

## UM2301 User manual

# Getting started with the Qi MP-A10 wireless charger Tx evaluation board based on STWBC-EP

### Introduction

The STEVAL-ISB044V1 wireless power transmitter evaluation board is based on the MP-A10 (CR419) wireless power consortium (WPC) standard version 1.2.3 and supports FOD (foreign object detection).

The transmitter supports all Qi-compatible receivers (such as those in Qi- enabled mobile phones) as well as resistive or capacitive modulation receivers.

In accordance with the Qi-MPA10 topology, the STEVAL-ISB044V1 supports a 5-13 V input voltage and a half-bridge stage with bridge voltage/frequency control.

The evaluation board is based on the STWBC- EP controller which integrates all the functions required to drive and monitor the transmitter, and controls the bridge voltage built in boost topology.

The STWBC-EP supports UART connectivity to a PC and, thanks to the STEVAL-ISB044V1 graphical interface, monitors the transmitter behavior in real-time.

The STEVAL-ISB044V1 reference design provides a complete kit which includes the STWBC-EP, firmware, layout based on cost- effective 2-layer PCB, graphical interfaces and tools.



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### **1** Getting started

### 1.1 System requirements

To use the STEVAL-ISB044V1 evaluation board with the graphical user interface (GUI), you need:

- a PC with Microsoft<sup>®</sup> Windows<sup>®</sup> operating system (XP or later versions)
- NET Framework 4
- a USB-to-UART cable to connect the board to the PC.

### 1.2 Package contents

- Hardware:
  - a STEVAL-ISB044V1 evaluation board
  - ST-LINK/V2 in-circuit debugger/programmer with single wire interface module (SWIM), available for download on <u>www.st.com</u>
  - a USB-to-UART interface dongle with a micro-USB cable for board debug and GUI use
- Software:
  - ST-LINK USB driver
  - STVP programming software (integrated in ST\_toolset available on www.st.com)
  - FTDI VCP driver (*http://www.ftdichip.com/Drivers/VCP.htm*)
  - PC GUI installation package



### 2 Hardware description and setup

### 2.1 System block diagram

Figure 2: STWBC-EP block diagram



### 2.2 STEVAL-ISB044V1 wireless transmitter board overview

The STEVAL-ISB044V1 evaluation board features:

- STWBC-EP digital controller
- 15 W output power
- Qi MP-A10 reference design
- WPC Qi1.2.3 standard compliant
- Robust demodulation algorithm, with triple path (V, I, f)
- Foreign object detection (FOD)
- Accurate power control
- Active presence detection
- UART protocol to control and monitor the system
- Complete reference design (evaluation board, IC, firmware and tools)
- 2-layer PCB for easy design
- Flash memory-based
- RoHS compliant



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Parameter	Input characteristics	Min.	Тур.	Max.	Unit	Notes and conditions
Vin	Input voltage	5	12	13	V	
lin	Input current		1.6	2	А	Vin nominal, lout = max. on MP1B Rx
	Input no-load current				mA	
	Input stand-by current		1.4		mA	At typical voltage

Table	1: STEVAL-ISB044V1	electrical	performance:	input	characteristics

Fable 2: STEVAL-ISB044V1	electrical	performance:	system	characteristics
--------------------------	------------	--------------	--------	-----------------

Parameter	Input characteristics	Min.	Тур.	Max.	Unit	Notes and conditions
Fs	Switching frequency	110		180	kHz	Decrease with load
Duty cycle	Duty cycle modulation	5		50	%	Duty cycle
η	Full load efficiency		80		%	Vin= 12 V, P Out Rx = 15 W

Figure 3: STEVAL-ISB044V1 evaluation board: connectors, LEDs and test points





#### Figure 4: STEVAL-ISB044V1 evaluation board: power supply selection

#### **Table 3: Connector description**

Connector reference	Description
J100	DC power jack connector
J101	Power/QC USB connector link
J500	SWIM connector used for the download
J501	UART jack connector used for the GUI
J700	Quick charge USB connector

#### Table 4: Test point description

Test point reference	Signal	Description
TP100	12 V	12 V power supply connection
TP101	GND	GND power connection
TP102	VIN	Input voltage
TP103	VDD_STWBC	4.5V LDO output voltage
TP200	VDCDC	Boost output voltage
TP301	ISENSE	Current measurement
TP302	GND	Power GND connection (Rsense)
TP303	VRSENSE	Rsense resistor voltage
TP304		Wireless charging coil connection
TP305		Wireless charging coil connection



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Hardware description and setup

Test point reference	Signal	Description
TP400	SYMBOL_DETECT	Symbol detector
TP501	I2C_SCL	STWBC I <sup>2</sup> C signal
TP502	I2C_SDA	STWBC I <sup>2</sup> C signal
TP503	USB_DP	STWBC UART Rx signal
TP504	USB_DM	STWBC UART Tx signal
TP506	GPIO_0	STWBC GPIO signal used for LEDs
TP507	GND	Ground
TP508	CURRENT_DEMOD	Symbol detector
TP509	QC_IO	Quick charge circuit signal
TP510	GND	Ground
TP511	GND	Ground

### 2.3 STWBC-EP pinout and pin description

The STWBC-EP is a multifunction device that can support several wireless charging architectures.

This section shows the STWBC-EP pinout when the MP-A10 configuration is used.



Figure 5: STWBC-EP pinout in MP-A10 configuration

#### Hardware description and setup

Table 5: STWBC-EP pin description					
Pin number	Pin name	Pin type	Firmware description		
1	UART_RX	DI	Uart RX link on USB debug connector		
2	PWM_QFOD	DO	PWM dedicated to QFOD circuit		
3	I2C_SDA		I2C_SDA		
4	I2C_SCL		I2C_SCL		
5	DNBL	DO	Output driver for Low side branch		
6	LED	DO	Digital output for light indicators		
7	QC_IO	DO	Quick charge circuit signal		
8	CMP_OUT_V	AI	Boost output voltage sensing		
9	CS_CMP	AI	Boost current sensing		
10	DCDC_DAC_REF	AI	DAC reference value for Boost output voltage		
11	WAVE_SNS	AI	Symbol detector based on delta frequency		
12	CURRENT_DEMOD	AI	Current demodulation		
13	VDDA	PS	Analog power supply		
14	VSSA	PS	Analog ground		
15	TANK_VOLTAGE	AI	Analog input to measure the LC voltage (power calculation)		
16	VTARGET	AI	Boost voltage measurement		
17	QFOD_ADC	AI	High sensitivity peak voltage detector used for Quality Factor measurement		
18	COIL_TEMP	AI	Analog input for temperature measurement. The input is connected to external NTC biased to VDD_STWBC		
19	ISENSE	AI	Analog input to measure the current flowing into the power bridge		
20	VMAIN	AI	Analog input to measure the main power supply		
21	DCDC_DRV	DO	DCDC boost PWM drive		
22	DEMAGNET	DI	Boost demagnetization		
23	SYMBOL_DETECT	DI	Voltage demodulation		
24	DCDC_DAC	DO	Boost PWM output DAC (setting the CPP3 comparator voltage reference)		
25	UPBL	DO	Output driver for high side branch		
26	DNBL_FB		Used for hardware PWM programmation		
27	SWIM	DIO	Digital IO for debug interface		
28	NRST	DI	Reset		
29	VDD	PS	Digital and I/O power supply		
30	VSS	PS	Digital and I/O ground		
31	VOUT	Supply	Internal LDO output		
32	UART_TX	DO	Uart TX link on USB debug connector		



All analog inputs are VDD compliant but can be used only between 0 and 1.2 V.





### 3 Download procedure

To download the firmware to the board, the user has to install the GUI software which allows a complete board monitoring via UART signals. Thus, to use the STSW-STWBCGUI, UART signals must be accessible.

In case of board issues, ST-LINK and STVP software can be installed to erase the STWBC-EP Flash memory.

### 3.1 STSW-STWBCGUI software installation

<sup>1</sup> Install the GUI by launching the STWBC\_GUI\_Setup.msi installation file Figure 6: STSW-STWBCGUI installation file

Name	Date modified	Туре	Size
setup.exe	3/14/2017 11:49 AM	Application	418 KB
💕 STWBC_GUI_Setup.msi	3/14/2017 11:50 AM	Windows Installer	2,011 KB

- <sup>2</sup> Connect the wireless power transmitter board to the PC via the USB-to-UART connection on J501 UART connector
- <sup>3</sup> Check Windows Device Manager to identify the correct port number and select the appropriate USB serial COM port



Figure 7: Windows Device Manager: COM port selection

<sup>4</sup> Enter a specific COM port number (if not listed in the selection window) in the Special text box (e.g., "COM12" or the specific syntax "\\.\COM12") If the GUI is switched off, ensure that the COM port is not used on your computer.



