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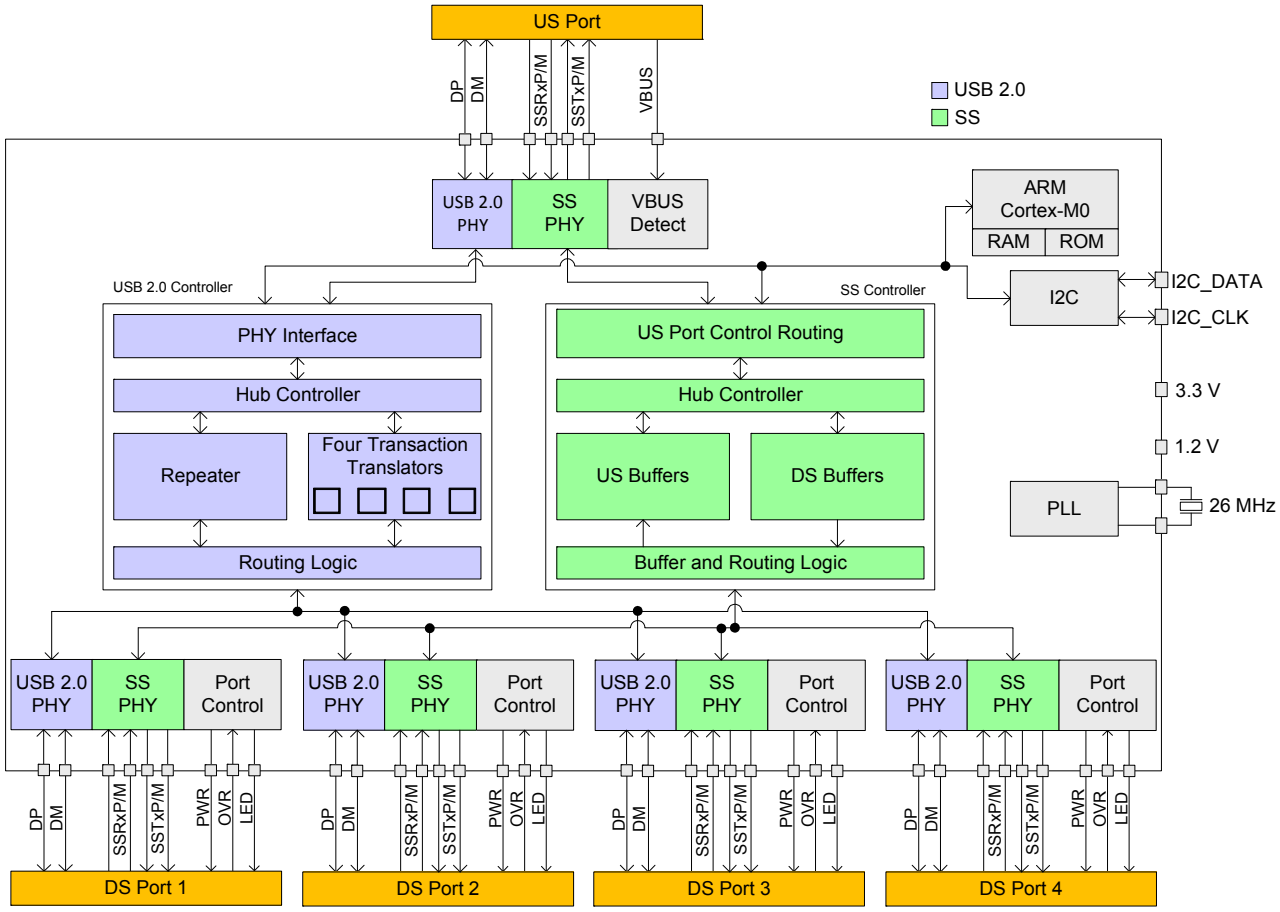
What Are Embedded - Microcontrollers - Application Specific?

Application-specific microcontrollers are engineered to

Details	
Product Status	Active
Applications	USB 3.0 Hub Controller
Core Processor	ARM® Cortex®-M0
Program Memory Type	ROM (32kB)
Controller Series	CYUSB
RAM Size	16K x 8
Interface	I²C
Number of I/O	10
Voltage - Supply	1.14V ~ 1.26V, 2.5V ~ 2.7V, 3V ~ 3.6V
Operating Temperature	0°C ~ 70°C
Mounting Type	Surface Mount
Package / Case	68-VFQFN Exposed Pad
Supplier Device Package	68-QFN (8x8)
Purchase URL	https://www.e-xfl.com/product-detail/infineon-technologies/cyusb3302-68ltxct

Block Diagram



Contents

Architecture Overview

The Block Diagram on page 2 shows the HX3 architecture. HX3 consists of two independent hub controllers (SS and USB 2.0), the Cortex-M0 CPU subsystem, an I^2C interface, and port controller blocks.

SS Hub Controller

This block supports the SS hub functionality based on the USB 3.0 specification. The SS hub controller supports the following:

- SS link power management (U0, U1, U2, U3 states)
- Full-duplex data transmission

USB 2.0 Hub Controller

This block supports the LS, FS, and HS hub functionalities. It includes the repeater, frame timer, and four transaction translators.

The USB 2.0 hub controller block supports the following:

- USB 2.0 link power management (L0, L1, L2, L3 states)
- Suspend, resume, and remote wake-up signaling
- Multi-TT (one TT for each DS port)

CPU

The ARM Cortex-M0 CPU subsystem is used for the following functions:

- System configuration and initialization
- Battery charging control
- Vendor-specific commands for the USB-to-I^2C bridge
- String-descriptor support
- Suspend status indicator
- Shared Link support in embedded systems

I^2C Interface

The I^2C interface in HX3 supports the following:

- I^2C Slave, Master, and Multi-master configurations
  - Configure HX3 by an external I^2C master in I^2C slave mode
  - Configure HX3 from an I^2C EEPROM
  - Multi-master mode to share EEPROM with other I^2C masters
- In-System Programming of the I^2C EEPROM from HX3's US port

Port Controller

The port controller block controls DS port power to comply with the BC v1.2 and USB 3.0 specifications. This block also controls the US port power in the ACA-Dock mode. Control signals for external power switches are implemented within the chip. HX3 controls the external power switches at power-on to reduce in-rush current.

