# ELECTROMAGNETIC EMISSION COMPLIANCE REPORT FOR LICENSED TRANSMITTER

| | |
|---|---|
| **Test Report No.** | **: OT-199-RWD-027** |
| **AGR No.** | **: A199A-034** |
| **Applicant** | **: Suntech International Ltd.** |
| **Address** | **: A-1705, A-1706, Greatvally, 32, Digital-ro 9-gil, Geumcheon-Gu, Seoul, Korea** |
| **Manufacturer** | **: Suntech International Ltd.** |
| **Address** | **: A-1705, A-1706, Greatvally, 32, Digital-ro 9-gil, Geumcheon-Gu, Seoul, Korea** |
| **Type of Equipment** | **: Telematics Device** |
| **FCC ID.** | **: WA2ST410** |
| **Model Name** | **: ST410** |
| **Multiple Model Name** | **: ST410GC** |
| **Serial number** | **: N/A** |
| **Total page of Report** | **: 39 pages (including this page)** |
| **Date of Incoming** | **: September 04, 2019** |
| **Date of issue** | **: September 18, 2019** |

## SUMMARY

The equipment complies with the regulation; **Part 2, Part 22 Subpart H**

This test report only contains the result of a single test of the sample supplied for the examination.

It is not a generally valid assessment of the features of the respective products of the mass-production.

Reviewed by: Tae-Ho, Kim / Senior Manager
ONETECH Corp.

Approved by: Ki-Hong, Nam / Chief Engineer
ONETECH Corp.

 

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## Revision History

| Rev. No. | Issue Report No. | Issued Date | Revisions | Section Affected |
|---|---|---|---|---|
| 0 | OT-199-RWD-027 | September 18, 2019 | Initial Release | All |
| | | | | |
| | | | | |



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# 1. VERIFICATION OF COMPLIANCE

| | |
|---|---|
| Applicant | : Suntech International Ltd. |
| Address | : A-1705, A-1706, Greatvally, 32, Digital-ro 9-gil, Geumcheon-Gu, Seoul, Korea |
| Contact Person | : Yohan, Kim / Manager |
| Telephone No. | : 82-2-6327-5661 |
| FCC ID | : WA2ST410 |
| Model Name | : ST410 |
| Serial Number | : N/A |
| Date | : September 18, 2019 |

| | |
|---|---|
| EQUIPMENT CLASS | PCB-PCS Licensed Transmitter |
| EQUIPMENT DESCRIPTION | Telematics Device |
| THIS REPORT CONCERNS | Original Grant |
| MEASUREMENT PROCEDURES | ANSI C63.26:2015, KDB Publication 971168 D01 |
| TYPE OF EQUIPMENT TESTED | Pre-Production |
| KIND OF EQUIPMENT AUTHORIZATION REQUESTED | Certification |
| EQUIPMENT WILL BE OPERATED UNDER FCC RULES PART(S) | FCC Part 2, Part 22 Subpart H |
| Modifications on the Equipment to Achieve Compliance | None |
| Final Test was Conducted On | 3 m Semi Anechoic Chamber |

-. The above equipment was tested by ONETECH Corp. for compliance with the requirement set forth in the FCC Rules and Regulations. This said equipment in the configuration described in this report, shows the maximum emission levels emanating from equipment are within the compliance requirements.

 

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# 2. TEST SUMMARY

## 2.1 Test items and results

| SECTION | TEST ITEMS | RESULTS |
|---|---|---|
| 2.1049 | Occupied Bandwidth | Met the Limit / PASS |
| 2.1051, 22.917(a) | Band Edge / Spurious and Harmonic Emissions at Antenna Termianl | Met the Limit / PASS |
| 2.1046 | Conducted Output Power | Met the Limit / PASS |
| 22.913(d), KDB Publication 971168 D01 | Peak-to-Average Ratio | Met the Limit / PASS |
| 2.1055, 22.355 | Frequency stability | Met the Limit / PASS |
| 22.913(a)(5) | EFFECTIVE RADIATED POWER | Met the Limit / PASS |
| 2.1053, 22.917(a) | Radiated Spurious and Harmonic Emissions | Met the Limit / PASS |

## 2.2 Additions, deviations, exclusions from standards

No additions, deviations or exclusions have been made from standard.

## 2.3 Related Submittal(s) / Grant(s)

Original submittal only

## 2.4 Purpose of the test

To determine whether the equipment under test fulfills the requirements of the regulation stated in Part 22 Subpart H.

## 2.5 Test Methodology

Both conducted and radiated testing was performed according to the procedures in ANSI C63.26:2015. Radiated testing was performed at a distance of 3 m from EUT to the antenna.

## 2.6 Test Facility

The Onetech Corp. has been designated to perform equipment testing in compliance with ISO/IEC 17025.

The Electromagnetic compatibility measurement facilities are located at 43-14, Jinsaegol-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea

-. Site Filing:

VCCI (Voluntary Control Council for Interference) – Registration No. R-4112/ C-14617/ G-10666 / T-1842

IC (Industry Canada) – Registration No. Site# 3736A-3

-. Site Accreditation:

KOLAS (Korea Laboratory Accreditation Scheme) - Accreditation NO. KT085

FCC (Federal Communications Commission) - Accreditation No. KR0013

RRA (Radio Research Agency) – Designation No. KR0013

 

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# 3. GENERAL INFORMATION

## 3.1 Product Description

The Suntech International Ltd., Model ST410 (referred to as the EUT in this report) is a Telematics Device. Product specification information described herein was obtained from product data sheet or user's manual.

| | | | | |
|---|---|---|---|---|
| DEVICE TYPE | Telematics Device | | | |
| OPERATING FREQUENCY | GSM850 | | TX | 824.2 MHz ~ 848.8 MHz |
| | | | RX | 869.2 MHz ~ 893.8 MHz |
| | PCS1900 | | TX | 1 850.2 MHz ~ 1 909.8 MHz |
| | | | RX | 1 930.2 MHz ~ 1 989.8 MHz |
| Modulation Type | GMSK | | | |
| Maximum ERP Power | GSM850 | ST410 | 24.32 dBm | |
| | | ST410GC | 24.19 dBm | |
| ANTENNA TYPE | PCB Pattern Antenna | | | |
| ANTENNA GAIN | GSM850 | | -0.98 dBi | |
| | PCS1900 | | 1.73 dBi | |
| List of each Osc. or crystal Freq.(Freq. >= 1 MHz) | 26 MHz | | | |

## 3.2 Alternative type(s)/model(s); also covered by this test report.

-. The following lists consist of the added model and their differences.

| Model Name | Differences | Tested |
|---|---|---|
| ST410 | This model uses a paper enclosure. | ☑ |
| ST410GC | This model uses a plastic enclosure. | ☑ |

Note: 1. Applicant consigns only basic model to test. Therefore this test report just guarantees the units, which have been tested.

2. The Applicant/manufacturer is responsible for the compliance of all variants.

# 4. EUT MODIFICATIONS

-. None

 

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# 5. SYSTEM TEST CONFIGURATION

## 5.1 Justification

This device was configured for testing in a typical way as a normal customer is supposed to be used. During the test, the following components were installed inside of the EUT.

| DEVICE TYPE | MANUFACTURER | MODEL/PART NUMBER | FCC ID |
|---|---|---|---|
| Main Board | N/A | N/A | N/A |
| Battery | N/A | N/A | N/A |
| Antenna | N/A | N/A | N/A |

## 5.2 Peripheral equipment

Defined as equipment needed for correct operation of the EUT, but not considered as tested:

| Model | Manufacturer | Description | Connected to |
|---|---|---|---|
| ST410 | Suntech International Ltd. | Telematics Device | - |
| ETA-U90KWK | RF Tech(Tianjin) Electronics Co,. Ltd | Adaptor | EUT |

 

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### 5.3 Mode of operation during the test

Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates, XYZ axis, and antenna ports. The worst case was found when positioned as the table below. Following channel(s) was (were) selected for the final test as listed below:

| Band | EIRP | Radiated Emission |
|---|---|---|
| GSM850 | X-plane | X-axis |

**Test Mode : GSM850**

| Test Item | Modulation | Mode | Test Channel |
|---|---|---|---|
| Conducted Output Power | GPRS | 1Tx slot | 824.2 MHz<br>836.6 MHz<br>848.8 MHz |
| Effective Radiated Power | GPRS | 1Tx slot | 824.2 MHz |
| | | | 836.6 MHz |
| | | | 848.8 MHz |
| Frequency stability | GPRS | 1Tx slot | 836.6 MHz |
| Occupied Bandwidth | GPRS | 1Tx slot | 824.2 MHz |
| | | | 836.6 MHz |
| | | | 848.8 MHz |
| Peak-to-Average Ratio | GPRS | 1Tx slot | 824.2 MHz |
| | | | 836.6 MHz |
| | | | 848.8 MHz |
| Band Edge | GPRS | 1Tx slot | 824.2 MHz |
| | | | 848.8 MHz |
| Spurious and Harmonic Emissions at Antenna Termianl | GPRS | 1Tx slot | 824.2 MHz |
| | | | 836.6 MHz |
| | | | 848.8 MHz |
| Radiated Spurious and Harmonic Emissions | GPRS | 1Tx slot | 824.2 MHz |
| | | | 836.6 MHz |
| | | | 848.8 MHz |

### 5.4 Frequency List of Low/Middle/High Channels

| GSM850 Channel and Frequency List | | | |
|---|---|---|---|
| Channel / Frequency | Low | Middle | High |
| Channel | 128 | 190 | 251 |
| Frequency | 824.2 MHz | 836.6 MHz | 848.8 MHz |

### 5.5 Configuration of Test System

**Radiated Emission Test**: Preliminary radiated emissions test were conducted using the procedure in ANSI C63.10: 2013 to determine the worse operating conditions. Final radiated emission tests were conducted at 3 m Semi Anechoic Chamber.

The turntable was rotated through 360 degrees and the EUT was tested by positioned three orthogonal planes to obtain the highest reading on the field strength meter. Once maximum reading was determined, the search antenna was raised and lowered in both vertical and horizontal polarization.

## 6. PRELIMINARY TEST

### 6.1 General Radiated Emissions Tests

During Preliminary Test, the following operating mode was investigated.

| Operation Mode | The Worse operating condition (Please check one only) |
|---|---|
| Transmitting Mode | X |

# 7. CONDUCTED OUTPUT POWER

## 7.1 Operating environment

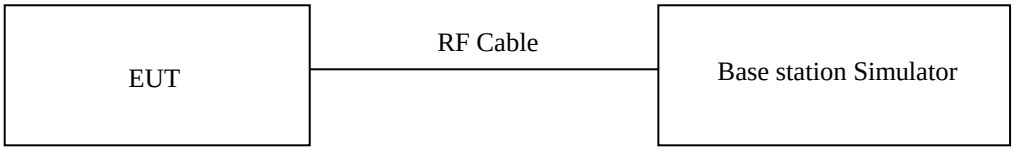
Temperature : 24 ℃

Relative humidity : 47 % R.H.

