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EMI Test User Guide

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Brief

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Revision History

Version	Change Description
V0.1.0	Initial release.
V0.2.0	The following parts are modified: Table 2-10, Table 3-4, Table 3-7 2.7.1 3
V0.3.0	Add TLSRB91 related information

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1. Overview

The steps of EMI test on the DUT board based on Telink chip are: first burn the corresponding EMI bin file onto the DUT board; at the same time ensure that the corresponding calibration parameters have been written to the corresponding flash position (such as cap, Tp0, Tp1); then modify the corresponding test parameters to achieve different test functions. There are two ways to modify the test parameters:

1. Modify the value in the corresponding address of Flash. After modifying the test parameters with this method, you must power on the board again to make the settings valid. Telink provides BDT and Wtcdb for modifying Flash data. This function is only supported by the program of some chip models, please refer to Chapter 2 for function supported.
2. Modify the value in the corresponding address of SRAM. After modifying the test parameters with this method, the settings is valid right after reset (cannot be reset by re-booting, and need to be set again after re-booting). Tools for modifying SRAM provided by Telink are BDT, Wtcdb, and EMI special test tool EMI_Test. This function supports all chips.

2. EMI_BIN Support Functions

2.1 TLSR8261

2.1.1 Bin File Description

The 4 bin files used for 8261 EMI testing are:

"8261_emi_test_12M_external_cap.bin", Support 12MHz crystal, use external capacitor;

"8261_emi_test_12M_internal_cap.bin", Support 12MHz crystal, use internal capacitor;

"8261_emi_test_16M_external_cap.bin", Support 16MHz crystal, use external capacitor;

"8261_emi_test_16M_internal_cap.bin", Support 16MHz crystal, use internal capacitor;

In addition, users can configure the internal capacitance (cap) size and calibration parameter (Tp) setting by writing the value at the corresponding address of the Flash. For the specific addresses of each parameter in the Flash, refer to the following table.

Table 2-1 8261 Parameter Configuration Flash Address Table

Parameter	Flash Address
cap	0x77000
Tp0	0x77040
Tp1	0x77041

2.1.2 Test Tool Support Functions

The EMI tool "EMI_Tool" and the non-signaling test tool "Non_Signaling_Test_Tool" support the functions of the above bin files as shown in the following table.

Table 2-2 8261 Test Bin File Supporting Function Table

Type 1	Type 2	Supporting Function
EMI_Tool		
RF	Carrier	Carrier, CarrierData (Support Hop)
	RX	Rx Test

Type 1	Type 2	Supporting Function
	PA	Support Self-defined PA
PM	PM	Deep, Suspend
Non_Signaling_Test_Tool		
RF	TX	PRBS9,0x55,0xf (Support circular sending and single sending 1000 packets)
	RX	Rx Test, Read_Rx_Cnt, ReadRssi
	PA	Support Self-defined PA
PM	PM	Deep, Suspend

2.2 TLSR8266

2.2.1 bin File Description

The 4 bin files used for 8266 EMI testing are:

"8266_12M_emi_test_external_cap.bin", support 12MHz crystal, use external capacitor;

"8266_12M_emi_test_internal_cap.bin", support 12MHz crystal, use internal capacitor;

"8266_16M_emi_test_external_cap.bin", support 16MHz crystal, use external capacitor;

"8266_16M_emi_test_internal_cap.bin", support 16MHz crystal, use internal capacitor;

In addition, users can configure the internal capacitance (cap) size and calibration parameter (Tp) setting by writing the value at the corresponding address of the Flash. For the specific addresses of each parameter in the Flash, refer to the following table.

Table 2-3 8266 Parameter Configuration Flash Address Table

Parameter	Flash Address
cap	0x1e000
Tp0	0x1e040
Tp1	0x1e041

2.2.2 Test Tool Support Functions

"EMI_Tool" and the non-signaling test tool "Non_Signaling_Test_Tool" support the functions of the above bin files as shown in the following table.

Table 2-4 8266 Test Bin File Supporting Function Table

Type 1	Type 2	Supporting Function
EMI_Tool		
RF	Carrier	Carrier, CarrierData (Support Hop)
	RX	Rx Test
	PA	Support Self-defined PA
PM	PM	Not Support
Non_Signaling_Test_Tool		
RF	TX	PRBS9,0x55,0xf (Support circular sending and single sending 1000 packets)
	RX	Rx Test, Read_Rx_Cnt, ReadRssi
	PA	Support Self-defined PA
PM	PM	Not Support

2.3 TLSR8267/8269/8646

2.3.1 bin File Description

The 4 bin files used for 8267/8269/8646 EMI testing are:

"8267_8269_8646_emi_test_12M_external_cap.bin", support 12MHz crystal, use external capacitor;

"8267_8269_8646_emi_test_12M_internal_cap.bin", support 12MHz crystal, use internal capacitor;

"8267_8269_8646_emi_test_16M_external_cap.bin", support 16MHz crystal, use external capacitor;

"8267_8269_8646_emi_test_16M_internal_cap.bin", support 16MHz crystal, use internal capacitor;

In addition, users can configure the internal capacitance (cap) size and calibration parameter (Tp) setting by writing the value at the corresponding address of the Flash. For the specific addresses of each parameter in the Flash, refer to the following table.

