

# TEST SOLUTION for LoRaWAN®

RedwoodComm is a leading company for development of wireless communication test solutions. 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

### Tester for LoRaWAN



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 the LoRa Alliance

## LoRaWAN® Compliance

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

RWC5020B pre-certification test is recommended for the purpose of pre-qualification. Some of the 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

#### LoRaWAN® Specification 1.0.2:

- LoRaWAN® European EU 863-870MHz Region End Device Certification Requirements
- LoRaWAN® US + Canada 902-928MHz Region End Device Certification Requirements
- LoRaWAN® Asia AS 923MHz Region End Device Certification Requirements
- LoRaWAN® South Korea 920-923MHz Region End Device Certification Requirements
- LoRaWAN® India IN865-867MHz Region End Device Certification Requirements

#### LoRaWAN® Specification 1.0.4:

- LoRaWAN® Certification Requirement for All Regions
- LoRaWAN® Class B/C Certification Requirement for All Regions
- Supported Regions: EU868, US/CA915, AS923-1/2/3/4, KR920, IN865, AU915, RU865, and EU433

### Supported LoRaWAN® Protocol

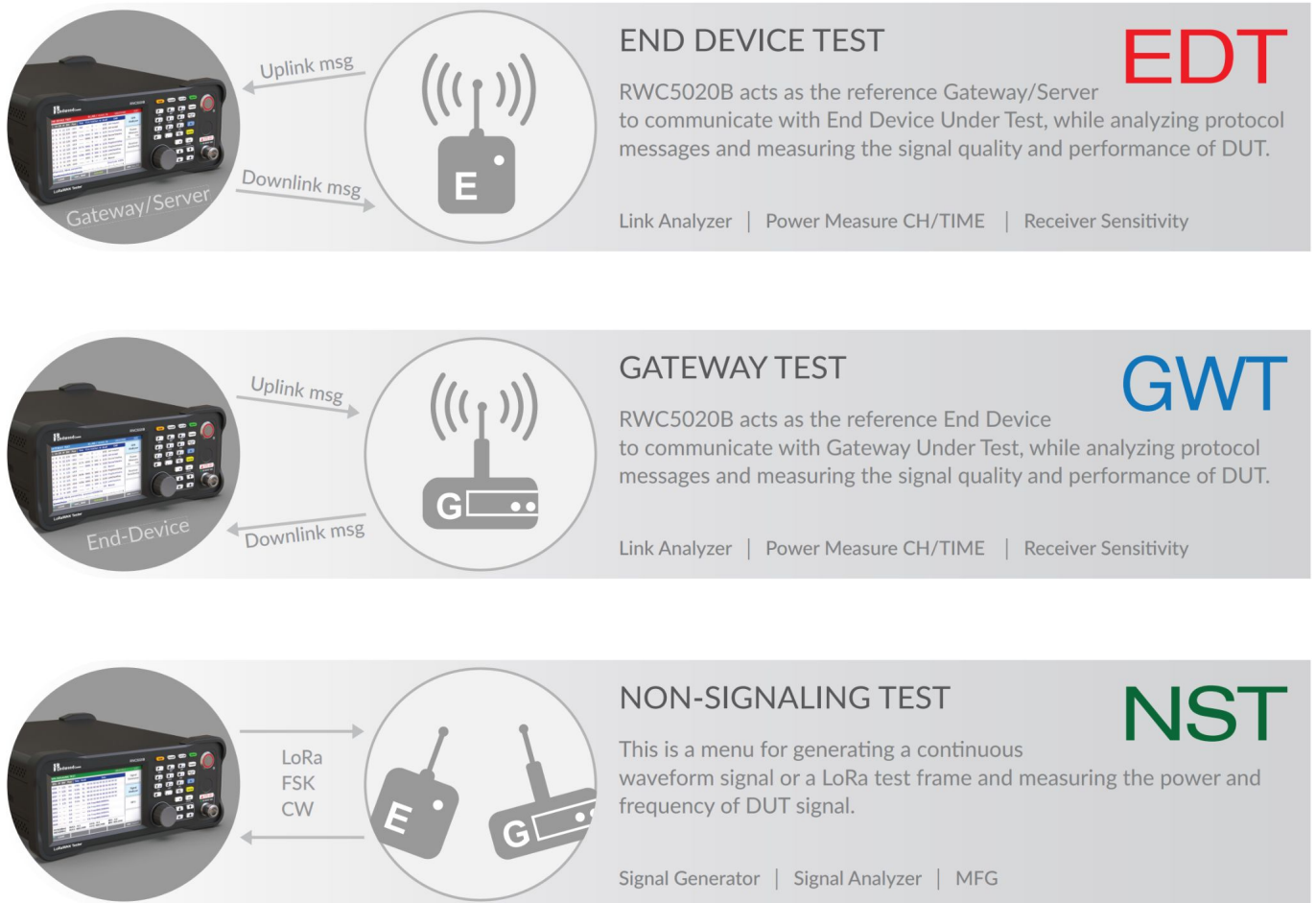
- Compatible with LoRaWAN® version of V1.0.2, 1.0.3, 1.0.4 and V1.1.0
- Class A/B/C
- Optionally upto 64(125kHz)+8(500kHz) channel for US/CA/AU915, 96(125kHz) channel for CN470

### Supported LoRaWAN® Region

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

## Key Features

### 3 main operational modes



### Protocol & Functional Test

- Support of LoRaWAN® Pre-Certification Tests for all regions
- Scenarios for transmission of MAC commands and user 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, RXC 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

- Signal Generator and Signal Analyzer
- Frequency Measurement Function
- Separate TX/RX Tests with DUT controls – power, frequency and sensitivity
- Simultaneous TX/RX Tests (MFG) without wired DUT controls