## 7.2 Test set-up

Conducted Output Power is tested in accordance with KDB971168 D01 Power Meas License Digital Systems v03r01, April 9, 2018, Section 5.2.

A base station simulator was used to establish communication with the EUT, and Spectrum analyzer was used for test results. This device was tested under all configurations and the highest power is reported. Conducted Output Powers of EUT are reported below.




## 7.3 Test equipment used

| | Model Number | Manufacturer | Description | Serial Number | Last Cal. |
|---|---|---|---|---|---|
| ■ - | E5515C | Agilent | WIRELESS COMMUNICATIONS TEST SET | MY48360785 | Mar. 11, 2019 (1Y) |
| ☐ - | GP-4303D | LG Precision Co.,Ltd | DC Power Supply | 5071069 | Jan. 10, 2019 (1Y) |

All test equipment used is calibrated on a regular basis.

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### 7.4 Test data for Basic Model: ST410

-. Test Date : September 04, 2019 ~ September 16, 2019

-. Test Result : Pass

Conducted Burst Average Output Power (dBm)

| Test Mode | Mode | Low Channel | Middle Channel | High Channel |
|---|---|---|---|---|
| | | 128 | 190 | 251 |
| | | 824.2 MHz | 836.6 MHz | 848.8 MHz |
| GPRS | 1TXslot | 32.13 | 32.21 | 32.24 |
| | 2TXslot | 31.56 | 31.62 | 31.66 |

Remark: GPRS 1TXslot mode has higher power, so the test below were not perfomed to GPRS 2TXslot mode.

### 7.5 Test data for Multiple Model: ST410GC

-. Test Date : September 04, 2019 ~ September 16, 2019

-. Test Result : Pass

Conducted Burst Average Output Power (dBm)

| Test Mode | Mode | Low Channel | Middle Channel | High Channel |
|---|---|---|---|---|
| | | 128 | 190 | 251 |
| | | 824.2 MHz | 836.6 MHz | 848.8 MHz |
| GPRS | 1TXslot | 32.11 | 32.23 | 32.21 |
| | 2TXslot | 31.46 | 31.58 | 31.62 |

Remark: GPRS 1TXslot mode has higher power, so the test below were not perfomed to GPRS 2TXslot mode.

**Tested by: Ju Yun Park / Assistant Manager**

 

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# 8. EFFECTIVE RADIATED POWER

## 8.1 Operating environment

Temperature : 24 ℃

Relative humidity : 48 % R.H.

## 8.2 Methods of Measurement

1. The testing follows ANSI C63.26 (2015) Section 5.5.3.
2. Substitution method is used for E.I.R.P measurement. In the semi-anechoic chamber, EUT placed on the 0.8 m (below or equal 1 GHz) and/or 1.5 m (above 1 GHz) height of Turn Table, rotated the table around 360 degrees to search the maximum radiation power and receiver antenna shall be rotated vertical and horizontal polarization and moved height from 1 m to 4 m to find the maximum polar radiated power. The “Read Value” is the spectrum reading the maximum power value.
3. The substitution antenna is substituted for EUT at the same position and signals generator export the CW signal to the substitution antenna via a tx cable. Rotated the Turn Table and moved receiving antenna to find the maximum radiation power. Adjust output power level of S.G to get a Value of spectrum reading equal to “Read Value” of step 2. Record the power level of S.G.
4. EIRP = Output power level of S.G – TX cable loss + Antenna gain of substitution antenna power can be Calculated. E.R.P power = E.I.P.R power - 2.15 dBi.

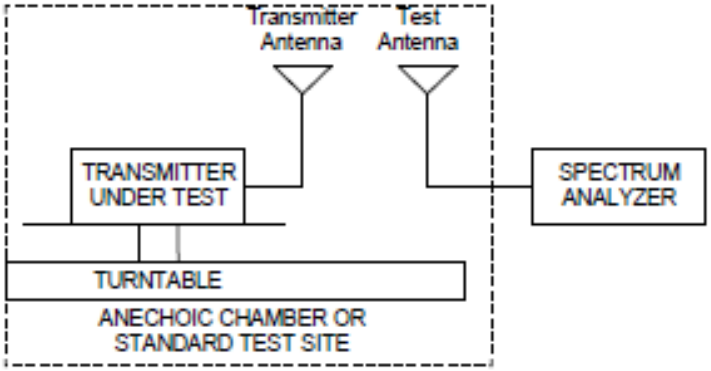
## 8.3 Limits

Rule Part 22.913(a).5 specifies that “mobile transmitters and auxiliary test transmitters must not exceed 7 watts.”

| | |
|---|---|
| Limit | 7 W (38.45 dBm) |

## 8.4 Test set-up

The EUT and measurement equipment were set up as shown in the diagram below.



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## 8.5 Test equipment used

| | Model Number | Manufacturer | Description | Serial Number | Last Cal. (Interval) |
|---|---|---|---|---|---|
| ■ - | ESR | Rohde & Schwarz | EMI Test Receiver | 101470 | Oct. 22, 2018 (1Y) |
| ■ - | 310N | Sonoma Instrument | AMPLIFIER | 312544 | Mar. 18, 2019 (1Y) |
| ■ - | FSV30 | Rohde & Schwarz | Signal Analyzer | 101372 | Jul. 24, 2019 (1Y) |
| □ - | BBV9718B | Schwarzbeck | Broadband Preamplifier | 009 | Mar. 20, 2019 (1Y) |
| ■ - | SCU-03 | Rohde & Schwarz | Signal Conditioning Unit | 100333 | Mar. 11, 2019 (1Y) |
| ■ - | SCU-18 | Rohde & Schwarz | Pre-Amplifier | 102266 | Jul. 24, 2019 (1Y) |
| ■ - | MA-4000XPET | Innco Systems GmbH | Antenna Master | MA4000/509 | N/A |
| □ - | HD100 | HD GmbH | Position Controller | N/A | N/A |
| ■ - | DT3000-3t | Innco Systems GmbH | Turn Table | N/A | N/A |
| □ - | FMZB 1513 | Schwarzbeck | LOOP ANTENNA | 1513-235 | May. 13, 2018 (2Y) |
| ■ - | VULB9163 | Schwarzbeck | TRILOG Broadband Antenna | 9163-255 | Jun 05, 2018 (2Y) |
| ■ - | VULB9163 | Schwarzbeck | Hybrid Antenna | 777 | Apr, 13, 2018 (2Y) |
| ■ - | BBHA9120D | Schwarzbeck | Horn Antenna | 9120D-1366 | Jul. 16, 2019 (1Y) |
| ■ - | BBHA9120D | Schwarzbeck | Horn Antenna | 9120D-295 | Jul. 16, 2019 (1Y) |
| □ - | SCU40A | Rohde & Schwarz | Pre-Amplifier | 100436 | Mar. 11, 2019 (1Y) |
| ■ - | E5515C | Agilent | WIRELESS COMMUNICATIONS TEST SET | MY48360785 | Mar. 11, 2019 (1Y) |
| □ - | GP-4303D | LG Precision Co.,Ltd | DC Power Supply | 5071069 | Jan. 10, 2019 (1Y) |

All test equipment used is calibrated on a regular basis.

 

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### 8.6 Test data for Basic Model: ST410

-. Test Date : September 04, 2019 ~ September 16, 2019

-. Test Result : Pass

| Frequency (MHz) | Substituted Level (dBm) | Ant. Pol. (H/V) | Cable Loss (dB) | Ant Gain (dBd) | ERP (dBm) | Limits (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|---|
| **Test Data for GSM 850** | | | | | | | |
| 824.2 | 19.61 | H | 0.91 | 5.45 | 24.15 | 38.45 | 14.30 |
| 824.2 | 18.57 | V | 0.91 | 5.45 | 23.11 | 38.45 | 15.34 |
| 836.6 | 19.99 | H | 0.92 | 5.25 | 24.32 | 38.45 | 14.13 |
| 836.6 | 18.82 | V | 0.92 | 5.25 | 23.15 | 38.45 | 15.3 |
| 848.8 | 20.18 | H | 0.94 | 5.05 | 24.29 | 38.45 | 14.16 |
| 848.8 | 18.98 | V | 0.94 | 5.05 | 23.09 | 38.45 | 15.36 |

Remark: GSM850 is measured the highest power mode.

"H": Horizontal, "V": Vertical

### 8.7 Test data for Multiple Model: ST410GC

-. Test Date : September 04, 2019 ~ September 16, 2019

-. Test Result : Pass

| Frequency (MHz) | Substituted Level (dBm) | Ant. Pol. (H/V) | Cable Loss (dB) | Ant Gain (dBd) | ERP (dBm) | Limits (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|---|
| **Test Data for GSM 850** | | | | | | | |
| 824.2 | 19.55 | H | 0.91 | 5.45 | 24.09 | 38.45 | 14.36 |
| 824.2 | 18.58 | V | 0.91 | 5.45 | 23.12 | 38.45 | 15.33 |
| 836.6 | 19.86 | H | 0.92 | 5.25 | 24.19 | 38.45 | 14.26 |
| 836.6 | 18.74 | V | 0.92 | 5.25 | 23.07 | 38.45 | 15.38 |
| 848.8 | 20.03 | H | 0.94 | 5.05 | 24.14 | 38.45 | 14.31 |
| 848.8 | 18.92 | V | 0.94 | 5.05 | 23.03 | 38.45 | 15.42 |

Remark: GSM850 is measured the highest power mode.

"H": Horizontal, "V": Vertical

**Tested by: Ju Yun Park / Assistant Manager**

 

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# 9. RADIATED SPURIOUS EMISSIONS

## 9.1 Operating environment

Temperature : 24 ℃

Relative humidity : 48 % R.H.

## 9.2 Test set-up

Radiated emission measurements are performed in the Semi-Anechoic chamber. The equipment under test is placed on a non-conductive table 3-meters away from the receive antenna in accordance with ANSI C63.26 (2015) Section 5.5.3. The turntable is rotated through 360°, and the receiving antenna scans in order to determine the level of the maximized emission. The level and position of the maximized emission is recorded with the spectrum analyzer using RMS detector.

A vertically polarized half-wave dipole is then substituted in place of the EUT. For emissions above 1GHz, a horn antenna is substituted in place of the EUT. The substitute antenna is driven by a signal generator and the previously recorded signal was duplicated.

The power is calculated by the following formula;

Pd(dBm) = Pg(dBm) – cable loss (dB) + antenna gain (dB)

Where: Pd is the dipole equivalent power and Pg is the generator output power into the substitution antenna.

The maximum EIRP is calculated by adding the forward power to the calibrated source plus its appropriate gain value. These steps are repeated with the receiving antenna in both vertical and horizontal polarization. the difference between the gain of the horn and an isotropic antenna are taken into consideration

**Limits**

Rule Part 22.917(a) specifies that “The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB.”