Table 2-5 8267/8269/8646 Parameter Configuration Flash Address Table

Parameter	Flash Address
cap	0x77000
Tp0	0x77040
Tp1	0x77041

2.3.2 Test Tool Support Functions

Please refer to Table 2-2 in Chapter 2.1.2 for supporting functions of the above bin files of the EMI tool "EMI_Tool " and the non-signaling test tool "Non_Signaling_Test_Tool ".

2.4 TLSR8258/8253/8251/8656/8359

2.4.1 bin File Description

The bin file used for 8258/8253/8251/8656/8359 EMI testing is "8258_Test_EMI_V0005.bin".

In addition, users can configure the size of the internal capacitor (cap) by writing the value in the corresponding address of Flash. The specific address is shown in the following table.

Table 2-6 8258/8253/8251/8656/8359 Parameter Configuration Flash Address Table

Parameter	Flash Address
cap	0x77000

2.4.2 Test Tool Support Functions

The EMI tool "EMI_Tool" and the non-signaling test tool "Non_Signaling_Test_Tool" support the functions of the above bin files as shown in the following table.

Table 2-7 8258/8253/8251/8656/8359 Test Bin File Supporting Function Table

Type 1	Type 2	Supporting Function
EMI_Tool		

Type 1	Type 2	Supporting Function
RF	Carrier	Carrier, CarrierData (Support Hop)
	RX	Rx Test
	PA	Support Self-defined PA
PM	PM	Deep, Suspend, Deep with retention
Non_Signaling_Test_Tool		
RF	TX	PRBS9,0x55,0xf(Support circular sending and single sending 1000 packets)
	RX	Rx Test,Read_Rx_Cnt, ReadRssi
	PA	Support Self-defined PA
PM	PM	Deep, Suspend, Deep with retention

2.5 TLSR8367/8369

2.5.1 bin File Description

The bin file used for 8367/8369 EMI testing is "8367_EMI_Test_SRAM_OTP_V0001".

In addition, users can configure the internal capacitance (cap) size and calibration parameter (Tp) setting by writing the value at the corresponding address of the Flash. For the specific addresses of each parameter in the Flash, refer to the following table.

Table 2-8 8367/8369 Parameter Configuration Flash Address Table

Parameter	Flash Address
cap	0x77000
Tp0	0x77040
Tp1	0x77041

2.5.2 Test Tool Support Functions

The EMI tool "EMI_Tool " and the non-signaling test tool "Non_Signaling_Test_Tool " support the functions of the above bin files as shown in the following table.

Table 2-9 8367/8369 Test Bin File Supporting Function Table

Type 1	Type 2	Supporting Function
EMI_Tool		
RF	Carrier	Carrier, CarrierData (Not Support Hop)
	RX	Rx Test
	PA	Support Self-defined PA
PM	PM	Not Support
Non_Signaling_Test_Tool		
RF	TX	PRBS9,0x55,0xf (Support circular sending and single sending 1000 packets)
	RX	Rx Test, Read_Rx_Cnt, ReadRssi
	PA	Support Self-defined PA
PM	PM	Not Support

2.6 TLSR8232

2.6.1 bin File Description

The bin file used for the 8232 EMI test is "8232_EMI_Test_V0004.bin ". The user can choose whether to use the internal capacitor by modifying the value on the corresponding address (0x00000004) of the bin file; support 128K Flash or 512K Flash, etc., please refer to Table 2- 10.

Table 2-10 bin file configuration value setting reference table

Address Bit	Definition
bit0	0: Use internal capacitors 1: Use external capacitors
bit1	0: Support 512K Flash 1: Support 128K Flash
bit2-bit5	BQB Test Related
bit6-bit7	Reserved

In addition, users can configure the internal capacitance (cap) size and calibration parameter (Tp) setting by writing the value at the corresponding address of the Flash. For the specific addresses of each parameter in the Flash, refer to the following table.

Table 2-11 8232 Parameter Configuration Flash Address Table

Parameter	Flash Address
cap(0<cap<0x1f)	0x1e000(128K), 0x77000(512K)
Tp0(0< Tp0 < 0xff)	0x1e040(128K), 0x77040(512K)
Tp1(0< Tp1 < 0xff)	0x1e041(128K),0x77041(512K)

2.6.2 Test Tool Support Functions

The EMI tool "EMI_Tool " and the non-signaling test tool "Non_Signaling_Test_Tool " support the functions of the above bin files as shown in the following table.

