CYPRESS
EMBEDDED IN TOMORROW™

FUTURE ELECTRONICS Tech Days

EZ-PD™ Barrel Connector Replacement (BCR) Controller

Power Your Next Product With Any USB-C Power Adapter

The World Has Started Moving to a USB-C Power Source

250+ Personal Computers

60+ Smartphones

500+ 3rd-party Chargers, Power Banks

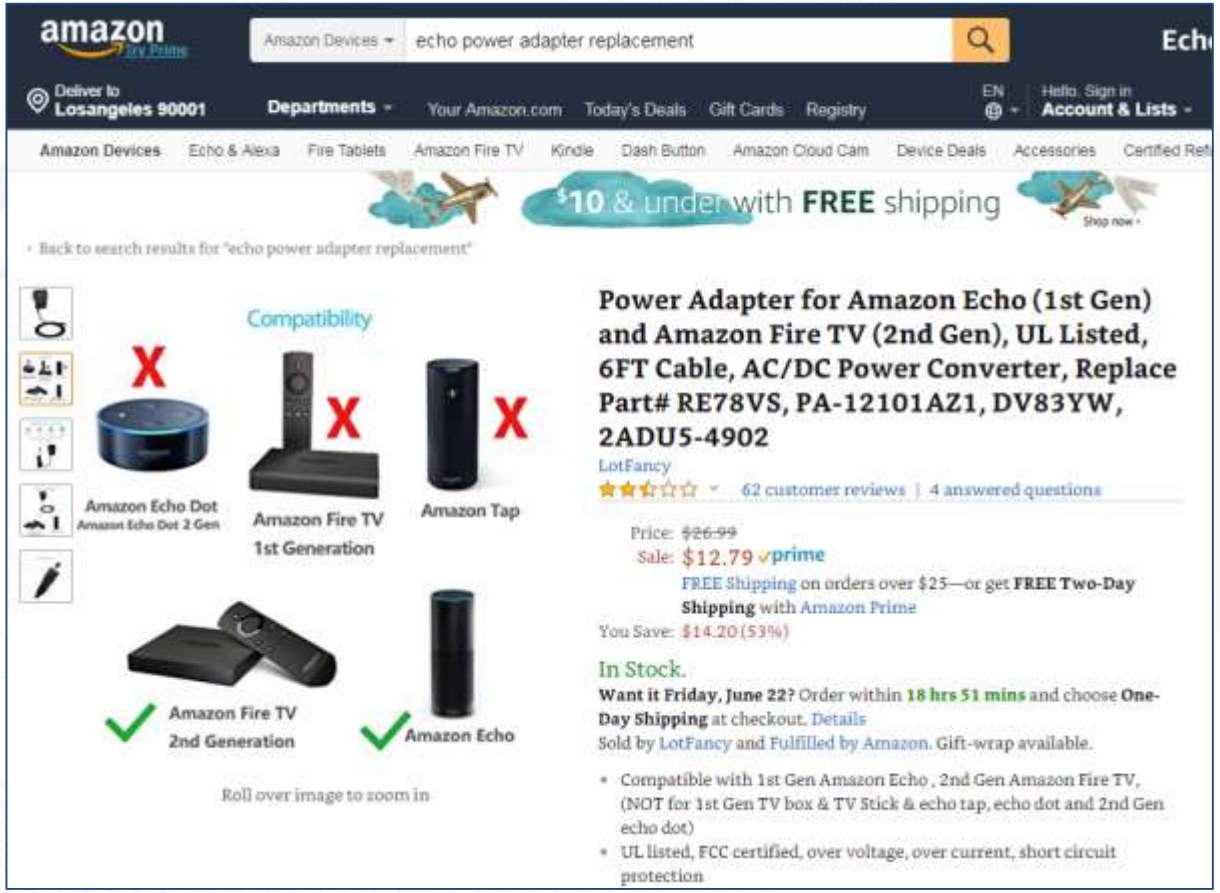
… And Many More to Come

Many Products Have Already Made The Switch To USB-C

CYPRESS EMBEDDED IN TOMORROW™

USB-C Standardizes Power Adapters to a Common Connector

Eliminate Confusion



Carry Only One Charger With You

USB-C: Past, Present and Future

2015 to Today

Data, Video, Power Over USB-C

USB-C enables one-cable docking to ultra-sleek, ultra-mobile notebook and smart phones

Next 5 Years

USB-C In Every Car

Abundance of USB-C ports in a car to fast-charge everyone's smart phone, tablet or notebook PC

Next 10 Years

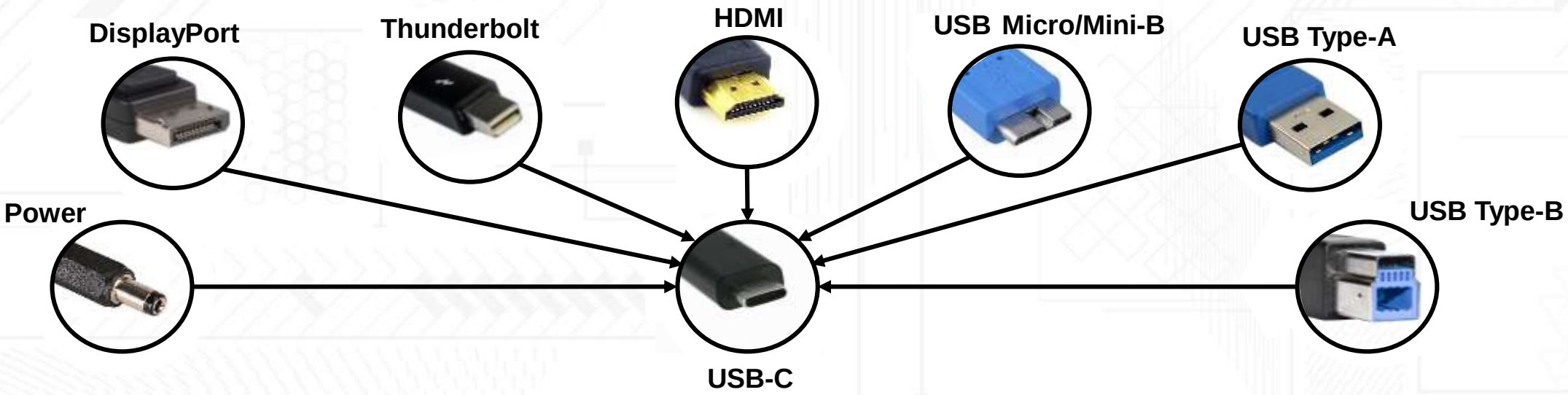
USB-C Powers Everything

USB-C chargers and power outlets replace all conventional power adapters

USB-C: The One Connector That Rules Them All

USB-C is the new USB standard that facilitates:

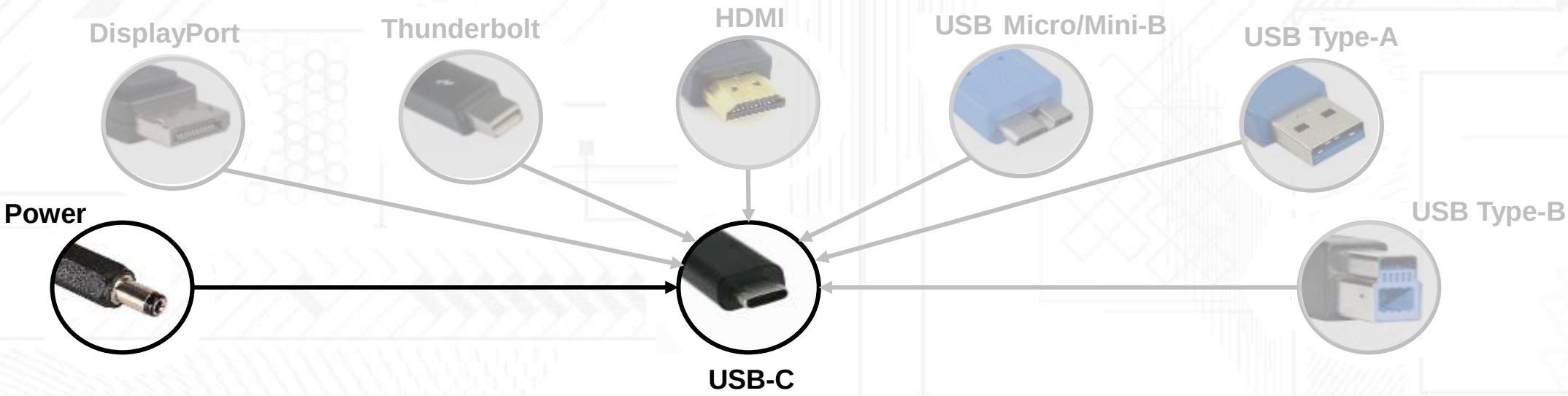
- **Slim industrial design with a 2.4-mm plug height**
- **Reversible plug orientation and cable direction**
- **Transport of USB data along with DisplayPort, HDMI, or Thunderbolt signals on the same connector**
- **Easy implementation of low-cost USB Power Delivery up to 100 Watts**



USB-C: The One Connector That Rules Them All

USB-C is the new USB standard that facilitates:

- Slim industrial design with a 2.4-mm plug height
- Reversible plug orientation and cable direction
- Transport of USB data along with DisplayPort, HDMI, or Thunderbolt signals on the same connector
- **Easy implementation of low-cost USB Power Delivery up to 100 Watts**



Design Problems Engineers Face

- **Converting a barrel connector to USB-C requires in-depth USB-C knowledge**
  - Requires expert knowledge of the USB PD specification and hands-on experience in USB PD system design
  - Must meet USB-IF certification requirements to ensure spec compliance and interoperability
- **Designing a product that can be powered by any USB-C power adapter is difficult**
  - Different products require different voltage levels and current ratings in power supplies
  - Requires an MCU and firmware development to implement a full USB PD stack
- **USB-C solutions are costly in comparison to legacy barrel connectors**
  - The cost of a USB-C controller plus connector is greater than a legacy barrel connector
  - Additional power-related protection circuitry and components further increase overall BOM cost

Solution: Cypress' Barrel Connector Replacement (BCR) Controller

- **USB-IF certified with market-proven USB PD stack, ensuring spec compliance and interoperability**
- **Supports all USB PD profiles commonly used in USB-C power adapters and requires no firmware development**
- **A highly integrated solution that minimizes the increase in BOM cost**

EZ-PD BCR

USB Type-C UFP Port Controller

Applications

Portable electronics – cameras, camcorders, smart speakers, toys, gaming, shavers, powered tools and any battery-powered devices.

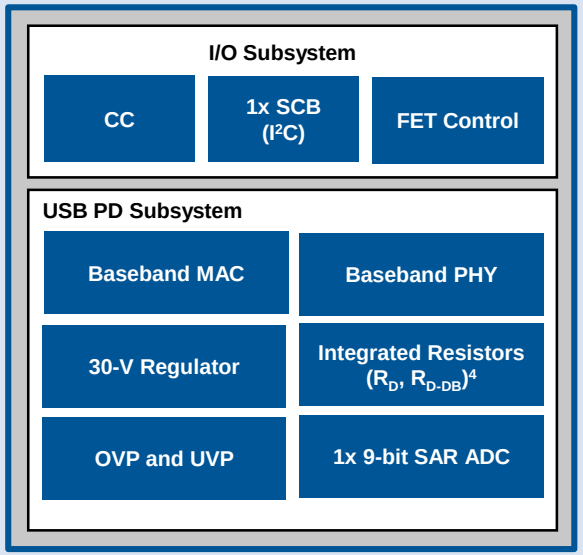
Industrial – LED lighting, scanner, printer, drones, IoT

Any electronics device consuming less than 100W

Features

- **Integrated Type-C and Power Delivery (PD) Transceiver**
  - Integrated high-voltage 30-V–tolerant LDO to power the BCR controller
  - One serial communication blocks (SCB) for slave I^2C
- **Integrated Analog**
  - V_{BUS} overvoltage (OVP) and undervoltage (UVP) protection
  - Fault detection for PDO mismatch
  - Slew rate-controlled PMOS FET gate driver
  - Minimum 25-V–tolerant CC pins and FET control pins
- **Low-Power Operation**
  - High-voltage (5–30 V, 30 V maximum) V_{BUS} voltage inputs
  - Sleep: ~3.5 mA; Deep Sleep: 50 µA with wake-on-I^2C or CC
- **System-Level ESD on CC, and V_{BUS}**
  - ±8-kV Contact, ±15-kV Air Gap IEC61000-4-2 Level 4C
- **Package**
  - 24-QFN (16 mm^2), supporting extended Industrial temp (-40 °C to 105 °C)

EZ-PD BCR: USB Type-C UFP Port Controller



Collateral

Datasheet: CY3177 Datasheet
Evaluation Kit: CY4533 Kit
Product Brochure: EZ-PD Barrel Connector Replacement Product Overview

Availability

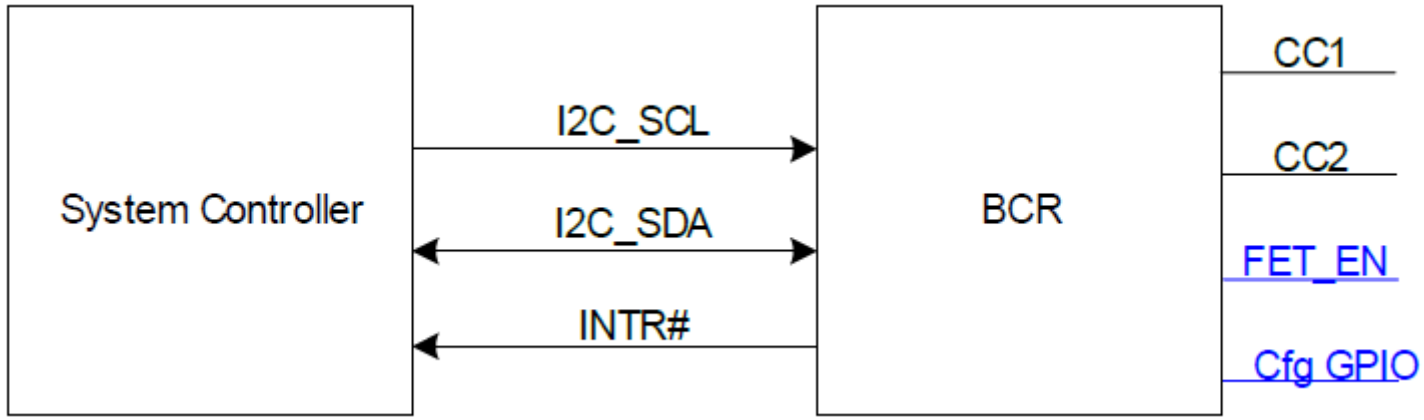
Production: Now

[1] Analog feedback voltage control circuit to control V_{BUS}
[2] Circuit to measure the current flowing on the V_{BUS}
[4] Termination resistors: R_D as a UFP, R_{D-DB} as a UFP supporting dead battery

BCR Operational Modes

Two Modes

- The EZ-PD BCR can operate in one of two modes
  - **Standalone mode**
    - EZ-PD BCR uses the voltage and current setting specified using configuration pin resistor dividers
  - **Host Processor Interface (HPI) mode**
    - EZ-PD BCR is controlled by I2C to dynamically specify voltage and current setting with application note
    - HPI is active in both modes, but only certain registers can be written in HPI mode



Functional Block Diagram

BCR Functional Block Diagram

Use VMIN and VMAX to set the VBus voltage range to be provided by a USB-C power adapter

