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Reference solutions for wireless charging and wireless power transfer

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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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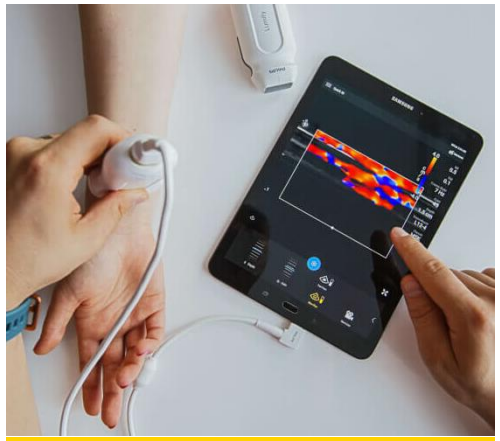
Wireless power adoptions

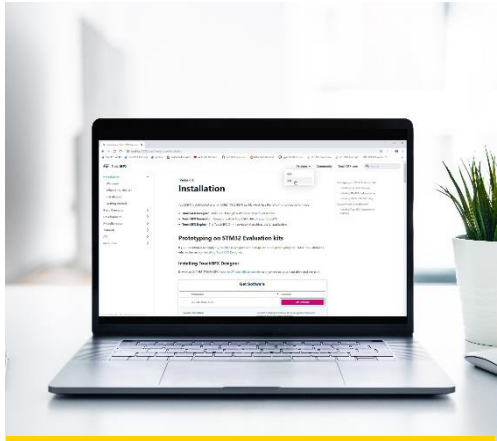
Smartphones

Tablets / POS

Wearable devices



Handheld medical devices

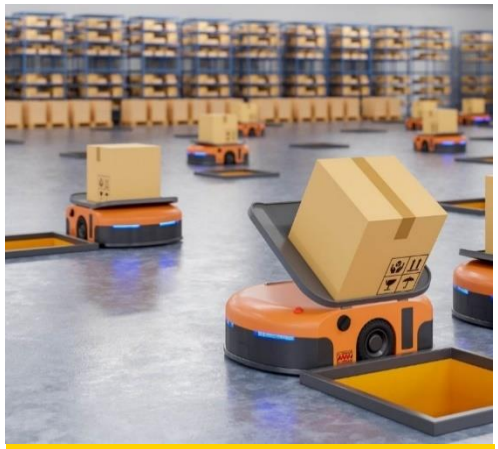


Laptops

Power tools

Drones

Home appliances

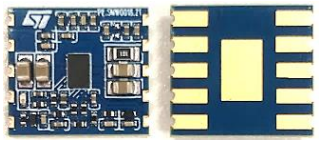


Industrial robots

Cordless kitchen

ST wireless charging turnkey evaluation kits

Qi 2 solution Coming soon

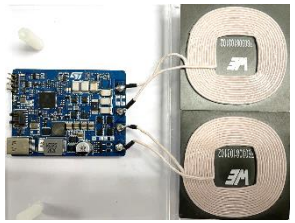


PE.SMW0018.21
(STWLC38 15W Rx)

STWBC86-EVK (5 W Tx)

STDES-70WRXWLC (70 W Rx)

STWLC98-EVK (70 W Rx)



STDES-50W2CWBC (50 W+)

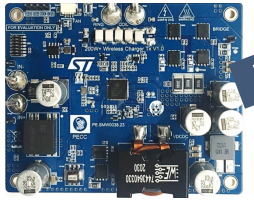
PE.SMW0022.21 (100 W Rx)

STWLC99-EVK (100 W Rx)

PE.SMW0015.21
(100 W Tx)

PE.SMW0032.22
(200 W Rx)

PE.SMW0034.22
(300 W Rx)



PE.SMW0038.23
(200 W+ Tx)

Ki TX-RX Coming soon

5 W 15 W 80 W 100 W 300 W 2200 W

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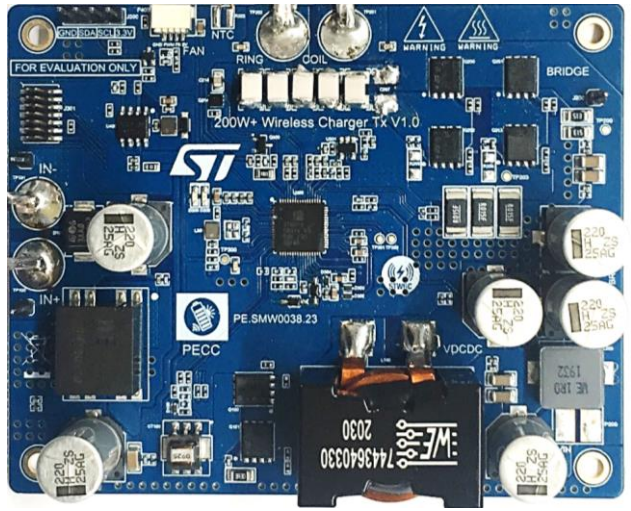
200 W+ wireless charging transmitter



Function	Component
Wireless charging transmitter SoC	STWBC2-HP
LV N-MOSFET	STL130N6F7
Operational amplifier	LMV321ILT

Application Key features

- STWBC2-HP based Tx solution, up to 200 W+ with ST proprietary protocol (STSC)
- Embedded controller and gate-drivers for synchronous BUCK DC-DC
- Embedded full-bridge controller and gate-drivers with up to 680 MHz resolution
- Rich protections with static and dynamic OVP, OCP, OTP, and power balanced FOD
- Dedicated extension for wireless power transfer (WPT) applications
- Dual-way in-band communication between transmitter and receiver
- Optional proprietary extension with out-of-band communication (e.g., BLE)

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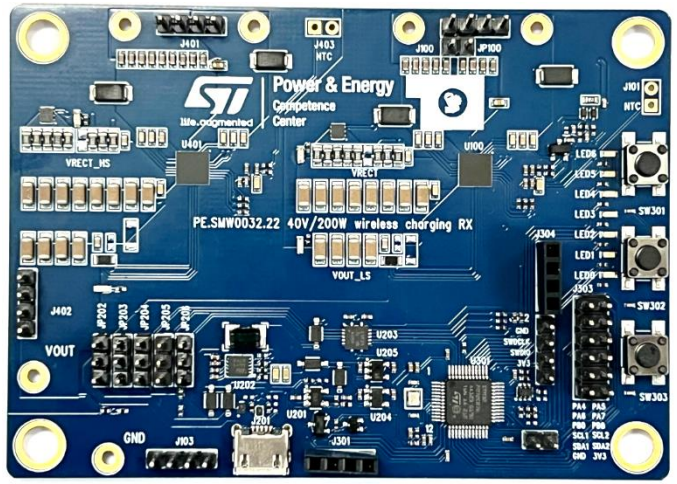
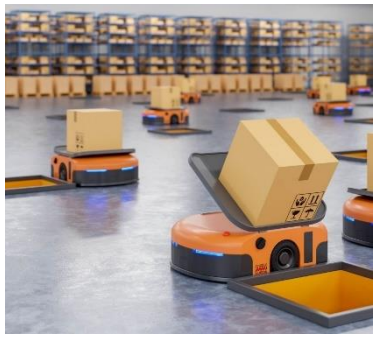
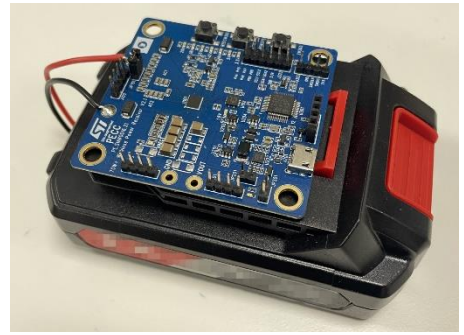
200 W wireless charging receiver







Function	Component
Wireless charging receiver SoC	STWLC99
Microcontroller	STM32F072CB
DC-DC controller	PM6644

Application key features

- Dual STWLC99 based wireless Charger Rx solution
- Up to 200 W (40 V, 5A) on Rx output with ST proprietary protocol (STSC)
- Compact design, TX-RX peak efficiency > 88%
- Customized coil and resonant hardware components
- Integrated OLED display and buttons to allow output voltage switching without PC
- Reference driver source code to STWLC99
- Optional proprietary extension with out-of-band communication (e.g., BLE)
- Optional proprietary extension for wider spatial freedom (X-Y-Z)

