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Thank you for your interest in the EZ-PD™ CCGx Dock Software Development Kit (SDK). This SDK supports USB Type-C peripheral solutions using Cypress CCG4, DMC, and HX3PD controllers.

**Introduction**

The CCGx Dock SDK provides a set of firmware resources that allows users to build customized self-powered peripherals using the CCG4 Type-C port controllers, Dock Management Controllers (DMC), and Hub Controllers from Cypress.

This is based on CCGx and DMC firmware stack, which is tested and proven to be fully compliant with the USB Type-C and USB-PD specifications, and provides programming hooks and interfaces for customers to implement their own policy and system management schemes. This SDK supports USB Type-C dock development based on the EZ-PD CCG4 USB Type-C Dock reference design and USB 3.1 Gen 2 Hub development based on the CY6611 EZ-USB HX3PD EVK.

**EZ-PD™ CCG4 USB Type-C Dock (CCG4 Dock)**

CCG4 Dock is a self-powered dock capable of providing power to both upstream and downstream ports while providing display and USB 3.1 Gen 1 functionality.

The CCG4 Dock incorporates the CYPD4236 PD Controller, CY7C65219 Dock Management Controller, and CYUSB3314 HX3 USB 3.1 Gen 1 Controllers. The SDK provides application sources, configurable binaries, and firmware configuration and update tools for these parts.

The design also utilizes CYUSB3610 EZ-USB GX3 USB-to-Gigabit-Ethernet Bridge Controller and CY7C65632 HX2VL USB 2.0 Hub Controllers (with no firmware update/configuration support).

CCG4 Dock supports the following features:

- Upstream Type-C port capable of providing power up to 60 W at 20 V (extendable to 100 W at 20 V with minor hardware and firmware-configuration changes), USB 3.1 Gen 1 (5 Gbps) data sink, and DisplayPort sink capability
- Downstream Type-C port capable of providing power up to 15 W at 5 V, USB 3.1 Gen 1 (5 Gbps) data source, and DisplayPort source capability
- HDMI port for display output
- Three USB 3.1 Gen 1 legacy Type-A connectors
- Two USB Hi-Speed downstream ports (Legacy Type-A connector)
- RJ45 port to provide Ethernet connectivity
- Billboard support to indicate Alternate mode status
- Firmware download support

The CCG4 Dock can support signed firmware update (firmware authentication using digital signatures) for all Cypress components supporting firmware update (DMC, CCG4, HX3).

For more details on the signed firmware capability, contact Cypress (www.cypress.com/support).

**Note:** The EZ-PD™ CCG4 USB Type-C Dock application included in this SDK is an upgrade to the application previously released as part of the EZ-PD™ Dock Reference Design version 1.1.
EZ-USB HX3PD Hub

HX3PD is a family of USB 3.1 Gen 2 Type-C hub with USB Power Delivery (PD) that complies with the USB 3.1 Gen 2 specification, and the latest Type-C and PD standards.

The HX3PD USB 3.1 Gen 2 Hub design included in this SDK is based on the CY6611 EZ-USB HX3PD Evaluation Kit (EVK).

The CYUSB4347 and CYUSB4357 HX3PD parts integrate a USB 3.1 Gen 2 Hub, a dual port PD Controller and a Dock Management Controller.

The HX3PD Hub design supports the following features:

▪ Upstream Type-C port capable of providing power up to 46 W at 20 V (extendable to 100 W at 20 V with firmware-configuration changes), USB 3.1 Gen 2 (10 Gbps).

▪ USB 3.1 Gen 2 (10 Gbps) data transfer on five DS ports (DS1-DS5). USB 2.0 data transfer on seven DS ports (DS1-DS7)

▪ USB PD 3.0 charging on US and DS1 port

▪ USB Battery Charging (BC v1.2) and Apple charging on four DS ports (DS2-DS5).

