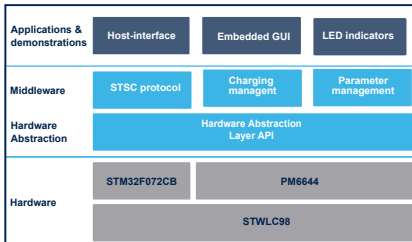# Firmware for STDES-70WRXWLC based on STWLC98

Features

- Implements ST super charger (STSC) protocol
- Implements the receiver mode and transmitter mode (for revert charging) of the STDES-70WRXWLC and manages the auto-switching
- Controls the STWLC98 through the I²C interface to implement up to 20 V, 70 W wireless power on the output in the receiver mode
- Controls the PM6644 DC-DC and automatically manages the 5 V power switching between the PM6644 and the STWLC98 embedded LDO
- Implements the embedded graphical user interface (GUI) to facilitate the evaluation
- Implements the embedded parameter management to facilitate the evaluation

Description

The STSW-70WRXWLC firmware runs on the STM32F072CB of the STDES-70WRXWLC reference design.

The firmware controls the STWLC98 SoC to implement a Qi v1.2.4 and Qi v1.3-compliant wireless charging receiver. Once working with the ST solution-based wireless charging transmitter, it supports up to 70 W in the receiver output based on the ST super charging (STSC) protocol.

The firmware is the basic reference for evaluation. Contact ST sales and distributors the get the updated firmware for various applications.

Product summary	
Firmware for STDES-70WRXWLC based on STWLC98	STSW-70WRXWLC
70W wireless charger receiver reference design	STDES-70WRXWLC
Qi-compliant inductive wireless charger power receiver for 70 W applications	STWLC98JR
Mainstream Arm Cortex-M0 USB line MCU with 128 Kbytes of flash memory, 48 MHz CPU, USB, CAN and CEC functions	STM32F072CBT6
350 mA adjustable step-down regulator	PM6644TR
Applications	Wireless Charger

DB4797 - Rev 1 - September 2022
For further information contact your local STMicroelectronics sales office.

www.st.com

1 Overview

The wireless power transfer is a fast-growing technology in many application fields. The wireless power could vary from several mW (for example, in the medical field) to tens of KW (for example, for electric vehicles). There are multiple methods to address wireless power, such as magnetic inductance, magnetic resonance, capacitive coupling, radio frequency, laser charging, etc.

The most popular mechanism is the magnetic inductive that follows the Qi standard defined by the Wireless Power Consortium (WPC).

The STWLC98 embedded synchronous rectifier converts the AC input power from the Rx coil to the rectified DC power. It also converts the output through the embedded main LDO regulator.

The STWBC2-HP output powers the STM32F072CB, which controls the STWLC98 to increase the power according to the STSC.

Once the STWLC98 output voltage is higher than 9 V, the PM6644 is turned on to provide a higher efficiency supply power to the STWLC98 and the STM32F072CB.

You can control the STWLC98 output voltage level according to STSC through dedicated buttons. The indication LEDs signal the output voltage level. The display is optional to configure the parameters of the reference design and show the wireless charging status.

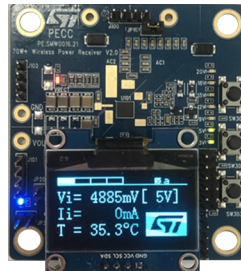**Figure 1. STDES-70WRXWLC block diagram**
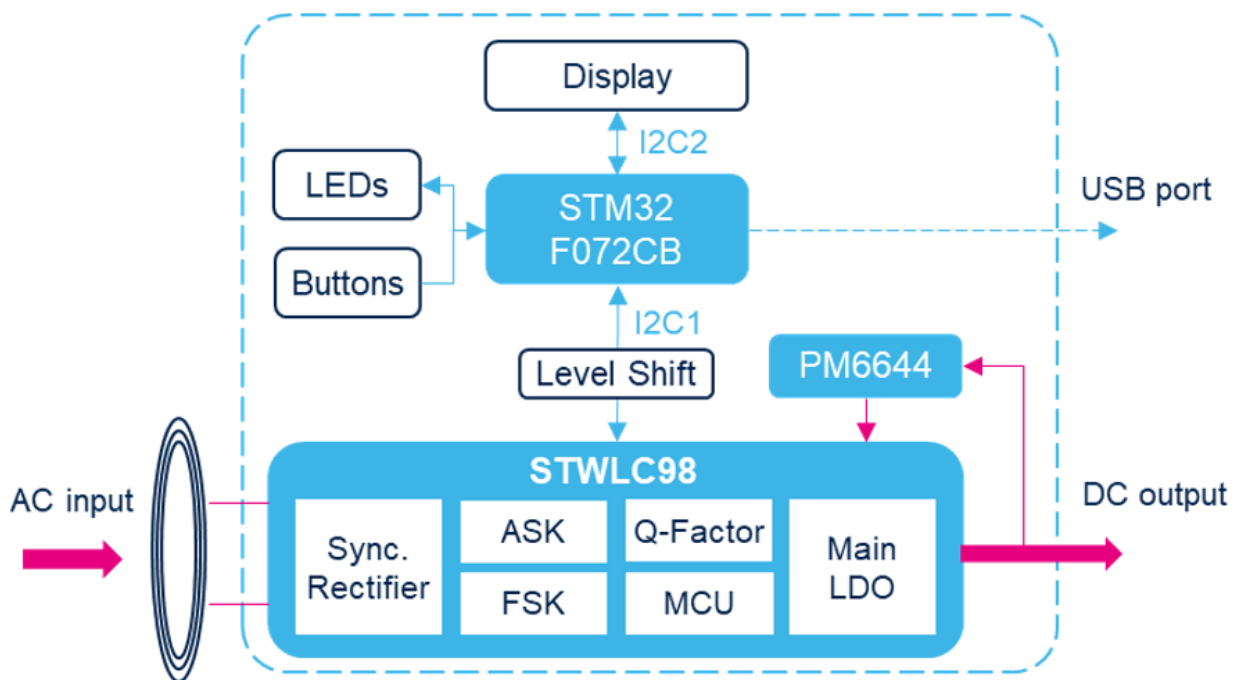
2 Graphical user interface

