Firmware for the EVALSTWBC-EP 15 W single coil Qi MP-A15 wireless power TX evaluation kit

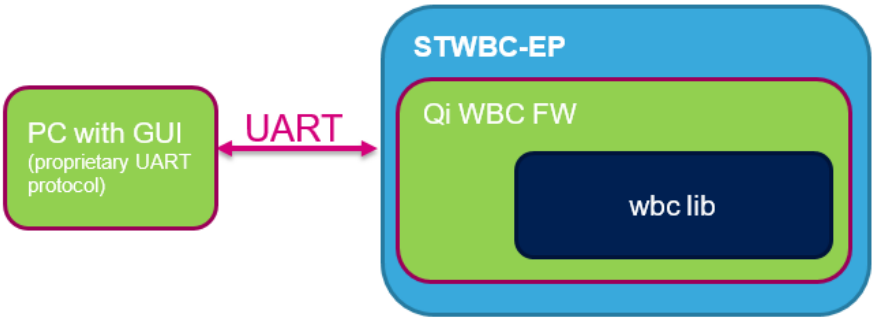
Introduction

The STSW-STWBC-EP firmware offers all the standard functions of the STWBC-EP digital controller for wireless battery charger transmitters, for the specific Qi EPP v1.2.4 MP-A15 topology.

The firmware is in a binary file that you can download directly onto the STWBC-EP flash. The firmware is a standalone block with embedded wbc lib library for core STWBC-EP implementation.

The firmware is highly suitable for standalone STWBC-EP solutions with UART interface for the PC GUI tool (STSW-STWBCGUI), which can be used to adjust certain parameters. The default configuration is set up for Qi v1.2.4.

Figure 1. STWBC-EP Qi EPP library architecture



1 List of acronyms and abbreviations

Table 1. List of acronyms

Acronym	Description
ADC	Analog to digital conversion
HW	Hardware
WBC	Wireless battery charger

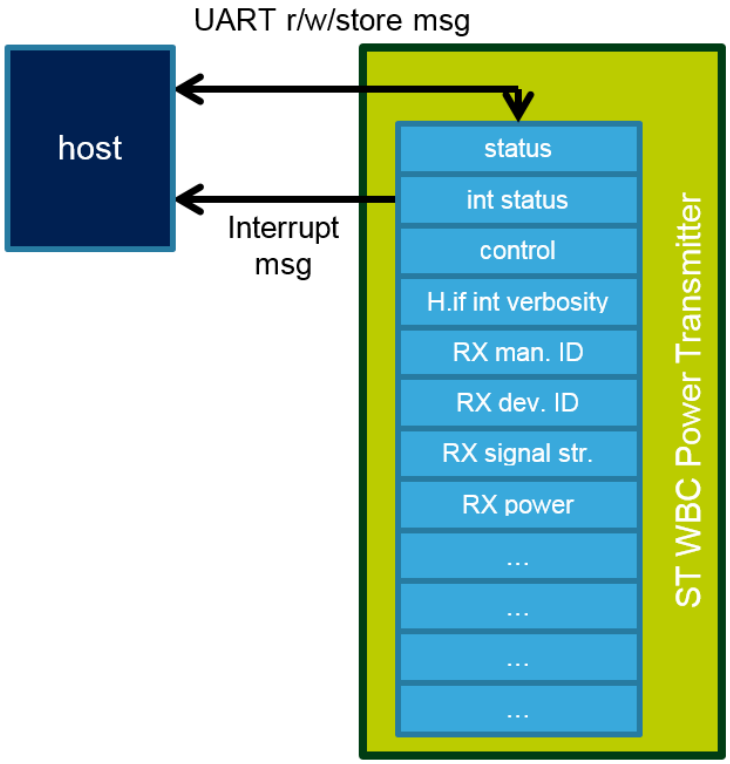
2 APIs

2.1 Host interface registers

The power transmitter controller interface is register-based.
The registers allow:

- getting the transmitter status
- getting event descriptions (such as errors)
- getting information about the attached receiver
- tuning some parameters

Figure 2. Host interface register architecture



2.2 Register map

Table 2. STWBC-EP register map

Register list	Address	Description
HOST_IF_STATUS	(0x00)	Overall status of the Qi wireless battery charger (object detected, identification on-going, power transfer on-going)
HOST_IF_INT_STATUS	(0x01)	Contains the interrupt sources, to be read after reception of “int” message.
HOST_IF_CONTROL	(0x02)	Type of command to execute..
HOST_IF_DATA_W	(0x03)	RESERVED

Register list	Address	Description
HOST_IF_INT_VERBOSITY	(0x04)	Contains the enabling/disabling status for the 2 “int” messages. Bit 0 corresponds to INT_SRC_LOG_MSG, and bit 1 corresponds to INT_SRC_LOG_ERROR. 0 → INT enabled (default) 1 → INT disabled.
HOST_IF_DEBUG_DATA_CFG	(0x05)	-
HOST_IF_DEBUG_DATA_0	(0x06)	-
HOST_IF_DEBUG_DATA_1	(0x07)	-
HOST_IF_DEBUG_DATA_2	(0x08)	-
HOST_IF_EXT_ID_MSB	(0x09)	MSB of the extended ID code given by the Qi receiver.(if extended packet is received)
HOST_IF_EXT_ID_7	(0x0A)	Ext ID word 7
HOST_IF_EXT_ID_6	(0x0B)	Ext ID word 6
HOST_IF_EXT_ID_5	(0x0C)	Ext ID word 5
HOST_IF_EXT_ID_4	(0x0D)	Ext ID word 4
HOST_IF_EXT_ID_3	(0x0E)	Ext ID word 3
HOST_IF_EXT_ID_2	(0x0F)	Ext ID word 2
HOST_IF_EXT_ID_LSB	(0x10)	LSB of the extended ID code given by the Qi receiver
HOST_IF_MAN_CODE_MSB	(0x11)	MSB of the manufacturer code given by the Qi receiver.
HOST_IF_MAN_CODE_LSB	(0x12)	LSB of the manufacturer code given by the Qi receiver.
HOST_IF_DEVICE_ID_MSB	(0x13)	MSB of device ID sent by the Qi receiver
HOST_IF_DEVICE_ID_3	(0x14)	-
HOST_IF_DEVICE_ID_2	(0x15)	-
HOST_IF_DEVICE_ID_LSB	(0x16)	LSB of device ID sent by the Qi receiver
HOST_IF_SIGNAL_STRENGTH	(0x17)	Qi receiver signal strength
HOST_IF_RX_POWER_MW_H	(0x18)	High part of the 16 bits Received Power from Qi receiver in mW divided by 64
HOST_IF_LOG_MSG	(0x19)	Qi Finite State status. To be read when an interrupt occurs with LOG_MSG bit set in INT_STATUS register. See table below for more explanation.
HOST_IF_VOLTAGE	(0x1A)	DCDC voltage target. In mV/128
HOST_IF_DUTYCYCLE	(0x1B)	Current output signal DC in %
HOST_IF_CUR_ERROR	(0x1C)	RESERVED
HOST_IF_BOOTMODE	(0x1D)	RESERVED
HOST_IF_TESTMODE	(0x1E)	RESERVED

