Hz *Depending on the drive model.* See Table 77
Default	See Table 77	
Level	ENGINEERING	
Address	1001	
Function	It represents the min. value of the modulation frequency being used.	

ATTENTION If the carrier frequency is changed via parameters **C001** or **C002**, a new tuning of the current control loops and the VTC flux regulator is required (see "VTC" Control Algorithm).

C002	**Maximum Carrier Frequency**	
Range	1600 ÷ 16000 *Depending on the drive model*	1600 ÷ 16000Hz *Depending on the drive model*. See Table 77
Default	See Table 77	
Level	ENGINEERING	
Address	1002	
Function	It represents the max. value of the modulation frequency being used.	

NOTE The max. value set in **C002** cannot be lower than the min. value set in **C001**. Decrease the min. value in **C001** if you need to decrease the max. value and if **C001** equals **C002**.

NOTE The max. value in **C002** also determines the max. allowable speed value for the selected motor, in order to ensure a minimum number of pulses per period of frequency produced. This value is 16 for maximum carrier frequency (max. **C002** value) greater than 5kHz and 10 for lower maximum carrier frequency (see Table 77).

C003	Pulse Number	
Range	0–5	0: [12] 1: [24] 2: [48] 3: [96] 4: [192] 5: [384]
Default	1	1: [24]
Level	ENGINEERING	
Address	1003	
Function	This parameter has effect only if **C001≠C002**. It represents the min. value of pulses per period obtained when modulation frequency changes (synchronous modulation).	

C004	Silent Modulation	
Range	0–1	0: [No]; 1: [Yes]
Default	See Table 77	
Level	ENGINEERING	
Address	1004	
Function	This parameter enables silent modulation. The electric noise due to the switching frequency is dampened.	

37. [CFG] MOTOR CONFIGURATION MENU

37.1.Overview

The control algorithms are identified with the acronyms:

- ✓ **IFD** (Voltage/Frequency Control);
- ✓ **VTC** (Vector Torque Control);

The **Voltage/Frequency control** allows controlling the motor by producing voltage depending on frequency.
The **Vector Torque Control (sensorless)** processes the machine equations depending on the equivalent parameters of the asynchronous machine. It also allows separating torque control from flux control with no need to use a transducer.

The parameter set for the motors to be configured is included in the [CFG] MOTOR CONFIGURATION MENU.

Table 70 shows the parameters in the [CFG] MOTOR CONFIGURATION MENU by type of motor.

Table 70: Description of the parameters classified by motor

Parameter Contents	Motor Control
Control algorithm being used	**C010**
Type of reference being used (speed/torque) (see Torque Control (VTC Only))	**C011**
Electric ratings of the motor	**C015 ÷ C025**
Max. speed and min. speed required, max. speed alarm threshold and enable	**C028 ÷ C031**
V/f pattern parameters	**C013 / C032 ÷ C038**
Slip compensation activation	**C039**
Drop in rated current voltage	**C040**
Fluxing ramp time	**C041**

The parameters that can be modified depend on the type of control that has been selected.

37.1.1. Electric Motor Ratings

This group of parameters can be divided into two subunits: the first subunit includes the motor ratings, the second subunit includes the parameters of the equivalent circuit of the asynchronous machine being used.

37.1.2. Motor Ratings

Table 71: Motor ratings

Type of Motor Ratings	Motor
Rated frequency	**C015**
Rated rpm	**C016**
Rated power	**C017**
Rated current	**C018**
Rated voltage	**C019**
No-load power	**C020**
No-load current	**C021**

37.1.3. PARAMETERS OF THE EQUIVALENT CIRCUIT OF THE ASYNCHRONOUS MACHINE

Table 72: Parameters of the equivalent circuit of the asynchronous machine

Type of data item	Motor
Stator resistance	**C022**
Leakage inductance	**C023**
Mutual inductance	**C024**
Rotor time constant	**C025**

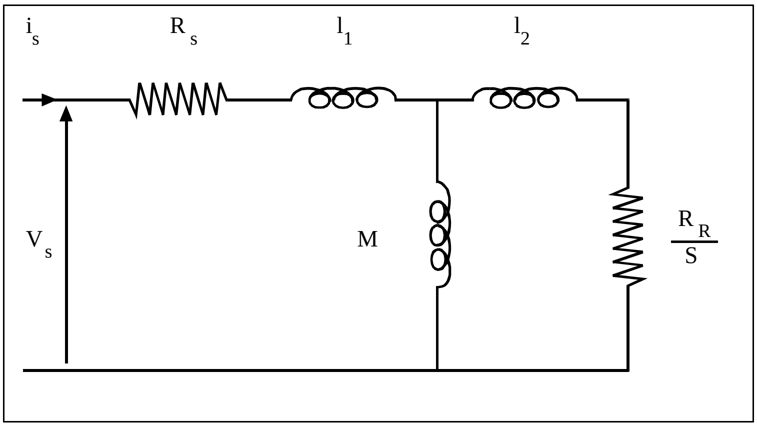


Figure 42: Equivalent circuit of the asynchronous machine

Where:
Rs: Stator resistance (wires included)
Rr: Rotor resistance
l_1+l_2: Full leakage inductance
M: Mutual inductance (not required for control implementation)
S: Slip
τ rot. ≅ M / Rr rotor time constant.

Because the motor characteristics are generally unknown, the IRIS BLUE is capable of automatically determining the motor characteristics (see the FIRST STARTUP **section and** [CFG] AUTOTUNE MENU**).**
However, some parameters may be manually adjusted to meet the requirements needed for special applications.

The parameters used for the different control algorithms are stated in the table below.

Table 73: Motor parameters used by control algorithms

Parameter	IFD	VTC
Stator resistance	ν	ν
Leakage inductance	—	ν
Mutual inductance	—	ν
Rotor time constant	—	ν

ν Used ; — Not used

NOTE **Because the value of the stator resistance is used for any type of control, always perform the autotune procedure with I073 = Motor Tune and I074 = 0: Motor Params.**

37.1.4. V/F PATTERN (IFD ONLY)

This group of parameters which is included in the **Motor Control Menu** defines the V/f pattern trend of the drive when it is used as an IFD control algorithm. When setting the type of V/f pattern (e.g. **C013**), the following curves can be used:

- Constant torque
- Quadratic
- Free setting

The diagram below illustrates three types of programmable curves compared to the theoretical V/f curve.
If **C013 = Constant Torque,** Preboost parameter **C034** allows changing the starting voltage value if compared to the theoretical V/f curve (this allows torque compensation for losses caused by the stator impedance and a greater torque at lower revs).
If **C013 = Quadratic,** the drive will follow a V/f pattern with a parabolic trend. You can set the starting voltage value (**C034**), the desired voltage drop compared to the relevant constant torque (use **C032**) and the frequency allowing implementing this torque reduction (use **C033**).
If **C013 = Free Setting,** you can program the starting voltage (**C034 Preboost**), the increase in voltage to 1/20 of the rated frequency (**C035 Boost0**), and the increase in voltage (**C036 Boost1**) at programmable frequency (**C037 Frequency for Boost1**).

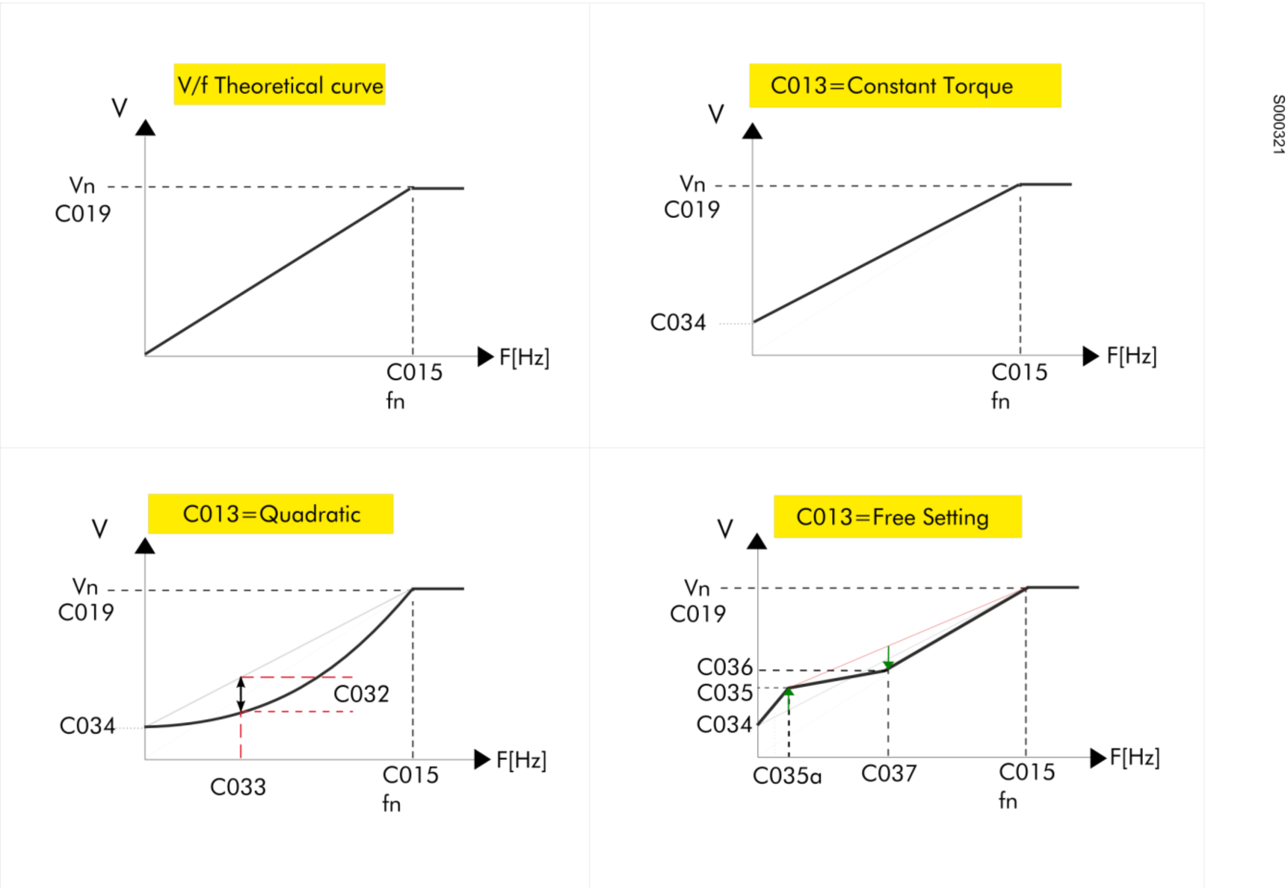


Figure 43: Types of programmable V/f curves

The voltage produced by the drive may be changed also by setting the **Automatic increase in torque curve** parameter **(C038)**.

For the description of the parameters used in the figure above, see table below.

Table 74: IFD control parameters for the connected motors

Parameter	Motor
Rated frequency: Rated frequency of the connected motor (current rating).	**C015**
Rated voltage: rated voltage of the connected motor (voltage rating).	**C019**
V/f curve type: Type of V/f curve applied.	**C013**
Torque reduction with quadratic curve: Torque reduction using V/f quadratic curve.	**C032**
Rated speed referring to torque reduction with quadratic curve: Speed actuating the torque reduction using a quadratic curve.	**C033**
Voltage preboost: Determines the voltage produced by the drive at min. output frequency fomin.	**C034**
Voltage Boost 0: Determines the voltage variations with respect to the nominal voltage at the frequency set up by the relevant parameter.	**C035**
Boost 0 application frequency: Determines the Boost 0 application frequency.	**C035a**
Voltage Boost 1: Determines the frequency for the application of the boost at preset frequency.	**C036**
Boost 1 application frequency: Determines the Boost 1 application frequency at preset frequency.	**C037**
Autoboost: Variable torque compensation expressed as a percentage of the rated motor voltage. The preset value expresses the voltage increase when the motor is running at rated torque.	**C038**

37.1.5. Example 1 - V/f Pattern Parameterization

The voltage/frequency pattern is to be programmed for an asynchronous motor (400V/50Hz) with a rated speed of 1500rpm up to 2000rpm.

Type of V/f curve	**C013**	Constant Torque
Rated frequency	**C015**	50 Hz
Rated motor rpm	**C016**	1500rpm
Rated voltage	**C019**	400 V
Preboost	**C034**	depending on the starting torque
Max. speed	**C029**	2000rpm

37.1.6. Example 2 - V/f Pattern Parameterization

The voltage/frequency pattern is to be programmed for an asynchronous motor (400V/50Hz) having a rated power of 7.5 kW and a rated speed of 1420 rpm with a voltage compensation depending on the motor torque:

Type of V/f pattern	**C013**	=	Constant Torque
Rated frequency	**C015**	=	50 Hz
Motor rpm	**C016**	=	1420rpm
Rated power	**C017**	=	7.5kW
Rated voltage	**C019**	=	400 V
Preboost	**C034**	=	depending on the starting torque
Autoboost	**C038**	=	4%

Voltage compensation (AutoBoost) results from the formula below:
ΔV = **C019** x (**C038**/100) x (T/Tn)
Where T is the estimated motor torque and Tn is the rated motor torque.
Tn is calculated as follows:
Tn = (Pn x pole pairs/2πf = (**C017** x pole pairs)/(2π x **C015**)
“Pole pairs” is the integer number obtained by rounding down (60* **C015**/**C016**).

The programmable parameters relating to the AutoBoost functions are the following:
C038 (AutoBoost): variable torque compensation expressed as a percentage of the motor rated voltage (**C019**). The value set in **C038** is the voltage increase when the motor is running at its rated torque.
C017 (Pn): rated power of the connected motor.

37.1.7. Slip Compensation (IFD Only)

This function allows compensating the speed decrease of the asynchronous motor when the mechanical load increases (slip compensation). This is available for IFD control only.
The parameters relating to this function are included in the Motor Control Menu (Configuration Menu).

Table 75: Parameters setting Slip Compensation (IFD Control)

Parameter	Motor
Rated voltage: Rated voltage of the connected motor (voltage rating).	**C019**
No-load power: Power absorbed by the motor when no load is connected to the motor; it is expressed as a percentage of the motor rated power.	**C020**
Stator resistance: Determines the resistance of the stator phases used to compute the power consumption due to Joule effect.	**C022**
Activation of slip compensation: If other than zero, this parameter enables slip compensation and defines its relevant value.	**C039**

Once the drive output power has been estimated and the power losses due to the Joule effect and to the mechanical parts (depending on output voltage and no-load power) have been subtracted, mechanical power is obtained. Starting from mechanical power and the value set for slip compensation (**C039**), you can obtain the increase of the output frequency limiting the error between the desired speed value and the actual speed value of the connected motor.

37.1.8. Torque Control (VTC Only)

The VTC control algorithm allows controlling the drive with a torque reference instead of a speed reference.
To do so, set **C011** to [1: Torque].

In this way, the main reference corresponds to the motor torque demand and may range from **C047** to **C048** (see [PAR] MULTISPEED MENU), minimum and maximum torque expressed as a percentage of the motor rated torque respectively.

When using a 0020 drive connected to a 15kW motor, **C048** is factory-set to 120% of the motor rated torque. If the max. reference is applied (**C143** = REF), the torque reference will be 120%.
If a 7.5kW motor is connected, **C048** may exceed 200%; torque values exceeding 200% may be obtained based on the value set in **C048**.
The motor rated torque results from the following formula:

$$C=P/\omega$$

where P is the rated power expressed in W and ω is the rated speed of rotation expressed in radiants/sec.

Example: the rated torque of a 15kW motor at 1420rpm is equal to:

$$C = \frac{15000}{1420 \cdot 2\pi/60} = 100.9 \text{ Nm}$$

The starting torque is:
rated torque * 120% = 121.1 Nm

37.1.9. Field Weakening (VTC Only)

When operating in field weakening mode, the asynchronous motor runs at a higher speed than its rated speed.

In field weakening mode, it is required to limit mechanical power not to exceed the motor ratings. In VTC mode, the maximum motor torque is limited as detailed in the [CFG] LIMITS MENU based on the external torque limit (defined in the [CFG] CONTROL METHOD MENU) and on the torque limit defined by parameters **C047**/**C048**.

Also, the field weakening mode requires limiting the maximum voltage required to the motor, mainly due to the back electromotive force, depending on the motor flux and the electric frequency. When in field weakening mode, the motor flux is to be properly reduced in order to limit output voltage.
Output voltage **M027** must be lower than the rated motor voltage (**C019**) not to exceed the motor ratings—at DC bus Vdc (**M029**) actually available—and not to introduce voltage harmonic distortion and current distortion. The phase-to-phase RMS voltage actually available is Vdc/√2.

Two field weakening modes are available for the VTC control mode and may be activated also simultaneously:

- *"static" field weakening*: configured via parameter **C030** (field weakening speed).
If **C030** = "0: Disable", the static field weakening is disabled.
If **C030** > 0, the magnetization current is decreased with respect to the rated value set in **C021** with inversely proportional pattern to speed (1/n) at a speed higher than the rated speed (**C016**) scaled by **C030**. For example, a motor with rated speed **C016**=1480rpm and **C030**=100%, with rated current **C018**=100A and **C021**=25%, up to 1480rpm, the magnetization current is **C018** * **C021** = 100A * 25% = 25A; at 3000rpm the magnetization current is reduced by **C018** * **C021** / 3000 * (**C1016** * **C030**) = 12.3A

- *"automatic" field weakening*: configured via parameter **C030a** (field weakening time constant).
If **C030a** = "0: Disable", the automatic field weakening is disabled.
If **C030a** > 0, the magnetization current and flux **M017** are automatically decreased so that output voltage **M027** is lower than rated motor voltage (**C019**) both at DC-link voltage divided by √2 and scaled by **C042**. In case the motor voltage exceeds the limits above, the automatic field weakening reduces the magnetization current until the output voltage equals the voltage limit.

The static field weakening is promptly activated based on a fixed magnetization current/speed relation, whilst the automatic field weakening dynamically adjusts the magnetization current with longer response time. When the operating conditions of the motor, e.g. the load torque, vary, the motor parameters depending on temperature and the DC-link voltage, the output voltage required to the motor and available to the motor vary accordingly. The automatic field weakening automatically adjusts the magnetization current to fit the motor operating conditions and enhancing output voltage.

NOTE In VTC mode, when the motor is stalled in field weakening mode, set **C030** = “0: Disable” to allow for the activation of the automatic field weakening only.

The static field weakening is inactive by default, while the automatic field weakening is enabled by default.

The figure below shows the magnetization current (Imag) pattern and the output voltage (Vout) pattern based on speed, with fixed load, for the static field weakening and the automatic field weakening.

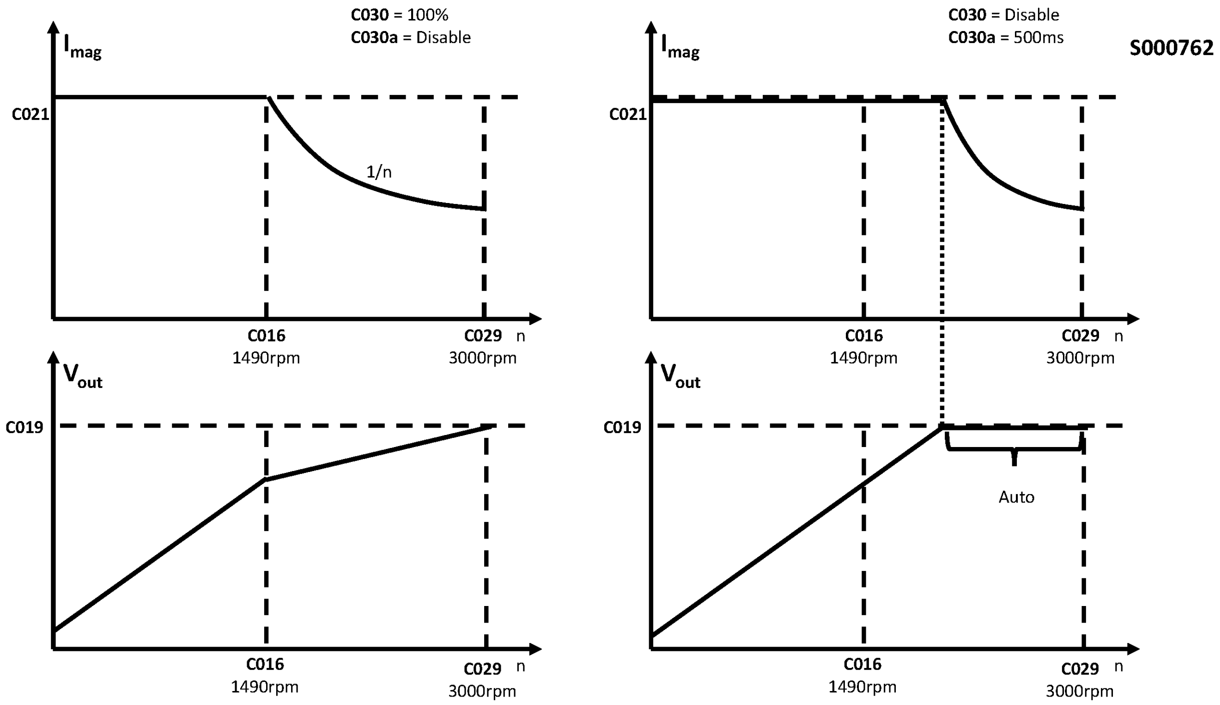


Figure 44: Comparing the static field weakening to the automatic field weakening

The parameters affecting field weakening operation are the following:

- Field Weakening Speed **C030**
- Field Weakening Time Constant **C030a**
- No-load Current **C021**
- Rotor Time Constant **C025**

The parameters above may be adjusted based on the following:

Failure	*What to do*
The motor is not capable of reaching the speed reference ("Limit St. Speed" displayed and the "Limit" LED comes ON on the display; "L" displayed on the 7-segment display)	Change one or more of the following parameters: A) enable automatic field weakening by setting **C030a**>0. B) decrease speed activating static field weakening **C030**. C) decrease no-load current **C021**.
During acceleration ramps in field weakening mode, current limit activates (the "Limit" LED comes ON on the display and "H" is displayed on the 7-segment display). The motor is not capable of performing quick acceleration ramps in field weakening mode.	This means that field weakening is not responsive as required. Do the following: A) Enable automatic field weakening by setting **C030a**>0. If activated, this means that the time constant set in **C030a** is too long, so decrease **C030a** to increase responsiveness of the automatic field weakening mode. B) Decrease the speed value activating static field weakening **C030**. C) Decrease no-load current **C021**.
Too high current required to deliver motor torque (the "Limit" LED comes ON on the display and "H" is displayed on the 7-segment display), or the maximum deliverable torque in field weakening mode is too low.	This means that the magnetizing current in field weakening mode is too low. Do the following: A) Increase **C030** in order to start reducing the magnetization current as 1/n at higher speed, or disable the static field weakening (**C030** = "Disable"). When **C030a**>0, the automatic field weakening dynamically reduces the magnetization current, only if required. B) Increase no-load current **C021** in order to increase the motor flux.
In field weakening mode, output voltage **M027** is lower than the rated voltage and the DC-link voltage divided by √2.	This means that the magnetization current in field weakening mode is too low, so field weakening is excessive for the motor. This affects the maximum deliverable torque. Do the following: A) Increase **C030**, because the speed value causing the magnetization current to decrease is too low, or disable static field weakening by setting **C030**=Disable. B) Increase no-load current **C021**.
In field weakening mode, speed, torque or current oscillations occur.	This means that the automatic field weakening is too jerky. Do the following: A) Increase time constant **C030a** B) Decrease the activation speed for the static field weakening **C030**, so that the automatic field weakening activates less frequently C) Decrease no-load current **C021**, so that the automatic field weakening activates less frequently
Output voltage **M027** required at high torque is lower than the no-load voltage (or at low torque), or is different than the expected torque based on the rated motor voltage.	This means that the motor flux is weak. This will affect the maximum deliverable torque. Do the following: A) Change the rotor time constant **C025**. B) Disable the static field weakening by setting **C030** = "Disable" (or increase its value)

37.2. List of Parameters C010 to C042

Table 76: List of Parameters C010 to C042

Parameter	FUNCTION	User Level	MODBUS Address	DEFAULT VALUES
C010	Type of control algorithm	BASIC	1010	0: IFD
C011	Type of reference	ADVANCED	1011	0: Speed (MASTER mode)
C013	Type of V/f curve	BASIC	1013	See Table 79
C014	Phase rotation	ENGINEERING	1014	0: No
C015	Rated motor frequency	BASIC	1015	50.0 Hz
C016	Rated motor rpm	BASIC	1016	1420 rpm
C017	Rated motor power	BASIC	1017	See Table 80
C018	Rated motor current	BASIC	1018	See Table 80
C019	Rated motor voltage	BASIC	1019	Depending on the drive size
C020	Motor no-load power	ADVANCED	1020	0.0%
C021	Motor no-load current	ADVANCED	1021	0%
C022	Motor stator resistance	ENGINEERING	1022	See Table 80
C023	Leakage inductance	ENGINEERING	1023	See Table 80
C024	Mutual inductance	ADVANCED	1024	250.00 mH
C025	Rotor time constant	ADVANCED	1025	0 ms
C026	Time constant of bus voltage low-pass filter	ENGINEERING	1026	0 ms
C028	Min. motor speed	BASIC	1028	0 rpm
C029	Max. motor speed	BASIC	1029	1500 rpm
C030	Field weakening start speed	ENGINEERING	1030	90%
C030a	Field weakening time constant	ENGINEERING	1137	500 ms
C031	Max. speed alarm	ADVANCED	1031	0: Disabled
C032	Reduction in quadratic torque curve	ADVANCED	1032	30%
C033	Rated revs referring to reduction in quadratic torque curve	ADVANCED	1033	20%
C034	Voltage Preboost for IFD	BASIC	1034	See Table 79
C035	Voltage Boost 0 at programmable frequency	ADVANCED	1035	See Table 79
C035a	Frequency for Boost 0 application	ADVANCED	1052	5%
C036	Voltage Boost 1 at programmable frequency	ADVANCED	1036	See Table 79
C037	Frequency for application of voltage Boost 1	ADVANCED	1037	See Table 79
C038	Autoboost	ADVANCED	1038	See Table 79
C039	Slip compensation	ADVANCED	1039	0: Disabled
C040	Voltage drop at rated current	ADVANCED	1040	0: Disabled
C041	Ramp times	ENGINEERING	1041	See Table 78
C042	Vout saturation percentage	ENGINEERING	1042	100%

C010	Type of Control Algorithm	
Range	0 ÷ 1	0: IFD 1: VTC
Default	0	0: IFD
Level	BASIC	
Address	1010	
Function	This parameter sets the type of control algorithm to be used: 0: IFD V/f control. 1: VTC Sensorless Vector Torque Control. The **V/f control (IFD)** allows controlling the motor by producing voltage depending on frequency. It is possible to configure several types of V/f patterns (see V/f Pattern (IFD). The VTC is a control mode w/out speed feedback, so no position/speed transducer is required: based on a dynamic model of an asynchronous motor, the algorithm estimates the speed and orientation of the motor flux. Both controllers guarantee segregation between the flux control and the torque control. In that way, the motor flux is adjusted based on the magnetizing current, obtained from **No-load current C021**. When using the VTC control, the connected motor can be controlled either via a torque reference or via a speed reference; in that case, the speed control loop, based on the estimated speed is the external control loop for the torque controller. The equations used for the VTC control algorithm require the following equivalent parameters of the asynchronous device: **Stator resistance C022** **Mutual inductance C024** **Rotor time constant C025** **Leakage inductance C023**	

CAUTION It is not advisable to set VTC algorithm with a nominal current motor lower than 50% of the drive size, otherwise the control performance is not guaranteed.

C011	Type of Reference (Master/Slave Mode)	
Range	0 ÷ 1	0: Speed (MASTER mode) 1: Torque (SLAVE mode)
Default	0	0: Speed (MASTER mode)
Level	ADVANCED	
Address	1011	
Control	VTC	
Function	This parameter defines the type of reference to be used. The torque control may be set up (see section Torque Control (VTC Only)).	

C013	Type of V/f of the Motor	
Range	0 ÷ 2	0: Constant Torque 1: Quadratic 2: Free Setting
Default	See Table 79	
Level	BASIC	
Address	1013	
Control	IFD	
Function	Allows selecting different types of V/f pattern. If **C013 = Constant torque**, voltage at zero frequency can be selected (Preboost **C034**) Con **C013 = Quadratic** you can select voltage at zero frequency: voltage at zero frequency (preboost **C034**); max. voltage drop with respect to the theoretical V/f pattern **C032**; frequency allowing implementing max. voltage drop **C033**. If **C013 = Free setting** you can set the following: voltage at zero frequency (preboost **C034**); voltage increase to 20% of the rated frequency (Boost0 **C035**); voltage increase to a programmed frequency (Boost1 **C036**); frequency for Boost1 **C037**.	

C014	Phase Rotation	
Range	0÷1	0: [No]; 1: [Yes]
Default	0	0: [No]
Level	ENGINEERING	
Address	1014	
Function	Allows reversing the mechanical rotation of the connected motor.	

DANGER!!! When activating **C014**, the mechanical rotation of the connected motor and its load is reversed accordingly.

C015	Rated Motor Frequency	
Range	10 ÷ 10000	1.0 Hz ÷ 1000.0 Hz
	See upper limits in Table 68.	
Default	500	50.0 Hz
Level	BASIC	
Address	1015	
Function	This parameter defines the rated motor frequency (nameplate rating).	

C016	Rated Motor Rpm	
Range	1 ÷ 32000	1 ÷ 32000 rpm
Default	1420	1420 rpm
Level	BASIC	
Address	1016	
Function	This parameter defines the rated motor rpm (nameplate rating).	

C017	Rated Motor Power	
Range	1 ÷ 32000	0.1 ÷ 3200.0 kW
	Upper limited to twice the default value. See Table 80	
Default	Value of **Pmot** column in Table 80	
Level	BASIC	
Address	1017	
Function	This parameter defines the rated motor power (nameplate rating).	

C018	Rated Motor Current	
Range	1 ÷ 32000	0.1 ÷ 3200.0 A
	Upper limited to the value in the **Inom** column in Table 77	
Default	Value of **Pmot** column in Table 80	
Level	BASIC	
Address	1018	
Function	This parameter defines the rated motor current (nameplate rating).	

C019	Rated Motor Voltage	
Range	50 ÷ 12000	5.0 ÷ 1200.0 V
Default	2300 for class 2T drives 4000 for class 4T drives	230.0V for class 2T drives 400.0V for class 4T drives
Level	BASIC	
Address	1019	
Function	This parameter defines the rated motor voltage (nameplate rating).	

C020	Motor No-load Power	
Range	0 ÷ 1000	0.0 ÷ 100.0%
Default	0	0.0%
Level	ADVANCED	
Address	1020	
Function	This parameter defines the power absorbed by the motor at rated voltage and rated rpm when no load is connected to the motor.	

C021	Motor No-load Current	
Range	1 ÷ 100	1 ÷ 100%
Default	0	0%
Level	ADVANCED	
Address	1021	
Function	This parameter defines the current absorbed by the motor at rated voltage and rated rpm when no load is connected to the motor. It is expressed as a percentage of the motor rated current **C018**. A value other than zero is to be entered to properly adjust the current loops required for the VTC control. If the stator resistance is tuned (**I073** = [1: Motor Tune]); **I074** = [0: Motor Params]) and the no load current parameter is zero, a value for a first attempt is assigned to this parameter, depending on power and pole pairs of the connected motor.	

C022	Motor Stator Resistance	
Range	0 ÷ 32000	0.000 ÷ 32.000Ω
Default	See Table 80	
Level	ENGINEERING	
Address	1022	
Function	This parameter defines stator resistance Rs. If a star connection is used, it matches with the value of the resistance of one phase (half the resistance measured between two terminals); if a delta connection is used, it matches with 1/3 of the resistance of one phase. Autotune is always recommended.	

C023	Motor Leakage Inductance	
Range	0 ÷ 32000	0.00 ÷ 320.00mH
Default	See Table 80	
Level	ENGINEERING	
Address	1023	
Function	This parameter defines the global leakage inductance of the connected motor. If a star connection is used, it matches with the value of the inductance of one phase; if a delta connection is used, it matches with 1/3 of the inductance of one phase.	

NOTE With the Autotune function, calculate the value of the leakage inductance (**C023**). From the resulting value, manually subtract the value in mH of the output inductance (if any).

C024	Mutual Inductance	
Range	0 ÷ 65000	0.00 ÷ 650.00mH
Default	25000	250.00mH
Level	ADVANCED	
Address	1024	
Function	This parameter defines the mutual inductance of the connected motor. The approximate value of the mutual inductance results from no-load current I_0 and stator resistor R_{stat} according to the formula below: $M \cong (V_{mot} - R_{stat} \times I_0) / (2\pi f_{mot} \times I_0)$	

NOTE

Parameter **C024** (mutual inductance) is **automatically calculated** based on the preset no-load current value (**C021**) whenever parameters **I073** and **I074** are set as follows:
I073 = [1: Motor Tune]
I074 = [0: Motor Params]
whether current loop tuning is performed or not.

C025	Rotor Time Constant	
Range	0 ÷ 5000	0 ÷ 5000 ms
Default	0	0 ms
Level	ADVANCED	
Address	1025	
Control	VTC	
Function	This parameter defines the rotor time constant of the connected motor. If the rotor time constant is not stated by the motor manufacturer, it can be obtained through the autotune function (see the section and the [CFG] AUTOTUNE MENU of this manual).	

C026	Time Constant of Bus Voltage Low-pass Filter	
Range	0 ÷ 32000	0.0 ÷ 3200.0 ms
Default	0	0.0 ms
Level	ENGINEERING	
Address	1026	
Function	This parameter defines the time constant of the low-pass filter of the bus voltage readout. Changing this value can avoid motor oscillations, especially when no load is connected to the motor.	

C028	**Minimum Motor Speed**	
Range	–32000 ÷ 32000 (*)	–32000 ÷ 32000 rpm (*)
Default	0	0 rpm
Level	BASIC	
Address	1028	
Function	This parameter defines the minimum speed of the connected motor. When references forming the global reference are at their min. relative value, the global reference equals the min. speed of the connected motor. *Example:* [CFG] CONTROL METHOD MENU **C143** → [1: REF] Selection of reference 1 source **C144** → [2: AIN1] Selection of reference 2 source **C145** → [0: Disable] Selection of reference 3 source **C146** → [0: Disable] Selection of reference 4 source [PAR] INPUTS FOR REFERENCES MENU **P050** → [0: ±10V] Type of reference for REF input **P051** → [– 10V] Value of the min. reference for REF input **P052** → [+10V] Value of the max. reference for REF input **P055** → [0: ±10V] Type of reference for AIN1 input **P056** → [– 5 V] Value of min. reference for AIN1 input **P057** → [+5 V] Value of max. reference for AIN1 input The speed reference is the min. speed set in **C028** when both REF input and AIN1 input values are lower than or equal to the minimum values set in **P051** and **P056** respectively.	

(*) NOTE The maximum allowable value (as an absolute value) for **C028** and **C029** (min. and max. motor speed) also depends on the preset **max. carrier frequency** (see Table 68). It can be max. 4 times the rated speed of the connected motor.

NOTE The value set as the min. speed is used as the saturation of the global reference; the speed reference will never be lower than the value set as min. speed.

C029	**Max. Motor Speed**	
Range	0 ÷ 32000 (*see note in **C028**)	0 ÷ 32000 rpm (*see note in **C028**)
Default	1500	1500 rpm
Level	BASIC	
Address	1029	
Function	This parameter defines the maximum speed of the connected motor. When references forming the global reference are at their max. relative value, the global reference equals the max. speed of the connected motor.	

C030	Field Weakening Start Speed	
Range	0 ÷ 200	0: [Disabled] ÷ 200 ms
Default	0	0: [Disabled]
Level	ENGINEERING	
Address	1030	
Control	VTC	
Function	This parameter defines the speed value determining the motor field weakening based on 1/n (“static” field weakening). It is expressed as a percentage of the rated motor speed **C016**. With **C030** =0: Disabled, the motor field weakening never occurs based on law 1/n. For more details, see Field Weakening (VTC Only).	

C030a	Field Weakening Time Constant	
Range	0 ÷ 32000	0: [Disabled] ÷ 32000 ms
Default	500	500 ms
Level	ENGINEERING	
Address	1137	
Control	VTC	
Function	With **C030a**=other than 0: Disabled, the motor field weakening follows a law optimizing the output voltage based on the available DC voltage (*“automatic” field weakening*). This parameter defines the operating speed of the automatic field weakening regulator. For more details, see Field Weakening (VTC Only).	

C031	Max. Speed Alarm	
Range	0 ÷ 32000	0: [Disabled] ÷ 32000 rpm
Default	0	0: Disabled
Level	ADVANCED	
Address	1031	
Function	If it is not set to zero, this parameter determines the speed value to be entered for the maximum speed alarm (**A076**).	

C032	Reduction in Quadratic Torque Curve	
Range	0 ÷ 1000	0 ÷ 100.0%
Default	300	30.0%
Level	ADVANCED	
Address	1032	
Control	IFD	
Function	If the V/f curve pattern **C013 = Quadratic**, this parameter defines the maximum voltage reduction in terms of V/f pattern at Constant Torque, which is implemented at the frequency programmed in **C033** (see V/f Pattern (IFD).	

C033	Max. Reduction Frequency for Quadratic Torque Pattern	
Range	1 ÷ 100	1 ÷ 100%
Default	20	20%
Level	ADVANCED	
Address	1033	
Control	IFD	
Function	If the V/f curve pattern **C013 = Quadratic**, this parameter defines the frequency implementing the max. torque reduction in terms of theoretical V/f pattern set in **C032** (see V/f Pattern (IFD).	

C034	Voltage Preboost for IFD	
Range	0 ÷ 50	0.0 ÷ 5.0 %
Default	See Table 79	
Level	BASIC	
Address	1034	
Control	IFD	
Function	Torque compensation at minimum frequency produced by the drive. IFD control: determines the increase of the output voltage at 0Hz.	

C035	Voltage Boost 0 at Programmable Frequency	
Range	–100 ÷ +100	–100 ÷ +100 %
Default	See Table 79	
Level	ADVANCED	
Address	1035	
Control	IFD	
Function	Torque compensation at preset frequency (parameter **C035a**). This parameter defines the output voltage variation at preset frequency with respect to the frequency resulting from the constant V/f ratio (voltage/frequency constant). It is expressed as a percentage of the nominal motor voltage (**C019**).	

C035a	Frequency for Boost 0 Application	
Range	0 ÷ 99	0 ÷ 99 %
Default	5	5%
Level	ADVANCED	
Address	1052	
Control	IFD	
Function	Frequency for the application of the boost preset with parameter **C035**. It is expressed as a percentage of the nominal motor frequency (**C015**).	

C036	Voltage Boost 1 at Programmable Frequency	
Range	–100 ÷ +400	–100 ÷ +400 %
Default	See Table 79	
Level	ADVANCED	
Address	1036	
Control	IFD	
Function	Torque compensation at preset frequency (**C037**). Determines how output voltage varies at preset frequency with respect to voltage obtained with a constant V/f pattern (constant voltage frequency). It is expressed as a percentage of the nominal motor frequency (**C019**).	

C037	Frequency for Boost 1 Application	
Range	6 ÷ 99	6 ÷ 99 %
Default	See Table 79	
Level	ADVANCED	
Address	1037	
Control	IFD	
Function	Frequency for application of voltage boost programmed with parameter **C036**. This is expressed as a percentage of the motor rated frequency (**C015**).	

C038	Autoboost	
Range	0 ÷ 10	0 ÷ 10 %
Default	See Table 79	
Level	ADVANCED	
Address	1038	
Control	IFD	
Function	Variable torque compensation expressed as a percentage of the motor rated voltage. The preset value expresses the voltage increase when the motor is running at its rated torque.	

C039	Slip Compensation	
Range	0 ÷ 200	[0: Disabled] ÷ 200 %
Default	0	[0: Disabled]
Level	ADVANCED	
Address	1039	
Control	IFD	
Function	This parameter represents the motor rated slip expressed as a value percent. If set to 0, this function is disabled.	

NOTE To ensure optimum operation, it is recommended that autotuning **I074**=0 be performed, as the slip compensation uses the stator resistor value in **C022**.
Also, the No-load power value in **C020** is required.

C040	Voltage Drop at Rated Current	
Range	0÷500	0÷50.0%
Default	0	0: Disabled
Level	ADVANCED	
Address	1040	
Control	IFD	
Function	Defines the voltage increase required to compensate the voltage drop between the inverter and the motor due to the presence of a filter. The voltage increase is given by: DeltaV = (**C040**/100) * Vmot * Iout/Imot * fout/fmot, where Iout is the output current, fout is the output frequency, Vmot, Imot and fmot are the rated motor voltage, rated motor current and rated motor frequency respectively (parameters **C019**, **C018** and **C015**). Example: **C040 = 10%** Voltage drop at rated current **C013 = Constant Torque** Type of V/f pattern **C015 = 50 Hz** Rated frequency **C019 = 380 V** Rated voltage **C018 = 50 A** Rated current If the drive output frequency is 25 Hz, it should deliver 190V. When the output current is 40A (**C018**) the voltage actually produced is Vout = 190 + ((10/100 * 380) * 40/50 * 25/50) = 190 + 15.2 = 205.2 V.	

C041	Fluxing Ramp Time	
Range	40 ÷ 4000	40 ÷ 4000 msec
Default	See Table 78	
Level	ENGINEERING	
Address	1041	
Control	VTC	
Function	This parameter indicates the time spent for motor fluxing.	

C042	Vout Saturation Percentage	
Range	10 ÷ 120	10 ÷ 120 %
Default	100	100%
Level	ENGINEERING	
Address	1042	
Function	This parameter sets the bus voltage value percent used to generate the output voltage of the drive. Changes made to this parameter affect the motor performance in terms of field weakening.	

37.3.Tables Including the Parameters Depending on the Drive Model

Table 77: Parameters depending on the drive model

SIZE	MODEL	INOM INV. [A]	IMAX INV. [A]	IPEAK INV. [A]	CARRIER DEF [kHz]	CARRIER MAX [kHz]	DEF Silent Modulation
					C001 C002	C001 C002	C004
S05	0005	10.5	11.5	14	5	16	YES
	0007	12.5	13.5	16	5	16	YES
	0008	15	16	19	5	10	YES
	0009	16.5	17.5	19	5	16	YES
	0010	17	19	23	5	10	YES
	0011	16.5	21	25	5	16	YES
	0013	19	21	25	5	10	YES
	0014	16.5	25	30	5	16	YES
	0015	23	25	30	5	10	YES
S05/S12	0016	27	30	36	3	10	YES
	0020	30	36	43	3	10	YES
S12	0017	30	32	37	3	10	YES
	0023	38	42	51	3	10	YES
	0025	41	48	58	3	10	YES
	0030	41	56	67	3	10	YES
	0033	51	56	68	3	10	YES
	0034	57	63	76	3	10	YES
	0036	60	72	86	3	10	YES
	0037	65	72	83	3	10	YES
S15	0040	72	80	88	3	16	YES
	0049	80	96	115	3	12.8	YES
S20	0060	88	112	134	3	10	YES
	0067	103	118	142	3	10	YES
	0074	120	144	173	3	10	YES
	0086	135	155	186	3	10	YES
S30	0113	180	200	240	2	10	YES
	0129	195	215	258	2	10	YES
	0150	215	270	324	2	8	YES
	0162	240	290	324	2	8	YES
S41	0180	300	340	408	2	6	NO
	0202	345	420	504	2	6	NO
	0217	375	460	552	2	6	NO
	0260	425	560	672	2	6	NO

Table 78: Parameters depending on the drive model

SIZE	MODEL	TFLUX DEF [ms]	ILIM DEC DEF [%Imot]	DCB RAMP DEF [ms]	Acc. Time DEF [sec]	Dec. Time DEF [sec]	Fire Mode Ramps DEF [sec]	U.o.m. Acc. / Dec. DEF [sec]	Dec. Ramp Ext. DEF
		C041	C045	C222	P009 P012	P010 P013	P032 P033	P014 P020	C210
S05	0005	300	150	50	10	10	10	0.1	0.2
	0007	300	150	50	10	10	10	0.1	0.2
	0008	300	150	50	10	10	10	0.1	0.2
	0009	300	150	50	10	10	10	0.1	0.2
	0010	300	150	50	10	10	10	0.1	0.2
	0011	300	150	50	10	10	10	0.1	0.2
	0013	300	150	50	10	10	10	0.1	0.2
	0014	300	150	50	10	10	10	0.1	0.2
	0015	300	150	50	10	10	10	0.1	0.2
S05/S12	0016	300	150	50	10	10	10	0.1	0.2
	0020	300	150	50	10	10	10	0.1	0.2
S12	0017	300	150	50	10	10	10	0.1	0.2
	0023	300	150	50	10	10	10	0.1	0.2
	0025	300	150	50	10	10	10	0.1	0.2
	0030	300	150	50	10	10	10	0.1	0.2
	0033	300	150	50	10	10	10	0.1	0.2
	0034	300	150	70	10	10	10	0.1	0.2
	0036	300	150	70	10	10	10	0.1	0.2
	0037	300	150	70	10	10	10	0.1	0.2
S15	0040	300	150	70	10	10	10	0.1	0.2
	0049	300	150	80	10	10	10	0.1	0.2
S20	0060	300	150	80	10	10	10	0.1	0.2
	0067	300	150	100	10	10	10	0.1	0.2
	0074	300	150	100	10	10	10	0.1	0.2
	0086	300	150	150	10	10	10	0.1	0.2
S30	0113	300	150	150	10	10	10	0.1	0.2
	0129	300	150	150	10	10	10	0.1	0.2
	0150	300	150	200	10	10	10	0.1	0.2
	0162	300	150	200	10	10	10	0.1	0.2
S41	0180	450	100	250	100	100	100	1	2
	0202	450	100	250	100	100	100	1	2
	0217	450	100	250	100	100	100	1	2
	0260	450	100	250	100	100	100	1	2

Table 79: Parameters depending on the drive model

SIZE	MODEL	V/f Pattern DEF	PREBOOST DEF [%Vmot]	BOOST @ 5% fmot and BOOST DEF [%Vmot]	Frequency for BOOST DEF [%fmot]	Auto BOOST DEF [%Vmot]
		C013	C034	C035/C036	C037	C038
S05	0005	0:CONST	1.0	0	50	1
	0007	0:CONST	1.0	0	50	1
	0008	0:CONST	1.0	0	50	1
	0009	0:CONST	1.0	0	50	1
	0010	0:CONST	1.0	0	50	1
	0011	0:CONST	1.0	0	50	1
	0013	0:CONST	1.0	0	50	1
	0014	0:CONST	1.0	0	50	1
	0015	0:CONST	1.0	0	50	1
S05/S12	0016	0:CONST	1.0	0	50	1
	0020	0:CONST	1.0	0	50	1
S12	0017	0:CONST	1.0	0	50	1
	0023	0:CONST	1.0	0	50	1
	0025	0:CONST	1.0	0	50	1
	0030	0:CONST	1.0	0	50	1
	0033	0:CONST	1.0	0	50	1
	0034	0:CONST	1.0	0	50	1
	0036	0:CONST	1.0	0	50	1
	0037	0:CONST	1.0	0	50	1
S15	0040	0:CONST	1.0	0	50	1
	0049	0:CONST	1.0	0	50	1
S20	0060	0:CONST	1.0	0	50	1
	0067	0:CONST	1.0	0	50	1
	0074	0:CONST	1.0	0	50	1
	0086	0:CONST	1.0	0	50	1
S30	0113	0:CONST	0.5	0	50	1
	0129	0:CONST	0.5	0	50	1
	0150	0:CONST	0.5	0	50	1
	0162	0:CONST	0.5	0	50	1
S41	0180	2:FREE	0.2	–20	20	0
	0202	2:FREE	0.2	–20	20	0
	0217	2:FREE	0.2	–20	20	0
	0260	2:FREE	0.2	–20	20	0

Table 80: Parameters depending on the drive model and voltage class

SIZE	MODEL	2T				4T			
		Pmot DEF [kW]	Imot DEF [A]	Rstat DEF [Ω]	Ldisp DEF [mH]	Pmot DEF [kW]	Imot DEF [A]	Rstat DEF [Ω]	Ldisp DEF [mH]
		C017	C018	C022	C023	C017	C018	C022	C023
S05	0005	---	---	---	---	3	6.4	2.500	30.00
	0007	1.8	7.3	1.155	14.43	4	8.4	2.000	25.00
	0008	2.2	8.5	1.000	12.00	---	---	---	---
	0009	---	---	---	---	4.5	9	1.600	16.00
	0010	3	11.2	0.800	7.50	---	---	---	---
	0011	---	---	---	---	5.5	11.2	1.300	12.00
	0013	3.7	13.2	0.650	6.00	---	---	---	---
	0014	---	---	---	---	7.5	14.8	1.000	8.00
	0015	4	16.6	0.600	5.00	---	---	---	---
S05/S12	0016	4.5	15.7	0.462	3.46	9.2	17.9	0.800	6.00
	0020	5.5	19.5	0.346	2.89	11	21.0	0.600	5.00
S12	0017	---	---	---	---	9.2	21	0.800	6.00
	0023	7.5	25.7	0.300	2.50	---	---	---	---
	0025	---	---	---	---	15	29	0.400	3.00
	0030	---	---	---	---	18.5	35	0.300	2.50
	0033	11	36	0.200	1.50	---	---	---	---
	0034	---	---	---	---	22	41	0.250	2.00
	0036	---	---	---	---	25	46	0.250	2.00
	0037	15	50	0.100	1.15	---	---	---	---
S15	0040	15	50	0.115	1.15	25	46	0.200	2.00
	0049	18.5	61	0.087	1.15	30	55	0.150	2.00
S20	0060	22	71	0.069	1.15	37	67	0.120	2.00
	0067	25	80	0.058	0.69	45	80	0.100	1.20
	0074	30	96	0.046	0.69	50	87	0.080	1.20
	0086	32	103	0.035	0.58	55	98	0.060	1.00
S30	0113	45	135	0.023	0.58	75	133	0.040	1.00
	0129	50	150	0.023	0.58	80	144	0.040	1.00
	0150	55	170	0.017	0.58	90	159	0.030	1.00
	0162	65	195	0.012	0.58	110	191	0.020	1.00
S41	0180	75	231	0.010	0.52	132	228	0.018	0.9
	0202	80	250	0.010	0.52	160	273	0.018	0.9
	0217	110	332	0.009	0.46	185	321	0.015	0.8
	0260	110	332	0.007	0.35	220	375	0.012	0.6

38. [CFG] LIMITS MENU

38.1.Overview

The **Limits Menu** defines the current/torque.
For IFD control, **current** limits are used. Three limit current levels are available, which are expressed as a percentage of the motor rated current:

1) Current limit while accelerating;
2) Current limit at constant rpm;
3) Current limit while decelerating.

Two special parameters are also available; one sets the decrease of the limit current value when the motor runs at constant power (field weakening), while the other parameter allows disabling the frequency decrease in case of acceleration current limit (this is useful for inertial loads).

If a VTC control is used, limits are expressed as a percentage of the rated motor torque.
Values set in the two parameters relating to min. torque and max. torque represent the limits for saturation of the control torque demand. If an external torque limit is set (**C147** in the [CFG] CONTROL METHOD MENU, the values set in the parameters above represent the range of the source used for limitation; the torque ramp times set in the [PAR] RAMPS MENU will be applied to the preset limit torque reference.

When in field weakening mode, such as when the system operates at a higher speed than the rated motor speed set in **C016**, the torque limits defined by parameters **C047**/**C048** are decreased following a law 1/speed at speed exceeding the rated speed, to limit the maximum mechanical power required to the motor.

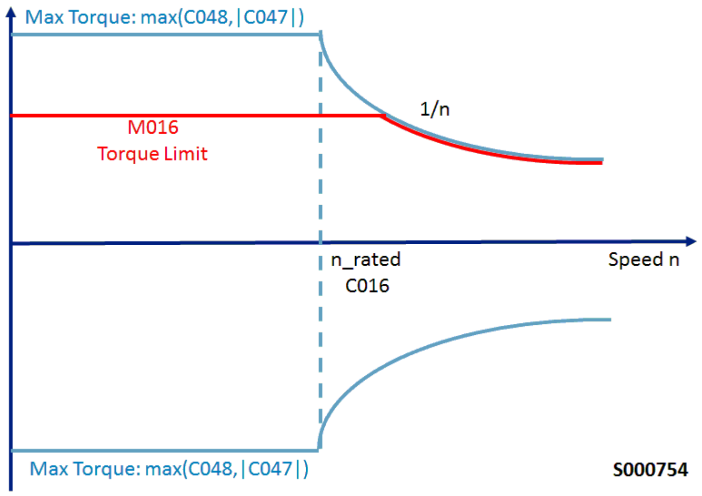


Figure 45: Torque limit for VTC control in field weakening mode

The Ipeak current load is available (see Table 77) for a maximum time of 3 seconds and only if the preset carrier frequency is lower than/equal to the default frequency value (see Table 77). When operating with synchronous modulation, the current peak value dynamically decreases when the output frequency increases.
Manually enabling/disabling that function can be done only when using the IFD control with current limit parameters **C043/C044/C045**. When using the **VTC** control, the system will automatically handle the maximum current value that can be used also based on the torque limit configured with **C047/C048.**

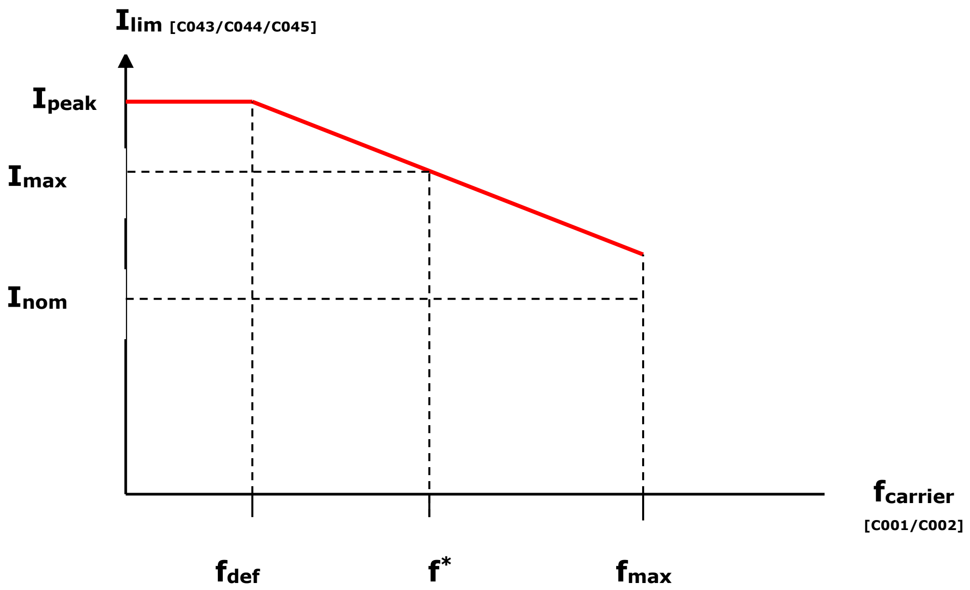


Figure 46: Current limit reduction based on carrier frequency

f_{def}: default carrier frequency
f*: maximum carrier frequency to obtain Imax
f_{max}: maximum programmable carrier frequency

CAUTION The pictures above show the Imax/Ipeak current limit based on carrier frequency.
Please refer to the IRIS BLUE – Installation Guide for the maximum carrier values recommended based on Inom rated current.

38.2. List of Parameters C043 to C050

Table 81: List of Parameters C043 to C050

Parameter	FUNCTION	User Level	MODBUS Address	DEFAULT VALUES
C043	Current limit while accelerating	BASIC	1043	150%
C044	Current limit at constant rpm	BASIC	1044	150%
C045	Current limit while decelerating	BASIC	1045	See Table 78
C046	Current limit decrease in field weakening	ADVANCED	1046	0: Disabled
C047	Minimum torque	ADVANCED	1047	0.0%
C048	Maximum torque	BASIC	1048	120.0%
C050	Frequency decrease during acceleration limit	ADVANCED	1050	0: Enabled

C043	Current Limit while Accelerating	
Range	0 ÷ 400 (*)	0: Disabled 1.0% ÷ the lesser between Ipeak/Imot and 400%
Default	150	150%
Level	BASIC	
Address	1043	
Control	IFD	
Function	This parameter defines the current limit while accelerating; it is expressed as a percentage of the rated current of the selected motor. No limit is applied if this parameter is set to 0: Disabled.	

