

LoRaWAN TEST SOLUTION

RedwoodComm is a professional developing company for wireless communication test solution. RedwoodComm develops and provides measurement system for R&D, mass-production of broadcast system and wireless communications such as DAB, DRM, RDS, NFC and LoRa technologies.

We will keep making every effort to be the world best company of test & measurement system based on technical know-how and experience of test & measurement system for wireless communications.





RWC5020B is a compact all-in-one tester, providing a perfect solution for test and measurement of LoRa and LoRaWAN technology, which is fully suitable for R&D, QC, and manufacturers.

It provides various test functions that can be performed in signaling mode, e.g. including activation procedures, as well as non-signaling mode. Automated PC software will help users test and debug their devices by performing pre-certification tests, as specified by LoRa Alliance.

LoRaWAN Compliance

RWC5020B

Confirming that the end device meets the functional requirements of the LoRaWAN® protocol specification

RWC5020B certification test is recommended for purpose of pre-qualification. Some of certification test items could be limited or not fully covered due to the limitation of maximum number of channels supported simultaneously.

Supported Pre-certification Test Option

- LoRa Alliance European EU 863-870MHz Region End Device Certification Requirements V1.5
- LoRa Alliance US + Canada US902-928MHz Region End Device Certification Requirements V1.3
- LoRa Alliance Asia AS 923MHz Region End Device Certification Requirements V1.1
- LoRa Alliance South Korea 920-923MHz Region End Device Certification Requirements V1.2
- LoRa Alliance India 865-867MHz Region End Device Certification Requirements V1.1

Supported LoRaWAN® Region

EU 868 // EU 433 // US 915 // AU 915 // CN 470 // KR 920 // AS 923 // IN 865 // RU 864 // KZ 865

Supported LoRaWAN® Protocol

- Compatible with LoRaWAN version of V1.0.2, V1.0.3 and V1.1
- Support of Class A, Class B and Class C





MAIN MENU 3 OPERATIONAL MODES



END DEVICE TEST



RWC5020B acts as the reference Gateway/Server to communicate with End Device Under Test, while analyzing protocol messages and measuring the signal quality and performance of DUT.

Link Analyzer | Power vs. Time | Power vs. Channel | Receiver Sensitivity



GATEWAY TEST



RWC5020B acts as the reference End Device to communicate with Gateway Under Test, while analyzing protocol messages and measuring the signal quality and performance of DUT.

Link Analyzer | Power vs. Time | Power vs. Channel | Receiver Sensitivity



NON-SIGNALING TEST



This is a menu for generating a continuous waveform signal or a LoRa test frame and measuring the power of DUT signal.

Signal Generator | Signal Analyzer | MFG

LoRa/LoRaWAN Test Solutions

Protocol Test Solutions

- Support of LoRaWAN Pre-Certification Tests EU V1.5, US/CA V1.3, AS V1.1, KR V1.2 and IN V1.1
- Scriptable scenario for transmission of MAC commands and user data (or application data)
- FUOTA Test with user firmware binaries

RF Test Solutions

- RF Performance Tests for End-device TX Power and RX Sensitivity (downlink: RX1, RX2 or Ping-slot)
- RF Performance Tests for Gateway TX Power and RX Sensitivity (uplink)
- Semtech's Non-regression Tests for Gateway integrated with RWC2020A Interference Generator
- LBT Test Solution for end-devices and gateways integrated with RWC2020A Interference Generator

Manufacturing Test Solutions

- Separate T/RX Tests with DUT controls power, frequency, and sensitivity
- Simultaneous T/RX Tests (MFG) without wired DUT controls

Link Analyzer

Analyzing frames for MAC/PHY analysis

RWC5020B provides a function of Link Analyzer for EDT and GWT. Link Analyzer in EDT (or GWT) helps to create a link between RWC5020B and an End Device (or Gateway/Server) Under Test and to analyze the protocol messages.