Register list	Address	Description
HOST_IF_LED_DISABLED	(0x1F)	Allows enabling or disabling the LEDs: 0 → LEDs are enabled (default) 1 → LEDs are disabled.
HOST_IF_LOG_ERROR	(0x20)	Error logging. To be read when an interrupt occurs with LOG_ERROR bit set in INT_STATUS register
HOST_IF_FREQUENCY	(0x21)	Current frequency used. In Hertz/2048
HOST_IF_CONTROL_ERROR	(0x22)	Indicates the control error obtained from the CONTROL_ERROR message (range [-128, 127]).
HOST_IF_ADC_CURRENT_H	(0x23)	Higher part of the ADC current sense measurement
HOST_IF_ADC_CURRENT_L	(0x24)	Lower part of the ADC current sense measurement
HOST_IF_ADC_VOLTAGE_H	(0x25)	Contains the newly set input voltage after PID calculation.
HOST_IF_ADC_VOLTAGE_L	(0x26)	Contains the newly set input voltage after PID calculation.
HOST_IF_TUNING_PRES_DET	(0x27)	Presence detection metric used during the analog ping phase.
HOST_IF_TUNING_FOD1_DYN_THR	(0x28)	Threshold used in the determination of the Foreign Object Detection algorithm during selection state.
HOST_IF_TUNING_FOD1_METRIC	(0x29)	Metric used in the determination of the Foreign Object Detection algorithm during selection state. This represents Q Factor measurement of detected object.
HOST_IF_TUNING_FOD2_CURR_H	(0x2A)	Higher part of a metric based on the current measurement and used in the Foreign Object Detection algorithm during power transfer phase.
HOST_IF_TUNING_FOD2_CURR_L	(0x2B)	Lower part of a metric based on the current measurement and used in the Foreign Object Detection algorithm during power transfer phase.
HOST_IF_TUNING_FOD2_VOLT_H	(0x2C)	Higher part of a metric based on the voltage measurement and used in the Foreign Object Detection algorithm during power transfer phase.
HOST_IF_TUNING_FOD2_VOLT_L	(0x2D)	Lower part of a metric based on the voltage measurement and used in the Foreign Object Detection algorithm during power transfer phase.
HOST_IF_TUNING_FOD2_METRIC_H	(0x2E)	Higher part of a computed metric used in the Foreign Object Detection algorithm during power transfer phase.
HOST_IF_TUNING_FOD2_METRIC_L	(0x2F)	Lower part of a computed metric used in the Foreign Object Detection algorithm during power transfer phase.
HOST_IF_TUNING_FOD2_THR_H	(0x30)	Higher part of a threshold used in the Foreign Object Detection algorithm during power transfer phase.

Register list	Address	Description
HOST_IF_TUNING_FOD2_THR_L	(0x31)	Lower part of a threshold used in the Foreign Object Detection algorithm during power transfer phase.
HOST_IF_MSG_DECODED	(0x32)	Rx received message counter. Counter initialized to 0xFF and decremented each time a message coming from the RX is correctly decoded. When the GUI reads this register, the counter is re-initialized to 0xFF.
HOST_IF_READ_UART_MSG	(0x33)	Used to read a message from UART link.
HOST_IF_REQ_UART_MSG	(0x34)	Used to write a message on UART link.
HOST_IF_RX_POWER_MW	(0x35)	Received Power from Qi receiver in mW divided by 64.
HOST_IF_FEATURE_DISABLED	(0x36)	RESERVED
HOST_IF_CHARGE_STATUS	(0x37)	Charge status indicated by the Receiver though the “Charge Status” message (see Qi standard). Default value is 0xFF.
HOST_IF_CURRENT_OFFSET_H	(0x38)	Higher part of the current offset value after ADC current auto-calibration.
HOST_IF_CURRENT_OFFSET_L	(0x39)	Lower part of the current offset value after ADC current auto-calibration.
HOST_IF_ADC_VOUT_DCDC_OFFSET_H	(0x3A)	Higher part of ADC DCDC measurement.
HOST_IF_ADC_VOUT_DCDC_OFFSET_L	(0x3B)	Lower part of ADC DCDC measurement.
HOST_IF_WPID_LSB	(0x3C)	LSB of the WPID number.
HOST_IF_WPID_1	(0x3D)	2rd byte of the WPID number.
HOST_IF_WPID_2	(0x3E)	3rd byte of the WPID number.
HOST_IF_WPID_3	(0x3F)	4th byte of the WPID number.
HOST_IF_WPID_4	(0x40)	5th byte of the WPID number.
HOST_IF_WPID_MSB	(0x41)	MSB of the WPID number.
HOST_IF_ADC_VIN_H	(0x42)	Higher part of the ADC Vin measurement.
HOST_IF_ADC_VIN_L	(0x43)	Lower part of the ADC Vin measurement.
HOST_IF_ADC_TEMPERATURE_H	(0x44)	Higher part of the ADC temperature measurement.
HOST_IF_ADC_TEMPERATURE_L	(0x45)	Lower part of the ADC temperature measurement.
HOST_IF_VOLTAGE_OFFSET_H	(0x46)	Higher part of the voltage offset value after ADC auto-calibration.
HOST_IF_VOLTAGE_OFFSET_L	(0x47)	Lower part of the voltage offset value after ADC auto-calibration.
HOST_IF_DEMOD_VOLTA_CMP_THR	(0x48)	Threshold above which a signal is detected by comparator A which is used in the voltage demodulation. This value is auto-calibrated at switch-on.
HOST_IF_DEMOD_VOLTB_CMP_THR	(0x49)	Threshold above which a signal is detected by comparator B which is used in the voltage demodulation. This value is auto-calibrated at switch-on.