= P(W) – [43 + 10log(P)](dB)

= [30+10Log(P)] (dBm) - [43 + 10log(P)](dB)

= -13 dBm

| | |
|---|---|
| Limit | -13 dBm |

**Radiated spurious emissions**

1. Frequency Range : 9 kHz ~ 10th Harmonics of highest channel fundamental frequency.

2. The EUT was setup to maximum output power. The 100 kHz RBW was used to scan from 30 MHz to 1 GHz. Also, the 1 MHz RBW was used to scan from 1 GHz to 10 GHz. The high, low and a middle channel were tested for out of band measurements.

 

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### 9.3 Test equipment used

| | Model Number | Manufacturer | Description | Serial Number | Last Cal. (Interval) |
|---|---|---|---|---|---|
| ■ - | ESR | Rohde & Schwarz | EMI Test Receiver | 101470 | Oct. 22, 2018 (1Y) |
| ■ - | 310N | Sonoma Instrument | AMPLIFIER | 312544 | Mar. 18, 2019 (1Y) |
| ■ - | FSV30 | Rohde & Schwarz | Signal Analyzer | 101372 | Jul. 24, 2019 (1Y) |
| □ - | BBV9718B | Schwarzbeck | Broadband Preamplifier | 009 | Mar. 20, 2019 (1Y) |
| ■ - | SCU-03 | Rohde & Schwarz | Signal Conditioning Unit | 100333 | Mar. 11, 2019 (1Y) |
| ■ - | SCU-18 | Rohde & Schwarz | Pre-Amplifier | 102266 | Jul. 24, 2019 (1Y) |
| ■ - | MA-4000XPET | Innco Systems GmbH | Antenna Master | MA4000/509 | N/A |
| □ - | HD100 | HD GmbH | Position Controller | N/A | N/A |
| ■ - | DT3000-3t | Innco Systems GmbH | Turn Table | N/A | N/A |
| □ - | FMZB 1513 | Schwarzbeck | LOOP ANTENNA | 1513-235 | May. 13, 2018 (2Y) |
| ■ - | VULB9163 | Schwarzbeck | TRILOG Broadband Antenna | 9163-255 | Jun 05, 2018 (2Y) |
| ■ - | VULB9163 | Schwarzbeck | Hybrid Antenna | 777 | Apr, 13, 2018 (2Y) |
| ■ - | BBHA9120D | Schwarzbeck | Horn Antenna | 9120D-1366 | Jul. 16, 2019 (1Y) |
| ■ - | BBHA9120D | Schwarzbeck | Horn Antenna | 9120D-295 | Jul. 16, 2019 (1Y) |
| □ - | SCU40A | Rohde & Schwarz | Pre-Amplifier | 100436 | Mar. 11, 2019 (1Y) |
| ■ - | E5515C | Agilent | WIRELESS COMMUNICATIONS TEST SET | MY48360785 | Mar. 11, 2019 (1Y) |
| □ - | GP-4303D | LG Precision Co.,Ltd | DC Power Supply | 5071069 | Jan. 10, 2019 (1Y) |

All test equipment used is calibrated on a regular basis.

 

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### 9.4 Test data for Basic Model: ST410

-. Test Date : September 04, 2019 ~ September 16, 2019

-. Detector : RMS

-. Measurement distance : 3 m

-. Result : PASSED

| Frequency (MHz) | Substituted Level (dBm) | Ant. Pol. (H/V) | Cable Loss (dB) | Ant Gain (dBi) | Corrected Readiang (dBm) | Limits (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|---|
| **Test Data for Low Channel** | | | | | | | |
| 1 648.40 | -66.91 | V | 1.32 | 7.20 | -61.03 | -13.00 | 48.03 |
| 2 472.60 | -57.81 | H | 1.61 | 5.70 | -53.72 | -13.00 | 40.72 |
| 3 296.80 | -80.34 | H | 1.95 | 12.25 | -70.04 | -13.00 | 57.04 |
| 4 121.00 | -81.34 | V | 2.26 | 12.74 | -70.86 | -13.00 | 57.86 |
| 4 945.20 | -80.04 | H | 2.53 | 12.61 | -69.96 | -13.00 | 56.96 |
| **Test Data for Middle Channel** | | | | | | | |
| 1 673.20 | -63.90 | H | 1.32 | 7.20 | -58.02 | -13.00 | 45.02 |
| 2 509.80 | -58.35 | V | 1.61 | 5.70 | -54.26 | -13.00 | 41.26 |
| 3 346.40 | -82.88 | V | 1.95 | 12.25 | -72.58 | -13.00 | 59.58 |
| 4 183.00 | -82.12 | H | 2.26 | 12.74 | -71.64 | -13.00 | 58.64 |
| 5 019.60 | -80.04 | V | 2.53 | 12.61 | -69.96 | -13.00 | 56.96 |
| **Test Data for High Channel** | | | | | | | |
| 1 693.20 | -59.15 | H | 1.32 | 7.20 | -53.27 | -13.00 | 40.27 |
| 2 539.80 | -57.76 | V | 1.61 | 5.70 | -53.67 | -13.00 | 40.67 |
| 3 386.40 | -83.54 | V | 1.95 | 12.25 | -73.24 | -13.00 | 60.24 |
| 4 233.00 | -74.67 | H | 2.26 | 12.74 | -64.19 | -13.00 | 51.19 |
| 5 079.60 | -78.88 | H | 2.53 | 12.61 | -68.80 | -13.00 | 55.80 |

Remark: 1. The other Spurious RF Radiated emissions level is no more than noise floor.

2. The worst case was measured the highest power mode.

3. Rule Part 22.917(a) specifies that “The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB.”
Limit : 38.45 - 43+10log(7.00) = -13 dBm

“C.L” : Cable Loss, “H”: Horizontal, “V”: Vertical

**Tested by: Ju Yun Park / Assistant Manager**

 

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### 9.5 Test data for Multiple Model: ST410GC

-. Test Date : September 04, 2019 ~ September 16, 2019

-. Detector : RMS

-. Measurement distance : 3 m

-. Result : PASSED

| Frequency (MHz) | Substituted Level (dBm) | Ant. Pol. (H/V) | Cable Loss (dB) | Ant Gain (dBi) | Corrected Readiang (dBm) | Limits (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|---|
| **Test Data for Low Channel** | | | | | | | |
| 1 648.40 | -66.14 | H | 1.32 | 7.20 | -60.26 | -13.00 | 47.26 |
| 2 472.60 | -57.34 | V | 1.61 | 5.70 | -53.25 | -13.00 | 40.25 |
| 3 296.80 | -79.70 | V | 1.95 | 12.25 | -69.40 | -13.00 | 56.40 |
| 4 121.00 | -80.99 | V | 2.26 | 12.74 | -70.51 | -13.00 | 57.51 |
| 4 945.20 | -79.36 | H | 2.53 | 12.61 | -69.28 | -13.00 | 56.28 |
| **Test Data for Middle Channel** | | | | | | | |
| 1 673.20 | -53.02 | H | 1.32 | 7.20 | -47.14 | -13.00 | 34.14 |
| 2 509.80 | -57.69 | V | 1.61 | 5.70 | -53.60 | -13.00 | 40.60 |
| 3 346.40 | -82.36 | V | 1.95 | 12.25 | -72.06 | -13.00 | 59.06 |
| 4 183.00 | -80.45 | H | 2.26 | 12.74 | -69.97 | -13.00 | 56.97 |
| 5 019.60 | -80.06 | V | 2.53 | 12.61 | -69.98 | -13.00 | 56.98 |
| **Test Data for High Channel** | | | | | | | |
| 1 693.20 | -65.09 | H | 1.32 | 7.20 | -59.21 | -13.00 | 46.21 |
| 2 539.80 | -58.58 | H | 1.61 | 5.70 | -54.49 | -13.00 | 41.49 |
| 3 386.40 | -83.53 | V | 1.95 | 12.25 | -73.23 | -13.00 | 60.23 |
| 4 233.00 | -77.42 | V | 2.26 | 12.74 | -66.94 | -13.00 | 53.94 |
| 5 079.60 | -78.98 | V | 2.53 | 12.61 | -68.90 | -13.00 | 55.90 |

Remark: 1. The other Spurious RF Radiated emissions level is no more than noise floor.

2. The worst case was measured the highest power mode.

3. Rule Part 22.917(a) specifies that “The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB.”
Limit : 38.45 - 43+10log(7.00) = -13 dBm

“C.L” : Cable Loss, “H”: Horizontal, “V”: Vertical

**Tested by: Ju Yun Park / Assistant Manager**

 

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# 10. PEAK-TO-AVERAGE RATIO

## 10.1 Operating environment

Temperature : 24 ℃

Relative humidity : 47 % R.H.

## 10.2 Test set-up

Peak to Average Power Ratio is tested in accordance with KDB971168 D01 Power Meas License Digital Systems v03r01, April 9, 2018, Section 5.7.

**- Section 5.7.2 Measurement of peak power in a broadband noise-like signal using CCDF**

a) Set resolution/measurement bandwidth ≥ OBW or specified reference bandwidth.

b) Set the number of counts to a value that stabilizes the measured CCDF curve.

c) Set the measurement interval as follows:

1) For continuous transmissions, set to the greater of [10 × (number of points in sweep) × (transmission symbol period)] or 1 ms.

2) For burst transmissions, employ an external trigger that is synchronized with the EUT burst timing sequence, or use the internal burst trigger with a trigger level that allows the burst to stabilize. Set the measurement interval to a time that is less than or equal to the burst duration.

3) If there are several carriers in a single antenna port, the peak power shall be determined for each individual carrier (by disabling the other carriers while measuring the required carrier) and the total peak power calculated from the sum of the individual carrier peak powers.

d) Record the maximum PAPR level associated with a probability of 0.1%.

e) The peak power level is calculated form the sum of the PAPR value from step d) to the measured average power.

**- Section 5.7.3 Alternate Procedure for PAPR**

Some regulatory requirements specify a PAPR limit when the output power limits are specified in terms of average power. If it becomes necessary to provide measurement data to demonstrate compliance to a PAPR limit, then the appropriate procedure from those provided in 5.2.3 shall be utilized to determine the peak power (or peak PSD) and the appropriate procedure from those provided in 5.2.4 shall be used to determine the average power (or average PSD). The data from these measurements is then used in Equation (2) to determine the PAPR of a narrowband CW-like signal. See 5.2.3.4 for guidance on determining the PAPR of a broadband noise-like signal.

$$PAPR\ (dB) = P_{Pk}\ (dBm\ or\ dBW) - P_{Avg}\ (dBm\ or\ dBW)$$

where

PAPR peak-to-average power ratio, in dB

$P_{Pk}$ measured peak power or peak PSD level, in dBm or dBW

$P_{Avg}$ measured average power or average PSD level, in dBm or dBW

 

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### 10.3 Test equipment used

| | Model Number | Manufacturer | Description | Serial Number | Last Cal. |
|---|---|---|---|---|---|
| ■ - | FSV30 | Rohde & Schwarz | Signal Analyzer | 101372 | Jul. 24, 2019 (1Y) |
| ■ - | AAMCS-UDC | AA-MCS | Directional Coupler | 400 | Jul. 25, 2019 (1Y) |
| ■ - | E5515C | Agilent | WIRELESS COMMUNICATIONS TEST SET | MY48360785 | Mar. 11, 2019 (1Y) |
| ☐ - | GP-4303D | LG Precision Co.,Ltd | DC Power Supply | 5071069 | Jan. 10, 2019 (1Y) |

All test equipment used is calibrated on a regular basis.