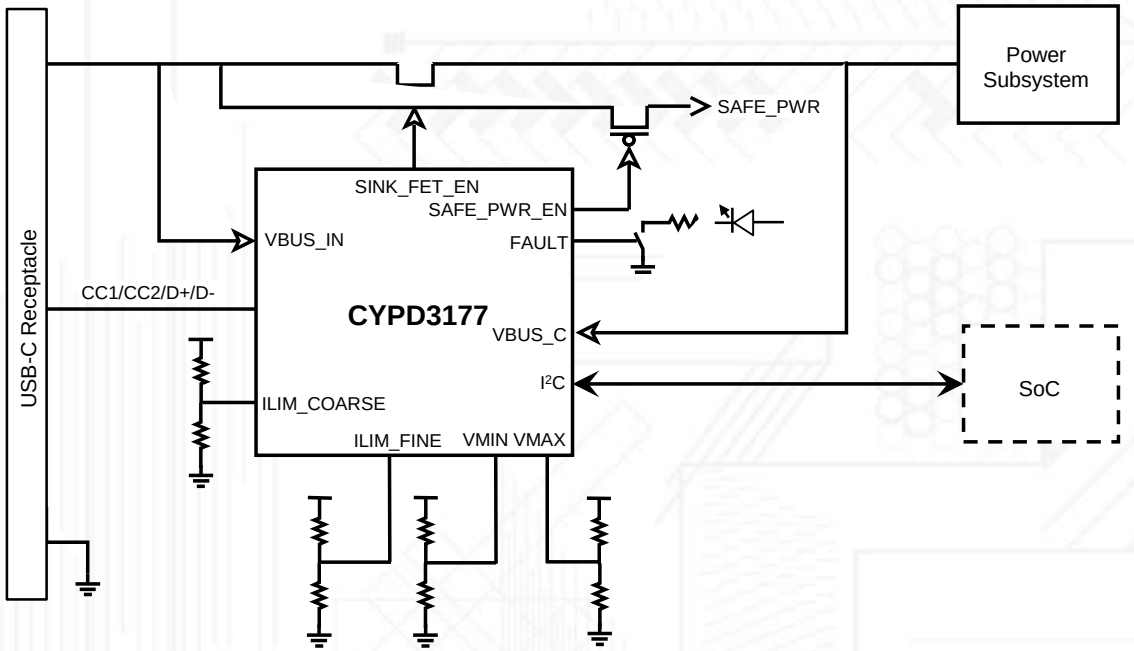
VBus	5V	9V	12V	15V	19V	20V
Pull-up	None	5.1KΩ	5.1KΩ	5.1KΩ	5.1KΩ	0KΩ
Pull-down	0KΩ	1KΩ	2.4KΩ	5.1KΩ	10KΩ	None

Use ILIM_COARSE and ILIM_FINE to set maximum current to be provided by a USB-C power adapter

ILIM_COARSE	0A	1A	2A	3A	4A	5A
Pull-up	None	5.1KΩ	5.1KΩ	5.1KΩ	5.1KΩ	0KΩ
Pull-down	0KΩ	1KΩ	2.4KΩ	5.1KΩ	10KΩ	None

ILIM_FINE	0mA	250mA	500mA	750mA	900mA
Pull-up	None	5.1KΩ	5.1KΩ	5.1KΩ	0KΩ
Pull-down	0KΩ	1KΩ	2.4KΩ	5.1KΩ	None

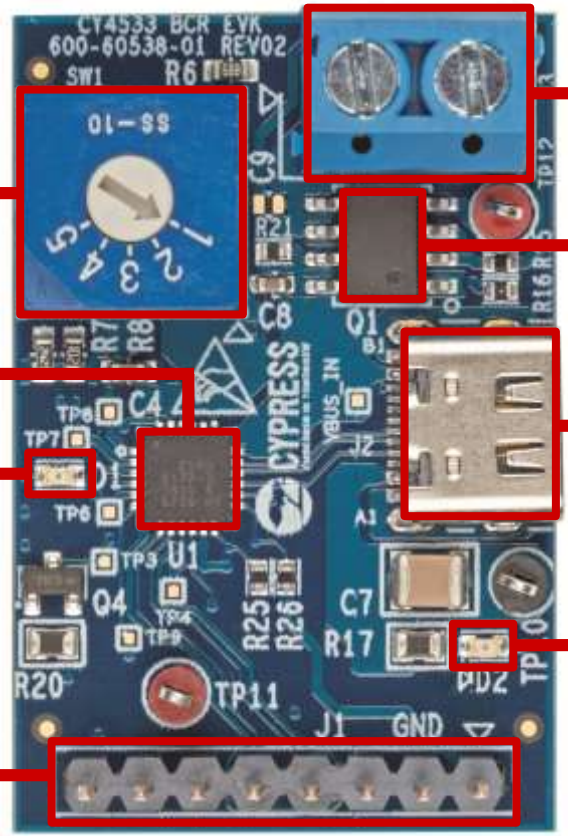
Maximum current = ILIM_COARSE + ILIM_FINE



Developers can use this reference design and the voltage divider guide on the left to quickly integrate BCR into their next design – **no firmware development required!**

Use EZ-PD BCR Kit to Quickly Prototype a USB-C Power Sink

CY4533
EZ-PD BCR Kit



Power Profile Selector

CYPD3177 BCR Controller

Fault LED

Header to External MCU (I^2C, FLIP)

Power Terminal (DC Out)

Power FETs

USB-C Receptacle (VBus In)

Power LED

3.7 cm x 2.5 cm

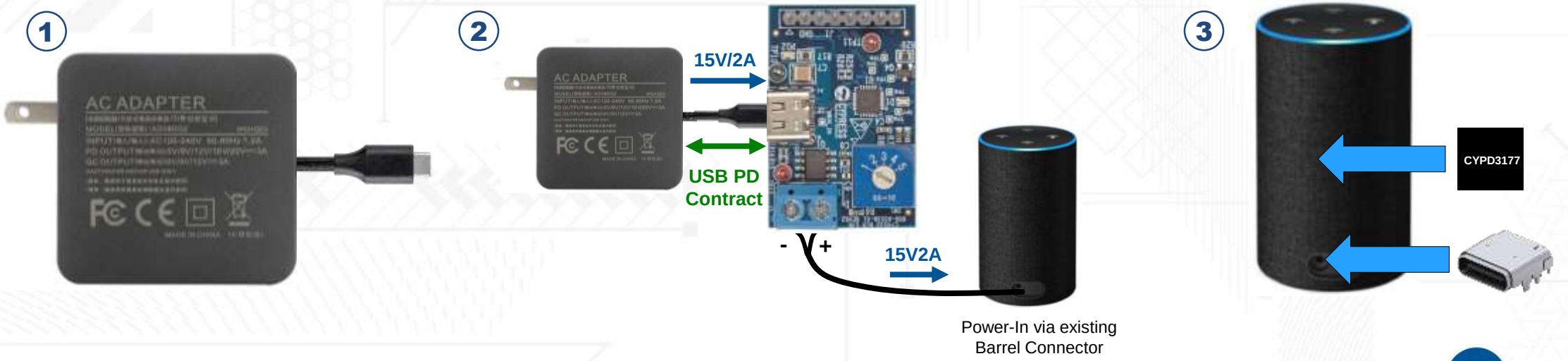
CYPRESS EMBEDDED IN TOMORROW™

3 Easy Steps to Jumpstart Your USB-C Conversion

1. Select a commercially available USB-C power adapter that supports the desired USB PD power profile

2. Set up the desired USB PD power profile with EZ-PD BCR Kit and quickly prototype by converting the USB-C power input to a barrel connector output to the product. No firmware development required

3. Embed **CYPD3177** BCR Controller into your product and replace the barrel receptacle with a USB-C receptacle. Your product can now be powered by any USB-C power adapter supporting the required power profile. The USB-C power adapter can be shipped in-box with the product, sold separately or be left to the users to use their own



How To Get Started

1. Purchase an EZ-PD BCR Cypress Dev Kit (CY4533)
2. Join the Cypress Developer Community (CDC)
3. Start your BCR prototype using the BCR Kit User Guide and resources to the right

Resources

- **Product Pages**
  - Cypress Barrel Connector Replacement BCR)
  - Cypress USB Type-C and Power Delivery
- **Cypress Developer Community (CDC)**
  - Cypress EZ-PD USB Type-C Community Forum
- **App Notes/Datasheets/ Technical Docs**
  - EZ-PD Barrel Connector Replacement (BCR) Datasheet
  - EZ-PD Barrel Connector Replacement Product Overview
  - Cypress USB Roadmap
- **Videos**
  - Type-C 101 Training Video Series

CY4500 EZ-PD Protocol Analyzer (optional)

CY4500 EZ-PD™ Protocol Analyzer

Last Updated: Sep 18, 2018

Version: *C

The CY4500 EZ-PD™ Protocol Analyzer records traffic passively on the Configuration Channel (CC) and allows users to analyze and debug USB Power Delivery communication. The low-cost and compact CY4500 acts as a pass-through for V_{BUS}, V_{CONN}, USB 3.1, USB 2.0 and USB-PD traffic. The EZ-PD Protocol Analyzer Installer includes a free Windows-based GUI (EZ-PD Analyzer Utility) that can be used to decode the USB-PD messages.

Features:

- Simple GUI for decoding USB Power Delivery packets in real-time on the CC lines
- V_{BUS} Voltage and Current monitoring
- Message ID based triggering
- Debug headers for CC, V_{BUS} and SBU
- Firmware upgradable for future updates

PRICE & AVAILABILITY

$199.00 In Stock

Buy from Cypress

Buy from Distributor**

Check on Shipping and Import Costs

**Pricing may vary.

RELATED RESOURCES

Other Resources (1)

RELATED PAGES

EZ-PD™ CCG1 Type-C Port Controller
EZ-PD™ CCG2 Type-C Cable Controller
EZ-PD™ CCG3 Type-C Port Controller
EZ-PD™ CCG4: Two-Port Type-C Controller with Power Delivery
EZ-PD™ CCG4M: Two Port USB Type-C Controller with PD and High-Speed Mux
EZ-USB™ HX3C: USB Type-C Hub with Power Delivery
USB-C and Power Delivery

CY4500 QUICK START GUIDE

CY4500 EZ-PD™ PROTOCOL ANALYZER

EZ-PD™ Protocol Analyzer Hardware

Jumper Wires (6 nos.)

USB 2.0 Type-A to Micro-B Cable

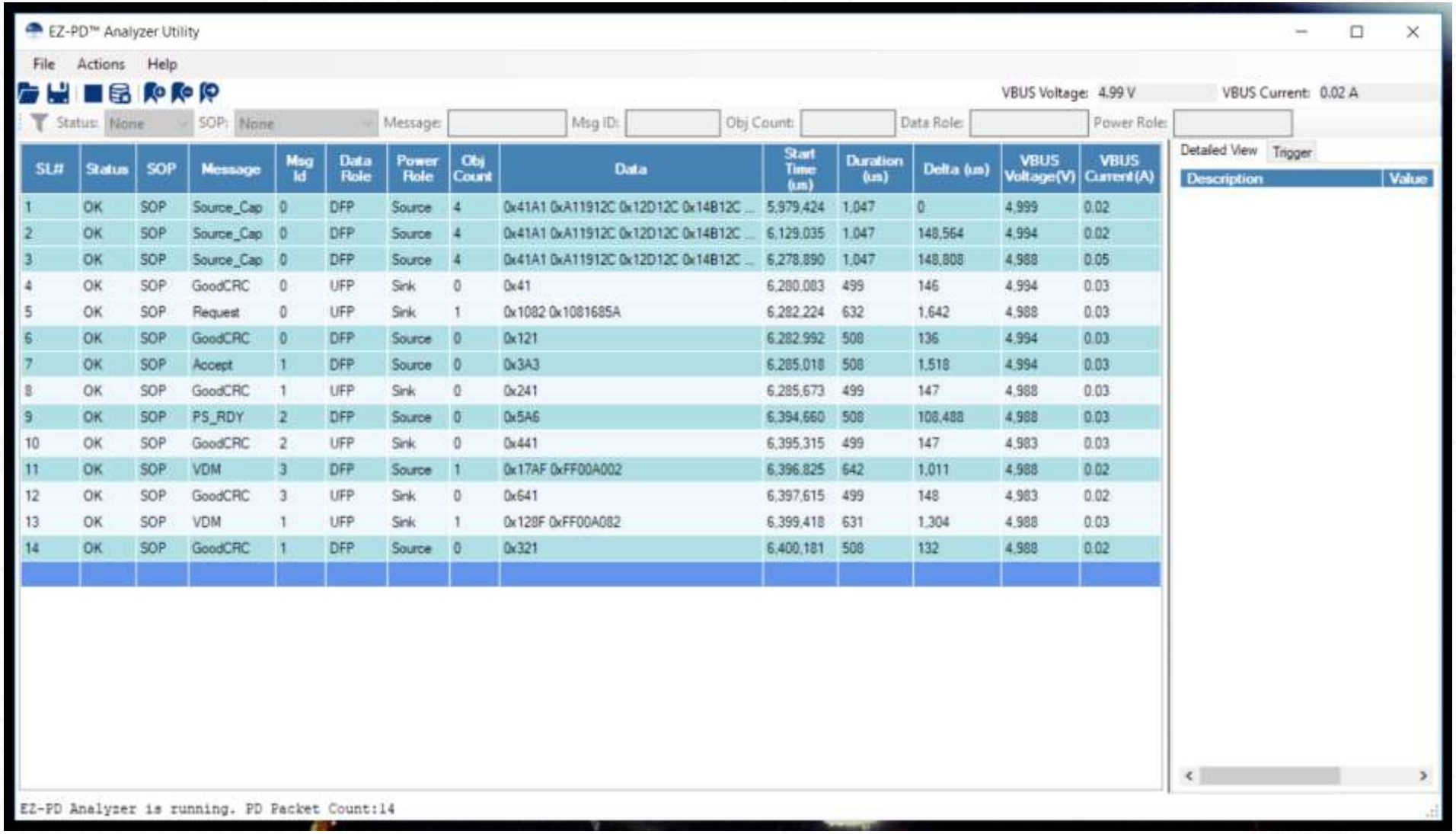
1

- Review the Analyzer Contents
- Download and install the latest Analyzer Setup *CY4500 Setup.exe* from www.cypress.com/CY4500

2

- Connect the CY4500 EZ-PD™ Protocol Analyzer to your PC via the USB2.0 Type-A to Micro-B Cable provided with the Analyzer. Observe LED1 (white color) blink continuously

CY4500 EZ-PD Protocol Analyzer (optional)



