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EZ-PD™ CCG2 Datasheet

USB Type-C Port Controller

General Description

EZ-PD™ CCG2 is a USB Type-C controller that complies with the latest USB Type-C and PD standards. EZ-PD CCG2 provides a complete USB Type-C and U1SB Power Delivery port control solution for passive cables, active cables, and powered accessories. It can also be used in many upstream and downstream facing port applications. EZ-PD CCG2 uses Cypress's proprietary M0S8 technology with a 32-bit, 48-MHz Arm® Cortex®-M0 processor with 32-KB flash and integrates a complete Type-C Transceiver including the Type-C termination resistors R_P, R_D and R_A.

Applications

- USB Type-C EMCA cables
- USB Type-C powered accessories
- USB Type-C upstream facing ports
- USB Type-C downstream facing ports

Features

32-bit MCU Subsystem

- 48-MHz ARM Cortex-M0 CPU
- 32-KB Flash
- 4-KB SRAM
- In-system reprogrammable

Integrated Digital Blocks

- Integrated timers and counters to meet response times required by the USB-PD protocol
- Run-time reconfigurable serial communication block (SCB) with reconfigurable I^2C, SPI, or UART functionality

Clocks and Oscillators

- Integrated oscillator eliminating the need for external clock

Type-C Support

- Integrated transceiver (baseband PHY)
- Integrated UFP (R_D), EMCA (R_A) termination resistors, and current sources for DFP (R_P)
- Supports one USB Type-C port

Low-Power Operation

- 2.7-V to 5.5-V operation
- Two independent VCONN rails with integrated isolation between the two
- Independent supply voltage pin for GPIO that allows 1.71-V to 5.5-V signaling on the I/Os
- Reset: 1.0 µA, Deep Sleep: 2.5 µA, Sleep: 2.0 mA

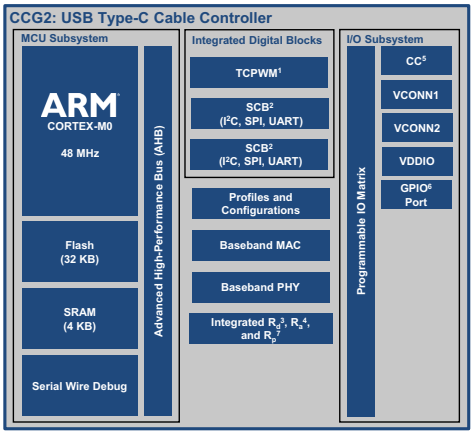
System-Level ESD on CC and VCONN Pins

- ±8-kV Contact Discharge and ±15-kV Air Gap Discharge based on IEC61000-4-2 level 4C

Packages

- 1.63 mm × 2.03 mm, 20-ball wafer-level CSP (WLCSP) with 0.4-mm ball pitch
- 2.5 mm × 3.5 mm × 0.6 mm 14-pin DFN
- 4.0 mm × 4.0 mm, 0.55 mm 24-pin QFN
- Supports industrial (–40 °C to +85 °C) and extended industrial (–40 °C to +105 °C) temperature ranges

Logic Block Diagram



[1] Timer, counter, pulse-width modulation block
[2] Serial communication block configurable as UART, SPI, or I²C
[3] Termination resistor denoting a UFP
[4] Termination resistor denoting an EMCA
[5] Configuration Channel
[6] General-purpose input/output
[7] Current Sources to indicate a DFP

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.

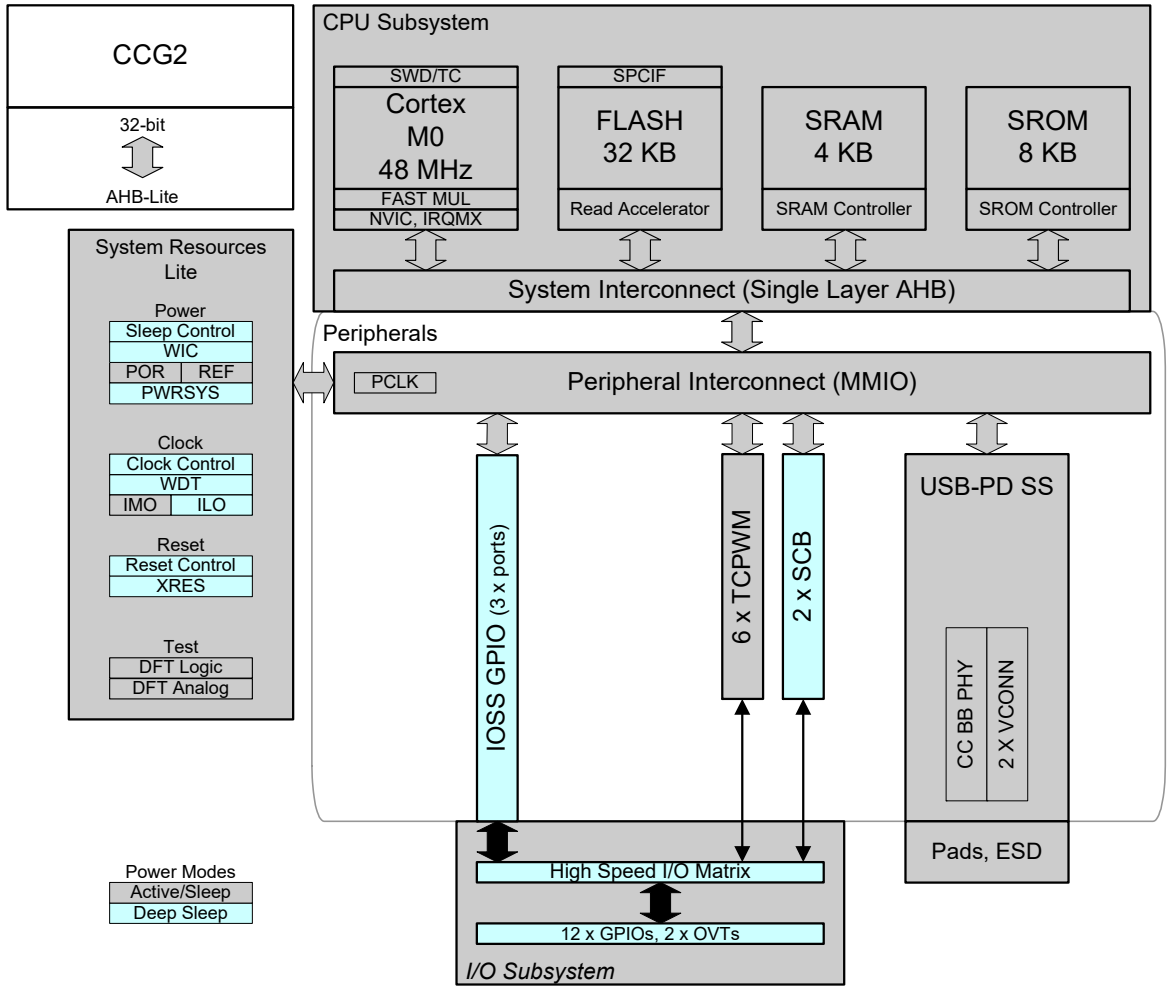
You can download the EZ-PD Configuration Utility and its associated documentation at the following link:

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

Contents

EZ-PD CCG2 Block Diagram

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

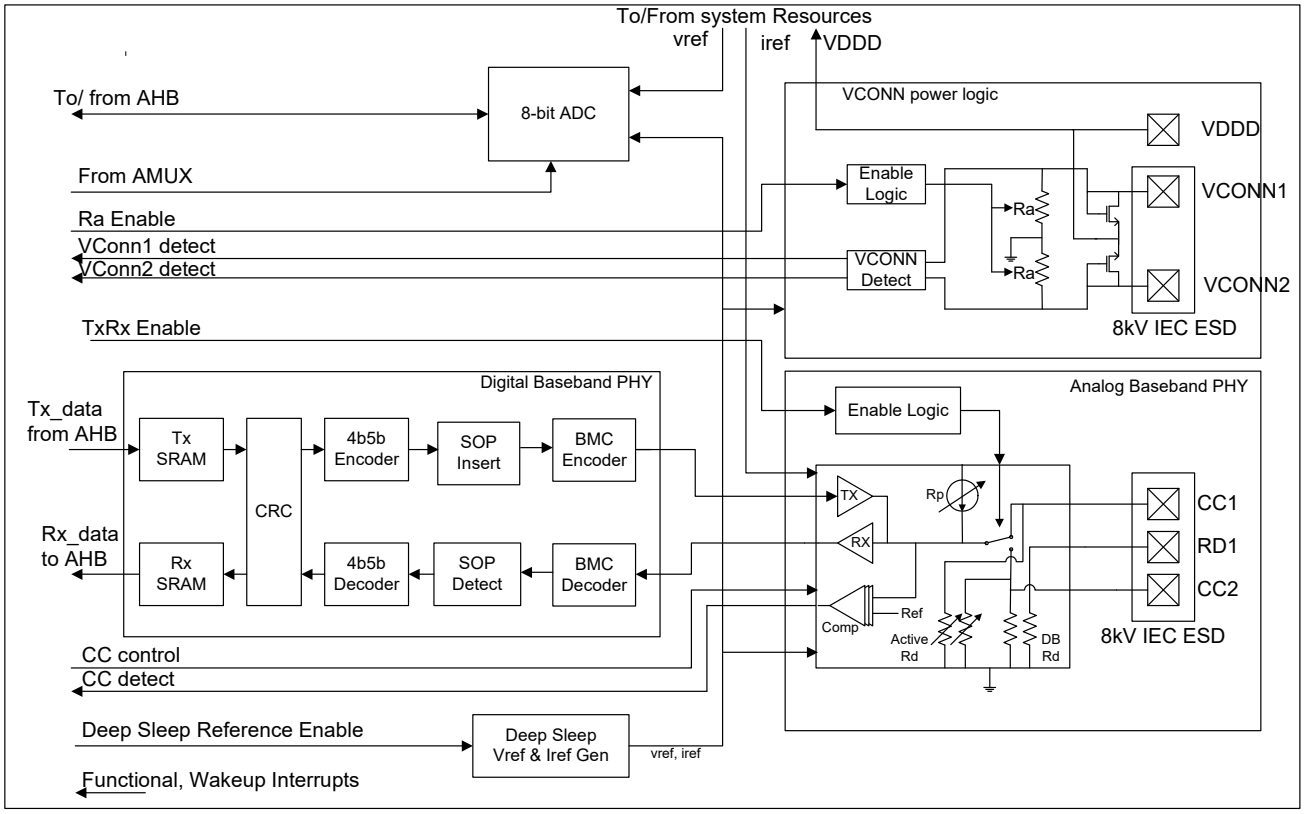
A supervisory ROM that contains boot and configuration routines is provided.

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 I^2C, SPI, or UART interface. The hardware I^2C 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 I^2C 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 I^2C that creates a mailbox address range in the memory of EZ-PD CCG2 and effectively reduce I^2C 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 I^2C peripherals are compatible with the I^2C Standard-mode, Fast-mode, and Fast-mode Plus devices as defined in the NXP I^2C-bus specification and user manual (UM10204). The I^2C bus I/Os are implemented with GPIO in open-drain modes.

