

LoRa® / LoRaWAN® Test Solutions

 **LoRa Alliance Certified™**
as an en-device for EU and KR



May 2023

Contents

- Summary of Key Features



- Product Comparison
- PC Application Software
- RF Shielding Enclosure
- Production Test Solution
- Stand-alone Operation of 5020B

End-device Test Solutions

Key Features



● Protocol Conformance Tests

○ LoRaWAN® Pre-Certification

● LW V1.0.2:

EU863-870, US/CA902-928, AS923, KR920-923, and IN865-867

● LW V1.0.4:

EU863-870, US/CA902-928, AS923-1/2/3/4, KR920-923, IN865-867, AU915-928, RU864-870, and EU433 Class B/C Certification

○ LoRaWAN® Protocol

● Compatible with LoRaWAN® version of V1.0.2, 1.0.3, 1.0.4 and V1.1.0

● Class A/B/C

● support 64(125kHz)+8(500kHz) channel, 96(125kHz) channel

○ Regional Parameters

● EU 868, US 915, EU 433, AU 915, CN 470, AS 923(1/2/3/4), KR 920, IN 865, and RU 864

○ Scenarios for MAC commands and application data

● Multiple MAC commands and MAC command script

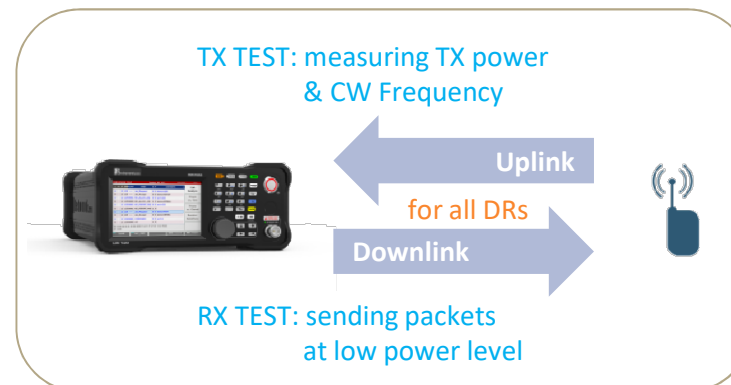
● RF Performance Tests

○ RX Sensitivity

● Class A/B/C

○ TX Power

○ TX CW Frequency



Gateway Test Solutions

Key Features

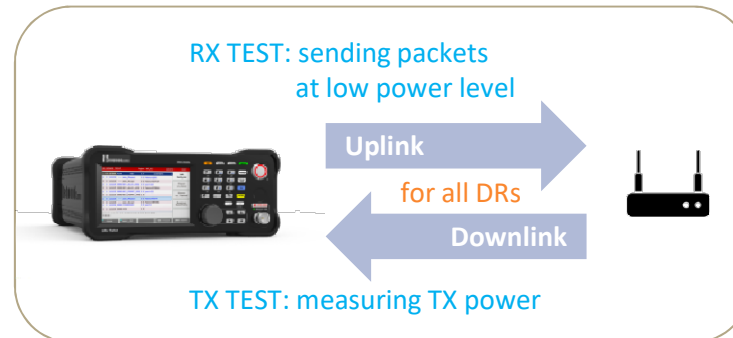


● Protocol Conformance Tests

- LoRaWAN® Protocol
 - Compatible with LoRaWAN® version of V1.0.2, 1.0.3, 1.0.4 and V1.1.0
 - Class A/B/C
- Regional Parameters
 - EU 868, US 915, EU 433, AU 915, CN 470, AS 923, KR 920, IN 865, and RU 864
- Scenarios for MAC commands and application data
 - Multiple MAC commands and MAC command script

● RF Performance Tests

- RX Sensitivity
- TX Power
- GW Non-regression Tests (Semtech)
 - TX Output Power Measurement
 - Sensitivity
 - PER / RSSI / SNR
 - Frequency Error Tolerance
 - CW Interferer / Blocker Immunity



LBT Test Solution

● What is LBT?

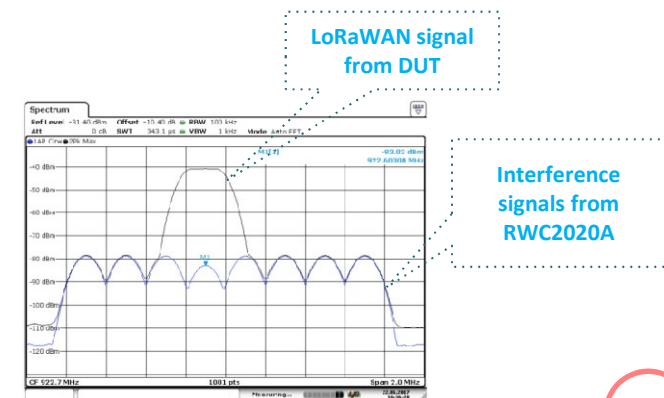
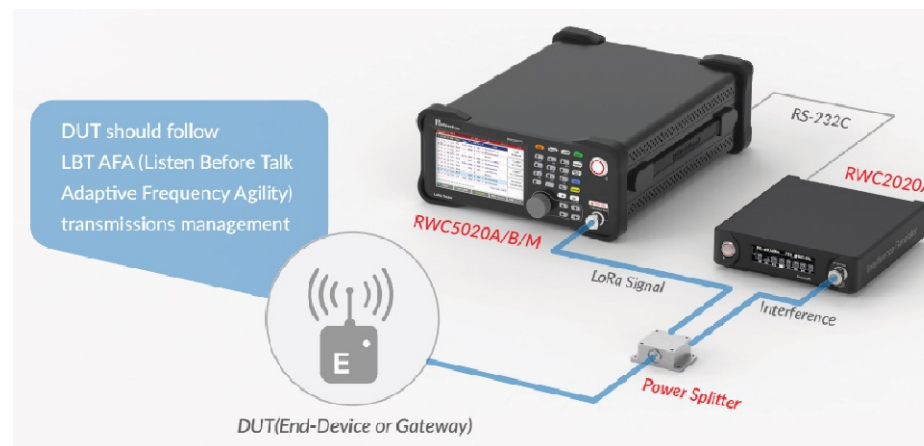
- Listen Before Talk; to prevent interference or collision between devices on common frequency channels

Key Features



● How to test LBT?

- Use RWC2020A Interference Generator as an interferer
 - Automatically controlled by RWC5020x via a serial communication
- For details, refer to the Local Regulations of Japan and Korea



Manufacturing Test Solutions

Key Features



● SOL #1: Separate TX/RX Test

- Non-signaling test (one-way test)
- Signal Analyzer function for TX Test
 - Measuring TX power and CW frequency
- Signal Generator function for RX Test
 - Measuring RX sensitivity with predefined test packets
- A wired control of DUT might be required

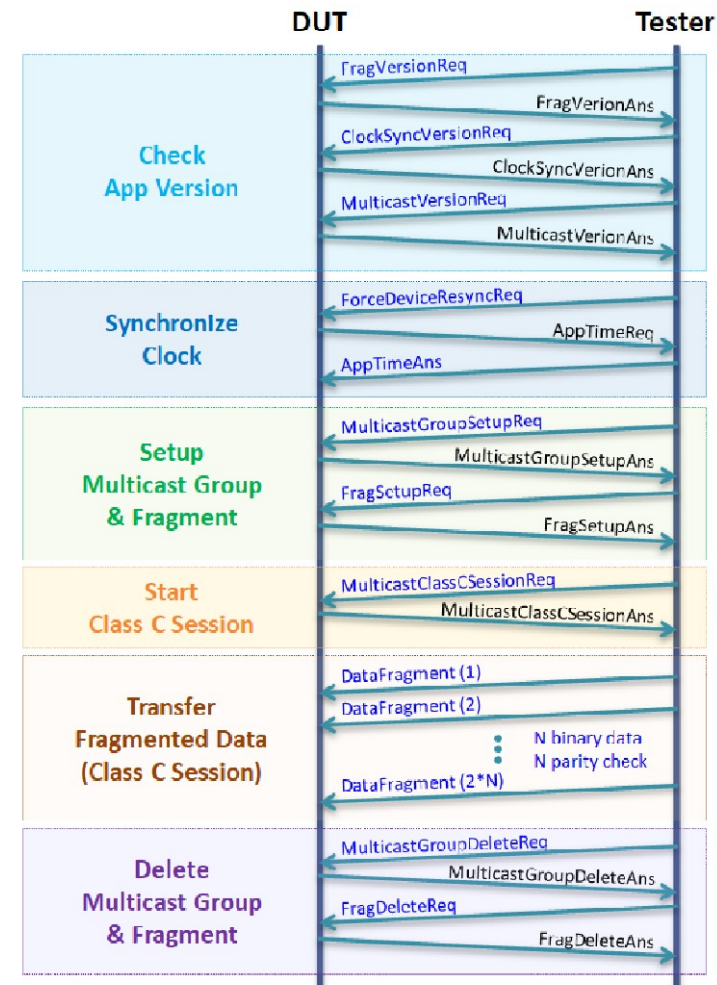
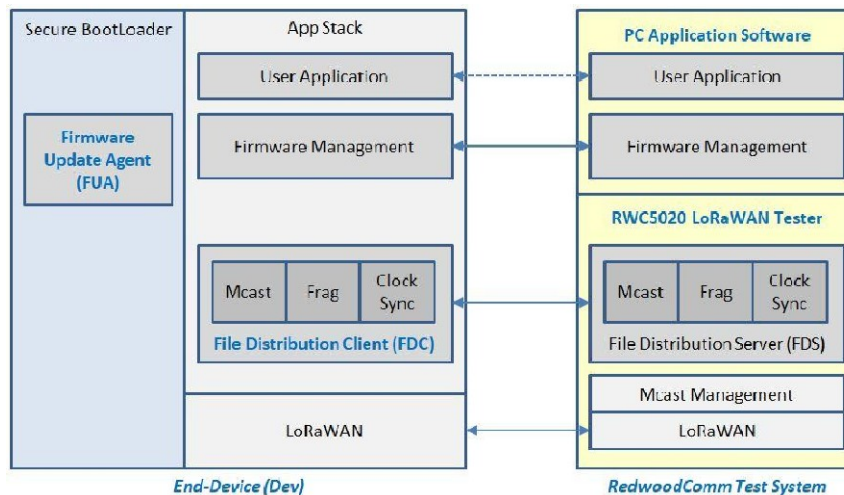
● SOL #2: Simultaneous TX/RX Test

- Combining the advantages of signaling test and non-signaling test
- Simple test protocol is defined between DUT and the tester
- A wired control of DUT might not be necessary

FUOTA Test Solution

Key Features

- Fully Automated Test Scenario
 - Easy to use
- Users can use their own binary files for testing



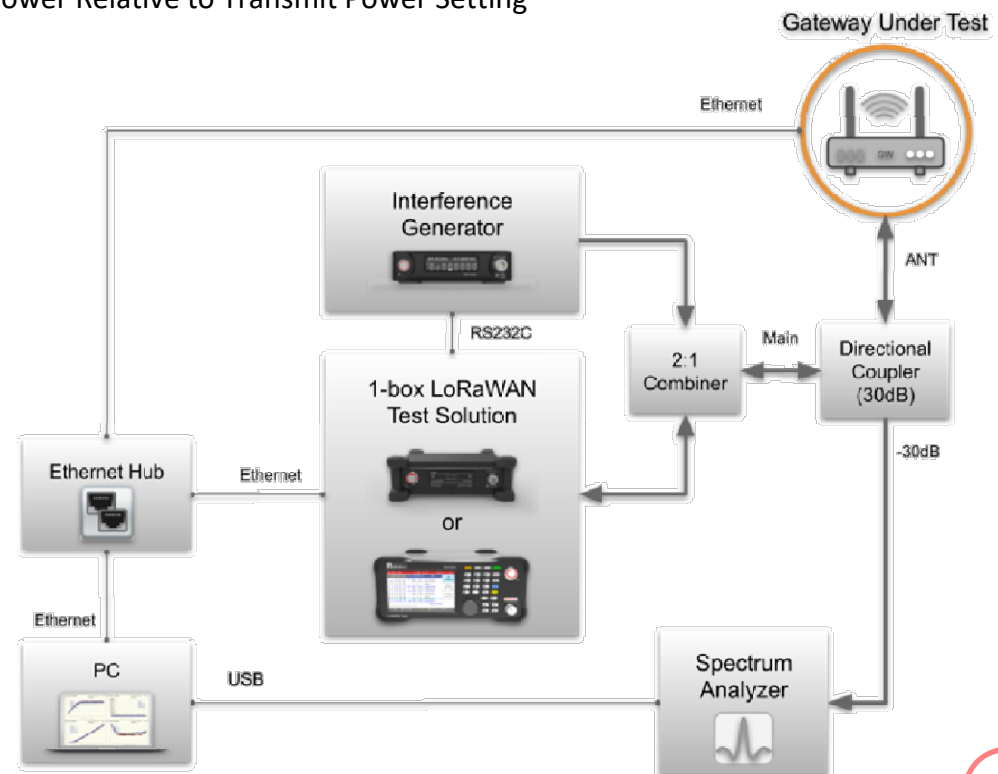
GW Test & Measurement Guidelines

● Related Document

○ [Download from the LoRa Alliance](#)

● Recommended instruments: RWC5020B (or M) and RWC2020A

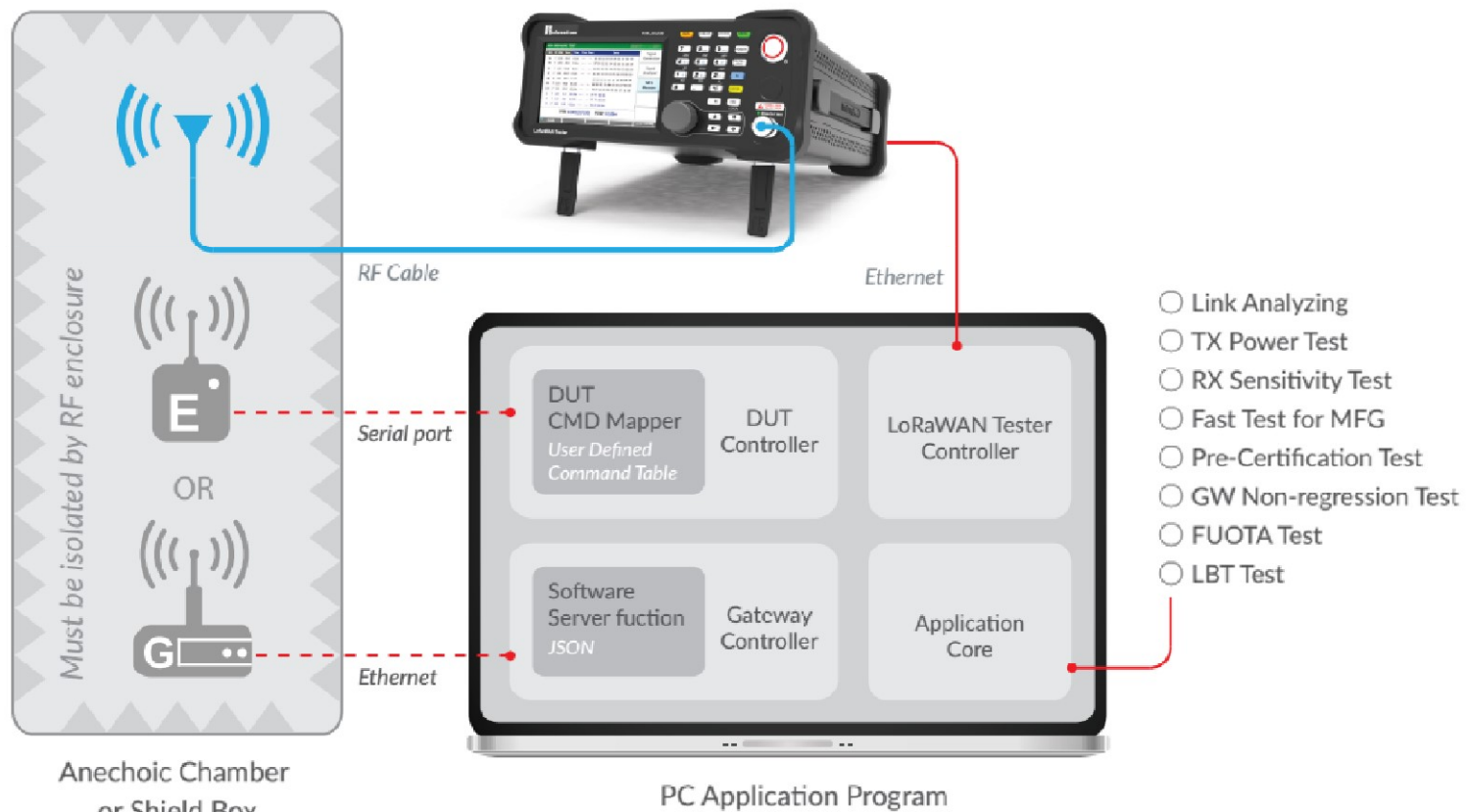
- Tx & Rx Operation and Survival with Open/Short Load
- Measured and Reported RF Transmit Power Relative to Transmit Power Setting
- Tx Conducted Emissions Out-of-Band
- Tx Intermodulation
- Tx Frequency Error
- Rx Sensitivity
- Rx Dynamic Range
- Rx In-Band Blocking/Selectivity
- Rx Out-of-Band Blocking/Selectivity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