SL#	Status	SOP	Message	Msg Id	Data Role	Power Role	Obj Count	Data	Start Time (us)	Duration (us)	Delta (us)	VBUS Voltage(V)	VBUS Current(A)
1	OK	SOP	Source_Cap	0	DFP	Source	4	0x41A1 0xA11912C 0x12D12C 0x14B12C ...	5,979,424	1,047	0	4.999	0.02
2	OK	SOP	Source_Cap	0	DFP	Source	4	0x41A1 0xA11912C 0x12D12C 0x14B12C ...	6,129,035	1,047	148,564	4.994	0.02
3	OK	SOP	Source_Cap	0	DFP	Source	4	0x41A1 0xA11912C 0x12D12C 0x14B12C ...	6,278,890	1,047	148,808	4.988	0.05
4	OK	SOP	GoodCRC	0	UFP	Sink	0	0x41	6,280,083	499	146	4.994	0.03
5	OK	SOP	Request	0	UFP	Sink	1	0x1082 0x1081685A	6,282,224	632	1,642	4.988	0.03
6	OK	SOP	GoodCRC	0	DFP	Source	0	0x121	6,282,992	508	136	4.994	0.03
7	OK	SOP	Accept	1	DFP	Source	0	0x3A3	6,285,018	508	1,518	4.994	0.03
8	OK	SOP	GoodCRC	1	UFP	Sink	0	0x241	6,285,673	499	147	4.988	0.03
9	OK	SOP	PS_RDY	2	DFP	Source	0	0x5A6	6,394,660	508	108,488	4.988	0.03
10	OK	SOP	GoodCRC	2	UFP	Sink	0	0x441	6,395,315	499	147	4.983	0.03
11	OK	SOP	VDM	3	DFP	Source	1	0x17AF 0xFF00A002	6,396,825	642	1,011	4.988	0.02
12	OK	SOP	GoodCRC	3	UFP	Sink	0	0x641	6,397,615	499	148	4.983	0.02
13	OK	SOP	VDM	1	UFP	Sink	1	0x128F 0xFF00A082	6,399,418	631	1,304	4.988	0.03
14	OK	SOP	GoodCRC	1	DFP	Source	0	0x321	6,400,181	508	132	4.988	0.02

Demo

USB Roadmap

Cypress Is #1 In USB-C with 37% Market Share

First-To-Market, Customer-Proven, Innovation Pace Setter

First USB PD Controller to Market	First EMCA Smallest USB PD Controller	First USB PD + Billboard Controller	First Dual-Port USB PD Controller	First Integrated USB PD Hub	First HDMI Alternate Mode Controller	First PD 3.0 PPS Controller	First PD Controller for Thunderbolt	First to Achieve QC 4.0 Certification
OCT'14	MAR'15	DEC'15	JAN'16	AUG'16	JAN'17	JUN'17	JUN'17	SEP'17
								
CCG1	CCG2	CCG3	CCG4	HX3C	CCG3	CCG3PA	CCG5	CCG3PA

Data Source: Gartner 2017, IHS 2016 and Cypress estimates

Cypress USB-C Leadership:

Five generations of market-proven solutions

Largest number of devices (with Cypress USB-C Controllers) certified by USB-IF

Standalone operation – Highly integrated solution for automotive applications (Console and Rear Seat Chargers)

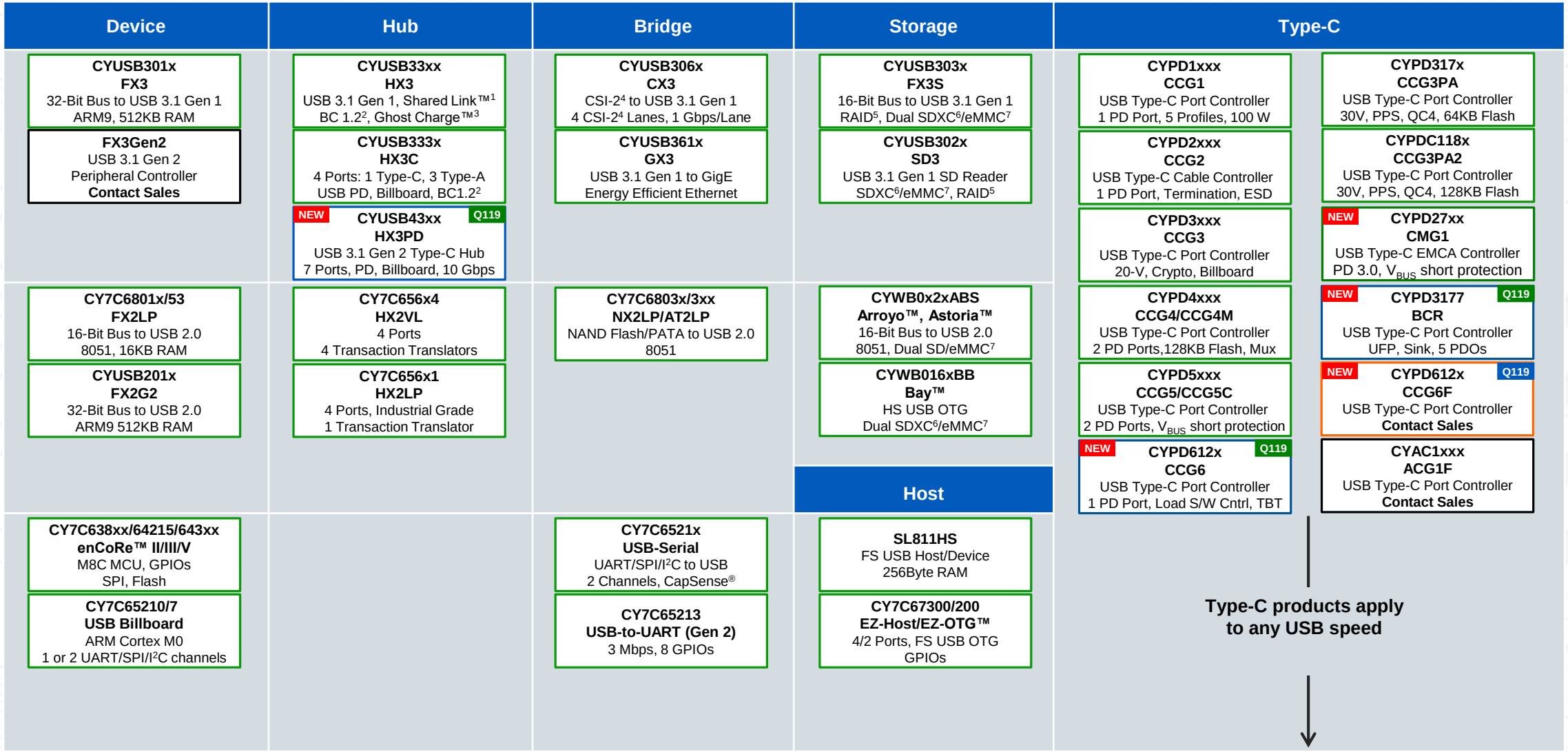
Programmability keeps pace with standard changes

100+ Man years of Mature Design Tools, Reference Designs and F/W Stack enables risk-free and faster designs

Worldwide customer training workshops proliferate best design practices

CYPRESS EMBEDDED IN TOMORROW™

Cypress USB Portfolio

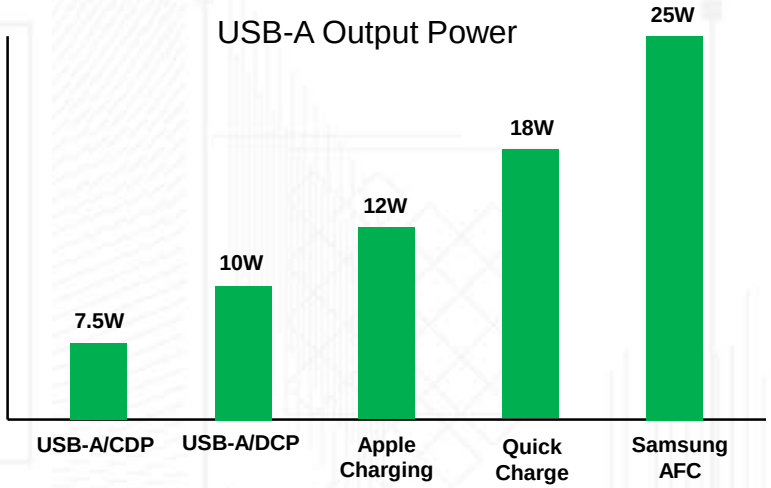


[1] Simultaneous USB 2.0 and SuperSpeed traffic on the same port
[2] Battery Charging specification v1.2
[3] Enables USB charging without host connection
[4] Camera Serial Interface v2.0
[5] Redundant array of independent disks
[6] SD extended capacity
[7] Embedded Multimedia Card

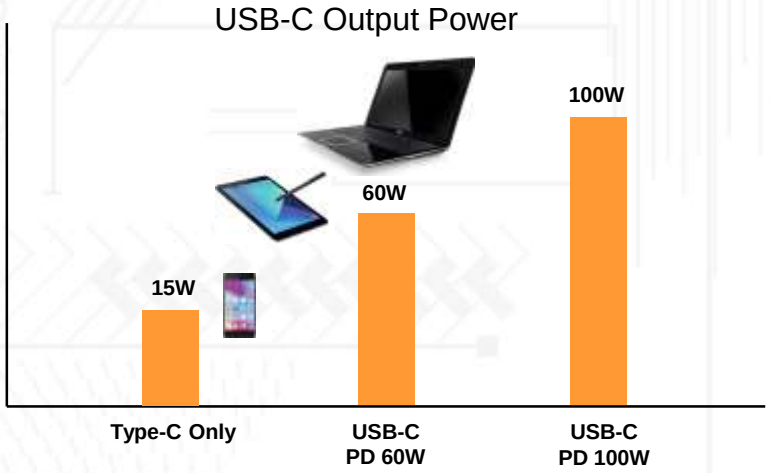
USB-C Auto Solutions

Q2 2019

USB Charging Trends in Automotive – Now & Future



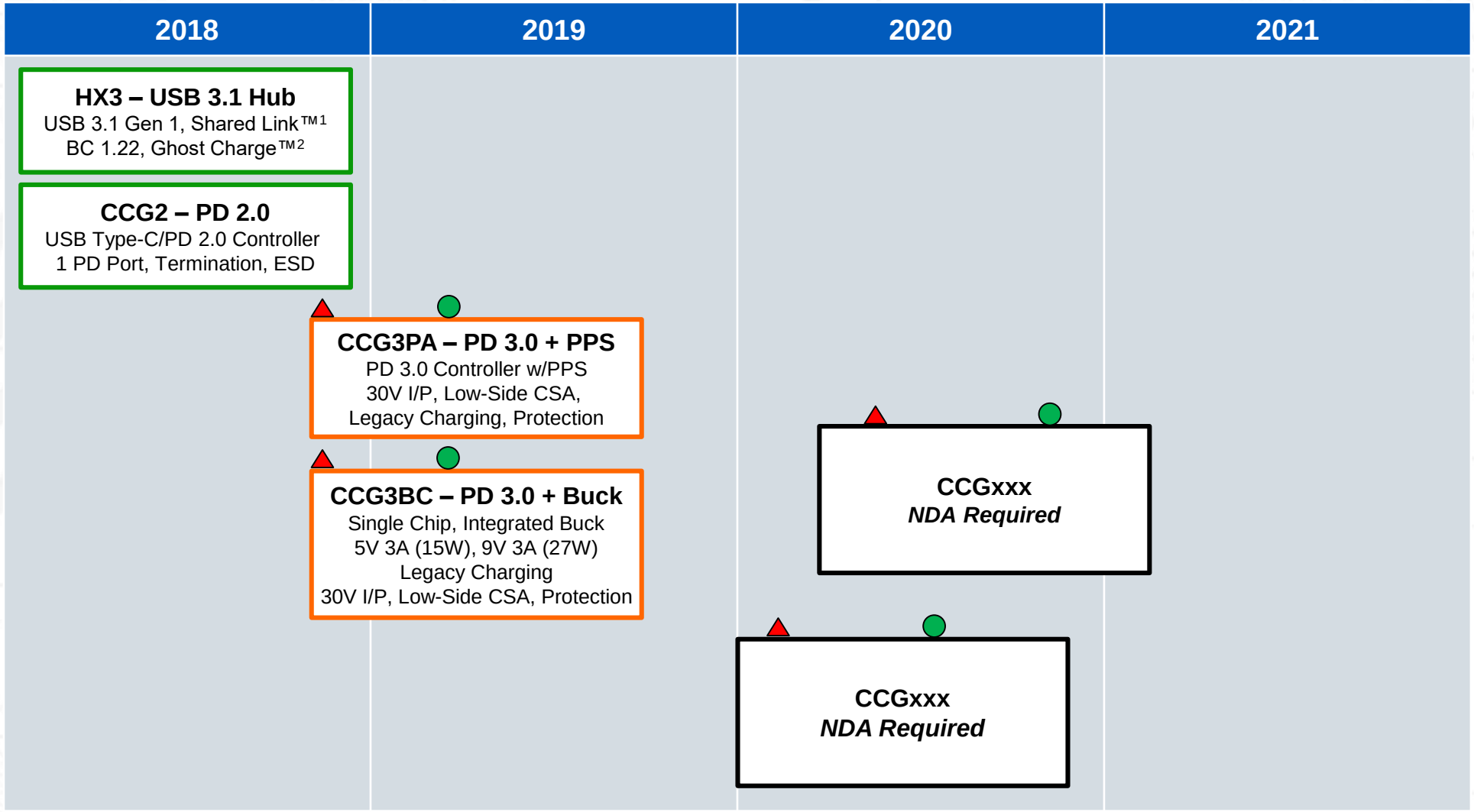
- **USB-A BC1.2 (CDP, DCP): Now**
  - Charging Downstream Port: 5V, 1.5A
  - Dedicated Charing Port: 5V, ~2A
- **USB-A Legacy Charging: Now**
  - Apple Charging: 5V, ~ 2.4A
  - Qualcomm's Quick Charge 3.0: up to 12V
  - Samsung AFC: up to 12V



- **USB Type-C: Now**
  - Type-C Only Charging: 5V, 3A
  - Optional: Legacy Charging (above)
- **USB Type-C PD: Future**
  - PD Charging: 15W ~ 100W (20V, 5A)
  - Qualcomm's Quick Charge 4.0
  - Optional: Legacy Charging (above)

CYPRESS EMBEDDED IN TOMORROW™

Cypress USB Auto Portfolio



[1] Simultaneous USB 2.0 and SuperSpeed traffic on the same port

[2] Enables USB charging without host connection

EZ-PD USB-C CCG3PA

CCG3PA = Type-C Controller Gen3 for Power Adapter

Add PD 3.0 and QC 4.0 to Your Charger Ports

CCG3PA: USB-C and Power Delivery Port Controller

Applications

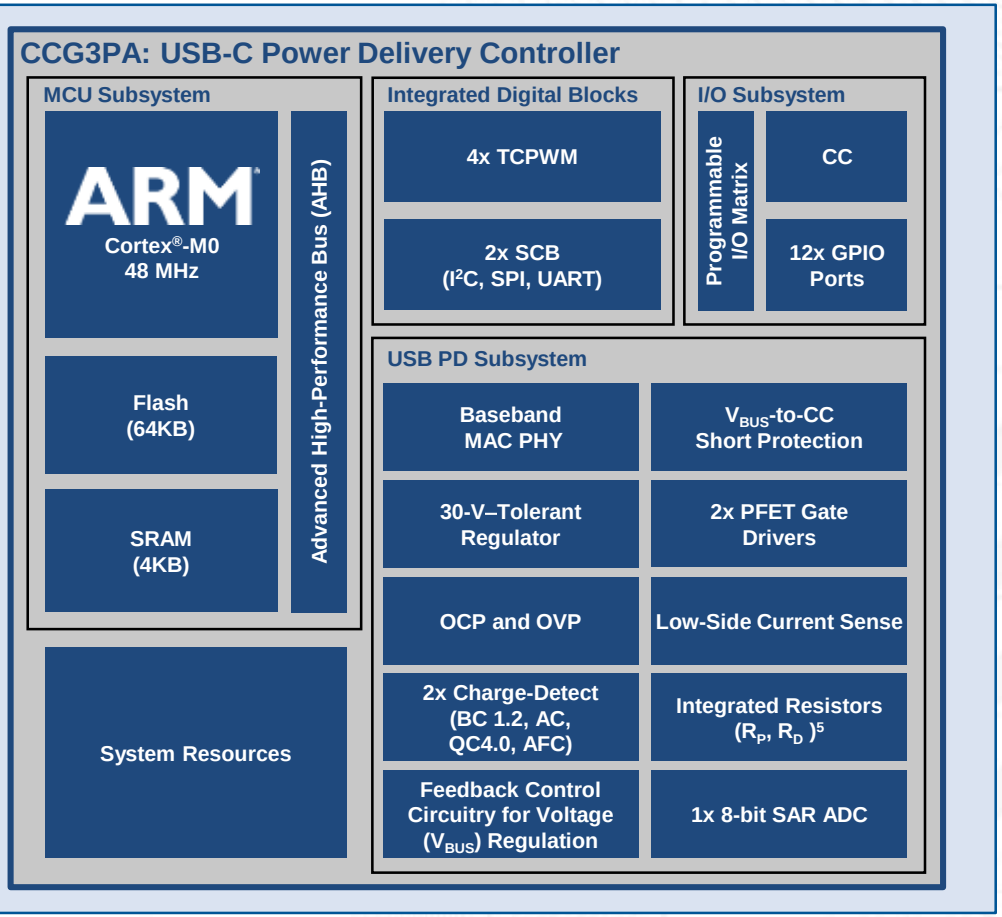
USB Type-C PD-based Automotive Chargers

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 µA with wake-on-CC
- **System-Level ESD on CC, Dp / Dn[4] and V_{BUS} Pins**
  - ±8-kV contact, ±15-kV Air Gap IEC61000-4-2 level 4C
- **Packages**
  - 24 QFN (Industrial), 24 QFN (Automotive) AEC-Q100 Grade-S

