AVNET SILICA

FOR ENERGY EFFICIENT INNOVATIONS

THINK ON.

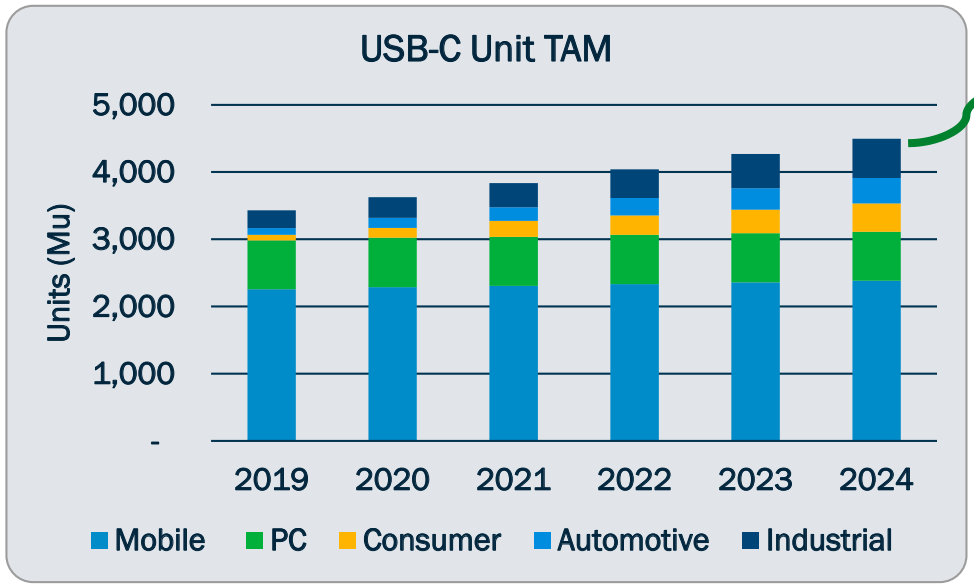
USB-C & PD Solutions

July 2020

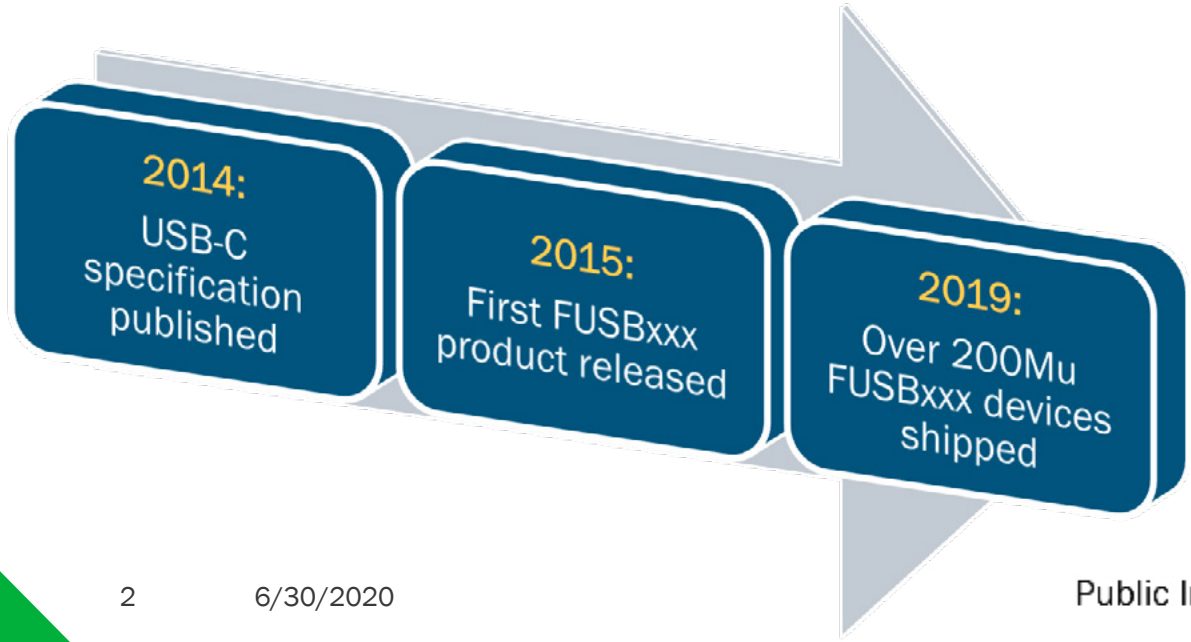
USB Solutions Group

Public Information

ON Semiconductor's Leadership in USB-C



4.5B units by 2024!



Solutions for all applications

- Programmable solutions for flexibility
- Fully integrated solutions for ease of implementation
- Switches for HV protection and audio performance

World class performance

- Lowest controller standby power
- Programmability through I2C to reduce MCU redundancy
- State machine based solutions to minimize power consumption

USB-C Standards Experts

- Early adopter of USB-C and seats on initial committees
- Current seats on multiple committees across key application areas
- Knowledge to anticipate spec changes

Mobile Power Switch – “Intellimax”

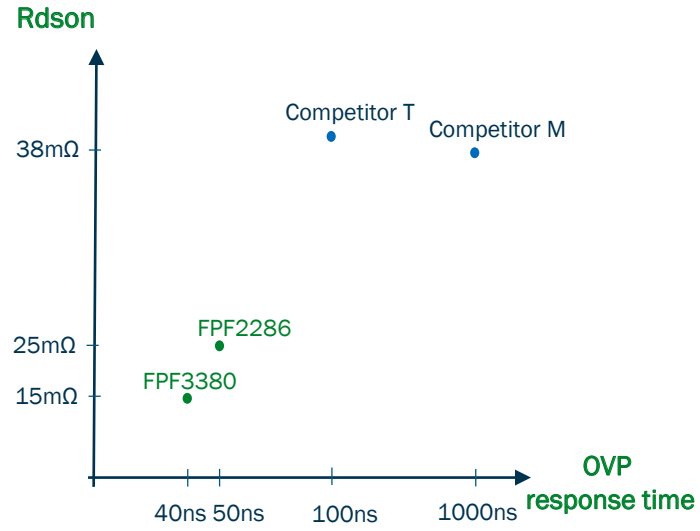
Compatibility and Flexibility

- Very Low Rdson
- Fast OVP response time < 50ns
- I2C interface for moisture detection
- Options for built-in TVS and external TVS, offering flexibility for suitable TVS
- OVP controller without built-in MOSFETs, offering flexibility for suitable MOSFETs

Market Leader

- >400Mu shipped a year
- Automotive quality products available
- Smartphones, tablets, computers, dongles, cameras, powerbanks, drones, wall outlets

On Semi solutions has less OVP response time, as well as lower Rdson, which means less heat.



Enabling A Universal Connection

Consumer
- DC-DC
  NCP81239
- PD Controller
  FUSB303B

Mobile
- Type-C Audio
  FSA4480
- PD Controller
  FUSB302/7
- Power Switch
  FPF3788
- SuperSpeed Switch
  FUSB340
- Protection
  FUSB251
- Redrivers
  NB7NPQ7042M

Computing
- DC-DC
  NCP81599
- Power Switches
  FPF3695

Cables
- Cable Marker
  FUSB380C
- Redrivers
  NB7NPQ7022M

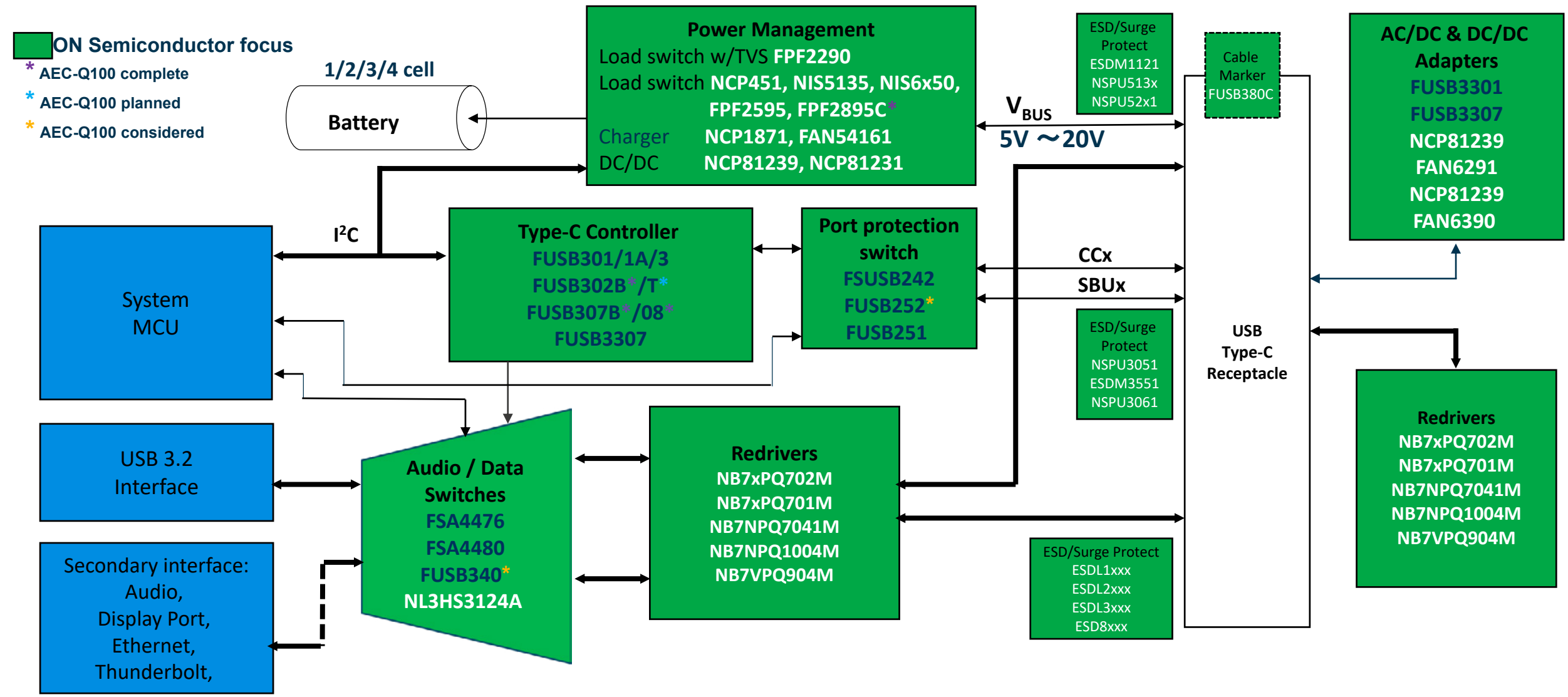
- Products listed are just examples, but full portfolios are included at www.onsemi.com
- Other ON Products: ESD/Surge Protection

Industrial
- AC-DC
  NCP1345
- PD Controller
  FUSB3307

Adapters
- AC-DC
  NCP12601
  NCP1568
- PD Controller
  FUSB3307
  FAN6390

Automotive
- DC-DC
  NCV81599
- PD Controller
  FUSB308BV

ON Semi USB Type-C/PD System Diagram



USB-C Reference Designs

Reference Designs





Automotive:

- 2 Port USB-C PD Source, 100W
- USB-C 3.0 and PPS DC/DC Charger, 60W

Industrial:

- USB-C 3.0 and PPS DC/DC Charger, 60W
- USB-C PD 3.0 AC/DC Charger, 65W

Computing:

- USB-C PD AC/DC Charger, 65W
- USB-C PD UHD AC/DC Charger, 60W

Consumer:

- 4 Port USB-C PD AC/DC Source 200W

Cables:

- USB3.1 Gen 2 Type-C to Type-C Active Cable

USB-PD 100W Dual Port

USB-PD Compliant Downstream Facing Port (DFP)

In Production

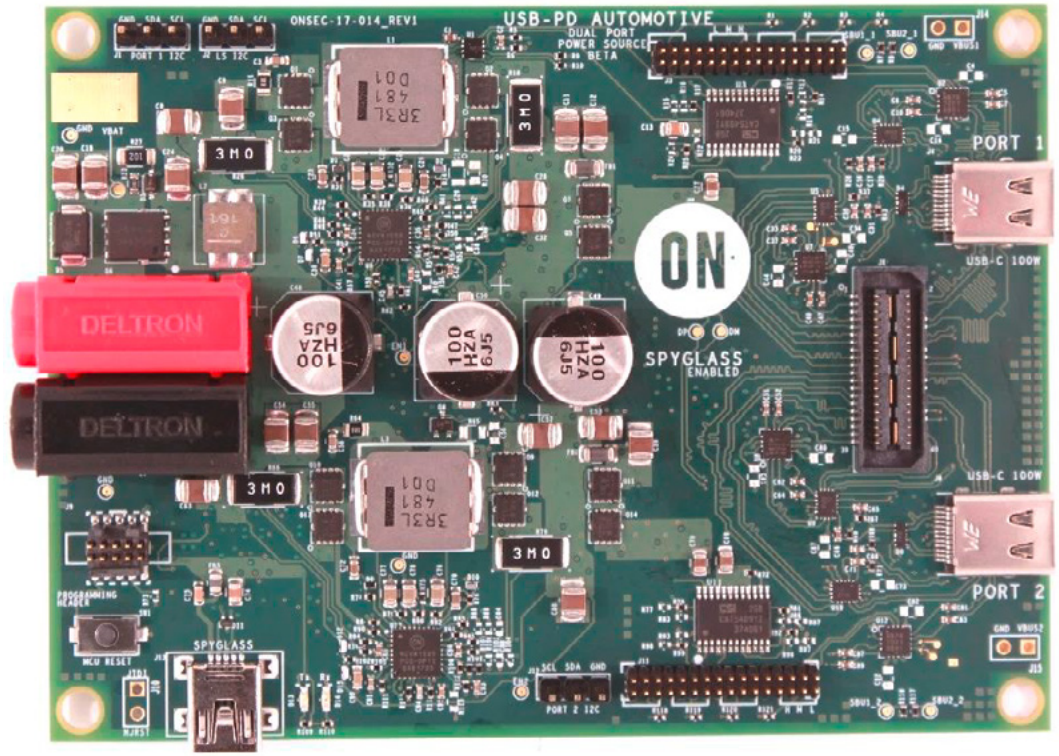
Value Proposition

This Strata based charging system demonstrates ON Semiconductor's broad portfolio of USB-PD and Power Solutions. The Strata software provides full control over the system and allows the user to experiment with various fault and foldback features, change power profiles on each port, and monitor telemetry while charging various load devices. Design collateral available including schematics, PCB layout, and test reports.

Specifications and Features

- USB-PD Compliant Downstream Facing Port (DFP)
- Primary Components
  - NCV81599 4-Switch Buck-Boost
  - FUSB302T USB-PD Port Controller
  - FUSB252 Type-C Protection Switch
- Voltage Profiles: 5V, 7V, 8V, 9V, 12V, 15V, 20V @ 5A max
- VCONN rail for EMarked cables
- Cable compensation
- Input and output power monitoring
- Temperature monitor
- Reverse battery protection
- Reprogrammable to support any output voltage and current up to 20V 5A (per USB-PD spec)

Demo Board Photo



https://www.onsemi.com/support/evaluation-board/str-usbc-2port-100w-evk

Market & Applications

- DC/DC Applications
- Automotive

NCV81599 + FUSB3307

60W USB PD3.0 w/PPS Demo Board

In Development

Value Proposition

This design demonstrates the potential of a 4-switch synchronous buck boost controller along with a fully compliant USB Type-C r1.4 and PD3.0 adaptive source charging controller utilizing ON Semiconductor's NCV81599 and FUSB3307 in a 60W ultra-high density design. It is 4.5V – 32V input and 5V, 9 V, 12 V, 15 V and 20 V output for USB PD applications.

