Power Solutions

Wireless Charging

USB Type-C and Power Delivery

ST enables the **Wireless Charging** World

Wearable

Consumer & Industrial
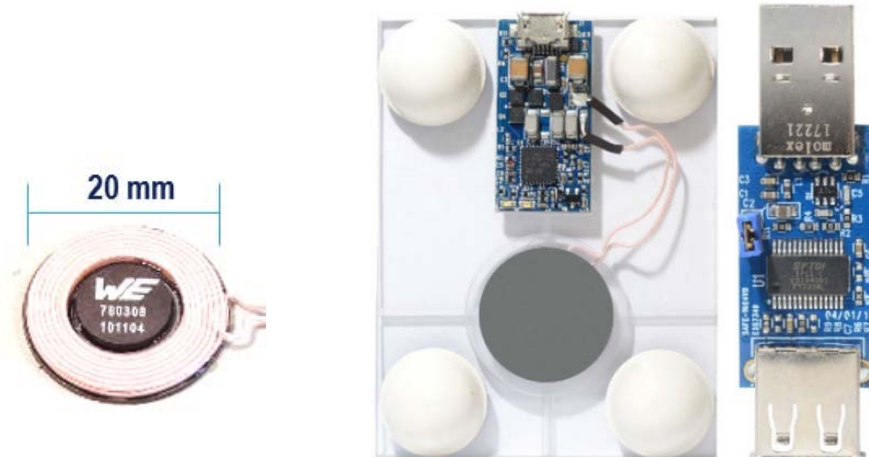
Dual Mode TRx

Multi-Coil

STWLC03

life.augmented

Wearable Solution

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
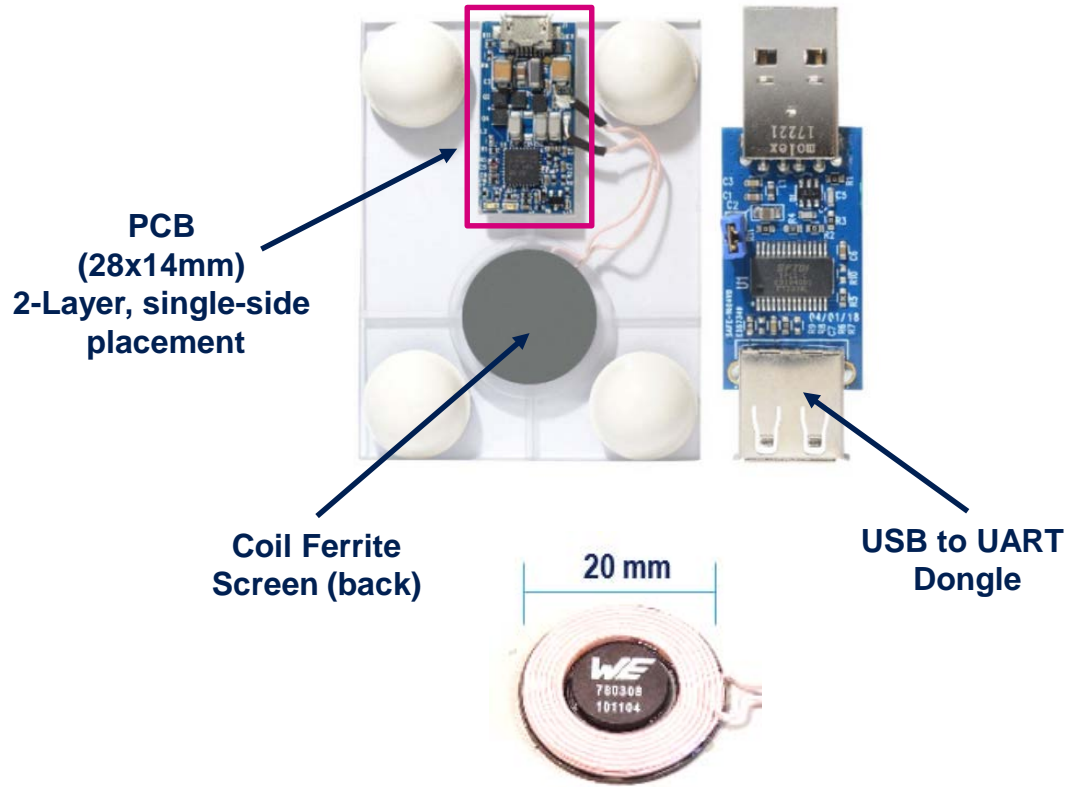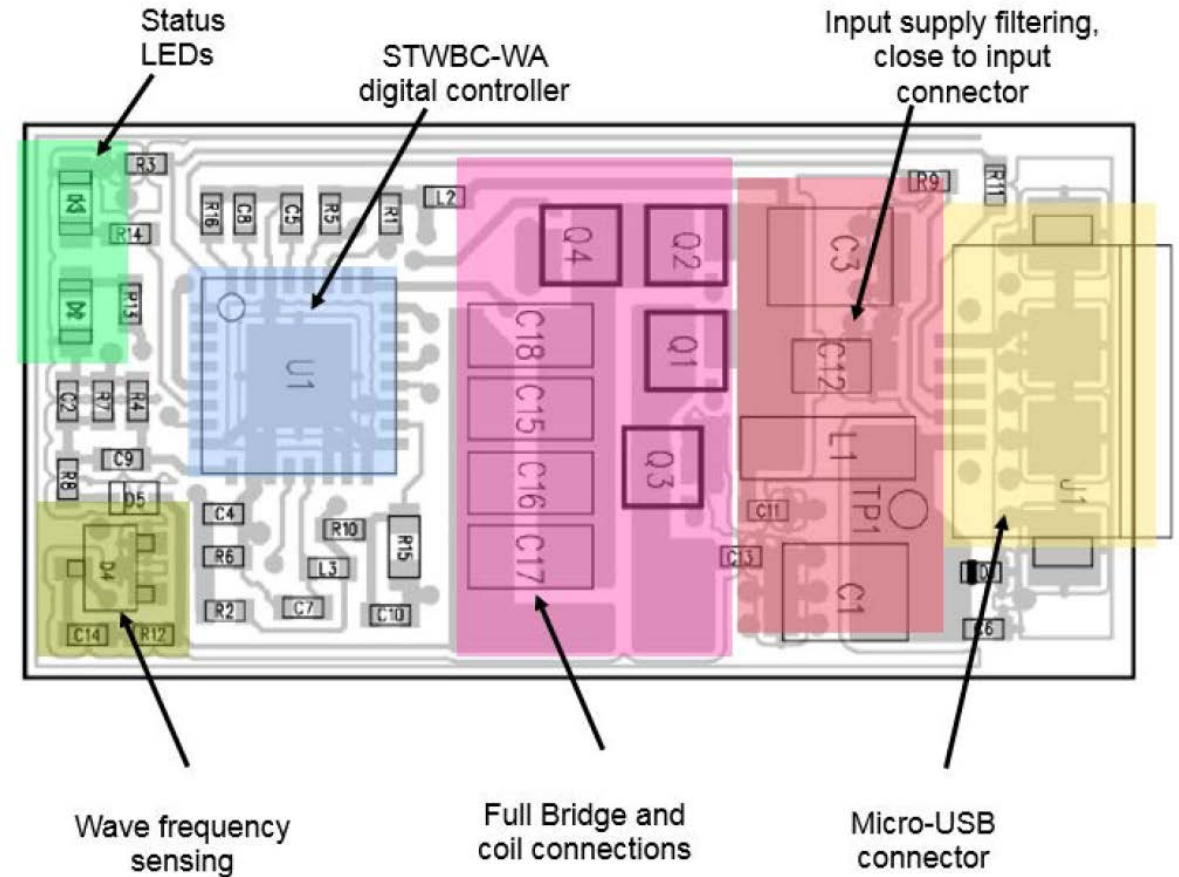- Application area 10x6mm
- 26mm coil

Wearable Solution

- System, bridge control and Qi protocol are handled by the STWBC-WA
- The transmitter is based on a Full-Bridge topology
- The inverter bridge is supplied by 5V input voltage (e.g. USB)
- Support up 2.5W with 20mm coil
- Scalable down to 1W with even smaller coil

Wearable Solution

- ## STWBC-WA 2.5W STEVAL-ISB045V1

PCB (28x14mm) 2-Layer, single-side placement

Coil Ferrite Screen (back)

USB to UART Dongle

20 mm

Small Coil

Status LEDs

STWBC-WA digital controller

Input supply filtering, close to input connector

Wave frequency sensing

Full Bridge and coil connections

Micro-USB connector

Wearable Solution

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

26mm Coil

STWLC30 Receiver IC

Application Area

STEVAL-ISB043V1

TVOUT
TPGND
TPHONE TVRECT
TINT
TSCL
TSDA
TGND
AC2
AC1

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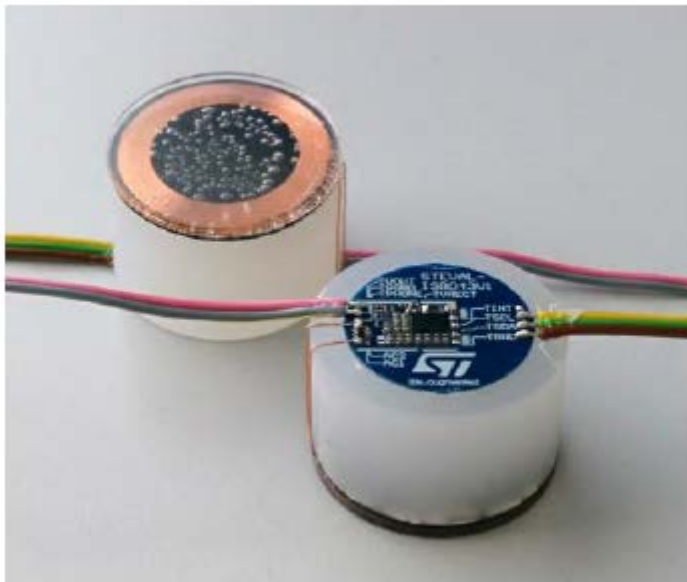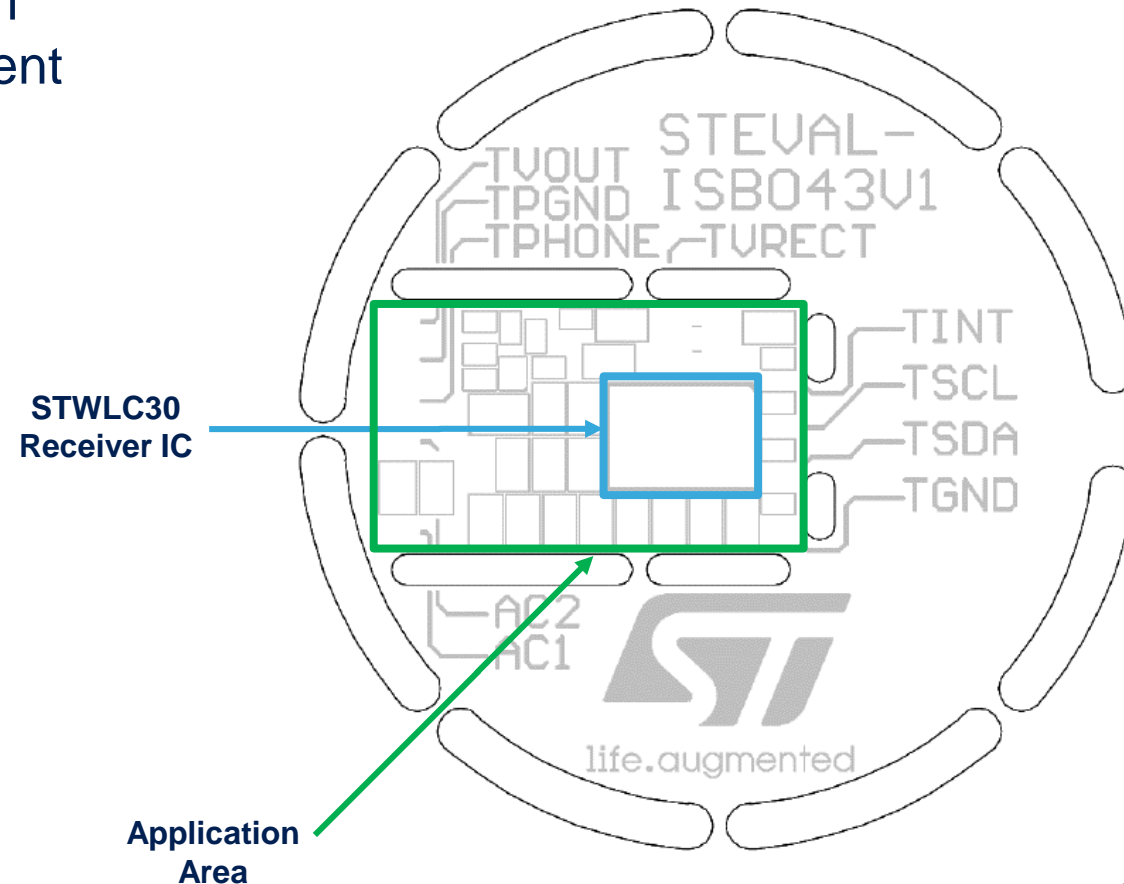
Wearable Solution