Collateral

Preliminary Datasheet: CCG3PA Datasheet



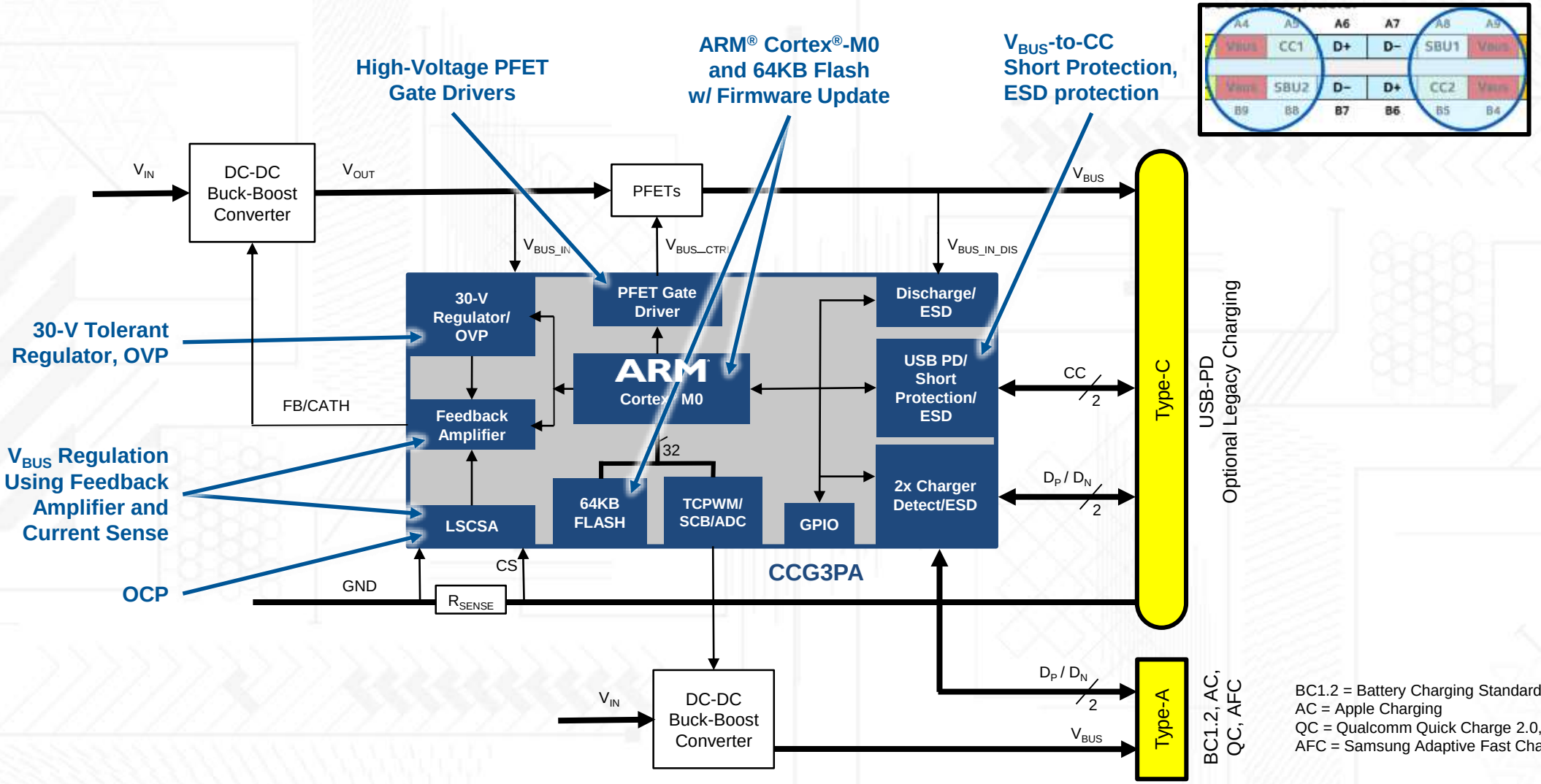
Availability

Production: Now

Samples: Noww (Auto) **Production:** Q1 2019 (Auto)

[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_P read as a DFP, R_D as a UFP

CCG3PA for Power Solutions



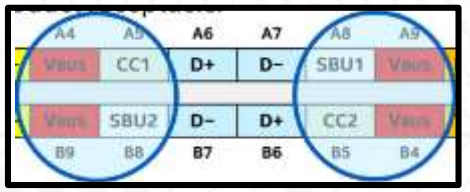
BC1.2 = Battery Charging Standard
AC = Apple Charging
QC = Qualcomm Quick Charge 2.0,3.0
AFC = Samsung Adaptive Fast Charge

