RAA458100GNP and RAA457100GBM
Wireless Charging Solution Evaluation Kit (WiQ-TX00-B00 / WiQ-RX00-B00)

R19AN0043EJ0101
Rev.1.01
Sep.03 2018

Introduction

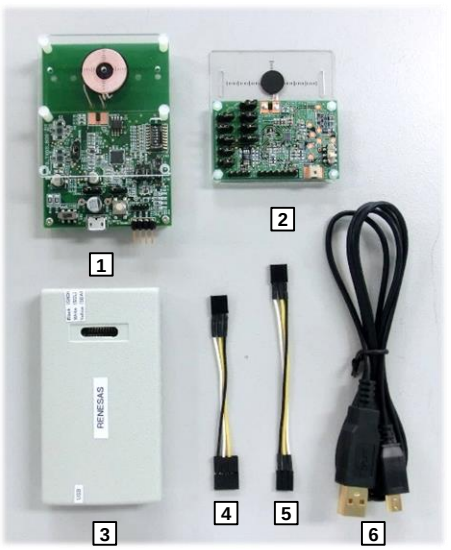
This document is explanatory material for the wireless charging evaluation by RAA458100GNP and RAA457100GBM. The evaluation kit is consisted of the Transmitter Board (WiQ-TX00-B00), the Receiver Board (WiQ-RX00-B00), the Host adaptor (RTK0EF0029Z00001BJ) and the Control Tool(RWCE_Tool_v2.xx). It can be considered in the application which has wireless charging function at a low cost and in a short period of time.

Features

- 2 types of evaluation boards mounted transmitter and receiver coil antenna for charge current 17mA and 64mA.
- It can be set operation mode by jumpers and switches on board.
  (Stand Alone, ATPC, MCU Control Mode)
- Excellent operability by dedicated GUI tool. (It can be monitored voltage and current, set to register.)

Evaluation Kit Configuration

No.	Item	Charge current :17mA	Charge current :64mA
1	TX Board	WiQ-TX00-B00-TD1	WiQ-TX00-B00-TD2
2	RX Board	WiQ-RX00-B00-TD1	WiQ-RX00-B00-TD2
3	Host adaptor	RTK0EF0029Z00001BJ	
4	Cable A	Host adaptor output cable	
5	Cable B	2 wire serial interface cable	
6	USB cable	USB A – mini B Cable	
7	Control tool	Renesas Wireless Charging Evaluation Tool : RWCE_Tool_v2.xx.zip	
8	USB Driver	USBdriver.zip	



Abbreviations and the meanings

The following table shows the abbreviations and the meanings used in this document.

Term	Description
TxIC	Wireless charging system transmitter IC RAA458100GNP.
RxIC	Wireless charging system receiver IC RAA457100GBM.
TxROM, EEPROM	EEPROM in transmitter system.
TxMCU	The device connected to TxIC by 2-wire interface. (mainly microcomputer)
RxMCU	The device connected to RxIC by 2-wire interface. (mainly microcomputer)
Tx system	Wireless charging transmitter system. It is constructed by “TxIC only” or “TxIC and TxMCU” or “TxIC and EEPROM”.
Rx system	Wireless charging receiver system. It is constructed by “RxIC only” or “RxIC and RxMCU”.
WPT communication	Communication on wireless power transmission carrier signal.
Tx2Rx WPT communication	WPT communication from TxIC to RxIC.
Rx2Tx WPT communication	WPT communication from RxIC to TxIC.
T_Header	The header of Tx2Rx WPT communication packet.
R_Header	The header of Rx2Tx WPT communication packet.

* The values described in this document are reference values, not guaranteed values.

Contents

1. Wireless charger evaluation kit overview

1.1 Evaluation board specification

Table 1.1, Table 1.2 show the board specification of WiQ-TX00-B00, WiQ-RX00-B00 (typical values).

Table 1.1 The board specification of WiQ-TX00-B00-TD1, WiQ-TX00-B00-TD2.

Item	Symbol	**WiQ-TX00-B00-TD1**	**WiQ-TX00-B00-TD2**	Unit
Input voltage	V_{IN}	5.0	5.0	V
Input current	I_{IN}	26	54	mA

I_{IN} is default value in TX board when RX board is default setting.
It is recommend that the power supply of TX board is used stabilized power supply or mobile battery or AC adaptor.

Table 1.2 The board specification of WiQ-RX00-B00-TD1, WiQ-RX00-B00-TD2.

Item	Symbol	**WiQ-RX00-B00-TD1**	**WiQ-RX00-B00-TD2**	Unit
Charge control voltage range	V_{CHG}	4.05 / 4.20(*) / 4.35	4.05 / 4.20(*) / 4.35	V
Fast charge current range	I_{CHG}	4.3 / 8.6(*) / 17.1	16 / 32(*) / 64	mA
Charge complete current range	I_{FC}	$0.20 \cdot I_{CHGR}$, $0.15 \cdot I_{CHGR}$ $0.10 \cdot I_{CHGR}$(*), $0.05 \cdot I_{CHGR}$	$0.20 \cdot I_{CHGR}$, $0.15 \cdot I_{CHGR}$ $0.10 \cdot I_{CHGR}$(*), $0.05 \cdot I_{CHGR}$	mA

I_{CHGR} is 17.1mA of WiQ-RX00-B00-TD1.
I_{CHGR} is 64.0mA of WiQ-RX00-B00-TD2.
(*) is default value. These values can be changed by setting window or register map in control tool.

1.2 Connection of the evaluation kit

Figure 1.1 shows the connection of TX board, RX board are set to slave device for 2-wire serial communication in ATPC Mode (AT4). Table 1.3 and Table 1.4 show default condition of TX board and RX board.

In this application note, ATCHG pin setting is low for evaluation in AT4, but ATCHG pin should be set to high if product system is actually configured in AT4.

The connection is different by the operation mode. Refer to chapter 2,3,4 about the connection in each operation modes.

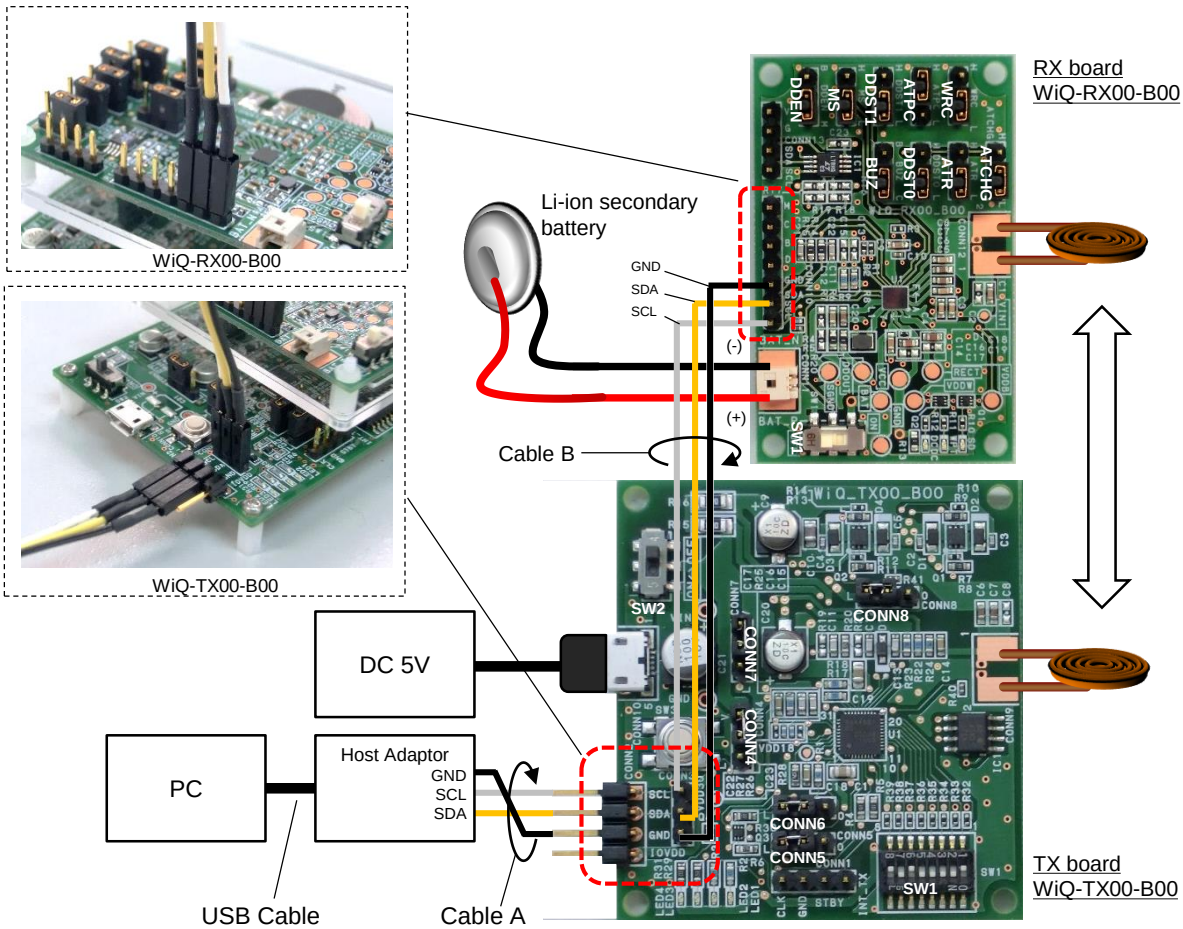


Figure 1.1 Connection of Wireless charging evaluation kit

Table 1.3 Initial pin setting of TX board

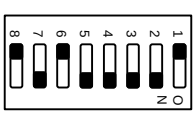
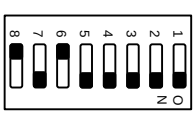
Item	Name	WiQ-TX00-B00-TD1	WiQ-TX00-B00-TD2
		Default Condition	Default Condition
Jumper	CONN4	V side	←
	CONN5	L side	←
	CONN6	L side	←
	CONN7	V side	←
	CONN8	L side	O side
Switch	SW1		
	SW2	OFF	←

Table 1.4 Initial pin setting of RX board

Item	Name	WiQ-TX00-B00-TD1/TD2
		Default Condition
Jumper	WRC	L side
	ATCHG	L side
	ATPC	H side
	ATR	L side
	DDST0	L side
	DDST1	L side
	MS	L side
	BUZ	C side
	DDEN	M side
Switch	SW1	OFF

1.3 Connection method of power supply to WiQ-TX00-B00

Figure 1.2 shows the connection of an input power supply and the TX board. Connect in either of Figure 1.2 (1) or (2).
[Caution !] Do not connect the mobile battery and DC power supply at the same time.

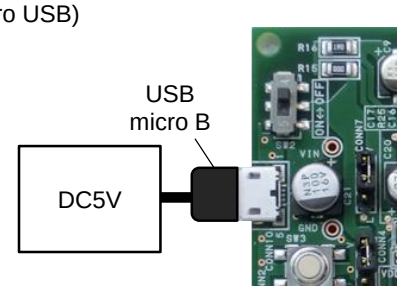
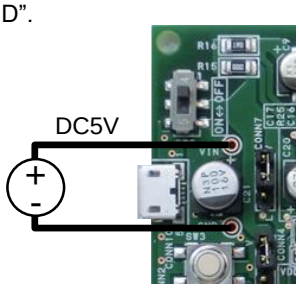
(1) Using a mobile battery	(2) Using a DC power supply
Connect a mobile battery to CONN10. (Micro USB) 	Connect a DC power supply to through hole of “VIN” and “GND”. 

Figure 1.2 Connection method of power supply to WiQ-TX00-B00

1.4 Host adaptor：RTK0EF0029Z00001BJ

In order to control the evaluation board from PC, host adaptor (RTK0EF0029Z00001BJ) is used. The host adaptor can control both boards when TX board and RX board are set to slave device.

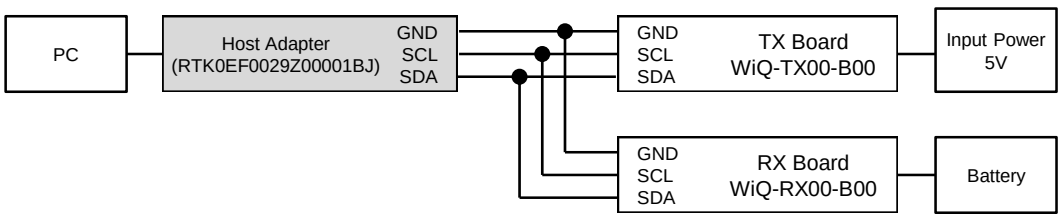


Figure 1.3 Connection of the host adaptor

1.4.1 Connection of the host adaptor

USB A – USB mini B cable is needed. This cable should be connected to USB mini B connector.
2-wire serial communication interface cable (Cable A) should be connected to CN1 connector.
SDA and SCL of 2-wire serial communication Interface (CN1) are pulled up with 5V by pull up resister (10kΩ) on board.

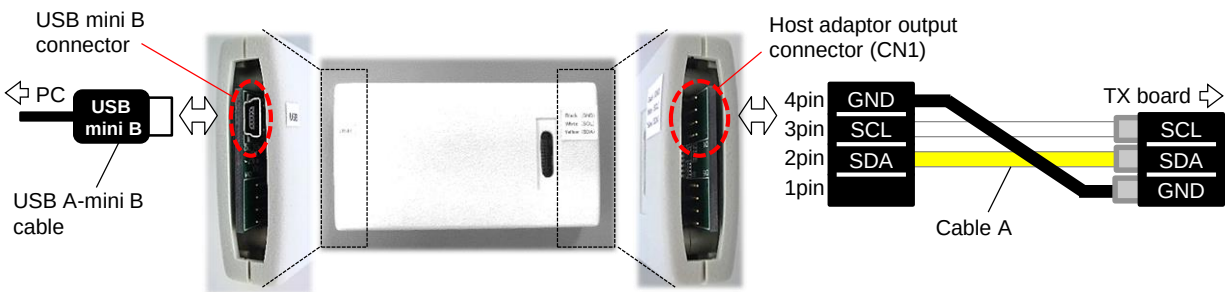


Figure 1.4 RTK0EF0029Z00001BJ description

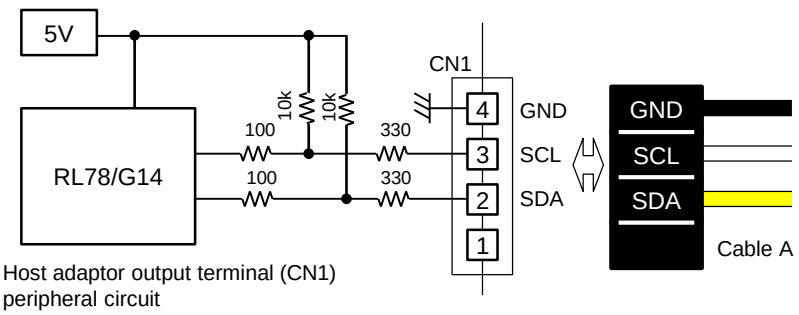


Figure 1.5 RTK0EF0029Z00001BJ CN1 internal circuit

1.4.2 Driver install procedure for the host adaptor

Windows7 need to install driver software. Driver install procedure is below.
Windows10 does not need to install it.

(1) Unzip “USBdriver.zip” on your PC.
(2) Host adaptor “RTK0EF0029Z00001BJ” should be connected your PC by USB cable.
(3) When device manager on your PC is opened, unrecognized device is displayed in table. Right click on unrecognized device, and select “Update driver software”.
(4) Select “RTK0EF0029Z00000BC_Win7.inf” in “USBdriver” folder to install to your PC.
(5) Confirm the port of device manager added “RTK0EF0029Z00000BC”.

1.5 Wireless charging control tool

1.5.1 System requirements

Windows 7, 10 PC

1.5.2 Installation guide

・No installation is required for using this tool. (Registry will not be changed.)
・Please unzip the .zip file into any folder. Run the file of “RWCE_Tool.exe” in unzipped folder, then RWCE tool will open.
・If you want to delete this tool, please delete the folder itself.
・Each settings describing after this are saved. So this tool restarts with settings just before closing.
・If you want to return each settings to initial value, please replace files to just unzipped file.

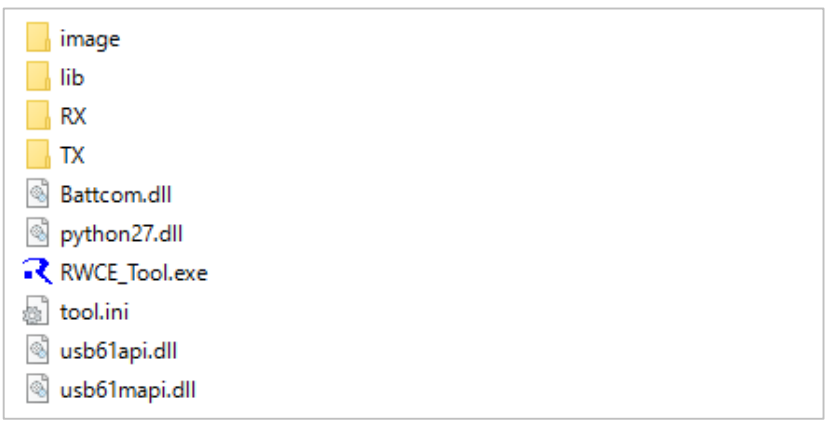


Figure 1.6 Unzipped file

1.6 Battery Charging System Configuration Example

Table 1.5 shows the battery charging system configuration and pin setting by using TxIC and RxIC. The evaluation kit can confirm the control operation by manipulating the control tool instead of TxMCU and RxMCU.
Refer to Table 1.5 and Chapter 2 to 4, if you evaluate the operation mode is not described in this application note.

Table 1.5 Battery charging system configuration example

Operation mode					Start up procedure for the evaluation kit	TxIC pin seting					RxIC pin setting				
No.	TX system		RX system			MS	ATPC	DUTY6	DUTY7	DUTY8	MS	ATPC	ATCHG	ATR	WRC
	Master	Slave	Master	Slave											
Stand Alone Mode															
SA1	-	TxIC	RxIC	-	-	L	L	Set one or more pins to high level			H	L	H	L	L
SA2	TxIC	TxROM	RxIC	-	-	H	L	Set one or more pins to high level			H	L	H	L	L
ATPC Mode															
AT1	TxIC	TxROM	RxIC	-	Chapter 3	H	H	L	L	L	H	H	L	X	L
AT2	TxMCU	TxIC	RxIC	-	-	L	H	L	L	L	H	H	L	X	L
AT3	TxMCU	TxIC	RxIC	RxMCU	-	L	H	L	L	L	H	H	L	X	L
AT4	TxMCU	TxIC	RxMCU	RxIC	Chapter 2	L	H	L	L	L	L	H	H	X	L
MCU Control Mode															
MC1	TxMCU	TxIC	RxMCU	RxIC	Chapter 4	L	L	L	L	L	L	L	H	L	L
Wired Charging Mode															
WC1	-	-	RxIC	-	-	-	-	-	-	-	H	L	H	L	H

X： Arbitrary value can be selected.

2. Start up procedure (1) for ATPC Mode (AT4)

This chapter describes connection of evaluation board and usage of control tool in below condition.
・“ATPC Mode”(AT4) : Automatic transmission power control mode. (Default setting in TX and Rx board)
・TxIC and RxIC are slave device setting in 2-wire serial communication interface.
・ The control operation is realized by manipulating the control tool instead of TxMCU and RxMCU.

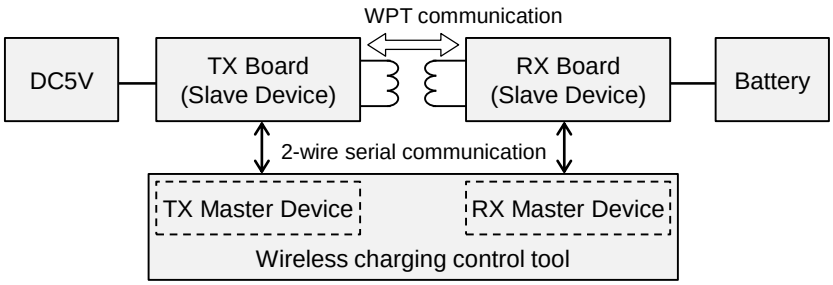


Figure2.1 Evaluation system in AT4

2.1 Connection of evaluation board

Page 3, Figure 1.1 shows the connection of TX board, RX board, Host adaptor, Coil antenna, Li-ion battery, and DC power to TX board (DC5V). The setting of jumpers and switches in TX board and RX board are default setting described in Table 1.3 to 1.4.
In this application note, ATCHG pin setting is low for evaluation in AT4, but ATCHG pin should be set high if product system is actually configured in AT4.

2.2 Start up evaluation tool

If host adaptor’s driver is not installed, setup the driver (Refer to Page5). If OS is Windows 10, It is not necessary to install the driver.
Install the Wireless Charging Evaluation Tool “RWCE_Tool_v2.xx” (Refer to Page5).
When “RWCE_Tool.exe” run, then tool window opens in Figure2.2. When WiQ-RX00-B00-TD2 is used, set “1.5”k ohm in RICHG value for calculation of the tool. When WiQ-RX00-B00-TD1 is used, RICHG value do not need to be changed. When the fast charge current is changed to 1C, select “1C” in “ICC_THM_M”.