Full Bridge 2.5W Transmitter based on STWBC-WA
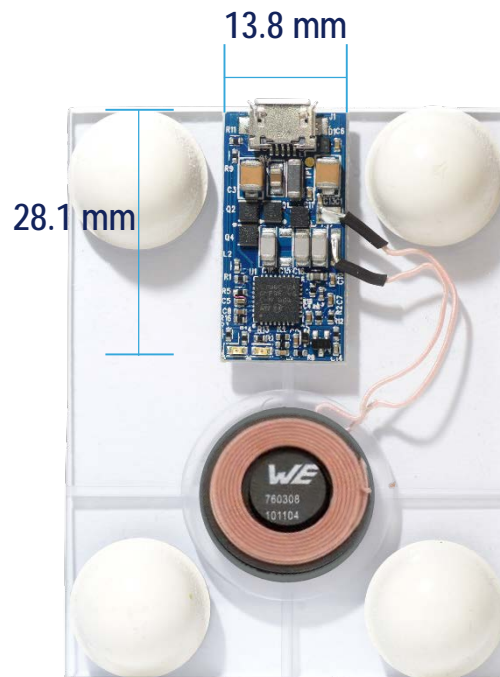
5V 1A USB input power

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

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
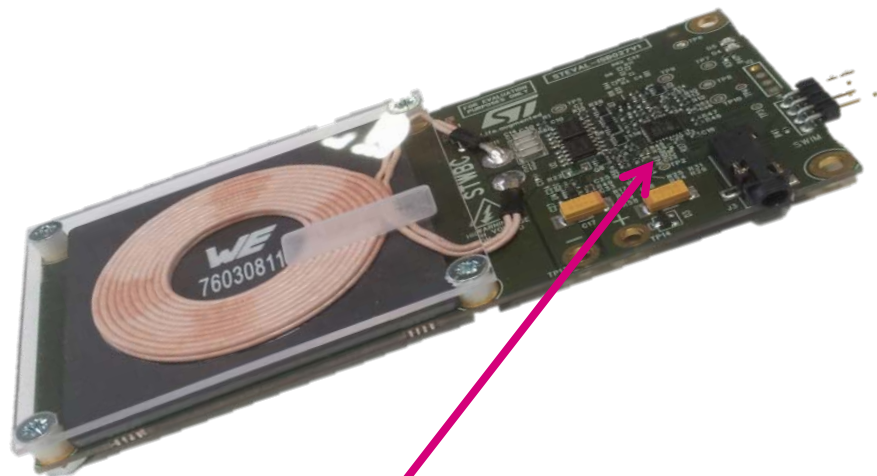
Flip Chip **2.68mm x 4.026mm**

Available now

13.8 mm

28.1 mm

26 mm

STEVAL-ISB045V1

STEVAL-ISB043V1

Consumer & Industrial Solution

- STWBC 5W A11 STEVAL-ISB027V1
- 2-Layer PCB ad single side placement
- 3mV consumption in stand-by
- Ping and FOD always active
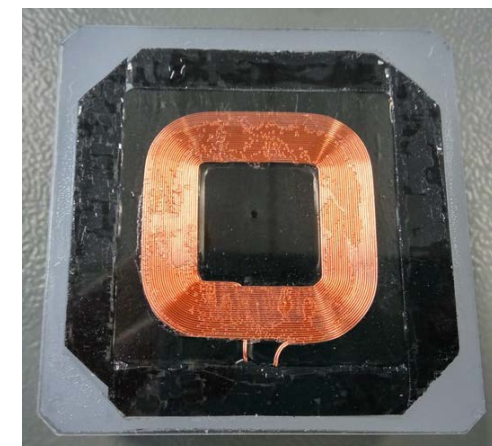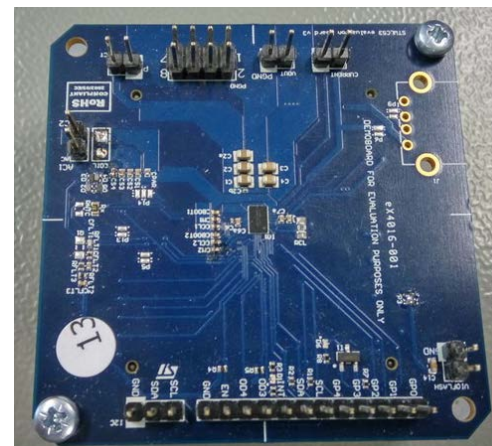
- STWLC33 – 15W / 5W Qi / AirFuel STEVAL-ISB042V1
- 4-Layer PCB and single-side placement
- Qi 1.2.3 and AirFuel Inductive certified
- 42x42mm coil
- BPP/EPP RX auto-switch (senses TX type)

Consumer & Industrial Solution

- 5W Qi, 1-Coil, 5V supply

- A11 requires accurate frequency control:
  - Operating frequency range 110kHz – 205kHz
  - Duty cycle 50%-10% @ 205kHz

15W Transmitter and Receiver Kit

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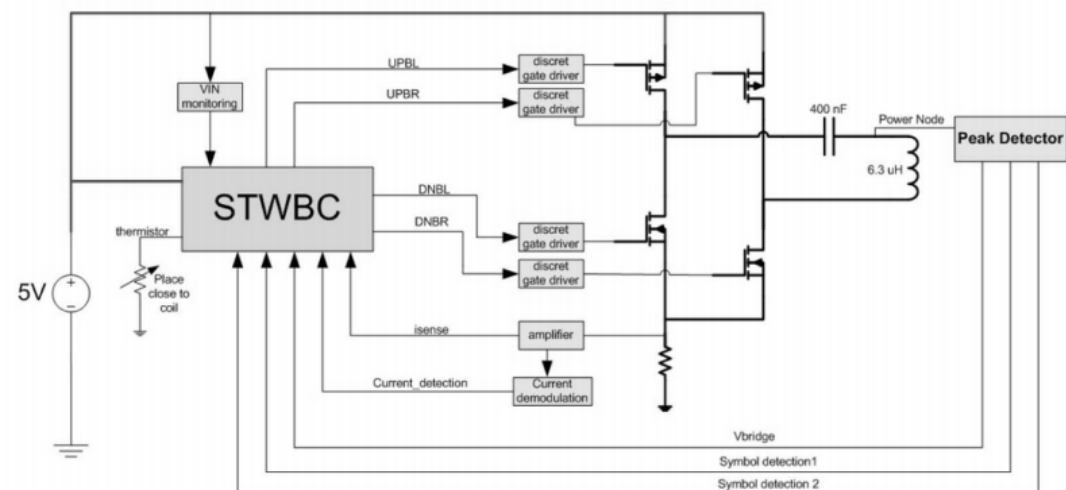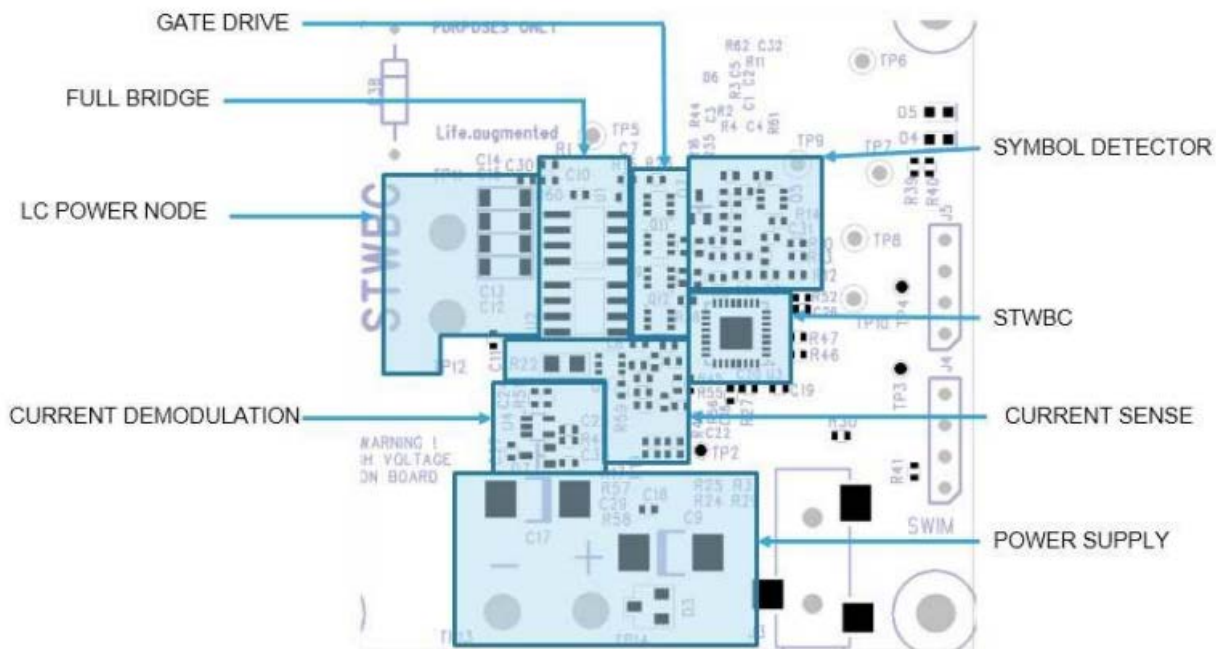- 17mW consumption in stand by
- Ping and FOD always active

