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High power wireless charging solution for mobile and industrial applications

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STMicroelectronics

Power & Energy
Competence
Center

“**If Only** I could charge all my devices wirelessly

This is where we come in

Everywhere a battery is needed, there is an opportunity for wireless charging

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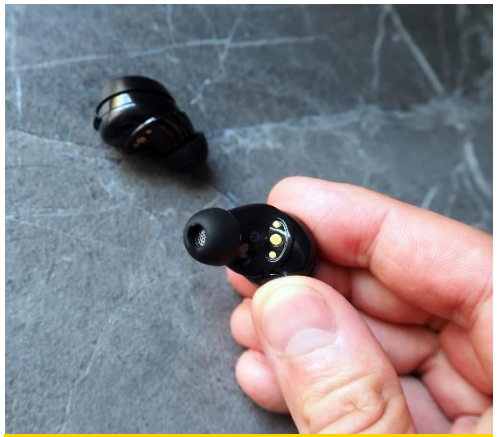
Wireless charging adoptions

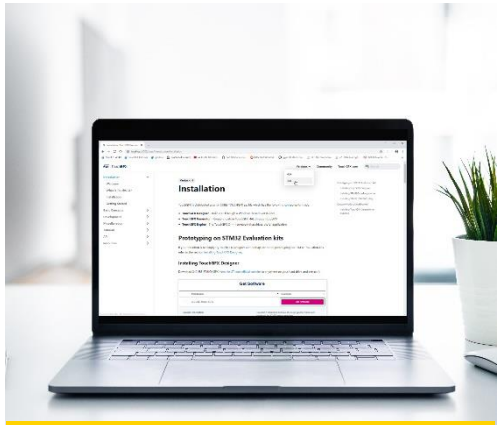
Smartphones

Tablets

Smartwatches



Earbuds / TWS



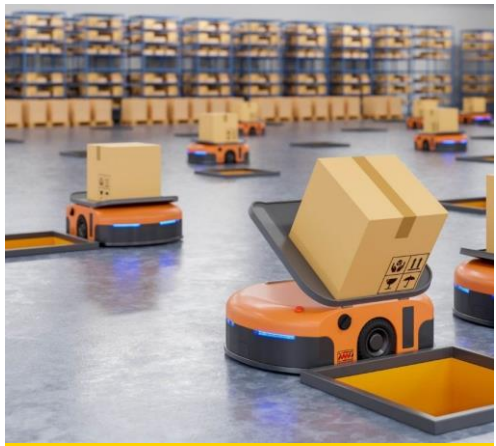
Laptops

Power Tools

Drones

POS & Pads

Home Appliances



Industrial Robots

ST Wireless charging turnkey evaluation kits

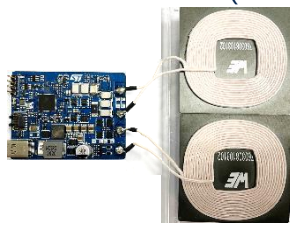
100 ~ 200 W
Industrial & Kitchen
Appliances, Power tools
Personal electronics

New TX-RX Solutions On The Way …

30W~100W TX-RX

30 W ~ 100W
Super fast charge
smartphones,
Appliances,
Power tools,
5G CPE


STWBC2-EVB5 (50W+)

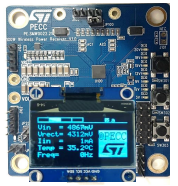

STDES-50W2CWBC (50W+)


PE.SMW0015.21 (100W+)


STWLC98-EVK (70W)


STWLC99-EVK (100W)


STDES-70WRXWLC (70W)


PE.SMW0022.21 (100W)

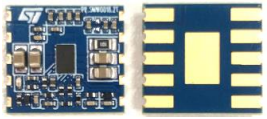
5W ~ 30W TX-RX

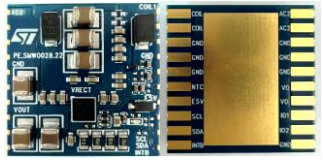
5 ~ 15 W ~ 30W
Standard Qi BPP/ EPP
Smartphones,
Wearables, fast charge


STWBC86-EVK (5W)


STWBC2-EVB5 (50W+)

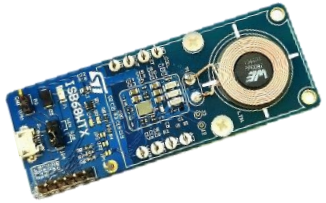

STEVAL-WLC38RX
(5W & 15W)


PE.SMW0018.21
(STWLC38 15W)


PE.SMW0018.21
(STWLC86 30W)

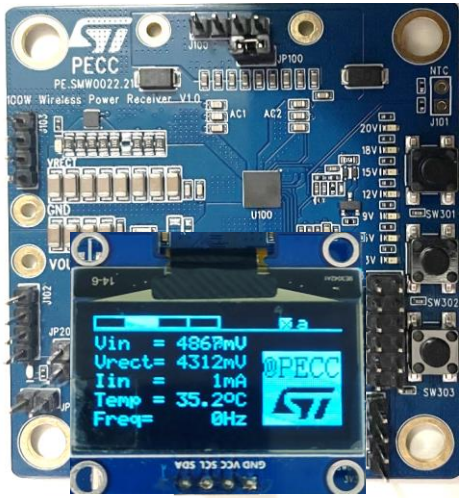
2.5W TX-RX

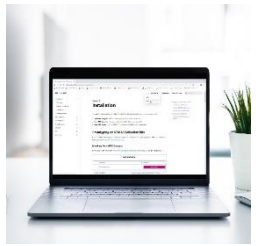
2.5 W
Standard Qi BPP
Smartphone, Wearables


STDES-WBC86WTX (2.5W)


STDES-WLC38WA (2.5W)

100W wireless charging receiver





Function	Component
Wireless Charging Receiver SoC	STWLC99
Microcontroller	STM32F072CB
DC-DC controller	PM6644

Application Key Features

- STWLC99 based Wireless Charger RX solution
- Up to 100W on RX output with ST proprietary protocol (STSC)
- Integrated OLED display and buttons to allow output voltage switching without PC
- Integrated power management to allow 25W reverse charging with USB adapter
- Embedded GUI to show dynamic voltage and power curves
- Integrated proprietary protocol to demonstrate customizable in-band communication
- Reference driver source code to STWLC99

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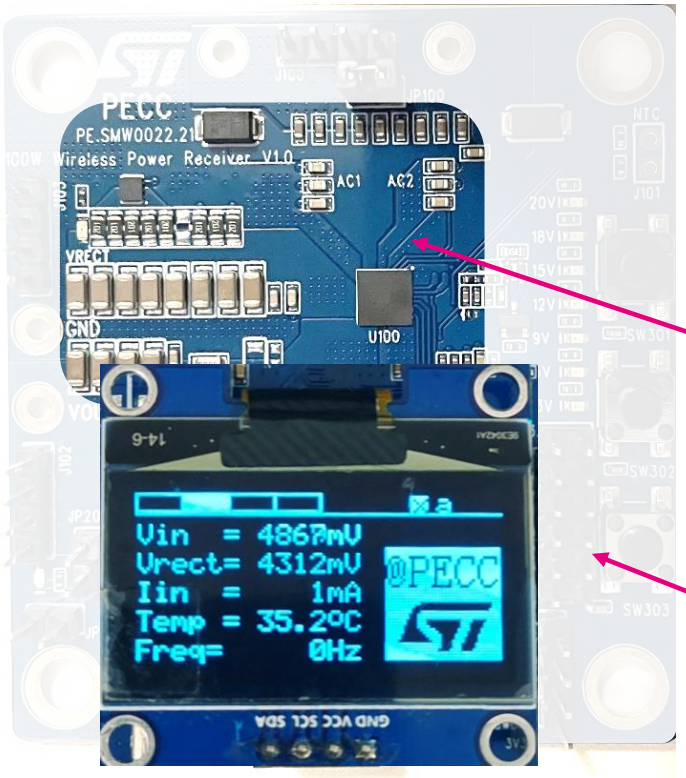
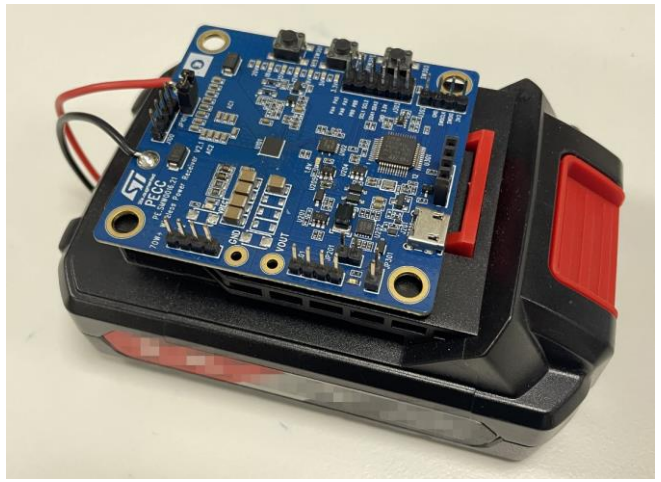
100W RX evaluation in system



- Work without display in customer system, PCB size 60 x 65 mm.
- Wireless charging receiver core board based on STWLC99.
- Flexible extension to other sub-systems.



