UM1861
User manual

Qi A11 wireless charger transmitter evaluation board based on STWBC

Introduction

The following describes the operation of the STEVAL-ISB027V1 Qi A11 wireless power transmitter evaluation board. The STEVAL-ISB027V1 is a certified reference design based on the Qi A11 wireless power consortium (WPC) standard version 1.1.2, and supports FOD (foreign object detection).

The transmitter is compatible with all Qi-compatible receivers, such as those already available in Qi-enabled mobile phones. Receivers with both resistive or capacitive modulation are supported.

In accordance with the Qi A11 topology, the STEVAL-ISB027V1 supports a 5 V input and a full bridge stage with both frequency and duty cycle control. The STEVAL-ISB027V1 features the STWBC controller, which integrates all the functions required to drive and monitor the transmitter.

STWBC supports UART connectivity to a PC and thanks to the STEVAL-ISB027V1 graphical interface, it is possible to monitor the behavior of the transmitter in real-time.

The STEVAL-ISB027V1 reference design provides a complete kit which includes the STWBC, firmware, layout, graphical interfaces and tools. The layout is based on a cost-effective 2-layer PCB.

This user manual explains the STEVAL-ISB027V1 hardware and software installation, as well as details on the evaluation of the board and the GUI interface.

Figure 1: STEVAL-ISB027V1 evaluation board

Contents

1 Getting started

1.1 System requirements

In order to use the STEVAL-ISB027V1 board with the GUI, a PC with the Microsoft® Windows® operating system must be used. The GUI (graphical user interface) works with Microsoft Windows XP® or later and NET Framework 4.

The connection between the PC and the board is made through a USB-to-UART cable.

1.2 Package contents

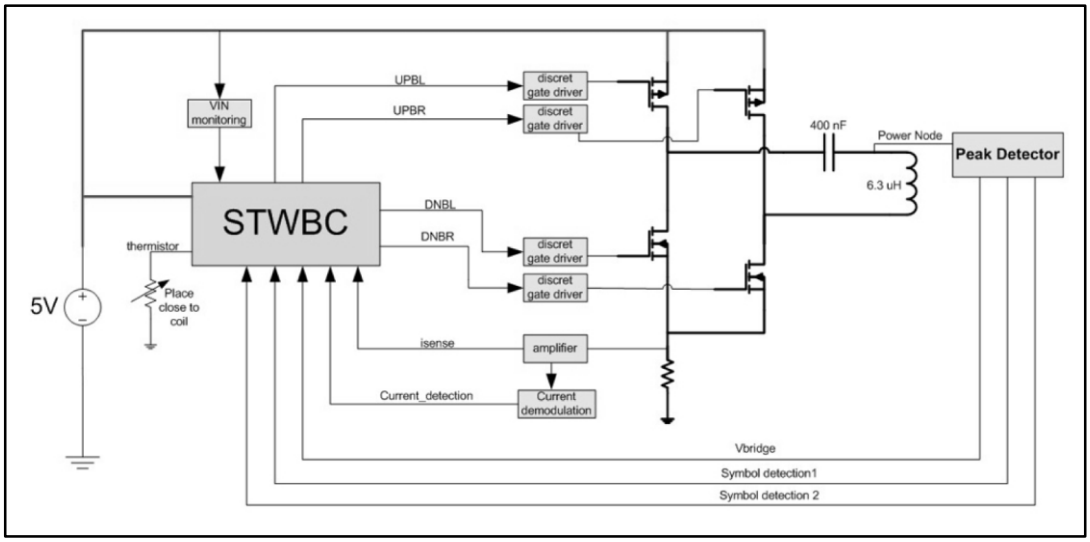
To be used, the STEVAL-ISB027V1 evaluation board requires the following items:

- Hardware:
  - STEVAL-ISB027V1 board
  - ST-LINK/V2 in-circuit debugger/programmer with single wire interface module (SWIM), available for download from www.st.com.
  - USB to UART interface cable with 3.5 mm jack connection TTL-232R-5V-AJ
- Software:
  - ST-LINK USB driver
  - STVP programming tool from STMicroelectronics (integrated into STVD tools)
  - FTDI VCP driver http://www.ftdichip.com/Drivers/VCP.htm
  - PC GUI installation package
- Documentation:
  - User manual

2 Hardware description and setup

2.1 System block diagram

Figure 2: Block diagram



2.2 STEVAL-ISB027V1 wireless transmitter board

The STEVAL-ISB027V1 board has the following features:

- WPC Qi 1.1.2 certified
- Standard Qi A11-type transmitter and coil
- Resistive and capacitive modulation
- Foreign object detection (FOD)
- LEDs for charge status indication
- UART connection for user interface
- SWIM connection for firmware download
- 5 V power supply

Table 1: STEVAL-ISB027V1 electrical performance

Parameter	Description	Notes and conditions	Min.	Typ.	Max.	Unit
Input characteristics						
V_{IN}	Input voltage		4.75	5	5.5	V
	Recommended input voltage	Measured on board power supply connector		5		V
I_{IN}	Input current	V_{IN} nominal, I_{OUT} = Max		1.5	2.5	A
	Input no-load current			-		mA
	Input standby current			0.70		mA
System characteristics						
FS	Switching frequency	Depends on Rx load	110		205	kHz
Duty cycle @ 205kHz	Duty cycle modulation	Only for FS= 205 kHz	10	50		%
ηPk	Peak efficiency	V_{IN} = 5 V, P Out Rx= 4 W		71		%

Parameter	Description	Notes and conditions	Min.	Typ.	Max.	Unit
Input characteristics						
η	Full load efficiency	V_{IN} = 5 V, RX_Power= 5 W			70	%

Figure 3: STEVAL-ISB027V1 Qi A11 evaluation board

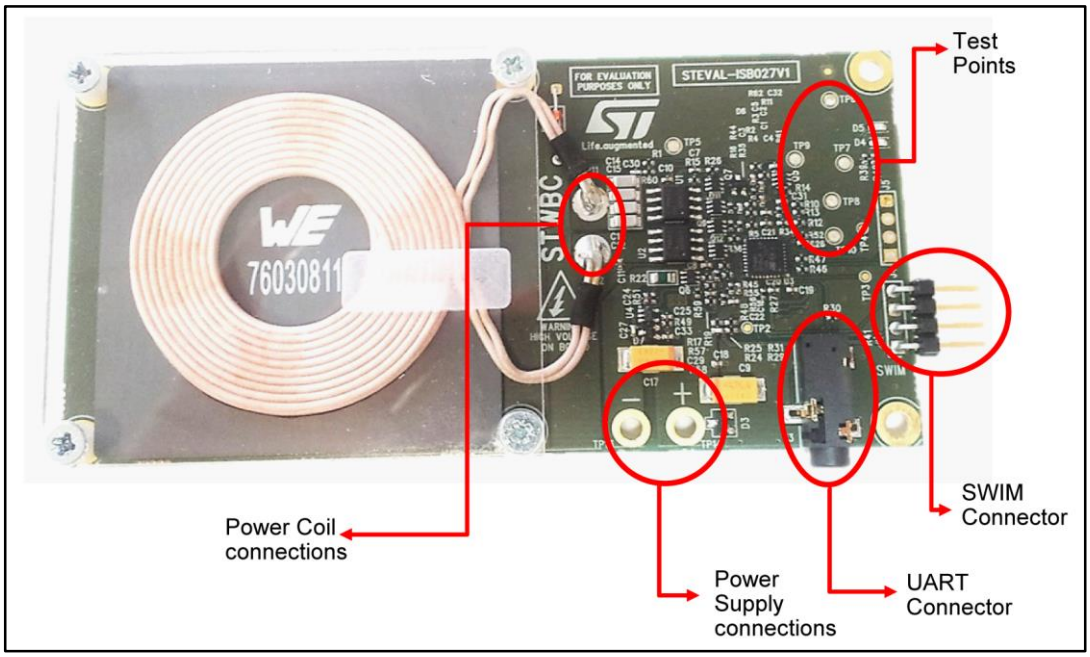


Figure 4: Board reference designators

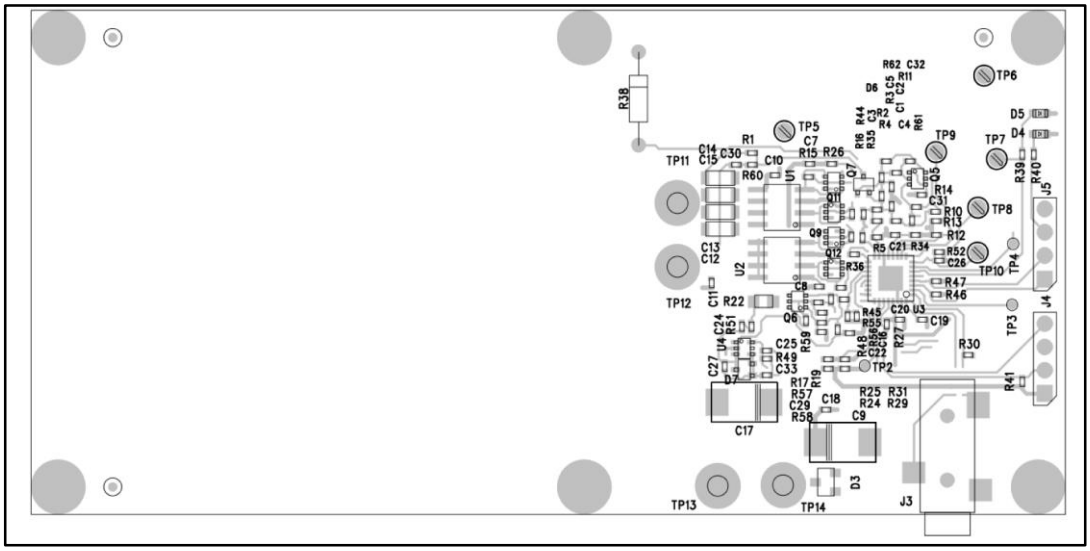


Table 2: Connector description

Test point reference	Description
J3	UART jack connector used for the GUI
J4	SWIM connector used for download
J5	I^2C connector not mounted

Table 3: Test points

Test point reference	Signal	Description
TP2	DIGIN[2]	Digital input 2
TP3	PWM_AUX/GPIO_2	PWM output or GPO
TP4	LED_RED	Digital output for the red light indicator
TP5	GND	Ground
TP6	GND	Ground
TP7	GPIO_0	Digital output for the green light indicator
TP8	SYMBOL_DETECT1	Symbol detector 1
TP9	SYMBOL_DETECT2	Symbol detector 2
TP10	CURRENT_DEMOD	Symbol detector 3
TP11	POWER COIL +	Connection point for the power coil
TP12	POWER COIL -	Connection point for the power coil
TP13	SUPPLY_GND	Connection point for the power supply ground
TP14	SUPPLY_5V	Connection point for the power supply 5V voltage

2.3 STWBC pinout and pin description

The STWBC is a multifunction device that can support several wireless charging architectures. The pinout is therefore application specific. This section shows the pinout used by the STWBC when the Qi A11 configuration is used. *Table 4: "Pinout description"* describes the function of each pin in case of turn-key and custom firmwares.

Figure 5: STWBC in Qi A11 configuration

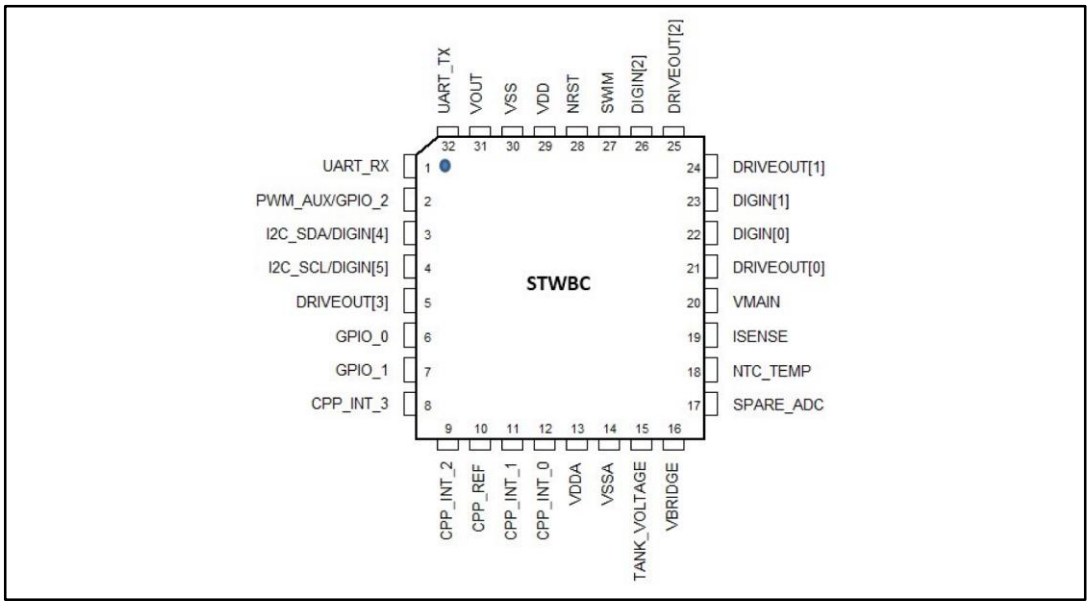


Table 4: Pinout description

Pin n°	Pin name	Pin type	Cust firmware description	Turnkey firmware description
1	UART_RX (1)	DI	UART RX link	UART RX link
2	PWM_AUX/GPIO_2 (1)	DO	PWM output or GPO	Not used, must not be connected to any potential
3	I2C_SDA/DIGIN[4] (1)		I2C_SDA / digital input 4	inactive (internal pull up)
4	I2C_SCL/DIGIN[5] (1)		I2C_SCL / digital input 5	inactive (internal pull up)
5	DRIVEOUT[3]	DO	Output driver for low side branch right	Output driver for low side branch right
6	GPIO_0 (1)	DO	Digital output for the green light indicator / General purpose I/O	Digital output for the green light indicator
7	GPIO_1 (1)	DO	Digital output for the red light indicator / General purpose I/O	Digital output for the red light indicator
8	CPP_INT_3	AI	Symbol detector	Symbol detector
9	CPP_INT_2	AI	Vmain monitor	Vmain monitor
10	CPP_REF	AI	External reference for CPP_INT_3 (if not used, must be tied to GND)	External reference for CPP_INT_3 (if not used, must be tied to GND)
11	CPP_INT_1	AI	Symbol detector	Symbol detector
12	CPP_INT_0	AI	Symbol detector	Symbol detector
13	VDDA	PS	Analog power supply	Analog power supply
14	VSSA	PS	Analog ground	Analog ground
15	TANK_VOLTAGE	AI	LC tank voltage probe	LC tank voltage probe
16	VBRIDGE		inactive (to be tied to GND)	inactive (to be tied to GND)
17	SPARE_ADC (1)		Spare analog input (to be tied to GND if not used)	Spare analog input (to be tied to GND)
18	NTC_TEMP	AI	NTC temperature measurement	NTC temperature measurement
19	ISENSE	AI	LC tank current measurement	LC tank current measurement
20	VMAIN	AI	Vmain monitor	Vmain monitor
21	DRIVEOUT[0]	DO	Output driver for low side branch left	Output driver for low side branch left
22	DIGIN[0] (1)		Digital input 0	Inactive (internal pull up)
23	DIGIN[1] (1)		Digital input 1	Inactive (internal pull up)
24	DRIVEOUT[1]	DO	Output driver for high side branch left	Output driver for high side branch left
25	DRIVEOUT[2]	DO	Output driver for high side branch right	Output driver for high side branch right
26	DIGIN[2] (1)		Digital input 2	Inactive (internal pull up)
27	SWIM	DIO	Debug interface	Debug interface
28	NRST	DI	Reset	Reset

