XR22417
Evaluation Board User's Manual

Introduction

The XR22417 evaluation board is for the MaxLinear USB 2.0 7-Port hub in both the 64 pin LQFP and 48 pin LQFP packages. This manual is intended to guide users to use various functions and configurations of the hub device. Either the 64 pin LQFP package or 48 pin LQFP package EVB can be ordered as shown in Table 1.

Table 1: Ordering Information

Device Ordering Part Number	Evaluation Board Ordering Part Number	Device Package	Device Location
XR22417CV64-F	XR22417CV64EVB	64-pin LQFP	U1
XR22417CV48-F	XR22417CV48EVB	48-pin LQFP	U2

Board Layout and Outline

Evaluation Board outline

Figure 1 shows the topography of the evaluation board. Either U1 or U2 will be installed depending upon the version of the evaluation board.

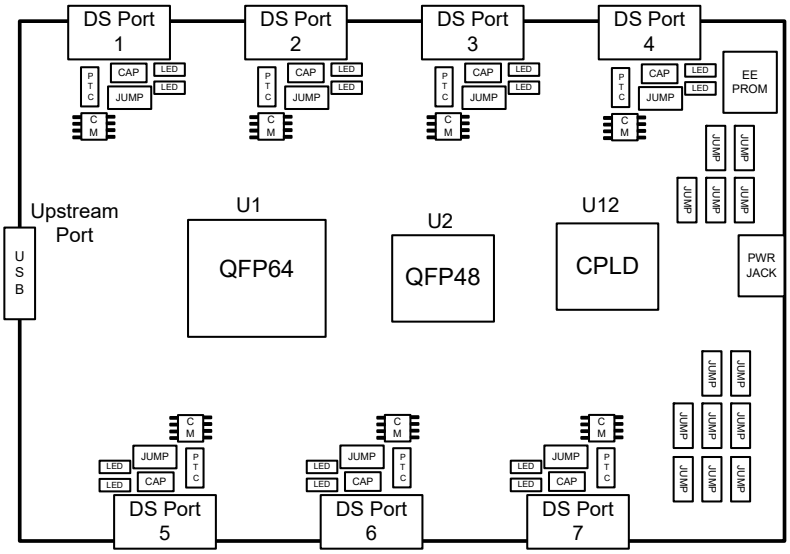

Figure 1: XR22417 PCB Outline

Evaluation Board Layout

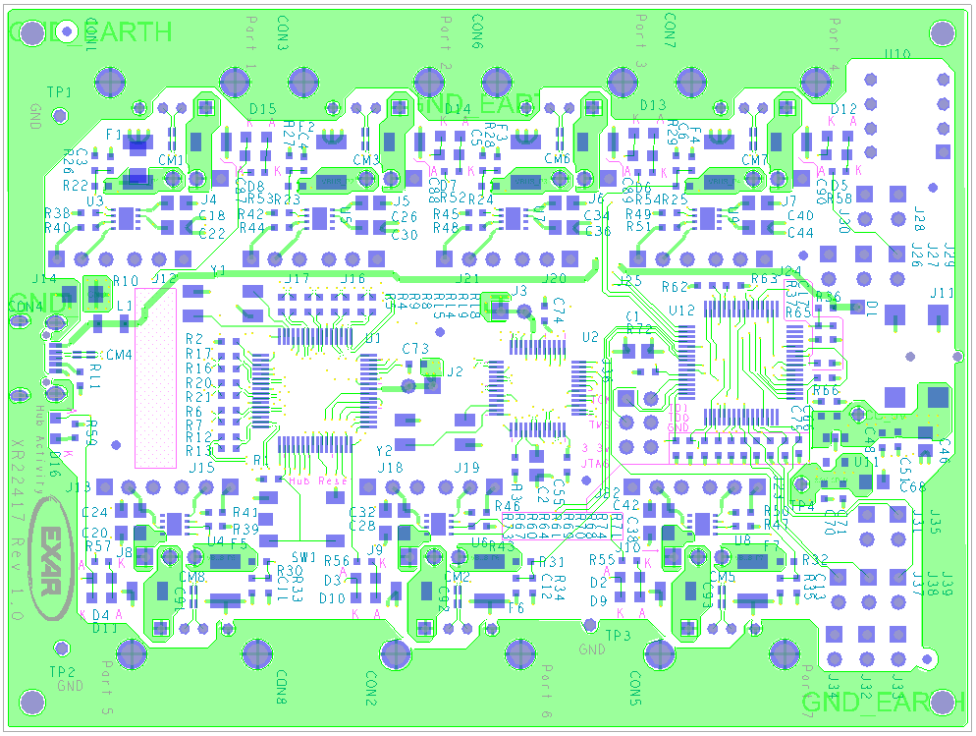

Figure 2: XR22417 PCB Layout Top View

Evaluation Board Picture

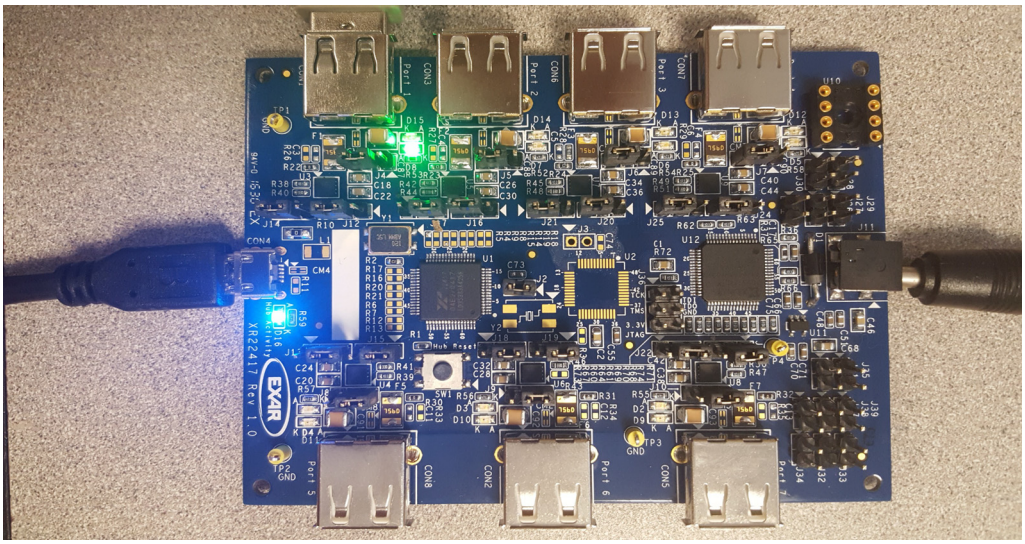

Figure 3: XR22417CV64 PCB

Hardware Configuration

This section describes the default board settings, when shipped from the factory, and jumper settings that may be used to reconfigure operation.

Differences between XR22417CV64EVB and XR22417CV48EVB

The XR22417 is available in two packages, a 64 pin LQFP and a 48 pin LQFP. The two versions of the evaluation board use the same bare PCB, but with different components assembled, which includes either the 64 or 48 pin package. The 64 pin device supports over-current sensing and power control. The 48 pin device implements fuse protection of each downstream port. Additionally, in order to avoid trace stubs on high speed USB (480 MHz) nets 0 ohm resistors are installed from the upstream and all seven downstream USB ports to connect to the LQFP48 device for the XR22417CV48EVB. These resistors are not installed for the LQFP64 EVB.

Power Configurations

The XR22417 EVB is self-powered and uses the 5V supplied by the external 5V DC input to J11 power jack. The PCB will also operate with limited functionality when powered only by VBUS from the USB host. When bus powered, the XR22417 may not be capable of providing sufficient power to all downstream ports. The XR22417 is always reported to the USB host as a self-powered device. As a self-powered device it may not draw more than the 100 mA from host VBUS power per USB specification.