Register list	Address	Description
HOST_IF_DEMOD_CURRENT_CMP_THR	(0x4A)	Threshold above which a signal is detected by the comparator which is used in the current demodulation. This value is auto-calibrated at switch-on.
HOST_IF_COUNT_DEBUG	(0x4B)	RESERVED
HOST_IF_RX_VERSION	(0x4C)	Indicates the receiver Qi version: 0 → Qi v1.0 1 → Qi v1.1 2 → Qi v1.2
HOST_IF_CURRENT_PRES_DET_DC_OFFSET	(0x4D)	Value of the current presence detection DC offset. This value is used for debug (verification of dc_offset_mean calibration for presence detection)
HOST_IF_FIRST_ADC_I_H	(0x4E)	Higher part of the ADC current sense measurement minus the current offset, measured at ping phase.
HOST_IF_FIRST_ADC_I_L	(0x4F)	Lower part of the ADC current sense measurement minus the current offset, measured at ping phase.
HOST_IF_FIRST_ADC_VOUT_DCDC_H	(0x50)	Higher part of the ADC DCDC measurement minus the ADC DCDC offset, measured at ping phase.
HOST_IF_FIRST_ADC_VOUT_DCDC_L	(0x51)	Lower part of the ADC DCDC measurement minus the ADC DCDC offset, measured at ping phase.
HOST_IF_FIRST_ADC_VOLTAGE_H	(0x52)	Higher part of the ADC input voltage measurement minus the input voltage offset, measured at ping phase.
HOST_IF_FIRST_ADC_VOLTAGE_L	(0x53)	Lower part of the ADC input voltage measurement minus the input voltage offset, measured at ping phase.
HOST_IF_PROPRIETARY_MSG	(0x54)	Allows to read received proprietary message Fifo
HOST_IF_REF_Q_FACTOR	(0x55)	Reference Q factor value given by a Qi v1.2.x Rx in its FOD_STATUS message.
HOST_IF_DEMOD_USED	(0x56)	Indicates which demodulations are used. This is cumulative information. The values used are: 1 → DEMOD_VOLTAGE_USED 2 → DEMOD_CURRENT_USED 3 → DEMOD_PHASE_USED e.g., if current and voltage demodulations have been used, the register is set to 0x3. The register is reset when an object is detected and when entering power transfer.
HOST_IF_LOG_EVENT	(0x57)	RESERVED

2.3 Register description

Table 3. HOST_IF_STATUS values

HOST_IF_STATUS values	Description	Value
STATUS_OBJECT_DETECTED	Qi receiver detected	0x1
STATUS_QI_POWER	Power transfer on-going	0x2
STATUS_QI_DETECTED	Qi identification on-going	0x4
STATUS_MEDIUM_POWER	Set when the TX is in EPP mode (maximum power in the power transfer contract is greater than 10)	0x8
STATUS_QI_ACTIVE_COIL_INDEX	Index (from 0 to n) of the current active coil	0xF0

Table 4. HOST_IF_INT_STATUS values

HOST_IF_INT_STATUS values	Description	Value
INT_SRC_QI_ID_RECEIVED	Reserved to the LIB	0x01
INT_SRC_REFILL	Reserved to the LIB	0x02
INT_SRC_EMPTY	Reserved to the LIB	0x04
INT_SRC_TX_DATA_TIMEOUT	Reserved to the LIB	0x08
INT_SRC_LOG_MSG	Set by the LIB when status is changed in HOST_IF_STATUS register. This is set by the LIB only if bit 0 of HOST_IF_INT_VERBOSITY has been reset.	0x10
INT_SRC_LOG_ERROR	Set by the LIB when a new error occurrs on WBC side (e.g., error in decoding packet or error in the finite state machine). This is set by the LIB only if bit1 of HOST_IF_INT_VERBOSITY has been reset.	0x20
INT_SRC_PROP_MSG_RECEIVED	Set by the LIB in case of reception of a proprietary message	0x40
INT_SRC_WPID_ RECEIVED	Set by the when the full WPID is received	0x80
MUTE_INT	Set by the LIB in case the UART message has to be muted.	0xFF
UNMUTE_INT	Set by the LIB in case the UART message has to be unmuted.	0x00

Table 5. HOST_IF_CONTROL values

HOST_IF_CONTROL values	Description	Value
CONTROL_TX_DATA_MODE	Reserved to the LIB	0x01
CONTROL_LOG	Reserved to the LIB	0x02
CONTROL_LOG_I2C	Sets to activate UART protocol.	0x04
CONTROL_QI_FSM_START	Starts the Qi FSM	0x08
CONTROL_QI_FSM_STOP	Stops the Qi FSM	0x10
CONTROL_TUNING_MODE	Switches the Lib to tuning mode	0x20
CONTROL_CLEAR_STICKY	Clears sticky errors	0x40

Table 6. HOST_IF_LOG_MSG values

HOST_IF_LOG_MSG values	Description	Value
NO_MSG	No change	0x00
STOP_MSG	FSM status changed to Stop phase	0x01
SELECTION_MSG	FSM status changed to Selection phase	0x02
PING_MSG	FSM status changed to Ping phase	0x03
IDENT_AND_CONFIG_MSG	FSM status changed to Identification and configuration phase	0x04
TX_DATA_STATE_MSG	Reserved to the LIB	0x05
POWER_TRANSFER_MSG	FSM status changed to Power Transfer phase	0x06
POWER_TRANSFER_MSG	FSM status changed to Power Transfer phase	0x06
NEGOTIATION_STATE_MSG	FSM status changed to Negotiation phase	0x07
CALIBRATION_STATE_MSG	FSM status changed to calibration phase	0x08
RENEGOTIATION_STATE_MSG	FSM status changed to renegotiation phase	0x09

Table 7. HOST_IF_LOG_ERROR values

HOST_IF_LOG_ERROR values	Description	Value
NO_ERROR	No error	0x0U
AUTOCAL_TEST_DONE	Reserved	0x01U
PING_TIMEOUT	Occurs when the digital ping phase is not completed on time (1).	0x02U
RX_REMOVED	Occurs when the Qi Finite State Machine detects that the Qi Rx has been removed in a specific case as after a “sticky error”.	0x03U
BAD_PACKET_SEQUENCE	Occurs when the Qi received messages do not come in the order specified in the Qi standard.	0x04U
TOO_MANY_PROPRIETARY_PACKETS	Occurs when more than 7 optional configuration packets are received during the Identification and Configuration phase (1).	0x05U
POWER_CTRL_HOLD_OFF_ERROR	Occurs when the Power Control Hold-off Time parameter received in the Power Control Hold-Off packet is not inside the range [5, 205] ms (1).	0x06U
PACKET_TIMEOUT	Occurs during the Identification phase when the Power Transmitter does not detect the start bit of the header byte of a next Packet in the sequence within the time interval (after the end of the directly preceding Packet in the sequence (3).	0x07U
Q_FOD	Occurs when a FOD has been detected before the power transfer phase.	0x08U
CONTROL_ERROR_TIMEOUT	Occurs in Power Transfer state when the control error packets are not received in time as described in the Qi standard.	0x09U
RECTIFIED_POWER_TIMEOUT	Occurs in Power Transfer state when the received power packets are not received in time as described in the Qi standard.	0x0AU
VIN_UNDER_VOLTAGE (VBUS_DROP_DOWN)	Occurs when an undervoltage is detected and the power transmitter cannot provide the requested amount of power to the power receiver.	0x0BU