Typical Test Setup

Key Features

● Automated PC Software and Example of Test Setup



NEW

Latest Updates

Key Features

● New Features for Next Version of RF Board

- 64(125kHz) + 8(500kHz) Channel Support
- SF5/SF6 Support
- Simultaneous emulation of End-device (ED) and Gateway (GW) for “Relay” test

● New Features Added

- Update of LoRaWAN Pre-Certification Test for Class B Devices
- Update of LoRaWAN Pre-Certification Test for Class C Devices
- Update of new version of FUOTA test procedures

Contents

- Summary of Key Features
- **Product Comparison**



- PC Application Software
- RF Shielding Enclosure
- Production Test Solution
- Stand-alone Operation of 5020B

RWC5020B

Product Comparison

- **Fully operable in both stand-alone and remote control mode**
 - User interface: 5" LCD and keypads
 - Remote control interface: Ethernet, RS-232C
- **Operation mode**
 - End-device Test / Gateway Test / Non-signaling Test
- **Target**
 - R&D, QC
- **Output Power**
 - 0 to -150dBm
- **Testing capability**
 - Protocol conformance
 - RF performance



RWC5020M

Product Comparison

- **Operable in remote control mode**
 - 2.8" OLED display for monitoring status
 - Remote control interface: Ethernet, RS-232C
- **Operation mode**
 - End-device Test / Gateway Test / Non-signaling Test
- **Target**
 - R&D, QC, production
- **Output Power**
 - 0 to -150dBm
- **Testing capability**
 - Protocol conformance
 - RF performance
- **Supply Power**
 - 12V/3A adapter provided



RWC5021P

Product Comparison

- **Operable in remote control mode**

- 4 LED status indicators
- Remote control interface: Ethernet, USB-C (VCOM)

- **Operation mode**

- End-device Test

- **Target**

- R&D, QC

- **Output Power**

- 0 to -30dBm

- **Testing capability**

- Protocol conformance

- **Supply Power**

- 5V/0.5A USB-C powered



Comparison Table 1/2

Product Comparison

	5020B	5020M	5021P
Stand-alone Capability	YES	NO	NO
Exterior			
- 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 provided)	5V/0.5A (USB-C)
- Control Interface	Ethernet, RS-232C	Ethernet, RS-232C	Ethernet, USB-C (VCOM)
Frequency Bands			
- 400MHz to 510MHz	Included	Selectable by Band	Selectable by Region
- 862MHz to 960MHz	Included	Selectable by Band	Selectable by Region
RF Power Level			
- 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
Operational Modes			
- End-device Test	Selectable	Selectable	Included
- Gateway Test	Selectable	Selectable	Not available
- Non-signaling Test	Included	Selectable	Not available

Comparison Table 2/2

Product Comparison

	5020B	5020M	5021P
Protocol Compliance Tests (end-device only)			
- LoRaWAN Pre-Certification Tests	Optional	Optional	Optional
- Operator Pre-Certification Tests	Optional	Optional	NO
RF Performance Tests			
- 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
Link Analyzer			
- 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
Functionalities			
- FUOTA Test	YES	YES	NO
- Manufacturing Test (MFG/NST)	YES	YES	NO
Compatibility with 5020x PC Application Software			
- Pre-Certification Test	YES	YES	YES
- RF Performance Test	YES	YES	NO
- Link Analyzer	YES	YES	YES
- Functions: NST, MFG, FUOTA	YES	YES	NO

Hardware Specification 1/2

Product Comparison

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

Hardware Specification 2/2

Product Comparison

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

Ordering Information (5020B)

Product Comparison

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-98	Calibration
O5020B-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.

Ordering Information (5020M)

Product Comparison

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-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 C5020M-xx.

Ordering Information (5021P)

Product Comparison

Main Product

Order Code	Part Name
C5021P-00	EDT

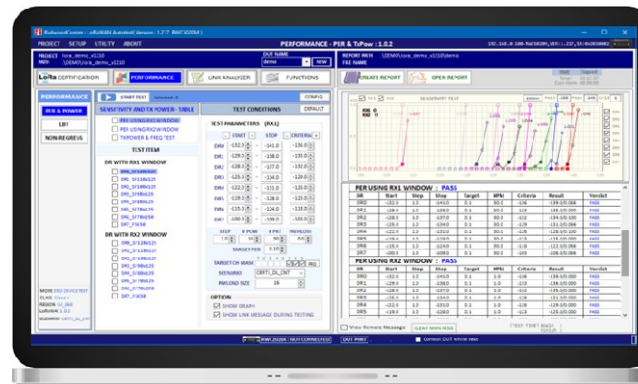
Options

Order Code	Part Name
O5021P-01	LoRaWAN Region EU868
O5021P-03	LoRaWAN Region US915
O5021P-04	LoRaWAN Region AS923
O5021P-05	LoRaWAN Region KR920
O5021P-06	LoRaWAN Region IN865
O5021P-09	LoRaWAN Region AU915
O5021P-11	LoRaWAN Region RU864
O5021P-12	LoRaWAN Region EU433
O5021P-99	SW/FW Maintenance

** The default PC software is provided with purchasing of C5021P-00.*

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- **PC Application Software**



- RF Shielding Enclosure
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Pre-Cert Test for LoRaWAN® V1.0.2

PC Application Software

RedwoodComm : LoRaWAN Autotest(SW Version : 1.334 RWC5020B)

PROJECT DEMO_V1330 DUT NEW CERT_EDT_EU868_V102_ClassA

REPORT PATH \\DEMO\\DEMO_V1330\\CERT_EDT_EU868_V102_ClassA

FILE NAME

LoRa CERTIFICATION PERFORMANCE LINK ANALYZER FUNCTIONS

CREATE REPORT OPEN REPORT

TIME Elapsed Estimated
Total 00:00:00 00:00:00
Curr-Item 00:00:00 00:00:00

CERTIFICATION

START TEST EU Certification Test CONFIG

Selected 0 SKIP

LoRa Alliance Conformance Test (EU)

1 Activation and Deactivation Pre and Post test

1.1 Certification Application Activation

1.2 Certification Application Deactivation

2 Over the Air Activation

2.1 Pre-Join Behaviour

2.2 Join Accept with DLSettings

2.3 Join Accept with Delay Settings on RX2 window

2.4 Join Accept with CFList

2.5 DevNonce Verification for Join Request

3 Activation by Personalization

3.1 Activation by Personalization

4 Certification Application Functionality

4.1 Default Setting Test

4.1.a Channel Plan and Usage

4.1.b Cryptograph

4.1.b.i AES Encryption

4.1.b.ii Message Integrity Code

4.1.c Downlink Error Rate

4.1.d Receive Window Timing

4.1.e Frame Sequence Number

Test Parameters PATHLOSS 0.0 DEFAULT

Add raw data
Stop link after test
Test ADR
Test Opt DR

LORA CERTIFICATION TEST SUMMARY (EU V1.6)

ITEMS	VERDICT	SUB VERDICT
1 Activation and Deactivation Pre and Post test	PASS	
1.1 Certification Application Activation		PASS
1.2 Certification Application Deactivation		PASS
2 Over the Air Activation	PASS	
2.1 Pre-Join Behaviour		PASS
2.2 Join Accept with DLSettings		PASS
2.3 Join Accept with Delay Settings on RX2 window		PASS
2.4 Join Accept with CFList		PASS
2.5 DevNonce Verification for Join Request		PASS
3 Activation by Personalization	PASS	
3.1 Activation by Personalization		PASS
4 Certification Application Functionality	PASS	
4.1 Default Setting Test	PASS	
4.1.a Channel Plan and Usage		PASS
4.1.b Cryptograph	PASS	
4.1.b.i AES Encryption		PASS
4.1.b.ii Message Integrity Code		PASS
4.1.c Downlink Error Rate		PASS
4.1.d Receive Window Timing		PASS
4.1.e Frame Sequence Number	PASS	

SCALE 1.0 CLEAR MSG

SPY MESSAGE CLEAR SAVE

View SPY MSG (Max 300 lines)

[TEST TIME] Begin :
Finish :

END DEVICE/EU_868 / 1.0.2 / CLASS A / OTAA RWC2020A : NOT CONNECTED REFCLK INT RXGAIN:MEDIUM

* **LoRaWAN V1.0.2:**
EU863-870, US/CA902-928, AS923, KR920-923,
and IN865-867

* Test summary and report generation
* Estimated and elapsed time information

Pre-Cert Test for LoRaWAN® V1.0.4

PC Application Software

RedwoodComm : LoRaWAN Autotest(SW Version : 1.334 RWC5020B)

PROJECT DEMO_V1330 DUT NEW CERT_EDT_EU868_V104_ClassA

REPORT PATH .\DEMO\DEMO_V1330\CERT_EDT_EU868_V104_ClassA

FILE NAME

LoRa CERTIFICATION PERFORMANCE LINK ANALYZER FUNCTIONS

CREATE REPORT OPEN REPORT

TIME Elapsed Estimated
Total 00:00:00 00:00:00
Curr-Item 00:00:00 00:00:00

CERTIFICATION

START TEST All Region Certification CONFIG

Selected 0 SKIP

LoRa Alliance Conformance Test (EU_868)

- 1 Activation Pre-test
 - 1.1 DUT Pre-condition Activation
- 2 Over the Air Activation
 - 2.1 Pre-Join Behaviour
 - 2.1.a For Dynamic Channel (DC) plan devices
 - 2.1.b For Fixed Channel (FC) plan devices
 - 2.2 Join-Accept with DLSettings
 - 2.3 Join-Accept with Delay Settings
 - 2.4 Join-Accept with CFList
- 3 Activation by Personalization
 - 3.1 Dynamic channel plan devices
 - 3.2 Fixed channel plan devices
- 4 Device Functionality Tests
 - 4.1 Default Setting Tests
 - 4.2 Confirmed Frames
- 5 MAC Command Tests
 - 5.1 DevStatusReq
 - 5.2 NewChannelReq
 - 5.3 DLChannelReq
 - 5.4 RXParamSetupReq
 - 5.5 RXTimingSetupReq
 - 5.6 TXParamSetupReq

PATHLOSS 0.0

☒ Add raw data
☐ Stop link after test
☒ Test ADR
☒ Test Opt DR

END DEVICE/EU_868 / 1.0.4 / CLASS A / OTAA

RWC2020A : NOT CONNECTED

REFCLK INT RXGAIN:MEDIUM

LORA CERTIFICATION TEST SUMMARY (ALL V1.0.0)

REGION : EU_868

ITEMS	VERDICT	SUB VERDICT
1 Activation Pre-test	PASS	
1.1 DUT Pre-condition Activation		PASS
2 Over the Air Activation	PASS	
2.1 Pre-Join Behaviour	PASS	
2.1.a For Dynamic Channel (DC) plan devices		PASS
2.1.b For Fixed Channel (FC) plan devices		NOT TESTED
2.2 Join-Accept with DLSettings		PASS
2.3 Join-Accept with Delay Settings		PASS
2.4 Join-Accept with CFList	PASS	
2.4.a For Dynamic Channel (DC) plan devices		PASS
2.4.b For Fixed Channel (FC) plan devices		NOT TESTED
3 Activation by Personalization	NOT TESTED	
3.1 Dynamic channel plan devices	NOT TESTED	
3.1.a All regions		NOT TESTED
3.1.b For regions with dwell time limitation only		NOT TESTED
3.2 Fixed channel plan devices	NOT TESTED	
3.2.a All regions		NOT TESTED
3.2.b For regions with dwell time limitation only		NOT TESTED
4 Device Functionality Tests	PASS	

SCALE 1.0

CLEAR MSG

SPY MESSAGE

CLEAR SAVE

View SPY MSG (Max 300 lines)

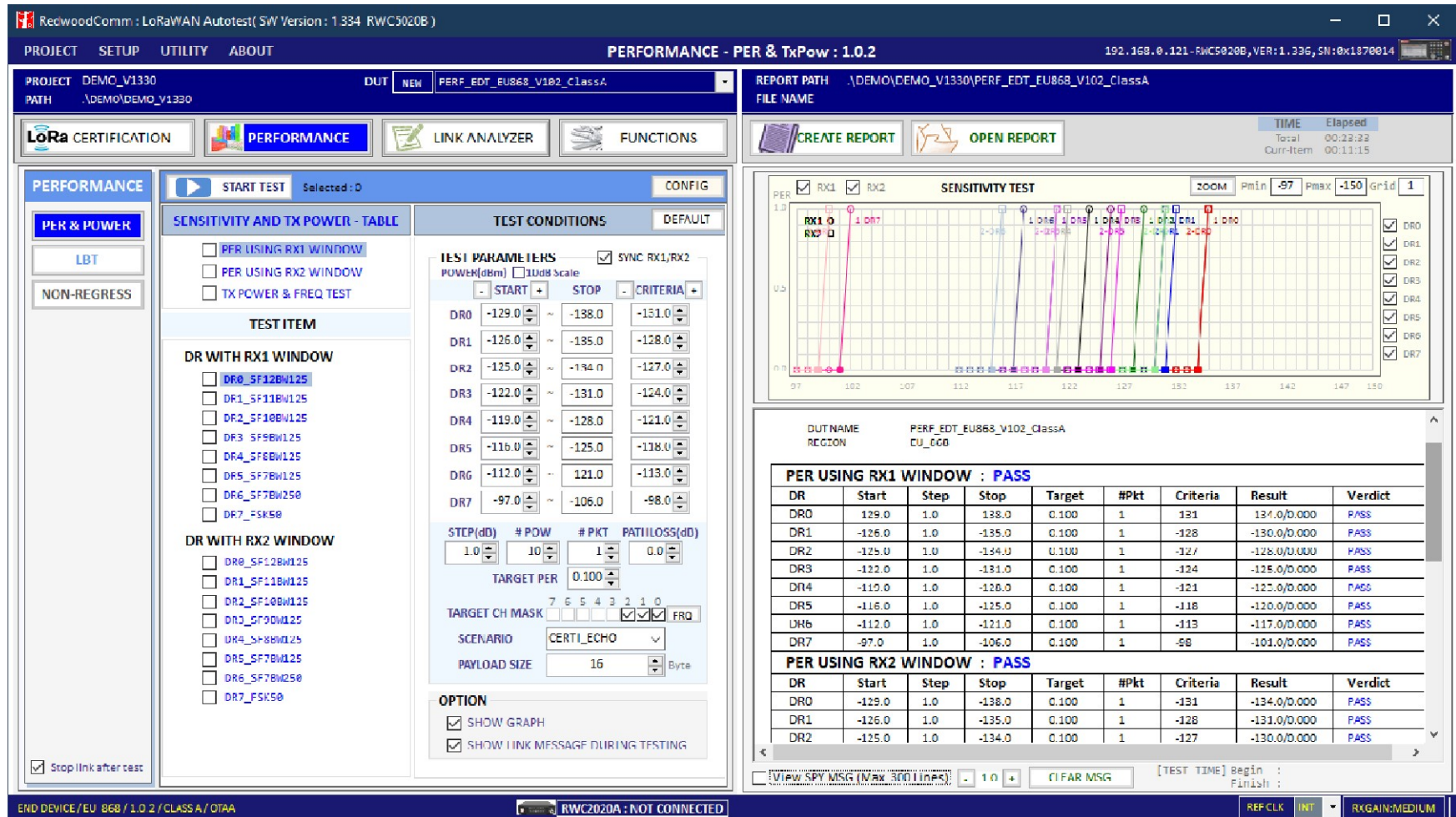
[TEST TIME] Begin :
Finish :

