

LoRa[®] / LoRaWAN[®] Test Solutions

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



RWC5020M



RWC5021P



RWC5020B

Feb 2022

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

○ 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*

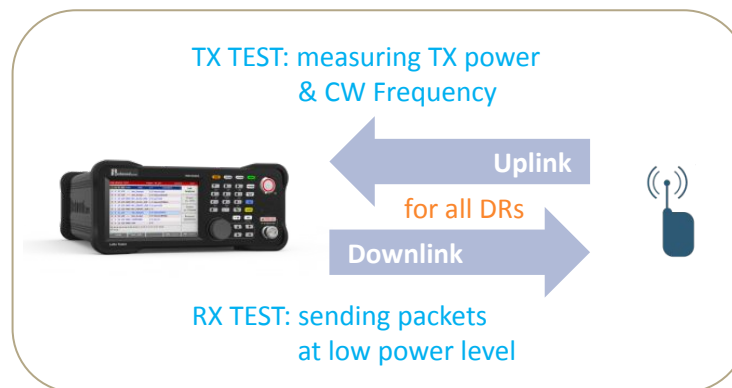
● RF Performance Tests

○ RX Sensitivity

- Class A/B/C

○ TX Power

○ TX CW Frequency



Gateway Test Solutions

Key Features

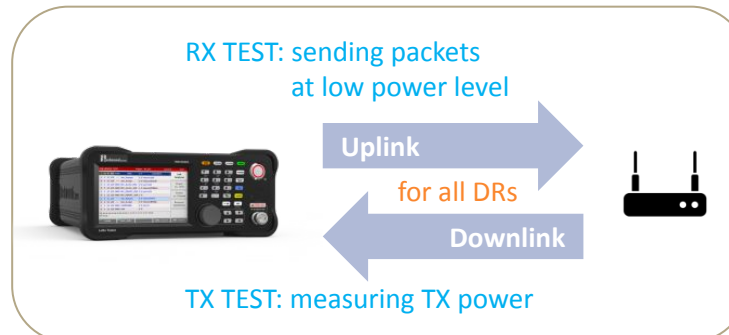
● Protocol Conformance Tests

- 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



Manufacturing Test Solutions

Key Features



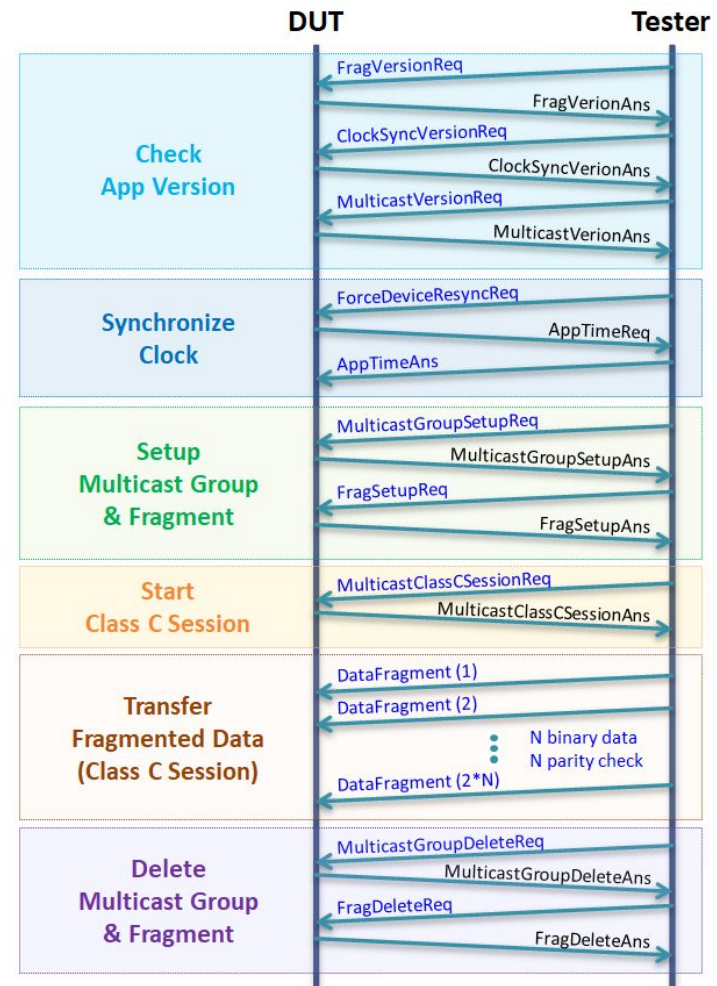
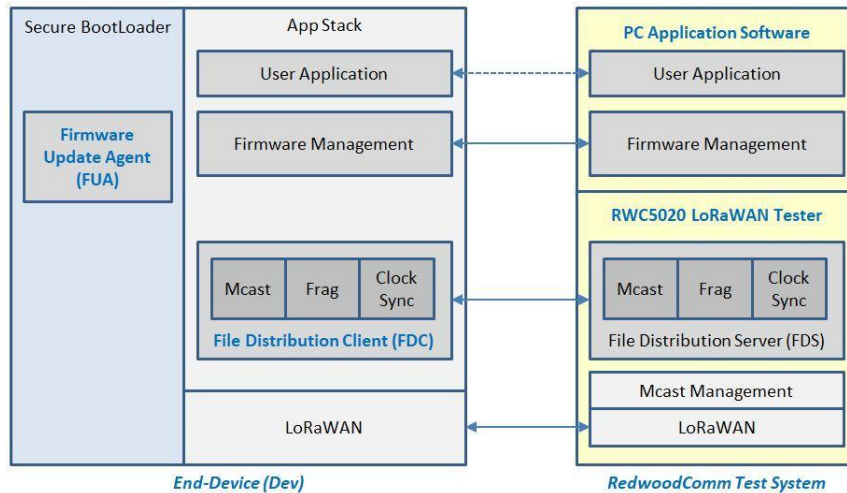
- **SOL #1: Separate TX/RX Test**
 - Non-signaling test (one-way test)
 - Signal Analyzer function for TX Test
 - Measuring TX power and CW frequency
 - Signal Generator function for RX Test
 - Measuring RX sensitivity with predefined test packets
 - A wired control of DUT might be required
- **SOL #2: 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



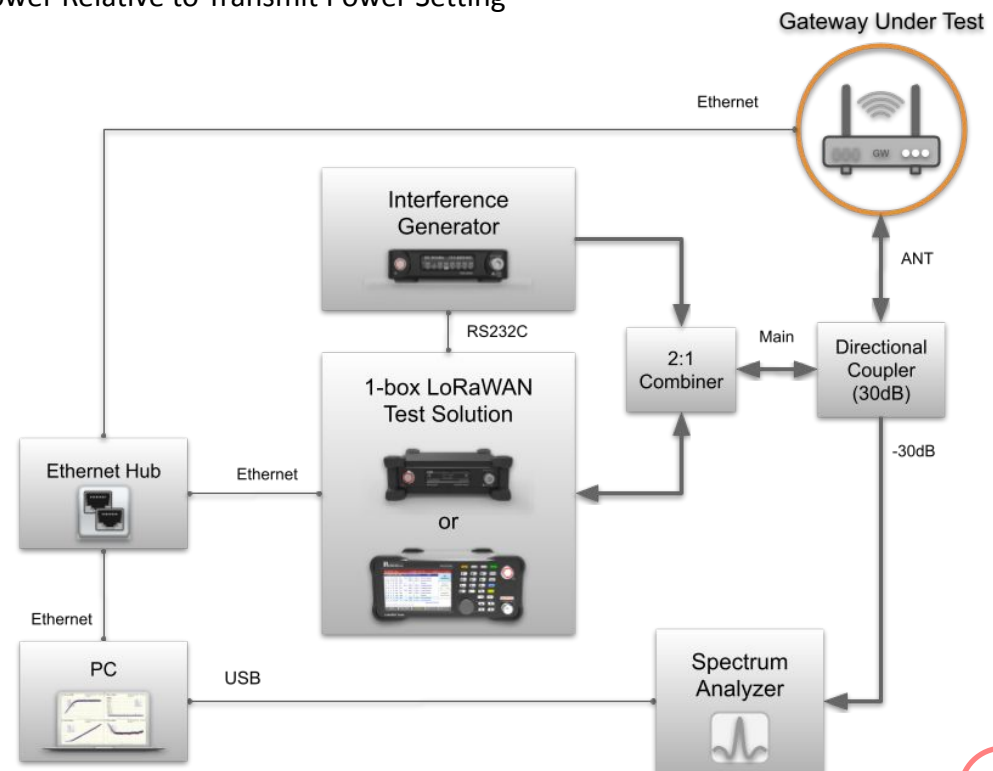
GW Test & Measurement Guidelines

● Related Document

○ [Download from the LoRa Alliance](#)

● Recommended instruments: RWC5020B (or M) and RWC2020A

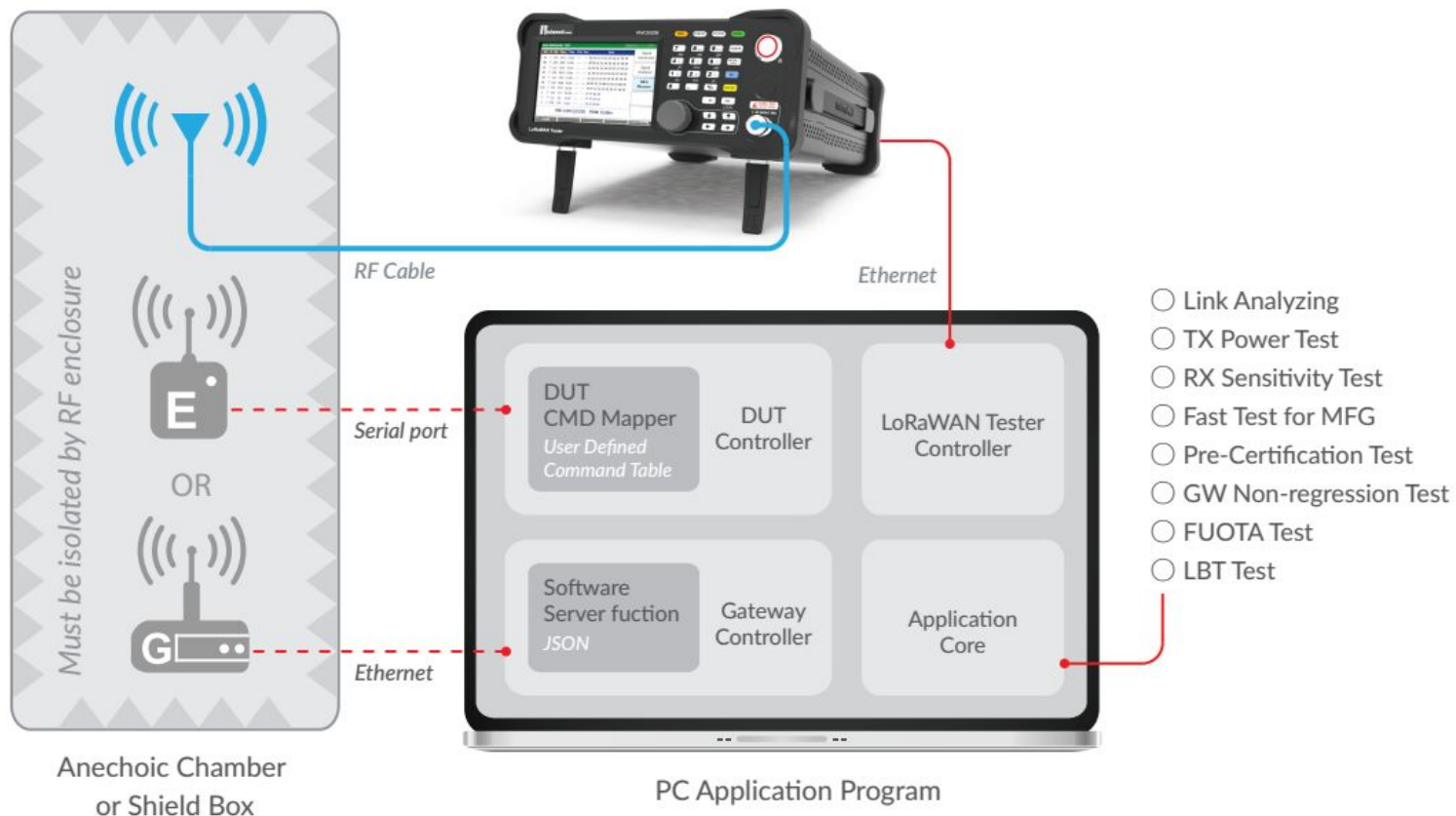
- Tx & Rx Operation and Survival with Open/Short Load
- Measured and Reported RF Transmit Power Relative to Transmit Power Setting
- Tx Conducted Emissions Out-of-Band
- Tx Intermodulation
- Tx Frequency Error
- Rx Sensitivity
- Rx Dynamic Range
- Rx In-Band Blocking/Selectivity
- Rx Out-of-Band Blocking/Selectivity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



