



# CERTIFICATION TEST REPORT

**Report Number. :** 12563734-E1V6

**Applicant :** Samsung Electronics Co., Ltd.  
129 Samsung-Ro, Yeongtong-Gu,  
Suwon-Si, Gyeonggi-Do, 16677, Korea

**Model :** SM-G970F/DS and SM-G970F

**FCC ID :** A3LSMG970F

**EUT Description :** GSM/WCDMA/LTE Phone with BT, DTS/UNII a/b/g/n/ac/11ax HE 20/40/80,  
ANT+ and NFC.

**Test Standard(s) :** FCC CFR47 PART 22 SUBPART H  
FCC CFR47 PART 24 SUBPART E  
FCC CFR47 PART 27 SUBPART F, H, L, and M  
FCC CFR47 PART 90 SUBPART S

**Date Of Issue:**  
JANUARY 28, 2019

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NVLAP Lab code: 200065-0

Revision History

| <u>Rev.</u> | <u>Issue Date</u> | <u>Revisions</u>  | <u>Revised By</u> |
|-------------|-------------------|---|-------------------|
| V1          | 12/20/2018        | Initial Review  | --                |
| V2          | 1/14/2019         | Updated Sections 5.1, 5.2, 5.4, 5.5, 6, 7.2, 8.1, 8.2, 8.5, and 9.2 | Steven Tran       |
| V3          | 1/22/2019         | Updated Sections 1, 5.2, 5.4, 5.5, 8.2, 8.3, 9.2, and 10            | Steven Tran       |
| V4          | 1/23/2019         | Updated Sections 5.2  | Steven Tran       |
| V5          | 1/25/2019         | Added Note in Section 9.1   | Steven Tran       |
| V6          | 1/28/2019         | Updated Section 5.5   | Steven Tran       |

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# 1. ATTESTATION OF TEST RESULTS

|  |   |  |
|--|---|--|
| Applicant Name and Address   | SAMSUNG ELECTRONICS CO., LTD.<br>129 SAMSUNG-RO, YEONGTONG-GU,<br>SUWON-SI, GYEONGGI-DO, 16677, KOREA |  |
| Model  | SM-G970F/DS AND SM-G970F  |  |
| FCC ID   | A3LSMG970F  |  |
| EUT Description  | GSM/WCDMA/LTE PHONE WITH BT, DTS/UNII A/B/G/N/AC/11AX HE 20/40/80,<br>ANT+ AND NFC.                   |  |
| Serial Number  | R38KA0H4BJF (CONDUCTED)R38B05BDYN (RADIATED)  |  |
| Date Tested  | OCTOBER 25, 2018 to JANUARY 22, 2019  |  |
| Applicable Standards   | FCC CFR 47 PART 22H, 24E, 27F,H,L,M and 90S   |  |
| Test Results   | Complies  |  |
| <p>UL Verification Services Inc. tested the above equipment in accordance with the requirements set forth in the above standards. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.</p> <p>The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. It is the manufacturer's responsibility to assure that additional production units of this model are manufactured with identical electrical and mechanical components. All samples tested were in good operating condition throughout the entire test program. Measurement Uncertainties are published for informational purposes only and were not taken into account unless noted otherwise.</p> <p>This document may not be altered or revised in any way unless done so by UL Verification Services Inc. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL Verification Services Inc. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of the U.S. government.</p> |   |  |
| Approved & Released For<br>UL Verification Services Inc. By:   | Reviewed By:  |  |
|   |                    |  |
| Dan Corona<br>Operations Leader<br>Consumer Technology Division<br>UL Verification Services Inc.   | Steven Tran<br>Project Engineer<br>Consumer Technology Division<br>UL Verification Services Inc.      |  |



## 2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.26:2015, ANSI C63.4:2014, TIA-603-E, FCC CFR 47 Part 2, Part 22, Part 24, Part 27, Part 90, FCC KDB 971168 D01 v3r1.

## 3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 and 47266 Benicia Street, and 47658 Kato Road, Fremont, California, USA. Line conducted emissions are measured only at the 47173 address. The following table identifies which facilities were utilized for radiated emission measurements documented in this report. Specific facilities are also identified in the test results sections.

| 47173 Benicia Street   | 47266 Benicia Street                              | 47658 Kato Rd                                     |
|--|---|---|
| <input checked="" type="checkbox"/> Chamber A (ISED:2324B-1) | <input type="checkbox"/> Chamber D (ISED:22541-1) | <input type="checkbox"/> Chamber I (ISED:2324A-5) |
| <input checked="" type="checkbox"/> Chamber B (ISED:2324B-2) | <input type="checkbox"/> Chamber E (ISED:22541-2) | <input type="checkbox"/> Chamber J (ISED:2324A-6) |
| <input type="checkbox"/> Chamber C (ISED:2324B-3)            | <input type="checkbox"/> Chamber F (ISED:22541-3) | <input type="checkbox"/> Chamber K (ISED:2324A-1) |
|  | <input type="checkbox"/> Chamber G (ISED:22541-4) | <input type="checkbox"/> Chamber L (ISED:2324A-3) |
|  | <input type="checkbox"/> Chamber H (ISED:22541-5) |   |

The above test sites and facilities are covered under FCC Test Firm Registration # 208313. Chambers above are covered under Industry Canada company address and respective code

UL Verification Services Inc. is accredited by NVLAP, Laboratory Code 200065-0

## 4. CALIBRATION AND UNCERTAINTY

### 4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

### 4.2. SAMPLE CALCULATION

#### RADIATED EMISSIONS

Where relevant, the following sample calculation is provided:

$$\text{Field Strength (dBuV/m)} = \text{Measured Voltage (dBuV)} + \text{Antenna Factor (dB/m)} + \text{Cable Loss (dB)} - \text{Preamp Gain (dB)}$$
$$36.5 \text{ dBuV} + 18.7 \text{ dB/m} + 0.6 \text{ dB} - 26.9 \text{ dB} = 28.9 \text{ dBuV/m}$$

#### MAINS CONDUCTED EMISSIONS

Where relevant, the following sample calculation is provided:

$$\text{Final Voltage (dBuV)} = \text{Measured Voltage (dBuV)} + \text{Cable Loss (dB)} + \text{Limiter Factor (dB)} + \text{LISN Insertion Loss.}$$
$$36.5 \text{ dBuV} + 0 \text{ dB} + 10.1 \text{ dB} + 0 \text{ dB} = 46.6 \text{ dBuV}$$

### 4.3. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

| PARAMETER   | UNCERTAINTY |
|---|-------------|
| Worst Case Conducted Disturbance, 9KHz to 0.15 MHz  | 3.84 dB     |
| Worst Case Conducted Disturbance, 0.15 to 30 MHz    | 3.65 dB     |
| Worst Case Radiated Disturbance, 9KHz to 30 MHz     | 3.15 dB     |
| Worst Case Radiated Disturbance, 30 to 1000 MHz     | 5.36 dB     |
| Worst Case Radiated Disturbance, 1000 to 18000 MHz  | 4.32 dB     |
| Worst Case Radiated Disturbance, 18000 to 26000 MHz | 4.45 dB     |
| Worst Case Radiated Disturbance, 26000 to 40000 MHz | 5.24 dB     |

Uncertainty figures are valid to a confidence level of 95%.

