XR22414

USB 2.0 4-Port MTT Hub

General Description

The XR22414 is a USB 2.0 4-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 (480Mbps) and Full-Speed (12Mbps) and downstream PHY supporting Hi-Speed, Full-Speed and Low-Speed (1.5Mbps) on each of the 4 downstream ports.

The XR22414 provides two power modes, ganged or individual power control as well as global or individual over-current sensing modes.

The XR22414 operates from a single 5V or 3.3V power input. When powered by 5V, internal regulators provide a 3.3V output which may be connected to VCC33 power input pins as well as external circuitry. 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. Individual port activity and overall hub activity indicators provide status outputs for external LEDs.

FEATURES

- USB 2.0 compliant interface
- Multiple transaction translators (MTT)
- Regulated +3.3V Output Power
- Individual port and hub activity LED indicators
- Individual or ganged port power enables
- Individual or global overcurrent sensing
- Single 5V or 3.3V power supply
- Single 12MHz Crystal
- 48-pin TQFN and LQFP package options

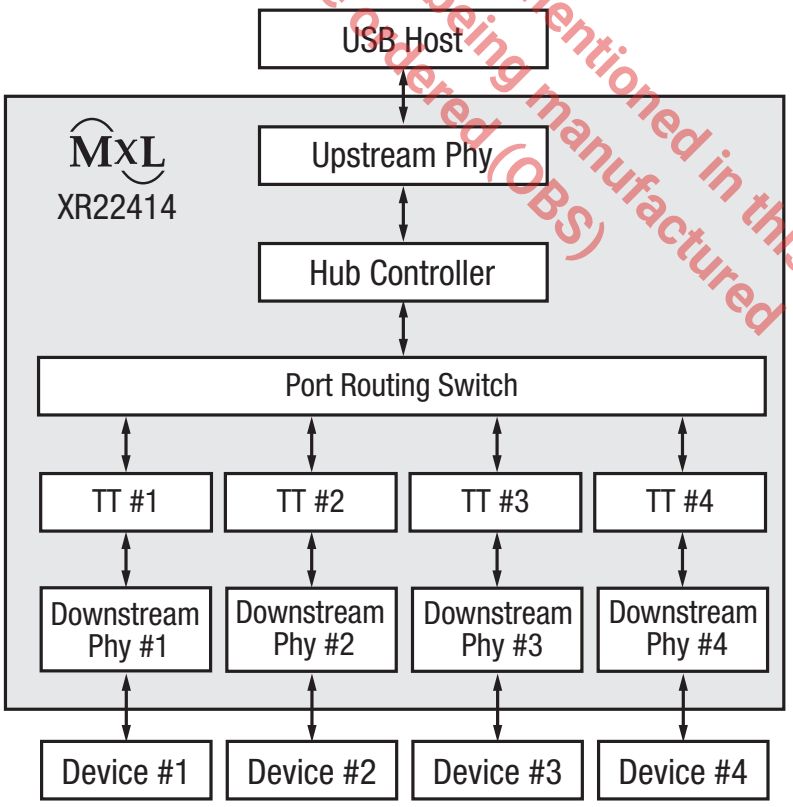
APPLICATIONS

- USB port expansion
- POS Terminals
- Test Instrumentation
- Factory Automation and Process Controls
- Industrial Applications

Ordering Information - Back Page

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

Block Diagram



Absolute Maximum Ratings

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

V_{CC} 5V supply voltage..... -0.5V to 6V

V_{CC} 3.3V supply voltage..... -0.5V to 4V

V_{CC} 1.8V supply voltage..... -0.5V to 2.5V

Input voltage
(all pins except USBD+, USBD–) ..... -0.3V to 5.5V

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

Junction temperature..... 125°C

Operating Conditions

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

V_{CC5} supply voltage .....4.4V to 5.5V

V_{CC33} supply voltage.....3.0V to 3.6V

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Electrical Characteristics

Unless otherwise noted: T_A = 0°C to 70°C; VCC5 = 4.4V to 5.25V or VCC33 = 3.0V to 3.6V.