▪ Firmware configuration and download support

Release Package Contents

Figure 1 provides an overview of the EZ-PD CCGx Dock SDK installation.
Figure 1. EZ-PD CCGx Dock SDK Installation Directory Structure

```
EZ-PD CCGx Dock SDK
| +---Documentation
|   | +---CCG4_Dock
|   |   | \---HX3PD_Hub
| +---Firmware
|   | +---lib
|   |   | +---projects
|   |   |   | +---CCG4_DOCK_REV05
|   |   |   | +---CCG4_DOCK_REV04
|   |   |   | +---HX3PD_HUB
|   |   | +---src
|   |   |   | +---app
|   |   |   |   | +---hpiss
|   |   |   |   | +---pd_common
|   |   |   |   | +---pd_hal
|   |   |   |   | +---scb
|   |   |   |   | +---system
|   |   |   | +---crypto
|   |   |   | +---dmc
|   |   |   | +---system
|   |   | \---binaries
|   |   |   | +---CCG4_Dock
|   |   |   |   | +---DMC
|   |   |   |   | \---binaries
|   |   |   |   | +---PD Controller
|   |   |   |   |   | \---binaries
|   |   |   |   |   | +---HX3_Tier1
|   |   |   |   |   |   | \---binaries
|   |   |   |   |   |   | +---HX3_Tier2
|   |   |   |   |   |   | \---binaries
|   |   | \---HX3PD Hub
|   |   |   | +---DMC
|   |   |   | \---binaries
|   |   | +---PD Controller
|   |   | \---binaries
|   | \---Hub Controller
|   \---binaries
| +---Hardware
|   +---CCG4_Dock
| \---HX3PD_Hub
| +---License
| +---Software Tools
| \---Updater
```

EZ-PD CCGx Dock SDK installation contains the following folders:

- **Documentation**: This folder contains the documentation, which includes release notes, dock/kit design guide, firmware user guide, and API reference guides.
- **Firmware**: This folder contains the firmware stack sources, pre-compiled libraries, and reference projects for various dock components in the CCG4 Dock and HX3PD Hub.
• lib: This folder contains the USB-PD stack, DMC stack and HPI module in pre-compiled library format.

  **Note:** The `lib` folder is made available for reference. A copy of the relevant libraries used by the project are added locally to the Reference project.

• projects: This folder contains the sources and PSoC Creator™ workspace for CCG4 Dock and HX3PD Hub applications.

• src: This folder contains the sources for the CCGx and DMC firmware stack organized by the firmware module.

  The `src` folder has the following sub-folders:

  ▪ **app:** The `app` folder contains the top-level application layer functionality that implements the required USB-PD controller functions. This includes functionality such as PDO evaluation and contract negotiation, VDM handling for both DFP and UFP roles, handling of control messages such as role swap; and alternate mode discovery and negotiation. The alternate mode specific implementation is in the `app/alt_mode` directory. The `app` folder also includes handlers for legacy charger detection and Type-A port controller detection.

  ▪ **hpiss:** This folder contains the header file for the HPI, which is an I2C-based software protocol that allows an external EC to monitor and control the CCGx device operation. HPI provides a register-based interface through which the EC can manage the power contracts, send and receive VDMs, and perform flash read/write operations. Contact Cypress for more details on HPI and its capabilities.

  ▪ **pd_common:** This folder contains the headers for the core Type-C and USB-PD stack for the CCGx device. This includes the HAL, the Type-C port manager, the USB-PD protocol layer, the USB-PD policy engine, and the Device Policy Manager.

  ▪ **pd_hal:** This folder contains the low-level driver header and source files for the USB-PD hardware block.

  ▪ **scb:** This folder contains the driver code for I2C slave mode operation using the Serial Controller Blocks (SCB) on the CCGx device. Since I2C slave mode is the most commonly-used interface for CCGx, a specially optimized driver is provided for the same.

  ▪ **system:** This folder contains header and source files relating to the CCGx device hardware and registers, bootloader and flash access functions, low-level drivers for the GPIO blocks on the CCGx device, and a soft timer implementation used by the firmware stack.

