

## 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

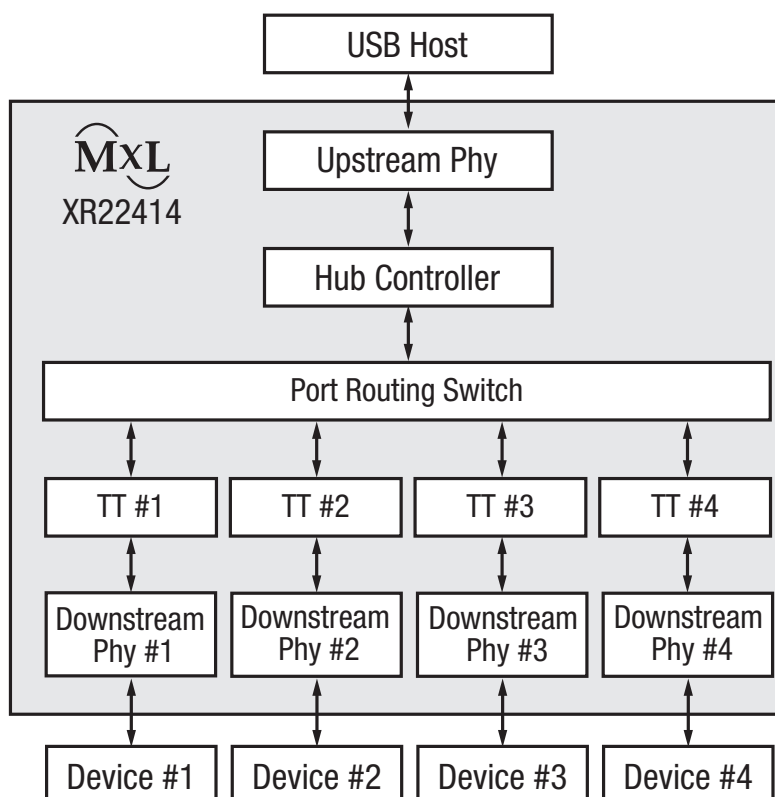
- USB 2.0 compliant interface
- Multiple transaction translators (MTT)
- Regulated +3.3V Output Power
- Individual port and hub activity LED indicators
- Individual or ganged port power enables
- Individual or global overcurrent sensing
- Single 5V or 3.3V power supply
- Single 12MHz Crystal
- 48-pin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

## APPLICATIONS

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

Ordering Information - [Back Page](#)

## 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<sub>CC</sub> 5V supply voltage..... -0.5V to 6V

V<sub>CC</sub> 3.3V supply voltage..... -0.5V to 4V

V<sub>CC</sub> 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<sub>CC5</sub> supply voltage ..... 4.4V to 5.5V

V<sub>CC33</sub> supply voltage..... 3.0V to 3.6V

## Electrical Characteristics

Unless otherwise noted:  $T_A = 0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ ;  $V_{CC5} = 4.4\text{V}$  to  $5.25\text{V}$  or  $V_{CC33} = 3.0\text{V}$  to  $3.6\text{V}$ .

| Symbol                                                                     | Conditions          |                                   |                               | Min | Typ | Max | Units |
|----------------------------------------------------------------------------|---------------------|-----------------------------------|-------------------------------|-----|-----|-----|-------|
|                                                                            | Upstream Port Speed | Number of Active Downstream Ports | Downstream Ports Device Speed |     |     |     |       |
| Power Consumption DC Supply Current (V <sub>CC</sub> = V <sub>CC5</sub> )  |                     |                                   |                               |     |     |     |       |
| I <sub>CC</sub>                                                            | 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 <sub>CC</sub> = V <sub>CC33</sub> ) |                     |                                   |                               |     |     |     |       |
| I <sub>CC</sub>                                                            | 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    |