Symbol	Conditions			Min	Typ	Max	Units
	Upstream Port Speed	Number of Active Downstream Ports	Downstream Ports Device Speed				
Power Consumption DC Supply Current (V_{CC} = V_{CC5})							
I_{CC}	High Speed	Suspend			0.5	2.5	mA
		None			39		mA
		1	1x Full Speed		45		mA
			1x High Speed		54		mA
		2	2x Full Speed		49		mA
			1x Full Speed, 1x High Speed		59		mA
			2x High Speed		67		mA
		4	4x Full Speed		54		mA
			4x High Speed		91		mA
	Full Speed	Suspend			0.5	2.5	mA
		None			27		mA
		1	1x Full Speed		32		mA
		4	4x Full Speed		42		mA
Power Consumption DC Supply Current (V_{CC} = V_{CC33})							
I_{CC}	High Speed	Suspend			0.4	2.5	mA
		None			39		mA
		1	1x Full Speed		46		mA
			1x High Speed		54		mA
		2	2x Full Speed		49		mA
			1x Full Speed, 1x High Speed		58		mA
			2x High Speed		66		mA
		4	4x Full Speed		53		mA
			4x High Speed		90		mA
	Full Speed	Suspend			0.4	2.5	mA
		None			26		mA
		1	1x Full Speed		32		mA
		4	4x Full Speed		42		mA

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Electrical Characteristics (Continued)

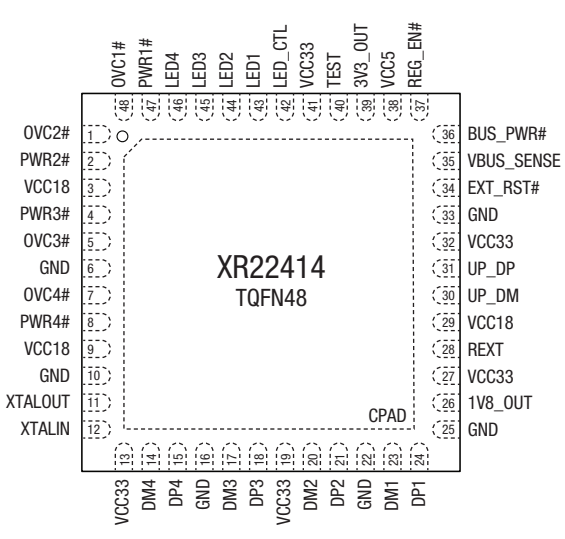
Unless otherwise noted: T_A = 0°C to 70°C; V_{CC5} = 4.4V to 5.25V or V_{CC33} = 3.0V to 3.6V.

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} = 4mA			0.4	V
V_{OH}	Output high voltage	I_{OL} = -4mA	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 100mA	3.0	3.3	3.6	V

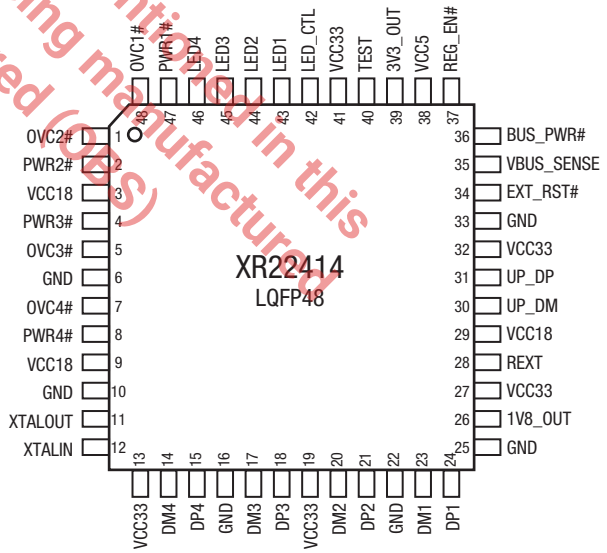
NOTE:
1. See USB 2.0 Specification for USB I/O pins DC Electrical Characteristics.