(*) *The maximum allowable value depends on the drive size.*

C044	Current Limit at Constant Rpm	
Range	0 ÷ 400 (*)	0: Disabled 1.0% ÷ the lesser between Ipeak/Imot and 400%
Default	150	150%
Level	BASIC	
Address	1044	
Control	IFD	
Function	This parameter defines the current limit at constant rpm; it is expressed as a percentage of the rated current of the selected motor. No limit is applied if this parameter is set to 0: Disabled.	

(*) *The maximum allowable value depends on the drive size.*

C045	Current Limit while Decelerating	
Range	0 ÷ 400 (*)	0: Disabled 1.0% ÷ the lesser between Ipeak/Imot and 400%
Default	See Table 78	
Level	BASIC	
Address	1045	
Control	IFD	
Function	This parameter defines the current limit while decelerating; it is expressed as a percentage of the rated current of the selected motor. No limit is applied if this parameter is set to 0: Disabled.	

(*) *The maximum allowable value depends on the drive size.*

C046	Current Limit Decrease in Field Weakening	
Range	0 ÷ 1	0: Disabled 1: Enabled
Default	0	
Level	ADVANCED	
Address	1046	
Control	IFD	
Function	This parameter enables the current limit decrease function in field weakening. The current limit is multiplied by the ratio between the motor rated torque and the frequency forced to the drive: limit = current limit being used * (Fmot/ Fout)	

C047	Minimum Torque Limit	
Range	–5000 ÷ 5000 (*)	–500.0% ÷ +500.0%
Default	0	
Level	ADVANCED	
Address	1047	
Control	VTC	
Function	This parameter sets the min. limit of the torque demanded by the control being used. Torque is expressed as a percentage of the rated torque of the selected motor.	

C048	Maximum Torque Limit	
Range	–5000(*) ÷ 5000 (*)	–500.0% ÷ +500.0%
Default	1200	
Level	BASIC	
Address	1048	
Control	VTC	
Function	This parameter sets the max. limit of the torque demanded by the control being used. Torque is expressed as a percentage of the rated torque of the selected motor.	

C050	Frequency Decrease during Acceleration Limit	
Range	0 ÷ 1	0: Enabled 1: Disabled
Default	0	
Level	ADVANCED	
Address	1050	
Control	IFD	
Function	This parameter enables output frequency decrease during acceleration limit.	

NOTE Setting "1:Disabled" is recommended for high inertia loads. When high inertia loads are connected to the drive, the frequency decrease can lead to strong regeneration and DC-bus voltage oscillations.

39. [CFG] CONTROL METHOD MENU

39.1.Overview

NOTE Please refer to IRIS BLUE – Installation Guide or the hardware description of digital inputs (COMMANDS) and analog inputs (REFERENCES).
See also the [PAR] INPUTS FOR REFERENCES MENU and [CFG] DIGITAL INPUTS MENU.

The drive is factory set to receive digital commands via the terminal board; the main speed reference is sent from the REF analog input, and no external limit for torque limitation is enabled.

The parameters in this menu allow selecting the following:

- The source of the **drive commands** (digital inputs) from **three signal sources** (through parameters **C140, C141, C142**) which are logically matched so as to obtain an active **M031** command set. For each of these 3 **parameters** you can select the source of the command signals from **4 different sources**;
- The source of the **speed reference** (or torque reference) from **4 different sources** (that can be selected with parameters **C143, C144, C145, C146)** that **can be summed up together.**
  For each of these **4 parameters**, you can select the source of the reference signals from **9 different sources**;
- The source of the **torque limit** reference (through parameter **C147**, allowing selecting the reference source from **9 different sources**).

Therefore, you can select and enable different **command sources** (hardware or virtual sources), different speed (or torque) **references** (hardware or virtual sources) and enable an external torque **limit**.
The drive **commands** may be sent from:

- The hardware terminal board (terminal board on the control board), which is logically separated into terminal board A and terminal board B;
- The keypad;
- The virtual remote terminal board: through serial link with MODBUS communications protocol;
- The virtual remote terminal board: through Fieldbus (optional board).

Multiple terminal boards may also be enabled (up to 3 terminal boards with parameters **C140, C141, C142**); in this case, the drive will apply logic functions **OR** or **AND** to the different terminals to obtain the activated terminal board (see Command Sources).

The following **references** and torque limit signals may be sent:

- Three analog inputs acquired to the hardware terminal board (REF, AIN1, AIN2), plus two analog inputs (XAIN4, XAIN5) acquired to the hardware terminal board located on ES847 optional board;
- Keypad;
- Serial link with MODBUS communications protocol;
- Fieldbus (optional board);
- Up/Down from MDI (Up and Down digital inputs).

Multiple reference sources may be enabled at the same time (up to 4 reference sources with parameters **C143, C144, C145, C146**); in this case, the drive will consider the sum of all active reference as the main reference.

Finally, a dynamic selection between two command sources and two reference sources is allowed when using the digital input configured as Source Selection (see **C179**) or, alternatively, of the inputs configured as Commands Selection and Reference Selection (**C179a** and **C179b**).

39.1.1. COMMAND SOURCES

The drive commands may be sent from the following sources:

0: Disabled
1: Terminal board
2: Serial link (with MODBUS protocol)
3: Fieldbus (fieldbus on optional board)
4: Keypad (remotable display/keypad)

The factory-setting enables only Terminal Board (**C140**=1 and **C141**=1) as a command source (see also the [CFG] DIGITAL INPUTS MENU).
The Terminal source refer to the same terminal board located on the control board, but allow switching between one set of START, STOP, REVERSE commands sent to three terminals to a different set of commands sent to three different terminals.

Most commands may be delayed (when enabled or disabled): refer to the [PAR] TIMERS MENU.

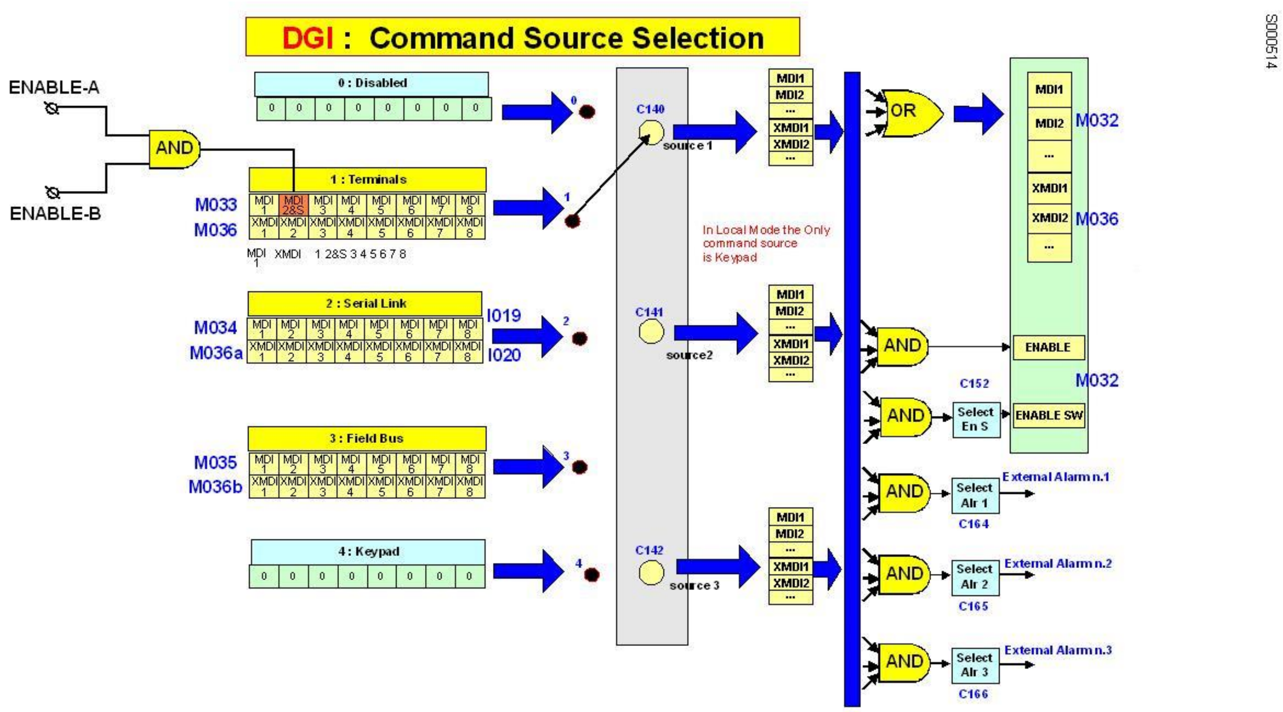


Figure 47: Selecting the command sources

If the keypad is not selected as a command source or, when the keypad is selected, the **STOP** input function is enabled as well (**C150**≠0), more than one command sources may be enabled at a time by programming parameters **C140, C141, C142.** The activation logic of the different sources is as follows:

Source programmed in:	**Activation Conditions**	
	If: **C179** (Source Selection) = 0: Disable and (logic AND) **C179a** (Commands Selection) = 0: Disable	If: **C179** = MDIx input or (logic OR) **C179a** = MDIx input
C140	Always active	Active if MDIx = 0
C141	Always active	Active if MDIx = 1
C142	Always active	Always active

Table 82: Activation conditions of the command sources

In that case, the logic function performed by the drive for the terminals of all the activated command sources is:

- **AND** for the terminals allocated to the **ENABLE** functions (**MDI2&S inputs** on physical terminals**, MDI2** via serial command or fieldbus), **ENABLE-SW, External Alarms n.1, n.2, n.3**.
- **OR** for all other terminals.

NOTE

If the keypad is enabled as a command source, the **START**, **STOP**, **RESET**, **LOC/REM** functions are enabled (to disable **LOC/REM** see parameter **P269**). The keypad is ignored for the processing of logic functions (AND/OR) of the other command sources that are enabled at that moment.

NOTE

As the **ENABLE-A** and **ENABLE-B** commands of the **physical terminal board** are a hardware safety device (they enable the drive) they are always active, even when none of parameters **C140, C141** or **C142** selects the terminal board (=1).
If the STO function is to be adopted, the control mode and the control circuit of these signals must be accomplished as per the Safe Torque Off Function – Application Manual**.**
That manual also includes a detailed validation procedure of the control configuration of the STO function to be executed upon first start-up and also periodically at yearly intervals.

NOTE

The commands for the **External Alarm n.1, n.2, n.3** functions are always considered for the drive terminal board only**.**

NOTE

The ***LOCAL mode,*** that can be enabled with the **LOC/REM** key from the keypad or with the **LOCAL** command function from the terminal board (see **C180**), forces the keypad as the only command source, thus ignoring the values set in parameters **C140**, **C141**, **C142**.
The following functions are however enabled for the hardware terminal board: **External Alarm n.,1 n.2, n.3 (C164, C165, C166)**, **Motor Sel. n.2 (C173)**, **Motor Sel. n.3 (C174)**, **SLAVE (C170)**, **Source Selection (C179, C179a, C179b)**, **LOCAL (C180)** and the **ENABLE-A** and **ENABLE-B** and **RESET** functions are always enabled for terminals **MDI2, S** and **MDI3**.
The **ENABLE-SW** and **DISABLE** functions are enabled in LOCAL mode if at least one of parameters **C140**, **C141**, **C142** is set to 1 (terminal board).

NOTE

If **C179** (Source Selection) and **C179a** (Command Selection) are deactivated, it is not possible to program 4: Keypad source and a different source in **C140** and **C141**. This will avoid conflicts in controlling the Start and Stop signals based on the logic level (1: Terminal Board and other sources) or rising edge signals (4: Keypad).
The only exception occurs if **C150**-MDI for the Stop function is set up. In that case, the conflict is resolved because rising edge signal management is active from 1: Terminal Board as well.

NOTE

If **C140** or **C141** are programmed to 1: Terminal Board, it is not possible to set 4: Keypad as a source for **C142** regardless of the programming in **C179**/**C179a**. This is because **C142** is always considered in OR and, again, conflicts would arise for the logic level or rising edge signals. Also in this case, if **C150** is programmed, **C142** may be set to 4: Keypad.

Table 83: Remote Command inputs from serial link

MODBUS Address	Input	User Level	Description	Range
1406	**I019**	BASIC	Remote, virtual terminal board from serial link	Bit input: 0÷1 for 8 bits corresponding to MDI1÷ MDI8
1407	**I020**	BASIC	Auxiliary, virtual terminal board from serial link	Bit input: 0÷1 for 8 bits corresponding to XMDI1÷ XMDI8

Example:

If **C140** = 3 (Fieldbus) and **C141** = 2 (Serial link), the **ENABLE** command is sent by closing terminals **ENABLE-A** and **ENABLE-B** on the terminal board and (AND) by forcing bit **MDI2** from the serial link on input **I019** (MODBUS address: 1406) **and** bit **MDI2** from Fieldbus (see the [CFG] FIELDBUS CONFIGURATION MENU).
The **START** command may also be sent (OR) by forcing bit **MDI1** from serial link on input **I019 or** by forcing bit **MDI1** from Fieldbus for the relevant variable.

39.1.2. Speed/Torque Reference Sources

The "**main reference**" is the value at constant speed to be attained by the controlled variable (speed or torque) (**M000**, **M007**) "required" from the drive.
This reference is acquired by the drive only if the **START** command and the **ENABLE-A** and **ENABLE-B** commands are active; otherwise, it is ignored.
When the main reference is acquired by the drive (**START**, **ENABLE-A** and **ENABLE-B** are active), it becomes the input signal controlled by the "time ramp" functions that generate the speed/torque reference setpoint for the connected motor.

The speed or torque references may come from the following command sources:

0. **Source disabled;**
1. **REF** (*single–ended analog input from terminal board*);
2. **AIN1** (*differential analog input from terminal board*);
3. **AIN2** (*differential analog input from terminal board*);
4. **FIN** (*frequency input from terminal board);*
5. **Serial link** (*with MODBUS protocol*);
6. **Fieldbus** (*fieldbus in optional board*);
7. **Keypad** (*remotable display/keypad*);
8. **Up Down from MDI** (*Up/down from digital inputs, see **C161*** and ***C162***)
9. **XAIN4** (*auxiliary, differential voltage analog input from ES847 terminal board)*
10. **XAIN5** (*auxiliary, differential current analog input from ES847 terminal board)*

The activation logic of the reference sources is as follows:

Source programmed in:	**Activation conditions:**	
	If: **C179** (Source Selection) = 0: Disable and (logic AND) **C179b** (Reference Selection) = 0: Disable	If: **C179** = MDIx input or (logic OR) **C179b** = MDIx input
C143	Always active	Active if MDIx = 0
C144	Always active	Active if MDIx = 1
C145	Always active	Always active
C146	Always active	Always active

Table 84: Activation condition of the reference sources

With factory-setting, only one source is enabled (**C143**=1, **C144**=2, **C145**=0 and **C146**=0). Because the digital input for source selection is programmed (**C179=6: MDI6**, see [CFG] DIGITAL INPUTS MENU), f this input is inactive, only the REF item is selected.
If multiple reference sources are enabled, by programming also **C144**, **C145**, or **C146**, the actual calculated reference is **the algebraic sum of all the active references** (see How to Manage the Reference Sources).

REF, AIN1 and AIN2

The sources called REF, AIN1 and AIN2 come from the analog inputs in the terminal board and generate a reference resulting from the setting of the relevant parameters (from **P050** to **P064**). See the [PAR] INPUTS FOR REFERENCES MENU). The inputs may be used as voltage or current inputs depending on the setting and the position of the relevant dip-switches (see IRIS BLUE – Installation Guide).

SERIAL LINK

The ***Serial Link*** source is an input located on the MODBUS link: the reference value must be written by the user to the addresses below:

Table 85: Reference Inputs from serial link

MODBUS Address	Input Code	User Level	Reference	Description	Range	Unit of Measurement
1412	**I025**	BASIC	Speed	Speed reference/limit (integer portion)	Min. speed ÷ Max. speed	RPM

NOTE

I I025 is the speed reference if at least one among parameters **C143**..**146** is set to 5:Serial Link and the type of reference of the connected motor (parameter **C011**) is set to 0:Speed; I025 is the speed limit if **C147**=5:Serial Link and the type of reference of the active motor is set to 2:Torque with Speed Limit. The range of this reference depends on the active Minimum Speed value and Maximum Speed value as set in parameter **C028** and **C029**.
If **C029** ≤ **C028**, then **Min. speed** = **C029**, **Max. speed** = **C028**.
If **C029** ≥ **C028**, then **Min. speed** = **C028**, **Max. speed** = **C029.**

FIELDBUS

For a description of the **Fieldbus** source, see the [CFG] FIELDBUS CONFIGURATION MENU.

KEYPAD

NOTE

The keypad is a special reference source. The keypad reference may be changed with the ▲ and ▼ keys only if this reference is on a Keypad page displaying a reference in line 4.
If the keypad is enabled, a **variation** to the active reference may be added through an algebraic sum (calculated by processing the other reference sources that are activated at that moment).
The reference variation method can be selected with parameters **P067**, **P068**, **P069**, and **C163**.
This function is the same as the **UP** and **DOWN** functions from the terminal board (see the [CFG] DIGITAL INPUTS MENU**: C161** and **C162, P068÷P069** in the [PAR] INPUTS FOR REFERENCES MENU).

NOTE

The ***LOCAL mode,*** that can be enabled with the **LOC/REM** key on the keypad or with the **LOCAL** command function from terminal board (see **C180**), forces the keypad to become the only command and reference source, thus ignoring the values set in parameters **C143**, **C144**, **C145, C146**.

UP/DOWN from digital inputs

To enable the **UP/DOWN from digital inputs** also set the relevant Up and Down inputs (see the [CFG] DIGITAL INPUTS MENU).

XAIN4 and XAIN5

XAIN4 and XAIN5 come from the analog inputs in the terminal board of ES847 and generate a reference determined by the settings of the relevant parameters (**P390** to **P399**), allowing proper scaling, offset compensation and filtering (see the [PAR] INPUTS FOR REFERENCES FROM OPTION BOARD MENU).

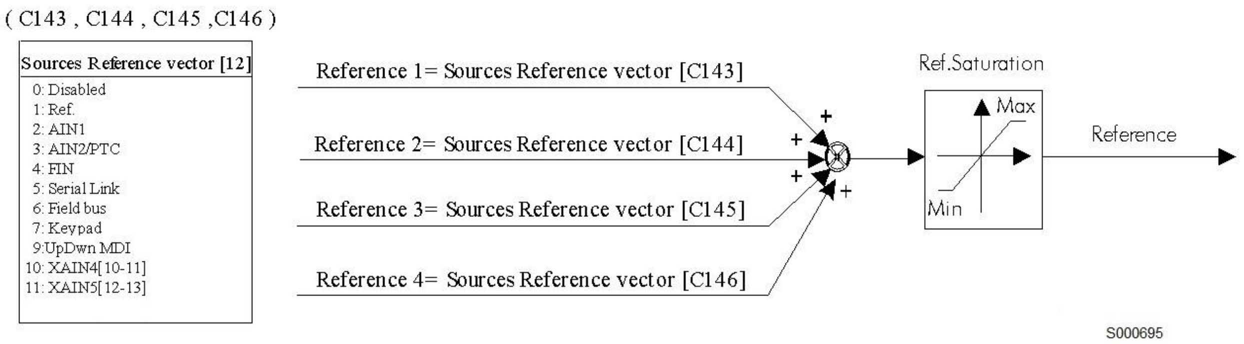


Figure 48: Selecting the source references

39.1.3. ALTERNATIVE COMMAND AND REFERENCE SOURCES

A digital input can be set as a selector between 2 alternative command and reference sources.

Example:

C179 MDI to select sources = **MDI6**
C140 to select command source number 1 = **Keypad**
C141 to select command source number 2 = **Fieldbus**
C143 to select reference source number 1 = **AIN1**
C144 to select reference source number 2 = **Fieldbus**

If **MD16** (in the drive terminal board) set as a selector is open, the drive will consider number 1 as reference and command sources (that is **C140 = Keypad** and **C143 = AIN1**); if it is closed, number 2 will be considered (**C141 = Fieldbus** and **C144 = Fieldbus**). See also How to Manage the Reference Sources.
If reference sources 3 and 4 (**C145 and C146**) are not set to Disable, the reference sent for these sources shall be a sum of the source selected by MD16 vector.

Please refer to **C179** in the [CFG] DIGITAL INPUTS MENU.

39.1.4. REMOTE/LOCAL

According to factory-setting, switching over from the **Remote** mode to the **Local** mode can only be made when the drive is disabled. The reference and command sources for the **Remote** mode depend on the settings of parameters **C140** to **C146** in the [CFG] CONTROL METHOD MENU and **C285÷C287** in the [CFG] PID CONFIGURATION MENU. When switching over from the Remote mode to the Local mode, the command and reference can be sent via keypad only. This is true for the switch over from the **Local** to the **Remote** mode as well.
Parameter **C148** allows customizing the Loc/Rem function so that it can be performed even when the drive is running. Parameter **C148** also allows setting whether the same running condition and the same reference must be maintained when switching over from the Remote to the Local mode.

NOTE For more details on the Loc/Rem function, see LOC/REM Key (Keypad Pages) and the [CFG] DIGITAL INPUTS MENU.

39.2. How to Manage the Reference Sources

This section covers how to manage the reference sources.
Two examples are given along with the table including the configuration of the parameters to be used.

Example 1: The Speed Reference is the algebraic sum of two references
Analog inputs REF and AIN1 (that are supposed to be 0-10V voltage inputs) are to be used as speed references. The main reference will be the sum of the two references being used. The end result may vary based on the parameters concerned.

P050	Type of Reference for REF Input	3: 0-10V
P051	Value of REF Input producing Min. Reference	0.0V
P051a	Percentage of Ref_Min producing Min. Reference	100.0%
P052	Value of REF Input producing Max. Reference	10.0V
P052a	Percentage of Ref_Max producing Max. Reference	100.0%
P055	Type of Signal over AIN1 input	3: 0-10V
P056	Value of AIN1 Input producing Min. Reference	0.0V
P056a	Percentage of Ref_Min producing Min. Reference	100.0%
P057	Value of AIN1 input producing Max. Reference	10.0V
P057a	Percentage of Ref_Max producing Max. Reference	100.0%
C028	Min. Motor Speed	0rpm
C029	Max. Motor Speed	1500rpm
C143	Selection of Reference 1	1: REF
C144	Selection of Reference 2	2: AIN1
C179	MDI for Source Selection	0: Disable

C179=0: Disable ensures that the main reference is the sum of the references being used. If a digital input for Source selection were used, either one reference would be selected as the main reference based on the input status.
Both REF and AIN1 references are programmed in order to meet the following requirements:

- at 0V, they are expected to generate 100% of the minimum motor speed reference (**C028**), i.e. 0rpm
- at 10V, they are expected to generate 100% of the maximum motor speed reference (**C029**), i.e. 1500rpm

The main reference will be their sum and will start from 0rpm (when both references are at 0V) and its maximum value would be 3000rpm (when both references are at 10V), but it will be limited to 1500, as set by **C029**, as soon as the sum of the two references exceeds 1500rpm.

Suppose that the parameters below are to be programmed (only the parameters changing with respect to the example above are given):

C028	Min. motor speed	50rpm

As the minimum motor speed is set to 50rpm, each of the two references, at 0V, will generate a reference equating 100% of 50rpm, i.e. 50rpm. The minimum value of the main reference, that is the sum of the two references, will then equating 100rpm if the two references are at 0V.
If the main reference shall start from 50rpm, that is it can generate the minimum motor speed, the following parameters shall be set accordingly:

P051a	Percentage of Ref_Min producing Min. Reference	50.0%
P056a	Percentage of Ref_Min producing Min. Reference	50.0%

In that way, either references at 0V will generate 50% of 50rpm, i.e. 25rpm. Their sum will be worth 50rpm at a minimum, as required.

If the whole resolution of the references is to be exploited, so that:

- at 0V, for both references, the minimum speed is 50rpm
- at 10V, for both references, the maximum speed is 1500rpm

then the following shall be programmed:

P052a	Percentage of Ref_Max producing Max. Reference	50.0%
P057a	Percentage of Ref_Max producing Max. Reference	50.0%

In that way, each reference will range from 25 to 750rpm and their sum will range from 50 and 1500rpm, as required.

Example 2: Speed references alternatively selected

The two REF analog inputs are to be used as alternative speed references. The following parameters shall be programmed accordingly:

P050	Type of Reference for REF Input	3: 0-10V
P051	Value of REF Input producing Min. Reference	0.0V
P051a	Percentage of Ref_Min producing Min. Reference	100.0%
P052	Value of REF Input producing Max. Reference	10.0V
P052a	Percentage of Ref_Max producing Max. Reference	100.0%
P055	Type of Signal over AIN1 input	3: 0-10V
P056	Value of AIN1 Input producing Min. Reference	0.0V
P056a	Percentage of Ref_Min producing Min. Reference	100.0%
P057	Value of AIN1 input producing Max. Reference	10.0V
P057a	Percentage of Ref_Max producing Max. Reference	100.0%
C143	Selection of Reference 1	1: REF
C144	Selection of Reference 2	2: AIN1
C179	MDI for Source Selection	6: MDI6

As MDI6 input is selected as reference source selection (**C179**), the references selected via **C143** and **C144** are selected as the main reference depending on the input status. When the input is inactive, REF will be the main reference; when the input is active, AIN1 will be the actual reference.

39.3. List of Parameters C140 to C148

Table 86: List of Parameters C140 to C148

Parameter	FUNCTION	User Level	MODBUS Address	DEFAULT VALUES
C140	Command Digital Input 1	ADVANCED	1140	1:Terminal Board
C141	Command Digital Input 2	ADVANCED	1141	1:Terminal Board
C142	Command Digital Input 3	ENGINEERING	1142	0
C143	Input Reference 1	ADVANCED	1143	1: REF
C144	Input Reference 2	ADVANCED	1144	2: AIN1
C145	Input Reference 3	ENGINEERING	1145	0
C146	Input Reference 4	ENGINEERING	1146	0
C148	Torque Limit Input	ENGINEERING	1148	0: StandBy or Fluxing

NOTE The programming range of parameters **C140**, **C141**, **C142** depends on the setting of parameter **C150** and vice versa (see the detailed description of the parameters above).

C140, C141, C142	Command Source Selection 1 (2, 3)	
Range	0 ÷ 4	0: Disabled 1: Terminal Board 2: Serial Link 3: Fieldbus 4: Keypad
Default	**C140** ÷ **C141**= 1 **C142** = 0	**C140** ÷ **C141**= 1: Terminal Board **C142** = 0: Disabled
Level	**C140** ÷ **C141** ADVANCED; **C142** ENGINEERING	
Address	1140 (1141, 1142)	
Function	Selection of the drive command source.	

NOTE By setting one of the three command sources to 5: Keypad and one or more of the other sources to a value different than 5: Keypad is possible only if:

1. the STOP or STOP B digital inputs (**C150** ≠ 0 or **C150a** ≠ 0) are set up to enable using the pushbuttons, or
2. the source selection function (**C179** ≠ 0) is set up.

NOTE If the digital input for source selection or command selection (parameters **C179** and **C179a** in the [CFG] DIGITAL INPUTS MENU) is set to a value other than 0:Disabled is always considered as OR bit by bit to the selected source. The ENABLE input (MDI2), however, is considered as AND to the source selected by the selector.

C143, C144, C145, C146	Reference n.1 (2, 3, 4) Selection	
Range	0 ÷ 9 0 ÷ 11 if ES847 is fitted	0: Disabled 1: REF 2: AIN1 3: AIN2 4: Frequency input 5: Serial Link 6: Fieldbus 7: Keypad 9: UpDown from MDI 10: XAIN4 11: XAIN5
Default	C143 = 1, C144 = 2 C145 ÷ C146 = 0	C143 = 1: REF, C144 = 2: AIN1 C145 ÷ C146 = 0: Disabled
Level	C143 ÷ C144 ADVANCED; C145 ÷ C146 ENGINEERING	
Address	1143 (1144, 1145, 1146)	
Function	This parameter selects the sources for the speed (or torque) reference. The reference resulting from the sum of the selected sources represents the drive speed or torque reference. If the PID action has been set as reference **C294 = Reference**, the drive speed or torque references shall only be given by the PID output and not by the sources set in **C143.** Reference sources 10 and 11 can be selected only after setting XAIN in parameter **R023**.	

C148	Switch over from Remote to Local Command	
Range	0 ÷ 3	0: StandBy + Fluxing 1: Drive Running / No Bumpless 2: Drive Running / Commands Bumpless 3: Drive Running / All Bumpless
Default	0	0: StandBy or Fluxing
Level	ENGINEERING	
Address	1148	
Function	The drive factory-setting (0: StandBy or Fluxing) allows switching over from Remote to Local mode (and vice versa) only when the drive is not running. Different settings allowed by parameter **C148** are detailed below; switching from Remote to Local mode (and vice versa) can be performed even when the drive is running: • No Bumpless → When switching from Remote to Local mode, a speed/torque reference = zero [*] is sent to the drive; the START button must be pressed to start the drive. • Commands Bumpless → When switching from Remote to Local mode, a speed/torque reference = zero [*] is sent to the drive, but the running conditions are the same as in Remote mode. For example, if the motor is running in Remote mode, the drive still runs even in Local mode and the reference can be changed with the INC/DEC keys starting from zero. • All Bumpless → When switching from Remote to Local mode, the drive maintains the same speed/torque reference and the same running condition as in Remote mode. For example, if the motor is running at 1000 rpm in Remote mode, the drive still runs even in Local mode with a reference of 1000 rpm that can be changed with the INC/DEC keys starting from zero. [*] or to the smallest value compatible with **C028/C029** or **C047/C048**.	

NOTE Parameter **C148** affects parameters **C140** to **C146** and **C285** to **C287** (see [CFG] PID CONFIGURATION MENU) when the PID controller is enabled.

40. [CFG] DIGITAL INPUTS MENU

40.1. Overview

NOTE Please refer to IRIS BLUE – Installation Guide for the hardware description of the digital inputs.

The parameters contained in this menu assign particular digital control functions to each digital input in the terminal board. Each parameter has a particular function, which is assigned to a given terminal on the terminal board.

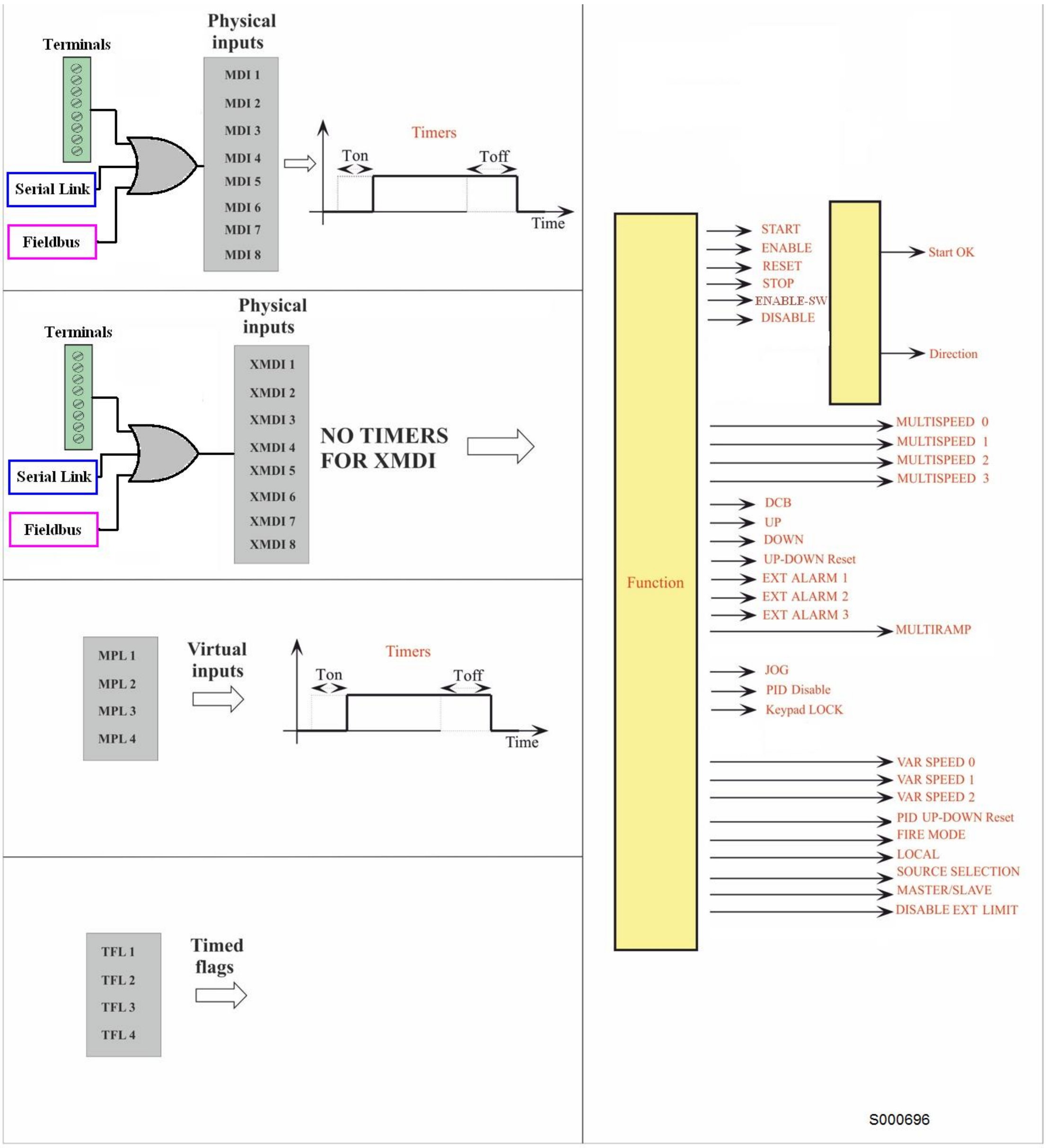


Figure 49: Inputs that can be selected to implement control functions

The full processing of the digital inputs also includes the selection of other remote/virtual terminal boards (see the [CFG] CONTROL METHOD MENU) and the possibility of delaying input digital signal enable/disable by means of software timers (see the [PAR] TIMERS MENU).

The digital input status is displayed in measurements **M031**, **M032**, **M033**, **M034**, **M035**.
Measurement **M033** shows the **current** status of the 8 inputs in the local hardware terminals in the drive board.
The input called **MDI2&S** ("**S**" on the display keypad) is active only if both physical inputs **ENABLE-A** and **ENABLE-B** are active.
The symbol □ displays the logic levels for terminals **M033** for inactive inputs; the active inputs are marked with ■.

Measurements **M034** and **M035** show the status of the terminal boards that can be activated via serial link and fieldbus respectively.

Measurement **M032** shows the **current** status of the virtual terminal board obtained by processing all active terminal boards. It includes 10 signals, with two additional signals with respect to the local hardware terminal board:

- Inputs **MDI1** to **MDI8** are obtained with the **logic OR** of the input signals for all active terminals;
- The **ENABLE** function is obtained with the logic **AND** of the input signals for terminal **MDI2&S** (physical terminal board) and terminals **MDI2** (serial link and fieldbus) in all active terminal boards, unless parameter C154a is inactive;
- The **ENABLE–SW** function is obtained with the logic **AND** of the terminals selected for this function in all active terminal boards.

Measurement **M031** is similar to **M032**, but it displays the status of the terminal board obtained after delaying the input signals of M032 using special timers.
The drive uses this terminal board to acquire digital commands.

Some functions cannot be programmed, but they are assigned to special terminals:

Table 87: Unprogrammable functions

Function	***Terminal***
ENABLE	MDI2
RESET	MDI3 (can be disabled if **C154** = Yes)

40.1.1. START

The **START** function may be assigned to a digital input (MDI1..8); to an auxiliary digital input (XMDI1..8); to a virtual auxiliary digital output (MPL1..4) or to a timed flag (TFL1..4). The input programming is set via parameter **C149**.
To enable the Start input, set the control modes via terminal board (factory setting). The **START** command can also be sent from the display/keypad. The programmed input Enable/Disable can be delayed via special timers.
The **START** input function is assigned to MDI1 terminal by default, but it can be assigned to other terminals as well. The same terminal programmed as **START** may be allocated to different functions as well.
The motor stop mode (**C185**) can be programmed. When removing the **START** command, the following motor stop modes can activate:
the motor stops following a deceleration ramp or starts idling; the motor is fluxed (VTC) only when the **START** command is shut down and the **ENABLE** is not active (**C184**).
When **START** is **active** (and when the **ENABLE** function is active as well), the **RUN** command is enabled: the speed (or torque) *setpoint* increases proportionally to the preset ramp until it reaches the active *reference*. (IFD control: in order to enable the RUN command, the main speed reference must be other than zero).
When **START** is **inactive** (also when the **ENABLE** is active), the **RUN** command is disabled: the reference is set to zero and the speed (or torque) setpoint decreases down to zero depending on the preset deceleration ramp.

NOTE

The way for the **START** function to enable or disable the drive **RUN** is also dependent on the programming of other functions, particularly the **STOP** and **REVERSE** functions (see parameters **C150**, **C151**).
If the **REVERSE** function is activated (**C151**≠0) this may cause **RUN** disable and enable; however, if the **START** and **REVERSE** functions are simultaneously active, the **RUN** is disabled.
In that case, indeed, ***START*** *is considered as FOWARD RUN and* ***REVERSE*** *as REVERSE RUN. When they are both active the system cannot interpret the query to be FORWARD or REVERSE.*
If the **STOP** function is enabled (**C150**≠0), the **RUN** command may be enabled/disabled only by pressing the relevant "key": see the description of the **STOP** function (**C150**).

NOTE

If only the keypad is enabled as the command source, press the **START** key located on the keypad to enable the drive **RUN** and press the **STOP** key to disable the drive **RUN**.

NOTE

If **C185** = Free Wheel when removing the **START** command, the drive will not carry out the deceleration ramp and will be put on stand-by.

40.1.2. ENABLE (TERMINALS 15:MDI2 AND S)

The **ENABLE** function is assigned to terminals **ENABLE-A (MDI2)** and **ENABLE-B (S)** (the series-connection of those inputs activates the **MDI2&S** input as displayed in **M033**) and **enables the drive operation**. It cannot be set to other terminals, whereas the same terminal may be assigned to different functions.

In order to enable the drive operation:
- **ENABLE-A** and **ENABLE-B** inputs must be active. In that way, **MDI2&S** displayed in measurement **M033** will be active;
- **MDI2** input must be active on all active terminal boards (serial link and fieldbus – [CFG] CONTROL METHOD MENU), unless parameter **C154a** is inactive. The command sources programmed in parameters **C140**, **C141**, **C142** are to be considered only if active. See Table 82.

The **ENABLE** function is detailed in the figure below:

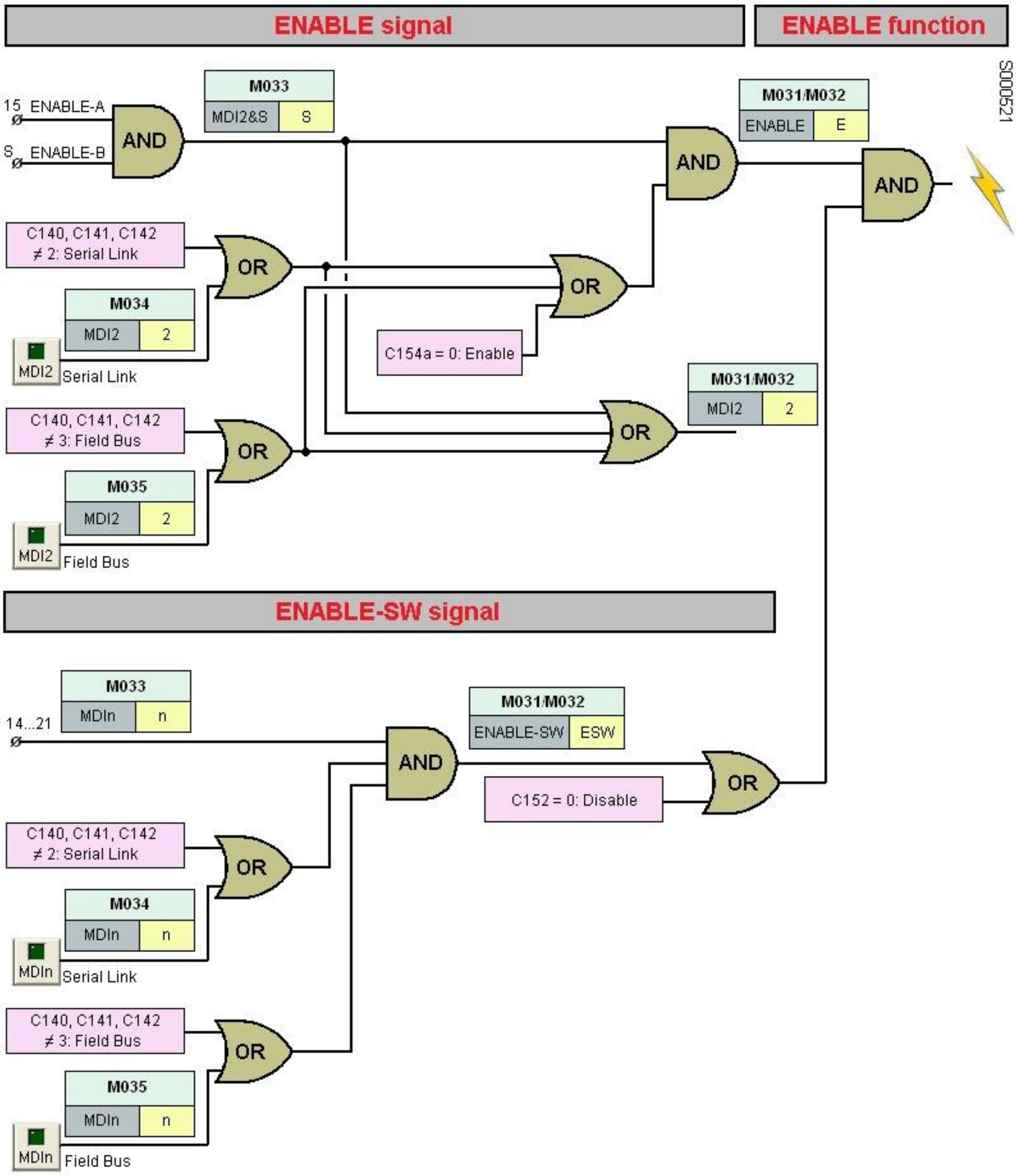


Figure 50: The ENABLE function

NOTE If the STO function is to be adopted, the control mode and the control circuit of the **ENABLE-A** and **ENABLE-B** signals must be accomplished as per the Safe Torque Off Function – Application Manual**.**
That manual also includes a detailed validation procedure of the control configuration of the STO function to be executed upon first start-up and also periodically at yearly intervals.

If the **ENABLE** input is disabled, the drive output voltage is always set to zero, so the connected motor starts **idling** (the motor idles and stops due to friction or the mechanical load).
In case of pulled loads, when the motor is idling, the mechanical load could cause the motor to run at uncontrolled speed!

If the **ENABLE** input is disabled when the drive is controlling the motor, it is closed with a delay time depending on the drive size. This **ENABLE** delay starts from the instant when the input is disabled irrespective of the enable delay (if any) set through a software timer in **MDI2**.

The operating mode and the logic used by the **ENABLE** input to enable/disable the drive also depends on the programming of the **DISABLE** and **ENABLE-SW** functions described below.

If the **IFD** control is used, the drive enabling also depends on the **START** input and the current value of the active reference: if the **START** command is active but the reference is lower than the preset threshold, the drive operation is disabled. To enable this operating mode with other types of control, parameters **P065** and **P066** must be set accordingly.

The drive may also be disabled by the **PID** regulator (see parameter **P255)**.

DANGER!!! The deactivation of the **ENABLE-SW** signal, the activation of the **DISABLE** signal, the deactivation of **MDI2** inputs from serial link or fieldbus DO NOT GUARANTEE that the Safe Torque Off – STO function is removed from the motor connected to the drive.
Safety stop conditions are guaranteed only when at least one of the two **ENABLE-A** and **ENABLE-B** inputs are opened.
For more details, consult the Safe Torque Off Function – Application Manual.

CAUTION If the **MDI2** inputs are disabled for one of the active terminal boards, the drive is instantly disabled and the motor starts idling! If so, the mechanical load could cause uncontrolled acceleration/slowing down of the connected motor!

CAUTION If the physical **ENABLE-A** or **ENABLE-B** inputs are opened, the drive is disabled and the motor starts idling! If this is the case, the mechanical load can cause uncontrolled acceleration/slowing down of the connected motor.

CAUTION If a protection/alarm trips, the drive disables and the motor starts idling!

NOTE If software timers are enabled for digital inputs, the timer for the **MDI2** input delays the signal enabling. The **ENABLE** signal is always instantly disabled (*for the **ENABLE** function, Toff in **MDI2** is ignored).*

NOTE The activation of the **ENABLE** command enables the alarms controlling the configuration consistency of certain parameters.

NOTE When the **ENABLE** function is active, C parameters cannot be changed (factory-setting). If **P003** Condition required for changing C parameters = Standby+Fluxing, the parameters may be changed even if the drive is enabled but the motor is not running.

NOTE When the **ENABLE** function is active for the VTC control, the motor is fluxed by the drive. Motor fluxing is allowed only if the **START** contact is shut down and **C184** = Yes.

NOTE If set accordingly, safety parameter **C181** prevents the drive from starting if the **ENABLE** function is already active when the drive is powered on.

40.1.3. RESET (TERMINAL 16:MDI3)

The **RESET** function is assigned to input terminal **MDI3**. It resets the alarms to unlock the drive operation. It cannot be set to other terminals, whereas the same terminal may be assigned to different functions. To disable the reset function from terminal MDI3, set **C154** = Yes.
If a protection trips, the drive locks, the **motor starts idling** (the motor idles and stops due to friction or the mechanical load) and an alarm message is displayed (see also the [CFG] AUTORESET MENU and LIST OF ALARMS AND WARNING).

Reset procedure
To unlock the drive, activate the **RESET** input for an instant, or press the **RESET** key from the keypad. When the drive unlocks and the cause responsible for the alarm has disappeared, “Inverter ok” comes up on the screen, otherwise, the alarm persists and cannot be reset.
If set up accordingly, safety parameter **C181** permits to deactivate and reactivate the **ENABLE** function to restart the drive once the cause responsible for the alarm has disappeared.

NOTE Factory setting does not reset alarms at power off. Alarms are stored and displayed at next power on and the drive is locked. A manual reset is then required to unlock the drive. See also the [CFG] AUTORESET menu for proper set up of autoreset parameters.

CAUTION If an alarm trips, see the LIST OF ALARMS AND WARNING section and reset the equipment after detecting the cause responsible for the alarm.

DANGER!!! Electrical shock hazard exists on output terminals (U, V, W) even when the drive is disabled.

NOTE Set **C154** = Yes to remove the reset function from MDI3. After that, only one different function can be allocated to MDI3 even when multiprogramming is active (see parameter **C182**).

40.2. Factory-setting of the Digital Inputs

Table 88: Terminal board: Factory-setting

Function	Terminal	Description
START	14: MDI1	Enables the drive RUN
ENABLE	15: MDI2&S	Enables the drive
RESET	16: MDI3	Resets the alarms tripped
MULTISPEED 0	17: MDI4	Bit 0 for Multispeed selection
MULTISPEED 1	18: MDI5	Bit 1 for Multispeed selection
Source Sel	19: MDI6	Source Selection
Loc/Rem	20: MDI7	Local / Remote Control Selection

40.3.List of Parameters C149 to C188c and I006

The parameters ranging from **C149** to **C180** and from **C186** to **C188c** (one for each command function) activate single functions and set the terminal for each enabling/disabling function.
Parameter **C181** enables a safe **START** mode.
Parameter **C182** enables multiple programming (if compatible) to the same terminal. Max. two functions can be programmed to the same input.

Table 89: List of Parameters C149 to C188c and I006

Parameter	FUNCTION	User Level	MODBUS Address	DEFAULT VALUE
I006	Function selection for MDI control	ADVANCED	1393	Inactive
C149	START Input	ADVANCED	1149	MDI1
C150	STOP Input	ADVANCED	1150	None
C151	REVERSE Input	ADVANCED	1151	None
C152	ENABLE-SW Input	ADVANCED	1152	None
C153	DISABLE Input	ADVANCED	1153	None
C154	Disable RESET alarms on MDI3	ADVANCED	1154	NO
C154a	Enable from Terminals only	ADVANCED	1154	NO
C155	MULTISPEED 0 Input	ADVANCED	1155	MDI4
C156	MULTISPEED 1 Input	ADVANCED	1156	MDI5
C157	MULTISPEED 2 Input	ADVANCED	1157	None
C159	CW/CCW Input	ADVANCED	1159	MDI8
C160	DCB Input	ADVANCED	1160	None
C161	UP Input	ADVANCED	1161	None
C162	DOWN Input	ADVANCED	1162	None
C163	RESET UP/DOWN Input	ADVANCED	1163	None
C164	External Alarm 1 Input	ADVANCED	1164	None
C164a	External Alarm 1 Trip Delay	ADVANCED	1305	Instant
C165	External Alarm 2 Input	ADVANCED	1165	None
C165a	External Alarm 2 Trip Delay	ADVANCED	1306	Instant
C166	External Alarm 3 Input	ADVANCED	1166	None
C166a	External Alarm 3 Trip Delay	ADVANCED	1307	Instant
C167	MultiRamp 0 Input	ENGINEERING	1167	None
C171	PID DISABLE Input	ADVANCED	1171	None
C171a	Input for PID Control Selection	ENGINEERING	1188	None
C172	KEYPAD Lock Input	ADVANCED	1172	None
C178	PID RESET UP/DOWN input	ADVANCED	1178	None
C179	SOURCE SELECTION Input	ADVANCED	1179	MDI6
C179a	COMMAND SELECTION Input	ADVANCED	1238	None
C179b	REFERENCE SELECTION Input	ADVANCED	1239	None
C180	LOC/REM Input	ADVANCED	1180	MDI7
C180a	Type of LOC/REM contact	ADVANCED	1303	Pushbutton+Storage
C181	Safety Start enable	ADVANCED	1181	Inactive
C182	Multiprogramming enable	ENGINEERING	1182	Inactive
C183	Max. fluxing time before drive Disable	ADVANCED	1183	Inactive
C184	Fluxing at activation only with START closed	ADVANCED	1184	No
C184a	Disable external torque limit during fluxing	ENGINEERING	1200	No
C185	Stop Mode	ADVANCED	1185	Deceleration ramp
C186	Fire Mode Enable Input	ENGINEERING	1186	None
C187	Torque Limit Source Ref. Disabling Input	ADVANCED	1187	None
C188a	PID Multireference 1 Input	ENGINEERING	1365	None
C188b	PID Multireference 2 Input	ENGINEERING	1366	None
C188c	PID Multireference 3 Input	ENGINEERING	1367	None

NOTE If a parameter is set to zero, its function is disabled, otherwise the parameter value stands for the MDIx input assigned to the function.

NOTE Auxiliary digital inputs XMDI (values from 17 to 24 in control function parameters) can be set up only after setting XMDI/O in parameter **R023**.

CAUTION Set **C182=1** to allocate 2 functions to the same terminal**.**

I006	**Function Selection for MDI Control**	
Range	0 ÷ 2	0 → Inactive 1 → Clear all 2 → Set factory default
Default	This is not a programming parameter: the input is set to zero whenever the drive is powered on and whenever the command is executed.	
Level	ADVANCED	
Address	1393	
Function	0 → Inactive. 1 → Forces to "0 → Inactive" the settings of all the digital inputs. 2 → Forces to the default values the settings of all the digital inputs.	

C149	**START Input**	
Range	0 ÷ 16 0 ÷ 24 with ES847 or ES870 fitted	0 → Inactive 1 ÷ 8 → MDI1 ÷ MDI8 9 ÷ 12 → MPL1 ÷ MPL4 13 ÷ 16 → TFL1 ÷TFL4 17 ÷ 24 → XMDI1 ÷ XMDI8
Default	1	MDI1
Level	ADVANCED	
Address	1149	
Function	When the **START** input is **activated** (the **ENABLE-A** and **ENABLE-B** inputs are activated as well), **RUN** is enabled: the speed (torque) *setpoint* increases following the programmed ramp until it reaches the active *reference*. In IFD control mode, <u>the main speed reference shall be other than zero for **RUN** enable</u>. When the **START** input is **inactive** (even if the **ENABLE-A** and **ENABLE-B** inputs are activated) **RUN** is disabled: the reference is set to zero and the speed (torque) *setpoint* drops to zero based on the programmed deceleration ramp.	

NOTE If the PROFIdrive option is present, parameter **C149 START Input** must be assigned to value 1: MDI1.

C150	**STOP Input**	
Range	0 ÷ 16 0 ÷ 24 with ES847 or ES870 fitted	0 → Inactive 1 ÷ 8 → MDI1 ÷ MDI8 9 ÷ 12 → MPL1 ÷ MPL4 13 ÷ 16 → TFL1 ÷ TFL4 17 ÷ 24 → XMDI1 ÷ XMDI8
Default	0	Inactive
Level	ADVANCED	
Address	1150	
Function	This parameter disables the **RUN** function enabled by the **START** command. The setting of this function affects the enabling/disabling mode of the **RUN** command: it can be enabled/disabled using the **START and STOP keys** or the **START, STOP and REVERSE keys** instead of the **START** key as **an ON/OFF switch** (factory-setting). If the drive is enabled: Press **START** to enable the drive **RUN;** Press **STOP** to disable the drive **RUN**: reference is set to zero, so the speed (or torque) setpoint decreases to zero based on the preset deceleration ramp. In case of preset **STOP**, the keypad and one or more terminal boards may be enabled at a time. In this case, the ***START*** key and the ***STOP*** key in the display/keypad are active and can enable or disable the drive **RUN**. The **STOP** input is a normally closed input signal.	

NOTE According to factory setting, only the hardware terminal board selected with command source 1 (**C140**=1) is active as a switch-operated mode (**C150**=0).
To switch to the key-operated mode, set the **STOP** input (**C150** ≠0). The keypad and other terminal boards may be selected in key-operated mode only.
If the **STOP** input is not programmed, and the switch-operated mode is active, the keypad may be selected as the only command source (**C140**=5, **C141**=0, **C142** =0).

NOTE The **STOP** function has priority over the **START** function; if both inputs are active, the **STOP** input prevails. Therefore, the **STOP** input acts as a key and as a **switch**.

NOTE The **START/STOP** commands are ignored when the drive is disabled.

C151	REVERSE Input - Reverse Run	
Range	0 ÷ 16 0 ÷ 24 if ES847 or ES870 is fitted	0 → Inactive 1 ÷ 8 → MDI1 ÷ MDI8 9 ÷ 12 → MPL1 ÷ MPL4 13 ÷ 16 → TFL1 ÷ TFL4 17 ÷ 24 → XMDI1 ÷ XMDI8
Default	0	Inactive
Level	ADVANCED	
Address	1151	
Function	The **REVERSE** function carries out a **START** command, but it reverses the motor direction of rotation. If both the **START** and **REVERSE** inputs are active at the same time, the drive is sent a STOP command. If the **STOP** input function is not programmed (**C150**=0), the **REVERSE** signal and the **START** input act as switches, otherwise they act as buttons.	

NOTE

If the keypad is active, pressing the **FWD/REV** key on the display/keypad will also reverse the direction of rotation of the connected motor.
The reference direction of rotation can be reversed with **Cw/CCw** if this is set up (**C159** ≠ 0).
Both functions cause a signal reversal; if they are both active, they will cancel each other.

CAUTION

When the reference sign is reversed, <u>the direction of rotation of the connected motor is not immediately reversed</u>: the setpoint decreases to zero following the preset deceleration ramp, and it increases up to the reference value having the opposite sign following the preset acceleration ramp.