- 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
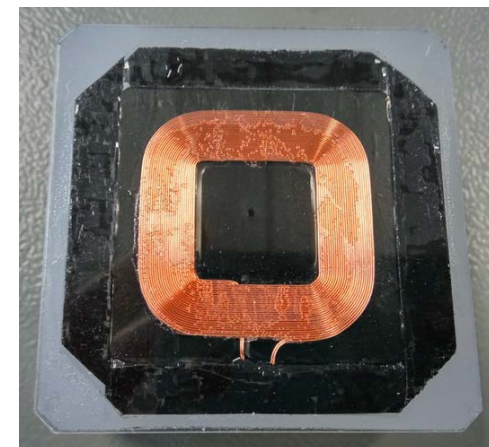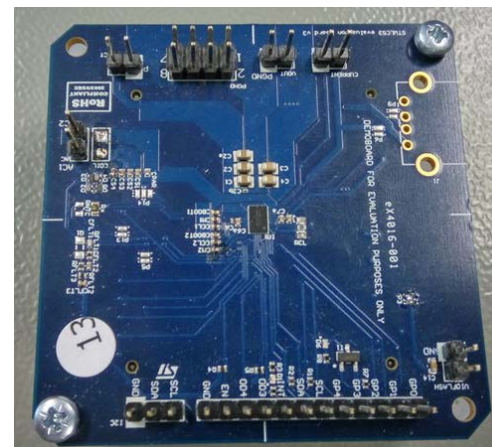
15W Transmitter Reference Board

LDO (DCDC optional)

Demodulation circuits

STWBC-EP

Voltage/current demodulation circuits

LED, SWIM and USB/UART debug connectors

Power Supply connections & input filtering

Boost Circuit

Quick Charge circuit

Half bridge driver and LC Tank circuit

WPC protoMP Tx
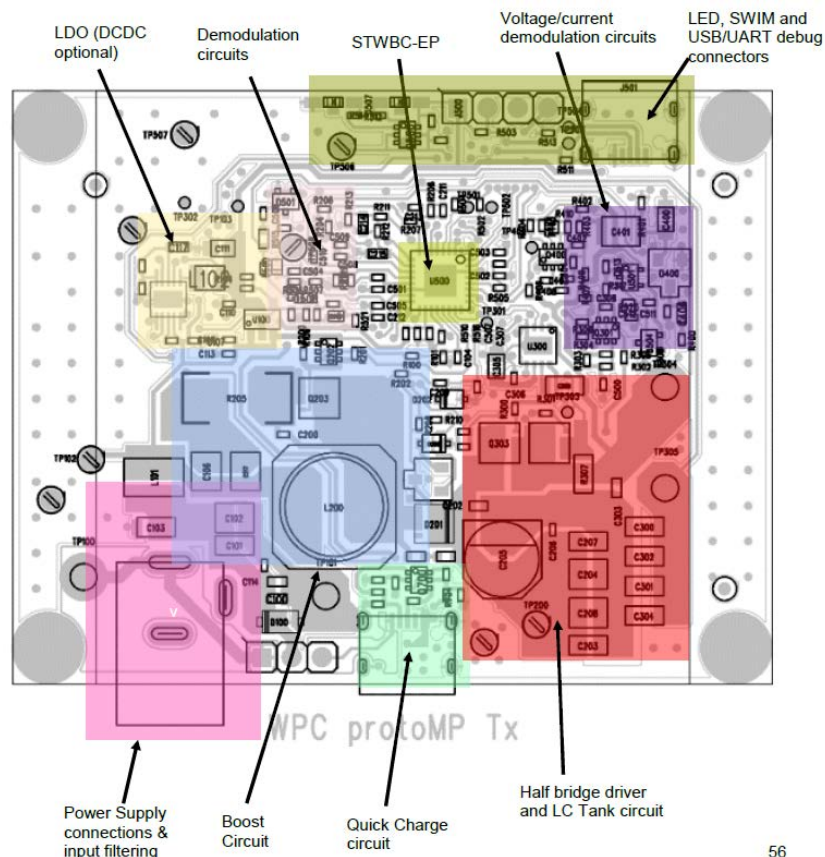
Certified Wireless Charger (15W)

- IC: STWBC-EP

- MP-A10 Design, Qi 1.2.3 Certified

- Support BPP and EPP (5W and 15

- Foreign Object Detection (FOD

- 5-12V input voltage range

- Half-Bridge topology

- Voltage/Frequency Control

- Graphical Interface for testing

DC to DC SMPS **Boost**

[Vin+2V, 16V] (LP)
[Vin+2V, 24V] (EP)

QFactor

LDO 4.5V

STWBC-EP

Bootstrap Gate Driver

Symbol Detection

Patent demod control

LC adapter

Current Amplifier

Symbol Detection

Vin
5 to 13V

56
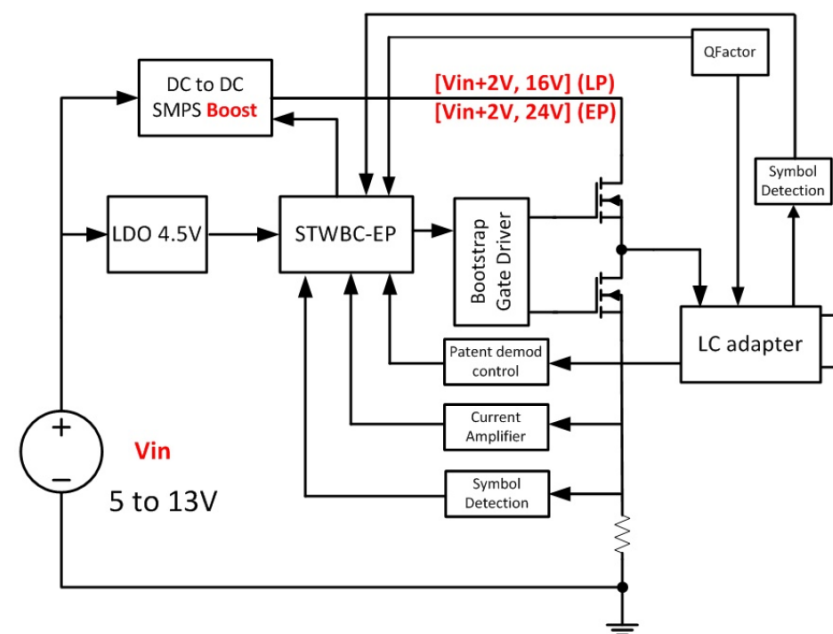
Consumer & Industrial Solution

15W RX   STWLC33 – STEVAL-ISB042V1

Qi/AirFuel Inductive Certified Wireless Receiver with <u>Transmit capability</u>

- 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 µm pitch 52 balls
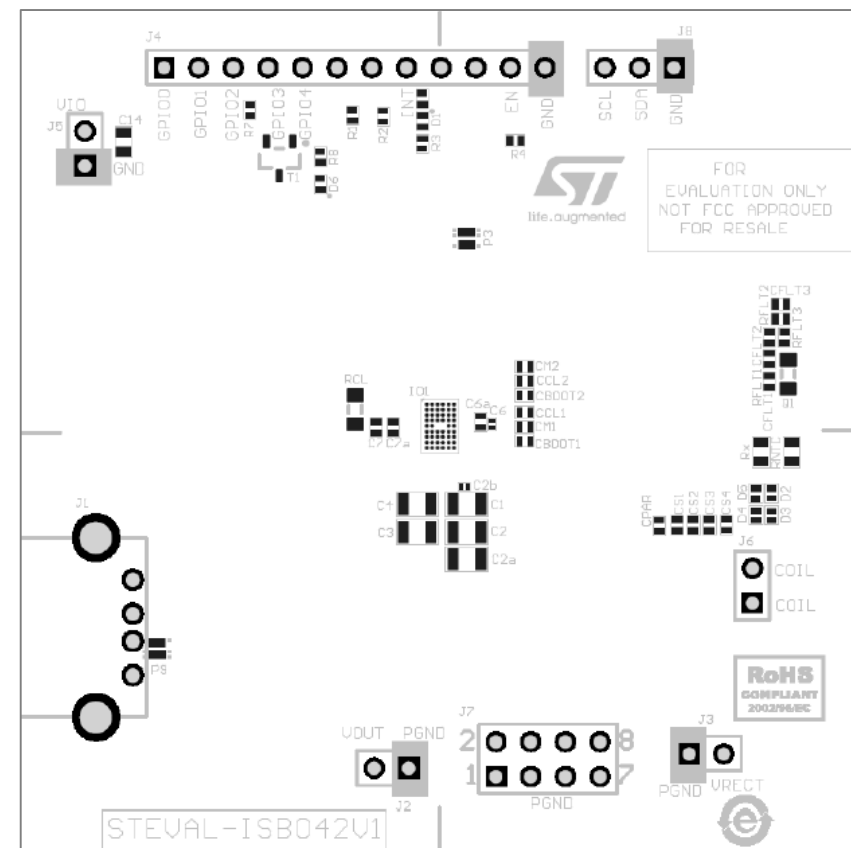
STWLC33 Dual Mode

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

Rx & Tx: STWLC33

Receiver: STWLC33

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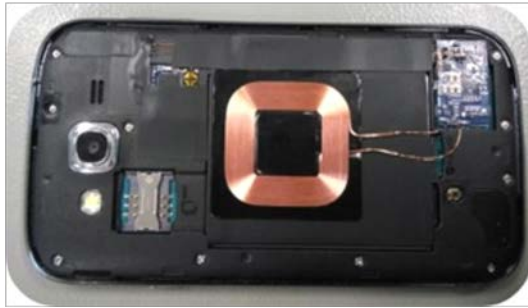
Receiver: Qi and Airfuel Inductive Standards
5V fixed output Voltage – up to 5W
(due to phone limitation)

