

Power Solutions

Wireless Charging



USB Type-C and Power Delivery



ST enables the **Wireless Charging World**



Wearable



Consumer &
Industrial



Dual Mode TRx



Multi-Coil



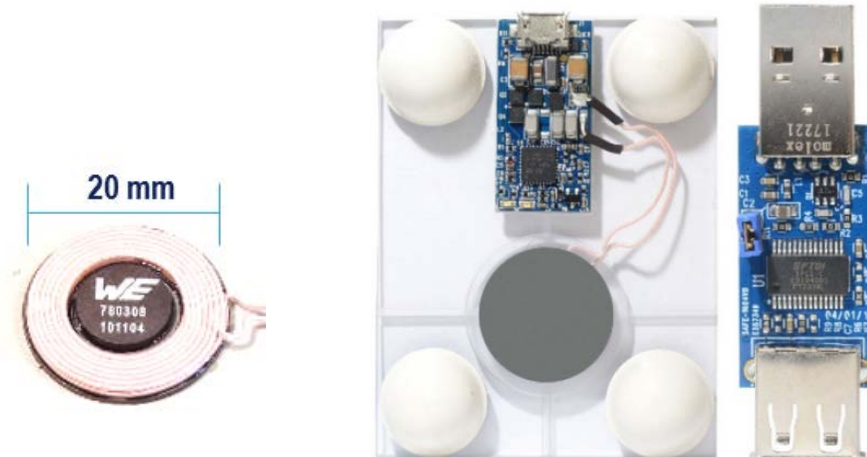


Wearable Solution

Wireless Charging Reference Design – 1-2.5W Watt Wireless Delivery

Transmitter

- STWBC-WA 2.5W STEVAL-ISB045V1
- 2-layer PCB and single-side placement
- 20mm coil



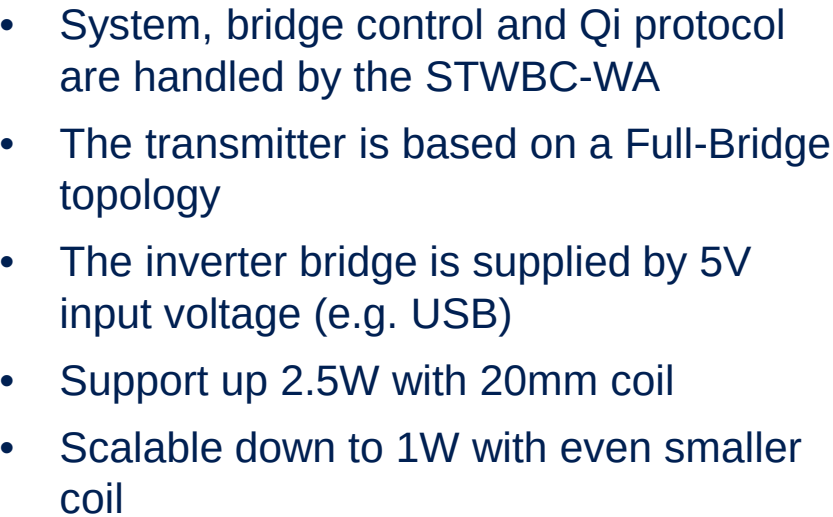
Receiver

- STWLC30 2.5W STEVAL-ISB043V1
- 3-Layer PCB and single-side placement
- Application area 10x6mm
- 26mm coil





Wireless Charging Reference Design – 2.5 Watt Transmitter Configuration

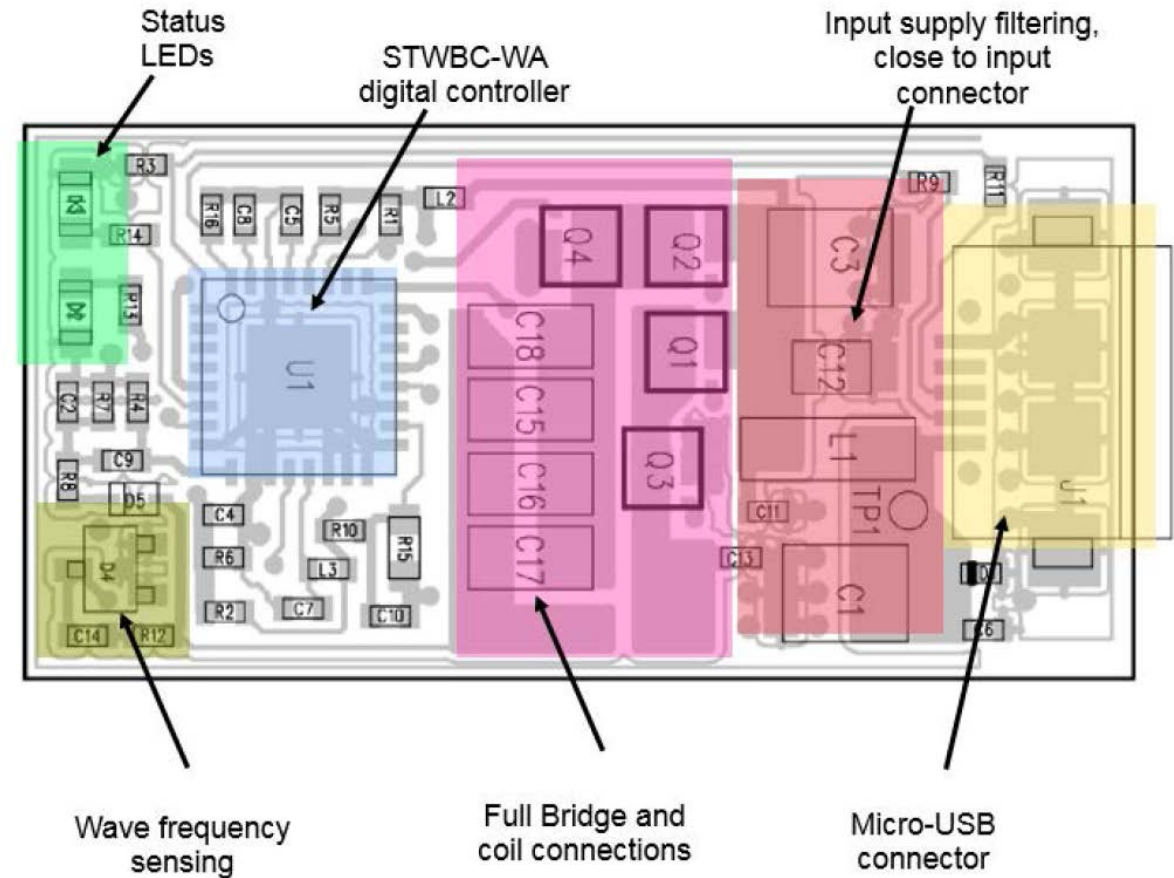
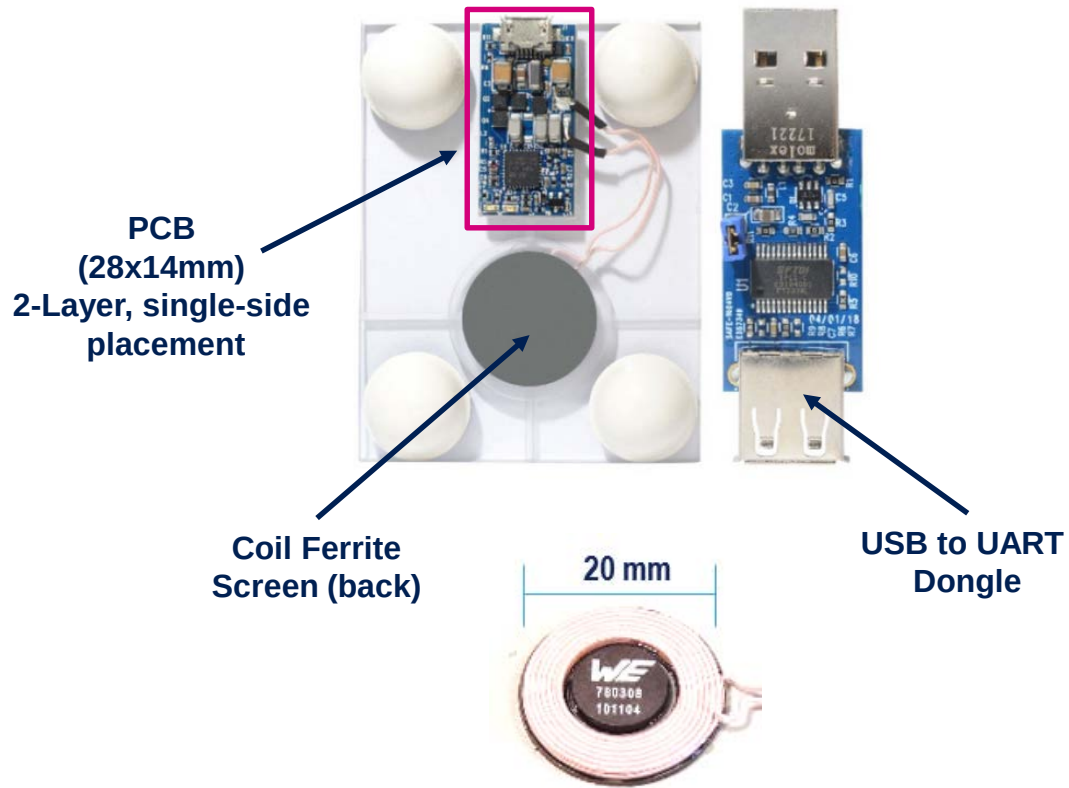