Power to each of the downstream ports of the XR22417 LQFP64 EVB is monitored by a resettable PTC fuse, by an XRP2527 USB power monitor, or by both the fuse and the power monitor devices. Over-current conditions detected by either XRP2527 current monitors or PTC fuses are signaled to the OVCn# pins of the device, and power out pins (PWRn#) are deasserted to then power down the offending port. In the LQFP48 EVB, PTCs protect each downstream port during over-current conditions. PTC fuses have a current trip of ~0.75A at ambient temperature of ~21 deg. C, and the XRP2527 current monitors have a current trip of ~0.5A with RSET resistance value of 215 kΩ. The RSET resistance can be changed from a minimum of 100 kΩ to 330 kΩ for current trip of ~ 0.33A to ~ 1.1A.

Table 2: Jumper Settings and components for PCB Power

Jumper	Description	Default
J4 - J10	J4 - J10 are used to select whether fuses only or current monitor (XRP2527) devices are used for downstream port over-current protection on the LQFP64 EVB. If J4 - J10 are installed from pin 2-3, downstream ports are protected by PTC fuses. If installed from pin 1-2, J12, J13, J16, J18, J20 J22 and J24 determine if downstream ports are protected by current monitor devices or both current monitors and fuses.	By default, on the LQFP64 EVB J4 - J10 are installed from pin 1-2. On the LQFP48 EVB, J4 - J10 are always connected from pin 2-3 for PTC protection.
J12, J13, J16, J18, J20, J22, J24	On the LQFP64 EVB, when J12, J13, J16, J18, J20, J22, J24 are installed from pin 1-2, the fuse protected 5V is also monitored by the current monitors. If installed pin 2-3, 5V is monitored only by current monitor devices.	By default, on the LQFP64 EVB J12, J13, J16, J18, J20, J22, J24 are installed from pin 2-3. These headers are not populated on the LQFP48.
J14, J15, J17, J19, J21, J23, J25	On the LQFP64 EVB, when J14, J15, J17, J19, J21, J23, J25 are installed from pin 1-2, the XRP2527 current monitors use USB 2.0 default trip voltage. If installed pin 2-3, the current monitors use trip at value established by the resistance of the RSET pin to ground using formula ILIM (trip current) = ~108.7 / RSET resistance (kΩ).	By default, on the LQFP64 EVB J14, J15, J17, J19, J21, J23, J25 are installed from pin 2-3. These headers are not populated on the LQFP48 EVB.

Strapping Configurations

XR22417 strapping options provide a mechanism for reducing the number of downstream ports that are reported to the USB host as well as a mechanism for reporting non-removable downstream devices. Table 3 and Table 4 show the jumper strapping options. Note that strapping options are detected by a device reset, either at power on, or from an externally

applied reset to the EXT_RST# pin. Re-enumerating a self-powered device without cycling power input will not cause strapping options to be applied.

Table 3: Strapping options for reducing usable downstream ports

Usable Downstream Ports	J28	J30
4, 3, 2, 1	Installed	Installed
5, 4, 3, 2, 1	Not Installed	Installed
6, 5, 4, 3, 2, 1	Installed	Not Installed
7, 6, 5, 4, 3, 2, 1	Not Installed	Not Installed

Table 4: Strapping options for reporting of non-removable USB devices

Non-removable Downstream Ports	J29	J27	J26
None	Not Installed	Not Installed	Not Installed
2	Not Installed	Not Installed	Installed
3, 2	Not Installed	Installed	Not Installed
3, 2, 1	Not Installed	Installed	Installed
4, 3, 2, 1	Installed	Not Installed	Not Installed
5, 4, 3, 2, 1	Installed	Not Installed	Installed
6, 5, 4, 3, 2, 1	Installed	Installed	Not Installed
7, 6, 5, 4, 3, 2, 1	Installed	Installed	Installed

Uninstalled components on XR22417CV64EVB and XR22417CV48EVB

Both XR22417 EVBs have a number of components that are not installed. These components have a variety of purposes and some may be installed after cutting the surface "shorting traces" which short across the pins of the devices when they are not installed. Table 5 lists the major uninstalled components in both versions of the EVB. Table 6 lists additional major components not installed in the XR22417CV48EVB.

