CYPD1120

USB Power Delivery Alternate Mode Controller on Type-C

General Description

The CYPD1120 device belongs to Cypress's CCG1 product family, which provides a complete USB Type-C and USB Power Delivery port control solution. The scalable and reconfigurable core architecture of CCG1 enables a base Type-C solution that can scale to a complete 100-W USB Power Delivery with Alternate Mode mux support. CCG1 is also a Type-C cable ID IC for active and passive cables. The ARM® Cortex®-M0 CPU based core can use common open source firmware or custom solutions developed with common libraries and APIs. CCG1 is the CC controller that detects connector insert, plug orientation, and V_{CONN} switching signals. CCG1 makes it easier to add USB Power Delivery to any architecture because it provides the control signals to manage external VBUS and V_{CONN} power management solutions as well as external mux controls for most single cable-docking solutions. CCG1's packaging options, and programmability, enables any USB Type-C and USB Power Delivery solution.

Applications

- Dongles, docking stations
- Type-C to DisplayPort
- Type-C to HDMI
- Type-C to DVI
- Type-C to VGA

Features

32-bit MCU Subsystem

- 48-MHz ARM Cortex-M0 CPU with 32-KB flash and 4-KB SRAM

Integrated Analog Blocks

- 12-bit, 1-Msps ADC for VBUS voltage and current monitoring

Integrated Digital Blocks

- Two configurable 16-bit TCPWM blocks
- One I^2C master or slave

Type-C Support

- Integrated transceiver (BB PHY)

PD Support

- Supports VESA DisplayPort Alternate Mode on USB Type-C Standard Version 1.0

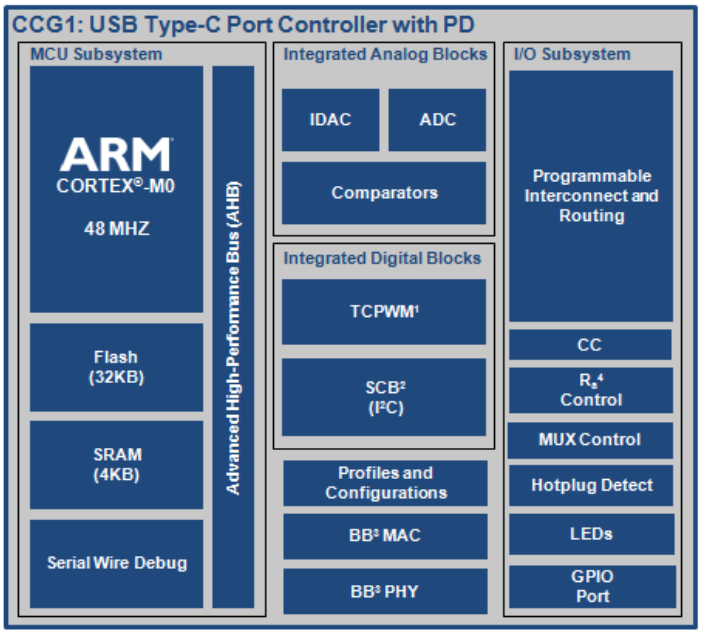
Low-power Operation

- 1.8-V to 5.5-V operation
- Sleep 1.3 mA, Deep Sleep 1.3 uA[2]

Packages

- 40-pin QFN
- 35-ball wafer-level CSP (WLCSP)

Figure 1. CCG1 Block Diagram[2, 3, 4, 5]



Notes

1. Values measured for CCG1 silicon only. Application specific power numbers may be higher.
2. Timer, counter, pulse-width modulation block.
3. Serial communication block configurable as I^2C.
4. Base band.
5. Termination resistor denoting an Alternate Mode Adaptor.

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Functional Definition

CPU and Memory Subsystem

CPU

The Cortex-M0 CPU in the CCG1 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 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 debug interface, the serial wire debug (SWD) interface, which is a 2-wire form of JTAG; the debug configuration used for CCG1 has four break-point (address) comparators and two watchpoint (data) comparators.

Flash

The CCG1 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 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.

System Resources

Power System

The power system is described in detail in the section Power on page 7. 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)). The CCG1 operates with a single external supply over the range of 1.8 to 5.5 V and has three different power modes: Active, Sleep, and Deep Sleep; transitions between modes are managed by the power system.

Serial Communication Blocks (SCB)

The CCG1 has one SCB, which can implement an I^2C interface. The hardware I^2C block implements a full multi-master and slave interface (it is capable of multimaster arbitration). In addition, the block supports an 8-deep FIFO for receive and transmit which, by increasing the time given for the CPU to read data, greatly reduces the need for clock stretching caused by the CPU not having read data on time.

The I^2C peripheral is 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/O is implemented with GPIO in open-drain modes.

The CCG1 is not completely compliant with the I^2C spec in the following respects:

- GPIO cells 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.
- When the SCB is an I^2C Master, it interposes an IDLE state between NACK and Repeated Start; the I^2C spec defines Bus free as following a Stop condition so other Active Masters do not intervene but a Master that has just become activated may start an Arbitration cycle.
- When the SCB is in the I^2C Slave mode, and Address Match on External Clock is enabled (EC_AM = 1) along with operation in the internally clocked mode (EC_OP = 0), then its I^2C address must be even.

GPIO

The CCG1 has up to 10 GPIOs, which are configured for various functions. Refer to the pinout tables for the definitions. The GPIO block implements the following:

- Eight drive strength modes:
  - Analog input mode (input and output buffers disabled)
  - 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.

Pin Definitions

Table 1 provides the pin definitions for 40-pin QFN and 35-ball WLCSP for the notebook, tablet, smartphone, and monitor applications. Refer to Table 20 on page 18 for par numbers to package mapping.

Table 1. Pin Definition for 40-Pin QFN and 35-Ball WLCSP

Functional Pin Name	CYPD1120-35FNXIT	CYPD1120-40LQXI	Type	Description
CC1_RX	C4	35	I	CC1 control 0: TX enabled z: RX sense
CC1_TX	D7	38	O	Configuration Channel 1
SWD_IO	D1	12	I/O	SWD IO
SWD_CLK	C1	13	I	SWD Clock
I2C_SCL	B1	18	I	I^2C Slave Clock signal
I2C_SDA	B2	19	I/O	I^2C Slave Data signal
I2C_INT	A2	20	O	I^2C INT
XRES	B6	30	I	Active Low Reset
VCCD	A7	31	POWER	Connect 1-µF capacitor between VCCD and Ground
VDDD	C7	32	POWER	VCONN Supply
VDDA	C7	33	POWER	
VSSA	B7	34	GND	Ground
VSS	–	9	GND	Ground
CC_VREF	C5	36	I	Data reference signal for CC lines
ADC_BYPASS	E7	40	I	No Connect
TX_U	B3	26	O	Signals for internal use only. The TX_U output signal should be connected to the TX_M signal
TX_M	B5	29	I	
TX_REF_IN	D3	3	I	Reference signal for internal use. Connect to TX_REF output via a 2.4K 1% resistor
TX_GND	A3	25	I	Connect to GND via 2K 1% resistor
TX_REF_OUT	D4	39	O	Reference signal generated by connecting internal current source to two 1K external resistors
RA_DISCONNECT	E4	4	O	Optional control signal to remove RA after assertion of VCONN 0: RA disconnected 1: RA connected
CC1_LPREF	A5	23	I	Reference signal for internal use. Connect to the output of resistor divider from VDDD.
VCONN_DET	E5	5	O	Detects presence of VCONN before responding to CC communication
BYPASS	D5	–	I	Bypass capacitor for internal analog circuits
	–	37		
CC1_LPRX	C3	22	I	Configuration Channel 1 RX signal for Low Power States
VBUS_DET	B4	28	I	Detects presence of VBUS before enabling Billboard device

