XR22417

USB 2.0 7-Port Hub

Description

The XR22417 is a USB 2.0 7-port hub using Multiple Transaction Translators (MTT) for highest possible bandwidth capability. The upstream USB interface has an integrated USB 2.0 PHY and device controller that is compliant with both hi-speed (480 Mbps) and full-speed (12 Mbps). The downstream PHY supports hi-speed, full-speed and low-speed (1.5 Mbps) on each of the 7 downstream ports. Individual port activity and overall hub activity indicators provide status outputs to control external LEDs for each port. An external EEPROM may be used with the XR22417 to change selected USB descriptors including the USB vendor and product IDs, the number of downstream ports and device serial number. Overcurrent protection and power control for each downstream port is available in the LQFP-64 package. The XR22417 operates from a single 5V power input. Internal regulators provide a 3.3V output which may be connected to VCC33 power input pins. In turn a second internal regulator provides a 1.8V output from the 3.3V input. This 1.8V output may be connected to VCC18 power input pins.

FEATURES

- USB 2.0 compliant interface
- Multiple transaction translators (MTT)
- Regulated +3.3V output power
- Individual port and hub activity LED indicators
- Individual power enables (LQFP-64)
- Individual overcurrent sensing (LQFP-64)
- Single 5V power input
- Single 12 MHz Crystal

APPLICATIONS

- USB port expansion
- Docking stations
- POS terminals
- Test instrumentation
- Factory automation and process controls
- Industrial applications

The product (or products) mentioned in this data sheet are no longer being manufactured and may not be ordered (OBS)

Typical Application

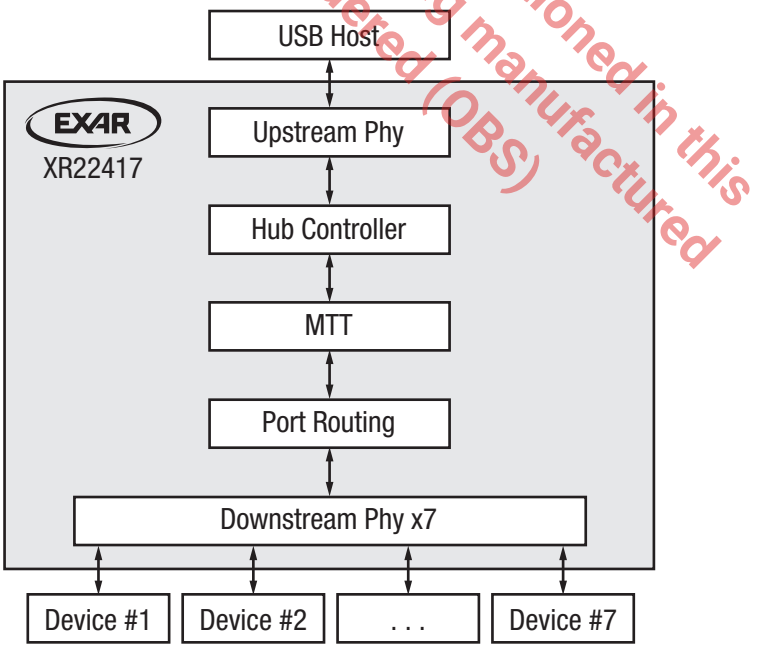


Figure 1. Typical Application

Absolute Maximum Ratings

Stresses beyond the limits listed below may cause permanent damage to the device. Exposure to any Absolute Maximum Rating condition for extended periods may affect device reliability and lifetime.

VCC5 supply voltage ..... -0.5V to 6.0V

VCC33 supply voltage ..... -0.5V to 4.0V

VCC18 supply voltage ..... -0.5V to 2.5V

Input voltage
(all pins except USBD+, USBD–) ..... -0.3V to 4.0V

Input voltage (USBD+ and USBD–) ..... -0.3V to 5.75V

Junction temperature ..... 125°C

Operating Conditions

Operating temperature range ..... 0°C to 70°C

VCC5 supply voltage .....4.4V to 5.5V

VCC33 supply voltage .....3.0V to 3.6V

VCC18 supply voltage .....1.62V to 1.98V

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Electrical Characteristics

Unless otherwise noted: T_A = 0°C to 70°C, VCC5 = 4.4V to 5.5V.

Symbol	Conditions			Min	Typ	Max	Units
	Upstream Port Speed	Number of Active Downstream Ports	Downstream Ports Device Speed				
Power Consumption DC Supply Current							
I_{CC}	High Speed	Suspend			0.6	2.5	mA
		None			53		mA
		1	1x Full Speed		63		mA
			1x High Speed		71		mA
		2	2x Full Speed		67		mA
			1x Full Speed, 1x High Speed		76		mA
			2x High Speed		87		mA
		7	7x Full Speed		71		mA
			7x High Speed		167		mA
	Full Speed	Suspend			0.6	2.5	mA
		None			38		mA
		1	1x Full Speed		45		mA
		7	7x Full Speed		78		mA

Electrical Characteristics (Continued)

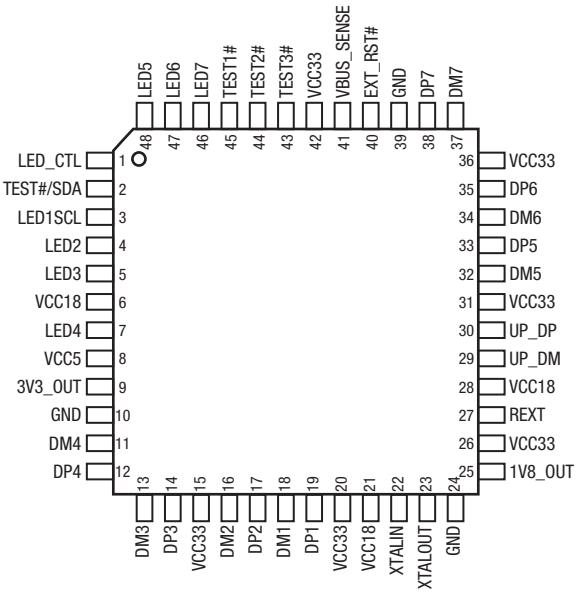
Unless otherwise noted: T_A = 0°C to 70°C, VCC5 = 4.4V to 5.5V.

