

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.



Wide Area Network for IoT



RWC5020B

LoRaWAN Tester

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

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

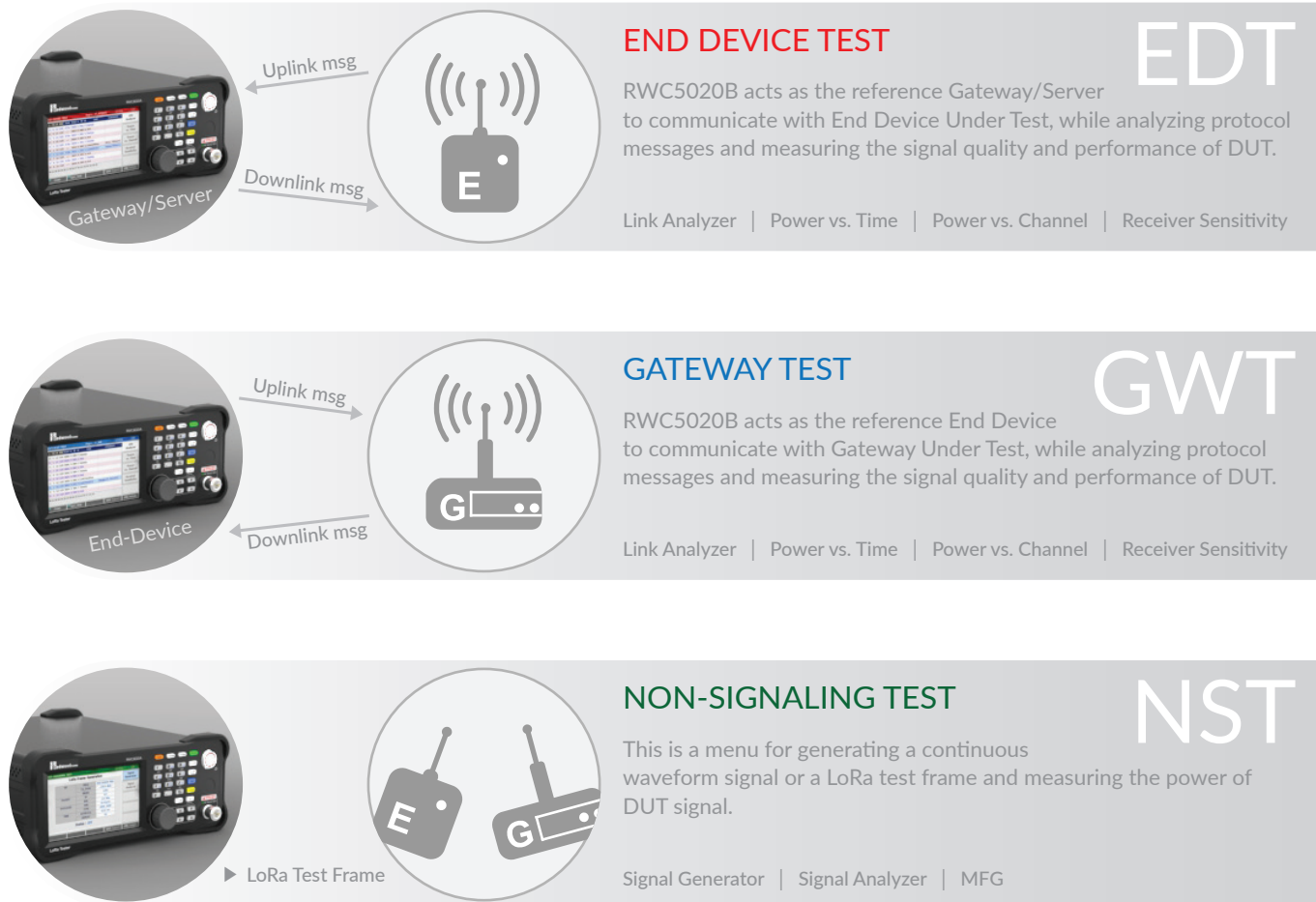
Supported LoRaWAN[®] Protocol

- 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



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.