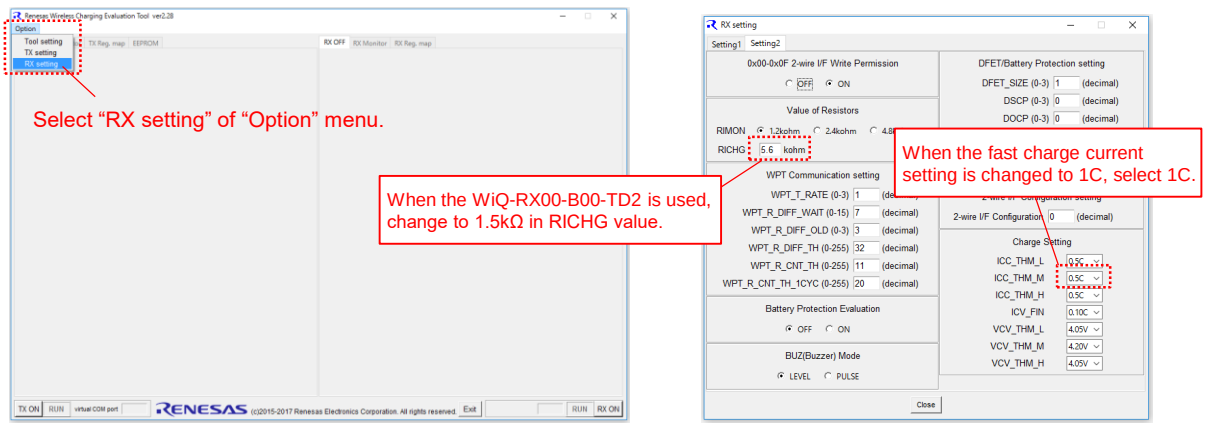


Figure 2.2 Tool window after start up

2.3 Wireless charging evaluation procedure in AT4

This section describes wireless charging procedure with control tool in ATPC Mode (AT4).

(1) Turn on the SW1 of RX board (WiQ-RX00-B00). LED1 is lightened for showing operation mode changes to discharge mode from shut down mode at RAA457100GBM. LED3 is also lightened for showing DCDC converter operates.

(2) Turn on the SW2 of TX board (WiQ-TX00-B00). DC 5V is supplied to TX board and LED4 is lightened.

(3) Click the “TX ON” and the “RX ON” on tool window. Monitor for evaluation is displayed as Figure 2.3.

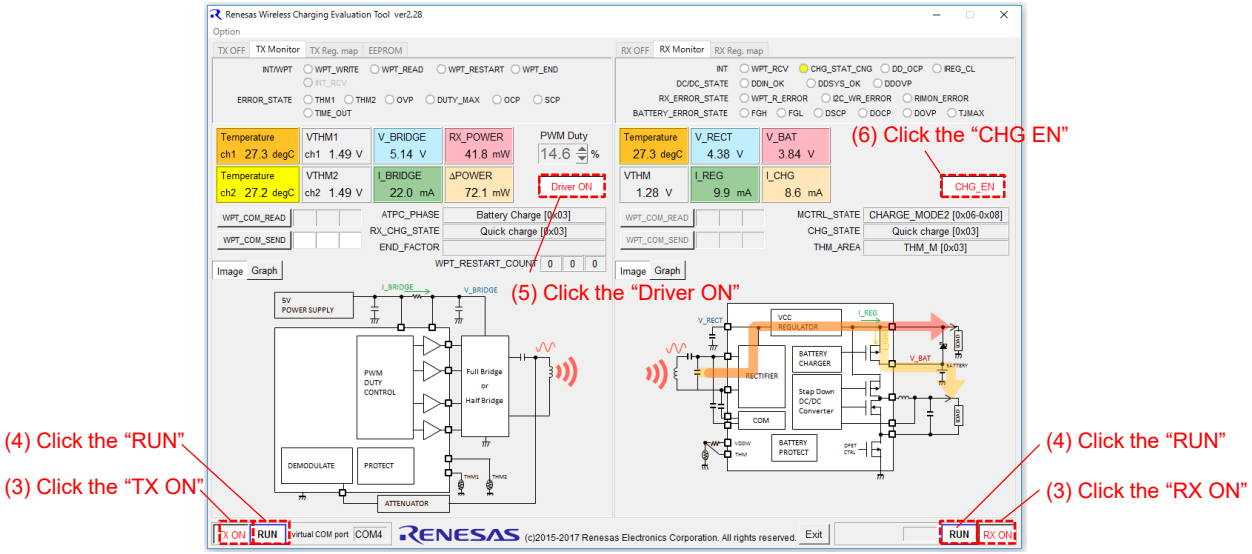


Figure 2.3 Control tool window at ATPC Mode

(4) Click the “RUN” in TX side and RX side on tool window.
RX side window : Animation of battery discharging and DCDC converter operation is displayed.
Register initial values are displayed in RX side monitor field.
TX side window : Monitored values are displayed in TX side monitor field.

(5) Click the “Driver ON” in TX side.
Bridge circuit of transmitter starts and power is transmitted to RX side. TxIC controls bridge driver duty to set the RECT pin voltage of RxIC into BAT pin voltage + 1.5V. Animation of TX side and RX side on tool window shows wireless power is transmitting. At this time, monitored values are displayed in RX side monitor field. LED1 of the TX board flashes on and off every 0.25s (default setting).

(6) Click the “CHG_EN” in RX side.
RxIC starts battery charging. At this time, TxIC controls bridge driver duty to set RECT pin voltage of RxIC into BAT pin voltage + 0.5V. LED1 of the TX board is switched over from a flash every 0.25s to lighting up.

(7) Battery charging is completed when battery voltage reaches charge control voltage and charging current reaches charge complete current set by “Option” / “RX setting” on control tool. LED1 of the TX board is switched over from lighting up to turning off the light.

(8) The “Driver ON” in TX side window can’t stop bridge circuit in ATPC Mode. When SW3 of TX board is pushed, TxIC become standby and TxIC register is initialized. Therefore bridge outputs stop. When SW3 of TX board is released, TxIC is activated. When TxIC is activated, TxIC register isn’t set. If you want to operate bridge circuit again, click the “TX ON” and close the TX side window. Then click the “TX ON” again, open the TX side window. Because TxIC register is set by this manipulation, bridge circuit operates again when the “Drive ON” in TX side is clicked.

(9) If the SW2 of TX board is turned off, the power supply in TX board is stopped.

Chapter 5 describes TX board and RX board in detail. Chapter 6 describes Control tool in detail.

3. Start up procedure (2) for ATPC Mode (AT1)

This chapter describes connection of evaluation board and usage of control tool in below condition.
・“ATPC Mode”(AT1) : Automatic transmission power control mode.
・TxIC and RxIC are master device setting in 2-wire serial communication interface.
・ Register setting is read from the EEPROM on TX board.

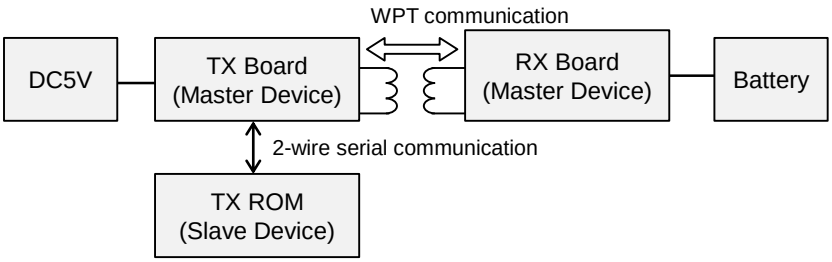


Figure 3.1 Evaluation system in AT1

3.1 Writing method to EEPROM in TX board

The control tool has EEPROM Write/Read tool. This section describes the procedure that necessary data is written into EEPROM in below condition.
・PWM initial duty is 24.9[%] ,fast charge current is 0.5xI_{CHGR}.

3.1.1 TX board connection in EEPROM Write/Read

Figure 3.2 shows the connection of TX board, Host adaptor and DC power supply to TX board (DC5V). The jumper and SW settings should be set default condition.(Refer to Table 1.3.)

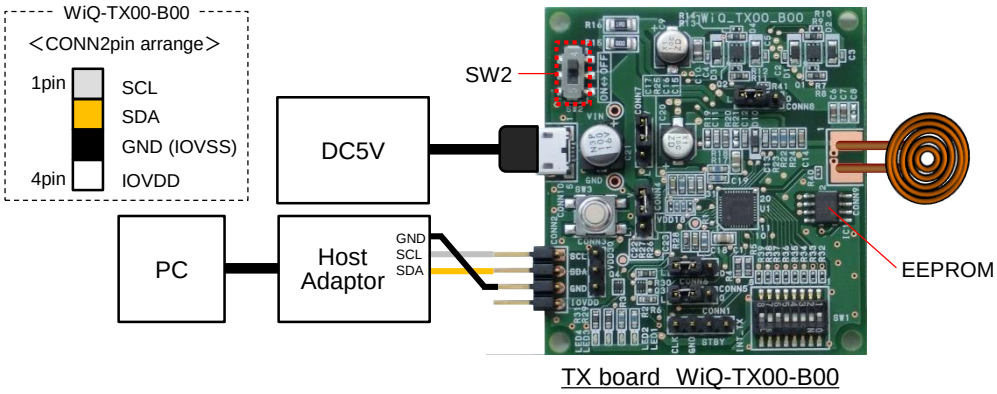


Figure 3.2 Connection in writing and reading EEPROM

3.1.2 Start up procedure of EEPROM Write/Read tool

This section describes start up procedure of EEPROM Write/Read tool. If host adaptor’s driver is not installed, setup the driver (Refer to Page5.). If OS is Windows 10, It is not necessary to install the driver.
Install the Wireless Charging Evaluation Tool “RWCE_Tool_v2.xx”. Refer to Page5.

(1) Turn on SW2 of TX board, Supply DC5V to TX board.
(2) When “RWCE_Tool.exe” run, then following window opens. (Figure 3.3)
(3) When “TX setting” in “Option” menu is selected, TX setting window opens.
(4) Select ”Master” in “Setting1” window, then click “Close” button.

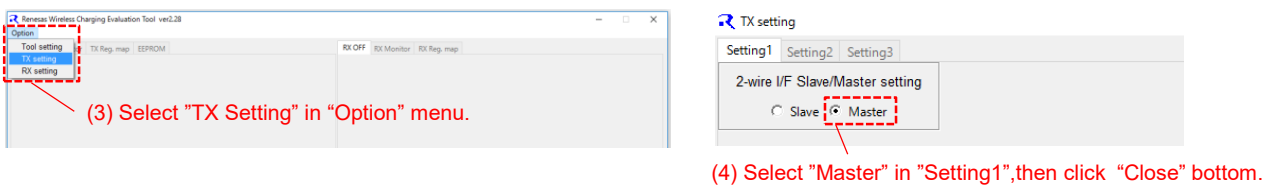


Figure 3.3 2-wire serial communication interface Slave/Master setting of TxIC in control tool

(5) When “TX ON” button is pushed, EEPROM Write / Read control tool opens. (Figure 3.4)

(6) Input EEPROM slave address into “I2C Slave Address”. Because default value is ”1010001” and EEPROM address setting of TX board is ”1010001”, Input address is not necessary.

(7) Input TX register address and data, RX register address and data into EEPROM tool window. For example, Figure 3.4 shows register setting that bridge duty is 24.9 [%] and fast charge current is 0.5xI_{CHGR}. The condition that fast charge current is 0.5xI_{CHGR} is default setting.

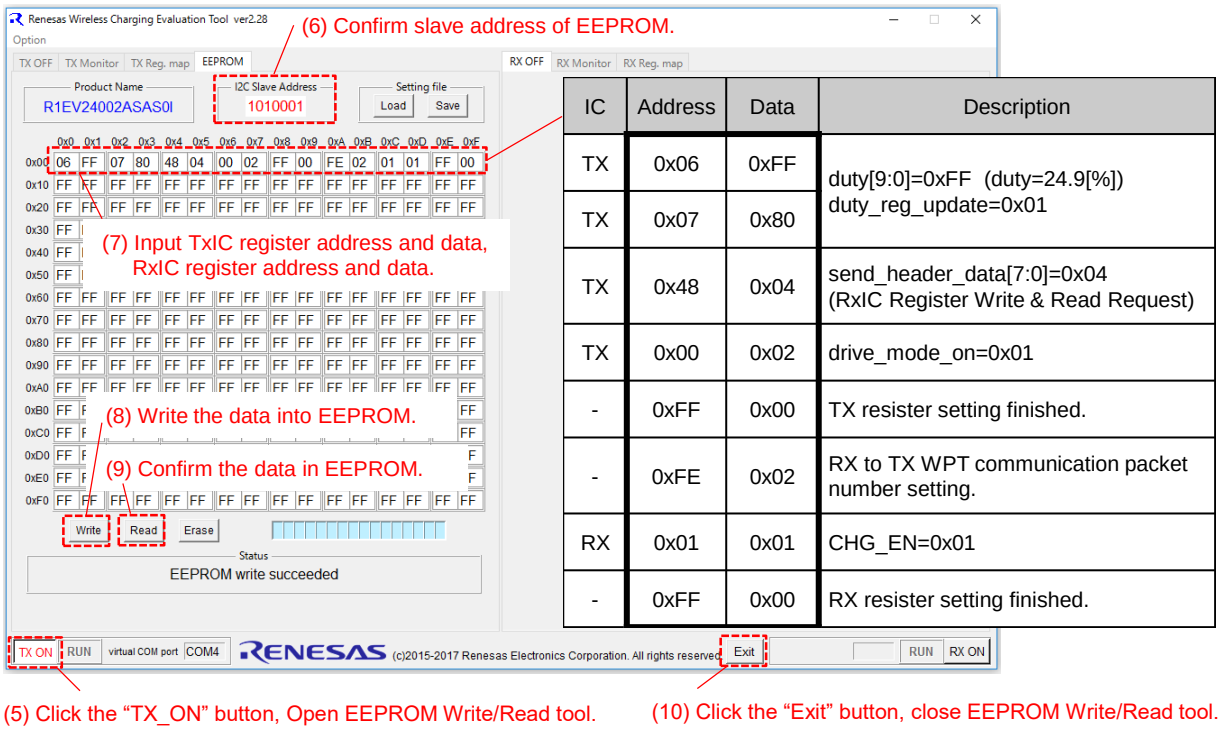
(8) When the “Write” button in tool window is clicked, data is written into EEPROM.

(9) When the “Read” button in tool window is clicked, written data in EEPROM is displayed. Confirm the EEPROM data.

(10) Click the “Exit” button in tool window, then close the control tool.

(11) Remove host adaptor output cable from TX board, Turn off the SW2 of TX board.

Refer to Page 35, 36 in detail (EEPROM Write/Read tool, Data configuration of EEPROM).



IC	Address	Data	Description
TX	0x06	0xFF	duty[9:0]=0xFF (duty=24.9[%]) duty_reg_update=0x01
TX	0x07	0x80	
TX	0x48	0x04	send_header_data[7:0]=0x04 (RxIC Register Write & Read Request)
TX	0x00	0x02	drive_mode_on=0x01
-	0xFF	0x00	TX resister setting finished.
-	0xFE	0x02	RX to TX WPT communication packet number setting.
RX	0x01	0x01	CHG_EN=0x01
-	0xFF	0x00	RX resister setting finished.

Figure 3.4 EEPROM Write/Read tool window

3.2 Connection of system board and procedure of wireless charging evaluation in AT1

3.2.1 Connection of system board in wireless charging evaluation in AT1

Connect the mobile battery or the external power supply to TX board. Change the 7 pin of SW1 in TX board setting to high side and the TxIC becomes master device for 2-wire serial communication interface (Figure 3.5).
Connect the battery to RX board. Change the jumper “MS” of RX board to high side and RxIC becomes master device for 2-wire serial communication interface. Remove the cable B between TX board and RX board.

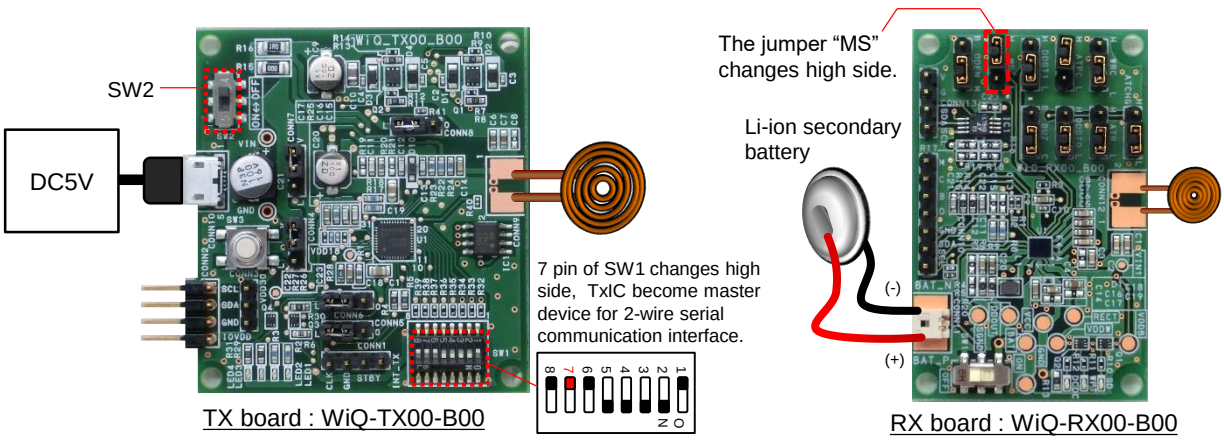


Figure 3.5 Connection of board in AT1

3.2.2 Wireless charging evaluation procedure in AT1 and the status of LED

When wireless charging is evaluated in AT1, the system evaluation tool is not used. Operation status of TX board and RX board can be confirmed by the status of LED lighting on TX board and RX board. Table 3.1 shows evaluation procedure in AT1 and the status of LED on TX board and RX board.

Table 3.1 Evaluation procedure in AT1 and the status of LED on TX board and RX board.

No.	Wireless charging evaluation procedure in AT1	TX Board				RX Board		
		LED1	LED2	LED3	LED4	SD (LED1)	WPT (LED2)	DCDC (LED3)
1	Turn on the SW1 of RX board.	Off	Off	Off	Off	On	Off	On
2	Turn on the SW2 of TX board.	↑	↑	↑	On	↑	↑	↑
3	Put RX board on TX board.							
	(1) Under WPT communication (Battery charging is available.)	Flashing (0.25s)	↑	↑	↑	↑	On	Off
	(2) Interruption signal in TxIC outputs after EEPROM data is written into RxIC by WPT communication.	↑	↑	On	↑	↑	↑	↑
	(3) Under battery charging.	On	↑	↑	↑	↑	↑	↑
	(4) Battery charge complete.	Off	↑	↑	↑	↑	↑	↑

When SW3 of TX board is pushed, TxIC become standby and TxIC register is initialized. Therefore bridge outputs stop. When SW3 of TX board is released, TxIC is activated. When TxIC is activated, TxIC starts to read the EEPROM data. TxIC starts to transmit power again.
If the SW2 of TX board is turned off, the power supply in TX board is stopped.

＜MEMO＞

4. Start up procedure (3) for MCU Control Mode (MC1)

This chapter describes connection of evaluation board and usage of control tool in below condition.
・“MCU Control Mode” : Bridge driver duty is set by control tool.
・TxIC and RxIC are slave device setting in 2-wire serial communication interface.
・The control operation is realized by manipulating the control tool instead of TxMCU and RxMCU.

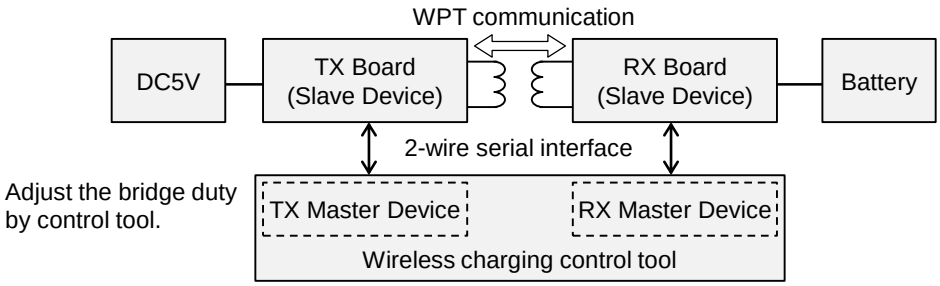


Figure 4.1 Evaluation system in MC1

4.1 Connection of evaluation board

Refer to section 1.2 for connection of TX board, RX board, Host adaptor, Coil antenna, Li-ion battery, and DC power to TX board (DC 5V). The setting of jumpers and switches of TX board and RX board are needed to change as shown Table 4.1 from Table 1.3 to 1.4.
In this application note, ATCHG pin setting is low for evaluation in MC1, but ATCHG pin should be set high if product system is actually configured in MC1.

Table 4.1 Setting of jumper and switch in MCU Control Mode

Board	Description
TX board WiQ-TX00-B00	SW1 : Selecting of MCU Control Mode. 6 pin (ATPC) = “L” (Refer to Table 1.3,1.4.) Setting of other jumpers and switches are default.
RX board WiQ-RX00-B00	Jumper “ATPC” is connected to “L” for MCU Control Mode. Setting of other jumpers are default.

4.2 Preparation

(1) Install the driver of host adaptor. Refer to Page 5/Chapter 1.4.2.

(2) Install the Wireless Charging Evaluation Tool “RWCE_Tool_v2.xx”. Refer to Page 5/Chapter 1.5.