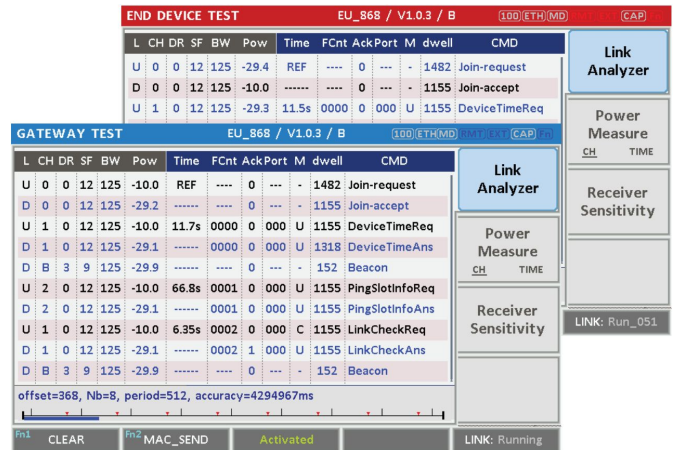
## Link Analyzer

### 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.

### 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



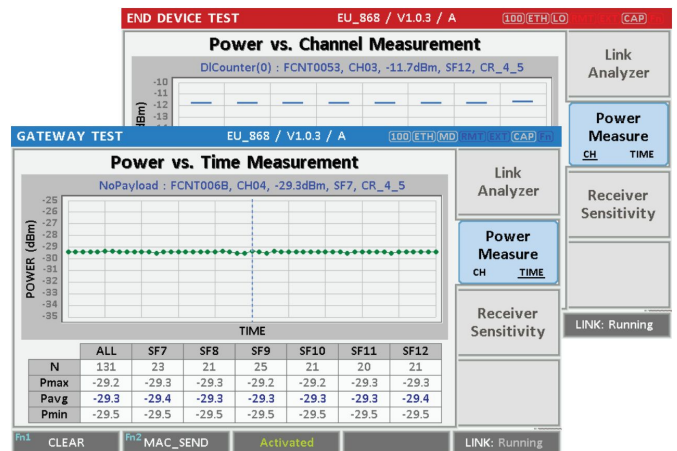
Link Analyzer in EDT/GWT

## Power Measure CH/TIME

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

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

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



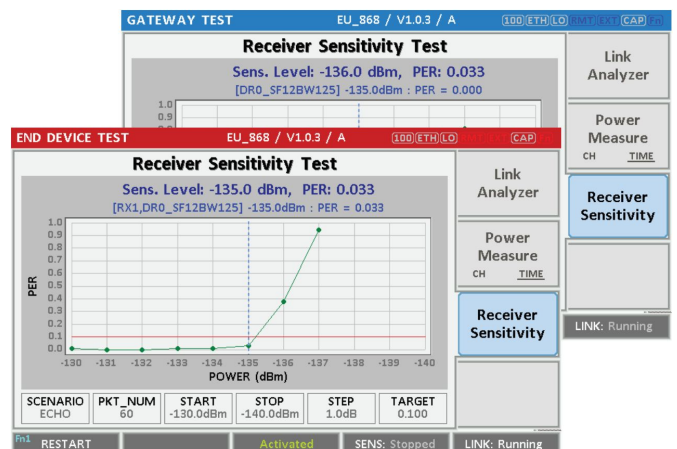
Power Measure CH/TIME in EDT/GWT

## Receiver Sensitivity

### Finding the minimum power level at 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 to find the minimum sensitivity level.

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



Receiver Sensitivity Test in EDT/GWT

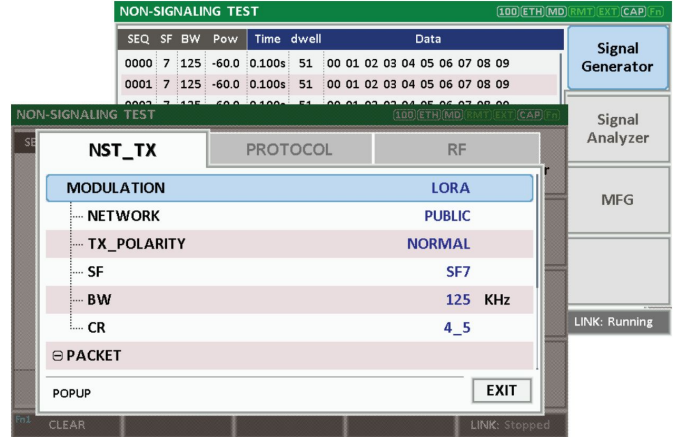
# Signal Generator

## Transmitting LoRa test frames/CW

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

### DUT's RX Performance Test

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



RX Test in NST

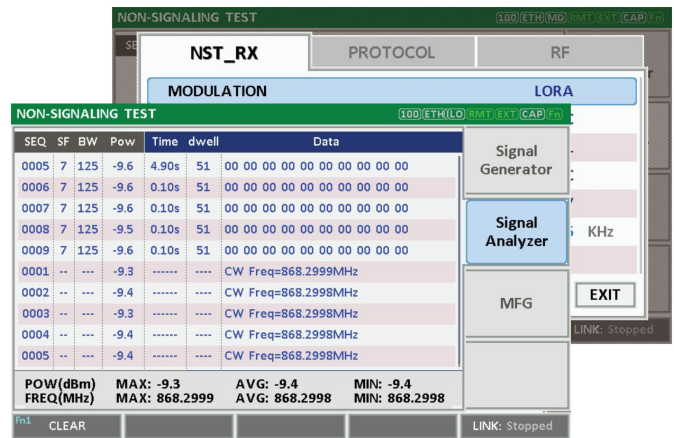
# Signal Analyzer

## 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 or FSK frame. Additionally TX power and frequency of DUT is measured in LoRa or CW mode.