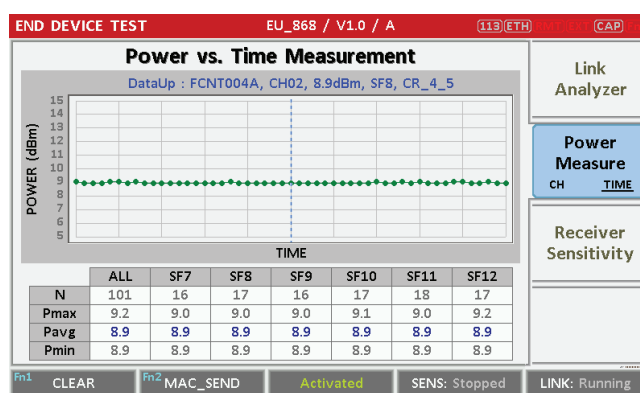


Link Analyzer for EDT

Power vs. Time

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

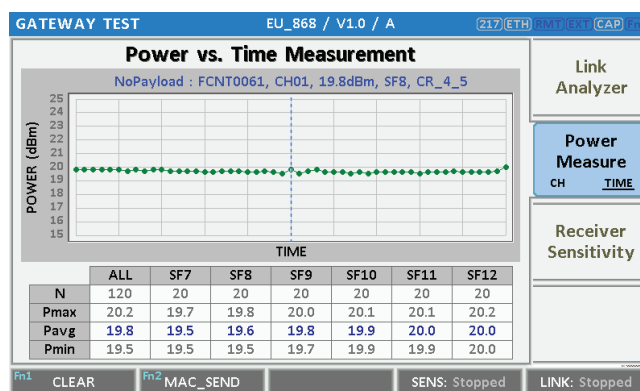
RWC5020B provides a function of Power vs. Time measurement for EDT and GWT. Power vs. Time measurement in EDT (or GWT) helps to create a link between RWC5020B and an End Device (or Gateway/Server) Under Test and to measure the received power with respect to data rates.



Power vs. Time for EDT



Link Analyzer for GWT



Power vs. Time for GWT

MAC command Test

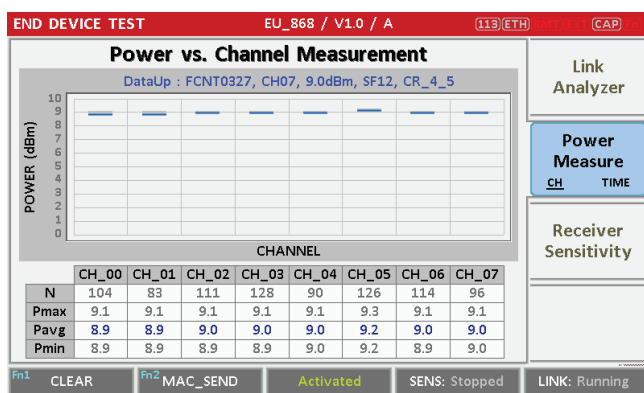
- Multiple MAC commands in a single frame
- All MAC commands defined in LoRaWAN with user-configurable parameters
- Field selection: frame payload or frame options
- Message type selection: confirmed or unconfirmed
- User defined message: editable payload data and port field

LINK	PROTOCOL	RF
MAC_CMD_TYPE	INSTANT_MAC_CMD	CONFIRMED
MAC_CMD_FIELD	LINK_CHECK	PAYLOAD
INSTANT_MAC_CMD	LINK_CHECK	LINK_CHECK
PERIODIC_UPLINK	DEVICES_TIME	PERIODIC_UP
INTERVAL	DEVICES_MODE	5 sec
PAYLOAD_TYPE		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.

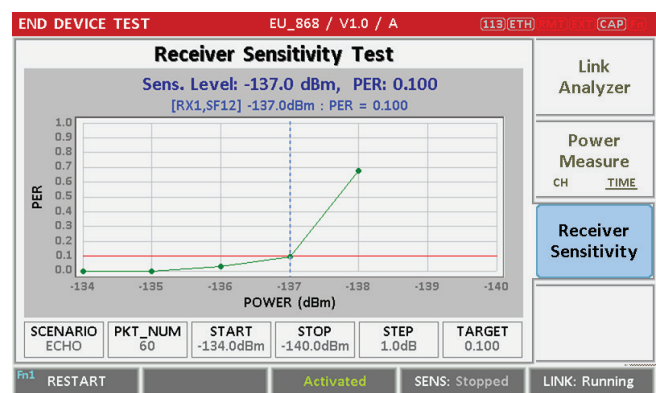


Power vs. Channel for EDT

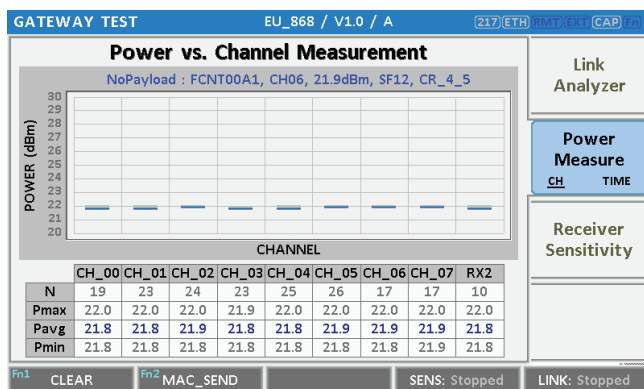
Receiver Sensitivity

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

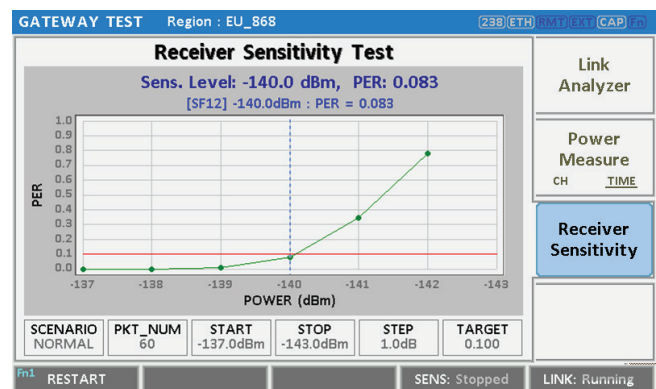
Receiver Sensitivity is a function of testing the receiver performance of DUT. RWC5020B sweeps its power level from the start value to the stop value with the step value and checks whether DUT functions properly, and stops immediately after DUT does not function properly.



