Quick Presentation:

**EZ-PD USB-C CCG3PA**

CCG3PA = Type-C Controller Gen3 for Power Adapter

Add PD 3.0 and QC 4.0 to Your USB Power Adapter
USB-C: Single-Wired Connector

- USB-C is the new USB-IF\(^1\) standard that enables:
  - Slim industrial design with a 2.4-mm plug height
  - Reversible plug orientation and cable direction
  - Transport of USB data along with either DisplayPort, HDMI or Thunderbolt signals on the same connector
  - Easy implementation of low-cost power delivery (PD) up to 100 W

\(^1\) The USB Implementers Forum creates and maintains USB specifications
Design Problems Engineers Face

- **A USB-C power source requires a large BOM**
  - A Type-C power adapter/charger requires multiple ICs, including 30-V–tolerant regulator, high-voltage PFET gate drivers, overvoltage protection (OVP) and overcurrent protection (OCP) circuits, $V_{BUS}$-to-configuration channel (CC) short protection and electrostatic discharge (ESD) protection

- **New power adapter/charger designs are required to support Power Delivery 3.0 (PD 3.0) with programmable power supply (PPS) support and Quick Charge 4.0 (QC 4.0) standards**
  - External low-side current sense\(^1\) and voltage regulation\(^2\) are required to enable programmable $V_{BUS}$ control

- **Rapidly evolving USB standards make compliance and interoperability a challenge**
  - USB-C and PD specifications are continuously changing
  - Many existing devices do not interoperate, creating user confusion and resentment

- **Cypress’ CCG3PA solves these problems, providing:**
  - Integrated 30-V–tolerant regulator, $V_{BUS}$-to-CC short protection, high-voltage PFET gate drivers, OVP, OCP and ESD protection
  - Integrated voltage regulation and low-side current-sense amplifier for programmable $V_{BUS}$ control
  - Integrated ARM® Cortex®-M0 and 64KB Flash with read-while-write function for firmware upgradeability to overcome interop issues

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\(^1\) Circuit to measure the current flowing on the $V_{BUS}$

\(^2\) Analog feedback control circuit to regulate $V_{BUS}$

CCG3PA enables a high level of integration, reduces BOM cost and simplifies system design
CCG3PA Simplifies System Design with BOM Integration

- **High-Voltage PFET Gate Drivers**
- **30-V Tolerant Regulator, OVP**
- **V<sub>BUS</sub> Regulation Using Feedback Amplifier and Current Sense**
- **OCP**

**ARM® Cortex®-M0 and 64KB Flash Supports Firmware Update**

1. Output voltage of the AC-to-DC adapter
2. Output voltage selection using feedback control
3. Signal to control V<sub>BUS</sub> load switch
4. A cable permanently attached to the AC adapter
5. Current-sensing input
6. Resistor used to sense overcurrent

1. Output voltage of the AC-to-DC adapter
2. Output voltage selection using feedback control
3. Signal to control V<sub>BUS</sub> load switch
4. A cable permanently attached to the AC adapter
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6. Resistor used to sense overcurrent
CCG3PA: USB-C and Power Delivery Port Controller

**Applications**
- Power adapters, mobile chargers, car chargers and power banks

**Features**
- USB-C PD Controller, PD 3.0 Transceiver and Qualcomm QC 4.0
- \( V_{BUS} \)-to-CC Short Protection
- Integrated High-Voltage 30-V–Tolerant LDO to Power CCG3PA
- Integrated Digital Blocks
  - Four timer/counter/pulse-width modulator (TCPWM) blocks, 12x GPIOs
  - Two serial communication blocks (SCBs) for configurable master/slave \( I^2C \), SPI or UART
- Integrated Analog Blocks
  - Configurable \( V_{BUS} \) overvoltage protection (OVP) and overcurrent (OCP) protection
  - Integrated voltage regulation\(^1\) with analog output and PFET gate drivers
  - Low-side current sense\(^2\) capable of detecting 100mA change
  - Two legacy charge-detect block (BC 1.2, Apple Charging 2.4A, QC 4.0 and Samsung AFC\(^3\))
- ARM® Cortex®-M0 with MCU Subsystem and 64KB Flash
- Low-Power Operation
  - High-voltage (3–30 V, 30 V maximum) \( V_{BUS} \) voltage inputs
  - Sleep: 3 mA; Deep Sleep: 30 \( \mu \)A with wake-on-CC
- System-Level ESD on CC, Dp / Dn\(^4\) and \( V_{BUS} \) Pins
  - \( \pm 8-kV \) contact, \( \pm 15-kV \) Air Gap IEC61000-4-2 level 4C
- Packages
  - 24 QFN (16 mm\(^2\)), 16- SOIC (60 mm\(^2\))

**Collateral**

**Preliminary Datasheet:** [CCG3PA Datasheet](#)

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\(^1\) Analog feedback control circuit to regulate \( V_{BUS} \)

\(^2\) Circuit to measure the current flowing on the \( V_{BUS} \)