### 10.4 Test data

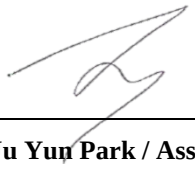
-. Test Date : September 04, 2019 ~ September 16, 2019

-. Test Result : Pass

GSM850

| Band | Channel | Peak-Average Ratio(PAR) CCDF 0.1 % | Limit (dB) | Result |
|---|---|---|---|---|
| GSM850 | Low | 4.23 | 13.00 | PASS |
| | Middle | 4.75 | 13.00 | PASS |
| | High | 4.23 | 13.00 | PASS |

Remark: Measured the using CCDFof spectrum analyzer.



**Tested by: Ju Yun Park / Assistant Manager**

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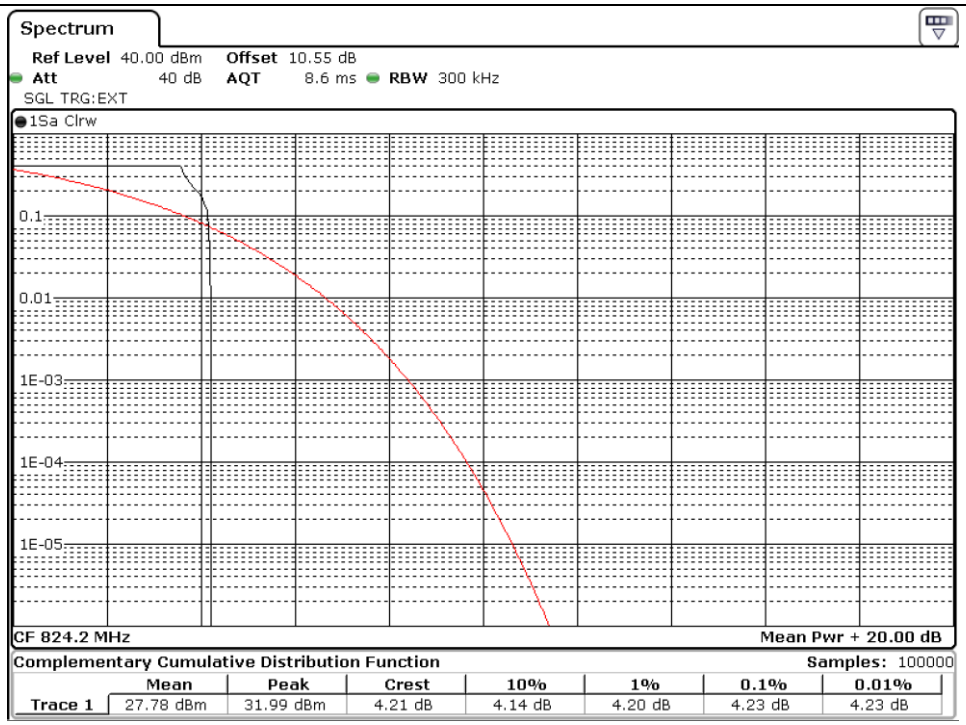
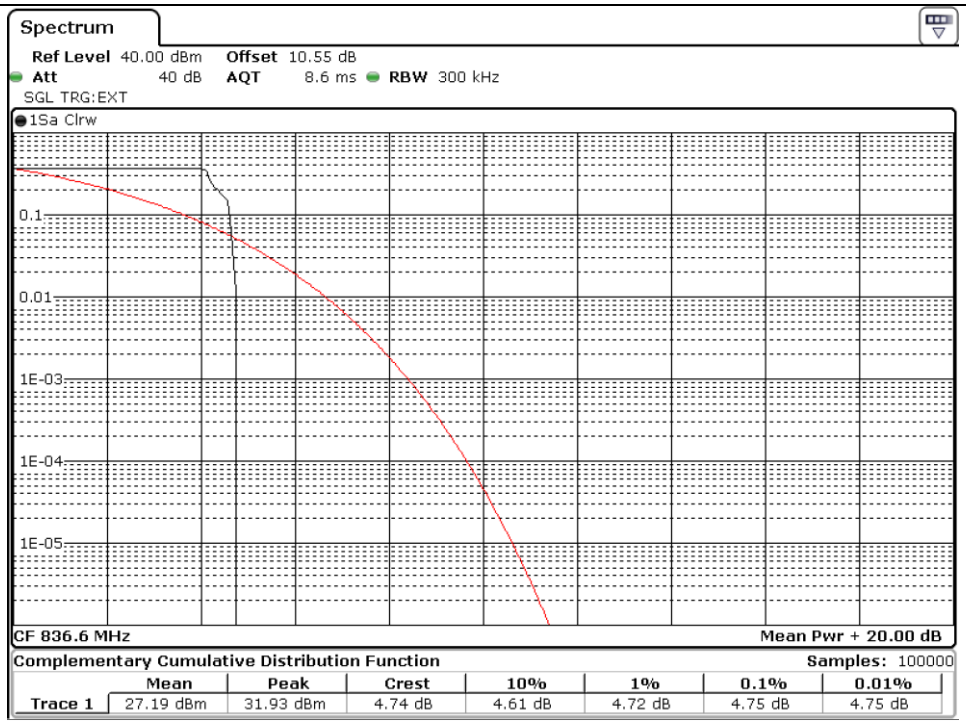
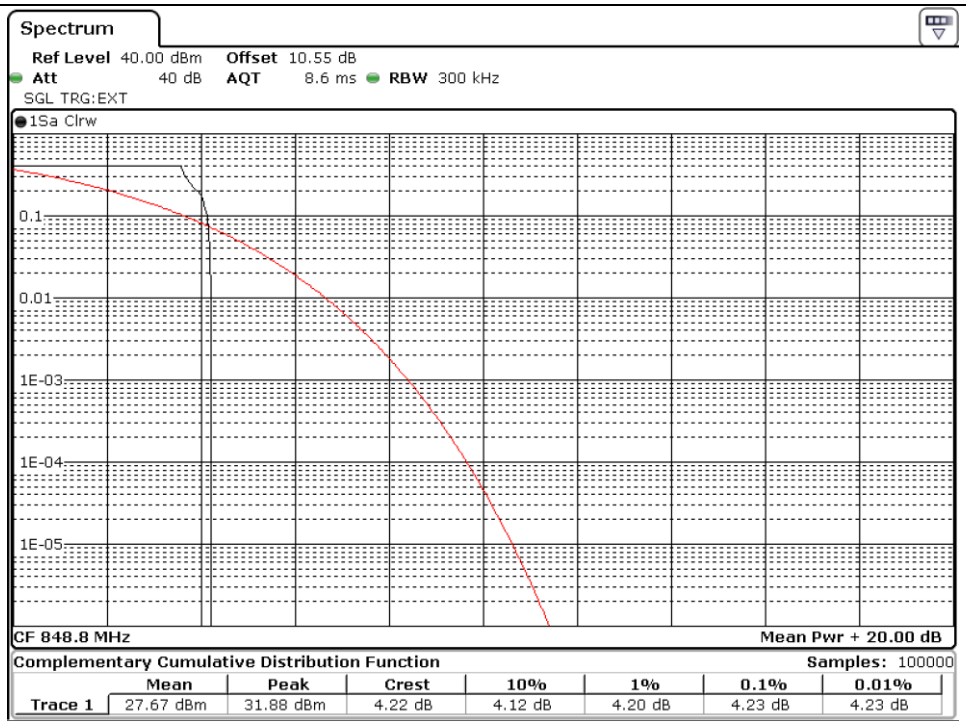



Low Channel




Middle Channel




High Channel

# 11. OCCUPIED BANDWIDTH

## 11.1 Operating environment

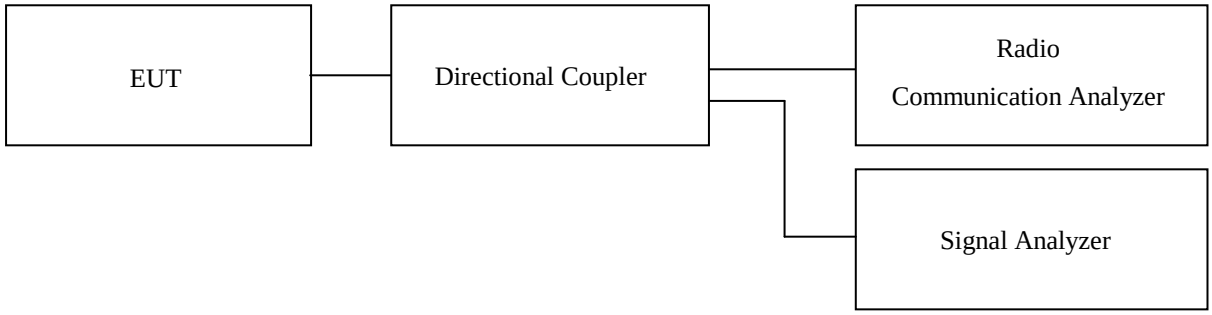
Temperature : 24 ℃

Relative humidity : 47 % R.H.

## 11.2 Test set-up

The emission bandwidth (×dB) is defined as the frequency range between two points, one above and one below the carrier frequency, at which the spectral density of the emission is attenuated × dB below the maximum in-band spectral density of the modulated signal. Spectral density (power per unit bandwidth) is to be measured with a detector of resolution bandwidth in the range of 1% to 5% of the anticipated emission bandwidth, and a video bandwidth at least 3× the resolution bandwidth. When the occupied bandwidth limit is not stated in the applicable RSS or reference measurement method, the transmitted signal bandwidth shall be reported as the 99% emission bandwidth, as calculated or measured.

- The transmitter shall be operated at its maximum carrier power measured under normal test conditions.
- The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts.
- The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the occupied bandwidth (OBW) and video bandwidth (VBW) shall be approximately 3×RBW.




## 11.3 Test equipment used

| | Model Number | Manufacturer | Description | Serial Number | Last Cal. |
|---|---|---|---|---|---|
| ■ - | FSV30 | Rohde & Schwarz | Signal Analyzer | 101372 | Jul. 24, 2019 (1Y) |
| ■ - | AAMCS-UDC | AA-MCS | Directional Coupler | 400 | Jul. 25, 2019 (1Y) |
| ■ - | E5515C | Agilent | WIRELESS COMMUNICATIONS TEST SET | MY48360785 | Mar. 11, 2019 (1Y) |
| ☐ - | GP-4303D | LG Precision Co.,Ltd | DC Power Supply | 5071069 | Jan. 10, 2019 (1Y) |

All test equipment used is calibrated on a regular basis.