The display, once attached, shows the embedded GUI to control the STDES-70WRXWLC reference design without using a PC.

Three buttons, from top to bottom, are available on the reference design: <UP>, <SWITCH>, and <DOWN>.

Figure 2. **STDES-70WRXWLC reference design**

The GUI consists of multiple pages. The <UP> button is used to increase the voltage. The <DOWN> button is used to decrease the voltage. The <SWITCH> button is used to switch among pages.

Figure 3. **Embedded GUI layout example**
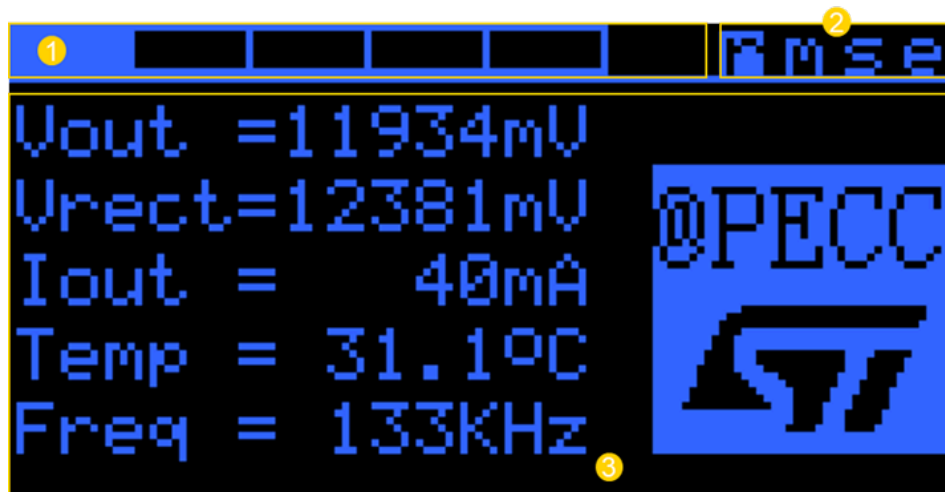
- The top-left bar shows the GUI total page number and the current page index. It changes in different working modes. You can switch page through the <SWITCH> button
- The top-right bar shows up to four icons for the general status
- The remaining area shows the main content of each page

The supported icons are:

- 'r': Rx mode
- 't': Tx mode
- 'x': debug mode
- 'a': automatically boost output voltage following STSC in the Rx mode
- 'm': manually boost output voltage following STSC in the Rx mode
- 's': STSC protocol identified with the transmitter
- 'e': 5 V supplied by an external DC-DC (PM6644)

GUI pages in Rx mode

Three GUI pages are dedicated to the receiver mode.

- 'Vout': output voltage in mV
- 'Vrect': synchronous rectifier output voltage in mV
- 'Iout': output current in mA
- 'Temp': STWLC98 chip temperature in °C
- 'Freq': wireless power signal AC frequency in kHz

The <UP> button is used to increase the output voltage level following the STSC. The <DOWN> button is used to decrease the output voltage. The <SWITCH> button is used to switch to the next GUI page.

Note: *The automatic boost feature is on by default. The output voltage is moved from 5 to 9, 12, 15, 18, and 20 V automatically at power-up. Once the <UP> or <DOWN> button is clicked, the automatic boost is stopped. The automatic boost can be resumed by double-clicking the <SWITCH> button.*

Figure 4. Embedded GUI for basic Rx information
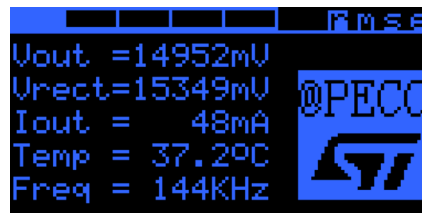
The second page shows the output voltage and power curves dynamically. The definition of the buttons is the same with the basic Rx information page.