The port controller block supports the following:

- Overcurrent detection
- SS and USB 2.0 port indicators for each DS port
- Ganged and individual power control modes
- Automatic port numbering based on active ports

Applications

- Standalone hubs
- PC and tablet motherboards
- Docking station
- Hand-held cradles
- Monitors
- Digital TVs
- Set-top boxes
- Printers

Figure 7. HX3 68-Pin QFN 4-Port Pinout

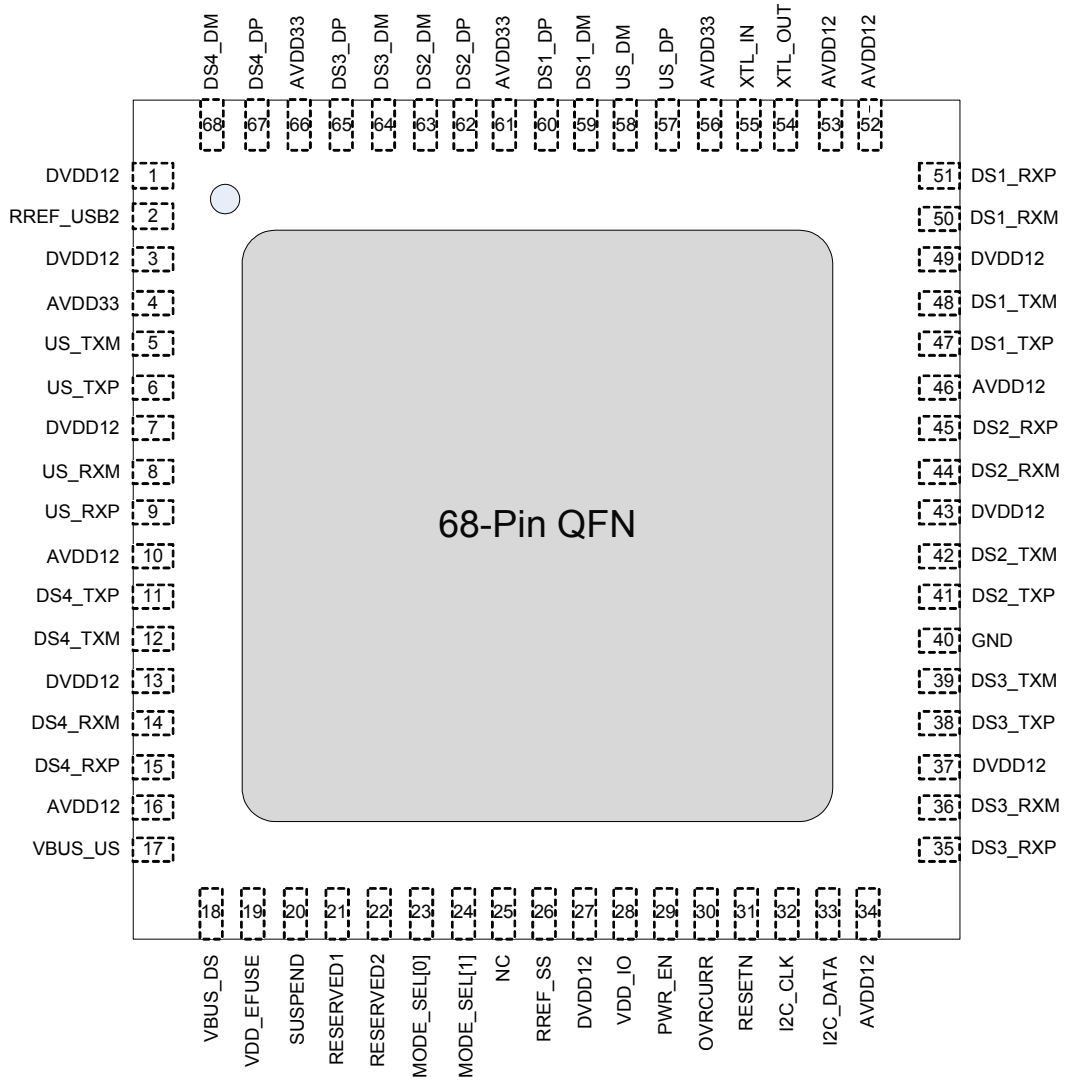


Figure 8. HX3 100-Ball BGA Pinout for CYUSB3302

A1	A2	A3	A4	A5	A6	A7	A8	A9	A10
NC	NC	NC	AVDD33	DS2_DM	DS2_DP	AVDD33	US_DM	US_DP	AVDD12
B1	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**B8**	**B9**	**B10**
NC	NC	NC	VDD_IO	VSS	AVDD33	NC	NC	NC	DVDD12
C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**	**C10**
US_TXM	NC	NC	NC	NC	VSS	DS1_DP	DS1_DM	AVDD12	DS1_RXM
D1	**D2**	**D3**	**D4**	**D5**	**D6**	**D7**	**D8**	**D9**	**D10**
US_TXP	NC	NC	DVDD12	VSS	DVDD12	VSS	DVDD12	VSS	DS1_RXP
E1	**E2**	**E3**	**E4**	**E5**	**E6**	**E7**	**E8**	**E9**	**E10**
DVDD12	RREF_USB2	NC	NC	XTL_IN	XTL_OUT	VDD_IO	DS1_TXM	VSS	DVDD12
F1	**F2**	**F3**	**F4**	**F5**	**F6**	**F7**	**F8**	**F9**	**F10**
US_RXM	VSS	AVDD33	MODE_SEL[1]	DVDD12	OVRCURR	RESETN	DS1_TXP	AVDD12	DS2_RXP
G1	**G2**	**G3**	**G4**	**G5**	**G6**	**G7**	**G8**	**G9**	**G10**
US_RXP	VBUS_DS	SUSPEND	RESERVED1	MODE_SEL[0]	VDD_IO	PWR_EN	I2C_DATA	VSS	DS2_RXM
H1	**H2**	**H3**	**H4**	**H5**	**H6**	**H7**	**H8**	**H9**	**H10**
AVDD12	VBUS_US	VDD_EFUSE	RESERVED2	RREF_SS	VSS	DS2_TXM	DS2_TXP	NC	AVDD12
J1	**J2**	**J3**	**J4**	**J5**	**J6**	**J7**	**J8**	**J9**	**J10**
VSS	AVDD12	VSS	GPIO	NC	I2C_CLK	NC	NC	VSS	NC
K1	**K2**	**K3**	**K4**	**K5**	**K6**	**K7**	**K8**	**K9**	**K10**
NC	NC	DVDD12	NC	NC	NC	NC	NC	DVDD12	NC

Table 2. 68-Pin QFN, 100-Ball BGA Pinout for CYUSB3302 and CYUSB3304 *(continued)*

