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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	I ² C, 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/cypd2119-24lqxit

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>

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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	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)

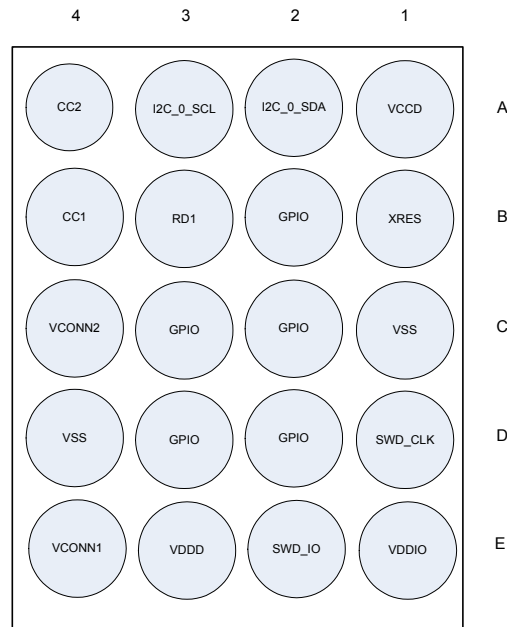


Figure 4. 14-pin DFN Pin Map (Top View)

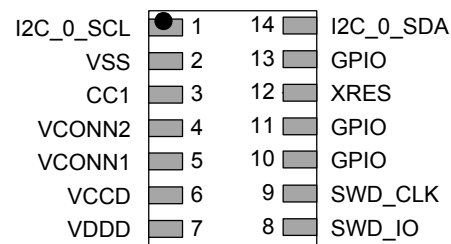
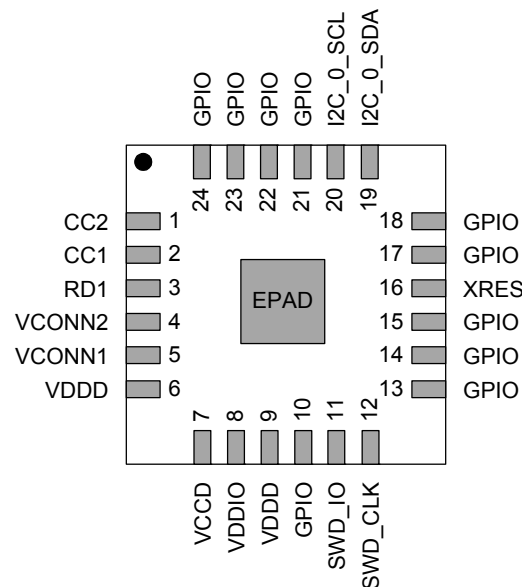


Figure 5. 24-Pin QFN Pin Map (Top View)



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 operated 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.

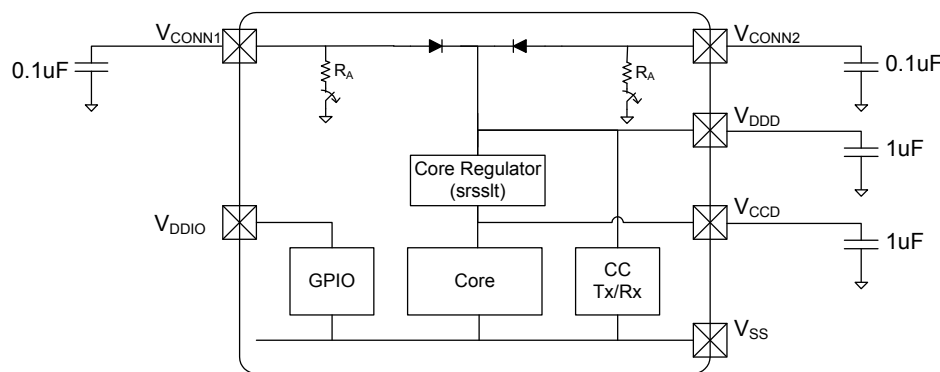
A separate I/O supply pin, VDDIO, allows the GPIOs to operate at levels from 1.71 to 5.5 V. The VDDIO pin can be equal to or less than the voltages connected to the VCONN1, VCONN2, and VDDD pins. The independent VDDIO supply is not available on the 14-DFN package. On this package, the VDDIO rail is internally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

