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# EZ-PD™ CMG1 Datasheet

# USB Type-C EMCA Controller

## General Description

EZ-PD™ CMG1 is a dedicated USB Type-C EMCA controller that complies with the USB Type-C and Power Delivery (PD) standards for Electronically Marked Type-C Thunderbolt and non-Thunderbolt passive cable applications. EZ-PD CMG1 integrates a complete Type-C transceiver including the $R_A$ termination resistors on the VCONN pins and VBUS short circuit protection on both VCONN and CC pins. CMG1 also includes 40 bytes of storage for configuration of vendor-, device-, and cable-specific configuration data. EZ-PD CMG1 is targeted for passive EMCA implementations with either one or two e-marker chips on the cable.

## Features

### Type-C Support and USB-PD Support

- Supports USB PD3.0 spec and USB Type-C spec version 1.3 (Including support for the revised minimum VCONN operating voltage of 3 V)
- Integrated high-voltage protection on CC, VCONN1, and VCONN2 pins to protect against accidental shorts to the VBUS pin on the Type-C connector
- 40-byte storage programmable over Type-C interface for storing vendor-, device-, and cable-specific configuration data
- Termination resistor $R_A$ on VCONN1 and VCONN2
- Supports $R_A$ weakening to reduce power consumption
- Supports electronically marked passive cable implementations with one or two controllers

### Clocks and Oscillators

- Integrated oscillator eliminating the need for external clock

### Power

- 2.7 V to 5.5 V operation
- Sleep: 1.7 mA

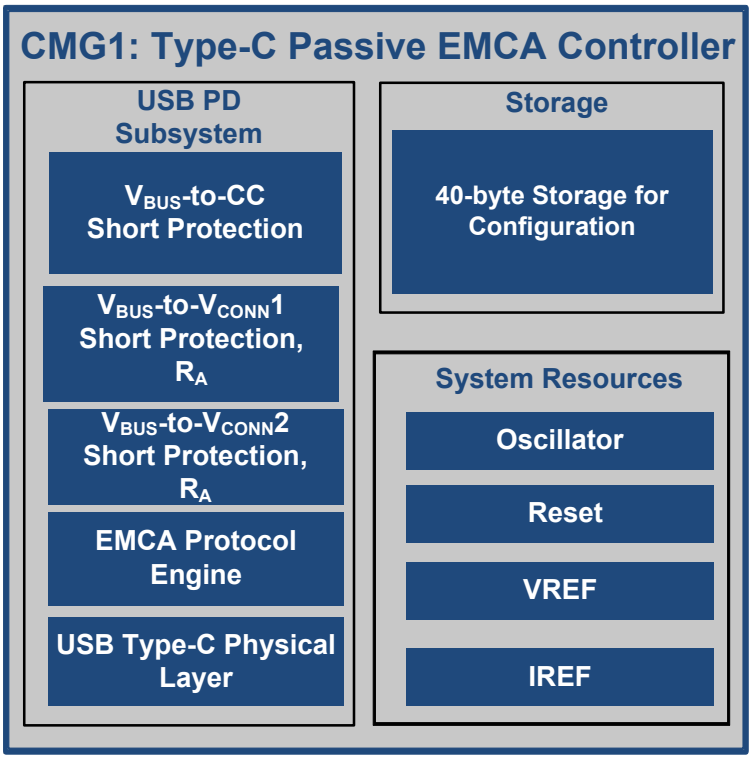
### System-Level ESD Protection

- On CC, VCONN1, and VCONN2 pins
- ± 8 kV Contact Discharge and ±15 kV Air Gap Discharge based on IEC61000-4-2 level 4C

### Package

- 9-ball WLCSP
- Supports industrial temperature range (–40 °C to +85 °C)