HOST_IF_LOG_ERROR values	Description	Value
OPTIONAL_PACKETS_MISMATCH	Occurs in identification and configuration phase when: • the number of optional configuration packets, received by the power transmitter, is equal to the value contained in the Count field of the configuration packet • after the [Ext] Identification packet the received packet is not a configuration packet, not a power control Hold Off packet nor a proprietary packet (1)	0x0CU
CHECKSUM_ERROR	Occurs in the Identification and Configuration phase when the power transmitter does not receive a packet correctly.	0x0DU
EPT_RECEIVED	Occurs when a “End Power Transfer” packet has been received with a code different from “Reconfigure”, “Charge complete”, “EPT over voltage”, “EPT over current”, “EPT over temperature”, “EPT battery failure”, “EPT no response”.	0x0EU
EPT_RX_OVER_CURRENT	Occurs when an “End Power Transfer” Packet has been received with a code equal to “Over Current”.	0x0FU
RX_OVER_TEMPERATURE	Occurs when an “End Power Transfer” Packet has been received from RX with a code equal to “Over Temperature”.	0x10U
TX_OVER_TEMPERATURE	Occurs when an overtemperature defect is detected on the transmitter side (4).	0x11U
EPT_CHARGE_COMPLETE	Occurs when an “End Power Transfer” packet has been received with a code equal to “Charge Complete”.	0x12U
EPT_OVER_VOLTAGE	Occurs when an “End Power Transfer” packet has been received with a code equal to “Over Voltage”.	0x13U
EPT_BATTERY_FAILURE	Occurs when an “End Power Transfer” packet has been received with a code equal to “Battery Failure”.	0x14U
EPT_RX_PACKET_ERROR	Occurs when an error is detected during the packet decoding.	0x15U
EPT_NO_RESPONSE	Occurs when an “End Power Transfer” packet has been received with a code equal to “no response”.	0x17U
FOREIGN_OBJECT_DETECTED	Occurs when a foreign object has been detected.	0x18U
FOREIGN_OBJECT_DETECTED_DURING_EPP	Occurs when a foreign object is detected during power transfer phase during an Extended Power Profile transfer (supported power above 5W).	0x19U
TX_OVER_CURRENT	Occurs when the transmitter cannot support the current required by the receiver (4). For Qi MP, this threshold is tuned and set for Vin=12V.	0x1AU
INTERNAL_WARNING	Reserved	0x1BU
AUTOCAL_TEST_FAILED	Reserved	0x1CU
TA_VOLT_NOT_SUITABLE	Occurs when “Quick charge” feature is enable and the Travel Adaptor voltage is not suitable.	0x1DU
EPT_NEGOTIATION_FAILURE	Occurs when an “End Power Transfer” Packet has been received with a code equal to “negotiation failure”.	0x1FU
NEGOTIATION_TIMEOUT	Occurs when the negotiation fails.	0x20U
BAD_NEGOTIATION	Occurs in negotiation phase when an “End Negotiation” message is received but the Power Transmitter has not sent an ACK Response earlier in the negotiation phase to both a Specific Request Packet with Request = 0x02 (Received Power Packet Type), and an FOD Status Packet (see Qi standard).	0x21U
FOD_DURING_NEGOTIATION	Occurs in negotiation/renegotiation phase when a FOD is detected after receiving a FOD_STATUS message.	0x22U

HOST_IF_LOG_ERROR values	Description	Value
BAD_MODE_VALUE_IN_MP_RP_PACKET	Occurs during calibration phase if the Power Transmitter receives a 24-bit Received Power Packet with a Mode value other than ‘001’ and ‘010’.	0x23U
WRONG_RP_FORMAT	Occurs if the Power Transmitter receives a Received Power Packet with a format that is different from the format that is agreed in the Power Transfer Contract.	0x24U
EPT_RESTART_POWER_TRANSFER	Occurs if the Power Transmitter receives an End Power Transfer Packet that contains an End Power transfer Code of 0x0B (Restart Power Transfer).	0x25U
CALIBRATION_PHASE_TOO_LONG	Occurs if the Power Transmitter does not receive a satisfactory Received Power Value within 10 seconds from entering the calibration phase.	0x26U
RESOURCE_CONFLICT	RESERVED	0x27U
CUST_ERROR	Occurs when an error comes from the customer code (4).	0x28U
EPT_UNKNOWN	Occurs when an “End Power Transfer” Packet has been received with a code equal to “Unknown”.	0x29U

1. *Refer to Qi standard*
2. *A “sticky error” corresponds to 3 consecutive occurrences of the following errors: EPT_NO_RESPONSE, EPT_RECEIVED, VIN_UNDER_VOLTAGE (VBUS_DROP_DOWN), EPT_CHARGE_COMPLETE or FO detected (PWR_BALANCE_FOD, PWR_BALANCE_FOD_MP, Q_FOD, FOD_DURING_NEGOTIATION).*
3. *Refer to timing tnext in the Qi standard*
4. *This notification is internal to the transmitter, it is not part of Qi specification.*

3 UART host interface

3.1 UART communication

The UART configuration is:

- Rate: 57600 bauds
- Data: 8 bits
- Parity: none
- Stop: 1 bit

UART communication consists of four messages (read, write, interrupts and store) sent to and from the customer host controller through UART. The structure is shown below:

Table 8. UART message structure

Byte0: header	Byte1: address	Byte2: data (optional)

Byte 2 is optional depending of the type of request.

Table 9. Byte values for UART communication

Type	Description	Format	Direction
Read	Reads the content of the host interface register.	• Byte0: “r” (=0x72) • Byte1: Host _if reg address	From host to STWBC
		STWBC sends back the corresponding data Byte0: Data read	From STWBC to host
Write	Writes data to the host interface register.	• Byte0: “w”(=0x77) • Byte1: Host _if reg address • Byte2: data	From host to STWBC
Interrupt	Sends an interrupt to the host (for example, to inform the host that new data is available).	Byte0: “i” (=0x69) On reception of the interrupt command, the host reads the int status register to get interrupt source.	From STWBC to host
Store	Copies parameters from RAM to EEPROM.	Byte0: “s” (=0x73)	From host to STWBC

Note: Low power mode is not possible when using UART. To return to low power mode when UART communication is no longer required, the host needs to send a "break" character.