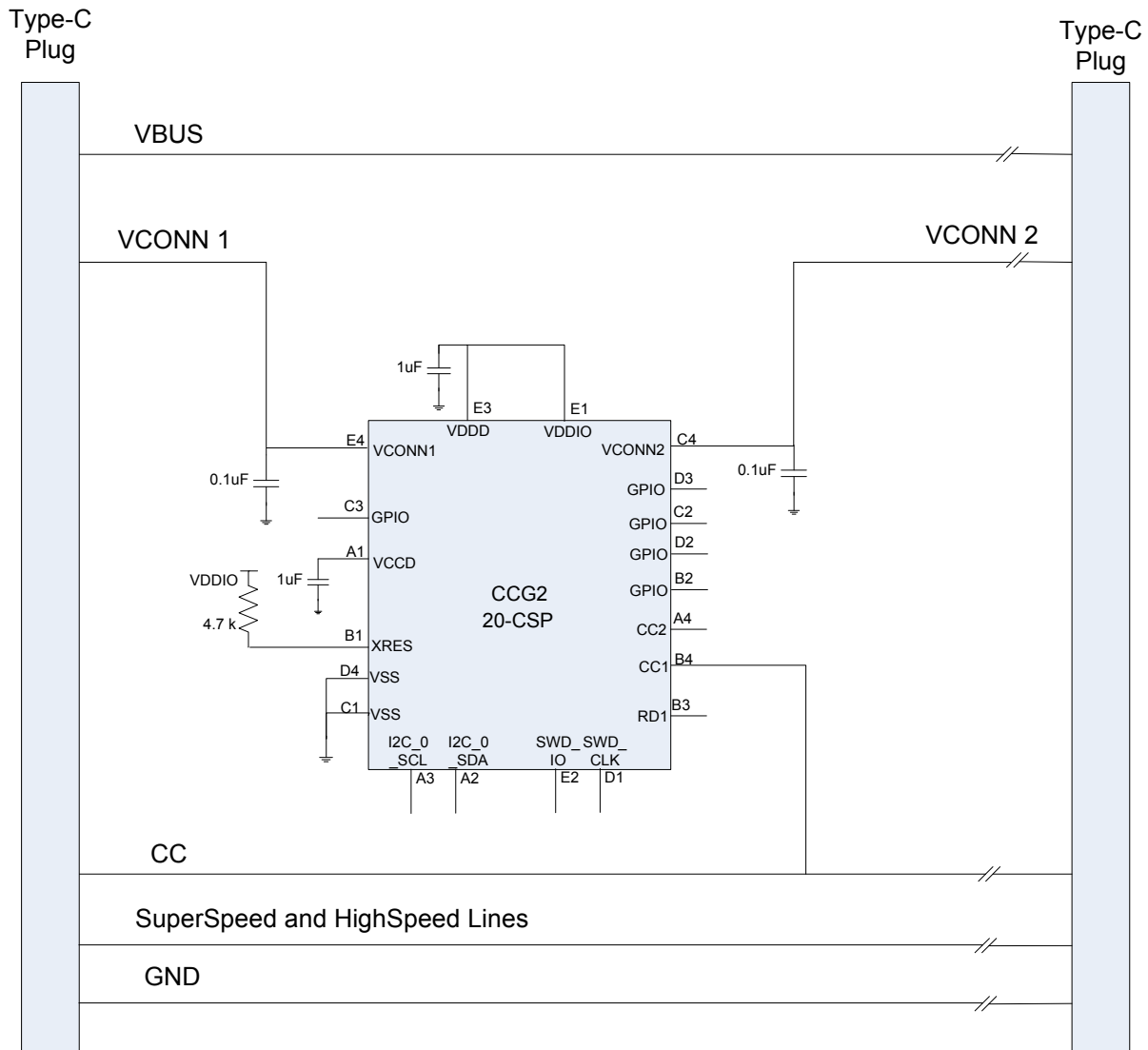


Application Diagrams

Figure 7 and Figure 8 show the application diagrams of a Passive EMCA application using CCG2 devices. Figure 7 shows the application using a single CCG2 device per cable present at one of the two plugs, whereas Figure 8 shows 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 diagram shown in Figure 7 requires 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 diagram shown in Figure 8, 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.