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Pin Configuration



Top View, TQFN48



Top View, LQFP48

Pin Functions

Pin Number	Pin Name	Type	Description
1	OVC2#	I	Downstream port 2 over current indicator, active low. If global over-current protection is selected by connecting PWR4# to ground, this pin is unused and should be tied to ground.
2	PWR2#	O	Power enable for port 2 downstream device. Asserted if OVC2# input is asserted in individual power mode or XR22414 is not configured. Unused when ganged power control mode is selected by connecting PWR4# to ground.
3	VCC18	PWR	1.8V power input
4	PWR3#	O	Power enable for port 3 downstream device. Asserted if OVC3# input is asserted in individual power mode or XR22414 is not configured. Unused when ganged power control mode is selected by connecting PWR4# to ground.
5	OVC3#	I	Downstream port 3 over current indicator, active low. If global over-current protection is selected by connecting PWR4# to ground, this pin is unused and should be tied to ground.
6	GND		Ground
7	OVC4#	I	Downstream port 4 over current indicator, active low. If global over-current protection is selected by connecting PWR4# to ground, this pin is unused and should be tied to ground.
8	PWR4#	I/O	Power enable for port 4 downstream device. Asserted if OVC4# input is asserted in individual power mode or XR22414 is not configured. If connected to ground, enables Ganged Power Control Mode and Global Over-Current Protection mode.
9	VCC18	PWR	1.8V power input
10	GND	PWR	Ground
11	XTALOUT	O	12MHz crystal feedback output
12	XTALIN	I	12MHz ±50 ppm crystal input with load capacitance rating of 16-20pF. An external 3.3V clock may be used instead on XTALIN, leaving XTALOUT unconnected.
13	VCC33	PWR	3.3V power input
14	DM4	I/O	Downstream port 4 USB D- data
15	DP4	I/O	Downstream port 4 USB D+ data
16	GND	PWR	Ground
17	DM3	I/O	Downstream port 3 USB D- data
18	DP3	I/O	Downstream port 3 USB D+ data
19	VCC33	PWR	3.3V power input
20	DM2	I/O	Downstream port 2 USB D- data
21	DP2	I/O	Downstream port 2 USB D+ data
22	GND	PWR	Ground
23	DM1	I/O	Downstream port 1 USB D- data
24	DP1	I/O	Downstream port 1 USB D+ data
25	GND	PWR	Ground
26	1V8_OUT	PWR	1.8V power output from internal 3.3V to 1.8V regulator, may be used to power VCC18 power inputs. Must be decoupled with minimum of 10uF
27	VCC33	PWR	3.3V power input
28	REXT	I	External bias resistor. Connect 2.7kOhm 1% resistor from this pin to GND
29	VCC18	PWR	1.8V power input
30	UP_DM	I/O	Upstream port USB D- data
31	UP_DP	I/O	Upstream port USB D+ data