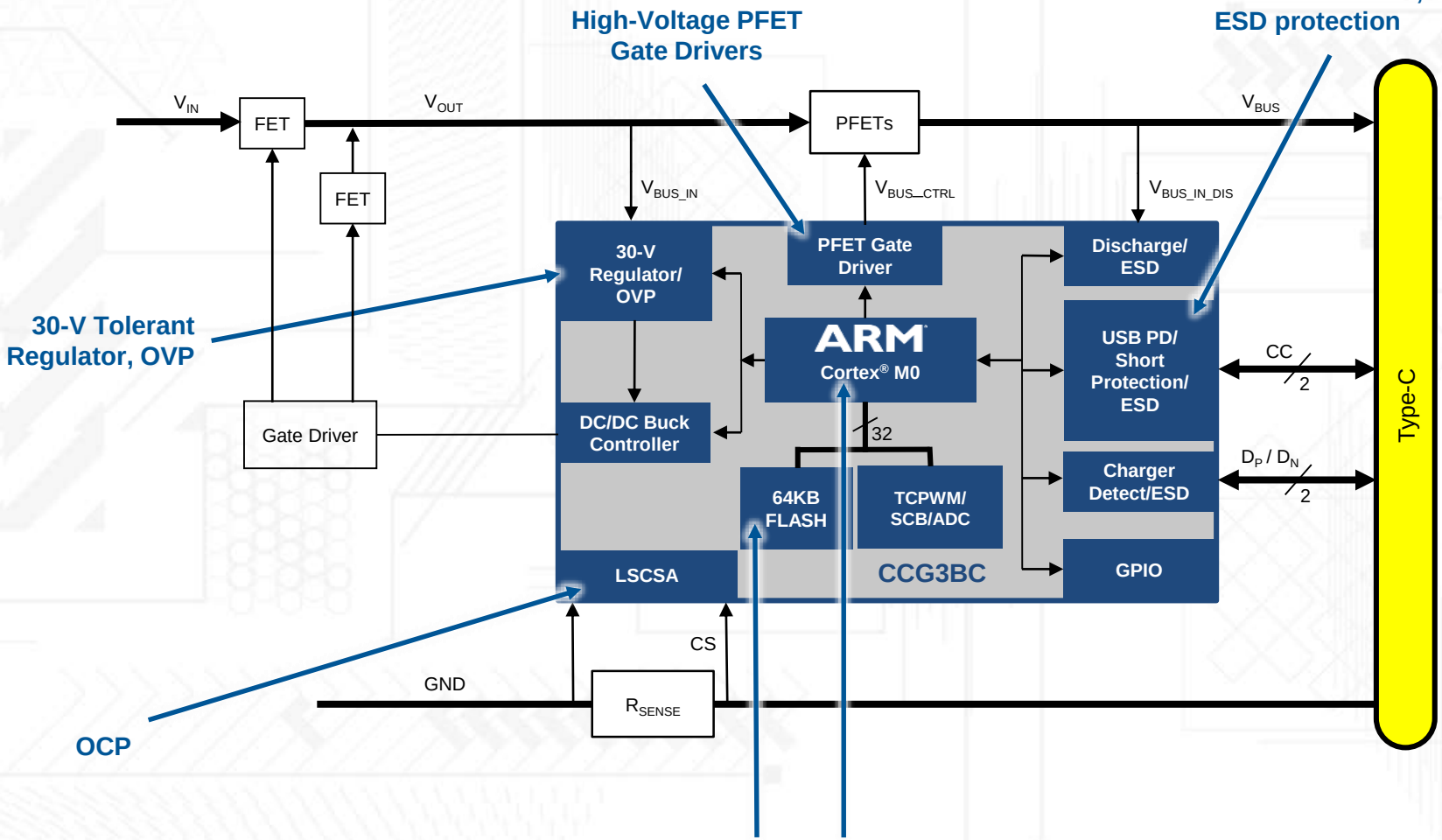
EZ-PD USB-C CCG3BC

CCG3BC = Type-C Controller Gen3 w/ Buck Converter

Buck Converter with PD 3.0 and Legacy Charging

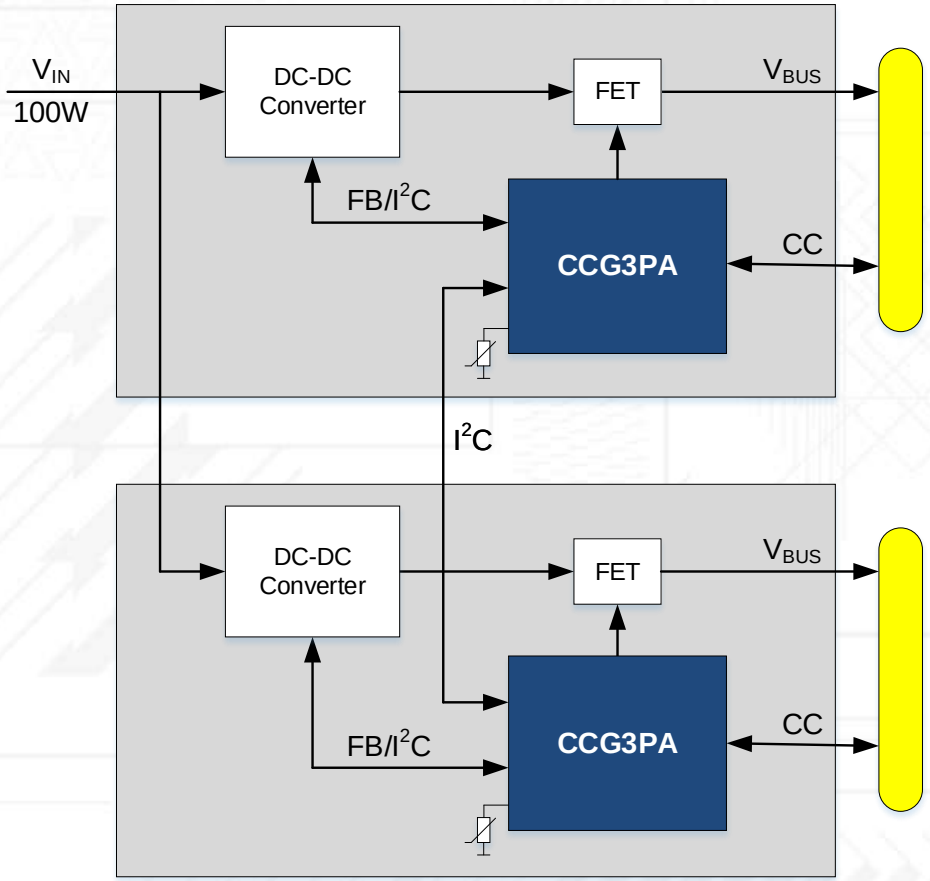
CCG3BC for Power Solutions

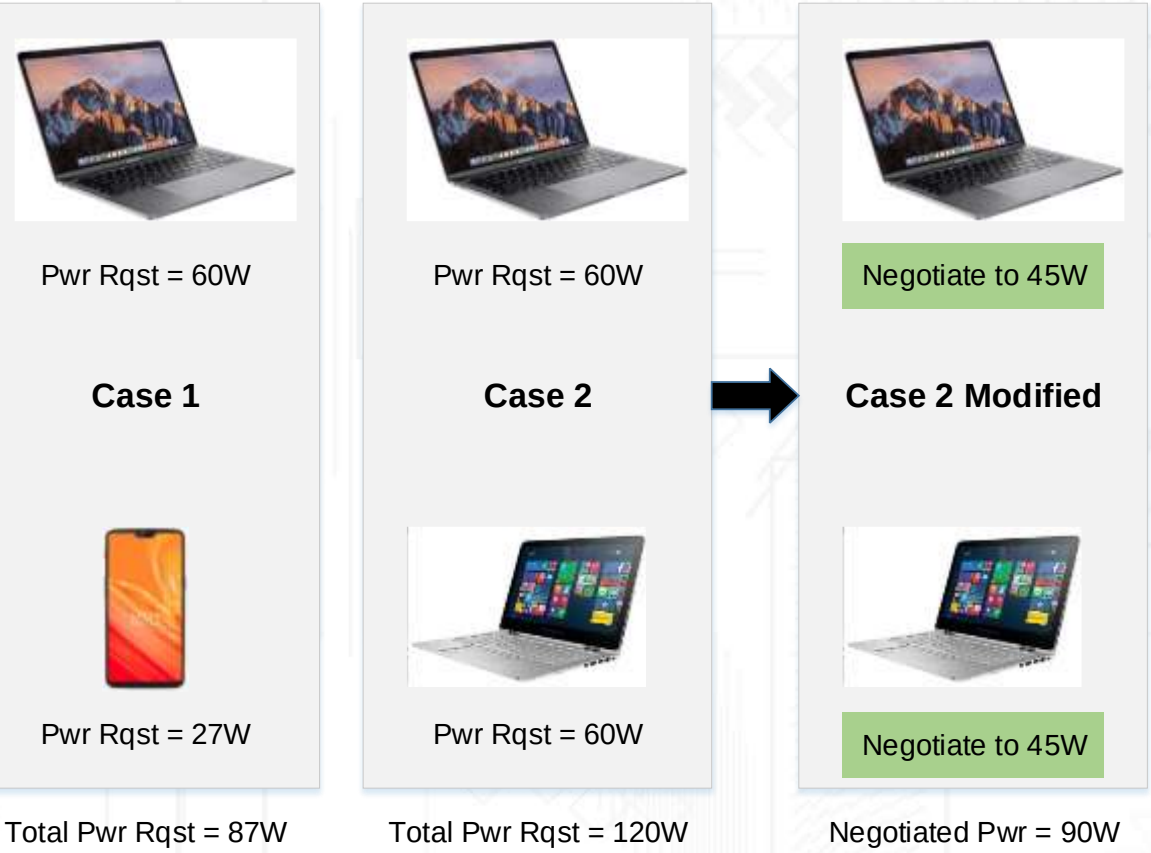




EZ-PD Features for Automotive Applications

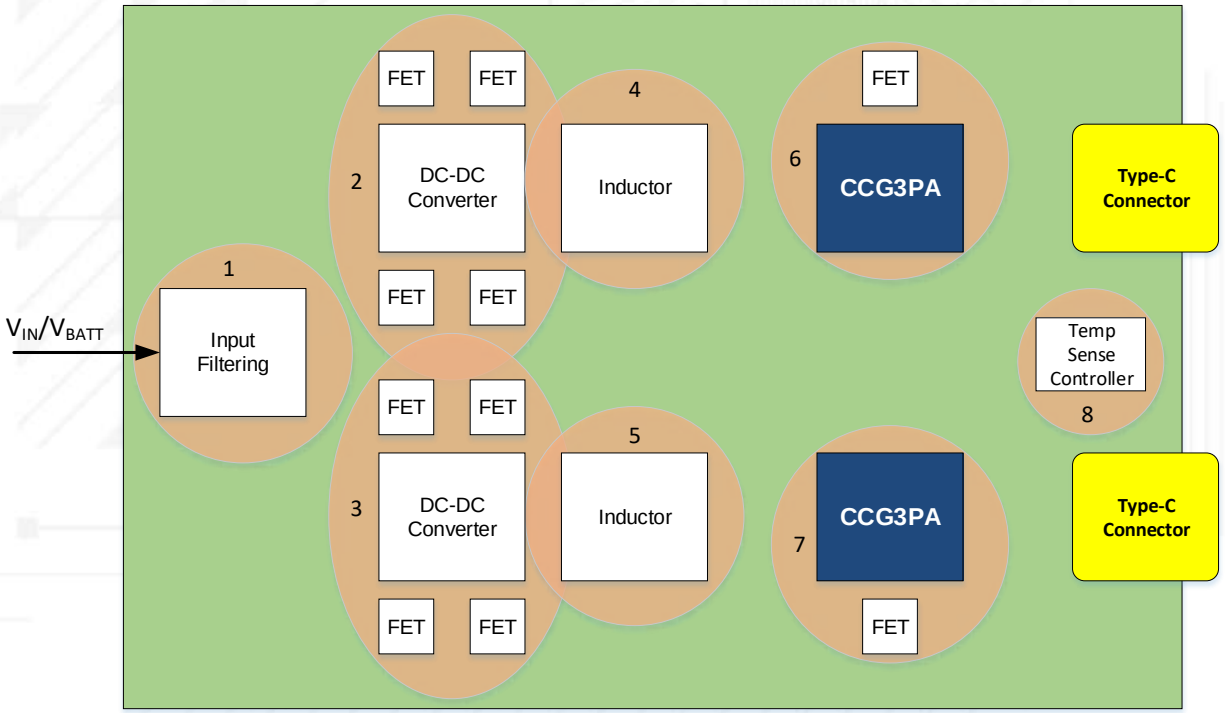
Dynamic Load-Sharing





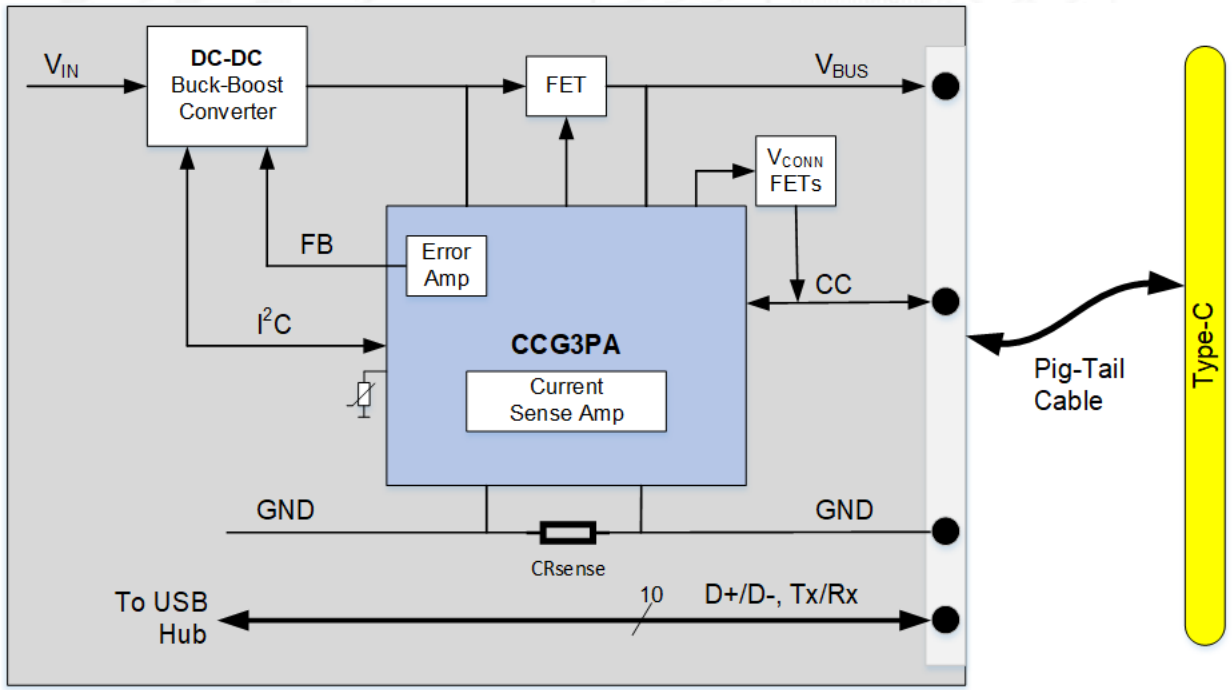
- Two CCG3PA devices are inter-connected over I^2C interface
- Power information shared between the two devices
- Source may request Sink's capabilities to determine the minimum power

Output Power Throttling



- **Temperature Sensing:**
  - **Measure Temperature Using:**
    - I^2C based Temperature Sense Controller
    - 4 NTC Thermistors (2 per CCG3PA)
      - Measure temp using CCG3PA's ADC
  - **Measure temp of Hot-spots on the PCB**
    - Zone 1 – Input filtering
    - Zone 2/3 – DC-DC Converter w/ FETs (if any)
    - Zone 4/5 – Inductor on V_{BUS} line
    - Zone 6/7 – PD controller and Power FET
    - Zone 8 – ambient temperature
  - **Control O/P Power:**
    - Reduce Power – when ambient temp is high
    - Go Min – 5V, 3A (15W) when hot
    - Shut Down when temp is critical
    - Configurable Temp and Power O/P Levels !!
- **V_{IN}/V_{BATT} measurement:**
  - Define Input Voltage Thresholds
  - Full O/P Power, if above Threshold
  - Reduce O/P Power (ex. 15W), if below Threshold

Cable Compensation – for Head Unit Application



- **USB PD has variable Voltages and Currents**
  - Voltages – 5V to 20V, Currents – 0 – 5A
  - Voltage Drop across the Cable Harness varies
  - Increase O/P of DC-DC Converter to meet the drop
- Current Sense Amplifier measures the O/P current
- Measure the output Voltage (V_{BUS})
- Modify the FB voltage based on these measurements, for O/P voltage compensation
- Create a look-up table with:
  - Step size for Current measurements (ex. 50 mA)
  - Impedance of the Cable Harness
  - FB correction value to compensate for the drop
  - This is done once at Design Time
- Interrupt is generated when current step is crossed, O/P voltage is measured and FB is corrected

USB PD and Programmable Power Supplies

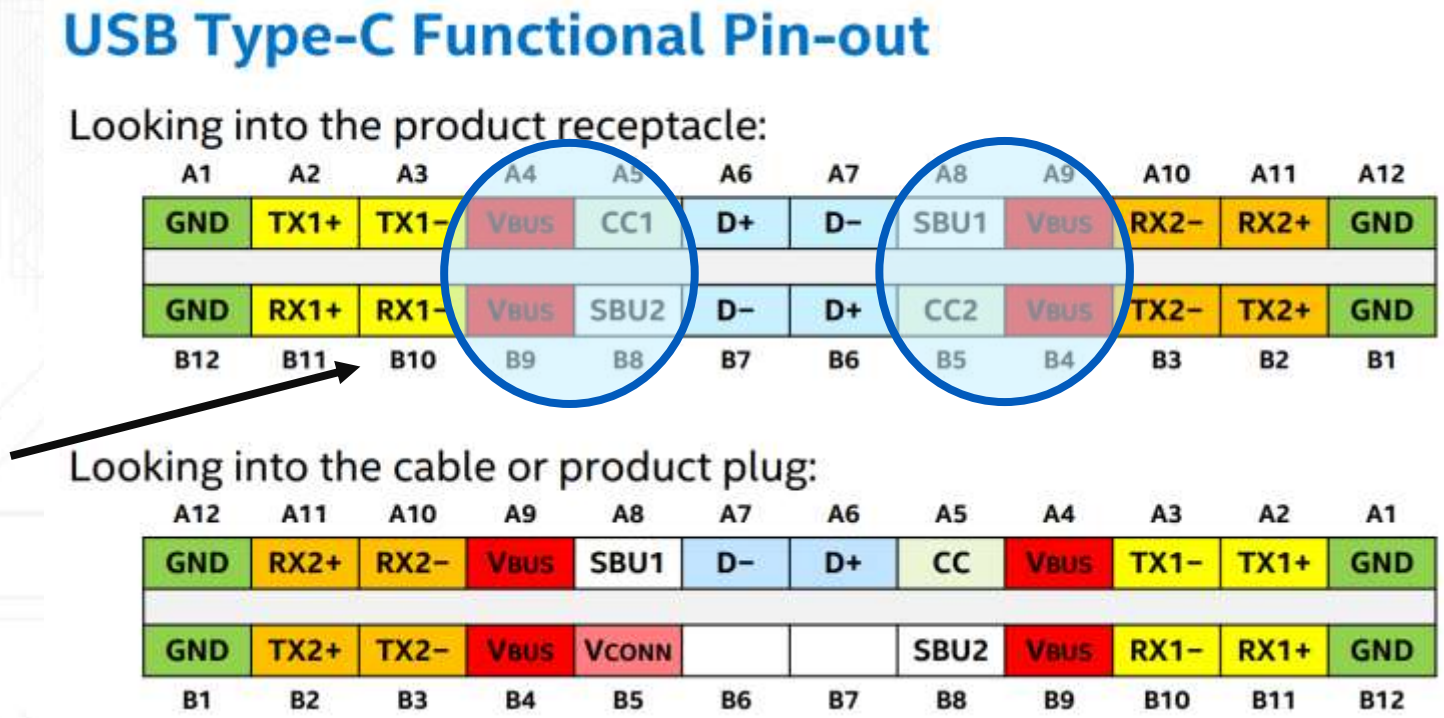
	5V Fixed	9V Fixed	15V Fixed	20V Fixed	5V Prog (3 – 6 V)	9V Prog (3 – 11 V)	15V Prog (3 – 16 V)	20V Prog (3 – 21 V)
With 3 A cables								
0 < PDP ≤ 15 W	PDP ÷ 5				PDP ÷ 5			
15 < PDP ≤ 27 W	3 A	PDP ÷ 9			3 A	PDP ÷ 9		
27 < PDP ≤ 45 W	3 A	3 A	PDP ÷ 15		3 A	3 A	PDP ÷ 15	
45 < PDP ≤ 60 W	3 A	3 A	3 A	PDP ÷ 20	3 A	3 A	3 A	PDP ÷ 20
Requires 5 A cables								
60 < PDP ≤ 100 W	3 A	3 A	3 A	PDP ÷ 20	3 A	3 A	3 A	PDP ÷ 20

Fixed Voltage Source *Programmable Power Supply (PPS)*

- PPS is an optional feature in the USB PD 3.0 spec.
- Devices supporting PPS will request a variable voltage (20mV steps) and current (50mA steps) from the Power Source, for an efficient battery charging
- In Automotive Applications, this feature will eliminate Cable Compensation
- Mobile devices will support PPS by 2020; we should enable customers with a futuristic design

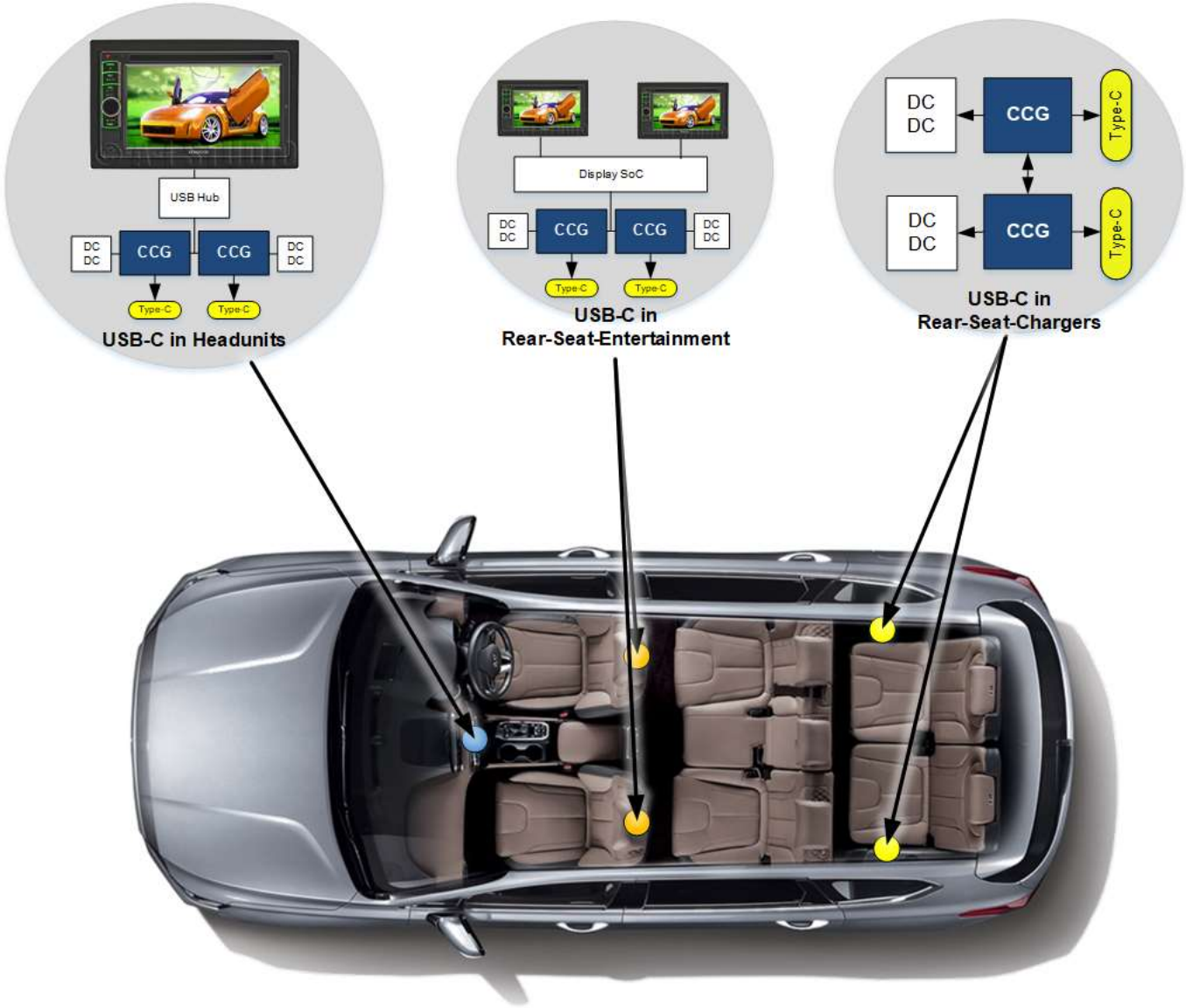
USB Type-C Connector and Short Protection (CCG3PA)

