Quick Presentation:
EZ-PD CCG3: USB Type-C Controller With Power Delivery

CCG3 = Type-C Controller Gen3
Type-C = Reversible Slim USB Connector

Add 20-V Operation, USB Authentication and Fail-Safe Updates to Your Type-C Products With CCG3
USB Type-C: Connector of the Future

USB Type-A and Type-B are the current USB-IF\(^1\) standards, but they have limitations:

- They use large connectors that prevent slim industrial designs (plug height: A = 4.5 mm; B = 10.4 mm)
- They require a fixed plug orientation and a fixed cable direction
- They carry only USB signals
- Power delivery implementation on them is complicated, expensive and limited to 7.5 W

USB Type-C is the new USB-IF\(^1\) standard that solves these problems and enables:

- Slim industrial design with a 2.4-mm plug height
- Reversible plug orientation and cable direction
- Transport of both USB along with either DisplayPort or Thunderbolt signals on the same connector
- Easy implementation of low-cost power delivery up to 100 W

USB Type-C is the new, slimmer, all-in-one, 100-W connector

\(^1\) The USB Implementers Forum creates and maintains USB specifications
USB Type-C Port Controllers
A $436M Market by 2020

USB Type-C port controllers are projected to grow from $15M in 2015 to $436M in 2020 at a 96% CAGR\(^1\)

The USB Type-C port is universal: it is slimmer, reversible, handles multiple protocols and supports up to 100-W PD
Every PD-capable, multiple-protocol USB Type-C port requires a dedicated controller

This fast-growing market requires a USB-IF certified solution that:
Marks cables electronically with a controller IC embedded in the cable plug to report the cable’s characteristics (e.g., current rating)
Multiplexes USB signals with Thunderbolt or DisplayPort signals on the same connector
Supports all Power Delivery profiles\(^2\) up to 100 W, for notebooks, tablets, monitors, USB cables and power adapters
Authenticates approved USB Type-C cables, devices and accessories

Cypress has been “Making USB Universal®” since 1996
Cypress has shipped over 1.4 billion USB controllers with industry-leading quality
Cypress has been a leading supplier in every generation of USB technology: USB 1.1, USB 2.0 and USB 3.0

Accelerate your conversion to USB Type-C and PD with Cypress’s CCGx Type-C port controllers
Cypress CCGx Design Wins

Elitebook Notebook PC
By HP

Eliteone All-In-One PC
By HP

Elitedesk Desktop PC
By HP

USB Type-C Cable
By Belkin

Type-C to HDMI Dongle
By Lenovo

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\(^1\) Gartner 2015 and Cypress estimates

\(^2\) A USB-IF specified combination of voltage and current ratings that define the power provided (e.g., 20 V and 5 A: 100-W power provided)
CCG3 Simplifies Power Adapter Design

CCG3 is an Integrated Type-C Solution that Simplifies a Power Adapter Design

CCG3’s 20-V operation enables a high level of integration, reducing BOM cost for power adapters

1 Output voltage of the AC-to-DC adapter
2 Resistor used to sense overcurrent
3 Current-sensing input
4 Signal to control \( V_{BUS} \) load switch
5 Output voltage selection
6 A cable permanently attached to the AC adapter
CCG3 Simplifies Video Dongle Design

A video dongle that converts Type-C to display standards such as DisplayPort, HDMI\(^1\) or VGA\(^2\) requires:

1. A Type-C and PD Controller
2. A USB Billboard Controller to implement USB Billboard Device Class\(^3\)
3. A Crypto Engine to implement USB Authentication
4. An analog switch for Sideband Use (SBU) signals

Multi-Chip Solution

CCG3 Single-Chip Solution

CCG3 reduces complexity and BOM for video dongles

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1. High-Definition Multimedia Interface is a display standard used for monitors/TVs
2. Video Graphics Array is a legacy display standard used for monitors
3. A specification that defines the method for a USB Device to communicate the supported Alternate Modes
4. Hot Plug Detect (HPD) is DisplayPort control signal used to detect when a DisplayPort monitor is plugged in
5. DisplayPort control signals used for audio
**Design Challenges**