* **LoRaWAN V1.0.4:**
 EU863-870, US/CA902-928, AS923-1/2/3/4, KR920-923,
 IN865-867, AU915-928, RU864-870, and EU433
 Class B/C Certification

* Test summary and report generation
 * Estimated and elapsed time information

RF Performance Test (EDT Class A)

PC Application Software



* PER measurement for **downlink – RX1/RX2 for Class A**

Scenario: **CERTI_ECHO, CERTI_DL_CNT, NORMAL_UL**

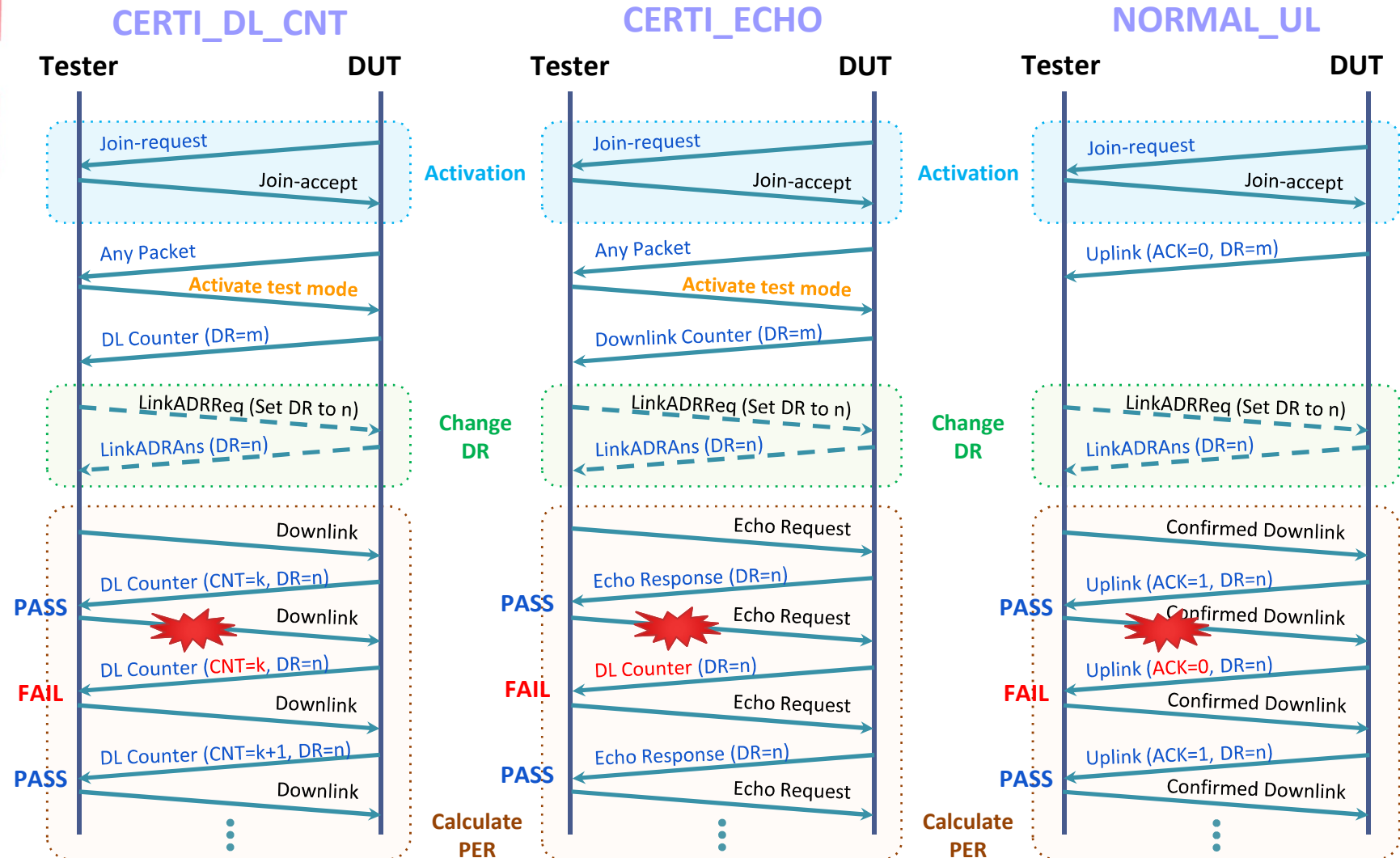
* TX power and CW frequency measurement

* Test summary and report generation

* Estimated and elapsed time information

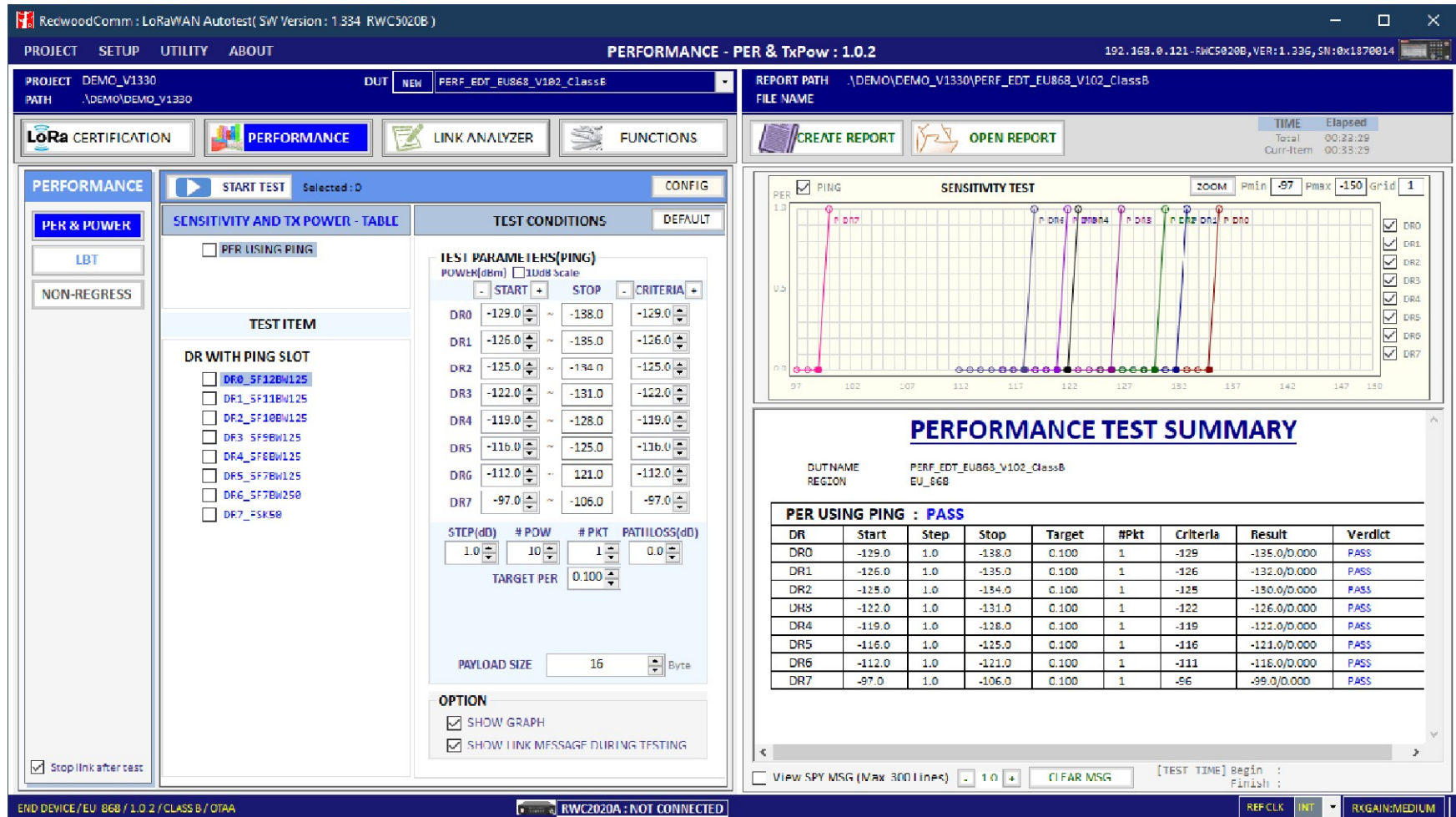
Sensitivity Test Scenario (Class A)

PC Application Software



RF Performance Test (EDT Class B)

PC Application Software



* PER measurement for **downlink** – **Ping-slot for Class B**

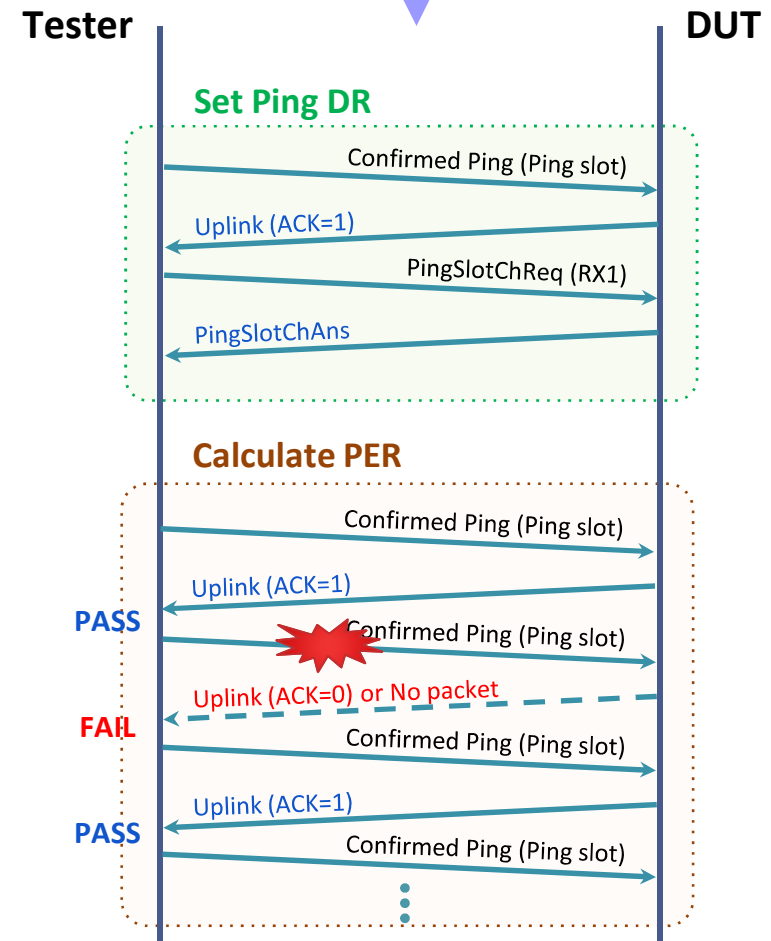
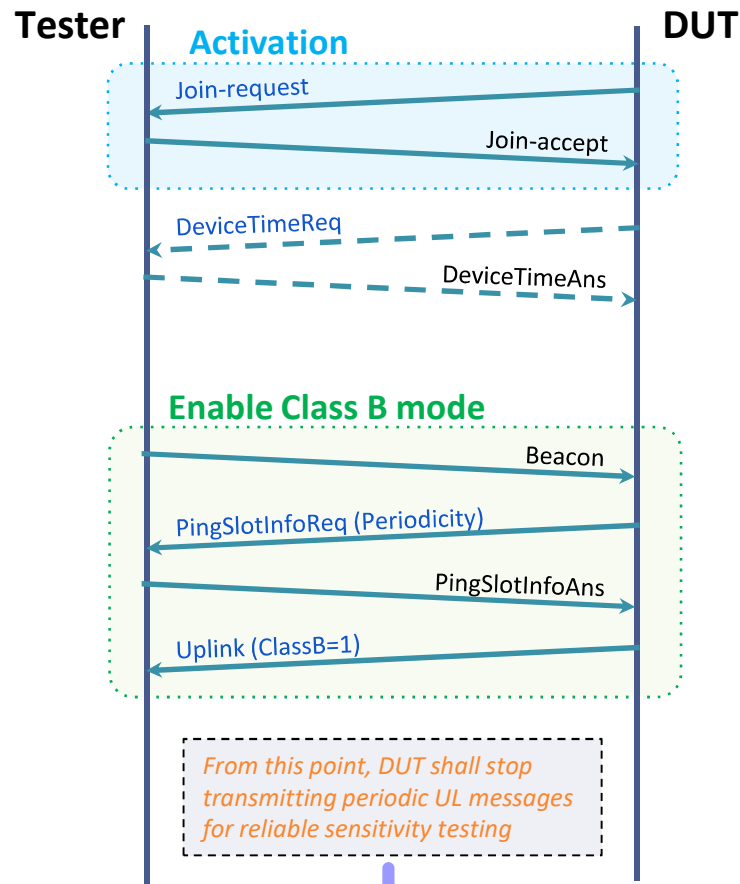
* Test summary and report generation

* Estimated and elapsed time information

Sensitivity Test Scenario (Class B)

PC Application Software

Ping-slot for Class B



RF Performance Test (GWT)

PC Application Software

RedwoodComm : LoRaWAN Autotest(SW Version : 1.334 RWC5020B)

PROJECT SETUP UTILITY ABOUT PERFORMANCE - PER & TxPow : 1.0.2 192.168.0.121-RWC5020B,VER:1.336,SN:0x1878014

PROJECT DEMO_V1330 DUT NEW PERF_GWT_EU868_V102_ClassA

PATH .\DEMO\DEMO_V1330

REPORT PATH .\DEMO\DEMO_V1330\PERF_GWT_EU868_V102_ClassA

FILE NAME

LoRa CERTIFICATION PERFORMANCE LINK ANALYZER FUNCTIONS

CREATE REPORT OPEN REPORT

TIME Elapsed
Total 00:00:00
Curr-Item 00:00:00

PERFORMANCE

START TEST Selected: 0 CONFIG

PER & POWER

LBT

NON-REGRESS

SENSITIVITY AND TX POWER - TABLE

TEST CONDITIONS DEFAULT

TEST PARAMETERS(UL)

POWER(dBm) 10dB Scale

START STOP CRITERIA

DR0 -129.0 -138.0 -129.0

DR1 -126.0 -135.0 -126.0

DR2 -125.0 -134.0 -125.0

DR3 -122.0 -131.0 -122.0

DR4 -119.0 -128.0 -119.0

DR5 -116.0 -125.0 -116.0

STEP(dB) # POW # PKT PATHLOSS(dB)

1.0 10 1 0.0

TARGET PER 0.100

SCENARIO NORMAL_UL

PAYLOAD SIZE 16 Byte

OPTION

☒ SHOW GRAPH

☒ SHOW LINK MESSAGE DURING TESTING

☒ Stop link after test

SENSITIVITY TEST

PER 1.0

0.0

97 102 107 112 117 122 127 132 137 142 147 150

DR0 DR1 DR2 DR3 DR4 DR5

PERFORMANCE TEST SUMMARY

DUTNAME PERF_GWT_EU868_V102_ClassA

REGION EU_868

PER OF GATEWAY : PASS

DR	Start	Step	Stop	Target	#Pkt	Criteria	Result	Verdict
DR0	-129.0	1.0	-138.0	0.1	1.0	-129	-129.0/0.000	PASS
DR1	-126.0	1.0	-135.0	0.1	1.0	-126	-132.0/0.000	PASS
DR2	-125.0	1.0	-134.0	0.1	1.0	-125	-128.0/0.000	PASS
DR3	-122.0	1.0	-131.0	0.1	1.0	-122	-126.0/0.000	PASS
DR4	-119.0	1.0	-128.0	0.1	1.0	-119	-123.0/0.000	PASS
DR5	-116.0	1.0	-125.0	0.1	1.0	-116	-119.0/0.000	PASS

