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1. Safety Information

1.1 Regulatory Compliance

The CY4541 EZ-PD CCG4 EVK is intended for use as a development platform for hardware or software in a laboratory environment. The board is an open-system design, which does not include a shielded enclosure. Due to this reason, the board may cause interference to other electrical or electronic devices in close proximity. In a domestic environment, this product may cause radio interference. In such cases, take adequate preventive measures. Also, do not use this board near any medical equipment or RF devices.

Attaching additional wiring to this product or modifying the product operation from the factory default may affect its performance and cause interference with other apparatus in the immediate vicinity. If such interference is detected, suitable mitigating measures must be taken.

The CY4541 EZ-PD CCG4 EVK as shipped from the factory has been verified to meet with requirements of CE as a Class A product.

The CY4541 EZ-PD CCG4 EVK contains ESD-sensitive devices. Electrostatic charges readily accumulate on the human body and any equipment, and can discharge without detection. Permanent damage may occur on devices subjected to high-energy discharges. Proper ESD precautions are recommended to avoid performance degradation or loss of functionality. Store unused CY4541 CCG4 EVK boards in the protective shipping package.

End-of-Life/Product Recycling

This kit has an end-of-life cycle of five years from the year of manufacturing mentioned on the back of the box. Contact your nearest recycler for discarding the kit.
1.2 General Safety Instructions

1.2.1 ESD Protection

ESD can damage boards and associated components. Cypress recommends that you perform procedures only at an ESD workstation. If an ESD workstation is not available, use appropriate ESD protection by wearing an antistatic wrist strap attached to the chassis ground (any unpainted metal surface) on the board when handling parts.

1.2.2 Handling Boards

CY4541 EZ-PD CCG4 EVK boards are sensitive to ESD. Hold the board only by its edges. After removing the board from its box, place it on a grounded, static-free surface. Use a conductive foam pad if available. Do not slide the board over any surface.

Any physical action on the CY4541 EZ-PD CCG4 EVK such as changing wires, jumper settings, or measuring voltages can cause stress on the CY4541 printed circuit board assembly (PCBA) and Type-C connectors. You must ensure that the PCBA has proper support on the bottom side to avoid stress on the PCBA when the EVK is in operation.
2. Introduction

The CY4541 EZ-PD™ CCG4 Evaluation Kit (EVK) is based on the Cypress's CCG4 dual port Type-C Power Delivery (PD) controllers. EZ-PD™ CCG4 is a dual USB Type-C controller that complies with the latest USB Type-C and PD standards. This EVK is primarily intended to be a demonstration vehicle for Type-C PC designs that house one or two Type-C ports. CCG4 can act either as a power provider (Source) or as a power consumer (Sink). The kit also helps to evaluate several features on two Type-C ports, using a Dual Role Port (DRP) or SuperSpeed USB demo, and a DisplayPort demo.

2.1 Kit Contents

The CY4541 EZ-PD CCG4 EVK contains the following items:

- Two CCG EVK base boards assembled with one CY4541 CCG4 daughter card
- One 24-V DC power adapter*
- Two USB 3.0 Type-A to Type-B Cables
- Two USB Type-C to Type-A adapters
- One USB 3.0 EMCA (Electronically Marked Cable Assembly) Type-C cable*
- One USB 2.0 Type-A to Mini-B cable
- One set of jumper wires
- One screwdriver
- Quick Start Guide

Note: *The CY4541 EZ-PD CCG4 EVK supports power up to 100 W (20 V, 5 A). The power adapter provided with the kit can support only up to 2.7 A (at 24 V). The USB 3.0 Type-C EMCA cable provided with the kit can support only up to 3 A.

2.1.1 Hardware Not Included With the Kit

The CY4541 EZ-PD CCG4 EVK does not come with all the hardware needed to perform the demonstrations documented in DRP and SuperSpeed USB Demo. The following hardware is not included with this kit:

- A multimeter to measure voltage.
- Two USB pen drives for Kit Operation.
- DisplayPort cables to connect the PC to the CCG EVK base board. If the PC has a Mini DisplayPort, then a Mini DisplayPort to DisplayPort cable will be required.
- Type-C to DP adapters (available on the web) to connect a display monitor to the CY4541 EZ-PD CCG4 EVK board, which only has a DisplayPort interface.
- Display Splitter adapter (available on the web) for the kit to operate during the dual DisplayPort demonstration.
- A USB Type-C power adapter (available on the web) for DRP kit operation. Dual Type-C port operation requires a USB Type-C power adapter that supports a 14-V to 20-V power profile.
- A display monitor with DisplayPort (DP), HDMI, or VGA interface for the DisplayPort demonstration.
- A PC with two USB ports. USB 3.0 ports and Windows XP, or later operating system, is recommended.
2.2 Getting Started

For instructions on how to run a quick demonstration and observe kit functionality, refer to DRP and SuperSpeed USB Demo.

2.3 List of Recommended Hardware

See Table 2-1 for the list of recommended hardware for this kit to demonstrate the Dual Role Port (DRP) and DisplayPort Connection.

Table 2-1. List of Recommended Cables

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Manufacturer</th>
<th>MPN</th>
<th>Vendor Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>DisplayPort to DisplayPort Cable (6&quot;, gold plated)*</td>
<td>Cable Matters</td>
<td>102005-6</td>
<td>Cablematters Link</td>
</tr>
<tr>
<td>2</td>
<td>Mini DisplayPort to DisplayPort Cable (3&quot;, gold plated)*</td>
<td>Cable Matters</td>
<td>101007-BLACK-3</td>
<td>Cablematters Link</td>
</tr>
<tr>
<td>3</td>
<td>Display Splitter Adapter</td>
<td>Lenovo</td>
<td>0B47092</td>
<td>Lenovo Link</td>
</tr>
<tr>
<td>4</td>
<td>USB Type-C to DisplayPort Adapter</td>
<td>Cable Matters</td>
<td>--</td>
<td>Amazon Link</td>
</tr>
<tr>
<td></td>
<td>USB Type-C to HDMI Adapter</td>
<td>Cable Matters</td>
<td>--</td>
<td>Amazon Link</td>
</tr>
<tr>
<td></td>
<td>USB Type-C to VGA Adapter</td>
<td>Cable Matters</td>
<td>--</td>
<td>Amazon Link</td>
</tr>
<tr>
<td>5</td>
<td>USB Type-C power adapter that supports 14V or above</td>
<td>Apple</td>
<td>--</td>
<td>Apple Store Link</td>
</tr>
<tr>
<td>6</td>
<td>USB 3.0 pen drive</td>
<td>SanDisk</td>
<td>--</td>
<td>Amazon Link</td>
</tr>
</tbody>
</table>

*Note: Use item 1 in Table 2-1 if the PC has a DisplayPort connector. Use item 2 in Table 2-1 if the PC has a Mini DisplayPort connector.

Refer to the Knowledge Base Article KBA12598 for getting information on the known issues of Apple USB-C Digital AV Multiport Adapter and Apple 29W USB-C Power Adapter while using with CY4541 EZ-PD CCG4 EVK.
3. Kit Installation

This chapter describes how to install the CY4541 EZ-PD CCG4 EVK.

3.1 CY4541 EZ-PD CCG4 EVK Kit Software Installation

To install the kit software, follow these steps:

1. Download the latest kit software setup, CY4541Setup.exe, from www.cypress.com/CY4541. This package contains the kit hardware files, kit guide, and quick start guide. Double-click CY4541Setup.exe to start the installation. Click Next when the screen shown in Figure 1 appears.

Figure 1. CY4541 EZ-PD CCG4 EVK Installer Screen

Welcome to the InstallShield Wizard for CY4541 EZ-PD CCG4 EVK

The InstallShield Wizard will install CY4541 EZ-PD CCG4 EVK on your computer. To continue, click Next.

Select folder where setup will install files.

Install CY4541 EZ-PD CCG4 EVK to

C:\Program Files\Cypress

< Back Next > Cancel
2. Select the required **Installation Type** and click the **Next** button to start the installation (Figure 2). For first-time installation, it is recommended that you select “Typical” as the **Installation Type**.

