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What Are Embedded - Microcontrollers - Application Specific?

Application specific microcontrollers are engineered to

Details	
Product Status	Active
Applications	USB Type C
Core Processor	ARM® Cortex®-M0
Program Memory Type	FLASH (32KB)
Controller Series	-
RAM Size	4K x 8
Interface	I²C, SPI, UART/USART, USB
Number of I/O	14
Voltage - Supply	1.71V ~ 5.5V
Operating Temperature	-40°C ~ 85°C (TA)
Mounting Type	Surface Mount
Package / Case	24-UFQFN Exposed Pad
Supplier Device Package	24-QFN (4x4)
Purchase URL	https://www.e-xfl.com/product-detail/infineon-technologies/cypd2122-24lqxi

Available Firmware and Software Tools

EZ-PD Configuration Utility

The EZ-PD Configuration Utility is a GUI-based Microsoft Windows application developed by Cypress to guide a CCGx user through the process of configuring and programming the chip. The utility allows users to:

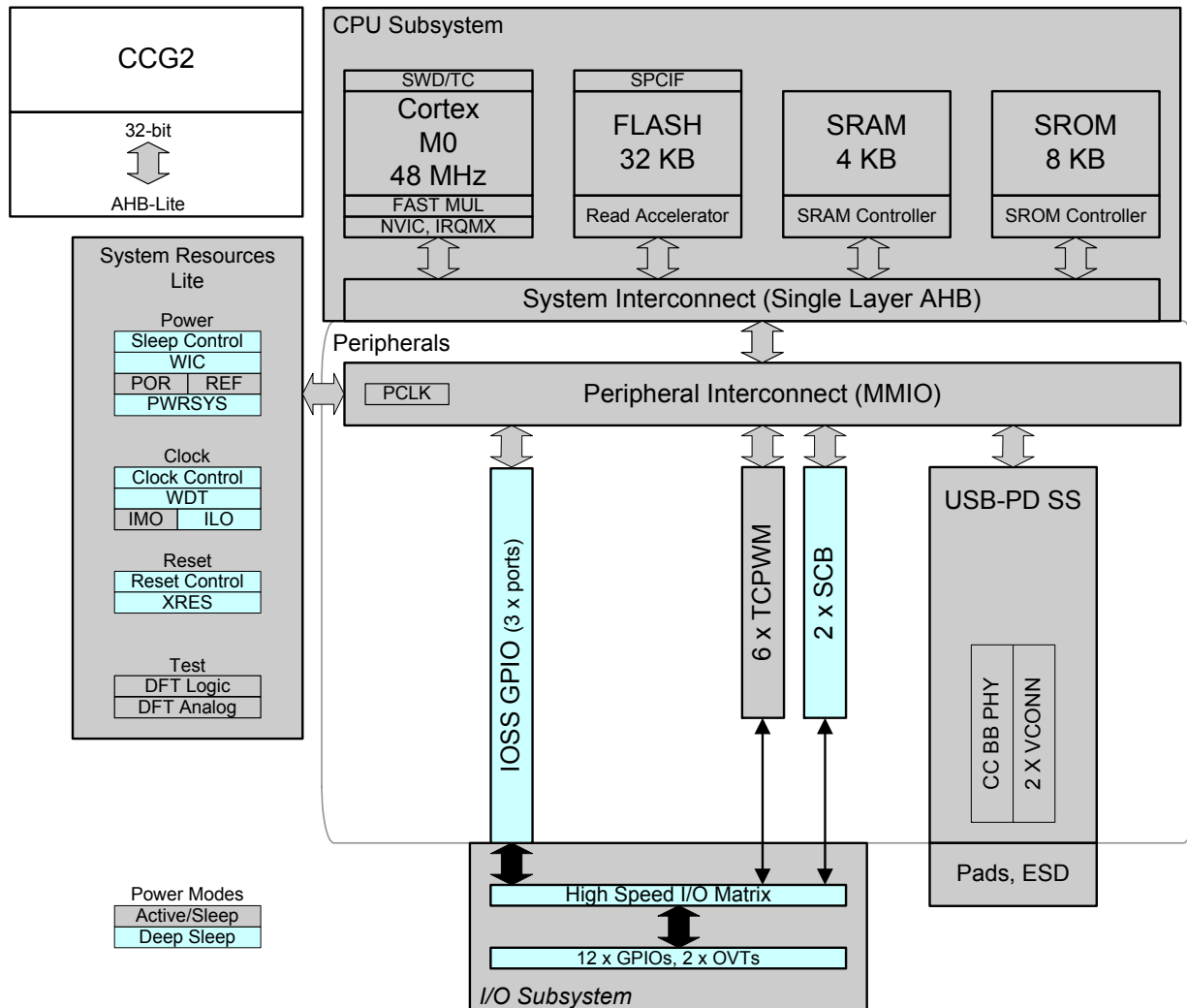
1. Select and configure the parameters they want to modify
2. Program the resulting configuration onto the target CCGx device.

The utility works with the Cypress supplied CCG1, CCG2, CCG3, and CCG4 kits, which host the CCGx controllers along with a USB interface. This version of the EZ-PD Configuration Utility supports configuration and firmware update operations on CCGx controllers implementing EMCA and Display Dongle applications. Support for other applications, such as Power Adapters and Notebook port controllers, will be provided in later versions of the utility.

You can download the EZ-PD Configuration Utility and its associated documentation at the following link:

<http://www.cypress.com/documentation/software-and-drivers/ez-pd-configuration-utility>

Figure 1. EZ-PD CCG2 Block Diagram



Functional Overview

CPU and Memory Subsystem

CPU

The Cortex-M0 CPU in EZ-PD CCG2 is part of the 32-bit MCU subsystem, which is optimized for low-power operation with extensive clock gating. It mostly uses 16-bit instructions and executes a subset of the Thumb-2 instruction set. This enables fully compatible binary upward migration of the code to higher performance processors such as the Cortex-M3 and M4, thus enabling upward compatibility. The Cypress implementation includes a hardware multiplier that provides a 32-bit result in one cycle. It includes a nested vectored interrupt controller (NVIC) block with 32 interrupt inputs and also includes a Wakeup Interrupt Controller (WIC). The WIC can wake the processor up from the Deep Sleep mode, allowing power to be switched off to the main processor when the chip is in the Deep Sleep mode. The Cortex-M0 CPU provides a Non-Maskable Interrupt (NMI) input, which is made available to the user when it is not in use for system functions requested by the user.

The CPU also includes a serial wire debug (SWD) interface, which is a 2-wire form of JTAG. The debug configuration used for EZ-PD CCG2 has four break-point (address) comparators and two watchpoint (data) comparators.

Flash

The EZ-PD CCG2 device has a flash module with a flash accelerator, tightly coupled to the CPU to improve average access times from the flash block. The flash block is designed to deliver 1 wait-state (WS) access time at 48 MHz and with 0-WS access time at 24 MHz. The flash accelerator delivers 85% of single-cycle SRAM access performance on average. Part of the flash module can be used to emulate EEPROM operation if required.

SROM

A supervisory ROM that contains boot and configuration routines is provided.