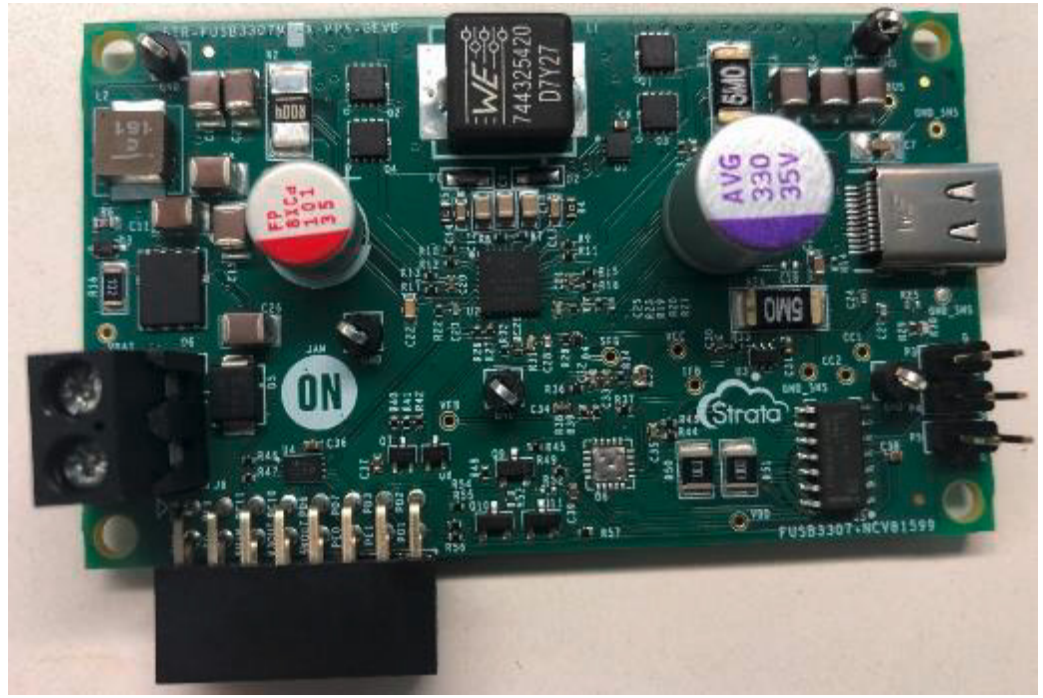
Specifications and Features

- Automotive Single Port PD Power Solution
- USB PD 3.0 with Programmable Power Supply (PPS) with ECRs v1.2+ compliant
- 100% Duty Cycle Operation
- Very Low Standby Power
- Dual Edge Current Mode Modulation
- Input and Output Voltage and Current Monitoring
- Integrated 5V LDO
- Four integrated FET drivers
- Tiny Adapter Power Outlet Size
- Pin Programmable Power
- OVP/OCP/UVP/OTP, VBUS & CC OVP Protection
- Self Powered (Operation 32V, Protection 40V)
- Drives Low Cost External NFETs
- State machine driven, no mcu required

Market & Applications

- DC/DC Applications
- Automotive

Demo Board Photo



- Design/Apps Note: End of Q4

NCP12601 + FUSB3307

65-W USB PD Evaluation Board

In Development

Value Proposition

The NCP12601 is a multi-mode controller which implements valley switching mode with a proprietary lockout scheme for noise-free operations. In high power conditions, the part operates in continuous conduction mode (CCM). As the load decreases, the converter enters discontinuous conduction mode (DCM). The NCP12601 controller is optimized for USB PD applications with the integration of high-voltage start-up, X2 discharge, auto-tuning OCP, and low loss dynamic self-supply.

Unique Features

- Multi-mode Operation
- Valley lockout
- Low loss DSS
- Auto-tuning OCP
- Quiet Skip

Benefits

- Improved efficiency
- Eliminates valley jumping
- Enables wide variable Vout
- OCP adjusts with variable Vout
- Reduces audible noise

Other Features

- High−Voltage Startup Circuit with Brownout Detection
- X2 Capacitor Discharge
- Valley switching in DCM for improved efficiency
- 65, 100 or 130 kHz fixed-frequency operation
- Frequency foldback down to 25 kHz
- Frequency jitter for improved EMI signature
- OTP on dedicated pin or combined on CS pin

Market & Applications

- USB PD Adapters
- Notebook Computer Adapters
- Printer Adapters

Demo Board Photo

- Transformer Type: RM10
- Power Density: 11 W/in3
- Board Dimensions: 100x40x24mm

- Design Note: End of Q4

NCP1568 + FUSB3307

60 W UHD USB PD Demo Board

In Development

Value Proposition

This design demonstrates the potential of the active-clamp flyback topology utilizing ON Semiconductor's NCP1568 PWM controller, NCP51530 HB Driver, NCP4305 SR controller in a 60W ultra-high density design. It is universal input and 5V, 9 V, 12 V, 15 V and 20 V output for USB PD applications. High switching frequency allows the use of an RM 8 LP transformer

Specifications and Features

- 60W, 3A max output
- Universal AC input operation: 90 -265 Vac
- Output Voltage: 5V/9V/12V/15V/20V
- High frequency operation up to 450 kHz
- RM 8 LP Transformer
- High full load and average efficiency
- Low standby power
- Very low ripple and noise
- Inherent SCP and OCP protection
- Thermal and OVP protection
- Adaptive frequency operation based on AC input and output load conditions
- Adaptive ZVS operation.
- Smaller EMI components.
- Multiple probe points for evaluation
- Smooth startup operation

Market & Applications

- Notebook Adapters
- USB PD Adapters

Demo Board Photo

- Transformer Type: RM 8 LP
- Power Density: 29 W/in3
- Board Dimensions: 1.66" x 1.78" x 0.70
- Design Note: Q1 2020

USB-PD 200W Four Port AC/DC Charger

USB-PD Compliant Downstream Facing Port (DFP)

In Production

Value Proposition

The 4-Port USB-PD Source showcases ON Semiconductor's broad portfolio of USB-PD power solutions. All ports are 100W capable with a total max system power limited to 200W using our First Come First Served power management algorithm. The Strata software provides powerful controls to test power profile configurations such as optional "assured" port 1 power, experiment with various fault and foldback features, and monitor system telemetry while charging various load devices. Design collateral such as schematics, PCB layout, test reports, etc. are supplied in the same Strata interface to ease evaluation.

Specifications and Features

- USB-PD Compliant Downstream Facing Port (DFP)
- Primary Components
  - NCP1399 LLC controller
  - NCP1615 PFC
  - NCP4305 secondary SR controller
  - NCP81239 4-Switch Buck-Boost
  - FUSB307B USB-PD Port Controller
  - FUSB252 Type-C Protection Switch
- Four USB Type-C Outputs
- Supports USB Power Delivery up to 100W Per Port
- Power Management Algorithm to Intelligently Deliver 200W Across Four Ports
- Default PDO's = 5V, 7V,8V, 9V, 12V, 15V, 20V at 5A
- Input and Output Power Monitoring
- Thermal Protection, Overcurrent Protection

Demo Board Photo

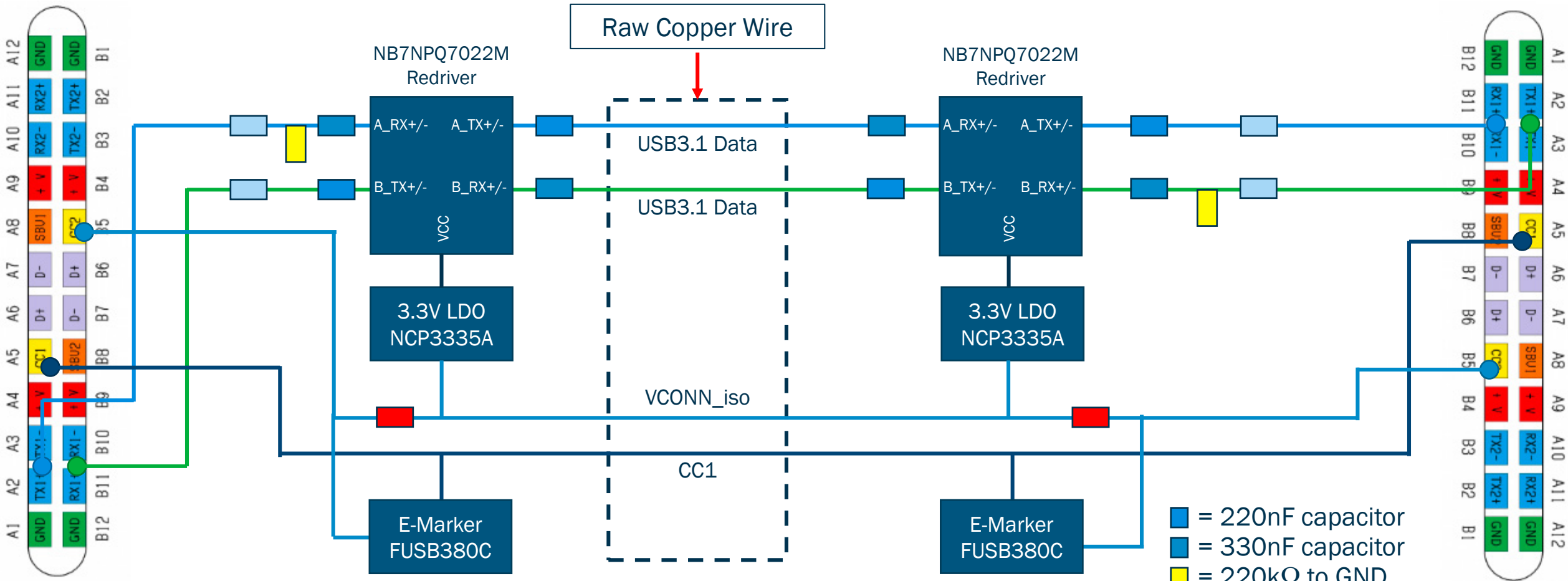
https://www.onsemi.com/PowerSolutions/evalBoard.do?id=STR-USBC-4PORT-200W-EVK

Market & Applications

- Consumer Electronics
- Computing
- USB Type-PD Systems

USB3.1 Gen 2 Type-C to Type-C Active Cable Connections

Option #1

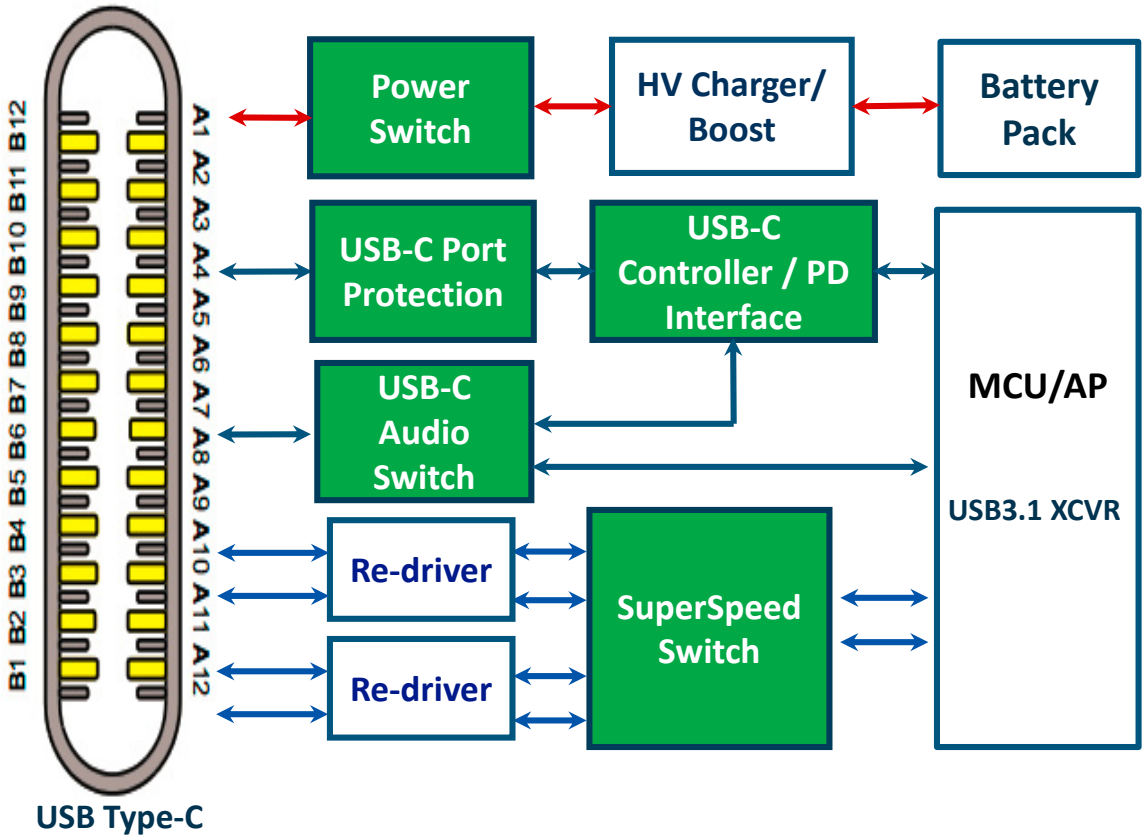


Notes:

1) Isolation diodes (RED) are used to isolate VCONN1 & VCONN2
2) VCONN must be routed through cable to ensure power is supplied to both sides of cable

Reference Designs Home Slide

USB-C & PD Interface Products



Product Type	Product Number	Competitive Advantage
USB-C Only Controller	FUSB303B	Small controller with power consumption 10x lower than competitors and compatible with the latest USB-C spec release 1.3.
USB-C PD Controller	FUSB302B/T	Full PD controller for solutions up to 100W and 40x power less than competitor. Automotive version also available.
	FUSB307B/08B	Full TCPC and PD 3.0 controller for multi port solutions including SNK/ SRC control lines and accessory debug. Automotive version also available.
	FUSB3307	Fully Autonomous & Compliant Rev 1.3 Type-C and Rev 3.0 Power Delivery with PPS Solution for DC-DC and AC-DC Power Sources
USB-C PD Cable Marker	FUSB380C	Full PD cable marker for passive and active cables with 28V tolerance on CC and VCONN pins. 5X customer programmability.
Dataline Protection Switch	FUSB251	USB-C CC and SBU High Speed Switch with HV tolerance, moisture detection and integrated IEC 61000 4-2 protection.
USB-C Audio Switch	FSA4480	USB-C switching and protection for analog audio while providing OMTP/CITA detection and pop suppression.
USB-C SS Switch	FUSB340	SuperSpeed switch compliant with USB 3.2 Gen2 data rates of 10Gbps. Small footprint and low power consumption
VBUS Protection Switch	FPF2895C	28V/5A ILIM Switch w/ OVP & TRCB. Tolerant to HV on both sides without extra protection. Fully supports USB-C with PD

In Production

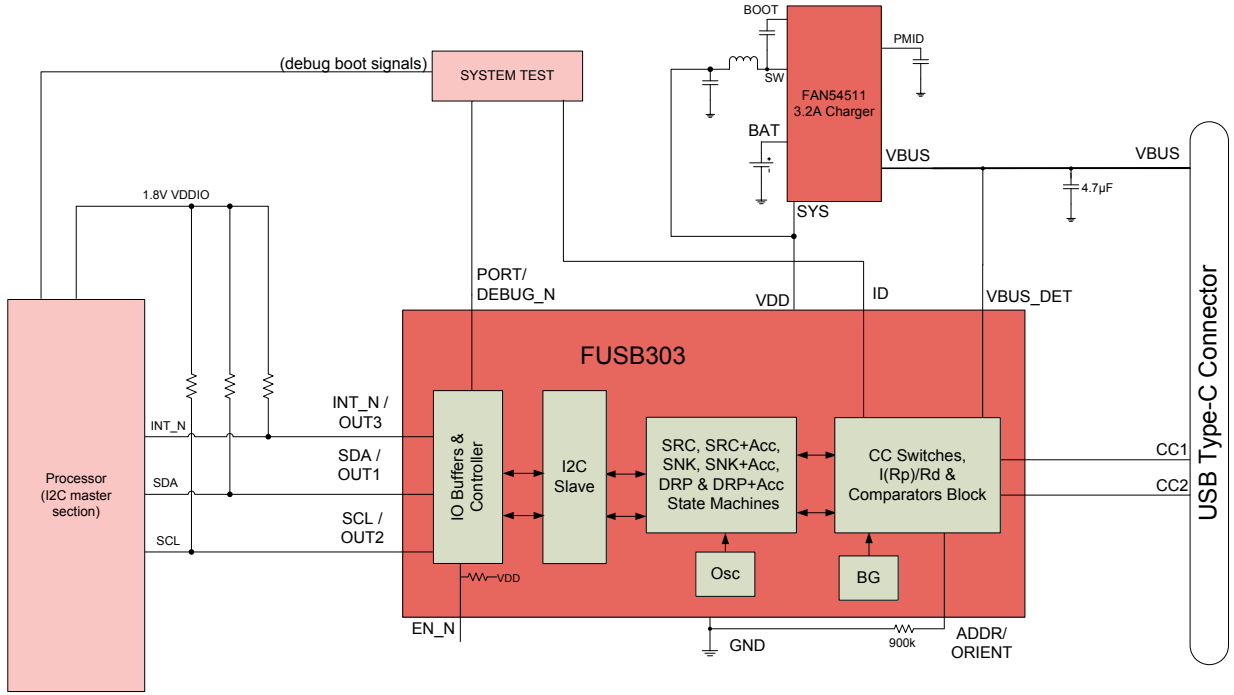
FUSB303B

Autonomous USB Type-C Controller

In Production

Benefits

- **Fully autonomous Type-C controller providing a seamless transition from USB to USB-C**
- Full V1.3 state machines with no software interaction required
- Low power (<10uA) and robust high voltage tolerance



Features

- Fully autonomous configurable Type-C controller
  - Supports USB Type-C™ Specification Release 1.3
  - Configurable as Source, Sink, and DRP roles with Accessory support
  - Source and Sink preferred roles through Try.SRC and Try.SNK
  - Configuration through GPIO or I^2C
- **Unique detection algorithms to ensure stable attaches with illegal cables and devices**
- Robust Max 28V DC and 4 kV HBM ESD on connector pins
- Wide 2.7V to 5.5V VDD supply operation
- 12-ld QFN (1.6mm x 1.6mm x 0.375mm)

Applications

- Smartphones, Tablets
- Laptops, Accessories, Power Banks
- Industrial, Ultraportable Applications

FUSB303B

Outstanding Among Type C Controllers

In Production

Features	FUSB303B	FUSB301/A	Comp1
Function	CC Controller	CC Controller	CC Controller
Standard Compatibility	USB Type-C Spec 1.3	USB Type-C Spec 1.1	USB Type-C Spec 1.1
Configuration	I2C/GPIO	I2C	I2C/GPIO
CC Pin Voltage Tolerance	28V Max	6V Max	6V Max
Recommended VBUS_DET Voltage	4V-22V	3.7V-21V	Need external resistor
Istand-by (unattached, internal toggling)	20μA Max	20μA Max	70μA Max
Package	1.6mm x 1.6mm x 0.4mm	1.6mm x 1.6mm x 0.4mm	1.6mm x 1.6mm x 0.4mm