![Installation Wizard](image)

Figure 2. Installation Wizard

3. Accept the license agreement for the software components and click **Next** (Figure 3) to proceed with the installation. If you do not accept the terms in the agreement, click **Cancel** to exit from the installation.

![License Agreement](image)

Figure 3. License Agreement
4. **Figure 4** shows the installation progress. EZ-PD Configuration Utility also gets installed along with CY4541 EZ-PD CCG4 EVK.

![Figure 4. Installation Progress](image)

5. Click **Finish** when complete (**Figure 5**).

![Figure 5. Software Installation Complete](image)
6. When the installation is complete, you have the option to Launch Update Manager to ensure you have the latest software package. Click the Check for updates button at the bottom of the window. If “No Updates” appears adjacent to the CY4541 EZ-PD CCG4 EVK, click the Exit button. If there are updates, click the Update button to download and install the latest kit package.

Figure 6. Cypress Update Manager

![Cypress Update Manager](image)

Note: You can launch the Cypress Update Manager from Start > All Programs > Cypress > Cypress Update Manager. The latest revision number of CY4541 EZ-PD CCG4 EVK may vary from the image shown in Figure 6.

7. After the installation is complete, the contents are available at the following location:
<Install Directory>\CY4541 CCG4 EVK\1.0.

Note: On the Windows 32-bit platform, the default <Install Directory> is C:\Program Files\Cypress; on the Windows 64-bit platform, it is C:\Program Files(x86)\Cypress.
4. CY4541 EZ-PD CCG4 EVK Hardware

4.1 CY4541 EZ-PD CCG4 EVK Architecture

Figure 7. CY4541 EZ-PD CCG4 EVK System-level Block Diagram

CCG4 is a dual USB Type-C controller that complies with the latest USB Type-C and PD standards. CCG4 provides a complete dual USB Type-C and USB-PD port control solution for PC designs. It can also be used in DRP applications in which a USB Type-C port can switch its power role from provider to consumer and vice-versa. CCG4 uses Cypress’s proprietary MOS8 technology integrated with a 32-bit, 48-MHz ARM® Cortex®-M0 processor, 128-KB flash, and two Type-C transceivers including the Type-C termination resistors Rp and Rd.

The CY4541 EZ-PD CCG4 EVK consists of two CCG EVK base boards and one CY4541 CCG4 daughter card. The CY4541 CCG4 daughter card is connected to the two CCG EVK base boards to evaluate the CCG4’s dual Type-C port capability as shown in Figure 7.

The CCG EVK base board consists of a DC input power supply, a display multiplexer, a DisplayPort connector, a SuperSpeed Type-B port, and a Type-C port. The CY4541 CCG4 daughter card consists of the CCG4 device and a USB-Serial IC to provide a USB interface for debugging. CCG4’s CC lines of the respective Type-C interface are connected to the Type-C port on the CCG EVK base board. CCG4 controls the display multiplexer over an I2C interface.
The CY4541 EZ-PD CCG4 EVK has a power provider and power consumer path control circuitry to showcase CCG4’s ability to switch its power role from a provider to a consumer and vice-versa. This EVK has overvoltage and overcurrent protection circuitry for VBUS and VCONN; it also supports programming CCG4 devices over SWD and I2C interfaces.

A PC with two USB 3.0 ports and a DisplayPort along with the CY4541 EZ-PD CCG4 EVK is equivalent to a PD-enabled dual Type-C port PC.

4.2 CY4541 EZ-PD CCG4 EVK

Figure 8 shows the CY4541 EZ-PD CCG4 EVK setup, in which two CCG EVK base boards are connected to the CY4541 CCG4 daughter card.

The following sections describe the CCG EVK base board and daughter card design.

4.3 CCG EVK Base Board

The CCG EVK base board is an evaluation board equipped with a Type-C port, a SuperSpeed USB Type-B port, and a DisplayPort interface. It is primarily intended as a demonstration board for PC designs that house a Type-C connector. The board also serves as a vehicle to evaluate the alternate Type-C modes, using the DisplayPort demo as an example.

4.3.1 Block Diagram

Figure 9 shows the CCG EVK base board block diagram. It has an onboard Type-C connector for the USB-PD interface and a CY4541 CCG4 daughter card interface connector to connect the CY4541 CCG4 daughter card. It also includes a SuperSpeed USB Type-B port and a DisplayPort connector to source video. The SuperSpeed USB signals and DisplayPort signals are connected to the Type-C connector through a display multiplexer controlled by the CCG4 device. A DC power adapter provides input voltage to the onboard Power Management IC (PMIC). The output voltage from the PMIC can be selected using two voltage selection lines, controlled by CCG4. This CCG EVK base board, along with the CY4541 CCG4 daughter card, helps convert any desktop or notebook PC with legacy USB ports to operate as a Type-C USB host.
4.3.2 Features

Table 4-1 shows the features of the CCG EVK base board.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power</td>
<td>Negotiated power from the DC power adapter controlled by PMIC and CCG4. 5 V from the Type-C connector (for dead battery support). For the dual Type-C port operation of this kit, use a USB Type-C power adapter that supports a 9 V to 20 V power profile. Note that the DC power adapter provided with the kit can support only up to 2.7A (at 24 V). This kit will not work with 5 V DC power adapters.</td>
</tr>
<tr>
<td>CY4541 CCG4 daughter card interface connector</td>
<td>Provides interface to connect the CY4541 CCG4 daughter card to the CCG EVK base board</td>
</tr>
<tr>
<td>Type-C Plug Orientation, Detection and Alternate modes</td>
<td>I2C interface between CCG4 and the display multiplexer to select between SuperSpeed USB and 2-lane or 4-lane DisplayPort. Hot Plug Detect (HPD) for DisplayPort Alternate mode of operation.</td>
</tr>
</tbody>
</table>
4.3.3 Connectors and Jumper Settings

Figure 10 shows the CCG EVK base board connectors and the default jumper settings.

Figure 10. CCG EVK Base Board Connectors
Table 4-2 shows a detailed description of the connectors and jumper settings.

<table>
<thead>
<tr>
<th>Jumper/Connector</th>
<th>Description</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>J1</td>
<td>DC power jack to connect the DC power adapter to the CCG EVK base board</td>
<td>NA</td>
</tr>
<tr>
<td>J2</td>
<td>SuperSpeed USB Type-B connector (receptacle)</td>
<td>NA</td>
</tr>
<tr>
<td>J3</td>
<td>USB Type-C connector (receptacle)</td>
<td>NA</td>
</tr>
<tr>
<td>J4</td>
<td>DisplayPort connector</td>
<td>NA</td>
</tr>
<tr>
<td>J7</td>
<td>Header for voltage measurement when CCG4 acts as power consumer or power output header</td>
<td>NA</td>
</tr>
<tr>
<td>J8</td>
<td>CY4541 CCG4 daughter card interface connector</td>
<td>NA</td>
</tr>
<tr>
<td>J9</td>
<td>Debug connector</td>
<td>NA</td>
</tr>
</tbody>
</table>

**Table 4-2. CCG EVK Base Board Jumper/Connector Description**

<table>
<thead>
<tr>
<th>Jumper/Connector</th>
<th>Description</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>J1</td>
<td>DC power jack to connect the DC power adapter to the CCG EVK base board</td>
<td>NA</td>
</tr>
<tr>
<td>J2</td>
<td>SuperSpeed USB Type-B connector (receptacle)</td>
<td>NA</td>
</tr>
<tr>
<td>J3</td>
<td>USB Type-C connector (receptacle)</td>
<td>NA</td>
</tr>
<tr>
<td>J4</td>
<td>DisplayPort connector</td>
<td>NA</td>
</tr>
<tr>
<td>J7</td>
<td>Header for voltage measurement when CCG4 acts as power consumer or power output header</td>
<td>NA</td>
</tr>
<tr>
<td>J8</td>
<td>CY4541 CCG4 daughter card interface connector</td>
<td>NA</td>
</tr>
<tr>
<td>J9</td>
<td>Debug connector</td>
<td>NA</td>
</tr>
</tbody>
</table>

**Note:** The pin descriptions are not fully transcribed due to the limitation of the text. For detailed pin descriptions, please refer to the original document.
4.4 CY4541 CCG4 Daughter Card

The CY4541 CCG4 daughter card is an evaluation board with a CCG4 controller (CYPD4225-40LQXI) and a USB-Serail Bridge Controller (CY7C65215) to provide a USB interface for debugging. The CY4541 CCG4 daughter card must be assembled with the CCG EVK base boards. This complete assembly setup supports Type-C host applications such as PCs.