Table 1. Pin Definition for 40-Pin QFN and 35-Ball WLCSP *(continued)*

Functional Pin Name	CYPD1120-35FNXIT	CYPD1120-40LQXI	Type	Description
BILLBOARD_CTRL	D6	–	O	Enables Billboard Device
	–	1		
DP_AUX_CTRL	E1	10	O	Closes AUX_P/N switch after successful Alternate Mode entry
AUX_CH_P_SENSE	E2	8	I	Senses presence of DisplayPort on UFP_D
AUX_CH_N_SENSE	E3	7	I	Senses presence of DisplayPort on DFP_D
HOTPLUG_DET	E6	6	I/O	HotPlug Detection/Driver for DisplayPort Alternate Mode
GPIO_0	A1	21	I/O	GPIO
GPIO_1	A6	27	I/O	GPIO
GPIO_2	C2	14	I/O	GPIO
GPIO_3	D2	11	I/O	GPIO
GPIO_4	C6	–	I/O	GPIO
	–	2		
GPIO_5	A4	24	I/O	GPIO
GPIO_6	–	15	I/O	GPIO
GPIO_7	–	16	I/O	GPIO
GPIO_8	–	17	I/O	GPIO

Pinouts

Figure 2. 40-pin QFN Pinout

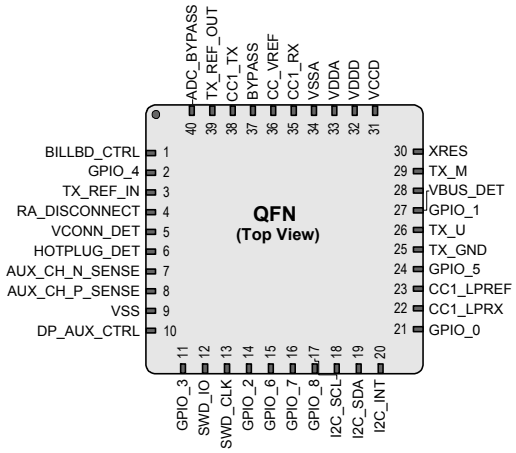
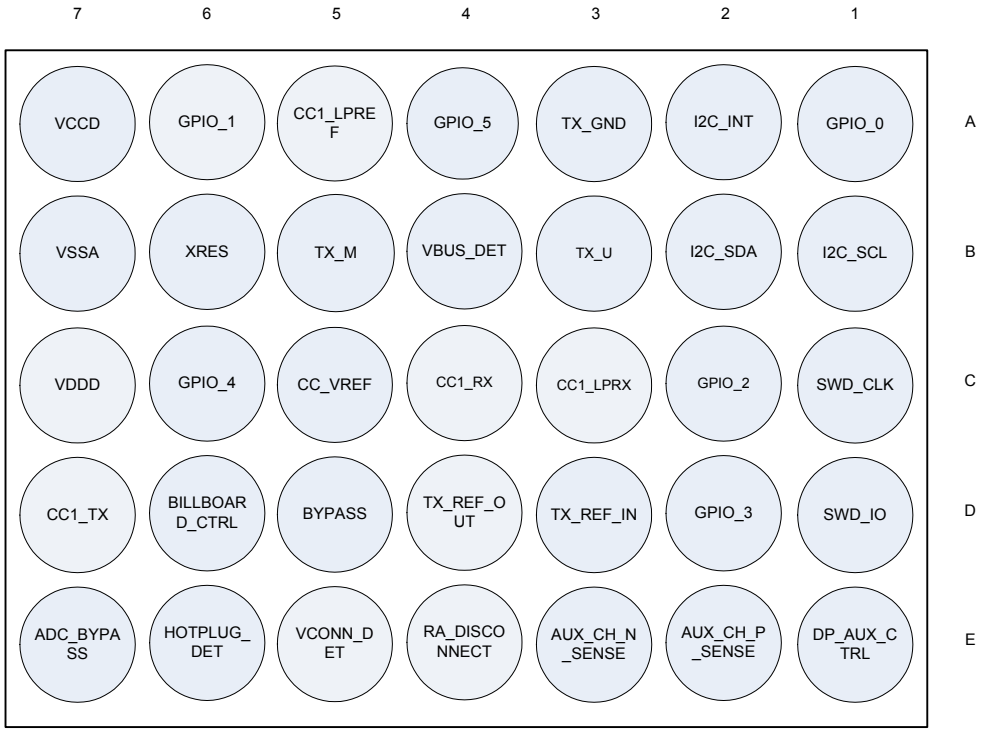


Figure 3. 35-Ball WLCSP Pinout



Power

The following power system diagram shows the minimum set of power supply pins as implemented for the CCG1. The system has one regulator in Active mode for the digital circuitry. There is no analog regulator; the analog circuits run directly from the VDDA input. There is a separate regulator for the Deep Sleep mode. There is a separate low-noise regulator for the bandgap. The supply voltage range is 1.8 V to 5.5 V with all functions and circuits operating over that range.

The CCG1 is powered by an external power supply that can be anywhere in the range of 1.8 V to 5.5 V. This range is also designed for battery-powered operation.For example, the chip can be powered from a battery system that starts at 3.5 V and works down to 1.8 V. In this mode, the internal regulator of the CCG1 supplies the internal logic and the VCCD output of the CCG1 must be bypassed to ground via an external capacitor (in the range of 1 µF to 1.6 µF; X5R ceramic or better). No voltage source should be applied to this pin.

VDDA and VDDD must be shorted together; the grounds, VSSA and VSS must also be shorted together. Bypass capacitors must be used from VDDD to ground. The typical practice for systems in this frequency range is to use a capacitor in the 1-µF range in parallel with a smaller capacitor (0.1 µF, for example). 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.

Examples of bypass schemes follow.