### DUT's TX Performance Test

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

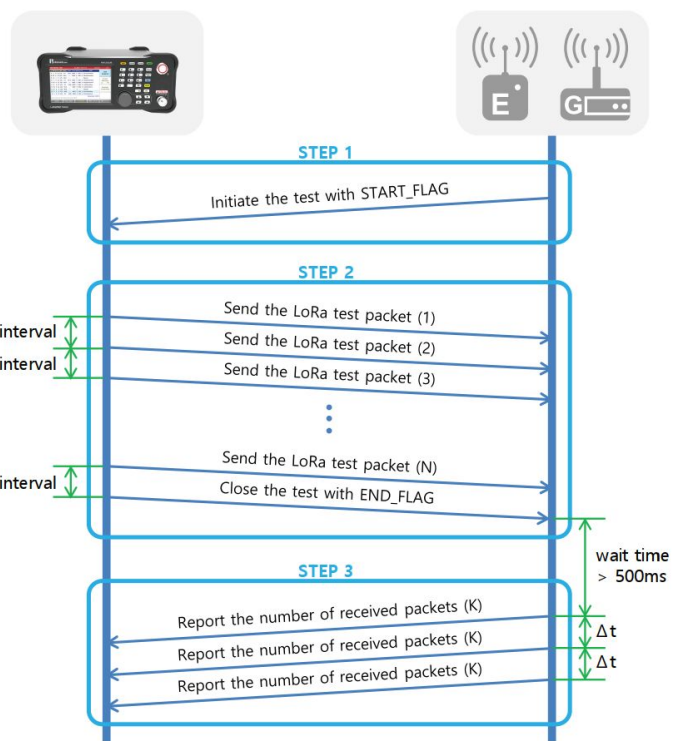
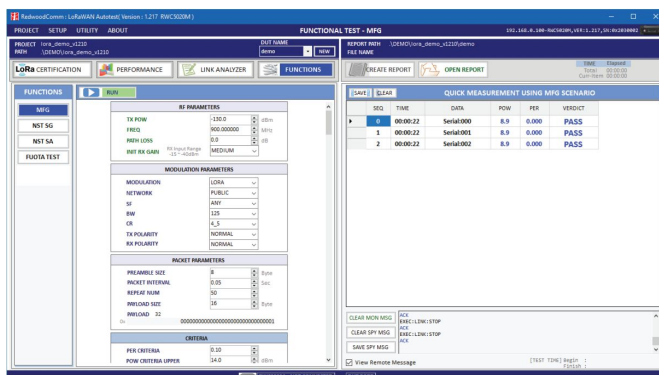


TX Test in NST

# MFG

## Speeding up the test in production lines

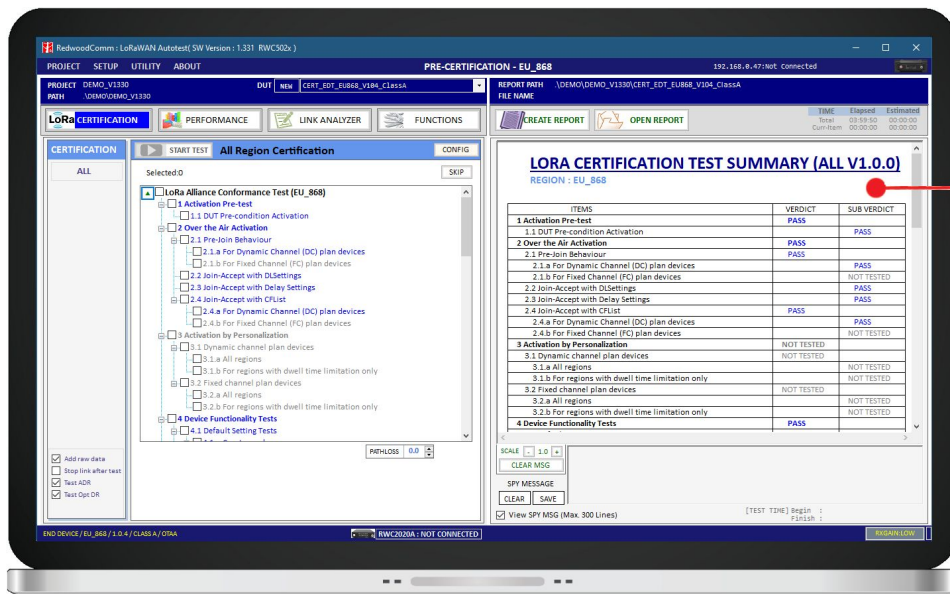
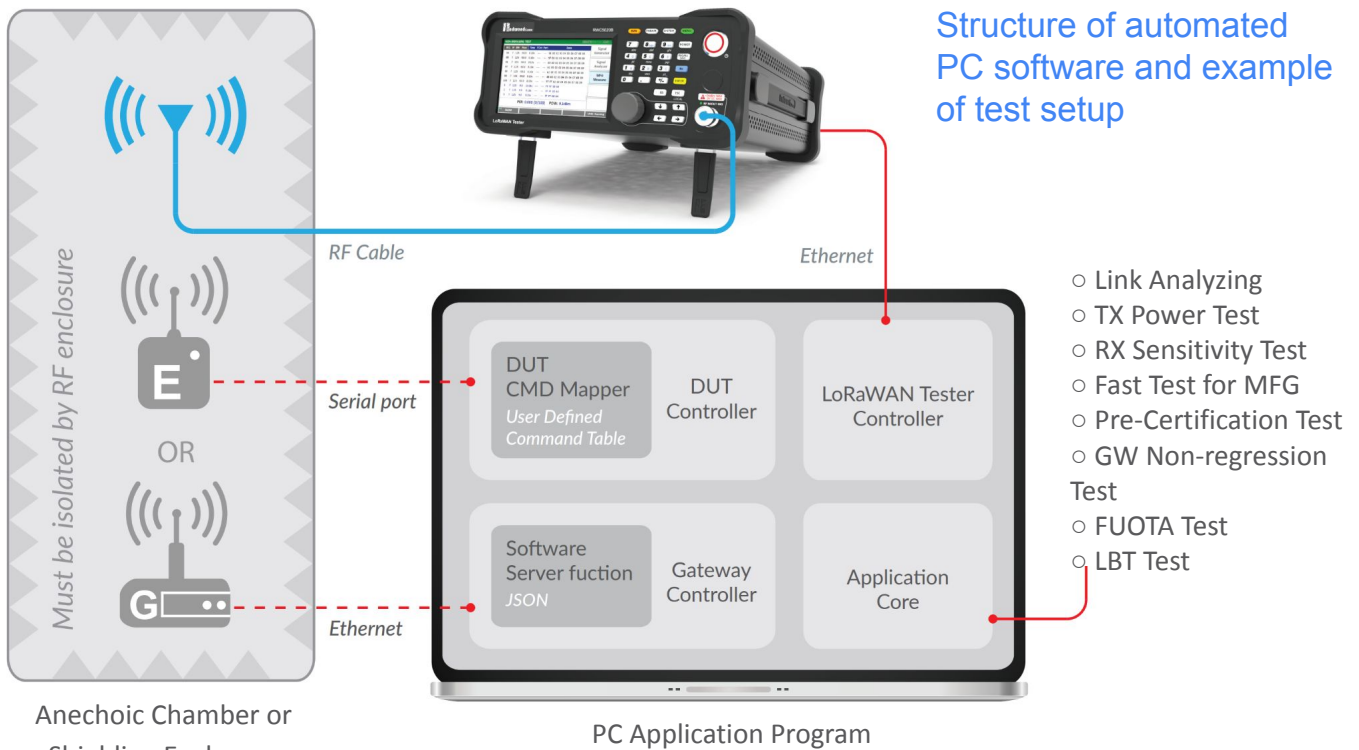
MFG is a function of manufacturing tests to measure the TX and RX performances of DUT simultaneously; power measurement for TX and sensitivity measurement for RX respectively. Basically manufacturing test of LoRa products should be performed in non-signaling mode because of two reasons; test time and a type of DUT.



