

FCC RF TEST REPORT

No. 180300344SHA-001

| TEST RESULT | : | PASS |
|--------------|---|--|
| Type/Model | : | DW0165S |
| Product Name | : | Laser Distance Measurer |
| Manufacturer | : | Northwest Instrument Inc. 330 Waterloo Valley Road Budd Lake NJ 07828 United States Of America |
| Applicant | : | Stanley Black & Decker, Inc. 400 Executive Blvd S, Southington, CT 06489 USA |

SUMMARY

The equipment complies with the requirements according to the following standard(s) or specification:

47CFR Part 15 (2017): Radio Frequency Devices (Subpart C)

ANSI C63.10 (2013): American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

RSS-247 Issue 2 (February 2017): Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices

RSS-Gen Issue 4 (November 2014): General Requirements for Compliance of Radio Apparatus

Date of issue: Mar 7, 2018

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FCC ID: 2ANWF-DW0165 IC: 23237-DW0165



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Content

| SL | SUMMARY1 | | |
|----|------------|------------------------------------|-----|
| DE | SCRIP | PTION OF TEST FACILITY | . 2 |
| 1 | GI | ENERAL INFORMATION | . 5 |
| | 1 1 | DESCRIPTION OF CLIENT | F |
| | 1.1 1.2 | DESCRIPTION OF CLIENT | |
| | 1.2 | TECHNICAL SPECIFICATION | |
| | | | - |
| 2 | TE | ST SPECIFICATIONS | . 7 |
| | 2.1 | STANDARDS OR SPECIFICATION | 7 |
| | 2.2 | MODE OF OPERATION DURING THE TEST | 7 |
| | 2.3 | TEST SOFTWARE LIST | 7 |
| | 2.4 | TEST PERIPHERALS LIST | 7 |
| | 2.5 | INSTRUMENT LIST | 8 |
| | 2.6 | TEST SUMMARY | 9 |
| | 2.7 | MEASUREMENT UNCERTAINTY | 10 |
| 3 | М | INIMUM 6DB BANDWIDTH | 11 |
| | 3.1 | LIMIT | 11 |
| | 3.2 | Test Configuration | |
| | 3.3 | Test Procedure and test setup | |
| | 3.4 | TEST PROTOCOL | |
| 4 | м | AXIMUM CONDUCTED OUTPUT POWER | |
| • | | | |
| | 4.1 | | - |
| | 4.2 | | |
| | 4.3 | TEST PROCEDURE AND TEST SETUP | |
| | 4.4 | TEST PROTOCOL | |
| 5 | PC | OWER SPECTRUM DENSITY | |
| | 5.1 | TEST LIMIT | 16 |
| | 5.2 | TEST CONFIGURATION | |
| | 5.3 | TEST PROCEDURE AND TEST SETUP | |
| | 5.4 | TEST PROTOCOL | 18 |
| 6 | EN | MISSION OUTSIDE THE FREQUENCY BAND | 19 |
| | 6.1 | TEST LIMIT | 19 |
| | 6.2 | TEST CONFIGURATION | 19 |
| | 6.3 | Test procedure and test setup | 20 |
| | 6.4 | Теят Protocol | 21 |
| 7 | R/ | ADIATED EMISSIONS | 22 |
| | 7.1 | | 22 |
| | 7.2 | TEST CONFIGURATION | |
| | 7.3 | TEST PROCEDURE AND TEST SETUP | |
| | 7.4 | TEST PROTOCOL | |
| 8 | | OWER LINE CONDUCTED EMISSION | |
| 5 | 8.1 | | |
| | 8.1 8.2 | LIMIT | |
| | 8.2 8.3 | TEST PROCEDURE AND TEST SET UP | |
| | 8.4 | TEST PROCEDURE AND TEST SET OP | - |
| 9 | A | NTENNA REQUIREMENT | 33 |



Test report no. 180300344SHA-001 Page 4 of 41

| APPENDIX A: TEST RESULTS | 34 |
|--------------------------|----|
|--------------------------|----|



1 GENERAL INFORMATION

1.1 Description of Client

| Applicant | : | Stanley Black & Decker, Inc. | |
|-----------------|---|--|--|
| | | 400 Executive Blvd S, Southington, CT 06489 USA | |
| Name of contact | : | Adam Rolfe | |
| Tel | : | 860-406-9227 | |
| Fax | : | | |
| Manufacturer | : | Northwest Instrument Inc. 330 Waterloo Valley Road Budd Lake NJ 07828 United States Of America | |

1.2 Identification of the EUT

| Product Name | : | Laser Distance Measurer |
|--------------|---|-------------------------|
| Type/model | : | DW0165S |
| FCC ID | : | 2ANWF-DW0165 |
| IC ID | : | 23237-DW0165 |
| | | |



1.3 Technical Specification

| Operation Frequency Band | : | 2402~2480MHz |
|-----------------------------|---|--|
| Type of Modulation | : | GFSK |
| EUT Modes of Modulation | : | Bluetooth BLE |
| Channel Number | : | 40 Channels |
| Description of EUT | : | The EUT is a wireless device with Bluetooth BLE mode. We tested the 2402CH , 2440CH and 2480CH and listed the worst data in this report. |
| Antenna | : | PCB antenna, 3.3dBi gain |
| Rating | : | DC 1.5X3V |
| Category of EUT | : | Class B |
| EUT type | : | ☐ Table top ☐ Floor standing |
| Sample received date | : | Jan 16, 2018 |
| Date of test | : | Jan 16~Mar 2, 2018 |



2 TEST SPECIFICATIONS

2.1 Standards or specification

47CFR Part 15 (2017) ANSI C63.10 (2013) KDB 558074 (v04) RSS-247 Issue 2 (February 2017) RSS-Gen Issue 4 (November 2014)

2.2 Mode of operation during the test

While testing transmitting mode of EUT, the internal modulation and continuously transmission was applied.

The EUT is a small unlicensed wireless device, so three axes (X, Y, Z) were observed while the test receiver worked as "max hold" continuously and the highest reading (X axis) among the whole test procedure was recorded.

2.3 Test software list

| Test Items | Software | Manufacturer | Version |
|-----------------------|----------|--------------|---------|
| Conducted emission | ESxS-K1 | R&S | V2.1.0 |
| Radiated emission | ES-K1 | R&S | V1.71 |

2.4 Test peripherals list

| Item No. | Name | Band and Model | Description | |
|----------|-----------------|------------------|----------------------|--|
| 1 | Laptop computer | HP ProBook 6470b | 100-240V AC, 50/60Hz | |



