# EZ-USB HX2LP™
# Low-Power USB 2.0 Hub Controller Family

## 1.0 Features

- **USB 2.0 hub controller**
- **Compliant with the USB 2.0 specification**
- **Windows® Hardware-quality lab (WHQL)-compliant**
- **Up to four downstream ports supported**
- **Supports bus-power and self powered modes**
- **Single-TT and Multi-TT modes supported**
  - **Single-TT option for low-cost**
  - **Multi-TT option for high performance**
- **2-Port**
  - **Single TT option for bus power**
- **Fit/form/function compatible option with CY7C65640 (TetraHub™)**
- **Multiple package options**
  - **Space-saving 56 QFN**
- **Single power supply requirement**
  - **Internal regulator for reduced cost**
- **Integrated upstream pull-up resistor**
- **Integrated pull-down resistors for all downstream ports**
- **Integrated upstream and downstream termination resistors**
- **Integrated port status indicator controls**
- **24-MHz external crystal (integrated PLL)**
- **Configurable with external SPI EEPROM**
  - **Vendor ID, Product ID, Device ID (VID/PID/DID)**
  - **Number of active ports**
  - **Number of removable ports**
  - **Maximum power setting for high-speed and full-speed**
  - **Hub controller power setting**
  - **Power-on timer**
  - **Overcurrent detection mode**
  - **Overcurrent timer**
  - **Enable/Disable overcurrent timer**
  - **Overcurrent pin polarity**
  - **indicator pin polarity**
  - **Compound device**
  - **Enable full-speed only**
  - **Disable port indicators**
  - **Gang power switching**
  - **Enable single-TT mode only**
  - **Self/bus powered compatibility**
  - **Fully configurable string descriptors for multiple language support**
- **In-system EEPROM programming**

## 2.0 Introduction

EZ-USB HX2LP™ is Cypress's next-generation family of high-performance, low-power USB 2.0 hub controllers. HX2LP is an ultra low-power single-chip USB 2.0 hub controller with integrated upstream and downstream transceivers, a USB Serial Interface Engine (SIE), USB Hub Control and Repeater logic, and Transaction Translator (TT) logic. Cypress has also integrated many of the external passive components, such as pull-up and pull-down resistors, reducing the overall bill-of-materials required to implement a hub design. The entire HX2LP portfolio consists of:

1. CY7C65640B (TetraHub *LP*): 4-port/multiple transaction translator

   This device option is fit/form/function compatible with Cypress's existing CY7C65640 device. Cypress's "Tetra" architecture provides four downstream USB ports, each with a dedicated Transaction Translator (TT), making it the highest-performance hub available. The TetraHub LP also offers best-in-class power consumption. The CY7C65640B is available in a 56 QFN (TetraHub pin-compatible) for space saving designs.

2. CY7C65630: 4-port/single transaction translator

   This device option is for ultra low-cost applications where performance is secondary consideration. All four ports must share a single transaction translator in this configuration. The CY7C65630 is available in a 56 QFN and is also pin for pin-compatible with the CY7C65640.

3. CY7C65620:

   This device option is for a 2-port bus powered application. Both ports must share a single transaction translator in this configuration. The CY7C65620 is available in a 56 QFN and is also pin for pin compatible with the CY7C65640.

All device options are supported by Cypress's world-class reference design kits, which include board schematics, bill of materials, Gerber files, Orcad files, and thorough design documentation.

## 3.0 Block Diagrams

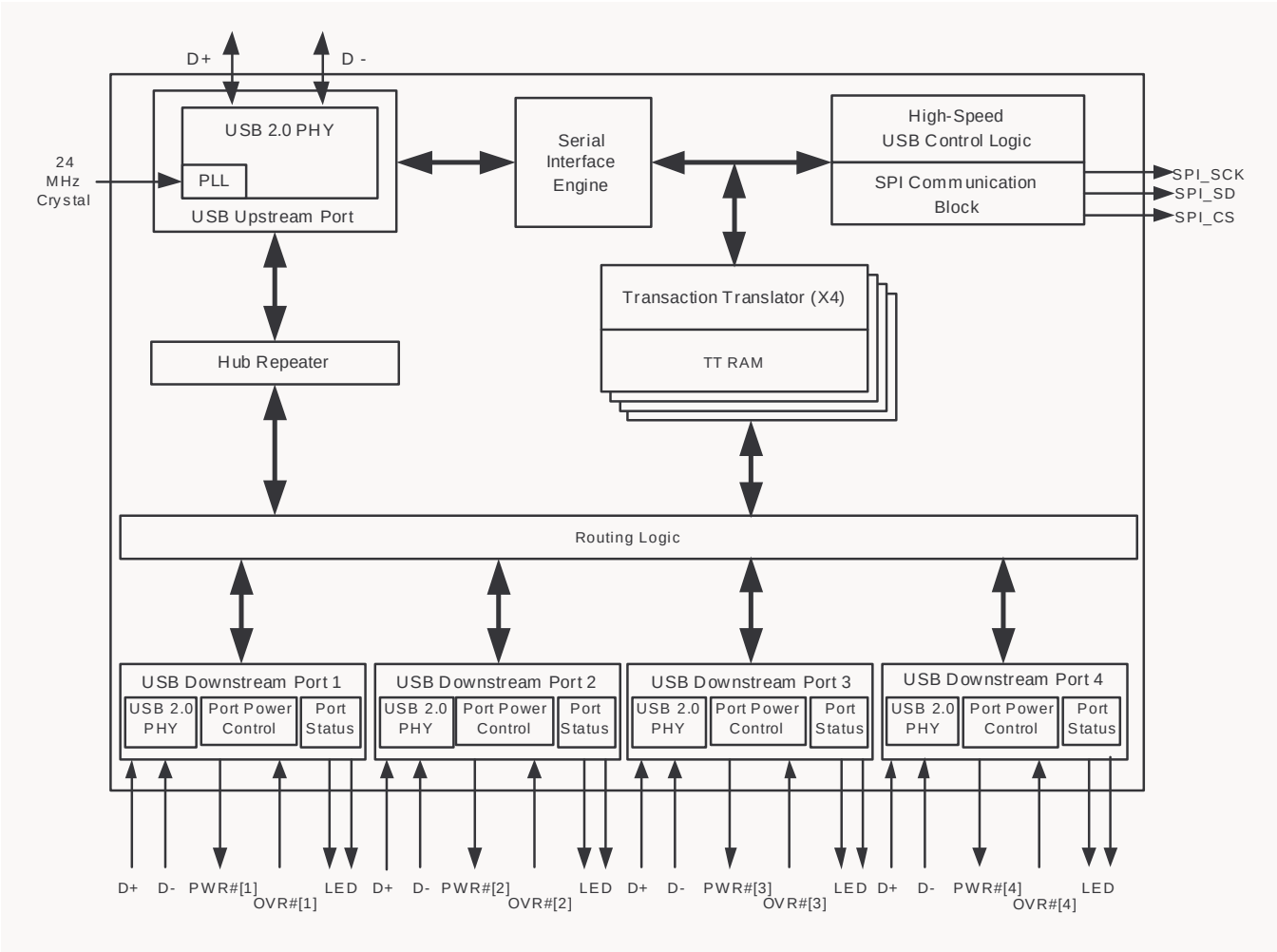



**Figure 3-1. CY7C65640B Block Diagram**

## 3.0 Block Diagrams (continued)

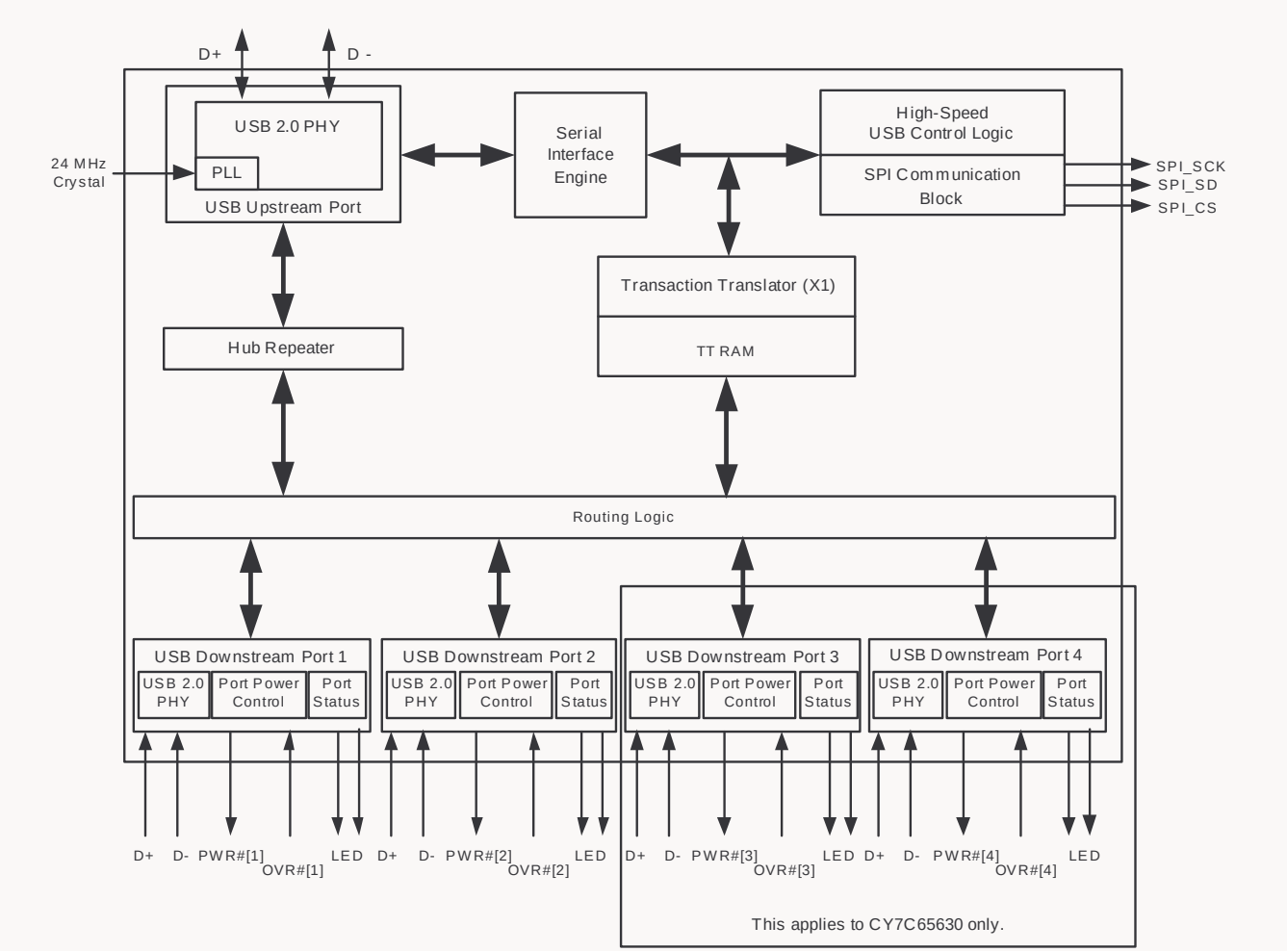



**Figure 3-2. CY7C65630/CY7C65620 Block Diagram**

### 3.1 USB Serial Interface Engine (SIE)

The SIE allows the CY7C656xx to communicate with the USB host through the USB repeater component of the HUB. The SIE handles the following USB activity independently of the HUB Control Block:

- Bit stuffing/unstuffing
- Checksum generation/checking
- ACK/NAK/STALL
- TOKEN type identification
- Address checking.