TX POWER TEST : PASS

POW	CH0	CH1	CH2	CH3	CH4	CH5	CH6	CH7	Verdict
0	-11.7	-11.6	-11.6						PASS

View SPY MSG (Max 300 lines) 1.0 CIFAR MSG [TEST TIME] Begin : Finish :

GATEWAY / EU_868 / 1.0.2 / CLASS A / OTAA RWC2020A : NOT CONNECTED REFCLK INT RXGAIN:MEDIUM

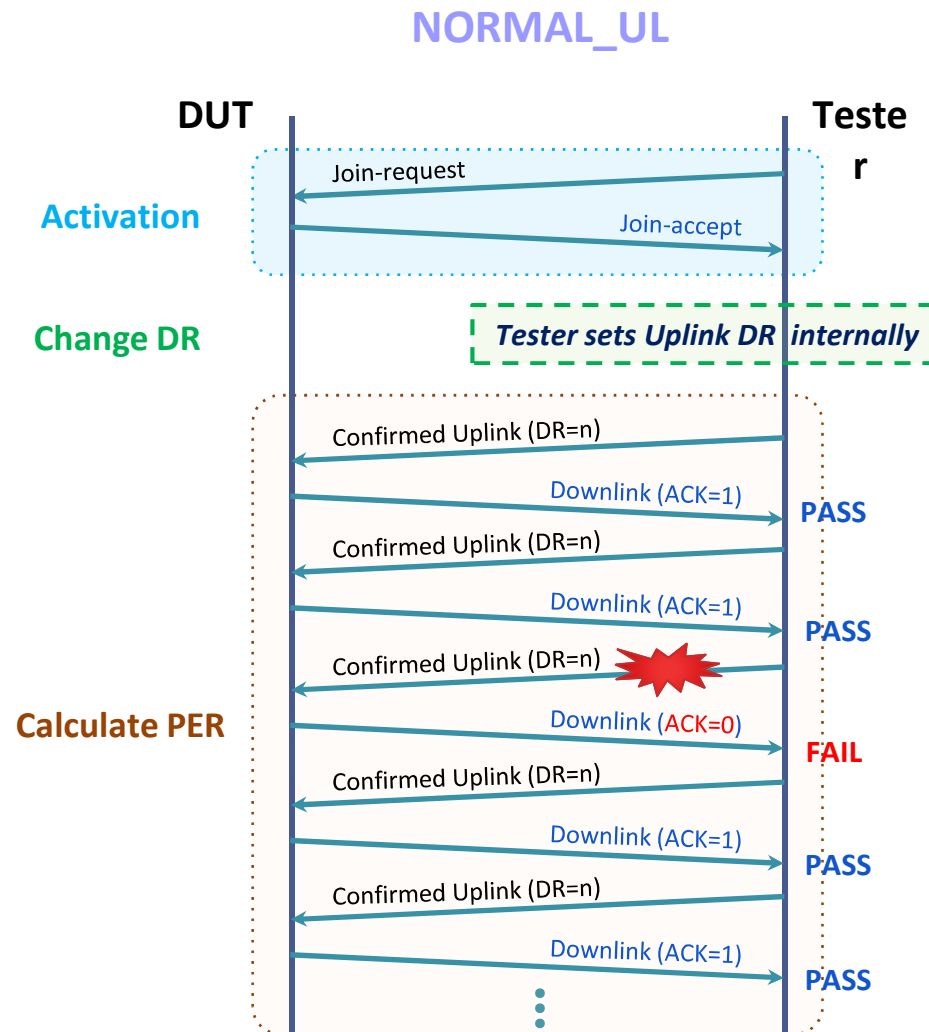
* PER measurement for **uplink (GWT)**

* Test summary and report generation

* Estimated and elapsed time information

Sensitivity Test Scenario (GWT)

PC Application Software



LBT Test (EDT, GWT)

PC Application Software

RedwoodComm : LoRaWAN Autotest(Version : 1.217 RWC5020M)

PROJECT SETUP UTILITY ABOUT PERFORMANCE - LBT 192.168.0.103-RWC5020M, VER:1.217, SN:0x2003000

PROJECT RT_V1220_2_kevin DUT NAME 25_01 NEW

PATH D:\RWC5020A\Software\RT_V1220_2_kevin

LoRa CERTIFICATION PERFORMANCE LINK ANALYZER FUNCTIONS

CREATE REPORT OPEN REPORT

TIME Elapsed
Total 00:01:08
Curr-Item 00:00:00

PERFORMANCE

PER & POWER

LBT

NON-REGRESS

RUN Save link message CONFIG

TEST ITEM

☒ CHANNEL MODE TEST

☐ BURST MODE TEST

Wanted Signal Pathloss (dB) 4.1

Unwanted Signal Pathloss (dB) 4.1

CHANNEL MODE PARAMETER

TEST TIME 1 Min RFF POW 80 dBm

CH00 CH01 CH02 CH03 CH04 CH05 CH06 CH07

+1 +1 -3 +1 +1 +1 +1 +1

RunTime:60

BURST MODE PARAMETERS

TEST ITERATION 10 Iteration

DURATION POWER DURATION POWER REPEAT

NORMAL BURST

POWER DURATION POWER DURATION

-83 dBm 10 Sec -79 dBm 10 Sec

LBT TEST (CHANNEL MODE)

TEST DURATION : 1 Min

REFERENCE POWER : -80 dBm

RELATIVE POWER : CH00 CH01 CH02 CH03 CH04 CH05 CH06 CH07

+1 +1 -3 +1 +1 +1 +1 +1

[LINK MESSAGE]

L	CH	DR	SF	BW	Pow	Time	DEL	FONT	Adr	Ack	FP	AAR	B	Port	M	Dwell	CMD	CNT
U	2	0	12	125	-----	REF	---	0	0	-	0	-	---	---	---	1482	Join-request	Notice
D	2	0	12	125	-30.0	-----	5	---	0	0	-	0	---	---	---	1155	Join-accept	RX1DR
U	2	0	12	125	-5.7	11.9s	-	0000	1	0	-	0	0	099	C	1646	DeaUp	Bytel
D	2	0	12	125	30.0	1	0000	1	1	0	-	0	0	224	U	1155	ActivateTM	
U	2	0	12	125	-5.7	4.51s	-	0001	1	0	-	0	0	224	U	1155	DIcounter(0)	Cnt=6
U	2	0	12	125	-5.7	7.99s	-	0002	1	0	-	0	0	224	U	1155	DIcounter(0)	Cnt=6
U	2	0	12	125	-5.7	7.99s	-	0003	1	0	-	0	0	224	U	1155	DIcounter(0)	Cnt=6
U	2	0	12	125	-5.7	7.99s	-	0004	1	0	-	0	0	224	U	1155	DIcounter(0)	Cnt=6
U	2	0	12	125	-5.7	7.99s	-	0005	1	0	-	0	0	224	U	1155	DIcounter(0)	Cnt=6

[RESULT]

RECEIVED #PKT	CH00	CH01	CH02	CH03	CH04	CH05	CH06	CH07
0	0	6	0	0	0	0	0	0

CLEAR MCN MSG 0 0 0 0 0 0 0 0

CONF:RWC2020:RF_OUT OFF

CLEAR SPY MSG ACK

EXEC:LINK:STOP

SAVE SPY MSG ACK

VIEW Remote Message

[TEST TIME] Begin : 4/19/2020 9:37:04 PM

Finish : 4/19/2020 9:38:13 PM

RWC2020A: CONNECTED

DUT PORT

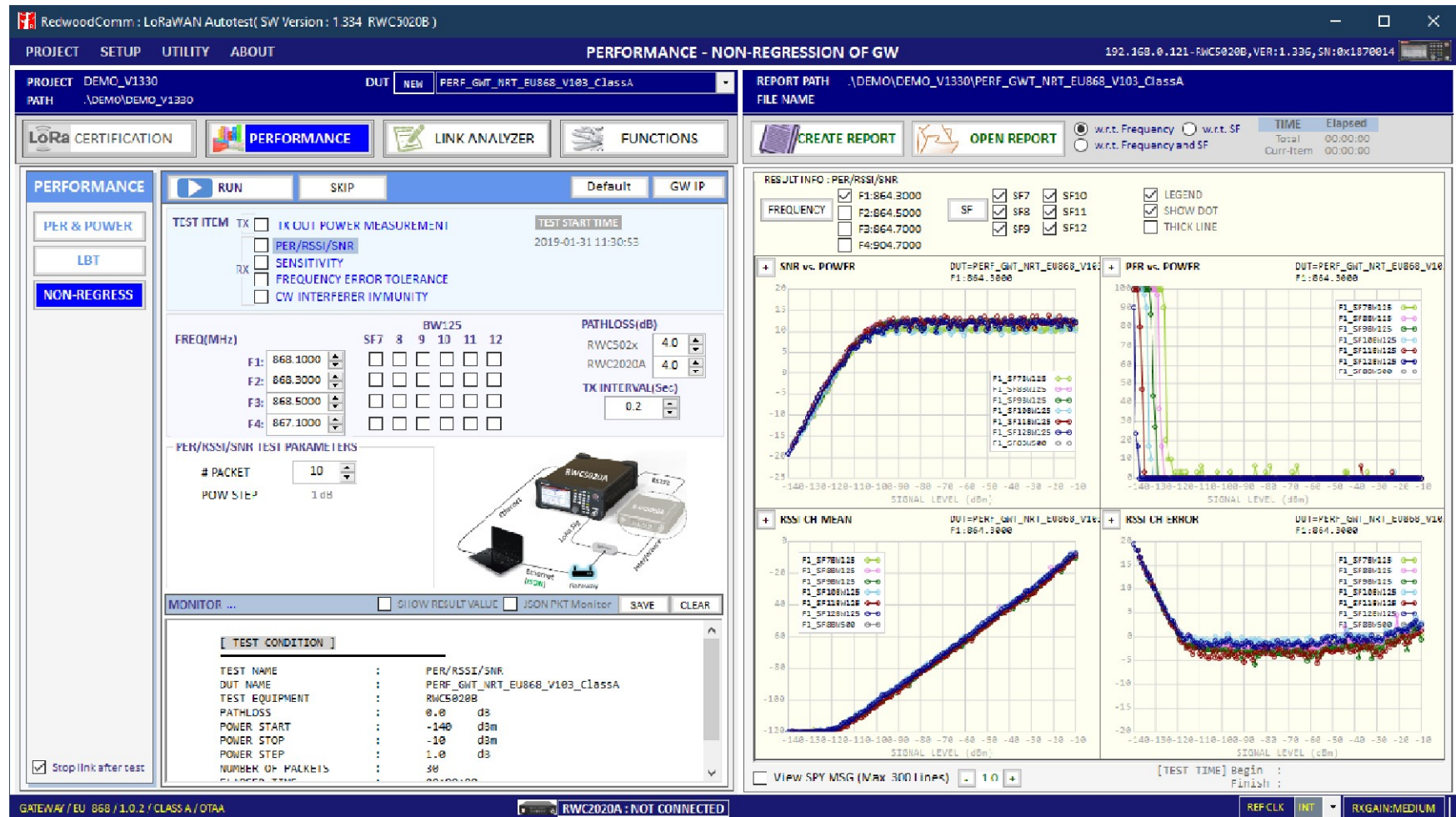
Control DUT while test

- * Integration with RWC2020A
- * Channel mode test
- * Burst mode test

- * Test summary and report generation
- * Elapsed time information

GW Non-regression Test (Semtech)

PC Application Software



- * Recommended by Semtech
- * Evaluation of a gateway hardware performances
- * JSON interface to control a gateway

- * Test summary and report generation
- * Elapsed time information

Link Analyzer & Script Editor

PC Application Software

RedwoodComm : LoRaWAN Autotest(Version : 1.217 RWC5020M)

PROJECT SETUP UTILITY ABOUT LINK ANALYZER 1.0.2 192.168.0.103 - RWC5020M, VER: 1.217, SN: 0x2030002

PROJECT lora_demo_v1210 DUT NAME demo NEW

PATH .\DEMO\lora_demo_v1210

REPORT PATH .\DEMO\lora_demo_v1210\demo

FILE NAME

LINK MESSAGE ☒ Clear Before Dump ☐ Show raw data SAVE MSG

PAYLOAD EDITOR SEND DL RX1 RX2 MSG CONFIRMED UNCONFIRMED CMD FIELD PAYLOAD FOPTS RESP TIMEOUT 60 CONFIG

END DEVICE TEST / LoRaWAN: 1.0.2 / EU_868 / CLASS A /

MAC COMMAND (PAYLOAD) ☐ USER DEFINED

☒ SET DEVICE_STATUS

☒ SET LINK_ADR_REQ

LinkADRReq Parameters

DR DR3_SF9BW125 TX_POW 1 NB_TRANS 1

MASK_CTL 0 CH_MASK 0x7

☐ SET RX_PARAM_SETUP

RX_PARAM_SETUP Parameters

RX1 DR OFF 0 RX2_FREQ 869.525

RX2_DR DR0_SF12BW125

SCRIPT EDITOR RUN SKIP COMMAND ADD DEL CLR SAVE LOAD

demo_MAC_Script_Proc_1

- UNCONFIRMED[PAYLOAD] 60
- DEVICE_STATUS
- LINK_ADR_REQ
 - ADR_DR DR3_SF9BW125
 - ADR_TX_POW 1
 - ADR_NB_TRANS 1
 - ADR_CH_MASK 0x7
- RX_PARAM_SETUP
 - RX1_DR_OFFSET 0
 - RX2_FREQUENCY 869.525
 - RX2_DR DR0_SF12BW125

L	CH	DR	SF	BW	Pow	Time	DEL	FCnt	ADR	Ack	FP	AAR	B	Port	M	Dwell	CMD	CONTENTS	
U	1	0	12	125	13.0	150s	-	0000	1	0	-	0	002	U	1646		DataUp	Bytelen=16	
D	1	0	12	125	-30.0	----	1	0000	1	0	-	-	224	U	1155		AckLvl=TM		
U	0	0	12	125	12.0	1.00s	-	0001	1	0	-	0	224	U	1155		DlCounter(0)	Cnt=0	
D	0	0	12	125	-30.0	----	1	0001	1	0	-	-	000	U	1482		DevStatusReq		
D	0	0	12	125	-30.0	----	1	0001	1	0	-	-	000	U	1482		LinkADRReq	Pow=1, DR=0, Mask	
D	0	0	12	125	-30.0	----	1	0001	1	0	-	-	000	U	1482		RXParamSetReq	RXIDROffset=0, R	
U	1	0	12	125	13.0	5.33s	-	0002	1	0	-	0	224	U	1482		{DevStatusAns}	Battery=254, SN	
U	1	0	12	125	13.0	5.33s	-	0002	1	0	-	0	224	U	1482		{LinkADRAns}	Pow=1, DR=1, Ma	
U	1	0	12	125	13.0	5.33s	-	0002	1	0	-	0	224	U	1482		{RXParamSetAns}	{RXParamSetAns}	
D	0	1	0	12	125	-30.0	----	1	0002	1	0	-	-	000	U	991		NoPayload	
U	2	0	12	125	13.0	4.68s	-	0003	1	0	-	0	224	U	1155		DlCounter(2)	Cnt=2	
U	1	0	12	125	13.0	5.00s	-	0004	1	0	-	0	224	U	1155		DlCounter(2)	Cnt=2	
U	0	0	12	125	13.0	5.00s	-	0005	1	0	-	0	224	U	1155		DlCounter(2)	Cnt=2	
U	1	0	12	125	13.0	5.00s	-	0006	1	0	-	0	224	U	1155		DlCounter(2)	Cnt=2	
U	0	0	12	125	13.0	5.00s	-	0007	1	0	-	0	224	U	1155		DlCounter(2)	Cnt=2	
U	2	0	12	125	13.0	5.00s	-	0008	1	0	-	0	224	U	1155		DlCounter(2)	Cnt=2	
U	1	0	12	125	13.0	5.00s	-	0009	1	0	-	0	224	U	1155		DlCounter(2)	Cnt=2	
U	0	0	12	125	13.0	5.00s	-	000A	1	0	-	0	224	U	1155		DlCounter(2)	Cnt=2	
U	2	0	12	125	13.0	5.00s	-	000B	1	0	-	0	224	U	1155		DlCounter(2)	Cnt=2	
U	1	0	12	125	13.0	5.00s	-	000C	1	0	-	0	224	U	1155		DlCounter(2)	Cnt=2	
U	2	0	12	125	13.0	5.00s	-	000D	1	0	-	0	224	U	1155		DlCounter(2)	Cnt=2	
U	0	0	12	125	13.0	5.00s	-	000E	1	0	-	0	224	U	1155		DlCounter(2)	Cnt=2	
U	2	0	12	125	13.0	5.00s	-	000F	1	0	-	0	224	U	1155		DlCounter(2)	Cnt=2	
U	1	0	12	125	13.0	5.00s	-	0010	1	0	-	0	224	U	1155		DlCounter(2)	Cnt=2	
U	2	0	12	125	13.0	5.00s	-	0011	1	0	-	0	224	U	1155		DlCounter(2)	Cnt=2	
U	1	0	12	125	13.0	5.00s	-	0012	1	0	-	0	224	U	1155		DlCounter(2)	Cnt=2	
U	2	0	12	125	13.0	5.00s	-	0013	1	0	-	0	224	U	1155		DlCounter(2)	Cnt=2	
U	0	0	12	125	13.0	5.00s	-	0014	1	0	-	0	224	U	1155		DlCounter(2)	Cnt=2	