Receiver Sensitivity Test for EDT



Power vs. Channel for GWT



Receiver Sensitivity Test for GWT

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

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

Signal Generator

Transmitting 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.

PHY Protocol Parameters for Signal Analyzer

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-SIGNALING TEST										
SEQ	SF	BW	Pow	Time	FCnt	Port	Data			
1	7	125	-30.0	0.10s	000A	99	60	01	00	00 00 0A 00 63 00
2	7	125	-30.0	0.10s	000B	99	60	01	00	00 00 0B 00 63 00
3	7	125	-30.0	0.10s	000C	99	60	01	00	00 00 0C 00 63 00
4	7	125	-30.0	0.10s	000D	99	60	01	00	00 00 0D 00 63 00
5	7	125	-30.0	0.10s	000E	99	60	01	00	00 00 0E 00 63 00
6	7	125	-30.0	0.10s	000F	99	60	01	00	00 00 0F 00 63 00
7	7	125	-30.0	0.10s	0010	99	60	01	00	00 00 10 00 63 00
8	7	125	-30.0	0.10s	0011	99	60	01	00	00 00 11 00 63 00
9	7	125	-30.0	0.10s	0012	99	60	01	00	00 00 12 00 63 00
10	7	125	-30.0	0.10s	0013	99	60	01	00	00 00 13 00 63 00

Signal Generator

Signal Analyzer

MFG Measure

Status : OFF

Example of Generating LoRa Test Frames

NON-SIGNALING TEST										
SEQ	SF	BW	Pow	Time	FCnt	Port	Data			
51	7	125	-31.0	7.35s	003C	99	40	01	00	00 00 00 3C 00 63 00
52	7	125	-31.0	0.25s	003D	99	40	01	00	00 00 3D 00 63 00
53	7	125	-31.0	0.23s	003E	99	40	01	00	00 00 3E 00 63 00
54	7	125	-30.9	0.24s	003F	99	40	01	00	00 00 3F 00 63 00
55	7	125	-31.0	0.23s	0040	99	40	01	00	00 00 40 00 63 00
56	7	125	-31.0	0.24s	0041	99	40	01	00	00 00 41 00 63 00
57	7	125	-30.9	0.23s	0042	99	40	01	00	00 00 42 00 63 00
58	7	125	-31.0	0.23s	0043	99	40	01	00	00 00 43 00 63 00
59	7	125	-31.0	0.24s	0044	99	40	01	00	00 00 44 00 63 00
60	7	125	-30.9	0.23s	0045	99	40	01	00	00 00 45 00 63 00

Signal Generator

Signal Analyzer

MFG Measure

MAX: -30.9dBm AVG: -31.1dBm MIN: -31.3dBm

Example of Receiving LoRa Test Frames

DUT's RX Performance Test

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

DUT's TX Performance Test

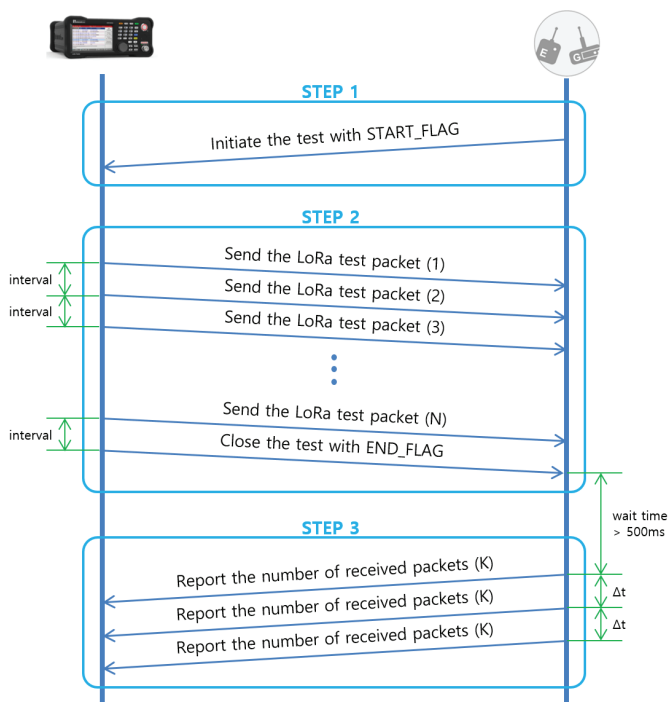
- Set the DUT to always transmit the pre-defined packet
- Tester measures CW frequency