### 3.2 Hub Repeater

The HUB Repeater manages the connectivity between upstream and downstream facing ports that are operating at the same speed. It supports full-/low-speed connectivity and high-speed connectivity. Per the USB 2.0 specification, the HUB Repeater provides the following functions:

- Sets up and tears down connectivity on packet boundaries
- Ensures orderly entry into and out of the Suspend state, including proper handling of remote wakeups.

### 3.3 Transaction Translator (TT)

The TT basically translates data from one speed to another. A TT takes high-speed split transactions and translates them to full-/low-speed transactions when the HUB is operating at high-speed (the upstream port is connected to a high-speed host controller) and has full-/low-speed devices attached. The operating speed of a device attached on a downstream facing port determines whether the Routing Logic connects a port to the Transaction Translator or Hub Repeater section. If a low-/full-speed device is connected to the hub operating at high-speed, the data transfer route includes the transaction translator. If a high-speed device is connected to this high-speed hub the route only includes the repeater and no transaction translator since the device and the hub are in conformation with respect to their data transfer speed. When the hub is operating at full speed (the upstream port is connected to a full-speed host controller), a high-speed peripheral will not operate at its full capability. These devices will only work at 1.1 speed. Full- and low-speed devices connected to this hub will operate at their 1.1 speed.

## 4.0 Applications

- Typical applications for the HX2LP device family are:
- Standalone hubs
- Motherboard hubs
- Monitor hubs
- Advanced port replicators
- Docking stations
- Split-PC designs
- External personal storage drives
- Keyboard hubs

## 5.0 Functional Overview

The Cypress CY7C656xx USB 2.0 Hubs are a high-performance, low-system-cost solution for USB. The CY7C656xx USB 2.0 Hubs integrate 1.5k upstream pull-up resistors for full-speed operation and all downstream 15k pull-down resistors as well as series termination resistors on all upstream and downstream D+ and D– pins. This results in optimization of system costs by providing built-in support for the USB 2.0 specification.

### 5.1 System Initialization

On power-up, the CY7C656xx will read an external SPI EEPROM for configuration information. At the most basic level, this EEPROM will have the Vendor ID (VID), Product ID (PID), and Device ID (DID) for the customer's application. For more specialized applications, other configuration options can be specified. See section 9.0 for more details.

After reading the EEPROM, if BUSPOWER (connected to upstream VBus) is HIGH, CY7C656xx will enable the pull-up resistor on the D+ to indicate that it is connected to the upstream hub, after which a USB Bus Reset is expected. During this reset, CY7C656xx will initiate a chirp to indicate that it is a high-speed peripheral. In a USB 2.0 system, the upstream hub will respond with a chirp sequence, and CY7C656xx will be in a high-speed mode, with the upstream D+ pull-up resistor turned off. In USB 1.x systems, no such chirp sequence from the upstream hub will be seen, and CY7C656xx will operate as a normal 1.x hub (operating at full speed).

### 5.2 Enumeration

After a USB Bus Reset, CY7C656xx is in an unaddressed, unconfigured state (configuration value set to 0). During the enumeration process, the host will set the hub's address and configuration by sending a SetCongfiguration request.

For high-speed multi-TT support, the host must also set the alternate interface setting to 1 (the default mode is single-TT). Once the hub is configured, the full hub functionality is available.

### 5.3 Multiple Transaction Translator Support

After the CY7C65640B is configured in a high-speed system, it will be in Single TT mode. The host may then set the hub into Multiple TT mode by sending a SetInterface command. In Multiple TT mode, each full speed port is handled independently and thus has a full 12-Mbps bandwidth available. In Single TT mode, all traffic from the host destined for full- or low-speed ports will be forwarded to all of those ports. This means that the 12-Mbps bandwidth is shared by all full- and low-speed ports.

### 5.4 Downstream Ports

The CY7C656xx supports a maximum of four downstream ports, each of which may be marked as usable or removable in the extended configuration (0xD2 EEPROM load, see section 9.2 or 0xD4 EEPROM load, see section 9.3). Downstream D+ and D– pull-down resistors are incorporated in CY7C656xx for each port. Prior to the hubs being configured, the ports are driven SE0 (Single Ended Zero, where both D+ and D– are driven low) and are set to the

unpowered state. Once the hubs are configured, the ports are not driven, and the host may power the ports by sending a SetPortPower command to each port. After a port is powered, any connect or disconnect event is detected by the hub. Any change in the port state is reported by the hubs back to the host through the Status Change Endpoint (endpoint 1). Upon receipt of SetPortReset command from the host, the hub will

- Drive SE0 on the corresponding port
- Put the port in an enabled state
- Enable the green port indicator for that port (if not previously overridden by the host)
- Enable babble detection once the port is enabled.

Babble consists of either unterminated traffic from a downstream port (or loss of activity), or a non-idle condition on the port after EOF2. If babble is detected on an enabled port, that port will be disabled. A ClearPortEnable command from the host will also disable the specified port.

Downstream ports can be individually suspended by the host with the SetPortSuspend command. If the hubs are not suspended, any resume will be confined to that individual port and reflected to the host through a port change indication in the Hub Status Change Endpoint. If the hubs are suspended, a resume on this port will be forwarded to the host, but other resume events will not be seen on that port. The host may resume the port by sending a ClearPortSuspend command.

## 5.5 Upstream Port

The upstream port includes the transmitter and the receiver state machine. The Transmitter and Receiver operate in high-speed and full-speed depending on the current hub configuration.

The transmitter state machine monitors the upstream facing port while the Hub Repeater has connectivity in the upstream direction. This monitoring activity prevents propagation of erroneous indications in the upstream direction. In particular, this machine prevents babble and disconnect events on the downstream facing ports of this hub from propagating and causing the hub to be disabled or disconnected by the hub to which it is attached. This allows the Hub to only disconnect the offensive port on detecting a babble from it.

## 5.6 Power Switching

The CY7C656xx includes interface signals for external port power switches. Both ganged and individual (per-port) configurations are supported, with individual switching being the default. Initially all ports are unpowered. After enumerating, the host may power each port by sending a SetPortPower command for that port. The power switching and over-current detection of downstream ports is managed by control pins connected to an external power switch device. PWR [n]# output pins of the CY7C656xx series are connected to the respective external power switch's port power enable signals. (Note that each port power output pin of the external power switch must be bypassed with an electrolytic or tantalum capacitor as required by the USB specification. These capacitors supply the inrush currents, which occur during downstream device hot-attach events.) The polarity of this pin can be configured through the EEPROM, see section 9.3.

## 5.7 Over-current Detection

Over-current detection includes timed detection of 8 ms by default. This parameter is configured from the external EEPROM in a range of 0 ms to 15 ms for both an enabled port and a disabled port individually. Detection of over-current on downstream ports is managed by control pins connected to an external power switch device.

The OVR[n]# pins of the CY7C656xx series are connected to the respective external power switch's port over-current indication (output) signals. Upon detecting an over-current condition, the hub device reports the over-current condition to the host and disables the PWR# output to the external power device. The polarity of this pin can be configured through the EEPROM, see section 9.3.

## 5.8 Port Indicators

The USB 2.0 port indicators are also supported directly by the CY7C656xx. As per the specification, each downstream port of the hub supports an optional status indicator. The presence of indicators for downstream facing ports is specified by bit 7 of the wHubCharacteristics field of the hub class descriptor. The default CY7C656xx descriptor specifies that port indicators are supported (wHubCharacteristics, bit 7 is set). If port indicators are not included in the hub, this should be disabled by the EEPROM.

Each port indicator is strategically located directly on the opposite edge of the port which it is associated with. The indicator provides two colors: green and amber. This is implemented as two separate LEDs, one amber and the other green. A combination of hardware and software control is used to inform the user of the current status of the port or the device attached to the port and to guide the user through problem resolution. Colors and blinking are used to provide information to the user. The significance of the color of the LED depend on the operational mode of the CY7C656xx. There are two modes of operation for the CY7C656xx port indicators: automatic and manual.

On power-up the CY7C656xx defaults to Automatic Mode, where the color of the Port Indicator (Green, Amber, Off) indicates the functional status of the CY7C656xx port. In Automatic Mode, the CY7C656xx will turn on the green LED whenever the port is enabled and the amber LED when it has had an overcurrent condition detected. The color of the port indicator is set by the port state machine. Blinking of the LEDs is not supported in Automatic Mode. *Table 5-1* below identifies the mapping of color to port state in Automatic Mode.

**Table 5-1. Automatic Port State to Port Indicator Color Mapping**

| Downstream Facing Hub Port State | | | |
|---|---|---|---|
| **Powered Off** | **Disconnected, Disabled, Not Configured, Resetting, Testing** | **Enabled, Transmit, or TransmitR** | **Suspended, Resuming, SendEOR, Restart_E /S** |
| Off or Amber if due to an Overcurrent Condition | Off | Green | Off |

The LED control lines can also be modulated with a square wave for power conservation in systems using batteries. Alone with this there is also a polarity control for these pins, see section 9.3.