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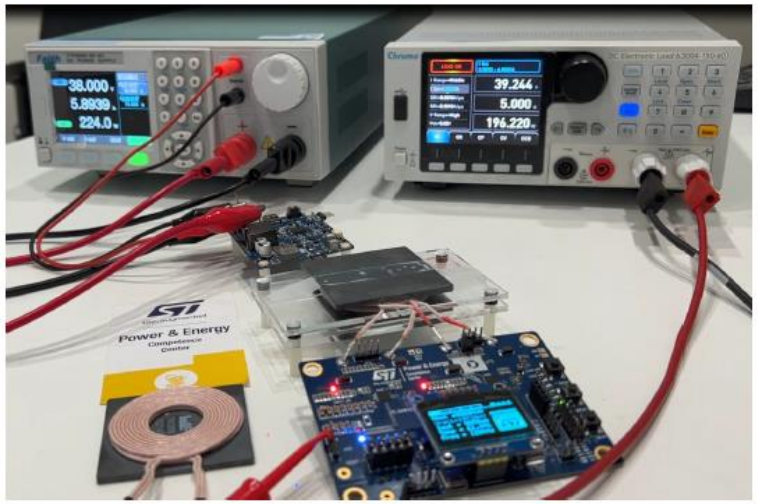
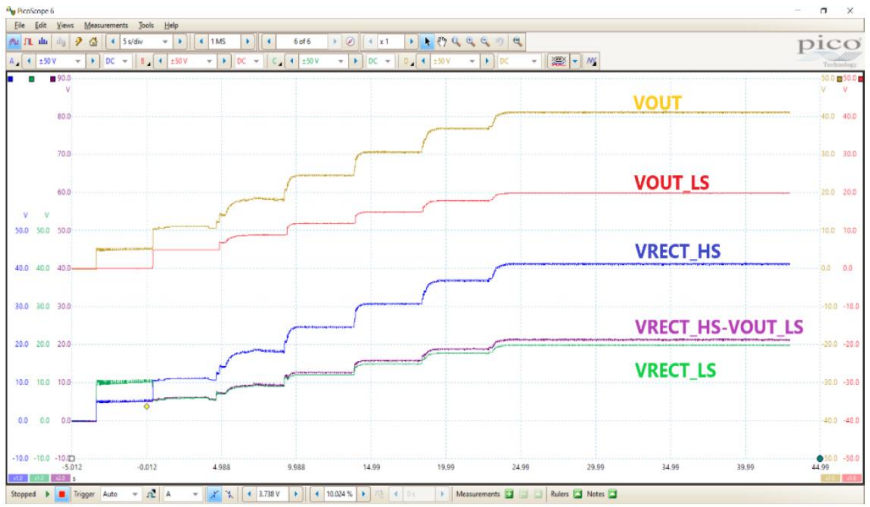
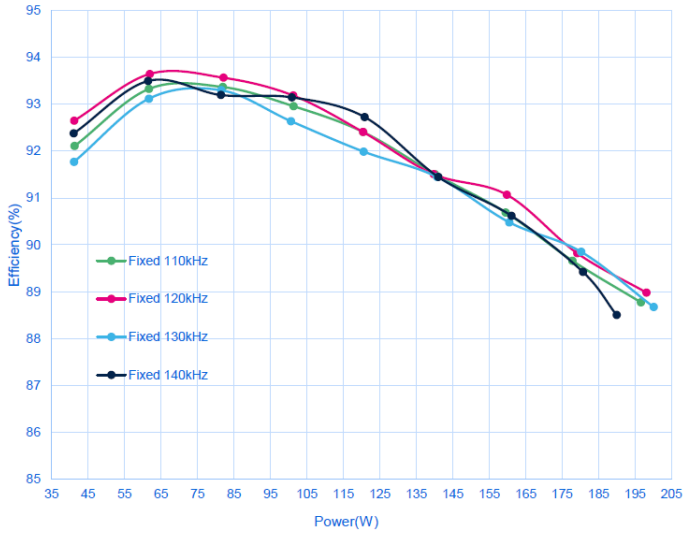
200 W test setup & results

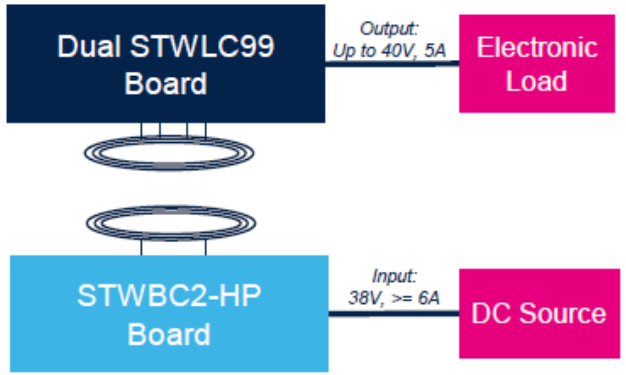


Automatic voltage raising

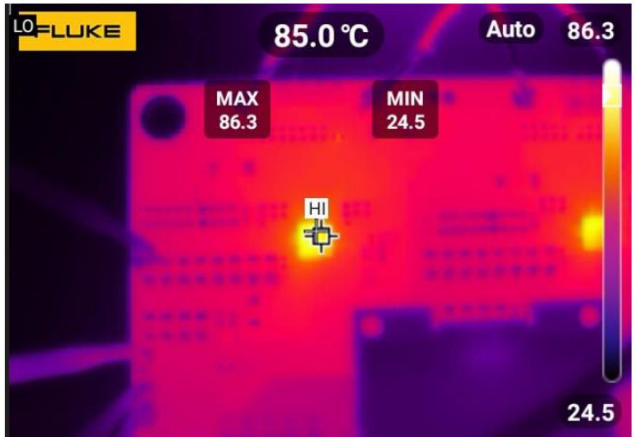


Power and efficiency

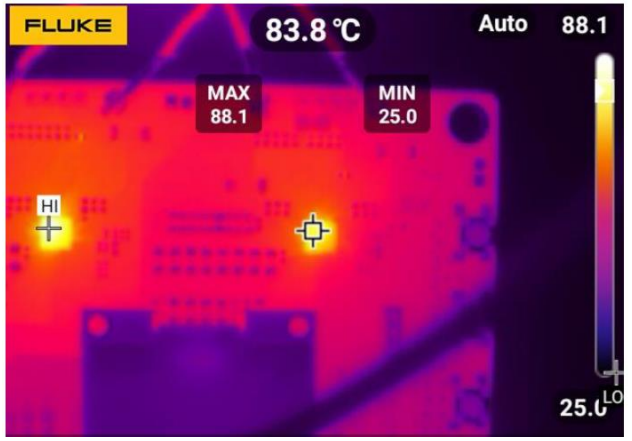




Thermal performance @ 200 W 15 min with free cooling



Upper STWLC99 is 85°C



Lower STWLC99 is 83.8°C

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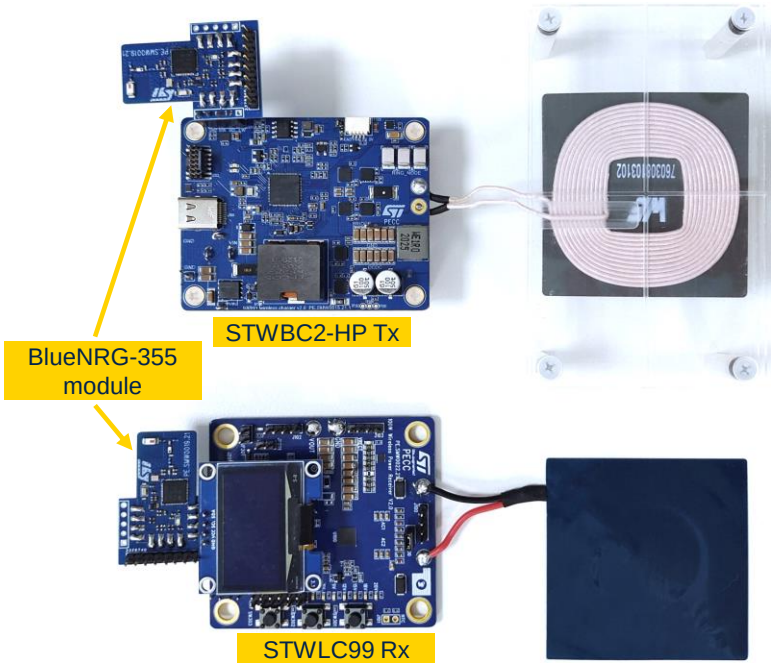
BLE based 100 W wireless charging Tx & Rx



Function	Component
Wireless charging transmitter SoC	STWBC2-HP
Wireless charging receiver SoC	STWLC99
Bluetooth SoC	BlueNRG-355
LV N-MOSFET	STL20N6F7
Microcontroller	STM32F072CB

Application Key features

- 100 W wireless power transfer solutions with STWBC2-HP and STWLC99
- BlueNRG-355 based BLE communication module and software
- Integrate BLE modules for out-of-band communication, data logging, and firmware upgrade
- Wireless charging STSC extension to switch to BLE based Out-Of-Band (OOB) communication
- Enable longer communication distance, faster power regulation and more robust in power transfer with BLE OOB than the traditional ASK and FSK
- Enable faster foreign object detection (FOD) in high power

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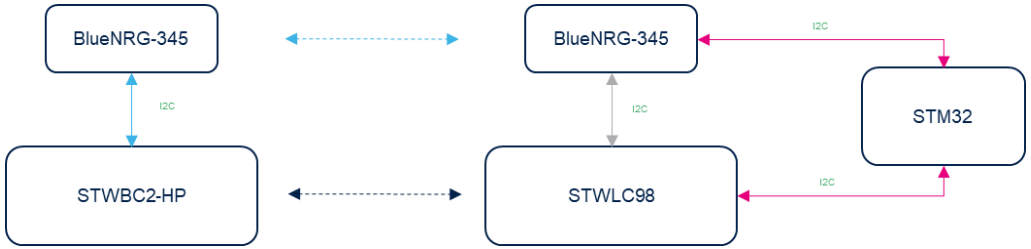
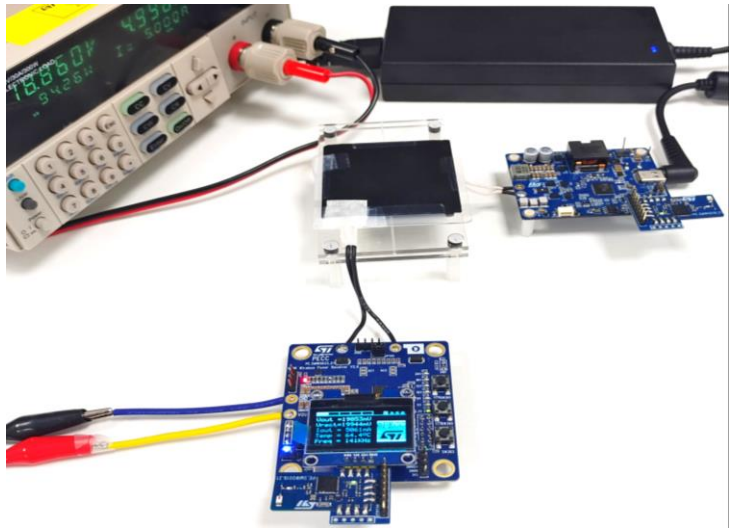
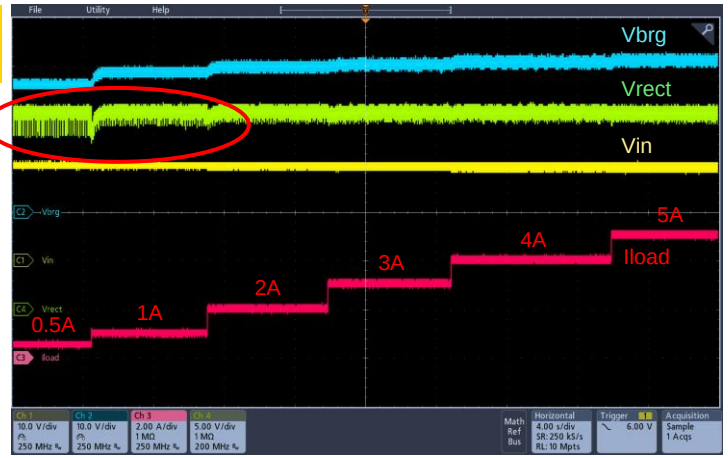
BLE test setup & results

- With BLE communication, finally system works in 100 W(20 V, 5A) state.
- The Vrect wave is smoother with BLE, compared with ASK/FSK communication.