EN	d d	EVI	CE	TES	г		E	J_8	68 /	V1.	0 / В		180 ETH	() RMT)(EXT (CAP) Fn)
L	сн	DR	SF	вw	Pow	Time	FCnt	Ack	Port	м		CMD		Link
U	2	0	12	125	9.2	13.6s	0000	0	000	U	Devi	ceTimeReq		Analyzer
D	R2	0	12	125	-50.0		0000	0	000	υ	Devi	ceTimeAns		
D	в	3	9	125	-50.0			0		-	Beac	on		Power
U	1	0	12	125	9.2	85.7s	0001	0	000	U	Pings	SlotInfoReq		Measure
D	R2	0	12	125	-50.0		0001	0	000	υ	Pings	SlotinfoAns		<u>CH</u> TIME
U	0	0	12	125	9.1	5.03s	0002	0	000	U	LinkCheckReq			
D	R2	0	12	125	-50.0		0002	0	000	υ	Link	CheckAns		Receiver
D	в	3	9	125	-50.0			0		-	Beac	on		Sensitivity
D	Ρ	3	9	125	-50.0		0003	0	000	υ	Devs	StatusReq		
U	1	0	12	125	9.2	146s	0003	0	000	U	DevStatusAns			
												DutyCycle	: 1.91%	
60	60 01 00 00 80 03 00 00 06 DA BC 98 F8													
Fn1	Fn1 CLEAR Fn2 MAC_SEND						Activated SENS: Stop					opped	LINK: Run_30	

Link Analyzer for EDT

Power vs. Time

Continuously monitoring TX power of DUT with respect to data rates(SF)

RWC5020B provides a function of Power vs. Time measurement for EDT and GWT. Power vs. Time measurement in EDT (or GWT) helps to create a link between RWC5020B and an End Device (or Gateway/Server) Under Test and to measure the received power with respect to data rates.



Power vs. Time for EDT



Power vs. Time for GWT

G/	TE	WA	Y 1	TEST			E	7 ⁸	68 /	V1.	0 / B (180)E	TH (RMT) (EXT) (CAP) (Fn)
L	сн	DR	SF	ВW	Pow	Time	FCnt	Ack	Port	м	CMD	Link
U	2	0	12	125	-60.0	REF		0		-	Join-request	Analyzer
D	2	0	12	125	19.5			0		-	Join-accept	
U	2	0	12	125	-60.0	12.9s	0000	0	000	υ	DeviceTimeReq	Power
D	2	0	12	125	19.5		0000	0	000	U	DeviceTimeAns	Measure
D	в	3	9	125	19.2			0		-	Beacon	<u>сн</u> тіме
U	2	0	12	125	-60.0	109s	0001	0	000	υ	PingSlotInfoReq	
D	2	0	12	125	19.4		0001	0	000	U	PingSlotInfoAns	Receiver
U	1	0	12	125	-60.0	5.00s	0002	0	000	υ	LinkCheckReq	Sensitivity
D	1	0	12	125	19.4		0002	0	000	U	LinkCheckAns	
D	в	3	9	125	19.1			0		-	Beacon	
Ep	och	- =0x	459	44200)							-
00	00 00 00 42 94 45 83 BF 00 C4 CB D3 25 C6 62 29 C9											
Fn1	c	LEA	٨R		Fn ² MA	C_SENE	,		Activ	ate	SENS: Stopped	LINK: Running
_												

Link Analyzer for GWT

MAC command Test

- O Multiple MAC commands in a single frame
- \bigcirc All MAC commands defined in LoRaWAN with user-configurable parameters
- \bigcirc Field selection: frame payload or frame options
- \bigcirc Message type selection: confirmed or unconfirmed
- \bigcirc User defined message: editable payload data and port field

LINK	PROTOCOL	RF	
MAC_CMD_TYPE	INSTANT MAC CMD	ONFIRMED	
MAC_CMD_FIELE		PAYLOAD	
INSTANT_MAC_	LINK_CHECK	INK_CHECK	
PERIODIC_UPLINK	DEVICE_TIME	FIRMED_UP	
···· INTERVAL	DEVICE_MODE	5	sec
- PAYLOAD_TY	ΡE	0000_0000	
···· FPORT		99	
POP-UP		[EXIT

Power vs. Channel

Continuously monitoring TX power of DUT with respect to channels

RWC5020B provides a function of Power vs. Channel measurement for EDT and GWT. Power vs. Channel measurement in EDT (or GWT) helps to create a link between RWC5020B and an End Device (or Gateway/Server) Under Test and to measure the received power with respect to RF channels.



Power vs. Channel for EDT

EU_868 / V1.0 / A

Link

Analyzer

Power

Measure

Receiver

Sensitivity

LINK: Stop

TIME

СН

Power vs. Channel Measurement

NoPayload : FCNT00A1, CH06, 21,9dBm, SF12, CR 4

CHANNEL

CH_00 CH_01 CH_02 CH_03 CH_04 CH_05 CH_06 CH_07 RX2

22.0 22.0

 21.8
 21.9

 21.8
 21.8

22.0 22.0

21.9 21.8

21.9

21.8 21.9 21.8

 23
 24
 23

 22.0
 22.0
 21.9

²MAC SEND

GATEWAY TEST

N

Pmax

Pavg 21.8 21.8 21.9 21.8

22.0

21.8 21.8 21.8 21.8

POWER (dBm)

Receiver Sensitivity

Finding the minimum power level which DUT can receive frames from the Tester

Receiver Sensitivity is a function of testing the receiver performance of DUT. RWC5020B sweeps its power level from the start value to the stop value with the step value and checks whether DUT functions properly, and stops immediately after DUT does not function properly.