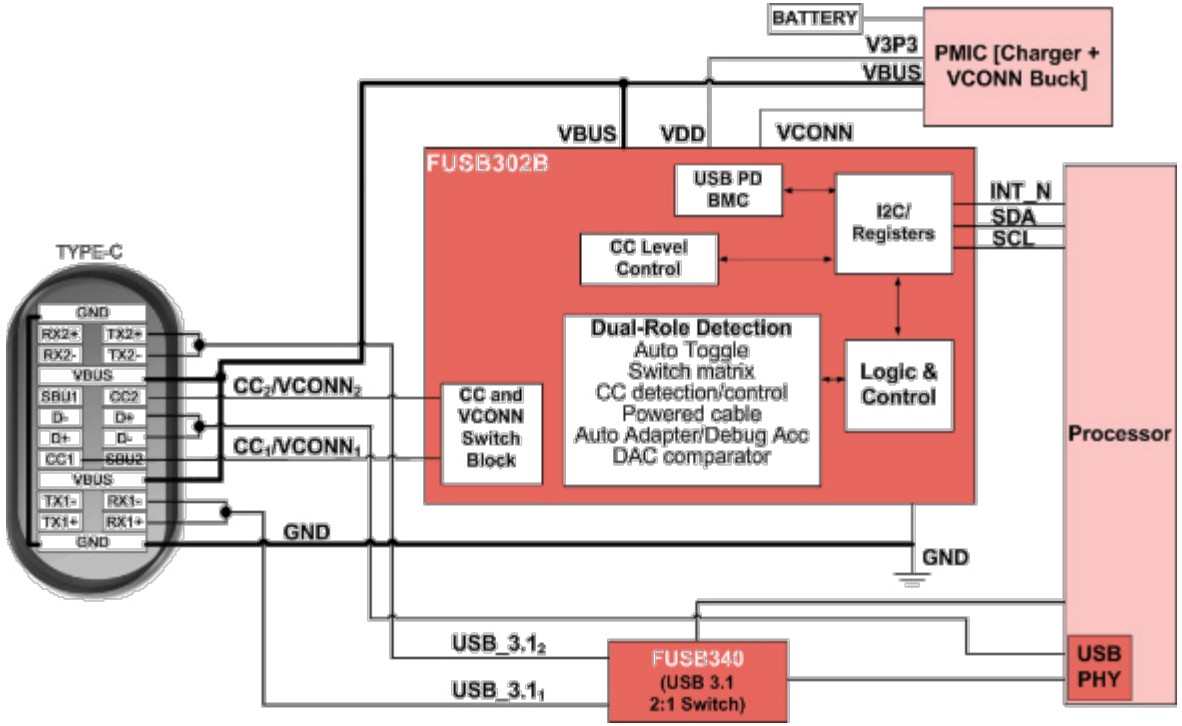
FUSB302B/T/V

Programmable USB Type-C Controller with Power Delivery

In Production

Benefits

- Fully configurable USB PD controller integrating timing critical features of the USB PD specification.
- **Open-source reference code that is configurable to implement all standard features of USB PD.**



Features

- USB Type-C 1.3 and Power Delivery (PD) 2.0, 3.0 Compatible
- Full open-source software support supporting all modes of operation and ARM, Linux and PIC hardware platforms
- Integrated VCONN to CCx Switch
- Robust BMC receiver tolerance
- Multiple product IDs for I2C slave address options
- Family Product Differences
  - FUSB302B – DRP, to enable charging in dead battery
  - FUSB302T – SRC, for power savings in travel adapters
  - FUSB302V – DRP, AEC−Q100 Automotive Qualified Temperature Grade 2: (−40 C to +105 C)
- 14-lead MLP (2.50mm x 2.50mm), FUSB302B/T/VMPX
- 9-ball WCSP (1.260mm x 1.215mm), FUSB302BUCX

Applications

- Smartphones, Notebooks, Travel Adapters, Source only applications
- Automotive

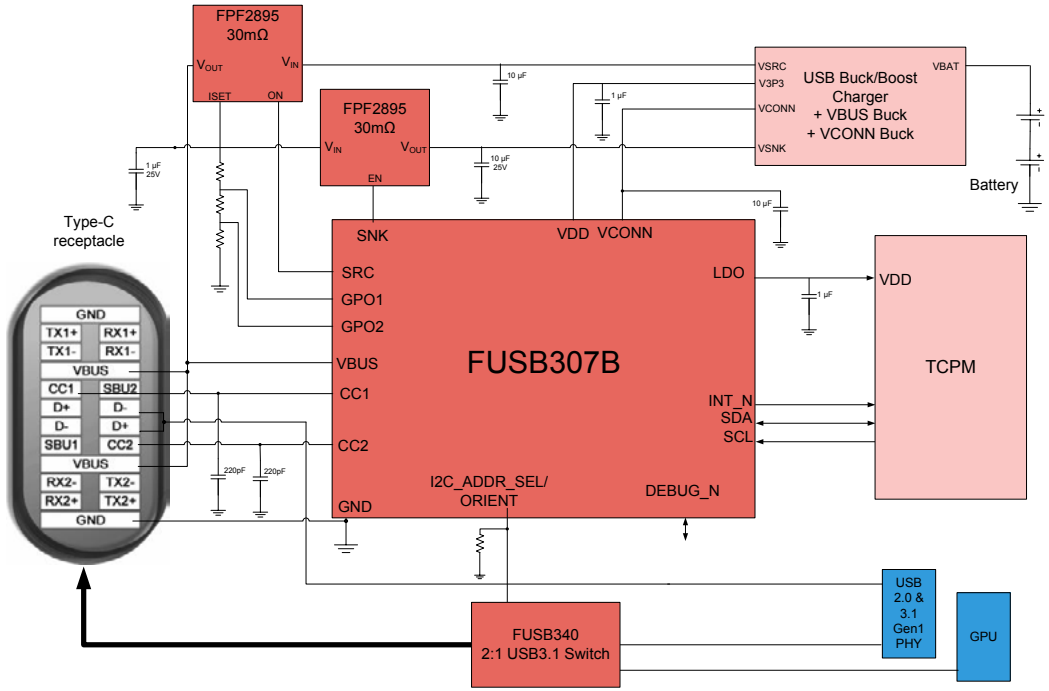
FUSB307B/V

Programmable USB Type-C Port Controller with Power Delivery

In Production

Benefits

- TCPC compliant USB PD port controller integrating timing critical features of the USB PD specification.
- **Open-source TCPM reference code that is configurable to implement all standard features of USB PD.**



Features

- Certified USB PD 3.0 compliant TCPC port controller supporting
  - USB Type-C Dual-Role Functionality
  - Automatic GoodCRC and Retry Packet Responses
  - Supports All SOP* types
  - VBUS Source and Sink Control with VBUS discharge
  - Integrated VCONN to CCx Switch
  - 2 Programmable GPIOs
  - Debug Accessory Detection and Fast Role Swap supported
- Full open-source software support supporting all modes of operation and ARM, Linux and PIC hardware platforms
- Automotive AEC-Q100, Temp Grade 2
- 16-Lead QFN (3.0mm x 3.0mm)

Applications

- Notebooks, Laptop, Accessories
- Travel Adapters, Automotive

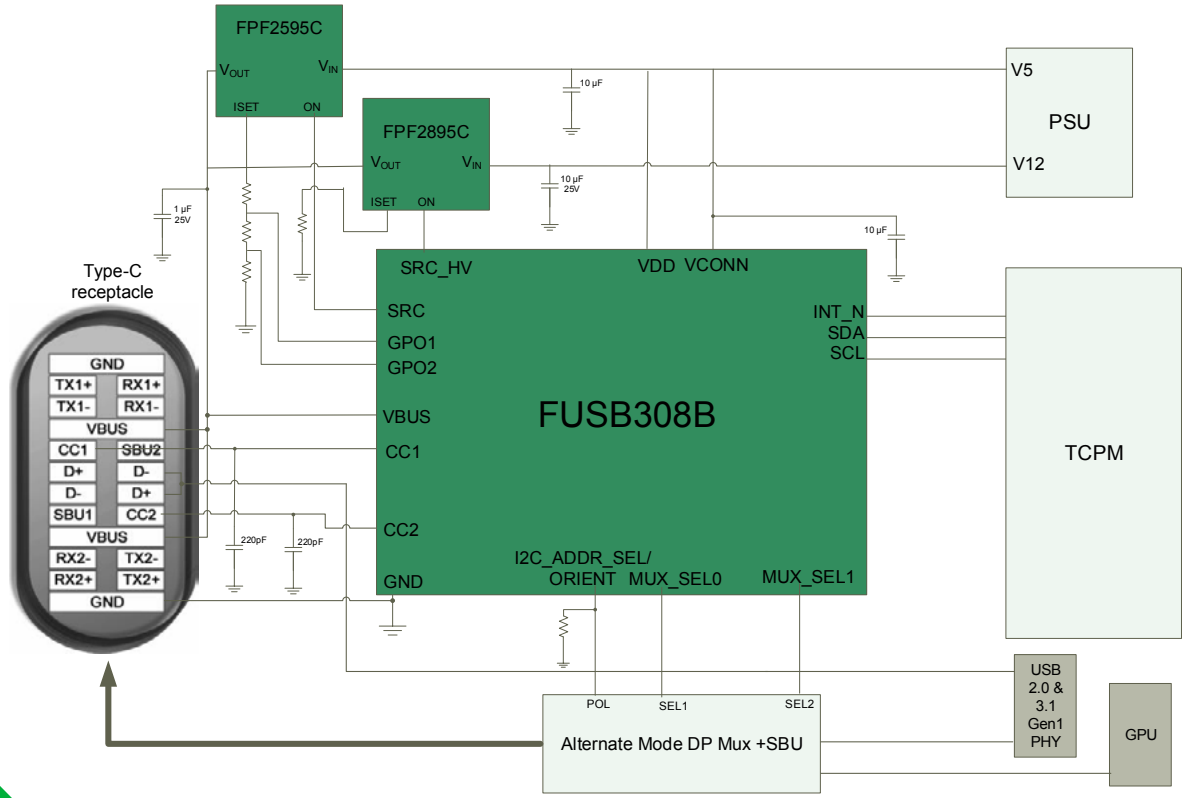
FUSB308BV

Source Specific Programmable USB Type-C Port Controller with Power Delivery

In Production

Benefits

- Discrete solution for integration of four USB Type-C port controllers with USB PD capabilities.
- Compliant with USB PD Inter-Block Specification (TCPC) for a standardized interface with a Type-C Port Manager (TCPM).



Features

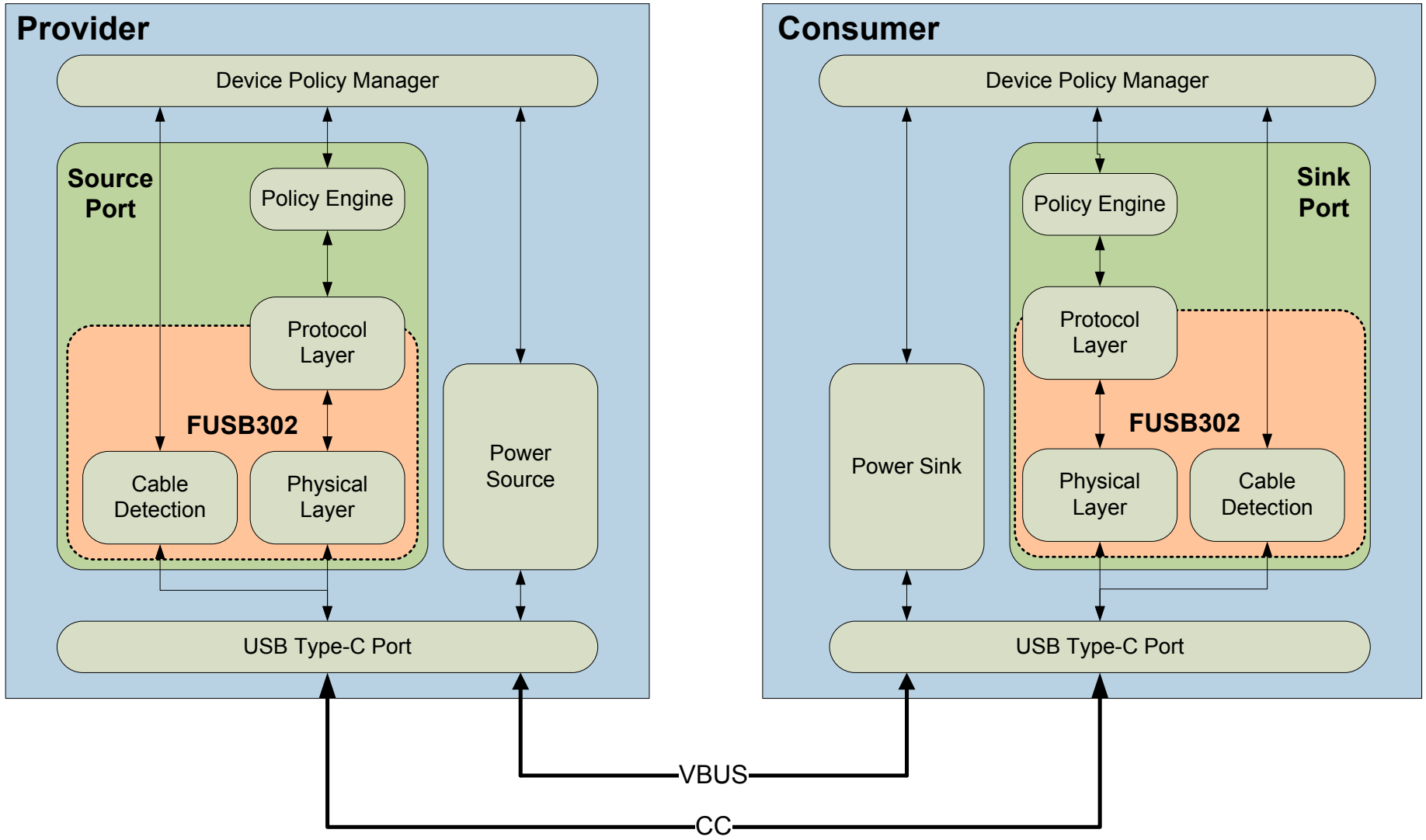
- Dual-Role Functionality for Type-C 1.3
- USB-PD Inter-Block Specification Support
  - Automatic GoodCRC Packet Response
  - Automatic Retries for Sending Packets
  - All SOP* types supported
- Control for 2 VBUS Sources (5V + High Voltage)
- CC Terminations Disabled when Unpowered
- 16 pin QFN package (0.5mm pitch)
- 2 Programmable GPIOs
- 4 Selectable I2C Addresses for Multiple Ports
- Integrated VBUS ADC and Discharge circuits
- Integrated VCONN to CCx Switch
- Automotive AEC-Q100, Temp Grade 2

Applications

- Automotive Modules
- Source for Adapters
- Source for Desktops
- DRP/Sink for Power Banks & Docks

USB-C Interface Products Home Slide

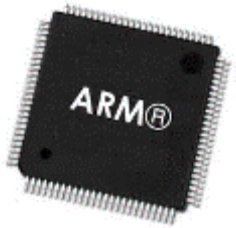
FUSB30x PD Architecture



FUSB30X PD System Integration

ON Semiconductor provides full reference code for the FUSB302B

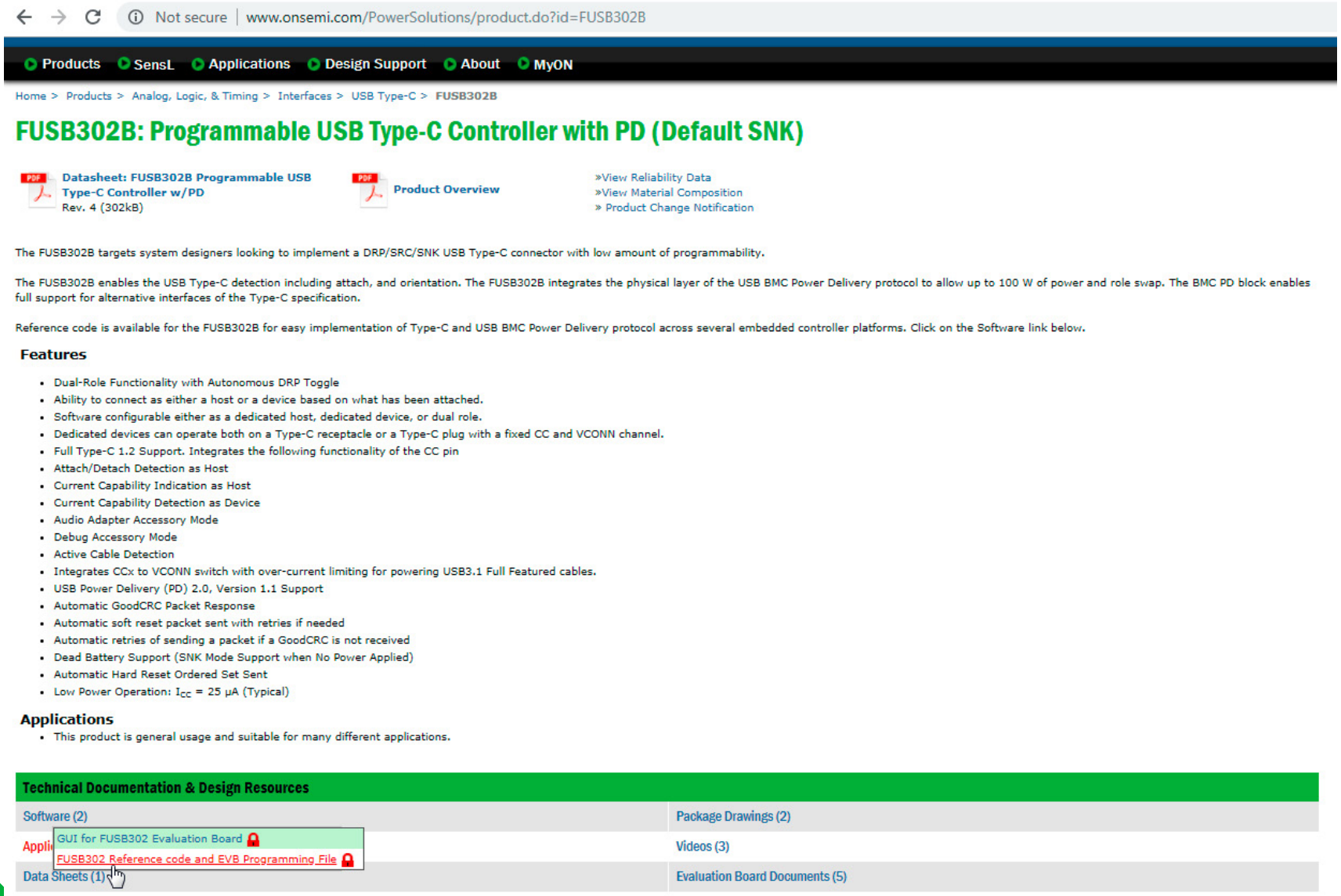
- Allows customers to quickly implement drivers for Type-C™ and USB PD interfaces for their products
- Flexibility to customize software for specific hardware platform requirements
- Organized source code allowing separation between USB PD and hardware specific functions
  - Core folders contain code common across all platforms
  - Platform folders contain code unique to that platforms hardware requirements (GPIOs, timing, etc)
- All major platforms supported
  - Microchip (PIC32MX795F512 example)
  - ARM (STM32F072 example)
  - Linux/Android (Dragonboard 810 example)
  - A “None” platform for a generic build example
- Full documentation and Integration Guide
  - Explains driver build options: Sink, Source, or Dual Role Power, Accessory Mode, Alt-Mode VDMs, Display Port support
  - Platform build configurations
  - Introduction to the provided core and platform functions



