| | |
|---|---|
| Test Report Serial Number: | **45461921 R2.0** |
| Test Report Date: | **29 April 2024** |
| Project Number: | **1658** |

# EMC Test Report - New Certification

Applicant:

**Garmin International Inc.**
**1200 East 151 St**
**Olathe, KS, 66062**
**USA**

FCC ID: **IPH-04808**

| Product Model Number / HVIN | Product Marketing Name / PMN |
|---|---|
| **A04808** | **A04808** |

In Accordance With:

**CFR Title 47, Part 15 Subpart C (§15.247), Part 15 Subpart B**
Digital Transmission System (DTS)

Approved By:

**Ben Hewson, President**
Celltech Labs Inc.
21-364 Lougheed Rd.
Kelowna, BC, V1X 7R8
Canada

**Test Lab Certificate: 2470.01** | **IC Registration 3874A** | **FCC Registration: CA3874**

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## 1.0 REVISION HISTORY

| Revision History | | | | |
|---|---|---|---|---|
| **Samples Tested By:** | Art Voss, P.Eng. | **Date(s) of Evaluation:** | | 18 March - 6 April, 2024 |
| **Report Prepared By:** | Art Voss, P.Eng. | **Report Reviewed By:** | | Ben Hewson |
| **Report Revision** | **Description of Revision** | **Revised Section** | **Revised By** | **Revision Date** |
| 0.1 | Draft | n/a | Art Voss | 11 April 2024 |
| 0.2 | Revised per applicant's comments | - | Art Voss | 15 April 2024 |
| 1.0 | Initial Release | - | Art Voss | 19 April 2024 |
| 2.0 | Revised OBW Measurements | 7 | Art Voss | 29 April 2024 |

## 2.0 CLIENT AND DUT INFORMATION

| Client Information | |
|---|---|
| **Applicant Name** | **Garmin International Inc.** |
| **Applicant Address** | 1200 East 151 St |
| | Olathe, KS, 66062 |
| | USA |
| **DUT Information** | |
| **Device Identifier(s):** | **FCC ID:** **IPH-04808** |
| **Device Model(s) / HVIN:** | A04808 |
| **Device Marketing Name / PMN:** | A04808 |
| **Test Sample Serial No.:** | 3469058597 - Conducted, 3469058595 - OTA |
| **Device Type:** | Portable Transceiver |
| **Equipment Class:** | Digital Transmission Systems (DTS) |
| | Spread Spectrum Transmitter (DSS) |
| | Low Power Communication Device (DTS) |
| | Global Navigation Satellite System (GNSS) Receivers |
| | NFC - Low Power Communication Device Transmitter (DXX) |
| **Transmit Frequency Range:** | WiFi (DTS): 2412-2472MHz |
| | BT/BLE/ANT: 2402-2480MHz |
| | NFC: 13.56MHz |
| **Manuf. Max. Rated Output Power:** | WiFi - Digital Transmission System (DTS): 12.2dBm EIRP |
| | BlueTooth - Spread Spectrum Transmitter (DSS): 6.2dBm EIRP |
| | BLE/ANT - Low Power Communication Device Transmitter (DTS): -2.3dBm EIRP |
| | NFC - Low Power Communication Device Transmitter (DXX): 55.62dBuV/m |
| **Antenna Type and Gain:** | -3.8dBi Max Slot Antenna |
| **Modulation:** | WiFi: DSSS, OFDM, CCK, MCS0-7 |
| | BT BR: GFSK |
| | BT EDR: Pi/4-DQPSK, 8DPSK |
| | BLE: GMSK |
| | ANT: GFSK |
| | NFC: ASK |
| **DUT Power Source:** | 4.5VDC Rechargeable Li-Ion |
| **DUT Dimensions [LxWxH]** | H x W x D: 51mm dia x 4.5mm |
| **Deviation(s) from standard/procedure:** | None |
| **Modification of DUT:** | None |

## 3.0 SCOPE

**Preface:**

This Certification Report was prepared on behalf of:

**Garmin International Inc.**

,(the '*Applicant*"), in accordance with the applicable Federal Communications Commission (FCC) CFR 47 and Innovation, Scientific and Economic Development (ISED) Canada rules parts and regulations (the '*Rules*'). The scope of this investigation was limited to only the equipment, devices and accessories (the '*Equipment*') supplied by the *Applicant*. The tests and measurements performed on this *Equipment* were only those set forth in the applicable *Rules* and/or the Test and Measurement Standards they reference. The *Rules* applied and the Test and Measurement Standards used during this evaluation appear in the Normative References section of this report. The limits set forth in the technical requirements of the applicable *Rules* were applied to the measurement results obtained during this evaluation and ,unless otherwise noted, these limits were used as the Pass/Fail criteria. The Pass/Fail statements made in this report apply to only the tests and measurements performed on only the *Equipment* tested during this evaluation. Where applicable and permissible, information including test and measurement data and/or results from previous evaluations of same or similar equipment, devices and/or accessories may be cited in this report.

**Device:**

The Garmin Model/HVIN: A04808 is a portable transceiver device consisting of a WiFi, BlueTooth (BT), BlueTooth Low Energy (BLE), Adaptive Network Topology (ANT) and Near Field Communication (NFC) transceivers. The WiFi and BT/BLE/ANT transceivers share the same antenna and cannot simultaneously transmit.

**Requirement:**

The transceivers of this *equipment* are subject to emissions evaluation in accordance with FCC: 47 CFR 2, 15C. As per FCC 47 CFR §2.1093, an RF Exposure (SAR) evaluation is required for this *Equipment* and the results of the RF Exposure (SAR) evaluation appear in a separate report.

**Application:**

This is an application for a New Certification.

**Scope:**

The scope of this investigation is limited to the evaluation and reporting of the wanted and spurious emissions in accordance with the rule parts cited in Normative References section of this report.

## 4.0 TEST SUMMARY

**TEST SUMMARY**

| Section | Description of Test | Procedure Reference | Applicable Rule Part(s) FCC | Test Date | Result |
|---|---|---|---|---|---|
| 7.0 | Occupied Bandwidth | ANSI C63.10-2013 KDB 558074 D01v05 | §2.1049 | 26 Mar 2024 | Pass |
| 8.0 | DTS Bandwidth | ANSI C63.10-2013 KDB 558074 D01v05 | §15.247(a)(2) | 26 Mar 2024 | Pass |
| 9.0 | Conducted Power (Fundamental) | ANSI C63.10-2013 KDB 558074 D01v05 | §2.1046 §15.247(b)(3) | 29 Feb 2024 | Pass |
| 10.0 | Conducted Power (Fundamental) | ANSI C63.10-2013 KDB 558074 D01v05 | §2.1046 §15.247(b)(1) | 21 Mar 2024 | Pass |
| 11.0 | Power Spectral Density | ANSI C63.10-2013 KDB 558074 D01v05 | §15.247(e) | 26 Mar 2024 | Pass |
| 12.0 | FHSS Hopping Characteristics | ANSI C63.4-2014 KDB 558074 D01v05 | §15.247(a)(1)(iii) | 28 Mar 2024 | Pass |
| 13.0 | FHSS Channel Separation | ANSI C63.4-2014 KDB 558074 D01v05 | §15.247(a)(1) | 28 Mar 2024 | Pass |
| 14.0 | FHSS Time of Occupancy | ANSI C63.4-2014 KDB 558074 D01v05 | §15.247(a)(1)(iii) | 28 Mar 2024 | Pass |
| 15.0 | Conducted Tx Spurious Emissions Band Edge | ANSI C63.10-2013 KDB 558074 D01v05 | §2.1051 §15.247(d) | 21 Mar 2024 | Pass |
| 16.0 | Conducted Tx Spurious Emissions | ANSI C63.10-2013 KDB 558074 D01v05 | §2.1051 §15.247(d) | 1 Apr 2020 | Pass |
| 17.0 | Radiated Tx Spurious Emissions And Restricted Band | ANSI C63.4-2014 KDB 558074 D01v05 | §15.109 §15.247(d) | 2-3 Apr 2024 | Pass |
| 18.0 | Radiated Rx Spurious Emissions | ANSI C63.4-2014 KDB 558074 D01v05 | §15.109 | 2-3 Apr 2024 | Pass |
| 19.0 | Power Line Conducted Emissions | ANSI C63.4-2014 | §15.107 | 5 Apr 2024 | Pass |

| Test Station Day Log | | | | | |
|---|---|---|---|---|---|
| **Date** | **Ambient Temp (°C)** | **Relative Humidity (%)** | **Barometric Pressure (kPa)** | **Test Station** | **Tests Performed Section(s)** |
| 29 Feb 2024 | 20.8 | 17 | 101.3 | **EMC** | **9** |
| 21 Mar 2024 | 21.2 | 16 | 101.2 | **EMC** | **10, 15** |
| 26 Mar 2024 | 20.0 | 16 | 101.2 | **EMC** | **7, 8, 11** |
| 28 Mar 2024 | 23.1 | 16 | 100.8 | **EMC** | **12, 13, 14** |
| 1 Apr 2024 | 22.1 | 17 | 100.9 | **EMC** | **16** |
| 2 Apr 2024 | 10.0 | 60 | 101.9 | **OATS** | **17, 18** |
| 3 Apr 2024 | 9.0 | 36 | 101.9 | **OATS** | **17, 18** |
| 5 Apr 2024 | 17.0 | 37 | 100.7 | **LISN** | **19** |

**EMC** - EMC Test Bench
**OATS** - Open Area Test Site
**LISN** - LISN Test Area
**IMM** - Immunity Test Area
**SAC** - Semi-Anechoic Chamber
**TC** - Temperature Chamber
**ESD** - ESD Test Bench
**RI** - Radiated Immunity Chamber

I attest that the data reported herein is true and accurate within the tolerance of the Measurement Instrument Uncertainty; that all tests and measurements were performed in accordance with accepted practices or procedures; and that all tests and measurements were performed by me or by trained personnel under my direct supervision. The results of this investigation are based solely on the test sample(s) provided by the client which were not adjusted, modified or altered in any manner whatsoever, except as required to carry out specific tests or measurements. This test report has been completed in accordance with ISO/IEC 17025.

Art Voss, P.Eng.
Technical Manager
Celltech Labs Inc.

11 April 2024
Date

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
A. F. VOSS
# 31327

## 5.0 NORMATIVE REFERENCES

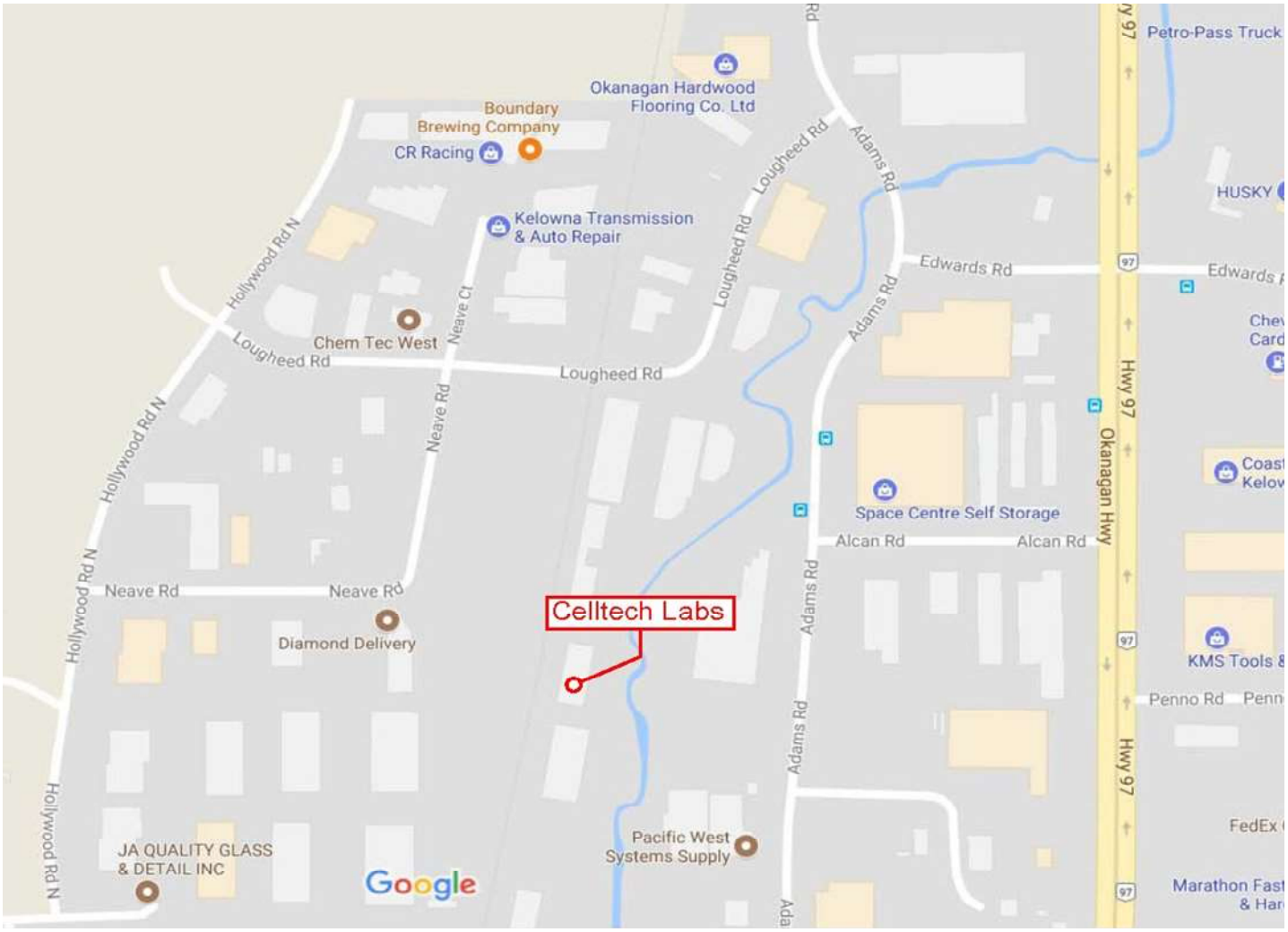
| Normative References | |
|---|---|
| ISO/IEC 17025:2017 | General requirements for the competence of testing and calibration laboratories |
| ANSI C63.4-2014 | American National Standard of Procedures for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electric and Electronic Equipment in the Range of 9kHz to 40GHz |
| ANSI C63.10-2013 | American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices |
| CFR<br>Title 47:<br>Part 2: | Code of Federal Regulations<br>Telecommunication<br>Frequency Allocations and Radio Treaty Matters; General Rules and Regulations |
| CFR<br>Title 47:<br>Part 15:<br>Subpart B: | Code of Federal Regulations<br>Telecommunication<br>Radio Frequency Devices<br>Unintentional Radiators |
| CFR<br>Title 47:<br>Part 15:<br>Sub Part C (15.247) | Code of Federal Regulations<br>Telecommunication<br>Radio Frequency Devices<br>Intentional Radiators |
| FCC KDB<br>558074 D01v05r02 | OET Major Guidance Publications, Knowledge Data Base<br>Guidance for Performing Compliance Measurements on Digital Transmission Systems (DTS) Operating Under Section 15.247 |

## 6.0 FACILITIES AND ACCREDITATIONS

### Facility and Accreditation:

The facilities used to evaluate this device outlined in this report are located at 21-364 Lougheed Road, Kelowna, British Columbia, Canada V1X 7R8. The radiated emissions site (OATS) conforms to the requirements set forth in ANSI C63.4 and is filed and listed with the FCC under Test Firm Registration Number CA3874 and Innovation, Science and Economic Development Canada under Test Site File Number ISED 3874A. Celltech is accredited to ISO 17025, through accrediting body A2LA and with certificate 2470.01.



## 7.0 OCCUPIED BANDWIDTH

| Test Procedure | |
|---|---|
| Normative Reference | FCC 47 CFR §2.1046, §15.247(b)(3), RSS-Gen (6.1.2), RSS-247 (5.4)(d), KDB 558074 (8.3.2.1), ANSI C63.10 (6.9.3) |

| General Procedure | |
|---|---|
| KDB 558074 (8.3.2.1) | **8.3.2.1 General**<br>Section 15.247 permits the maximum conducted (average) output power to be measured as an alternative to the maximum peak conducted output power for demonstrating compliance to the limit. When this option is exercised, the measured power is to be referenced to the OBW rather than the DTS bandwidth. |
| C63.10 (6.9.3) | **6.9.3 Occupied bandwidth—power bandwidth (99%) measurement procedure**<br>The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission. The following procedure shall be used for measuring 99% power bandwidth:<br>a) The instrument center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be between 1.5 times and 5.0 times the OBW.<br>b) The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW, and VBW shall be approximately three times the RBW, unless otherwise specified by the applicable requirement.<br>c) Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than [10 log (OBW/RBW)] below the reference level. Specific guidance is given in 4.1.5.2.<br>d) Step a) through step c) might require iteration to adjust within the specified range.<br>e) Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until the trace stabilizes) shall be used.<br>f) Use the 99% power bandwidth function of the instrument (if available) and report the measured bandwidth. |

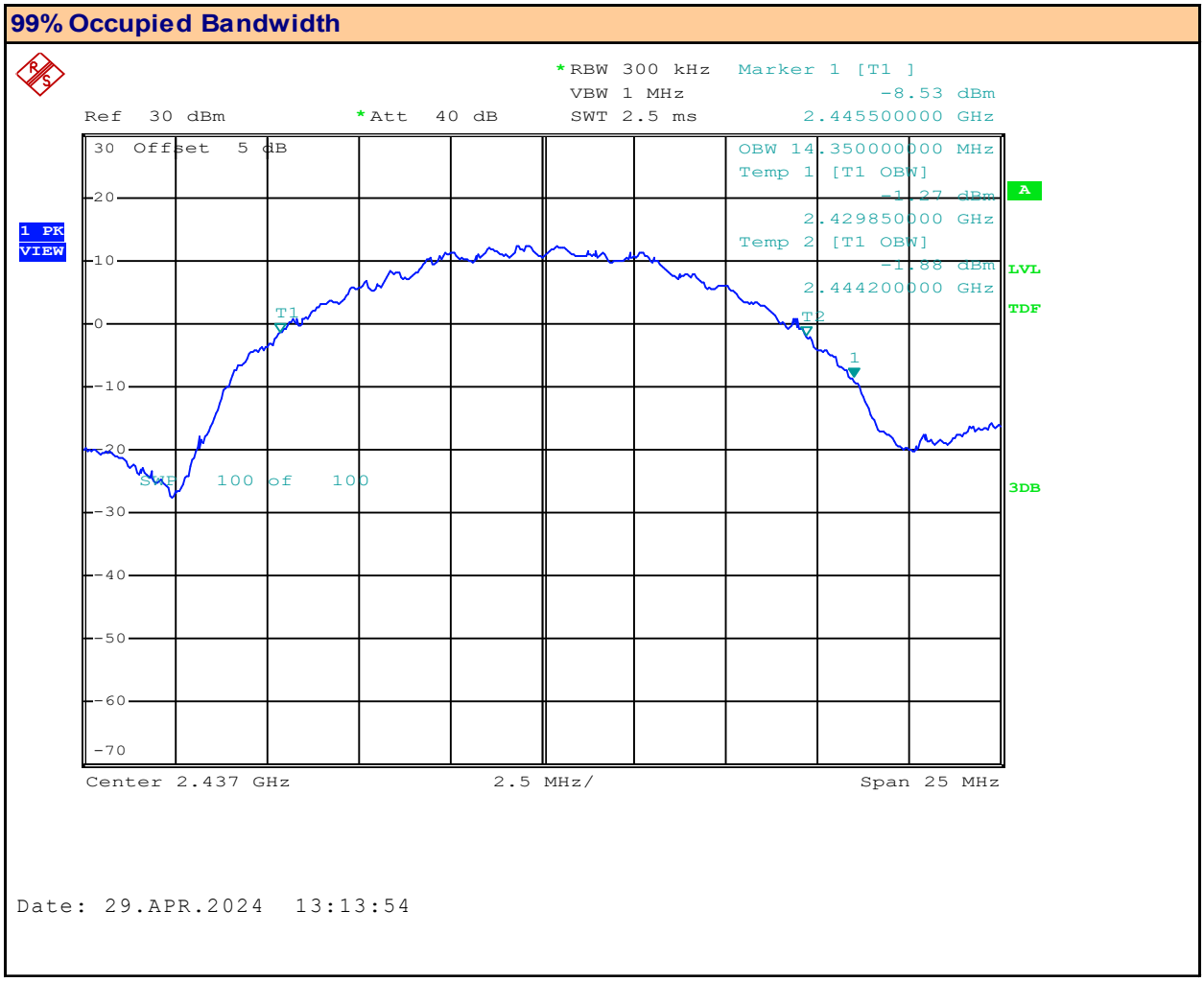
| Test Setup | Appendix A - Figure A.1 |
|---|---|

**Measurement Procedure**

The DUT was connected to a Spectrum Analyzer (SA) via a 30dB attenuator connected to the DUT's antenna port. The SA was configured as described above using the 99% Occupied Bandwidth function. The output power of the DUT was set to the manufacturer's highest output power setting at the Low, Mid and High frequency channels as permitted by the device. The DUT was set to transmit at its maximum Duty Cycle. The 99% Occupied Bandwidth was measured and recorded and used for the basis for measuring the Conducted Output Power (See Section 10.0) and Power Spectral Density (See Section 11.0).

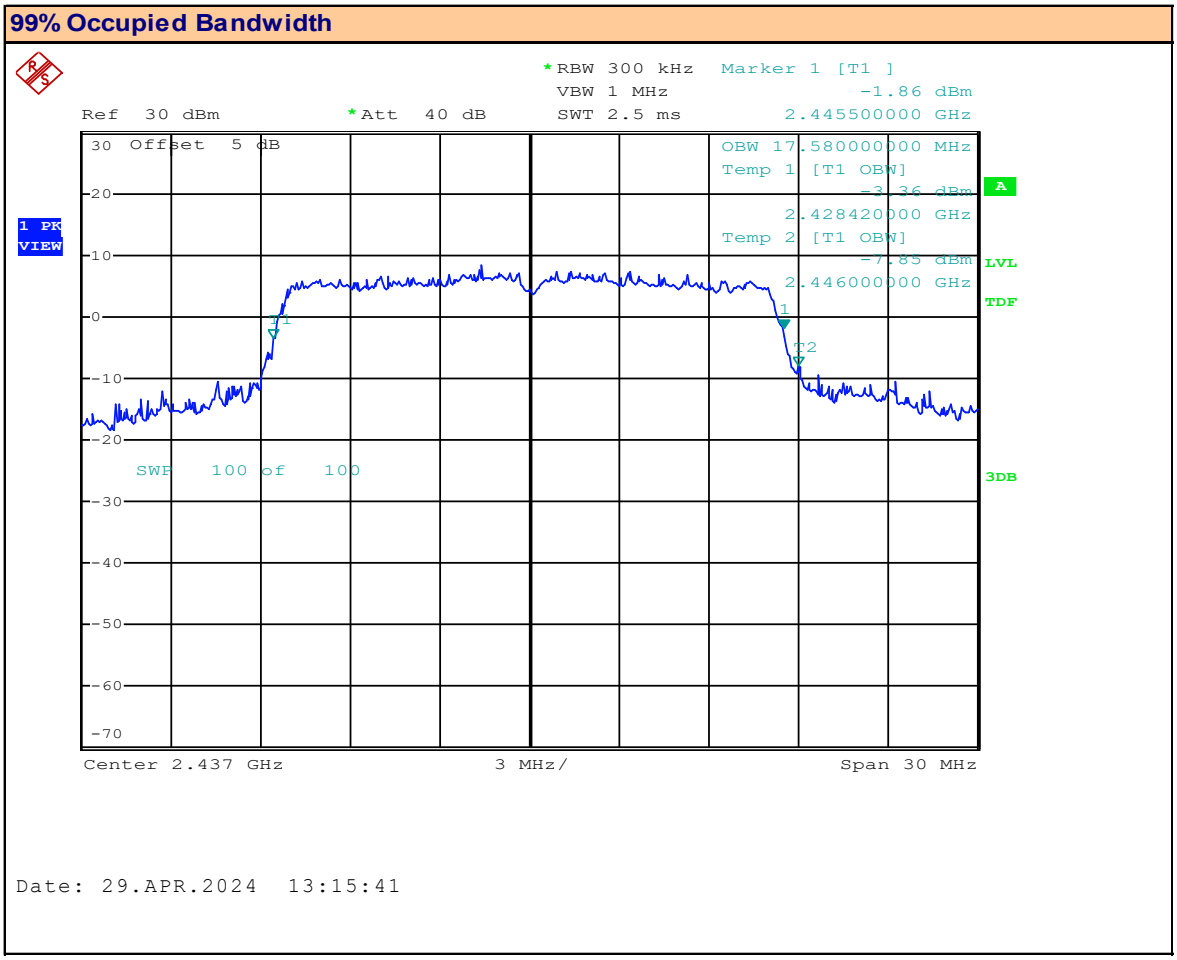
**Plot 7.1 – Occupied Bandwidth, 802.11b**




| | | | |
|---|---|---|---|
| **Channel:** | **6** | **Channel Frequency:** | **2437** **MHz** |
| **Mode:** | **802.11b** | **Modulation:** | **DSSS 5.5** |
| | | **Measured Occupied Bandwidth:** | **14.35** **MHz** |

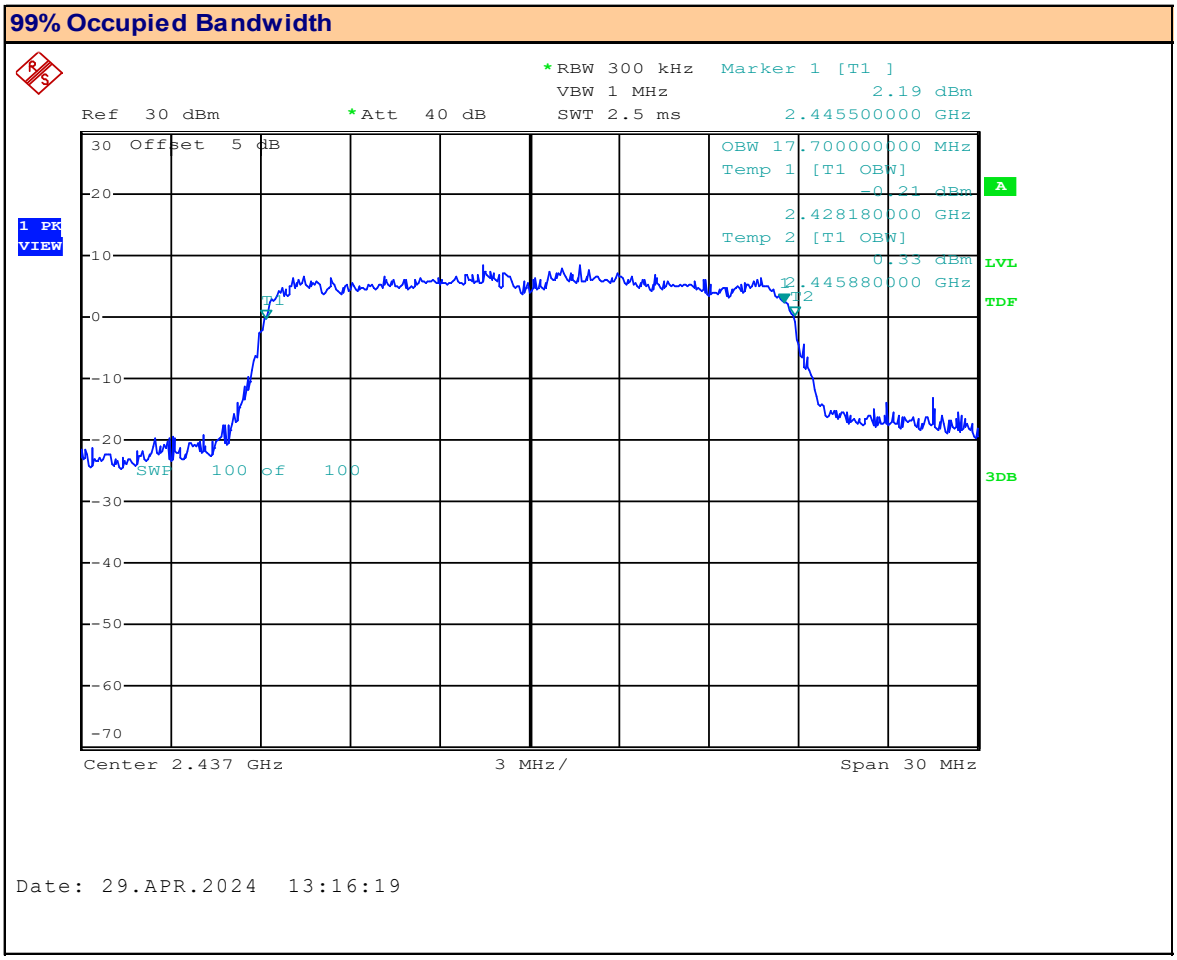
**Plot 7.2 – Occupied Bandwidth, 802.11g**




| | | | |
|---|---|---|---|
| **Channel:** | 6 | **Channel Frequency:** | 2437 MHz |
| **Mode:** | 802.11g | **Modulation:** | OFDM 12 |
| | | **Measured Occupied Bandwidth:** | 17.58 MHz |

