

Getting started with the X-NUCLEO-LED12A1 LED driver expansion board based on LED1202 for STM32 Nucleo

Introduction

The X-NUCLEO-LED12A1 LED driver expansion board for STM32 Nucleo features four LED1202 devices that can drive up to 48 LEDs.

The LED1202 is a 12-channel low quiescent current LED driver, which guarantees 5 V output driving capability. Each channel is able to provide up to 20 mA with a headroom voltage of 350 mV (typ.) only.

The output current can be adjusted separately for each channel through an 8-bit analog and 12-bit digital dimming control.

The X-NUCLEO-LED12A1 expansion board comes with an additional LED panel board that houses two LEDs matrices: a 6x8 white LED matrix and a 4x4 RGB matrix.

LED matrices can be supplied via an external power supply connected to J13 connector and by selecting the right path through J15 jumper to reach the maximum luminosity available.

Figure 1. X-NUCLEO-LED12A1 expansion board

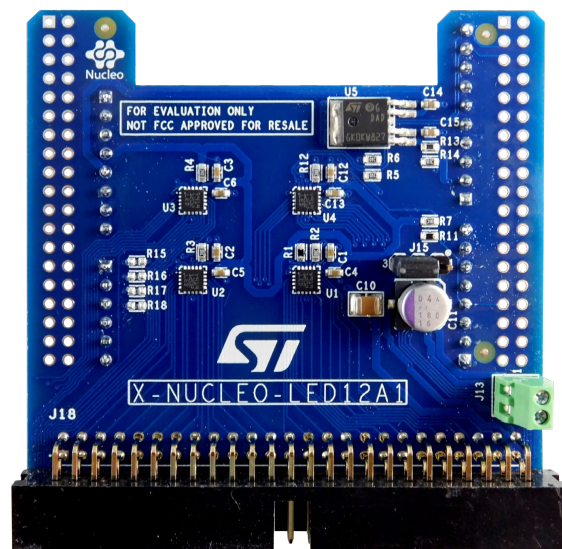
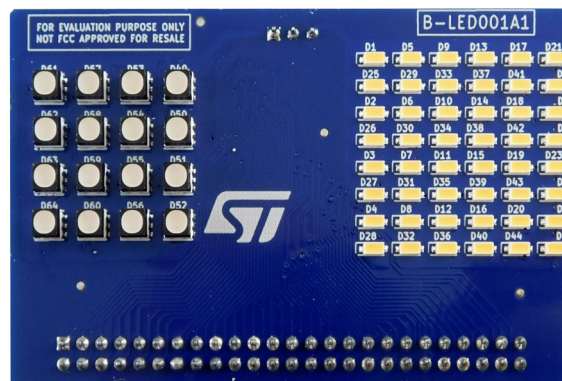


Figure 2. LED panel board



1 Getting started

1.1 Overview

The [X-NUCLEO-LED12A1](#) expansion board features:

- Four [LED1202](#) devices driving up to 48 LEDs
- One double row pin array connector for external LED panel connection
- One jumper selector for internal/external LED power supply
- One panel with 48 white LEDs/16 RGB LEDs included
- Arduino UNO R3 connectors
- Free comprehensive development firmware library compatible with [STM32Cube](#)
- Scalable solution for multiple board stack
- RoHS and WEEE compliant

1.2 Hardware requirements

The [X-NUCLEO-LED12A1](#) expansion board is designed to be used with any [STM32 Nucleo](#) development board, although complete testing has been performed using the [NUCLEO-L073RZ](#) hosting the [STM32L073RZ](#) microcontroller.

1.3 System requirements

To use [STM32 Nucleo](#) development boards with the [X-NUCLEO-LED12A1](#) expansion board, the following software and hardware are required:

- an [STM32 Nucleo-64](#) development board
- a Windows® PC to install the firmware package
- a USB type A to Mini-B USB cable to connect the [STM32 Nucleo](#) board to the PC
- 128 MB of RAM and 40 MB of free hard disk space to install the firmware package (order code: [X-CUBE-LED12A1](#))

2 Connectors

The X-NUCLEO-LED12A1 expansion board allows the user to test the functionality of the LED1202, together with the use of the additional LED panel board.

The 4 LED1202 ICs and the STM32 Nucleo development board are connected through CN5, CN6, CN8 and CN9 connectors (see the tables below).

