UM1999
User manual

Getting started with X-NUCLEO-LED61A1 DC-DC LED driver expansion board for STM32 Nucleo

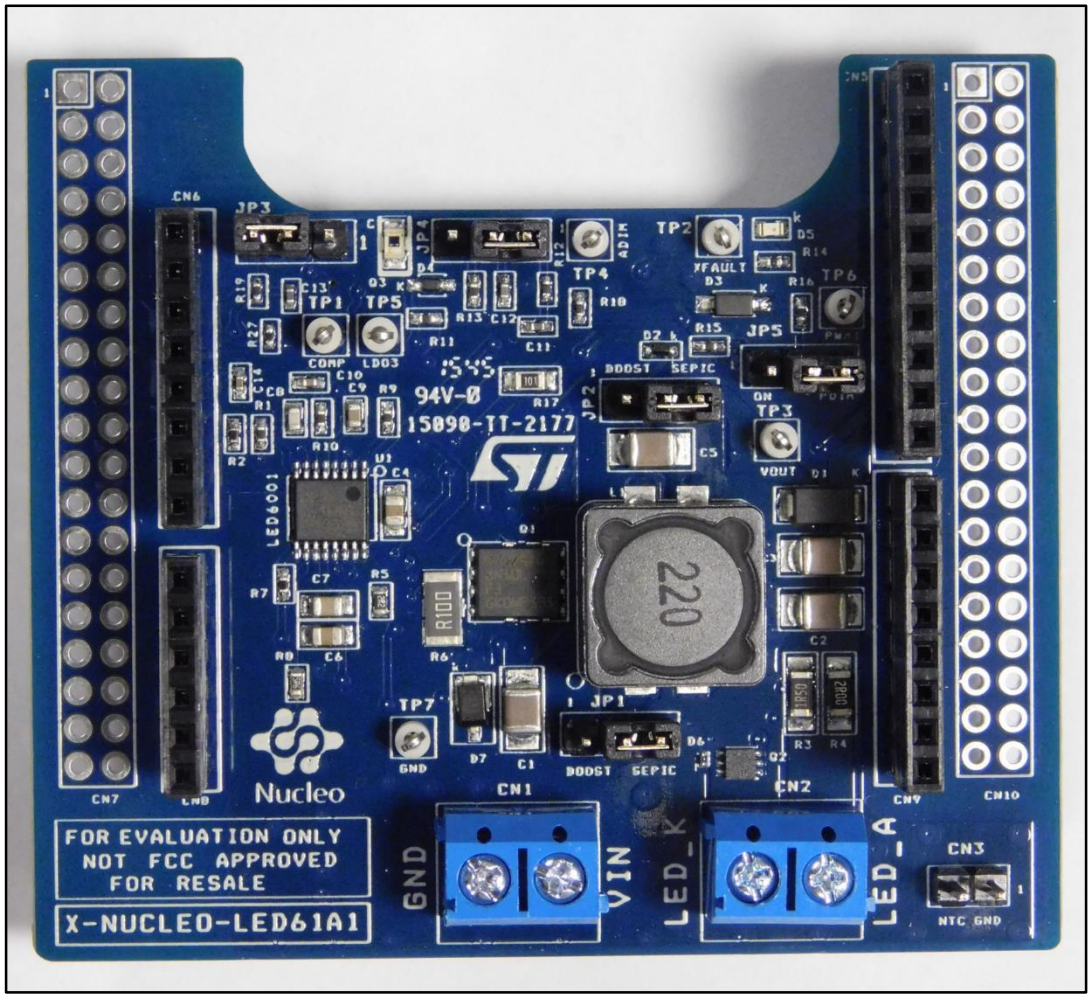
Introduction

The X-NUCLEO-LED61A1 is an expansion board designed to provide sample compact LED driver applications using the LED6001.

X-NUCLEO-LED61A1 can be configured to operate LEDs through a boost converter or SEPIC converter and comes with a photo-transistor for ambient light sensing. The X-NUCLEO-LED61A1 is compatible with the ST morpho connector and supports the addition of other boards which can be stacked onto a single STM32 Nucleo board. The user can also mount the Arduino™ UNO R3 connector.