## 5. EQUIPMENT UNDER TEST

### 5.1. DESCRIPTION OF EUT

The EUT is a GSM/WCDMA/LTE phone with BT, DTS/UNII a/b/g/n/ac/11ax HE 20/40/80, ANT+ and NFC. The model SM-G970F was used for final testing and is representative of the test results in this report.

### 5.2. MAXIMUM OUTPUT POWER

#### ERP/EIRP LIMIT

FCC: §2.1046, §22.913, §24.232, §27.50, §90.635

#### EIRP/ERP TEST PROCEDURE

ANSI C63.26:2015/ TIA-603-E Clause 2.2.17  
KDB 971168 D01 Section 5.6  
KDB 412172 D01

$ERP/EIRP = P_{Meas} + GT - LC$

where: ERP/EIRP = effective or equivalent radiated power, respectively (expressed in the same units as  $P_{Meas}$ , typically dBW or dBm);

$P_{Meas}$  = measured transmitter output power or PSD, in dBm or dBW;

GT = gain of the transmitting antenna, in dBd (ERP) or dBi (EIRP);

LC = signal attenuation in the connecting cable between the transmitter and antenna, in dB.

For devices utilizing multiple antennas, KDB 662911 provides guidance for determining the effective array transmit antenna gain term to be used in the above equation.

The transmitter has a maximum average conducted and ERP / EIRP output powers as follows:

**GSM MODES**

| <b>Part 22 850MHz</b>  |            |                           |                    |           |       |       |              |                     |
|------------------------|------------|---------------------------|--------------------|-----------|-------|-------|--------------|---------------------|
| Frequency range (MHz)  | Modulation | Conducted (Average) (dBm) | Antenna Gain (dBi) | Limit (W) | ERP   |       | 99% BW (kHz) | Emission Designator |
|                        |            |                           |                    |           | (dBm) | (W)   |              |                     |
| 824.2-848.8            | GPRS       | 33.6                      | -1.32              | 7.0       | 30.13 | 1.030 | 245.77       | 246KGXW             |
|                        | EGPRS      | 26.7                      |                    |           | 23.23 | 0.210 | 244.6        | 245KG7W             |
| <b>Part 24 1900MHz</b> |            |                           |                    |           |       |       |              |                     |
| Frequency range (MHz)  | Modulation | Conducted (Average) (dBm) | Antenna Gain (dBi) | Limit (W) | EIRP  |       | 99% BW (kHz) | Emission Designator |
|                        |            |                           |                    |           | (dBm) | (W)   |              |                     |
| 1850.2-1909.8          | GPRS       | 30.5                      | -0.30              | 2.0       | 30.20 | 1.047 | 241.31       | 241KGXW             |
|                        | EGPRS      | 25.7                      |                    |           | 25.40 | 0.347 | 232.14       | 232KG7W             |

**WCDMA MODE**

| <b>Part 22 Band 5</b> |            |                           |                    |           |       |       |              |                     |
|-----------------------|------------|---------------------------|--------------------|-----------|-------|-------|--------------|---------------------|
| Frequency range (MHz) | Modulation | Conducted (Average) (dBm) | Antenna Gain (dBi) | Limit (W) | ERP   |       | 99% BW (kHz) | Emission Designator |
|                       |            |                           |                    |           | (dBm) | (W)   |              |                     |
| 826.4-846.6           | REL 99     | 24.9                      | -1.32              | 7.0       | 21.43 | 0.139 | 4160         | 4M16F9W             |
|                       | HSDPA      | 23.5                      |                    |           | 20.03 | 0.101 | 4180         | 4M18F9W             |
| <b>Part 24 Band 2</b> |            |                           |                    |           |       |       |              |                     |
| Frequency range (MHz) | Modulation | Conducted (Average) (dBm) | Antenna Gain (dBi) | Limit (W) | ERP   |       | 99% BW (kHz) | Emission Designator |
|                       |            |                           |                    |           | (dBm) | (W)   |              |                     |
| 1852.4-1907.6         | REL 99     | 24.5                      | -0.30              | 2.0       | 24.20 | 0.263 | 4150         | 4M15F9W             |
|                       | HSDPA      | 23.9                      |                    |           | 23.60 | 0.229 | 4170         | 4M17F9W             |
| <b>Part 27 Band 4</b> |            |                           |                    |           |       |       |              |                     |
| Frequency range (MHz) | Modulation | Conducted (Average) (dBm) | Antenna Gain (dBi) | Limit (W) | EIRP  |       | 99% BW (kHz) | Emission Designator |
|                       |            |                           |                    |           | (dBm) | (W)   |              |                     |
| 1712.4-1752.6         | REL 99     | 24.3                      | 0.60               | 1.0       | 24.90 | 0.309 | 4160         | 4M16F9W             |
|                       | HSDPA      | 24.4                      |                    |           | 25.00 | 0.316 | 4180         | 4M18F9W             |

**LTE BAND 2**

| Part 24            |            |                     |                       |                         |                    |                  |              |                     |
|--------------------|------------|---------------------|-----------------------|-------------------------|--------------------|------------------|--------------|---------------------|
| EIRP Limit (W)     |            | 2.00                |                       |                         |                    |                  |              |                     |
| Antenna Gain (dBi) |            | -0.30               |                       |                         |                    |                  |              |                     |
| Bandwidth (MHz)    | Modulation | Low Frequency (MHz) | Upper Frequency (MHz) | Conducted Average (dBm) | EIRP Average (dBm) | EIRP Average (W) | 99% BW (kHz) | Emission Designator |
| 1.4                | QPSK       | 1850.7              | 1909.3                | 24.2                    | 23.90              | 0.245            | 1090         | 1M09G7W             |
|                    | 16QAM      |                     |                       | 22.4                    | 22.10              | 0.162            | 1090         | 1M09D7W             |
|                    | 64QAM      |                     |                       | 21.1                    | 20.80              | 0.120            |              |                     |
| 3.0                | QPSK       | 1851.5              | 1908.5                | 24.4                    | 24.10              | 0.257            | 2690         | 2M69G7W             |
|                    | 16QAM      |                     |                       | 22.8                    | 22.50              | 0.178            | 2690         | 2M69D7W             |
|                    | 64QAM      |                     |                       | 21.7                    | 21.40              | 0.138            |              |                     |
| 5.0                | QPSK       | 1852.5              | 1907.5                | 24.3                    | 24.00              | 0.251            | 4500         | 4M50G7W             |
|                    | 16QAM      |                     |                       | 22.9                    | 22.60              | 0.182            | 4510         | 4M51D7W             |
|                    | 64QAM      |                     |                       | 21.7                    | 21.40              | 0.138            |              |                     |
| 10.0               | QPSK       | 1855.0              | 1905.0                | 24.4                    | 24.10              | 0.257            | 8970         | 8M97G7W             |
|                    | 16QAM      |                     |                       | 22.7                    | 22.40              | 0.174            | 8970         | 8M97D7W             |
|                    | 64QAM      |                     |                       | 21.7                    | 21.40              | 0.138            |              |                     |
| 15.0               | QPSK       | 1857.5              | 1902.5                | 24.5                    | 24.20              | 0.263            | 13440        | 13M4G7W             |
|                    | 16QAM      |                     |                       | 22.7                    | 22.40              | 0.174            | 13420        | 13M4D7W             |
|                    | 64QAM      |                     |                       | 21.6                    | 21.30              | 0.135            |              |                     |
| 20.0               | QPSK       | 1860.0              | 1900.0                | 24.4                    | 24.10              | 0.257            | 17880        | 17M9G7W             |
|                    | 16QAM      |                     |                       | 22.8                    | 22.50              | 0.178            | 17870        | 17M9D7W             |
|                    | 64QAM      |                     |                       | 21.6                    | 21.30              | 0.135            |              |                     |