C152	ENABLE-SW Input	
Range	0 ÷ 16 0 ÷ 24 if ES847 or ES870 if fitted	0 → Inactive 1 ÷ 8 → MDI1 ÷ MDI8 9 ÷ 12 → MPL1 ÷ MPL4 13 ÷ 16 → TFL1 ÷ TFL4 17 ÷ 24 → XMDI1 ÷ XMDI8
Default	0	Inactive
Level	ADVANCED	
Address	1152	
Function	This is an additional software-controlled Enable signal which is estimated in series to the **ENABLE** function associated to **MDI2** inputs. If this function is enabled, the drive is enabled *if and only if* the **ENABLE-A**, **ENABLE-B** and **ENABLE-SW** inputs are simultaneously activated. If the **ENABLE-SW** function is programmed (**C152**≠0), do the following to enable the drive: • activate the **ENABLE-SW** signal • activate the **ENABLE-A** and **ENABLE-B** signals • activate **MDI2** inputs via serial link and fieldbus, if those inputs are selected via **C140**, **C141**, **C142**. • activate the **DISABLE** signal if programmed via **C153.**	

NOTE The **ENABLE-SW** signal may not be delayed by the timers: if a timer is programmed to the terminal related to the **ENABLE-SW** signal, this will not affect the **ENABLE-SW** function, while it normally delays other functions set to the same terminal.

DANGER!!! The deactivation of the **ENABLE-SW** signal, the activation of the **DISABLE** signal, the deactivation of **MDI2** inputs from serial link or fieldbus DO NOT GUARANTEE that the Safe Torque Off – STO function is removed from the motor connected to the drive.
Safety stop conditions are guaranteed only when at least one of the two **ENABLE-A** and **ENABLE-B** inputs are opened.
For more details, consult the Safe Torque Off Function – Application Manual.

C153	DISABLE Input	
Range	0 ÷ 16 0 ÷ 24 if ES847 or ES870 is fitted	0 → Inactive 1 ÷ 8 → MDI1 ÷ MDI8 9 ÷ 12 → MPL1 ÷ MPL4 13 ÷ 16 → TFL1 ÷ TFL4 17 ÷ 24 → XMDI1 ÷ XMDI8
Default	0	Inactive
Level	ADVANCED	
Address	1153	
Function	The **DISABLE** function disables the drive and overrides any **ENABLE-A and ENABLE-B** signals**.** The **DISABLE** command sets the drive output voltage to zero, so the motor starts idling (the motor idles and stops due to friction or the mechanical load). If the **DISABLE** function is set up (**C153**≠0), do the following to enable the drive: • deactivate the input signal on the terminal selected via **C153** • activate the **ENABLE-A** and **ENABLE-B** signals • activate the **MDI2** inputs via serial link and fieldbus, if selected via **C140**, **C141**, **C142** • activate the **ENABLE-SW** signal if programmed via **C152**.	

DANGER!!! The deactivation of the **ENABLE-SW** signal, the activation of the **DISABLE** signal, the deactivation of **MDI2** inputs from serial link or fieldbus DO NOT GUARANTEE that the Safe Torque Off – STO function is removed from the motor connected to the drive.
Safety stop conditions are guaranteed only when at least one of the two **ENABLE-A** and **ENABLE-B** inputs are opened.

C154	Disable RESET Alarms on MDI3	
Range	0 ÷ 1	0: NO; 1: Yes
Default	0	0: NO
Level	ADVANCED	
Address	1154 bit 0	
Function	If **C154 =1: Ye**s, the alarm reset function can be disabled from MDI3, that can be assigned to other functions.	

C154a	Enable via Terminal Board only	
Range	0 ÷ 1	0: NO; 1: Yes
Default	0	0: NO
Level	ADVANCED	
Address	1154 bit 1	
Function	When **C154a=1: Yes** it is possible to force the system to consider the only terminal physical input as the ENABLE input, independently of the active command sources set in **C140**, **C141**, **C142**.	

NOTA

Parameters **C154** and **C154a** may have binary values only and they share the same Modbus address. The bit-parameter match is given in the table below.
It is important to consider this if the address is updated from an external interface system: before writing a new value, read the address value and change the bit concerned only, to avoid changing the other parameter as well.

These precautions are not necessary for the changes made via keypad or IrisControl.

Table 90: Coding of Parameters C154 and C154a

bit [15..2]	bit [1]	bit [0]
Not used	**C154a**	**C154**

C155, C156, C157	Multispeed Inputs	
Range	0 ÷ 16 0 ÷ 24 if ES847 or ES870 is fitted	0 → Inactive 1 ÷ 8 → MDI1 ÷ MDI8 9 ÷ 12 → MPL1 ÷ MPL4 13 ÷ 16 → TFL1 ÷ TFL4 17 ÷ 24 → XMDI1 ÷ XMDI8
Default	**C155** = 4, **C156** = 5, **C157** = 0	**C155** = MDI4, **C156** = MDI5, **C157** = Inactive
Level	ADVANCED	
Address	1155, 1156, 1157	
Function	This function generates up to 7 speed references that can be programmed with parameters **P081÷P090** according to the programming mode set in **P080**. The 4 Multispeed functions determine which of the 15 active speed references are active: active value (**1**) or inactive value (**0**) of each preset input signal determines a bit-logic binary number: **MULTISPEED 0** is the less significant bit (bit 0) and **MULTISPEED 2** is the most significant bit (bit 2). If one of these functions is not set up, its relevant bit is “zero”.	

Table 91: Multispeed selection

Multispeed selected =	Bit 2	Bit 1	Bit 0
	MULTISPEED 2	**MULTISPEED 1**	**MULTISPEED 0**

Table 92: Selected speed reference

Function	Status of the relevant input								
START	0	1	1	1	1	1	1	1	1
MULTISPEED 0	X	0	1	0	1	0	1	0	1
MULTISPEED 1	X	0	0	1	1	0	0	1	1
MULTISPEED 2	X	0	0	0	0	1	1	1	1
Multispeed selected	*X*	*0*	*1*	*2*	*3*	*4*	*5*	*6*	*7*
Resulting reference	0	(*)	P081	P083	P085	P087	P088	P089	P090

If one of these functions is not set up, its relevant bit is “zero”.
For example, if **C156** and **C157** are Inactive (0), while **C155** and **C158** are programmed to two different terminals, only Multispeed 0, 1, 8, 9 can be selected, relating to the following references:

(*)	**P081**	**P087**	**P088**

(*) Factory-setting: (**P080** = ***Preset Speed***) if no Multispeed function is selected, the active reference **is** the reference set according to the parameters in the [PAR] INPUTS FOR REFERENCES MENU.
If **P080** = ***Speed Sum***, the selected Multispeed function **adds up** to the active reference: the reference set according to the parameters in the [PAR] INPUTS FOR REFERENCES MENU.
If **P080** = ***Preset Speed Esc***, the selected Multispeed **replaces** the active reference, which will be ignored. If no Multispeed function is selected, the resulting reference is equal to zero.
See also the [PAR] INPUTS FOR REFERENCES MENU for the reference processing sequence: the **Speed Decrease** function and the **Reference Reversal** function become active downstream of the **Multispeed** function.

NOTE

In Table 92:
0 ⇒ Inactive input;
1 ⇒ Active input;
X ⇒ Input having no effect.

C159	**CW/CCW Input**	
Range	0 ÷ 16 0 ÷ 24 if ES847 or ES870 is fitted	0 → Inactive 1 ÷ 8 → MDI1 ÷ MDI8 9 ÷ 12 → MPL1 ÷ MPL4 13 ÷ 16 → TFL1 ÷ TFL4 17 ÷ 24 → XMDI1 ÷ XMDI8
Default	0	Inactive
Level	ADVANCED	
Address	1159	
Function	The **CW/CCW** function reverses the **active reference signal**: the connected motor decelerates to zero following the preset deceleration ramp, then it accelerates following the preset acceleration ramp until it reaches the new reference value.	

C160	DCB Input	
Range	0 ÷ 16 0 ÷ 24 if ES847 or ES870 is fitted	0 → Inactive 1 ÷ 8 → MDI1 ÷ MDI8 9 ÷ 12 → MPL1 ÷ MPL4 13 ÷ 16 → TFL1 ÷ TFL4 17 ÷ 24 → XMDI1 ÷ XMDI8
Default	0	Inactive
Level	ADVANCED	
Address	1160	
Function	The DCB command enables **DC braking at stop** for a time period depending on the speed value determining the input activation. See the [CFG] DC BRAKING MENU.	

C161, C162	UP and DOWN Inputs	
Range	0 ÷ 16 0 ÷ 24 if ES847 or ES870 is fitted	0 → Inactive 1 ÷ 8 → MDI1 ÷ MDI8 9 ÷ 12 → MPL1 ÷ MPL4 13 ÷ 16 → TFL1 ÷ TFL4 17 ÷ 24 → XMDI1 ÷ XMDI8
Default	0	Inactive
Level	ADVANCED	
Address	1161, 1162	
Function	This function increases (**UP**) or decreases (**DOWN**) the reference for which the **UpDown source from MDI has been selected** by adding a quantity to the reference itself. This also depends upon the following parameters: **C163** Up/Down Reset **P067** Up/Down Ramp Time **P068** Store Up/Down value at power off **P068b** PID Up/Down Reset at stop **P068d** PID Up/Down Reset at sources changeover **P069** Up/Down Reference range	

C163	Reset Up/Down Input for Speed/Torque Reference	
Range	0 ÷ 16 0 ÷ 24 if ES847 or ES870 is fitted	0 → Inactive 1 ÷ 8 → MDI1 ÷ MDI8 9 ÷ 12 → MPL1 ÷ MPL4 13 ÷ 16 → TFL1 ÷ TFL4 17 ÷ 24 → XMDI1 ÷ XMDI8
Default	0	Inactive
Level	ADVANCED	
Address	1163	
Function	This function sets to zero the reference **variation** obtained via the **UP** or **DOWN** inputs or the ▲ and ▼ keys located on the display/keypad.	

C164, C165, C166	External Alarm Inputs	
Range	0 ÷ 16 0 ÷ 24 if ES847 or ES870 is fitted	0 → Inactive 1 ÷ 8 → MDI1 ÷ MDI8 9 ÷ 12 → MPL1 ÷ MPL4 13 ÷ 16 → TFL1 ÷ TFL4 17 ÷ 24 → XMDI1 ÷ XMDI8
Default	0	Inactive
Level	ADVANCED	
Address	1164, 1165, 1166	
Function	When allocating one of these 3 functions to a digital input, the status of this input will **ALWAYS BE CHECKED ON THE DRIVE'S TERMINAL BOARD**. When the command contact opens, the drive is locked due to an alarm tripped. Parameters **C164a, C165a, C166a** allow delaying external alarms. To restart the drive, the digital input set as an external alarm must be closed and a Reset procedure is required. Alarms tripped due to these 3 functions are **A083**, **A084**, **A085** respectively. This function is factory set as disabled.	

CAUTION

The terminal board for these 3 functions is the hardware terminal board of the drive. If different command sources are enabled (see the [CFG] CONTROL METHOD MENU), the "External Alarm" signal command is obtained only for the hardware terminal board of the drive. Therefore, in order to avoid any external alarm, the input signal for the active terminal must be active in the terminal board.
Alarms trip when only one input signal for the terminal selected on one of the active command sources is disabled. A trip delay can be programmed with parameters **C164a, C165a, C166a.**

C164a, C165a, C166a	External Alarm Trip Delay	
Range	0 ÷ 32000	0 ÷ 32000 msec
Default	0	Instant
Level	ADVANCED	
Address	1305, 1306, 1307	
Function	External alarm trip delay. To avoid untimely alarm trip, it may be necessary to set a check time for the opening of the input set as an external alarm before the alarm trips.	

C167	MULTIRAMP Input	
Range	0 ÷ 16 0 ÷ 24 if ES847 or ES870 is fitted	0 → Inactive 1 ÷ 8 → MDI1 ÷ MDI8 9 ÷ 12 → MPL1 ÷ MPL4 13 ÷ 16 → TFL1 ÷ TFL4 17 ÷ 24 → XMDI1 ÷ XMDI8
Default	0	Inactive
Level	ENGINEERING	
Address	1167	
Function	This function allows selecting between the **2 different acceleration and deceleration ramps**. Each ramp has its own programming parameters; see [PAR] RAMPS MENU (**P009 to P033**). **The ramps are numbered; for the selected ramp, add 1 to the binary figure obtained**. If one of these functions is not programmed, the relevant bit is "zero".	

Table 93: Multiramp selection

			Bit 0	
Selected ramp	=	(	Multiramp 0	) + 1

Table 94: Selected ramp

Function	Input Status	
Multiramp 0	0	1
Selected ramp	**1**	**2**
Active ramp times (parameters determining the ramp model)	P009 P010 P014 (*)	P012 P013 P014 (*)

C171	**DISABLE PID Input**	
Range	0 ÷ 16 0 ÷ 24 if ES847 or ES870 is fitted	0 → Inactive 1 ÷ 8 → MDI1 ÷ MDI8 9 ÷ 12 → MPL1 ÷ MPL4 13 ÷ 16 → TFL1 ÷ TFL4 17 ÷ 24 → XMDI1 ÷ XMDI8
Default	0	Inactive
Level	ADVANCED	
Address	1171	
Function	This function is used for managing the PID regulator (see the [CFG] PID CONFIGURATION). When the terminal allocated to this function is activated, the <u>PID regulator can be disabled</u>: its output and its external variable are set to zero. More precisely, if the PID regulator is in **External Out** mode (**C294**=0), when the **PID DISABLE** function is enabled, the PID output is set to zero and the external variable regulated by the PID regulator (feedback) <u>is no longer regulated by the PID regulator itself</u>. In Reference mode, the **PID DISABLE** function <u>disables the PID regulator</u> as described above and **<u>switches the reference,</u>** thus <u>becoming the main active reference again</u>.	

C171a	**Input for PID Control Selection**	
Range	0 ÷ 16 0 ÷ 24 if ES847 or ES870 is fitted	0 → Inactive 1 ÷ 8 → MDI1 ÷ MDI8 9 ÷ 12 → MPL1 ÷ MPL4 13 ÷ 16 → TFL1 ÷ TFL4 17 ÷ 24 → XMDI1 ÷ XMDI8
Default	0	0: Inactive
Level	ENGINEERING	
Address	1188	
Function	This parameter pertains to the activation of the two PIDs or the 2-zone mode (see the [CFG] PID CONFIGURATION). It allows using the PID regulator outputs in different ways and allows disabling the 2-zone mode.	

C172	**KEYPAD LOCK Input**	
Range	0 ÷ 16 0 ÷ 24 if ES847 or ES870 is fitted	0 → Inactive 1 ÷ 8 → MDI1 ÷ MDI8 9 ÷ 12 → MPL1 ÷ MPL4 13 ÷ 16 → TFL1 ÷ TFL4 17 ÷ 24 → XMDI1 ÷ XMDI8
Default	0	Inactive
Level	ADVANCED	
Address	1172	
Function	This function **<u>avoids</u> accessing parameter modification** through the removable display/keypad and **<u>avoids</u> accessing the *LOCAL mode*** by pressing the **LOC/REM** key or by enabling the **LOCAL** input function **(C181).**	

NOTE

If the ***LOCAL*** mode is <u>already active,</u> the **LOCK** command will have no effect on the ***LOCAL*** function: it only avoids changing the programming parameters, while it is still possible to send references and the ***START/STOP/REV/JOG/RESET*** commands via keypad.
If the **LOCK** command is active and the ***LOCAL mode*** is disabled, the **LOCK** function prevents the LOCAL mode from activating.

C178	PID Up/Down Reset	
Range	0 ÷ 16 0 ÷ 24 if ES847 or ES870 is fitted	0 → Inactive 1 ÷ 8 → MDI1 ÷ MDI8 9 ÷ 12 → MPL1 ÷ MPL4 13 ÷ 16 → TFL1 ÷ TFL4 17 ÷ 24 → XMDI1 ÷ XMDI8
Default	0	Inactive
Level	ADVANCED	
Address	1178	
Function	This function **resets the variation of the PID reference** obtained with the ▲ and ▼ keys on the KEYPAD page of the user interface on the display/keypad in PID mode.	

C179	Source Selection Input	
Range	0 ÷ 16 0 ÷ 24 if ES847 or ES870 is fitted	0 → Inactive 1 ÷ 8 → MDI1 ÷ MDI8 9 ÷ 12 → MPL1 ÷ MPL4 13 ÷ 16 → TFL1 ÷ TFL4 17 ÷ 24 → XMDI1 ÷ XMDI8
Default	6	MDI6
Level	ADVANCED	
Address	1179	
Function	The digital input set as a source selector is **considered in the drive terminal board only,** not in the virtual terminal boards, as Fieldbus or Serial Link (see C). When the digital input set as a source selector is open, only the first command sources and references programmed in the [CFG] CONTROL METHOD MENU (are considered (**C140** command source n.1 and **C143** reference source n.1 respectively) as well as the first reference and feedback sources programmed in the [CFG] PID CONFIGURATION (parameter **C285** for reference source n. 1 and **C288** for feedback source n.1). When the digital input set as a source selector is closed, only the second command source and the second reference source programmed in the [CFG] CONTROL METHOD MENU are considered (C141 for command source n. 2 and C144 for reference source n.2), as well as the second reference sources and feedback sources set in the [CFG] PID CONFIGURATION (parameter C286 for reference source n.2 and parameter C289 for feedback source n.2).	

CAUTION If set different from **0:Disabled**, reference sources n.3 (**C145** in the [CFG] CONTROL METHOD MENU and **C287** and **C290** in the [CFG] PID CONFIGURATION MENU) and n.4 (**C146** in the [CFG] CONTROL METHOD MENU) are always considered as summed up to the reference source selected by the source selector.

CAUTION Command source n.3 (**C142** in the [CFG] CONTROL METHOD MENU), if programmed other than **0: Disabled**, is always considered as OR bit by bit to the one selected by the selector. The ENABLE input (MDI2), however, is considered as AND to the selected source.

CAUTION **C179** programming is exclusive in respect to **C179a** and **C179b** and vice versa. If **C179** is ≠ 0, neither **C179a** nor **C179b** may be programmed. If **C179a** and **C179b** are not both set to 0, **C179** may not be programmed.

C179a	Input for Source Selection	
Range	0 ÷ 16 0 ÷ 24 if ES847 or ES870 is fitted	0 → Inactive 1 ÷ 8 → MDI1 ÷ MDI8 9 ÷ 12 → MPL1 ÷ MPL4 13 ÷ 16 → TFL1 ÷ TFL4 17 ÷ 24 → XMDI1 ÷ XMDI8
Default	0	Inactive
Level	ADVANCED	
Address	1238	
Function	Programming this parameter is an alternative to programming **C179**. Make sure that **C179** is set to zero before setting up **C179a**. The digital input set as Command selector **is considered only in the drive terminal board** and not in the virtual terminal boards, such as Fieldbus or Serial Links (see Command Sources). By programming a digital input as Command Selector, when this is not active (relevant MDI open in the terminal board) only the first control board **C140** programmed in the [CFG] CONTROL METHOD MENU is considered. When the MDI programmed in **C179a** is closed, only the second command source **C141** programmed in the [CFG] CONTROL METHOD MENU is considered.	

CAUTION Command source n.3 (**C142** in the [CFG] CONTROL METHOD MENU), if set to value other than 0: Disabled, is always considered as OR bit by bit to the selected source. The ENABLE input (MDI2), however, is considered as AND to the selected source.

C179b	Input for Reference Selection	
Range	0 ÷ 16 0 ÷ 24 if ES847 or ES870 is fitted	0 → Inactive 1 ÷ 8 → MDI1 ÷ MDI8 9 ÷ 12 → MPL1 ÷ MPL4 13 ÷ 16 → TFL1 ÷ TFL4 17 ÷ 24 → XMDI1 ÷ XMDI8
Default	0	Inactive
Level	ADVANCED	
Address	1239	
Function	Programming this parameter is an alternative to programming **C179**. Make sure that **C179** is set to zero before setting up **C179b**. The digital input set as Reference selector **is considered only in the drive terminal board** and not in the virtual terminal boards, such as Fieldbus or Serial Links (see Command Sources). By programming a digital input as Source Selector, when this is not active (relevant MDI open in the terminal board) only the first control board **C143** programmed in the [CFG] CONTROL METHOD MENU is considered, as well as the first reference and feedback source in the [CFG] PID CONFIGURATION MENU (**C285** Reference Source N.1 and **C288** Feedback Source N.1 respectively). When the MDI programmed in **C179b** is closed, only the second command source **C144** programmed in the [CFG] CONTROL METHOD MENU is considered, as well as the second reference and feedback source in the [CFG] PID CONFIGURATION MENU (**C286** Reference Source N.2 and **C289** Feedback Source N.2 respectively).	

C180	LOC/REM Input	
Range	0 ÷ 16 0 ÷ 24 if ES847 or ES870 is fitted	0 → Inactive 1 ÷ 8 → MDI1 ÷ MDI8 9 ÷ 12 → MPL1 ÷ MPL4 13 ÷ 16 → TFL1 ÷ TFL4 17 ÷ 24 → XMDI1 ÷ XMDI8
Default	7	MDI7
Level	ADVANCED	
Address	1180	
Function	The digital input set as a source selector is **considered in the drive terminal board only,** not in the virtual terminal boards, as Fieldbus or Serial Link (see Command Sources). The **LOCAL mode** can be enabled via the relevant digital input (it ignores any enabling/disable delay times set via software timers) or by pressing the **LOC/REM** key located on the display/keypad. Factory setting allows enabling the Local mode only when the drive is not running. Settings may be changed through **C148 Changeover from Remote to Local Command** (see the [CFG] CONTROL METHOD MENU); switching from Remote to Local command is allowed even when the drive is operating and when the running condition or reference must be maintained in Local mode. This function allows switching over to **LOCAL mode** and allows ignoring parameters **C140** to **C146** and **C285** to **C287** (see the [CFG] PID CONFIGURATION MENU) when the PID controller is enabled, **thus allowing setting them via KEYPAD only**. The following functions are still active in the hardware terminal board of the control board being used: **ENABLE**, **External Alarm 1,2,3, Sel.Motor n.2, Sel.Motor n.3, SLAVE, PID Disable**, and **<u>the LOCAL function itself</u>**, that can be disabled at any time. If the input is deactivated when the drive is disabled, signals coming from different sources will activate again. If the main reference of the drive is the PID output, you can set **C180a Type of LOC/REM Contact** = **Pushbutton** and **P266 Type of Keypad page** in **Local Mode = Ref.Activated + Spd**. As a result, when the **Loc** key is pressed and released once, the drive enters the Local mode and the PID reference can be changed, whereas when the **Loc** command is pressed and released again (provided that the drive is not enabled) the PID is disabled and the RPM reference can be sent to the connected motor. See also the [CFG] CONTROL METHOD MENU and the Keypad page and Local mode in the [PAR] DISPLAY/KEYPAD MENU.	

C180a	Type of LOC/REM Contact	
Range	0 ÷ 2	0:[Switch] 1:[Pushbutton] 2:[[Pushbutton+Storage]
Default	2	2:[Pushbutton+Storage]
Level	ADVANCED	
Address	1303	
Function	Factory-setting: the digital contact set as LOC/REM (**C180**) is Pushbutton based. If the PID output is the main reference and **P266 Type of Keypad Page in Local Mode = Ref.Activated + Spd**, allowing entering the LOCAL mode when the LOC/REM command is first sent, thus controlling the PID reference, and allowing the LOCAL mode to be maintained when the LOC/REM command is sent for the second time, thus disabling the PID and allowing setting a speed reference, the LOC/REM digital input must be set as **C180a=Pushbutton**. If **C180a**=**2**, the logic status of **LOC/REM** will be saved at power off and will be used when the drive is next powered on.	

C181	Safety Start	
Range	0 ÷ 1	Inactive, Active
Default	0	Inactive
Level	ADVANCED	
Address	1181	
Function	This function **enables** the ***Safety START mode.*** When this function is enabled and the drive is to be restarted after resetting an alarm, open and close the **ENABLE-A** and **ENABLE-B** terminals. This prevents the drive from RUNNING when it is turned off and on again (for example after a mains loss) and the **START** and **ENABLE-A** and **ENABLE-B** inputs are on.	

NOTE If multiple terminal boards are selected with parameters **C140**, **C141**, **C142**, open and close the **MDI2** terminals in one of the active terminal boards to restart the drive.

C182	MDI Multiprogramming Enable	
Range	0 ÷ 1	Inactive, Active
Default	1	Inactive
Level	ENGINEERING	
Address	1182	
Function	This function allows allocating two different functions to the same terminal.	

NOTE Only few preset combinations are allowed.
When invalid configurations are set up, "ILLEGAL DATA" appears on the display/keypad of the drive.

C183	Maximum Fluxing Time before Disable	
Range	0 ÷ 65000	0 ÷ 65000 ms
Default	0	Disabled
Level	ADVANCED	
Address	1183	
Control	VTC	
Function	This function disables the drive if the fluxing time period is longer than the preset time (if the **ENABLE** function, not a **START** command, is active). To restore motor fluxing, disable and enable the **ENABLE** function, or if with the active **ENABLE** function a **START** command is also activated.	

C184	Fluxing at Activation only with START Closed	
Range	0 ÷ 1	0:NO; 1:Yes
Default	0	0:NO
Level	ADVANCED	
Address	1184	
Control	VTC	
Function	Fluxing may be carried out only when the **START** command is closed.	

C185	STOP Mode	
Range	0 ÷1	0: [Deceleration Ramp] – 1:[Free Wheel]
Default	0	0: [Deceleration Ramp]
Level	ADVANCED	
Address	1185	
Function	This function allows selecting whether the drive is to be deactivated with a controlled deceleration ramp or is left idling when the **START** command is open.	

C186	FIRE MODE Enable Input	
Range	0 ÷ 16 0 ÷ 24 if ES847 or ES870 is fitted	0 → Inactive 1 ÷ 8 → MDI1 ÷ MDI8 9 ÷ 12 → MPL1 ÷ MPL4 13 ÷ 16 → TFL1 ÷ TFL4 17 ÷ 24 → XMDI1 ÷ XMDI8
Default	0	Inactive
Level	ENGINEERING	
Address	1186	
Function	This parameter allows programming a digital input to activate the Fire Mode (see the Fire Mode section).	

C188a, C188b, C188c	Inputs for PID MULTIREFERENCES	
Range	0 ÷ 16 0 ÷ 24 if ES847 or ES870 is fitted	0 → Inactive 1 ÷ 8 → MDI1 ÷ MDI8 9 ÷ 12 → MPL1 ÷ MPL4 13 ÷ 16 → TFL1 ÷ TFL4 17 ÷ 24 → XMDI1 ÷ XMDI8
Default	0	Inactive
Level	ADVANCED	
Address	1365, 1366, 1367	
Function	This function allows generating up to 7 PID references that can be programmed with parameters **P081a** to **P087a** according to the operating mode selected with **P080a**. The 3 functions determine which is the active reference among the 7 available PID references: the active value (**1**) or the inactive value (**0**) of each programmed input signal determines a bit-logic value, where **MULTIREF 0** is the least significant bit (bit 0) and **MULTIREF 2** is the most significant bit (bit 2). If one of the available functions is not programmed, the value of the relevant bit is “zero”.	

Table 95: Selection of PID Multireferences

Multireferences selected =	Bit 2	Bit 1	Bit 0
	MULTIREFERENCE 2	**MULTIREFERENCE 1**	**MULTIREFERENCE 0**

41. [CFG] RAMP EXTENSION MENU

41.1. Overview

The promptness of the DC bus voltage control can be adjusted in order to avoid Overvoltage alarm **A048**, causing abrupt deceleration. Special parameters are available, enabling controlling actions to limit DC bus voltage increase due to motor load variation.

41.1.1. Ramp Extension

Parameter **C210** sets promptness, with respect to variations of DC bus, for the deceleration ramp slowing-down, in order not to overload the bus capacitor bank.
For the other controls with **C210**=0, deceleration slows down when given values of the bus voltage are reached (depending on the drive voltage class).
If **C210** is > 0, the DC bus voltage is controlled by considering the derivative of the bus voltage. The higher the value in **C210**, the lower the values for voltage variation affecting deceleration ramp times.

41.1.2. Torque Limit and Frequency Increase Due to Overvoltage – SVC (Smart Voltage Control)

For VTC control, special functionality is available, allowing reducing the resisting torque due to DC-bus voltage increase, in order to prevent Overvoltage alarm **A048** from tripping. A PI regulator is implemented to keep DC voltage below a preset threshold, thus limiting the maximum value of the resisting torque. Parameters **C213a** and **C213b** are the regulator's proportional gain and integral gain respectively. Parameter **C213c** sets the voltage threshold, that equals:

Vth = C213c * Vunlock /100

where **Vunlock** depends on the drive voltage class.

Parameter **C213d** enables reducing the rotor flux when the regulator activates, thus further limiting the DC voltage increase.

CAUTION The reduction of the resisting torque generated by the function above affects the speed control when the motor accelerates due to external causes. Consequently, it can happen that the motor accelerates and exceeds the maximum allowable value set in parameter **C029**.

IFD control only: parameter **C213** causes a step increase of the output frequency to limit the DC bus voltage increase due to an abrupt change (decrease) of the motor load torque.

41.2. List of Parameters C210 to C213d

Table 96: List of Parameters C210 to C213d

Parameter	FUNCTION	User Level	MODBUS Address	DEFAULT VALUES
C210	Automatic extension of down ramp	ENGINEERING	1210	See Table 78
C213	Frequency Increase for Overvoltage Compensation	ENGINEERING	1279	0.0000
C213a	Torque Limit Proportional Gain due to Overvoltage	ENGINEERING	1251	0.020
C213b	Torque Limit Integral Gain due to Overvoltage	ENGINEERING	1252	0.010
C213c	Voltage Reference for Torque Limit	ENGINEERING	1253	100.0%
C213d	Flux Limit due to Torque Limit Activation	ENGINEERING	1254	0.0%

C210	Automatic Extension of Down Ramp	
Range	0 ÷ 32000	0; 320.00
Default	See Table 78	
Level	ENGINEERING	
Address	1210	
Function	The down ramp is extended if the variation in DC bus voltage is too rapid or exceeds certain threshold values. Set a higher value in parameter **C210** for a more sensitive ramp extension (a lower rating of regenerated power allows obtaining longer ramps), thus avoiding overvoltage.	

NOTE

Parameter **C210** decreases the DC bus voltage threshold setting the ramp extension. The k factor is as follows:
k = Pout/(Pmax*100***C210**),
k ranges from 1.0 to 1.3

The greater the k factor, the lower the DC bus level setting the ramp extension.

For example, when **C210**=0.2, power Pout shall exceed 5% of Pmax in order to obtain k>1.
When **C210**=2, 0.5% of Pmax is required to obtain k>1.

C213	Frequency Increase for Overvoltage Compensation – Smart Voltage Control	
Range	0 ÷ 1000	0 ÷ 0.1000
Default	0	0.0000
Level	ENGINEERING	
Address	1279	
Control	IFD	
Function	If this parameter is set > 0, a value given by **C213** * derivative_voltage_DC (expressed in V/s) is summed up to the frequency currently set for the motor. In that way, when DC voltage abruptly changes due to sudden variations of the load torque, the output frequency is promptly adjusted to compensate for voltage increase and avoid overvoltage conditions. A value equal to 0.0200 ensures optimum operation in most applications; however, the optimum value for this parameter is to be found by trial and error.	

C213a	Torque Decrease Proportional Gain due to Overvoltage	
Range	0 ÷ 32000	0.000 ÷ 32.000
Default	20	0.020
Level	ENGINEERING	
Address	1251	
Control	VTC	
Function	This function is available only when the VTC control is activated. This is the proportional gain of the DC-bus voltage regulator adjusting the resisting torque limit when voltage exceeds the value set in parameter **C213c**.	

C213b	Torque Decrease Integral Gain due to Overvoltage	
Range	0 ÷ 32000	0.000 ÷ 32.000
Default	10	0.010
Level	ENGINEERING	
Address	1252	
Control	VTC	
Function	This function is available only when the VTC control is activated. This is the integral gain of the DC-bus voltage regulator adjusting the resisting torque limit when voltage exceeds the value set in parameter **C213c**.	

C213c	Voltage Reference for Torque Decrease	
Range	0 ÷ 1200	0.0 ÷ 120.0%
Default	1000	100.0%
Level	ENGINEERING	
Address	1253	
Control	VTC	
Function	This function is available only when the VTC control is activated. It sets the reference value for the regulator DC voltage adjusting the resisting torque limit. The limiting function activates when voltage exceeds the value below: **Vth = C213c * Vunlock /100** where **Vunlock** is based on the drive voltage class.	

C213d	Flux Limit due to Torque Decrease Activation	
Range	0 ÷ 1000	0.0 ÷ 100.0%
Default	0	0.0%
Level	ENGINEERING	
Address	1254	
Control	VTC	
Function	This function is available only when the VTC control is activated. If the torque limit is adjusted by the DC bus voltage regulator, the rotor flux is decreased by the same value of the torque limit multiplied by the value of this parameter. Example: If the regulator generates a 50% instant torque limit and **C213d** is worth 30%, the flux will be decreased by 50 * 30 / (100 * 100) = 15%, and will be increased to 85% of the value that should be adopted under normal operating conditions. This parameter keeps DC voltage low when the motor acceleration due to external causes continues over time. Low parameter values (< 50%) may cause uncontrolled rotation of the motor.	

42. [CFG] DC BRAKING MENU

42.1. Overview

DC current can be injected into the motor to stop it. DC current may be automatically injected at stop and/or at start; DC current injection may also be controlled by the terminal board. All relevant parameters are included in the [CFG] . The intensity of the DC current injected is expressed as a percentage of the rated current of the active motor.

42.1.1. DC Braking at Start and Non-condensing Function

To activate DC braking at start, set **C216** to [YES]. Braking occurs after sending a **START** command, with a speed reference other than zero, before the acceleration ramp. A **START** command may be one of the following: **RUN** command or **REV** command sent via terminal board; **START** command from keypad, etc., depending on the preset control mode. DC braking level and duration are set in the following parameters:

C220 Expressed as a percentage of the rated current of the controlled motor.
C218 Expressed in seconds.

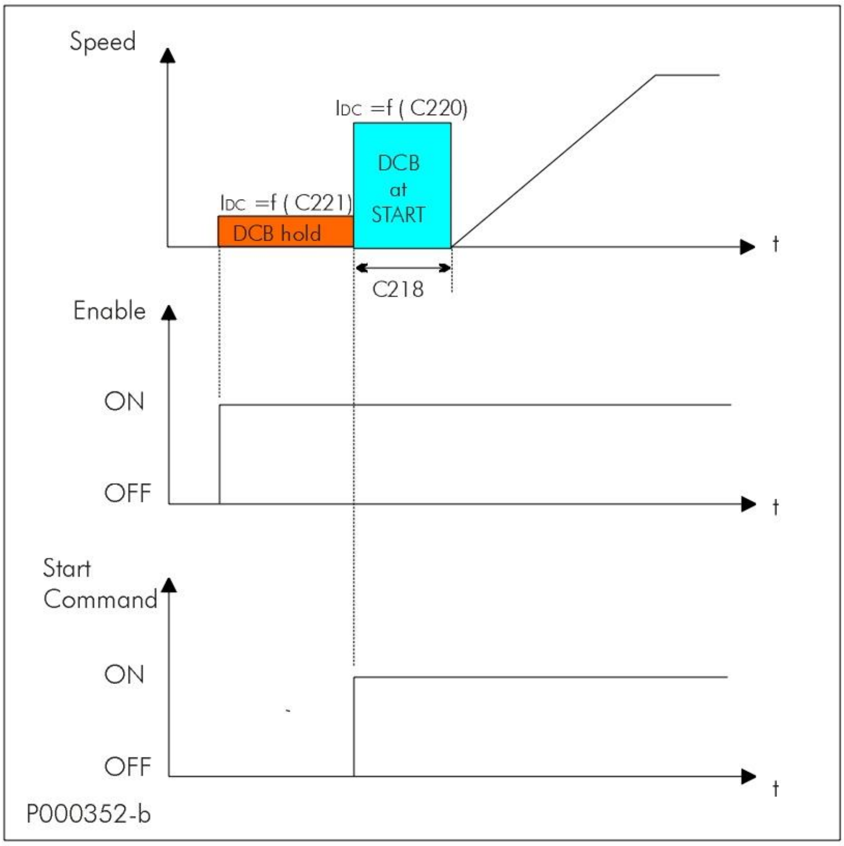


Figure 51: DCB Hold and DCB At Start

Output speed, holding and DC braking current when the DCB Hold and DCB at Start functions are active.

The non-condensing function consists in injecting DC into the motor. DC current brakes the motor and heats the motor windings, thus avoiding condensation. This function is active only for the IFD control if **C221** is other than zero and the **ENABLE** function is activated. For the other control algorithms, the non-condensing function is performed by injecting current during motor fluxing. Parameter **C221**, expressed as a percentage of the rated current of the controlled motor, determines the level of direct current injected into the motor.

Parameters used to program this function are the following:

C216 enabling DCB at Start;
C218 setting the duration of DCB at Start;
C220 setting the intensity of the DC braking;
C221 setting the intensity of the holding current (this function is active for the IFD control only).

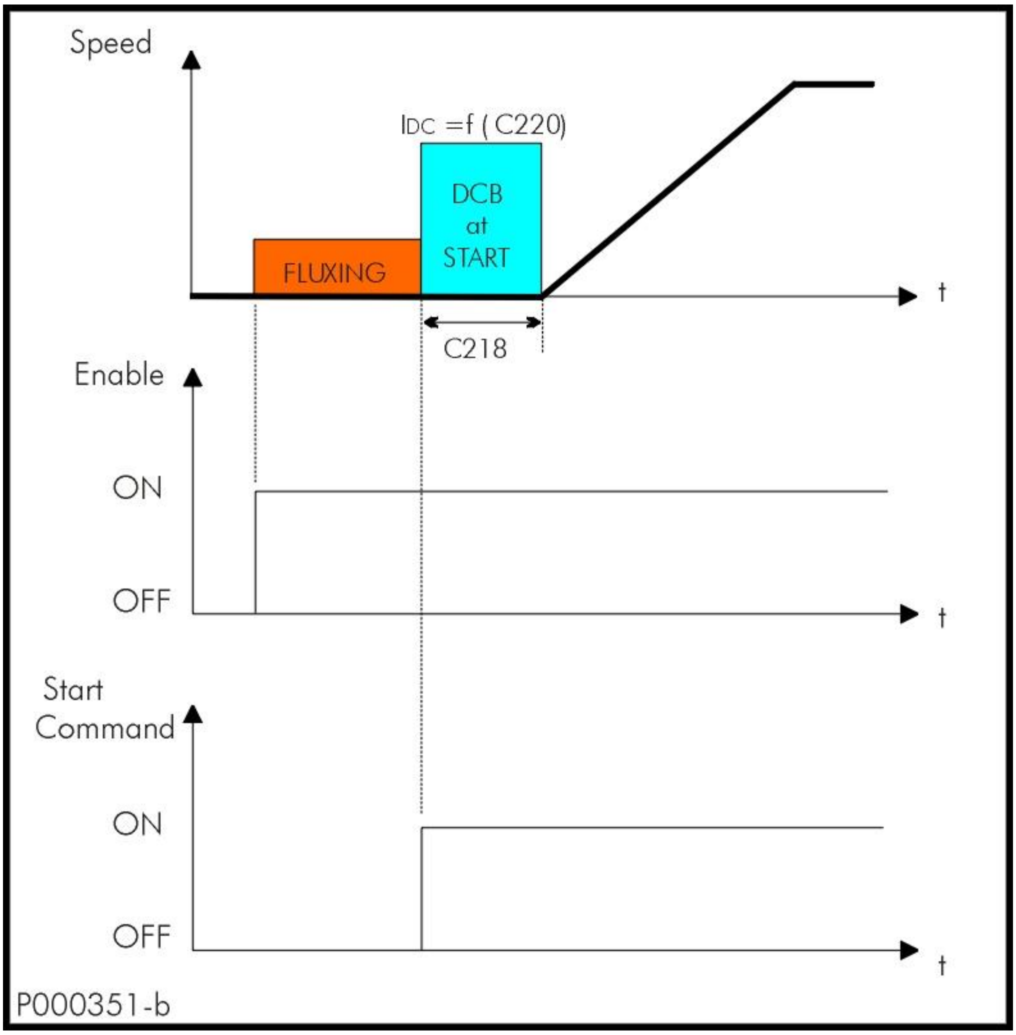


Figure 52: DCB at Start with VTC control

Output Speed and DC Braking when the DCB At Start Function is active for the Vector Torque control.

42.1.2. DC Braking at Stop

To activate this function, set **C215** to [YES].

DC Braking occurs after sending a “stop with ramp” command.

Figure 53 illustrates the output speed and DC Braking trends when the DC Braking at Stop function is active.

Parameters used to program this function are the following:

C215 function enabling;
C217 braking duration;
C219 motor speed at the beginning of DC Braking;
C220 intensity of DC braking.

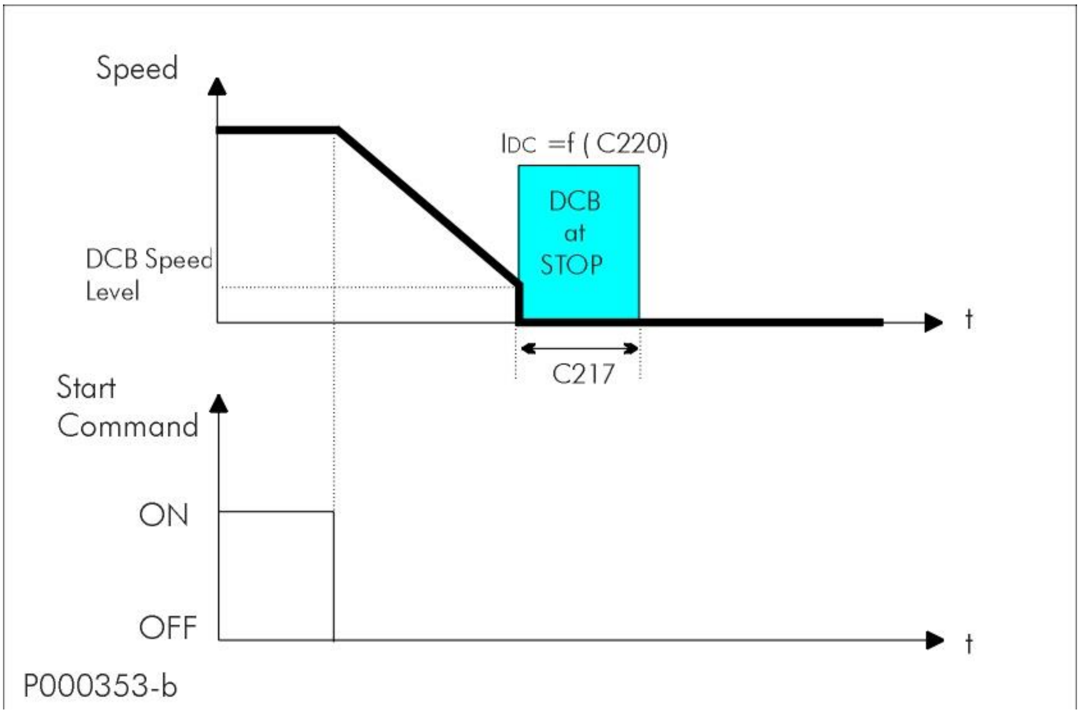


Figure 53: DCB At Stop

Motor speed and DC Braking patterns when the DC BRAKING AT STOP function is active.

42.1.3. DC Braking Command Sent from Digital Input

Activate the digital input set as DCB (**C160**) to send a DC Braking command. DC Braking duration is determined by the following formula:

$t^* =$ **C217** x (n_{OUT} / **C219**) with n_{OUT} / **C219** equal to max. 10.

NOTE DC braking sent from digital input operates when the drive is STOPPED.

Possible cases:

a) **t1 > t*** time t1 for braking command is longer than t*.

To restart the motor following the preset acceleration ramp when DC Braking is over, just disable the DCB command and disable and enable again the **START** command (see figure below).

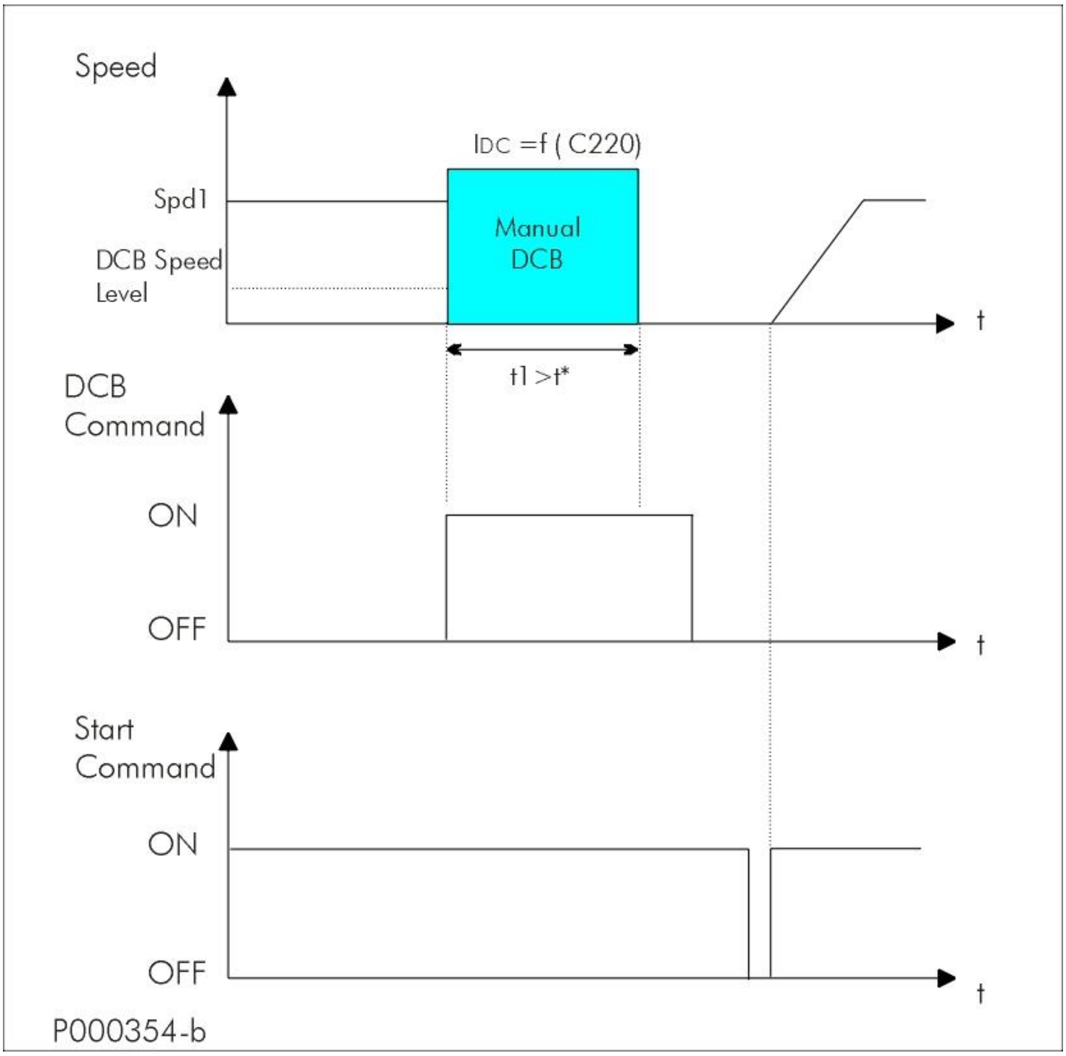


Figure 54: Manual DCB (Example 1)

Motor Speed, DC Braking, Manual DCB Command and START Command if t1>t*.

b) **t1 < t*** time t1 for braking command is shorter than t*.
Two different cases may occur, depending on the control algorithm and the setup of the motor speed searching function.

Speed Searching function disabled (C245 [NO])

Prematurely disable the manual braking command to stop DC braking. If the motor is still rotating, it will start idling. To restart the motor following the preset acceleration ramp, simply disable and enable the **START** command (see Figure 55).

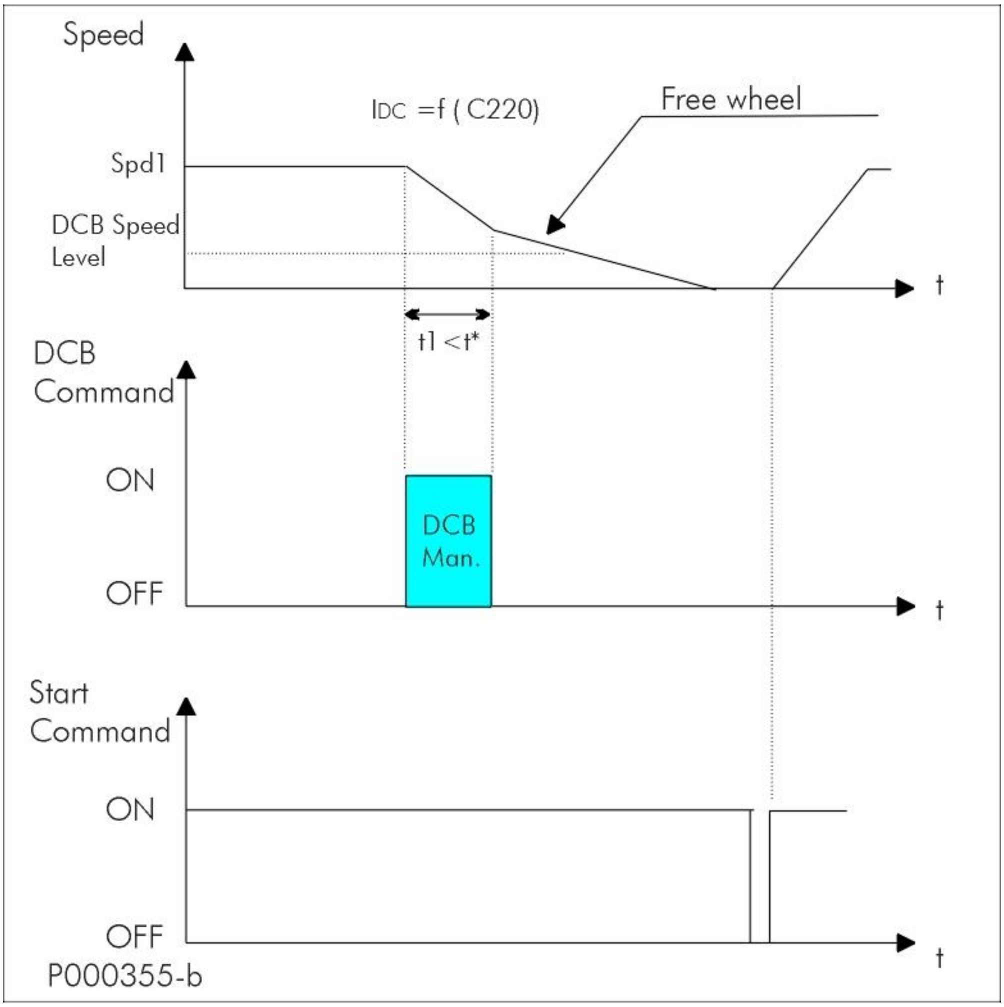


Figure 55: Manual DCB (Example 2)

Motor Speed, DC Braking, Manual DCB Command and START Command if t1<t* and the Speed Searching Function is disabled.

Speed Searching function enabled (C245 [YES])

Prematurely disable the manual braking command to activate the Speed Searching function. When the motor speed searching occurs, the motor speed is increased depending on the preset acceleration ramp (see Figure 56).

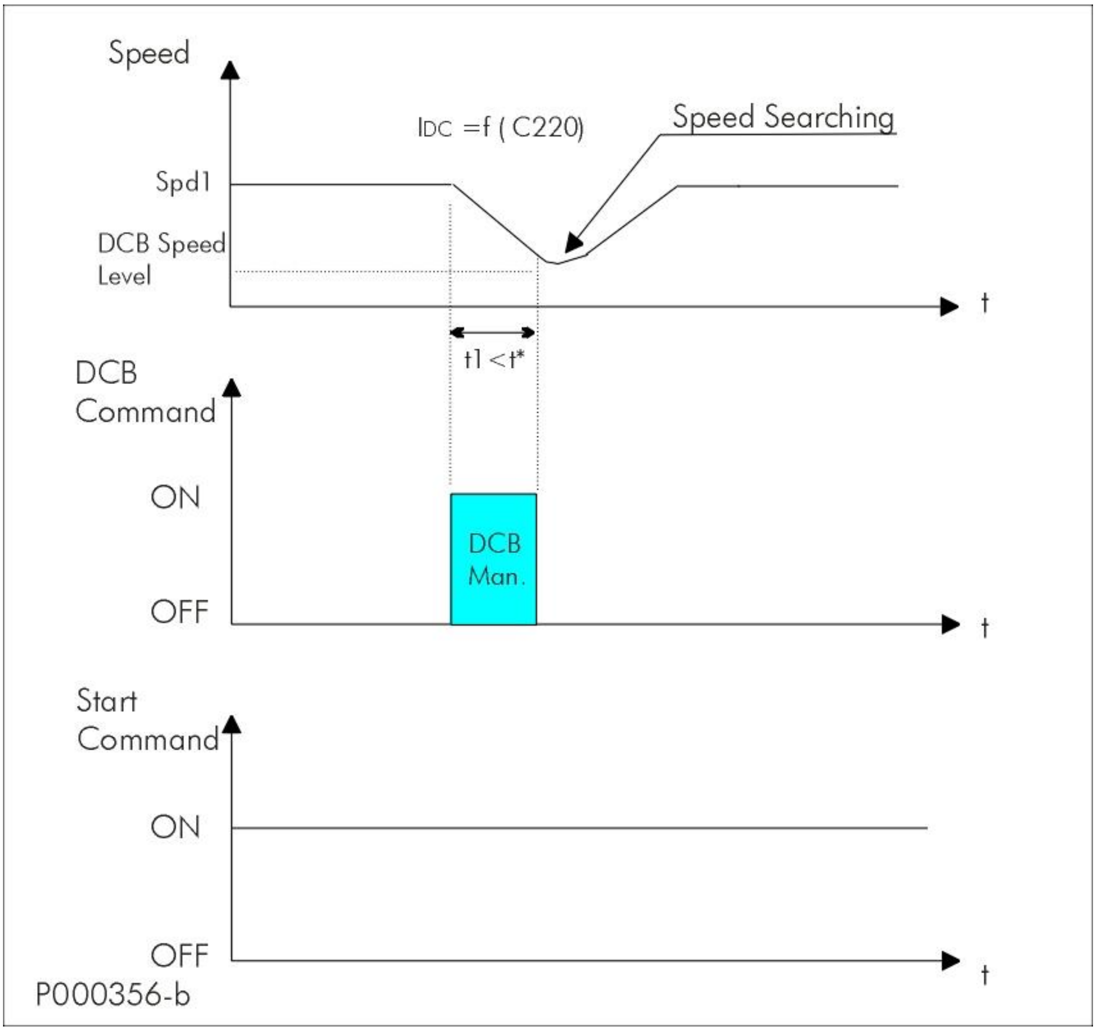


Figure 56: Manual DCB (Example 3)

Motor Speed, DC Braking and Manual DCB Command and START Command if t1<t*, the control algorithm is IFD and the Speed Searching Function is enabled.