## Logic Block Diagram



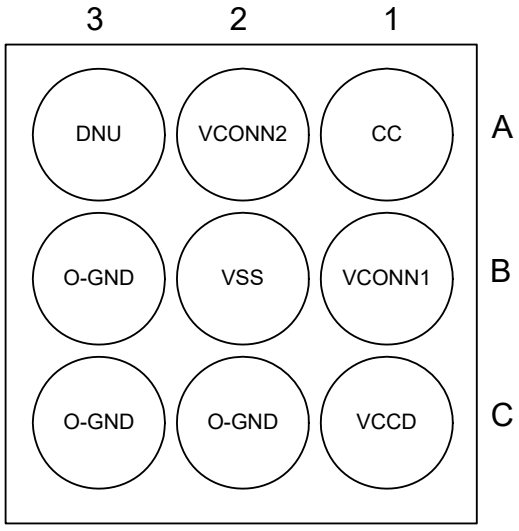
## Contents

## Pinout

**Table 1. 9-Ball CSP Pin Description**

| 9-Ball CSP | Pin Name | Description |
|---|---|---|
| A1 | CC | Communication Channel (VBUS short protected)/IEC |
| A2 | VCONN2 | VCONN2 supply with $R_A$ termination (2.7 V to 5.5 V) (VBUS Short protected)/IEC |
| A3 | DNU[1] | Do not use[1] |
| B1 | VCONN1 | VCONN1 supply with $R_A$ termination (2.7 V to 5.5 V) (VBUS Short protected)/IEC |
| B2 | VSS | Ground pin. Mandatory to connect to system GND |
| B3 | O-GND[2] | Optional GND pin. This pin can be connected to the system GND for better board layout routability. |
| C1 | VCCD | 1.8-V Core Voltage Out. Connect to 1-µF capacitor |
| C2 | O-GND[2] | Optional GND pin. This pin can be connected to system GND for better board layout routability. |
| C3 | O-GND[2] | Optional GND pin. This pin can be connected to system GND for better board layout routability. |

**Figure 1. Pinout of 9-WLCSP Bottom (Balls Up) View**

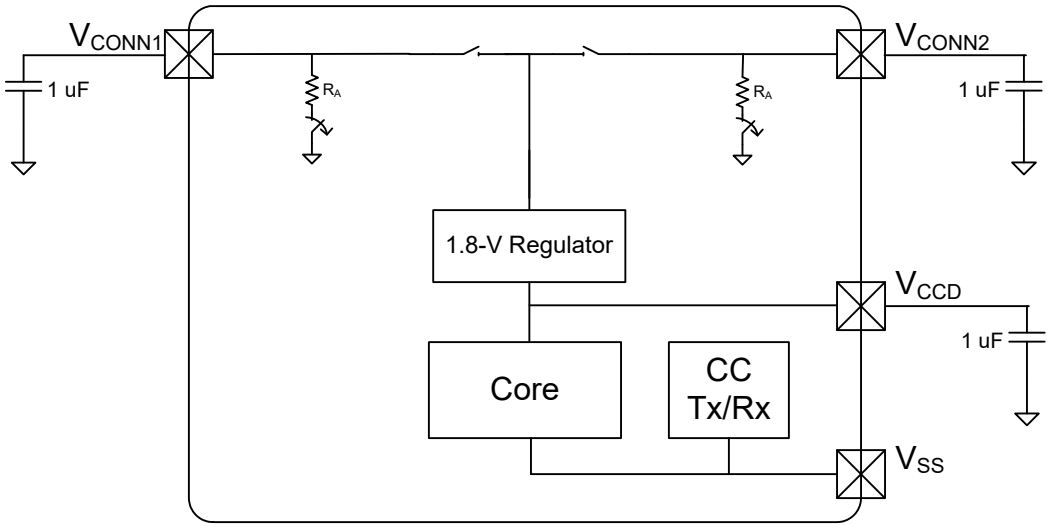



**Notes**
1. Keep pin A3 floating for all passive EMCA applications. See Figure 4 and Figure 5 for more details.
2. Any of the optional GND pins B3, C2, and C3 can be connected to system GND for better board layout routability. If connected to GND, ensure that the selected pin/s are shorted with the VSS pin (B2) of the CMG1 device in their board layout. If users are not planning to connect these optional GND pins to system GND, then it is mandatory to leave them unconnected in their board designs.