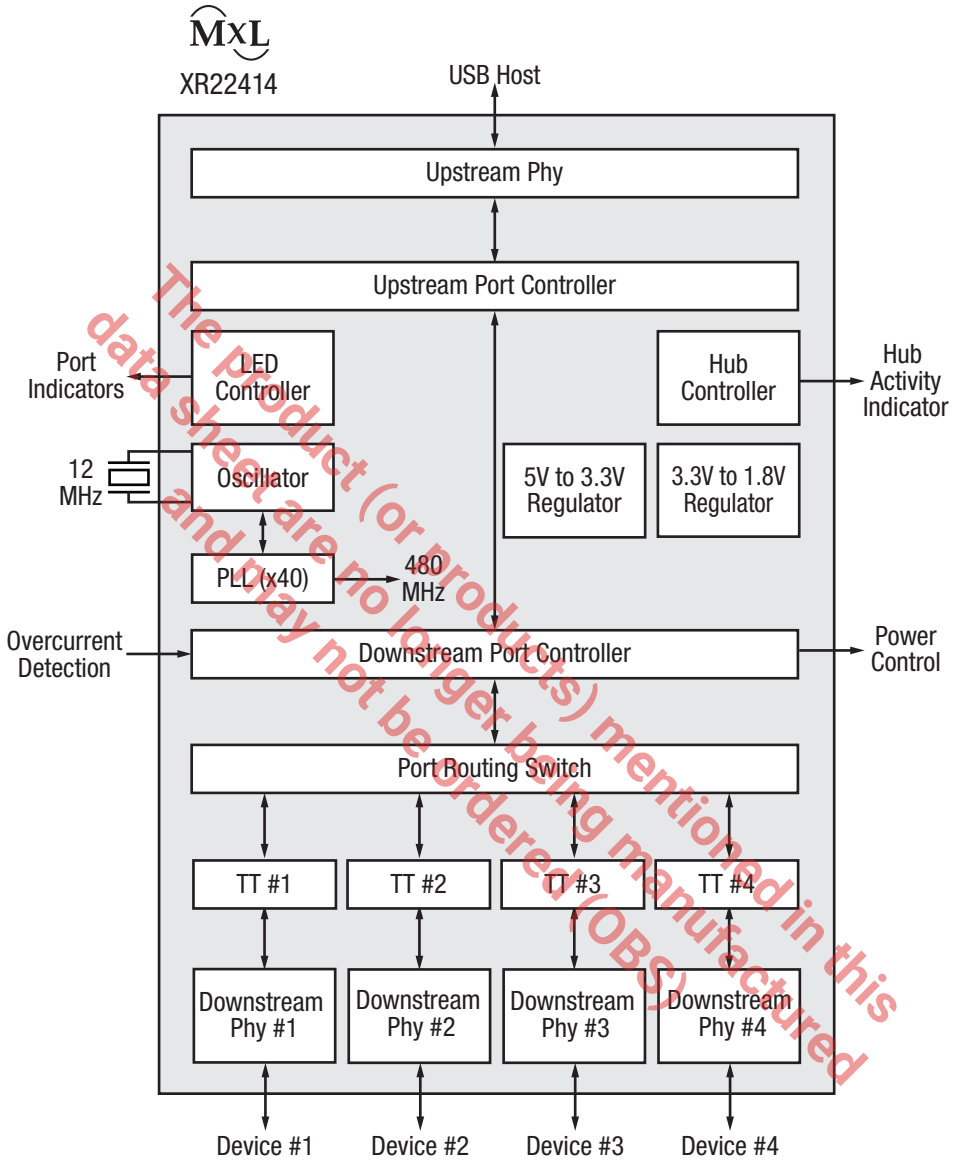
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Pin Number	Pin Name	Type	Description
32	VCC33	PWR	3.3V power input
33	GND	PWR	Ground
34	EXT_RST#	I	External reset input, active low. Must be asserted for a minimum of 10uS.
35	VBUS_SENSE	I	Connect to VBUS from USB host. In self-powered mode, indicates presence of host VBUS power.
36	BUS_PWR#	I	Bus power indicator, active low. For bus powered mode, connect to ground. For self powered mode, connect to logic '1'.
37	REG_EN#	I	Active low enable of internal 5V to 3.3V regulator. Connect to logic '1' when XR22414 is powered by 3.3V.
38	VCC5	PWR	5V power to internal 5V to 3.3V regulator. When XR22414 is powered by 3.3V, VCC5 should not be connected to 5V, and REG_EN# should be tied to logic '1'.
39	3V3_OUT	PWR	3.3V power output from internal 5V to 3.3V regulator, may be used to power VCC33 power inputs if enabled by REG_EN# pin. Must be decoupled with minimum of 10 uF. Leave unconnected if XR22414 is powered by external 3.3V.
40	TEST	I	Test mode enable. Tie to ground for normal device operation.
41	VCC33	PWR	3.3V power input
42	LED_CTL	I/O	LED hub active indicator. May also be used in conjunction with port status LEDs. Refer to Figure 4.
43	LED1	I/O	Port 1 LED Indicator. Max source current 3mA. May be used in conjunction with LED_CTL pin. Refer to Figure 4. Connecting LED1 to ground marks downstream port 1 as non-removable device.
44	LED2	I/O	Port 2 LED Indicator. Max source current 3mA. May be used in conjunction with LED_CTL pin. Refer to Figure 4. Connecting LED2 to ground marks downstream port 2 as non-removable device.
45	LED3	I/O	Port 3 LED Indicator. Max source current 3mA. May be used in conjunction with LED_CTL pin. Refer to Figure 4. Connecting LED3 to ground marks downstream port 3 as non-removable device.
46	LED4	I/O	Port 4 LED Indicator. Max source current 3mA. May be used in conjunction with LED_CTL pin. Refer to Figure 4. Connecting LED4 to ground marks downstream port 4 as non-removable device.
47	PWR1#	O	Power enable for port 1 downstream device in individual power mode. Asserted if OVC1# input is asserted in individual or global power mode or XR22414 is not configured. Used as global power control pin if ganged power control mode is selected by connecting PWR4# to ground.
48	OVC1#	I	Downstream port 1 over current indicator in individual current-sensing mode, active low. If PWR4# is tied to ground, this pin is a global over-current sense input.
49	CPad	PWR	Connect TQFN package center pad to PCB ground plane with thermal vias.

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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Applications Information

Functional Description

The XR22414 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 4 downstream ports. The MTT architecture allows for higher bandwidth as the 4 individual ports are not constrained by a shared resource.

