# RF TEST REPORT

| | | |
|---|---|---|
| **TEST STANDARD(S)** | : | ETSI EN 301 511 V12.5.1 (2017-03)<br>ETSI TS 151 010-1 V12.8.0 (2016-05) |
| **CLIENT / APPLICANT** | : | Robert Bosch (Pty) Ltd. |
| **CLIENT ADDRESS** | : | 33 Piet Rautenbach, Industrial Site, Brits, 0250 |
| **TEST SAMPLE (EUT)** | : | Tracking Device |
| **MODEL NUMBER** | : | MK2 |
| **UNTESTED VARIANT(s)** | : | None |
| **REPORT TYPE** | : | Delta 2G Test Report |
| **REPORT NUMBER** | : | TRR02193-3-23 |
| **ASSESSMENT RESULT** | : | Pass |
| **DATE ISSUED** | : | 28/11/2023 |
| **REVISION** | : | 1.0 |

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**This test report was prepared by:** ***Name:*** *HE Olivier*
***Title:*** *RF Test Engineer*

**This test report was approved by:** ***Name:*** *RM van den Berg*
***Title:*** *Technical Signatory (RF)*

T0812

*This test report is issued in accordance with SANAS accreditation requirements. SANAS is a signatory to the ILAC Mutual Recognition arrangement for the mutual recognition of the equivalence of testing and calibration reports.*

## DOCUMENT CONTROL

| Revision | Date | Author | Pages affected | Change proposal |
|---|---|---|---|---|
| 1.0 | 28/11/2023 | HE Olivier | All | N/A |
| | | | | |
| | | | | |

## TEST LABORATORY INFORMATION

Established in 2017, iSERT (Pty) Ltd. Provides EMC, RF, Safety & Performance testing services by our skilled Engineers. Our services employ a wide variety of advanced cutting-edge test equipment with one of the widest ranges of accredited standards in the country.

The site and apparatus are constructed in conformance with the requirements of CISPR 16-1-4, EN 50147-1 and other equivalent standards. The laboratory is compliant with the requirements of ISO/IEC 17025.

It is our definite objective to institute long-term, trust-based associations with our clients. The expectation we set up with our clients is based on outstanding service, practical expertise, and devotion to a certified value structure. Our passion is to grant our clients with the best EMC, RF & Safety services by knowledgeable and accommodating staff.

Our test site is located at 129 Khai-Appel Street, Montana, Pretoria, South Africa 0186.

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# ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| AVE | Average |
| ARFCN | Absolute Radio Frequency Channel Number |
| C | Circular |
| CSE | Conducted Spurious Emissions |
| CSIR | Council for Scientific and Industrial Research |
| DCS | Digital Cellular System |
| E-Fields | Electric Fields |
| EIRP | Effective isotropic radiated power |
| ERP | Effective radiated power |
| EFT | Electrical Fast Transients |
| EMC | Electromagnetic Compatibility |
| EMI | Electromagnetic Interference |
| ESD | Electrostatic Discharge |
| EUT | Equipment Under Test |
| FW | Firmware |
| GPRS | General packet radio service |
| GSM | Global System for Mobile Communications |
| HW | Hardware |
| MS | Mobile Station |
| NIST | National Institute of Science and Technology |
| N/A | Not Applicable |
| OATS | Open Area Test Site |
| PC | Personal Computer |
| PK | Peak |
| Pol | Polarized |
| QP | Quasi-Peak |
| RSE | Radiated Spurious Emissions |
| RED | Radio Equipment Directive |
| RCSE | Receiver Conducted Spurious Emissions (idle mode) |
| RMS | Root Mean Square |
| RRSE | Receiver Radiated Spurious Emissions (idle mode) |
| RSE | Radiated Spurious Emissions |
| RF | Radio Frequency |
| *R&TTE* | Radio and telecommunications terminal equipment |
| SANAS | South African National Accreditation System |
| SRD | Short Range Equipment |
| TCSE | Transmitted conducted Spurious Emissions (allocated mode) |
| TRSE | Transmitted Radiated Spurious Emissions (allocated mode) |
| VH | Voltage High (Maximum |
| VL | Voltage Low (minimum) |
| VN | Voltage Normal |
| TH | Temperature High (maximum) |
| TN | Temperature Normal |
| TL | Temperature Low (Minimum) |

# TABLE OF CONTENTS

# 1. INTRODUCTION

This report details the results of the tests performed on the Robert Bosch Tracking Device with model number: MK2. The testing was carried out by HE Olivier on 17/10/2023.

The EUT was tested according to the following standards and methods:

- ETSI EN 301 511 V12.5.1 (2017-03): “Global System for Mobile Communications (GSM); Mobile Stations (MS) Equipment; Harmonized Standard covering the Essential Requirements of Article 3.2 of Directive 2014/53/EU”.
- ETSI TS 151 010-1 V12.8.0 (2016-05): “Digital Cellular Telecommunications System (Phase 2+) (GSM); Mobile Station (MS) Conformance Specification; Part 1: Conformance Specification (3GPP TS 51.010-1 version 13.11.0 Release 13)”

# 2. SUMMARY OF TEST RESULTS

The module was fully tested according to the essential requirements of article 3.2 of Directive 2014/53/EU, see Appendix A.

For the EUT to fulfil the essential requirements of article 3.2 of Directive 2014/53/EU, delta tests were performed to ensure the EUT complies after integration.

**Table 1:** Summary of Test Results

| ETSI EN 301 511 V12.5.1 (2017-03) | | | |
|---|---|---|---|
| **Parameter to be Tested** | **Requirement** | **Method (1)** | **Result** |
| Transmitter – Frequency Error and Phase Error | 4.2.1 | 13.1.4 | ✓✓ |
| Transmitter – Frequency Error under Multipath and Interference Conditions | 4.2.2 | 13.2.4 | ✓✓ |
| Frequency Error and Phase Error in GPRS Multislot Configuration | 4.2.4 | 13.16.1.4 | ✓✓ |
| Transmitter Output Power and Burst Timing (2) | 4.2.5 | 13.3.4 | ✓ |
| Transmitter – Output RF Spectrum | 4.2.6 | 13.4.4 | ✓✓ |
| Transmitter Output Power in GPRS Multislot Configuration | 4.2.10 | 13.16.2.4 | ✓✓ |
| Output RF Spectrum in GPRS Multislot Configuration | 4.2.11 | 13.16.3.4 | ✓✓ |
| Conducted Spurious Emissions – MS Allocated | 4.2.12 | 12.1.1 | ✓✓ |
| Conducted Spurious Emissions – MS Idle | 4.2.13 | 12.1.2 | ✓✓ |
| Radiated Spurious Emissions – MS Allocated | 4.2.16 | 12.2.1 | ✓ |
| Radiated Spurious Emissions – MS Idle | 4.2.17 | 12.2.2 | ✓ |
| Receiver Blocking and Spurious Response – Speech Channels | 4.2.20 | 14.7.1.4 | ✓✓ |
| Frequency Error and Modulation Accuracy in EGPRS Configuration | 4.2.26 | 13.17.1.4 | ✓✓ |
| Frequency Error under Multipath and Interference Conditions in EGPRS Configuration | 4.2.27 | 13.17.2.4 | ✓✓ |
| EGPRS Transmitter Output Power | 4.2.28 | 13.17.3.4 | ✓✓ |
| Output RF Spectrum in EGPRS Configuration | 4.2.29 | 13.17.4.4 | ✓✓ |
| Blocking and Spurious Response in EGPRS Configuration | 4.2.30 | 14.18.5.4 | ✓✓ |
| Intermodulation Rejection - Speech Channels | 4.2.32 | 14.6.1.4 | ✓✓ |
| Intermodulation Rejection - EGPRS | 4.2.34 | 14.18.4.4 | ✓✓ |
| AM Suppression - Speech Channels | 4.2.35 | 14.8.1.4 | ✓✓ |

| | | | |
|---|---|---|---|
| Adjacent Channel Rejection - Speech Channels (TCH/FS) | 4.2.38 | 14.5.1.4 | ✔ |
| Adjacent Channel Rejection - EGPRS | 4.2.40 | 14.18.3.4 | ✔ |
| Reference Sensitivity - TCH/FS | 4.2.42 | 14.2.1.4 | ✔ |
| Reference Sensitivity - FACCH/F | 4.2.43 | 14.2.3.4 | ✔ |
| Minimum Input Level for Reference Performance - GPRS | 4.2.44 | 14.16.1.4 | ✔ |
| Minimum Input Level for Reference Performance - EGPRS | 4.2.45 | 14.18.1.4 | ✔ |

**Notes:**

1. *According to ETSI TS 151 010-1 V12.8.0 (2016-05).*
2. *For RF exposure.*

**Test Case Verdicts:**

| | |
|---|---|
| N/A | Test case does not apply to EUT. |
| N/T | Test case was not performed on EUT. |
| ✔ | Test case passed the minimum conformance requirements. |
| ✔ | Test case passed the minimum conformance requirements as a certified module, assessed by an ISO 17025 accredited laboratory, refer to the test report Appendix A. |
| ✔ | Test case passed the minimum conformance requirements with a margin less than the uncertainty budget. |
| ✘ | Test case failed the minimum conformance requirements. |

## 3. CONCLUSION

Based on the results of our investigation, it is concluded that the EUT (in the configuration tested) **complies** with the requirements of the standard(s) indicated in this test report. The results obtained in this test report are only valid for the item(s) tested. iSERT (Pty) Ltd. does not make any claims of compliance for samples or variants which were not tested.

In cases where levels measured are within the laboratory's stated uncertainty budget, there is a possibility that this unit, or a similar unit selected from production may not meet the required limit specification should it be tested by another agency.

# 4. EQUIPMENT DESCRIPTION

**Table 2:** Equipment Under Test Description

| Description | Customer Declaration | |
|---|---|---|
| Type Of Equipment | Stand-alone radio equipment | |
| Intended Use | Portable Outdoor | |
| Operational Frequency Band (S) | GSM900, DCS1800 | |
| Supported Network | Packet Data | |
| Radio Modular Detail | Quectel BG600L-M3 | |
| Maximum Transmitter Power | 33 dBm (GSM900), 30 dBm (DCS1800) | |
| Modulation | GMSK | |
| GPRS Class | 12 | |
| Other Radio Technologies | 868 MHz Sigfox, 868 MHz LoRaWAN, NB-IoT | |
| Antenna Details | Location | Internal |
| | Type | Cellular Flex Antenna |
| | Make/Model | Antenova FlexiiANT – Armata SRFC011 |
| | Gain | 2.46 dBi |
| Power Source | Internal | Lithium-Ion Polymer Battery |
| | External | -- |
| Build Status | Production | |
| Build Revision | Hardware | V1.04 |
| | Software | Not Provided |

# 5. MEASURING EQUIPMENT SETUP AND CONFIGURATION

## 5.1. MEASUREMENT EQUIPMENT

**Table 3:** Calibration Information of Measurement Equipment

| Instrument | Manufacturer | Model | Serial number | Next Cal date |
|---|---|---|---|---|
| Signal Analyzer | Keysight | N9020A | MY52330018 | June 2024 |
| Universal Radio Tester | R & S | CMW500 | 112781 | October 2024 |
| Horn antenna | AH systems | SAS-571 | 1129 | February 2028 |
| Combilog antenna | ETS Lingren | 3142B | 2613 | June 2027 |
| Pre-Amplifier | Adv Microwave | WLA652B | ISQ002 | January 2024 |
| High Pass Filter | Wainwright | WHKX12-1000 | IS0002 | November 2024 |
| Coaxial Cable | Semflex | 60637 | X116BFSX10060 | October 2024 |
| Coaxial Cable | Mini-Circuits | CBL-0.5M-NMNM+ | 122547 | November 2024 |
| Multimeter | Fluke | 179 | 40850243 | November 2024 |
| Laboratory Power Supply | Manson | HCS-3202 | G071710100 | Verify before use |
| Temperature Hygrometer | Flus | ET-951W | 2015106449 | November 2024 |
| Environmental chamber | Jeiotech | PBV-012 | 1B097018 | January 2024 |

## 5.2. MEASUREMENT UNCERTAINTY

ISO / IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions results be included in the test report. The uncertainties were calculated according to TF 100 028 [2] and are based on a 95.45% confidence level (coverage factor k = 2).

**Table 4:** Measurement Uncertainty

| Parameter | Range | Test Uncertainty |
|---|---|---|
| Radio frequency | 9kHz to 26.5GHz | ±22.8Hz |
| Total RF power conducted | 400MHz to 6GHz | ±0.47dB |
| Effective radiated power | 400MHz to 1GHz | ±2.18dB |
| Equivalent Isotopically Radiated Power | 1GHz to 3GHz | ±3.42dB |
| RF emissions radiated | 30MHz to 200MHz | ±5.16dB |
| | 200MHz to 1GHz | ±4.44dB |
| | 1GHz to 18GHz | ±4.15dB |
| | 18GHz to 26.5GHz | ±4.34dB |
| RF emissions conducted | 9kHz to 10MHz | ±1.78dB |
| | 10MHz to 1GHz | ±1.56dB |
| | 1GHz to 18GHz | ±2.76dB |
| | 18GHz to 26.5GHz | ±2.83dB |
| Transmitter maximum output power | 700MHz to 3GHz | ±0.47dB |
| DC voltages | 10mV to 600V | ±0.7% |
| Temperature | -20°C to +85°C | ±0.9°C |
| Humidity | 10% to 75% | ±5.0% |

## 5.3. MEASUREMENT SETUP

### 5.3.1. RADIATED SETUP

All radiated measurements were performed inside a CISPR-16 compliant, fully anechoic shielded chamber, with an antenna-to-EUT distance of 3m, represented by Figures 1 and 2.