PD System Integration - Continued

- The reference code provides a basis for implementing various target applications
  - PD Source with the ability to change data role (DR_SWAP) from source to sink (i.e. Android Auto or Apple CarPlay)
  - Dual role power (DRP) port with Try.SRC or Try.SNK support enabled for preferred attaches as either a source or sink
  - Additional configurations supported per the USB Type-C and PD specifications
- Supports Alternate Modes through Vendor Defined Messages (VDMs)
  - Support for Display Port (DP) handled with alt-mode VDMs
- Quickly and easily build various USB Type-C™ and USB Power Delivery (PD) configurations using a vendor_info.h file
  - Follows the Vendor Information File (VIF) format that the USB-IF uses for their USB Workshops
  - Configure the Type-C™ port role
  - Configure the source and sink Power Data Objects (PDOs) offered as a USB PD device
  - Other programmable features
- All build configurations validated against full suite of USB-IF Type-C and PD compliance testers
- Linux/Android build functionally validated on Intrinsyc's Dragonboard 810 development kit

FUSB30X Reference Code



- Reference code available through FUSB302B, FUSB307B product pages on external webpage
- Automatic notifications when updates are released
  - Updated on quarterly basis
- Reference code is same code used for USB-IF compliance
- Latest Versions
  - FUSB302B: 4.1.1
  - FUSB307B: 1.2.0

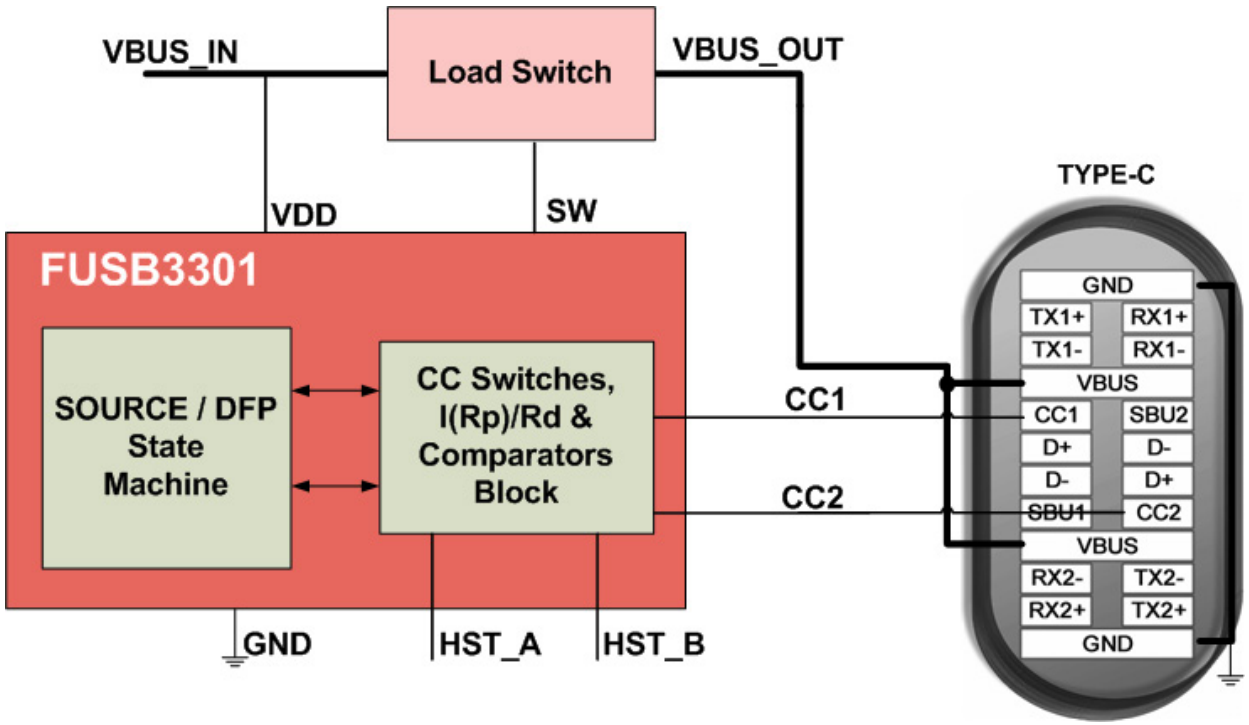
FUSB3301

Source Only Type-C Controller for 5V Power Adapter

In Production

Benefits

- Enables a simple low cost Type-C compliant solution for 15W Power Adapters



Features

- Auto CC detection and control logic
- Supports Type-C Version 1.1
- Selectable Host Current (900mA, 1.5A, 3.0A)
- VBUS Load Switch Enable Output
- Low Standby Power (5µA, typical)
- 10-ld MLP – 0.5mm pitch
  - 3mm(W) x 3mm(L)

Applications

- Travel Adapters, Wall Outlets
- Power Banks, Automotive

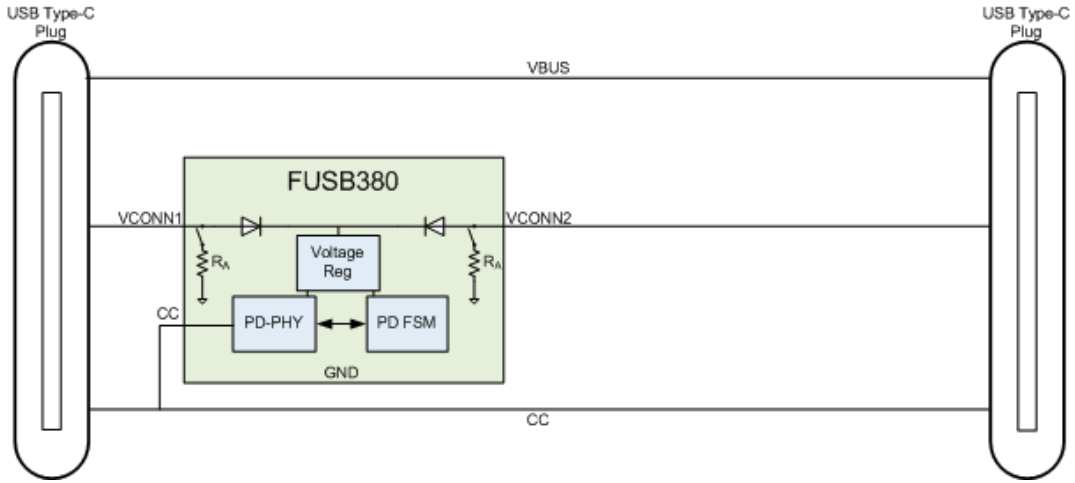
FUSB380C

Autonomous USB Type-C Cable Marker

In Production

Benefits

- USB PD2.0 and PD3.0 compliant solution providing a robust and small footprint solution for passive and active cable applications.
- Reduces cabling costs by being used at both ends of the able and eliminating the need to wire VCONN through entire cable.



Features

- Integrated USB−PD 3.0 Protocol Layer and Device Policy Engines
- 5x Programmable for Different Cable Configurations
- USB PD 2.0 and 3.0 Certified
- Robust Design Features:
  - 28 V Tolerant CC and VCONN
  - Integrated Isolation Between VCONN1 and VCONN2
  - 2.4 V − 5.5 V VCONN Operation
- Programmable serial number for supply chain tracking
- SOP' Signaling Support
- Automatic Ra weakening to reduce power consumption
- 12-Ball WLCSP (1.21mm x 1.67mm)

Applications

- Passive Cables
- Active Cables

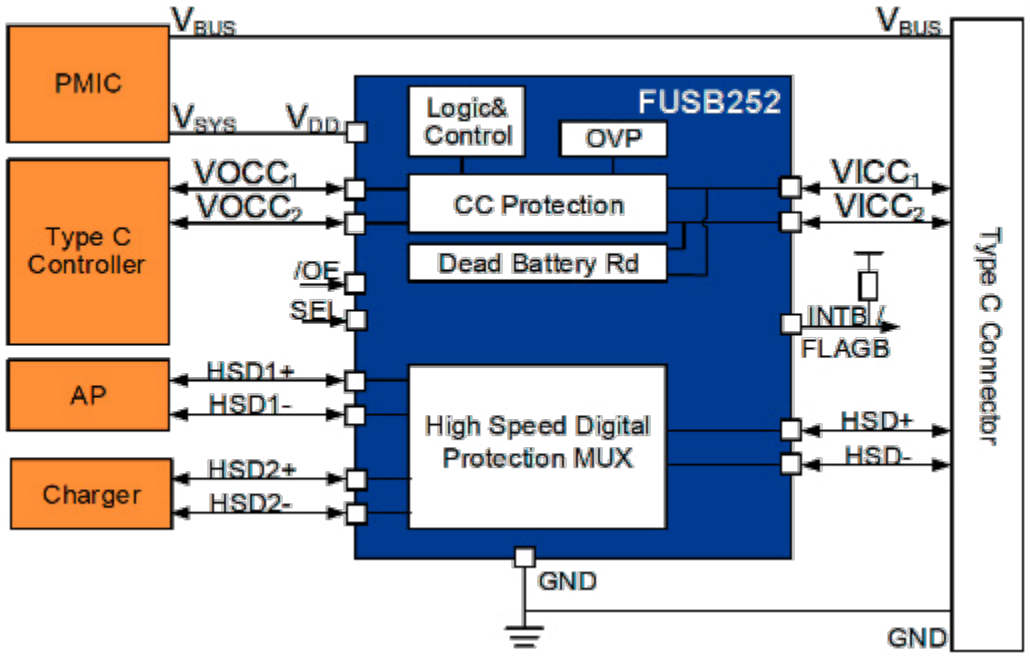
FUSB252

Type-C CC with D+\D- Port Protection Switch

In Production

Benefits

- Fully integrated USB Type-C protection switch designed to seamlessly add protection to existing designs.
- Protects system critical USB Type-C CC pins and USB data pins from permanent damage caused by VBUS shorts to connector pins.



Features

- Supports USB Type-C™ Specification 1.3, including dead battery R_D pull-down resistors on CC pins
- Integrated 1GHz USB 2:1 switch enabling UART, ADC and other connections to the USB pins
- Power/Analog Mux for CC & V_{CONN}
  - 0.35Ω R_{ON} V_{CONN} to $VICC_X$
  - 5Ω R_{ON} D+/D- path
- 20V DC protection for CC connector pins
- 16V DC protection for D+/D- connector pins
- 5.8V OVP protection and UVLO
- FLAGB fault indicator pin
- 16-Lead UMLP (1.8mm x 2.6mm)

Applications

- Smartphones, Tablets
- Laptops, Docking Stations, Automotive

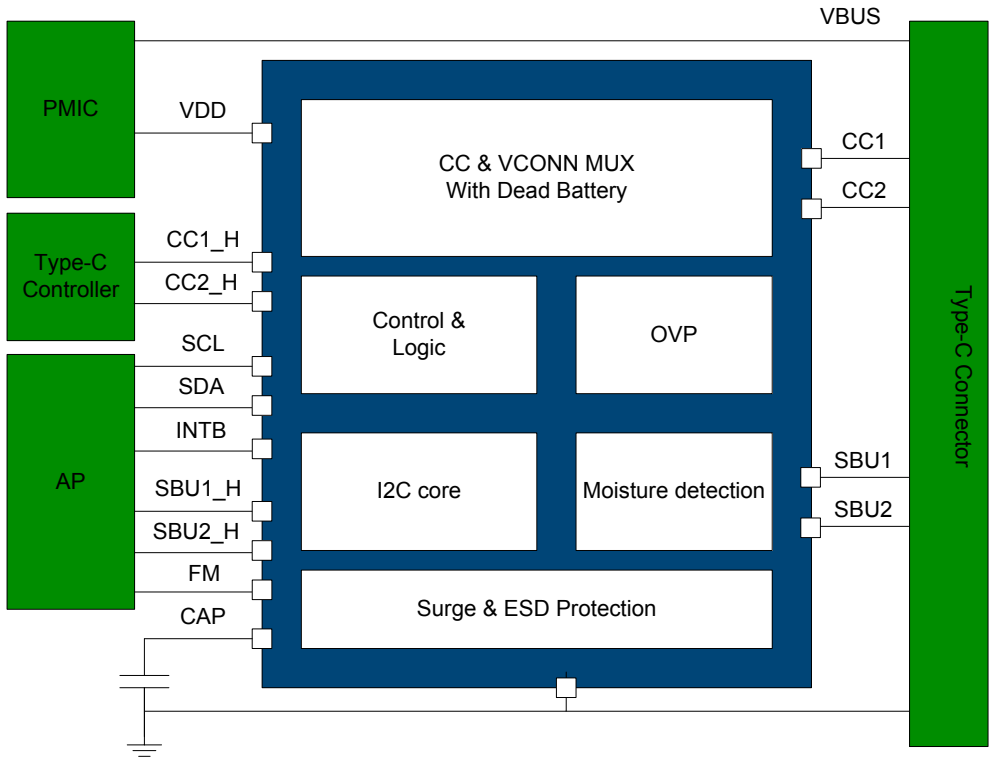
FUSB251

CC/SBU Protection with Integrated TVS

In Production

Benefits

- Integrated moisture detection with software controlled secondary detection preventing connector corrosion
- Integrated IEC surge and system level ESD protection saving both system cost and 2.5mm^2 board area



Features

- Supports USB Type-C™ Specification 1.3, including dead battery R_D pull-down resistors on CC pins
- SPST Protection for CC and SBU Type-C connector pins
  - 24V DC protection for CC and SBU pins
  - Integrated IEC 61000-4-5 ±35V Surge protection
  - Integrated IEC 61000-4-2 ESD protection (8kV contact & 15kV Air)
- Proprietary Moisture detection on CC and SBU automatically preventing corrosion of Type-C connector
- Operation from 3.0V to 5.5V with UVLO function
- Low 2nA Max Leakage Current on SBU paths
- 50MHz -3db Bandwidth on SBU switch
- 15-Ball WLCSP (1.49mm x 2.06mm)