USB Interface

The hub function of the XR22414 supports one configuration and utilizes the following USB endpoints:

- Control endpoint
- Status change endpoint

The XR22414 hub may be configured for bus powered mode with a maximum power of 500mA or self-powered mode by connecting the BUS_PWR# pin to the appropriate logic state. In bus powered mode, downstream ports are limited to low power (100mA or less). When self-powered, downstream devices can draw up to 500mA on each of the four ports.

USB Vendor ID

Exar's USB vendor ID is 0x04E2.

USB Product ID

Exar's USB hub product ID is 0x0414.

Device Reset

The XR22414 has both an automatic power-up reset and an external hardware pin reset. Strapping option for ganged power enables and global over-current sensing are selected by tying the PWR4# pin to logic '0'. This pin is sampled at device reset and the resulting option selected is set.

USB Suspend

All USB peripheral devices must support the USB suspend mode in bus powered mode. Per USB standard, the XR22414 device will begin to enter the suspend state if it does not detect any activity, (including Start of Frame or SOF packets) on its USB data lines for 3ms. The peripheral device must then reduce power consumption from VBUS power within the next 7 ms to the allowed limit of 2.5mA for the suspended state. Note that in this context, the "device" is all circuitry (including the XR22414) that draws power from the host VBUS. Each attached downstream port is also allowed an additional 2.5mA of suspend current. If no devices are connected to the XR22414 downstream ports, the USB host will suspend the hub.

Individual vs. Ganged Power Control and Global Over-current protection mode

Ganged power control mode is enabled when PWR4# is tied to ground. In this mode only the PWR1# output pin is used for power control and the remaining PWR# pins are unused and should be left unconnected. Global over-current protection mode is also enabled when PWR4# is tied to ground. In this mode only OVC1# input pin is used for current sensing and the remaining OVC# pins should be connected to ground. Figure 1 depicts ganged power control / global over-current protection. Figure 2 depicts individual mode power and over-current modes for ports 1 and 2 (repeat for ports 3 and 4).

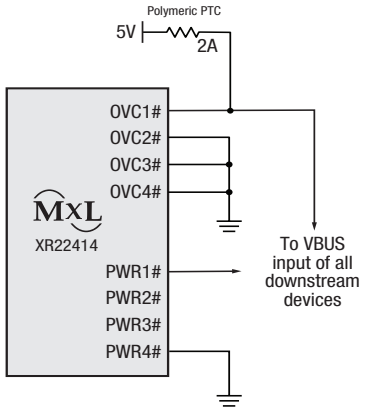


Figure 1: Ganged Power Control and Global Over-Current Protection Mode

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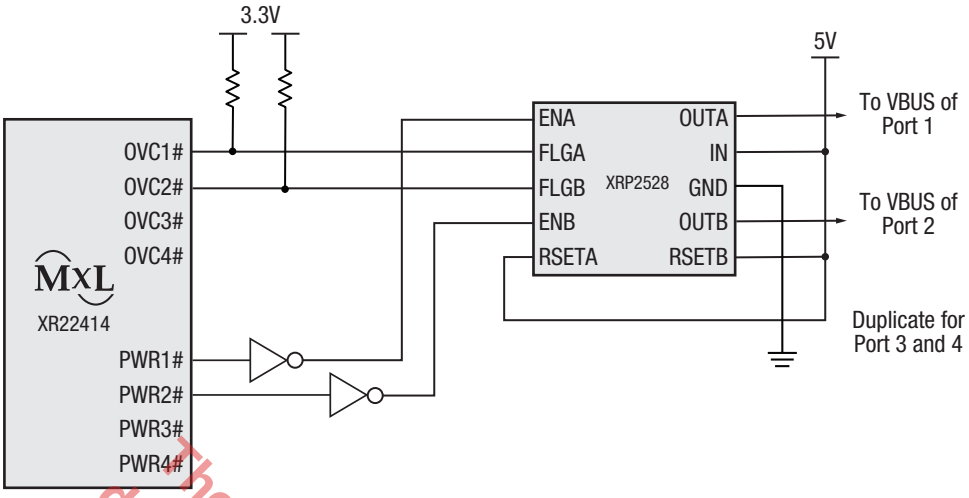


Figure 2: Individual Power Control and Over-Current Protection Mode

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USB Hub Drivers

All Operating Systems provide a native USB hub device driver for the XR22414 device to operate. No other device drivers are necessary for the XR22414.