- Max voltage on V_{BUS} = 20V
- Proximity of CC and V_{BUS} pins increases the possibility of short due to poor quality cables
- A short between CC and V_{BUS} will destroy CCG3PA, disabling the port
- Protecting CC pins requires additional components: increasing BOM and PCB area
- <u>CCG3PA Integrates CC to V_{BUS} short-circuit protection – eliminates the need for external components</u>



USB-C in Automotive Applications

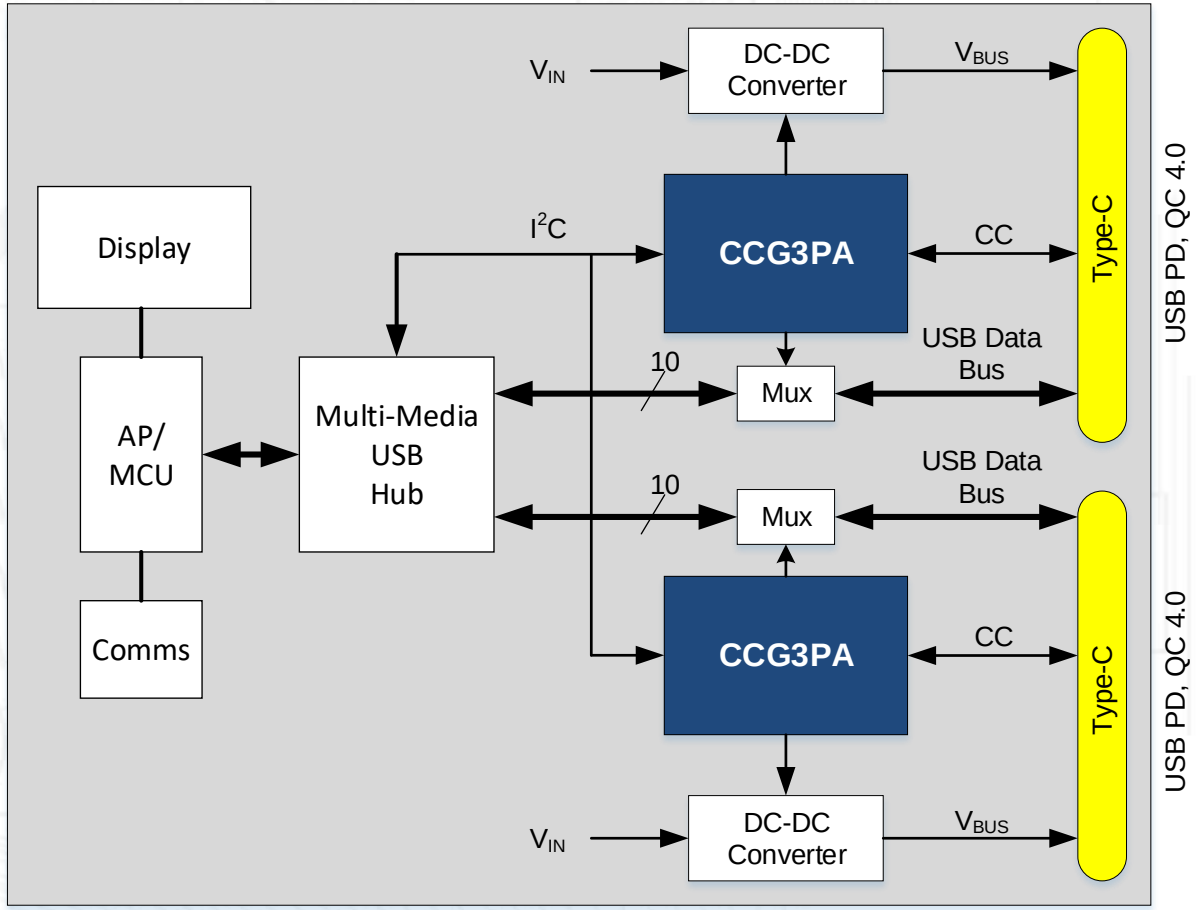
USB-C and Power Delivery in Automotive



- Head Units:
  - Interface to multi-Media Hubs
  - Cable compensation for pig-tail cables

- **Programmable PD Controller:**
  - Highly Integrated Standalone Controller
  - Single-chip solution for Type-C and Type-A
  - Dynamic Load Sharing between ports
  - Cable Compensation
  - Temperature-based power throttling
  - Interface to Multi-Media USB Hubs
  - Alternate Mode support for rear seat systems
  - Support for Legacy Charging Standards
  - Flash upgradability

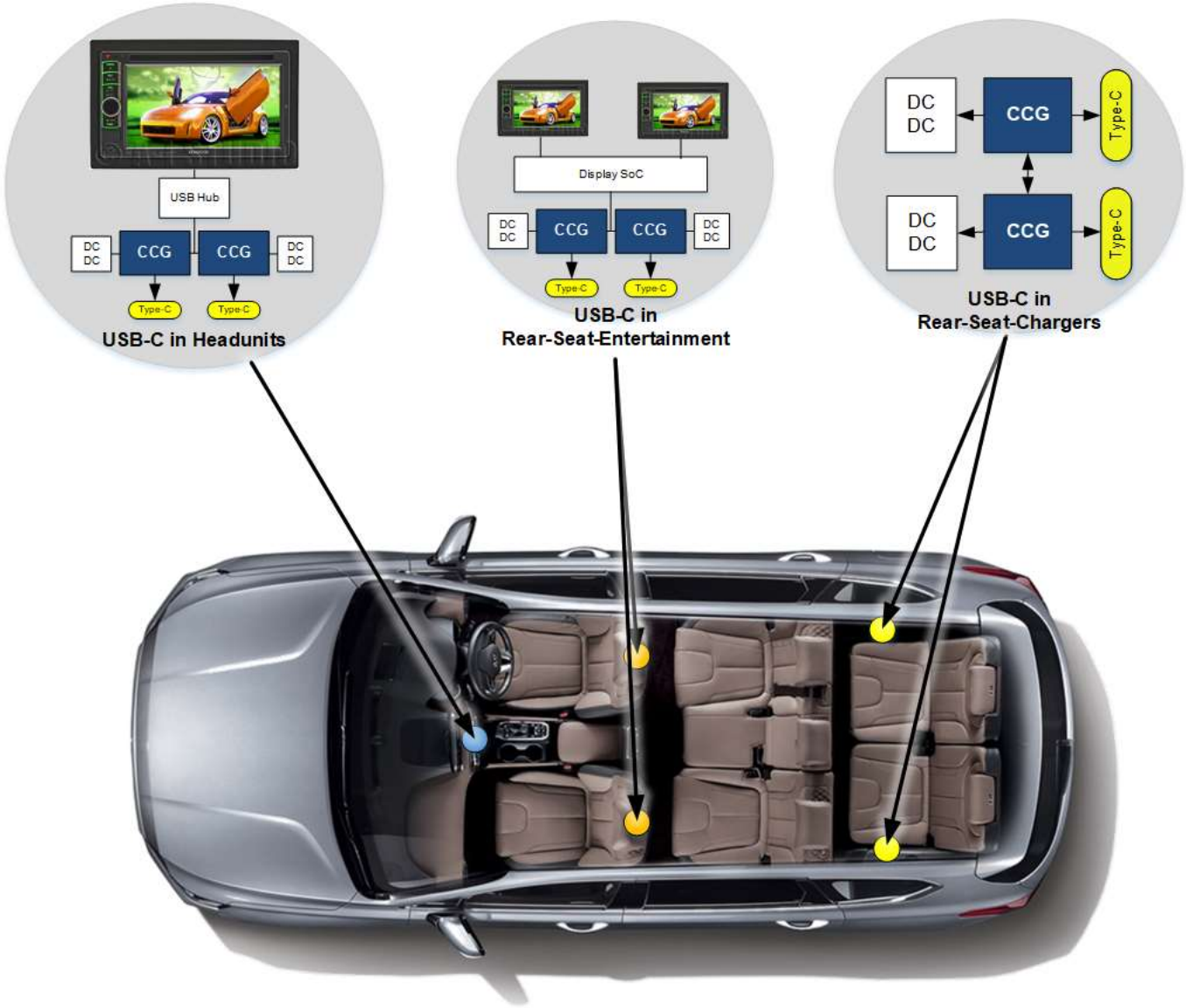
Head Unit: USB-C PD Features



Features:

- **PD 3.0 with PPS**
  - BC 1.2, QC 4.0, Apple VDMs
- **Cable Compensation:**
  - Compensate for voltage drop over Cable
- **Dynamic Load Sharing:**
  - Inter-Connect Two CCG3PA with I^2C interface
  - Power information shared between the two devices
- **Interface to DC-DC Converters:**
  - Analog Control (PPS), I^2C, PWM, GPIO
- **Interface to USB Hub:**
  - I^2C interface to USB Hub
  - Share USB-C Port status
- **FW Upgradability:**
  - Future proof design with FW Upgradability
  - Over I^2C Interface
- **Output Power Throttling:**
  - Temperature sensing with thermistors on CCG3PA
  - V_{IN} based output Power Throttling
- **Protection:**
  - V_{BUS} to CC pins SCP up to 30V
  - OCP/OVP/OTP/SCP

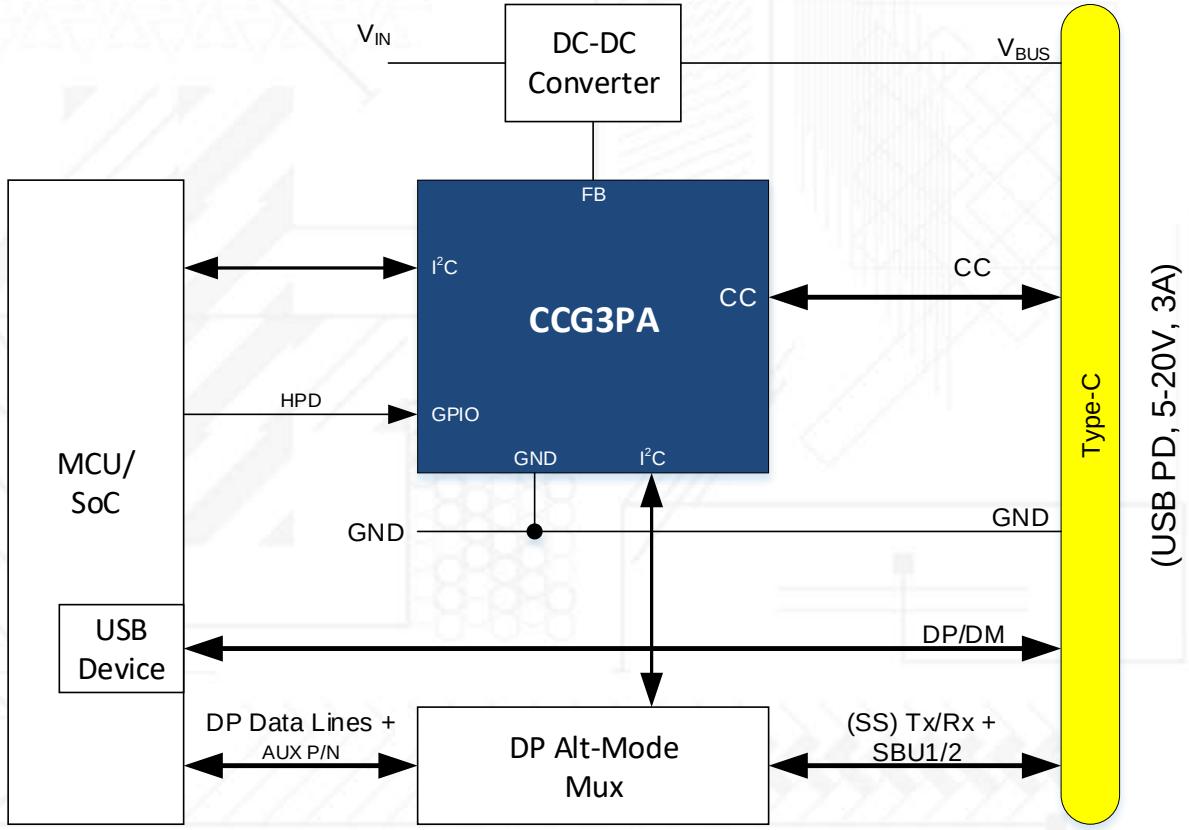
USB-C and Power Delivery in Automotive



- Rear-Seat Entertainment Systems:
  - Support Alternate Mode functionality
  - Implement USB Billboard Device Class

- **Programmable PD Controller:**
  - Highly Integrated Standalone Controller
  - Single-chip solution for Type-C and Type-A
  - Dynamic Load Sharing between ports
  - Cable Compensation
  - Temperature-based power throttling
  - Interface to Multi-Media USB Hubs
  - Alternate Mode support for rear seat systems
  - Support for Legacy Charging Standards
  - Flash upgradability