Table 1. Interconnections between X-NUCLEO-LED12A1 expansion board and NUCLEO-L073RZ development board (left side)

Signal	Connector	Pin number	NUCLEO-L073RZ	X-NUCLEO-LED12A1
NC	CN6 Power	1	-	-
IOREF		2	-	(NC)
RESET		3	-	-
3V3		4	-	3V3
5V		5	-	5V (VDD)
GND		6	-	GND
GND		7	-	GND
VIN		8	-	-
A0	CN8 Power	1	PA0	IRQ_MCU (alt.)
A1		2	PA1	IRQ_MCU (alt.)
A2		3	PA4	IRQ_MCU (alt.)
A3		4	PB0	IRQ_MCU (alt.)
A4		5	PC1	NC
A5		6	PC0	NC

Table 2. Interconnections between X-NUCLEO-LED12A1 expansion board and NUCLEO-L073RZ development board (right side)

Signal	Connector	Pin number	NUCLEO-L073RZ	X-NUCLEO-LED12A1
D15	CN5 Digital	10	PB8	SCL_MCU
D14		9	PB9	SDA_MCU
AVDD		8	AVDD	NC
GND		7	GND	NC
D13		6	PA5	NC
D12		5	PA6	NC
D11		4	PA7	NC
D10		3	PB6	NC
D9		2	PC7	NC
D8		1	PA9	NC
D7	CN9 Digital	8	PA8	NC
D6		7	PB10	NC
D5		6	PB4	NC
D4		5	PB5	NC

Signal	Connector	Pin number	NUCLEO-L073RZ	X-NUCLEO-LED12A1
D3	CN9 Digital	4	PB3	IRQ_MCU
D2		3	PA10	NC
D1		2	PA2	NC
D0		1	PA3	NC

3 Host interface and GPIO connection

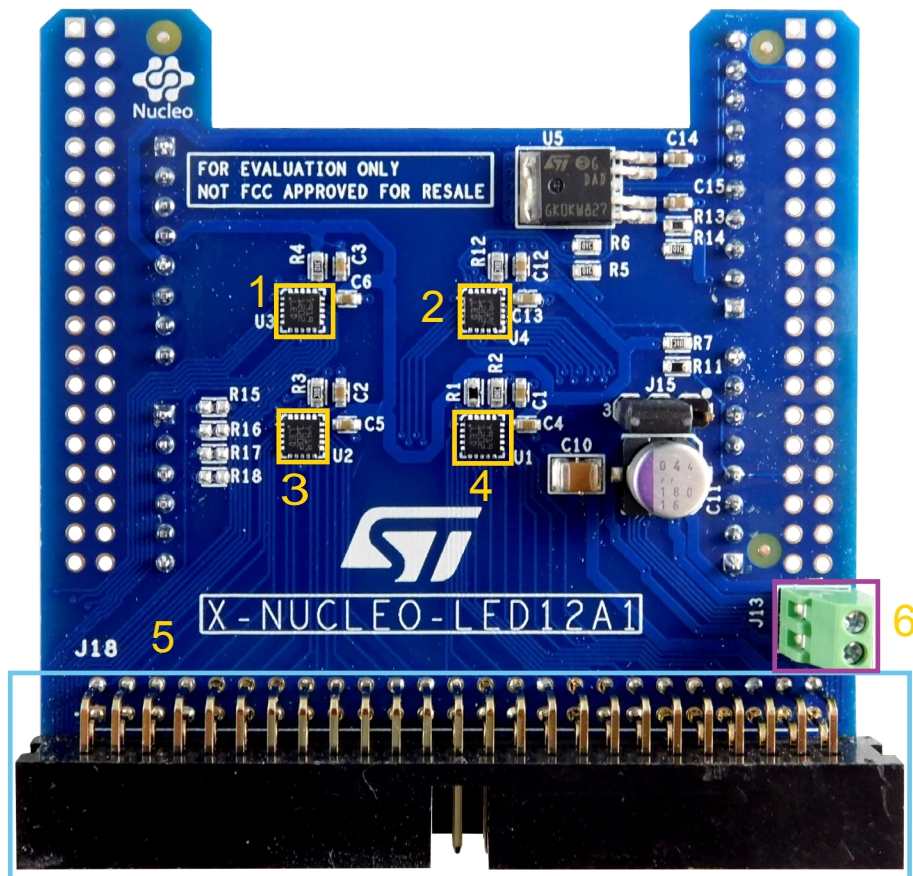
The [X-NUCLEO-LED12A1](#) expansion board embeds four [LED1202](#) devices and is powered by the [STM32 Nucleo](#) development board.

The devices are driven by the microcontroller via I²C interface, connected through the same I²C bus and synchronized by a clock chain.