Pin Name		Type	68-QFN Pin#	100-BGA Ball #	Description
CYUSB3302	CYUSB3304				
RESERVED1		I/O	21	G4	This pin must be pulled HIGH using a 10 kΩ to VDD_IO.
RESERVED2		I	22	H4	This pin must be pulled HIGH using a 10 kΩ to VDD_IO.
Mode Select, Clock, and Reset					
MODE_SEL[0]		I	23	G5	Device operation mode select bit 0; refer to Table 5 on page 24
MODE_SEL[1]		I	24	F4	Device operation mode select bit 1; refer to Table 5 on page 24
XTL_OUT		A	54	E6	Crystal out
XTL_IN		A	55	E5	Crystal in
RESETN		I	31	F7	Active LOW reset input
I2C_CLK		I/O	32	J6	I^2C clock
I2C_DATA		I/O	33	G8	I^2C data
SUSPEND		I/O	20	G3	Hub suspend status indicator. This pin is asserted if both the SS and USB 2.0 hubs are in the suspend state and is de-asserted when either of the hubs comes out of the suspend state.
Power and Ground					
VDD_EFUSE		PWR	19	H3	1.2 V normal operation, 2.5 V for programming. Customers should connect to 1.2 V.
AVDD12		PWR	10, 16, 34, 46, 52, 53	A10, C9, F9, H1, H10, J2	1.2 V analog supply
GND		PWR	40	B5, C6, D5, D7, D9, E9, F2, G9, H6, J1, J3, J9	GND pin
DVDD12		PWR	1, 3, 7, 13, 27, 37, 43, 49,	B10, D4, D6, D8, E1, E10, F5, K3, K9	1.2 V core supply
VBUS _US		PWR	17	H2	This pin must be connected to VBUS from US port
VBUS_DS		PWR	18	G2	This pin is used to power the Apple-charging circuit in HX3. For BC v1.2 compliance testing, connect pin to GND. For normal operation, connect pin to local 5 V supply.
AVDD33		PWR	4, 56, 61, 66	A4, A7, B6, F3	3.3 V analog supply
VDD_IO		PWR	28	B4, E7, G6	3.3 V I/O supply
USB Precision Resistors					
RREF_USB2		A	2	E2	Connect pin to a precision resistor (6.04 kΩ ±1%) to generate a current reference for USB 2.0 PHY.
RREF_SS		A	26	H5	Connect pin to a precision resistor (200 Ω ±1%) for SS PHY termination impedance calibration.

Note
4. These pins are Do Not Use (DNU); they must be left floating.

Table 3. 68-Pin QFN, 100-Ball BGA Pinout for CYUSB2302 and CYUSB2304 *(continued)*

Pin Name		Type	68-QFN Pin#	100-BGA Ball #	Description
CYUSB2302	CYUSB2304				
RESERVED1		I/O	21	G4	This pin must be pulled HIGH using a 10 kΩ to VDD_IO.
RESERVED2		I	22	H4	This pin must be pulled HIGH using a 10 kΩ to VDD_IO.
Mode Select, Clock, and Reset					
MODE_SEL[0]		I	23	G5	Device operation mode select bit 0; refer to Table 5 on page 24
MODE_SEL[1]		I	24	F4	Device operation mode select bit 1; refer to Table 5 on page 24
XTL_OUT		A	54	E6	Crystal out
XTL_IN		A	55	E5	Crystal in
RESETN		I	31	F7	Active LOW reset input
I2C_CLK		I/O	32	J6	I^2C clock
I2C_DATA		I/O	33	G8	I^2C data
SUSPEND		I/O	20	G3	Hub suspend status indicator. This pin is asserted if both the SS and USB 2.0 hubs are in the suspend state and is de-asserted when either of the hubs comes out of the suspend state.
Power and Ground					
VDD_EFUSE		PWR	19	H3	1.2 V normal operation, 2.5 V for programming. Customers should connect to 1.2 V.
AVDD12		PWR	10, 16, 34, 46, 52, 53	A10, C9, F9, H1, H10, J2	1.2 V analog supply
GND		PWR	40	B5, C6, D5, D7, D9, E9, F2, G9, H6, J1, J3, J9	GND pin
DVDD12		PWR	1, 3, 7, 13, 27, 37, 43, 49,	B10, D4, D6, D8, E1, E10, F5, K3, K9	1.2 V core supply
VBUS _US		PWR	17	H2	This pin must be connected to VBUS from US port
VBUS_DS		PWR	18	G2	This pin is used to power the Apple-charging circuit in HX3. For BC v1.2 compliance testing, connect pin to GND. For normal operation, connect pin to local 5 V supply.
AVDD33		PWR	4, 56, 61, 66	A4, A7, B6, F3	3.3 V analog supply
VDD_IO		PWR	28	B4, E7, G6	3.3 V I/O supply
USB Precision Resistors					
RREF_USB2		A	2	E2	Connect pin to a precision resistor (6.04 kΩ ±1%) to generate a current reference for USB 2.0 PHY.
RREF_SS		A	26	H5	Connect pin to a precision resistor (200 Ω ±1%) for SS PHY termination impedance calibration.