Pin n°	Pin name	Pin type	Cust firmware description	Turnkey firmware description
29	VDD	PS	Digital and I/O power supply	Digital and I/O power supply
30	VSS	PS	Digital and I/O ground	Digital and I/O ground
31	VOUT	Supply	Internal LDO output	Internal LDO output
32	UART_TX (1)	DO	UART TX link	UART TX link

Notes:

(1)API configurable

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

3 Software installation

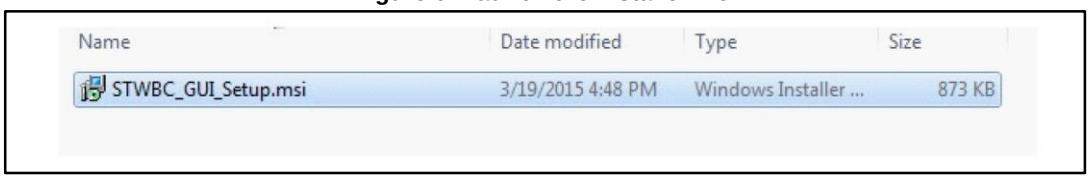
In order to download the firmware to the board, the GUI software must be installed. This software allows also the user to have a complete monitoring of the board.

In case of problem with the board, ST-LINK and STVP software can be installed in order to erase the flash of the STWBC.

3.1 STWBC GUI software installation

To install the GUI, launch the installer file.

Figure 6: Launch the installer file



To connect the wireless power transmitter board to the PC, a USB-to-UART cable must be used.

The first screen that will appear is shown in *Figure 7: "GUI start screen"*, where you are asked to choose your COM Port.

Figure 7: GUI start screen

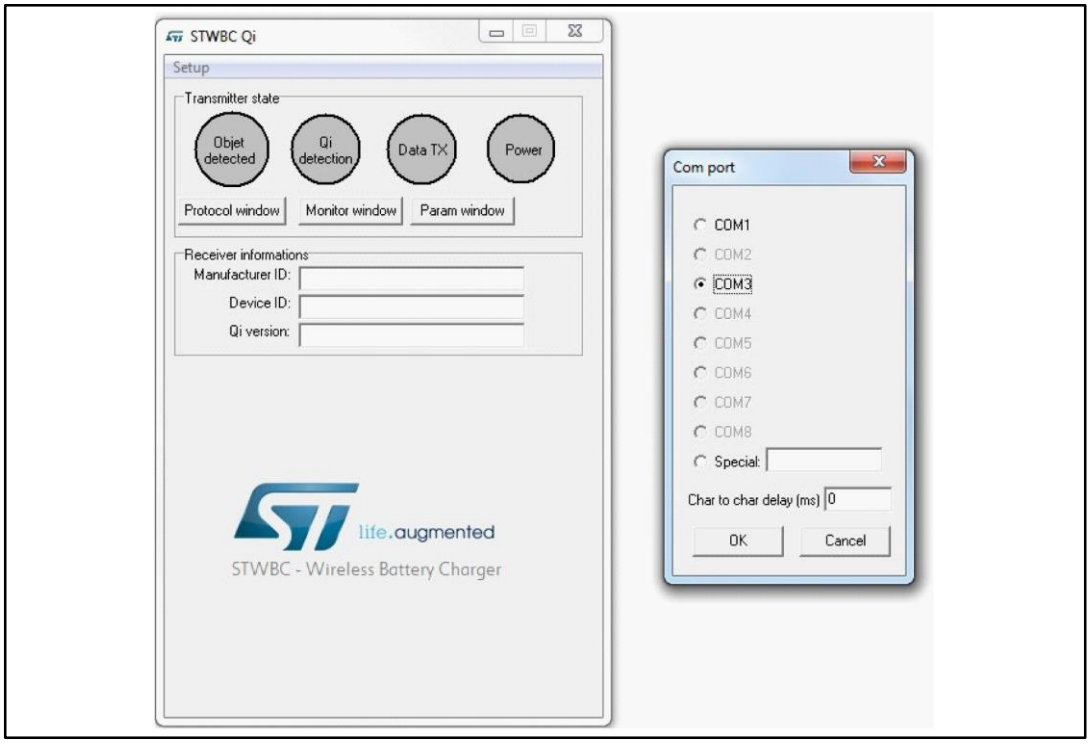
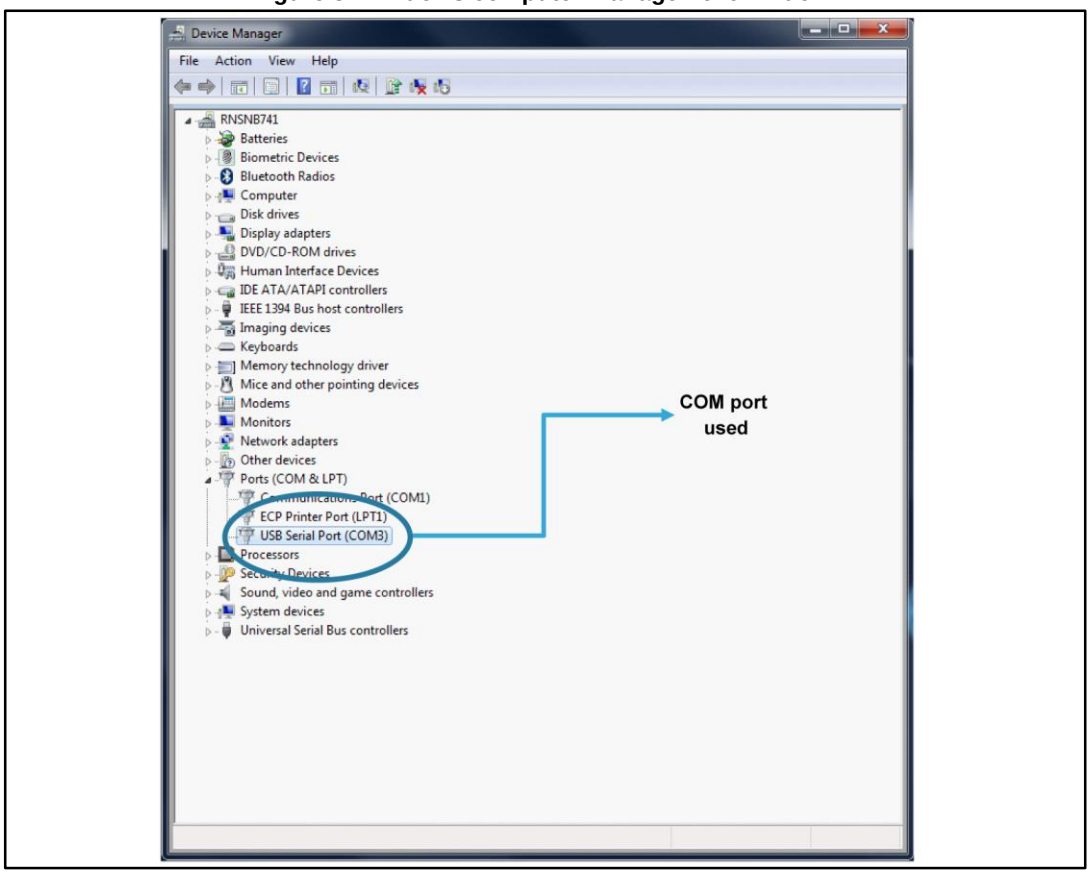
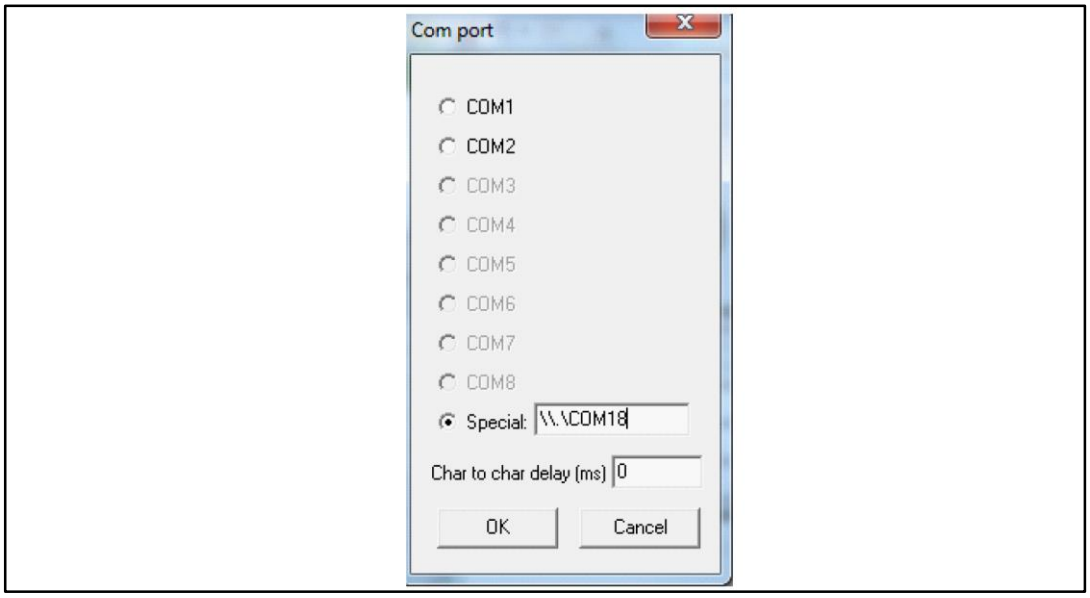


Figure 8: Windows computer management window



If the COM port number is higher than 8, the user needs to use a particular syntax: \\\\.\\COMx where COMx is the COM port number (see *Figure 9: "Specific COM port selection"*).

Figure 9: Specific COM port selection



Now select from GUI the correct COM port and press the "OK" button.

The GUI is ready to run.

3.2 Firmware download with STWBC GUI

This procedure describes the firmware download through UART using the STWBC GUI.

The Generic GUI includes the possibility to download a firmware through UART.

The download includes 3 files contained into a *.cab file

Here are the different steps to load the board with the firmware:

1. Power up the board and connect the UART cable
2. Click on Load FW to board 8 (see *Figure 10: "Firmware download with STWBC GUI"*)

Figure 10: Firmware download with STWBC GUI

1. Select the CAB file containing the Firmware to download (see*Figure 11: "Firmware file selection message"* and *Figure 12: "Firmware file selection"*)

Figure 11: Firmware file selection message

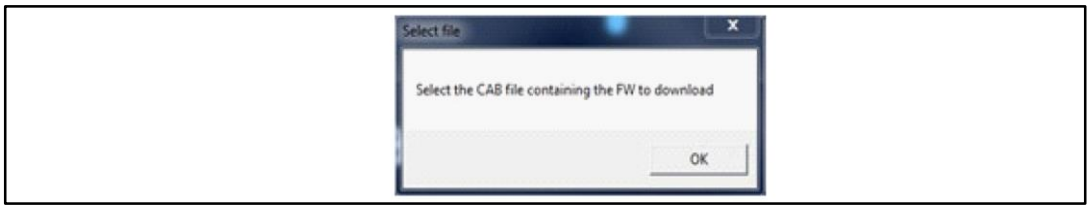
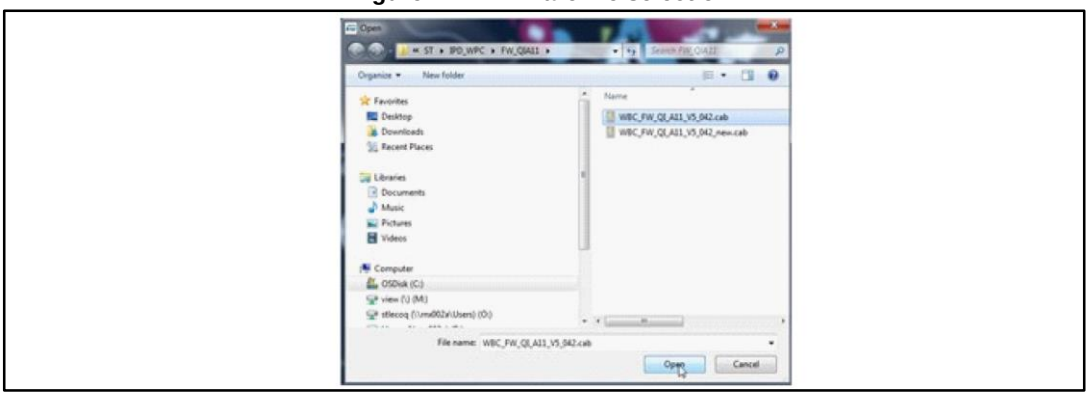


Figure 12: Firmware file selection



1. Power on the board and keep it powered (see *Figure 13: "Power on message"*)

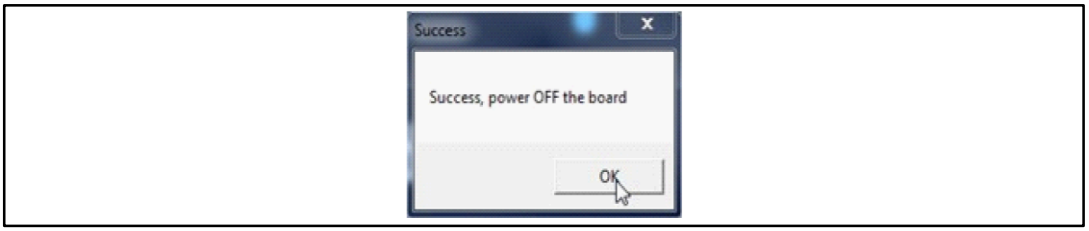
Figure 13: Power on message

1. Download in progress (see *Figure 14: "Download in progress dos window"*)

Figure 14: Download in progress dos window

1. A message indicated the success of the download (see *Figure 15: "Download success message"*)

Figure 15: Download success message



If the STWBC memory is erased, the sequencing of the procedure is a bit different. The user should first connect UART cable, then select load FW to board and power up the board in last step.