Figure 4. 40-pin QFN Example

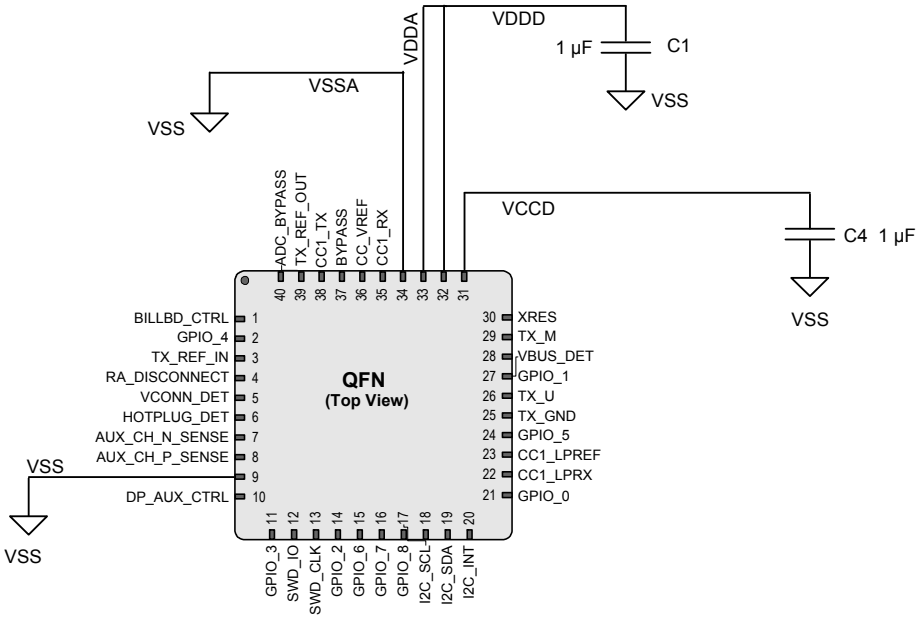
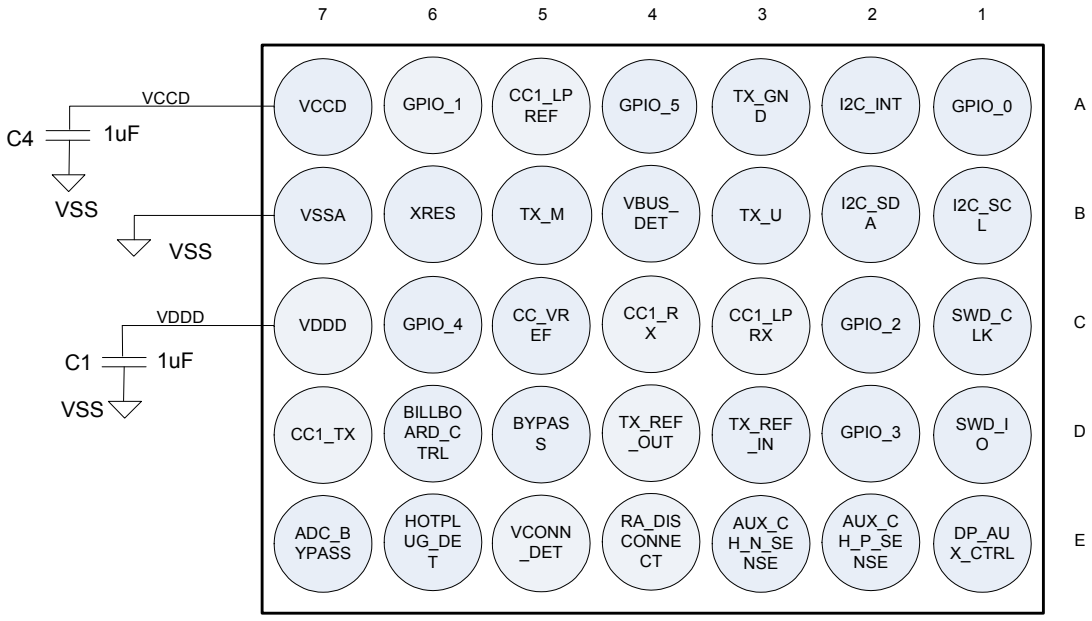


Figure 5. 35-ball WLCSP Example



Electrical Specifications

Absolute Maximum Ratings

Table 2. Absolute Maximum Ratings[6]

Spec ID#	Parameter	Description	Min	Typ	Max	Units	Details/ Conditions
SID1	V_{DDD_ABS}	Digital supply relative to V_{SSD}	–0.5	–	6.0	V	Absolute max
SID2	V_{CCD_ABS}	Direct digital core voltage input relative to V_{SSD}	–0.5	–	1.95	V	Absolute max
SID3	V_{GPIO_ABS}	GPIO voltage	–0.5	–	V_{DDD}+0.5	V	Absolute max
SID4	I_{GPIO_ABS}	Maximum current per GPIO	–25.0	–	25.0	mA	Absolute max
SID5	$I_{GPIO_injection}$	GPIO injection current, Max for $V_{IH} > V_{DDD}$, and Min for $V_{IL} < V_{SS}$	–0.50	–	0.5	mA	Absolute max, current injected per pin
BID44	ESD_HBM	Electrostatic discharge human body model	2200	–	–	V	–
BID45	ESD_CDM	Electrostatic discharge charged device model	500	–	–	V	–
BID46	LU	Pin current for latch-up	–200	–	200	mA	–

Device Level Specifications

All specifications are valid for –40 °C ≤ T_A ≤ 85 °C and T_J ≤ 100 °C for 35-CSP and 40-QFN package options. Specifications are valid for 1.8 V to 5.5 V, except where noted.

Table 3. DC Specifications

Spec ID#	Parameter	Description	Min	Typ	Max	Units	Details/ Conditions
SID53	V_{DDD}	Power supply input voltage	1.8	–	5.5	V	With regulator enabled
SID54	V_{CCD}	Output voltage (for core logic)	–	1.8	–	V	–
SID55	C_{EFC}	External regulator voltage bypass	1.0	1.3	1.6	µF	X5R ceramic or better
SID56	C_{EXC}	Power supply decoupling capacitor	–	1.0	–	µF	X5R ceramic or better
Active Mode, V_{DDD} = 1.8 to 5.5 V. Typical values measured at V_{DD} = 3.3 V.							
SID19	I_{DD14}	Execute from flash; CPU at 48 MHz	–	12.8	–	mA	T = 25 °C
SID20	I_{DD15}	Execute from flash; CPU at 48 MHz	–	–	13.8	mA	–
Sleep Mode, V_{DDD} = 1.8 to 5.5 V							
SID25A	I_{DD20A}	I^2C wakeup and comparators on	–	1.7	2.2	mA	–
Deep Sleep Mode, V_{DDD} = 1.8 to 3.6 V (Regulator on)							
SID31	I_{DD26}	I^2C wakeup on	–	1.3	–	µA	T = 25 °C, 3.6 V
SID32	I_{DD27}	I^2C wakeup on	–	–	50.0	µA	T = 85 °C
Deep Sleep Mode, V_{DDD} = 3.6 to 5.5 V							
SID34	I_{DD29}	I^2C wakeup	–	15.0	–	µA	T = 25 °C, 5.5 V
XRES Current							
SID307	I_{DD_XR}	Supply current while XRES asserted	–	2.0	5.0	mA	–

Note

6. 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.