The I^2C port on SCB 1 block of EZ-PD CCG2 is not completely compliant with the I^2C spec in the following respects:

- The GPIO cells for SCB 1's I^2C port are not overvoltage-tolerant and, therefore, cannot be hot-swapped or powered up independently of the rest of the I^2C 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 I^2C and SWD pins, which can also be used as GPIOs. The I^2C 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 LVTTL)
- 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

Table 1. 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)

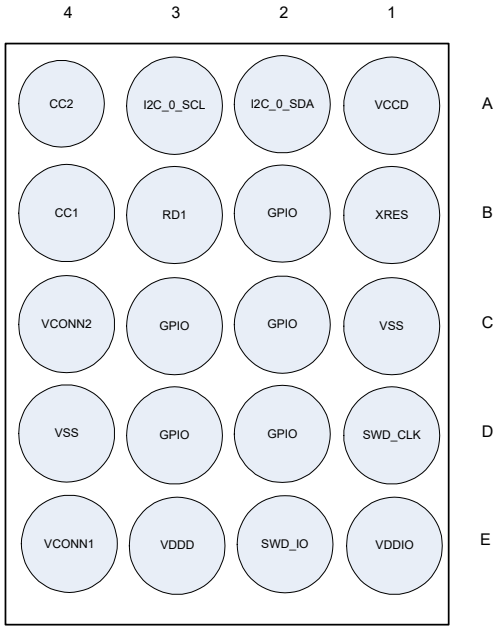


Figure 4. 14-pin DFN Pin Map (Top View)

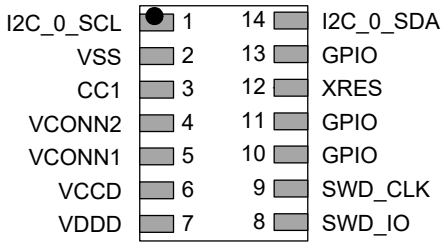
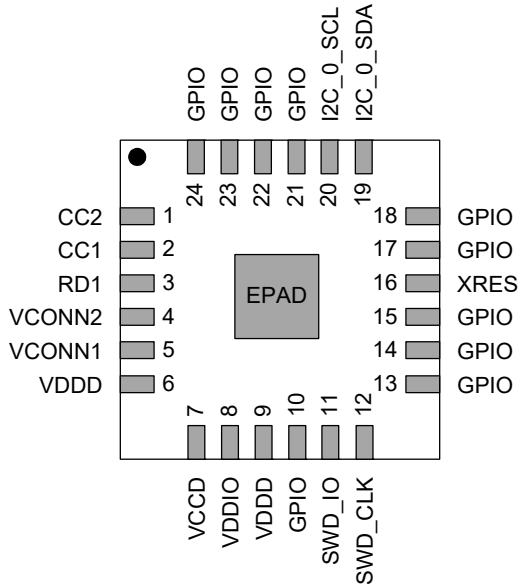


Figure 5. 24-Pin QFN Pin Map (Top View)



Power

The following power system diagram shows the set of power supply pins as implemented in EZ-PD CCG2.

EZ-PD CCG2 can operate from three different power sources. VCONN1 and VCONN2 pins can be used as connections to the VCONN pins on a Type-C plug of a cable or VCONN-powered accessory. Each of these inputs support operation over 4.0 to 5.5 V. An internal isolation between VCONN1 and VCONN2 pins is provided allowing them to be at different levels simultaneously. CCG2 can be used in EMCA applications with only one or both VCONN pins as power sources. This is illustrated later in the section on Applications. Besides being power inputs, each VCONN pin is also internally connected to a R_A termination resistor required for EMCA and VCONN-powered accessories.

EZ-PD CCG2 can also be operate from 2.7 to 5.5 V when operated from the VDDD supply pin. VCONN-powered accessory applications require that CCG2 work down to 2.7 V. In such applications, both the VDDD and VCONN pins should be connected to the VCONN pin of the Type-C plug in the accessory.

In UFP, DFP, and DRP applications, CCG2 can be operated from VDDD as the only supply input. In such applications, the VCONN pins are left open. In DFP applications, the lowest VDDD level that CCG2 can operate is 3.0 V due to the need to support disconnect detection thresholds of up to 2.7 V.

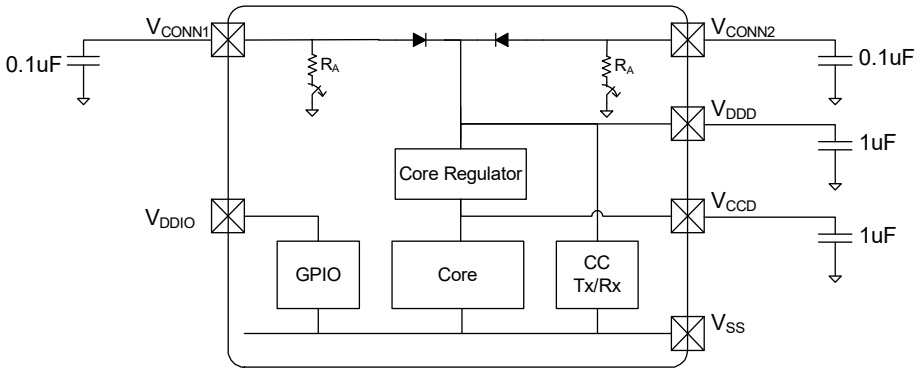
A separate I/O supply pin, VDDIO, allows the GPIOs to operate at levels from 1.71 to 5.5 V. The VDDIO pin can be equal to or less than the voltages connected to the VCONN1, VCONN2, and VDDD pins. The independent VDDIO supply is not available on the 14-DFN package. On this package, the VDDIO rail is internally connected to the VDDD rails.

The VCCD output of EZ-PD CCG2 must be bypassed to ground via an external capacitor (in the range of 1 to 1.6 µF; X5R ceramic or better).

Bypass capacitors must be used from VDDD and VCONN pins to ground; typical practice for systems in this frequency range is to use a 0.1-µF capacitor. Note that these are simply rules of thumb and that for critical applications, the PCB layout, lead inductance, and the bypass capacitor parasitic should be simulated to design and obtain optimal bypassing.

An example of the power supply bypass capacitors is shown in Figure 6.

Figure 6. EZ-PD CCG2 Power and Bypass Scheme Example



CCG2 Programming and Bootloading

There are two ways to program application firmware into a CCG2 device:

1. Programming the device flash over SWD Interface
2. Application firmware update over specific interfaces (CC, I^2C)

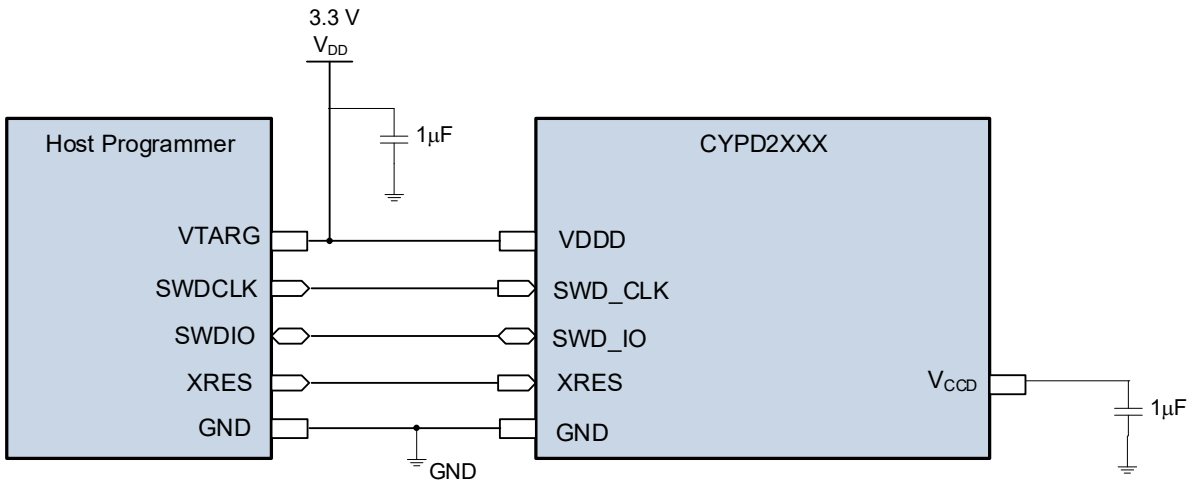
Generally, the CCG2 devices are programmed over SWD interface only during development or during the manufacturing process of the end product. Once the end product is manufactured, the CCG2 device's application firmware can be updated via the appropriate bootloader interface. However, it is recommended to disable the update over bootloader interface before the end product goes to mass production, unless a secure method of firmware update is implemented by the customer.

Programming the CCG2 Device Flash over SWD Interface

The CCG2 family of devices can be programmed using the SWD interface. Cypress provides programming kits (CY8CKIT-002 MiniProg3 Kit) called MiniProg3 and (CY8CKIT-005 MiniProg4 Kit) MiniProg4 which can be used to program the flash as well as debug firmware. The flash is programmed by downloading the information from a hex file. This hex file is a binary file generated as an output of building the firmware project in PSoC Creator Software. Click here for more information on how to use the MiniProg3 programmer. Click here for more information on how to use the MiniProg4 programmer. There are many third-party programmers that support mass programming in a manufacturing environment.

As shown in the block diagram in Figure 7, the SWD_IO and SWD_CLK pins are connected to the host programmer's SWDIO (data) and SWDCLK (clock) pins respectively. During SWD programming, the device can be powered by the host programmer by connecting its VTARG (power supply to the target device) to VDDD pin of CCG2 device. If the CCG2 device is powered using an on-board power supply, it can be programmed using the “Reset Programming” option. For more details, refer to CCGx Programming Specifications.

Figure 7. Connecting the Programmer to CCG2 Device



Application Firmware Update (I²C, CC)

The application firmware can be updated over two different interfaces depending on the default firmware programmed into the CCG2 device. Refer to Table 28 for more details on default firmware that various part numbers of the CCG2 family of devices are pre-programmed with (note that some of the devices have bootloader only and some have bootloader plus application firmware).

Application Firmware Update over I²C Interface

This method primarily applies to CYPD2104, CYPD2119, CYPD2120, CYPD2121, CYPD2122, CYPD2125 devices of the CCG2 family. In these applications, the CCG2 device interfaces to an on-board application processor or an embedded controller or a billboard device that will act as a USB to I²C bridge over I²C interface. Refer to Figure 8 for more details. For dongle applications like C-HDMI or C-DisplayPort, the application firmware update can be done as shown in Figure 9.