Wearable Solution

Wireless Charging Reference Design – 2.5 Watt Transmitter Reference Board

- STWBC-WA 2.5W STEVAL-ISB045V1

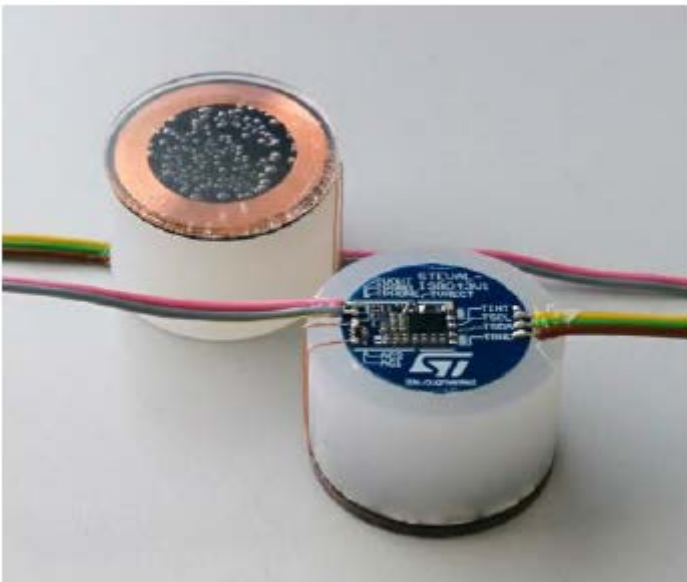




Wearable Solution

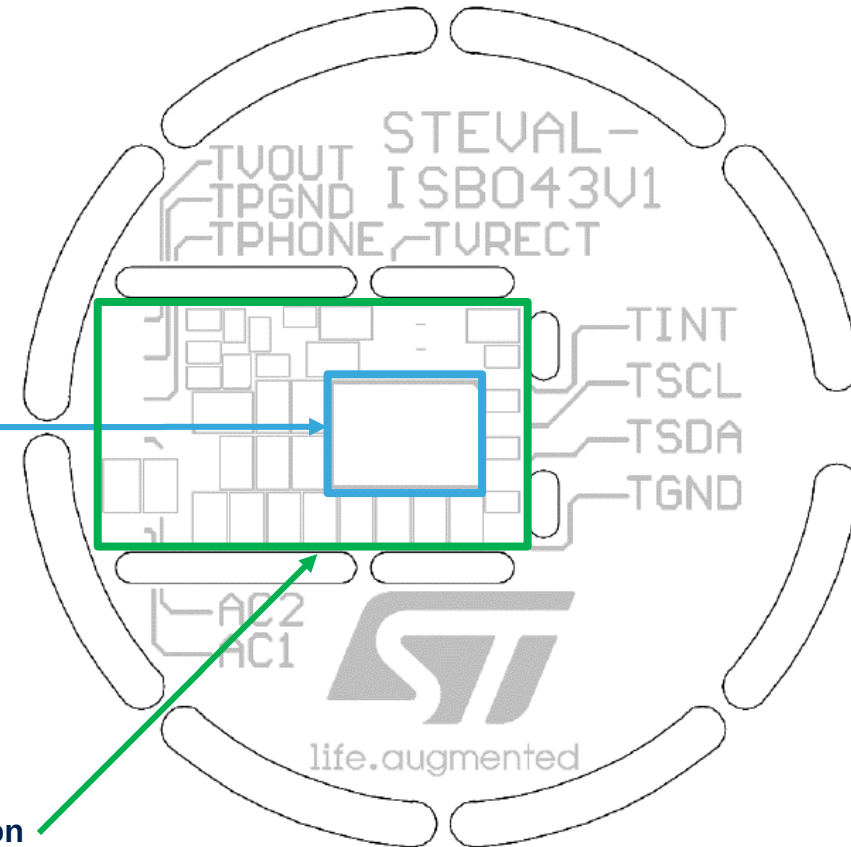
Wireless Charging Reference Design – 2.5W Receiver Reference Board

- STWLC30 – 2.5W STEVAL-ISB043V1
- 3-Layer PCB and single-side placement
- Application area 10x6mm



STWLC30
Receiver IC

Application
Area





Wearable Solution

Wireless Charging Reference Design – 2.5W TX - RX kit

Full Bridge 2.5W Transmitter based on STWBC-WA

5V 1A USB input power

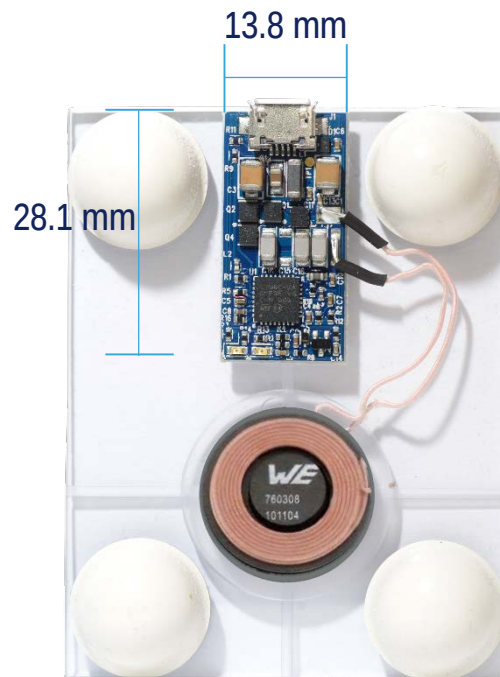
Smart standby
Automatic receiver recognition
Open FOD for increased safety
Patented demodulation

Wurth 760308101104
20 mm diameter coil

2-layer PCB with optimized eBOM possible
remote coil w/ dedicated tuning

Turnkey solution customization via GUI

Available Now



STEVAL-ISB045V1



STEVAL-ISB043V1

2.5W Receiver based on STWLC30

• 5V output voltage

• Space saving solution: 6x10mm
1mm total thickness (PCB + BOM)
• Coil Rx –Wurth 760308101309

Max. Z @ 2.5 W: 4 mm
Output Leakage: <1uA

67% total system efficiency with 1mm gap

Flip Chip 2.68mm x 4.026mm

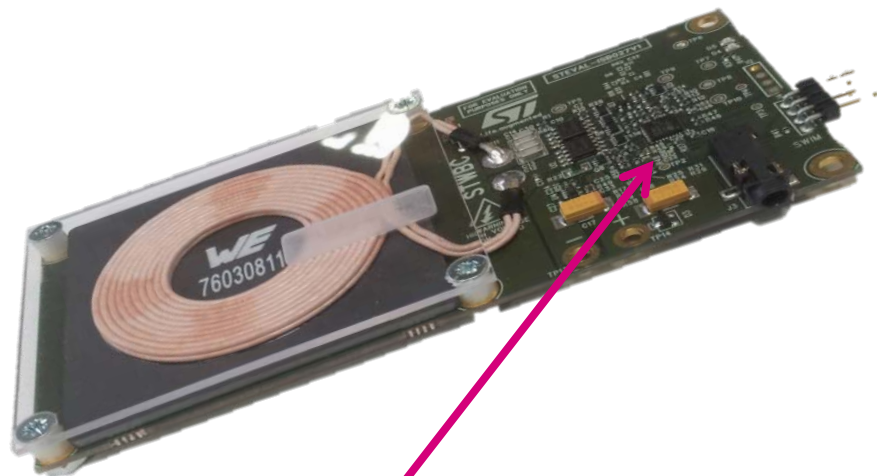
Available now



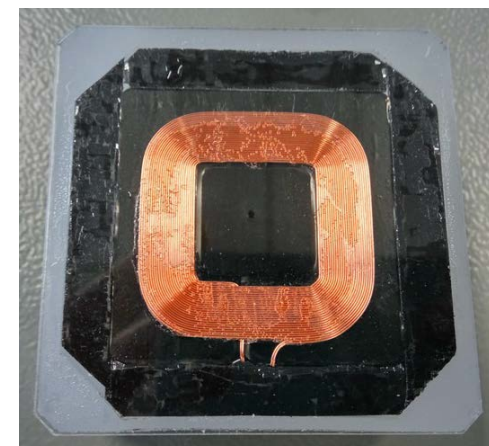
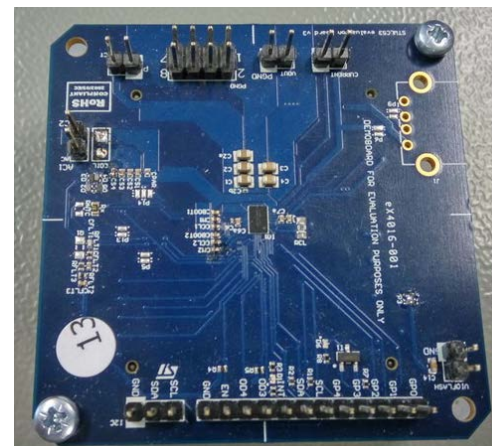


Consumer & Industrial Solution

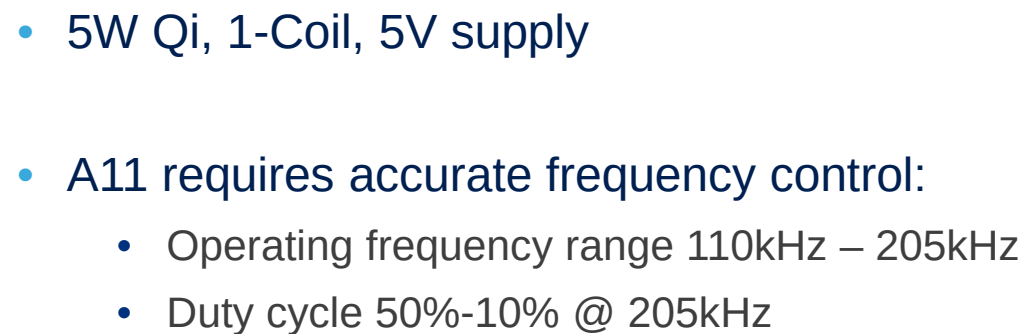
5W Transmitter and Receiver Kit



- STWBC 5W A11 STEVAL-ISP027V1
- 2-Layer PCB and single side placement
- 3mV consumption in stand-by
- Ping and FOD always active



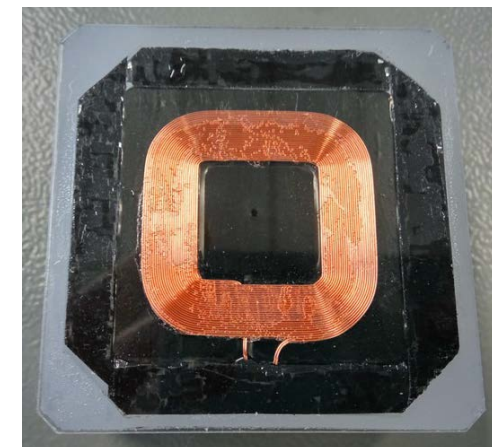
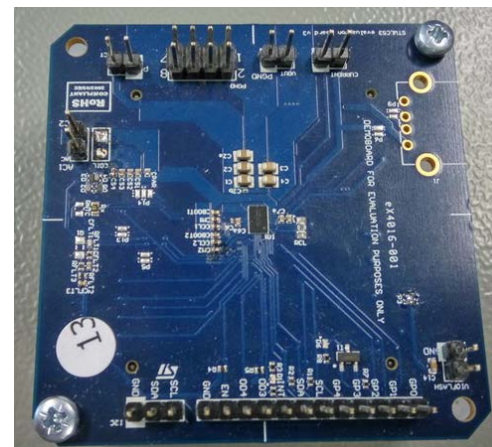
- STWLC33 – 15W / 5W Qi / AirFuel STEVAL-ISP042V1
- 4-Layer PCB and single-side placement
- Qi 1.2.3 and AirFuel Inductive certified
- 42x42mm coil
- BPP/EPP RX auto-switch (senses TX type)





Consumer & Industrial Solution

15W Transmitter and Receiver Kit



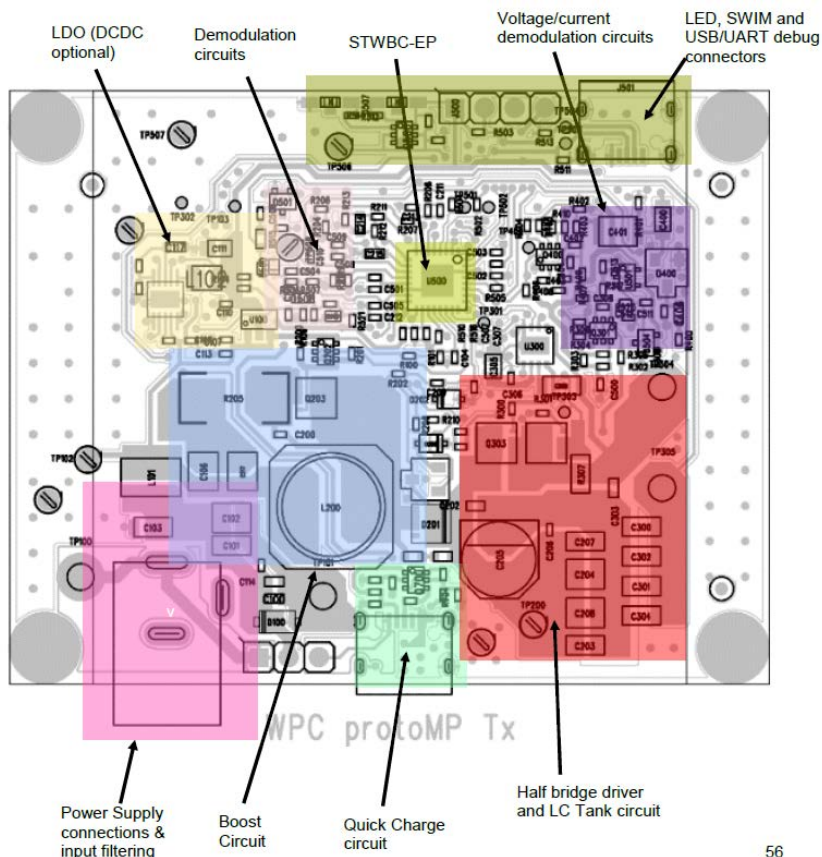
- STWBC-EP 15W MP-A10 STEVAL-ISB044V1
- 2-Layer PCB and single side placement
- 17mW consumption in stand by
- Ping and FOD always active

