

UM2787

User manual

Getting started with the X-CUBE-DISPLAY STM32Cube Expansion Package

Introduction

This user manual gives an overview of the X-CUBE-DISPLAY Expansion Package and explains how to get started in STM32CubeMX.

The X-CUBE-DISPLAY Expansion Package enables display and user interface features on top of STM32 Nucleo-64 and Nucleo-144 boards. Various user interfaces are supported by the X-CUBE-DISPLAY Expansion Package such as LCD controllers, touch panel, user buttons, joystick, external memories, and others.

The X-CUBE-DISPLAY Expansion Package supports the X-NUCLEO-GFX01M1, X-NUCLEO-GFX01M2, and X-NUCLEO-GFX02Z1 expansion boards, offering the needed drivers as well as simple examples.

The X-CUBE-DISPLAY main features are:

- Software building block supporting the addition of display expansion boards to Nucleo-64 and Nucleo-144 boards, including
 - drivers for the supported LCD controllers
 - drivers for the supported external flash memories
- Simple "hello world" example available on
 - the X-NUCLEO-GFX01M1 expansion board connected to the NUCLEO-G071RB or NUCLEO-L476RG Nucleo-64 development board
 - the X-NUCLEO-GFX01M2 expansion board connected to the NUCLEO-G071RB or NUCLEO-WB55RG Nucleo-64 development board
 - the X-NUCLEO-GFX02Z1 expansion board connected to the NUCLEO-L4R5ZI or NUCLEO-U575ZI-Q Nucleo-144 development board
- FreeRTOS[™] examples available on
 - the X-NUCLEO-GFX01M1 expansion board connected to the NUCLEO-L476RG Nucleo-64 development board
 - the X-NUCLEO-GFX02Z1 expansion board connected to the NUCLEO-L4R5ZI Nucleo-144 development board
- Azure[®] RTOS ThreadX examples available on
 - the X-NUCLEO-GFX02Z1 expansion board connected to the NUCLEO-U575ZI-Q Nucleo-144 development board
- Easy portability across STM32 microcontrollers with STM32CubeMX in the STM32Cube ecosystem
- Free and user-friendly license terms

Figure 1. X-CUBE-DISPLAY running on NUCLEO-G071RB equipped with X-NUCLEO-GFX01M1





Picture is not contractual

1 General information

This user manual briefly describes the X-CUBE-DISPLAY Expansion Package. It focuses on X-CUBE-DISPLAY usage. It does not explain the LCD controllers and the input devices.

Table 1 presents the definitions of the acronyms that are relevant for a better understanding of this document.

Acronym	Definition
API	Application programming interface
BSP	Board support package
FMC	Flexible memory controller
HAL	Hardware abstraction layer
IDE	Integrated development environment
LCD	Liquid-crystal display
SPI	Serial peripheral interface
UIX	User interaction and experience

Table 1. List of acronyms

The X-CUBE-DISPLAY Expansion Package runs on STM32 32-bit microcontrollers based on the Arm[®] Cortex[®] processor. Some of its examples run with the FreeRTOS[™] or Azure[®] RTOS ThreadX middleware.

Note:

Arm is a registered trademark of Arm Limited (or its subsidiaries) in the US and/or elsewhere. FreeRTOS is a trademark of Amazon in the United States and/or other countries. Azure is a trademark of the Microsoft group of companies.

arm

2 Package description

This section details the X-CUBE-DISPLAY Expansion Package contents and how to use it.

2.1 General description

The X-CUBE-DISPLAY Expansion Package provides simple and generic support software for the X-NUCLEO-GFX01M1, X-NUCLEO-GFX01M2, and X-NUCLEO-GFX02Z1 expansion boards. It runs on the STM32 microcontroller.

The following integrated development environments are supported:

- IAR Systems[®] IAR Embedded Workbench[®] for Arm[®] (EWARM)
- Keil[®] Microcontroller Development Kit for Arm[®]-based microcontrollers (MDK-ARM)
- STMicroelectronics STM32CubeIDE

Note: Refer to the release note available in the root folder of the delivery package for information about the IDE versions supported.