Table 2-12 8232 Test Bin File Supporting Function Table

Type 1	Type 2	Supporting Function
EMI_Tool		
RF	Carrier	Carrier, CarrierData (Not Support Hop)
	RX	Rx Test

Type 1	Type 2	Supporting Function
	PA	Support Self-defined PA
PM	PM	Not Support
Non_Signaling_Test_Tool		
RF	TX	PRBS9,0x55,0xf (Support circular sending and single sending 1000 packets)
	RX	Rx Test,Read_Rx_Cnt, ReadRssi
	PA	Support Self-defined PA
PM	PM	Not Support

2.7 TLSR8278

2.7.1 bin File Description

There are 3 bin files used for 8278Emi test, which are:

"8278_EMI_DCDC _SRAM64K_V0002.bin", adopts DCDC power supply mode and supports 64KSRAM;

"8278_EMI_LDO _SRAM32K_FLASH512K_V0002.bin", using LDO power supply mode, supporting 32K SRAM and 512K Flash;

"8278_EMI_LDO _SRAM64K_FLASH512K_V0002.bin", using LDO power supply mode, supporting 64K SRAM and 512K Flash;

In addition, users can configure the size of the internal capacitor (cap) by writing the value in the corresponding address of Flash. The specific address is shown in the following table.

Table 2-13 8278 Parameter Configuration Flash Address Table

Parameter	Flash Address
cap	0x77000

2.7.2 Test Tool Support Functions

The EMI tool "EMI_Tool" and the non-signaling test tool "Non_Signaling_Test_Tool" support the functions of the above bin files as shown in the following table.

Table 2-14 8232 Test Bin File Supporting Function Table

Type 1	Type 2	Supporting Function
EMI_Tool		
RF	Carrier	Carrier, CarrierData (Support Hop)
	RX	Rx Test
	PA	Support Self-defined PA
PM	PM	Deep, Suspend, Deep with retention
Non_Signaling_Test_Tool		
RF	TX	PRBS9,0x55,0xf (Support circular sending and single sending 1000 packets)
	RX	Rx Test,Read_Rx_Cnt, ReadRssi
	PA	Support Self-defined PA
PM	PM	Deep, Suspend, Deep with retention

2.8 TLSRB91

2.8.1 bin File Description

There are 4 bin files used for B91Emi test, supporting 256K SRAM and 1M Flash, which are:

"B91_EMI_DCDC _V0001_FLASH.bin", using DCDC power supply mode, supporting downloading configuration to Flash;

"B91_EMI_LDO _V0001_FLASH.bin", using LDO power supply mode, supporting downloading configuration to Flash;

"B91_EMI_DCDC _V0001_SRAM.bin", using DCDC power supply mode, supporting downloading configuration to SRAM;

"B91_EMI_LDO _V0001_SRAM.bin", using LDO power supply mode, supporting downloading configuration to SRAM;

In addition, users can configure the size of the internal capacitor (cap) by writing the value in the corresponding address of Flash. The specific address is shown in the following table.

Table 2-15 8278 Parameter Configuration Flash Address Table

Parameter	Flash Address
cap	0xfe000

2.8.2 Test Tool Support Functions

The EMI tool "EMI_Tool" and the non-signaling test tool "Non_Signaling_Test_Tool" support the functions of the above bin files as shown in the following table.

Table 2-16 B91 Test Bin File Supporting Function Table

Type 1	Type 2	Supporting Function
EMI_Tool		
RF	Carrier	Carrier, CarrierData (Support Hop)
	RX	Rx Test
	PA	Not support Self-defined PA
PM	PM	Not Support deep, Suspend, Deep with retention
Non_Signaling_Test_Tool		
RF	TX	PRBS9,0x55,0xf (Support circular sending and single sending 1000 packets)
	RX	Rx Test,Read_Rx_Cnt, ReadRssi
	PA	Not support Self-defined PA
PM	PM	Not support Deep, Suspend, Deep with retention

3. Protocols

Different test functions can be realized by modifying test parameters such as "run", "mode", "power", "channel", "cmd", and "hop". The definition of each parameter is: "run" parameter is used to control the start and stop of EMI test; "mode" parameter is used to select the RF working mode; "power" parameter is used to select the energy level of Tx; "channel" parameter is used to select the frequency point; "cmd" parameter is used to select EMI Test mode; "hop" parameter is used to control whether to use frequency hopping mode in "carrier_data" test mode (controlled by "cmd"). In addition to the above main parameters that control EMI testing, there are also parameters for users to obtain certain key values and calibration parameters. The above parameters related test protocols will be described in details in the following sections.

3.1 TLSR8261

The detailed description of each parameter of TLSR8261 is shown in Table 3-1.