Otherwise, try another USB port.

rigure 6. 515W-51WbCG01 start	5010011
🐨 STWBC Qi 3.42	
Setup Test	
Transmitter state	
Objet detected Qi detection Power BPP	
Protocol window Monitor window Param window	
Receiver informations	
Manufacturer ID:	Mirologo C
Device ID:	Com port
Qi version:	
Charge status: Not available	C COM1
	C COM2
	COM3
	С СОМ4
	C COM5
	C COM6
life.augmented	C COM7
STWBC - Wireless Battery Charger	С СОМ8
	C Special:
	Char to char delay (ms)
	OK Cancel

<sup>5</sup> Press "OK".

The GUI is ready to run.

### 3.2 Firmware download via STSW-STWBCGUI

The following sections describe the firmware download through the UART connector via STSW-STWBCGUI.

The download contains 3 files incorporated in a single cabfile.

#### 3.2.1 Download procedure with a new chip (never been programmed)

If the chip has never been programmed, the download mode is enabled by default.

<sup>1</sup> Connect the USB-to-UART dongle to the computer.



Do not connect the transmitter board for the moment.





From the GUI, select Load FW to board from the setup menu.
 Figure 10: Firmware download via STSW-STWBCGUI

STWBC Q13.40		
up lest		1
сом		
Load FW to be	bard	
Modify param	ieters in CAB file	( Power )
Convert CAB	o STVP files	
Thermistor co	nfiguration	Param window
eceiver informatio	ns	
Manufacturer ID.		
Device ID:		
Qi version:		
Charge status:	0%	
STWBC	- Wireless Battery	<b>nented</b> Charger



3

As prompted, select the CAB file containing the firmware to download

#### Figure 11: Firmware file selection message

Select file	
Select the CAB file contain	ing the FW to download

#### Figure 12: Firmware file selection



<sup>4</sup> Supply the board with 12 V and keep it powered.

#### Figure 13: Power on message

Action	X
Power ON the board an	d keep it powered !
	ок

<sup>5</sup> When the DOS window appears, connect the transmitter board to the dongle using a micro-USB cable.



Take care to connect it to the USB debug connector J501 on the opposite side of the power supply connection.

Figure 14: USB-to-UART dongle to STEVAL-ISB044V1 connection



<sup>6</sup> Follow the download progress in the DOS window and power the board off when prompted.

#### Figure 15: DOS window: download in progress



#### **3.2.2** Firmware upgrade procedure (chip already programmed)

If a chip has already been programmed with the firmware, the download mode is disabled and special command needs to be sent to STWBC-EP to enable the download mode.

- <sup>1</sup> Supply the transmitter board via a power supply set to12 V.
- <sup>2</sup> Connect the USB-to-UART dongle to the transmitter board.
- <sup>3</sup> The STWBC-EP UART Rx/Tx signals are accessible on the transmitter board J501 connector, respectively on USB\_DP and USB\_DM (see *Figure 14: "USB-to-UART dongle to STEVAL-ISB044V1 connection"*).



- <sup>4</sup> From the STSW-STWBCGUI, select **Load FW to board** in the setup menu (see *Figure 10: "Firmware download via STSW-STWBCGUI"*).
- <sup>5</sup> As prompted, select the CAB file containing the firmware to download (see *Figure 11: "Firmware file selection message"*).
- <sup>6</sup> As prompted, power the board on and keep it powered.
- Follow the download progress in the DOS window and power the board off when prompted (see *Figure 15: "DOS window: download in progress"*). In case of problems in downloading the firmware through UART (for example, firmware corruption during update), refer to the following section.

### 3.3 Erasing firmware procedure using STVP

#### 3.3.1 Requirements

To start the firmware erasing procedure using STVP, you have to install on your PC:

- ST-LINK USB driver
- STVP programming tool (available at www.st.com)
- ST-LINK hardware tools

You also need to configure STVP as shown below.

#### Figure 16: STVP configuration

Hardware :	Port :	Device :		
RLINK ST7255-EPB ST72589-EPB ST726X-EPB ST7277-EPB ST727x4-EPB ST7-DVP3 ST7-ENU3 ST7MDP01-EPB ST7MDT10-EPB ST7MDT1-DVP ST7MDT1-DVP2 ST7MDT1-DVP2	VSB Programming mode: JTAG SWD SWIM	STM8AF516 STM8AF517 STM8AF518 STM8AF518A STM8AF519 STM8AF514 STM8AF526 STM8AF528 STM8AF528 STM8AF6126 STM8AF6126 STM8AF6148	E	OK Cancel
ST7MDT1-EFB2 ST7MDT1-KIT ST7MDT20J-EPB ST7MDT20J-EPB ST7MDT25-EPB ST7MDT2-DVP ST7MDT2-DVP2 ST7MDT2-EPB2 ST7MDT2-EPB2 ST7MDT2-KIT ST7MDT4-EPB ST7MDT4-EPB ST7MDT4-EPB2 ST7MDT6-EPB2 ST7MDT6-EPB2 ST7MDT7-EPB2 ST7MDT7-EPB ST7MDT9-EPB ST7MDT9-EPB ST7MDT9-EPB ST7MDT03-EPB ST7MDT03-EPB ST7MDT05-VD13 ST1CE		STM8AF6168 STM8AF6169 STM8AF617 STM8AF618A STM8AF618A STM8AF618A STM8AF618A STM8AF6223 STM8AF6226TxSSS STM8AF6226TxSSS STM8AF6246 STM8AF6246 STM8AF6246 STM8AF6268 STM8AF6268 STM8AF6269 STM8AF6269 STM8AF628 STM8AF628 STM8AF628 STM8AF628 STM8AF628 STM8AF628 STM8AF628 STM8AF628 STM8AF519	Ŧ	



#### 3.3.2 Procedure

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- <sup>1</sup> Power the target off.
- <sup>2</sup> Power the target on.
- <sup>3</sup> Connect ST-LINK circuit to the PC via USB.
- <sup>4</sup> Connect the ST-LINK–SWIM cable to the target.



Pay special attention in connecting the SWIM cable to the transmitter board correctly, as shown below.



Figure 17: STEVAL-ISB044V1 evaluation board: ST-LINK connection

- <sup>5</sup> Launch STVP software.
- 6 Select STM8AF6166 as core.

Figure 18: STVP core selection

M no project - STVP	A result manual frage 1
Eile Edit Project Conf	igure Read Inogram Inity Erase Blank-Check View Help
📙 🖬 🚔 🛱 🔓	🔄 STM8AF6166 🖃 🔿 🚸 🦀 🦛 🐡 ล 📥 🔺 🦛 🦛



Do not upload any program into the STVP RAM area, as all bits will be erased (load 00 00 00).



#### Download procedure

7 Transfer the "00 00" to the STWBC-EP via the SWIM interface using the appropriate push button.

Figure 19: STVP	download
🖗 no project - STVP	
Eile Edit Project Configure Read Program Verify Erase B	lank-Check View Help
🖶 😹 🏟 🛅 💧 🐥 STM8AF6166 🛛 🛃 🐗	* * * * * <b>* * *</b> * * * *

<sup>8</sup> Click OK if a "wrong device selected" alert appears.

#### Figure 20: STVP wrong device selected alert

IVF	
Wrong device selected ! Check the confi	guration or the device !
	ОК

9 Click YES if "An incompatibility has been found with this device" alert appears.
 Figure 21: STVP incompatibility device action query

An incor	npatibility has been	n found with this o	device.	
Do you v on next a	want to ignore it an actions in this conf	d ignore all the de guration ?	vice compatibili	ty checks

After this operation, the programming procedure starts. At completion, the STVP informs the user that the program is loaded and verified.

- < PROGRAM MEMORY programming completed.
- > Verifying PROGRAM MEMORY area..
- < PROGRAM MEMORY successfully verified.
- 10 Exit from the STVP program.
- 11 Disconnect SWIM.
- 12 Remove power supply from the STEVAL-ISB044V1 transmitter board.
- <sup>13</sup> Retry the UART download procedure if necessary.