Regulated 3.3V Power Output

The XR22414 internal voltage regulator provides 3.3VDC output power when the device is powered by 5V input. The 3.3V output can be utilized by other circuitry. Refer to Electrical Characteristics on page 3 for maximum power capability.

Downstream Port LED Indicators

Four port indicator (LED1 - LED4) pins, provide status of connection of downstream devices. Ports with permanently connected devices should ground their respective port LED indicator. Ports using LED indicators may configure status LEDs in a number of configurations in conjunction with the LED_CTL pin. Figure 3 and Figure 4 show alternate configurations for LED status indicators. Green / amber LEDs in Figure 4 are implemented per USB hub specification USB 2.0 spec, chapter 11.

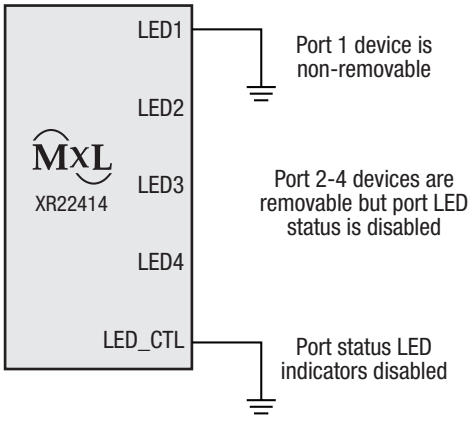


Figure 3: Port status LED indicators disabled

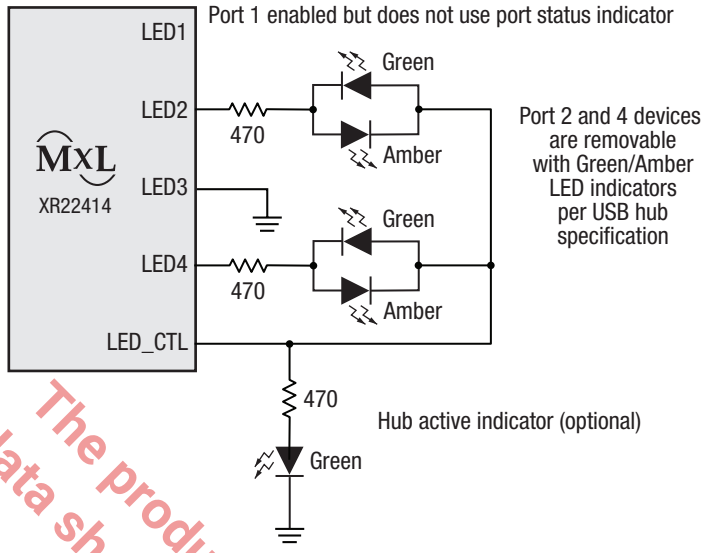
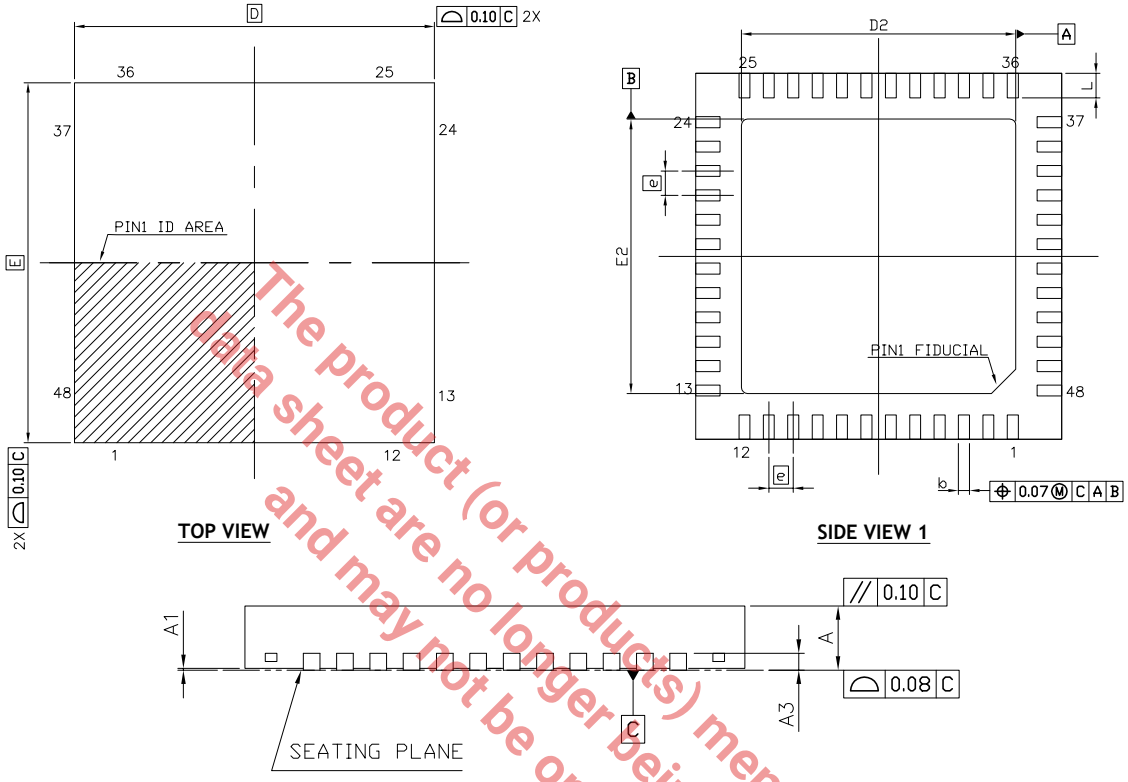