MFG

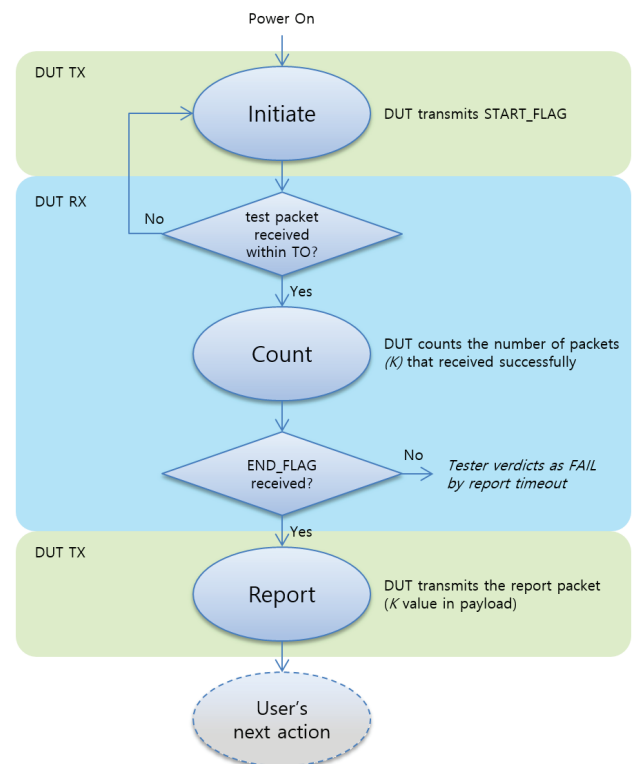
Speeding up the test time in production lines

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.



Test Procedure for MFG Test



State Transition Diagram during MFG Test

NON-SIGNALING TEST	
NST_MFG	PROTOCOL
MODE	LORA
NETWORK	PUBLIC
BW	125 KHz
SF	SF7
PREAMBLE_SIZE	8
REPEAT_NUM	100
INTERVAL	0.10 sec
POP_UP	
EXIT	

LINK: Running

PHY Protocol Parameters for MFG

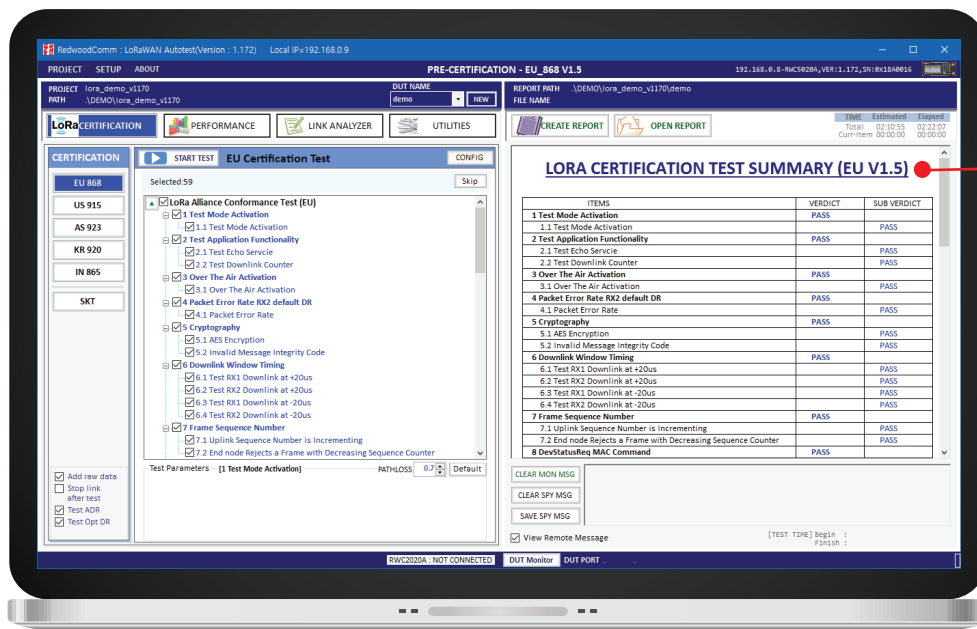
NON-SIGNALING TEST	
NST_MFG	PROTOCOL
PREAMBLE_SIZE	8
REPEAT_NUM	100
INTERVAL	0.10 sec
PER_CRITERIA	0.100
POW_CRITERIA_UPPER	14.0 dBm
POW_CRITERIA_LOWER	0.0 dBm
TIME_OUT	5 sec
0.001 ~ 1	
EXIT	

LINK: 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.