MFG Test Procedure

## PC Software

This PC application provides a variety of special measurement functions such as LoRaWAN pre-certification test, RF 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.



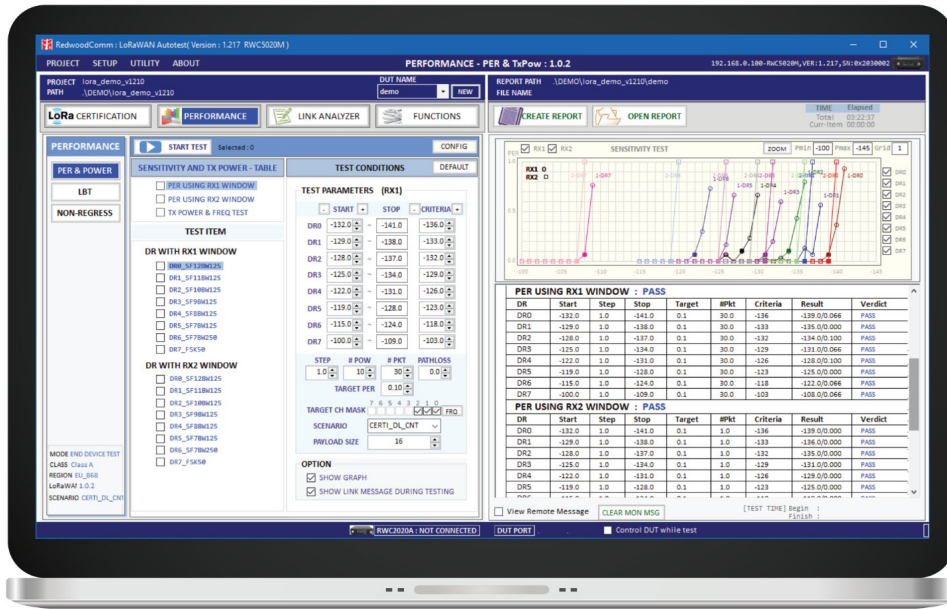
## LoRaWAN Pre-certification Tests

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



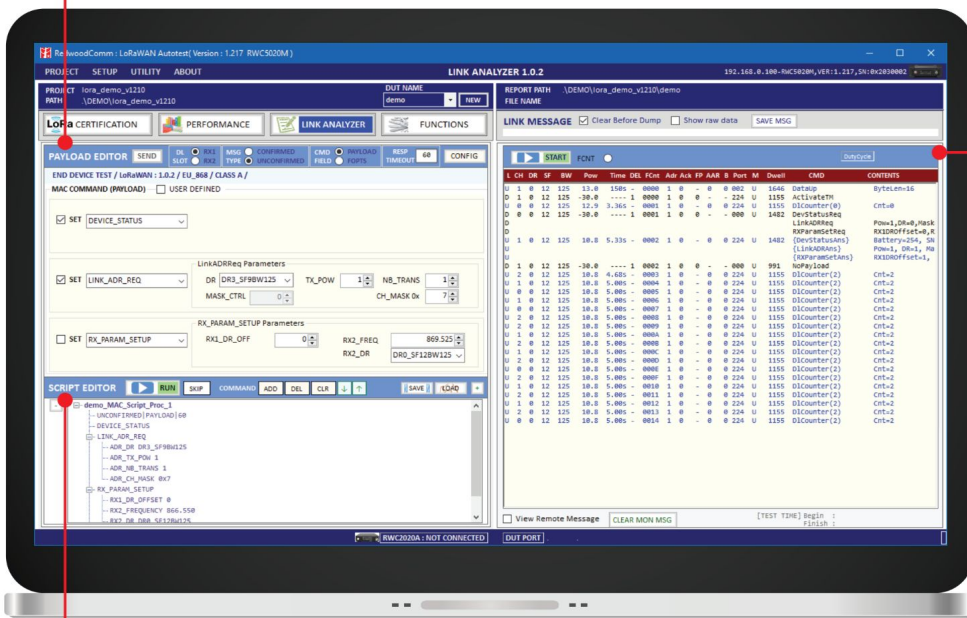
### TX/RX Performance Tests

It provides fully automated RF performance measurement functions such as TX Power, CW Frequency and RX sensitivity