Figure 4: Port status LED indicators enabled dual LED mode

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Mechanical Dimensions

TQFN-48



SYMBOL	DIMENSION (MM)		
	MIN.	NOM.	MAX.
A	0.70	0.75	0.80
A1	0	0.02	0.05
A3		0.203 REF	
b	0.15	0.20	0.25
D	5.90	6.00	6.10
D2	4.40	4.50	4.60
E	5.90	6.00	6.10
E2	4.40	4.50	4.60
e		0.40 BSC	
L	0.30	0.40	0.50

TERMINAL DETAILS

- ALL DIMENSIONS ARE IN MILLIMETERS.
- DIMENSIONS AND TOLERANCE PER JEDEC MO-220.

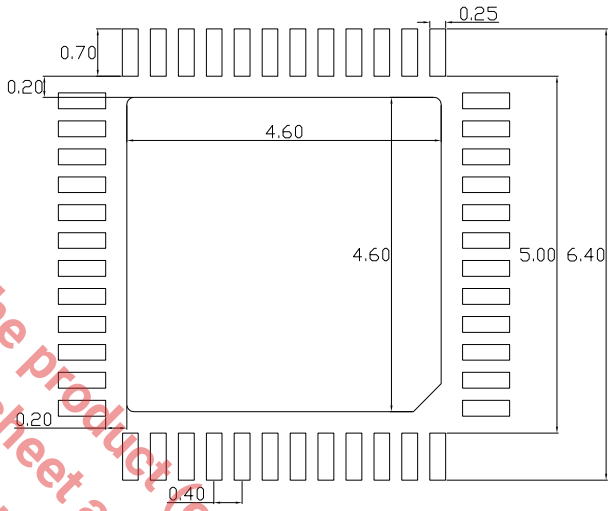
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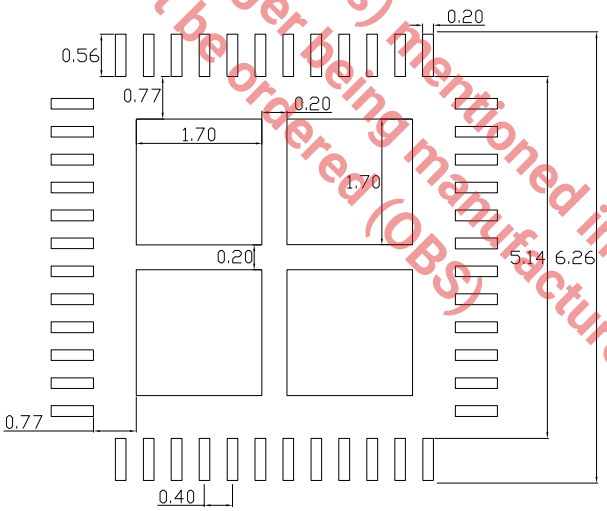
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Recommended Land Pattern and Stencil