Figure 11. HX3 88-Pin QFN 4-Port Pinout

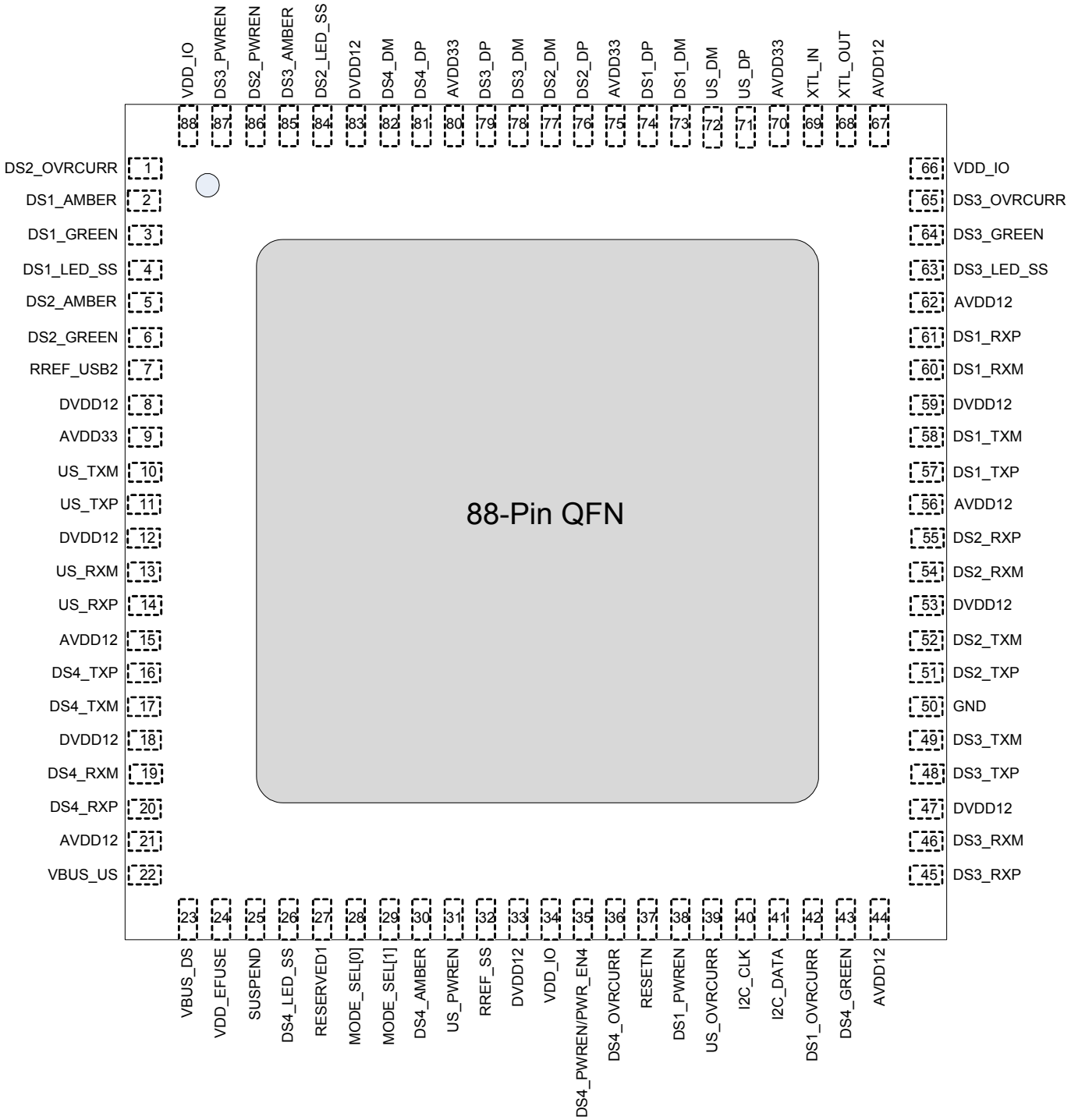


Figure 13. HX3 100-Ball BGA Pinout for CYUSB3314, CYUSB332x

A1	A2	A3	A4	A5	A6	A7	A8	A9	A10
DS3_PWREN	DS4_DM	DS4_DP	AVDD33	DS2_DM	DS2_DP	AVDD33	US_DM	US_DP	AVDD12
B1	**B2**	**B3**	**B4**	**B5**	**B6**	**B7**	**B8**	**B9**	**B10**
DS2_OVRCURR	DS2_PWREN	DS3_AMBER	VDD_IO	VSS	AVDD33	DS3_OVRCURR	DS3_GREEN	DS3_LED_SS	DVDD12
C1	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**	**C8**	**C9**	**C10**
US_TXM	DS1_AMBER	DS2_LED_SS	DS3_DP	DS3_DM	VSS	DS1_DP	DS1_DM	AVDD12	DS1_RXM
D1	**D2**	**D3**	**D4**	**D5**	**D6**	**D7**	**D8**	**D9**	**D10**
US_TXP	DS1_LED_SS	DS1_GREEN	DVDD12	VSS	DVDD12	VSS	DVDD12	VSS	DS1_RXP
E1	**E2**	**E3**	**E4**	**E5**	**E6**	**E7**	**E8**	**E9**	**E10**
DVDD12	RREF_USB2	DS2_GREEN	DS2_AMBER	XTL_IN	XTL_OUT	VDD_IO	DS1_TXM	VSS	DVDD12
F1	**F2**	**F3**	**F4**	**F5**	**F6**	**F7**	**F8**	**F9**	**F10**
US_RXM	VSS	AVDD33	MODE_SEL[1]	DVDD12	DS4_OVRCURR	RESETN	DS1_TXP	AVDD12	DS2_RXP
G1	**G2**	**G3**	**G4**	**G5**	**G6**	**G7**	**G8**	**G9**	**G10**
US_RXP	VBUS_DS	SUSPEND	RESERVED1	MODE_SEL[0]	VDD_IO	DS4_PWREN	I2C_DATA	VSS	DS2_RXM
H1	**H2**	**H3**	**H4**	**H5**	**H6**	**H7**	**H8**	**H9**	**H10**
AVDD12	VBUS_US	VDD_EFUSE	DS4_LED_SS	RREF_SS	VSS	DS2_TXM	DS2_TXP	DS4_GREEN	AVDD12
J1	**J2**	**J3**	**J4**	**J5**	**J6**	**J7**	**J8**	**J9**	**J10**
VSS	AVDD12	VSS	DS4_AMBER	US_PWREN	I2C_CLK	DS1_PWREN	DS1_OVRCURR	VSS	DS3_RXM
K1	**K2**	**K3**	**K4**	**K5**	**K6**	**K7**	**K8**	**K9**	**K10**
DS4_TXP	DS4_TXM	DVDD12	DS4_RXP	DS4_RXM	US_OVRCURR	DS3_TXP	DS3_TXM	DVDD12	DS3_RXP

Table 4. 88-Pin QFN, 100-Ball BGA Pinout for CYUSB331X and CYUSB332X *(continued)*