- STWLC33 – 15W Qi/AirFuel STEVAL-ISB042V1
- 4-Layer PCB and single-side placement
- Qi 1.2.3 and AirFuel Inductive certified
- 42x42mm coil
- BPP/EPP RX auto-switch (senses TX type)



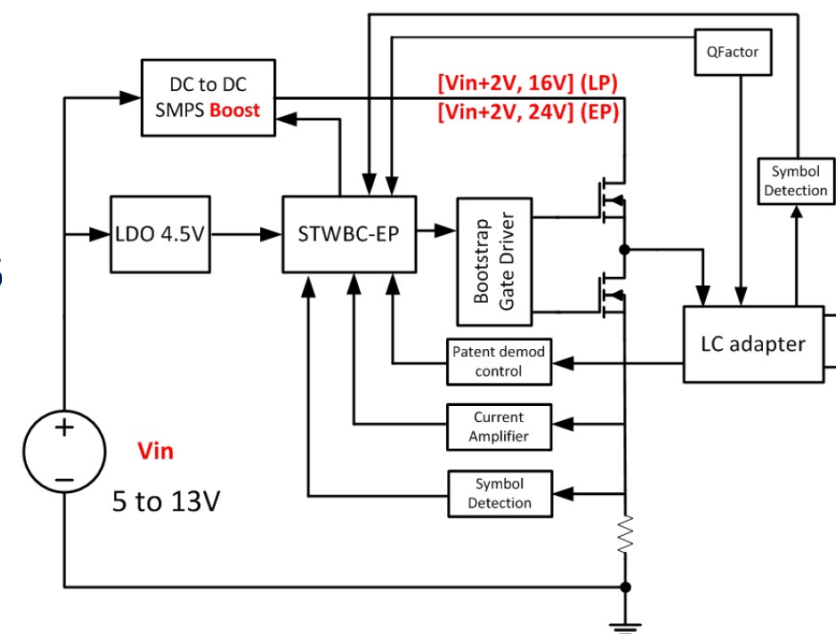
Consumer & Industrial Solution

15W Transmitter Reference Board



Certified Wireless Charger (15W)

- IC: STWBC-EP
- MP-A10 Design, Qi 1.2.3 Certified
- Support BPP and EPP (5W and 15W)
- Foreign Object Detection (FOD)
- 5-12V input voltage range
- Half-Bridge topology
- Voltage/Frequency Control
- Graphical Interface for testing



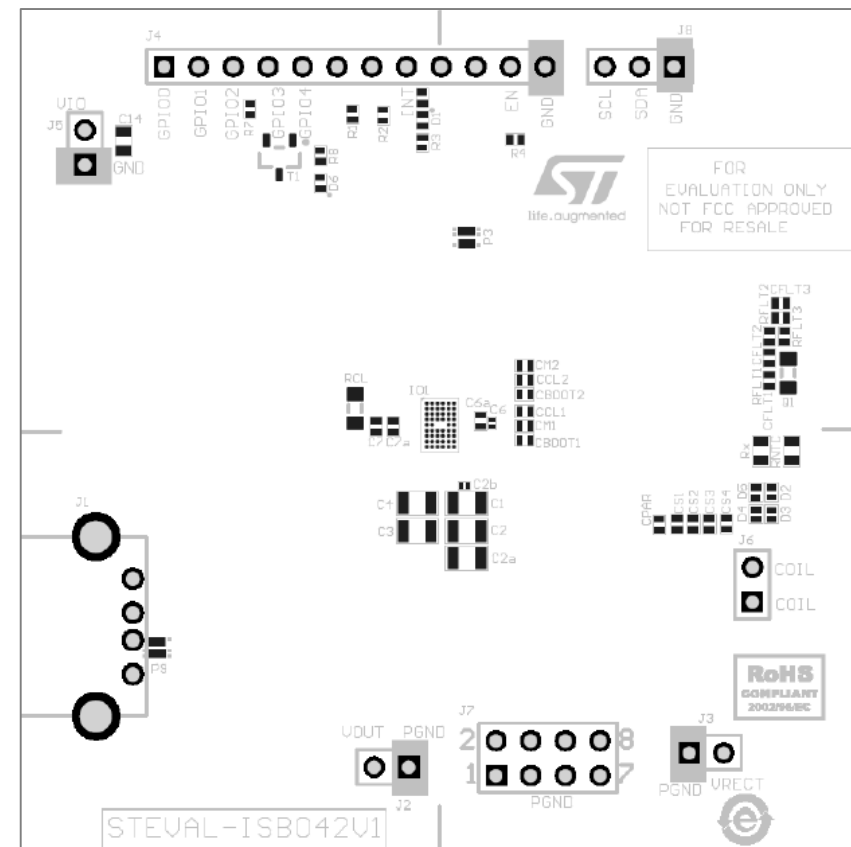


Consumer & Industrial Solution

15W RX STWLC33 – STEVAL-ISB042V1

Qi/AirFuel Inductive Certified Wireless Receiver with Transmit capability

- Up to 15 W output power in RX mode and **5 W in TX mode**
- Qi 1.2 and AirFuel inductive standard
- Integrated high efficiency synchronous rectifier
- Low drop regulator
- Total system efficiency up to 80%
- 32-bit, 32 MHz ARM Cortex microcontroller with 32 kB FW memory, 8 kB RAM memory, 4 kB NVM for configuration
- 10-bit 8-channel A/D converter
- Up to 5 configurable GPIOs
- Integrated 5 V LDO for auxiliary features
- Precise voltage and current measurements for FOD function
- Overvoltage clamp protection
- HW FSK and ASK demodulators
- I²C interface
- CSP 3.97x2.67 mm, 400 μ m pitch 52 balls



STWLC33 Dual Mode

Multi Mode Qi/Airfuel 15W Wireless Power Receiver with Tx function

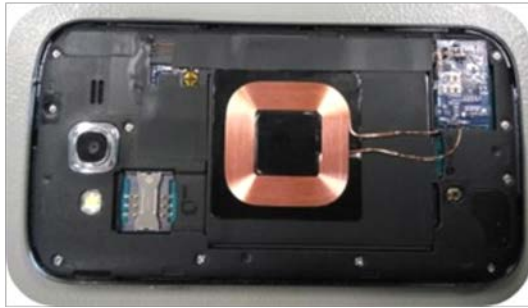


- STWLC33 works as a 15W RX
- STWLC33 also works as a 5W RX (same TX coil)
- Qi and Airfuel Inductive Standards as Transmitter
- Qi Based as Transmitter

STWLC33 DUAL MODE

STWLC33 Dual Mode – Retrofit example

Rx & Tx: STWLC33



Receiver: Qi and Airfuel Inductive Standards
5V fixed output Voltage – up to 5W
(due to phone limitation)

Transmitter: Qi based
Transmitted Power up to 3W

PCB Dimension 15x25mm
Coil Rx-Tx - TDK WR424245-13K2-G

The Phone and the Smartwatch presented at APEC have been both retrofitted with STWLC33. The phone will charge itself from a pad and, on request, will be able to charge the Smartwatch

Receiver: STWLC33



5V fixed output voltage
Li-Ion direct battery charging Option

- Space saving solution: 6x10mm
1mm total thickness (PCB + BOM)
- Coil Rx – TDK WR303050-15F5-G

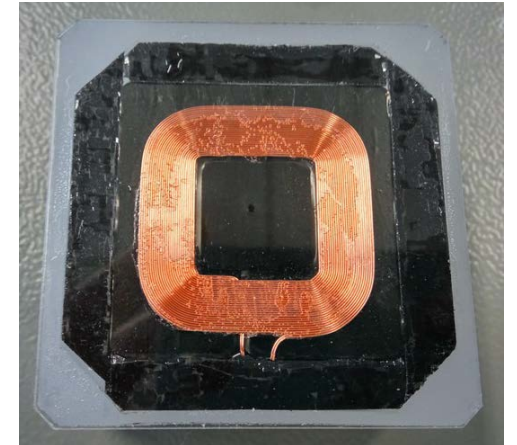
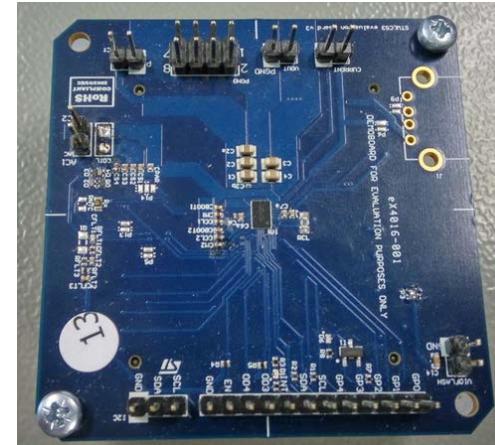
Max Output Power: 3W
Output Leakage: <1uA