TQFN-48



TYPICAL RECOMMENDED LAND PATTERN



TYPICAL RECOMMENDED STENCIL

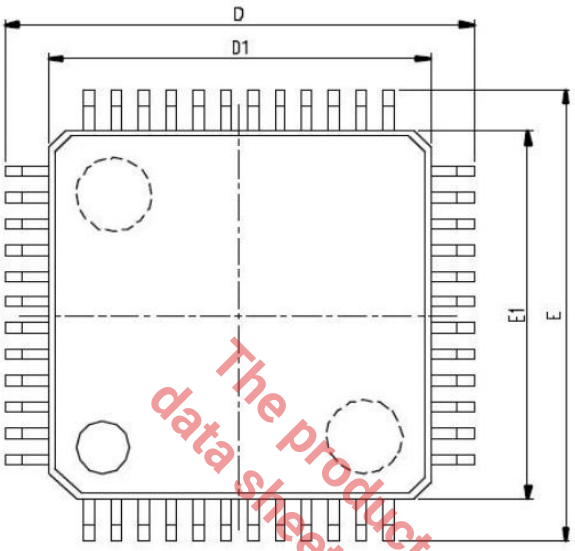
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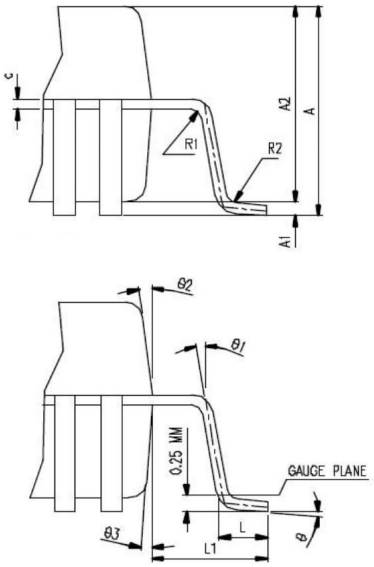
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Mechanical Dimensions

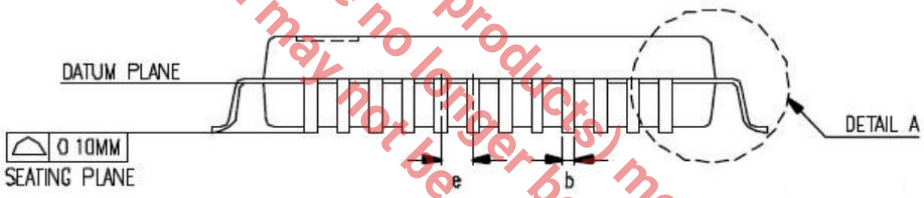
LQFP-48



TOP VIEW



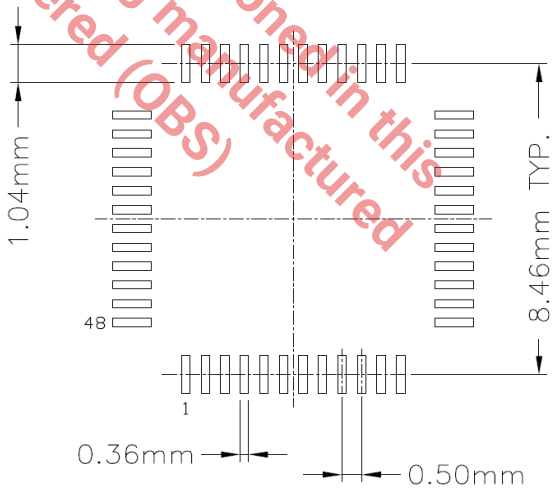
DETAIL A



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

Drawing No. : POD - 00000096

Revision: A

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Ordering Information[1]

Part Number	Operating Temperature Range	Lead-Free	Package	Packaging Method
XR22414CL48TR-F	0°C to +70°C	Yes[2]	48-pin TQFN	Reel
XR22414CV48TR-F	0°C to +70°C		48-pin LQFP	Reel
XR22414CL48EVB	XR22414 48-pin TQFN Evaluation Board			
XR22414CV48EVB	XR22414 48-pin LQFP Evaluation Board			

NOTE:
1. Refer to www.exar.com/XR22414 for most up-to-date Ordering Information.
2. Visit www.exar.com for additional information on Environmental Rating.

Revision History

Revision	Date	Description
1A	February 2017	Initial Release
1B	August 2018	Update to MaxLinear logo. Update format. Change QFN package name to TQFN. Changed DRV pin to LED_CTL. Input voltage absolute max changed to 5.5V. Updated Figure 2.

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