If the download need to be automatized, the following command can be used, starting from the STWBC GUI folder: C:\\Program Files (x86)\\STMicroelectronics\\STWBC GUI Version-X>STWBC_Loader.exe -com "COM number" -cab "Firmware name.cab" (see *Figure 16: "STWBC address"*)

Where:

- COM number" is the COM Port used by the STWBC GUI
- Firmware name.cab" is the name of the firmware with the .cab extension

Figure 16: STWBC address

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

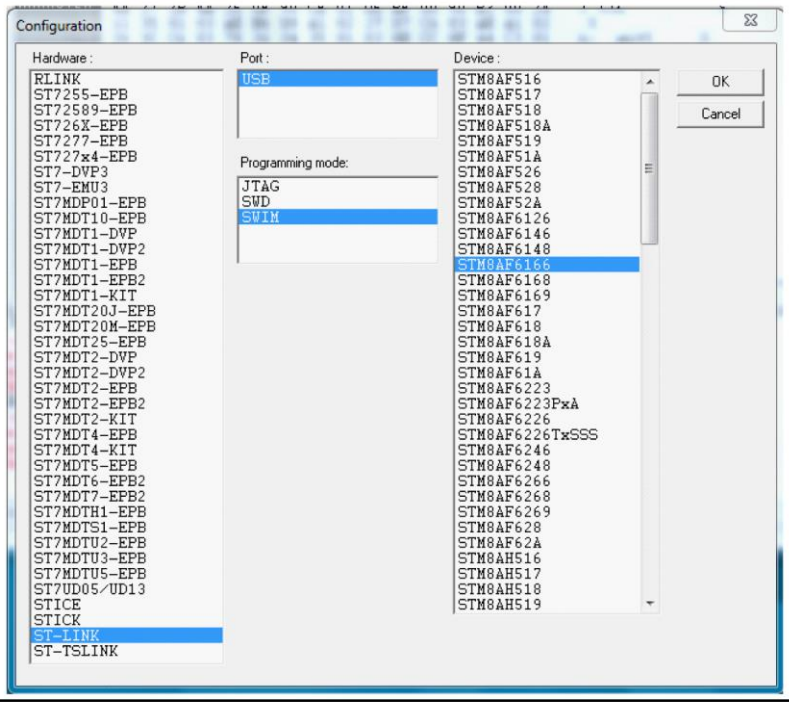
3.3 Firmware erasing with STVP

This procedure describes the firmware erasing procedure using STVP. It has to be used in case of problem on the STWBC board (e.g. firmware corruption, updating a firmware older than release 5.41,...)

3.3.1 Requirements

- ST-LINK USB Driver installed.
- STVP programming tool from STMicroelectronics installed.
- ST-LINK hardware tools (also used on IAR compiler)
- Configuration of STVP (see *Figure 17: "Configuration of STVP"*)

Figure 17: Configuration of STVP



3.3.2 Procedure

1. Target power off
2. Target power on
3. ST-LINK circuit connected to the computer by USB
4. Connect ST-LINK - SWIM cable with target. Be very careful to connect the SWIM cable in the correct way on the transmitter board, see pictures below (white strip towards the bottom) (see *Figure 18: "ST-LINK connection on the board"* and *Figure 19: "SWIM cable connection (zoomed)"*)

Figure 18: ST-LINK connection on the board

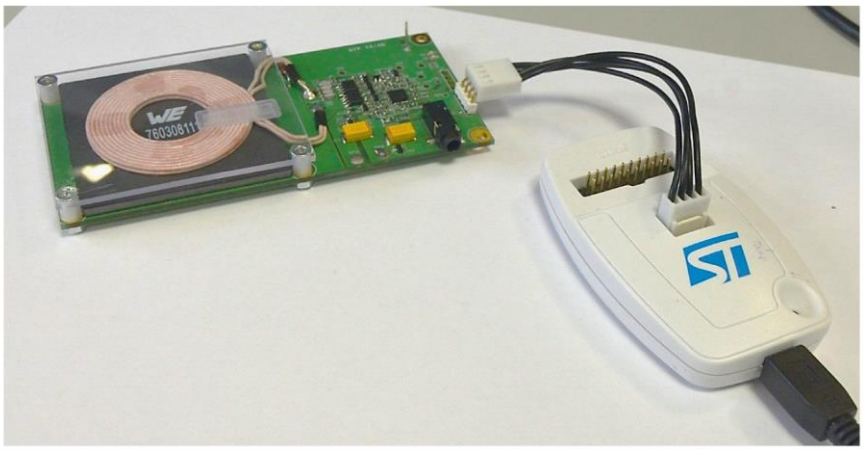
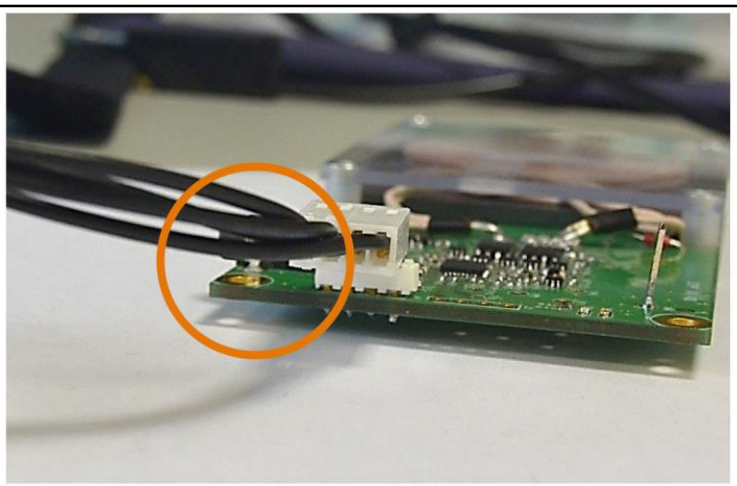
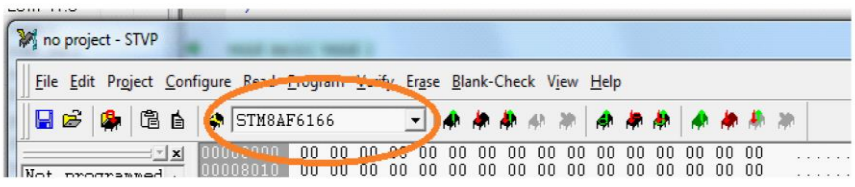


Figure 19: SWIM cable connection (zoomed)



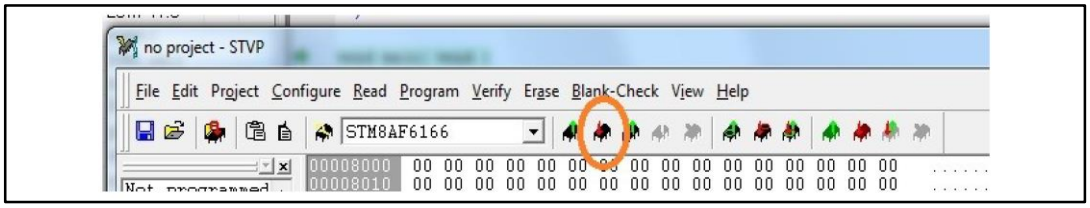
1. Launch STVP program
2. Select STM8AF6166 core (see *Figure 20: "STVP core selection"*)

Figure 20: STVP core selection



1. Do not load any program into Ram area of STVP program: all bits will be erased (load 00 00 00 …)
2. Transfers the "00 00" into STWBC through the SWIM interface using the appropriate push-button. (see *Figure 21: "STVP download"*)

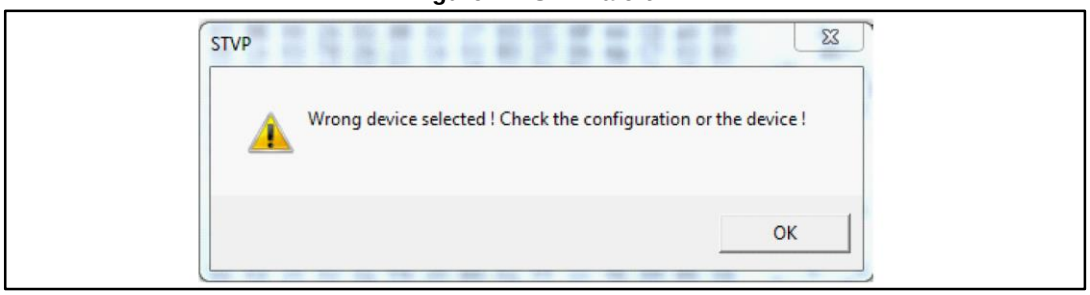
Figure 21: STVP download



During the program the STVP tools provides information about:

- Wrong device select (see *Figure 22: "STVP alert 1"*)

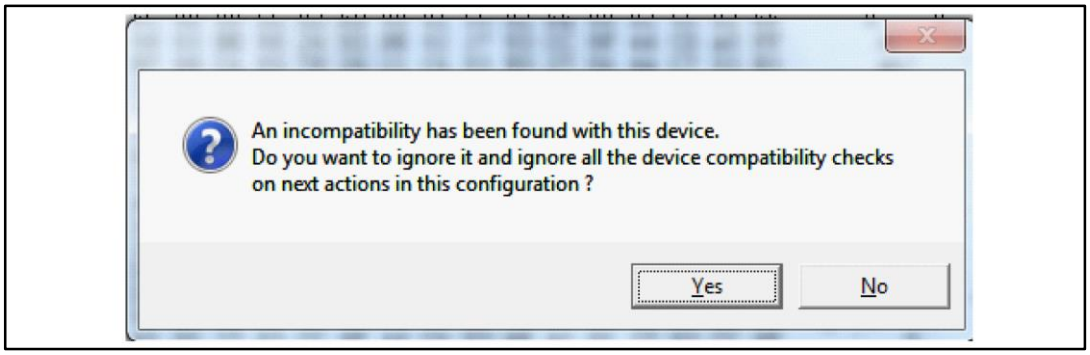
Figure 22: STVP alert 1



Select “OK” to continue.

- Any incompatibility found with the device (see *Figure 23: "STVP alert 2"*)

Figure 23: STVP alert 2



Select “Yes” to continue.