PD-enabled USB products (such as a PC with a Type-C port) operate as a power provider and a power consumer. The USB PD specification refers to such USB Type-C ports as Dual Role Ports (DRPs).

4.4.1 Block Diagram

Figure 11 shows the CY4541 CCG4 daughter card block diagram.
### 4.4.2 Features

Table 4-3 lists the CY4541 CCG4 daughter card features.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCG4 device</td>
<td>CYPD4225-40LQXI</td>
</tr>
<tr>
<td>CCG4 package</td>
<td>40-QFN</td>
</tr>
<tr>
<td><strong>USB PD/Type-C</strong></td>
<td></td>
</tr>
<tr>
<td>CCG4 device</td>
<td></td>
</tr>
<tr>
<td>CCG4 package</td>
<td></td>
</tr>
<tr>
<td>Dual Type-C port support</td>
<td></td>
</tr>
<tr>
<td>Ability to act as power provider (source) and power consumer (sink)</td>
<td></td>
</tr>
<tr>
<td>Supports the following PD capabilities (VSEL pins):</td>
<td></td>
</tr>
<tr>
<td>5 V up to 3 A</td>
<td></td>
</tr>
<tr>
<td>5 V up to 5 A</td>
<td></td>
</tr>
<tr>
<td>9 V up to 5 A</td>
<td></td>
</tr>
<tr>
<td>15 V up to 5 A</td>
<td></td>
</tr>
<tr>
<td>20 V up to 5 A</td>
<td></td>
</tr>
<tr>
<td>VBUS provider and consumer FET control for VBUS source or sink path</td>
<td></td>
</tr>
<tr>
<td>VBUS discharge control FET</td>
<td></td>
</tr>
<tr>
<td>VBUS Provider path and Consumer path control</td>
<td></td>
</tr>
<tr>
<td>VBUS provider path and consumer path control FETs per Type-C port</td>
<td></td>
</tr>
<tr>
<td>OVP and OCP</td>
<td></td>
</tr>
<tr>
<td>VCONN overcurrent protection</td>
<td></td>
</tr>
<tr>
<td>VBUS overvoltage protection</td>
<td></td>
</tr>
<tr>
<td>VBUS overcurrent protection</td>
<td></td>
</tr>
<tr>
<td>Plug orientation, Detection and Alternate modes</td>
<td></td>
</tr>
<tr>
<td>Dual Alternate mode/Display support</td>
<td></td>
</tr>
<tr>
<td>Three mux-select pins per Type-C port to select between SuperSpeed USB and 2-lane or 4-lane DisplayPort</td>
<td></td>
</tr>
<tr>
<td>Hot Plug Detect (HPD) for DisplayPort Alternate Mode operation</td>
<td></td>
</tr>
<tr>
<td>SBU (Side Band Use) multiplexer support to select between Auxiliary lines and UART TXD/RXD signals</td>
<td></td>
</tr>
<tr>
<td>USB/I2C Programming</td>
<td></td>
</tr>
<tr>
<td>USB Type-B Mini receptacle connected to USB-to-serial device, which programs the CCG4 controller using the EZ-PD Configuration Utility</td>
<td></td>
</tr>
<tr>
<td>SWD Programming</td>
<td></td>
</tr>
<tr>
<td>SWD pin debugging/programming using MiniProg3 device (not provided with the kit)</td>
<td></td>
</tr>
<tr>
<td>Power</td>
<td></td>
</tr>
<tr>
<td>5 V from DC power jack</td>
<td></td>
</tr>
<tr>
<td>5 V regulated from Type-C connector</td>
<td></td>
</tr>
<tr>
<td>5 V from USB Type-B mini connector</td>
<td></td>
</tr>
<tr>
<td>1.8 V/3.3 V/5 V From SWD programming header</td>
<td></td>
</tr>
</tbody>
</table>
4.4.3 Connectors and Jumper Settings

Figure 12 shows the CY4541 CCG4 daughter card connectors and default jumper settings. Table 4-4 lists the jumpers and header description and default settings.

Table 4-4. CY4541 CCG4 daughter card Jumper Description and Default Settings

<table>
<thead>
<tr>
<th>Jumper/Connector</th>
<th>Description</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>J1</td>
<td>USB 2.0 Mini-B connector (receptacle)</td>
<td>NA</td>
</tr>
<tr>
<td>J2</td>
<td>Type-C Port1 interface&lt;br&gt;PIN 1: USB_P_PWR_P1 (USB Provider power)&lt;br&gt;PIN 2: USB_P_PWR_P1 (USB Provider power)&lt;br&gt;PIN 3: Type-C_VBUS_P1&lt;br&gt;PIN 4: Type-C_VBUS_P1</td>
<td>NA</td>
</tr>
<tr>
<td>Jumper/Connector</td>
<td>Description</td>
<td>Default</td>
</tr>
<tr>
<td>------------------</td>
<td>--------------------------------------</td>
<td>---------------</td>
</tr>
<tr>
<td>Pin 5: USB_C_PWR_P1 (USB Consumer power)</td>
<td>Pin 6: USB_C_PWR_P1 (USB Consumer power)</td>
<td></td>
</tr>
<tr>
<td>Pin 7: GND</td>
<td>Pin 8: GND</td>
<td></td>
</tr>
<tr>
<td>Pin 9: I2C_SCL</td>
<td>Pin 10: VBUS_DISCHRG_P1</td>
<td></td>
</tr>
<tr>
<td>Pin 11: I2C_SDA</td>
<td>Pin 12: SWD_IO</td>
<td></td>
</tr>
<tr>
<td>Pin 15: P_PWR_P1_MON</td>
<td>Pin 16: XRES</td>
<td></td>
</tr>
<tr>
<td>Pin 17: VSEL2_P1(Voltage Selection line 2)</td>
<td>Pin 18: I2C_ADDR_P1</td>
<td></td>
</tr>
<tr>
<td>Pin 19: V5P0_P1</td>
<td>Pin 20: No Connect</td>
<td></td>
</tr>
<tr>
<td>Pin 21: CC1_P1</td>
<td>Pin 22: CC2_P1</td>
<td></td>
</tr>
<tr>
<td>Pin 23: V3P3_P1</td>
<td>Pin 24: VBUS_P_CTRL_P1 (VBUS Provider Control)</td>
<td></td>
</tr>
<tr>
<td>Pin 25: RXD_P1</td>
<td>Pin 26: VBUS_MON_P1 (VBUS Monitoring I/O)</td>
<td></td>
</tr>
<tr>
<td>Pin 27: TXD_P1</td>
<td>Pin 28: I2C_INT_EC</td>
<td></td>
</tr>
<tr>
<td>Pin 29: DP_AUXN_P1</td>
<td>Pin 30: VBUS_C_CTRL_N_P1 (VBUS Consumer Control)</td>
<td></td>
</tr>
<tr>
<td>Pin 31: DP_AUXXP_P1</td>
<td>Pin 32: OVP_TRIP_P1 (Overvoltage Detection Signal)</td>
<td></td>
</tr>
<tr>
<td>Pin 33: SBU2_P1</td>
<td>Pin 34: I2C_SDA_EC</td>
<td></td>
</tr>
<tr>
<td>Pin 35: SBU1_P1</td>
<td>Pin 36: HOTPLUG_DET_P1</td>
<td></td>
</tr>
<tr>
<td>Pin 37: I2C_SCL_EC</td>
<td>Pin 38: USB2_DP</td>
<td></td>
</tr>
<tr>
<td>Pin 39: VSEL1_P1(Voltage selection line 1)</td>
<td>Pin 40: USB2_DM</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Jumper/Connector</th>
<th>Description</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pin 1: USB_P_PWR_P2 (USB Provider power)</td>
<td>Pin 2: USB_P_PWR_P2 (USB Provider power)</td>
<td></td>
</tr>
<tr>
<td>Pin 3: Type-C_VBUS_P2</td>
<td>Pin 4: Type-C_VBUS_P2</td>
<td></td>
</tr>
<tr>
<td>Pin 5: USB_C_PWR_P2 (USB Consumer power)</td>
<td>Pin 6: USB_C_PWR_P2 (USB Consumer power)</td>
<td></td>
</tr>
<tr>
<td>Pin 7: GND</td>
<td>Pin 8: GND</td>
<td></td>
</tr>
<tr>
<td>Pin 9: I2C_SCL</td>
<td>Pin 10: VBUS_DISCHRG_P2</td>
<td></td>
</tr>
<tr>
<td>Pin 11: I2C_SDA</td>
<td>Pin 12: No Connect</td>
<td></td>
</tr>
<tr>
<td>Pin 13: OCP_P2 (Over Current Protection)</td>
<td>Pin 14: No Connect</td>
<td></td>
</tr>
<tr>
<td>Pin 15: P_PWR_P2_MON</td>
<td>Pin 16: No Connect</td>
<td></td>
</tr>
<tr>
<td>Pin 17: VSEL2_P2(Voltage Selection line 2)</td>
<td>Pin 18: I2C_ADDR_P2</td>
<td></td>
</tr>
<tr>
<td>Pin 19: V5P0_P2</td>
<td>Pin 20: VCONN_MON</td>
<td></td>
</tr>
</tbody>
</table>