Table 3-1 TLSR8261Chip EMI test reference table

Parameter	Value description	Default Value	Storage Address
run	0:Stop EMI Test 1: Start EMI Test	1	SRAM: 0x808006
mode	0: ble_2M 1: ble_1M 2: zigbee	1	Flash: 0xf00a SRAM: 0x80800a
power	0: 7dBm 6: -11dBm 12: -18.8dBm 1: 6dBm 7: -11.5dBm 13: -23.3dBm 2: 5dBm 8: -12dBm 14: -27.5dBm 3: -0.6dBm 9: -13dBm 15: -30dBm 4: -4.3dBm 10: -14dBm 16: -37dBm 5: -9.5dBm 11:-15dBm 17: Disable PA	0	Flash: 0xf008 SRAM: 0x808008
channel	$\text{frequency} = (2400 + \text{channel})\text{MHz}(0 \leq \text{channel} \leq 100)$	2	Flash: 0xf009 SRAM: 0x808009
cmd	1: emi_carrier_only 2: emi_carrier_data 3: emi_rx_test	1	Flash: 0xf007 SRAM: 0x808007

Parameter	Value description	Default Value	Storage Address
	4: emi_tx _prbs9 5: emi_tx_0x55 6: emi_tx_0x0f 7: pm_pad_deep 8: pm_32kTimer_deep 9: pm_pad_suspend 10: pm_32kTlmer_suspend		
hop	For cmd(2), the following two modes can be configured: 0: Turn off frequency hopping mode 1: Turn on frequency hopping mode	0	SRAM: 0x80800b
cap	$0xbf < cap < 0xe0$		Flash: 0x1e000
Tp0	BLE 1M: $0x13 < Tp0 < 0x27$ BLE 2M: $0x36 < Tp0 < 0x4a$		Flash: 0x1e040
Tp1	BLE 1M: $0x0f < Tp0 < 0x23$ BLE 2M: $0x2f < Tp0 < 0x43$		Flash: 0x1e041
rssi	Read only		SRAM: 0x808004
tx_mode	For cmd (4/5/6), it can be configured as the following two modes: 1: sending 1000 packets 0: keep sending packets	0	SRAM: 0x808005
rx_packet_num	Read only		SRAM: 0x80800c

3.2 TLSR8266

The detailed description of each parameter of TLSR8266 is shown in Table 3-2.

Table 3-2 TLSR8266 Chip EMI test reference table

Parameter	Value description	Default Value	Storage Address
run	0:stop EMI Testing 1:start EMI Testing	1	SRAM: 0x808006
mode	0: ble_2M 1: ble_1M 2: zigbee	1	Flash: 0x3f00a SRAM: 0x80800a
power	0: 7dBm 1: 5dBm 2: -0.6dBm 3: -4.3dBm 4: -9.5dBm 5: -13.6dBm 6: -18.8dBm 7: -23.3dBm 8: -27.5dBm 9: -30dBm 10: -37dBm 11: Disable PA	0	Flash: 0x3f008 SRAM: 0x808008
channel	$\text{frequency} = (2400 + \text{channel})\text{MHz}(0 \leq \text{channel} \leq 100)$	2	Flash: 0x3f009 SRAM: 0x808009
cmd	1: emi_carrier_only 2: emi_carrier_data 3: emi_rx_test 4: emi_tx _prbs9 5: emi_tx_0x55 6: emi_tx_0x0f	1	Flash: 0x3f007 SRAM: 0x808007
hop	For cmd(2), the following two modes can be configured: 0: Turn off frequency hopping mode 1: Turn on frequency hopping mode	0	SRAM: 0x80800b
cap	$0xbf < cap < 0xe0$		Flash: 0x77000
Tp0	BLE 1M: $0x15 < Tp0 < 0x29$ BLE 2M: $0x39 < Tp0 < 0x4a$		Flash: 0x77040
Tp1	BLE 1M: $0x11 < Tp0 < 0x25$		Flash: 0x77041

Parameter	Value description	Default Value	Storage Address
	BLE 2M: $0x32 < Tp0 < 0x46$		
rssi	Read only		SRAM: 0x808004
tx_mode	For cmd (4/5/6), it can be configured as the following two modes: 1: sending 1000 packets 0: keep sending packets		SRAM:0x808005
rx_packet_num	Read only		SRAM: 0x80800c

3.3 TLSR8267/8269/8646

The detailed description of each parameter of TLSR8267/8269/8646 is shown in Table 3-3.