1. 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.
```

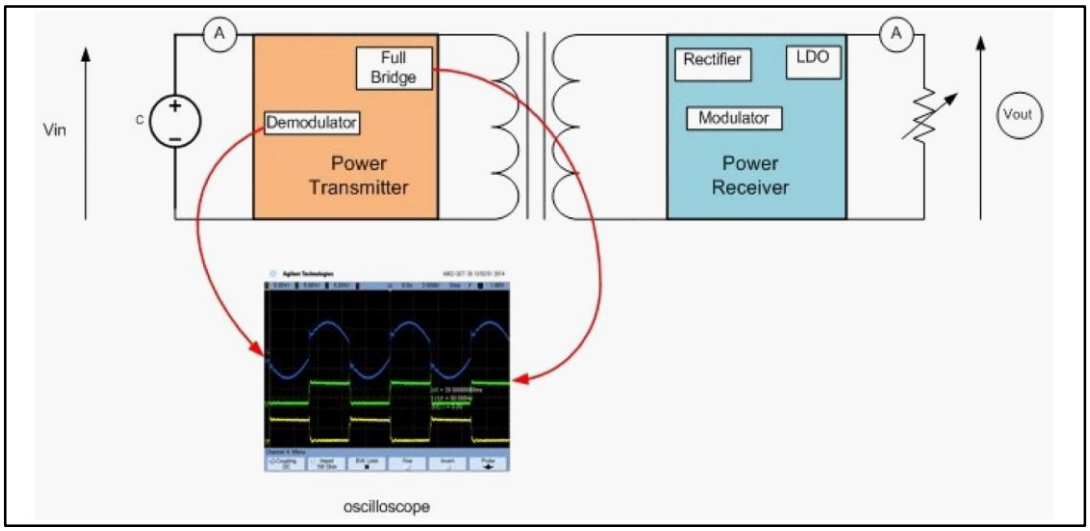
1. Exit from STVP
2. Disconnect SWIM
3. Power off the STEVAL-ISB027V1 board

That IAR Tool chain can also be installed for firmware compilation and download.

4 Evaluation setup equipment

Here is the block diagram of the setup configuration for the testing

Figure 24: Measurement setup



Board is powered with a power supply set to 5 V / 2 A.

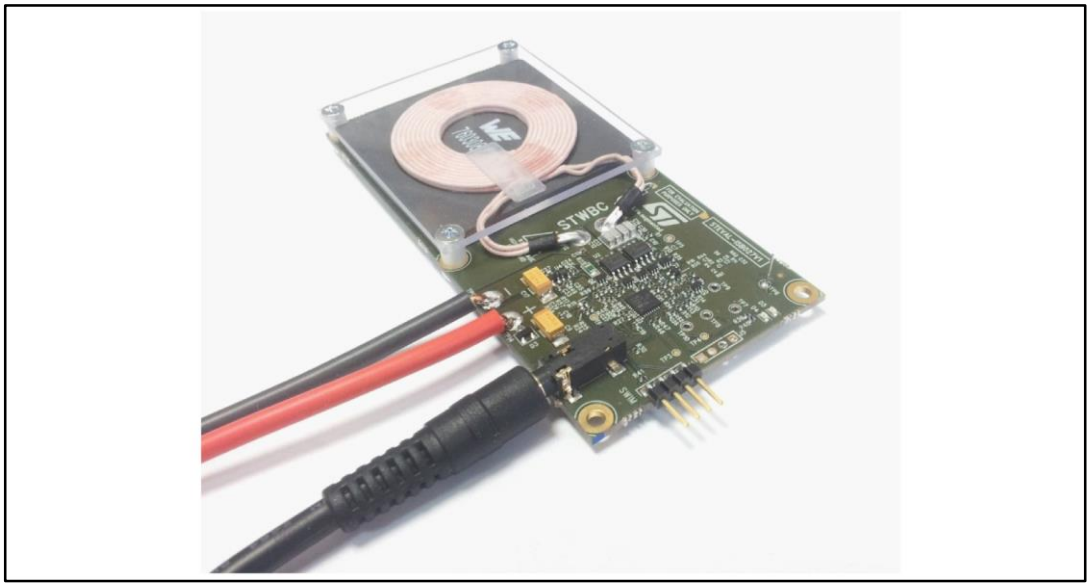
An electronic load able to draw 5 W is connected on the receiver output.

Voltmeters and ammeters to measure input and output currents and voltages.

GUI is installed on the PC which is connected to the board thanks to UART connector.

Oscilloscope to monitor mainly the power node voltage and the symbol detection signals.

Figure 25: UART connection



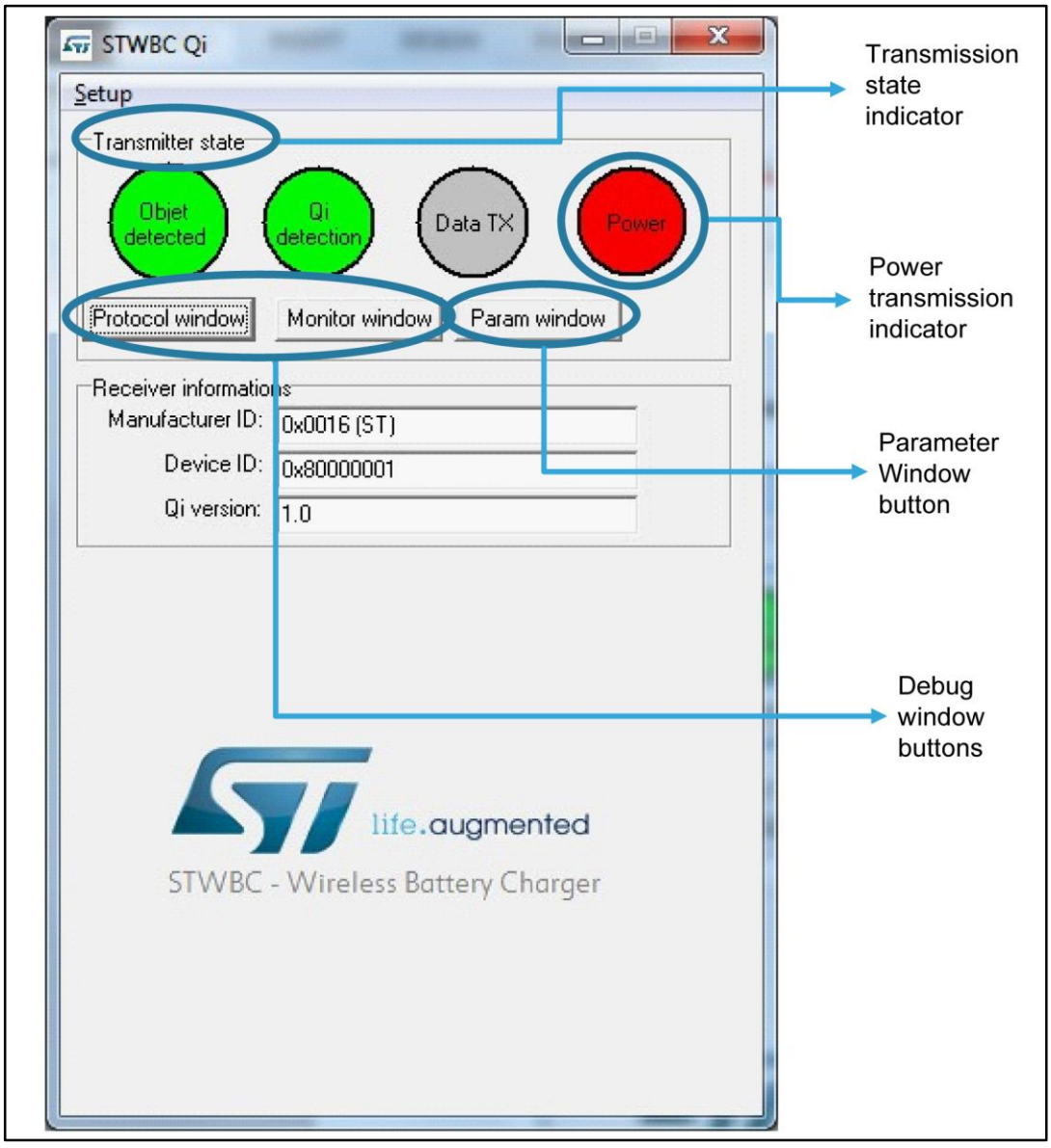
5 GUI and evaluation procedure

To install the GUI and connect the evaluation board, please refer to chapter 3.1 "GUI software installation".

The STWBC GUI offers complete monitoring of STWBC operation.

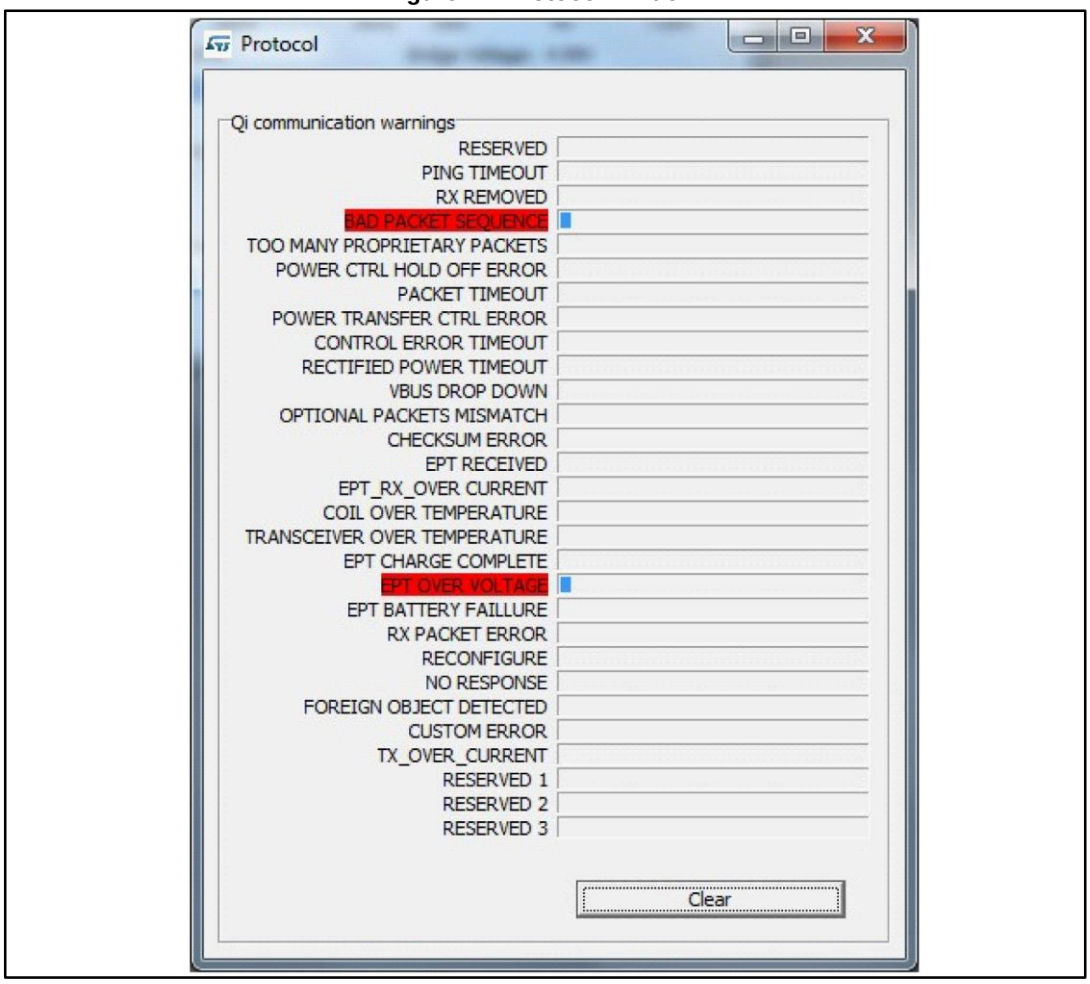
The main screen gives the status of the transmitter state and Qi receiver information (see *Figure 26: "Object detected and charge in progress"*).

Figure 26: Object detected and charge in progress



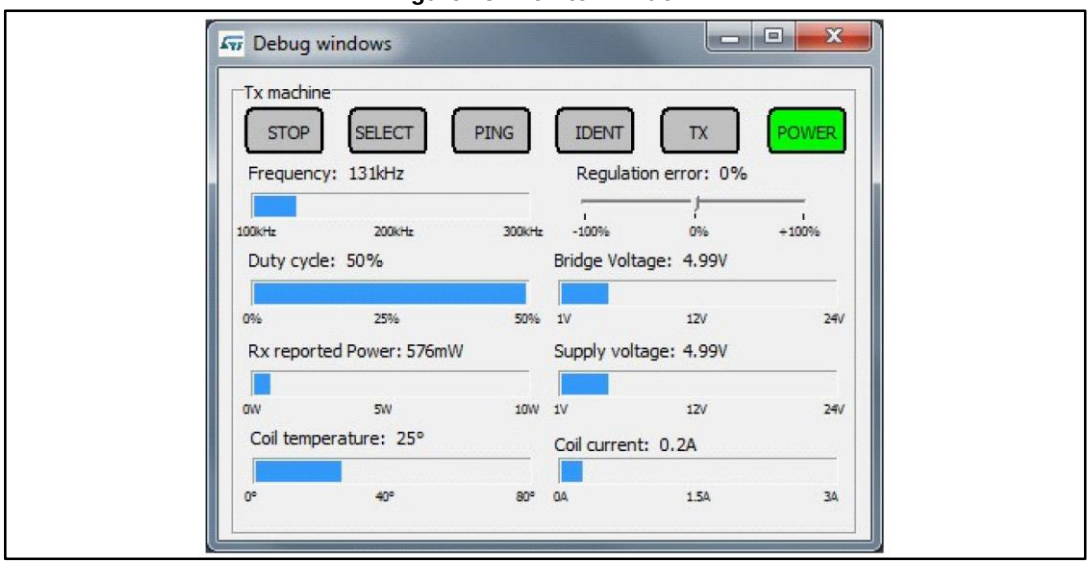
The STWBC GUI can also display the Rx to Tx communication protocol errors which is helpful for system debugging (see *Figure 27: "Protocol window"*).

Figure 27: Protocol window



On top of main state machine behavior, the user can monitor STWBC internal variables such as the operating frequency, the Rx reported power, the coil temperature, etc. (see *Figure 28: "Monitor window"*)

Figure 28: Monitor window

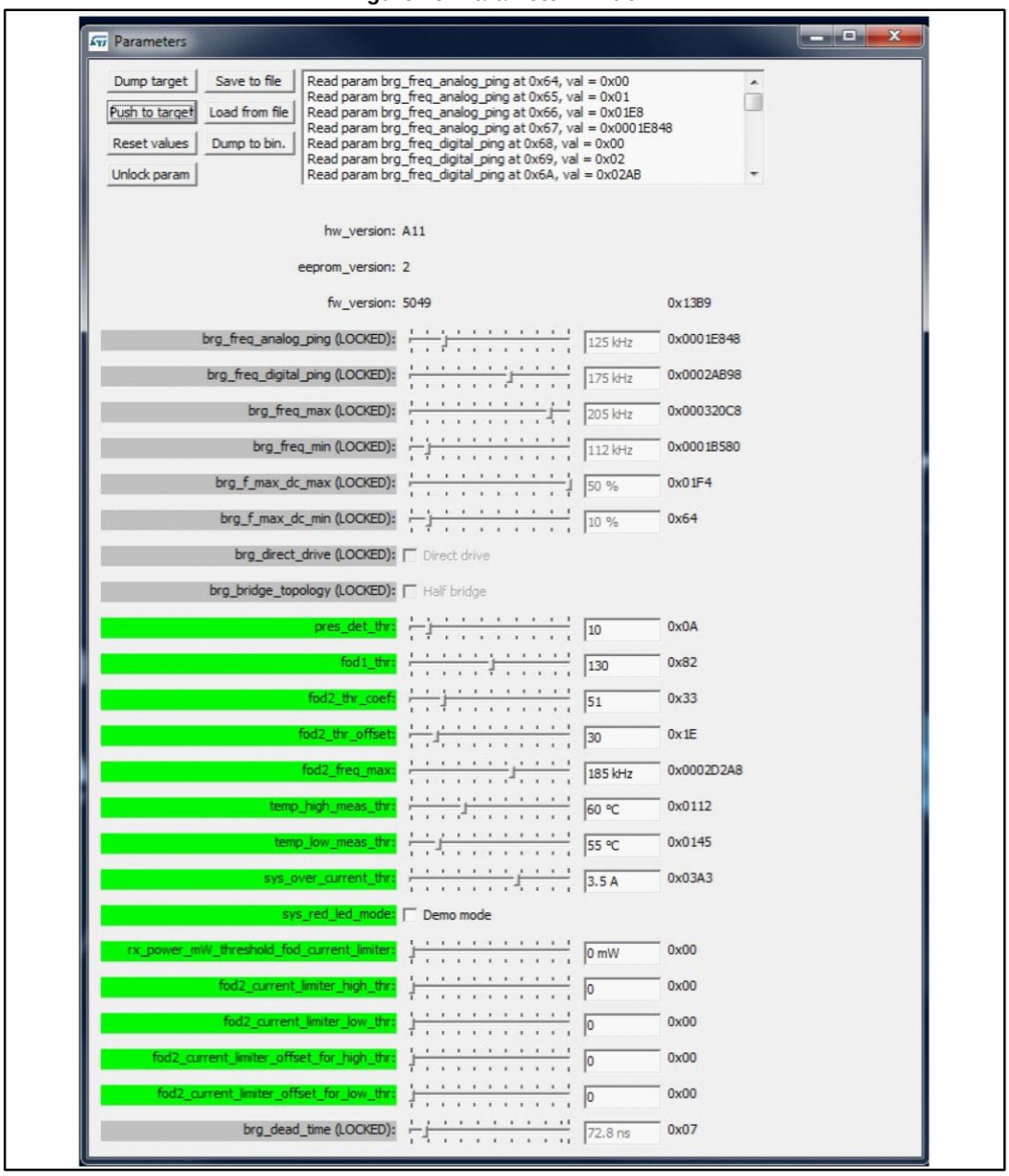


The STWBC GUI provides the interface to the STWBC tuning parameters. The user-friendly interface allows efficient system adjustment (frequencies, duty cycle, thresholds). The STWBC GUI provides ways to load/store parameters from/to the computer disk (see *Figure 29: "Parameter window"*).

There are 2 levels of protection for the parameters:

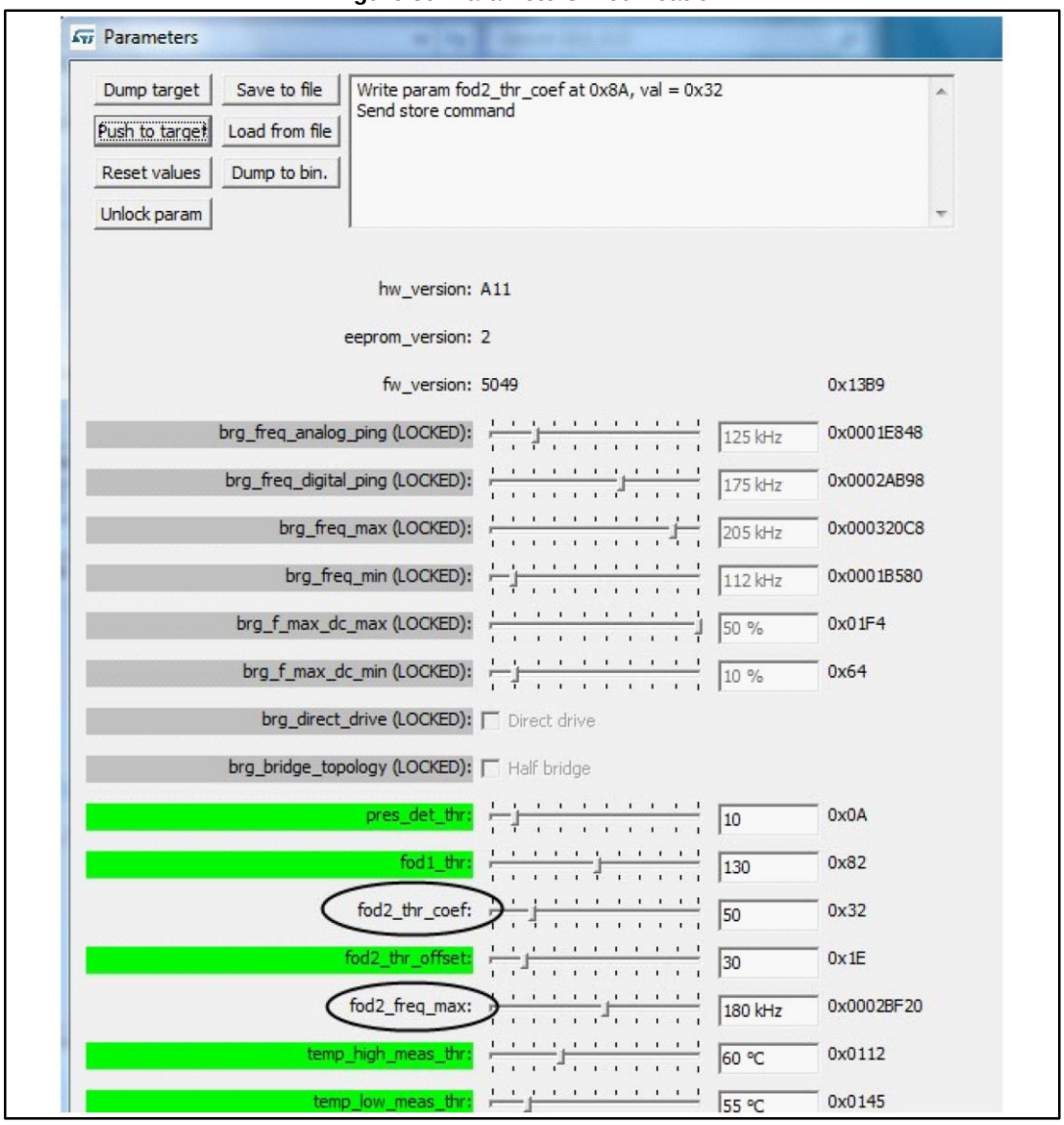
- Level 0: parameters can be modified without protection
- Level 1: more critical parameters that can be modified with caution. Click on "unlock param" button to be able to modify them. This can lead to system malfunction or generate behaviors incompatible with Qi standard. So the user should be very cautious when modify them.

Figure 29: Parameter window



New parameters can be tested straight away by clicking the button "push to target". The modified parameters are not colored anymore (see *Figure 30: "Parameters modification"*).