  ▪ **crypto:** This folder contains the Hardware Abstraction Layer (HAL) or the low-level hardware driver for the crypto hardware in DMC. The driver functionality includes crypto block initialization, SHA-256 calculation code, crypto block de-initialization.

  ▪ **dmc:** This folder contains the Billboard and firmware update implementation for DMC. This also includes the wrapper for SHA-256 module. In addition, the folder provides I2C master module for providing driver level access to multiple SCB components and HPI master to communicate with CCGx controllers.

  ▪ **usb:** This folder contains header and source files relating to the hardware and registers of USB-FS PHY present within DMC. The folder also contains handler for reading and writing to EP0 and non-EP0 endpoints.

  **Binaries:** This folder contains the pre-built firmware binary for reference designs.

  ▪ **Hardware** directory includes reference schematic, BOM, and layout files.

  ▪ **License** directory includes the Cypress Software and End User License Agreements.

  ▪ **Software Tools** directory includes the following tools:

    ▪ EZ-PD Dock DMC Configuration Generation Tool, Version 1.2.1.8: This tool (ezpd_dockconfiguredmc.exe) can be used to create DMC images with modified configuration information.

    ▪ EZ-PD Dock Image Creation Tool, Version 1.2.0.20: This tool (ezpd_dockcreateimage.exe) is used to create a single combined firmware image file, referred to as the composite dock image (.bin) from firmware files of components present in the dock.
EZ-PD Dock Firmware Update Tool, Version 1.3.1.30: This tool (ezpd_dockupdatefw.exe) is a WinUSB-based application that runs on Windows systems. This tool updates firmware for devices in the dock and reports the final consolidated status. This tool takes the files generated using the EZ-PD Dock Image Creation Tool as input and initiates a firmware update.

Dock Serial Number Update tool: This tool (DockSerialNumberUpdateTool.exe) is used to update the custom serial number for HX3 and DMC.

The EZ-PD CCGx Dock SDK 3.3 installer also includes the following additional tools for configuring CCG4 Dock and HX3PD Hub firmware images:

- CCG4 Configuration: EZ-PD Configuration Utility with support for CYPD4236-40LQXI part
- HX3 Configuration: HX3 Blaster Plus utility

### Limitations and Known Issues with Software Tools

None

### Other Limitations and Known Issues

When firmware upgrade is attempted from a Thunderbolt™ 3 host, the EZ-PD Dock may not enumerate after completing the firmware upgrade successfully. CCG4 Dock needs to be disconnected from the host and reconnected to recover.

**Note:** EZ-PD™ CCG4 USB Type-C Dock firmware update mechanism causes a self-reset of all dock components after completing the firmware update to enable the newly downloaded firmware to take effect. This results in disconnection and reconnection of the dock with the host and the host needs to enumerate the dock/kit again. It was found that the above-mentioned issue observed with Thunderbolt hosts can be eliminated by introducing a delay of 30 seconds in the CCG4 dock firmware between the disconnection and reconnection events so that the Thunderbolt host can reload the driver properly. The Dock CCG4 firmware provides a compile time option to introduce a configurable delay which can be used to eliminate this issue. See the ENABLE_HPI_SOFTRESET_DELAY macro in the *CCG4 Dock Firmware User Guide* for more details.

**Note:** Enabling the macro and introducing the delay in the CCG4 firmware will cause DMC to reenumerate after the configured delay. This would require the EZ-PD Dock Firmware Update Tool re-enumeration timeout also to be set to a value equal to the delay (at the least) set in the CCG4 firmware. See the tool context help for more details on the re-enumeration timeout parameter.
EZ-PD™ CCG4 USB Type-C Dock Firmware
Release Notes

This section describes the CCG4, DMC, and HUB(HX3) firmware for EZ-PD CCG4 USB Type-C Dock. This section also describes key updates and known issues.

Power Delivery Controller (CCG4) Firmware

CCG4 firmware on CCG4 Dock is based on a CCGx firmware stack, which is tested and proven to be fully compliant with the USB Type-C and USB-PD specifications, and provides programming hooks and interfaces for customers to implement their own policy and system management schemes.