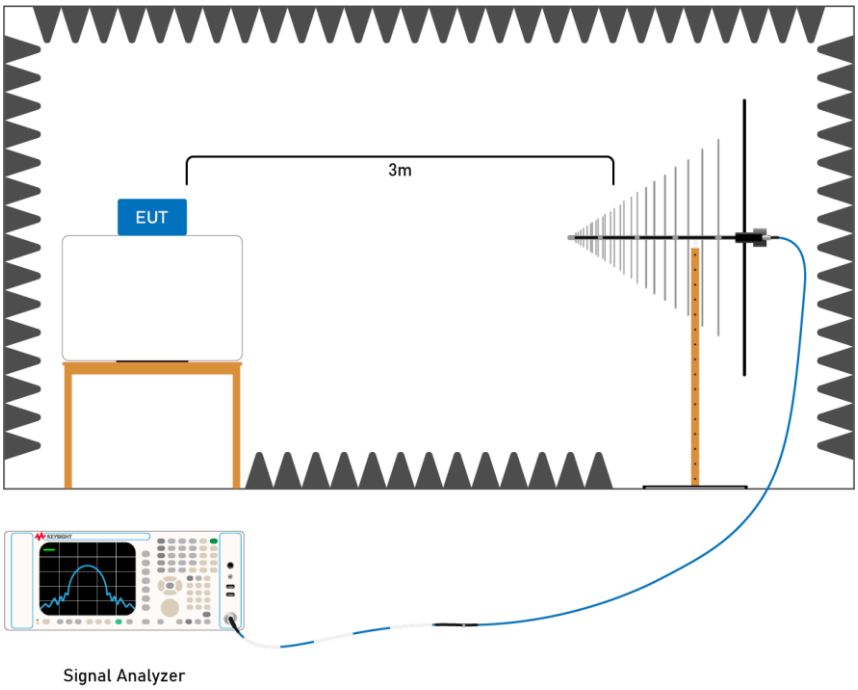



**Figure 1:** Radiated Emissions Setup Below 1 GHz

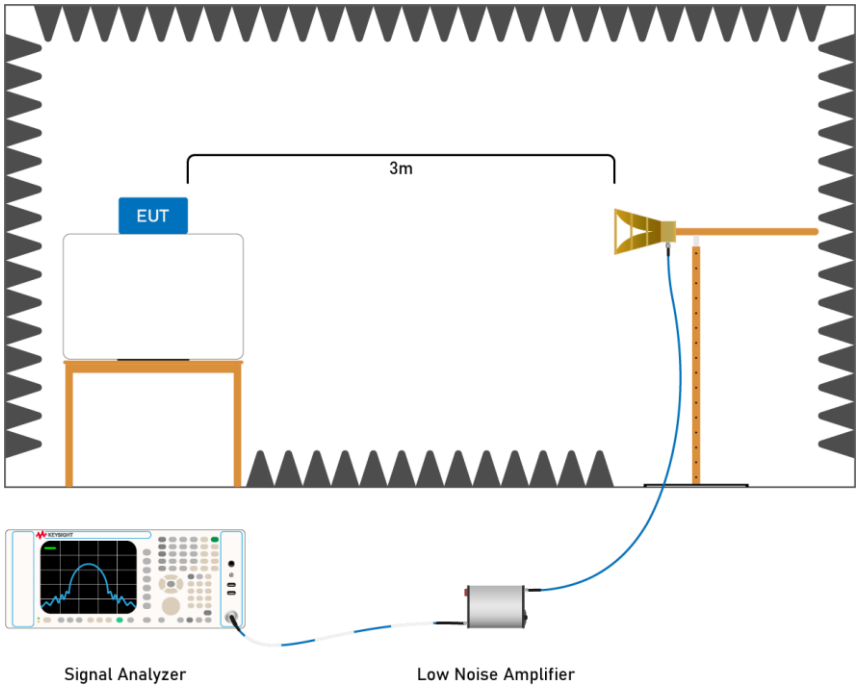



**Figure 2:** Radiated Emissions Setup Above 1 GHz

### 5.3.2. CONDUCTED SETUP

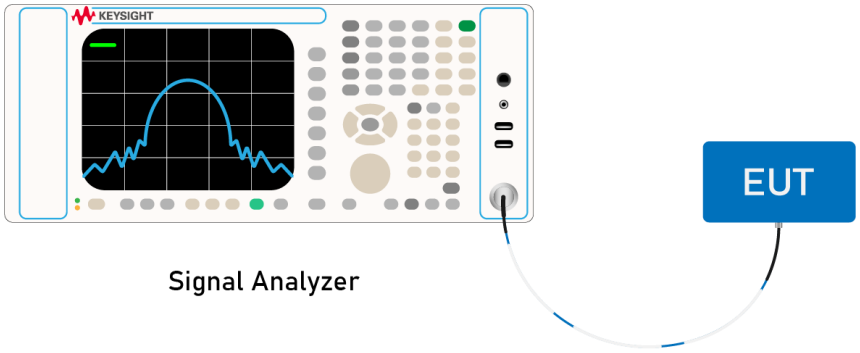



**Figure 3:** Conducted Setup

### 5.3.3. EXTREME CONDITIONS SETUP

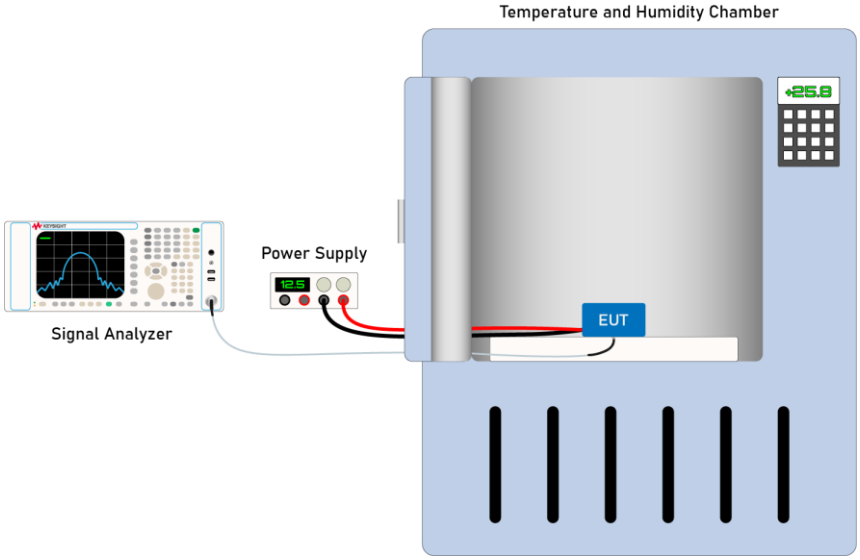



**Figure 4:** Extreme Conditions Setup

## 5.4. GSM TEST SIGNALS

A test signal, according to ETSI TS 151 010-1 V12.8.0 (2016-05) A5.2, is a modulated or unmodulated carrier generated by the EUT to facilitate a test. During this assessment the EUT must generating one or more of the following test signals:

**Table 5:** List of Test Signals

| Test Signal | Description |
|---|---|
| C0 | Unmodulated continuous carrier. |
| C1 | A standard signal with GMSK AQPSK, 8-PSK, 16-QAM or 32-QAM modulation as appropriate. The channel coder will depend on the test and the cipher mode shall be selectable by the test method. When using this signal in the non-hopping mode, the unused seven time slots shall also contain dummy bursts, with power levels variable with respect to the used timeslot, see also DYNAMIC LEVEL SETTING in subclause A5.3.4.7 of ETSI TS 151 010-1 V12.8.0 (2016-05). |

# 6. TEST SETUP AND CONFIGURATION

## 6.1. TEMPERATURE CONDITIONS

### 6.1.1. NORMAL

All measurements were taken under conditions of temperature and humidity that were within the limits specified in ETSI TS 151 010-1 V12.8.0 (2016-05) clause A1.2.2.

**Table 6:** Environmental Conditions during Testing

| Condition | Value | Limit |
|---|---|---|
| Temperature | +20°C to +22°C | +15°C to +35°C |
| Relative Humidity | 38% to 42% | Up to 75% |

### 6.1.2. EXTREME

For tests at extreme temperatures, measurements shall be made in accordance with the procedures specified in ETSI TS 151 010-1 V12.8.0 (2016-05) clause A1.2.3, at the upper and lower temperature ranges given in the table below.

**Table 7:** Extreme Temperature Ranges

| Description | Temperature Range |
|---|---|
| Small MS Units | -10°C to +55°C |
| Other Units | -20°C to +55°C |

The RF module was already certified at extreme temperatures through an accredited test lab, therefore all tests in this report were conducted in normal temperature conditions.

## 6.2. POWER SUPPLY DETAILS

The equipment shall be tested using the appropriate test power source as specified in ETSI TS 151 010-1 V12.8.0 (2016-05) clauses A1.2.2 and A1.2.3.

The EUT was assessed at test voltages described in the table below as declared by the manufacturer.

**Table 8:** Equipment Under Test Extreme Voltages

| Source Location | Source Type | Source Description | Power source range (V) | | |
|---|---|---|---|---|---|
| | | | VL | VN | VH |
| Internal | DC | Lithium-Ion Polymer Battery | (1) | 3.7 | (1) |
| External | -- | -- | -- | -- | -- |

**Notes:**

1. *The RF module was already certified at extreme voltages through an accredited test lab, therefore all tests in this report were conducted in normal voltage conditions.*

## 6.3. SUPPORT EQUIPMENT AND SOFTWARE

### 6.3.1. SUPPORT EQUIPMENT

The support equipment below was used during this assessment:

**Table 9:** List of Support Equipment

| Instrument | Manufacturer | Model | Serial number |
|---|---|---|---|
| -- | -- | -- | -- |

### 6.3.2. AUXILIARY EQUIPMENT

The EUT has been tested as an independent unit with Ancillary/auxiliary equipment. The following equipment/accessories were used to form a representative test configuration during this assessment:

**Table 10:** List of Auxiliary Equipment

| Product Description | Manufacturer | Model Number | Serial number |
|---|---|---|---|
| -- | -- | -- | -- |

### 6.3.3. INPUT/OUTPUT CABLES

**Table 11:** List of External Input and/or Output Cables

| Cable Description | Length (m) | From Port | To |
|---|---|---|---|
| -- | -- | -- | -- |

### 6.3.4. EXERCISE SOFTWARE

The EUT was programmed with production software for the test configuration.

## 6.4. MODIFICATION RECORD

| Modification | | Description |
|---|---|---|
| ✓ | None | No modification was made to the EUT during this assessment. |
| | Temporary RF connector | To facilitate some measurements, the customer provided a separate EUT that was fitted with a 50Ω coaxial connector in place of the integral antenna as per ETSI EN 301 511 V12.5.1 (2017-03) clause 4.3.8.2 |

## 6.5. DEVIATIONS FROM THE TEST STANDARD

No deviations from the applicable test standards or test plan were made during this assessment.

## 6.6. OPERATING CHANNELS AND PICS / PIXIT INFORMATION

**Table 12:** GSM Operating Channel Information

| Band | Name | DL Frequency (MHz) | | | DL / UL BW (MHz) | UL Frequency (MHz) | | | Network BW (kHz) | Tx Class | Power (dBm) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Low | Middle | High | | Low | Middle | High | | | |
| 3 | 1800+ | 1805 | 1842.5 | 1880 | 75 | 1710 | 1747.5 | 1785 | 200 | 1 | 30 |
| 8 | 900 GSM | 925 | 942.5 | 960 | 35 | 880 | 897.5 | 915 | 200 | 4 | 33 |

## 6.7. GSM MODES OF OPERATION

### 6.7.1. MODE 1 – MS IDLE

The GSM on the EUT was enabled but not allowed to attach to any network. If the EUT consists of more than one transceiver, these transceivers are disabled.

### 6.7.2. MODE 2 – GSM900 MS ALLOCATED

The GSM on the EUT was enabled and allowed to connect to the Universal Radio Tester. A data cell was established in loop-back mode to transmit a continuous GPRS signal on ARFCN 62 (middle channel) with the settings below:

- Transmit Power: 33 dBm
- Transfer Rate: 85.6 Kbps (uplink)
- Modulation: GMSK

If the EUT consists of more than one transceiver, these transceivers were disabled.

For the worst possible condition with regards to transmit power (33 dBm), GPRS (class 4) was selected.

### 6.7.3. MODE 3 – DCS1800 MS ALLOCATED

The GSM on the EUT was enabled and allowed to connect to the Universal Radio Tester. A data cell was established in loop-back mode to transmit a continuous GPRS signal on ARFCN 698 (middle channel) with the settings below:

- Transmit Power: 30 dBm
- Transfer Rate: 85.6 Kbps (uplink)
- Modulation: GMSK

If the EUT consists of more than one transceiver, these transceivers were disabled.
For the worst possible condition with regards to transmit power (30 dBm), GPRS (class 1) was selected.