Multi-Coil Solution

15W 3-coil Transmitter and Receiver Kit



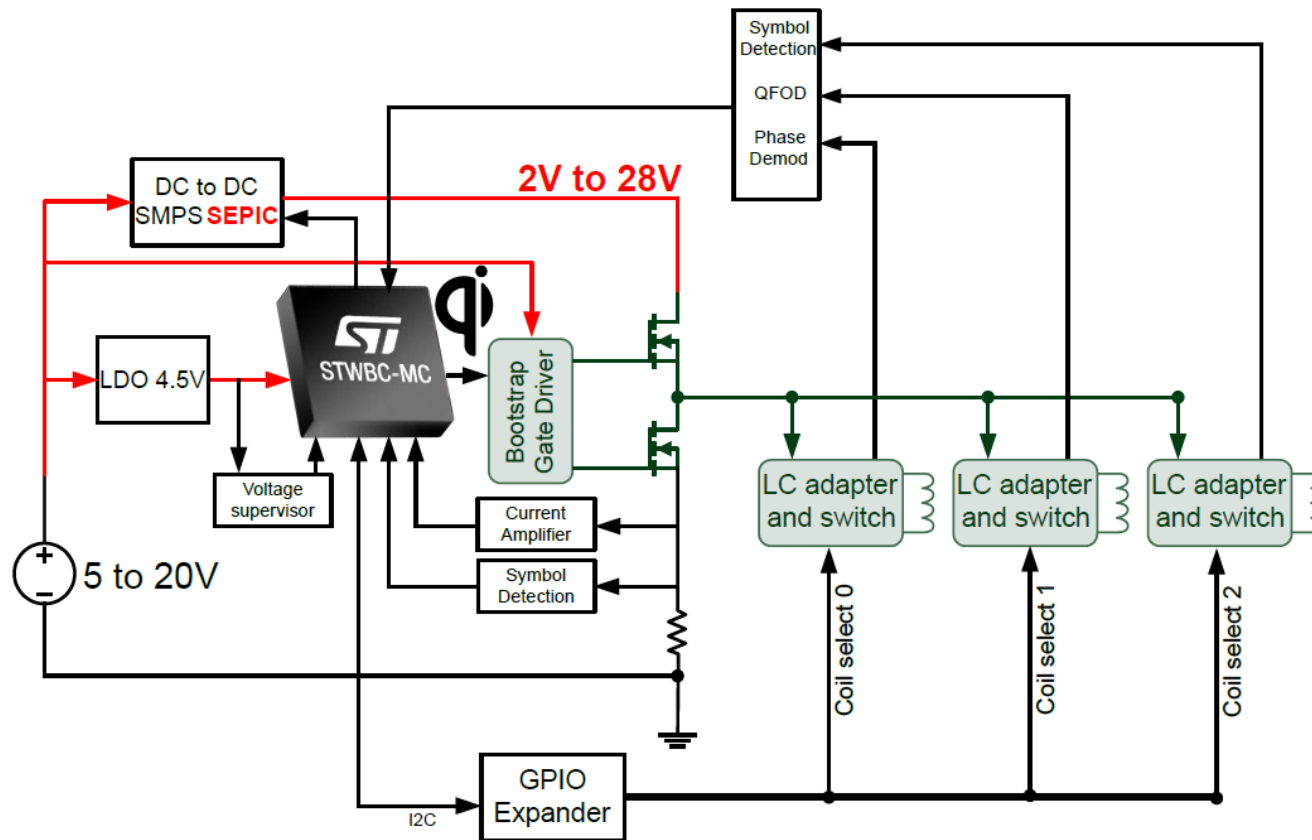
- STWBC-MC 15W MP-A15 STEVAL-ISB047V1
- 2-Layer PCB and single side placement
- 17mW consumption in stand by
- Ping and FOD always active
- Fast Charge Support



- STWLC33 – 15W Qi/AirFuel STEVAL-ISB042V1
- 4-Layer PCB and single-side placement
- Qi 1.2.3 and AirFuel Inductive certified
- 42x42mm coil
- BPP/EPP RX auto-switch (senses TX type)

Multi-Coil Solution

15W 3-coil Transmitter Configuration

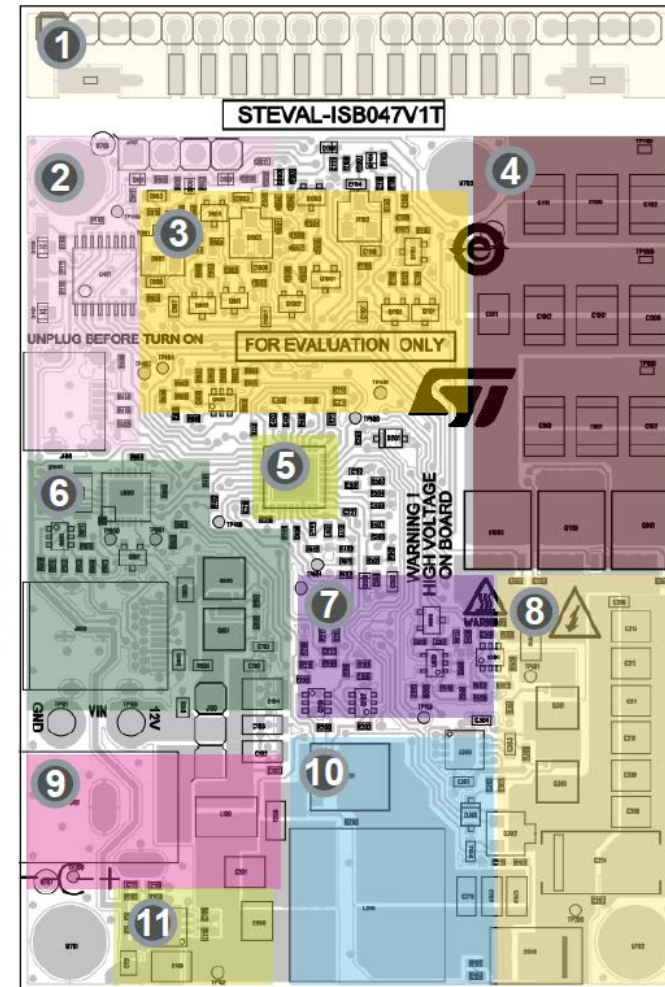
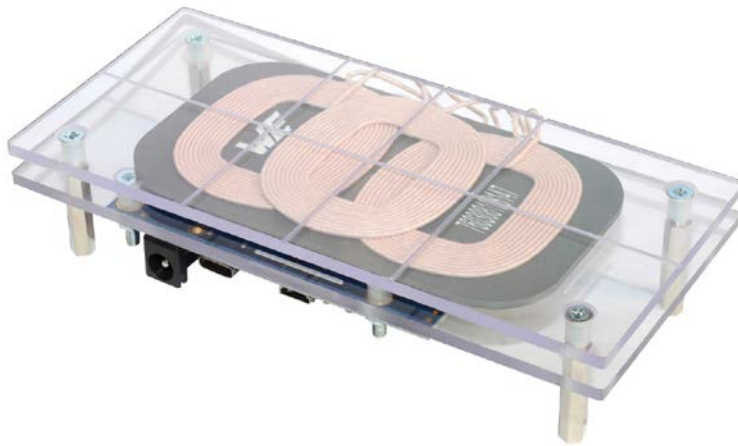


- STWBC-MC MP-A15
- Qi 1.2.4 EPP (Extended Power Profile) up to 15W and BPP up to 5W
- 127.7 kHz fixed frequency
- **Fast Charge support**
- Wide supply voltage range, 5 to 20V, with USB-C and support for legacy 5V USB

Multi-Coil Solution

15W 3-coil Transmitter Reference Board

- STWBC-MC 15W MP-A15 STEVAL-ISB047V1
- 2-Layer PCB ad single side placement
- Fast Charge Support



1. Test point for debugging only (may be removed)
2. LED, SWIM and USB/UART debug connectors
3. Sensing detection circuits
4. Coil selection and detection
5. STWBC-MC
6. USB PD/QC IO charger
7. Voltage/current demodulation circuits
8. Half bridge driver and LC Tank circuit
9. Jack power supply connections and input filtering
10. Sepic circuit
11. LDO

Standby

- 17mW consumption
- Ping active
- FOD active

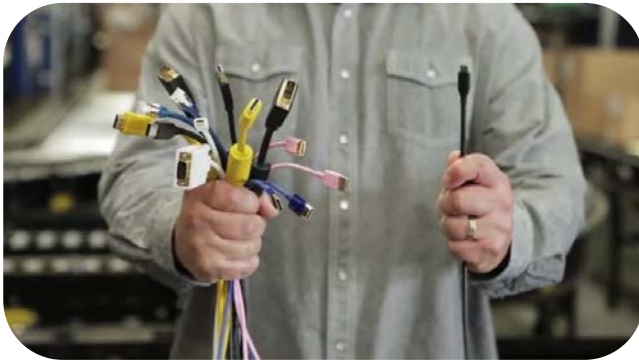


USB Type-C™ and Power Delivery



Overview:
Flexible, robust
solution for power
and interconnect

Type-C & USB-PD
Architecture



ST products for
Type-C & USB-PD

Type-C & USB-PD
Solution





The Re-evolution of USB

USB has evolved from a data interface capable of supplying limited power to a primary provider of power with a data interface



USB
Type-C



Power
Delivery



USB
Data



Alternate
Mode

A smart and green technology

- More **flexibility** with a new reversible & thinner connector, more robust
- More **power** with USB Power Delivery (up to 100W)
- More **speed** with USB 3.1 (5/10Gbps) or USB 3.2 (20Gbps)
- More **protocols** (Display Port, HDMI, Thunderbolt 3, ...)



USB Type-C™ Pin Outs Functions

Enhance ease of use

Receptacle



A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11	A12
GND	TX1+	TX1-	V _{BUS}	CC1	D+	D-	SBU1	V _{BUS}	RX2-	RX2+	GND
B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1
GND	RX1+	RX1-	V _{BUS}	SBU2	D-	D+	CC2	V _{BUS}	TX2-	TX2+	GND

Two pins on the USB Type-C receptacle, CC1 and CC2, are used in the discovery, configuration and management of connections across the USB Type-C cable

Plug



A12	A11	A10	A9	A8	A7	A6	A5	A4	A3	A2	A1
GND	RX2+	RX2-	V _{BUS}	SBU1	D-	D+	CC	V _{BUS}	TX1-	TX1+	GND
B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12
GND	TX2+	TX2-	V _{BUS}	V _{CONN}			SBU2	V _{BUS}	RX1-	RX1+	GND

On a standard USB Type-C cable, only a single CC wire within each plug is connected through the cable to establish signal orientation. The other CC pin is repurposed as V_{CONN} for powering electronics
Also, only one set of USB 2.0 D+/D- wires are implemented

High Speed Data Path
(RX for USB 3.1, or reconfigured in Alternate Mode)

High Speed Data Path
(TX for USB 3.1, or reconfigured in Alternate Mode)

USB 2.0 Interface

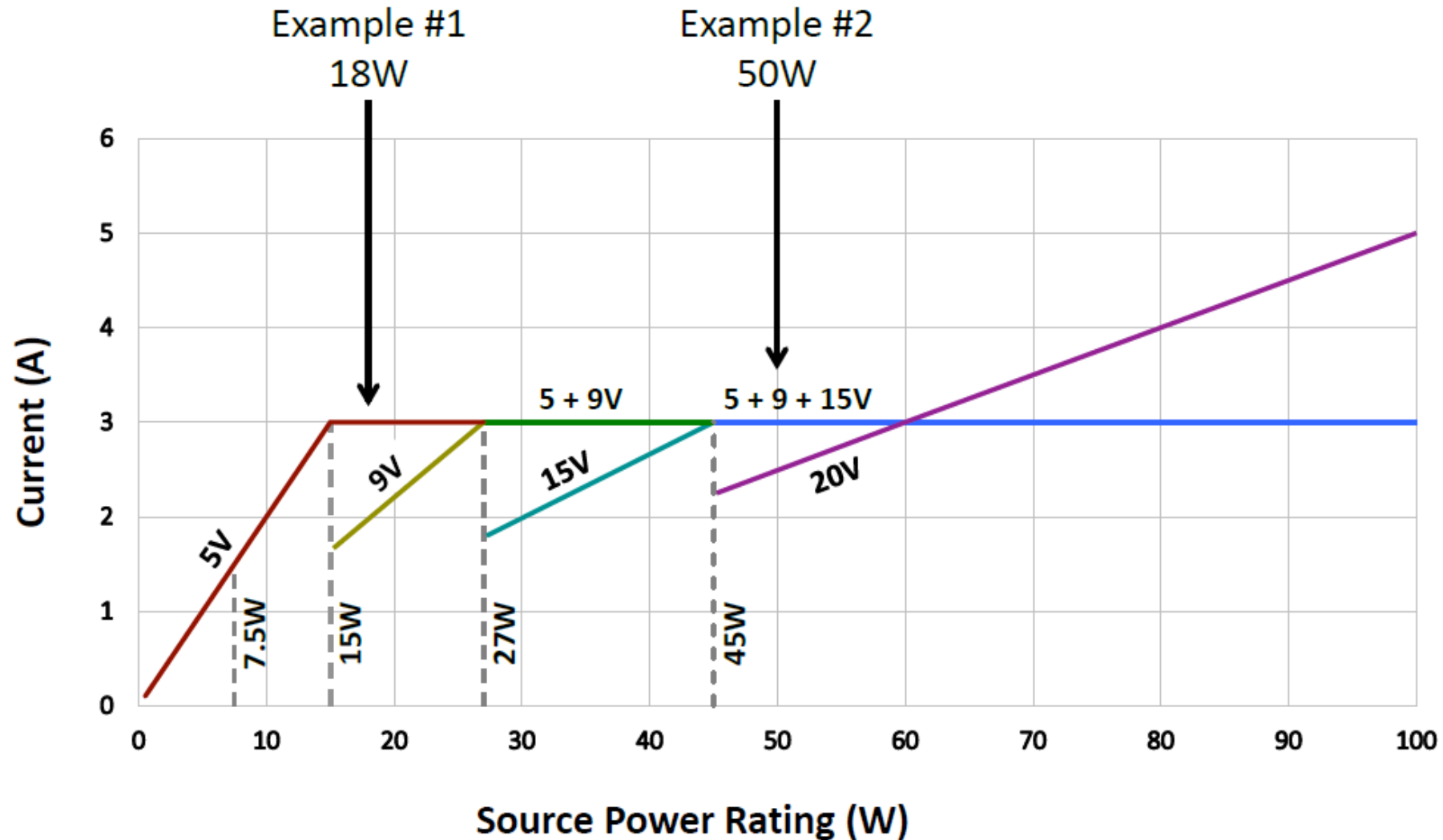
Cable Bus Power
(from 5V up to 20V)