In manual mode, the indicators are under the control of the host, which can turn on one of the LEDs, or leave them off. This is done by a system software USB Hub class request. Blinking of the LEDs is supported in Manual Mode. The port indicators allow the user to intervene on any error detection. For example, when babble is detected on plugging in a defective device, or on occurrence of an overcurrent condition, the port indicators corresponding to the downstream port will blink green or only light the amber LED, respectively.

*Table 5-2* displays the color definition of the indicators when CY7C656xx is in Manual Mode.[1]

**Table 5-2. Port Indicator Color Definitions in Manual Mode**

| Color Definition | Port State |
|---|---|
| Off | Not operational |
| Amber | Error condition |
| Green | Fully Operational |
| Blinking Off/Green | Software Attention |
| Blinking Off/Amber | Hardware Attention |
| Blinking Green/Amber | Reserved |

**Note:**
1. Information presented in *Table 5-1* and *Table 5-2* is from USB 2.0 specification Tables 11-6 and 11-7, respectively.

## 6.0 Pin Configuration

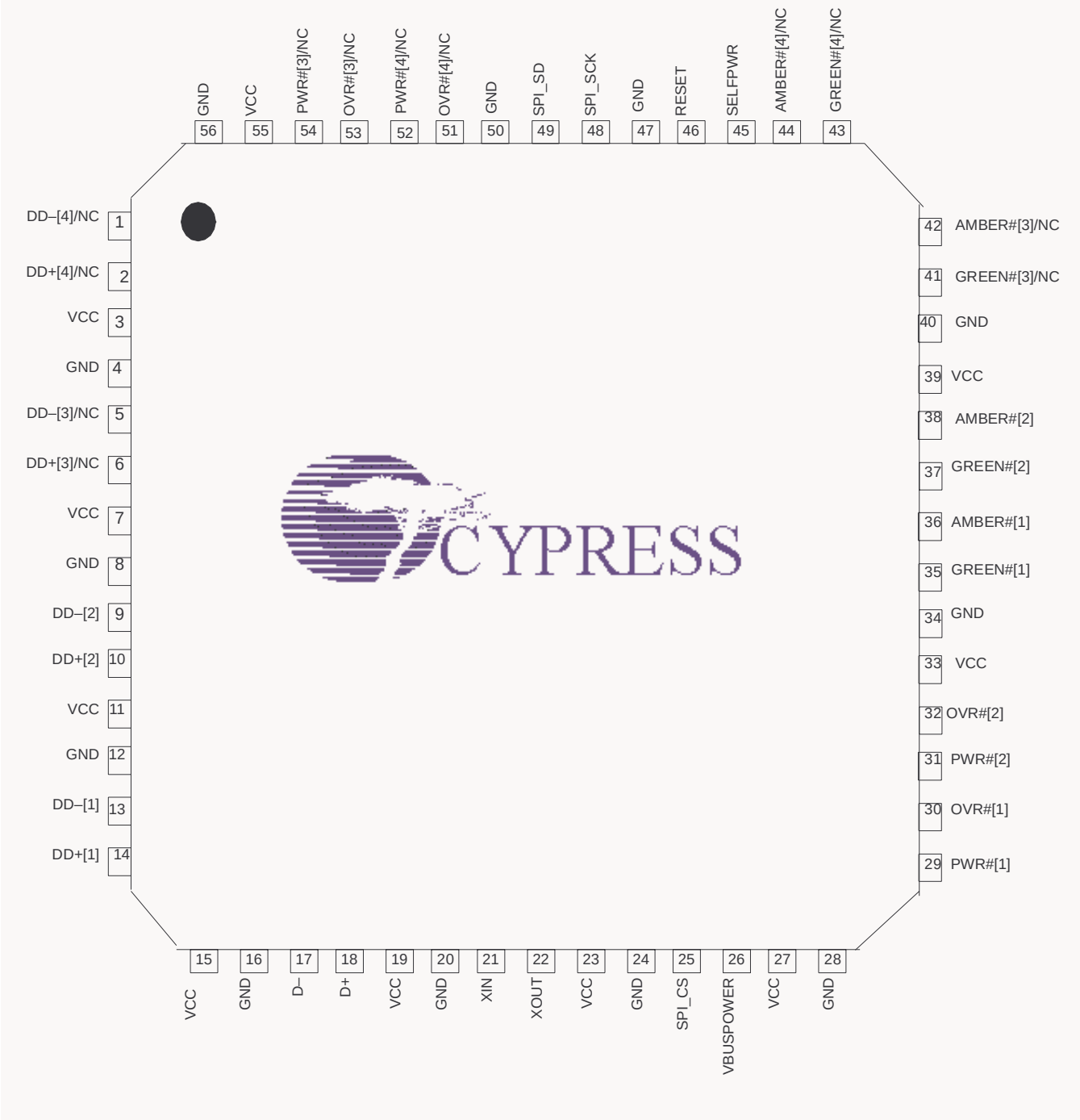



**Figure 6-1. 56-pin Quad Flat Pack No Leads (8 mm x 8 mm)**[2]

**Note:**
2. NC are for CY7C65620 ONLY.

## 7.0 Pin Description Table

*Table 7-1* below displays the pin assignments.

**Table 7-1. Pin Assignments** [3]

| CY7C65640B / CY7C65630 Pin | CY7C65620 Pin | Name | Type | Default | Description |
|---|---|---|---|---|---|
| 3 | 3 | VCC | Power | N/A | **$V_{CC}$.** This signal provides power to the chip. |
| 7 | 7 | VCC | Power | N/A | **$V_{CC}$.** This signal provides power to the chip. |
| 11 | 11 | VCC | Power | N/A | **$V_{CC}$.** This signal provides power to the chip. |
| 15 | 15 | VCC | Power | N/A | **$V_{CC}$.** This signal provides power to the chip. |
| 19 | 19 | VCC | Power | N/A | **$V_{CC}$.** This signal provides power to the chip. |
| 23 | 23 | VCC | Power | N/A | **$V_{CC}$.** This signal provides power to the chip. |
| 27 | 27 | VCC | Power | N/A | **$V_{CC}$.** This signal provides power to the chip. |
| 33 | 33 | VCC | Power | N/A | **$V_{CC}$.** This signal provides power to the chip. |
| 39 | 39 | VCC | Power | N/A | **$V_{CC}$.** This signal provides power to the chip. |
| 55 | 55 | VCC | Power | N/A | **$V_{CC}$.** This signal provides power to the chip. |
| 4 | 4 | GND | Power | N/A | **GND.** Connect to Ground with as short a path as possible. |
| 8 | 8 | GND | Power | N/A | **GND.** Connect to Ground with as short a path as possible. |
| 12 | 12 | GND | Power | N/A | **GND.** Connect to Ground with as short a path as possible. |
| 16 | 16 | GND | Power | N/A | **GND.** Connect to Ground with as short a path as possible. |
| 20 | 20 | GND | Power | N/A | **GND.** Connect to Ground with as short a path as possible. |
| 24 | 24 | GND | Power | N/A | **GND.** Connect to Ground with as short a path as possible. |
| 28 | 28 | GND | Power | N/A | **GND.** Connect to Ground with as short a path as possible. |
| 34 | 34 | GND | Power | N/A | **GND.** Connect to Ground with as short a path as possible. |
| 40 | 40 | GND | Power | N/A | **GND.** Connect to Ground with as short a path as possible. |
| 47 | 47 | GND | Power | N/A | **GND.** Connect to Ground with as short a path as possible. |
| 50 | 50 | GND | Power | N/A | **GND.** Connect to Ground with as short a path as possible. |
| 56 | 56 | GND | Power | N/A | **GND.** Connect to Ground with as short a path as possible. |
| 21 | 21 | XIN | Input | N/A | **24-MHz Crystal IN or External Clock Input.** |
| 22 | 22 | XOUT | Output | N/A | **24-MHz Crystal OUT.** |
| 46 | 46 | RESET# | Input | N/A | **Active LOW Reset.** This pin resets the entire chip. It is normally tied to $V_{CC}$ through a 100K resistor, and to GND through a 0.1-µF capacitor. Other than this, no other special power-up procedure is required. |
| 45 | 45 | SELFPWR | Input | N/A | Indicator for bus/self powered. 0 is bus powered, 1 is self-powered. |
| 26 | 26 | VBUSPOWER | Input | N/A | **VBUS.** Connect to the VBUS pin of the upstream connector. This signal indicates to the hub that it is in a connected state, and may enable the D+ pull-up resistor to indicate a connection. (The hub will do so after the external EEPROM is read, unless it is put into a high-speed mode by the upstream hub). |
| **SPI Interface** | | | | | |
| 25 | 25 | SPI_CS | O | O | **SPI Chip Select.** Connect to CS pin of the EEPROM. |
| 48 | 48 | SPI_SCK | O | O | **SPI Clock.** Connect to EEPROM SCK pin. |
| 49 | 49 | SPI_SD | I/O/Z | Z | **SPI Dataline Connect to GND** with 15-KΩ resistor and to the Data I/O pins of the EEPROM. |

**Note:**

3. Unused port DD+/DD– lines can be left floating. The port power, amber, and green LED pins should be left unconnected, and the overcurrent pin should be tied HIGH. The overcurrent pin is an input and it should not be left floating.