## 6.8. TEST CONFIGURATION

**Table 13:** Equipment Under Test Configuration for GSM Tests

| Parameter to be tested | Test Signal | Band | Mode | Test Channel | Power Source | RF Port | Condition |
|---|---|---|---|---|---|---|---|
| Transmitter Output Power | C1 | 900 | 2 | Middle | External | Radiated | Normal |
| | | 1800 | 3 | | | | |
| Radiated Spurious Emissions – MS Allocated | | 900 | 2 | | | | |
| | | 1800 | 3 | | | | |
| Radiated Spurious Emissions – MS Idle | | 900 | 1 | | | | |
| | | 1800 | | | | | |

## 6.9. TYPES OF GSM MOBILE STATIONS

ETSI EN 301 511 V12.5.1 (2017-03) Table B.1 lists the following types of mobile stations:

**Table 14:** Types of Mobile Stations

| Item | Type of Mobile Station | Support | Mnemonic |
|---|---|---|---|
| 1 | HSCSD Multislot MS | | Type_HSCSD_Multislot |
| 2 | R-GSM MS | | Type_R-GSM |
| 3 | GPRS Multislot class on the UL | ✓ | Type_GPRS_Multislot_uplink |
| 4 | EGPRS | | Type_EGPRS |
| 5 | EGPRS 8PSK in UL, of all Multislot classes | | Type_EGPRS_8PSK_uplink |
| 6 | ER-GSM MS | | Type_ER-GSM |
| 7 | DLMC MS | | Type_DLMC |
| 8 | 8W Improved Receiver R-GSM MS/ER-GSM MS | | Type_8W_Improved_Receiver |
| 9 | 2W Improved Receiver R-GSM MS/ER-GSM MS | | Type_2W_Improved_Receiver |

## 6.10. ADDITIONAL INFORMATION FOR GSM

Additional information related to the device configuration according to ETSI EN 301 511 V12.5.1 (2017-03) Table C.1:

**Table 15:** Device Configuration Additional Information

| Item | Additional Information | Support | Mnemonic |
|---|---|---|---|
| 1 | Telephony | | TSPC_Serv_TS11 |
| 2 | Permanent Antenna Connector | ✓ | TSPC_AddInfo_PermAntenna |
| 3 | Integrated Antenna | ✓ | TSPC_AddInfo_HHIntegAntenna |

# 7. DETAILS OF TEST RESULTS

## 7.1. TRANSMITTER OUTPUT POWER

### 7.1.1. DESCRIPTION

According to ETSI TS 151 010-1 V12.8.0 (2016-05), the transmitter output power is the average value of the power delivered to an artificial antenna or radiated by the MS and its integral antenna, over the time that the useful information bits of one burst are transmitted.

This test is normally done at the RF port but in this case the Effective Radiated Power is measured to determine antenna performance as well as to assist with Human exposure calculations when the product is operated at more than 20 cm from a human body.

### 7.1.2. LIMITS

**Table 16:** Transmitter Output Power Limits

| Frequency Band | Mode of Operation | Power class | Power control level | Maximum power (dBm) |
|---|---|---|---|---|
| GSM900 | GPRS | 4 | 5 | 33 |
| DCS1800 | GPRS | 1 | 0 | 30 |

### 7.1.3. RESULTS

**Table 17:** Transmitted Radiated Output Power Results

| Test Condition | | Power Control Level | Operating Band | ARFCN | Frequency (MHz) | Level Measured (dBm) | Limit (dBm) | Result |
|---|---|---|---|---|---|---|---|---|
| Temp (°C) | Voltage (V) | | | | | | | |
| TN | VN | 5 | GSM900 | 62 | 902.4 | 15.6 | 33 | Pass |
| | | 0 | DCS1800 | 698 | 1747.4 | 20.3 | 30 | Pass |

## 7.2. RADIATED SPURIOUS EMISSIONS – MS ALLOCATED

### 7.2.1. DESCRIPTION

According to ETSI TS 151 010-1 V12.8.0 (2016-05), radiated spurious emissions, when the MS has been allocated a channel, are any emissions radiated by the cabinet and structure of the mobile station, including all interconnecting cables.

### 7.2.2. LIMITS

According to ETSI TS 151 010-1 V12.8.0 (2016-05), The radiated spurious power emitted by the MS, when allocated a channel, shall be no more than the levels in Table 18 under normal and extreme voltage conditions.

**Table 18:** Limits for Radiated Spurious Emissions – MS Allocated

| Frequency Range | Power Level Limit (dBm) | | |
|---|---|---|---|
| | **GSM 400<br>GSM 700<br>T-GSM 810<br>GSM 850<br>GSM 900** | **DCS 1800** | **PCS 1900** |
| 30 MHz to 1 GHz | -36 | -36 | -36 |
| 1 GHz to 4 GHz | -30 | -- | -30 |
| 1 GHz to 1710 MHz | -- | -30 | -- |
| 1710 MHz to 1785 MHz | -- | -36 | -- |
| 1785 MHz to 4 GHz | -- | -30 | -- |

### 7.2.3. RESULTS

**Table 19:** Results for Radiated Spurious Emissions – MS Allocated to GSM900

| Frequency (MHz) | Level (dBm) | Receive Antenna Polarization | Receiver RBW (kHz) | Detector Used | Limit (dBm) | Margin (dB) | Test Result |
|---|---|---|---|---|---|---|---|
| 1804 | -43.2 | H | 1000 | PK | -30 | -13.2 | Pass |
| 1804 | -41.1 | V | 1000 | PK | -30 | -11.1 | Pass |
| 1933 | -52.8 | H | 1000 | PK | -30 | -22.8 | Pass |
| 2708 | -50.2 | H | 1000 | PK | -30 | -20.2 | Pass |

**Table 20:** Results for Radiated Spurious Emissions – MS Allocated to DCS1800

| Frequency (MHz) | Level (dBm) | Receive Antenna Polarization | Receiver RBW (kHz) | Detector Used | Limit (dBm) | Margin (dB) | Test Result |
|---|---|---|---|---|---|---|---|
| 2562 | -48.7 | V | 1000 | PK | -30 | -18.7 | Pass |
| 2565 | -53.8 | H | 1000 | PK | -30 | -23.8 | Pass |
| 2612 | -53.0 | V | 1000 | PK | -30 | -23.0 | Pass |
| 3494 | -50.2 | V | 1000 | PK | -30 | -20.2 | Pass |
| 3496 | -50.0 | H | 1000 | PK | -30 | -20.0 | Pass |

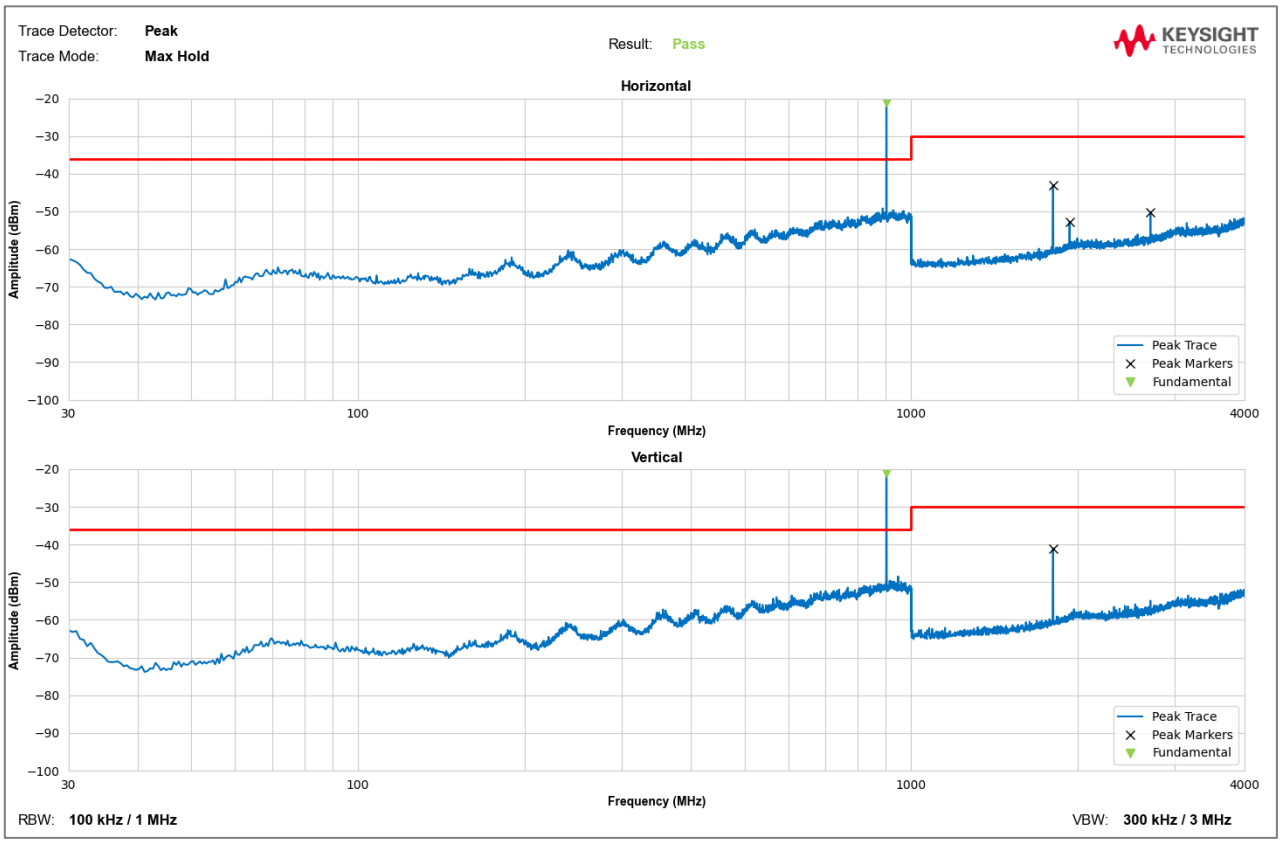



**Figure 5:** Results for Radiated Spurious Emissions – MS Allocated to GSM900

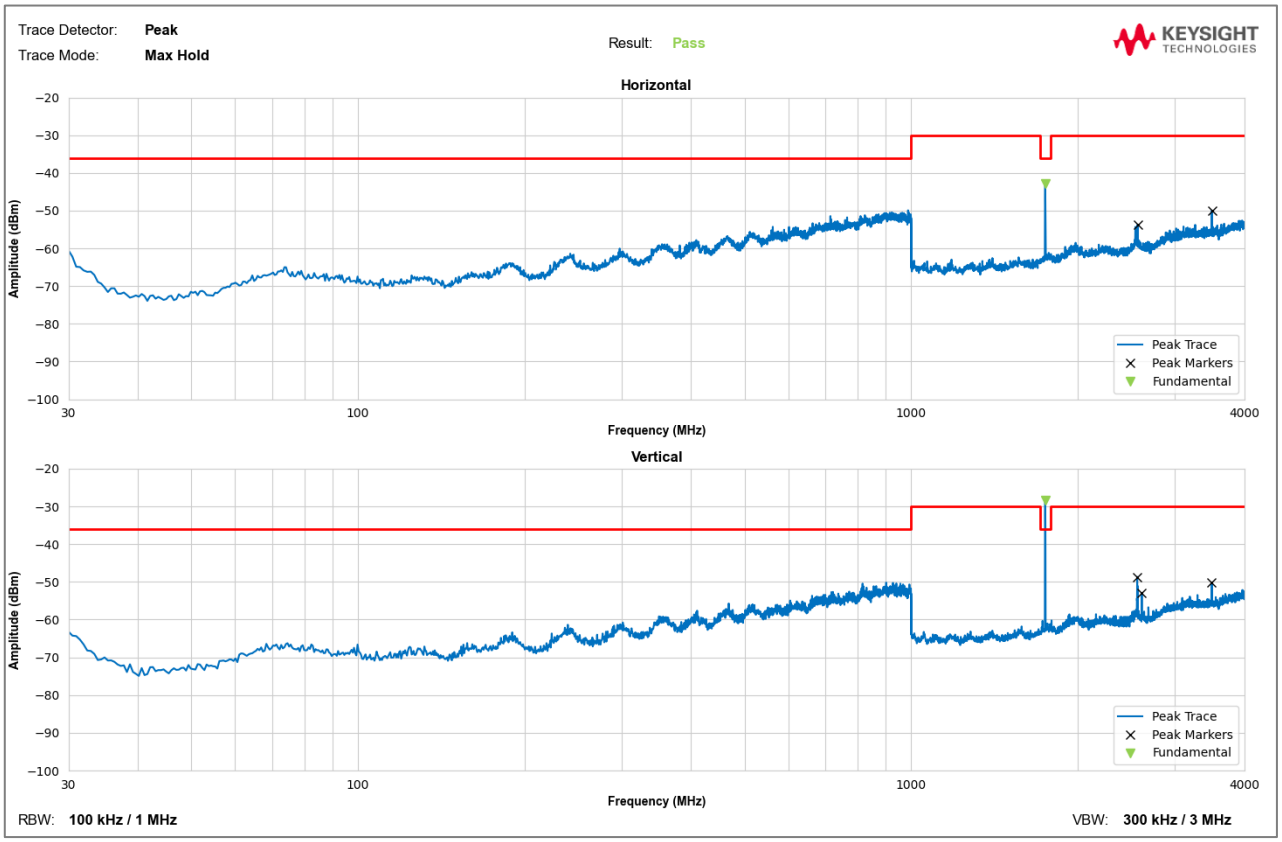



**Figure 6:** Results for Radiated Spurious Emissions – MS Allocated to DCS1800

## 7.3. RADIATED SPURIOUS EMISSIONS – MS IDLE

### 7.3.1. DESCRIPTION

According to ETSI TS 151 010-1 V12.8.0 (2016-05), radiated spurious emissions, when the MS is in idle mode, are any emissions radiated by the cabinet and structure of the mobile station, including all interconnecting cables.