2.5 Instrument list

| Radiat | Radiated Emission | | | | | | |
|-----------------------|-----------------------------|----------------------|---------------|--------------|------------|--|--|
| Used | Equipment | Manufacturer | Туре | Internal no. | Due date | | |
| | Test Receiver | R&S | ESIB 26 | EC 3045 | 2018-09-12 | | |
| | Bilog Antenna | TESEQ | CBL 6112D | EC 4206 | 2018-05-30 | | |
| 2 | Horn antenna | R&S | HF 906 | EC 3049 | 2018-09-23 | | |
| 2 | Horn antenna | TOYO | HAP18-26W | EC 4792-3 | 2018-07-09 | | |
| < | Pre-amplifier | R&S | Pre-amp 18 | EC5881 | 2018-06-19 | | |
| N | Semi-anechoic chamber | Albatross project | - | EC 3048 | 2018-09-15 | | |
| RF tes | t | | | | | | |
| Used | Equipment | Manufacturer | Туре | Internal no. | Due date | | |
| 2 | PXA Signal Analyzer | Keysight | N9030A | EC 5338 | 2018-09-10 | | |
| | Power sensor | Agilent | U2021XA | EC 5338-1 | 2018-03-06 | | |
| | Vector Signal Generator | Agilent | N5182B | EC 5175 | 2018-03-06 | | |
| | MXG Analog Signal Generator | Agilent | N5181A | EC 5338-2 | 2018-03-03 | | |
| | Mobile Test System | Litepoint | lqxel | EC 5176 | 2019-01-11 | | |
| | Power meter | Agilent | N1911A/N1921A | EC4318 | 2018-05-12 | | |
| Additional instrument | | | | | | | |
| Used | Equipment | Manufacturer | Туре | Internal no. | Due date | | |
| 2 | Therom-Hygrograph | ZJ1-2A | S.M.I.F. | EC 2323 | 2018-06-14 | | |
| | Therom-Hygrograph | ZJ1-2A | S.M.I.F. | EC 3325 | 2018-03-23 | | |

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2.6 Test Summary

This report applies to tested sample only. The test results have been compared directly with the limits, and the measurement uncertainty is recorded. This report shall not be reproduced in part without written approval of Intertek Testing Service Shanghai Limited.

| TEST ITEM | FCC REFERANCE | IC Reference | RESULT |
|--|-----------------|-------------------------------|--------|
| Minimum 6dB Bandwidth& Occupied bandwidth | 15.247(a)(2) | RSS-247 Issue 2 Clause 5 | Pass |
| Maximum peak output power | 15.247(b) | RSS-247 Issue 2 Clause 5 | Pass |
| Power spectrum density | 15.247(e) | RSS-247 Issue 2 Clause 5 | Pass |
| Radiated emission | 15.205 & 15.209 | RSS-247 Issue 2 Clause 5 | Pass |
| Emission outside the frequency band | 15.247(d) | RSS-247 Issue 2 Clause 5 | Pass |
| Power line conducted emission | 15.207 | RSS-Gen Issue 4 Clause 8.8 | NA |

Notes: 1: NA =Not Applicable

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2.7 Measurement uncertainty

The measurement uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

| Test item | Measurement uncertainty |
|---|-------------------------|
| Maximum peak output power | ± 0.74 dB |
| Radiated Emissions in restricted frequency bands below 1GHz | \pm 4.90dB |
| Radiated Emissions in restricted frequency bands above 1GHz | \pm 5.02dB |
| Emission outside the frequency band | ± 2.89dB |
| Power line conducted emission | ± 3.19dB |



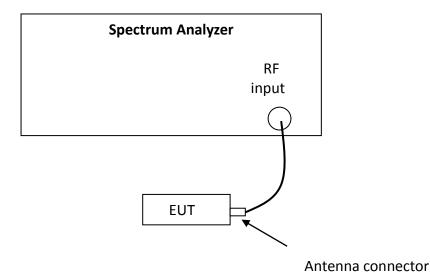
3 Minimum 6dB Bandwidth& Occupied bandwidth

Test result: Pass

3.1 Limit

For systems using digital modulation techniques that may operate in the 902 - 928 MHz, 2400 - 2483.5 MHz and 5725 - 5850 MHz bands, the minimum 6 dB bandwidth shall be at least 500 kHz.

3.2 Test Configuration



3.3 Test Procedure and test setup

The minimum 6dB bandwidth per FCC §15.247(a)(2) is measured using the Spectrum Analyzer according to DTS test procedure of "KDB558074 D01 DTS Meas Guidance" for compliance to FCC 47CFR 15.247 requirements(clause 8.2).

a) Set RBW = 100 kHz.

- b) Set the video bandwidth (VBW) \geq 3 × RBW.
- c) Detector = Peak.
- d) Trace mode = max hold.
- e) Sweep = auto couple.
- f) Allow the trace to stabilize.

g) 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.



3.4 Test Protocol

Temperature:25 °CRelative Humidity:55 %Test Results of Minimum 6dB bandwidth& Occupied bandwidthPlease refer to Appendix A



4 Maximum Conducted Output power

Test result: Pass

4.1 Test limit

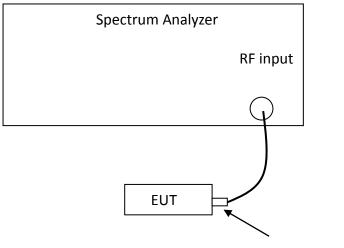
For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt

For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts

For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt and the e.i.r.p. shall not exceed 4 W.

If the transmitting antenna of directional gain greater than 6dBi is used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi. If there have a beam forming type, the limit should be the minimum of 30dBm and 30+ (6 –antenna gain-beam forming gain).

4.2 Test Configuration



Antenna connector



4.3 Test procedure and test setup

The EUT was tested according to DTS test procedure of "KDB558074 D01 DTS Meas Guidance" for compliance to FCC 47CFR 15.247 requirements (clause 9.1.1).

- a) Set the RBW \geq DTS bandwidth.
- b) Set VBW \geqslant 3 imes RBW.
- c) Set span \geq 3 x RBW
- d) Sweep time = auto couple.
- e) Detector = peak.
- f) Trace mode = max hold.
- g) Allow trace to fully stabilize.
- h) Use peak marker function to determine the peak amplitude level.



4.4 Test protocol

Temperature:25 °CRelative Humidity:55 %Test Results of Maximum conducted output powerPlease refer to Appendix AConclusion: The maximum EIRP = -2.61 dBm+3.3dBi = 0.69dBm = 0.0012W which is lowerthan the limit of 4W listed in RSS-247.



5 Power spectrum density

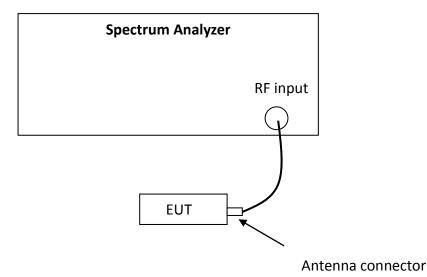
Test result:Pass

5.1 Test limit

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8dBm in any 3kHz band during any time interval of continuous transmission.

If the transmitting antenna of directional gain greater than 6dBi is used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi. If there have a beam forming type, the limit should be the minimum of 8dBm/3kHz and 8+ (6 –antenna gain-beam forming gain).

5.2 Test Configuration



FCC ID: 2ANWF-DW0165 IC: 23237-DW0165



5.3 Test procedure and test setup

The power output per FCC §15.247(e) was tested according to DTS test procedure of "KDB558074 D01 DTS Meas Guidance" (clause 10.2) for compliance to FCC 47CFR 15.247 requirements.

- a) Set analyzer center frequency to DTS channel center frequency.
- b) Set the span to 1.5 times the DTS bandwidth.
- c) Set the RBW to: 3 kHz \leq RBW \leq 100 kHz.
- d) Set the VBW \geq 3 × RBW.
- e) Detector = peak.
- f) Sweep time = auto couple.
- g) Trace mode = max hold.
- h) Allow trace to fully stabilize.
- i) Use the peak marker function to determine the maximum amplitude level within the RBW.
- j) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.