Transmitter: Qi based
Transmitted Power up to 3W

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

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

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Multi-Coil Solution

15W 3-coil Transmitter and Receiver Kit
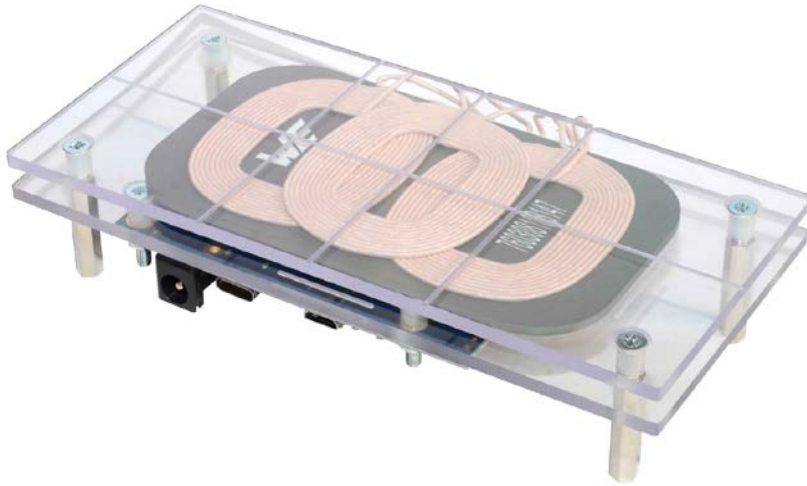
- STWBC-MC 15W MP-A15 STEVAL-ISB047V1
- 2-Layer PCB ad single side placement
- 17mW consumption in stand by
- Ping and FOD always active
- Fast Charge Support
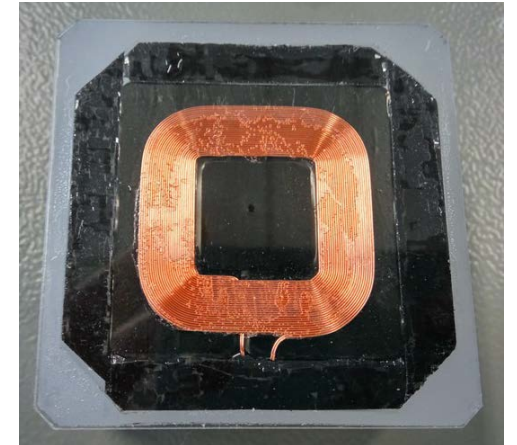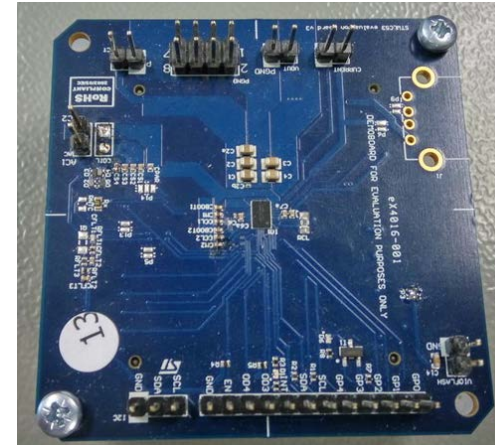
- STWLC33 – 15W Qi/AirFuel STEVAL-ISB042V1
- 4-Layer PCB and single-side placement
- Qi 1.2.3 and AirFuel Inductive certified
- 42x42mm coil
- BPP/EPP RX auto-switch (senses TX type)

Multi-Coil Solution
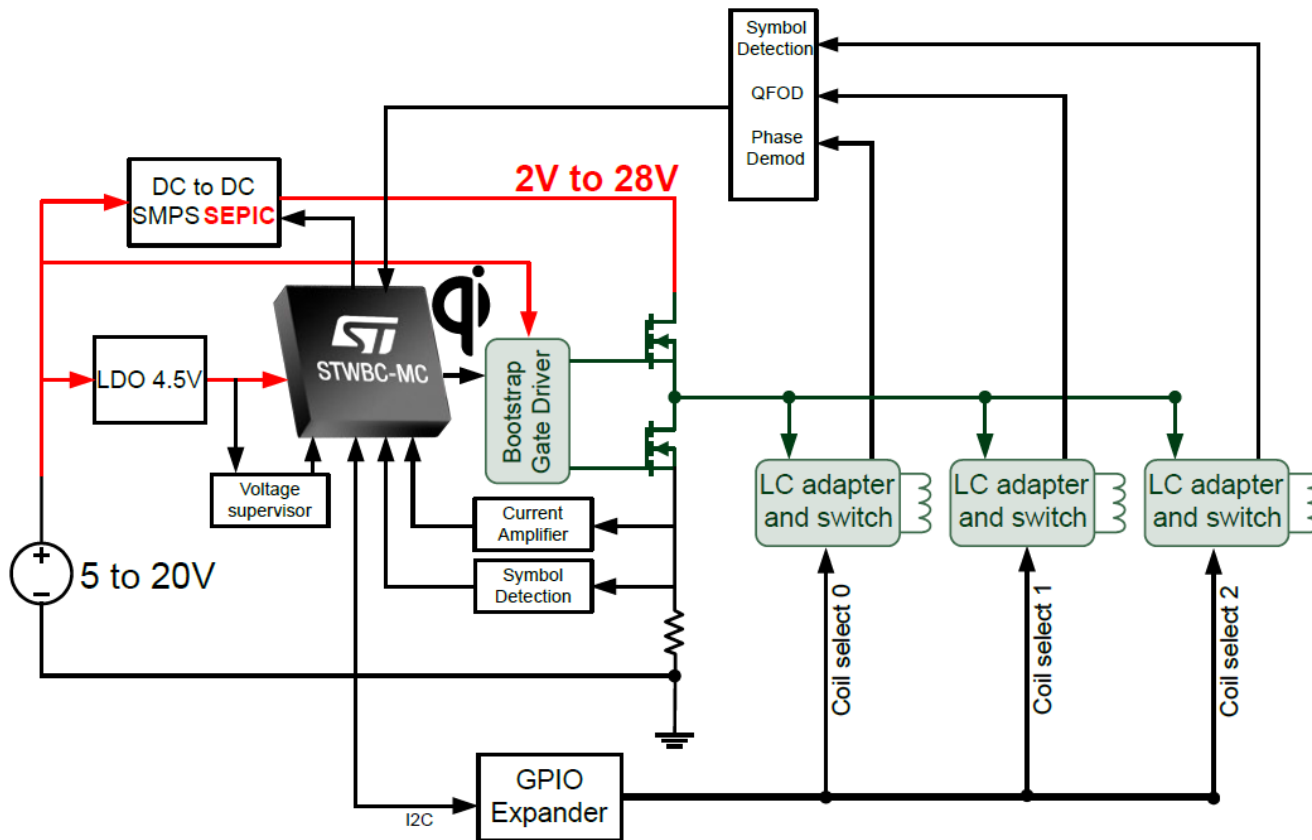
- STWBC-MC MP-A15

- 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

STEVAL-ISB047V1T
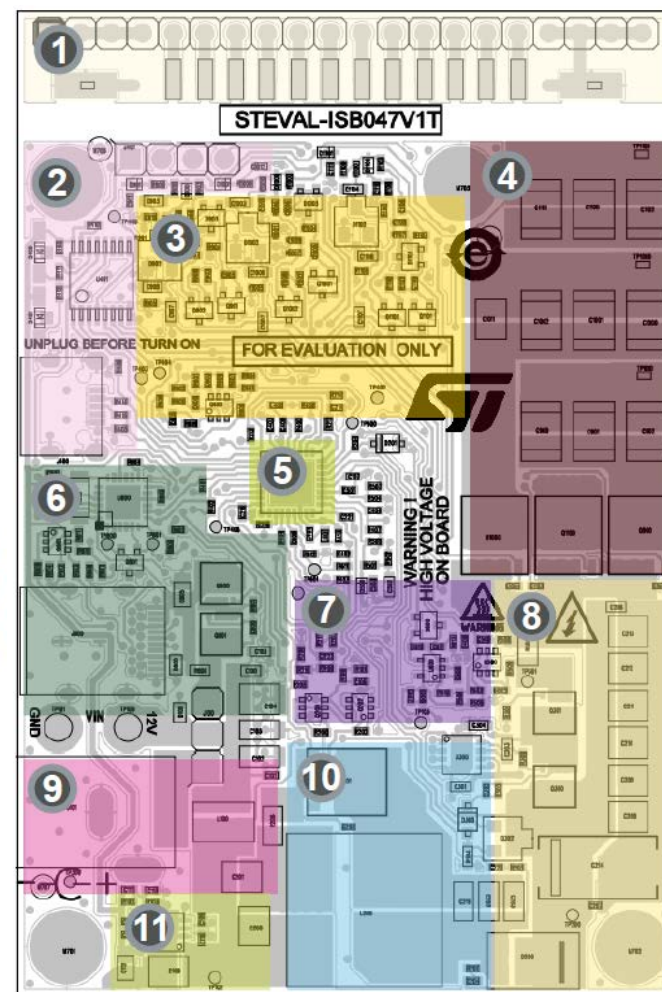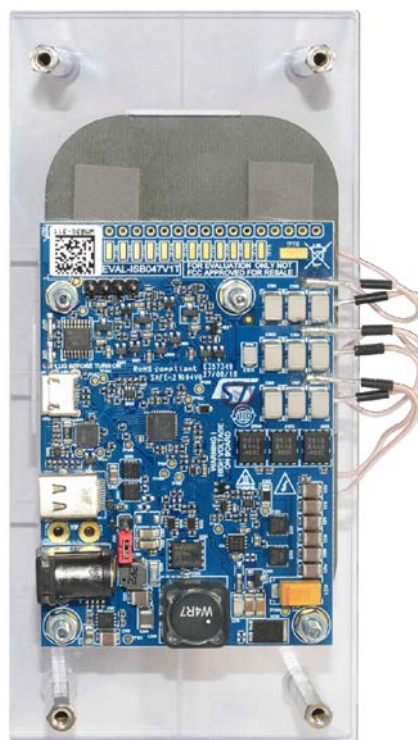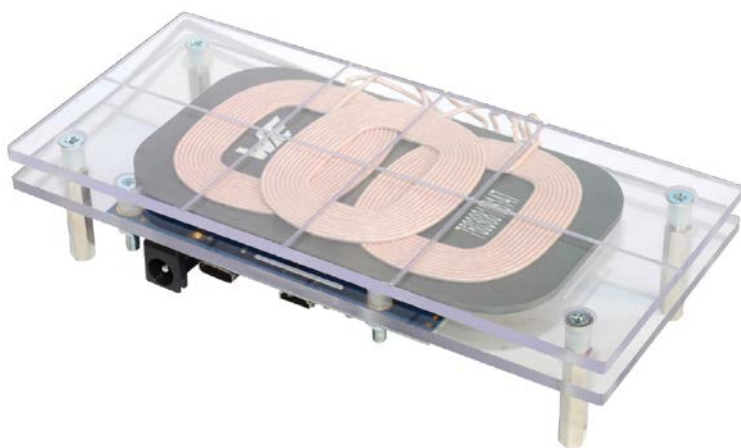
1. Test point for debugging only (may be removed)
2. LED, SWIM and USB/UART debug connectors
3. Sensing detection circuits
4. Coil selection and detection
5. STWBC-MC
6. USB PD/QC IO charger
7. Voltage/current demodulation circuits
8. Half bridge driver and LC Tank circuit
9. Jack power supply connections and input filtering
10. Sepic circuit
11. LDO

Standby
- **17mW** consumption
- Ping active
- FOD active

USB Type-C™ and Power Delivery
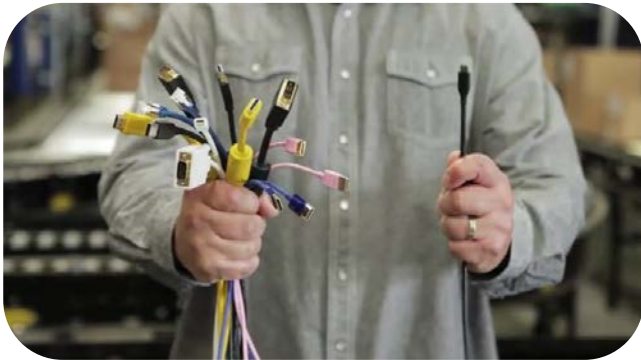
Overview:
Flexible, robust solution for power and interconnect

Type-C & USB-PD Architecture

ST products for Type-C & USB-PD

Type-C & USB-PD Solution

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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, …)

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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

