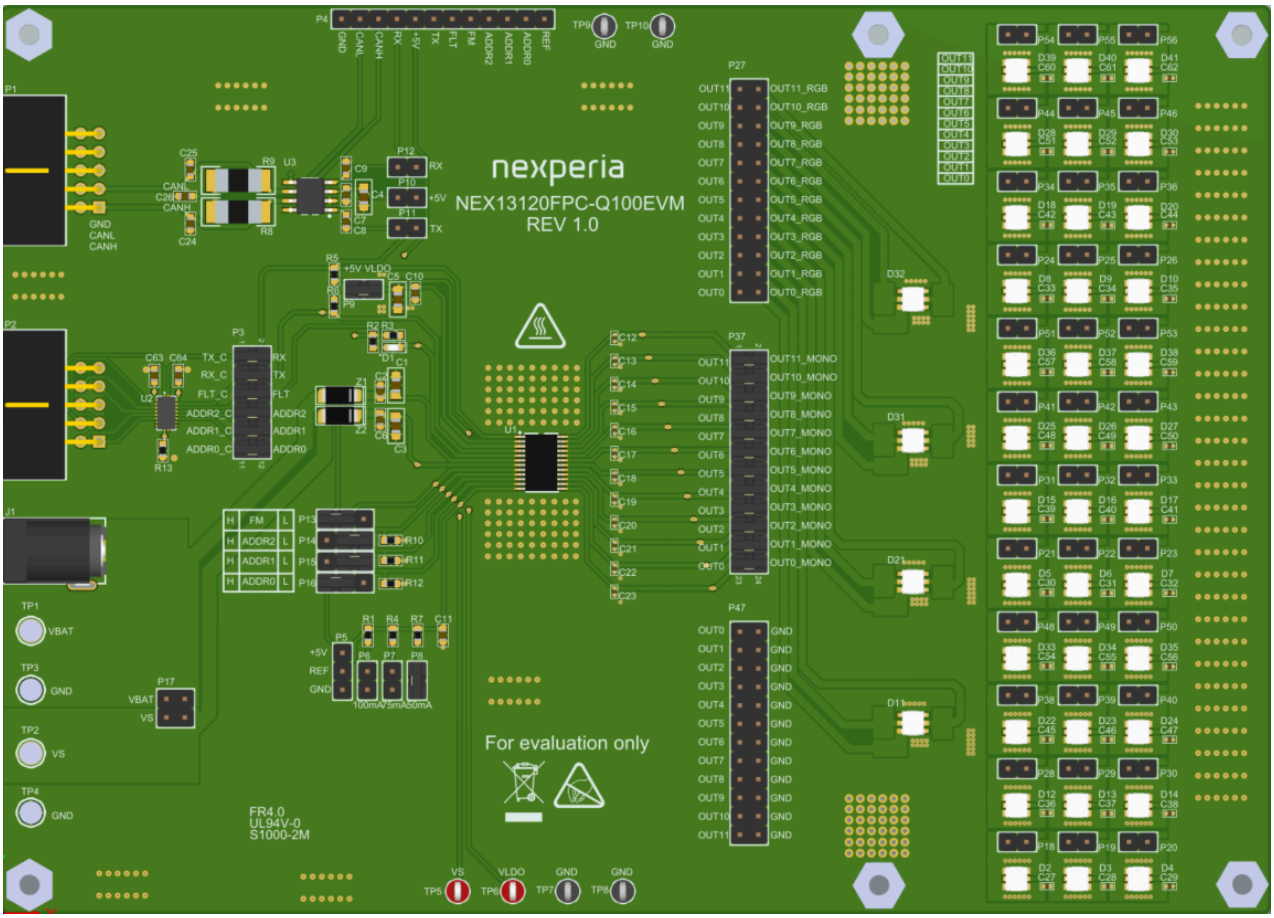
UM90058

Rev. 1 — 27 May 2025

user manual

NEX13120FPC-Q100 12-channel automotive linear LED driver evaluation board



Abstract: The user manual describes the NEVB-NEX13120FPC evaluation board, which serves as a valuable tool for designers to assess the functionality and performance of NEX13120FPC-Q100, a 12-bit automotive 12-channel LED driver featuring a UART interface. The manual offers guidance on hardware setup, NEX13120GUI software instructions, a schematic diagram, bill of materials, and board layouts.

Keywords: NEX13120FPC-Q100, linear LED driver, evaluation board

nexperia

1. Board description

1.1. Application

The NEX13120FPC-Q100 is used in following applications:

- Automotive exterior rear light
- Automotive exterior headlight
- Automotive interior ambient light

1.2. Features

The NEVB-NEX13120FPC offers a range of features, including:

- VBAT input range: 4.5 V to 36 V
- VS input range: 3.5 V to 36 V
- Power supply parallel terminal (P17), which allows for shorting VBAT and VS
- Optional VBAT power terminal (J1 or TP1)
- Optional UART and CAN protocol communication (P1 or P2)
- Fail-safe mode selection (P13) and address configuration (P14, P15, P16)
- REF short to ground terminal (P5) and REF resistor selection terminal (P6, P7, P8)
- Optional RGB and monochrome dimming terminal (P27 and P37)
- LED short to ground terminal (P47) and single LED short terminals (P20 to 26, P28 to P36, P38 to P46, P48 to P56)

1.3. Board description

Refer to Table 1 for descriptions of connectors and inputs on the NEVB-NEX13120FPC.

Table 1. Descriptions of connectors/inputs on NEVB-NEX13120FPC

Connector	Label	Descriptions
J1	VBAT	VBAT input Jack
TP1	VBAT	VBAT input terminal
TP2	VS	VS input terminal
TP3, TP4	GND	Power ground
TP5	VS	VS test point
TP6	VLDO	VLDO test point
TP7, TP8, TP9, TP10	GND	Ground test point
P1	CAN	CAN connector, includes CANH, CANL, GND
P2	UART	UART connector includes TX, RX, VCC, and GND
P3	Not applicable	Connect when selecting the UART protocol
P4	Not applicable	Test pin
P5	Not applicable	REF short to the ground terminal/REF pull-up terminal
P6, P7, P8	Not applicable	REF resistor selection terminal
P9	VLDO	5 V pull-up connector
P10, P11, P12	Not applicable	Connect when selecting the CAN protocol
P13	FM	Fail-safe mode selection
P14, P15, P16	ADDRx	Address configuration pin
P17	Not applicable	Short VBAT and VS

Connector	Label	Descriptions
P18 to 26	Not applicable	Single LED short terminals
P27	Not applicable	RGB dimming selection connector
P28 to P36	Not applicable	Single LED short terminals
P37	Not applicable	Monochrome dimming selection connector
P38 to P46	Not applicable	Single LED short terminals
P47	Not applicable	LED short to the ground terminal
P48 to P56	Not applicable	Single LED short terminals

Note: The default settings have been optimized. Refer to General configuration and description for details on board power and operating mode.