5.4 Test Protocol

Temperature:25 °CRelative Humidity:55 %Test Results of Power spectrum densityPlease refer to Appendix A



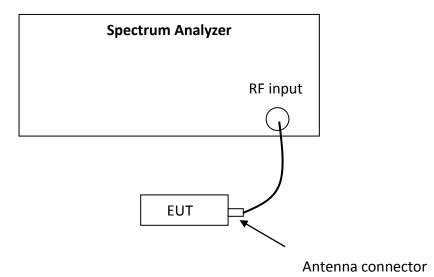
6 Emission outside the frequency band

Test result: Pass

6.1 Test limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 30 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power.

6.2 Test Configuration





6.3 Test procedure and test setup

The EUT was tested according to DTS test procedure of "KDB558074 D01 DTS Meas Guidance" (clause 11.0) for compliance to FCC 47CFR 15.247 requirements.

Reference level measurement

Establish a reference level by using the following procedure:

- a) Set instrument center frequency to DTS channel center frequency.
- b) Set the span to \geq 1.5 times the *DTS bandwidth*.
- c) Set the RBW = 100 kHz.
- d) Set the VBW \geq 3 x RBW.
- e) Detector = peak.
- f) Sweep time = auto couple.
- g) Trace mode = max hold.
- h) Allow trace to fully stabilize.

i) Use the peak marker function to determine the maximum PSD level.

Note that the channel found to contain the maximum PSD level can be used to establish the reference level.

Emission level measurement

- a) Set the center frequency and span to encompass frequency range to be measured.
- b) Set the RBW = 100 kHz.
- c) Set the VBW \geq 3 x RBW.
- d) Detector = peak.
- e) Sweep time = auto couple.
- f) Trace mode = max hold.
- g) Allow trace to fully stabilize.
- h) Use the peak marker function to determine the maximum amplitude level.

Ensure that the amplitude of all unwanted emissions outside of the authorized frequency band (excluding restricted frequency bands) are attenuated by at least the minimum requirements specified in 11.1 a) or 11.1 b). Report the three highest emissions relative to the limit.



6.4 Test Protocol

Temperature:25 °CRelative Humidity:55 %The results of Emission outside the frequency bandPlease refer to Appendix A



7 Radiated Emissions

Test result: Pass

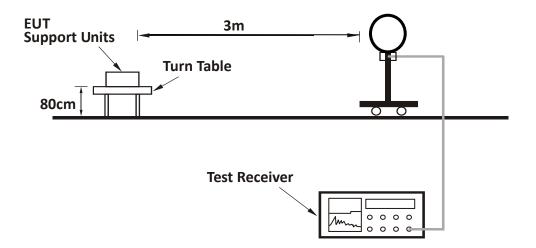
7.1 Test limit

The radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) showed as below:

| Frequencies (MHz) | Field Strength (microvolts/meter) | Measurement Distance (meters) |
|----------------------|--------------------------------------|----------------------------------|
| 0.009 ~ 0.490 | 2400/F(kHz) | 300 |
| 0.490 ~ 1.705 | 24000/F(kHz) | 30 |
| 1.705 ~ 30.0 | 30 | 30 |
| 30 ~ 88 | 100 | 3 |
| 88 ~ 216 | 150 | 3 |
| 216 ~ 960 | 200 | 3 |
| Above 960 | 500 | 3 |

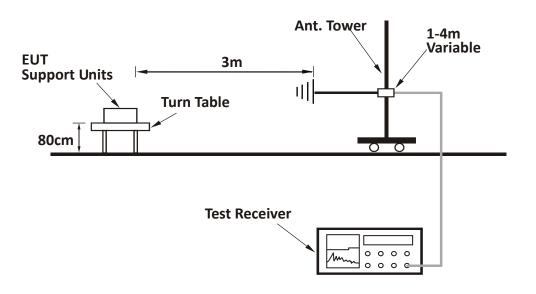
7.2 Test Configuration

For Radiated emission below 30MHz:

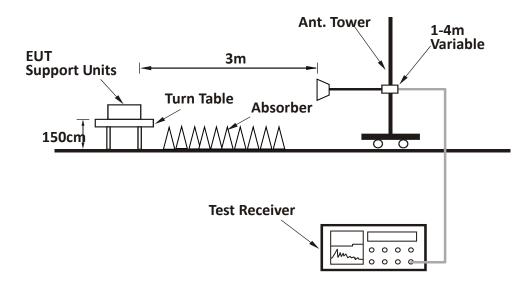




For Radiated emission 30MHz to 1GHz:



For Radiated emission above 1GHz:





7.3 Test procedure and test setup

For Radiated emission below 30MHz:

a) The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter chamber room. The table was rotated 360 degrees to determine the position of the highest radiation.

b) The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

c) Both X and Y axes of the antenna are set to make the measurement.

d) For each suspected emission, the EUT was arranged to its worst case and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.

e) The test-receiver system was set to Quasi-Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.

NOTE:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 9kHz at frequency below 30MHz.

For Radiated emission above 30MHz:

a) The EUT was placed on the top of a rotating table 0.8 meters (for 30MHz ~ 1GHz) / 1.5 meters (for above 1GHz) above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.

b) The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

c) The height of antenna 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.

d) 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 rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.

e) The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.

f) The test-receiver system was set to peak and average detect function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

Note:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.

2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.



3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is \geq 1/T (Duty cycle < 98%) or 3 x RBW (Duty cycle \geq 98%) for Average detection (AV) at frequency above 1GHz.

4. All modes of operation were investigated and the worst-case emissions are reported

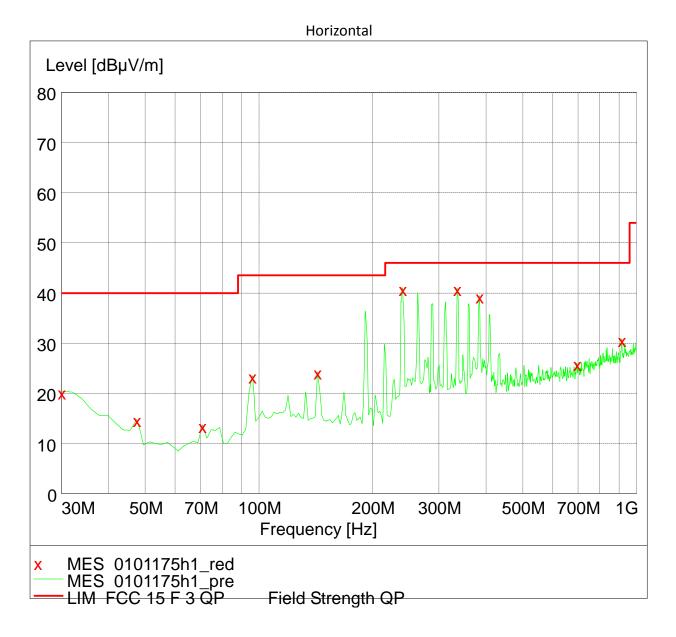


7.4 Test Protocol

| Temperature: | 25 °C |
|--------------------|-------|
| Relative Humidity: | 55 % |