Typical Test Setup

Key Features

- Automated PC Software and Example of Test Setup



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



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 |

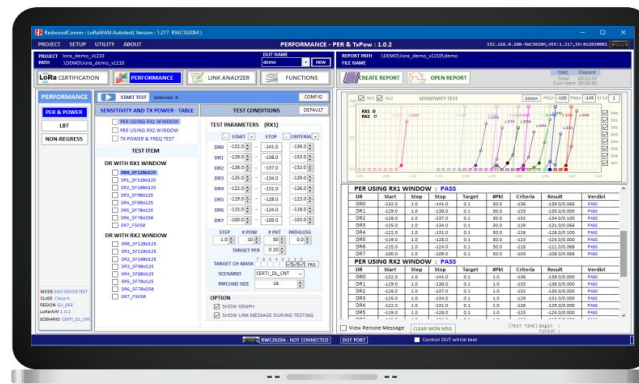
Options

| 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.*

Contents

- Summary of Key Features
- Product Comparison
- **PC Application Software**



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

Pre-Cert Test for LoRaWAN[®] V1.0.2

PC Application Software

RedwoodComm : LoRaWAN Autotest(SW Version : 1.334 RWC5020B)

PROJECT SETUP UTILITY ABOUT PRE-CERTIFICATION - EU_868 192.168.0.121 - RWC5020B, VER:1.336, SN:0x1870014

PROJECT DEMO_V1330 DUT NEW CERT_EDT_EU868_V102_ClassA REPORT PATH \\DEMO\DEMO_V1330\CERT_EDT_EU868_V102_ClassA
PATH \\DEMO\DEMO_V1330 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

EU868 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

END DEVICE / EU_868 / 1.0.2 / CLASS A / OTAA RWC2020A : NOT CONNECTED REF CLK INT RXGAIN-MEDIUM

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 :

* **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 SETUP UTILITY ABOUT PRE-CERTIFICATION - EU_868 192.168.0.121-RWC5020B, VER:1.336, SN:0x1870014

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

ALL 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
 - 2.2 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

SCALE 1.0 CLEAR MSG

SPY MESSAGE CLEAR SAVE

View SPY MSG (Max. 300 Lines) [TEST TIME] Begin : Finish :

END DEVICE / EU_868 / 1.0.4 / CLASS A / OTAA RWC2020A : NOT CONNECTED REF CLK 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 | | |
| 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 | |

* **LoRaWAN V1.0.4:**

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

* Test summary and report generation

* Estimated and elapsed time information

RF Performance Test (EDT Class A)

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:0x1870014

PROJECT DEMO_V1330 DUT NEW PERF_EDT_EU868_V102_ClassA REPORT PATH .\DEMO\DEMO_V1330\PERF_EDT_EU868_V102_ClassA FILE NAME

LoRa CERTIFICATION PERFORMANCE LINK ANALYZER FUNCTIONS CREATE REPORT OPEN REPORT TIME Elapsed Total 00:23:33 Curr-Item 00:11:15

PERFORMANCE START TEST Selected: 0 CONFIG

PER & POWER LBT NON-REGRESS

SENSITIVITY AND TX POWER - TABLE

PER USING RX1 WINDOW
 PER USING RX2 WINDOW
 TX POWER & FREQ TEST

TEST CONDITIONS DEFAULT

TEST PARAMETERS SYNC RX1/RX2
POWER(dBm) 10dB Scale

| | START | STOP | CRITERIA |
|-----|--------|--------|----------|
| DR0 | -129.0 | -138.0 | -131.0 |
| DR1 | -126.0 | -135.0 | -128.0 |
| DR2 | -125.0 | -134.0 | -127.0 |
| DR3 | -122.0 | -131.0 | -124.0 |
| DR4 | -119.0 | -128.0 | -121.0 |
| DR5 | -116.0 | -125.0 | -118.0 |
| DR6 | -112.0 | -121.0 | -113.0 |
| DR7 | -97.0 | -106.0 | -98.0 |

STEP(dB) # POW # PKT PATHLOSS(dB)
1.0 10 1 0.0

TARGET PER 0.100

TARGET CH MASK 7 6 5 4 3 2 1 0
 FRQ

SCENARIO CERTI_ECHO

PAYLOAD SIZE 16 Byte

OPTION
 SHOW GRAPH
 SHOW LINK MESSAGE DURING TESTING

Stop link after test

SENSITIVITY TEST ZOOM Pmin -97 Pmax -150 Grid 1

DUT NAME PERF_EDT_EU868_V102_ClassA
REGION EU_868

PER USING RX1 WINDOW : PASS

| DR | Start | Step | Stop | Target | #Pkt | Criteria | Result | Verdict |
|-----|--------|------|--------|--------|------|----------|--------------|---------|
| DR0 | -129.0 | 1.0 | -138.0 | 0.100 | 1 | -131 | -134.0/0.000 | PASS |
| DR1 | -126.0 | 1.0 | -135.0 | 0.100 | 1 | -128 | -130.0/0.000 | PASS |
| DR2 | -125.0 | 1.0 | -134.0 | 0.100 | 1 | -127 | -128.0/0.000 | PASS |
| DR3 | -122.0 | 1.0 | -131.0 | 0.100 | 1 | -124 | -125.0/0.000 | PASS |
| DR4 | -119.0 | 1.0 | -128.0 | 0.100 | 1 | -121 | -123.0/0.000 | PASS |
| DR5 | -116.0 | 1.0 | -125.0 | 0.100 | 1 | -118 | -120.0/0.000 | PASS |
| DR6 | -112.0 | 1.0 | -121.0 | 0.100 | 1 | -113 | -117.0/0.000 | PASS |
| DR7 | -97.0 | 1.0 | -106.0 | 0.100 | 1 | -98 | -101.0/0.000 | PASS |

PER USING RX2 WINDOW : PASS

| DR | Start | Step | Stop | Target | #Pkt | Criteria | Result | Verdict |
|-----|--------|------|--------|--------|------|----------|--------------|---------|
| DR0 | -129.0 | 1.0 | -138.0 | 0.100 | 1 | -131 | -134.0/0.000 | PASS |
| DR1 | -126.0 | 1.0 | -135.0 | 0.100 | 1 | -128 | -131.0/0.000 | PASS |
| DR2 | -125.0 | 1.0 | -134.0 | 0.100 | 1 | -127 | -130.0/0.000 | PASS |

[View SPY MSG (Max. 300 Lines)] 1.0 CLEAR MSG [TEST TIME] Begin : Finish :

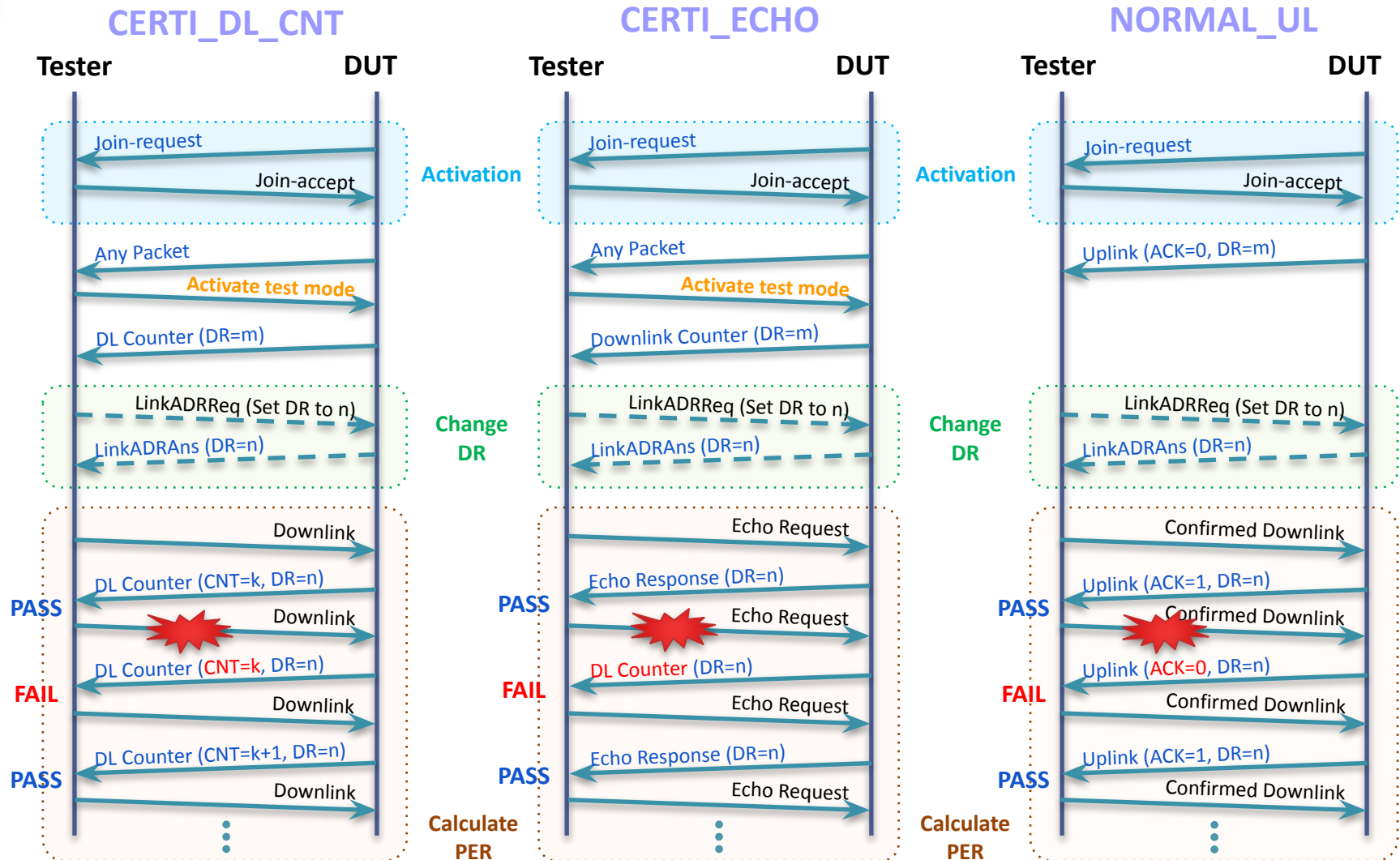
END DEVICE / EU_868 / 1.0.2 / CLASS A / OTAA RWC2020A : NOT CONNECTED REF CLK INT RXGAIN-MEDIUM