## Power

Figure 2 shows an overview of the CMG1 power system requirement. CMG1 operates from two possible external supply sources, VCONN1 and VCONN2. The VCONN supplies support operation over 2.7 V–5.5 V. CMG1 has two different power modes: Active and Sleep, transitions between which are managed by the Power System. The VCCD pin, the output of the core regulator (1.8 V), is brought out for connecting a 1-µF capacitor for regulator stability only. This pin is not supported as a power supply.

**Figure 2. Power System**



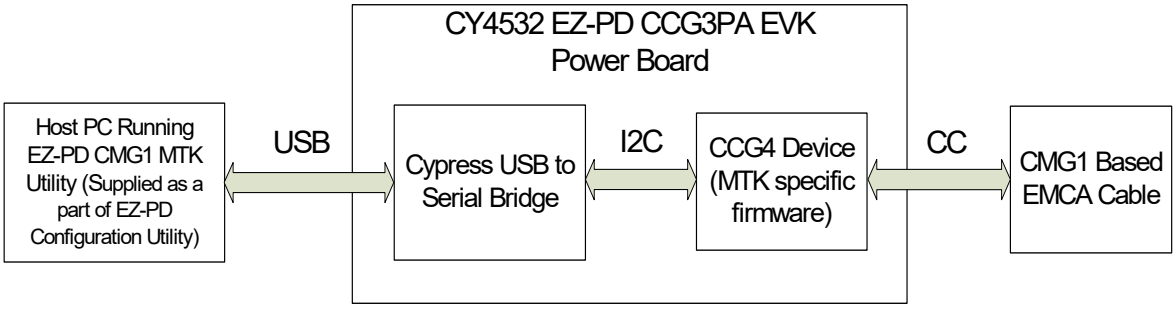
## CMG1 Application Configuration Update Over CC Interface

The CMG1 Manufacturing Test Kit (MTK) Utility is used for updating the configuration parameters of the CMG1 devices over the CC interface. The CMG1 MTK Utility is integrated as a part of the EZ-PD Configuration Utility and is supported by its version 1.1 Beta (or later). Vendor-specific and cable-specific parameters can be set using the EZ-PD Configuration Utility. Once the parameters are set, the CMG1 MTK Utility is used for configuration and testing of CMG1-based passive EMCA cables.

To use the CMG1 MTK Utility, you must use the CY4532 EZ-PD CCG3PA EVK as shown in a high-level block diagram in Figure 3. The CMG1 MTK Utility is accompanied with a CMG1 MTK-specific firmware solution, which is intended for the CCG4 device present on the CY4532 EZ-PD CCG3PA EVK's Power Board. If customers are using the CY4532 EZ-PD CCG3PA EVK for the first time to update the configuration parameters of CMG1 devices, then the CCG4 device's firmware needs to be updated to this MTK-specific firmware (detailed instructions are provided in Getting Started with EZ-PD CMG1 Application Note).

The EZ-PD Configuration Utility 1.1 Beta (or later), which integrates and supports the CMG1 MTK Utility, can be downloaded here. For further details, follow the instructions provided in Getting Started with EZ-PD CMG1 Application Note for hardware setup and step-by-step instructions. Also, see Chapter 4 of the EZ-PD Configuration Utility User Manual for more details on how to configure and test CMG1-based passive EMCA cables.

**Figure 3. CMG1 Application Configuration Update Over CC Interface**



## Application Diagrams

Figure 4 and Figure 5 show the application diagrams of a Passive EMCA application using CMG1 devices. Figure 4 shows the application using a single CMG1 device per cable present at one of the two plugs, whereas Figure 5 shows the same with two CMG1 devices per cable present at each plug. The VBUS signal, the SuperSpeed lines, Hi-Speed lines, and CC lines are connected directly from one end to another. The application diagram shown in Figure 4 requires a single VCONN wire to run through the cable so that the CMG1 device can be powered irrespective of which plug is connected to the host (DFP). However, in the application diagram shown in Figure 5, the VCONN signal does not run through the entire cable, but only runs to the respective VCONN pin of the CMG1 device at each end of the plug. Also, only one CMG1 device is powered at any given instance, depending on which one is nearer to the DFP that supplies VCONN.