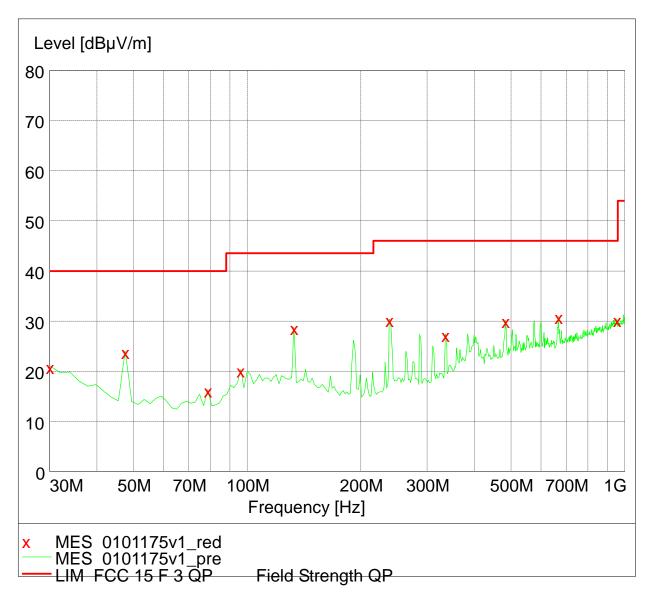
The low frequency, which started from 9 kHz to 30MHz, was pre-scanned and the result which was 20dB lower than the limit line per 15.31(o) was not reported.

The worst waveform from 30MHz to 1000MHz is listed as below:











Test data 30MHz~1GHz:

| Polarization | Frequency (MHz) | Measured level (dBµV/m) | Limits (dBµV/m) | Margin (dB) | Detector |
|--------------|--------------------|----------------------------|--------------------|----------------|----------|
| | 30.00 | 20.3 | 40.0 | 19.7 | РК |
| | 70.82 | 13.7 | 40.0 | 26.3 | РК |
| | 96.09 | 23.5 | 43.5 | 20.0 | PK |
| Н | 142.74 | 24.3 | 43.5 | 19.2 | РК |
| | 239.93 | 41.0 | 46.0 | 5.0 | РК |
| | 335.19 | 40.9 | 46.0 | 5.1 | РК |
| | 383.78 | 39.4 | 46.0 | 6.6 | РК |
| | 30.00 | 21.0 | 40.0 | 19.0 | PK |
| | 78.59 | 16.3 | 40.0 | 23.7 | РК |
| | 96.09 | 20.3 | 43.5 | 23.2 | РК |
| V | 133.02 | 28.8 | 43.5 | 14.7 | РК |
| | 237.99 | 30.4 | 46.0 | 15.6 | РК |
| | 335.19 | 27.4 | 46.0 | 18.6 | РК |
| | 482.92 | 30.2 | 46.0 | 15.8 | РК |

Note: The worst test result (30MHz to 1GHz) of channel L (2402MHz) was chosen to list in the report as representative.



Test result above 1GHz:

The emission was conducted from 1GHz to 25GHz.

| СН | Antenna | Frequency (MHz) | Measure Level (dBuV/m) | Reading Level (dBuV) | Over Limit (dB) | Limit (dBuV/m) | Factor (dB) | Туре |
|-----|---------|--------------------|------------------------------|----------------------------|--------------------|-------------------|----------------|------|
| | Н | 2390.00 | 46.36 | 15.16 | -27.64 | 74.00 | 31.20 | РК |
| | Н | 2390.00 | 37.57 | 6.37 | -16.43 | 54.00 | 31.20 | AV |
| | V | 4804.00 | 50.43 | 51.93 | -23.57 | 74.00 | -1.50 | РК |
| L | V | 4804.00 | 33.25 | 34.75 | -20.75 | 54.00 | -1.50 | AV |
| | V | 7206.00 | 61.80 | 58.30 | -12.20 | 74.00 | 3.50 | РК |
| | V | 7206.00 | 46.57 | 43.07 | -7.43 | 54.00 | 3.50 | AV |
| | V | 4880.00 | 49.35 | 50.45 | -24.65 | 74.00 | -1.10 | РК |
| N 4 | V | 4880.00 | 32.24 | 33.34 | -21.76 | 54.00 | -1.10 | AV |
| M | V | 7320.00 | 59.73 | 56.13 | -14.27 | 74.00 | 3.60 | РК |
| | V | 7320.00 | 44.36 | 40.76 | -9.64 | 54.00 | 3.60 | AV |
| | V | 2483.50 | 45.41 | 14.22 | -28.59 | 74.00 | 31.19 | РК |
| | V | 2483.50 | 36.38 | 5.19 | -17.62 | 54.00 | 31.19 | AV |
| | V | 4960.00 | 47.39 | 44.62 | -26.61 | 74.00 | 2.77 | РК |
| н | V | 4960.00 | 31.88 | 29.11 | -22.12 | 54.00 | 2.77 | AV |
| | V | 7440.00 | 58.73 | 54.93 | -15.27 | 74.00 | 3.80 | РК |
| | V | 7440.00 | 43.26 | 39.46 | -10.74 | 54.00 | 3.80 | AV |

Remark: 1. Correct Factor = Antenna Factor + Cable Loss (+ Amplifier, for higher than 1GHz), the value was added to Original Receiver Reading by the software automatically.

- 2. Corrected Reading = Original Receiver Reading + Correct Factor
- 3. Margin = Limit Corrected Reading

4. If the PK Corrected Reading is lower than AV limit, the AV test can be elided.

Example: Assuming Antenna Factor = 30.20dB/m, Cable Loss = 2.00dB,

Gain of Preamplifier = 32.00dB, Original Receiver Reading = 10.00dBuV, Limit = 40.00dBuV/m. Then Correct Factor = 30.20 + 2.00 – 32.00 = 0.20dB/m;

Corrected Reading = 10dBuV + 0.20dB/m = 10.20dBu



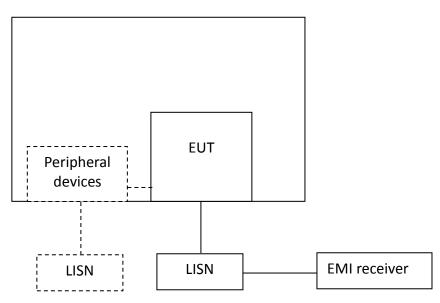
8 Power line conducted emission

Test result: NA

8.1 Limit

| Frequency of Emission (MHz) | Conducted Limit (dBuV) | | | |
|--|------------------------|------------|--|--|
| | QP | AV | | |
| 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. | | | | |

8.2 Test configuration



For table top equipment, wooden support is 0.8m height table

For floor standing equipment, wooden support is 0.1m height rack.



8.3 Test procedure and test set up

Measured levels of ac power-line conducted emission shall be the emission voltages from the voltage probe, where permitted, or across the 50 Ω LISN port (to which the EUT is connected), where permitted, terminated into a 50 Ω measuring instrument. All emission voltage and current measurements shall be made on each current-carrying conductor at the plug end of the EUT power cord by the use of mating plugs and receptacles on the LISN, if used. Equipment shall be tested with power cords that are normally supplied or recommended by the manufacturer and that have electrical and shielding characteristics that are the same as those cords normally supplied or recommended by the manufacturer. For those measurements using a LISN, the 50 Ω measuring port is terminated by a measuring instrument having 50 Ω input impedance. All other ports are terminated in 50 Ω loads.