#### **3.4** Firmware download with command line

#### 3.4.1 Firmware download with written chip

- <sup>1</sup> Ensure a dedicated directory has the following files:
  - STWBC\_Loader.exe
  - stwbc\_loader\_not\_empty.bat
  - enable\_boot.bin
  - "firmware version".cab

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Starting from the STSW-STWBCGUI folder, run the stwbc\_loader\_not\_empty.bat from the command line, specifying the COM number (e.g. COM2) and firmware filename parameters ("firmware name.cab").



#### Figure 22: STSW-STWBCGUI command line

#### 3.4.2 Firmware download with blank chip

If the STWBC-EP memory is erased, the procedure sequence is a bit different.

- <sup>1</sup> Connect the UART cable to the board.
- <sup>2</sup> Select **Load FW to board** from the STSW-STWBCGUI and power the board.
- <sup>3</sup> Execute the command line as per the example below with the appropriate firmware filename.

#### Figure 23: STSW-STWBCGUI command line with blank chip

			- S
C:\Program Files (x86)\STMicroelectronics\STWBC GUI 3.16>stwbc_loader COM2 -cab WBC_FW_QI_1W_U5.094.cab_	.exe	-com	*



If the COM port is > COM8, the user has to use the syntax \\.\COMx where COMx is the COM port number.



A dedicated tool is available for simultaneous downloads (refer to the STSW-STWBCFWDT firmware downloader tool).

### 3.5 STVP file creation

To use the STVP to download, you must generate new files from the \*.cab. The existing GUI gives you this possibility.

Select the convert CAB to STVP files command from the STSW-STWBCGUI setup menu



#### Figure 24: STSW-STWBCGUI: convert CAB to STVP files

COM Load FW to b Modify paran Convert CAB	oard neters in CAB file to STVP files
Protocol window	Monitor window Param window
Manufacturer ID: Device ID: Qi version: Charge status:	Not available
Charge status:	Not available
STWBC	- Wireless Battery Charger

Follow the prompt to select the appropriate cabfile.
 Figure 25: Selecting the CAB file to be converted

STWBC Qi 3.40					
Setup Test	Qi	Power	Groanize T New fr	LIB > FW_QL_LIB_MP_V0_069 >	• 49 Search F
Protocol window	Monitor window Para	m window	20-Arch A	Name	Date m 20/03/
Receiver informatic Manufacturer ID: Device ID: Qi version: Charge status:	Dx0016 (ST) [0x64CC6611 [1.2 Medium Power [Not available]		40-Soft 50-Firm Delive		
STWBC	life.augmented - Wireless Battery Charger		A RANGE AND A RANG	<m e name: WBC_FW_ST_MP1_V0.69.cab</m 	Open

<sup>3</sup> Follow the prompt to provide the project file name.



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#### Download procedure

Figure 26: S	TVP project file name
Fr STWBC Qi 3.40	
Transmitter state Connected	Groupen     Search F       Organize *     New folder
Protocol window Monitor window Param window	20-Arch Name Date mo
Receiver informations	WBC_FW_ST_MP1_V0.69.cab 20/03/2
Manufacturer ID: 0x0016 (ST)	🎉 50-Firm
Device ID: 0x64CC6611	🍶 Admir
Qi version: 1.2 Medium Power	Delive
Charge status: Not available	🕌 Non
STWBC - Wireless Battery Charger	No     Ph     Q1     W     J1     SYS     Terr     Docur     File name: WBC_FW_ST_MP1_V0.69.cab     Open

Four files will be generated as shown below.

Figure 27: STVP	files created
-----------------	---------------

<b>G</b>		• 4	Search STVP files	-		×-
File Edit V	fiew Tools Help					
Organize 👻	New folder			H ·		0
*	Name	Date modified	Туре	Size		
🕞 Libra	FW_Qi_LIB_MP_V0_069.stp	06/04/2017 11:13	STP File		1 KE	3
Do	options.hex	06/04/2017 11:13	HEX File		1 KE	3
ar Mi	parameters.hex	06/04/2017 11:13	HEX File		3 KB	3
Vic	program.hex	06/04/2017 11:12	HEX File		84 KE	3
P Corr						
S OS						

### 3.6 Firmware download with STVP

- <sup>1</sup> Power the target off.
- <sup>2</sup> Power the target on.
- <sup>3</sup> Connect ST-LINK circuit to the PC via USB.
- <sup>4</sup> Connect the ST-LINK–SWIM cable to the target.



Pay special attention in connecting the SWIM cable to the transmitter board correctly, as shown in *Figure 17: "STEVAL-ISB044V1 evaluation board: ST-LINK connection"*.

5 Launch STVP software.



- 6 Select STM8AF6166 as core (see Figure 18: "STVP core selection").
- 7 In STVP, open the Project menu and click Open.
- 8 Select the .stp given in the zip file.

#### Figure 28: STVP file selection 23 Configuration Hardware : Port : Device RLINK STM8AF516 RLINK ST7255-EPB ST72589-EPB ST726X-EPB ST7277-EPB ST727x4-EPB OK . STM8AF517 STM8AF518 Cancel STM8AF518A STM8AF519 STM8AF51A Programming mode: ST7-DVP3 STM8AF526 12 JTAG ST7-EMIL3 STM8AF528 ST7MDP01-EPB SWD STM8AF52A ST7MDT10-EPB STM8AF6126 ST7MDT1-DVP ST7MDT1-DVP2 STM8AF6146 STM8AF6148 ST7MDT1-EPB ST7MDT1-EPB2 ST7MDT1-KIT STM8AF6168 STM8AF6169 ST7MDT20J-EPB STM8AF617 ST7MDT20M-EPB ST7MDT25-EPB STM8AF618 STM8AF618A ST7MDT2-DVP STM8AF619 STM8AF61A STM8AF6223 STM8AF6223PxA ST7MDT2-DVP2 ST7MDT2-EPB ST7MDT2-EPB2 ST7MDT2-KIT ST7MDT4-EPB STM8AF6226 STM8AF6226TxSSS ST7MDT4-KIT STM8AF6246 ST7MDT5-EPB ST7MDT6-EPB2 ST7MDT7-EPB2 STM8AF6248 STM8AF6266 STM8AF6268 ST7MDTH1-EPB STM8AF6269 ST7MDTS1-EPB STM8AF628 ST7MDTU2-EPB STM8AF62A STM8AH516 ST7MDTU3-EPB ST7MDTU5-EPB STM8AH517 STM8AH518 STM8AH519 ST7UD05/UD13 STICE STICK ST-TSLINK

9 Wait few seconds.

#### The following message should appear:



#### It is normal that some warnings appear:



- 10 In STVP, open the Program menu and select All tabs (on active sectors, if any)
- 11 Click OK if a "wrong device selected" alert appears (see Figure 20: "STVP wrong device selected alert").
- 12 Click YES if "An incompatibility has been found with this device" alert appears (see Figure 21: "STVP incompatibility device action query").

After this operation, the programming procedure starts. At completion, the STVP informs the user that the program is loaded and verified.



- < PROGRAM MEMORY programming completed.
  > Verifying PROGRAM MEMORY area...
  < PROGRAM MEMORY successfully verified.</pre>
- 13 Exit from the STVP program.
- 14 Disconnect SWIM.
- 15 Remove power supply from the STEVAL-ISB044V1 transmitter board. The IAR toolchain can be installed also for firmware compilation and download.



## 4 Evaluation equipment setup

#### Figure 29: STEVAL-ISB044V1 evaluation board: test setup configuration



The board is powered via an external power supply or a USB charger. An electronic load is connected to the receiver output to load up to 15 W.

On the basis of measurements, voltmeters and ammeters measure input/output voltage and current.

### 4.1 External power supply

The power supply is set to 12 V/2 A for EPP mode and 5 V/2 A for BPP mode.

The board is connected to the external power supply through wires.

The jumper has to be set to select the jack/external power supply input.

#### Figure 30: STEVAL-ISB044V1 evaluation board: external power supply connection



### 4.2 USB charger

The board can be supplied by a USB charger. The jumper J101 should be set to select the USB supply input.

CIA simple 5 V USB charger can be used. Considering the peak currents and the system efficiency, a 5 V/2 A USB charger must be considered. At this input voltage, BPP mode only is available.

It is also possible to use a Quick Charge (QC) wall charger in order to provide higher voltage. By default, D+/D- interface selects 12V on  $V_{BUS}$ . This enables to support EPP mode.