### Payload Editor

Any type of LoRa MAC commands defined in LoRa protocol can be transmitted



### Link Analyzer

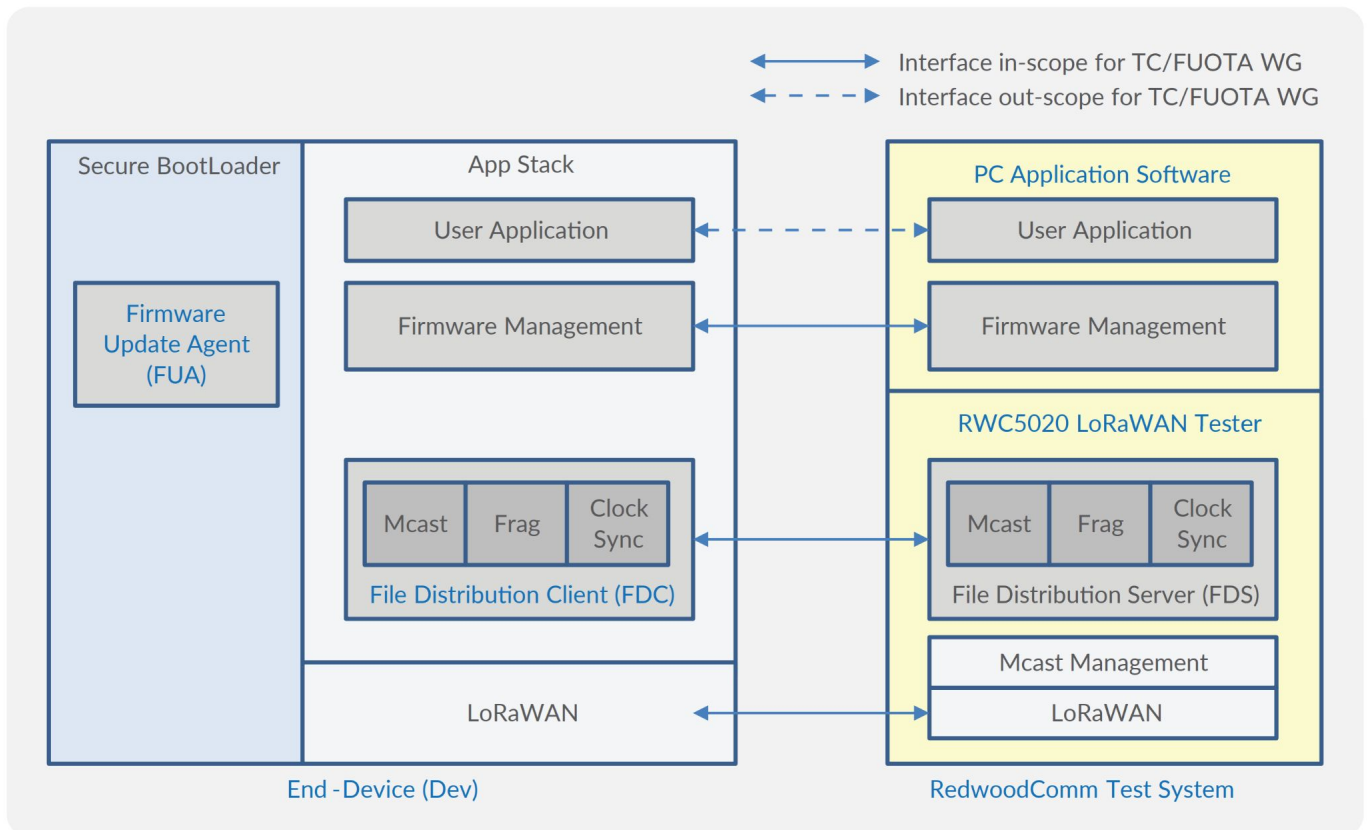
All protocol messages with link analyzer function can be captured and saved

### Script Editor

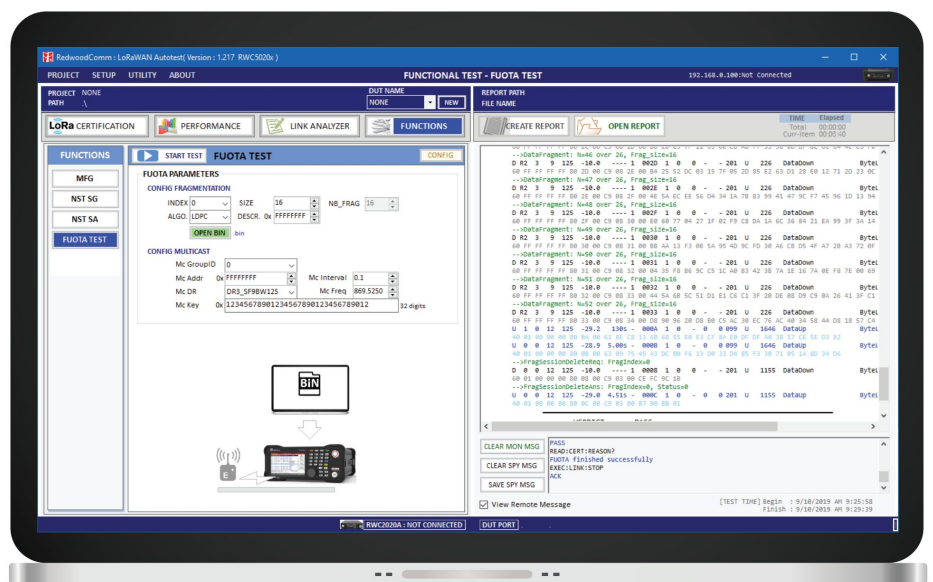
Add, remove or edit MAC command scenarios as needed

## FUOTA Test

RWC5020B/M provides two kinds of FUOTA test function; one is Unicast Method which just uses data fragmentation to send user's firmware file, and the other is Multicast Method which uses Clock synchronization, Multicast, and Data fragmentation. The System block diagram is as follows.