Tabletop devices shall be placed on a platform of nominal size 1 m by 1.5 m, raised 80 cm above the reference ground plane. The vertical conducting plane or wall of an RF-shielded (screened) room shall be located 40 cm to the rear of the EUT. Floor-standing devices shall be placed either directly on the reference ground-plane or on insulating material as described in ANSI C63.4. All other surfaces of tabletop or floor-standing EUTs shall be at least 80 cm from any other grounded conducting surface, including the case or cases of one or more LISNs.

The bandwidth of the test receiver is set at 9 kHz.



8.4 Test protocol

| Temperature: | °C |
|--------------------|----|
| Relative Humidity: | % |

L Line

Test Data:

| Frequency | Quasi-peak | | | Quasi-peak | | | Average | |
|-----------|-----------------|-----------------|----------------|-----------------|-----------------|----------------|---------|--|
| (MHz) | level dB(μV) | Limit dB(µV) | Margin (dB) | level dB(μV) | limit dB(μV) | Margin (dB) | | |
| 0.16 | NA | 65.3 | NA | NA | 55.3 | NA | | |
| 0.25 | NA | 61.9 | NA | NA | 51.9 | NA | | |
| 0.60 | NA | 56.0 | NA | NA | 46.0 | NA | | |
| 4.29 | NA | 56.0 | NA | NA | 46.0 | NA | | |
| 10.45 | NA | 60.0 | NA | NA | 50.0 | NA | | |
| 19.40 | NA | 60.0 | NA | NA | 50.0 | NA | | |

Note: *means margin is more than 10dB.

N Line

Test Data:

| Frequency | Quasi-peak | | | | Average | |
|-----------|-----------------|-----------------|----------------|-----------------|-----------------|----------------|
| (MHz) | level dB(μV) | Limit dB(µV) | Margin (dB) | level dB(μV) | limit dB(μV) | Margin (dB) |
| 0.16 | NA | 65.2 | NA | NA | 55.2 | NA |
| 0.25 | NA | 61.8 | NA | NA | 51.8 | NA |
| 0.95 | NA | 56.0 | NA | NA | 46.0 | NA |
| 4.14 | NA | 56.0 | NA | NA | 46.0 | NA |
| 10.32 | NA | 60.0 | NA | NA | 50.0 | NA |
| 19.24 | NA | 60.0 | NA | NA | 50.0 | NA |

Note: *means margin is more than 10dB.

Remark: 1. Correct Factor = LISN Factor + Cable Loss, the value was added to Original Receiver Reading by the software automatically.

2. Corrected Reading = Original Receiver Reading + Correct Factor

3. Margin = Limit - Corrected Reading

4. If the PK Corrected Reading is lower than AV limit, the AV test can be elided.

Example: Assuming LISN Factor = 10.00dB, Cable Loss = 2.00dB,

Original Receiver Reading = 10.00dBuV, Limit = 66.00dBuV.

Then Correct Factor = 10.00 + 2.00 = 12.00dB;

Corrected Reading = 10dBuV + 12.00dB = 22.00dBuV;

Margin = 66.00dBuV – 22.00dBuV = 44.00dB.



9 Antenna Requirement

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

Result:

EUT uses PCB antenna to the intentional radiator, so it can comply with the provisions of this section.



Appendix A: Test results

1. RF Output Power

1.1 Test Result and Data

| BLE Maximum Output Power | | | | |
|--------------------------|-------------|--------|--|--|
| Test Frequency (MHz) | Power (dBm) | Result | | |
| 2402 | -2.61 | Pass | | |
| 2440 | -2.78 | Pass | | |
| 2480 | -3.07 | Pass | | |

| 2402N | 1Hz | 2440N | ИНz |
|--|---|--|--|
| ■ Replant Spectrum Analyzer - Swept 5A 0 RL BF 90 00 Contor Freq 2.402000000 GHz NFE PN0: Fsat Trig: Free Run FGainLow FAtten: 30 dB | Id41841 AH MarQ1, 2018 Avg Type: Log-Pwr Two: Doctor or Doctor Def Doctor | Center Revised Section Advice - Seqt 5A SENSE INT Center Freq 2.440000000 GHz SENSE INT NFE PN0: Fast Trig: Free Run #Atten: 30 dB | Avg Type: Log-Pwr TACC D 2 45 T D 2 45 |
| Ref Offset 0.8 dB 10 dB/div Ref 20.00 dBm | Mkr1 2.401 96 GHz -2.61 dBm | Ref Offset 0.8 dB 10 dB/div Ref 20.00 dBm | Mkr1 2.440 45 GHz -2.78 dBm |
| 100 | Center Fr 2:40200000 G | | Center Fri 2.44000000 Gi |
| -100 | Start Fr 2.39700000 G | 12 10.0 | Start Fr 2.43500000 G |
| | 2.40700000 G | 22 330 | 2.44500000 G |
| 60.0 | Auto M Freq Offe | 0.03- (0.03- (0.03-) | Auto M Freq Offs 0 |
| -73.0 | Scale Ty | | Scale Ty |
| Center 2.402000 GHz #Res BW 3.0 MHz #VBW 8.0 MHz | Span 10.00 MHz Sweep 1.000 ms (1001 pts) | 2 Center 2.440000 GHz #Res BW 3.0 MHz #VBW 8.0 MHz | Span 10.00 MHz Sweep 1.000 ms (1001 pts) |
| 2480N | - | | |
| Keysight Spectrum Analyzer - Swept SA R L RF [50 Ω DC SENSE:INT Center Freq 2.480000000 GHz | 04-28:08 AM Mar01, 2018 Avg Type: Log-Pwr TRACE 12 34 3 0 Frequency | | |
| Ref Offset 0.00 dBm | Mkr1 2.480 34 GHz -3.06 dBm | e | |
| 100 4 1 | Center Fr 2.48000000 G | | |
| | Start Fr 2.47500000 G | 2 | |
| | ۲۰۰۰۲۲۰۰۲ Stop Fr 2.48500000 G | z | |
| 500 | Auto M FreqOffs | | |
| | 0 Scale Ty | | |
| Center 2.480000 GHz #Res BW 3.0 MHz #VBW 8.0 MHz | Span 10.00 MHz Sweep 1.000 ms (1001 pts) | | |
| ASG | Ko status | | |