To provide 15 W on the receiver side and considering the system efficiency, a 24 W Quick Charge wall charger should be used.

The 24 W QC wall charger, with Quick Charge 3.0, tested with our solution is manufactured by KOVOL.

The USB cable between the charger and the board should be of good quality. To minimize the losses, a 20 AWG USB cable must be used.



Figure 31: STEVAL-ISB044V1 evaluation board: power supply connection

### 4.3 UART configuration

The STSW-STWBCGUI is installed on the PC connected to the board via the USB-to-UART cable (connected on the board J501 USB debug connector).



This UART connection is mandatory for parameter settings and debug of the board which is using the STSW-STWBCGUI.







### 5 GUI and evaluation procedure

The STSW-STWBCGUI thoroughly monitors STWBC-EP operations.

The main screen provides transmitter and Qi receiver status information.

Figure 33: STSW-STWBCGUI: object detected and charge in progress



The STSW-STWBCGUI can also display the Rx to Tx communication protocol errors, useful for system debugging.



Log window mode  communication  AUTOCAL_TEST_DONE  PING TIMEOUT  RX REMOVED  BAD PACKET SEQUENCE  POWER CTRL HOLD OFF ERROR  POWER CTRL HOLD OFF ERROR  Q FOD  POWER CTRL HOLD OFF ERROR  Q FOD  INTERNAL_WARNING  CONTROL ERROR TIMEOUT  VIN UNDER-VOLTAGE  OPTIONAL PACKET SINSMATCH  EPT NEGOTIATION FAILURE  EPT NEGOTIATION IF PARCET  EPT CHARGE COMPLETE  EPT CHARGE COMPLETE  EPT OVER VOLTAGE  Oprietary packets  CLear  CIE	Protocol	
communication     AUTOCAL_TEST_DONE     EPT BATTERY FAILLURE       PINS TIMEOUT     RX PACKET ERROR       RX REMOVED     NO RESPONSE       DOO MANY PROPRIETARY PACKETS     PWR, BALANCE, FOD       POWER CTRL HOLD OFF ERROR     CLISTOM ERROR       Q FOD     INTERNAL, WARNING       CONTROL ERROR TIMEOUT     AUTOCAL_TEST_FAIL       RECTIFIED POWER TIMEOUT     AUTOCAL_TEST_FAIL       OPTIONAL PACKETS MISMATCH     EPT NEGOTIATION FAILURE       EPT RECEIVED     BAD MOEOI IN MP RP ACKET       EPT RECEIVED     BAD MOE OTIATION       EPT RECEIVED     BAD MOE OTIATION       EPT CHARGE COMPLETE     BAD MOE IN MP RP ACKET       EPT CHARGE COMPLETE     EPT RESTART POWER TRANSFER       EPT OVER VOLTAGE     CALIBRATION PHASE TOO LONG       Oprietary packets     CONFLICT	Log window mode	
AUTOCAL_TEST_DONE PING TIMEOUT RX REMOVED BAD PACKET SEQUENCE POWER CTRL HOLD OFF ERROR POWER CTRL HOLD OFF ERROR CONTROL ERROR TIMEOUT QFOD CONTROL ERROR TIMEOUT RECTIFIED POWER TIMEOUT QFOD OPTIONAL PACKETS MISMATCH EPT NEGOTIATION FAILURE BAD NEGOTIATION FAILURE DFT NEGETIVED EPT NEGETIVED EPT NEGETIVED EPT CHARGE COMPLETE EPT CHARGE COMPLETE EPT OVER VOLTAGE OPTIEVARY BAD AND AND AND AND AND AND AND AND AND A	communication	
PINS TIMEOUT     RX PROVED       BAD PACKET SEQUENCE     NO RESPONSE       DOO MANY PROPRIETARY PACKETS     PWR_BALANCE_FOD       POWER CTRLHOLD OFF ERROR     CUSTOM ERROR       Q FOD     UNTERNAL_WARKING       CONTROL ERROR TIMEOUT     TX_OVER_CURRENT       Q FOD     UNTERNAL_WARKING       CONTROL ERROR TIMEOUT     AUTOCAL_TEST_FAIL       RECTIFIED POWER TIMEOUT     AUTOCAL_TEST_FAIL       OPTIONAL PACKETS MISMATCH     EPT NEGOTIATION FAILURE       EPT ERCIVED     BAD MODE IN MR REGOTIATION       EPT CHARGE COMPLETE     BAD MODE IN MR PP PACKET       EPT CHARGE COMPLETE     EPT RESTART POWER TRANSFER       EPT OVER VOLTAGE     CALIBRATION PRESE TOO LONG       Oprietary packets     CI	AUTOCAL_TEST_DONE	EPT BATTERY FAILLURE
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TOO MANY PROPRIETARY PACKETS POWER CTRL HOLD OFF BEROR POWER CTRL HOLD OFF BEROR Q FOO UT Q FOO UT CONTROL ERROR TIMEOUT Q FOO UNITERNAL_WARNING OPTIONAL PACKETS MISMATCH EPT NEGOTIATION TAILURE OPTIONAL PACKETS MISMATCH EPT NEGOTIATION TAILURE EPT PACUER UNBEROR RX OVER TEMPERATURE EPT CHARGE COMPLETE EPT CHARGE COMPLETE EPT OVER VOLTAGE Oprietary packets CL	BAD PACKET SEQUENCE	NO RESPONSE
POWER CTRL HOLD OFF ERROR     CUSTOM ERROR       PACKET TIMEOUT     TX_OVER_CURRENT       Q FOD     INTERNAL_WARNING       CONTROL ERROR TIMEOUT     AJTOCAL_TEST_FAIL       RECTIFIED POWER TIMEOUT     AJTOCAL_TEST_FAIL       OPTIONAL PACKETS MISMATCH     EPT NEGOTIATION FAILURE       OPTIONAL PACKETS MISMATCH     EPT NEGOTIATION FAILURE       OPTIONAL PACKETS MISMATCH     EPT NEGOTIATION FAILURE       DET_RX_OVER CURRENT     FOD DURING NEGOTIATION       RX OVER TEMPERATURE     BAD MOE IN MP RP ACKET       TX OVER TEMPERATURE     BAD MODE IN MP RP ACKET       EPT CHARGE COMPLETE     EPT RESTART POWER TRANSFER       EPT OVER VOLTAGE     CALIBRATION PARES TOO LONG       Clear     Oprietary packets	TOO MANY PROPRIETARY PACKETS	PWR_BALANCE_FOD
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Q FOD     INTERNAL_WARNING       CONTROL ERROR TIMEOUT     AUTOCAL_TEST_FAIL       VID UNDER-VOLTAGE     EPT NEGOTIATION FAILURE       OPTIONAL PACKETS INSWATCH     EPT NEGOTIATION FAILURE       EPT RECEIVED     BAD NEGOTIATION       RX OVER TEMPERATURE     BAD MODE IN MP RP PACKET       TX OVER TEMPERATURE     WRONG RP FORMAT       EPT CHARGE COMPLETE     EPT RESTART POWER TRANSFER       EPT OVER VOLTAGE     CALIBRATION PHASE TOO LONG       Clear     Oprietary packets	PACKET TIMEOUT	TX_OVER_CURRENT
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EPT RECEIVED     BAD NEGOTIATION       EPT RECEIVED     FOD DURING NEGOTIATION       RX OVER TEMPERATURE     BAD MODE IN MP RP PACKET       TX OVER TEMPERATURE     BAD MODE IN MP RP PACKET       EPT CHARGE COMPLETE     EPT RESTART FOWER TRANSFER       Clear     Clear	CHECKSUM ERROR	NEGOTIATION TIMEOUT
PT_RX_OVER CURRENT FOO DURING REGOTATION RX OVER TEMPERATURE BAD MODE IN MP RP ACKET TX OVER TEMPERATURE CONFLICT EPT CHARGE COMPLETE CONFLICT EPT OVER VOLTAGE CONFLICT Clear oprietary packets	EPT RECEIVED	BAD NEGOTIATION
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EPT CHARGE COMPLETE EPT RESTART POWER TRANSFER EPT OVER VOLTAGE CALIBRATION PHASE TOO LONG RESOURCE CONFLICT Clear oprietary packets	TX OVER TEMPERATURE	WRONG RP FORMAT
EPT OVER VOLTAGE CALIBRATION PHASE TOO LONG RESOURCE CONFLICT	EPT CHARGE COMPLETE	EPT RESTART POWER TRANSFER
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You can also monitor STWBC-EP internal variables such as bridge voltage and frequency, Rx reported power, coil temperature, etc.