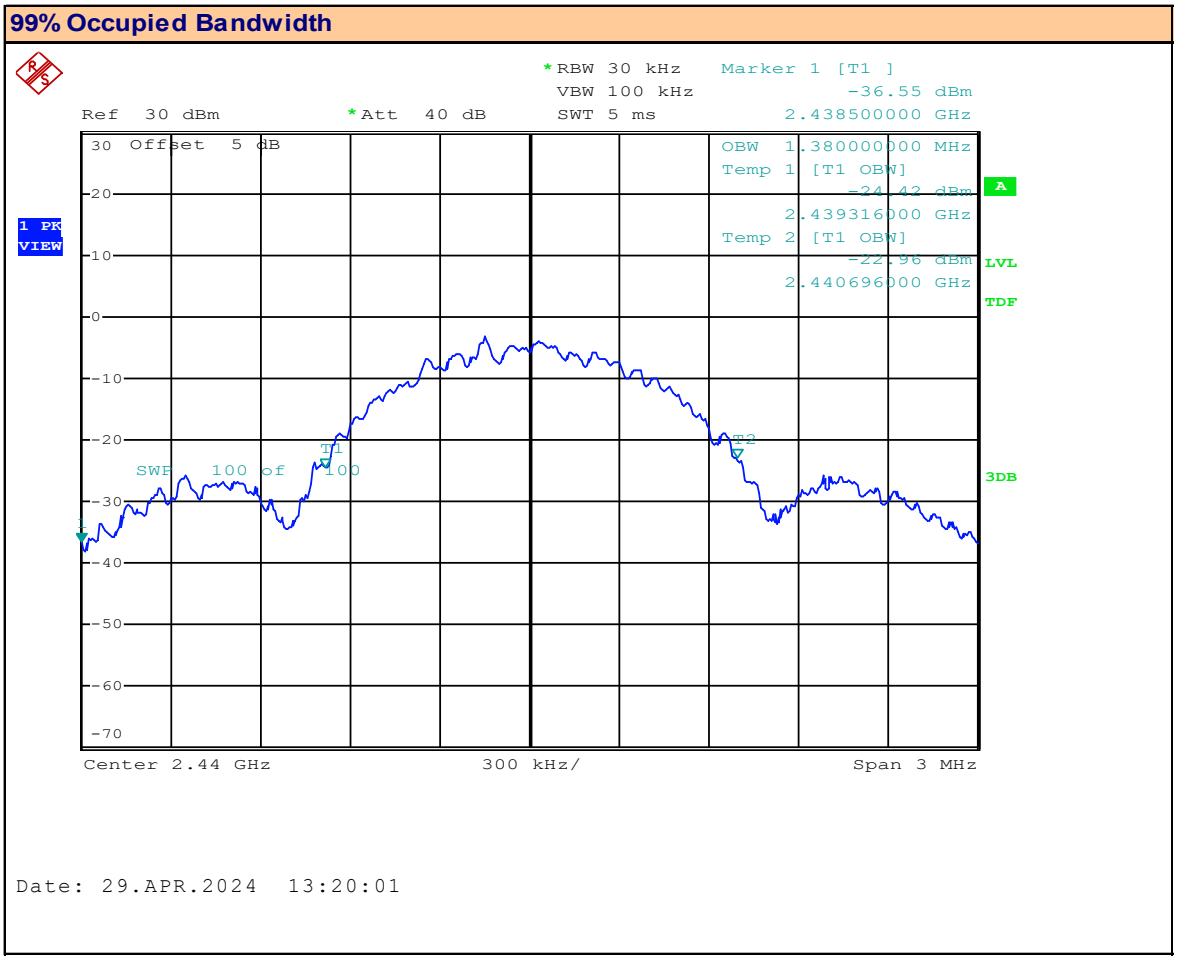
**Plot 7.3 – Occupied Bandwidth, 802.11n**




| | | | | | |
|---|---|---|---|---|---|
| **Channel:** | **6** | | **Channel Frequency:** | **2437** | **MHz** |
| **Mode:** | **802.11n** | | **Modulation:** | **MCS0** | |
| | | | **Measured Occupied Bandwidth:** | **17.7** | **MHz** |

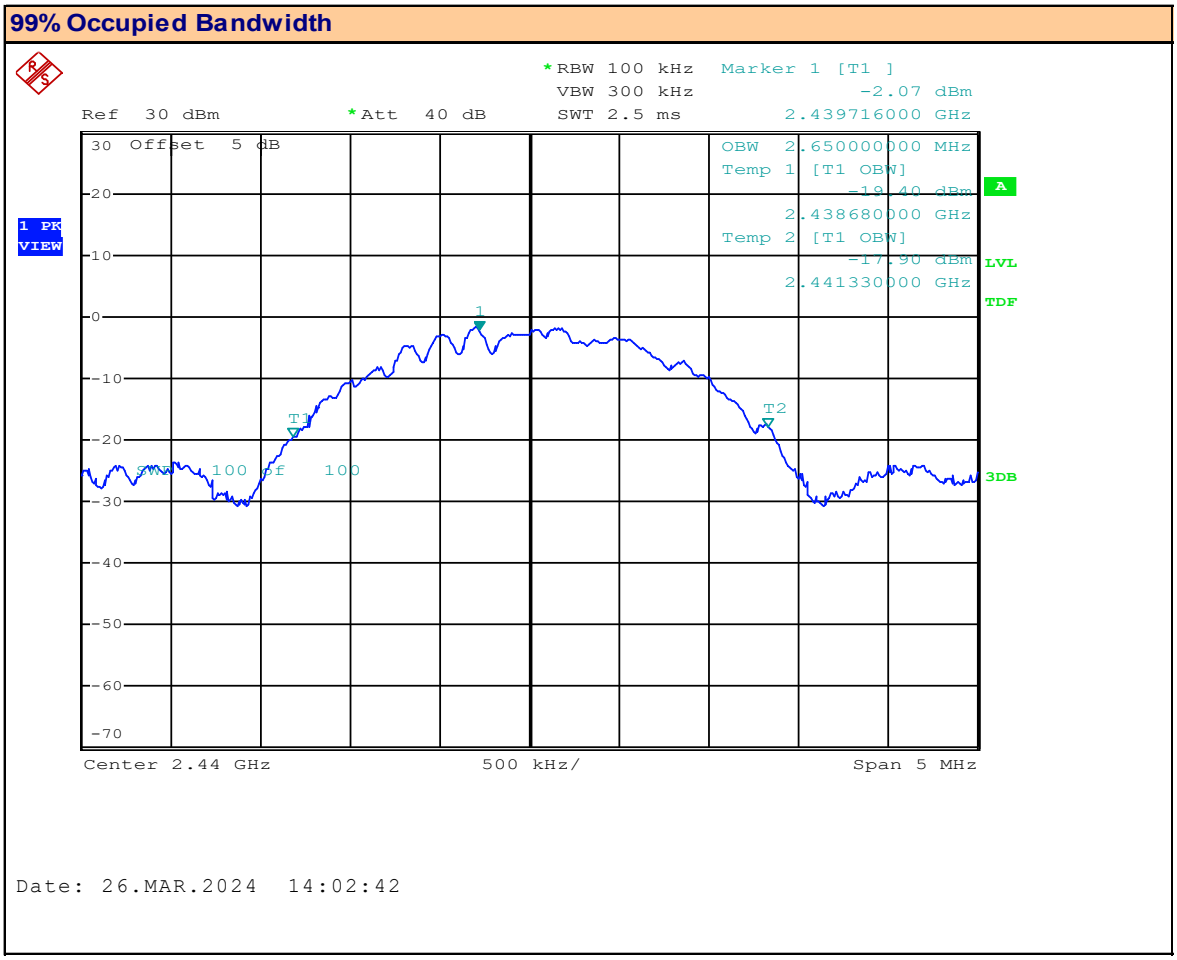
**Plot 7.4 – Occupied Bandwidth, BLE1**




| | | | | | |
|---|---|---|---|---|---|
| **Channel:** | **17** | | **Channel Frequency:** | **2440** | **MHz** |
| **Mode:** | **BLE 1mb** | | **Modulation:** | **GMSK** | |
| | | | **Measured Occupied Bandwidth:** | **1.38** | **MHz** |

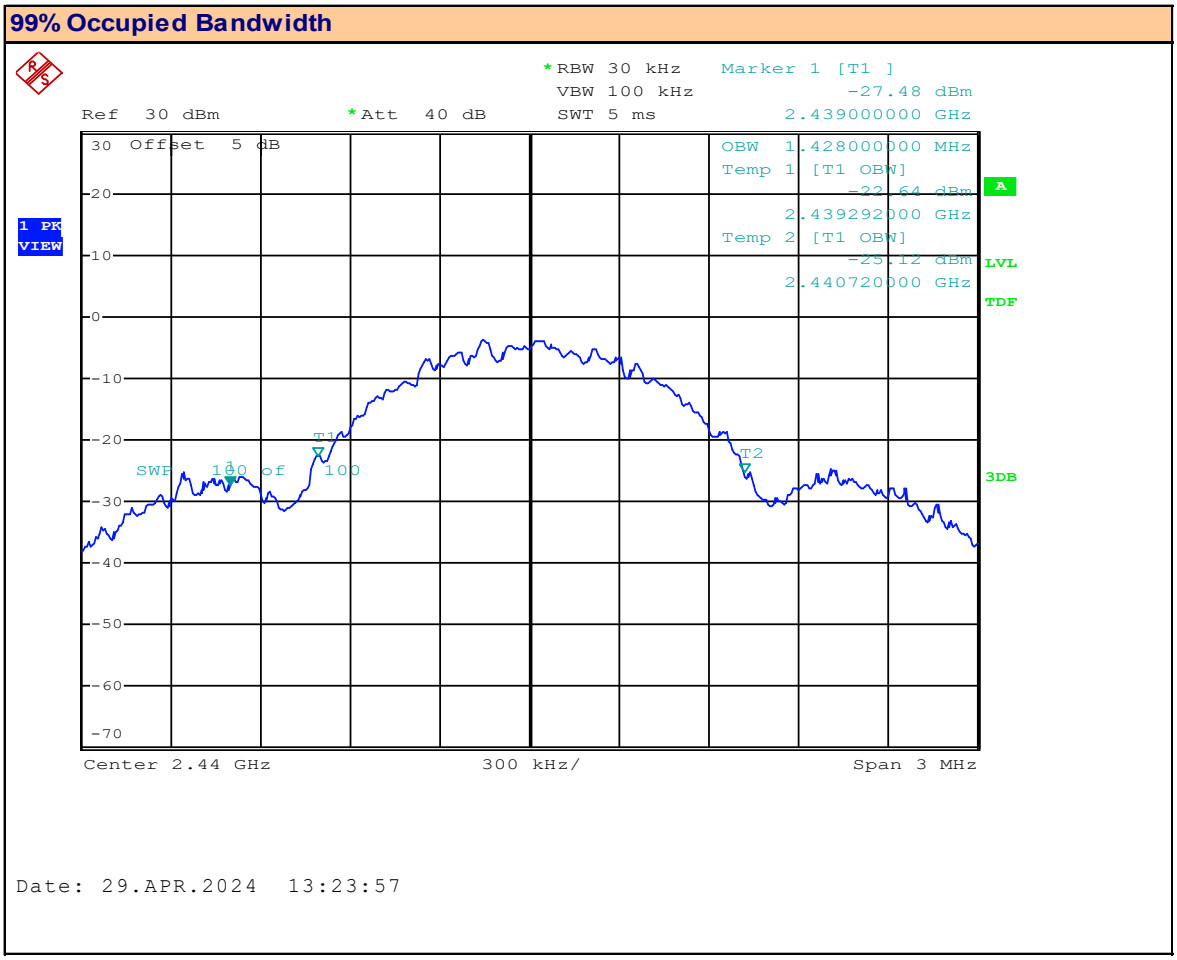
**Plot 7.5 – Occupied Bandwidth, BLE2**




| | | | | | |
|---|---|---|---|---|---|
| **Channel:** | 17 | | **Channel Frequency:** | 2440 | MHz |
| **Mode:** | BLE 2mb | | **Modulation:** | GMSK | |
| | | | **Measured Occupied Bandwidth:** | 2.65 | MHz |

**Plot 7.6 – Occupied Bandwidth, ANT**




| | | | | | |
|---|---|---|---|---|---|
| **Channel:** | 38 | | **Channel Frequency:** | 2440 | MHz |
| **Mode:** | ANT | | **Modulation:** | GFSK | |
| | | | **Measured Occupied Bandwidth:** | 1.428 | kHz |

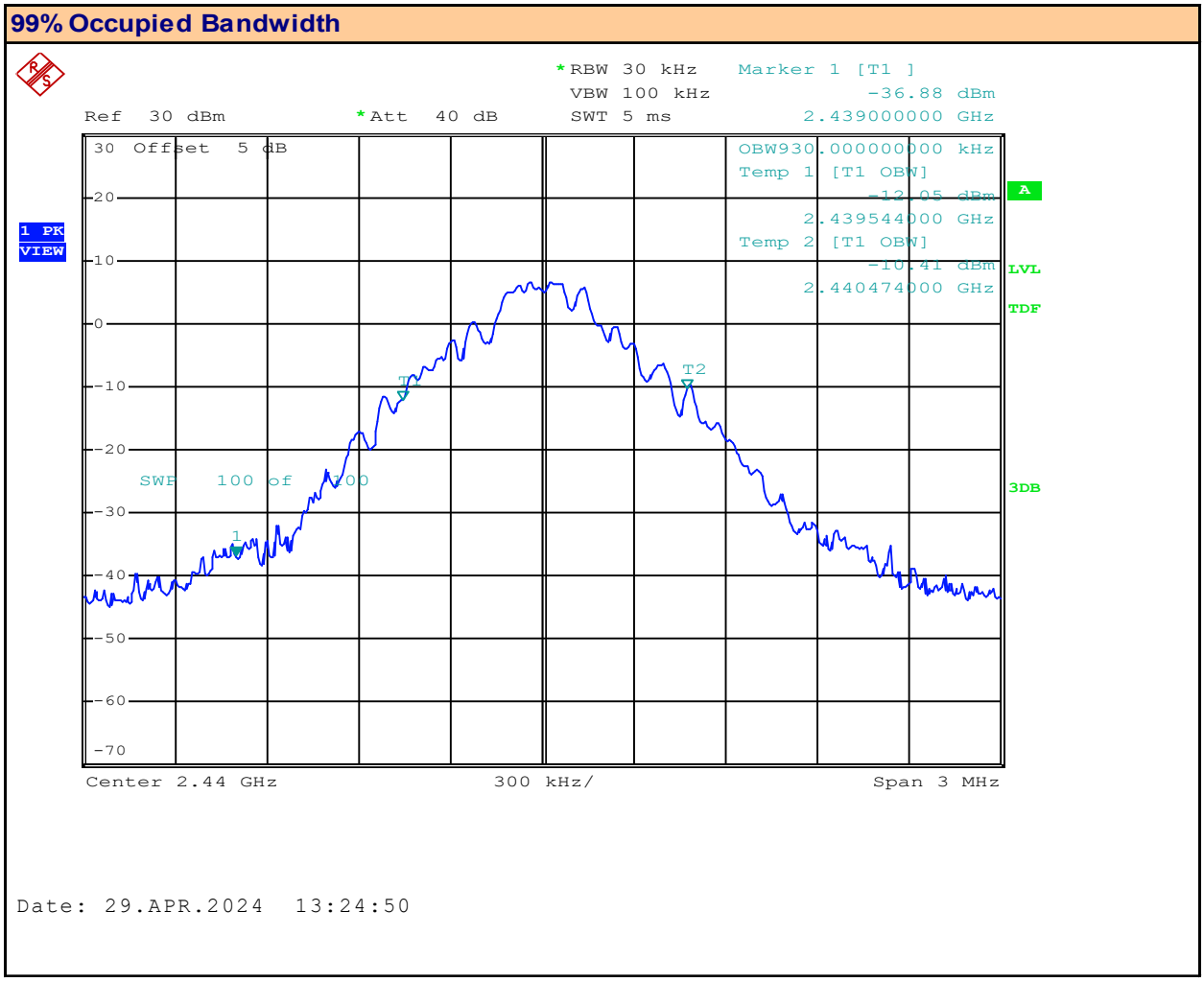
 

**Table 7.1 – Summary of Occupied Bandwidth Measurements, (DTS)**

| 99% Occupied Bandwidth Results: DTS | | | | | |
|---|---|---|---|---|---|
| Channel Number | Channel Frequency (MHz) | Mode | Modulation | Measured Occupied Bandwidth (MHz) | Emission Designator |
| 6 | 2437.0 | 802.11b | DSSS 5.5 | 14.4 | 14M4D1D |
| | | 802.11g | OFDM 12 | 17.6 | 17M6D1D |
| | | 802.11n | MCS0 | 17.7 | 17M7D1D |
| 17 | 2440.0 | BLE 1mb | GMSK | 1.38 | 1M38G1D |
| 17 | | BLE 2mb | GMSK | 2.65 | 2M65G1D |
| 38 | | ANT | GFSK | 1.43 | 1M43F1D |
| | | | | Result: | Complies |

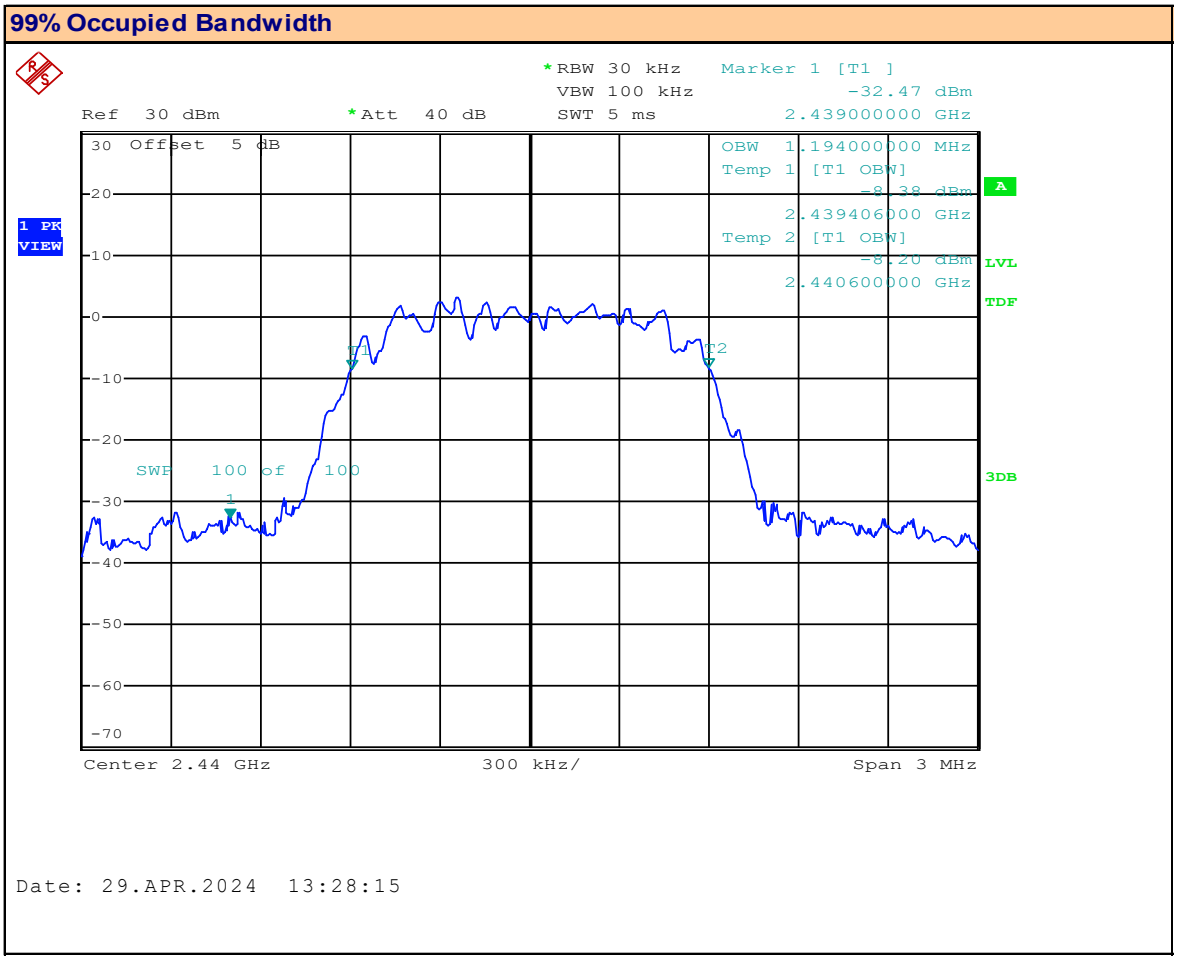
**Plot 7.7 – Occupied Bandwidth, BT BR**




| | | | |
|---|---|---|---|
| **Channel:** | 38 | **Channel Frequency:** | 2440 MHz |
| **Mode:** | BT BR | **Modulation:** | GFSK |
| | | **Measured Occupied Bandwidth:** | 930 kHz |

**Plot 7.8 – Occupied Bandwidth, BT 2EDR**




| | | | |
|---|---|---|---|
| **Channel:** | 38 | **Channel Frequency:** | 2440 MHz |
| **Mode:** | BT 2EDR | **Modulation:** | Pi/4-DQPSK |
| | | **Measured Occupied Bandwidth:** | 1194 kHz |

**Plot 7.9 – Occupied Bandwidth, BT 3EDR**


| | | | | | |
|---|---|---|---|---|---|
| **Channel:** | 38 | | **Channel Frequency:** | 2440 | MHz |
| **Mode:** | BT 3EDR | | **Modulation:** | 8-DPSK | |
| | | | **Measured Occupied Bandwidth:** | 1242 | kHz |

**Table 7.2 – Summary of Occupied Bandwidth Measurements (DSS)**

| 99% Occupied Bandwidth Results: DSS | | | | | |
|---|---|---|---|---|---|
| Channel Number | Channel Frequency (MHz) | Mode | Modulation | Measured Occupied Bandwidth (kHz) | Emission Designator |
| 38 | 2440.0 | BT BR | GFSK | 930.0 | 930KF1D |
| | | BT 2EDR | Pi/4-DQPSK | 1194.0 | 1M19G1D |
| | | BT 3EDR | 8-DPSK | 1242.0 | 1M24G1D |
| | | | | Result: | Complies |

## 8.0 DTS BANDWIDTH

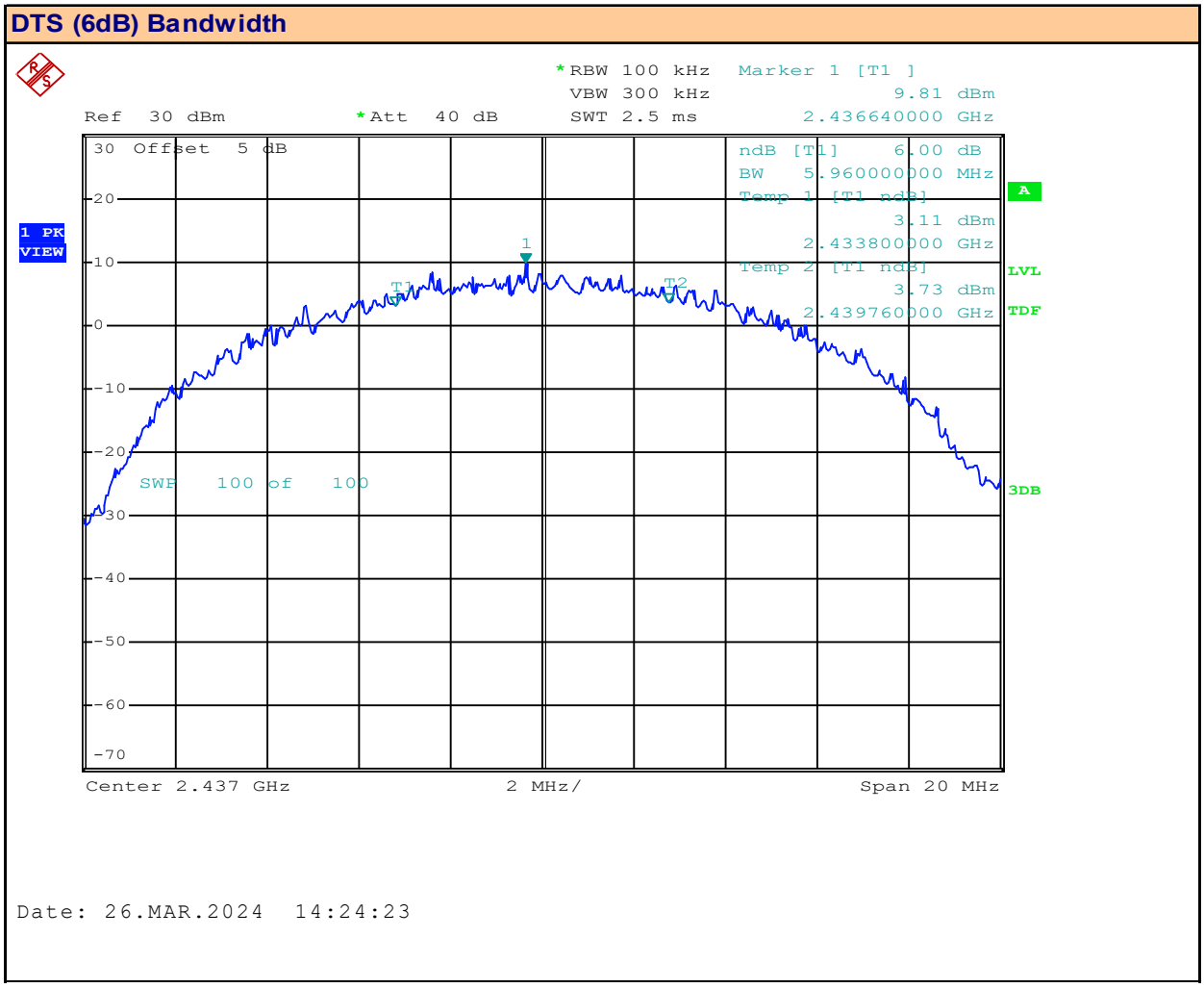
| Test Procedure | |
|---|---|
| **Normative Reference** | **FCC 47 CFR §2.1049, §15.247(a)(2), RSS-Gen (6.7), RSS-247 (5.2)(a),** |
| | **KDB 558074 (8.2), ANSI C63.10 (11.8.2)** |

| Limits | |
|---|---|
| 47 CFR §15.247(a)(2) | (a) Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:<br>(2) Systems using digital modulation techniques 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. |
| RSS-247 (5.2)(a) | 5.2 Digital transmission systems<br>DTSs include systems that employ digital modulation techniques resulting in spectral characteristics similar to direct sequence systems. The following applies to the bands 902-928 MHz and 2400 - 2483.5 MHz:<br>a) The minimum 6 dB bandwidth shall be 500 kHz. |
| KDB 558074 (8.2)<br>C63.10 (11.8.2) | **8.2 Option 2**<br>The automatic bandwidth measurement capability of an instrument may be employed using the X dB bandwidth mode with X set to 6 dB, if the functionality described above (i.e., RBW = 100 kHz, VBW ≥ 3 X RBW, peak detector with maximum hold) is implemented by the instrumentation function. When using this capability, care shall be taken so that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be ≥ 6 dB. |
| **Test Setup** | **Appendix A Figure A.1** |

| Measurement Procedure |
|---|
| The DUT was connected to a Spectrum Analyzer (SA) via a 30dB attenuator connected to the DUT's antenna port. The SA was configured as above using the Automatic 6dB Cursor Bandwidth measurement. The output power of the DUT was set to the manufacturer's highest output power setting at the Low, Mid and High frequency channels as permitted by the device. The DUT was set to transmit at 100% Duty Cycle. |

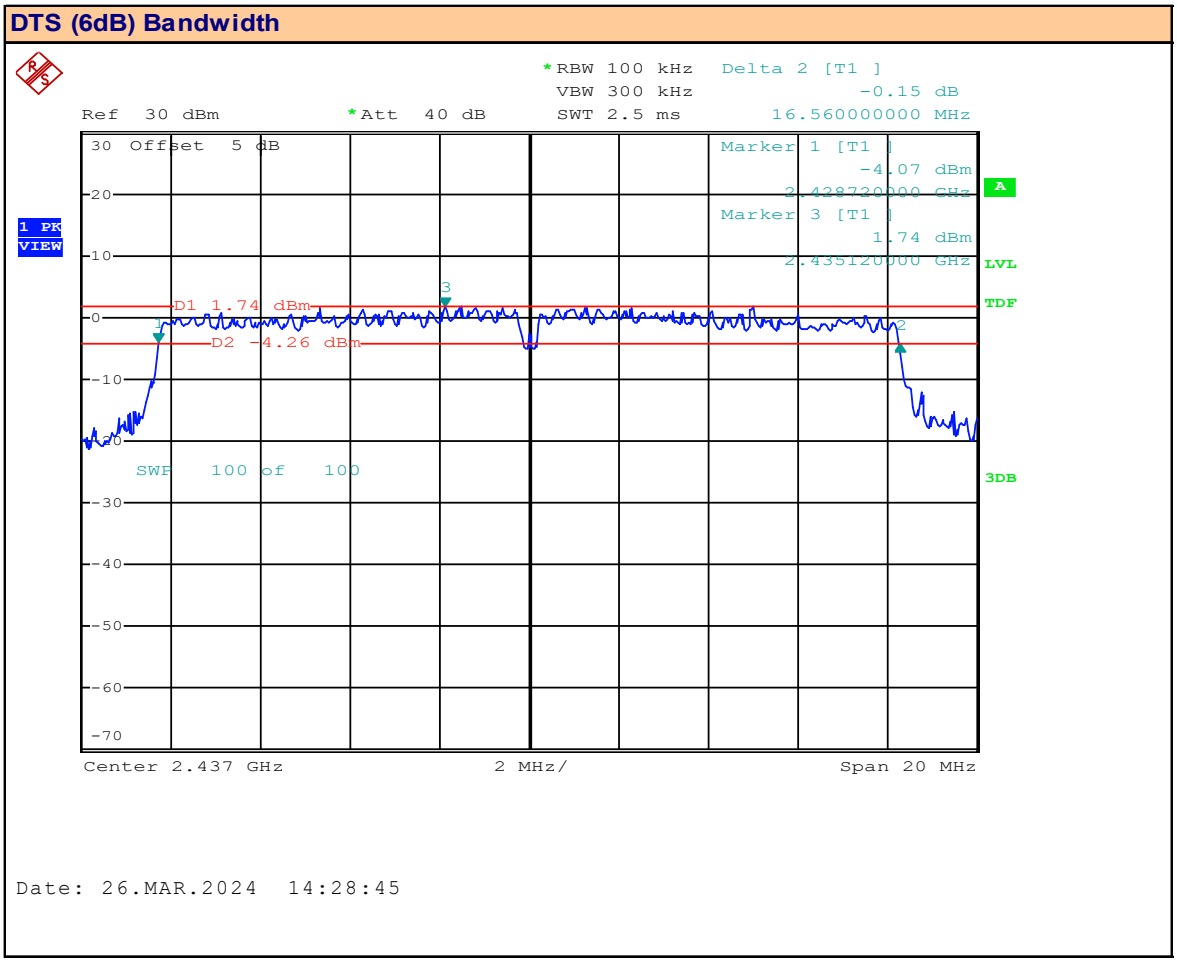
**Plot 8.1 – 6dB DTS Bandwidth 802.11b**




| | | | |
|---|---|---|---|
| **Channel:** | **6** | **Channel Frequency:** | **2437** **MHz** |
| **Mode:** | **802.11b** | **Modulation:** | **DSSS 5.5** |
| | | **Measured Occupied Bandwidth:** | **5.96** **MHz** |