**Type-C Port2 Interface**
### Jumper/Connector Description

<table>
<thead>
<tr>
<th>Jumper/Connector</th>
<th>Description</th>
<th>Default</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pin 21: CC1_P2</td>
<td>Pin 22: CC2_P2</td>
<td></td>
</tr>
<tr>
<td>Pin 23: V3P3_P2</td>
<td>Pin 24: VBUS_P_CTRL_P2 (VBUS Provider Control)</td>
<td></td>
</tr>
<tr>
<td>Pin 25: RXD_P2</td>
<td>Pin 26: VBUS_MON_P2 (VBUS Monitoring I/O)</td>
<td></td>
</tr>
<tr>
<td>Pin 27: TXD_P2</td>
<td>Pin 28: No Connect</td>
<td></td>
</tr>
<tr>
<td>Pin 29: DP_AUXN_P2</td>
<td>Pin 30: VBUS_C_CTRL_N_P2 (VBUS Consumer Control)</td>
<td></td>
</tr>
<tr>
<td>Pin 31: DP_AUXP_P2</td>
<td>Pin 32: OVP_TRIP_P2 (Overvoltage)</td>
<td></td>
</tr>
<tr>
<td>Pin 33: SBU2_P2</td>
<td>Pin 34: No Connect</td>
<td></td>
</tr>
<tr>
<td>Pin 35: SBU1_P2</td>
<td>Pin 36: HOTPLUG_DET_P2</td>
<td></td>
</tr>
<tr>
<td>Pin 37: No Connect</td>
<td>Pin 38: SW1_P2</td>
<td></td>
</tr>
<tr>
<td>Pin 39: VSEL1_P2 (Voltage selection line 1)</td>
<td>Pin 40: SW0_P2</td>
<td></td>
</tr>
</tbody>
</table>

### SWD Programming header

<table>
<thead>
<tr>
<th>J4</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pin 1: VTARG</td>
<td></td>
</tr>
<tr>
<td>Pin 2: GND</td>
<td></td>
</tr>
<tr>
<td>Pin 3: XRES</td>
<td></td>
</tr>
<tr>
<td>Pin 4: SWD_CLK</td>
<td></td>
</tr>
<tr>
<td>Pin 5: SWD_IO</td>
<td></td>
</tr>
</tbody>
</table>

### VDDD voltage selection for CCG4 device

<table>
<thead>
<tr>
<th>J5</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 and 2 short: 3.3 V</td>
<td></td>
</tr>
<tr>
<td>2 and 3 short: 5.0 V</td>
<td></td>
</tr>
</tbody>
</table>

### 4.5 CCG EVK Base Board and CCG4 Daughter Card Revisions

Table 4-5 provides details about the latest revision of the CCG EVK Base Board and CCG4 Daughter Card.

<table>
<thead>
<tr>
<th>Board</th>
<th>Revision</th>
</tr>
</thead>
<tbody>
<tr>
<td>CCG EVK Base Board</td>
<td>Rev 05</td>
</tr>
<tr>
<td>CCG4 Daughter Card</td>
<td>Rev 04</td>
</tr>
</tbody>
</table>

Schematic and BoM details for the latest revision of hardware are available in Appendix A. The complete set of latest hardware files (Schematic, BoM & Layout) files are available under `<Install Directory>\CY4541 CCG EVK\1.0\Hardware`. 
Revision number of a given hardware can be identified on the PCB as shown in Figure 13.

Figure 13: Revision Number of CCG EVK Base Board

Note that hardware design files (Schematic, BoM & Layout) of the earlier revisions of the hardware are also available as part of the kit installer. Refer to `<Install Directory>`\`CY4541 CCG4 EVK\1.0\Hardware\README.txt` to get more details.
5. Programming the CCG4 Device

The CCG4 device in the CY4541 EZ-PD CCG4 EVK is preprogrammed with the latest cyacd* firmware binary image at the time of manufacturing. However, a more recent cyacd* file for CCG4 is available on the CY4541 EZ-PD CCG4 EVK webpage as well as in the CY4541 EZ-PD CCG4 EVK installer. The firmware version of the onboard CCG4 device can be verified by using the EZ-PD Configuration Utility as shown in Figure 17. If the onboard CCG4’s firmware version does not match the latest version on the CY4541 EZ-PD CCG4 EVK webpage, follow the steps in this chapter to reprogram the CCG4 device. This firmware update is required for successful kit operation. Device configuration parameters (such as vendor ID, Power Data Objects (PDOs), DisplayPort mode parameters) can be updated using EZ-PD Configuration Utility. Refer to the EZ-PD Configuration Utility User Manual for more details.

Note *: cyacd is the bootloader application and code data file format. The file consists of a header followed by lines of flash data. Excluding the header, each line in the .cyacd file represents an entire row of flash data. The data is stored as ASCII data in Big Endian format.

5.1 Programming CCG4 Device on the CY4541 CCG4 Daughter Card

Follow these steps to update the firmware running on the CCG4 device of the CY4541 CCG4 daughter card:

1. If the kit installation is not performed yet or was not performed recently, install the latest version of the software by downloading and installing the latest kit setup CY4541Setup.exe from www.cypress.com/CY4541.

2. Ensure that the voltage selection jumper (J5) is set to 5 V (pins 2 and 3 of jumper J5 on the CY4541 CCG4 daughter card are shorted).

3. Connect the boards and cables (USB 2.0 USB 2.0 Type-A to Mini-B cable, DC power adapter, and wires between the power input header (J12) on CCG EVK base board 1 and CCG EVK base board 2) as shown in Figure 14. Connect the DC power adapter to CCG EVK base board 1.
4. The EZ-PD Configuration Utility is a Microsoft Windows Application, which can be used to configure and program the CCG4 device on the CY4541 CCG4 daughter card. After the kit installation, EZ-PD Configuration utility is available at the following location:

`<Install_Directory>/Cypress/ EZ-PD Configuration utility`

Alternatively, download and install the EZ-PD Configuration Utility from the Cypress webpage.