Table 5: Major Uninstalled Components

Uninstalled Components	
J2 & J3	By default are not installed. For power measurements, an ammeter may be installed by cutting either the surface trace on J2 (when using the LQFP64 device) or J3 (when using the LQFP48 device). J2 or J3 can then be installed or an ammeter in series can be used for power measurements.
CM1 - CM8	Common Mode chokes on upstream and 7 downstream ports for EMI purposes. Install if desired after cutting surface traces.
L1	Ferrite bead L1 is not installed as DC power should be supplied by external AC to DC power supply. Install if desired after cutting surface trace.
Y1 / Y2 and R2 / R3	For the XR22417CV64EVB Y2 and R3 are not installed. For the XR22417CV48EVB Y1 and R2 are not installed.

Table 5: Major Uninstalled Components

Uninstalled Components	
R4 - R9, R12 - R21	Not installed on LQFP64 EVB to prevent stubs on high speed critical nets. Installed on LQFP48 EVB to connect USB upstream and downstream ports to LQFP48 device.
D1	D1 is for test purposes only and is not installed by default. The XR22417 may only be self-powered and must use an external 5V source for USB compliance and functionality.

Table 6: Additional Uninstalled Components on XR22417CV48EVB

Uninstalled Components	
U3 - U9, J12 - J25, R38 - R51, C18, C20, C22 - C26, C28, C30 - C34, C36 - C38, C40, C42 - C45	Power monitor circuit unused on LQFP48 EVB
U12, J31 - J39	CPLD logic unused
U11, C65, C66, C68, C70, C71	Unused CPLD 3.3V power

LED Indicators

Each USB port of the XR22417 EVBs has status indicators. The upstream port has a single blue LED to indicate any hub activity. The LED is lit when the hub is connected to a USB host. However, if there are no downstream ports connected, following device enumeration and a short period of inactivity, the hub will be placed in suspend state and the hub activity LED will not be lit. On the CV64 EVB, the 7 downstream ports have both green and amber LEDs with status indications per USB specification. A solid green lit LED indicates normal port activity. A lit or flashing amber LED indicates an error condition most likely caused by an over-current condition from the fuse or current monitors as described in chapter 11 of the USB 2.0 specification. The CV48 EVB has only green LEDs to indicate a downstream device connection.

EEPROM

As documented in the XR22417 datasheet, an EEPROM can be used to configure the hub descriptors reported to the USB host. Note that using the EEPROM requires the use of serial numbers. By USB specification, if the hub is serialized, each individual device must be guaranteed to have a unique serial number.

XR22417 Evaluation Board Bill of Materials

The Bill of Materials for the two versions of the XR22417 evaluation boards are in the following tables. The XR22417CV48EVB BOM is in Table 7 and XR22417CV64EVB in Table 8. Several component part numbers marked "DNI" may typically be not installed on the MaxLinear evaluation boards. However, these may be used on customer PCBs for EMI or other purposes as desired.