Symbol	Parameter	Conditions	Min	Typ	Max	Units
Non-USB I/O Pins						
V_{IL}	Input low voltage		-0.3		0.8	V
V_{IH}	Input high voltage		2.0		5.5	V
V_{OL}	Output low voltage	I_{OL} = 4 mA			0.4	V
V_{OH}	Output high voltage	I_{OL} = -4 mA	2.4			V
I_{IL}	Input low leakage current				±10	µA
I_{IH}	Input high leakage current				±10	µA
C_{IN}	Input pin capacitance				5	pF
USB I/O Pins(1)						
3.3V Regulated Power Output						
3V3_OUT	Output voltage	Max load current 100 mA	3.0	3.3	3.6	V

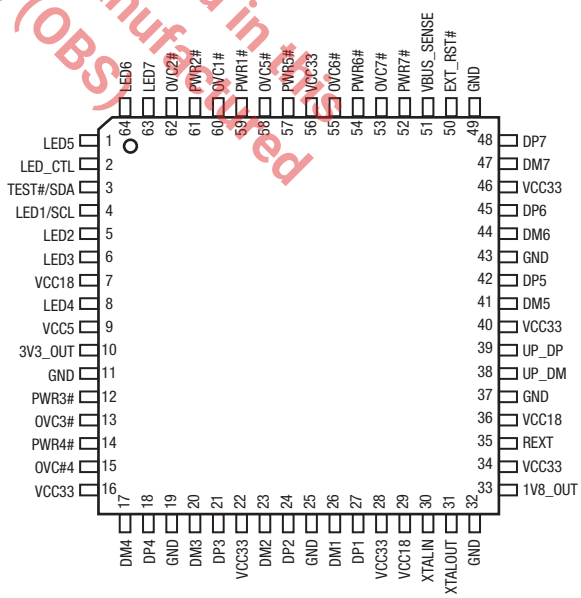
NOTE:
1. See USB 2.0 Specification for USB I/O pins DC Electrical Characteristics.

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Pin Configuration, Top View



48-Pin LQFP



64-Pin LQFP

Pin Functions

LQFP-48 Pin Number	LQFP-64 Pin Number	Pin Name	Type	Description
48	1	LED5	O	Port 5 LED indicator. May be used in conjunction with LED_CTL pin.
1	2	LED_CTL	O	LED hub active indicator. May be used in conjunction with port status LEDs.
2	3	TEST#/SDA	I/O OD	Test mode enable. Active low and I²C serial data. Leave unconnected for normal device operation if no external EEPROM is used.
3	4	LED1/SCL	I/O OD	Port 1 LED indicator and I²C serial clock. May be used in conjunction with LED_CTL pin.
4	5	LED2	O	Port 2 LED indicator. May be used in conjunction with LED_CTL pin.
5	6	LED3	O	Port 3 LED indicator. May be used in conjunction with LED_CTL pin.
6	7	VCC18	PWR	1.8V power input.
7	8	LED4	O	Port 4 LED indicator. May be used in conjunction with LED_CTL pin.
8	9	VCC5	PWR	5V power input.
9	10	3V3_OUT	PWR	3.3V power output from internal 5V to 3.3V regulator. Must be decoupled with minimum of 10 µF.
10	11	GND	PWR	Ground.
-	12	PWR3#	OD	Power enable for port 3 downstream device, active low. Asserted if OVC3# input is asserted or device is not configured.
-	13	OVC3#	I	Downstream port 3 over current indicator, active low.
-	14	PWR4#	OD	Power enable for port 4 downstream device, active low. Asserted if OVC4# input is asserted or device is not configured.
-	15	OVC4#	I	Downstream port 4 overcurrent indicator, active low.
15	16	VCC33	PWR	3.3V power input.
11	17	DM4	I/O	Downstream port 4 USBD- data.
12	18	DP4	I/O	Downstream port 4 USBD+ data.
-	19	GND	PWR	Ground.
13	20	DM3	I/O	Downstream port 3 USBD- data.
14	21	DP3	I/O	Downstream port 3 USBD+ data.
-	22	VCC33	PWR	3.3V power input.
16	23	DM2	I/O	Downstream port 2 USBD- data.
17	24	DP2	I/O	Downstream port 2 USBD+ data.
-	25	GND	PWR	Ground.
18	26	DM1	I/O	Downstream port 1 USBD- data.
19	27	DP1	I/O	Downstream port 1 USBD+ data.
20	28	VCC33	PWR	3.3V power input.
21	29	VCC18	PWR	1.8V power input.
22	30	XTALIN	I	12 MHz ± 50 ppm crystal input with load capacitance rating of 16-20 pF.
23	31	XTALOUT	O	12 MHz crystal feedback output.

NOTE:
Type: I = Input, O = Output, I/O = Input/Output, PWR = Power, OD = Open-Drain.