Figure 35: STSW-STWBCGUI: Qi monitor window

Tx machin STOP	SELECT	PING	IDENT	NEGO	POWER
Frequenc	y: 155kHz		Regulatio	on error: 0%	
100kHz	200.42	3001.Hz	-100%	0%	+ 100%
Duty tyti	e: 50%	_	bridge voica	ye: 21,12V	
0%	29%	50%	١٧	12V	24
Rx report	ted Power: 108	₿m₩	Supply volta	age: 12,03V	
aw	10W	20W	1V	12V	24
Coil temp	erature: 45°		Coil current	: 0A	
0ª Py prece	40° nce: 151	80°	04	1.54	AL
Selected	coil: 0 Me	as. Q: 113	FOD margin	: 44	
Massas	rate:		1		1

The GUI user-friendly interface allows efficient system adjustment (thresholds, regulation error) and lets you store parameters to and load parameters from your computer.

The parameters have the following levels of protection:

• Level 0: parameters can be modified without protection



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•

Level 1: more critical parameters to be modified with caution. You must click the **Unlock param** button before modifying it, with caution, as it can lead to system malfunction or trigger unexpected behavior incompatible with Qi standard.

Parameters				-0	
Dump target	Save to file	Read param force_high	power at 0x68, val =	0x00	
Push to target	Load from file	Read param brg_freq_a Read param brg_freq_a	nalog_ping at 0x6D, v nalog_ping at 0x6E, v	al = 0x00 al = 0x00	1
Reset values	Dump to bin.	Read param brg_freq_a Read param brg_freq_a	nalog_ping at 0x6F, v nalog_ping at 0x70, v	ai = 0x75 al = 0x7530	
Unlock param		Read param brg_freq_d	igital_ping at 0x71, va igital_ping at 0x72, va	l = 0x00 l = 0x00	
	eeprom_v	ersion: 14			
	fw_v	ersion: 0.69			ा
	force_high_	power:		0×00	
	brg_freq_analog_ping (LO	CKED):	120 kHz	0×7530	1
	brg_freq_digital_ping (LO	CKED):	170 kHz	0xA604	
	brg_freq_max (LO	CKED):	180 kHz	0xAFC8	
	brg_freq_min (LO	CKED):	110 kHz	0x686C	
	brg_f_max_dc_max (LO	CKED):	50 %	0x01F4	
1	brg_f_max_dc_min (LO	CKED):	5%	0×32	
1	brg_bridge_topology (LO	CKED): 🔽 Half bridge			
	pres_d	t_the	5	0×05	
	temp_high_mea	as_thr: :::::::::::::::::::::::::::::::::::	70.8 °C	0xA8	
	temp_low_mea	s_thr:	58.2 °C	0×0101	

Figure 36: STSW-STWBCGUI: Parameters window

Parameters can be modified and their effect can be tested immediately by clicking **Push to target**; modified parameters lose their highlighted background.

Figure 37:	STSW-STWBCGUI:	modified	parameters
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Dump target	Save to file	Write param fod2_thr_coef at 0x8A, val = 0x34	•
Push to target	Load from file	Write param tod2_treq_max at 0x8D, val = 0x00 Write param tod2_freq_max at 0x8E, val = 0x02	
Reset values	Dump to bin.	Write param fod2_freq_max at 0x8F, val = 0x8F Write param fod2_freq_max at 0x90, val = 0x20	
Unlock param		Send store command	-
	hra fran analos	fw_version: 5097	0x13E9
	bro freq analog		0x0001D4C0
	brg_freq_digital	_ping (LOCKED):	0x00027100
	brg_freq	_max (LOCKED):	0x00035860
	brg_free	q_min (LOCKED):	0x0001D4C0
	brg_f_max_dc	_max (LOCKED):	0x01F4
	brg_f_max_d	c_min (LOCKED):	0x64
	brg_f_tx_ft	sk_mod_lo_level:	0x64
	brg f tx fs	sk mod hi level:	- 0x64

The GUI embeds the STSW-STWBCFWDT downloader interface (which uses UART connection) and includes tools to generate binary files with adjusted parameters and to build new firmware packages incorporating these files.

Through the GUI, you can change the parameters and produce a new cab to program a batch of new boards. To this aim, dump the parameters into a bin file, but only after clicking the **Push to target** button.

Figure 38: STSW-STWBCGUI: saving modified parameters (Dump to bin)

Dump target	Save to file	Write param fod2_thr_coef at 0x8A, val = 0x3	4	
Push to target	Load from file	Write param fod2_freq_max at 0x8D, val = 0x0 Write param fod2_freq_max at 0x8E, val = 0x0	02	
Reset values	Dump to bin.	Write param fod2_freq_max at 0x8+, val = 0x2 Write param fod2_freq_max at 0x90, val = 0x2	20	
Unlock param	( I	Send store command		-
		hw_version: unknown eeprom_version: 6		
		fw_version: 5097		0x13E9
	brg_freq_analog		120 kHz	0x0001D4C0
	brg_freq_digita	(_ping (LOCKED):	160 kHz	0x00027100
	brg_free		220 kHz	0x00035860
	brg_fre	q_min (LOCKED):	120 kHz	0x0001D4C0
	brg_f_max_do	(LOCKED):	50 %	0x01F4
	brg_f_max_d	lc_min (LOCKED):	10 %	0x64
	brg_f_tx_f	sk_mod_lo_level:	0.1 kHz	0x64
	bra f tx f	sk mod hi level:	0.1447	0x64

Figure 39: STSW-STWBCGUI: bin file backup

Save As				
00 • 📕 « W	BC_LIB + FW_QI_LIB_MP_V	ro_069 ▶ ·	• 49 Search FW_QI	LIB_MP_V0_069
Organize 👻 Ne	w folder			)II • (
20- ^ 30- 40- 50- 2 / E C	Name *		Date modified 06/04/2017 11:13	Type File folder
File name: Save as type:	parametersnewibin	III		
🔿 Hide Folders			Save	Cancel

You can then select **Modify parameters in CAB file** from the setup menu and select the appropriate firmware CAB file to be patched. This operation will alter the firmware file with new tuning parameters, which can be subsequently loaded using the standard procedure.



5.1

#### GUI and evaluation procedure

Setup COM Load FW to board Modify parameters in CAB file Protocol window Monitor window Protocol Protoco
COM Load FW to board Modify parameters in CAB file Protocol window Monitor window Parameters in CAB file Protocol window Monitor window Parameters in CAB file Power Protocol window Monitor window Parameters in CAB file Power Pow
Load FW to board Modify parameters in CAB file Protocol window Monitor window Faram window Receiver informations Manufacturer ID: Device ID: Qi version:
Modify parameters in CAB file Power Protocol window Monitor window Faram window Receiver informations Manufacturer ID: Device ID: Qi version:
Protocol window Monitor window Faram window Receiver informations Manufacturer ID: Device ID: Qi version:
Protocol window Monitor window Faram window Protocol window Monitor window Processor Protocol
Receiver informations Manufacturer ID: Device ID: Qi version:
Manufacturer ID: Device ID: Qi version:
Device ID: Qi version:
Qi version:
Charge status: Not available
STWBC - Wireless Battery Charger

Status LEDs

The status LEDs give the state of the charge:

#### At startup

- Red short blinking: when the board auto-calibration is on-going. The user has to wait for the LED to be switched off before putting a receiver on the surface.
- Red and green blinking once: an internal reset occurred.
- Red and green steady state: firmware/STWBC chip mismatch
- Red steady and after 2 seconds green steady state: board hardware subversion detected does not match the firmware

#### In steady state

- Green blinking: power transfer in progress
- Green steady state: the charge is complete
- Red blinking: an error has been detected, as incomplete charge due to battery fault, overvoltage, overcurrent, etc.
- Red steady state: the transmitter is stuck until the receiver is removed, as mentioned in the Qi standard (power transfer stopped three times in a row due to the amount of power not provided to the receiver, some types of end power transfer or no response error code)

### 5.2 Test procedure for board calibration

There are 2 auto-calibration phases in the GUI: one for the presence detection and one for the QFOD.



Both calibrations are mandatory to ensure a good functioning of the transmitter board.