Table 7: XR22417CV48EVB BOM

Item	Qty	Ref. Des	Description	Part Number
1	8	CM1, CM2, CM3, CM4, CM5, CM6, CM7, CM8	Common Mode Choke Surface Mount	744230900_DNI
2	7	CON1, CON2, CON3, CON5, CON6, CON7, CON8	USB Conn, Receptable, A-type	61400416021
3	1	CON4	Connector, USB_MICRO_ B	885012107014
4	5	C1, C2, C46, C53, C59	Ceramic Capacitor, 10uF/16V 0805	885012107014
5	2	J2, J3	2 Positions Header, 0.100" (2.54mm)	61300211121_DNI
6	7	C3, C4, C5, C6, C11, C12, C13	Ceramic Capacitor, 10nF/25V 0603	885012206065_DNI
7	12	C47, C55, C56, C60, C61, C63, C73, C74, C79, C80, C81, C83	Ceramic Capacitor, 100nF/25V 0603	885012206071
8	7	C18, C20, C26, C28, C34, C38, C40	Ceramic Capacitor, 1uF/16V, 0805	885012207051_DNI
9	7	C87, C88, C89, C90, C91, C92, C93	Ceramic Capacitor, 47uF/16V 1210	885012109011
10	1	D1	Diode Schottky 20V 1A DO41 DNI	1N5817-T_DNI
11	7	D2, D3, D4, D5, D6, D7, D8	LED, Green, 0805	150080GS75000
12	1	D16	LED, Blue, 0805	150080BS75000
13	7	F1, F2, F3, F4, F5, F6, F7	PTC Resettable, 0.75A 13.2V 1812	MF-MSMF075-2
14	5	J26, J27, J28, J29, J30	2 Positions Header, 0.100" (2.54mm)	61300211121
15	7	J4, J5, J6, J7, J8, J9, J10	3 Positions Header, 0.100" (2.54mm)	61300311121
16	1	J11	Connector, Power Jack, DC RA SMD	694103107102
17	1	L1	Ferrite Bead, 2.5A 600 Ohm 1206 Surface Mount	74279221601_DNI
18	2	R1, R37	Resistor, 100 kOhm, 5%, 0603	
19	8	R3, R52, R53, R54, R55, R56, R57, R58	Resistor, 2.7 kOhm, 1%, 0603	
20	17	R4, R5, R6, R7, R8, R9, R10, R12, R13, R14, R15, R16, R17, R18, R19, R20, R21	Resistor, 0 Ohm, 0603	
21	1	R11	Resistor, 0 Ohm, 0603	DNI
22	7	R26, R27, R28, R29, R33, R34, R35	Resistor, 100 kOhm, 5%, 0603	DNI
23	1	R36	Resistor, 10 kOhm, 5%, 0603	
24	7	R40, R41, R44, R46, R48, R50, R51	Resistor, 215 kOhm, 5%, 0603	DNI
25	1	R59	Resistor, 470 Ohm, 5%, 0603	
26	1	SW1	Switch, SPST-NO	431481031816
27	3	TP1, TP2, TP3	Test Point PC Mini .040"D Yellow	36-5004-ND

Table 7: XR22417CV48EVB BOM

Item	Qty	Ref. Des	Description	Part Number
28	1	U2	IC, USB 2.0 Hub, 7 Port	XR22417CV48-F
29	4	J34, J37, J38, J39	2 Positions Header, 0.100" (2.54mm)	61300211121_DNI
30	1	U10	IC, EEPROM 2KBIT 400KHZ 8DIP	24LC02B/P
31	1	Y2	12MHz ±20ppm Crystal 18pF -20°C ~ 70°C 4-SMD	ABMM-12.000MHZ-B2-T

Note: Part numbers marked _DNI are not installed.