## Electrical Characteristics (Continued)

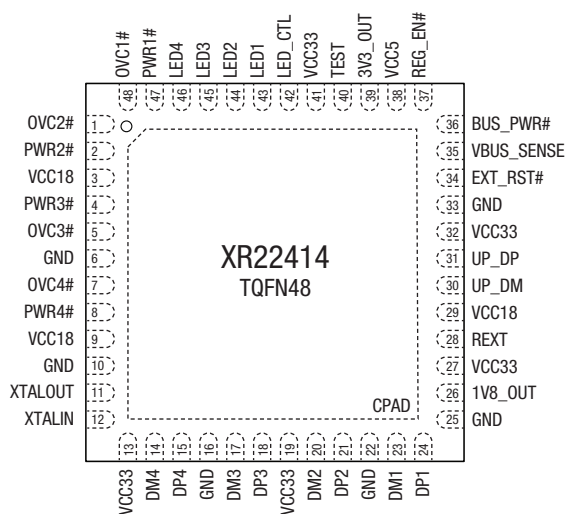
Unless otherwise noted:  $T_A = 0^{\circ}\text{C}$  to  $70^{\circ}\text{C}$ ;  $V_{CC5} = 4.4\text{V}$  to  $5.25\text{V}$  or  $V_{CC33} = 3.0\text{V}$  to  $3.6\text{V}$ .

| 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         | $I_{OL} = 4\text{mA}$  |      |     | 0.4      | V             |
| $V_{OH}$                    | Output high voltage        | $I_{OL} = -4\text{mA}$ | 2.4  |     |          | V             |
| $I_{IL}$                    | Input low leakage current  |                        |      |     | $\pm 10$ | $\mu\text{A}$ |
| $I_{IH}$                    | Input high leakage current |                        |      |     | $\pm 10$ | $\mu\text{A}$ |
| $C_{IN}$                    | Input pin capacitance      |                        |      |     | 5        | pF            |
| USB I/O Pins <sup>(1)</sup> |                            |                        |      |     |          |               |
| 3.3V Regulated Power Output |                            |                        |      |     |          |               |
| 3V3_OUT                     | Output voltage             | Max load current 100mA | 3.0  | 3.3 | 3.6      | V             |

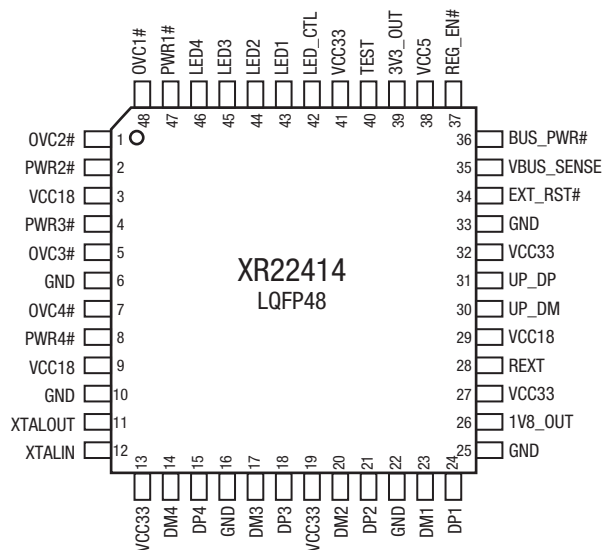
### NOTE:

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

## Pin Configuration



Top View, TQFN48



Top View, LQFP48

## Pin Functions

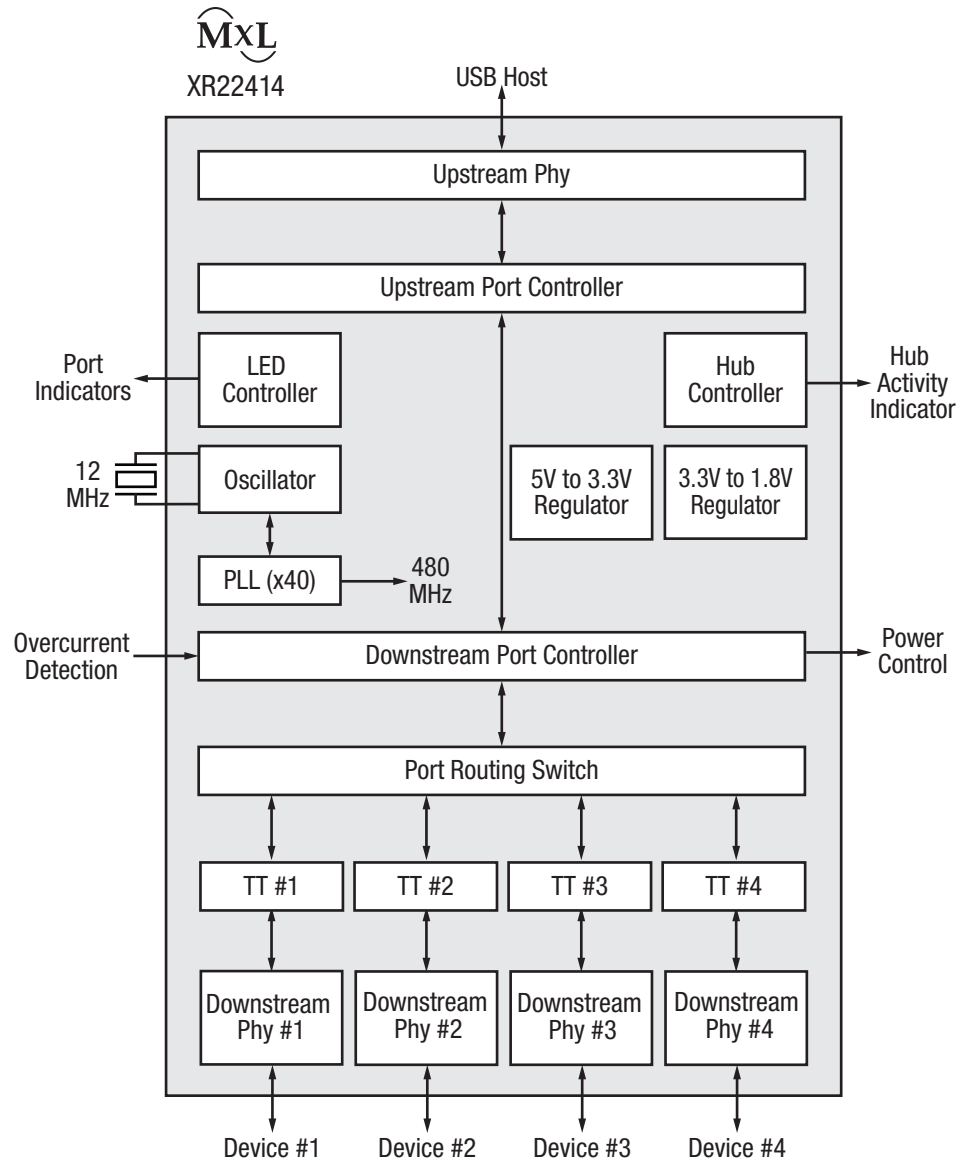
| Pin Number | Pin Name | Type | Description                                                                                                                                                                                                                              |
|------------|----------|------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 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 $\pm 50$ 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                                                                                                                                                                                                                |

| 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 <a href="#">Figure 4</a> .                                                                                                                                                              |
| 43         | LED1       | I/O  | Port 1 LED Indicator. Max source current 3mA. May be used in conjunction with LED_CTL pin. Refer to <a href="#">Figure 4</a> . 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 <a href="#">Figure 4</a> . 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 <a href="#">Figure 4</a> . 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 <a href="#">Figure 4</a> . 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.