2. General configuration and description

This section outlines the correct procedure for connecting the connectors to ensure the proper setup and use of the NEVB-NEX13120FPC.

2.1. Powering the EVB

The NEVB-NEX13120FPC requires two power supplies VBAT and VS for operation. If there are two power supplies available, connect a 12 V power supply to TP1 (VBAT) and TP3 (GND) and a 9 V power supply to TP2 (VS) and TP4 (GND).

If there is only one power supply or one power adapter available, short the P17 connector with a jumper to link VS and VBAT. This allows the utilization of a single power supply connected to TP1 (VBAT) and TP3 (GND), or a power adapter linked to J1 (Power Jack).

2.2. Communication

Two hardware setups enable communication between MCU and NEVB-NEX13120FPC, directly or through CAN transceiver.

2.2.1. Communication with USB2UART

Figure 1 shows the hardware setup when CAN Transceiver is not used. NEVB-NEX13120FPC part shows the jumper configurations for the NEVB-NEX13120FPC with USB2UART connected.

Figure 2 shows the jumper configurations of USB2UART for NEVB-NEX13120FPC without CAN Transceiver connected. This is the default jumper configuration shipped with the board.

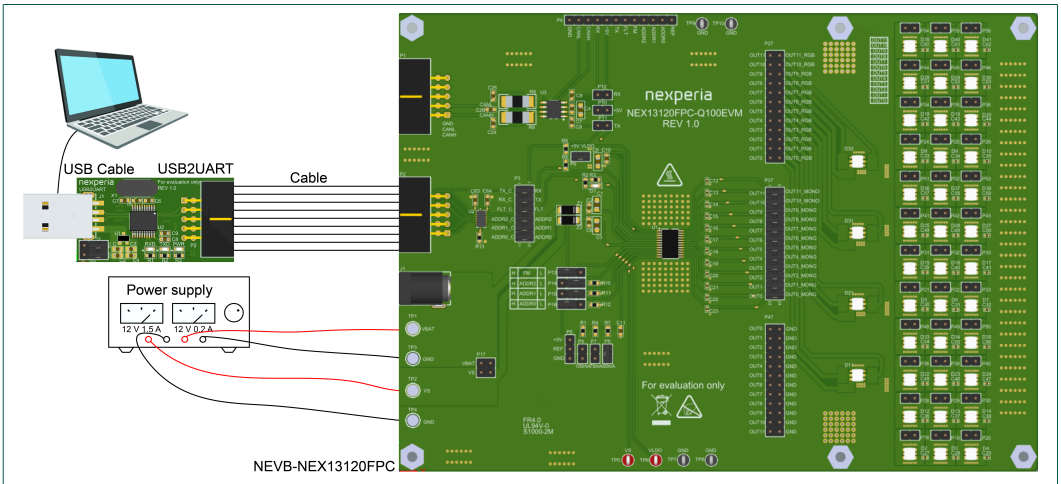


Fig. 1. Hardware setup with USB2UART

- Connect a 12 V power supply to TP1 (VBAT) and TP3 (GND) and an 8 V power supply to TP2 (VS) and TP4 (GND).
- Short the P17 connector with a jumper to short VS and VBAT if there is only one power supply.
- Connect the USB2UART to the PC through the USB port.
- Connect the USB2UART to the P2 connector of NEVB-NEX13120FPC through a ribbon cable.

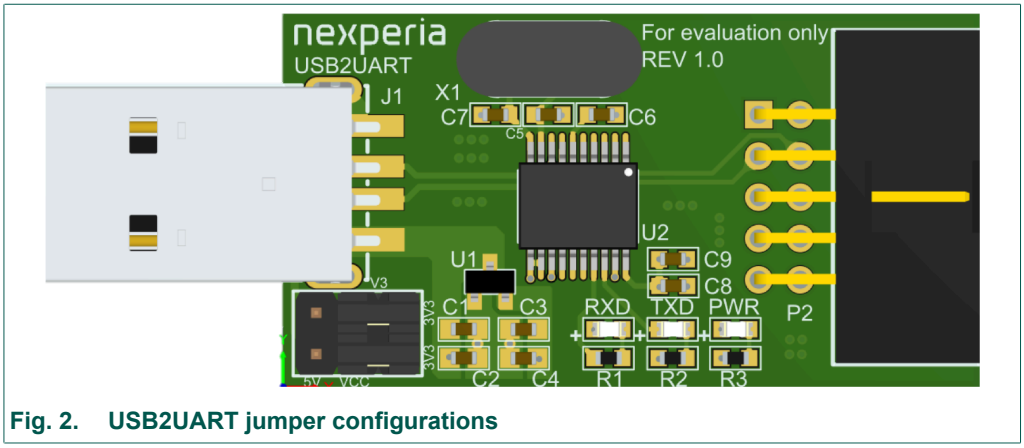


Fig. 2. USB2UART jumper configurations

- Connect the jumper to the right side to select 3.3 V voltage.

Refer to Table 2 for descriptions of connectors on NEVB-NEX13120FPC with USB2UART connected.

Table 2. NEVB-NEX13120FPC jumpers setting with USB2UART connected

NEVB-NEX13120FPC connector	Setting
P4, P5, P6, P7, P10, P11, P12, P17, P27, P47	Open
P3, P8, P9, P37	Short
P13	Short “FM” to “H”
P14	Short “ADDR2” to “L”
P15	Short “ADDR1” to “L”
P16	Short “ADDR0” to “H”
All headers paralleled with LEDs	Open
USB2UART connector	**Setting**
J1	Short “VCC” and “V3” to “3V3”

2.2.2. Communication with CAN transceiver

Figure 3 shows the hardware setup when the CAN Transceiver is used. NEVB-NEX13120FPC part shows the jumper configurations for the NEVB-NEX13120FPC with CAN Transceiver connected.

Figure 4 shows the jumper configurations of USB2UART for NEVB-NEX13120FPC with the CAN Transceiver connected.

Figure 5 shows the CAN Transceiver PCB layout.