**Figure 4. Passive EMCA Application - Single CMG1 Chip Per Cable**

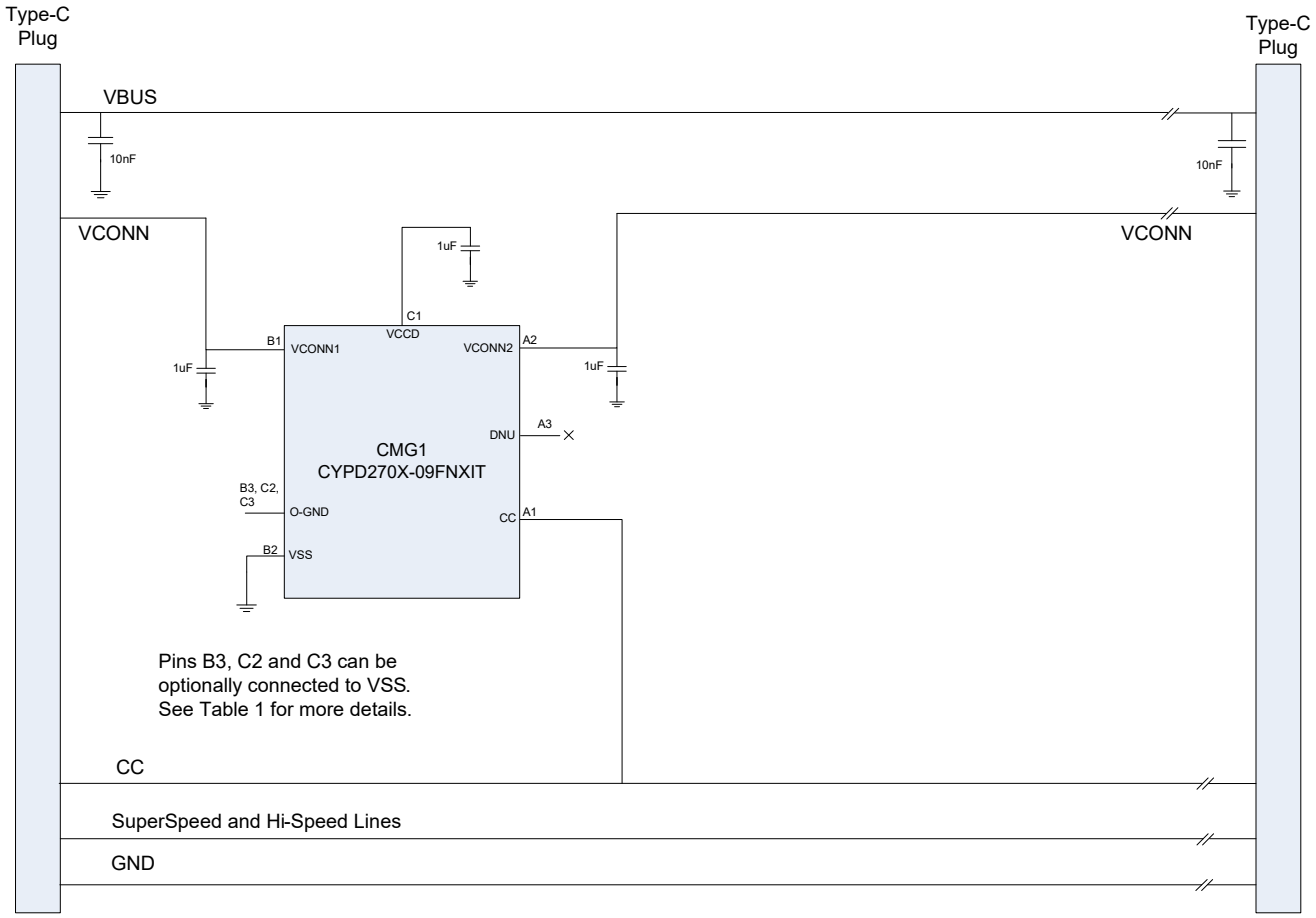
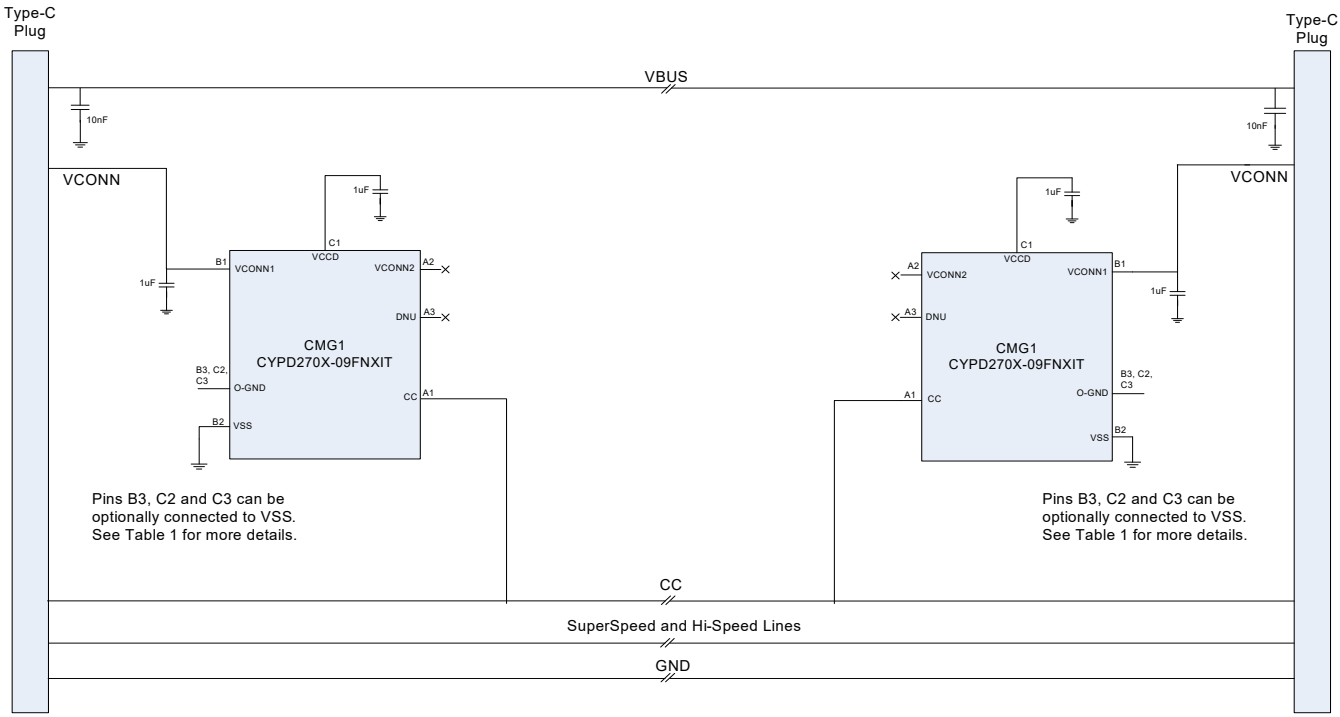