Pin Name		Type	Pin#	Ball#	Description
CYUSB3312	CYUSB3314 CYUSB3324 CYUSB3326 CYUSB3328				
SUSPEND		I/O	25	G3	Hub suspend status indicator. This pin is asserted if both the SS and USB 2.0 hubs are in the suspend state and is de-asserted when either of the hubs comes out of the suspend state.
Power and Ground					
VDD_EFUSE		PWR	24	H3	1.2 V normal operation, 2.5 V for programming. Customers should connect to 1.2 V
AVDD12		PWR	15, 21, 44, 56, 62, 67	A10, C9, F9, H1, H10, J2	1.2 V analog supply
GND		PWR	50	B5, C6, D5, D7, D9, E9, F2, G9, H6, J1, J3, J9	GND pin
DVDD12		PWR	8, 12, 18, 33, 47, 53, 59, 83	B10, D4, D6, D8, E1, E10, F5, K3, K9	1.2 V core supply
VBUS _US		PWR	22	H2	CYUSB3324/3328: Connect the VBUS_US pin to the local 5 V supply. If ACA-Dock mode is disabled using Configuration Options on page 24, this pin must be connected to VBUS from US port. Other part numbers: This pin must be connected to VBUS from US port.
VBUS_DS		PWR	23	G2	This pin is used to power the Apple-charging circuit in HX3. For BC v1.2 compliance testing, connect pin to GND. For normal operation, connect pin to local 5 V supply.
AVDD33		PWR	9, 70, 75, 80	A4, A7, B6, F3	3.3 V analog supply
VDD_IO		PWR	34, 66, 88	B4, E7, G6	3.3 V I/O supply
USB Precision Resistors					
RREF_USB2		A	7	E2	Connect pin to a precision resistor (6.04 kΩ ±1%) to generate a current reference for USB 2.0 PHY.
RREF_SS		A	32	H5	Connect pin to a precision resistor (200 Ω ±1%) for SS PHY termination impedance calibration.

System Interfaces

Upstream Port (US)

This port is compliant with the USB 3.0 specification and includes an integrated 1.5 kΩ pull-up and termination resistors. It also supports ACA-Dock to enable charging an OTG host connected on the US port.

Downstream Ports (DS1, 2, 3, 4)

DS ports are compliant with the USB 3.0 specification and integrate 15 kΩ pull-down and termination resistors. Ports can be disabled or enabled, and can be set to removable or non-removable options. BC v1.2 charging is enabled by default and can be disabled on each DS port using the configuration options (see Configuration Options).

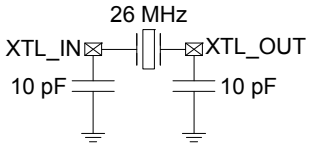
Communication Interfaces (I^2C)

The interface follows the Inter-IC Bus specification, version 3.0, with support for the standard mode (100 kHz) and the fast mode (400 kHz) frequencies. HX3 supports I^2C in the slave and master modes. The I^2C interface supports the multi-master mode of operation. Both the SCL and SDA signals require external pull-up resistors based on the specification. VDD_IO for HX3 is 3.3 V and it is expected that the I^2C pull-up resistors will be connected to the same supply.

Oscillator

HX3 requires an external crystal with a frequency of 26 MHz and an accuracy of ±150 ppm in parallel resonant, fundamental mode. The crystal drive circuit is capable of a low-power drive level (<200 µW). The crystal connection to the XTL_OUT and XTL_IN pins is shown in Figure 14.

Figure 14. Crystal Connection



GPIOs

HX3 GPIOs are used for overcurrent sensing, controlling external power switches, and driving LEDs. These pins can sink up to 4 mA current each. GPIOs also enable pin-straps for input configuration. Refer to Table 6 for more details.

Power Control

The PWR_EN[1-4] and OV_CURR[1-4] pins interface HX3 to external power switches. These pins are used to control power switches for DS port power and monitor overcurrent conditions. The power switch polarity and the power control mode (individual and ganged) can be changed using the configuration options.

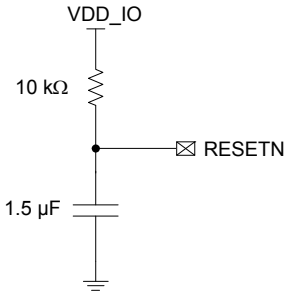
Reset

HX3 operates with two external power supplies, 3.3 V and 1.2 V. There is no power sequencing requirement between these two supplies. However, the RESETN pin should be held LOW until both these supplies become stable.

The RESETN pin can be tied to VDD_IO through an external resistor and to ground (GND) through an external capacitor (minimum 5 ms time constant), as shown in Figure 15. This creates a clean reset signal for power-on reset (POR).

HX3 does not support internal brown-out detection. If the system requires this feature, an external reset should be provided on the RESETN pin when supplies are below their valid operating ranges.

Figure 15. Reset Connection



Configuration Mode Select

Configuration options are selected through the MODE_SEL pins and the pin-strap enable pin (PIN_STRAP). After power-up, these pins are sampled by an on-chip bootloader to determine the configuration options (see Table 5).

Table 5. HX3 Boot Sequence

MODE SEL[1]	MODE SEL[0]	HX3 Configuration Modes
0	0	Reserved. Do not use this mode.
1	1	Internal ROM configuration
0	1	I^2C Master, read configuration from I^2C EEPROM*
1	0	I^2C Slave, configure from an external I^2C Master*

* Download Cypress-provided firmware from www.cypress.com/hx3.

Configuration Options

HX3 can be configured by using one of the following:

- eFuse (one-time programmable memory)
- Pin-Strap (read configuration from dedicated pins at power on)
- External I^2C slave such as an EEPROM
- External I^2C master

The I^2C master/slave configuration overrides the pin-strap configuration. Pin-straps override the eFuse configuration, and the eFuse configuration overrides the internal ROM configuration.

eFuse Configuration

HX3 contains eFuses, which are OTP elements on the chip that can be electrically blown. The eFuses are read by the bootloader to determine the customer-specific configurations. eFuse programming is supported only at factory and distributor locations where programming conditions can be controlled. eFuse programming is supported under the following conditions:

Temperature range of 25 °C–70 °C and programming voltage of 2.5 V–2.7 V.

Pin-Strap Configuration

Pin-straps are supported for select product options (see Table 1 on page 5) to provide reconfigurability without an additional EEPROM. The pin-strap configuration is enabled by pulling the Pin #63 of 88-pin QFN HIGH. Table 6 on page 25 shows the configuration options supported through pin-straps and the GPIOs used for this purpose. Figure 16 and Figure 17 show how the GPIOs need to be connected if pin-strap and LED connection are required or only pin-strap is required.

HX3 samples pin-strap GPIOs at power-up. Floating straps are considered as invalid and the default configuration is used. If PIN_STRAP (Pin #63 of 88-pin QFN) is floating, all strap inputs are considered invalid. A GPIO is considered strapped "1" or "0" when connected with a weak pull-up (10 kΩ) or pull-down (10 kΩ) respectively. After the initial sampling at power-up and reset, the GPIOs are used in their normal functions.