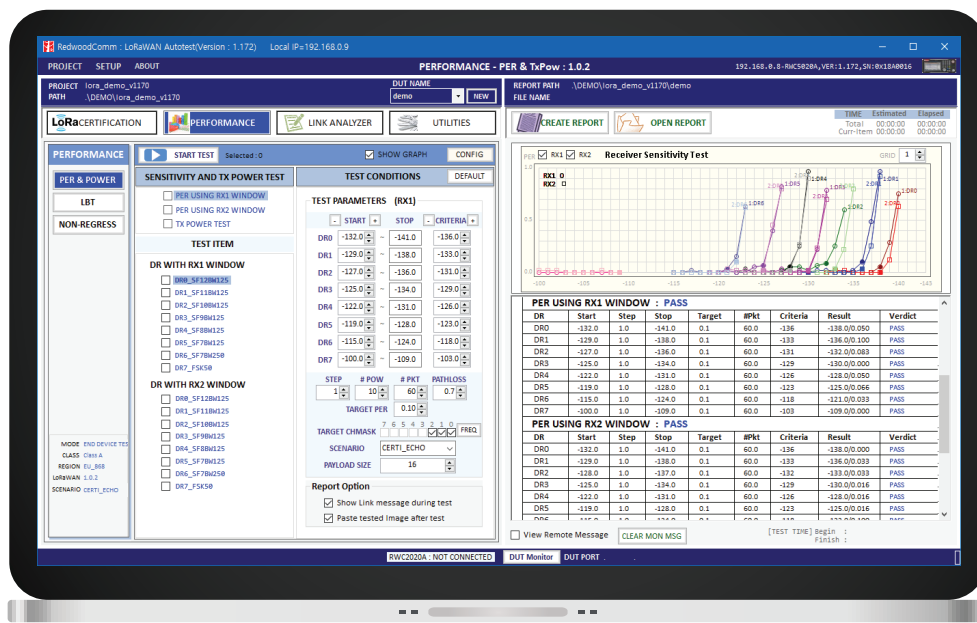
LoRa Pre-certification Tests

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

Output report



.doc



TX/RX Performance Tests

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

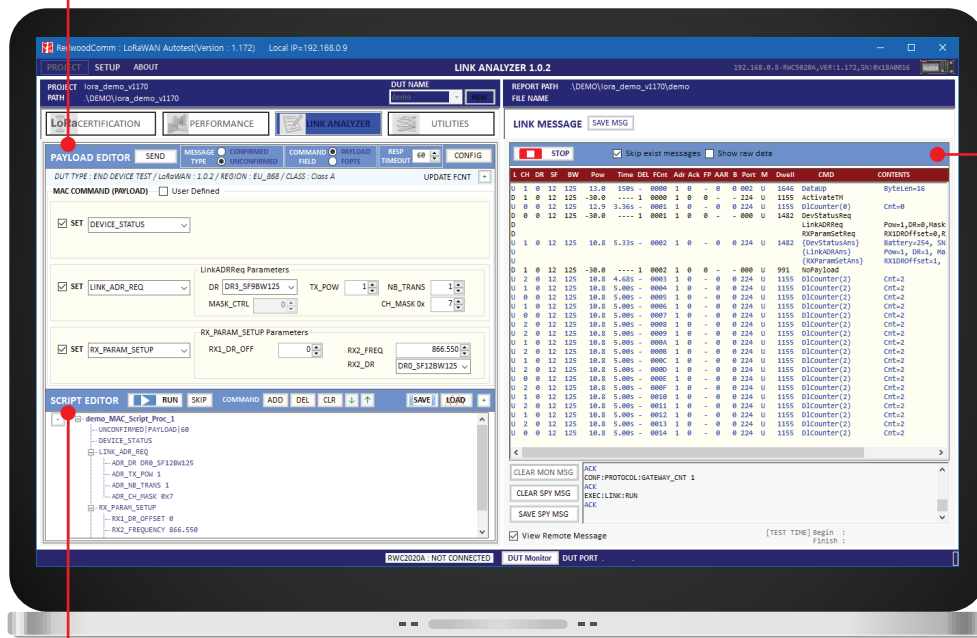
Ethernet



PC Software

Payload Editor