**Figure 5. Passive EMCA Application - Single CMG1 Chip Per Plug**



# Electrical Specifications

## Absolute Maximum Ratings

**Table 2. Absolute Maximum Ratings**

| Parameter | Description | Min | Typ | Max | Units | Details/Conditions |
|---|---|---|---|---|---|---|
| $V_{CONN\_MAX}$ | Max supply voltage relative to $V_{SS}$ | – | – | 25 | V | Absolute max |
| $V_{CC\_PIN\_ABS}$ | Max voltage on the CC pin | – | – | 25 | V | |
| ESD_HBM | Electrostatic discharge human body model | 2200 | – | – | V | – |
| ESD_CDM | Electrostatic discharge charged device model | 500 | – | – | V | – |
| LU | Pin current for latch-up | –140 | – | 140 | mA | – |
| ESD_IEC_CON | Electrostatic discharge IEC61000-4-2 | 8000 | – | – | V | Contact discharge on CC and $V_{CONN}$ pins |
| ESD_IEC_AIR | Electrostatic discharge IEC61000-4-2 | 15000 | – | – | V | Air discharge for CC and $V_{CONN}$ pins |

## Device-Level Specifications

See basic specifications in the following tables. More specifications will be added in a future version of this document.

**Table 3. DC Specifications**

| Spec ID | Parameter | Description | Min | Typ | Max | Units | Details/Conditions |
|---|---|---|---|---|---|---|---|
| SID.PWR#1 | $V_{CONN1}$ or $V_{CONN2}$ | Power supply input voltage | 2.7 | – | 5.5 | V | – |
| SID.PWR#5 | $V_{CCD}$ | Output voltage (for core logic) | – | 1.8 | – | V | – |
| SID.PWR#12 | $C_{EFC}$ | External regulator voltage bypass on $V_{CCD}$ | 0.8 | 1 | 1.2 | µF | X5R ceramic or better |
| SID.PWR#13 | $C_{VCONN}$ | Power supply decoupling capacitor on $V_{CONN1}$ and $V_{CONN2}$ | 0.8 | 1 | – | µF | X5R ceramic or better |
| **Active Mode, $V_{CONN1}$ or $V_{CONN2}$ = 2.7 V to 5.5 V. Typical values measured at $V_{CONN1}$ or $V_{CONN2}$ = 5 V** | | | | | | | |
| SID.PWR#8 | $I_{DD\_A}$ | Active current | – | 5 | 7.5 | mA | CC I/O in Transmit or Receive |
| **Sleep Mode, Typical values measured at $V_{CONN1}$ or $V_{CONN2}$ = 5 V and $T_A$ = 25 °C** | | | | | | | |
| SID25A | $I_{DD\_S}$ | Sleep mode current | – | 1.7 | 3.0 | mA | CC as wakeup source. One VCONN supply is powered, the other is floating or grounded. |

**Table 4. PD DC Specifications**

| Spec ID | Parameter | Description | Min | Typ | Max | Units | Details/Conditions |
|---|---|---|---|---|---|---|---|
| SID.PD.6 | $R_A$ | Power cable termination | 0.8 | 1 | 1.2 | kΩ | All supplies force 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.14 | $I_{LEAK}$ | Leaker on $V_{CONN1}$ or $V_{CONN2}$ for discharge upon cable detach | 150 | – | – | µA | – |
| SID.PD.15 | $V_{GNDOFST}$ | Ground offset tolerated by BMC receiver | –500 | – | 500 | mV | Relative to remote BMC transmitter |
| SID.PD.16 | $Z_{OPEN\_PD}$ | Impedance of CC pin with VCONN1 and VCONN2 un-powered | 200 | – | – | kΩ | 0 V ≤ CC Voltage ≤ 5.5 V |

**Table 5. Storage Specifications**

| Spec ID | Parameter | Description | Min | Typ | Max | Units | Details/Conditions |
|---|---|---|---|---|---|---|---|
| SID.MEM#3 | NVL_ERASE | NVL bulk erase time | 25 | – | 100 | ms | –40 °C ≤ $T_A$ ≤ 85 °C |
| SID.MEM#4 | NVL_WRITE | NVL program | 2 | – | 10 | ms | |
| SID.MEM#5 | NVL_DR | NVL data retention | 20 | – | – | years | 25 °C ≤ $T_A$ ≤ 55 °C |
| SID.MEM#5A | NVL_DR | NVL data retention | 10 | – | – | years | 55 °C ≤ $T_A$ ≤ 85 °C |
| SID.MEM#6 | NVL_ENPB | NVL write endurance | 100 | – | – | cycles | 25 °C ≤ $T_A$ ≤ 55 °C |