Figure 8. Application Firmware Update Over I²C Interface

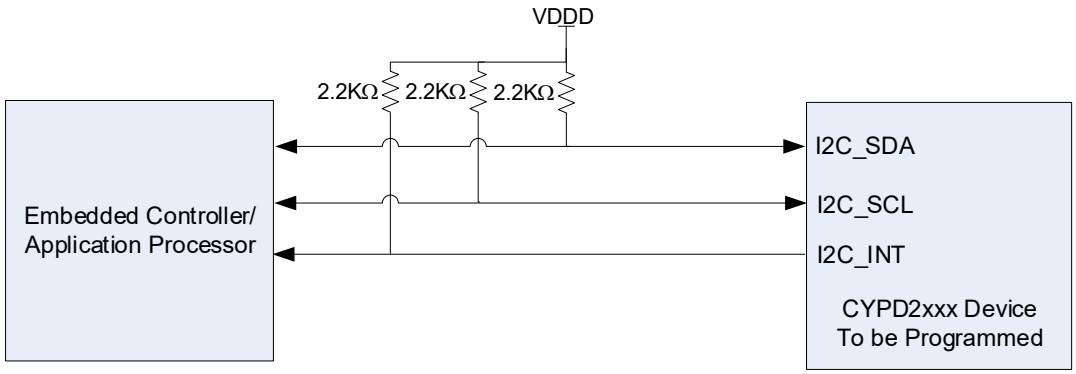
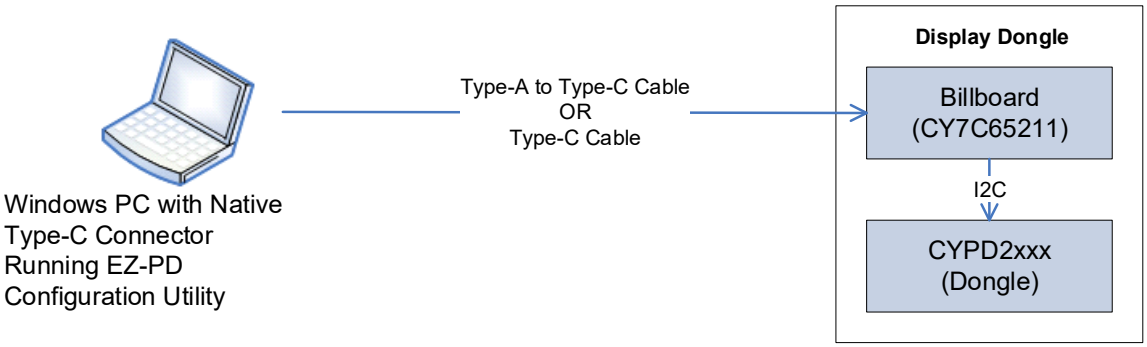


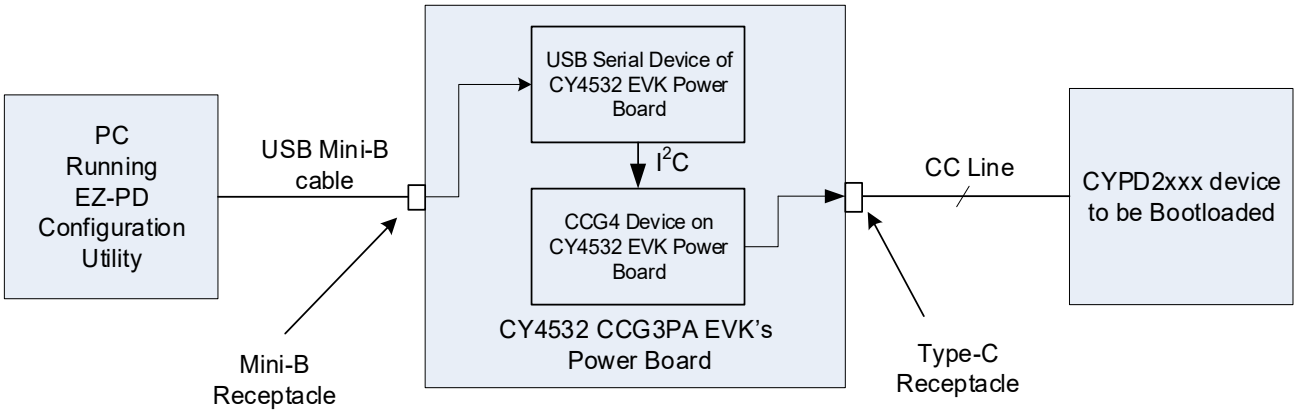
Figure 9. Application Firmware Update Over I²C Interface (for CYPD2119 and CYPD2120 Devices)



Application Firmware Update over CC Interface for DFP Applications

This method primarily applies to the CYPD2134 device of the CCG2 family. For bootloading, the CY4532 CCG3PA EVK can be used to send programming and configuration data as Cypress specific Vendor Defined Messages (VDMs) over the CC line. The CY4532 EVK's base board is connected to the system containing CCG2 device on one end and a Windows PC running the EZ-PD™ Configuration Utility as shown in Figure 10 on the other end to bootload the CCG2 device.

Figure 10. Application Firmware Update Over CC Interface for DFP Applications



Application Firmware Update Over CC Interface for Cable Applications

This method primarily applies to the CYPD2103 and CYPD2105 devices of the CCG2 family. Refer to the EZ-PD Configuration Utility User Manual for further details on how to do the application firmware update over CC interface for Cable applications.

Application Diagrams

EMCA Applications

Figure 11 to Figure 14 show the application diagrams of a Passive EMCA application using CCG2 devices. Figure 11 and Figure 12 show the application using a single CCG2 device per cable present at one of the two plugs, whereas Figure 13 and Figure 14 show the same with two CCG2 devices per cable present at each plug. The VBUS signal, the SuperSpeed lines, HighSpeed lines, and CC lines are connected directly from one end to another.

The application diagrams shown in Figure 11 and Figure 12 require a single VCONN wire to run through the cable so that the CCG2 device can be powered irrespective of which plug is connected to the host (DFP). However, in the application diagrams shown in Figure 13 and Figure 14, the VCONN signal does not run through the entire cable, but only runs to the respective VCONN pin of the CCG2 device at each end of the plug. Also, only one CCG2 device is powered at any given instance, depending on which one is nearer to the DFP that supplies VCONN.

Note: Application diagram in Figure 12 requires external diodes to operate in the extended VCONN voltage range of 2.7V to 5.5V

Cypress provides different firmware images for PD3.0 EMCA and USB4 EMCA. Please contact Cypress for the latest firmware images.

Figure 11. Passive EMCA Application – Single EZ-PD CCG2 Per Cable (VCONN range between 4.0V to 5.5V)

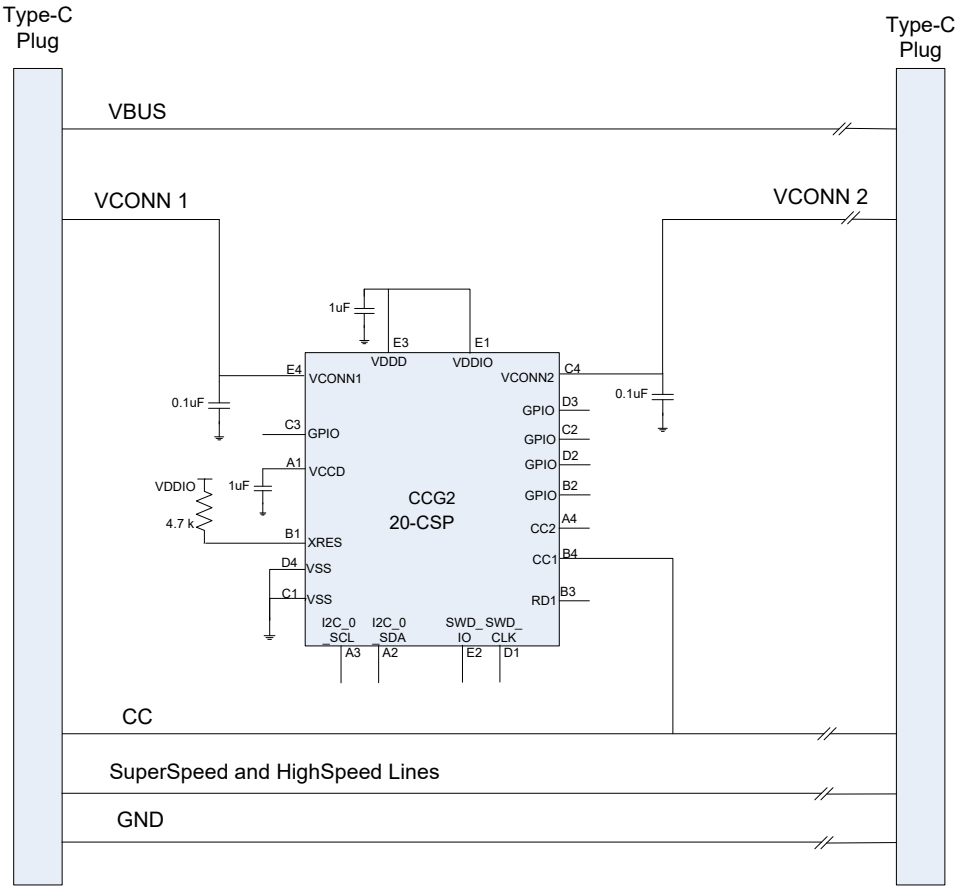


Figure 12. Passive EMCA Application (PD3.0/USB4) – Single EZ-PD CCG2 Per Cable (VCONN range between 2.7V to 5.5V)

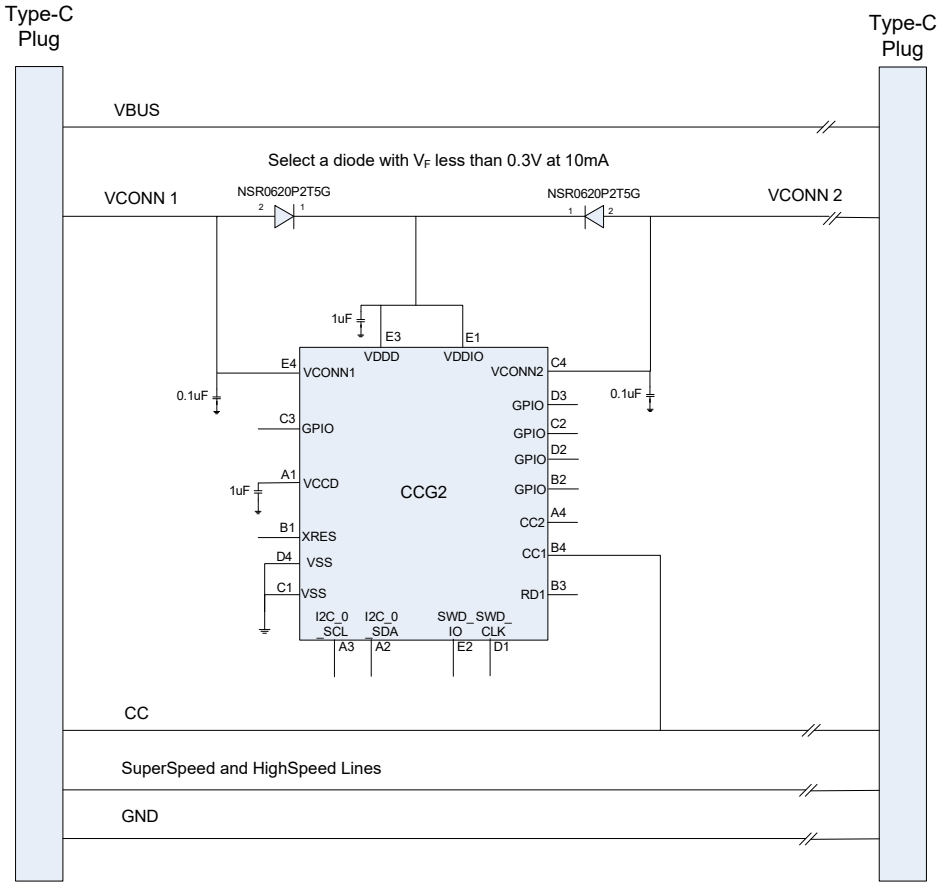


Figure 13. Passive EMCA Application – Single EZ-PD CCG2 Per Plug (VCONN range between 4.0V to 5.5V)