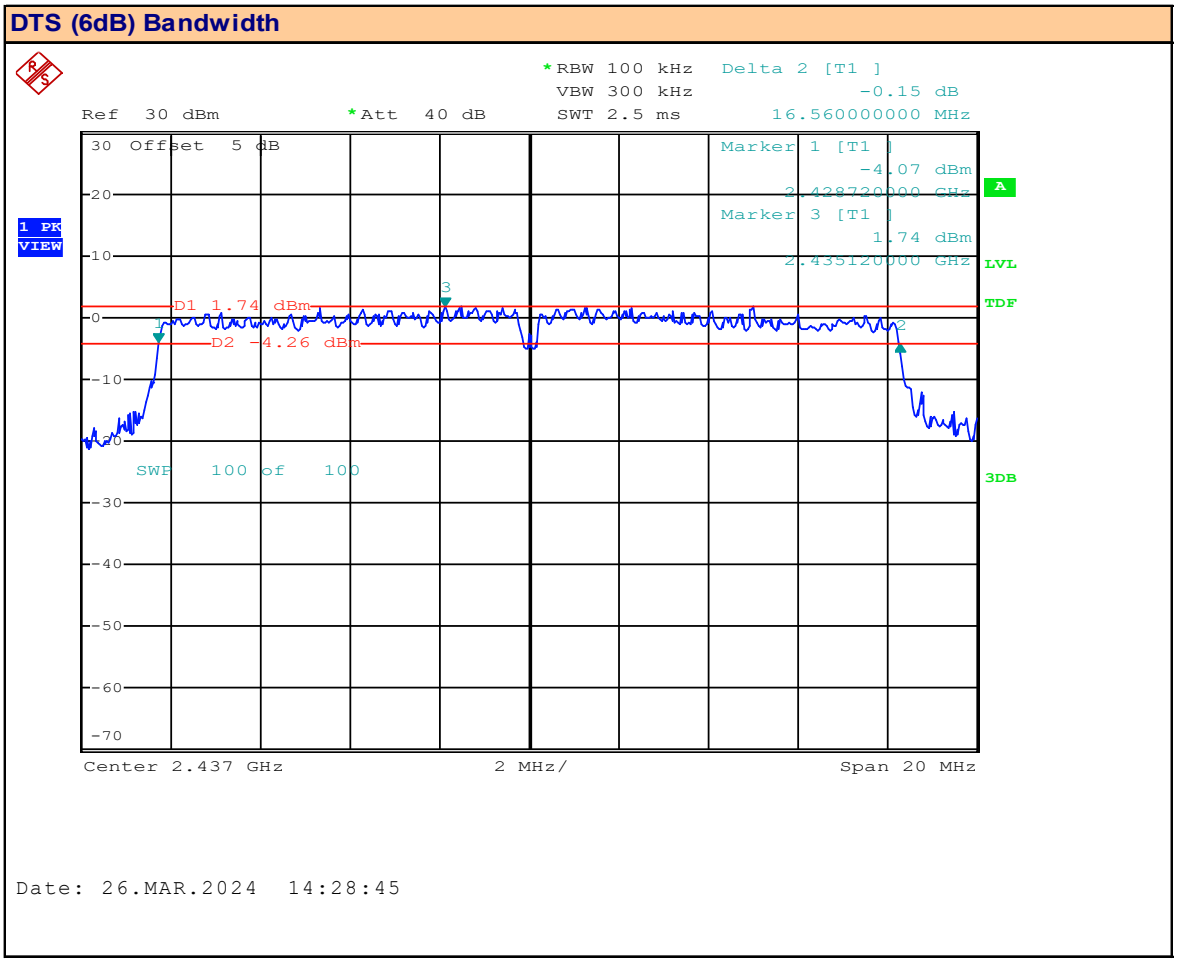
**Plot 8.2 – 6dB DTS Bandwidth 802.11g**




| | | | | | |
|---|---|---|---|---|---|
| **Channel:** | **6** | | **Channel Frequency:** | **2437** | **MHz** |
| **Mode:** | **802.11g** | | **Modulation:** | **OFDM 12** | |
| | | | **Measured Occupied Bandwidth:** | **16.56** | **MHz** |

**Plot 8.3 – 6dB DTS Bandwidth 802.11n**




| | | | | | |
|---|---|---|---|---|---|
| **Channel:** | **6** | | **Channel Frequency:** | **2437** | **MHz** |
| **Mode:** | **802.11g** | | **Modulation:** | **OFDM 12** | |
| | | | **Measured Occupied Bandwidth:** | **16.56** | **MHz** |

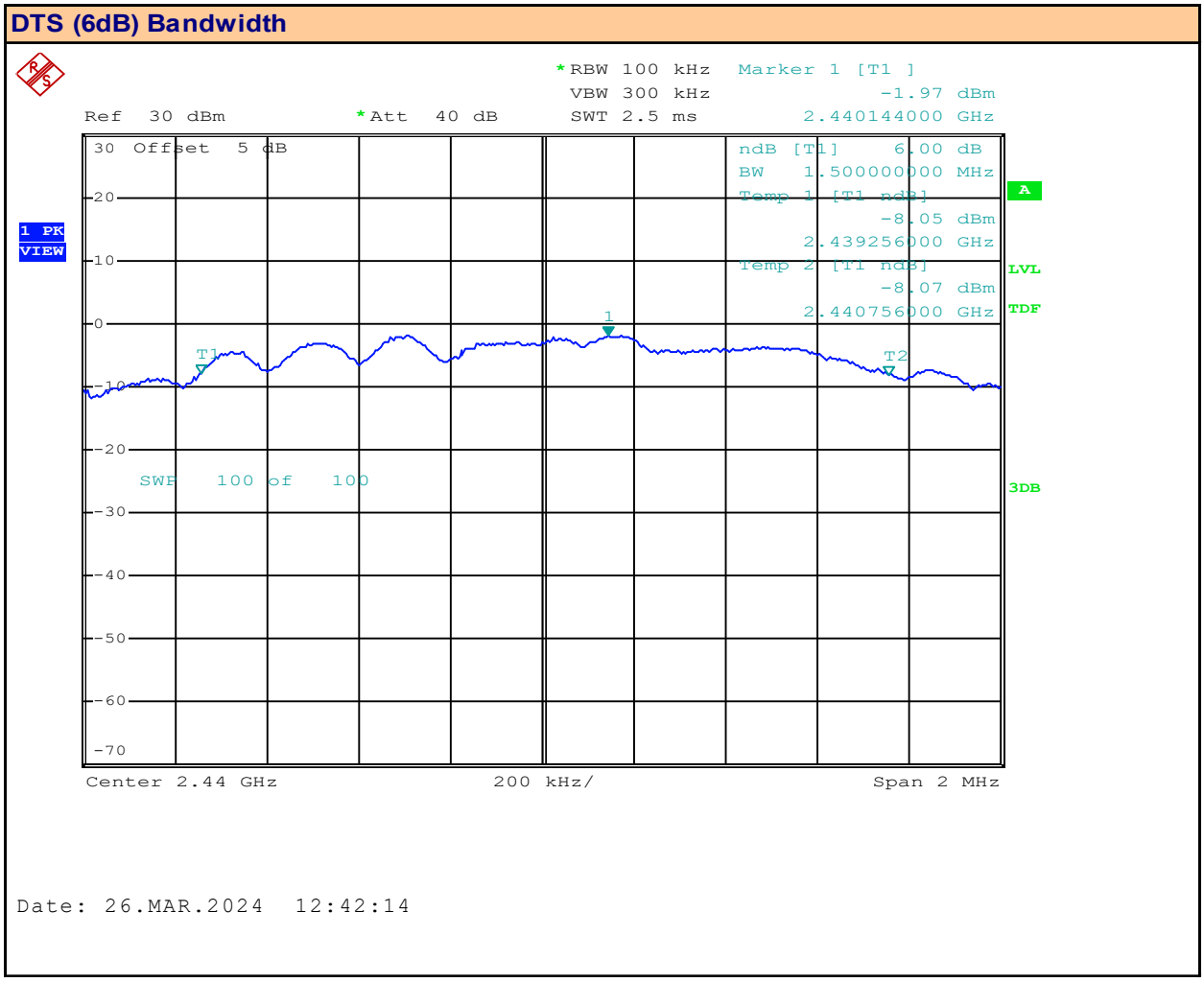
 

**Plot 8.4 – 6dB DTS Bandwidth BLE1**


| | | | |
|---|---|---|---|
| **Channel:** | 17 | **Channel Frequency:** | 2440 MHz |
| **Mode:** | BLE 1mb | **Modulation:** | GMSK |
| | | **Measured Occupied Bandwidth:** | 0.82 MHz |

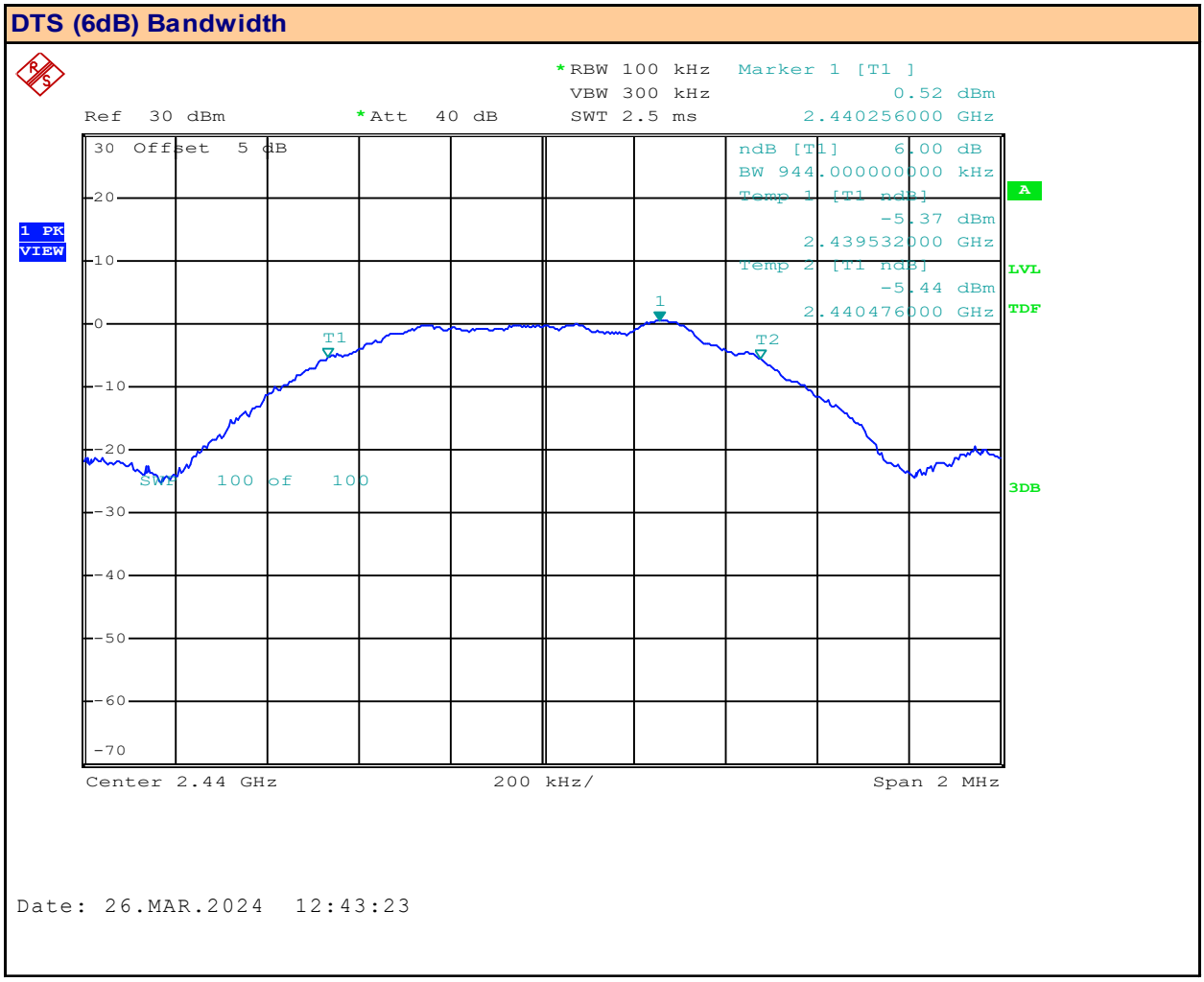
**Plot 8.5 – 6dB DTS Bandwidth BLE2**




| | | | |
|---|---|---|---|
| **Channel:** | 17 | **Channel Frequency:** | 2440 MHz |
| **Mode:** | BLE 2mb | **Modulation:** | GMSK |
| | | **Measured Occupied Bandwidth:** | 1.5 MHz |

**Plot 8.6 – 6dB DTS Bandwidth ANT**




| | | | |
|---|---|---|---|
| **Channel:** | **38** | **Channel Frequency:** | **2440** **MHz** |
| **Mode:** | **ANT** | **Modulation:** | **GFSK** |
| | | **Measured Occupied Bandwidth:** | **0.944** **MHz** |

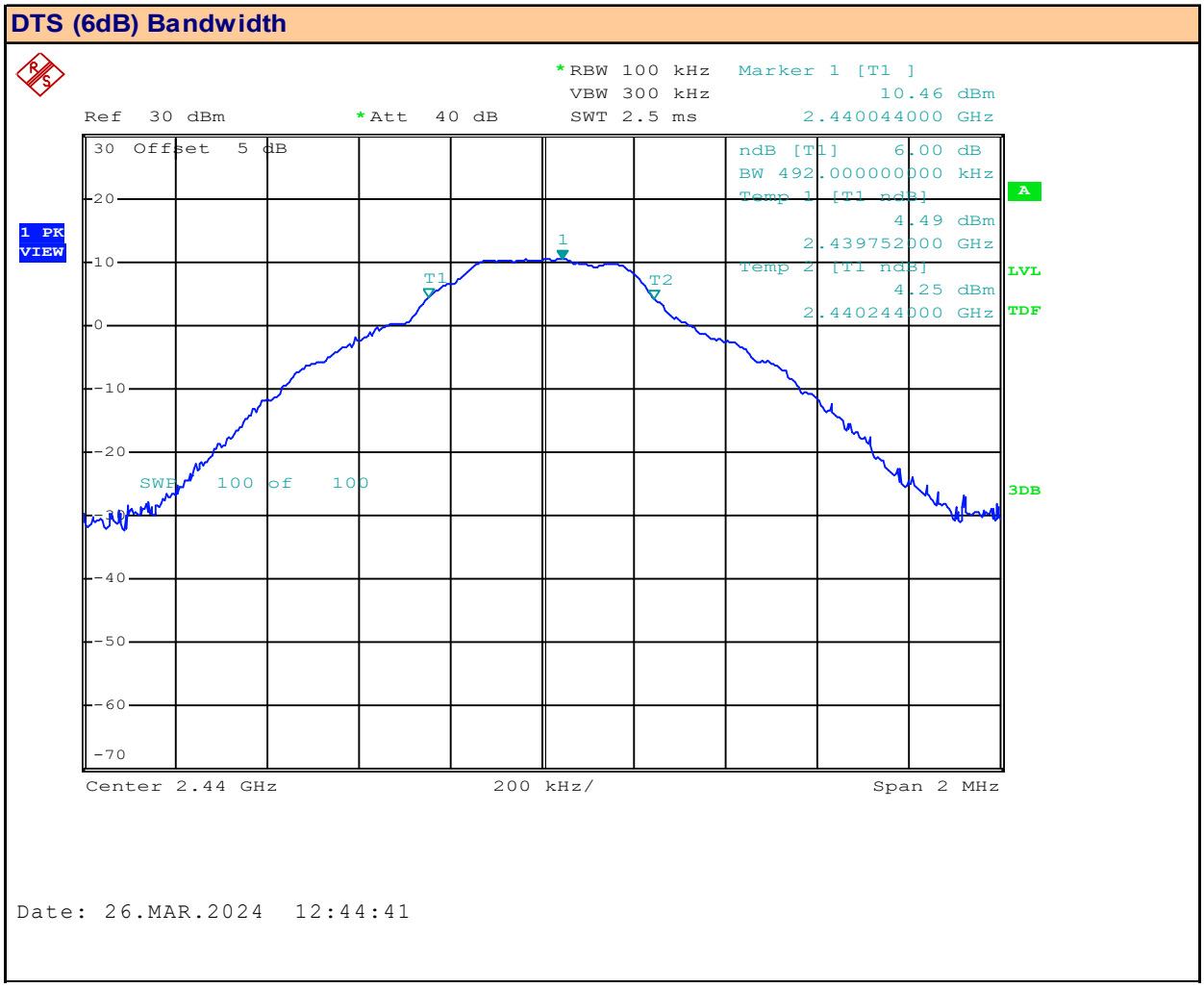
 

**Table 8.1 – Summary of 6dB DTS Bandwidth Measurements, (DTS**

| DTS Bandwidth Results: (DTS) | | | | | | |
|---|---|---|---|---|---|---|
| Channel Number | Channel Frequency (MHz) | Mode | Modulation | Measured 6dB BW [BW] (MHz) | Minimum 6dB BW [$BW_{Min}$] (MHz) | Margin (MHz) |
| 6 | 2437.0 | 802.11b | DSSS 5.5 | 5.96 | 0.50 | 5.46 |
| | | 802.11g | OFDM 12 | 16.60 | | 16.10 |
| | | 802.11n | MCS0 | 17.60 | | 17.10 |
| 17 | 2440.0 | BLE1 | GMSK | 0.82 | 0.50 | 0.32 |
| 17 | | BLE2 | GMSK | 1.50 | | 1.00 |
| 38 | | ANT | GFSK | 0.94 | | 0.44 |
| | | | | Result: | | Complies |

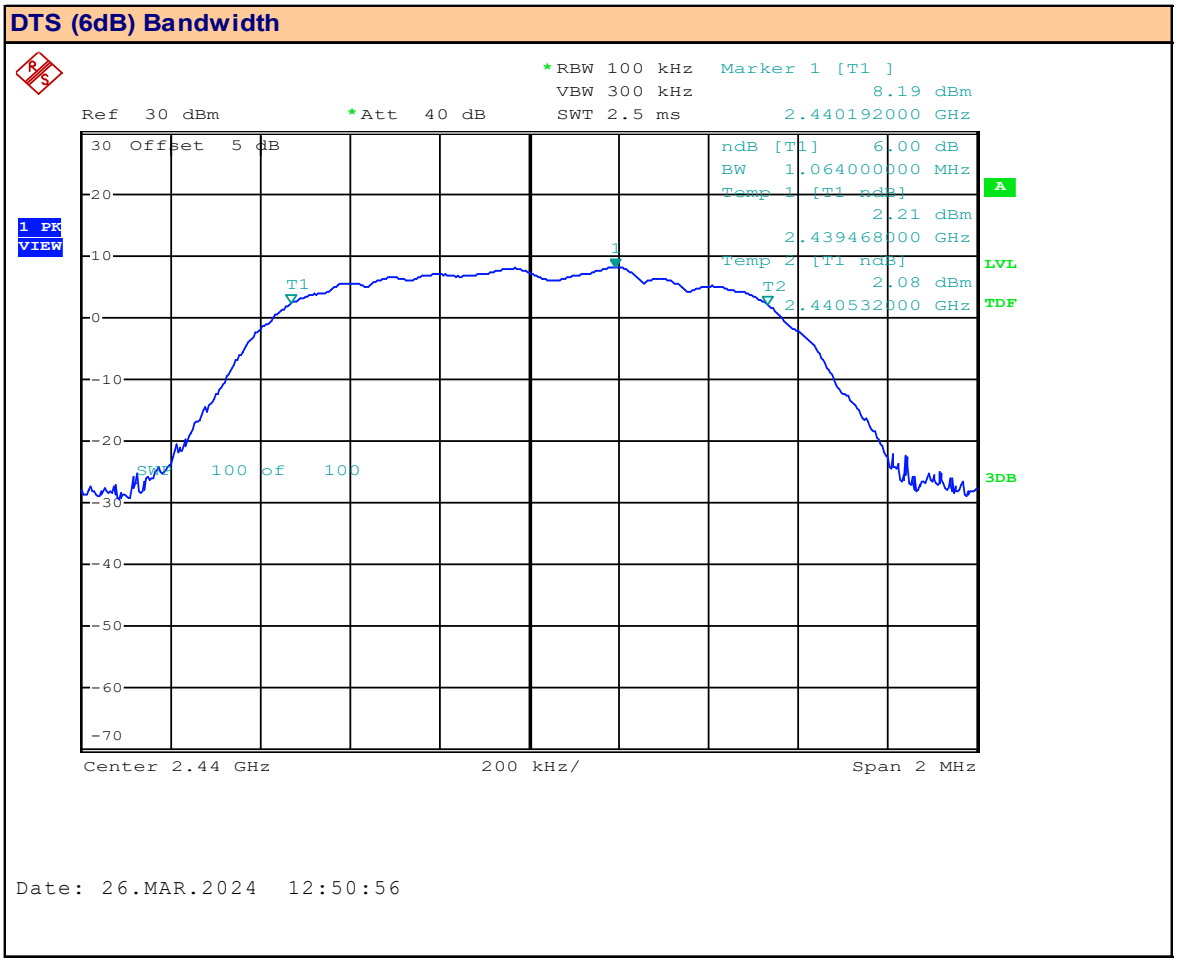
**Plot 8.7 – 6dB DTS Bandwidth, BT BR**




| | | | | | |
|---|---|---|---|---|---|
| **Channel:** | **38** | | **Channel Frequency:** | **2440** | **MHz** |
| **Mode:** | **BT BR** | | **Modulation:** | **GFSK** | |
| | | | **Measured Occupied Bandwidth:** | **492** | **kHz** |

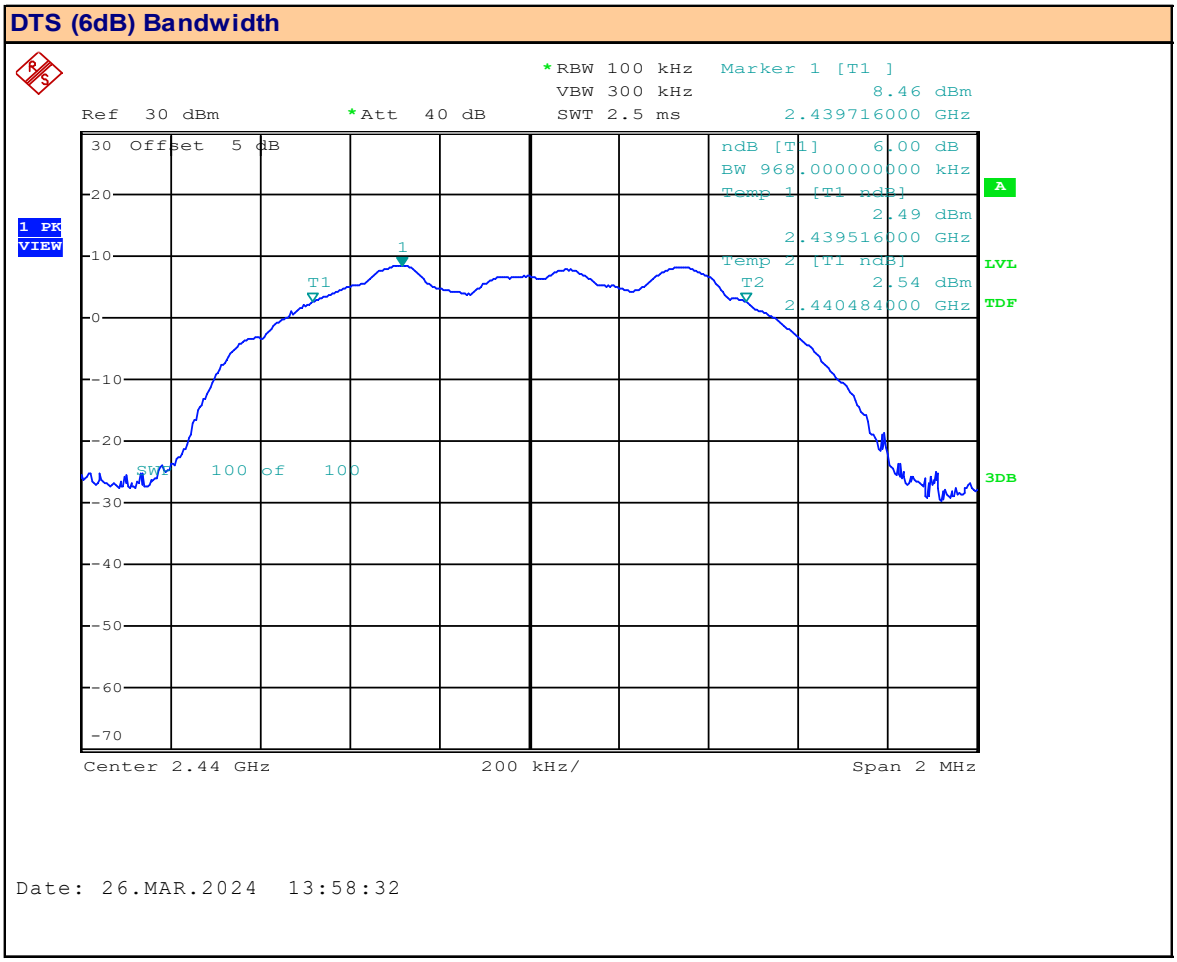
**Plot 8.8 – 6dB DTS Bandwidth, BT 2EDR**




| | | | | | |
|---|---|---|---|---|---|
| **Channel:** | **38** | | **Channel Frequency:** | **2440** | **MHz** |
| **Mode:** | **BT 2EDR** | | **Modulation:** | **Pi/4-DQPSK** | |
| | | | **Measured Occupied Bandwidth:** | **1064** | **kHz** |

**Plot 8.9 – 6dB DTS Bandwidth, BT 3EDR**




| | | | | | |
|---|---|---|---|---|---|
| **Channel:** | **38** | | **Channel Frequency:** | **2440** | **MHz** |
| **Mode:** | **BT 3EDR** | | **Modulation:** | **8-DPSK** | |
| | | | **Measured Occupied Bandwidth:** | **968** | **kHz** |

**Table 8.2 – Summary of 6dB DTS Bandwidth Measurements, (DSS)**

| DTS Bandwidth Results: (DSS) | | | | | |
|---|---|---|---|---|---|
| Channel Number | Channel Frequency (MHz) | Mode | Modulation | Measured 6dB BW [BW] (kHz) | Margin |
| 38 | 2440.0 | BT BR | GFSK | 492.00 | n/a |
| | | BT 2EDR | Pi/4-DQPSK | 1064.00 | |
| | | BT 3EDR | 8-DPSK | 968.00 | |
| | | | | Result: | Complies |

## 9.0 ANTENNA PORT CONDUCTED POWER, (DTS)

| Test Procedure | |
|---|---|
| Normative Reference | FCC 47 CFR §2.1046, §15.247(b)(3), RSS-Gen (6.1.2), RSS-247 (5.4)(d), KDB 558074 (8.3.2), ANSI C63.10 (11.9.2.2.2) |

| Limits | |
|---|---|
| 47 CFR §15.247(b)(3) | (b) The maximum peak conducted output power of the intentional radiator shall not exceed the following:<br>(3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. |
| RSS-247 (5.4)(d) | **5.4 Transmitter output power and equivalent isotropically radiated power (e.i.r.p.)**<br>Devices shall comply with the following requirements, where applicable:<br>d) For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1W. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e).<br>As an alternative to a peak power measurement, compliance can be based on a measurement of the maximum conducted output power. |