VIEW Remote Message CLEAR MON MSG [TEST TIME] Begin : Finish :

RWC2020A: NOT CONNECTED DUT PORT

- * Link creation and analysis
- * MAC command and user data transmission
- * Multiple MAC commands
- * Script editor for user scenarios

- * Recording link messages
- * Raw data available in hexadecimal format

FUOTA Test

PC Application Software

RedwoodComm : LoRaWAN Autotest(Version : 1.217 RWC5020x)

PROJECT SETUP UTILITY ABOUT

FUNCTIONAL TEST - FUOTA TEST 192.168.0.103: Not Connected

PROJECT NONE DUT NAME NONE NEW

PATH .\

LoRa CERTIFICATION PERFORMANCE LINK ANALYZER FUNCTIONS

CREATE REPORT OPEN REPORT

TIME Elapsed
Total 00:00:00
Curr-Item 00:00:40

FUNCTIONS

START TEST FUOTA TEST CONFIG

FUOTA PARAMETERS

CONFIG FRAGMENTATION

INDEX 0 SIZE 16 NB_FRAG 16

ALGO: LUPC Descr: 0x FFFFFFFF

OPEN BIN .bin

CONFIG MULTICAST

Mc GroupID 0

Mc Addr: 0x FFFFFFFF Mc Interval 0.1

Mc DR DR8_SF9BW125 Mc Freq 859.5250

Mc Key 0x 12345678901234567890123456789012 32 digits

Bin

View Remote Message

[TEST TIME] Begin : 9/10/2019 AM 9:25:58
Finish : 9/10/2019 AM 9:29:39

RWC2020A: NOT CONNECTED DUT PORT

```

-->DataFragment: N=46 over 26, Frag_size=16
D R2 3 9 125 -10.0 ---- 1 0020 1 0 0 - - 201 U 226 DataDown Bytel
60 FF FF FF FF 80 20 00 C9 08 2E 00 B4 25 52 DC 03 15 7F 05 20 85 E2 63 D1 28 E0 12 71 20 23 9C
-->DataFragment: N=47 over 26, Frag_size=16
D R2 3 9 125 -10.0 ---- 1 002E 1 0 0 - - 201 U 226 DataDown Bytel
60 FF FF FF FF 80 2E 00 C9 08 2F 00 4E 5A EC EE 56 D4 34 1A 7B 03 99 41 47 9C F7 45 96 10 13 94
-->DataFragment: N=40 over 26, Frag_size=16
D R2 3 9 125 -10.0 ---- 1 002F 1 0 0 - - 201 U 226 DataDown Bytel
60 FF FF FF FF 80 2F 00 C9 08 30 00 E0 60 77 04 27 1F 02 F9 C8 DA 1A 6C 36 84 21 EA 95 3F 3A 14
-->DataFragment: N=49 over 26, Frag_size=16
D R2 3 9 125 -10.0 ---- 1 0030 1 0 0 - - 201 U 226 DataDown Bytel
60 FF FF FF FF 80 30 00 C9 08 31 00 BB AA 13 F3 08 5A 95 4D 9C FD 30 A6 CB D5 4F A7 2E A3 72 0F
-->DataFragment: N=50 over 26, Frag_size=16
D R2 3 9 125 -10.0 ---- 1 0031 1 0 0 - - 201 U 226 DataDown Bytel
60 FF FF FF FF 80 31 00 C9 08 32 00 04 35 F8 B6 9C C5 1C A0 B3 42 38 7A 1E 16 7A 0E F8 7E 00 59
-->DataFragment: N=51 over 26, Frag_size=16
D R2 3 9 125 -10.0 ---- 1 0032 1 0 0 - - 201 U 226 DataDown Bytel
60 FF FF FF FF 80 32 00 C9 08 33 00 44 5A 68 5C 51 D1 E1 C6 C1 3F 20 DE 08 D9 C9 0A 26 41 3F C1
-->DataFragment: N=52 over 26, Frag_size=16
D R2 3 9 125 -10.0 ---- 1 0033 1 0 0 - - 201 U 226 DataDown Bytel
60 FF FF FF FF 80 33 00 C9 08 34 00 D8 90 96 20 D8 B0 C5 AC 30 EC 76 AC 40 34 58 44 D8 18 57 C4
U 1 0 12 125 -29.2 1305 - 000A 1 0 - 0 0 099 U 1646 DataUp Bytel
40 01 00 00 00 00 0A 00 63 8E C8 13 6B 68 55 E0 E3 CF 8A E0 DF A0 3B 57 CE 5E D3 82
U 0 0 12 125 -28.9 5.00s - 0000 1 0 - 0 0 099 U 1646 DataUp Bytel
40 01 00 00 00 00 06 00 63 09 75 45 A3 DC 00 F6 13 D0 33 04 85 F3 30 71 05 1A 8D 34 D6
-->FragSessionDeleteReq: FragIndex=0
D 0 0 12 125 -10.0 ---- 1 0000 1 0 0 - - 201 U 1155 DataDown Bytel
60 01 00 00 00 00 08 00 C9 03 00 CE FC 9C 18
-->FragSessionDeleteAns: FragIndex=0, Status=0
U 0 0 12 125 -29.0 4.51s - 000C 1 0 - 0 0 201 U 1155 DataUp Bytel
40 01 00 00 00 00 0C 00 C0 03 00 D7 30 DD 01
  
```

CLEAR MON MSG PASS
READ: CERT: REASON?
FUOTA finished successfully
EXEC: LINK: STOP
ACK

CLEAR SPY MSG
SAVE SPY MSG

View Remote Message

[TEST TIME] Begin : 9/10/2019 AM 9:25:58
Finish : 9/10/2019 AM 9:29:39

RWC2020A: NOT CONNECTED DUT PORT

- * Clock synchronization
- * Multicast / Unicast
- * Fragmentation and data transport
- * User binary file

- * Test summary and report generation
- * Elapsed time information

NST / MFG Test

PC Application Software

RedwoodComm : LoRaWAN Autest(Version : 1.217 RWC3020M)

PROJECT SETUP UTILITY ABOUT

FUNCTIONAL TEST - MFG

192.168.0.100-RWC3020M, VER:1.217, SN:0x203B002

PROJECT lora_demo_v1210
PATH .\DEMO\lora_demo_v1210

DUT NAME demo NEW

LoRa CERTIFICATION

PERFORMANCE

LINK ANALYZER

FUNCTIONS

RUN

RF PARAMETERS

Tx POW -130.0 dBm
FREQ 900.000000 MHz
PATH LOSS 0.0 dB
INIT RX GAIN MEDIUM

MODULATION LORA
NETWORK PUBLIC
SF ANY
BW 125
CR 4_5
TX POLARITY NORMAL
RX POLARITY NORMAL

PACKET PARAMETERS

PREAMBLE SIZE 8 Byte
PACKET INTERVAL 0.05 Sec
REPEAT NUM 50
PAYLOAD SIZE 16 Byte
PAYLOAD 32
Ox 00000000000000000000000000000000

CRITERIA

PER CRITERIA 0.10
PCW CRITERIA UPPER 14.0 dBm

REPORT PATH .\DEMO\lora_demo_v1210\demo
FILE NAME

CREATE REPORT OPEN REPORT

TIME Elapsed
Total 00:00:00
Curr-item 00:00:00

SUCCESS SAVE CLEAR QUICK MEASUREMENT USING MFG SCENARIO

SEQ	TIME	DATA	POW	PER	VERDICT
0	00:00:22	Serial:000	8.9	0.000	PASS
1	00:00:22	Serial:001	8.9	0.000	PASS
2	00:00:22	Serial:002	8.9	0.000	PASS

NON-SIGNALING TEST [180]THRMTEXTCAP:Fn

SEQ	SF	BW	Powr	Time	Fcnt	Port	Data
94	7	125	-50.0	0.05%	----	---	5E 00 00 00 00 00 00 00 00 00
95	7	125	-50.0	0.05%	----	---	5F 00 00 00 00 00 00 00 00 00
96	7	125	-50.0	0.05%	----	---	60 00 00 00 00 00 00 00 00 00
97	7	125	-50.0	0.05%	----	---	61 00 00 00 00 00 00 00 00 00
98	7	125	-50.0	0.05%	----	---	62 00 00 00 00 00 00 00 00 00
99	7	125	-50.0	0.05%	----	---	63 00 00 00 00 00 00 00 00 00
100	7	125	-50.0	0.05%	----	---	FF FF 00 00 00 00 00 00 00 00
1	7	125	9.0	22.95%	----	---	00 64
2	7	125	8.9	0.18%	----	---	00 64
3	7	125	8.9	0.20%	----	---	00 64

PER: 0.000 (0/100) POW: 8.9dBm

CLEAR LINK: Running

CLEAR MSG MON EXEC: LINK: STOP ACK

CLEAR SPY MSG EXEC: LINK: STOP ACK

SAVE SPY MSG

[TEST TIME] Begin :
Finish :

HWID: 0 WRC3020A NOT CONNECTED DUT PORT

- * One of production test examples
- * RX test – PER measurement
- * TX test – Power measurement

- * *Test summary and report generation*
- * *Elapsed time information*

Contents

- Summary of Key Features
- Product Comparison
- PC Application Software
- **RF Shielding Enclosure**

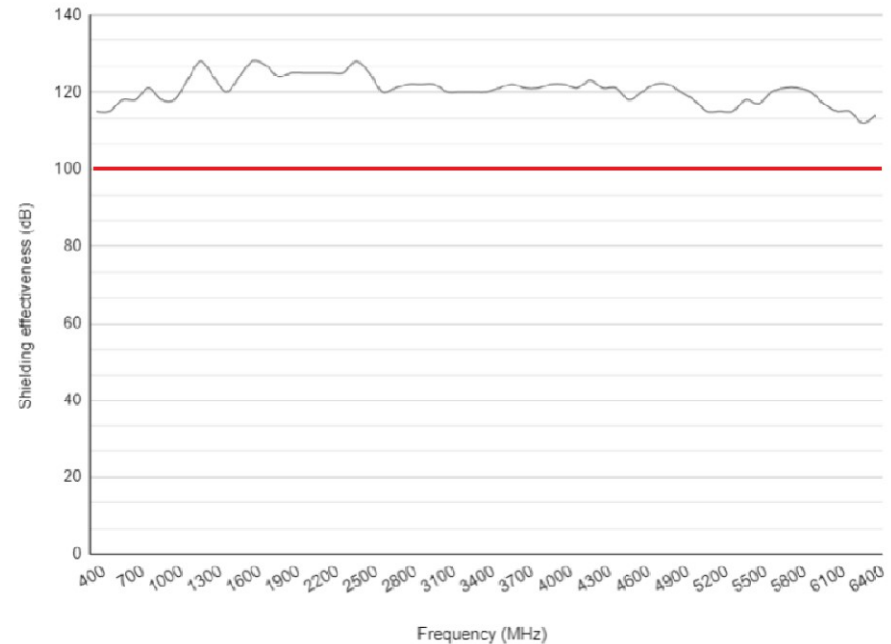


- Production Test Solution
- Stand-alone Operation of 5020B

RWC7100A

RF Shielding Enclosure

- Very High Shielding Effectiveness (dB)



- Applications

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

Add-on Modules

RF Shielding Enclosure

● IO Modules

- USB 3.0 Fiber Interface Module
- USB 3.0 to 2.0 HUB Module
- N to SMA Module
- SMA to SMA Module
- DB9 Module



● Antenna Modules

- Wide-band Right-hand Circular Polarized (RHCP) Antenna Set
- Wide-band Left-hand Circular Polarized (LHCP) Antenna Set



Contents

- Summary of Key Features
- Product Comparison
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- **Production Test Solution**



- Stand-alone Operation of 5020B

Manufacturing Solution 1

Production Test Solution

● Separate TX/RX Test with SG/SA (NST)



DUT

End-device or Gateway

SF, BW, length, ...
Frequency,
Low TX Power

Number of
packets

0. Configure the test packet

1. Repeat sending packets

3. Stop

Signal Generator

0. Enter **RX** Test Mode

2. Count # of RX packets

4. Calculate PER

Any form of LoRa test packets can be generated
with various flexible protocol parameters

SF, BW, ...
Frequency

0. Configure the receiver

2. Measure TX Power &
CW Frequency

Signal Analyzer

0. Enter **TX** Test Mode

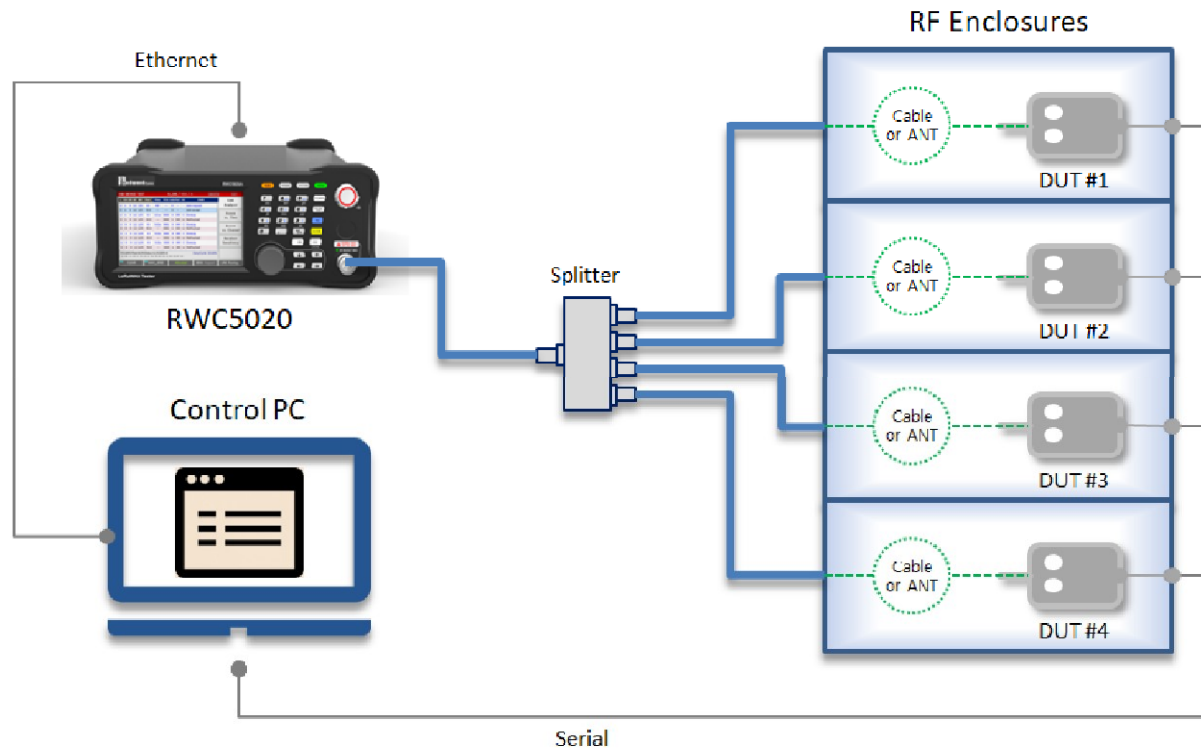
1. Repeat sending packets

3. Stop

Test Example of Multiple DUTs

Production Test Solution

Using NST SG/SA



[RX TEST]

- The test packets sent by the tester as specified are transferred to each DUT by a splitter at the same time.
- Each DUT counts the number of packets it receives, which is read by the user application software.