- * 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

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:0x1870014

PROJECT DEMO_V1330 DUT NEW PERF_EDT_EU868_V102_ClassB REPORT PATH .\DEMO\DEMO_V1330\PERF_EDT_EU868_V102_ClassB
PATH .\DEMO\DEMO_V1330 FILE NAME

LoRa CERTIFICATION PERFORMANCE LINK ANALYZER FUNCTIONS CREATE REPORT OPEN REPORT

TIME Elapsed
Total 00:33:29
Curr-Item 00:33:29

PERFORMANCE START TEST Selected: 0 CONFIG

PER & POWER LBT NON-REGRESS

SENSITIVITY AND TX POWER - TABLE TEST CONDITIONS DEFAULT

PER USING PING

TEST ITEM

DR WITH PING SLOT

DR0_SF12BW125
 DR1_SF11BW125
 DR2_SF10BW125
 DR3_SF9BW125
 DR4_SF8BW125
 DR5_SF7BW125
 DR6_SF7BW250
 DR7_FSK50

TEST PARAMETERS(PING)
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 |
| DR6 | -112.0 | -121.0 | -112.0 |
| DR7 | -97.0 | -106.0 | -97.0 |

STEP(dB) # POW # PKT PATHLOSS(dB)
1.0 10 1 0.0

TARGET PER 0.100

PAYLOAD SIZE 16 Byte

OPTION
 SHOW GRAPH
 SHOW LINK MESSAGE DURING TESTING

Stop link after test

PER SENSITIVITY TEST

PERFORMANCE TEST SUMMARY

DUT NAME PERF_EDT_EU868_V102_ClassB
REGION EU_868

PER USING PING : PASS

| DR | Start | Step | Stop | Target | #Pkt | Criteria | Result | Verdict |
|-----|--------|------|--------|--------|------|----------|--------------|---------|
| DR0 | -129.0 | 1.0 | -138.0 | 0.100 | 1 | -129 | -135.0/0.000 | PASS |
| DR1 | -126.0 | 1.0 | -135.0 | 0.100 | 1 | -126 | -132.0/0.000 | PASS |
| DR2 | -125.0 | 1.0 | -134.0 | 0.100 | 1 | -125 | -130.0/0.000 | PASS |
| DR3 | -122.0 | 1.0 | -131.0 | 0.100 | 1 | -122 | -126.0/0.000 | PASS |
| DR4 | -119.0 | 1.0 | -128.0 | 0.100 | 1 | -119 | -122.0/0.000 | PASS |
| DR5 | -116.0 | 1.0 | -125.0 | 0.100 | 1 | -116 | -121.0/0.000 | PASS |
| DR6 | -112.0 | 1.0 | -121.0 | 0.100 | 1 | -111 | -118.0/0.000 | PASS |
| DR7 | -97.0 | 1.0 | -106.0 | 0.100 | 1 | -96 | -99.0/0.000 | PASS |

View SPY MSG (Max. 300 Lines) 1.0 CLEAR MSG [TEST TIME] Begin : Finish :

END DEVICE / EU_868 / 1.0.2 / CLASS B / OTAA RWC2020A : NOT CONNECTED REF CLK INT RXGAIN-MEDIUM

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

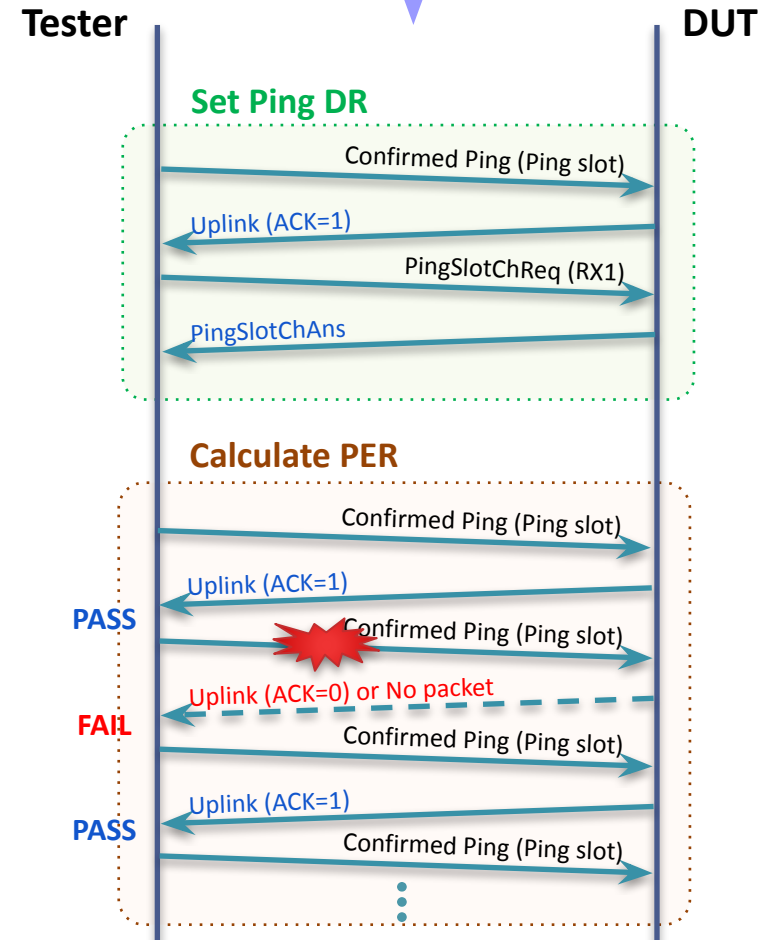
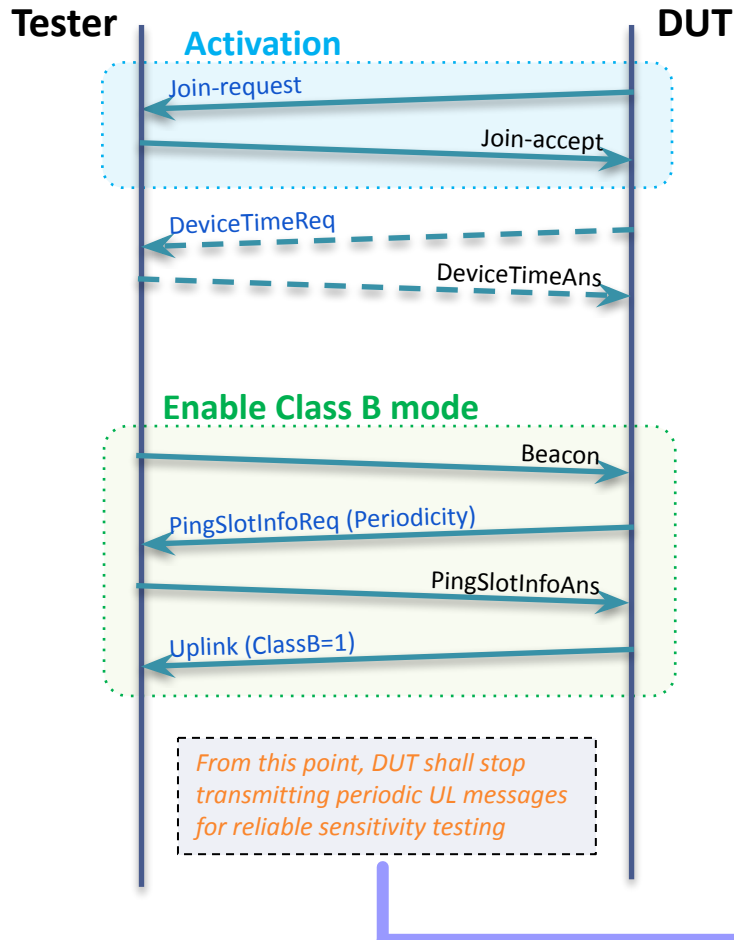
* Test summary and report generation

* 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:0x1870014

PROJECT DEMO_V1330 DUT NEW PERF_GWT_EU868_V102_ClassA REPORT PATH .\DEMO\DEMO_V1330\PERF_GWT_EU868_V102_ClassA
PATH .\DEMO\DEMO_V1330 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

PER OF GATEWAY
 TX POWER TEST

TEST ITEM

DR

DR0_SF12BW125
 DR1_SF11BW125
 DR2_SF10BW125
 DR3_SF9BW125
 DR4_SF8BW125
 DR5_SF7BW125

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

PERFORMANCE TEST SUMMARY

DUT NAME 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 | -135.0/0.000 | 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 CLEAR MSG [TEST TIME] Begin : Finish :