It is designed to provide sample solutions for several applications involving single LED strings (e.g., off-grid street lighting, advertisement boards, signs, gaming etc.)

Figure 1: X-NUCLEO-LED61A1 expansion board based on LED6001 for STM32 Nucleo



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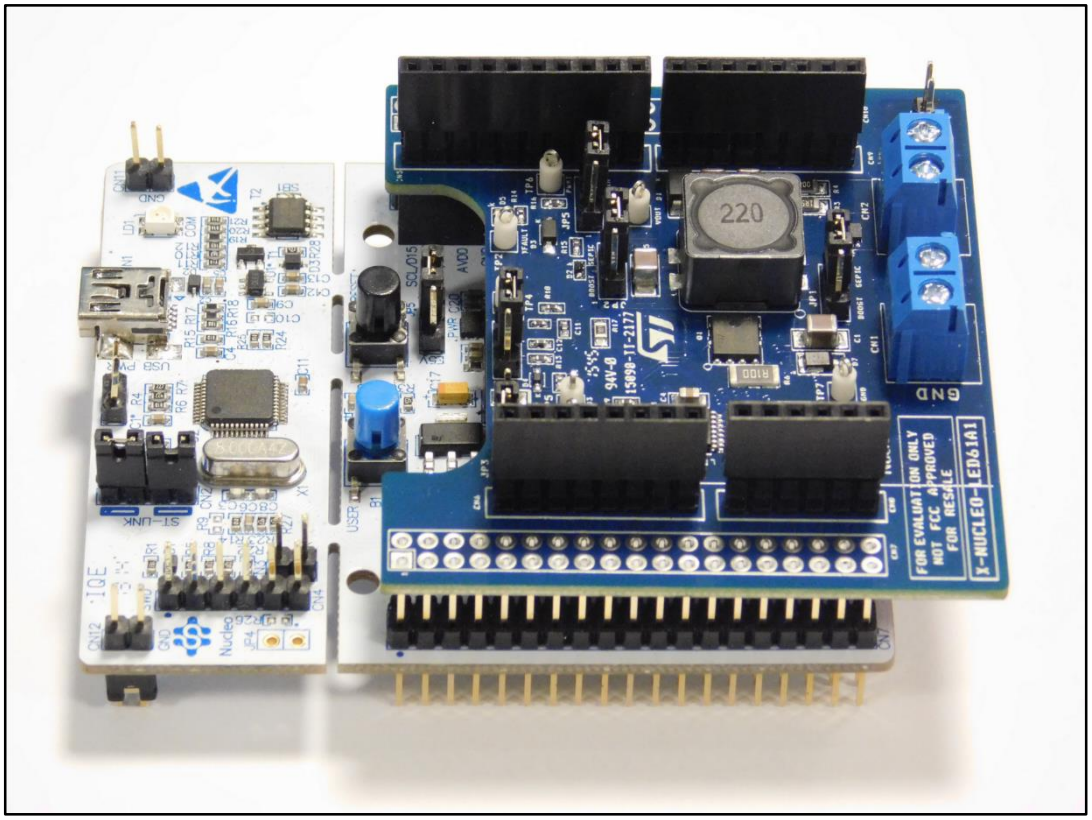
1 Getting started

This section describes the hardware and software requirements for the X-NUCLEO-LED61A1 expansion board for STM32 Nucleo.

1.1 System setup

The X-NUCLEO-LED61A1 is an expansion board for use with STM32 Nucleo boards. It can operate as a stand-alone board or it can be mounted on STM32 Nucleo (to run example solution demo) as shown in figure 2.

Figure 2: X-NUCLEO-LED61A1 expansion board plugged on a STM32 Nucleo board



The connection between STM32 Nucleo and X-NUCLEO-LED61A1 is designed for use with any STM32 Nucleo or Arduino UNO R3 Platform.