Figure 16. Pin-Strap With LED or LED-Only Connection

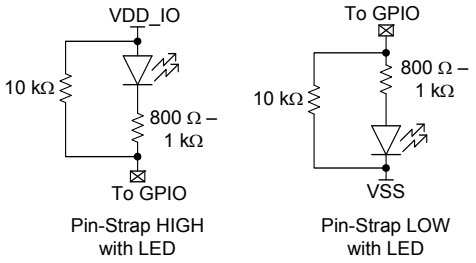


Figure 17. Pin-Strap Connection

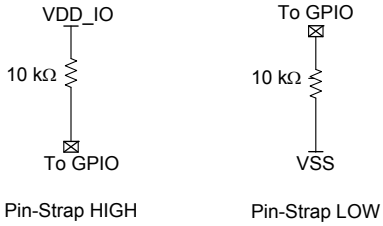


Table 6. Pin-Strap Configuration

88-QFN Pin #	Pin-Strap Name	Strapped '0'[11]		Strapped '1'[11]	
30	I2C_DEV_ID[12]	ID 0: HX3 I²C slave address (7 bits) is 0x60. This is also the default I²C slave address for the 68-pin QFN package.		ID 1: HX3 I²C slave address (7 bits) is 0x58	
31	PWR_SW_POL	Power enable and overcurrent will be active LOW		Power enable and overcurrent will be active HIGH	
2	ACA_DOCK	Disabled		Enabled	
84	PWR_EN_SEL	Individual		Gang	
63	PIN_STRAP[13]	No pin-strapping		Pin-strapping configuration enabled	
4	PORT_DISABLE[1]	PORT_DISABLE[1:0] = b'00: DS1, DS2, DS3, DS4 active b'01: DS1, DS2, DS3 active b'10: DS1, DS2 active b'11: DS1 active Pin-straps cannot enable ports disabled by factory setting.			
3	PORT_DISABLE[0]				
6	NON_REMOVABLE[1][14]	NON_REMOVABLE[1:0] = b'00: DS1, DS2, DS3, DS4 removable b'01: DS1, DS2, DS3 removable b'10: DS1, DS2 removable b'11: DS1 removable			
5	NON_REMOVABLE[0][14]				
85	VID[2]	Reserved. If PIN_STRAP is enabled and CY VID is required, strap VID[2:0] to '1'.			
64	VID[1]				
43	VID[0]				
38	DS1_CDP_EN[15]	strapped '0'	strapped '1'	strapped '0'	strapped '1'
		DS1 CDP enabled	DS1 CDP disabled	DS1 CDP disabled	DS1 CDP enabled
86	DS2_CDP_EN[15]	DS2 CDP enabled	DS2 CDP disabled	DS2 CDP disabled	DS2 CDP enabled
87	DS3_CDP_EN[15]	DS3 CDP enabled	DS3 CDP disabled	DS3 CDP disabled	DS3 CDP enabled
35	DS4_CDP_EN[15]	DS4 CDP enabled	DS4 CDP disabled	DS4 CDP disabled	DS4 CDP enabled

Notes
11. See Figure 16 and Figure 17.
12. I2C_DEV_ID is valid only when HX3 is in I²C slave mode.
13. VID, PORT_DISABLE, NON_REMOVABLE are group straps. If one of the pins in a group strap is floating (INVALID), that group input will be INVALID and the default will not be overwritten.
14. These DS ports are exposed ports and the connected devices can be removed.
15. DSx_CDP_EN will be active LOW input when PWR_SW_POL is set to active LOW; similarly DSx_CDP_EN will be active HIGH input when PWR_SW_POL is set to active HIGH.

Table 7. EEPROM Map *(continued)*

I²C Offset	Bits	Name	Default	Description
23	7:6	HS_AMPLITUDE_DS4	b'00	HS driver amplitude control; HS driver current: +0% to +7.5% b'00: Default b'01: +2.5% b'10: +5% b'11: +7.5%
	5:4	HS_AMPLITUDE_DS3	b'00	
	3:2	HS_AMPLITUDE_DS2	b'00	
	1:0	HS_AMPLITUDE_DS2	b'00	
24	7:6	HS_AMPLITUDE_US	b'00	
	5:2	HS_SLOPE	b'0100	HS driver slope control for all ports b'0000: +15% b'0001: +5% b'0100: Default b'0101: -5% b'1111: -7.5%
	1:0	HS_TX_VREF	b'10	Reference voltage for HS squelch (transmission envelope detector) for all ports b'00: 96 mV b'01: 108 mV b'10: 120 mV b'11: 132 mV
25	7:3	HS_PREEMP_EN[4:0]	b'00000	HS driver pre-emphasis enable – for ports DS4, DS3, DS2, DS1, and US 0: pre-emphasis is disabled 1: pre-emphasis is enabled
	2	HS_PREEMP_DEPTH_DS4[17]	0	HS driver pre-emphasis depth 0: +10% 1: +20%
	1	HS_PREEMP_DEPTH_DS3[17]	0	
	0	HS_PREEMP_DEPTH_DS2[17]	0	
26	7	HS_PREEMP_DEPTH_DS1[17]	0	
	6	HS_PREEMP_DEPTH_US[17]	0	
	5	Reserved	1	Reserved
	4:1	PCS_TX_DEEMPH_DS4	0x6	USB 3.0 Tx driver de-emphasis value 0x3: -2.75 dB 0x6: -3.4 dB (Default) 0x9: -4.0 dB
	0	Reserved	0	Reserved
27	7:4	PCS_TX_DEEMPH_DS3	0x6	USB 3.0 Tx driver de-emphasis value 0x3: -2.75 dB 0x6: -3.4 dB (Default) 0x9: -4.0 dB
	3:0	PCS_TX_DEEMPH_DS2	0x6	
28	7:4	PCS_TX_DEEMPH_DS1	0x6	
	3:0	PCS_TX_DEEMPH_US	0x6	
29	7	Reserved	0	Reserved
	6	Reserved	1	Reserved
	5:0	PCS_TX_SWING_FULL_DS4	0x29	Adjust launch amplitude of the transmitter 0x1F – 0.9 V 0x29 – 1.0 V (Default) 0x35 – 1.1 V 0x3F – 1.2 V
30	7:6	Reserved	0	Reserved
	5:0	PCS_TX_SWING_FULL_DS3	0x29	Adjust launch amplitude of the transmitter 0x1F – 0.9 V 0x29 – 1.0 V (Default) 0x35 – 1.1 V 0x3F – 1.2 V

Note
17. HS_PREEMP_DEPTH is valid only when corresponding HS_PREEMP_EN is set for that port.

Absolute Maximum Ratings

Exceeding maximum ratings may shorten the useful life of the device. User guidelines are not tested.