2. Minimum 6dB bandwidth

2.1 Test Result and Data

| BLE Occupied 6dB Bandwidth | | | | | |
|----------------------------|-----------------------------|-----------------|--------|--|--|
| Test Frequency (MHz) | Occupied Bandwidth (kHz) | Min Limit (kHz) | Result | | |
| 2402 | 692.1 | 500 | Pass | | |
| 2440 | 709.6 | 500 | Pass | | |
| 2480 | 706.3 | 500 | Pass | | |

| | 2402MHz 2440MHz | | | 2440MHz |
|---|---|---|--|---|
| RL M S00 Counter Freq 2.402000001 No 0.00 No No< | Trig: Free Run Avg Hold: 1000 #FGain:Low #Atten: 30 dB | Radio Device: BTS Ikr1 2.402186 GHz -2.7827 dBm | Center Freq | Inter Spectra Bit Inter Spectra Bit |
| Center 2.402 GHz #Res BW 100 kHz Occupied Bandwidth 1.0 Transmit Freq Error x dB Bandwidth | #VBW 300 kHz Total Power 682 MHz 191.12 kHz % of OBW Power 692.1 kHz x dB | Span 3 MHz Sweep 1.333 ms 3.67 dBm 99.00 % -6.00 dB | CFStep 300.000 kHz 2 Man FreqOffset 0 Hz | Center 2.44 GHz Span 3 MHz Span 3 MHz Center 2.44 GHz #VBW 300 kHz Sweep 1.533 ms Occupied Bandwidth Total Power 3.74 dBm 1.0736 MHz Freq Offs Transmit Freq Error 191.76 kHz % of OBW Power 99.00 % x dB Bandwidth 709.6 kHz x dB -6.00 dB |
| MSG | 2480MHz | STATUS | | nso Contrarte |
| Keysight Spectrum Analyzer - Occupied BW 38 RL R So DOC Center Freq 2.480000000 0 NFE a Ref Onfset 0.8 dB T0 dB/div Ref 20.0 dBm | SHZ Center Freq: 2.48000000 GHz Trig: Free Run Avg Hold: 1000 #RFGein:Low #Atten: 30 dB | 04-27:07 AM Mar01, 2018 Radio Std: None Radio Device: BTS Ikr1 2.480192 GHz -3.2532 dBm | Frequency | |
| 100 | | | Center Freq 48000000 GHz | |
| Center 2.48 GHz #Res BW 100 kHz Occupied Bandwidth | #VBW 300 kHz Total Power | Span 3 MHz Sweep 1.533 ms 3.46 dBm | CF Step 300.000 kH z 2 Man | |
| | 751 MHz 195.29 kHz % of OBW Power 706.3 kHz x dB | 99.00 % -6.00 dB | Freq Offset 0 Hz | |



3. Occupied Bandwidth

3.1 Test Result and Data

| BLE 99% Occupied Bandwidth | | | | |
|----------------------------|------------------------------|--------|--|--|
| Test Frequency (MHz) | 99% Occupied Bandwidth (MHz) | Result | | |
| 2402 | 1.038 | Pass | | |
| 2440 | 1.0467 | Pass | | |
| 2480 | 1.047 | Pass | | |



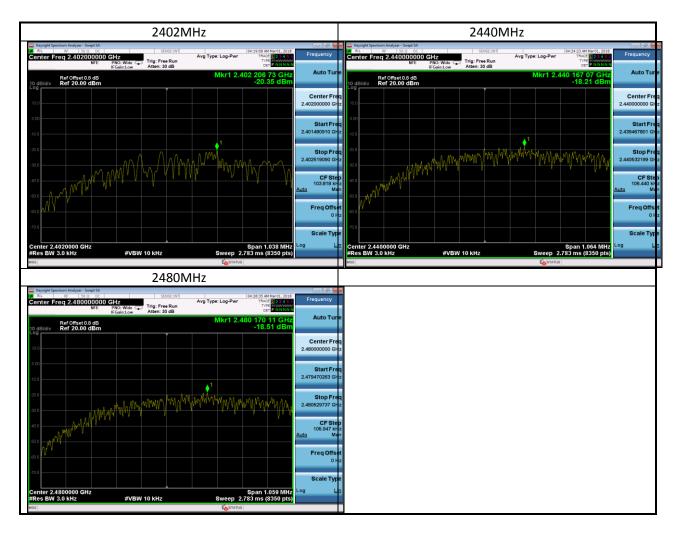


Total Quality. Assured.

4. Power Spectral Density

4.1 Test Result and Data

| | BLE Peak Power Spectral Density | |
|----------------------|---------------------------------|--------|
| Test Frequency (MHz) | PSD (dBm/3kHz) | Result |
| 2402 | -20.35 | Pass |
| 2440 | -18.21 | Pass |
| 2480 | -18.51 | Pass |



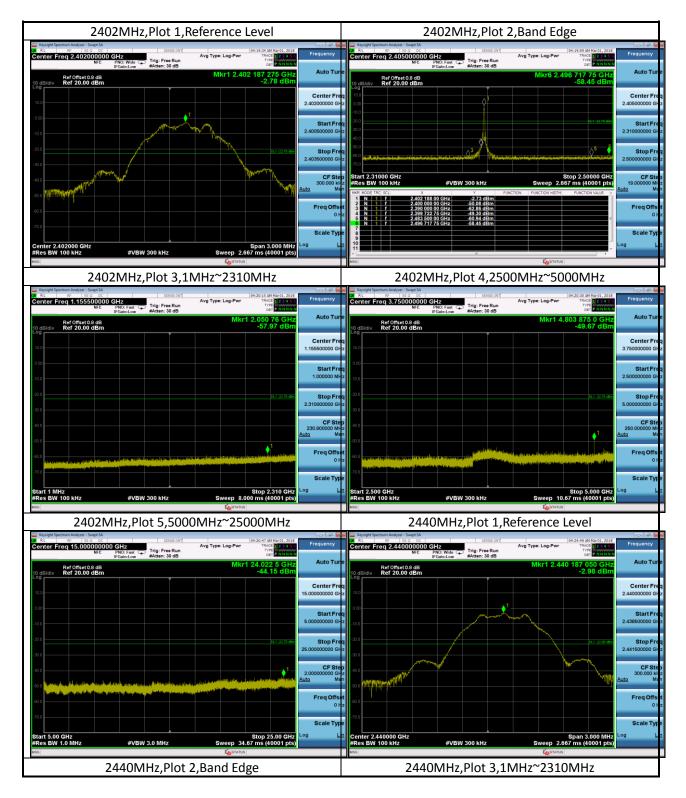


5. Emission outside the frequency band

5.1 Test Result and Data

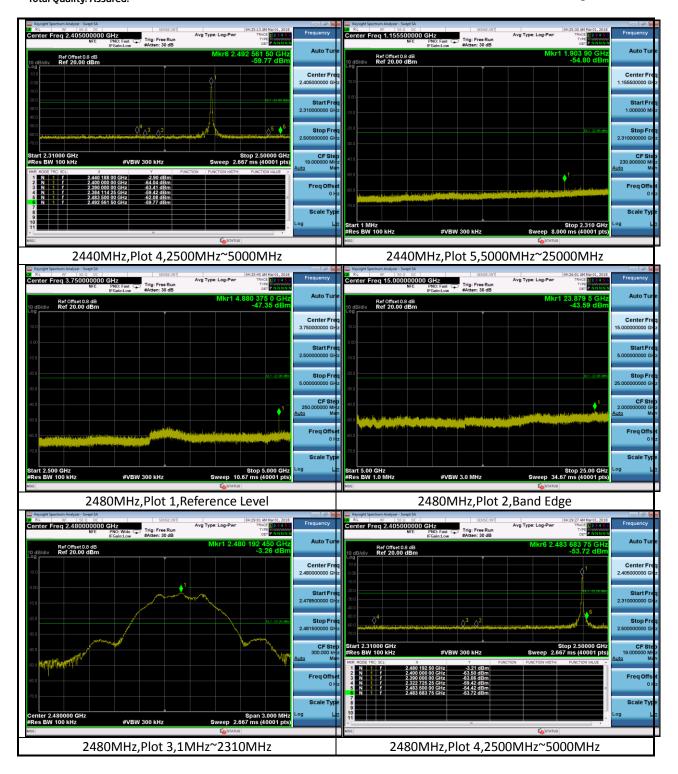
| | BLE Transmitter S | purious Emission | |
|----------------------|-------------------|------------------|--------|
| Test Frequency (MHz) | Test Range | Power (dBm) | Result |
| 2402 | 1MHz~2310MHz | -57.97 | Pass |
| 2402 | 2500MHz~5000MHz | -49.67 | Pass |
| 2402 | 5000MHz~25000MHz | -44.15 | Pass |
| 2402 | Band Edge | -49.30 | Pass |
| 2402 | Reference Level | -2.78 | Pass |
| 2440 | 1MHz~2310MHz | -54.80 | Pass |
| 2440 | 2500MHz~5000MHz | -47.35 | Pass |
| 2440 | 5000MHz~25000MHz | -43.59 | Pass |
| 2440 | Band Edge | -59.42 | Pass |
| 2440 | Reference Level | -2.98 | Pass |
| 2480 | 1MHz~2310MHz | -57.16 | Pass |
| 2480 | 2500MHz~5000MHz | -50.43 | Pass |
| 2480 | 5000MHz~25000MHz | -43.57 | Pass |
| 2480 | Band Edge | -53.72 | Pass |
| 2480 | Reference Level | -3.26 | Pass |