When mounting X-NUCLEO-LED61A1 on the STM32 Nucleo:

- ensure that all are pins aligned with their corresponding connector.
- handle both boards carefully to avoid damaging or bending the male/female connectors and pins.

1.2 System requirements

Using the X-NUCLEO-LED61A1 board requires following software and hardware:

- External power supply 8 V – 24 V, 2A, to be connected using CN1
- External series LED load (ILED > 350 mA). No. of LEDs may vary from 5 to 10 depending on the mode (boost or SEPIC) and input voltage, to be connected using CN2

- Windows® (XP, Vista, 7, 8) PC on which to install the software
- USB type A to Mini-B USB cable to connect the STM32 Nucleo to the PC for installation of the board firmware package (order code: X-CUBE-LED1). A utility running on the user's PC will complete the demo.
- The user’s PC must have the following minimum characteristics:
  - At least 128 MB of RAM
  - 40 MB of available hard disk space for the X-CUBE-LED1 firmware package and relative documentation, available on www.st.com

2 Hardware description

X-NUCLEO-LED61A1 is a compact LED driver using the LED6001, and can operate over a wide DC input voltage range from 8 V to 24 V and 2 A external power supply. The board has a single channel and provides 350 mA constant current with configurable boost or SEPIC topologies.

The brightness of the LED string connected to its output can be controlled through an external PWM signal (0 % to 100 % dimming). The X-NUCLEO-LED61A1 is equipped with a photo sensor for ambient light sensing, which can also be used to control LED brightness (analog dimming).

2.1 Hardware settings

The X-NUCLEO-LED61A1 board can be configured to boost and SEPIC modes with on-board jumpers to switch between the two.

Table 1: Boost vs SEPIC configuration

Jumper	Boost			SEPIC		
	Pin1	Pin2	Pin3	Pin1	Pin2	Pin3
JP1	yes	yes	no	no	yes	yes
JP2	yes	yes	no	no	yes	yes

Table 2: Standalone vs STM32 Nucleo operation

Jumper	Standalone			Nucleo		
	Pin1	Pin2	Pin3	Pin1	Pin2	Pin3
JP3	no	yes	yes	no	yes	yes
JP4	no	yes	yes	yes	yes	no
JP5	yes	yes	no	no	yes	yes

2.2 Fault management

X-NUCLEO-LED61A1 can detect fault conditions such as open LED, feedback disconnection, LED over-current and output-to-ground short circuit (SEPIC only) and protects the board from damage.

2.3 Connector description

The default pin assignment for X-NUCLEO-LED61A1 (Arduino) connectors are shown below:

Table 3: X-NUCLEO connector (Arduino) connector table

Connector	Pin	Signal
CN5	2	GND
CN6	4	3.3V
	6	GND
	7	GND

Connector	Pin	Signal
CN8	4	ADC_PS
CN9	5	XFAULT
	6	ADIM_TIMER
	7	PDIM_TIMER

Table 4: Input and output connector table

Connector	Pin	Signal
CN1 (IN)	1	GND
	2	Vin
CN2 (OUT)	1	LED_A
	2	LED_K
CN3 (OUT)	1	GND
	2	NTC

2.4 Jumper descriptions

The following table shows the various jumper connections for X-NUCLEO-LED61A1.

Table 5: Input and output connector table

Jumper	Pin	Signal
JP1	1	Boost
	2	Common
	3	SEPIC
JP2	1	Boost
	2	Common
	3	SEPIC
JP3	1	ADIM
	2	Photo sensor
	3	ADC_PS
JP4	1	ADIM_TIMER
	2	ADIM
	3	NTC
JP5	1	VIN
	2	PWMI
	3	PDIM_TIMER

3 Board schematics and bill of materials

This section contains the bill of materials schematic and layout of the X-NUCLEO-LED61A1.