GATEWAY/ EU_868 / 1.0.2 / CLASS A / OTAA RWC2020A : NOT CONNECTED REF CLK INT RXGAIN-MEDIUM

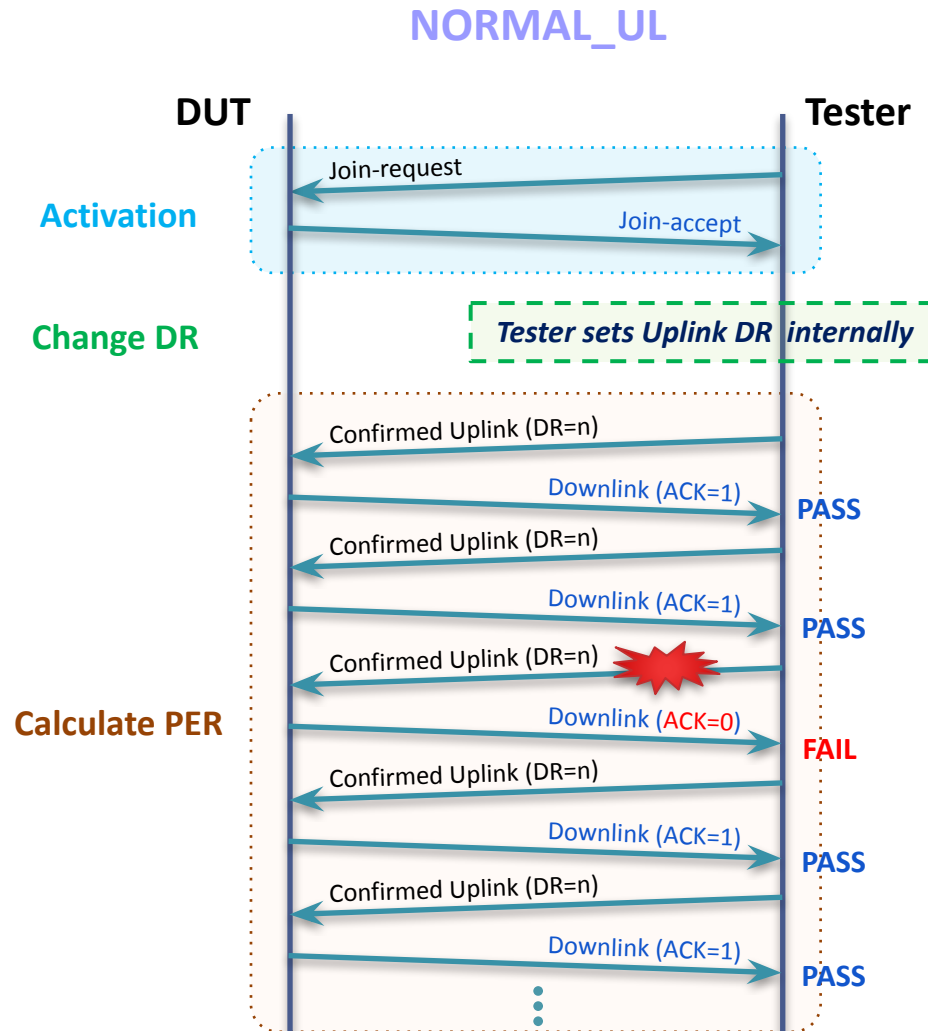
* PER measurement for **uplink (GWT)**

* 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 192.168.0.100-RWC5020M, VER:1.217, SN:0x2003000

PROJECT RT_V1220_2_kevin DUT NAME 25_01 NEW

PATH D:\RWC5020A\Software\RT_V1220_2_kevin

REPORT PATH D:\RWC5020A\Software\RT_V1220_2_kevin\25_01

FILE NAME

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 | REF POW | CH00 | CH01 | CH02 | CH03 | CH04 | CH05 | CH06 | CH07 |
|-----------|---------|------|------|------|------|------|------|------|------|
| 1 Min | -80 dBm | +1 | +1 | -3 | +1 | +1 | +1 | +1 | +1 |

RunTime:60

BURST MODE PARAMETERS

TEST ITERATION 10 Iteration

DURATION POWER REPEAT

NORMAL BURST

POWER DURATION POWER DURATION

-83 dBm 10 Sec -79 dBm 10 Sec

PROJECT NAME : RT_V1220_2_kevin

DUT NAME : 25_01

TESTER SERIAL : 0x2003000

TEST DATE & TIME : 4/19/2020 9:37:04 PM

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 | FCNT | Adr | Ack | FP | AAR | B | Port | M | Dwell | CMD | CNT | |
|---|----|----|----|-----|-------|-------|-----|------|-----|-----|----|-----|-----|------|------|-------|--------------|------------|-----|
| U | 2 | 0 | 12 | 125 | --- | REF | --- | 0 | 0 | 0 | 0 | --- | --- | --- | --- | 1482 | Join-request | Nonce | |
| D | 2 | 0 | 12 | 125 | -30.0 | --- | 5 | --- | 0 | 0 | 0 | --- | --- | --- | --- | 1155 | Join-accept | RX1DF | |
| U | 2 | 0 | 12 | 125 | -5.7 | 11.9s | --- | 0000 | 1 | 0 | 0 | 0 | 099 | C | 1646 | --- | Dataup | Bytel | |
| D | 2 | 0 | 12 | 125 | -30.0 | --- | 1 | 0000 | 1 | 1 | 0 | --- | --- | --- | 224 | U | 1155 | ActivateTM | --- |
| U | 2 | 0 | 12 | 125 | -5.7 | 4.51s | --- | 0001 | 1 | 0 | 0 | 0 | 224 | U | 1155 | U | DICounter(0) | Cnt=6 | |
| U | 2 | 0 | 12 | 125 | -5.7 | 7.99s | --- | 0002 | 1 | 0 | 0 | 0 | 224 | U | 1155 | U | DICounter(0) | Cnt=6 | |
| U | 2 | 0 | 12 | 125 | -5.7 | 7.99s | --- | 0003 | 1 | 0 | 0 | 0 | 224 | U | 1155 | U | DICounter(0) | Cnt=6 | |
| U | 2 | 0 | 12 | 125 | -5.7 | 7.99s | --- | 0004 | 1 | 0 | 0 | 0 | 224 | U | 1155 | U | DICounter(0) | Cnt=6 | |
| U | 2 | 0 | 12 | 125 | -5.7 | 7.99s | --- | 0005 | 1 | 0 | 0 | 0 | 224 | U | 1155 | U | 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 MON MSG 0 0 6 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

RedwoodComm : LoRaWAN Autotest(SW Version : 1.334 RWC5020B)

PROJECT SETUP UTILITY ABOUT PERFORMANCE - NON-REGRESSION OF GW 192.168.0.121-RWC5020B, VER:1.336, SN:0X1870014

PROJECT DEMO_V1330 DUT NEW PERF_GWT_NRT_EU868_V103_ClassA REPORT PATH .\DEMO\DEMO_V1330\PERF_GWT_NRT_EU868_V103_ClassA FILE NAME

LoRa CERTIFICATION PERFORMANCE LINK ANALYZER FUNCTIONS CREATE REPORT OPEN REPORT

PERFORMANCE RUN SKIP Default GW IP

PER & POWER LBT NON-REGRESS

TEST ITEM TX TX OUT POWER MEASUREMENT TEST START TIME 2019-01-31 11:30:53
 PER/RSSI/SNR
 RX SENSITIVITY
 FREQUENCY ERROR TOLERANCE
 CW INTERFERER IMMUNITY

FREQ(MHz) SF7 8 9 10 11 12 PATHLOSS(dB)
 F1: 868.1000 RWC502x 4.0
 F2: 868.3000 RWC2020A 4.0
 F3: 868.5000 TX INTERVAL(Sec) 0.2
 F4: 867.1000

PER/RSSI/SNR TEST PARAMETERS
 # PACKET 10
 POW STEP 1 dB

MONITOR ... SHOW RESULT VALUE JSON PKT Monitor SAVE CLEAR

[TEST CONDITION]
 TEST NAME : PER/RSSI/SNR
 DUT NAME : PERF_GWT_NRT_EU868_V103_ClassA
 TEST EQUIPMENT : RWC5020B
 PATHLOSS : 0.0 dB
 POWER START : -140 dBm
 POWER STOP : -10 dBm
 POWER STEP : 1.0 dB
 NUMBER OF PACKETS : 30
 CHANNEL TIME : 03:00:00

RESULT INFO: PER/RSSI/SNR
 FREQUENCY F1:864.3000 SF7 SF10
 F2:864.5000 SF8 SF11
 F3:864.7000 SF9 SF12
 F4:904.7000

LEGEND SHOW DOT THICK LINE

+ SNR vs. POWER DUT=PERF_GWT_NRT_EU868_V103 F1:864.3000
 + PER vs. POWER DUT=PERF_GWT_NRT_EU868_V103 F1:864.3000

+ RSSI CH MEAN DUT=PERF_GWT_NRT_EU868_V103 F1:864.3000
 + RSSI CH ERROR DUT=PERF_GWT_NRT_EU868_V103 F1:864.3000

View SPY MSG (Max. 300 Lines) 1.0 [TEST TIME] Begin : Finish :

GATEWAY / EU_868 / 1.0.2 / CLASS A / OTAA RWC2020A : NOT CONNECTED REF CLK INT RXGAIN-MEDIUM

- * 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 1.0.2 192.168.0.100-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

LoRa CERTIFICATION PERFORMANCE LINK ANALYZER FUNCTIONS

PAYLOAD EDITOR SEND DL SLOT RX1 MSG TYPE 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