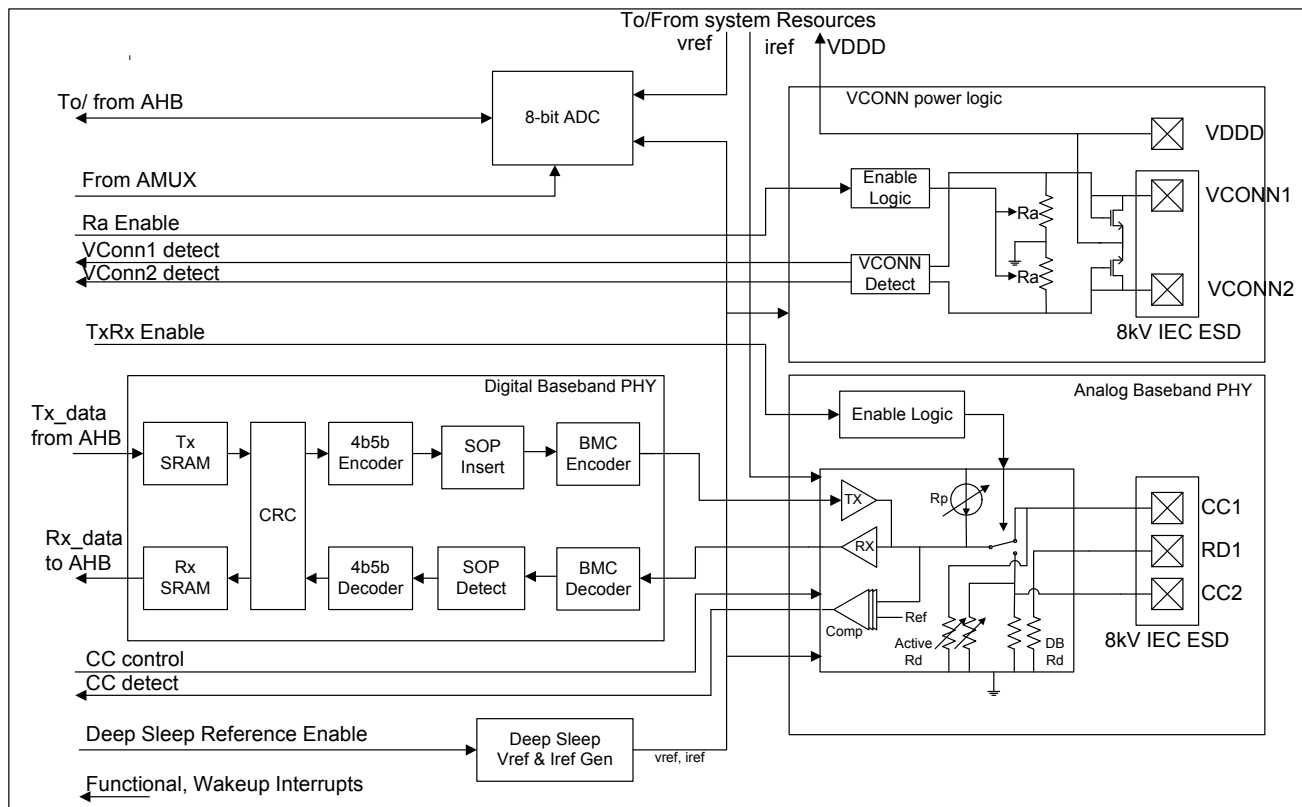
USB-PD Subsystem (SS)

EZ-PD CCG2 has a USB-PD subsystem consisting of a USB Type-C baseband transceiver and physical-layer logic. This transceiver performs the BMC and the 4b/5b encoding and decoding functions as well as the 1.2-V front end. This subsystem integrates the required termination resistors to identify the role of the EZ-PD CCG2 solution. R_A is used to identify EZ-PD CCG2 as an accessory or an electronically marked cable. R_D is used to identify EZ-PD CCG2 as a UFP in a hybrid cable or a dongle. When configured as a DFP, integrated current sources perform the role of R_P or pull-up resistors. These current sources can be programmed to indicate the complete range of current capacity on VBUS defined in the Type-C spec. EZ-PD CCG2 responds to all USB-PD communication. The

EZ-PD CCG2 USB-PD sub-system can be configured to respond to SOP, SOP', or SOP'' messaging.

The USB-PD sub-system contains a 8-bit SAR (Successive Approximation Register) ADC for analog to digital conversions. The ADC includes a 8-bit DAC and a comparator. The DAC output forms the positive input of the comparator. The negative input of the comparator is from a 4-input multiplexer. The four inputs of the multiplexer are a pair of global analog multiplex busses an internal bandgap voltage and an internal voltage proportional to the absolute temperature. All GPIO inputs can be connected to the global Analog Multiplex Busses through a switch at each GPIO that can enable that GPIO to be connected to the mux bus for ADC use. The CC1, CC2 and RD1 pins are not available to connect to the mux busses.

Figure 2. USB-PD Subsystem



System Resources

Power System

The power system is described in detail in the section [Power on page 9](#). It provides assurance that voltage levels are as required for each respective mode and either delay mode entry (on power-on reset (POR), for example) until voltage levels are as required for proper function or generate resets (Brown-Out Detect (BOD)) or interrupts (Low Voltage Detect (LVD)). EZ-PD CCG2 can operate from three different power sources over the range of 2.7 to 5.5 V and has three different power modes, transitions between which are managed by the power system. EZ-PD CCG2 provides Sleep and Deep Sleep low-power modes.

Clock System

The clock system for EZ-PD CCG2 consists of the Internal Main Oscillator (IMO) and the Internal Low-power Oscillator (ILO).

Peripherals

Serial Communication Blocks (SCB)

EZ-PD CCG2 has two SCBs, which can be configured to implement an I²C, SPI, or UART interface. The hardware I²C blocks implement full multi-master and slave interfaces capable of multimaster arbitration. In the SPI mode, the SCB blocks can be configured to act as master or slave.

In the I²C mode, the SCB blocks are capable of operating at speeds of up to 1 Mbps (Fast Mode Plus) and have flexible buffering options to reduce interrupt overhead and latency for the CPU. These blocks also support I²C that creates a mailbox address range in the memory of EZ-PD CCG2 and effectively reduce I²C communication to reading from and writing to an array in memory. In addition, the blocks support 8-deep FIFOs for receive and transmit which, by increasing the time given for the CPU to read data, greatly reduce the need for clock stretching caused by the CPU not having read data on time.

The I²C peripherals are compatible with the I²C Standard-mode, Fast-mode, and Fast-mode Plus devices as defined in the NXP I²C-bus specification and user manual (UM10204). The I²C bus I/Os are implemented with GPIO in open-drain modes.

The I²C port on SCB 1 block of EZ-PD CCG2 is not completely compliant with the I²C spec in the following respects:

- The GPIO cells for SCB 1's I²C port are not overvoltage-tolerant and, therefore, cannot be hot-swapped or powered up independently of the rest of the I²C system.
- Fast-mode Plus has an I_{OL} specification of 20 mA at a V_{OL} of 0.4 V. The GPIO cells can sink a maximum of 8-mA I_{OL} with a V_{OL} maximum of 0.6 V.
- Fast-mode and Fast-mode Plus specify minimum Fall times, which are not met with the GPIO cell; Slow strong mode can help meet this spec depending on the bus load.