[TX TEST]

- A DUT is forced to transmit CW signal.
- The tester measures the power and the frequency* of the CW signal.
- A DUT is forced to send the LoRa test packets.
- The tester measures the power of the test packets.
- The rest of DUTs are tested in turns.

- The tester shall be controlled by the user application software via Ethernet.
- This software may also control the DUTs if necessary.

- The DUTs should be put into RF enclosure(s) to minimize the effect of interferences.
- Any available or efficient method can be adopted for RF connection; either radiated or conducted.

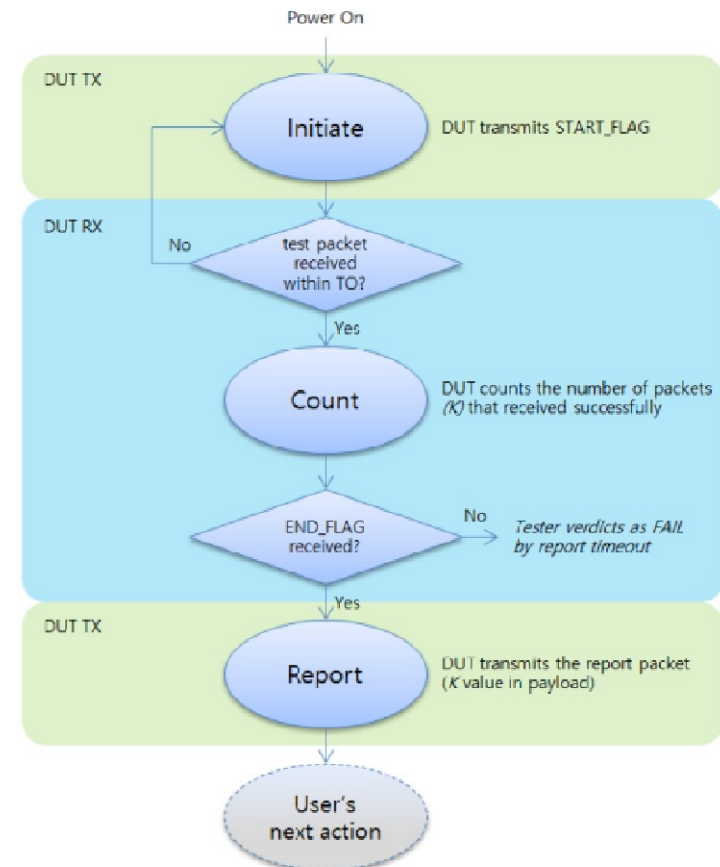
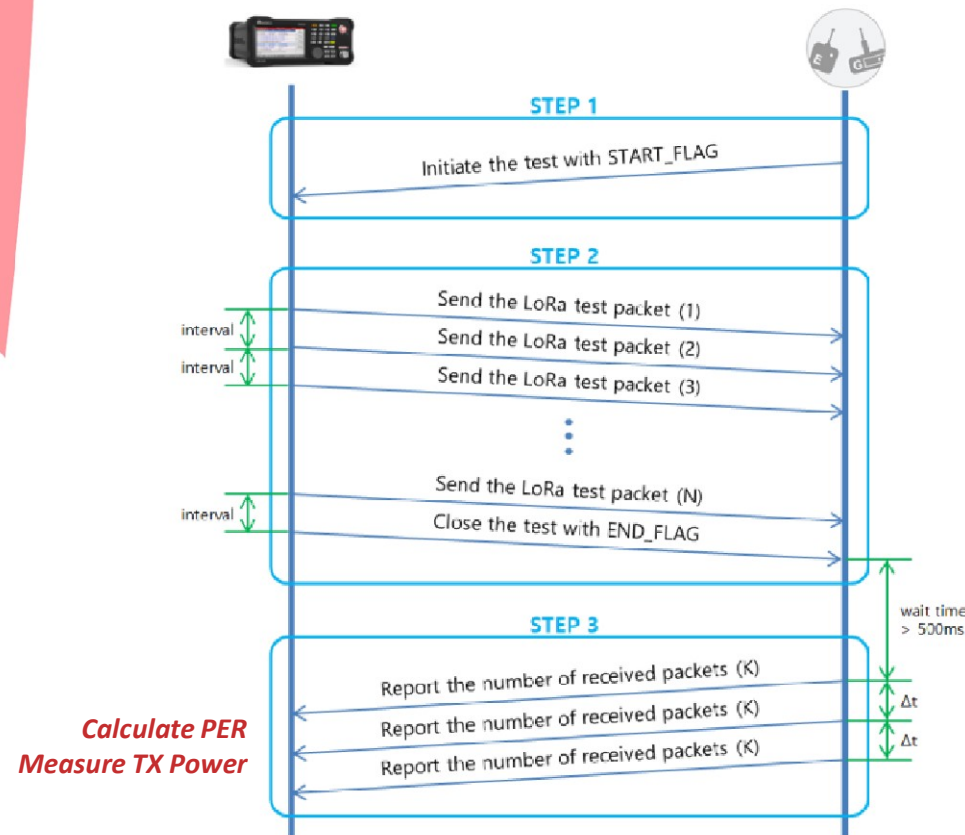
* Frequency measurement is available only in **RWC5020B/M**.

Manufacturing Solution 2

Production Test Solution

● Simultaneous TX/RX Test with MFG

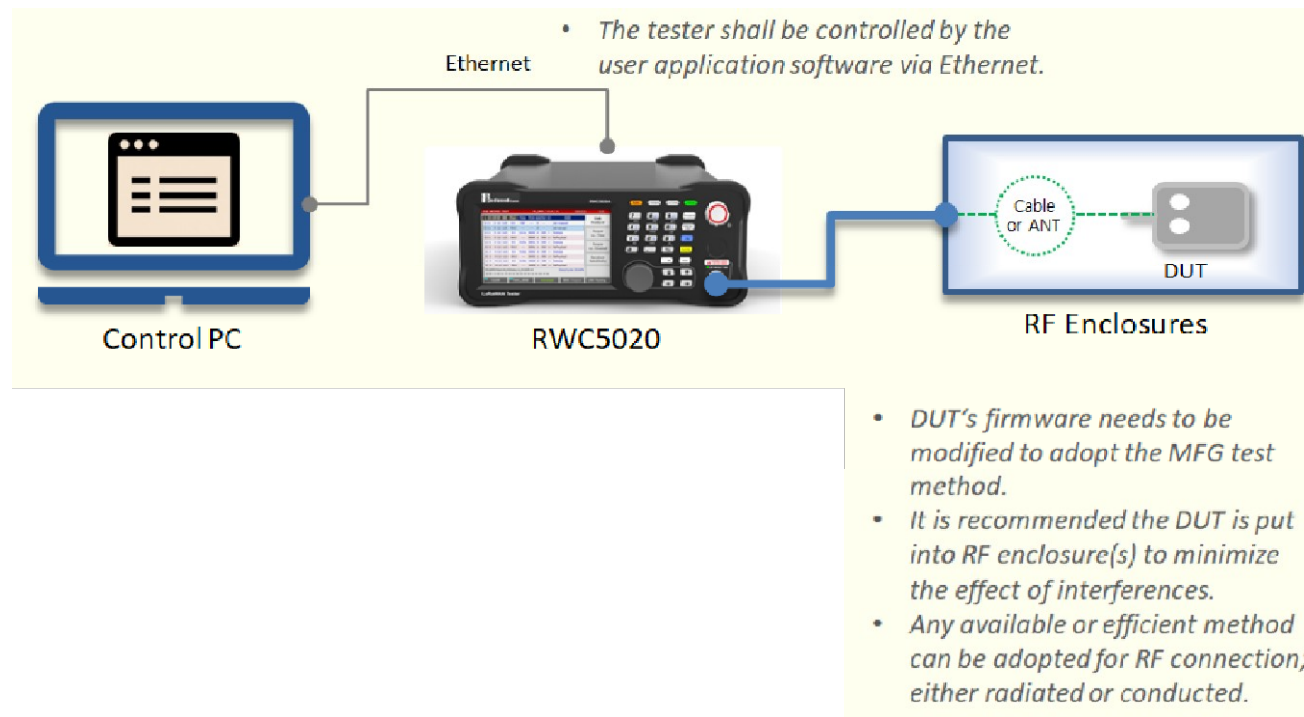
Applicable to all LoRa products (end-devices & gateways)



Test Example of a Single DUT

Production Test Solution

Using MFG Function



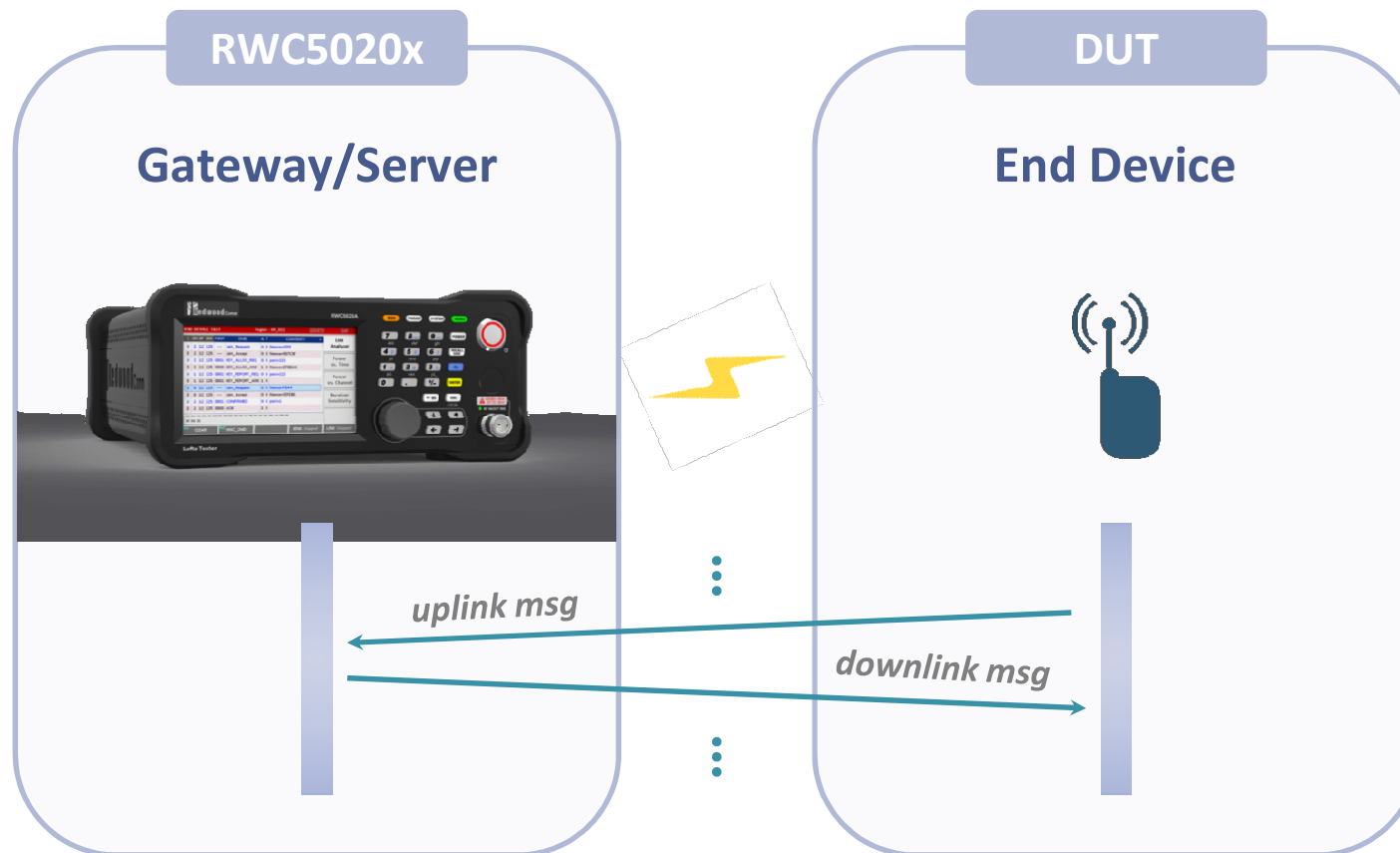
Contents

- Summary of Key Features
- Product Comparison
- PC Application Software
- RF Shielding Enclosure
- Production Test Solution
- **Stand-alone Operation of 5020B**



End Device Test

Stand-alone Operation



Link Analyzer

Stand-alone Operation

- Create a LoRaWAN link between a DUT and the tester
- Analyze the MAC and application messages

Uplink message

Downlink message

Contents of the message at cursor

Raw data in hexa-decimal format

Calculated Duty Cycle

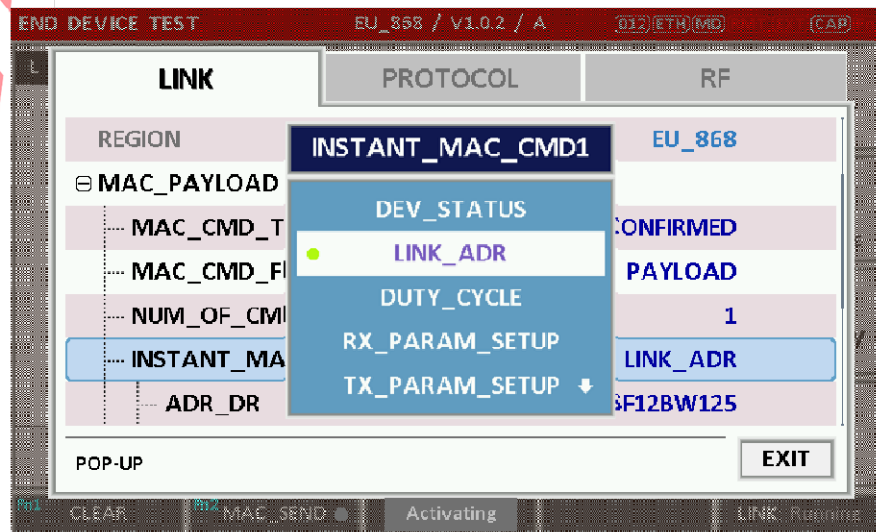
END DEVICE TEST												EU_868 / V1.0.2 / A		012 (ETH) RMT (BT) CAP (FM)	
L	CH	DR	SF	BW	Pow	Time	FCnt	AckPort	M	dwell	CMD	Link Analyzer			
U	2	0	12	125	-28.2	REF	----	0	---	-	1482	Join-request	Power Measure		
D	2	0	12	125	0.0	----	----	0	---	-	1155	Join-accept			
U	0	0	12	125	-29.2	11.9s	0000	0	099	C	1646	DataUp	Receiver Sensitivity		
D	0	0	12	125	0.0	----	0000	1	000	U	991	NoPayload			
U	1	0	12	125	-29.3	5.00s	0001	0	099	C	1646	DataUp	LINK: Running		
D	1	0	12	125	0.0	----	0001	1	000	U	991	NoPayload			
U	2	0	12	125	-29.5	5.00s	0002	0	099	C	1646	DataUp	DutyCycle: 23.44%		
D	2	0	12	125	0.0	----	0002	1	000	U	991	NoPayload			
U	2	0	12	125	-29.5	5.00s	0003	0	099	C	1646	DataUp	RX1DROffset=0,RXDelay=1,RX2DR=0		
D	2	0	12	125	0.0	----	0003	1	000	U	991	NoPayload			
20 71 B0 B0 00 00 00 01 00 00 00 00 01 E8 32 4B 3F												Raw data in hexa-decimal format			