GND	RX1+	RX1-	V$_{BUS}$	SBU2	D-	D+	CC2	V$_{BUS}$	TX2-	TX2+	GND
B12	B11	B10	B9	B8	B7	B6	B5	B4	B3	B2	B1

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

GND	TX2+	TX2-	V$_{BUS}$	V$_{CONN}$			SBU2	V$_{BUS}$	RX1-	RX1+	GND
B1	B2	B3	B4	B5	B6	B7	B8	B9	B10	B11	B12

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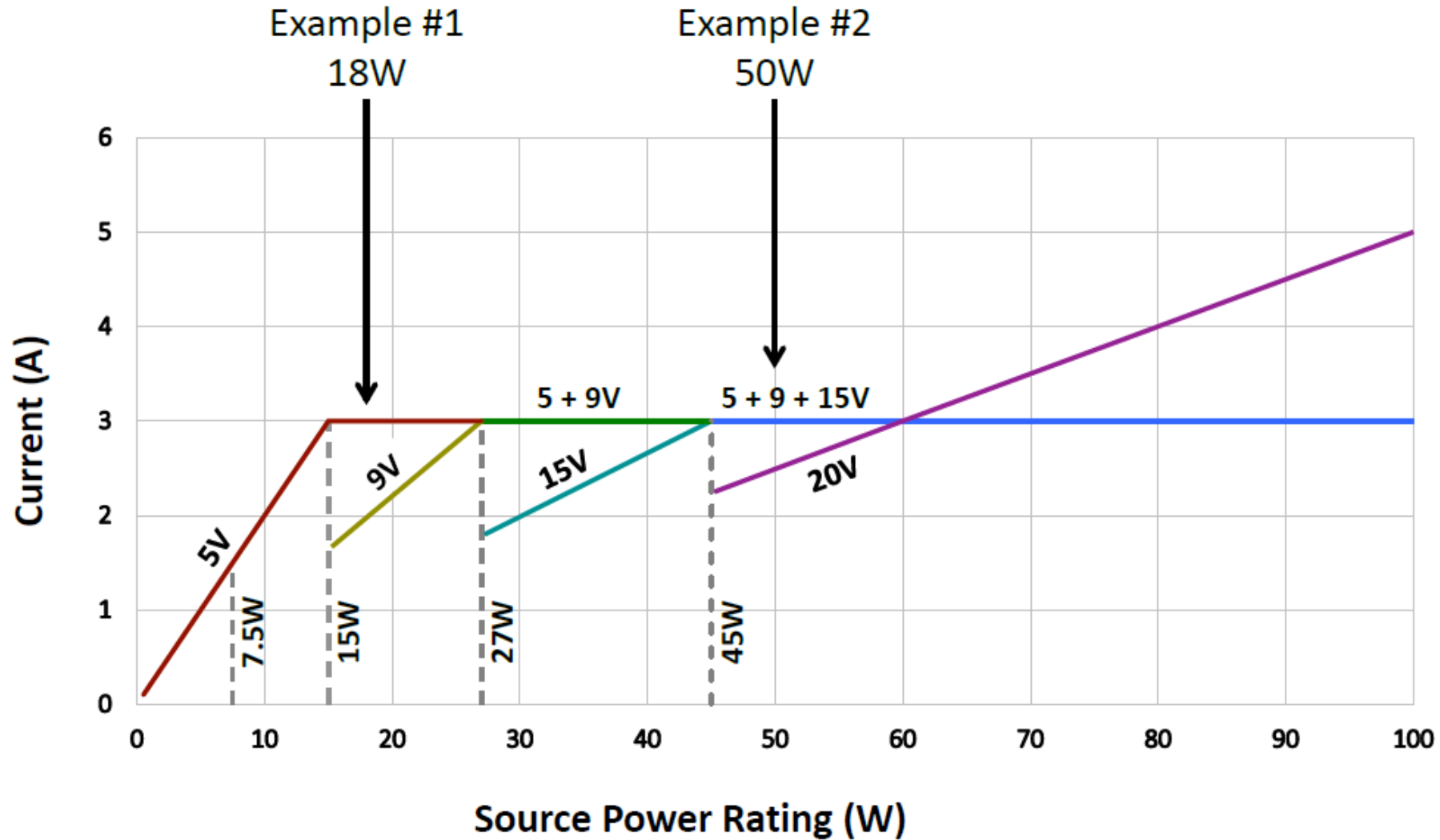
USB Type-C CC Connections
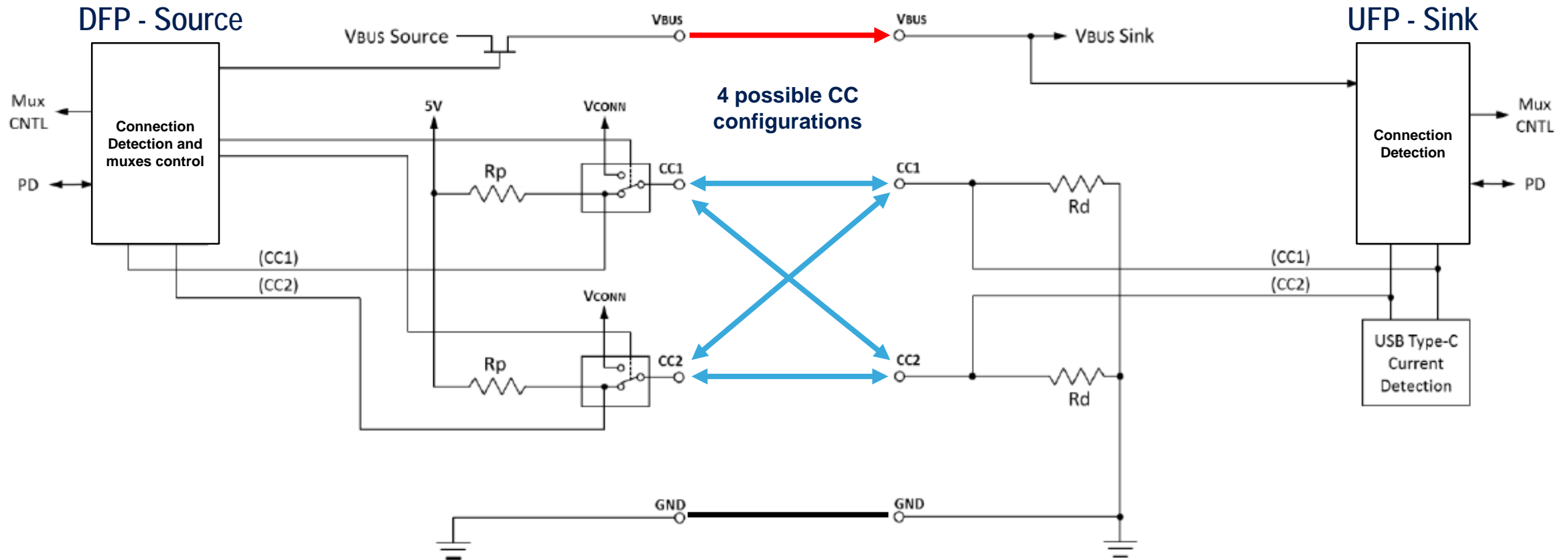
- Detect attach/detach of USB ports, e.g. a DFP to a UFP
- **Resolve cable orientation and twist connections** to establish USB data bus routing
- Establish DFP and UFP roles between two attached ports
- Discover and configure VBUS
- USB Power Delivery Communication

USB Type-C™ and USB Power Delivery
High level architecture

The different layers can be implemented in different topologies HW / SW
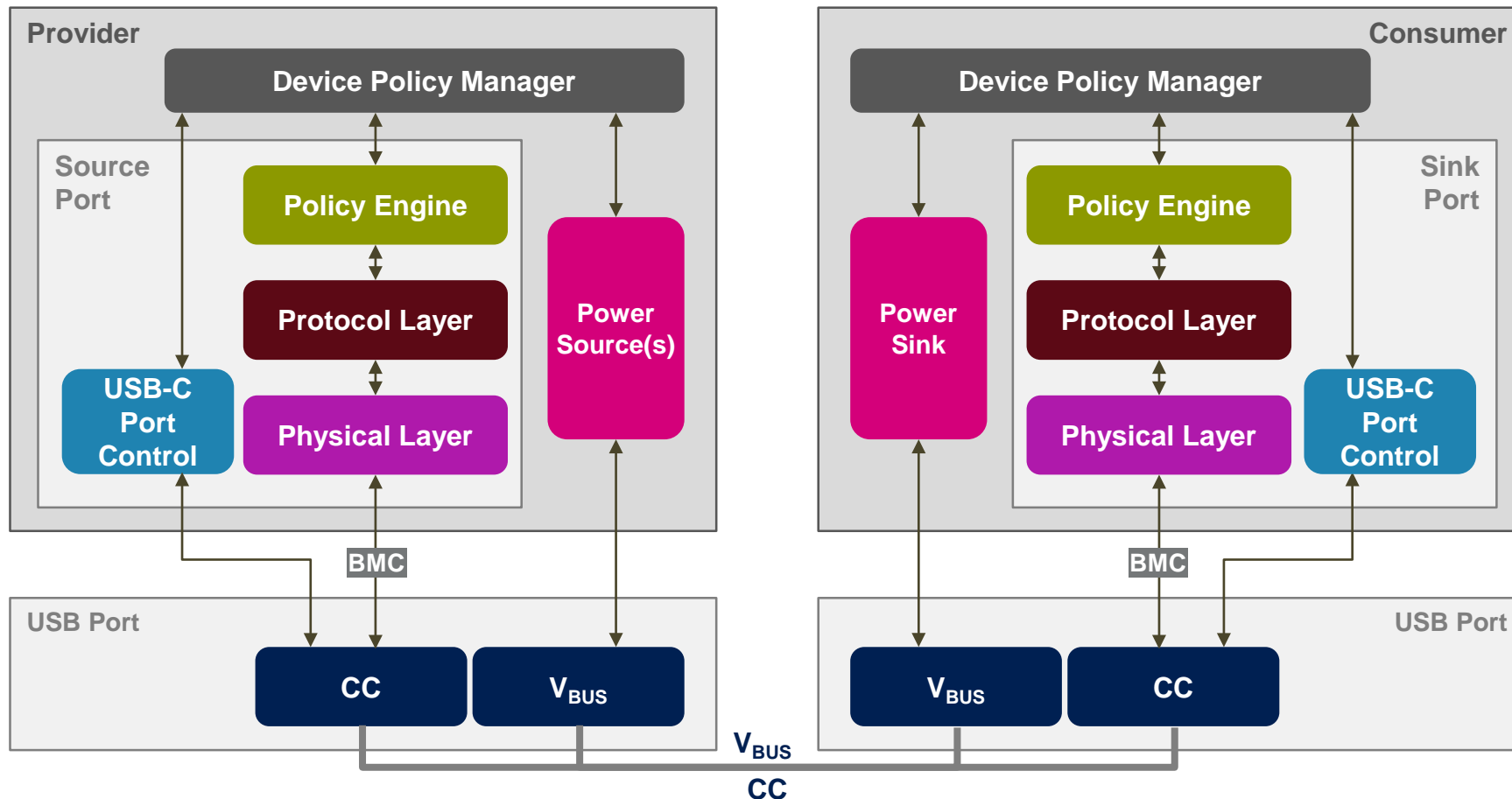
Communication across the channel uses Biphase Mark Coding (BMC) over CC in Type C connector