Applications

- Smartphones , Tablets
- Laptops , Docking Stations

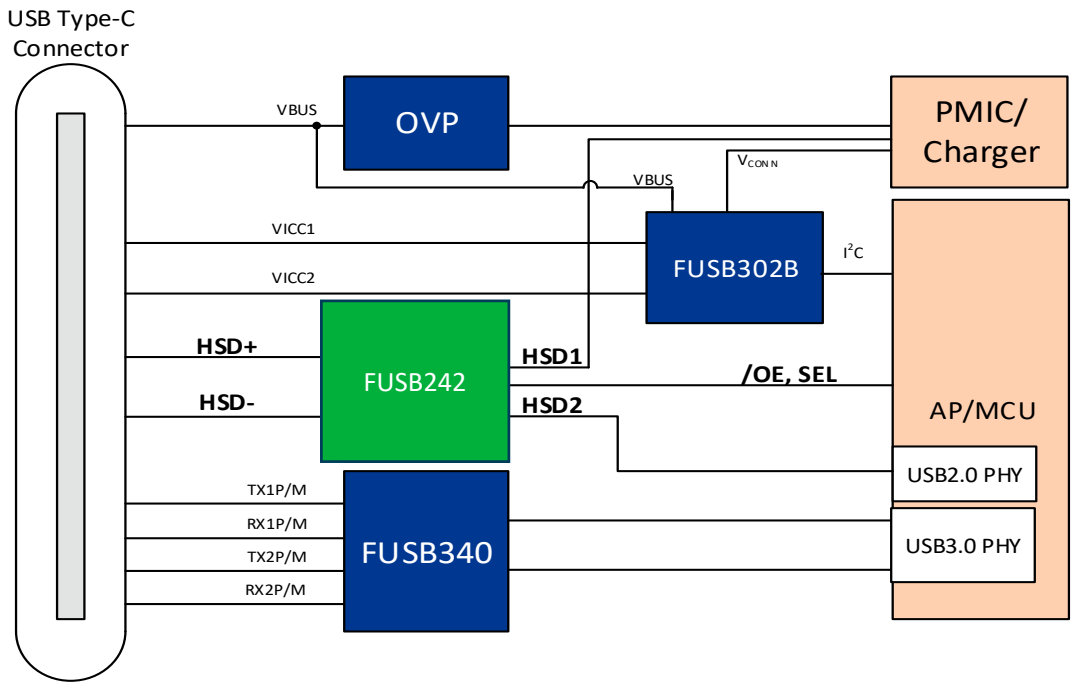
FSUSB242

USB Protection Switch, HSD+/HSD-

In Production

Benefits

- Provides high voltage and surge protection for the HSD+/HSD- lines for small form factor connectors
- Provides 2:1 switching while maintaining sufficient signal integrity for USB 2.0 HS eye diagram compliance



Features

- Full USB Data Port Protection
  - 12V DC Tolerance on VDD
  - -18V, +20V DC tolerance on HSD± Port
  - ±25 V IEC 61000-4-5 Surge Protection
- Wide Operating Range, 2.7V- 5.5 V
- Critical USB Path Parameters
  - 5Ω Typical On Resistance
  - 5pf Typical On Capacitance
  - -3dB Bandwidth of 1GHz
- Low Power Operation: Icc < 10µA
- Over Voltage Protection based on switch selection:
  - HSD1 3.6V OVP
  - HSD2 4.5V OVP
- 9-Ball WLCSP (1.20mm x 1.20mm)

Applications

- Smartphones,Tablets, Laptops, Docking Stations

Protection Selection Table

	FUSB252	FUSB251	FSUSB242
Protection Features			
CC Pins	20V	24V	-
D+/D- USB Pins	16V	-	-18V, +20V
SBU Pins	-	24V	-
OVP	5.8V (CC)	5.85V(CC) 4.5V (SBU)	3.6V (HSD1) 4.5V (HSD2)
Features			
Fault Flag	Yes	I2C	No
2:1 USB Mux	Yes	No	Yes
Type-C Dead Battery Rd	Yes	Yes	-
CC Switch Ron	0.35Ω	0.30Ω	-
Moisture Detection	No	Yes	No
IEC 61000-4-5 Surge	±24V (CC) ±16V (D+/D-)	±35V	±25V
IEC61000-4-2 ESD	-	8KV/15KV	-
Package	16-UMLP	15-Ball CSP	9-Ball CSP

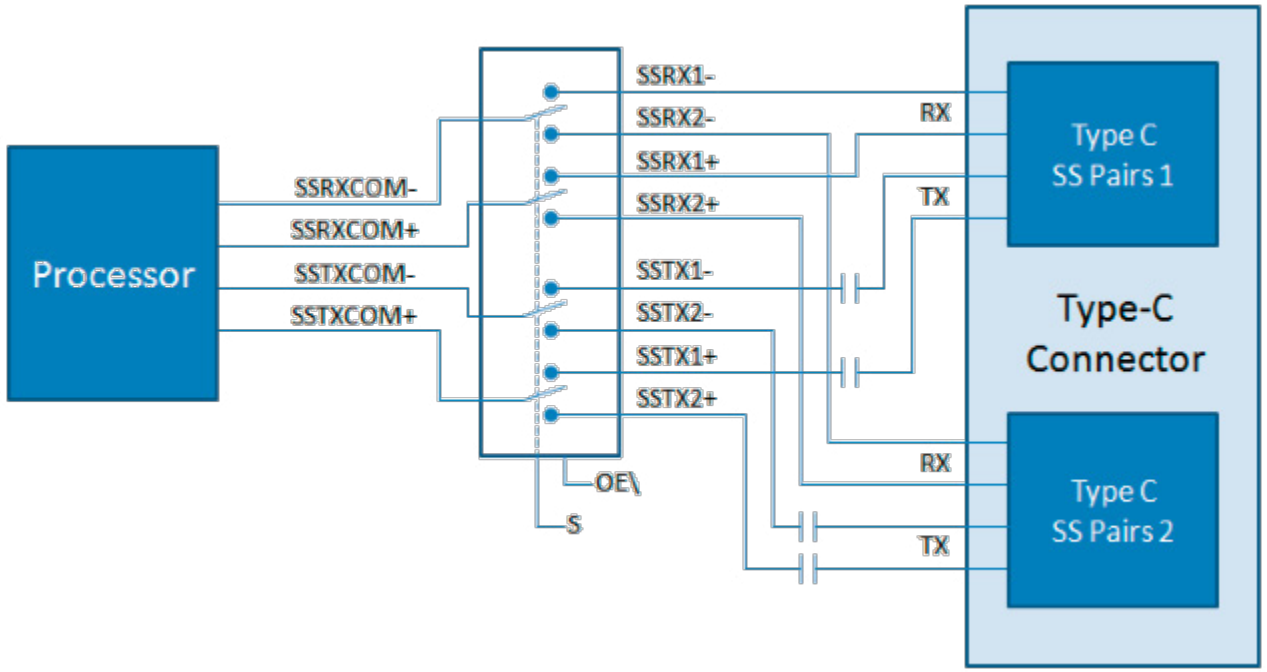
FUSB340

10Gbps USB3.1 SuperSpeed Switch

In Production

Benefits

- Small discrete solution for the required Type-C USB3.1 connector reversibility for phones, tablets, laptops.



Features

- USB 3.2 (Gen 2) – 10Gbps
- 10GHz bandwidth
- VDD: 1.5V – 5.0V
- 2KV HBM ESD protection
- -1dB Insertion Loss @ 2.5GHz
- Low Active Power < 12uA
- Low Power shutdown < 1uA
- 18-lead TMLP, 0.4mm pitch (2.0mm x 2.8mm x 0.4mm)

Applications

- Smartphones
- Notebooks
- Ultraportable Applications

FUSB340 Competitive Analysis

The data below was extracted from publicly available competitor datasheets. The Fairchild data was collected in the char and apps labs.

Supplier	ON Semi	Comp 1	Comp 2	Comp 3	Comp 4	Comp 5	Comp 6	ON Semiconductor Advantage
Supply Voltage	**1.5 to 5.0V**	3.0 to 3.6V	3.0 to 3.6V	3.0 to 3.6V	1.5 to 2.0V	3.0 to 3.6V	1.65 to 1.95V	Wide supply range
Data Rate	**10.0 Gbps**	8.0 Gbps	10.0 Gbps*	5.4 Gbps	5.0 Gbps	8.0 Gbps	5.0 Gbps	Sufficient data rate
Bandwidth	**10.0 GHz**	10.0 GHz	8.0 GHz*	5.4 GHz	4.1GHz	6.5 GHz	8.0 GHz	Highest bandwidth
Insertion Loss @ 2.5GHz	**-1.0 dB**	-1.3 dB**	-0.8 dB	-1.6 dB	-2.0 dB	-1.1dB	-1.0dB	Low insertion loss
Diff Off Isolation	**-28 dB**	-20 dB**	-23 dB	-26 dB	-22 dB	-19dB**	-30 dB	Low differential insertion loss
Diff Cross Talk @ 2.5GHz	**-44 dB**	-35 dB**	-35 dB	-30 dB	-41 dB	-29 dB	-25 dB	Lowest differential cross talk
ICCmax Shutdown (max)	**1µA**	1µA	20µA	5µA	NA	NA	25µA	Lowest ICC
ICC Active (max)	**0.03mA**	2.5mA	0.80mA	0.90mA	0.20mA	0.30mA	0.20mA	Lowest ICC by >5x
ESD (HBM)	**2kV**	2kV	2kV	4kV	2kV	2kV	-	Meets Jedec standard
Package	**18 LD TMLP**	20 LD QFN	20 LD VQFN	28 LD QFN	28 LD TQFN	40 LD TQFN	20 LD WLCSP	Lowest Lead Count
Package Dimensions	**2.0 x 2.8 x 0.37mm**	2.5 x 4.2 x 0.85mm	2.5 x 4.5 x 0.9mm	3.5 x 5.0 x 0.8mm	3.5 x 5.5 x 0.8mm	3.0 x 6.0 x *** 0.75mm	1.6 x 2.0 x 0.5mm	Smallest Leaded Footprint Thinnest height

*Data is measured as relative, not absolute.
**Data point are measured at f=@4GHz

FPF2495CUCX

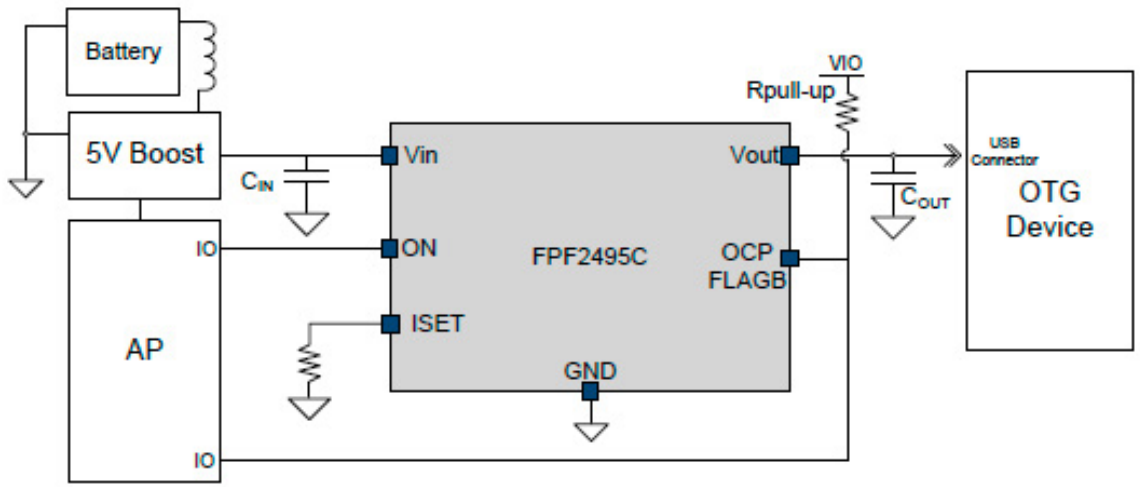
Adjustable ILIM Switch with OVP

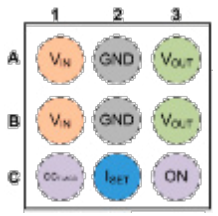
Production

Benefits

- True Reverse-Current Blocking function to obstruct unwanted reverse current from VOUT to VIN during ON and OFF state
- Wide Operating range

Application Diagram





Features

- 28V ratings at VOUT, 6V ratings at VIN
- 2.5V to 5.5V Operating Range
- Adjustable ILIM : 0.1~2A with +/-10%
- Low Ron : typ 70 mΩ at 5V
- Output OVP threshold: 5.6Vmin / 5.8Vtyp / 6Vmax
- Active HIGH
- UVLO & TRCB, Thermal Shutdown
- ESD protected:
  - 2kV HBM & 2.5kV CDM
  - IEC61000-4-2 Air Discharge: >15KV
  - IEC61000-4-2 Contact Discharge: >8KV
- Package:
  - 9 balls in WL-CSP with 0.4mm pitch
  - 3 x 3 bump array in 1.21mm x 1.21 mm

Applications

- Mobile device and smart phones
- Portable media devices
- Advanced Dongle and Docking Station

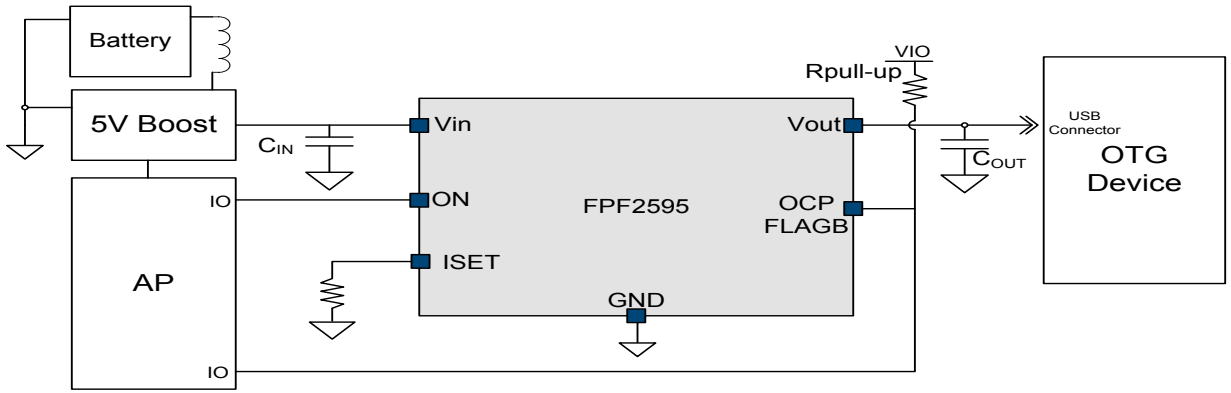
FPF2595UCX

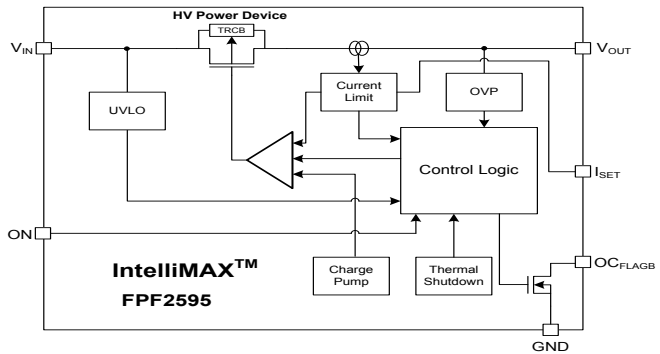
28V output tolerant load switch with adj. current limit

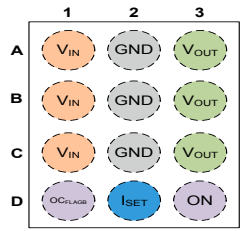
Production

Benefits

- Protect system against over voltage from external plug-in
- Protect short circuit event from external plug-in
- Avoid system damage from reverse current
- Keep output current under control in OTG application







Features

- **Low On-Resistance: typ.35mΩ, max.45mΩ @VIN=5V**
- Power supply: 2.5V to 5.5V
- **Adjustable ILIM: 0.1~3.5A with ±10% accuracy**
- Open-Drain OCP warning on FLAGB
- Under Voltage Lockout (UVLO): typ. 2.2V
- Output OVP: typ. 5.8V±0.2V
- Quiescent / Shutdown current: typ. 65uA / 0.1uA
- True Reverse Current Block (TRCB)
- ESD protection:
  - Human Body Model: 2kV
  - Charged Device Model: 2.5kV
  - IEC 61000-4-2 Air Discharge:15kV
  - IEC 61000-4-2 Contact Discharge: 8kV
- Package:
  - WLCSP-12 with Backside Laminate
  - 1.3mm x 1.8mm, 0.4mm ball pitch

Applications

- Notebook and Desktop with USB connectors
- Smart Phones and Tablet PCs

USB-C Interface Products Home Slide

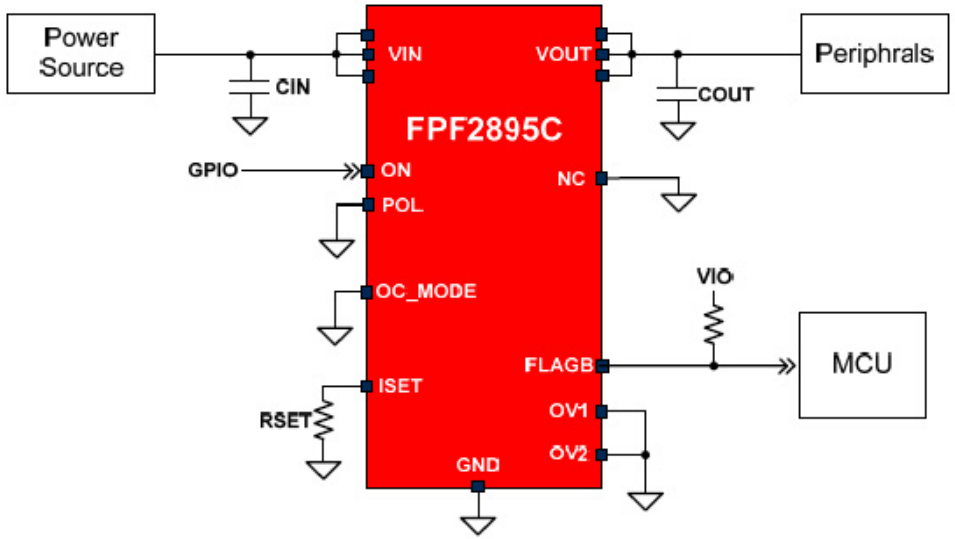
FPF2895C

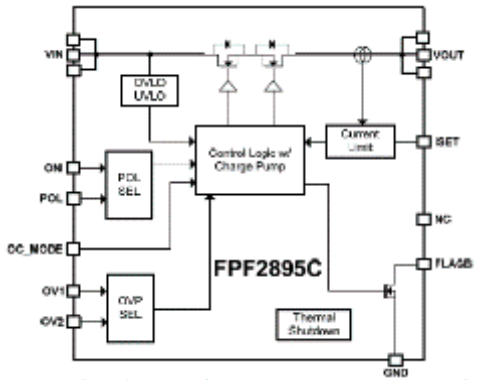
28V/5A ILIM Switch w/ OVP & TRCB for USB PD