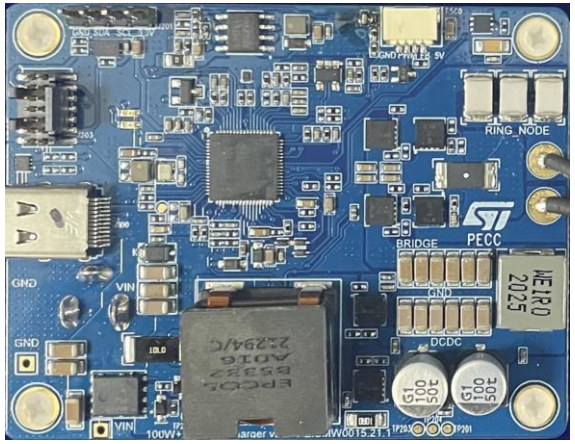
BLE or 60GHz RF

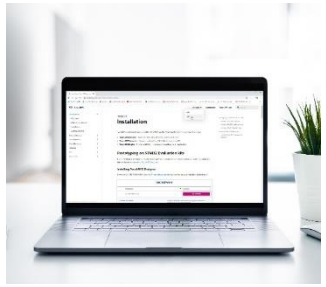
Switch Cap.

NVDC

• • •

100W+ wireless charging transmitter



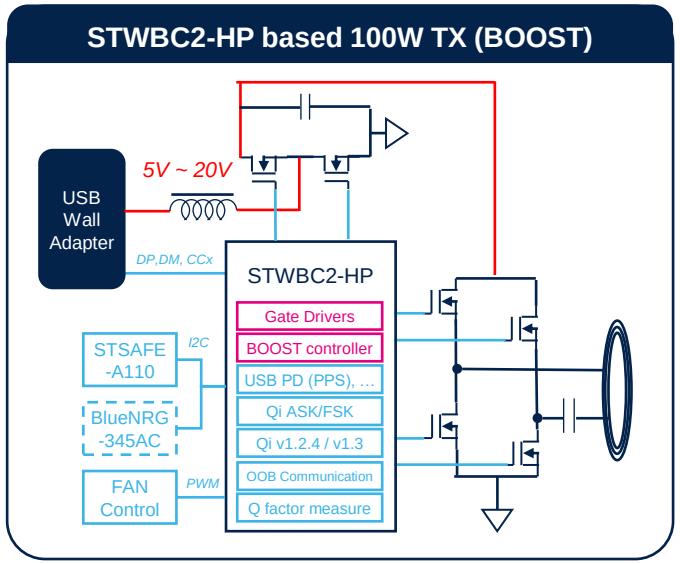


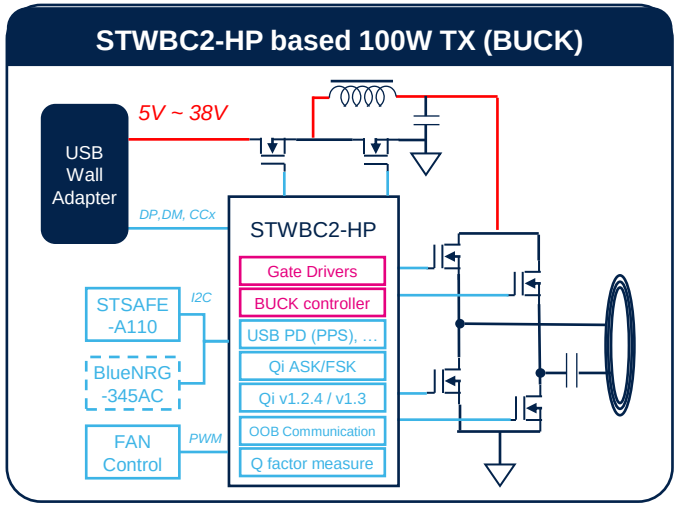
Function	Component
Wireless Charging Transmitter SoC	STWBC2-HP
LV N-MOSFET	STL20N6F7
Secure Element for Qi 1.3	STSAFE-A110

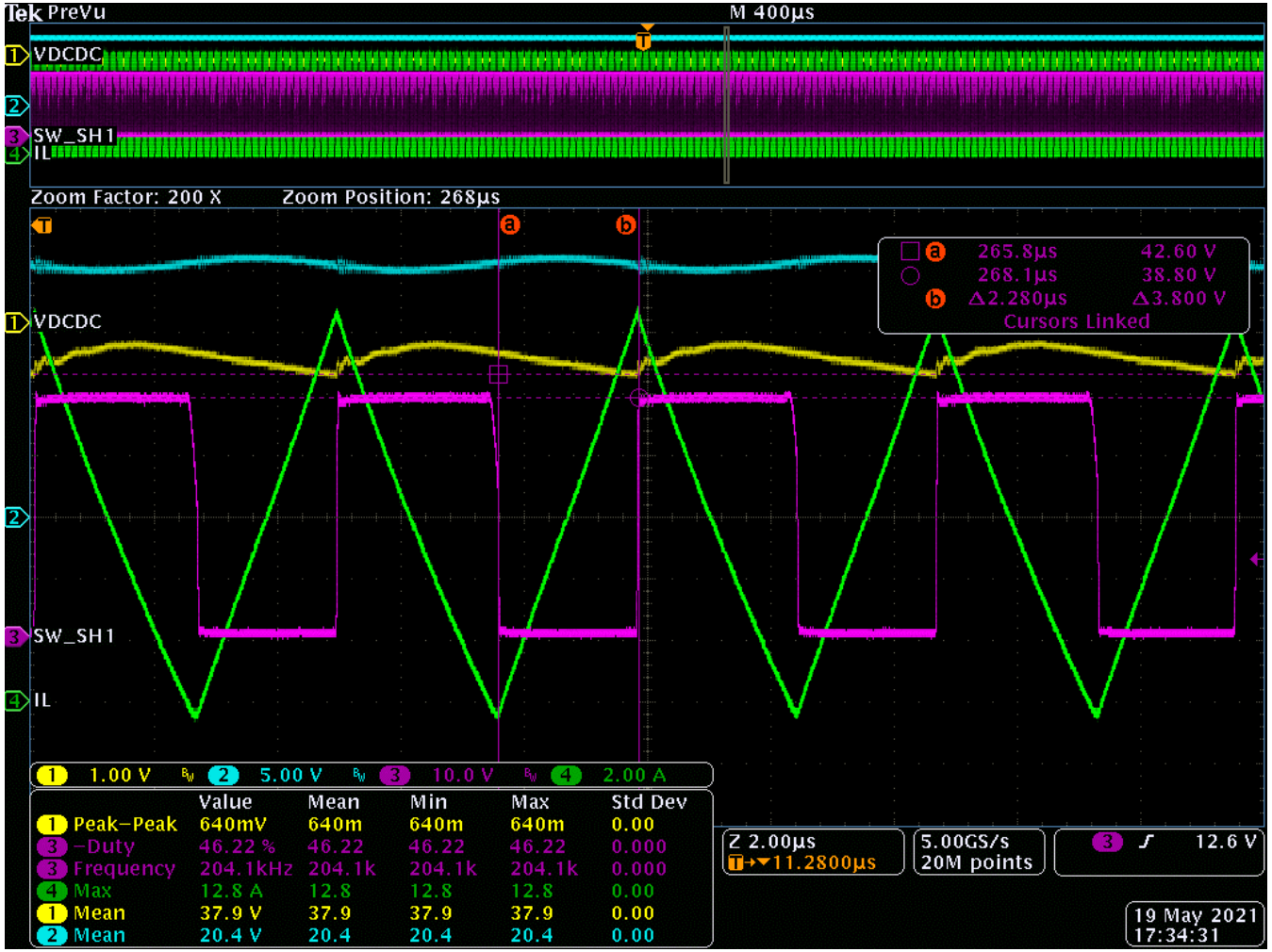
Application Key Features

- STWBC2-HP based wireless charger TX solution, up to 100W+ with ST proprietary protocol (STSC)
- Qi V1.3 EPP 15W compliant with MP-A2 topology, authentication with STSAFE-A110
- 38V+ bridge voltage for high power extension, based on 40V bridge driver of STWBC2-HP
- Type-C input interface supports USB-PD 3.0, including PPS, and so on
- Innovative Q factor measurement for high accuracy QFOD (Foreign Object Detection)
- Rich protections with static and dynamic OVP, OCP, OTP and power balanced FOD
- Optional proprietary extension with out-of-band communication (e.g., BLE)
- Optional proprietary extension for wider spatial freedom (X-Y-Z)