3.2 Configurable parameters

You can use the GUI to change certain parameters used by the firmware. The parameters are stored in EEPROM and copied into RAM when the firmware initializes.

Note:

- *The physical quantity of the frequency parameter is Hertz/4 (i.e., granularity is 4 Hz)*
- *The physical quantity of the duty cycle parameter is %*10 (i.e., granularity is 1/10th %)*

Table 10. List of configurable parameters

Parameter name	Description	Unit
hw_version	Version of the HW (Read Only)	NA
eeprom_version	Version of the EEPROM (Read Only)	NA
fw_version	Version of the FW (Read Only)	NA
fw_sub_version_1	Sub-version of the FW (Read Only)	NA
fw_sub_version_2	Sub-version of the FW (Read Only)	NA
hw_sub_version	Sub Version of the HW (Read Only)	NA
qi_version	RFU	NA
force_high_power	Debug parameter that forces CPU to High Power Mode (no deep sleep, no WFI state enabled) Allows use of IAR debug tools. 1 → Force High power mode 0 → Restore previous power mode	NA
brg_freq_analog_ping	Specific power signal operational frequency used during object detection phase. Sets frequency and duty cycle (via function) of produced Analog Ping burst.	Hertz/4
brg_freq_digital_ping	Specific power signal operational frequency used during Digital Ping state.	Hertz/4
brg_freq_max	Maximum power signal frequency allowed by the transmitter	Hertz/4
brg_freq_min	Minimum power signal frequency allowed by the transmitter.	Hertz/4
brg_f_max_dc_max	Maximum power signal duty cycle allowed by the transmitter.	%*10
brg_f_max_dc_min	Minimum power signal duty cycle allowed by the transmitter.	%*10
brg_bridge_topology	Variable to indicate if the HW is full or half bridge. Must be set to: FULL_BRIDGE_ENABLE or HALF_BRIDGE_ENABLE	NA
pres_det_thr	Threshold above which an object is considered detected (used during analog ping).	NA
temp_high_meas_thr	If during coil temperature check, the average of several ADC measurements is below temp_high_meas_thr, an over-temperature error is assumed.	NA
temp_low_meas_thr	After an over-temperature, if the ADC measurement is above temp_low_meas_thr, the over-temperature issue is considered as solved.	NA
sys_number_of_coils	Number of coils on the HW	NA
sys_gpio_expander_address	Address of the GPIO expander	NA
sys_over_current_thr	Threshold above which the Tx will limit the current. If there is a large current step (500mA above the threshold) the system will stop immediately, raising a TX_OVER_CURRENT error	NA
sys_red_led_mode	Red LED mode management: Normal mode → LED blinks for all errors Demo mode → LED blinks for FOD error only	NA
dcdc_v_init	DCDC init voltage	mV
dcdc_v_lo_coil	DCDC voltage value during digital ping on the top primary coils or for single coil HW	mV
dcdc_v_hi_coil	RESERVED	NA

Parameter name	Description	Unit
brg_dead_time	Dead time for bridge driving	96 MHz clock periods (=10.41 ns)
power_profile_type	Indicates the profile of the transmitter: 0 → Baseline Power Profile 2 → Extended Power Profile	NA
vin_LP_MP_transition_thr	Low power/medium power threshold: below → the TX considers that the power supply indicates that it will low power mode above → the TX considers that the power supply indicates that it will run in EPP mode	NA
dcdc_voltage_max_lp	Maximum DCDC voltage when the power transfer is in “baseline power profile” mode	mV
dcdc_voltage_max_mp	Maximum DCDC voltage when the power transfer is in “extended power profile” mode	mV
sys_pow_limitation	Used for power limitation: 0 → power limitation disabled between 0 and 30000 → power limitation value (e.g., 4400 means power limited to 4,400 mV). greater than 30000 → power limitation = Vin – (30000 – value) (e.g. 31000 means power limited to Vin - 1000 mV). In the GUI, a negative value means Vin - value (-1000 mV means power limited to Vin - 1000 mV). Note that a clamp is set at 4.6V (if you set a value below 4.6V, you will have a limitation at 4.6V).	mV
fod2_thr_coef	Coefficient used during power transfer phase on the central coil when determining the threshold above which a Foreign Object is detected. 0 → it disables the FOD feature used during power transfer.	NA
fod2_thr_offset	Offset used during power transfer phase on the central coil when determining the threshold above which a Foreign Object is detected.	NA
fod2_freq_max	Frequency below which, during power transfer, if all the foreign object detection criteria are met, a foreign object detection error is raised. Above this frequency, no foreign object detection error can occur during power transfer.	Hertz
fod2_loss_correction_1	Loss contribution as square of bridge voltage. Used during the secondary FOD algorithm when power transfer is on the central coil.	NA
fod2_loss_correction_2	Loss contribution as square of ringing voltage. Used during the secondary FOD algorithm when power transfer is on the central coil.	NA
fod2_loss_correction_3	Loss contribution as power at ringing voltage. Used during the secondary FOD algorithm when power transfer is on the central coil.	NA
fod2_loss_correction_4	Loss contribution as square of bridge current. Used during the secondary FOD algorithm when power transfer is on the central coil.	NA
fod2_loss_correction_5	Loss contribution as square of bridge current. Used during the secondary FOD algorithm when power transfer is on the central coil.	NA
fod2_loss_correction_6	Reserved for future use.	NA
fod2_thr_coef_ext	Coefficient used during power transfer phase on the external coils when determining the threshold above which a Foreign Object is detected. 0 → disables the FOD feature used during power transfer.	NA