Receiver Sensitivity Test for EDT



Receiver Sensitivity Test for GWT

Continuous monitoring of DUT's TX Power w.r.t. Channel
 Calculating the maximum/average/minimum values

Power vs. Channel for GWT

- \bigcirc Determine power range and step for testing
- \bigcirc The result value is the minimum power level at which DUT can receive the Tester's frame

Signal Generator

Transmiting LoRa test frames/CW

Signal Generator is a function of transmitting the defined test waveform to DUT repeatedly. Two different modes are provided; LoRa and CW. Especially in case of LoRa mode, various parameters are configurable to compose a LoRa test frame.

NST_TX PROTOCOL RF LORA MODE NETWORK PUBLIC BW 125 KHz SF SF7 PREAMBLE_SIZE 8 REPEAT_NUM 10 INTERVAL 0.10 sec EXIT POPUP

PHY Protocol Parameters for Signal Analyzer

NON-	NON-SIGNALING TEST 180 ETH RMT EXT CAP Fn								
SEQ	SF	ВW	Pow	Time	FCnt	Port	Data		Signal
1	7	125	-30.0	0.10s	000A	99	60 01 00 00 00 00 0A 00 63 00	Ī	Generator
2	7	125	-30.0	0.10s	000B	99	60 01 00 00 00 00 0B 00 63 00		
3	7	125	-30.0	0.10s	000C	99	60 01 00 00 00 00 0C 00 63 00		Signal
4	7	125	-30.0	0.10s	000D	99	60 01 00 00 00 00 0D 00 63 00		Analyzer
5	7	125	-30.0	0.10s	000E	99	60 01 00 00 00 00 0E 00 63 00		MEG
6	7	125	-30.0	0.10s	000F	99	60 01 00 00 00 00 0F 00 63 00		Measure
7	7	125	-30.0	0.10s	0010	99	60 01 00 00 00 00 10 00 63 00		
8	7	125	-30.0	0.10s	0011	99	60 01 00 00 00 00 11 00 63 00		
9	7	125	-30.0	0.10s	0012	99	60 01 00 00 00 00 12 00 63 00		
10	7	125	-30.0	0.10s	0013	99	60 01 00 00 00 00 13 00 63 00		
	Status : OFF								
Fn1 (Fn1 CLEAR LINK: Stopped							LINK: Stopped	

Example of Generating LoRa Test Frames

Signal Analyzer

Receiving LoRa frames and measuring the power

Signal Analyzer is a function of analyzing LoRa frames received from DUT repeatedly. Various parameters are configurable to receive a specific LoRa frame. Additionally TX power of DUT is measured in LoRa or CW mode.



PHY Protocol Parameters for Signal Analyzer

NON-	NON-SIGNALING TEST									RMT)EXT)CAP)Fn								
SEQ	SF	вw	Pow	Time	FCnt	Port					I	Data	a					Signal
51	7	125	-31.0	7.35s	003C	99	40	01	00	00	00	00	зc	00	63	00	Ī	Generator
52	7	125	-31.0	0.25s	003D	99	40	01	00	00	00	00	3D	00	63	00		
53	7	125	-31.0	0.23s	003E	99	40	01	00	00	00	00	ЗE	00	63	00		Signal
54	7	125	-30.9	0.24s	003F	99	40	01	00	00	00	00	ЗF	00	63	00		Analyzer
55	7	125	-31.0	0.23s	0040	99	40	01	00	00	00	00	40	00	63	00		MEG
56	7	125	-31.0	0.24s	0041	99	40	01	00	00	00	00	41	00	63	00		Measure
57	7	125	-30.9	0.23s	0042	99	40	01	00	00	00	00	42	00	63	00		
58	7	125	-31.0	0.23s	0043	99	40	01	00	00	00	00	43	00	63	00		
59	7	125	-31.0	0.24s	0044	99	40	01	00	00	00	00	44	00	63	00	l	
60	7	125	-30.9	0.23s	0045	99	40	01	00	00	00	00	45	00	63	00		
	: 	МАХ	: -30.9	dBm	AVG	i: -3:	L.1¢	lBn	n	м	IN:	-3:	1.3	dBr	n		I	
Fn1	CLE	٩R																LINK: Running

Example of Receiving LoRa Test Frames

DUT's RX Performance Test

- \bigcirc Set the DUT to always listen the pre-defined packet
- \bigcirc Tester transmit pre-defined number of packets
- \bigcirc DUT needs to calculate PER by itself

DUT's TX Performance Test

- \bigcirc Set the DUT to always transmit the pre-defined packet
- \bigcirc Tester measures CW frequency

MFG

Speeding up the test time in production lines

MFG is a function of manufacturing tests to measure the TX and RX performances of DUT simultaneously; power measurement for TX and sensitivity measurement for RX respectively.