**LTE BAND 4**

| Part 27            |            |                     |                       |                         |                    |                  |              |                     |
|--------------------|------------|---------------------|-----------------------|-------------------------|--------------------|------------------|--------------|---------------------|
| EIRP Limit (W)     |            | 1.00                |                       |                         |                    |                  |              |                     |
| Antenna Gain (dBi) |            | 0.60                |                       |                         |                    |                  |              |                     |
| Bandwidth (MHz)    | Modulation | Low Frequency (MHz) | Upper Frequency (MHz) | Conducted Average (dBm) | EIRP Average (dBm) | EIRP Average (W) | 99% BW (kHz) | Emission Designator |
| 1.4                | QPSK       | 1710.7              | 1754.3                | 24.2                    | 24.80              | 0.302            | 1080         | 1M08G7W             |
|                    | 16QAM      |                     |                       | 22.4                    | 23.00              | 0.200            | 1090         | 1M09D7W             |
|                    | 64QAM      |                     |                       | 21.3                    | 21.90              | 0.155            |              |                     |
| 3.0                | QPSK       | 1711.5              | 1753.5                | 24.4                    | 25.00              | 0.316            | 2680         | 2M68G7W             |
|                    | 16QAM      |                     |                       | 22.8                    | 23.40              | 0.219            | 2680         | 2M68D7W             |
|                    | 64QAM      |                     |                       | 21.6                    | 22.20              | 0.166            |              |                     |
| 5.0                | QPSK       | 1712.5              | 1752.5                | 24.3                    | 24.90              | 0.309            | 4500         | 4M50G7W             |
|                    | 16QAM      |                     |                       | 22.5                    | 23.10              | 0.204            | 4510         | 4M51D7W             |
|                    | 64QAM      |                     |                       | 21.3                    | 21.90              | 0.155            |              |                     |
| 10.0               | QPSK       | 1715.0              | 1750.0                | 24.2                    | 24.80              | 0.302            | 8960         | 8M96G7W             |
|                    | 16QAM      |                     |                       | 22.4                    | 23.00              | 0.200            | 8970         | 8M97D7W             |
|                    | 64QAM      |                     |                       | 21.4                    | 22.00              | 0.158            |              |                     |
| 15.0               | QPSK       | 1717.5              | 1747.5                | 24.4                    | 25.00              | 0.316            | 13410        | 13M4G7W             |
|                    | 16QAM      |                     |                       | 22.5                    | 23.10              | 0.204            | 13370        | 13M4D7W             |
|                    | 64QAM      |                     |                       | 21.5                    | 22.10              | 0.162            |              |                     |
| 20.0               | QPSK       | 1720.0              | 1745.0                | 24.2                    | 24.80              | 0.302            | 17860        | 17M9G7W             |
|                    | 16QAM      |                     |                       | 22.6                    | 23.20              | 0.209            | 17870        | 17M9D7W             |
|                    | 64QAM      |                     |                       | 21.6                    | 22.20              | 0.166            |              |                     |

**LTE BAND 5**

| Part 22H           |            |                     |                       |                         |                   |                 |              |                     |
|--------------------|------------|---------------------|-----------------------|-------------------------|-------------------|-----------------|--------------|---------------------|
| ERP Limit (W)      |            | 7.00                |                       |                         |                   |                 |              |                     |
| Antenna Gain (dBi) |            | -1.32               |                       |                         |                   |                 |              |                     |
| Bandwidth (MHz)    | Modulation | Low Frequency (MHz) | Upper Frequency (MHz) | Conducted Average (dBm) | ERP Average (dBm) | ERP Average (W) | 99% BW (kHz) | Emission Designator |
| 1.4                | QPSK       | 824.7               | 848.3                 | 24.8                    | 21.33             | 0.136           | 1080         | 1M08G7W             |
|                    | 16QAM      |                     |                       | 22.7                    | 19.23             | 0.084           | 1090         | 1M09D7W             |
|                    | 64QAM      |                     |                       | 21.6                    | 18.13             | 0.065           |              |                     |
| 3.0                | QPSK       | 825.5               | 847.5                 | 25.0                    | 21.53             | 0.142           | 2680         | 2M68G7W             |
|                    | 16QAM      |                     |                       | 22.9                    | 19.43             | 0.088           | 2690         | 2M69D7W             |
|                    | 64QAM      |                     |                       | 21.8                    | 18.33             | 0.068           |              |                     |
| 5.0                | QPSK       | 826.5               | 846.5                 | 24.8                    | 21.33             | 0.136           | 4510         | 4M51G7W             |
|                    | 16QAM      |                     |                       | 22.7                    | 19.23             | 0.084           | 4520         | 4M52D7W             |
|                    | 64QAM      |                     |                       | 21.7                    | 18.23             | 0.067           |              |                     |
| 10.0               | QPSK       | 829.0               | 844.0                 | 24.7                    | 21.23             | 0.133           | 8950         | 8M95G7W             |
|                    | 16QAM      |                     |                       | 22.3                    | 18.83             | 0.076           | 8940         | 8M94D7W             |
|                    | 64QAM      |                     |                       | 21.4                    | 17.93             | 0.062           |              |                     |