Flexible DC-DC stage for multiple topologies



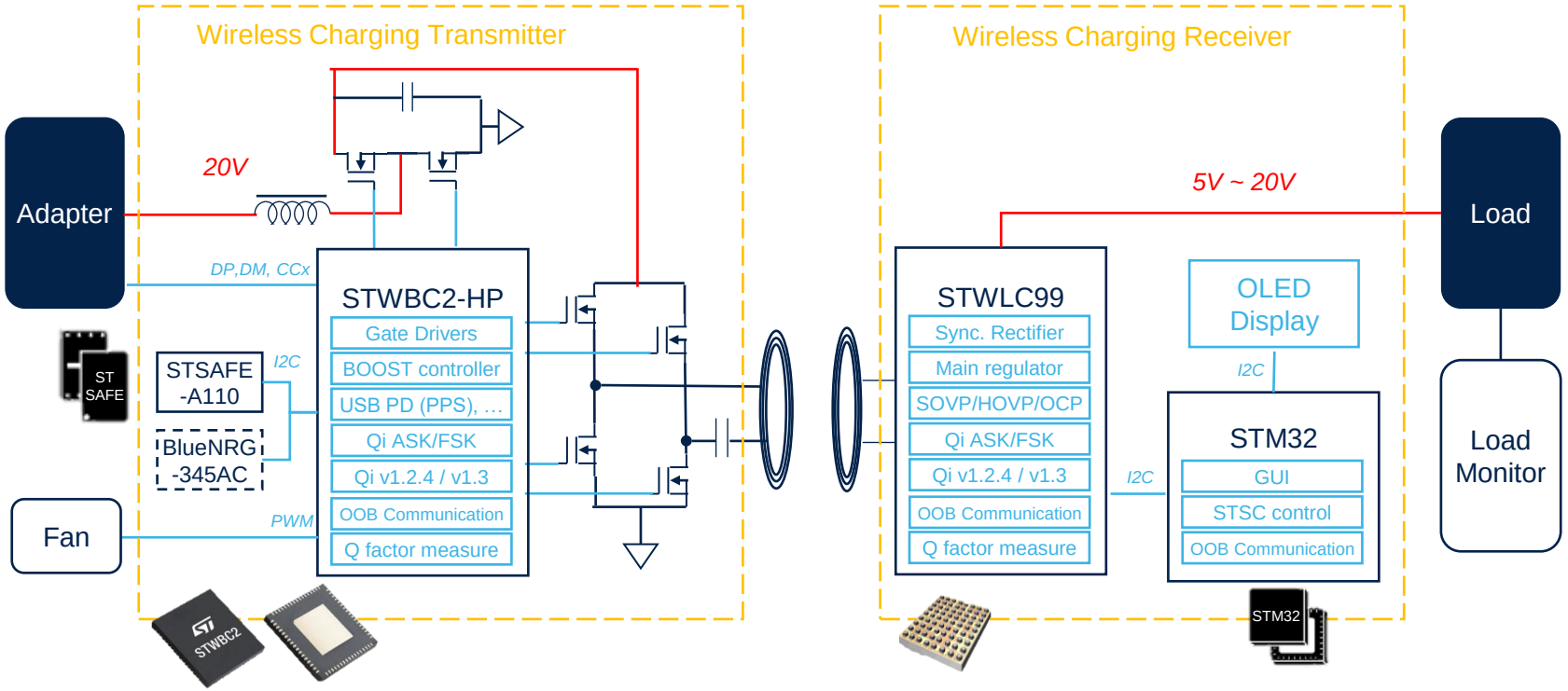




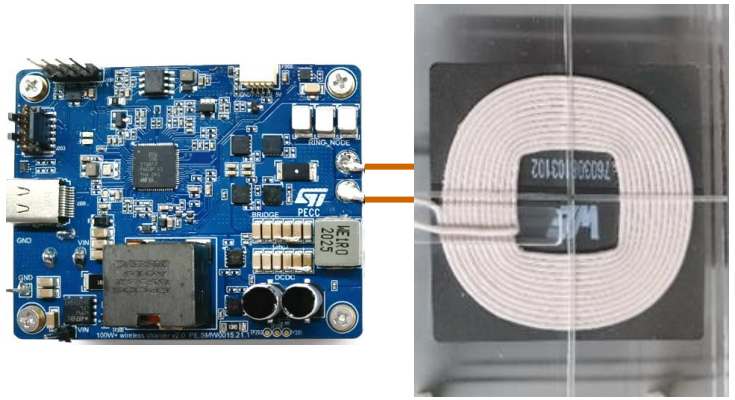
DCDC works on BOOST mode, up to 160W

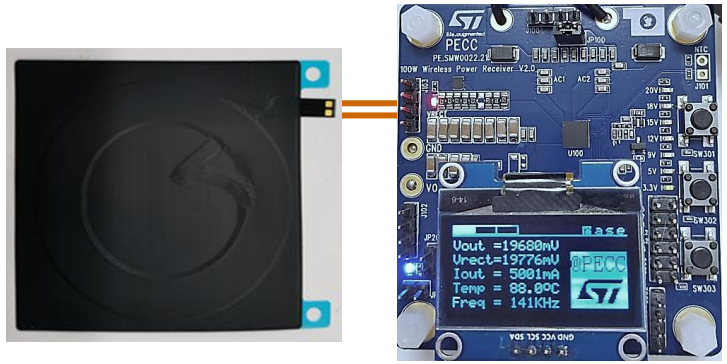
STWBC2-HP – STWLC99 100W TX-RX

Main Components
STWBC2-HP
STL20N6F7
STSAFE-A110



Main Components
STWLC99
STM32F072CB
PM6644





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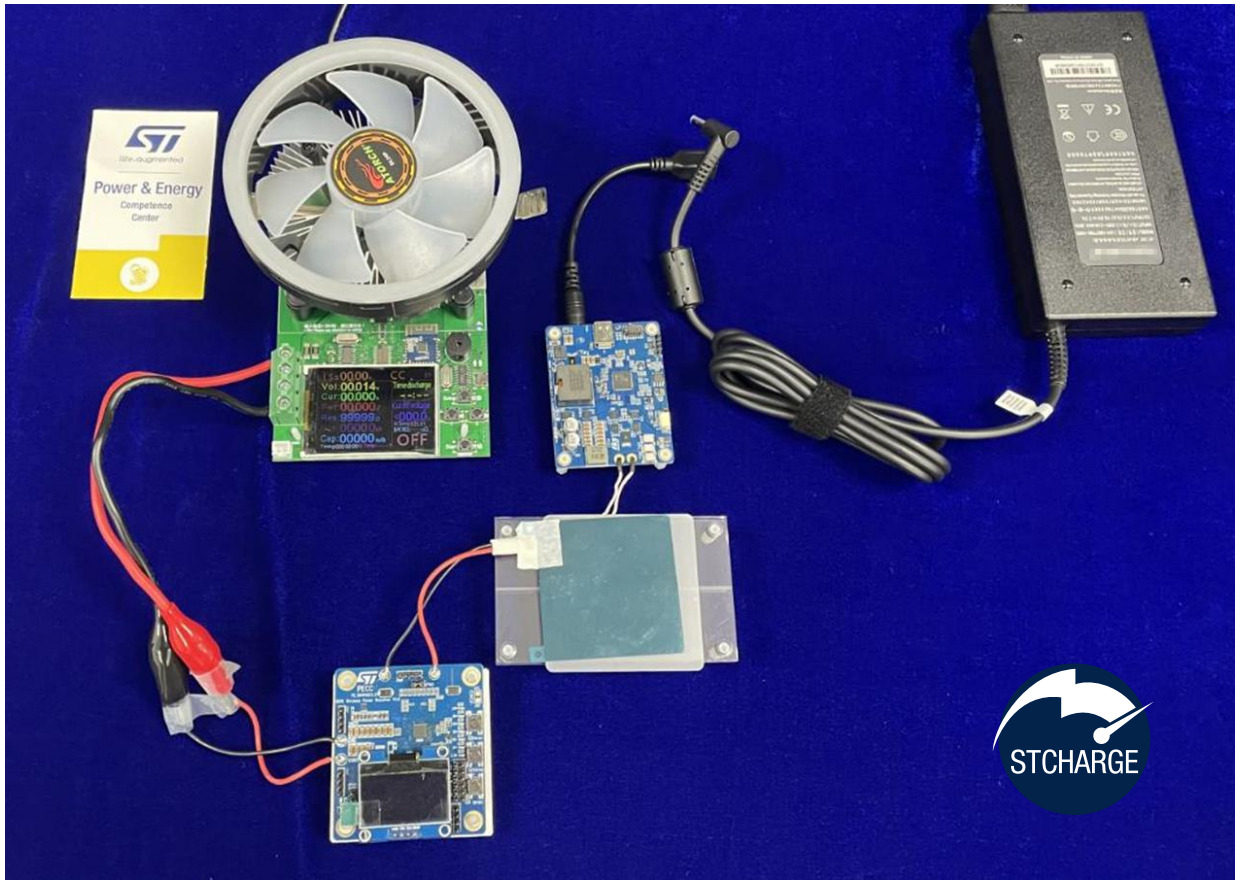
STWBC2-HP – STWLC99 100W evaluation setup