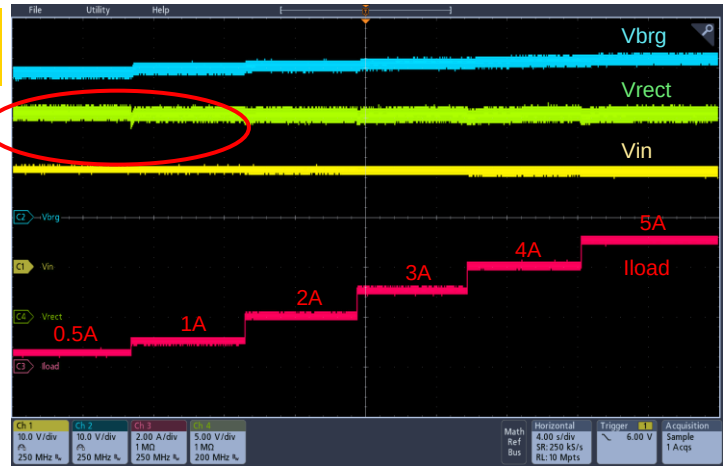




With ASK/FSK communication



With BLE communication



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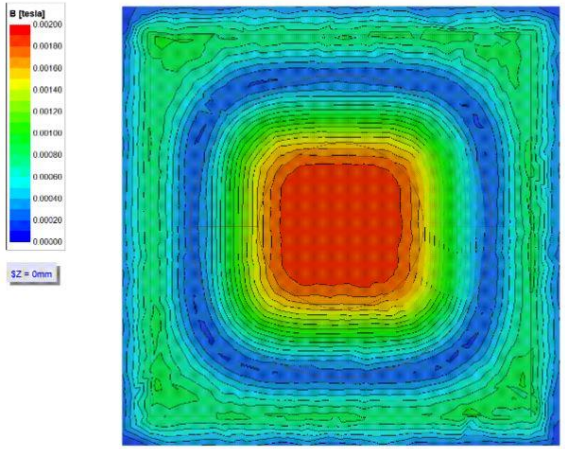
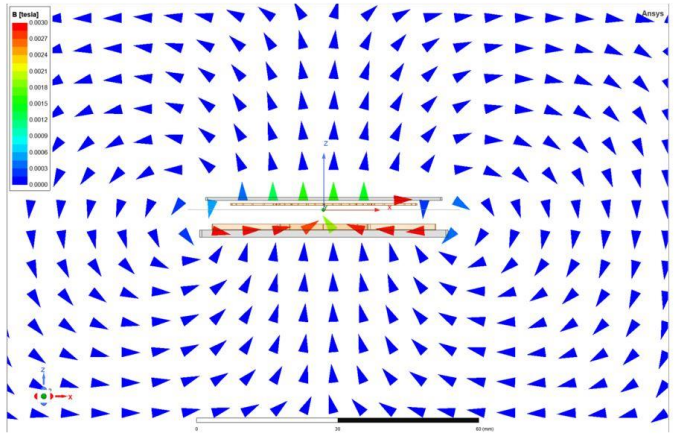
Coil simulation for wireless charging systems

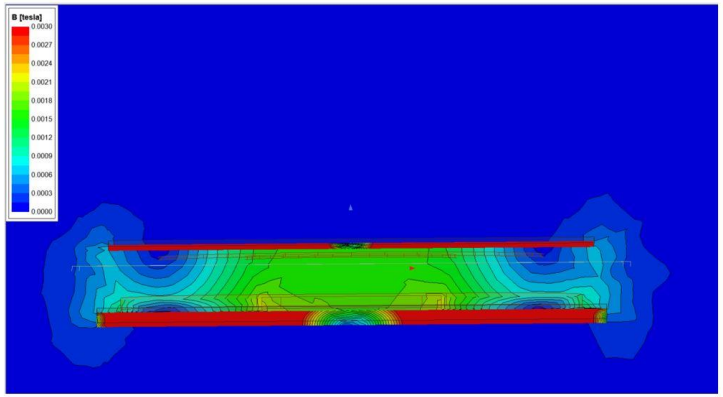
The magnetic field distribution difference as Z changed



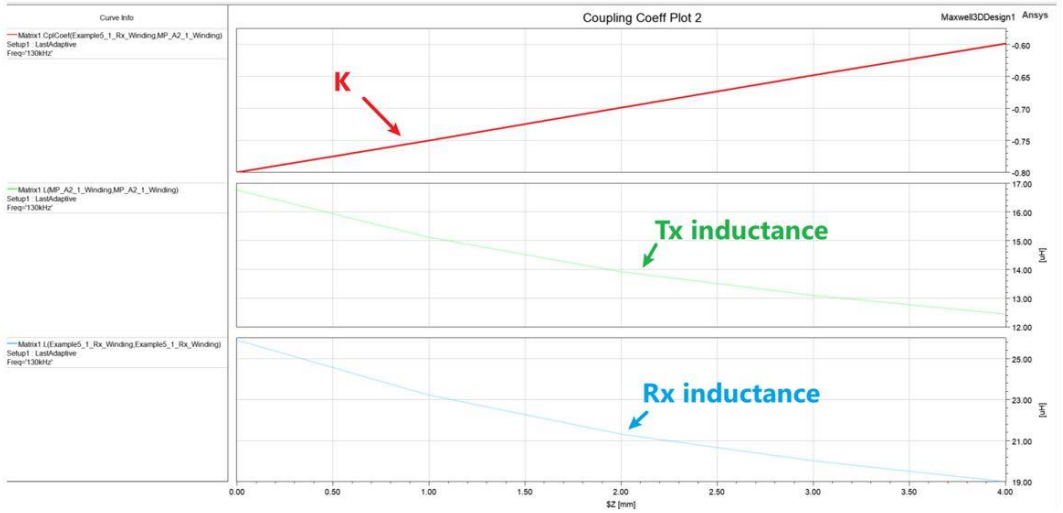
Magnetic field vector distribution



The magnetic induction intensity nephogram



Parametric scanning



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Qi certification support

ST owns official Qi compliance tester

MP500-TCL3

- As a base station with Qi TPT unit for testing of receivers and TPR unit for testing of transmitters.

Nok9 CATS II

- BST for Tx testing
- MDT for Rx testing
- The official WPC Qi compliance tester that is also used by WPC Test Labs for real Qi certification

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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
Superfast 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

STSWC58JR

- **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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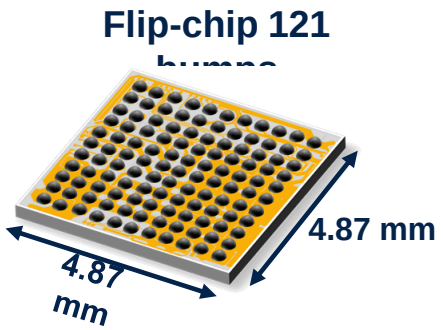
STWLC99

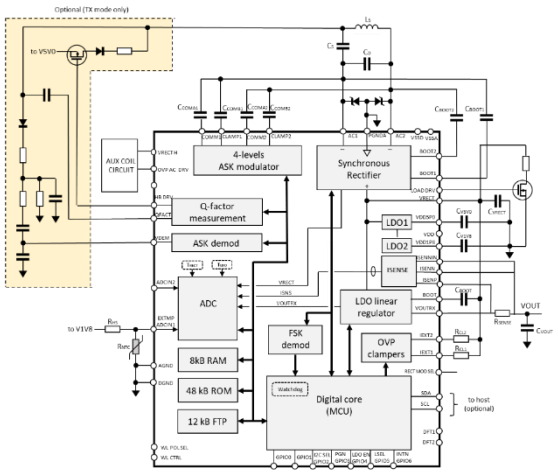
Qi dual mode wireless power receiver / transmitter for up to 100 W consumer and industrial applications

In MP now
STWLC99JR

Optimized for

- Fast charging smartphone
- Tablets, laptops
- Industrial applications





- 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 64 MHz
- 12 KB FTP for firmware 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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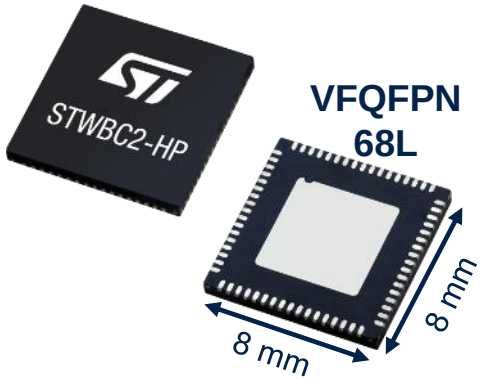
STWBC2-HP