USB-PD: Power Negotiation Sequence
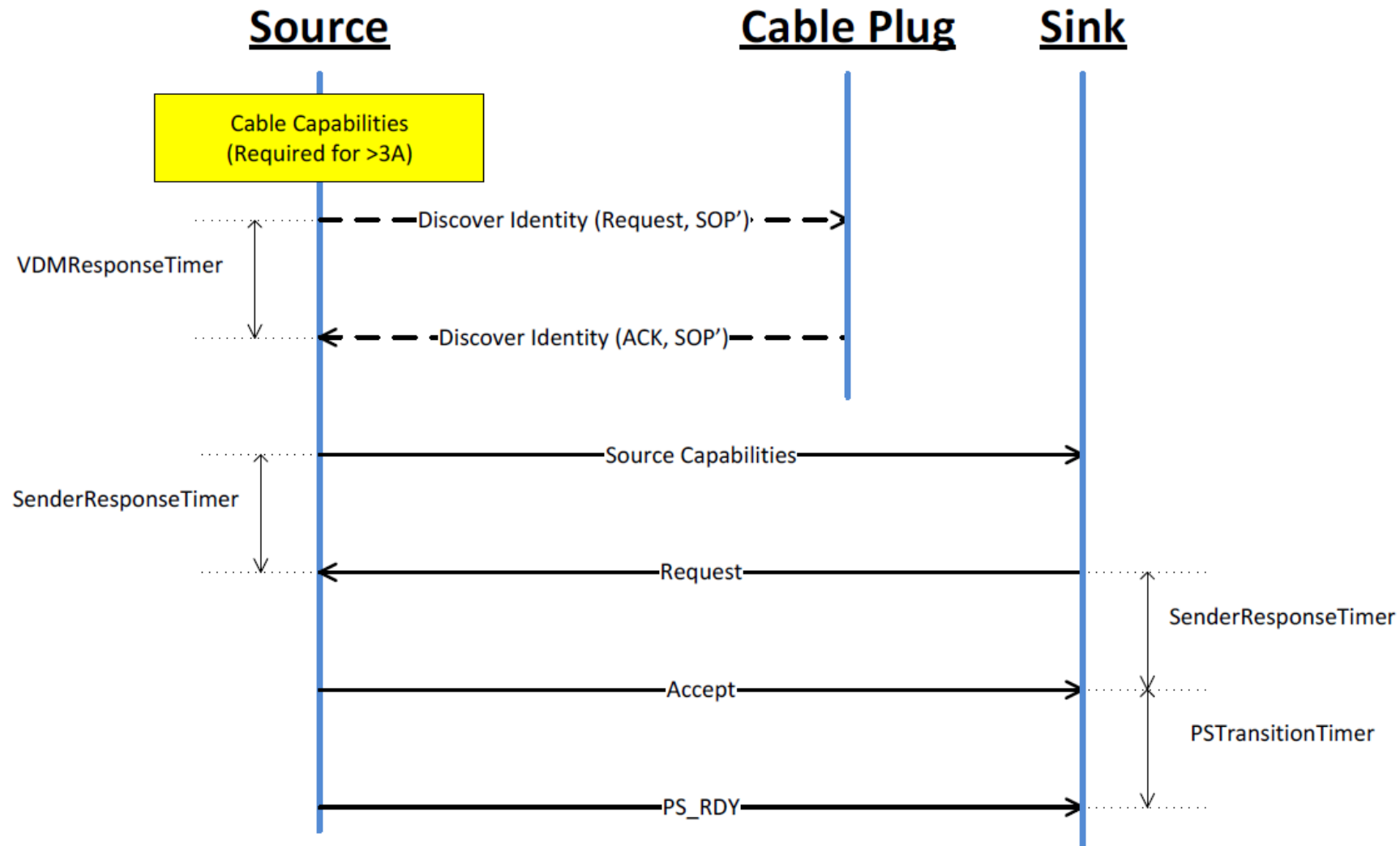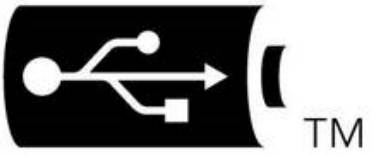
USB Type-C + USB 2.0
HW implementation in DRP mode

POWER path

Battery charger

5V~20V DC/DC

SINK path

SRC path

VBUS

VBUS_SENSE

VDD

VBUS

System & USB PD controller

3.3V LDO (optional)

VSYS

MCU

I²C interface

USB-C & PD controller

CC1

CC2

DATA path

USB 2.0 Controller +PHY

D+ / D-

D-

D+

USB Type-C receptacle

GND | GND
RX1+ | TX1+
RX1− | TX1−
VBUS | VBUS
SBU2 | CC1
D− | D+
D+ | D−
CC2 | SBU1
VBUS | VBUS
TX2− | RX2−
TX2+ | RX2+
GND | GND
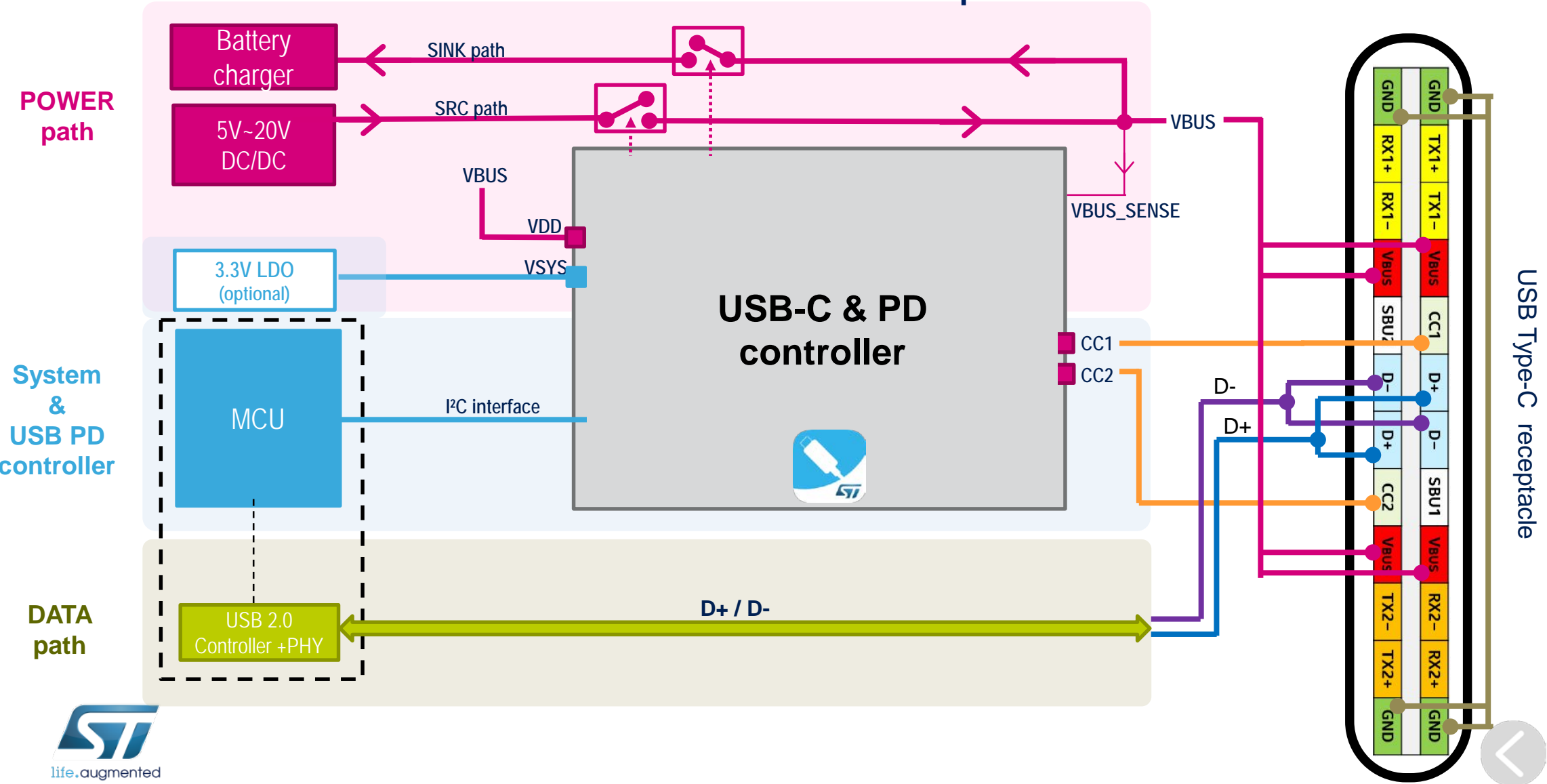
Hard Coded Type-C™ and USB PD Controllers

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

PD stack running in

STM32 **F**   SPC5

	Standalone	Standalone (NEW)	Standalone	
	STUSB1600	**STUSB45**	**STUSB47**	**STUSB1602**
	USB Type-C controller **DUAL ROLE**	Power Delivery controller **SINK only**	Power Delivery controller **PROVIDER only**	USB Type-C controller with USB PD PHY **DUAL ROLE**

USB Type-C

+

Power Delivery

+

Alternate Mode

< 15W

15-60W
60-100W

Any power
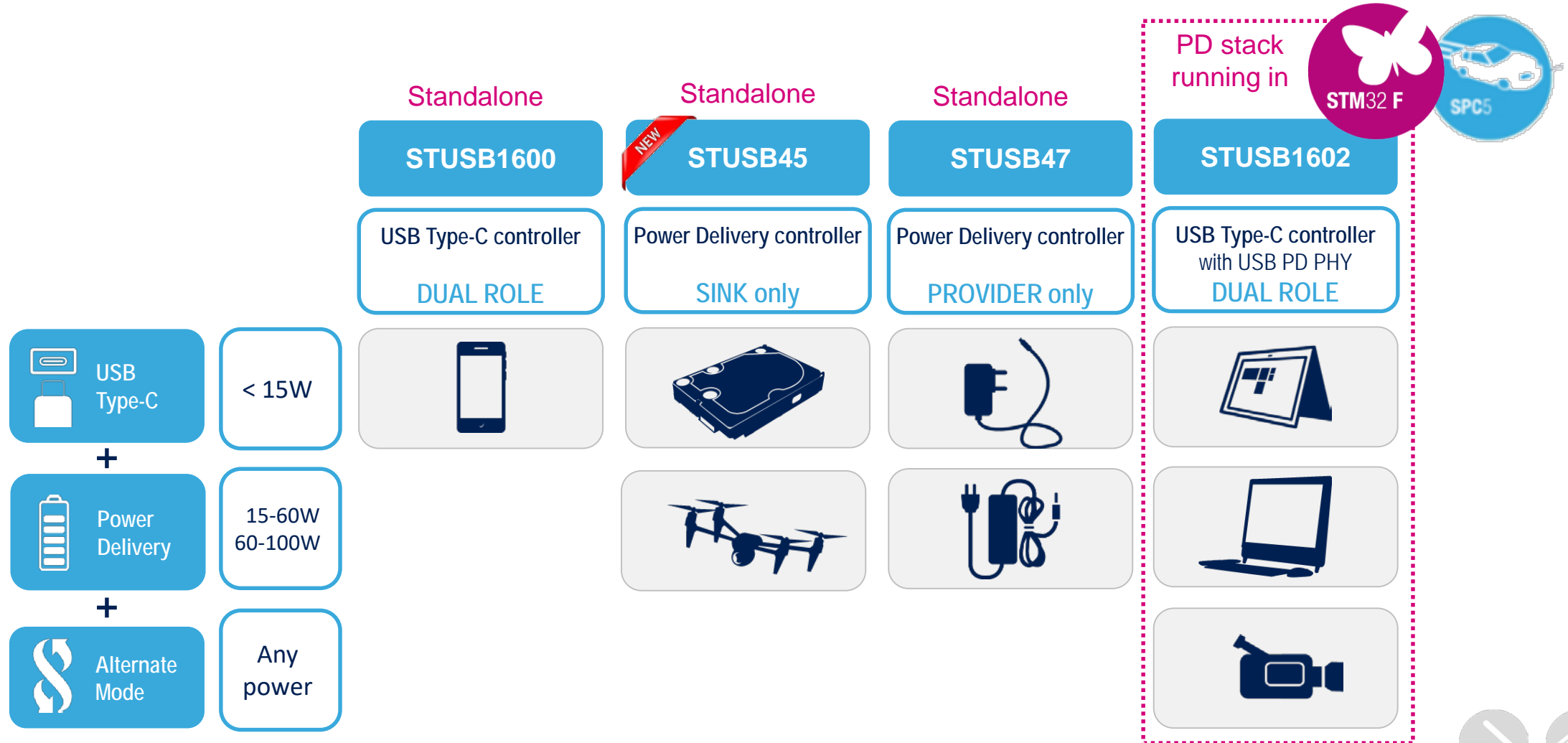
Type-C & USB PD Controllers
Certified Solutions