LinkADDRReq Parameters

SET LINK_ADR_REQ DR DR3_SF9BW125 TX_POW 1 NB_TRANS 1 MASK_CTRL 0 CH_MASK 0x7

RX_PARAM_SETUP Parameters

SET RX_PARAM_SETUP 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 866.550
    └── RX2_DR DR0_SF12BW125
  
```

LINK MESSAGE Clear Before Dump Show raw data SAVE MSG

START FCNT DutyCycle

| 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 | | ActivateTM | |
| U | 0 | 0 | 12 | 125 | 12.9 | 3.36s | - | 0001 | 1 | 0 | - | 0 | 224 | U | 1155 | | DIcounter(0) | Cnt=0 |
| D | 0 | 0 | 12 | 125 | -30.0 | ---- | 1 | 0001 | 1 | 0 | - | - | 000 | U | 1482 | | DevStatusReq | |
| U | 1 | 0 | 12 | 125 | 10.8 | 5.33s | - | 0002 | 1 | 0 | - | 0 | 224 | U | 1482 | | LinkADDRReq | Pow=1,DR=0,Mask |
| U | 1 | 0 | 12 | 125 | 10.8 | 5.33s | - | 0002 | 1 | 0 | - | 0 | 224 | U | 1482 | | RXParamSetReq | RX1DROffset=0,R |
| U | 1 | 0 | 12 | 125 | 10.8 | 5.33s | - | 0002 | 1 | 0 | - | 0 | 224 | U | 1482 | | {DevStatusAns} | Battery=254, SN |
| U | 1 | 0 | 12 | 125 | 10.8 | 5.33s | - | 0002 | 1 | 0 | - | 0 | 224 | U | 1482 | | {LinkADRAns} | Pow=1, DR=1, Ma |
| U | 1 | 0 | 12 | 125 | 10.8 | 5.33s | - | 0002 | 1 | 0 | - | 0 | 224 | U | 1482 | | {RXParamSetAns} | RX1DROffset=1, |
| D | 1 | 0 | 12 | 125 | -30.0 | ---- | 1 | 0002 | 1 | 0 | - | - | 000 | U | 991 | | NoPayload | |
| U | 2 | 0 | 12 | 125 | 10.8 | 4.68s | - | 0003 | 1 | 0 | - | 0 | 224 | U | 1155 | | DIcounter(2) | Cnt=2 |
| U | 1 | 0 | 12 | 125 | 10.8 | 5.00s | - | 0004 | 1 | 0 | - | 0 | 224 | U | 1155 | | DIcounter(2) | Cnt=2 |
| U | 0 | 0 | 12 | 125 | 10.8 | 5.00s | - | 0005 | 1 | 0 | - | 0 | 224 | U | 1155 | | DIcounter(2) | Cnt=2 |
| U | 1 | 0 | 12 | 125 | 10.8 | 5.00s | - | 0006 | 1 | 0 | - | 0 | 224 | U | 1155 | | DIcounter(2) | Cnt=2 |
| U | 0 | 0 | 12 | 125 | 10.8 | 5.00s | - | 0007 | 1 | 0 | - | 0 | 224 | U | 1155 | | DIcounter(2) | Cnt=2 |
| U | 2 | 0 | 12 | 125 | 10.8 | 5.00s | - | 0008 | 1 | 0 | - | 0 | 224 | U | 1155 | | DIcounter(2) | Cnt=2 |
| U | 2 | 0 | 12 | 125 | 10.8 | 5.00s | - | 0009 | 1 | 0 | - | 0 | 224 | U | 1155 | | DIcounter(2) | Cnt=2 |
| U | 1 | 0 | 12 | 125 | 10.8 | 5.00s | - | 000A | 1 | 0 | - | 0 | 224 | U | 1155 | | DIcounter(2) | Cnt=2 |
| U | 2 | 0 | 12 | 125 | 10.8 | 5.00s | - | 000B | 1 | 0 | - | 0 | 224 | U | 1155 | | DIcounter(2) | Cnt=2 |
| U | 1 | 0 | 12 | 125 | 10.8 | 5.00s | - | 000C | 1 | 0 | - | 0 | 224 | U | 1155 | | DIcounter(2) | Cnt=2 |
| U | 2 | 0 | 12 | 125 | 10.8 | 5.00s | - | 000D | 1 | 0 | - | 0 | 224 | U | 1155 | | DIcounter(2) | Cnt=2 |
| U | 0 | 0 | 12 | 125 | 10.8 | 5.00s | - | 000E | 1 | 0 | - | 0 | 224 | U | 1155 | | DIcounter(2) | Cnt=2 |
| U | 2 | 0 | 12 | 125 | 10.8 | 5.00s | - | 000F | 1 | 0 | - | 0 | 224 | U | 1155 | | DIcounter(2) | Cnt=2 |
| U | 1 | 0 | 12 | 125 | 10.8 | 5.00s | - | 0010 | 1 | 0 | - | 0 | 224 | U | 1155 | | DIcounter(2) | Cnt=2 |
| U | 2 | 0 | 12 | 125 | 10.8 | 5.00s | - | 0011 | 1 | 0 | - | 0 | 224 | U | 1155 | | DIcounter(2) | Cnt=2 |
| U | 1 | 0 | 12 | 125 | 10.8 | 5.00s | - | 0012 | 1 | 0 | - | 0 | 224 | U | 1155 | | DIcounter(2) | Cnt=2 |
| U | 2 | 0 | 12 | 125 | 10.8 | 5.00s | - | 0013 | 1 | 0 | - | 0 | 224 | U | 1155 | | DIcounter(2) | Cnt=2 |
| U | 0 | 0 | 12 | 125 | 10.8 | 5.00s | - | 0014 | 1 | 0 | - | 0 | 224 | U | 1155 | | DIcounter(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 192.168.0.100:Not Connected

PROJECT NONE DUT NAME NONE NEW REPORT PATH FILE NAME

LoRa CERTIFICATION PERFORMANCE LINK ANALYZER FUNCTIONS CREATE REPORT OPEN REPORT

TIME Elapsed
Total 00:00:00
Curr-Item 00:03:40

FUNCTIONS START TEST FUOTA TEST CONFIG

MFG
NST SG
NST SA
FUOTA TEST


FUOTA PARAMETERS

CONFIG FRAGMENTATION

INDEX 0 SIZE 16 NB_FRAG 16
ALGO. LDPC DESCR. 0x FFFFFFFF
OPEN BIN .bin

CONFIG MULTICAST

Mc GroupID 0
Mc Addr 0x FFFFFFFF Mc Interval 0.1
Mc DR DR3_SF9BW125 Mc Freq 869.5250
Mc Key 0x 12345678901234567890123456789012 32 digits