Table 3-3TLSR8267/8269/8646 Chip EMI test reference table

Parameter	Value description	Default Value	Storage Address
run	0:Stop EMI Test 1: Start EMI Test	1	SRAM: 0x808006
mode	0: ble_2M 1: ble_1M 2: zigbee	1	Flash: 0x3f00a SRAM: 0x80800a
power	0: 7dBm 6: -11dBm 12: -18.8dBm 1: 6dBm 7: -11.5dBm 13: -23.3dBm 2: 5dBm 8: -12dBm 14: -27.5dBm 3: -0.6dBm 9: -13dBm 15: -30dBm 4: -4.3dBm 10: -14dBm 16: -37dBm 5: -9.5dBm 11:-15dBm 17: Disable PA	0	Flash: 0x3f008 SRAM: 0x808008
channel	$\text{frequency} = (2400 + \text{channel})\text{MHz}(0 \leq \text{channel} \leq 100)$	2	Flash: 0x3f009

Parameter	Value description	Default Value	Storage Address
			SRAM: 0x808009
cmd	1: emi_carrier_only 2: emi_carrier_data 3: emi_rx_test 4: emi_tx _prbs9 5: emi_tx_0x55 6: emi_tx_0x0f 7: pm_pad_deep 8: pm_32kTimer_deep 9: pm_pad_suspend 10: pm_32kTlmer_suspend	1	Flash: 0x3f007 SRAM: 0x808007
hop	For cmd(2), the following two modes can be configured: 0: Turn off frequency hopping mode 1: Turn on frequency hopping mode	0	SRAM: 0x80800b
cap	$0xbf < cap < 0xe0$		Flash: 0x77000
Tp0	BLE 1M: $0x13 < Tp0 < 0x27$ BLE 2M: $0x36 < Tp0 < 0x4a$		Flash: 0x77040
Tp1	BLE 1M: $0x0f < Tp0 < 0x23$ BLE 2M: $0x2f < Tp0 < 0x43$		Flash: 0x77041
rssi	Read only		SRAM: 0x808004
tx_mode	For cmd (4/5/6), it can be configured as the following two modes: 1: sending 1000 packets 0: keep sending packets		SRAM: 0x808005
rx_packet_num	Read only		SRAM: 0x80800c

3.4 TLSR8258/8253/8251/8656/8359

The detailed description of each parameter of TLSR8258/8253/8251/8656/8359 is shown in Table 3-4.

Table 3-4TLSR8258/8253/8251/8656/8359Chip EMI test reference table

Parameter	Value description	Default Value	Storage Address
run	0: Stop EMI Test 1: Start EMI Test	1	SRAM: 0x840006
mode	0: ble_2M 1: ble_1M 2: zigbee 3: ble_125k 4: ble_500k	1	SRAM: 0x84000a
power	0 : 10.5dBm 1 : 10.3dBm 2 : 10.0dBm 3 : 9.8dBm 4 : 9.5dBm 5 : 9.2dBm 6 : 9.0dBm 7 : 8.7dBm 8 : 8.4dBm 9 : 8.1dBm 10 : 7.8dBm 11 : 7.4dBm 12 : 7.0dBm 13 : 6.6dBm 14 : 6.1dBm 15 : 5.6dBm 16 : 5.1dBm 17 : 4.6dBm 18 : 3.9dBm 19 : 3.2dBm 20 : 3.0dBm 21 : 2.1dBm 22 : 2.6dBm 23 : 2.4dBm 24 : 2.0dBm 25 : 1.7dBm 26 : 1.4dBm 27 : 1.1dBm 28 : 0.9dBm 29 : 0.5dBm 30 : 0.0dBm 31 : -0.1dBm 32 : -0.9dBm 33 : -1.4dBm 34 : -1.8dBm 35 : -2.5dBm 36 : -3.0dBm 37 : -3.6dBm 38 : -4.2dBm 39 : -5.0dBm 40 : -5.8dBm 41 : -6.6dBm 42 : -7.6dBm 43 : -8.6dBm 44 : -9.8dBm 45 : -11.4dBm 46 : -13.2dBm 47 : -15.8dBm 48 : -19.2dBm 49 : -25.1dBm	0	SRAM: 0x840008

Parameter	Value description	Default Value	Storage Address
channel	$\text{frequency} = (2400 + \text{channel})\text{MHz}(0 \leq \text{channel} \leq 100)$	2	SRAM: 0x840009
cmd	1: emi_carrier_only 2: emi_con_prbs9 3: emi_rx_test 4: emi_tx_prbs9 5: emi_tx_0x55 6: emi_tx_0x0f 7: emi_deep_io_no_retention 8: emi_deep_timer_no_retention 9: emi_suspend_io_no_retention 10:emi_suspend_timer_no_retention 11: emi_deep_io_retention 12: emi_deep_timer_retention	1	SRAM: 0x840007
hop	For cmd(2), the following two modes can be configured: 0: Turn off frequency hopping mode 1: Turn on frequency hopping mode	0	SRAM: 0x84000b
cap	$0x40 < \text{cap} < 0x7f$		Flash: 0x77000
rssi	Read only		SRAM: 0x840004
tx_mode	For cmd (4/5/6), it can be configured as the following two modes: 1: sending 1000 packets 0: keep sending packets	0	SRAM: 0x840005
rx_packet_num	Read only		SRAM: 0x84000c

3.5 TLSR8367/8369

The detailed description of each parameter of TLSR8367/8369 is shown in Table 3-5.