**LTE BAND 7**

| Part 27            |            |                     |                       |                         |                    |                  |              |                     |
|--------------------|------------|---------------------|-----------------------|-------------------------|--------------------|------------------|--------------|---------------------|
| EIRP Limit (W)     |            | 2.00                |                       |                         |                    |                  |              |                     |
| Antenna Gain (dBi) |            | 2.64                |                       |                         |                    |                  |              |                     |
| Bandwidth (MHz)    | Modulation | Low Frequency (MHz) | Upper Frequency (MHz) | Conducted Average (dBm) | EIRP Average (dBm) | EIRP Average (W) | 99% BW (kHz) | Emission Designator |
| 5.0                | QPSK       | 2502.5              | 2567.5                | 24.4                    | 27.04              | 0.506            | 4500         | 4M50G7W             |
|                    | 16QAM      |                     |                       | 22.8                    | 25.44              | 0.350            | 4510         | 4M51D7W             |
|                    | 64QAM      |                     |                       | 21.4                    | 24.04              | 0.254            |              |                     |
| 10.0               | QPSK       | 2505.0              | 2565.0                | 24.4                    | 27.04              | 0.506            | 8960         | 8M96G7W             |
|                    | 16QAM      |                     |                       | 22.7                    | 25.34              | 0.342            | 8950         | 8M95D7W             |
|                    | 64QAM      |                     |                       | 21.3                    | 23.94              | 0.248            |              |                     |
| 15.0               | QPSK       | 2507.5              | 2562.5                | 24.5                    | 27.14              | 0.518            | 13400        | 13M4G7W             |
|                    | 16QAM      |                     |                       | 22.9                    | 25.54              | 0.358            | 13380        | 13M4D7W             |
|                    | 64QAM      |                     |                       | 21.6                    | 24.24              | 0.265            |              |                     |
| 20.0               | QPSK       | 2510.0              | 2560.0                | 24.5                    | 27.14              | 0.518            | 17890        | 17M9G7W             |
|                    | 16QAM      |                     |                       | 23.0                    | 25.64              | 0.366            | 17880        | 17M9D7W             |
|                    | 64QAM      |                     |                       | 21.7                    | 24.34              | 0.272            |              |                     |

**LTE BAND 12**

| Part 27            |            |                     |                       |                         |                   |                 |              |                     |
|--------------------|------------|---------------------|-----------------------|-------------------------|-------------------|-----------------|--------------|---------------------|
| ERP Limit (W)      |            | 3.00                |                       |                         |                   |                 |              |                     |
| Antenna Gain (dBi) |            | -2.15               |                       |                         |                   |                 |              |                     |
| Bandwidth (MHz)    | Modulation | Low Frequency (MHz) | Upper Frequency (MHz) | Conducted Average (dBm) | ERP Average (dBm) | ERP Average (W) | 99% BW (kHz) | Emission Designator |
| 1.4                | QPSK       | 699.7               | 715.3                 | 24.1                    | 19.80             | 0.095           | 1080         | 1M08G7W             |
|                    | 16QAM      |                     |                       | 22.6                    | 18.30             | 0.068           | 1090         | 1M09D7W             |
|                    | 64QAM      |                     |                       | 21.4                    | 17.10             | 0.051           |              |                     |
| 3.0                | QPSK       | 700.5               | 714.5                 | 24.3                    | 20.00             | 0.100           | 2680         | 2M68G7W             |
|                    | 16QAM      |                     |                       | 22.7                    | 18.40             | 0.069           | 2690         | 2M69D7W             |
|                    | 64QAM      |                     |                       | 21.4                    | 17.10             | 0.051           |              |                     |
| 5.0                | QPSK       | 701.5               | 713.5                 | 24.1                    | 19.80             | 0.095           | 4520         | 4M52G7W             |
|                    | 16QAM      |                     |                       | 22.5                    | 18.20             | 0.066           | 4490         | 4M49D7W             |
|                    | 64QAM      |                     |                       | 21.4                    | 17.10             | 0.051           |              |                     |
| 10.0               | QPSK       | 704.0               | 711.0                 | 24.1                    | 19.80             | 0.095           | 8970         | 8M97G7W             |
|                    | 16QAM      |                     |                       | 22.3                    | 18.00             | 0.063           | 8950         | 8M95D7W             |
|                    | 64QAM      |                     |                       | 21.5                    | 17.20             | 0.052           |              |                     |

**LTE BAND 13**

| Part 27            |            |                     |                       |                         |                   |                 |              |                     |
|--------------------|------------|---------------------|-----------------------|-------------------------|-------------------|-----------------|--------------|---------------------|
| ERP Limit (W)      |            | 3.00                |                       |                         |                   |                 |              |                     |
| Antenna Gain (dBi) |            | -4.60               |                       |                         |                   |                 |              |                     |
| Bandwidth (MHz)    | Modulation | Low Frequency (MHz) | Upper Frequency (MHz) | Conducted Average (dBm) | ERP Average (dBm) | ERP Average (W) | 99% BW (kHz) | Emission Designator |
| 5.0                | QPSK       | 779.5               | 784.5                 | 24.8                    | 18.05             | 0.064           | 4510         | 4M51G7W             |
|                    | 16QAM      |                     |                       | 22.7                    | 15.95             | 0.039           | 4510         | 4M51D7W             |
|                    | 64QAM      |                     |                       | 21.8                    | 15.05             | 0.032           |              |                     |
| 10.0               | QPSK       | 782.0               | 782.0                 | 24.7                    | 17.95             | 0.062           | 8940         | 8M94G7W             |
|                    | 16QAM      |                     |                       | 22.5                    | 15.75             | 0.038           | 8940         | 8M94D7W             |
|                    | 64QAM      |                     |                       | 21.5                    | 14.75             | 0.030           |              |                     |

**LTE BAND 17**

| Part 27            |            |                     |                       |                         |                   |                 |              |                     |
|--------------------|------------|---------------------|-----------------------|-------------------------|-------------------|-----------------|--------------|---------------------|
| ERP Limit (W)      |            | 3.00                |                       |                         |                   |                 |              |                     |
| Antenna Gain (dBi) |            | -2.15               |                       |                         |                   |                 |              |                     |
| Bandwidth (MHz)    | Modulation | Low Frequency (MHz) | Upper Frequency (MHz) | Conducted Average (dBm) | ERP Average (dBm) | ERP Average (W) | 99% BW (kHz) | Emission Designator |
| 5.0                | QPSK       | 706.5               | 713.5                 | 24.1                    | 19.80             | 0.095           | 4510         | 4M51G7W             |
|                    | 16QAM      |                     |                       | 22.4                    | 18.10             | 0.065           | 4500         | 4M50D7W             |
|                    | 64QAM      |                     |                       | 21.4                    | 17.10             | 0.051           |              |                     |
| 10.0               | QPSK       | 709.0               | 711.0                 | 24.1                    | 19.80             | 0.095           | 8950         | 8M95G7W             |
|                    | 16QAM      |                     |                       | 22.6                    | 18.30             | 0.068           | 8930         | 8M93D7W             |
|                    | 64QAM      |                     |                       | 21.5                    | 17.20             | 0.052           |              |                     |