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Pin Functions (Continued)

LQFP-48 Pin Number	LQFP-64 Pin Number	Pin Name	Type	Description
24	32	GND	PWR	Ground.
25	33	1V8_OUT	PWR	1.8V power output from internal 3.3V to 1.8V regulator. Must be decoupled with minimum of 10 µF.
26	34	VCC33	PWR	3.3V power input.
27	35	REXT	I	External bias resistor. Connect 2.7kΩ 1% resistor from this pin to GND.
28	36	VCC18	PWR	1.8V power input.
-	37	GND	PWR	Ground.
29	38	UP_DM	I/O	Upstream port USBD- data.
30	39	UP_DP	I/O	Upstream port USBD+ data.
31	40	VCC33	PWR	3.3V power input.
32	41	DM5	I/O	Downstream port 5 USBD- data.
33	42	DP5	I/O	Downstream port 5 USBD+ data.
-	43	GND	PWR	Ground.
34	44	DM6	I/O	Downstream port 6 USBD- data.
35	45	DP6	I/O	Downstream port 6 USBD+ data.
36	46	VCC33	PWR	3.3V power input.
37	47	DM7	I/O	Downstream port 7 USBD- data.
38	48	DP7	I/O	Downstream port 7 USBD+ data.
39	49	GND	PWR	Ground.
40	50	EXT_RST#	I	External reset input, active low. Must be asserted for a minimum of 10 µS. This pin requires an external pull-up resistor to 3.3V.
41	51	VBUS_SENSE	I	Active high, indicates connection to USB host. Must connect to VBUS power input from USB host through a series 10kΩ resistor. A 100kΩ pull-down resistor and 100nF shunt capacitance are also required on this pin.
-	52	PWR7#	OD	Power enable for port 7 downstream device, active low. Asserted if OVC7# input is asserted or device is not configured.
-	53	OVC7#	I	Downstream port 7 over current indicator, active low.
-	54	PWR6#	OD	Power enable for port 6 downstream device, active low. Asserted if OVC6# input is asserted or device is not configured.
-	55	OVC6#	I	Downstream port 7 over current indicator, active low.
42	56	VCC33	PWR	3.3V power input.
-	57	PWR5#	OD	Power enable for port 5 downstream device. Asserted if OVC5# input is asserted or device is not configured.

NOTE:
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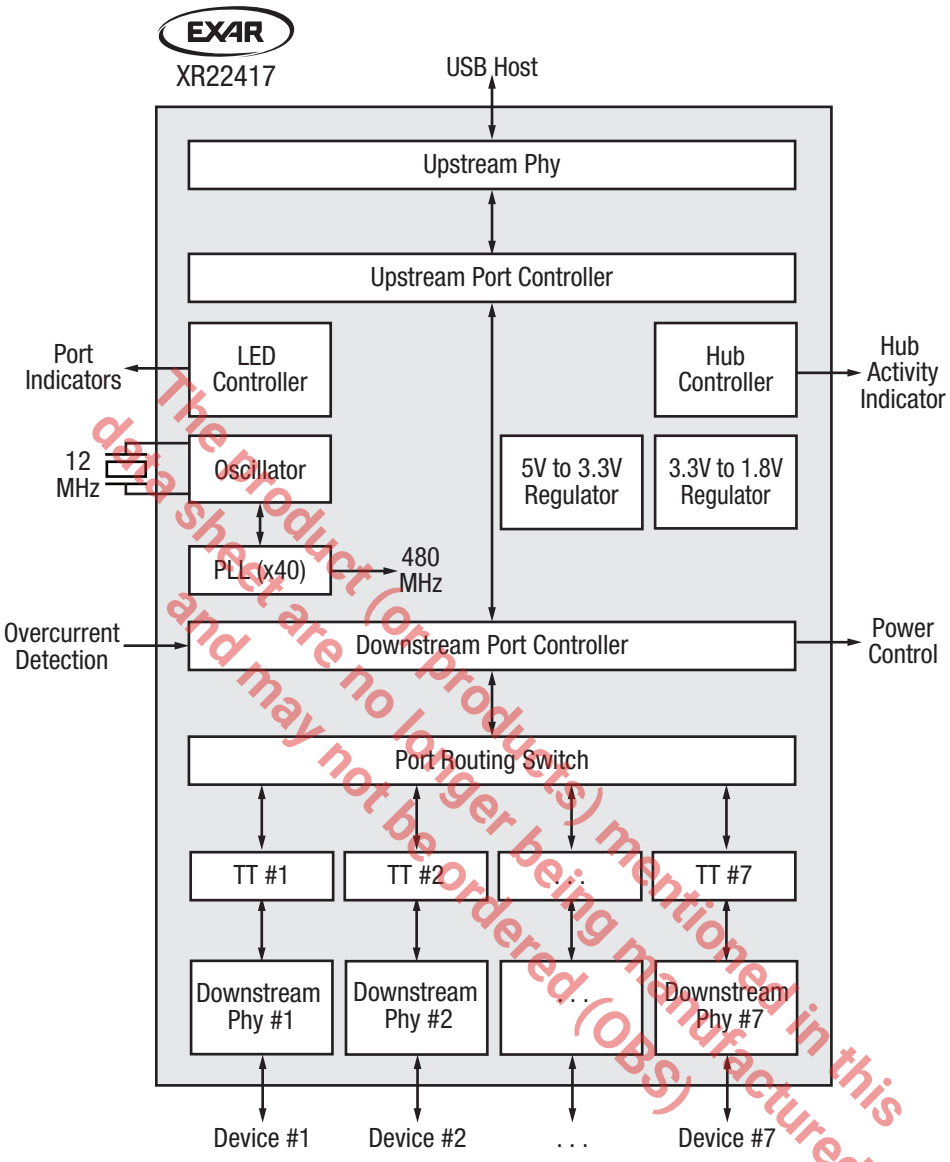
Pin Functions (Continued)