Users can load the firmware binary file for FUOTA test. Fragmentation parameters as well as Multicast parameters are editable using this GUI. Multicast function is optional. The clock Synchronization function will be performed automatically when Multicast function is selected.







## RWC5020M

### Tester for LoRaWAN

RWC5020M is a compact all-in-one tester for LoRa/LoRaWAN, which offers most of the industry-leading features of RWC5020B at a very attractive price. It supports both engineering and manufacturing tests with a single tester: RF Performance, LoRaWAN Pre-certification, Firmware Update Over The Air (FUOTA), and more.

## RWC5021P

### Protocol Tester for LoRaWAN



RWC5021P is a compact dongle-type tester for LoRaWAN<sup>®</sup> protocol analysis for end devices, providing the pre-certification test function and link analyzer function that can be performed in signaling mode. In the case of the precertification function, it follows the standardized procedure of the LoRaWAN<sup>®</sup> specified by the LoRa Alliance<sup>®</sup>. In the case of the link analyzer, users can let RWC5021P communicate with user's DUT with MAC commands even with users' defined commands or malfunctioned MAC commands.

In order to use all dedicated functions, it must be connected with the RWC5020x PC software that will help users test and debug users' devices by performing the pre-certification tests, as specified by the LoRa Alliance<sup>®</sup>. It provides only End device test mode.

	RWC5020B	RWC5020M	RWC5021P
<b>Stand-alone Capability</b>	YES	NO	NO
<b>Exterior</b>			
Dimensions	250(w)x110(h)x348(d) mm	200(w)x70(h)x220(d) mm	100(w)x30(h)x140(d) mm
Weight	5 kg	2.2 kg	0.5 kg
Display	5", 800x480, 16M color, TFT LCD	2.8", 256x64, 16 gray, OLED	4 LED indicators
Front Keypad	YES	NO	NO
Power Input	100 to 240 VAC, 50/60Hz	12V/3A VDC (AC/DC adapter)	5V/0.5A (USB-C)
Control Interface	Ethernet, RS-232C	Ethernet, RS-232C	Ethernet, USB-C (VCOM)
<b>Frequency Bands</b>			
400MHz to 510MHz	Included	Selectable by Band option	Selectable by Region option
862MHz to 960MHz	Included	Selectable by Band option	Selectable by Region option
<b>RF Power Level</b>			
Output Power	0dBm to -150dBm	0dBm to -150dBm	0dBm to -30dBm
Input for Power Measurement	+30dBm to -80dBm	+30dBm to -80dBm	+30dBm to -80dBm
Input for Frequency Measurement	+30dBm to -50dBm	+30dBm to -50dBm	Not available
<b>Operational Modes</b>			
End-device Test	Selectable	Selectable	Included
Gateway Test	Selectable	Selectable	Not available
Non-signaling Test	Included	Selectable	Not available
<b>Protocol Compliance Tests (end-device only)</b>			
LoRaWAN Pre-Certification Tests	Optional	Optional	Optional
Operator Pre-Certification Tests	Optional	Optional	NO
<b>RF Performance Tests</b>			
Receiver Sensitivity Test	YES	YES	NO
Output Power Measurement	YES	YES	NO
Carrier Frequency Measurement	YES	YES	NO
LBT Test	YES (2020A required)	YES (2020A required)	NO
Gateway Non-regression Test	YES (2020A required partly)	YES (2020A required partly)	NO
<b>Link Analyzer</b>			
Message Logging and Analysis	YES	YES	YES
MAC Commands Transmission	YES	YES	YES
Application/User Data Transmission	YES	YES	YES
User Script Generation	YES	YES	YES
<b>Functionalities</b>			
FUOTA Test	YES	YES	NO
Manufacturing Test (MFG/NST)	YES	YES	NO
<b>Compatibility with 502x PC Application Software</b>			
Pre-Certification Test	YES	YES	YES
RF Performance Test	YES	YES	NO
Link Analyzer	YES	YES	YES
Functions: NST, MFG, FUOTA	YES	YES	NO

## RWC2020A Interference Generator



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 shall be connected to RWC5020x 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 RWC5020x. 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 the RWC5020B GUI or PC software.



## Semtech's Non-regression Tests for Gateway

RWC5020x provides the Semtech's Non-regression tests for gateway performance. The application software will manage RWC5020A/B/M and RWC2020A, and will internally run a simple network server function which can communicate with a gateway under test via the JSON interface. It consists of TX output power measurement, sensitivity, PER, RSSI, SNR, frequency error tolerance, and CW interferer/blocker immunity.