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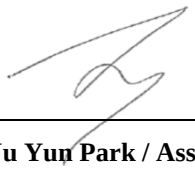
### 11.4 Test data for GSM850

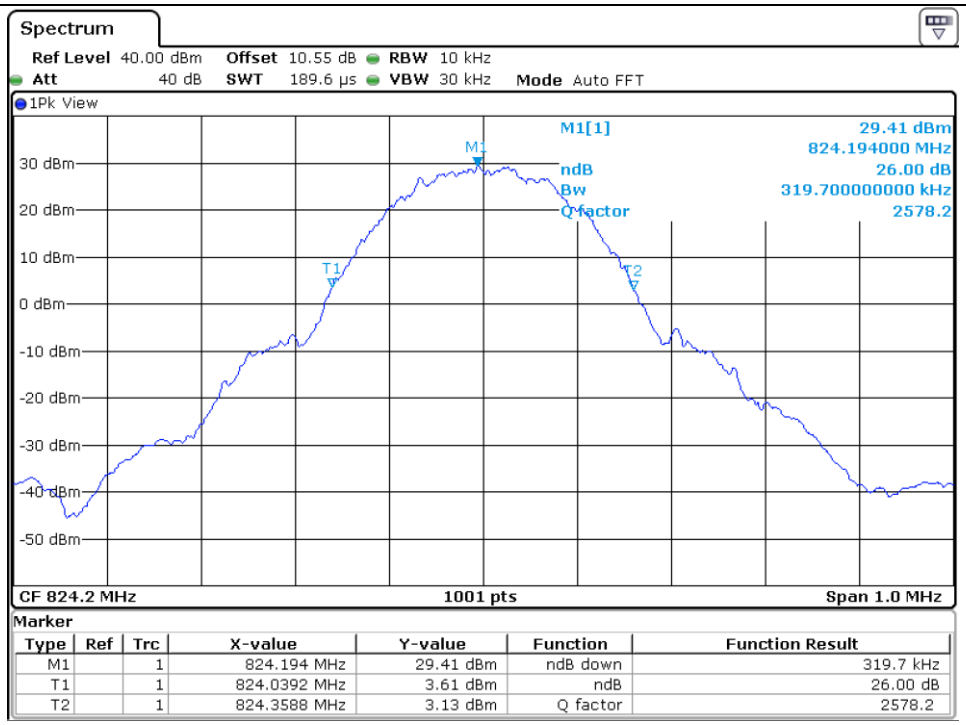
-. Test Date : September 04, 2019 ~ September 16, 2019

-. Test Result : Pass

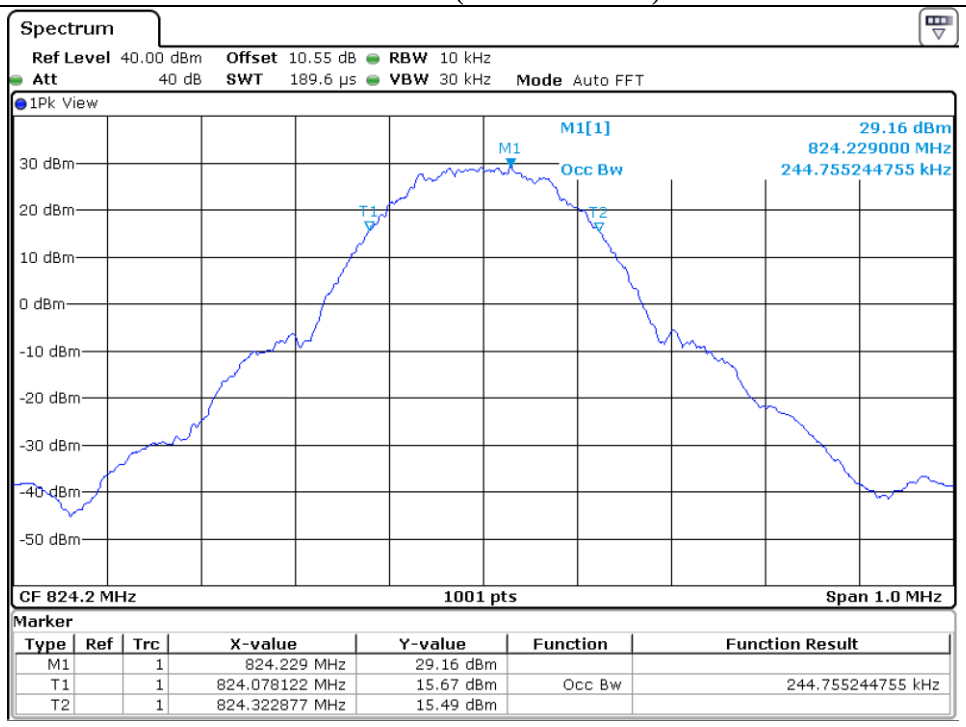
| Band | Channel | 26 dB Bandwidth (MHz) | 99 % Occupied Bandwidth (MHz) | Result |
|---|---|---|---|---|
| GSM850 | Low | 319.70 | 244.76 | PASS |
| | Middle | 320.70 | 244.76 | PASS |
| | High | 319.70 | 243.76 | PASS |



**Tested by: Ju Yun Park / Assistant Manager**




Low Channel (26 dB Bandwidth)




Low Channel (99 % Occupied Bandwidth)

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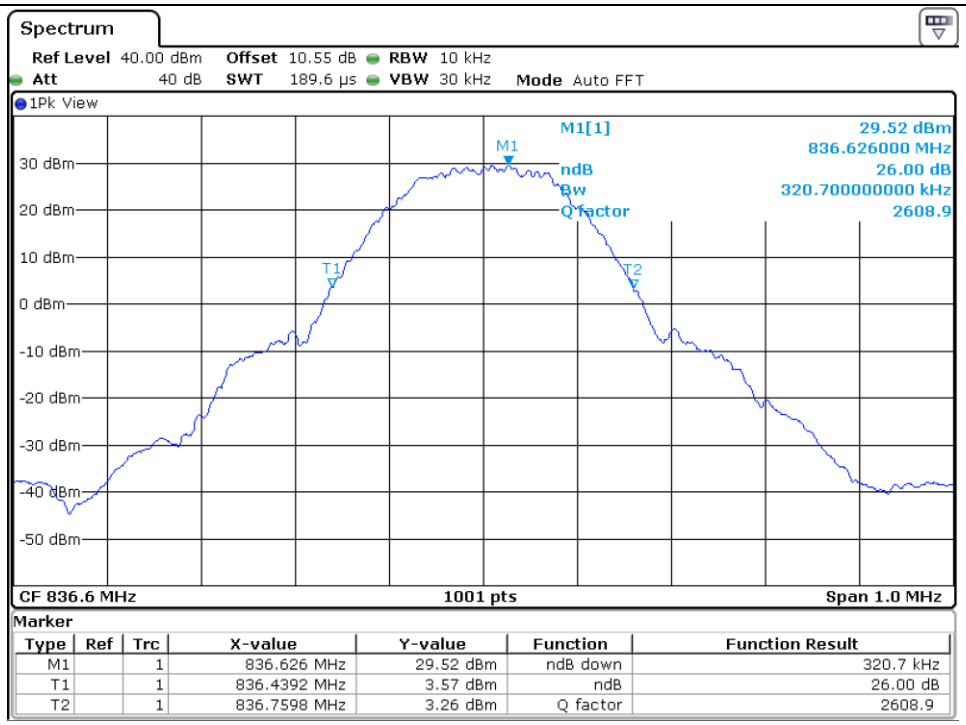
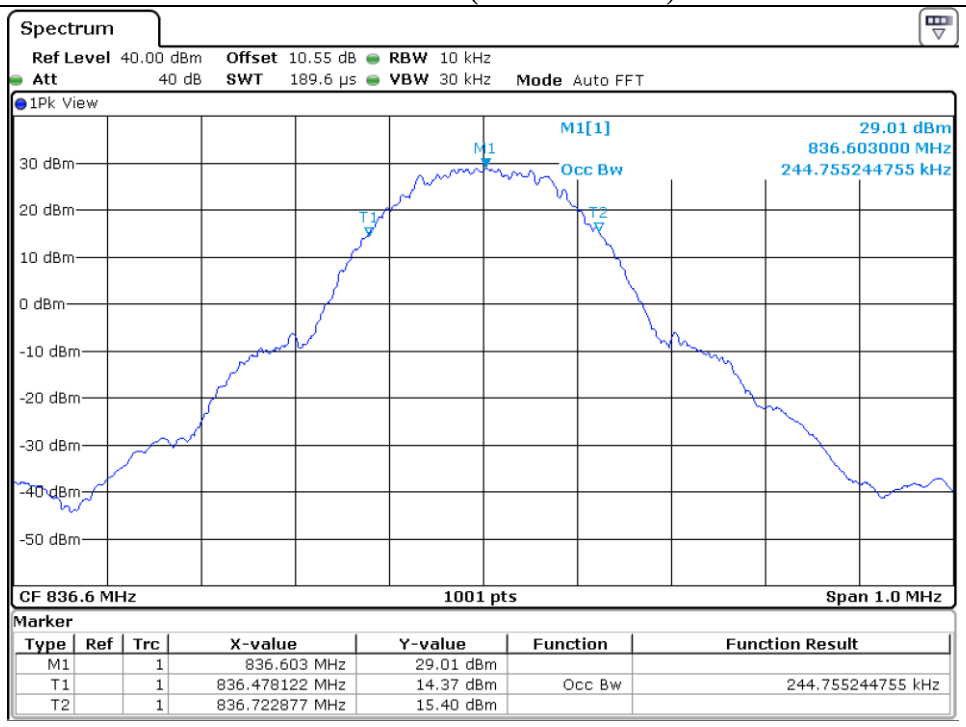



Middle Channel (26 dB Bandwidth)




Middle Channel (99 % Occupied Bandwidth)