LQFP-48 Pin Number	LQFP-64 Pin Number	Pin Name	Type	Description
-	58	OVC5#	I	Downstream port 5 over current indicator, active low.
-	59	PWR1#	OD	Power enable for port 1 downstream device. Asserted if OVC1# input is asserted or device is not configured.
-	60	OVC1#	I	Downstream port 1 over current indicator, active low.
-	61	PWR2#	OD	Power enable for port 2 downstream device, active low.
-	62	OVC2#	I	Downstream port 2 over current indicator, active low.
43	-	TEST1#	I	Test input. Use pull-up resistor to 3.3V for normal operation.
44	-	TEST2#	O	Test output. Leave unconnected.
45	-	TEST3#	I	Test input. Use pull-up resistor to 3.3V for normal operation.
46	63	LED7	O	Port 7 LED Indicator. May be used in conjunction with LED_CTL pin.
47	64	LED6	O	Port 6 LED Indicator. May be used in conjunction with LED_CTL pin.

NOTE:
Type: I = Input, O = Output, I/O = Input/Output, PWR = Power, OD = Open-Drain.

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Functional Block Diagram



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Figure 2. Functional Block Diagram

Applications Information

Functional Description

The XR22417 hub has a multiple transaction translator architecture that provides one Transaction Translator (TT) for each of the downstream USB ports. The transaction translators allow the USB 2.0 hub to take incoming high speed packets from the USB host on the upstream port and translate these commands, if necessary to full or low speed devices on any of the 7 downstream ports. The MTT architecture allows for higher bandwidth as the 7 individual ports are not constrained by a shared resource.

USB Interface

The hub function of the XR22417 supports one configuration and supports all USB endpoints:

- Control endpoint
- Interrupt-in and interrupt-out endpoints
- Bulk-in and bulk-out endpoints
- Isochronous-in and isochronous-out endpoints

The XR22417 may be placed into a low power or suspended state by the USB host. The XR22417 hub may only be utilized in self-powered mode. Each of the downstream ports may draw up to 500mA.

Operating the XR22417 in bus powered mode violates the USB specification, as the device reports as self-powered in USB descriptors. A bus powered hub must provide 100mA on each downstream port but a 7-port hub cannot since it can only draw 500mA maximum from the USB host.

USB Vendor ID

Exar's USB vendor ID is 0x04E2.

USB Product ID

Exar's USB hub product ID is 0x0417.

Device Reset

The XR22417 has both an automatic power-up reset and an external hardware pin reset. Strapping options selected by tying pins to logic '0' or logic '1' states are sampled at either reset and the resulting hardware configuration selected by the strapping is then set. Refer to Tables 2 and Table 3.

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Applications Information (Continued)

External EEPROM

An external I²C EEPROM may be used with the XR22417 to configure USB device descriptors, the number of downstream ports, a device serial number, and downstream non-removable devices. The contents of the EEPROM are described in Table 1. In order for contents of the EEPROM to be used by the XR22417, both the EEPROM check values at address 0x00, 0x01 and the checksum at address 0x1F must be correct. If either field is incorrect, the EEPROM contents will be ignored and the device will use the default descriptor values. 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.

Table 1: EEPROM Contents

Address	Content	Description
0x00	0x40	EEPROM check value.
0x01	0x1A	EEPROM check value.
0x02	Vendor ID, LSB	idVendor field LSB of device descriptor.
0x03	Vendor ID, MSB	idVendor field MSB of device descriptor.
0x04	Product ID, LSB	idProduct field LSB of device descriptor.
0x05	Product ID, MSB	idProduct field MSB of device descriptor.
0x06	Device Release, LSB	bcdDevice field LSB of device descriptor in binary coded decimal format.
0x07	Device Release, MSB	bcdDevice field MSB of device descriptor in binary coded decimal format.
0x08 to 0x17	Device Serial Number	ASCII alpha-numeric serial number with maximum length 16 characters. First character of serial number string in location 0x08.
0x18	Serial Number Length	Length of device serial number.
0x19	0x00	Reserved.
0x1A	Downstream Ports	Number of downstream ports in the bNbrPorts field of the hub descriptor. EEPROM value will take precedence over any strapping options from Table 2 and Table 3.
0x1B	0x00	Reserved.
0x1C	Device Removable	Device removable field of hub descriptor. Bit n = '0' indicates a removable device, or bit n = '1' indicates a non-removable device for port n, (n = port 1 - 7). Bit 0 is reserved. EEPROM value will take precedence over any strapping options from Table 2 and Table 3.
0x1D	0x00	Reserved.
0x1E	Device Attributes	Bit 0: port indicators support, bit 7 of *wHubCharacteristics* field of hub descriptor - 0: port indicators are not supported on its downstream facing ports and PORT_ INDICATOR request has no effect. 1: port indicators are supported on its downstream facing ports and PORT _INDICATOR request controls the indicators. Bit 1: identifies a compound device, bit 2 of *wHubCharacteristics* field of hub descriptor - 0: hub is not part of a compound device. 1: hub is part of a compound device. Bit 2: maximum current requirements of the hub controller electronics, *bHubContrCurrent* field of hub descriptor - 0: 200 mA. 1: 500 mA. Bit 3 to 7, reserved, must be 0's.
0x1F	Checksum	Bitwise checksum of EEPROM values from address 0x00 to 0x1E.