42.2. List of Parameters C215 to C222

Table 97: List of Parameters C215 to C222

Parameter	FUNCTION	User Level	MODBUS Address	Default Values
C215	Enabling DCB at Stop Function	ADVANCED	1069	0:NO
C216	Enabling DCB at Start Function	ADVANCED	1070	0:NO
C217	DCB at Stop Duration	ADVANCED	1071	0.5sec
C218	DCB at Start Duration	ADVANCED	1072	0.5 sec
C219	Speed at the Beginning of DCB at Stop	ADVANCED	1073	50rpm
C219a	VTC Speed Ramp Duration	ENGINEERING	1074	500 ms
C220	DCB Current Level	ADVANCED	1075	100%
C220a	VTC Current Filter Time Constant	ENGINEERING	1076	300 ms
C220b	Proportional Gain of the VTC Current Controller	ENGINEERING	1077	0.2
C220c	Integral Time Constant of the VTC Current Regulator	ENGINEERING	1078	100 ms
C221	DCB Hold	ADVANCED	1079	0%
C222	DC Braking Ramp Time	ENGINEERING	1080	See Table 78

C215	**Enabling DCB at Stop Function**	
Range	0 ÷ 1	0: No; 1: Yes
Default	0	0: No
Level	ADVANCED	
Address	1069	
Function	Enables DC Braking during deceleration when the speed set in **C219** is reached.	

C216	**Enabling DCB at Start Function**	
Range	0 ÷ 1	0: No; 1: Yes
Default	0	0: No
Level	ADVANCED	
Address	1070	
Function	Enables the DC Braking at Start function.	

C217	**DCB at Stop Duration**	
Range	1 ÷ 600	0.1; 60.0 sec
Default	5	0.5 sec
Level	ADVANCED	
Address	1071	
Function	Determines the duration of the DCB at Stop function (**C215**=1:Yes or **C160** enabled).	

C218	DCB at Start Duration	
Range	1 ÷ 600	0.1 ÷ 60.0 sec
Default	5	0.5 sec
Level	ADVANCED	
Address	1072	
Function	Determines the duration of the DCB at Start function.	

C219	Speed at the Beginning of DCB at Stop	
Range	0 ÷ 1000	0 ÷ 1000 rpm
Default	50	50 rpm
Level	ADVANCED	
Address	1073	
Function	Determines the speed at the beginning of DCB at stop while decelerating (**C215**=1:Yes or **C160** enabled).	

C219a	VTC Speed Ramp Duration	
Range	1 ÷ 32000	1 ÷ 32000 ms
Default	500	500 ms
Level	ENGINEERING	
Address	1074	
Control	VTC	
Function	Ramp duration to zero speed before activating DC Brake in case of manual request by digital input (VTC control).	

C220	DC Current Level	
Range	0 ÷ MIN [(Ipeak inverter/Imot)*100) ; 120]	0% ÷ Min[Ipeak inverter/Imot, 120%]
Default	100	100%
Level	ADVANCED	
Address	1075	
Function	Determines the level of direct current injected to brake the motor. It is expressed as a percentage of the rated current of the controlled motor.	

C220a	VTC Current Filter Time Constant	
Range	0 ÷ 32000	0 ÷ 32000 ms
Default	300	300 ms
Level	ENGINEERING	
Address	1076	
Control	VTC	
Function	Filter time constant for a smooth change between actual currents and DC Brake currents (id=i_DCB, iq=0) when the VTC control algorithm is activated.	

C220b	Proportional Gain of the VTC Current Controller	
Range	0 ÷ 32000	0 ÷ 32000
Default	20	0.2
Level	ENGINEERING	
Address	1077	
Control	VTC	
Function	Current proportional gain during DC Braking when the VTC control algorithm is activated.	

C220c	Integral Time Constant of the VTC Current Regulator	
Range	1 ÷ 32000	1 ÷ 32000 ms [Disabled]
Default	100	100 ms
Level	ENGINEERING	
Address	1078	
Control	VTC	
Function	Current integral time constant during DC Braking when the VTC control algorithm is activated.	

C221	DCB Hold	
Range	0 ÷ 100	0 ÷ 100%
Default	0	0%
Level	ADVANCED	
Address	1079	
Function	Determines the level of direct current injected during the Hold function. To activate this function, set a value other than zero in parameter **C221**. DC level is expressed as a percentage of the rated current of the controlled motor.	

C222	Ramp Braking Time for DCB	
Range	2 ÷ 32000	2 ÷ 32000 msec
Default	See Table 78	
Level	ENGINEERING	
Address	1080	
Function	This parameter represents the time required for field weakening before DCB.	

43. [CFG] SPEED SEARCHING

43.1.Overview

When a command is sent to disable the drive, the motor idles. When the drive activates again, the Speed Searching function allows the drive to reach the motor speed.
All parameters relating to this function are included in the Speed Searching submenu in the Configuration menu.

The Speed Searching function activates when **C245** is set to [YES]:

– When **C245** is set to [YES], do the following to activate the Speed Searching function:
– deactivate and reactivate the **ENABLE** function before t_{SSdis} is over (**C246**);
– if **C185** = 1:[Free wheel], open and close the START command before t_{SSdis} (**C246**) is over;
– disable the DC Braking command before the DC braking preset time is over (see the [CFG] DC BRAKING MENU);
– reset any alarm tripped (with reference other than 0) before t_{SSdis} is over.

If **C250 ≠ 0 [Disable]**, the Speed Searching function activates only if the programmed input is active.
Speed searching does not take place when the drive turns off due to mains loss.

If the drive restarts after a time longer than t_{SSdis} (**C246**), frequency output is generated following the acceleration ramp, and no speed searching takes place.

If **C246 0: (Always On)**, speed searching (if enabled with **C245**) occurs when the drive restarts (RUN), irrespective of the time elapsed from disabling.

The figures below show output frequency and motor rpm during speed searching.

After time t_0 for rotor demagnetization, speed searching occurs as follows (see 3 steps below):

Speed at the beginning of the speed searching function depends on the settings in C249

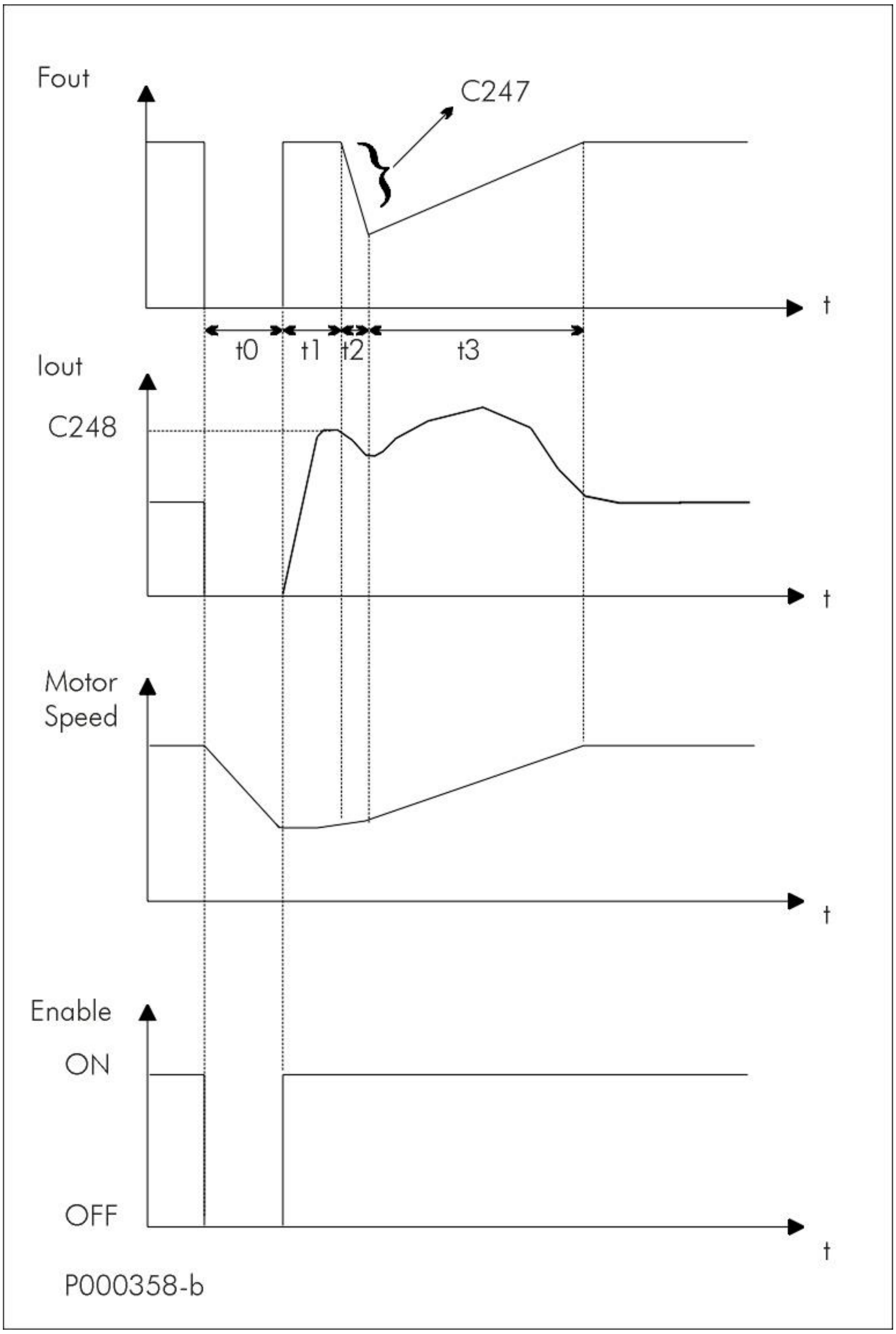


Figure 57: Speed Searching (Example 1)

Output Frequency and motor RPM for the Speed Searching Function (**C245** = [YES]) activated by the **ENABLE-A** and **ENABLE-B** command. $t_O < t_{SSdis}$ (**C246**) or **C246** = 0.

Three stages:

Time t_1 The drive output frequency corresponds to the last value which was active before disabling the drive; output current matches with the value set in **C248**;

Time t_2 Output frequency is decremented following the ramp set in **C247** for rotation speed searching;

Time t_3 The connected motor accelerates following the acceleration ramp.

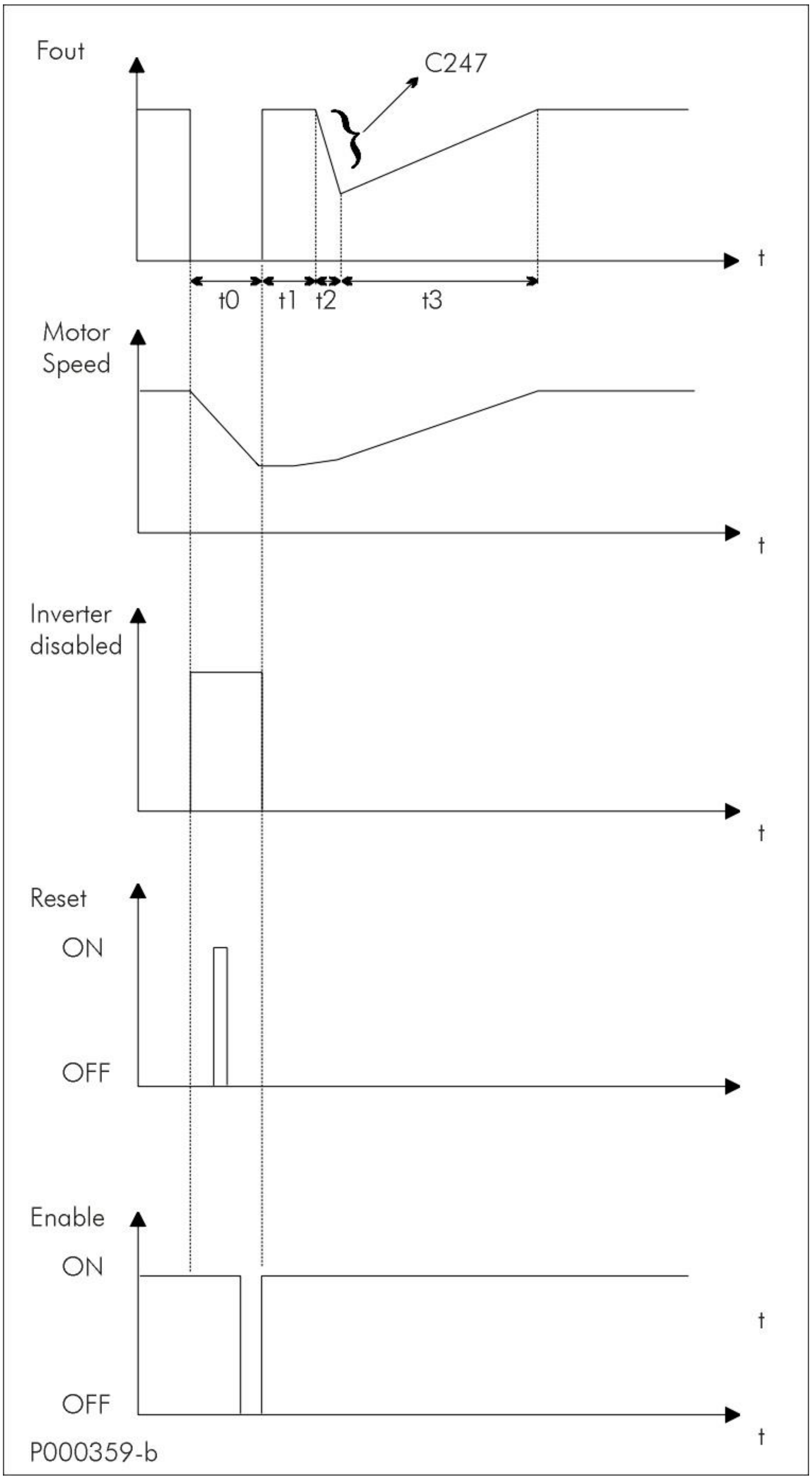


Figure 58: Speed Searching (Example 2)

Frequency, Motor Rpm, Drive Lock, **RESET** and **ENABLE** during Speed Searching (**C245** =[YES]) due to an Alarm Trip $t_{OFF} < t_{SSdis}$ (**C246**) or **C246** = 0.

NOTE If the Safety at Start function is disabled (**C181** = [Inactive]), it is not necessary to activate and deactivate the **ENABLE** function; the Speed Searching activation would match with the **RESET** command.

43.2.List of Parameters C245 to C250

Table 98: List of Parameters C245 to C250

Parameter	FUNCTION	User Level	MODBUS Address	DEFAULT VALUES
C245	Speed Searching enable	ENGINEERING	1061	0: No
C246	Run limit delay for Speed Searching	ENGINEERING	1062	1sec
C247	Speed Searching time as % deceleration ramp	ENGINEERING	1063	10%
C248	Current used for Speed Searching	ENGINEERING	1064	75%
C249	Speed searching starting level	ENGINEERING	1065	Last speed
C250	MDI for Speed Searching enable	ENGINEERING	1066	0: Disable

C245	**Speed Searching Enable**	
Range	0 ÷ 1	0: No ÷ 1: Yes
Default	0	0: No
Level	ENGINEERING	
Address	1061	
Function	This parameter enables the speed searching function. The Speed Searching function is enabled in the following cases: – when the **ENABLE** function is deactivated and reactivated before time t_{SSdis} (**C246**); – when the DC Braking command is disabled before the preset time is over (see the [CFG] DC BRAKING MENU); – when an alarm is reset (with a reference other than 0) before time t_{SSdis}.	

C246	**Run Limit Delay for Speed Searching**	
Range	0; 3000	0:[Always On] ÷ 3000 sec
Default	1	1 sec
Level	ENGINEERING	
Address	1062	
Function	Determines the maximum allowable time passing between the drive disable and enable command when the Speed Searching function is activated. When the drive is restarted, output frequency will depend on the preset acceleration ramp. When **C246** = 0: (Always ON) , speed searching will always occur, independently of the time passing between the drive disable and enable.	

C247	Frequency Decrease Rate	
Range	1 ÷ 1000	1 ÷ 1000%
Default	10	10%
Level	ENGINEERING	
Address	1063	
Function	This parameter sets the frequency decrease rate during the speed search stage. The frequency decrease rate (expressed in Hz/s) is given from the following formula: (f_{max} x **C247**) / 10 This means that when **C247**=100%=1, the IRIS BLUE drive takes 10s to go from the max. frequency to 0Hz. When C247=10%=0.1 (default value), the system takes 100s to go from the max. frequency to 0Hz. The maximum frequency of the connected motor is given from the following formula: f_{max} = (npoles x **C029**) / (2 x 60).	

NOTE The frequency decrease rate is not dependent on the preset ramp times.

NOTE When the drive enters the current limitation mode, the time the system takes for speed searching can be longer than the preset time.

C248	Current Used for Speed Searching	
Range	20 ÷ Min[Ipeak inverter/Imot, 100]	20% ÷ Min[Ipeak inverter/Imot, 100%]
Default	75	75%
Level	ENGINEERING	
Address	1064	
Function	Determines the max. current level for speed searching; it is expressed as a percentage of the rated motor current.	

C249	Speed Searching Start Level	
Range	0 ÷ 3	0: Last speed 1: MaxSpd/Last dir. 2: MaxSpd/Pos. Dir. 3: MaxSpd/Neg.Dir.
Default	0	0: Last speed
Level	ENGINEERING	
Address	1065	
Function	Speed Searching starts according to the value set in **C249**: **C249 = 0:[Last Speed Value]** – the last speed search value generated before disabling the system is used for speed searching. **C249 = 1:[MaxSpd/LastDir.]** – the max. speed programmed for the motor in the last direction of rotation of the connected motor is produced. **C249 = 2:[MaxSpd/Pos.Dir]** – the speed searching function will begin with the max. speed programmed for the motor in the positive direction of rotation independently of the last frequency value produced before disabling the drive. **C249 = 3:[MaxSpd/Neg.Dir]** – as “2”, but the direction of rotation of the connected motor will always be negative.	

C250	MDI for Speed Searching Enabled	
Range	0 ÷ 16 0 ÷ 24 if ES847 or ES870 is fitted	0 → Inactive 1 ÷ 8 → MDI1 ÷ MDI8 9 ÷ 12 → MPL1 ÷ MPL4 13 ÷ 16 → TFL1 ÷ TFL4 17 ÷ 24 → XMDI1 ÷ XMDI8
Default	0	0: Inactive
Level	ENGINEERING	
Address	1066	
Function	If set to Inactive, it will take no effect. Otherwise, Speed Searching activates only if the preset input is active.	

44. [CFG] AUTORESET MENU

44.1. Overview

The Autoreset function can be enabled in case an alarm trips. You can enter the maximum number of autoreset attempts and the time required for resetting the attempt number. If the Autoreset function is disabled, you can program an autoreset procedure at power on, which resets an active alarm when the drive is shut off.
Always in this menu

- It is possible to enable Mains Loss alarm **A064** tripping when this event is detected and
- It is possible to define if this alarm and Undervoltage alarm **A047** are to be stored to the fault list.

To activate the Autoreset function, set a number of attempts other than zero in parameter **C255**. When the number of reset attempts is the same as the value set in **C255**, the autoreset function is disabled. It will be enabled again only when a time equal to or longer than the time set in **C256** has passed.
If the drive is turned off when an alarm is active, the alarm tripped is stored to memory and will be active at next power on. Regardless of the Autoreset function setup, an automatic reset of the last alarm stored can be obtained when the drive is next turned on (**C257** [Yes]).

NOTE Undervoltage alarm **A047** (DC bus voltage below allowable threshold with motor running) or Mains Loss alarm **A064** (mains loss when the motor is running) are not stored in the fault list when the drive is powered off (factory-setting). To enable parameter storage, set **C258** to [Yes].

44.2. List of Parameters C255 to C258a

Table 99: List of Parameters C255 to C258a

Parameter	FUNCTION	User Level	MODBUS Address	DEFAULT VALUES
C255	Autoreset attempt number	ENGINEERING	1255	0
C256	Attempt counting reset time	ENGINEERING	1256	300 sec
C257	Alarm reset at Power On	ENGINEERING	1257	0: [Disabled]
C258	Enable Undervoltage and Mains Loss alarms	ENGINEERING	1258	0: [Disabled]
C258a	Mains Loss Alarm Disable	ADVANCED	1135	1: [Yes]

C255	Autoreset Attempt Number	
Range	0 ÷ 100	0 ÷ 100
Default	0	0
Level	ENGINEERING	
Address	1255	
Function	If set other than 0, this parameter enables the Autoreset function and sets the max. allowable number of reset attempts. The autoreset attempt count is reset when a time equal to the time set in **C256** passes starting from the last alarm tripped.	

C256	Attempt Counting Reset Time	
Range	0; 1000	0; 1000 sec
Default	300	300 sec
Level	ENGINEERING	
Address	1256	
Function	Determines the time that passes from the last alarm tripped to reset the autoreset attempt number.	

C257	Alarm Reset at Power On	
Range	0; 1	0: [Disabled]; 1: [Yes]
Default	0	0: [Disabled]
Level	ENGINEERING	
Address	1257	
Function	At power on, this parameter enables the automatic reset of the alarms tripped when the drive is powered off.	

C258	Enable Saving Undervoltage and Mains Loss Alarms	
Range	0; 1	0: [Inactive]; 1: [Yes]
Default	0	0: [Inactive]
Level	ENGINEERING	
Address	1258	
Function	This parameter saves Undervoltage alarm **A047** and Mains Loss alarm **A064** to the fault list.	

C258a	Mains Loss Alarm Enable	
Range	0; 1	0: [Inactive]; 1: [Yes]
Default	1	1: [Yes]
Level	ADVANCED	
Address	1135	
Function	Disables the activation of Mains Loss alarm **A064**.	

45. [CFG] MOTOR THERMAL PROTECTION MENU

45.1.Overview

The Motor Thermal Protection function protects the motor against overloads.
Some IRIS BLUE models offer the possibility to set the heatsink temperature for the activation of cooling fans.
All relevant parameters are included in the Motor Thermal Protection menu.

Parameter **C265** allows configuring the thermal protection function in 4 different modes, depending on the cooling system being used (configuration modes 1, 2 and 3):

Value	Descr.	IEC 34-6 Compliance	Description
0:NO	**[NO]**	-	The Motor Thermal Protection function is disabled;
1:YES	**[No Derated]**	IC410	The Motor Thermal Protection function is active with trip current **It** independent of operating speed (No derating);
2:YES A	**[Forced Cooled]**	IC416	The Motor Thermal Protection function is active with trip current **It** depending on operating speed, with fan-cooled motor de-rating (Forced Cooling);
3: YES B	**[Self-Cooled]**	IC411	The Motor Thermal Protection function is active; trip current **It** depends on operating speed and de-rating is suitable for motors having a fan keyed to the shaft (Fan on Shaft) (factory setting).

When **C265**=1, 2 and 3, the motor thermal model is considered. The heating of a motor is proportional to the square of the current flowing (I_o^2). Motor overheated alarm **A075** will trip after the time “t” computed based on the motor thermal model is over.
The alarm can be reset only after a given time depending on the thermal constant (**C267**) of the motor, thus allowing for the correct cooling of the motor.

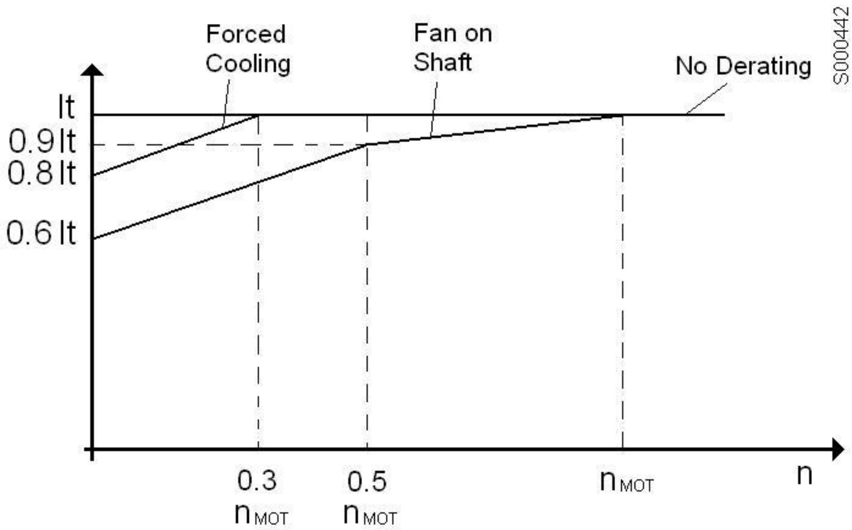


Figure 59: Trip current drop depending on speed values

The graph above shows how trip current **It** drops depending on the generated speed based on the value set in parameter **C265**.

NOTE The motor heating can be monitored with measurement **M026a**.
This value is expressed as a percentage of the asymptotic value that can be attained.

When **C274**=Enabled, the thermal protection function is implemented from a PTC sensor: the PTC alarm (**A055**) trips when voltage acquired by AIN2 used as a PTC signal input exceeds a preset threshold value when the characteristic temperature is attained. Alarm A055 can be reset only if temperature decreases by 5% with respect to the trip temperature.

45.2. Choosing the Characteristic Parameters

Parameter **C266** relates to the instantaneous trip current that the internal thermal protection function will begin to monitor the current. The default value of 105% is a typical value and it is usually unnecessary to change it.

The motor thermal time is specific to the motor design and it varies between different motor manufacturers.

If the motor thermal time is unknown, the thermal time constant (**C267**) can be set up as described in the sections below IEC Class, Maximum Locked Rotor Time – Basic and Maximum Locked Rotor Time – Enhanced.
The first method is the simplest and gives an approximate result. The other two methods are more complex, but give more accurate results.

45.2.1. IEC Class

The motor can be protected as defined in the IEC 60947-4-1 standard for the thermal overload relays.
If the protection class is known, in order to set-up the thermal protection for a certain IEC trip class, the value of **C267** can be entered as:

Class IEC	C267 [s]
10	360
20	720
30	1080

Table 100: Suggested values for the motor thermal time constant

The standard above defines a 7.2 ratio between LRC and FLC.
The value to be entered in **C267** is then defined from the formula below:

C267 = IEC Class x 36.

If the ratio between LRC and FLC is not 7.2, please refer to the graph in Figure 60.

45.2.2. Maximum Locked Rotor Time – Basic

If the IEC class is not known, then the IEC class can be approximated by the procedure described below.

The following values must be known:
- Full Load Current (FLC) of the motor
- Locked Rotor Current (LRC)
- Maximum Locked Rotor Time (LRT) or Direct On Line (DOL) Start Time

The FLC of the motor can be obtained directly from the nameplate on the motor. The LRC and LRT must be obtained from the manufacturer or the motor datasheets.
The LRC, also referred to as starting current or motor start-up current, is the current that a motor draws at start-up when full voltage is applied to the terminals.
LRT is the time a motor can safely maintain LRC from a cold start. This information might also be available as a thermal withstand curve or a thermal damage curve. If this is the case, then the LRC and LRT must be deduced from the curves.

The following formula can be applied:

$$\text{IEC Class} = \frac{\text{LRC x LRT}}{\text{FLC x 6}}$$

Once the IEC class has been calculated, use the motor thermal time constant (**C267**) that corresponds to the closest IEC class from Table 100.

Example 1a: the 7.5kW motor in the table below can be approximated to have a trip class of:

$$\text{IEC Class} = \frac{820 \times 20}{100 \times 6} = 27.3$$

The motor thermal time constant that you would select is IEC class 30, **C267** = 1080s.

NOTE As an even quicker guide, the IEC trip class can generally be approximated as the locked rotor time.

Output [kW]	IEC Frame	Locked Rotor Current - LRC [% FLC]	Full Load Current - FLC [A]	Locked Rotor Time (cold) - LRT [s]	Rated speed [rpm]	
0.12	63	450	0.41	44	1415	
0.18	63	460	0.58	59	1400	
0.25	71	500	0.7	106	1400	
0.37	71	500	1.03	81	1395	
0.55	80	600	1.3	37	1430	
0.75	80	570	1.61	35	1420	
1.1	90S	700	2.37	31	1445	
1.5	90L	750	3.28	22	1450	
2.2	112M	720	4.42	55	1455	
4	112M	660	7.85	26	1445	
5.5	132S/M	850	10.34	26	1465	
7.5	132S/M	820	14	20	1465	Example 1a/1b
9.2	160M	560	17.4	59	1460	
11	160M	600	20.84	42	1465	
15	160L	650	28.4	37	1465	
18.5	180M/L	800	34.83	26	1470	
22	180L	790	39.4	35	1475	
30	200L	700	55.6	40	1475	
37	225S/M	720	65.2	35	1480	
45	225S/M	740	78.11	33	1480	
55	250S/M	720	95.2	37	1480	
75	250S/M	750	131.25	35	1480	
90	280S/M	780	154.41	55	1485	
110	315S/M	760	189	64	1485	Example 2
132	315S/M	780	225.53	55	1485	
150	315S/M	750	260	44	1485	
160	315S/M	760	277	44	1485	
185	355M/L	720	320	117	1490	
200	355M/L	660	342	108	1490	
220	355M/L	700	375	84	1490	

Table 101: Typical datasheet for 4-pole, 50Hz-400V motors

45.2.3. MAXIMUM LOCKED ROTOR TIME – ENHANCED

If a more precise calculation is required, when the ratio between LRC and FLC is different from 7.2, you can refer to the graph below, where the x axis shows the LRC/FLC ratio, and the y axis shows the multiplicative constant to be applied to the LRT to calculate the value of parameter **C267:**

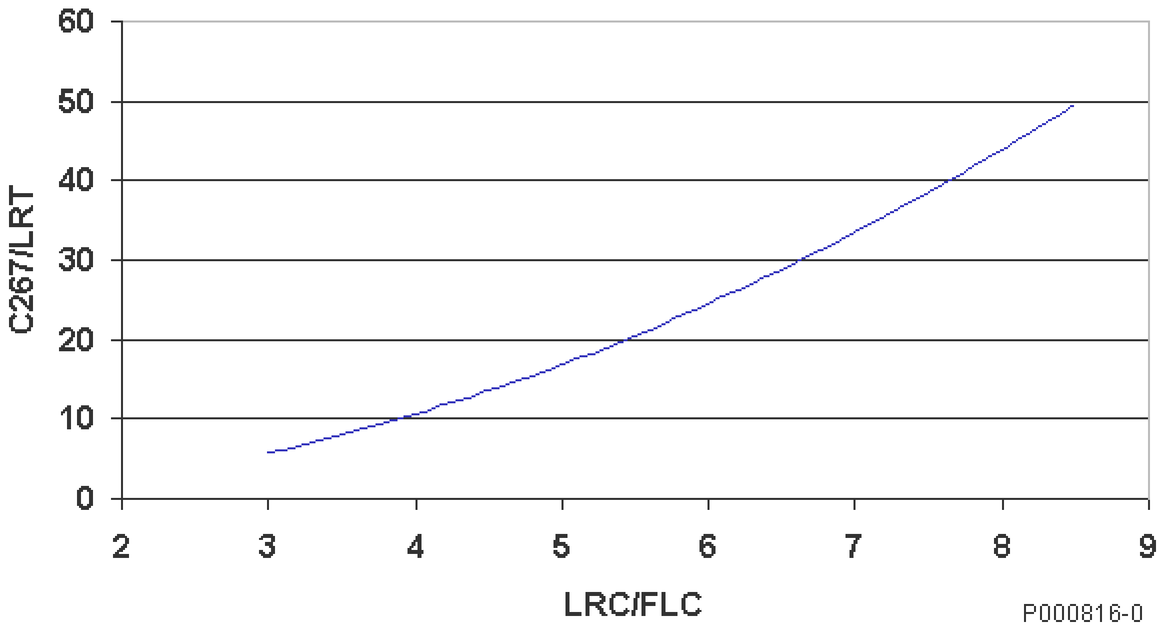


Figure 60: Set up of parameter C267 depending on the LRC/FLC ratio

Example 1b: When using a 7.5kW motor, the multiplicative constant corresponding to an LRC/FLC=8.2 is approx. 46 if referring to the graph above.

As a result, the motor thermal time constant that you would select is 27.3 x 46, **C267** = 1257s, which is a more accurate value than 1080s computed in Example 1a.

Example 2: The 250kW motor in Table 101 may be computed as follows:

$$\text{IEC Class} = \frac{690 \times 79}{100 \times 6} = 90.85$$

Because this value is not given in Table 100, the motor thermal time constant that you would select is **C267** = 90.85 x 36 = 3260s, or 90.85 x 33 = 2998s if the value “33” is considered, resulting from Table 101, with a ratio between LRC/FLC=6.9.

45.3. Thermal Protection Trip Delay

The graph below shows the thermal protection trip delay depending on the IEC Class and the current flowing (which is supposed to be constant).
Parameter **C266** (trip current) is factory set to 105%.

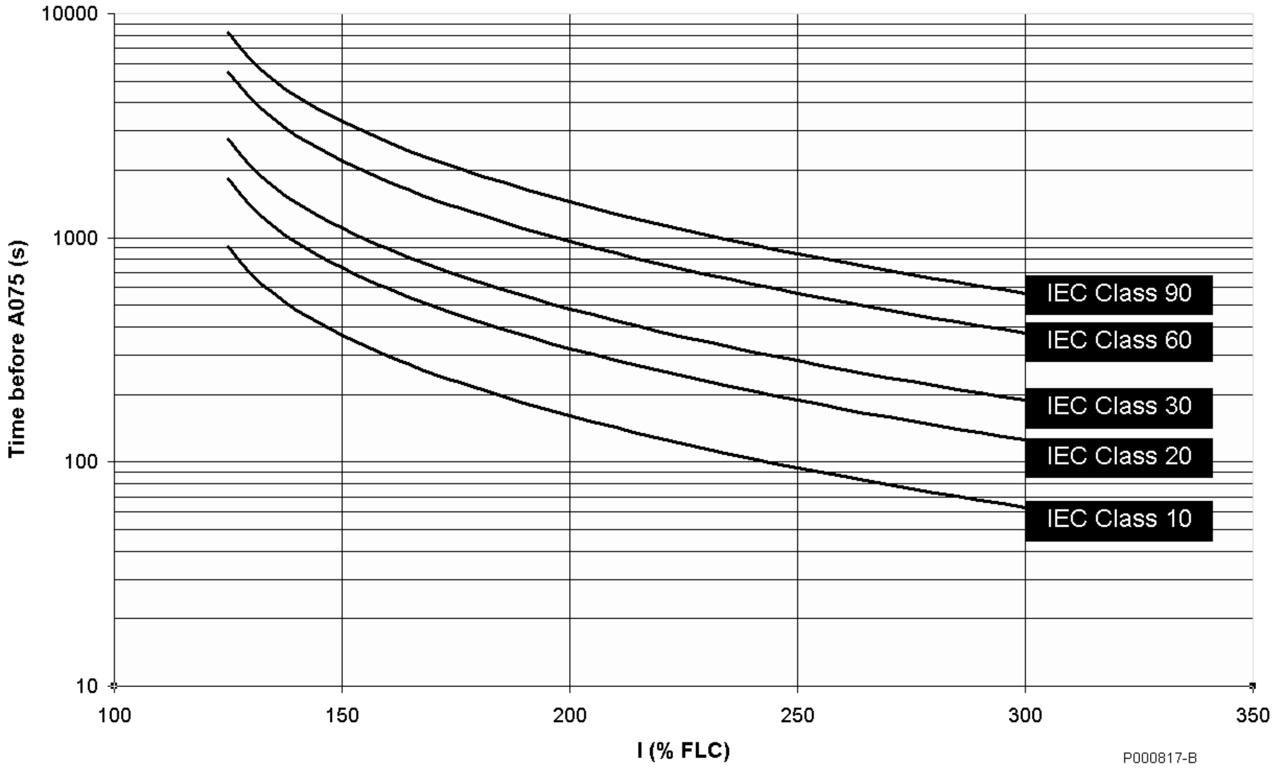


Figure 61: Trip delay of alarm A075 based on the IEC Class

Example: The protection level is compliant with IEC Class 30. If the current flowing is 200% of the FLC, alarm **A075** will trip after approx. 480s (8 minutes).

45.4. List of Parameters C264 to C274

Table 102: List of Parameters C264 to C274

Parameter	FUNCTION	User Level	MODBUS Address	DEFAULT VALUES
C264	Heatsink temperature for fan activation	ADVANCED	1264	50°C
C264a	Fan activation logic selector	ADVANCED	1280	0: Default
C265	Motor Thermal Protection activation	BASIC	1265	3: [Self-cool.]
C266	Motor Trip current [Imot%]	ADVANCED	1266	105%
C267	Motor Thermal time constant	BASIC	1267	720s
C274	PTC Thermal Protection Enable	BASIC	1274	0: [Disabled]

C264	**Heatsink Temperature for Fan Activation**	
Range	0 ÷ 50	0 ÷ 50°C
Default	50	50°C
Level	ADVANCED	
Address	1264	
Function	This parameter sets the heatsink threshold for the activation of its cooling fans according to the control logic set in **C264a**. This parameter is active only if **C264a**=0: Default or 2: By Temperature Only. The real temperature of the heatsink can be displayed in measurement parameter **M064**.	

C264a	**Fan Activation Logic Selector**	
Range	0 ÷ 2	0: [Default] 1: [Always On] 2: [By Temperature Only]
Default	0	0: [Default]
Level	ADVANCED	
Address	1280	
Function	This parameter defines the control logic of the heatsink cooling fans. 0: [Default]: The heatsink cooling fans are on whenever the drive is enabled (and IGBTs are switching); when the drive is disabled, fans are off only if the heatsink temperature drops below **C264**. 1: [Always On]: Fans are always on. 2: [By Temperature Only]: Fans are on only if the heatsink temperature is higher than the value set in **C264**, regardless of the drive status.	

NOTE Parameters **C264** and **C264a** take effect only for the IRIS BLUE models where fans are controlled directly by the drive control board (F), as displayed on the Product screen in the [IDP] PRODUCT MENU.
See Table 18 and Table 19.

C265	Thermal Protection Activation	
Range	0 ÷ 3	0: [Disabled] 1: [No Derating] 2: [ForcedCool.] 3: [Self-cool.]
Default	3	3: [Self-cooled]
Level	BASIC	
Address	1265	
Function	This parameter enables the Motor Thermal Protection function. It also selects the type of thermal protection among different trip patterns.	

C266	Trip Current	
Range	1 ÷ the lesser between Imax/Imot and 120%	1 ÷ the lesser between Imax/Imot and 120%
Default	105	105%
Level	ADVANCED	
Address	1266	
Function	This parameter sets the thermal protection trip current expressed as a percentage of the motor rated current.	

C267	Thermal Time Constant	
Range	1 ÷ 10800	1 ÷ 10.800s
Default	720	720s (corresponding to IEC Class 20)
Level	BASIC	
Address	1267	
Function	This parameter sets the thermal time constant of the connected motor. The time constant is the time within which the calculated thermal stage has reached 63% of its final value. The motor attains its thermal time constant when it operates in constant load conditions for a time equal to approx. 5 times the constant set in this parameter.	

C274	Thermal Protection Enable with PTC	
Range	0 ÷ 1	0: Disabled ÷ 1: Enabled
Default	0	Disabled
Level	ADVANCED	
Address	1274	
Function	This parameter enables the PTC probe (AIN2 analog input)	

NOTE If the PTC thermal protection (**C274**) is enabled, the reference from **AIN2** is automatically managed as a 0 ÷10V input. The only parameter enabled for the control of AIN2 is **P064**; **P060, P061, P062** and **P063** cannot be viewed and are not considered for calculations.

46. [CFG] MAINTENANCE MENU

46.1. Overview

The Maintenance menu allows setting partial counters for the drive Operation Time (OT) and Supply Time (ST). When the preset time is reached, a warning message appears (**W48** OT Time over and **W49** ST Time over respectively).

46.2. List of Parameters C275 to C278

Table 103: List of Parameters C275 to C278

Parameter	FUNCTION	User Level	MODBUS Address	DEFAULT VALUES
C275	Operation time counter reset	ENGINEERING	1275	NO
C276	Operation time threshold	ENGINEERING	1276	0h
C277	Supply time counter reset	ENGINEERING	1277	NO
C278	Supply time threshold	ENGINEERING	1278	0h

C275	Operation Time Counter Reset	
Range	0 ÷ 1	0: [NO] ÷ 1 [YES]
Default	0	NO
Level	ENGINEERING	
Address	1275	
Function	This parameter resets the partial counter for the drive operation time.	

C276	Operation Time Threshold	
Range	0 ÷ 65000	0 ÷ 650000h
Default	0	0h
Level	ENGINEERING	
Address	1276	
Function	This parameter sets the threshold for the operation time of the drive. When this time is exceeded, Warning “**W48 OT Over**” appears. To reset the warning message, reset the partial counter or set the counter threshold to zero.	

C277	Supply Time Counter Reset	
Range	0 ÷ 1	0: [NO] ÷ 1 [YES]
Default	0	NO
Level	ENGINEERING	
Address	1277	
Function	This parameter resets the partial counter for the drive supply time.	

C278	Supply Time Threshold	
Range	0 ÷ 65000	0 ÷ 650000h
Default	0	0h
Level	ENGINEERING	
Address	1278	
Function	This parameter sets the threshold for the supply time of the drive. When this time is exceeded, Warning "**W49 ST Over**" appears. To reset the warning message, reset the partial counter or set the counter threshold to zero.	

47. [CFG] PID CONFIGURATION MENU

47.1. Overview

The IRIS BLUE is provided with two separate PID (Proportional, Integral, Derivative) regulators allowing performing regulation loops such as pressure control, delivery control, etc., with no need to connect external auxiliary devices.
The PID Configuration Menu defines configuration parameters for the two PID regulators.
The configuration parameters for the PID regulator can be modified only when the drive is in stand-by and they set the following variables: reference sources, feedback sources and type of PID output action.
The programming parameters for the two PID regulators, including coefficients of proportional, integral and derivative terms, output saturation, etc., are covered in the [PAR] PID PARAMETERS MENU and [PAR] PID2 PARAMETERS MENU.

47.2. Operation and Structure of the PID Regulator

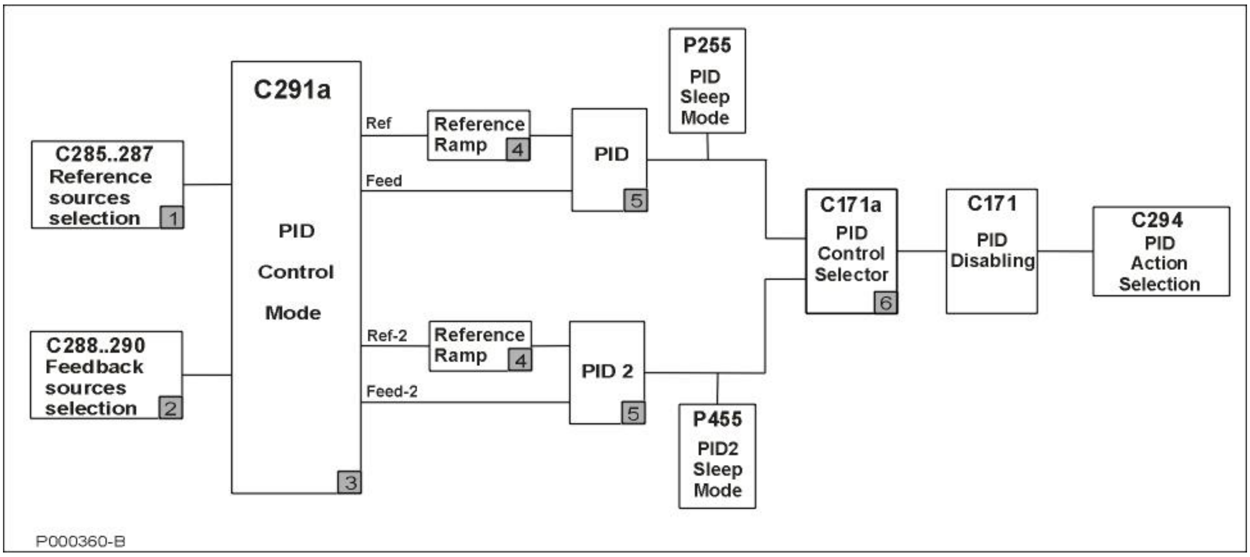


Figure 62: Structure of the PID Regulator

The figure above illustrates the block diagram of the PID regulator. Each block is described below:

Block 1: PID reference sources
Multiple reference sources can be selected at a time (up to 3 reference sources can be selected with parameters **C285**, **C286**, **C287**).
The resulting reference value depends on the setup in **C291a** (see block 3).
Dynamic selection is possible between two reference sources using the digital input configured as the source selector (see **C179** and **C179b**); this parameter has effect only if the Two PIDs mode is activated.

Block 2: PID feedback sources
Multiple feedback sources can be selected at a time (up to 3 feedback sources can be selected with parameters **C288, C289, C290**).
The resulting reference value depends on the setup in **C291a** (see block 3).
Dynamic selection is possible between two feedback sources using the digital input configured as the source selector (see **C179** and **C179b**); this parameter has effect only if the Two PIDs mode is activated.

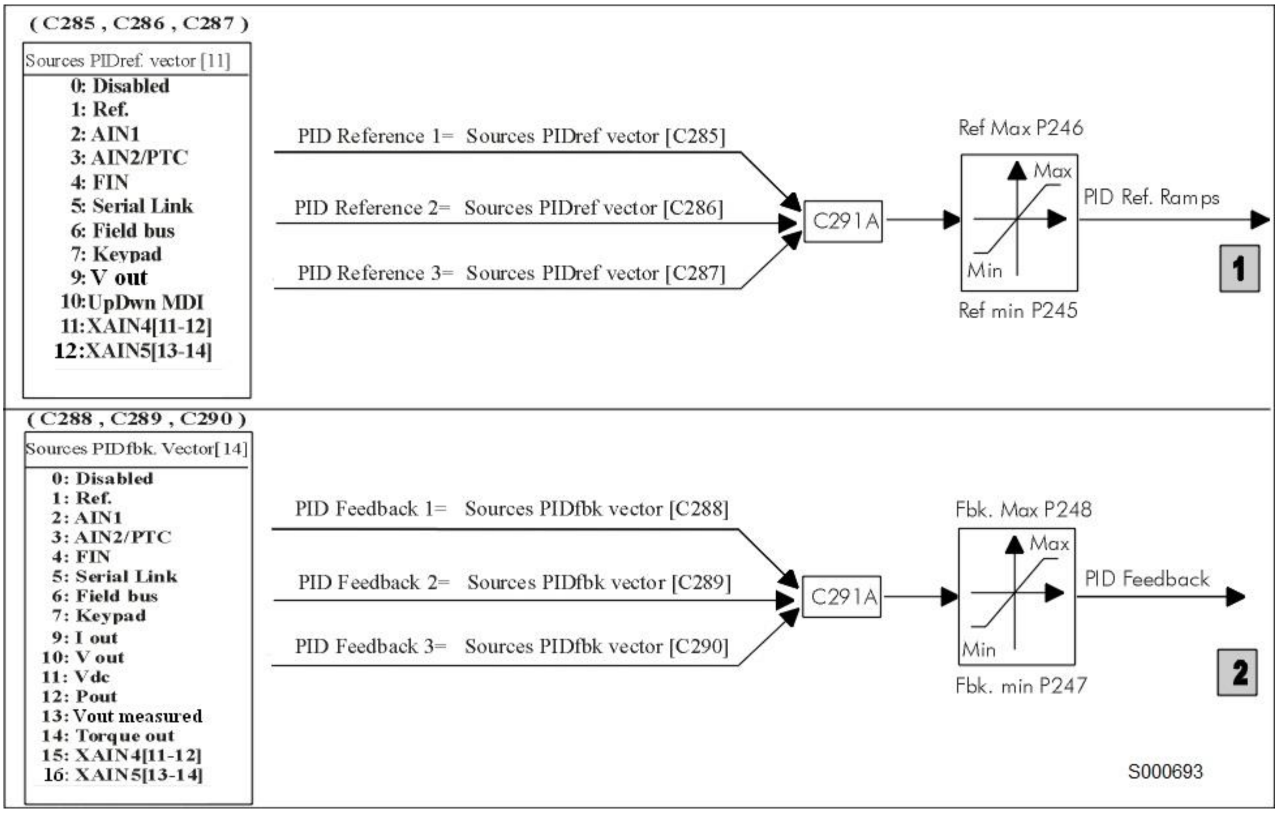


Figure 63: Reference source and feedback source selection

NOTA The signals selected in the Sources Vector are to be considered as percentage values; therefore, analog signals are expressed as a percentage of the preset maximum values and minimum values. For example, when selecting a reference source, if **P052** Ref. max. = 8V and **P051** Ref. min. = –3V, 100% will be considered when Ref. = 8V and –100% will be considered when Ref. = –3V.

NOTA Among the allowable variables for the PID feedback, electrical variables Iout (output current), Vout (output voltage), Vdc (DC bus voltage), Pout (output power) and Torque out (output torque – VTC control).
Their percentage values relate to rated current values and rated voltage values of the selected motor and to 1500VDC respectively.

Block 3: PID Control Mode

This block allows applying different processing types to the feedback signals and allows enabling/disabling the PID2 integrated into the system (see **C291a**).

Block 4: Ramp over PID Reference

A ramp may be applied to the PID references sent from block 3. The same ramp is applicable for both blocks: the processed references are the ones actually used in the PID regulator. The parameters of the PID reference ramp are illustrated in the figure below. The initial rounding-off is applied to the reference whenever a new acceleration/deceleration ramp is started, while the end reference is applied at the end of each ramp.

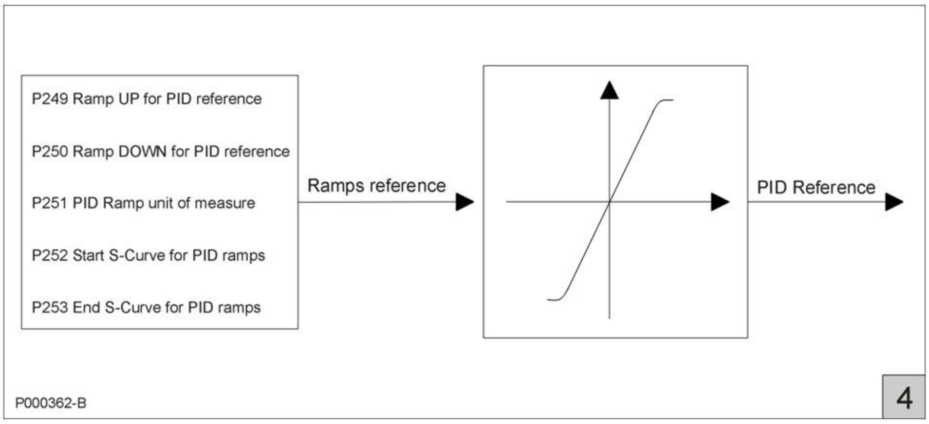


Figure 64: PID ramp reference

NOTE The PID2 ramp reference control is the same, but parameters **P2xx** are replaced with parameters **P4xx**.

Block 5: PID regulators
This is the real PID regulator. Its output may be disabled by an external digital command (if programmed with **C171**). If the PID regulator is used as a reference source and **P255** (**P455** for PID2) is not set to zero, the PID output value control is enabled. If the PID output equals the preset minimum value for a time longer than **P255** (**P455** for PID2), the drive is automatically put on stand-by.

In the last block, the PID output is applied to the function defined by the "PID Action" parameter (**C294**).

The PID regulator structure is detailed in the diagram below (block 5).

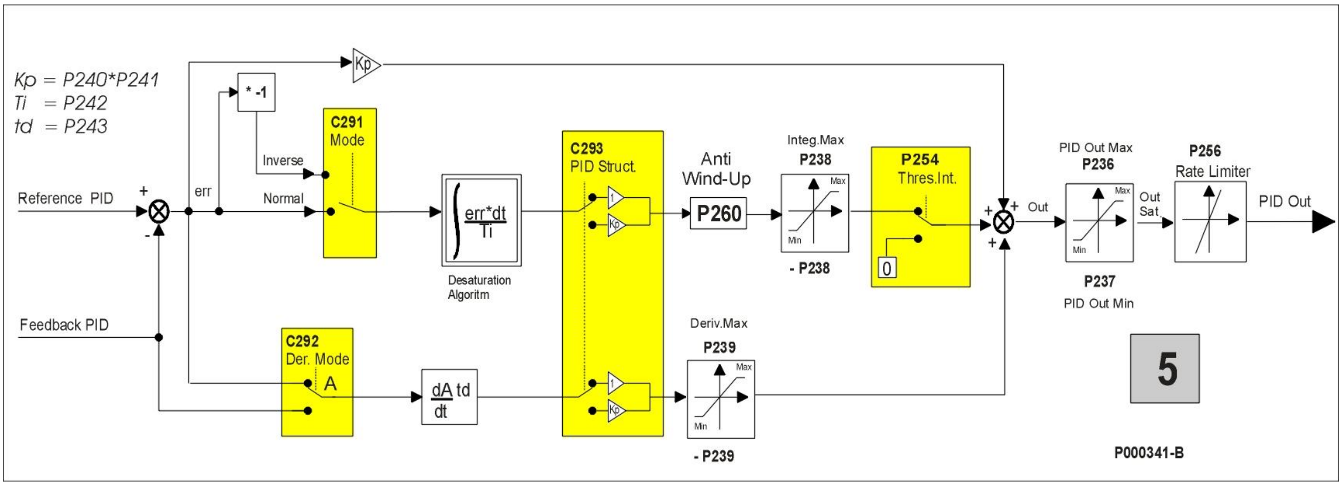


Figure 65: Details of the PID regulator structure

NOTE The PID2 structure is the same as the PID structure, but parameters **P2xx** are replaced with **P4xx** and parameter **C291** is replaced with parameter **C291b**. Parameters **C292** and **C293** are in common for PID and PID2.

Block 6: Digital input for PID control selection.
Block 6 activates only when both PIDs are enabled (**C291a** = **2 PID**) or when in 2-Zone mode (**C291a** = **2-Zone MIN** or **2-Zone MAX**).

In PID 2 modes:
if **C171a** = **0: Disabled**, the PID output is summed with the PID2 output;
if **C171a** is enabled, the logic state of the configured input determines which is the output of the PID regulator to be used: 0 → PID, 1→ PID2.

In 2-zone mode:
if **C171a** is enabled, when the selected input is activated, the 2-zone mode (MIN or MAX) is disabled. In that case, the PID regulator always operates on the error resulting from **C285–C288** and with parameters **P2xx**.

The PID regulator output may be used as:
- an external output;
- a speed/torque reference of the drive;
- a speed/torque reference increase or, if the IFD control is used, the PID regulator input may be used for correcting the output voltage.

If the PID regulator output is the speed reference of the drive, the selected speed/torque ramp is applied.

SERIAL LINK

The ***Serial Link*** source is an input from the MODBUS link: the reference value shall be written by the user to the following addresses:

Table 104: Reference sources from serial link

MODBUS Address	Input	User Level	Type of Reference	Description	Unit of Measurement
1418	**I031**	BASIC	PID Reference	PID reference value	Set in **P267**
1420	**I033**	BASIC	PID Feedback	PID feedback value	Set in **P267**

47.3. List of Parameters C285 to C294

Table 105: List of Parameters C285 to C294

Parameter	FUNCTION	User Level	MODBUS Address	Default Values
C285	Selection of PID reference n. 1	ENGINEERING	1285	2:AIN1
C286	Selection of PID reference n. 2	ENGINEERING	1286	0:Disable
C287	Selection of PID reference n. 3	ENGINEERING	1287	0:Disable
C288	Selection of PID feedback n. 1	ENGINEERING	1288	3:AIN2/PTC
C289	Selection of PID feedback n. 2	ENGINEERING	1289	0:Disable
C290	Selection of PID feedback n. 3	ENGINEERING	1290	0:Disable
C291	PID operating mode	ENGINEERING	1291	0:Disable
C291a	PID control mode	ENGINEERING	1295	0:Standard SUM
C291b	PID2 operating mode	ENGINEERING	1296	1: Normal
C292	Selection of the variable for calculating the derivative term	ENGINEERING	1292	0:Measurement
C293	Proportional Multiplier of derivative and integral terms	ENGINEERING	1293	0:NO
C294	PID action	ENGINEERING	1294	1:Reference

C285 C286, C287	Selection of PID Reference n.1 (2, 3)	
Range	0 ÷ 10 0 ÷ 12 when ES847 is fitted	0: Disable 1: REF 2: AIN1 3: AIN2/PTC 4: Pulse Input 5: Serial Link 6: Fieldbus 7: Keypad/display 9: V out 10: Up Down from MDI 11: XAIN4 12: XAIN5
Default	**C285** = 2 **C286** = 0 **C287** = 0	**C285** = 2: AIN1 **C286** = 0 **C287** = 0
Level	ENGINEERING	
Address	1285 (1286, 1287)	
Function	**C285** selects the first PID reference source from the PID regulator. Up to three reference sources may be configured **(285 – C287)** considered as a sum. The sources are used by the PID and are expressed in percentage values (with reference to their max. value and min. value set in the [PAR] INPUTS FOR REFERENCES MENU). If multiple reference sources are selected, their sum is considered. They are saturated between **P246** and **P245** (PID reference maximum and minimum value respectively). Source 9 (V out) is useful when **C294** = 3: Voltage Sum. This is the output voltage in IFD control with no PID corrections. Reference sources 11 and 12 can be selected only after setting **XAIN** in parameter **R023**.	