intertek Total Quality. Assured.



Test report no. 180300344SHA-001 Page 40 of 41

intertek Total Quality. Assured.



Test report no. 180300344SHA-001 Page 41 of 41

intertek Total Quality. Assured.

| Keysight Spectrum Analyzer - Swept SA | | | | 00 | Keysight Spect | rum Analyzer - Swept SA | | | _ | _ | | | - |
|--|--|---|--|---|------------------------------|--|------------------------|-------------------------------|-----------------|-----------------------|------------------|---|--------------|
| RL RF 50 Ω DC enter Freq 1.15550000 | SENSE: | Avg Type: Log-Pwr | 04:29:42 AM Mar 01, 2018 TRACE 2 3 4 5 6 | Frequency | DO RL | RF 50 Ω DC | | SENS | | Avg Type: L | 0 OR-Dwr | 04:29:58 AM Mar 01, 20 TRACE 2 3 4 | 18 |
| NFE | PNO: Fast Trig: Free Ru IFGain:Low #Atten: 30 dB | un li | DET P NNNN | | Center Fre | NFE NFE | PNO: Fast G | Trig: Free F | Run | Ang type. D | | DET P N NN | |
| Ref Offset 0.8 dB | | | 1 2.037 77 GHz | Auto Tune | | Ref Offset 0.8 dB | | | | N | /kr1 4.96 | 60 375 0 GH | 1 2 A |
| Bidiv Ref 20.00 dBm | | | -57.16 dBm | | 10 dB/div Log | Ref Offset 0.8 dB Ref 20.00 dBm | | | | | | -50.43 dB | m |
| | | | | Center Freq | | | | | | | | | Ce |
| | | | | 1.155500000 GHz | 10.0 | | | | | | | | 3.7500 |
|) | | | | | 0.00 | | | | | | | | _ |
| | | | | Start Freq 1.000000 MHz | | | | | | | | | 2.5000 |
| | | | | 1.000000 Mill 2 | -10.0 | | | | | | | | 2.0000 |
| | | | 011-23.26 (80 | Stop Free | -20.0 | | | | | | | | en : |
| | | | | 2.31000000 GHz | | | | | | | | | 5.0000 |
| | | | | | -30.0 | | | | | | | | |
| | | | | CF Step 230.900000 MHz | -40.0 | | | | | | | | 250.0 |
| | | | | <u>Auto</u> Man | | | | | | | | | Auto |
| | | | ↓ ¹ | | -30.0 | | | Inches | | | | | |
| and the design of the second | | والمرحوقا والمرجوبة والتحمير ورديا كالخاط فتحقق كالالا | and a standard second at the second | Freq Offset 0 Hz | -60.0 100 100 100 100 | and the part of th | New York Street Street | Personal Property in the last | Calendary State | a contrast de | teletetti bus | a incertage of the second s | Fi |
| A separation of the second second second | and the second | | | | man ittee | and the second | anni sanairan | A Plant | | اللاطر المتحدية ومرية | Recta Statistics | in distants in Altri | |
| | | | | Scale Type | 70.0 | | | | | | | | s |
| rt 1 MHz | | | Stop 2.310 GHz | | Start 2.500 | GHz | | | | | | Stop 5.000 GH | tz Log |
| s BW 100 kHz | #VBW 300 kHz | | 00 ms (40001 pts) | | #Res BW 1 | 00 kHz | #VBV | N 300 kHz | | | eep 10.67 | 7 ms (40001 pt | s) |
| | | STATUS | | | MSG | | | | | [| STATUS | | |
| 2480 | MHz,Plot 5,50 | 000MHz~25(| 000MHz | | | | | | | | | | |
| | | | | | | | | | | | | | |
| eysight Spectrum Analyzer - Swept SA | , , | 20011112 200 | | - 2 - | | | | | | | | | |
| L RF 50 Ω DC | SENSE: | | 04:30:15 AM Mar 01, 2018 | Frequency | 1 | | | | | | | | |
| L RF 50 Ω DC | SENSE: | | 04:30:15 AM Mar 01, 2018 | Frequency | | | | | | | | | |
| nter Freq 15.0000000 NFE | DOO GHz PNO: Fast IFGain:Low Trig: Free Rt #Atten: 30 dB | INT Avg Type: Log-Pwr In B | 04:30:15 AM Mar01, 2018 TRACE 2 3 4 5 0 TYPE DET POINTUR 1 22.842 0 GHz | | 1 | | | | | | | | |
| ter Freq 15.0000000 NFE Ref Offset 0.8 dB | DOO GHz PNO: Fast IFGain:Low Trig: Free Rt #Atten: 30 dB | INT Avg Type: Log-Pwr In B | 04:30:15 AM Mar 01, 2018 TRACE 2 3 4 5 0 TYPE M | Frequency | | | | | | | | | |
| L RF 50Ω DC hter Freq 15.0000000 NFE | DOO GHz PNO: Fast IFGain:Low Trig: Free Rt #Atten: 30 dB | INT Avg Type: Log-Pwr In B | 04:30:15 AM Mar01, 2018 TRACE 2 3 4 5 0 TYPE DET POINTUR 1 22.842 0 GHz | Frequency Auto Ture Center Freq | | | | | | | | | |
| nter Freq 15.0000000 NFE | DOO GHz PNO: Fast IFGain:Low Trig: Free Rt #Atten: 30 dB | INT Avg Type: Log-Pwr In B | 04:30:15 AM Mar01, 2018 TRACE 2 3 4 5 0 TYPE DET POINTUR 1 22.842 0 GHz | Frequency Auto Ture | | | | | | | | | |
| L RF 50Ω DC hter Freq 15.0000000 NFE | DOO GHz PNO: Fast IFGain:Low Trig: Free Rt #Atten: 30 dB | INT Avg Type: Log-Pwr In B | 04:30:15 AM Mar01, 2018 TRACE 2 3 4 5 0 TYPE DET POINTUR 1 22.842 0 GHz | Frequency Auto Ture Center Freq 15.00000000 GHz | | | | | | | | | |
| L RF 50Ω DC hter Freq 15.0000000 NFE | DOO GHz PNO: Fast IFGain:Low Trig: Free Rt #Atten: 30 dB | INT Avg Type: Log-Pwr In B | 04:30:15 AM Mar01, 2018 TRACE 2 3 4 5 0 TYPE DET POINTUR 1 22.842 0 GHz | Frequency Auto Ture Center Freq | | | | | | | | | |