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Applications Information (Continued)

Configurations for Reduced Downstream Ports

The number of usable downstream ports of the XR22417 may be configured using an external EEPROM. Additionally, the number of usable downstream ports may be reduced from 7 down to a minimum of 4 by strapping options on the device, shown in Table 2. Both the EEPROM values and the strapping options will change the bNbrPorts field of the hub descriptor reported to the USB host. LED pins for unusable downstream ports are disabled.

Table 2: Strapping Options for Reducing Usable Downstream Ports

Usable Downstream Ports	LED7	LED6
4, 3, 2, 1	Logic ‘0’	Logic ‘0’
5, 4, 3, 2, 1	Normal	Logic ‘0’
6, 5, 4, 3, 2, 1	Logic ‘0’	Normal
7, 6, 5, 4, 3, 2, 1	Normal	Normal

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Configurations for Non-Removable Devices

Non-removable devices are reported in the device removable field of the hub descriptor. They can be identified by strapping options. LED pins for non-removable downstream ports are disabled.

Table 3: Strapping Options for Configuring Non-Removable Downstream Ports

Non-Removable Downstream Ports	LED4	LED3	LED2
None	Normal	Normal	Normal
2	Normal	Normal	Logic ‘0’
3, 2	Normal	Logic ‘0’	Normal
3, 2, 1	Normal	Logic ‘0’	Logic ‘0’
4, 3, 2, 1	Logic ‘0’	Normal	Normal
5, 4, 3, 2, 1	Logic ‘0’	Normal	Logic ‘0’
6, 5, 4, 3, 2, 1	Logic ‘0’	Logic ‘0’	Normal
7, 6, 5, 4, 3, 2, 1	Logic ‘0’	Logic ‘0’	Logic ‘0’

Applications Information (Continued)

Port Status Indicators

Seven port indicator (LED1 - LED7) pins, provide status of downstream devices. Ports using LED indicators may configure status LEDs in a number of configurations in conjunction with the LED_CTL pin. Per the USB 2.0 spec, amber and green LEDs are used to indicate port status automatically controlled by the USB hub. When the hub is suspended or not yet configured the LEDs must be off, solid green indicates normal operation, and amber or flashing green and/or amber indicate various error conditions as defined in the specification. The TEST#/SDA and LED1/SCL pins may also be connected to an external EEPROM.

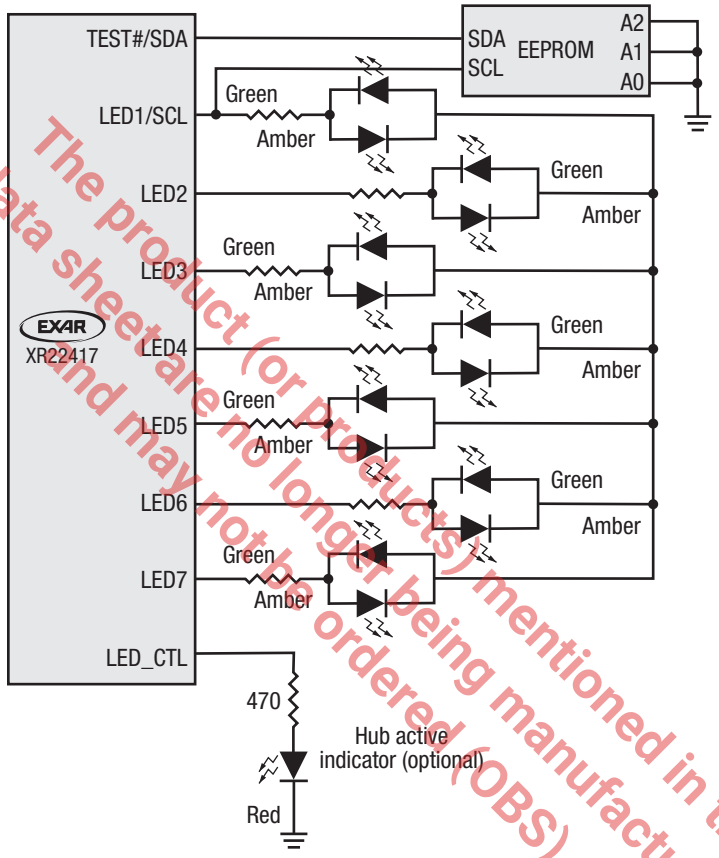


Figure 3. Port and Hub Status Indicators

The product (or products) mentioned in this data sheet are no longer being manufactured and may not be ordered (OBS)

Applications Information (Continued)

In the following example, LED3 is tied to logic '0' indicating that port 2 and 3 are connected to non-removable devices. LED6 is also connected to logic '0' indicating there are 5 usable ports, ports 1-5. LED2 and LED7 are unneeded and left floating. Ports 1, 4 and 5 may be used for removable devices.