**LTE BAND 25**

| Part 24            |            |                     |                       |                         |                    |                  |              |                     |
|--------------------|------------|---------------------|-----------------------|-------------------------|--------------------|------------------|--------------|---------------------|
| EIRP Limit (W)     |            | 2.00                |                       |                         |                    |                  |              |                     |
| Antenna Gain (dBi) |            | -0.30               |                       |                         |                    |                  |              |                     |
| Bandwidth (MHz)    | Modulation | Low Frequency (MHz) | Upper Frequency (MHz) | Conducted Average (dBm) | EIRP Average (dBm) | EIRP Average (W) | 99% BW (kHz) | Emission Designator |
| 1.4                | QPSK       | 1850.7              | 1914.3                | 24.4                    | 24.10              | 0.257            | 1090         | 1M09G7W             |
|                    | 16QAM      |                     |                       | 22.7                    | 22.40              | 0.174            | 1090         | 1M09D7W             |
|                    | 64QAM      |                     |                       | 21.5                    | 21.20              | 0.132            |              |                     |
| 3.0                | QPSK       | 1851.5              | 1913.5                | 24.7                    | 24.40              | 0.275            | 2690         | 2M69G7W             |
|                    | 16QAM      |                     |                       | 22.7                    | 22.40              | 0.174            | 2690         | 2M69D7W             |
|                    | 64QAM      |                     |                       | 21.8                    | 21.50              | 0.141            |              |                     |
| 5.0                | QPSK       | 1852.5              | 1912.5                | 24.4                    | 24.10              | 0.257            | 4520         | 4M52G7W             |
|                    | 16QAM      |                     |                       | 23.1                    | 22.80              | 0.191            | 4500         | 4M50D7W             |
|                    | 64QAM      |                     |                       | 21.6                    | 21.30              | 0.135            |              |                     |
| 10.0               | QPSK       | 1855.0              | 1910.0                | 24.5                    | 24.20              | 0.263            | 8970         | 8M97G7W             |
|                    | 16QAM      |                     |                       | 22.6                    | 22.30              | 0.170            | 8980         | 8M98D7W             |
|                    | 64QAM      |                     |                       | 21.7                    | 21.40              | 0.138            |              |                     |
| 15.0               | QPSK       | 1857.5              | 1907.5                | 24.6                    | 24.30              | 0.269            | 13410        | 13M4G7W             |
|                    | 16QAM      |                     |                       | 22.9                    | 22.60              | 0.182            | 13420        | 13M4D7W             |
|                    | 64QAM      |                     |                       | 21.7                    | 21.40              | 0.138            |              |                     |
| 20.0               | QPSK       | 1860.0              | 1905.0                | 24.6                    | 24.30              | 0.269            | 17900        | 17M9G7W             |
|                    | 16QAM      |                     |                       | 23.1                    | 22.80              | 0.191            | 17860        | 17M9D7W             |
|                    | 64QAM      |                     |                       | 21.9                    | 21.60              | 0.145            |              |                     |

**LTE BAND 26 (FCC Part 90S)**

| Part 90S           |            |                     |                       |                         |                   |                 |              |                     |
|--------------------|------------|---------------------|-----------------------|-------------------------|-------------------|-----------------|--------------|---------------------|
| ERP Limit (W)      |            | 100.00              |                       |                         |                   |                 |              |                     |
| Antenna Gain (dBi) |            | -2.11               |                       |                         |                   |                 |              |                     |
| Bandwidth (MHz)    | Modulation | Low Frequency (MHz) | Upper Frequency (MHz) | Conducted Average (dBm) | ERP Average (dBm) | ERP Average (W) | 99% BW (kHz) | Emission Designator |
| 1.4                | QPSK       | 814.7               | 823.3                 | 24.5                    | 20.24             | 0.106           | 1080         | 1M08G7W             |
|                    | 16QAM      |                     |                       | 22.5                    | 18.24             | 0.067           | 1090         | 1M09D7W             |
|                    | 64QAM      |                     |                       | 21.7                    | 17.44             | 0.055           |              |                     |
| 3.0                | QPSK       | 815.5               | 822.5                 | 24.5                    | 20.24             | 0.106           | 2690         | 2M69G7W             |
|                    | 16QAM      |                     |                       | 22.9                    | 18.64             | 0.073           | 2690         | 2M69D7W             |
|                    | 64QAM      |                     |                       | 21.7                    | 17.44             | 0.055           |              |                     |
| 5.0                | QPSK       | 816.5               | 821.5                 | 24.4                    | 20.14             | 0.103           | 4510         | 4M51G7W             |
|                    | 16QAM      |                     |                       | 22.8                    | 18.54             | 0.071           | 4510         | 4M51D7W             |
|                    | 64QAM      |                     |                       | 21.8                    | 17.54             | 0.057           |              |                     |
| 10.0               | QPSK       | 819.0               | 819.0                 | 24.4                    | 20.14             | 0.103           | 8940         | 8M94G7W             |
|                    | 16QAM      |                     |                       | 22.7                    | 18.44             | 0.070           | 8950         | 8M95D7W             |
|                    | 64QAM      |                     |                       | 21.6                    | 17.34             | 0.054           |              |                     |
| 15.0               | QPSK       | 821.5               | 821.5                 | 24.4                    | 20.14             | 0.103           | 13420        | 13M4G7W             |
|                    | 16QAM      |                     |                       | 22.8                    | 18.54             | 0.071           | 13450        | 13M5D7W             |
|                    | 64QAM      |                     |                       | 21.4                    | 17.14             | 0.052           |              |                     |



**LTE BAND 26 (FCC Part 22)**

| Part 22            |            |                     |                       |                         |                   |                 |              |                     |
|--------------------|------------|---------------------|-----------------------|-------------------------|-------------------|-----------------|--------------|---------------------|
| ERP Limit (W)      |            | 7.00                |                       |                         |                   |                 |              |                     |
| Antenna Gain (dBi) |            | -1.32               |                       |                         |                   |                 |              |                     |
| Bandwidth (MHz)    | Modulation | Low Frequency (MHz) | Upper Frequency (MHz) | Conducted Average (dBm) | ERP Average (dBm) | ERP Average (W) | 99% BW (kHz) | Emission Designator |
| 1.4                | QPSK       | 824.7               | 848.3                 | 24.3                    | 20.83             | 0.121           | 1090         | 1M09G7W             |
|                    | 16QAM      |                     |                       | 22.5                    | 19.03             | 0.080           | 1080         | 1M08D7W             |
|                    | 64QAM      |                     |                       | 21.8                    | 18.33             | 0.068           |              |                     |
| 3.0                | QPSK       | 825.5               | 847.5                 | 24.5                    | 21.03             | 0.127           | 2680         | 2M68G7W             |
|                    | 16QAM      |                     |                       | 22.9                    | 19.43             | 0.088           | 2690         | 2M69D7W             |
|                    | 64QAM      |                     |                       | 21.7                    | 18.23             | 0.067           |              |                     |
| 5.0                | QPSK       | 826.5               | 846.5                 | 24.2                    | 20.73             | 0.118           | 4500         | 4M50G7W             |
|                    | 16QAM      |                     |                       | 22.8                    | 19.33             | 0.086           | 4500         | 4M50D7W             |
|                    | 64QAM      |                     |                       | 21.6                    | 18.13             | 0.065           |              |                     |
| 10.0               | QPSK       | 829.0               | 844.0                 | 24.3                    | 20.83             | 0.121           | 8960         | 8M96G7W             |
|                    | 16QAM      |                     |                       | 22.4                    | 18.93             | 0.078           | 8980         | 8M98D7W             |
|                    | 64QAM      |                     |                       | 21.5                    | 18.03             | 0.064           |              |                     |
| 15.0               | QPSK       | 831.5               | 841.5                 | 24.5                    | 21.03             | 0.127           | 13380        | 13M4G7W             |
|                    | 16QAM      |                     |                       | 22.7                    | 19.23             | 0.084           | 13420        | 13M4D7W             |
|                    | 64QAM      |                     |                       | 21.7                    | 18.23             | 0.067           |              |                     |