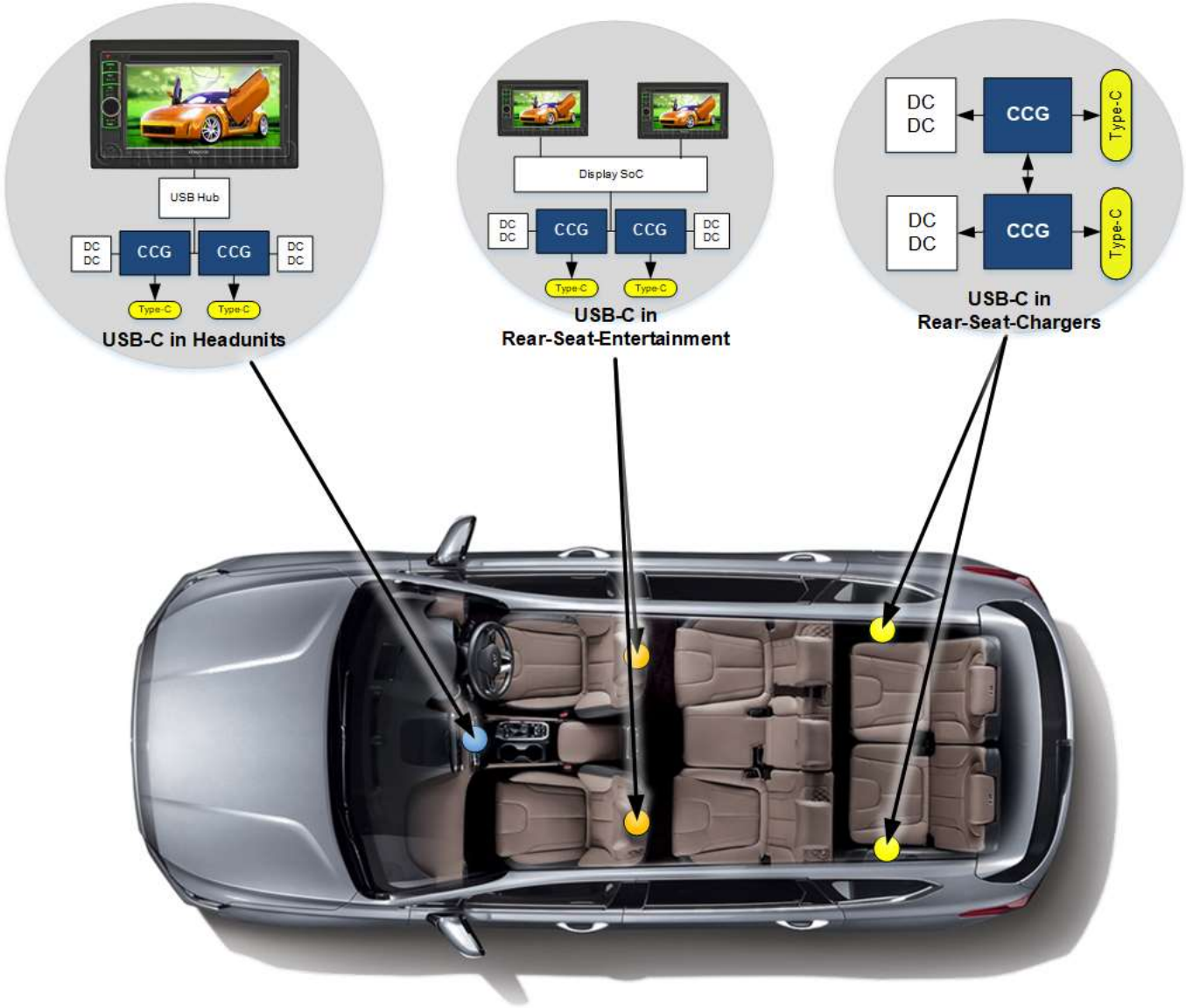
Rear-Seat Entertainment: USB-C PD Features



Features:

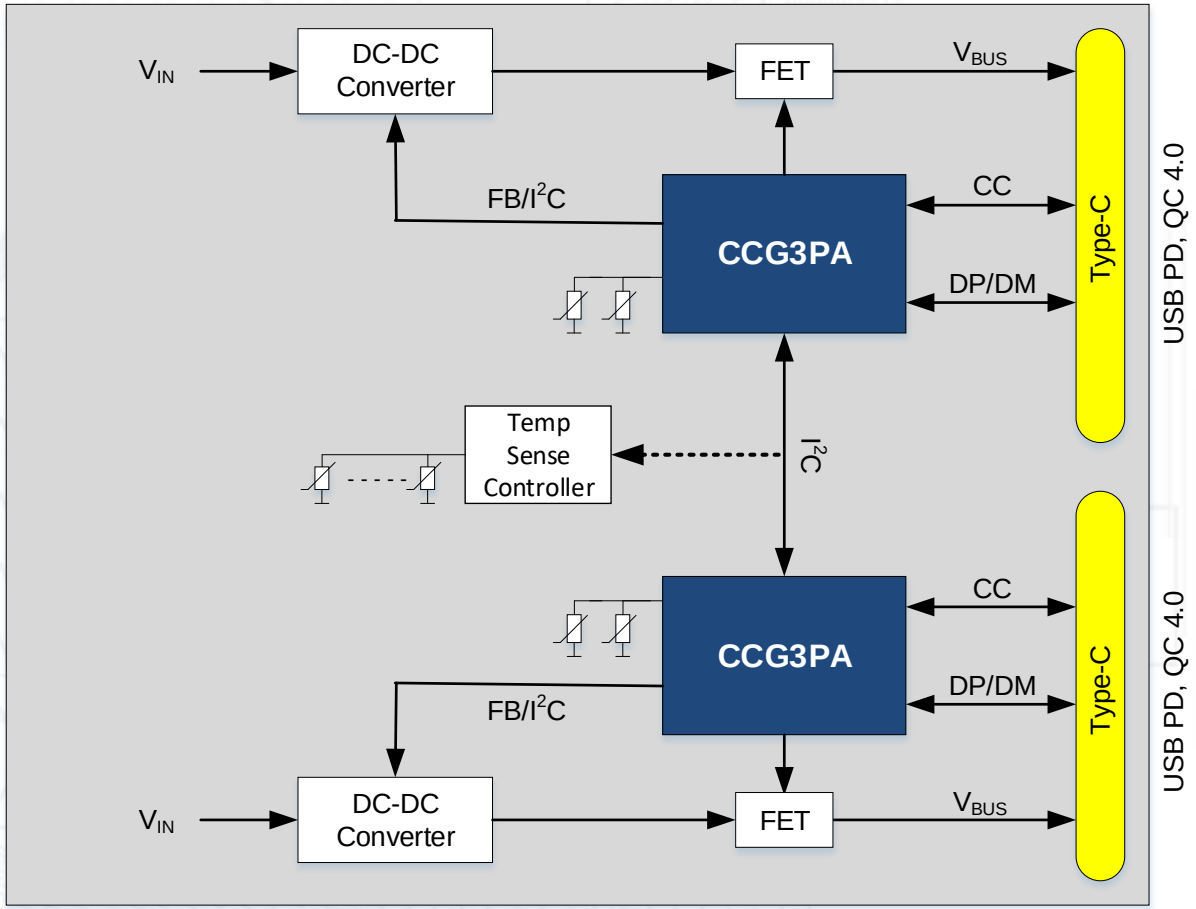
- **PD 3.0 with PPS**
  - BC 1.2 (CDP), QC 4.0, Apple VDMs
- **Alternate Mode Support**
  - USB Billboard Device Class, for error reporting
  - Generate HPD Signaling
  - Control DP Alt-Mode Mux
- **Dynamic Load Sharing:**
  - Inter-Connect Two CCG3 with I^2C interface
  - Power information shared between the two devices
- **Interface to DC-DC Converters:**
  - Analog Control (PPS), PWM, I^2C, GPIO
- **FW Upgradability:**
  - Future proof design with FW Upgradability
  - Over I^2C Interface
- **Output Power Throttling:**
  - Temperature sensing with thermistors on CCG3PA
  - V_{IN} based output Power Throttling
- **Protection:**
  - OCP/OVP/SCP

USB-C and Power Delivery in Automotive



- Rear-Seat Chargers:
  - Standalone Operation
  - Load-Sharing and Thermal Sensing
- **Programmable PD Controller:**
  - Highly Integrated Standalone Controller
  - Single-chip solution for Type-C and Type-A
  - Dynamic Load Sharing between ports
  - Cable Compensation
  - Temperature-based power throttling
  - Interface to Multi-Media USB Hubs
  - Alternate Mode support for rear seat systems
  - Support for Legacy Charging Standards
  - Flash upgradability

Rear-Seat Chargers: USB-C PD Features



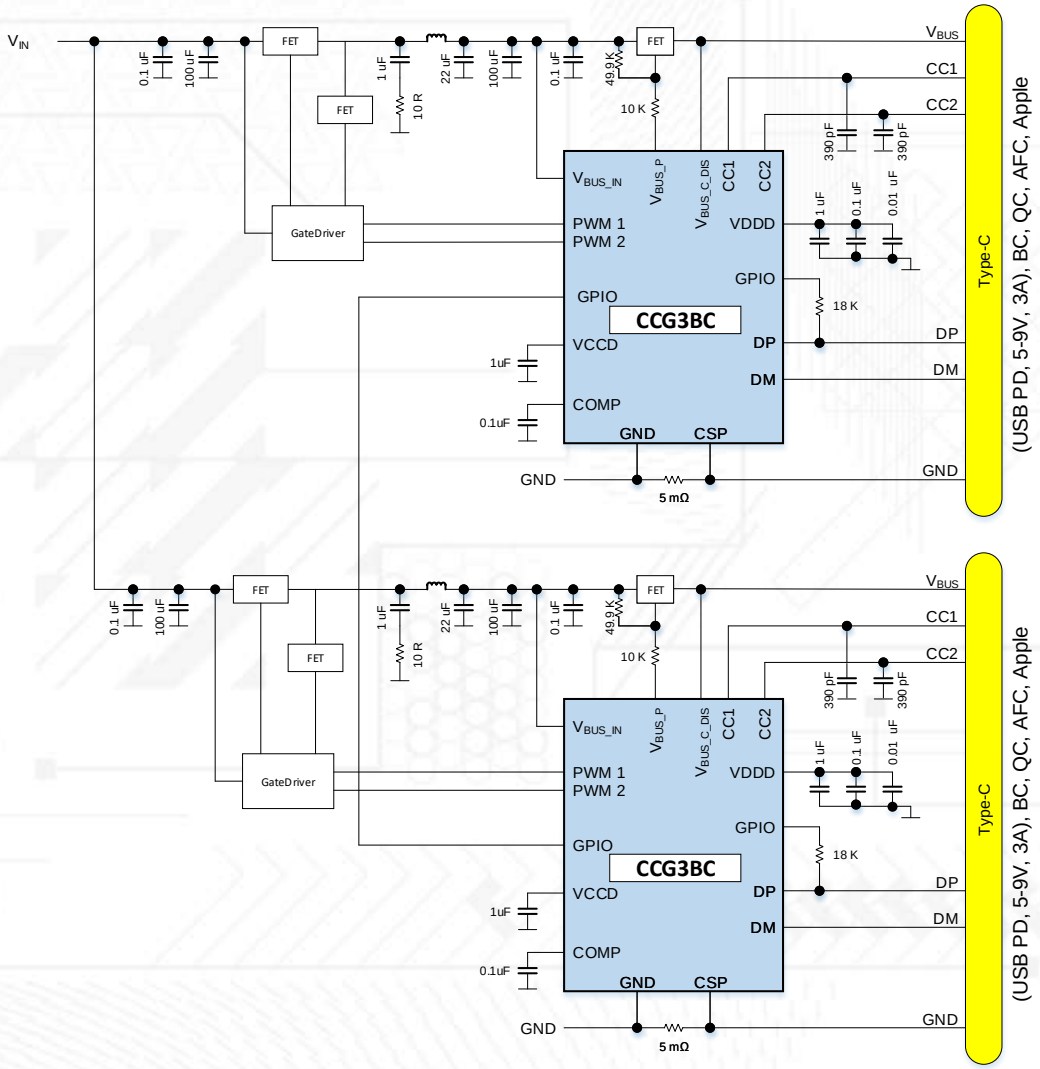
Features:

- **PD 3.0 with PPS and Legacy Charging**
  - BC 1.2, QC (2.0, 3.0, 4.0+), Apple, Samsung AFC
- **Dynamic Load Sharing:**
  - Inter-Connect Two CCG3PA with I²C interface
  - Power information shared between the two devices
- **Interface to DC-DC Converters:**
  - Analog Control (PPS), I²C, PWM, GPIO
- **FW Upgradability:**
  - Future proof design with FW Upgradability
  - Over CC pins
- **Output Power Throttling:**
  - Temperature sensing with thermistors on CCG3PA
  - (or) Use I²C based Temp Sense Controller
  - V_{IN} based output Power Throttling
- **Protection:**
  - V_{BUS} to CC pins SCP up to 30V
  - OCP/OVP/OTP/SCP

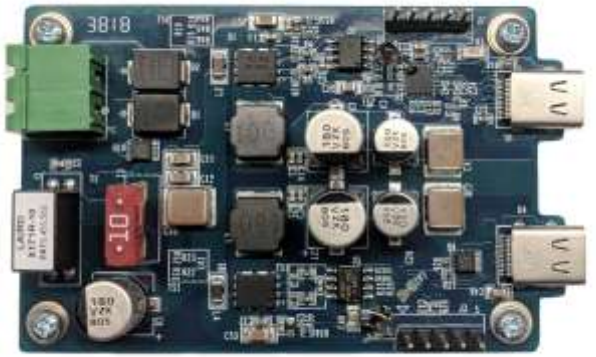
USB-C Reference Designs

15/27W, 60W and 100W – Charge Only Ports

2x 27W USB-C PD Ports, with Integrated Buck Converter



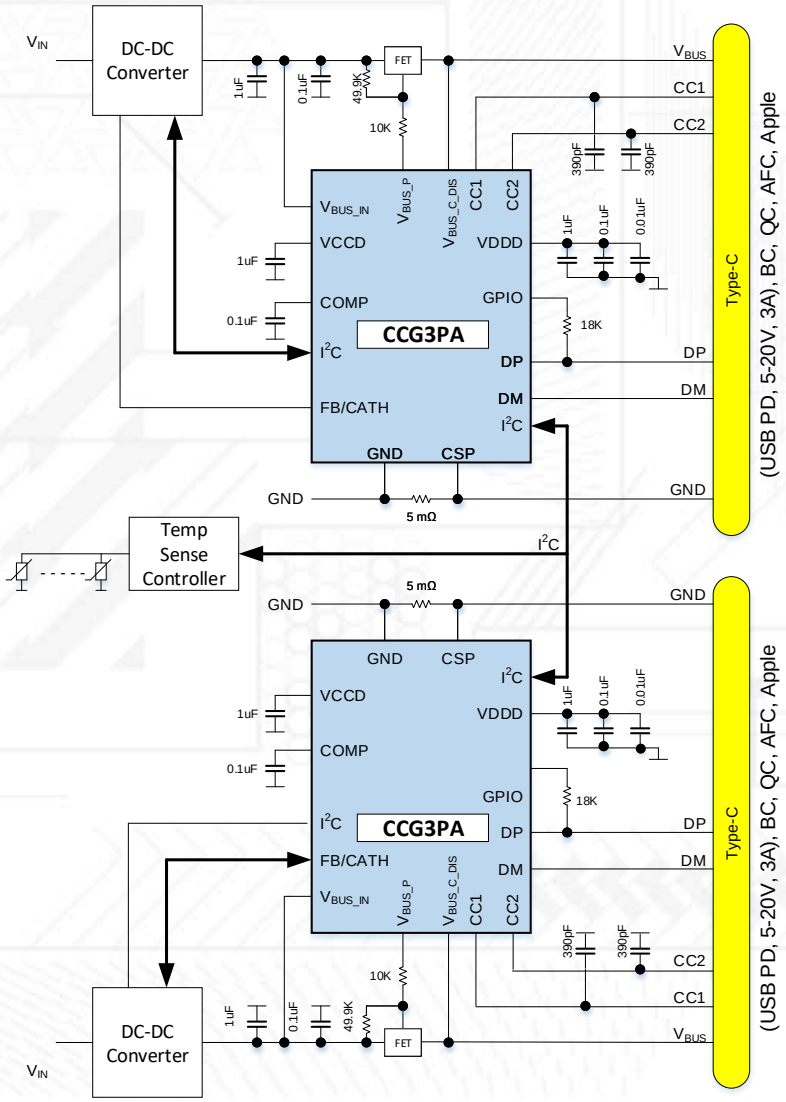
- **PD 3.0 with Legacy Charging**
- **PD Controller with DC-DC Buck Converter**
  - External power NFETs and Gate Drivers
  - PWM Switching Frequency up to 600 kHz (configurable)
- **USB-PD and Legacy Charging on Type-C Port:**
  - 5V/3A and 9V/3A PD Profiles
  - Legacy Charging (optional) – BC, AC, QC, AFC