3.1 Bill of materials

Table 6: X-NUCLEO-LED61A1 bill of materials (1 of 2)

Item	Qty	Reference	Part / Value	Voltage / Watt / Ampere	Type / tech information	Tol.
1	2	CN1,CN2	CON2	10A		
2	1	CN3	CON2			
3	1	CN5	CON10			
4	2	CN6,CN9	CON8			
5	2	CN7,CN10	DNM			
6	1	CN8	CON6			
7	4	C1,C2,C3,C5	10u	50V	Ceramic X7R	±10%
8	2	C4,C6	1u	50V	Ceramic X7R	±10%
9	1	C7	2.2u	25V	Ceramic X5R	±10%
10	1	C9	1u	16V	Ceramic X7R	±10%
11	2	C10,C14	100n	16V	Ceramic X7R	±10%
12	1	C8	100p	50V	C0G,NP0	±10%
13	3	C12,C11,C13	2.2u	16V	Ceramic X5R	±10%
14	1	D1	STPS2L60	2A,60V		
15	2	D2,D4	BAS70K	70mA,70V		
16	1	D3	BZT52C4V3	4.3V	Zener	
17	1	D5	LED_RED	5mA,2V		
18	1	D6	ESDAULC5	140W	ESD	
19	1	D7	SMM4F	2.4kW		
20	5	JP1,JP2,JP3,JP4,JP5	SIL3			
21	1	L1	22uH in parallel	4A		±20%
22	1	Q1	STL8N10LF3	7.8A,100V		
23	1	Q2	STL3N10F7	4A,100V		
24	1	Q3	SFH3710		Phototransistor	
25	1	R1	220k	1/16W	thick film	±1%
26	1	R2	6.8k	1/16W	thick film	±1%
27	1	R3	1.5R	0.25W	thick film	±1%
28	1	R4	2R	0.25W	thick film	±1%

Item	Qty	Reference	Part / Value	Voltage / Watt / Ampere	Type / tech information	Tol.
29	1	R5	2.2R	1/10W	thick film	±5%
30	1	R6	0.1R	0.5W	thick film	±1%
31	1	R7	1.5k	1/16W	thick film	±1%
32	1	R8	5.6R	1/16W	thick film	±5%
33	1	R9	82k	1/10W	thick film	±5%
34	1	R10	330R	1/16W	thick film	±5%
35	1	R11	22k	1/16W	thick film	±5%
36	1	R12	510k	1/16W	thick film	±5%
37	2	R13,R19	1M	1/16W	thick film	±5%
38	1	R14	680R	1/16W	thick film	±5%
39	2	R15,R18	100k	1/16W	thick film	±5%
40	1	R16	1k	1/10W	thick film	±5%
41	1	R17	100R	1/8W	thick film	±5%
42	4	R20,R22,R23,R28	0R			
43	3	R21,R24,R29	DNM			
44	1	R25	1k_DNM			
45	1	R26	1k			
46	1	R27	10k	1/16W	thick film	±5%
47	7	TP1,TP2,TP3,TP4,TP5,TP6,TP7				
48	1	U1	LED6001			

Table 7: X-NUCLEO-LED61A1 bill of materials (2 of 2)

Item	Package	Manufacturer	Manuf. order code / Orderable Part No.	Additional Notes
1	Through Hole	TE Connectivity	282836-2	or equivalent
2	Through Hole	FCI	77311-118-02LF	or equivalent
3	Through Hole	SAMTEC	SSQ-110-03-F-S	
4	Through Hole	SAMTEC	SSQ-108-03-F-S	
5	Through Hole	SAMTEC	SSQ-119-04-L-D	
6	Through Hole	SAMTEC	SSQ-106-03-G-S	
7	SMD 1210	Murata	GRM32ER71H106KA12L	or equivalent
8	SMD 0805	Murata	GRM21BR71H105KA12L	or equivalent
9	SMD 0603	Murata	GRM188R61E225ME84D	or equivalent
10	SMD 0603	Murata	GRM188R71C105KE15D	or equivalent
11	SMD 0402	Murata	GRM155R71C104KA88D	or equivalent
12	SMD 0402	TDK Corporation	C1005C0G1H101K050BA	or equivalent