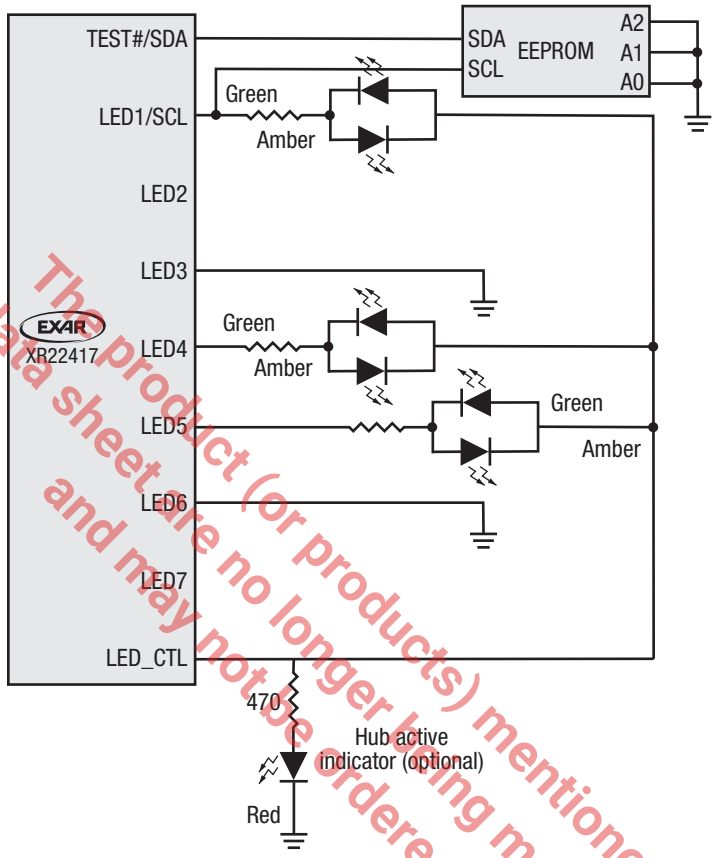


Figure 4. Port Indicators Example

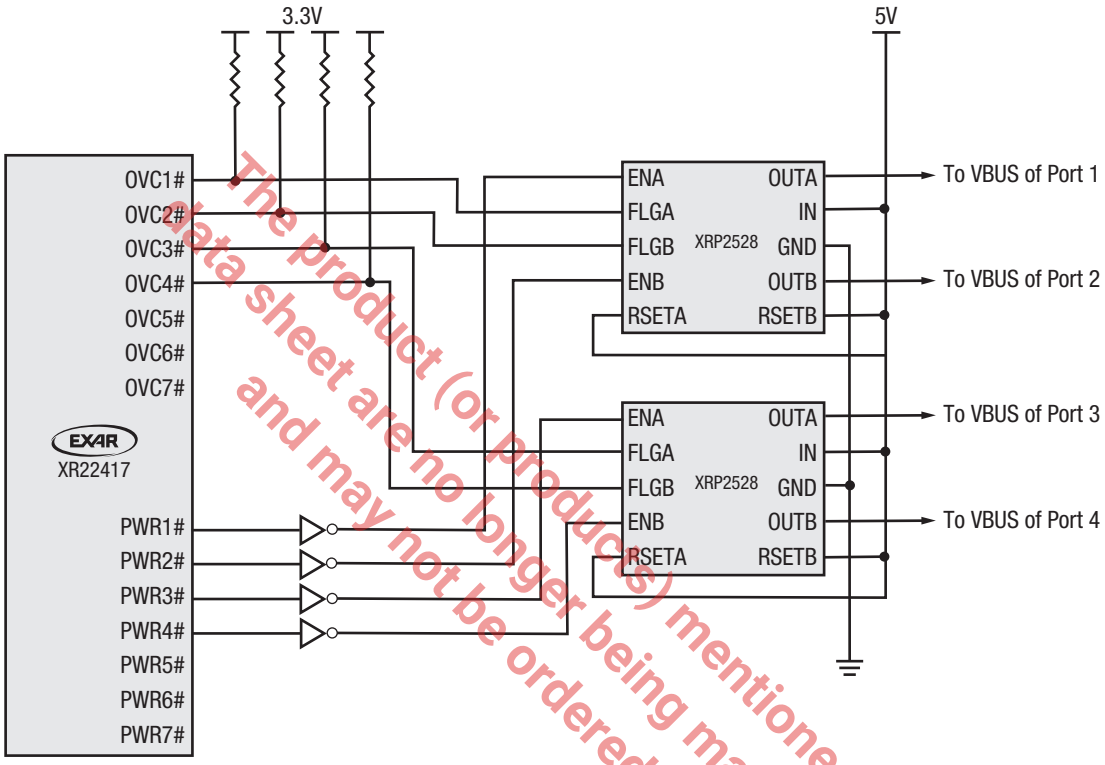
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Applications Information (Continued)

Power Control and Overcurrent Protection

In the LQFP-64 package, the XR22417 OVCn# pins monitor overcurrent conditions for each port and individual PWRn# pins enable power to devices connected to each downstream port. Figure 5 depicts downstream ports 1-4 using individual power and overcurrent protection.

NOTE:
Ports 5-7 are unused in this example. If used can duplicate the monitor and control using the XRP2528.



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Figure 5. LQFP-64 Individual Power Control and Overcurrent Mode

USB Hub Drivers

All operating systems provide a native USB hub device driver for the XR22417 device to operate. No other device drivers are necessary for the XR22417.

Regulated 3.3V Power Output

The XR22417 internal voltage regulator provides 3.3 VDC output power from 5V input, which can be utilized by other circuitry. Refer to Electrical Characteristics on page 2 for maximum power capability.

Applications Information (Continued)

External Crystal

A 12 MHz ± 50 PPM fundamental frequency external crystal must be connected between the XTALIN and XTALOUT pins of the XR22417 device. The crystal should have a rated load capacitance of 16-20pF. However, note that both the load capacitors and feedback resistance are internal to the XR22417 device as shown.