Top Side

Bottom Side

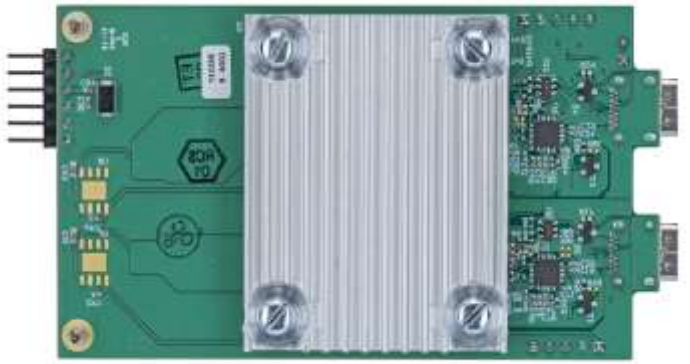
2x 60W USB-C PD Charge Only Ports



- **PD 3.0 with PPS**
- **USB-PD Charging on Type-C Port:**
  - 60W PD and QC 4.0
  - Optional Legacy Charging (BC/AC/QC/AFC) support

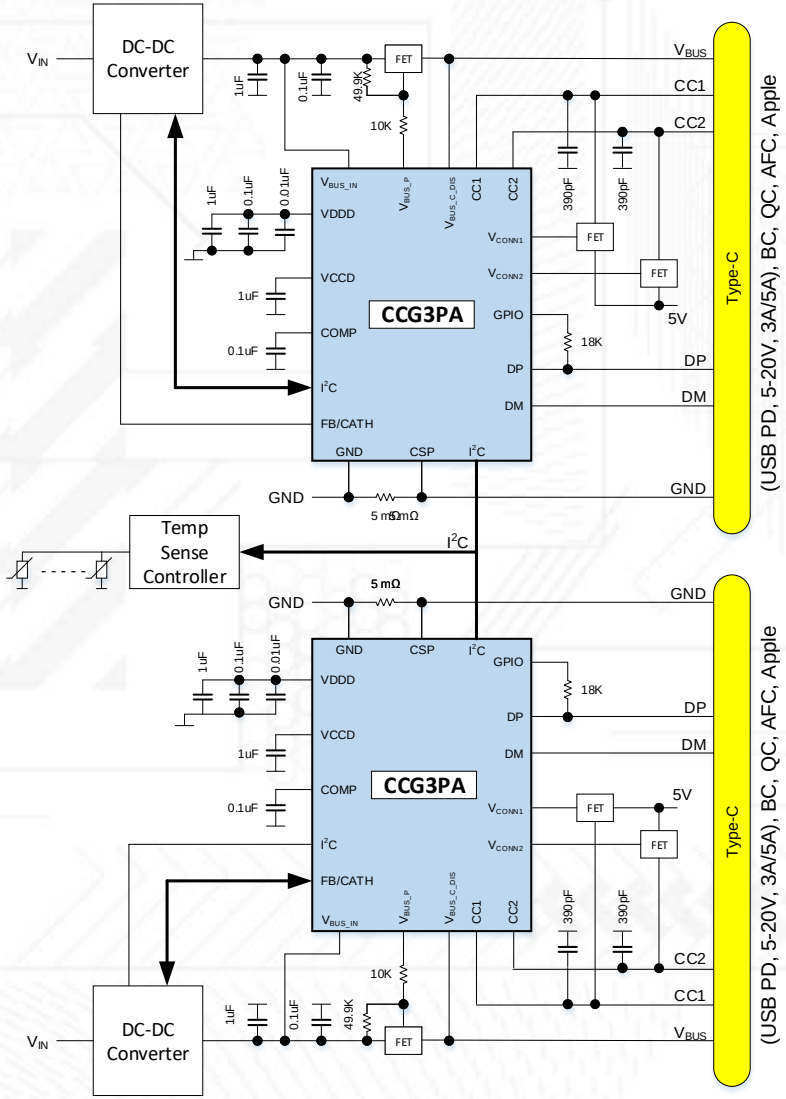
Top Side

Bottom Side



CYPRESS EMBEDDED IN TOMORROW™

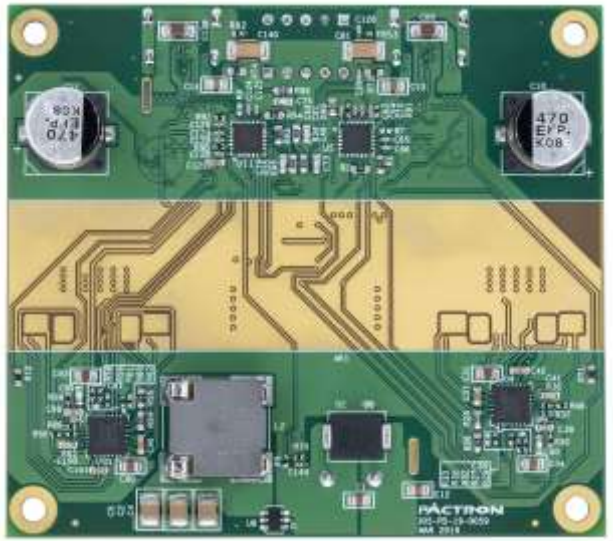
2x 100W USB-C PD Charge Only Ports



- **PD 3.0 with PPS**
- **USB-PD Charging on Type-C Port:**
  - 100W PD and QC 4.0
  - EMCA cable identification and negotiation
  - Optional Legacy Charging (BC/AC/QC/AFC) support

Top Side

Bottom Side



CYPRESS EMBEDDED IN TOMORROW™

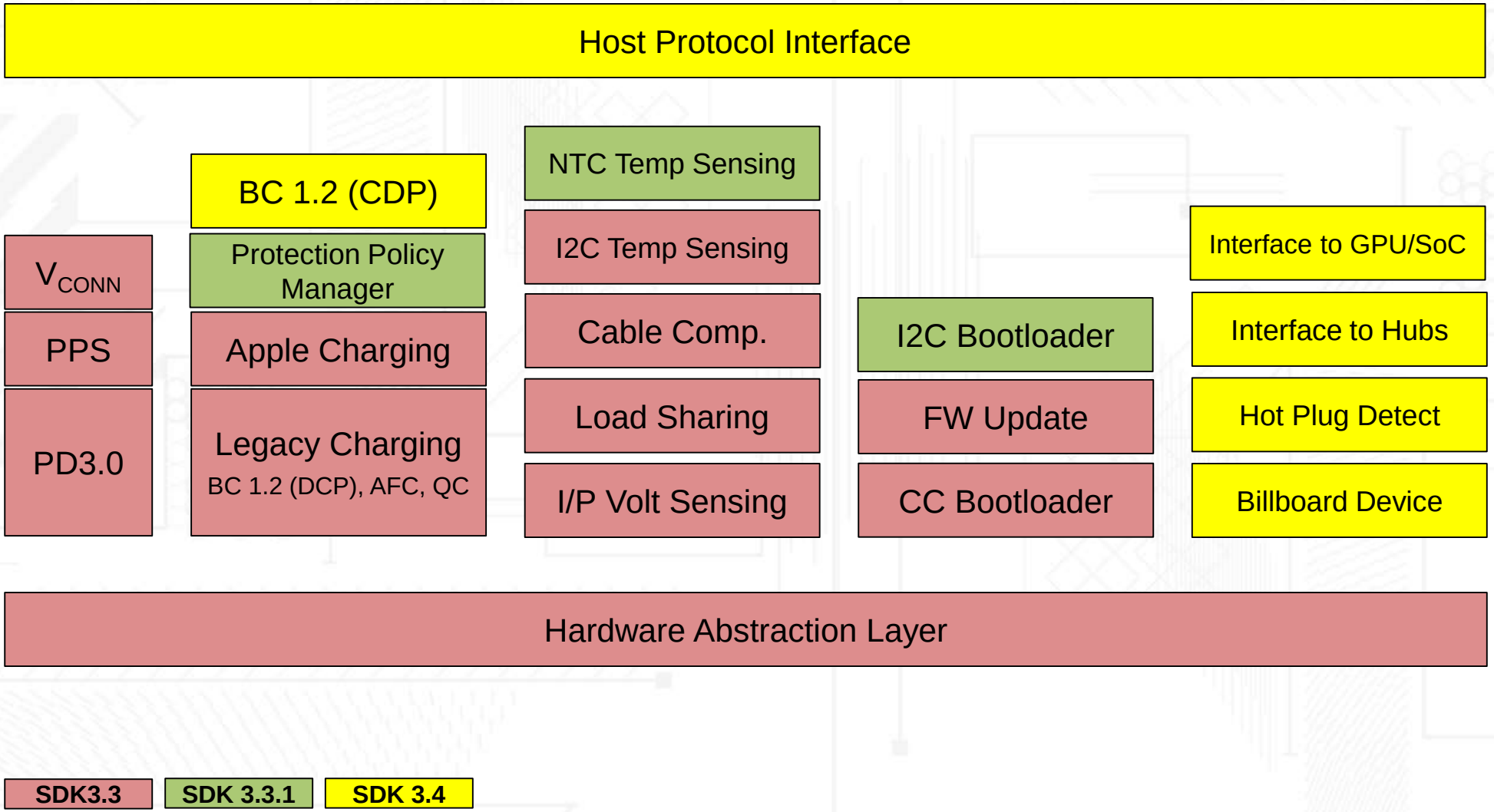
CCG3PA-Auto: MPNs, Features and Target Use-Cases

<table>
<tr><th rowspan="2">MPN</th><th colspan="2">Features</th><th rowspan="2">Applications</th></tr>
<tr><th>Common Features</th><th>Differences</th></tr>
<tr><td>CYPD3195-24LDXS (CCG3PA)</td><td rowspan="4">• PD 3.0 w/ PPS
• Support 1x Type-C and 1x Type-A ports
• Works with external DC-DC Buck-Boost Converter
• Legacy Charging
(BC1.2, Apple Charging, QC, Samsung AFC)
• Input Voltage Detection
• Interface 2x NTC Thermistors to GPIOs
(for Temperature sensing)
• Cable Compensation
• I²C Interface to Ext. Processor
• V_{CONN} FET control
• 24-QFN, -40° to +105°C, AEC-Q100
• Dynamic Load-Sharing
• O/P Power Control (Temperature and I/P Voltage)
• Host Protocol Interface[1]</td><td>• I²C Bootloader
• FW Update over I²C bus (from external Hub or MCU)</td><td rowspan="2">• Head Units
• Rear Seat Charge only ports</td></tr>
<tr><td>CYPD3196-24LDXS (CCG3PA)</td><td>• CC Bootloader
• FW Update over CC pins[2]</td></tr>
<tr><td>CYPD3193-24LDXS (CCG3PA)</td><td>• I²C Bootloader
• FW Update over I²C bus (from external MCU)
• Alternate-Mode Support (control external mux)
• USB Bill-Board Device Class Support[3]</td><td rowspan="2">• Rear Seat Entertainment System</td></tr>
<tr><td>CYPD3194-24LDXS (CCG3PA)</td><td>• CC Bootloader
• FW Update over CC pins[2]
• Alternate-Mode Support (control external mux)
• USB Bill-Board Device Class Support[3]</td></tr>
<tr><td>CYPD3197-24LDXS (CCG3BC)</td><td rowspan="2">• PD 3.0 supporting 15W (5V/3A) & 27W (9V/3A)
• Integrated DC-DC Buck Converter (100 kHz – 600 kHz)
• Legacy Charging
(BC1.2, Apple Charging, QC, Samsung AFC)
• Input Voltage Detection
• Interface 2x NTC Thermistors to GPIOs
(for Temperature sensing)
• I²C Interface to Ext. Processor
• V_{CONN} FET control
• 24-QFN, -40° to +105°C, AEC-Q100
• O/P Power Control (Temperature and I/P Voltage)
• Host Protocol Interface[1]</td><td>• I²C Bootloader
• FW Update over I²C bus (from external Hub or MCU)</td><td rowspan="2">• Head Units
• Rear Seat Charge only ports</td></tr>
<tr><td>CYPD3198-24LDXS (CCG3BC)</td><td>• CC Bootloader
• FW Update over CC pins
(from PC connected to Type-C port)</td></tr>
<tr><td colspan="4">Use CYPD3175-24LQXQ (extended industrial temp part) for proto-builds. QFN PCB footprint is same for Auto Part versions listed above</td></tr>
</table>

[1] Interface exchange w/ embedded system controller [2] FW downloaded from a PC connected to the Type-C port [3] Source code will be provided to execute on external USB Device

EZ-PD Auto SDK

EZ-PD SDK Building Blocks




CYPRESS®
EMBEDDED IN TOMORROW™

APPENDIX

EZ-PD BCR Product Selector Guide

Part Number	Application	Termination Resistor	Role	VBUS-CC Short Protection	OVC OCP	30 °C-Tolerant LDO	Package
CYPD3177-24LQXQ	BCR	R_d[1], $R_{d\text{-}db}$[2]	UFP	Yes	Yes	Yes	24-QFN

Part Numbering Decoder

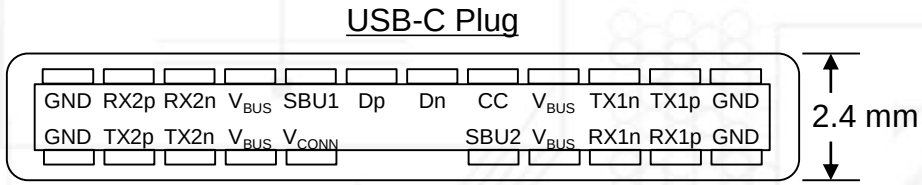
CY PD X X XX – XX XX X X X

- T = Tape and Reel
- Temperature Range: Q = Extended Industrial (-40 °C to 105 °C)
- Lead: X = Lead-Free
- Package Type: LQ = QFN
- Number of Pins in the Package
- Application and Feature Combination Designation
- Number of Type-C Ports: 1 = 1 Port
- Product Type: 2 = Second Generation, 3 = Third Generation
- Marketing Code: PD = Power Delivery Product Family
- Company ID: CY = Cypress

[1] Termination resistor denoting an upstream facing port (UFP)
[2] Termination resistor denoting a UFP supporting Dead Battery

Glossary

- **USB Power Delivery (USB-PD, Power Delivery, PD, PD 3.0)**
  - A new USB standard that increases power delivery over V_{BUS} from 7.5 W to 100 W
  - Both USB hosts (e.g., PCs) and USB devices (e.g., hard disk drives) can act as either a provider[1] (DFP – Downstream Facing Port) or a consumer[2] (UFP – Upstream Facing Port) of power
- **USB-C (USB Type-C, Type-C)**
  - A new standard with a slimmer and reversible USB plug, a reversible cable, multiple protocol support, and 100-W PD



- **DisplayPort**
  - A digital display interface standard developed by the Video Electronic Standards Association (VESA)
  - Used primarily to connect a video source to a display, such as a PC to a monitor
- **HDMI**
  - A digital display interface standard developed and licensed by HDMI Licensing, LLC
  - Used primarily to connect a consumer electronics to a display, such as a game console to a TV
- **Thunderbolt**
  - An interface jointly defined by Intel and Apple that connects peripherals to a computer
  - Uses the same connector as USB-C

[1] Provider: A Type-C port that sources power over V_{BUS}

[2] Consumer: A Type-C port that sinks power from V_{BUS}