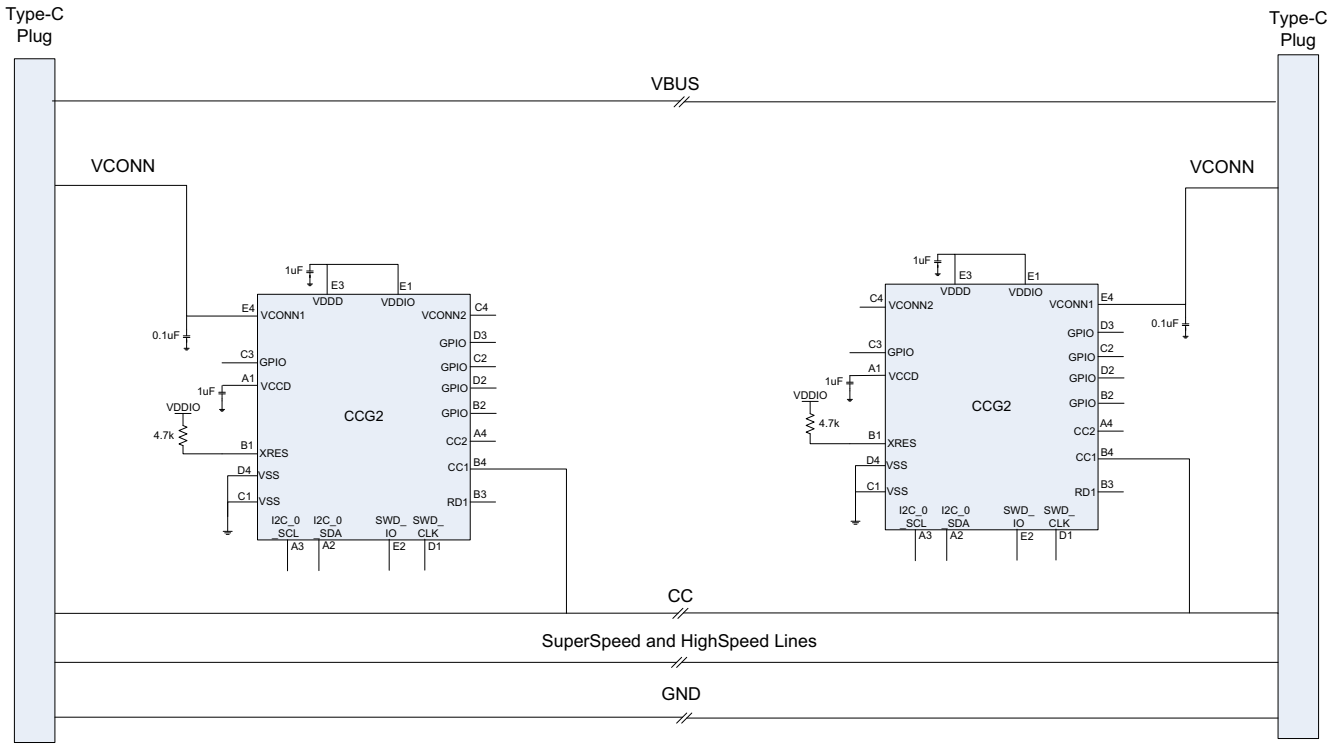
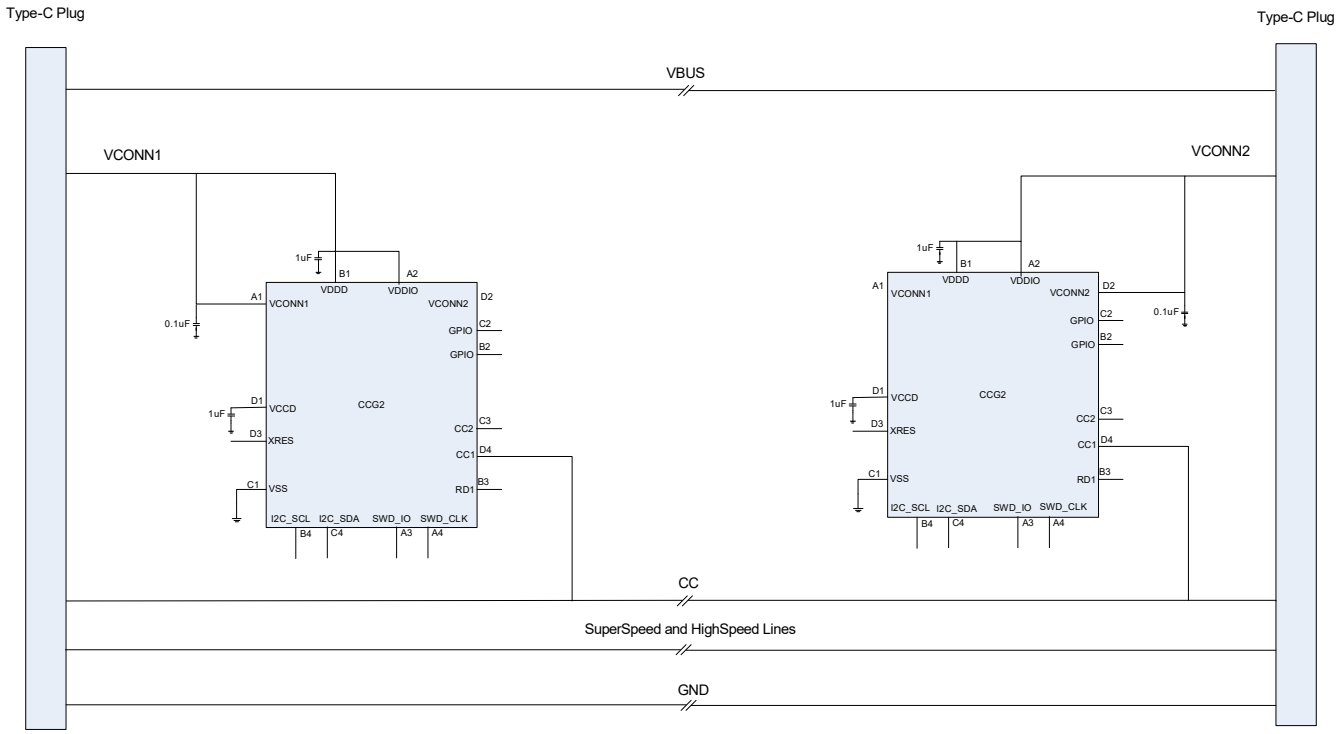


Figure 14. Passive EMCA Application – Single EZ-PD CCG2 Per Plug (VCONN range between 2.7V to 5.5V)

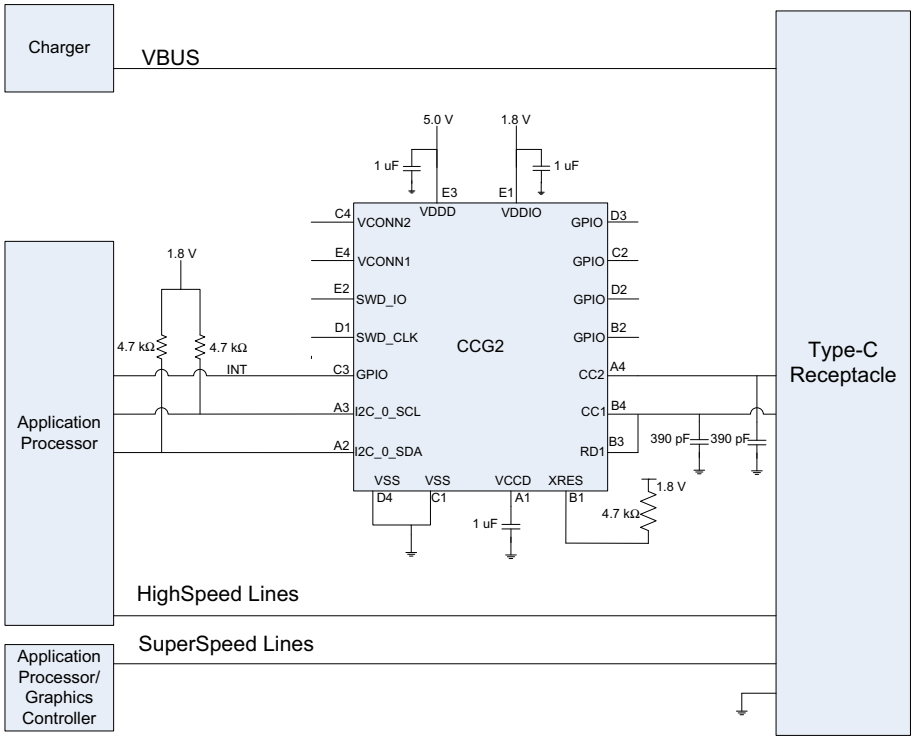


Upstream Facing Port Applications

Figure 15 shows a CCG2 device being used in a UFP application (tablet with a Type-C port) only as a power consumer.

The Type-C receptacle brings in HighSpeed and SuperSpeed lines, which are connected directly to the applications processor. The VBUS line from the Type-C receptacle goes directly to the UFP (tablet) charger circuitry. The applications processor communicates over the I^2C signal with the CCG2 device, and the CC1 and CC2 lines from the Type-C receptacle are connected directly to the respective CC1/2 pins of the CCG2 device.

Figure 15. Upstream Facing Port (UFP) Application – Tablet with a Type-C Port



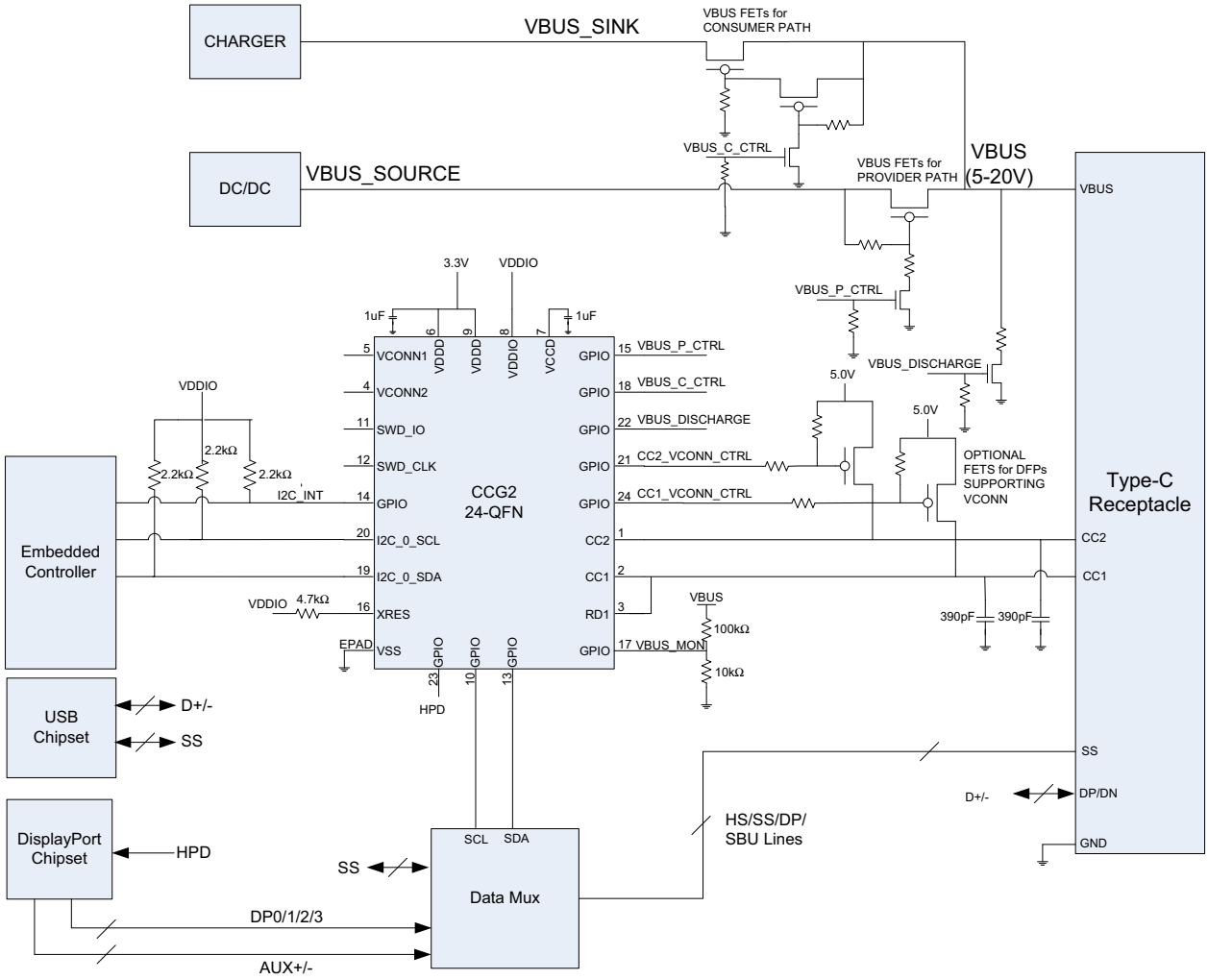
Notebook Applications

Figure 16 shows a Notebook DRP application diagram using a CCG2 device. CCG2 is not recommended for new designs for the PC and notebook applications. CCG4, CCG5, CCG5C, CCG6DF, CCG6SF devices are more suited for notebook applications. The below section is just maintained for legacy purposes.