5. Open the EZ-PD Configuration Utility as shown in Figure 15. After the installation, the EZ-PD Configuration Utility is available at the following location:

`Start > All Programs > Cypress > EZ-PD Configuration Utility > EZ-PD Configuration Utility.exe`
USB Type-C is the new USB-IF standard that solves several challenges faced while using today’s Type-A and Type-B cables and connectors. USB Type-C uses a slimmer connector - measuring only 2.4-mm in height - to allow for increasing miniaturization of consumer and
6. Select the **Tools > Firmware Update** menu option to update the firmware of the CCG4 device as shown in Figure 16. Refer to the **EZ-PD Configuration Utility User Manual** for more details. To open this document, click Help > User Manual in the EZ-PD Configuration Utility as shown in Figure 16.

Figure 16. Upgrading CCG4 Firmware

7. The internal device flash contains two copies of the firmware, which can mutually update each other. These copies are called FW1 and FW2, and are designed to be placed at different flash locations. If the CCG4 device is currently running FW1, only FW2 can be updated and vice-versa. Specify both firmware binaries in the Firmware path 1 and Firmware path 2 widgets. The EZ-PD Configuration Utility selects the appropriate firmware binary image based on the current image running in CCG4. To update both FW1 and FW2 binary images, perform step 9 and step 10 twice. When Step 9 and 10 are executed the first time after connecting the EVK, the FW1 image is updated. When steps 9 and 10 are repeated, the EZ-PD Configuration utility dynamically switches the firmware image to FW2 and, the FW2 image is updated in the CCG4 device.

8. Download the latest CY4541 firmware from the **CY4541 EZ-PD CCG4 EVK webpage**. The firmware binary images are also available at the following location after the CY4541 EZ-PD CCG4 EVK installation.

<Install_Directory>\CY4541 CCG4 EVK\1.0\Firmware
9. Select **NOTEBOOK** from the “select target” list shown in Figure 17. Select the firmware binary image 1 (CYPD4225-40LQXI_notebook_one_x_y_z_bb*0_0_0_nb.cyacd) by clicking Browse (…) in the Firmware path 1 widget. Select the firmware binary image 2 (CYPD4225-40LQXI_notebook_two_x_y_z_bb*0_0_0_nb.cyacd) by clicking Browse (…) in the Firmware path 2 widget. Click **Program**.

**Note**: Here, x_y_z_bb refers to the firmware version and build number.

Figure 17. Selection of DRP-NOTEBOOK from EZ-PD Configuration Utility

10. Press switch SW1 (XRES) on CY4541 CCG4 daughter card to reset the CCG4 device.

11. Firmware for the CCG4 device is provided in .cyacd format. Sample firmware binaries for each application are provided on the CY4541 EZ-PD CCG4 EVK webpage. The firmware update over I²C will take few moments to complete. Progress messages are displayed in the Messages window and a progress bar indicates the progress of the firmware update process. The old and new firmware versions are displayed in the Messages window at the end of a successful firmware update process.

12. The CCG4 device can also be programmed with a hex file using SWD header J4 on the CY4541 CCG4 daughter card. MiniProg3 (not provided with the kit) is required to perform SWD programming. Refer to the Knowledge Base Article 96477 for more details.

**Warning**: Do not disconnect the EVK from the PC while the firmware update is in progress.
6. Kit Operation

This chapter describes how to configure the CY4541 EZ-PD CCG4 EVK to demonstrate the operation and functionality of the CCG4 as a DRP device. It demonstrates that each Type-C port of a DRP device can act as a power provider or a power consumer. It also provides details about connecting a USB host (PC) to either a device (USB pen drive/display monitor) or a USB Type-C power adapter through the CY4541 EZ-PD CCG4 EVK board.

This chapter provides details of the following demos:

a. DRP and SuperSpeed USB demo – This demo shows the ability of CCG4 to control two Type-C ports simultaneously. In this demo, both Type-C ports act as power providers.

b. Dead Battery Charging demo – This demo shows the ability of CCG4 to consume power from a USB Type-C power adapter when the external DC power supply is absent. This demonstrates a dead battery notebook, which can be powered by connecting the USB Type-C power adapter to its Type-C port.

c. DisplayPort Alternate Mode demo -- This demo shows the ability of CCG4 to transfer DisplayPort signals to a display monitor over the Type-C interface.

Before starting with the demos, let us understand power supply system of the CY4541 EZ-PD CCG4 EVK in detail.

6.1 Power Supply Connections

A PC with two USB 3.0 ports and a DisplayPort, along with the CY4541 EZ-PD CCG4 EVK, is equivalent to a PD-enabled dual Type-C port PC as shown in Figure 18. In a real Type-C notebook design, power from the power output header (J7) of the CCG EVK base board acting as the USB Type-C power adapter is connected to a Battery Charger Circuit (BCC) of a USB 3.0 notebook/PC. On the CCG4 EVK, the DC power jack (J1) on the CCG EVK base board is provided for demonstration purposes only since the internal supply from the Power Management IC (PMIC) is not available. A notebook power adapter (as shown in Figure 18) would be connected to the "ORing" controller block which supplies power to the Battery Charger Circuit (BCC).

In a real system, the power input header (J12) of CCG EVK base board 2 would be connected to the output of the PMIC. Since this tapping of power from the PMIC is not available in existing PCs, wires are directly connected between the power output and power input headers of CCG EVK base boards to mimic the Type-C notebook design using CY4541 EZ-PD CCG4 EVK.

Power being provided to the CCG4 EVK would come from a PMIC in the Notebook, and the input source to that PMIC could either be the notebook battery, a notebook power adapter or a USB Type-C power adapter. Hence, in a Notebook it is possible to connect both the DC power adapter and the USB Type-C power adapter. However, in the case of the CY4541 EZ-PD™ CCG4 EVK, since the internal power points to the Notebook are inaccessible, it is mandatory that power is not provided via the power jack J1 of either of the CCG EVK base boards when the CY4541 EZ-PD™ CCG4 EVK is powered by a USB Type-C power adapter (as shown in Figure 23 and Figure 24) as this can damage the EVK boards. This restriction is not due to a limitation on the CCG4 device, but only because of the inaccessibility of the internal power points inside a Notebook/PC.
The CY4541 CCG4 daughter card consists of both a power provider and a power consumer circuitry for each Type-C port. The CCG4 device controls this circuitry and decides the source of the power for both CCG EVK base boards and the CY4541 CCG4 daughter card. The power input header on each CCG EVK base board can receive DC power directly. The power output header on the CCG EVK base board can receive and source power directly when a USB Type-C power adapter is connected to Type-C port 1 or 2. The CY4541 CCG4 daughter card receives power either from CCG EVK base board 1 or from CCG EVK base board 2 (whichever is higher).

In a CY4541 EZ-PD CCG4 EVK enabled dual Type-C PC design, the entire EVK can be powered using the following methods:

**Scenario 1:** A DC power adapter is connected to the DC power jack (J1) on CCG EVK base board 1 or CCG EVK base board 2. In this scenario, the CCG4 device turns on the power provider control circuitry and power is available on the power input headers. Wires must be connected between the power input headers (J12) on both the CCG EVK base boards (shown by the dotted line...
Both the CCG EVK base boards and the CY4541 CCG4 daughter card are powered by the DC Power supply connected to either CCG EVK base board 1 or CCG EVK base board 2.

**Scenario 2:** A USB Type-C power adapter is connected to Type-C port 1 or Type-C port 2

In this scenario, the CCG4 device turns on the power consumer control circuitry and power is available on the power output headers. Wires must be connected between the power output header (J7) of CCG EVK base board 1 and power input header (J12) of CCG EVK base board 2 when a USB Type-C power adapter is connected to Type-C port 1. If a USB Type-C power adapter is connected to Type-C port 2, then the wires must be connected between the power output header of CCG EVK base board 2 and the power input header of CCG EVK base board 1.

### 6.1.1 Valid Power Supply Connections

This section shows the four valid power supply connections between the power output and power input headers on the CCG EVK base boards.