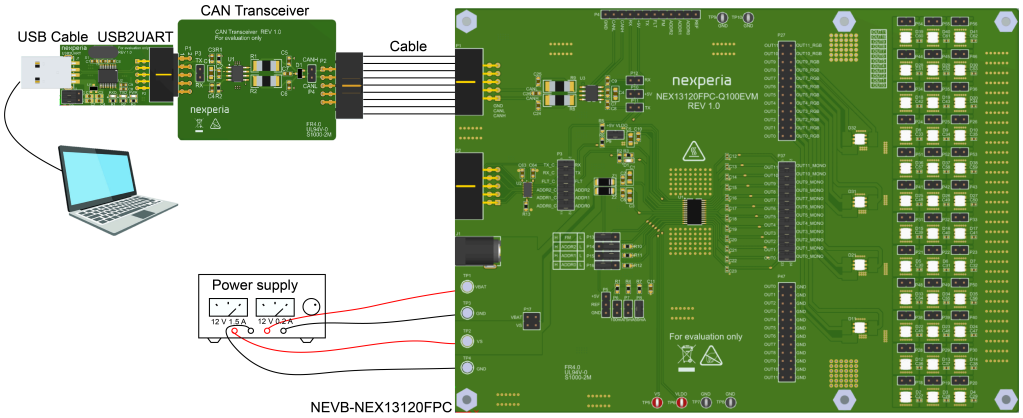


Fig. 3. Hardware setup with CAN transceiver

- Connect a 12 V power supply to TP1 (VBAT) and TP3 (GND) and an 8 V power supply to TP2 (VS) and TP4 (GND).
- Short the P17 connector with a jumper to short VS and VBAT if there is only one power supply.
- Connect the CAN Transceiver to the USB2UART through P1 connector of CAN transceiver.
- Connect the CAN Transceiver to the P2 connector of NEVB-NEX13120FPC through a ribbon cable.
- Connect the USB2UART to the PC through the USB port.

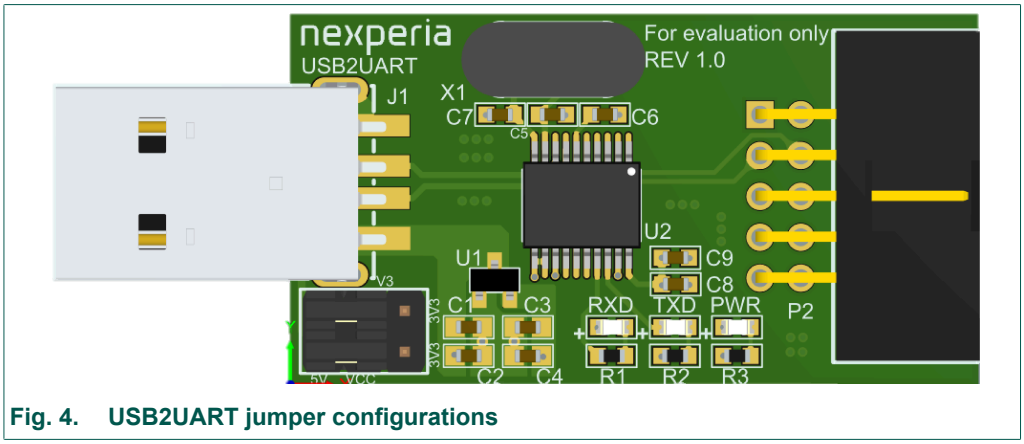


Fig. 4. USB2UART jumper configurations

- Connect the jumper to the left side to select 5 V voltage.

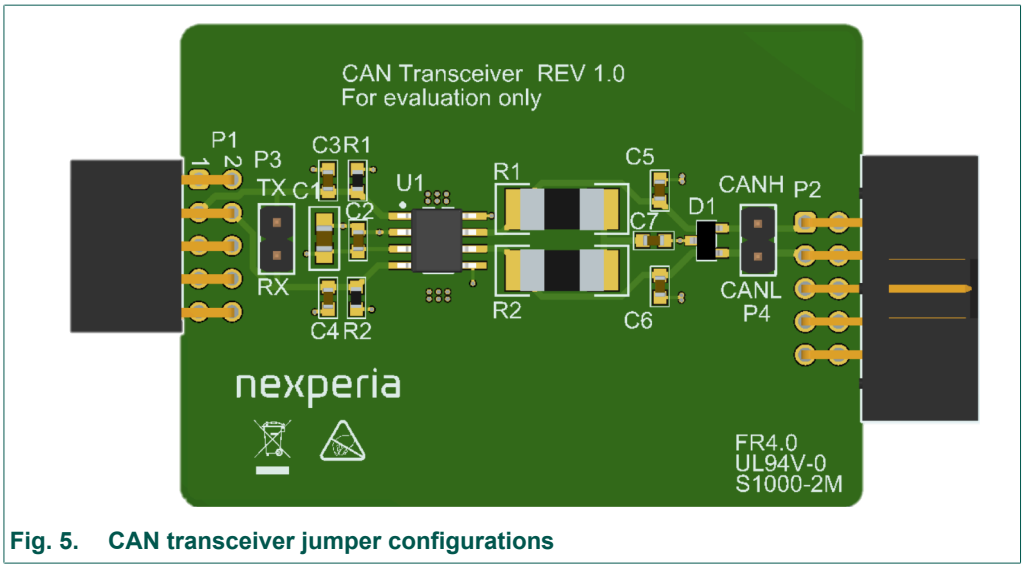


Fig. 5. CAN transceiver jumper configurations

Refer to Table 3 below for descriptions of connectors on NEVB-NEX13120FPC with CAN transceiver.

Table 3. NEVB-NEX13120FPC jumpers setting with CAN transceiver connected

NEVB-NEX13120FPC connector	Setting
P4, P5, P6, P7, P17, P27, P47	Open
P3, P8, P9, P10, P11, P12, P37	Short
P13	Short “FM” to “H”
P14	Short “ADDR2” to “L”
P15	Short “ADDR1” to “L”
P16	Short “ADDR0” to “H”
All headers paralleled with LEDs	Open
USB2UART connector	**Setting**
J1	Short “VCC” and “V3” to “5V”

2.3. Address configuration

NEX13120FPC-Q100 supports up to 27 node devices. NEX13120FPC-Q100 has three pinouts including ADDR2, ADDR1, and ADDR0 for node address configuration. Different configurations enable the NEX13120FPC-Q100 to support various node setups, as detailed below.

NEX13120FPC-Q100 register default NV_EXTADDR = 0.

- If NV_EXTADDR = 0, the device uses NV_DEVADDR [3] code together with external inputs on ADDR2, ADDR1 and ADDR0 to support 16 nodes as Table 5 shows.
- If NV_EXTADDR = 1, ADDR2, ADDR1 and ADDR0 can support three statuses, include M status as Table 4 shows. The device uses external inputs on ADDR2, ADDR1 and ADDR0 to set 27 nodes as shown in Table 6.