Timer/Counter/PWM Block (TCPWM)

EZ-PD CCG2 has six TCPWM blocks. Each implements a 16-bit timer, counter, pulse-width modulator (PWM), and quadrature decoder functionality. The block can be used to measure the period and pulse width of an input signal (timer), find the number of times a particular event occurs (counter), generate PWM signals, or decode quadrature signals.

GPIO

EZ-PD CCG2 has up to 10 GPIOs in addition to the I²C and SWD pins, which can also be used as GPIOs. The I²C pins from SCB 0 are overvoltage-tolerant. The number of available GPIOs vary with the package. The GPIO block implements the following:

- Seven drive strength modes:
 - Input only
 - Weak pull-up with strong pull-down
 - Strong pull-up with weak pull-down
 - Open drain with strong pull-down
 - Open drain with strong pull-up
 - Strong pull-up with strong pull-down
 - Weak pull-up with weak pull-down
- Input threshold select (CMOS or LVTTTL)
- Individual control of input and output buffer enabling/disabling in addition to the drive strength modes
- Hold mode for latching previous state (used for retaining I/O state in Deep Sleep mode)
- Selectable slew rates for dV/dt related noise control to improve EMI

During power-on and reset, the I/O pins are forced to the disable state so as not to crowbar any inputs and/or cause excess turn-on current. A multiplexing network known as a high-speed I/O matrix is used to multiplex between various signals that may connect to an I/O pin.

Pinouts

Group	Name	Pin Map 24-QFN	Ball Location 20-CSP	Pin Map 14-DFN	Description
USB Type-C Port	CC1	2	B4	3	USB PD connector detect/Configuration Channel 1
	CC2	1	A4	N/A	USB PD connector detect/Configuration Channel 2
	RD1	3	B3	N/A	Dedicated Rd resistor pin for CC1 Must be left open for cable applications and connected together with CC1 ball for UFP or DFP with dead battery applications
GPIOs and serial interfaces	GPIO	22	C3	N/A	GPIO / SPI_0_CLK / UART_0_RX
	GPIO	18	D3	13	GPIO / SPI_0_MOSI / UART_0_TX
	GPIO	13	C2	10	GPIO / I2C_1_SDA / SPI_1_MISO / UART_1_RX
	GPIO	10	D2	N/A	GPIO / I2C_1_SCL / SPI_1_CLK / UART_1_TX
	GPIO	15	B2	11	GPIO / SPI_1_SEL / UART_1_RTS
	GPIO	14	N/A	N/A	GPIO
	GPIO	17	N/A	N/A	GPIO
	GPIO	21	N/A	N/A	GPIO
	GPIO	23	N/A	N/A	GPIO
	GPIO	24	N/A	N/A	GPIO
	I2C_0_SCL	20	A3	1	GPIO / I2C_0_SCL / SPI_0_MISO / UART_0_RTS
	I2C_0_SDA	19	A2	14	GPIO / I2C_0_SDA / SPI_0_SEL / UART_0_CTS
	SWD_IO	11	E2	8	SWD IO / GPIO / UART_1_CTS / SPI_1_MOSI
	SWD_CLK	12	D1	9	SWD clock / GPIO
RESET	XRES	16	B1	12	Reset input
POWER	VCONN1	5	E4	5	VCONN 1 input (4.0 V to 5.5 V)
	VCONN2	4	C4	4	VCONN 2 input (4.0 V to 5.5 V)
	VDDIO	8	E1	N/A	1.71-V to 5.5-V supply for I/Os
	VCCD	7	A1	6	1.8-V regulator output for filter capacitor
	VDDD	9	E3	7	VDDD supply input/output (2.7 V to 5.5 V)
	VDDD	6			VDDD supply input/output (2.7 V to 5.5 V)
	VSS	EPAD	N/A	EPAD	Ground supply
	VSS		D4	2	Ground supply
	VSS		C1		Ground supply

Figure 3. 20-ball WLCSP EZ-PD CCG2 Ball Map (Bottom (Balls Up) View)

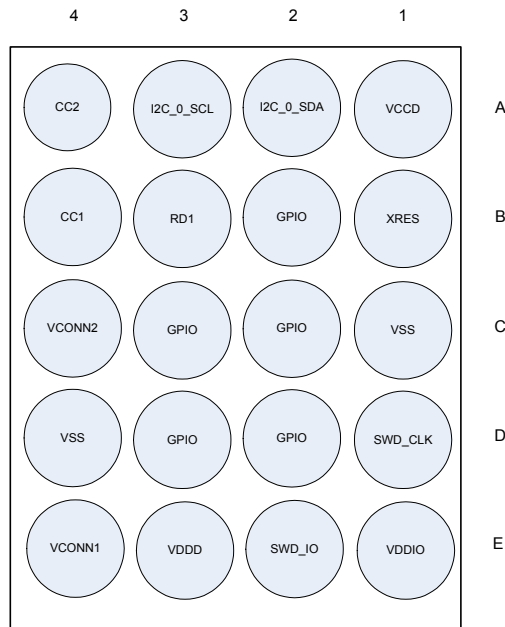


Figure 4. 14-pin DFN Pin Map (Top View)

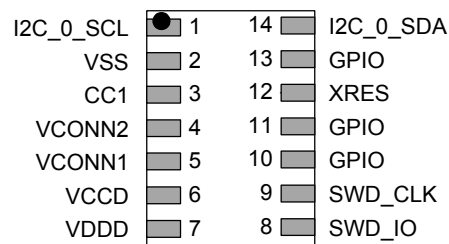


Figure 5. 24-Pin QFN Pin Map (Top View)

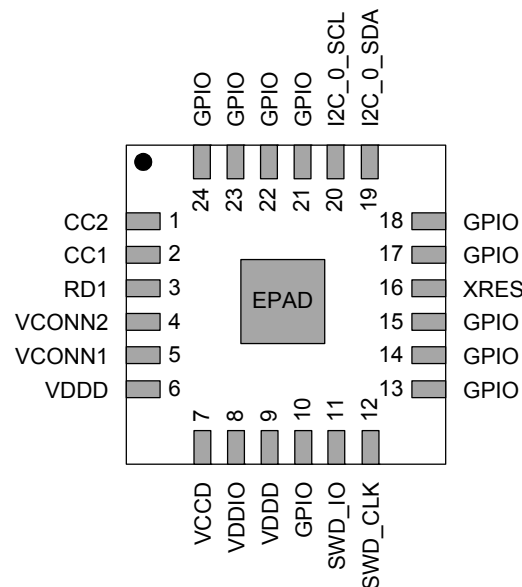


Figure 10 shows a Notebook DRP application diagram using a CCG2 device. The Type-C port can be used as a power provider or a power consumer. The CCG2 device communicates with the Embedded controller (EC) over I²C. It also controls the Data Mux to route the High Speed signals either to the USB chipset (during normal mode) or the DisplayPort Chipset (during Alternate Mode). The SBU lines, SuperSpeed and HighSpeed lines are routed directly from the Display Mux of the notebook to the Type-C receptacle.