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

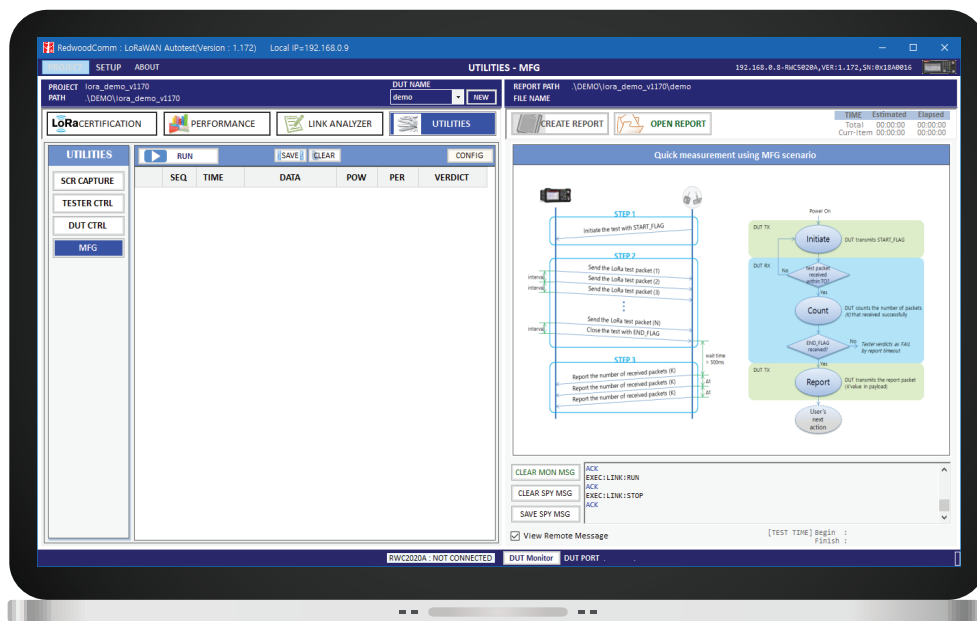


Link Analyzer

You can gather 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

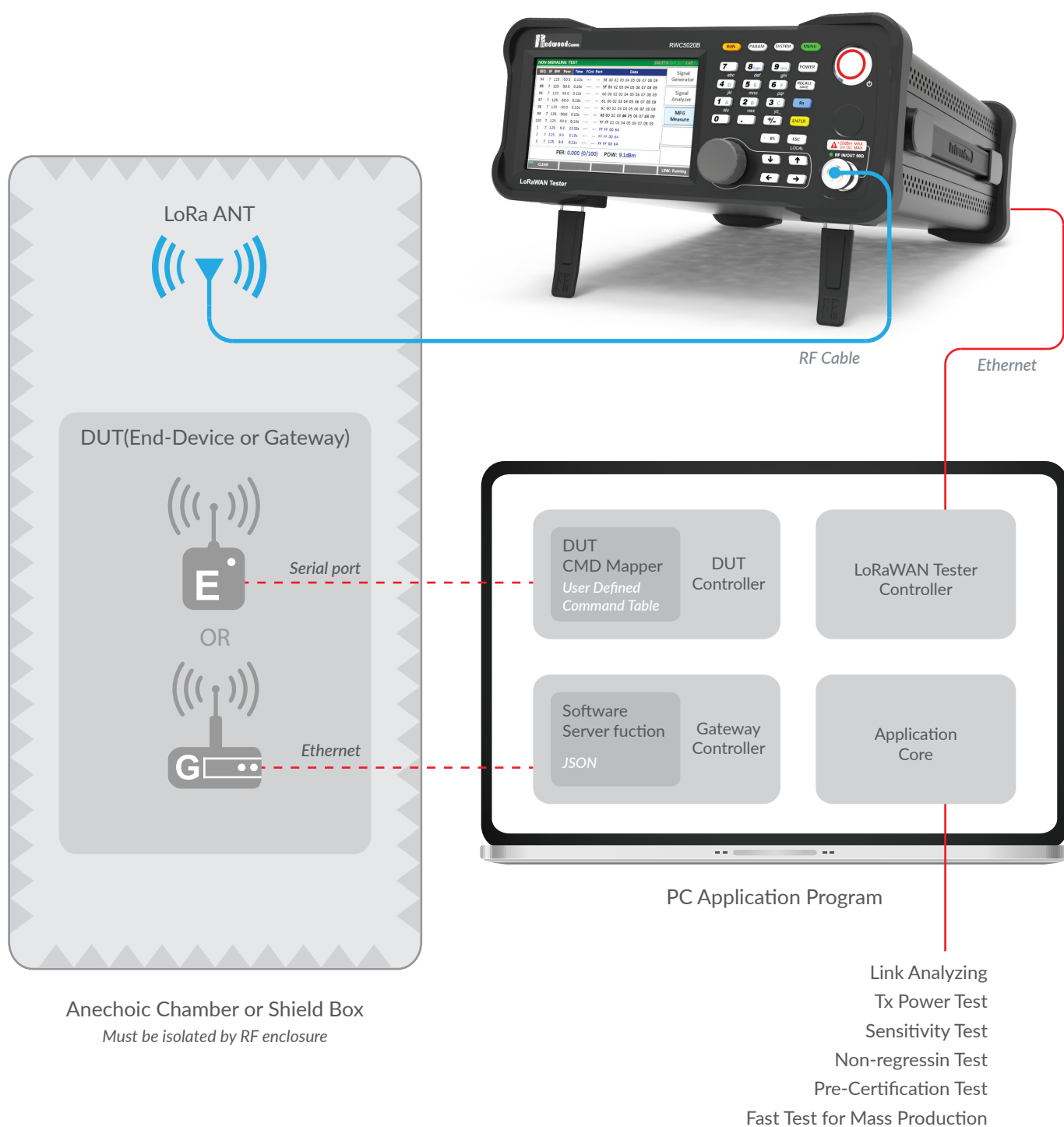
It provides Non-signaling functions such as TX/RX/MFG Test for fast manufacturing Tests.