**Figure 5. Embedded GUI for dynamic Rx curves**
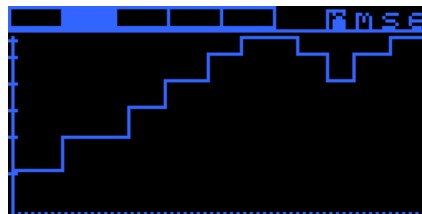
The third page shows an example of the customized bidirectional data communication between the wireless charging transmitter and the receiver following STSC.

A flashing LED is defined in the STWBC2-HP-based reference design, as, for example, the STDES-50W2CWBC. The STSC proprietary command from the STDES-70WRXWLC controls the flashing speed.

The <UP> and <DOWN> buttons are used to increase and decrease the LED flash speed.

**Figure 6. Embedded GUI for bidirectional communication demo**
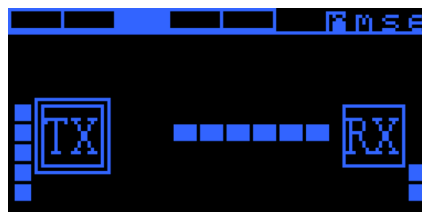
GUI pages in Tx mode

There is one dedicated page for the Tx mode.

- 'Vin': the input voltage in mV. The input might be from a USB adapter or a DC source
- 'Vrect': the synchronous rectifier output voltage in mV. It is lower than the input voltage
- 'Iin': the input current in mA
- 'Temp': the STWLC98 chip temperature in $^{\circ}$C
- 'Freq': the wireless power signal AC frequency in kHz

**Figure 7. Embedded GUI for basic Tx information**
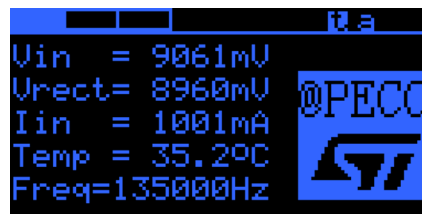
GUI pages in common

There are two GUI pages for all modes.

- 'Chip': the wireless charger SoC chip ID, 0x0062 for STWLC98
- 'Rev': chip reversion
- 'Cust': customer ID
- 'Rom': ROM ID
- 'FtpP': few time program (FTP) patch ID
- 'RamP': RAM patch ID
- 'Cfg': configuration ID
- 'Pe': product engineering ID
- 'PRMC': power receiver manufacture ID, 0x0016 for STMicroelectronics
- 'McuV': STM32F072CB firmware version

All the STM32F07CB firmware, the STWLC98 patch, and configuration can be upgraded. Contact ST sales or distributors to get the latest version if needed.

Figure 8. Embedded GUI for chip information
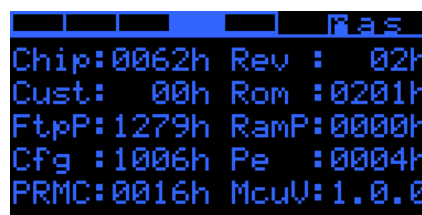
The configuration page is used to modify parameters and trigger special operations.
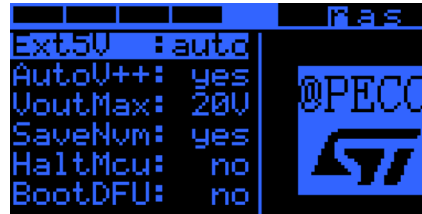
Figure 9. **Embedded GUI for configuration**

Table 1. **Configuration of STSW-70WRXWLC**

Item	Options	Description
Ext5V	Auto/off	Enables external 5 V DC-DC once Vrect > 10 V if it is "auto"
AutoV++	Yes/no	Whether the boost output voltage in the Rx mode automatically (affects only on RESET, the automatic boost can be turned on/off via buttons)
VoutMax	20 V/5 V/9 V/12 V/15 V/18 V	Sets the maximum output voltage allowed, for some dedicated evaluation that does not allow a high voltage
SaveNvm	Yes/no	Once the options change, it is "no" automatically. Switching to "yes" would save all the options to the STM32 flash memory, to be available after RESET
HaltMCU	No	Switching this item would turn off the MCU, OLED, and LEDs, while keeping the STWLC98 working, to measure efficiency more accurately. Need to RESET to re-enable the MCU and GUI.
BootDFU	No	Switch this item to enter the STM32 firmware upgrade mode

The <UP> button is used to switch among options in one parameter. The <DOWN> button is used to navigate among parameter items. The <SWITCH> button is used to switch to other GUI pages.

Revision history

Table 2. Document revision history

Date	Revision	Changes
19-Sep-2022	1	Initial release.

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