Parameter name	Description	Unit
fod2_thr_offset_ext	Offset used during power transfer phase on the external coils in the determination of the threshold above which a Foreign Object is detected.	NA
fod2_loss_correction_ext_1	Same as fod2_loss_correction_1 but for external coils.	NA
fod2_loss_correction_ext_2	Same as fod2_loss_correction_2 but for external coils.	NA
fod2_loss_correction_ext_3	Same as fod2_loss_correction_3 but for external coils.	NA
fod2_loss_correction_ext_4	Same as fod2_loss_correction_4 but for external coils.	NA
fod2_loss_correction_ext_5	Same as fod2_loss_correction_5 but for external coils.	NA
fod2_loss_correction_ext_6	Reserved for future use.	NA
ovp_adc_thr	Threshold above which the overvoltage protection is activated. 0 → the OVP feature is deactivated.	mV
dcdc_voltage_max_at_dping	Maximum allowed DCDC voltage value during the digital ping phase.	mV
qfactor_l_value	Primary coil inductance for Q factor estimation.	µH *1000
qfactor_q_adjust	Scaling coefficient applied on Q factor estimation on the central coil.	NA
qfactor_q_adjust_ext	Scaling coefficient applied on Q factor estimation on the external coils.	NA
qfactor_q_target	Q factor estimator target value reached after calibration (i.e., when nothing is on TX surface)	NA
qfactor_comp_tolerance	Coefficient applied to reported Q factor used to calculate threshold for FO during negotiation detection. Corresponding percentage can be obtained by multiplying by (100/128).	NA
qfod_qfactor_thr	Threshold used for early FO detection in both MP and LP Rx mode. This threshold is compared to measured Q factor.	
qfod_qperiod_thr	Margin used for early FO detection in both MP and LP Rx mode. This is applied to Q factor estimator 2nd metric (period) to finely detect or not a FO presence.	
fast_charge_enable	Indicates the fast charging status: 1 → enabled 0 → disabled	NA
nb_pid_iteration	Number of iterations during the PID loop. The default value is set to 4.	NA
open_loop_pid_speed	Reserved for future use	NA
fod2_temperature_comp	Coefficient used for the temperature compensation in the FOD algorithm during power transfer.	NA
checksum	Checksum of EEPROM values	NA

4 Parameter tuning GUI

The parameter tuning GUI tool (STSW-STWBCGUI) allows accessing registers used by the firmware.
You can modify the default parameters and push the new values into EEPROM.
The list of available registers is given directly in the GUI.

4.1 Launching the GUI

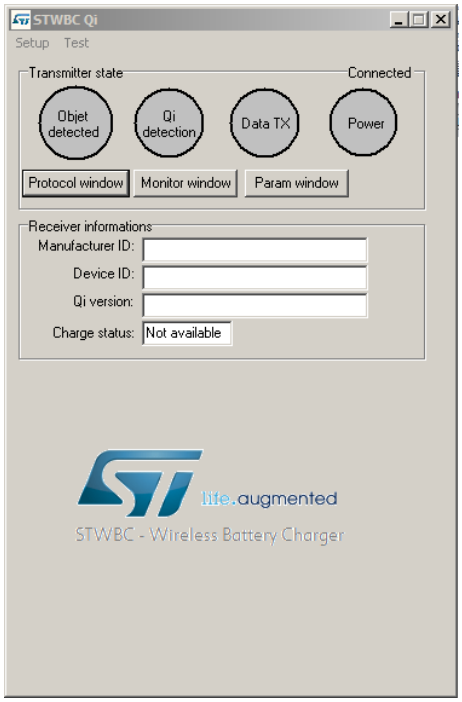
To launch the STSW-STWBCGUI:

Step 1. Switch the board on

Step 2. Plug the UART jack connector

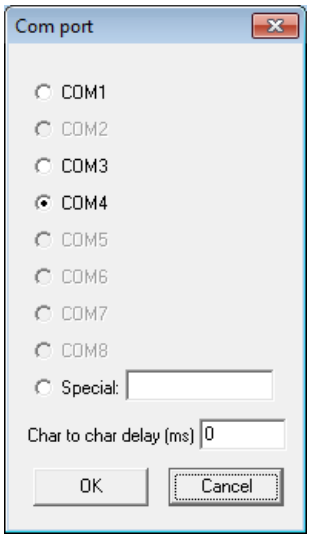
Step 3. Launch the executable program

Figure 3. STSW-STWBCGUI main panel



Step 4. Select the UART COM port in the [**Setup**]>[**COM**] menu to connect the board.

Figure 4. STSW-STWBCGUI COM setup panel



4.2 Modifying the registers

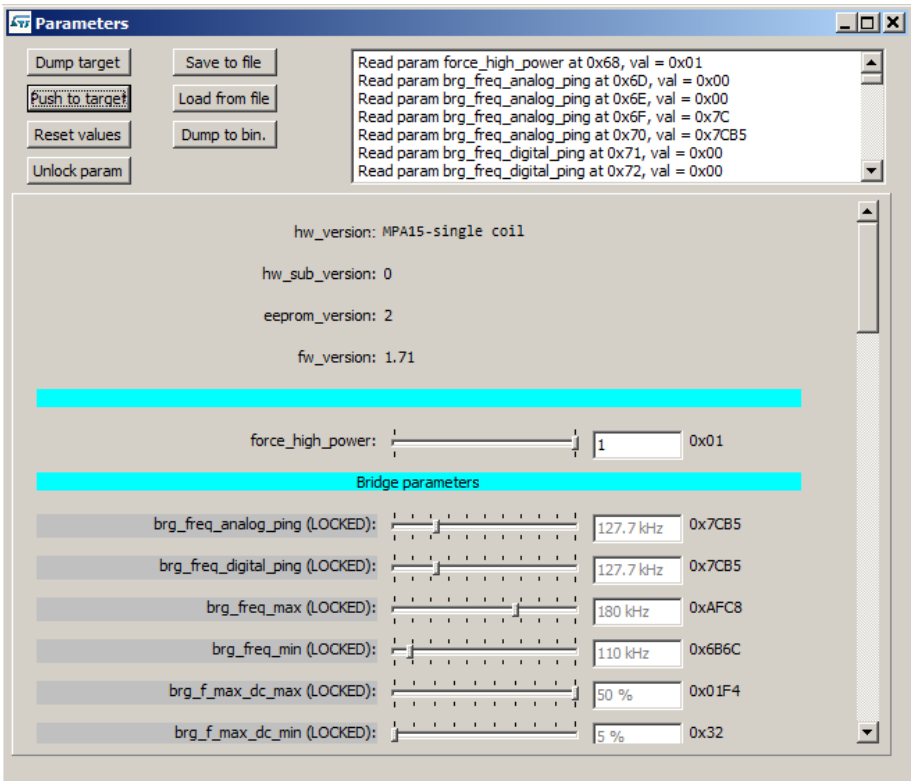
Step 1. Click on the [**Param window**] in the STSW-STWBCGUI main panel.

When you open the panel, all parameters are transferred from the board to the GUI. The parameters free to be modified are highlighted in green, whereas the more critical ones are highlighted in grey and tagged as "LOCKED".

Step 2. To update the grey parameters, click the [**Unlock param**] button.