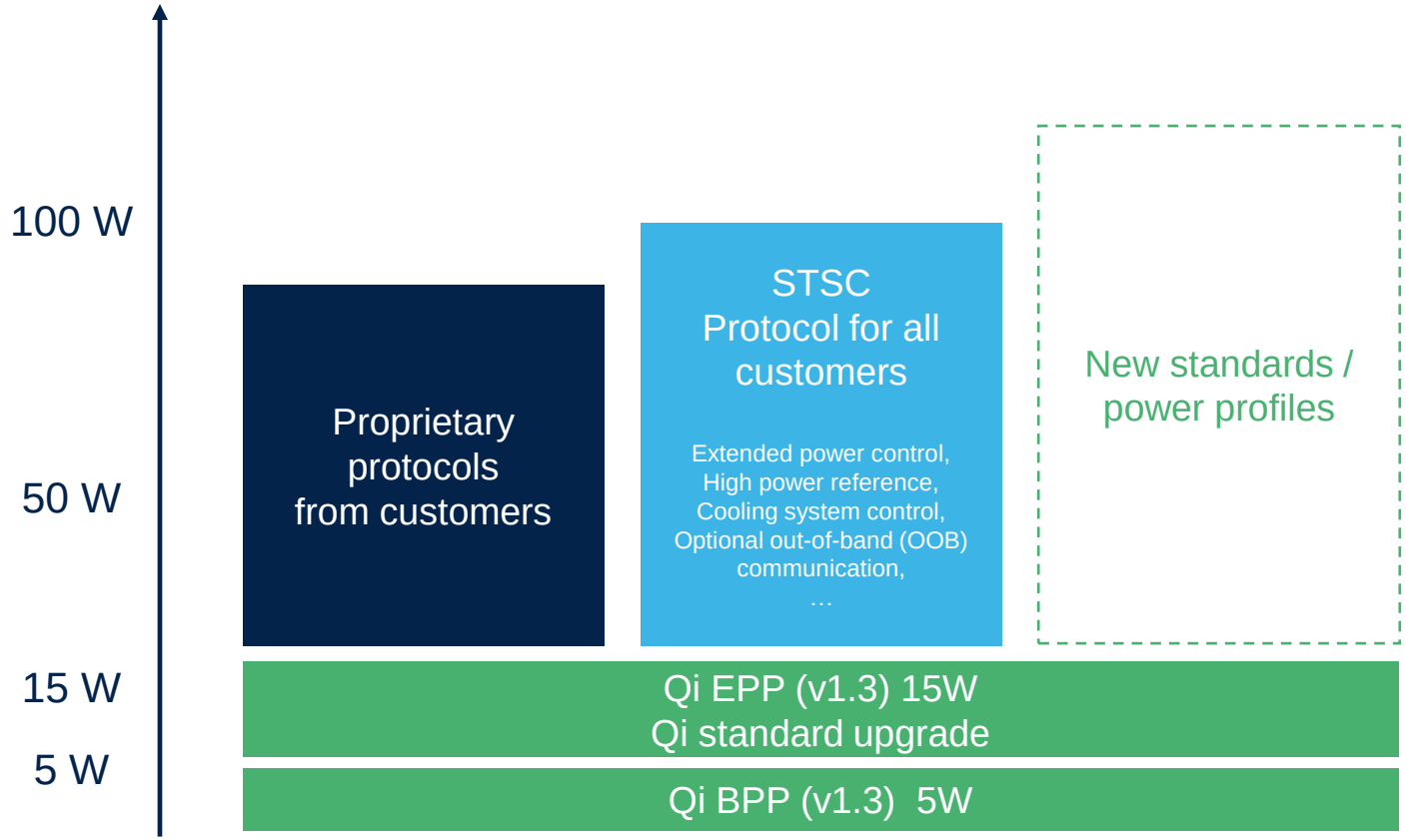
Quick Evaluation

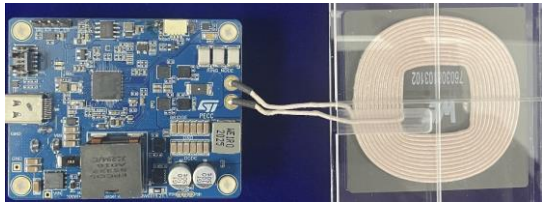
- STWLC99 Board (Display and buttons) — Electronic Load >= 100W
- STWBC2-HP Board — Laptop adapter 19.5V, >6A

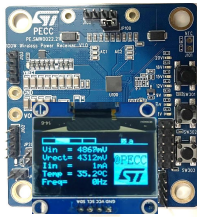


Live demo video available online

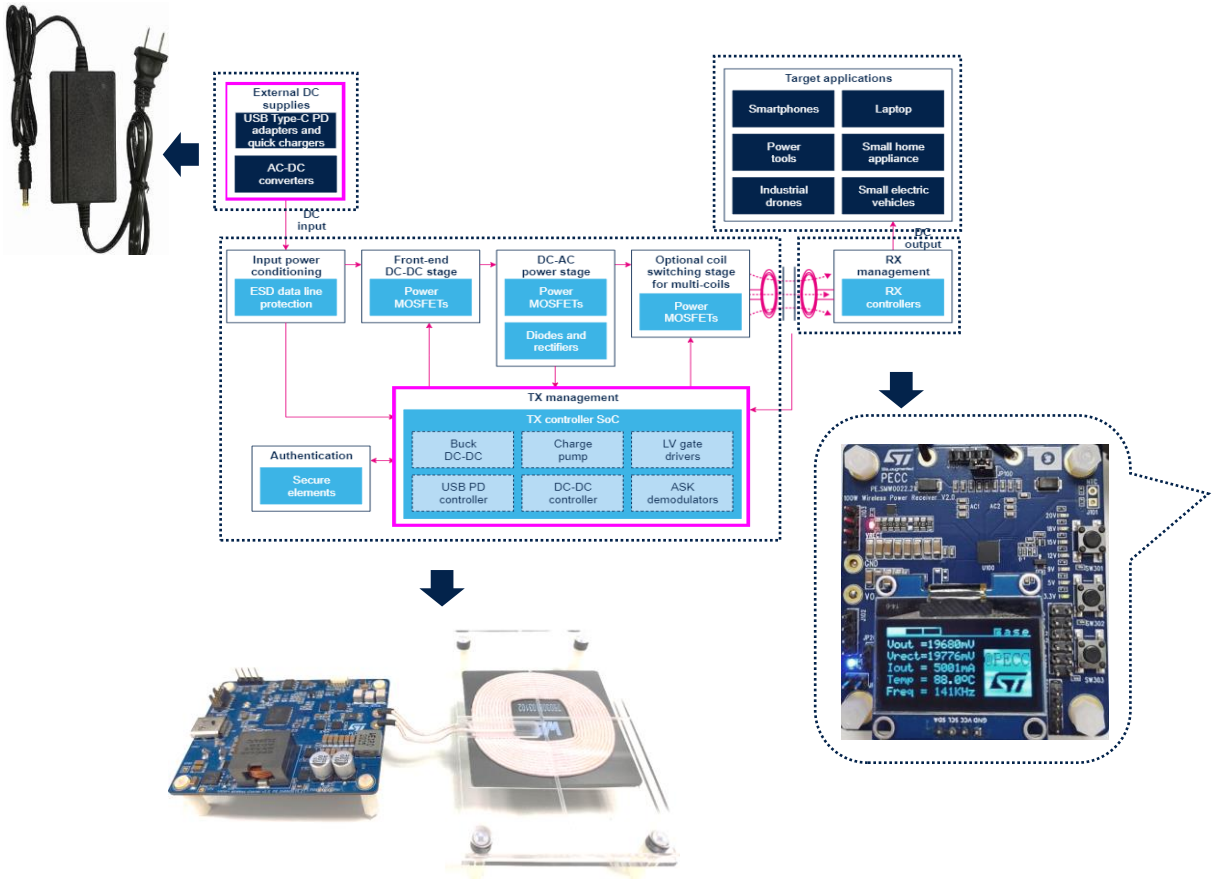
ST Super Charging Protocol for beyond 15W