\(^3\) Adaptive Fast Charging

\(^4\) USB-C bus wires used to transmit and receive USB 2.0 data

\(^5\) Termination resistors: \( R_T \) read as a DFP, \( R_P \) as a UFP
CCG3PA Evaluation Kit provides:

- Support for power adapters/chargers and power banks
- One Type-C source or sink port and Type-A source port
- Support for USB PD 3.0 with PPS support
- Support for QC 4.0, BC 1.2, Apple Charging 2.4A and Samsung AFC\(^1\) charging protocols on Type-A port
- Support for 1-cell and 2-cell battery (power bank application)
- Charging for notebooks, mobile phones and USB-powered devices
- Firmware upgradeability

\(^1\) Adaptive Fast Charging

$149 CCG3PA Evaluation Kit (CY4532)
CCG3PA Solution Example:
Type-C Power Adapter / Mobile Charger

**CCG3PA Value**

- **Design Problems**
  - Power adapter / mobile charger must support latest standards
  - Must be turnkey for ease-of-design
  - Must be highly integrated to lower BOM cost
  - Must be reprogrammable to keep up with USB-IF standards
  - Industry standards demand low power for no-load conditions

- **CCG3PA Solution**
  - Provides Type-C solution with Power Delivery 3.0 (PD 3.0) with programmable power supply support and Quick Charge 4.0 (QC 4.0)
  - Includes an ARM® Cortex®-M0 and certified USB-PD stack
  - Integrates voltage regulation, 30-V–tolerant regulator, \( V_{\text{BUS}} \)-to-CC short protection, high-voltage PFET gate driver and ESD protection
  - Supports field upgrades with free, fully-compliant firmware
  - Delivers Low Power: 30 µA (Deep Sleep Mode)

**Suggested Collateral**

- Webpages: Type-C, CCG3PA and Reference Design
- Datasheet: CCG3PA Datasheet
- Video: CCG3PA Demo Video

**How to Get Started**

Contact Sales for CCG3PA Evaluation Board

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

New Smartphone Charger with USB-C Receptacle
CCG3PA Solution Example:

**Type-C Car Charger**

### CCG3PA Value

- **Design Problems**
  - Car charger must support latest standards
  - Must be turnkey for ease-of-design
  - Must be highly integrated to lower BOM cost
  - Must be reprogrammable to keep up with USB-IF standards
  - Industry standards demand low power for no-load conditions

- **CCG3PA Solution**
  - Provides Type-C solution with Power Delivery 3.0 (PD 3.0) with programmable power supply support and Quick Charge 4.0 (QC 4.0)
  - Includes an ARM® Cortex®-M0 and certified USB-PD stack
  - Integrates voltage regulation, 30-V–tolerant regulator, $V_{BUS}$-to-CC short protection, high-voltage PFET gate driver and ESD protection
  - Supports field upgrades with free, fully-compliant firmware
  -Delivers Low Power: 30 µA (Deep Sleep Mode)

### Suggested Collateral

- Webpages: [Type-C](#), [CCG3PA](#) and [Reference Design](#)
- Datasheet: [CCG3PA Datasheet](#)
- Video: [CCG3PA Demo Video](#)

### How To Get Started

Contact Sales for CCG3PA Evaluation Board

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1. Output voltage of the AC-to-DC adapter
2. Signal to control $V_{BUS}$ load switch
3. Output voltage selection using I2C or PWM
4. A cable permanently attached to the AC adapter
5. Current-sensing input
6. Resistor used to sense overcurrent
### CCG3PA Solution Example:
#### Type-C Power Bank

**CCG3PA Value**

- **Design Problems**
  - Power bank must support latest standards
  - Must be turnkey for ease-of-design
  - Must be highly integrated to lower BOM cost
  - Must be reprogrammable to keep up with USB-IF standards
  - Industry standards demand low power for no-load conditions

- **CCG3PA Solution**
  - Provides Type-C solution with Power Delivery 3.0 (PD 3.0) with programmable power supply support and Quick Charge 4.0 (QC 4.0)
  - Includes an ARM® Cortex®-M0 and certified USB-PD stack
  - Integrates voltage regulation, 30-V–tolerant regulator, VBUS-to-CC short protection, high-voltage PFET gate driver and ESD protection
  - Supports field upgrades with free, fully-compliant firmware
  - Delivers Low Power: 30 µA (Deep Sleep Mode)

**Suggested Collateral**

- **Webpages:** [Type-C](#), [CCG3PA](#) and [Reference Design](#)
- **Datasheet:** [CCG3PA Datasheet](#)
- **Video:** [CCG3PA Demo Video](#)

**How To Get Started**

[Contact Sales](#) for CCG3PA Evaluation Board

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1. Battery Voltage
2. Signal to control VBUS load switch
3. Output voltage selection using i2C or PWM
4. Current-sensing input
5. Resistor used to sense overcurrent

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**Type-C Power Bank with CCG3PA**

![Diagram of Type-C Power Bank with CCG3PA](#)