4 Components

Figure 3. X-NUCLEO-LED12A1 expansion board component placement

1. LED1202
2. LED1202
3. LED1202
4. LED1202
5. LED panel connector
6. LED panel power supply connector



5 LED1202

The LED1202 is a 12-channel low quiescent current LED driver which guarantees 5 V output driving capability. Each channel is able to provide up to 20 mA with a headroom voltage of 350 mV (typ.) only. The output current can be adjusted separately for each channel by an 8-bit analog and 12-bit digital dimming control.

A slow turn-on and turn-off time improves the system low noise generation performance; moreover, the phase shifting function helps to reduce the inrush current. Eight patterns can be stored in the internal registers for automatic sequencing without involving the MCU.

The pattern sequence can be also configured for duration time and number of repetitions. In multi-device applications, a common clock domain can be shared for timing synchronization.

The device features thermal shutdown and open LED detection. The device I²C interface is based on fast mode specification and works up to 400 kHz. Eight I²C addresses are possible by using two configuration pins (A0/A1) only.

6 Board setup

To test the expansion board follow the procedure below.

- Step 1.** Connect the X-NUCLEO-LED12A1 expansion board to the STM32 Nucleo development board from the top through the Arduino UNO R3 connectors.
- Step 2.** Power the STM32 Nucleo development board using a mini-B USB cable.
- Step 3.** Program the firmware on the STM32 Nucleo development board using the provided example.
- Step 4.** Reset the MCU using the STM32 Nucleo reset button.
- Step 5.** Configure J15 jumper for internal or external LED power supply.
 - Connect pin 1 with pin 2 for external LED power supply.
 - Connect pin 2 with pin 3 for internal LED power supply.

For internal LED power supply, the PC USB port drives the LED current.

Important:

For external LED power supply, the current capability has to be provided through J13 connector. Do not apply an external voltage greater than 6 V: as this is the absolute maximum rating of LED1202 LED channels, it is recommended to remain below 5.5 V.