```

-->DataFragment: N=46 over 26, Frag_size=16
D R2 3 9 125 -10.0 ---- 1 002D 1 0 0 - - 201 U 226 DataDown ByteL
60 FF FF FF FF 80 2D 00 C9 08 2E 00 B4 25 52 DC 03 15 7F 05 2D 85 E2 63 D1 28 E0 12 71 2D 23 0C
-->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 83 99 41 47 9C F7 45 96 1D 13 94
-->DataFragment: N=48 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 99 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 0B 5A 95 40 9C FD 30 A6 CB D5 4F A7 2B 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 78 7E 00 69
-->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 6B 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 130s - 000A 1 0 - 0 0 099 U 1646 DataUp ByteL
40 01 00 00 00 0A 00 63 BE C8 13 6B 68 55 E0 E3 CF BA E0 DF AB 3B 57 CE 5E D3 B2
U 0 0 12 125 -28.9 5.00s - 000B 1 0 - 0 0 099 U 1646 DataUp ByteL
40 01 00 00 00 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 0008 1 0 0 - - 201 U 1155 DataDown ByteL
60 01 00 00 00 08 00 C9 03 00 CE FC 9C 1B
-->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 0C 00 C9 03 00 87 90 88 01

```

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

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

Contents

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

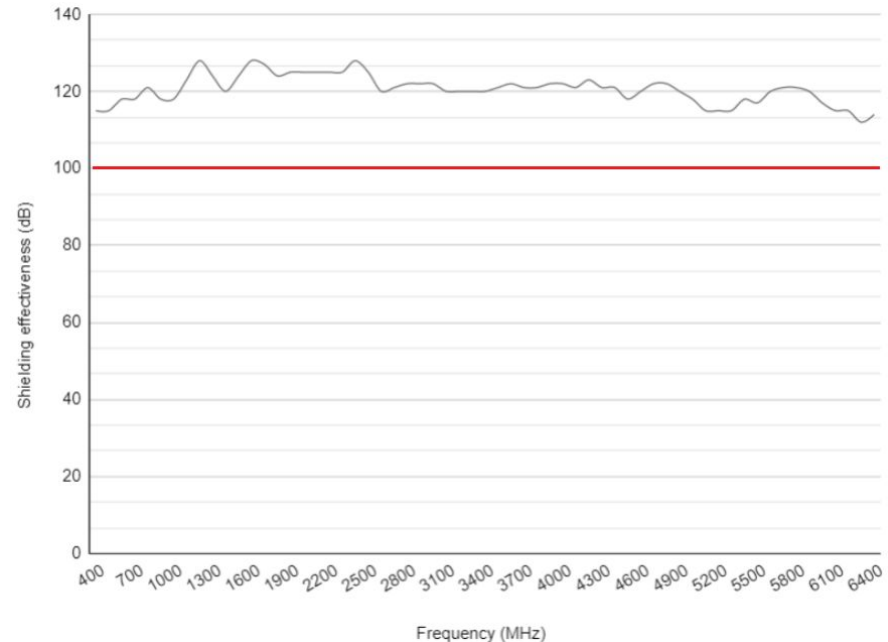


- Production Test Solution
- Stand-alone Operation of 5020B

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
- PC Application Software
- RF Shielding Enclosure
- **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**

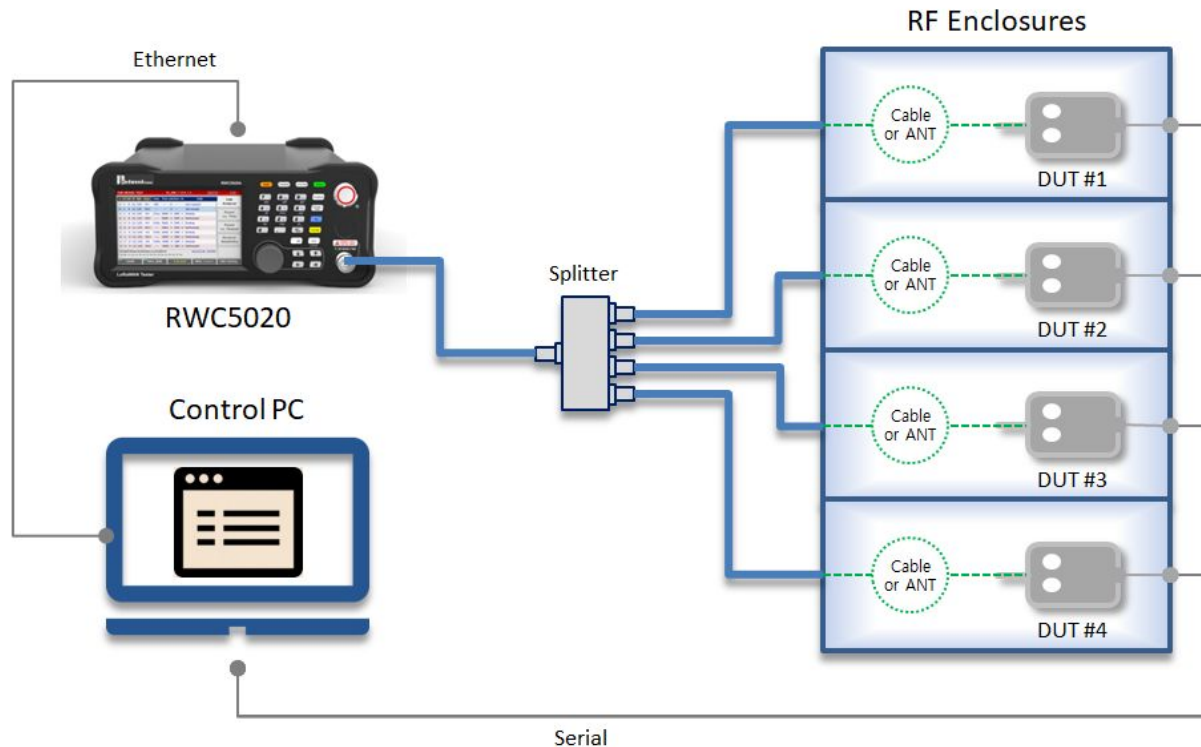


0. Enter **TX** Test Mode
1. Repeat sending packets
3. Stop

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.

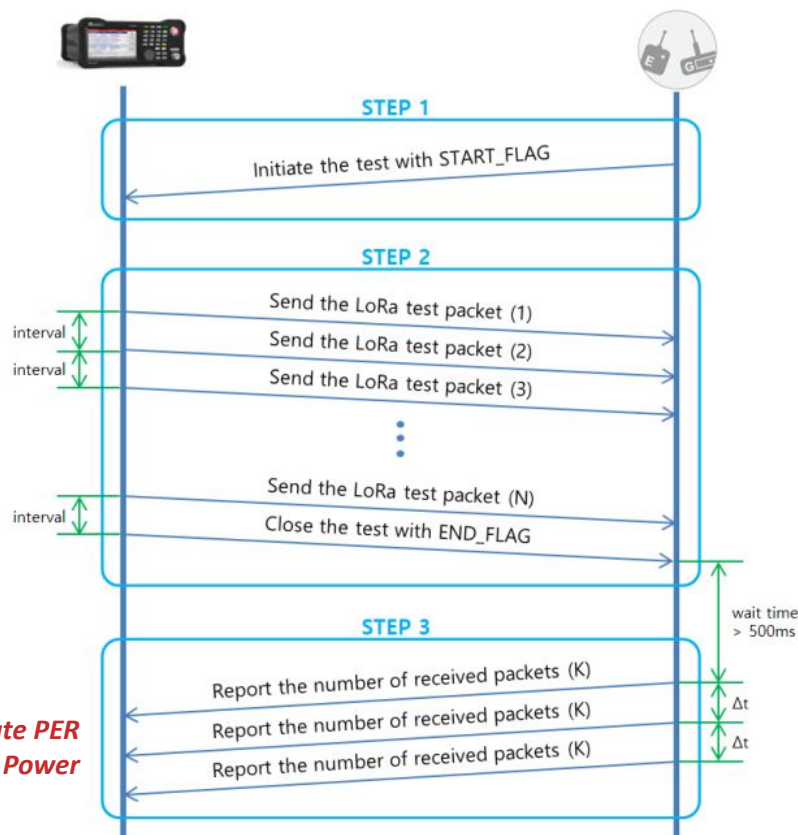
* Frequency measurement is available only in **RWC5020B/M**.

Manufacturing Solution 2

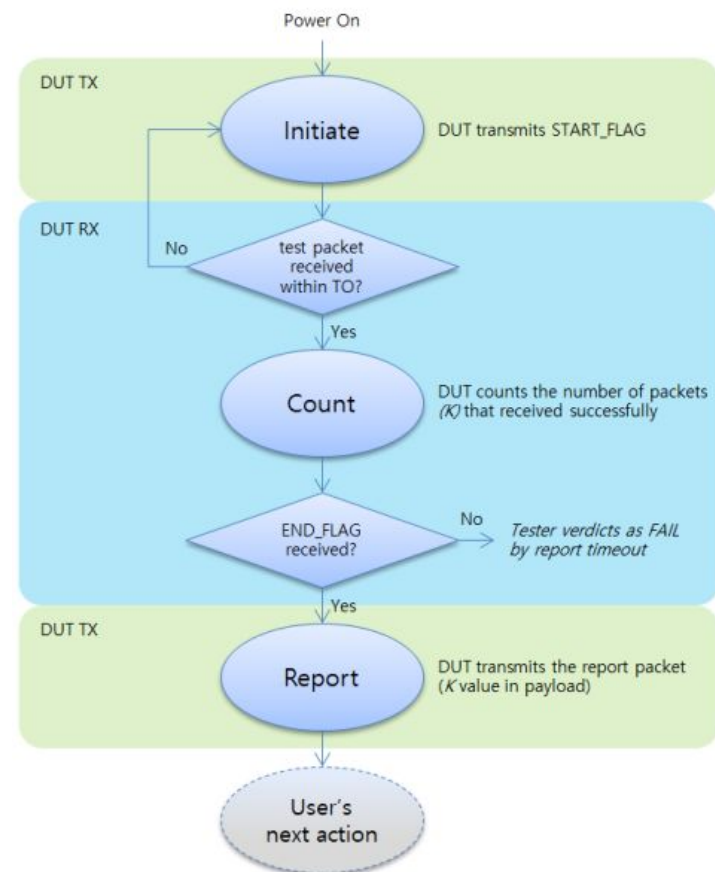
Production Test Solution

- Simultaneous TX/RX Test with MFG

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



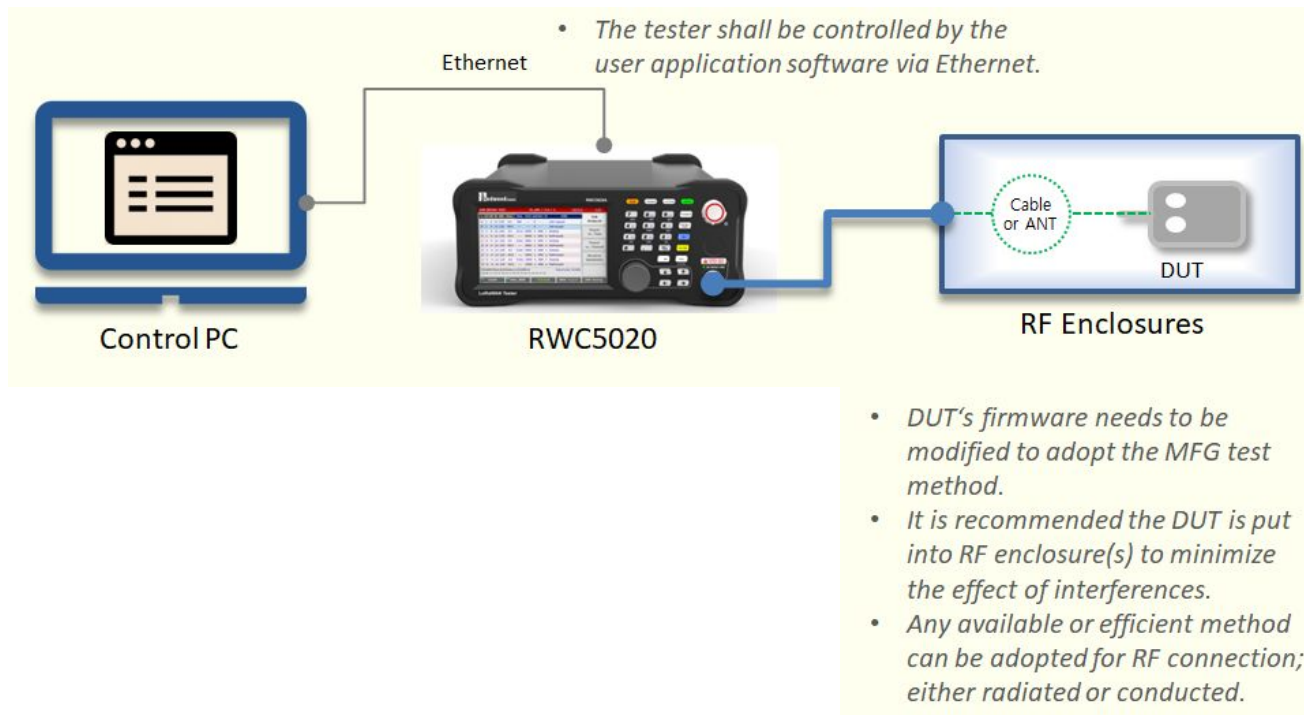
Calculate PER
Measure TX Power



Test Example of a Single DUT

Production Test Solution

Using MFG Function



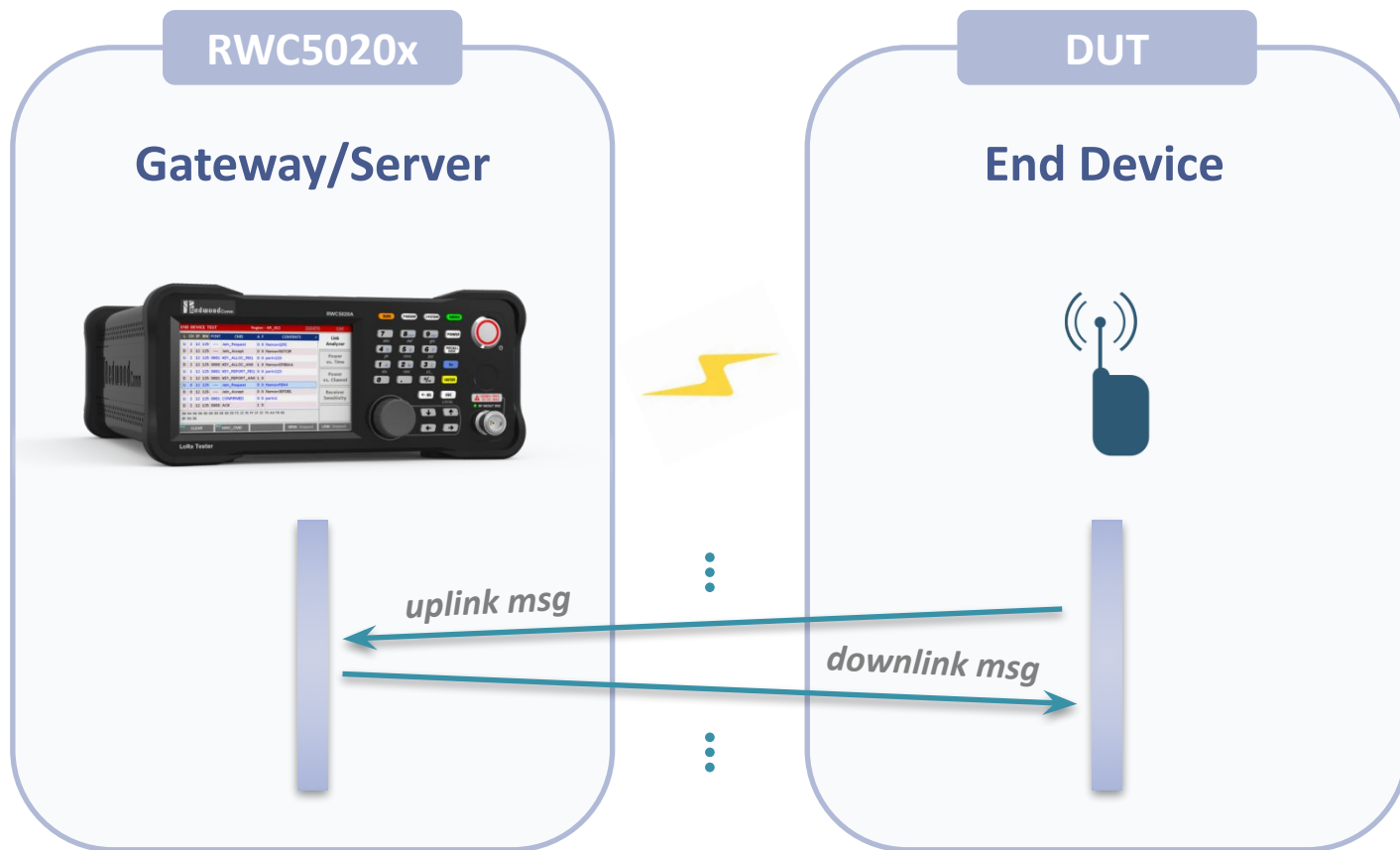
Contents

- 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

Link Analyzer

Power Measure

Receiver Sensitivity

Calculated Duty Cycle

| END DEVICE TEST | | | | | | | | | | | | | EU_868 / V1.0.2 / A | | | 012 ETH RST TEST CAP | | |
|--|----|----|--------------|-----|-------|-----------|------|---------|---------------|-------|-------------------|--------------|---------------------|--|--|----------------------|--|--|
| L | CH | DR | SF | BW | Pow | Time | FCnt | AckPort | M | dwell | CMD | | | | | | | |