Fn1 CLEAR Fn2 MAC_SEND Activated

Link Analyzer

Stand-alone Operation

- Transmission of MAC Command or Application Data
 - To check how a DUT responds to MAC commands
 - Supporting all LoRaWAN MAC commands with user configuration
 - Field selection: frame payload or frame options
 - Message type selection: confirmed or unconfirmed
 - User defined message: editable payload data and port field

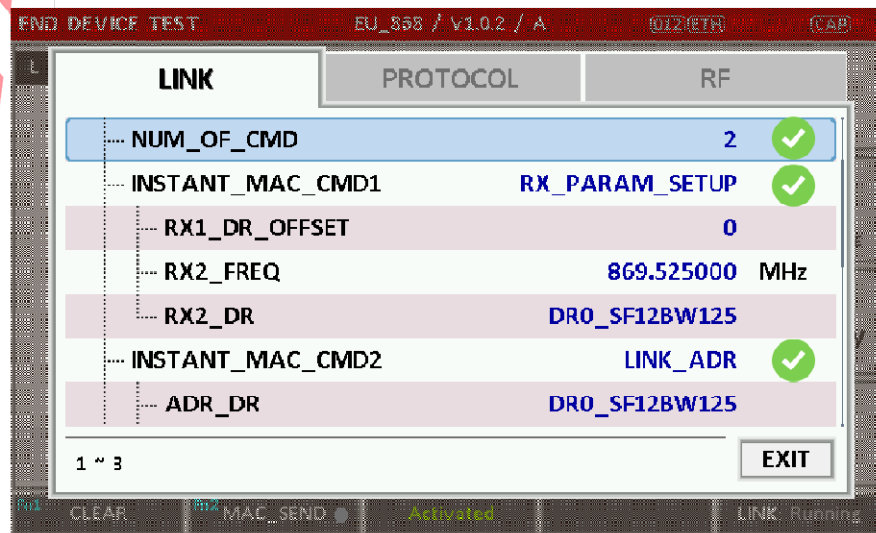


END DEVICE TEST EU_868 / V1.0.2 / A (012) (ETH) (CAP)													
L	CH	DR	SF	BW	Pow	Time	FCnt	AckPort	M	dwell	CMD		
U	0	0	12	125	-29.2	5.00s	003A	0	099	U	1646	DataUp	
U	2	0	12	125	-29.5	5.00s	003B	0	099	U	1646	DataUp	
U	1	0	12	125	-29.2	5.01s	003C	0	099	U	1646	DataUp	
U	1	0	12	125	-29.3	5.00s	003D	0	099	U	1646	DataUp	
D	1	0	12	125	0.0	----	0031	0	000	U	1318	LinkADRReq	
U	0	0	12	125	-29.2	4.51s	003E	0	000	U	1155	LinkADRAns	
U	2	0	12	125	-29.5	5.50s	003F	0	099	U	1646	DataUp	
U	1	0	12	125	-29.2	5.01s	0040	0	099	U	1646	DataUp	
U	0	0	12	125	-29.3	5.00s	0041	0	099	U	1646	DataUp	
U	2	0	12	125	-29.5	5.00s	0042	0	099	U	1646	DataUp	
Pow=1, DR=1, Mask=1 40 01 00 00 00 8D 3E 00 00 03 07 5A 35 77 FE													
<div> <div>Fn1 CLEAR</div> <div>Fn2 MAC_SEND Activated</div> <div>LINK: Running</div> </div>													

Link Analyzer

Stand-alone Operation

- Transmission of Multiple MAC commands in a single frame
 - To check how a DUT responds to multiple MAC commands
 - Up to 3 MAC commands



END DEVICE TEST EU_868 / V1.0.2 / A 022 (ETH) (CAP) (S)

L	CH	DR	SF	BW	Pow	Time	FCnt	AckPort	M	dwell	CMD	Link Analyzer
U	2	0	12	125	-29.6	5.00s	0004	0	099	U	1646	DataUp
U	1	0	12	125	-29.6	10.1s	0006	0	099	U	1646	DataUp
U	0	0	12	125	-29.6	5.00s	0007	0	099	U	1646	DataUp
D	0	0	12	125	-10.0	----	0000	0	000	U	1482	RXParamSetReq
D												LinkADRReq
U	1	0	12	125	-29.6	4.68s	0008	0	000	U	1318	RXParamSetAns
U												LinkADRAns
D	1	0	12	125	-10.0	----	0001	0	000	U	991	NoPayload
U	0	0	12	125	-29.6	5.33s	0009	0	099	U	1646	DataUp
U	1	0	12	125	-29.6	5.00s	000A	0	099	U	1646	DataUp

RX1DROffset=1, RX2DR=1, CH=1

Fn1 CLEAR Fn2 MAC_SEND Activated LINK: Running

Power Measure

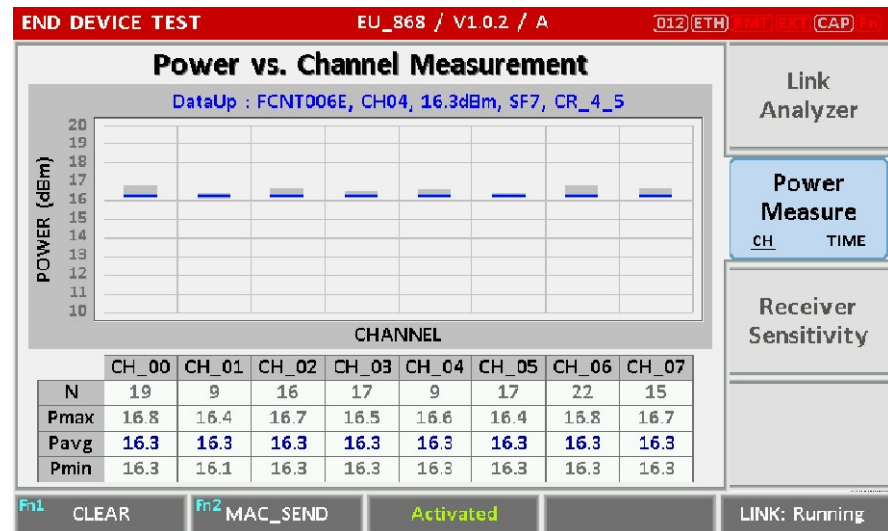
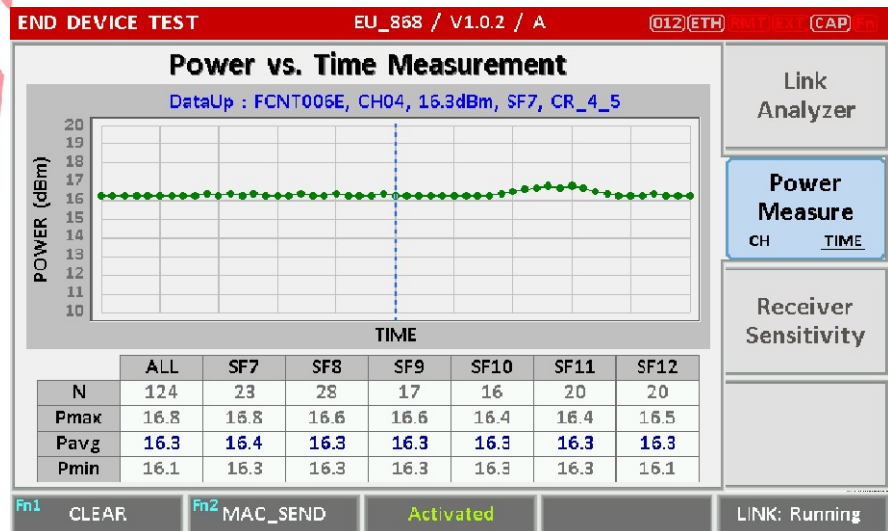
CH TIME

Receiver Sensitivity

Power Measurement

Stand-alone Operation

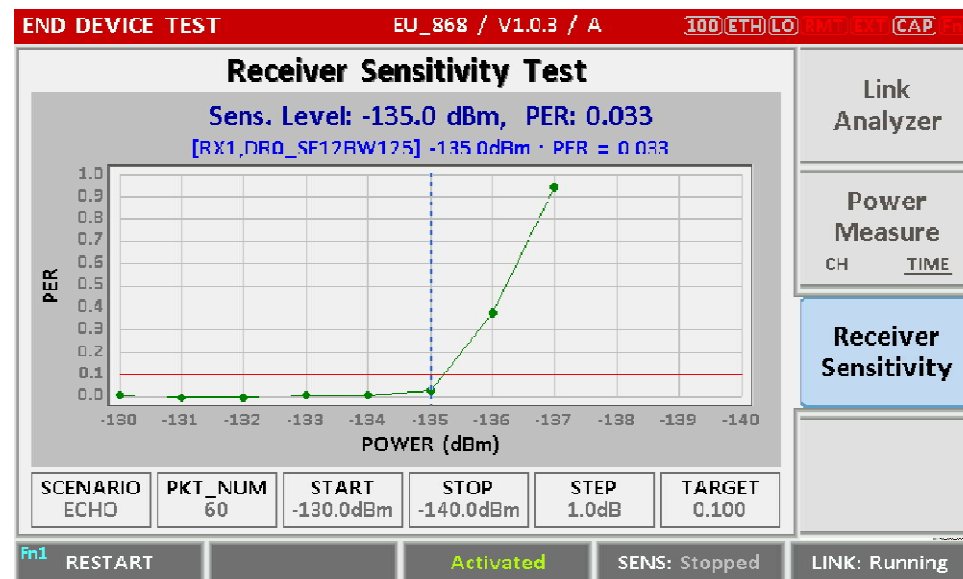
- Power vs. Time
 - Continuous monitoring of DUT's TX Power w.r.t. SF
- Power vs. Channel
 - Continuous monitoring of DUT's TX Power w.r.t. Channel
- Calculating the maximum/average/minimum values



RX Sensitivity Test

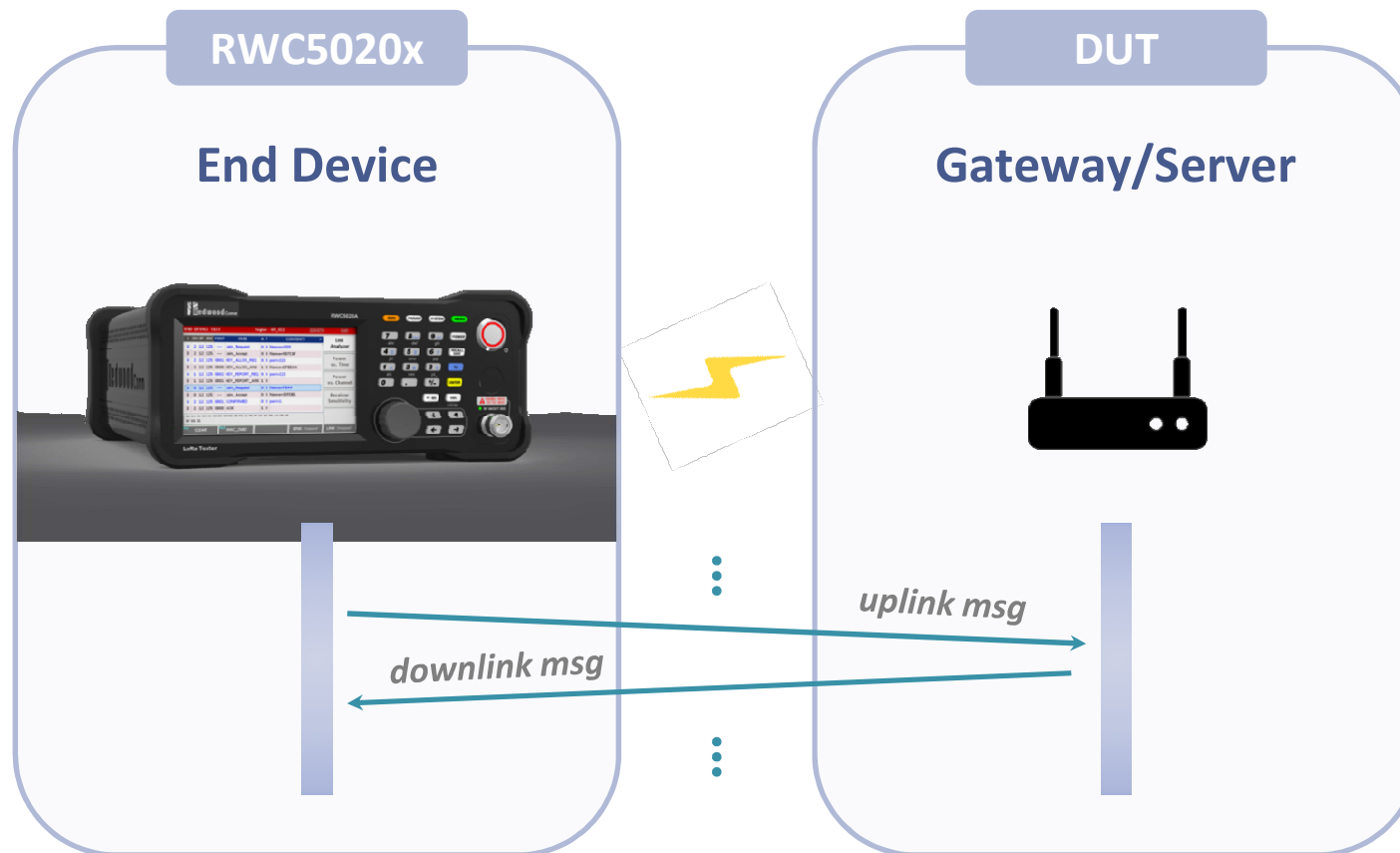
Stand-alone Operation

- Automatic Search of the Minimum Sensitivity Level
 - Determine range and step for the power sweep
 - Select the class of device and the target receive window
 - RX1 and RX2 for Class A, Ping-slot for Class B, RXC for Class C
 - The result value is the minimum power level at which the measured PER does not exceed the limit (TARGET_PER)



Gateway Test

Stand-alone Operation



Link Analyzer

Stand-alone Operation

- Create a LoRaWAN link between a DUT and the tester
- Analyze the MAC and application messages

GATEWAY TEST

EU_868 / V1.0.2 / A

022|ETH|RMT|EXT|CAP|Fn

L	CH	DR	SF	BW	Pow	Time	FCnt	AckPort	M	dwell	CMD	
U	1	0	12	125	-10.0	REF	----	0	---	-	1482	Join-request
D	1	0	12	125	-28.4	----	----	0	---	-	1155	Join-accept
U	0	0	12	125	-10.0	11.7s	0000	0	099	C	1646	DataUp
D	0	0	12	125	-29.3	----	0000	1	---	U	991	NoPayload
U	2	0	12	125	-10.0	5.00s	0001	0	099	C	1646	DataUp
D	2	0	12	125	-29.3	----	0001	1	---	U	991	NoPayload
U	1	0	12	125	-10.0	5.00s	0002	0	099	C	1646	DataUp
D	1	0	12	125	-29.3	----	0002	1	---	U	991	NoPayload
U	2	0	12	125	-10.0	5.00s	0003	0	099	C	1646	DataUp
D	2	0	12	125	-29.2	----	0003	1	---	U	991	NoPayload