**LTE BAND 41**

| Part 27            |            |                     |                       |                         |                    |                  |              |                     |
|--------------------|------------|---------------------|-----------------------|-------------------------|--------------------|------------------|--------------|---------------------|
| EIRP Limit (W)     |            | 2.00                |                       |                         |                    |                  |              |                     |
| Antenna Gain (dBi) |            | 2.21                |                       |                         |                    |                  |              |                     |
| Bandwidth (MHz)    | Modulation | Low Frequency (MHz) | Upper Frequency (MHz) | Conducted Average (dBm) | EIRP Average (dBm) | EIRP Average (W) | 99% BW (kHz) | Emission Designator |
| 5.0                | QPSK       | 2498.5              | 2687.5                | 23.7                    | 25.91              | 0.390            | 4510         | 4M51G7W             |
|                    | 16QAM      |                     |                       | 21.7                    | 23.91              | 0.246            | 4500         | 4M50D7W             |
|                    | 64QAM      |                     |                       | 21.7                    | 23.91              | 0.246            |              |                     |
| 10.0               | QPSK       | 2501.0              | 2685.0                | 23.7                    | 25.91              | 0.390            | 8980         | 8M98G7W             |
|                    | 16QAM      |                     |                       | 22.0                    | 24.21              | 0.264            | 8970         | 8M97D7W             |
|                    | 64QAM      |                     |                       | 20.9                    | 23.11              | 0.205            |              |                     |
| 15.0               | QPSK       | 2503.5              | 2682.5                | 23.8                    | 26.01              | 0.399            | 13450        | 13M5G7W             |
|                    | 16QAM      |                     |                       | 22.0                    | 24.21              | 0.264            | 13450        | 13M5D7W             |
|                    | 64QAM      |                     |                       | 21.0                    | 23.21              | 0.209            |              |                     |
| 20.0               | QPSK       | 2506.0              | 2680.0                | 23.9                    | 26.11              | 0.408            | 17910        | 17M9G7W             |
|                    | 16QAM      |                     |                       | 22.0                    | 24.21              | 0.264            | 17910        | 17M9D7W             |
|                    | 64QAM      |                     |                       | 21.2                    | 23.41              | 0.219            |              |                     |

**LTE BAND 66**

| Part 27            |            |                     |                       |                         |                    |                  |              |                     |
|--------------------|------------|---------------------|-----------------------|-------------------------|--------------------|------------------|--------------|---------------------|
| EIRP Limit (W)     |            | 1.00                |                       |                         |                    |                  |              |                     |
| Antenna Gain (dBi) |            | 0.60                |                       |                         |                    |                  |              |                     |
| Bandwidth (MHz)    | Modulation | Low Frequency (MHz) | Upper Frequency (MHz) | Conducted Average (dBm) | EIRP Average (dBm) | EIRP Average (W) | 99% BW (kHz) | Emission Designator |
| 1.4                | QPSK       | 1710.7              | 1779.3                | 24.1                    | 24.70              | 0.295            | 1090         | 1M09G7W             |
|                    | 16QAM      |                     |                       | 22.5                    | 23.10              | 0.204            | 1080         | 1M08D7W             |
|                    | 64QAM      |                     |                       | 22.3                    | 22.90              | 0.195            |              |                     |
| 3.0                | QPSK       | 1711.5              | 1778.5                | 24.3                    | 24.90              | 0.309            | 2690         | 2M69G7W             |
|                    | 16QAM      |                     |                       | 22.5                    | 23.10              | 0.204            | 2690         | 2M69D7W             |
|                    | 64QAM      |                     |                       | 22.5                    | 23.10              | 0.204            |              |                     |
| 5.0                | QPSK       | 1712.5              | 1777.5                | 24.2                    | 24.80              | 0.302            | 4500         | 4M50G7W             |
|                    | 16QAM      |                     |                       | 22.6                    | 23.20              | 0.209            | 4520         | 4M52D7W             |
|                    | 64QAM      |                     |                       | 21.5                    | 22.10              | 0.162            |              |                     |
| 10.0               | QPSK       | 1715.0              | 1775.0                | 24.1                    | 24.70              | 0.295            | 8950         | 8M95G7W             |
|                    | 16QAM      |                     |                       | 22.3                    | 22.90              | 0.195            | 8960         | 8M96D7W             |
|                    | 64QAM      |                     |                       | 21.4                    | 22.00              | 0.158            |              |                     |
| 15.0               | QPSK       | 1717.5              | 1772.5                | 24.3                    | 24.90              | 0.309            | 13380        | 13M4G7W             |
|                    | 16QAM      |                     |                       | 22.6                    | 23.20              | 0.209            | 13400        | 13M4D7W             |
|                    | 64QAM      |                     |                       | 21.6                    | 22.20              | 0.166            |              |                     |
| 20.0               | QPSK       | 1720.0              | 1770.0                | 24.2                    | 24.80              | 0.302            | 17890        | 17M9G7W             |
|                    | 16QAM      |                     |                       | 22.6                    | 23.20              | 0.209            | 17880        | 17M9D7W             |
|                    | 64QAM      |                     |                       | 21.7                    | 22.30              | 0.170            |              |                     |

### 5.3. SOFTWARE AND FIRMWARE

The EUT firmware installed during testing was G970F.001

### 5.4. MAXIMUM ANTENNA GAIN

Please see table below:

| LTE Bands                                 | Antenna Gain (dBi) |
|---|--------------------|
| GSM850, 824-849MHz                        | -1.32              |
| GSM1900, 1850-1910MHz                     | -0.30              |
| WCDMA Band 2, 1850-1910 MHz               | -0.30              |
| WCDMA Band 4, 1710-1755 MHz               | 0.60               |
| WCDMA Band 5, 824-849 MHz                 | -1.32              |
| LTE BAND 2, 1850 - 1910 MHz               | -0.30              |
| LTE BAND 4, 1710 - 1755 MHz               | 0.60               |
| LTE BAND 5, 824 - 849 MHz                 | -1.32              |
| LTE BAND 7, 2500 - 2570 MHz               | 2.64               |
| LTE BAND 12, 699 - 716 MHz                | -2.15              |
| LTE BAND 13, 777 - 787 MHz                | -4.60              |
| LTE BAND 17, 704 - 716 MHz                | -2.15              |
| LTE BAND 25, 1850 - 1915 MHz              | -0.30              |
| LTE BAND 26 (FCC PART 22), 824 - 849 MHz  | -1.32              |
| LTE BAND 26 (FCC PART 90S), 814 - 824 MHz | -2.11              |
| LTE BAND 41 (FCC), 2496 - 2690 MHz        | 2.21               |
| LTE BAND 66, 1710 - 1780 MHz              | 0.60               |

## 5.5. WORST-CASE CONFIGURATION AND MODE

The EUT supports LTE Bands of:

Band 2, Band 4, Band 5, Band 7, Band 12, Band 13, Band 17, Band 25, Band 26, Band 38, Band 41 and Band 66.