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 I^2C. 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 16. Dual Role Port (DRP) Application (Not Recommended for New Designs)

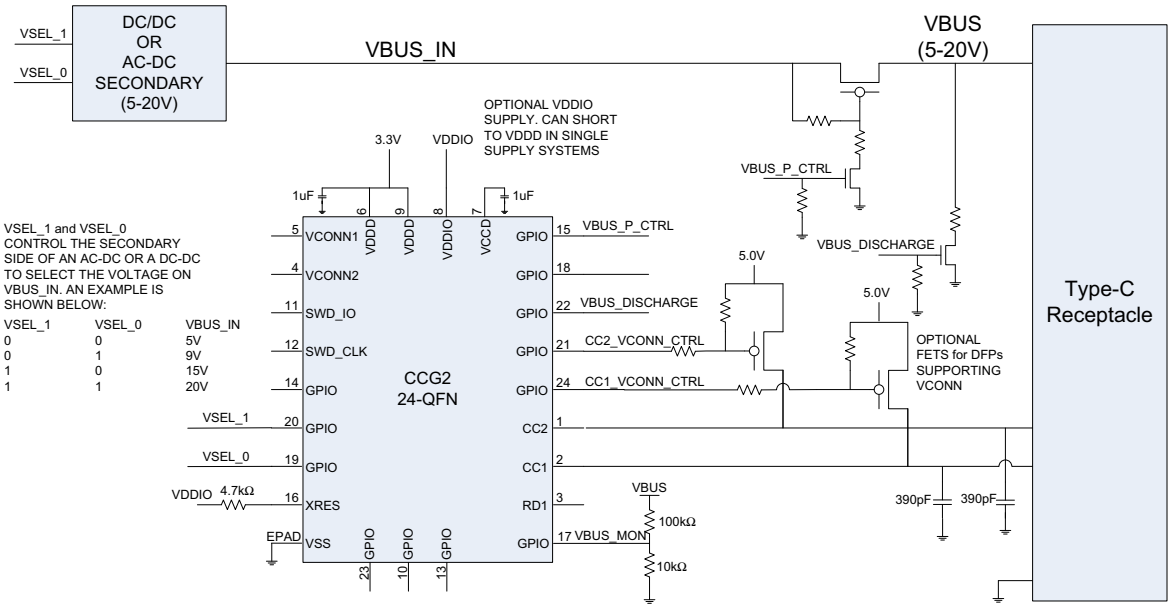


Downstream Facing Port Applications

Figure 17 shows a CCG2 receptacle-based Power Adapter application in which the CCG2 device is used as a DFP. CCG2 integrates all termination resistors and uses GPIOs (VSEL_0 and VSEL_1) to indicate the negotiated power profile. The VBUS voltage on the Type-C port is monitored using internal ADC to detect undervoltage and overvoltage conditions on VBUS. To ensure quick discharge of VBUS when the power adapter cable is detached, a discharge path is also provided.

For downstream facing port applications, CCG3PA offers a much more integrated solution and depending on the customer's application, it may result in additional BoM cost savings. Please refer to the CCG3PA datasheet for more information.

Figure 17. Downstream Facing Port (DFP) Application



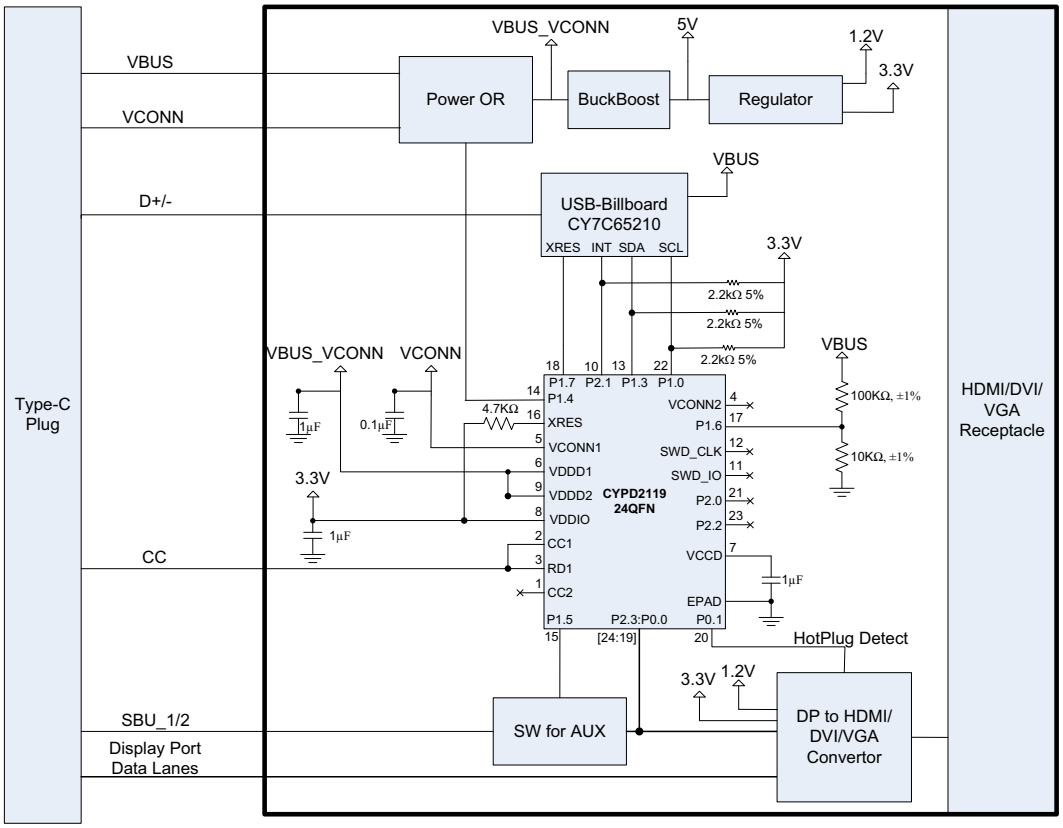
C-HDMI Dongle Application

CCG2 is not recommended for new designs of Type-C to video dongles. CCG3 offers a much more integrated solution for this application and also supports PD3.0. Please refer to the CCG3 datasheet for more details.This section is just maintained for legacy purposes only.

Figure 18 shows a USB Type-C to HDMI/DVI/VGA 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 HDMI/DVI/VGA interface. It enables users of any Notebook that implements USB-Type C to connect to other display types.

This application has a Type-C plug on one end and the legacy video (HDMI/DVI/VGA) receptacle on the other end. This application meets the requirements described in Section 4.3 of the VESA DisplayPort Alt Mode on USB Type-C Standard Version 1.0. This application supports display output at a resolution of up to 4K Ultra HD (3840x2160) at 60 Hz. 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 18. USB Type-C to HDMI/DVI/VGA Dongle Application Diagram



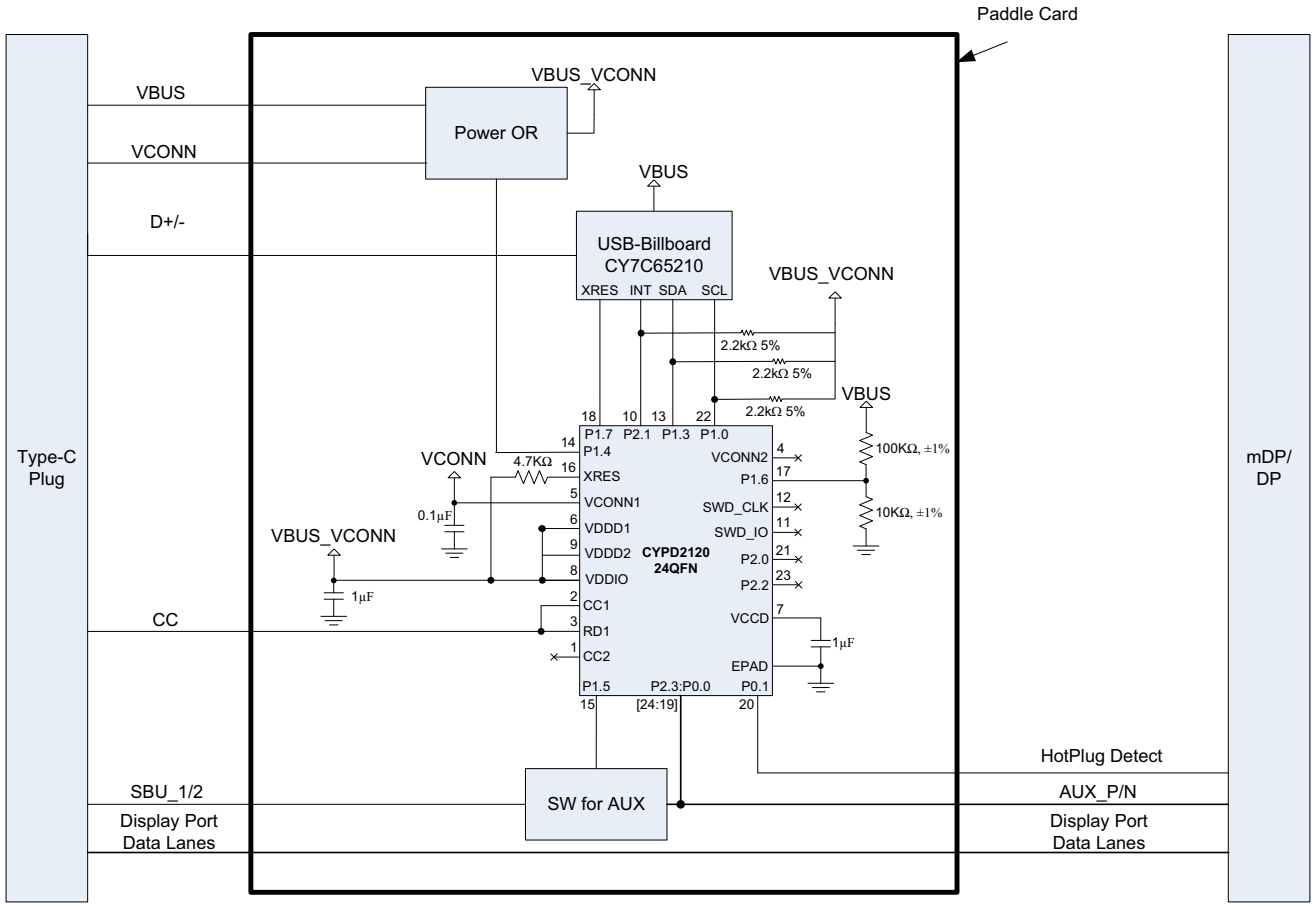
C-DisplayPort Dongle Application

CCG2 is not recommended for new designs of Type-C to video dongles. CCG3 offers a much more integrated solution for this application and also supports PD3.0. Please refer to the CCG3 datasheet for more details.This section is just maintained for legacy purposes only.