Table 4. AC Specifications

Spec ID#	Parameter	Description	Min	Typ	Max	Units	Details/ Conditions
SID48	F_{CPU}	CPU frequency	DC	–	48.0	MHz	$1.8 \le V_{DD} \le 5.5$
SID49	T_{SLEEP}	Wakeup from sleep mode	–	0	–	µs	Guaranteed by characterization
SID50	$T_{DEEPSLEEP}$	Wakeup from Deep Sleep mode	–	–	25.0	µs	24-MHz IMO. Guaranteed by characterization
SID52	$T_{RESETWIDTH}$	External reset pulse width	1.0	–	–	µs	Guaranteed by characterization

I/O

Table 5. I/O DC Specifications

Spec ID#	Parameter	Description	Min	Typ	Max	Units	Details/ Conditions
SID57	V_{IH}[7]	Input voltage high threshold	0.7 × V_{DDD}	–	–	V	CMOS Input
SID58	V_{IL}	Input voltage low threshold	–	–	0.3 × V_{DDD}	V	CMOS Input
SID241	V_{IH}[7]	LVTTL input, V_{DDD} < 2.7 V	0.7× V_{DDD}	–	–	V	–
SID242	V_{IL}	LVTTL input, V_{DDD} < 2.7 V	–	–	0.3 × V_{DDD}	V	–
SID243	V_{IH}[7]	LVTTL input, $V_{DDD} \ge 2.7$ V	2.0	–	–	V	–
SID244	V_{IL}	LVTTL input, $V_{DDD} \ge 2.7$ V	–	–	0.8	V	–
SID59	V_{OH}	Output voltage high level	V_{DDD} –0.6	–	–	V	I_{OH} = 4 mA at 3-V V_{DDD}
SID60	V_{OH}	Output voltage high level	V_{DDD} –0.5	–	–	V	I_{OH} = 1 mA at 1.8-V V_{DDD}
SID61	V_{OL}	Output voltage low level	–	–	0.6	V	I_{OL} = 4 mA at 1.8-V V_{DDD}
SID62	V_{OL}	Output voltage low level	–	–	0.6	V	I_{OL} = 8 mA at 3-V V_{DDD}
SID62A	V_{OL}	Output voltage low level	–	–	0.4	V	I_{OL} = 3 mA at 3-V V_{DDD}
SID63	R_{PULLUP}	Pull-up resistor	3.5	5.6	8.5	kΩ	–
SID64	$R_{PULLDOWN}$	Pull-down resistor	3.5	5.6	8.5	kΩ	–
SID65	I_{IL}	Input leakage current (absolute value)	–	–	2.0	nA	25 °C, V_{DDD} = 3.0 V
SID65A	I_{IL_CTBM}	Input leakage current (absolute value) for analog pins	–	–	4.0	nA	–
SID66	C_{IN}	Input capacitance	–	–	7.0	pF	–
SID67	V_{HYSTTL}	Input hysteresis LVTTL	15.0	40.0	–	mV	$V_{DDD} \ge 2.7$ V. Guaranteed by characterization
SID68	$V_{HYSCMOS}$	Input hysteresis CMOS	200.0	–	–	mV	$V_{DDD} \ge 4.5$ V. Guaranteed by characterization
SID69	I_{DIODE}	Current through protection diode to V_{DD}/V_{SS}	–	–	100.0	µA	Guaranteed by characterization
SID69A	I_{TOT_GPIO}	Maximum Total Source or Sink Chip Current	–	–	200.0	mA	Guaranteed by characterization

Note
7. V_{IH} must not exceed V_{DDD} + 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	2.0	–	12.0	ns	3.3-V V_{DDD}, Cload = 25 pF
SID71	T_{FALLF}	Fall time	2.0	–	12.0	ns	3.3-V V_{DDD}, Cload = 25 pF

XRES

Table 7. XRES DC Specifications

Spec ID#	Parameter	Description	Min	Typ	Max	Units	Details/ Conditions
SID77	V_{IH}	Input voltage high threshold	0.7 × V_{DDD}	–	–	V	CMOS input
SID78	V_{IL}	Input voltage low threshold	–	–	0.3 × V_{DDD}	V	CMOS input
SID79	R_{PULLUP}	Pull-up resistor	3.5	5.6	8.5	kΩ	–
SID80	C_{IN}	Input capacitance	–	3.0	–	pF	–
SID81	$V_{HYSXRES}$	Input voltage hysteresis	–	100.0	–	mV	Guaranteed by characterization
SID82	I_{DIODE}	Current through protection diode to V_{DDD}/V_{SS}	–	–	100.0	µA	Guaranteed by characterization

Digital Peripherals

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

Pulse Width Modulation (PWM) for VSEL and CUR_LIM Pins

Table 8. PWM AC Specifications

(Guaranteed by Characterization)

Spec ID#	Parameter	Description	Min	Typ	Max	Units	Details/Conditions
SID140	$T_{PWMFREQ}$	Operating frequency	–	–	48.0	MHz	–
SID141	$T_{PWMPWINT}$	Pulse width (internal)	42.0	–	–	ns	–
SID142	T_{PWMEXT}	Pulse width (external)	42.0	–	–	ns	–
SID143	$T_{PWMKILLINT}$	Kill pulse width (internal)	42.0	–	–	ns	–
SID144	$T_{PWMKILLEXT}$	Kill pulse width (external)	42.0	–	–	ns	–
SID145	$T_{PWMEINT}$	Enable pulse width (internal)	42.0	–	–	ns	–
SID146	$T_{PWMENEXT}$	Enable pulse width (external)	42.0	–	–	ns	–
SID147	$T_{PWMRESWINT}$	Reset pulse width (internal)	42.0	–	–	ns	–
SID148	$T_{PWMRESWEXT}$	Reset pulse width (external)	42.0	–	–	ns	–

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 kHz	–	–	10.5	µA	–
SID150	I_{I2C2}	Block current consumption at 400 kHz	–	–	135.0	µA	–
SID151	I_{I2C3}	Block current consumption at 1 Mbps	–	–	310.0	µA	–
SID152	I_{I2C4}	I^2C enabled in Deep Sleep mode	–	–	1.4	µA	–

Table 10. Fixed I²C AC Specifications

(Guaranteed by Characterization)

Spec ID#	Parameter	Description	Min	Typ	Max	Units	Details/Conditions
SID153	F_{I2C1}	Bit rate	–	–	1.0	Mbps	–

Memory

Table 11. Flash DC Specifications

Spec ID#	Parameter	Description	Min	Typ	Max	Units	Details/Conditions
SID173	V_{PE}	Erase and program voltage	1.8	–	5.5	V	–

Table 12. Flash AC Specifications

Spec ID#	Parameter	Description	Min	Typ	Max	Units	Details/Conditions
SID174	$T_{ROWWRITE}$[8]	Row (block) write time (erase and program)	–	–	20.0	ms	Row (block) = 128 bytes
SID175	$T_{ROWERASE}$[8]	Row erase time	–	–	13.0	ms	–
SID176	$T_{ROWPROGRAM}$[8]	Row program time after erase	–	–	7.0	ms	–
SID178	$T_{BULKERASE}$[8]	Bulk erase time (32 KB)	–	–	35	ms	–
SID180	$T_{DEVPROG}$[8]	Total device program time	–	–	7.0	seconds	Guaranteed by characterization
SID181	F_{END}	Flash endurance	100 K	–	–	cycles	Guaranteed by characterization
SID182	F_{RET}[9]	Flash retention. $T_A \leq 55$ °C, 100 K P/E cycles	20	–	–	years	Guaranteed by characterization
SID182A	–	Flash retention. $T_A \leq 85$ °C, 10 K P/E cycles	10	–	–	years	Guaranteed by characterization
SID182B	–	Flash retention. 85 °C < $T_A \leq$ 105 °C, 10K P/E cycles	3	–	–	years	Guaranteed by characterization

System Resources

Power-on-Reset (POR) with Brown Out

Table 13. Imprecise Power On Reset (PRES)

Spec ID#	Parameter	Description	Min	Typ	Max	Units	Details/Conditions
SID185	$V_{RISEIPOR}$	Rising trip voltage	0.80	–	1.45	V	Guaranteed by characterization
SID186	$V_{FALLIPOR}$	Falling trip voltage	0.75	–	1.40	V	Guaranteed by characterization
SID187	$V_{IPORHYST}$	Hysteresis	15.0	–	200.0	mV	Guaranteed by characterization

Table 14. 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	1.64	–	–	V	Guaranteed by characterization
SID192	$V_{FALLDPSLP}$	BOD trip voltage in Deep Sleep	1.40	–	–	V	Guaranteed by characterization

Note

8. 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.
9. Cypress provides a retention calculator to calculate the retention lifetime based on customers' individual temperature profiles for operation over the –40 °C to +105 °C ambient temperature range. Contact customercare@cypress.com.