### 7.3.2. LIMITS

According to ETSI TS 151 010-1 V12.8.0 (2016-05), the radiated spurious power emitted by the MS, when in idle mode, shall be no more than the levels in Table 21 under normal and extreme voltage conditions.

**Table 21:** Limits for Radiated Spurious Emissions – MS Idle

| Frequency Range | Power Level Limit (dBm) | |
|---|---|---|
| | **GSM 400<br>T-GSM 810<br>GSM 900<br>DCS 1800** | **GSM 700<br>GSM 850<br>PCS 1900** |
| 30 MHz to 880 MHz | -57 | -57 |
| 880 MHz to 915 MHz | -59 | -57 |
| 915 MHz to 1 GHz | -57 | -57 |
| 1 GHz to 1710 MHz | -47 | -- |
| 1710 MHz to 1785 MHz | -53 | -- |
| 1785 MHz to 4 GHz | -47 | -- |
| 1 GHz to 1850 MHz | -- | -47 |
| 1850 MHz to 1910 MHz | -- | -53 |
| 1910 MHz to 4 GHz | -- | -47 |

### 7.3.3. RESULTS

**Table 22:** Results for Radiated Spurious Emissions – MS Idle

| Frequency (MHz) | Level (dBm) | Receive Antenna Polarization | Receiver RBW (kHz) | Detector Used | Limit (dBm) | Margin (dB) | Test Result |
|---|---|---|---|---|---|---|---|
| 30 – 1000 | Noise Floor | H / V | 100 | PK | Table 21 | -- | Pass |
| 1000 – 4000 | Noise Floor | H / V | 1000 | PK | | -- | Pass |

**Notes:**

*During this assessment, preliminary tests were performed in **Idle mode** in all the frequency bands covered in this test report. The GSM900 band was selected as the worst-case condition and only the worst-case condition results were recorded in this test report.*

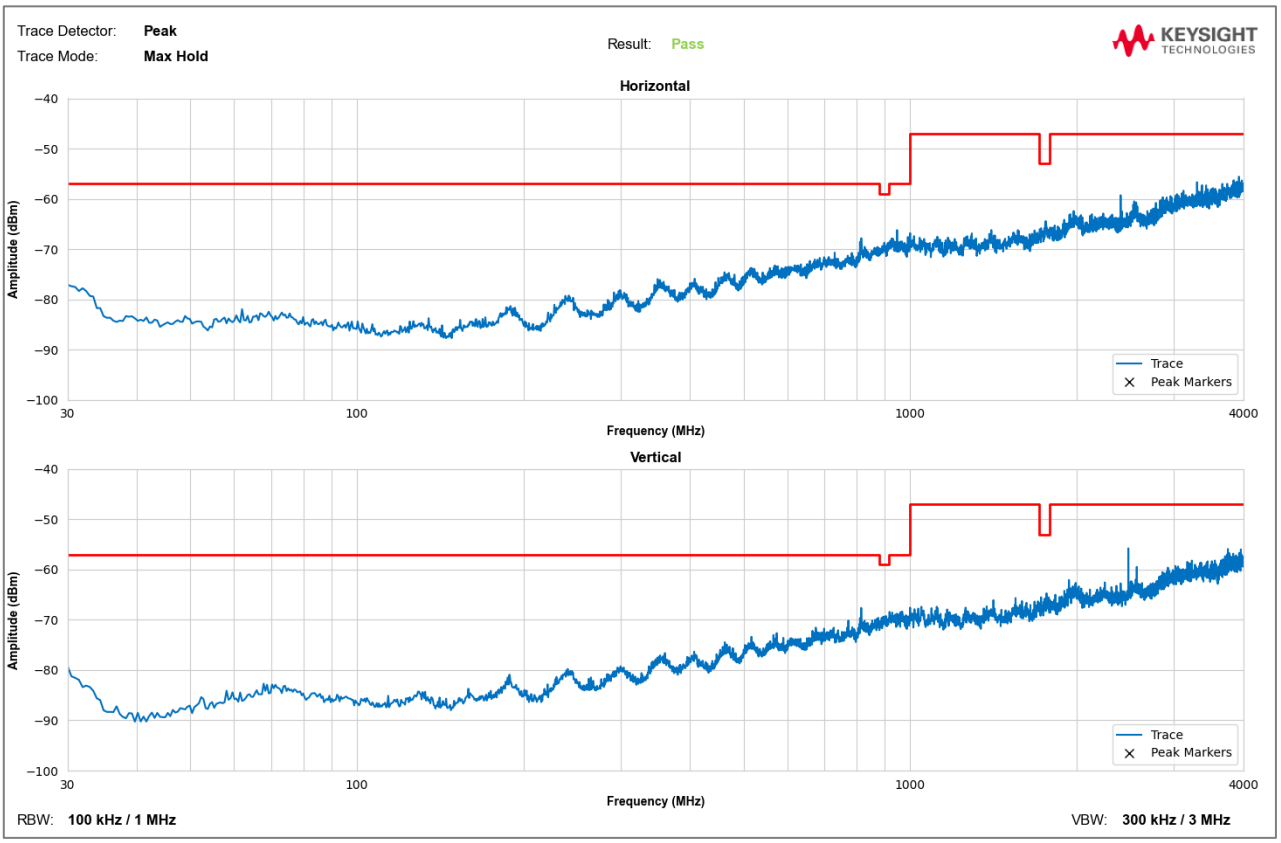
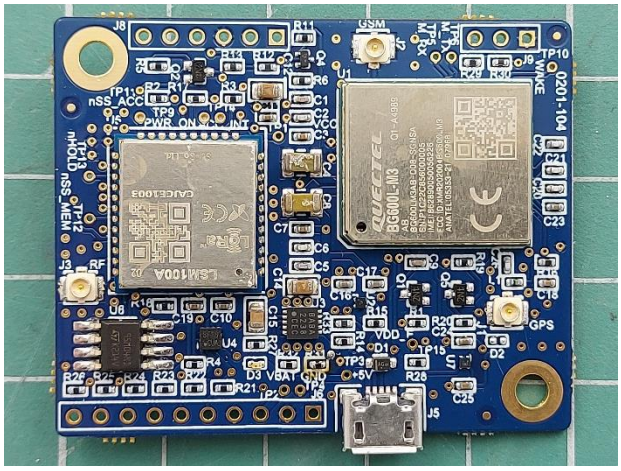


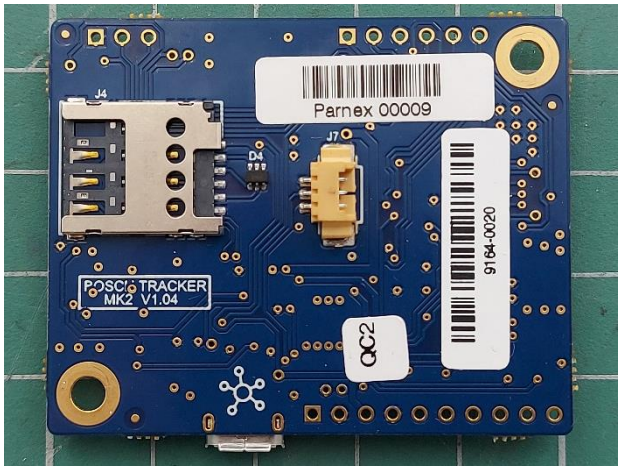

**Figure 7:** Results for Radiated Spurious Emissions – MS Idle

## 8. TEST IMAGES


**Figures 8 & 9:** Measurement Setup for Radiated Emissions between 30 MHz and 4 GHz


**Figures 10 & 11:** External Top and Bottom View of EUT






**Figures 12 & 13:** Internal Top and Bottom View of EUT



**Figures 14 & 15:** Detailed View of RF Circuit

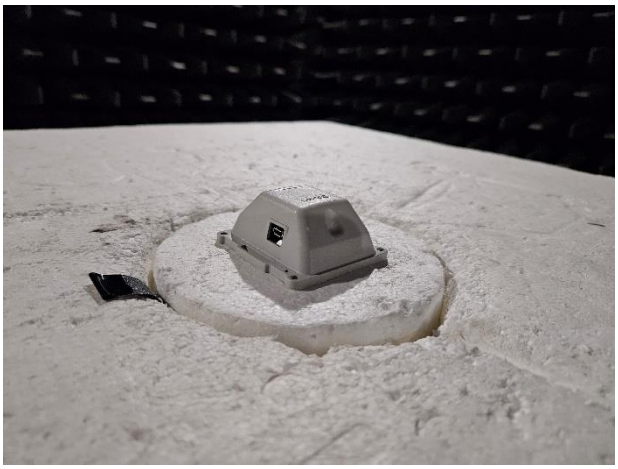


**Figure 16:** Setup of EUT in the Fully Anechoic Chamber

*** END OF THIS REPORT ***

## APPENDIX A: MODULAR TEST REPORT

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# RF TEST REPORT

| | |
|---|---|
| **Applicant** | Quectel Wireless Solutions Co., Ltd |
| **Product** | LTE Cat M1 & Cat NB2 & EGPRS Module |
| **Brand** | Quectel |
| **Model** | BG600L-M3 |
| **Report No.** | R2003A0167-R1 |
| **Issue Date** | June 15, 2020 |

TA Technology (Shanghai) Co., Ltd. tested the above equipment in accordance with the requirements in **ETSI EN 301 511 V12.5.1**. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

*Performed by: Peng Tao* *Approved by: Kai Xu*


## TA Technology (Shanghai) Co., Ltd.

*No.145, Jintang Rd, Tangzhen Industry Park, Pudong Shanghai, China*

*TEL:+86-021-50791141/2/3*

*FAX:+86-021-50791141/2/3-8000*

# TABLE OF CONTENT

# Summary of Measurement Results

| Test case | | Conclusion |
|---|---|---|
| ETSI EN 301 511 V12.5.1 (ETSI TS 151 010-1 V12.8.0) | 4.2.1 (13.1) Transmitter - Frequency error and phase error | PASS |
| | 4.2.2 (13.2) Transmitter - Frequency error under multipath and interference conditions | PASS |
| | 4.2.4 (13.16.1)Frequency error and phase error in GPRS multi-slot configuration | PASS |
| | 4.2.5 (13.3)Transmitter output power and burst timing - MS with permanent or temporary antenna connector | PASS |
| | 4.2.6 (13.4)Output RF spectrum | PASS |
| | 4.2.10 (13.16.2)Transmitter output power in GPRS multi-slot configuration | PASS |
| | 4.2.11 (13.16.3)Output RF spectrum in GPRS multi-slot configuration | PASS |
| | 4.2.12 (12.1.1) Conducted spurious emissions, MS allocated a channel | PASS |
| | 4.2.13 (12.1.2) Conducted spurious emissions, MS in idle mode | PASS |
| | 4.2.16 (12.2.1) Radiated spurious emissions, MS allocated a channel | PASS |
| | 4.2.17 (12.2.2) Radiated spurious emissions, MS in idle mode | PASS |
| | 4.2.20 (14.7.1) Receiver Blocking and spurious response – speech channels | PASS |
| | 4.2.26 (13.17.1)Frequency error and modulation accuracy in EGPRS configuration | PASS |
| | 4.2.27 (13.17.2)Frequency error under multi-path and interference conditions in EGPRS configuration | PASS |
| | 4.2.28 (13.17.3)EGPRS Transmitter output power | PASS |
| | 4.2.29 (13.17.4)Output RF spectrum in EGPRS configuration | PASS |
| | 4.2.30 (14.18.5) Blocking and spurious response | PASS |
| | 4.2.32(14.6.1)Intermodulation rejection - speech channels | PASS |
| | 4.2.34 (14.18.4)Intermodulation rejection - EGPRS (GMSK/8PSK) | PASS |
| | 4.2.35( 14.8.1)AM suppression - speech channels | PASS |
| | 4.2.38 (14.5.1)Adjacent channel rejection - speech channels (TCH/FS) | PASS |
| | 4.2.40 (14.18.3)Adjacent channel rejection - EGPRS (GMSK/8PSK) | PASS |

| | | |
|---|---|---|
| | 4.2.42 (14.2.1)Reference sensitivity - TCH/FS | PASS |
| | 4.2.43 (14.2.3)Reference sensitivity - FACCH/F | PASS |
| | 4.2.44 (14.16.1)Minimum Input level for Reference Performance - GPRS | PASS |
| | 4.2.45 (14.18.1)Minimum Input level for Reference Performance - EGPRS (GMSK/8PSK) | PASS |
| Date of Testing: April 23, 2020 ~ June 3, 2020 | | |
| Note: All indications of Pass/Fail in this report are opinions expressed by TA Technology (Shanghai) Co., Ltd. based on interpretations and/or observations of test results. Measurement Uncertainties were not taken into account and are published for informational purposes only. | | |

# 1. Test Laboratory

## 1.1. Notes of the test report

This report shall not be reproduced in full or partial, without the written approval of **TA Technology (Shanghai) Co., Ltd.** The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. Measurement Uncertainties were not taken into account and are published for informational purposes only. This report is written to support regulatory compliance of the applicable standards stated above.