Figure 19 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 19 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 19. USB Type-C to Display Port Application Diagram



Dock/Monitor Application

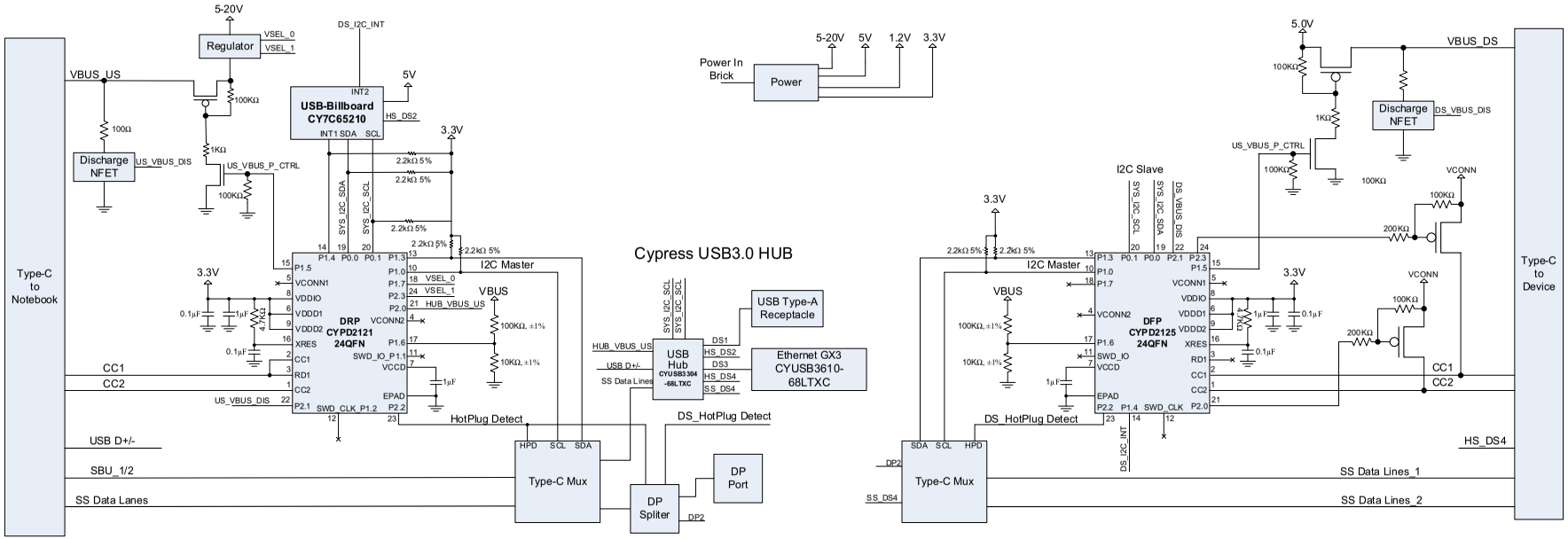
CCG2 is not recommended for new designs of docks/monitors. CCG4 offers a much more integrated solution for this application and also supports PD3.0. Please refer to the CCG4 datasheet more details.This section is just maintained for legacy purposes only.

Figure 20 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 20. CCG2 in Dock/Monitor Application Diagram



CCG2 connected on the Upstream Port

CCG2 connected on the Downstream Port

Electrical Specifications

Absolute Maximum Ratings

Table 2. Absolute Maximum Ratings[1]

Parameter	Description	Min	Typ	Max	Units	Details/Conditions
V_{DDD_MAX}	Digital supply relative to V_{SS}	–0.5	–	6	V	Absolute max
V_{CONN1_MAX}	Max supply voltage relative to V_{SS}	–	–	6	V	Absolute max
V_{CONN2_MAX}	Max supply voltage relative to V_{SS}	–	–	6	V	Absolute max
V_{DDIO_MAX}	Max supply voltage relative to V_{SS}	–	–	6	V	Absolute max
V_{GPIO_ABS}	GPIO voltage	–0.5	–	V_{DDIO} + 0.5	V	Absolute max
V_{CC_ABS}	Absolute max voltage for CC1 and CC2 pins	–	–	6	V	Absolute max
I_{GPIO_ABS}	Maximum current per GPIO	–25	–	25	mA	Absolute max
$I_{GPIO\_injection}$	GPIO injection current, Max for $V_{IH} > V_{DDD}$, and Min for $V_{IL} < V_{SS}$	–0.5	–	0.5	mA	Absolute max, current injected per pin
ESD_HBM	Electrostatic discharge human body model	2200	–	–	V	–
ESD_CDM	Electrostatic discharge charged device model	500	–	–	V	–
LU	Pin current for latch-up	–200	–	200	mA	–
ESD_IEC_CON	Electrostatic discharge IEC61000-4-2	8000	–	–	V	Contact discharge on CC1, CC2, VCONN1, and VCONN2 pins
ESD_IEC_AIR	Electrostatic discharge IEC61000-4-2	15000	–	–	V	Air discharge for pins CC1, CC2, VCONN1, and VCONN2

Note
1. Usage above the absolute maximum conditions listed in Table 2 may cause permanent damage to the device. Exposure to absolute maximum conditions for extended periods of time may affect device reliability. The maximum storage temperature is 150 °C in compliance with JEDEC Standard JESD22-A103, High Temperature Storage Life. When used below absolute maximum conditions but above normal operating conditions, the device may not operate to specification.

Device Level Specifications

All specifications are valid for –40 °C ≤ TA ≤ 85 °C and TJ ≤ 100 °C, except where noted. Specifications are valid for 3.0 V to 5.5 V, except where noted.

Table 3. DC Specifications

Spec ID	Parameter	Description	Min	Typ	Max	Units	Details/Conditions
SID.PWR#1	V_{DDD}	Power supply input voltage	2.7	–	5.5	V	UFP Applications
SID.PWR#1_A	V_{DDD}	Power supply input voltage	3.0	–	5.5	V	DFP/DRP Applications
SID.PWR#23	V_{CONN1}	Power supply input voltage	4.0	–	5.5	V	–
SID.PWR#23_A	V_{CONN2}	Power supply input voltage	4.0	–	5.5	V	–
SID.PWR#13	V_{DDIO}	GPIO power supply	1.71	–	5.5	V	–
SID.PWR#24	V_{CCD}	Output voltage (for core logic)	–	1.8	–	V	–
SID.PWR#15	C_{EFC}	External regulator voltage bypass on V_{CCD}	1	1.3	1.6	µF	X5R ceramic or better
SID.PWR#16	C_{EXC}	Power supply decoupling capacitor on V_{DDD}	–	1	–	µF	X5R ceramic or better
SID.PWR#25		Power Supply Decoupling Capacitor on V_{CONN1} and V_{CONN2}	–	0.1	–	µF	X5R ceramic or better
Active Mode, V_{DDD} = 2.7 to 5.5 V. Typical values measured at V_{DD} = 3.3 V.							
SID.PWR#12	I_{DD12}	Supply current	–	7.5	–	mA	V_{CONN1} or V_{CONN2} = 5 V, T_A = 25 °C, CC I/O IN Transmit or Receive, R_A disconnected, no I/O sourcing current, CPU at 12 MHz
Sleep Mode, V_{DDD} = 2.7 to 5.5 V							
SID25A	I_{DD20A}	I^2C wakeup. WDT ON. IMO at 48 MHz	–	2.0	3.0	mA	V_{DDD} = 3.3 V, T_A = 25 °C, all blocks except CPU are ON, CC I/O ON, no I/O sourcing current
Deep Sleep Mode, V_{DDD} = 2.7 to 3.6 V (Regulator on)							
SID_DS_RA	$I_{DD\_DS\_RA}$	V_{CONN1} = 5.0, R_A termination disabled	–	100	–	µA	V_{CONN1}, V_{CONN2} = 5 V, T_A = 25 °C. R_A termination disabled on V_{CONN1} and V_{CONN2}, see SID.PD.7. VCONN leaker circuits turned off during deep sleep
SID34	I_{DD29}	V_{DDD} = 2.7 to 3.6 V. I^2C wakeup and WDT ON	–	50	–	µA	R_A switch disabled on V_{CONN1} and V_{CONN2}. V_{DDD} = 3.3 V, T_A = 25 °C
SID_DS	I_{DD_DS}	V_{DDD} = 2.7 to 3.6 V. CC wakeup ON	–	2.5	–	µA	Power source = V_{DDD}, Type-C not attached, CC enabled for wakeup, R_P disabled
XRES Current							
SID307	I_{DD_XR}	Supply current while XRES asserted	–	1	10	µA	–

Table 4. 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_{DDD} ≤ 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 5. 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	$V_{HYSCMOS}$	Input hysteresis CMOS	0.05 × V_{DDIO}	–	–	mV	Guaranteed by characterization
SID69	I_{DIODE}	Current through protection diode to V_{DDIO}/Vss	–	–	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.

Table 6. I/O AC Specifications

(Guaranteed by Characterization)

Spec ID	Parameter	Description	Min	Typ	Max	Units	Details/Conditions
SID70	T_{RISEF}	Rise time	2	–	12	ns	3.3-V V_{DDIO}, Cload = 25 pF
SID71	T_{FALLF}	Fall time	2	–	12	ns	3.3-V V_{DDIO}, Cload = 25 pF

XRES

Table 7. XRES DC Specifications

Spec ID	Parameter	Description	Min	Typ	Max	Units	Details/Conditions
SID.XRES#1	V_{IH}	Input voltage HIGH threshold	0.7 × V_{DDIO}	–	–	V	CMOS input
SID.XRES#2	V_{IL}	Input voltage LOW threshold	–	–	0.3 × V_{DDIO}	V	CMOS input
SID.XRES#3	C_{IN}	Input capacitance	–	–	7	pF	Guaranteed by characterization
SID.XRES#4	$V_{HYSXRES}$	Input voltage hysteresis	–	–	0.05 × V_{DDIO}	mV	Guaranteed by characterization

Digital Peripherals

The following specifications apply to the Timer/Counter/PWM peripherals in the Timer mode.