Figure 7. Passive EMCA Application – Single EZ-PD CCG2 Per Cable



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 I²C 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.

The diagram illustrates the internal circuitry of the CC2 USB-C connector. It shows the connection between the CC2 chip and the external components, including the Charger (VBUS), Application Processor, and Application Processor/Graphics Controller. The chip is powered by a 5.0V supply (VDD) and a 1.8V supply (VDDIO). The chip has pins for VCONN2, VCONN1, SWD_IO, SWD_CLK, GPIO, I2C_0_SCL, I2C_0_SDA, VSS, VCCD, and XRES. It also has pins for D3, C2, D2, B2, A4, B4, C4, B3, and A1. The diagram shows the connection of the chip to a Type-C Receptacle, which includes a 1.8V supply, a 4.7kΩ resistor, and a 390pF capacitor. The chip is labeled 'CCG2'.

Figure 11 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.

Figure 11. Downstream Facing Port (DFP) Application

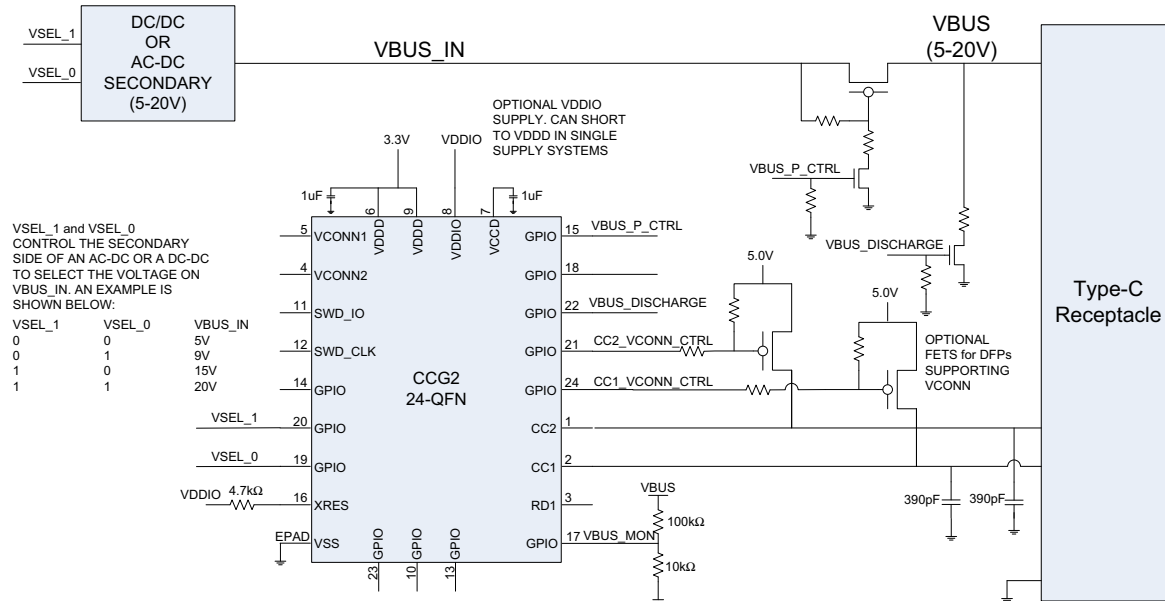


Figure 12 shows a USB Type-C to HDMI/DVI/VGA adapter application, which enables connectivity between a PC that supports a Type-C port with DisplayPort Alternate Mode support and a legacy monitor that has HDMI/DVI/VGA interface. It enables users of any Notebook that implements USB-Type C to connect to 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 appli-

cation 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 12. USB Type-C to HDMI/DVI/VGA Dongle Application Diagram