Optional FETs are provided for applications that need to provide power for accessories and cables using the VCONN pin of the Type-C receptacle. VBUS FETs are also used for providing power over VBUS and for consuming power over VBUS. A VBUS_DISCHARGE FET controlled by CCG2 device is used to quickly discharge VBUS after the Type-C connection is detached.

Figure 10. Dual Role Port (DRP) Application

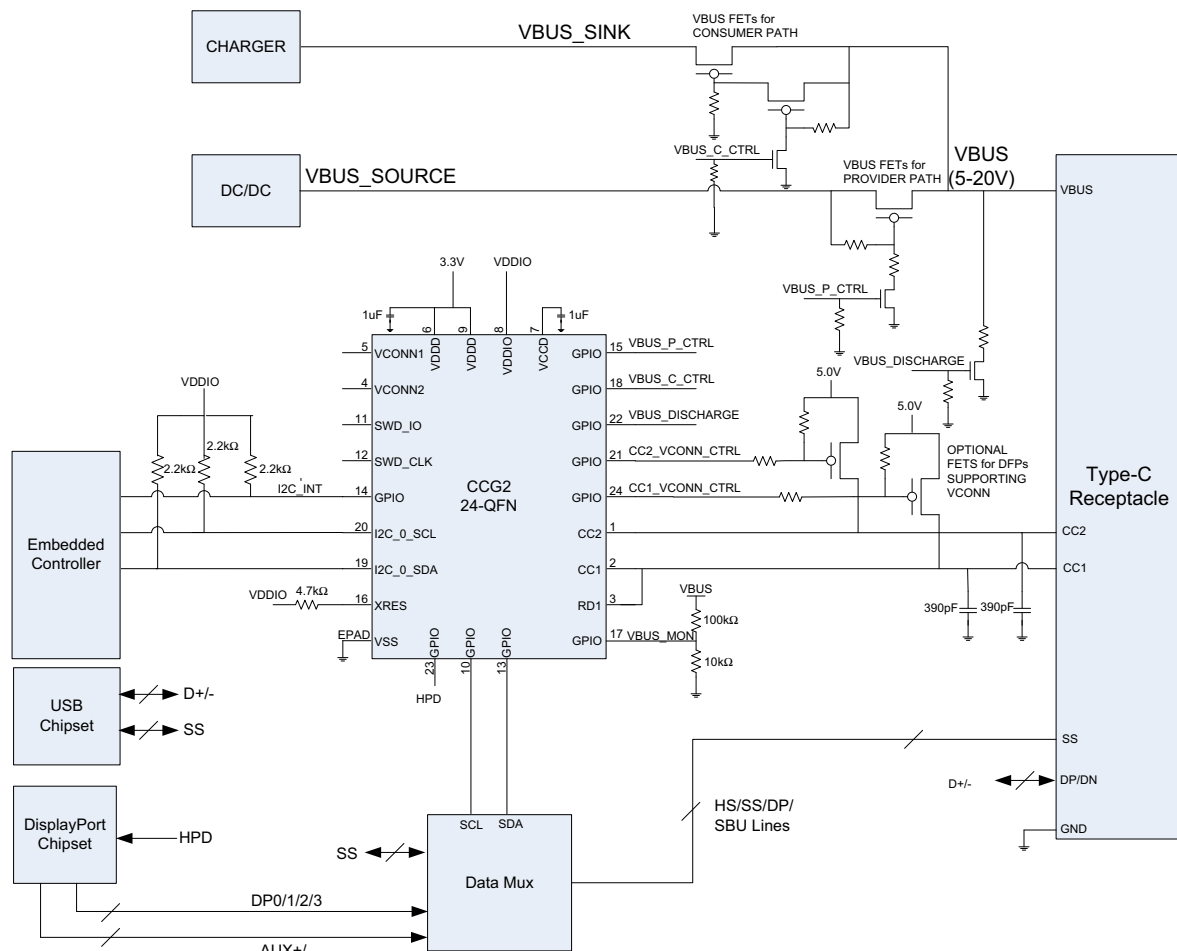


Figure 13 shows a USB Type-C to DisplayPort adapter application, which enables connectivity between a PC that supports a Type-C port with DisplayPort Alternate Mode support and a legacy monitor that has a DisplayPort interface.

Figure 13 shows a Type-C plug on one end and a DP/mDP plug on the other end. The application meets the requirements described in Section 4.2 of the VESA DisplayPort Alt Mode on USB Type-C Standard Version 1.0 (Scenarios 2a and 2b USB

Type-C to DisplayPort Cables). It also supports the USB Billboard Device Class, which is required by the USB PD specification for enumeration of any accessories that support Alternate Mode when connected to a host PC.