Table 4. Address pin status assessment

NEVB-NEX13120FPC connector settings	Status	Settings
P14, P15, P16 short to “L”	0	Ground directly
P14, P15, P16 floating	M	Ground through 30 kΩ
P14, P15, P16 short to “H”	1	Connect to V_{CC} directly

Table 5. Address setting: NV_EXTADDR = 0

Address (Decimal)	Bit 3	Bit 2	Bit 1	Bit 0
	NV_DEVADDR	ADDR 2	ADDR 1	ADDR 0
Address setting (NV_EXTADDR = 0)				
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1
10	1	0	1	0
11	1	0	1	1

Address (Decimal)	Bit 3	Bit 2	Bit 1	Bit 0
	NV_DEVADDR	ADDR 2	ADDR 1	ADDR 0
Address setting (NV_EXTADDR = 0)				
12	1	1	0	0
13	1	1	0	1
14	1	1	1	0
15	1	1	1	1

Table 6. Address setting: NV_EXTADDR = 1

Address (Dec)	ADDR 2	ADDR 1	ADDR 0
Address setting (NV_EXTADDR = 1)			
0	0	0	0
1	0	0	1
2	0	1	0
3	0	1	1
4	1	0	0
5	1	0	1
6	1	1	0
7	1	1	1
8	0	0	M
9	0	1	M
10	1	0	M
11	1	1	M
12	0	M	0
13	0	M	1
14	1	M	0

Table 7. Address setting: NV_EXTADDR = 1

Address (Dec)	ADDR 2	ADDR 1	ADDR 0
Address setting (NV_EXTADDR = 1)			
15	1	M	1
16	M	0	0
17	M	0	1
18	M	1	0
19	M	1	1
20	0	M	M
21	1	M	M
22	M	0	M
23	M	1	M
24	M	M	0
25	M	M	1
26	M	M	M

3. NEX13120GUI function

This section provides instructions to run the NEVB-NEX13120FPC using the NEX13120GUI.

3.1. Connection status

Power up the NEVB-NEX13120FPC correctly and connect with the PC via the USB2UART or CAN transceiver tool before launching the NEX13120GUI.

Failure to follow this sequence may result in abnormal functioning of the NEX13120GUI. In such cases, please restart the NEX13120GUI. Figure 6 shows the NEX13120GUI connection setup page.

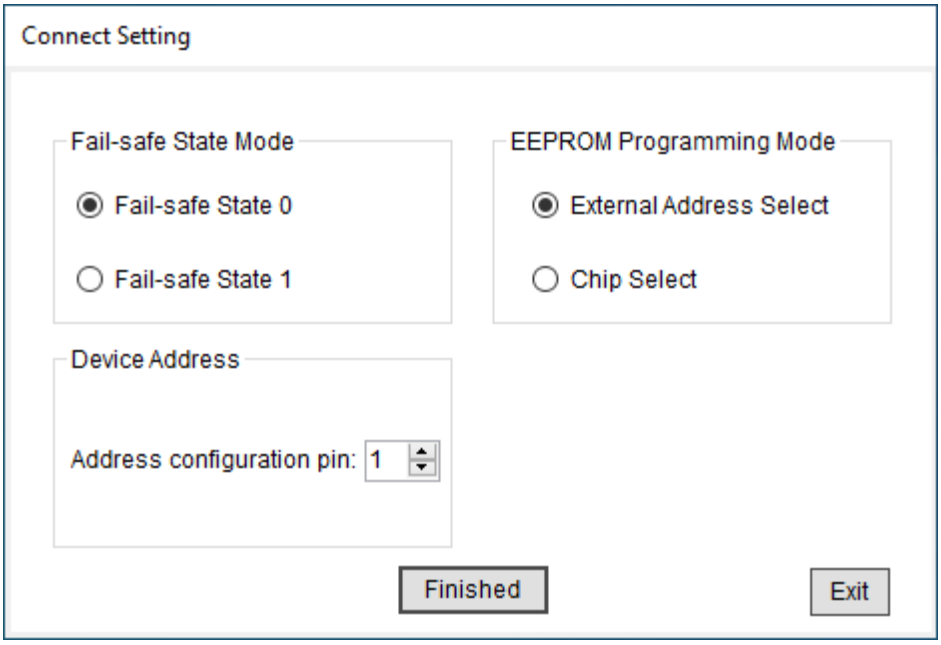


Fig. 6. NEX13120GUI connection setup

Before using the NEX13120GUI, ensure that the device address is properly configured and that the hardware connections are established successfully. The default device address setting value in the NEX13120GUI is 0x01 upon its launch.

You can verify the connection status on the home page at the top of the NEX13120GUI, if there is a “Disconnected” mark, it signifies the hardware is not connected, please reconnect the device.

3.2. NEX13120GUI function

This section describes the functions of the NEX13120GUI.

3.2.1. Quick start

The current operating mode is displayed on the top left corner of the page. Error flags and global faults icons provide real-time status information about the device.

LED strings can be controlled individually or simultaneously, with adjustable PWM duty cycles and output currents for selected LEDs.

Figure 7 shows the quick start page. On the top right corner of the page, all ADC channels can be selected to update the reading value in real-time. Clicking the "Force FS" button triggers the device to enter the configured fail-safe mode, automatically transitioning from the normal state to the relevant fail-safe mode. Once an LED is lit, short or single LED short-circuit is detected, the related flag turns red within the channel diagnostics panel.

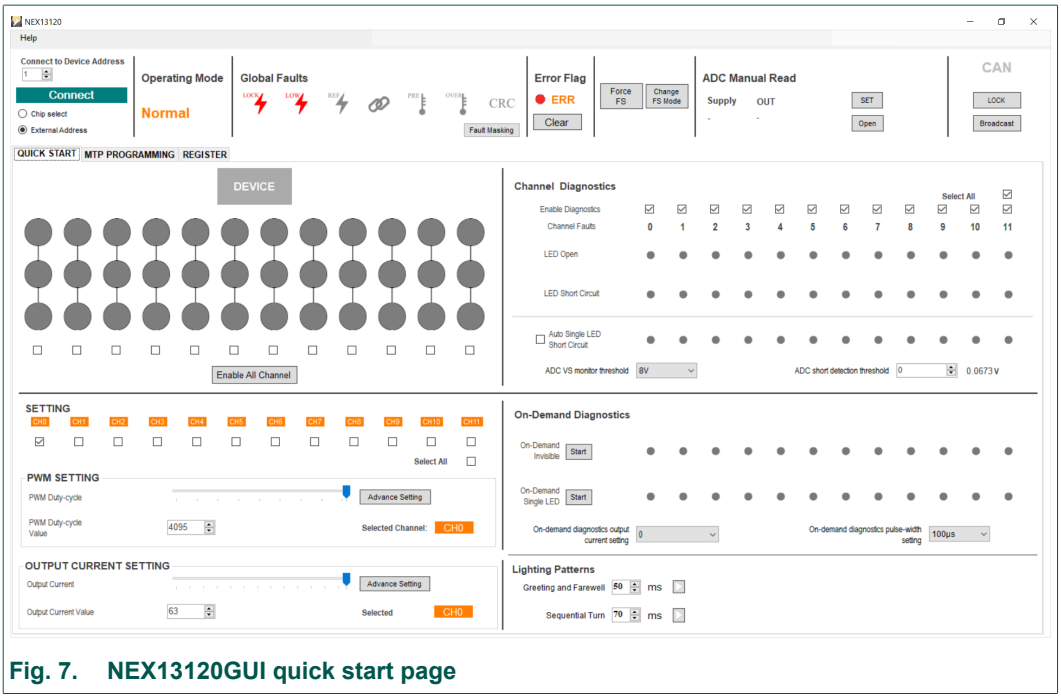


Fig. 7. NEX13120GUI quick start page

3.2.2. MTP programming

The device supports two programming modes for different applications: either through chip select or external address select. Figure 8 shows the MTP programming page.