Item	Package	Manufacturer	Manuf. order code / Orderable Part No.	Additional Notes
13	SMD 0402	TDK Corporation	C1005X5R1C225K050BC	or equivalent
14	SMA	ST	STPS2L60A	
15	SOD-523	ST	BAS70KFILM	
16	SOD-123	Diodes Incorporated	BZT52C4V3-7-F	
17	SMD 0603	Lite on	MSD1278-223	or equivalent
18	ST0201	ST	ESDAULC5-1BF4	
19	Stmite Flat	ST	SMM4F33A-TR	
20	Through Hole	FCI	68000-103HLF	or equivalent
21	SMD (coupled inductor)	BOURNS	SRF1280A-220M	or equivalent
22	PowerFlat 5x6	ST	STL8N10LF3	
23	PowerFlat 2x2	ST	STL3N10F7	
24	SMD-Diode 0805	OSRAM	SFH 3710-3/4-Z	
25	SMD 0402	Stackpole	RMCF0402FT220K	or equivalent
26	SMD 0402	Stackpole	RMCF0402FT6K80	or equivalent
27	SMD 1206	Stackpole	RMCF1206FT1R50	or equivalent
28	SMD 1206	ROHM	MCR18ERTFL2R00	or equivalent
29	SMD 0603	Panasonics	ERJ-3GEYJ2R2V	or equivalent
30	SMD 2010	ROHM	MCR25JZHFLR100	or equivalent
31	SMD 0402	ROHM	MCR01MRTF1501	or equivalent
32	SMD 0402	Yageo	RC0402JR-075R6L	or equivalent
33	SMD 0402	Panasonics	ERJ-2GEJ823X	or equivalent
34	SMD 0402	Stackpole	RMCF0402JT330R	or equivalent
35	SMD 0402	Panasonic	ERJ-2GEJ223X	or equivalent
36	SMD 0402	Stackpole	RMCF0402JT510K	or equivalent
37	SMD 0402	Stackpole	RMCF0402JT1M00	or equivalent
38	SMD 0402	StackPole	RMCF0402JT680R	or equivalent
39	SMD 0402	yageo	RC0402JR-07100KL	or equivalent
40	SMD 0402	panasonics	ERJ-2GEJ102X	or equivalent
41	SMD 0805	Stackpole	RMCF0805JT100R	or equivalent
42	SMD 0805-Nucleo CON			or equivalent
43	SMD 0805-Nucleo CON			
44	SMD 0805-Nucleo CON			

Item	Package	Manufacturer	Manuf. order code / Orderable Part No.	Additional Notes
45	SMD 0805-Nucleo CON			
46	SMD 0402	yageo	RC0402FR-0710KP	or equivalent
47	Through Hole	Keystone	5002	or equivalent
48	HTSSOP16	ST	LED6001TR	

3.2 Schematic

Figure 3: X-NUCLEO-LED61A1 circuit schematic (1 of 3)