2.2 Architecture

The software runs on STM32 Nucleo-64 and Nucleo-144 boards. It allows the display and control of graphics and texts via add-on display, memories, and controlling modules.

The package is split into the following components:

- LCD controllers
- External memories
- Buttons and joysticks

2.2.1 Architecture concept

This section provides a high-level view of the software architecture to support the display expansion boards.



The display expansion boards expose three main interfaces to applications:

- Display interface: via LCD controllers or dedicated display bus
- External memory interface: external memory devices to store graphical assets
- User interface: touch panel, joystick, and buttons

The LCD IO layer abstracts the actual hardware bus interface used with the LCD controller.

The MEM_IO layer abstracts the actual hardware bus interface used with external memory devices.

The KEY IO layer abstracts the actual hardware button interface used with the expansion board.



2.3 X-CUBE-DISPLAY Expansion Package contents

The X-CUBE-DISPLAY Expansion Package is an expansion for STM32CubeMX with the following main characteristics:

- It complies with the STM32CubeMX architecture recommendation (code generator and folders)
- It expands STM32CubeMX to enable the development of UIX applications
- It is based on STM32CubeHAL, which is the hardware abstraction layer for STM32 microcontrollers

The software components used by the application software to exchange with remote applications are the following ones:

• **STM32CubeHAL**: the HAL driver layer provides a generic multi-instance simple set of APIs (application programming interfaces) to interact with the upper layers (application, libraries, and stacks).

It is composed of generic and extension APIs. It is directly built around a generic architecture and allows the layers that are built upon, such as the middleware layer, to implement their functionalities without dependencies on the specific hardware configuration for a given microcontroller.

This structure improves the library code reusability and guarantees easy portability onto other devices.

- Configuration files:
 - lcd_conf.h defines the mapping of the GPIO and hardware interface specific to a logical name to ease software porting to another board. It provides also the configuration for the hardware bus interface (for example SPI) to be used for communication with the LCD controller.
 - mem_conf.h defines the mapping of the GPIO and hardware interface specific to a logical name to ease software porting to another board. It provides also the configuration for the hardware bus interface (for example SPI) to be used for communication with the external memory device.
 - key_conf.h defines the mapping of the GPIO specific to a logical name to ease software porting to another board. It provides the GPIO configurations to be used to provide controls for the user.
- **Example projects**: This release provides the "hello world" examples for the board associations listed in the table below.

STM32 Nucleo boarde		Expansion boards				
3110132		X-NUCLEO-GFX01M1	X-NUCLEO-GFX01M2	X-NUCLEO-GFX02Z1		
	NUCLEO-G071RB	Yes	Yes	-		
Nucleo-64	NUCLEO-L476RG	Yes	-	-		
	NUCLEO-WB55RG	-	Yes	-		
Nucleo 111	NUCLEO-L4R5ZI	-	-	Yes		
1100100-144	NUCLEO-U575ZI-Q	-	-	Yes		

Table 2. Board associations demonstrated in X-CUBE-DISPLAY



3 Sample application description

This section provides a short overview of the sample applications and examples included in X-CUBE-DISPLAY. The sample applications and examples

- are ready-to-use projects that can be generated with STM32CubeMX for any supported STM32 Nucleo-64 or Nucleo-144 board used together with the X-NUCLEO-GFX01M1, X-NUCLEO-GFX01M2, or X-NUCLEO-GFX02Z1 expansion board
- show the users how to use the APIs to initialize correctly and use the X-NUCLEO-GFX01M1, X-NUCLEO-GFX01M2, and X-NUCLEO-GFX02Z1 peripherals

3.1 GFX01M1_HelloWorld application

This application provides a "hello world" example that configures the LCD controller and displays an image stored in the X-NUCLEO-GFX01M1 expansion board external memory. The example provides controls to the user through the joystick buttons.