C288, C289, C290	Selection of PID Feedback n.1 (2, 3)	
Range	0 ÷ 14 0 ÷ 16 when ES847 is fitted	0: Disable 1: REF 2: AIN1 3: AIN2/PTC 4: Pulse Input 5: Serial Link 6: Fieldbus 7: Display/keypad 9: Iout 10: Vout 11: Vdc 12: Pout 13: Vout measured 14: Tout 15: XAIN4 16: XAIN5
Default	**C288**= 3 **C289**= 0 **C290**= 0	**C288**= 3: AIN2/PTC **C289**= 0: Disable **C290**= 0: Disable
Level	ENGINEERING	
Address	1288	
Function	**C288** selects the first PID feedback source. Up to three feedback sources can be configured among the available reference sources. If multiple sources are selected, their sum is considered. They are saturated based on parameters **P247** and **P248** (PID feedback maximum and minimum value respectively). See also parameter **C285**. Feedback source 13 is useful if **C294** = 3:Add Voltage. This is a RMS measurement of the output voltage obtained from the readout of the values of two properly transformed phase-to-phase output voltages from **AIN1** and **AIN2**. Feedback sources 15 and 16 can be selected only after setting **XAIN** in parameter **R023**.	

C291	PID Operating Mode	
Range	0 ÷ 2	0: Disable 1: Normal 2: Reverse
Default	0	0: Disable
Level	ENGINEERING	
Address	1291	
Function	This parameter defines how to compute the PID output. Three computing modes are available: 0: **Disable**, 1: **Normal**, 2: **Reverse**. If **0: Disable** is selected, the PID regulator is inactive and its output is always set to zero. In **Normal** mode, the real PID output is considered. If **2: Reverse** is selected, the output actuated by the PID regulator results from the subtraction of the max. output value set in **P236** from the output obtained by the PID regulator. This operating mode can be used for special applications (see Keeping Fluid Level Constant (Example)).	

C291a	PID Control Mode	
Range	0 ÷ 7	0: Standard SUM 1: Standard DIFF 2: Average 3: Minimum 4: Maximum 5: 2-Zone MIN 6: 2-Zone MAX 7: 2 PID
Default	0	0: Standard SUM
Level	ENGINEERING	
Address	1295	
Function	This parameter sets the PID control mode. Functions 0 to 4 set the processing mode of the feedback signal as detailed below. If **C179** (Input for Source Selection) and **C179b** (Input for Reference Selection) are both set as: **STANDARD SUM**: All the selected feedback signals are summed up. **STANDARD DIFF**: The sum of the remaining selected feedback signals is subtracted from the feedback signal programmed in **C288**. **AVERAGE**: The resultant of the feedback is given from the arithmetical average of the selected signals. **MINIMUM**: The signal having the smallest value among the selected signals is considered as the feedback. **MAXIMUM**: The signal having the largest value among the selected signals is considered as the feedback. If **C179** and **C179b** are enabled: **STANDARD SUM**: **C288**+**C290** or **C289**+**C290**. **STANDARD DIFF**: **C288**–**C290** or **C289**–**C290**. **AVERAGE**: AVG(**C288**,**C290**) or AVG(**C289**,**C290**). **MINIMUM**: MIN(**C288**,**C290**) or MIN(**C289**,**C290**). **MAXIMUM**: MAX(**C288**,**C290**) or MAX(**C289**,**C290**). The references are always summed with each other, unless they are managed with the Source Selection (see **C179** and **C179b**). Functions 5 and 6 (2-Zone Mode) automatically disable the Source Selection function that can be programmed with **C179** and **C179b**. In functions 5 and 6 only the references selected with **C285-C286** and the feedback values selected with **C288**-**C289** are used. **2-Zone MIN**: The PID operates on the system with the larger algebraic error MAX(**C285**–**C288**,**C286**–**C289**). This means that the system takes control of the PID having the minimum feedback with respect to its setpoint. **2-Zone MAX**: The PID operates on the system with the smaller algebraic error MIN(**C285**–**C288**,**C286**–**C289**). This means that the system takes control of the PID having the maximum feedback with respect to its reference. **NOTE:** When **C171a Input for PID Control Selection** is activated and the selected input is activated, the 2-zone (MIN or MAX) mode is disabled and the PID always operates on the error resulting from **C285**–**C288**. Function 7 (Two PIDs programming) automatically disables the Source Selection function that can be programmed with **C179** and **C179b**. The two PIDs use only the signals selected with **C285/C288** for PID and with **C286/C289** for PID2. **2 PID:** PID and PID2 operate in parallel; the outputs of the two PIDs are matched based on the configuration of **C171a:** If **C171a** = **0: Disabled**, the outputs of the two PIDs are summed to each other; If **C171a** is enabled, the output of the PID regulator depends on the logic state of the configured input: 0 → PID, 1→ PID2.	

C291b	PID2 Operating Mode	
Range	1 ÷ 2	1: Normal 2: Inverse
Default	1	1: Normal
Level	ENGINEERING	
Address	1296	
Function	This parameter sets how to calculate the PID2 output. Two modes are available: 1: **Normal**, 2: **Inverse**. In **Normal** mode, the output of the PID regulator is the actual PID2 output. If 2: **Inverse** is selected, the error sign is reversed. The Inverse operating mode can be used for special applications only (see Keeping Fluid Level Constant (Example)).	

C292	Selection of the Variable for Calculating the Derivative Term	
Range	0 ÷ 1	0: Measurement 1: Error
Default	0	0: Measurement
Level	ENGINEERING	
Address	1292	
Function	This parameter sets the variable used for calculating the derivative term. By default, the derivative term is computed according to the feedback measurement, but it can also be computed according to the PID error: Error = Reference – Feedback.	

C293	Proportional Multiplier of Derivative and Integral Terms	
Range	0 ÷ 1	0: No 1: Yes
Default	0	0: No
Level	ENGINEERING	
Address	1293	
Function	This parameter defines if the proportional term is used for the multiplication of the derivative and integral terms as well. 0: No means that the proportional term DOES NOT multiply the integral term.	

C294	PID Action	
Range	0 ÷ 1	0: External Output 1: Reference
Default	1	1: Reference
Level	ENGINEERING	
Address	1294	
Function	This parameter sets the type of implementation carried out by the PID regulator. ***C294** = External Output:* The PID regulator is independent of the drive operation, unless a digital input is configured for PID disabling; if the digital input closes, the PID regulator is disabled and the output is set to zero. In order to use the PID regulator output externally to the drive, configure one of the analog outputs as PID Out. ***C294** = Reference:* The PID regulator output is the speed/torque reference of the connected motor (depending on the type of reference configured when the motor is running); any other reference source which will be selected will be ignored. If the output is a speed reference, 100% corresponds to the max. absolute value between min. speed and max. speed set for the motor being used: max { | **C028** |; | **C029** | } If the output is a torque reference, 100% is the max. absolute value between the min. limit and the max. limit of the torque of the motor: max { | **C047** |; | **C048** | }.	

47.4.Keeping Fluid Level Constant (Example)

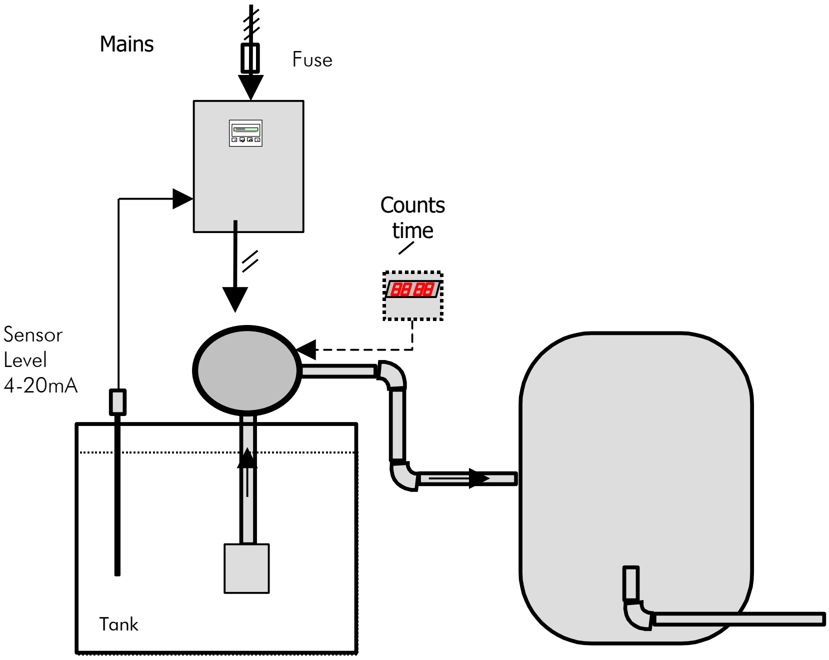


Figure 66: Keeping fluid level constant (example)

Suppose that the maximum level in the tank is to be kept at 50% and that a 4–20mA level probe is used, with an output of 4mA for the min. level and 20mA for the max. level. The PID reference is sent from keypad, while the probe feedback is sent to AIN2/PTC analog input, which is configured as follows:

R	W	S	P060-Type of Reference for Input AIN2/PTC	2: 4-20mA [SW1-3 On]	
R	W	S	P061-Reference Minimum Value for Input AIN2/PTC	4.0	mA
R	W	S	P062-Reference Maximum Value for Input AIN2/PTC	20.0	mA
R	W	S	P063-Offset for Input AIN2/PTC	0.000	mA
R	W	S	P064-Filter AIN2/PTC Constant	5	ms

The reference shall be saved from keypad, thus avoiding setting it up again when the drive is shut off.

R	W	S	P068-Storage of UP/DN values at Power Off	1: Yes
R	W	S	P068a-Reset of Speed/Torque UP/DN value at Stop	0: No
R	W	S	P068b-Reset of PID UP/DN value at Stop	0: No
R	W	S	P068c-Reset of Speed/Torque UP/DN value at Source Selection	0: No
R	W	S	P068d-Reset of PID UP/DN value at Source Selection	0: No
R	W	S	P069-Amplitude of UP/DN and KPD Reference	1: Unipolar

The PID regulator action and the PID output computing mode must also be set.

R	W	S	C285-Selection of Reference Type 1 PID	2: AIN1 [5-6]
R	W	S	C286-Selection of Reference Type 2 PID	0: Disabled
R	W	S	C287-Selection of Reference Type 3 PID	0: Disabled
R	W	S	C288-Selection of Feedback Type 1 PID	3: AIN2 [7-8]
R	W	S	C289-Selection of Feedback Type 2 PID	0: Disabled
R	W	S	C290-Selection of Feedback Type 3 PID	0: Disabled
R	W	S	C291-PID Operating Mode	1: Normal
R	W	S	C291a-PID Control Mode	0: Standard SUM
R	W	S	C291b-PID2 Operating Mode	1: Normal
R	W	S	C292-Quantity Selection to Compute Derivative Term	0: Measure
R	W	S	C293-Kp Used as a Multiplier for Integral and Derivative Terms	0: No
R	W	S	C294-PID Operation	1: Reference

The PID regulator parameters are defined in the [PAR] PID PARAMETERS MENU. This configuration limits the PID output between 0 and 100% for a proper rotation of the connected pump. Set **P255** = 1000 ts: if the PID output is equal to the min. value for 5 seconds, the drive is put on stand-by.

R	W	S	P236-PID Maximum Output	100.00	%	
R	W	S	P237-PID Minimum Output	0.00	%	
R	W	S	P237a-Wake-Up mode for PID	0: Disabled		
R	W	S	P237b-Wake-Up level for PID	0.00	%	
R	W	S	P238-Maximum Value of PID Integral Term	100.00	%	
R	W	S	P239-Maximum Value of PID Derivative Term	100.00	%	
R	W	S	P240-Proportional Coefficient Value	5.000		
R	W	S	P241-Proportional Term Multiplicative Factor	0: 1		
R	W	S	P242-Integral Time (Multiples of Tc)	500	Tc	Disabled
R	W	S	P243-Derivative Time (Multiples of Tc/1000)	0	mTc	
R	W	S	P244-Cycle Time Tc	5	ms	
R	W	S	P245-PID Reference Min. Value	-100.00	%	
R	W	S	P246-PID Reference Max. Value	100.00	%	
R	W	S	P247-PID Feedback Minimum Value	-100.00	%	
R	W	S	P248-PID Feedback Maximum Value	100.00	%	
R	W	S	P249-PID Ramp UP Acceleration Time	0.00	s	
R	W	S	P250-PID Ramp DOWN Deceleration Time	0.00	s	
R	W	S	P251-Unit of Measure for PID Ramps	2: 1 s		
R	W	S	P252-Start S-Curve for PID Ramps	1	%	
R	W	S	P253-End S-Curve for PID Ramps	1	%	
R	W	S	P254-PID Out Threshold Enabling Integral Implem.	0.0	%|Refmax	
R	W	S	P255-Inverter Disabling Time for PID Output Equal to Min. Value	5	s	Disabled
R	W	S	P256-Time Spent by PID Output from 0% to 100%	1	ms	

When the level of liquid in the tank exceeds the reference value set from keypad, a negative error is produced (Error = Reference – Feedback). Because the complemented output computing mode is selected and because the complemented output is the speed reference, the higher the error absolute value, the higher the PID output value. This means that the quicker the level increases, the quicker the pump suction. On the other hand, if the level is lower than the reference, a positive error is produced, because the PID output is limited to 0%, the pump will not activate; if the PID output is equal to the min. value for a timer longer than **P255** = 1000***P244** = 5sec, the drive is put on stand-by.

48. [CFG] DATE AND TIME MENU

48.1. Overview

The Clock/Calendar of the control board (RTC – Real Time Clock) is based on the Clock/Calendar of the Data Logger ES851 (please refer to the IRIS BLUE – Installation Guide).

NOTE The Data and Time Menu may be accessed only if the Data Logger board is installed (even the ES851 RTC version only) and if parameter **R021** Data Logger setting is set to 2: ENABLE.

The clock/calendar can be updated via special parameters. The display/keypad permits to immediately update the clock/calendar: just select the Set Time page or the Set Date page and press **ENTER**. Press **ESC** to go to the next field; press **ENTER** to confirm.
If you use the serial link of the inverter where the Data Logger is installed, the Clock/Calendar is viewed in the measurement parameters below. To update the Clock/Calendar via serial link, set the new values in **C310** to **C315** and send the edit command (**C316**).
Parameters **R050** to **R053** set the rules for daylight saving time.

Change TIME by pressing Save/Enter

```
C314  Set  TIME
DST:  OFF
>        16:29:55
2016/JAN/01:FRI
```

First page from the Date and Time menu on the display/keypad

Change DATE by pressing Save/Enter

```
C310  Set  DATE

          16:29:55
>2016/JAN/01:FRI
```

Second page of the Date and Time menu on the display/keypad

The date and time on the display/keypad are represented by the measurements below:

Time (Hours)		
Range	0 ÷ 23	0 ÷ 23 ore
Active	This measurement is available only if the Data Logger ES851 is installed and activated (**R021** = ENABLE).	
Address	3342	
Level	BASIC	
Function	Time - hours (current value).	

Minutes		
Range	0 ÷ 59	0 ÷ 59 min
Active	This measurement is available only if the Data Logger ES851 is installed and activated (**R021** = ENABLE).	
Address	3343	
Level	BASIC	
Function	Minutes (current value).	

Seconds		
Range	0 ÷ 59	0 ÷ 59 sec
Active	This measurement is available only if the Data Logger ES851 is installed and activated (**R021** = ENABLE).	
Address	3344	
Level	BASIC	
Function	Seconds (current value).	

Day of the Week		
Range	1 ÷ 7	1: Mon. 2: Tues. 3: Wed. 4: Th. 5: Fri. 6: Sat. 7: Sun.
Active	This measurement is available only if the Data Logger ES851 is installed and activated (**R021** = ENABLE).	
Address	3345	
Level	BASIC	
Function	Day of the week (current value).	

Day of the Month		
Range	1 ÷ 31	1 ÷ 31 days
Active	This measurement is available only if the Data Logger ES851 is installed and activated (**R021** = ENABLE).	
Address	3346	
Level	BASIC	
Function	Day of the month (current value).	

Daylight Saving Time		
Range	0 ÷ 2	0 ÷ 2
Active	This measurement is available only if the Data Logger ES851 is installed and activated (**R021** = ENABLE).	
Address	528	
Level	BASIC	
Function	Status of the DST: 0: Inactive 1: Inactive from less than 1 hour 2: Active	

Month		
Range	1 ÷ 12	1: January 2. February 3: March 4: April 5: May 6: June 7: July 8: August 9: September 10: October 11: November 12: December
Active	This measurement is available only if the Data Logger ES851 is installed and activated (**R021** = ENABLE).	
Address	3347	
Level	BASIC	
Function	Month (current value).	

Year		
Range	2000 ÷ 2099	2000 ÷ 2099 years
Active	This measurement is available only if the Data Logger ES851 is installed and activated (**R021** = ENABLE).	
Address	3348	
Level	BASIC	
Function	Year (current value).	

48.2.List of Parameters C310 to C316

Table 106: List of Parameters C310 to C316

Parameter	FUNCTION	User Level	MODBUS Address
C310	Day of the week to be changed	ADVANCED	1053
C311	Day of the month to be changed	ADVANCED	1054
C312	Month to be changed	ADVANCED	1055
C313	Year to be changed	ADVANCED	1056
C314	Time (Hours) to be changed	ADVANCED	1057
C315	Time (Minutes) to be changed	ADVANCED	1058
C316	Clock/Calendar editing command	ADVANCED	1060

C310	Day of the Week to Be Changed	
Range	1 ÷ 7	1: Mon. 2: Tues. 3: Wed. 4: Th. 5: Fri. 6: Sat. 7: Sun.
Default	1	1: Mon.
Active	This parameter can be viewed and changed only if the Data Logger ES851 is installed and activated (**R021** = ENABLE).	
Address	1053	
Level	ADVANCED	
Function	This parameter sets the value of the day of the week to be changed.	

C311	Day of the Month to Be Changed	
Range	1 ÷ 31	1 ÷ 31 days
Default	1	Day 1
Active	This parameter can be viewed and changed only if the Data Logger ES851 is installed and activated (**R021** = ENABLE).	
Address	1054	
Level	ADVANCED	
Function	This parameter sets the value of the day of the month to be changed.	

C312	Month to Be Changed	
Range	1 ÷ 12	1: January 2. February 3: March 4: April 5: May 6: June 7: July 8: August 9: September 10: October 11: November 12: December
Default	1	1: January
Level	ADVANCED	
Active	This parameter can be viewed and changed only if the Data Logger ES851 is installed and activated (**R021** = ENABLE).	
Address	1055	
Function	This parameter sets the value of the month to be changed.	

C313	Year to be Changed	
Range	2000 ÷ 2099	2000 ÷ 2099 years
Default	0	Year 2000
Level	ADVANCED	
Active	This parameter can be viewed and changed only if the Data Logger ES851 is installed and activated (**R021** = ENABLE).	
Address	1056	
Function	This parameter sets the value of the year to be changed.	

C314	Time (Hours) to Be Changed	
Range	0 ÷ 23	0 ÷ 23 hours
Default	0	0 hours
Level	ADVANCED	
Active	This parameter can be viewed and changed only if the Data Logger ES851 is installed and activated (**R021** = ENABLE).	
Address	1057	
Function	This parameter sets the time (hour) to be changed.	

C315	Minutes to Be Changed	
Range	0 ÷ 59	0 ÷ 59 min.
Default	0	0 minutes
Level	ADVANCED	
Active	This parameter can be viewed and changed only if the Data Logger ES851 is installed and activated (**R021** = ENABLE).	
Address	1058	
Function	This parameter sets the time (minutes) to be changed.	

C316	Clock/Calendar Editing Command	
Range	0 ÷ 1	0 ÷ 1
Default	0	0
Level	ADVANCED	
Active	This parameter can be viewed and changed only if the Data Logger ES851 is installed and activated (**R021** = ENABLE).	
Address	1060	
Function	f this parameter is set to 1, all the values set in parameters **C310** to **C315** are written and stored to the clock/calendar of the board and the measurements described above are instantly changed. **CAUTION** Also unchanged parameters are written to the clock/calendar. Make sure that unchanged parameters are correct.	

49. [CFG] TIMED FLAGS MENU

49.1. Overview

The Timed Flag Menu includes the parameters setting the four timed flags for the inverter, TFL1..4. The following data items are set for each timed flag: activation time (Time ON), deactivation time (Time OFF), days of the week when activation shall occur.
The timed flags may be used as they were digital inputs, both when managing digital outputs (MDO) and when managing virtual digital outputs (MPL). It is also possible to assign the same control functions that can be associated to the other digital inputs (see the [CFG] DIGITAL INPUTS MENU).

NOTE The Timed Flags Menu may be accessed only if the Data Logger board is installed (even the ES851 RTC version only) and if parameter **R021** Data Logger setting is set to 2: ENABLE.

49.2. Examples

Every time flag features 3 parameters (Hour, Minute, Second) setting the activation time of the flag itself; 3 parameters (Hour, Minute, Second) setting the deactivation time of the flag itself; 1 parameter setting the days of the week when the flag shall activate. If the activation time precedes the deactivation time, the flag will have the TRUE logic value at the activation time, whilst it will have the FALSE logic value at the deactivation time in the days of the week concerned. If the activation time is subsequent to the deactivation time, the flag will have the TRUE logic value at the activation time, whilst it will have the FALSE logic value at the deactivation time of the following day.

Example 1:

C330	TFL1: Time ON – Hour	08
C331	TFL1: Time ON – Minutes	00
C332	TFL1: Time ON – Seconds	00
C333	TFL1: Time OFF – Hour	20
C334	TFL1: Time OFF – Minutes	00
C335	TFL1: Time OFF – Seconds	00
C336	TFL1: Days of the week	1000000

The timed flag TFL1 is TRUE from 8:00:00AM to 08:00:00PM every Monday.

Example 2:

C330	TFL1: Time ON – Hour	20
C331	TFL1: Time ON – Minutes	00
C332	TFL1: Time ON – Seconds	00
C333	TFL1: Time OFF – Hour	08
C334	TFL1: Time OFF – Minutes	00
C335	TFL1: Time OFF – Seconds	00
C336	TFL1: Days of the week	1000000

The timed flag TFL1 is TRUE from 08:00:00PM on every Monday to 8:00:00AM on every Tuesday.

49.3.List of Parameters C330 to C357

Table 107: List of Parameters C330 to C357

Parameter	FUNCTION	User Level	DEFAULT VALUES	MODBUS Address
C330	TFL1: Time ON – Hour	ADVANCED	0	271
C331	TFL1: Time ON – Minutes	ADVANCED	0	272
C332	TFL1: Time ON – Seconds	ADVANCED	0	273
C333	TFL1: Time OFF – Hour	ADVANCED	0	274
C334	TFL1: Time OFF – Minutes	ADVANCED	0	275
C335	TFL1: Time OFF – Seconds	ADVANCED	0	276
C336	TFL1: Days of the week	ADVANCED	0	277
C337	TFL2: Time ON – Hour	ADVANCED	0	278
C338	TFL2: Time ON – Minutes	ADVANCED	0	279
C339	TFL2: Time ON – Seconds	ADVANCED	0	280
C340	TFL2: Time OFF – Hour	ADVANCED	0	281
C341	TFL2: Time OFF – Minutes	ADVANCED	0	282
C342	TFL2: Time OFF – Seconds	ADVANCED	0	283
C343	TFL2: Days of the week	ADVANCED	0	284
C344	TFL3: Time ON – Hour	ADVANCED	0	285
C345	TFL3: Time ON – Minutes	ADVANCED	0	286
C346	TFL3: Time ON – Seconds	ADVANCED	0	287
C347	TFL3: Time OFF – Hour	ADVANCED	0	288
C348	TFL3: Time OFF – Minutes	ADVANCED	0	289
C349	TFL3: Time OFF – Seconds	ADVANCED	0	290
C350	TFL3: Days of the week	ADVANCED	0	291
C351	TFL4: Time ON – Hour	ADVANCED	0	292
C352	TFL4: Time ON – Minutes	ADVANCED	0	293
C353	TFL4: Time ON – Seconds	ADVANCED	0	294
C354	TFL4: Time OFF – Hour	ADVANCED	0	295
C355	TFL4: Time OFF – Minutes	ADVANCED	0	296
C356	TFL4: Time OFF – Seconds	ADVANCED	0	297
C357	TFL4: Days of the week	ADVANCED	0	298

C330, C337, C344, C351	Hour of Activation of the Timed Flag TFL1 (TFL2, TFL3, TFL4)	
Range	0 ÷ 23	0 ÷ 23
Default	0	0
Level	ADVANCED	
Address	271 (278, 285, 292)	
Function	Sets the hour of activation of the timed flag **TFL1 (TFL2, TFL3, TFL4)**.	

C331, C338, C345, C352	Minute of Activation of the Timed Flag TFL1 (TFL2, TFL3, TFL4)	
Range	0 ÷ 59	0 ÷ 59
Default	0	0
Level	ADVANCED	
Address	272 (279, 286, 293)	
Function	Sets the minute of activation of the timed flag **TFL1 (TFL2, TFL3, TFL4)**.	

C332, C339, C346, C353	Second of Activation of the Timed Flag TFL1 (TFL2, TFL3, TFL4)	
Range	0 ÷ 59	0 ÷ 59
Default	0	0
Level	ADVANCED	
Address	273 (280, 287, 294)	
Function	Sets the second of activation of the timed flag **TFL1 (TFL2, TFL3, TFL4)**.	

C333, C340, C347, C354	Hour of Deactivation of the Timed Flag TFL1 (TFL2, TFL3, TFL4)	
Range	0 ÷ 23	0 ÷ 23
Default	0	0
Level	ADVANCED	
Address	274 (281, 288, 295)	
Function	Sets the hour of deactivation of the timed flag **TFL1 (TFL2, TFL3, TFL4)**.	

C334, C341, C348, C355	Minute of Deactivation of the Timed Flag TFL1 (TFL2, TFL3, TFL4)	
Range	0 ÷ 59	0 ÷ 59
Default	0	0
Level	ADVANCED	
Address	275 (282, 289, 296)	
Function	Sets the minute of deactivation of the timed flag **TFL1 (TFL2, TFL3, TFL4)**.	

C335, C342, C349, C356	Second of Deactivation of the Timed Flag TFL1 (TFL2, TFL3, TFL4	
Range	0 ÷ 59	0 ÷ 59
Default	0	0
Level	ADVANCED	
Address	276 (283, 290, 297)	
Function	Sets the second of deactivation of the timed flag **TFL1 (TFL2, TFL3, TFL4)**.	

C336, C343, C350, C357	Days of the Week of the Activation of the Timed Flag TFL1 (TFL2, TFL3, TFL4)	
Range	0000000b ÷1111111b binary	0 ÷ 127
Active	0	
Address	ADVANCED	
Level	277(284, 291, 298)	
Function	Sets the second of deactivation of the timed flag **TFL1 (TFL2, TFL3, TFL4)**. Every bit corresponds to a day of the week: bit 1 corresponds to Monday, bit 7 corresponds to Sunday. Example: 1111100: flag TLF1 will activate every day of the week but Saturday and Sunday. 0000000: the flag will never activate. 1111111: the flag will activate every day.	

50. [CFG] SERIAL LINKS

50.1. Overview

NOTE Please refer to the IRIS BLUE – Installation Guide for the description of the serial links and connections.

NOTE For a greater immunity against communication interference, an optional optoisolated serial board (ES822) may be used instead of RS485 serial link. Serial links RS232 and RS485 can interface with ES822 board.
Please refer to the IRIS BLUE – Installation Guide for the description of the optional optoisolated board.

NOTE The parameters described in this menu are **Rxxx** parameters.
Once changed and saved, they become active only when the drive is next switched on or when the control board is reset (by holding down the **RESET** key for more than 5 secs).

The drives of the IRIS BLUE series may be connected to peripheral devices through a serial link. This enables both reading and writing of all parameters normally accessed through the display/keypad. Two-wire RS485 is used, which ensures better immunity against disturbance even on long cable paths, thus reducing the communication errors.

Two serial links are available. **Serial Link 0** is provided with a 9-pole, male D connector; **Serial Link 1** is provided with an RJ45 connector (or a three-phone connector) connected to the display/keypad.

NOTE The display/keypad connected through RJ45 connector dialogues correctly with the drive using the default values preset in the parameter set for serial link 1.

The drive will typically behave as a slave device (i.e. it only answers to queries sent by another device). A master device (typically a computer) is then needed to start serial communications.
The following items may be configured for both serial links:

1. The drive MODBUS address.
2. The drive response delay to a Master query.
3. The baud rate of the serial link (expressed in bits per second);
4. The time added to the 4 byte–time;
5. The serial link watchdog (which is active if the relevant parameter is not set at 0);
6. The type of parity used for serial communications.

50.1.1. Watchdog Alarms

The Watchdog alarms determined by the serial link may be the following:

- **A061** Serial alarm n.0 WDG
- **A062** Serial alarm n.1 WDG
- **A081** Keypad Watchdog

The first two alarms trip when no legal message is sent from the serial link to the drive for a time longer than the time set in the relevant watchdog parameters; **these alarms are active only if parameters R005 or R012 are set other than zero.**

NOTE Alarms **A061** and **A062** do not trip if, due to the parameters in the [CFG] CONTROL METHOD MENU or due to the status of the SOURCE SELECTION or LOC/REM inputs (see the [CFG] DIGITAL INPUTS MENU), the information sent via serial link is not currently used for the commands or the references.

The third alarm trips only if the **display/keypad used as a reference/command source** detects a communication loss for a time longer than 2 seconds.

50.2.List of Parameters R001 to R013

Table 108: List of Parameters R001 to R013

Parameter	FUNCTION	User Level	MODBUS Address	DEFAULT VALUES
R001	Drive MODBUS Address for Serial Link 0 (D9-pole)	ENGINEERING	588	1
R002	Response Delay for Serial Link 0 (D9-pole)	ENGINEERING	589	5msec
R003	Baud Rate for Serial Link 0 (D9-pole)	ENGINEERING	590	6:38400 bps
R004	Time added to 4byte–time for Serial Link 0 (D9-pole)	ENGINEERING	591	2msec
R005	Watchdog time for Serial Link 0 (D9-pole)	ENGINEERING	592	0.0sec
R006	Parity Bit for Serial Link 0 (D9-pole)	ENGINEERING	593	1:Disabled 2 Stop-bits
R008	Drive MODBUS address for Serial Link 1 (RJ45)	ENGINEERING	595	1
R009	Response Delay for Serial Link 1 (RJ45)	ENGINEERING	596	5 msec
R010	Baud Rate for Serial Link 1 (RJ45)	ENGINEERING	597	6:38400 bps
R011	Time Added to 4byte–time for Serial link 1 (RJ45)	ENGINEERING	598	2msec
R012	Watchdog Time for Serial Link 1 (RJ45)	ENGINEERING	599	0.0sec
R013	Parity Bit for Serial Link 1 (RJ45)	ENGINEERING	600	1:Disabled 2 Stop-bits

R001	**Drive MODBUS Address for Serial Link 0 (D9-pole)**	
Range	1 ÷ 247	1 ÷ 247
Default	1	1
Level	ENGINEERING	
Address	588	
Function	This parameter determines the address assigned to the drive connected through RS485 of serial link 0 (9-pole, male D connector).	

R002	**Response Delay for Serial Link 0 (D9-pole)**	
Range	1 ÷ 1000	1 ÷ 1000 msec
Default	5	5 msec
Level	ENGINEERING	
Address	589	
Function	This parameter determines the drive response delay after a master query sent through serial link 0 (9-pole, male D connector).	

R003	Baud Rate for Serial Link 0 (D9-pole)	
Range	1 ÷ 7	1: 1200 bps 2: 2400 bps 3: 4800 bps 4: 9600 bps 5: 19200 bps 6: 38400 bps 7: 57600 bps
Default	6	6: 38400bps
Level	ENGINEERING	
Address	590	
Function	This parameter determines the baud rate, expressed in bits per second, for serial link 0 (9-pole, male D connector).	

R004	Time added to 4–Byte–Time for Serial Link 0 (D9-pole)	
Range	1 ÷ 10000	1 ÷ 10000 msec
Default	2	2 msec
Level	ENGINEERING	
Address	591	
Function	This parameter determines the limit time when no character is received from serial link 0 (9-pole, male D connector) and the message sent from the master to the drive is considered as complete.	

R005	Watchdog Time for Serial Link 0 (D9-pole)	
Range	0 ÷ 60000	0 ÷ 6000.0 sec
Default	0	0.0 sec
Level	ENGINEERING	
Address	592	
Function	If not set at zero, this parameter determines the time limit after which alarm **A061** WDG Serial 0 Alarm trips if the drive does not receive any legal message through serial link 0 (9-pole, male D connector).	

R006	Parity Bit for Serial Link 0 (D9-pole)	
Range	0 ÷ 3	0: Disabled 1 Stop–bit 1: Disabled 2 Stop–bit 2: Even (1 Stop bit) 3: Odd (1 Stop bit)
Default	1	1: Disabled 2 Stop–bit
Level	ENGINEERING	
Address	593	
Function	This parameter determines whether the parity bit is used or not when creating the MODBUS message through serial link 0 (9-pole, male D connector).	

R008	Drive MODBUS Address for Serial Link 1 (RJ45)	
Range	1 ÷ 247	1 ÷ 247
Default	1	1
Level	ENGINEERING	
Address	595	
Function	This parameter determines the address assigned to the drive connected to the network through RS485 of serial link 1 (RJ45 connector).	

NOTE The display/keypad connected through RJ45 connector dialogues correctly with the drive using the default values preset in the parameter set for serial link 1 (RJ45).

R009	Response Delay for Serial Link 1 (RJ45)	
Range	1 ÷ 1000	1 ÷ 1000 msec
Default	5	5 msec
Level	ENGINEERING	
Address	596	
Function	This parameter determines the drive response delay after a master query sent through serial link 1 (RJ45 connector).	

R010	Baud Rate for Serial Link 1 (RJ45)	
Range	1 ÷ 7	1: 1200 bps 2: 2400 bps 3: 4800 bps 4: 9600 bps 5: 19200 bps 6: 38400 bps 7: 57600 bps
Default	6	6: 38400bps
Level	ENGINEERING	
Address	597	
Function	This parameter determines the baud rate, expressed in bits per second, for serial link 1 (RJ45 connector).	

R011	Time Added to 4–Byte–Time for Serial Link 1 (RJ45)	
Range	1÷10000	1 ÷ 10000 msec
Default	2	2 msec
Level	ENGINEERING	
Address	598	
Function	This parameter determines the time limit when no character is received from serial link 1 (RJ45 connector) and the message sent from the master to the drive is considered as complete.	

R012	Watchdog Time for Serial Link 1 (RJ45)	
Range	0 ÷ 60000	0 ÷ 6000.0 sec
Default	0	0.0 sec
Level	ENGINEERING	
Address	599	
Function	If this parameter is not set at zero, it determines the time limit after which alarm **A062** WDG Serial Link 1 Alarm trips if the drive does not receive any legal message through serial link 1 (RJ45 connector).	

R013	Parity Bit for Serial Link 1 (RJ45)	
Range	0 ÷ 3	0: Disabled 1 Stop–bit 1: Disabled 2 Stop–bit 2: Even (1 Stop bit) 3: Odd (1 Stop bit)
Default	1	1: Disabled 2 Stop–bit
Level	ENGINEERING	
Address	600	
Function	This parameter determines whether the parity bit is used or not when creating the MODBUS message through serial link 1 (RJ45 connector).	

51. [CFG] FIELDBUS CONFIGURATION MENU

51.1. Overview

NOTE See the OPTIONAL BOARDS FOR FIELDBUS section in the IRIS BLUE – Installation Guide for the description of the optional board required.

NOTE The parameters included in this menu are **Rxxx** parameters.
Once saved, they are active only when the drive is next switched on or when the control board is reset (by holding down the **RESET** key for more than 5 secs).

CAUTION This menu is not applicable to ES919 communications boards (see relevant section in the IRIS BLUE – Installation Guide). ES919 boards act as gateways and change the **MODBUS** RS485 packets into the packets of each protocol being used.
The exchanged parameters are all the **Mxxx** measurements from the IRIS BLUE to the Master and all the **Ixxx** inputs from the Master to the IRIS BLUE (as detailed in the [MEA] MEASUREMENTS MENU, Table 83 and Table 85).

51.1.1. ALARM **A070** (COMMUNICATION SUSPENDED)

Alarm **A070** trips if the IRIS BLUE is not sent any legal message via FIELDBUS within the timeout set in parameter **R016**. Set parameter **R016** = 0 to disable alarm **A070**.
A legal message is as follows:

- **PROFIdrive:** The master drive writes bit 11=1 of the Control Word (see PROFIdrive COMMUNICATIONS BOARD – User Manual).
- **Other Fieldbuses:** The master drive writes the digital input word (word 5 - **M035**) with bit 15=1 or as set in parameter **R018b**.

NOTE This is enabled only when the drive receives the first message with this bit =1.

Do the following to reset alarm **A070**, if tripped:
- restore legal communications between the Master and the IRIS BLUE;
- reactivate control of bit 15 in the word of the digital inputs as above (bit 11 of the Control Word when the PROFIdrive is used);
- reset the board.

NOTE Alarm **A070** does not trip if, due to the parameters in the [CFG] CONTROL METHOD MENU or due to the status of the SOURCE SELECTION or LOC/REM inputs (see the [CFG] DIGITAL INPUTS MENU), the information sent via serial link is not currently used for the commands or the references.

51.2.List of Parameters R016 to R018b and I080

Table 109: List of Parameters R016 to R018b and I080

Parameter	FUNCTION	User Level	MODBUS Address	DEFAULT VALUES
R016	Fieldbus Watchdog Time	ENGINEERING	603	0 ms
R017	Analog Outputs Controlled by the Fieldbus	ENGINEERING	604	000b
R018	Node address in the Fieldbus	ENGINEERING	230 bit 0-7	0
R018a	Fieldbus BaudRate	ENGINEERING	230 bit 8-11	125k
R018b	Type of Fieldbus Watchdog	ENGINEERING	230 bit 12-15	0 → bit 15 at 1
I080	IP Address Reset	ENGINEERING	519	Inactive

R016	**Fieldbus Watchdog Time**	
Range	0 ÷ 60000	0 ÷ 60000 ms
Default	0	0 ms
Level	ENGINEERING	
Address	603	
Function	If not set to zero, this parameter determines the time limit after which **A070** Fieldbus WDG trips if no legal writing is received from the fieldbus.	

NOTE The Watchdog activates only once the drive has received the first legal message from the master, as described in Alarm A070 (Communication Suspended). This avoids untimely activation due to different start times between the master and the drive.

R017	**Analog Outputs Controlled by the Fieldbus**	
Range	000b ÷ 111b binary 0000h ÷ 0007h hex 0 ÷ 7 decimal	000b → None 001b → AO1 010b → AO2 100b → AO3
Default	000b	000b → None
Level	ENGINEERING	
Address	604	
Function	To select analog outputs controlled by the fieldbus, select the bit corresponding to the analog output to be controlled. Example: **R017** = 0011b = 3 decimal → analog outputs AO1 and AO2 are controlled directly by the fieldbus, **irrespective of their configuration in the** [PAR] ANALOG AND FREQUENCY OUTPUTS MENU.	

R018	**Node Address in the Fieldbus**	
Range	0 ÷ 126 for Profibus 0 ÷ 63 for DeviceNet	0 ÷ 126 for Profibus 0 ÷ 63 for DeviceNet
Default	0	0
Level	ENGINEERING	
Validity	Boards: B40, Profibus and DeviceNet	
Address	230 bit 0-7	
Function	This is the slave address. This parameter is active only for Profibus and DeviceNet fieldbus with B40 boards.	

R018a	Fieldbus Baud Rate	
Range	0÷3	0 → 125k 1 → 250k 2 → 500k 3 → Autodetect
Default	0	0 → 125k
Level	ENGINEERING	
Validity	Boards: B40 Profibus and DeviceNet	
Address	230 bit 8-11	
Function	This is the slave baud rate in bps. It is active only for DeviceNet fieldbus with B40 boards.	

R018b	Type of Watchdog	
Range	0÷2	0 → bit 15 at 1 1 → bit 15 in toggle 2 → with B40 state
Default	0	0 → bit 15 at 1
Level	ENGINEERING	
Validity	Boards: B40	
Address	230 bit 8-11	
Function	Indicates the type of active WatchDog: 0 → after having established a connection to the Master device for the first time, if **R016** > 0, the system checks if bit 15 of the digital inputs is set to 1. If the bit drops to zero for a time longer than **R016**, alarm **A070** Fieldbus WDG trips. 1 → after having established a connection to the Master device for the first time, if **R016** > 0, the system checks if bit 15 continuously changes 0-1. If the bit is kept at one of two values for a time longer than **R016**, **A070** alarm **A070** Fieldbus WDG trips. 2 → after having established a connection to the Master device for the first time, if **R016** > 0, the system checks if the status of B40 board is kept in Connect status. If the Disconnect status is kept for a time longer than **R016**, **A070** alarm **A070** Fieldbus WDG trips. It is active only for B40 boards.	

Table 110: Coding of parameters R018, R018a and R018b

bit [15..12]	bit [11..8]	bit [7..0]
R018b	**R018a**	**R018**

I080	IP Address Reset	
Range	0 ÷ 1	0 → Inactive 1 → Address reset
Default	This is not a parameter: the input is set to zero at power on and whenever the command is executed.	
Level	ENGINEERING	
Validity	Boards: B40, Modbus TCP-IP, Profinet, EtherCAT	
Address	519	
Function	Pressing the button causes forcing the following after the boars is reset: IP → 192.168.0.2 subnet mask → 255.255.255.0 gateway → 0.0.0.0 and DHCP disabled. This parameter is active only for Modbus TCP-IP and Profinet fieldbus with B40 boards.	

51.3. Exchanged Parameters

The tables below state the IRIS BLUE parameters exchanged via Fieldbus.

Each table contains:
1) the parameter code;
2) its description;
3) its range;
4) its unit of measurement (also indicated on the display);
5) the ratio between the IRIS BLUE value (exchanged via Fieldbus) and the represented hardware value (as displayed).

NOTE Each parameter is exchanged as an integer value with 16-bit sign (-32768 to +32767).

NOTE Bytes are exchanged in **big-endian mode** (the most significant value is stored to the smallest memory address).
When using an Intel based master/PLC chipset, then the data below will be byte-swapped.

NOTE The PLC has to enter all the changeover variables without skipping any. If need be, these variables may be suppressed in sequence after the latest one desired.
For example, if all the data from the Master to the Iris Blue up to "Command for Digital Outputs from FIELDBUS" are required, the PLC must enter the first six variables. Variables from the 7 on may not be entered.

51.3.1. From the Master to the IRIS BLUE

Word	1) Code	2) Description	3) Range	4) Unit of Measurement	5) Scaling
1	**M042**	Speed reference/limit from FIELDBUS (integer portion)	– 32000 ÷ + 32000	rpm	1
2	–	Speed reference/limit from FIELDBUS (decimal portion)	–	–	–
3	**M045**	Torque reference/limit from FIELDBUS	– 5000 ÷ + 5000	%	x 10
4	**M047**	PID reference from FIELDBUS	– 10000 ÷ + 10000	%	x 100
5	**M035 + M036b**	Digital inputs and auxiliary digital inputs from FIELDBUS	–	–	–
6		Command for Digital Outputs from FIELDBUS	–	–	–
7	**AO1**	Analog Output 1 controlled by FIELDBUS	+ 111 ÷ + 1889	–	–
8	**AO2**	Analog Output 2 controlled by FIELDBUS	+ 111 ÷ + 1889	–	–
9	**AO3**	Analog Output 3 controlled by FIELDBUS	+ 111 ÷ + 1889	–	–
10	**M049**	PID Feedback from FIELDBUS	– 10000 ÷ + 10000	–	x 100

The parameter exchange memory zone may also be used to read and write all the IRIS BLUE drive's parameters by referring to their Modbus address.

Word	1) Number	2) Description	3) Range	4) Unit of measurement	5) Ratio
11	**Type of cycle**	Read or write cycle	Allowable values 0x80, 0x40	–	1
12	**Address**	Modbus address of the variable to be read/written	0 ÷ 8191	–	1
13	**Value**	Value to be written to the Modbus address	–32768 ÷ +32767	–	1

Word 1: Speed reference/limit from FIELDBUS

Word 1 of the speed reference (**M042**).

bit [15..8]	bit [7..0]
Speed reference integer portion	

This value is included in the global speed reference of the drive (measurement **M000**) along with the other reference sources if at least one of parameters **C143** to **C146** is set as 6:FieldBus.

Word 2: Not used

Word 3: Torque reference/limit from FIELDBUS
The torque reference from the FIELDBUS (**M045**) is significant if at least one of parameters **C143** to **C146** is set as 6:FieldBus and if the type of reference of the active motor (parameters **C011**) is set as 1:Torque or as 2:Torque with Speed Limit, or if the drive is in slave mode from digital input.

The value sent by the Master to the IRIS BLUE as the torque reference/torque limit must be multiplied by 10.
In order to send a torque reference/torque limit of 50%, the word must contain the value 500_{10} or 111110100_2 ($50\%_{10}$ x 10 = 500_{10}).

bit [15..8]	bit [7..0]
Torque reference/limit	

Word 4: PID reference from FIELDBUS

The PID reference (**M047**) can be sent from the fieldbus if at least one of the parameters **C285** to **C287** is set as 6:Fieldbus.

The value sent by the Master to the IRIS BLUE as the PID reference must be multiplied by 100.
E.g. In order to send a PID reference of 50%, the word must contain the value 5000_{10} or 111110100_2 ($50\%_{10}$ x 100 = 5000_{10}).

bit [15..8]	bit [7..0]
PID Reference from FIELDBUS	

Word 5: Digital Inputs and Auxiliary Digital Inputs from FIELDBUS
The virtual digital inputs via the Fieldbus are the low byte of the word:

bit [7..0]							
MDI8	MDI7	MDI6	MDI5	MDI4	MDI3 (RESET)	MDI2	MDI1

The virtual auxiliary digital inputs via the Fieldbus are in the high byte of the word:

bit15	bit [14..8]						
XMDI8/ Watchdog	XMDI7	XMDI6	XMDI5	XMDI4	XMDI3	XMDI2	XMDI1

The logic status of these bits is included in the overall status of the drive digital inputs (measurement **M031**) along with the other command sources if at least one of the parameters **C140** ÷ **C142** is set as 6:FieldBus.

NOTE

Digital input XMDI8, associated to bit 15 in Word 5, may be controlled provided that:
R016 = 0 (inactive watchdog), or
R016 > 0 (active watchdog) and **R018b** = 2.

CAUTION

If **R016** > 0 (active watchdog), controlling bit 15 is connected with parameter **R018b**:

- **R018b** = 0/1: see parameter description
- **R018b** = 2: not used.

Word 6: Command for Digital Outputs from FIELDBUS

Digital commands from FIELDBUS are the 4 lower bytes of the word:

bit [15...4]	bit [3..0]			
	CMD 4	CMD 3	CMD 2	CMD 1

Byte format:

bit	Command	Position in the selection vector
0	Fbus CMD 1	D34
1	Fbus CMD 2	D35
2	Fbus CMD 3	D36
3	Fbus CMD 4	D37

Columns 2 and 3 state the name and position of the commands sent via fieldbus.
Example: to control digital output 1 via fieldbus through command 4, set the parameters below in the [PAR] DIGITAL OUTPUTS MENU.

P270 = 1: Digital	Digital Output Mode
P271 = D37: Fbus CMD4	Variable A Selection
P278 = 1: True	Output Logic Level

Words 7, 8, 9: Analog Outputs controlled by FIELDBUS

Parameter **R017** needs to be properly set up to distinguish which Analog Outputs are to be controlled by the Fieldbus.

Byte format:

Bit	Analog Output controlled by the fieldbus
0	AO1
1	AO2
2	AO3

Example: **R017** = 011_2 = 3_{10} → analog outputs AO1 and AO2 are controlled directly by the fieldbus, independently of their configuration in the [PAR] ANALOG AND FREQUENCY OUTPUTS MENU**.**

The correspondence between the exchanged value and the real value (in volts) of the analog outputs is as follows:

Exchanged value	Voltage (V)	Current (mA)
+ 2833 + 1500 + 167	+ 10 0 – 10	+ 20 mA 0 – 20 mA

Word 10: PID feedback from FIELDBUS

The PID feedback (**M049**) can be sent from the fieldbus if at least one of the parameters **C288** to **C290** is set as 6:Fieldbus.

The value sent by the Master to the IRIS BLUE as the PID feedback must be multiplied by 100.
E.g. In order to send a PID feedback of 50%, the word must contain the value 5000_{10} or 111110100_2 ($50\%_{10}$ x 100 = 5000_{10}).

bit [15..8]	bit [7..0]
PID feedback from FIELDBUS	

Word 11: Type of cycle required
The word states the cycle required:
0x40: Write cycle
0x80: Read cycle

For the "Read cycle", the field including the read address (Word 12) is to be completed beforehand.
For the "Write cycle", the field including the write address (Word 12) as well as the field including the value to be written (Word 13) are to be completed beforehand.

NOTE At the end of each read/write cycle or between any two cycles, enter value "0x00" in Word 11.

Word 12: Modbus address of the variable to read/write
Includes the Modbus address of the variable to be read (read cycle) or written (write cycle).

NOTE In order to save a parameter to non-volatile memory, see **I009 Parameter save**.

Word 13: Value to be written
Only in case of write cycles, it includes the value to be written to the address required.

51.3.2. From the IRIS BLUE to the Master

Word	1) Code	2) Description	3) Range	4) Unit of Measurement	5) Scaling
1	–	Status + Alarms	–	–	–
2	**M026**	Output Current	0 ÷ 65000	A	x 10
3	**M004**	Motor Speed	– 32000 ÷ + 32000	rpm	x 1
4	–	Third measurement that may be configured with **P330**	All the measurements	See selected measurement	See selected measure
5	–	Fourth measurement that may be configured with **P331**	All the measurements	See selected measurement	See selected measurement
6	**DIN**	Digital inputs and auxiliary digital inputs	–	–	–
7	**DOU**	Digital outputs and auxiliary digital outputs	–	–	–
8	**REF**	REF Analog Input (default 0÷10V)	0 ÷ 15366	–	–
9	**AIN1**	AIN1Analog Input (default 4÷20mA)	1529..7652	–	–
10	**AIN2**	AIN2 Analog Input (default 4÷20mA)	1529..7652	–	–

The words below are significant only when using the parameter exchange memory zone to read and write all the IRIS BLUE's parameters by referring to their Modbus address.

Word	1) Code	2) Description	3) Range	4) Unit of Measurement	5) Scaling
11	**Return Value**	Return value of the cycle required	–	–	1
12	**Value**	Read value	–32768 ÷ +32767	–	1

Word 1: Status + Alarms
The **Status** and **Alarms** are displayed over the fieldbus in the following format:

bit [15..8]	bit [7..0]
Status	**Alarms**

The **Status** codes are given in Table 131**,** section LIST OF ALARMS AND WARNING

The **Alarms** codes are given in Table 128, section LIST OF ALARMS AND WARNING**.**

Word 2: Output Current
The output current measurement (**M026**) is displayed as a value that must be divided by 10 to obtain the actual motor current.

bit [15..8]	bit [7..0]
Output current x 10	

Word 3: Motor Speed

The output motor speed (**M004**) is displayed as follows:

bit [15..8]	bit [7..0]
Motor Speed	

Words 4 & 5: Third & Fourth measurement that may be configured with P330 & P331
Words 4 & 5 may be configured with **P330** and **P331** – more details are given in the [PAR] FIELDBUS PARAMETERS MENU).
Both words 4 & 5 are represented as follows:

bit [15..8]	bit [7..0]
Mxxx represented by **P330** and **P331**	

Word 6: Digital inputs and auxiliary digital inputs
Word 6 includes the states of the digital inputs and the auxiliary digital inputs from the terminal board:

bit [15..8]								bit [7..0]							
XMDI8	XMDI7	XMDI6	XMDI5	XMDI4	XMDI3	XMDI2	XMDI1	MDI8	MDI7	MDI6	MDI5	MDI4	MDI3 (RESET)	MDI2	MDI1

Word 7: Digital outputs and auxiliary digital outputs
Word 7 includes the states of the digital outputs and the auxiliary digital outputs:

bit [15..14]	bit [13..8]						bit 7	bit 6	bit [5..4]	bit [3.0]			
	XMDO6	XMDO5	XMDO4	XMDO3	XMDO2	XMDO1		[*]		MDO4	MDO3	MDO2	MDO1/ FOUT

[*]Status of the Pre-charge contactor

Words 8, 9, 10: REF, AIN1, AIN2 Analogue Signal
Full scale values

- 0 ÷ 15366 (0 ÷10V input)
- –15366 ÷ 15366 (± 10V input)
- 1529 ÷ 7652 (4..20mA input)

are nominal values.
± 16380 is a rated value corresponding to an input range of ± 10V 10V (for 4..20mA input, the full-scale value is 1310 - 6652). This value can be changed due to automatic compensation of the tolerance of the input stage.

bit [15..8]	bit [7..0]
REF / AIN1 / AIN2	

NOTE

The measurements of the analog inputs sent from the IRIS BLUE to the Master are the unfiltered measurement values detected in the A/D converter output.
For filtered measurements, use **M037**, **M038** and **M039** respectively.

Word 11: Return value of the cycle required
The word includes the return value of the cycle required (bits):

bit [15..8]	bit 7	bit [6..0]
	1= active	See table below

0	NO ANSWER
1	WAITING
2	ANSWER OK
3	ILLEGAL DATA VALUE
4	ILLEGAL ADDRESS VALUE
5	CONTROL IS ON
6	WRONG ACCESS LEVEL
7	MMI IS PROGRAMMING

Word 12: Read value
The word includes the value read in case of Read cycle.
This value is to be considered as legal when Word 11= 0x82 (active cycle + ANSWER OK).

52. [CFG] EXPANSION BOARD CONFIGURATION MENU

52.1.Overview

NOTE Parameters in this menu are **Rxxx** parameters.
Once saved, they are active only when the drive is next switched on or when the control board is reset (by holding down the **RESET** key for more than 5 secs).

52.2.List of Parameters R021 to R023

Table 111: List of Parameters R021 to R023

Parameter	FUNCTION	User level	MODBUS Address	DEFAULT
R021	Data Logger setting	ENGINEERING	551	Disable
R023	I/O board setting	ENGINEERING	553	None

R021	DataLogger Setting	
Range	1 ÷ 2	1: Disable 2: Enable
Default	1	1: Disable
Level	ENGINEERING	
Address	551	
Function	This parameter enables or disables Data Logger initialization (if the Data Logger board is fitted).	

R023	I/O Board Setting	
Range	0 ÷ 4	0: None 1: 8I + 6O 2: 8I + 6O + XAIN 3: 8I + 6O + PT100 4: 8I + 6O + XAIN + PT100
Default	0	0: None
Level	ENGINEERING	
Address	553	
Function	Based on the settings in the relevant parameter, this parameter enables controlling digital I/O (XMDI/O), analog inputs (XAIN) and PT100 probes located on optional control boards.	

NOTE ES847 is required to control analog inputs (XAIN) and PT100 probes.
Either ES847 or ES870 can be used to control digital I/O (XMDI/O).

53. [CFG] PROFIDRIVE BOARD CONFIGURATION MENU

53.1.Overview

This menu allows programming the PROFIdrive expansion board. It can be viewed only if the PROFIdrive board is connected to the control board.