Table 3-5 TLSR8367/8369Chip EMI test reference table

Parameter	Value description	Default Value	Storage Address
run	0: Stop EMI Test 1: Start EMI Test	1	SRAM: 0x808006
mode	0: ble_1M_NO_PN 1: ble_2M_NO_PN	0	SRAM: 0x80800a
power	0: 7dBm 4: 0dBm 8: --12dBm 1: 6dBm 5: -1dBm 9: -14dBm 2: 3dBm 6: -2dBm 10: -15dBm 3: 2dBm 7: -10dBm 11: -17dBm	1	SRAM: 0x808008
channel	$\text{frequency} = (2400 + \text{channel})\text{MHz}(0 \leq \text{channel} \leq 100)$	2	SRAM: 0x808009
cmd	1: emi_carrier_only 2: emi_con_prbs9 3: emi_rx_test 4: emi_tx_prbs9 5: emi_tx_0x55. 6: emi_tx_0x0f	1	SRAM: 0x808007
hop	For cmd(2), the following two modes can be configured: 0: Turn off frequency hopping mode 1: Turn on frequency hopping mode	0	SRAM: 0x80800b
cap	$0xbf < cap < 0xe0$		Flash:0x77000
Tp0	$0 < Tp0 < 0xff$		Flash:0x77040
Tp1	$0 < Tp1 < 0xff$		Flash:0x77041
rssi	Read only		SRAM: 0x808004
tx_mode	For cmd (4/5/6), it can be configured as the following two modes: 1: Sending 1000 packets	0	SRAM: 0x808005

Parameter	Value description	Default Value	Storage Address
	0: keep sending packets		
rx_packet_num	Read only		SRAM: 0x80800c

3.6 TLSR8232

The detailed description of each parameter of TLSR8232 is shown in Table 3-6.

Table 3-6 TLSR8232 Chip EMI test reference table

Parameter	Value description	Default Value	Storage Address
run	0: Stop EMI Test 1: Start EMI Test	0	SRAM: 0x808006
mode	0: ble_2M 1: ble_1M 2: zigbee	1	SRAM: 0x80800a
power	0: 7.9dBm 6: 0dBm 12: -11.5dBm 1: 7dBm 7: -1.5dBm 13: -13.3dBm 2: 6.3dBm 8:-3.1dBm 14: -16dBm 3: 4.9dBm 9: -5dBm 15: -17.8dBm 4: 3.3dBm 10: -7.3dBm 16: -19.5dBm 5: 1.6dBm 11: -9.6dBm 17: Disable PA	0	SRAM: 0x808008
channel	$\text{frequency} = (2400 + \text{channel})\text{MHz}(0 \leq \text{channel} \leq 100)$	2	SRAM: 0x808009
cmd	1: emi_carrier_only 2: emi_con_prbs9 3: emi_rx_test 4: emi_tx_prbs9 5: emi_tx_0x55 6: emi_tx_0x0f	1	SRAM: 0x808007
hop	For cmd(2), the following two modes can be configured:	0	SRAM: 0x80800b

Parameter	Value description	Default Value	Storage Address
	0: Turn off frequency hopping mode 1: Turn on frequency hopping mode		
cap	$0xbf < cap < 0xe0$		Flash:0x77000
Tp0	$0 < Tp0 < 0xff$		Flash:0x77040
Tp1	$0 < Tp1 < 0xff$		Flash:0x77041
rssi	Read only		SRAM: 0x808004
tx_mode	For cmd (4/5/6), it can be configured as the following two modes: 1: sending 1000 packets 0: keep sending packets	0	SRAM: 0x808005
rx_packet_num	Read only		SRAM: 0x80800c

3.7 TLSR8278

The detailed description of each parameter of TLSR8278 is shown in Table 3-7.