Figure 30: Parameters modification



As mentioned in firmware download chapter, the STWBC GUI embeds the interface to the STWBC FW downloader (which uses UART connection).

The STWBC GUI embeds tools allowing the generation of tuning parameters binary file and the modification of FW package to insert custom tuning parameters file.

The GUI allows us to change the parameters for producing a new cab which can then be used to program a batch of new boards.

In order to do this, the user should first dump the parameters to a bin file. Prior to this, be very careful to press the "push to target" button! (see *Figure 31: "Dump to bin file button"* and *Figure 32: "Bin file backup"*)

Figure 31: Dump to bin file button

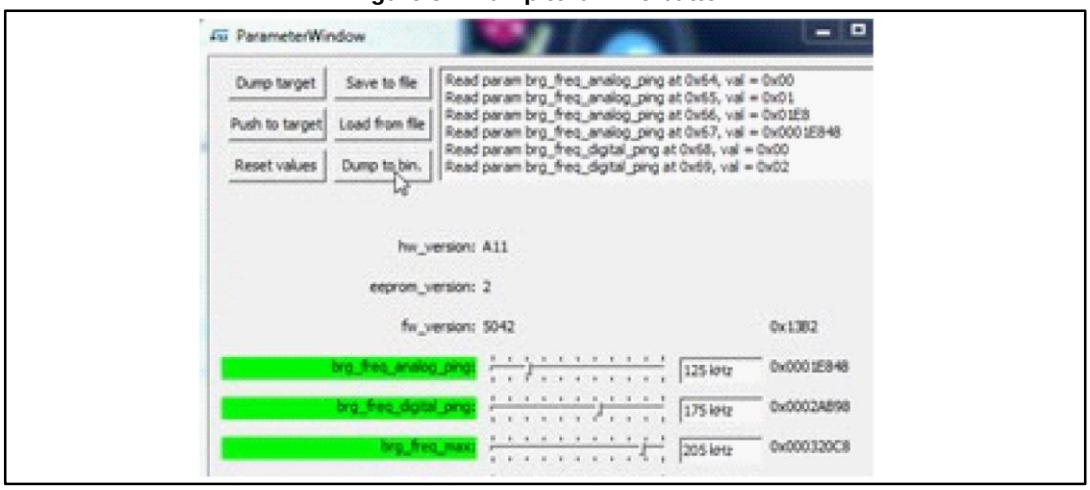
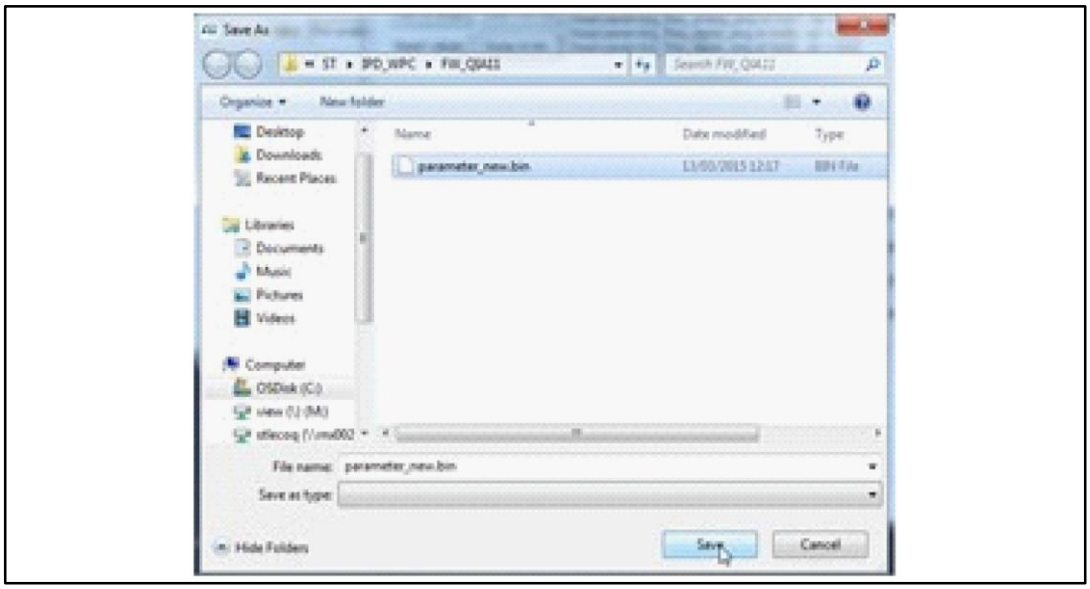


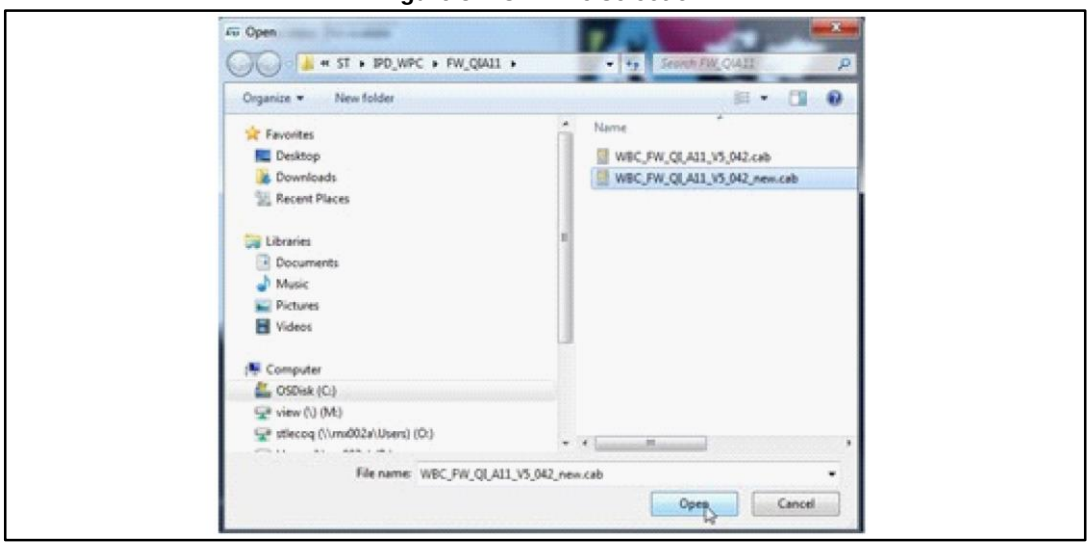
Figure 32: Bin file backup



Then the user should select the firmware CAB file to be patched (see *Figure 33: "CAB file patch button"* and *Figure 34: "CAB file selection"*).

Figure 33: CAB file patch button

Figure 34: CAB file selection



The patched firmware with the new tuning parameters is then generated and can be loaded using the standard procedure (refer to *Section 3.2: "Firmware download with STWBC GUI"*).

5.1 Efficiency

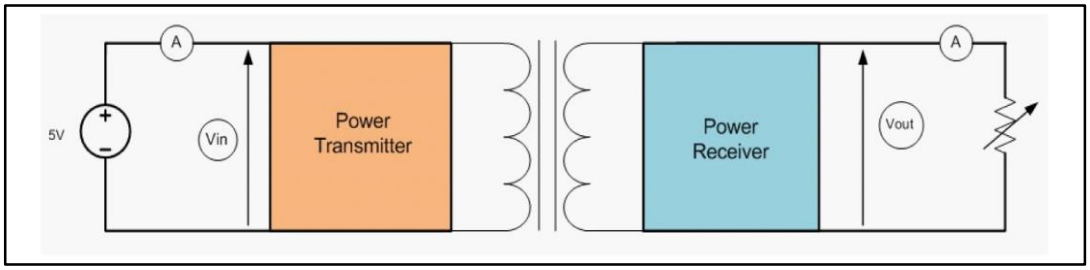
High efficiency of more than 70 % can be achieved with the QIA11 STEVAL-ISB027V1 reference board.

Efficiency measurements are done with a QiA11 Power receiver. QiA11 Transmitter is supplied at 5 V and receiver voltage level is also 5 V.

Pout is the output power measured really at the output of the receiver itself (not only rectifier output) and Pin is the input power.

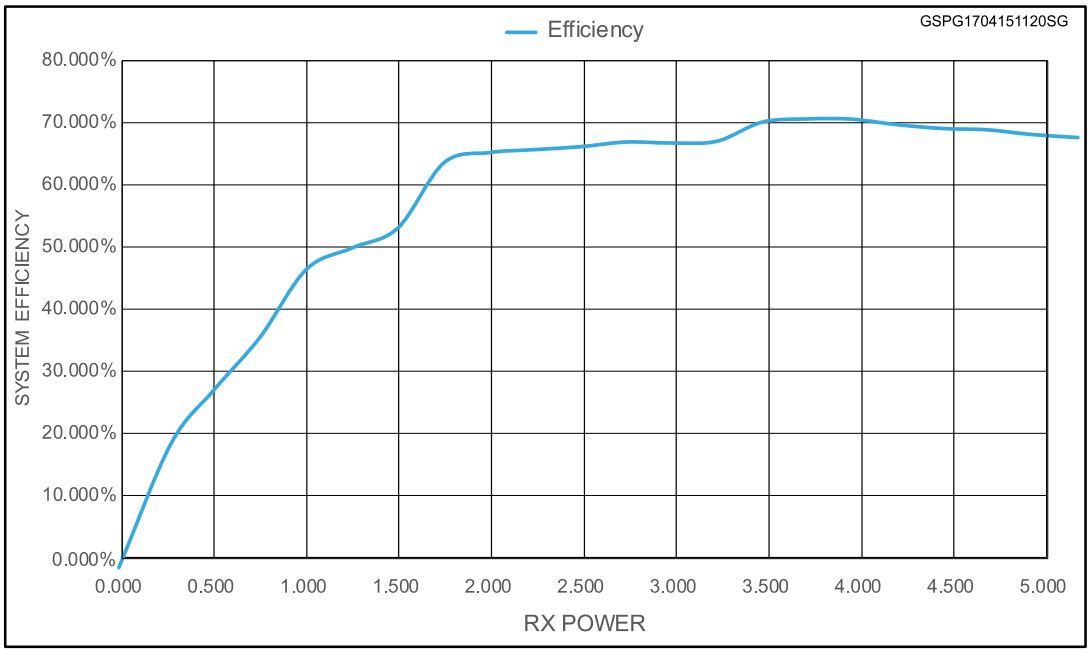
Efficiency is measured with the below set up configuration:

Figure 35: Efficiency set up



Below are the typical efficiency performances. Efficiency = Pout / Pin:

Figure 36: Efficiency performances



5.2 Standby consumption

In Standby, when supplied at 5 V, very low power consumption is achieved.

In this mode, device detection is still ensured; power consumption is reduced down to 700 µA in average. STEVAL_USB027V1 reference board can demonstrate a low standby power of only 3,5 mW.

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

5.3 Status LEDs

The LEDs status gives the state of the charge:

- Green Blinking: power transfer in progress
- Green Steady state: the charge is complete
- Red blinking: an error has been detected. It includes bad end of charge like battery fault, over voltage, over current….