**Table 9.1 – Summary of Conducted Power Measurements, (DTS)**

See Appendix D for Measurement Plots

| Conducted Power Measurement Results: DTS | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Channel Number | Channel Frequency (MHz) | Mode | Modulation | Rated Power (EIRP) | Measured Power [$P_{Meas}$] (dBm) | Limit [$P_{Lim}$] (dBm) | Conducted Margin (dB) | Antenna Gain [G] (dBi) | EIRP [$E_{Meas}$] (dBm) | EIRP Limit [$E_{Lim}$] (dBm) | EIRP Margin (dB) |
| 6 | 2437.00 | 802.11b | CCK 1 | 12.2 | 15.080 | 30 | 14.9 | -3.8 | 11.3 | 36 | 24.7 |
| | | | CCK 2 | | 15.270 | | 14.7 | | 11.5 | | 24.5 |
| | | | DSSS 5.5 | | 15.560 | | 14.4 | | 11.8 | | 24.2 |
| | | | DSSS 11 | | 15.100 | | 14.9 | | 11.3 | | 24.7 |
| 1 | 2412.00 | | DSSS 5.5 | | 15.630 | | 14.4 | | 11.8 | | 24.2 |
| 2 | 2417.00 | | | | 15.720 | | 14.3 | | 11.9 | | 24.1 |
| 11 | 2462.00 | | | | 15.070 | | 14.9 | | 11.3 | | 24.7 |
| 13 | 2472.00 | | | | 15.070 | | 14.9 | | 11.3 | | 24.7 |
| 6 | 2437.00 | 802.11g | OFDM6 | 11.2 | 14.140 | | 15.9 | | 10.3 | | 25.7 |
| | | | OFDM9 | | 14.640 | | 15.4 | | 10.8 | | 25.2 |
| | | | OFDM12 | | 14.640 | | 15.4 | | 10.8 | | 25.2 |
| 1 | 2412.00 | | | | 12.580 | | 17.4 | | 8.8 | | 27.2 |
| 2 | 2417.00 | | | | 14.910 | | 15.1 | | 11.1 | | 24.9 |
| 11 | 2462.00 | | | | 14.200 | | 15.8 | | 10.4 | | 25.6 |
| 13 | 2472.00 | | | | 11.380 | | 18.6 | | 7.6 | | 28.4 |
| 6 | 2437.00 | 802.11n | MCS0 | | 14.440 | | 15.6 | | 10.6 | | 25.4 |
| | | | MCS3 | | 13.680 | | 16.3 | | 9.9 | | 26.1 |
| | | | MCS7 | | 8.800 | | 21.2 | | 5.0 | | 31.0 |
| 1 | 2412.00 | | MCS0 | | 14.610 | | 15.4 | | 10.8 | | 25.2 |
| 11 | 2462.00 | | | | 13.860 | | 16.1 | | 10.1 | | 25.9 |
| 13 | 2472.00 | | | | 12.100 | | 17.9 | | 8.3 | | 27.7 |
| | | | | | | | | | | Result: | Complies |

Conducted Margin = Conducted Limit [$P_{Limit}$] - Measure Power [$P_{Meas}$]

EIRP [$E_{Meas}$] = Measure Power [$P_{Meas}$] + Antenna Gain [G]

EIRP Margin = EIRP Limit [$E_{Lim}$] - EIPR [$E_{Meas}$]

**Table 9.1 – Summary of Conducted Power Measurements, (DTS) – Cont.**

See Appendix D for Measurement Plots

| Conducted Power Measurement Results: DTS | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Channel Number | Channel Frequency (MHz) | Mode | Modulation | Rated Power (EIRP) | Measured Power [$P_{Meas}$] (dBm) | Limit [$P_{Lim}$] (dBm) | Conducted Margin (dB) | Antenna Gain [G] (dBi) | EIRP [$E_{Meas}$] (dBm) | EIRP Limit [$E_{Lim}$] (dBm) | EIRP Margin (dB) |
| 37 | 2402.00 | BLE 1mb | GMSK | -2.8 | -1.67 | 30 | 31.7 | -3.8 | -5.5 | 36 | 41.5 |
| 17 | 2440.00 | | | | 0.70 | | 29.3 | | -3.1 | | 39.1 |
| 39 | 2480.00 | | | | -3.37 | | 33.4 | | -7.2 | | 43.2 |
| 1 | 2404.00 | BLE 2mb | | -2.3 | 1.48 | | 28.5 | | -2.3 | | 38.3 |
| 17 | 2440.00 | | | | 1.00 | | 29.0 | | -2.8 | | 38.8 |
| 36 | 2478.00 | | | | -3.63 | | 33.6 | | -7.4 | | 43.4 |
| 0 | 2402.00 | ANT | GFSK | -2.3 | -1.41 | | 31.4 | | -5.2 | | 41.2 |
| 38 | 2440.00 | | | | 1.07 | | 28.9 | | -2.7 | | 38.7 |
| 78 | 2480.00 | | | | -3.37 | | 33.4 | | -7.2 | | 43.2 |
| | | | | | | | | | | Result: | Complies |

Conducted Margin = Conducted Limit [$P_{Limit}$] - Measure Power [$P_{Meas}$]

EIRP [$E_{Meas}$] = Measure Power [$P_{Meas}$] + Antenna Gain [G]

EIRP Margin = EIRP Limit [$E_{Lim}$] - EIPR [$E_{Meas}$]

## 10.0 ANTENNA PORT CONDUCTED POWER, (DSS)

| Test Procedure | |
|---|---|
| Normative Reference | FCC 47 CFR §2.1046, §15.247(b)(3), RSS-Gen (6.1.2), RSS-247 (5.4)(d), KDB 558074 (8.3.2), ANSI C63.10 (11.9.2.2.2) |

| Limits | |
|---|---|
| 47 CFR §15.247(b)(3) | (b) The maximum peak conducted output power of the intentional radiator shall not exceed the following:<br>(3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. |
| RSS-247 (5.4)(d) | **5.4 Transmitter output power and equivalent isotropically radiated power (e.i.r.p.)**<br>Devices shall comply with the following requirements, where applicable:<br>d) For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1W. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e).<br>As an alternative to a peak power measurement, compliance can be based on a measurement of the maximum conducted output power. |

**Table 10.1 – Summary of Conducted Power Measurements, (DSS)**

See Appendix D for Measurement Plots

| Conducted Power Measurement Results: DSS | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Channel Number | Channel Frequency (MHz) | Mode | Modulation | Rated Power (EIRP) | Measured Power [$P_{Meas}$] (dBm) | Limit [$P_{Lim}$] (dBm) | Conducted Margin (dB) | Antenna Gain [G] (dBi) | EIRP [$E_{Meas}$] (dBm) | EIRP Limit [$E_{Lim}$] (dBm) | EIRP Margin (dB) |
| 2 | 2404.00 | BT BR | GFSK | 6.2 | 10.00 | 30 | 20.0 | -3.8 | 6.2 | 36 | 29.8 |
| 38 | 2440.00 | | | | 9.91 | | 20.1 | | 6.1 | | 29.9 |
| 78 | 2480.00 | | | | 8.93 | | 21.1 | | 5.1 | | 30.9 |
| 2 | 2404.00 | BT 2EDR | Pi/4-DQPSK | | 9.16 | | 20.8 | | 5.4 | | 30.6 |
| 38 | 2440.00 | | | | 9.30 | | 20.7 | | 5.5 | | 30.5 |
| 78 | 2480.00 | | | | 8.26 | | 21.7 | | 4.5 | | 31.5 |
| 2 | 2404.00 | BT 3EDR | 8-DPSK | | 9.17 | | 20.8 | | 5.4 | | 30.6 |
| 38 | 2440.00 | | | | 9.12 | | 20.9 | | 5.3 | | 30.7 |
| 78 | 2480.00 | | | | 8.10 | | 21.9 | | 4.3 | | 31.7 |
| | | | | | | | | | | Result: | Complies |

Conducted Margin = Conducted Limit [$P_{Limit}$] - Measure Power [$P_{Meas}$]

EIRP [$E_{Meas}$] = Measure Power [$P_{Meas}$] + Antenna Gain [G]

EIRP Margin = EIRP Limit [$E_{Lim}$] - EIPR [$E_{Meas}$]

## 11.0 POWER SPECTRAL DENSITY

| Test Procedure | |
|---|---|
| Normative Reference | FCC 47 CFR §15.247(e), RSS-247 (5.2)(b), |
| | KDB 558074 (10.3), ANSI C63.10 (11.10.3) |

| Limits | |
|---|---|
| 47 CFR §15.247(e) | (e) For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density. |
| RSS-247 (5.2)(b) | b) The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of section 5.4(d), (i.e. the power spectral density shall be determined using the same method as is used to determine the conducted output power). |
| KDB 558074 (10.3)<br>C63.10 (11.10.3) | **Method AVGPSD-1** (trace averaging with EUT transmitting at full power throughout each sweep)<br>This procedure may be used when the maximum (average) conducted output power was used to demonstrate compliance to the output power limit. This is the baseline method for determining the maximum (average) conducted PSD level. If the instrument has an RMS power averaging detector, it must be used; otherwise, use the sample detector. The EUT must be configured to transmit continuously (duty cycle ≥ 98 %); otherwise sweep triggering/signal gating must be implemented to ensure that measurements are made only when the EUT is transmitting at its maximum power control level (no transmitter off time is to be considered).<br>a) Set instrument center frequency to DTS channel center frequency.<br>b) Set span to at least 1.5 X OBW.<br>c) Set RBW to: 3 kHz ≤ RBW ≤ 100 kHz. .<br>d) Set VBW ≥ 3 X RBW.<br>e) Detector = RMS<br>f) Ensure that the number of measurement points in the sweep ≥ 2 X span/RBW.<br>g) Sweep time = auto couple.<br>h) Employ trace averaging (RMS) mode over a minimum of 100 traces.<br>i) Use the peak marker function to determine the maximum amplitude level.<br>j) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat (note that this may require zooming in on the emission of interest and reducing the span in order to meet the minimum measurement point requirement as the RBW is reduced). |
| Test Setup | **Appendix A Figure A.1** |

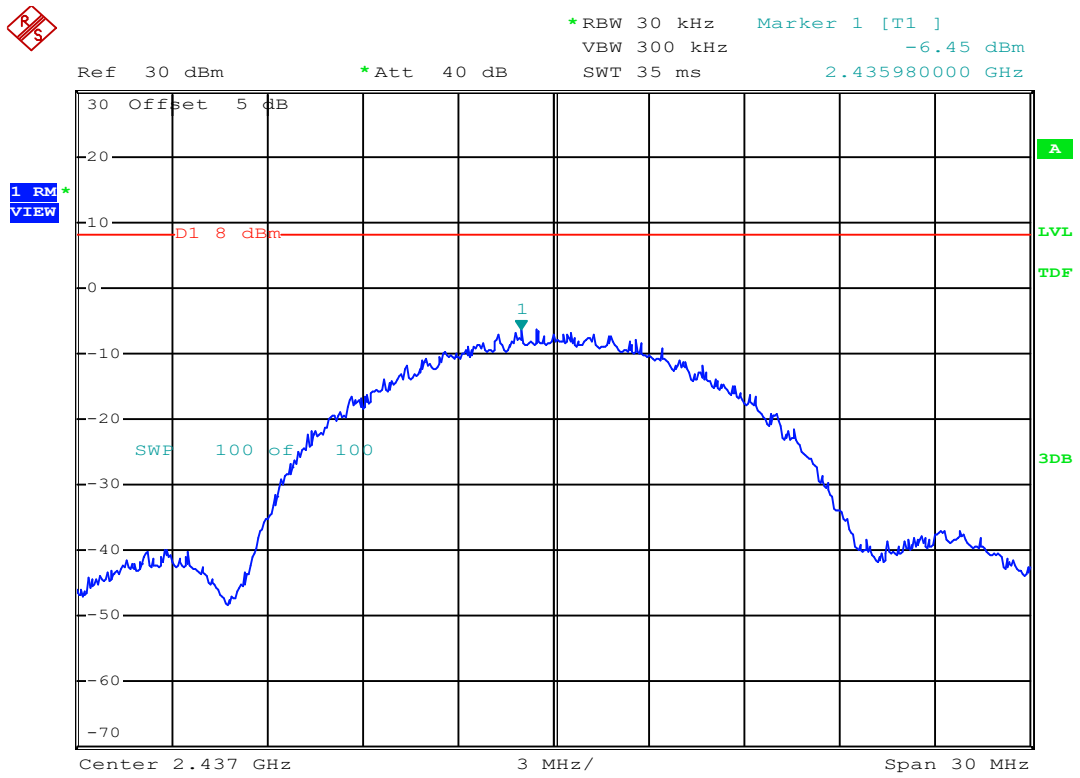
### Measurement Procedure

The DUT was connected to a Spectrum Analyzer (SA) via a 30dB attenuator connected to the DUT's antenna port. The SA was configured as described above. Number of Sweep Points ≥ 2 X Span / RBW = 2 X (1.5MHz / 3kHz ) = 1000, the SA was configured for 1001 Points. The output power of the DUT was set to the manufacturer's highest output power setting at the Low, Mid and High frequency channels as permitted by the device. The DUT was set to transmit at 100% Duty Cycle. The Power Spectral Density was measured and recorded.

**Plot 11.1 – Power Spectral Density, 802.11b**

## Power Spectral Density

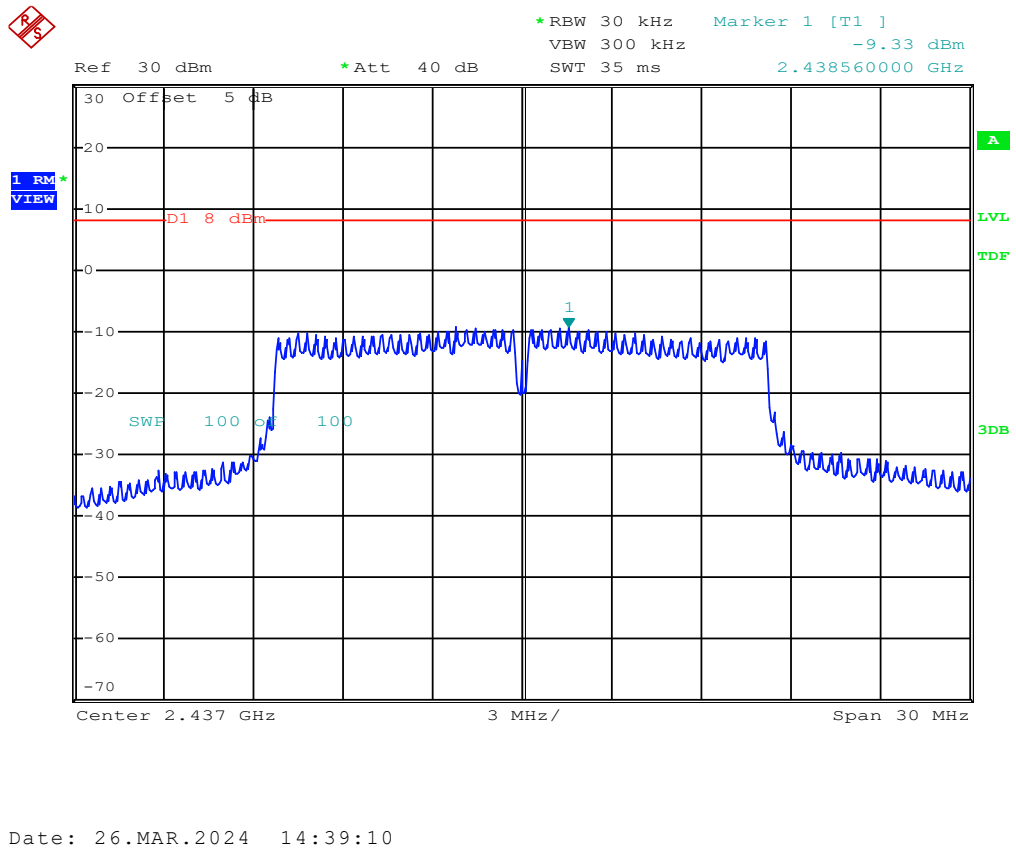



| | | | | | |
|---|---|---|---|---|---|
| **Channel:** | **6** | | **Channel Frequency:** | **2437** | **MHz** |
| **Mode:** | **802.11b** | | **Modulation:** | **DSSS 5.5** | |
| | | | **Measured PSD:** | **-6.45** | **dBm** |

**Plot 11.2 – Power Spectral Density, 802.11g**

**Power Spectral Density**

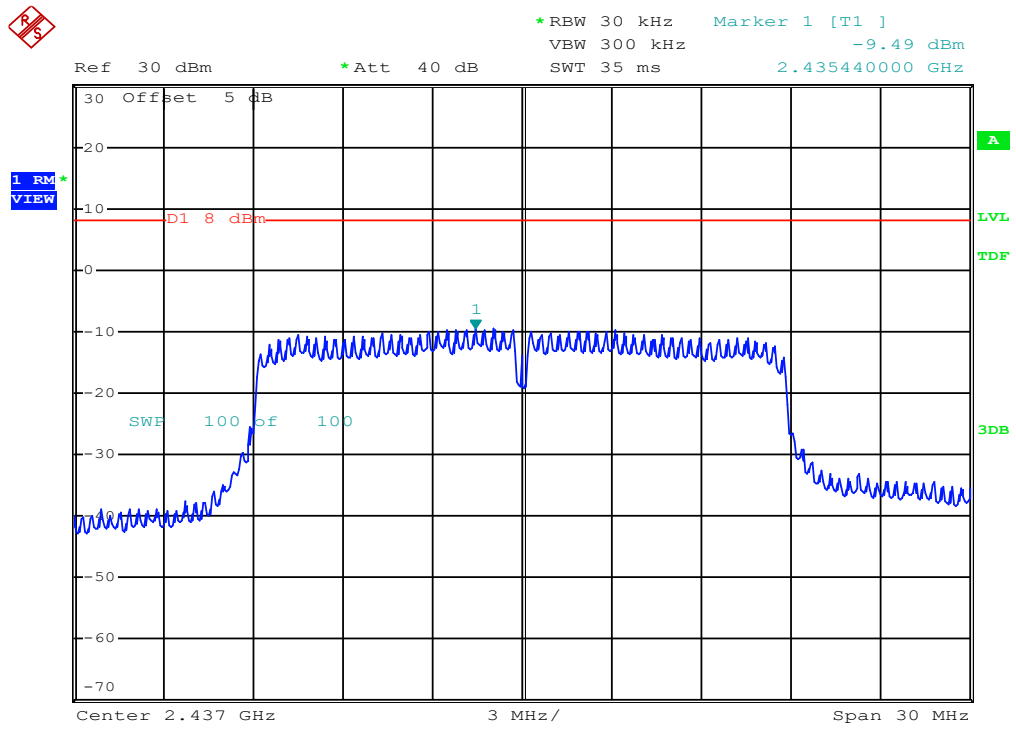



| | | | |
|---|---|---|---|
| **Channel:** | 6 | **Channel Frequency:** | 2437 MHz |
| **Mode:** | 802.11g | **Modulation:** | OFDM12 |
| | | **Measured PSD:** | -9.33 dBm |

**Plot 11.3 – Power Spectral Density, 802.11n**

**Power Spectral Density**

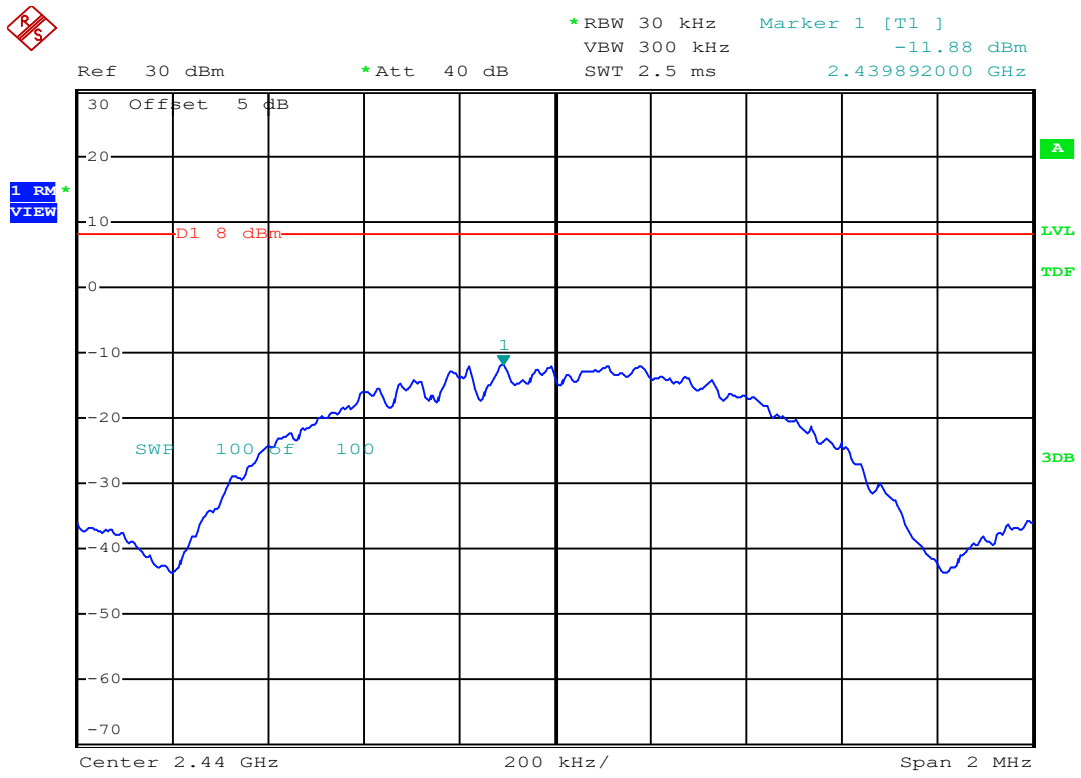



| | | | | | |
|---|---|---|---|---|---|
| **Channel:** | **6** | | **Channel Frequency:** | **2437** | **MHz** |
| **Mode:** | **802.11n** | | **Modulation:** | **MCS0** | |
| | | | **Measured PSD:** | **-9.49** | **dBm** |

**Plot 11.4 – Power Spectral Density, BLE1**

## Power Spectral Density

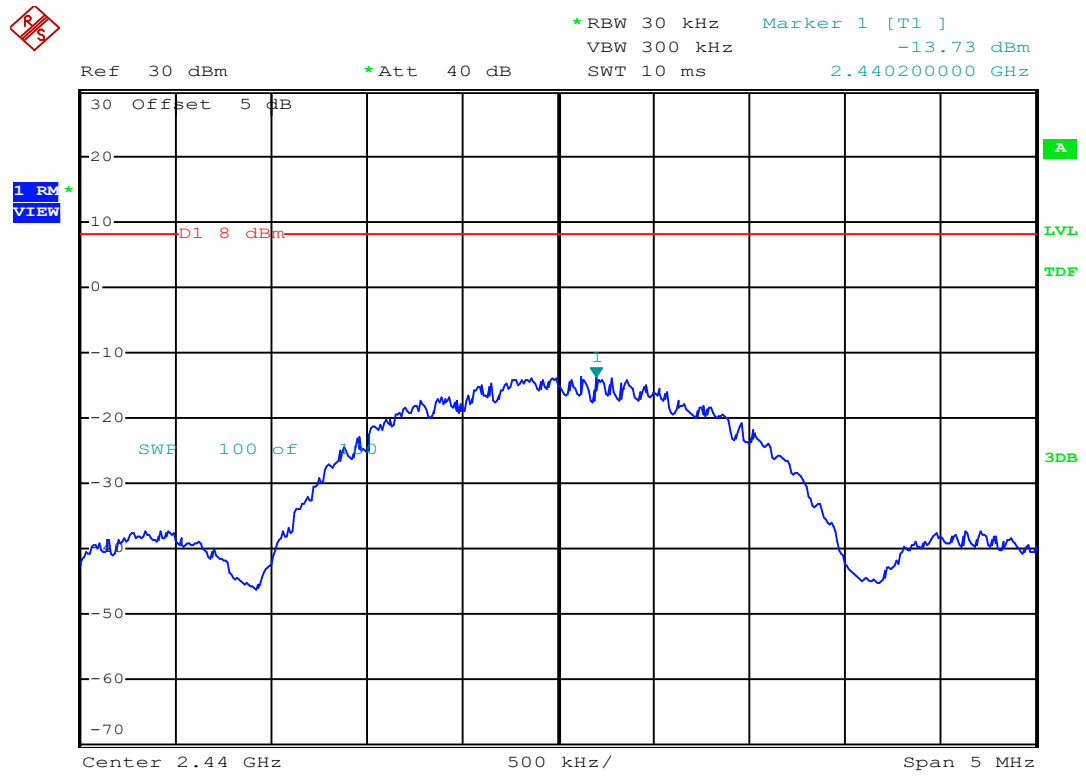



| | | | | |
|---|---|---|---|---|
| **Channel:** | **17** | **Channel Frequency:** | **2440** | **MHz** |
| **Mode:** | **BLE 1mb** | **Modulation:** | **GMSK** | |
| | | **Measured PSD:** | **-11.88** | **dBm** |

**Plot 11.5 – Power Spectral Density, BLE2**

## Power Spectral Density

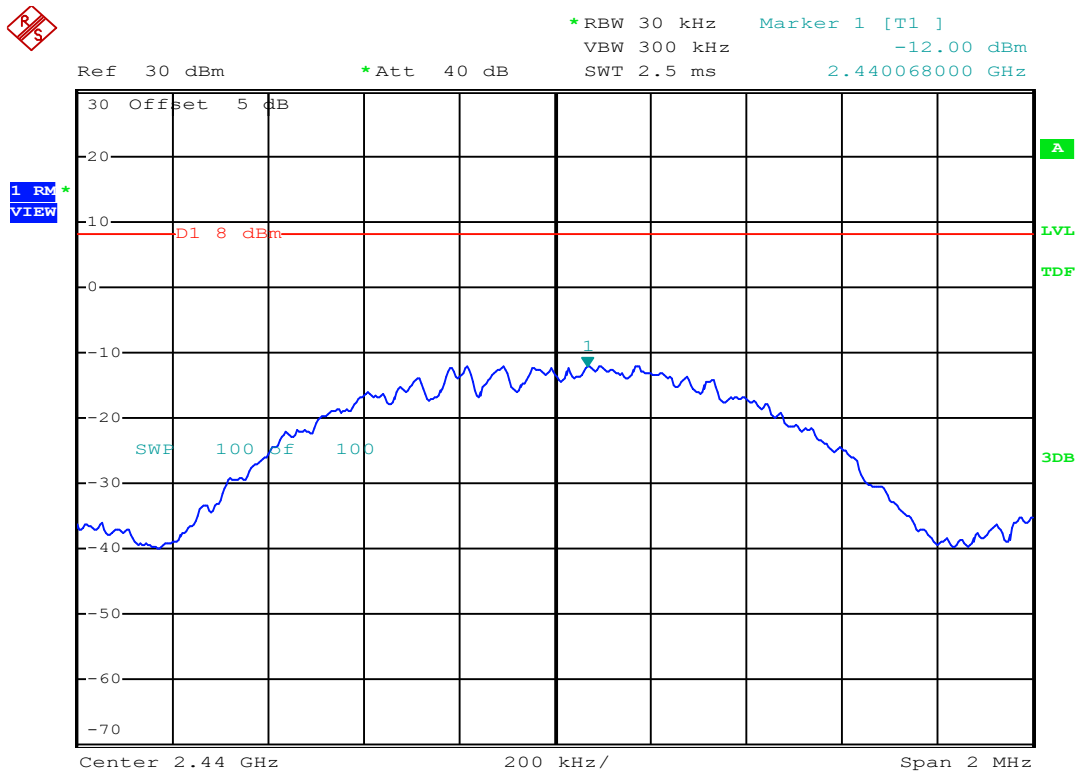



| | | | | | |
|---|---|---|---|---|---|
| **Channel:** | 17 | | **Channel Frequency:** | 2440 | MHz |
| **Mode:** | BLE 2mb | | **Modulation:** | GMSK | |
| | | | **Measured PSD:** | -13.73 | dBm |

**Plot 11.6 – Power Spectral Density, ANT**

## Power Spectral Density




| | | | | |
|---|---|---|---|---|
| **Channel:** | 38 | **Channel Frequency:** | 2440 | MHz |
| **Mode:** | ANT | **Modulation:** | GFSK | |
| | | **Measured PSD:** | -12 | dBm |