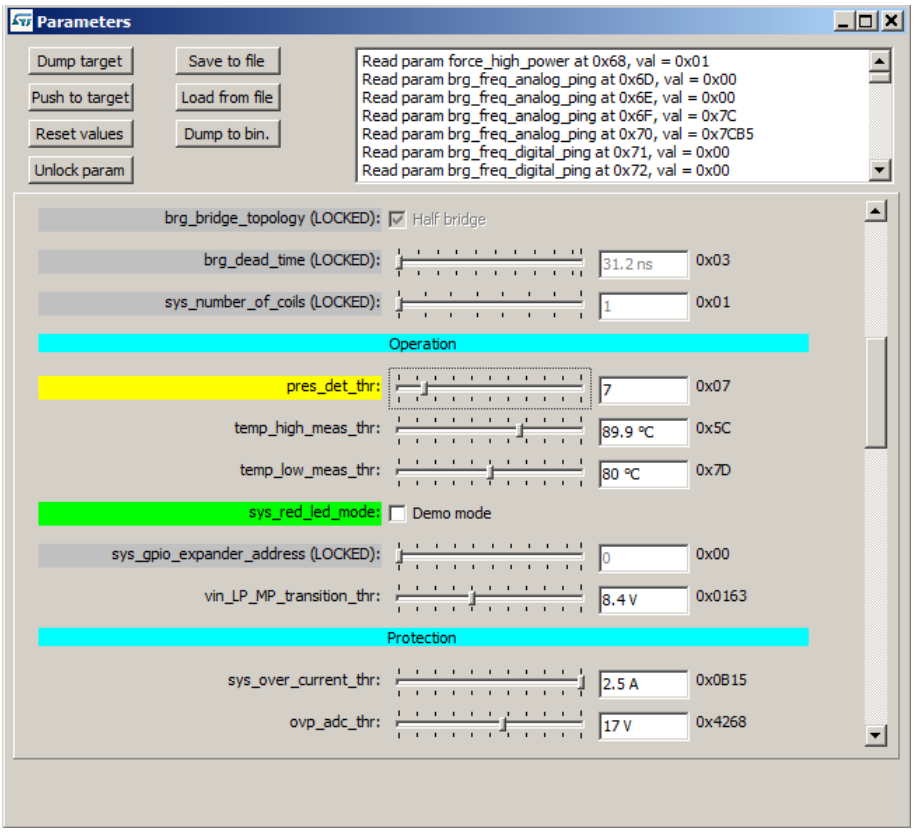
Note: The parameters that remain grey cannot be modified.

Figure 5. STSW-STWBCGUI parameter tuning window



Step 3. Select the value you want to update and then [**Enter**] on your keyboard.
The modified values will be highlighted in yellow.

Figure 6. STSW-STWBCGUI parameter update

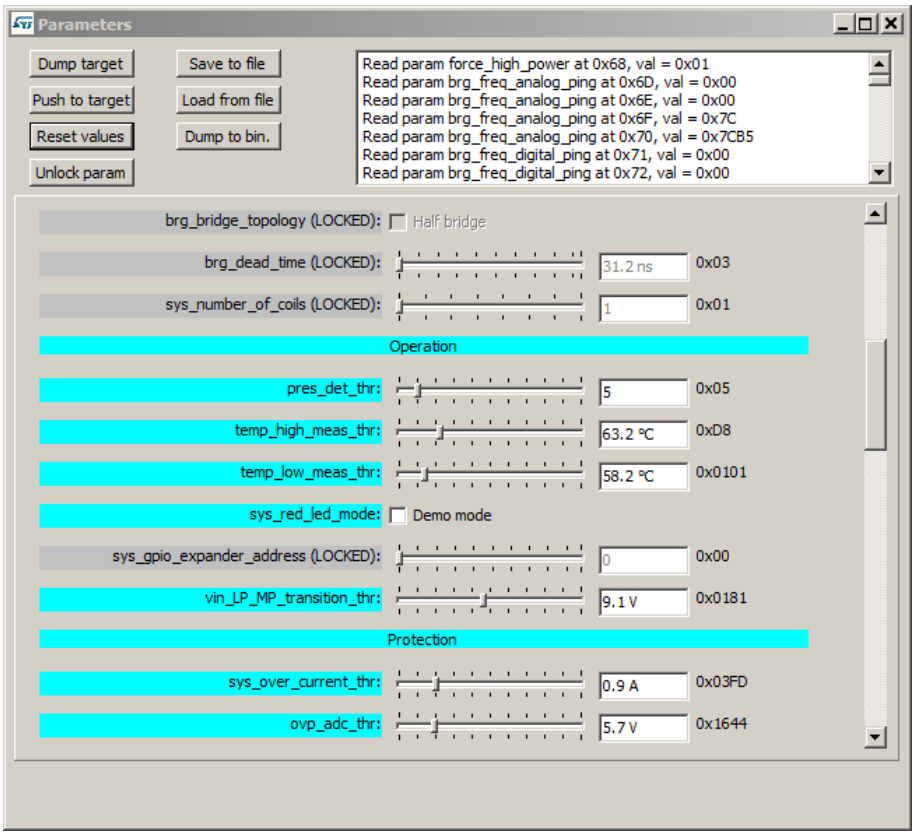


Step 4. Click on [**Push to target**] button to send updated parameter(s) to the board EEPROM parameter table.
All the parameters will be highlighted in green again.

4.3 Restore default values

Step 1. Click on [**Reset values**]
The background turns to light blue

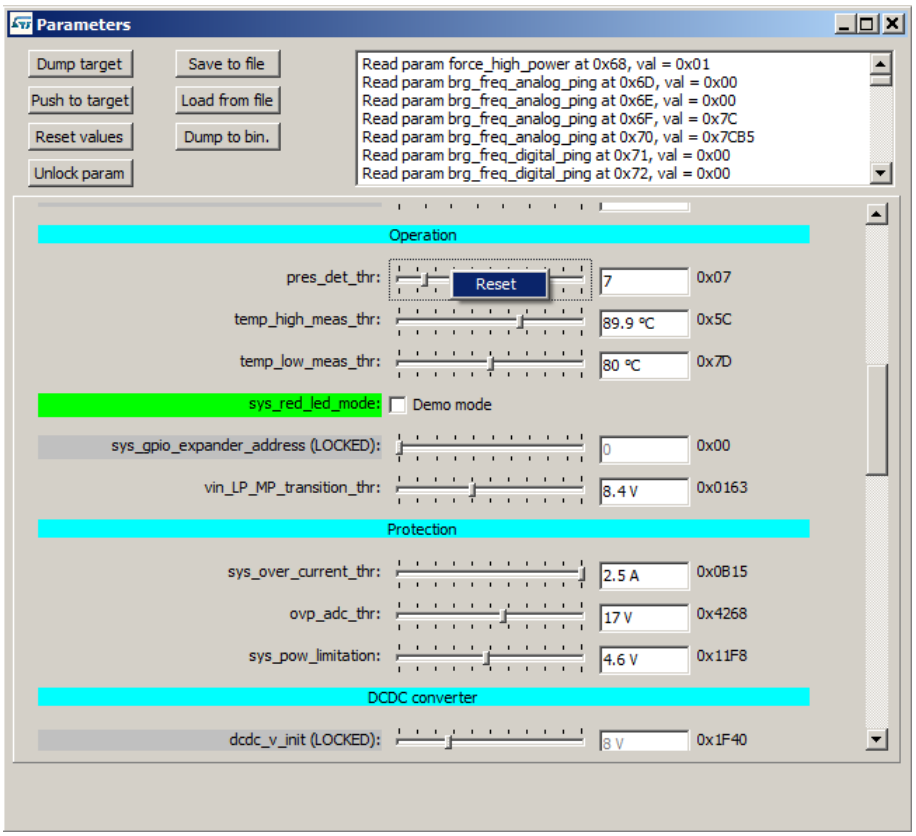
Figure 7. STSW-STWBCGUI parameter tuning window: restore default values