**Case 1:** This case refers to Scenario 1 when the DC power supply is connected to DC power jack (J1) of CCG EVK base board 1. Wires must be connected between the power input header (J12) of CCG EVK base board 1 and the power input header (J12) of CCG EVK base board 2, as shown in Figure 19.

![Figure 19. Valid Power Supply Connections for Case 1](image-url)
Case 2: This case refers to Scenario 1 when a DC power supply is connected to DC power jack (J1) of CCG EVK base board 2. Wires must be connected between the power input header (J12) of CCG EVK base board 1 and the power input header (J12) of CCG EVK base board 2, as shown in Figure 20.

Figure 20: Valid Power Supply Connections for Case 2

Case 3: This case refers to Scenario 2 when the USB Type-C power adapter is connected to Type-C port 1. Wires must be connected between the power output header (J7) of CCG EVK base board 1 and the power input header (J12) of CCG EVK base board 2 as shown in Figure 21.

Figure 21: Valid Power Supply Connections for Case 3
**Case 4:** This case refers to Scenario 2 when a USB Type-C power adapter is connected to Type-C port 2. Wires must be connected between the power input header (J12) of CCG EVK base board 1 and the power output header (J7) of CCG EVK base board 2, as shown in Figure 22.
6.1.2 Invalid Power Supply Connections

This section shows the two invalid power supply connections between the power output and power input headers on the CCG EVK base boards.

**Caution:** Connecting the DC power adapter with the wire connections based on any of the invalid cases described in this section will damage the EVK or its accessories.

**Case 1:** Figure 23 illustrates an invalid power supply connection as described below when:

- A DC power adapter is connected to DC power jack (J1) of CCG EVK base board 1
- Wires are connected between the power input header (J12) of CCG EVK base board 1 and the power output header (J7) of CCG EVK base board 2

Figure 23. Invalid Power Supply Connections for Case 1
Case 2: Figure 24 illustrates an invalid power supply connection as described below:
- A DC power adapter is connected to the DC power jack (J1) of CCG EVK base board 2
- Wires are connected between the power output header (J7) of CCG EVK base board 1 and the power input header (J12) of CCG EVK base board 2

Figure 24. Invalid Power Supply Connections for Case 2

6.1.3 Non Recommended Power Supply Connections with Custom Firmware
This section shows the three non-recommended power supply connections, if CY4541 EZ-PD CCG4 EVK is programmed with custom firmware, which enables both power provider and power consumer path circuitry simultaneously. Default firmware in CY4541 EZ-PD CCG4 EVK does not enable both provider and consumer paths at the same time, which allows the following power supply connections with pre-programmed CY4541 EZ-PD CCG4 EVK.

Note: While modifying the firmware of CCG4 device, care should be taken to not enable the power provider and power consumer path of CCG4 at the same time.

Case 1: Figure 25 illustrates non-recommended power supply connection as described below:
- A USB Type-C power adapter is connected to Type-C port 1 or Type-C port 2 when a DC power adapter is connected to DC power jack (J1) of the CCG EVK base board 1
- Wires are connected between power input headers (J12) of CCG EVK base board 1 and CCG EVK base board 2
Figure 25. Non-Recommended Power Supply Connection for Case 1

[Diagram showing non-recommended power supply connection for Case 1]
**Case 2:** Figure 26 illustrates non-recommended power supply connection as described below:

- A USB Type-C power adapter is connected to Type-C port 1 or Type-C port 2 when a DC power adapter is connected to the DC power jack (J1) of CCG EVK base board 2
- Wires are connected between the power input headers (J12) of CCG EVK base board 1 and CCG EVK base board 2

![Figure 26. Non-Recommended Power Supply Connection for Case 2](image)

**Case 3:** Figure 27 illustrates non-recommended power supply connection as described below:

- A USB Type-C power adapter is connected to both Type-C port 1 and Type-C port 2
- Wires are connected between the power input header (J12) of CCG EVK base board 1 and the power output header (J7) of CCG EVK base board 2 as well as between the power output header (J7) of CCG EVK base board 1 and the power input header (J12) of CCG EVK base board 2
6.2 Dual Role Port (DRP) and SuperSpeed USB Demo

The DRP and SuperSpeed USB demo is a full end-to-end demo that demonstrates the following:

- Type-C connectivity between the Downstream Facing Port (DFP)* (such as a USB host) and Upstream Facing Port (UFP)* (such as a USB device - for example, a SuperSpeed USB pen drive).
- The ability of CCG4 to switch the power role from provider to consumer and vice-versa (Dual Role Port device) on each Type-C port

*Note that the DFP is a Type-C port, which by default is a USB host and power source. The UFP is by default a USB device and power sink. DRP can switch its power role from source to sink.

6.2.1 Boards, Cables, and Accessories

The following items are needed to perform this demo:

- A USB host device (for example, a PC with USB host controller and port)
- CY4541 EZ-PD CCG4 EVK setup (CCG EVK base board and daughter card, refer to Section 4.3 and Section 4.4 for more information)
- Two SuperSpeed USB Type-A to Type-B cables
- Two USB Type-C to Type-A adapters
- USB Type-C power adapter (not provided with the kit; refer to the recommended hardware section)
- Two USB pen drives (not provided with the kit)
6.2.2 Running the DRP SuperSpeed USB Demo

A PD-enabled Type-C PC (here, the USB host PC and CY4541 EZ-PD CCG4 EVK) operates as a power provider and a power consumer on each Type-C port. The Type-C Specification calls this a DRP device. CCG4 has the ability to switch its power role from provider to consumer and vice-versa.

CCG4 as Power Provider for both Type-C Ports:

1. Use the CY4541 EZ-PD CCG4 EVK setup (assembled CCG EVK base board and CY4541 CCG4 daughter cards) as shown in Figure 28.

2. Connection details:
   - Verify that the User LED jumper (J11) is populated on CCG EVK base board 1 and the voltage selection jumper (J5) on the CY4541 CCG4 daughter card is set to 3.3 V (in position 1-2). By default, the User LED jumper (J11) on CCG EVK base board 2 is populated. This jumper (J11) on CCG EVK base board 2 is optional.
   - Ensure that the wires are connected between the power input headers (J12) of both CCG EVK base boards as shown in Figure 28.
   - Connect the DC power adapter (provided with the kit) to the DC power jack (J1) of either of the CCG EVK base boards.
   - Verify that the setup is as shown in Figure 28. LED1 (Green) on the CY4541 CCG4 daughter card and both the CCG EVK base boards glow to indicate that the kit is powered. Also, LED2 (Orange) on CCG EVK base board 1 blinks continuously to indicate that CCG4 is powered and active.

Figure 28. Power Supply Connections
3. Connect the boards and cables (USB 3.0 Type-A to Type-B Cables and USB Type-C to Type-A adapters) as shown in Figure 29. Note that the USB Type-C to Type-A adapters (provided with the kit) and the color of the solder mask of both CCG EVK base boards and the CY4541 CCG4 daughter card may vary from the image shown in Figure 29. Plug USB pen drives (not provided with the kit) into each USB Type-C to Type-A adapter.

Figure 29. Setup of SuperSpeed USB Demo Using the CY4541 EZ-PD CCG4 EVK

4. Observe that both the USB pen drives connected to the USB Type-C to Type-A adapters enumerate on the PC that is plugged into the CY4541 EZ-PD CCG4 EVK. Verify the functionality by accessing (adding/deleting) files on the connected USB pen drives through the PC. This demonstrates CCG4’s capability to control two Type-C interfaces simultaneously.
Kit Operation

CCG4 as a DRP device on both Type-C ports and Dead Battery Charging demo:
A PC with two USB 3.0 ports and a DisplayPort along with the CY4541 EZ-PD CCG4 EVK is equivalent to a PD-enabled dual Type-C port PC.