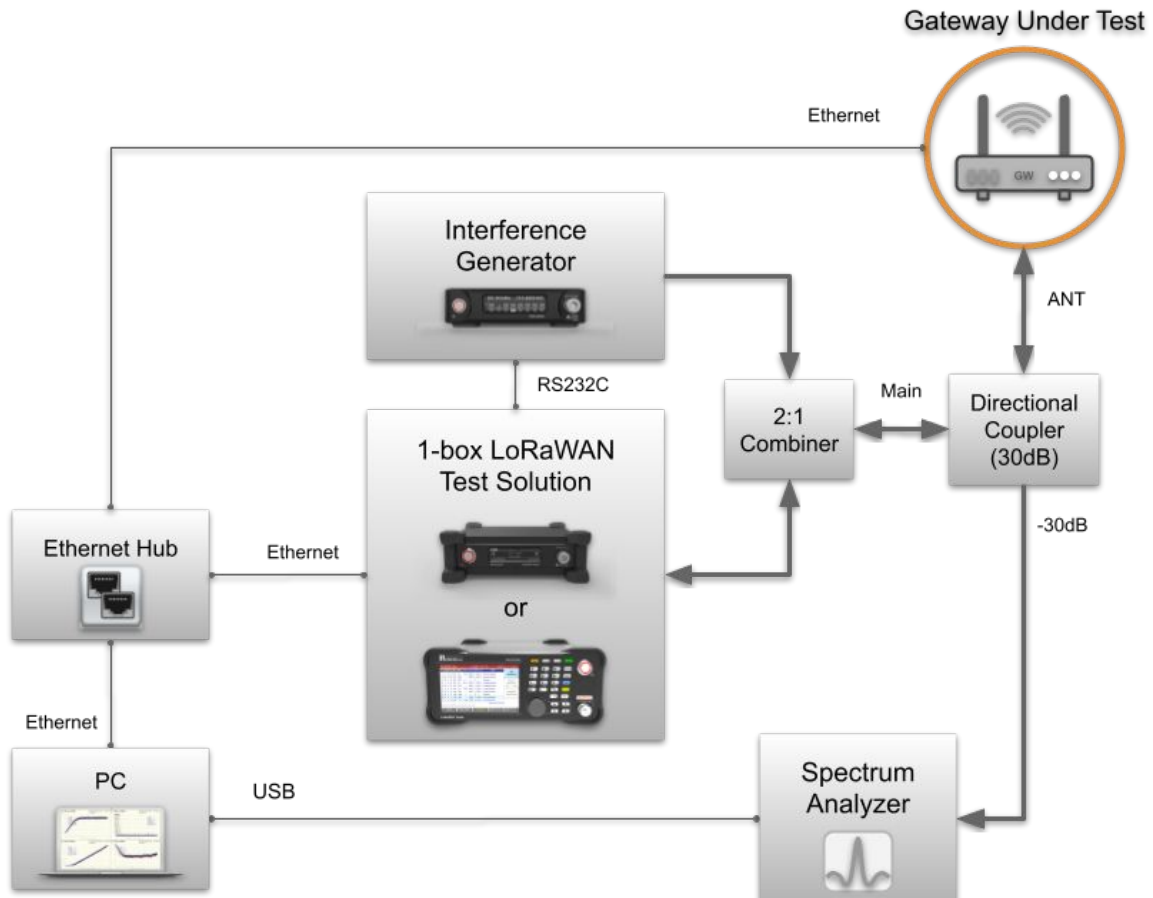


## Gateway Test & Measurement Guidelines

The LoRa Alliance introduces the new guidelines for LoRaWAN gateways provide recommendations for what and how to measure RF performance to standardize and accelerate deployments. As shown below, the RWC5020M/B with RWC2020A forms the heart of a full recommended test set up. We can supply the individual testers stand alone or as part of a full turn-key test solution. For the detailed information, please visit the LoRa Alliance at <https://lora-alliance.org/>.

The list of test items include:

- Tx & Rx Operation and Survival with Open/Short Load
- Measured and Reported RF Transmit Power Relative to Transmit Power Setting
- Tx Conducted Emissions Out-of-Band
- Tx Intermodulation
- Tx Frequency Error
- Rx Sensitivity
- Rx Dynamic Range
- Rx In-Band Blocking/Selectivity
- Rx Out-of-Band Blocking/Selectivity
- Rx Intermodulation
- Cold Start
- Time Accuracy