SWD Interface

Table 15. SWD Interface Specifications

Spec ID	Parameter	Description	Min	Typ	Max	Units	Details/Conditions
SID213	F_SWDCLK1	3.3 V ≤ V_{DDD} ≤ 5.5 V	–	–	14.0	MHz	SWDCLK ≤ 1/3 CPU clock frequency
SID214	F_SWDCLK2	1.8 V ≤ V_{DDD} ≤ 3.3 V	–	–	7.0	MHz	SWDCLK ≤ 1/3 CPU clock frequency
SID215	T_SWDI_SETUP	T = 1/f SWDCLK	0.25*T	–	–	ns	Guaranteed by characterization
SID216	T_SWDI_HOLD	T = 1/f SWDCLK	0.25*T	–	–	ns	Guaranteed by characterization
SID217	T_SWDO_VALID	T = 1/f SWDCLK	–	–	0.5*T	ns	Guaranteed by characterization
SID217A	T_SWDO_HOLD	T = 1/f SWDCLK	1	–	–	ns	Guaranteed by characterization

Internal Main Oscillator

Table 16. IMO DC Specifications

(Guaranteed by Design)

Spec ID	Parameter	Description	Min	Typ	Max	Units	Details/Conditions
SID218	I_{IMO1}	IMO operating current at 48 MHz	–	–	1000.0	µA	–

Table 17. IMO AC Specifications

Spec ID	Parameter	Description	Min	Typ	Max	Units	Details/Conditions
SID223	$F_{IMOTOL1}$	Frequency variation	–	–	±2.0	%	With API-called calibration
SID226	$T_{STARTIMO}$	IMO startup time	–	–	12.0	µs	–
SID229	$T_{JITRMSIMO3}$	RMS Jitter at 48 MHz	–	139.0	–	ps	–

Internal Low-Speed Oscillator

Table 18. ILO DC Specifications

(Guaranteed by Design)

Spec ID	Parameter	Description	Min	Typ	Max	Units	Details/Conditions
SID231	I_{ILO1}	ILO operating current at 32 kHz	–	0.30	1.05	µA	Guaranteed by characterization
SID233	$I_{ILOLEAK}$	ILO leakage current	–	2.0	15.0	nA	Guaranteed by design

Table 19. ILO AC Specifications

Spec ID	Parameter	Description	Min	Typ	Max	Units	Details/Conditions
SID234	$T_{STARTILO1}$	ILO startup time	–	–	2.0	ms	Guaranteed by characterization
SID236	$T_{ILODUTY}$	ILO duty cycle	40.0	50.0	60.0	%	Guaranteed by characterization
SID237	$F_{ILOTRIM1}$	32-kHz trimmed frequency	15.0	32.0	50.0	kHz	±60% with trim

Applications in Detail

Figure 6. Type-C to DisplayPort/Mini-DisplayPort Application Using 35-CSP Package

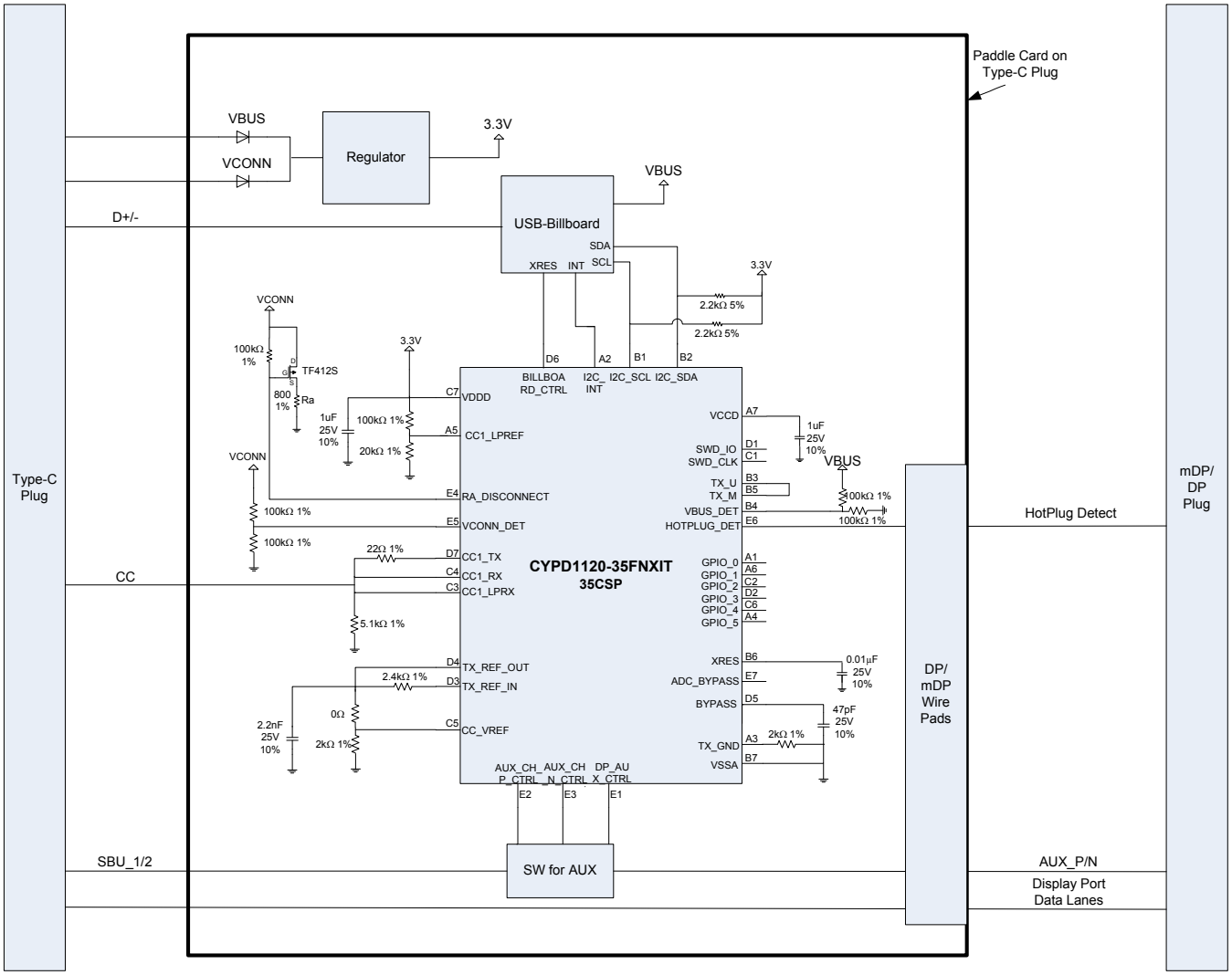


Figure 7. Type-C to DisplayPort/mini-DisplayPort Application Using 40-QFN Package