(3) Run the control tool. Click the “Tool setting” in “Option” menu.

Select “MCU Control Mode” in “System configuration”.

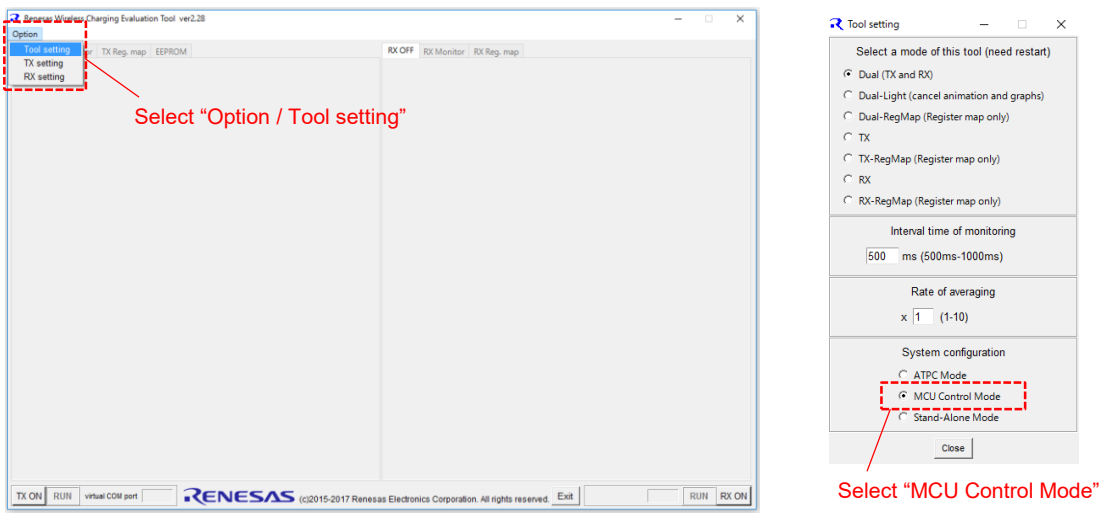


Figure 4.2 Tool window after start up

4.3 Wireless charging evaluation procedure in MC1

This section describes wireless charging procedure with control tool in MCU Control Mode.

(1) Turn on the SW1 of RX board. SD(LED1) is lightened for showing operation mode changes to discharge mode from shut down mode at RAA457100GBM. DCDC(LED3) is also lightened for showing DCDC converter operates.

(2) Turn on the SW2 of TX board. DC 5V is supplied to TX board ,then LED4 is lighted.

(3) Click the “TX ON” and the “RX ON” on tool window. Monitor for evaluation is displayed as Figure 4.3.

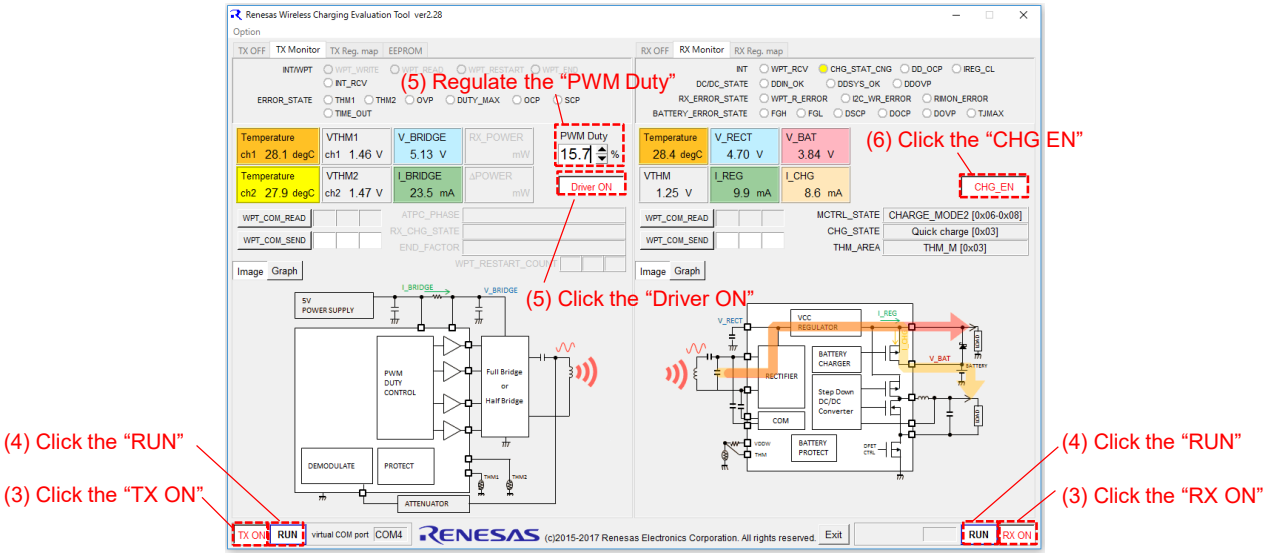


Figure 4.3 Control tool window in MCU Control Mode

(4) Click the “RUN” in TX side and RX side on tool window.
RX side window : Animation of battery discharging and DCDC converter operation is displayed.
Register initial values are displayed in RX side monitor field.
TX side window : Monitored values are displayed in TX side monitor field.

(5) Click the “Driver ON” in TX side.
Bridge circuit of transmitter starts and power is transmitted to RX board. Animation of TX side and RX side on tool window shows wireless power is transmitting. At this time, monitored values are displayed in RX side monitor field. Bridge driver duty can be set by entering directly value into “PWM Duty” or clicking up/down button in 0.1% resolution.

(6) Click the “CHG_EN” in RX side. RxIC starts battery charging. When “CHG_EN” is clicked again, battery charging is stopped.

(7) Battery charging is completed when battery voltage reaches charge control voltage and charging current reaches charge complete current set by “Option” / “RX setting” on control tool.

(8) The “Driver ON” in TX side can stop bridge circuit in MCU Control Mode. When the “Driver ON” is clicked in operating bridge circuit, bridge circuit stops.

(9) If the SW2 of TX board is turned off, the power supply in TX board is stopped.

Chapter 5 describes TX board and RX board in detail. Chapter 6 describes Control tool in detail.

5. Evaluation board description

5.1. Transmitter board WiQ-TX00-B00

Figure 5.1 shows name and function of transmitter board, and Table 5.1 shows the function of jumper and switch.

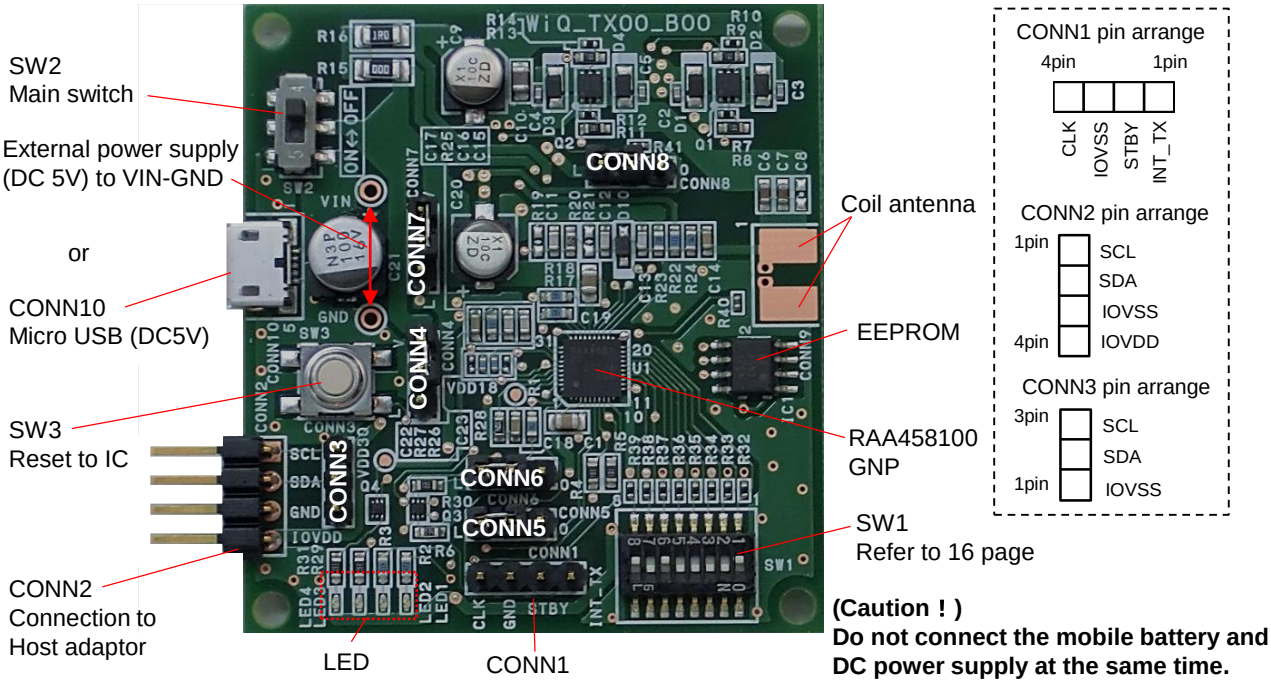


Figure 5.1 Name and function of transmitter board

Table 5.1 Default setting and function of jumper at WiQ-TX00-B00.

CONN No.	TxIC pin name	Description	Setting	
1	-	Connect this terminal when the external clock or STBY signal are inputted and INT_TX signal are monitored.	-	-
2	-	Connect the host adaptor (RTK0EF0029Z00001BJ).	-	-
3	-	Connect SDA, SCL, GND to CONN10 of RX board from this terminal as necessary.	-	-
4	IOVDD	Selecting of IOVDD pin voltage. CONN4 should be connected to “V” for VIN voltage. CONN4 should be connected to “L” for another voltage. Another voltage should be powered from 4 pin (IOVDD) of CONN2.	(V)	VIN voltage
			L	External input voltage
5	CLKI	Selecting of on chip clock or external reference clock. CONN5 = “L” then on chip clock. CONN5 =“O” then external reference clock, and input external clock to 4 pin (CLK) of CONN1. CONN5 and CONN7 setting should be matched for selecting clock.	O	External clock
			(L)	On chip clock
6	STBY	Selecting of operation or standby. If CONN6 is connected to “L”, TxIC automatically starts up when VIN pin is powered. To control STBY signal from outside, CONN6 should be connected to “O” and STBY signal should be inputted to 2 pin of CONN1.	O	External input
			(L)	IOVDD ,SW3 control
7	CLKSEL	Selecting of on chip clock or external reference clock. CONN7 should be connected to “V” for on chip clock. CONN7 should be connected to “L” for external reference clock. CONN5 and CONN7 setting should be matched for selecting clock.	(V)	On chip clock
			L	External clock
8 (*1)	(ANT2)	Selecting of half bridge or full bridge circuit. CONN8 should be connected to “L” for half bridge circuit. CONN8 should be connected to “O” for full bridge circuit. BRGSEL pin setting is also needed by SW1. (Refer to next page.)	(O)	Full Bridge
			(L)	Half Bridge

(*1) ◯ CONN8=“L” in WiQ-TX00-B00-TD1 , ◌ CONN8=“O” in WiQ-TX00-B00-TD2.

Figure 5.2 and Table 5.2 show SW1 settings of transmitter board WiQ-TX00-B00.
Table 5.3 shows SW2 and SW3 settings.

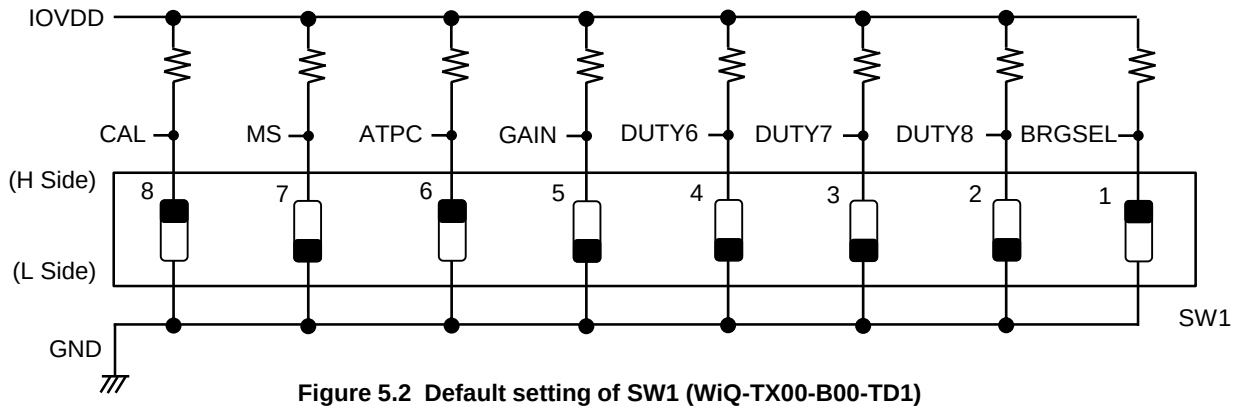


Figure 5.2 Default setting of SW1 (WiQ-TX00-B00-TD1)

Table 5.2 Default setting and function of SW1 at WiQ-TX00-B00 board

SW1 pin No.	TxIC pin name	Description	Setting	
1 (*1)	BRGSEL	Selecting of half bridge circuit or full bridge circuit. 1pin =“H” then half bridge circuit. 1pin=“L” then full bridge circuit. CONN8 setting is also needed (Refer to 15 page, Table 5.1).	(H)	Half Bridge
			(L)	Full Bridge
2	DUTY8	Setting of duty register 0x07 D[0] for bridge output. 2pin = “H” then 0x07 D[0] is “1” , 2pin = “L” then 0x07 D[0] is “0”	H	0x07 D[0] = 1
			(L)	0x07 D[0] = 0
3	DUTY7	Setting of duty register 0x06 D[7] for bridge output. 3pin = “H” then 0x06 D[7] is “1” , 3pin = “L” then 0x06 D[7] is “0”	H	0x06 D[7] = 1
			(L)	0x06 D[7] = 0
4	DUTY6	Setting of duty register 0x06 D[6] for bridge output. 4pin = “H” then 0x06 D[6] is “1” , 4pin = “L” then 0x06 D[6] is “0”	H	0x06 D[6] = 1
			(L)	0x06 D[6] = 0
5	GAIN	Setting of GAIN pin in ATPC Mode. 5pin = “H” then GAIN=0.250 , 5pin = “L” then =0.125 This setting is not applicable except for ATPC Mode.	H	GAIN=0.250
			(L)	GAIN=0.125
6	ATPC	Selecting of ATPC Mode. 6pin = “H” then ATPC Mode ,6pin = “L” then MCU Control Mode or Stand Alone Mode. Mode setting should be matched for RX board.	(H)	ATPC Mode
			L	MCU Control Mode , Stand Alone Mode
7	MS	Selecting of master device or slave device for 2-wire serial communication interface. 7pin = “H” then master device , 7pin = “L” then slave device.	H	Master device
			(L)	Slave device
8	CAL	Selecting of CS amplifier offset calibration. 8pin = “H” then calibration on , 8pin = “L” then calibration off.	(H)	Offset calibration ON
			L	Offset calibration OFF

(*1) (H) Pin1=“H” in WiQ-TX00-B00-TD1 , (L) Pin1=“L” in WiQ-TX00-B00-TD2.

Table 5.3 Default setting and function of SW2 and SW3 at WiQ-TX00-B00 board

Switch	TxIC pin name	Description	Default Condition
SW2	VIN	Main power switch. When SW2 is slid to ON, DC 5V supplies to the TxIC.	OFF
SW3	STBY	Reset switch. When SW3 is pushed, RAA458100GNP moves to standby and is initialized.	OPEN

5.2 Receiver board WiQ-RX00-B00

Figure 5.3 shows name and function of receiver board, and Table 5.4, 5.5 show the function of jumpers and switch.

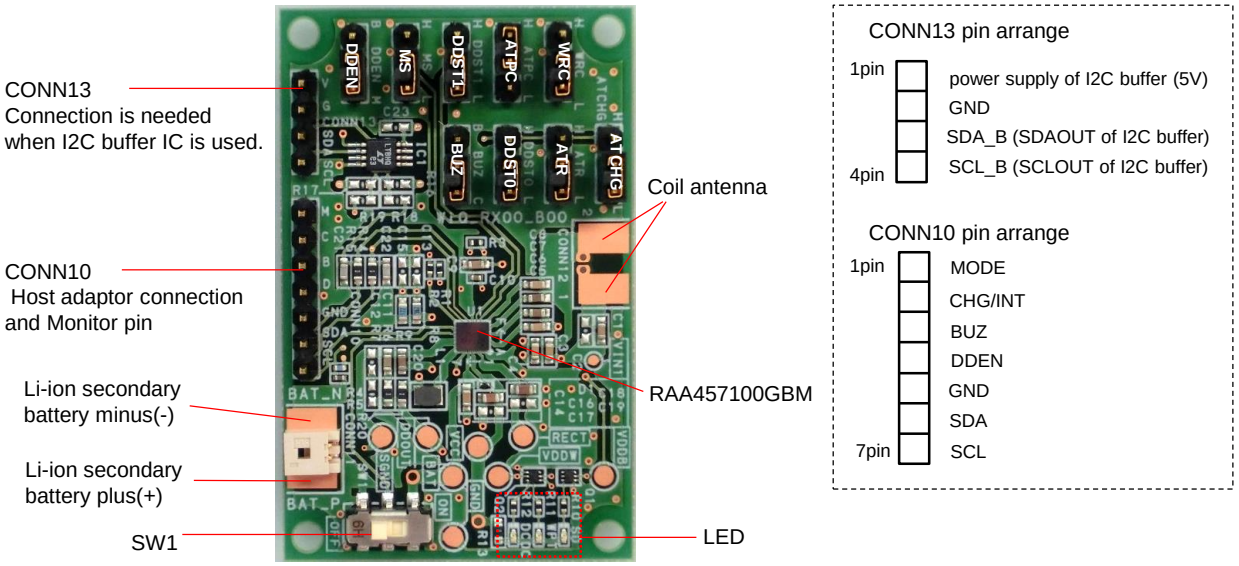


Figure 5.3 Name and function of receiver board

Table 5.4 Default setting and function of jumper at WiQ-RX00-B00.

Jumper	Description	Setting	
WRC	Selecting of wired charging or wireless charging. WRC should be connected to “L” for wireless charging.	H	Wired charging
		(L)	Wireless charging
ATCHG	Selecting of automatic start of battery charge. ATCHG should be connected to “H” for automatic start. When ATCHG is connected to “L”, charging start or stop can be selected with “CHG_EN” button on control tool.	H	Enable automatic start of battery charging.
		(L)	Disable automatic start of battery charging.
ATPC	Selecting of ATPC Mode. ATPC should be connected to “H” for ATPC Mode. ATPC should be connected to “L” except for ATPC Mode. Mode setting should be matched for TX board.	(H)	ATPC Mode
		L	MCU Control Mode or Stand Alone Mode
ATR	Selecting of rectifier circuit parameter automatic adjust function. ATR should be connected to “H” for available. ATR should be connected to “L” for unavailable.	H	Enable automatic control of rectifier
		(L)	Disable automatic control of rectifier
DDST1 DDST0	Setting of DCDC converter output voltage. DDST1, DDST0=Low(L), Low(L) : 1.2V (Default setting) DDST1, DDST0=Low(L), High(H) : 1.5V DDST1, DDST0=High(H), Low(L) : 1.8V DDST1, DDST0=High(H), High(H) : 3.0V	(L,L)	1.2V output
		L,H	1.5V output
		H,L	1.8V output
		H,H	3.0V output
MS	Setting of Master or Slave device for 2-wire serial communication interface. MS should be connected to “L” for slave device. MS should be connected to “H” for master device.	H	Master device
		(L)	Slave device
BUZ	Selecting of connection of pull up resistor at BUZ pin and CHG/INT pin. BUZ should be connected to “B” for SYS pin voltage. BUZ should be connected to “C” for VCC pin voltage.	B	Pull-up to SYS voltage.
		(C)	Pull-up to VCC voltage.
DDEN	Selecting of connection of DDEN pin. When DDEN is connected to “M”, DDEN pin is connected to MODE pin, then DCDC converter works only in discharge mode. When DDEN is connected to “B”, then DCDC converter works in both of charge and discharge mode.	B	DCDC converter works in both of charge and discharge mode.
		(M)	DCDC converter works only in discharge mode.

Table 5.5 Default setting and function of SW1 at WiQ-RX00-B00.

Switch	Description	Default Condition
SW1	Switching of shut down mode or discharge mode. When SW1 is OFF, RxIC is shut down mode. When SW1 is ON, RxIC is discharge mode.	OFF

5.3 LED function on the WiQ-TX00-B00 and WiQ-RX00-B00 board

Table 5.6, Table 5.7 show the function of LED on each evaluation board. Table 5.8 shows operation mode, operation status, setting register, and LED1,2 flashing pattern.

Table 5.6 Description of LED in TX board (WiQ-TX00-B00)

LED	Description
LED1	Refer to Table 5.8.
LED2	Refer to Table 5.8.
LED3	INT_TX terminal is low level.
LED4	When SW2 of TX board turns on, VDD30 regulator is operating.

Table 5.7 Description of LED in RX board (WiQ-RX00-B00)

LED	Description
SD (LED1)	SW1 of RX board is on.
WPT (LED2)	Charge mode operation.
DCDC (LED3)	DCDC converter is operating.