Pulse Width Modulation (PWM) for GPIO Pins

Table 8. PWM AC Specifications

(Guaranteed by Characterization)

Spec ID	Parameter	Description	Min	Typ	Max	Units	Details/Conditions
SID.TCPWM.3	$T_{CPWMFREQ}$	Operating frequency	–	Fc	–	MHz	Fc max = CLK_SYS. Maximum = 48 MHz.
SID.TCPWM.4	$T_{PWMENEXT}$	Input trigger pulse width	–	2/Fc	–	ns	For all Trigger Events
SID.TCPWM.5	T_{PWMEXT}	Output trigger pulse width	–	2/Fc	–	ns	Minimum possible width of Overflow, Underflow, and CC (Counter equals Compare value) outputs
SID.TCPWM.5A	T_{CRES}	Resolution of counter	–	1/Fc	–	ns	Minimum time between successive counts
SID.TCPWM.5B	PWM_{RES}	PWM resolution	–	1/Fc	–	ns	Minimum pulse width of PWM output
SID.TCPWM.5C	Q_{RES}	Quadrature inputs resolution	–	1/Fc	–	ns	Minimum pulse width between quadrature-phase inputs

I^2C

Table 9. 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 10. 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	–

UART

Table 11. 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 12. 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

SPI

Table 13. 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 14. 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 15. 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 16. 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 Sclock Capturing edge	40	–	–	ns	Guaranteed by characterization
SID171	T_{DSO}	MISO Valid after Sclock driving edge	–	–	42 + (3 × T_{CPU})	ns	TCPU = 1/FCPU. Guaranteed by characterization.
SID171A	T_{DSO_EXT}	MISO Valid after Sclock 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	$T_{SSELSCK}$	SSEL Valid to first SCK Valid edge	100	–	–	ns	Guaranteed by characterization

Memory

Table 17. 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. $T_A \leq 55$ °C, 100 K P/E cycles	20	–	–	years	Guaranteed by characterization
SID182A	F_{RET2}	Flash retention. $T_A \leq 85$ °C, 10 K P/E cycles	10	–	–	years	Guaranteed by characterization

Note

3. 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 18. 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 19. 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 20. SWD Interface Specifications

Spec ID	Parameter	Description	Min	Typ	Max	Units	Details/Conditions
SID.SWD#1	F_SWDCLK1	$3.3\ V \le V_{DDIO} \le 5.5\ V$	–	–	14	MHz	SWDCLK ≤ 1/3 CPU clock frequency
SID.SWD#2	F_SWDCLK2	$1.8\ V \le V_{DDIO} \le 3.3\ V$	–	–	7	MHz	SWDCLK ≤ 1/3 CPU clock frequency
SID.SWD#3	T_SWDI_SETUP	T = 1/f SWDCLK	0.25 × T	–	–	ns	Guaranteed by characterization
SID.SWD#4	T_SWDI_HOLD	T = 1/f SWDCLK	0.25 × T	–	–	ns	Guaranteed by characterization
SID.SWD#5	T_SWDO_VALID	T = 1/f SWDCLK	–	–	0.5 × T	ns	Guaranteed by characterization
SID.SWD#6	T_SWDO_HOLD	T = 1/f SWDCLK	1	–	–	ns	Guaranteed by characterization

Internal Main Oscillator

Table 21. 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 22. 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 23. 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 24. 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 25. 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	–	M	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 26. 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 27. 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

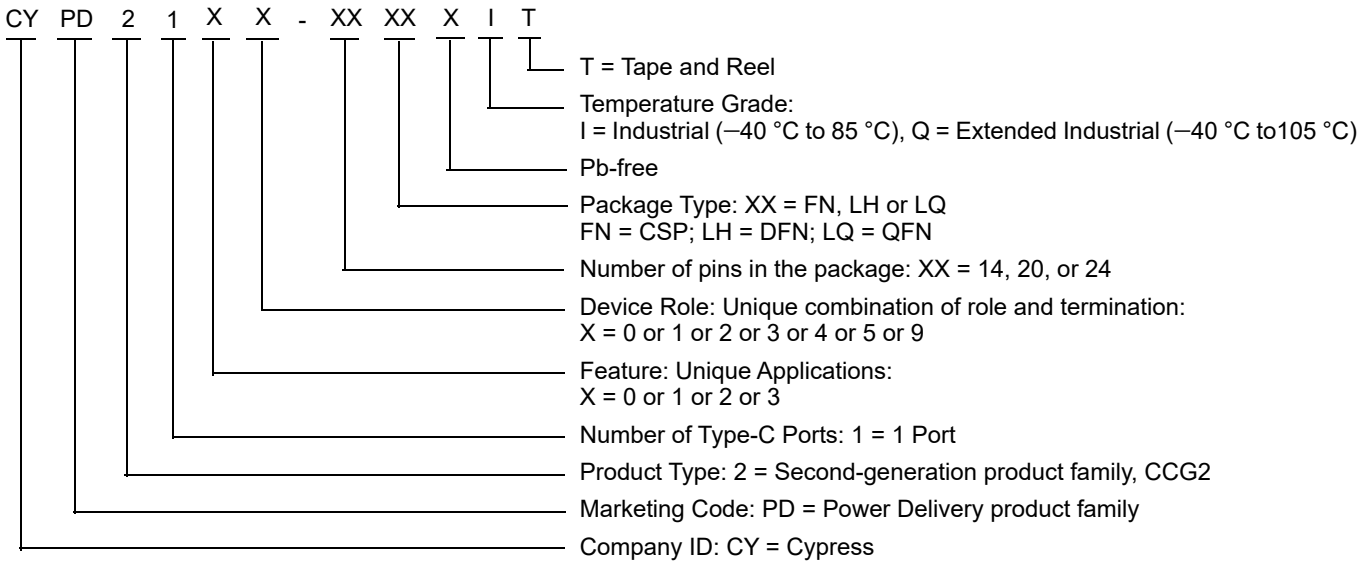
Ordering Information

The EZ-PD CCG2 part numbers and features are listed in Table 28.

Table 28. EZ-PD CCG2 Ordering Information

Part Number	Application	Type-C Ports	Termination Resistor	Role	Default FW	Package
CYPD2103-20FNXIT	Cable	1	R_A[4]	Cable	EMCA CC Bootloader with Application firmware	20-ball CSP
CYPD2103-14LHXIT	Cable	1	R_A[4]	Cable		14-pin DFN
CYPD2104-20FNXIT	Accessory	1	R_D[5]	Accessory	I^2C Bootloader Only	20-ball CSP
CYPD2105-20FNXIT	Active Cable	1	R_A[4]	Active Cable	EMCA CC Bootloader with Application firmware	20-ball CSP
CYPD2119-24LQXIT	C-DP	1	R_D[5]	UFP	I^2C Bootloader with Application firmware	24-pin QFN
CYPD2120-24LQXIT	C-HDMI	1	R_D[5]	UFP		24-pin QFN
CYPD2121-24LQXIT	Dock/Monitor Upstream port	1	R_P[6], R_D[5]	DRP	I^2C Bootloader Only	24-pin QFN
CYPD2122-20FNXIT	Tablet	1	R_P[6], R_D[5]	DRP		20-ball CSP
CYPD2122-24LQXI	Notebook	1	R_P[6], R_D[5]	DRP		24-pin QFN
CYPD2122-24LQXIT	Notebook	1	R_P[6], R_D[5]	DRP		24-pin QFN
CYPD2125-24LQXIT	Dock/Monitor Downstream port	1	R_P[6]	DFP		24-pin QFN
CYPD2134-24LQXIT	DFP	1	R_P[6]	DFP	DFP CC Bootloader Only	24-pin QFN
CYPD2134-24LQXQT	DFP	1	R_P[6]	DFP		24-pin QFN

Ordering Code Definitions



Notes
4. Termination resistor denoting an EMCA.
5. Termination resistor denoting an accessory or upstream facing port.
6. Termination resistor denoting a downstream facing port.

Packaging

Table 29. 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

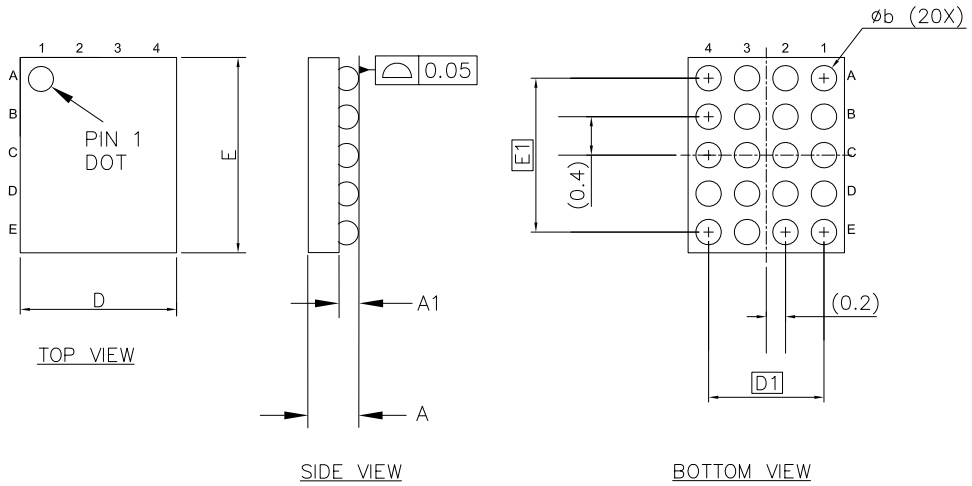
Table 30. Solder Reflow Peak Temperature

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 31. 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 21. 20-ball WLCSP (1.63 × 2.03 × 0.55 mm) Package Outline, 001-95010



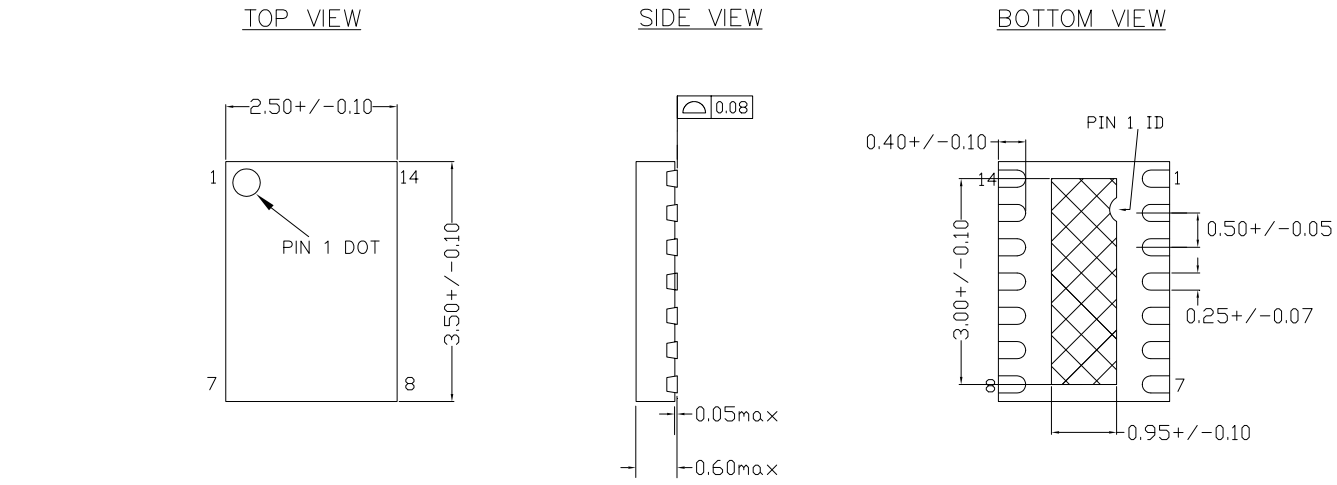
SYMBOL	DIMENSIONS		
	MIN.	NOM.	MAX.
A	——	——	0.55
A1	0.18	0.21	0.24
D	1.605	1.63	1.655
E	2.005	2.03	2.055
D1	1.2 BSC		
E1	1.6 BSC		
n	20		
Øb	0.23	0.26	0.29

NOTES

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

001-95010 *B

Figure 22. 14-pin DFN ((2.5 × 3.5 × 0.6 mm) 0.95 × 3.00 E-Pad (Sawn)) Package Outline, 001-96312