3.2 GFX01M2_HelloWorld application

This application provides a "hello world" example that configures the LCD controller and displays an image stored in the X-NUCLEO-GFX01M2 expansion board external memory. The example provides controls to the user through the joystick buttons.

3.3 GFX02Z1_HelloWorld application

This application provides a "hello world" example that configures the LCD controller and displays an image stored in the X-NUCLEO-GFX02Z1 expansion board external memory. The example provides controls to the user through the joystick buttons.

3.4 GFX01M2_FreeRTOS application

This application is similar to GFX01M2_HelloWorld with the exception that it runs with FreeRTOS[™].

3.5 GFX02Z1_FreeRTOS application

This application is similar to GFX02Z1_HelloWorld with the exception that it runs with FreeRTOS[™].

3.6 GFX02Z1_ThreadX application

This application is similar to GFX02Z1_HelloWorld with the exception that it runs with Azure[®] RTOS ThreadX.



4 Installing X-CUBE-DISPLAY in STM32CubeMX

After downloading (from *www.st.com*), installing and launching STM32CubeMX (V6.0.0 or above), the X-CUBE-DISPLAY package can be installed following the few steps described below.

Step 1. From the menu, select [Help]>[Manage embedded software packages].

Figure 3. Managing embedded software packages in STM32CubeMX STM8 0 🧕 🖪 🖸 🄰 🔆 🖅 File Window Help Help At About Tutorial Videos Refresh Data A8-1 **Existing Projects** Ne Manage software installations At-User Preferences heck for Updates AI-C lanage embedded spftware packages AI-U **Open Existing Projects** 2 Check for STM32CubeMX and embedded softwar. ettings . ided software package releases. DATES sk for ne Start My project from MCU Install or remove embedded software packages Start My project from ST Bo. Start My project from Exam. EXAMPLE SELEC SIL Build your certified safety system with STM32 and STM8 57

- 2. From the Embedded Software Packages Manager window, press the [Refresh] button to get the
- Step 2. From the Embedded Software Packages Manager window, press the [Refresh] button to get the updated add-on package list. Go to the STMicroelectronics tab to find the X-CUBE-DISPLAY package.

Figure 4. Installing the X-CUBE-DISPLAY package in STM32CubeMX

🛄 Emb	bedded Software Packages Manager X							
	STM32Cube MCU Packages and embedded software packs releases							
•	Releases Information was last refreshed 2 days ago.							
ST ST	M32Cube	MCU Packages 🏼 🌆	7 STMicroelectroni	cs ARM TaraS	ystems			
	Status	Description					Availa	ble Version
٠		X-CUBE-AI						
•		X-CUBE-ALGOBU	ILD					
•		X-CUBE-BLE1						
•		X-CUBE-BLE2						
•		X-CUBE-DISPLAY	Da					
•		X-CUBE-GNSS1						
٠		X-CUBE-MEMS1						
F		X-CUBE-NFC4						
Detail	s							
Expan	sion Pack	for display modules						
From	n Local	From Url			Refresh	Install Now	Remove Now	Close

Step 3. Checking the corresponding checkbox to select X-CUBE-DISPLAY and install it by pressing the [Install Now] button. Once the installation is completed, the corresponding box becomes green, the [Close] button can be pressed, and the configuration of a new project can start.

Figure 5. The X-CUBE-DISPLAY package in STM32CubeMX

🛄 Emb	bedded Software Packages Manager					
	STM32Cube MCU Packages and embedded software packs releases					
- 🕀	Release					
477 ST	M32Cube	MCU Packages AT STMicroelectronics ARM TaraSystems				
	Status	Description	Available Version			
٠		X-CUBE-AI				
•		X-CUBE-ALGOBUILD				
•		X-CUBE-BLE1				
Þ		X-CUBE-BLE2				
•		X-CUBE-DISPLAY				
-		Expansion Pack for display modules	1.0.0			
٠		X-CUBE-GNSS1				
•		X-CUBE-MEMS1				
Detail	s					
Expan	ision Pack	for display modules				
From	n Local	From Url Refresh Install Now Rem	ove Now			



5 Starting a new project

After launching STM32CubeMX, start a new project as described in the steps below. **Step 1.** Choose to start a new project from the *MCU Selector* or *Board Selector*.