**Table 11.1 – Summary of Power Spectral Density Measurements, (DTS)**

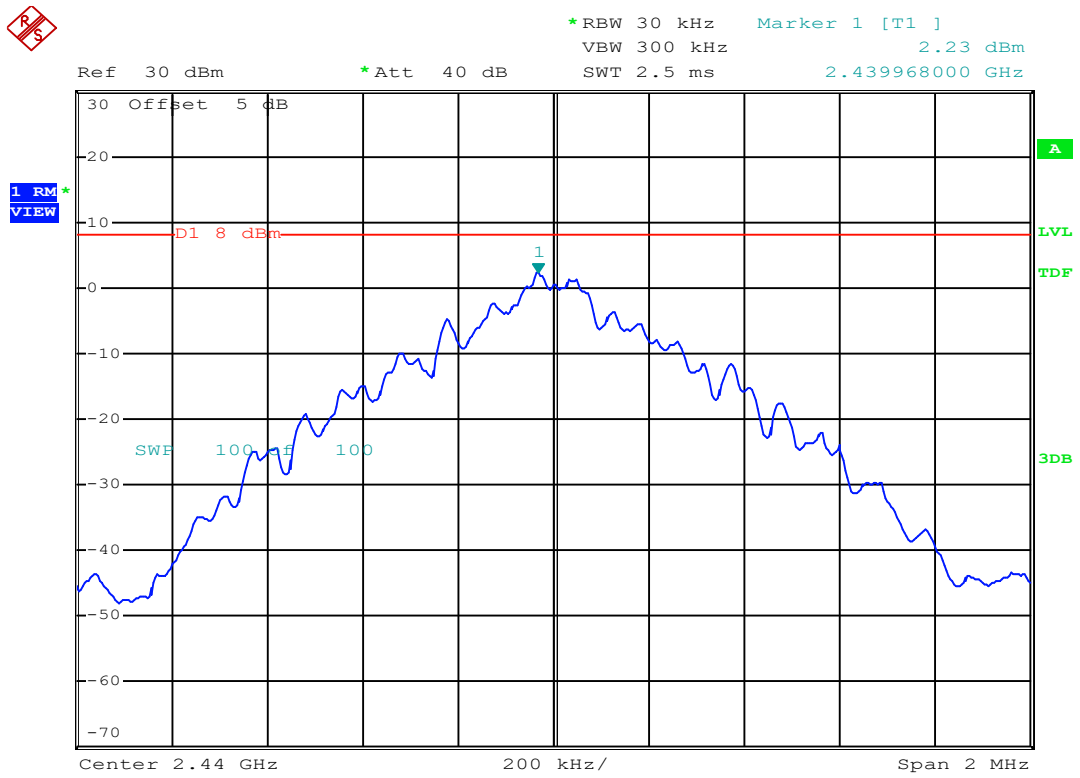
| PSD Results: | | | | | | |
|---|---|---|---|---|---|---|
| Channel Number | Channel Frequency (MHz) | Mode | Modulation | Measured PSD [$P_{Meas}$] (dBm) | PSD Limit [$P_{Lim}$] (dBm) | Margin (dB) |
| 6 | 2437.0 | 802.11b | DSSS 5.5 | -6.45 | 8.0 | 14.45 |
| | | 802.11g | OFDM12 | -9.33 | | 17.33 |
| | | 802.11n | MCS0 | -9.49 | | 17.49 |
| 17 | 2440.0 | BLE1 | GMSK | -11.88 | 8.0 | 19.88 |
| 17 | | BLE2 | GMSK | -13.73 | | 21.73 |
| 38 | | ANT | GFSK | -12.00 | | 20.00 |
| | | | | | Result: | Complies |

Margin = [$P_{Lim}$] - [$P_{Meas}$]

**Plot 11.7 – Power Spectral Density, BT BR**

## Power Spectral Density

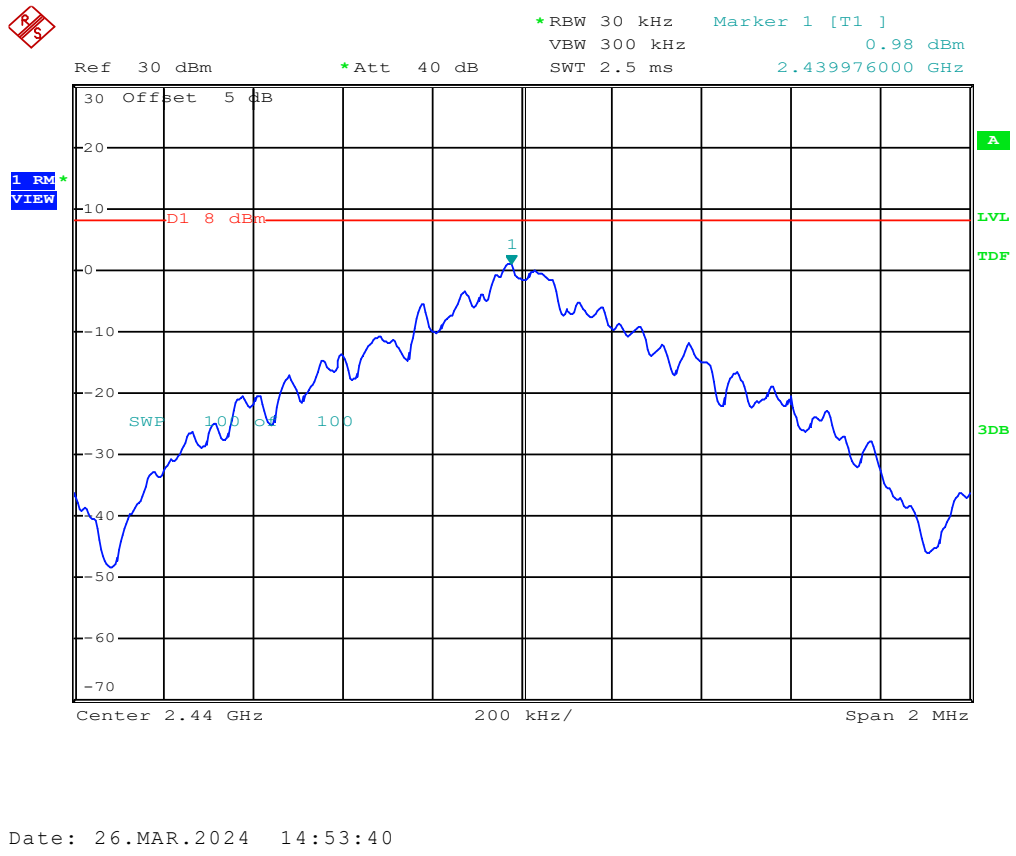



| | | | |
|---|---|---|---|
| **Channel:** | 38 | **Channel Frequency:** | 2440 MHz |
| **Mode:** | BT BR | **Modulation:** | GFSK |
| | | **Measured PSD:** | 2.23 dBm |

**Plot 11.8 – Power Spectral Density, BT 2EDR**

**Power Spectral Density**

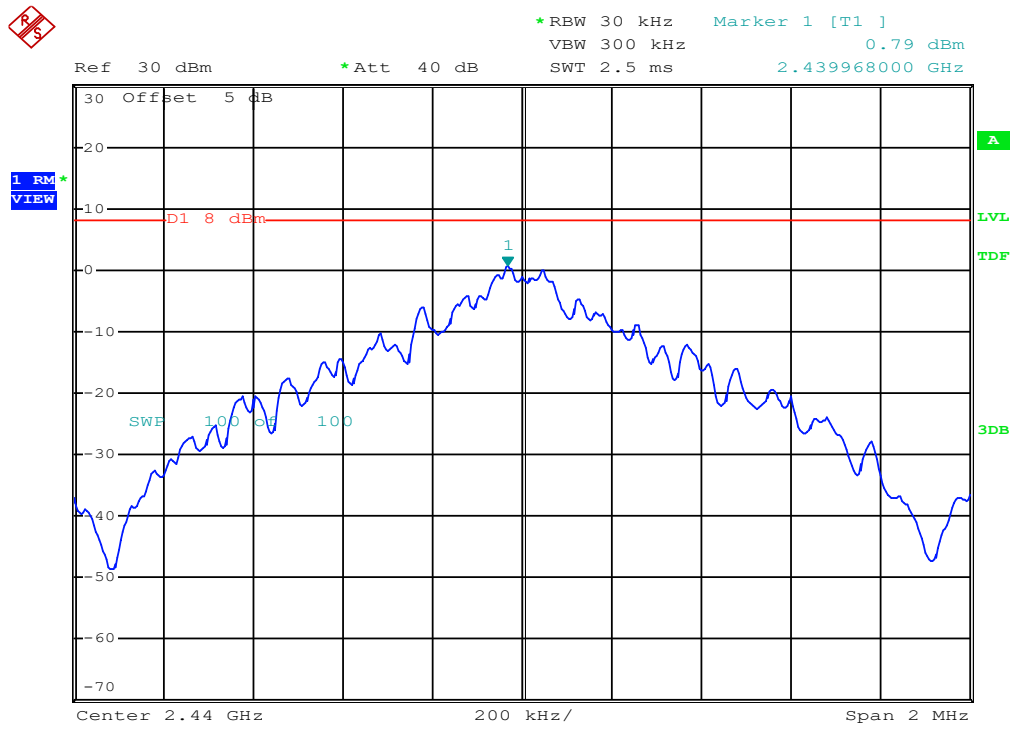



| | | | |
|---|---|---|---|
| **Channel:** | **38** | **Channel Frequency:** | **2440** **MHz** |
| **Mode:** | **BT 2EDR** | **Modulation:** | **Pi/4-DQPSK** |
| | | **Measured PSD:** | **0.98** **dBm** |

**Plot 11.9 – Power Spectral Density, BT 3EDR**

**Power Spectral Density**




| | | | |
|---|---|---|---|
| **Channel:** | **38** | **Channel Frequency:** | **2440** **MHz** |
| **Mode:** | **BT 3EDR** | **Modulation:** | **8-DPSK** |
| | | **Measured PSD:** | **0.79** **dBm** |

**Table 11.2 – Summary of Power Spectral Density Measurements, (DSS)**

| PSD Results: | | | | | | |
|---|---|---|---|---|---|---|
| Channel Number | Channel Frequency (MHz) | Mode | Modulation | Measured PSD [$P_{Meas}$] (dBm) | PSD Limit [$P_{Lim}$] (dBm) | Margin (dB) |
| 38 | 2440.0 | BT BR | GFSK | 2.23 | 8.0 | 5.77 |
| | | BT 2EDR | Pi/4-DQPSK | 0.98 | | 7.02 |
| | | BT 3EDR | 8-DPSK | 0.79 | | 7.21 |
| | | | | | Result: | Complies |

Margin = [$P_{Lim}$] - [$P_{Meas}$]

## 12.0 FHSS NUMBER OF HOPPING CHANNELS

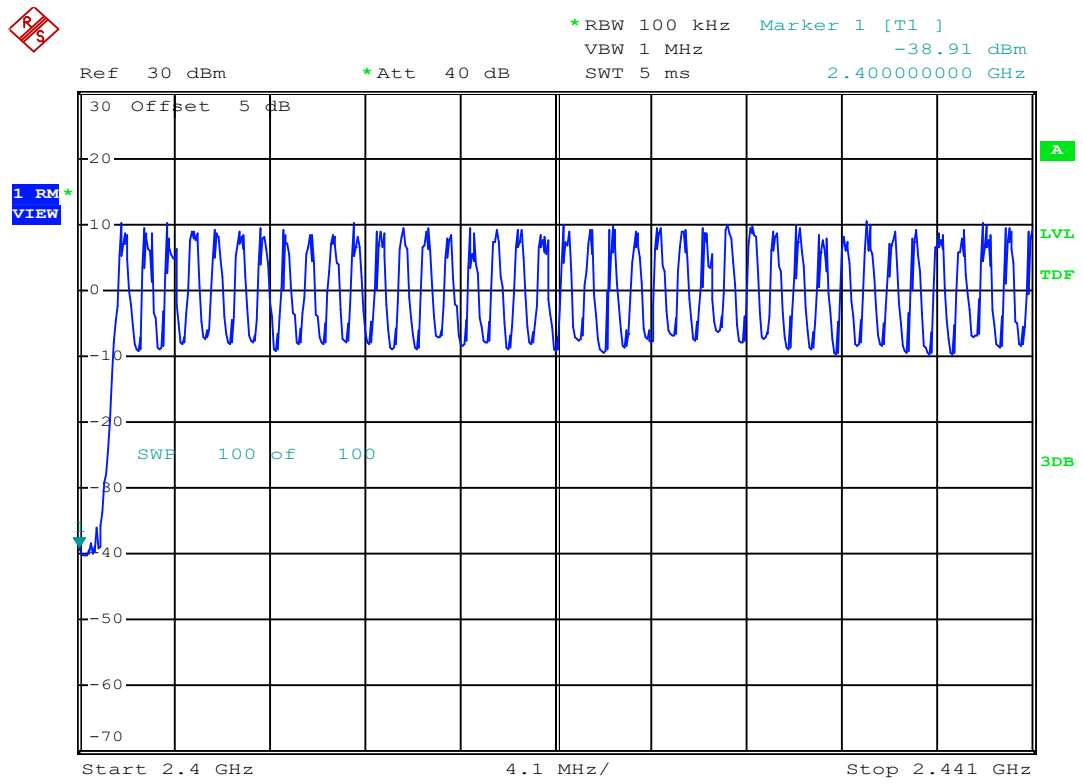
| Test Procedure | |
|---|---|
| Normative Reference | FCC 47 CFR §15.247, RSS-247 |
| | KDB 558074, ANSI C63.10 |

| Limits | |
|---|---|
| 47 CFR §15.247(a)(1) | (iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used. |
| RSS-247 (5.1)(d) | **5.1 Frequency hopping systems (FHS)**<br>The following applies to FHSs in each of the three bands:<br>FHSs operating in the band 2400-2483.5 MHz shall use at least 15 hopping channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds, multiplied by the number of hopping channels employed. Transmissions on particular hopping frequencies may be avoided or suppressed provided that at least 15 hopping channels are used. |

**Plot 12.1 – Number of Hopping Channels, BT BR**

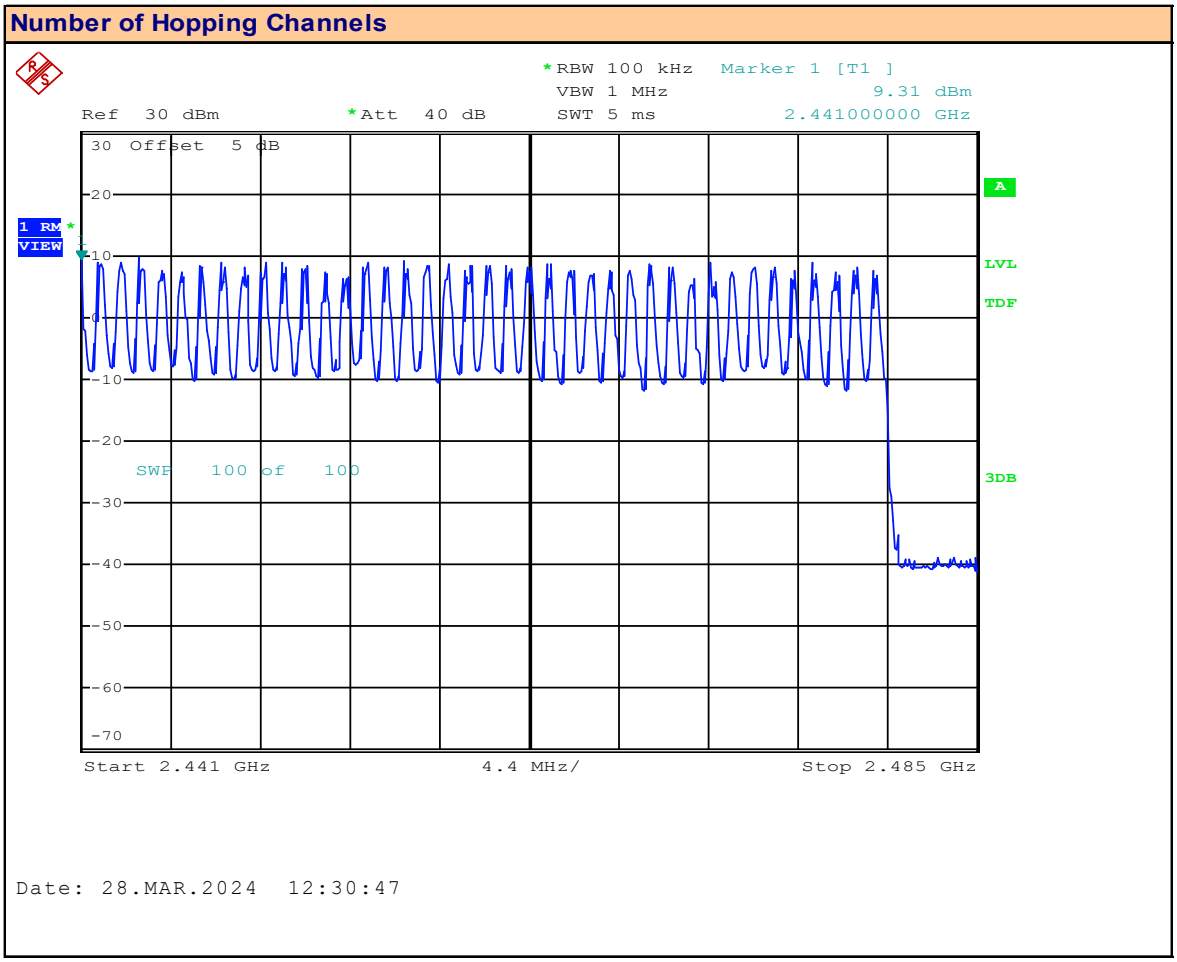
## Number of Hopping Channels




| | | | | | |
|---|---|---|---|---|---|
| **Start Freq:** | 2400 | MHz | **Stop Freq:** | 2441 | MHz |
| **Mode:** | BT BR | | **Modulation:** | GFSK | |
| | | | **Number of Channels:** | 40 | kHz |

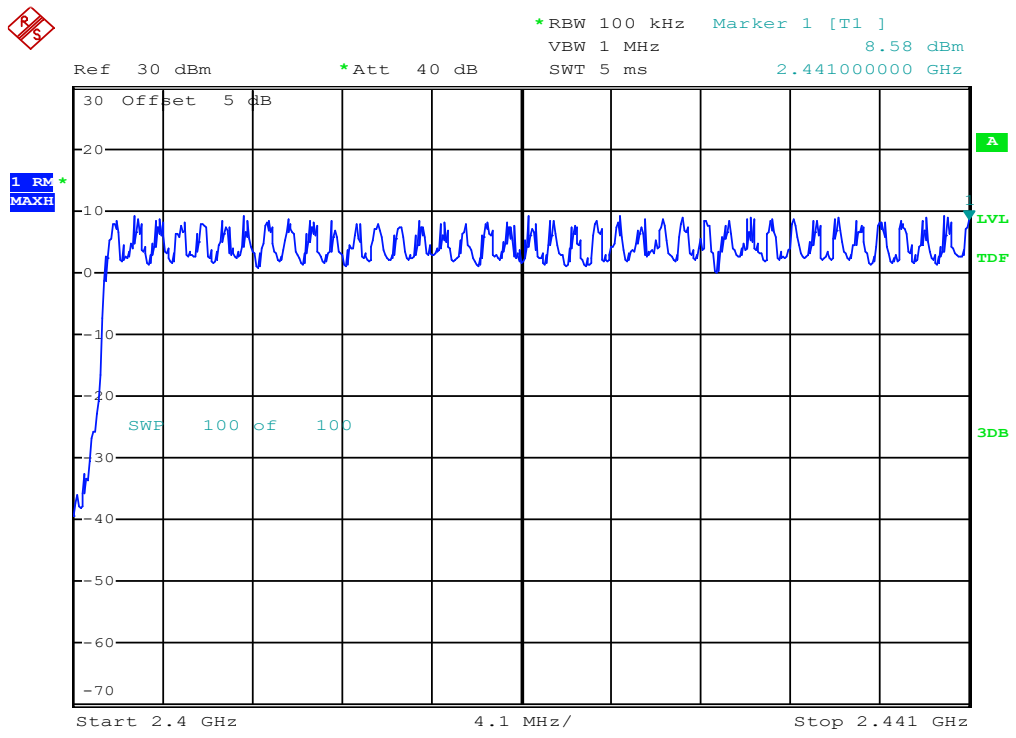
**Plot 12.2 – Number of Hopping Channels, BT BR**




| | | | | | |
|---|---|---|---|---|---|
| Start Freq: | 2441 | MHz | Stop Freq: | 2485 | MHz |
| Mode: | BT BR | | Modulation: | GFSK | |
| | | | Number of Channels: | 39 | kHz |

**Plot 12.3 – Number of Hopping Channels, BT 2EDR**

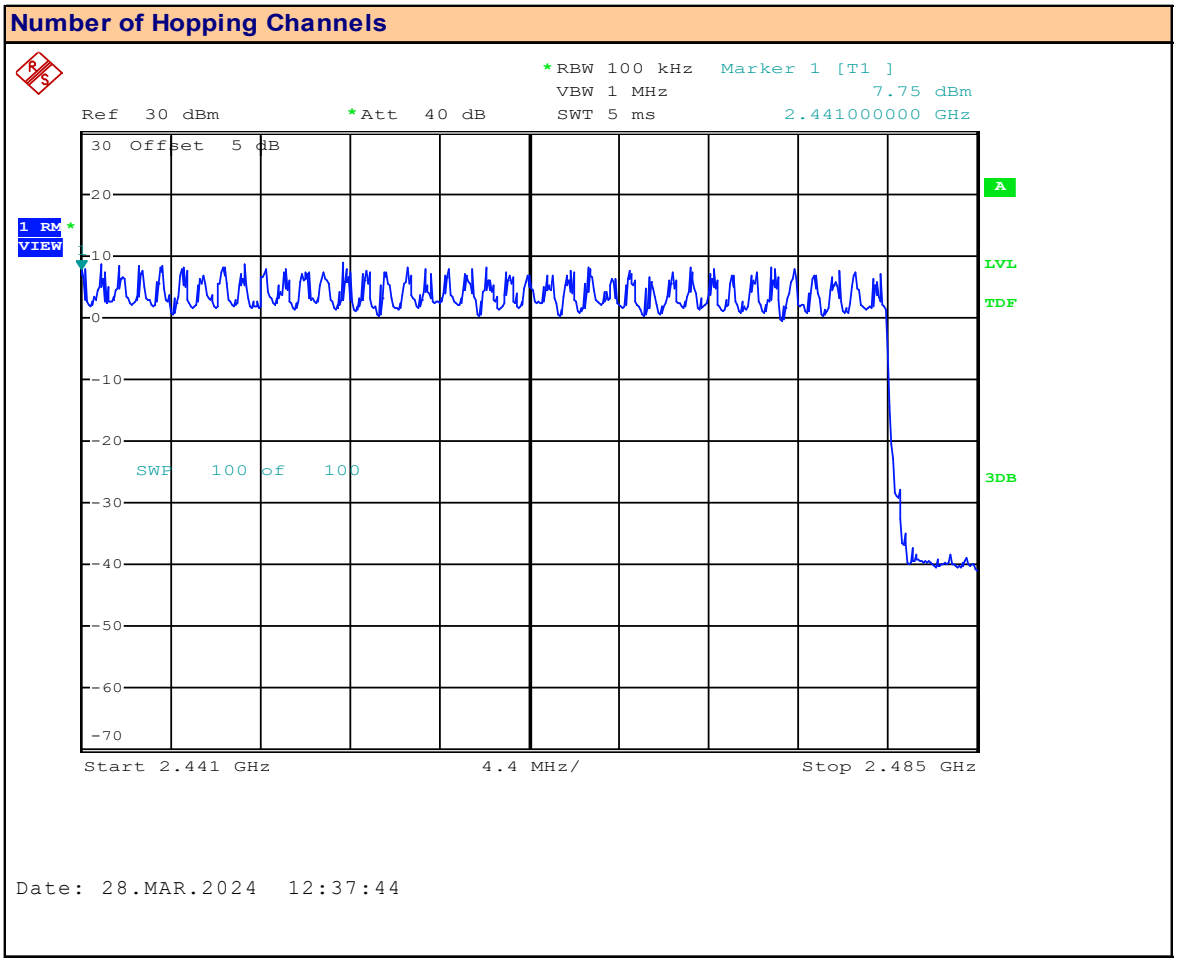
## Number of Hopping Channels




| | | | | | |
|---|---|---|---|---|---|
| **Start Freq:** | 2400 | MHz | **Stop Freq:** | 2441 | MHz |
| **Mode:** | BT 2EDR | | **Modulation:** | Pi/4-DQPSK | |
| | | | **Number of Channels:** | 40 | kHz |

**Plot 12.4 – Number of Hopping Channels, BT 2EDR**




| | | | | | |
|---|---|---|---|---|---|
| Start Freq: | 2441 | MHz | Stop Freq: | 2485 | MHz |
| Mode: | BT BR | | Modulation: | Pi/4-DQPSK | |
| | | | Number of Channels: | 39 | kHz |

**Table 12.2 – Summary of FHSS Number of Hopping Channels**

| Number of Hopping Channels | | | | |
|---|---|---|---|---|
| Start Frequency (MHz) | Channel Frequency (MHz) | Mode | Modulation | Number of Channels |
| 2400 | 2441.0 | BT BR | GFSK | 40 |
| 2441 | 2485.0 | | | 39 |
| | | | Total [$N_{Chan}$] | 79 |
| 2400 | 2441.0 | BT 2EDR | Pi/4-DQPSK | 40 |
| 2441 | 2485.0 | | | 39 |
| | | | Total [$N_{Chan}$] | 79 |

## 13.0 FHSS CHANNEL SEPARATION

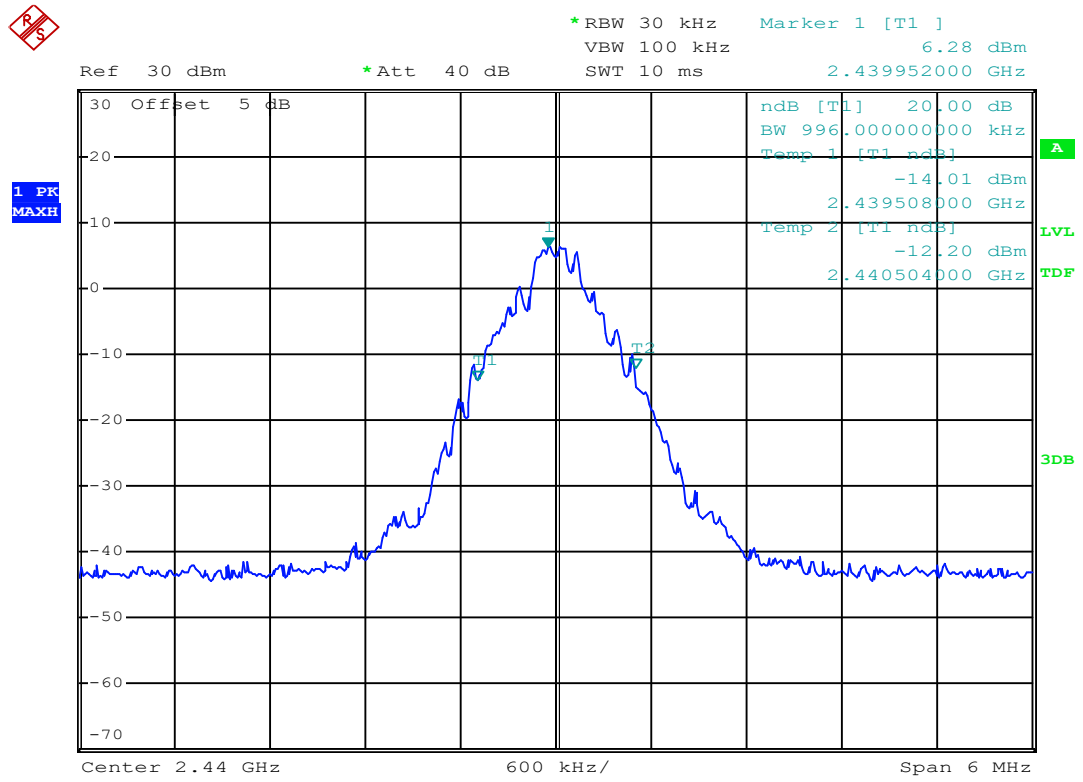
| Test Procedure | |
|---|---|
| Normative Reference | FCC 47 CFR §15.247, RSS-247 |
| | KDB 558074, ANSI C63.10 |

| Limits | |
|---|---|
| 47 CFR §15.247(a)(1) | (1) Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400- 2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW. |
| RSS-247 (5.1)(db) | **5.1 Frequency hopping systems (FHS)**<br>The following applies to FHSs in each of the three bands:<br>FHSs shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, FHSs operating in the band 2400-2483.5 MHz may have hopping channel carrier frequencies that are separated by 25 kHz or two thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided that the systems operate with an output power no greater than 0.125 W. |

**Plot 13.1 – 20dB BW, BT BR**

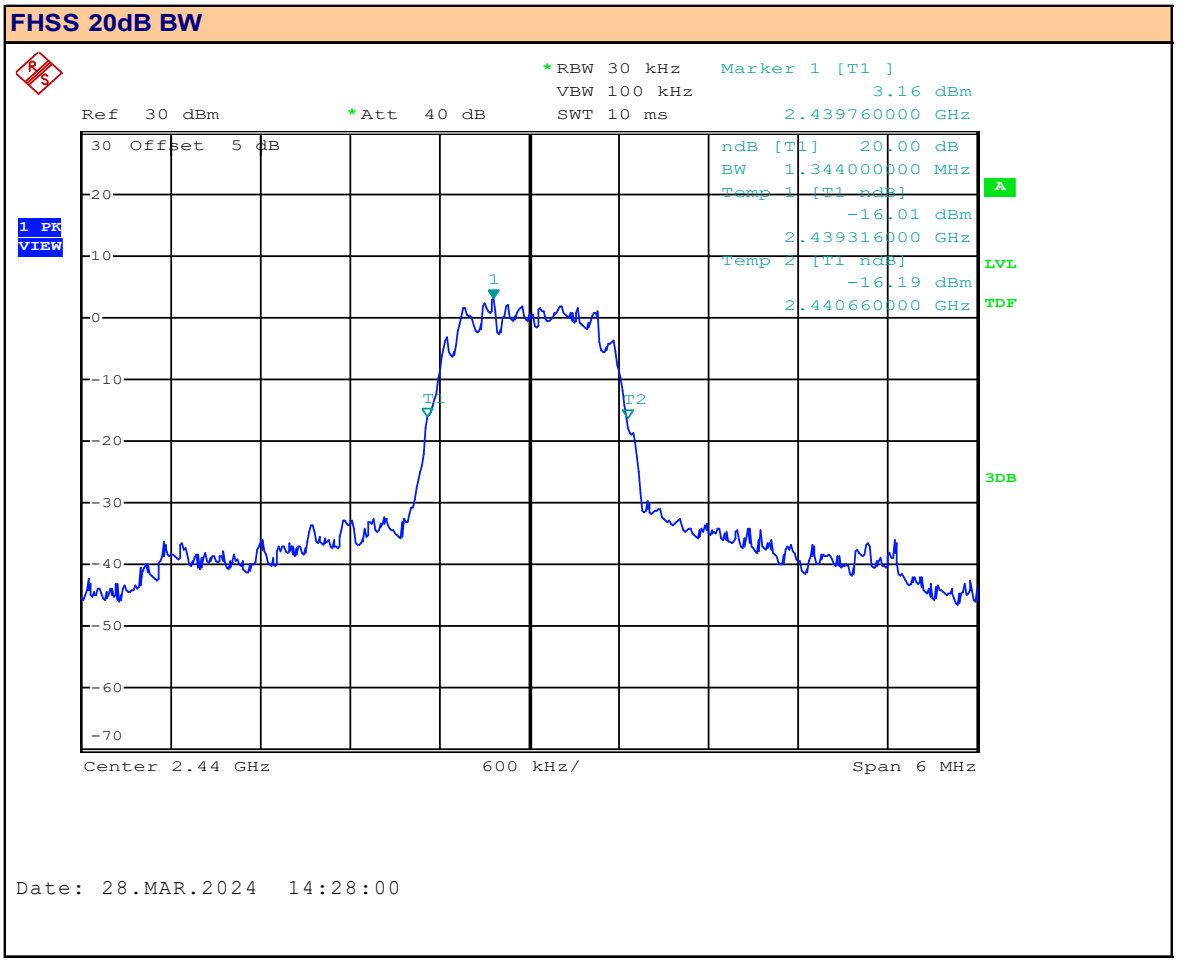
## Hopping Channel Separation




| | | | |
|---|---|---|---|
| **Channel:** | 38 | **Frequency:** | 2440 MHz |
| **Mode:** | BT BR | **Modulation:** | GFSK |
| | | **Measured 20dB BW:** | 0.996 MHz |