Table 8: XR22417CV64EVB BOM

Item	Qty	Ref. Des	Description	Part Number
1	8	CM1, CM2, CM3, CM4, CM5, CM6, CM7, CM8	Common Mode Choke Surface Mount	744230900_DNI
2	7	CON1, CON2, CON3, CON5, CON6, CON7, CON8	USB Conn, Receptable, A-type	61400416021
3	1	CON4	Connector, USB_MICRO_ B	885012107014
4	5	C1, C2, C46, C53, C59	Ceramic Capacitor, 10uF/16V 0805	885012107014
5	2	J2, J3	2 Positions Header, 0.100" (2.54mm)	61300211121_DNI
6	7	C3, C4, C5, C6, C11, C12, C13	Ceramic Capacitor, 10nF/25V 0603	885012206065_DNI
7	19	C17, C54, C57, C58, C62, C64, C66, C70, C73, C75, C76, C77, C78, C79, C82, C84, C85, C86, C94	Ceramic Capacitor, 100nF/25V 0603	885012206071
8	16	C18, C20, C22, C24, C26, C28, C30, C32, C34, C36, C38, C40, C42, C44, C65, C68	Ceramic Capacitor, 1uF/16V, 0805	885012207051
9	14	C23, C25, C31, C33, C37, C43, C45, C87, C88, C89, C90, C91, C92, C93	Ceramic Capacitor, 47uF/16V 1210	885012109011
10	1	D1	Diode Schottky 20V 1A DO41 DNI	1N5817-T_DNI
11	7	D2, D3, D4, D5, D6, D7, D8	LED, Green, 0805	150080GS75000
12	7	D9, D10, D11, D12, D13, D14, D15	LED, Amber, 0805	150080YS75000
13	1	D16	LED, Blue, 0805	150080BS75000
14	5	F1, F2, F3, F4, F5, F6, F7	PTC Resettable, .75A 13.2V 1812	MF-MSMF075-2
15	8	J26, J27, J28, J29, J30, J37, J38, J39	2 Positions Header, 0.100" (2.54mm)	61300211121
16	21	J12, J13, J14, J15, J16, J17, J18, J19, J20, J21, J22, J23, J24, J25, J4, J5, J6, J7, J8, J9, J10	3 Positions Header, 0.100" (2.54mm)	61300311121
17	1	J11	Connector, Power Jack, DC RA SMD	694103107102
18	1	J36	6 Positions Header, dual row, 0.100" (2.54mm)	61300621121
19	1	L1	Ferrite Bead, 2.5A 600 Ohm 1206 Surface Mount	74279221601_DNI
20	2	R1, R37	Resistor, 100 kOhm, 5%, 0603	
21	8	R2, R52, R53, R54, R55, R56, R57, R58	Resistor, 2.7 kOhm, 1%, 0603	
22	8	R10, R22, R23, R24, R25, R30, R31, R32	Resistor, 0 Ohm, 0603	
23	1	R11	Resistor, 0 Ohm, 0603	DNI
24	7	R26, R27, R28, R29, R33, R34, R35	Resistor, 100 kOhm, 5%, 0603	DNI
25	15	R36, R38, R39, R42, R43, R45, R47, R49, R60, R61, R62, R63, R64, R65, R66	Resistor, 10 kOhm, 5%, 0603	
26	7	R40, R41, R44, R46, R48, R50, R51	Resistor, 215 kOhm, 5%, 0603	
27	1	R59	Resistor, 470 Ohm, 5%, 0603	
28	1	SW1	Switch, SPST-NO	431481031816

Table 8: XR22417CV64EVB BOM

Item	Qty	Ref. Des	Description	Part Number
29	4	TP1, TP2, TP3, TP4	Test Point PC Mini .040"D Yellow	36-5004-ND
30	1	U1	IC, USB 2.0 Hub, 7 Port	XR22417CV64-F
31	8	J31, J32, J33, J34, J35, J37, J38, J39	2 Positions Header, 0.100" (2.54mm)	61300211121_DNI
32	7	U3, U4, U5, U6, U7, U8, U9	IC, USB Power Monitor	XRP2527IHB-1-F
33	1	U10	IC, EEPROM 2KBIT 400KHZ 8DIP	24LC02B/P_DNI
34	1	U11	IC, LDO, 200 mA	SP6260GEK-L/TR
35	1	U12	IC, CPLD, 64VQFP	XC9572XL-10VQG64C
36	1	Y1	12MHz ±20ppm Crystal 18pF -20°C ~ 70°C 4-SMD	ABMM-12.000MHZ-B2-T

Note: Part numbers marked _DNI are not installed.

Revision History

Revision	Date	Description
1A	August 2016	Initial release
1B	October 2016	BOM updates
1C	August 2018	Update to MaxLinear logo. Update format.

Corporate Headquarters:
5966 La Place Court
Suite 100
Carlsbad, CA 92008
Tel.:+1 (760) 692-0711
Fax: +1 (760) 444-8598
www.maxlinear.com

High Performance Analog:
1060 Rincon Circle
San Jose, CA 95131
Tel.: +1 (669) 265-6100
Fax: +1 (669) 265-6101
www.exar.com

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