NOTE Parameters in this menu are **Rxxx** parameters.
Once changed and saved, they become active only when the drive is next switched on or when its control board is reset by holding down the **RESET** key for more than 5 secs.

NOTE For the correct operation of the PROFIdrive board, please refer to the IRIS BLUE's Motor Drives Accessories – User Manual and to the PROFIdrive COMMUNICATIONS BOARD – User Manual.

NOTE If the PROFIdrive option is present, parameter **C149 START Input** must be assigned to value 1: MDI1.

NOTE If the PROFIdrive option is fitted, alarm **A070** is allocated to bit 11 of the Control Word. **A070** trips if parameter **R016** is > 0 and bit 11 is set to 0 for a time longer than the time set in **R016**. See [CFG] FIELDBUS CONFIGURATION MENU.

53.2.List of Parameters R025 to R045

Table 112: List of Parameters R025 to R045

Parameter	FUNCTION	User Level	MODBUS Address	DEFAULT VALUES
R025	Slave Address	ENGINEERING	547	1
R026	PZD3 OUT	ENGINEERING	548	1: DIGITAL INPUTS
R027	PZD4 OUT	ENGINEERING	549	0: NOT USED
R028	PZD5 OUT	ENGINEERING	550	0: NOT USED
R029	PZD6 OUT	ENGINEERING	554	0: NOT USED
R030	PZD7 OUT	ENGINEERING	555	0: NOT USED
R031	PZD8 OUT	ENGINEERING	556	0: NOT USED
R032	PZD9 OUT	ENGINEERING	557	0: NOT USED
R033	PZD10 OUT	ENGINEERING	558	0: NOT USED
R034	PZD3 IN	ENGINEERING	559	0: NOT USED
R035	PZD4 IN	ENGINEERING	581	0: NOT USED
R036	PZD5 IN	ENGINEERING	582	0: NOT USED
R037	PZD6 IN	ENGINEERING	583	0: NOT USED
R038	PZD7 IN	ENGINEERING	584	0: NOT USED
R039	PZD8 IN	ENGINEERING	585	0: NOT USED
R040	PZD9 IN	ENGINEERING	586	0: NOT USED
R041	PZD10 IN	ENGINEERING	587	0: NOT USED
R044	Drive Profile Communication Mode	ENGINEERING	520	0: DP V0
R045	Drive Profile Selection	ENGINEERING	521	1: VENDOR SPECIFIC

R025	Slave Address	
Range	0 ÷ 126	0 ÷ 126
Default	1	1
Level	ENGINEERING	
Address	547	
Function	This parameter sets the address for the PROFIdrive board.	

NOTE The programmed value has effect only if the board address selectors are set to zero (see the IRIS BLUE's Installation (see IRIS BLUE – IRIS BLUE – Installation Guide and the PROFIdrive COMMUNICATIONS BOARD – User Manual).

R026 ÷ R033	PZD3(/10) OUT	
Range	0 ÷ 6	0: NOT USED 1: DIGITAL INPUTS 2: AUXILIARY DIGITAL INPUTS (I/O expansion board) 3: DIGITAL OUTPUT COMMANDS 4: TORQUE REFERENCE 5: PID REFERENCE 6: PID FEEDBACK
Default	1	1: DIGITAL INPUTS
Level	ENGINEERING	
Address	548 ÷ 550 // 554 ÷ 558	
Function	These parameters allow selecting the inputs to be downloaded from the Master PLC to the drive through the eight process data items that can be mapped in the fast communication area between the Master and the Slave station.	

R034 ÷ R041	PZD3(/10) IN	
Range	0 ÷ 91	See [MEA] MEASUREMENTS MENU and Table 57
Default	0	0: NOT USED
Level	ENGINEERING	
Address	559 // 581 ÷ 587	
Function	These parameters allow selecting the measurements to be passed to the drive from the Master PLC through the eight process data items that can be mapped in the fast communication area between the Master and the Slave station. You can select any measurement from the [MEA] MEASUREMENTS MENU.	

R044	Drive Profile Communication Mode	
Range	0 ÷ 1	0: DP V0 1: DP V1
Default	0	0: DP V0
Level	ENGINEERING	
Address	520	
Function	This parameter sets the version of the PROFIdrive protocol.	

R045	Drive Profile Selection	
Range	0 ÷ 2	0: PROFIDRIVE 1: VENDOR SPECIFIC 1 2: VENDOR SPECIFIC 2
Default	1	1: VENDOR SPECIFIC 1
Level	ENGINEERING	
Address	521	
Function	This parameter sets the control mode (Command and Reference) for the Slave station.	

	Command	Reference
PROFIDRIVE	According to the PROFIdrive protocol.	According to the PROFIdrive protocol.
VENDOR SPECIFIC 1	According to the PROFIdrive protocol.	One-to-one scale of the programmed reference.
VENDOR SPECIFIC 2	The eight low bits in the CONTROL WORD represent the eight digital inputs in the control board.	One-to-one scale of the programmed reference.

NOTE Bit 11 in the control board enables or not the Fieldbus line watchdog in any of the three control modes above, provided parameter **R016** is set higher than zero.

NOTE The watchdog activates only after the drive has received the first legal message sent from the master (see Alarm A070 thus preventing alarm **A070** from tripping due to different power-on times between the master station and the IRIS BLUE.

54. [CFG] DAYLIGHT SAVING TIME

54.1. Overview

NOTE The Daylight Saving Time menu may be accessed only if the Data Logger board is installed (even the ES851 RTC version only) and if parameter **R021** Data Logger setting is set to 2: ENABLE.

Parameters **R050** to **R053** set the DST rules for the Clock/Calendar of the Data Logger or the ES851 RTC. See [CFG] DATE AND TIME MENU.

NOTE By setting parameters **R050** and **R052** to 0, the DST is not managed.

54.2. List of Parameters R050 to R053

Table 113: List of Parameters R050 to R053

Parameter	FUNCTION	User Level	DEFAULT VALUES	MODBUS Address
R050	DST Start WDMM	ENGINEERING	5703	524
R051	DST Start HHMM	ENGINEERING	200	525
R052	DST End WDMM	ENGINEERING	5710	526
R053	DST End HHMM	ENGINEERING	200	527

R050	DST Start WDMM – Week/Day/Month	
Range	0 ÷ 9112	0 ÷ 9112
Default	5703	5703
Level	ENGINEERING	
Active	This parameter can be viewed and changed only if the Data Logger ES851 is installed and activated (**R021** = ENABLE).	
Address	524	
Function	**If the first digit of the parameter is lower than 6:** The first digit (W) indicates the week of the month when the DST starts (1 = first week, 2 = second week, 3 = third week, 4 = fourth week, 5 = last week). The second digit (D) indicates the day of the week (1 = Monday, 7 = Sunday). The third and fourth digits (MM) indicate the start month (01 = January, 12 = December). Example: European Union: 5703 (last Sunday in March) USA: 2703 (second Sunday in March) Brazil: 3710 (third Sunday in October) **If the first digit of the parameter is higher than or equal to 6:** The first two digits (WD) correspond to the day of the month when the DST starts, added to 60 (61 corresponds to 1, 91 corresponds to 31). The third and fourth digit (MM) indicate the start month (01 corresponds to January, 12 corresponds to December). Example: 7504 = 15 April.	

R051	DST Start HHMM – Hour/Minutes	
Range	100 ÷ 2400	100 ÷ 2400
Default	200	200
Level	ENGINEERING	
Active	This parameter can be viewed and changed only if the Data Logger ES851 is installed and activated (**R021** = ENABLE).	
Address	525	
Function	The first digit or the first two digits (if the total digits are 3 or 4 respectively) correspond to the start hours. The last two digits correspond to the minutes. Example: 200 = 2h 00m 2400 = 0h 0m (midnight between the day set in **R050** and the previous day.)	

R052	DST End WDMM – Week/Day/Month	
Range	0 ÷ 9112	0 ÷ 9112
Default	5710	5710
Level	ENGINEERING	
Active	This parameter can be viewed and changed only if the Data Logger ES851 is installed and activated (**R021** = ENABLE).	
Address	526	
Function	**If the first digit of the parameter is lower than 6:** The first digit (W) indicates the week of the month when the DST ends (1 = first week, 2 = second week, 3 = third week, 4 = fourth week, 5 = last week). The second digit (D) indicates the day of the week (1 = Monday, 7 = Sunday). The third and fourth digits (MM) indicate the start month (01 = January, 12 = December). Example: European Union: 5710 (last Sunday in October) USA: 1711 (first Sunday in November) Brazil: 3702 (third Sunday in February) **If the first digit of the parameter is higher than or equal to 6:** The first two digits (WD) correspond to the day of the month when the DST starts, added to 60 (61 corresponds to 1, 91 corresponds to 31). The third and fourth digit (MM) indicate the start month (01 corresponds to January, 12 corresponds to December). Example: 6110 = 1 October.	

R053	DST End HHMM – Hour/Minutes	
Range	100 ÷ 2400	100 ÷ 2400
Default	200	200
Level	ENGINEERING	
Active	This parameter can be viewed and changed only if the Data Logger ES851 is installed and activated (**R021** = ENABLE).	
Address	527	
Function	The first digit or the first two digits (if the total digits are 3 or 4 respectively) correspond to the end hours. The last two digits correspond to the minutes. Example: 200 = 2h 00m 2400 = 0h 0m (midnight between the day set in **R052** and the previous day.)	

55. [CFG] DATA LOGGER MENU

55.1. Overview

The Data Logger menu is to be used if the IRIS BLUE drive cannot dialog with the Data Logger ES851 board through the IrisControl software.
Parameter **R116** imposes to ES851 the type of connection required for the communication mode being used.

NOTE The Data Logger menu may be accessed only if the Data Logger board is installed and if parameter **R021** Data Logger setting is set to 2: ENABLE.
Important: The complete version of the Data Logger ES851 shall be installed (the RTC version only is not suitable for this functionality). Please refer to the (see Motor Drives Accessories – User Manual).

NOTE The parameters described in this menu are **Rxxx** parameters.
Once changed and saved, they become active only when the drive is next switched on or when the control board is reset (by holding down the **RESET** key for more than 5 secs).

CAUTION The parameters set from this menu are not saved to non-volatile memory of the Data Logger board.
They must be confirmed and saved using the IrisControl software.

55.2. List of Parameters R115 to R116

Table 114: List of parameters R115 and R116

Parameter	FUNCTION	User Level	MODBUS Address	DEFAULT VALUES
R115	SIM Card PIN	BASIC	563	“0000”
R116	Preset connection status	ENGINEERING	134	0: no active preset

R115	**SIM Card PIN**	
Range	0x0000 ÷ 0xAAAA	“0” ÷ “9999”
Default	0x0000	“0000”
Level	BASIC	
Address	563	
Function	This parameter indicates the digits of the PIN of the SIM card fitted in the GSM/GPRS modem. The digits must be aligned left; the # symbol, which is codified as 0xA (hex) is intended as the number terminator.	

NOTE Max. 4 digits are allowed for the SIM card PIN.
The PIN can be composed of less than 4 digits and the # symbol can be used as the PIN terminator.

R116	**Preset Connection Status (Line 2)**	
Range	0 ÷ 20	See Table 115
Address	1337	
Function	This parameter indicates if preset configurations are actually set up for the types of connections supported by ES851.	

R116	Preset Connections (Line 4)	
Range	0 ÷ 20	See Table 115
Default	0	0: no active preset
Level	ENGINEERING	
Address	134	
Function	This parameter allows forcing one of the available connecting modes to the Data Logger ES851 board. The parameters used for Ethernet connections and modem connections are the ones stored in the IRIS BLUE drive. Configurations 19 and 20 support both dial in and dial out.	

NOTE **After imposing any of the preset values given in** Table 115, the Data Logger is forced to Interlocked mode (see the Data Logger).

Table 115: Preset connections

Value	COM	Baudrate [bps]	Stop bits	Parity	Delay [ms]
0	No active presetting				
1	Ethernet enabled				
2	PPP null modem				
3	1(RS232)	38400	2	no	2
4	1(RS232)	38400	1	no	2
5	1(RS232)	38400	2	no	20
6	1(RS232)	38400	1	no	20
7	1(RS232)	9600	2	no	2
8	1(RS232)	9600	1	no	2
9	1(RS232)	9600	2	no	20
10	1(RS232)	9600	1	no	20
11	2(RS485)	38400	2	no	2
12	2(RS485)	38400	1	no	2
13	2(RS485)	38400	2	no	20
14	2(RS485)	38400	1	no	20
15	2(RS485)	9600	2	no	2
16	2(RS485)	9600	1	no	2
17	2(RS485)	9600	2	no	20
18	2(RS485)	9600	1	no	20
19	Dial Out analog modem				
20	Dial Out GSM modem				

56. [CFG] EEPROM MENU

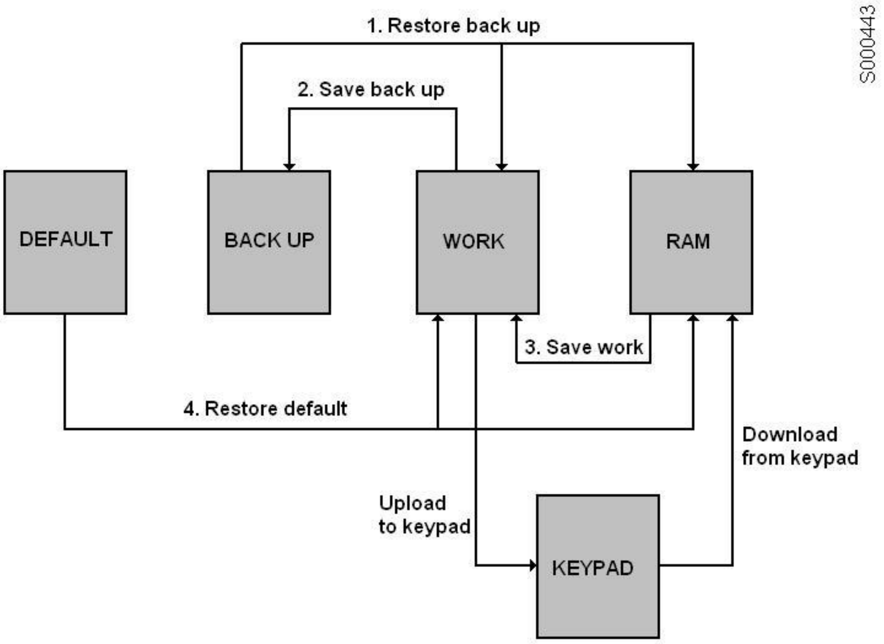
56.1. Overview

The drive has four different memory zones:

- **RAM** → Volatile memory containing the drive's current parameterization;
- **DEFAULT Zone** → Non-volatile memory that cannot be accessed by the user, containing the factory-setting of the drive parameters.
- **WORK Zone** → Non-volatile memory where customized parameters are saved. Whenever the drive is reset, this parameterization is loaded to the RAM.
- **BACKUP Zone** → Non-volatile memory storing a new drive parameterization. Back-up parameters are modified only when the user explicitly saves the BACKUP zone.

Any parameter can be changed by the user. The drive will immediately use the new parameter value.
The user may save the parameter value in the Work zone. If no new value is saved for a given parameter, the drive will use the parameter value stored in the Work zone when next turned on.

- **"P"** parameters can be written at any moment.
- According to factory-setting, "**C"** parameters may be written when the equipment is on stand-by or when the motor is not running and the equipment is fluxing. See **P003** to modify them only when the **ENABLE-A** and **ENABLE-B** commands are deactivated (terminal **MDI2** open).
- "**R"** parameters have the same features as "C" parameters, but the new parameter value, once written and saved, will be used only at next power on. To use the new parameter value immediately, turn the drive off and on or press the **RESET** key for at least 5 seconds.
- The WORK zone may be copied to the BACKUP zone through **I012** included in the Eeprom menu and described in the section below.
- **I012** input also allows copying the Backup zone to the WORK zone in order to restore the parameter values stored in the WORK zone.
- **I012** input also allows restoring the factory-setting values for all parameters in the WORK zone.



56.2.List of Inputs I009 to I012

Table 116: List of programmable inputs I009 to I013

Input	FUNCTION	User Level	MODBUS Address
I009	Parameter save	BASIC	1396
I012	EEPROM control	BASIC	1399
I013	Alarm control	BASIC	1400

I009	Parameter Save	
Range	131 ÷ 2466	131 ÷ 2466
Default	This is not a parameter: at power on and whenever the EEPROM command is executed, **I009** is set to zero.	
Level	BASIC	
Address	1396	
Function	Allows only one parameter to be saved to EEPROM. The value to be saved must be the same as the value set in the Address field of the parameter concerned.	

I012	EEPROM Control	
Range	0, 2, 4, 5, 11	0: No Command 2: Restore Backup 4: Save Backup 5: Save Work 11: Restore Default
Default	This is not a parameter: at power on and whenever the EEPROM command is executed, **I012** is set to zero.	
Level	BASIC	
Address	1399	
Function	This parameter saves and restores the entire set of parameters that can be accessed by the user: **2: Restore Backup**: the parameters stored in the BACKUP zone are copied and stored in the WORK zone. They represent the new RAM parameterization; the previous RAM parameters are cleared. **BACKUP → RAM → Work;** **4: Save Backup**: the parameters in the WORK zone are saved to a copy of the Backup zone. **WORK → BACKUP;** **5: Save Work**: the current values of the parameters stored in the RAM zone are saved to non-volatile memory in the Work zone. All the parameters are saved with this command. **RAM → WORK**; **11: Restore Default**: factory-setting values are restored for all parameters; each factory-setting value is stored to non-volatile memory in the Work zone. **DEFAULT → RAM → WORK**.	

I013	Alarm Control	
Range	1, 777	1: Trips alarm **A040** 777: Resets the alarms tripped
Default	This is not a programming parameter: the input is set to zero whenever the drive is powered on and whenever the command is executed.	
Level	BASIC	
Address	1400	
Function	**1**: **Trips alarm A040 (User alarm)**. It may be helpful to test the system. **777**: **Resets the alarms tripped**. Resets any alarm tripped (not only **A040**).	

57. MULTIMOTOR CONTROL (MMC)

The Multimotor Control feature integrated into the IRIS BLUE drive controls up to 5 parallel-connected motors.

The Multimotor Control feature allows doing the following:

- Adjusting delivery, fluid level, pressure, etc., thus controlling the slave motors based on the demand of the internal PID regulator;
- controlling all slave motors operating at fixed speed (which are connected to the mains through a contactor or a soft starter) or operating at variable speed (connected to a drive);
- balancing the working time of the connected motors;
- cyclically changing over operating motors and inactive motors which are ready to start;
- operating in Multimaster mode which allows two master IRIS BLUE drives to operate and providing dual redundancy should one of the master drives be isolated from the system;
- housing a spare motor. The spare motor starts running only when one of the operating motors fails.

No additional external device is required.

NOTE Slave motors at fixed speed

<u>The power ratio of the connected motors must meet one of the following requirements</u>:

- Requirement 1: All motors must have the same power ratings.
- Requirement 2: The connected motors can have different power ratings, provided that:
  a) each motor with the greatest power rating is matched with lower-rated motors that, if combined, have power ratings equal to/higher than the former motor;
  b) the power rating of the motor connected to the Master drive is larger than/equal to the power rating of the lower-rated slave motor.

NOTE Slave motors at variable speed

<u>All the connected motors must have the same power ratings.</u>

57.1. Master Drive

A PI(D) regulator integrated into the Master IRIS BLUE drive configures the operating motors and their working speed.

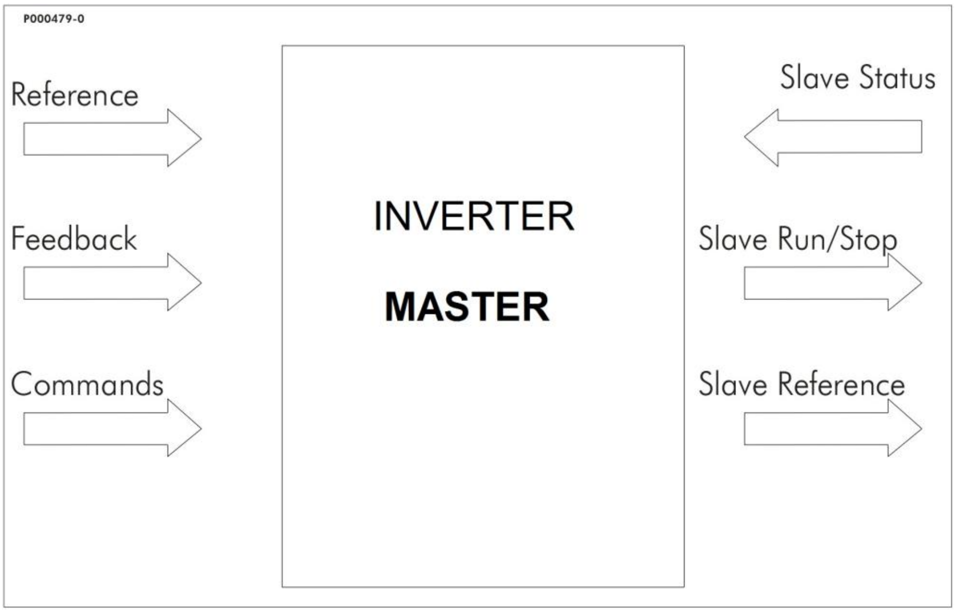


Figure 67: Block diagram – Master drive

As shown in Figure 67, the signals that must be sent to the Master drive are as follows:

- The reference of the quantity to be controlled
- The feedback of the quantity to be controlled
- The system commands (activation, run, stop…)
- The status of the available slave motors:
  - if the slave motors are controlled at variable-speed, the "Inverter OK" signal
  - if the motors are connected "Direct On Line", the Normally Connected contact signal of the motor thermal protection or PTC
  - if the motors are controlled at fixed speed with a Soft Starter, the "Soft Starter OK" signal.

The Master drive will provide:

- the reference, if the motors are controlled by the drive at variable-speed
- the start/stop command to the slave motors

The commands, the operating signals and the enable signals (digital and analog inputs/outputs) required by the Master of the plant are given in the input/output sections relating to the default settings of the IRIS BLUE drive, if not stated otherwise.

The operating diagram of the Multimotor Control feature is shown in the figure below. The parameters relating to the Master mode are also given.

NOTE If **C179** is set up, the PID reference sources can be selected through the programmed digital input.

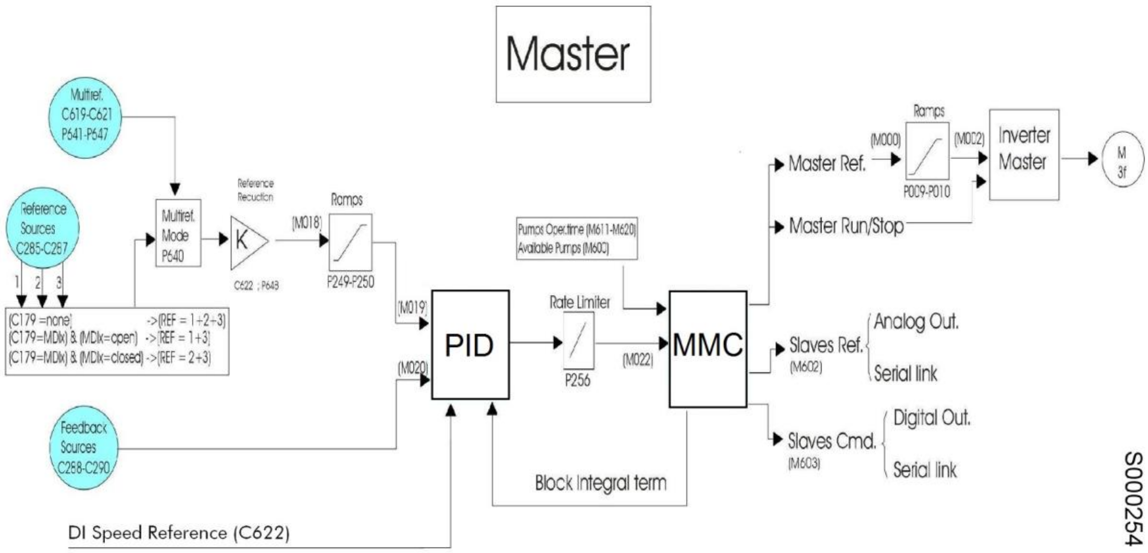


Figure 68: Block diagram of the IRIS BLUE operating in Master mode

57.2. System Operating Mode

The Multimotor Control feature allows controlling the motors in two different modes:

- Fixed Speed
- Variable Speed

57.2.1. Fixed-Speed Mode

When **C605** = M2-M5 Fixed Speed, the master motor is always working to ensure the fine tuning of the plant, whereas the slave motors are started/stopped depending on the following criteria:

- **Percentage of the output frequency required for the master motor (allowing optimum performance of the plant).**
  When setting a minimum allowable output frequency for the variable-speed motor (**P600** > 0%), the Master drive will configure the operating motors based on the working conditions required for the variable-speed motor.

- **Maximum allowable adjusting error.**
  If an adjusting error occurs, which is exceeding the maximum allowable error (**P605**) for a given time (**P606**), a configuration changeover for the "ON" motors and the "OFF" motors can be implemented.

- **Maximum difference among the working time of each available motor.**
  If the function of the maximum difference among the working time of each available motor is activated (**P621** > 0) and the difference in working time is greater than the preset value between a working motor and an available inactive motor, the working times are automatically exchanged.

If the function above is disabled (**P621** = 0), when changing from On to Off motors, the best combination is chosen, so as to obtain an even working period of the connected motors.

If the master motor is not available for whatever reason (maintenance, etc.), the plant can be kept operating by setting a step control through the fixed-speed motors only (**C606** = 0: No). In that case, the maximum allowable adjusting error depends on parameters **P610** and **P611**.

Controlling slave motors at fixed speed may be obtained in two modes:

- Direct On Line (DOL): consists in connecting the motor directly to the mains power supply by simply placing a disconnecting switch. See Figure 69.
- Controlled start through a Soft Starter. See Figure 70.

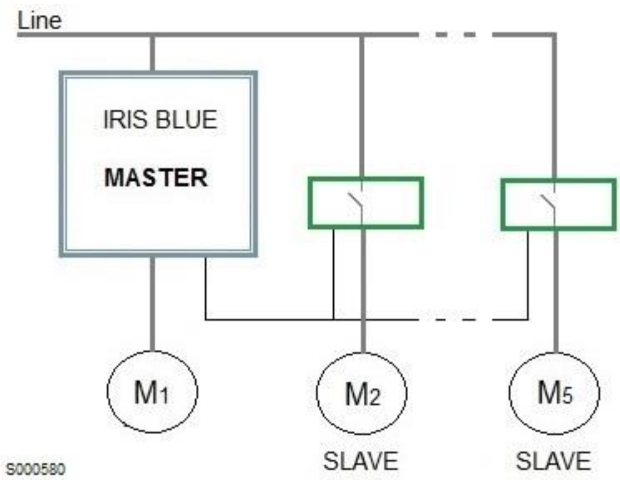


Figure 69: Block diagram of MMC operating mode – Direct On Line

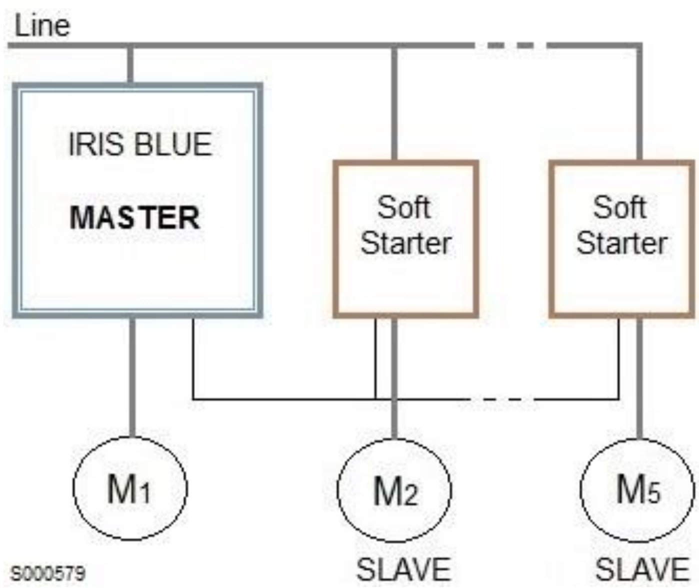


Figure 70: Block diagram of MMC operating mode – Direct On Line – Controlled start through a Soft Starter

NOTE

If **C606** = [0: No], the system is NOT disabled when the master motor or the master drive is out of order. The only conditions that stop the system are the following:

1) When a digital input of the master drive configured as an external alarm is detected as open.
2) When an analogue input is set as 4-20mA and the IRIS BLUE drive detects a signal either lower than 4mA (failure in the sensor or the sensor wiring) or higher than 20mA.
3) When a WATCHDOG for fieldbus or serial link trips (if configured with **R016** and **R005** respectively).

Configuration of a Fixed-Speed System

The power ratio of the connected motors must meet one of the following requirements:

- Requirement 1: All motors must have the same power ratings.
- Requirement 2: The connected motors can have different power ratings, provided that:

  a) each motor with the greatest power rating is matched with lower-rated motors that, if combined, have power ratings equal to/higher than the former motor;
  b) the power rating of the motor connected to the Master drive must be higher than/equal to the power rating of the lower-rated slave motor.

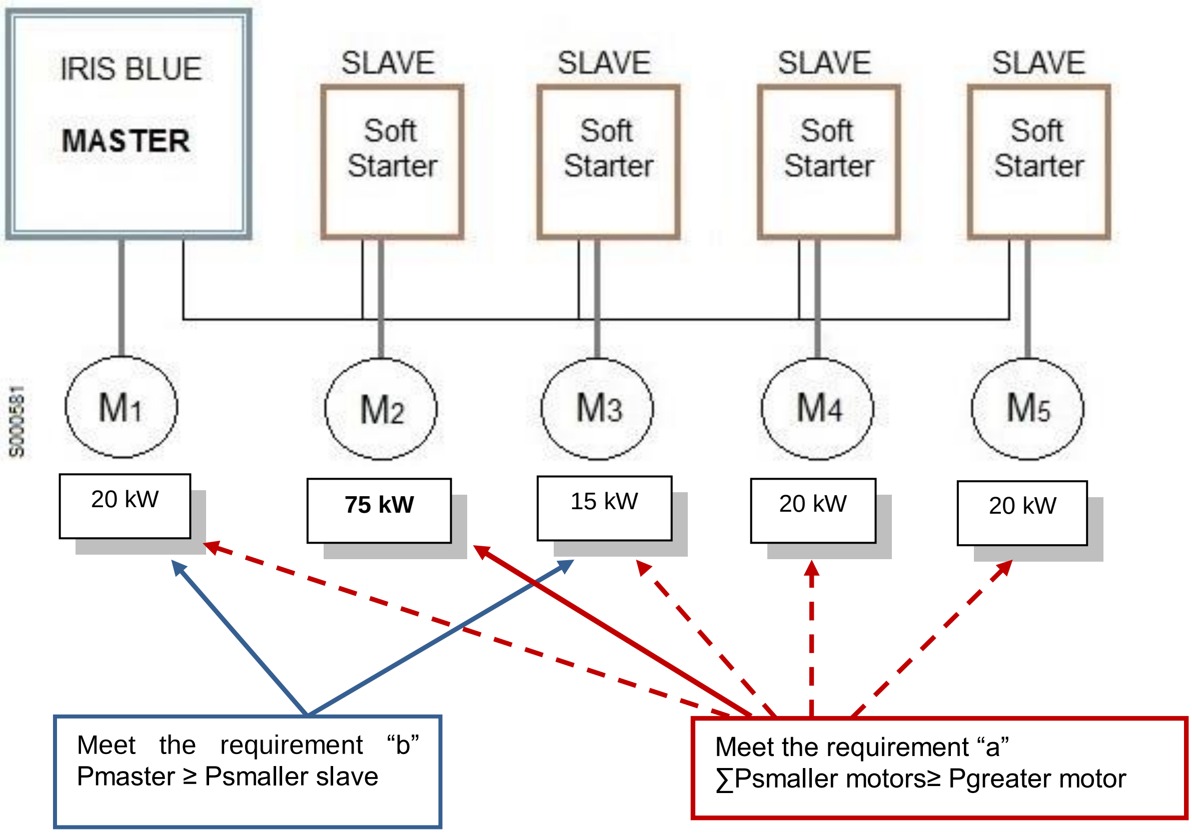


Figure 71: Example of configuration with different motor power ratings

57.2.2. Variable-speed Mode

When **C605** = M2-M5 Variab. Speed, the slave motors and the master motor are started/stopped based on the following criteria:

1) **Percentage of the output frequency required for the master motor (allowing optimum performance of the plant).**
By setting a given frequency range for the variable-speed motors ([**P600** ÷ **P601**]; [fmin% ÷ fmax%]), this condition is searched when the system is operating. For example, if **P600** = 60% and 4 motors are working at 50% of their frequency for a time longer than the time set in **P602**, the master IRIS BLUE drive will stop one of the four motors and will force the remaining motors to work at higher frequency, so that the operating frequency of the working motors is included in the preset frequency range [**P600** ÷ **P601**].

2) **Maximum allowable adjusting error.**
If an adjusting error occurs, which is exceeding the maximum allowable error (**P605**) for a given time (**P606**), a configuration changeover for the "ON" motors and the "OFF" motors can be implemented.

3) **Maximum difference among the working time of each available motor.**
If the function of the maximum difference among the working time of each available motor is activated (**P621** > 0) and the difference in working time is greater than the preset value between a working motor and an available inactive motor, the working time are automatically exchanged.

If the function above is disabled (**P621** = 0), when changing from On to Off motors, the best combination is chosen, so as to obtain an even working period of the connected motors.

If the master motor is not available for whatever reason (maintenance, etc.), the plant can be kept operating by setting **C606** = 0: No.

NOTE

If **C606** = [0: No], the system is NOT disabled when the master motor or the master drive is out of order. The only conditions that stop the system are the following:

1) When a digital input of the master drive configured as an external alarm is detected as open.
2) When an analogue input is set as 4-20mA and the IRIS BLUE drive detects a signal either lower than 4mA (failure in the sensor or the sensor wiring) or higher than 20mA.
3) When a WATCHDOG for fieldbus or serial link trips (if configured with **R016** and **R005** respectively).

Controlling slave motors at variable speed may be obtained in two modes:

- System completely operated by IRIS BLUE inverters.
- System operated with different inverters (slaves), for example: Sinus H, Sinus M, etc.

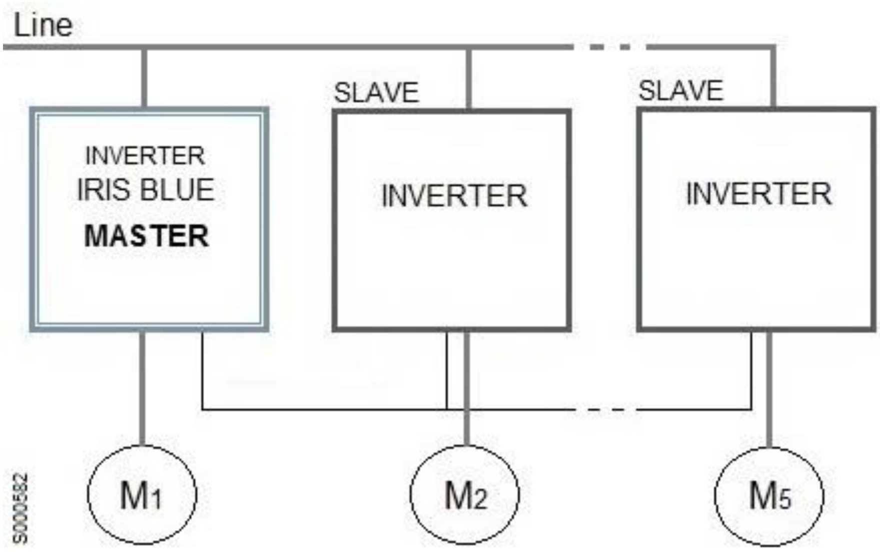


Figure 72: Block diagram of MMC operating mode – variable-speed motors

Configuration with a Backup Master

In order to ensure greater continuity of service in case of failure, thus preventing the Master drive from operating, it is possible to define a Backup Master (IRIS BLUE inverter) which will control the system.

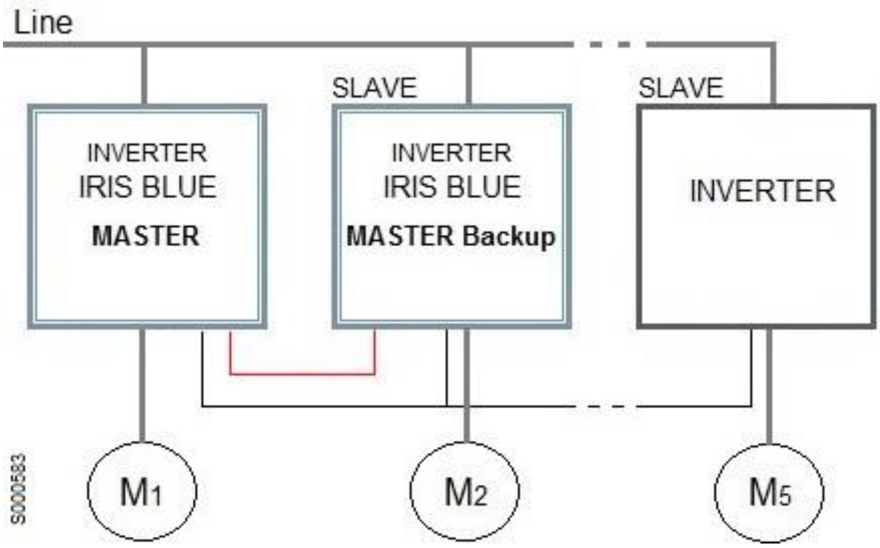


Figure 73: Block diagram - variable-speed operating mode with a Backup Master

To configure the Backup Master mode, the following parameters are to be programmed on both IRIS BLUE Master drives:

- **C615** (digital input motor 2 available) **= 9: Serial Link** (serial-type connection required)
- **C650** (type of motor drive 2) **= 5: IRIS BLUE Master**
- One among **P630, P632, P634, P636** (MMC digital output selection) must be programmed as **D613: Master MMC**
- **C623** (Digital input of Slave Mode) programmed as a digital input

The digital outputs from both drives must be programmed as Master MMC and must be connected to the digital inputs set in **C623** from the other inverter. In this way, the two master drives will be able to coordinate with each other in an autonomous way.

Configuration of a Variable-Speed System

<u>All the connected motors must have the same power ratings</u>.

57.3. Wiring Diagrams

57.3.1. POWER WIRING DIAGRAM WHEN USING SLAVE FIXED-SPEED MOTORS

NOTE When slave fixed-speed motors are used, set parameter **C605 = 1: M2-M5 Fixed Speed**.

The power wiring of the Master drive controlling a Multimotor installation is shown in the diagram below.

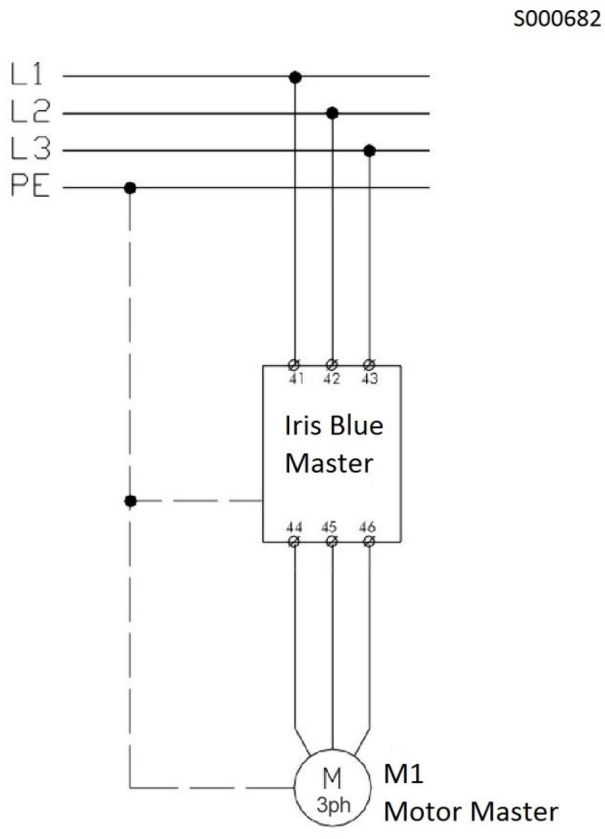


Figure 74: Wiring diagram for the Master drive

The slave motors may also be manually controlled via the Auto/Man selector switch (the drive is then by-passed).

The IRIS BLUE drive also allows overriding the automatic control of the slave motors and forcing their startup (or stop) without using the Auto/Man. selector switches (see [CFG] By-Pass Master).
Auxiliary relays are required to control slave motors M4 and M5.

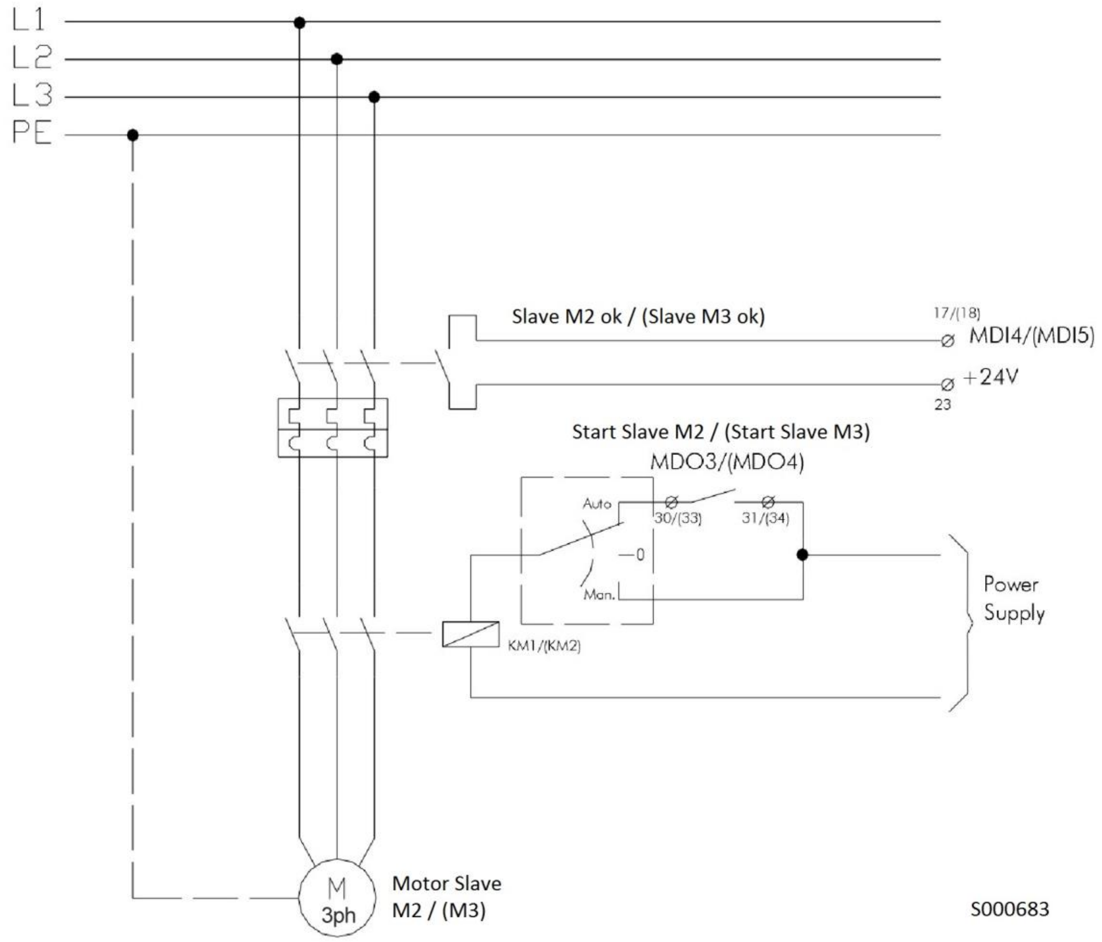


Figure 75: Power wiring for slave motors M2 and M3

The enable signals of Slave M2 OK and Slave M3 OK must be sent to inputs MDI4 and MDI5 respectively of the Master drive. The Start Slave M2 and Start Slave M3 commands are sent from relay digital outputs MDO3 and MDO4.

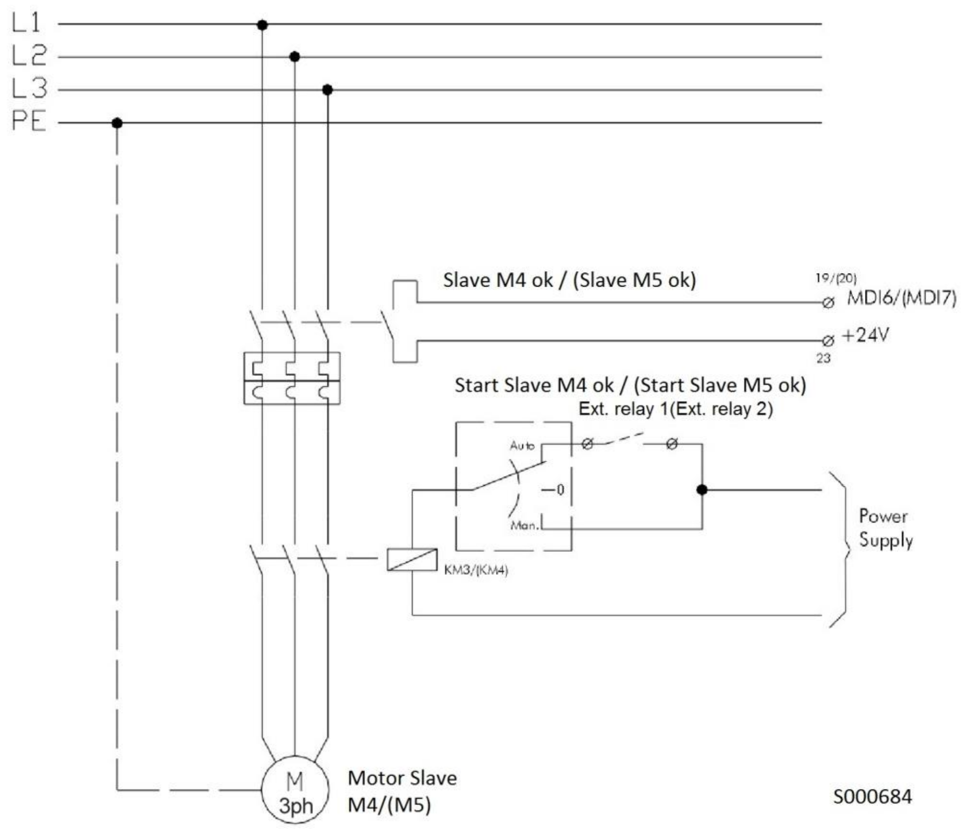


Figure 76: Power wiring for slave motors M4 and M5 with direct starting

The enable signals of Slave M4 OK and Slave M5 OK must be sent to inputs MDI6 and MDI7 respectively of the Master drive.

Digital outputs MDO1 and MDO2 allow controlling two auxiliary relays (Imax = 50mA) sending the Start Slave 4 and Start Slave 5 commands.

The auxiliary relays controlled via MDO1 and MDO2 can be powered through 24V power supply of the control board or through an external power source (Vmax. =48V). When using digital outputs MDO1 and MDO2 to control an inductive load (coil of the auxiliary relay), a freewheeling diode is always recommended.

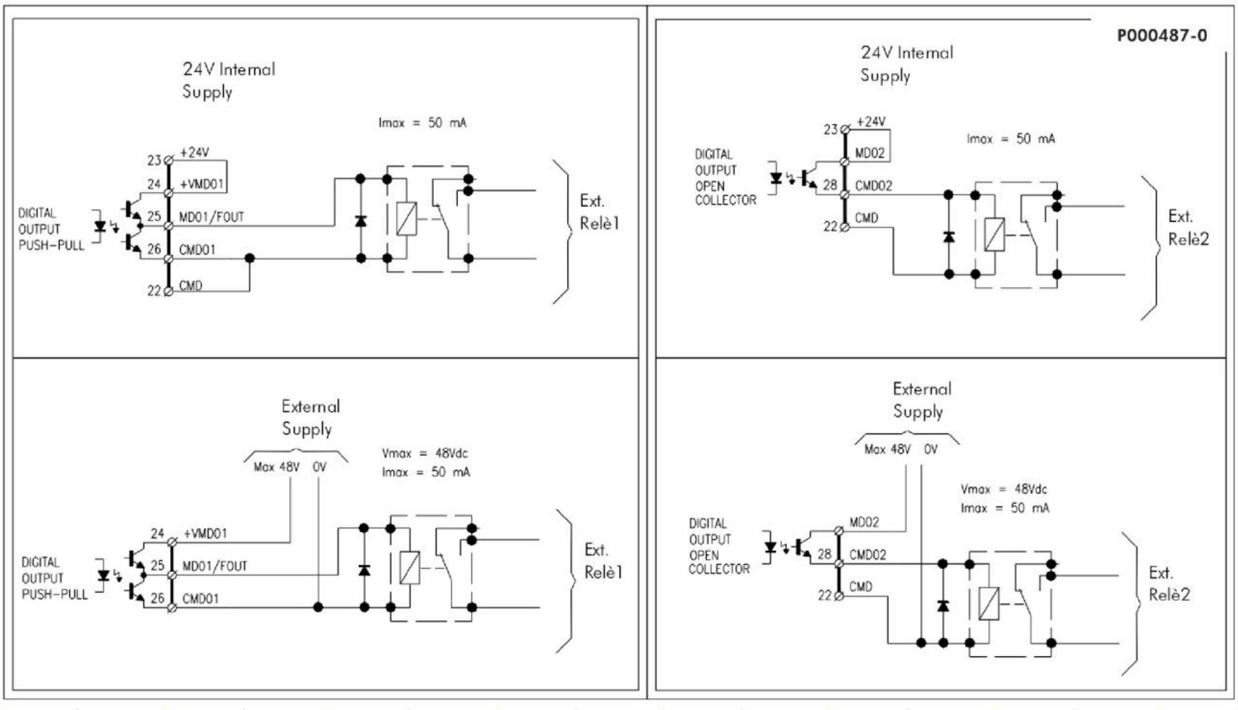


Figure 77: Wiring diagram for digital outputs MDO1 and MDO2 used to control the two auxiliary relays (Start Slave M4 and Start Slave M5 commands)

57.3.2. Signal Wiring Diagram when using Slave Fixed-Speed Motors

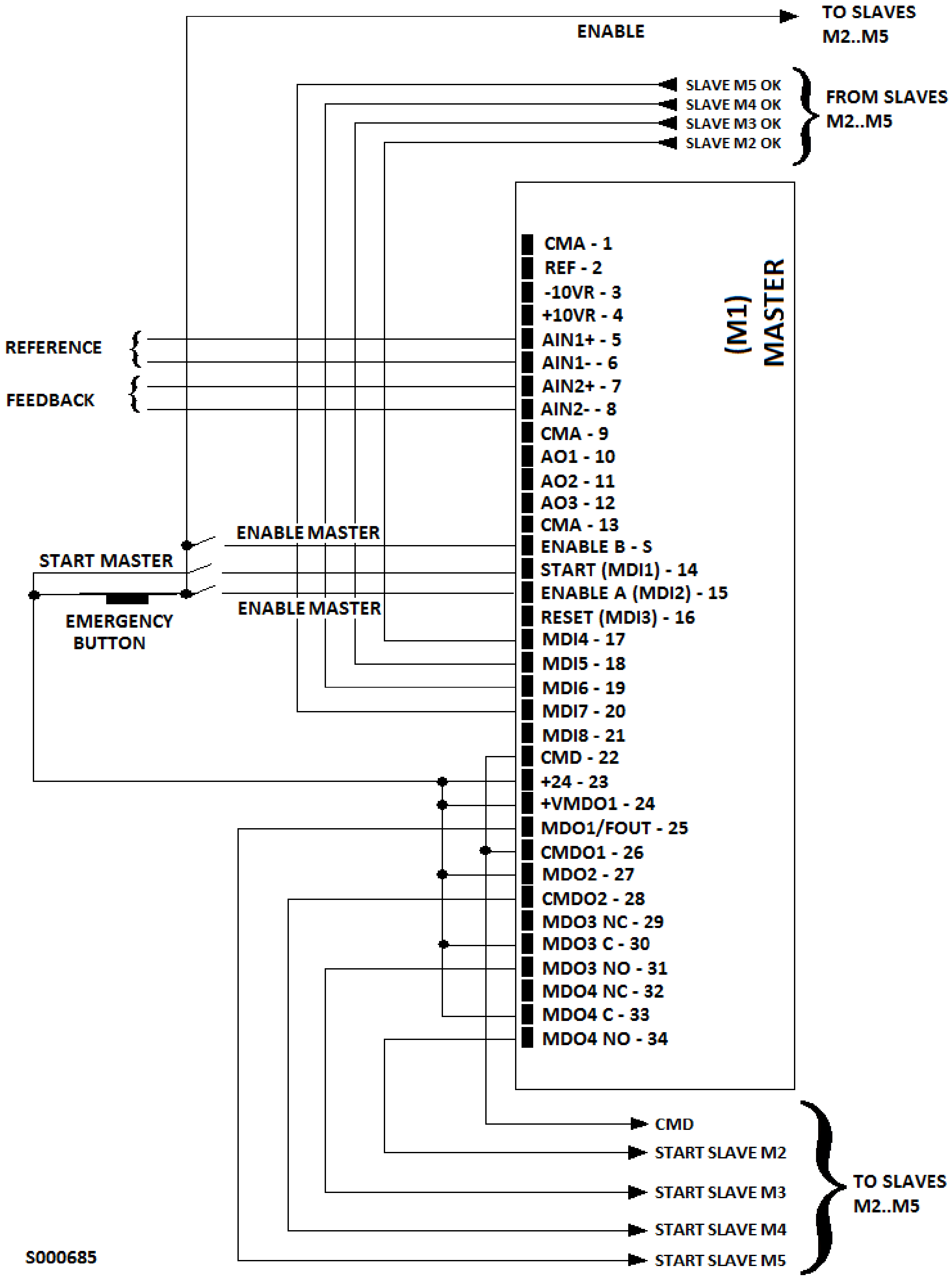


Figure 78: Wiring diagram of the signals sent to the Master drive when slave fixed-speed motors are used and when digital outputs MDO1 and MDO2 are powered through internal 24V power supply

NOTE The Start Slave M4 and Start Slave M5 commands cannot be used to directly energize a contactor (Vmax. = 48V, Imax. = 50mA); an auxiliary relay must then be used (see section above).

57.3.3. Power Wiring Diagram when using Slave Variable-Speed Motors

NOTE When variable fixed-speed motors are used, set parameter **C605 = 0: M2-M5 Variab. Speed.**

The power wiring of the Master drive controlling a Multimotor installation is shown in the diagram below.