**USB-C Power Bank with USB-PD**

```
Battery Charger + Buck Boost

CCG3PA CYPD3171

Type-C_VBUS

PFETs

VBUS_CTRL

USB Type-C Receptacle

Dp / Dn

Type-C_VBUS

V_BATT

Battery (1-Cell or 2-Cell)

GND

CSH

RSENSE

V_BATT

PC/PWM

USB Type-A Receptacle

Type-A_VBUS

Regulator

Dp / Dn

PC/PWM

V_BATT

Battery Charger + Buck Boost

CCG3PA CYPD3171

Type-C_VBUS

PFETs

VBUS_CTRL

USB Type-C Receptacle

Dp / Dn

Type-C_VBUS

V_BATT

Battery (1-Cell or 2-Cell)

GND

CSH

RSENSE

V_BATT

PC/PWM

USB Type-A Receptacle

Type-A_VBUS

Regulator

Dp / Dn

PC/PWM

V_BATT
```
<table>
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<tr>
<th>Product</th>
<th>dialog</th>
<th>DIODES</th>
<th>Power Integrations</th>
<th>MPS</th>
<th>SouthChip</th>
<th>SliERGY</th>
</tr>
</thead>
</table>

| Mobile Charger 27-W PD 3.0 + QC 4.0 | ✔   | ✔   | ✔   | ✔   |           |         |
| Notebook Power Adapter 45-W/60-W PD 3.0 | ✔   |   | ✔   |     |           |         |
| Power Bank               |       | ✔   | ✔   | ✔   |           |         |
| 60-W Car Charger         |       |   | ✔   | ✔   |           |         |
# Cypress CCGx Product Family Comparison

<table>
<thead>
<tr>
<th>Features</th>
<th>CCG2</th>
<th>CCG3</th>
<th>CCG3PA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Type-C+PD Ports</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Integrated ARM® Cortex®-M0 MCU @ 48 MHz</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Memory (Flash / SRAM)</td>
<td>32KB / 4KB</td>
<td>128KB / 8KB</td>
<td>64KB / 4KB</td>
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<tr>
<td>PD 3.0 with PPS Support</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Serial Communication Blocks (I²C / SPI / UART)</td>
<td>2</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>V&lt;sub&gt;BUS&lt;/sub&gt; Current Sense</td>
<td>No</td>
<td>No</td>
<td>Yes (Low)</td>
</tr>
<tr>
<td>Integrated Voltage (V&lt;sub&gt;BUS&lt;/sub&gt;) Regulation</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Integrated V&lt;sub&gt;BUS&lt;/sub&gt; Discharge Drivers</td>
<td>0</td>
<td>1</td>
<td>2</td>
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<tr>
<td>Total GPIOs</td>
<td>14</td>
<td>20</td>
<td>12</td>
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<tr>
<td>Integrated V&lt;sub&gt;CONN&lt;/sub&gt; FETs</td>
<td>0</td>
<td>1 Pair</td>
<td>0</td>
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<tr>
<td>Integrated High-Voltage V&lt;sub&gt;BUS&lt;/sub&gt; Gate Drivers</td>
<td>No</td>
<td>4 (NFET / PFET)</td>
<td>2 (PFET)</td>
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<td>Supply Voltage</td>
<td>2.7–5.5 V</td>
<td>2.7–21.5 V</td>
<td>2.7–21.5 V</td>
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<tr>
<td>V&lt;sub&gt;BUS&lt;/sub&gt; (absolute maximum)</td>
<td>6 V (no V&lt;sub&gt;BUS&lt;/sub&gt;)</td>
<td>24 V</td>
<td>30 V</td>
</tr>
<tr>
<td>V&lt;sub&gt;BUS&lt;/sub&gt; Short Protection on CC Pins</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
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<tr>
<td>Dedicated V&lt;sub&gt;BUS&lt;/sub&gt; OVP and OCP</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>BC 1.2, Apple Charging, QC 4.0, Samsung Adaptive Fast Charging</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>ESD Protection ±8 kV (Contact), ±15 kV (Air)</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
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<tr>
<td>Packages</td>
<td>24-QFN, 14-DFN, 20-CSP</td>
<td>40-QFN, 42-CSP</td>
<td>16-SOIC, 24-QFN</td>
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<tr>
<td>Availability (Samples / Production)</td>
<td>Now</td>
<td>Now</td>
<td>Q217 / Q317</td>
</tr>
</tbody>
</table>
References and Links

**CCG3PA**
- Web Page: [www.cypress.com/ccg3pa](http://www.cypress.com/ccg3pa)
- Datasheet: [www.cypress.com/ccg3pads](http://www.cypress.com/ccg3pads)
- Evaluation Kit: [www.cypress.com/cy4532](http://www.cypress.com/cy4532)
- Application Note: "Getting Started with EZ-PD™ CCG3PA (AN218179)"

**Knowledge Base Article**
- [www.cypress.com/CCGx_KBAs](http://www.cypress.com/CCGx_KBAs)

**USB 3.1 Specification (including Type-C)**
- [www.usb.org/developers/docs](http://www.usb.org/developers/docs)

**USB Power Delivery Specification**
- [www.usb.org/developers/powerdelivery](http://www.usb.org/developers/powerdelivery)