7 Schematic diagrams

Figure 4. X-NUCLEO-LED12A1 expansion board circuit schematic

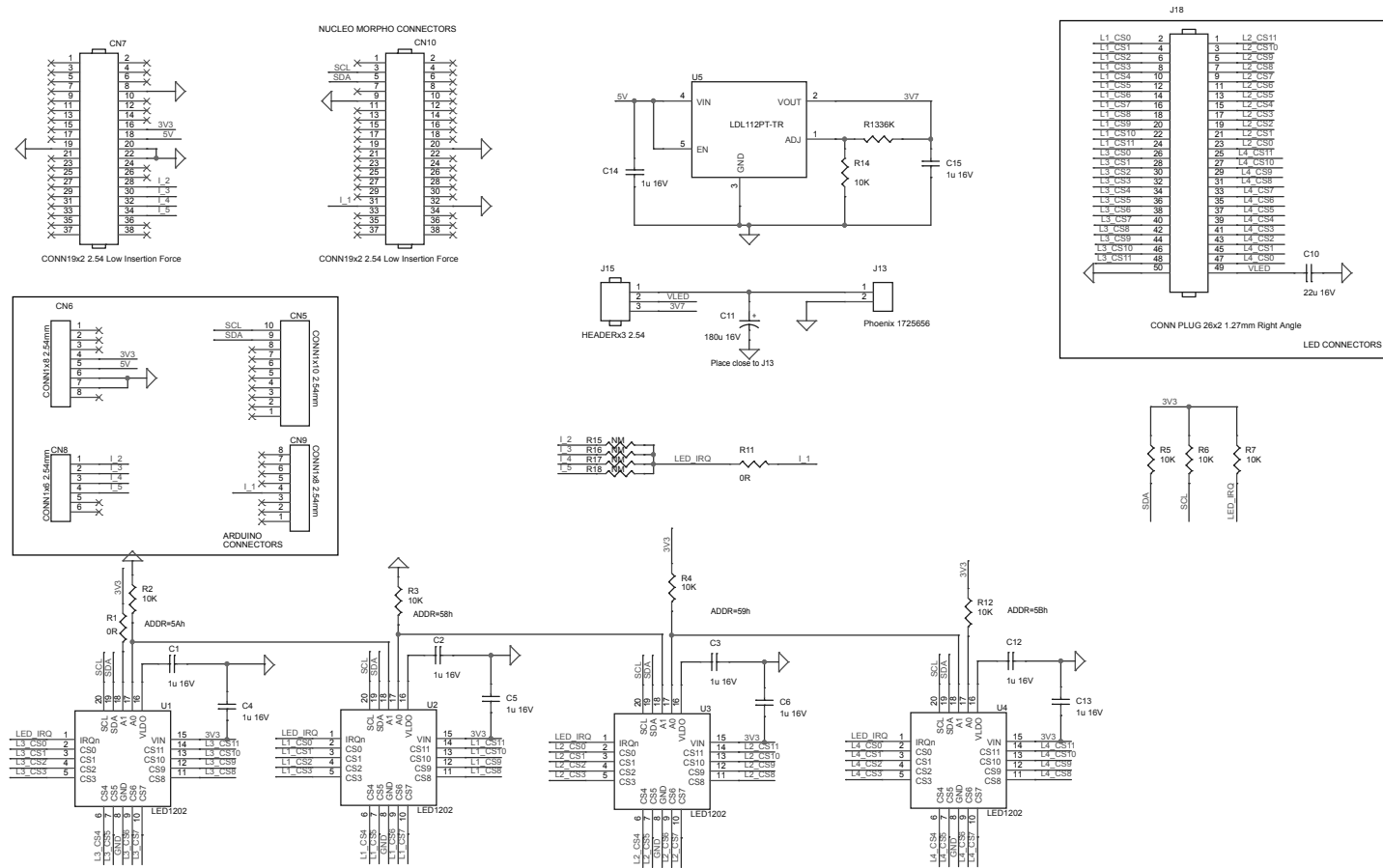
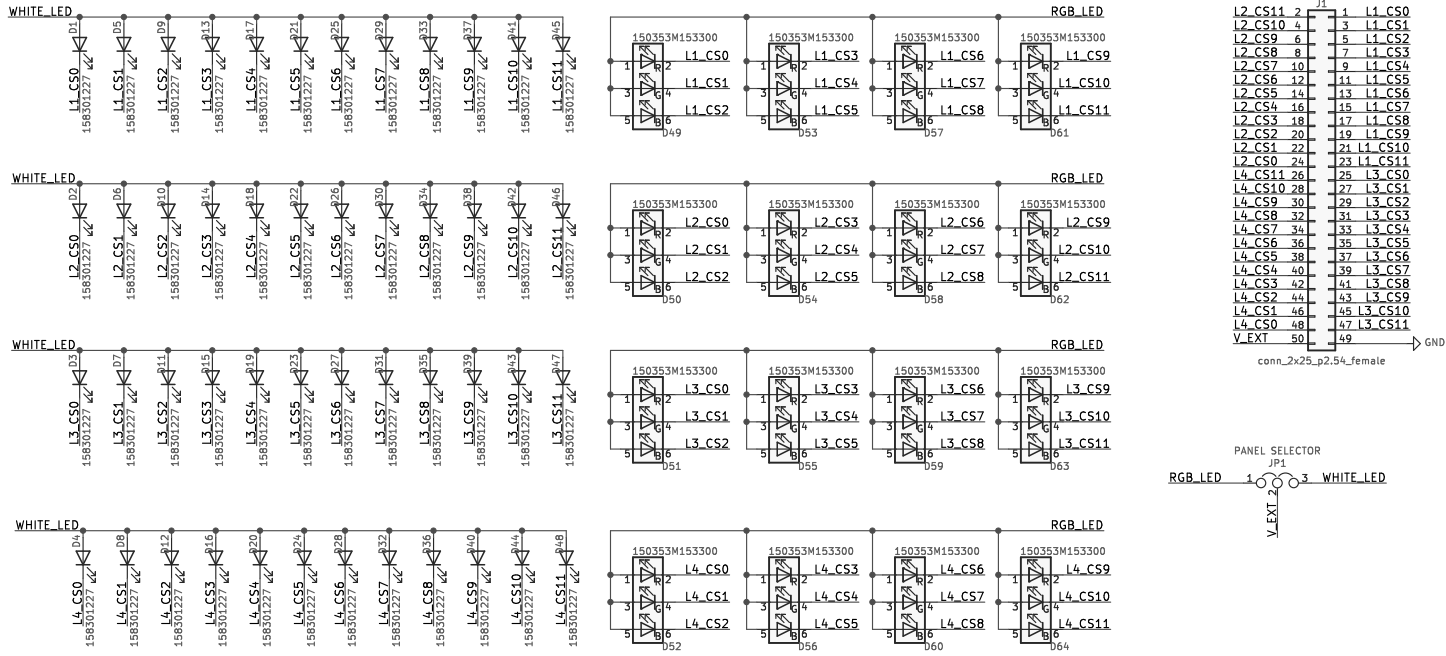
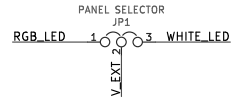