Sideband use

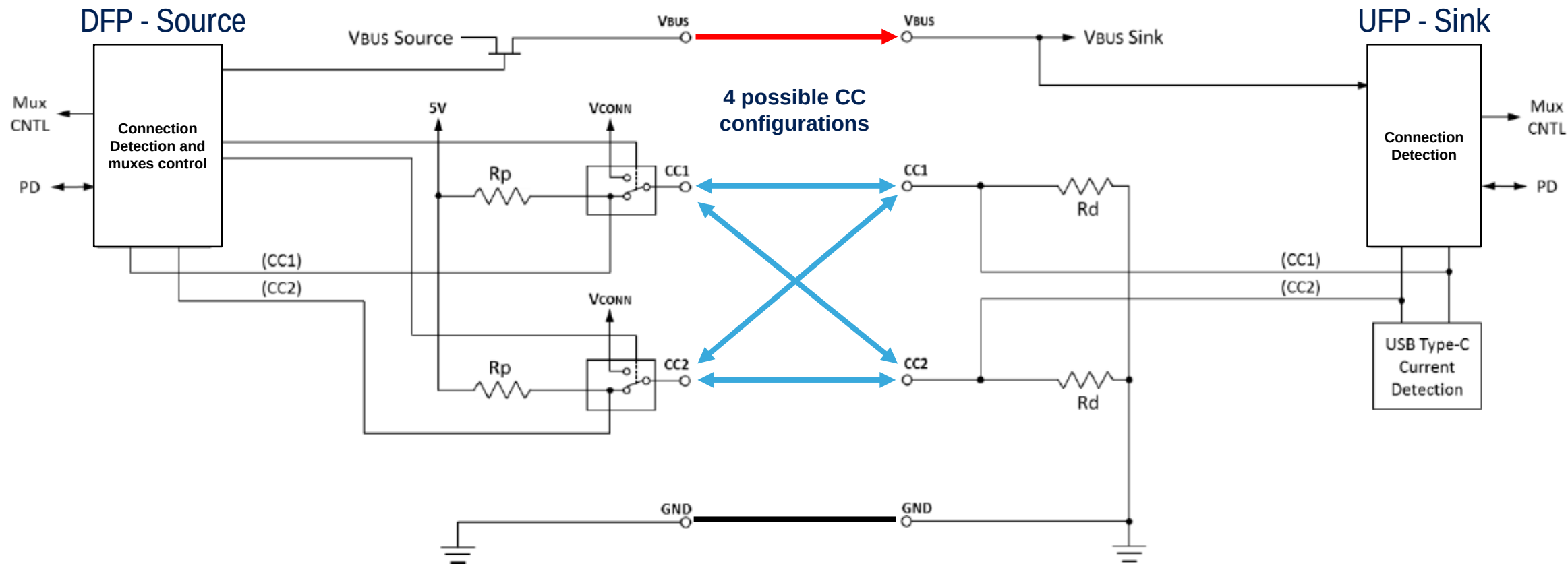
Cable Ground

Configuration Channel

USB PD Power Rules



USB Type-C CC Connections

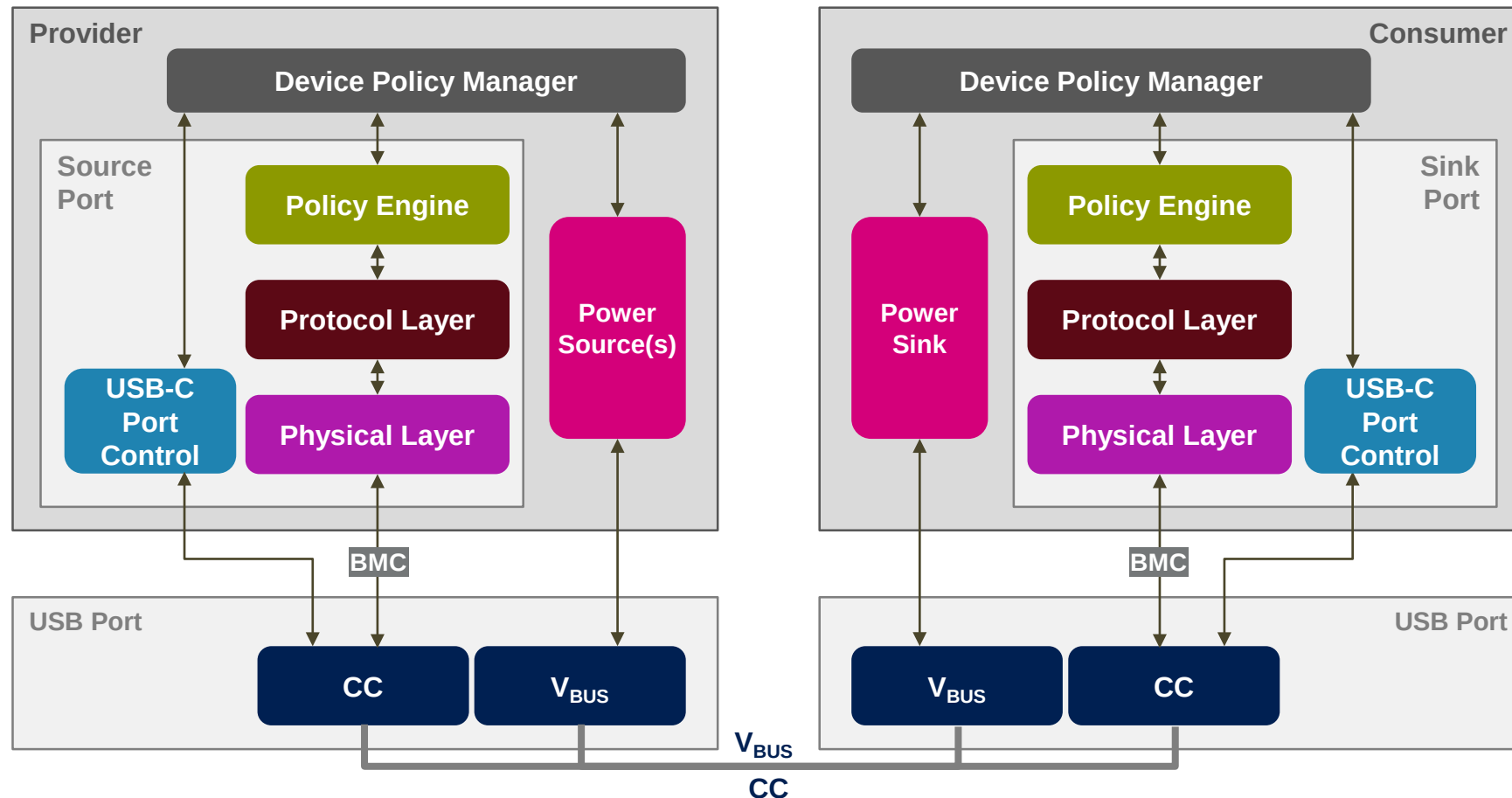


- Detect attach/detach of USB ports, e.g. a DFP to a UFP
- **Resolve cable orientation and twist connections** to establish USB data bus routing
- Establish DFP and UFP roles between two attached ports
- Discover and configure VBUS
- USB Power Delivery Communication

USB Type-C™ and USB Power Delivery

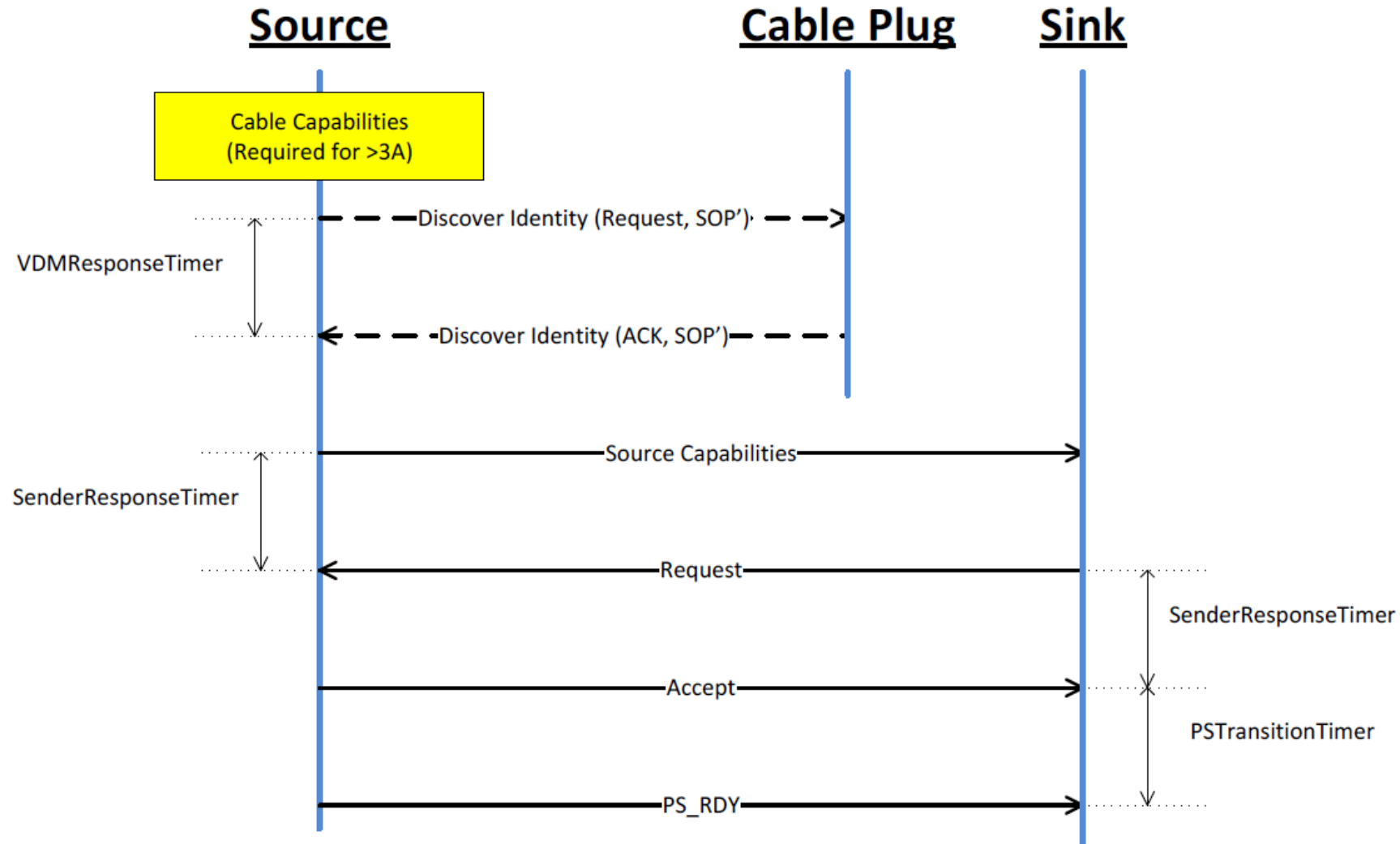
High level architecture

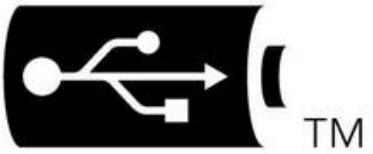
The different layers can be implemented in different topologies HW / SW