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

Operating temperature ..... –40 °C to +85 °C

Electrostatic discharge voltage ..... 2200 V

Oscillator or crystal frequency ..... 26 MHz ±150 ppm

I/O voltage supply .....3 V to 3.6 V

Maximum input sink current per I/O ..... 4 mA

Electrical Specifications

HX3 meets all USB-IF Electrical Compliance specifications.

DC Electrical Characteristics

Table 8. DC Electrical Characteristics

Parameter	Description	Conditions	Min	Typ	Max	Units
DVDD12	1.2 V core supply	–	1.14	1.2	1.26	V
VDD_EFUSE	eFuse supply	Normal operation	1.14	1.2	1.26	V
		Programming	2.5	2.6	2.7	V
AVDD12	1.2 V analog supply	–	1.14	1.2	1.26	V
VDD_IO	3.3 V I/O supply	–	3	3.3	3.6	V
AVDD33	3.3 V analog supply	–	3	3.3	3.6	V
V_{IH}	Input HIGH voltage	–	0.7 × VDD_IO	–	VDD_IO	V
V_{IL}	Input LOW voltage	–	0	–	0.3 × VDD_IO	V
V_{OH}	Output HIGH voltage	Output HIGH voltage at $I_{OH} \leq +4$ mA	2.4	–	–	V
V_{OL}	Output LOW voltage	Output LOW voltage at $I_{OL} \geq -4$ mA	–	–	0.4	V
I_{OS}	Input sink current	LED GPIO usage	–	–	4	mA
I_{IX}	Input leakage current	All I/O signals held at VDD_IO or GND	–1	–	1	µA
I_{OZ}	Output HI-Z leakage current	–	–	–	10	µA
I_{CC}	1.2 V supplies combined operating current	–	–	410	526	mA
I_{CC}	3.3 V supplies combined operating current	–	–	260	286	mA
V_{RAMP}	Voltage ramp rate on core and I/O supplies	Voltage ramp must be monotonic	0.2	–	50	V/ms
V_N	Noise level permitted on core and I/O supplies	Max p-p noise level permitted on all supplies except AVDD	–	–	100	mV
V_{N_USB}	Noise level permitted on AVDD12 and AVDD33 supply	Max p-p noise level permitted USB supply	–	–	20	mV

Ordering Information

Table 11 lists HX3's ordering information. The table contains only the part numbers that are currently available for order. Additional part numbers for industrial temperature range can be made available on request. For more information, visit the Cypress website or contact the local sales representative.

Table 11. Ordering Information

Serial No.	Ordering Part Number	Number of DS Ports	Number of Shared Link Ports	Ghost Charge	ACA-Dock	Temperature	Package
1.	CYUSB3302-68LTXC	2 (USB 3.0)	0	Yes	No	0-70 °C	68-QFN
2.	CYUSB3302-68LTXI	2 (USB 3.0)	0	Yes	No	–40-85 °C	68-QFN
3.	CYUSB3304-68LTXC	4 (USB 3.0)	0	Yes	No	0-70 °C	68-QFN
4.	CYUSB3304-68LTXI	4 (USB 3.0)	0	Yes	No	–40-85 °C	68-QFN
5.	CYUSB3312-88LTXC	2 (USB 3.0)	0	Yes	No	0-70 °C	88-QFN
6.	CYUSB3312-88LTXI	2 (USB 3.0)	0	Yes	No	–40-85 °C	88-QFN
7.	CYUSB3314-88LTXC	4 (USB 3.0)	0	Yes	No	0-70 °C	88-QFN
8.	CYUSB3314-88LTXI	4 (USB 3.0)	0	Yes	No	–40-85 °C	88-QFN
9.	CYUSB3324-88LTXC	4 (USB 3.0)	0	Yes	Yes	0-70 °C	88-QFN
10.	CYUSB3324-88LTXI	4 (USB 3.0)	0	Yes	Yes	–40-85 °C	88-QFN
11.	CYUSB3326-88LTXC	6 (2 USB 3.0, 2 SS, 2 USB 2.0)	2	Yes	No	0-70 °C	88-QFN
12.	CYUSB3326-88LTXI	6 (2 USB 3.0, 2 SS, 2 USB 2.0)	2	Yes	No	–40-85 °C	88-QFN
13.	CYUSB3328-88LTXC	8 (4 SS, 4 USB 2.0)	4	Yes	Yes	0-70 °C	88-QFN
14.	CYUSB3328-88LTXI	8 (4 SS, 4 USB 2.0)	4	Yes	Yes	–40-85 °C	88-QFN
15.	CYUSB3302-BVXC	2 (USB 3.0)	0	Yes	No	0-70 °C	100-BGA
16.	CYUSB3302-BVXI	2 (USB 3.0)	0	Yes	No	–40-85 °C	100-BGA
17.	CYUSB3304-BVXC	4 (USB 3.0)	0	Yes	No	0-70 °C	100-BGA
18.	CYUSB3304-BVXI	4 (USB 3.0)	0	Yes	No	–40-85 °C	100-BGA
19.	CYUSB3312-BVXC	2 (USB 3.0)	0	Yes	No	0-70 °C	100-BGA
20.	CYUSB3312-BVXI	2 (USB 3.0)	0	Yes	No	–40-85 °C	100-BGA
21.	CYUSB3314-BVXC	4 (USB 3.0)	0	Yes	No	0-70 °C	100-BGA
22.	CYUSB3314-BVXI	4 (USB 3.0)	0	Yes	No	–40-85 °C	100-BGA
23.	CYUSB3324-BVXC	4 (USB 3.0)	0	Yes	Yes	0-70 °C	100-BGA
24.	CYUSB3324-BVXI	4 (USB 3.0)	0	Yes	Yes	–40-85 °C	100-BGA
25.	CYUSB3326-BVXC	6 (2 USB 3.0, 2 SS, 2 USB 2.0)	2	Yes	No	0-70 °C	100-BGA
26.	CYUSB3326-BVXI	6 (2 USB 3.0, 2 SS, 2 USB 2.0)	2	Yes	No	–40-85 °C	100-BGA
27.	CYUSB3328-BVXC	8 (4 SS, 4 USB 2.0)	4	Yes	Yes	0-70 °C	100-BGA
28.	CYUSB2302-68LTXI	2 (USB 2.0)	0	Yes	No	–40-85 °C	68-QFN
29.	CYUSB2304-68LTXI	4 (USB 2.0)	0	Yes	No	–40-85 °C	68-QFN