Certified

CERTIFIED USB™ CHARGER 45W

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

USB-PD stack

Highest **flexibility** and **adaptability** with GP STM32 MCU for **multi ports** management

+

Embedded Software (X-CUBE-USB-PD) & Low level drivers for USB1602

+

Highest **integration** with High Voltage USB-C and PD controllers (STUSBXX)

Digital functions		STM32 F	STM32 F0			
Device Policy Manager				Full Hardware USB PD Controller Optimized for AC Adapters (Provider)	Full Hardware USB PD Controller for Device side (Consumer)	USB PD Controller DFP/UFP/DRP
Policy Engine		STM32 MCUs	STM32 MCUs			STM32G0 (UCPD)
Protocol layer						
4b5b, CRC, SoP		**X-CUBE-USB-PD**	**X-CUBE-USB-PD**			
BMC encoder						
USB PD RX/TX analog PHY			Type-C Controller STUSB1602 DFP/UFP/DRP	STUSB47	STUSB45	
Type-C Interface	STUSB1600	Discrete Analog Front End PHY (CC interface)				
High Voltage Analog	DFP/UFP/DRP					High Voltage Analog

Analog functions

③   ①   ②   ④   ⑤   ⑥

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

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ST Products for USB Type-C & PD

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

Host USB 3.x CTRL, AP, etc.

SuperSpeed Switch

Rx/Tx pairs

SBUx

D+/D-

Protections

USB 3.x

USB 2.0

USB-C receptacle

USB Type-C™

Authentication

USB PD Controller (MCU or ASSP)

USB Type-C Interface (PHY)

Protections

CC lines

Power Management

VBUS
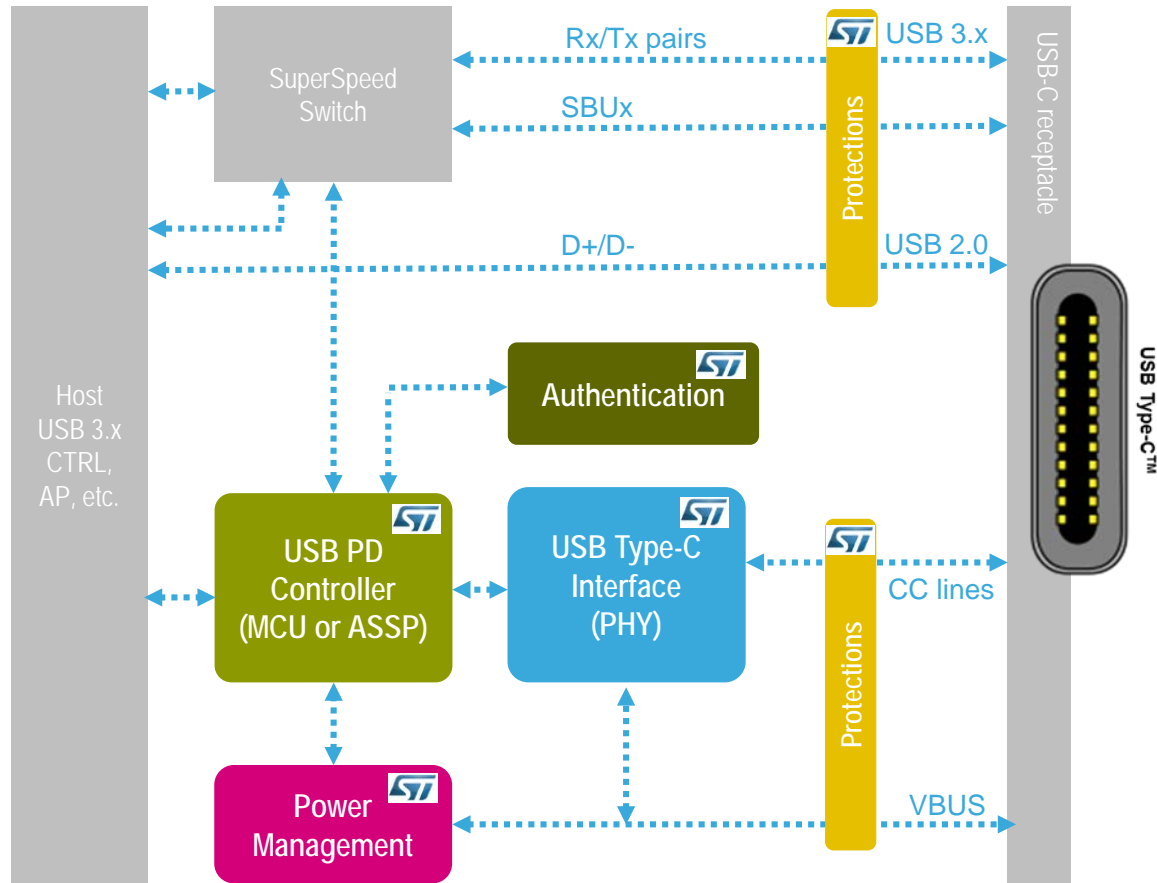
Scalable offer for USB-PD controller and USB Type-C interface: from STM32 general purpose MCU to hard-coded solution to fit different use cases and power ratings
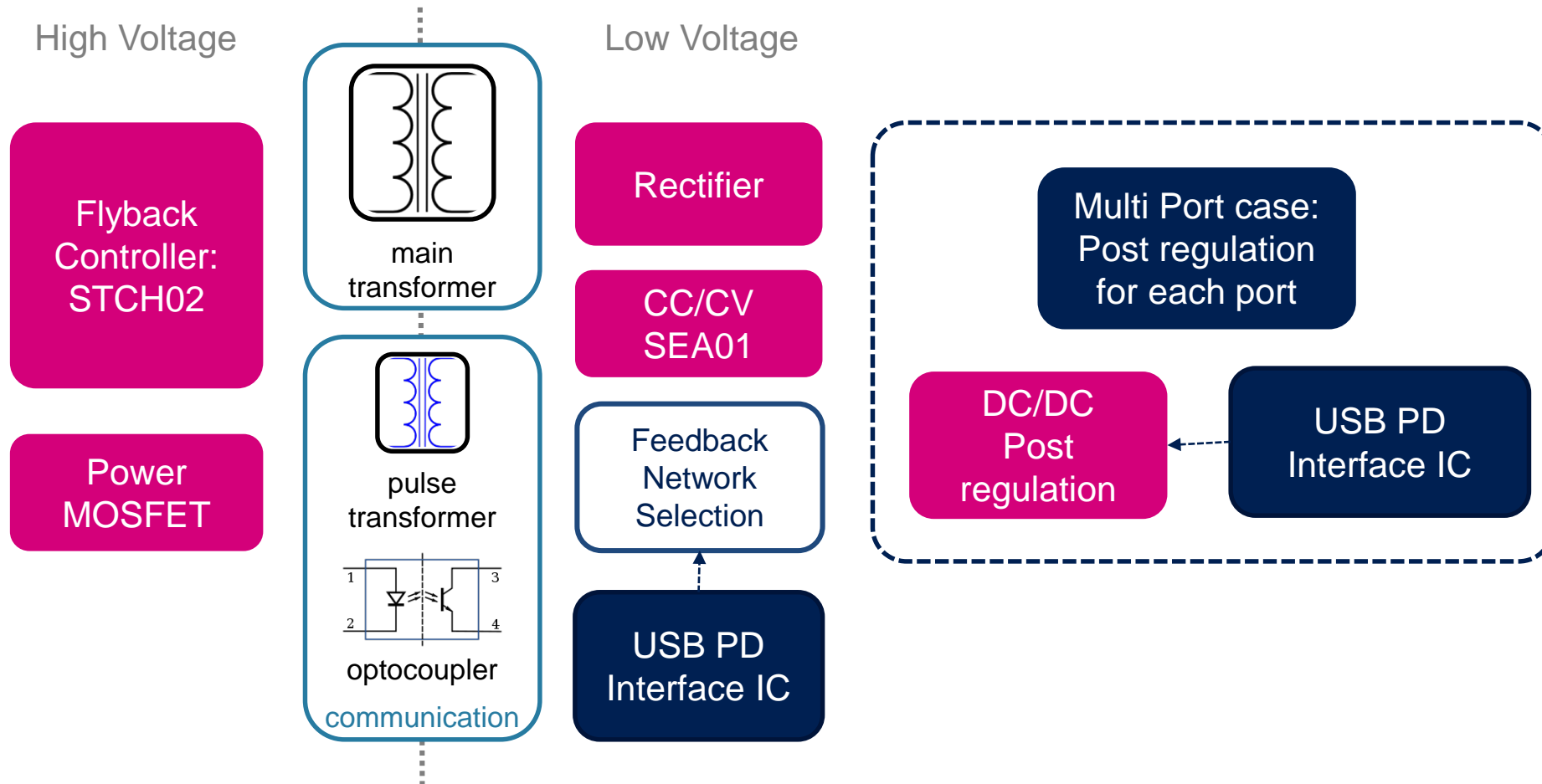
Large product portfolio for protection and filtering covering all the application needs