Figure 6. STM32Cu	beMX main page
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STM32CubeMX Unit	led			- a ×
STM 22	File	Window	Help	🎯 🖪 💶 🄰 🔆 🖅
Home				
Existing	Projects		New Project	Manage software installations
Open Ex	isting Projects	E 2	I need to :	Check for STM32CubeMX and embedded softwar
				CHECK FOR UPDATES
			Start My project from MCU ACCESS TO MCU SELECTOR	Install or remove embedded software packages
			÷	INSTALL / REMOVE
			Start My project from ST Bo	
			ACCESS TO BOARD SELECTOR	
			Start My project from Exam.	
			ACCESS TO EXAMPLE SELECTO	R SIL ASIL ClassB Pogean
				Ready Ready Ready
				Build your certified safety system
				with STM32 and STM8

Step 2. Select the desired STM32 microcontroller or platform from the pop-up *MCU Selector* or *Board Selector* window.

Figure 7. STM32CubeMX Board Selector window example

UNIDII Calaster Decad Cal	antes 5		Course Coloriso						
U/MPU Selector Board Sel	ector E	Example S	elector Cross Selector						
pard Filters									
* 🗋 🛱	3		Features	Large Picture	Docs & Resource	s 🕒 Datasł	heet 🖸	Buy	E+ Start Project
Commercial Part Number NUCLEO-G0		~	STM32G0 Series						
Vendor		>	NUCLEO	-G071RB	STMicroelectronics NUCLEO	-G071RB Board Suppor	t and Examples		
Tune		>	ACTIVE Active		Part Number : NUCLEO-G071RB		Unit Price (US\$):	10.32	
1 ype			Product is in mass production	ń	Commercial Part Number : NUCLEO-GO	71RD	Mounted Device :	STM32G071RBTx	
Price = 10.32 Oscillator Freq. = 0 (MHz)		_		edema The Ac develop The ST Packag	I SMPS significantly reduces power con suno™ Uno V3 connectivity support an innent platform with a wide choice of sp M32 Nucleo-64 board does not require M32 Nucleo-64 board comes with the 5 e.	sumption in Run mode. d the ST morpho headers allo coalized shields. any separate probe as it inter TM32 comprehensive free sol	w the easy expansion of grates the ST-LINK debu fixare libraries and exam	the functionality of gger/programmer, ples available with	the STM32 Nucleo open the STM32Cube MCU
Peripheral ØAccelerometer	0	0		Featur	res On-board ST-LINKV2-1 USB VBUS, ext. VN, ext. 5V, ext +3.3V				
Peripheral Accelerometer Analog I/O	0	0		Feature International	res On-board ST-LINKV2-1 USB VBUS, ext. VN, ext. 5V, ext +3.3V				
Peripheral O Accelerometer O Analog I/O O Arduino Form Factor	0	0	Boards List: 3 items	Featur T	res On-board ST-LNKV2-1 USB VBUS, ed. VN, ed. 5V, ed.+3.3V				🔥 Expor
Peripheral ② Accelerometer ③ Analog I/O ③ Arduino Form Factor ③ Audio Line In	0 0 0 0 0		Boards List: 3 items	Overview X	Commercial Part No *	Type X	Marketing Status >	Unit Price (U	t Expor
Peripheral Accelerometer Analog I/O Arduino Form Factor Audio Line In Audio Line Out	0 0 0 0 0 0 0 0	> 0 0 0 0	Boards List: 3 items	Overview X	res On-board ST-LINKV2-1 USB VBUS, ert. VN, ert. SV, ert +3.3V Commercial Part No	Туре Х	Marketing Status >	(Unit Price (U	Expor Style Key Mounted Device