Table 5.8 Operation mode, Operation status, Setting register, LED1 and LED2 flashing pattern

Mode	Operation status	TxIC Setting register 1	TxIC Setting register 2	Value	LED1	LED2
Initial	During start up	-	-	-	Off	Off
ATPC	Under WPT Communication (Battery charging is available)	0x10 D[3]=0 led_force_mode *3	0x12 D[1:0] led_trans_sel	0	Flashing (0.25sec)	Off
				1	Off	Flashing (0.25sec)
				2	On	Off
				3	Off	On
	Under battery charging		0x12 D[2] led_charge_sel	0	On	Off
				1	Off	On
	Battery charge complete		0x12 D[4] led_end_sel	0	Off	Off
				1	Off	On
	Restart *1		0x12 D[6] led_err_sel	0	Flashing (1sec)	Off
				1	Off	Off
	Transmitting power stopped *2		0x12 D[7] led_errend_sel	0	Flashing (1sec)	Off
				1	Off	Off
Stand Alone	Transmitting power		-	-	On	Off
	TX Timer timeout		-	-	Off	Off
	Protection detected		-	-	Flashing (1sec)	Off
MCU Control	Selection by external controller(MCU)	0x10 D[3]=1 led_force_mode *4	0x10 D[1:0] led1_force_sel	0	Off	-
				1	Flashing (1sec)	-
				2	Flashing (0.25sec)	-
				3	On	-
			0x10 D[5:4] led2_force_sel	0	-	Off
				1	-	Flashing (1sec)
				2	-	Flashing (0.25sec)
				3	-	On

*1 Restart is processing when protection is detected, or WPT communication error is occurred.
*2 Transmitting power is completely stopped when the count of protection detection or WPT communication error becomes specified number.
*3 Register setting of 0x10 D[3] should be 0 in ATPC Mode and Stand Alone Mode.
*4 Register setting of 0x10 D[3] should be 1 in MCU Mode. LED is off regardless of setting in 0x10 D[1:0] and 0x10 D[5:4] when register of 0x10 D[3] is 0.

6. Overview of wireless charging control tool

6.1 Option setting

“Tool setting”, “TX setting”, RX setting” can be selected from “Option” menu on main view.

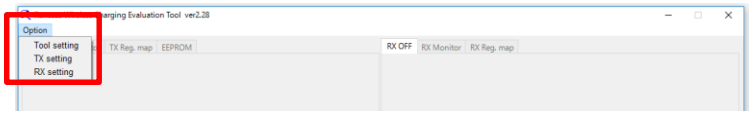


Figure 6.1 Option menu

6.1.1 Tool Setting

Initial tool setting can be set by clicking “Tool setting” in “Option” menu. When “Tool setting” is clicked ,Tool setting window (Figure 6.2) opens.

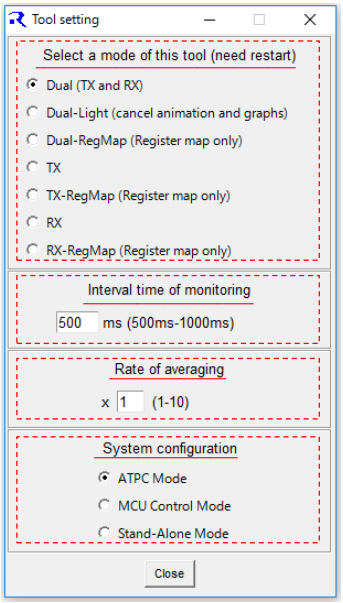


Figure 6.2 Tool setting window

・Select a mode of this tool
Operation mode can be selected for purpose. Refer to Table 6.1.

・Interval time of monitoring
Interval time accessing from tool to TX board and RX board can be set.

・Rate of averaging
Averaging rate of monitored value can be set.
I_BRIDGE of TX side, I_REG and I_CHG of Rx side can be averaged.

・System configuration
Operation mode of this system can be selected.

Each settings are applied after closing this window and clicking “TX_ON” and “RX_ON” button.
(The setting of “Select a mode of this tool” is applied after restarting this tool.)

Table 6.1 Description of “Select a mode of this tool”

Select mode	Description
Dual (TX and RX)	Animated operation status and monitored values of TX and RX are displayed. Graph of monitored values are displayed by clicking “Graph” on main view.
Dual-Light (cancel animation and graphs)	Animation and Graph are disable for light operation.
Dual-Regmap (Register map only)	Register Map window only.
TX	Animated operation status and monitored values of TX are displayed. Graph of monitored values are displayed by clicking “Graph” on main view.
TX-RegMap (Register map only)	TX Register Map window only.
RX	Animated operation status and monitored values of RX are displayed. Graph of monitored values are displayed by clicking “Graph” on main view.
RX-Regmap (Register map only)	RX Register Map window only.

6.1.2 Setting of TX IC

Register of TX IC ”RAA458100GNP” can be set initially on “TX setting” in “Option” menu.
TX setting has three tabs such as “Setting1”, “Setting2” and “Setting3”.

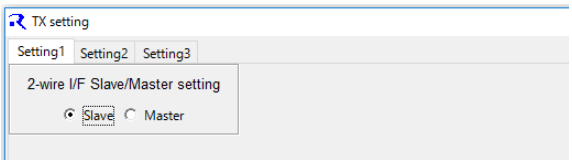


Figure 6.3 TX setting_Setting1

Master device or slave device at 2-wire serial communication interface of RAA458100GNP can be selected. Main window function and register map tool is available at Slave.
EEPROM Read/Write tool is available at Master. Main window and register map tool is unavailable at Master.

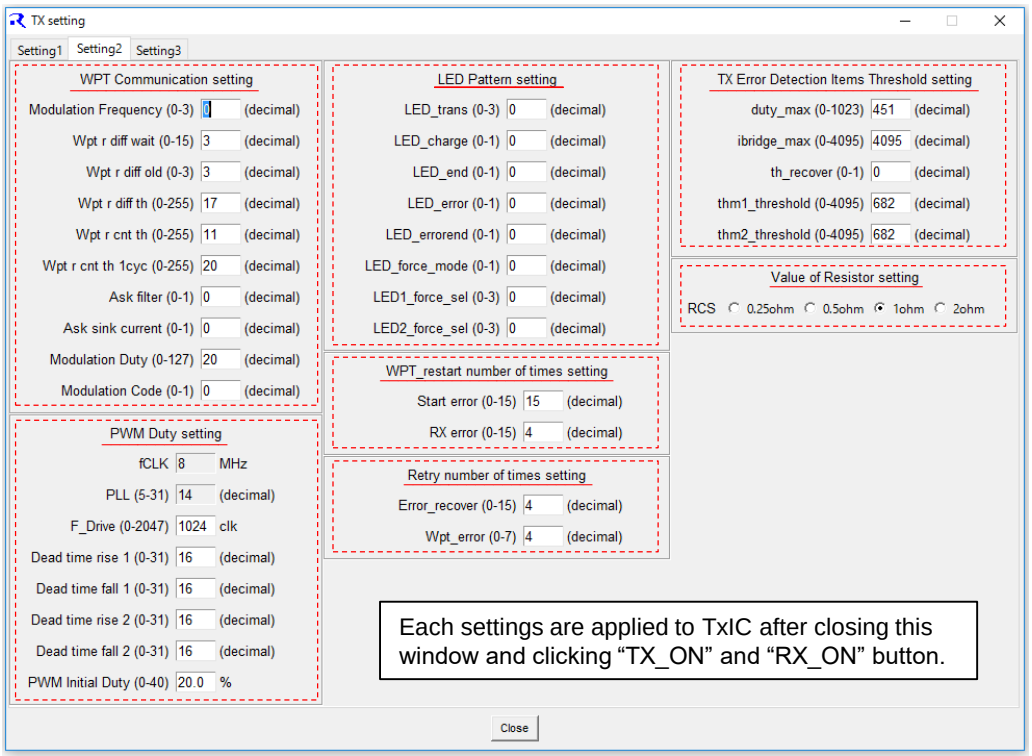


Figure 6.4 TX setting_Setting2

・WPT Communication setting
Initial setting of register for WPT communication can be set. Refer to Table 6.2.

・PWM Duty setting
Initial register setting for determining initial PWM duty can be set. Refer to Table 6.3.

・LED Pattern setting
LED flashing pattern can be set. Refer to Table 6.4 and Page 18 / Table 5.8 in detail.

・WPT restart number of times setting
-Start_error(0x35 D[3:0]) : The restart number of times by the receive error of R_Header 0x01 in ATPC Mode is set.
-RX error (0x35 D[7:4]) : The restart number of times by the WPT communication error in ATPC Mode is set.

・ Retry number of times setting
-Error_recover(0x37 D[3:0]) : The restart number of times by TxIC abnormality detection 1 in ATPC Mode is set.
-Wpt_error(0x37 D[6:4]) : The number of times to access a device register of RX side by WPT communication in ATPC Mode is set.

・TX Error Detection Items Threshold setting
Threshold value of error detection can be set. Refer to Table 6.5.

・Value of Resistor setting
Current sense resistor value can be selected. Select 1 ohm because 1 ohm resistance is mounted on the TX board.

Table 6.2 Input items of “WPT Communication setting”

Item	TxIC Register	Description
Modulation Frequency	0x0E D[2:1]	WPT communication data rate setting from TX to RX.
Wpt r diff wait	0x30 D[3:0]	Timing setting to acquire ASKOUT pin voltage variation for WPT communication packet demodulation.
Wpt r diff old	0x30 D[5:4]	Assigning data point to calculate ASKOUT pin voltage variation for WPT communication packet demodulation.
Wpt r dff th	0x31 D[7:0]	Threshold to detect ASKOUT pin voltage variation for WPT communication packet demodulation.
Wpt r cnt th	0x33 D[7:0]	Counter timing to detect data 1/0 for WPT communication packet demodulation.
Wpt r cnt th 1cyc	0x34 D[7:0]	Counter timing to detect data presence/absence for WPT communication packet demodulation.
Ask filter	0x30 D[6]	ASKIN filter setting.
Ask sink current	0x30 D[7]	ASKIN sink current setting.
Modulation Duty	0x0D D[6:0]	Modulation duty of bridge driver output pulse.
Modulation Code	0x0D D[7]	Select add or subtract for the modulation duty.

Table 6.3 Input items of “PWM Duty setting”

Item	TxIC Register	Description
F_Drive	0x05 D[2:0], 0x04 D[7:0]	Switching frequency of bridge driver output pulse. Switching frequency = 1000 X (128 / F_Drive[10:0]) [kHz]
Dead time rise 1	0x09 D[4:0]	Dead time of bridge driver output pulse. GD1 Low to High.
Dead time fall 1	0x0A D[4:0]	Dead time of bridge driver output pulse. GD1 High to Low.
Dead time rise 2	0x0B D[4:0]	Dead time of bridge driver output pulse. GD2 Low to High.
Dead time fall 2	0x0C D[4:0]	Dead time of bridge driver output pulse. GD2 High to Low.
PWM Initial Duty	0x07 D[1:0], 0x06 D[7:0]	Duty of bridge driver output pulse.

Table 6.4 Input items of “LED Pattern setting” (Refer to Page 18 / Table 5.8 in detail.)

Item	TxIC Register	Description
LED_trans	0x12 D[1:0]	LED flashing pattern setting under WPT communication (Battery charging is available) in ATPC mode.
LED_charge	0x12 D[2]	LED flashing pattern setting under battery charging in ATPC mode.
LED_end	0x12 D[4]	LED flashing pattern setting for battery charge complete in ATPC mode.
LED_error	0x12 D[6]	LED flashing pattern setting for restart in ATPC mode.
LED_errorend	0x12 D[7]	LED flashing pattern setting for transmitting power stopped in ATPC mode.
LED_force_mode	0x10 D[3]	LED1,2 control setting.
LED1_force_sel	0x10 D[1:0]	LED1 flashing pattern selection.
LED2_force_sel	0x10 D[5:4]	LED2 flashing pattern selection.

Table 6.5 Input items of “TX Error Detection Items Threshold setting”

Item	TxIC Register	Description
duty_max	0x14 D[1:0], 0x13 D[7:0]	Maximum duty threshold for bridge driver output pulse.
ibridge_max	0x16 D[3:0], 0x15 D[7:0]	Over current protection threshold for bridge circuit.
th_recover	0x18 D[4]	Restart condition in temperature protection in ATPC mode. “0”: Restart without releasing temperature protection. “1”: Restart after releasing temperature protection.
thm1_threshold	0x18 D[3:0], 0x17 D[7:0]	682 code should be set. Temperature protection of thermister1 operates in 65degC.
thm2_threshold	0x1A D[3:0], 0x19 D[7:0]	682 code should be set. Temperature protection of thermister2 operates in 65degC.

Setting of over power detection of transmission power can be set by Setting3. Refer to Table 6.6.
The calculated values and graph are reflected by inputting each setting. In order to reflect the tool window, click the "Close" button, close the tool window and open the "Setting3" of "TX setting" again.

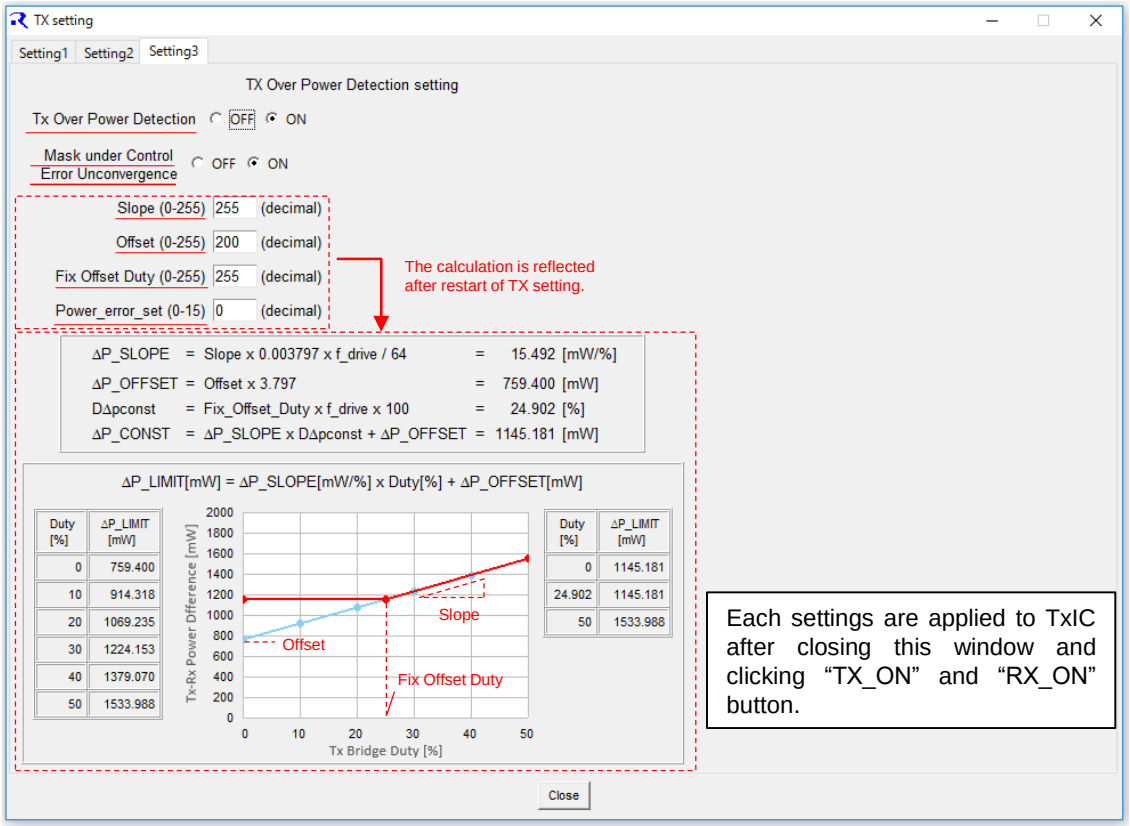


Figure 6.5 TX setting_Setting3

Table 6.6 Input items of "TX Over Power Detection setting"

Item	TxIC Register	Description
Tx Over Power Detection	0x3F D[3]	Select ON or OFF of over power detection of transmission power.
Mask under Control Error Unconvergence	0x3F D[2]	Select ON or OFF of masking over power detection when control error value is not converged.
Slope (0-255)	0x3B D[7:0]	Set Slope for calculation of delta P_SLOPE.
Offset (0-255)	0x3C D[7:0]	Set Offset for calculation of delta P_OFFSET.
Fix Offset Duty (0-255)	0x3E D[7:0]	Set Fix Offset Duty. Threshold of the Tx-Rx Power Difference for over power detection is fixed when TX bridge duty is under Fix Offset Duty.
Power error set (0-15)	0x32 D[7:4]	Error count threshold to detect differential power error between transmitting power and receiving power. When this is 0, TX over power detection is off.

6.1.3 Setting of RX IC

Register of RX IC ”RAA457100GBM” can be set initially on “RX setting” in “Option” menu.
“RX setting” has two tabs such as “Setting1” and “Setting2”.

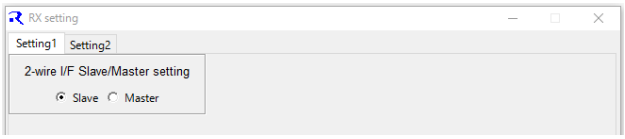


Figure 6.6 RX Setting1

Master device or Slave device for 2-wire serial communication interface of RAA457100GBM can be selected. Main window function and register map tool is available at Slave. Main window and register map tool is unavailable at Master.

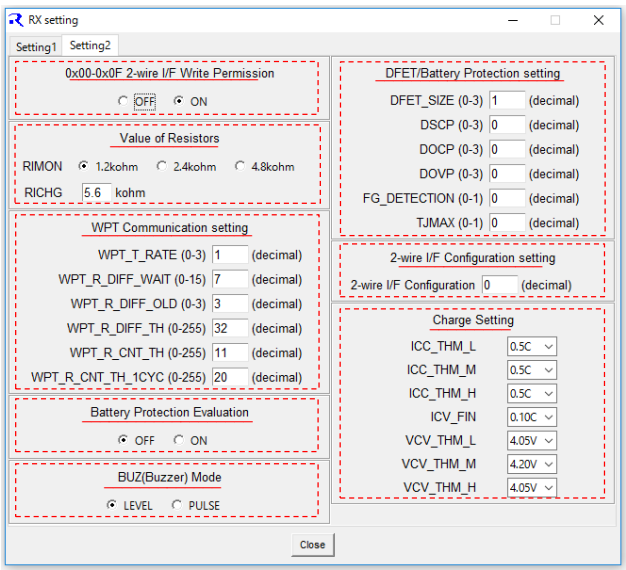


Figure 6.7 RX Setting2

Each settings are applied to RxIC after closing this window and clicking “TX_ON” and “RX_ON” button.

・0x00-0x0F 2-wire I/F Write Permission
Select ON or OFF of 2-wire serial communication Write Permission in address 0x00 to 0x0F at register map. Refer to 0x40 D0 at register map.

・Value of Resistors
Select RIMON resistance of RIMON pin. 1.2k ohm should be selected.
Set RICHG resistance of RICHG pin.
・5.6k ohm should be set in WiQ-RX00-B0-TD1.
・1.5k ohm should be set in WiQ-RX00-B0-TD2.

・WPT Communication setting
Initial register setting for WPT communication. Refer to Table 6.7.

・Battery Protection Evaluation
If “OFF” is selected, 2-wire serial communication interface is unavailable when battery protection is detected and DFET is off. If “ON” is selected for evaluation, DFET is not off when battery protection is detected, and 2-wire serial communication interface is available.

・BUZ(Buzzer) Mode
Select notification action of BUZ pin when battery low voltage is detected. Refer to 0x34 D2 at register map.
・LEVEL: Output low level
・PULSE: Output pulse

・DFET/Battery Protection setting
Set Battery protection parameters. Refer to Table 6.8.

・2-wire I/F Configuration setting
Zero should be set.

・Charge Setting
Set charge control profile for battery temperature. Set fast charge current, charge complete current, and constant voltage charge control voltage. Refer to Table 6.9.

Table 6.7 Input items of “WPT Communication setting”

Item	RxIC Register	Description
WPT_T_RATE	0x27 D[1:0]	WPT communication data rate setting. (Receiver to Transmitter communication)
WPT_R_DIFF_WAIT	0x27 D[7:4]	Timing to acquire the rectified output voltage variation for WPT communication packet demodulation.
WPT_R_DIFF_OLD	0x27 D[3:2]	Assigning data point to calculate the rectified output voltage variation for WPT communication packet demodulation.
WPT_R_DIFF_TH	0x28 D[7:0]	Threshold to detect the rectified output voltage variation for WPT communication packet demodulation.
WPT_R_CNT_TH	0x29 D[7:0]	Counter timing to detect data 0/1 for WPT communication packet demodulation.
WPT_R_CNT_TH_1CYC	0x2A D[7:0]	Counter timing to detect data presence/absence for WPT communication packet demodulation.