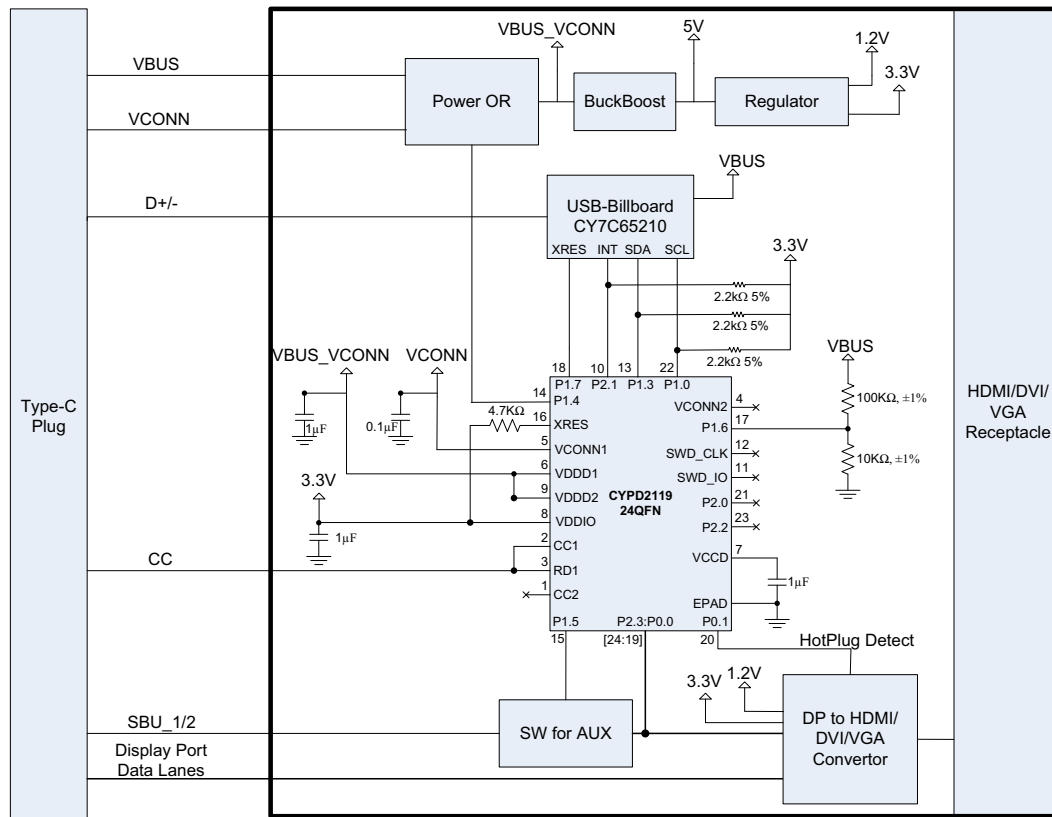
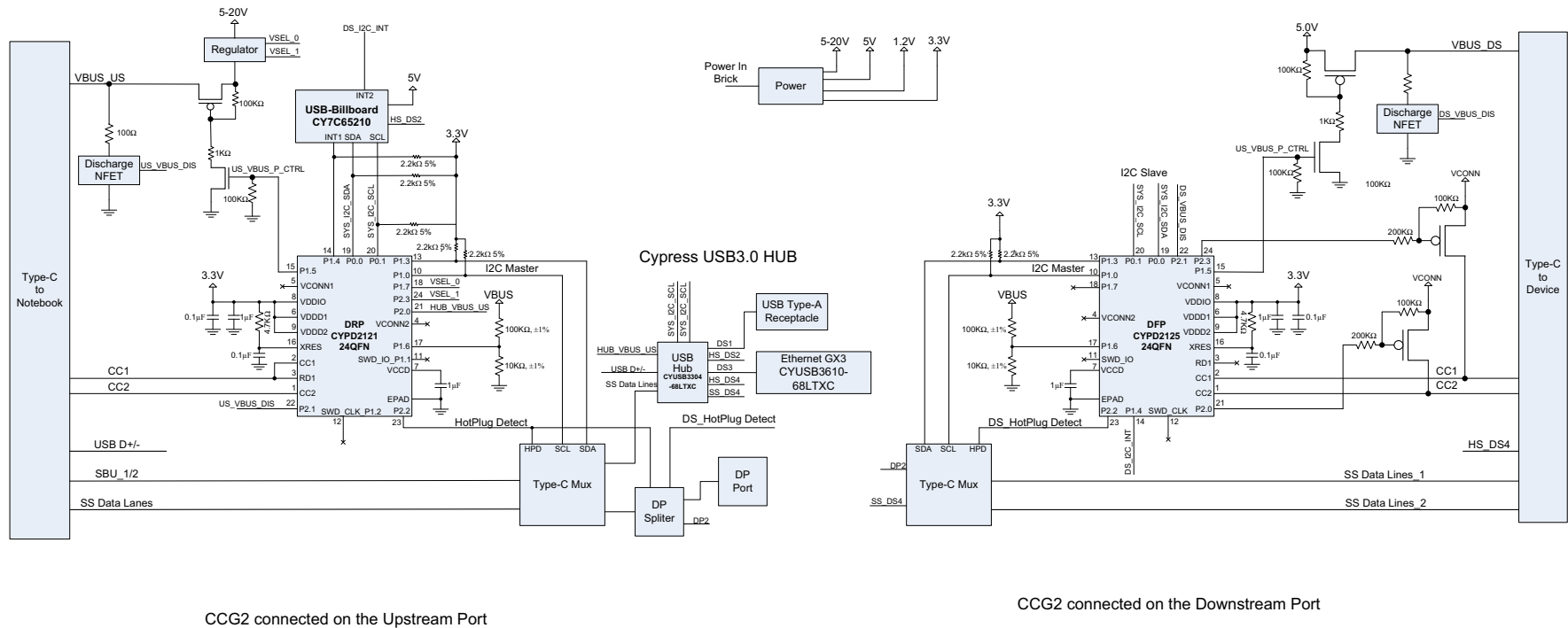