- Red Steady state: the transmitter remains stuck until the receiver is removed, as mentioned in the Qi standard (power transfer stopped three times in a row due to amount of power not provided to the receiver, End Power Transfer due to Reconfigure, No Response code, FOD detection after 3 attempts)
- Red and Green blinking once at startup: a watchdog reset occurred
- Red and Green Steady state: Firmware / STWBC chip mismatch

5.4 Oscilloscope screenshots

Below are some examples of waveforms that can be monitored on oscilloscope during power transfer.

Figure 37: Power node switching and peak voltage demodulation

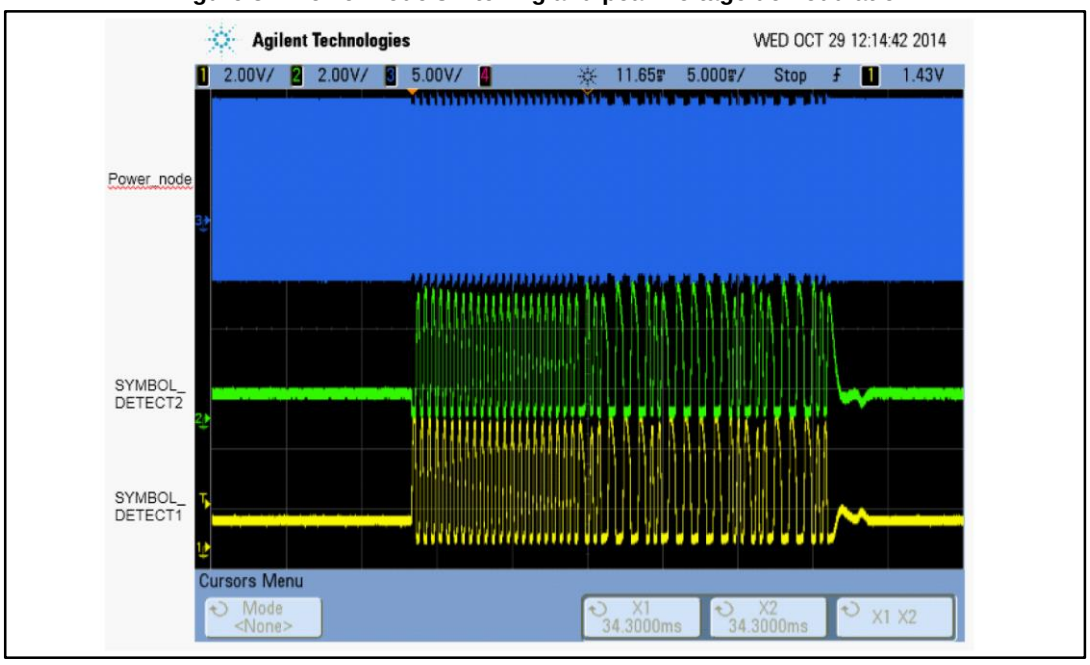
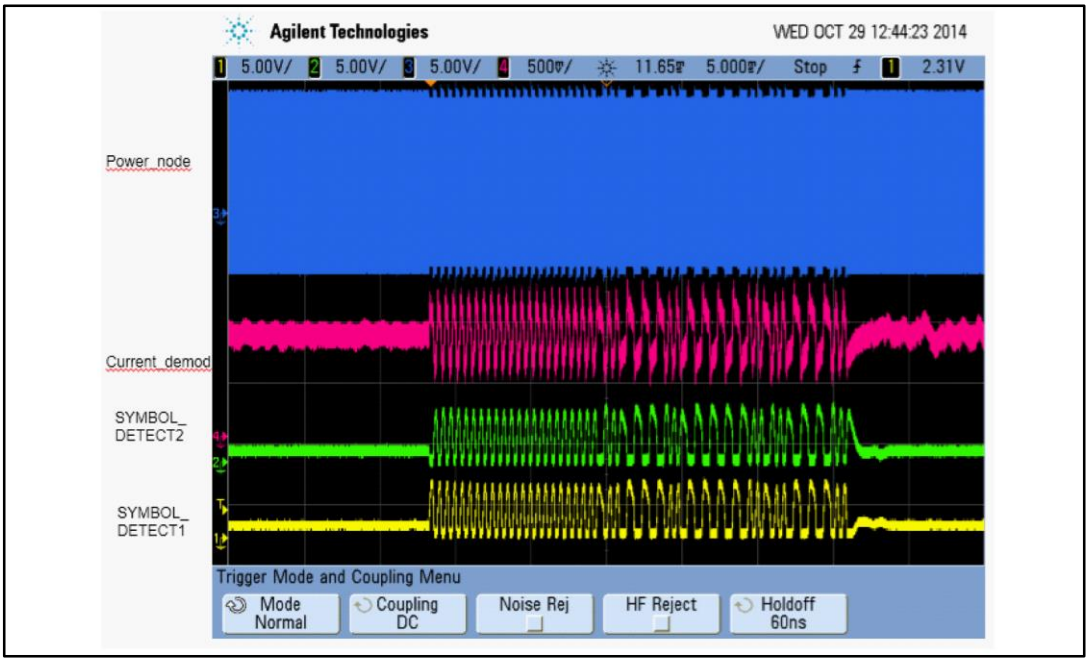


Figure 38: Power node switching and current demodulation



6 Board diagrams

Figure 39: STEVAL-ISB027V1 circuit schematic (1 of 3)

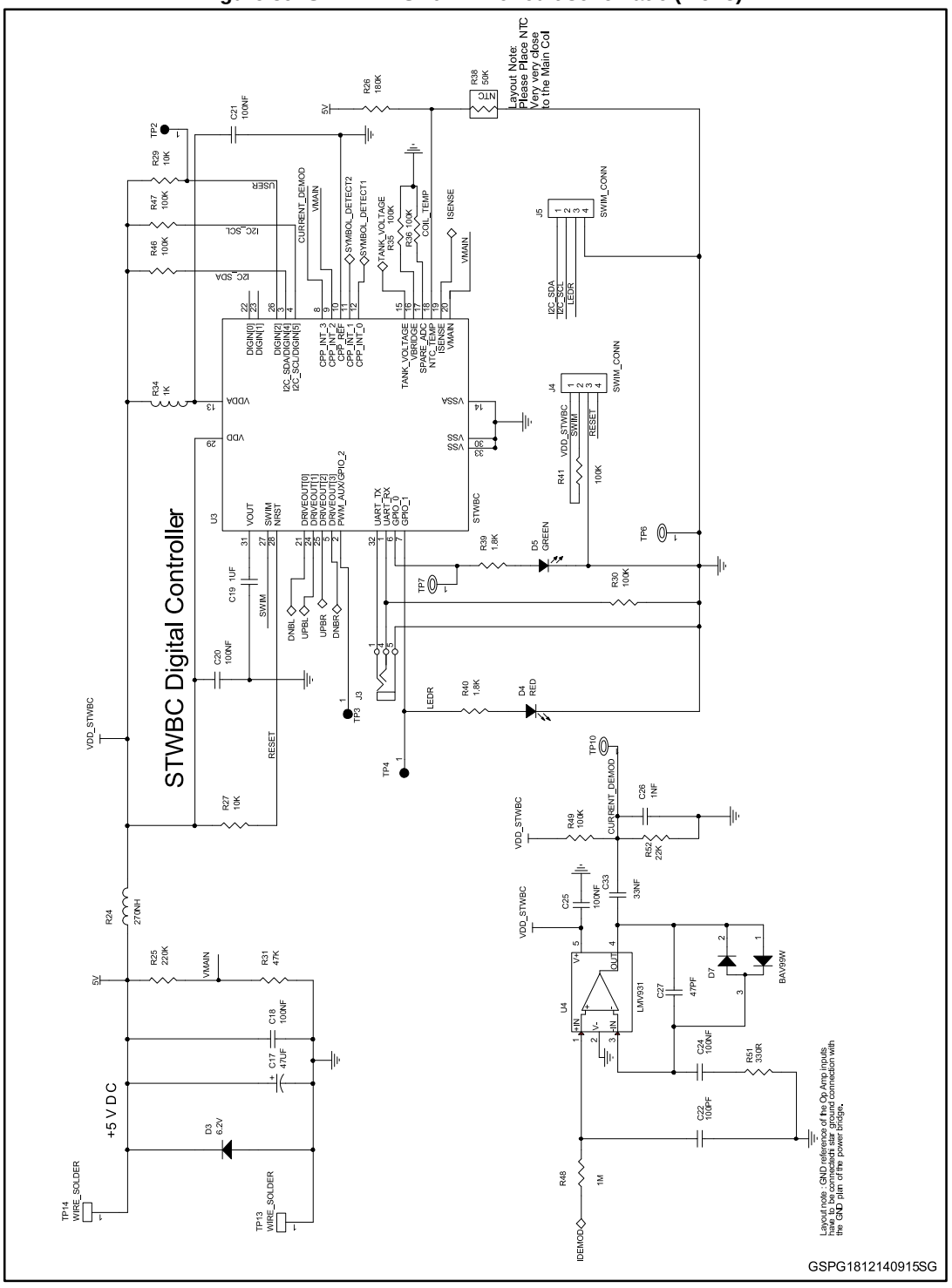


Figure 40: STEVAL-ISB027V1 circuit schematic (2 of 3)

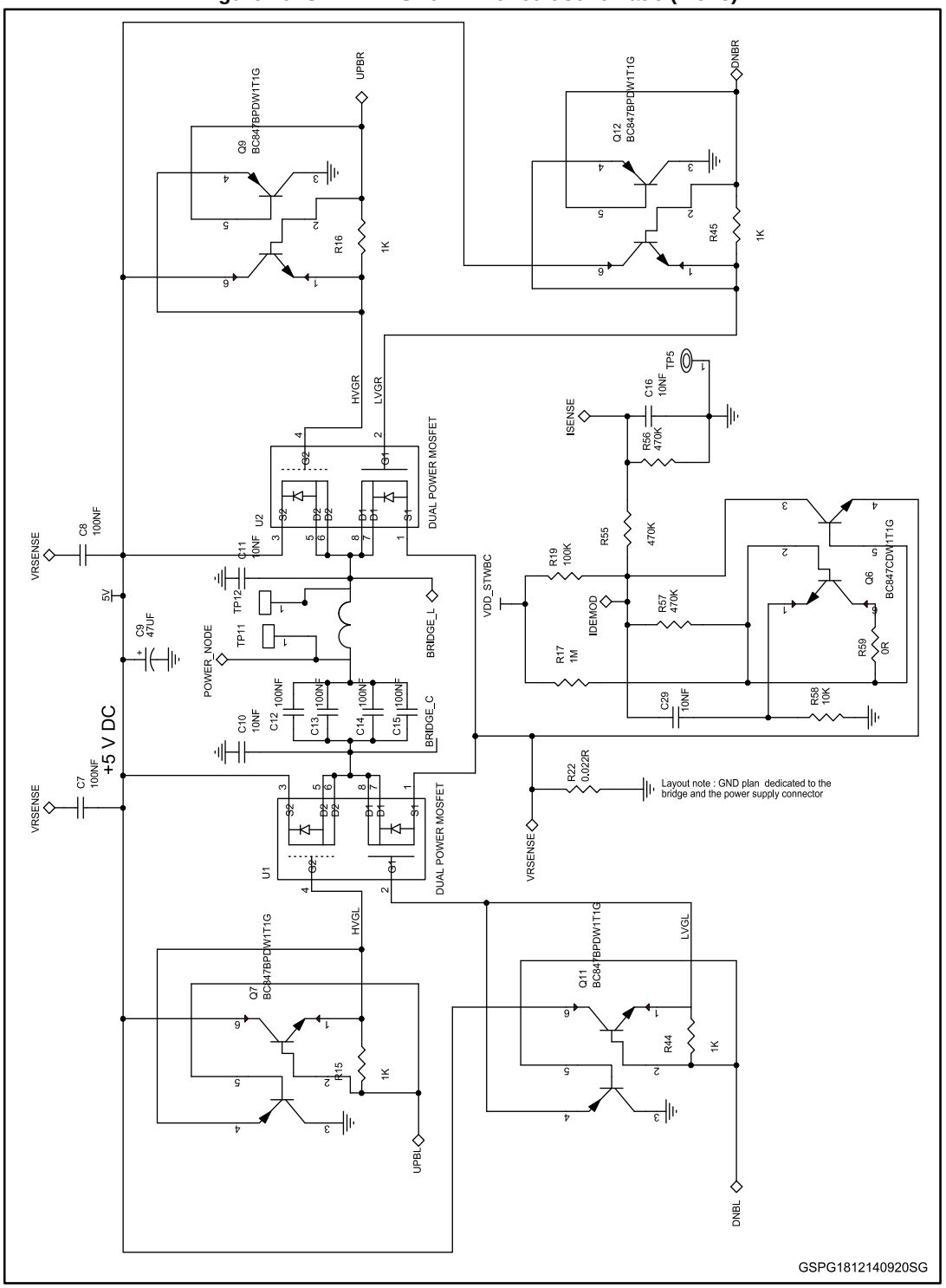
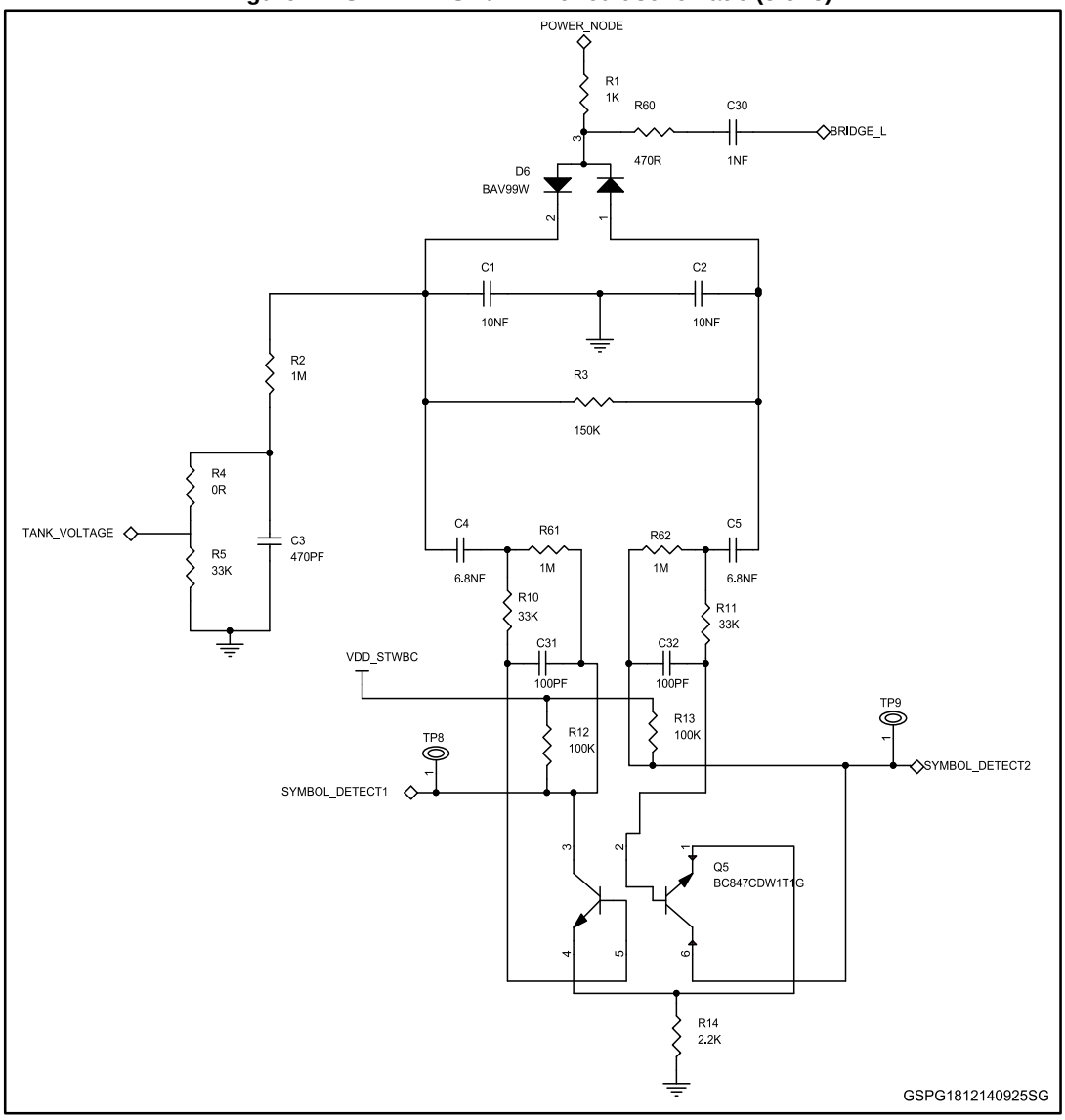


Figure 41: STEVAL-ISB027V1 circuit schematic (3 of 3)



7 Bill of materials

Table 5: QiA11 bill of material

Ref.	Part / value	Volts/ Amps/ Watts	Type	Tolerance	Package	Manufacturer	Notes
C1, C2	10nF	50V	Ceramic	10%	C0402	Murata	CAP CER 10nF 50V X7R 0402
C3	470pF	50V	Ceramic	15%	C0402		CAP CER 470PF 50V X7R 0402
C4, C5	6.8nF	50V	Ceramic	15%	C0402		CAPR 6.8NF 50V X7R 0402
C7, C8	100nF	50V	Ceramic	15%	C0402		CAP CER 100nF 50V X5R 0402
C9, C17	47µF	10V	Tantalum	10%	C+TAJ-D	Kemet	CAP TANT 47µF 10V 10% SMD_D
C10 C11 C16 C29	10nF	50V	Ceramic	15%	C0402		CAP CER 10nF 50V X7R 0402
C12 C13 C14 C15	100nF	50V	Ceramic	5%	C1206	Murata	Multilayer ceramic capacitors GRM31C5C1H104JA01L, 0.1µF, 50V DC, C0G, package 1206
C18 C20 C21 C24 C25	100nF	25V	Ceramic	15%	C0402		CAP CER 100nF 25V X5R 0402
C19	1µF	16V	Ceramic	10%	C0402		CAP CER 1UF 16V X5R 0402
C22	100pF	50V	Ceramic	5%	C0402		CAP CER 100pF 50V COG 0402
C26	1nF	6.3V	Ceramic	15%	C0402		CAP CER 1nF 6V3 X5R 0402
C27	47pF	6.3V	Ceramic	15%	C0402		CAP CER 47pF 6V3 X5R 0402
C30	1nF	50V	Ceramic	15%	C0402		CAP CER 1nF 50V X5R 0402
C31 C32	100pF	50V	Ceramic	5%	C0402		CAP CER 100pF 50V X5R 0402
C33	33nF	50V	Ceramic	15%	C0402		CAP CER 33nF 50V X7R 0402
D3	6.2V		Zener		BZX84C6V2	Fairchild	ZENER REGULATOR SOT23
D4	RED		LED		LEDC-0603_RED	Wurth Elektronik	150060RS75000
D5	GREEN		LED		LEDC-0603_GREEN	Wurth Elektronik	150060VS75000
D6, D7	BAV99W		Diode		BAV99W		Double diode high speed switching diode

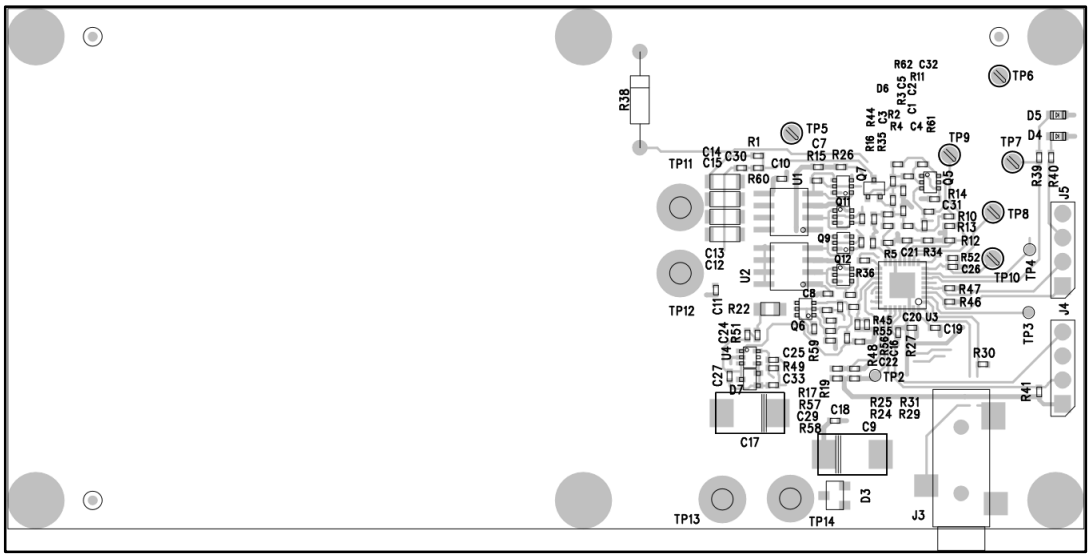
Ref.	Part / value	Volts/ Amps/ Watts	Type	Tolerance	Package	Manufacturer	Notes
J3	Stereo		Jack, audio		CONN_JACK_35RASMT2BHNTRX	Digi-Key	SC1489-1-ND