Basically manufacturing test of LoRa products should be performed in non-signaling mode because of two reasons; test time and a type of DUT. Testing in signaling mode requires much longer test time caused by the limitation of LoRa communication technology. Testing in non-signaling mode does not concern about a type of DUT, in other words, either an End-device or a Gateway can be tested under the same test concept.





State Transition Diagram during MFG Test

NON	I-SIGNALING TEST		(180)ETH) RA	IT EXT (CAP)(Fn)
SE	NST_MFG	PROTOCOL	RF	
	MODE		LORA	
	NETWORK		PUBLIC	
	BW		125	KHz
	SF		SF7	
	PREAMBLE_SIZE		8	
	REPEAT_NUM		100	
	INTERVAL		0.10	sec
	POP_UP		[EXIT
Fn1	CLEAR		L	iNK: Running

Test Procedure for MFG Test

PHY Protocol Parameters for MFG

NO	N-SIGNALING TEST		(180)ETH) RA	TTIEXT (CAP) Fn)
SE	NST_MFG	PROTOCOL	RF	Ŧ
	PREAMBLE_SIZE		8	
	REPEAT_NUM		100	
	INTERVAL		0.10	sec
	PER_CRITERIA		0.100	
	POW_CRITERIA_UP	PER	14.0	dBm 📃
	POW_CRITERIA_LO	WER	0.0	dBm
	TIME_OUT		5	sec
	0.001 ~ 1		[EXIT
Fni	CLEAR		L	NK: Running

Users' Criteria for MFG

PC Software

This PC application provides a variety of special measurement functions such as LoRa pre-certification test, performance measurement, link message logging and DUT control. The RWC5020B automatically measures specified characteristics such as the PER of the DUT, obtains data such as link messages or measurement data according to the LoRa Alliance standard, and summarizes and creates the report in one click.



LoRa Pre-certification Tests

It provides each regional pre-certification test which follows the procedures in LoRaWAN Specification.





TX/RX Performance Tests

It provides fully automated RF performance measurement functions such as TX Power and RX sensitivity.



PC Software

Payload Editor

You can transmit any type of LoRa MAC commands defined in LoRa protocol.

PROI CT SETUP ABOUT	LINK ANALY	LYZER 1.0.2 192.168.0.8 - RMC5020A, VER: 1.172, SN: 0X18A00	16
PROI(CT lora_demo_v1170 PATH .\DEMO\lora_demo_v1170	demo - NEW	REPORT PATH \\DEMO\lors_demo_v1170\demo FRE NAME	
	UTILITIES	LINK MESSAGE SAVE MSG	
PAYLOAD EDITOR SEND TYPE O UNCONFIRMED FIELD FOPTS	RESP 60 🚽 CONFIG	STOP Skip exist messages Show raw data	
DUT TYPE : END DEVICE TEST / LoñaWAN : 1.0.2 / REGION : EU_868 / CLASS : Class A	UPDATE FCNT 💽	L CH DR SF BW Pow Time DEL FCnt Adr Ack FP AAR B Port M Dwell CMD CONTEN	rs
MACCOMMAND (PMCDAD) User Defined Str DEVICE_STATUS Str DEVICE_STATUS UniALDBReg Parameters DE 083_3798W125 v) TURE_ADR_REQ DE 083_3798W125 v) MASE_CTRL 0_0 Str DE 083_978W125 v) Str DE 083_978W125 v) V DE 083_978W125 v) Str DE 084_978W125 v)	NB, TRANS 10 MASK 6V 70 DR0_5F126W125 V SAVE 10,400 2	1 0 0 1 0	en=16 , 0.08-0, Mask Offset=0, R fy=254, 5N 00ffset=1, 1 1 1 1 2 2 2 2 2 2 2 2 2 2 2 2 2
- 69/025_57476 - 140_00_490 - 440_00_490 - 440_00_490_57310423 - 440_00_490_57310423 - 440_00_5749141 - 440_00_574914 - 440_00_57491 - 440_00_5749 - 440_000_5749 - 440_000_5749 -	•	CLEAR MON MGG ACC CORE (PROTOCOL:SKTEWAY_DIT 1 CLEAR SPY MGG SwE SPY MGG View Remote Message (TEST TD#) Regin : Place : Pl	>

Link Analyzer

You can gether and save all protocol messages with link analyzer function.