Qi wireless power Tx controller with highest level of integration

In MP now
STWBC2-HP

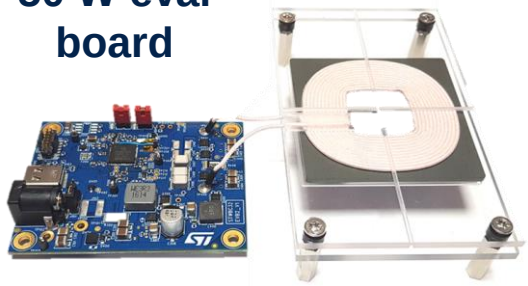
Optimized for

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



- **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

50 W eval board



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

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STWBC86

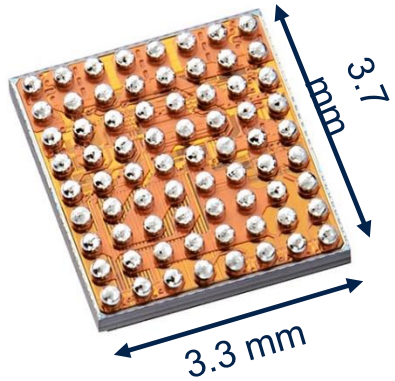
Qi monolithic wireless power transmitter (Tx) for up to 5 W charging applications based on Qi A11a topology

In MP now
STWBC86JR

Optimized for

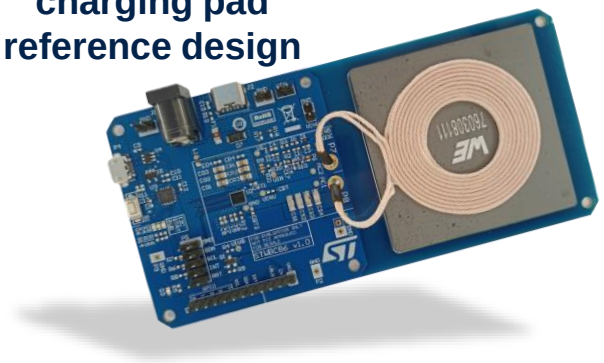
- Proprietary charging pads
- Smartwatches, wearables, hearables
- Performs best with STWLC38 Rx

Flip-chip 72 bumps monolithic Tx



- Monolithic solution **with integrated full-bridge inverter**
- **Up to 5 W** transmitter (coil dependent)
- Up to 15 W with proprietary mode
- **WPC Qi 1.2.4 BPP** compatible
- Low Rds-on inverter for **higher efficiency**
- Arm 32-bit Cortex™-M0+ core up to 64 MHz
- **8 KB FTP for firmware patch-ability**
- 8 KB RAM

5 W monolithic charging pad reference design



- **Optimized device size** for small form factor applications
- **Lowest BOM** with A11a topology for **Qi BPP** certified Tx products
- **Class-leading** efficiency for low power wearable applications
- **Robust ASK / FSK** for bidirectional Qi based communication
- 2.5 W smartwatch and 5 W charging pad **reference designs**

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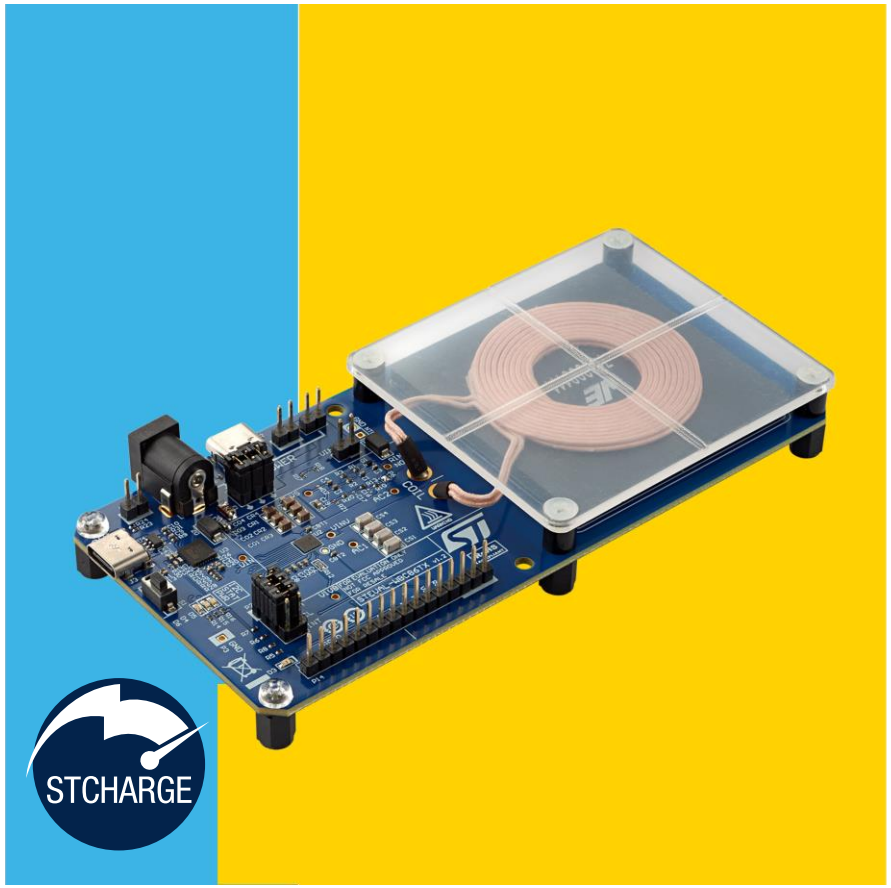
ST wireless power transmission evaluation board

STEVAL-WBC86TX evaluation board

Qi 5W monolithic wireless power transmitter (Tx)

STEVAL-WBC86TX monolithic wireless power transmission evaluation board, based on Qi protocol, is very suitable for wearable, e-cigarette, and other charging board applications. It can quickly and reliably charge up to 5W, and all power modules are integrated into the STWBC86 chip.

Read more



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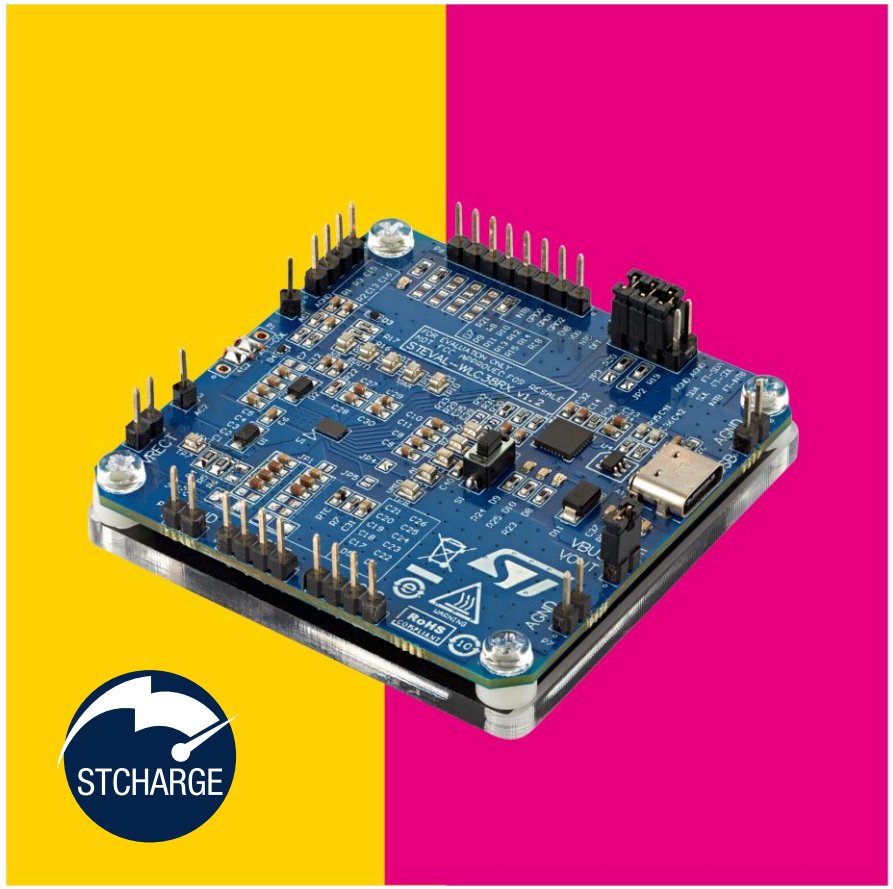
ST wireless power receiver evaluation board

STEVAL-WLC38RX evaluation board

Supporting two modes of Qi, up to 15W wireless power receiver (RX)

The wireless power receiver evaluation board STEVAL-WLC38RX, based on Qi protocol, can provide maximum power of 5W in BPP mode and 15W in EPP mode. All power devices are integrated into the STWLC38 chip

Read more



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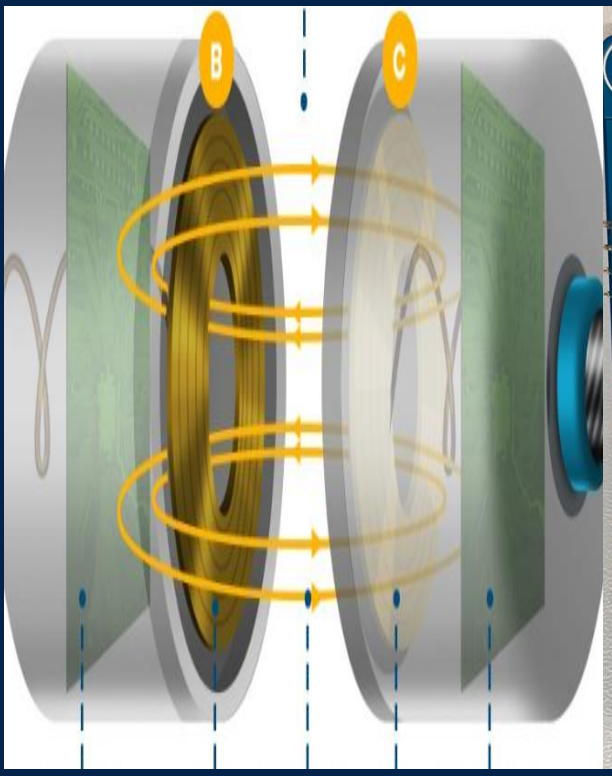
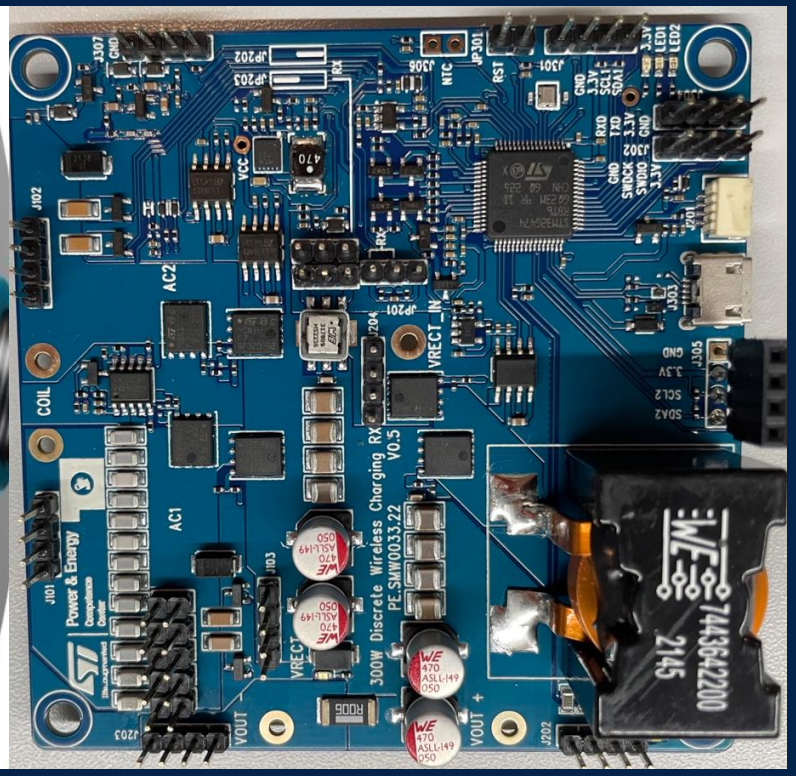
300 W wireless power transfer