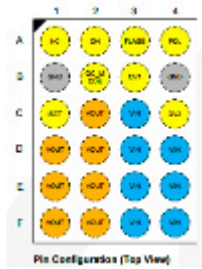
Production

Benefits

- Tolerant to HV on both side without extra protection
- Fully support USB type C with PD







Features

- Low On-Resistance: Typ. 27mΩ @VIN=5V
- 28V Vabs for VIN and VOUT
- Maximum 5A DC current capability
- Precise Adjustable ILIM:
  - 0.5~2.0A with ±10% accuracy
  - 2.0~5.0A with ±5% accuracy
- Selectable ON polarity and OVLO trigger point
- Selectable OC behavior
  - Auto-restart
  - Current source
- True Reverse Current Block (TRCB)
- Open-Drain OCP warning on FLAGB
- Package:
  - WLCSP-24 with Backside Laminate
  - 1.68mm x 2.7mm, 0.4mm ball pitch

Applications

- Mobile device and smart phones
- Portable media devices
- Advanced Notebook, UMPC and MID

USB-C Interface Products Home Slide

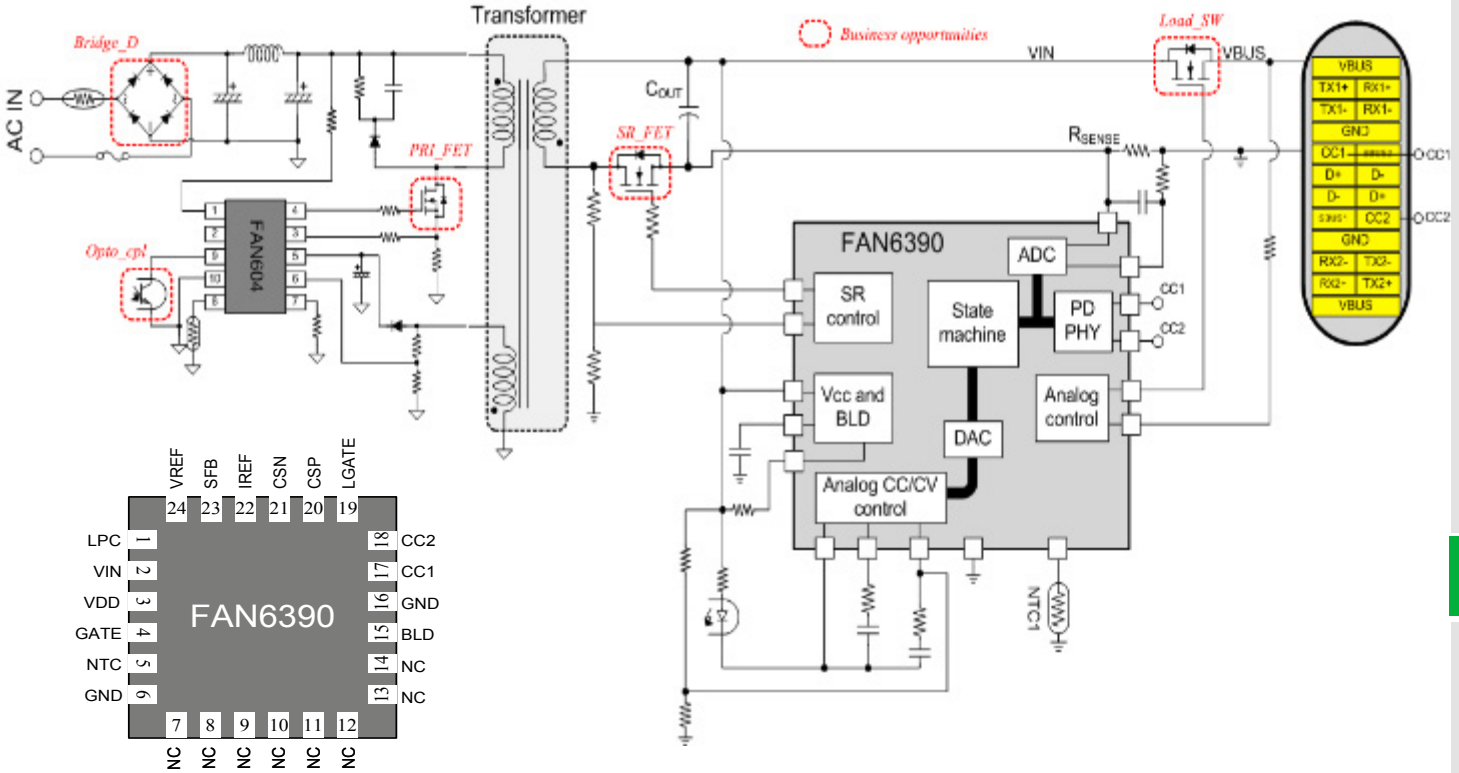
FAN6390

USB PD PPS protocol state machine controller with SR

In Production

Benefits

- USB PD3.0/PPS State Machine Engine
- Embedded SR Controller with Competitive Performance versus Independent SR Controller
- Support Low Cost N-FET for Load Switch



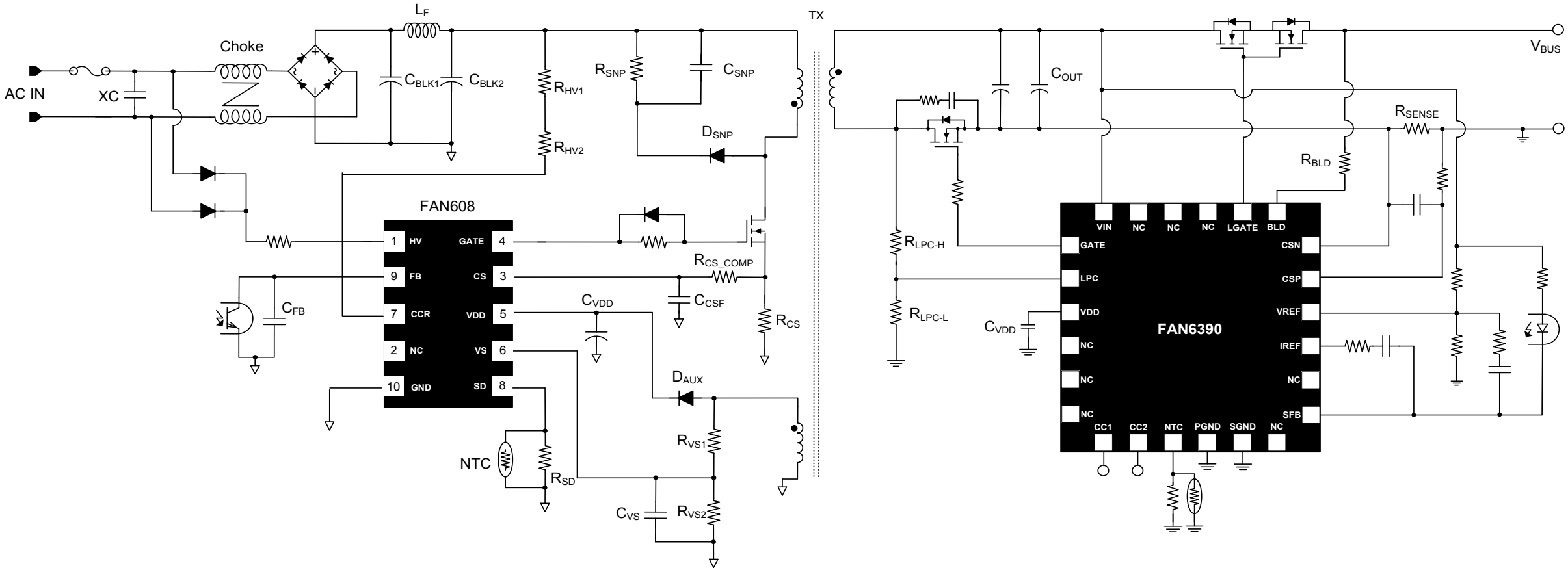
Features

- USB PD3.0 & PPS state machine controller with SR controller embedded
  - USB PD3.0 and PPS by state machine (no firmware required)
  - SR integration for easier secondary side system design
- 10bit DAC support
  - Min 20mV/step CV resolution for 3.3V~21V
  - Min 5mA/step CC resolution for up to 5A
- Support N-FET(back to back) for load SW
- Various options of protection modes for general power regulation and load switch control
- VBUS impedance detection to avoid cable burn-out
- NTC support temperature information
- Use 5mΩ Rsense for high efficiency
- 24-Lead QFNW (4.0mm x 4.0mm)

Applications

- Up To 100W USB PD 3.0 Applications
  - 20V Desktop/Notebook Adapters
  - Up to 20V Wall Outlet Embedded Chargers
  - Car Chargers, Power Banks Source Ports

FAN6390 Based USB-PD2.0/3.0/PPS System Application



In Development

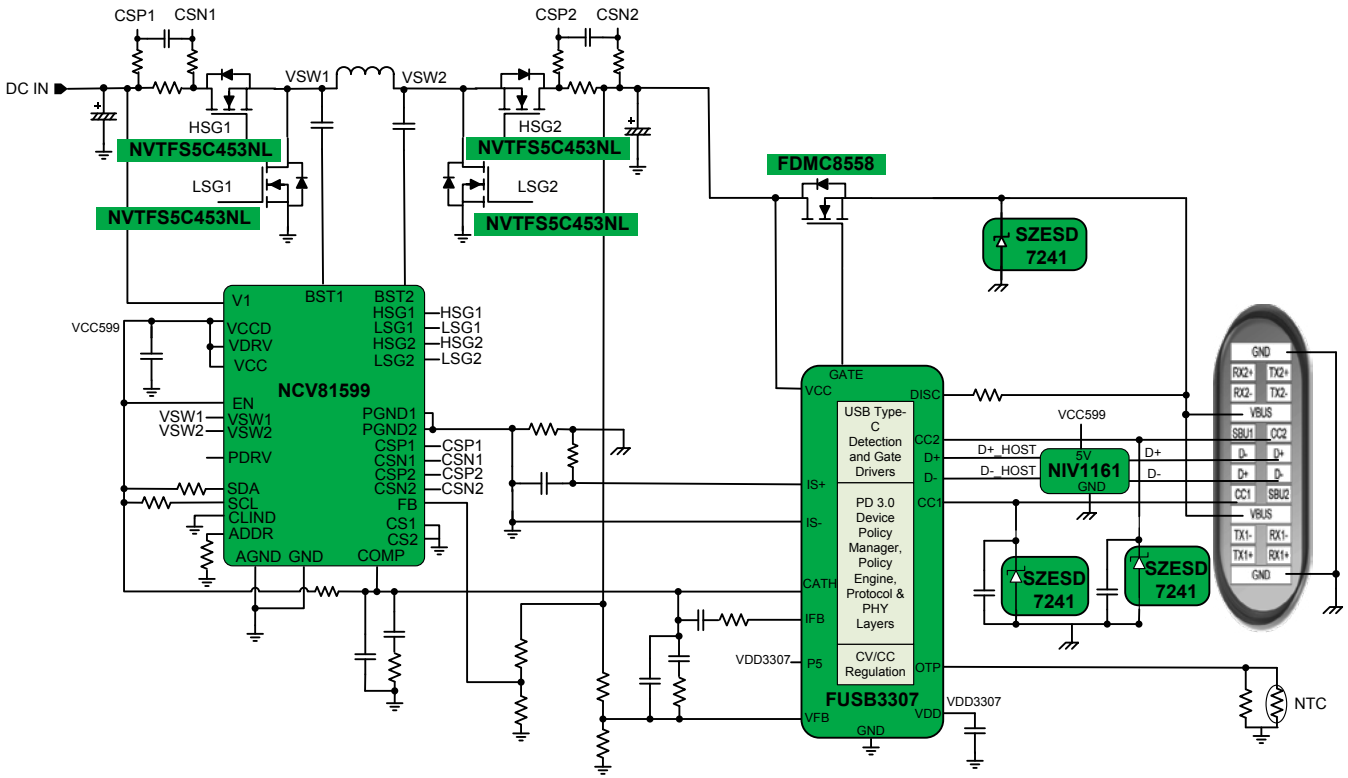
FUSB3307

USB Type-C & Power Delivery 3.0 Source Controller

Samples Now

Benefits

The FUSB3307 Enables a Fully Autonomous & Compliant Rev 1.3 Type-C and Rev 3.0 Power Delivery with PPS Solution for DC-DC and AC-DC Power Sources Delivering Pin Programmable Power From 16W to 100W



Features

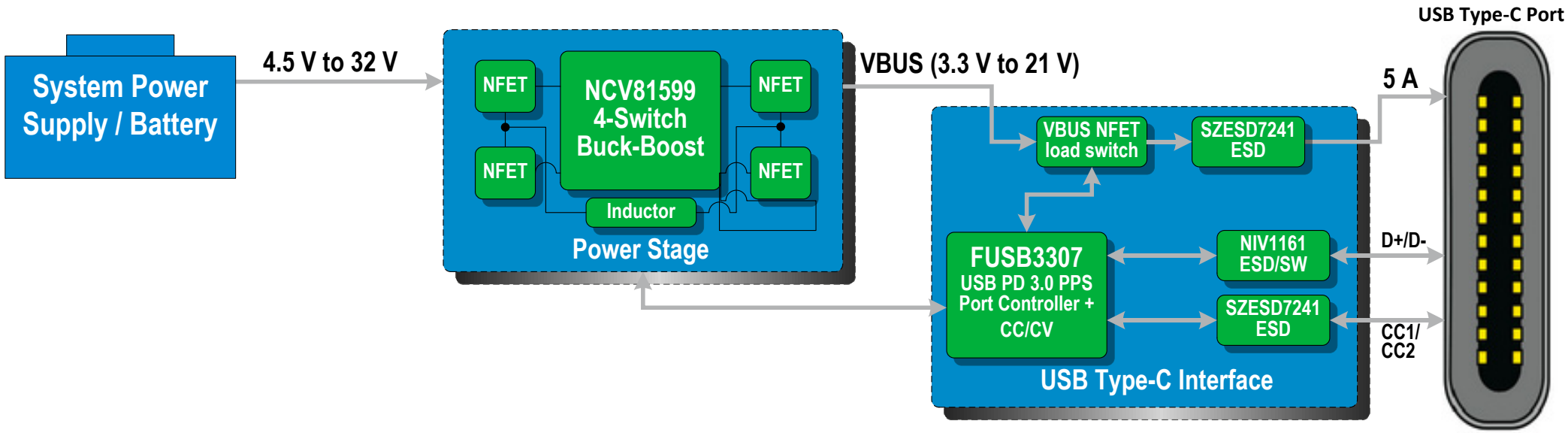
- Full Autonomous PD 3.0 v1.2 Source
- VBUS 3V to 21V (20mV Steps); Current 5A (50mA Steps)
- Up to 7 Fixed & Programmable(PPS) Power Data Objects
- 1W Step Factory & Pin Programmable Power Choices
- Constant Voltage / Constant Current Regulation
- VBUS NFET Gate Drivers & VBUS Discharge
- Low Cost Hardware Solution – No MCU Needed
- OVP/OCP/UVP/OTP; VBUS & CC1/CC2 Short Tolerance
- Internal VDD and VCONN Supplies
- Very Low Active Power
- 14-Lead SOIC (8.75mm x 4.0mm x 1.75mm)
- 20-Lead QFNW (4.0mm x 4.0mm)

Applications

- Up To 100W USB PD 3.0 Applications
  - 20V Desktop/Notebook Adapters
  - Up to 20V Wall Outlet Embedded Chargers
  - Car Chargers, Power Banks Source Ports