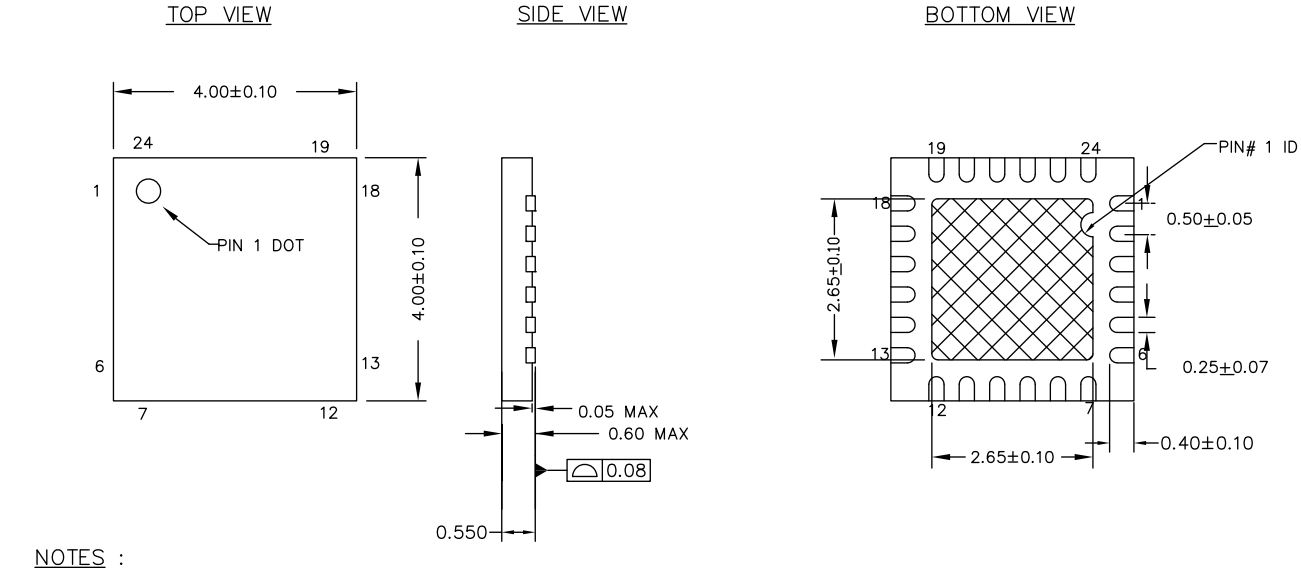


NOTES :

1. HATCH AREA IS SOLDERABLE EXPOSED METAL
2. ALL DIMENSIONS ARE IN MILLIMETERS

001-96312 **

Figure 23. 24-Pin QFN ((4 × 4 × 0.55 mm) 2.65 × 2.65 E-Pad (Sawn)) Package Outline, 001-13937



NOTES :

1. HATCH IS SOLDERABLE EXPOSED METAL.
2. REFERENCE JEDEC # MO-248
3. PACKAGE WEIGHT : 29 ± 3 mg
4. ALL DIMENSIONS ARE IN MILLIMETERS

001-13937 *H

Acronyms

Table 32. 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
I^2C, 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
LVTTL	low-voltage transistor-transistor logic
MCU	microcontroller unit
NC	no connect
NMI	nonmaskable interrupt
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	I^2C serial clock
SDA	I^2C 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 33. 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
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

References and Links To Applications Collaterals

Knowledge Base Articles

- Key Differences Among EZ-PD™ CCG1, CCG2, CCG3 and CCG4 – KBA210740
- Programming EZ-PD™ CCG2, EZ-PD™ CCG3 and EZ-PD™ CCG4 Using PSoC® Programmer and MiniProg3 – KBA96477
- CCGX Frequently Asked Questions (FAQs) – KBA97244
- Handling Precautions for CY4501 CCG1 DVK – KBA210560
- Cypress EZ-PD™ CCGx Hardware – KBA204102
- Difference between USB Type-C and USB-PD – KBA204033
- CCGx Programming Methods – KBA97271
- Getting started with Cypress USB Type-C Products – KBA04071
- Type-C to DisplayPort Cable Electrical Requirements
- Dead Battery Charging Implementation in USB Type-C Solutions – KBA97273
- Termination Resistors Required for the USB Type-C Connector – KBA97180
- VBUS Bypass Capacitor Recommendation for Type-C Cable and Type-C to Legacy Cable/Adapter Assemblies – KBA97270
- Need for Regulator and Auxiliary Switch in Type-C to DisplayPort (DP) Cable Solution – KBA97274
- Need for a USB Billboard Device in Type-C Solutions – KBA97146
- CCG1 Devices in Type-C to Legacy Cable/Adapter Assemblies – KBA97145
- Cypress USB Type-C Controller Supported Solutions – KBA97179
- Termination Resistors for Type-C to Legacy Ports – KBA97272
- Handling Instructions for CY4502 CCG2 Development Kit – KBA97916
- Thunderbolt™ Cable Application Using CCG3 Devices - KBA210976
- Power Adapter Application Using CCG3 Devices – KBA210975
- Methods to Upgrade Firmware on CCG3 Devices – KBA210974
- Device Flash Memory Size and Advantages – KBA210973
- Applications of EZ-PD™ CCG4 – KBA210739

Application Notes

- AN96527 – Designing USB Type-C Products Using Cypress's CCG1 Controllers
- AN95615 – Designing USB 3.1 Type-C Cables Using EZ-PD™ CCG2
- AN95599 – Hardware Design Guidelines for EZ-PD™ CCG2
- AN210403 – Hardware Design Guidelines for Dual Role Port Applications Using EZ-PD™ USB Type-C Controllers
- AN210771 – Getting Started with EZ-PD™ CCG4

Reference Designs

- EZ-PD™ CCG2 Electronically Marked Cable Assembly (EMCA) Paddle Card Reference Design
- EZ-PD™ CCG2 USB Type-C to DisplayPort Cable Solution
- CCG1 USB Type-C to DisplayPort Cable Solution
- CCG1 USB Type-C to HDMI/DVI/VGA Adapter Solution
- EZ-PD™ CCG2 USB Type-C to HDMI Adapter Solution
- CCG1 Electronically Marked Cable Assembly (EMCA) Paddle Card Reference Design
- CCG1 USB Type-C to Legacy USB Device Cable Paddle Card Reference Schematics
- EZ-USB GX3 USB Type-C to Gigabit Ethernet Dongle
- EZ-PD™ CCG2 USB Type-C Monitor/Dock Solution
- CCG2 20W Power Adapter Reference Design
- CCG2 18W Power Adapter Reference Design
- EZ-USB GX3 USB Type-A to Gigabit Ethernet Reference Design Kit

Kits

- CY4501 CCG1 Development Kit
- CY4502 EZ-PD™ CCG2 Development Kit
- CY4531 EZ-PD™ CCG3 Evaluation Kit
- CY4541 EZ-PD™ CCG4 Evaluation Kit

Datasheets

- CCG1 Datasheet: USB Type-C Port Controller with Power Delivery
- CYPD1120 Datasheet: USB Power Delivery Alternate Mode Controller on Type-C
- CCG3: USB Type-C Controller Datasheet
- CCG4: Two-Port USB Type-C Controller Datasheet

Document History Page

Description Title: EZ-PD™ CCG2 Datasheet, USB Type-C Port Controller Document Number: 001-93912			
Revision	**ECN**	**Submission Date**	**Description of Change**
*E	4680071	03/07/2015	Post to external web.
*F	4718374	04/09/2015	Added 24-pin QFN package related information in all instances across the document. Updated Application Diagrams: Added Figure 16. Added Figure 17. Updated Ordering Information: Updated Table 28: Updated part numbers. Updated Packaging: Added spec 001-13937 *E.
*G	4774142	06/15/2015	Changed status from Preliminary to Final. Updated Logic Block Diagram. Updated Functional Overview: Updated GPIO: Updated description. Updated Power: Updated description. Updated Application Diagrams: Updated Figure 17. Updated Electrical Specifications: Updated Device Level Specifications: Updated Table 3: Added SID.PWR#1_A spec and its corresponding details. Updated Digital Peripherals: Updated UART: Updated Table 11: Updated all values corresponding to SID160 spec. Updated Ordering Information: Updated Table 28: Updated part numbers. Removed “Errata”.
*H	4979175	10/23/2015	Updated EZ-PD CCG2 Block Diagram: Updated Figure 1. Updated Pinouts: Updated Figure 5.

Document History Page *(continued)*

Description Title: EZ-PD™ CCG2 Datasheet, USB Type-C Port Controller Document Number: 001-93912			
Revision	**ECN**	**Submission Date**	**Description of Change**
*H (cont.)	4979175	10/23/2015	Updated Electrical Specifications: Updated Absolute Maximum Ratings: Updated Table 2: Added VCC_ABS spec and its corresponding details. Updated Device Level Specifications: Updated I/O: Updated Table 5: Updated details in “Details/Conditions” column corresponding to SID.GIO#16, SID.GIO#17 specs. Updated XRES: Updated Table 7: Updated details in “Details/Conditions” column corresponding to SID.XRES#3 spec. Updated Digital Peripherals: Updated UART: Updated Table 11: Updated details in “Details/Conditions” column corresponding to all specs. Updated Table 12: Updated details in “Details/Conditions” column corresponding to all specs. Updated SPI: Updated Table 13: Updated details in “Details/Conditions” column corresponding to all specs. Updated Table 14: Updated details in “Details/Conditions” column corresponding to all specs. Updated Table 15: Updated details in “Details/Conditions” column corresponding to all specs. Updated Table 16: Updated details in “Details/Conditions” column corresponding to all specs. Updated System Resources: Updated Internal Main Oscillator: Updated Table 13: Updated details in “Details/Conditions” column corresponding to SID226, SID229 specs Updated Analog-to-Digital Converter: Updated Table 26: Updated details in “Details/Conditions” column corresponding to all specs. Updated all values corresponding to SID.ADC.4 spec. Updated Table 27: Updated details in “Details/Conditions” column corresponding to all specs.
*I	5028128	12/04/2015	Updated Application Diagrams: Added Figure 18. Added Figure 19. Added Figure 20. Updated Ordering Information: Updated Table 28: Updated part numbers.
*J	5186972	03/28/2016	Updated Features: Updated Packages: Updated description. Updated Ordering Information: Updated Table 28: Updated part numbers. Updated Packaging: No change in revisions. Updated Table 29: Updated all details corresponding to T_A and T_J parameters.

Document History Page *(continued)*

Description Title: EZ-PD™ CCG2 Datasheet, USB Type-C Port Controller Document Number: 001-93912			
Revision	**ECN**	**Submission Date**	**Description of Change**
*K	5303957	06/13/2016	Added Available Firmware and Software Tools. Updated Application Diagrams: Added description. Updated Figure 12. Updated Figure 15. Updated Figure 16. Updated Figure 17. Added References and Links To Applications Collaterals. Updated to new template.
*L	5387677	08/02/2016	Updated Ordering Information: Updated Table 28: Updated part numbers. Completing Sunset Review.
*M	6097993	07/11/2018	Updated Application Diagrams: Updated description. Updated Figure 11 (Updated caption only). Added Figure 12. Updated Figure 13 (Updated caption only). Added Figure 14. Updated Packaging: spec 001-95010 – Changed revision from *A to *B. spec 001-13937 – Changed revision from *F to *G. Added compliance to USB Specification. Updated to new template.
*N	7035126	12/04/2020	Updated Figure 6 in Power section. Added CCG2 Programming and Bootloading section. Updated descriptions before all application diagrams in Application Diagrams section. Added column “Default FW” in Table 28 in Ordering Information section. Updated Figure 23 in Packaging section.

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