J4	SWIM_CONN		Header		HE14-4	Molex	MOLEX - 90121-0764 - EMBASE 1 RANGEE 90 DEGRES COUDE 4 VOIES
Q5, Q6	BC847CDW1T1G		Transistor		BC847CDW1T1G-SOT363	ON Semiconductor	XSTR,GEN PURP,dual NPN,45V,100mA,225mW,SOT-363
Q7, Q9 Q11 Q12	BC847BPDW1T1G		Transistor		BC847CPDW1T1G-SOT363	ON Semiconductor	XSTR,GEN PURP,dual NPN/PNP,45V,100mA,225mW,SOT-363
R1, R15 R16 R44 R45	1K		CMS	5%	R0402		RES 1KΩ 5% 1/16W 0402 SMD
R2, R17 R48 R61 R62	1M		CMS	5%	R0402		RES 1MΩ 1/16W 5% 0402 SMD
R3	150K		CMS	5%	R0402		RES 150KΩ 5% 1/16W 0402 SMD
R4, R59	0R		CMS	5%	R0402		RES 0Ω 5% 1/16W 0402
R5, R10 R11	33K		CMS	5%	R0402		33KΩ 5% 1/16W
R12 R13 R19 R30 R35 R36 R41 R46 R47 R49	100K		CMS	5%	R0402		RES 100KΩ 5% 1/16W 0402 SMD
R14	2.2K		CMS	5%	R0402		RES 2.2KΩ 1/16W 5% 0402 SMD
R22	0.022R		CMS	2%	R0805		RES 0.022Ω 2%
R24	270NH		COIL	5%	L0402	Wurth Elektronik	744784227A
R25	220K		CMS	1%	R0402		RES 220KΩ 1% 1/16W 0402 SMD
R26	180K		CMS	5%	R0402		RES 180KΩ 5% 1/16W 0402 SMD
R27 R29 R58	10K		CMS	5%	R0402		RES 10KΩ 5% 1/16W 0402 SMD
R31	47K		CMS	1%	R0402		RES 47KΩ 1% 1/16W 0402 SMD
R34	1K		Ferrite	25%	L0402	Murata	FERRITE BEAD1K 0.2A 0402

Ref.	Part / value	Volts/ Amps/ Watts	Type	Tolerance	Package	Manufacturer	Notes
R38	50K		Thermistance		DkF503B10		Temperature measurement probe assemblies
R39 R40	1.8K		CMS	5%	R0402		RES 1.8KΩ 1/16W 5% 0402 SMD
R51	330R		CMS	5%	R0402		330RΩ 5% 1/10W
R52	22K		CMS	5%	R0402		RES 22KΩ 1/16W 5% 0402 SMD
R55 R56 R57	470K		CMS	5%	R0402		RES 470KΩ 5% 0402
R60	470R		CMS	5%	R0402		RES 470Ω 5% 1/16W 0402
U1 U2	FDS8858CZ		Power MOSFET		SO-8	Fairchild	Dual Power MOSFET N&P Channel, 8.6A, 30V, 0.0205Ω
	Recommended Part STS8C5H30L or STL40C30H3LL		Power MOSFET		SO-8 or PowerFLAT 5x6	ST	Dual Power MOSFET N-channel 30, 0.018Ω, 8A, P-channel 30V, 0.045Ω, 5A or Dual Power MOSFET N-channel 30, 0.019Ω, 10A, P-channel 30V, 0.024Ω, 8A
U3	STWBC		Digital controller		QFN32	ST	Digital controller
U4	LMV931		Op amp		SC70-5	TI	Single Op amp, 1.5MHz, 1.8V, rail-to-rail, SC70-5
Power coil	WE 760308111		Wireless charging coil		53.3 x 53.3 mm	Wurth Elektronik	Tx coil 1 layer 6.3 µH 13A Qi A11
Plastic cover			Polycarbonate Cover		64 x 55 x 2 mm		Coil cover, thickness 2mm

8 Board assembly and layout

The evaluation board has been 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 solution with probes. In addition, UART is accessible through a 3.5 mm jack connector and SWIM is routed to a header connector.

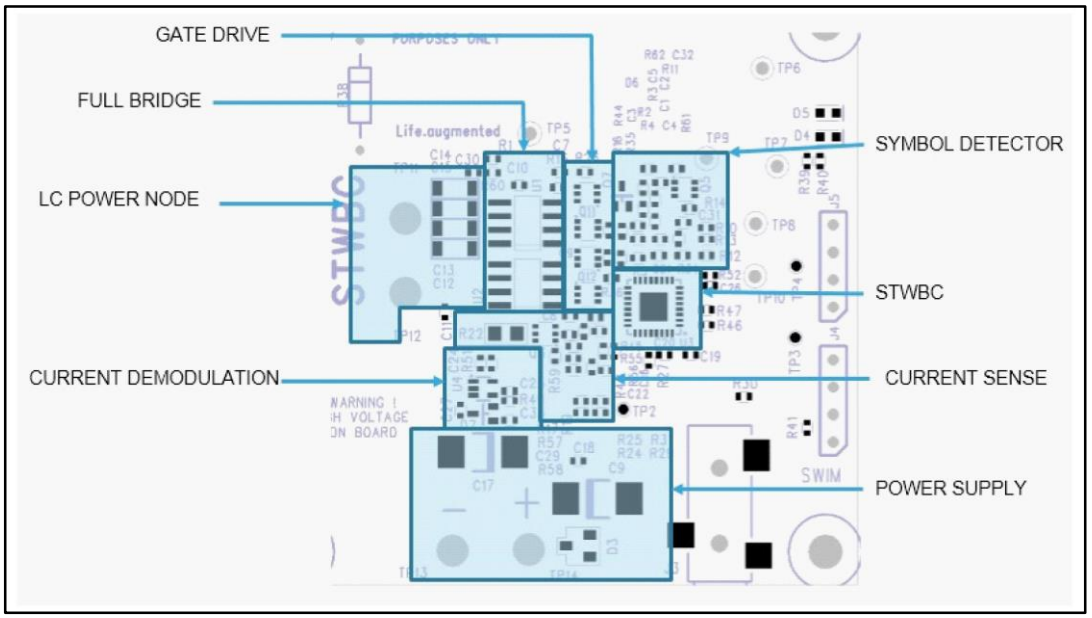
Figure 42: Board assembly



The evaluation board can be divided in several main blocks.

Here is the placement:

Figure 43: Evaluation board placement



In order to ensure good behavior of the board, some design rules need to be respected