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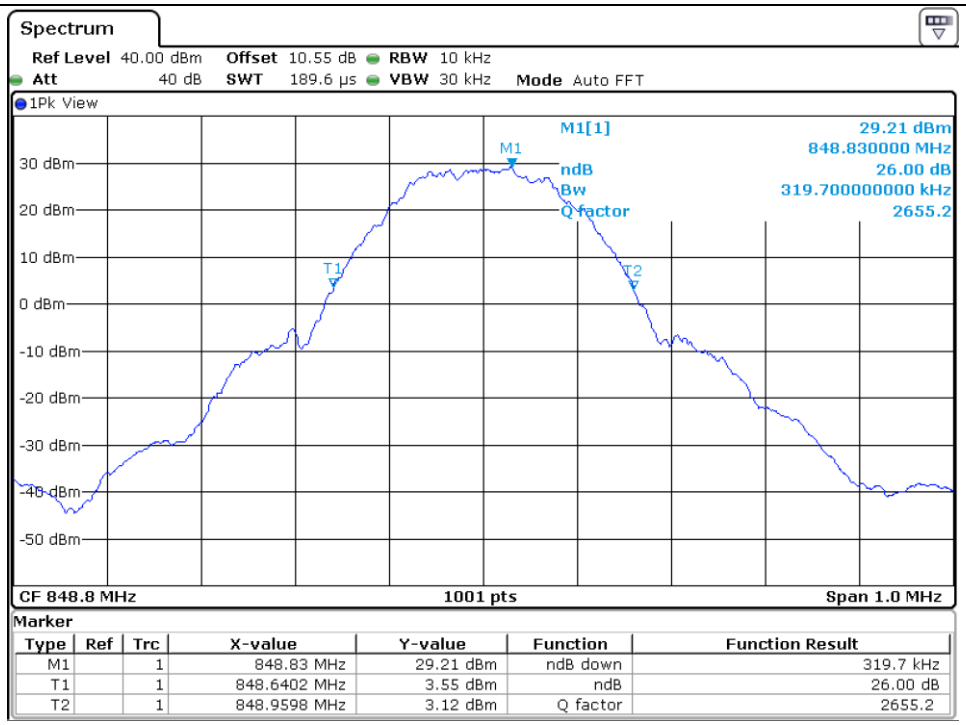
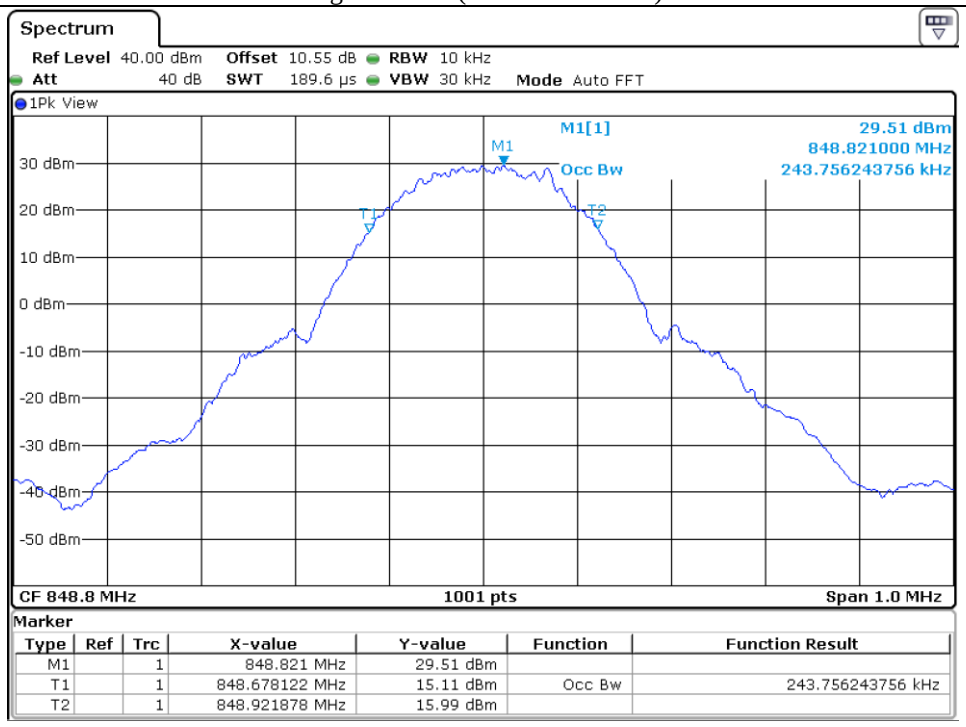



High Channel (26 dB Bandwidth)




High Channel (99 % Occupied Bandwidth)

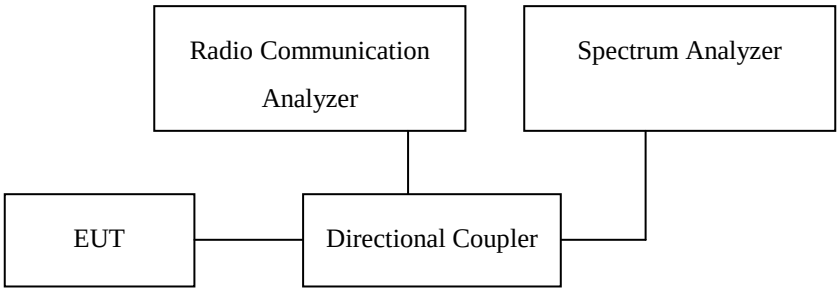
# 12. Conducted Band Edge

## 12.1 Operating environment

Temperature : 24 ℃

Relative humidity : 47 % R.H.

## 12.2 Test set-up




(Configuration of conducted Emission measurement)

Conducted Spurious Emissions is tested in accordance with KDB971168 D01 Power Meas License Digital Systems v04, April 9, 2018, Section 6.

The EUT makes a call to the communication simulator. The power was measured with R&S Spectrum Analyzer. All measurements were done at 3 channels(low, middle and high operational range.)

The Conducted Spurious Emissions used the power splitter via EUT RF power connector between simulation base station and spectrum analyzer.

The communication simulator station system controlled a EUT to export maximum output power under transmission mode and specific channel frequency.

## 12.3 Methods of Measurement

1. All measurements were done at low and high operational frequency range.
2. Set spectrum analyzer with RMS detector.
3. The center frequency of spectrum is the band edge frequency and set RBW of the spectrum is 20 kHz and VBW of the spectrum is 50 kHz

## 12.4 Limits

Rule Part 22.917(a) specifies that “The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB.”

= P(W) – [43 + 10log(P)](dB)

= [30+10Log(P)] (dBm) - [43 + 10log(P)](dB)

= -13 dBm

| | |
|---|---|
| Limit | -13 dBm |

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### 12.5 Test equipment used

| | Model Number | Manufacturer | Description | Serial Number | Last Cal. |
|---|---|---|---|---|---|
| ■ - | FSV30 | Rohde & Schwarz | Signal Analyzer | 101372 | Jul. 24, 2019 (1Y) |
| ■ - | AAMCS-UDC | AA-MCS | Directional Coupler | 400 | Jul. 25, 2019 (1Y) |
| ■ - | E5515C | Agilent | WIRELESS COMMUNICATIONS TEST SET | MY48360785 | Mar. 11, 2019 (1Y) |
| ☐ - | GP-4303D | LG Precision Co.,Ltd | DC Power Supply | 5071069 | Jan. 10, 2019 (1Y) |

All test equipment used is calibrated on a regular basis.

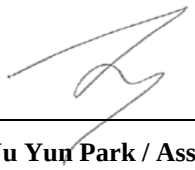
### 12.6 Test data

### 12.6.1 Test data for GSM850

-. Test Date : September 04, 2019 ~ September 16, 2019

-. Test Result : Pass

| Band | Channel | Edge Frequency (MHz) | MEASURED VLAUE (dBm) | Limit (dBm) | Result |
|---|---|---|---|---|---|
| GSM850 | Low | 824.000 0 | -30.74 | -13.00 | PASS |
| | High | 849.000 0 | -31.51 | -13.00 | PASS |



**Tested by: Ju Yun Park / Assistant Manager**

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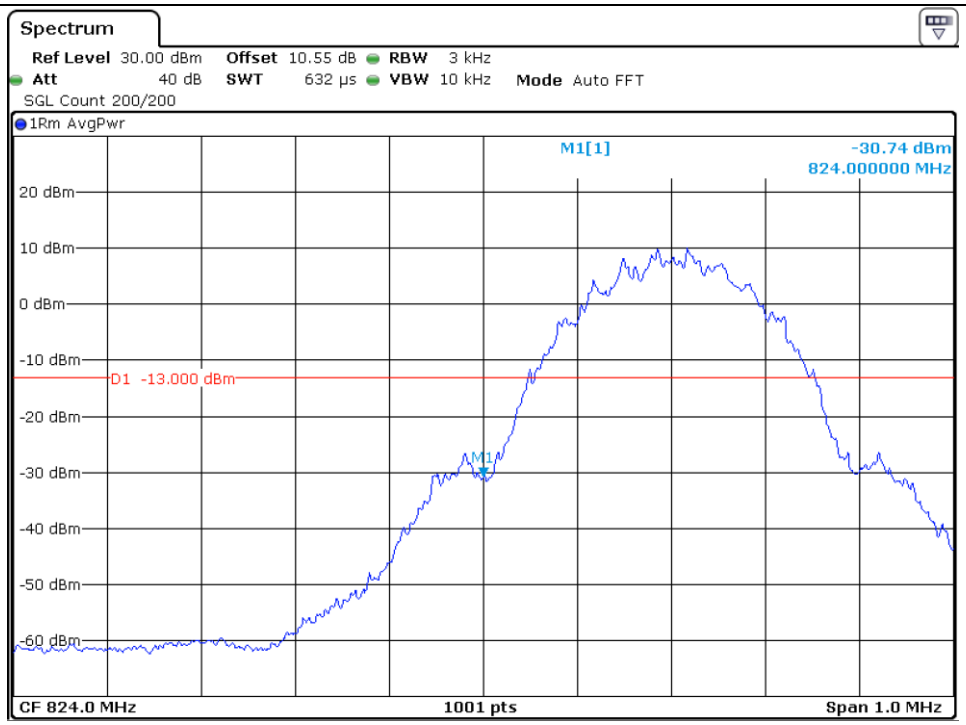
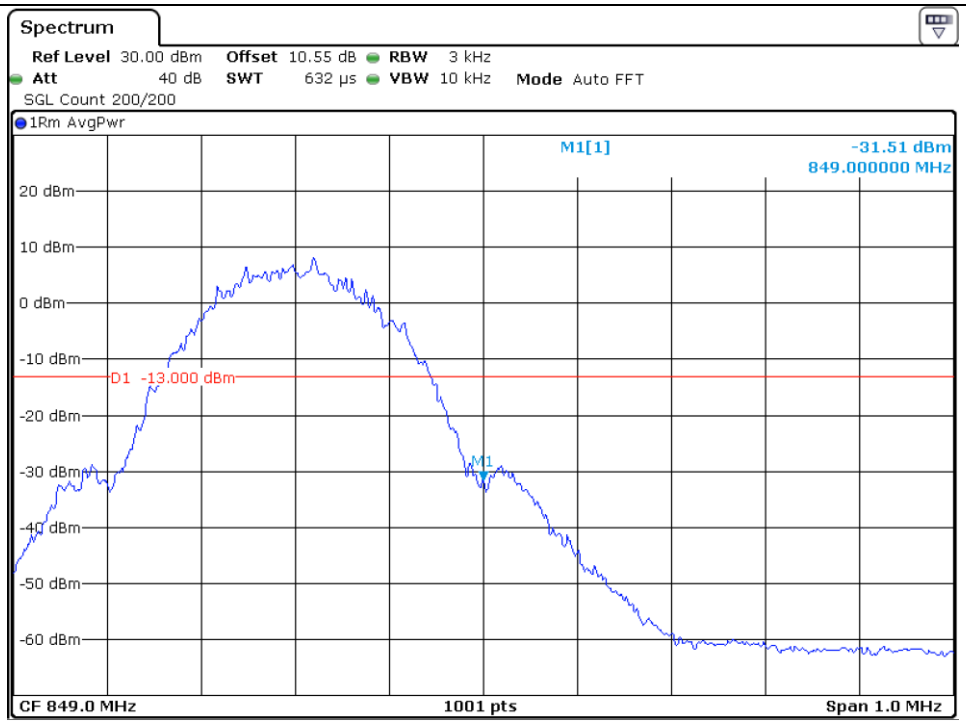
### 12.6.2 Test data for GSM850