- Higher power, for industry application
- Higher efficiency
- Faster transition response
- Long distance
- Agile delivery, flexible adoption

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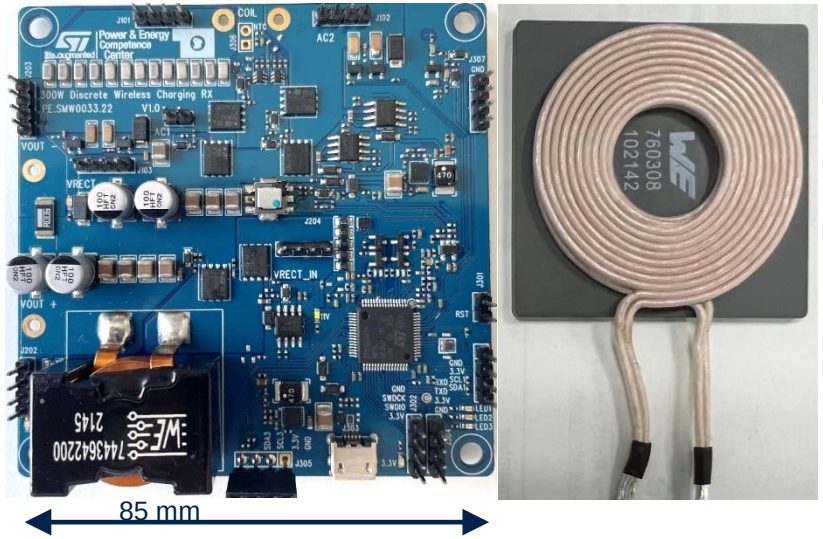
Center

300 W wireless power transfer receiver



Application Key features

- Output voltage range: 5V-36V.
- Maxim output current: 8.5A.
- Output power level: 100 W@12V, 200 W@24V, 300 W@36V.
- Operation frequency range: 110kHz-145kHz.
- On board ASK modulation, on board FSK demodulation.
- ASK modulation @2Kbps, FSK demodulation.
- Digital Buck and dummy load control.
- Over voltage protections.
- Host interface based on UART.

Function	Component
Controller	STM32G474RB
Gate driver	L6498D
N-MOSFET	STL90N10F7, STL130N6F7
DC-DC	L7983PUR

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Wireless charging in consumer and industrial

	Consumer WLC	Industrial WLC / WPT
Size	Very small, ultrathin.	No much limit.
Peak power	Only needed in short-term.	Need work stable in peak power.
Efficiency	Best trade-off with size.	The higher the better.
Thermal dissipation	Limited capability.	Strong dissipation.
Z-distance	Well coupled, < 10 mm.	Sometimes need several cm.
Load-transient	Regulation in 50 ~ 250 ms	Sometimes need <= 1 ms.

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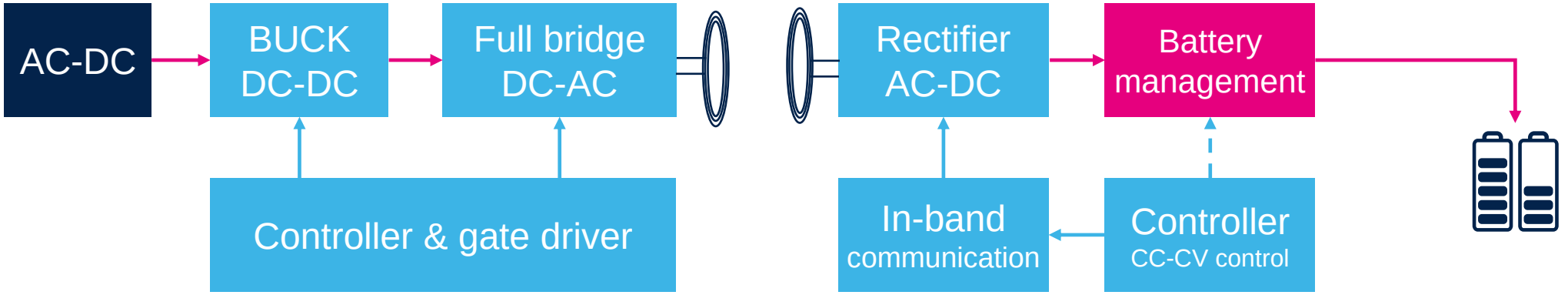
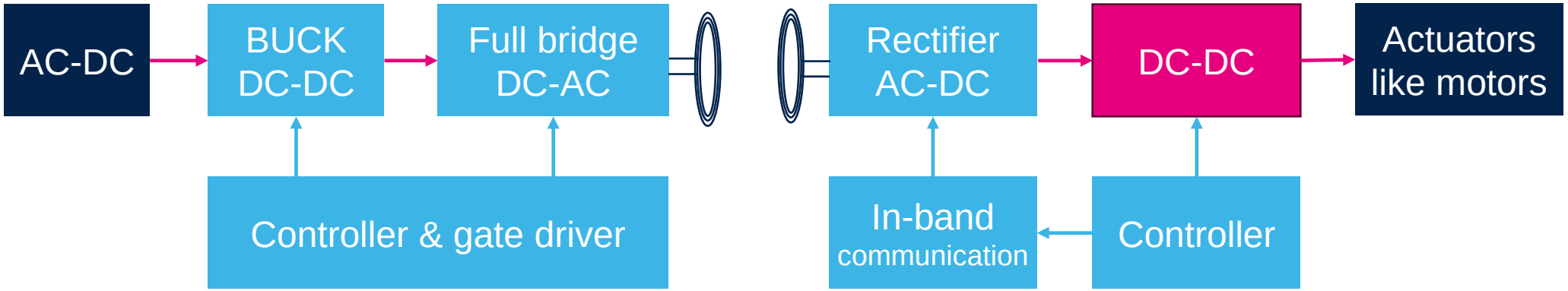
Industrial wireless charging and power transfer structure

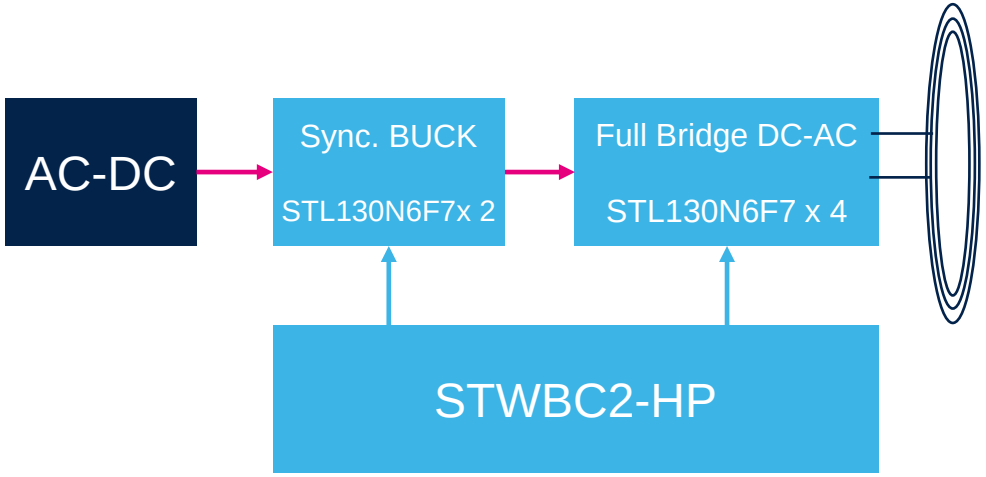


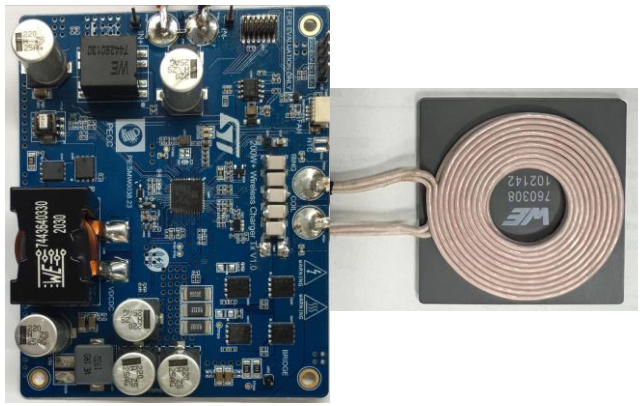
- *WLC: need battery management coworking with wireless charging.*
- *WPT: need very fast load transient on PRX Vout.*