## 1.2. Test facility

**A2LA (Certificate Number: 3857.01)**

TA Technology (Shanghai) Co., Ltd. has been listed by American Association for Laboratory Accreditation to perform electromagnetic emission measurement.

## 1.3. Testing Location

| | |
|---|---|
| Company: | TA Technology (Shanghai) Co., Ltd. |
| Address: | No.145, Jintang Rd, Tangzhen Industry Park, Pudong Shanghai, China |
| City: | Shanghai |
| Post code: | 201201 |
| Country: | P. R. China |
| Contact: | Xu Kai |
| Telephone: | +86-021-50791141/2/3 |
| Fax: | +86-021-50791141/2/3-8000 |
| Website: | http://www.ta-shanghai.com |
| E-mail: | xukai@ta-shanghai.com |

# 2. General Description of Equipment under Test

## 2.1. Applicant and Manufacturer Information

| | |
|---|---|
| **Applicant** | Quectel Wireless Solutions Co., Ltd |
| **Applicant address** | Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin Road, Minhang District, Shanghai, China 200233 |
| **Manufacturer** | Quectel Wireless Solutions Co., Ltd |
| **Manufacturer address** | Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin Road, Minhang District, Shanghai, China 200233 |

## 2.2. General information

| **EUT Description** | | | |
|---|---|---|---|
| Model | BG600L-M3 | | |
| IMEI | 860873040012816 | | |
| Hardware Version | R1.2 | | |
| Software Version | BG600LM3LAR02A03 | | |
| Power Supply | External Power Supply | | |
| Antenna Type | The EUT don't have standard Antenna, The Antenna used for testing in this report is the after-market accessory (Dipole Antenna) | | |
| Antenna Gain | 4dBi | | |
| Test Mode(s) | GSM 900/GSM 1800 | | |
| Test Modulation | GSM /GPRS: GMSK<br>EGPRS: GMSK/8PSK | | |
| Operating Frequency Range(s) | Band | Tx (MHz) | Rx (MHz) |
| | GSM 900 | 880 ~ 915 | 925 ~ 960 |
| | GSM 1800 | 1710 ~ 1785 | 1805 ~ 1880 |
| Note: 1. The EUT is sent from the applicant to TA and the information of the EUT is declared by the applicant. | | | |

# 3. Applied Standards

According to the specifications of the manufacturer, it must comply with the requirements of the following standards:

**Test standards**

- **ETSI EN 301 511 V12.5.1 (2017-03)**
- **ETSI TS 151 010-1 V12.8.0 (2016-05)**

# 4. PICS/PIXIT Information

| Item | Release | Type of Mobile Station |
|---|---|---|
| 1 | Phase 2 | Extended GSM Band (EGSM900) |
| 2 | Phase 2 | DCS 1800 |
| 3 | Phase 2 | GSM Power Class 4 |
| 4 | Phase 2 | DCS Power Class 1 |
| 5 | R97 | GPRS Multislot operation |
| 6 | R97 | GPRS Multislot Class33 |
| 7 | R99 | EGPRS capable of 8PSK in Uplink, of all Multislot classes |
| 8 | R99 | EGPRS Multislot Class33 |

# 5. The Case Results

**Test Information**

| **Normal Condition:** | |
|---|---|
| Ambient Temperature | 19~25°C |
| Voltage | 3.8 V |
| Relative Humidity | 25~70% |
| **Extreme Conditions:** | |
| Temperature | High:+85°C |
| | Low: -40°C |
| Voltage | High: 4.3 V |
| | Low: 3.3 V |
| NV | Normal Voltage |
| HV | High Voltage |
| LV | Low Voltage |
| NTC | Normal test condition |
| LT/LV | Low Temperature, Low Voltage |
| LT/HV | Low Temperature, High Voltage |
| HT/LV | High Temperature, Low Voltage |
| HT/HV | High Temperature, High Voltage |
| Vib -X | Vibration test condition for X axis |
| Vib -Y | Vibration test condition for Y axis |
| Vib -Z | Vibration test condition for Z axis |
| Test cases | Identification number and description in 3GPP test specification and ETSI test specification |
| Pass | Amount of test cases which are conformant to the applied standards in the given GSM frequency band |
| Fail | Amount of test cases which are not conformant to the applied standards in the given GSM frequency band |
| Category | Describes the current test categories as specified in the Conformance Assessment Table of GCF-CC and NAPRD TC list |

| ETSI EN 301 511 V12.5.1 (ETSI TS 151 010-1 V12.8.0) | | | |
|---|---|---|---|
| Test case | Condition | GSM 900 | GSM 1800 |
| | | Results | |
| 4.2.1 (13.1) Transmitter - Frequency error and phase error | NTC | PASS | PASS |
| | HTHV | PASS | PASS |
| | HTLV | PASS | PASS |
| | LTHV | PASS | PASS |
| | LTLV | PASS | PASS |
| | Vib -X | PASS | PASS |
| | Vib -Y | PASS | PASS |
| | Vib - Z | PASS | PASS |
| 4.2.2 (13.2) Transmitter Frequency error under multipath and interference conditions | NTC | PASS | PASS |
| | HTHV | PASS | PASS |
| | HTLV | PASS | PASS |
| | LTHV | PASS | PASS |
| | LTLV | PASS | PASS |
| 4.2.4 (13.16.1) Frequency error and phase error in GPRS multi-slot configuration | NTC | PASS | PASS |
| | HTHV | PASS | PASS |
| | HTLV | PASS | PASS |
| | LTHV | PASS | PASS |
| | LTLV | PASS | PASS |
| | Vib -X | PASS | PASS |
| | Vib -Y | PASS | PASS |
| | Vib - Z | PASS | PASS |
| 4.2.5 (13.3) Transmitter output power and burst timing | NTC | PASS | PASS |
| | HTHV | PASS | PASS |
| | HTLV | PASS | PASS |
| | LTHV | PASS | PASS |
| | LTLV | PASS | PASS |
| 4.2.6 (13.4) Transmitter Output RF spectrum | HTHV, modulation | PASS | PASS |
| | HTLV, modulation | PASS | PASS |
| | LTHV, modulation | PASS | PASS |
| | LTLV, modulation | PASS | PASS |
| | HTHV, switching | PASS | PASS |
| | HTLV, switching | PASS | PASS |
| | LTHV, switching | PASS | PASS |
| | LTLV, switching | PASS | PASS |

| | | | |
|---|---|---|---|
| | modulation, normal | PASS | PASS |
| | modulation, detailed | PASS | PASS |
| | Spurious emissions in receive bands | PASS | PASS |
| | switching, normal | PASS | PASS |
| 4.2.10 (13.16.2) Transmitter output power in GPRS multi-slot configuration | NTC | PASS | PASS |
| | HTHV | PASS | PASS |
| | HTLV | PASS | PASS |
| | LTHV | PASS | PASS |
| | LTLV | PASS | PASS |
| 4.2.11 (13.16.3) Output RF spectrum in GPRS multi-slot configuration | HTHV, modulation | PASS | PASS |
| | HTLV, modulation | PASS | PASS |
| | LTHV, modulation | PASS | PASS |
| | LTLV, modulation | PASS | PASS |
| | HTHV, switching | PASS | PASS |
| | HTLV, switching | PASS | PASS |
| | LTHV, switching | PASS | PASS |
| | LTLV, switching | PASS | PASS |
| | modulation, normal | PASS | PASS |
| | modulation, detailed | PASS | PASS |
| | Spurious emissions in receive bands | PASS | PASS |
| | switching, normal | PASS | PASS |
| 4.2.12 (12.1.1) Conducted spurious emissions, MS allocated a channel | NV | PASS | PASS |
| | HV | PASS | PASS |
| | LV | PASS | PASS |
| 4.2.13 (12.1.2) Conducted spurious emissions, MS in idle mode | NV | PASS | PASS |
| | HV | PASS | PASS |
| | LV | PASS | PASS |
| 4.2.16 (12.2.1) Radiated spurious emissions, MS allocated a channel | NV | PASS | PASS |
| | HV | PASS | PASS |
| | LV | PASS | PASS |
| 4.2.17 (12.2.2) Radiated spurious emissions, MS in idle mode | NV | PASS | PASS |
| | HV | PASS | PASS |
| | LV | PASS | PASS |
| 4.2.20 (14.7.1) Receiver Blocking and spurious response – speech channels | NTC | PASS | PASS |
| 4.2.26 (13.17.1) Frequency error and modulation | NTC | PASS | PASS |
| | HTHV | PASS | PASS |

| | | | |
|---|---|---|---|
| accuracy in EGPRS configuration | HTLV | PASS | PASS |
| | LTHV | PASS | PASS |
| | LTLV | PASS | PASS |
| 4.2.27 (13.17.2) Frequency error under multi-path and interference conditions in EGPRS configuration | NTC | PASS | PASS |
| | HTHV | PASS | PASS |
| | HTLV | PASS | PASS |
| | LTHV | PASS | PASS |
| | LTLV | PASS | PASS |
| 4.2.28 (13.17.3) EGPRS Transmitter output power | NTC | PASS | PASS |
| | HTHV | PASS | PASS |
| | HTLV | PASS | PASS |
| | LTHV | PASS | PASS |
| | LTLV | PASS | PASS |
| 4.2.29 (13.17.4) Output RF spectrum in EGPRS configuration | modulation, normal | PASS | PASS |
| | modulation, detailed | PASS | PASS |
| | Spurious emissions in receive bands | PASS | PASS |
| | switching, normal | PASS | PASS |
| | HTHV, modulation | PASS | PASS |
| | HTLV, modulation | PASS | PASS |
| | LTHV, modulation | PASS | PASS |
| | LTLV, modulation | PASS | PASS |
| | HTHV, switching | PASS | PASS |
| | HTLV, switching | PASS | PASS |
| | LTHV, switching | PASS | PASS |
| | LTLV, switching | PASS | PASS |
| 4.2.30 (14.18.5) Blocking and spurious response in EGPRS | GMSK(MCS4),USF | PASS | PASS |
| | 8PSK(MCS9),USF | PASS | PASS |
| | GMSK,PDTCH | PASS | PASS |
| | 8PSK,PDTCH | PASS | PASS |
| 4.2.32(14.6.1) Intermodulation rejection - speech channels | NTC | PASS | PASS |
| | HTHV | PASS | PASS |
| | HTLV | PASS | PASS |
| | LTHV | PASS | PASS |
| | LTLV | PASS | PASS |
| 4.2.34 (14.18.4) Intermodulation rejection - EGPRS (GMSK/8PSK) | NTC | PASS | PASS |
| | HTHV | PASS | PASS |
| | HTLV | PASS | PASS |
| | LTHV | PASS | PASS |
| | LTLV | PASS | PASS |

| | | | |
|---|---|---|---|
| 4.2.35( 14.8.1)<br>AM suppression - speech channels | NTC | PASS | PASS |
| 4.2.38 (14.5.1)<br>Adjacent channel rejection - speech channels (TCH/FS) | NTC | PASS | PASS |
| | HTHV | PASS | PASS |
| | HTLV | PASS | PASS |
| | LTHV | PASS | PASS |
| | LTLV | PASS | PASS |
| 4.2.40 (14.18.3)<br>Adjacent channel rejection - EGPRS (GMSK/8PSK) | NTC | PASS | PASS |
| | HTHV | PASS | PASS |
| | HTLV | PASS | PASS |
| | LTHV | PASS | PASS |
| | LTLV | PASS | PASS |
| 4.2.42 (14.2.1)<br>Reference sensitivity - TCH/FS | NTC | PASS | PASS |
| | HTHV | PASS | PASS |
| | HTLV | PASS | PASS |
| | LTHV | PASS | PASS |
| | LTLV | PASS | PASS |
| 4.2.43 (14.2.3)<br>Reference sensitivity - FACCH/F | NTC | PASS | PASS |
| 4.2.44 (14.16.1)<br>Minimum Input level for Reference Performance - GPRS | NTC,AckNack | PASS | PASS |
| | HTHV,AckNack | PASS | PASS |
| | HTLV,AckNack | PASS | PASS |
| | LTHV,AckNack | PASS | PASS |
| | LTLV,AckNack | PASS | PASS |
| | NTC,usf | PASS | PASS |
| | HTHV,usf | PASS | PASS |
| | HTLV,usf | PASS | PASS |
| | LTHV,usf | PASS | PASS |
| | LTLV,usf | PASS | PASS |
| 4.2.45 (14.18.1)<br>Minimum Input level for Reference Performance - EGPRS (GMSK/8PSK) | NTC | PASS | PASS |
| | HTHV | PASS | PASS |
| | HTLV | PASS | PASS |
| | LTHV | PASS | PASS |
| | LTLV | PASS | PASS |

## 5.1. Maximum output power Results

During the test, the preliminary test was performed in Transmitter output power with five conditions (NTC, HTHV, HTLV, LTHV and LTLV), and the worst-case condition was recorded in this report.