8.1 Power signals (5 V, GND and LC power node)

5 V power signal is shared in 2 branches:

- One connected to the small ferrite bead for the digital side
- The other one connected with large track to the driver and the pre driver

GND is shared in 2 areas:

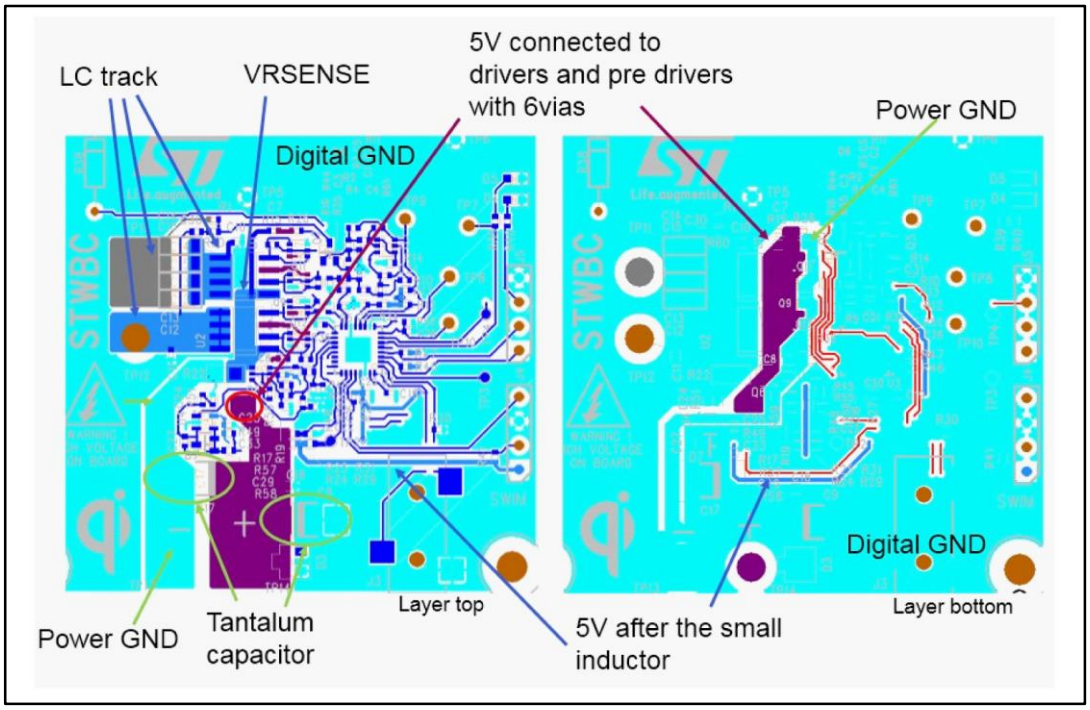
- Power GND which is relative to the gate drivers, the full bridge and Rsense connections
- Digital GND which is relative to all the other blocks including STWBC, current demodulator, current sense measurement

On each GND branch, a tantalum capacitor is placed for decoupling.

As the current flowing into the board can be huge, many vias must be used in order to route the 5 V and the Power GND from top to bottom.

Large track or plane should be used for power GND, power 5 V, V_{RSENSE} and LC power node.

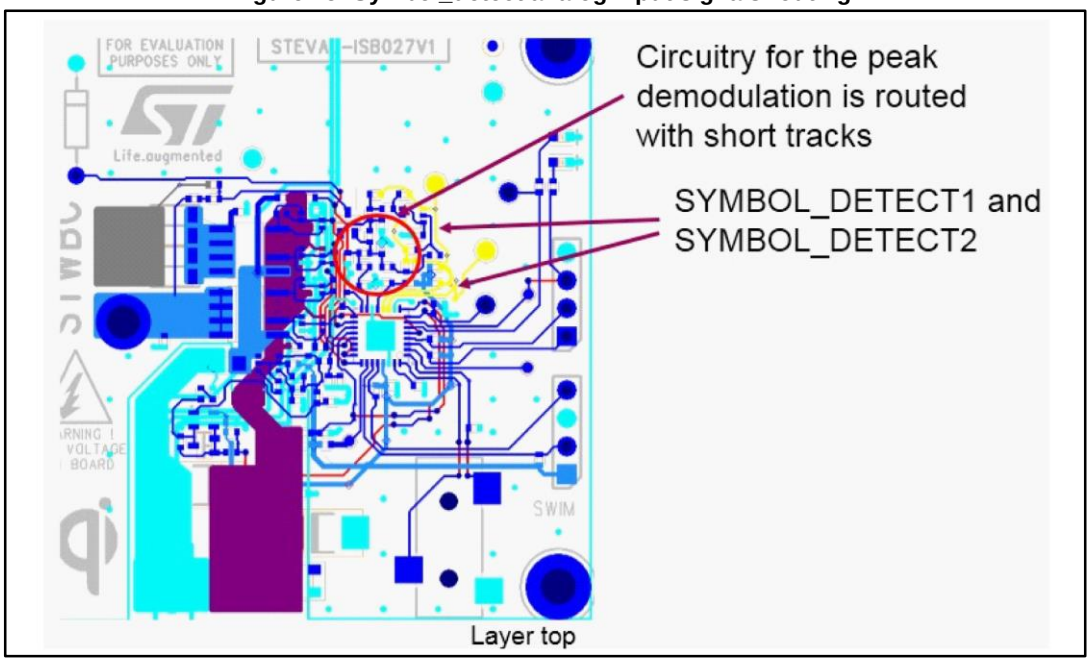
Figure 44: GND and 5 V layout



8.2 Sensitive signals

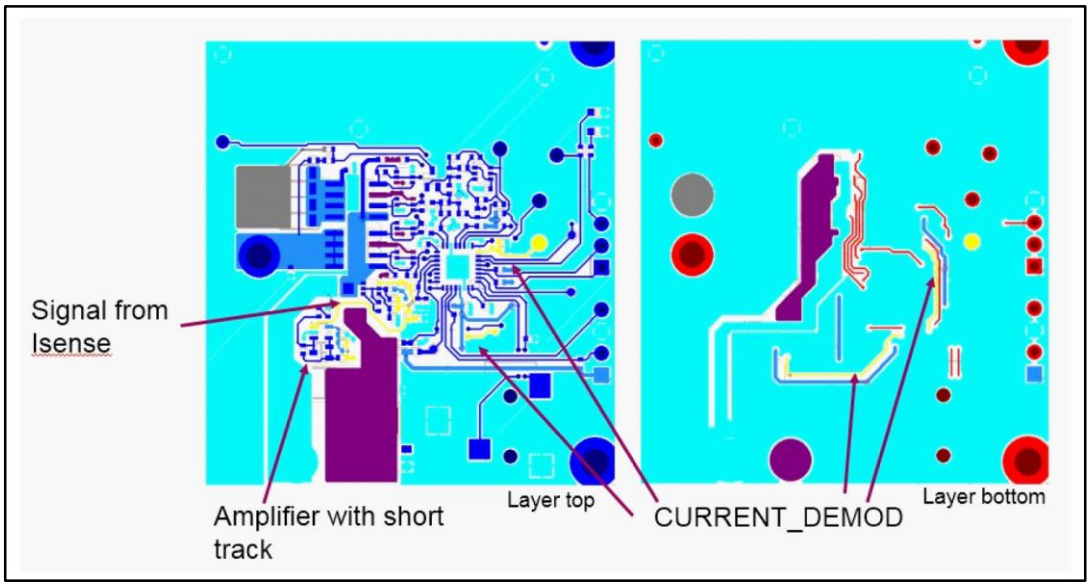
SYMBOL_DETECT1 and SYMBOL_DETECT2 are connected to comparator inputs and are used for peak detection (demodulation). So the layout must be clean on order to avoid any coupling.

Figure 45: Symbol_detect analog input signals routing



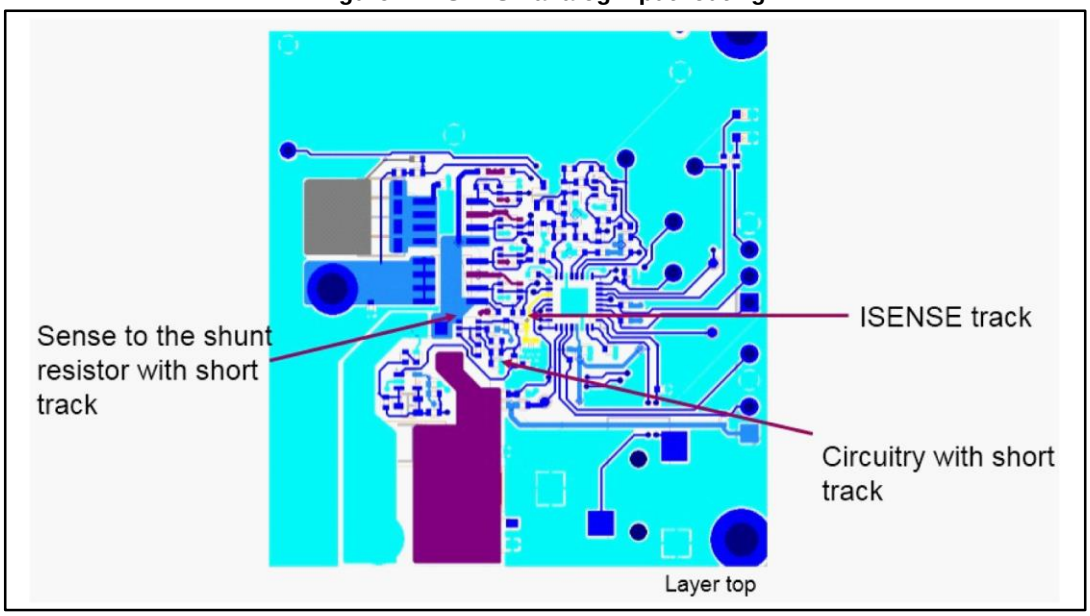
For the current demodulation circuit, the information is picked up from the I_{SENSE} circuitry. Then the information is amplified and sent to the STWBC through an analog input (CURRENT_DEMOD). Short tracks should be used also to avoid any coupling.

Figure 46: Current_demod analog input routing



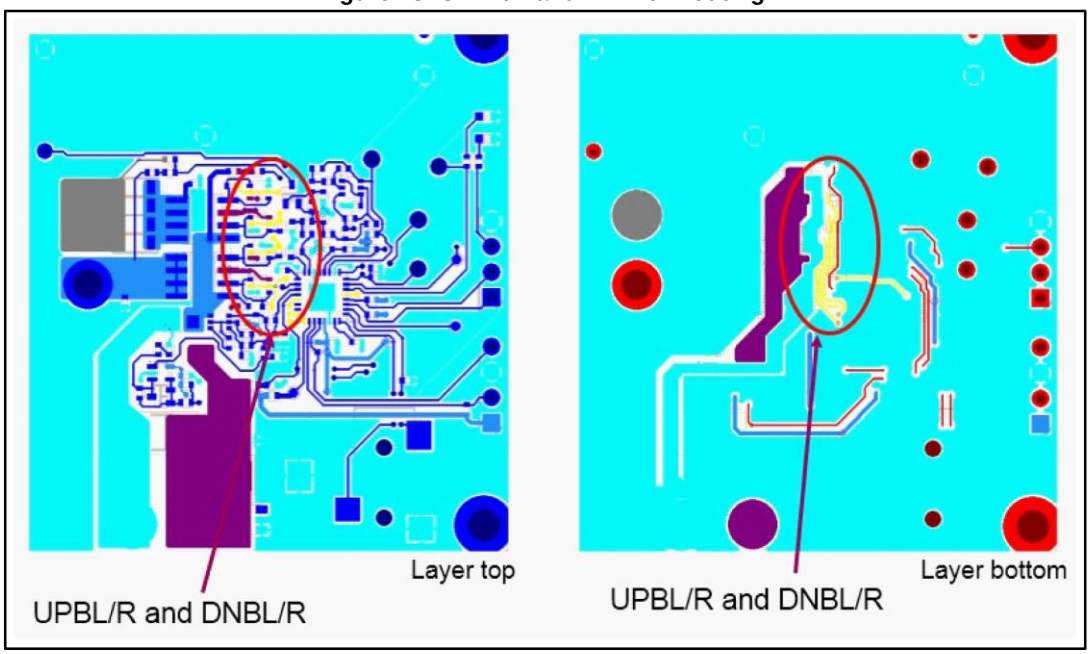
I_{SENSE} is the image of the current flowing into the full bridge and is connected to an ADC input. This is part of the PID algorithm, thus it should be routed carefully.

Figure 47: ISENSE analog input routing



UPBL/R and DNBL/R (highlighted in yellow) are the PWM coming from the STWBC and driving the full bridge. Those signals are quite noisy and must be isolated from signals going to comparators. They should be routed close to insensitive tracks or some GND guard lines should be added.

Figure 48: UPBL/R and DNBL/R routing



9 References

- Datasheet: STWBC - Digital controller for wireless battery charger transmitters with multistandard Qi, PMA and wearable support
- Data brief: STEVAL-ISB027V1 - Qi A11 wireless charger transmitter evaluation board based on STWBC

10 Revision history

Table 6: Document revision history

Date	Revision	Changes
06-Mar-2015	1	Initial release.
25-May-2015	2	Updated: - Section 3: Software installation Added: - Section 8: Board assembly and layout
28-Apr-2016	3	Updated: - U1 and U2 Ref. value on *Table 5: "QiA11 bill of material"*

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