Figure 14 shows a CCG2 Monitor/Dock application diagram. It enables connectivity between a USB Type-C host system on the Upstream port and multiple Display/Data devices on the Downstream port. This application has a USB Type-C receptacle on the Upstream port, which supports data, power, and display.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



Device Level Specifications

All specifications are valid for $-40\text{ }^{\circ}\text{C} \leq T_A \leq 85\text{ }^{\circ}\text{C}$ and $T_J \leq 100\text{ }^{\circ}\text{C}$, except where noted. Specifications are valid for 3.0 V to 5.5 V, except where noted.

Table 2. 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 ² C 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 ² C 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 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.

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 _{SSELSCK}	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.

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	R _{p_std}	DFP CC termination for default USB Power	64	80	96	μA	–
SID.PD.2	R _{p_1.5A}	DFP CC termination for 1.5A power	166	180	194	μA	–
SID.PD.3	R _{p_3.0A}	DFP CC termination for 3.0A power	304	330	356	μA	–
SID.PD.4	R _d	UFP CC termination	4.59	5.1	5.61	kΩ	–
SID.PD.5	R _{d_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	R _{a_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	R _{leak_1}	V _{CONN} leaker for 0.1-μF load	–	–	216	kΩ	Managed Active Cable (MAC) discharge
SID.PD.9	R _{leak_2}	V _{CONN} leaker for 0.5-μF load	–	–	41.2	kΩ	
SID.PD.10	R _{leak_3}	V _{CONN} leaker for 1.0-μF load	–	–	19.6	kΩ	
SID.PD.11	R _{leak_4}	V _{CONN} leaker for 2.0-μF load	–	–	9.8	kΩ	
SID.PD.12	R _{leak_5}	V _{CONN} leaker for 5.0-μF load	–	–	4.1	kΩ	
SID.PD.13	R _{leak_6}	V _{CONN} leaker for 10-μF load	–	–	2.0	kΩ	
SID.PD.14	I _{leak}	Leaker on V _{CONN1} and V _{CONN2} for discharge upon cable detach	150	–	–	μA	–