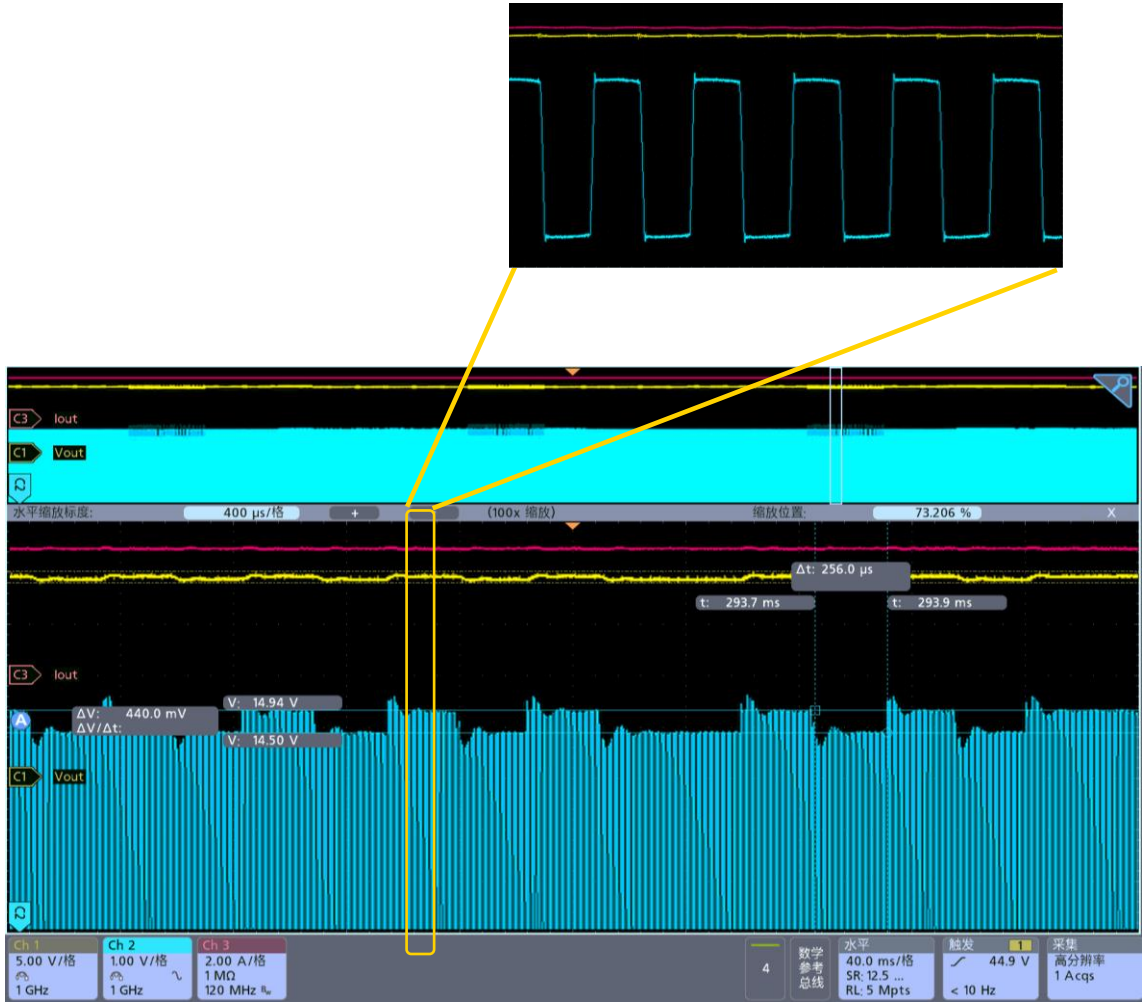






Power transfer and ASK communication at 100W

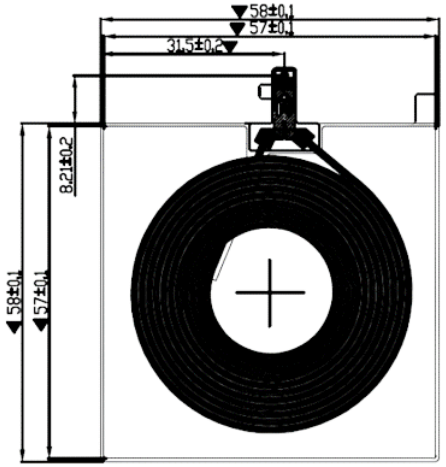




RX ASK modulation @100W (Vout = 20V, Iout = 5A)

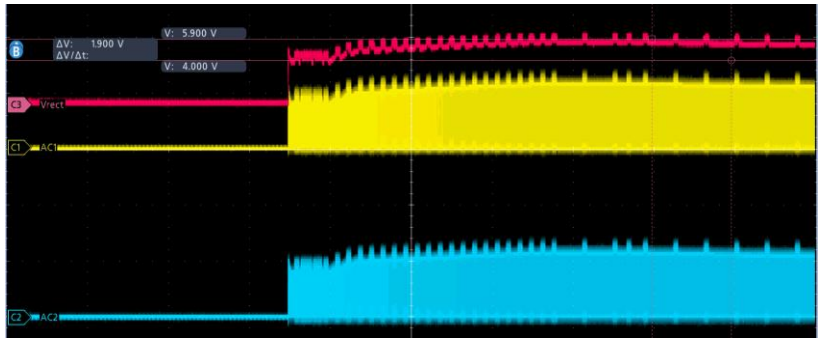
Enable low-inductance coil for high power

ARC (Adaptive Rectifier Configuration) mode improves the ping up and power transfer spatial freedom of the system in both X and Y direction

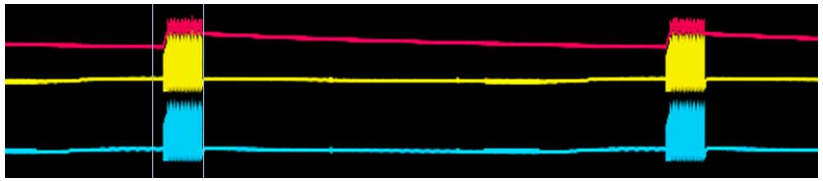


RX coil examples

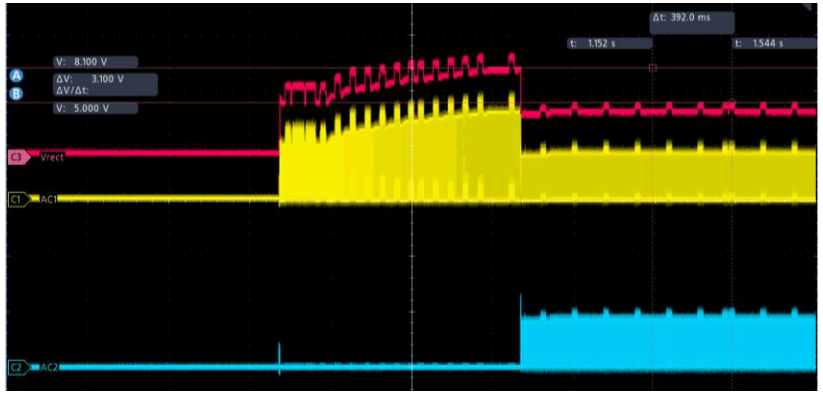
Inductance	8uH coil	4uH coil
Outer diameter	49 mm	50 mm
DC resistance	190 mΩ	75 mΩ
AC resistance @100KHz	220 mΩ	95 mΩ