Communication across the channel uses Biphase Mark Coding (BMC) over CC in Type C connector

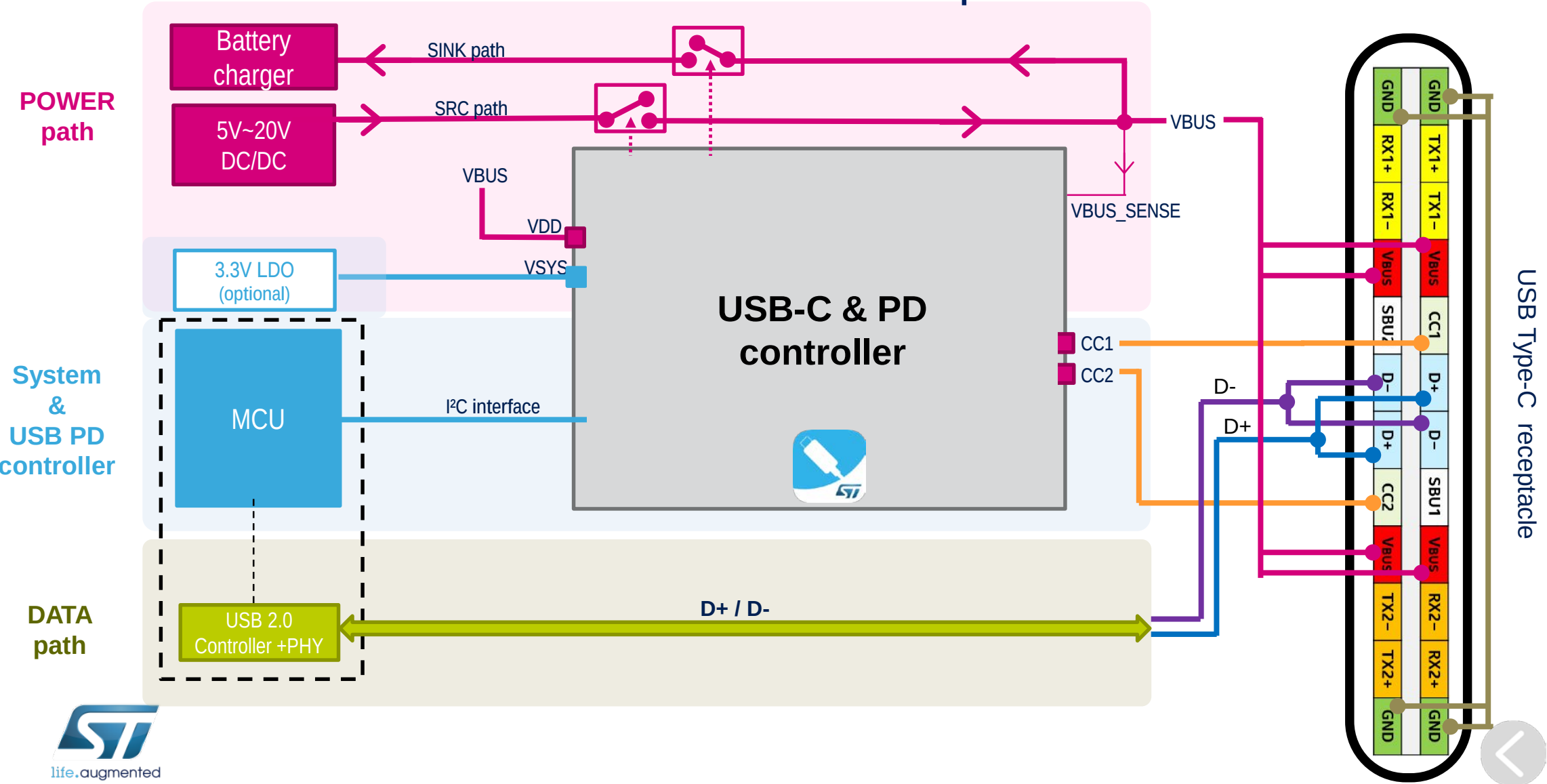
USB-PD: Power Negotiation Sequence





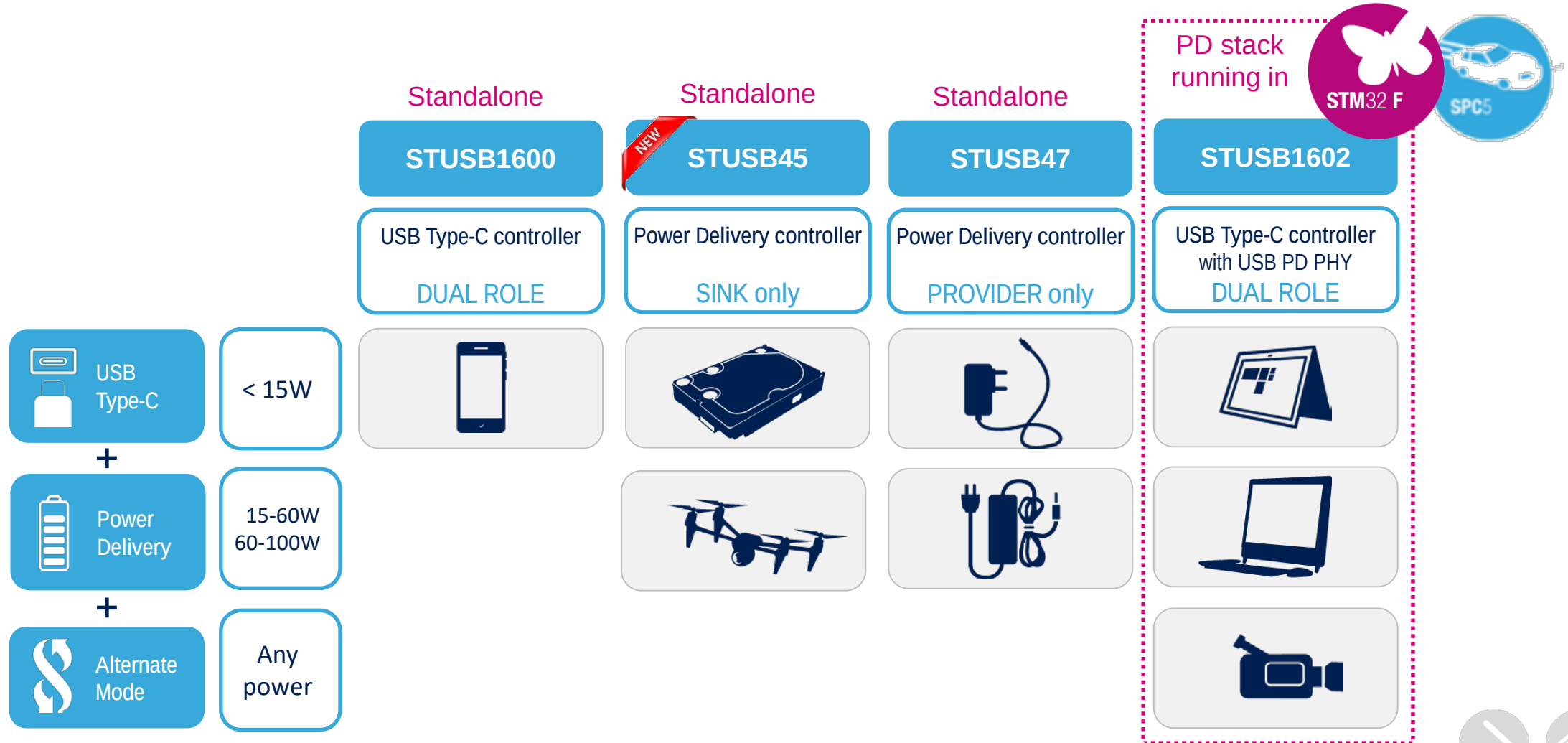
USB Type-C + USB 2.0

HW implementation in DRP mode



Hard Coded Type-C™ and USB PD Controllers

Covering all use cases from Type-C to full feature Power Delivery

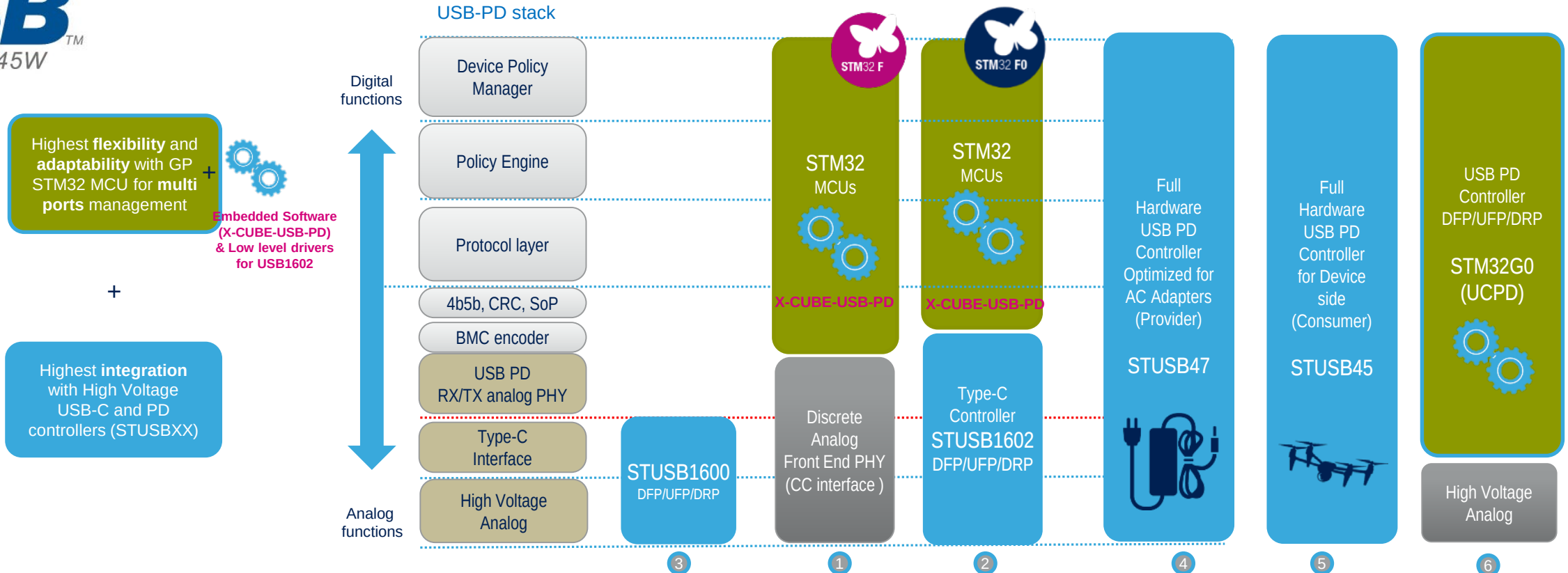




Type-C & USB PD Controllers

Certified Solutions

Offer to designers the flexibility to enable the needed optimization of stack partitioning and BOM