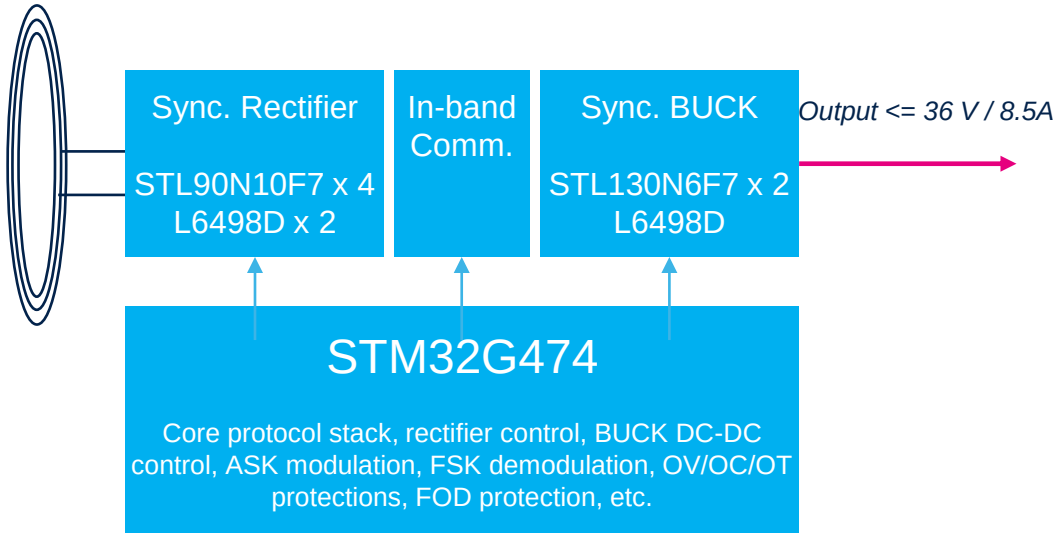
Wireless power transfer solution structure

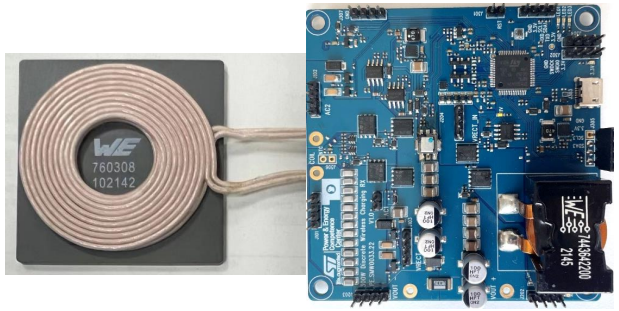
200 W+ WPT transmitter



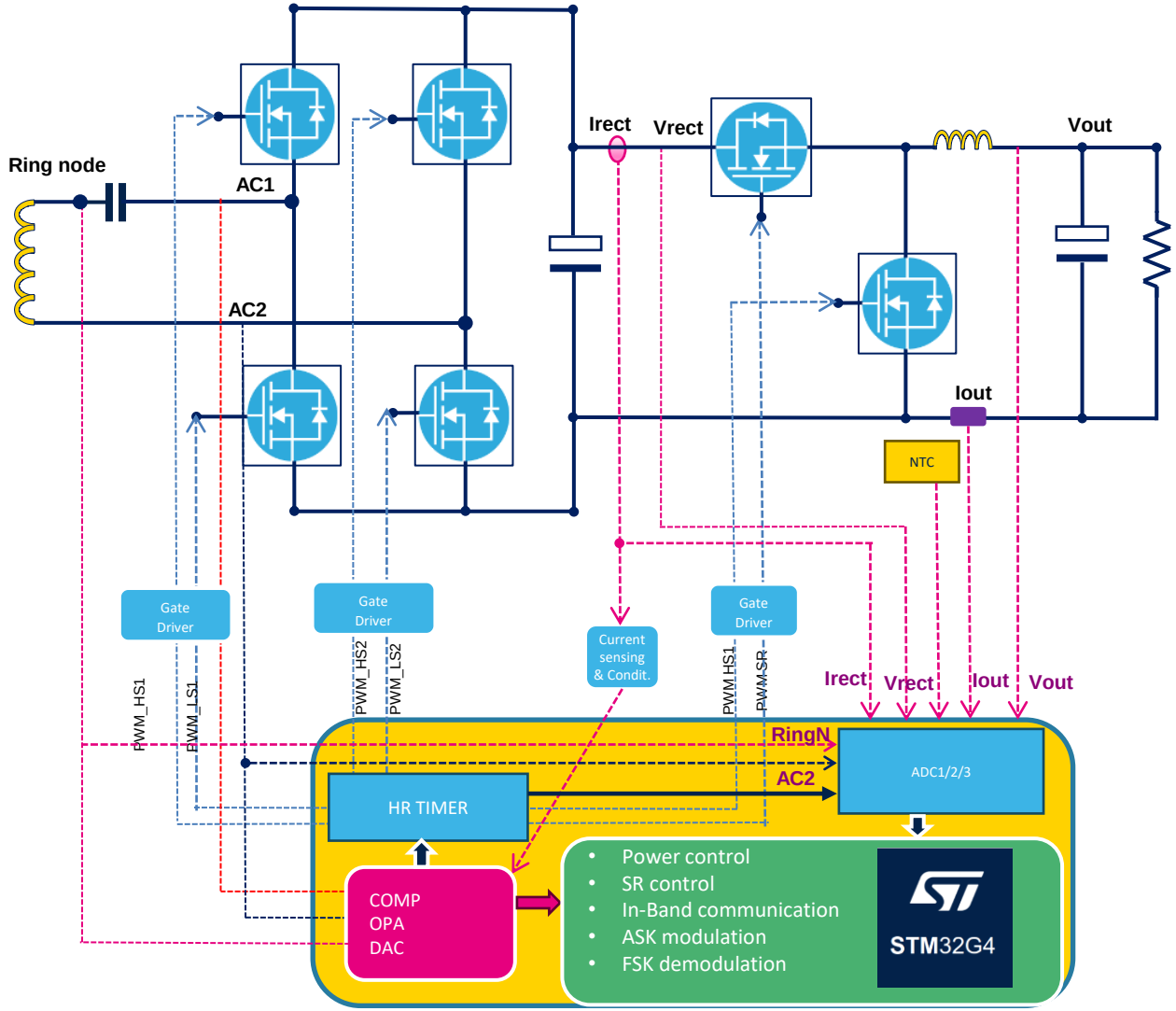


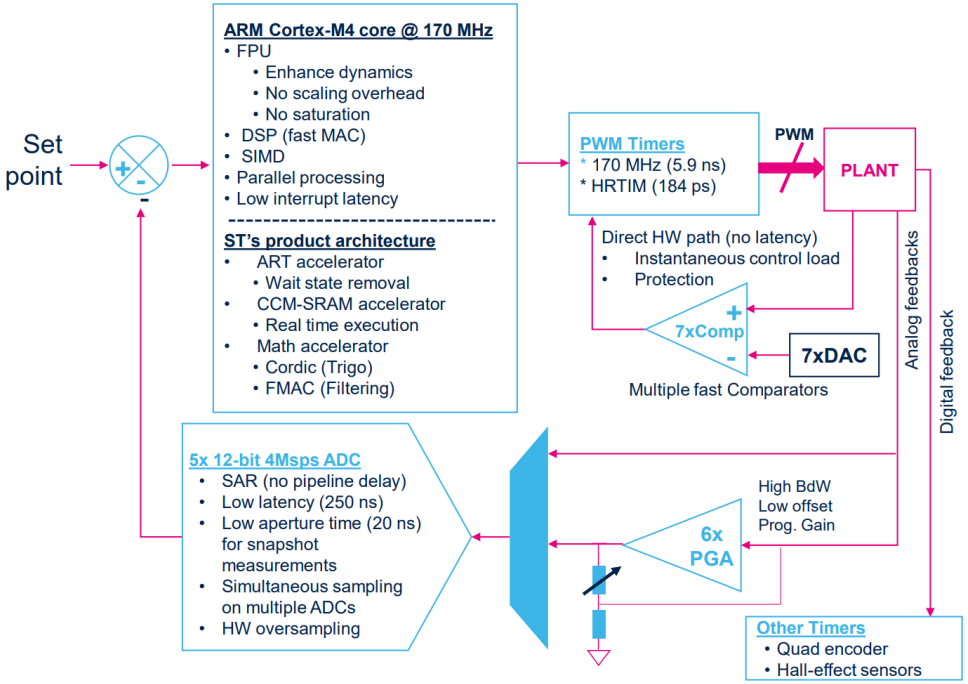
300 W WPT receiver





300 W wireless power transfer: STM32G4-based system diagram





STM32G474 key peripheral boost performance:

- Analog comparator: Synch-Rectifier switch control.
- HRTIM: Synch-Driver, FSK demodulation.
- DAC: Optimize control performance by dynamic adjust.
- CortexM4 with FPU: Boost digital control loop and DSP performance.
- FMAC: Boost control loop or high order digital filter.
- PGA: ASK demodulation, reduce external component.