**Table 7-1. Pin Assignments** (continued)[3]

| CY7C65640B / CY7C65630 Pin | CY7C65620 Pin | Name | Type | Default | Description |
|---|---|---|---|---|---|
| **Upstream Port** | | | | | |
| 17 | 17 | D– | I/O/Z | Z | **Upstream D– Signal.** |
| 18 | 18 | D+ | I/O/Z | Z | **Upstream D+ Signal.** |
| **Downstream Port 1** | | | | | |
| 13 | 13 | DD–[1] | I/O/Z | Z | **Downstream D– Signal.** |
| 14 | 14 | DD+[1] | I/O/Z | Z | **Downstream D+ Signal.** |
| 36 | 36 | AMBER#[1] | O | 1 | **LED.** Driver output for Amber LED. Port Indicator Support. Default is Active LOW. Polarity is controlled through EEPROM. |
| 35 | 35 | GREEN#[1] | O | 1 | **LED.** Driver output for Green LED. Port Indicator Support. Default is Active LOW. Polarity is controlled through EEPROM. |
| 30 | 30 | OVR#[1] | Input | 1 | **Overcurrent Condition Detection Input.** Default is Active LOW. Polarity is controlled through EEPROM. |
| 29 | 29 | PWR#[1] | O/Z | Z | **Power Switch Driver Output.** Default is Active LOW. Polarity is controlled through EEPROM. |
| **Downstream Port 2** | | | | | |
| 9 | 9 | DD–[2] | I/O/Z | Z | **Downstream D– Signal.** |
| 10 | 10 | DD+[2] | I/O/Z | Z | **Downstream D+ Signal.** |
| 38 | 38 | AMBER#[2] | O | 1 | **LED.** Driver output for Amber LED. Port Indicator Support. Default is Active LOW. Polarity is controlled through EEPROM. |
| 37 | 37 | GREEN#[2] | O | 1 | **LED.** Driver output for Green LED. Port Indicator Support. Default is Active LOW. Polarity is controlled through EEPROM. |
| 32 | 32 | OVR#[2] | Input | 1 | **Overcurrent Condition Detection Input.** Default is Active LOW. Polarity is controlled through EEPROM. |
| 31 | 31 | PWR#[2] | O/Z | Z | **Power Switch Driver Output.** Default is Active LOW. Polarity is controlled through EEPROM. |
| **Downstream Port 3** | | | | | |
| 5 | - | DD–[3] | I/O/Z | Z | **Downstream D– Signal.** |
| 6 | - | DD+[3] | I/O/Z | Z | **Downstream D+ Signal.** |
| 42 | - | AMBER#[3] | O | 1 | **LED.** Driver output for Amber LED. Port Indicator Support. Default is Active LOW. Polarity is controlled through EEPROM. |
| 41 | - | GREEN#[3] | O | 1 | **LED.** Driver output for Green LED. Port Indicator Support. Default is Active LOW. Polarity is controlled through EEPROM. |
| 53 | - | OVR#[3] | Input | 1 | **Overcurrent Condition Detection Input.** Default is Active LOW. Polarity is controlled through EEPROM. |
| 54 | - | PWR#[3] | O/Z | Z | **Power Switch Driver Output.** Default is Active LOW. Polarity is controlled through EEPROM. |
| **Downstream Port 4** | | | | | |
| 1 | - | DD–[3] | I/O/Z | Z | **Downstream D– Signal.** |
| 2 | - | DD+[3] | I/O/Z | Z | **Downstream D+ Signal.** |
| 44 | - | AMBER#[3] | O | 1 | **LED.** Driver output for Amber LED. Port Indicator Support. Default is Active LOW. Polarity is controlled through EEPROM. |
| 43 | - | GREEN#[3] | O | 1 | **LED.** Driver output for Green LED. Port Indicator Support. Default is Active LOW. Polarity is controlled through EEPROM. |
| 51 | - | OVR#[3] | Input | 1 | **Overcurrent Condition Detection Input.** Default is Active LOW. Polarity is controlled through EEPROM. |
| 52 | - | PWR#[3] | O/Z | Z | **Power Switch Driver Output.** Default is Active LOW. Polarity is controlled through EEPROM. |

# 8.0 Default Descriptors

## 8.1 Device Descriptor

The standard device descriptor for CY7C656xx is based on the VID, PID, and DID found in the SPI EEPROM. This VID/PID/DID in the EEPROM will overwrite the default VID/PID/DID. If no EEPROM is used, the CY7C656xx will enumerate with the default descriptor values as shown below.

| Byte | Full Speed | High Speed | Field Name | Description |
|---|---|---|---|---|
| 0 | 0x12 | 0x12 | bLength | 18 Bytes |
| 1 | 0x01 | 0x01 | bDescriptorType | DEVICE_DESCRIPTOR |
| 2,3 | 0x0110 | 0x0200 | bcdUSB | USB specification 2.0 in HS (1.1 if forced FS) |
| 4 | 0x09 | 0x09 | bDeviceClass | HUB |
| 5 | 0x00 | 0x00 | bDeviceSubClass | None |
| 6 | 0x00 | 0x01[4]/ 0x02[5] | bDeviceProtocol | None |
| 7 | 0x40 | 0x40 | bMaxPacketSize0 | 64 bytes |
| 8,9 | 0x04B4 | 0xx04B4 | wIdVendor | VID (overwritten by what is defined in EEPROM) |
| 10,11 | 0x6560 | 0x6560 | wIdProduct | PID (overwritten by what is defined in EEPROM) |
| 12, 13 | 0x0910<br>0x0810 | 0x0910<br>0x0810 | wbcdDevice | DID (overwritten by what is defined in EEPROM) |
| 14 | 0x00 | 0x00 | iManufacturer | No manufacturer string supported |
| 15 | 0x00 | 0x00 | iProduct | No product string supported |
| 16 | 0x00 | 0x00 | iSerialNumber | No serial string supported |
| 17 | 0x01 | 0x01 | bNumConfigurations | One configuration supported |

## 8.2 Configuration Descriptor

| Byte | Full Speed | High Speed | Field Name | Description |
|---|---|---|---|---|
| 0 | 0x09 | 0x09 | bLength | 9 Bytes |
| 1 | 0x02[7]/ 0x07[8] | 0x02[7]/ 0x07[8] | bDescriptorType | CONFIG_DESCRIPTOR |
| 2 | 0x0019<br>0x0029 | 0x0019[4]<br>0x0029[5] | wTotalLength | Length of all other descriptors |
| 4 | 0x01 | 0x01 | bNumInterfaces | 1 |
| 5 | 0x01 | 0x01 | bConfigurationValue | The configuration to be used |
| 6 | 0x00 | 0x00 | iConfiguration | |
| 7 | 0xA0<br>0xE0 | 0xA0<br>0xE0 | bmAttributes | Value depends on pin 45 - SELFPWR signal<br>SELFPWR = 0 yields 0xA0 and =1 yields 0xE0 |
| 8 | 0x28 | 0x57[6] | bMaxPower | |

## 8.3 Interface Descriptor

| Byte | Full Speed | High Speed | Field Name | Description |
|---|---|---|---|---|
| 0 | 0x09 | 0x09 | bLength | 9 Bytes |
| 1 | 0x04 | 0x04 | bDescriptorType | INTERFACE_DESCRIPTOR |
| 2 | 0x00 | 0x00 | bInterfaceNumber | |
| 3 | 0x00 | 0x00 | bAlternateSetting | |
| 4 | 0x01 | 0x01 | bNumEndpoints | |
| 5 | 0x09 | 0x09 | bInterfaceClass | |
| 6 | 0x00 | 0x00 | bInterfaceSubClass | |
| 7 | 0x00[4]/ 0x01[5] | 0x00[4]/ 0x01[5] | bInterfaceProtocol | |
| 8 | 0x00 | 0x00 | iInterface | |

**Notes:**

4. If configured as single-TT hub.
5. If configured as multi-TT hub and other speed.
6. This value is configured through the External EEPROM.
7. Configured speed descriptor
8. Other speed descriptor

### 8.4 Endpoint Descriptor

| Byte | Full Speed | High Speed | Field Name | Description |
|---|---|---|---|---|
| 0 | 0x07 | 0x07 | bLength | 7 Bytes |
| 1 | 0x05 | 0x05 | bDescriptorType | ENDPOINT_DESCRIPTOR |
| 2 | 0x81 | 0x81 | bEndpointAddress | IN Endpoint #1 |
| 3 | 0x03 | 0x03 | bmAttributes | Interrupt |
| 4,5 | 0x0001 | 0x0001 | wMaxPacketSize | Maximum Packet Size |
| 6 | 0xFF | 0x0C | bInterval | Polling Rate |

### 8.5 Interface Descriptor[9,10]

| Byte | Full Speed | High Speed | Field Name | Description |
|---|---|---|---|---|
| 0 | N/A | 0x09 | bLength | 9 Bytes |
| 1 | N/A | 0x04 | bDescriptorType | INTERFACE_DESCRIPTOR |
| 2 | N/A | 0x00 | bInterfaceNumber | Interface Descriptor Index |
| 3 | N/A | 0x01 | bAlternateSetting | Alternate Setting for the Interface |
| 4 | N/A | 0x01 | bNumEndpoints | Number of Endpoints Defined |
| 5 | N/A | 0x09 | bInterfaceClass | Interface Class |
| 6 | N/A | 0x00 | bInterfaceSubClass | Interface Sub-Class |
| 7 | N/A | 0x02 | bInterfaceProtocol | Interface Protocol |
| 8 | N/A | 0x00 | bInterface | Interface String Index |

### 8.6 Endpoint Descriptor[9,10]

| Byte | Full Speed | High Speed | Field Name | Description |
|---|---|---|---|---|
| 0 | N/A | 0x07 | bLength | 7 Bytes |
| 1 | N/A | 0x05 | bDescriptorType | ENDPOINT_DESCRIPTOR |
| 2 | N/A | 0x81 | bEndpointAddress | IN Endpoint #1 |
| 3 | N/A | 0x03 | bmAttributes | Interrupt |
| 4,5 | N/A | 0x0001 | wMaxPacketSize | Maximum Packet Size |
| 6 | N/A | 0x0C | bInterval | Polling Rate |

### 8.7 Device Qualifier Descriptor

| Byte | Full Speed | High Speed | Field Name | Description |
|---|---|---|---|---|
| 0 | 0x0A | 0x0A | bLength | 10 Bytes |
| 1 | 0x06 | 0x06 | bDescriptorType | DEVICE_QUALIFIER |
| 2,3 | 0x0200 | 0x0200 | bcdUSB | |
| 4 | 0x09 | 0x09 | bDeviceClass | |
| 5 | 0x00 | 0x00 | bDeviceSubClass | |
| 6 | 0x01[4]<br>0x02[5] | 0x00 | bDeviceProtocol | |
| 7 | 0x40 | 0x40 | bMaxPacketSize0 | |
| 8 | 0x01 | 0x01 | bNumConfigurations | |
| 9 | 0x00 | 0x00 | bReserved | |

**Note:**
9. If CY7C65640B is configured for singled-TT only or CY7C65630 or CY7C65620 (from the external EEPROM), this descriptor is not present.
10. If connected at high-speed

