

TEST REPORT

KOSTEC Co., Ltd.

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Hwaseong-si, Gyeonggi-do, Korea
Tel:031-222-4251, Fax:031-222-4252

Report No.: KST-FCR-180009(1)



KOSTEC Co., Ltd.
<http://www.kostec.org>

1. Applicant

- Name : Dogtra Co., Ltd.
- Address : #715-2(146BL-3L) Gojan-dong, Namdong-gu, Incheon, Korea

2. Test Item

- Product Name: DOG TRAINING DEVICE
- Model Name: BALL TRAINER
- Brand: None
- FCC ID: SWN-BT10U

3. Manufacturer

- Name : Dogtra Co., Ltd.
- Address : #715-2(146BL-3L) Gojan-dong, Namdong-gu, Incheon, Korea

4. Date of Test : 2018. 03. 20. ~ 2018. 03. 21.

5. Test Method Used : FCC CFR 47, Part 15. Subpart C-15.249
ANSI C63.10:2013

6. Test Result : Compliance

7. Note: None

Supplementary Information

The device bearing the brand name and FCC ID specified above has been shown to comply with the applicable technical standards as indicated in the measurement report and was tested in accordance with measurement procedures specified in ANSI C 63.10-2013.

We attest to the accuracy of data and all measurements reported herein were performed by KOSTEC Co., Ltd. and were made under Chief Engineer's supervision. We assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

The results shown in this test report refer only to the sample(s) tested unless otherwise stated.

| | | |
|-------------|---|--|
| Affirmation | Tested by Name : Lee, Mi-Young (Signature) | Technical Manager Name : Park, Gyeong-Hyeon (Signature) |
|-------------|---|--|

2018. 03. 29.

KOSTEC Co., Ltd.

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1. GENERAL INFORMATION

1.1 Test Facility

Test laboratory and address

KOSTEC Co., Ltd.

128(175-20,Annyeong-dong)406-gil sejaro, Hwaseong-si Gyeonggi-do, Korea

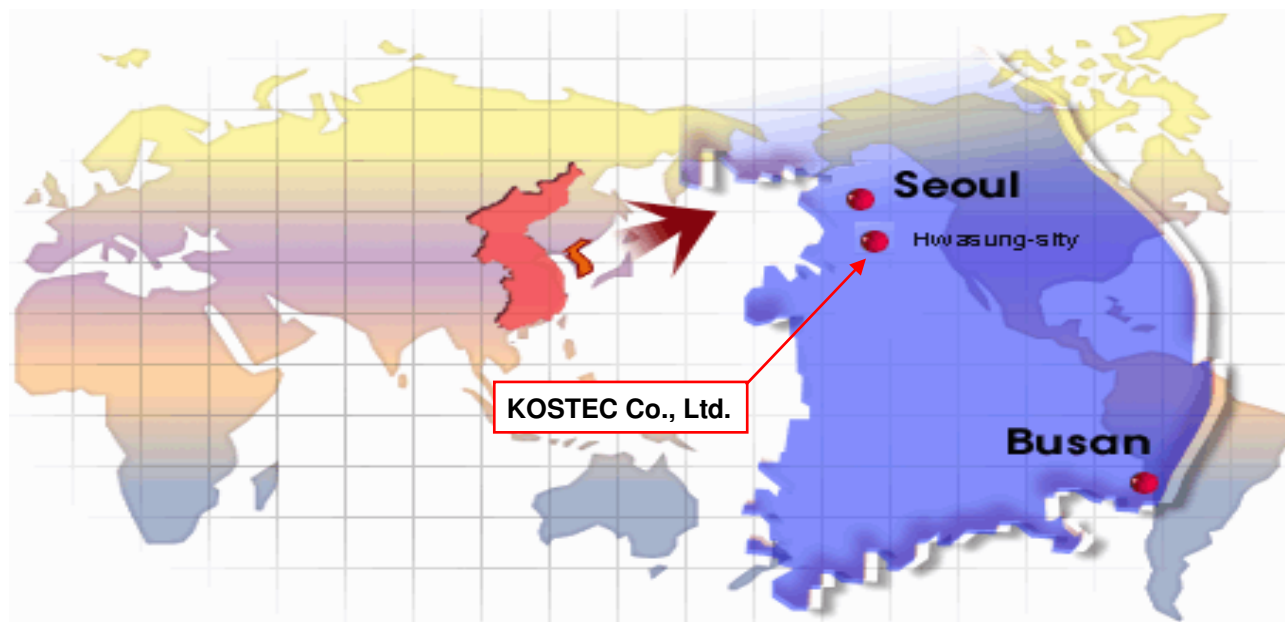
Registration information

KOLAS No. : 232

FCC Designation No. : KR0041

IC Registration Site No. : 8305A-1

1.2 Location



1.3 Revision History of test report

| Rev. | Revisions | Effect page | Reviewed | Date |
|------|--|-------------|--------------------|---------------|
| - | Initial issue | All | Gyeong Hyeon, Park | 2018. 03. 26. |
| 1 | It was add max fundamental field strength value in the summary section It was add test setup and procedure of occupied bandwidth in the section 5 Annotations were added to the table of the fundamental field strength in 14 page | 5, 10, 14 | Gyeong Hyeon, Park | 2018. 03. 29. |

2. EQUIPMENT DESCRIPTION

The product specification described herein was declared by manufacturer. And refer to user's manual for the details.

| | |
|--------------------------------|--|
| Equipment Name | DOG TRAINING DEVICE |
| Model No | BALL TRAINER |
| Usage | DOG TRAINING DEVICE |
| Serial Number | Proto type |
| Modulation type | FSK |
| Emission Type | F1D |
| Operated Frequency | 915 MHz |
| Max fundamental field strength | 80.08 dBμV /m |
| Channel Number | 1 |
| Operation temperature | -20 °C ~ 55 °C |
| Power Source | AAA 1.5 V alkaline batterie x 2ea |
| Antenna Description | Internal PCB antenna, gain : -4.016 dBi |
| Remark | <ol style="list-style-type: none"> 1. The device was operating at its maximum output power for all measurements. 2. The radiation measurements are performed in X, Y, Z axis positioning. Only the worst case (X) is shown in the report. 3. The above DUT's information was declared by manufacturer. Please refer to the specifications or user manual for more detailed description. |
| FCC ID | SWN-BT10U |

3. SYSTEM CONFIGURATION FOR TEST

3.1 Characteristics of equipment

The EUT is a dog training device that launches and drops balls, designed for training working dogs.