## Functional Block Diagram



## 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).

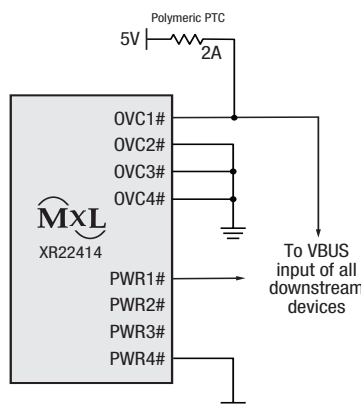


Figure 1: Ganged Power Control and Global Over-Current Protection Mode

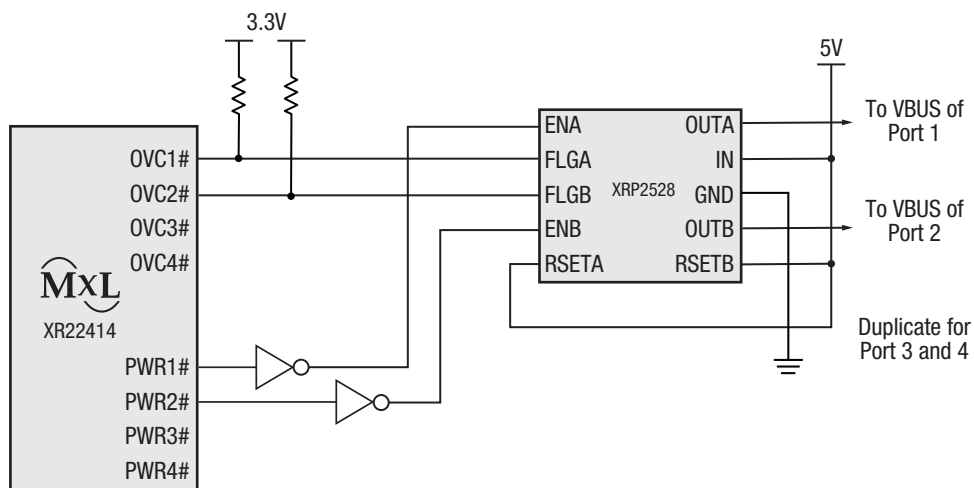


Figure 2: Individual Power Control and Over-Current Protection Mode

### 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.

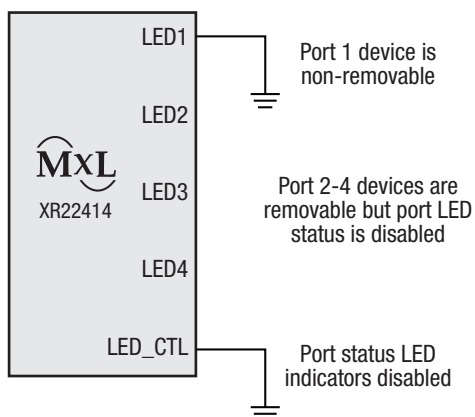


Figure 3: Port status LED indicators disabled

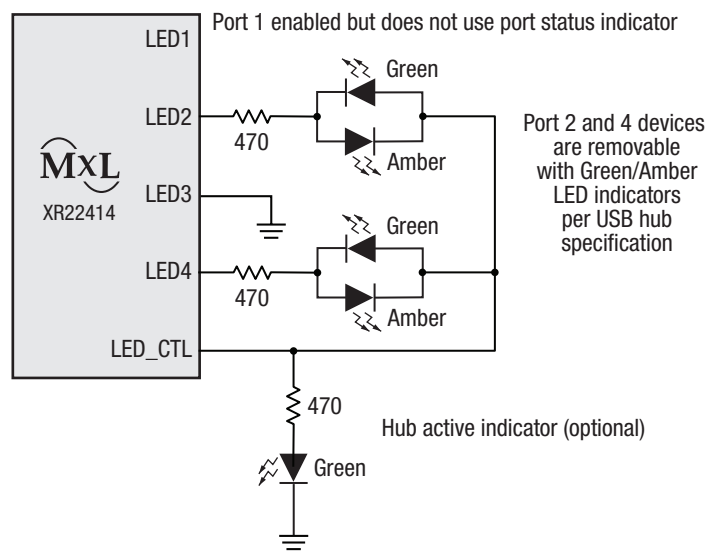
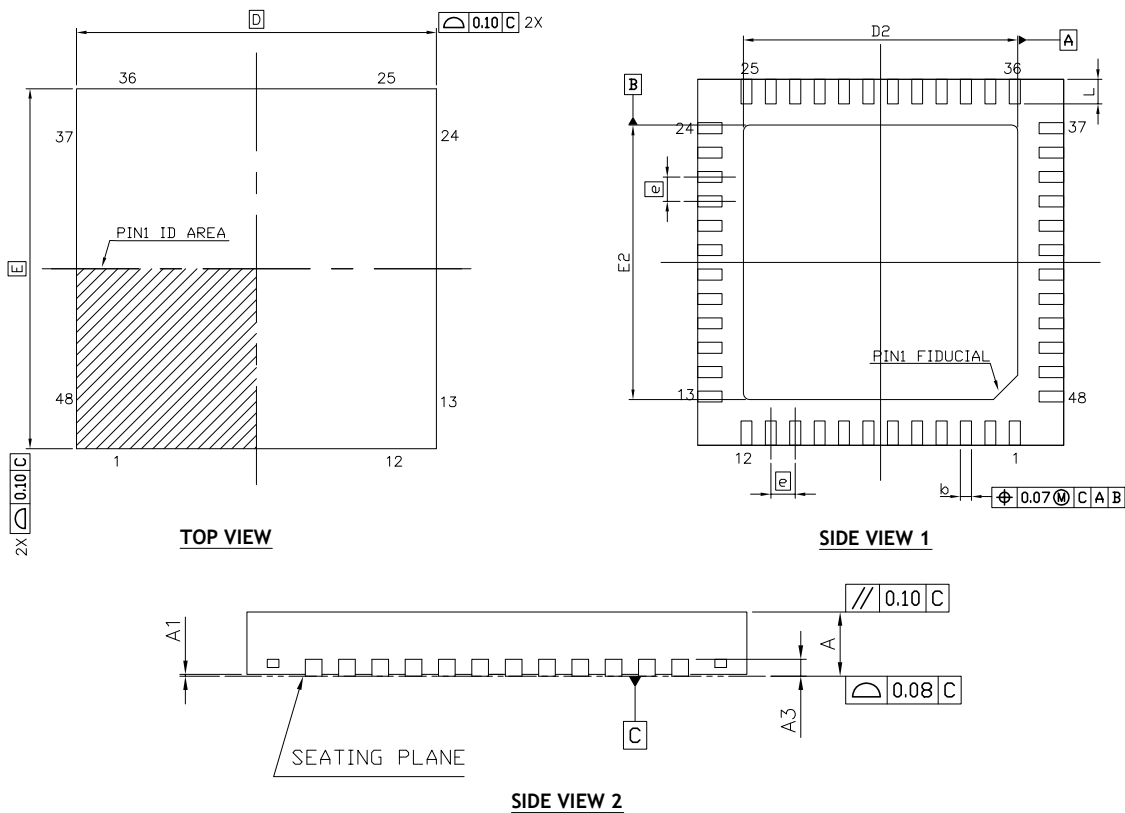