### 8.8 Hub Descriptor

| Byte | All Speed | Field Name | Description |
|---|---|---|---|
| 0 | 0x09 | bLength | 9 Bytes |
| 1 | 0x29 | bDescriptorType | HUB Descriptor |
| 2 | 0x04[11]<br>0x02 | bNbrPorts | Number of ports supported, CY7C65640B or CY7C65630.<br>Number of ports supported, CY7C65620. |
| 3,4 | 0x0089[11] | wHubCharacteristics | b1, b0: Logical Power Switching Mode<br>00: Ganged power switching (all ports' power at once)<br>01: Individual port power switching (Default in CY7C656xx)<br>b2: Identifies a Compound Device,<br>0: Hub is not part of a compound device (Default in CY7C656xx),<br>1: Hub is part of a compound device.<br>b4, b3: Over-current Protection Mode<br>00: Global Overcurrent Protection. The hub reports overcurrent as a summation of all ports current draw, without a breakdown of individual port overcurrent status.<br>01: Individual Port Overcurrent Protection. The hub reports overcurrent on a per-port basis. Each port has an over-current status (Default in CY7C656xx).<br>1X: No Overcurrent Protection. This option is allowed only for bus-powered hubs that do not implement overcurrent protection.<br>b6, b5: TT Think Time<br>00: TT requires at most 8 FS bit times of inter transaction gap on a full-/low-speed downstream bus (Default in CY7C656xx).<br>b7: Port Indicators Supported,<br>0: Port Indicators are not supported on its downstream facing ports and the PORT_INDICATOR request has no effect.<br>1: Port Indicators are supported on its downstream facing ports and the PORT_INDICATOR request controls the indicators. See Section 5.0 and 10.0 (Default in CY7C656xx).<br>b15,. b8: Reserved |
| 5 | 0x32[11] | bPwrOn2PwrGood | Time from when the port is powered to when the power is good on that port |
| 6 | 0x28[11]<br>0xAE[11] | bHubContrCurrent | Maximum current requirement for the Hub Controller at full-speed.<br>Maximum current requirement for the Hub Controller at high-speed. |
| 7 | 0x00[11] | bDeviceRemovable | Indicates if the port has a removable device attached |
| 8 | 0xFF[11] | bPortPwrCtrlMask | Required for compatibility with software written for 1.0 compliant devices |

**Note:**
11. This value is configured through the External EEPROM.

## 9.0 Configuration Options

Systems using CY7C656xx that do not have the fuse ROM pre-set at the factory must have an external EEPROM in order for the device to have a unique VID, PID, and DID. The CY7C656xx can communicate with SPI EEPROM that are either double byte addressed or a single byte with the 9th bit within the instruction byte, such as the 24LC040 parts use. The 25LC080 EEPROM uses the double byte address format, and therefore the CY7C656xx can communicate with these parts. The '010s and '020s uses the same command format as used to interface with the '040 and hence these can also be used to interface with the CY7C656xx.

### 9.1 Default – 0xD0 Load

When used in default mode, only a unique VID, PID, and DID must be present in the external SPI EEPROM. The contents of the EEPROM must contain this information in the following format:

| Byte | Value |
|---|---|
| 0 | 0xD0 |
| 1 | VID (LSB) |
| 2 | VID (MSB) |
| 3 | PID (LSB) |
| 4 | PID (MSB) |
| 5 | reversed |
| 6 | DID (MSB) |

### 9.2 Configured – 0xD2 Load

| Byte | Value (MSB->LSB) |
|---|---|
| 0 | 0xD2 |
| 1 | VID (LSB) |
| 2 | VID (MSB) |
| 3 | PID (LSB) |
| 4 | PID (MSB) |
| 5 | reversed |
| 6 | DID (MSB) |
| 7 | EnableOverCurrentTimer[3:0], DisableOvercurrent-Timer[3:0] |
| 8 | ActivePorts[3:0], RemovablePorts[3:0] |
| 9 | MaxPower |
| 10 | HubControllerPower |
| 11 | PowerOnTimer |
| 12 | IllegalHubDescriptor, CompoundDevice, FullspeedOnly, NoPortIndicators, Reserved, GangPowered, SingleTTOnly, Reserved |

**Byte 0: 0xD2**

Needs to be programmed with 0xD2

**Byte 1: VID (LSB)**

Least Significant Byte of Vendor ID

**Byte 2: VID (MSB)**

Most Significant Byte of Vendor ID

**Byte 3: PID (LSB)**

Least Significant Byte of Product ID

**Byte 4: PID (MSB)]**

Most Significant Byte of Product ID

**Byte 5: Reserved**

Reserved.

**Byte 6: DID (MSB)]**

Most Significant Byte of Device ID

**Byte 7: EnableOvercurrentTimer[3:0], DisabledOvercurrentTimer[3:0]**

Count time in ms for filtering overcurrent detection. Bits 7–4 are for an enabled port, and bits 3–0 are for a disabled port. Both range from 0 ms to 15 ms. See section 5.8. Default: 8 ms = 0x88.

**Byte 8: ActivePorts[3:0], RemovablePorts[3:0]**

Bits 7–4 are the ActivePorts[3:0] bits that indicates if the corresponding port is usable. For example, a two-port hub that uses ports 1 and 4 would set this field to 0x09. The total number of ports reported in the Hub Descriptor: bNbrPorts field is calculated from this. Bits 3–0 are the RemovablePorts[3:0] bits that indicates whether the corresponding port is removable (set to high). This bit values are recorded appropriately in the HubDescriptor:DeviceRemovable field. Default: 0xFF.

**Byte 9: MaximumPower**

This value is reported in the ConfigurationDescriptor:bMaxPower field and is the current in 2-mA intervals that is required from the upstream hub. Default: 0x28 = 80 mA for full-speed and 0x57 = 174 mA for high-speed.

**Byte 10: HubControllerPower**

This value is reported in the HubDescriptor:bHubContrCurrent field and is the current in milliamperes required by the hub controller. Default: 0x28 = 80 mA for full-speed and 0x57 = 174 mA for high-speed.

**Byte 11: PowerOnTimer**

This value is reported in the HubDescriptor: bPwrOn2PwrGood field and is the time in 2-ms intervals from the SetPortPower command until the power on the corresponding downstream port is good. Default: 0x32 = 100 ms.

**Byte 12: IllegalHubDescriptor, CompoundDevice, FullspeedOnly, NoPortIndicators, Reserved, GangPowered, SingleTTOnly**

Bit 7: IllegalHubDescriptor: For GetHubDescriptor request, some USB hosts use a DescriptorTypeof 0x00 instead of HUB_DESCRIPTOR, 0x29. According to the USB 2.0 standard, a hub must treat this as a Request Error, and STALL the transaction accordingly (USB 2.0, 11.24.2.5). For systems that do not accept this, the IllegalHubDescriptor configuration bit may be set to allow CY7C656xx to accept a DescriptorType of 0x00 for this command. Default is 1.

Bit 6: CompoundDevice: Indicates whether the hub is part of a compound device. This is reported in the HubDescriptor, wHub-Characteristics: b2. Default set to 0.

Bit 5: Fullspeed: Only configures the hub to be a full-speed only device. Default set to 0.

Bit 4: NoPortIndicators: Turns off the port indicators and does not report them as present in the HubDescriptor, wHubCharacteristics b7 field. Default set to 0.

Bit 3: Reserved. Should be set to 0.

Bit 2: GangPowered: Indicates whether the port power switching is ganged (set to 1) or per-port (set to 0). This is reported in the HubDescriptor, wHubCharacteristics field, b4, b3, b1, and b0. Default set to 0.

Bit 1: SingleTTOnly: Indicates that the hub should only support single Transaction Translator mode. This changes various descriptor values. Default set to 0.

Bit 0: Reserved. Default set to 0.

### 9.3 Configured – 0xD4 Load

| Byte | Value (MSB->LSB) |
|---|---|
| 0 | 0xD4 |
| 1 | VID (LSB) |
| 2 | VID (MSB) |
| 3 | PID (LSB) |
| 4 | PID (MSB) |
| 5 | reserved |
| 6 | DID (MSB) |

| Byte | Value (MSB->LSB) |
|---|---|
| 7 | EnableOverCurrentTimer[3:0], DisableOvercurrentTimer[3:0] |
| 8 | MaxPower (Full-speed) |
| 9 | MaxPower (High-speed) |
| 10 | Reserved |
| 11 | Reserved |
| 12 | HubControllerPower Full-Speed |
| 13 | HubControllerPower High-Speed |
| 14 | Reserved |
| 15 | Reserved |
| 16 | PowerOnTimer |
| 17 | IllegalHubDescriptor, CompoundDevice, FullspeedOnly, NoPortIndicators, Reserved, GangPowered, SingleTTOnly, Reserved |
| 18 | AmberPolarity, GreenPolarity, ModulateIndicators, PowerControlPolarity, OverCurrentPolarity, OverCurrentMode1, OverCurrentMode2 |
| 19 | Write Protect |
| 20 | NumLangs |
| 21 | SupportedStrings |
| 22 | ActivePorts[3:0] |
| 23 | RemovablePorts[3:0] |
| 24 | LangID |
| a =24+2N | iManufacturer |
| b =a+2N | iProduct |
| c =b+2N | iSerialNumber |
| d =c+2N | iConfiguration(FS) |
| e =d+2N | iConfiguration(HS) |
| f =e+2N | iInterface(0) |
| g =f+2N | iInterface(1) |
| h=g+2N | Strings |

N:NumLangs

**Byte 0: 0xD3**

Needs to be programmed with 0xD3

**Byte 1: VID (LSB)**

Least Significant Byte of Vendor ID

**Byte 2: VID (MSB)**

Most Significant Byte of Vendor ID

**Byte 3: PID (LSB)**

Least Significant Byte of Product ID

**Byte 4: PID (MSB)]**

Most Significant Byte of Product ID

**Byte 5: Reserved**

Reserved.

**Byte 6: DID (MSB)]**

Most Significant Byte of Device ID

**Byte 7: EnableOvercurrentTimer[3:0], DisabledOvercurrentTimer[3:0]**

Count time in ms for filtering overcurrent detection. Bits 7–4 are for an enabled port, and bits 3–0 are for a disabled port. Both range from 0 ms to 15 ms. See section 5.8. Default: 8 ms = 0x88.

**Byte 8: MaximumPower (Full-Speed)**

This value is reported in the ConfigurationDescriptor:bMaxPower field and is the current in 2-mA intervals that is required from the upstream hub when connected at full-speed. Default: 0x28 = 160 mA for full-speed.