| U | 2 | 0 | 12 | 125 | -28.2 | REF | ---- | 0 | --- | - | 1482 | Join-request | | | | | | |
| 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 | | | | | | |
| 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 | | | | | | |
| 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 | | | | | | |
| 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 | | | | | | |
| D | 2 | 0 | 12 | 125 | 0.0 | ---- | 0003 | 1 | 000 | U | 991 | NoPayload | | | | | | |
| RX1DROffset=0,RXDelay=1,RX2DR=0 | | | | | | | | | | | DutyCycle: 23.44% | | | | | | | |
| 20 71 B0 B0 00 00 00 01 00 00 00 00 01 E8 32 4B 3F | | | | | | | | | | | | | | | | | | |
| Fn1 CLEAR | | | Fn2 MAC_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
 - 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(MD) (CAP)

| LINK | PROTOCOL | RF |
|-------------|------------------|-----------|
| REGION | INSTANT_MAC_CMD1 | EU_868 |
| MAC_PAYLOAD | DEV_STATUS | CONFIRMED |
| MAC_CMD_T | LINK_ADR | PAYLOAD |
| MAC_CMD_FI | DUTY_CYCLE | 1 |
| NUM_OF_CMI | RX_PARAM_SETUP | LINK_ADR |
| INSTANT_MA | TX_PARAM_SETUP | RF12BW125 |
| ADR_DR | | |

POP-UP EXIT

Fn1 CLEAR Fn2 MAC_SEND Activating LINK: Running

END DEVICE TEST EU_868 / V1.0.2 / A (012)ETH (CAP)

| L | CH | DR | SF | BW | Pow | Time | FCnt | AckPort | M | dwll | CMD | Link Analyzer | |
|---|----|----|----|-----|-------|-------|------|---------|-----|------|------|---------------|--|
| U | 0 | 0 | 12 | 125 | -29.2 | 5.00s | 003A | 0 | 099 | U | 1646 | DataUp | Power Measure CH TIME Receiver Sensitivity |
| 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 80 3E 00 00 03 07 5A 35 77 FE

Fn1 CLEAR Fn2 MAC_SEND Activated LINK: Running

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 @12(ETH) CAP

| LINK | PROTOCOL | RF |
|------------------|----------------|----------------|
| NUM_OF_CMD | | 2 ✓ |
| INSTANT_MAC_CMD1 | RX_PARAM_SETUP | ✓ |
| RX1_DR_OFFSET | | 0 |
| RX2_FREQ | | 869.525000 MHz |
| RX2_DR | | DRO_SF12BW125 |
| INSTANT_MAC_CMD2 | LINK_ADR | ✓ |
| ADR_DR | | DRO_SF12BW125 |

1 ~ 3 EXIT

Fn1 CLEAR Fn2 MAC_SEND Activated LINK: Running

END DEVICE TEST EU_868 / V1.0.2 / A @22(ETH) CAP

| L | CH | DR | SF | BW | Pow | Time | FCnt | AckPort | M | dwell | CMD |
|---|----|----|----|-----|-------|-------|------|---------|-----|--------|---------------|
| 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

Link Analyzer

Power Measure

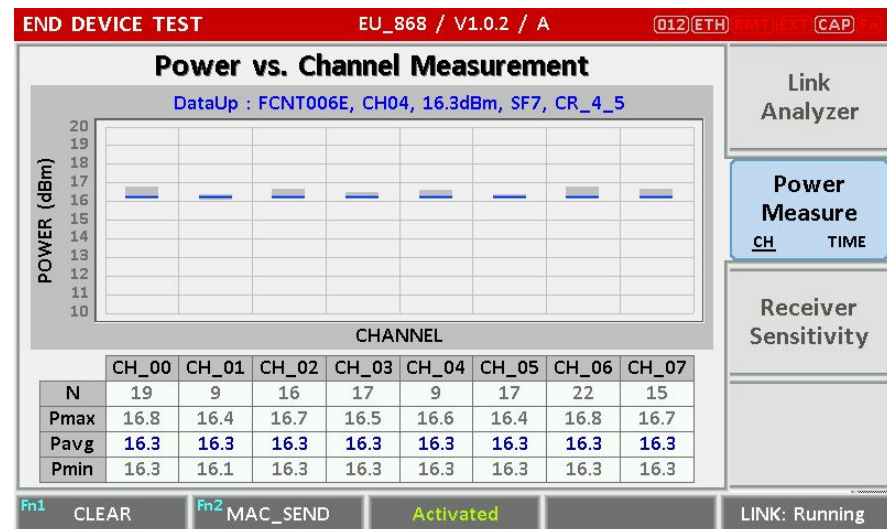
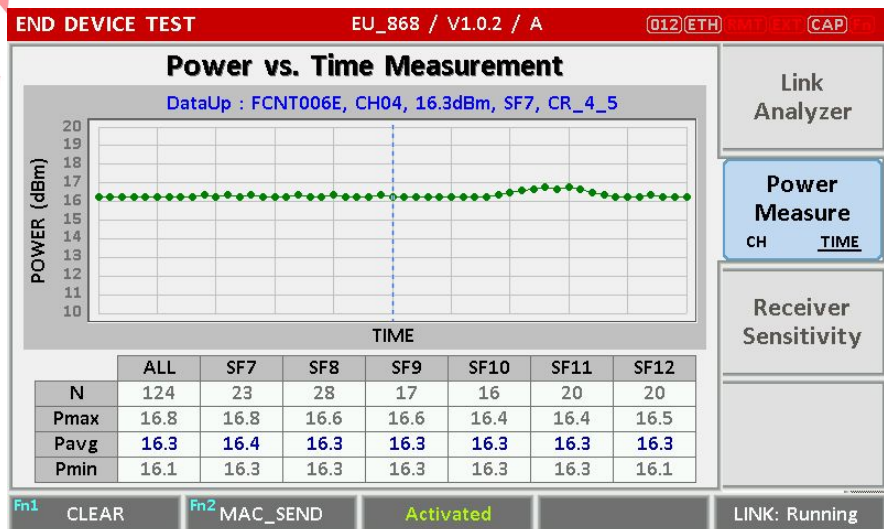
CH TIME

Receiver Sensitivity

Power Measurement

Stand-alone Operation

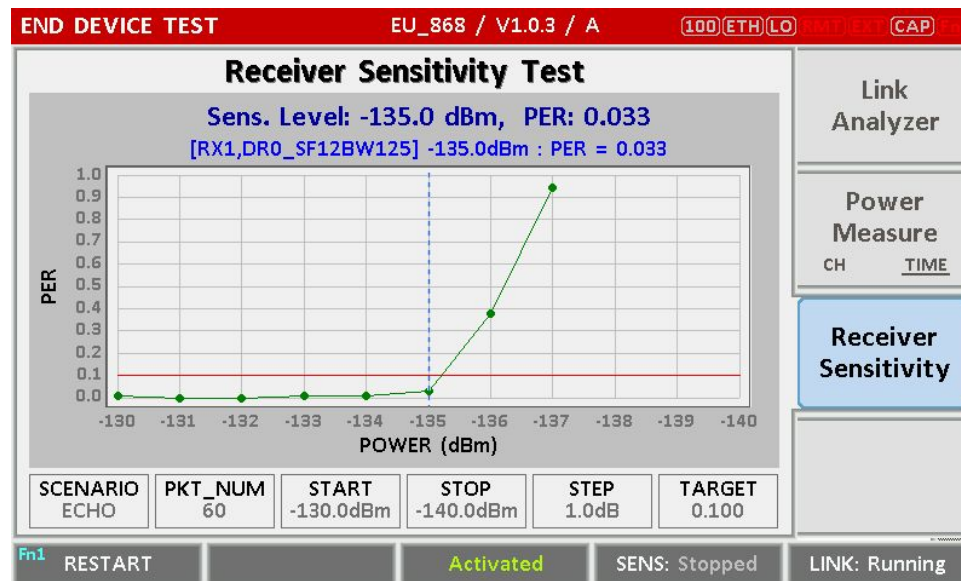
- Power vs. Time
 - Continuous monitoring of DUT's TX Power w.r.t. SF
- Power vs. Channel
 - Continuous monitoring of DUT's TX Power w.r.t. Channel