| GSM 900 | | | Maximum output power (dBm) | | |
|---|---|---|---|---|---|
| Operation Mode | | Power level | Channel/Frequency (MHz) | | |
| | | | 975/880.2 | 38/897.6 | 124/914.8 |
| GSM (GMSK) | | 5 | 32.58 | 32.61 | 32.62 |
| GPRS (GMSK) | 1Txslot | 5 | 32.51 | 32.59 | 32.53 |
| | 2 Txslots | 5 | 30.86 | 30.96 | 30.95 |
| | 3 Txslots | 5 | 28.71 | 28.84 | 28.83 |
| | 4 Txslots | 5 | 27.65 | 27.79 | 27.80 |
| | 4 Txslots | 10 | 22.72 | 22.98 | 22.95 |
| | 4 Txslots | 19 | 4.92 | 5.04 | 5.06 |
| EGPRS (GMSK) | 1Txslot | 5 | 32.44 | 32.63 | 32.61 |
| | 2 Txslots | 5 | 30.78 | 31.04 | 30.98 |
| | 3 Txslots | 5 | 28.67 | 28.92 | 28.91 |
| | 4 Txslots | 5 | 27.66 | 27.88 | 27.92 |
| | 4 Txslots | 10 | 22.78 | 22.94 | 22.93 |
| | 4 Txslots | 19 | 5.07 | 5.11 | 5.12 |
| EGPRS (8PSK) | 1Txslot | 8 | 27.32 | 27.38 | 27.35 |
| | 2 Txslots | 8 | 25.37 | 25.39 | 25.41 |
| | 3 Txslots | 8 | 23.11 | 23.12 | 23.14 |
| | 4 Txslots | 8 | 22.29 | 22.31 | 22.37 |
| | 4 Txslots | 10 | 22.07 | 21.93 | 21.87 |
| | 4 Txslots | 19 | 3.62 | 3.79 | 3.54 |
| **GSM 1800** | | | **Maximum output power (dBm)** | | |
| **Operation Mode** | | **Power level** | **Channel/Frequency (MHz)** | | |
| | | | **512/1710.2** | **698/1747.4** | **885/1784.8** |
| GSM (GMSK) | | 0 | 29.45 | 29.69 | 29.80 |
| GPRS (GMSK) | 1Txslot | 0 | 29.41 | 29.70 | 29.75 |
| | 2 Txslots | 0 | 27.88 | 28.13 | 28.20 |
| | 3 Txslots | 0 | 25.88 | 26.09 | 26.18 |
| | 4 Txslots | 0 | 24.93 | 25.13 | 25.24 |
| | 4 Txslots | 10 | 9.69 | 10.13 | 10.29 |
| | 4 Txslots | 15 | -0.63 | 0.21 | 0.27 |
| EGPRS (GMSK) | 1Txslot | 0 | 29.49 | 29.81 | 29.94 |
| | 2 Txslots | 0 | 27.94 | 28.26 | 28.38 |
| | 3 Txslots | 0 | 25.92 | 26.23 | 26.37 |
| | 4 Txslots | 0 | 24.98 | 25.28 | 25.45 |

| | | | | | |
|---|---|---|---|---|---|
| | 4 Txslots | 10 | 9.67 | 10.09 | 10.27 |
| | 4 Txslots | 15 | -0.72 | 0.08 | 0.17 |
| EGPRS (8PSK) | 1Txslot | 2 | 26.19 | 26.21 | 26.33 |
| | 2 Txslots | 2 | 24.78 | 24.88 | 24.89 |
| | 3 Txslots | 2 | 22.68 | 22.79 | 23.12 |
| | 4 Txslots | 2 | 21.69 | 21.87 | 21.95 |
| | 4 Txslots | 10 | 9.52 | 9.71 | 9.78 |
| | 4 Txslots | 15 | 0.58 | 0.25 | 0.45 |

## 5.2. Radiated Spurious Emissions

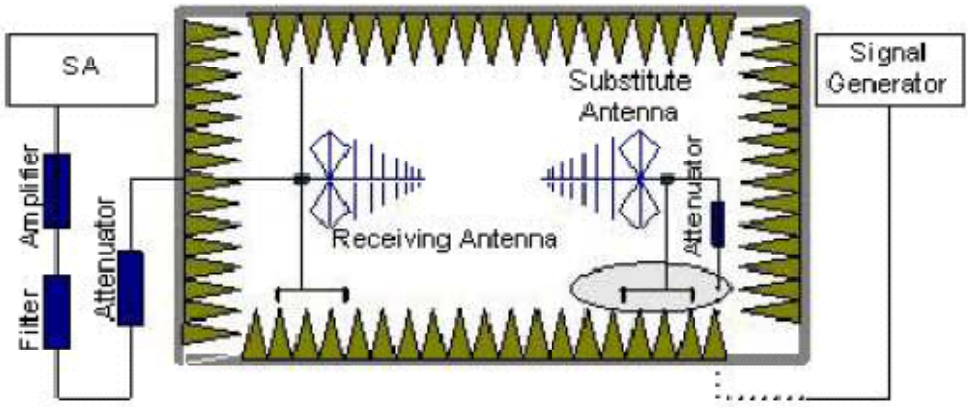
**Ambient condition**

| Temperature | Relative humidity | Pressure |
|---|---|---|
| 23°C ~26°C | 45%~50% | 101.5kPa |

**Methods of Measurement**

Initially the test antenna is closely coupled to the MS and any spurious emission radiated by the MS are detected by the test antenna and receiver in the range 30 MHz to 4 GHz. Radiated spurious emissions s tested under normal voltage conditions and extreme voltage conditions.
The procedure of Radiates Spurious Emission is as follows:

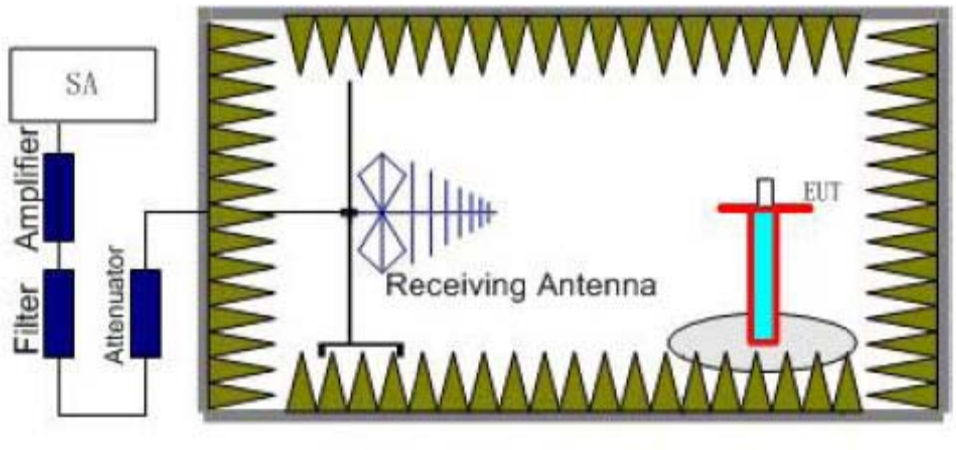
1. Pre-calibration
   In a fully anechoic chamber, A log-periodic antenna or double-ridged waveguide horn antenna shall be substituted at a 3 meter test distance from the receive antenna. An RF signal source is connected to the dipole with a Tx cable that has been constructed to not interfere with radiation pattern of the antenna. A known (measured) power (Pin) is applied to input of dipole, and the power received (Pr) is recorded from the spectrum analyzer.
   "Reference Path loss" is established as Pin – Pr – Tx cable loss + Substitution antenna gain.




2. EUT Test
   EUT was placed on a 1.5 meter high non – conductive table at a 3 meter test distance from the receive antenna. The height of receiving antenna is 1.5 m. The test setup refers to figure below. Detected emissions were maximized at each frequency by rotating the table and adjusting the receiving antenna polarization. The measurement is carried out using a spectrum analyzer. A notch filter is necessary in the band near to the carrier frequency. A high pass filter is needed to avoid the distortion of the testing equipment in the band above the carrier frequency. If the harmonic could not be detected above the noise floor, the ambient level was recorded.
   The level of the spurious emissions can be calculated through the level of the signal generator, cable loss, the gain of the substitution antenna and the reading of the spectrum analyzer or receiver.
   Calculation procedure:

RSE = Rx (dBm) + Reference Path loss

Rx: reading of the receiver




The field strength of spurious emission was measured in the following position: EUT stand-up position (Z axis), lie-down position (X, Y axis). Receiver antenna polarization (horizontal and vertical). The worst emission was found in position (X axis, horizontal polarization) and the worst case was recorded.

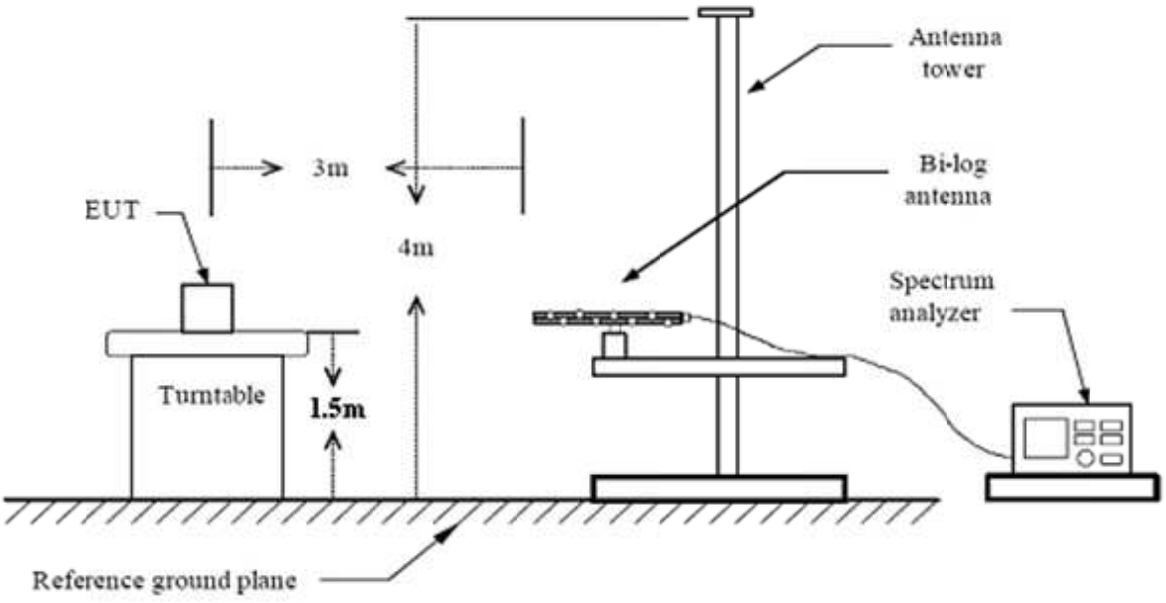
Radiated Spurious Emission is tested under normal voltage conditions and extreme voltage conditions.

During the test, the EUT is worked at maximum output power in the modulation type of GMSK, the power level set to”5” of GSM 900 and ”0” of GSM 1800.

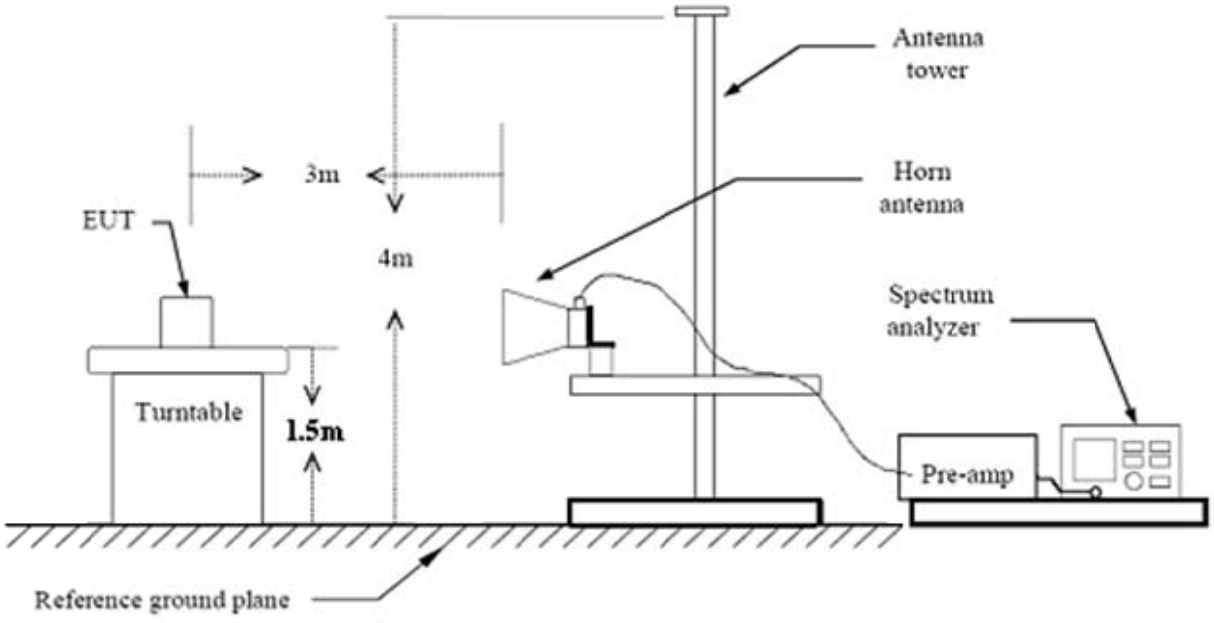
The tests were performed as link mode and idle mode.