**Byte 9: MaximumPower (High-Speed)**

This value is reported in the ConfigurationDescriptor:bMaxPower field and is the current in 2-mA intervals that is required from the upstream hub when connected at high-speed. Default: 0x57 = 348 mA for high-speed.

**Byte 10: Reserved**

Zeros should be written to this location.

**Byte 11: Reserved**

Zeros should be written to this location.

**Byte 12: HubControllerPower (Full-Speed)**

This value is reported in the HubDescriptor:bHubContrCurrent field and is the current in milliamperes required by the hub controller when connected on the upstream hub as a full-speed. Default: 0x50 = 80 mA for full-speed.

**Byte 13: HubControllerPower (High-speed)**

This value is reported in the HubDescriptor:bHubContrCurrent field and is the current in milliamperes required by the hub controller when connected on the upstream hub as a high-speed. Default: 0xAE = 174 mA for high-speed.

**Byte 14: Reserved**

Zeros should be written to this location.

**Byte 15: Reserved**

Zeros should be written to this location.

**Byte 16: PowerOnTimer**

This value is reported in the HubDescriptor: bPwrOn2PwrGood field and is the time in 2-ms intervals from the SetPortPower command until the power on the corresponding downstream port is good. Default: 0x32 = 100 ms.

**Byte 17: IllegalHubDescriptor, CompoundDevice, FullspeedOnly, NoPortIndicators, Reserved, GangPowered, SingleTTOnly**

Bit 7: IllegalHubDescriptor: For GetHubDescriptor request, some USB hosts use a DescriptorTypeof 0x00 instead of HUB_DESCRIPTOR, 0x29. According to the USB 2.0 standard, a hub must treat this as a Request Error, and STALL the transaction accordingly (USB 2.0, 11.24.2.5). For sys-

tems that do not accept this, the IllegalHubDescriptor configuration bit may be set to allow CY7C656xx to accept a DescriptorType of 0x00 for this command. Default is 0, recommended setting is 1.

Bit 6: CompoundDevice: Indicates whether the hub is part of a compound device. This is reported in the HubDescriptor, wHub-Characteristics: b2. Default set to 0.

Bit 5: Fullspeed: Only configures the hub to be a full-speed only device. Default set to 0.

Bit 4: NoPortIndicators: Turns off the port indicators and does not report them as present in the HubDescriptor, wHubCharacteristics b7 field. Default set to 0.

Bit 3: Reserved. Should be set to 0.

Bit 2: GangPowered: Indicates whether the port power switching is ganged (set to 1) or per-port (set to 0). This is reported in the HubDescriptor, wHubCharacteristics field, b4, b3, b1, and b0. Default set to 0.

Bit 1: SingleTTOnly: Indicates that the hub should only support single Transaction Translator mode. This changes various descriptor values. Default set to 0.

Bit 0: **Reserved. Default set to 0.**

**Byte 18: AmberPolarity, GreenPolarity, SelfPowerable, ModulateIndicators, PowerControlPolarity, OverCurrentPolarity, OverCurrentMode1, OverCurrentMode2**

Bit 7: AmberPolarity—Indicates the polarity of the amber indicator control.

Bit 6: GreenPolarity—Indicates the polarity of the green indicator control.

Bit 5: SelfPowerable—Indicates whether the hub is capable of operating in self-powered mode. If ‘0’, the hub is capable of bus-powered operation only.

Bit 4: ModulateIndicators—If this bit is set, the indicator outputs will be modulated by a square wave of programmable frequency, for power savings. If ‘0’, the outputs will be static.

Bit 3: PowerControlPolarity—If set, the power control outputs will be active HIGH. If not set, the power control outputs will be active LOW.

Bit 2: OverCurrentPolarity—If set, the over-current inputs will be active HIGH. If not set, the over-current inputs will be active LOW.

Bit 1: OverCurrentMode1—Reported as bit 4 of the wHub-Characteristics field of the hub descriptor. If set to ‘1’, this bit disables over-current detection.

Bit 0: OverCurrentMode2—Reported as bit 3 of the wHub-Characteristics field of the hub descriptor. If Bit 1 of this byte is set to ‘0’, over-current detection is enabled. If this bit (Bit 0) is set to ‘1’, the hub reports over-current on a per-port basis. If set to ‘0’, the hub reports over-current as the summation of all ports’ current draw.

**Byte 19: Write Protect**

**Byte 20: NumLangs**

Number of supported string languages. CHC supports a maximum of 31 languages; if this field is set to 0 or a number larger than 31, all string support will be disabled.

**Byte 21: SupportedStrings**

This field contains a bitmap of strings supported by the hub. A set bit indicates that the standard string is supported. A bit not set indicates that the string is not supported. The hub controller will return a non-zero index for each string which is supported, and will return 0x00 for each string not supported, as indicated by this field. The bits in this field correspond to the following standard strings.

| Bit | Name | Description |
|---|---|---|
| 7 | reserved | |
| 6 | iInterface (1) | The iInterface string index reported in the second interface descriptor (alternate setting 1). |
| 5 | iInterface (0) | The iInterface string index reported in the first interface descriptor (alternate setting 0). |
| 4 | iConfiguration | (high-speed) The iConfiguration string index reported in the configuration descriptor, when operating at high-speed. |
| 3 | iConfiguration | (full-speed) The iConfiguration string index reported in the configuration descriptor, when operating at full-speed. |
| 2 | iSerialNumber | The iSerialNumber string index reported in the device descriptor. |
| 1 | iProduct | The iProduct string index reported in the device descriptor. |
| 0 | iManufacturer | The iManufacturer string index reported in the device descriptor. |

**Byte 22: ActivePorts[3:0]**

Bits 3–0 are the ActivePorts[3:0] bits that indicates if the corresponding port is usable. For example, a two-port hub that uses ports 1 and 4 would set this field to 0x09. The total number of ports reported in the Hub Descriptor: bNbrPorts field is calculated from this.

**Byte 23: RemovablePorts[3:0]**

Bits 3–0 are the RemovablePorts[3:0] bits that indicates whether the corresponding port is removable (set to high). This bit values are recorded appropriately in the HubDescriptor:DeviceRemovable field. Default: 0xFF.

**Byte 24: LangID**

Array of LangID codes supported by the hub. Each LangID consists of two bytes, stored LSB first. The array has NumLangs entries (2 * NumLangs bytes).

**Byte a: iManufacturer**

Array of addresses for the iManufacturer strings. Each address is two bytes long, stored LSB first. The array has NumLangs entries (2 * NumLangs bytes). (The starting EEPROM address is based upon the number entered for NumLangs.
The address a = 24 + 2 * NumLangs.

**Byte b: iProduct**

Array of addresses for the iProduct strings. Each address is two bytes long, stored LSB first. The array has NumLangs entries (2 * NumLangs bytes).
The address b = a + 2*NunLangs.

**Byte c: iSerialNumber**

Array of addresses for the iSerialNumber strings. Each address is two bytes long, stored LSB first. The array has NumLangs entries (2 * NumLangs bytes).
The address c = b + 2 * NumLangs.

**Byte d: iConfiguration(Full-Speed)**

Array of addresses for the iConfiguration (full-speed) strings. Each address is two bytes long, stored LSB first. The array has NumLangs entries (2 * NumLangs bytes).
The address d = c + 2*NumLangs.

**Byte e: iConfiguration(High-Speed)**

Array of addresses for the iConfiguration (high-speed) strings. Each address is two bytes long, stored LSB first. The array has NumLangs entries (2 * NumLangs bytes).
The address e = d + 2 * NumLangs.

**Byte f: iInterface(0)**

Array of addresses for the iInterface(0) strings. Each address is two bytes long, stored LSB first. The array has NumLangs entries (2 * NumLangs bytes).
The address f = e + 2 * NumLangs.

**Byte g: iInterface(1)**

Array of addresses for the iInterface(1) strings. Each address is two bytes long, stored LSB first. The array has NumLangs entries (2 * NumLangs bytes).
The address g = f + 2 * NumLangs.

**Byte h: Strings**

Strings addressed by the string pointers. Strings must comply with the USB specification. The first byte must be the length of the string in bytes, the second must be 0x03, and the string must be in Unicode.

## 10.0 Supported USB Requests

### 10.1 Device Class Commands

**Table 10-1. Device Class Requests**

| Request | bmRequestType | bRequest | wValue | wIndex | wLength | Data |
|---|---|---|---|---|---|---|
| GetDeviceStatus | 10000000B | 0x00 | 0x0000 | 0x0000 | 0x0002 | 2 Byte Device Status |
| GetInterfaceStatus | 10000001B | 0x00 | 0x0000 | 0x0000 | 0x0002 | 2 Byte Endpoint Status |
| GetEndpointStatus | 10000010B | 0x00 | 0x0000 | 0x0000 | 0x0002 | 2 Byte Endpoint Status |
| GetDeviceDescriptor | 10000000B | 0x06 | 0x0001 | Zero or Language ID | Descriptor Length | Descriptor |
| GetConfigDescriptor | 10000000B | 0x06 | 0x0002 | Zero or Language ID | Descriptor Length | Descriptor |
| GetDeviceQualifierDescriptor | 10000000B | 0x06 | 0x0006 | Zero or Language ID | Descriptor Length | Descriptor |
| GetOtherSpeedConfigurationDescriptor | 10000000B | 0x06 | 0x0007 | Zero or Language ID | Descriptor Length | Descriptor |
| GetConfiguration[12] | 10000000B | 0x08 | 0x0000 | 0x0000 | 0x0001 | Configuration value |
| SetCongfiguration[12] | 00000000B | 0x09 | Configuration Value | 0x0000 | 0x0000 | None |
| GetInterface | 10000001B | 0xA | 0x0000 | 0x0000 | 0x0001 | Interface Number |