Figure 13. USB Type-C to Display Port Application Diagram

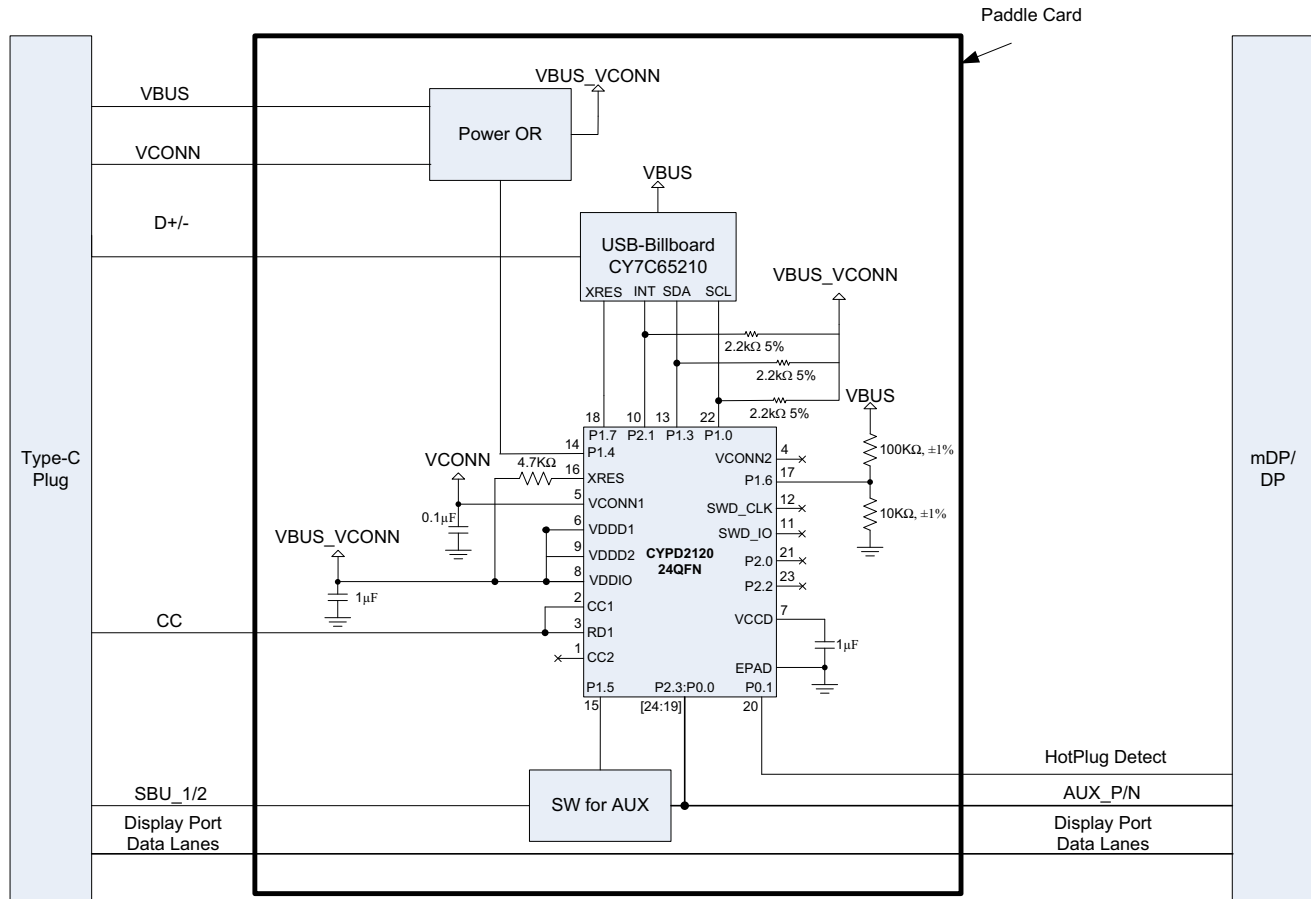


Figure 14 shows a CCG2 Monitor/Dock application diagram. It enables connectivity between a USB Type-C host system on the Upstream port and multiple Display/Data devices on the Downstream port. This application has a USB Type-C receptacle on the Upstream port, which supports data, power, and display. On the Downstream port, this application supports: USB Type-A, Gigabit Ethernet, DisplayPort, and USB Type-C receptacle.

The main features of this solution are:

- Powered from an external 24-V DC power adapter
- Provides up to 45 W (15 V at 3A) on the Upstream Type-C port and up to 15 W (5 V at 3A) on the Downstream USB Type-C port

- Provides simultaneous 4K display output with USB 3.1 Gen 1 on the USB Type-A port
- Four-lane display on the DisplayPort connector
- Multi-Stream support on DisplayPort and Downstream Type-C port
- USB 3.1 Gen 1 hub for USB port expansion
- Gigabit Ethernet using RJ45 connector
- Supports firmware upgrade of CCG2 controllers, HX3 Hub controller, and Billboard controller

Figure 14. CCG2 in Dock/Monitor Application Diagram

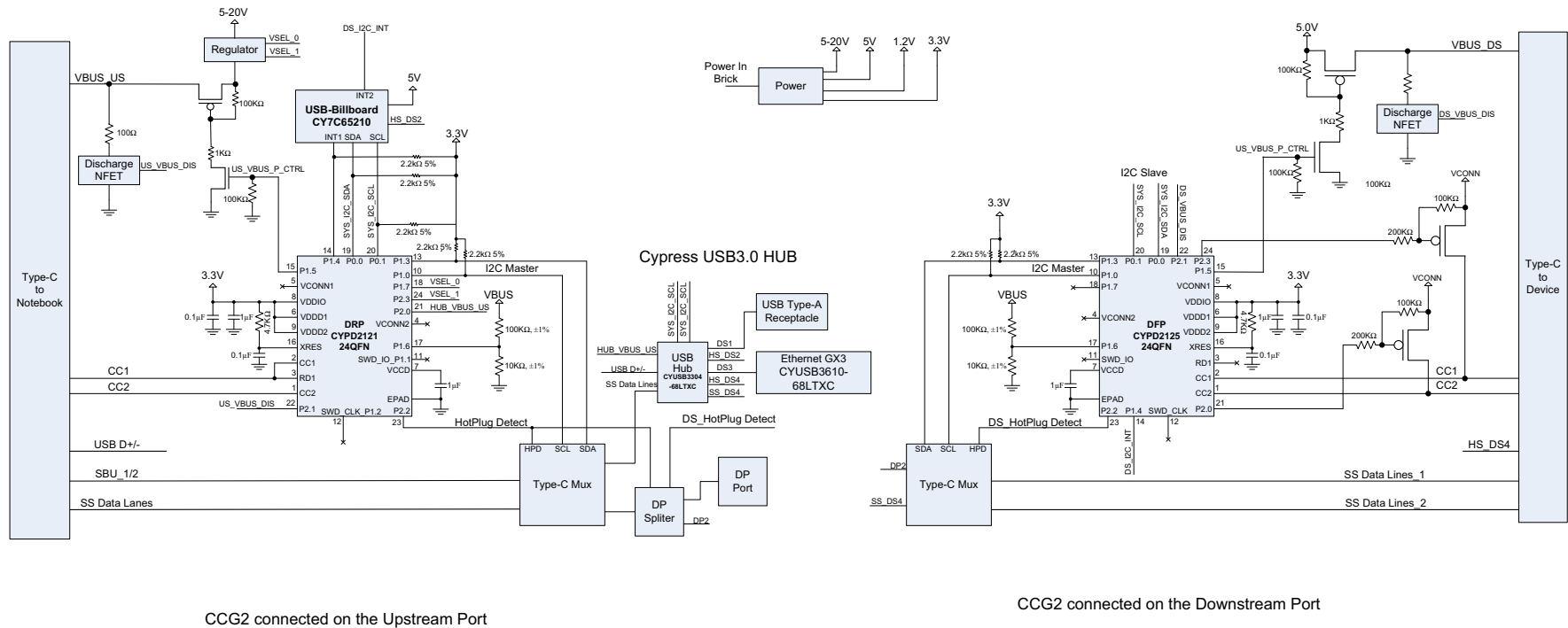


Table 3. AC Specifications

Spec ID	Parameter	Description	Min	Typ	Max	Units	Details/Conditions
SID.CLK#4	F _{CPU}	CPU frequency	DC	–	48	MHz	3.0 V ≤ V _{DD} ≤ 5.5 V
SID.PWR#20	T _{SLEEP}	Wakeup from sleep mode	–	0	–	μs	Guaranteed by characterization
SID.PWR#21	T _{DEEPSLEEP}	Wakeup from Deep Sleep mode	–	–	35	μs	24-MHz IMO. Guaranteed by characterization
SID.XRES#5	T _{XRES}	External reset pulse width	5	–	–	μs	Guaranteed by characterization
SYS.FES#1	T _{PWR_RDY}	Power-up to “Ready to accept I2C / CC command”	–	5	25	ms	Guaranteed by characterization