LOW Channel




High Channel

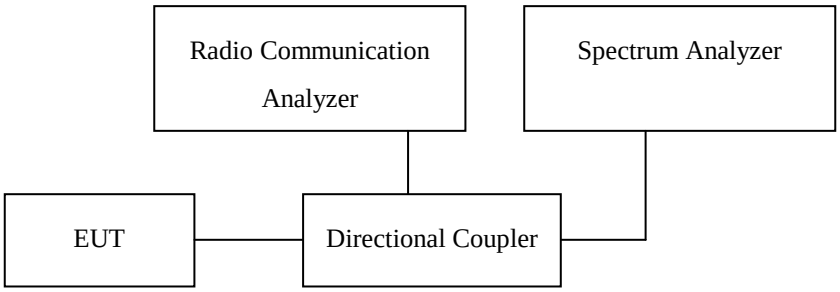
# 13. Conducted Spurious and Harmonic Emissions at Antenna Termianl

## 13.1 Operating environment

Temperature : 24 ℃

Relative humidity : 47 % R.H.

## 13.2 Test set-up




(Configuration of conducted Emission measurement)

Conducted Spurious Emissions is tested in accordance with KDB971168 D01 Power Meas License Digital Systems v04, April 9, 2018, Section 6.

The EUT makes a call to the communication simulator. The power was measured with R&S Spectrum Analyzer. All measurements were done at 3 channels(low, middle and high operational range.)

The Conducted Spurious Emissions used the power splitter via EUT RF power connector between simulation base station and spectrum analyzer.

The communication simulator station system controlled a EUT to export maximum output power under transmission mode and specific channel frequency.

**Conducded spurious emissions**

The EUT was setup to maximum output power. The 100 kHz RBW and 300 kHz VBW was used to scan from 30 MHz to 1 GHz. Also, the 1 MHz RBW and 3 MHz VBW was used to scan from 1 GHz to 10 GHz. The high, low and a middle channel were tested for out of band measurements.

## 13.3 Limits

Rule Part 22.917(a) specifies that “The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB.”

= P(W) – [43 + 10log(P)](dB)

= [30+10Log(P)] (dBm) - [43 + 10log(P)](dB)

= -13 dBm

| | |
|---|---|
| Limit | -13 dBm |

### 13.4 Test equipment used

| | Model Number | Manufacturer | Description | Serial Number | Last Cal. |
|---|---|---|---|---|---|
| ■ - | FSV30 | Rohde & Schwarz | Signal Analyzer | 101372 | Jul. 24, 2019 (1Y) |
| ■ - | AAMCS-UDC | AA-MCS | Directional Coupler | 400 | Jul. 25, 2019 (1Y) |
| ■ - | E5515C | Agilent | WIRELESS COMMUNICATIONS TEST SET | MY48360785 | Mar. 11, 2019 (1Y) |
| ☐ - | GP-4303D | LG Precision Co.,Ltd | DC Power Supply | 5071069 | Jan. 10, 2019 (1Y) |

All test equipment used is calibrated on a regular basis.

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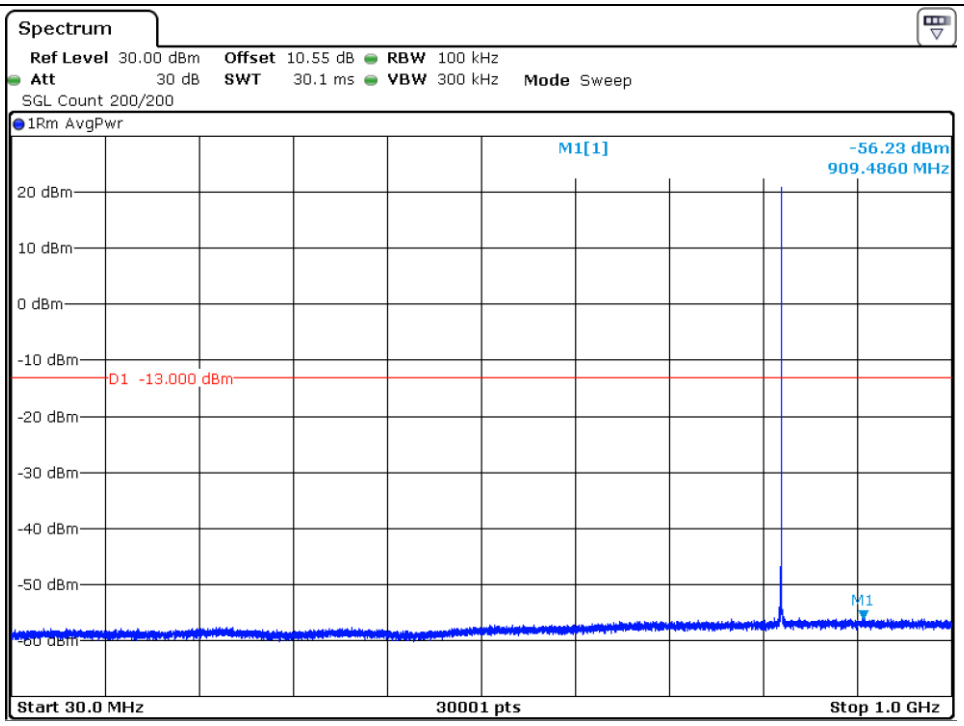
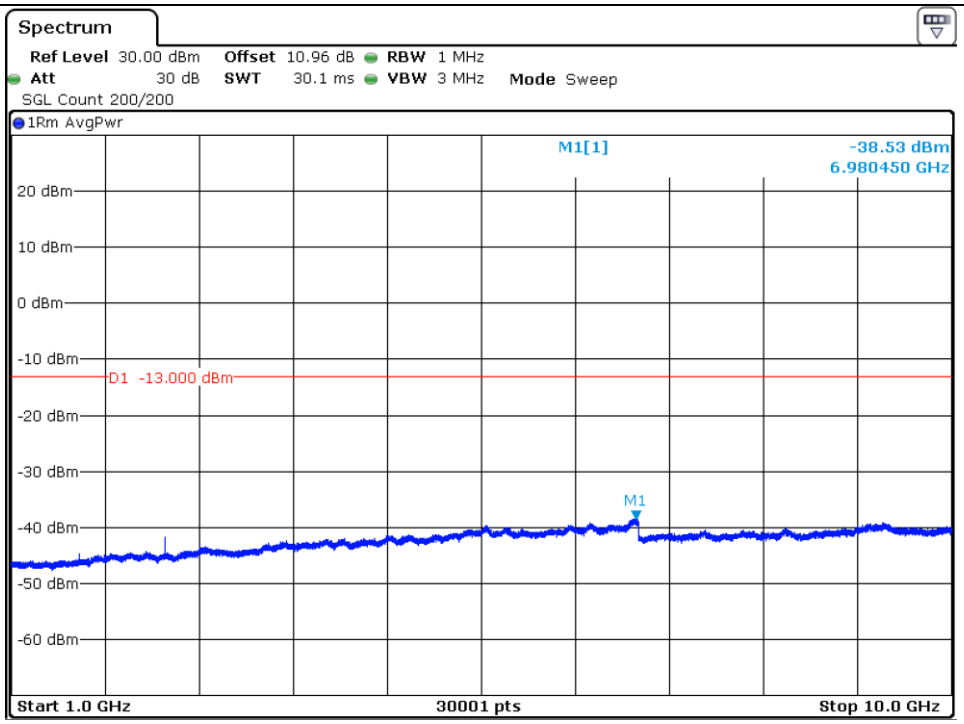
## 13.5 Test data