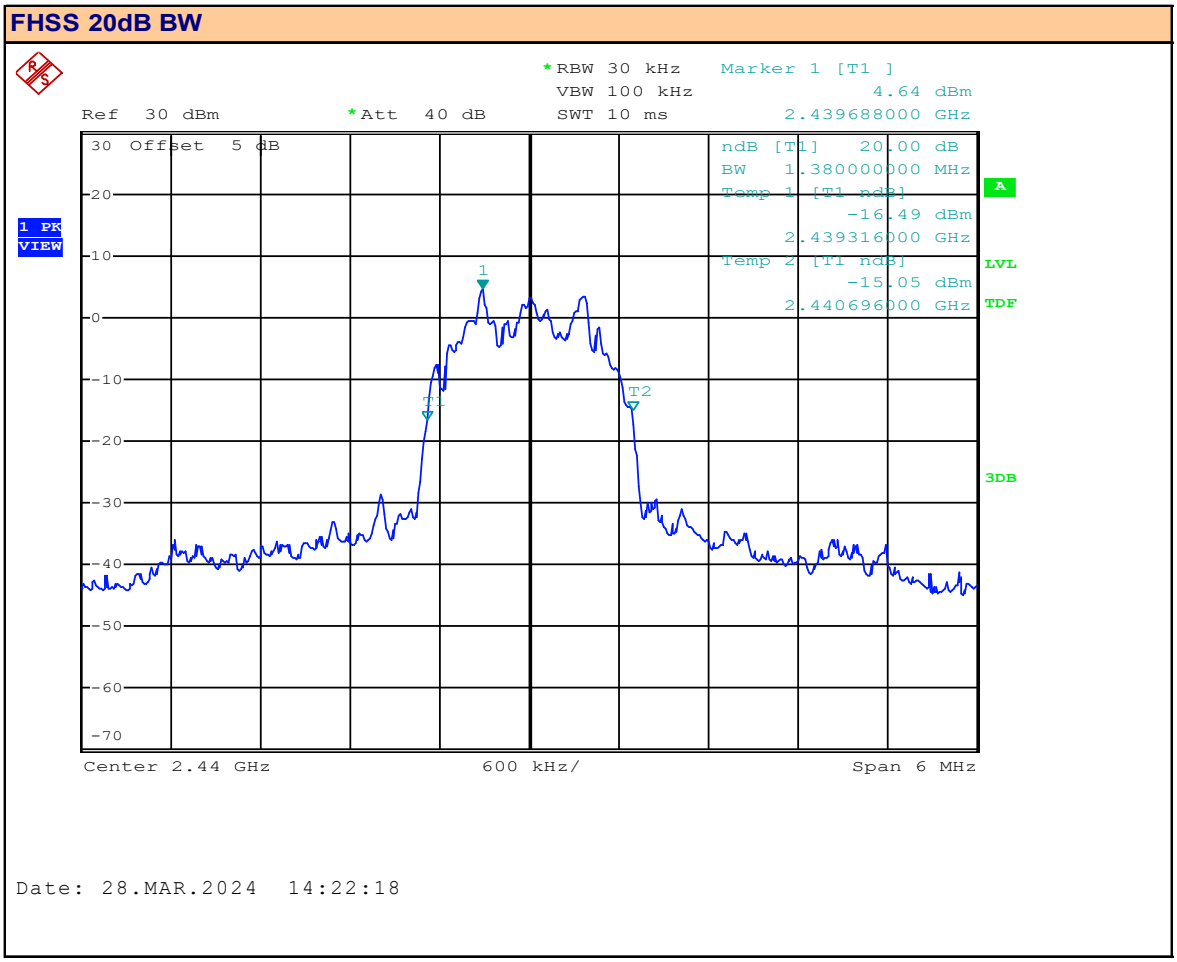
**Plot 13.2 – 20dB BW, BT 2EDR**




| | | | |
|---|---|---|---|
| **Channel:** | 38 | **Frequency:** | 2440 MHz |
| **Mode:** | BT 2EDR | **Modulation:** | Pi/4-DQPSK |
| | | **Measured 20dB BW:** | 1.344 MHz |

**Plot 13.3 – 20dB BW, BT 3EDR**

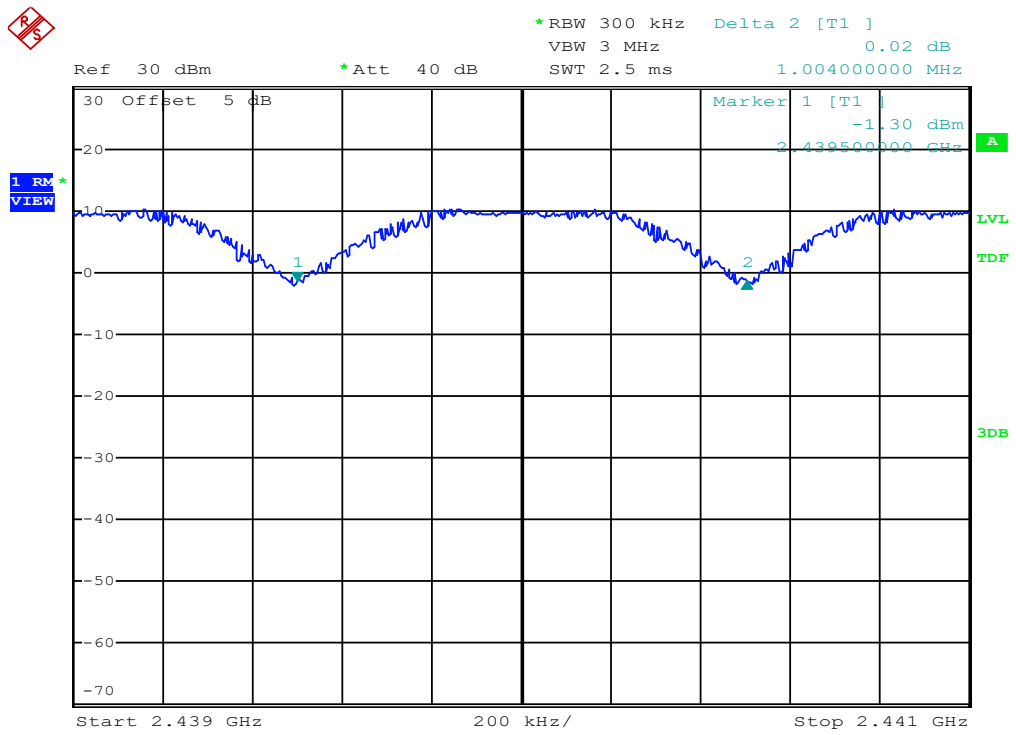



| | | | | | |
|---|---|---|---|---|---|
| **Channel:** | 38 | | **Frequency:** | 2440 | MHz |
| **Mode:** | BT 3EDR | | **Modulation:** | 8-DPSK | |
| | | | **Measured 20dB BW:** | 1.38 | MHz |

**Plot 13.4 – FHSS Channel Separation, BT BR**

## FHSS Channel Separation

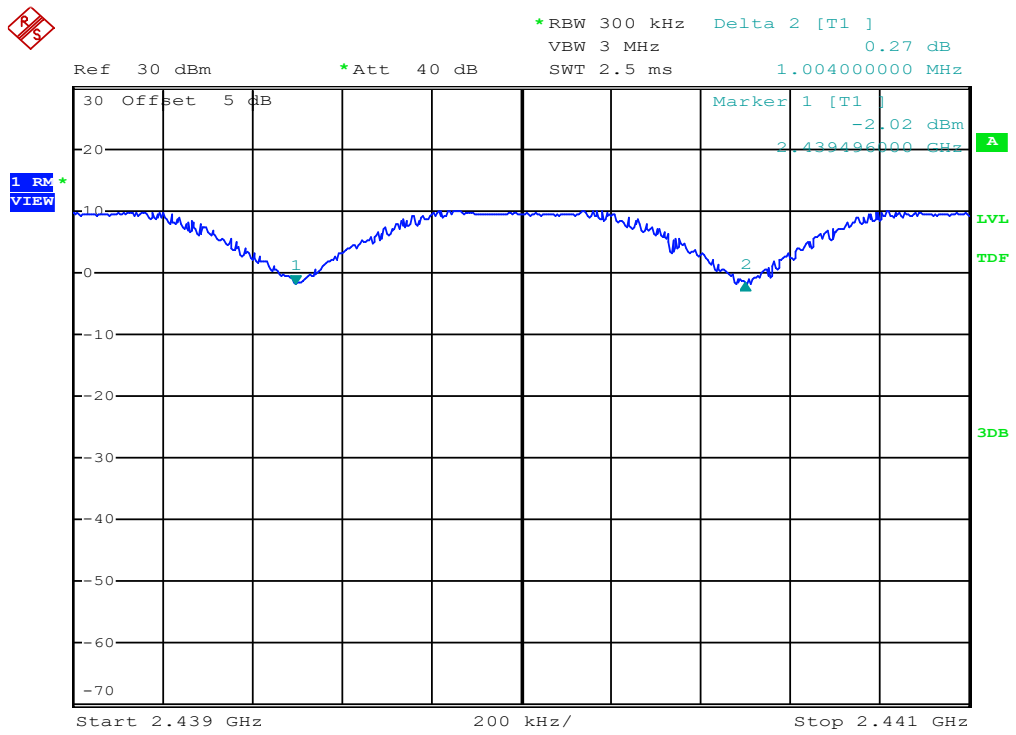



| | | | | |
|---|---|---|---|---|
| **Channel:** | - | **Frequency:** | - | MHz |
| **Mode:** | BT BR | **Modulation:** | GFSK | |
| | | **Measured Channel Separation:** | 1.004 | MHz |

**Plot 13.5 – FHSS Channel Separation, BT 2EDR**

## FHSS Channel Separation

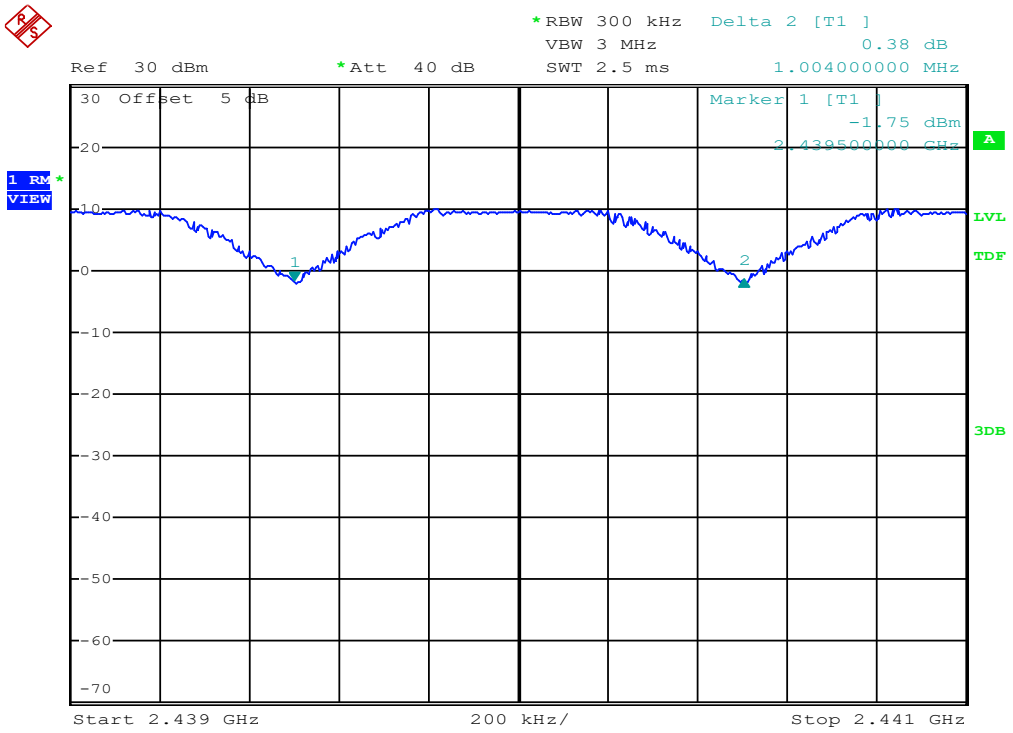



| | | | | | |
|---|---|---|---|---|---|
| **Channel:** | - | | **Frequency:** | - | MHz |
| **Mode:** | BT 2EDR | | **Modulation:** | Pi/4-DQPSK | |
| | | | **Measured Channel Separation:** | 1.004 | MHz |

**Plot 13.6 – FHSS Channel Separation, BT 3EDR**

## FHSS Channel Separation




| | | | | | |
|---|---|---|---|---|---|
| **Channel:** | - | | **Frequency:** | - | MHz |
| **Mode:** | BT 3EDR | | **Modulation:** | 8-DPSK | |
| | | | **Measured Channel Separation:** | 1.004 | MHz |

**Table 13.1 – Summary of FHSS Channel Separation**

| Hopping Channel Separation | | | | | |
|---|---|---|---|---|---|
| Mode | Modulation | 20dB Bandwidth (MHz) | Channel Separation (MHz) | Minimum Separation (MHz) | Margin (MHz) |
| BT BR | GFSK | 0.996 | 1.004 | 0.664 | 0.340 |
| BT 2EDR | Pi/4-DQPSK | 1.344 | 1.004 | 0.896 | 0.108 |
| BT 3EDR | 8-DPSK | 1.380 | 1.004 | 0.920 | 0.084 |
| | | | Result: | | Complies |

Minimum Bandwidth = 20dB BW X 2/3

Margin = Channel Separation - 20dB Bandwidth

## 14.0 FHSS TIME OF OCCUPANCY

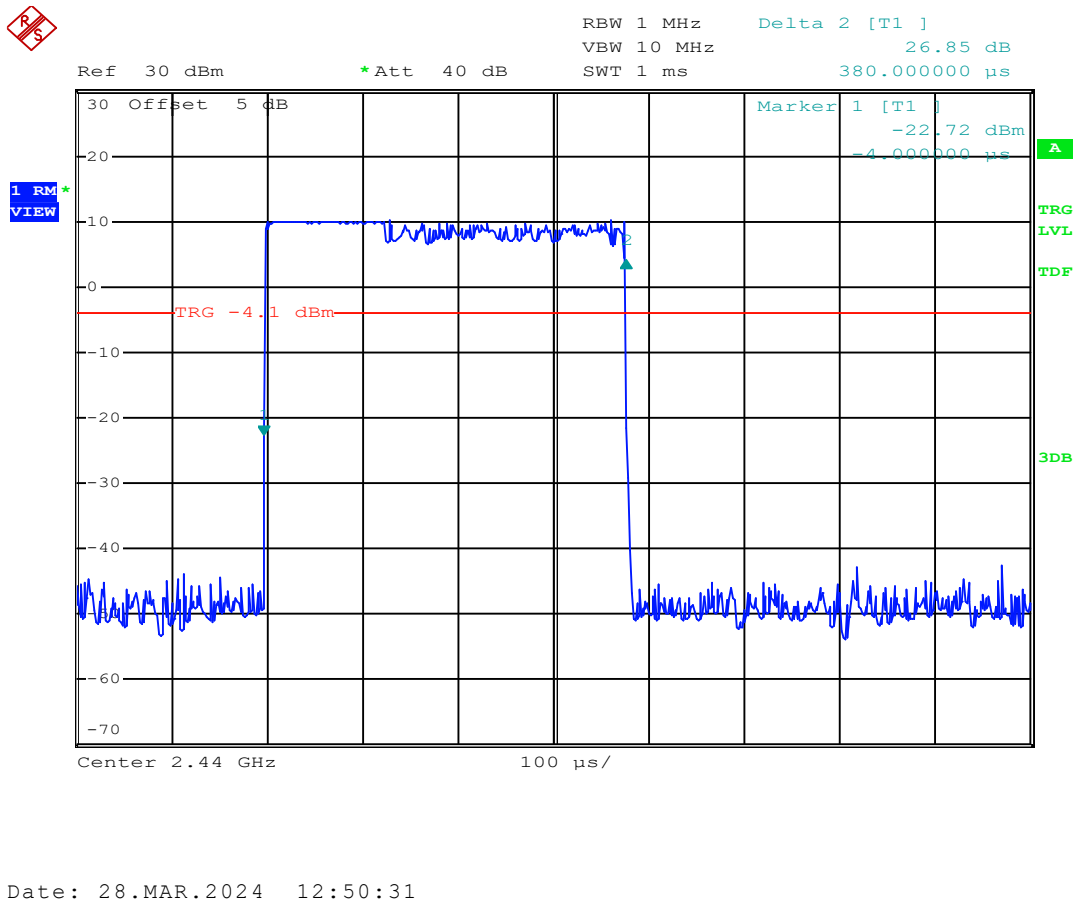
| Test Procedure | |
|---|---|
| Normative Reference | FCC 47 CFR §15.247, RSS-247 |
| | KDB 558074, ANSI C63.10 |

| Limits | |
|---|---|
| 47 CFR §15.247(a)(1) | (iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used. |
| RSS-247 (5.1)(d) | **5.1 Frequency hopping systems (FHS)**<br>FHSs operating in the band 2400-2483.5 MHz shall use at least 15 hopping channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds, multiplied by the number of hopping channels employed. Transmissions on particular hopping frequencies may be avoided or suppressed provided that at least 15 hopping channels are used. |

**Plot 14.1 – Time of Occupancy, DH1, 2-DH1, 3-DH1, DM1**

## Dwell Time

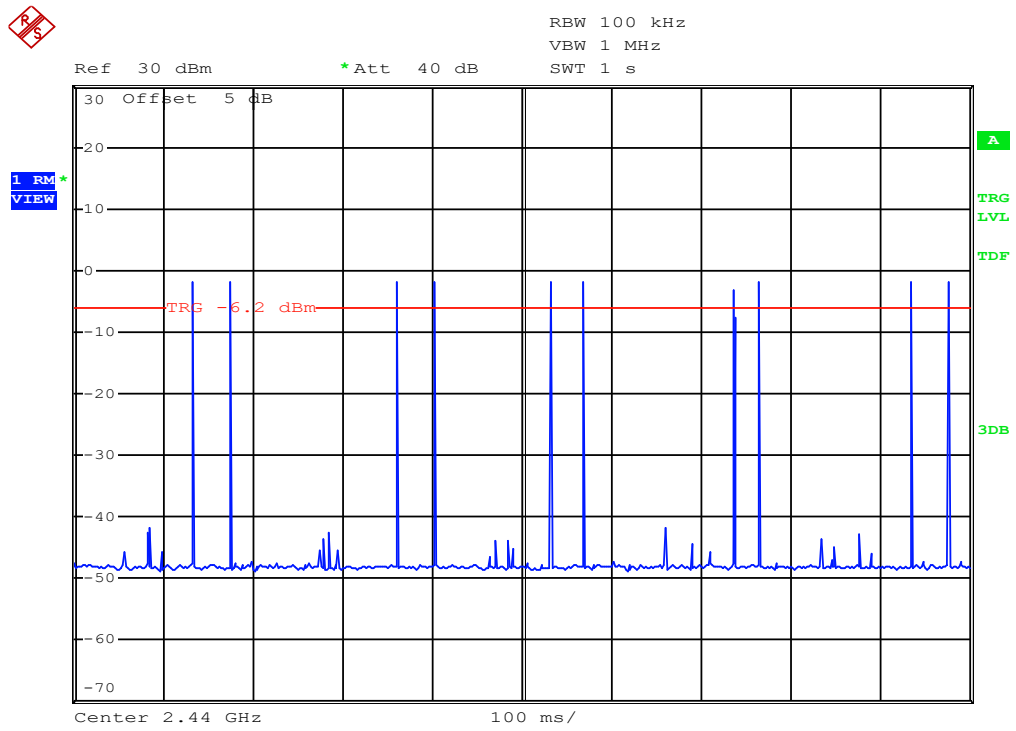



**Packet:** DH1, DM1, 2-DH1, 3-DH1 **Measured Dwell Time:** 0.38 **mSec**

**Plot 14.2 – Time of Occupancy, DH1, 2-DH1, 3-DH1, DM1**

## Number of Transmits

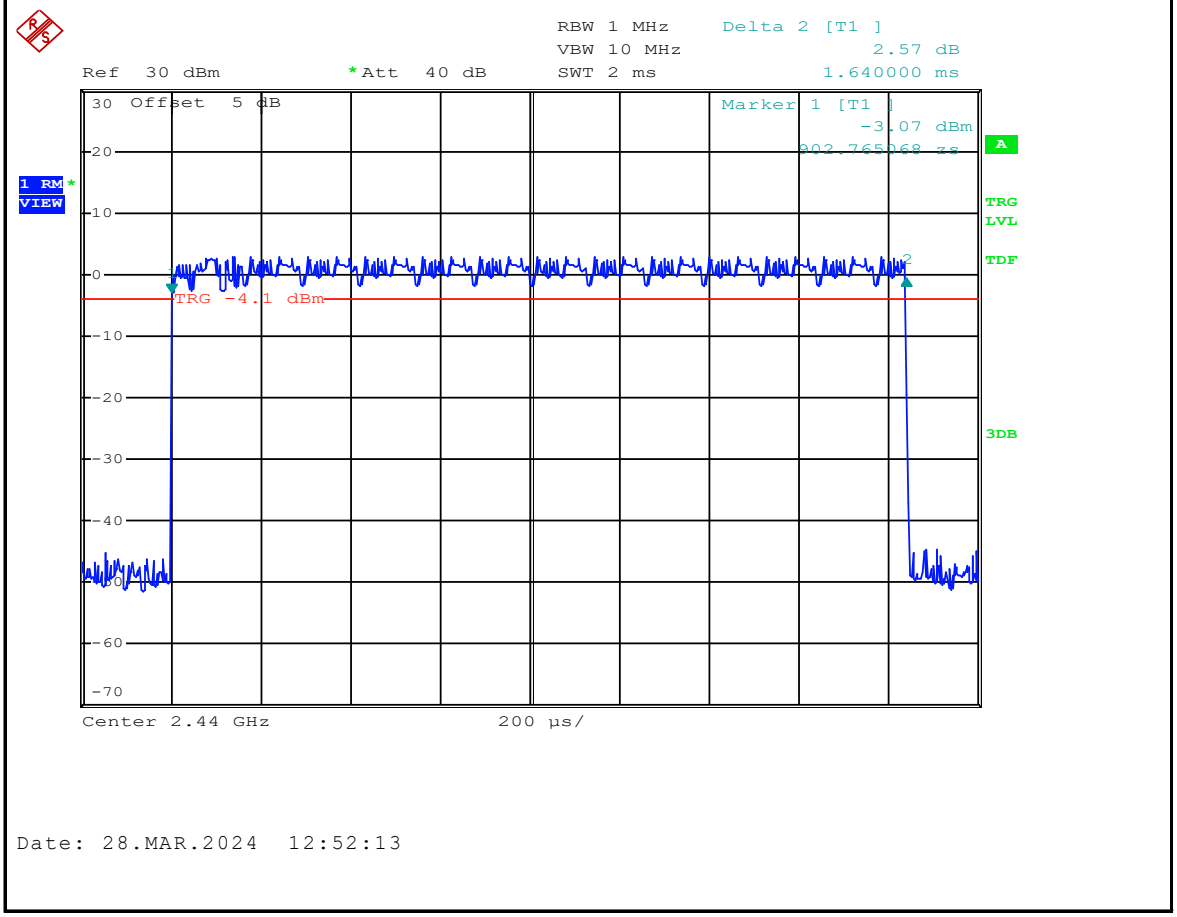



| | | | | |
|---|---|---|---|---|
| **Packet:** | DH1, DM1, 2-DH1, 3-DH1 | **Transmit Count:** | 10 | /1000 mSec |
| | | **Measurement Period:** | 1000 | mSec |

**Plot 14.3 – Time of Occupancy, DH3, 2-DH3, 3-DH3, DM3**

**Dwell Time**

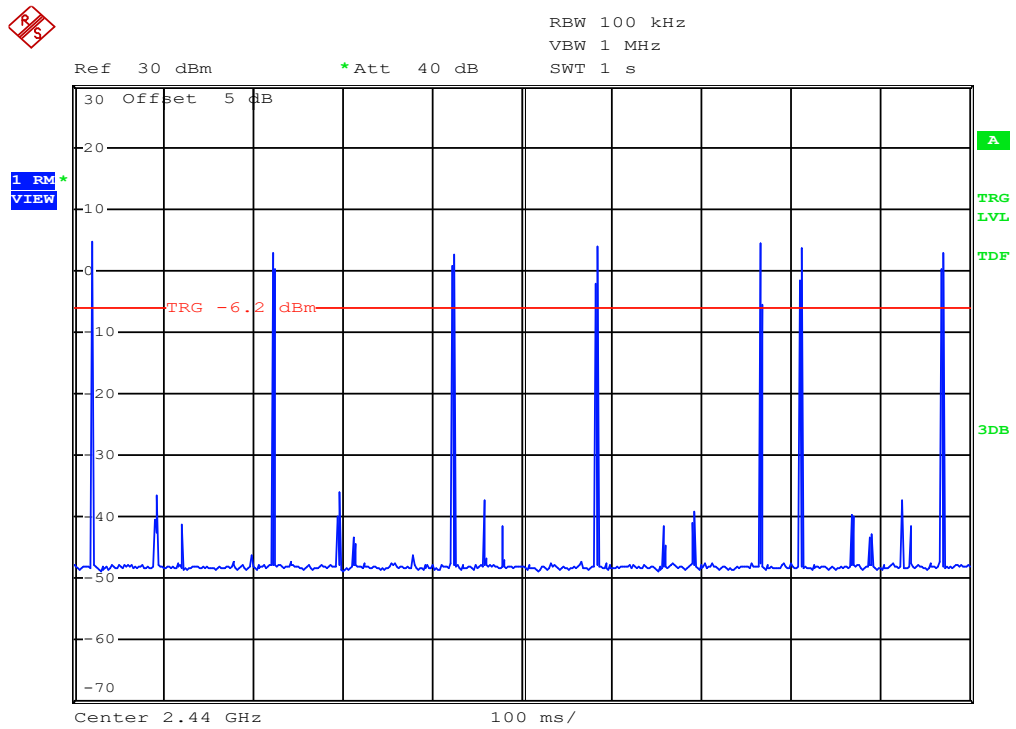



**Packet:** DH3, DM3, 2-DH3, 3-DH3 **Measured Dwell Time:** 1.64 **mSec**

**Plot 14.4 – Time of Occupancy, DH3, 2-DH3, 3-DH3, DM3**

## Number of Transmits

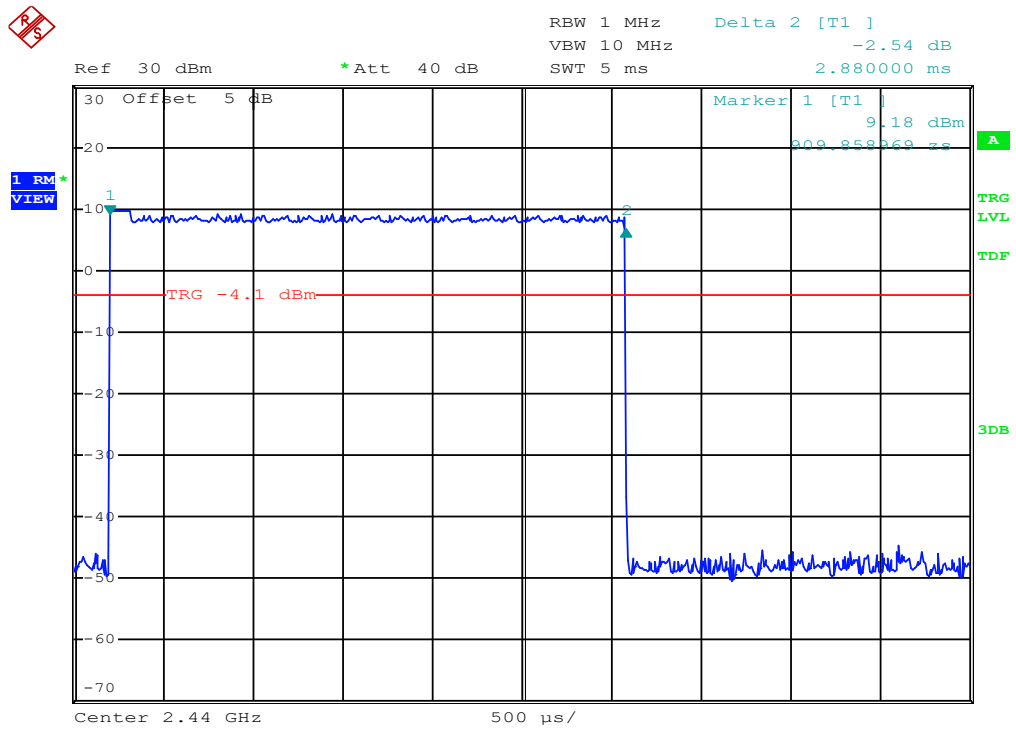



| | | | | |
|---|---|---|---|---|
| **Packet:** | DH3, DM3, 2-DH3, 3-DH3 | **Transmit Count:** | 7 | /1000 mSec |
| | | **Measurement Period:** | 1000 | mSec |