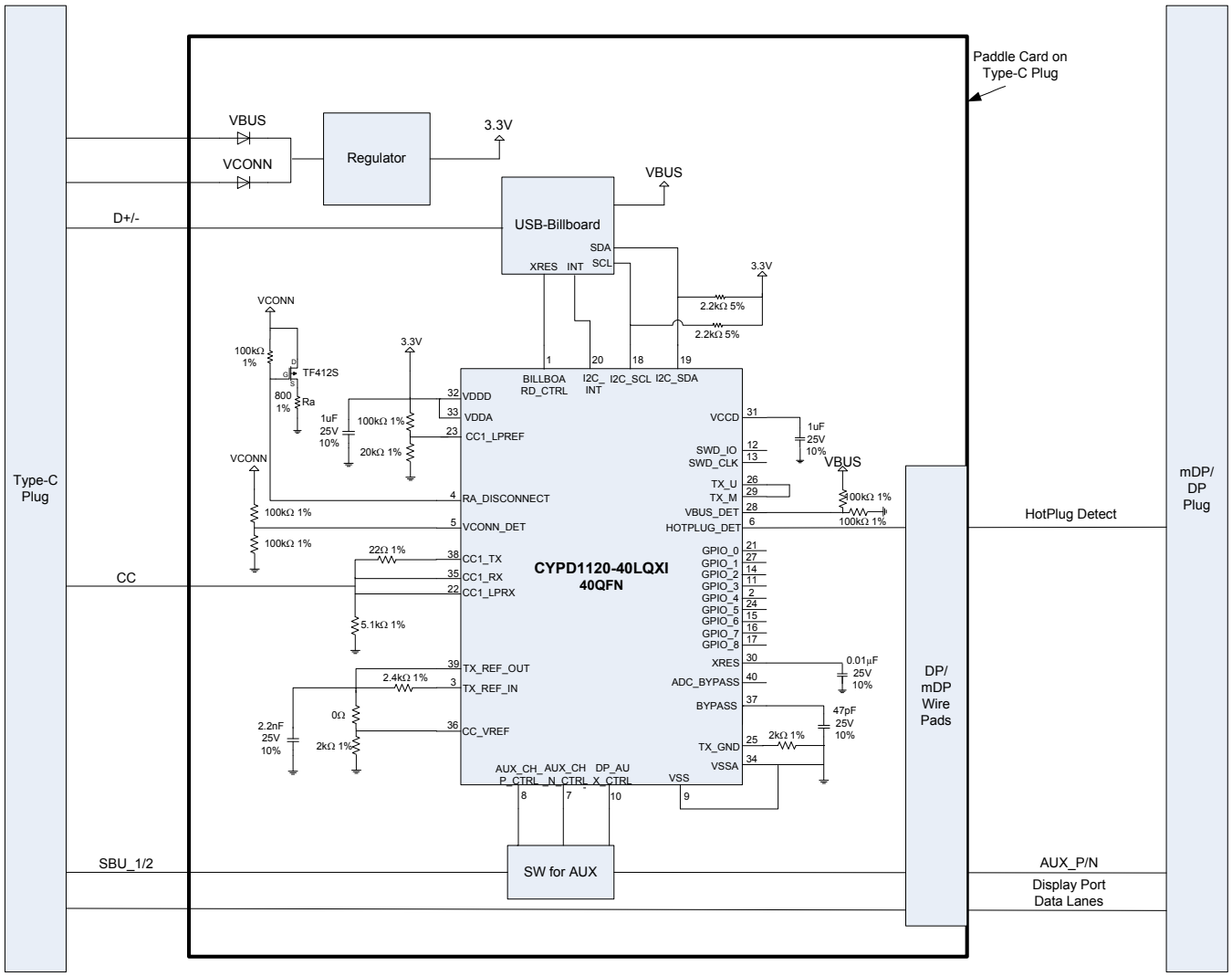


Figure 8. Type-C to HDMI Application Using 35-CSP Package

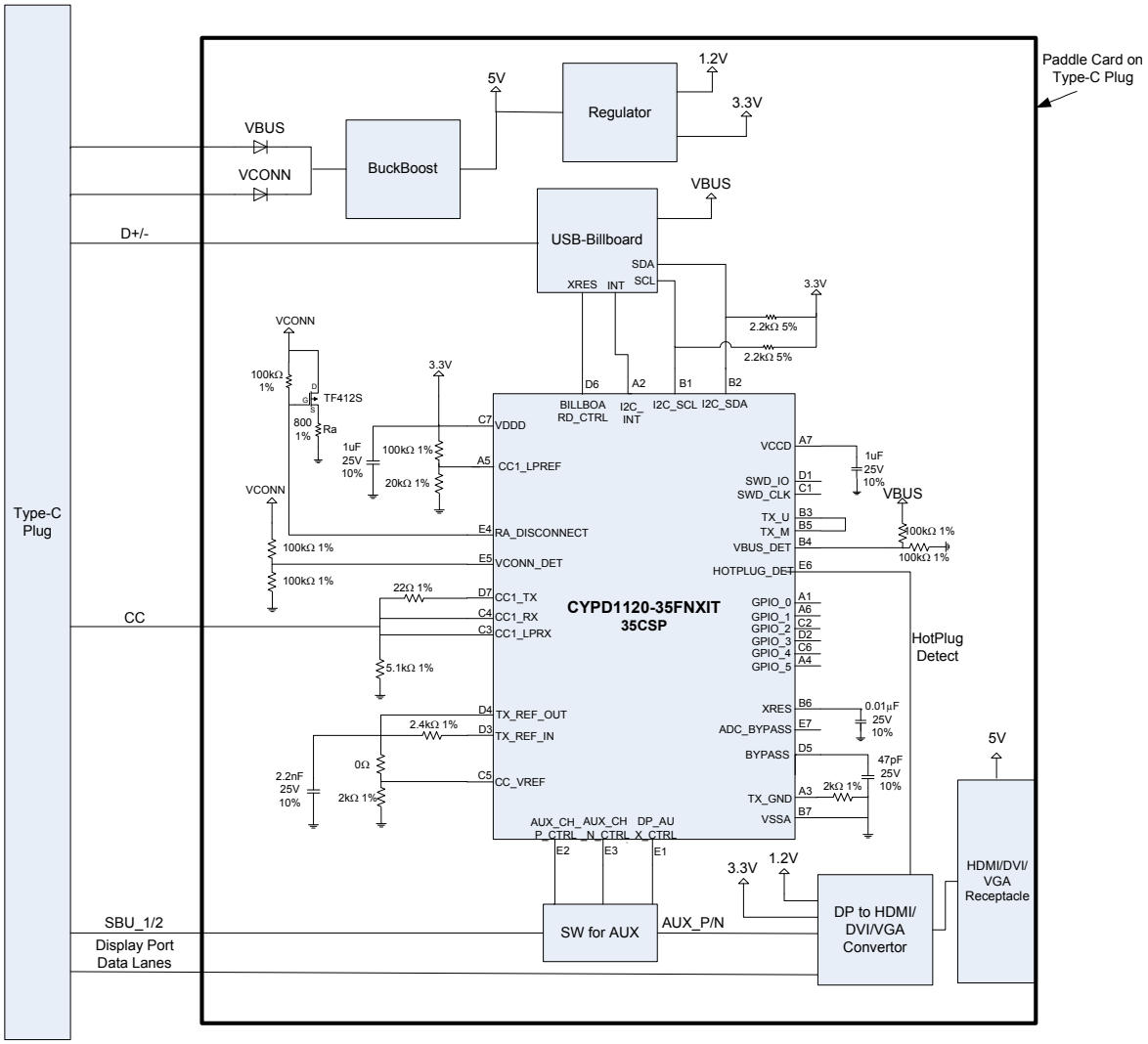
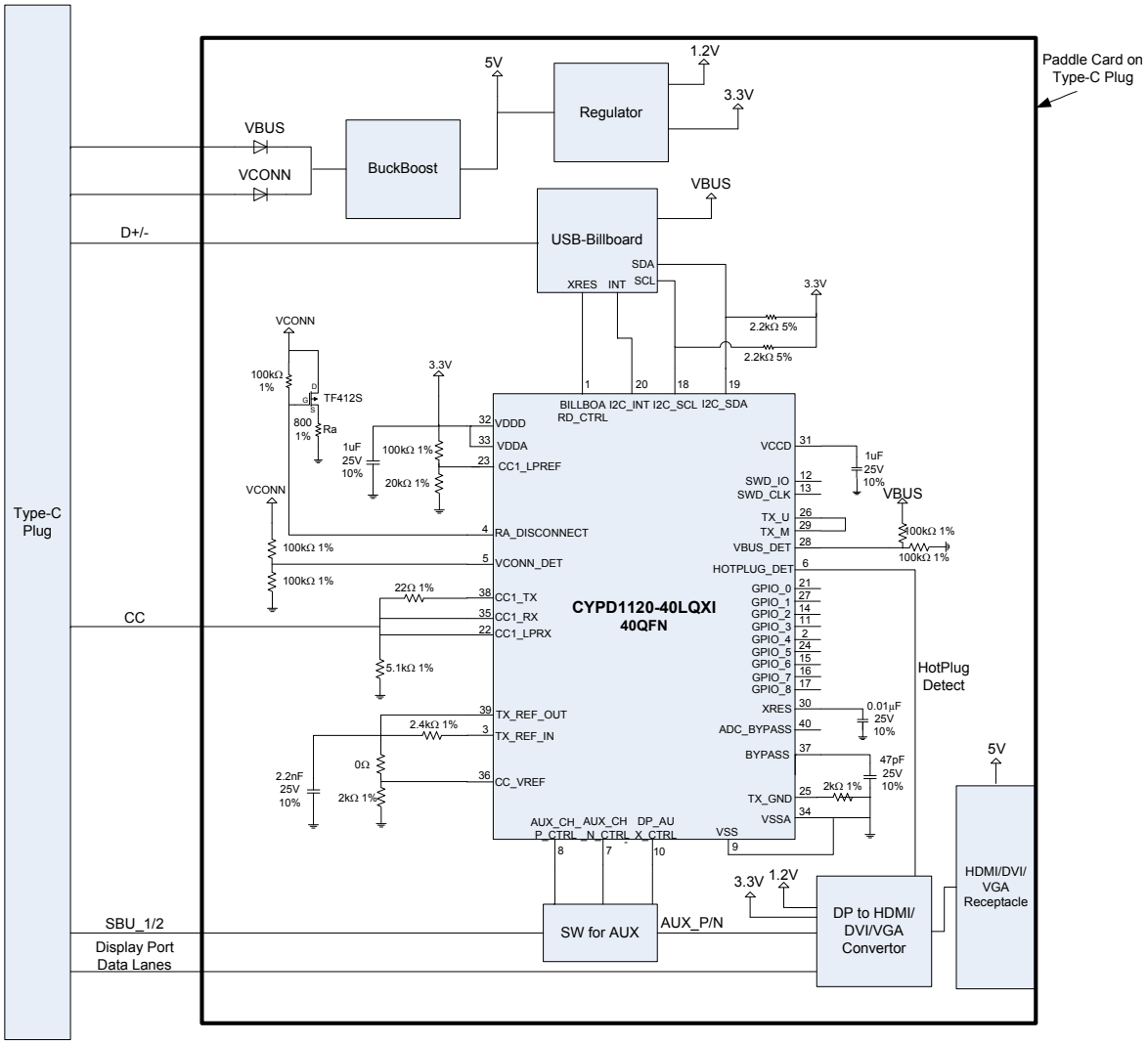


Figure 9. Type-C to HDMI Application Using 40-QFN Package



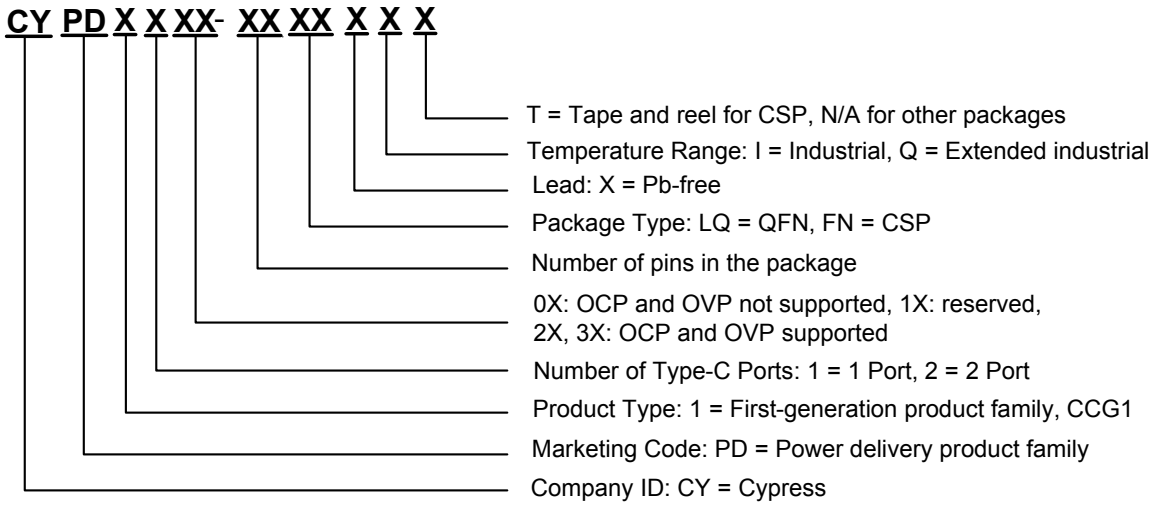
Ordering Information

The CCG1 part numbers and features are listed in the following table.

Table 20. CCG1 Ordering Information

Part Number[10]	Application	Type-C Ports[11]	Termination Resistor[12]	Role[13]	Package	Si ID
CYPD1120-35FNXIT	Type-C to DP, Type-C to HDMI	1	R_d[14]	UFP[17]	35-WLCSP[15]	0492
CYPD1120-40LQXI	Type-C to DP, Type-C to HDMI	1	R_d[14]	UFP[17]	40-QFN[16]	0488
CYPD1120-40LQXIT	Type-C to DP, Type-C to HDMI	1	R_d[14]	UFP[17]	40-QFN[16]	0488

Ordering Code Definitions



Notes
10. All part numbers support: Input voltage range from 1.8 to 5.5 V. Industrial parts support -40 °C to +85 °C, Extended Industrial parts support -40 °C to 105 °C.
11. Number of USB Type-C Ports Supported .
12. Default V_{CONN} Termination.
13. PD Role.
14. Termination resistor denoting an upstream facing port.
15. 35-WLCSP#1 pinout.
16. 40-QFN#3 pinout.
17. Upstream Facing Port.