Initially, all configured values are transferred to corresponding shadow registers. Upon clicking the "Start Programming" button, these shadow register values overwrite their related MTP registers. It implies that only after clicking the "Start Programming" button, the current configuration values replace the corresponding MTP registers.

Clicking the "Load Default" button restores all current registers to default values as described in the data sheet. The present register configuration can be saved for future use.

Moving to other pages from the programming page automatically exits the MTP programming mode by clearing the register CONF_STAYINEEP, which means the newly modified MTP registers' values will not update to the corresponding configuration registers upon exiting MTP programming mode. CLR_REG can be set via the register map page to update configuration registers with the latest MTP register value immediately.

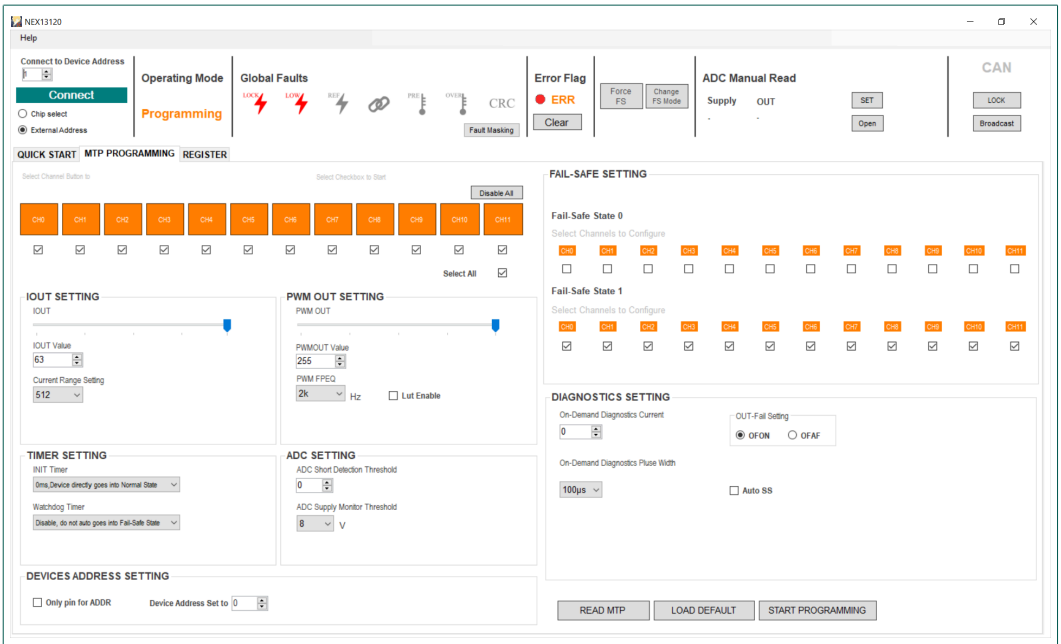


Fig. 8. NEX13120GUI MTP programming page

3.2.3. Register map

Figure 9 shows the register map page. All the configuration and MTP registers are available on this page.

Clicking on a register row automatically updates the corresponding field view on the right side of the page. The register value can be modified by clicking the "Value" column or double-clicking the "Bits" column. The modified value is effective immediately if the "Immediate" function is selected in the top right corner.

However, if the "Deferred" function is selected, the modified value only takes effect upon clicking the "WRITE REGISTER" button. Click the "READ REGISTER" button only to read the selected register's value. All registers' values can be read back or write once by clicking "READ ALL REGISTERS" or "WRITE ALL REGISTERS".

Modifying the MTP registers' value on the register map page does not overwrite the actual MTP registers' values. Actual MTP registers' values can only be modified through the MTP programming page.

The NEX13120GUI includes built-in serial port tools for users to debug. Users can customize the command read/write, custom baud rate, and custom command sending intervals. Users can use 'R' or 'r' to represent a read instruction and 'W' or 'w' to represent a written instruction. For example, 'W,50,01', where 'w' means writing, '50' means the register address, and '01' means the data to be written. For multi-byte data writing, users should refer to the datasheet to avoid formatting errors.