I/O

Table 4. I/O DC Specifications

Spec ID	Parameter	Description	Min	Typ	Max	Units	Details/Conditions
SID.GIO#37	V _{IH} ^[2]	Input voltage HIGH threshold	0.7 × V _{DDIO}	–	–	V	CMOS input
SID.GIO#38	V _{IL}	Input voltage LOW threshold	–	–	0.3 × V _{DDIO}	V	CMOS input
SID.GIO#39	V _{IH} ^[2]	LVTTL input, V _{DDIO} < 2.7 V	0.7 × V _{DDIO}	–	–	V	–
SID.GIO#40	V _{IL}	LVTTL input, V _{DDIO} < 2.7 V	–	–	0.3 × V _{DDIO}	V	–
SID.GIO#41	V _{IH} ^[2]	LVTTL input, V _{DDIO} ≥ 2.7 V	2.0	–	–	V	–
SID.GIO#42	V _{IL}	LVTTL input, V _{DDIO} ≥ 2.7 V	–	–	0.8	V	–
SID.GIO#33	V _{OH}	Output voltage HIGH level	V _{DDIO} – 0.6	–	–	V	I _{OH} = 4 mA at 3-V V _{DDIO}
SID.GIO#34	V _{OH}	Output voltage HIGH level	V _{DDIO} – 0.5	–	–	V	I _{OH} = 1 mA at 1.8-V V _{DDIO}
SID.GIO#35	V _{OL}	Output voltage LOW level	–	–	0.6	V	I _{OL} = 4 mA at 1.8-V V _{DDIO}
SID.GIO#36	V _{OL}	Output voltage LOW level	–	–	0.6	V	I _{OL} = 8 mA at 3 V V _{DDIO}
SID.GIO#5	R _{PULLUP}	Pull-up resistor	3.5	5.6	8.5	kΩ	–
SID.GIO#6	R _{PULLDOWN}	Pull-down resistor	3.5	5.6	8.5	kΩ	–
SID.GIO#16	I _{IL}	Input leakage current (absolute value)	–	–	2	nA	25 °C, V _{DDIO} = 3.0 V. Guaranteed by characterization
SID.GIO#17	C _{IN}	Input capacitance	–	–	7	pF	Guaranteed by characterization
SID.GIO#43	V _{HYSTTL}	Input hysteresis LVTTL	25	40	–	mV	V _{DDIO} ≥ 2.7 V. Guaranteed by characterization.
SID.GPIO#44	V _{HYS CMOS}	Input hysteresis CMOS	0.05 × V _{DDIO}	–	–	mV	Guaranteed by characterization
SID69	I _{DIODE}	Current through protection diode to V _{DDIO} /V _{SS}	–	–	100	μA	Guaranteed by characterization
SID.GIO#45	I _{TOT_GPIO}	Maximum total source or sink chip current	–	–	200	mA	Guaranteed by characterization

Note

2. V_{IH} must not exceed V_{DDIO} + 0.2 V.

I^2C
Table 8. Fixed I^2C DC Specifications

(Guaranteed by Characterization)

Spec ID	Parameter	Description	Min	Typ	Max	Units	Details/Conditions
SID149	I_{I2C1}	Block current consumption at 100 kbps	–	–	60	μA	–
SID150	I_{I2C2}	Block current consumption at 400 kbps	–	–	185	μA	–
SID151	I_{I2C3}	Block current consumption at 1 Mbps	–	–	390	μA	–
SID152	I_{I2C4}	I^2C enabled in Deep Sleep mode	–	–	1.4	μA	–

Table 9. Fixed I^2C AC Specifications

(Guaranteed by Characterization)

Spec ID	Parameter	Description	Min	Typ	Max	Units	Details/Conditions
SID153	F_{I2C1}	Bit rate	–	–	1	Mbps	–

Table 10. Fixed UART DC Specifications

(Guaranteed by Characterization)

Spec ID	Parameter	Description	Min	Typ	Max	Units	Details/Conditions
SID160	I_{UART1}	Block current consumption at 100 Kbps	–	–	125	μA	Guaranteed by characterization
SID161	I_{UART2}	Block current consumption at 1000 Kbps	–	–	312	μA	Guaranteed by characterization

Table 11. Fixed UART AC Specifications

(Guaranteed by Characterization)

Spec ID	Parameter	Description	Min	Typ	Max	Units	Details/Conditions
SID162	F_{UART}	Bit rate	–	–	1	Mbps	Guaranteed by characterization

Table 12. Fixed SPI DC Specifications

(Guaranteed by Characterization)

Spec ID	Parameter	Description	Min	Typ	Max	Units	Details/Conditions
SID163	I_{SPI1}	Block current consumption at 1 Mbps	–	–	360	μA	Guaranteed by characterization
SID164	I_{SPI2}	Block current consumption at 4 Mbps	–	–	560	μA	Guaranteed by characterization
SID165	I_{SPI3}	Block current consumption at 8 Mbps	–	–	600	μA	Guaranteed by characterization

Table 13. Fixed SPI AC Specifications

(Guaranteed by Characterization)

Spec ID	Parameter	Description	Min	Typ	Max	Units	Details/Conditions
SID166	F_{SPI}	SPI Operating frequency (Master; 6X oversampling)	–	–	8	MHz	Guaranteed by characterization

Table 14. Fixed SPI Master Mode AC Specifications

(Guaranteed by Characterization)

Spec ID	Parameter	Description	Min	Typ	Max	Units	Details/Conditions
SID167	T _{DMO}	MOSI Valid after SClock driving edge	–	–	15	ns	Guaranteed by characterization
SID168	T _{DSI}	MISO Valid before SClock capturing edge	20	–	–	ns	Full clock, late MISO sampling. Guaranteed by characterization
SID169	T _{HMO}	Previous MOSI data hold time	0	–	–	ns	Referred to Slave capturing edge. Guaranteed by characterization

Table 15. Fixed SPI Slave Mode AC Specifications

(Guaranteed by Characterization)

Spec ID	Parameter	Description	Min	Typ	Max	Units	Details/Conditions
SID170	T _{DMI}	MOSI Valid before Scklock Capturing edge	40	–	–	ns	Guaranteed by characterization
SID171	T _{DSO}	MISO Valid after Scklock driving edge	–	–	42 + 3 * T _{CPU}	ns	T _{CPU} = 1/FCPU. Guaranteed by characterization.
SID171A	T _{DSO_EXT}	MISO Valid after Scklock driving edge in Ext Clk mode	–	–	48	ns	Guaranteed by characterization
SID172	T _{HSO}	Previous MISO data hold time	0	–	–	ns	Guaranteed by characterization
SID172A	T _{SSELCK}	SSEL Valid to first SCK Valid edge	100	–	–	ns	Guaranteed by characterization

Memory

Table 16. Flash AC Specifications

Spec ID	Parameter	Description	Min	Typ	Max	Units	Details/Conditions
SID.MEM#4	T _{ROWWRITE} ^[3]	Row (block) write time (erase and program)	–	–	20	ms	Row (block) = 128 bytes
SID.MEM#3	T _{ROWERASE} ^[3]	Row erase time	–	–	13	ms	–
SID.MEM#8	T _{ROWPROGRAM} ^[3]	Row program time after erase	–	–	7	ms	–
SID178	T _{BULKERASE} ^[3]	Bulk erase time (32 KB)	–	–	35	ms	–
SID180	T _{DEVPROG} ^[3]	Total device program time	–	–	7.5	seconds	Guaranteed by characterization
SID181	F _{END}	Flash endurance	100 K	–	–	cycles	Guaranteed by characterization
SID182	F _{RET1}	Flash retention. T _A ≤ 55 °C, 100 K P/E cycles	20	–	–	years	Guaranteed by characterization
SID182A	F _{RET2}	Flash retention. T _A ≤ 85 °C, 10 K P/E cycles	10	–	–	years	Guaranteed by characterization

Note

- It can take as much as 20 milliseconds to write to Flash. During this time the device should not be Reset, or Flash operations will be interrupted and cannot be relied on to have completed. Reset sources include the XRES pin, software resets, CPU lockup states and privilege violations, improper power supply levels, and watchdogs. Make certain that these are not inadvertently activated.