USB-C PD 3.0 PPS Reference Design

In Development

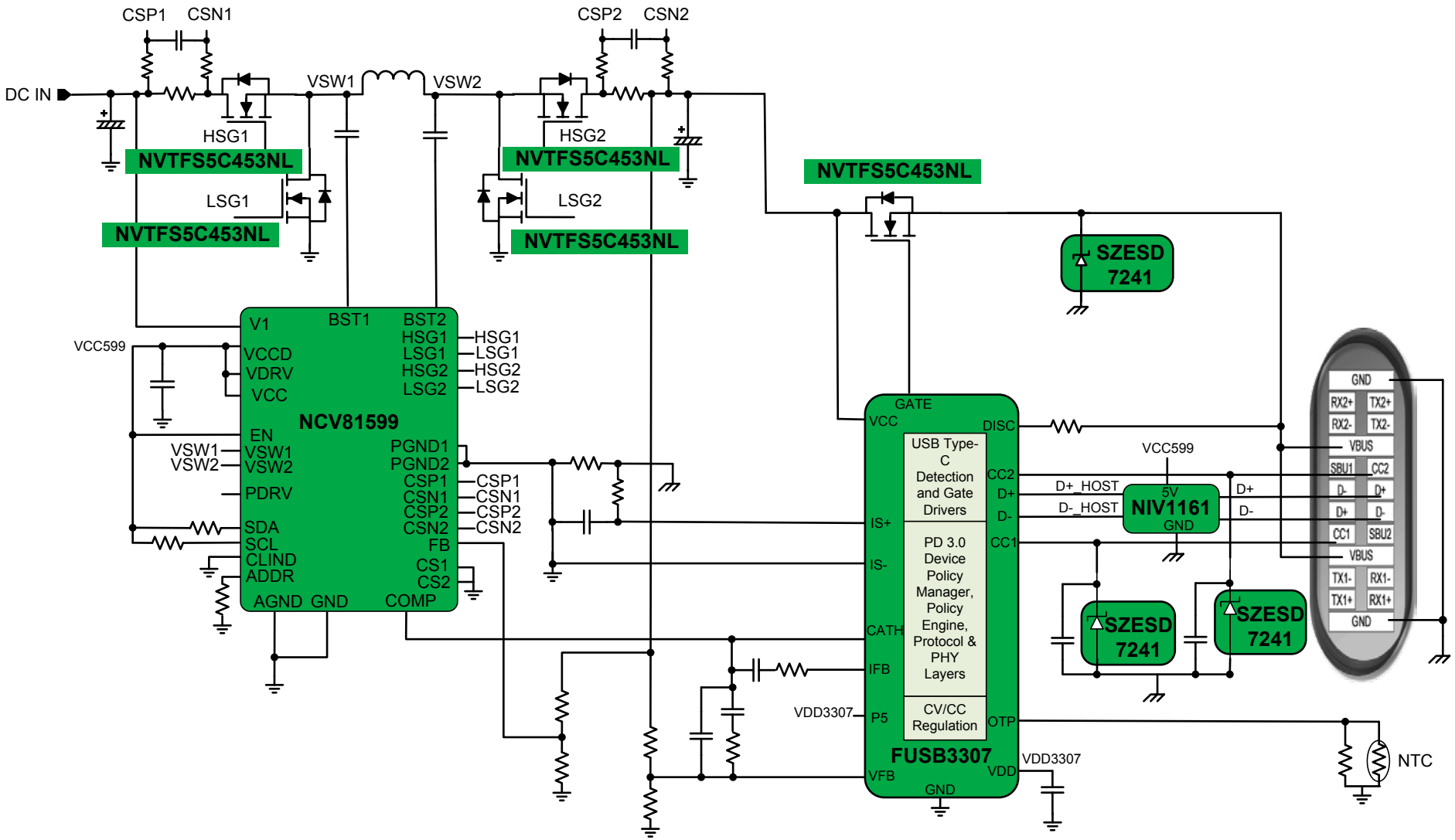


Features

- Automotive Single Port PD Power Solution compliant to USB PD 3.0 with Programmable Power Supply (PPS) with ECRs v1.2+
- 100% Duty Cycle Operation
- Very Low Standby Power
- Dual Edge Current Mode Modulation
- Input and Output Voltage and Current Monitoring
- Pin Programmable Power
- OVP/OCP/UVP/OTP, VBUS & CC OVP Protection
- Self Powered
- Drives Low Cost External NFETs
- Tiny Solution Size (20mm x 55mm)

Detailed Diagram of Automotive Port Power Solution

In Development



Public Information

ON Semiconductor USB-C SDK

Easy Integration

- Open-source reference code
- Fully documented API for customizations
- Easily configurable to required interface types

Full Support For Common Platforms

- Linux, Android and generic “None” build examples
- ARM – STM32F072 example provided
- PIC – PIC32MX795F512 example provided

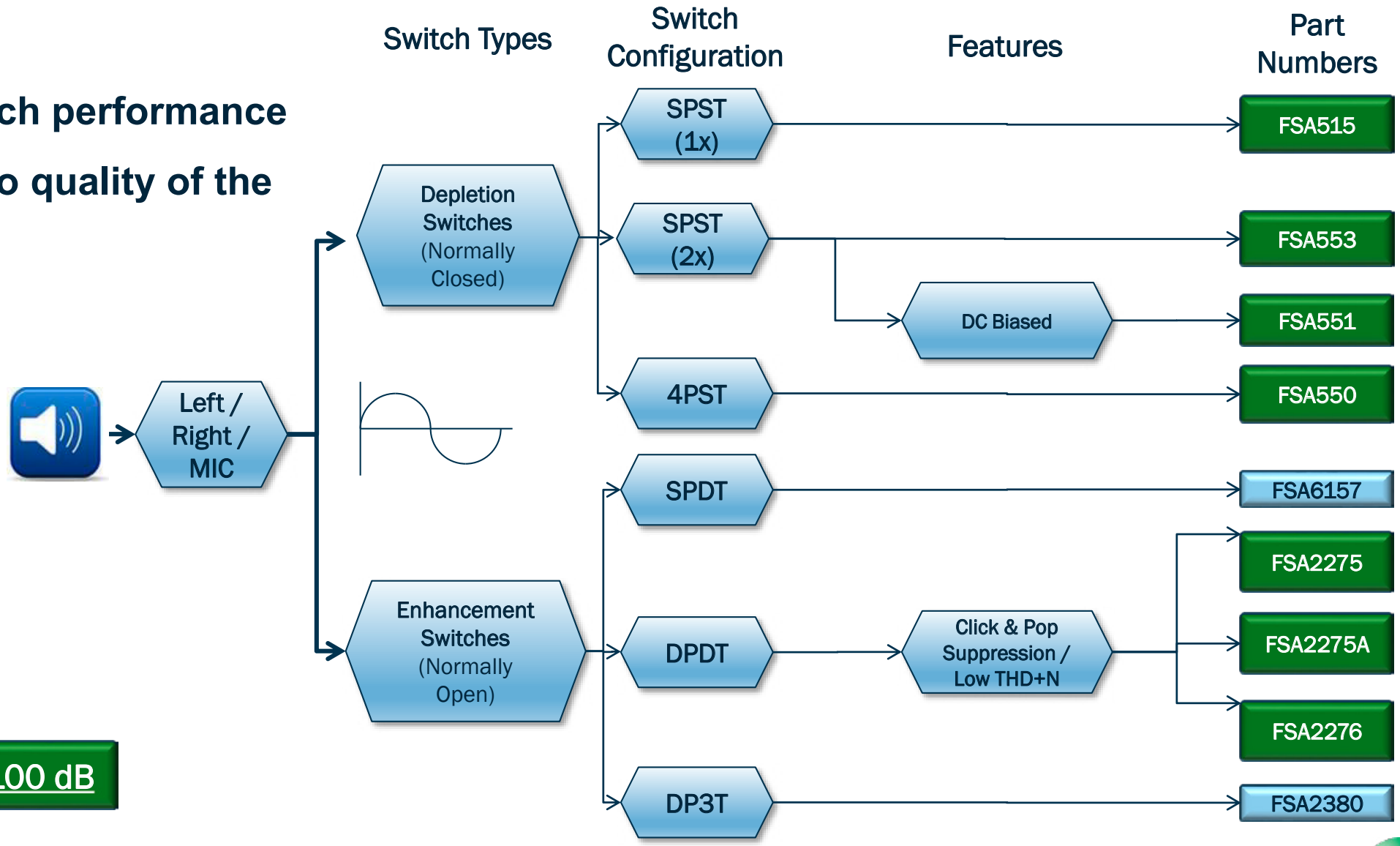
Stay Up To Date

- Automatic notification of code updates
- Maintained to USB-IF compliance events and testers
- Common learnings across all customers and applications

Type-C Audio Switches

High Performance Audio Switches (THD+N < -100 dB)

Poor THD+N switch performance can limit the audio quality of the entire system!



Indicates THD+N <-100 dB

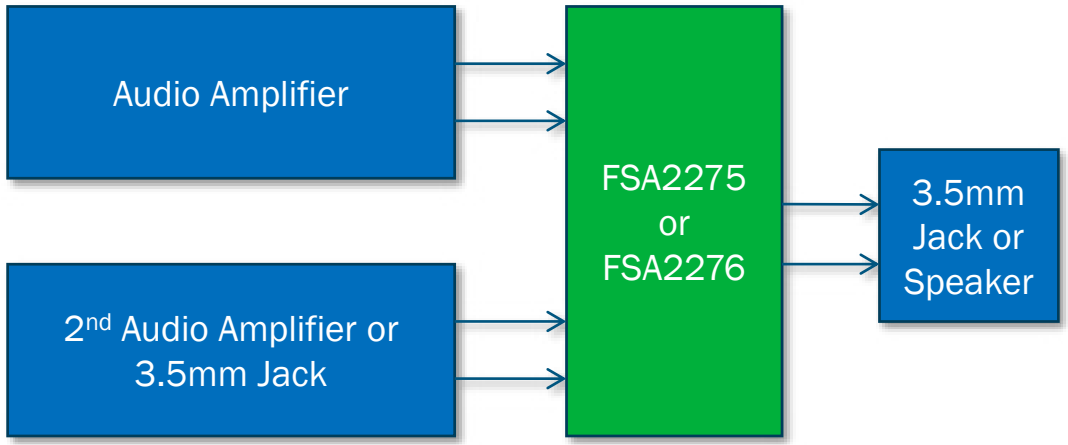
FSA2275/5A/6

DPDT (0.5Ω) HiFi Audio Switch w/ Click and Pop Suppression

Production

Benefits

- Low THD+N to not limit audio system performance
- Patented ability to suppress click and pop
- Superior off isolation performance with or without power
- Low current consumption, 70% lower than competitor
- Excellent ESD protection for direct port connections

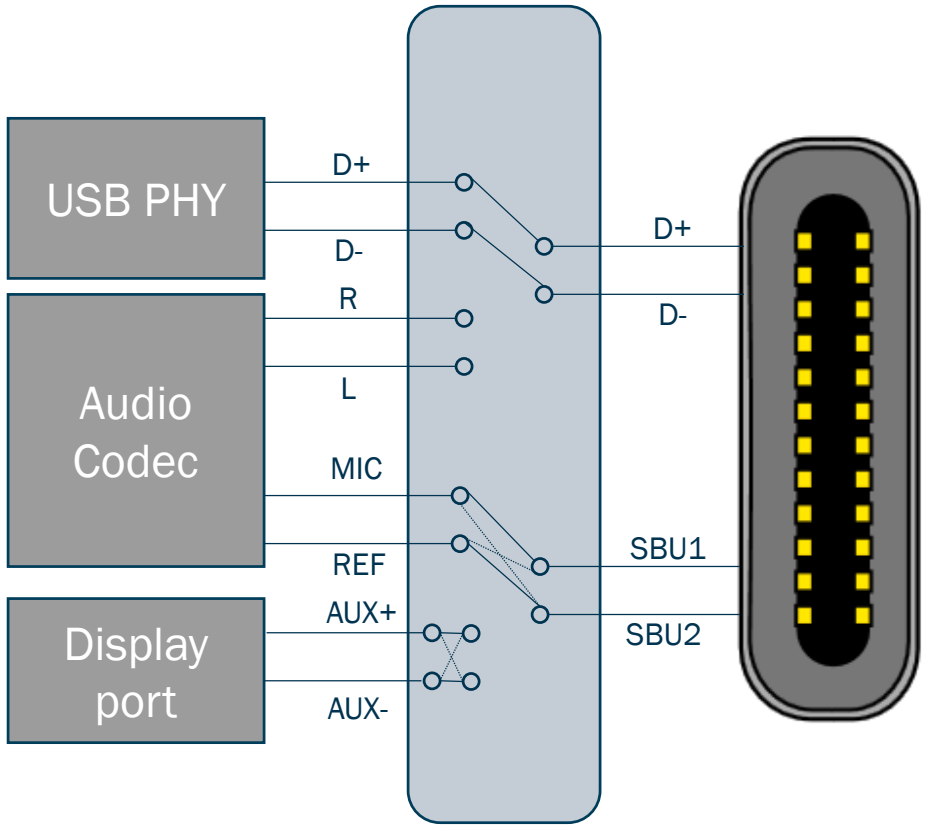


For mobile devices or headsets

Features

- Supply Range:
  - FSA2275*: 2.5V to 5.5V
  - FSA2276: 1.65V to 5.5V
- On-Resistance
  - 0.5 Ω Typical On Resistance (RON)
  - 5 mΩ Maximum RON Flatness
- THD+N
  - -115 dB; 2 VRMS, 20 kΩ Load; f=1 kHz
  - -113 dB; 2 VRMS, 32 Ω Load; f=20 Hz to 20 kHz
- Supply Current:
  - <1 µA when disabled
  - 7 µA when in standby
- ESD
  - 8kV IEC contact, 15kV IEC air
  - 5kV HBM, 2kV CDM
- Package
  - 12-Lead UMLP (1.8mm x 1.8mm)

USB Type-C Analog Audio Solutions



Discrete solution	
USB/Audio SW	FSA1153
MIC /GND	FSA2275A
Display port	FSA2275A
MIC/G+DP	3*FSA2275A

Integrated solution	
USB/Audio SW	FSA4476 FSA4480
MIC /GND	
Display port	
MIC/G+DP	

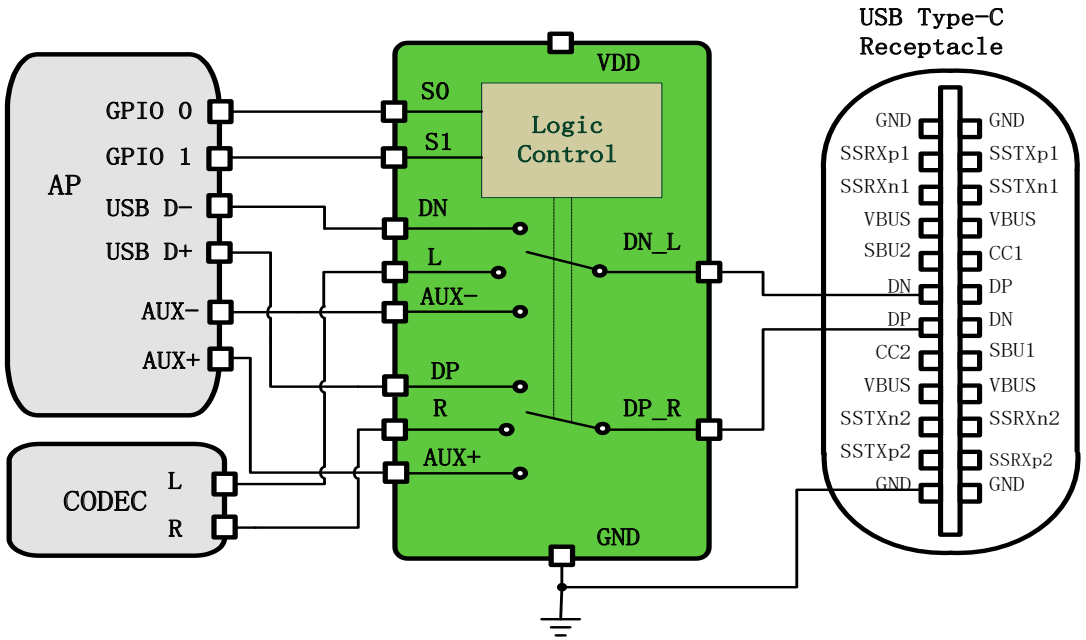
FSA1153

HS 3:1 USB2.0/AUDIO/AUX Type-C Analog Switch with Protection

Production

Benefits

- Provide integrated solution with USB2.0 high speed, Audio with negative swing range and providing a AUX data channel
- 20.5V OVP and ±20.5V Surge protection for Common Port DN_L/DP_R
- Excellent ESD protection: 8kV IEC contact, 15kV IEC air,4kV HBM, 1kV CDM



Feature

- Bi-Directional DP3T USB2.0 HS /Audio/AUX Analog Switch
- VDD operating range 3.3V/2.7-5.5V
- Icc: 30uA Typical, Iccz =1uA max
- 20.5V OV protection on Common Port DN_L/DP_R
- USB Switch: -3dB bandwidth 1GHz
- Audio Switch
  - Negative Swing range capability -3V to 3V
  - RON=1Ω(Typ) at Vcc=3.3V
  - THD+N= -110dB: 1 V_{RMS}, 32Ω Load; f = 20Hz~20kHz with A Weighted Filter
- AUX Switch: RON =5Ω(Typ) at Vcc=3.3V
- ±20.5V Surge protection on SBUx, GSBUx (IEC61000-4-5)
- 12-Ball WLCSP (1.41mm x 1.575mm)