Gr STWBC Qi       Image test       Image test </th <th>ga. e e . e</th> <th>Ent by csep cubiest</th>	ga. e e . e	Ent by csep cubiest
Setup       Test         Trans       Manage test         Objet       Oi         Objet       Objet	🖅 STWBC Qi	Fig Protocol
Trans       Manage test       Connected         Objet       Oil       Data TX       Power         Protocol window       Data TX       Power         Protocol window       Monitor window       Param window         Protocol window       Param window       Power         Manufacturer ID:       Device ID:       Device ID:         Diversion:       Connected       POWER TRANSFEC TRUE ERROR         Charge status:       Not available       Connected         STWBC - Wireless Battery Charger       EPT Okarge Isote Power       EPT Okarge Isote Power         Clear       Clear       Clear	Setup Test	Log window mode
Biet       Gi       Data TX       Power         Protocol window       Monitor window       Param window         Protocol window       Param window       Param window         Receiver informations       PACKET TIMEOUT       RECTIFIED POWER TRANSFER CTRU ERROR         Device ID:       Devision:       PACKET TIMEOUT         Qi version:       Policy estatus:       Not available         Charge status:       Not available       PST_RX_OVER CTRU ERROR         STWBC - Wireless Battery Charger       Parameted       RESERVED 1         RESERVED 2       RESERVED 2       RESERVED 2         RESERVED 3       Clear	Trans Manage test Connected	Oi communication warnings
Diget delected       Gi delection       Data TX       Power         Protocol window       Monitor window       Param window         Protocol window       Monitor window       Param window         Receiver informations:       Power         Manufacturer ID:       Power         Device ID:       Control ERROR         Qi version:       Port Receiver informations         Charge status:       Not available         Strubberger       Port Receiver         Manufacturer ID:       Power         Qi version:       Port Receiver         Qi version:       Port Receiver         Charge status:       Not available         Strubbe - wireless Battery Charger       Protocol Response         Reserved 2       Reserved 2         Reserved 3       Reserved 3		ALTOCAL TEST DONE
Dijet Gelecidi Gelecidi Gelecidi Protocol window       Data TX       Power         Protocol window       Monitor window       Param window         Protocol window       Param window       Param window         Receiver informations       PACKET TIMEOUT         Manufacturer ID:       Power         Device ID:       Power         Qi version:       Potocol window         Charge status:       Not available         For Low Construction       Power         Coll Over TRANSFER CTRUE BARD       Power         Device ID:       Power         Qi version:       Power         Charge status:       Not available         STWBC - Wireless Battery Charger       Portect Delecter         Clear       Clear		DING TIMEOLIT
Image: Construction of the construc	(Objet) (Qi) (Data TX) (Power)	RX REMOVED
Pitotocol window       Param window         Protocol window       Param window         Protocol window       Param window         Power TRN HOLD OFF BROR       POWER TRN HOLD OFF BROR         Manufacturer ID:       Power TRN HOLD OFF BROR         Device ID:       Power TRN HOLD OFF BROR         Qi version:       Power TRN HOLD OFF BROR         Charge status:       Not available         For Low Componented       BFT RX OFFE CIRCHER         STWBC - Wireless Battery Charger       RESERVED 1         RESERVED 2       RESERVED 2         RESERVED 3       Clear	(detected) (detection) (Data IC) (Tower)	BAD PACKET SECI ENCE
Protocol window       Monitor window       Param window         Power TRL HOLD OF BRIDE       PACKET TIMEOUT         Manufacturer ID:       CONTROL ERROR TIMEOUT         Device ID:       Web Shore Down         Qi version:       BFT RECEIVED         Charge status:       Not available         STWBC - Wireless Battery Charger       BFT RECEIVED         Clear       Clear		TOO MANY PROPRIETARY PACKETS
Protocol window       Monitor window       Param window         Receiver informations       PACKET TIMEOUT         Manufacturer ID:       POWER TRANSPER CTRUE BEROR         Device ID:       CONTROL ERROR TIMEOUT         Qi version:       CHECKSUM ERROR         Charge status:       Not available         For CHAR COMPLETE       EPT CHARCE PROP         EFT FRANCE       CONTROL ERROR TIMEOUT         RECIFIED POWER TRANSPER CTRUE       CONTROL ERROR TIMEOUT         Qi version:       CHECKSUM ERROR         Charge status:       Not available         FILE.cougmented       STWBC - Wireless Battery Charger         STWBC - Wireless Battery Charger       Clear		
Receiver informations         Manufacturer ID:         Device ID:         Qi version:         Charge status:         Not available             POWER TRANSFER CTRL ERROR         CONTROL ERROR TIMEOUT         VBLS DROP DOWN         OPTIONAL PRACHTS MISMATCH         OPTIONAL PRACHTS MISMAT	Protocol window Monitor window Param window	POWER CIRCINE DARKER
Receiver informations       CONTROL ERROR TIMEOUT         Manufacturer ID:       Control ERROR TIMEOUT         Device ID:       Velus BROP DOWN         Qi version:       Control ERROR TIMEOUT         Charge status:       Not available         Charge status:       Not available         STWBC - Wireless Battery Charger       EPT OF ORE CORPLETE         Clear       Clear		
Manufacture ID:       Device ID:         Qi version:       Vest Status:         Charge status:       Not available         Origin:       EPT RECEIVED         EPT RCCURE       EPT RECEIVED         EPT RCCURE       EPT RCCURE         Charge status:       Not available         EPT RCCURE       EPT RCCURE         EPT RCCURE       EPT RCCURE         EPT RCCURE       EPT RCCURE         EPT RCCURE       EPT RCCURE         EPT OVER TEMPERATURE       EPT OVER TEMPERATURE         STWBC - Wireless Battery Charger       NO RESERVED 1         RESERVED 1       RESERVED 2         RESERVED 2       RESERVED 3	- Possiur informations	
Manuacture ID:	Man Cashan ID	DECTIFIED DOWER TIMEOUT
Device ID: Qi version: Charge status: Not available Charge stat	Manuracturer ID:	VBUS DEOD DOWN
Qi version:	Device ID:	OPTIONAL PACKETS MISMATCH
Giversion: Charge status: Not available Charge status: Not avail		
Charge status: Not available  Charge status: Not available  EPT_RX_OVER CURRENT COLL OVER TEMPERATURE  EPT CHARGE OVER TEMPERATURE  EPT CHARGE OVER TEMPERATURE  EPT CHARGE OVER TEMPERATURE  EPT ATTERY FAILURE  R RACET ERROR  R RECOMPLETE  OVER TOWER VOLTAGE  FOREIGN OBJECT DETECTED  CUSTOM BRAROR  TX_OVER CURRENT  RESERVED 1  RESERVED 2  RESERVED 3  Clear	Qi version:	EDT DECEIVED
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TRANSCEIVER OVER TEMERATURE EPT CHARGE COMPLETE EPT OVER VOLTAGE EPT BATTERY FALLURE R RACKT ERROR R RECONFIGURE NO RESPONSE FOREIGN OBJECT COMPLETE NO RESPONSE FOREIGN OBJECT COMPLETE NO RESPONSE FOREIGN OBJECT COMPLETE RESERVED 1 RESERVED 2 RESERVED 3 Clear	Charge status: Not available	
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EPT OVER VOLTAGE EPT BATTERY FALLURE RX PACKET ERROR RECONFIGURE NO RESPONSE FOREIGN OBJECT DETECTED CUSTOM ERROR TX_OVER_CURRENT RESERVED 1 RESERVED 2 RESERVED 2 RESERVED 3		EPT CHARGE COMPLETE
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STWBC - Wireless Battery Charger         RESERVED 1         RESERVED 1         RESERVED 2         RESERVED 3		EPT BATTERY FATULIRE
RECONFIGURE         NO RESPONSE         FOREIGN 00 JECT DETECTED         CUSTOW BROR         TX_OVER_CURRENT         RESERVED 1         RESERVED 2         RESERVED 3		RX PACKET ERROR
NO RESPONSE FOREIGN OBJECT DETECTED CUSTOM FBROR TX_OVER_CURRENT RESERVED 1 RESERVED 2 RESERVED 2 RESERVED 3		RECONEIGURE
FOREIGN OBJECT DETECTED CUSTOM BROR STWBC - Wireless Battery Charger RESERVED 2 RESERVED 3 Clear		NO RESPONSE
LUSTOM BROR TX_ONER CURRENT RESERVED 1 RESERVED 2 RESERVED 3 Clear		EOREIGN OBJECT DETECTED
STWBC - Wireless Battery Charger		CLISTOM ERROR
STWBC - Wireless Battery Charger RESERVED 1 RESERVED 2 RESERVED 3 Clear Clear	me.duginenied	TX OVER CHRRENT
RESERVED 2 RESERVED 3	CTM/DC M//Charles Dates Charles	RESERVED 1
RESERVED 3	STVVBC - VVIreless battery Charger	RESERVED 2
Clear Clear		RESERVED 3
Clear		
<u>Clear</u>		
		Clear
<u></u>		
		0

Figure 41: STSW-STWBCGUI: start auto-calibration

This calibration should be done only once after each new firmware download, with **NO Receiver** placed on the transmitter.