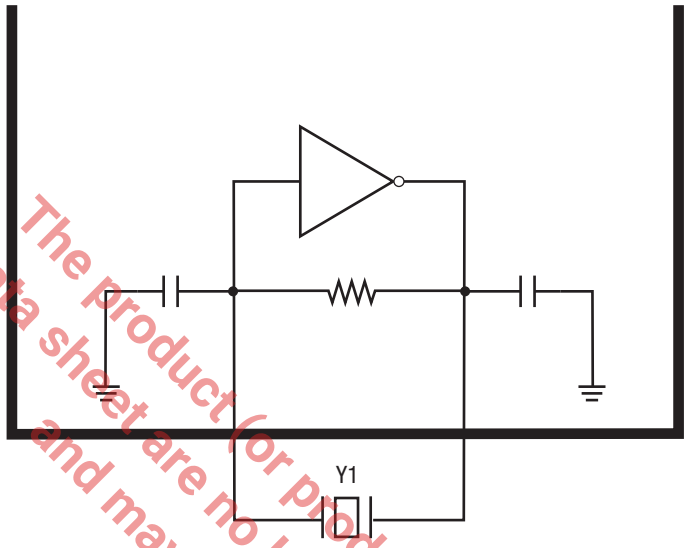
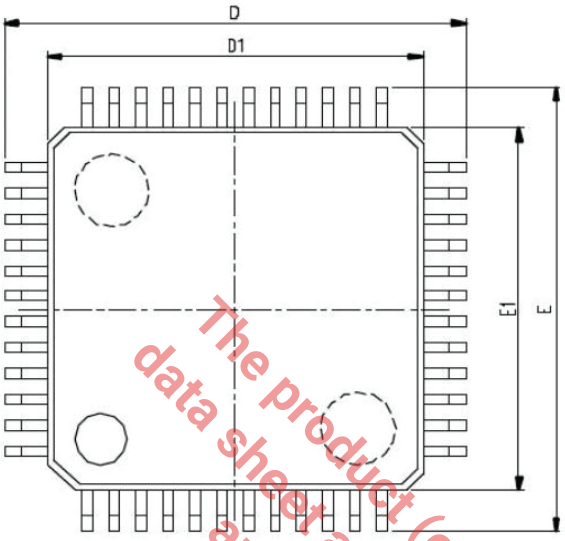


Figure 6. Typical Oscillator Connections

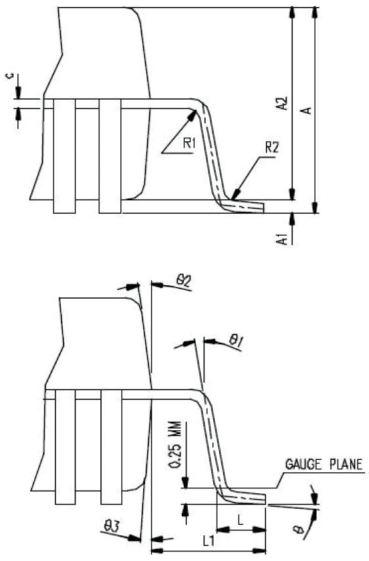
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Package Description

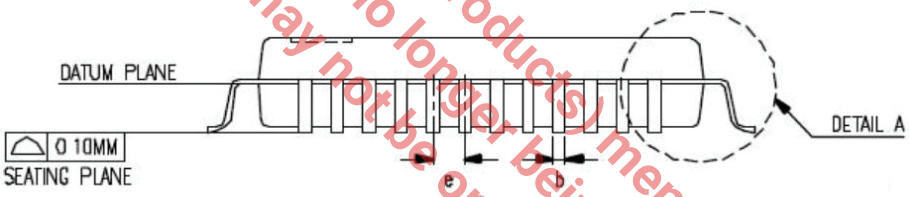
LQFP-48



TOP VIEW



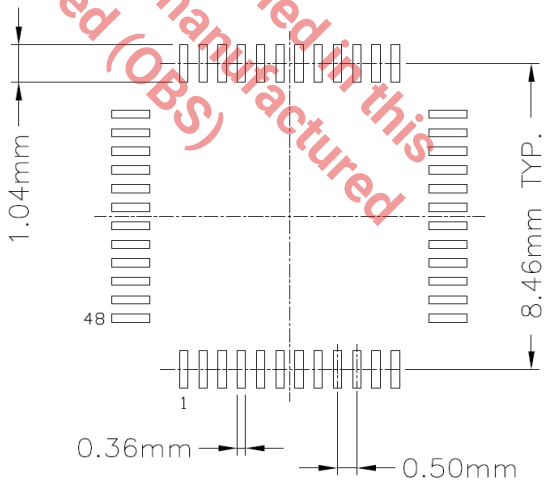
DETAIL A



SIDE VIEW

SYMBOL	DIMENSION IN MM		
	MIN.	NOM.	MAX.
A			1.60
A1	0.05		0.15
A2	1.35	1.40	1.45
⚠ b	0.17	0.22	0.27
⚠ c	0.09		0.20
e	0.50 BASIC		
D	9.00 BASIC		
D1	7.00 BASIC		
E	9.00 BASIC		
E1	7.00 BASIC		
L	0.45	0.60	0.75
L1	1.00 REF.		
R1	0.08		
R2	0.08		0.20
θ	0°	3.5°	7°
θ1	0°		
θ2	11°	12°	13°
θ3	11°	12°	13°