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

Profile 1-2-3

Power source building blocks

High Voltage

Low Voltage

Flyback Controller: STCH02

main transformer

Rectifier

CC/CV SEA01

Multi Port case: Post regulation for each port

Power MOSFET

pulse transformer

optocoupler

communication

Feedback Network Selection

USB PD Interface IC

DC/DC Post regulation

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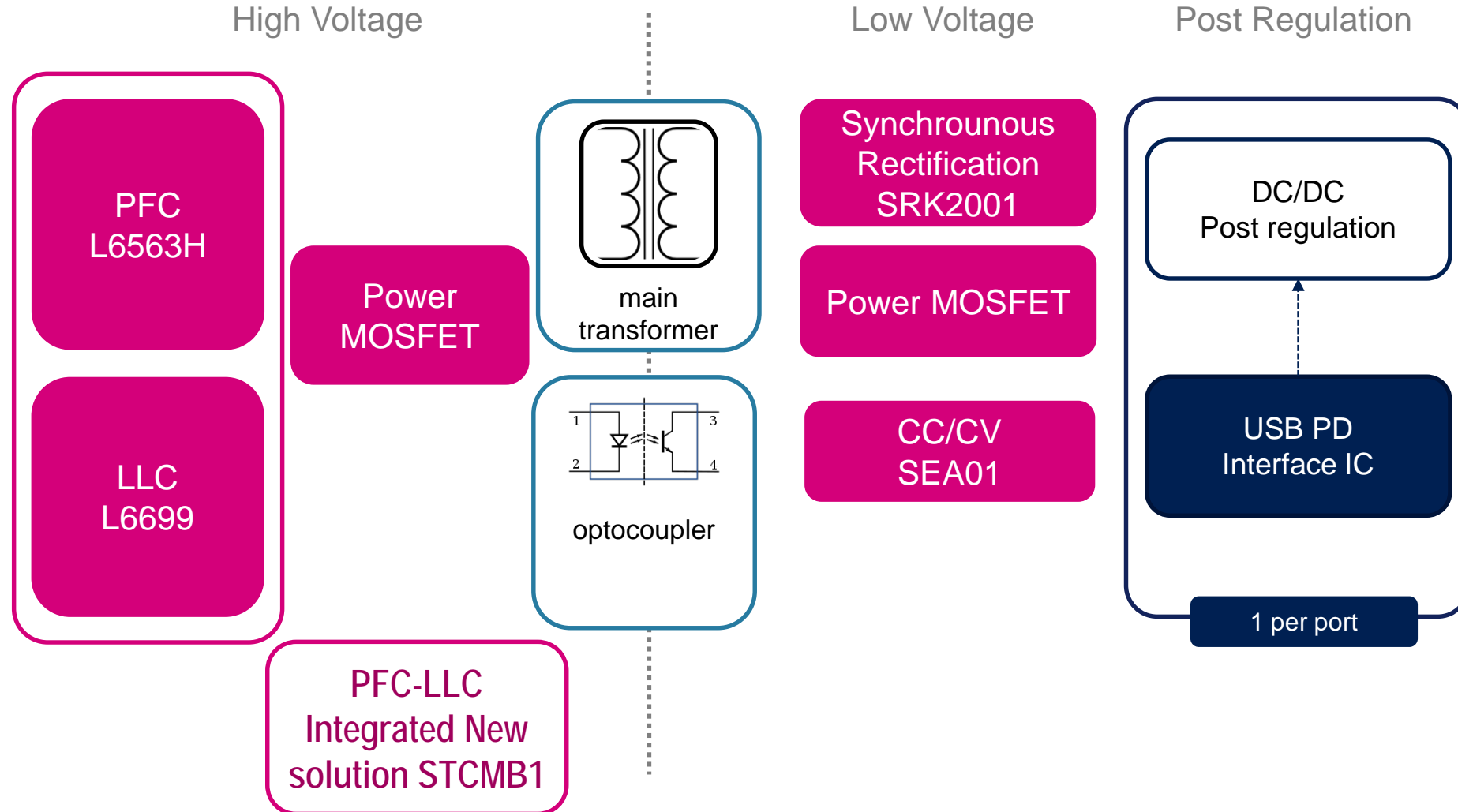
- *It covers profile 1-2-3 from 5W to 45W*
- *High Efficiency*
- *Low EMI design: intelligent Jitter for EMI suppression*

Power source building blocks

High Voltage

Low Voltage

Post Regulation

PFC
L6563H

Power
MOSFET

main
transformer

optocoupler

LLC
L6699

PFC-LLC
Integrated New
solution STCMB1

Synchrounous
Rectification
SRK2001

Power MOSFET

CC/CV
SEA01

DC/DC
Post regulation

USB PD
Interface IC

1 per port

STUSB47 meets STUSB45

Stand-alone controllers for SOURCE and SINK applications

CERTIFIED **USB** CHARGER 45W™

Passive components supplied by Würth Elektronik:
WE
WÜRTH ELEKTRONIK

PROVIDER: STUSB47
SOURCE - Autorun

CONSUMER: STUSB45
SINK - Autorun

load exemple

shaver
Typical power:
15V / 1A

VSNK

VBUS

DC/DC AC/DC — VBUS

STUSB47
CC1
CC2

VBUS

CC1
CC2
STUSB45

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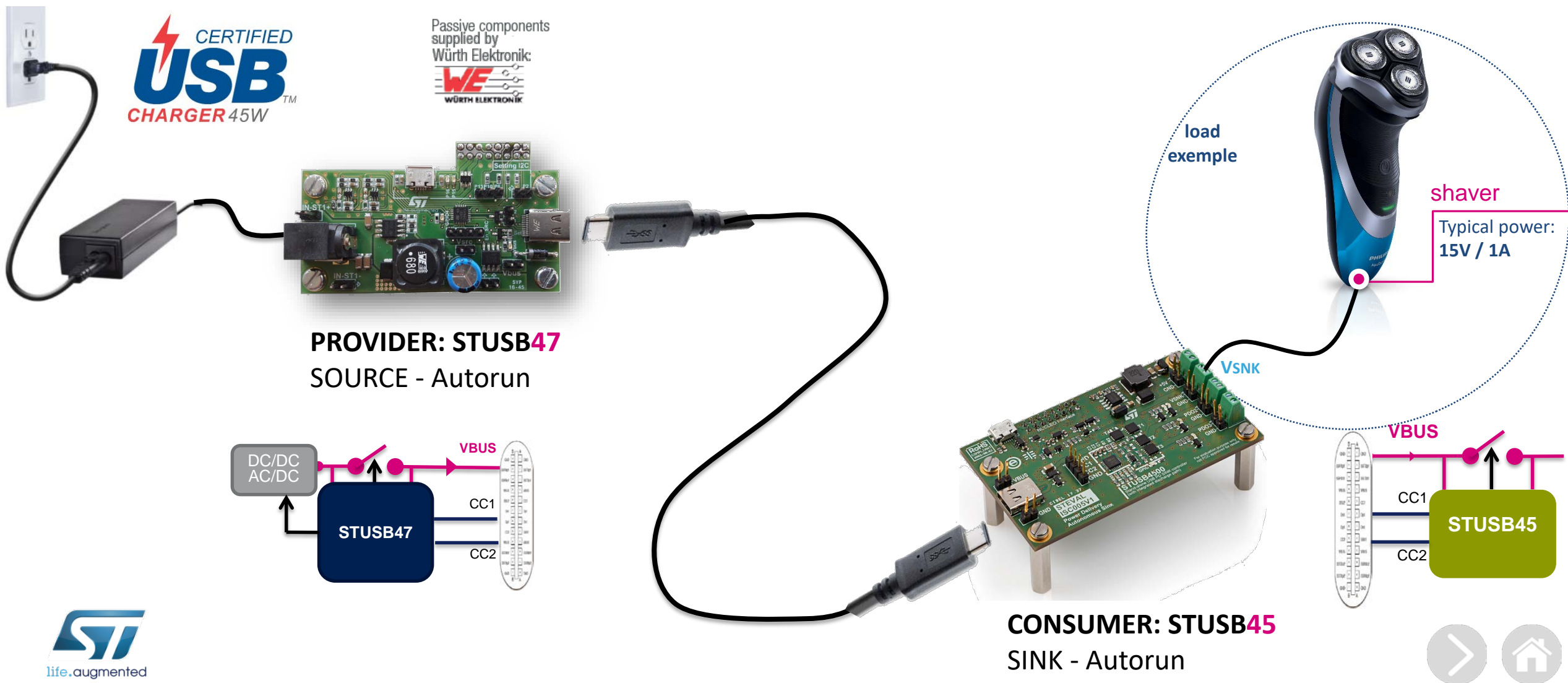
STM32G0 USB-C Discovery

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

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
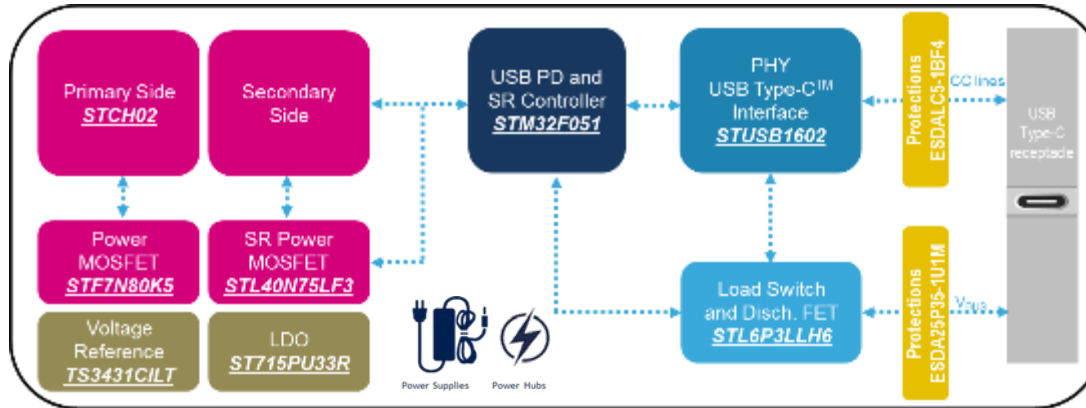
STPS0520Z: Power Schottky rectifier

X-CUBE-USB-PD: STM32 USB-PD package consisting of libraries and application examples for STM32F0 devices acting as USB-PD controllers
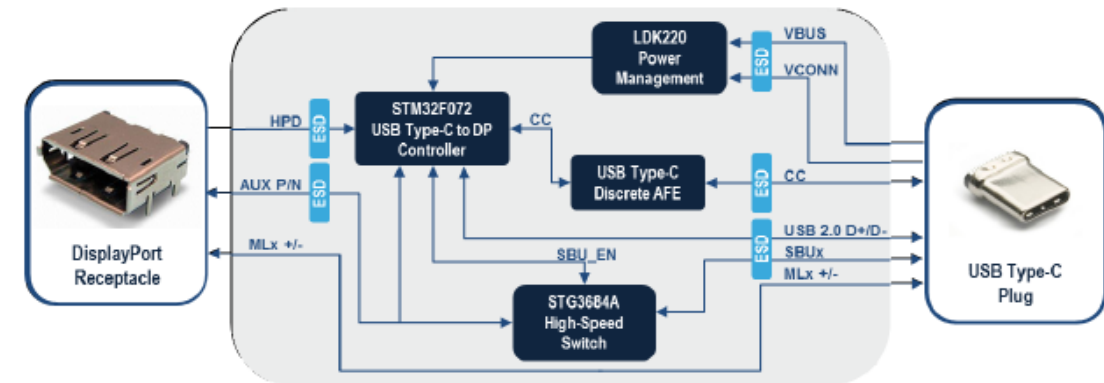
AC/DC 45W USB-C PD adapter with SR (STEVAL-USBPD45C)

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

2.2 cm
7.3 cm
5.2 cm
PSB
DCB

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

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
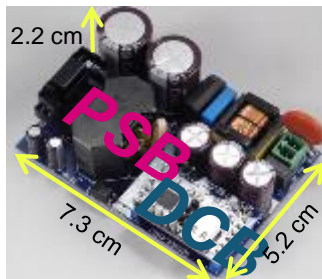
SR MOSFET: STL40N75LF3
STripFET™ III N-Channel Power MOSFET specifically designed to minimize on-resistance and gate charge to provide superior switching performance

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

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