You must first calibrate the presence detection and then the QFOD.

#### 5.2.1 Presence detection calibration procedure

- 1 Set the test number to 1
- 2 Click the **Start** button

Figure 42: STSW-STWBCGUI: presence detection test

	Arr Protocol	
Setup Test	🗌 🕅 Log window mode	
Transmitter state	⊂Qi communication warnings	
	AUTOCAL TEST DONE	
	PING TIMEOUT	
Ubjet { Ui } { Data TX } Power }	RX REMOVED	
	BAD PACKET SEQUENCE	
	TOO MANY PROPRIETARY PACKETS	
Description and Henderstein and Description	POWER CTRL HOLD OFF ERROR	
Protocol window Monitor window Param window	PACKET TIMEOUT	
	POWER TRANSFER CTRL ERROR	
Receiver informations	CONTROL ERROR TIMEOUT	
Manufacturer ID:	RECTIFIED POWER TIMEOUT	
	VBUS DROP DOWN	
Device ID:	OPTIONAL PACKETS MISMATCH	
0	CHECKSUM ERROR	
ui version.	EPT RECEIVED	
Charge status: Not available	EPT_RX_OVER CURRENT	
charge status. Hitor available	COIL OVER TEMPERATURE	
	TRANSCEIVER OVER TEMPERATURE	
	EPT CHARGE COMPLETE	
Test	EPT OVER VOLTAGE	
	EPT BATTERY FAILLURE	
Test number:	RX PACKET ERROR	
Start Stop	RECONFIGURE	
State Stop	NO RESPONSE	
Status: Test done	FOREIGN OBJECT DETECTED	
	CUSTOM ERROR	
	TX_OVER_CURRENT	
STWRC - Wireless Battery Charger	RESERVED 1	
sinter inners securit sherger	RESERVED 2	
	RESERVED 3	
	200	
		Clear

At the end of the test, in the protocol window, the AUTOCAL\_TEST\_DONE is set and in the test window the status is **Test Done**.

Figure 43: STSW-STWBCGUI: test result					
STWBC Qi	Sur Protocol				
Setup Test	Log window mode				
Transmitter state       Connected         Objet       Gio       Data TX       Power         Protocol window       Monitor window       Param window       Power         Protocol window       Monitor window       Param window       Param window         Receiver informations:       Monitor window       Param window       Param window         Device ID:       Device ID:       Device ID:       Device ID:         Gi version:       Charge status:       Not available:         Test       Status:       Test       Status:         Itstus:       Test       Status:       Status:         Status:       Test       Status:       Status:         Status:       Test       Status:       Stop         Status:       Test       Status:       Status:         StWBC - Wireless Battery Charger       StWBC - Wireless Battery Charger	Q communication warnings PINS TIMEOUT RX REMOVED BAD PACKET SQUENCE POWER CTR.I HOLD OFF ERROR PACKET TIMEOUT POWER TRAINSFER CTR.I ERROR CONTROL ERROR TIMEOUT VBUS DROP DOWN OPTIONAL PACKETS MISMATCH OCHORNEL TRAINSFER CTR.I ERROR COLL OVER, TEMPERATURE EPT RECEIVED EPT CALVER CURRENT COLL OVER, TEMPERATURE EPT ONER CURRENT COLL OVER, TEMPERATURE EPT ONER CURRENT RANSCEIVER OVER, TEMPERATURE EPT ONER COMPLETE BPT ONER VOLTAGE EPT CALVER, CURRENT RX PACKET BRROR RX PACKET BRRON RX PACKET	Clear			

<sup>3</sup> Start the test again if the returned status is different.

#### 5.2.2 QFOD calibration procedure

- 1 Set the test number to 2
- 2 Click the **Start** button

	Frotocol	_ <b>_</b> ×
Setup Test	C Log window mode	
Transmitter state       Connected         Objet       Qi         detected       Data TX         Protocol window       Monitor window         Param window       Param window         Beceiver informations       Monitor window         Device ID:       Device ID:         Qi version:       Charge status:         Charge status:       Not available         Test       Stop         Status:       Stop         Intercoorgenometroe       STWBC - Wireless Battery Charger	QI communication warnings ALTOCAL_TEST_DONE PINTOCAL_TEST_DONE PINTOCAL_TEST_DONE PINTOCAL_TEST_DONE PINTOCAL_TEST_DONE BAD PACET SEQUENCE TOO MANY PROPRIETARY PAACETS POWER CTRL HOLD OFF ERROR PACKET TIMEOUT POWER CTRL HOLD OFF ERROR CONTROL ERROR TIMEOUT RECTIFIED POWER TIMEOUT CHCKSUM ERROR ET RECORFICE ET RATORE COMPLETE COLL OVER TEMPERATURE TRANSCELVER OVER TIMEORATURE TRANSCELVER OVER TIMEORATURE ET CHARGE COMPLETE RROR RROR FOREIGN DIBLECT DETECTED CUSTOM ERROR FOREIGN DIBLECT DETECTED CUSTOM ERROR TX_OVER_CURRENT RESERVED 1 RESERVED 3	
	C	ear

At the end of the test, in the protocol window, the AUTOCAL\_TEST\_DONE is set and in the test window the status is **Test Done**.



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Setup       Test         Test       Test         Test       Start         Start       Stop	📅 STWBC Qi 📃 💻 🗙	Frotocol	>
Transmitter state       Connected         Objet       Qi         Objet       Qiata TX         Protocol window       Data TX         Protocol window       Param window         Param window       Param window         Param window       Param window         Device ID:       COUTOWER TRANSPACITIER         Qi version:       Coll Over Renorm         Qi version:       Coll Over Temperature         Test number:       Z         Start:       Stop         Start:       Stop	etup Test	Log window mode	
	Transmitter state Transmitter state Transmitter state Transmitter state Transmitter state Transmitter state Test Test Test Test Test Test Test Te	Qi communication warnings PING TIMEOUT RX REMOVED BAD PACKET SEQUENCE TOO MANY PROPRIETARY PACKETS POWER TRANSFER CTRL ERROR POWER TRANSFER CTRL ERROR POWER TRANSFER CTRL ERROR CONTROL REACT WEUS BRORG TIMEOUT RECTIFIED POWER TIMEOUT RECTIFIED POWER TIMEOUT CONTROL REACKETS MISMATCH CHCOSUME REROR EPT RACKETS MISMATCH COLI OVER TEMPERATURE EPT CHAREC COMPLETE EPT OHAREC COMPLETE EPT OHAREC COMPLETE EPT BATTERY FAILLIRE RX PACKET ERROR RECONFIGURE NO RESPONSE	
STWBC - Wireless Battery Charger RESERVED 1 RESERVED 2 RESERVED 3	STWBC - Wireless Battery Charger	FOREIGN OBJECT DETECTED CUSTOM ERROR TX_OVER_CURRENT RESERVED 1 RESERVED 2 RESERVED 3	

<sup>3</sup> Start the test again if the returned status is different.

### 5.3 Efficiency

Efficiency measurements are performed on a Qi certification tester.

The STEVAL-ISB044V1 transmitter is supplied by 12 V/2 A and the receiver voltage level is 12 V (MP1B).

 $P_{\text{OUT}}$  is the output power actually measured at the receiver output (not only at the rectifier output) and  $P_{\text{IN}}$  is the input power.

Efficiency is measured with a setup configuration as per the picture below.



The figure below shows the typical performance on different coils (efficiency=P<sub>OUT</sub>/P<sub>IN</sub>).







The maximum efficiency is 82.2% at 7 W.

### 5.4 Stand-by consumption

In stand-by, when the board is supplied at 12 V, very low power consumption is achieved.