Figure 4: Port status LED indicators enabled dual LED mode

## 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 |
| $\Delta$ | 0.40 BSC       |      |      |
| L        | 0.30           | 0.40 | 0.50 |

## TERMINAL DETAILS

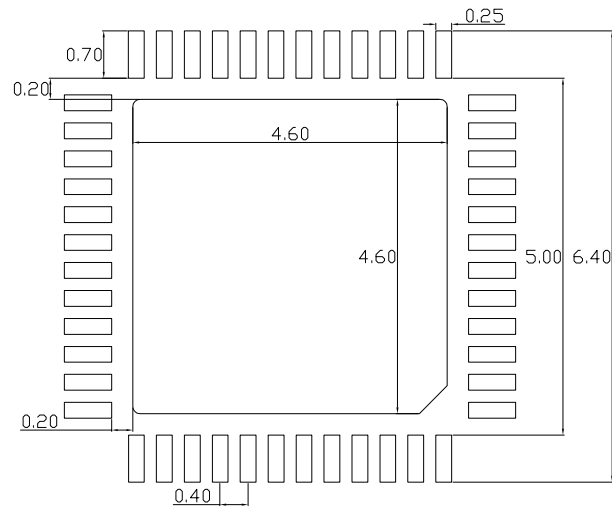
- ALL DIMENSIONS ARE IN MILLIMETERS.
- DIMENSIONS AND TOLERANCE PER JEDEC MO-220.