1. Connection details:
   - Remove the DC power adapter from the DC power jack (J1).
   - Remove the wires from the power input header (J12) of CCG EVK base board 1. Connect wires between the power output header (J7) of CCG EVK base board 1 and the power input header J12 of CCG EVK base board 2. This connection provides power from CCG EVK base board 1 to CCG EVK base board 2 when a USB Type-C power adapter is connected to CCG EVK base board 1, as shown in Figure 30. Connect wires between the power output header J7 of CCG EVK base board 2 and the power input header J12 of CCG EVK base board 1, as shown in Figure 30. This wire connection provides power from CCG EVK base board 2 to CCG EVK base board 1 when a USB Type-C power adapter is connected to CCG EVK base board 2.
   - Make sure that a DC power adapter is not connected to J1 as this will damage the board in this power configuration. Connecting a DC power adapter to Type-C port 1 or Type-C port 2 bypasses the regulator and supplies power directly to the attached Type-C device.
   - Disconnect the USB pen drive from the USB Type-C to Type-A adapter connected to CCG EVK base board 1.

   Figure 30. Setup of DRP and Dead Battery Charging Demo (Example 1)

2. Because a DC power adapter is not connected to the EVK, the onboard CCG4 is not powered. This emulates a dead battery dual Type-C notebook. The CCG4 can be powered by connecting a USB Type-C power adapter to one of the EVK’s Type-C ports as shown in Figure 30. Connect a USB Type-C power adapter that supports a 14-V to 20-V power profile (not provided with the kit; refer to the recommended hardware section) to Type-C port 1. Verify your setup as shown in Figure 30. Note that the connection of wires between the power output header (J7) of CCG EVK base board 1 and the power input header (J12) of CCG EVK base board 2 is mandatory as current flows from CCG EVK base board 1 to CCG EVK base board 2 when the USB Type-C power adapter is connected to Type-C port 1. Also, the connection of the USB 3.0 Type-A to Type-B Cable to SuperSpeed USB Type-B connector (J2) of CCG EVK base board 2 is mandatory when the USB pen...
drive is connected to Type-C port 2. LED1 (Green) on the CY4541 CCG4 daughter card and both the CCG EVK base boards glow to indicate that the kit is powered. The LED2 (Orange) on CCG EVK base board 1 blinks continuously to indicate that CCG4 is powered and active. When the CCG4 on the EVK is powered, it establishes a power contract with the USB Type-C power adapter and starts consuming power. This can be verified by connecting a multimeter to the power output header (J7) of the CCG EVK base board (where the USB Type-C power adapter is connected) to measure the output voltage in the dead battery charging scenario. The output voltage at the power provider header (J7) is based on the power negotiation between the CCG4 device and the USB Type-C power adapter. Thus, it will vary with respect to the attached USB Type-C power adapter. This demonstrates that a CCG4-enabled dual Type-C notebook can be charged from the dead battery condition.

3. The CCG4 is now active and provides power to the UFP device (USB pen drive) connected to Type-C port 2. Observe the enumeration of the SuperSpeed USB pen drive on the PC. In this scenario, Type-C port 1 acts as a power consumer and Type-C port 2 acts as a power provider.

4. Interchange the connection of the USB Type-C to Type-A adapter and the USB Type-C power adapter between Type-C port 1 and Type-C port 2, as shown in Figure 31. Note that the connection of wires between the power input header (J12) of CCG EVK base board 1 and the power output header (J7) of CCG EVK base board 2 is mandatory as current flows from CCG EVK base board 2 to CCG EVK base board 1 when a USB Type-C power adapter is connected to Type-C port 2. Also, the connection of USB 3.0 Type-A to Type-B Cable to SuperSpeed USB Type-B connector (J2) of CCG EVK base board 1 is mandatory when the USB pen drive is connected to Type-C port 1.
Figure 31. Setup of DRP and Dead Battery Charging Demo (Example 2)

5. Repeat steps 2 and 3. In this scenario, Type-C port 1 acts as a power provider and Type-C port 2 acts as a power consumer. This demonstrates that the CCG4 device can switch the power role of the ports from provider to consumer and vice-versa.
6.2.3 Common Problems and Troubleshooting
If the demo does not function, follow these guidelines to troubleshoot:

1. Ensure that both the CCG EVK base boards and the CY4541 CCG4 daughter card are powered by verifying that LED1 (Green) on both the CCG EVK base boards and CY4541 CCG4 daughter card are ON.
2. Ensure that LED2 (Orange) on CCG EVK base board 1 is blinking continuously. If LED2 is not blinking, CCG4 is not active. Assert and release the reset button on the CY4541 CCG4 daughter card (SW1).
3. Ensure that CY4541 CCG4 daughter card is connected to both CCG EVK base boards.
4. If there is no voltage at jumper J7 (in the Dead Battery Charging demo), ensure that the connected USB Type-C power adapter supports a 14-V to 20-V power profile.

6.3 DisplayPort Demo
The DisplayPort Alternate Mode demo is an end-to-end demo that demonstrates the following:

- Type-C alternate mode support for display: Delivers the DisplayPort video from the host (in this case, a PC) to a display monitor.
- Dual Type-C alternate mode support for display: Delivers the DisplayPort video from the host (in this case, a PC) to display monitors connected to both Type-C port 1 and Type-C port 2.

6.3.1 Boards, Cables, and Accessories
The following items are needed to perform this demo:

- One DisplayPort video source (for example, a PC) with a DisplayPort output connector and DisplayPort Splitter board (not provided with the kit) or two DisplayPort video sources (two PCs with DisplayPort outputs or one PC with two DisplayPort outputs)
- Two DisplayPort monitors
- CY4541 EZ-PD CCG4 EVK (CCG EVK base board + CY4541 CCG4 daughter card, refer to Section 4.3 and Section 4.4 for more information)
- A DisplayPort cable that connects the CY4541 EZ-PD CCG4 EVK to the PC. If the PC has a Mini DisplayPort plug, use the Mini DisplayPort to DisplayPort cable (DisplayPort cables are not provided with the kit. See List of Recommended Hardware section)
- Type-C to DisplayPort, Type-C to HDMI, Type-C to VGA or Type-C to DVI dongle (not provided with the kit. See List of Recommended Hardware section)

6.3.2 Running the Single DisplayPort Demo
1. Use the default jumper settings shown in Figure 28 to configure the CY4541 EZ-PD CCG4 EVK.
2. Connection details:
   - Remove wires from the power output header (J7) on CCG EVK base board 1 and CCG EVK base board 2. Connect wires between the power input headers (J12) of both the CCG EVK base boards as shown in Figure 32. Note that this is the same setup as used in the DRP and SuperSpeed USB demo shown in Figure 28.
   - Connect the DC power adapter (provided with the kit) to the DC power jack (J1) of either of the CCG EVK base boards. LED1 (Green) on the CY4541 CCG4 daughter card, and both the CCG EVK base boards glow to indicate that the board is powered. Also, LED2 (Orange) on the CCG EVK base board 1 blinks continuously to indicate that CCG4 is powered and active.
3. Connect the boards, cables, and dongles as shown in Figure 32. Ensure that the monitor supports a DisplayPort, HDMI, VGA, or DVA interface.

Figure 32. Setup of the DisplayPort Demo

4. Ensure that the “Extended Display” feature is enabled in the USB host PC. For Windows users, this feature can be enabled by clicking Extended Display, available at “Control Panel|All Control Panel Items|Display|Connect to a Projector” window. For Linux or Mac users, this feature can be enabled by checking the Mirror image option, available at “System Preferences (or Settings)|Display”.

5. Observe that the DisplayPort video is transmitted from the host (PC) to the display monitor through Type-C port 2. This demonstrates the CCG4’s capability to control the transfer of DisplayPort data over the Type-C interface.

6. SuperSpeed USB data transfer can be performed simultaneously by connecting USB Type-C to Type-A adapter and USB pen-drive to Type-C port 1 as shown in Figure 32. Also, the connection of USB 3.0 Type-A to Type-B Cable to the SuperSpeed USB Type-B connector (J2) of CCG EVK base board 1 is mandatory when the USB pen drive is connected to Type-C port 1.