Table 6.8 Input items of “DFET/Battery protection setting”

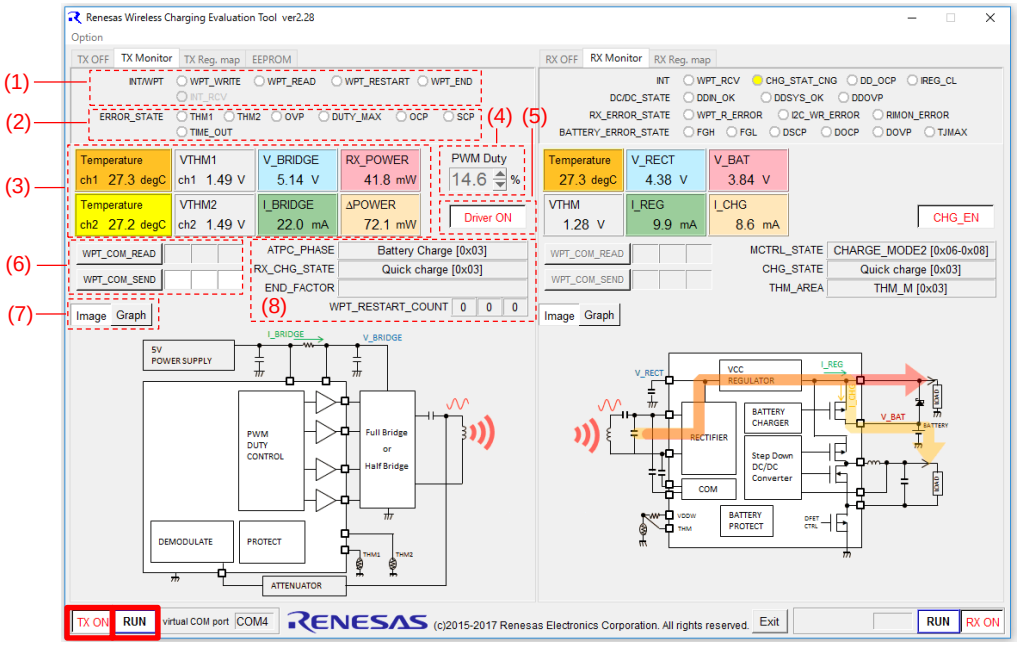
Item	Description			
DFET SIZE	Set DFET resistance. 0: 160m ohm, 1: 320m ohm, 2: 480m ohm, 3: 640m ohm			
DSCP	Set discharge short circuit current detection level. 0: 100mV, 1: 120mV, 2: 140mV, 3: 160mV			
DOCP	Set discharge overcurrent detection level 0: 50mV, 1: 60mV, 2: 70mV, 3: 80mV			
DOVP	Set discharge overvoltage detection level 0: 2.8V, 1: 2.7V, 2: 2.9V, 3: 3.0V			
FG DETECTION	Set battery low voltage detection level depending on DCDC converter output voltage.			
	Value	DCDC output voltage setting	Detection level high	Detection level low
	0	1.2V,1.5V,1.8V	3.20V	3.05V
	0	3.0V	3.55V	3.35V
	1	1.2V,1.5V,1.8V	3.30V	3.15V
	1	3.0V	3.65V	3.45V
TJMAX	Junction temperature detection level 0: 68[degC] 1: 79[degC]			

Table 6.9 Input items of “Charge Setting”

Item	RxIC Register	Description
ICC_THM_L	0x02 D[3:2]	Fast charge current setting of low temperature operation in battery temperature profile. (1C / 0.5C / 0.25C)
ICC_THM_M	0x02 D[5:4]	Fast charge current setting of suitable temperature operation in battery temperature profile. (1C / 0.5C / 0.25C)
ICC_THM_H	0x02 D[7:6]	Fast charge current setting of high temperature operation in battery temperature profile. (1C /0.5C / 0.25C)
ICV_FIN	0x03 D[1:0]	Constant voltage charge complete current setting. (0.05C / 0.10C /0.15C /0.20C)
VCV_THM_L	0x03 D[3:2]	Constant voltage charge control voltage setting of low temperature operation in battery temperature profile. (4.05V / 4.20V / 4.35V)
VCV_THM_M	0x03 D[5:4]	Constant voltage charge control voltage setting of suitable temperature operation in battery temperature profile. (4.05V / 4.20V /4.35V)
VCV_THM_H	0x03 D[7:6]	Constant voltage charge control voltage setting of high temperature operation in battery temperature profile. (4.05V /4.20V /4.35V)

6.2 TX side Main view

This section describes the function of TX side window on main view.



Monitor animation is displayed by clicking “TX_ON” and “RUN”.

Figure 6.8 TX side window on main view

(1) Interruption status

Interruption status of WPT communication is displayed. Displayed items are different in ATPC Mode and MCU Control Mode. Click the lighted mark to turn off.

Table 6.10 Interruption status in MCU Control Mode

Item	TxIC Register	Explanation
INT_RCV	0x1B D[1]	WPT communication packet is received.

Table 6.11 Interruption status in ATPC Mode

Item	TxIC Register	Explanation
WPT_WRITE	0x1B D[2]	Write completion by WPT communication in ATPC Mode.
WPT_READ	0x1B D[3]	Read completion by WPT communication in ATPC Mode.
WPT_RESTART	0x1B D[4]	Restart is performed in ATPC Mode.
WPT_END	-	Stop wireless transmission power in ATPC Mode.

(2) Error status

Error status is displayed. Error status is unavailable in Stand Alone Mode.

Table 6.12 TX Error State

Item	TxIC Register	Explanation
THM1	0x1D D[0]	Temperature protection 1 at thermistor connected to THM1 pin.
THM2	0x1D D[1]	Temperature protection 2 at thermistor connected to THM2 pin.
OVP	0x1D D[2]	Over voltage protection for bridge circuit.
DUTY MAX	0x1D D[4]	Maximum output pulse duty of bridge driver.
OCP	0x1D D[5]	Over current protection for bridge circuit.
SCP	0x1D D[3]	Short circuit protection for bridge circuit.
TIME_OUT	0x12 D[5]	Time out of transmitter timer .

(3) Monitored value

Monitored values in TX IC are displayed.

Table 6.13 TX Monitor output

Monitor	TxIC Register	Explanation
Temperature ch1	-	Temperature of thermistor connected to THM1 pin.
Temperature ch2	-	Temperature of thermistor connected to THM2 pin.
VTHM1	0x25 D[7:4] 0x26 D[7:0]	THM1 pin voltage. VTHM1 [V]＝(th1 D[11:0] / 4096) x 3
VTHM2	0x27 D[7:4] 0x28 D[7:0]	THM2 pin voltage. VTHM2 [V]＝(th2 D[11:0] / 4096) x 3
V_BRIDGE	0x21 D[7:4] 0x22 D[7:0]	Supplied voltage to bridge circuit. V_BRIDGE [V]=vbridge D[11:0] / 4096 x 3 x 2.16
I_BRIDGE	0x23 D[7:4] 0x24 D[7:0]	Input current to bridge circuit. I_BRIDGE [A]=((ibridge D[11:0]) x 3) / (4096 x 10 x RCS) RCS：current sense resistance[Ω]
RX_POWER	0x43 D[7:0]	Input power (V_RECT x I_REG) of RX system in ATPC Mode. RX_POWER [mW]=3.797 x rx_power D[7:0]
⊿POWER	-	Differential power between TX output power and RX input power in ATPC Mode.

(4) PWM Duty

PWM Duty driving bridge circuit is displayed. The value of setting “PWM Initial Duty” in “TX setting” is initially displayed. Duty can be set by entering directly value into “PWM Duty” or clicking up/down button in 0.1% resolution in MCU Mode.

(5) Driver ON

Driving bridge circuit can be started or stopped. Red letters indicate driving. Black letters indicate stopping drive. Operation is different at modes and settings. Refer to Table 6.14.

Table 6.14 “Driver ON” function at each Mode

Mode	Explanation
ATPC Mode	When “Driver ON” is clicked, automatic transmission power control starts from initial duty “PWM Initial Duty”. Push the SW3 of the TX board and reset register of TX IC or Turn off the SW2 of the TX board and stop the power supply if the bridge circuit is stopped. “Driver ON” can’t stop the bridge circuit.
MCU Control Mode	“Driver ON” can control the bridge circuit ON/OFF. When “Driver on” is clicked, driving bridge circuit starts at “PWM Initial Duty”. When ”Driver ON” is clicked again, driving bridge circuit stops.

(6) WPT communication

Header, Message1, Message2 are input by hex number into input box, and “WPT_COM_SEND” is clicked, then data can be sent from TX to RX. When data is sent from RX to TX, received data at TX is displayed by clicking ”WPT_COM_READ”.

(7) Switching display

Animation of the operation is displayed in block chart by clicking “Image”. Monitored values are plotted in graph by clicking ”Graph”.

(8) Information display in ATPC Mode

Information is displayed in ATPC Mode.

Table 6.15 Information in ATPC mode

Item	TxIC Register	Explanation
ATPC_PHASE	0x42 D[3:2]	Status information in RX IC.
RX_CHG_STATE	0x42 D[7:4]	Charging status in RX IC.
END_FACTOR	Refer to Table 6.16	Factor for stopping to the transmission power in ATPC Mode Refer to Table 6.16.
WPT_RESTART _COUNT	0x4B D[3:0]	The left box indicates the number that WPT communication packet from RX to TX is not received.
	0x4B D[7:4]	The center box indicates the number that WPT communication error or RX IC error occurs.
	0x3A D[7:4]	The right box indicates the number that TX IC occurs error.

Table 6.16 Error detection item

Error	TxIC Error Condition	Error condition
WPT Com Undetected [ER1]	0x35 D[3:0]=0x4B D[3:0]	WPT communication packet from RX to TX is not received. (Ping Phase)
WPT Com Undetected [ER2]	0x35 D[7:4]=0x4B D[7:4]	WPT communication packet from RX to TX is not received. (Configuration, Battery Charge Phase)
Control Error Unconvergence [ER2-1]	0x35 D[7:4]=0x4B D[7:4] & 0x3F D[5]=1	Control error unconvergence.
RX Tjmax Detected [ER2-1]	0x35 D[7:4]=0x4B D[7:4] & 0x3F D[6]=1	Maximum junction temperature detection in RX IC.
TX2RX WPT Com Error [ER2-2]	0x35 D[7:4]=0x4B D[7:4] & 0x37 D[6:4]=0x38 D[3:0]	RX IC register access error detection.
RX2RXMCU I2C Com Error [ER2-3]	0x35 D[7:4]=0x4B D[7:4] & 0x37 D[6:4]=0x3A D[3:0]	RX MCU register access error detection.
RX Charge Error [ER2-4]	0x35 D[7:4]=0x4B D[7:4] & 0x39 D[3:0]=4	RX IC charging status error detection.
TX Over Power [ER2-5]	0x35 D[7:4]=0x4B D[7:4] & 0x32 D[7:4]=0x39 D[7:4]	Over power of transmission power detection.
TX Error Detected1 [ET1]	0x37 D[3:0]=0x3A [7:4]	TX IC error detection1.
TX Error Detected2 [ET2]	0x1D D[3]=1 | 0x1D D[5]=1 | 0x12 D[5]=1	TX IC error detection2.

＜MEMO＞

6.3 RX side Main view

This section describes the function of RX side window on main view.

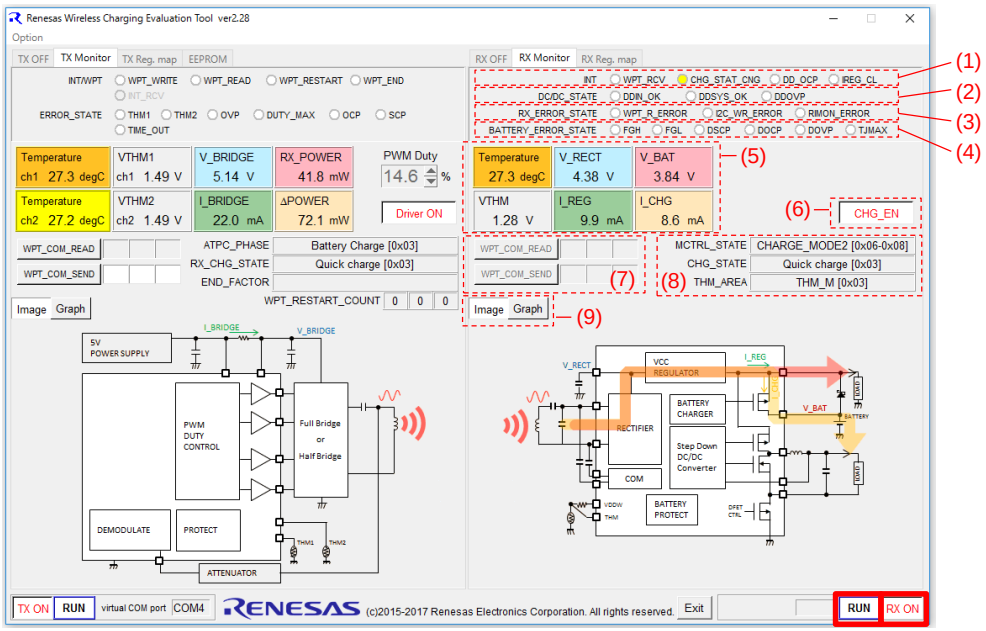


Figure 6.9 RX side window on main view

Monitor animation is displayed by clicking “RX_ON” and “RUN”.

(1) Interruption status

Interruption status is displayed.

Table 6.17 Interruption status

Item	RxIC Register	Explanation
WPT_RCV	0x30 D[0]	Data packet is received from TX by WPT communication. Light can be turned off by clicking light point.
CHG_STAT_CNG	0x30 D[1]	Battery charging state transition. Light can be turned off by clicking light point.
DD_OCP	0x30 D[2]	Over current is detected at DCDC converter.
IREG_CL	0x30 D[3]	Current limit is detected at VCC regulator.

(2) DCDC converter status

DCDC converter operation status is displayed.

Table 6.18 DCDC converter status

Item	RxIC Register	Explanation
DDIN_OK	0x33 D[4]	UVLO(Under Voltage Lock Out) of DCDC converter is released.
DDSYS_OK	0x33 D[5]	Starting up of DCDC converter is completed.
DDOVP	0x33 D[6]	Over voltage is detected at DCDC converter

(3) RX Error status

Error status is displayed.

Table 6.19 Error status

Item	RxIC Register	Explanation
WPT_R_ERROR	0x33 D[0]	WPT communication error.
I2C_WR_ERROR	0x33 D[1]	2-wire serial communication error.
RIMON_ERROR	0x33 D[2]	Unsuitable resistance is connected to RIMON pin. Suitable resistance is 1.2k or 2.4k or 4.8k ohm.

(4) Battery error state

Battery error status is displayed.

Table 6.20 Battery Error State

Item	RxIC Register	Explanation
FGH	0x34 D[0]	Battery low voltage detection threshold H is detected.
FGL	0x34 D[1]	Battery low voltage detection threshold L is detected.
DSCP	0x34 D[4]	Battery discharge short circuit current is detected.
DOCP	0x34 D[5]	Battery discharge over current is detected.
DOVP	0x34 D[6]	Battery discharge over voltage is detected.
TJMAX	0x34 D[7]	Maximum junction temperature is detected.

(5) Monitored value

Monitored values in RX IC are displayed.

Table 6.21 RX monitored value

Monitor item	RxIC Register	Explanation
Temperature	-	Temperature of thermistor connected to THM pin.
VTHM	0x3E D[7:4] 0x3F D[7:0]	THM pin voltage. VTHM [V]=(ADC_VTHM_I2C D[11:0]/4096) x 2.7
V_RECT	0x36 D[7:4] 0x37 D[7:0]	RECT pin voltage. V_RECT [V]=(ADC_VRECT_I2C D[11:0]/4096) x 2.7 x 4
I_REG	0x38 D[7:4] 0x39 D[7:0]	VCC regulator output current. I_REG [A]=(ADC_IVCC_I2C D[11:0]/4096) x 2.7 x 80/R_{IMON} R_{IMON} : Resistance between RIMON pin and GND pin [Ω]
V_BAT	0x3A D[7:4] 0x3B D[7:0]	BAT pin voltage. V_BAT [V]=(ADC_VBAT_I2C D[11:0]/4096) x 2.7 x 2
I_CHG	0x3C D[7:4] 0x3D D[7:0]	Battery charge current. I_CHG [A]=(ADC_ICHG_I2C D[11:0]/4096) x 2.7 x 80/R_{ICHG} R_{ICHG} : Resistance between RICHG pin and GND pin [Ω]

(6) Charge enable

If the ATCHG pin is low level, “CHG_EN” can control charge start or stop. When “CHG_EN” is clicked, charging starts and letter becomes red. When “CHG_EN” is clicked again, charging stops and letter becomes black.

If the ATCHG pin is high level, “CHG_EN” is unavailable because charging starts automatically.

(7) WPT communication

Header, Message1, Message2 are input by hex number into input box, and “WPT_COM_SEND” is clicked, then data can be sent from RX to TX. When data is sent from TX to RX, received data at RX is displayed by clicking ”WPT_COM_READ”. ”WPT_COM_READ” and “WPT_COM_SEND” is unavailable in ATPC Mode.

(8) RX status information display

Information of RX IC is displayed.

Table 6.22 RX status information

Item	RxIC Register	Explanation
MCTRL_STATE	0x31 D[3:0]	Operation mode of RX IC is displayed.
CHG_STATE	0x32 D[3:0]	Charge status of RX IC is displayed.
THM_AREA	0x32 D[6:4]	Battery temperature area for charge control is displayed.

(9) Switching display

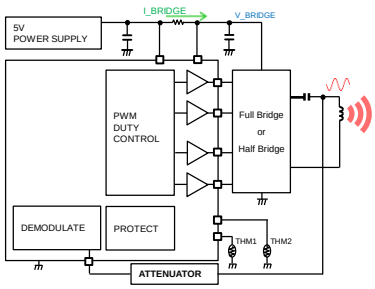
Operation is animated in block chart by clicking “Image”. Monitored values are plotted in graph by clicking ”Graph”.

6.4 Operation animation example “Image”

This section shows Operation animation of TX and RX example.

TX

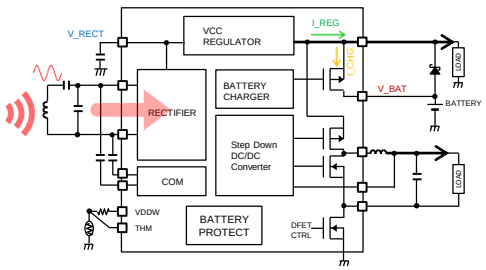
Driving bridge circuit and output power.



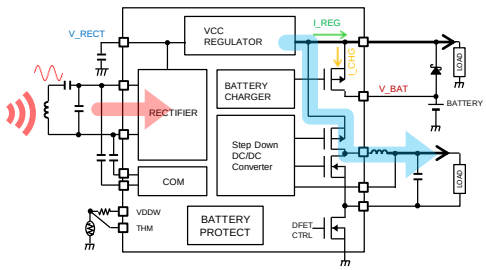
RX

RX receives wireless power but power is not enough.

DCDC converter is not operating.

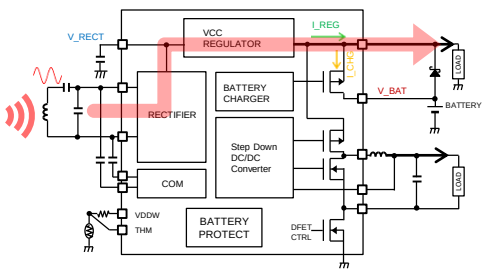


DCDC converter is operating.

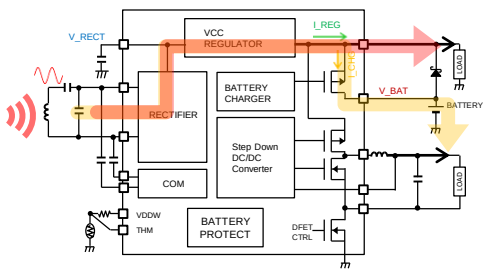


RX receives wireless power and power is enough for battery charging.

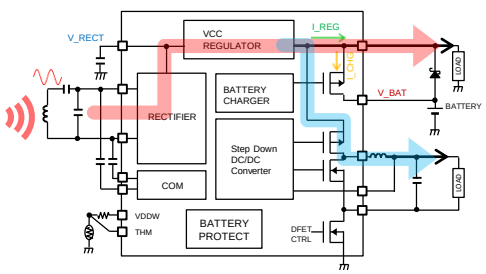
Only VCC regulator is operating.



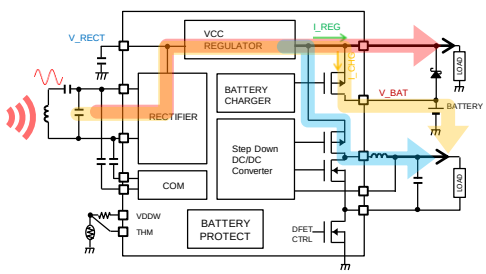
Battery is charged.



DCDC converter is operating.

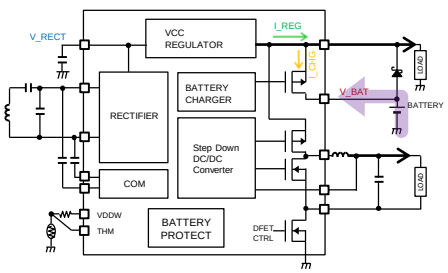


Battery is charged and DCDC converter is operating.

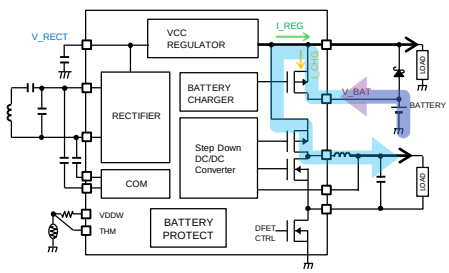


Battery is discharged.