	RWC5020B	RWC5020M
<b>Frequency</b>	<ul style="list-style-type: none"> <li>• Range : 400MHz to 510MHz, 862MHz to 960MHz</li> <li>• Resolution : 100Hz</li> <li>• Stability vs. +25°C : ±0.5ppm standard</li> <li>• Stability vs. Aging : ±1ppm/1st year</li> </ul>	
<b>Output Level</b>	<ul style="list-style-type: none"> <li>• Range : 0dBm to -150dBm</li> <li>• Resolution : 0.1dB</li> <li>• Accuracy : ±1dB</li> <li>• Impedance : 50Ω</li> </ul>	
<b>Input Level</b>	<ul style="list-style-type: none"> <li>• +30dBm to -80dBm for Power Measurement</li> <li>• +30dBm to -50dBm for Frequency Measurement</li> </ul>	
<b>Measurement Accuracy</b>	<ul style="list-style-type: none"> <li>• ±1dB for Power</li> <li>• ±1KHz for Frequency (Single Tone)</li> </ul>	
<b>VSWR</b>	<ul style="list-style-type: none"> <li>• Better than 1:1.5</li> </ul>	
<b>External Reference Frequency Input</b>	<ul style="list-style-type: none"> <li>• Frequency : 10MHz</li> <li>• Power Range : 0dBm to +20dBm</li> </ul>	
<b>Remote Programming Ports</b>	<ul style="list-style-type: none"> <li>• RJ45(Ethernet)</li> <li>• RS-232C</li> </ul>	
<b>Miscellaneous</b>	<ul style="list-style-type: none"> <li>• Operating Temperature : 5 to 40°C</li> <li>• Line Voltage : 100 to 240 VAC, 50/60Hz</li> <li>• Dimension : 250(w) x 110(h) x 348(d) mm</li> <li>• Weight : 5kg</li> </ul>	<ul style="list-style-type: none"> <li>• Operating Temperature : 5 to 40°C</li> <li>• Input : 12V/3A VDC</li> <li>• Dimension : 200(w) x 70(h) x 220(d) mm</li> <li>• Weight : 2.2kg</li> </ul>
	RWC5021P	RWC2020A
<b>Frequency</b>	<ul style="list-style-type: none"> <li>• Range : 400MHz to 510MHz, 862MHz to 960MHz</li> <li>• Resolution : 100Hz</li> <li>• Stability vs. +25°C : ±5 ppm</li> <li>• Stability vs. Aging : ±2.5ppm/year</li> </ul>	<ul style="list-style-type: none"> <li>• Range : 400MHz to 1000MHz</li> <li>• Resolution : 100Hz</li> <li>• Accuracy : ±2ppm/year @ operating temperature</li> </ul>
<b>Output Level</b>	<ul style="list-style-type: none"> <li>• Range : 0dBm to -30dBm</li> <li>• Resolution : 0.1dB</li> <li>• Accuracy : ±2dB</li> <li>• Impedance : 50Ω</li> </ul>	<ul style="list-style-type: none"> <li>• Range : -10dBm to -100dBm</li> <li>• Resolution : 0.1dB</li> <li>• Accuracy : ±1dB</li> <li>• Impedance : 50Ω</li> </ul>
<b>Input Level</b>	<ul style="list-style-type: none"> <li>• +30dBm to -80dBm for Power Measurement</li> </ul>	N/A
<b>Measurement Accuracy</b>	<ul style="list-style-type: none"> <li>• ±3dB for Power</li> </ul>	N/A
<b>VSWR</b>	<ul style="list-style-type: none"> <li>• Better than 1:1.5</li> </ul>	<ul style="list-style-type: none"> <li>• Better than 1:1.5</li> </ul>
<b>Phase Noise (Single tone mode)</b>	N/A	<ul style="list-style-type: none"> <li>• -103dBc @ 1kHz</li> <li>• -110dBc @ 10kHz</li> <li>• -110dBc @ 100kHz</li> <li>• -138dBc @ 1MHz</li> </ul>
<b>Remote Programming Ports</b>	<ul style="list-style-type: none"> <li>• RJ45 (Ethernet)</li> <li>• USB-C (VCOM)</li> </ul>	<ul style="list-style-type: none"> <li>• RJ45 (Ethernet)</li> <li>• RS-232C</li> </ul>
<b>Miscellaneous</b>	<ul style="list-style-type: none"> <li>• Operating Temperature : 5 to 40°C</li> <li>• Input : 5V/0.5A (USB-C)</li> <li>• Dimension : 100(w) x 30(h) x 140(d) mm</li> <li>• Weight : 0.5kg</li> </ul>	<ul style="list-style-type: none"> <li>• Operating Temperature : 5 to 40°C</li> <li>• Input : 12V/3A VDC</li> <li>• Dimension : 166(w) x 50(h) x 194(d) mm</li> <li>• Weight : 0.95kg</li> </ul>

## RWC5020B

## Main Product

Order Code	Part Name
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

## Options

Order Code	Part Name
O5020B-01	LoRaWAN Pre-Cert EU868
O5020B-03	LoRaWAN Pre-Cert US915
O5020B-04	LoRaWAN Pre-Cert AS923
O5020B-05	LoRaWAN Pre-Cert KR920
O5020B-06	LoRaWAN Pre-Cert IN865
O5020B-09	LoRaWAN Pre-Cert AU915
O5020B-11	LoRaWAN Pre-Cert RU864
O5020B-12	LoRaWAN Pre-Cert EU433
O5020B-64	64CH/SF5/SF6 Option
O5020B-98	Calibration
O5020B-99	SW/FW Maintenance

## RWC5020M

## Main Product

Order Code	Part Name
C5020M-X0	EDT+GWT+NST
C5020M-X1	EDT+GWT
C5020M-X2	NST
C5020M-X3	EDT
C5020M-X4	GWT
C5020M-X5	EDT+NST
C5020M-X6	GWT+NST
X: H or L	Select Freq Band: High or Low
O5020M-10	Multiple Freq Band Option

## Options

Order Code	Part Name
O5020M-01	LoRaWAN Pre-Cert EU868
O5020M-03	LoRaWAN Pre-Cert US915
O5020M-04	LoRaWAN Pre-Cert AS923
O5020M-05	LoRaWAN Pre-Cert KR920
O5020M-06	LoRaWAN Pre-Cert IN865
O5020M-09	LoRaWAN Pre-Cert AU915
O5020M-11	LoRaWAN Pre-Cert RU864
O5020M-12	LoRaWAN Pre-Cert EU433
O5020M-64	64CH/SF5/SF6 Option
O5020M-98	Calibration
O5020M-99	SW/FW Maintenance

\* All regional parameters of the LoRaWAN® specification are provided in EDT or GWT.

\* Pre-Certification Tests are add-on options for EDT only.

\* The default PC software is provided with purchasing of C5020B-xx and C5020M-xx.

## **RWC7100A**

### RF Shielding Enclosure



A triple contact shielding structure guarantees more than 100 dB isolation. The outstanding shielding effectiveness over wide frequency range up to 6.4GHz ensures reliable environment for testing and measuring wireless communication products that have excellent sensitivity performance.

## Features

- Stable and outstanding shielding characteristics with the triple contact shielding structure
- Reliable radiation test environment with internal absorbers
- Convenient radiation test setup with antenna mountable on the lid
- Easy to replace shielding gaskets for maintenance
- Easy to mount / unmount IO modules

## Application

LTE, NB-IoT devices (700 MHz, 2-6 GHz)  
LoRa, Sigfox devices (400 MHz, 900 MHz, 2.4 GHz)  
WiFi devices (2.4 GHz, 5.8-6.2 GHz)  
Bluetooth devices (2.4 GHz)  
GNSS devices (1.2-1.6 GHz)

## Specification

### Shielding Effectiveness

≥ 100 dB @ 400 MHz to 6.4 GHz

### Miscellaneous

Dimension W x D x H mm (inches)

Interior : 260 x 190 x 100 (10.2" x 7.5" x 3.9")

Exterior : 355 x 270 x 185 (14" x 10.6" x 7.3")

Packing : 450 x 350 x 270 (17.7" x 13.8" x 10.6")

Weight

Product : approx. 8.5 kg

Packing : approx. 10.5 kg





### **Headquarters**

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