Table 3-7 TLSR8278 Chip EMI test reference table

Parameter	Value description	Default Value	Storage Address
run	0: Stop EMI Test 1: Start EMI Test	0	SRAM: 0x840006
mode	0: ble_2M 1: ble_1M 2: zigbee_250K 3: ble_125K 4: ble_500K	1	SRAM: 0x84000a Flash: 0x7c004(512K) Flash: 0x1c004(128K)
power	0: 11.3dBm 17: 5.3dBm 34: -0.7dBm 1: 11.1dBm 18: 4.7dBm 35: -1.2dBm 2: 10.8dBm 19: 4.0dBm 36: -1.7dBm	0	SRAM: 0x840008 Flash: 0x7c002(512K) Flash: 0x1c002(128K)

	3: 10.6dBm 20: 3.5dBm 37: -2.2dBm 4: 10.3dBm 21: 3.3dBm 38: -2.8dBm 5: 10.1dBm 22: 3.1dBm 39: -3.5dBm 6: 9.8dBm 23: 2.9dBm 40: -4.2dBm 7: 9.5dBm 24: 2.6dBm 41: -5.0dBm 8: 9.2dBm 25: 2.4dBm 42: -5.9dBm 9: 8.9dBm 26: 2.1dBm 43: -6.8dBm 10: 8.6dBm 27: 1.8dBm 44: -7.9dBm 11: 8.2dBm 28: 1.6dBm 45: -9.1dBm 12: 7.8dBm 29: 1.3dBm 46: -10.7dBm 13: 7.4dBm 30: 0.7dBm 47: -12.6dBm 14: 6.9dBm 31: 0.5dBm 48: -15.0dBm 15: 6.5dBm 32: -0.3dBm 49: -18.4dBm 16: 5.9dBm 33: -0.5dBm 50: -24.3dBm		
channel	$\text{frequency} = (2400 + \text{channel})\text{MHz}(0 \leq \text{channel} \leq 100)$	2	SRAM: 0x840009 Flash: 0x7c003(512K) Flash: 0x1c003(128K)
cmd	1: emi_carrier_only 2: emi_con_prbs9 3: emi_rx_test 4: emi_tx_prbs9 5: emi_tx_0x55 6: emi_tx_0x0f 7: emi_deep_io_no_retention 8: emi_deep_timer_no _retention 9: emi_suspend_io_no _retention 10: emi_suspend_timer_no_retention 11: emi_deep_io_retention 12: emi_deep_timer_retention	1	SRAM: 0x840007 Flash: 0x7c001(512K) Flash: 0x1c001(128K)
hop	For cmd(2), the following two modes can be configured:	0	SRAM: 0x84000b Flash: 0x7c005(512K)

	0: Turn off frequency hopping mode 1: Turn on frequency hopping mode		Flash: 0x1c005(128K)
cap	0x00 < cap < 0x7f		Flash: 0x77000(512K) Flash: 0x1e000(128K)
cap_close_en	0xff:enable internal capacitor 0：disable internal capacitor	0xff	Flash: 0x7c006(512K) Flash: 0x1c006(128K)
rssi	Read only		SRAM: 0x840004
tx_num_mode	For cmd (4/5/6), it can be configured as the following two modes: 1: sending 1000 packets 0: keep sending packets	0	SRAM: 0x840005 Flash: 0x7c000(512K) Flash: 0x1c000(128K)
rx_packet_num	Read only		SRAM: 0x84000c

3.8 TLSRB91

The detailed description of each parameter of TLSRB91 is shown in Table below.

Table 3-8 TLSRB91 Chip EMI test reference table

Parameter	Value description	Default Value	Storage Address
run	0: Stop EMI test 1: Start EMI test	0	SRAM: 0xc0000006
mode	0: ble_2M 1: ble_1M 2: zigbee_250K 3: ble_125K 4: ble_500K	1	SRAM: 0xc000000a
power	0: 9.1dBm 8: 3.3dBm 16: -2.0dBm 1: 8.6dBm 9: 2.8dBm 17: -3.4dBm 2: 8.1dBm 10: 2.3dBm 18: -4.8dBm 3: 7.5dBm 11: 1.7dBm 19: -6.5dBm 4: 7.0dBm 12: 0.8dBm 20: -8.8dBm	0	SRAM: 0xc0000008

Parameter	Value description	Default Value	Storage Address
	5: 6.0dBm 13: 0dBm 21: -12.1dBm 6: 4.4dBm 14: -0.5dBm 22: -17.8dBm 7: 3.8dBm 15: -1.4dBm 23: -23.5dBm		
channel	$\text{frequency} = (2400 + \text{channel})\text{MHz}$（$0 \leq \text{channel} \leq 100$）	2	SRAM: 0xc0000009
cmd	1: emi_carrier_only 2: emi_con_prbs9 3: emi_rx_test 4: emi_tx_prbs9 5: emi_tx_0x55 6: emi_tx_0x0f	1	SRAM: 0xc0000007
cap	$0x40 < \text{cap} < 0x7f$		Flash: 0xfe000
rssi	Read only		SRAM: 0xc0000004
tx_num_mode	For cmd (4/5/6), it can be configured as the following two modes: 1: sending 1000 packets 0: keep sending packets	0	SRAM: 0xc0000005
rx_packet_num	Read only		SRAM: 0xc000000c

FCC STATEMENT

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:
This device may not cause harmful interference, and
This device must accept any interference received, including interference that may cause undesired operation.