3.2 Used peripherals list

| Description | Model No. | Serial No. | Manufacture | Remark |
|-------------|-----------|------------|-------------|--------|
| | | | | |
| | | | | |

3.3 Product Modification

N/A

3.4 Operating Mode

Constantly transmitting with a modulated carrier at maximum power.

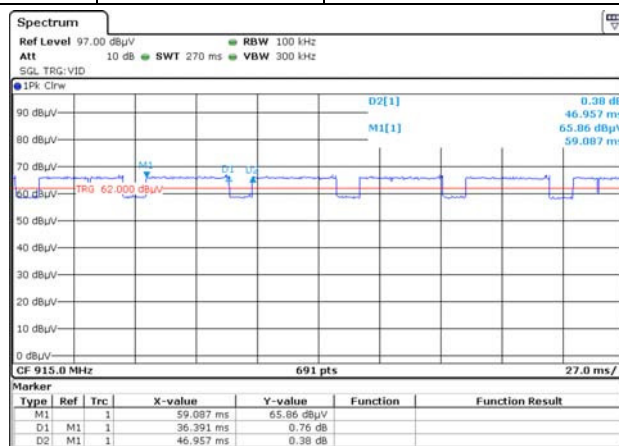
3.5 Test Setup of EUT

EUT
(Standalone)

3.6 Duty Cycle Of Test signal

Duty cycle is < 98%, duty factor shall be considered. Duty cycle = Tx on/(Tx on+ Tx off), Duty factor = 10*log(1/duty cycle)

| Freq | Tx on | Tx on+Tx off | Duty cycle | Duty Cycle Factor |
|---------|-----------|--------------|------------|-------------------|
| 915 MHz | 36.391 ms | 46.957 ms | 0.7749 | 1.1 |



3.7 Used Test Equipment List

| No. | Instrument | Model | S/N | Manufacturer | Due to cal date | Cal interval | used |
|-----|-------------------------------|--------------------|--------------|----------------------------|-----------------|--------------|-------------------------------------|
| 1 | T & H Chamber | EY-101 | 90E14260 | TABAI ESPEC | 2018.09.06 | 1 year | <input type="checkbox"/> |
| 2 | T & H Chamber | RCT-V-THC-403-1(H) | 20030210 | R.C.T | 2018.09.06 | 1 year | <input type="checkbox"/> |
| 3 | T & H Chamber | SH-641 | 92006831 | ESPEC CORP | 2019.02.14 | 1 year | <input type="checkbox"/> |
| 4 | Spectrum Analyzer | 8593E | 3710A02859 | Agilent Technology | 2019.02.01 | 1 year | <input type="checkbox"/> |
| 5 | Spectrum Analyzer | 8563EC | 3046A00527 | Agilent Technology | 2019.02.01 | 1 year | <input type="checkbox"/> |
| 6 | Signal Analyzer | FSV13 | 101247 | Rohde & Schwarz | 2019.02.01 | 1 year | <input type="checkbox"/> |
| 7 | Spectrum Analyzer | FSV30 | 20-353063 | Rohde & Schwarz | 2019.02.01 | 1 year | <input checked="" type="checkbox"/> |
| 8 | Signal Analyzer | N9010A | MY56070441 | Agilent Technologies | 2018.05.15 | 1 year | <input checked="" type="checkbox"/> |
| 9 | EMI Test Receiver | ESCI7 | 100823 | Rohde & Schwarz | 2019.01.29 | 1 year | <input checked="" type="checkbox"/> |
| 10 | EMI Test Receiver | ESI | 837514/004 | Rohde & Schwarz | 2018.09.05 | 1 year | <input checked="" type="checkbox"/> |
| 11 | Vector Signal Analyzer | 89441A | 3416A02620 | Agilent Technology | 2019.02.01 | 1 year | <input type="checkbox"/> |
| 12 | Network Analyzer | 8753ES | US39172348 | AGILENT | 2018.09.04 | 1 year | <input type="checkbox"/> |
| 13 | EPM Series Power meter | E4418B | GB39512547 | Agilent Technology | 2019.01.31 | 1 year | <input type="checkbox"/> |
| 14 | RF Power Sensor | E9300A | MY41496631 | Agilent Technology | 2019.01.31 | 1 year | <input type="checkbox"/> |
| 15 | Microwave Frequency Counter | 5352B | 2908A00480 | Agilent Technology | 2019.01.30 | 1 year | <input type="checkbox"/> |
| 16 | Audio Analyzer | 8903B | 3514A16919 | Agilent Technology | 2019.01.30 | 1 year | <input type="checkbox"/> |
| 17 | Audio Telephone Analyzer | DD-5601CID | 520010281 | CREDIX | 2019.01.30 | 1 year | <input type="checkbox"/> |
| 18 | Modulation Analyzer | 8901A | 3041A0576 | H.P | 2019.01.31 | 1 year | <input type="checkbox"/> |
| 19 | Digital storage Oscilloscope | TDS3052 | B015962 | Tektronix | 2018.09.04 | 1 year | <input type="checkbox"/> |
| 20 | ESG-D Series Signal Generator | E4436B | US39260458 | Agilent Technology | 2019.01.31 | 1 year | <input type="checkbox"/> |
| 21 | Vector Signal Generator | SMBV100A | 257557 | Rohde & Schwarz | 2019.01.31 | 1 year | <input type="checkbox"/> |
| 22 | Signal Generator | SMB100A | 179628 | Rohde & Schwarz | 2018.05.18 | 1 year | <input type="checkbox"/> |
| 23 | Tracking Source | 85645A | 070521-A1 | Agilent Technology | 2019.02.01 | 1 year | <input type="checkbox"/> |
| 24 | SLIDAC | None | 0207-4 | Myoung sung Ele. | 2019.01.29 | 1 year | <input type="checkbox"/> |
| 25 | DC Power supply | DRP-5030 | 9028029 | Digital Electronic Co.,Ltd | 2019.01.29 | 1 year | <input type="checkbox"/> |
| 26 | DC Power supply | 6038A | 3440A12674 | Agilent Technology | 2019.01.29 | 1 year | <input type="checkbox"/> |
| 27 | DC Power supply | E3610A | KR24104505 | Agilent Technology | 2019.01.29 | 1 year | <input type="checkbox"/> |
| 28 | DC Power supply | UP-3005T | 68 | Unicon Co.,Ltd | 2019.01.29 | 1 year | <input type="checkbox"/> |
| 29 | DC Power Supply | SM 3400-D | 114701000117 | DELTAELEKTRONIKA | 2019.01.29 | 1 year | <input type="checkbox"/> |
| 30 | DC Power supply | 6632B | MY43004005 | Agilent Technology | 2019.01.31 | 1 year | <input type="checkbox"/> |
| 31 | DC Power Supply | 6632B | MY43004137 | Agilent Technology | 2019.01.31 | 1 year | <input type="checkbox"/> |
| 32 | Termination | 1433-3 | LM718 | WEINSCHEL | 2018.07.20 | 1 year | <input type="checkbox"/> |
| 33 | Termination | 1432-3 | QR946 | AEROFLEX/WEINSCHEL | 2018.07.20 | 1 year | <input type="checkbox"/> |
| 34 | Attenuator | 24-30-34 | BX5630 | Aeroflex / Weinschel | 2018.12.15 | 1 year | <input type="checkbox"/> |
| 35 | Attenuator | 8498A | 3318A09485 | HP | 2019.01.31 | 1 year | <input type="checkbox"/> |
| 36 | Step Attenuator | 8494B | 3308A32809 | HP | 2019.01.31 | 1 year | <input type="checkbox"/> |
| 37 | Attenuator | 18B50W-20F | 64671 | INMET | 2019.01.31 | 1 year | <input type="checkbox"/> |
| 38 | Attenuator | 10 dB | 1 | Rohde & Schwarz | 2018.05.18 | 1 year | <input type="checkbox"/> |
| 39 | Attenuator | 10 dB | 2 | Rohde & Schwarz | 2018.05.18 | 1 year | <input type="checkbox"/> |
| 40 | Attenuator | 10 dB | 3 | Rohde & Schwarz | 2018.05.18 | 1 year | <input type="checkbox"/> |
| 41 | Attenuator | 10 dB | 4 | Rohde & Schwarz | 2018.05.18 | 1 year | <input type="checkbox"/> |
| 42 | Attenuator | 54A-10 | 74564 | WEINSCHEL | 2018.08.29 | 1 year | <input type="checkbox"/> |
| 43 | Attenuator | 56-10 | 66920 | WEINSCHEL | 2018.05.18 | 1 year | <input type="checkbox"/> |
| 44 | Attenuator | 48-20-11 | BV2658 | Aeroflex/Weinschel | 2018.08.16 | 1 year | <input type="checkbox"/> |
| 45 | Attenuator | 48-30-33-LIM | BL5350 | Weinschel Corp. | 2018.08.04 | 1 year | <input type="checkbox"/> |
| 46 | Power divider | 11636B | 51212 | HP | 2019.02.01 | 1 year | <input type="checkbox"/> |
| 47 | 3Way Power divider | KPDSU3W | 00070365 | KMW | 2018.09.04 | 1 year | <input type="checkbox"/> |
| 48 | 4Way Power divider | 70052651 | 173834 | KRYTAR | 2019.02.01 | 1 year | <input type="checkbox"/> |
| 49 | 3Way Power divider | 1580 | SQ361 | WEINSCHEL | 2018.05.18 | 1 year | <input type="checkbox"/> |