The worst-case scenario for all measurements is based on the average conducted output power measurement investigation results. Output power measurements were measured on QPSK, 16QAM, and 64QAM modulations. All testing was performed using QPSK, and 16QAM modulations to represent the worst case.

The fundamental of the EUT was investigated in three orthogonal orientations X, Y, & Z, and it was determined that Y-Axis for 1880MHz, Z-Axis for 800MHz, and X-Axis for 2500MHz with AC/DC Adapter and headset was worst-case orientation.

All radios that can be transmitted simultaneously have been evaluated for radiated for all possible combinations of transmission and found to be in compliance.

In addition, LTE Band 38[Single carrier] (Frequency range: 2570-2620 MHz) is covered by LTE Band 41 (Frequency range: 2496-2690 MHz) due to overlapping frequency range, same maximum tune-up limit and same channel bandwidth.

### **For check the Part15B receiver mode (Appendix A):**

For GSM850 / LTE B5 / WCDMA B5, the spurious emissions was investigated in three orthogonal orientations X, Y and Z it was determined that Z orientation was worst-case orientation.

For LTE B12 , the spurious emissions was investigated in three orthogonal orientations X, Y and Z it was determined that Z orientation was worst-case orientation.

For LTE B13 , the spurious emissions was investigated in three orthogonal orientations X, Y and Z it was determined that Z orientation was worst-case orientation. The middle channel was set for final test as it is the worst case.

In addition, LTE Band 17 (Frequency range: 734-746 MHz) is covered by LTE Band 12 (Frequency range: 729-746 MHz) due to overlapping frequency range, same maximum tune-up limit and same channel bandwidth.

For LTE B26 , the spurious emissions was investigated in three orthogonal orientations X, Y and Z it was determined that Z orientation was worst-case orientation. The middle channel was set for final test as it is the worst case.

## 5.6. DESCRIPTION OF TEST SETUP

### SUPPORT EQUIPMENT

| Support Equipment List |              |          |               |        |
|------------------------|--------------|----------|---------------|--------|
| Description            | Manufacturer | Model    | Serial Number | FCC ID |
| AC Adapter             | Samsung      | EP-TA300 | R3KB5B01S1SE3 | N/A    |
| USB Data Cable         | Samsung      | N/A      | N/A           | N/A    |
| Earphone               | Samsung      | N/A      | N/A           | N/A    |

### I/O CABLES (RF Conducted Test)

| I/O Cable List |              |                      |                        |            |                  |         |
|----------------|--------------|----------------------|------------------------|------------|------------------|---------|
| Cable No       | Port         | # of identical ports | Connector Type         | Cable Type | Cable Length (m) | Remarks |
| 1              | RF Out       | 1                    | Spectrum Analyzer      | Shielded   | None             | NA      |
| 2              | Antenna Port | 1                    | EUT                    | Shielded   | 0.1m             | NA      |
| 3              | RF In/Out    | 1                    | Communication Test Set | Shielded   | 1m               | NA      |

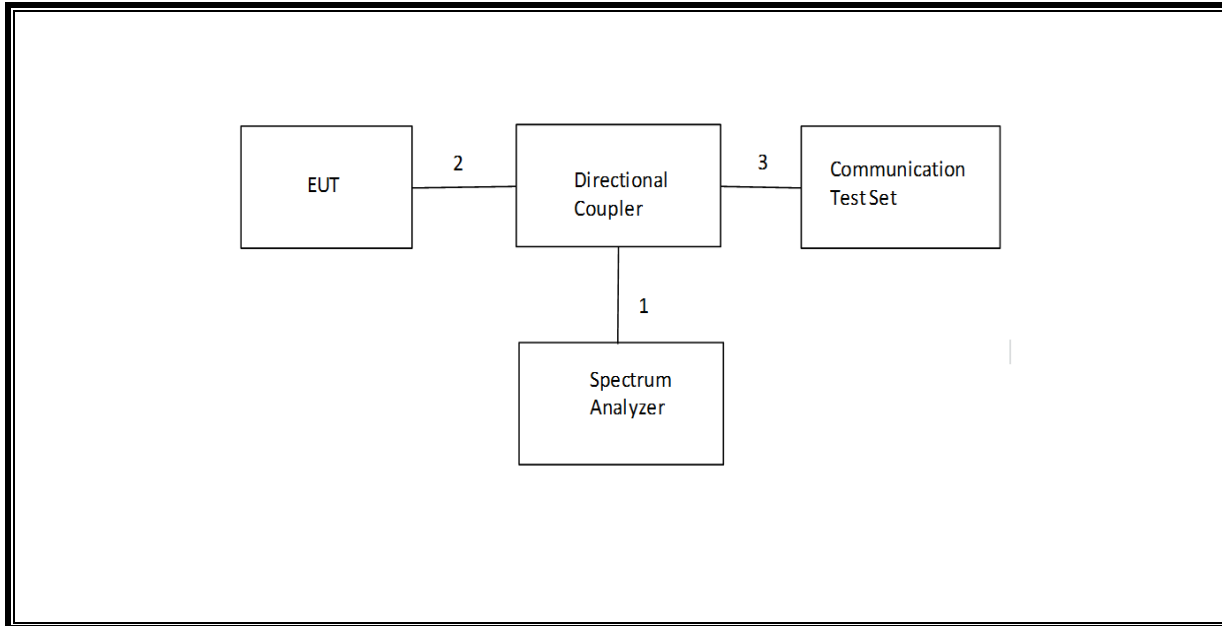
### I/O CABLES (RF Radiated Test)

| I/O Cable List |           |              |                        |             |              |         |
|----------------|-----------|--------------|------------------------|-------------|--------------|---------|
| Cable No       | Port      | # of identic | Connector Type         | Cable Type  | Cable Length | Remarks |
| 1              | USB       | 1            | AC Adapter             | Un-shielded | 1.2m         | No      |
| 2              | Earphone  | 1            | USB                    | Un-shielded | 1m           | No      |
| 3              | RF In/out | 1            | Communication Test Set | Un-shielded | 2m           | No      |