## Test Setup

### Below 3 GHz




### Above 3 GHz



**Limits**

**Transmitter Mode**

| Frequency Range | Power Level (dBm) | | |
|---|---|---|---|
| | GSM 400, GSM 700, T-GSM 810 GSM 850, GSM 900. | DCS 1800 | PCS 1900 |
| 30 MHz to 1 GHz | -36 | -36 | -36 |
| 1 GHz to 4 GHz | -30 | / | -30 |
| 1 GHz to 1710 MHz | / | -30 | / |
| 1710 MHz to 1785 MHz | / | -36 | / |
| 1785 MHz to 4 GHz | / | -30 | / |

**Receiver Mode**

According to 3GPP TS 51.010-1

| Frequency Range | Power Level (dBm) | |
|---|---|---|
| | GSM 400, T-GSM 810, GSM 900, DCS 1800 | GSM 700, GSM 850, PCS 1900 |
| 30 MHz to 880 MHz | -57 | -57 |
| 880 MHz to 915 MHz | -59 | -57 |
| 915 MHz to 1000 MHz | -57 | -57 |
| 1 GHz to 1710 MHz | -47 | / |
| 1710 MHz to 1785 MHz | -53 | / |
| 1785 MHz to 4 GHz | -47 | / |
| 1000 MHz to 1850 MHz | / | -47 |
| 1850 MHz to 1910 MHz | / | -53 |
| 1910 MHz to 4 GHz | / | -47 |

**Measurement Uncertainty**

The assessed measurement uncertainty to ensure 95％ confidence level for the normal distribution is with the coverage factor $k$ = 1.96, $U$= 3.55 dB.

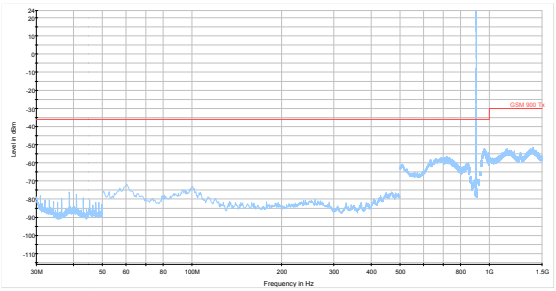
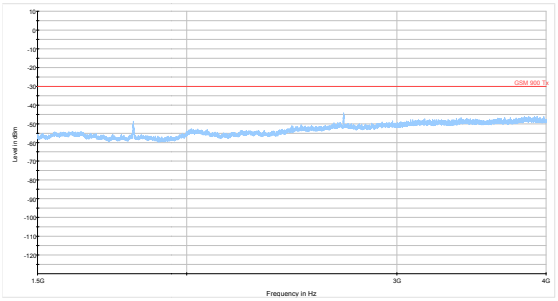
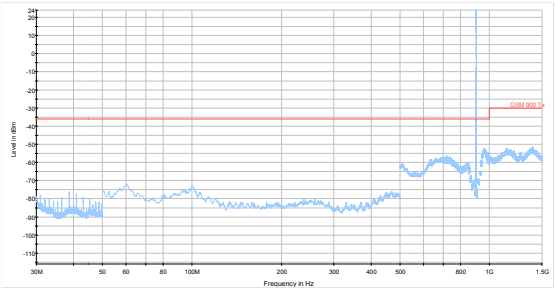
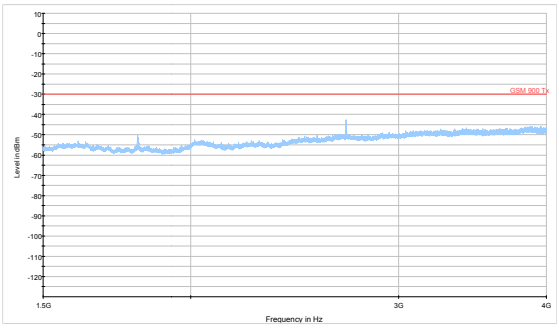
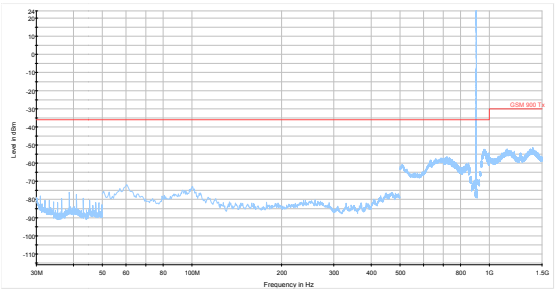
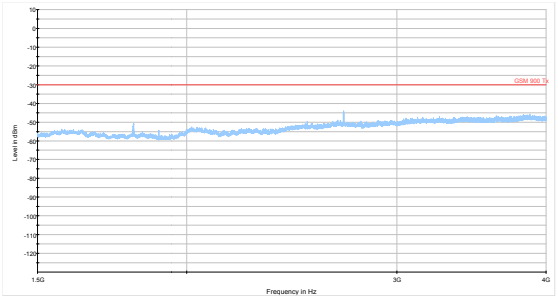
## Test Results

### Transmitter

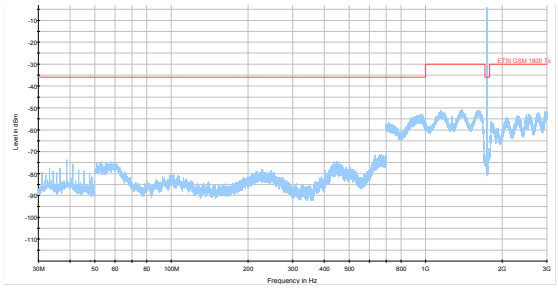
For radiated spurious emissions test, the worst mode should be reflected in the report.

Sweep from 30MHz to 4GHz, emissions more than 20 dB below the limit are not reported.

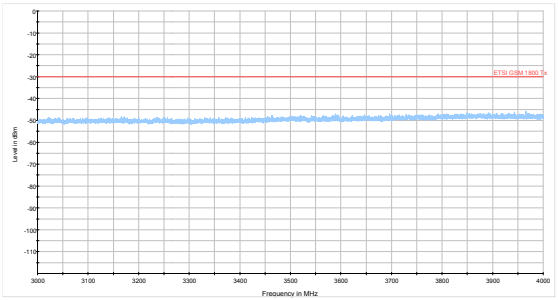
The signal beyond the limit is carrier.

| | |
|---|---|
| GSM 900 LV 30MHz~1.5GHz | GSM 900 LV 1.5GHz~4GHz |
|  |  |
| GSM 900 NV 30MHz~1.5GHz | GSM 900 NV 1.5GHz~4GHz |
|  |  |
| GSM 900 HV 30MHz~1.5GHz | GSM 900 HV 1.5GHz~4GHz |
|  |  |

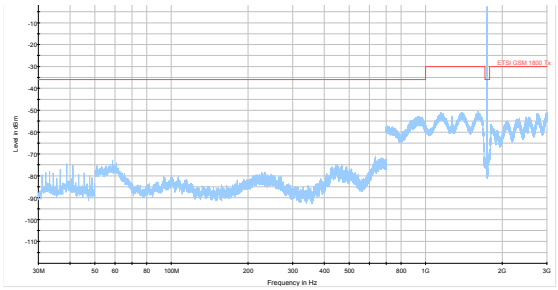
GSM 1800 LV 30MHz~3GHz



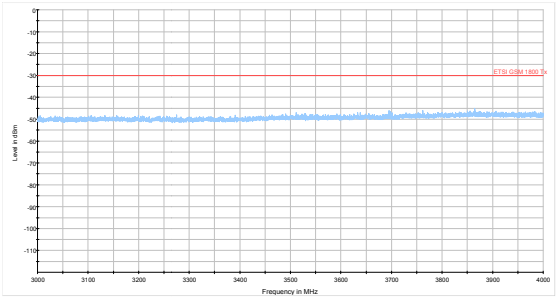

GSM 1800 LV 3GHz~4GHz



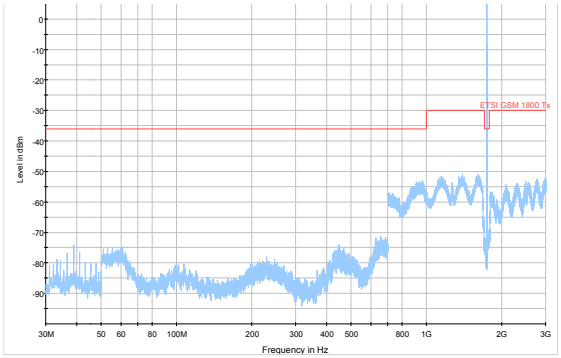

GSM 1800 NV 30MHz~3GHz



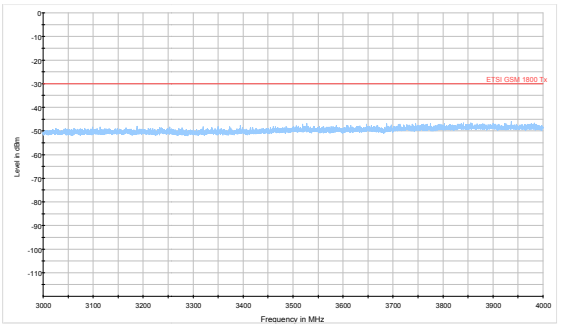

GSM 1800 NV 3GHz~4GHz




GSM 1800 HV 30MHz~3GHz




GSM 1800 HV 3GHz~4GHz



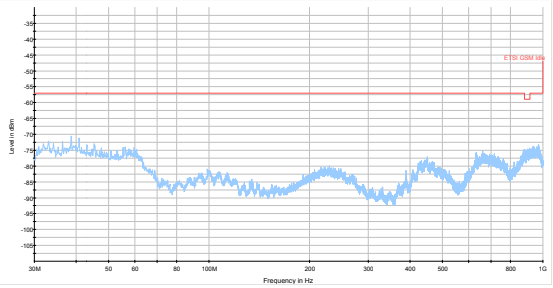

If disturbances were found more than 20dB below limit line, the mark is not required for the EUT.

| Mode | Frequency (MHz) | Level (dBm) | Limit (dBm) | Margin (dB) | Degree |
|---|---|---|---|---|---|
| RSE_GSM900_CH62_LOWV_HH_1.5-4GHz | 2707.31 | -44.30 | -30.00 | 14.30 | 45 |
| RSE_GSM900_CH62_HighV_HH_1.5-4GHz | 2706.94 | -44.04 | -30.00 | 14.04 | 180 |

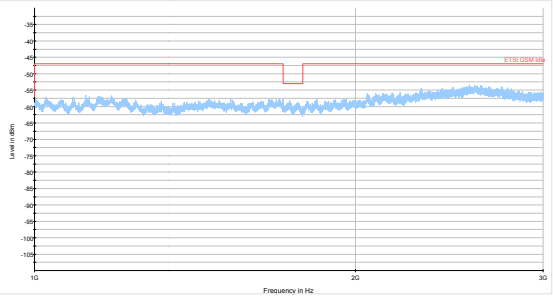
**Receiver**

During the test, the preliminary test was performed in Idle Mode with all frequency bands, GSM 900 are selected as the worst condition. The test data of the worst-case condition was recorded in this report.

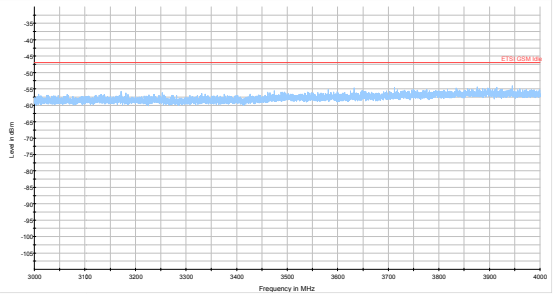
GSM Idle Mode 30MHz~1GHz



GSM Idle Mode 1GHz~3GHz



GSM Idle Mode 3GHz~4GHz



# 6. Uncertainty Measurement

As a summary, the following table provides an overview of the results of measurement uncertainty for 2G test cases that are in the development plan for GS-8800:

| Test Case | Test Description | Tolerance | Level Uncertainty |
|---|---|---|---|
| 51.010-1 | | | |
| **Transceiver Tests** | | | |
| 12.1.1 | Conducted Spurious Emissions – MS Allocated channel | ± | 0.55dB |
| 12.1.2 | Conducted Spurious Emissions – MS in idle mode | ± | 0.55dB |
| 13.1 | Frequency Error | ± | 4.92Hz |
| | RMS Phase Error | ± | 0.63 |
| | Peak Phase Error | ± | 2.01 |
| 13.2 | Frequency Error | ± | 4.92Hz |
| | RMS Phase Error | ± | 0.58 |
| | Peak Phase Error | ± | 2 |
| 13.3 | Tx Output Power | | |
| | GSM850/GSM900 | ± | 0.31dB |
| | DCS1800/PCS1900 | ± | 0.32dB |
| 13.3 | Power vs. Time (Normal Burst) | | |
| | -7<= Power <= +1 | ± | 0.23dB |
| | -20<= Power <=-7 | ± | 0.58dB |
| | -32<= Power <=-20 | ± | 1.08dB |
| | -50<= Power <=-45 | ± | 1.41dB |
| | -60<= Power <=-50 | ± | 1.55dB |
| 13.3 | Tx Output Power (RACH) | | |
| | GSM850/GSM900 | ± | 0.31dB |
| | DCS1800/PCS1900 | ± | 0.32dB |
| 13.3 | Power vs. Time (RACH) | | |
| | -7<= Power <= +1 | ± | 0.23dB |
| | -20<= Power <=-7 | ± | 0.58dB |
| | -32<= Power <=-20 | ± | 1.08dB |
| | -45<= Power <=-32 | ± | 1.32dB |
| | -50<= Power <=-45 | ± | 1.41dB |
| | -60<= Power <=-50 | ± | 1.55dB |
| 13.4 | ORFS (Output RF Spectrum) due to modulation | ± | 0.85dB |
| 13.4 | ORFS due to Switching | ± | 0.85dB |
| 13.4 | Wideband Noise, 1800KHz offset to Edge of Tx band | ± | 0.47dB |
| 13.4 | Spurious Emissions in MS Rx band | ± | 0.54dB |