**Note:**
12. Only one configuration is supported in CY7C656xx.

**Table 10-1. Device Class Requests** (continued)

| Request | bmRequestType | bRequest | wValue | wIndex | wLength | Data |
|---|---|---|---|---|---|---|
| SetInterface | 00000001B | 0x0B | Alternate Setting | Interface Number | 0x0000 | None |
| SetAddress | 00000000B | 0x05 | Device Address | 0x0000 | 0x0000 | None |
| SetDeviceRemoteWakeup | 00000000B | 0x03 | 0x01 | 0x0000 | 0x0000 | None |
| SetDeviceTest_J | 00000000B | 0x03 | 0x02 | 0x0100 | 0x0000 | None |
| SetDeviceTest_K | 00000000B | 0x03 | 0x02 | 0x0200 | 0x0000 | None |
| SetDeviceTest_SE0_NAK | 00000000B | 0x03 | 0x02 | 0x0300 | 0x0000 | None |
| SetDeviceTest_Packet | 00000000B | 0x03 | 0x02 | 0x0400 | 0x0000 | None |
| SetEndpointHalt | 00000000B | 0x03 | 0x00 | 0x0000 | 0x0000 | None |
| ClearDeviceRe-moteWakeup | 00000000B | 0x01 | 0x01 | 0x0000 | 0x0000 | None |
| ClearEndpointHalt | 00000000B | 0x01 | 0x00 | 0x0000 | 0x0000 | None |

## 10.2 Hub Class Commands

**Table 10-2. Hub Class Requests**

| Request | bmRequestType | bRequest | wValue | wIndex | wLength | Data |
|---|---|---|---|---|---|---|
| GetHubStatus | 10100000B | 0x00 | 0x0000 | 0x0000 | 0x0004 | Hub Status (See Table 11-19 of Spec) Change Status (See Table 11-20 of Spec) |
| GetPortStatus | 10100011B | 0x00 | 0x0000 | Byte 0: 0x00 Byte 1: Port | 0x0004 | Port Status (See Table 11-21 of Spec) Change Status (See Table 11-20 of Spec) |
| ClearHubFeature | 00100000B | 0x01 | Feature Selectors[13] 0 or 1 | 0x0000 | 0x0000 | None |
| ClearPortFeature | 00100011B | 0x01 | Feature Selectors[13] 1, 2, 8, 16, 17, 18, 19, or 20 | Byte 0: 0x00 Byte 1: Port | 0x0000 | None |
| ClearPortFeature | 00100011B | 0x01 | Feature Selectors[13] 22 (PORT_INDICATOR) | Byte 0: Selectors[14] 0, 1, 2, or 3 Byte 1: Port | 0x0000 | None |
| SetHubFeature | 00100000B | 0x03 | Feature Selector[13] 0 or 1 | 0x0000 | 0x0000 | |
| SetPortFeature | 00100011B | 0x03 | Feature Selectors[13] 2, 4 or 8 | Port | 0x0000 | None |
| SetPortFeature | 00100011B | 0x03 | Feature Selector[13] 21 (PORT_TEST) | Byte 0: Selectors[15] 1,2, 3, 4 or 5 Byte 1: Port | 0x0000 | None |
| SetPortFeature | 00100011B | 0x03 | Feature Selector[13] 22 (PORT_INDICATOR) | Byte 0: Selectors[14] 0, 1, 2, or 3 Byte 1: Port | 0x0000 | None |
| GetHubDescriptor | 10100000B | 0x06 | Descriptor Type and Descriptor Index | | Hub Descriptor Length | |

**Notes:**
13. Feature selector values for different feature is presented in *Table 10-3*.
14. Selector values for different feature is presented in *Table 10-5*.

**Table 10-2. Hub Class Requests** (continued)

| Request | bmRequestType | bRequest | wValue | wIndex | wLength | Data |
|---|---|---|---|---|---|---|
| ClearTTBuffer | 00100011B | 0x08 | Dev_Addr, EP_Num | TT_Port | 0x0000 | None |
| ResetTT | 00100000B | 0x09 | 0x0000 | Byte 0: 0x00<br>Byte 1: Port | 0x0000 | None |
| GetTTState | 10100011B | 0X0A | TT_Flags | Byte 0: 0x00<br>Byte 1: Port | TT State Length | TT State |
| StopTT | 00100011B | 0x0B | 0x0000 | Byte 0: 0x00<br>Byte 1: Port | 0x0000 | None |
| **Vendor Commands** | | | | | | |
| Read EEPROM | 11000000B | 0x02 | 0x00 | 0x00 | Length | Data |
| This request results in Length bytes of Data being read from the external memory device, and returned to the host. Data is read beginning with address 0. This request will fail if there is no external memory device present. This request is only valid if the hub is in the Configured state; the request will fail otherwise. | | | | | | |
| Write EEPROM | 01000000B | 0x01 | 0x00 | 0x00 | Length | Data |
| This request results in Length bytes of Data being written to the external memory device. Data is written beginning with address 0. This request will fail if there is no external memory device present. This request is only valid if the hub is in the Configured state; the request will fail otherwise. | | | | | | |

**Table 10-3. Hub Class Feature Selector**

| Feature Selector | Recipient | Value |
|---|---|---|
| C_HUB_LOCAL_POWER | Hub | 0 |
| C_HUB_OVER_CURRENT | Hub | 1 |
| PORT_CONNECTION | Port | 0 |
| PORT_ENABLE | Port | 1 |
| PORT_SUSPEND | Port | 2 |
| PORT_RESET | Port | 4 |
| PORT_POWER | Port | 8 |
| PORT_LOW_SPEED | Port | 9 |
| C_PORT_CONNECTION | Port | 16 |
| C_PORT_ENABLE | Port | 17 |
| C_PORT_SUSPEND | Port | 18 |
| C_PORT_OVER_CURRENT | Port | 19 |
| C_PORT_RESET | Port | 20 |
| PORT_TEST | Port | 21 |
| PORT_INDICATOR | Port | 22 |

**Table 10-4. Test Mode Selector for Feature Selector PORT_TEST (0x21)[15]**

| PORT_TEST Mode Description | Selector Value |
|---|---|
| Test_J | 1 |
| Test_K | 2 |
| Test_SE0_NAK | 3 |
| Test_Packet | 4 |
| Test_Force_Enable | 5 |

**Table 10-5. Port Indicator Selector for Feature Selector PORT_INDICATOR (0x22)**

| Port Indicator Color | Selector Value | Port Indicator Mode |
|---|---|---|
| Color Set Automatically as shown in *Table 5-1* | 0 | Automatic Mode |
| Amber | 1 | Manual Mode |
| Green | 2 | Manual Mode |
| Off | 3 | Manual Mode |

**Note:**
15. Selector values for different features are presented in *Table 10-4*.

## 11.0 Upstream USB Connection

The following is a schematic of the USB upstream connector.

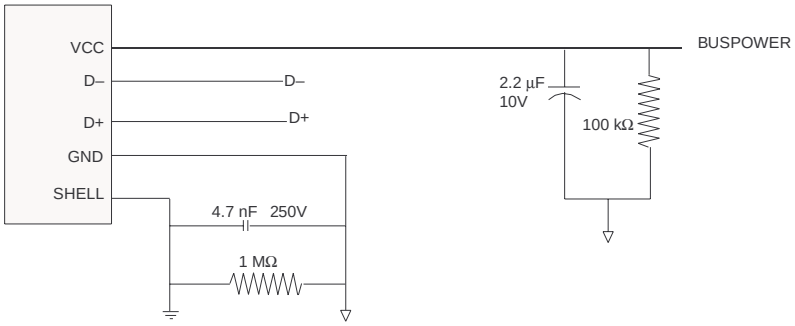



**Figure 11-1. USB Upstream Port Connection**

## 12.0 Downstream USB Connections

The following is a schematic of the USB downstream connector.

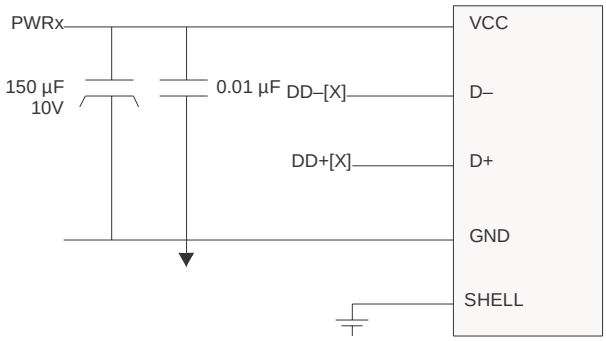



**Figure 12-1. USB Downstream Port Connection**

## 13.0 LED Connections

The following is a schematic of the LED circuitry.