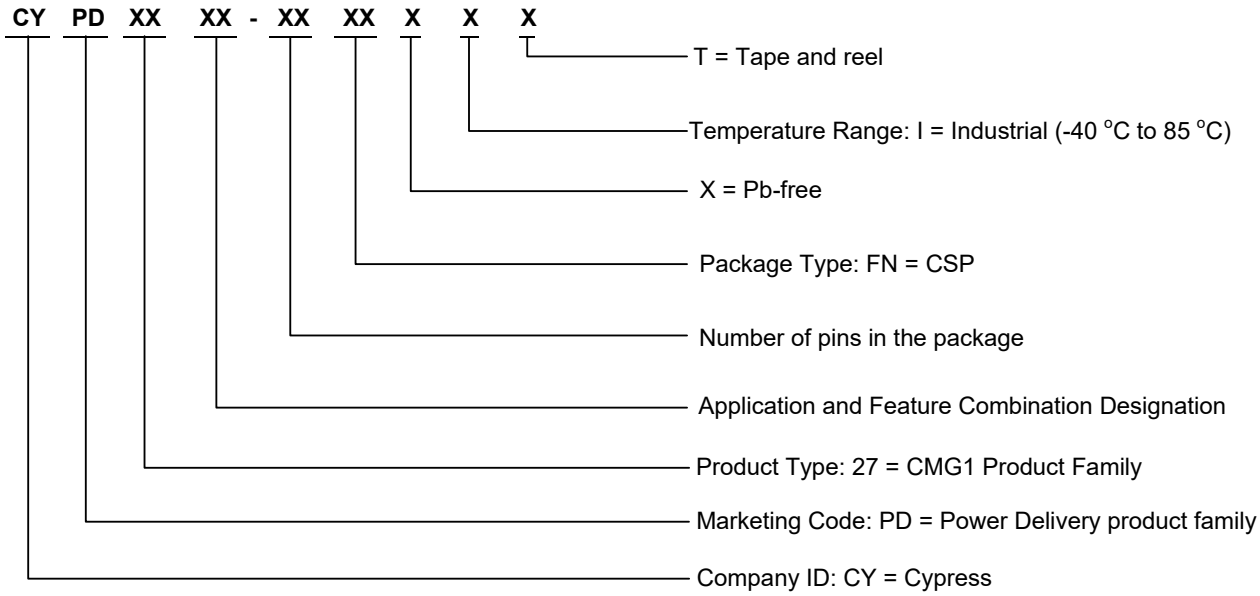
## Ordering Information

Table 6 lists the EZ-PD CMG1 part numbers and features.

**Table 6. CMG1 Ordering Information**

| MPN | Application | Type-C Ports | Role | Package Type | Si ID |
|---|---|---|---|---|---|
| CYPD2703-09FNXIT | Passive Cable | 1 | EMCA | 9-ball CSP | 2600 |
| CYPD2704-09FNXIT | Thunderbolt Passive Cable | 1 | EMCA | 9-ball CSP | 2601 |

### Ordering Code Definition



## Packaging

**Table 7. Package Characteristics**

| Parameter | Description | Conditions | Min | Typ | Max | Units |
|---|---|---|---|---|---|---|
| $T_A$ | Operating ambient temperature | Industrial | –40 | 25 | 85 | °C |
| $T_J$ | Operating junction temperature | Industrial | –38.68 | 26.32 | 86.32 | °C |
| $T_{JA}$ | Package $\theta_{JA}$ (9-pin CSP) | | – | – | 31.9 | °C/W |
| $T_{JC}$ | Package $\theta_{JC}$ (9-pin CSP) | | – | – | 20.02 | °C/W |