| L RF 50Ω DC hter Freq 15.0000000 NFE | DOO GHz PNO: Fast IFGain:Low Trig: Free Rt #Atten: 30 dB | INT Avg Type: Log-Pwr In B | 04:30:15 AM Mar01, 2018 TRACE 2 3 4 5 0 TYPE DET POINTUR 1 22.842 0 GHz | Frequency Auto Ture Center Freq 15.00000000 GHz Start Freq | | | | | | | | | |
| L RF 50 Ω DC Iter Freq 15.0000000 NFE | DOO GHz PNO: Fast IFGain:Low Trig: Free Rt #Atten: 30 dB | INT Avg Type: Log-Pwr In B | 01-30:15 4M Mar 01, 2018 TRACE D 3 3 45 30 TYPE D 3 4 50 0 TYPE D 3 5 0 | Frequency Auto Ture Center Freq 15.00000000 GHz 5.00000000 GHz | | | | | | | | | |
| L RF 50Ω DC hter Freq 15.0000000 NFE | DOO GHz PNO: Fast IFGain:Low Trig: Free Rt #Atten: 30 dB | INT Avg Type: Log-Pwr In B | 04:30:15 AM Mar01, 2018 TRACE 2 3 4 5 0 TYPE DET POINTUR 1 22.842 0 GHz | Frequency Auto Ture Center Freq 15.00000000 GHz Start Freq | | | | | | | | | |
| nter Freq 15.0000000 NFE | DOO GHz PNO: Fast IFGain:Low Trig: Free Rt #Atten: 30 dB | INT Avg Type: Log-Pwr In B | 01-30:15 4M Mar 01, 2018 TRACE D 3 3 45 30 TYPE D 3 4 50 0 TYPE D 3 5 0 | Frequency Auto Turo Center Frq 15.00000000 GHz Start Frq 5.00000000 GHz Stop Frq 25.00000000 GHz | | | | | | | | | |
| nter Freq 15.0000000 NFE | DOO GHz PNO: Fast IFGain:Low Trig: Free Rt #Atten: 30 dB | INT Avg Type: Log-Pwr In B | 01-30:15 4M Mar 01, 2018 TRACE D 3 3 45 30 TYPE D 3 4 50 0 TYPE D 3 5 0 | Frequency Auto Tune Center Freq 15.00000000 GH2 Start Freq 5.000000000 GH2 Stop Freq 25.00000000 GH2 CF Step 2.00000000 GH2 | | | | | | | | | |
| nter Freq 15.0000000 NFE | DOO GHz PNO: Fast IFGain:Low Trig: Free Rt #Atten: 30 dB | INT Avg Type: Log-Pwr In B | 01-30:15 4M Mar 01, 2018 TRACE D 3 3 45 30 TYPE D 3 4 50 0 TYPE D 3 5 0 | Frequency Auto Ture Center Freq 15.00000000 GH Start Freq 5.00000000 GH 25.0000000 GH 25.0000000 GH | | | | | | | | | |
| RL RF 50Ω DC nter Freq 15.0000000 NFE | DOO GHz PNO: Fast IFGain:Low Trig: Free Rt #Atten: 30 dB | INT Avg Type: Log-Pwr In B | 01-30:15 4M Mar 01, 2018 TRACE D 3 3 45 30 TYPE D 3 4 50 0 TYPE D 3 5 0 | Frequency Auto Ture Center Freq 15.00000000 GHz Start Freq 5.00000000 GHz Stop Freq 25.00000000 GHz CF Step 2.00000000 GHz Quito | | | | | | | | | |
| nter Freq 15.0000000 NFE | DOO GHz PNO: Fast IFGain:Low Trig: Free Rt #Atten: 30 dB | INT Avg Type: Log-Pwr In B | 01-30:15 4M Mar 01, 2018 TRACE D 3 3 45 30 TYPE D 3 4 50 0 TYPE D 3 5 0 | Frequency Auto Tune Center Freq 15.00000000 GH2 Start Freq 5.000000000 GH2 Stop Freq 25.00000000 GH2 CF Step 2.00000000 GH2 | | | | | | | | | |
| nter Freq 15.0000000 NFE | DOO GHz PNO: Fast IFGain:Low Trig: Free Rt #Atten: 30 dB | INT Avg Type: Log-Pwr In B | 01-30:15 4M Mar 01, 2018 TRACE D 3 3 45 30 TYPE D 3 4 50 0 TYPE D 3 5 0 | Frequency Auto Ture Center Freq 5.00000000 GHz Start Freq 5.00000000 GHz 25.00000000 GHz 2.00000000 GHz Auto Men Freq Offset | | | | | | | | | |
| nter Freq 15.0000000 NFE | DOO GHz PNO: Fast IFGain:Low Trig: Free Rt #Atten: 30 dB | INT Avg Type: Log-Pwr In B | 01-30:15 4M Mar 01, 2018 TRACE D 3 3 45 30 TYPE D 3 4 50 0 TYPE D 3 5 0 | Frequency Auto Ture Center Freq 5.00000000 GHz Start Freq 5.00000000 GHz 25.00000000 GHz 2.00000000 GHz Auto Men Freq Offset | | | | | | | | | |
| Le production de la construcción | DOO GHz PNO: Fast IFGain:Low Trig: Free Rt #Atten: 30 dB | INT Avg Type: Log-Pwr In B | (4) 2013 AM Mur01, 2018 Trace 122, 842 0 GHz -43, 57 dBm 122, 842 0 GHz -43, 57 dBm 124, 94 0 GHz -44, 94 0 GHz - | Frequency Auto Turn Center Freq 15.00000000 GH Stop Freq 25.00000000 GH CF Stop COSSOURCE OF CF Stop COSSOURCE OF Scale Type Scale Type | | | | | | | | | |
| L RF 50Ω DC hter Freq 15.0000000 NFE | DOO GHz PNO: Fast IFGain:Low Trig: Free Rt #Atten: 30 dB | Avg Type: Log-Pwr an B MKC MKC Avg Type: Log-Pwr MKC Avg Type: Log-Pwr Avg Type: Log | 01-30:15 4M Mar 01, 2018 TRACE D 3 3 45 30 TYPE D 3 4 50 0 TYPE D 3 5 0 | Frequency Auto Ture Center Freq 15.0000000 GH Start Freq 5.00000000 GH 25.0000000 GH 20.000000 GH 20.0000000 GH CF Step 2.00000000 GH CF Step 2.0000000 GH CF Step 2.00000000 GH CF Step 2.00000000 GH CF Step 2.00000000 GH CF Step 2.000000000 GH CF Step 2.0000000000 GH CF Step 2.000000000000 GH CF Step 2.0000000000000 GH CF Step 2.000000000000000000000000000000000000 | | | | | | | | | |