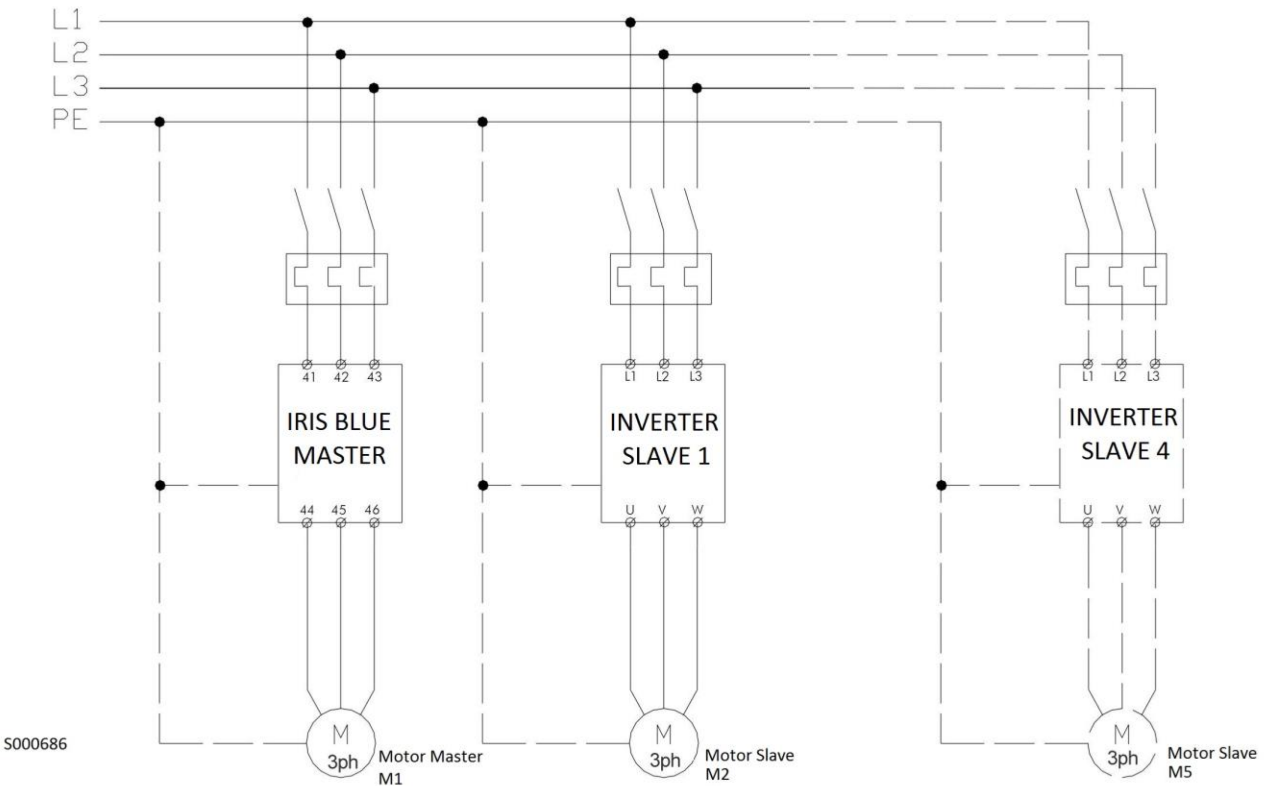


Figure 79: Power wiring of the drives controlling a Multimotor installation

57.3.4. Signal Wiring Diagram when using Slave Variable-Speed Motors

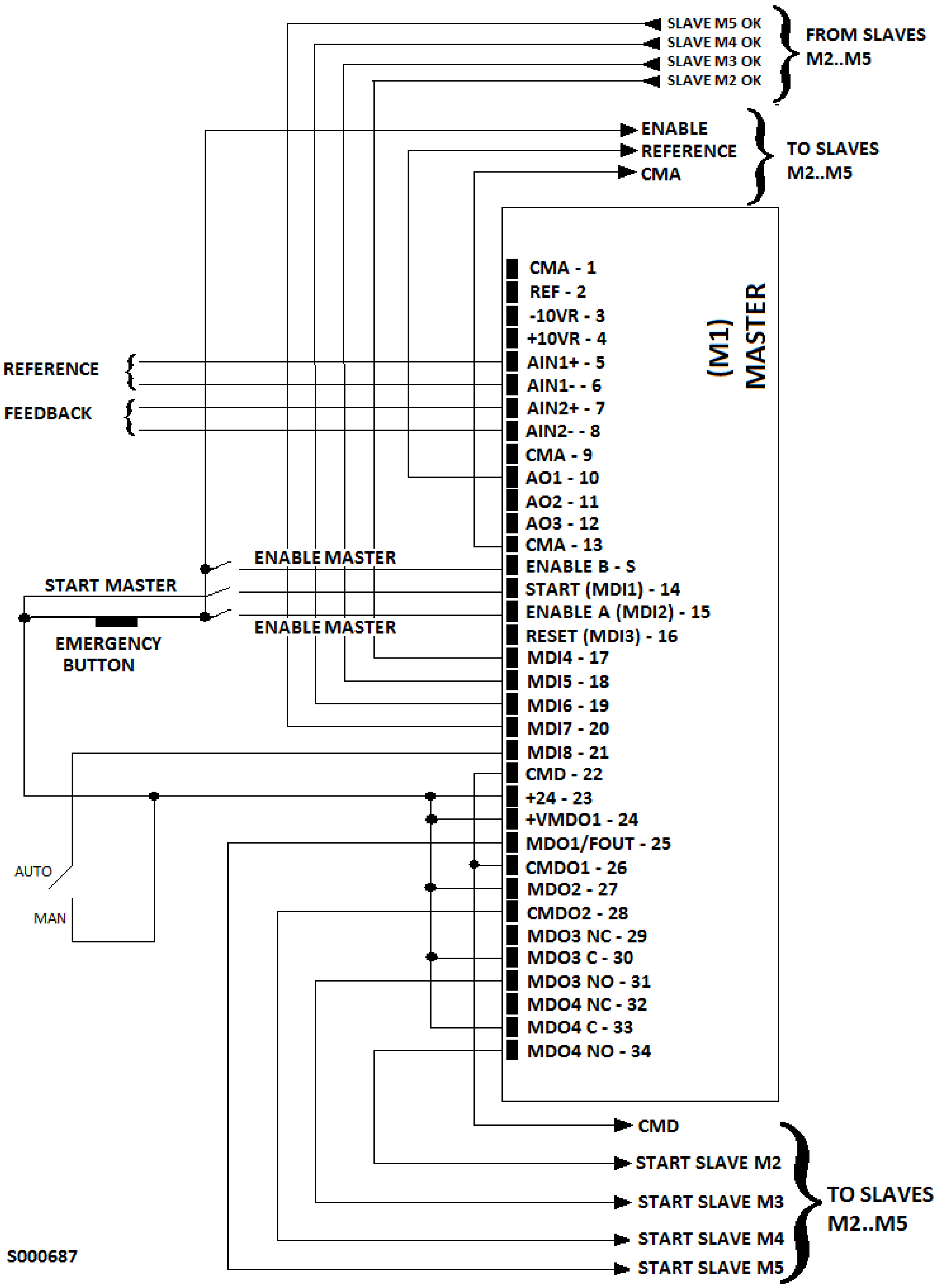


Figure 80: Signal wiring for the Master drive handling slave motors operating at variable speed

As shown in the diagrams above, the motors can be manually operated as follows:

- The Master motor can be manually operated by closing input MDI8 (or any other available digital input) after programming **C622** = MDI8;

- The slave motors can be manually operated by by-passing the master drive via the Auto/Man selector switch and by setting a speed reference from the digital input set as Multireference (**C155** = MDI4, as by default).

The IRIS BLUE drive also allows overriding the automatic control of the slave motors and allows forcing their startup (or stop) without using the Auto/Man. selector switches. See [CFG] By-Pass Master.

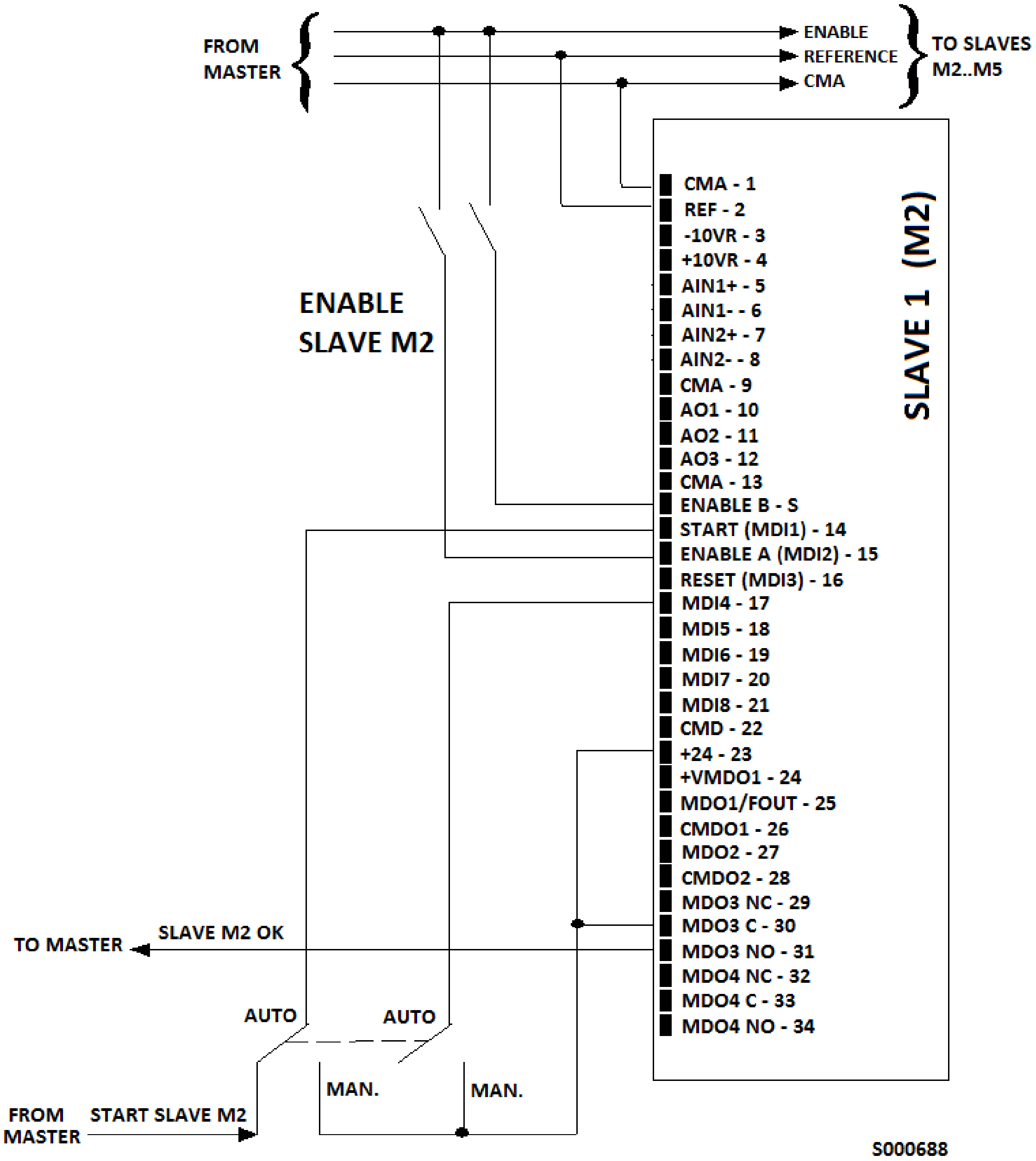


Figure 81: Signal wiring for the slave drive with Auto./Man. selector switch allowing selecting the type of automatic or manual control and forcing a speed reference through MDI4 set as Multireference

57.3.5. Wiring Diagram when using the Master Serial Port

NOTE To activate the control via serial port, set digital inputs for Motor OK **C615÷C618** to **9=[Serial Link].**

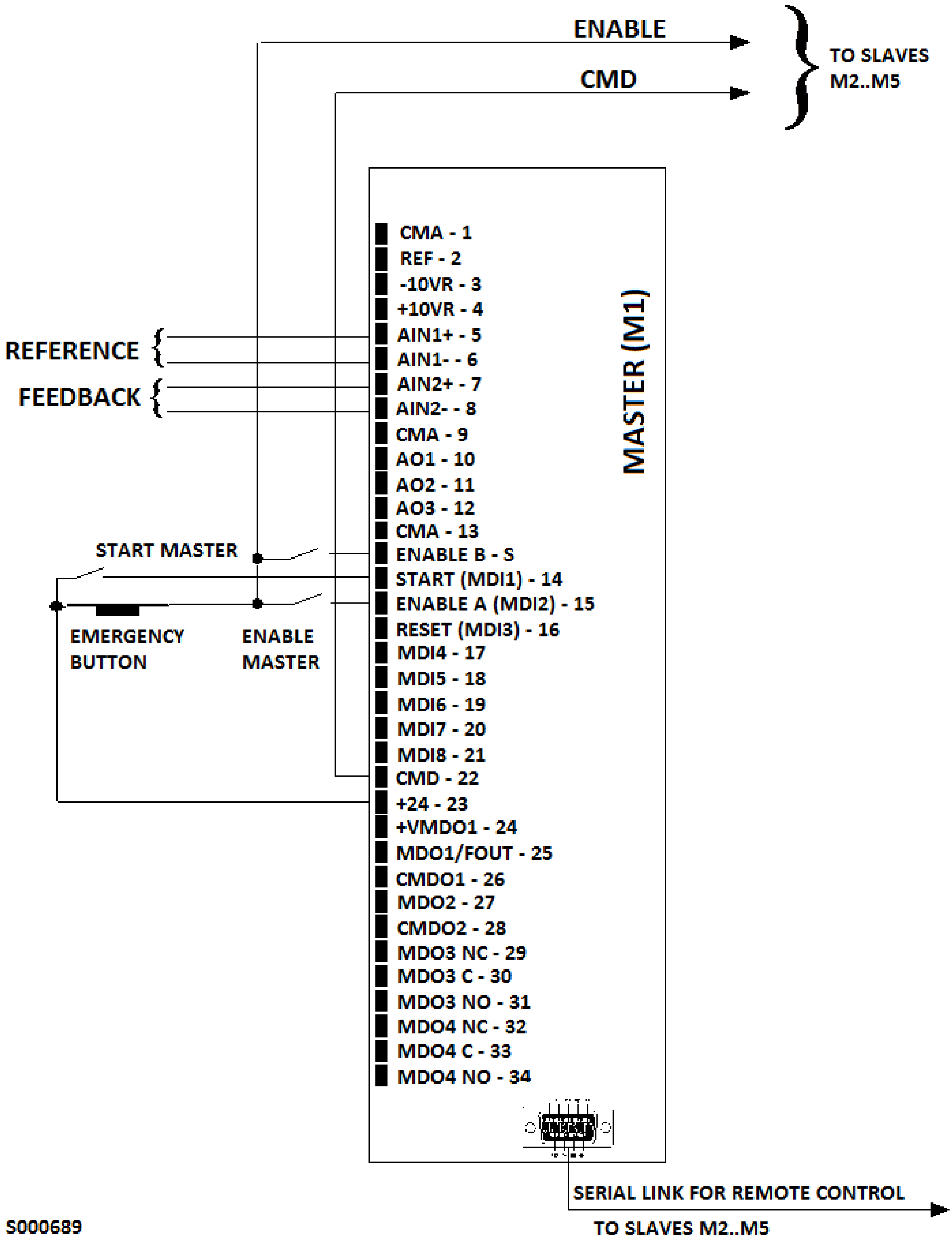


Figure 82: Wiring diagram of the Master drive when the slave motors are controlled via serial link

57.3.6. MULTIMASTER WIRING DIAGRAM (N.2 IRIS BLUE DRIVES)

NOTE

To configure the Multimaster mode, the following parameters are to be programmed on the two IRIS BLUE drives being used as master:

- **C615 = 9: Serial Link** (Digital input for motor 2 available – the connection between the two IRIS BLUE drives must be a serial link)
- **C650 = 6: IRIS BLUE – Master di Backup** (Type of drive motor 2)
- One digital output is to be programmed as **D613: Master MMC** (MDO1 in the diagram to be programmed via **P630**)
- **C623** (Slave Mode digital input) programmed as a digital input (MDI4 in the diagram).

The outputs programmed as Master for both the IRIS BLUE drives are to be connected to digital inputs set to **C623** of the other drive, as shown in the diagram below.

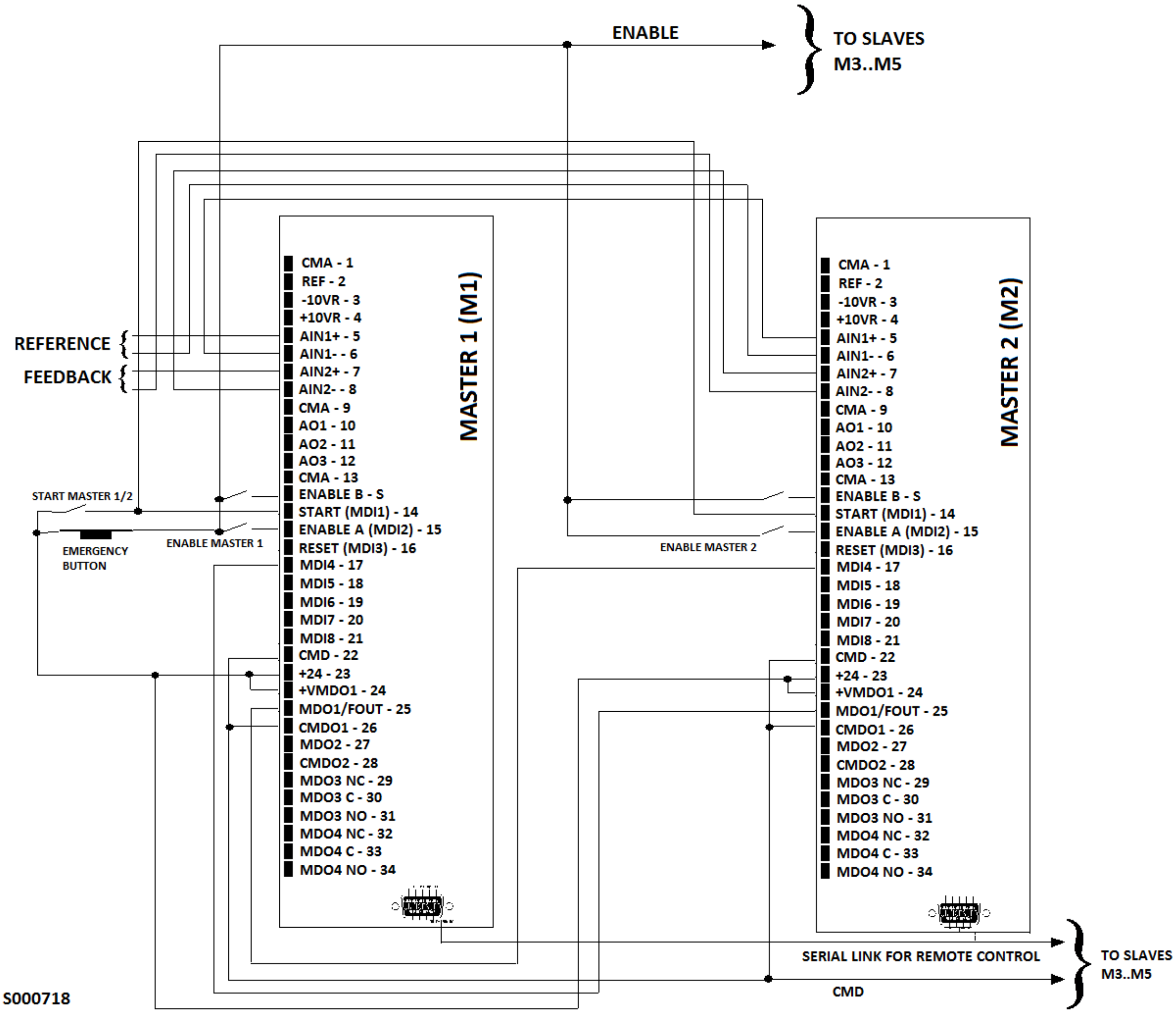


Figure 83: Wiring diagram in Multimaster configuration

When the motor drives are connected via serial link, up to 5 motors can be controlled (1 master + 1 backup master + 3 slaves).

NOTE

Vice versa, if the drives of the slave motors are controlled through the digital inputs, only 2 additional motors can be controlled, because one digital output of the two IRIS BLUE drives is used for allocating the speed reference of the slaves to the analogue output of the drive which is operating as the Master drive (digital output programmed as Master MMC drive). See Figure 84, where **P636** = **D613 Master MMC** and **MDO4** for each inverter is used for reference deviation to the other slaves.

NOTE

Reference and feedback can be configured on either REF, AIN1, AIN2. Wiring above in Figure 83 shows typical wiring with the reference via AIN1 and feedback via AIN2.

This wiring diagram relates to AIN1 and AIN2 factory-set as 4-20mA. As far as the connection of voltage signals is concerned, the relevant DIP-switches and parameters are to be set accordingly.

CAUTION

The Multimaster configuration allows the runtime commutation of the plant supervisor from MMC1 to MMC2 (see parameter **C606**).
To avoid uneven adjustment of the plant, the same settings are required for both master drives, except for the [CFG] Master Serial Link Menu.

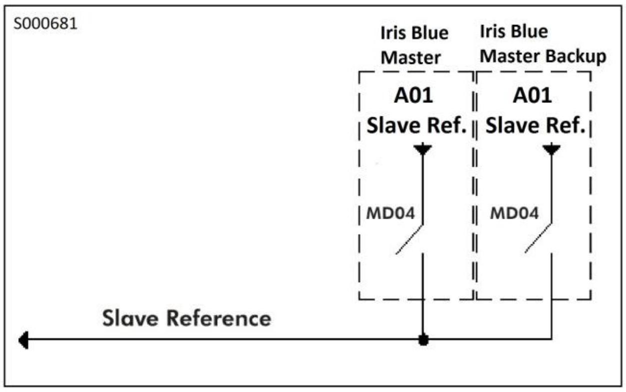


Figure 84: Connection of the reference from Multimaster to Slave controlled via digital outputs and analog reference

57.3.7. SLAVE MODBUS/RS485 WIRING CONNECTION

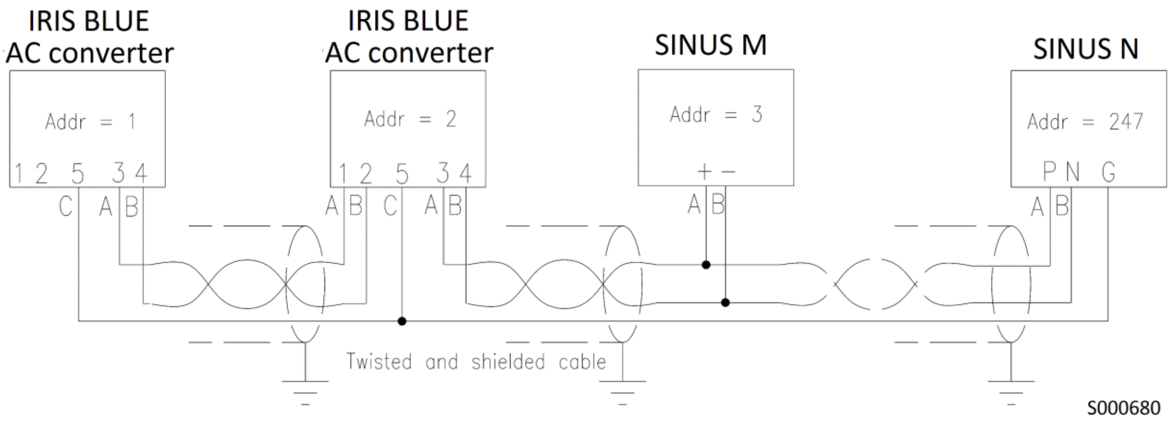


Figure 85: **Typical Modbus wiring connections for Multimaster IRIS BLUE and Sinus M and N slave devices**

57.4.First Start Up

1) Motor parameters

NOTE

The term “drive” used throughout this section refers to the following:
- A motor drive, in case of variable speed motors
- A soft starter or a direct starter in case of fixed speed motors

Set the following:
- **C600** N. of Motors in the Plant (1÷5)
- **C601÷C604** Motor Power Ratings (2÷5)
- **C605** Plant Operating Mode [0: P2-P5 at fixed speed; 1: P2-P5 at variable speed].
- **C615÷C618** Digital Input for Motor OK. Setting [9: Serial Link] means that the slave motor is connected via serial link, and parameters **C650÷C695** in the [CFG] Master Serial Link Menu are enabled.

In serial link configuration, also set:
- **C650**/**C662**/**C674**/**C686** Motor 2/3/4/5 Type of Drive

In Multimaster configuration, also set (on both master drives):
- **C650** Motor 2 Type of Drive → [5: Iris Blue – Backup Master]
- a digital output as **D613: Master MMC**, by way of one among parameters **P630**, **P632**, **P634**, **P636**
- **C623** (Slave Mode digital input) as a digital input (MDI1÷MDI8)
- Then, make sure that the outputs programmed as Master of both the Master drives are connected respectively to the digital inputs set in **C623** of the other drive.
- Remember that the two master drives must be connected via serial link.
- **C662/C674/C686** Motor 3/4/5 Type of Drive → Please refer to the options described in the [CFG] Master Serial Link Menu
- **C606** Plant Disabled with Master Drive KO → [2: No – MMC Backup Master]
- **P630** MDO1: Signal Selection → [13: Master MMC]
- **C623** Slave Mode Digital Input

On the secondary master, par. **C651** must be set up as follows:
- **C651** Motor 2 Device Address = Serial address for motor 1 (e.g. 1).

2) Slave Motor Commands

The drives of the slave motors may be connected to the master via serial link (the start/stop commands are sent via serial link); otherwise, the following may be used:
- The digital outputs of the master to control start up,
- The analog output for the reference and
- The digital inputs to detect motor availability.

This manual includes the wiring diagrams for the connection of the slave drives to the master in case of serial link or in case the control signals are obtained via inputs/outputs of the master drive.

Motor availability and start commands are visible in the [MEA] Multimotor Control Measurements Menu, measurements **M600** and **M601**. In case the slaves are controlled via serial link, the communications status is also available in **M604**.

Slave Drives controlled by way of digital inputs/outputs.

Check that wiring matches the digital inputs/outputs and the analog outputs programming (see [CFG] MMC Digital Inputs Menu and [PAR] MMC Digital Outputs Menu.

Drive slave controlled via serial link.

Access the [CFG] Master Serial Link Menu; if the slave drives are from Elettronica Santerno, select the type of drive: the values required for communications will automatically be preset (remember to save them with SAVE); if the drives are from a different manufacturer, set the type of Drive parameters as [0:Generic] and set the relevant parameters required for communications.

CAUTION

Set the correct device address to the slave drives (as well as the correct baud rate, stop bit and parity).
It is also recommended, where possible, that a serial communications watchdog be activated on the slave drives.

3) Serial Links Menu

If required, access the [CFG] SERIAL LINKS menu and proceed as follows:

Check that the serial address parameters of the slave devices are unique (changes will take effect after resetting the slave drives).

Check that the baud rate (**R003**), parity and stop bit (**R006**) are the same for all the drives.

Check that for all the slave drives, “Command Source Selection” = Serial Link/RS485.

Check that for all the slave drives, “Reference” = Serial Link/RS485

For the slave drives connected to a serial link, also set **C655**/**C667**/**C679**/**C691** Motor 2/3/4/5 Value for Maximum Reference. See [CFG] Master Serial Link Menu for the selection modes.

57.5.[MEA] Multimotor Control Measurements Menu

M600	Available Motors	
Range	0 ÷ 31 decimal 00000b ÷ 11111 binary 00h ÷ 1F h hex	Bit-controlled measurement 0: Not available 1: Available Bit 0 → motor 1 Bit 1 → motor 2 Bit 2 → motor 3 Bit 3 → motor 4 Bit 4 → motor 5
Active	Always active.	
Address	1551	
Function	This measurement displays the motor status detected through a digital input or via serial link, depending on the settings in **C615** – **C618**.	

M601	Working Motors	
Range	0 ÷ 31 decimal 00000b ÷ 11111 binary 00h ÷ 1F h hex	Bit-controlled measurement 0: Not working 1: Working Bit 0 → motor 1 Bit 1 → motor 2 Bit 2 → motor 3 Bit 3 → motor 4 Bit 4 → motor 5
Active	Always active.	
Address	1552	
Function	This measurement shows the motor operating conditions.	

NOTE If the Multimaster mode is active, the MMC motor operating as the Master will always consider the slave MUP as Motor 2.

M602	Slave Motors Setpoint	
Range	0 ÷ 10000	0 ÷ 100.00%
Active	Always active.	
Address	1553	
Function	This is the reference for the slave motors (provided they are controlled by the drive at variable speed).	

M603	Master Motor Setpoint	
Range	0 ÷ 10000	0 ÷ 100.00%
Active	Always active.	
Address	1554	
Function	This is the reference of the motor controlled by the Master drive.	

M604	Status of the Serial Communications to the Slave Motors	
Range	0 ÷ 15 decimal 0000b ÷ 1111 binary 00h ÷ 0F h hex	Bit-controlled measurement 0: Communications KO 1: Communications OK Flashing: exception code from the slave motor Bit 0 → motor 2 Bit 1 → motor 3 Bit 2 → motor 4 Bit 3 → motor 5
Active	Always active.	
Address	1555	
Function	This measurement displays the status of the serial communications to the motors programmed as Serial Link in **C615** ÷ **C618**. If the bit flashes between 0 and 1 and the serial link timeout warning **W47** appears, this means that the slave motor has sent a Modbus exception code. The exception codes are the following: 0x01 [ILLEGAL FUNCTION] 0x02 [ILLEGAL DATA ADDRESS] 0x03 [ILLEGAL DATA VALUE] 0x06 [SLAVE DEVICE BUSY].	

M605	Operating Condition of the Multimotor Control	
Range	0 ÷ 1	0: MMC Master 1: MMC Slave
Active	Always active.	
Address	1556	
Function	The operating condition of the MMC drive is displayed in this measurement. When operating via the Slave drive, the MMC drive overrides the plant manager control and is sent the speed reference and the run command from the Manager MMC drive via the serial link. If the digital input set as Slave MMC drive deactivates, the drive becomes the Master MMC and takes control of the system.	

57.6.[MEA] Motor Working Time

The Motor Working Time menu displays the working time of the slave motors computed by the MUP drive based on the motor duty cycles. The user can set the motor working time in the special parameters (see the [CFG] Motor Working Time Settings Menu).

M651	Working Time for Motor 1	
Range	0 ÷ 2147483647	0 ÷ 429496729.4 sec
Active	Always active.	
Address	1951-1952 (LSWord, MSWord)	
Function	The working time for motor 1 is displayed.	

M653	Working Time for Motor 2	
Range	0 ÷ 2147483647	0 ÷ 429496729.4 sec
Active	Always active.	
Address	1953-1954 (LSWord, MSWord)	
Function	The working time for motor 2 is displayed.	

M655	Working Time for Motor 3	
Range	0 ÷ 2147483647	0 ÷ 429496729.4 sec
Active	Always active.	
Address	1955-1956 (LSWord, MSWord)	
Function	The working time for motor 3 is displayed.	

M657	Working Time for Motor 4	
Range	0 ÷ 2147483647	0 ÷ 429496729.4 sec
Active	Always active.	
Address	1957-1958 (LSWord, MSWord)	
Function	The working time for motor 4 is displayed.	

M659	Working Time for Motor 5	
Range	0 ÷ 2147483647	0 ÷ 429496729.4 sec
Active	Always active.	
Address	1959-1960 (LSWord, MSWord)	
Function	The working time for motor 5 is displayed.	

NOTE If the Multimaster mode is activated, the working time for Motor 1 always relates to the motor that is currently working as the Master MMC; when the Master is changed over, the working time for M1 are changed with the working time for M2.

57.7. [CFG] Motor Power Ratings Menu

57.7.1. Description

The Motor Power Ratings menu includes the rated power of the slave motors and the type of motors being used (whether at controlled speed or not), as well as the operating conditions of the plant when the Master drive is disabled.

57.7.2. List of Parameters C600 to C607

Table 117: List of Parameters C600 to C607

Parameter	FUNCTION	User Level	MODBUS Address
C600	N. of Motors in the Plant	BASIC	1346
C601	Power Ratings for Motor 2	BASIC	1347
C602	Power Ratings for Motor 3	BASIC	1348
C603	Power Ratings for Motor 4	BASIC	1349
C604	Power Ratings for Motor 5	BASIC	1350
C605	Plant Operating Mode	BASIC	1351
C606	Plant Disabled with Master Drive KO	ENGINEERING	1352
C607	Spare Motor Available	ENGINEERING	1353

C600	Number of Motors in the Plant	
Range	1÷5	1÷ 5
Default	1	1
Level	BASIC	
Address	1346	
Function	Number of motors in the plant.	

C601	Power Ratings for Motor 2	
Range	0 ÷ 65000	0.0 ÷ 6500.0 kW
Default	0	0.0 kW
Level	BASIC	
Address	1347	
Function	Rated power for Motor 2.	

C602	Power Ratings for Motor 3	
Range	0 ÷ 65000	0.0 ÷ 6500.0 kW
Default	0	0.0 kW
Level	BASIC	
Address	1348	
Function	Rated power for Motor 3.	

C603	Power Ratings for Motor 4	
Range	0 ÷ 65000	0.0 ÷ 6500.0 kW
Default	0	0.0 kW
Level	BASIC	
Address	1349	
Function	Rated power for Motor 4.	

C604	Power Ratings for Motor 5	
Range	0 ÷ 65000	0.0 ÷ 6500.0 kW
Default	0	0.0 kW
Level	BASIC	
Address	1350	
Function	Rated power for Motor 5.	

C605	Type of Slave Motors	
Range	0 ÷ 1	0: M2-M5 Variable Speed 1: M2-M5 Fixed Speed
Default	1	1: M2-M5 Fixed Speed
Level	BASIC	
Address	1351	
Function	This parameter sets the type of plant: 0: slave motors M2-M5 operating at controlled speed (drive-controlled). 1: slave motors M2-M5 not speed-controlled (direct starting or soft starter).	

C606	Plant Disabled with Master Drive KO	
Range	0 ÷ 2	0: No 1: Yes 2: No – Backup MMC Master
Default	1	1: Yes
Level	ENGINEERING	
Address	1352	
Function	This parameter sets the plant operation when the Master drive is in emergency conditions or is disabled. **0: No** → If the Master drive deactivates when an alarm trips or if it is disabled (the Enable Master contact is open), the plant operates through slave motors M2-M5 unless an external alarm trips or a “min. threshold” fault of the analogue input set as 4-20mA occurs or a WATCHDOG from fieldbus or serial link (if configured with **R016** and **R005** respectively) trips. Even when deactivated, the Master MMC is still the plant supervisor. **1: Yes** → If the Master drive deactivates when an alarm trips or if it is disabled (the Enable Master contact is open), all motors are shut off and the plant is locked until the cause responsible for the Master drive deactivation disappears. **2: No – Backup MMC Master** → As **0: No**, but the Slave MMMC becomes the plant supervisor if its parameter **C606** is set to 2.	

NOTE Option 2 can be selected only after setting the serial communications parameters and after setting an MUP drive as “Motor 2”.

NOTE The control source is programmed with the Control Method. The same configuration is required for both the MUP drives. When an MUP drive is operating in slave mode, programming is overridden in the menu dedicated to sending the commands from the slave MUP drive via serial link.

C607	Spare Motor Available	
Range	0 ÷ 1	0: No 1: Yes
Default	0	0: No
Level	ENGINEERING	
Address	1353	
Function	If **C607**=1: Yes, the system works at most with a number of operating motors equal to **C600** [N. of Motors in the Plant] – 1. This means that one of the preset motors is not activated, but operates only when one of the three motors fails.	

NOTE If the spare motor is present, this is however involved in the start and stop cycles of the plant to evenly share the working time of all the connected motors.

NOTE If the preset motors have different power ratings, the power rating of the spare motor is referred to the power rating of motor 1.

C608	Maximum Number of Motors that can be Started Simultaneously	
Range	1 ÷ 4	1 ÷ 4
Default	1	1
Level	BASIC	
Address	1354	
Function	This parameter is active only in case of slave motors at fixed speed (**C605**=1: M2-M5 Fixed Speed). It limits the maximum number of motors that can change their configuration simultaneously. For example, given a plant featuring N. 3 motors, the default value set to 1 does not enable simultaneous power on/off of two different motors.	

57.8. [CFG] By-Pass Master Menu

57.8.1. Overview

This menu allows disabling the automatic control of the connected motors and allows forcing their manual operation.

57.8.2. List of Parameters C610 to C611

Table 118: List of Parameters C610 to C611

Parameter	FUNCTION	User Level	MODBUS Address
C610	Enable Motor Manager By-pass	BASIC	1356
C611	Enable Motors	BASIC	1357

C610	Enable Motor Manager By-pass	
Range	0÷1	0: No 1: Yes
Default	0	0: No
Level	BASIC	
Address	1356	
Function	Set **C610** = [1: Yes] to override the automatic control of the motors and to manually force both their startup (**C611**) and their operating speed (**P625**, when slave motors at controlled speed are used).	

C611	Enable Motors	
Range	0 ÷ 31 decimal 00000b ÷ 11111 binary 00h ÷ 1F h hex	On/Off motor bit allocation 0: Off 1: On Bit 0 → motor 1 Bit 1 → motor 2 Bit 2 → motor 3 Bit 3 → motor 4 Bit 4 → motor 5
Default	0	All motors off
Level	BASIC	
Address	1357	
Function	This parameter allows selecting the operating conditions of the plant motors in manual mode (**C610** = [1: Yes]). When variable speed motors are used, their speed setpoint must be set up with **P625**.	

57.9. [CFG] MMC Digital Inputs Menu

57.9.1. OVERVIEW

This menu sets the digital inputs allocated to the slave motors (Slave M2 OK to Slave M5 OK).

- If controlled-speed slave motors are used, signals to the digital inputs consist of the Inverter OK contact of the slave drives;
- If fixed speed motors are used, signals to the digital inputs consist of the feedback of the motor thermal protection (PTC or thermal/magnetic circuit breaker).

When using a Multimotor plant with a serial link between the Master drive and the Slave drives, parameters **C615** to **C618** (relating to the slave motors) must be set accordingly: properly set the serial link remote control to [9: Serial Link] and the communications parameters (see the [CFG] Master).

57.9.2. LIST OF PARAMETERS C615 TO C623

Table 119: List of Parameters C615 to C623

Parameter	FUNCTION	User Level	MODBUS Address
C615	Input for Motor 2 OK	BASIC	1361
C616	Input for Motor 3 OK	BASIC	1362
C617	Input for Motor 4 OK	BASIC	1363
C618	Input for Motor 5 OK	BASIC	1364
C623	Input for Backup Master Drive	BASIC	1369

NOTE

If the remote control of the slave drives must be used by the Multimotor drive (Master drive, do the following:

- set **C615**-**C618** (digital input for Motor OK) to **9=[Serial Link]**
- set the same comms settings for all the connected drives:

- Baud Rate
- stop bits
- type of parity
- device addresses. Also, set the relevant parameters in the Master Serial Link menu accordingly.

C615÷618	Input for Motor 2/3/4/5 OK	
Range	0 ÷ 9	0: Inactive 1: MDI1 ÷ 8: MDI8 9: Serial Link
Default	0	0: Inactive
Level	BASIC	
Address	C615 → 1361 C616 → 1362 C617 → 1363 C618 → 1364	
Function	Allocation of the digital input receiving the "Motor OK" signal. No other function can be allocated to the digital input. If "Serial Link" is selected, the reference, command, status signals of the slave motors are exchanged via serial link using the Modbus RTU protocol (see the [CFG] Master Serial Link Menu).	

C623	Input for Backup Master Drive	
Range	0 ÷ 16 0 ÷ 24 when ES847 or ES870 is fitted	0 → Inactive 1 ÷ 8 → MDI1 ÷ MDI8 9 ÷ 12 → MPL1 ÷ MPL4 13 ÷ 16 → TFL1 ÷ TFL4 17 ÷ 24 → XMDI1 ÷ XMDI8
Default	0	Inactive
Level	BASIC	
Address	1369	
Function	Allocation of the digital input used as Backup MMC Master. In the same plant, if two MMC drives are connected via serial link, the first drive that detects when the Slave Multimotor input closes will disable the motor Manager and will acknowledge the reference and commands sent from the MMC Master via serial link. When the plant is operating, if the MMC drive is not available (off), the Slave MMC drive becomes the Master and takes control of the plant.	

NOTE

When the digital output configured as Master Multimotor is activated, if the drive detects that the Slave Multimotor digital input is activated, alarm "**A124** Master Conflict" will trip, because a conflict is occurring between the two Multimotor drives installed in the plant (both drives are operating as Master drives). Check programming and wiring of the digital inputs/outputs set as Slave/Master Multimotor for both drives implementing the MMC firmware.

57.10. [CFG] Motor Working Time Settings Menu

57.10.1. Overview

This menu includes the parameters required for setting the working time of the plant motors.

NOTE The motor on/off time periods and their working time difference (**P621**) depend on the actual working time of the motors; as a result, the working time of the plant motors can be set up either when the plant is not operating or for the motors that are not currently operating (the Slave P2-5 OK signal is inactive).

NOTE This menu can be accessed only when the system is in Master mode (**M605** = MMC Master).

57.10.2. List of Inputs I021 to I022

Table 120: List of Inputs I021 to I022

Parameter	FUNCTION	User Level	MODBUS Address
I021	Working Time to be Allocated	ADVANCED	1408
I022	Motors to be Allocated to the Working Time	ADVANCED	1409

I021	Motors to be Allocated to the Working Time	
Range	–1 ÷ 32000	–1 [Auto] ÷ 32000h
Default	–1	[Auto]
Level	ADVANCED	
Address	1408	
Function	This parameter sets the working time to be assigned to the motors selected with **I022**. When the default value [Auto] is assigned, the motor working time is automatically refreshed based on the actual duty cycles of the motors. When a working time included between 0 and 32000 hours is set up, parameter **I022** can be used to select the motor(s) to be assigned to this working time.	

I022	Motors to be Allocated to the Working Time	
Range	0 ÷ 31 decimal 00000b ÷ 11111 binary 00h ÷ 1F h hex	Motor bit allocation 0: Irrelevant 1: Active selection Bit 0 → motor 1 Bit 1 → motor 2 Bit 2 → motor 3 Bit 3 → motor 4 Bit 4 → motor 5
Default	0	0: No motor selected
Level	ADVANCED	
Address	1409	
Function	This bit-controlled parameter allows selecting the motors to be assigned to the working time set in **I021**.	

NOTE First set **I021**, then **I022**. When all motors are assigned to their working time, both **I021** and **I022** are automatically restored to their default value.

57.11. [CFG] Master Serial Link Menu

57.11.1. OVERVIEW

This menu defines the parameters to be set up in order to control the slave drives/soft starters via serial link.

If the drives/soft starters being used are manufactured by Elettronica Santerno, the system will use preset parameter values required for serial communications. The user will only have to set the value to be exchanged via serial link and corresponding to the maximum setpoint for the slave motor. Also, the serial address of the drive is to be set up.

On the other hand, if the drives/soft starters being used are not produced by Elettronica Santerno, set the Type of Drive as **Generic** and set the specific parameters for reference control, state control, RUN/STOP command.

The plant wiring is simpler when a serial link is used.

NOTE

Do the following when using the Multimotor drive (Master drive) for the remote control of the slave drives:

- set **C615÷C618** (digital input for Motor OK) to **9=[Serial Link]**;
- set the same Baud Rate, stop bit number and parity for all the connected drives; set the correct device addresses for all the connected drives.

CAUTION

If serial communications is configured for the system control (Motor OK, **C615** to **C618** = 9 [Serial Link]) the control board will use the MODBUS communications protocol in MASTER mode.
This will prevent the system from communicating with the serial link concerned, e.g. with the Iris Control.
To disable the MODBUS Master mode (and to enable serial communications again), deactivate the Serial Link mode in parameters **C615** to **C618**.

57.11.2. List of Parameters C650 to C695

Table 121: List of Parameters C650 to C695

Parameter	FUNCTION	User Level	MODBUS Address
C650	Motor 2, Type of Drive	BASIC	1086
C651	Motor 2, Device Address	BASIC	1087
C652	Motor 2, Address for Reference	BASIC	1088
C653	Motor 2, Address for Command	BASIC	1089
C654	Motor 2, Address for Status Detection	BASIC	1090
C655	Motor 2, Value for Max. Reference	BASIC	1091
C656	Motor 2, Value for Run Command	BASIC	1092
C657	Motor 2, Value for Stop Command	BASIC	1093
C658	Motor 2, Value for Status Test OK	BASIC	1094
C659	Motor 2, Logic for Status Test OK	BASIC	1095
C662	Motor 3, Type of Drive	BASIC	1098
C663	Motor 3, Device Address	BASIC	1099
C664	Motor 3, Address for Reference	BASIC	1100
C665	Motor 3, Address for Command	BASIC	1101
C666	Motor 3, Address for Status Detection	BASIC	1102
C667	Motor 3, Value for Max. Reference	BASIC	1103
C668	Motor 3, Value for RUN Command	BASIC	1104
C669	Motor 3, Value for STOP Command	BASIC	1105
C670	Motor 3, Value for Status Test OK	BASIC	1106
C671	Motor 3, Logic for Status Test OK	BASIC	1107
C674	Motor 4, Type of Drive	BASIC	1110
C675	Motor 4, Device Address	BASIC	1111
C676	Motor 4, Address for Reference	BASIC	1112
C677	Motor 4, Address for Command	BASIC	1113
C678	Motor 4, Address for Status Detection	BASIC	1114
C679	Motor 4, Value for Max. Reference	BASIC	1115
C680	Motor 4, Value for Run Command	BASIC	1116
C681	Motor 4, Value for Stop Command	BASIC	1117
C682	Motor 4, Value for Status OK Test	BASIC	1118
C683	Motor 4, Logic for Status OK Test	BASIC	1119
C686	Motor 5, Type of Drive	BASIC	1122
C687	Motor 5, Device Address	BASIC	1123
C688	Motor 5, Address for Reference	BASIC	1124
C689	Motor 5, Address for Command	BASIC	1125
C690	Motor 5, Address for Status Detection	BASIC	1126
C691	Motor 5, Value for Max. Reference	BASIC	1127
C692	Motor 5, Value for Run Command	BASIC	1128
C693	Motor 5, Value for Stop Command	BASIC	1129
C694	Motor 5, Value for Status Test OK	BASIC	1130
C695	Motor 5, Logic for Status Test OK	BASIC	1131

NOTE To access the parameters above, set parameters **C615-C618** “Digital Input for Motor OK” to [9: Serial Link].

C650 (C662, C674, C686)	Motor 2 (3; 4; 5) Type of Drive	
Range	0 ÷ 5	0: Generic 1: IRIS BLUE/Sinus Penta 2: Sinus N and Sinus M 3: Sinus H 4: ASAB/ASAC/ASA 4.0 5: IRIS BLUE – Backup Master
Default	0	0: Generic
Level	BASIC	
Address	1086 (1098; 1110; 1122)	
Function	Allocation of the Type of Drive controlling the slave motor. If an ASAB/ASAC/ASA 4.0 soft starter is used, all the parameters required for serial communications are preconfigured when this parameter is set up. If a drive manufactured by Elettronica Santerno is used, all the parameters required for serial communications, except for the value corresponding to the maximum speed reference to be sent via serial communications, are preset when this parameter is set up. **Note 0:** If the soft starter being used is not manufactured by Elettronica Santerno, set the speed reference as Not Present to ensure correct data exchange. **Note 1:** Set the same baud rate, parity and stop bit number for all drives. **Note 2:** Option N. 5 (IRIS BLUE – Backup Master) can be set up for Motor 2 only.	

C651 (C663, C675, C687)	Motor 2 (3; 4; 5) Address Device	
Range	0 ÷ 255	0 ÷ 255
Default	2 (3; 4; 5)	2 (3; 4; 5)
Level	BASIC	
Address	1087 (1099; 1111; 1123)	
Function	Serial address of the slave device.	

CAUTION Set the corresponding Device Address for the Slave drive as well.

C652 (C664, C676, C688)	Motor 2 (3; 4; 5) Address for Reference	
Range	0 ÷ 65001	0 ÷ 65001=[Not Present]
Default	0	0
Level	BASIC	
Address	1088 (1100; 1112; 1124)	
Function	Modbus address for the speed reference of the slave drive. If a soft starter is used, set this parameter as 65001: [Not Present].	

CAUTION For the Slave drive, set the speed reference sent via serial link.

C653 (C665, C677, C689)	Motor 2 (3; 4; 5) Address for Commands	
Range	0 ÷ 65000	0 ÷ 65000
Default	0	0
Level	BASIC	
Address	1089 (1101; 1113; 1125)	
Function	Modbus address for the command of the slave drive.	

CAUTION For the Slave drive, set the command sent via serial link.

C654 (C666, C678, C690)	Motor 2 (3; 4; 5) Address for Status Detection	
Range	0 ÷ 65000	0 ÷ 65000
Default	0	0
Level	BASIC	
Address	1090 (1102; 1114; 1126)	
Function	Modbus address allowing detecting the status of the slave drive (“Inverter OK” status).	

C655 (C667, C679, C691)	Motor 2 (3; 4; 5) Value for Max. Reference	
Range	0 ÷ 65000	0 ÷ 65001: Not Present
Default	0	0
Level	BASIC	
Address	1091 (1103; 1115; 1127)	
Function	Value to be sent via serial link and corresponding to the maximum reference for the Slave drive. For example: if a Sinus H is used and if the maximum allowable frequency is 50Hz, this parameter is to be set to “5000”, which is the value exchanged via serial link and, if properly scaled, this value matches with the desired reference value. Examples for the drives manufactured by Elettronica Santerno:	

Type of Drive	Required value	Value to be programmed
IRIS BLUE	1500rpm	1500
Sinus Penta	1500rpm	1500
Sinus H	50.00Hz	5000
Sinus N	50.00Hz	5000
Sinus M	50.00Hz	5000

C656 (C668, C680, C692)	Motor 2 (3; 4; 5) Value for RUN Command	
Range	0 ÷ 65000	0 ÷ 65000
Default	0	0
Level	BASIC	
Address	1092 (1104; 1116; 1128)	
Function	Value to be sent via serial link and corresponding to the RUN command for the Slave drive.	

C657 (C669, C681, C693)	Motor 2 (3; 4; 5) Value for STOP Command	
Range	0 ÷ 65000	0 ÷ 65000
Default	0	0
Level	BASIC	
Address	1093 (1105; 1117; 1129)	
Function	Value to be sent via serial link and corresponding to the STOP command for the Slave drive.	

C658 (C670, C682, C694)	Motor 2 (3; 4; 5) Value for Status OK Test	
Range	0 ÷ 65000	0 ÷ 65000
Default	0	0
Level	BASIC	
Address	1094 (1106; 1118; 1130)	
Function	Value to be detected via serial link in order to check the status of Slave Drive OK (the drive is available and ready to start).	

C659 (C671, C683, C695)	Motor 2 (3; 4; 5) Logic for Status OK Test	
Range	0 ÷ 1	0:[True] ÷ 1:[False]
Default	0	0: [True]
Level	BASIC	
Address	1095 (1107; 1119; 1131)	
Function	Test logic to check the status of Slave Drive OK (the drive is available and ready to start). Example: **C658** = 5; **C659** = 1:[False]. The drive of Motor 2 is detected as ready to start only if the status detected via serial link at the address set in **C654** is other than 5.	

57.12. [PAR] Adjusting Range Menu

57.12.1. Overview

This menu includes the parameters allowing setting the minimum and maximum frequency required for the operation of variable-speed motors. If the operating frequency of the variable-speed motors is lower than/(higher than) or equal to the minimum/(maximum) threshold set in **P600**/(**P601**) for a time longer than **P602**, the system will stop/(start) one of the operating/(available) motors.

57.12.2. List of Parameters P600 to P602

Table 122: List of Parameters P600 to P602

Parameter	FUNCTION	User Level	MODBUS Address
P600	Minimum Operating Frequency	BASIC	950
P601	Maximum Operating Frequency	BASIC	951
P602	Configuration Changeover Delay due to Out of Range Values	BASIC	952

P600	**Minimum Operating Frequency**	
Range	0 ÷ 100	0 ÷ 100%
Default	0	0%
Level	BASIC	
Address	950	
Function	Sets the minimum operating frequency for the connected motors. If set to 0% (default), **P600** has no effect. Frequency is expressed as a percentage of the rated motor frequency (**C015**). <u>Slave motors at variable speed</u>: Example: If **P600** = 50%, **C015** = 50Hz then the minimum operating frequency of the connected motors is 25Hz. If during operation 4 motors are operating at 20Hz and this speed continues for the time set in **P602**, the Primary Master drive would stop one motor and would increase the speed of the remaining three operating motors to 25Hz. This procedure would be repeated until the operating frequency of the active motors would range between **P600** and **P601** (maximum operating frequency). <u>Slave motors at fixed speed</u>: **P600** is the minimum operating frequency for the Variable Speed Master motor only. It also defines the criteria for the selection of the slave fixed speed motors. Example: If **P600** = 30%, the system will choose the slave fixed speed motor configuration allowing the Master motor to operate at a frequency higher than the value set in **P600** and lower than the value set in **P601**. If the operating frequency of the Master motor is not within the preset range [**P600**-**P601**] for the time set in **P602**, the configuration of the slave fixed speed motors is changed to meet the new operating requirements.	

NOTE

The minimum value to be set for this parameter must be ≥ **P237** (Min. PID Out) and is refreshed if **P237** exceeds the value set in **P600**.

NOTE

To avoid any malfunction, the value to be set for **P600** should comply to:

$$P600 \leq \frac{(C600 - 1)}{C600} \times 100 \ [*]$$

Example: **C600** = 5 motors (the output power of each motor is 20%). As a result, **P600** should be set to ≤ 80%.

If the formula above **[*]** is not fulfilled, then continuous activation/deactivation of the available motors can occur depending on **P605**.

P601	**Maximum Operating Frequency**	
Range	0 ÷ 100	0 ÷ 100%
Default	100	100%
Level	BASIC	
Address	951	
Function	Sets the maximum operating frequency for the connected motors. If set to 0% (default), **P601** has no effect. Frequency is expressed as a percentage of the rated motor frequency (**C015**). <u>Slave motors at variable speed</u>: Example: If **P601** = 80%, **C015** = 50Hz, then the maximum operating frequency of the connected motors is 40Hz. If during operation 4 motors are operating at 45Hz and this speed continues for the time set in **P602**, the Primary Master drive would start one motor (if available) and would search for the new operating conditions. This procedure would be repeated until the operating frequency of the active motors would range between **P600** (minimum operating frequency) and **P601.** <u>Slave motors at fixed speed</u>: **P601** is the maximum operating frequency for the Master motor only. It also defines the criteria for the selection of the slave fixed speed motors. Example: If **P601** = 80%, the system will choose the slave fixed speed motor configuration allowing the Master motor to operate at a frequency higher than the value set in **P600** and lower than the value set in **P601**. If the operating frequency of the Master motor is not within the preset range [**P600**-**P601**] for the time set in **P602**, the configuration of the slave fixed speed motors is changed to meet the new operating requirements.	

P602	Configuration Changeover Delay due to Out of Range Values	
Range	0 ÷ 65000	0.0 ÷ 6500.0sec
Default	100	10.0sec
Level	BASIC	
Address	952	
Function	Delay time for the configuration changeover of On/Off motors when the frequency of the active variable-speed motors is not included in the preset frequency range.	

NOTE The time set in parameter **P602** must be shorter than the time set in parameter **P255**, thus preventing the system from stopping the motors before changing their current ON/OFF configuration.

57.13. [PAR] Adjusting Error Menu

57.13.1. Overview

This menu sets the maximum adjusting error and its check time. The On/Off configuration is changed both for the operation of the system when at least one variable-speed motor is available (**P605** and **P606**) and for the operation of the system when only the fixed-speed motors are operating (Master motor out of order—**P610** and **P611**).
This menu also includes a parameter allowing entering an adjusting dead zone (where the adjusting error is null).

57.13.2. List of Parameters P605 to P612

Table 123: List of Parameters P605 to P612

Parameter	FUNCTION	User level	MODBUS Address
P605	Max. Adjusting Error with M2-5 at Variable Speed	BASIC	955
P606	Configuration Changeover Delay due to Max. Error with M2-5 at Variable Speed	BASIC	956
P610	Max. Adjusting Error with M2-5 at Fixed Speed	BASIC	960
P611	Configuration Changeover Delay due to Max. Error with M2-5 at Fixed Speed	BASIC	961
P612	Semiamplitude of the Adjusting Dead Zone	BASIC	962

P605	**Max. Adjusting Error with M2-5 at Variable Speed**	
Range	0 ÷ 1000	0.0 ÷ 100.0 %
Default	20	2.0%
Level	BASIC	
Address	955	
Function	The delay time count starts when the system is working at variable speed and this adjusting error threshold (considered as an absolute value) is exceeded. A configuration changeover occurs if the value set in **P606** is exceeded. The current adjusting error is visible in measurement **M021** (PID Error (%)).	