| No. | Instrument | Model | S/N | Manufacturer | Due to cal date | Cal interval | used |
|-----|-------------------------------------|----------------------------------|-------------|-----------------------------|-----------------|--------------|-------------------------------------|
| 50 | OSP | OSP120 | 101577 | Rohde & Schwarz | 2018.05.19 | 1 year | <input type="checkbox"/> |
| 51 | White noise audio filter | ST31EQ | 101902 | SoundTech | 2018.09.04 | 1 year | <input type="checkbox"/> |
| 52 | Dual directional coupler | 778D | 17693 | HEWLETT PACKARD | 2019.01.31 | 1 year | <input type="checkbox"/> |
| 53 | Dual directional coupler | 772D | 2839A00924 | HEWLETT PACKARD | 2019.01.31 | 1 year | <input type="checkbox"/> |
| 54 | Band rejection filter | 3TNF-0006 | 26 | DOVER Tech | 2019.02.01 | 1 year | <input type="checkbox"/> |
| 55 | Band rejection filter | 3TNF-0007 | 311 | DOVER Tech | 2019.02.01 | 1 year | <input type="checkbox"/> |
| 56 | Band rejection filter | WTR-BRF2442-84NN | 09020001 | WAVE TECH Co.,LTD | 2019.01.31 | 1 year | <input type="checkbox"/> |
| 57 | Band rejection filter | WRCJV12-5695-5725-5825-5855-50SS | 1 | Wainwright Instruments GmbH | 2018.05.18 | 1 year | <input type="checkbox"/> |
| 58 | Band rejection filter | WRCJV12-5120-5150-5350-5380-40SS | 4 | Wainwright Instruments GmbH | 2018.05.18 | 1 year | <input type="checkbox"/> |
| 59 | Band rejection filter | WRCGV10-2360-2400-2500-2540-50SS | 2 | Wainwright Instruments GmbH | 2018.05.18 | 1 year | <input type="checkbox"/> |
| 60 | Highpass Filter | WHJS1100-10EF | 1 | WAINWRIGHT | 2019.01.31 | 1 year | <input checked="" type="checkbox"/> |
| 61 | Highpass Filter | WHJS3000-10EF | 1 | WAINWRIGHT | 2019.01.31 | 1 year | <input type="checkbox"/> |
| 62 | Highpass Filter | WHNX6-5530-7000-26500-40CC | 2 | Wainwright Instruments GmbH | 2018.05.19 | 1 year | <input type="checkbox"/> |
| 63 | Highpass Filter | WHNX6-2370-3000-26500-40CC | 4 | Wainwright Instruments GmbH | 2018.05.19 | 1 year | <input type="checkbox"/> |
| 64 | WideBand Radio Communication Tester | CMW500 | 102276 | Rohde & Schwarz | 2019.02.01 | 1 year | <input type="checkbox"/> |
| 65 | Radio Communication Tester | CMU 200 | 112026 | Rohde & Schwarz | 2019.01.31 | 1 year | <input type="checkbox"/> |
| 66 | Bluetooth Tester | TC-3000B | 3000B6A0166 | TESCOM CO., LTD. | 2019.01.31 | 1 year | <input type="checkbox"/> |
| 67 | Loop Antenna | 6502 | 9203-0493 | EMCO | 2019.05.29 | 2 year | <input checked="" type="checkbox"/> |
| 68 | BiconiLog Antenna | 3142B | 1745 | EMCO | 2018.07.11 | 2 year | <input checked="" type="checkbox"/> |
| 69 | Biconical Antenna | VUBA9117 | 9117-342 | Schwarz beck | 2020.03.12 | 2 year | <input type="checkbox"/> |
| 70 | Trilog-Broadband Antenna | VULB 9168 | 9168-606 | SCHWARZBECK | 2018.09.09 | 2 year | <input type="checkbox"/> |
| 71 | Horn Antenna | 3115 | 2996 | EMCO | 2020.02.14 | 2 year | <input checked="" type="checkbox"/> |
| 72 | Horn Antenna | 3115 | 9605-4834 | EMCO | 2020.03.12 | 2 year | <input type="checkbox"/> |
| 73 | Horn Antenna | BBHA9170 | 743 | SCHWARZBECK | 2019.04.25 | 2 year | <input type="checkbox"/> |
| 74 | Antenna Master(3) | AT13 | None | AUDIX | N/A | N/A | <input type="checkbox"/> |
| 75 | Turn Table(3) | None | None | AUDIX | N/A | N/A | <input type="checkbox"/> |
| 76 | PREAMPLIFIER(3) | 8449B | 3008A02577 | Agilent | 2019.02.02 | 1 year | <input type="checkbox"/> |
| 77 | Antenna Master(10) | MA4000-EP | None | innco systems GmbH | N/A | N/A | <input checked="" type="checkbox"/> |
| 78 | Turn Table(10) | None | None | innco systems GmbH | N/A | N/A | <input checked="" type="checkbox"/> |
| 79 | AMPLIFIER(10) | TK-PA6S | 120009 | TESTEK | 2019.01.29 | 1 year | <input checked="" type="checkbox"/> |
| 80 | AMPLIFIER | TK-PA18 | 150003 | TESTEK | 2018.05.19 | 1 year | <input type="checkbox"/> |
| 81 | AMPLIFIER | TK-PA1840H | 160010-L | TESTEK | 2018.07.15 | 1 year | <input type="checkbox"/> |
| 82 | AMPLIFIER | 8447D | 2944A07881 | H.P | 2019.01.29 | 1 year | <input type="checkbox"/> |
| 83 | Antenna Mast | MA2000-EP | None | innco systems GmbH | N/A | N/A | <input type="checkbox"/> |
| 84 | Turn Device | DE3700-RH | None | innco systems GmbH | N/A | N/A | <input type="checkbox"/> |

4. SUMMARY TEST RESULTS

| Description of Test | FCC Rule | Reference Clause | Used | Test Result |
|---|-----------------------------------|------------------|-------------------------------------|---|
| 20 dB Bandwidth | 15.215(c) | Clause 5.1 | <input checked="" type="checkbox"/> | Compliance |
| Spurious RF radiated emissions & Field strength of fundamental | 15.205(a) & 15.209(a) & 15.249(a) | Clause 5.2 | <input checked="" type="checkbox"/> | Compliance |
| Antenna requirement | 15.203 | Clause 5.3 | <input checked="" type="checkbox"/> | Compliance |
| AC Power Conducted emissions | 15.207 | Clause 5.4 | <input type="checkbox"/> | N/A : This EUT uses alkaline batteries. |
| <p>Compliance/pass : The EUT complies with the essential requirements in the standard.</p> <p>Not Compliance : The EUT does not comply with the essential requirements in the standard.</p> <p>N/A : The test was not applicable in the standard.</p> | | | | |

Procedure Reference

FCC CFR 47, Part 15. Subpart C-15.249

ANSI C 63.10-2013

5. MEASUREMENT RESULTS

5.1 20 dB Bandwidth

5.1.1 Standard Applicable [FCC §15.215(c)]

(c) Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

5.1.2 Test Environment conditions

- Ambient temperature : 22 °C • Relative Humidity : (52 ~ 55) % R.H.

5.1.3 Measurement Procedure

The 20 dB bandwidth is measured with a spectrum analyzer connected via a receive antenna placed near the EUT while the EUT is operating in transmission mode.

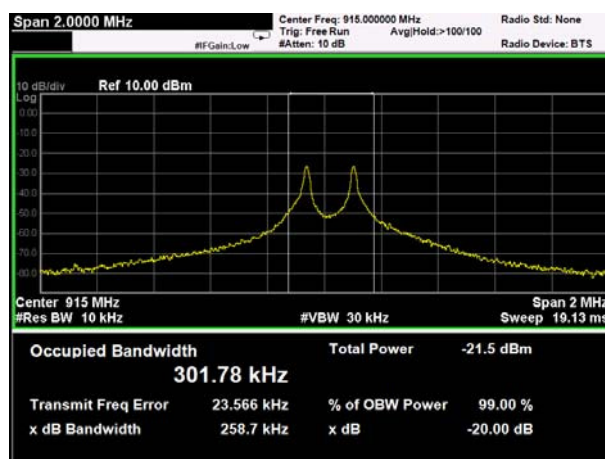
The spectrum analyzer is set to the as follows :

- Set RBW = 10 kHz.
- Set the video bandwidth (VBW) $\geq 3 \times$ RBW.
- Detector = Peak.
- Trace mode = max hold.
- Sweep = auto couple.
- Allow the trace to stabilize.
- Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

5.1.4 Measurement Result

| Channel | Frequency [MHz] | 20 dB Bandwidth [KHz] | 99 % Bandwidth [KHz] | Test Results |
|---------|-----------------|-----------------------|----------------------|---------------------------------|
| - | 915 | 258.7 | 301.78 | No limit (for information only) |

5.1.5 Test Plot



5.2 Spurious RF Radiated emissions & Field strength of fundamental

5.2.1 Standard Applicable [FCC §15.249(a)]

(a) Except as provided in paragraph (b) of this section, the field strength of emissions from intentional radiators operated within these frequency bands shall comply with the following:

| Fundamental frequency | Field strength of fundamental (millivolts/meter) | Field strength of harmonics (microvolts/meter) |
|-----------------------|--|--|
| 902-928 MHz | 50 | 500 |
| 2400-2483.5 MHz | 50 | 500 |
| 5725-5875 MHz | 50 | 500 |
| 24.0-24.25 GHz | 250 | 2500 |

§15.209 limits for radiated emissions measurements (distance at 3 m)

| Frequency Band [MHz] | DISTANCE [Meters] | Limit [$\mu\text{V}/\text{m}$] | Limit [$\text{dB}\mu\text{V}/\text{m}$] | Detector |
|----------------------|-------------------|---|---|------------|
| 0.009 ~ 0.490 | 300 | 2400/F(kHz) | 67.6-20log(F) | Peak |
| 0.490 ~ 1.705 | 30 | 24000/F(kHz) | 87.6-20log(F) | Peak |
| 1.705 ~ 30.0 | 30 | 30 | 29.54 | Peak |
| 30 - 88 | 3 | 100 ** | 40.00 | Quasi peak |
| 88 - 216 | 3 | 150 ** | 43.52 | Quasi peak |
| 216 - 960 | 3 | 200 ** | 46.02 | Quasi peak |
| Above 960 | 3 | 500 | 54.00 | Average |
| Above 1000 | 3 | 74.0 $\text{dB}\mu\text{V}/\text{m}$ (Peak), 54.0 $\text{dB}\mu\text{V}/\text{m}$ (Average) | | |

** fundamental emissions from intentional radiators operation 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 Section 15.231 and 15.241

§15.205. Restrict Band of Operation

| [MHz] | [MHz] | [MHz] | [GHz] |
|-----------------------|-------------------------|-------------------|---------------|
| 0.090 - 0.110 | 16.42 - 16.423 | 399.9 - 410 | 4.5 - 5.15 |
| 0.495 - 0.505** | 16.694 75 - 16.695 25 | 608 - 614 | 5.35 - 5.46 |
| 2.173 5 - 2.190 5 | 16.804 25 - 16.804 75 | 960 - 1 240 | 7.25 - 7.75 |
| 4.125 - 4.128 | 25.5 - 25.67 | 1 300 - 1 427 | 8.025 - 8. |
| 4.177 25 - 4.177 75 | 37.5 - 38.25 | 1 435 - 1 626.5 | 9.0 - 9.2 |
| 4.207 25 - 4.207 75 | 73 - 74.6 | 1 645.5 - 1 646.5 | 9.3 - 9.5 |
| 6.215 - 6.218 | 74.8 - 75.2 | 1 660 - 1 710 | 10.6 - 12.7 |
| 6.267 75 - 6.268 25 | 108 - 121.94 | 1 718.8 - 1 722.2 | 13.25 - 13.4 |
| 6.311 75 - 6.312 25 | 123 - 138 | 2 200 - 2 300 | 14.47 - 14.5 |
| 8.291 - 8.294 | 149.9 - 150.05 | 2 310 - 2 390 | 15.35 - 16.2 |
| 8.362 - 8.366 | 156.524 75 - 156.525 25 | 2 483.5 - 2 500 | 17.7 - 21.4 |
| 8.376 25 - 8.38 6 75 | 156.7 - 156.9 | 2 690 - 2 900 | 22.01 - 23.12 |
| 8.414 25 - 8.414 75 | 162.012 5 - 167.17 | 3 260 - 3 267 | 23.6 - 24.0 |
| 12.29 - 12.293 | 167.72 - 173.2 | 3 332 - 3 339 | 31.2 - 31.8 |
| 12.519 75 - 12.520 25 | 240 - 285 | 3 345.8 - 3 358 | 36.43 - 36.5 |
| 12.576 75 - 12.577 25 | 322 - 335.4 | 3 600 - 4 400 | Above 38.6 |
| 13.36 - 13.41 | | | |

** Until February 1, 1999, this restricted band shall be 0.490-0.510

5.2.2 Test Environment conditions

- Ambient temperature : (21 ~ 22) °C • Relative Humidity : (50 ~ 52) % R.H.

5.2.3 Measurement Procedure

The measurements procedure of the Spurious RF Radiated emissions is as following describe method.

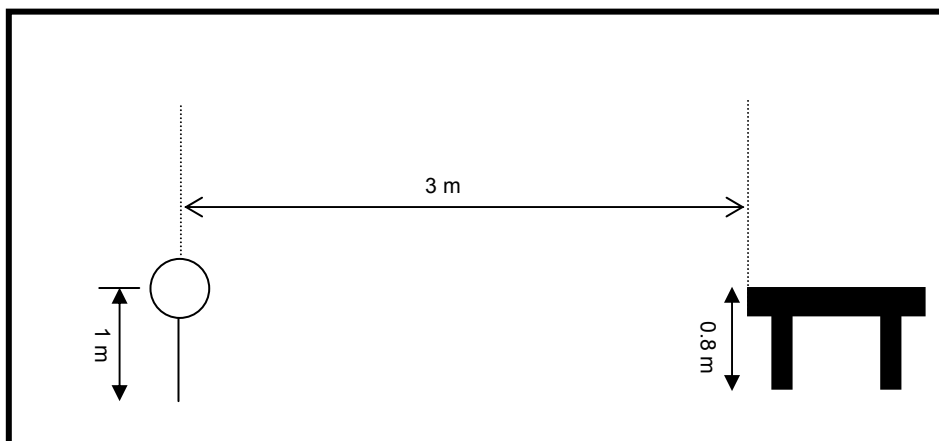
1. The EUT was placed on the top of a rotating table (0.8 meters for below 1 GHz and 1.5 meters for above 1 GHz) above the ground at a 3 meter camber. The table was rotated 360 degree to determine the position of the highest radiation.
 2. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna master.
 3. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both Horizontal and vertical polarizations of the antenna are set to make the measurement.
 4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotating table was turned from 0 - 360 degrees to find the maximum reading.
 5. The measuring receiver was set to peak detector and specified bandwidth with max hold function.
 6. Low, Middle and high channels were measured, and radiation measurements are performed in X, Y, Z axis positioning. And found the worst axis position and only the test worst case mode is recorded in the report.
- The measurement results are obtained as described below:
$$\text{Result(dB}\mu\text{V/m)} = \text{Reading(dB}\mu\text{V)} + \text{Antenna factor(dB/m)} + \text{CL(dB)} + \text{other applicable factor (dB)}$$
 - The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for RMS Average (Duty cycle < 98 %) for Average detection (AV) at frequency above 1 GHz, then the measurement results was added to a correction factor ($10 \log(1/\text{duty cycle})$).
 - The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 10 Hz (Duty cycle \geq 98 %) for Average detection (AV) at frequency above 1 GHz.
 - According to §15.33 (a)(1), Frequency range of radiated measurement is performed the tenth harmonic.

5.2.4 Measurement Uncertainty

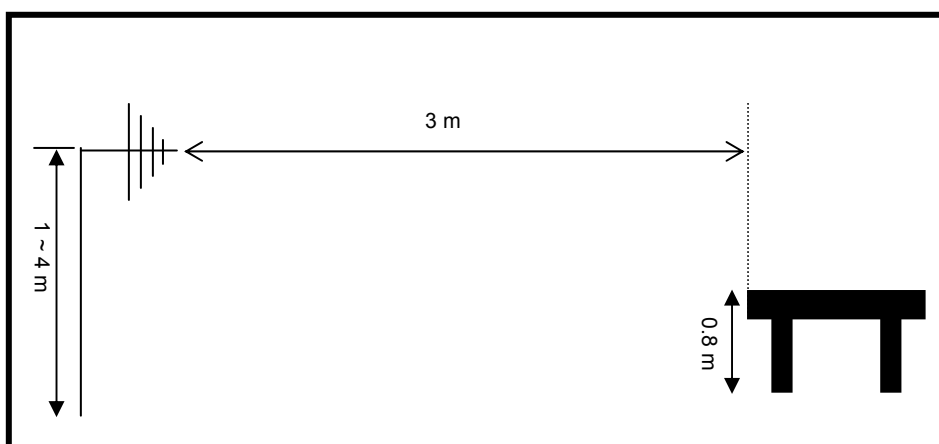
Radiated Emission measurement: Below 1 GHz: 3.66 dB (CL: Approx 95 %, k=2)
Above 1 GHz: 4.04 dB (CL: Approx 95 %, k=2)

5.2.5 Test Configuration

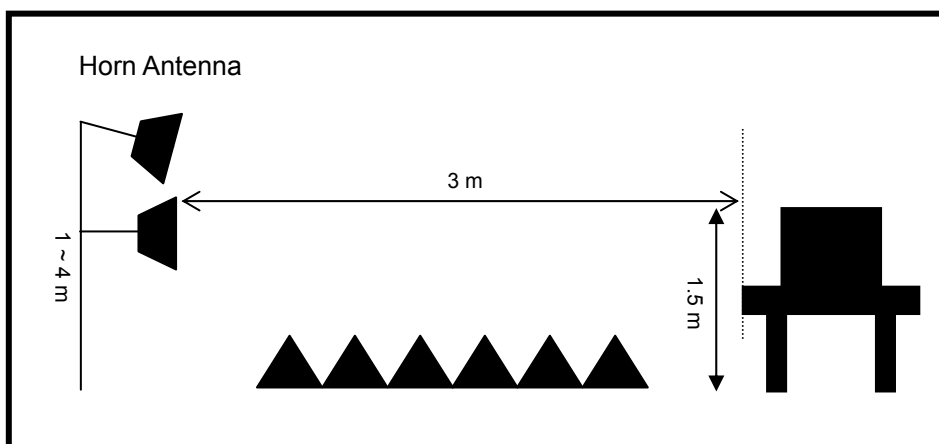
Radiated emission setup, below 30 MHz



Radiated emission setup, below 1 000 MHz



Radiated emission setup, above 1 GHz



5.2.6 Measurement Result

Field strength of fundamental

| Freq. (MHz) | Reading (dBμV/m) | Table (Deg) | Antenna | | | CL (dB) | AMP (dB) | Meas Result (dBμV /m) | Limit (dBμV/m) | Mgn (dB) | Result |
|-------------|------------------|-------------|------------|------------|--------------|---------|----------|-----------------------|-----------------|----------|------------|
| | | | Height (m) | Pol. (H/V) | Fctr. (dB/m) | | | | | | |
| 915 | 90.30 | 170 | 1.5 | V | 23.89 | 4.21 | -38.32 | 80.08 | 94 | 13.92 | Compliance |
| 915 | 88.82 | 170 | 1.8 | H | 23.89 | 4.21 | -38.32 | 78.60 | 94 | 15.40 | Compliance |

Note: Peak detector was used as an alternative to CISPR quasi-peak measurements for the fundamental signal level.
The peak value below quasi-peak limit, the quasi-peak test didn't perform.

Band Edge

| Freq. (MHz) | Reading (dBμV/m) | Table (Deg) | Antenna | | | CL (dB) | AMP (dB) | Meas Result (dBμV /m) | Limit (dBμV/m) | Mgn (dB) | Result |
|-------------|------------------|-------------|------------|------------|--------------|---------|----------|-----------------------|-----------------|----------|------------|
| | | | Height (m) | Pol. (H/V) | Fctr. (dB/m) | | | | | | |
| 902 | 31.93 | 160 | 1.5 | V | 23.81 | 4.17 | -38.31 | 25.30 | 46 | 20.70 | Compliance |
| 902 | 30.74 | 170 | 1.6 | H | 23.81 | 4.17 | -38.31 | 24.11 | 46 | 21.89 | Compliance |
| 928 | 32.83 | 170 | 1.5 | V | 23.97 | 4.25 | -38.33 | 26.50 | 46 | 19.50 | Compliance |
| 928 | 32.13 | 170 | 1.6 | H | 23.97 | 4.25 | -38.33 | 25.80 | 46 | 20.20 | Compliance |

Note: Peak detector was used as an alternative to CISPR quasi-peak measurements for the band edge.
The peak value below quasi-peak limit, the quasi-peak test didn't perform.

Harmonic

Below 1 GHz

| Freq. (MHz) | Reading (dBμV/m) | Table (Deg) | Antenna | | | CL (dB) | AMP (dB) | Meas Result (dBμV /m) | Limit (dBμV/m) | Mgn (dB) | Result |
|-------------|------------------|-------------|------------|------------|--------------|---------|----------|-----------------------|-----------------|----------|------------|
| | | | Height (m) | Pol. (H/V) | Fctr. (dB/m) | | | | | | |
| - | - | - | - | - | - | - | - | - | - | - | Compliance |
| - | - | - | - | - | - | - | - | - | - | - | Compliance |

Note: quasi-peak was used.
There is no spurious emission.

Above 1 GHz

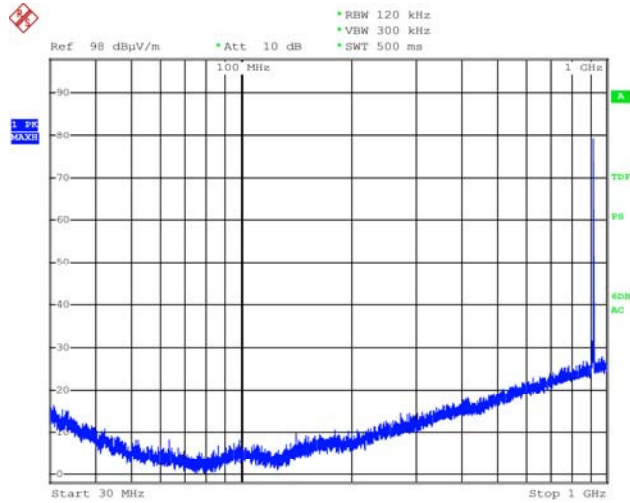
| Freq. (GHz) | Reading (dBμV/m) | | Table (Deg) | Antenna | | | CL (dB) | AMP (dB) | Meas Result (dBμV/m) | | Limit (dBμV/m) | | Mgn. (dB) | | Result |
|-------------|------------------|-------|-------------|------------|------------|--------------|---------|----------|----------------------|-------|-----------------|----|-----------|-------|------------|
| | PK | AV | | Height (m) | Pol. (H/V) | Fctr. (dB/m) | | | PK | AV | PK | AV | PK | AV | |
| 1.828 | 55.18 | 50.37 | 160 | 1.5 | V | 27.27 | 5.91 | -40.51 | 47.84 | 43.03 | 74 | 54 | 26.16 | 10.97 | Compliance |
| 1.828 | 53.59 | 48.45 | 160 | 1.5 | H | 27.27 | 5.91 | -40.51 | 46.25 | 41.11 | 74 | 54 | 27.75 | 12.89 | Compliance |
| 2.743 | 57.26 | 49.50 | 180 | 1.5 | V | 29.09 | 7.57 | -42.82 | 51.10 | 43.34 | 74 | 54 | 22.90 | 10.66 | Compliance |
| 2.743 | 56.02 | 47.31 | 180 | 1.6 | H | 29.09 | 7.57 | -42.82 | 49.86 | 41.15 | 74 | 54 | 24.14 | 12.85 | Compliance |
| 3.656 | 57.99 | 52.95 | 170 | 1.5 | V | 31.53 | 8.31 | -42.40 | 55.43 | 50.39 | 74 | 54 | 18.57 | 3.61 | Compliance |
| 3.656 | 55.94 | 50.99 | 170 | 1.6 | H | 31.53 | 8.31 | -42.40 | 53.38 | 48.43 | 74 | 54 | 20.62 | 5.57 | Compliance |
| 4.583 | 51.13 | 44.27 | 160 | 1.5 | V | 32.40 | 10.19 | -38.93 | 54.80 | 47.94 | 74 | 54 | 19.20 | 6.06 | Compliance |
| 4.583 | 49.00 | 42.19 | 160 | 1.5 | H | 32.40 | 10.19 | -38.93 | 52.67 | 45.86 | 74 | 54 | 21.33 | 8.14 | Compliance |

※Note

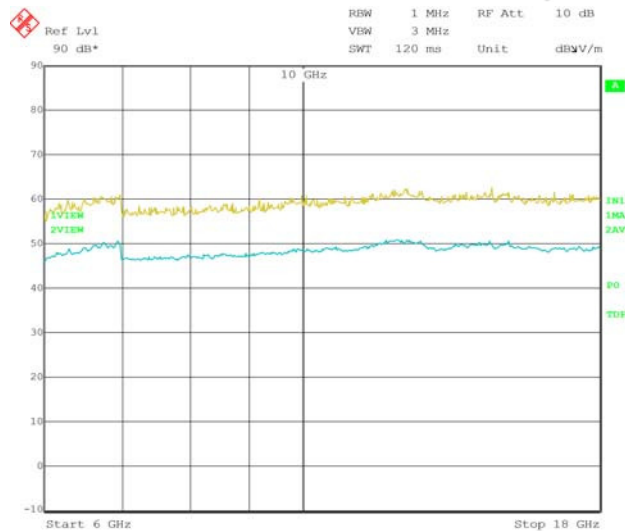
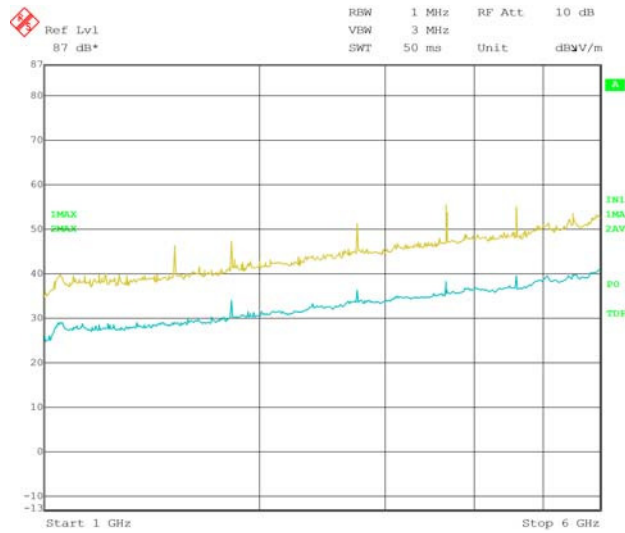
- It is not recorded on the report that the reading of emissions are attenuated more than 20 dB below the permissible limits or the field strength is too small to measured.
- For the below 30 MHz and above 4.583 GHz, measured any other signal is not detected on test receiver
- The Reading values are already added value of the duty cycle factor and correction Factor was applied for Average Field Strength.
- The transmitter radiated spectrum was investigated from 9 kHz to 10 GHz.

5.2.7 Plots

- Below 1 GHz



- Above 1 GHz



* The worst case only.

5.3 Antenna requirement

5.3.1 Standard applicable [FCC §15.203]

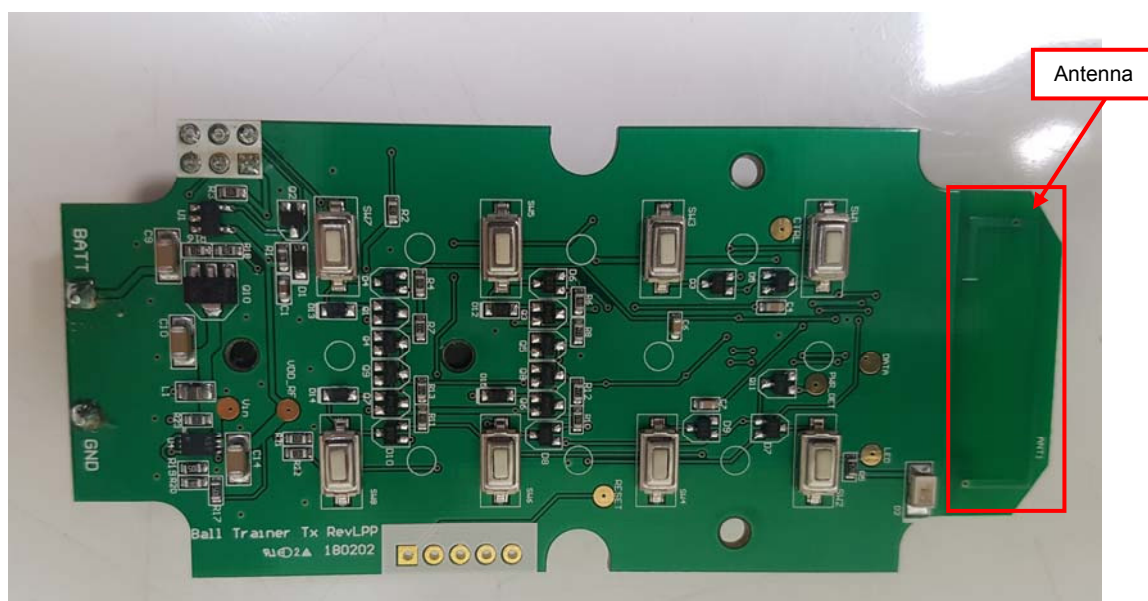
For intentional device, according to §15.203, an intentional radiator shall be designed to ensure that no antenna other than furnished by responsible party shall be used with the device.

The use of a permanently attached antenna or of an antenna that user a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

The manufacturer may design the unit so that broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

5.3.2 Antenna details

| Frequency Band | Antenna Type | Gain [dBi] | Results |
|----------------|----------------------|------------|------------|
| 915 | Internal PCB antenna | -4.016 | Compliance |



5.4 AC Power Conducted emissions

5.4.1 Standard Applicable [FCC §15.207(a)]

For 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 frequencies hopping mode within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 μ H/50 ohms line Impedance stabilization network(LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

§15.207 limits for AC line conducted emissions;

| Frequency of Emission(MHz) | Conducted Limit (dB μ V) | |
|----------------------------|------------------------------|------------|
| | Quasi-peak | Average |
| 0.15 ~ 0.5 | 66 to 56 * | 56 to 46 * |
| 0.5 ~ 5 | 56 | 46 |
| 5 ~ 30 | 60 | 50 |

* Decreases with the logarithm of the frequency

5.4.2 Test Environment conditions

• Ambient temperature : - • Relative Humidity : -

5.4.3 Measurement Procedure

EUT was placed on a non- metallic table height of 0.8 m above the reference ground plane. Cables connected to EUT were fixed to cause maximum emission. Test was made with the antenna positioned in both the horizontal and vertical planes of polarization. The measurement antenna was varied in height above the conducting ground plane to obtain the Maximum signal strength.

5.4.4 Used equipment

| Equipment | Model No. | Serial No. | Manufacturer | Next cal date | Cal interval | Used |
|---------------|-----------|------------|-----------------|---------------|--------------|--------------------------|
| Test receiver | ESCS30 | 100111 | Rohde & Schwarz | 2019. 01. 29 | 1 year | <input type="checkbox"/> |
| LISN | ESH2-Z5 | 100044 | R&S | 2019. 01. 29 | 1 year | <input type="checkbox"/> |
| | ESH3-Z5 | 100147 | R&S | 2019. 01. 29 | 1 year | <input type="checkbox"/> |

*Test Program: " ESXS-K1 V2.2"

Measurement uncertainty

Conducted Emission measurement: 4.48 dB (CL: Approx 95 %, $k=2$)

5.4.5 Measurement Result

- N/A

| Freq. [MHz] | Factor [dB] | | POL | QP | | | CISPR AV | | |
|----------------|----------------|---------------|-----|------------------|--------------------|-------------------|------------------|--------------------|-------------------|
| | | | | Limit [dB/μV] | Reading [dB/μV] | Result [dB/μV] | Limit [dB/μV] | Reading [dB/μV] | Result [dB/μV] |
| | LISN | CABLE +P/L | | | | | | | |
| | | | | | | | | | |
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- * LISN: LISN insertion Loss, Cable: Cable Loss, P/L: pulse limiter factor
- * L: Line. Live, N: Line. Neutral
- * Reading: test receiver reading value (with cable loss & pulse limiter factor)
- * Result = LISN + Reading