RX power up with 8uH coil

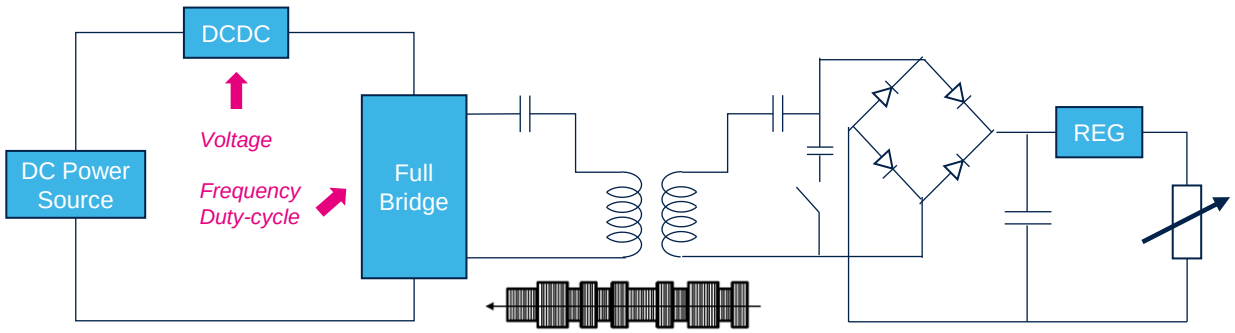


RX power up with 4uH coil, in same condition, no ARC mode

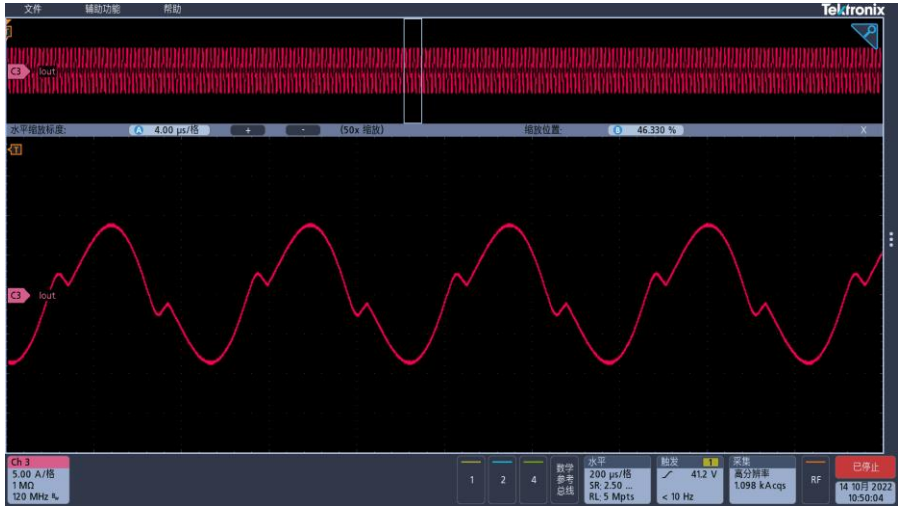


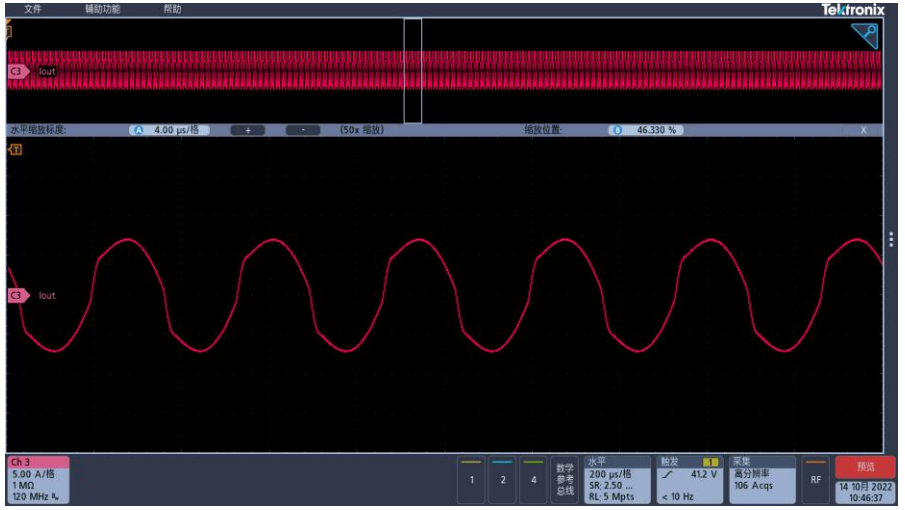
RX power up with 4uH coil, in same condition, with ARC mode

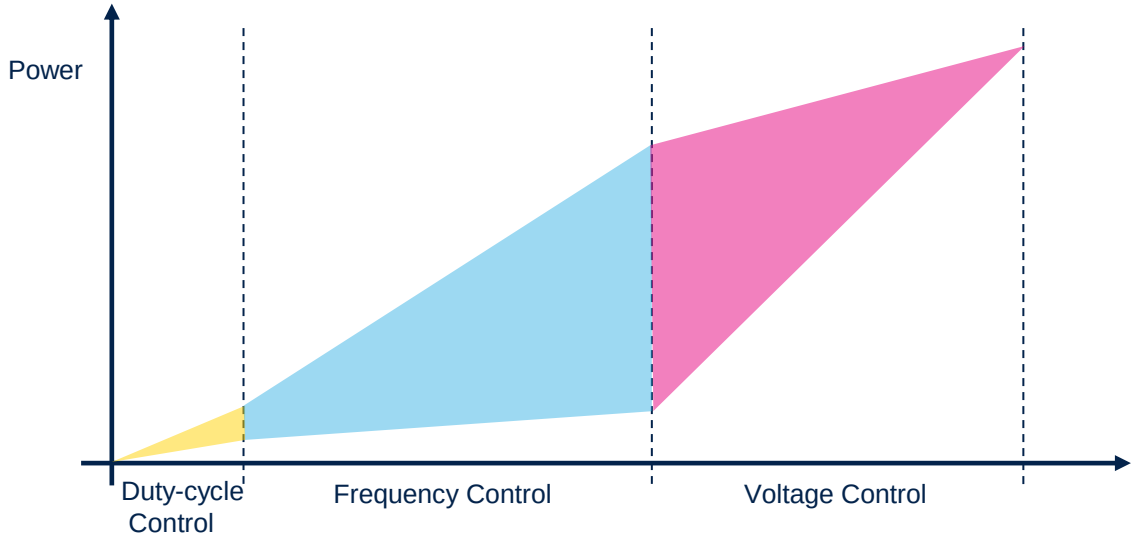
Proprietary power control for high power range



Wireless Charging topology example
high dynamic range of load will impact the resonance.







Proprietary power control over STSC
to have good resonance in full load range

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WPC Qi v1.3 compatibility

Qi 1.2.4 TX test items	
Power delivery test	28
Communication test	42
FOD test	43
Thermal test	2
Total	115

Qi 1.3 TX test items	
Power delivery test	40
Communication test	548
FOD test	76
Thermal test	4
Authentication test	9
Total	677

Specifications/Standards Tested

Qi 1.2.4	-
Qi 1.3.2	99.8 %
Qi Market Inspection	94.4 %
IEC FOD (by proxy)	100.0 %
Samsung Proprietary Extension 1.0.4	-
Samsung Proprietary Extension 1.1.0	-
WPT Efficiency	-
IEC efficiency (draft)	-
CE4A	-

Overview

Started	2022-09-21 16:05:11
Finished	2022-10-14 14:43:51
Total Number of tests	680
Total Execution Time	12:54:48:420

Passed 99.4 % (676) | Failed 0.3 % (2) Passed from Oscilloscope | Inconclusive 0.0 % (0) | Not Run 0.3 % (2) BPP thermal test

Quality Report Page 1 of 230 www.nok9.com

Qi1.3 Test TX Report

nok9

Ping
Configuration & Identification
Negotiation
Authentication
Power Transfer

RX

Authentication with STSAFE

CATS II BST - Quality Report

Nok9 Test Coils	
EPP Coils	**BPP Coils**
TPR#MP1A	TPR#1A
TPR#MP1B	TPR#1B
TPR#MP1C	TPR#1C
TPR#MP3	TPR#1D
TPR#MP4 (only Qi1.3)	TPR#1E
TPR-Thermal-15W	TPR#1F
	TPR#3
	TPR#5
	TPR#6
	TPR#7

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Wireless charging and battery management product outline

100 W
Industrial & kitchen appliances,
Power tools, personal electronics

70 W
Tablets, laptops, handheld devices
Autonomous robots, drones

30 W
Super fast charge smartphones,
Portable POS, medical devices

15 W
Standard Qi EPP 1.3
Fast charge smartphones, portables

5 W
Standard Qi BPP, smartphones,
Wearables, BT devices, e-cig, …

1 W
Wearables, hearables, TWS
E-cigarettes, trackers, medical, …

STWLC99

- **100 W** Rx

STWLC98

- **70 W** Rx
- 15 W Tx mode
- WPC Qi 1.3 with standalone authentication

STWLC38

- **15 W** Rx
- 5 W Tx mode
- **WPC Qi 1.3** EPP & BPP compatible
- Supports **high frequency** operation

STWBC2-HP

- **Limitless high-power** with external full bridge
- **15 W** Qi EPP
- **Qi 1.3** with **STSAFE** secure MCU
- **MP-A2** topology

STWBC86

- **15 W** Tx
- **Monolithic** with integrated full bridge
- Qi **BPP** 1.2.4 compatible
- Supports **high frequency** operation

Coming soon

- **2:1** SC battery charger
- **98% efficiency**
- **Fast** charging
- **Supports WLC** and **USB-C**