6.3.3 Running the Dual DisplayPort Demo

In this demo, CCG4 delivers a DisplayPort video from the host (PC) to display monitors connected to Type-C port 1 and Type-C port 2 using a Display Splitter board (not provided with the kit; refer to the List of Recommended Hardware section). If a Display Splitter board is not available, then the Dual DisplayPort demo can be performed by connecting two PCs having DisplayPort outputs, as shown in Figure 34. In this case, the DisplayPort output of PC 1 is connected to the DisplayPort connector of CCG EVK base board 1 and the DisplayPort output of PC 2 is connected to the DisplayPort connector of CCG EVK base board 2.

1. Use the default jumper settings shown in Figure 28 to configure the CY4541 EZ-PD CCG4 EVK.

2. Connection details:
   - Remove wires from the power output header (J7) on CCG EVK base board 1 and CCG EVK base board 2. Connect wires between the power input headers (J12) of both the CCG EVK base boards as shown in Figure 33. Note that this is the same setup as used in the DRP and SuperSpeed USB demo shown in Figure 28.
   - Connect the DC power adapter (provided with the kit) to the DC power jack (J1) of either of the CCG EVK base boards. LED1 (Green) on the CY4541 CCG4 daughter card and on both the CCG EVK base boards glow to indicate that the board is powered. Also, LED2 (Orange) on the CCG EVK base board, connected to Type-C port 1 of the CY4541 CCG4 daughter card, blinks continuously.
3. Connect the boards, cables, and dongles as shown in Figure 33 if a Display Splitter board is available. Otherwise, connect the boards to two PCs having DisplayPort outputs as shown in Figure 34. Ensure that the monitor used supports a DisplayPort, HDMI, VGA, or DVA interface.

Figure 33. Setup of the Dual DisplayPort Demo using a CY4541 EZ-PD CCG4 EVK and a Display Splitter Board
Figure 34. Setup of a Dual DisplayPort Demo using two PCs with DP output

4. In the setup shown in Figure 33, the Display Splitter transfers the DisplayPort video from the host (PC) to the display monitors connected at Type-C port 1 and Type-C port 2 using Type-C to DP adapters. In the setup shown in Figure 34, this demonstrates CCG4’s capability to control two DisplayPorts simultaneously.

6.3.4 Common Problems and Troubleshooting

If the demo does not function, follow these guidelines to troubleshoot.

1. Ensure that both CCG EVK base boards and the CY4541 CCG4 daughter card are powered by verifying that LED1 (Green) on all of the boards are ON.

2. Ensure that LED2 (Orange) of CCG EVK base board 1 is blinking continuously. If LED2 is not blinking, CCG4 is not active. Assert and release the reset button on the CY4541 CCG4 daughter card (SW1).

3. Ensure that the boards are powered before connecting the DisplayPort cables.

4. Ensure that the CY4541 CCG4 daughter card is connected to both the CCG EVK base boards.

5. Ensure that the “Extended Display” is enabled in the USB host PC.

6. If the PC video is not displayed on the monitor, assert and release the reset button on the CY4541 CCG4 daughter card (SW1).
Appendix A: Terminology

This guide assumes that the user of the CCG4 board is familiar with the fundamentals of Type-C connectivity and the USB Power Delivery protocol. A brief description of Type-C terms is provided here for reference.

- **Alternate Modes**: A feature of a USB Type-C system where one or both of the SuperSpeed lanes may be repurposed for use with a different serial protocol, such as a DisplayPort, eSATA, or Thunderbolt.
- **Client**: A USB peripheral such as a hub, docking station, or monitor.
- **Configuration channel (CC)**: A USB Type-C bus wire used to transmit protocol signals. This is a half-duplex 300-kHz signal.
- **Consumer**: A Type-C port that sinks power from VBUS.
- **DisplayPort**: A digital display interface standard developed by the Video Electronics Standards Association. It is used primarily to connect a video source to a display such as a computer monitor.
- **Downstream facing port (DFP)**: A USB Type-C port on a host or a hub to which devices are connected and a default power source.
- **Dp, Dn**: USB Type-C bus wires used to transmit and receive USB 2.0 data.
- **Dual-role port**: A USB Type-C port that can operate as either a DFP or a UFP, and either as power provider or power consumer.
- **Electronically Marked Cable Assembly (EMCA)**: A USB cable that includes an IC that reports cable characteristics (such as current rating) to the Type-C ports.

Figure 35: USB Type-C Plug and receptacle
Appendix A: Terminology

- **Host**: A USB host system such as a PC.
- **Provider**: A Type-C port that sources power over VBUS.
- **Sideband use (SBU)**: A USB Type-C bus wire used for non-USB control signals, such as DisplayPort control signals.
- **Type-C Transceiver**: A transmitter/receiver that communicates over the CC.
- **TX1p, TX1n, RX1p, RX1n, TX2p, TX2n, RX2p, and RX2n**: USB Type-C bus wires used to transmit and receive SuperSpeed USB and PCIe or DisplayPort data.
- **Upstream facing port (UFP)**: A USB Type-C port on a device or a hub that connects to a host or the DFP of a hub and a default power sink.
- **USB Power Delivery (USB PD, PD)**: A new USB standard that increases power delivery over USB from 7.5 W to 100 W.
- **USB Type-C (Type-C)**: A new standard with a slimmer USB connector and a reversible cable, capable of sourcing up to 100 W of power and supporting Alternate Modes.
- **VBUS**: A USB Type-C bus wire used for power; initially 5 V, but increased up to 20 V on USB PD systems.
- **VCONN**: A USB Type-C bus wire used to power the IC in the EMCA.
Appendix B: Schematic and Bill Of Materials

B.1 CY4541 CCG4 Base Board Schematic (Rev5* CCG EVK Base board)

Note*: Rev5 denotes the revision number of a CCG EVK base board PCB as shown in Figure 13.
The voltage monitor is connected to the FB voltage of the Vbus regulator Vfb. In general, the Vfb is regulated to 1.25V and the power good threshold is set at +/- 9% of the output voltage.
B.2 CY4541 CCG4 Daughter Card Schematic (Rev 4* CCG4 Daughter Card)

Note*: Rev4 denotes the revision number of a CCG4 daughter card PCB as shown in Figure 13.
Appendix B: Schematic and Bill Of Materials

Ensure layout is suitable for 5A continuous current for below path 
USB_P_PWR_P1, TYPE-C_VBUS_P1, USB_C_PWR_P1

Consumer Path

Provider Path

定向流晶

Consumer Path ON
for Dead battery case

Customer Path: 0 1 OFF OFF
Provider Path: 0 0 ON OFF

Customer Path: 1 0 OFF OFF
Provider Path: 1 1 OFF ON

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Rev A

1/2/1/1 2016

CY4541 EZ-PD™ CCG4 Evaluation Kit Guide, Doc. No. 002-10353 Rev. 'E' 57
B.3 Type-C to Type-A Adapter Schematic
## B.4 Bill of Materials

### B.4.1 CCG EVK Base Board BOM (Rev5 CCG EVK Base Board)

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### Appendix B: Schematic and Bill Of Materials


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#### B.4.2 CY4541 CCG4 Daughter Card BOM (Rev 4 CCG4 Daughter Card)

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### Appendix B: Schematic and Bill Of Materials

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**MISC components**

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## Appendix B: Schematic and Bill Of Materials

### No load components

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### B.4.3 Type-C to Type-A Adapter BOM

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## Revision History

**Document Revision History**

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<td>02/11/2016</td>
<td>MVTA/SELV</td>
<td>New evaluation kit guide.</td>
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<td>04/07/2016</td>
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| *B       | 04/21/2016    | MVTA             | 1. Added KBA link in section 2.3
2. Added section 4.5
3. Added section 6.1.5
4. Updated PCBA images
5. Updated Appendix B
6. Added footnote in page#48 and page#53 |
| *C       | 04/05/2016    | MVTA             | Updated Figure 5 in chapter 2                                                         |
| *D       | 07/25/2016    | MVTA             | Updated PCBA images                                                                   |
| *E       | 05/26/2017    | NIBK             | Updated Cypress Logo and Copyright.                                                    |