P606	**Configuration Changeover Delay for Max. Error with M2-5 at Variable Speed**	
Range	0 ÷ 65000	0.0 ÷ 6500.0 sec.
Default	30	3.0 sec.
Level	BASIC	
Address	956	
Function	Maximum time when the adjusting error condition persists for a time longer than the max. error (**P605**) allowed before changing the On/Off configuration of the plant motors when working at variable speed.	

P610	**Max. Adjusting Error with M2-5 at Fixed Speed**	
Range	0 ÷ 1000	0.0 ÷ 100.0 %
Default	20	2.0%
Level	BASIC	
Address	960	
Function	The delay time count starts if this adjusting error threshold (considered as an absolute value) is exceeded when the fixed-speed motors are operating; if the value set in **P611** is exceeded, a configuration changeover occurs. The current adjusting error is visible in measurement **M021** (Percent Error).	

P611	**Configuration Changeover Delay due to Max. Error with M2-5 at Fixed Speed**	
Range	0 ÷ 65000	0.0 ÷ 6500.0 sec.
Default	30	3.0 sec.
Level	BASIC	
Address	961	
Function	Maximum time when the adjusting error condition persists for a time longer than the max. adjusting error (**P610**) allowed before changing the On/Off configuration of the plant motors when only the fixed-speed motors are working.	

P612	**Semiamplitude of the Adjusting Dead Zone**	
Range	0 ÷ 1000	0.0 ÷ 100.0 %
Default	0	0.0%
Level	BASIC	
Address	962	
Function	Semiamplitude of the adjusting dead zone. The adjusting errors with an absolute value under **P612** will be considered as null.	

57.14. [PAR] Adjusting Timeout Menu

57.14.1. Overview

This menu sets the maximum allowable timeout (**P616**) for adjusting errors (**P615**) before the adjusting timeout countdown starts and before choosing what to do when this happens (plant deactivation or warning only).

57.14.2. List of Parameters P615 to P617

Table 124: List of Parameters P615 to P617

Parameter	FUNCTION	User Level	MODBUS Address
P615	Timeout Indication Error	ENGINEERING	965
P616	Timeout Indication Delay	ENGINEERING	966
P617	Plant Deactivation due to Adjusting Timeout	ENGINEERING	967

P615	**Timeout Indication Error**	
Range	0 ÷ 1000	0.00%[Disabled function] ÷ 100.0%
Default	0	DISABLE
Level	ENGINEERING	
Address	965	
Function	Error threshold for checking the adjusting timeout.	

P616	**Timeout Indication Delay**	
Range	0 ÷ 65000	0.0 ÷ 6500.0 sec.
Default	0	0.0 sec.
Level	ENGINEERING	
Address	966	
Function	Maximum delay time for the adjusting timeout when the adjusting error exceeds **P615** (error threshold for checking the adjusting timeout).	

P617	**Plant Deactivation due to Adjusting Timeout**	
Range	0 ÷ 1	0: [No] Indication only 1: [Yes] Plant deactivation
Default	0	0: [No] Indication only
Level	ENGINEERING	
Address	967	
Function	Allows sending a warning indication or allows deactivating the whole plant.	

57.15. [PAR] Special Functions Menu

57.15.1. Overview

This menu includes the parameters implementing special functions, as described below.

57.15.2. List of Parameters P620 to P625

Table 125: List of Parameters P620 to P625

Parameter	FUNCTION	User Level	MODBUS Address
P620	Min. Time Between a Configuration Changeover and the Next	BASIC	970
P621	Maximum Difference among Motor Working Time	BASIC	971
P622	Exponent of the Load Curve	BASIC	972
P623	Min. Motor Operating Speed	BASIC	973
P624	Load Loss Compensation at Max. Delivery	BASIC	974
P625	Motor Reference with Enabled By-Pass	BASIC	975

P620	**Min. Time between a Configuration Changeover and the Next**	
Range	0 ÷ 65000	0: [Deactivated function] ÷ 6500.0 sec
Default	0	0: [Deactivated function]
Level	BASIC	
Address	970	
Function	Min. time passing between an On/Off motor configuration and the next.	

P621	**Max. Difference among Motor Working Time**	
Range	0 ÷ 1000	0: [Deactivated function] ÷ 1000 h.
Default	10	10 h
Level	BASIC	
Address	971	
Function	Maximum difference among the working time of the available motors. If **P621** is set to 0, this function is disabled: whenever a motor On/Off configuration is performed, the motor that has been working for the shortest time is activated, while the motor that has been working for the longest time is shut off. When **P621** is other than zero, the system also checks the difference among the working time of the available motors. If the difference in working time between a working motor and an available inactive motor is greater than the value set in **P621**, the active motor automatically is shut off and the inactive available motor is started up.	

P622	Exponent of the Load Curve	
Range	0 ÷ 1000	0 ÷ 10.00
Default	100	1.00
Level	BASIC	
Address	972	
Function	This parameter defines the exponent of the curve representing the relationship between the controlled variable and the RPM and allows precompensating the speed reference of the controlled-speed motors so as to obtain the smoothest response from the PI(D) regulator. Typically, when controlling the delivery of a motor, the Delivery-Rpm relationship can be approximated to smooth operation (**P622** = 1.00), whereas if the pressure of a motor is controlled, the relationship between Discharge head–Rpm is normally a quadratic trend (**P622** = 2.00).	

P624	Load Loss Compensation at Max. Delivery	
Range	0 ÷ 500	0 ÷ 50.0%
Default	0	disable
Level	BASIC	
Address	974	
Function	This parameter sets the reference increase percent implemented when the motors run at their max. speed. For example, when adjusting the motor pressure and the starting measurement is known, when the flow delivery of the plant increases, the load loss in the ductwork increases as well, so the fluid pressure is weaker in the farthest distance. To obviate this problem, the pressure reference is increased in a linear way, based on the controlled delivery, up to the maximum delivery for which the increase percentage will be equal to **P624**.	

P625	Motor Reference with Enabled By-pass	
Range	0 ÷ 1000	0 ÷ 100.0%
Default	1000	100.0%
Level	BASIC	
Address	975	
Function	This is the speed reference of the motors when the by-pass is enabled: **C610** = [1: Yes].	

57.16. [PAR] MMC Digital Outputs Menu

57.16.1. Overview

This menu includes the parameters required for the allocation of the control functions to the available digital outputs.

By setting the parameters for signal selection [0: Function Mode], the digital outputs are set up via parameters P27x-P30x of the Digital Outputs menu.
Specific settings for the Multimotor application may be obtained when parameters **P630**, **P632**, **P634** and **P636** are set from 1 on (see Table 127).

57.16.2. List of Parameters P630 to P637

Table 126: List of Parameters P630 to P637

Parameter	FUNCTION	User Level	MODBUS Address
P630	MDO1: Signal Selection	ADVANCED	980
P631	MDO1: Output Logic Level	ADVANCED	981
P632	MDO2: Signal Selection	ADVANCED	982
P633	MDO2: Output Logic Level	ADVANCED	983
P634	MDO3: Signal Selection	ADVANCED	984
P635	MDO3: Output Logic Level	ADVANCED	985
P636	MDO4: Signal Selection	ADVANCED	986
P637	MDO4: Output Logic Level	ADVANCED	987

Table 127: List of the selectable signals for the MMC digital outputs

Selectable Value	Description
1	Inverter Run OK
2	Inverter OK On
3	Inverter Alarm
4	Inverter Run Alarm
5	PID Out Max
6	PID Out Min
7	Timeout Reg.
8	All Motors On
9	Motor 2 On
10	Motor 3 On
11	Motor 4 On
12	Motor 5 On
13	Master MMC
14	Serial Comm. KO

P630	MDO1: Signal Selection	
Range	0 ÷ 14	600: [Function Mode] ÷ 614: [Serial Comm KO] (See Table 127)
Default	0	600: [Function Mode]
Level	ADVANCED	
Address	980	
Function	Selection of the signal allocated to MDO1 digital output (transistor open collector output). **600: Function Mode** → MDO1 will implement the function programmed in the Digital Outputs Menu. Functions **601** to **606** are detailed in the [PAR] DIGITAL OUTPUTS MENU. **607: Timeout Reg.** → **A**ctivation of the adjusting timeout (see the [PAR] Adjusting Timeout Menu **P615 ÷ P617**). **608: All Motors On** → All motors ON. **609: Motor 2 On** → Start Slave M2 Command (motor 2 starts up). **610: Motor 3 On** → Start Slave M3 Command (motor 3 starts up). **611: Motor 4 On** → Start Slave M4 Command (motor 4 starts up). **612: Motor 5 On** → Start Slave M5 Command (motor 5 starts up). **613: Master MMC** → Warning from Master drive. **614: Serial Comm. KO** → Serial communications to the slave drive failed (set as 9:Serial Link in **C615** – **C618**). No drive programmed for the control via serial link responds to the queries sent from the Multimotor master.	

NOTE When the digital output configured as Master Multimotor is activated, if the drive detects that the Slave Multimotor digital input is activated, alarm “A124 Master Conflict” will trip, because a conflict is occurring between the two Multimotor drives installed in the plant (both drives are operating as Master drives). Check programming and wiring of the digital inputs/outputs set as Slave/Master Multimotor for both drives implementing the MUP firmware.

NOTE When controlling a contactor, an additional relay (Vmax=48V and Imax=50mA) is required.

P631	MDO1: Output Logic Level	
Range	0 ÷ 1	0: [False] ÷ 1: [True]
Default	1	1: [True]
Level	ADVANCED	
Address	981	
Function	Logic of the digital signal allocated to MDO1 (false or true).	

P632	MDO2: Signal Selection	
Range	0 ÷ 14	600: [Function Mode] ÷ 614: [Serial Comm KO] (See Table 127)
Default	0	600: [Function Mode]
Level	ADVANCED	
Address	982	
Function	Selection of the signal allocated to MDO2 (transistor push-pull) digital output. The selectable functions are given in the description of parameter **P630**.	

NOTE When controlling a contactor, an additional relay (Vmax=48V and Imax=50mA) is required.

P633	MDO2: Output Logic Level	
Range	0 ÷ 1	0: [False] ÷ 1: [True]
Default	1	1: [True]
Level	ADVANCED	
Address	983	
Function	Logic of the digital signal allocated to MDO2 (false or true).	

P634	MDO3: Signal Selection	
Range	0 ÷ 14	600: [Function Mode] ÷ 614: [Serial Comm KO] (See Table 127)
Default	0	600: [Function Mode]
Level	ADVANCED	
Address	984	
Function	Selection of the signal allocated to MDO3 digital output (relay output). The selectable functions are given in the description of parameter **P630,** except for 0:[Function Mode], which is not available for relay outputs.	

P635	MDO3: Output Logic Level	
Range	0 ÷ 1	0: [False] ÷ 1: [True]
Default	1	1: [True]
Level	ADVANCED	
Address	985	
Function	Logic of the digital signal allocated to MDO3 (false or true).	

P636	MDO4: Signal Selection	
Range	0 ÷ 14	600: [Function Mode] ÷ 614: [Serial Comm KO] (See Table 127)
Default	0	600: [Function Mode]
Level	ADVANCED	
Address	986	
Function	Selection of the signal allocated to MDO4 digital output (relay output). The selectable functions are given in the description of parameter **P630,** except for 0:[Function Mode], which is not available for relay outputs.	

P637	MDO4: Output Logic Level	
Range	0 ÷ 1	0: [False] ÷ 1: [True]
Default	1	1: [True]
Level	ADVANCED	
Address	987	
Function	Logic of the digital signal allocated to MDO4 (false or true).	

58. LIST OF ALARMS AND WARNINGS

CAUTION If a protection trips or the drive enters the emergency mode, the drive is locked and the motor starts idling!

58.1. What Happens When a Protection Trips

NOTE Before operating the drive in emergency conditions, carefully read this section and the following section "What to Do When an Alarm Trips".

The drive alarms are detailed below.

When a protection / alarm trips:
1) the **ALARM** LED on the keypad comes on;
2) the page displayed on the keypad is the root page of the **FAULT LIST**;
3) the **FAULT LIST** is refreshed;
4) when using the Drive Profile board, the drive reports faults as hexadecimal values, which are assigned and coded according to the DRIVECOM specification. See Table 131).

In factory-setting, when the drive is switched on after an alarm has tripped—which has not been reset—it is kept in emergency condition.
If the drive is in emergency mode when switched on, this could be due to an alarm tripped before the drive was reset.
To avoid storing the alarms tripped before the drive is switched off, set parameter **C257** in the [CFG] AUTORESET MENU.
The drive stores the moment when an alarm trips to the **FAULT LIST** (supply–time and operation–time). The drive status when the alarm tripped and some measurements sampled when the alarm tripped are also stored to the Fault List.
The readout and storage of the fault list can be very useful to detect the cause responsible for the alarm and its possible solution (see also the Fault List Menu (Fault List)).

NOTE Alarms **A001** to **A039** relate to the main microcontroller (DSP Motorola) of the control board, which detected a fault on the control board itself. No fault list is available for Alarms **A001** to **A039** and no Reset command can be sent via serial link; alarms can be reset through the **RESET** terminal on the terminal board or the **RESET** key on the keypad. No software for the keypad interface is available; the drive parameters and measurements cannot be accessed via serial link.
Avoid resetting alarms **A033** and **A039**, as they trip when the flash memory is not provided with its correct software. Alarms **A033** and **A039** can be reset only when proper software is downloaded for the the inverter flash memory.

CAUTION Before resetting an alarm, deactivate the **ENABLE-A** and **ENABLE-B** signals on terminal **MDI2** to disable the inverter and prevent the connected motor from running at uncontrolled speed, unless parameter **C181**=1 (the Safety Start function is active): after resetting an alarm or after supplying the inverter, this will start only if the **ENABLE-A** and **ENABLE-B** contacts are opened and closed again.

58.2. What to Do When an Alarm Trips

CAUTION If a protection trips or the drive is in emergency condition, the drive is locked and the motor starts idling!

CAUTION Before resetting an alarm, disable the **ENABLE-A** and **ENABLE-B** signals on terminal **MDI2** to disable the drive and to prevent the connected motor from running at uncontrolled speed.

Proceed as follows:

1. Disable the **ENABLE-A** and **ENABLE-B** signals on terminal **MDI2** to disable the drive and to lock the motor, unless parameter **C181**=1 (the Safety Start function is active): after resetting an alarm or after supplying the drive, this will start only if the **ENABLE-A** and **ENABLE-B** contacts are open and closed.

2. If the motor is idling, wait until it stops.

Check the **FAULT LIST** carefully for any information about the alarm tripped, in order to determine the cause responsible for the alarm and its possible solutions.
Any information stored to the FAULT LIST is also required when contacting Elettronica Santerno's Customer Service.

3. In the following sections, find the relative alarm code and follow the instructions.

4. Solve any external problems that may have been responsible for the protection trip.
5. If the alarm tripped due to the entry of wrong parameter values, set new correct values and save them.
6. Reset the alarm.
7. If the alarm condition persists, please contact Elettronica Santerno Customer Service.

A **RESET** command must be sent to reset the alarms tripped. Do one of the following:

- Enable the **RESET** signal in **MDI3** terminal in the hardware terminal board;
- Press the **RESET** key on the keypad;
- Enable the **RESET MDI3** signal in one of the virtual terminal boards enabled as remote control sources (see the [CFG] CONTROL METHOD MENU).

To activate the **Autoreset** function, enable parameter **C255** (see the [CFG] AUTORESET MENU); the drive will automatically try to reset the alarms tripped.

58.3. Alarm List

Table 128: List of the possible alarms

Alarm	Alarm Message	Description
A001 ÷ A032	…	*Control board failure*
A033	TEXAS VER KO	Incompatible Texas Software Version
A039	FLASH KO	Texas Flash not programmed
A040	User Fault	Alarm caused by the user
A041	PWMA Fault	General hardware fault from IGBT
A042	Illegal XMDI in DGI	Illegal configuration of XMDI in the Digital Inputs menu
A043	False Interrupt	*Control board failure*
A044	SW OverCurrent	Software overcurrent
A045	Bypass Circuit Fault	Fault of the precharge By–Pass
A046	Bypass Connector Fault	Precharge By–Pass connector fault
A047	UnderVoltage	Dc bus voltage lower than Vdc_min
A048	OverVoltage	Dc bus voltage exceeding Vdc_max
A049	RAM Fault	*Control board failure*
A050	PWMA0 Fault	Hardware Fault from IGBT converter
A051	PWMA1 Fault	Hardware overcurrent
A052	Illegal XMDI in DGO	Illegal configuration of XMDI in the Digital Outputs menu
A053	PWMA Not ON	Hardware failure, IGBT power on impossible
A054	Optional Board not in	Failure in detecting preset optional I/O board
A055	PTC Alarm	External PTC tripped
A056	PTC Short Circuit	External PTC in short circuit
A057	Illegal XMDI in MPL	Illegal configuration of XMDI in the Virtual Digital Outputs (MPL) menu
A061	SR0 WatchDog	Watchdog tripped in serial link 0 (9-pole D connector)
A062	SR1 WatchDog	Watchdog tripped in serial link 1 (RJ45)
A063	Generic Motorola	*Control board failure*
A064	Mains Loss	No power is supplied from the mains
A065	AutoTune Fault	Autotune failed
A066	REF < 4mA	REF Current input (4÷20mA) lower than 4mA
A067	AIN1 < 4mA	AIN1 Current input (4÷20mA) lower than 4mA
A068	AIN2 < 4mA	AIN2 Current input (4÷20mA) lower than 4mA
A069	XAIN5 < 4mA	XAIN5 Current input (4÷20mA) lower than 4mA
A070	Fbs WatchDog	Fieldbus Watchdog tripped
A071	1ms Interrupt OverTime	*Control board failure*
A072	Parm Lost Chk	Parameter download/upload error
A073	Parm Lost COM1	Parameter download/upload error
A074	Drive OverHeated	Drive thermal protection tripped
A075	Motor OverHeated	Motor thermal protection tripped
A076	Speed Alarm	Motor speed too high
A078	MMI Trouble	*Control board failure*
A081	KeyPad WatchDog	Communication watchdog via keypad
A083	External Alarm 1	External alarm 1
A084	External Alarm 2	External alarm 2
A085	External Alarm 3	External alarm 3
A086	XAIN5 > 20mA	XAIN5 Current input (4÷20mA or 0÷20mA) greater than 20mA
A087	±15V LOSS	± 15V Loss
A088	ADC Not Tuned	*Control board failure*
A089	Parm Lost COM2	Parameter download/upload error
A090	Parm Lost COM3	Parameter download/upload error

Alarm	Alarm Message	Description
A092	SW Version KO	*Control board failure*
A093	Bypass Circuit Open	By-Pass relay open
A094	HeatSink Overheated	IGBT heatsink temperature too high
A095	Illegal Drive Profile Board	Drive Profile board not correctly configured
A096	Fan Fault	Fault of the cooling fans
A097	Motor Not Connected	Motor not connected
A099	2nd Sensor Fault	Fault of fan sensor 2
A102	REF > 20mA	REF Current input (4÷20mA or 0÷20mA) greater than 20mA
A103	AIN1 > 20mA	AIN1 Current input (4÷20mA or 0÷20mA) greater than 20mA
A104	AIN2 > 20mA	AIN2 Current input (4÷20mA or 0÷20mA) greater than 20mA
A105	PT100 Channel 1 Fault	Hardware address out of measurement range of the drive
A106	PT100 Channel 2 Fault	Hardware address out of measurement range of the drive
A107	PT100 Channel 3 Fault	Hardware address out of measurement range of the drive
A108	PT100 Channel 4 Fault	Hardware address out of measurement range of the drive
A109	Amb.Overtemp.	Ambient overtemperature
A110	Fieldbus Board Fault	Fault occurring in the Fieldbus board
A111 ÷ A120	…	*Control board failure*
A121	DLX Master Not On	Alarm specific to Multimotor Control General malfunction of the Master serial communications
A122	DLX Timeout	Alarm specific to Multimotor Control Timeout from serial communications detected by the Master
A123	DLX Error	Alarm specific to Multimotor Control Error from serial communications detected by the Master
A124	Conflict Master	Alarm specific to Multimotor Control Two drives have been configured as the Master
A129	No Output Phase	Output phase loss
A136	Dry Run	Dry run: no water is delivered to the working pump
A137	Pressure Loss	Pressure Loss: water system leakage or breakage
A140	Torque Off not Safe	Malfunctioning of ENABLE-A and ENABLE-B inputs for STO function
A141	Illegal Hardware	SW version incompatible with the drive hardware

A001÷A032, A043, A049, A063, A071, A078, A088, A092, A111÷A120	Control Board Failure
Description	Control board failure
Event	There may be several causes: the board autodiagnostic file constantly checks its operating conditions.
Possible Cause	• Strong electromagnetic disturbance or radiated interference. • Possible failure of the microcontroller or other circuits on the control board.
Solutions	1. Reset the alarm: send a **RESET** command. 2. If the alarm persists, please contact ELETTRONICA SANTERNO’s Customer Service.

A033	Texas Software KO
Description	Incompatible Software Texas version
Event	When switched on, DSP Motorola detected an incompatible version of the software downloaded to Flash Texas (software version incompatible with Motorola).
Possible Cause	The wrong software was downloaded.
Solution	1. Download the correct DSP Texas software version. 2. If the alarm persists, please contact ELETTRONICA SANTERNO’s Customer Service.

A039	Texas Flash not Programmed
Description	Texas Flash not programmed
Event	When switched on, DSP Motorola detected that Flash Texas is not correctly programmed.
Possible Cause	A prior attempt to download DSP Texas software failed.
Solution	1. Download the correct DSP Texas software version. 2. If the alarm persists, please contact ELETTRONICA SANTERNO's Customer Service.

A040	User Alarm
Description	Alarm trip caused by the user (as a system testing procedure)
Event	The user has forced the alarm to trip.
Possible Cause	Value 1 was entered to address MODBUS 1400 via serial link.
Solution	Reset the alarm: send a **RESET** command.

A041	IGBT Fault
Description	General hardware fault from IGBT
Event	The power converter generated a general alarm.
Possible Cause	• Electromagnetic disturbance or radiated interference. • Overcurrent, IGBT overtemperature, IGBT fault.
Solution	1. Reset the alarm: send a **RESET** command. 2. If the alarm persists, please contact ELETTRONICA SANTERNO's Customer Service.

A042	Illegal XMDI in DGI
Description	Illegal configuration of XMDI in the Digital Inputs menu
Event	• The drive checked if at least one XMDI input from ES847 or ES870 I/O optional board is available in the [CFG] DIGITAL INPUTS MENU. • The drive checked if **R023** (I/O Board setting) is set to 0 in the [CFG] EXPANSION BOARD CONFIGURATION MENU.
Possible Cause	Wrong settings.
Solution	Check settings and enter correct settings.

A044	SW Overcurrent
Description	SW Overcurrent
Event	Immediate current limit tripped
Possible Cause	• Abrupt variations of the connected load • Output short-circuit or ground short-circuit • Strong electromagnetic disturbance or radiated interference. If alarm **A044** tripped while accelerating: • Too short acceleration ramp; If alarm **A044** tripped while decelerating: • Too short deceleration ramp. • Excessive gain of the current regulator (**P155**). • Excessive gain of the speed regulator (**P128**) or too short integral time (**P126**) when using the **VTC** control algorithm.
Solution	1. Check if the drive and the motor are properly dimensioned with respect to the connected load. 2. Make sure that no output short-circuit is to be found between two phases or between one phase and the grounding (terminals **U, V, W**). (Remove voltage from the motor, set IFD control and operate the drive in no-load conditions.) 3. Check if the command signals are sent to the drive using screened cables where required (see IRIS BLUE – Installation Guide). Detect external sources for electromagnetic disturbance, check wiring and make sure that antidisturbance filters are installed on the coils of contactors and electrovalves (if fitted inside the cabinet). 1. If necessary, set longer acceleration times (see the [PAR] RAMPS MENU). 2. If necessary, set longer deceleration times (see the[PAR] RAMPS MENU). 3. If necessary, decrease the values set in the [CFG] LIMITS MENU.

A045	Fault Bypass
Description	Bypass precharge Fault
Event	The drive forced to close its relay or contactor for the short-circuit of the precharge resistors in DC-link capacitors (DC bus), but it did not detect the relevant closing signal while precharging. See also **A046**.
Possible Cause	• Disconnection of auxiliary signal. • Precharge relay/contactor failure.
Solution	1. Reset the alarm: send a **RESET** command. 2. If the alarm persists, please contact ELETTRONICA SANTERNO's Customer Service.

A046	Bypass Connector Fault
Description	Precharge bypass connector fault.
Event	Auxiliary signal for the closing of the bypass connector of the short-circuit precharge resistor is considered as closed before the relevant closing command is sent. See also **A045**.
Possible Cause	• Precharge bypass connector reversed. • Precharge relay/contactor failure.
Solution	1. Reset the alarm: send a **RESET** command. 2. If the alarm persists, please contact ELETTRONICA SANTERNO's Customer Service.

A047	Undervoltage
Description	DC bus Voltage lower than minimum voltage.
Event	Voltage measured in DC bus capacitors has dropped below the min. value allowed for a proper operation of the drive class being used.
Possible Cause	• Supply voltage has dropped below 200Vac–15% (class 2T), 380V–15% (class 4T). • Alarm **A047** can trip even when voltage temporarily drops below the allowable min. value (which is caused for example by the direct starting of the connected load). • If the drive is powered directly by the bus bar, the bus feeder is responsible for the alarm. • Failure in DC bus voltage measurement circuit.
Solution	1. Check voltage in terminals **R**, **S**, **T**. Check mains voltage value **M030** and DC bus voltage value **M029**. Also check the values of **M030** and **M029** sampled in the **FAULT LIST** when the alarm tripped. 2. If the alarm persists, please contact ELETTRONICA SANTERNO's Customer Service.

A048	Overvoltage
Description	Overvoltage in DC bus (voltage in DC-link).
Event	Voltage measured in DC bus (DC-link) capacitors has exceeded the max. value allowed for a proper operation of the drive class being used.
Possible Cause	• Check that voltage does not exceed 240Vac +10% (class 2T), 480Vac +10% (class 4T). • Very inertial loads and a too short deceleration ramp (see the [PAR] RAMPS MENU). • Alarm **A048** can trip even when the motor is pulled by the load (eccentric load). • If the drive is powered directly by the bus bar, the bus feeder is responsible for the alarm trip. • Failure in DC bus voltage measurement circuit.
Solution	1. Check voltage in terminals **R**, **S**, **T**. Check mains voltage value **M030** and DC bus voltage value **M029**. Also check the values of **M030** and **M029** sampled in the **FAULT LIST** when the alarm tripped. 2. In case of very inertial loads and if the alarm tripped when decelerating, try to set a longer deceleration ramp. 3. If the alarm persists, please contact ELETTRONICA SANTERNO's Customer Service.

A050	IGBT Fault
Description	Hardware Fault from IGBT converter
Event	The IGBT drivers of power converter have detected IGBT failure.
Possible Cause	• Strong electromagnetic disturbance or radiated interference. • Overcurrent, Overtemperature, IGBTs, IGBT fault.
Solution	1. Reset the alarm: send a **RESET** command. 2. If the alarm persists, please contact ELETTRONICA SANTERNO's Customer Service.

A051	Overcurrent HW
Description	Hardware overcurrent
Event	Hardware overcurrent detected by the drive output current circuit.
Possible Cause	See **A044 SW Overcurrent**.
Solution	See **A044 SW Overcurrent**.

A052	Illegal XMDI in DGO
Description	Illegal configuration of XMDI in the Digital Outputs menu.
Event	The drive has simultaneously checked the following: • if at least one XMDI input from ES847 or ES870 I/O optional board is available in the [PAR] DIGITAL OUTPUTS MENU; • if **R023** (I/O Board setting) is set to 0 in the [CFG] EXPANSION BOARD CONFIGURATION MENU.
Possible Cause	Wrong settings.
Solution	Check settings and enter correct settings.

A053	Not PWONA
Description	Hardware failure; IGBT A power on failure.
Event	IGBT A power on controlled by Motorola microcontroller has failed.
Possible Cause	Control board failure.
Solution	1. Reset the alarm: send a **RESET** command. 2. If the alarm persists, please contact ELETTRONICA SANTERNO's Customer Service.

A054	Option Board not in
Description	ES847 or ES870 not in.
Event	The control board detects no ES847 or ES870 I/O expansion boards after parameter **R023** (I/O Board Setting) is set as ≠ 0.
Possible Cause	Optional board not in or faulty.
Solution	1. Check consistency of parameter **R023** (see [CFG] EXPANSION BOARD CONFIGURATION MENU). 2. Reset the alarm: send a **RESET** command. 3. If the alarm persists, please contact ELETTRONICA SANTERNO's Customer Service.

A055	PTC Alarm
Description	External PTC resistor tripped.
Event	The drive detected the opening of the PTC connected to **AIN2** input (R > 3600 ohm)
Possible Cause	• Opening of the PTC due to motor overheating. • Incorrect wiring of PTC. • Incorrect setting of **SW1** hardware switch on the control board (see IRIS BLUE – Installation Guide).
Solution	1. Allow the motor to cool, then reset the alarm. 2. Make sure that the PTC is correctly connected to **AIN2** analog input (see IRIS BLUE – Installation Guide). 3. Make sure that **SW1** hardware switch is correctly set.

A056	PTC Short Circuit
Description	External PTC resistor short circuit.
Event	Detected the short circuit of the PTC connected to **AIN2** input (R < 10 ohm).
Possible Cause	• Short circuit in the PTC. • Incorrect wiring of PTC. • Incorrect setting of **SW1** hardware switch on the control board (see IRIS BLUE – Installation Guide).
Solution	1. Make sure that the PTC is correctly connected to **AIN2** analog input (see IRIS BLUE – Installation Guide). 2. Make sure that **SW1** hardware switch is correctly set.

A057	Illegal XMDI in MPL
Description	Illegal configuration of XMDI in the [PAR] VIRTUAL DIGITAL OUTPUTS (MPL) MENU
Event	The drive has simultaneously checked the following: • if at least one XMDI input from ES847 or ES870 I/O optional board is available in the [PAR] VIRTUAL DIGITAL OUTPUTS (MPL) MENU[PAR] ; • The drive checked if **R023** (I/O Board setting) is set to 0 in the [CFG] EXPANSION BOARD CONFIGURATION MENU.
Possible Cause	Wrong settings.
Solution	Check settings and enter correct settings.

A061, A062	Serial Link Watchdog
Description	**A061**: Serial Link Watchdog 0 tripped **A062**: Serial Link Watchdog 1 tripped
Event	The serial link watchdog has tripped. Communication failure: no read/write query sent to serial link for a time longer than the time set in the parameters relating to serial link watchdog (see the [CFG] CONTROL METHOD MENU). This alarm does not trip if, due to parameters in the [CFG] CONTROL METHOD MENU or due to the status of the source selection or LOC/REM inputs (see the [CFG] DIGITAL INPUTS MENU), the information sent from serial link is not currently used for the commands or the references
Possible Cause	• Serial link is disconnected. • Communication failure on remote master side. • Watchdog operating times too short.
Solution	1. Check serial link. 2. Make sure that the remote master constantly sends read/write queries with max. intervals between two queries lower than the preset watchdog operating time. 3. Set longer watchdog operating times (see **R005** for serial link 0 and **R012** for serial link 1).

A064	Mains Loss
Description	Mains loss
Event	Mains loss.
Possible Cause	• One supply cable is disconnected. • Mains supply too weak. • Mains gap.
Solution	1. Check voltage in terminals **R**, **S**, **T**. Check mains voltage value **M030**. Also check the value of **M030** sampled in the **FAULT LIST** when the alarm tripped. 2. This protection may be disabled via parameter **C258a**.

A065	Autotune KO
Description	Autotune failed.
Event	Autotune aborted or failed.
Possible Cause	• The **ENABLE** contact was disabled before autotune was over. • Autotune aborted, maybe because the parameter values were inconsistent with the motor ratings.
Solution	1. Reset the alarm: send a **RESET** command. 2. Check the motor parameters and make sure that they are consistent with the motor ratings (see the [CFG] MOTOR CONFIGURATION MENU) and perform a new autotune procedure. 3. If the alarm persists, please contact ELETTRONICA SANTERNO’s Customer Service.

A066÷A069	Current Input < 4mA
Description	**A066**: REF Current input (4÷20mA) lower than 4mA **A067**: AIN1 Current input (4÷20mA) lower than 4mA **A068**: AIN2 Current input (4÷20mA) lower than 4mA **A069:** XAIN5 current input (4÷20mA) lower than 4mA
Event	A current value lower than 4 mA has been detected over one input (REF, AIN1, AIN2, XAIN5) set with the following range: 4÷20mA.
Possible Cause	• Wrong setting of **SW1** on the control board (except for **A069**). • Signal cable disconnected. • Failure in the current signal source.
Solution	1. Check setting of **SW1** (except for **A069**). 2. Check that the signal cable is properly connected to its terminal. 3. Check the current signal source.

NOTE The alarms above trip only if the relevant inputs have been selected (see [CFG] CONTROL METHOD MENU and [CFG] PID CONFIGURATION MENU).

A070	WatchDog Fieldbus
Description	Watchdog Fieldbus tripped
Event	The watchdog fieldbus tripped and communication is suspended. Communication is interrupted: the Master did not send any valid message for a time longer than the time set in the parameter relating to the value set with parameter **R016** of the fieldbus watchdog time (see the [CFG] FIELDBUS CONFIGURATION MENU). This alarm does not trip if, due to parameters in the [CFG] CONTROL METHOD MENU or due to the status of the source selection or LOC/REM inputs [CFG] DIGITAL INPUTS MENU), the information sent from fieldbus is not currently used for the commands or the references.
Possible Cause	• Voltage removed from Fieldbus. • No communication from Master. • Watchdog times too short.
Solution	1. Check fieldbus connections. 2. Check that the master ensures a constant sequence of legal messages with max. time intervals lower than the preset watchdog time. 3. Set longer watchdog times (see **R016**). 4. To reset alarm **A070**, force communication between the Master and the IRIS BLUE drive with bit 15 of the digital input word (bit 11 of the Control Word when using the PROFIdrive) as required by parameter **R018b** and reset the drive control board. If communication between the Master and the Slave (IRIS BLUE) cannot be restored, alarm **A070** is restored after setting parameter R016 to zero and after resetting the IRIS BLUE drive. When the drive is next powered on, the alarm reset will affect the drive control board.

A072-A073 A089-A090	Parameter Upload/Download Error from Keypad to Drive
Description	Upload/download failed, one of the controls of the parameter consistency detected a fault.
Event	A communication error occurred while uploading/downloading the programming parameters from the keypad to the drive.
Possible Cause	Temporary interruption to the serial link between keypad and control board.
Solution	Check the connection between the keypad and the control board, reset the alarm and perform a new upload/download procedure.

A074	Overload
Description	Drive thermal protection tripped.
Event	The output current has been exceeding the drive rated current for long periods.
Possible Cause	• Current equal to **Ipeak** + 20% for **3 seconds**, or • Current equal to **Imax** for **120 seconds** (S05÷S30 2T/4T), • Current equal to **Imax** for **60 seconds** (S41 2T/4T)
Solution	Check the drive current output during ordinary operation (**M026** in the Motor Measurements Menu); check the mechanical conditions of the connected load (load locked / overload).

A075	Motor Overheated
Description	Motor thermal protection tripped
Event	The software motor thermal protection tripped. Output current has been exceeding the motor rated current for long periods.
Possible Cause	• Poor mechanical conditions of the connected load. • Wrong setting of parameters in the Thermal Protection Menu.
Solution	1. Check mechanical conditions of the connected load. 2. Check parameters **C265**, **C266**, **C267** (and equivalent parameters for motors 2 and 3) in the [CFG] MOTOR THERMAL PROTECTION MENU.

A076	Limit Speed
Description	The motor speed is too high.
Event	The motor speed is higher than the current value set in parameter **C031** (for motor 1) or similar parameters for motors n.2 and n.3. If **C031** = 0, the limit speed protection is disabled. The variable used for this software protection is: • The current speed setpoint for IFD. • The estimated motor speed for VTC control.
Possible Cause	• Value of parameter **C031** too low. • Torque reference too high for **SLAVE** mode.
Solution	1. Check the compatibility of the parameter with respect to the maximum speed parameter. 2. In **SLAVE** mode, check the torque reference value.

A081	Keypad Watchdog
Description	Watchdog for the communication to the keypad.
Event	Communication failed when the keypad was enabled as a reference source or a command source or when it was in Local mode (Watchdog time is equal to approx. 1.6 seconds)
Possible Cause	• Keypad cable disconnected. • Failure of one of the two connectors of the keypad. • Strong electromagnetic disturbance or radiated interference. • Keypad failure. • Incorrect setting in parameters relating to serial link 1 (see [CFG] SERIAL LINKS).
Solution	1. Check the connection of the keypad cable. 2. Make sure that the keypad cable connectors are intact (on both drive side and keypad side). 3. Check communication parameters of serial link 1.

A083÷A085	External Alarm
Description	**A083**: External alarm 1 **A084**: External alarm 2 **A085**: External alarm 3
Event	The External Alarm (1, 2, 3) functionality has been programmed, but the relevant digital input is disabled (see the [CFG] DIGITAL INPUTS MENU). If multiple digital command sources are programmed, alarms **A083**-**A085** trip if one of the terminals in the active sources is disabled (see the [CFG] CONTROL METHOD MENU).
Possible Cause	The cause for the alarm trip does not depend on the drive; check for the reason why the contact connected to terminal **MDIx** where the External Alarm function is programmed opens.
Solution	Check external signal.

A087	±15V Loss
Description	Loss of ±15V.
Event	• The voltage level of ±15V is inadequate.
Possible Cause	• Possible failure of the control board or other circuits in the IRIS BLUE Drive.
Solution	1. Reset the alarm: send a **RESET** command. 2. If the alarm persists, please contact ELETTRONICA SANTERNO's Customer Service.

A093	Precharge: Bypass open
Description	Bypass relay open.
Event	The control board requested the closure of the bypass relay (or contactor) for the short-circuit of the DC-link capacitor precharge resistors, **but no closing signal is sent** (auxiliary of the relay) during functioning (precharge already closed).
Possible Cause	Failure in the relay control circuit or in the auxiliary signal circuit detecting relay closing.
Solution	1. Reset the alarm: send a **RESET** command. 2. If the alarm persists, please contact ELETTRONICA SANTERNO's Customer Service.

A094	Heatsink Overheated
Description	IGBT heatsink temperature too high.
Event	IGBT power heatsink overheated even if the cooling fan is on (see also **A096** and **A099**).
Possible Cause	• Ambient temperature exceeding 40 °C. • Too high motor current. • Excessive carrier frequency for the application required.
Solution	1. Check ambient temperature. 2. Check motor current. 3. Decrease IGBT carrier frequency (see the [CFG] CARRIER FREQUENCY MENU).

A095	Illegal Drive Profile Board
Description	An illegal Drive Profile board is implemented.
Event	Incorrect configuration of the optional Drive Profile board.
Possible Cause	• The Drive Profile board is configured for a different drive. • The Drive Profile board is not configured. • Faulty Drive Profile board.
Solution	1. Make sure that the Drive Profile board is correctly configured for the IRIS BLUE drive. 2. Replace the Drive Profile board.

A096	Fan Fault
Description	Fan alarm.
Event	Power heatsink overheated with fan locked or disconnected or faulty (see also **A094** and **A099**).
Possible Cause	Fan locked or disconnected or faulty.
Solution	Replace fan.

A097	Motor Cables KO
Description	Motor not connected.
Event	This protection trips during autotune or DC Brake if the motor is not connected to the drive or if its current value is not compatible with the drive size.
Possible Cause	• One cable of the motor is disconnected. • The motor size is too small if compared to the drive size.
Solution	1. Check that motor cables are properly connected to terminals **U**, **V**, **W**. 2. Check the motor parameters; perform autotune procedure again (VTC control).

A099	Sensor 2 Fault
Description	Sensor 2 fault.
Event	Power heatsink overheated with cooling fan off (see also **A094** and **A096**).
Possible Cause	Failure in temperature control device and/or cooling system.
Solution	Please contact ELETTRONICA SANTERNO's Customer Service.

A102÷A104, A086	Current Input > 20mA
Description	**A102:** REF Current input (4÷20mA or 0÷20mA) greater than 20mA **A103:** AIN1 Current input (4÷20mA or 0÷20mA) greater than 20mA **A104:** AIN2 Current input (4÷20mA or 0÷20mA) greater than 20mA **A086:** XAIN5 Current input (4÷20mA or 0÷20mA) greater than 20mA
Event	A current value greater than 20mA has been detected over one input (REF, AIN1, AIN2, XAIN5) set with the following ranges: 4÷20mA or 0÷20mA.
Possible Cause	• Wrong setting of **SW1** on the control board (except for **A086**). • Failure in the current signal source.
Solution	1. Check setting of SW1(except for **A086**). 2. Check the current signal source.

A105÷A108	PT100 Channel 1,2,3,4 Fault
Description	**A105**: PT100 Channel 1 fault **A106**: PT100 Channel 2 fault **A107**: PT100 Channel 3 fault **A108**: PT100 Channel 4 fault
Event	Hardware input out of the measurement range of the drive.
Possible Cause	• Wrong setting of SW1 or SW2 on optional control board ES847 • Failure in the current signal source.
Solution	1. Check setting of SW1 and SW2. 2. Check the current signal source.

A109	Ambient Overtemperature
Description	The ambient temperature is too high.
Event	The control board has detected a too high ambient temperature.
Possible Cause	Inverter or cabinet overheated; failure of control board NTC.
Solution	1. Open the cabinet and check its conditions. Also check measurement **M062**. 2. Reset the alarm: send a **RESET** command. 3. If the alarm persists, please contact ELETTRONICA SANTERNO's Customer Service.

A110	Fieldbus Board Fault
Description	Fault occurring in the fieldbus board
Event	The fieldbus board has detected severe network failure.
Possible Cause	Wrong configuration of the fieldbus network and/or Fieldbus Master.
Solution	1. Reset the drive 2. Establish a connection to the fieldbus, making sure that the Fieldbus Master configuration is correct 3. If the alarm persists, please contact ELETTRONICA SANTERNO's Customer Service.

A121	DLX Master Not On
Description	Failure in the Master drive serial communications.
Event	Not defined.
Possible Cause	Strong electromagnetic disturbance. Possible failure in the microcontroller or in other circuits in the control board.
Solution	1. Reset the alarm: send a RESET command. 2. If the alarm persists, please contact ELETTRONICA SANTERNO's Customer Service.

A122	DLX Timeout
Description	The Master drive has detected a timeout from serial communications.
Event	The Slave drives did not respond for a time > 2 seconds to the queries sent via Modbus.
Possible Cause	Incorrect setting or wiring.
Solution	Check setting and wiring of the Master drive and the Slave drives.

A123	DLX Error
Description	The Master drive has detected a serial communications error.
Event	The Slave drives have sent inconsistent responses to the queries sent via Modbus.
Possible Cause	Incorrect setting or wiring.
Solution	Check setting and wiring of the Master drive and the Slave drives.

A124	Conflict Master
Description	The drive with the active digital output set as MMC Master has the digital input set as Backup MMC Master activated.
Event	Conflict between the two drives in the plant both operating as the Master drive.
Possible Cause	Wrong setting or wiring.
Solution	Check settings and wiring of the digital inputs/outputs programmed as Backup/Master MMC Master in both drives.

A129	No Output Phase
Description	Output phase loss
Event	The output current from one of phases U, V, W is close to zero, while the other phases are properly operating. Output phase loss is detected only if: • IFD control is selected (**C010=0**) • Output power exceeds 1Hz
Possible Cause	One or multiple links to the motor (phases U, V, W) disconnected.
Solution	1. Check continuity between the drive and the motor. 2. If the alarm persists, please contact ELETTRONICA SANTERNO's Customer Service.

NOTE This alarm may be enabled only by Elettronica Santerno and is to be explicitly requested at the time when ordering the drive.

A136	Dry Run
Description	Dry Run: no water is being delivered to the pump, or the dangerous cavitation phenomenon is about to occur.
Event	The drive has been working under Dry-run conditions (see Figure 37) for a time longer than **P712** and with a speed reference higher than the minimum value between **P711** and **C029.**
Possible Cause	No water in the hydraulic circuit.
Solution	Restore water level in the hydraulic circuit.

A137	Pressure Loss
Description	Pressure loss: leakage or breakage in the hydraulic circuit.
Event	The PID regulator has detected pressure loss in the hydraulic circuit by monitoring the feedback or error (see Figure 38) for a time equal to at least **P722**.
Possible Cause	Leakage or breakage in the hydraulic circuit.
Solution	Repair the hydraulic circuit.

A140	Torque Off not safe
Description	Malfunctioning of **ENABLE-A** and **ENABLE-B** inputs for the STO function
Event	The redundant circuitry for the drive enable (simultaneous activation of the **ENABLE-A** and **ENABLE-B** inputs) is no longer active, so opening those inputs does not guarantee that the STO function is properly implemented. For more details, please consult the Safe Torque Off Function – Application Manual.
Possible Cause	Fault in the circuitry dedicated to the Safe Torque Off function.
Solution	1. Reset the alarm: send a **RESET** command. 2. If the alarm persists, please contact ELETTRONICA SANTERNO's Customer Service.

A141	Illegal Hardware
Description	IRIS BLUE hardware incompatible with IRIS BLUE SW (IB)
Event	The SW downloaded to the control board is incompatible with the drive hardware.
Possible Cause	Illegal software downloaded.
Solution	1. Download the correct release of the IB software. 2. Please contact ELETTRONICA SANTERNO's Customer Service.

58.4. List of the DRIVECOM Alarm Codes

If a PROFIdrive expansion board is used (see [CFG] PROFIDRIVE BOARD CONFIGURATION MENU), the IRIS BLUE fault codes are also coded according to the DRIVECOM communication profile.
The specific code is readable @ address 947 of the specific PROFIDRIVE PARAMETERS (see PROFIdrive COMMUNICATIONS BOARD USER MANUAL).

The DRIVECOM User Group e.V. is an association of international drive manufacturers, universities, and institutes. It has set itself a goal to develop a simple integration of drives in open automation systems. The DRIVECOM User Group therefore decided to standardise the communication interface for accessing drives..

Also visit www.drivecom.org.

Table 129: List of the DRIVECOM alarm codes

Code	Meaning	IRIS BLUE Alarm	#
0000	**No malfunction**	–	A000
1000	**General malfunction**		
		AutoTune Fault	A065
		No Output Phase	A129
2000	**Current**		
2300	Current on device output side		
2310	Continuous overcurrent		
2311	Continuous overcurrent No. 1	SW OverCurrent	A044
2312	Continuous overcurrent No. 2	PWMA1 Fault	A051
2320	Short circuit / earth leakage	PWMA Fault	A041
		PWMA0 Fault	A050
		PWMA Not ON	A053
3000	**Voltage**		
3100	Mains voltage		
3130	Phase failure	Mains Loss	A064
3200	Internal voltage		
3210	Internal overvoltage	OverVoltage	A048
3220	Internal undervoltage	UnderVoltage	A047
4000	**Temperature**	PT100 Channel 1 Fault	A105
		PT100 Channel 2 Fault	A106
		PT100 Channel 3 Fault	A107
		PT100 Channel 4 Fault	A108
4100	Ambient		
4110	Excess ambient temperature	Amb.Overtemp.	A109
4300	Drive temperature		
4310	Excess drive temperature	Drive OverHeated	A074
		HeatSink Overheated	A094
5000	**Device hardware**		
5111	U1 = supply +/– 15 V	±15V Loss	A087
5200	Control	Torque Off Not Safe	A140
5210	Measurement control	ADC Not Tuned	A088
5220	Computing circuit		
5300	Operating unit	Parm Lost Chk	A072
		Parm Lost COM1	A073
		MMI Trouble	A078
		KeyPad WatchDog	A081
		Parm Lost COM2	A089
		Parm Lost COM3	A090
5400	Power section	Fan Fault	A096
		2nd Sensor Fault	A099
5440	Contactors		
5441	Contactor 1 = manufacturer specific	Bypass Circuit Fault	A045
5442	Contactor 2 = manufacturer specific	Bypass Connector Fault	A046
5443	Contactor 3 = manufacturer specific	Bypass Circuit Open	A093
5500	Data storage		
5510	RAM	RAM Fault	A049

6000	**Device software**		
6010	Software reset (Watchdog)		
6100	Internal software	False Interrupt	A043
		Generic Motorola	A063
		1ms Interrupt OverTime	A071
		Illegal Hardware	A141
6200	User software	User Fault	A040
6300	Data record		
6301	Data record No. 1	SW Version KO	A092
6302	Data record No. 2	Option Board not in	A054
6303	Data record No. 3	Illegal XMDI in DGI	A042
6304	Data record No. 4	Illegal XMDI in DGO	A052
6305	Data record No. 5	Illegal XMDI in MPL	A057
7000	**Supplementary modules**		
7100	Power		
7120	Motor	Motor Not Connected	A097
7300	Sensor	PTC Alarm	A055
		PTC Short Circuit	A056
		REF < 4mA	A066
		AIN1 < 4mA	A067
		AIN2 < 4mA	A068
		XAIN5 < 4mA	A069
		REF > 20mA	A102
		AIN1 > 20mA	A103
		AIN2 > 20mA	A104
		XAIN5 > 20mA	A086
7301	Tacho fault		
		Speed Alarm	A076
7310	Speed	Ser WatchDog	A061
7500	Communication	SR1 WatchDog	A062
		Fbs WatchDog	A070
		Illegal Drive Profile Board	A095
		DLX Master Not On	A121
7510	Serial interface No. 1	DLX Timeout	A122
		DLX Error	A123
		Conflict Master	A124
8000	**Monitoring**		
8300	Torque control		
8311	Excess torque	Motor OverHeated	A075
9000	**General malfunction**		
		External Alarm 1	A083
		External Alarm 2	A084
		External Alarm 3	A085

58.5. Warnings

Warning messages are displayed on the display/keypad. They are flashing messages that usually appear in line 1 or 2 of the first three lines of the display.

NOTE Warnings are neither protections nor alarms, and are not stored to the fault list.

Some warnings simply state what's happening or suggest what to do when using the keypad.
However, most of the warning messages are **Coded warnings**: they are displayed with letter **"W" followed by two digits** stating which warning is active at that moment. Example:

W	3	2		O	P	E	N			E	N	A	B	L	E

Warning messages are detailed in the following section.

58.6. Warning List

Table 130: Warning list

Warning	Message	Description
W03	SEARCHING…	The user interface is searching the data of the next page to display.
W04	DATA READ KO	Software warnings concerning data reading.
W06	HOME SAVED	The page displayed has been saved as the home page displayed at power on.
W07	DOWNLOADING	The keypad is **writing** to the drive the WORK zone parameters saved on its own flash memory.
W08	UPLOADING	The keypad is **reading** from the drive the WORK zone parameters that will be saved on its own flash memory.
W09	DOWNLOAD OK	Parameters were successfully downloaded (**written**) from the keypad to the drive.
W11	UPLOAD OK	Parameters were successfully uploaded (**read**) from the drive to the keypad.
W12	UPLOAD KO	The keypad interrupted parameter upload to the drive. Parameter **reading** has failed.
W13	NO DOWNLOAD	A Download procedure was queried, but no parameter is saved to the flash memory.
W16	PLEASE WAIT…	Wait until the system completes the operation required.
W17	SAVE IMPOSSIBLE	Parameter save is not allowed.
W18	PARAMETERS LOST	The keypad interrupted parameter download to the drive. Parameter **writing** has failed. As a result, not all parameters have been updated (parameter inconsistency).
W19	NO PARAMETERS LOAD	UPLOAD impossible.
W20	NOT NOW	The required function is not available at the moment.
W21	CONTROL ON	The required function is inhibited because the drive is running: **ENABLE-A** and **ENABLE-B** are active.
W23	DOWNLOAD VER. KO	Download failed because parameters saved to keypad memory relate to a SW version or product ID incompatible with the drive SW version or product ID.
W24	VERIFY DATA	Download preliminary operation underway, the system is checking the integrity and compatibility of the parameters saved in the keypad memory.
W28	OPEN START	Open and close the **START** signal to start the drive.
W32	OPEN ENABLE	Open and close the **ENABLE-A** and **ENABLE-B** signals to enable the drive.
W33	WRITE IMPOSSIBLE	Writing procedure impossible.
W34	ILLEGAL DATA	Illegal value entered, operation failed.
W35	NO WRITE CONTROL	Writing procedure impossible because Control is active and the drive is running.
W36	ILLEGAL ADDRESS	Illegal address entered, operation failed.
W37	ENABLE LOCKED	The drive is disabled and does not acknowledge the **ENABLE-A** and **ENABLE-B** commands because it is writing a **Cxxx** parameter. **CAUTION: The drive will start up as soon as writing is over!!!**

Warning	Message	Description
W38	LOCKED	Editing mode cannot be accessed because parameter modification is disabled: **P000** is different from **P002**.
W40	FAN FAULT	Fan locked or disconnected or faulty.
W41	SW VERSION KO	Download impossible because of different SW Versions.
W42	IDP KO	Download impossible because of different IDPs (Identification Products).
W43	PIN KO	Download impossible because of different PINs (Part Identification Numbers).
W44	CURRENT CLASS KO	Download impossible because of different current classes.
W45	VOLTAGE CLASS KO	Download impossible because of different voltage classes.
W46	DOWNLOAD KO	Download impossible (generic cause).
W47	SERIAL TIMEOUT	Master-Slave connection failure in case of control via serial link
W48	OT Time over	The preset threshold for the drive Operation Time has been exceeded.
W49	ST Time over	The preset threshold for the drive Supply Time has been exceeded.
W50	NTC Fault	NTC sensor for heatsink temperature disconnected or faulty.
W51	DRY RUN	Dry-run condition detected.
W52	PRESSURE LOSS	Pressure loss for leakage or breakage in the hydraulic circuit.

58.7. State List

Table 131: State list

Number	State	Description
0	ALARM!!!	Alarm tripped
1	START UP	The drive is starting up
2	MAINS LOSS	Mains loss
3	TUNING	The drive is tuning
4	SPEED SEARCHING	Searching for motor speed
5	DCB at START	DC Braking at start
6	DCB at STOP	DC Braking at stop
7	DCB HOLDING	DC current for Hold function
8	DCB MANUAL	Manual DC Braking
9	LIMIT IN ACCEL.	Current/torque limit while accelerating
10	LIMIT IN DECEL.	Current/torque limit while decelerating
11	LIMIT IN CONSTANT RPM	Current/torque limit at constant rpm
12	BRAKING	Braking module startup or deceleration ramp extension
13	CONSTANT RUN	Drive running at speed set point
14	IN ACCELERATION	Drive running with motor in acceleration stage
15	IN DECELERATION	Drive running with motor in deceleration stage
16	INVERTER OK	Drive on Stand-by with no alarms tripped
17	FLUXING	Motor fluxing stage
18	MOTOR FLUXED	Motor fluxed
19	FIRE MODE RUN	Constant rpm in Fire Mode
20	FIRE MODE ACCEL.	Acceleration in Fire Mode
21	FIRE MODE DECEL.	Deceleration in Fire Mode
22	INVERTER OK*	Drive on Stand-by with no alarms tripped; void warranty due to alarm trip in Fire Mode
25	SPARE	Board in Spare mode
27	WAIT NO ENABLE	Waiting for opening **ENABLE-A** and **ENABLE-B** commands
28	WAIT NO START	Waiting for opening **START** command
29	PIDOUT min DISAB	Drive disabled due to PID output < Min.
30	REF min DISAB.	Drive disabled due to REF < Min.
31	IFD WAIT REF.	Drive enabled with IFD control waiting for reference in order to start
32	IFD WAIT START	Drive enabled with IFD control waiting for START in order to start
33	DISABLE NO START	When fluxing, the RUN command was not given within the max. time set in **C183**. The drive is kept disabled until the RUN command is given.
34	MASTER NOT USED	The plant is operating with the Master drive stopped
35	REG. TIMEOUT	Downtime is occurring due to adjustment timeout (see [PAR] Adjusting Timeout Menu).

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