Short time-to-market demands programmable solutions  
Solutions must be turnkey for ease of design  
Solutions must support 20-V operation  
Solutions must be flexible to keep up with USB-IF standards  
Solutions must include authentication for approved devices

**CCG3 Solution**

Includes an ARM® Cortex®-M0 with dual 64KB flash  
Ships with USB-IF-compliant factory-programmed firmware  
Supports 20-V operation, including $V_{BUS}$ Gate Drivers, OVP and OCP circuitry  
Integrates 2x64KB flash with fail-safe flash updates  
Integrates a Crypto Engine supporting USB Authentication

**Suggested Collateral**

Webpage: [CCG3 Product Web Page](#)  
Datasheet: [CCG3 Datasheet](#)  
Development Kit: [CCG3 Development Kit](#)  
Video: [CCG3 Demo Video](#)

**How To Get Started**

Get a [CCG3 Development Kit](#)

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1. A new USB standard that increases Power Delivery over $V_{BUS}$ from 7.5 W to 100 W  
2. Circuits to control the gates of external power Field-Effect Transistors (FETs) on $V_{BUS}$ (5-20 V)  
3. Overvoltage protection and overcurrent protection  
4. The encryption hardware and software required to implement USB Authentication  
5. A new USB-IF specification that defines the standard authentication protocol for Type-C accessories  
6. Output voltage of the AC to DC adapter  
7. The power wire of the USB bus  
8. Current-sensing input  
9. Signal to control $V_{BUS}$ load switch  
10. Output voltage selection  
11. Configuration Channel: The USB Type-C bus wire used to carry the PD protocol signals  
12. A cable permanently attached to the AC adapter

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*Figure 1: Type-C Power Adapter with PD*  
A 100-W power adapter that uses a Type-C connector and requires all PD profiles
Design Challenges
Short time-to-market demands programmable solutions
Solutions must be turnkey for ease of design
Solutions must support Alternate Modes\(^2\)
Solutions must be flexible to keep up with USB-IF\(^3\) standards
Solutions must include authentication for approved devices

CCG3 Solution
Includes an ARM® Cortex®-M0 with dual 64KB flash
Ships with USB-IF-compliant factory-programmed firmware
Integrates USB Billboard Controller\(^4\) for Alternate Modes\(^2\)
Integrates 2x64KB flash with fail-safe flash updates
Integrates a Crypto Engine\(^5\) supporting USB Authentication\(^6\)

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USB Type-C DisplayPort\(^1\) Cable
By Goodway
A notebook PC accessory that converts a USB Type-C port to a DisplayPort\(^1\) output to connect a monitor

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\(^1\) A display interface standard developed by the Video Electronics Standards Association (VESA)
\(^2\) Mode of operation in which the data lines are repurposed to transmit non-USB data
\(^3\) The USB Implementers Forum creates and maintains USB specifications
\(^4\) A USB Device controller that is used to implement the USB Billboard Device Class
\(^5\) The encryption hardware and software required to implement USB Authentication
\(^6\) A new USB-IF specification that defines the standard authentication protocol for Type-C accessories
\(^7\) USB Type-C bus wire used for system power
\(^8\) USB Type-C bus wires used to transmit and receive USB 2.0 data
\(^9\) USB Type-C bus wire used to power the controller in the EMCA
\(^10\) Configuration Channel: The USB Type-C bus wire used to carry the PD protocol signals
\(^11\) The use of a USB Type-C bus wire for non-USB control signals, such as DisplayPort signals
\(^12\) DisplayPort control signals used for audio
\(^13\) Hot Plug Detect: A DisplayPort control signal used to detect when a monitor is plugged in