In this mode, device detection is still ensured; power consumption is reduced down to 1.4 mA average.

The STEVAL-ISB044V1 evaluation board has a low stand-by power of only 17 mW.

To measure this low power consumption, the UART cable must be unplugged.



### 6 Schematic diagram





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#### Figure 54: STEVAL-ISB044V1 circuit schematic (7 of 8)



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### 7 Bill of materials

Table 6: STEVAL-ISB044V1 bill of materials

ltem	Q. ty	Ref.	Part/Value	Description	Manufacturer	Order code
1	2	C100, C114	NP, 0603	Ceramic capacitors	Any	C_NP_0603
2	2	C101, C103	10 μF, 25 V, 1206, ±20%	Ceramic capacitors	Wurth Elektronik	885012108021
3	1	C102	NP, 1210	Ceramic capacitor	Any	C_NP_1210
4	4	C104, C108, C212, C507	10 NF, 50 V, 0402, ±15%	Ceramic capacitors	Any	10NF_50V_X7R_0402
5	4	C106, C204, C208, C217	22 μF, 25 V, 1210, ±20%	Ceramic capacitors	Wurth Elektronik	885012109014
6	8	C107, C110, C115, C306, C500, C501, C502, C509	100 NF, 25 V,0402, ±15%	Ceramic capacitors	Any	100NF_25V_X5R_0402
7	4	C109, C116, C200, C211	NP, 0402	Ceramic capacitors	Any	C_NP_0402
8	1	C111	10 μF, 10 V, 0805, ±10%	Ceramic capacitor	Murata	GRM21BR71A106KE51L
9	4	C112, C113, C510, C512	100 NF, 50 V, 0402, ±15%	Ceramic capacitors	Any	100NF_50V_X5R_0402
10	1	C117	NP, 0603	Ceramic capacitor	Murata	GRM188R61E105KA12J
11	1	C202	100 NF, 50 V, 0603, ±5%	Ceramic capacitor	Murata	GRM188R71H104KA93D
12	2	C203, C207	10 μF, 50 V, 1206, ±10%	Ceramic capacitors	Any	10UF_50V_X5R_1206
13	1	C205	100 μF, 35 V, ±20%	Aluminium capacitor	Panasonic	EEEFT1V101AP
14	1	C206	5.6 NF, 50 V, 0402, ±15%	Ceramic capacitor	Any	5.6NF_50V_X7R_0402
15	1	C209	1 NF, 50 V, 0402, ±15%	Ceramic capacitor	Any	1NF_50V_X5R_0402



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ltem	Q. ty	Ref.	Part/Value	Description	Manufacturer	Order code
16	1	C213	10 PF, 50 V, 0402, ±15%	Ceramic capacitor	Any	10PF_50V_X7R_0402
17	2	C214,C21 5	220 NF, 35 V, 0603, ±15%	Ceramic capacitors	Any	220NF_35V_X7R_0603
18	1	C216	470pF, 50V,15%	Ceramic capacitor	Any	470pF_50V_COG_402
19	4	C300, C301, C302, C304	47 NF, 100 V, 1206, ±5%	Ceramic capacitors	TDK	C3216C0G2A473J115AC
20	1	C303	1 NF, 50 V, 0603, ±15%	Ceramic capacitor	Any	1NF_50V_X5R_0603
21	1	C305	10 μF, 6.3 V, 0805, ±15%	Ceramic capacitor	Any	10UF_6V3_X5R_0805
22	2	C307, C505	22 NF, 50 V, 0402, ±15%	Ceramic capacitors	Any	22NF_50V_X7R_0402
23	1	C308	470 PF, 50 V, 0402, ±15%	Ceramic capacitor	Any	470PF_50V_X7R_0402
24	1	C309	470 NF, 25 V, 1206, ±15%	Ceramic capacitor	Any	470NF_25V_X7R_1206
25	1	C310	1.5 NF, 50 V, 0402, ±10%	Ceramic capacitor	Any	1.5NF_50V_X7R_0402
26	1	C400	10 NF, 100 V, 0805, ±5%	Ceramic capacitor	ТDК	C2012C0G2A103J125AA
27	1	C401	22 NF, 100 V, 1210, ±5%	Ceramic capacitor	ТDК	C3225C0G2A223J160AA
28	1	C402	100 PF, 50 V, 0402, ±5%	Ceramic capacitor	Any	100PF_50V_COG_0402
29	2	C403, C513	22 PF, 50 V, 0402, ±5%	Cer,402	Any	22PF_50V_COG_0402
30	1	C404	4.7 NF, 50 V, 0402, ±15%	Ceramic capacitor	Any	4.7NF_50V_X7R_0402
31	1	C405	220NF, 50V,10%	Ceramic capacitor	Any	220NF_50V_X7R_0402
32	1	C406	4.7 NF, 100 V, 0603, ±10%	Ceramic capacitor	ТDК	CGA3E2X7R2A472K080 AA
33	1	C503	1 μF, 16 V, ±10%	Ceramic capacitor	Any	1UF_16V_X5R_0402
34	2	C504, C506	1 NF, 100 V, 0402, ±15%	Ceramic capacitors	Any	1NF_100V_X7R_0402
35	1	C508	2.2 μF, 25 V, 0402, ±10%	Ceramic capacitor	Any	2.2UF_25V_X5R_0402
36	1	C511	220 PF, 50 V, 0402, ±15%	Ceramic capacitor	Any	220PF_50V_X7R_0402



Bill of materials

Item	Q. ty	Ref.	Part/Value	Description	Manufacturer	Order code
37	1	C514	2.2 NF, 50 V, 0402, ±15%	Ceramic capacitor	Any	2.2NF_50V_X7R_0402
38	3	C801, C803, C807	100 NF, 50 V, 0603, ±15%	Ceramic capacitors	Any	100NF_50V_X7R_0603
39	1	C802	10 NF, 50 V, 0603, ±15%	Ceramic capacitor	Any	10NF_50V_X7R_0603
40	2	C804, C805	47 PF, 25 V, 0603, ±15%	Ceramic capacitors	Any	47PF_25V_X5R_0603
41	1	C806	10 μF, 25 V, 0805, ±10%	Ceramic capacitor	Any	10UF_25V_X7R_0805
42	1	D100	SMM4F13A	TVS	ST	SMM4F13A-TR
43	1	D201	STPS8L30DEE	Power Schottky rectifier	ST	STPS8L30DEE-TR



### 8 Board assembly and layout

The STEVAL-ISB044V1 evaluation board is designed using a low cost 2-layers PCB with all the components on the top side.

The test points allow the user to evaluate the STWBC-EP solution with probes.

In addition, UART is accessible through a micro-USB connector and the SWIM is routed to a header connector.







## 8.1 Power signals (BOOST, GND, LC)



DC-DC boost signals are designed on the same layer: tracks must be wide (>2 mm) to handle high current.





Figure 59: STEVAL-ISB044V1 evaluation board: DC-DC boost routing details

Bridge nets are designed on the top layer; traces must be very large (>2 mm).

GND from R307: connected near GND from " GND VBOOST"

C300 4

Чŀ 12 | 47N 304 II<sup>47N</sup>





Figure 61: STEVAL-ISB044V1 evaluation board: bridge node routing details



Figure 62: STEVAL-ISB044V1 evaluation board: shunt resistor routing details

### 8.2 EMI components



Ceramic capacitors (C100, C101, C103, C112, C114 and C100) for EMI and filters must be placed close to the supply input and L101.



Figure 64: STEVAL-ISB044V1 evaluation board: EMI components (2 of 2)

#### **STWBC-EP** layout 8.3





8.4





### 9 References

Freely available on www.st.com:

- 1. STWBC-EP datasheet
- 2. STEVAL-ISB044V1 data brief (DB3408): "Qi MP-A10 15 W wireless charger TX evaluation kit based on STWBC-EP"
- 3. STSW-ISB044FW data brief (DB3409): "Firmware for the STEVAL-ISB044V1 wireless power transmitter evaluation board based on STBWC-EP"
- 4. STSW-STWBCFWDT data brief (DB3410): "STWBC firmware downloader tool"
- 5. STSW-STWBCGUI data brief (DB3418): "Graphical user interface for wireless power transmitter evaluation boards based on the STWBC chip family"



### 10 Revision history

Table 7: Document revision history

Date	Version	Changes
30-Oct-2017	1	Initial release.



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