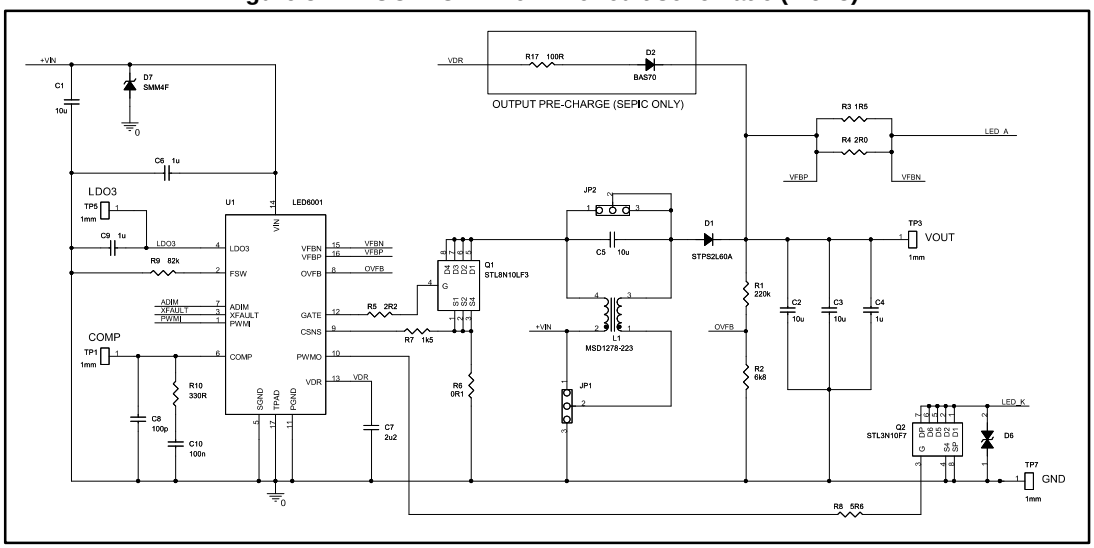


Figure 4: X-NUCLEO-LED61A1 circuit schematic (2 of 3)

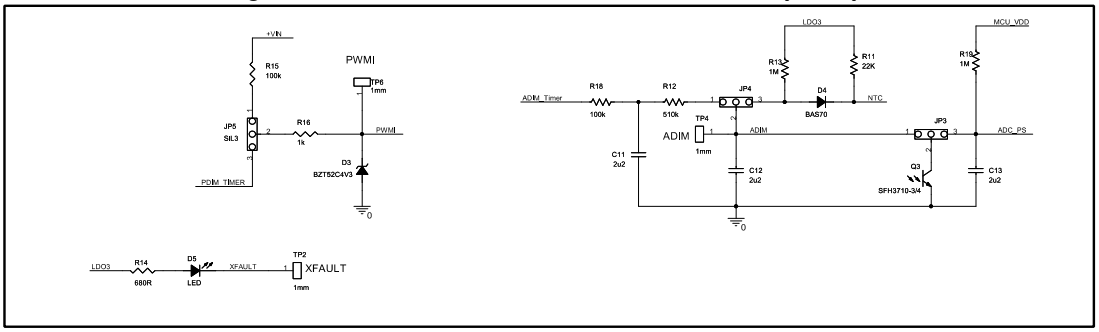
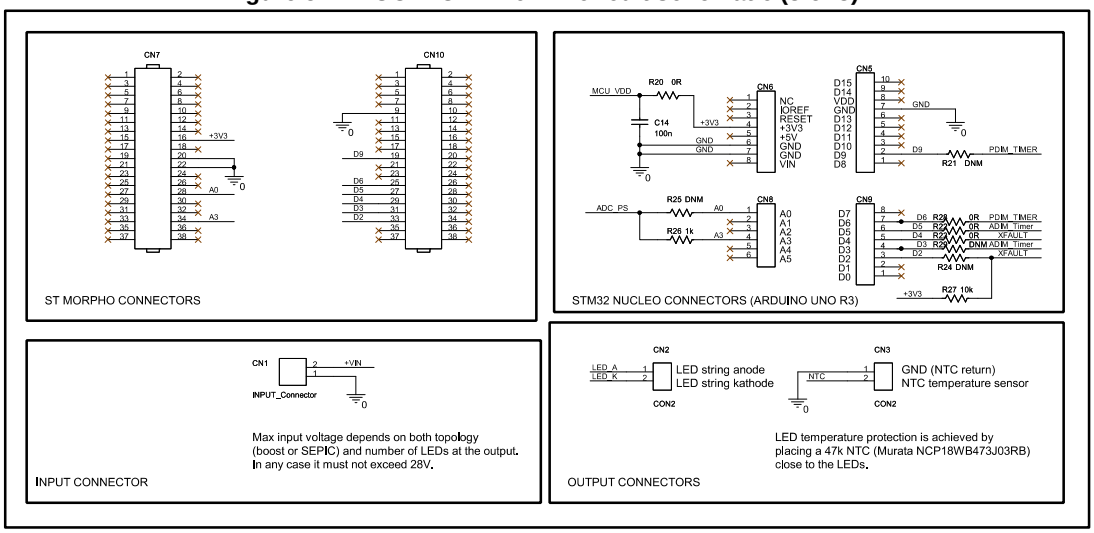