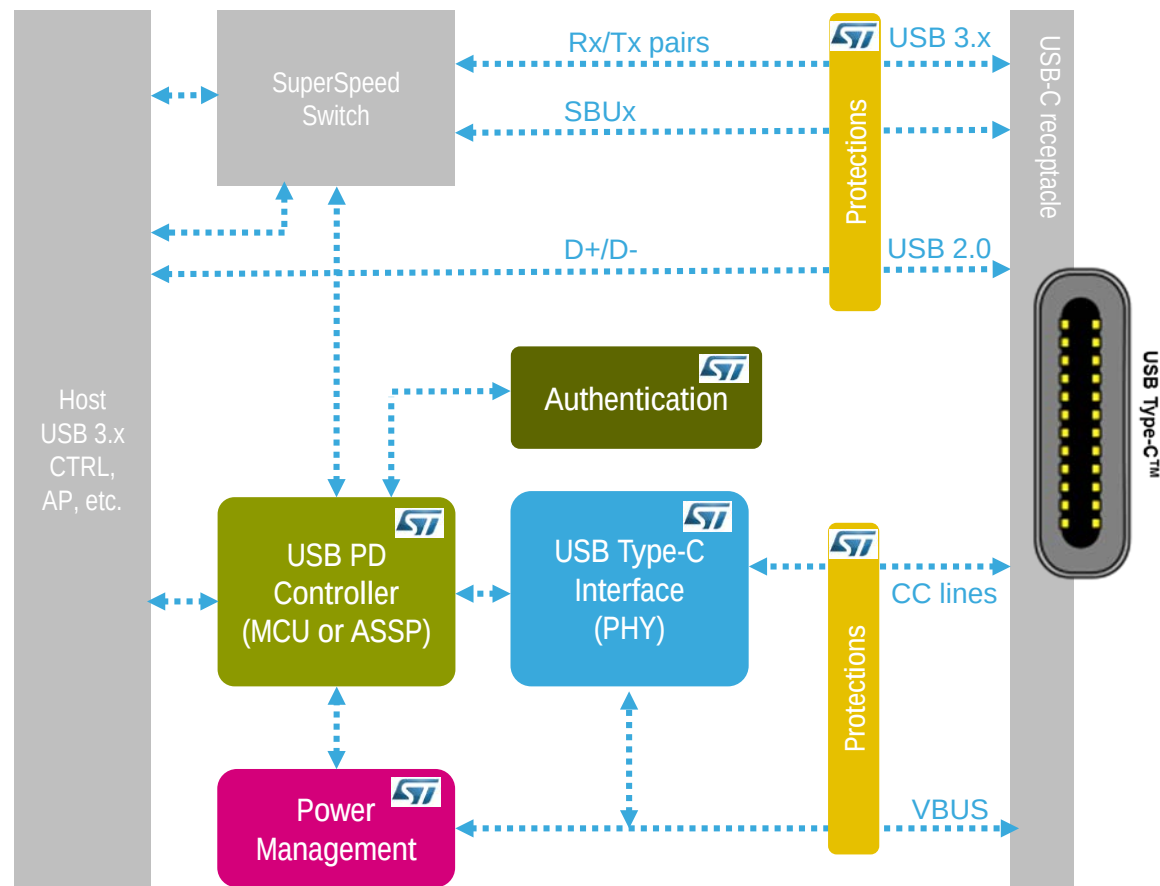


1. Market proven FW solution on STM32F0 with discrete Analog Front End to control two DRP Type-C
2. More integration with STUSB1602 Type-C PD Controller including PD PHY and BMC line driver
3. Full HW solution with STUSB47 PD controller optimized for AC adapters (1 Port Provider)
4. Standalone Type-C interface STUSB1600 up to 15W



ST Products for USB Type-C & PD

ST Chipset: A flexible offer in the USB Type-C PD ecosystem



Scalable offer for USB-PD controller and USB Type-C interface: from STM32 general purpose MCU to hard-coded solution to fit different use cases and power ratings

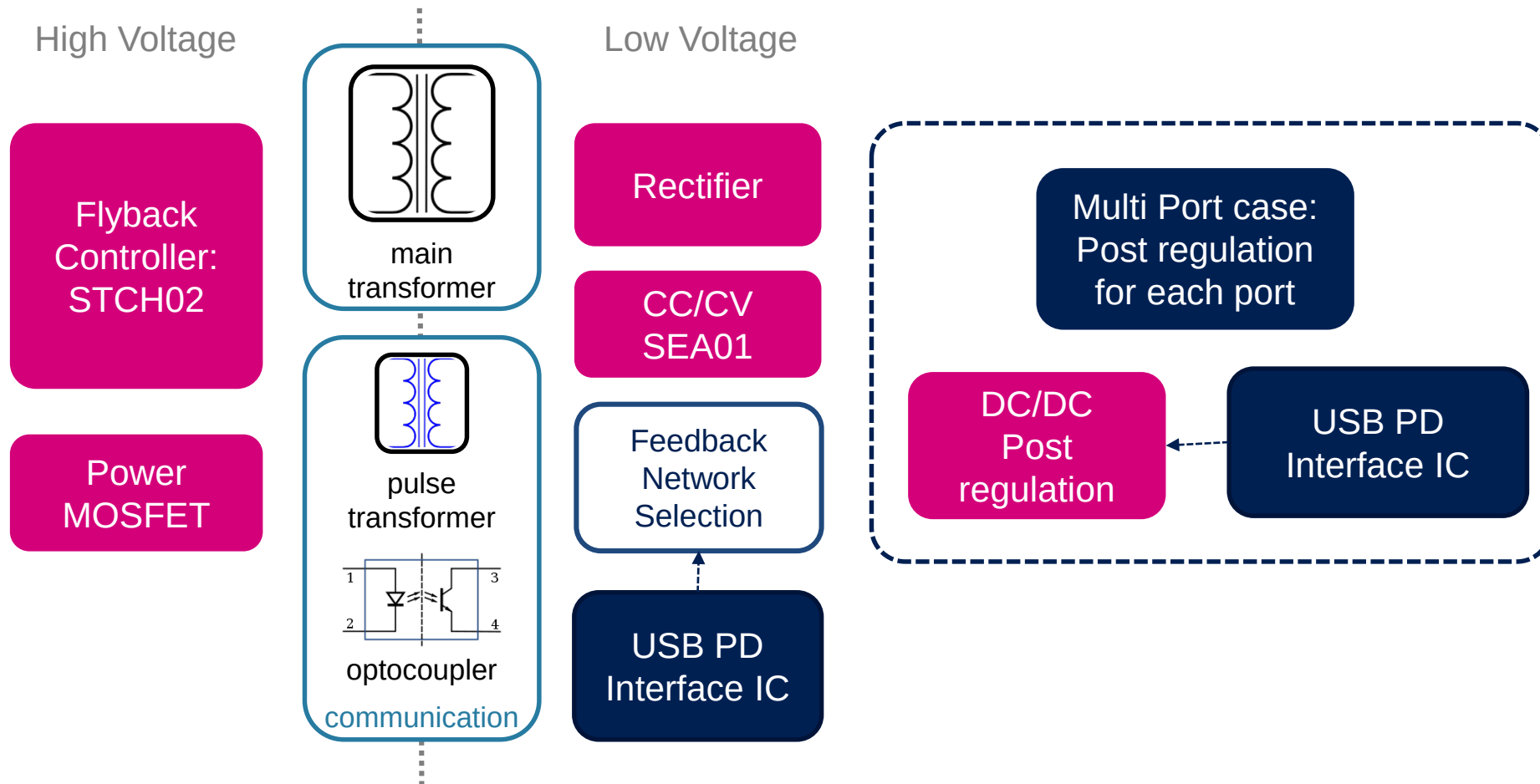
Large product portfolio for protection and filtering covering all the application needs

Highly secure solution using STSAFE secure element family for strong authentication needs



Profile 1-2-3

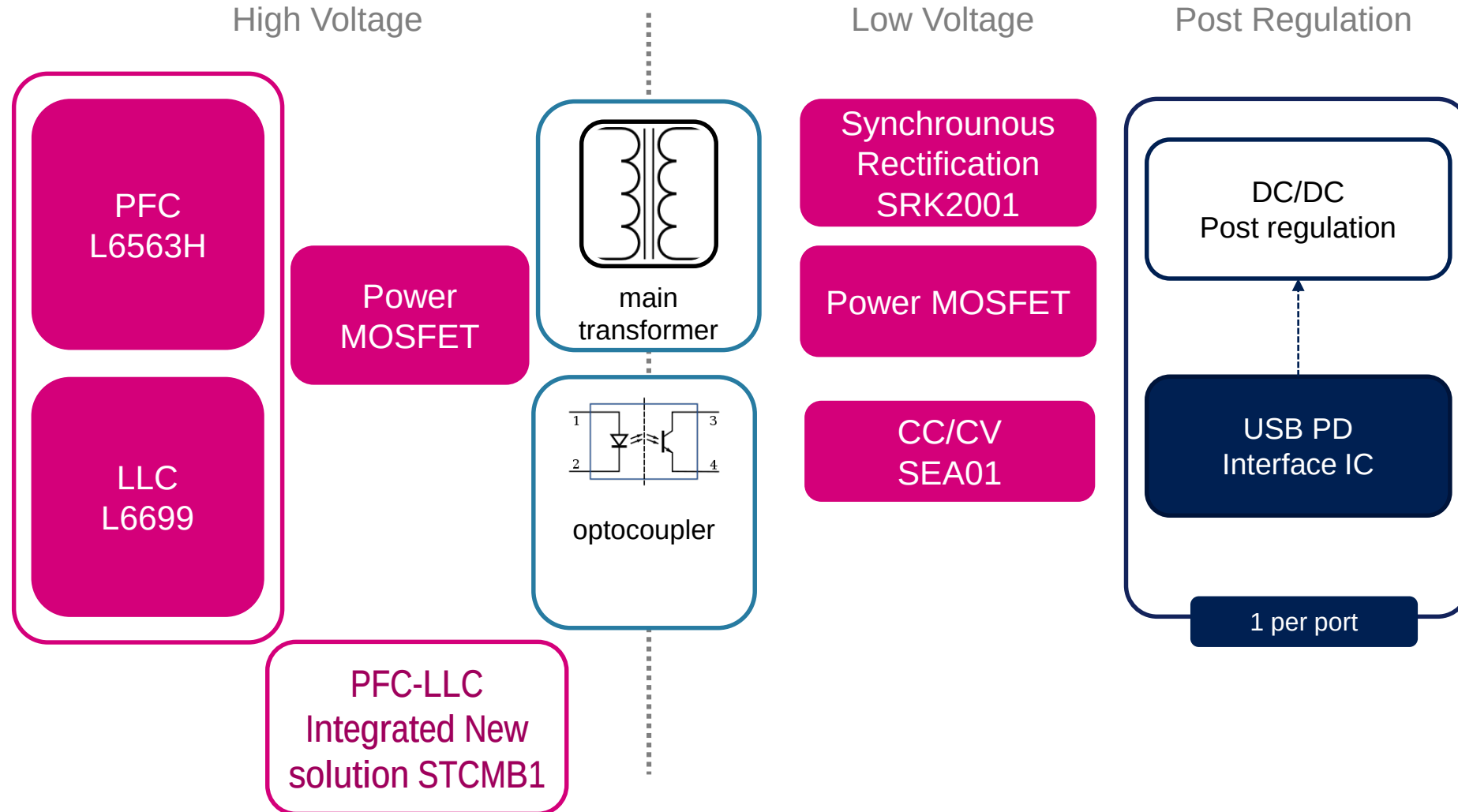
Power source building blocks



- It covers profile 1-2-3 from 5W to 45W
- High Efficiency
- Low EMI design: intelligent Jitter for EMI suppression