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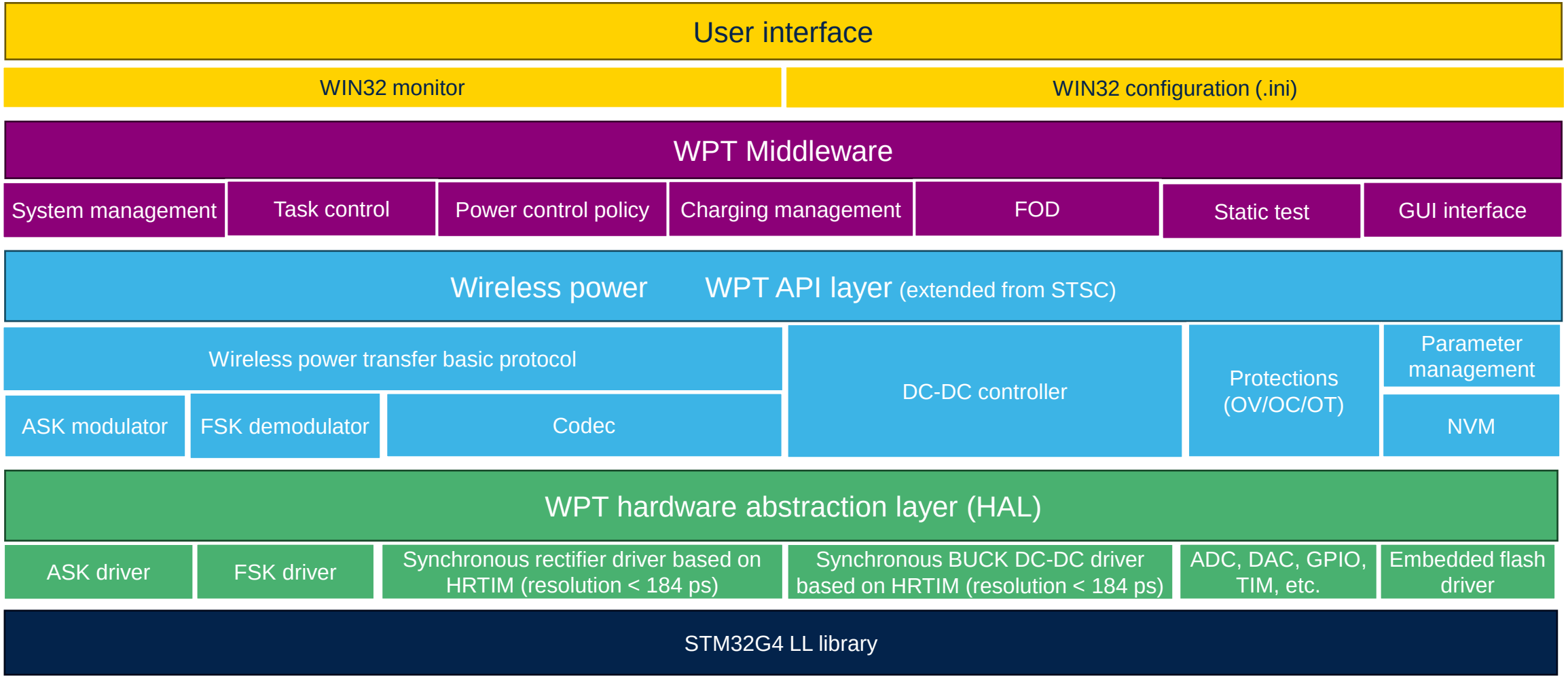
300 W wireless power transfer: software architecture



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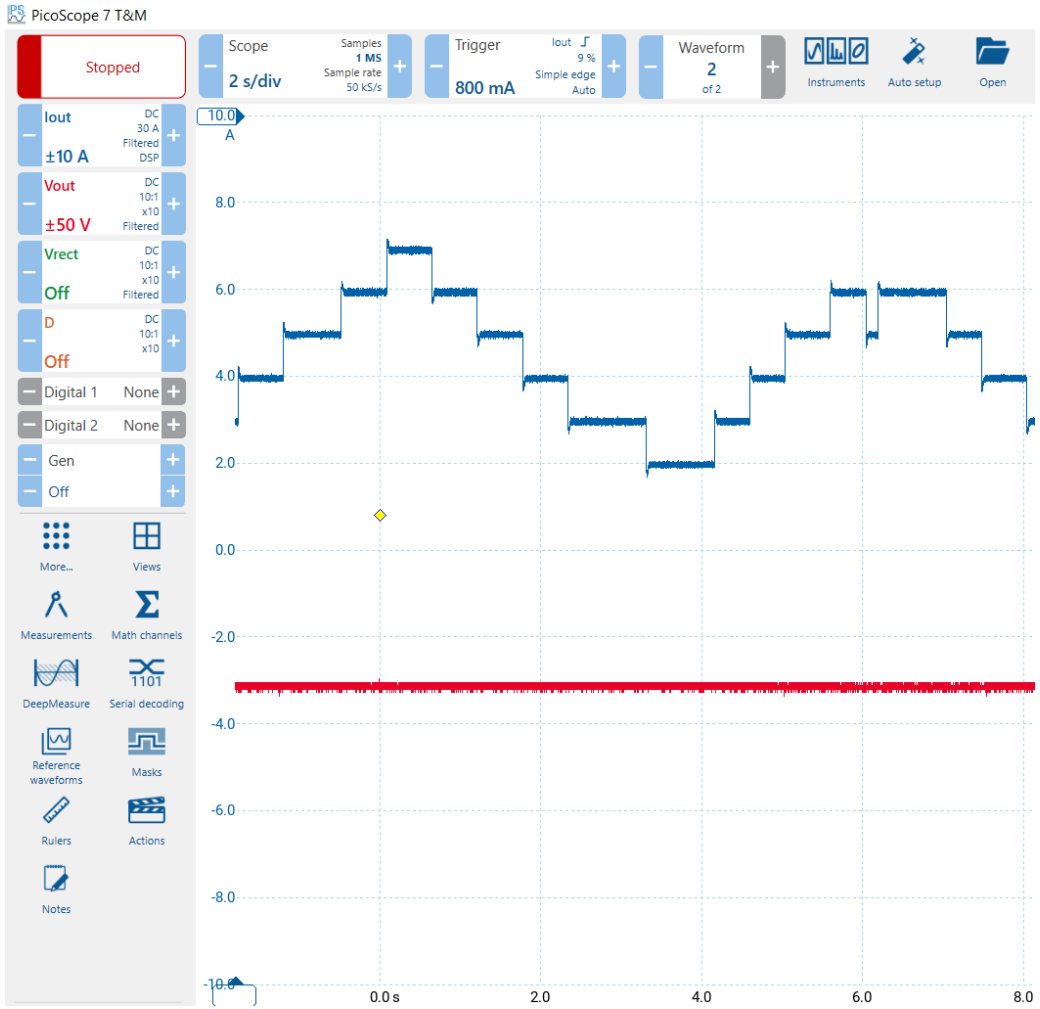
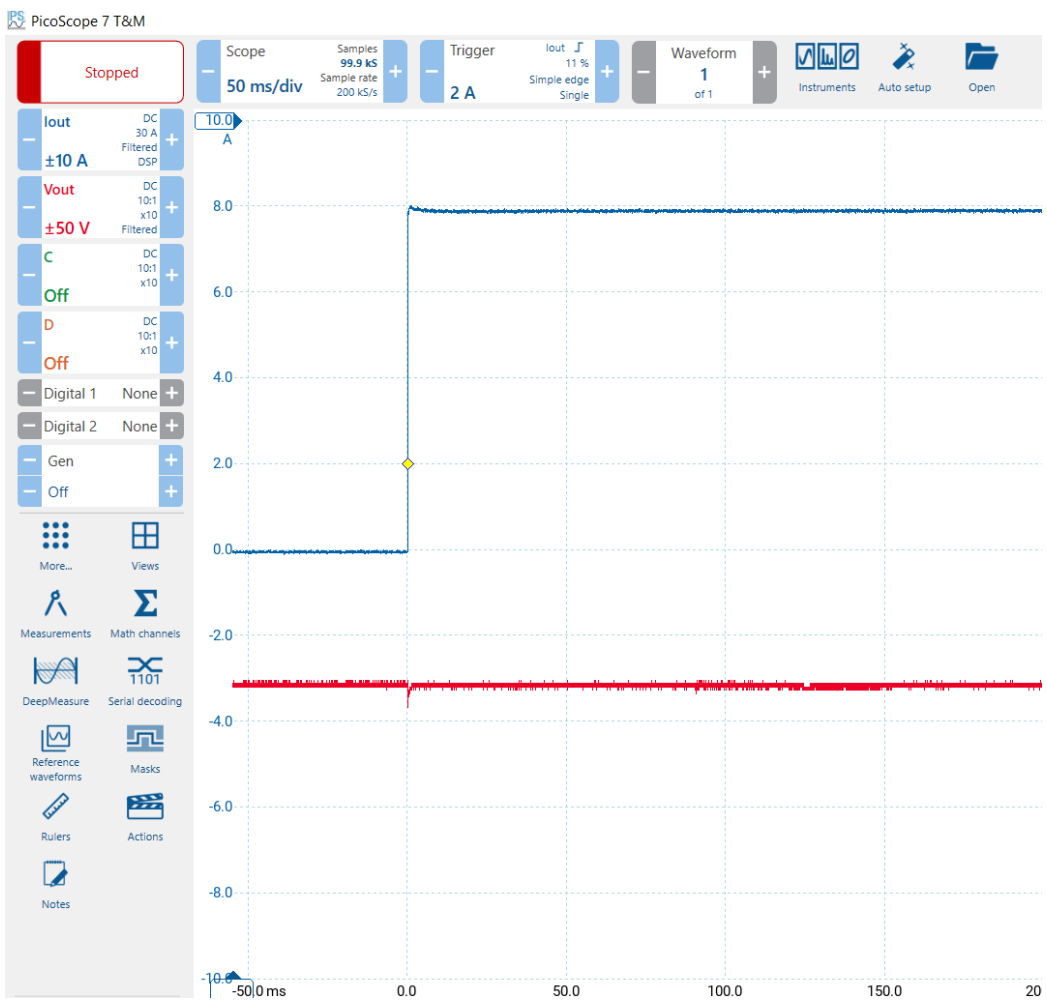
300 W wireless power transfer: transition response

- Red curve is Vout of DCDC, blue curve is output current.
- The output voltage regulation is very stable when the load transition, the output stage DCDC is capable of handle fast load transition for industry use application.