Drawing No.: POD-00000101

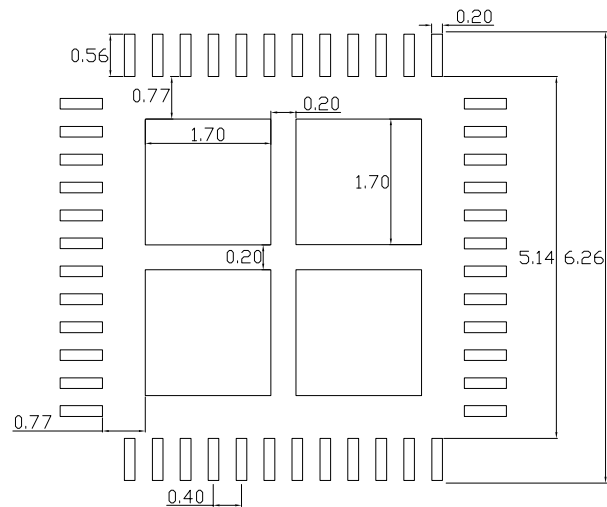
Revision: C

## Recommended Land Pattern and Stencil

TQFN-48



**TYPICAL RECOMMENDED LAND PATTERN**



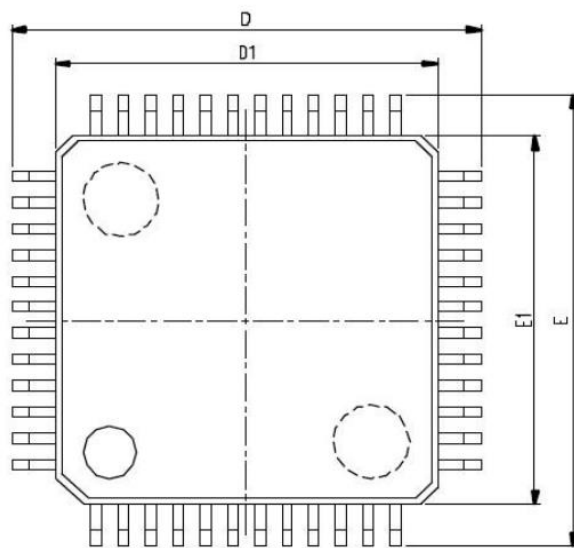
**TYPICAL RECOMMENDED STENCIL**

Drawing No.: POD-00000101

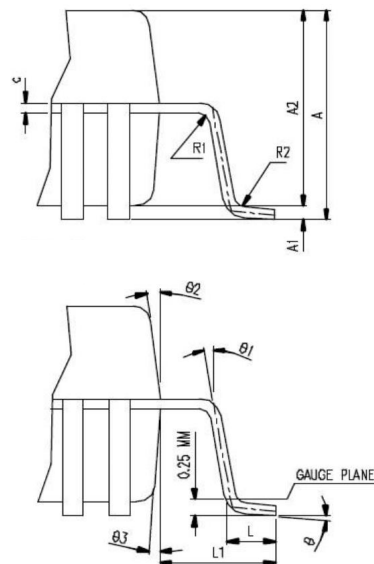
Revision: C

## Mechanical Dimensions

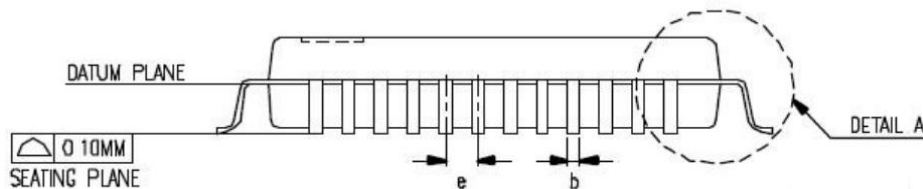
LQFP-48



**TOP VIEW**



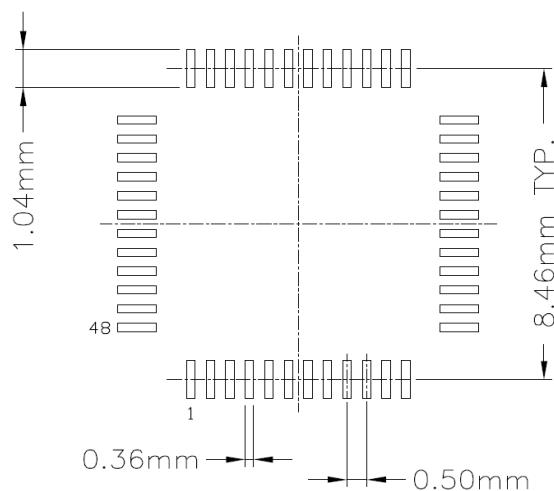
**DETAIL A**



**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

Ordering Information<sup>(1)</sup>

| Part Number     | Operating Temperature Range          | Lead-Free          | Package     | Packaging Method |
|-----------------|--------------------------------------|--------------------|-------------|------------------|
| XR22414CL48TR-F | 0°C to +70°C                         | Yes <sup>(2)</sup> | 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](http://www.exar.com/XR22414) for most up-to-date Ordering Information.
2. Visit [www.exar.com](http://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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