The key application-level features for the CCG4 firmware stack are as follows:

▪ USB Type-C Revision 1.2 and USB-PD Revision 3.0 specification-compliant PD stack
▪ Docking Application support with one USB-PD port on the dock upstream and one USB-PD port on the dock downstream, with independent functionality.
▪ Drivers for various hardware blocks on the CCGx controllers.
▪ Implementation of a Host Processor Interface (HPI) that allows an external Embedded Controller (EC) to monitor and control the CCGx device operation.
▪ Implementation of the DisplayPort Alternate Mode that allows transfer of video signals over the Type-C data lanes.
▪ Allow manufacturing-level customization of device parameters such as power profiles, default port behavior, over-voltage protection, and so on, without changing the firmware.
▪ Map firmware to system hardware design changes without any impact on the core firmware modules.
▪ Facilitate source-level debugging so that new customers can get familiarized with the stack.

Dock Management Controller (DMC) Firmware

DMC firmware on CCG4 Dock is based on a DMC firmware stack and provides APIs, interfaces, and sample code for customers to implement their own update logic for the custom devices.

The key application-level features for DMC firmware stack are as follows:

▪ USB device stack that is compliant with the USB 2.0 specification
▪ Billboard device class support (compliant with the USB Billboard Specification Revision 1.21)
▪ Implementation of firmware update interface for other components of the dock
▪ Comprehensive dock status query support
▪ Implementation of crypto block with support for Secure Hash Algorithm (SHA-256)
▪ Drivers for various hardware blocks on DMC

Hub Controller (HX3) Firmware

The CCG4 Dock’s (HX3) firmware images for this reference design are stored on external I2C EEPROM devices connected to each of the HX3. The EEPROM devices should be 32 KB in size to support dual firmware images for each HX3.

▪ Supports USB 3.0 functionality with four downstream (DS) ports.
▪ HX3 supports SuperSpeed (SS), Hi-Speed (HS), Full-Speed (FS), and Low-Speed (LS) on all ports.
▪ HX3 has integrated termination, pull-up, and pull-down resistors, and supports configuration options through pin-straps to reduce the overall BOM of the system.
▪ Ghost Charge™: Charging DS port without Upstream (US) connection.
▪ The Tier-1 HX3 hub in the CCG4 Dock supports the following:
  o Upstream Port connected to Dock Upstream Type-C Port.
- One Downstream USB 3.0 port on a Type-C receptacle.
- One Downstream USB 3.0 port on a Type-A receptacle.
- One Downstream port connected to the Upstream port of the Tier-2 HX3 hub.

**The Tier-2 HX3 hub in the CCG4 Dock supports the following:**
- Upstream Port connected to Downstream port of Tier-1 hub.
- Two Downstream USB 3.0 ports on Type-A receptacles.
- One Downstream port connected to the Upstream port of the Tier-3 HX2VL hub.
- One Downstream port connected to the CYUSB3610 GX3 USB 3.0 To Ethernet Controller.

### Changes from EZ-PD Dock Reference Design Version 1.1

This version of the EZ-PD CCG4 USB Type-C Dock firmware supports the following key application-level features:

- Support for Revision 05 of EZ-PD Dock Reference Design hardware has been added in this Dock SDK release to support the following features:
  - Power Adapter Detect: Detect the validity of the power adaptor connected and the power budget of the adaptor connected and take appropriate action based on the design.
  - Over-current Protection (OCP) using Buck Boost controller.
  - Power Saving mode added for Buck Boost Controller.
  - All new features and fixes to Revision 04 hardware.

**Note:** These features are only available on the Revision 05 hardware, due to the requirement of hardware changes to support them.

- Features added/updated for Revision 04 (hardware revision released as part of EZ-PD Dock RDK 1.1) hardware
  - DisplayPort (DP) Lane switching from 2-Lane to 4-Lane and vice versa using button control.
  - LED control for DP lane information. This LED control can be customized (Breathing/Blinking/ON/OFF) per the requirement.
  - LED Control for Type-C Port attach detach.
  - Custom Alternate Mode Support in addition to DisplayPort Alternate mode
  - Custom Serial number programming for DMC and HX3 Hubs
  - Under-voltage Protection (UVP).
  - Compliance fixes for USB-PD and USB Type-C specification updates.