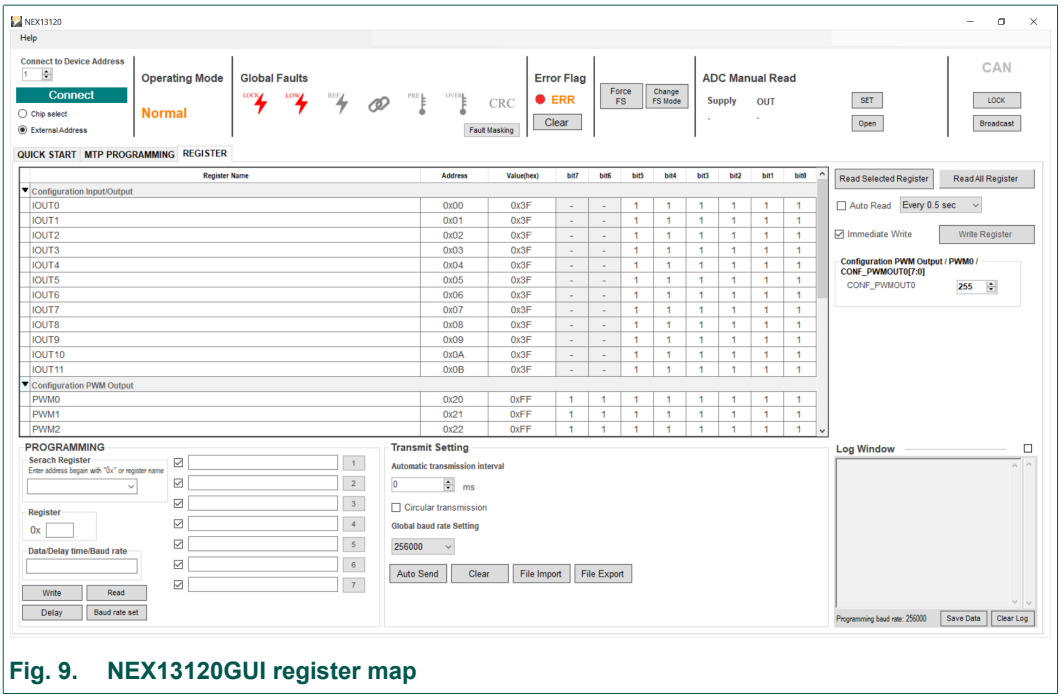


Fig. 9. NEX13120GUI register map

4. Schematic

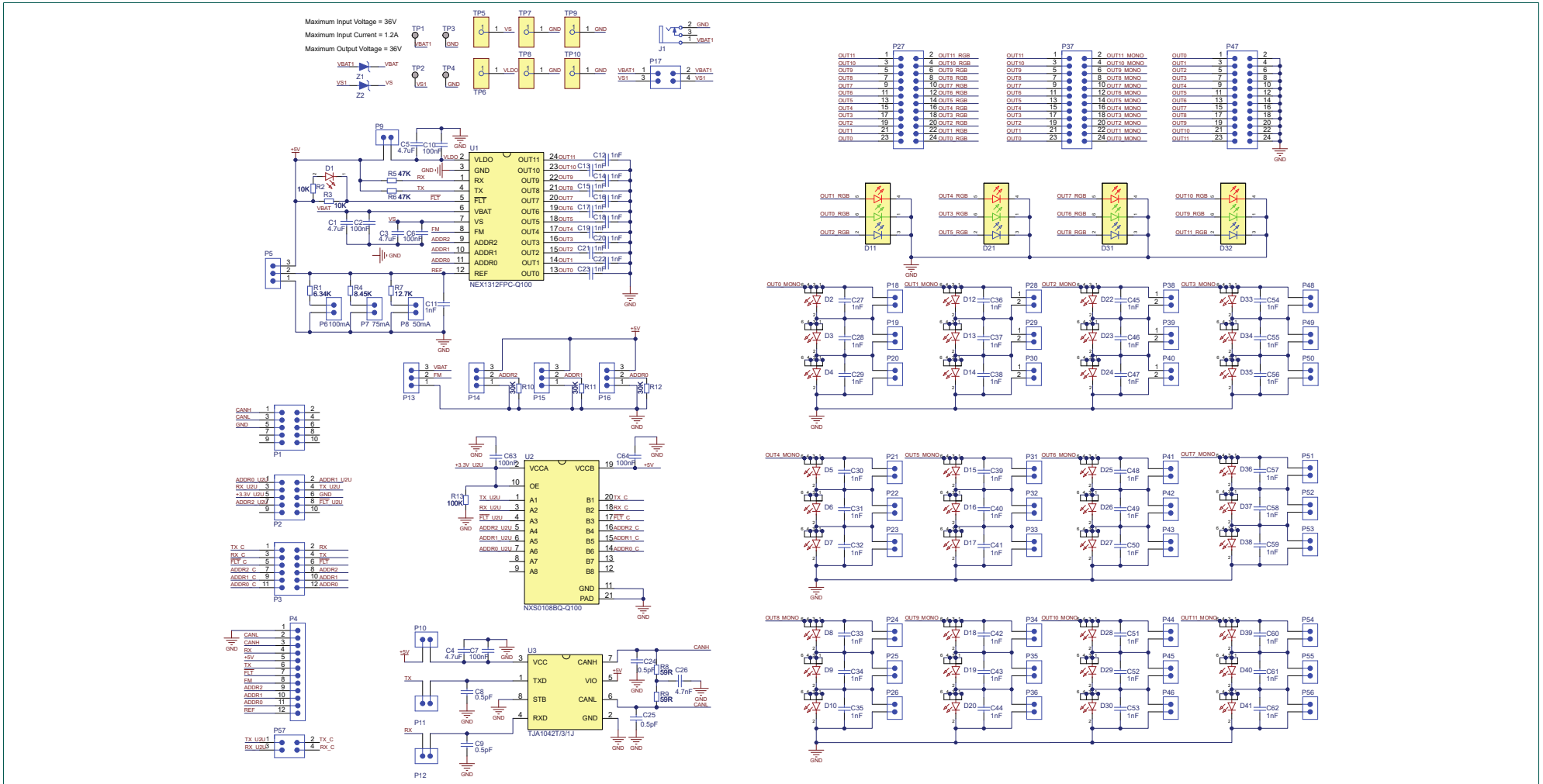


Fig. 10. NEVB-NEX13120FPC schematic diagram

5. Board layout

Figure 11 and Figure 12 show the top and bottom routing layout of NEVB-NEX13120FPC.

Figure 13 and Figure 14 show the top and bottom layer 3D view of NEVB-NEX13120FPC.