Script Editor

You can add, remove or edit MAC command even multi-commands as you wish.



Manufacturing Tests

It provides Non-signaling functions such as TX/RX/MFG Test for fast manufacturing Tests.

User can measure TX power and RX sensitivity simultaneously using MFG function on the production line.

Ethernet	_
Annalas moreas	0
The second secon	
No. of the local distance of the local dista	



Structure of automated PC software and example of test setup



Pre-Certification Test Fast Test for Mass Production



Specifications

Frequency	Range: 400MHz ~ 510MHz, 862MHz ~ 960MHz Resolution: 100Hz Stability vs. +25°C: ±0.5ppm standard Stability vs. Aging: ±1ppm/1st year
Output Level	Range: 0dBm ~ -150dBm Resolution: 0.1dB Accuracy: ±1dB Impedance: 50Ω
Input Level	+30dBm ~ -80dBm for Power Measurement +30dBm ~ -50dBm for Frequency Measurement
Measurement Accuracy	±1dB for Power ±1KHz for Frequency (Single Tone)
VSWR	Better than 1:1.5
External Frequency Reference	Frequency: 10MHz Power Range: 0dBm ~ +20dBm
Remote Programming Ports	RJ45(Ethernet) RS-232C
Miscellaneous	Operating temperature: 5 ~ 40°C Line Voltage: 100 to 240 VAC, 50/60Hz Dimension: 250(w) x 110(h) x 348(d) mm Weight: 5kg



Order code (for RWC5020B LoRaWAN Tester)

- C5020B-00 EDT+GWT+NST
- **C5020B-01** EDT+GWT
- C5020B-02 NST
- **C5020B-03** EDT
- **C5020B-04** GWT
- **C5020B-05** EDT+NST
- **C5020B-06** GWT+NST

- **O5020B-01** LoRaWAN Pre-Certification Test EU Option
- O **05020B-03** LoRaWAN Pre-Certification Test US/CA Option
- O **05020B-04** LoRaWAN Pre-Certification Test AS Option
- O 5020B-05 LoRaWAN Pre-Certification Test KR Option
- **O5020B-06** LoRaWAN Pre-Certification Test IN Option
- \bigcirc O5020B-95 Eextra Hardware Warranty Option
- \bigcirc O5020B-99 Maintenance option for software and firmware upgrade

Each option can be purchased later as an upgrade method.



RWC2020A is an interference generator being able to be used for the purpose of various tests or measurements, e.g. the Listen Before Talk (LBT) test, the Gateway Non-regression tests, the Intermodulation Immunity test and so on. It can generate up to eight multi-tone signals with different output levels per each tone for the LBT test and two tones of up to 20MHz distant for the Intermodulation Immunity test. It also can generate a single tone with phase noise of high performance for the Gateway Non-regression tests.

RWC2020A Interference Generator



RWC2020A shall be connected to RWC5020B via RS-232C for control and setup of the full automation tests.

LBT Test

Listen Before Talk (LBT) is a technique that device enters RX mode and senses the interference signal level before it starts a transmission. It is used to prevent interference or collision between devices that use common frequency bands. RWC2020A provides a perfect solution to verify LBT functionality of DUT, gateways or end-devices, as a supplementary equipment synchronized with RWC5020A. It generates up to eight interference signals to occupy frequency bands. The interference signal level, the number of channels, and channel frequencies are editable through RWC5020B LoRaWAN tester GUI or PC software.



CW Interferer Immunity Test

The CW Interferer Immunity Test and Intermodulation Immunity Test which are ones of the Gateway Non-regression tests require CW interference signals with high performance phase noise. RWC2020A generates a single-tone or dual-tone interference signal for those tests.



Specifications

Frequency	Range : 400MHz ~ 1000MHz Resolution : 100Hz Accuracy : ±2ppm/year@operating temperature
Output Level	Range : -10dBm ~ -100dBm Resolution : 0.1dB Accuracy : ±1dB
RF Characteristics	Phase Noise (Single tone mode) : -103dBc@1kHz / -110dBc@10kHz / -110dBc@100kHz / -138dBc@1MHz VSWR : Better than 1:1.5 Impedance : 50Ω
Remote Interface	RS-232C
Miscellaneous	Operating temperature : 5 ~ 40℃ Input : DC 12V, 3A Dimension : 166(w) x 50(h) x 194(d) mm Weight : 950g



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