Peripheral Accelerometer Analog I/O Arduino Form Factor Audio Line In Audio Line Out Battery Period	0 0 0 0 0		Boards List: 3 items	Overview X	res On-board ST-LINKV2-1 USB VBUS, et. VN, et. 5V, et. +3 3V Commercial Part No *	Type ×	Marketing Status >	Unit Price (U	C Expor JS\$) X Mounted Device STM320031K8Tx
Peripheral Accelerometer Analog I/O Analog I/O Audio Line In Audio Line Out Battery Batton Com	0 0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 2	Boards List: 3 items	Overview X	res On-board ST-LINKV2-1 USB VBUS, ext. Vit, ext. 5V, ext. +3.3V Commercial Part No - JCLEO-G031K8	Type X Nucleo-32	Marketing Status > Active	Unit Price (U	Expor ISS) X Mounted Device STM320001K8Ty
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Peripheral Accelerometer Analog I/O Ardulus Form Factor Audio Line In Audio Line Out Battery Can Can Can Canera Comera Com	0 0 0 0 0 0	0 0 0 0 0 0 0 0 0 0	Boards List: 3 items	Coverview X N	res On board \$14,990/2-1 UBX VIXIS, ed. VM, ed. 59, ed. 43 3V Commercial Part No. UCLEO-G031K8 UCLEO-G070RB	Type X Nucleo-32	Marketing Status > Active	Unit Price (U 10.32	Expor SS) X Mounted Device STM320031K8Tx STM3200708BTx
Peripheral Accelerometer Acadiog I/O Anduion Form Factor Audio Line Out Battery Batteny CAN CAN Cannera Compass Custor Form Factor		0 0 0 0 0 0 2 0 0 0 0	Boards List: 3 items	Cverview X X X X X X X X X X X X X X X X X X X	rea On about ST LUBNY2-1 SUBNYRUS, ext VX, ext 5V, ext +3 3V Commercial Part No 1 UCLEO-G031K8 UCLEO-G0370RB	Type X Nucleo-32	Marketing Status > Active Active	Unit Price (U 10.32	Export 155) X Mounted Davided STM320031K8Tx STM320070R8Tx
Peripheral Accelerometer Acadiog I/O Arduino Form Factor Addio Line In Addio Line Out Battery Button CAN Cannera Compass Cosmo Form Factor Digital I/O	0 0 0 0 0 0 0 0 0	0 0 0 0 0 0 2 0 0 0 0 0 0 0	Boards List: 3 items	Cverview X	commercial Part No Commercial Part	Type X Nucleo-32	Marketing Status > Active Active	Unit Price (U 10.32 10.32	Export SSTM320031K87x STM320070R87x STM320070 STM320070R87X STM320070 STM3200
Peripheral Accelerometer Accelerometer Acado Line In Audio Line In Audio Line Out Battery Cannea Cannea Cannea Compass Custom Form Factor Digital I/O Ethemet		0 0 0 0 0 2 0 0 0 0 0 0 0 0 0 108	Boards List: 3 items	Cvertview ×	es On Docard 51,219(V2-1 USBV VIX.9, et 31,419(V2-1 UCLEO-G031K8 UCLEO-G031K8 UCLEO-G070R8 D	Nucleo-84	Marketing Status X Active Active Active	C Unit Price (U 10.32 10.32 10.32	Expor STM320011K81x STM320070881x STM320070881x STM320071881x





Step 3. Select the microcontroller or the board to display the pinout of the corresponding STM32 microcontroller.

From the window, the user can set up the project by adding one or more additional software and peripherals, and configuring the clock.



Figure 8. STM32CubeMX Pinout & Configuration window

Step 4. Select the [Software Packs]>[Select Components] menu to add X-CUBE-DISPLAY as additional software to the project.