Warning: Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

-Reorient or relocate the receiving antenna.
-Increase the separation between the equipment and receiver.
-Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
-Consult the dealer or an experienced radio/TV technician for help.

The device has been evaluated to meet general RF exposure requirement. The device can be used in portable exposure condition without restriction.

- English: "
This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions:
(1) this device may not cause interference, and
(2) this device must accept any interference, including interference that may cause undesired operation of the device."

- French:"
Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes :
(1) l'appareil nedoit pas produire de brouillage, et
(2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement."

Integration instructions for host product manufacturers according to KDB 996369 D03 OEMManual v01

Conditions on using Shandong Goldencell Power Technology Co.,Ltd regulatory approvals:
A. Customer must ensure that its product (the“CUSTOMER Product”) is electrically identical to Shandong Goldencell Power Technology Co.,Ltd reference designs. Customer acknowledges that any modifications to Shandong Goldencell Power Technology Co.,Ltd reference designs may

invalidate regulatory approvals in relation to the CUSTOMER Product, or may necessitate notifications to the relevant regulatory authorities.
B. Customer is responsible for ensuring that antennas used with the product are of the same type, with same or lower gains as approved and providing antenna reports to Shandong Goldencell Power Technology Co.,Ltd.
C. Customer is responsible for regression testing to accommodate changes to Shandong Goldencell Power Technology Co.,Ltd reference designs, new antennas, and portable RF exposure safety testing/approvals.
D. Appropriate labels must be affixed to the CUSTOMER Product that comply with applicable regulations in all respects.
E. A user's manual or instruction manual must be included with the customer product that contains the text as required by applicable law. Without limitation of the foregoing, an example (for illustration purposes only) of possible text to include is set forth below:

2.2 List of applicable FCC rules and RSS rules
FCC Part 15 Subpart C 15.247 & 15.207 & 15.209& 15.205
RSS-Gen Issue 5 Amendment 2, February 2021
RSS-247 Issue 2, February 2017

2.3 Specific operational use conditions
Operation Frequency:2402~2480MHz
Number of Channel:40 Channels
Modulation Type:GFSK
Antenna Type:PCB antenna
Antenna Gain(Peak):0 dBi (Provided by customer)
The module can be used for mobile or portable applications with a maximum 0 dBi antenna. The host manufacturer installing this module into their product must ensure that the final composit product complies with the FCC requirements by a technical assessment or evaluation to the FCC rules, including the transmitter operation. The host manufacturer has to be aware not to provide informationto the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module. The end user manual shall include all required regulatory information/warning as show in this manual.

2.4 Limited module procedures
Not applicable. The module is a Single module and complies with the requirement of FCC Part 15.212.

2.5 Trace antenna designs
Applicable.

2.6 RF exposure considerations
The device can be used in portable exposure condition without restriction and if RF exposure statement or module layout is changed, then the host product manufacturer required to take responsibility of the module through a change in FCC ID or newapplication. The FCC ID of the module cannot be used on the final product. In these circumstances, the host manufacturer will be responsible for re-

evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

2.7 Antennas

Antenna Specification are as follows:
Antenna Type:PCB antenna
Antenna Gain(Peak):0 dBi (Provided by customer)
This device is intended only for host manufacturers under the following conditions:
The transmitter module may not be co-located with any other transmitter or antenna;
The module shall be only used with the External antenna(s) that has been originally tested and certified with this module. The antenna must be either permanently attached or employ a 'unique'antenna coupler.

As long as the conditions above are met, further transmitter test will not be required. However, the host manufacturer is still responsible for testing their end-product for any additional compliance requirements required with this module installed (for example, digital device emissions, PC peripheralrequirements, etc.).

2.8 Label and compliance information

Host product manufacturers need to provide a physical or e-label stating "Contains FCC ID 2BC4G-BLE002"/" "Contains IC: 31403-JBDBLE002" With their finished product.

2.9 Information on test modes and additional testing requirements

Operation Frequency:2402~2480MHz
Number of Channel:40 Channels
Modulation Type:GFSK
Antenna Type:PCB antenna
Antenna Gain(Peak):0 dBi (Provided by customer)
Host manufacturer must perfom test of radiated & conducted emission and spurious emission, etcaccording to the actual test modes for a stand-alone modular transmitter in a host, as well as for multiple simultaneously transmitting modules or other transmitters in a host product.
Only when all the test results of test modes comply with FCC requirements, then the end product canbe sold legally.

2.10 Additional testing, Part 15 Subpart B disclaimer

The modular transmitter is only FCC authorized for FCC Part 15 Subpart C 15.247 & 15.207 & 15.209 & 15.205 and that the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification. If the grantee markets their product as being Part 15 Subpart B compliant (when it also contains unintentional-radiator digital circuity), then the grantee shall provide a notice stating that the final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed.