

TEST REPORT

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|---|---|---|
| KCTL Inc. 65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea TEL: 82-31-285-0894 FAX: 82-505-299-8311 www.kctl.co.kr | Report No.: KR19-SRF0130-A Page (1) of (14) |  |
|---|---|---|

1. Client

- Name : Kum Oh Electronics Co., Ltd.
- Address : 35, Gilju-ro 444beon-gil, Bucheon-si, Gyeonggi-do, Republic of Korea
- Date of Receipt : 2019-07-03

2. Use of Report : -

3. Name of Product and Model : USPs Button Module(Horizontal) /
 KDUB-019H

4. Manufacturer and Country of Origin : Kum Oh Electronics Co., Ltd. / Korea

5. FCC ID : 2AJKSKDUB-019H

6. Date of Test : 2019-07-31 to 2019-08-14

7. Test Standards : FCC Part 15 Subpart C, 15.209

8. Test Results : Refer to the test result in the test report

| | | |
|-------------|--|--|
| Affirmation | Tested by Name : MyeongJun Kwon (Signature) | Technical Manager Name : Jaehyong Lee (Signature) |
|-------------|--|--|

2019-09-26

KCTL Inc.

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**Report revision history**

| Date | Revision | Page No |
|------------|---|---------|
| 2019-08-20 | Initial report | - |
| 2019-09-26 | Added the comment for simultaneous transmission | 5 |
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1. General information

Client : Kum Oh Electronics Co., Ltd.
 Address : 35, Gilju-ro 444beon-gil, Bucheon-si, Gyeonggi-do, Republic of Korea
 Manufacturer : Kum Oh Electronics Co., Ltd.
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 Factory : NCC VINA ELECTRONICS CO., LTD
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 Address : 65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea
 Accreditations : FCC Site Designation No: KR0040, FCC Site Registration No: 687132
 VCCI Registration No. : R-3327, G-198, C-3706, T-1849
 Industry Canada Registration No. : 8035A
 KOLAS No.: KT231

2. Device information

Equipment under test : USPs Button Device Module(Horizontal)
 Model : KDUB-019H
 Frequency range : 2 402 MHz ~ 2 480 MHz (Bluetooth LE)
 0.531 MHz (WPT)
 Modulation technique : Bluetooth LE_GFSK
 WPT_AM
 Number of channels : 40 ch (Bluetooth LE)
 Power source : DC 5 V
 Antenna specification : PCB Antenna (Bluetooth LE)
 Loop Coil Antenna (WPT)
 Antenna gain : 3.10 dBi (Bluetooth LE)
 Software version : Rev1.0
 Hardware version : Rev1.0
 Test device serial No. : N/A
 Operation temperature : -20 °C ~ 50 °C

2.1. Accessory information

| Equipment | Manufacturer | Model | Serial No. | Power source |
|------------|------------------------------|----------|------------|--------------|
| Stylus Pen | Samsung Electronics Co., Ltd | EN-PN960 | - | - |

2.2. Frequency/channel operations

| Frequency (kHz) |
|-----------------|
| 531 |

2.3. Simultaneously transmission condition

| Technology | Modulation | Test mode | Test channel |
|-------------------------|------------|-----------|--------------|
| Bluetooth Low energy | GFSK | BLE | 0 |
| Wireless Power Transfer | AM | Charging | - |

Note.

The emission of the simultaneous operation (WPT & Bluetooth Low energy) have been evaluated and the test results of the worst case was recorded.

3. Antenna requirement

Requirement of FCC part section 15.203:

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

Requirement of RSS-Gen Section 6.8:

The applicant for equipment certification shall provide a list of all antenna types that may be used with the transmitter, where applicable (i.e. for transmitters with detachable antenna), indicating the maximum permissible antenna gain (in dB_i) and the required impedance for each antenna. The test report shall demonstrate the compliance of the transmitter with the limit for maximum equivalent isotropically radiated power (e.i.r.p.) specified in the applicable RSS, when the transmitter is equipped with any antenna type, selected from this list.

For expediting the testing, measurements may be performed using only the antenna with highest gain of each combination of transmitter and antenna type, with the transmitter output power set at the maximum level. However, the transmitter shall comply with the applicable requirements under all operational conditions and when in combination with any type of antenna from the list provided in the test report (and in the notice to be included in the user manual, provided below).

When measurements at the antenna port are used to determine the RF output power, the effective gain of the device's antenna shall be stated, based on a measurement or on data from the antenna's manufacturer.

The test report shall state the RF power, output power setting and spurious emission measurements with each antenna type that is used with the transmitter being tested.

Immediately following the above notice, the manufacturer shall provide a list of all antenna types which can be used with the transmitter, indicating the maximum permissible antenna gain (in dB_i) and the required impedance for each antenna type.

- The transmitter has permanently attached Coil antenna(Internal antenna) on board.

4. Summary of tests

| FCC Part section(s) | Parameter | Test results |
|---------------------|---|--------------|
| 15.209(a) | Field Strength of Fundamental and Spurious Emission | Pass |
| 2.1049 | 20dB Bandwidth | Pass |
| 15.203 | Antenna requirement | Pass |
| 15.207(a) | AC Power Line Conducted Emission | Pass |

Notes:

1. The fundamental of the EUT was investigated in three orthogonal orientations X, Y and Z. It was determined that X orientation was worst-case orientation. Therefore, all final radiated testing was performed with the EUT in X orientation.
2. The test procedure(s) in this report were performed in accordance as following.
 - ◆ ANSI C63.10-2013
3. The measurement facility is compliant with the test site requirements specified in ANSI C63.4-2014.

5. Measurement uncertainty

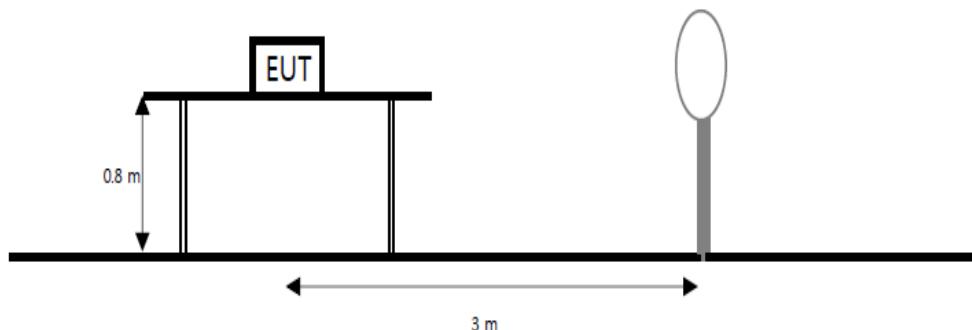
The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.10-2013.

All measurement uncertainty values are shown with a coverage factor of $k=2$ to indicated a 95 % level of confidence. The measurement data shown herein meets or exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and thus, can be compared directly to specified limits to determine compliance.

| Parameter | Expanded uncertainty (\pm) | |
|-----------------------------|--------------------------------|---------|
| Radiated spurious emissions | 9 kHz ~ 30 MHz | 2.28 dB |

6. Test results**6.1. Field Strength of Fundamental and Spurious Emission****Test setup**

The diagram below shows the test setup that is utilized to make the measurements for emission from 9 kHz to 30 MHz Emissions

**Limit****FCC**

According to section 15.209(a), RSS-Gen(8.9) Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

| Frequency (MHz) | Field strength (μ V/m) | Measurement distance (m) |
|-----------------|-----------------------------|--------------------------|
| 0.009 - 0.490 | $2400/F(\text{kHz})$ | 300 |
| 0.490 - 1.705 | $24000/F(\text{kHz})$ | 30 |
| 1.705 - 30 | 30 | 30 |
| 30 - 88 | 100** | 3 |
| 88 - 216 | 150** | 3 |
| 216 - 960 | 200** | 3 |
| Above 960 | 500 | 3 |

**Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54–72 MHz, 76–88 MHz, 174–216 MHz or 470–806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., Section 15.231 and 15.241.

Test procedure

ANSI C63.10-2013

Test settings**Test Procedures for emission from 9 kHz to 30 MHz**

- a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter anechoic chamber test site. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. Then antenna is a loop antenna is fixed at one meter above the ground to determine the maximum value of the field strength. Both parallel and perpendicular of the antenna are set to make the measurement.
- c. For each suspected emission, the EUT was arranged to its worst case and then the table was turned from 0 degrees to 360 degrees to find the maximum reading.
- d. The test-receiver system was set to peak and average detect function and specified bandwidth with maximum hold mode.

Notes:

1. $f < 30 \text{ MHz}$, extrapolation factor of 40 dB/decade of distance. $F_d = 40 \log(D_m/D_s)$

Where:

F_d = Distance factor in dB

D_m = Measurement distance in meters

D_s = Specification distance in meters

2. The test measurement distance is 3 meter

3. Limit (dB(μ V/m)) = For 0.009 MHz - 0.490 MHz, $20 \log(2400/F(\text{kHz}))$ dB(μ V/m)
For 0.490 MHz - 1.705 MHz, $20 \log(24000/F(\text{kHz}))$ dB(μ V/m)
For 1.705 MHz - 30 MHz, $20 \log(30) = 29.54$ dB(μ V/m)

Test results**Radiated Emissions Fundamental & 9 kHz to 30 MHz – Worst case_Horizontal**

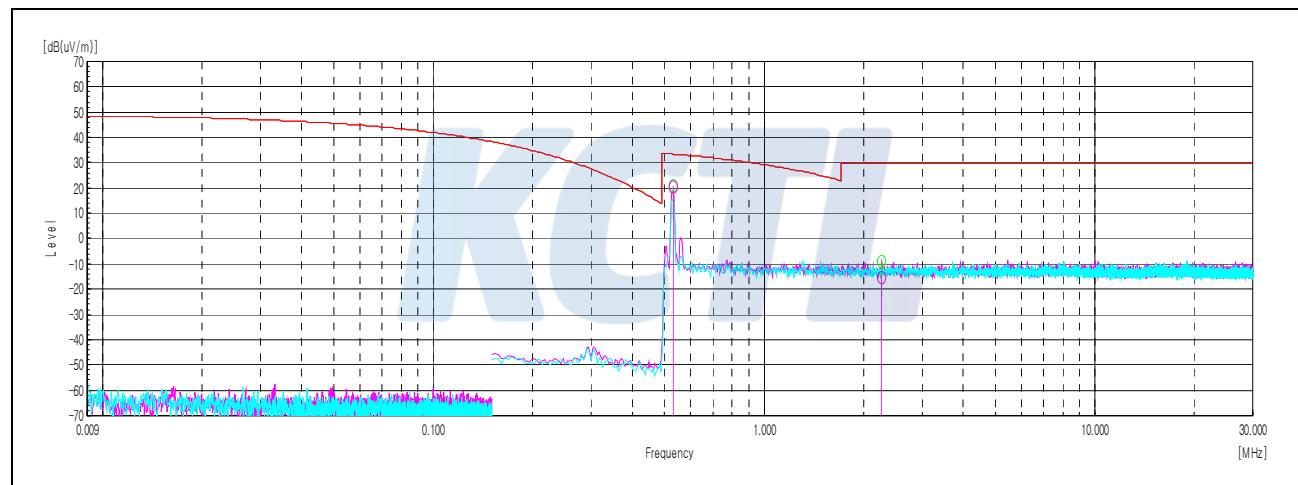
| Frequency | Reading | Detector | Ant. Factor | Amp. + Cable | Distance factor | Factor | Result at 3m | Result at 30m | Limit at 30m | Margin |
|-----------|----------|----------|-------------|--------------|-----------------|--------|--------------|---------------|--------------|--------|
| (MHz) | (dB(µV)) | Mode | (dB) | (dB) | (dB) | (dB) | (dB(µV/m)) | (dB(µV/m)) | (dB(µV/m)) | (dB) |
| 0.531 | 72.30 | QP | 19.28 | -31.38 | -40.00 | -52.10 | 60.20 | 20.20 | 33.10 | 12.90 |

| Frequency | Reading | Detector | Ant. Factor | Amp. + Cable | Distance factor | Factor | Result at 3m | Result at 30m | Limit at 30m | Margin |
|-----------|----------|----------|-------------|--------------|-----------------|--------|--------------|---------------|--------------|--------|
| (MHz) | (dB(µV)) | Mode | (dB) | (dB) | (dB) | (dB) | (dB(µV/m)) | (dB(µV/m)) | (dB(µV/m)) | (dB) |
| 2.269 | 36.30 | QP | 19.24 | -31.14 | -40.00 | -51.90 | 24.40 | -15.60 | 29.54 | 45.14 |

Note.

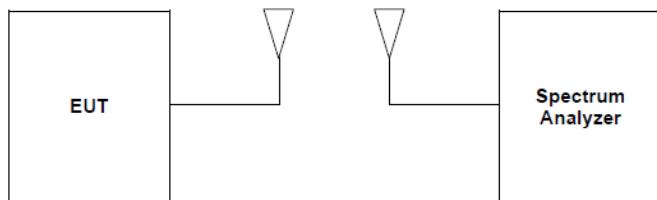
¹⁾ Factor(dB) = Antenna Factor + Amp. Gain + Cable Loss + distance factor(dB)

²⁾ -80 is distance factor = 40*log(3/300), -40 is distance factor = 40*log(3/30)



6.2. 20dB Bandwidth

Test setup



Limit

For reporting purpose only

Test settings

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 3x RBW.

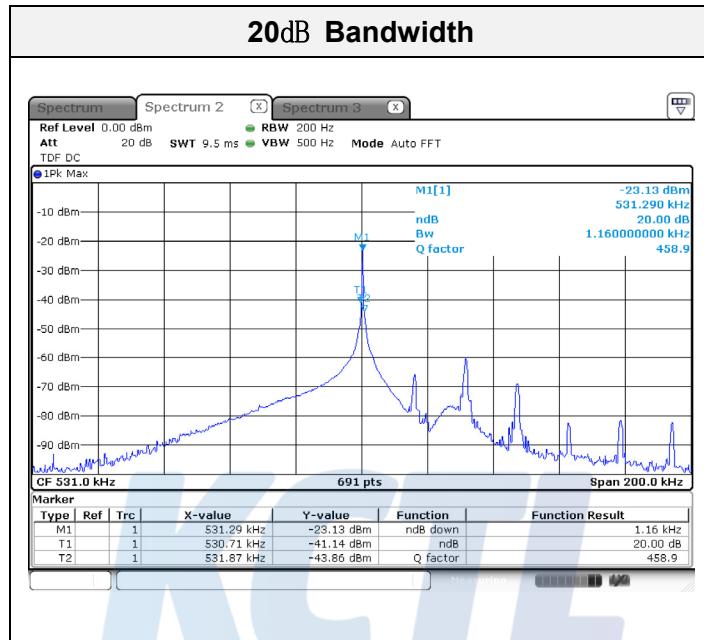
A peak, or peak hold, may be used in place of the sampling detector as this may produce a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold may be necessary to determine the occupied bandwidth if the device is not transmitting continuously.

The trace data points are recovered and are directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded.

The difference between the two recorded frequencies is the 99% occupied bandwidth.

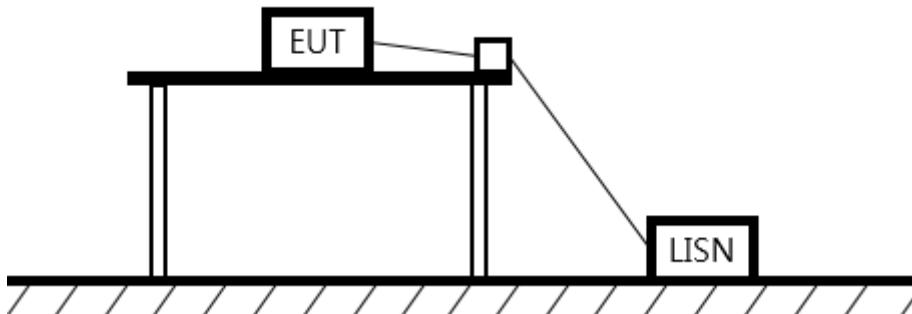
Test results**20dB Bandwidth**

| Frequency (kHz) | Occupied Bandwidth (kHz) | Limit |
|-----------------|--------------------------|------------------------|
| 531 | 1.16 | Reporting purpose only |

Test Plots

6.3. AC Conducted emission

Test setup



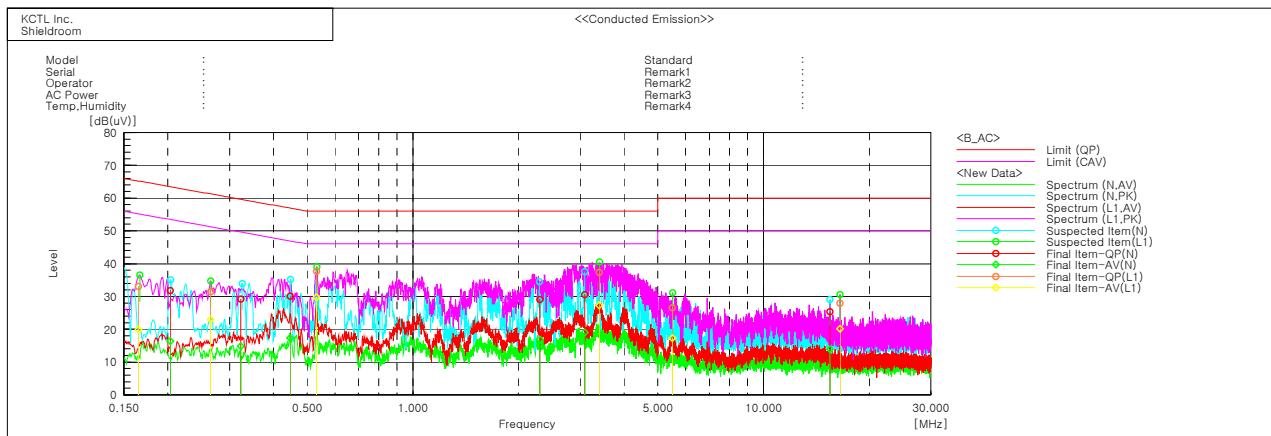
Limit

According to 15.207(a), For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50uH/50 ohm line impedance stabilization network (LISN). Compliance with the provision of this paragraph shall on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower applies at the boundary between the frequencies ranges.

| Frequency of Emission (MHz) | Conducted limit (dB μ V/m) | |
|-----------------------------|--------------------------------|----------|
| | Quasi-peak | Average |
| 0.15 – 0.50 | 66 - 56* | 56 - 46* |
| 0.50 – 5.00 | 56 | 46 |
| 5.00 – 30.0 | 60 | 50 |

Measurement procedure

1. The EUT was placed on a wooden table of size, 1 m by 1.5 m, raised 80 cm in which is located 40 cm away from the vertical wall and 1.5m away from the side wall of the shielded room.
2. Each current-carrying conductor of the EUT power cord was individually connected through a 50Ω/50μH LISN, which is an input transducer to a spectrum analyzer or an EMI/Field Intensity — Meter, to the input power source.
3. Exploratory measurements were made to identify the frequency of the emission that had the highest amplitude relative to the limit by operating the EUT in a range of typical modes of operation, cable position, and with a typical system equipment configuration and arrangement. Based on the exploratory tests of the EUT, the one EUT cable configuration and arrangement and mode of operation that had produced the emission with the highest amplitude relative to the limit was selected for the final measurement.
4. The final test on all current-carrying conductors of all of the power cords to the equipment that comprises the EUT (but not the cords associated with other non-EUT equipment is the system) was then performed over the frequency range of 0.15 MHz to 30 MHz.
5. The measurements were made with the detector set to peak amplitude within a bandwidth of 10 kHz or to quasi-peak and average within a bandwidth of 9 kHz. The EUT was in transmitting mode during the measurements.

Test results

Final Result

--- N Phase ---

| No. | Frequency | Reading QP | Reading CAV | c.f. | Result QP | Result CAV | Limit QP | Limit AV | Margin QP | Margin CAV |
|-----|-----------|------------|-------------|------|-----------|------------|----------|----------|-----------|------------|
| | [MHz] | [dB(uV)] | [dB(uV)] | | [dB] | [dB] | [dB(uV)] | [dB(uV)] | [dB] | [dB] |
| 1 | 0.20352 | 21.9 | 6.5 | 9.9 | 31.8 | 16.4 | 63.5 | 53.5 | 31.7 | 37.1 |
| 2 | 0.32281 | 19.5 | 5.1 | 9.7 | 29.2 | 14.8 | 59.6 | 49.6 | 30.4 | 34.8 |
| 3 | 0.44629 | 20.2 | 7.4 | 9.9 | 30.1 | 17.3 | 56.9 | 46.9 | 26.8 | 29.6 |
| 4 | 2.30233 | 19.3 | 7.2 | 9.7 | 29.0 | 16.9 | 56.0 | 46.0 | 27.0 | 29.1 |
| 5 | 3.09318 | 20.8 | 9.4 | 9.7 | 30.5 | 19.1 | 56.0 | 46.0 | 25.5 | 26.9 |
| 6 | 15.46815 | 15.4 | 3.9 | 10.0 | 25.4 | 13.9 | 60.0 | 50.0 | 34.6 | 36.1 |

--- L1 Phase ---

| No. | Frequency | Reading QP | Reading CAV | c.f. | Result QP | Result CAV | Limit QP | Limit AV | Margin QP | Margin CAV |
|-----|-----------|------------|-------------|------|-----------|------------|----------|----------|-----------|------------|
| | [MHz] | [dB(uV)] | [dB(uV)] | | [dB] | [dB] | [dB(uV)] | [dB(uV)] | [dB] | [dB] |
| 1 | 0.16485 | 22.9 | 9.8 | 10.1 | 33.0 | 19.9 | 65.2 | 55.2 | 32.2 | 35.3 |
| 2 | 0.26494 | 21.8 | 13.2 | 9.7 | 31.5 | 22.9 | 61.3 | 51.3 | 29.8 | 28.4 |
| 3 | 0.53076 | 27.8 | 19.9 | 9.9 | 37.7 | 29.8 | 56.0 | 46.0 | 18.3 | 16.2 |
| 4 | 3.40283 | 27.6 | 17.6 | 9.7 | 37.3 | 27.3 | 56.0 | 46.0 | 18.7 | 18.7 |
| 5 | 5.49862 | 16.9 | 7.6 | 9.7 | 26.6 | 17.3 | 60.0 | 50.0 | 33.4 | 32.7 |
| 6 | 16.53162 | 17.8 | 10.1 | 10.1 | 27.9 | 20.2 | 60.0 | 50.0 | 32.1 | 29.8 |

7. Measurement equipment

| Equipment Name | Manufacturer | Model No. | Serial No. | Next Cal. Date |
|--------------------------|-------------------|-----------|-------------|----------------|
| SIGNAL GENERATOR | R&S | SMR40 | 100007 | 20.05.13 |
| VECTOR SIGNAL GENERATOR | R&S | SMBV100A | 257566 | 20.01.04 |
| Spectrum Analyzer | R & S | FSV40 | 101437 | 20.07.30 |
| COAXIAL FIXED ATTENUATOR | AGILENT | 8491A | MY52461848 | 20.05.04 |
| EMI TEST RECEIVER | R & S | ESCI | 100732 | 19.08.23 |
| LOOP Antenna | R & S | HFH2-Z2 | 892665/035 | 20.08.24 |
| AMPLIFIER | SONOMA INSTRUMENT | 310N | 284608 | 19.08.23 |
| Antenna Mast | MATURO | EAS 1.5 | 042/8941211 | - |
| Antenna Mast | MATURO | EAS 1.5 | 043/8941211 | - |
| Turn Table | MATURO | TT 0.8 PF | 041/8941211 | - |
| Cable Assembly | gigalane | RG-400 | - | - |

End of test report**KCTL**