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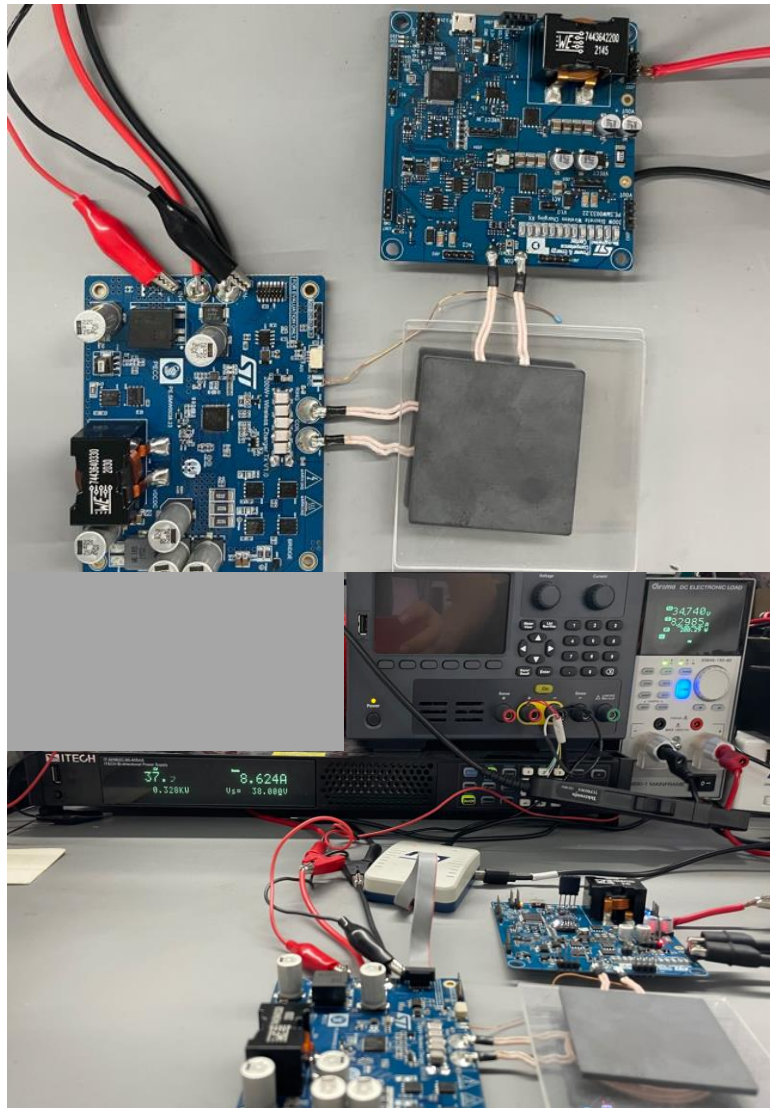
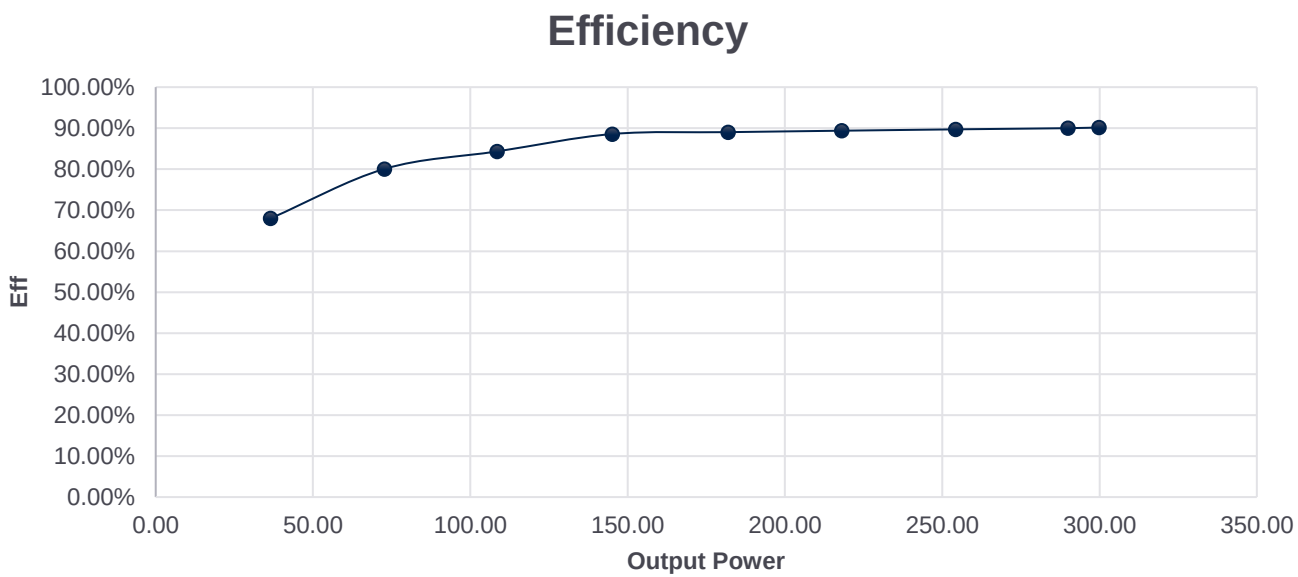
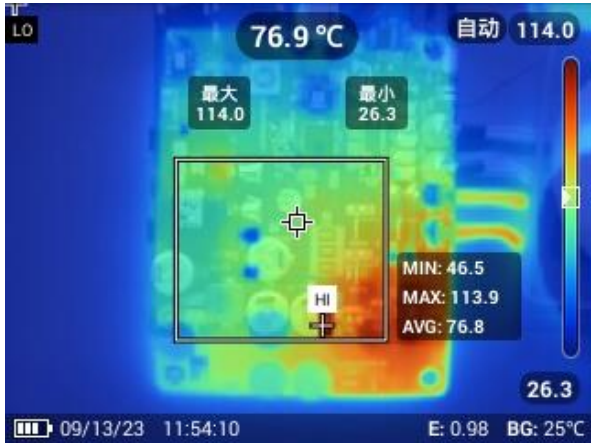
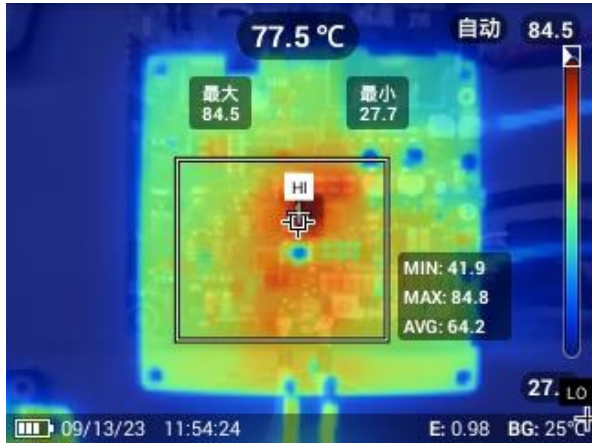
300 W wireless power transfer: system glance









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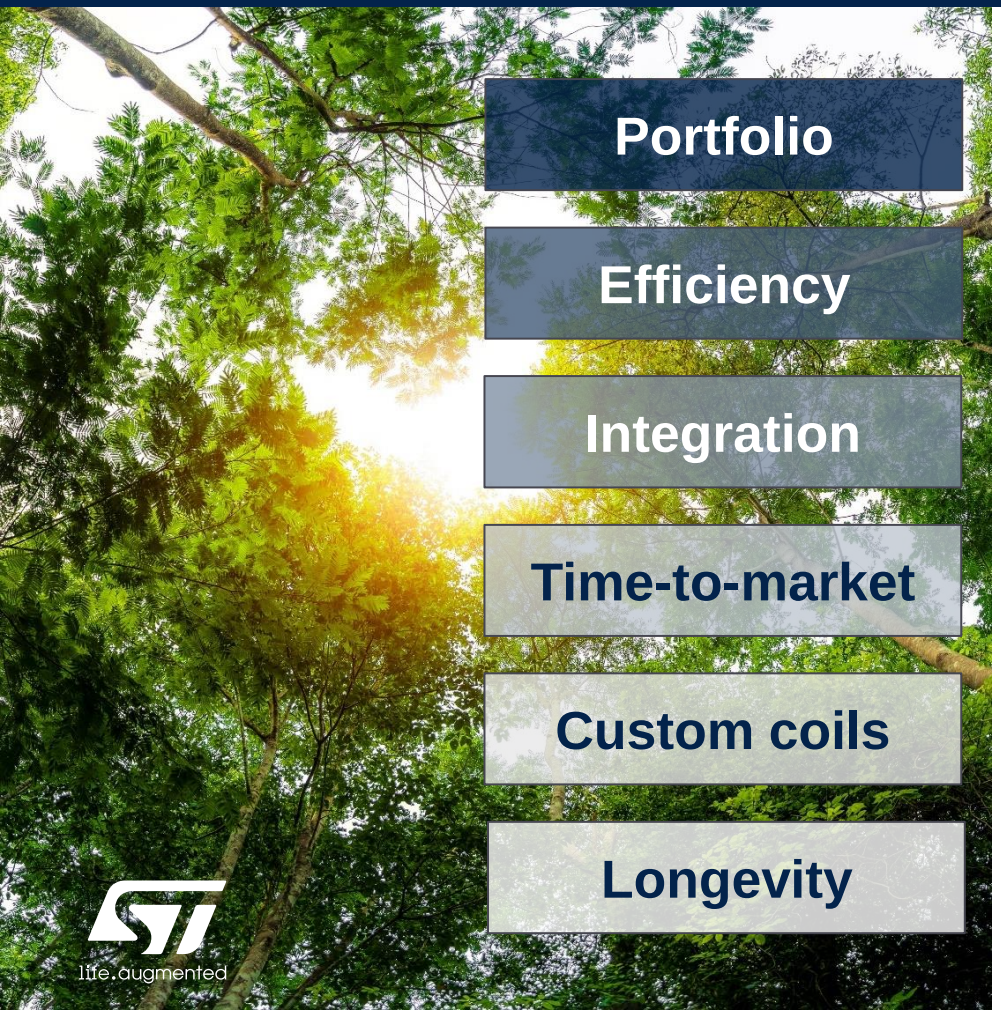
Why ST wireless charging?

Leading supplier of wireless charging and battery management ICs



Portfolio	Wide range of product and reference solution portfolio from 1 W to 100 W
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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