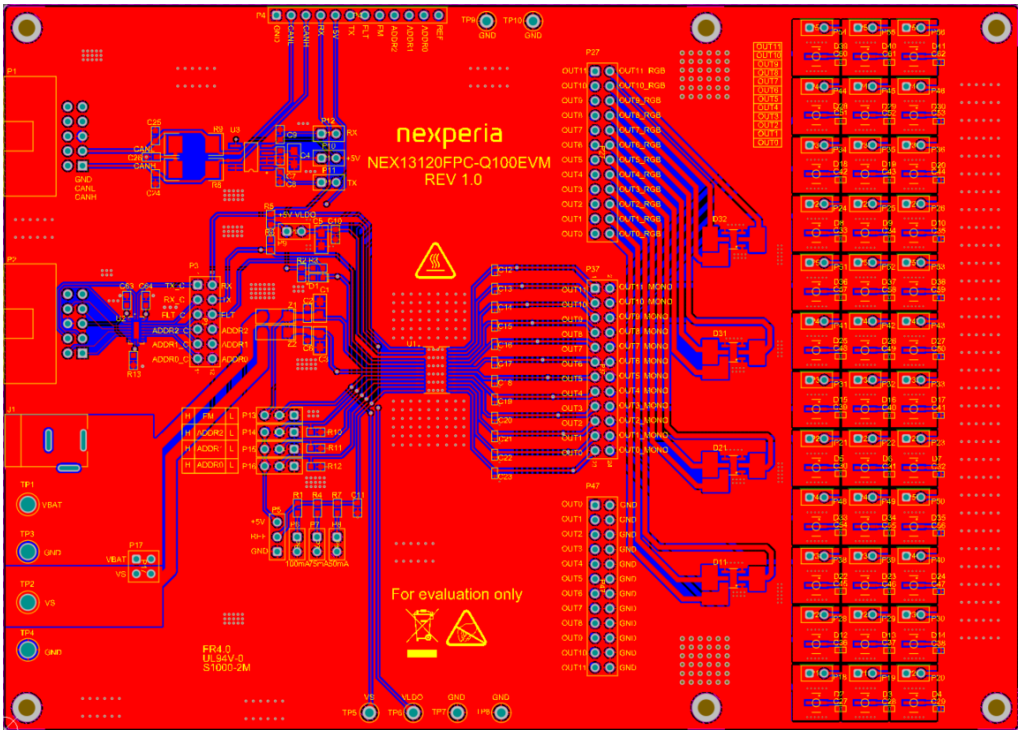


Fig. 11. NEVB-NEX13120FPC top layer routing

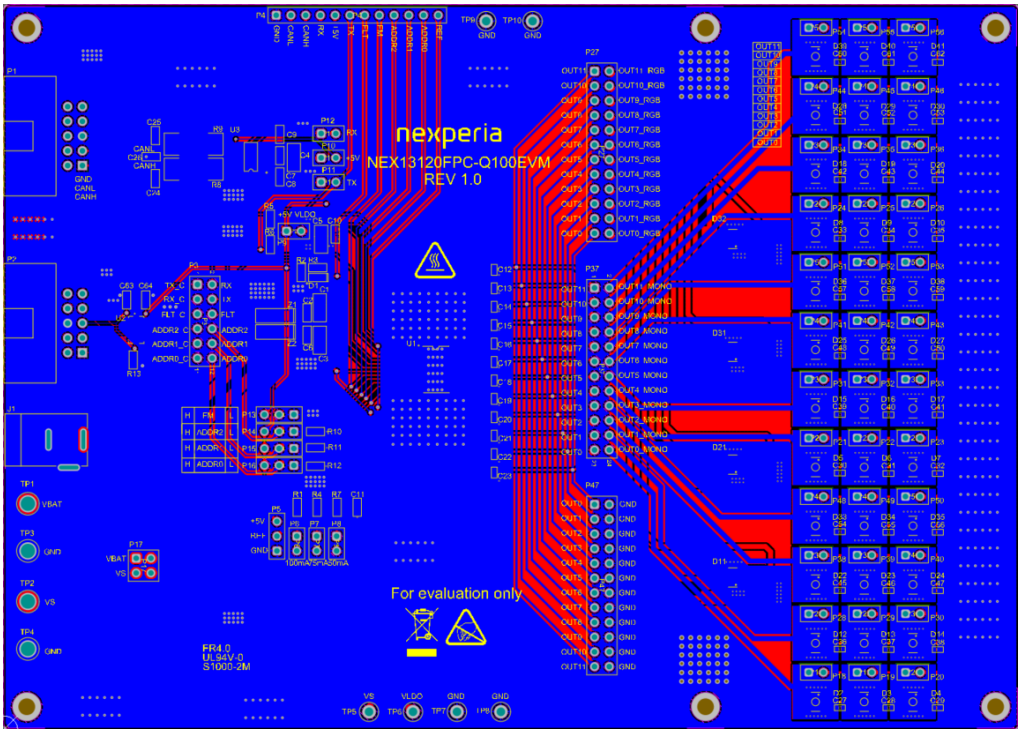


Fig. 12. NEVB-NEX13120FPC bottom layer routing

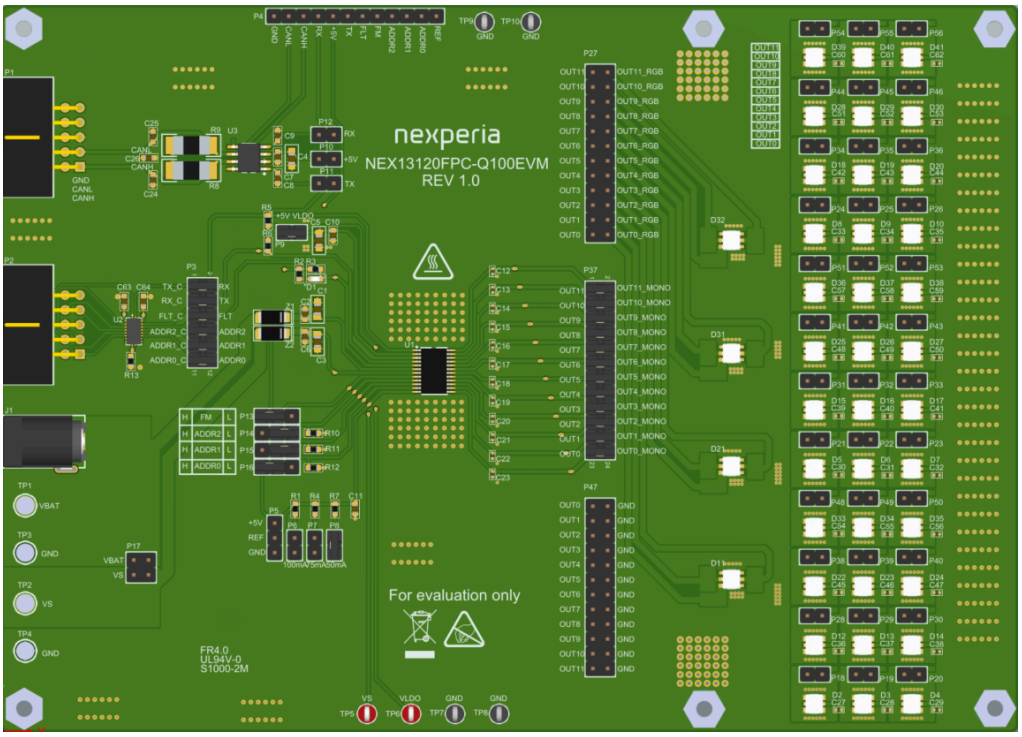


Fig. 13. NEVB-NEX13120FPC top layer view in 3D

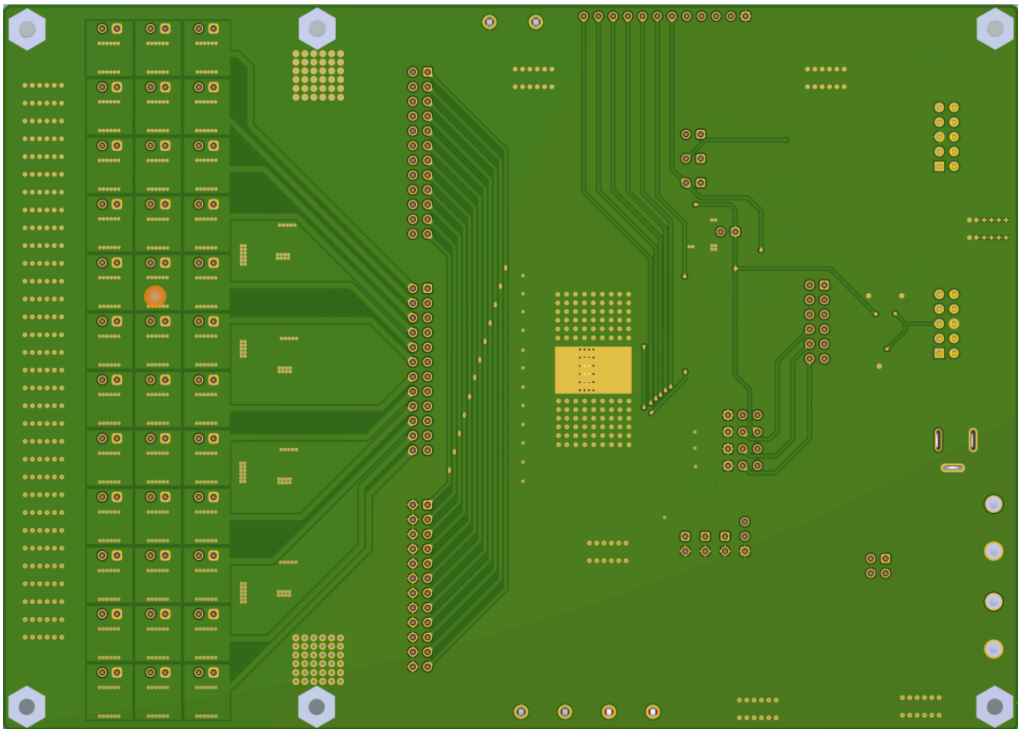


Fig. 14. NEVB-NEX13120FPC bottom layer view in 3D

6. Bill of materials

Table 8 details the bill of materials (BOM) of NEVB-NEX13120FPC.