TERMINAL DIMENSION



TYPICAL RECOMMENDED LAND PATTERN

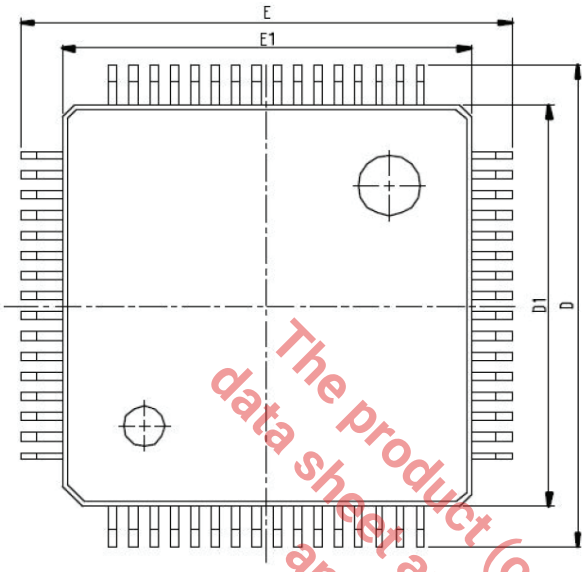
- Control dimensions are in Millimeters
- Jedec MS 026

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Revision: A

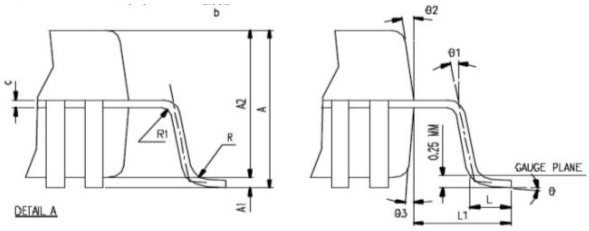
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Package Description (Continued)

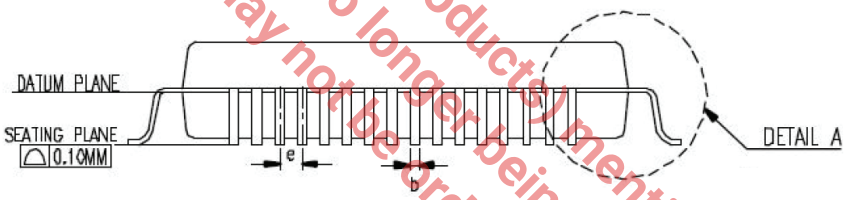
LQFP-64



TOP VIEW



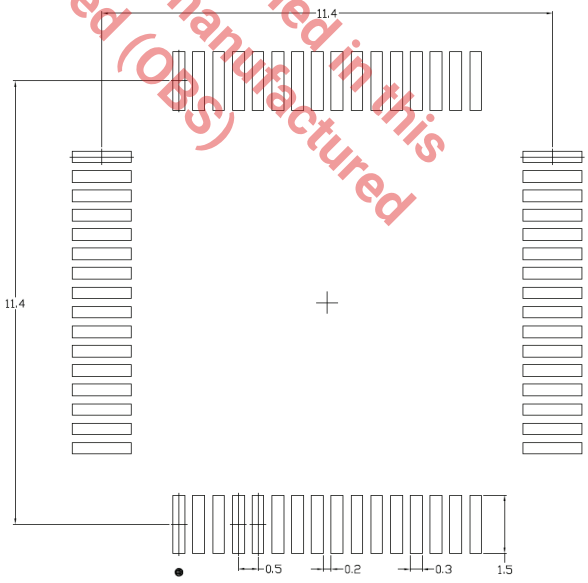
DETAIL A



SIDE VIEW

SYMBOL	DIMENSION IN MM			DIMENSION IN INCH		
	MIN.	NOM.	MAX.	MIN.	NOM.	MAX.
A			1.60			0.063
A1	0.05		0.15	0.002		0.006
A2	1.35	1.40	1.45	0.053	0.055	0.057
b	0.17	0.20	0.23	0.007	0.008	0.009
c	0.09		0.16	0.004		0.006
e	0.50 BASIC			0.020 BASIC		
D	12.00 BASIC			0.472 BASIC		
D1	10.00 BASIC			0.394 BASIC		
E	12.00 BASIC			0.472 BASIC		
E1	10.00 BASIC			0.394 BASIC		
L	0.45	0.60	0.75	0.018	0.024	0.030
L1	1.00 REF.			0.039 REF.		
R1	0.08			0.003		
R	0.08		0.20	0.003		0.008
θ	0	3.5	7	0	3.5	7
θ1	0			0		
θ2	11	12	13	11	12	13
θ3	11	12	13	11	12	13
JEDEC	MS-026 (BCD)					

TERMINAL DIMENSION



TYPICAL RECOMMENDED LAND PATTERN

1. Control dimensions are in Millimeters
2. Dimensions and tolerance per Jedec MS-026

Drawing No. : POD - 00000092
Revision: A

The product (or product) mentioned in this data sheet are no longer being manufactured and may not be ordered (OBS)

Ordering Information[1]

Part Number	Operating Temperature Range	Lead-Free	Package	Packaging Method
XR22417CV48-F	0°C to 70°C	Yes[2]	48-pin LQFP	Tray
XR22417CV48TR-F				Reel
XR22417CV64-F			64-pin LQFP	Tray
XR22417CV48EVB	Evaluation board for LQFP-48			
XR22417CV64EVB	Evaluation board for LQFP-64			

NOTE:
1. Refer to www.exar.com/XR22417 for most up-to-date Ordering Information.
2. Visit www.exar.com for additional information on Environmental Rating.

Revision History

Revision	Date	Description
1A	Aug 2016	Initial Release

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