Packaging

Table 12. Package Characteristics

Parameter	Description	Min	Typ	Max	Units
T_A	Operating ambient temperature	–40	–	85	°C
T_J	Operating junction temperature	–40	–	125	°C
T_{JA}	Package J_A (68-pin QFN)	–	16.2	–	°C/W
T_{JA}	Package J_A (88-pin QFN)	–	15.7	–	°C/W
T_{JA}	Package J_A (100-ball BGA)	–	35	–	°C/W
T_{JC}	Package J_C (68-pin QFN)	–	23.8	–	°C/W
T_{JC}	Package J_C (88-pin QFN)	–	18.9	–	°C/W
T_{JC}	Package J_C (100-ball BGA)	–	12	–	°C/W

Table 13. Solder Reflow Peak Temperature

Package	Maximum Peak Temperature	Maximum Time at Peak Temperature
68-pin QFN	260 °C	30 seconds
88-pin QFN	260 °C	30 seconds
100-ball BGA	260 °C	30 seconds

Table 14. Package Moisture Sensitivity Level (MSL), IPC/JEDEC J-STD-2

Package	MSL
68-pin QFN	MSL 3
88-pin QFN	MSL 3
100-ball BGA	MSL 3

Acronyms

Table 15. Acronyms Used in this Document

Acronym	Description
ACA	Accessory Charging Adapter
ASSP	Application-Specific Standard Product
BC	Battery Charging
CDP	Charging Downstream Port
DS	DownStream
DCP	Dedicated Charging Port
DNU	Do Not Use
DWG	Device Working Group
EEPROM	Electrically Erasable Programmable Read-Only Memory
FS	Full-Speed
FW	FirmWare
GND	GrouND
GPIO	General-Purpose Input/Output
HS	Hi-Speed
ISP	In-System Programming
I/O	Input/Output
LS	Low-Speed
NC	No Connect
OTG	On-The-Go
PID	Product ID
POR	Power-On Reset
ROM	Read-Only Memory
SCL	Serial CLock
SDA	Serial DAta
SS	SuperSpeed
TT	Transaction Translator
US	UpStream
VID	Vendor ID

Reference Documents

USB 2.0 Specification

USB 3.0 Specification

Battery Charging Specification

Document Conventions

Units of Measure

Table 16. Units of Measure

Symbol	Unit of Measure
°C	degree celsius
Ω	ohm
Gbps	gigabit per second
KB	kilobyte
kHz	kilohertz
kΩ	kiloohm
Mbps	megabit per second
MHz	megahertz
µA	microampere
mA	milliampere
ms	millisecond
mW	milliwatt
ns	nanosecond
ppm	parts per million
V	volt

Silicon Revision History

This datasheet is applicable for the USB-IF certified (TID# 330000060) HX3 Rev. *D and Rev. *C Silicon.

Rev. *D: This Silicon revision improves the yield of HX3, and is drop-in compatible for all the part numbers. There is no need to change the board design or layout to use the HX3 Rev. *D Silicon. Products are completely compatible with the HX3 Rev. *C Silicon.

Rev. *C: This Silicon revision fixes the errata applicable to the Rev. *A Silicon.

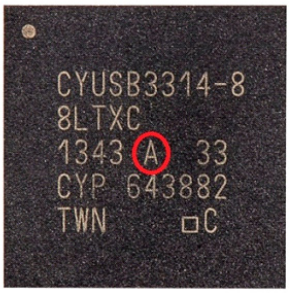
The following table defines the changes between Rev. *A, Rev. *C, and Rev. *D Silicon.

No.	Items	Part Numbers	Rev. *A	Rev. *C	Rev. *D
1	USB-IF Compliance	All	Requires firmware on external EEPROM	No external EEPROM required	No external EEPROM required
2	FS-only hub or host connected to HX3 Upstream Port	All	Not supported	Supported	Supported
3	Suspend Power	All	90 mW	37.8 mW	37.8 mW

Method of Identification

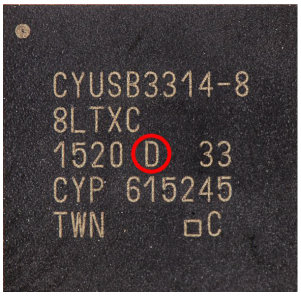
Markings on row 3 of the HX3 package differentiate Rev. *D Silicon from Rev. *C Silicon and Rev. *A Silicon as indicated in the example below. Cypress maintains traceability of product to wafer level, including wafer fabrication location, through the lot number marked on the package.

HX3 REV *A SILICON



HX3 REV *C SILICON

HX3 REV *D SILICON



Document History Page

Document Title: CYUSB330x/CYUSB331x/CYUSB332x/CYUSB230x, HX3 USB 3.0 Hub Document Number: 001-73643				
Revision	**ECN**	**Orig. of Change**	**Submission Date**	**Description of Change**
*E	4271496	MURT	02/21/2014	Changed status from Preliminary to Final.
*F	4291210	MURT	02/25/2014	Post to external web.
*G	4308926	MURT	03/14/2014	Updated System Interfaces: Updated Configuration Options: Updated HX3 as I2C Slave: Updated Table 7.
*H	4463533	MURT	08/01/2014	Updated Features: Updated TID#. Updated Electrical Specifications: Updated Power Consumption: Updated Table 9: Updated details corresponding to suspend power. Removed Errata.
*I	4483117	RAJM	08/22/2014	Added Silicon Revision History.
*J	4499514	RAJM	09/15/2014	Added BGA package information.
*K	4582512	PRJI	11/28/2014	Updated HX3 Product Options: Updated Table 1. Updated Pin Information: Updated Table 4.
*L	4632890	HBM	01/20/2015	Updated Pin Information: Updated Figure 12. Updated Figure 13. Updated Table 4. Added Packaging. Updated Package Diagrams: spec 51-85209 – Changed revision from *D to *E.
*M	4669639	HBM	02/24/2015	No technical updates. Completing Sunset Review.
*N	4764583	HBM	05/13/2015	Updated Package Diagrams: spec 001-76569 – Changed revision from *A to *B. Updated Silicon Revision History. Updated Method of Identification.
*O	4941772	HBM	11/25/2015	Updated HX3 Product Options: Updated Table 1: Included CYUSB2302-68LTXI and CYUSB2304-68LTXI part numbers related information. Updated Ordering Information: Updated Table 11: Updated part numbers.
*P	5466603	HBM	10/20/2016	Updated Features: Replaced “USB 3.0-Certified Hub, TID# 330000060” with “USB-IF Certified Hub, TID# 330000060, 30000074”. Updated Package Diagrams: spec 51-85209 – Changed revision from *E to *F. Updated to new template. Completing Sunset Review.

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