**Plot 14.5 – Time of Occupancy, DH5, 2-DH5, 3-DH5, DM5**

**Dwell Time**

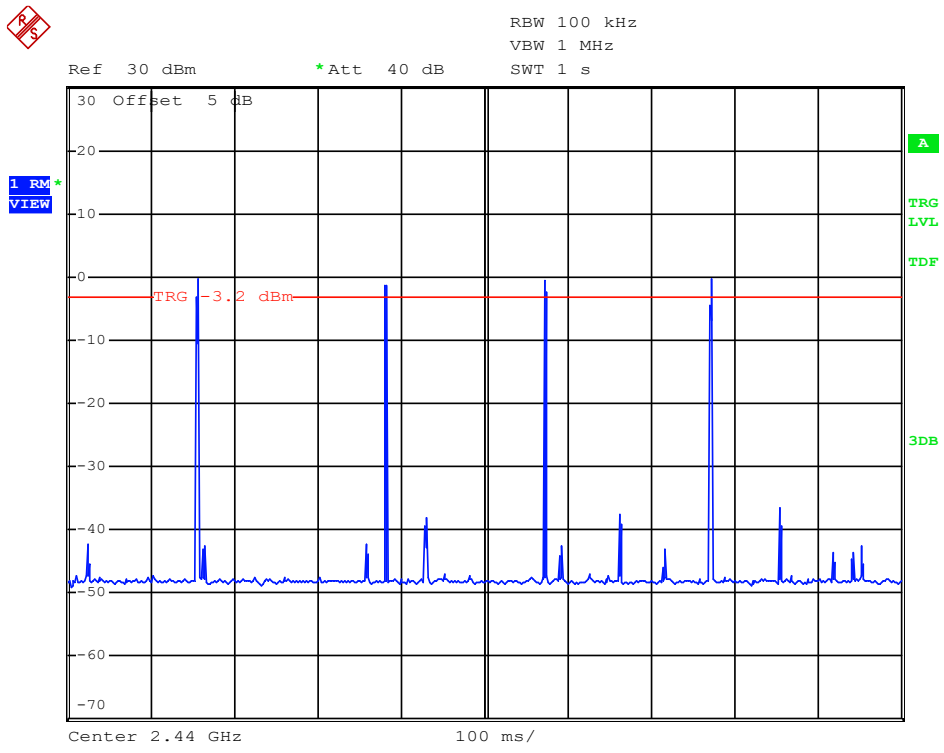



| Packet: | DH5, DM5, 2-DH5, 3-DH5 | Measured Dwell Time: | 2.88 | mSec |
|---|---|---|---|---|

**Plot 14.6 – Time of Occupancy, DH5, 2-DH5, 3-DH5, DM5**

**Number of Transmits**




| | | | | |
|---|---|---|---|---|
| **Packet:** | DH5, DM5, 2-DH5, 3-DH5 | **Transmit Count:** | 4 | /1000 mSec |
| | | **Measurement Period:** | 1000 | mSec |

**Table 14.1 – Summary of FHSS Time of Occupancy**

| Accumulated Time of Occupancy DSS | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Channel Frequency (MHz) | Packet | Channel On Time (Dwell) [$t_{Dwell}$] (mSec) | Meas Period [$t_{Meas}$] (mSec) | Number of Tx per Period [$N_{Tx}$] | Number of Channels Employed [$N_{Chan}$] | Maximum TOO Per Channel [$t_{Max}$] (mSec) | Maximum TOO Period [$t_{Period}$] (mSec) | Accumulated Time of Occupancy [$t_{Occ}$] (mSec) | Limit [Limit] (mSec) | Margin (mSec) |
| 2440.00 | DH1, … | 0.380 | 1000 | 10 | 79 | 400.0 | 31600 | 120.1 | 400 | 279.9 |
| | DH3, … | 1.640 | | 7 | | | | 362.8 | | 37.2 |
| | DH5, … | 2.880 | | 4 | | | | 364.0 | | 36.0 |
| | | | | | | | | | Result: | Complies |

TOO = Time of Occupancy

Number of Channels Employed [$N_{Chan}$]: See Table 11.1

Maximum TOO Period [$t_{Period}$] = Number of Channels [$N_{Chan}$] X 0.4Sec, as per §15.247, RSS-247

$$\text{Accumulated Time of Occupancy } [t_{Occ}] = \frac{\text{(Number of Tx per Period } [N_{Tx}] \text{ X Dwell Time } [t_{Dwell}] \text{ X Maximum TOO Period } [t_{Period}])}{\text{Measurement Period } [t_{Meas}]}$$

Margin = Limit [Limit] - Accumulated Time of Occupancy [$t_{Occ}$]

## 15.0 CONDUCTED SPURIOUS EMISSIONS -BAND EDGE

| Test Procedure | |
|---|---|
| Normative Reference | FCC 47 CFR §2.1051, §15.247(d), RSS-Gen (6.13), RSS-247 (5.5), |
| | KDB 558074 (11.3), ANSI C63.10 (11.11.3) |

| Limits | |
|---|---|
| 47 CFR §15.247(d) | (d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. |
| KDB 558074 (11.3)<br>C63.10 (11.11.3) | **11.1 General**<br>The DTS rules specify that in any 100 kHz bandwidth outside of the authorized frequency band, the power shall be attenuated according to the following conditions:<br>b) If maximum conducted (average) output power was used to demonstrate compliance as described in 9.2, then the peak power in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 30 dB relative to the maximum in-band peak PSD level in 100 kHz (i.e., 30 dBc).<br>**11.2 Reference level measurement**<br>a) Set instrument center frequency to DTS channel center frequency.<br>b) Set the span to ≥ 1.5 X *DTS bandwidth.*<br>c) Set the RBW = 100 kHz.<br>d) Set the VBW ≥ 3 X RBW.<br>e) Detector = peak.<br>f) Sweep time = auto couple.<br>g) Trace mode = max hold.<br>h) Allow trace to fully stabilize.<br>i) Use the peak marker function to determine the maximum PSD level.<br>Note that the channel found to contain the maximum PSD level can be used to establish the reference |

**Table 15.1 – Summary of Spurious Emission Measurements – Band Edge, (DTS)**

See Appendix E for Measurement Plots

**Band Edge Measurement Results: DTS**

| Mode | Channel Number | Frequency (MHz) | Modulation | Emission Power [$P_{Em}$] (dBm) | Fundamental Power [$P_{Fund}$] (dBm) | Attenuation [Atten] (dB) | Limit (dB) | Margin (dB) | Antenna Gain (dBi) | Emission EIRP [$E_{Em}$] (dBm) | Fundamental EIRP [$E_{Fund}$] (dBm) | EIRP Attenuation [Atten] (dB) | Limit (dB) | EIRP Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 802.11b | 1 | 2412.00 | DSSS 5.5 | -24.78 | 15.63 | 40.41 | 30 | 10.4 | -3.8 | -28.58 | 11.83 | 40.41 | 30 | 10.4 |
| | 11 | 2462.00 | | -37.01 | 15.07 | 52.08 | | 22.1 | | -40.81 | 11.27 | 52.08 | | 22.1 |
| | 12 | 2467.00 | | -30.98 | 15.07 | 46.05 | | 16.1 | | -34.78 | 11.27 | 46.05 | | 16.1 |
| | 13 | 2472.00 | | -20.75 | 15.07 | 35.82 | | 5.8 | | -24.55 | 11.27 | 35.82 | | 5.8 |
| 802.11g | 1 | 2412.00 | OFDM 12 | -22.21 | 12.58 | 34.79 | | 4.8 | | -26.01 | 8.78 | 34.79 | | 4.8 |
| | 11 | 2462.00 | | -22.08 | 14.20 | 36.28 | | 6.3 | | -25.88 | 10.40 | 36.28 | | 6.3 |
| | 12 | 2467.00 | | -16.51 | 14.15 | 30.66 | | 0.7 | | -20.31 | 10.35 | 30.66 | | 0.7 |
| | 13 | 2472.00 | | -20.28 | 11.38 | 31.66 | | 1.7 | | -24.08 | 7.58 | 31.66 | | 1.7 |
| 802.11n | 1 | 2412.00 | MCS0 | -22.18 | 14.61 | 36.79 | | 6.8 | | -25.98 | 10.81 | 36.79 | | 6.8 |
| | 11 | 2462.00 | | -26.21 | 13.86 | 40.07 | | 10.1 | | -30.01 | 10.06 | 40.07 | | 10.1 |
| | 12 | 2467.00 | | -18.08 | 13.80 | 31.88 | | 1.9 | | -21.88 | 10.00 | 31.88 | | 1.9 |
| | 13 | 2472.00 | | -18.37 | 12.10 | 30.47 | | 0.5 | | -22.17 | 8.30 | 30.47 | | 0.5 |
| BLE 1mb | 37 | 2402.00 | GMSK | -38.44 | 0.70 | 39.14 | 30 | 9.1 | -3.8 | -42.24 | -3.10 | 39.14 | 30 | 9.1 |
| | 39 | 2480.00 | | -39.99 | 0.70 | 40.69 | | 10.7 | | -43.79 | -3.10 | 40.69 | | 10.7 |
| BLE 2mb | 0 | 2404.00 | GMSK | -36.97 | 1.48 | 38.45 | | 8.5 | | -40.77 | -2.32 | 38.45 | | 8.5 |
| | 39 | 2480.00 | | -39.40 | 1.48 | 40.88 | | 10.9 | | -43.20 | -2.32 | 40.88 | | 10.9 |
| ANT | 0 | 2402.00 | GFSK | -39.52 | 1.07 | 40.59 | | 10.6 | | -43.32 | -2.73 | 40.59 | | 10.6 |
| | 78 | 2480.00 | | -40.03 | 1.07 | 41.10 | | 11.1 | | -43.83 | -2.73 | 41.10 | | 11.1 |
| | | | | | | | | | | | | | Result: | Complies |

Attenuation [Atten] = [$P_{Fund}$] - [$P_{Em}$]
Margin = [Atten] - Limit

**Table 15.2 – Summary of Spurious Emission Measurements – Band Edge, (DSS)**

See Appendix E for Measurement Plots

**Band Edge Measurement Results: DSS**

| Mode | Channel Number | Frequency (MHz) | Modulation | Emission Power [$P_{Em}$] (dBm) | Fundamental Power [$P_{Fund}$] (dBm) | Attenuation [Atten] (dB) | Limit (dB) | Margin (dB) | Antenna Gain (dBi) | Emission EIRP [$E_{Em}$] (dBm) | Fundamental EIRP [$E_{Fund}$] (dBm) | EIRP Attenuation [Atten] (dB) | Limit (dB) | EIRP Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| BT BR | 0 | 2402.00 | GFSK | -34.33 | 10.00 | 44.33 | 30 | 14.3 | -3.8 | -38.13 | 6.20 | 44.33 | 30 | 14.3 |
| | 78 | 2480.00 | | -39.60 | | 39.60 | | 9.6 | | -43.40 | -3.80 | 39.60 | | 9.6 |
| BT 2EDR | 0 | 2402.00 | Pi/4-DQPSK | -32.95 | 9.30 | 42.25 | | 12.3 | | -36.75 | 5.50 | 42.25 | | 12.3 |
| | 78 | 2480.00 | | -39.57 | | 39.57 | | 9.6 | | -43.37 | -3.80 | 39.57 | | 9.6 |
| BT 3EDR | 2 | 2404.00 | 8-DPSK | -38.41 | 9.17 | 47.58 | | 17.6 | | -42.21 | 5.37 | 47.58 | | 17.6 |
| | 78 | 2480.00 | | -39.63 | | 39.63 | | 9.6 | | -43.43 | -3.80 | 39.63 | | 9.6 |
| | | | | | | | | | | | | Result: | | Complies |

Attenuation [Atten] = [$P_{Fund}$] - [$P_{Em}$]
Margin = [Atten] - Limit

## 16.0 CONDUCTED SPURIOUS EMISSIONS

| Test Procedure | |
|---|---|
| Normative Reference | FCC 47 CFR §2.1051, §15.247(d), RSS-Gen (6.13), RSS-247 (5.5), KDB 558074 (11.3), ANSI C63.10 (11.11.3) |

| Limits | |
|---|---|
| 47 CFR §15.247(d) | (d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. |
| KDB 558074 (11.3)<br>C63.10 (11.11.3) | **11.1 General**<br>The DTS rules specify that in any 100 kHz bandwidth outside of the authorized frequency band, the power shall be attenuated according to the following conditions:<br>b) If maximum conducted (average) output power was used to demonstrate compliance as described in 9.2, then the peak power in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 30 dB relative to the maximum in-band peak PSD level in 100 kHz (i.e., 30 dBc).<br>**11.2 Reference level measurement**<br>a) Set instrument center frequency to DTS channel center frequency.<br>b) Set the span to ≥ 1.5 X *DTS bandwidth.*<br>c) Set the RBW = 100 kHz.<br>d) Set the VBW ≥ 3 X RBW.<br>e) Detector = peak.<br>f) Sweep time = auto couple.<br>g) Trace mode = max hold.<br>h) Allow trace to fully stabilize.<br>i) Use the peak marker function to determine the maximum PSD level.<br>Note that the channel found to contain the maximum PSD level can be used to establish the reference |

**Table 16.1 – Summary of Conducted Spurious Emissions, (DTS)**

See Appendix F for Measurement Plots

| Conducted Spurious Emissions Measurement Results: | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Channel Number | Frequency (MHz) | Modulation | Emission Power [$P_{Em}$] (dBm) | Emission Frequency (MHz) | Fundamental Measurment [$P_{Fund}$] (dBm) | Attenuation [Atten] (dB) | Limit (dB) | Margin (dB) |
| 6 | 2437.00 | DSSS 5.5 | -38.47 | 3588 | 8.25 | 46.72 | 30 | 16.7 |
| | | | | | | | Complies | |

Attenuation [Atten] = [$P_{Fund}$] - [$P_{Em}$]
Margin = Attenuation - Limit
ND = None Detected

**Table 16.2 – Summary of Conducted Spurious Emissions, (DSS)**

See Appendix F for Measurement Plots

| Conducted Spurious Emissions Measurement Results: | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Channel Number | Frequency (MHz) | Modulation | Emission Power [$P_{Em}$] (dBm) | Emission Frequency (MHz) | Fundamental Measurment [$P_{Fund}$] (dBm) | Attenuation [Atten] (dB) | Limit (dB) | Margin (dB) |
| 38 | 2440.00 | GFSK | ND | ND | 4.86 | n/a | 30 | n/a |
| | | | | | | | Complies | |

Attenuation [Atten] = [$P_{Fund}$] - [$P_{Em}$]
Margin = Attenuation - Limit
ND = None Detected

## 17.0 RADIATED TX SPURIOUS EMISSIONS

| Test Procedure | |
|---|---|
| Normative Reference | FCC 47 CFR §2.1051, §15.247(d), §15.205(a), §15.205(c ), §15.209(a) |
| | KDB 558074 (8.6), ANSI C63.10 (11.12) |

| Limits | |
|---|---|
| 47 CFR §15.247(d) | (d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, 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) (see §15.205(c)). |
| 47 CFR §15.209(a) | **§15.209 Radiated emission limits; general requirements.**<br>(a) 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 (microvolts/meter) |
|---|---|
| 0.009 - 0.490 | 2400/F (kHz) @300m |
| 0.490 - 1.705 | 24000/F (kHz) @30m |
| 1.705 - 30 | 30 @ 30m |
| 30 - 88 | 100 @3m |
| 88 - 216 | 150 @3m |
| 216 - 960 | 200 @3m |
| Above 960 | 500 @3m |

**Table 17.1 – Summary of Radiated Tx Spurious Emissions, (DTS)**

See Appendix G for Measurement Plots

| Summary of Radiated Tx Emissions | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Measured Frequency Range (MHz) | Channel Frequency (MHz) | Antenna Polarization | Emission Frequency (MHz) | Measured Emission [$E_{Meas}$] (dBuV) | Antenna ACF [ACF] (dB) | Cable Loss [$L_C$] (dB) | Amplifier Gain [$G_A$] (dB) | Corrected Emission [$E_{Corr}$] (dBuV/m) | Limit (dBuV) | Margin (dB) |
| 30-1000 MHz | 2437.0 | Horizontal | ND | (1) AV | n/a | n/a | 0.00 (3) | ND | n/a | **(1)** |
| 30-1000 MHz | | Vertical | ND | (1) AV | n/a | n/a | 0.00 (3) | ND | n/a | **(1)** |
| 1-18 GHz | | Horizontal | ND | (1) AV | n/a | n/a | 0.00 (3) | ND | n/a | **(1)** |
| 1-18GHz | | Vertical | ND | (1) AV | n/a | n/a | 0.00 (3) | ND | n/a | **(1)** |
| 18-25 GHz | | Horizontal | ND | (1) AV | n/a | n/a | 0.00 (3) | ND | n/a | **(1)** |
| 18 -25 GHz | | Vertical | ND | (1) AV | n/a | n/a | 0.00 (3) | ND | n/a | **(1)** |
| | | | | | | | | **Results:** | **Complies** | |

(1) No Emissions Detected (ND) above ambient or within 20dB of the limit
(2) Antenna ACF, Cable Loss and Amplifier Gain corrected in Spectrum Analyzer Transducer Factor
(3) External Amplier not used

$E_{Corr} = E_{Meas} + ACF^E + L_C - G_A$

Where $ACF^E$ is the Electric Antenna Correction Factor
* Without Manufacturer's Accessories, ** With Manufacturer's Accessories

**Table 17.2 – Summary of Radiated Tx Spurious Emissions, (DSS)**

See Appendix G for Measurement Plots

**Summary of Radiated Tx Emissions**

| Measured Frequency Range (MHz) | Channel Frequency (MHz) | Antenna Polarization | Emission Frequency (MHz) | Measured Emission [$E_{Meas}$] (dBuV) | | Antenna ACF [ACF] (dB) | Cable Loss [$L_C$] (dB) | Amplifier Gain [$G_A$] (dB) | | Corrected Emission [$E_{Corr}$] (dBuV/m) | Limit (dBuV) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 30-1000 MHz | 2440.0 | Horizontal | ND | (1) | AV | n/a | n/a | 0.00 | (3) | ND | n/a | **(1)** |
| 30-1000 MHz | | Vertical | ND | (1) | AV | n/a | n/a | 0.00 | (3) | ND | n/a | **(1)** |
| 1-18 GHz | | Horizontal | ND | (1) | AV | n/a | n/a | 0.00 | (3) | ND | n/a | **(1)** |
| 1-18GHz | | Vertical | ND | (1) | AV | n/a | n/a | 0.00 | (3) | ND | n/a | **(1)** |
| 18-25 GHz | | Horizontal | ND | (1) | AV | n/a | n/a | 0.00 | (3) | ND | n/a | **(1)** |
| 18 -25 GHz | | Vertical | ND | (1) | AV | n/a | n/a | 0.00 | (3) | ND | n/a | **(1)** |
| | | | | | | | | | | **Results:** | **Complies** | |

(1) No Emissions Detected (ND) above ambient or within 20dB of the limit
(2) Antenna ACF, Cable Loss and Amplifier Gain corrected in Spectrum Analyzer Transducer Factor
(3) External Amplier not used

$E_{Corr} = E_{Meas} + ACF^E + L_C - G_A$

Where $ACF^E$ is the Electric Antenna Correction Factor
* Without Manufacturer's Accessories, ** With Manufacturer's Accessories

## 18.0 RADIATED RX SPURIOUS EMISSIONS

| Test Procedure | |
|---|---|
| **Normative Reference** | **FCC 47 CFR §15.109, ICES-003(6.2)**<br>**ANSI C63.4:2014** |

| Limits | |
|---|---|
| 47 CFR §15.109 | (a) Except for Class A digital devices, the field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values:<br>30-88MHz: 40dBuV/m<br>88-216MHz: 43.5dBuV/m<br>216-960MHz: 46dBuV/m<br>> 960MHz: 54dBuV/m |
| ICES-003(6.2.1) | 6.2.1 - Radiated Emissions Limits Below 1 GHz<br>Class B: ITE that does not meet the conditions for Class A operation shall comply with the Class B radiated limits set out in Table 5 determined at a distance of 3 metres.<br>30-88MHz: 40dBuV/m<br>88-216MHz: 43.5dBuV/m<br>216-960MHz: 46dBuV/m<br>> 960MHz: 54dBuV/m |

| Test Setup | Appendix A Figure A.2 |
|---|---|

| Measurement Procedure |
|---|
| The DUT was set up as per ANSI C63.4:2014. Emissions were scanned between 30MHz and 1000MHz. The turntable was rotated 360 degrees and the antenna was elevated to 4m to optimize the measured emissions. |

**Table 18.1 – Summary of Radiated Rx Spurious Emissions**

See Appendix H Measurement Plots

| Summary of Radiated Rx Emissions | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Measured Frequency Range (MHz) | Channel Frequency (MHz) | Antenna Polarization | Emission Frequency (MHz) | Measured Emission [$E_{Meas}$] (dBuV) | | Antenna ACF [ACF] (dB) | Cable Loss [$L_C$] (dB) | Amplifier Gain [$G_A$] (dB) | | Corrected Emission [$E_{Corr}$] (dBuV/m) | Limit (dBuV) | Margin (dB) |
| 30-1000 | - | Horizontal | **(1)** | (1) | AV | - | - | 0.00 | (3) | **(1)** | - | **(1)** |
| 30-1000 | - | Vertical | **(1)** | (1) | AV | - | - | 0.00 | (3) | **(1)** | - | **(1)** |
| 1000-25000 | - | Horizontal | **(1)** | (1) | AV | - | - | 0.00 | (3) | **(1)** | 54.0 | **(1)** |
| 1000-25000 | - | Vertical | **(1)** | (1) | AV | - | - | 0.00 | (3) | **(1)** | 54.0 | **(1)** |
| | | | | | | | | | | **Results:** | **Complies** | |

(1) No Emissions Detected (ND) above ambient or within 20dB of the limit
(3) External Amplier not used

$E_{Corr} = E_{Meas} + ACF^E + L_C - G_A$

Where $ACF^E$ is the Electric Antenna Correction Factor

## 19.0 LINE CONDUCTED EMISSIONS

| Test Procedure | |
|---|---|
| **Normative Reference** | **FCC 47 CFR §15.107, ICES-003(6.1)**<br>**ANSI C63.4-2014** |

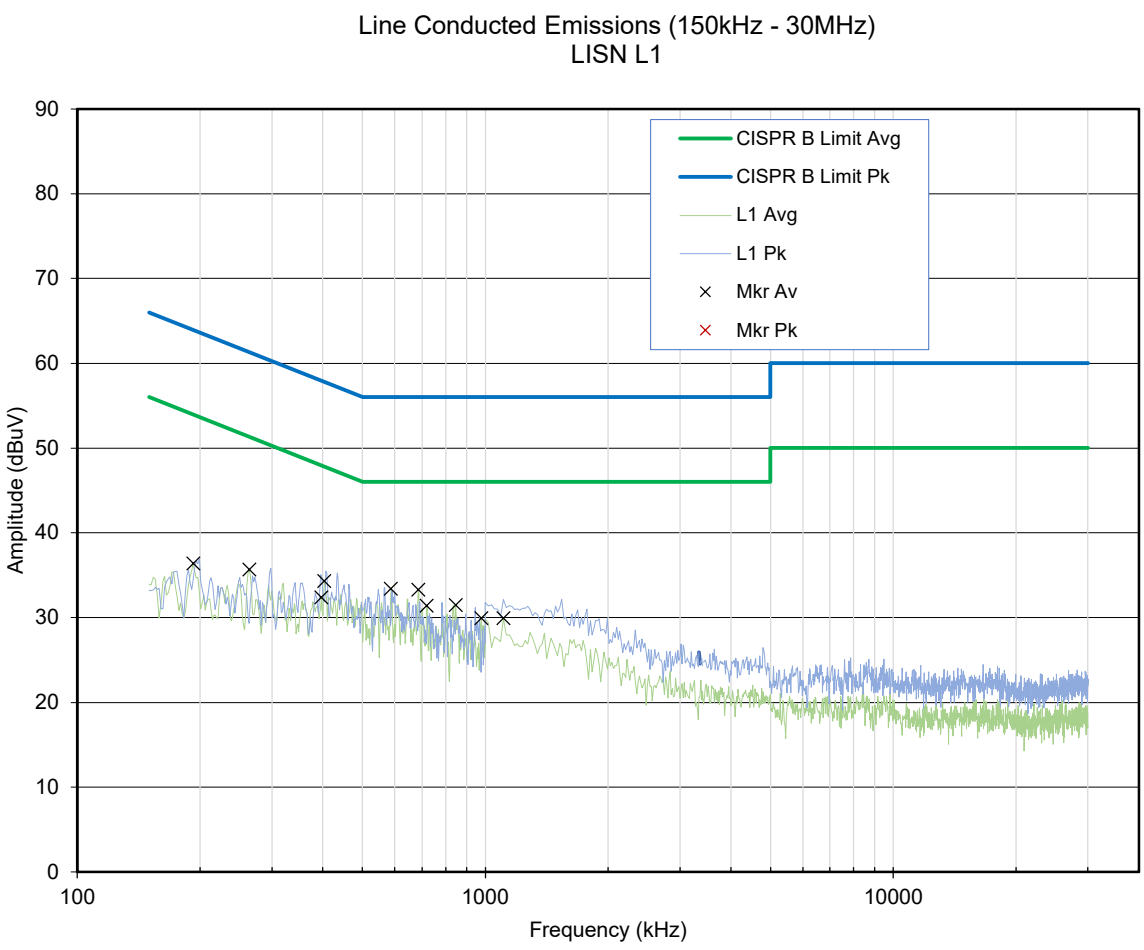
| Limits | |
|---|---|
| 47 CFR §15.107 | (a) Except for Class A digital devices, for equipment that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 μH/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 band edges.<br>0.15-0.5MHz: 66-56 dBuV Quasi Peak, 56-46 dBuV Average, Decreases with the logrithm of the frequency<br>0.5 - 5.0 MHz: 56 dBuV Quasi Peak, 46 dBuV Average<br>5.0 - 30.0 MHz: 60 dBuV Quasi Peak, 50 dBuV Average |
| ICES-003(6.1) | 6.1 - AC Power Line Conducted Emissions Limits<br>Class B: ITE that does not meet the conditions for Class A operation shall comply with the Class B radiated limits set out in Table 2.<br>0.15-0.5MHz: 66-56 dBuV Quasi Peak, 56-46 dBuV Average, Decreases with the logrithm of the<br>0.5 - 5.0 MHz: 56 dBuV Quasi Peak, 46 dBuV Average<br>5.0 - 30.0 MHz: 60 dBuV Quasi Peak, 50 dBuV Average |

| Test Setup | **Appendix A** **Figure A.7** |
|---|---|

**Plot 19.1 – Power Line Conducted Emissions, Line 1**

**Line Conducted Emissions**



**Plot 19.2 – Power Line Conducted Emissions, Line 2**

**Line Conducted Emissions**

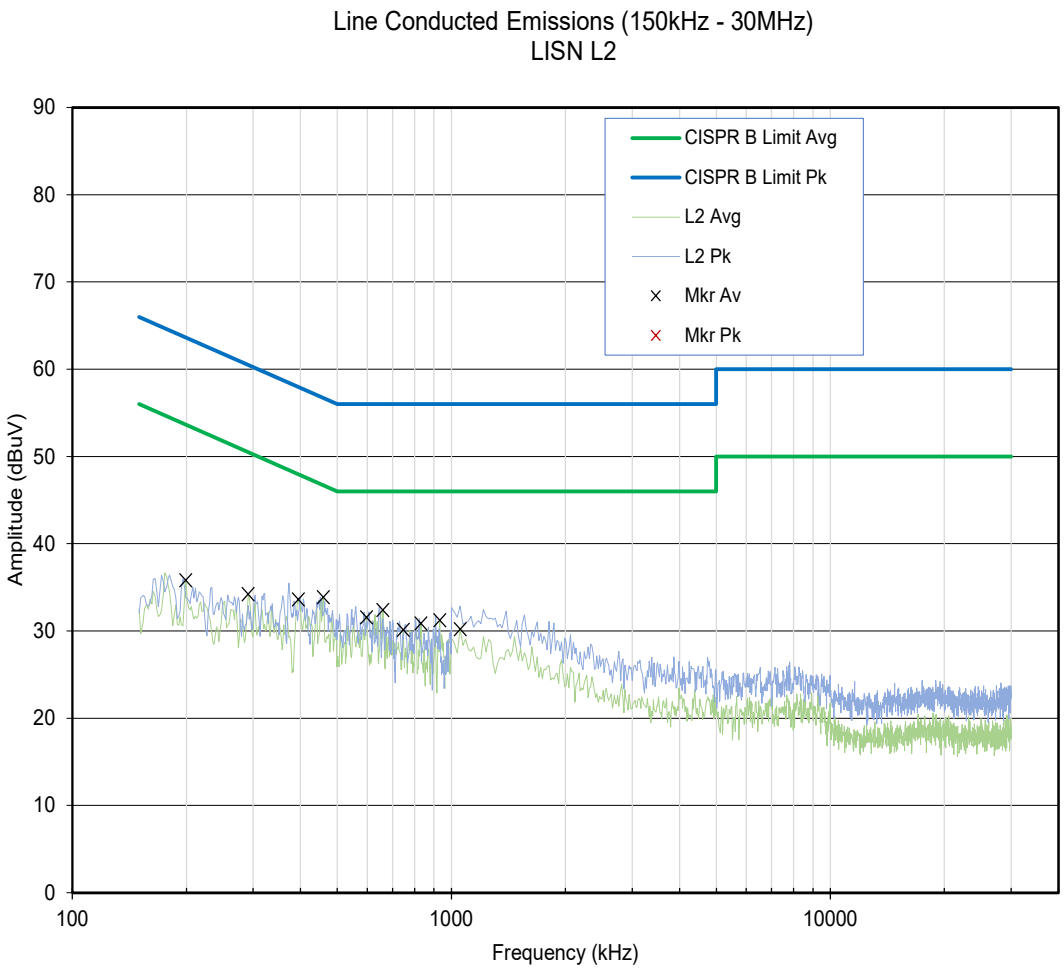


**Table 19.1 – Summary of Power Line Conducted Emissions – L1**

| §15.107, ICES-003 (6.1) | | | | | |
|---|---|---|---|---|---|
| Emission Frequency | LISN Port | Detector | Corrected Emission [$E_{Corr}$]* (W) | Limit [Limit] (dBuV/m) | Margin [Margin] (dB) |
| 192.5 kHz | L1 | Average | 36.40 | 54.3 | **17.9** |
| 263.9 kHz | L1 | Average | 35.65 | 51.6 | **15.9** |
| 396.5 kHz | L1 | Average | 32.39 | 48.0 | **15.6** |
| 403.3 kHz | L1 | Average | 34.31 | 47.9 | **13.6** |
| 586.9 kHz | L1 | Average | 33.40 | 46.0 | **12.6** |
| 685.5 kHz | L1 | Average | 33.26 | 46.0 | **12.7** |
| 717.8 kHz | L1 | Average | 31.38 | 46.0 | **14.6** |
| 847.0 kHz | L1 | Average | 31.48 | 46.0 | **14.5** |
| 977.9 kHz | L1 | Average | 29.92 | 46.0 | **16.1** |
| 1108.0 kHz | L1 | Average | 29.92 | 46.0 | **16.1** |
| | | | **Results:** | **Complies** | |