Table 8. BOM of NEVB-NEX13120FPC

Designator	Description	Manufacturer	Part name	Quantity
C1, C3, C4, C5	CAP, CERM, 4.7 µF, 16 V, +/- 10%, X7R, AEC-Q200 Grade 1, 0805	TDK	CGA4J3X7R1C475K125AB	4
C2, C6, C7, C10, C63, C64	CAP, CERM, 0.1 µF, 25 V, +/- 10%, X7R, AEC-Q200 Grade 1, 0603	TDK	CGA3E2X7R1E104K080AA	6
C8, C9, C24, C25	CAP, CERM, 0.5 pF, 50 V, +/- 50%, C0G, 0603	TDK	C1608C0G1H0R5C080AA	4
C11	CAP, CERM, 1000 pF, 50 V, +/- 5%, C0G, AEC-Q200 Grade 1, 0603	TDK	CGA3E2C0G1H102J080AA	1
C26	CAP, CERM, 4.7 nF, 100 V, +/- 10%, X7R, AEC-Q200 Grade 1, 0603	TDK	CGA3E2X7R2A472K080AA	1
C12, C13, C14, C15, C16, C17, C18, C19, C20, C21, C22, C23, C27, C28, C29, C30, C31, C32, C33, C34, C35, C36, C37, C38, C39, C40, C41, C42, C43, C44, C45, C46, C47, C48, C49, C50, C51, C52, C53, C54, C55, C56, C57, C58, C59, C60, C61, C62	CAP, CERM, 1 nF, 50 V, +/- 10%, X7R, AEC-Q200 Grade 1, 0402	TDK	CGA2B2X7R1H102K050BA	48
D1	LED, Red, SMD, 0805	OSRAM	LS R976-NR-1	1
D2, D3, D4, D5, D6, D7, D8, D9, D10, D12, D13, D14, D15, D16, D17, D18, D19, D20, D22, D23, D24, D25, D26, D27, D28, D29, D30, D33, D34, D35, D36, D37, D38, D39, D40, D41	LED, Super Red, SMD	OSRAM	LS G6SP-CADB-1-1	36
D11, D21, D31, D32	LED, RGB, SMD	OSRAM	LRTB GVSG-UEVE-24+AMAQ-29+SCUC-HR	4
J1	WR-DC DC Power Jack, R/A, TH	Wurth Elektronik	694106301002	1
P1, P2	WR-BHD Pin Header, THT, Angled, pitch 2.54 mm, 2 Row, 10P	Wurth Elektronik	612010235221	2
P3	WR-PHD Pin Header, THT, Vertical, pitch 2.54 mm, 2 Row, 12P	Wurth Elektronik	61301221121	1
P4	WR-PHD Pin Header, THT, Vertical, pitch 2.54 mm, 1 Row, 12P	Wurth Elektronik	61301211121	1
P5, P13, P14, P15, P16	WR-PHD Pin Header, THT, Vertical, pitch 2.54 mm, 1 Row, 3P	Wurth Elektronik	61300311121	5

P6, P7, P8, P9, P10, P11, P12, P18, P19, P20, P21, P22, P23, P24, P25, P26, P28, P29, P30, P31, P32, P33, P34, P35, P36, P38, P39, P40, P41, P42, P43, P44, P45, P46, P48, P49, P50, P51, P52, P53, P54, P55, P56	WR-PHD Pin Header, THT, Vertical, pitch 2.54 mm, 1 Row, 2P	Wurth Elektronik	61300211121	43
P17	WR-PHD Pin Header, THT, Vertical, pitch 2.54 mm, 2 Row, 4P	Wurth Elektronik	61300421121	1
P27, P37, P47	WR-PHD Pin Header, THT, Vertical, pitch 2.54 mm, 2 Row, 24P	Wurth Elektronik	61302421121	3
R1	RES, 6.34 kΩ, 1%, 0.1 W, 0603	Yageo	AC0603FR-076K34L	1
R2, R3	RES, 10.0 kΩ, 1%, 0.1 W, 0603	Yageo	AC0603FR-0710KL	2
R4	RES, 8.45 kΩ, 1%, 0.1 W, 0603	Yageo	AC0603FR-078K45L	1
R5, R6	RES, 47.0 kΩ, 1%, 0.1 W, 0603	Yageo	AC0603FR-0747KL	2
R7	RES, 12.7 kΩ, 1%, 0.1 W, 0603	Yageo	AC0603FR-0712K7L	1
R8, R9	RES, 59, 1%, 1 W, AEC-Q200 Grade0, 2512	Yageo	AC2512FK-0759RL	2
R10, R11, R12	RES, 30.0 kΩ, 1%, 0.1 W, 0603	Yageo	AC0603FR-0730KL	3
R13	RES, 100.0 kΩ, 1%, 0.1 W, 0603	Yageo	AC0603FR-07100KL	1
TP1, TP2, TP3, TP4	Solder Turret Terminal	Keystone	1502-2	4
TP5, TP6	Test point compact RED	Keystone	5005	2
TP7, TP8, TP9, TP10	Test point compact BLACK	Keystone	5006	4
U1	12-channel automotive LED driver	Nexperia	NEX13120FPC-Q100	1
U2	Automotive Fault Protected CAN Transceiver with Flexible Data-Rate	NXP	TJA1042T/3	1
U3	Open Drain and Push-Pull Applications 8-Bit Bidirectional Voltage Level Conversion	Nexperia	NXS0108BQ-Q100	1
Z1, Z2	Diode, Schottky, 60 V, 3 A, SOD128	Nexperia	PMEG60T30ELP-Q	2
Screws	Nylon Machine Screws, 4-40, 1/4L	B&F Fastener Supply	NY PMS 440 0025 PH	6
Stands	M-F Nylon Stand, 4-40, 1/2L	Keystone	1902C	6
Stands	F-F Nylon Stand, 4-40, 1/2L	Keystone	4802	4
Jumper	WR-PHD 2.54 mm Multi-Jumper	Wurth Elektronik	60900213421	27

7. Revision history

Table 9. Revision history

Revision number	Date	Description
UM90058 v. 1	20250527	Initial version

8. Legal information

Definitions

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For sales office addresses, please send an email to: salesaddresses@nexperia.com
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