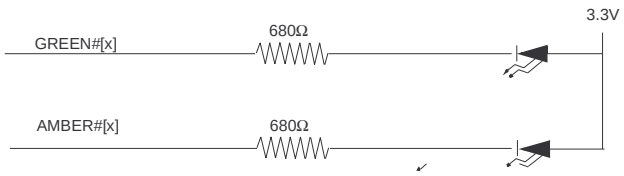



**Figure 13-1. USB Downstream Port Connection**

## 14.0 System Block Diagram

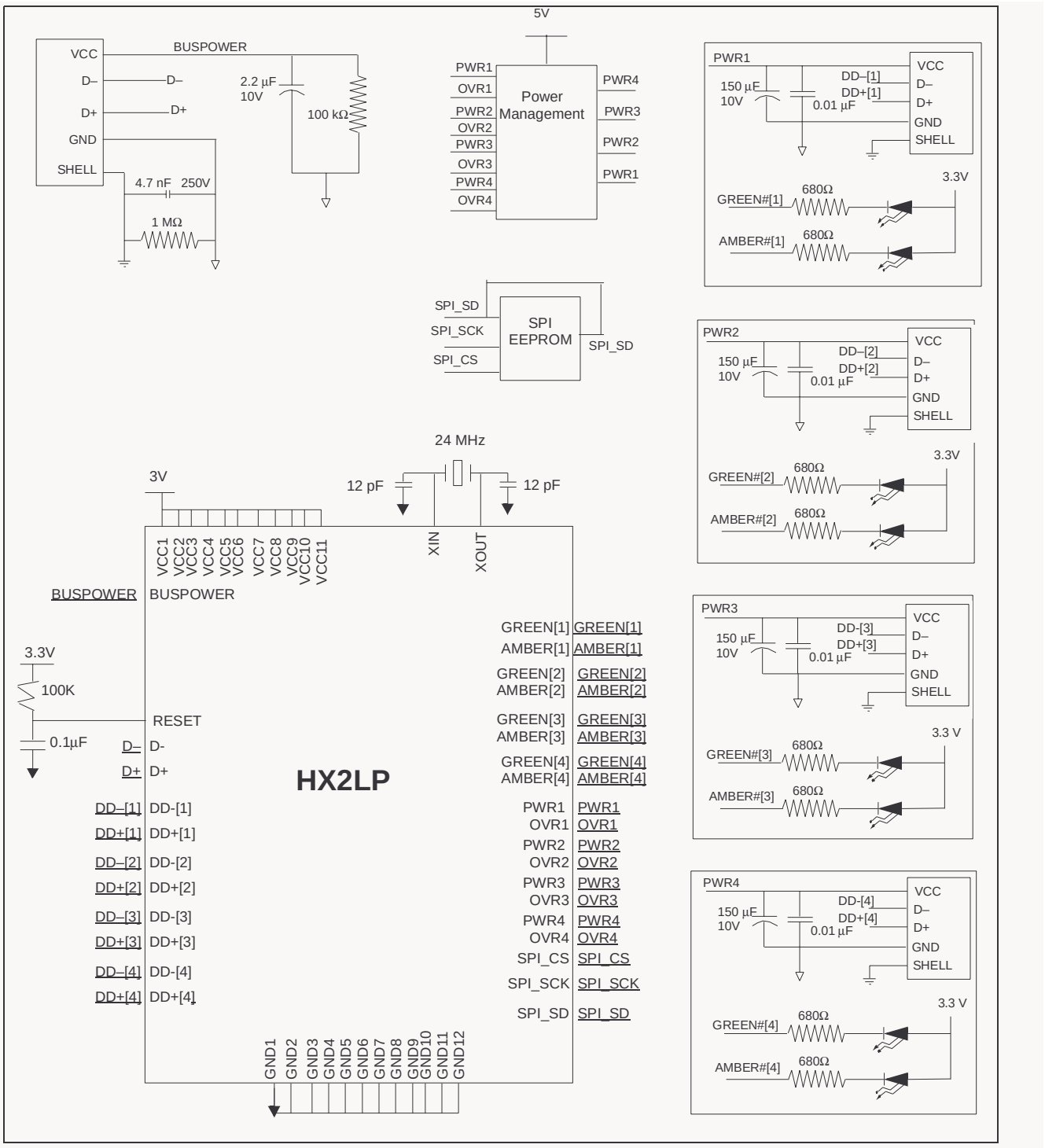



**Figure 14-1. Sample Schematic**

## 15.0 Electrical Characteristics

### 15.1 Absolute Maximum Ratings

Storage Temperature ..... –65°C to +150 °C

Ambient Temperature with Power Applied..... 0°C to +70°C

Supply Voltage to Ground Potential ..... –0.5V to +4.0V

DC Voltage Applied to Outputs in High Z State ..... –0.5V to $V_{CC}$ + 0.5V

Power Dissipation (4 HS ports)..... TBD W

Static Discharge Voltage..... > 2000V

Max. Output Sink Current per I/O ..... 10 mA

### 15.2 Operating Conditions

$T_A$ (Ambient Temperature Under Bias)..... 0°C to +70°C

Supply Voltage .....+3.15V to +3.45V

Ground Voltage ..... 0V

FOSC (Oscillator or Crystal Frequency)..... 24 MHz ± 0.05%

parallel resonant, fundamental mode, 12-pF load capacitance, 0.5 mW

### 15.3 DC Electrical Characteristics

| Parameter | Description | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| $V_{CC}$ | Supply Voltage | | 3.15 | 3.3 | 3.45 | V |
| $V_{CC}$ RampUp | Ramp rate on $V_{CC}$ | | | | 18 | V/ms |
| $V_{IH}$ | Input High Voltage | | 2 | | 5.25 | V |
| $V_{IL}$ | Input Low Voltage | | –0.5 | | 0.8 | V |
| $I_I$ | Input Leakage Current | $0 < V_{IN} < V_{CC}$ | | | ±10 | µA |
| $V_{OH}$ | Output Voltage High | $I_{OUT}$ = 4 mA | 2.4 | | | V |
| $V_{OL}$ | Output Low Voltage | $I_{OUT}$ = –4 mA | | | 0.4 | V |
| $I_{OH}$ | Output Current High | | | | 4 | mA |
| $I_{OL}$ | Output Current Low | | | | 4 | mA |
| $C_{IN}$ | Input Pin Capacitance | | | | 10 | pF |
| $I_{SUSP}$ | Suspend Current | | | TBD | | µA |
| **$I_{CC}$** | **Supply Current** | | | | | |
| | 4 Active ports | Full-speed Host, Full-speed Devices | | 53 | | mA |
| | | High-speed Host, High-speed Devices | | 174 | | mA |
| | | High-speed Host, Full-speed Devices | | 77 | | mA |
| | 2 Active Ports | Full-speed Host, Full-speed Devices | | 50 | | mA |
| | | High-speed Host, High-speed Devices | | 123 | | mA |
| | | High-speed Host, Full-speed Devices | | 75 | | mA |
| | No Active Ports | Full-speed Host | | 48 | | mA |
| | | High-speed Host | | 72 | | mA |

### 15.4 USB Transceiver

USB 2.0-Compliant in full-, low-, and high-speed modes.

### 15.5 AC Electrical Characteristics

Both the upstream USB transceiver and all four downstream transceivers have passed the USB-IF USB 2.0 Electrical Certification Testing.

#### *15.5.1 Serial Peripheral Interface*

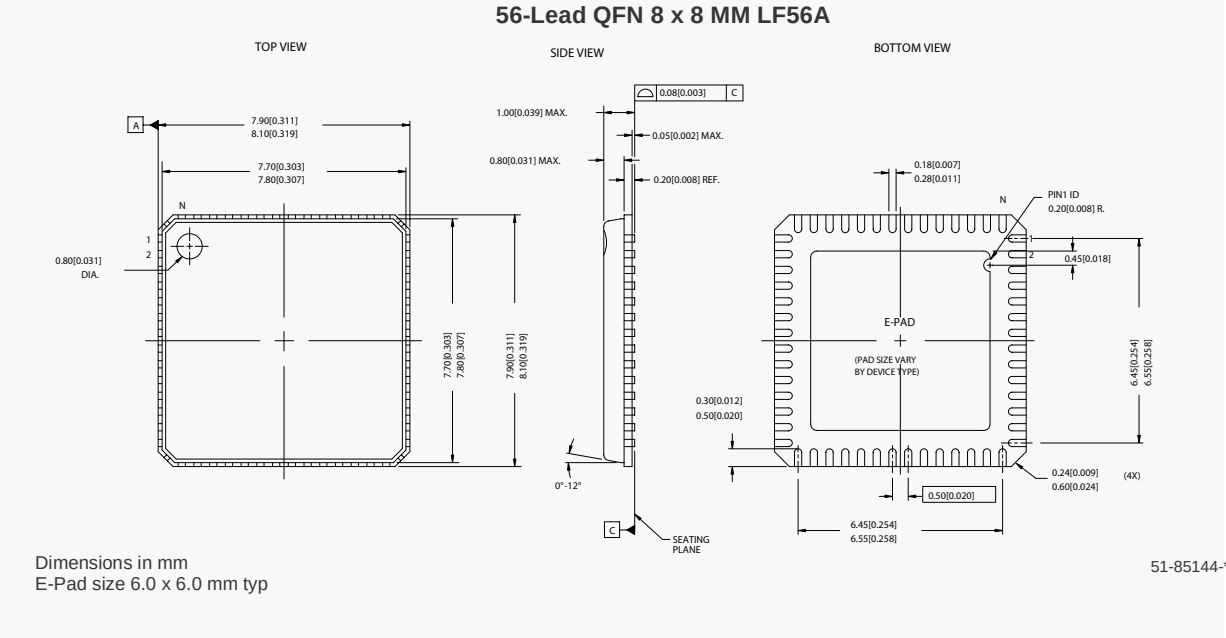
| Parameter | Description | Conditions | Min. | Typ. | Max. | Unit |
|---|---|---|---|---|---|---|
| | Clock Rise/Fall Time | | | | 500 | ns |
| | Clock Frequency | | | | 250 | KHz |
| | Data Set-up Time | | 50 | | | ns |
| | Hold Time | | 100 | | | ns |
| | Reset Period | | 1.9 | | | ms |

## 16.0 Ordering Information

| Ordering Code | Package Type |
|---|---|
| CY7C65640B-56LFXC | 56-pin QFN Mult-TT |
| CY7C65630-56LFXC | 56-pin QFN Single-TT |
| CY7C65620-56LFXC | 56-pin QFN 2-Port Single-TT |
| CY46XX | CY7C656xx USB 2.0 4 port Hub Reference Design Kit |

## 17.0 Package Diagrams

The CY7C656xx is available in a space-saving 56-pin QFN (8 × 8 mm).



## Document History Page

| Document Title: CY7C656xx EZ-USB HX2LP™ Low-Power USB 2.0 Hub Controller Family<br>Document Number: 38-08037 | | | | |
|---|---|---|---|---|
| **REV.** | **ECN NO.** | **Issue Date** | **Orig. of Change** | **Description of Change** |
| ** | 131505 | 02/12/2004 | JTC | New Data Sheet |
| *A | 231329 | See ECN | KKU | Changed load capacitors to 12 pF, updated part numbers, added functional overviews, block descriptions, pin configurations, default descriptors, configurations options, supported USB requests, electrical characteristics and package diagram |
| *B | 250869 | See ECN | ARI | Added typical values for Icc in Table 15.3, changed MPN CY7C65650 to CY7C65640B, added CY7C65620 package |
| *C | 330195 | See ECN | KKU | Added Reset period in table 15.5.1<br>Added 0xD4 EEPROM Load<br>Added vendor command values<br>Added $V_{CC}$ ramp rate<br>Updated block diagram |
| *D | 342997 | See ECN | KKU | Updated features list.<br>Removed from section 5.2 “Once the hub is configured, the full hub functionality is available.”<br>Added reference to 0xD4 load to section 5.4<br>Added reference to polarity control in sections 5.6 and 5.7<br>Updated table 5-1 to match USB-IF spec changes.<br>Added LED modulation to section 5.8<br>Updated pin description table - SELFPWR# to SELFPWR and removed references to limitations of bus powered. Added reference to polarity control on PWR#, OVR# and LED control lines.<br>Updated Default descriptors<br>Updated EEPROM list to include 25LC080<br>Removed NoEOPatEOF1 bit.<br>Added LED polarity control |