**Note:** Customers who have designed docks using Revision 04 hardware from “EZ-PD Dock Reference Design V1.1” should update to the latest Revision 04 application.

### Limitations and Known Problems of EZ-PD CCG4 USB Type-C Dock

The Hub compliance tools from compliance test vendors are currently designed for single-level hubs. As this design has a multi-level hub design (Tier-1 and Tier-2 HX3 and Tier 3 HX2VL) there might be failures reported during the compliance tests for ports on Tier-2 and Tier-3 hubs. Contact Cypress technical support for any clarifications.
EZ-USB HX3PD Hub Firmware
Release Notes

This section describes the PD, DMC and Hub controller firmware for EZ-USB HX3PD. This section also describes known issues.

**EZ-USB HX3PD Power Delivery (PD) Firmware**

EZ-USB HX3PD Power Delivery firmware on EZ-USB HX3PD Hub is based on a CCGx firmware stack, which is tested and proven to be fully compliant with the USB Type-C and USB-PD specifications, and provides programming hooks and interfaces for customers to implement their own policy and system management schemes.

The key application-level features for the EZ-USB HX3PD Power Delivery firmware stack are as follows:

- USB Type-C Revision 1.2 and USB-PD Revision 3.0 v1.1 specification-compliant PD stack
- Dual PD 3.0 port support with one USB-PD port on the hub upstream (US) and one USB-PD port on the hub downstream (DS1), with independent functionality.
- Drivers for various hardware blocks on the HX3PD's PD controller.
- Allow manufacturing-level customization of device parameters such as power profiles, default port behavior, over-voltage protection, and so on, without changing the firmware.
- Map firmware to system hardware design changes without any impact on the core firmware modules.
- Facilitate source-level debugging so that new customers can get familiarized with the stack.

**EZ-USB HX3PD Dock Management Controller (DMC) Firmware**

DMC firmware on EZ-USB HX3PD is based on a DMC firmware stack and provides APIs, interfaces, and sample code for customers to implement their own update logic for the custom devices.

The key application-level features for DMC firmware stack are as follows:

- USB device stack that is compliant with the USB 2.0 specification
- Billboard device class support (compliant with the USB Billboard Specification Revision 1.21)
- Implementation of firmware update interface in other components of the dock
- Comprehensive dock status query support
- Implementation of crypto block with support for Secure Hash Algorithm (SHA-256)
- Drivers for various hardware blocks on DMC
**HX3PD Hub Controller Firmware**

EZ-USB HX3PD’s Hub Controller supports the following features:

- Five DS ports support SS (10 Gbps), SS (5 Gbps), and are backward-compatible with HS (480 Mbps), FS (12 Mbps), and LS (1.5 Mbps).
- Two DS ports support HS (480 Mbps) and are backward-compatible with FS (12 Mbps), and LS (1.5 Mbps).
- SS (10 Gbps), SS (5 Gbps), and USB 2.0 Link Power Management (LPM).

Port-wise capabilities and the connector types for the HX3PD Hub on the CY6611 kit are listed below:

<table>
<thead>
<tr>
<th>Port</th>
<th>Connector Type</th>
<th>USB Speed</th>
<th>Charging Protocols</th>
<th>Default Charging Configuration</th>
</tr>
</thead>
<tbody>
<tr>
<td>US</td>
<td>Type-C</td>
<td>USB 3.1 Gen 2 (10 Gbps)</td>
<td>USB PD 3.0</td>
<td>2.3 A at 20 V (46 W)</td>
</tr>
<tr>
<td>DS1</td>
<td>Type-C</td>
<td>USB 3.1 Gen 2 (10 Gbps)</td>
<td>USB PD 3.0</td>
<td>1 A at 5 V (5 W)</td>
</tr>
<tr>
<td>DS2</td>
<td>Type-C</td>
<td>USB 3.1 Gen 2 (10 Gbps)</td>
<td>BC 1.2, Apple Charging</td>
<td>2.4 A at 5 V (12 W)</td>
</tr>
<tr>
<td>DS3</td>
<td>Type-C</td>
<td>USB 3.1 Gen 2 (10 Gbps)</td>
<td>BC 1.2, Apple Charging</td>
<td>2.4 A at 5 V (12 W)</td>
</tr>
<tr>
<td>DS4</td>
<td>Type-A</td>
<td>USB 3.1 Gen 2 (10 Gbps)</td>
<td>BC 1.2, Apple Charging</td>
<td>2.4 A at 5 V (12 W)</td>
</tr>
<tr>
<td>DS5</td>
<td>Type-A</td>
<td>USB 3.1 Gen 2 (10 Gbps)</td>
<td>BC 1.2, Apple Charging</td>
<td>2.4 A at 5 V (12 W)</td>
</tr>
<tr>
<td>DS6</td>
<td>Type-A</td>
<td>USB 2.0 (480 Mbps)</td>
<td>SDP Charging</td>
<td>500 mA at 5 V (2.5 W)</td>
</tr>
<tr>
<td>DS7</td>
<td>Type-A</td>
<td>USB 2.0 (480 Mbps)</td>
<td>SDP Charging</td>
<td>500 mA at 5 V (2.5 W)</td>
</tr>
</tbody>
</table>

**Note:** Power profiles for the PD 3.0 capable ports US and DS1 can be modified depending on the capabilities of the customer hardware.

**Changes from EZ-PD Dock Reference Design Version 1.1**

HX3PD Hub design is an addition to the SDK 3.3 release.

The following are the features of HX3PD firmware release:

- Support for the CYUSB4347-BZXC part.
- US Type-C port supports the Dual Role Port (DRP) feature and Downstream Port 1 (DS1) supports Downstream Facing Port (DFP).

The following are the Power Data Objects (PDOs) for US and DS1 Type-C ports:

<table>
<thead>
<tr>
<th>Port</th>
<th>Parameter</th>
<th>Supported Settings</th>
</tr>
</thead>
<tbody>
<tr>
<td>US</td>
<td>Source PDOs</td>
<td>5 V @ 3.0 A, 9 V @ 3.0 A, 15 V @ 3.0 A, 20 V @ 2.3 A</td>
</tr>
<tr>
<td></td>
<td>Sink PDOs</td>
<td>5 V @ 0 A</td>
</tr>
<tr>
<td>DS1</td>
<td>Source PDOs</td>
<td>5 V @ 1.0A</td>
</tr>
<tr>
<td></td>
<td>Sink PDOs</td>
<td>-</td>
</tr>
</tbody>
</table>

- Supports VBUS over-voltage protection on US and DS1 PD ports.
- Supports VBUS over-current protection on US and all DS ports based on external current limiting load switch.
- Supports USB PD extended messages.
- PD controller supports a self-controlled swap logic. US port becomes Source and Upstream Facing Port (UFP) (PR_Swap, DR_Swap, VCONN_Swap are sent if required), and the DS1 port becomes Source and DFP.
- DMC acts as system management controller to provide following functionalities:
  - Firmware download support to controllers within HX3PD.
Comprehensive status querying and version reporting of all controller firmware.

**IMPORTANT NOTE:** If you have downloaded a pre-SDK 3.3 release of the HX3PD firmware on your hardware, make sure that you update the firmware for all HX3PD controllers (PD Controller, DMC, and Hub Controller). Doing a selective firmware upgrade (e.g., upgrading only the PD Controller firmware) may result in erroneous HX3PD operation.

## Limitations and Known Problems of HX3PD Hub

None

## Technical Support

For further assistance, go to [www.cypress.com/support](http://www.cypress.com/support).

## Additional Information

For more information about the HX3PD PD Type-C controller, visit the webpage:


For more information about HX3PD design, visit the webpage:


For more information about the Cypress Type-C controller family, visit the webpage:

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