RX1DROffset=0,RXDelay=1,RX2DR=0

203984020000000100000000010E46E421

Link Analyzer

Power Measure

CHTIME

Receiver Sensitivity

Fn1CLEAR

Fn2MAC_SEND

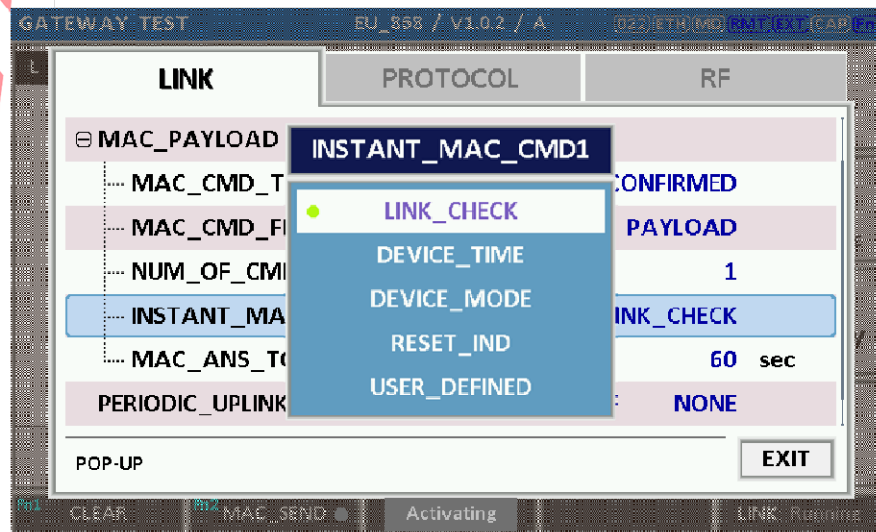
Activated

LINK: Running

Link Analyzer

Stand-alone Operation

- Transmission of MAC Command or Application Data
 - To check how a DUT responds to MAC commands
 - Supporting all LoRaWAN MAC commands with user configuration
 - Multiple MAC commands in a single frame (Up to 3 commands)



L	CH	DR	SF	BW	Pow	Time	FCnt	AckPort	M	dwell	CMD	Link Analyzer
U	1	0	12	125	-10.0	5.00s	0014	0	099	C	1646	DataUp
D	1	0	12	125	-29.3	----	0014	1	---	U	991	NoPayload
U	2	0	12	125	-10.0	5.00s	0015	0	099	C	1646	DataUp
D	2	0	12	125	-29.3	----	0015	1	---	U	991	NoPayload
U	0	0	12	125	-10.0	5.00s	0016	0	000	U	1155	LinkCheckReq
D	0	0	12	125	-29.3	----	0016	0	000	U	1155	LinkCheckAns
U	2	0	12	125	-10.0	5.00s	0017	0	099	C	1646	DataUp
D	2	0	12	125	-29.3	----	0017	1	---	U	991	NoPayload
U	0	0	12	125	-10.0	5.00s	0018	0	099	C	1646	DataUp
D	0	0	12	125	-29.3	----	0018	1	---	U	991	NoPayload

Margin=20, GwCnt=1

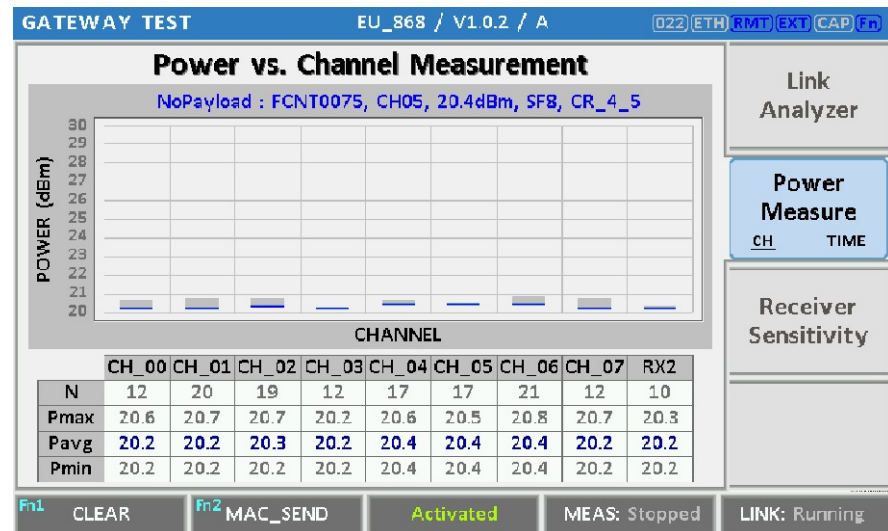
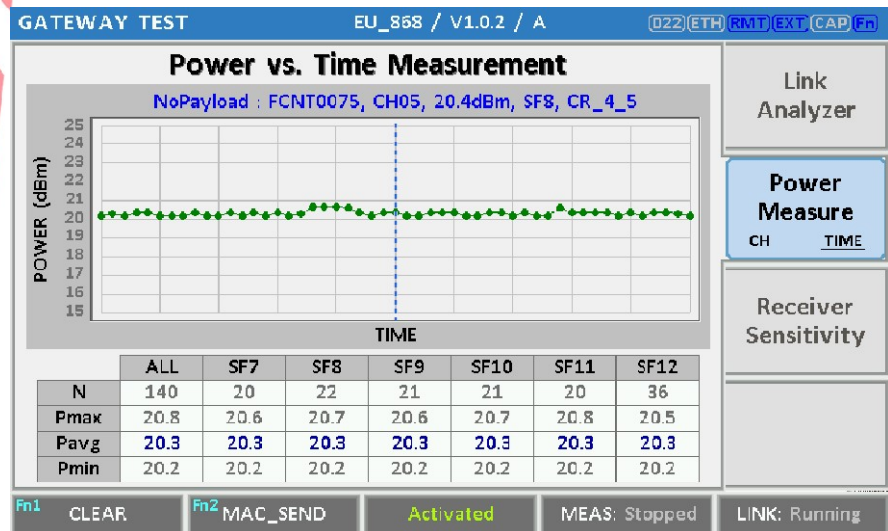
60 01 00 00 00 80 16 00 00 02 14 01 D5 ED E8 F4

Fn1 CLEAR Fn2 MAC_SEND Activated LINK: Running

Power Measurement

Stand-alone Operation

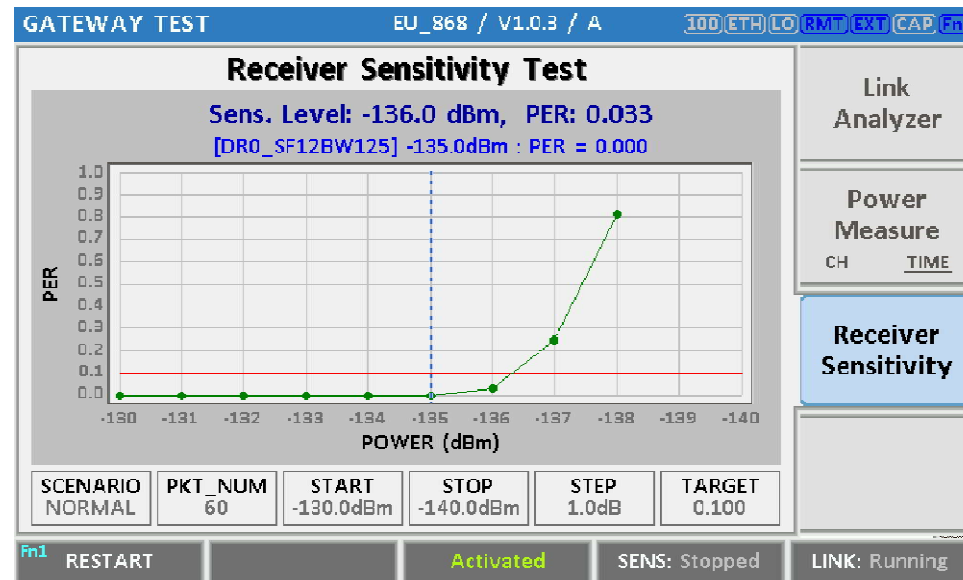
- Power vs. Time
 - Continuous monitoring of DUT's TX Power w.r.t. SF
- Power vs. Channel
 - Continuous monitoring of DUT's TX Power w.r.t. Channel
- Calculating the maximum/average/minimum values



RX Sensitivity Test

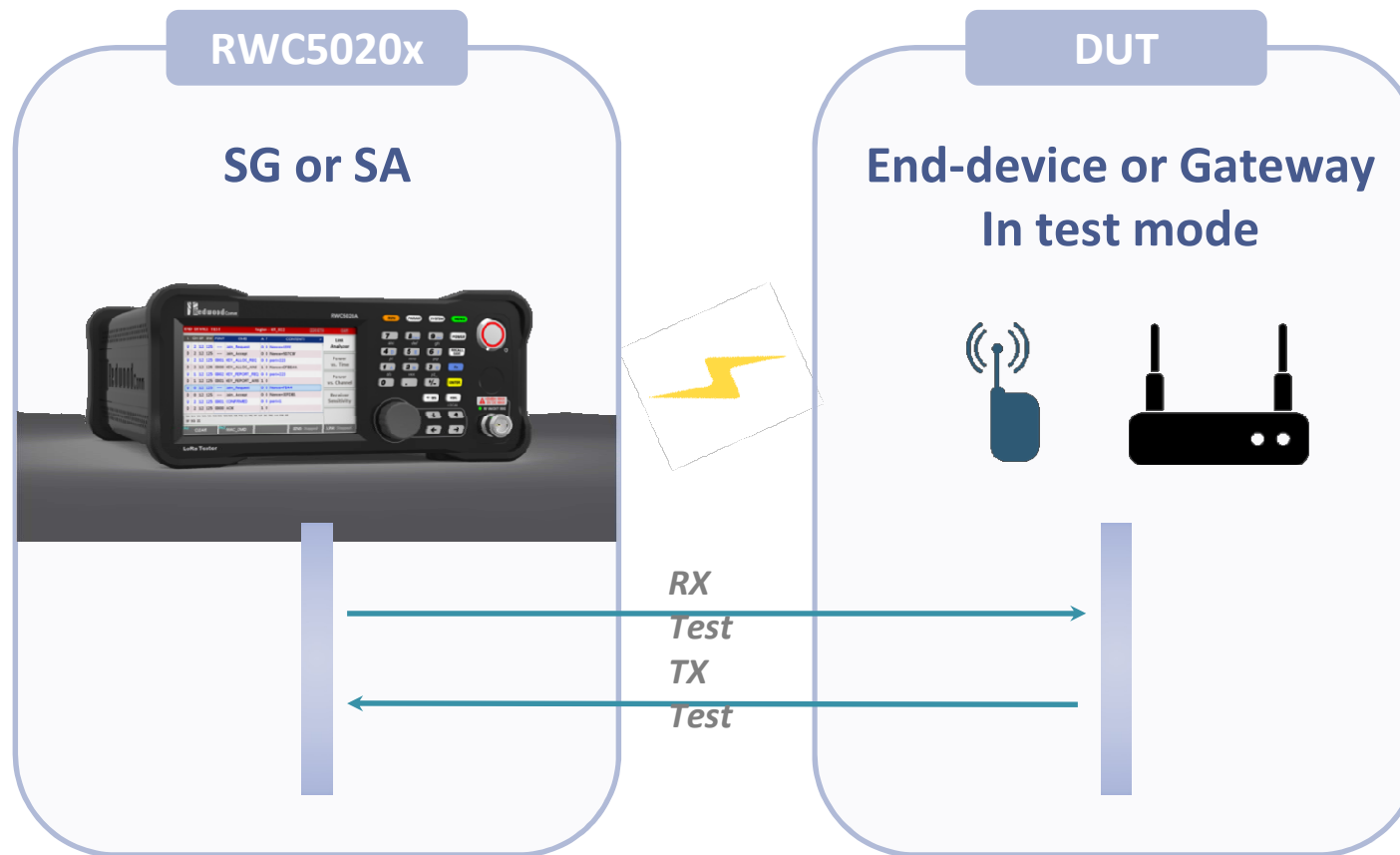
Stand-alone Operation

- Automatic Search of the Minimum Sensitivity Level
 - Determine range and step for the power sweep
 - The result value is the minimum power level at which the measured PER does not exceed the limit (TARGET_PER)



Non-signaling Test

Stand-alone Operation



NST

NST TX

Stand-alone Operation

● Signal Generator

- Modulation - LoRa, FSK, CW
- LoRa Modulation - Network, Polarity, SF, BW, CR
- LoRa Packet - Preamble, Payload
- Repeat number, Packet interval

NON-SIGNALING TEST										121	ETH	MD	RMT	EXT	CAP	Fn
SEQ	SF	BW	Pow	Time	dwell	Data										
0030	7	125	0.0	0.100s	51	00	01	02	03	04	05	06	07	08	09	
0040	8	125	0.0	0.100s	92	00	01	02	03	04	05	06	07	08	09	
0050	9	125	0.0	0.100s	164	00	01	02	03	04	05	06	07	08	09	
0060	10	125	0.0	0.100s	329	00	01	02	03	04	05	06	07	08	09	
0070	11	125	0.0	0.100s	659	00	01	02	03	04	05	06	07	08	09	
0080	12	125	0.0	0.100s	1318	00	01	02	03	04	05	06	07	08	09	
Status : OFF																
Fn1 CLEAR																LINK: Stopped

NST

NST RX

Stand-alone Operation

● Signal Analyzer

- Power Measurement - LoRa / FSK / CW
- Frequency Measurement - CW

NON-SIGNALING TEST

(121) (ETH) (LO) (RMT) (EXT) (CAP) (Fn)

SEQ	SF	BW	Pow	Time	dwell	Data									
0000	7	125	-----	-----	51	00	01	02	03	04	05	06	07	08	09
0001	7	125	-10.8	0.15s	51	00	01	02	03	04	05	06	07	08	09
0002	7	125	-10.8	0.15s	51	00	01	02	03	04	05	06	07	08	09
0003	7	125	-10.8	0.15s	51	00	01	02	03	04	05	06	07	08	09
0004	7	125	-10.8	0.15s	51	00	01	02	03	04	05	06	07	08	09
0005	7	125	-10.8	0.15s	51	00	01	02	03	04	05	06	07	08	09
0006	7	125	-10.8	0.15s	51	00	01	02	03	04	05	06	07	08	09
0007	7	125	-10.8	0.15s	51	00	01	02	03	04	05	06	07	08	09
0008	7	125	-10.8	0.15s	51	00	01	02	03	04	05	06	07	08	09
0009	7	125	-10.8	0.15s	51	00	01	02	03	04	05	06	07	08	09
POW(dBm) MAX: -10.8			AVG: -10.8			MIN: -10.8									

Signal Generator

Signal Analyzer

MFG

Fn1

CLEAR

LINK: Running

NON-SIGNALING TEST

(121)

(ETH)

(LO)

(RMT)

(EXT)

(CAP)

(Fn)

SEQ	SF	BW	Pow	Time	dwell	Data
0006	--	---	-10.5	-----	---	CW Freq=868.299927MHz
0007	--	---	-10.5	-----	---	CW Freq=868.299988MHz
0008	--	---	-10.5	-----	---	CW Freq=868.299988MHz
0009	--	---	-10.5	-----	---	CW Freq=868.299927MHz
0010	--	---	-10.5	-----	---	CW Freq=868.299927MHz
0011	--	---	-10.5	-----	---	CW Freq=868.299927MHz
0012	--	---	-10.5	-----	---	CW Freq=868.299927MHz
0013	--	---	-10.5	-----	---	CW Freq=868.299988MHz
0014	--	---	-10.5	-----	---	CW Freq=868.299988MHz
0015	--	---	-10.5	-----	---	CW Freq=868.299988MHz

POW(dBm) MAX: -10.5

AVG: -10.5

MIN: -10.6

FREQ(MHz) MAX: 868.299988

AVG: 868.299959

MIN: 868.299927

Signal Generator

Signal Analyzer

MFG

LINK: Running

Fn1

CLEAR

Stand-alone Operation

- Test scenario defined by RedwoodComm
- DUT triggers a test transmitting 0xFFFF
- Simultaneous TX/RX Test
 - RX Sensitivity (PER)
 - TX Power

NON-SIGNALING TEST [121] [ETH] [LO] [RMT] [EXT] [CAP] [Fn]

SEQ	SF	BW	Pow	Time	dwell	Date
0006	7	125	-11.7	-----	30	FF FF
0007	7	125	0.0	0.100s	51	00 01 02 03 04 05 06 07 08 09
0008	7	125	5.0	0.100s	30	FF FF
0009	7	125	-11.7	15.45s	30	FF FF 00 64
0010	7	125	-11.7	0.13s	30	FF FF 00 64
0011	7	125	-11.7	0.13s	30	FF FF 00 64

PER: 0.000 (0/100) POW: -11.7dBm

Signal Generator

Signal Analyzer

MFG

LINK: Running

Feedback

If you have any questions,
contact us at sales@redwoodcomm.com or
visit www.redwoodcomm.com.