DCDC converter is not operating.



DCDC converter is operating.



6.5 Plotted graph example ”Graph”

Monitored values are plotted in graph by clicking ”Graph”.
Graph is not updated in no DC power to TX and no wireless power to RX.

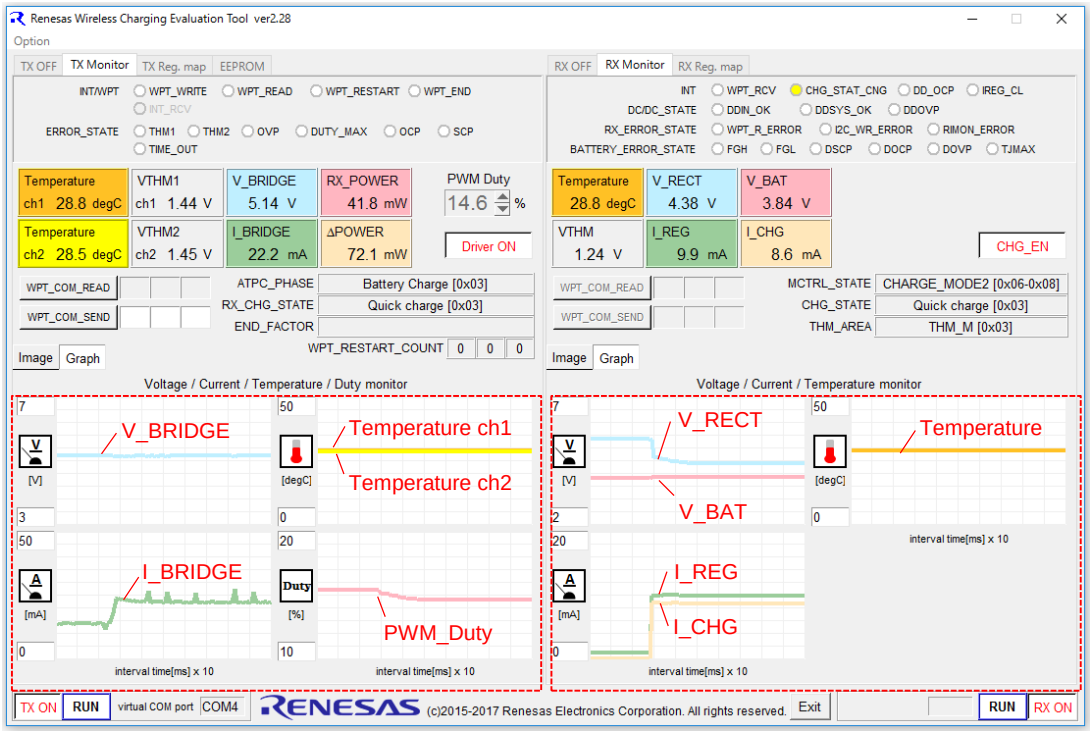


Figure 6.10 Graph display

6.6 Register map tool

Register map tool is opened by clicking “TX Reg. map” and “RX Reg. map” on condition that RUN button is off. Register write and read are available in this register map.

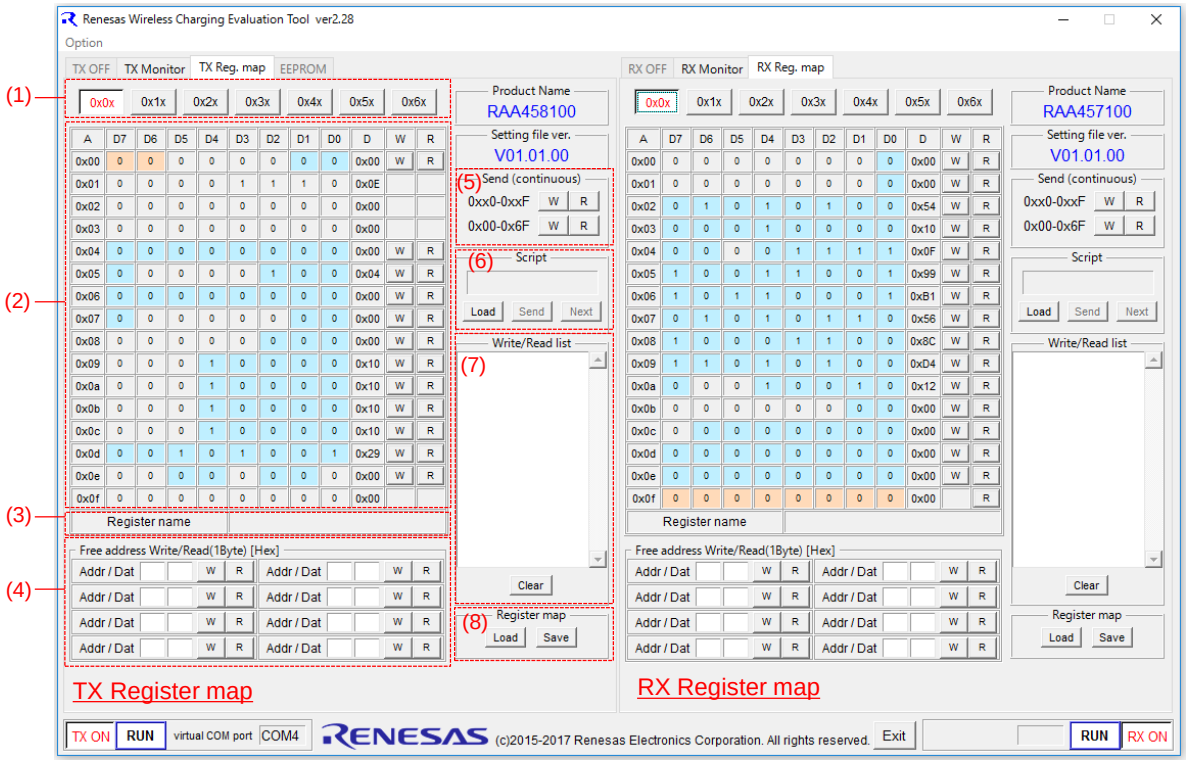


Figure 6.11 Register map

(1) Switch displayed register sheet

Each register map are for 16Byte in a sheet. Another sheet is opened by clicking address button.

(2) Register data write or read by each Byte.

The light blue register in register map can be written and read. The orange register in register map can be read.

・Register data write by each Byte

Displayed register data is changed to “0” or “1” by clicking light blue register.
The data is written into IC by clicking “W” button of address.

・Register data read by each Byte

The data on this register map is updated by clicking ”R” button of address.

(3) Register name

Register name is displayed on “Register name” by moving the cursor onto light blue or orange data.

(4) Free address Write / Read (1Byte)

The data can be directly written by inputting register address and data into entry field (Hexadecimal) and clicking “W” button.
The data can be directly read by inputting register address into entry field (Hexadecimal) and clicking “R” button.

(5) All register Write or Read

・Register data write or read together by 16Byte

The whole registers (16byte) displayed in sheet can be written or read by clicking “W” or “R” in 0xx0 – 0xxF field.

・Register data write or read together by whole data

The whole data can be written or read by clicking “W” or “R” in 0x00 – 0x6F field.

(6) Script Load

Script data which is described as specified format can be load.

Example of description of script

```
a,b,c,d

a  0: run, 1:  stop before run (restart by “Next” button)
b  r:read , w: write
c  Specify the address (Hexadecimal as 0x**)
d  Describe for Write data. It is unnecessary for the read.

ex.)
0,w,0x00,0xff
0,w,0x01,0xff
0,w,0x02,0xff
1,r,0x00
0,r,0x01
0,r,0x02
1,w,0x03,0xff
0,w,0x04,0xff
0,w,0x05,0xff
1,r,0x03
0,r,0x04
0,r,0x05
```

(7) Write/Load List

Log list is displayed. List is cleared by clicking “Clear” button.

(8) Register Load/Save

・Register load

The .csv format data can be loaded to the tool.

・Register save

Register data can be saved from the tool to the .csv format data.

Example of description for register map

```
a,b,c

a  Product name
b  Version of this file
c  You can write some comment (Blank: if unnecessary  )

・Second line or later  (You need to describe into all register 0x00-0x6F )
a,b,c,d,e,f

a  0: Invalid Register , 1:  Valid Register
b  Address
c  Bit
d  Name of Register
e  Initial value
f  R/W: available Read/Write , R：Read only

ex.)
RAA457100,V01.01.00,
1,0x00,D0,MODE_OFF,0,R/W
0,0x00,D1,,0,R
0,0x00,D2,,0,R
0,0x00,D3,,0,R
0,0x00,D4,,0,R
0,0x00,D5,,0,R
0,0x00,D6,,0,R
0,0x00,D7,,0,R
1,0x01,D0,CHG_EN,0,R/W
```

6.7 EEPROM Write / Read tool

This tool can access to the EEPROM.

EEPROM Write/Read tool setup procedure

1. Set slave at MS pin of RAA458100GNP on TX board. Refer to Table 5.2.
2. Supply DC 5V to TX board, and turn on SW2.
3. Select Master at “Setting1” of “TX setting” in “Option” menu. Refer to Figure 6.12.
4. EEPROM Write/Read tool is opened by clicking “TX_ON” button. Refer to Figure 6.13.

Figure 6.12 2-wire serial I/F Slave/Master setting

Figure 6.13 tool start up

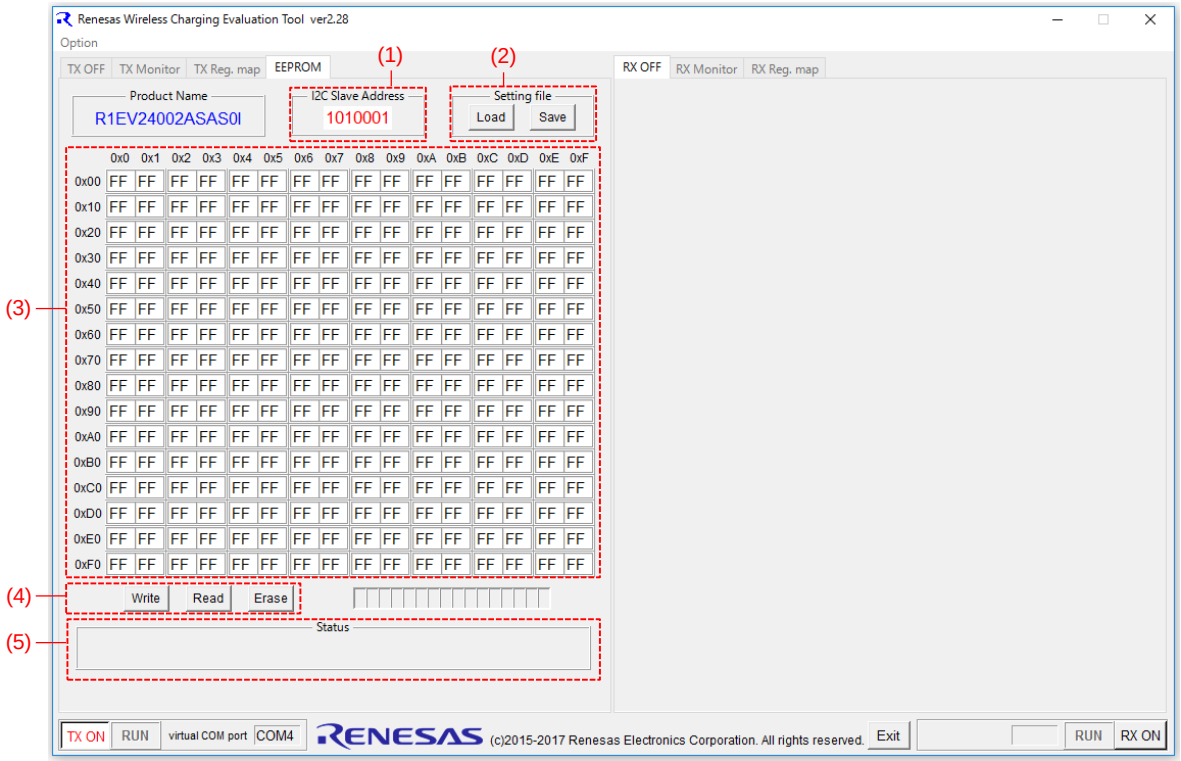


Figure 6.14 EEPROM Write/Read tool

(1) 2-wire I/F Slave address

Input slave address of EEPROM to 2-wire I/F Slave address. ”1010001” is input to entry field by default.

(2) Setting file

The .csv format data can be loaded to the tool by “Load” button.
Register data can be saved from displayed data to the .csv format data by “Save” button.

(3) EEPROM data

Data is displayed. Data can be changed by inputting directly to entry field.
When setting file is loaded, loaded data is displayed. When EEPROM data is read, read data is displayed.

(4) Write, Read, Erase

- ”Write” : Displayed data is written to the EEPROM.
- ”Read” : EEPROM data is read and displayed.
- ”Erase” : “0xFF” is written to all EEPROM data.

(5) Status

Operation state in this tool is displayed.

6.8 Data configuration of EEPROM（TxROM）

By applying EEPROM(TxROM) in TX system, the register of TxIC can be set. The registers of RxIC can be set by WPT communication in ATPC Mode(AT1). TxIC reads the data from EEPROM in start process(Initial Mode), and set the data into the register of TxIC. When the register of RxIC is set from TxIC, the register data stored in EEPROM is read by TxIC, and TxIC transfer the register data to RxIC by Tx2Rx WPT communication at proper timing.

Table 6.23 shows the data configuration of EEPROM. Device slave address of EEPROM is 7'b1010001 of the evaluation board. The data read from EEPROM by TxIC starts from word address "0" and continues to completion code in incrementing word address by "1". Read cycle is random read cycle. TxIC does not have a writing function to EEPROM.

Table 6.23 Slave address, read cycle, data configuration of EEPROM (TxROM)

Item	Description	
Communication method	2-wire serial communication (SCL frequency is fixed at 64[kHz].)	
EEPROM Device slave address	ADDR pin setting into low	7'b1010000
	ADDR pin setting into high	7'b1010001 (Evaluation board)
EEPROM read cycle	Random read cycle (Data reading is started from address "0" and increment word address by "1")	
EEPROM word address	Word address range is from "0" to "255". 2K bit EEPROM is available.	
EEPROM data configuration		
EEPROM word address	**EEPROM data**	**Description**
0	TxIC register address	TxIC register setting area. Even address : TxIC register address Odd address : TxIC register data
1	TxIC register data	
2	TxIC register address	
3	TxIC register data	
・ ・ ・	・ ・ ・	
2n-6	0x48	When register of RxIC is set from TxIC by Tx2Rx WPT communication, it should be set "T_0x48 D[7:0]=0x04" (Packet Header is specified).
2n-5	0x04	
2n-4	0x00	After setting necessary register, it should be set "T_0x00 D[1]=0x01". (Operation mode of TxIC changes from Initial Mode to Drive Mode.)
2n-3	0x02	
2n-2	0xFF	Completion code. Even address : 0xFF, Odd address : 0x00 TxIC register setting is finished.
2n-1	0x00	
2n	0xFE	Count setting of receiving packet in Rx2Tx WPT communication. Data "0xFE" is set in even address, and count of receiving packet is set in odd address. (*1)
2n+1	Count of receiving packet	
2n+2	RxIC register address	RxIC register setting area. Even address : RxIC register address Odd address : RxIC register data If register of RxIC does not need to be set, completion code should be set soon. (Even address : 0xFF, Odd address : 0x00)
2n+3	RxIC register data	
2n+4	RxIC register address	
2n+5	RxIC register data	
・ ・ ・	・ ・ ・	
2m-4	0x01	After setting necessary register, it should be set "R_0x01 D[0]=0x01" for starting battery charge.
2m-3	0x01	
2m-2	0xFF	Completion code. Even address : 0xFF, Odd address : 0x00 RxIC register setting is finished.
2m-1	0x00	

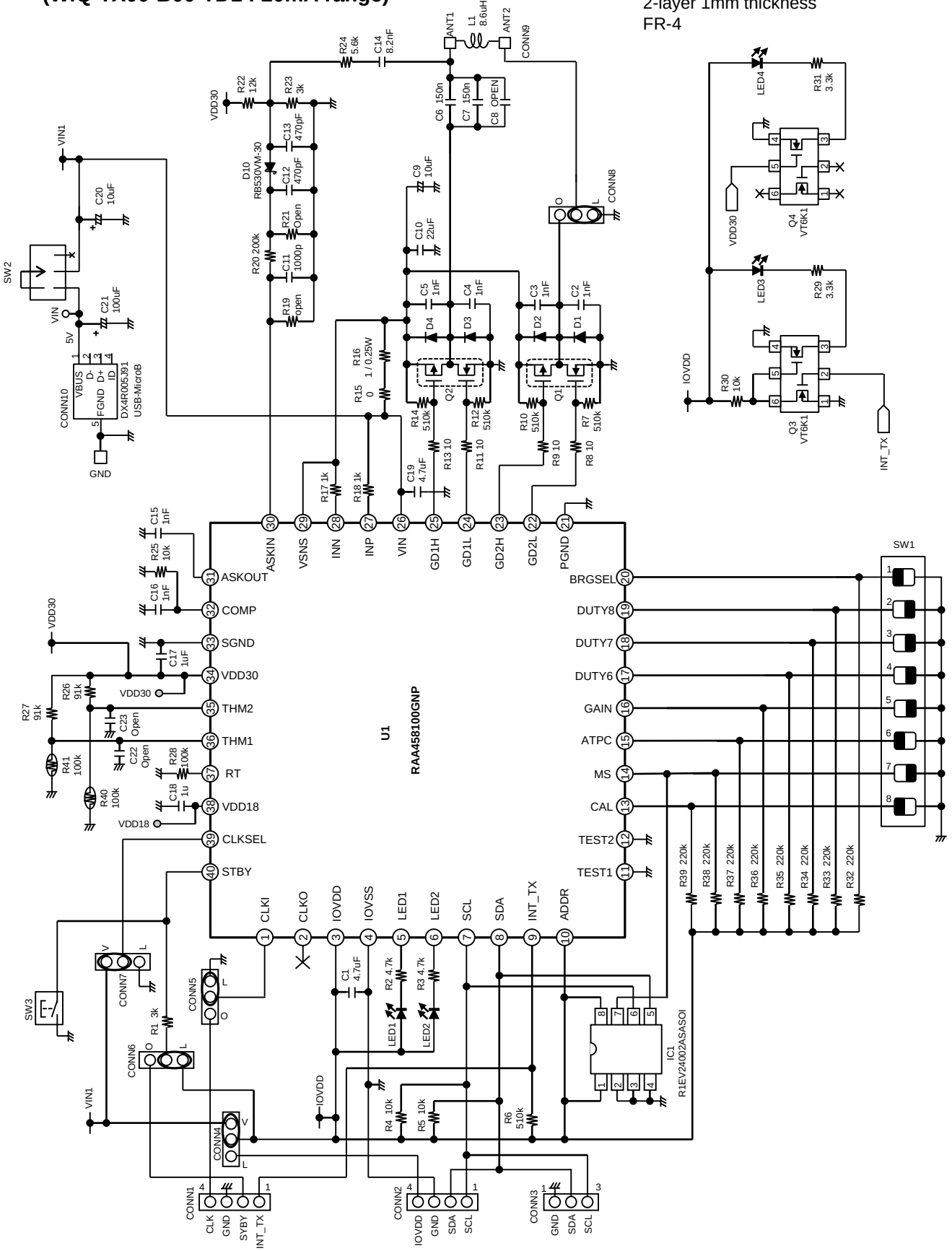
*1 When there is this setting, TxIC restarts to read from next word address after receiving Rx2Tx WPT communication packet "the setting value +1" times. This operation is to perform over power detection of transmission power at power transmission start timing. If over power detection is not needed, this setting is not need.