Figure 9. STM32CubeMX Software Packs window

Select a display expansion board from the [Extension Board DISPLAY] selector in Software Packs Step 5. Component Selector and resolve its dependencies with the support of STM32CubeMX. In the example illustrated in Figure 10, expansion board X-NUCLEO-GFX01M1 is selected.

MX Software Packs Component Selector					
Packs					
🚍 🗞 🕕 🗦					
Pack / Bundle / Component	Status	Versio	n	Selection	
STMicmelectronics X-CUBE-AZRTOS-G4	10	1004		Install	
STMicroelectronics X-CUBE-AZRTOS-H7	101	2100	\sim	Install	
STMicroelectronics X-CUBE-AZRTOS-L4	10	100			
STMicroelectronics X-CUBE-AZRTOS-L5	10	100			
> STMicroelectronics.X-CUBE-AZRTOS-WL	ö	1.0.0 🖬		Install	
> STMicroelectronics.X-CUBE-BLE1		6.2.3 👜	\sim	Install	
> STMicroelectronics.X-CUBE-BLE2		3.2.2 🕒	~	Install	
STMicroelectronics.X-CUBE-DISPLAY	\odot	2.2.0	\sim		
✓ Extension Board DISPLAY	⊘	2.2.0			
GFX01M1		2.2.0			
GFX01M2	0	2.2.0			
GFX02Z1		2.2.0			
V Device Application	\odot	2.2.0			
Application	\odot	2.2.0		GFX01M2_HelloWorld ~	\sim
✓ Board Part LCD	\odot	2.2.0			
Custom				Not selected ~	\sim
ILI9341				Not selected ~	\sim
ST7789V	\odot	2.2.0		SPI V	\sim
	\odot	2.2.0			
Custom				Not selected ~	\sim
MX25L6433F	\odot	2.2.0		SPI ~	\sim
> STMicroelectronics.X-CUBE-EEPRMA1		3.1.1 😐	\sim	Install	
> STMicroelectronics.X-CUBE-GNSS1		6.0.0	\sim		
> STMicroelectronics.X-CUBE-MEMS1		9.2.0 🗎	\sim	Install	
> STMicroelectronics.X-CUBE-MEMS1		9.2.0 🗎	~	Install	

Figure 10. STM32CubeMX Software Packs Component Selector window

Select the [Device Application] for the selected display expansion board among the possible ones Step 6. automatically filtered and proposed by STM32CubeMX.

In the example illustrated in Figure 10, application GFX01M2_HelloWorld is proposed for expansion board X-NUCLEO-GFX01M2.

Step 7. Press the [OK] button to return to STM32CubeMX Pinout view.

To enable and configure the selected X-CUBE-DISPLAY modules ([Extension Board GFX01M1], [Device Application], or both), select [STMicroelectronics.X-CUBE-DISPLAY.2.0.0] in *Software Packs* from the *Categories* list.



Figure 11. STMicroelectronics.X-CUBE-DISPLAY selection

Step 8. Enable display modules

Figure 12. Display modules enabled



Step 9. Configure the selected interfaces: LCD, memory, and keys.

Step 9a. Parameters for FMC display and Quad-SPI flash memory.

	Configuration	
Reset Configuration		
risson sonngalation		
Parameter Settings Subser Constants Settings	Platform Settings	
Configure the below parameters :		
Q Search (Ctrl+F) 🔇 🕥		0
 Common Parameters 		
Real-Time Operating System	No OS	
✓ Display Parameters		
Bus Type	Parallel FMC	
FMC Bank ID	FMC Bank 1	
FMC Base Address	0×6000000	
GPDMA Instance	GPDMA1 Channel 13	
Number of Cache lines	80	
Tearing Effect Event Source	LCD TE Pin	
Tearing Effect Mode	Mode 1	
Tearing Effect Scanline	0	
Use HW Timer for line counting		
Swap Red and Blue		
Big Endian		
 External Memory Parameters 		
Bus Type	Octo SPI	
Instance	OCTOSPI1	
Memory Base Address	0×9000000	
Memory Mapped Mode		
 External Memory Configuration 		
Dummy Read Cycles	8	
Dummy Dual Read Cycles	4	
Dummy Quad Read Cycles	6	
 Joystick Configuration 		
COMMON Pin level	Low	

Figure 13. FMC display and Quad-SPI flash memory parameters

Step 9b. Parameters for SPI display and SPI flash memory.