System Resources

Power-on-Reset (POR) with Brown Out

Table 17. Imprecise Power On Reset (PRES)

Spec ID	Parameter	Description	Min	Typ	Max	Units	Details/Conditions
SID185	V _{RISEIPOR}	Rising trip voltage	0.80	–	1.50	V	Guaranteed by characterization
SID186	V _{FALLIPOR}	Falling trip voltage	0.75	–	1.4	V	Guaranteed by characterization

Table 18. Precise Power On Reset (POR)

Spec ID	Parameter	Description	Min	Typ	Max	Units	Details/Conditions
SID190	V _{FALLPPOR}	BOD trip voltage in active and sleep modes	1.48	–	1.62	V	Guaranteed by characterization
SID192	V _{FALLDPSLP}	BOD trip voltage in Deep Sleep	1.1	–	1.5	V	Guaranteed by characterization

SWD Interface

Table 19. SWD Interface Specifications

Spec ID	Parameter	Description	Min	Typ	Max	Units	Details/Conditions
SID.SWD#1	F_SWDCCLK1	$3.3\text{ V} \leq V_{DDIO} \leq 5.5\text{ V}$	–	–	14	MHz	SWDCCLK ≤ 1/3 CPU clock frequency
SID.SWD#2	F_SWDCCLK2	$1.8\text{ V} \leq V_{DDIO} \leq 3.3\text{ V}$	–	–	7	MHz	SWDCCLK ≤ 1/3 CPU clock frequency
SID.SWD#3	T_SWDI_SETUP	$T = 1/f\text{ SWDCCLK}$	0.25*T	–	–	ns	Guaranteed by characterization
SID.SWD#4	T_SWDI_HOLD	$T = 1/f\text{ SWDCCLK}$	0.25*T	–	–	ns	Guaranteed by characterization
SID.SWD#5	T_SWDO_VALID	$T = 1/f\text{ SWDCCLK}$	–	–	0.5 * T	ns	Guaranteed by characterization
SID.SWD#6	T_SWDO_HOLD	$T = 1/f\text{ SWDCCLK}$	1	–	–	ns	Guaranteed by characterization

Internal Main Oscillator

Table 20. IMO DC Specifications

(Guaranteed by Design)

Spec ID	Parameter	Description	Min	Typ	Max	Units	Details/Conditions
SID218	I _{IMO}	IMO operating current at 48 MHz	–	–	1000	μA	–

Table 21. IMO AC Specifications

Spec ID	Parameter	Description	Min	Typ	Max	Units	Details/Conditions
SID.CLK#13	F _{IMOTOL}	Frequency variation at 24, 36, and 48 MHz (trimmed)	–	–	±2	%	–
SID226	T _{STARTIMO}	IMO startup time	–	–	7	μs	Guaranteed by characterization
SID229	T _{JITRMSIMO}	RMS jitter at 48 MHz	–	145	–	ps	Guaranteed by characterization
F _{IMO}	–	IMO frequency	24	–	48	MHz	–

Internal Low-Speed Oscillator

Table 22. ILO DC Specifications

(Guaranteed by Design)

Spec ID	Parameter	Description	Min	Typ	Max	Units	Details/Conditions
SID231	I _{ILO}	ILO operating current at 32 kHz	–	0.3	1.05	μA	Guaranteed by Characterization
SID233	I _{ILOLEAK}	ILO leakage current	–	2	15	nA	Guaranteed by Design

Table 23. ILO AC Specifications

Spec ID	Parameter	Description	Min	Typ	Max	Units	Details/Conditions
SID234	T _{STARTILO}	ILO startup time	–	–	2	ms	Guaranteed by characterization
SID236	T _{ILODUTY}	ILO duty cycle	40	50	60	%	Guaranteed by characterization
SID.CLK#5	F _{ILO}	ILO Frequency	20	40	80	kHz	–

Power Down

Table 24. PD DC Specifications

Spec ID	Parameter	Description	Min	Typ	Max	Units	Details/Conditions
SID.PD.1	Rp_std	DFP CC termination for default USB Power	64	80	96	μA	–
SID.PD.2	Rp_1.5A	DFP CC termination for 1.5A power	166	180	194	μA	–
SID.PD.3	Rp_3.0A	DFP CC termination for 3.0A power	304	330	356	μA	–
SID.PD.4	Rd	UFP CC termination	4.59	5.1	5.61	kΩ	–
SID.PD.5	Rd_DB	UFP Dead Battery CC termination on RD1 and CC2	4.08	5.1	6.12	kΩ	All supplies forced to 0 V and 0.6 V applied at RD1 or CC2
SID.PD.6	R _A	Power cable termination	0.8	1.0	1.2	kΩ	All supplies forced to 0 V and 0.2 V applied at V _{CONN1} or V _{CONN2}
SID.PD.7	Ra_OFF	Power cable termination - Disabled	0.4	0.75	–	MΩ	2.7 V applied at V _{CONN1} or V _{CONN2} with R _A disabled
SID.PD.8	Rleak_1	V _{CONN} leaker for 0.1-μF load	–	–	216	kΩ	Managed Active Cable (MAC) discharge
SID.PD.9	Rleak_2	V _{CONN} leaker for 0.5-μF load	–	–	41.2	kΩ	
SID.PD.10	Rleak_3	V _{CONN} leaker for 1.0-μF load	–	–	19.6	kΩ	
SID.PD.11	Rleak_4	V _{CONN} leaker for 2.0-μF load	–	–	9.8	kΩ	
SID.PD.12	Rleak_5	V _{CONN} leaker for 5.0-μF load	–	–	4.1	kΩ	
SID.PD.13	Rleak_6	V _{CONN} leaker for 10-μF load	–	–	2.0	kΩ	
SID.PD.14	Ileak	Leaker on V _{CONN1} and V _{CONN2} for discharge upon cable detach	150	–	–	μA	–

Analog-to-Digital Converter

Table 25. ADC DC Specifications

Spec ID	Parameter	Description	Min	Typ	Max	Units	Details/Conditions
SID.ADC.1	Resolution	ADC resolution	–	8	–	bits	Guaranteed by characterization
SID.ADC.2	INL	Integral non-linearity	–1.5	–	1.5	LSB	Guaranteed by characterization
SID.ADC.3	DNL	Differential non-linearity	–2.5	–	2.5	LSB	Guaranteed by characterization
SID.ADC.4	Gain Error	Gain error	–1	–	1	LSB	Guaranteed by characterization

Table 26. ADC AC Specifications

Spec ID	Parameter	Description	Min	Typ	Max	Units	Details/Conditions
SID.ADC.5	SLEW_Max	Rate of change of sampled voltage signal	–	–	3	V/ms	Guaranteed by characterization