7. Board circuit

7.1 TX board circuit diagram

(WiQ-TX00-B00-TD1 : 20mA range)

TX board
Size： 55mm × 80 mm
2-layer 1mm thickness
FR-4



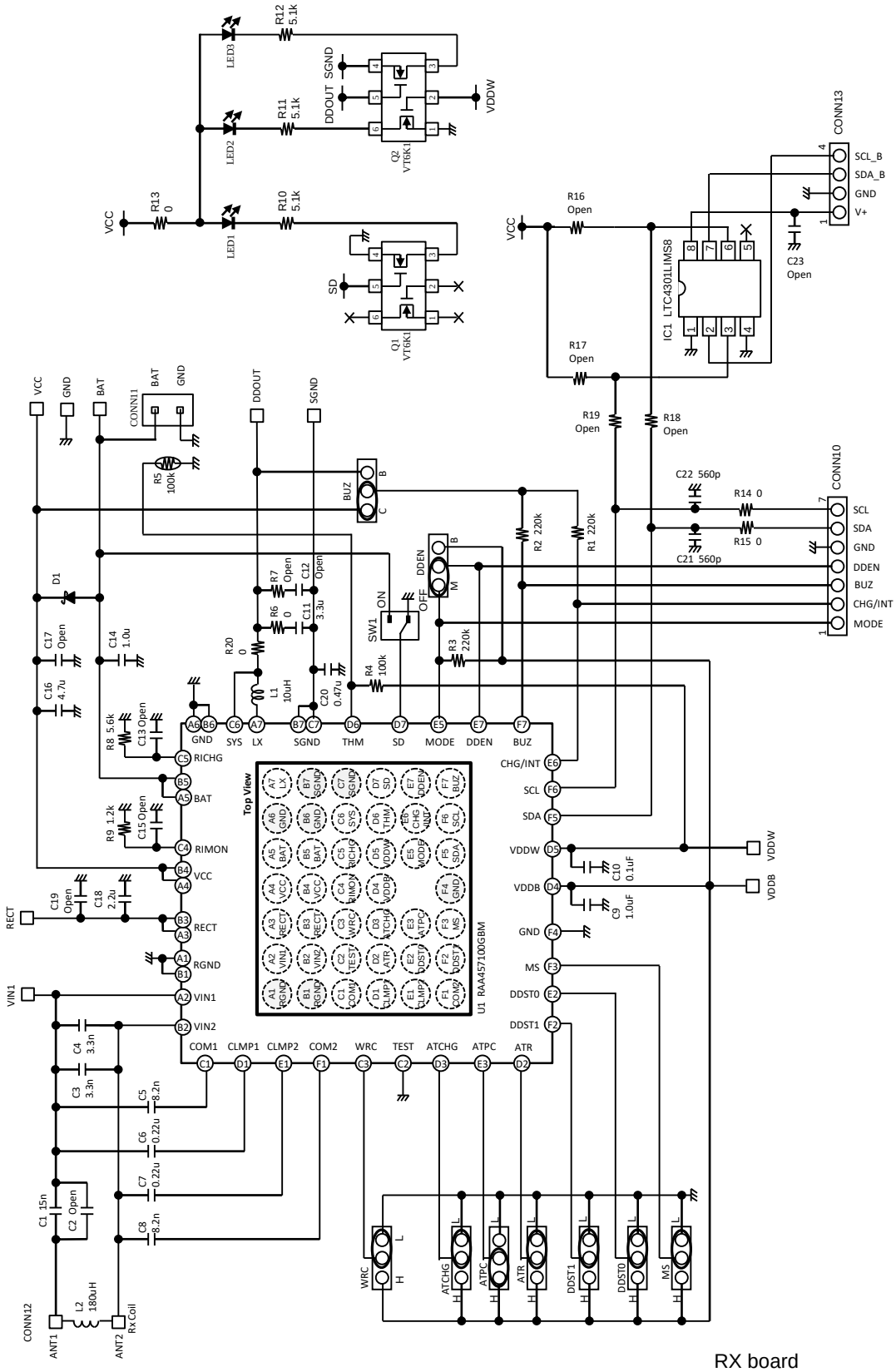
7.2 Bill of materials :WiQ-TX00-B00-TD1（20mA range）

Table7.1 WiQ-TX00-B00-TD1 board Bill Of Materials List

No	Symbol	Value	Size [mm]			Mfr.	Part Number
			L(typ)	W(typ)	T(max)		
1	C1,C19	4.7uF/25V	2.0	1.25	1.35	Murata	GRM21BB31E475KA75
2	C2,C,3,C,4,C5	1nF/50V	1.0	0.5	0.55	Murata	GRM1552C1H102JA01
3	C6,C7	150nF/50V	1.6	0.8	0.9	Murata	GCM188R71H154KA64
4	C8	-	1.6	0.8	-	-	-
5	C9,C20	10uF/16V	5.3	5.3	3.9	Nichicon	UZD1C100MCL1GB
6	C10	22uF/25V	2.0	1.25	1.45	Murata	GRM21BR61E226ME44L
7	C11,C15,C16	1000pF/50V	1.6	0.8	0.9	Murata	GRM1882C1H102JA01
8	C12,C13	470pF/50V	1.6	0.8	0.9	Murata	GRM1882C1H471JA01
9	C14	8.2nF/50V	1.6	0.8	0.9	Murata	GRM188B11H822KA01
10	C17,C18	1.0uF/25V	1.6	0.8	0.9	Murata	GRM188B31E105KA75
11	C21	100uF/16V	6.3	6.3	5.4	Nichicon	UWT1C101MCL1GB
12	C22,C23	-	1.0	0.5	-	-	-
13	R1	3kΩ	1.6	0.8	0.55	KOA	RK73H1JTTD3001F
14	R2,R3	4.7kΩ	1.6	0.8	0.55	KOA	RK73H1JTTD4701F
15	R4,R5,R30	10kΩ	1.6	0.8	0.55	KOA	RK73B1JTTD103J
16	R6	510kΩ	1.6	0.8	0.55	KOA	RK73B1JTTD514J
17	R7,R10,R12,R14	510kΩ	1.0	0.5	0.4	KOA	RK73B1ETTP514J
18	R8,R9,R11,R13	10Ω	1.6	0.8	0.55	KOA	RK73B1JTTD100J
19	R15	0Ω	3.2	1.6	0.7	Panasonic	ERJ8GEY0R00V
20	R16	1Ω	3.2	1.6	0.7	Panasonic	ERJ8RQF1R0V
21	R17,R18	1kΩ	1.6	0.8	0.55	KOA	RK73H1JTTD1001F
22	R19	-	1.6	0.8	-	-	-
23	R20	200kΩ	1.6	0.8	0.55	KOA	RK73B1JTTD204J
24	R21	-	1.6	0.8	-	-	-
25	R22	12kΩ	1.6	0.8	0.55	KOA	RK73H1JTTD1202F
26	R23	3kΩ	1.6	0.8	0.55	KOA	RK73H1JTTD3001F
27	R24	5.6kΩ	1.6	0.8	0.55	KOA	RK73H1JTTD5601F
28	R25	10kΩ	1.6	0.8	0.55	KOA	RK73H1JTTD1002F
29	R26,R27	91kΩ	1.0	0.5	0.4	KOA	RK73H1ETTP9102F
30	R28	100kΩ	1.6	0.8	0.55	Panasonic	ERA3AEB104V
31	R29,R31	3.3kΩ	1.6	0.8	0.55	KOA	RK73B1JTTD332J
32	R32~R39	220kΩ	1.0	0.5	0.4	KOA	RK73B1ETTP224J
33	R40,R41	NCT	1.0	0.5	0.55	Murata	NCP15WF104F03RC
34	LED1	Red	1.0	0.6	0.25	Rohm	SML-P12UTT86R
35	LED2	Green	1.0	0.6	0.25	Rohm	SML-P13PTT86R
36	LED3	Yellow	1.0	0.6	0.25	Rohm	SML-P12YTT86R
37	LED4	Red	1.0	0.6	0.25	Rohm	SML-P12UTT86R
38	SW1	DIP switch	11.7	8.0	2.5	Nidec	CHS-08B
39	SW2	Slide switch	8.5	5.0	5.5	ALPS	SSSS213202
40	SW3	Tactile switch	7.5	6.0	3.4	Omuron	B3SN-3012P
41	Q1,Q2	MOS	2.0	2.0	0.75	Renesas	uPA2690T1R
42	Q3,Q4	MOS	1.2	1.2	0.55	Rohm	VT6K1T2CR
43	D1,D2,D3,D4	Schottky diode	2.5	1.3	0.8	Rohm	RSX051VA-30TR
44	D10	Schottky diode	2.5	1.25	0.9	Rohm	RB530VM-30TE-17
45	L1	8.6uH	20.5	20.5	1.95	Toda kogyo	WKC20-T20179R
46	IC1	EEPROM	6.02	4.89	1.73	Renesas	R1EV24002ASAS0I
47	U1	Tx IC	5.0	5.0	0.65	Renesas	RAA458100GNP

* There is a possibility to change the materials for performance improvement.

7.3 RX board circuit diagram (WiQ-RX00-B00-TD1 : 20mA range)



RX board
Size： 55mm × 35 mm
4-layer 1mm thickness
FR-4

7.4 Bill of materials :WiQ-RX00-B00-TD1（20mA range）

Table 7.2 WiQ-RX00-B00-TD1 board Bill Of Materials List

No	Symbol	Value	Size [mm]			Mfr.	Part Number
			L(typ)	W(typ)	T(max)		
1	C1	15nF/50V	1.6	0.8	0.9	Murata	GRM188B11H153KA01
2	C2	-	1.6	0.8	-	-	-
3	C3,C4	3.3nF/50V	1.6	0.8	0.9	Murata	GRM188B11H332KA01
4	C5,C8	8.2nF/50V	1.6	0.8	0.9	Murata	GRM188B11H822KA01
5	C6,C7	0.22uF/25V	1.6	0.8	0.9	Murata	GRM188R61E224KA88
6	C9,C14	1.0uF/10V	1.6	0.8	0.9	Murata	GRM188B11A105KA61
7	C10	0.1uF/10V	1.0	0.5	0.55	Murata	GRM155B11A104KA01
8	C11	3.3uF/10V	1.6	0.8	0.9	Murata	GRM188B31A335KE15
9	C12	-	1.6	0.8	-	-	-
10	C13	-	1.6	0.8	-	-	-
11	C15	-	1.6	0.8	-	-	-
12	C16	4.7uF/16V	1.6	0.8	0.95	Murata	GRM188B31C475KAAJ
13	C17	-	1.6	0.8	-	-	-
14	C18	2.2uF/25V	1.6	0.8	1.0	Murata	GRT188C81E225KE13
15	C19	-	1.6	0.8	-	-	-
16	C20	0.47uF/10V	1.6	0.8	0.9	Murata	GRM188B11A474KA61
17	C21,C22	560pF/50V	1.6	0.8	0.9	Murata	GRM1882C1H561JA01
18	C23	-	1.6	0.8	-	-	-
19	R1,R2,R3	220kΩ	1.0	0.5	0.4	KOA	RK73B1ETTP224J
20	R4	100kΩ	1.0	0.5	0.4	KOA	RK73H1ETTP1003F
21	R5	NCT	1.0	0.5	0.55	Murata	NCP15WF104F03RC
22	R6,R13,R14,R15,R20	0Ω	1.6	0.8	0.55	KOA	RK73Z1JTTD
23	R7	-	1.6	0.8	-	-	-
24	R8	5.6kΩ	1.6	0.8	0.55	KOA	RK73H1JTTD5601F
25	R9	1.2kΩ	1.6	0.8	0.55	KOA	RK73H1JTTD1201F
26	R10,R11,R12	5.1kΩ	1.0	0.5	0.4	KOA	RK73B1ETTP512J
27	R16	-	1.6	0.8	-	-	-
28	R17	-	1.6	0.8	-	-	-
29	R18	-	1.6	0.8	-	-	-
30	R19	-	1.6	0.8	-	-	-
31	D1	Schottky diode	0.6	0.3	0.33	Rohm	RB520ZS-30T2R
32	LED1	Red	1.0	0.6	0.25	Rohm	SML-P12UTT86R
33	LED2	Yellow	1.0	0.6	0.25	Rohm	SML-P12YTT86R
34	LED3	red	1.0	0.6	0.25	Rohm	SML-P12UTT86R
35	SW1	Switch	8.5	3.5	5.5	COPAL	CL-SB-22B-01T
36	Q1,Q2	MOS	1.2	1.2	0.55	Rohm	VT6K1T2CR
37	L1	10uH	2.5	2.0	0.8	TDK	VLS252008ET-100M
38	L2	180uH	10.5	10.5	1.1	Toda kogyo	WKC20-R109180R
39	IC1	I2C Buffer	3.5	2.38	0.8	Linear Technology	LTC4301LIMS8#PBF
40	U1	Rx IC	2.77	3.22	0.7	Renesas	RAA457100GBM

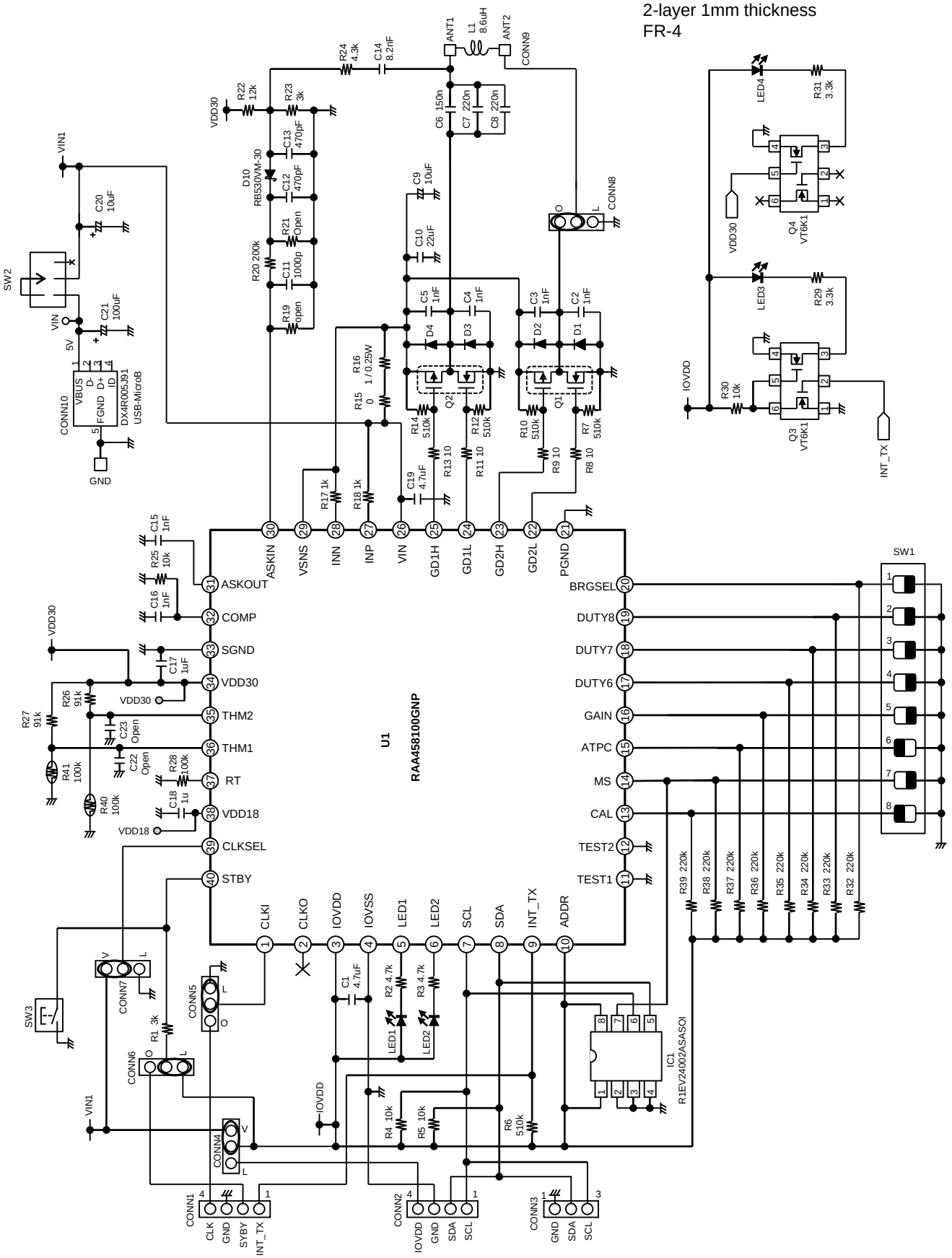
If DCDC converter output voltage is set to 3.0V ,change C12, C20, R6, R7.

No	Symbol	Value	Size [mm]			Mfr.	Part Number
			L(typ)	W(typ)	T(max)		
1	C12	4.7uF/16V	1.6	0.8	0.9	Murata	GRM188B31C475KAAJ
2	C20	1.0uF/10V	1.6	0.8	0.95	Murata	GRM188B11A105KA61
3	R6	-	1.6	0.8	-	-	-
4	R7	330mΩ	1.6	0.8	0.55	Panasonic	ERJ3BQFR33V

* There is a possibility to change the materials for performance improvement.

7.5 TX board circuit diagram (WiQ-TX00-B00-TD2 : 70mArange)

TX board
Size： 55mm × 80 mm
2-layer 1mm thickness
FR-4



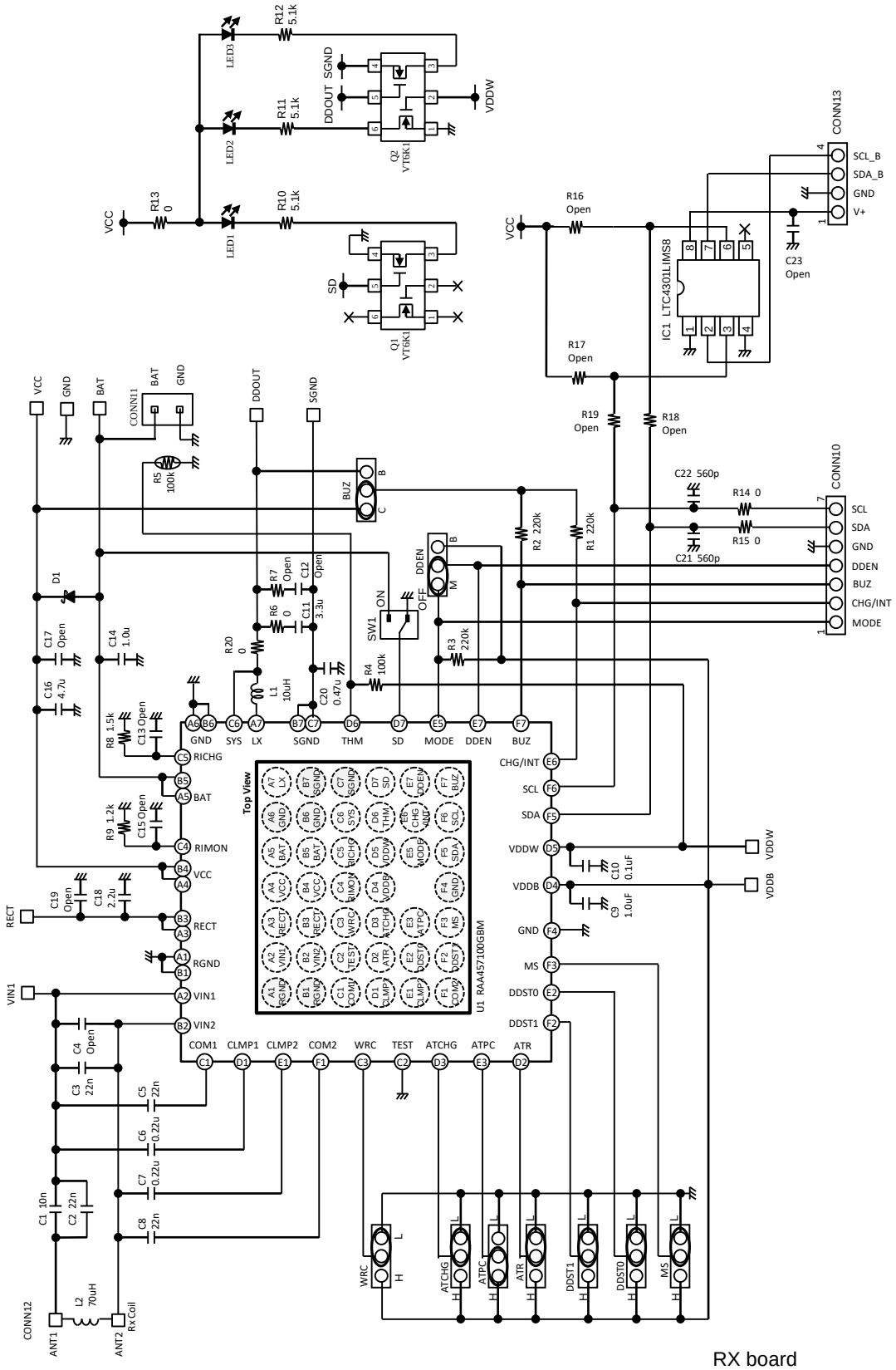
7.6 Bill of materials :WiQ-TX00-B00-TD2（70mA range）