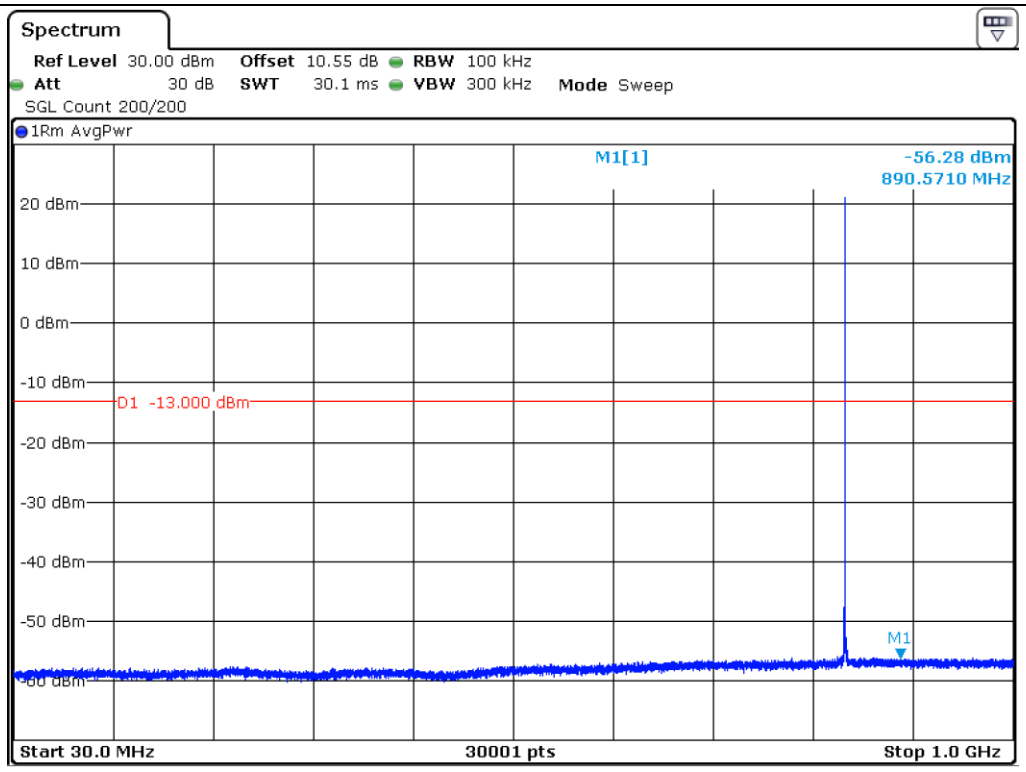
### 13.5.1 Test data for GSM850



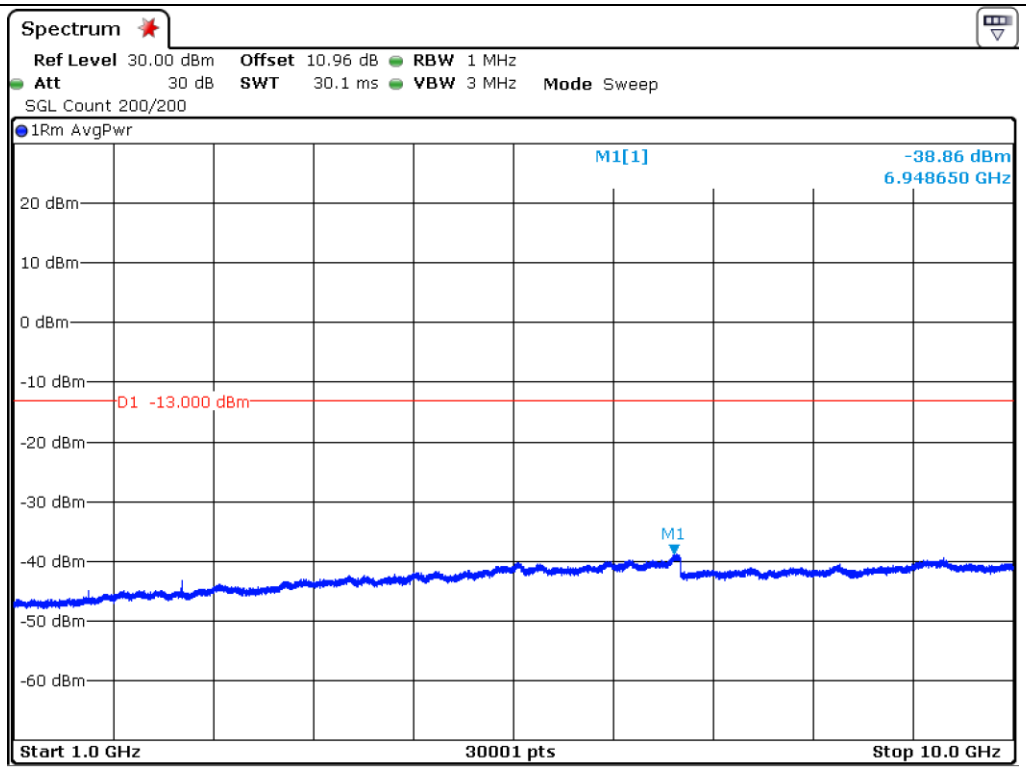

Low Channel




Low Channel




Midle Channel




Midle Channel

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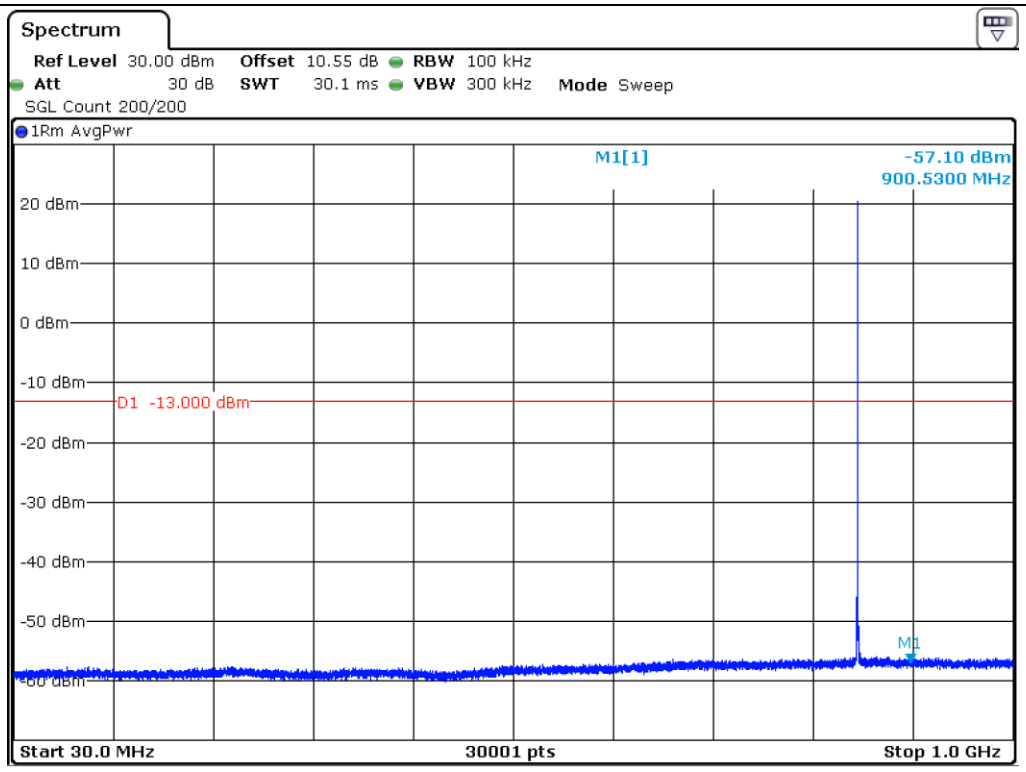
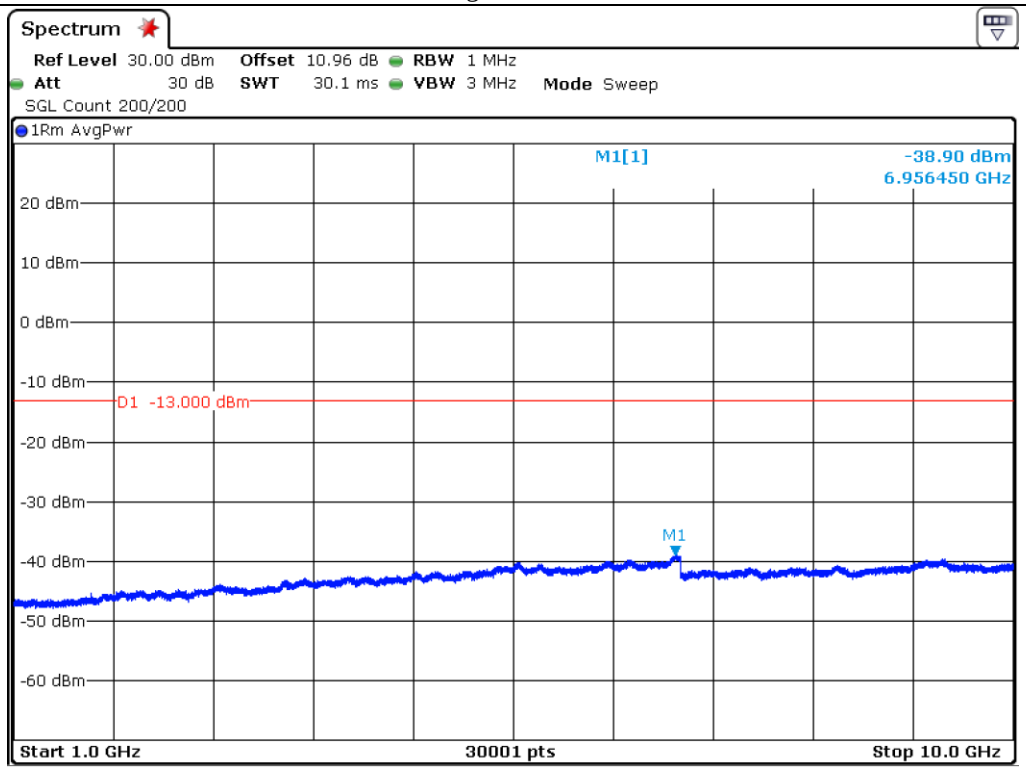



High Channel




High Channel

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# 14. FREQUENCY STABILITY / VARIATION OF AMBIENT TEMPERATURE

## 14.1 Operating environment

Temperature : 24 ℃

Relative humidity : 47 % R.H.

## 14.2 Test set-up

1. Frequency Stability (Voltage Variation)

+20 ℃ temperature and ±15% supply voltage variations. If a product is specified to operate over a range of input voltage then the −15% variation is applied to the lowermost voltage and the +15% is applied to the uppermost voltage.

(1) Vary primary supply voltage from ±15% of the nominal value for other than hand carried battery equipment.

(2) For hand carried, battery powered equipment, reduce primary supply voltage to the battery-operating end point which shall be specified by the manufacturer.

2. Frequency Stability (Temperature Variation)

Turn EUT off and set chamber temperature to -30 ℃ and then allow sufficient time (approximately 20 to 30 minutes after chamber reach the assigned temperature) for EUT to stabilize. Turn ON EUT and measure the EUT operating frequency and then turn off the EUT after the measurement. The temperature in the chamber was raised 10 ℃ step from -30 ℃ to +50 ℃. Repeat above method for frequency measurements every 10 ℃ step and then record all measured frequencies on each temperature step.

## 14.3 Test equipment used

| | Model Number | Manufacturer | Description | Serial Number | Last Cal. |
|---|---|---|---|---|---|
| ■ - | FSV30 | Rohde & Schwarz | Signal Analyzer | 101372 | Jul. 24, 2019 (1Y) |
| ■ - | AAMCS-UDC | AA-MCS | Directional Coupler | 400 | Jul. 25, 2019 (1Y) |
| ■ - | E5515C | Agilent | WIRELESS COMMUNICATIONS TEST SET | MY48360785 | Mar. 11, 2019 (1Y) |
| ■ - | PSL-2KP | ESPEC | Environmental Test Chamber | 14009407 | Feb. 22, 2019 (1Y) |
| ■ - | GP-4303D | LG Precision Co.,Ltd | DC Power Supply | 5071069 | Jan. 10, 2019 (1Y) |

All test equipment used is calibrated on a regular basis.

## 14.4 Test data

### 14.4.1 Test data for Voltage(V)

| Temperature( ˚C) | Power(VDC) | Center Freq. | Measured Freq. | PPM |
|---|---|---|---|---|
| 20 | 3.700 | 836 600 000 | 836 600 003 | 0.0036 |
| | 3.145 | | 836 599 999 | -0.0012 |
| | 4.255 | | 836 600 004 | 0.0048 |

### 14.4.2 Test data for Temperature( ˚C)

| Temperature( ˚C) | Power(VDC) | Center Freq. | Measured Freq. | PPM |
|---|---|---|---|---|
| -30 | 3.7 | 836 600 000 | 836 599 989 | -0.0131 |
| -20 | | | 836 599 991 | -0.0108 |
| -10 | | | 836 599 993 | -0.0084 |
| 0 | | | 836 599 995 | -0.0060 |
| 10 | | | 836 599 997 | -0.0036 |
| 20 | | | 836 600 003 | 0.0036 |
| 30 | | | 836 600 004 | 0.0048 |
| 40 | | | 836 600 007 | 0.0084 |
| 50 | | | 836 600 005 | 0.0060 |

**Tested by: Ju Yun Park / Assistant Manager**

 

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