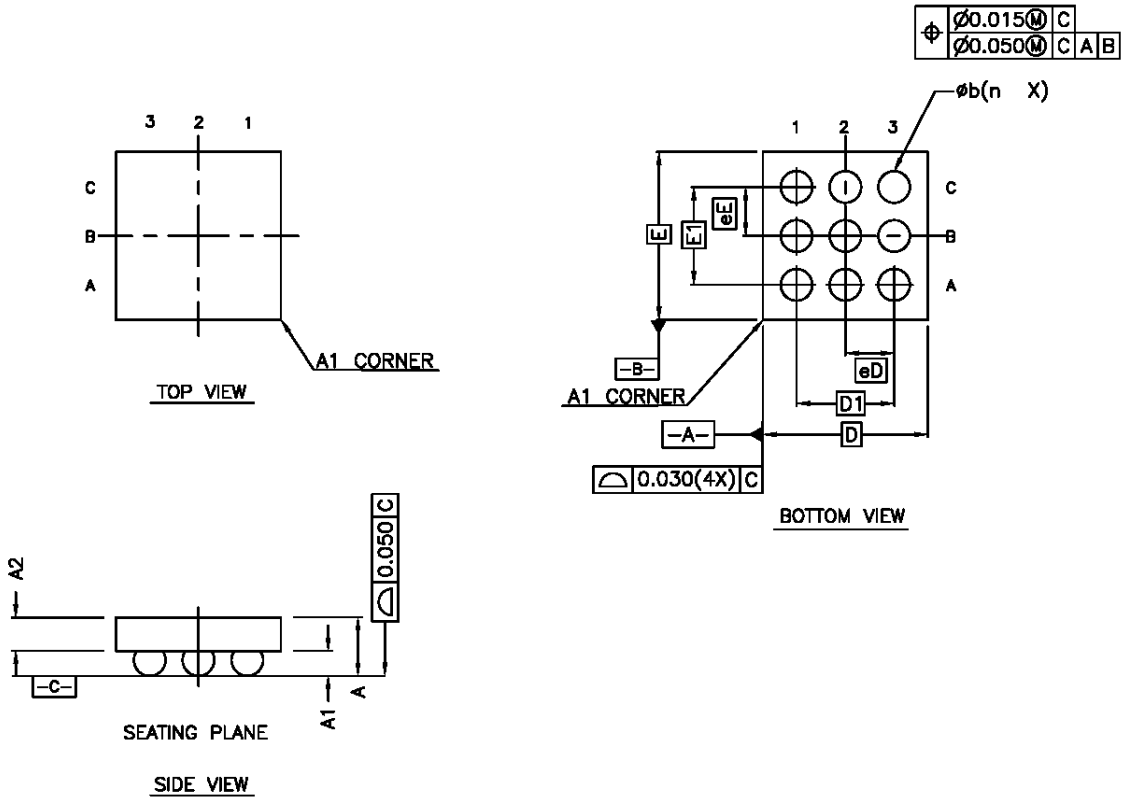
**Table 8. Solder Reflow Peak Temperature**

| Package | Maximum Peak Temperature | Maximum Time within 5 °C of Peak Temperature |
|---|---|---|
| 9-pin CSP | 260 °C | 30 seconds |

**Table 9. Package Moisture Sensitivity Level (MSL), IPC/JEDEC J-STD-2**

| Package | MSL |
|---|---|
| 9-pin CSP | MSL 1 |

**Figure 6. 9-ball CSP Package Outline**




| SYMBOL | DIMENSIONS | | |
|---|---|---|---|
| | MIN. | NOM. | MAX. |
| A | - | - | 0.520 |
| A1 | 0.122 | 0.152 | 0.182 |
| A2 | 0.250 | 0.275 | 0.300 |
| D | 1.351 BSC | | |
| E | 1.376 BSC | | |
| D1 | 0.800 BSC | | |
| E1 | 0.800 BSC | | |
| n | 9 | | |
| Øb | 0.188 | 0.218 | 0.248 |
| eD | 0.400 BSC | | |
| eE | 0.400 BSC | | |

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS.

002-21607 *B

## Acronyms

**Table 10. Acronyms Used in this Document**

| Acronym | Description |
|---|---|
| CC | configuration channel |
| CPU | central processing unit |
| DFP | downstream facing port |
| DRP | dual role port |
| EMCA | electronically marked cable assembly, a USB cable that includes an IC that reports cable characteristics (e.g., current rating) to the Type-C ports |
| ESD | electrostatic discharge |
| IC | integrated circuit |
| MCU | microcontroller unit |
| NC | no connect |
| NVL | non-volatile latch |
| PD | power delivery |
| PHY | physical layer |
| POR | power-on reset |
| PSoC® | Programmable System-on-Chip™ |
| RX | receive |
| 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 |
| USB | Universal Serial Bus |

## Document Conventions

### Units of Measure

**Table 11. 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 |

## Document History Page

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|---|---|---|---|---|
| **Revision** | **ECN** | **Orig. of Change** | **Submission Date** | **Description of Change** |
| *H | 6242326 | VGT | 07/13/2018 | Changed datasheet status to Final. |
| *I | 6554744 | VGT | 04/24/2019 | Updated 9-ball CSP package diagram. |

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