Table 7.3 WiQ-TX00-B00-TD2 board Bill Of Materials List

No	Symbol	Value	Size [mm]			Mfr.	Part Number
			L(typ)	W(typ)	T(max)		
1	C1,C19	4.7uF/25V	2.0	1.25	1.35	Murata	GRM21BB31E475KA75
2	C2,C,3,C,4,C5	1nF/50V	1.0	0.5	0.55	Murata	GRM1552C1H102JA01
3	C6	150nF/50V	1.6	0.8	0.9	Murata	GCM188R71H154KA64
4	C7,C8	220nF/50V	1.6	0.8	0.9	Murata	GCM188R71H224KA64
5	C9,C20	10uF/16V	5.3	5.3	3.9	Nichicon	UZD1C100MCL1GB
6	C10	22uF/25V	2.0	1.25	1.45	Murata	GRM21BR61E226ME44L
7	C11,C15,C16	1000pF/50V	1.6	0.8	0.9	Murata	GRM1882C1H102JA01
8	C12,C13	470pF/50V	1.6	0.8	0.9	Murata	GRM1882C1H471JA01
9	C14	8.2nF/50V	1.6	0.8	0.9	Murata	GRM188B11H822KA01
10	C17,C18	1.0uF/25V	1.6	0.8	0.9	Murata	GRM188B31E105KA75
11	C21	100uF/16V	6.3	6.3	5.4	Nichicon	UWT1C101MCL1GB
12	C22,C23	-	1.0	0.5	-	-	-
13	R1	3kΩ	1.6	0.8	0.55	KOA	RK73H1JTTD3001F
14	R2,R3	4.7kΩ	1.6	0.8	0.55	KOA	RK73H1JTTD4701F
15	R4,R5,R30	10kΩ	1.6	0.8	0.55	KOA	RK73B1JTTD103J
16	R6	510kΩ	1.6	0.8	0.55	KOA	RK73B1JTTD514J
17	R7,R10,R12,R14	510kΩ	1.0	0.5	0.4	KOA	RK73B1ETTP514J
18	R8,R9,R11,R13	10Ω	1.6	0.8	0.55	KOA	RK73B1JTTD100J
19	R15	0Ω	3.2	1.6	0.7	Panasonic	ERJ8GEY0R00V
20	R16	1Ω	3.2	1.6	0.7	Panasonic	ERJ8RQF1R0V
21	R17,R18	1kΩ	1.6	0.8	0.55	KOA	RK73H1JTTD1001F
22	R19	-	1.6	0.8	-	-	-
23	R20	200kΩ	1.6	0.8	0.55	KOA	RK73B1JTTD204J
24	R21	-	1.6	0.8	-	-	-
25	R22	12kΩ	1.6	0.8	0.55	KOA	RK73H1JTTD1202F
26	R23	3kΩ	1.6	0.8	0.55	KOA	RK73H1JTTD3001F
27	R24	4.3kΩ	1.6	0.8	0.55	KOA	RK73H1JTTD4301F
28	R25	10kΩ	1.6	0.8	0.55	KOA	RK73H1JTTD1002F
29	R26,R27	91kΩ	1.0	0.5	0.4	KOA	RK73H1ETTP9102F
30	R28	100kΩ	1.6	0.8	0.55	Panasonic	ERA3AEB104V
31	R29,R31	3.3kΩ	1.6	0.8	0.55	KOA	RK73B1JTTD332J
32	R32~R39	220kΩ	1.0	0.5	0.4	KOA	RK73B1ETTP224J
33	R40,R41	NCT	1.0	0.5	0.55	Murata	NCP15WF104F03RC
34	LED1	Red	1.0	0.6	0.25	Rohm	SML-P12UTT86R
35	LED2	Green	1.0	0.6	0.25	Rohm	SML-P13PTT86R
36	LED3	Yellow	1.0	0.6	0.25	Rohm	SML-P12YTT86R
37	LED4	Red	1.0	0.6	0.25	Rohm	SML-P12UTT86R
38	SW1	DIP switch	11.7	8.0	2.5	Nidec	CHS-08B
39	SW2	Slide switch	8.5	5.0	5.5	ALPS	SSSS213202
40	SW3	Tactile switch	7.5	6.0	3.4	Omuron	B3SN-3012P
41	Q1,Q2	MOS	2.0	2.0	0.75	Renesas	uPA2690T1R
42	Q3,Q4	MOS	1.2	1.2	0.55	Rohm	VT6K1T2CR
43	D1,D2,D3,D4	Schottky diode	2.5	1.3	0.8	Rohm	RSX051VA-30TR
44	D10	Schottky diode	2.5	1.25	0.9	Rohm	RB530VM-30TE-17
45	L1	8.6uH	20.5	20.5	1.95	Toda kogyo	WKC20-T20179R
46	IC1	EEPROM	6.02	4.89	1.73	Renesas	R1EV24002ASAS0I
47	U1	Tx IC	5.0	5.0	0.65	Renesas	RAA458100GNP

* There is a possibility to change the materials for performance improvement.

7.7 RX board circuit diagram (WiQ-RX00-B00-TD2 : 70mA range)



RX board
Size： 55mm × 35 mm
4-layer 1mm thickness
FR-4

7.8 Bill of materials :WiQ-RX00-B00-TD2（70mA range）

Table 7.4 WiQ-RX00-B00-TD2 board Bill Of Materials List

No	Symbol	Value	Size [mm]			Mfr.	Part Number
			L(typ)	W(typ)	T(max)		
1	C1	10nF/50V	1.6	0.8	0.9	Murata	GRM188B11H103KA01
2	C2,C3,C5,C8	22nF/50V	1.6	0.8	0.9	Murata	GRM188B11H223KA01
3	C4	-	1.6	0.8	-	-	-
5	C6,C7	0.22uF/25V	1.6	0.8	0.9	Murata	GRM188R61E224KA88
6	C9,C14	1.0uF/10V	1.6	0.8	0.9	Murata	GRM188B11A105KA61
7	C10	0.1uF/10V	1.0	0.5	0.55	Murata	GRM155B11A104KA01
8	C11	3.3uF/10V	1.6	0.8	0.9	Murata	GRM188B31A335KE15
9	C12	-	1.6	0.8	-	-	-
10	C13	-	1.6	0.8	-	-	-
11	C15	-	1.6	0.8	-	-	-
12	C16	4.7uF/16V	1.6	0.8	0.95	Murata	GRM188B31C475KAAJ
13	C17	-	1.6	0.8	-	-	-
14	C18	2.2uF/25V	1.6	0.8	1.0	Murata	GRT188C81E225KE13
15	C19	-	1.6	0.8	-	-	-
16	C20	0.47uF/10V	1.6	0.8	0.9	Murata	GRM188B11A474KA61
17	C21,C22	560pF/50V	1.6	0.8	0.9	Murata	GRM1882C1H561JA01
18	C23	-	1.6	0.8	-	-	-
19	R1,R2,R3	220kΩ	1.0	0.5	0.4	KOA	RK73B1ETTP224J
20	R4	100kΩ	1.0	0.5	0.4	KOA	RK73H1ETTP1003F
21	R5	NCT	1.0	0.5	0.55	Murata	NCP15WF104F03RC
22	R6,R13,R14,R15,R20	0Ω	1.6	0.8	0.55	KOA	RK73Z1JTTD
23	R7	-	1.6	0.8	-	-	-
24	R8	1.5kΩ	1.6	0.8	0.55	KOA	RK73H1JTTD1501F
25	R9	1.2kΩ	1.6	0.8	0.55	KOA	RK73H1JTTD1201F
26	R10,R11,R12	5.1kΩ	1.0	0.5	0.4	KOA	RK73B1ETTP512J
27	R16	-	1.6	0.8	-	-	-
28	R17	-	1.6	0.8	-	-	-
29	R18	-	1.6	0.8	-	-	-
30	R19	-	1.6	0.8	-	-	-
31	D1	Schottky diode	0.6	0.3	0.33	Rohm	RB520ZS-30T2R
32	LED1	Red	1.0	0.6	0.25	Rohm	SML-P12UTT86R
33	LED2	Yellow	1.0	0.6	0.25	Rohm	SML-P12YTT86R
34	LED3	red	1.0	0.6	0.25	Rohm	SML-P12UTT86R
35	SW1	Switch	8.5	3.5	5.5	COPAL	CL-SB-22B-01T
36	Q1,Q2	MOS	1.2	1.2	0.55	Rohm	VT6K1T2CR
37	L1	10uH	2.5	2.0	0.8	TDK	VLS252008ET-100M
38	L2	70uH	15.0	15.0	1.1	Toda kogyo	WKC70-R15270R
39	IC1	I2C Buffer	3.5	2.38	0.8	Linear Technology	LTC4301LIMS8#PBF
40	U1	Rx IC	2.77	3.22	0.7	Renesas	RAA457100GBM

If DCDC converter output voltage is set to 3.0V ,change C12, C20, R6, R7.

No	Symbol	Value	Size [mm]			Mfr.	Part Number
			L(typ)	W(typ)	T(max)		
1	C12	4.7uF/16V	1.6	0.8	0.9	Murata	GRM188B31C475KAAJ
2	C20	1.0uF/10V	1.6	0.8	0.95	Murata	GRM188B11A105KA61
3	R6	-	1.6	0.8	-	-	-
4	R7	330mΩ	1.6	0.8	0.55	Panasonic	ERJ3BQFR33V

* There is a possibility to change the materials for performance improvement.

7.9 Reference antenna coil overview

Table 7.5 shows the reference coil antenna overview.

Table 7.5 Reference coil antenna

Coil set	Coil Type	Figure	L [uH] / R [Ohm]	Coupling coefficient (Gap=3mm)	Diameter [mm]	Thickness [mm]	Mfr.	Part Number
20mA range	TX Coil		8.6 / 0.16	0.25	20.5	1.95	TODA KOGYO	WKC20-T20179R
	RX Coil		180 / 10		10.5	1.1	TODA KOGYO	WKC20-R109180R
70mA range	TX Coil		8.6 / 0.16	0.38	20.5	1.95	TODA KOGYO	WKC20-T20179R
	RX Coil		70 / 1.8		15.0	1.1	TODA KOGYO	WKC70-R15270R

* The values described in this table are reference values, not guaranteed values.

【Appendix 1】Error information of the control tool

Table 10.1 shows error information of the control tool.

Table 10.1 Error item and description

Error item	Description
TX initialized error(1) ,(2) ,(3).	Register of TX IC can not be set initially. Check setting of MS pin and connection (SDA, SCL) of host adaptor.
RX initialized error(1) ,(2) ,(3).	Register of RX IC can not be set initially. Check setting of MS pin and connection (SDA, SCL) of host adaptor.

【Appendix2】Initial pin setting of system boards （WiQ-TX00-B00-TD1 ,WiQ-RX00-B00-TD1）

Table 10.2 to Table 10.4 show the initial pin setting of system boars (WiQ-TX00-B00-TD1 ,WiQ-RX00-B00-TD1). Refer to Chapter 5 in detail.

Table 10.2 Initial setting of SW1 in WiQ-TX00-B00-TD1.

pin No. (pin name)	Condition	Description
1pin (BRGSEL)	H	Half bridge circuit setting.
2pin (DUTY8)	L	Bridge driver output pulse duty setting：0x07 D[0]=0.
3pin (DUTY7)	L	Bridge driver output pulse duty setting：0x06 D[7]=0.
4pin (DUTY6)	L	Bridge driver output pulse duty setting：0x06 D[6]=0.
5pin (GAIN)	L	GAIN setting is 0.125 for automatic transmission power control.
6pin (ATPC)	H	Enable automatic transmission power control.
7pin (MS)	L	Slave device setting for 2-wire serial communication interface.
8pin (CAL)	H	Enable for CS amplifier offset calibration.

Table 10.3 Initial jumper setting in WiQ-TX00-B00-TD1.

CONN (pin name)	Condition	Description
CONN1	-	OPEN
CONN2	-	OPEN
CONN3	-	OPEN
CONN4 (IOVDD)	V	IOVDD pin = VIN pin.
CONN5 (CLKI)	L	On-chip clock is used.
CONN6 (STBY)	L	STBY pin is connected to IOVDD via 3kΩ resistance.
CONN7 (CLKSEL)	V	On-chip clock is used.
CONN8	L	Half bride circuit setting.

Table 10.4 Initial jumper setting in WiQ-RX00-B00-TD1.

Jumper	Condition	Description
WRC	L	Disable wired charging.
ATCHG	L	Disable automatic start of battery charging.
ATPC	H	Enable automatic transmission power control.
ATR	L	Enable automatic control of rectifier.
DDST0	L	DCDC converter output voltage setting is 1.2V.
DDST1	L	
MS	L	Slave device setting for 2-wire serial communication interface.
BUZ	C	BUZ pin and CHG/INT pin are connected VCC pin via pull-up resistance.
DDEN	M	DCDC converter operates only in discharge mode.

【Appendix2】Initial pin setting of system boards （WiQ-TX00-B00-TD2 ,WiQ-RX00-B00-TD2）

Table 10.5 to Table 10.7 show the initial pin setting of system boars (WiQ-TX00-B00-TD2 ,WiQ-RX00-B00-TD2). Refer to Chapter 5 in detail.

Table 10.5 Initial setting of SW1 in WiQ-TX00-B00-TD2.

pin No. (pin name)	Condition	Description
1pin (BRGSEL)	L	Full bridge circuit setting.
2pin (DUTY8)	L	Bridge driver output pulse duty setting：0x07 D[0]=0.
3pin (DUTY7)	L	Bridge driver output pulse duty setting：0x06 D[7]=0.
4pin (DUTY6)	L	Bridge driver output pulse duty setting：0x06 D[6]=0.
5pin (GAIN)	L	GAIN setting is 0.125 for automatic transmission power control.
6pin (ATPC)	H	Enable automatic transmission power control.
7pin (MS)	L	Slave device setting for 2-wire serial communication interface.
8pin (CAL)	H	Enable for CS amplifier offset calibration.

Table 10.6 Initial jumper setting in WiQ-TX00-B00-TD2.

CONN (pin name)	Condition	Description
CONN1	-	OPEN
CONN2	-	OPEN
CONN3	-	OPEN
CONN4 (IOVDD)	V	IOVDD pin = VIN pin.
CONN5 (CLKI)	L	On-chip clock is used.
CONN6 (STBY)	L	STBY pin is connected to IOVDD via 3kΩ resistance.
CONN7 (CLKSEL)	V	On-chip clock is used.
CONN8	O	Full bride circuit setting.

Table 10.7 Initial jumper setting in WiQ-RX00-B00-TD2.

Jumper	Condition	Description
WRC	L	Disable wired charging.
ATCHG	L	Disable automatic start of battery charging.
ATPC	H	Enable automatic transmission power control.
ATR	L	Enable automatic control of rectifier.
DDST0	L	DCDC converter output voltage setting is 1.2V.
DDST1	L	
MS	L	Slave device setting for 2-wire serial communication interface.
BUZ	C	BUZ pin and CHG/INT pin are connected VCC pin via pull-up resistance.
DDEN	M	DCDC converter operates only in discharge mode.

Website and Support

Renesas Electronics Website
http://www.renesas.com/

Inquire
http://www.renesas.com/contact/

Revision Record

Rev.	Date	Description	
		Page	Summary
1.00	Mar. 31 , 2017	-	First Edition issued
1.01	Sep. 03 , 2018	18	LED1, LED2 flashing pattern of battery charge complete state in Table 5.8

Notice

1. Descriptions of circuits, software and other related information in this document are provided only to illustrate the operation of semiconductor products and application examples. You are fully responsible for the incorporation or any other use of the circuits, software, and information in the design of your product or system. Renesas Electronics disclaims any and all liability for any losses and damages incurred by you or third parties arising from the use of these circuits, software, or information.
2. Renesas Electronics hereby expressly disclaims any warranties against and liability for infringement or any other claims involving patents, copyrights, or other intellectual property rights of third parties, by or arising from the use of Renesas Electronics products or technical information described in this document, including but not limited to, the product data, drawings, charts, programs, algorithms, and application examples.
3. No license, express, implied or otherwise, is granted hereby under any patents, copyrights or other intellectual property rights of Renesas Electronics or others.
4. You shall not alter, modify, copy, or reverse engineer any Renesas Electronics product, whether in whole or in part. Renesas Electronics disclaims any and all liability for any losses or damages incurred by you or third parties arising from such alteration, modification, copying or reverse engineering.
5. Renesas Electronics products are classified according to the following two quality grades: "Standard" and "High Quality". The intended applications for each Renesas Electronics product depends on the product's quality grade, as indicated below.

   "Standard": Computers; office equipment; communications equipment; test and measurement equipment; audio and visual equipment; home electronic appliances; machine tools; personal electronic equipment; industrial robots; etc.

   "High Quality": Transportation equipment (automobiles, trains, ships, etc.); traffic control (traffic lights); large-scale communication equipment; key financial terminal systems; safety control equipment; etc.

   Unless expressly designated as a high reliability product or a product for harsh environments in a Renesas Electronics data sheet or other Renesas Electronics document, Renesas Electronics products are not intended or authorized for use in products or systems that may pose a direct threat to human life or bodily injury (artificial life support devices or systems; surgical implantations; etc.), or may cause serious property damage (space system; undersea repeaters; nuclear power control systems; aircraft control systems; key plant systems; military equipment; etc.). Renesas Electronics disclaims any and all liability for any damages or losses incurred by you or any third parties arising from the use of any Renesas Electronics product that is inconsistent with any Renesas Electronics data sheet, user's manual or other Renesas Electronics document.
6. When using Renesas Electronics products, refer to the latest product information (data sheets, user's manuals, application notes, "General Notes for Handling and Using Semiconductor Devices" in the reliability handbook, etc.), and ensure that usage conditions are within the ranges specified by Renesas Electronics with respect to maximum ratings, operating power supply voltage range, heat dissipation characteristics, installation, etc. Renesas Electronics disclaims any and all liability for any malfunctions, failure or accident arising out of the use of Renesas Electronics products outside of such specified ranges.
7. Although Renesas Electronics endeavors to improve the quality and reliability of Renesas Electronics products, semiconductor products have specific characteristics, such as the occurrence of failure at a certain rate and malfunctions under certain use conditions. Unless designated as a high reliability product or a product for harsh environments in a Renesas Electronics data sheet or other Renesas Electronics document, Renesas Electronics products are not subject to radiation resistance design. You are responsible for implementing safety measures to guard against the possibility of bodily injury, injury or damage caused by fire, and/or danger to the public in the event of a failure or malfunction of Renesas Electronics products, such as safety design for hardware and software, including but not limited to redundancy, fire control and malfunction prevention, appropriate treatment for aging degradation or any other appropriate measures. Because the evaluation of microcomputer software alone is very difficult and impractical, you are responsible for evaluating the safety of the final products or systems manufactured by you.
8. Please contact a Renesas Electronics sales office for details as to environmental matters such as the environmental compatibility of each Renesas Electronics product. You are responsible for carefully and sufficiently investigating applicable laws and regulations that regulate the inclusion or use of controlled substances, including without limitation, the EU RoHS Directive, and using Renesas Electronics products in compliance with all these applicable laws and regulations. Renesas Electronics disclaims any and all liability for damages or losses occurring as a result of your noncompliance with applicable laws and regulations.
9. Renesas Electronics products and technologies shall not be used for or incorporated into any products or systems whose manufacture, use, or sale is prohibited under any applicable domestic or foreign laws or regulations. You shall comply with any applicable export control laws and regulations promulgated and administered by the governments of any countries asserting jurisdiction over the parties or transactions.
10. It is the responsibility of the buyer or distributor of Renesas Electronics products, or any other party who distributes, disposes of, or otherwise sells or transfers the product to a third party, to notify such third party in advance of the contents and conditions set forth in this document.
11. This document shall not be reprinted, reproduced or duplicated in any form, in whole or in part, without prior written consent of Renesas Electronics.
12. Please contact a Renesas Electronics sales office if you have any questions regarding the information contained in this document or Renesas Electronics products.

(Note 1) "Renesas Electronics" as used in this document means Renesas Electronics Corporation and also includes its directly or indirectly controlled subsidiaries.

(Note 2) "Renesas Electronics product(s)" means any product developed or manufactured by or for Renesas Electronics.

(Rev.4.0-1 November 2017)

RENESAS

SALES OFFICES

Renesas Electronics Corporation

http://www.renesas.com

Refer to "http://www.renesas.com/" for the latest and detailed information.

Renesas Electronics America Inc.
1001 Murphy Ranch Road, Milpitas, CA 95035, U.S.A.
Tel: +1-408-432-8888, Fax: +1-408-434-5351

Renesas Electronics Canada Limited
9251 Yonge Street, Suite 8309 Richmond Hill, Ontario Canada L4C 9T3
Tel: +1-905-237-2004

Renesas Electronics Europe Limited
Dukes Meadow, Millboard Road, Bourne End, Buckinghamshire, SL8 5FH, U.K
Tel: +44-1628-651-700

Renesas Electronics Europe GmbH
Arcadiastrasse 10, 40472 Düsseldorf, Germany
Tel: +49-211-6503-0, Fax: +49-211-6503-1327

Renesas Electronics (China) Co., Ltd.
Room 1709 Quantum Plaza, No.27 ZhichunLu, Haidian District, Beijing, 100191 P. R. China
Tel: +86-10-8235-1155, Fax: +86-10-8235-7679

Renesas Electronics (Shanghai) Co., Ltd.
Unit 301, Tower A, Central Towers, 555 Langao Road, Putuo District, Shanghai, 200333 P. R. China
Tel: +86-21-2226-0888, Fax: +86-21-2226-0999

Renesas Electronics Hong Kong Limited
Unit 1601-1611, 16/F., Tower 2, Grand Century Place, 193 Prince Edward Road West, Mongkok, Kowloon, Hong Kong
Tel: +852-2265-6688, Fax: +852 2886-9022

Renesas Electronics Taiwan Co., Ltd.
13F, No. 363, Fu Shing North Road, Taipei 10543, Taiwan
Tel: +886-2-8175-9600, Fax: +886 2-8175-9670

Renesas Electronics Singapore Pte. Ltd.
80 Bendemeer Road, Unit #06-02 Hyflux Innovation Centre, Singapore 339949
Tel: +65-6213-0200, Fax: +65-6213-0300

Renesas Electronics Malaysia Sdn.Bhd.
Unit 1207, Block B, Menara Amcorp, Amcorp Trade Centre, No. 18, Jln Persiaran Barat, 46050 Petaling Jaya, Selangor Darul Ehsan, Malaysia
Tel: +60-3-7955-9390, Fax: +60-3-7955-9510

Renesas Electronics India Pvt. Ltd.
No.777C, 100 Feet Road, HAL 2nd Stage, Indiranagar, Bangalore 560 038, India
Tel: +91-80-67208700, Fax: +91-80-67208777

Renesas Electronics Korea Co., Ltd.
17F, KAMCO Yangjae Tower, 262, Gangnam-daero, Gangnam-gu, Seoul, 06265 Korea
Tel: +82-2-558-3737, Fax: +82-2-558-5338

Colophon 7.1