* Measurement Compensated for Cable Loss and Antenna Correction Factor

$E_{Corr} = E_{Meas} + L_C + AFC$

Margin = Limit - $E_{Corr}$

**Table 19.1 – Summary of Power Line Conducted Emissions – L2**

| §15.107, ICES-003 (6.1) | | | | | |
|---|---|---|---|---|---|
| **Emission Frequency** | **LISN Port** | **Detector** | **Corrected Emission [$E_{Corr}$]* (W)** | **Limit [Limit] (dBuV/m)** | **Margin [Margin] (dB)** |
| 199.3 kHz | L2 | Average | 35.83 | 54.0 | **18.2** |
| 291.1 kHz | L2 | Average | 34.22 | 50.7 | **16.5** |
| 394.8 kHz | L2 | Average | 33.64 | 48.1 | **14.4** |
| 459.4 kHz | L2 | Average | 33.88 | 46.7 | **12.9** |
| 597.1 kHz | L2 | Average | 31.59 | 46.0 | **14.4** |
| 660.0 kHz | L2 | Average | 32.40 | 46.0 | **13.6** |
| 746.7 kHz | L2 | Average | 30.14 | 46.0 | **15.9** |
| 831.7 kHz | L2 | Average | 30.85 | 46.0 | **15.2** |
| 932.0 kHz | L2 | Average | 31.23 | 46.0 | **14.8** |
| 1054.0 kHz | L2 | Average | 30.22 | 46.0 | **15.8** |
| | | | **Results:** | **Complies** | |

-

* Measurement Compensated for Cable Loss and Antenna Correction Factor

$E_{Corr} = E_{Meas} + L_C + AFC$

Margin = Limit - $E_{Corr}$

## APPENDIX A – TEST SETUP DRAWINGS

**Table A.1 – Conducted Measurement Setup**

| Equipment List | | | | |
|---|---|---|---|---|
| **Asset Number** | **Manufacturer** | **Model Number** | **Serial Number** | **Description** |
| 00241 | R&S | FSU40 | 100500 | Spectrum Analyzer |
| 00263 | Koaxis | KP10-1.00M-TD | 263 | 1m Armoured Cable |

**Figure A.1 – Test Setup – Conducted Measurements**

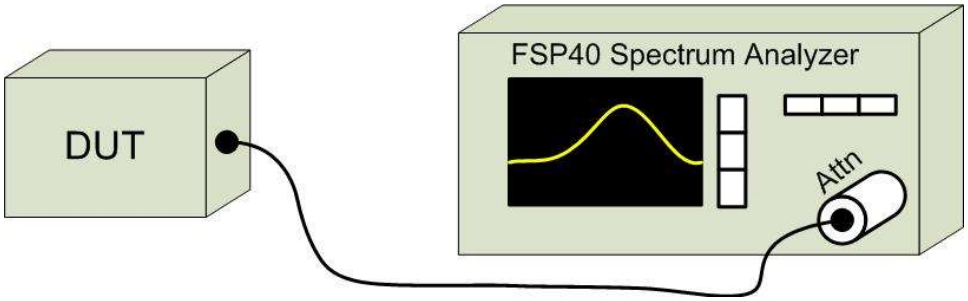


**Table A.2 – Radiated Emissions Measurement Equipment**

| Equipment List | | | | |
|---|---|---|---|---|
| **Asset Number** | **Manufacturer** | **Model Number** | **Serial Number** | **Description** |
| 00050 | Chase | CBL-6111A | 1607 | Bilog Antenna |
| 00034 | ETS | 3115 | 6267 | Double Ridged Guide Horn |
| 00035 | ETS | 3115 | 6276 | Double Ridged Guide Horn |
| 00085 | EMCO | 6502 | 9203-2724 | Loop Antenna |
| 00161 | Waveline Inc. | 889 | | Standard Gain Horn 18-26GHz |
| 00162 | Waveline Inc. | 889 | | Standard Gain Horn 18-26GHz |
| 00165 | Waveline Inc. | 801-KF | | Waveguide Adapter 18-26GHz |
| 00166 | Waveline Inc. | 801-KF | | Waveguide Adapter 18-26GHz |
| 00333 | HP | 85685A | 3010A01095 | RF Preselector |
| 00049 | HP | 85650A | 2043A00162 | Quasi-peak Adapter |
| 00051 | HP | 8566B | 2747A05510 | Spectrum Analyzer |
| 00241 | R&S | FSU40 | 100500 | Spectrum Analyzer |
| 00265 | Miteq | JS32-00104000-58-5P | 1939850 | Microwave L/N Amplifier |
| 00071 | EMCO | 2090 | 9912-1484 | Multi-Device Controller |
| 00072 | EMCO | 2075 | 0001-2277 | Mini-mast |
| 00073 | EMCO | 2080 | 0002-1002 | Turn Table |
| 00263 | Koaxis | KP10-1.00M-TD | 263 | 1m Armoured Cable |
| 00263B | Koaxis | KP10-1.00M-TD | 263B | 1m Armoured Cable |
| 00275 | TMS | LMR400 | n/a | 25m Cable |
| 00278 | TILE | 34G3 | n/a | TILE Test Software |

**Figure A.2 – Test Setup Radiated Measurements 9kHzMHz – 30MHz**

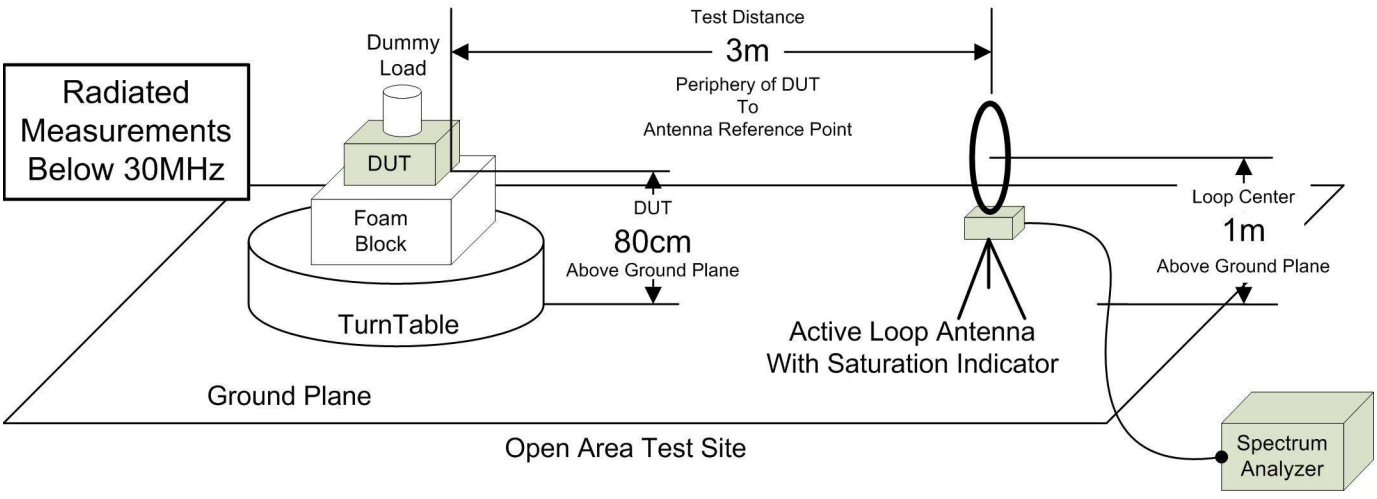


**Figure A.3 – Test Setup Radiated Measurements 30MHz – 1GHz**

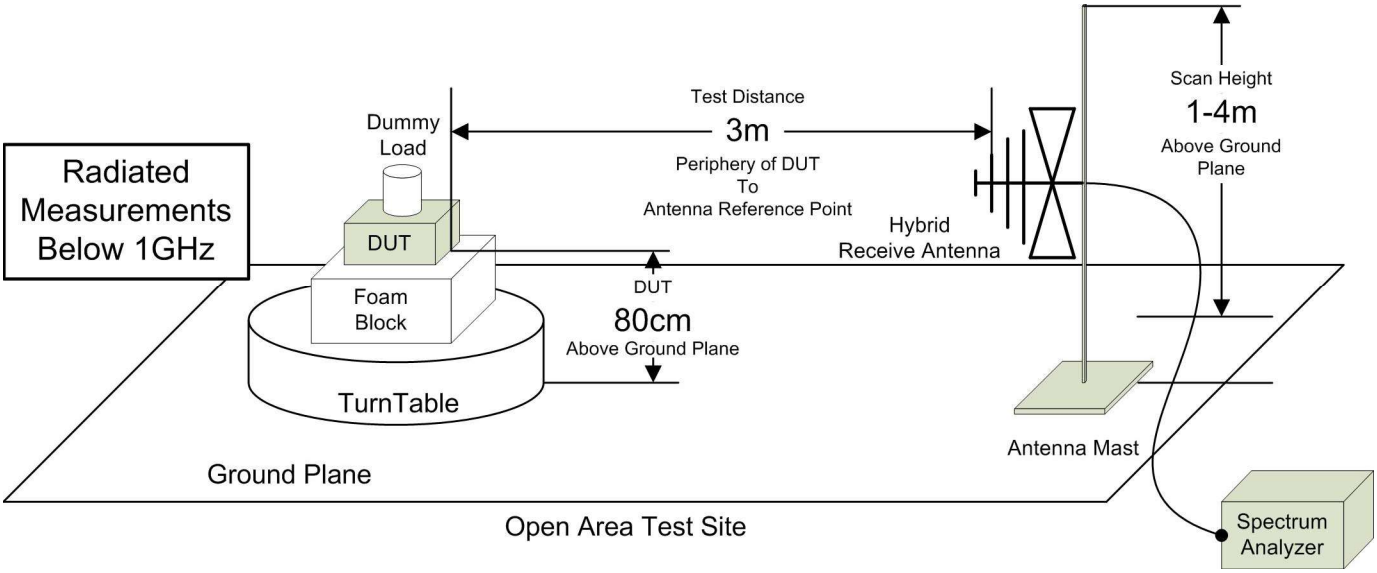



**Figure A.4 – Test Setup Radiated Measurements 30MHz – 1GHz, Signal Substitution**

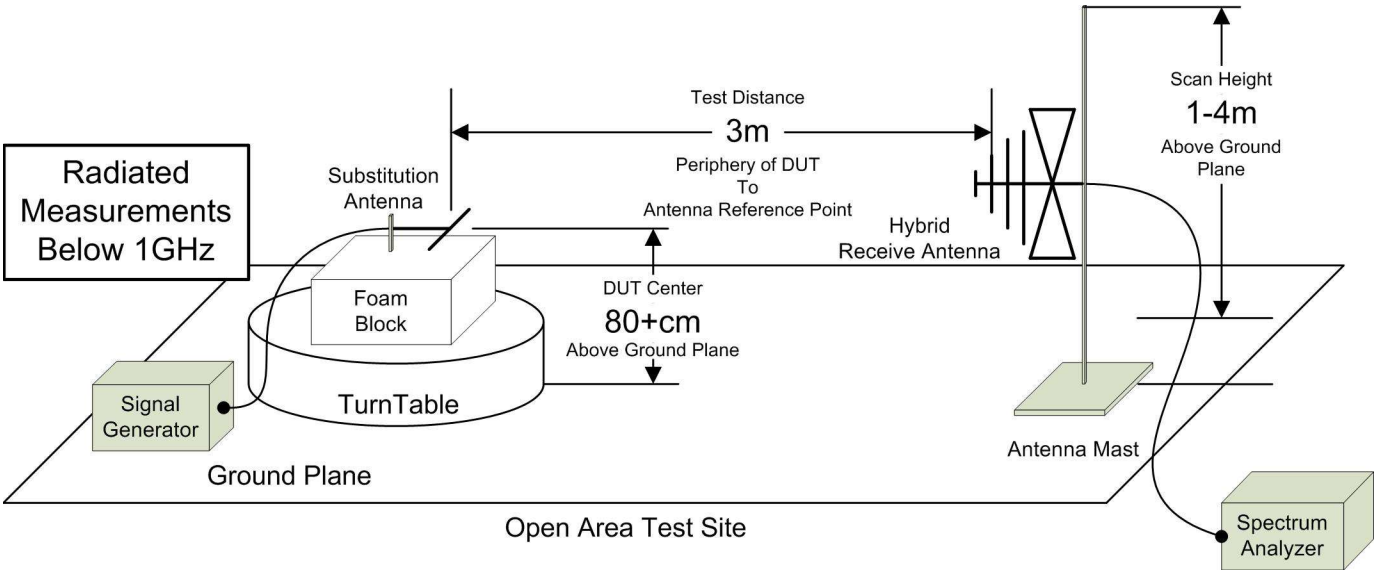


**Figure A.5 – Test Setup Radiated Measurements 1 – 18GHz,**

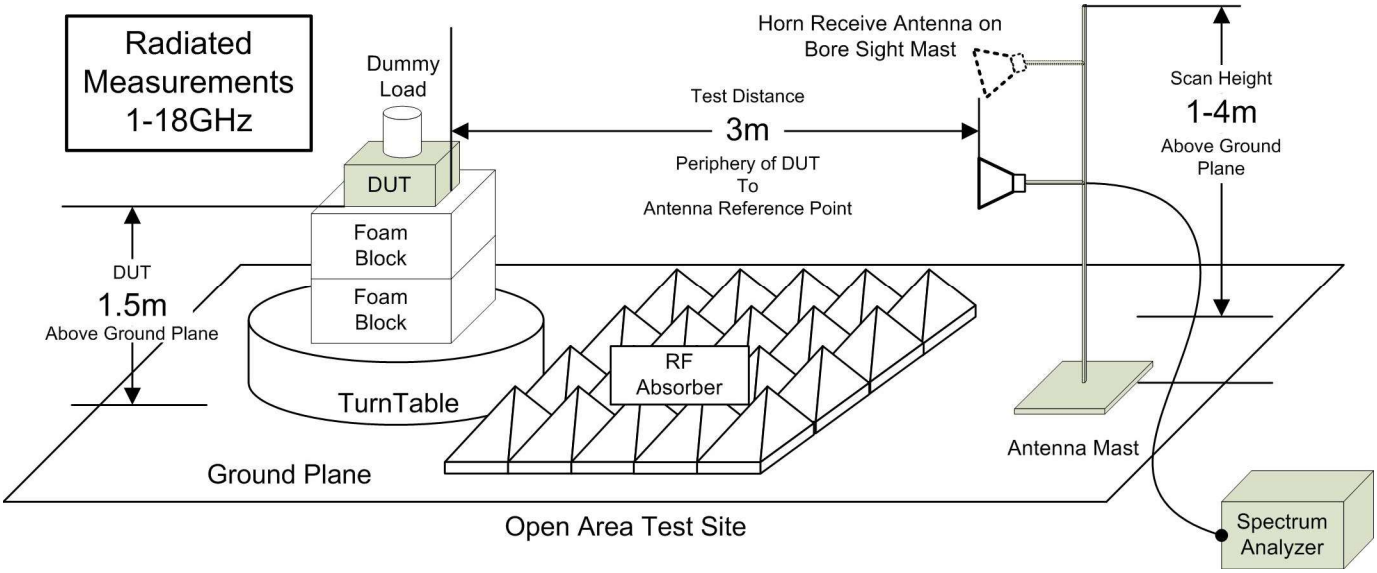



**Figure A.6 – Test Setup Radiated Measurements 18 – 26.5GHz,**

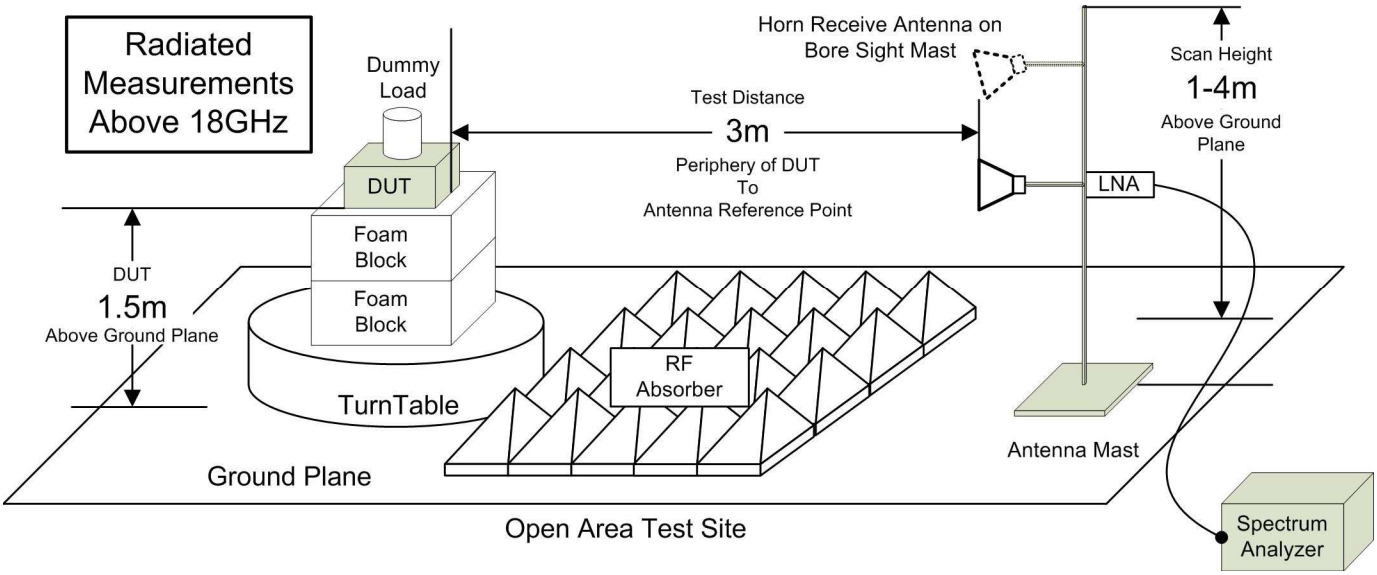


**Table A.3 – Setup – Line Conducted Emissions Equipment List**

| Equipment List | | | | |
|---|---|---|---|---|
| **Asset Number** | **Manufacturer** | **Model Number** | **Serial Number** | **Description** |
| 00333 | HP | 85685A | 3010A01095 | RF Preselector |
| 00049 | HP | 85650A | 2043A00162 | Quasi-peak Adapter |
| 00051 | HP | 8566B | 2747A05510 | Spectrum Analyzer |
| 00223 | HP | 8901A | 3749A07154 | Modulation Analyzer |
| 00257 | Com-Power | LI-215A | 191934 | LISN |
| 00276 | TMS | LMR400 | n/a | 4m Cable |

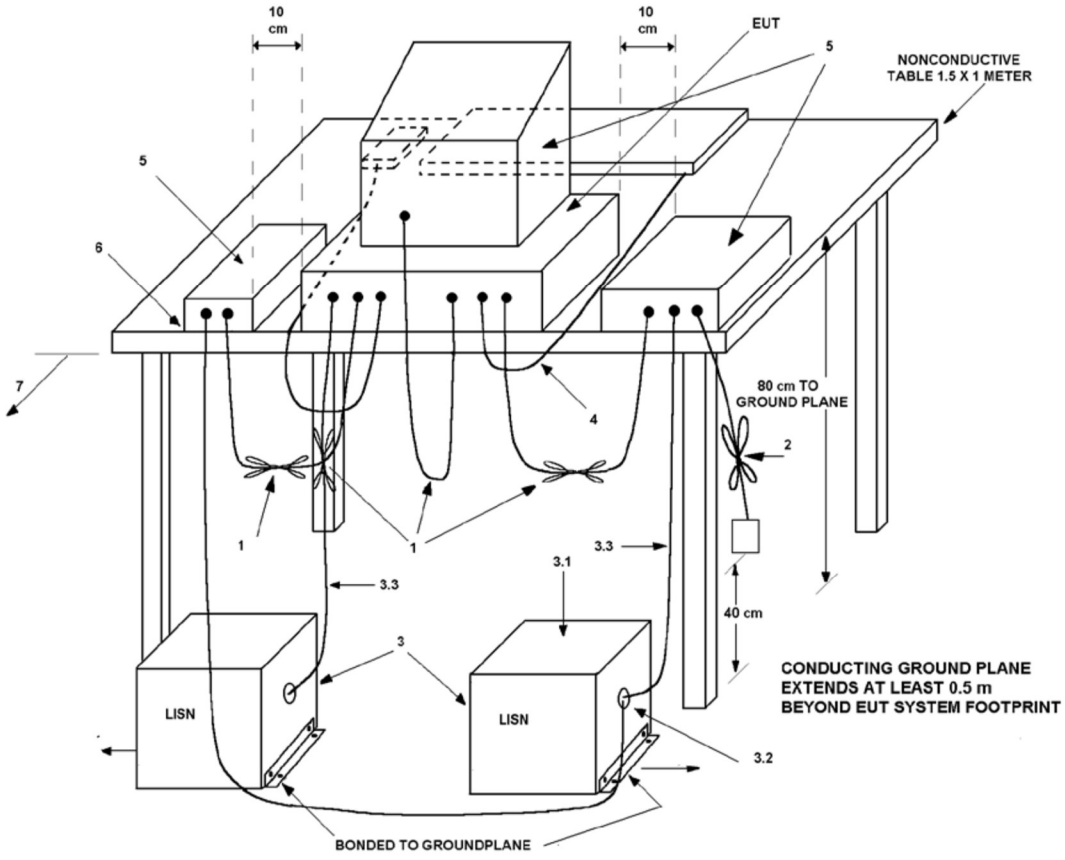



**Figure A.7 – Test Setup Conducted Emissions Measurements**

## APPENDIX B – EQUIPMENT LIST AND CALIBRATION

| Equipment List | | | | | | | |
|---|---|---|---|---|---|---|---|
| Asset Number | Manufacturer | Model Number | Serial Number | Description | Last Calibrated | Calibration Interval | Calibration Due |
| 00050 | Chase | CBL-6111A | 1607 | Bilog Antenna | 16 Nov 2023 | Triennial | 16 Nov 2026 |
| 00035 | ETS | 3115 | 6276 | Double Ridged Guide Horn | 4 Mar 2022 | Triennial | 4 Mar 2025 |
| 00085 | EMCO | 6502 | 9203-2724 | Loop Antenna | 6 Sep 2022 | Triennial | 6 Sep 2025 |
| 00161 | Waveline Inc. | 889 | | Standard Gain Horn 18-26GHz | NCR | n/a | NCR |
| 00165 | Waveline Inc. | 801-KF | | Waveguide Adapter 18-26GHz | NCR | n/a | NCR |
| 00241 | R&S | FSU40 | 100500 | Spectrum Analyzer | 10 Aug 2021 | Triennial | 10 Aug 2024 |
| 00005 | HP | 8648D | 3847A00611 | Signal Generator | 28 Jun 2023 | Triennial | 28 Jun 2026 |
| 00003 | HP | 53181A | 3736A05175 | Frequency Counter | 28 Jun 2023 | Triennial | 28 Jun 2026 |
| 00257 | Com-Power | LI-215A | 191934 | LISN | 27 Dec 2021 | Triennial | 27 Dec 2024 |
| 00071 | EMCO | 2090 | 9912-1484 | Multi-Device Controller | n/a | n/a | n/a |
| 00072 | EMCO | 2075 | 0001-2277 | Mini-mast | n/a | n/a | n/a |
| 00073 | EMCO | 2080 | 0002-1002 | Turn Table | n/a | n/a | n/a |
| 00081 | ESPEC | ECT-2 | 0510154-B | Environmental Chamber | NCR | n/a | CNR |
| 00234 | VWR | 61161-378 | 140320430 | Temp/Humidity Meter | New | Triennial | New |
| 00263 | Koaxis | KP10-1.00M-TD | 263 | 1m Armoured Cable | COU | n/a | COU |
| 00275 | TMS | LMR400 | n/a | 25m Cable | COU | n/a | COU |
| 00276 | TMS | LMR400 | n/a | 4m Cable | COU | n/a | COU |
| 00278 | TILE | 34G3 | n/a | TILE Test Software | NCR | n/a | NCR |

NCR: No Calibration Required
COU: Calibrate On Use

## APPENDIX C – MEASUREMENT INSTRUMENT UNCERTAINTY

| CISPR 16-4 Measurement Uncertainty ( $U_{LAB}$ ) |
|---|
| This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence interval using a coverage factor of k=2 |
| **Radiated Emissions 30MHz - 200MHz** |
| **$U_{LAB}$ = 5.14dB  $U_{CISPR}$ = 6.3dB** |
| **Radiated Emissions 200MHz - 1000MHz** |
| **$U_{LAB}$ = 5.90dB  $U_{CISPR}$ = 6.3dB** |
| **Radiated Emissions 1GHz - 6GHz** |
| **$U_{LAB}$ = 4.80dB  $U_{CISPR}$ = 5.2dB** |
| **Radiated Emissions 6GHz - 18GHz** |
| **$U_{LAB}$ = 5.1dB  $U_{CISPR}$ = 5.5dB** |
| **Power Line Conducted Emissions 9kHz to 150kHz** |
| **$U_{LAB}$ = 2.96dB  $U_{CISPR}$ = 3.8dB** |
| **Power Line Conducted Emissions 150kHz to 30MHz** |
| **$U_{LAB}$ = 3.12dB  $U_{CISPR}$ = 3.4dB** |

| | If the calculated uncertainty $U_{lab}$ is **less** than $U_{CISPR}$ then: |
|---|---|
| 1 | Compliance is deemed to occur if **NO** measured disturbance exceeds the disturbance limit |
| 2 | Non-Compliance is deemed to occur if **ANY** measured disturbance **EXCEEDS** the disturbance limit |
| | If the calculated uncertainty $U_{lab}$ is **greater** than $U_{CISPR}$ then: |
| 3 | Compliance is deemed to occur if **NO** measured disturbance, increased by ( $U_{lab}$ - $U_{CISPR}$ ), exceeds the disturbance limit |
| 4 | Non-Compliance is deemed to occur if **ANY** measured disturbance, increased by ( $U_{lab}$ - $U_{CISPR}$ ), **EXCEEDS** the disturbance limit |

| Other Measurement Uncertainties ( $U_{LAB}$ ) |
|---|
| **RF Conducted Emissions 9kHz - 40GHz** |
| **$U_{LAB}$ = 1.0dB  $U_{CISPR}$ = n/a** |
| **Frequency/Bandwidth 9kHz - 40GHz** |
| **$U_{LAB}$ = 0.1ppm  $U_{CISPR}$ = n/a** |
| **Temperature** |
| **$U_{LAB}$ = 1$^{O}$C  $U_{CISPR}$ = n/a** |

# END OF REPORT

## APPENDIX D – CONDUCTED POWER MEASUREMENT PLOTS

## APPENDIX E – CONDUCTED BAND EDGE PLOTS

## APPENDIX F – CONDUCTED SPURIOUS EMISSIONS MEASUREMENT PLOTS

## APPENDIX G – RADIATED TX EMISSIONS MEASUREMENT PLOTS

## APPENDIX H – RADIATED RX EMISSIONS MEASUREMENT PLOTS