Packaging

Table 28. Package Characteristics

Parameter	Description	Conditions	Min	Typ	Max	Units
T _A	Operating ambient temperature	Industrial	-40	25	85	°C
		Extended Industrial			105	°C
T _J	Operating junction temperature	Industrial	-40	-	100	°C
		Extended Industrial			125	°C
T _{JA}	Package θ_{JA} (20-ball WLCSP)	-	-	66	-	°C/W
T _{JC}	Package θ_{JC} (20-ball WLCSP)	-	-	0.7	-	°C/W
T _{JA}	Package θ_{JA} (14-pin DFN)	-	-	31	-	°C/W
T _{JC}	Package θ_{JC} (14-pin DFN)	-	-	59	-	°C/W
T _{JA}	Package θ_{JA} (24-pin QFN)	-	-	22	-	°C/W
T _{JC}	Package θ_{JC} (24-pin QFN)	-	-	29	-	°C/W

Table 29. Solder Reflow Peak Temperature

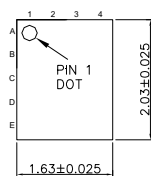
Package	Maximum Peak Temperature	Maximum Time within 5 °C of Peak Temperature
20-ball WLCSP	260 °C	30 seconds
14-pin DFN	260 °C	30 seconds
24-pin QFN	260 °C	30 seconds

Table 30. Package Moisture Sensitivity Level (MSL), IPC/JEDEC J-STD-2

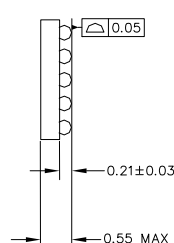
Package	MSL
20-ball WLCSP	MSL 1
14-pin DFN	MSL 3
24-pin QFN	MSL 3

Figure 15. 20-ball WLCSP (1.63 × 2.03 × 0.55 mm) FN20B Package Outline, 001-95010

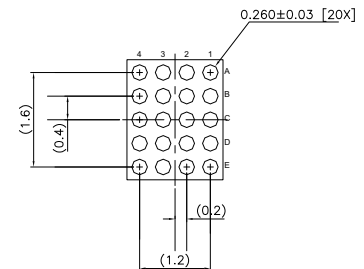
TOP VIEW



SIDE VIEW



BOTTOM VIEW



NOTES:

1. REFERENCE JEDEC PUBLICATION 95, DESIGN GUIDE 4.18
2. ALL DIMENSIONS ARE IN MILLIMETERS

001-95010 *A

Acronyms

Table 31. Acronyms Used in this Document

Acronym	Description
ADC	analog-to-digital converter
API	application programming interface
ARM®	advanced RISC machine, a CPU architecture
CC	configuration channel
CCG2	Cable Controller Generation 2
CPU	central processing unit
CRC	cyclic redundancy check, an error-checking protocol
CS	current sense
DFP	downstream facing port
DIO	digital input/output, GPIO with only digital capabilities, no analog. See GPIO.
DRP	dual role port
EEPROM	electrically erasable programmable read-only memory
EMCA	a USB cable that includes an IC that reports cable characteristics (e.g., current rating) to the Type-C ports
EMI	electromagnetic interference
ESD	electrostatic discharge
FPB	flash patch and breakpoint
FS	full-speed
GPIO	general-purpose input/output
IC	integrated circuit
IDE	integrated development environment
I²C, or IIC	Inter-Integrated Circuit, a communications protocol
ILO	internal low-speed oscillator, see also IMO
IMO	internal main oscillator, see also ILO
I/O	input/output, see also GPIO
LVD	low-voltage detect
LVTTTL	low-voltage transistor-transistor logic
MCU	microcontroller unit
NC	no connect
NMI	nonmaskable interrupt

Table 31. Acronyms Used in this Document (continued)

Acronym	Description
NVIC	nested vectored interrupt controller
opamp	operational amplifier
OCP	overcurrent protection
OVP	overvoltage protection
PCB	printed circuit board
PD	power delivery
PGA	programmable gain amplifier
PHY	physical layer
POR	power-on reset
PRES	precise power-on reset
PSoC®	Programmable System-on-Chip™
PWM	pulse-width modulator
RAM	random-access memory
RISC	reduced-instruction-set computing
RMS	root-mean-square
RTC	real-time clock
RX	receive
SAR	successive approximation register
SCL	I²C serial clock
SDA	I²C serial data
S/H	sample and hold
SPI	Serial Peripheral Interface, a communications protocol
SRAM	static random access memory
SWD	serial wire debug, a test protocol
TX	transmit
Type-C	a new standard with a slimmer USB connector and a reversible cable, capable of sourcing up to 100 W of power
UART	Universal Asynchronous Transmitter Receiver, a communications protocol
USB	Universal Serial Bus
USBIO	USB input/output, CCG2 pins used to connect to a USB port
XRES	external reset I/O pin

Document Conventions

Units of Measure

Table 32. Units of Measure

Symbol	Unit of Measure
°C	degrees Celsius
Hz	hertz
KB	1024 bytes
kHz	kilohertz
kΩ	kilo ohm
Mbps	megabits per second
MHz	megahertz
MΩ	mega-ohm
Msps	megasamples per second
μA	microampere
μF	microfarad
μs	microsecond

Table 32. Units of Measure (continued)

Symbol	Unit of Measure
μV	microvolt
μW	microwatt
mA	milliampere
ms	millisecond
mV	millivolt
nA	nanoampere
ns	nanosecond
Ω	ohm
pF	picofarad
ppm	parts per million
ps	picosecond
s	second
sps	samples per second
V	volt

Document History Page

Description Title: EZ-PD™ CCG2 Datasheet USB Type-C Port Controller Document Number: 001-93912				
Revision	ECN	Orig. of Change	Submission Date	Description of Change
*E	4680071	GAYA	03/07/2015	Release to web
*F	4718374	AKN	04/09/2015	Added 24-pin QFN pin and package information. Added DRP and DFP Application diagrams
*G	4774142	AKN	06/15/2015	Changed datasheet status from Preliminary to Final. Updated Logic Block Diagram. Changed number of GPIOs to 10 and added a note about the number of GPIOs varying depending on the package. Updated Power and Digital Peripherals section. Updated Application diagrams. Added SID.PWR#1_A parameter. Added CYPD2122-20FNXIT part in Ordering Information. Removed Errata.
*H	4979175	VGT	10/23/2015	Updated Figure 1 and Figure 5. Added VCC_ABS spec and updated the SID.ADC.4 parameter. Added "Guaranteed by characterization" note for the following specs: SID.GIO#16, SID.GIO#17, SID.XRES#3, SID 160 to SID 172A, SID 2226, SID 229, SID.ADC.1 to SID.ADC.5.
*I	5028128	VGT	12/04/2015	Updated Application Diagrams : Added Figure 12 . Added Figure 13 . Added Figure 14 . Updated Ordering Information . Added part numbers CYPD2119-24LQXIT, CYPD2120-24LQXIT, CYPD2121-24LQXIT, CYPD2125-24LQXIT.
*J	5186972	VGT	03/28/2016	Updated temperature ranges in Features . Updated Table 28 . Updated Ordering Information .
*K	5303957	VGT	06/13/2016	Added Available Firmware and Software Tools . Updated Figure 8 : Per the USB PD3.0 spec, SOP" implementation is no longer valid for passive cables. Updated Figure 9 , Figure 10 , and Figure 11 . Added descriptive notes for the application diagrams. Added References and Links To Applications Collaterals . Updated Ordering Information . Updated Cypress logo and copyright information.
*L	5387677	VGT	08/02/2016	Added CYPD2122-24LQXI part number in Ordering Information .