Analog-to-Digital Converter

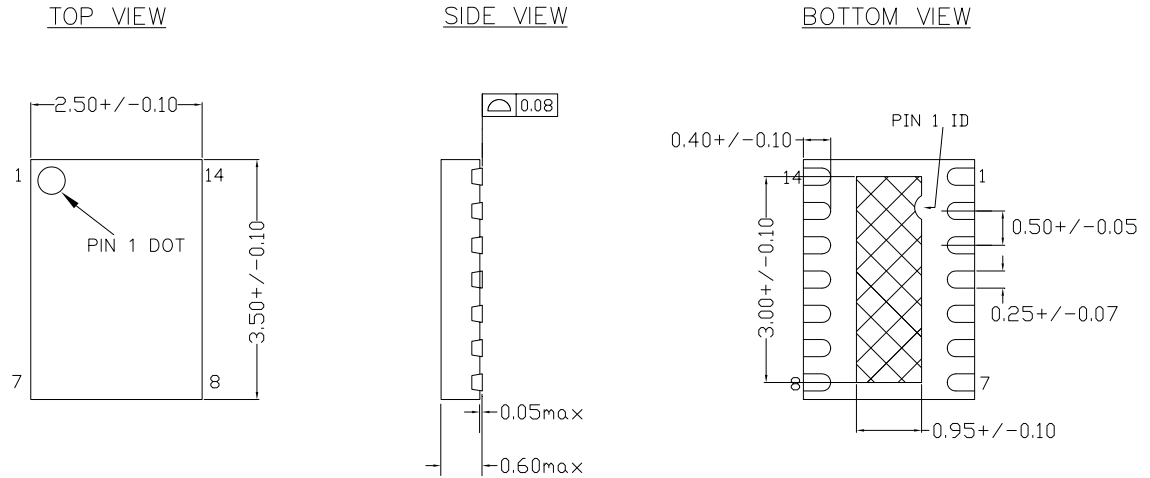
Table 25. ADC DC Specifications

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

Figure 16. 14-pin DFN (2.5 × 3.5 × 0.6 mm), LH14A, 0.95 × 3.00 E-Pad (Sawn) Package Outline, 001-96312

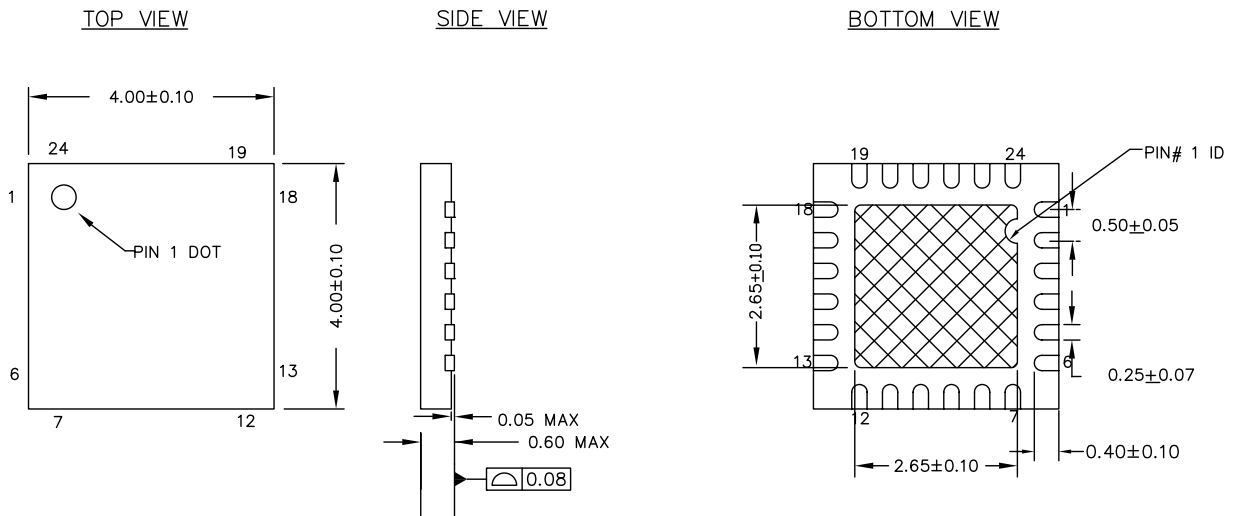


NOTES :


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

001-96312 **

Figure 17. 24-Pin QFN (4 × 4 × 0.55 mm), LQ24A, 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 *F

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
I ² C, 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	I ² C serial clock
SDA	I ² C 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

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