Wireless Charging **Transmitter**

Wireless Charging **Receiver** with Tx Mode

Switched Capacitor Chargers

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STWLC99

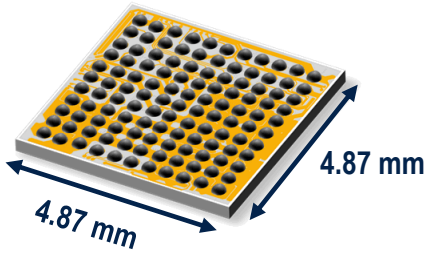
Qi Dual mode wireless power receiver / transmitter for up to 100 W consumer and industrial applications

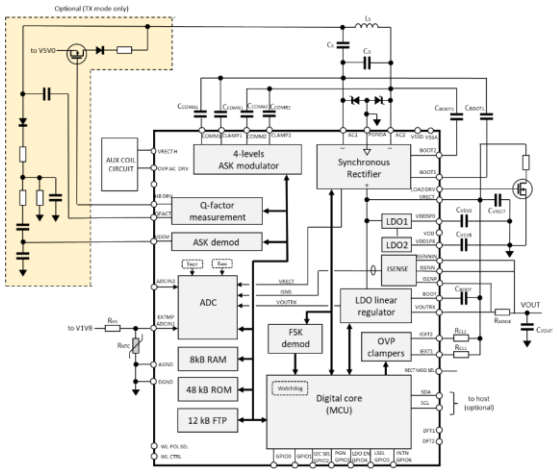
In MP now
STWLC99JR

Optimized for

- Fast charging smartphone
- Tablets, laptops
- Industrial applications

Flip-chip 121 bumps





- Up to **100 W** output power in receiver (RX) mode
- Up to **25 W** output power in transmitter (TX) mode
- **WPC Qi 1.3 compliant**
- ARM 32-bit **Cortex™-M0+ core** up to 64MHz
- 12KB FTP for FW patch-ability
- Auxiliary coil support and protection
- Accurate current and voltage sensing
- Q-factor measurement

- Market leading high-power solution
- System level optimization for best thermal performance
- Proprietary ST Super Charge (STSC) protocol

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STWBC2-HP

Qi wireless power TX controller with highest level of integration

In MP now
STWBC2-HP

Optimized for

- Qi-EPP certified charging pads
- Cordless power tools, vacuum / robot cleaners, smartphones,

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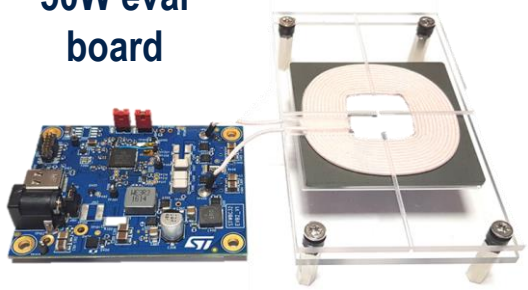
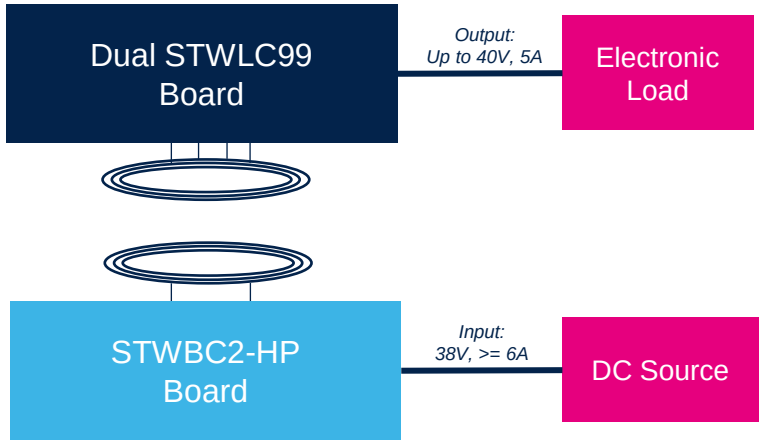
- **WPC Qi 1.3** and fast charge proprietary extensions
- **Qi EPP** with **MP-A2** transmitter topology
- ARM 32-bit Cortex™-M0+ core up to 64 MHz
- **Buck / Boost digital DC/DC** + full bridge inverter
- 3x Half bridge drivers
- 1 ns resolution PWM generator (40 MHz PLL, 17-step DLL)
- USB-PD interface, patented fast PID loop, high-voltage & flash memory, USB PD, robust triple demodulation (I, V, Φ)
- Integrated I, V, Φ sensors and demodulators
- Compatible with STSAFE-A110 secure MCU for Qi 1.3 authentication

50W eval board



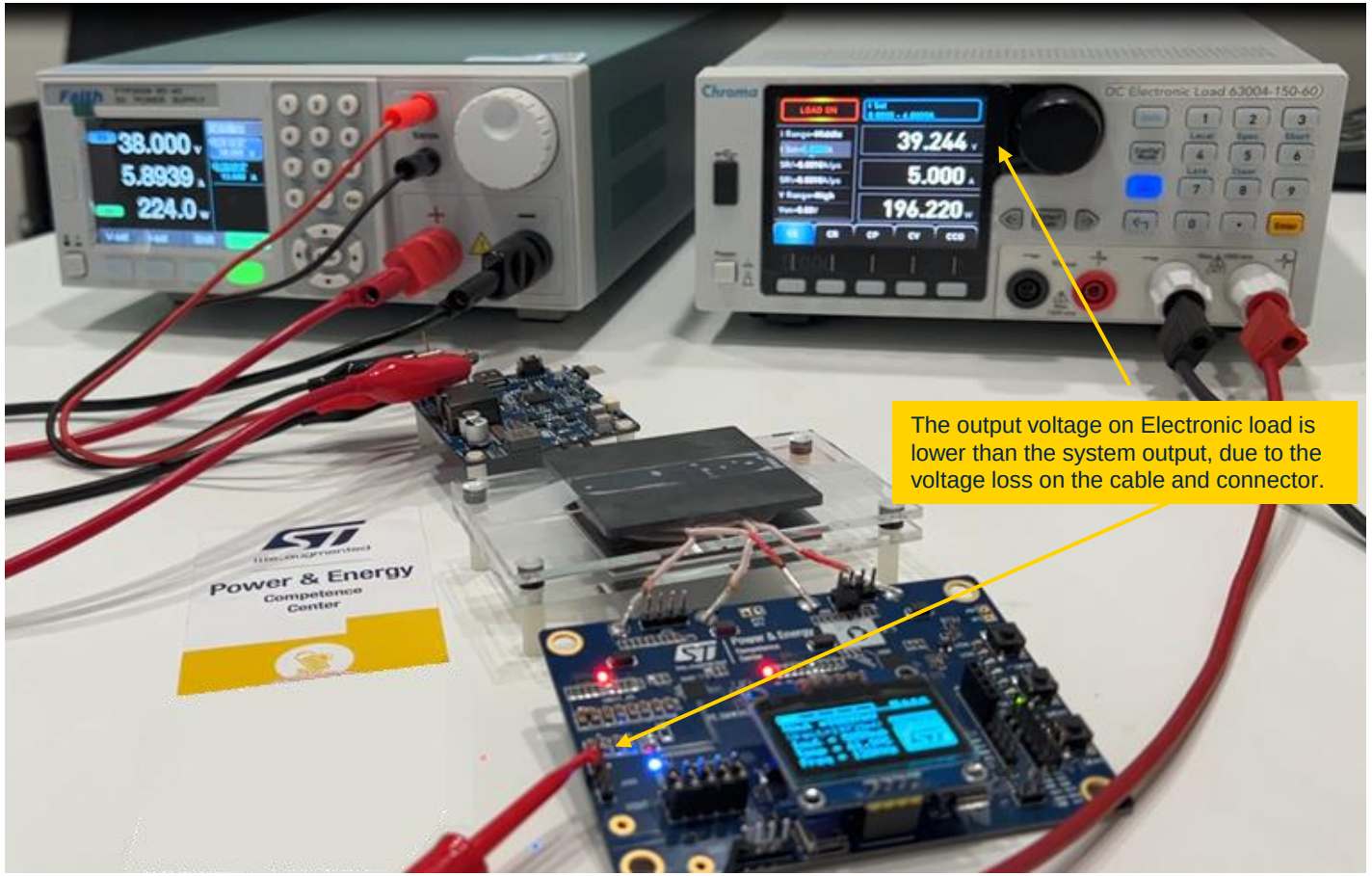
- **Limitless** fast charge operations (70W and more)
- **Leading edge** integration – Low BOM
- **Best** in class efficiency
- In-field **FW update** with 128 kB flash, 32 kB SRAM

STWBC2-HP – STWLC99 200W evaluation system



Application Key Features

- STWBC2-HP based wireless charging transmitter, BUCK based topology, up to 200W+.
- Dual STWLC99 based wireless charging receiver, with customized RX coil, supports very compact wireless power module design.
- Flexibly system topology to support more than 200W extension.