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

Ethernet



Structure of automated PC software and example of test setup



Specifications

Frequency	Range: 400MHz ~ 510MHz, 862MHz ~ 960MHz Resolution: 100Hz Stability vs. +25℃: ±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℃ 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 | ☐ O5020B-01 LoRaWAN Pre-Certification Test EU Option |
| ☐ C5020B-01 EDT+GWT | ☐ O5020B-03 LoRaWAN Pre-Certification Test US/CA Option |
| ☐ C5020B-02 NST | ☐ O5020B-04 LoRaWAN Pre-Certification Test AS Option |
| ☐ C5020B-03 EDT | ☐ O5020B-05 LoRaWAN Pre-Certification Test KR Option |
| ☐ C5020B-04 GWT | ☐ O5020B-06 LoRaWAN Pre-Certification Test IN Option |
| ☐ C5020B-05 EDT+NST | ☐ O5020B-95 Eextra Hardware Warranty Option |
| ☐ C5020B-06 GWT+NST | ☐ 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.

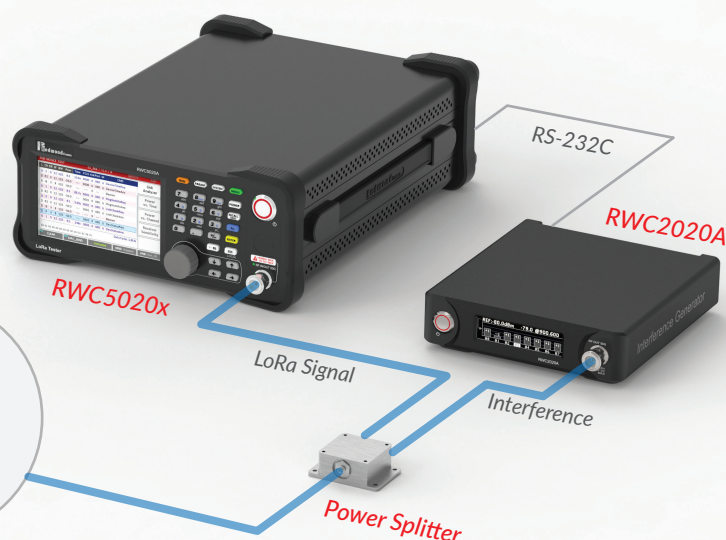
LBT Test

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.

DUT should follow
LBT AFA (Listen Before Talk
Adaptive Frequency Agility)
transmissions management



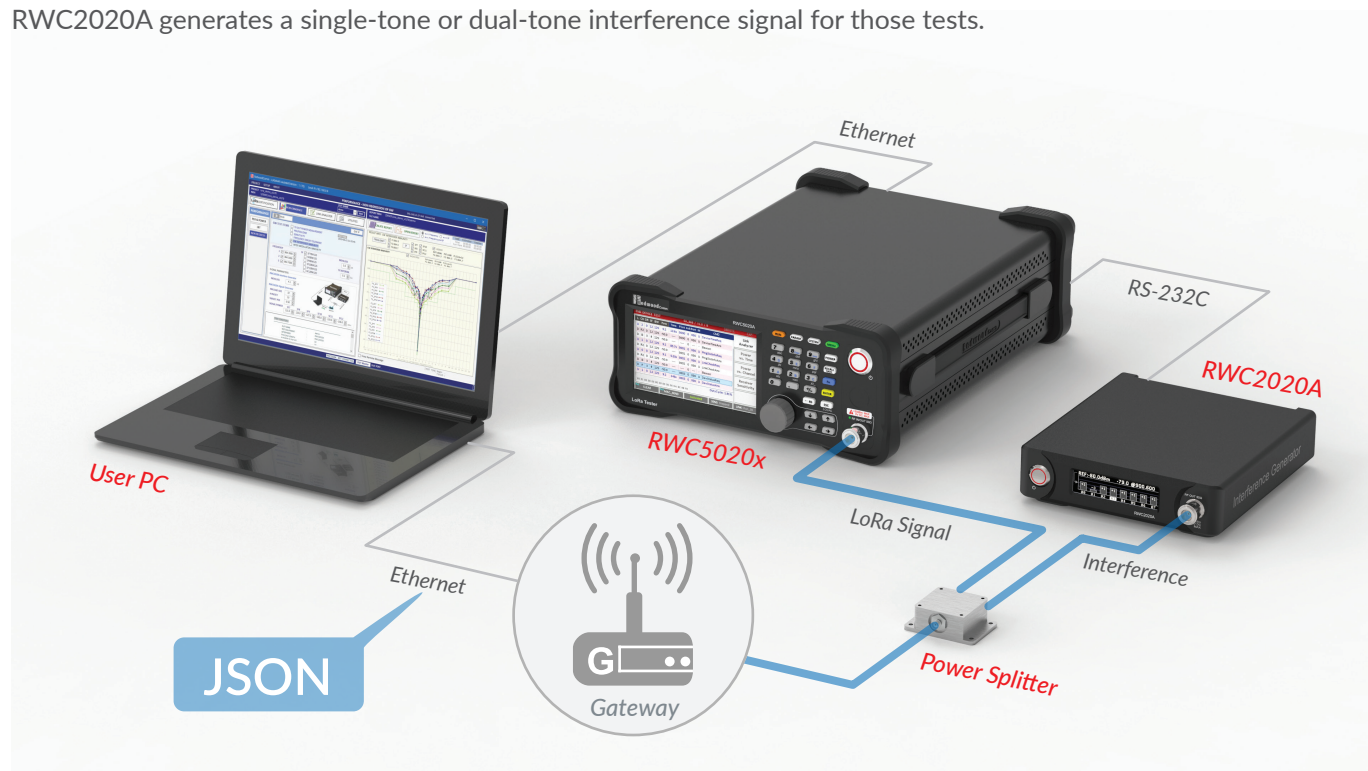
DUT(End-Device or Gateway)