Step 2. Click on [**Push to target**] button to send updated parameter(s) to the board EEPROM parameter table.
All the parameters will be highlighted in green again.

Step 3. To restore the default value of a single parameter, right click on the parameter and click [**Reset**]>[**Push to target**]

Figure 8. STSW-STWBCGUI parameter tuning window: reset default values



4.4 Save and load parameter values

Step 1. Click on **Save to file** to save all the parameter values in the GUI to a file.

Step 2. Click on **Dump to bin** to dump the parameters into a bin file.

Step 3. Click on **Load from file** to reload all the parameter values in the GUI from a saved parameter file.

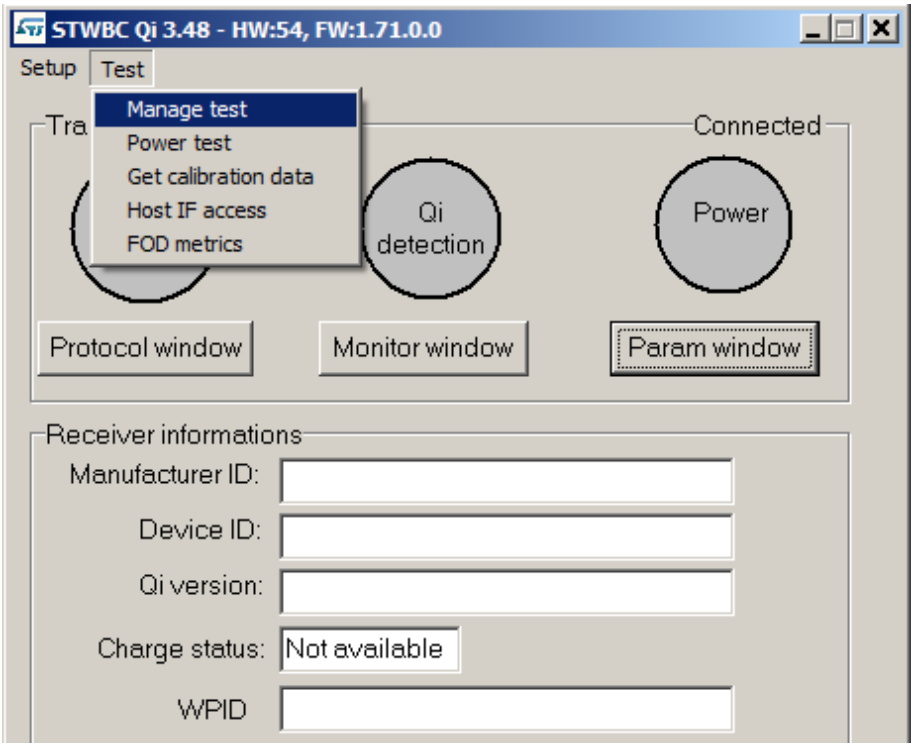
4.5 How to launch auto-calibrations and tests

Platform allows performing some tests (e.g for production test purpose) and system auto-calibrations.

Important:
Auto-calibration is mandatory when a new firmware version or a new EEPROM version is downloaded onto the platform.

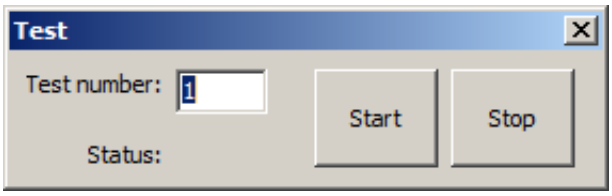
Step 1. In the GUI, go to [**Test**]>[**Manage test**].

Figure 9. Test menu



[**Manage test**] opens the following dialog box.

Figure 10. Test dialog box



Step 2. To launch system auto-calibration (presence detection, FOD, etc.), use the test dialog box:

Step 2a. Enter auto-calibration corresponding number in “Test number” field

Step 2b. Press [**Start**] to make the chosen auto-calibration start (the status field indicates "Started")

Step 2c. When auto-calibration stops (from few seconds to a minute depending on the auto-calibration), the system sends an end notification in the dialog box to warn user: if auto-calibration is OK, the status field indicates “Test done”, otherwise it indicates “Test failed”.

Note: “Test failed” status can sometimes occur for a 1st trial of a board auto-calibration. In that case you have to power the board off/on and try again.

Note: A new firmware version download resets auto-calibration tunings. You have to perform all the necessary auto-calibrations again.

5 Read proprietary message

When an interrupt message is received with the bit `INT_SRC_PROP_MSG_RECEIVED` set in the status register, it means that a proprietary message has been received.

The Host can read the content of the message by sending a read command for the `HOST_IF_PROPRIETARY_MSG` register.

The first byte read is the header of the message, followed by the payload. The host uses the message length information in the header to send the correct number of read requests.

6 LED status

State	Red LED	Green LED	Meaning
At startup	Short blink	Off	Occurs during board auto-calibration. Wait until the LED switches off before putting a receiver on the surface.
	Blink once	Blink once	An internal reset occurred.
	On	On	Firmware/STWBC chip mismatch.
In steady state	Off	Blink normal rate	Charging at maximum 5W.
	Off	Blink fast rate	Charging at fast rate (maximum 10W in AFC or 15W in EPP mode).
	Off	Blink slow rate	Charging at reduced rate due to either: • Over voltage protection active • Power limitation caused by limited supply capabilities • Current limitation protection
	Off	On	Charge complete.
	Blink	Off	An error has been detected.
	On	Off	A sticky error has been detected (e.g., 3 FOD in a row).

Revision history

Table 11. **Document revision history**

Date	Version	Changes
14-May-2019	1	Initial release.
17-Sep-2019	2	Minor changes inside the document

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