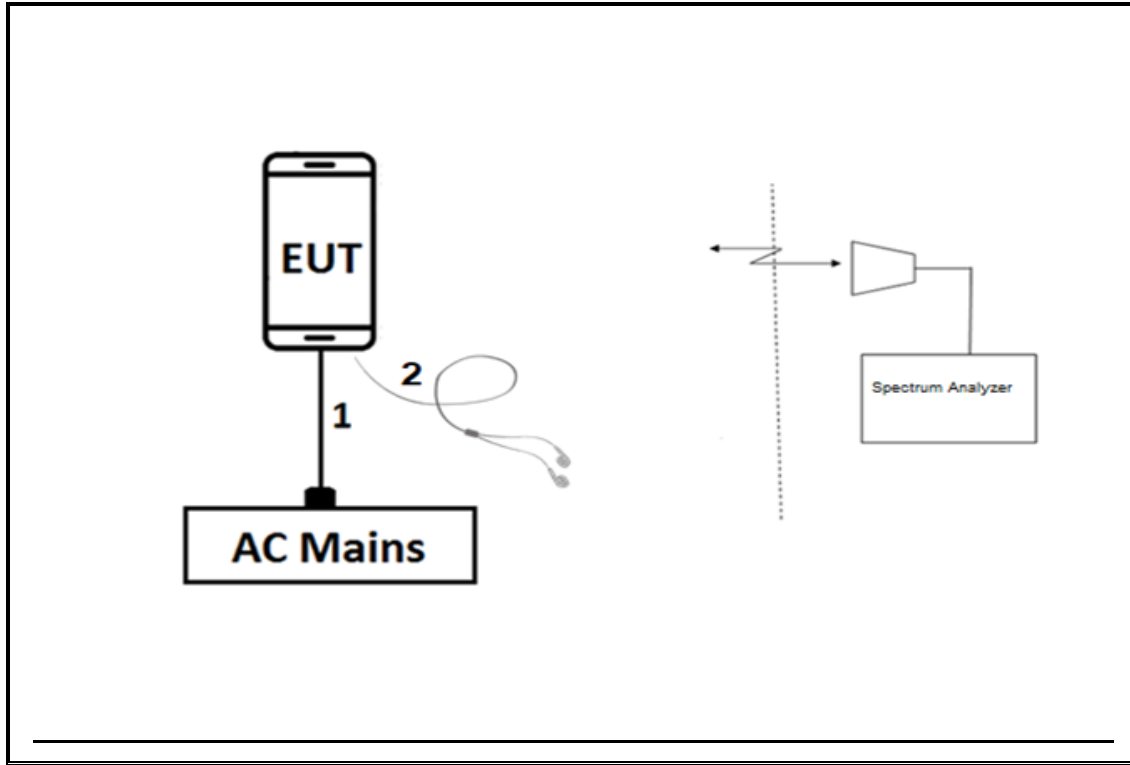
### TEST SETUP

The EUT is continuously communicated to the call box during the tests

**CONDUCTED TEST SETUP DIAGRAM**



**RADIATED TEST SETUP DIAGRAM**



## 6. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

| TEST EQUIPMENT LIST                       |                                 |                        |        |            |            |
|---|---------------------------------|------------------------|--------|------------|------------|
| Description                               | Manufacturer                    | Model                  | ID Num | Cal Due    | Last Cal   |
| Highpass Filter, 2.7 GHz                  | Micro-Circuits                  | H2G518G6               | T772   | 07/05/19   | 07/05/18   |
| Highpass Filter, 1 GHz                    | Micro-Tronics                   | HPM18129               | T889   | 02/21/19   | 02/21/18   |
| Highpass Filter, 1.5 GHz                  | Micro-Tronics                   | HPM50114               | T1852  | 07/16/19   | 07/16/18   |
| Highpass Filter, 4GHz                     | Micro-Tronics                   | HPM13351               | T1241  | 07/19/19   | 07/19/18   |
| Antenna, Horn 1-18GHz                     | ETS-Lindgren                    | 3117                   | T345   | 04/25/19   | 04/25/18   |
| Antenna, Horn 1-18GHz                     | ETS-Lindgren                    | 3117                   | T863   | 06/21/19   | 06/21/18   |
| Antenna, Horn 18 - 26.5 GHz               | ARA                             | MWH-1826/B             | T477   | 06/16/2019 | 06/16/2018 |
| RF Amplifier                              | MITEQ                           | AFS42-00101800-25-S-42 | T1165  | 06/12/19   | 06/12/18   |
| RF Amplifier                              | MITEQ                           | AFS42-00101800-25-S-42 | T493   | 04/03/19   | 04/03/18   |
| Directional Coupler                       | Mini-Circuits                   | ZUDC10-183+            | T1136  | 06/18/19   | 06/18/18   |
| Wideband Communication Test Set, Call Box | R&S                             | CMW500                 | T972   | 05/29/19   | 05/29/18   |
| Wideband Communication Test Set, Call Box | R&S                             | CMW500                 | T1872  | 02/15/19   | 02/15/18   |
| Wideband Communication Test Set, Call Box | R&S                             | CMW500                 | T949   | 02/21/19   | 02/21/18   |
| Chamber, Environmental                    | Thermotron                      | SE-600-10-10           | T80    | 02/22/19   | 02/22/18   |
| Spectrum Analyzer                         | Agilent (Keysight) Technologies | E4446A                 | T146   | 07/18/19   | 07/18/18   |
| Spectrum Analyzer                         | Agilent                         | CCS01178-1C            | T200   | 09/11/19   | 09/11/18   |
| Spectrum Analyzer, PXA, 3Hz to 44GHz      | Agilent (Keysight) Technologies | N9030A                 | T1450  | 02/05/19   | 02/05/18   |
| Spectrum Analyzer, PXA, 3Hz to 44GHz      | Agilent (Keysight) Technologies | N9030A                 | T1466  | 04/16/19   | 04/16/18   |
| Spectrum Analyzer, PXA, 3Hz to 44GHz      | Agilent (Keysight) Technologies | N9030A                 | T1454  | 01/08/19   | 01/08/18   |
| DC power supply, 8 V @ 3 A or 15 V @ 2 A  | Agilent / HP                    | E3610A                 | None   | CNR        | CNR        |
| DC power supply 15V                       | Spresen                         | XT15-4                 | T463   | CNR        | CNR        |

| UL AUTOMATION SOFTWARE     |    |       |                            |
|----------------------------|----|-------|----------------------------|
| CLT Software               | UL | UL RF | Ver 7.6, November 11, 2017 |
| Power Measurement Software | UL | UL RF | Ver 2.2, June 2017         |

### NOTES:

1. Equipment listed above that calibrated during the testing period was set for test after the calibration.
2. Equipment listed above that has a calibration due date during the testing period, the testing is completed before equipment expiration date.