CW Interferer Immunity Test

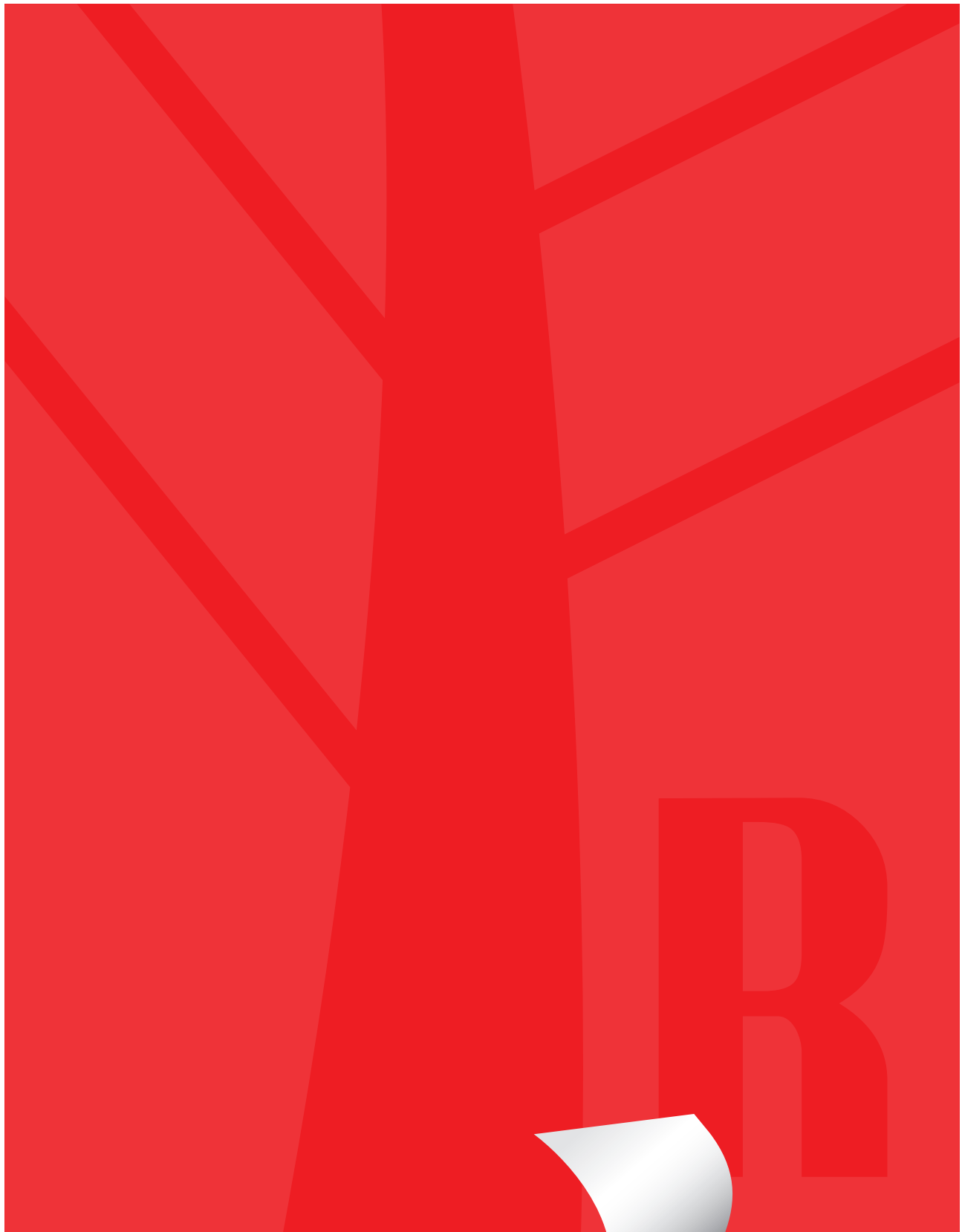
The CW Interferer Immunity Test and Intermodulation Immunity Test which are ones of the Gateway Non-regression tests require CW interference signals with high performance phase noise.

RWC2020A generates a single-tone or dual-tone interference signal for those tests.



Specifications

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



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