Figure 5. LED panel circuit schematic



L2_CS11	2	J1	1	L1_CS0
L2_CS10	4		3	L1_CS1
L2_CS9	6		5	L1_CS2
L2_CS8	8		7	L1_CS3
L2_CS7	10		9	L1_CS4
L2_CS6	12		11	L1_CS5
L2_CS5	14		13	L1_CS6
L2_CS4	16		15	L1_CS7
L2_CS3	18		17	L1_CS8
L2_CS2	20		19	L1_CS9
L2_CS1	22		21	L1_CS10
L2_CS0	24		23	L1_CS11
L4_CS11	26		25	L3_CS0
L4_CS10	28		27	L3_CS1
L4_CS9	30		29	L3_CS2
L4_CS8	32		31	L3_CS3
L4_CS7	34		33	L3_CS4
L4_CS6	36		35	L3_CS5
L4_CS5	38		37	L3_CS6
L4_CS4	40		39	L3_CS7
L4_CS3	42		41	L3_CS8
L4_CS2	44		43	L3_CS9
L4_CS1	46		45	L3_CS10
L4_CS0	48		47	L3_CS11
V_EXT	50		49	GND

conn_2x25_p2.54_female



8 Bill of materials

Table 3. X-NUCLEO-LED12A1 expansion board bill of materials

Item	Q.ty	Ref.	Part/Value	Description	Manufacturer	Order code
1	1	CN5 Female on Top, Male on Bottom	CONN1x10 2.54 mm	Connector	Würth	61301011121
2	2	CN6, CN9 Female on Top, Male on Bottom	CONN1x8 2.54 mm	Connectors	Würth	61300811121
3	2	CN7, CN10	CONN19x2 2.54, low insertion force	Connectors (not mounted)	Any	Any
4	1	CN8 Female on Top, Male on Bottom	CONN1x6 2.54 mm	Connector	Würth	61300611121
5	10	C1, C2, C3, C4, C5, C6, C12, C13, C14, C15	1 μ F, 16 V, C0603	Capacitors	Any	Any
6	1	C10	22 μ F, 16 V, CAPC-1210	Capacitor	Any	Any
7	1	C11	180u 16V, CEVSMD_6V3X8_T	Capacitor	Any	Any
8	1	J13	WR-TBL Series 2109 2.54 mm, horizontal entry, MORS_2P_2V54_P	Header	Würth	691210910002
9	1	J15	HEADERx3 2.54 mm	Header	Würth	61300311121
10	1	J18	CONN PLUG 25x2 2.54 mm, right angle	Header	Amphenol	T821150A1R100CEU
11	2	R1, R11	0 R, R0603	Resistors	Any	Any
12	8	R2, R3, R4, R5, R6, R7, R12, R14	10K, R0603	Resistors	Any	Any
13	1	R13	36 K, R0603	Resistor	Any	Any
14	4	R15, R16, R17, R18	0 R, R0603	Resistors (not mounted)	Any	Any
15	4	U1, U2, U3, U4	LED1202, VFQFPN20_3X3	12-channel low quiescent current LED driver	ST	LED1202QTR
16	1	U5	LDL112PT-TR, PPAK	1.2 A low quiescent current LDO with reverse current protection	ST	LDL112PT-TR

Table 4. LED panel bill of materials

Item	Q.ty	Ref.	Value	Description	Manufacturer	Part Number
1	48	D1, D2, D3, D4, D5, D6, D7, D8, D9, D10, D11, D12, D13, D14, D15, D16, D17, D18, D19, D20, D21, D22, D23, D24, D25, D26, D27, D28, D29, D30, D31, D32, D33, D34, D35, D36, D37, D38, D39, D40, D41, D42, D43, D44, D45, D46, D47, D48	PLCC	White LEDs	Würth	158301227
2	16	D49, D50, D51, D52, D53, D54, D55, D56, D57, D58, D59, D60, D61, D62, D63, D64	150353M153300, WL-SFTD-3535	RGB LEDs	Würth	150353M153300
3	1	J1	PinSocket_2x25_P2.54mm_Vertical_SMD	LED connector	Multicomp	2214S-50SG-85
4	1	JP1	PinHeader_1x03_P2.54mm_Horizontal	Panel selector	Würth	61300311021

Revision history

Table 5. Document revision history

Date	Revision	Changes
27-Sep-2021	1	Initial release.
08-Nov-2021	2	Updated Section 2 Connectors and Section 6 Board setup.

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