Packaging

Table 21. Package Characteristics

Parameter	Description	Conditions	Min	Typ	Max	Units
T_A (40-QFN, 35-CSP)	Operating ambient temperature	–	–40	25.00	85	°C
T_J (40-QFN, 35-CSP)	Operating junction temperature	–	–40	–	100	°C
T_{JA}	Package θ_{JA} (40-pin QFN)	–	–	15.34	–	°C/Watt
T_{JA}	Package θ_{JA} (35-CSP)	–	–	28.00	–	°C/Watt
T_{JC}	Package θ_{JC} (40-pin QFN)	–	–	02.50	–	°C/Watt

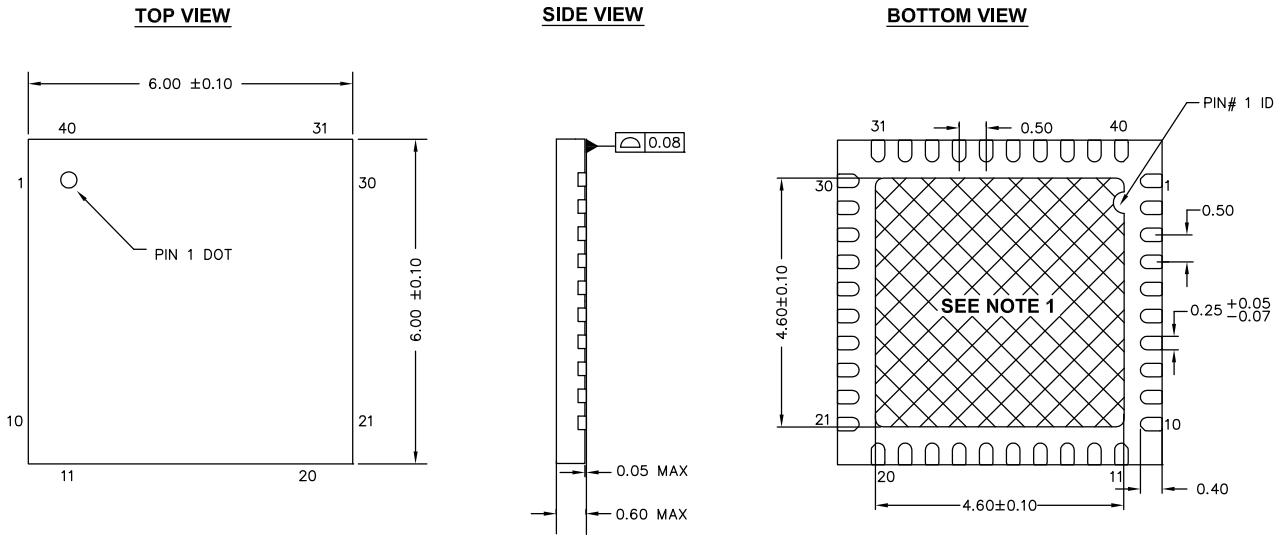
Table 22. Solder Reflow Peak Temperature

Package	Maximum Peak Temperature	Maximum Time at Peak Temperature
40-pin QFN	260 °C	30 seconds
35-ball WLCSP	260 °C	30 seconds

Table 23. Package Moisture Sensitivity Level (MSL), IPC/JEDEC J-STD-2

Package	MSL
40-pin QFN	MSL 3
35-ball WLCSP	MSL 1

Figure 10. 40-pin QFN Package Outline, 001-80659



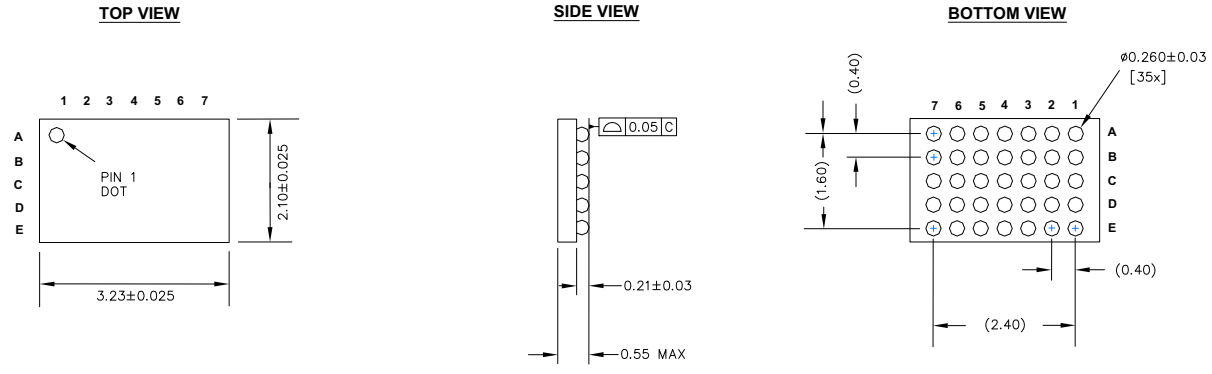
NOTES:

1. HATCH AREA IS SOLDERABLE EXPOSED PAD
2. REFERENCE JEDEC # MO-248
3. PACKAGE WEIGHT: 68 ±2 mg
4. ALL DIMENSIONS ARE IN MILLIMETERS

001-80659 *A

The center pad on the QFN package should be connected to ground (VSS) for best mechanical, thermal, and electrical performance. If not connected to ground, it should be electrically floating and not connected to any other signal.

Figure 11. 35-Ball WLCSP Package Outline, 001-93741



NOTES:

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

001-93741 **

Acronyms

Table 24. 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
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.
DP	DisplayPort
EEPROM	electrically erasable programmable read-only memory
EMI	electromagnetic interference
ESD	electrostatic discharge
FPB	flash patch and breakpoint
FS	full-speed
GPIO	general-purpose input/output, applies to a PSoC pin
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, DIO, SIO, USBIO
LVD	low-voltage detect
LVTTL	low-voltage transistor-transistor logic
MCU	microcontroller unit
NC	no connect
NMI	nonmaskable interrupt
NVIC	nested vectored interrupt controller

Table 24. Acronyms Used in this Document *(continued)*

Acronym	Description
opamp	operational amplifier
OCP	Overcurrent protection
OVP	Overvoltage protection
PCB	printed circuit board
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
UART	Universal Asynchronous Transmitter Receiver, a communications protocol
UFP	Upstream Facing Port
USB	Universal Serial Bus
USBIO	USB input/output, PSoC pins used to connect to a USB port
VESA	Video Electronics Standards Association
XRES	external reset I/O pin

Document Conventions

Units of Measure

Table 25. 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

Revision History

Description Title: CYPD1120, USB Power Delivery Alternate Mode Controller on Type-C Document Number: 001-96786				
Revision	**ECN**	**Orig. of Change**	**Submission Date**	**Description of Change**
**	4686071	VGT	05/13/2015	New datasheet
*A	4829889	VGT	07/20/2015	Added CYPD1120-40LQXIT in Ordering Information.
*B	5104916	VGT	02/05/2016	Updated Ordering Information.
*C	5705375	VGT	04/21/2017	Updated Sales, Solutions, and Legal Information. Updated Copyright and Disclaimer. Updated template.

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