| | | | |
|---|---|---|---|
| 13.16.1 | Freq Error | ± | 4.92Hz |
| | RMS phase Error | ± | 0.63 |
| | Peak phase Error | ± | 2.01 |
| 13.16.2 | Monotonic Power Sequence in GPRS configuration | | |
| | GSM850/GSM900 | ± | 0.40dB |
| | DCS1800/PCS1900 | ± | 0.41dB |
| 13.16.2 | Power vs. Time in GPRS configuration (Normal burst) | | |
| | -7<= Power <= +1 | ± | 0.23dB |
| | -20<= Power <=-7 | ± | 0.58dB |
| | -32<= Power <=-20 | ± | 1.08dB |
| | -45<= Power <=-32 | ± | 1.32dB |
| | -50<= Power <=-45 | ± | 1.41dB |
| | -60<= Power <=-50 | ± | 1.55dB |
| 13.16.2 | Tx Output Power in GPRS multislot configuration (RACH) | | |
| | GSM850/GSM900 | ± | 0.31dB |
| | DCS1800/PCS1900 | ± | 0.32dB |
| 13.16.2 | Power vs. Time in GPRS configuration (RACH) | | |
| | -7<= Power <= +1 | ± | 0.23dB |
| | -20<= Power <=-7 | ± | 0.58dB |
| | -32<= Power <=-20 | ± | 1.08dB |
| | -45<= Power <=-32 | ± | 1.32dB |
| | -50<= Power <=-45 | ± | 1.41dB |
| | -60<= Power <=-50 | ± | 1.55dB |
| 13.16.3 | ORFS due to Modulation in GPRS multislot configuration | ± | 0.85dB |
| 13.16.3 | ORFS due to Switching in GPRS multislot configuration | ± | 0.85dB |
| 13.16.3 | Wideband Noise, 1800KHz offset to edge of Tx band in GPRS multislot configuration | ± | 0.47dB |
| 13.16.3 | Spurious Emissions in MS Rx band in GPRS multislot configuration | ± | 0.54dB |
| 13.17.1 | Frequency error and modulation accuracy in EGPRS Configuration | | |
| | Freq Error | ± | 4.27Hz |
| | Residual rms EVM | ± | 0.0199 |
| | Origin Offset | ± | 0.86dB |
| 13.17.2 | Frequency error under multipath and interference conditions in EGPRS configuration | | |
| | Freq Error | ± | 4.27Hz |
| | Residual rms EVM | ± | 0.0199 |
| | Origin Offset | ± | 0.86dB |
| 13.17.3 | Tx Output Power in EGPRS multislot configuration (Normal burst) | | |
| | GSM850/GSM900 | ± | 0.40dB |

| | | | |
|---|---|---|---|
| | DCS1800/PCS1900 | ± | 0.41dB |
| 13.17.3 | Monotonic Power Sequence in GPRS configuration | | |
| | GSM850/GSM900 | ± | 0.40dB |
| | DCS1800/PCS1900 | ± | 0.41dB |
| 13.17.3 | Power vs. Time in GPRS configuration (Normal burst) | | |
| | -7<= Power <= +1 | ± | 0.23dB |
| | -20<= Power <=-7 | ± | 0.58dB |
| | -32<= Power <=-20 | ± | 1.08dB |
| | -50<= Power <=-45 | ± | 1.41dB |
| | -60<= Power <=-50 | ± | 1.55dB |
| 13.17.4 | ORFS due to Modulation in EGPRS multislot configuration | ± | 0.85dB |
| 13.17.4 | ORFS due to Switching in EGPRS multislot configuration | ± | 0.85dB |
| 13.17.4 | Wideband Noise, 1800KHz offset to edge of Tx band in EGPRS multislot configuration | ± | 0.47dB |
| 13.17.4 | Spurious Emissions in MS Rx band in EGPRS multislot configuration | ± | 0.54dB |
| 14.1.1.1 | Bad Frame Indication-TCH/FS-Random RF Input | ± | 1.0E-09 |
| 14.1.1.2 | Bad Frame Indication-TCH/FS-Frequency hopping and downlink DTX | ± | 1.0E-09 |
| 14.1.2.1 | Bad Frame Indication-TCH/HS-Random RF Input | ± | 1.0E-09 |
| 14.1.2.2 | Bad Frame Indication-TCH/HS-Frequency hopping and downlink DTX | ± | 1.0E-09 |
| 14.1.5.1 | Bad Frame Indication-TCH/AFS-Random RF Input | ± | 1.0E-09 |
| 14.1.6.1 | Bad Frame Indication-TCH/AHS-Random RF Input | ± | 1.0E-09 |
| 14.2.1 | Reference Sensitivity, TCH/FS | ± | 0.4652dB |
| 14.2.2. | Reference Sensitivity, TCH/HS | ± | 0.4652dB |
| 14.2.3 | Reference Sensitivity, FACCH/F | ± | 0.4652dB |
| 14.2.4 | Reference Sensitivity, FACCH/H | ± | 0.3156dB |
| 14.2.10 | Reference Sensitivity, TCH/AFS | ± | 0.3156dB |
| 14.2.18 | Reference Sensitivity, TCH/AHS | ± | 0.3156dB |
| 14.2.19 | Reference sensitivity - TCH/AFS-INB | ± | 0.3156dB |
| 14.2.20 | Reference sensitivity - TCH/AHS-INB | ± | 0.3156dB |
| 14.3 | Useable Receiver Input Level Range | ± | 0.3156dB |
| 14.4.1 | Co-Channel Rejection, TCH/FS | ± | 0.3156dB |
| 14.4.4 | Co-Channel Rejection, FACCH/F | ± | 0.3156dB |
| 14.4.5 | Co-Channel Rejection, FACCH/H | ± | 0.3156dB |
| 14.4.7 | Receiver performance, co-channel & frequency hopping on one carrier | ± | 0.6577dB |
| 14.4.8 | Co-Channel Rejection, TCH/AFS | ± | 0.4652dB |

| | | | |
|---|---|---|---|
| 14.4.16 | Co-Channel Rejection, TCH/AHS | ± | 0.4652dB |
| 14.4.17 | Co-channel rejection - TCH/AFS-INB | ± | 0.4652dB |
| 14.4.18 | Co-channel rejection - TCH/AHS-INB | ± | 0.4652dB |
| 14.5.1.1 | Adjacent Channel Rejection, Speech Channel, TCH/FS | ± | 0.4652dB |
| 14.5.1.2 | Adjacent Channel Rejection, Speech Channel, TCH/AFS | ± | 0.4652dB |
| 14.5.1.3 | Adjacent Channel Rejection, Speech Channel, TCH/AHS | ± | 0.4652dB |
| 14.5.2 | Adjacent Channel Rejection, Control Channel | ± | 0.4652dB |
| 14.6.1 | Intermediation Rejection, Speech Channel | ± | 0.6577dB |
| 14.6.2 | Intermediation Rejection, Control Channel | ± | 0.4652dB |
| 14.7.1 | Blocking & Spurious Response, Speech Channel | ± | 0.6577dB |
| 14.8.1 | AM Suppression, Speech Channel | ± | 0.6577dB |
| 14.8.2 | AM Suppression, Control Channel | ± | 0.4652dB |
| 14.10.1 | Performance of the Codec Mode Request Generation - TCH/AFS | ± | 0.4652dB |
| 14.10.2 | Performance of the Codec Mode Request Generation - TCH/AHS | ± | 0.4652dB |
| 14.16.1 | Minimum Input Level for Reference Performance for GPRS operation | ± | 0.4652dB |
| 14.16.2 | Co-Channel Rejection for Packet Channel | ± | 0.4652dB |
| 14.18.1 | Minimum Input Level for Reference Performance for EGPRS operation | ± | 0.4652dB |
| 14.18.2 | Co-Channel Rejection for EGPRS operation | ± | 0.6577dB |
| 14.18.3 | Adjacent Channel Rejection for EGPRS operation | ± | 0.6577dB |
| 14.18.4 | Intermediation Rejection for EGPRS operation | ± | 0.4652dB |
| 14.18.5 | Blocking and spurious response for EGPRS operation | ± | 0.6577dB |
| 14.18.7 | Incremental Redundancy Performance | ± | 0.6577dB |
| 14.11.1.1 | DARP Phase 1 Speech Beaerer TCH/FS - DTS1 | ± | 0.4652dB |
| 14.11.2.1 | DARP Phase 1 Speech Beaerer TCH/AFS - DTS1 | ± | 0.4652dB |
| 14.11.2.2 | DARP Phase 1 Speech Beaerer TCH/AFS - DTS4 | ± | 0.4652dB |
| 14.11.2.3 | DARP Phase 1 Speech Beaerer TCH/AFS - DTS2/3/5 | ± | 0.4652dB |
| 14.11.3.1 | DARP Phase 1 Speech Beaerer TCH/AHS - DTS1 | ± | 0.4652dB |
| 14.11.3.3 | DARP Phase 1 Speech Beaerer TCH/AHS - DTS2/3 | ± | 0.4652dB |
| 14.12.1.1 | DARP Phase 1 Speech Beaerer FACCH - DTS1 | ± | 0.4652dB |
| 14.12.1.2 | DARP Phase 1 Speech Beaerer FACCH - DTS2/3 | ± | 0.4652dB |
| 14.10.3 | Performance of the Codec Mode Request Generation – TCH/AFS - | ± | 0.4652dB |
| | improved RX | | |
| 14.10.4 | Performance of the Codec Mode Request Generation – TCH/AHS - improved RX | ± | 0.4652dB |
| 14.16.4.1 | Synchronous single co-channel interferer (DTS-1) | ± | 0.4652dB |

| | | | |
|---|---|---|---|
| 14.16.4.2 | Synchronous multiple interferers (DTS-2 / DTS-3) | ± | 0.4652dB |
| 14.18.8.1 | Synchronous single co-channel interferer (DTS-1) | ± | 0.4652dB |
| 14.18.8.2 | Synchronous single co-channel interferer (DTS-2 / DTS-3) | ± | 0.4652dB |

# 7. Main Test Instruments

| Name | Manufacturer | Type | Serial Number | Calibration Date | Expiration Time |
|---|---|---|---|---|---|
| Signal Analyzer | R&S | FSV40 | 15195-01-00 | 2020-05-17 | 2021-05-16 |
| Trilog Antenna | SCHWARZBECK | VULB 9163 | 9163-201 | 2017-11-18 | 2020-11-17 |
| Horn Antenna | R&S | HF907 | 100126 | 2018-07-07 | 2020-07-06 |
| Climate Chamber | ESPEC | SU-242 | 93000506 | 2017-12-17 | 2020-12-16 |
| Electro-Dynamic Shaker | Dangling | ESS-050-120 | D1007126 | 2020-05-05 | 2025-05-04 |
| ESG Vector Signal Generator | Keysight | E4438C | MY49070900 | 2019-05-17 | 2020-05-18 |
| ESG Vector Signal Generator | Keysight | E4438C | MY49070900 | 2020-05-18 | 2021-05-17 |
| Power Meter | Keysight | E4418B | MY50000623 | 2019-05-17 | 2020-05-18 |
| Power Meter | Keysight | E4418B | MY50000623 | 2020-05-18 | 2021-05-17 |
| RF filter box | Keysight | N1962A | MY45490189 | 2019-05-17 | 2020-05-18 |
| RF filter box | Keysight | N1962A | MY45490189 | 2020-05-18 | 2021-05-17 |
| PSG Analog Signal Generator | Keysight | E8257D | MY49281101 | 2019-05-17 | 2020-05-18 |
| PSG Analog Signal Generator | Keysight | E8257D | MY49281101 | 2020-05-18 | 2021-05-17 |
| Base Station Simulator | Keysight | E5515C | MY48367192 | 2019-05-17 | 2020-05-18 |
| Base Station Simulator | Keysight | E5515C | MY48367192 | 2020-05-18 | 2021-05-17 |
| Wireless Channel Simulator | SPIRENT | SR5500 | WCE290Z4 | 2019-05-17 | 2020-05-18 |
| Wireless Channel Simulator | SPIRENT | SR5500 | WCE290Z4 | 2020-05-18 | 2021-05-17 |
| Spectrum Analyzer | Keysight | E4445A | MY46181146 | 2019-05-17 | 2020-05-18 |
| Spectrum Analyzer | Keysight | E4445A | MY46181146 | 2020-05-18 | 2021-05-17 |
| Mob Comms DC Supply | Keysight | 66319D | MY43004105 | 2019-05-17 | 2020-05-18 |
| Mob Comms DC Supply | Keysight | 66319D | MY43004105 | 2020-05-18 | 2021-05-17 |
| Software | Aglient | GS-8800 RF Design verification | DUT2.7.1.3.0 | / | / |

| | | | | | |
|---|---|---|---|---|---|
| | | test system | | | |
| Software | R&S | EMC32 | 9.26.0 | / | / |

********END OF REPORT ********