- Calculating the maximum/average/minimum values



RX Sensitivity Test

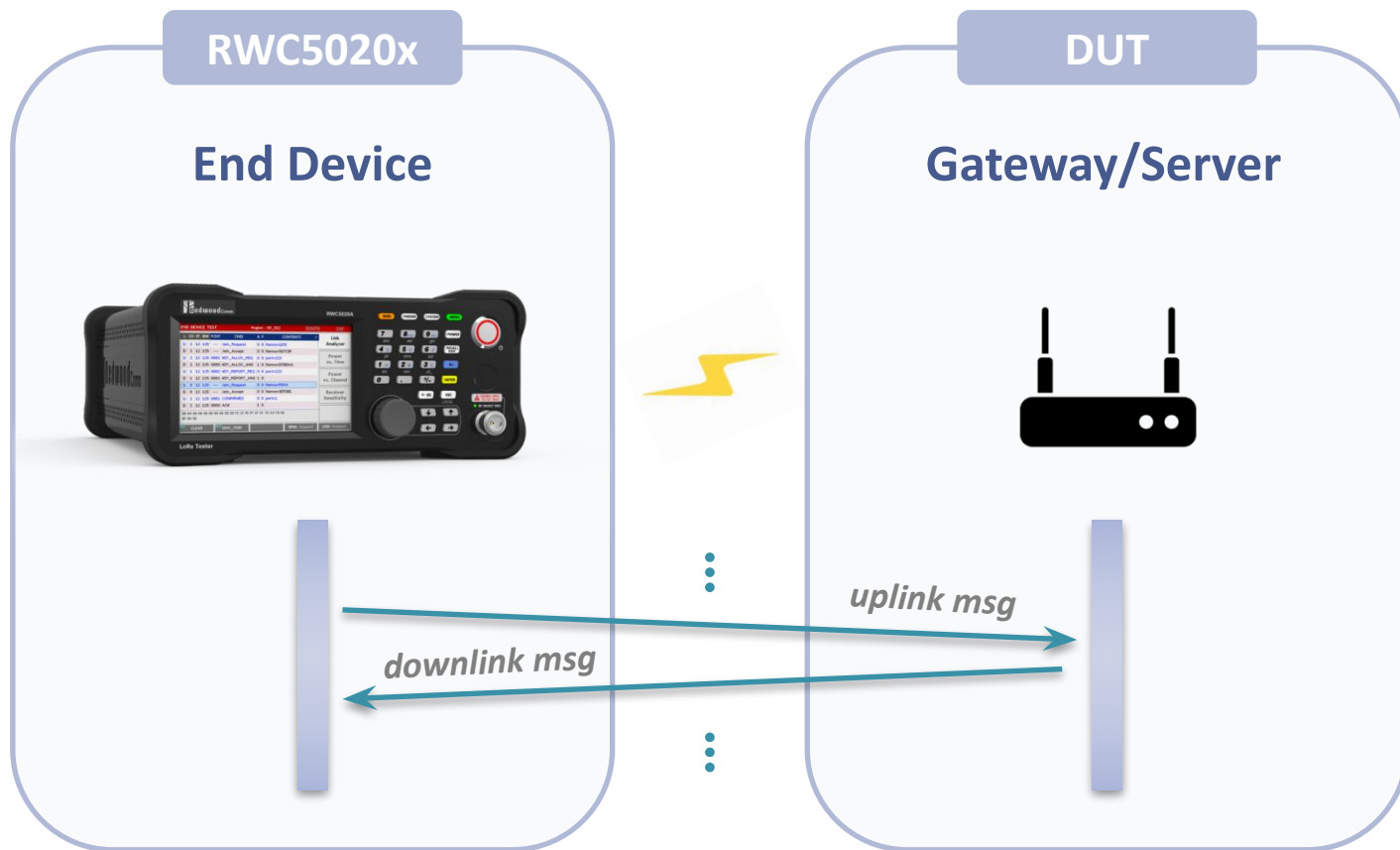
Stand-alone Operation

- 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 | Link Analyzer | | | | | |
| U | 1 | 0 | 12 | 125 | -10.0 | REF | ---- | 0 | --- | - | 1482 | Join-request | Power Measure CH TIME Receiver Sensitivity | | | | |
| 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 20 39 84 02 00 00 00 01 00 00 00 00 01 DE 46 E4 21 | | | | | | | | | | | | 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)

GATEWAY TEST EU_868 / V1.0.2 / A (022)ETH(MD)(RMT)(EXT)(CAP)(Fn)

| LINK | PROTOCOL | RF |
|-----------------|------------------|-----------|
| MAC_PAYLOAD | INSTANT_MAC_CMD1 | |
| MAC_CMD_T | LINK_CHECK | CONFIRMED |
| MAC_CMD_F | LINK_CHECK | PAYLOAD |
| NUM_OF_CMI | | 1 |
| INSTANT_MA | LINK_CHECK | |
| MAC_ANS_TO | | 60 sec |
| PERIODIC_UPLINK | | NONE |

POP-UP EXIT

Fn1 CLEAR Fn2 MAC_SEND Activating LINK: Running

GATEWAY TEST EU_868 / V1.0.2 / A (022)ETH(RMT)(EXT)(CAP)(Fn)

| L | CH | DR | SF | BW | Pow | Time | FCnt | AckPort | M | dwll | 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 |

Power Measure CH TIME

Receiver Sensitivity

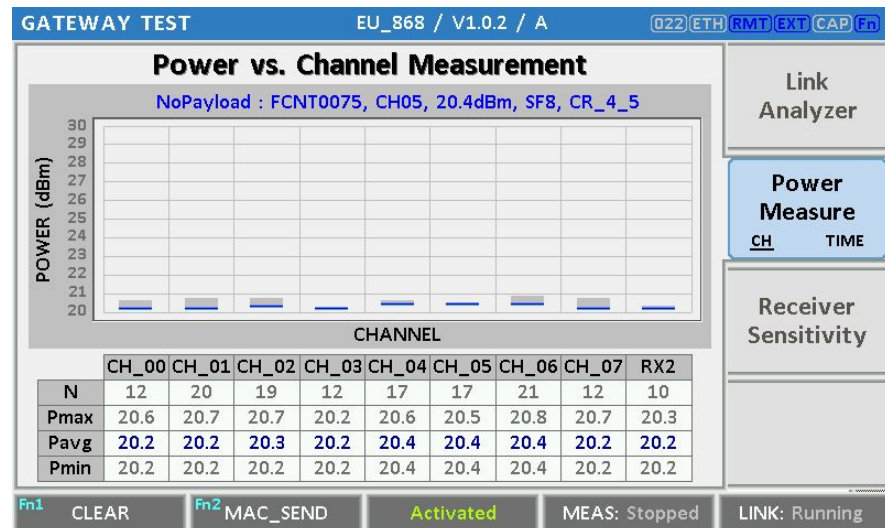
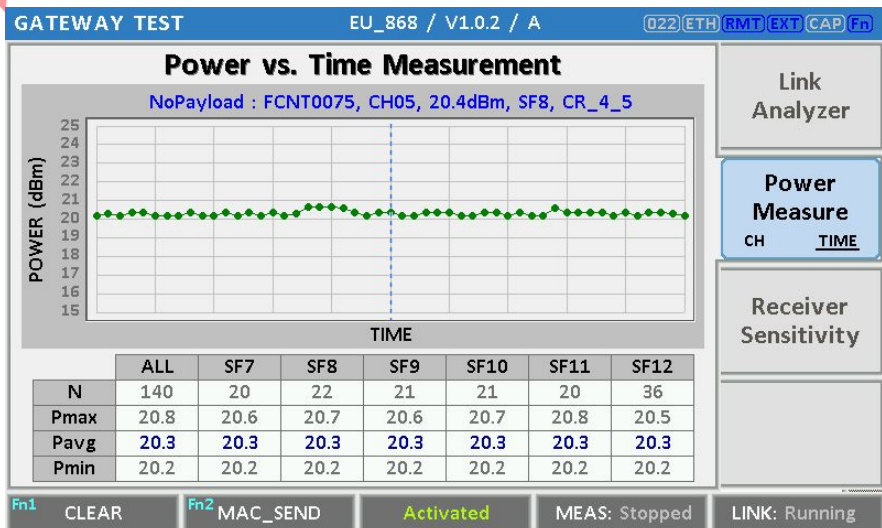
Margin=20, GwCnt=1
60 01 00 00 00 80 16 00 00 02 14 01 D5 ED E8 F4

Fn1 CLEAR Fn2 MAC_SEND Activated LINK: Running

Power Measurement

Stand-alone Operation

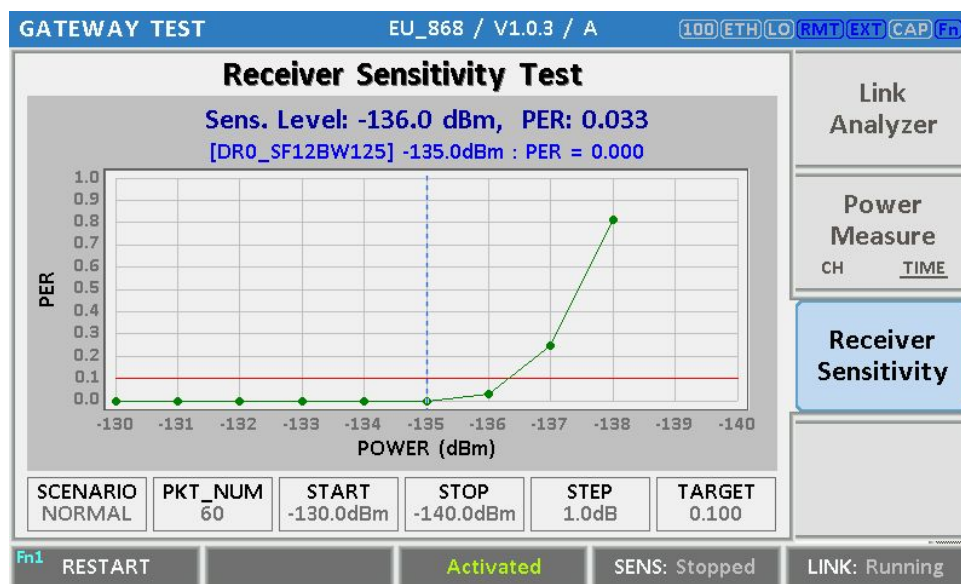
- Power vs. Time
 - Continuous monitoring of DUT's TX Power w.r.t. SF
- Power vs. Channel
 - Continuous monitoring of DUT's TX Power w.r.t. Channel
- Calculating the maximum/average/minimum values



RX Sensitivity Test

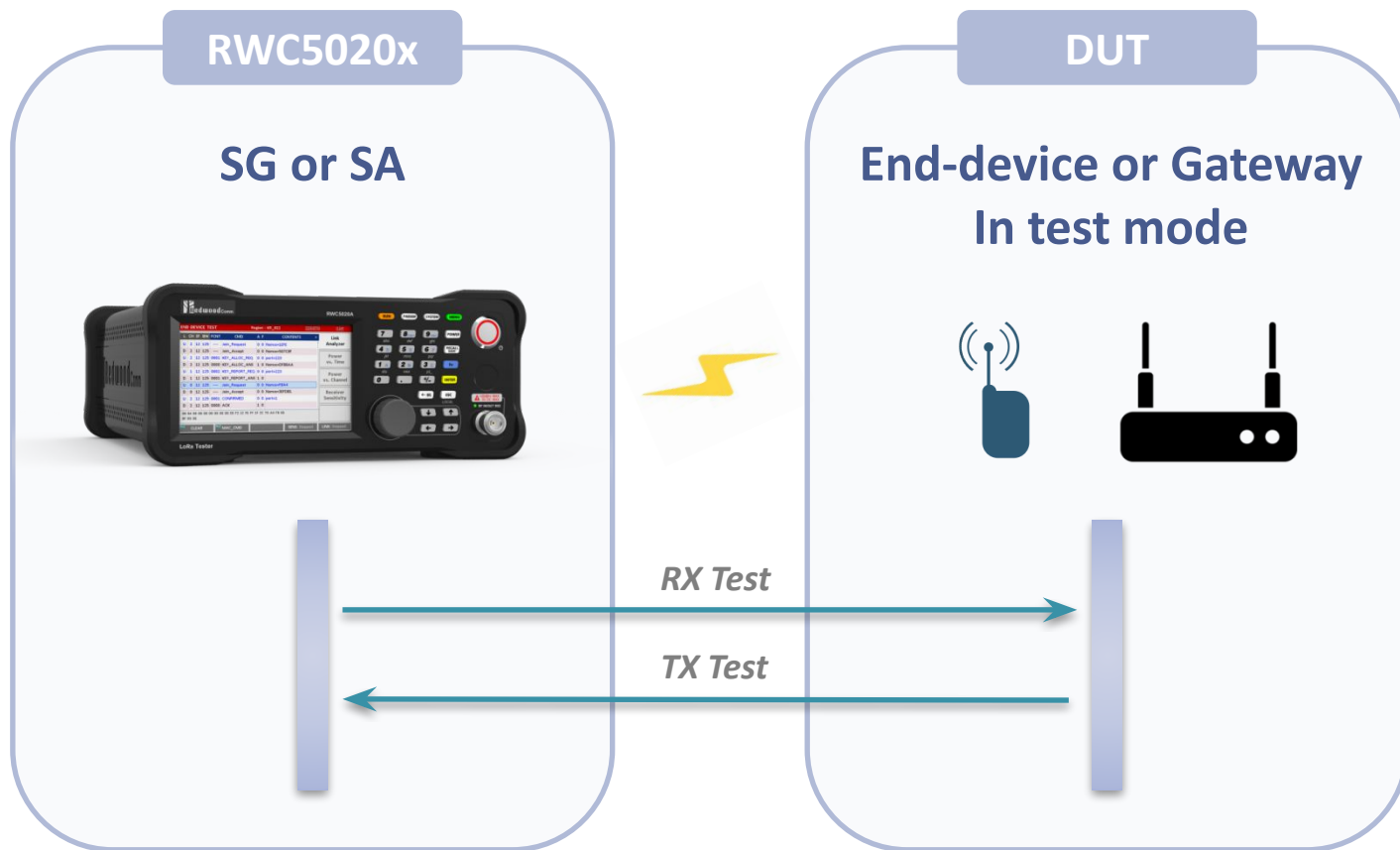
Stand-alone Operation

- 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 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 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 | | | | Signal Generator | | | | | | |
| 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 Analyzer | | | MFG | | | | |
| Fn1 CLEAR | | | | | | | | | | LINK: Running | | | | | | |

| NON-SIGNALING TEST | | | | | | | | | | [121] (ETH) (LO) (RMT) (EXT) (CAP) (Fn) | | |
|---------------------------|----|----|-----------------|-------|-------|-----------------------|--|--|-----------------|---|--|-----|
| SEQ | SF | BW | Pow | Time | dwell | Data | | | | Signal Generator | | |
| 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 | | | Signal Analyzer | | | MFG |
| FREQ(MHz) MAX: 868.299988 | | | AVG: 868.299959 | | | MIN: 868.299927 | | | | | | |
| Fn1 CLEAR | | | | | | | | | | LINK: Running | | |

Feedback

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