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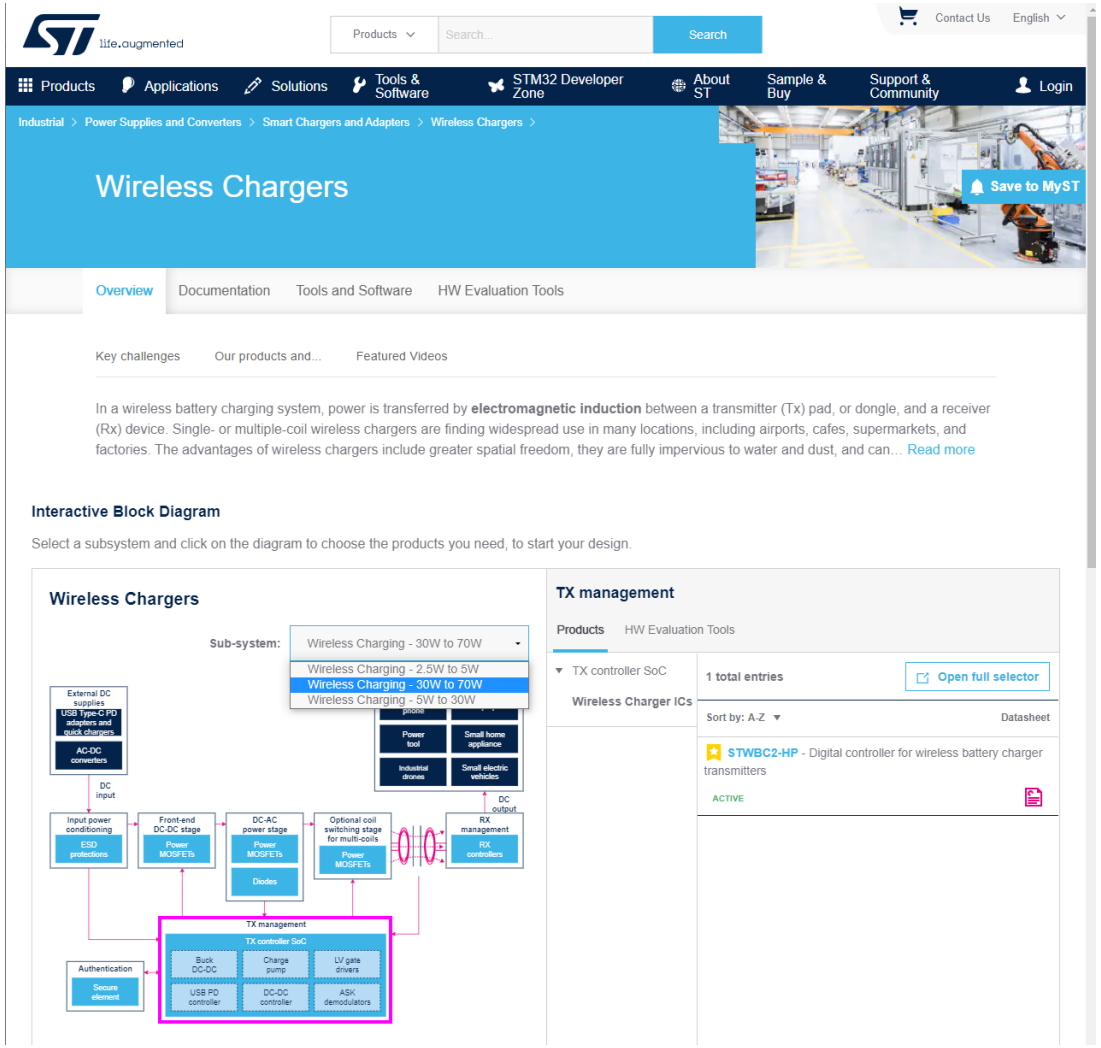
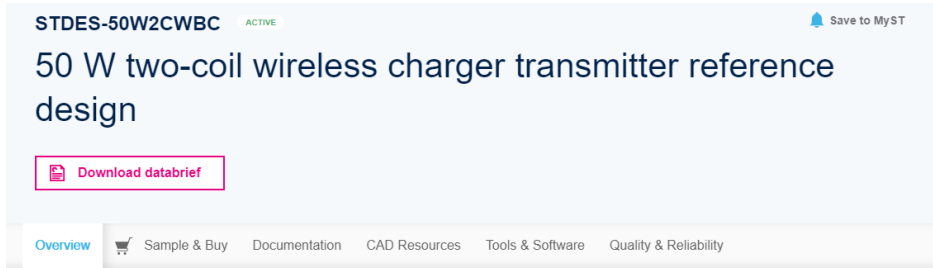
Wireless Chargers application on www.st.com



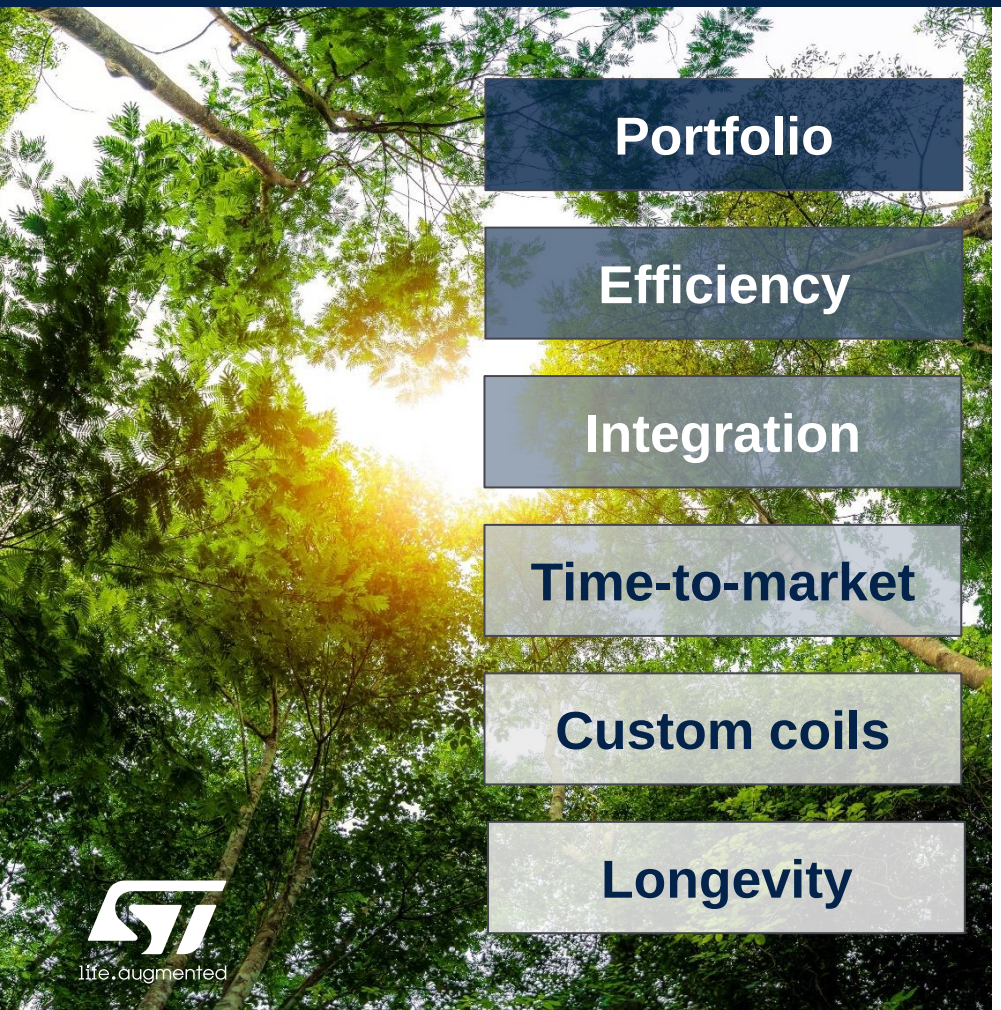


Documents ✓ Schematics ✓ Gerber files ✓ Firmware ✓

https://www.st.com/en/applications/power-supplies-and-converters/wireless-chargers.html

Why ST wireless charging?

Leading supplier of wireless charging and battery management ICs



Portfolio	Wide range of product and reference solution portfolio from 1W to 100W
Efficiency	Best-in-class efficiency in the full load range enabling sustainable innovation
Integration	High integration reducing overall BOM in the final application
Time-to-market	Ecosystem with EVKs, design manuals, software and support for fast time-to-market
Custom coils	Coil simulation and customization for the best electromechanical performance
Longevity	Certified longevity supply commitments protecting customer application

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