Applications

- Mobile Phone, Tablets, Notebook PC
- Type C Accessories

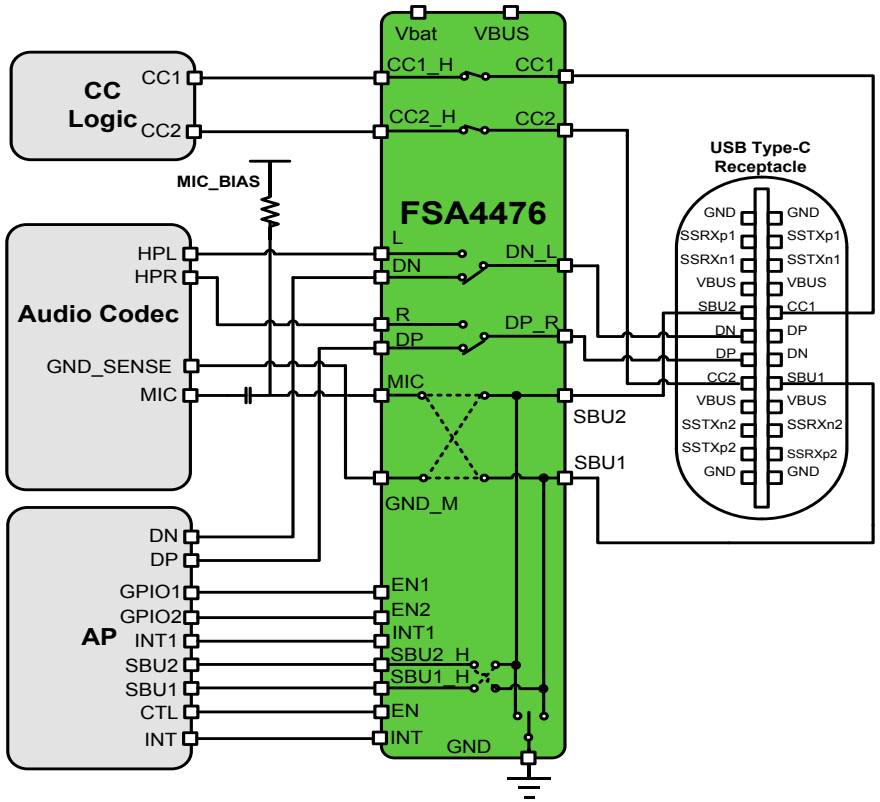
FSA4476

USB Type-C analog switch with protection

Production

Benefits

- Fully integrated high performance Type-C audio solution
- HV tolerance to protect internal silicon from surge, false connection



Features

- Vbat range from 2.7V to 5.5V (Primary)
- VBUS range from 4.0V to 20V (Active when VBAT is off)
- OVP function on Common node pins
- Power-Off Protection on Common Ports
- Analog Audio device unplug detection
- HiFi Audio/USB SW
  - Audio SW, THD+N <-110dB; 1 VRMS, 32 Ω Load;
  - USB SW, BW:1GHz
- MIC/GND SW
- 500m Ω on GND_M to SBUx
- 80m Ω on SBUx to GND
- SBU Bypass SW – 5 Ω Typical On Resistance
- 25-Ball WLCSP (2.03mm x 2.03mm)

Applications

- USB Type-C interface device, Mobile phone
- Tablets and Notebooks

USB-C Interface Products Home Slide

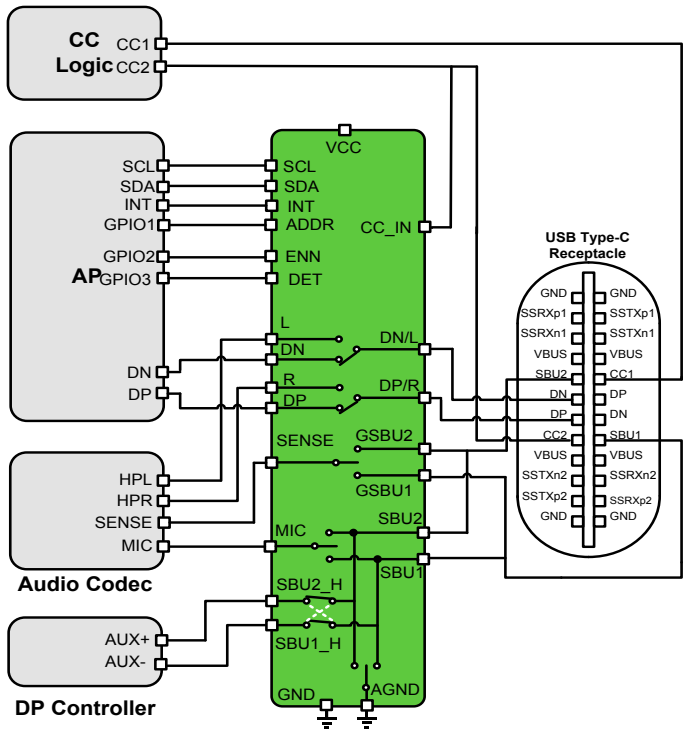
FSA4480

USB Type-C analog switch with protection

Production

Benefits

- HV tolerance to protect internal silicon from surge, false connection
- Provide feasibility to connect analog/digital audio accessory through USB Type-C interface



FSA4480

Features

- VCC range from 2.7V to 5.5V (Primary)
- OVP function on Common node pins
- Analog Audio device unplug detection
- 20V tolerance on connector side pins: DP/R,DN/L, CC_IN,GBSUx,SBUx
- High performance Audio/USB SW
  - Audio SW, THD+N <-105dB; 1 VRMS, 32 Ω Load;
  - USB SW, BW:950 MHz
- 300m Ω on Sense to GSBUx
- 50m Ω on SBUx to AGND
- Software controllable through I2C interface
- 25-Ball WLCSP25 (2.24mm x 2.28mm)

Applications

- USB Type-C interface device
- Mobile phone, Tablets and Notebooks

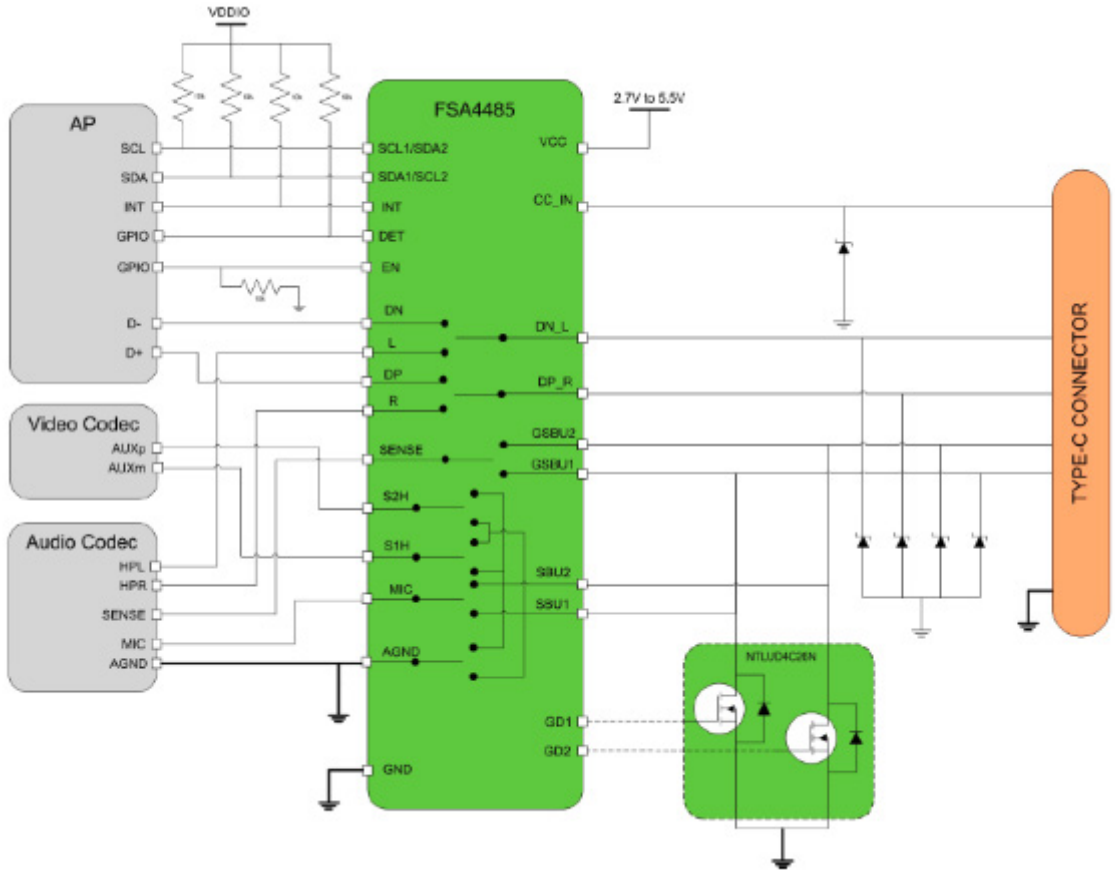
FSA4485

USB Type-C analog switch with protection

Samples

Benefits

- HV tolerance to protect internal silicon from surge, false connection
- Provides feasibility to connect analog/digital audio accessory through USB Type-C interface



Features

- VCC range from 2.7V to 5.5V (Primary)
- OVP function on Common node pins
- OCP function on SBU
- Gate Drive for optional external MOSFET.
- Factory Mode Power Up Function
- 16V tolerance on connector side pins: DP/R,DN/L, CC_IN,GBSUx,SBUx
- High performance Audio/USB SW
  - Audio SW, THD+N <-105dB; 1 VRMS, 32 Ω Load;
  - USB SW, BW: 1 GHz
- 250m Ω on Sense to GSBUx
- 75m Ω on SBUx to AGND
- Software controllable through I2C interface
- 25-Ball WLCSP25 (2.24mm x 2.28mm)

Applications

- USB Type-C interface device
- Mobile phone, Tablets and Notebooks

USB-C Interface Products Home Slide

FSA4476 vs. FSA4480 vs FSA4485 Comparison Table

Feature	FSA4476	FSA4480	FSA4485
USB/Audio Switch	Yes	Yes	Yes
MIC/GND Switch	Yes	Yes	Yes
Sense Switch	Yes	Yes	Yes
AUX Switch	Yes	Yes	Yes
CC Switch	Yes	No	No
GPIO/I2C	GPIO	I2C	2 Address I2C
OVP	Yes	Yes	Yes
Switch Slow Turn-on	No	Yes	Yes
OMTP/CITA Detection	No	Yes	Yes
MOSFET Gate Driver	No	No	Yes x2
Factory Mode Data Switch	No	No	Yes
Moisture Detection	No	Yes	Yes
Over Current Protection	No	No	Yes

USB-C Interface Products Home Slide

TA Solution Comparison

TA	Controller IC	Ports	QC2.0	QC3.0	QC4.0	PD2.0	PD3.0	PPS	SCP	FCP	AFC	APPLE2.4	BC1.2
MDY-11-EF_xiaomi inbox 30W	IP2718	Type A	V	V		V	V		V	V	V	V	V
ADC90TM_xiaomi inbox 90W for PC	WT6615F	Type C		V	V		V	V					
AD653_xiaomi after market 65W	CCG3+FP6601Q	2A1C	V	V						V	V	V	
AD651_xiaomi after market 65W	WT6636	1C	V	V			V				V	V	
MDY-11-EB_xiaomi inbox 65W for MI10	WT6633P	Type A	V	V	V		V						
MDY-08-ES_xiaomi inbox 18W	INN2215K	Type A	V	V									
MDY-10-ED_xiaomi inbox 18W	IP2161	Type A	V	V					V			V	V
HW-200200CP1_huawei 65W aftermarket 65W	RT7752/RT7207KB	Type C	V				V		V	V			

Offices

AUSTRIA
Vienna
Phone: +43 186 642 300
Fax: +43 186 642 350
wien@avnet.eu

BELGIUM
Merelbeke
Phone: +32 9 210 24 70
Fax: +32 9 210 24 87
gent@avnet.eu

BULGARIA
Sofia
sofia@avnet.eu

CZECH REPUBLIC (SLOVAKIA)
Prague
Phone: +420 234 091 031
Fax: +420 234 091 030
praha@avnet.eu

DENMARK
Herlev
Phone: +45 432 280 10
Fax: +45 432 280 11
herlev@avnet.eu

ESTONIA (LATVIA, LITHUANIA)
Pärnu
Phone : +372 56 637737
paernu@avnet.eu

FINLAND
Espoo
Phone: +358 207 499 200
Fax: +358 207 499 280
helsinki@avnet.eu

FRANCE (TUNISIA)
Cesson Sévigné
Phone: +33 299 838 485
Fax: +33 299 838 083
rennes@avnet.eu

Illkirch
Phone: +33 390 402 020
Fax: +33 164 479 099
strasbourg@avnet.eu

Massy Cedex
Phone: +33 164 472 929
Fax: +33 164 470 084
paris@avnet.eu

Toulouse
Phone: +33 05 62 47 47
toulouse@avnet.eu

Vénissieux Cedex
Phone: +33 478 771 360
Fax: +33 478 771 399
lyon@avnet.eu

GERMANY
Berlin
Phone: +49 30 214 882 0
Fax: +49 30 214 882 33
berlin@avnet.eu

Freiburg
Phone: +49 761 881 941 0
Fax: +49 761 881 944 0
freiburg@avnet.eu

Hamburg
Phone: +49 40 608 235 922
Fax: +49 40 608 235 920
hamburg@avnet.eu

Holzwickede
Phone: +49 2301 919 0
Fax: +49 2301 919 222
holzwickede@avnet.eu

Lehrte
Phone: +49 5132 5099 0
hannover@avnet.eu

Leinfelden-Echterdingen
Phone: +49 711 782 600 1
Fax: +49 711 782 602 00
stuttgart@avnet.eu

Leipzig
Phone: +49 34204 7056 00
Fax: +49 34204 7056 11
leipzig@avnet.eu

Nürnberg
Phone: +49 911 24425 80
Fax: +49 911 24425 85
nuernberg@avnet.eu

Poing
Phone: +49 8121 777 02
Fax: +49 8121 777 531
muenchen@avnet.eu

Wiesbaden
Phone: +49 612 258 710
Fax: +49 612 258 713 33
wiesbaden@avnet.eu

HUNGARY
Budapest
Phone: +36 1 43 67215
Fax: +36 1 43 67213
budapest@avnet.eu

ITALY
Cusano Milanino
Phone: +39 02 660 921
Fax: +39 02 660 923 33
milano@avnet.eu

Firenze
Phone: +39 055 428 2301
Fax: +39 055 431 035
firenze@avnet.eu

Modena
Phone: +39 059 348 933
Fax: +39 059 344 993
modena@avnet.eu

Padova
Phone: +39 049 807 368 9
Fax: +39 049 773 464
padova@avnet.eu

Rivoli
Phone: +39 011 204 437
Fax: +39 011 242 869 9
torino@avnet.eu

Roma Tecnocittà
Phone: +39 06 412 319 10
Fax: +39 06 413 116 1
roma@avnet.eu

NETHERLANDS
Breda
Phone: +31 765 722 700
Fax: +31 765 722 707
breda@avnet.eu

NORWAY
Asker
Phone: +47 667 736 00
Fax: +47 667 736 77
asker@avnet.eu

POLAND
Gdansk
Phone: +48 58 307 81 51
Fax: +48 58 307 81 50
gdansk@avnet.eu

Katowice
Phone: +48 32 259 50 10
Fax: +48 32 259 50 11
katowice@avnet.eu

Warszawa
Phone: +48 222 565 760
Fax: +48 222 565 766
warszawa@avnet.eu

PORTUGAL
Vila Nova de Gaia
Phone: +35 1 223 779 502
Fax: +35 1 223 779 503
porto@avnet.eu

ROMANIA (BULGARIA)
Bucharest
Phone: +40 21 528 16 32
Fax: +40 21 529 68 30
bucuresti@avnet.eu

RUSSIA (BELARUS, UKRAINE)
Moscow
Phone: +7 495 737 36 70
Fax: +7 495 737 36 71
moscow@avnet.eu

Saint Petersburg
Phone: +7 812 245 1571
stpetersburg@avnet.eu

SLOVAKIA
Bratislava
Phone: +421 232 242 211
Fax: +421 232 242 210
bratislava@avnet.eu

SLOVENIA (BOSNIA AND HERZEGOVINA, CROATIA, MACEDONIA, MONTENEGRO, SERBIA)
Ljubljana
Phone: +386 156 097 50
Fax: +386 156 098 78
ljubljana@avnet.eu

SPAIN
Barcelona
Phone: +34 933 278 530
Fax: +34 934 250 544
barcelona@avnet.eu

Galdàcano. Vizcaya
Phone: +34 944 572 777
Fax: +34 944 568 855
bilbao@avnet.eu

Las Matas
Phone: +34 913 727 100
Fax: +34 916 369 788
madrid@avnet.eu

SWEDEN
Sundbyberg
Phone: +46 8 587 461 00
Fax: +46 8 587 461 01
stockholm@avnet.eu

SWITZERLAND
Rothrist
Phone: +41 62 919 555 5
Fax: +41 62 919 550 0
rothrist@avnet.eu

TURKEY (GREECE, EGYPT)
Kadikoy Istanbul
Phone: +90 216 528 834 0
Fax: +90 216 528 834 4
istanbul@avnet.eu

UNITED KINGDOM (IRELAND)
Berkshire
Phone: +44 1628 512 900
Fax: +44 1628 512 999
maidenhead@avnet.eu

Bolton
Phone: +44 1204 547 170
Fax: +44 1204 547 171
bolton@avnet.eu

Bucks, Aylesbury
Phone: +44 1296 678 920
Fax: +44 1296 678 939
aylesbury@avnet.eu

Stevenage, Herts, Meadway
Phone: +44 1438 788 310
Fax: +44 1438 788 250
stevenage@avnet.eu

ISRAEL
TEL-MOND
Phone: +972 (0)9 7780280
Fax: +972 (0)3 760 1115
avnet.israel@avnet.com

SOUTH AFRICA
Cape Town
Phone: +27 (0)21 689 4141
Fax: +27 (0)21 686 4709
sales@avnet.co.za

Durban
Phone: +27 (0)31 266 8104
sales@avnet.co.za

Johannesburg
Phone: +27 (0)11 319 8600
Fax: +27 (0)11 319 8650
sales@avnet.co.za