Profile 4, 5

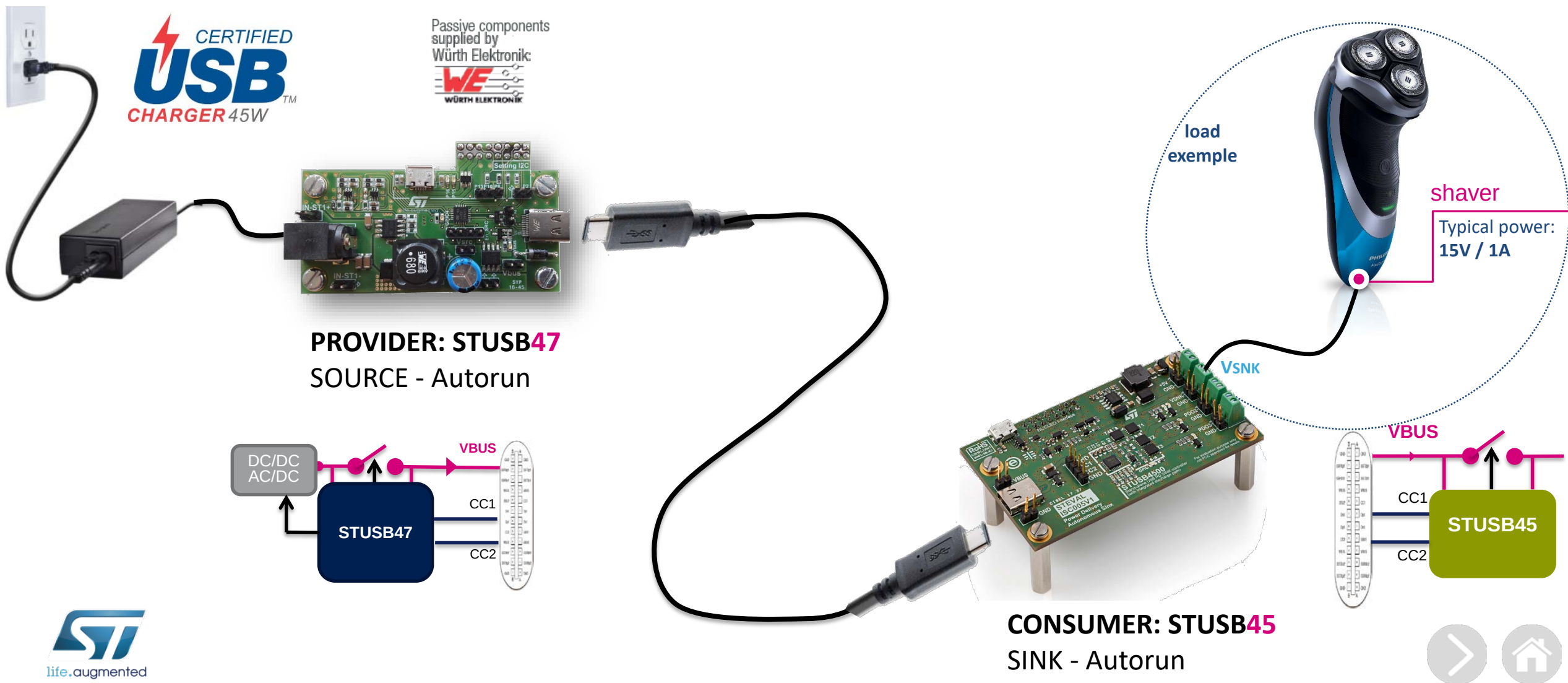
Power source building blocks





STUSB47 meets STUSB45

Stand-alone controllers for SOURCE and SINK applications



STM32G0 USB-C Discovery



Promotional kit and tool to learn and discover USB-C port capabilities. It offers 3 operating modes :

1. **“Standalone” mode**: Discover and display power / data / Alternate Mode capability of any USB-C host (source/DRP).
2. **“Sniffer + USB PD meter” mode**: Display current direction, power information (V_{bus} voltage, I_{bus} current) between two USB-C enabled devices.
3. **“Advanced User” mode**: Debug, configure, inject USB PD3.0 packet using “STM32CubeMonUCPD”.

Ordering info :

RPN :STM32G071B-DISCO

POS/RRP : 65\$



STEVAL-USBC2DP: USB Type-C to DisplayPort adapter

Key Features:

- The USB Type-C to DisplayPort Adapter expands a USB Type-C laptop screen onto a monitor or projector equipped with DisplayPort
- Based on the Alternate Mode Functional Extension of the USB Type-C & Power Delivery to enables the DisplayPort interface

Advantages

- Type-C Alternate Mode demo in a compact PCB design (5.5 x 2.3 mm)
- Full ST BOM for a cost-effective solution based on Discrete AFE approach
- Including the DFU feature



 **DisplayPort**

Key Products

STM32F072: the high-performance ARM® Cortex®-M0 32-bit RISC core operating at up to 48 MHz frequency, high-speed embedded memories and with USB 2.0 data interface.

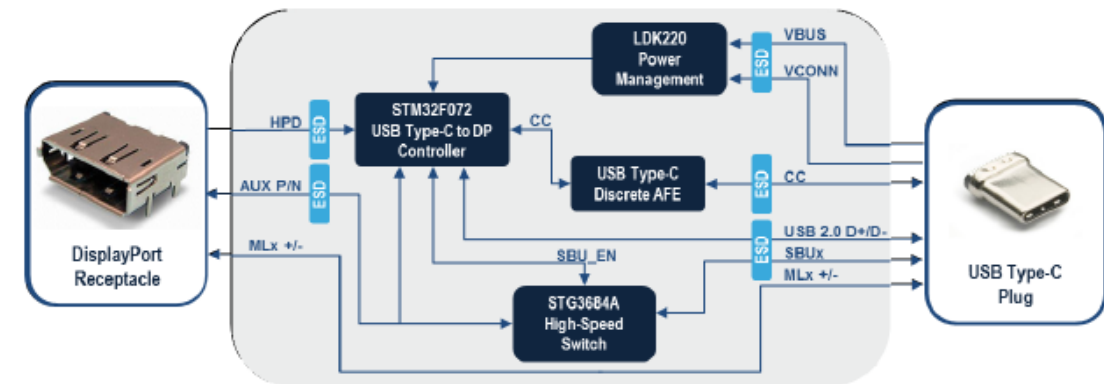
LDK220: 200 mA low quiescent current and low noise LDO.

STG3684A: Low Voltage 0.5 Ohm Max Dual SPDT Switch with Break-Before-Make

ESDALC5-1BF4: Low clamping and low capacitance bidirectional single line ESD protection

STPS0520Z: Power Schottky rectifier

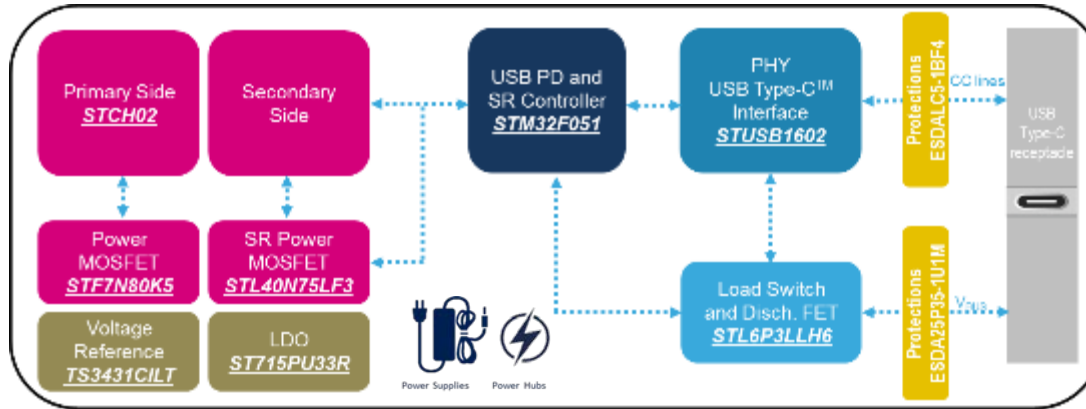
X-CUBE-USB-PD: STM32 USB-PD package consisting of libraries and application examples for STM32F0 devices acting as USB-PD controllers



AC/DC 45W USB-C PD adapter with SR (STEVAL-USBPD45C)

Key Features

- Modular design composed of Power Supply Board (PSB) STEVAL-USBPD45P and Digital Control Board (DCB) STEVAL-USBPD45I.
- Adaptive Synchronous Rectification with direct driving managed by STM32 for better efficiency
- USB Type-C and Power Delivery based on certified STM32F0 and STUSB1602A
- Supported PDOs: 5V@3A, 9V@3A, 15V@3A, 20V@2.25A
- VDM support for customized messages and features
- PD 3.0 core features support



Key Products

Primary Side Controller: STCH02 (or STCH03)

High efficient and fully integrated AC-DC controller with primary CC regulation enabling, low stand-by power, high efficiency and low EMI design of AC-DC adapters

Primary MOSFET: STF7N80K5

MDmesh™ K5 HV Power MOSFET with reduced switching losses and ultra-low gate charge for applications requiring superior power density and high efficiency

SR MOSFET: STL40N75LF3

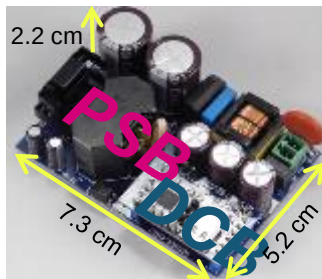
STripFET™ III N-Channel Power MOSFET specifically designed to minimize on-resistance and gate charge to provide superior switching performance

USB PD and SR Controller: STM32F051K8U7

32-bit ARM Cortex™-M0 48 MHz, managing USB Power Delivery Stack (X-CUBE-USB-PD) and Synchronous Rectification

USB Type-C Interface: STUSB1602A

Type-C™ Interface with PD PHY BMC driver, featuring high voltage protections on V_{BUS} and CC lines, V_{BUS} monitoring and discharge path



ORDERING CODE:
STEVAL-USBPD45C:
STEVAL-USBPD45P +
STEVAL-USBPD45I
(STM32F051+STUSB1602A)