Figure 5: X-NUCLEO-LED61A1 circuit schematic (3 of 3)



3.3 Layout

Figure 6: X-NUCLEO-LED61A1 top side layout

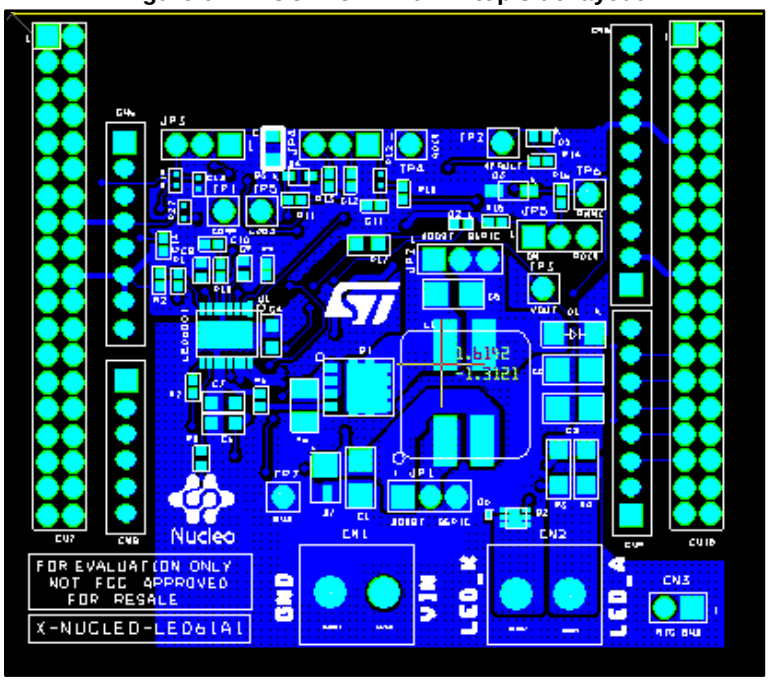
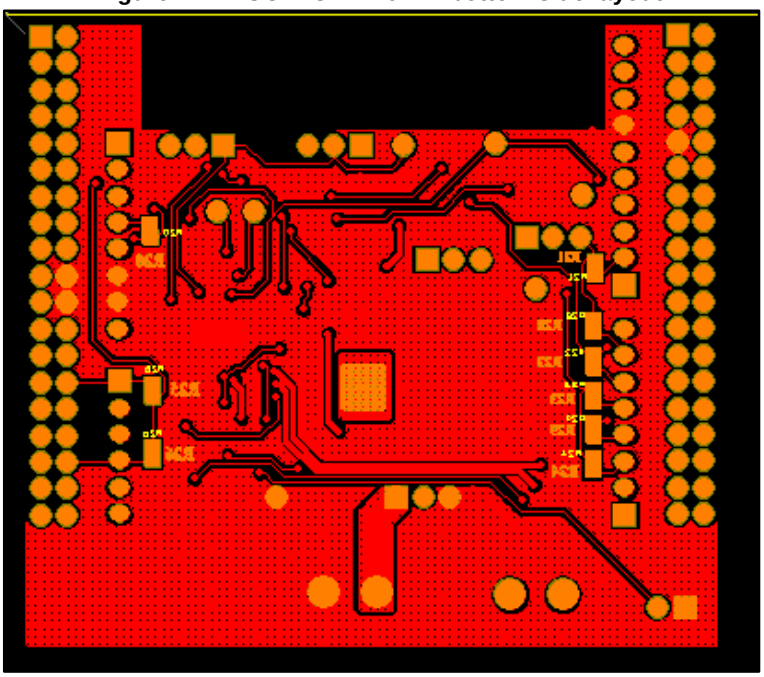


Figure 7: X-NUCLEO-LED61A1 bottom side layout



4 Revision history

Date	Revision	Changes
10-Dec-2015	1	Initial release

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