	Configuration	
Reset Configuration		
🗢 Parameter Settings 🛛 📀 User Constants	⊘ Platform Settings	
Configure the below parameters :		
Q Search (Ctrl+F) ③ ③		0
✓ Common Parameters		
Real-Time Operating System	No OS	
✓ Display Parameters		
Bus Type	SPI	
Number of Cache lines	24	
Tearing Effect Event Source	LCD TE Pin	
Tearing Effect Mode	Mode 1	
Tearing Effect Scanline	0	
Use HW Timer for line counting		
Swap Red and Blue		
Big Endian	V	
 External Memory Parameters 		
Bus Type	SPI	
Memory Base Address	0×9000000	
 Joystick Configuration 		
COMMON Pin level	Low	

Figure 14. SPI display and SPI flash memory parameters

Step 9c. Platform settings.

		Config	uration		
Reset Configurat	tion				
📀 Parameter Sett	ings 🛛 🥺 User Constants	🛛 🛛 Platform	n Settings		
Platform proposal –					
Name IP	or Components		Found Solutions		BSP API
Key Right Pin GF	PIO:Input	\sim	PA0 [KEY_RIGHT]	```	- Unknown
Key Left Pin GF	PIO:Input	\sim	PA4 [KEY_LEFT]	```	- Unknown
Key Down Pin GF	PIO:Input	\sim	PA15 [KEY_DOWN]	```	- Unknown
Key Center Pin GF	PIO:Input	\sim	PA9 [KEY_CENTER]	```	- Unknown
Key Up Pin GF	PIO:Input	\sim	PC2 [KEY_UP]	```	- Unknown
MX25L6433F					
Name	IPs or Components		Found Solutions	BS	P API
Memory CS Pin	GPIO:Output	~	PC13 [SPIB_NCS]	∨ Unkr	nown
Memory BUS IO dr	river SPI:Full-Duplex Master	~	SPI2	✓ BSP	_BUS_DRIVER
ILI9341					
Name	IPs or Components		Found Solutions	BS	P API
LCD RESET Pin	GPIO:Output	~	PC1 [DISP_NRESET]	∨ Unkr	nown
LCD TE HSync Tin	ner TIM:Internal Clock	~	TIM2	 ✓ Unkr 	nown
LCD BUS IO driver	SPI:Full-Duplex Master	~	SPI1	✓ BSP	_BUS_DRIVER
LCD TE Pin	GPIO:EXTI	~	PC0 [DISP_TE]	✓ HAL	EXTI_DRIVER
LCD CS Pin	GPIO:Output	~	PC12 [SPIA_NCS]	∨ Unkr	nown
LCD DCX Pin	GPIO:Output	~	PA8 [SPIA_DCX]	∨ Unkr	nown

Figure 15. Platform settings

Revision history

Table 3. Document revision history

Date	Revision	Changes
18-Dec-2020	1	Initial release.
1-Dec-2021	2	 Extended the document scope to the support of the X-NUCLEO-GFX01M2 and X-NUCLEO-GFX02Z1 display expansion boards and their associated examples: Updated Introduction, Package description, and Starting a new project Added GFX01M2_HelloWorld application and GFX02Z1_HelloWorld application
2-Sep-2022	3	 Updated for X-CUBE-DISPLAY version 2.2.0 with the addition of examples running on the FreeRTOS[™] and Azure[®] RTOS ThreadX middleware: Updated Introduction Updated Figure 10, Figure 13, Figure 14, and Figure 15 in Starting a new project Added GFX01M2_FreeRTOS application, GFX02Z1_FreeRTOS application, and GFX02Z1_ThreadX application

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