



REGULATORY COMPLIANCE TEST REPORT

FCC CFR 47 15.247, RSS-247 Issue 2

Report No.: ALNT93-U2 Rev A

Company: Alien Technology, LLC

Model Name: Nexus Multiplexer System

REGULATORY COMPLIANCE TEST REPORT

Company: Alien Technology, LLC

Model Name: Nexus Multiplexer System

To: FCC CFR 47 Part 15 Subpart C 15.247, RSS-247 Issue 2

Test Report Serial No.: ALNT93-U2 Rev A

This report supersedes: None

Applicant: Alien Technology, LLC
845 Embedded Way
San Jose, 95138
USA

Product Function: Nexus 8 Port Multiplexer with the ALR-F800
RFID Reader

Issue Date: 12th November 2019

This Test Report is Issued Under the Authority of:

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MiCOM Labs is an ISO 17025 Accredited Testing Laboratory

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1. ACCREDITATION, LISTINGS & RECOGNITION

1.1. TESTING ACCREDITATION

MiCOM Labs, Inc. is an accredited Electrical testing laboratory per the international standard ISO/IEC 17025:2005. The company is accredited by the American Association for Laboratory Accreditation (A2LA) www.a2la.org test laboratory number 2381.01. MiCOM Labs test schedule is available at the following URL; <http://www.a2la.org/scopepdf/2381-01.pdf>



Accredited Laboratory

A2LA has accredited

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for technical competence in the field of

Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2005 *General requirements for the competence of testing and calibration laboratories*. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated April 2017).



Presented this 14th day of May 2018.



Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 2381.01
Valid to February 29, 2020
Revised November 7, 2019

For the tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.

1.2. RECOGNITION

MiCOM Labs, Inc has widely recognized wireless testing capabilities. Our international recognition includes Conformity Assessment Body designation by APEC MRA countries. MiCOM Labs test reports are accepted globally.

| Country | Recognition Body | Status | Phase | Identification No. |
|-----------|---|--------|------------|---|
| USA | Federal Communications Commission (FCC) | TCB | - | US0159 Listing #: 102167 |
| Canada | Industry Canada (IC) | FCB | APEC MRA 2 | US0159 Listing #: 4143A-2 4143A-3 |
| Japan | MIC (Ministry of Internal Affairs and Communication) | CAB | APEC MRA 2 | RCB 210 |
| | VCCI | -- | -- | A-0012 |
| Europe | European Commission | NB | EU MRA | NB 2280 |
| Australia | Australian Communications and Media Authority (ACMA) | CAB | APEC MRA 1 | US0159 |
| Hong Kong | Office of the Telecommunication Authority (OFTA) | CAB | APEC MRA 1 | |
| Korea | Ministry of Information and Communication Radio Research Laboratory (RRL) | CAB | APEC MRA 1 | |
| Singapore | Infocomm Development Authority (IDA) | CAB | APEC MRA 1 | |
| Taiwan | National Communications Commission (NCC) Bureau of Standards, Metrology and Inspection (BSMI) | CAB | APEC MRA 1 | |
| Vietnam | Ministry of Communication (MIC) | CAB | APEC MRA 1 | |

EU MRA – European Union Mutual Recognition Agreement.

NB – Notified Body

APEC MRA – Asia Pacific Economic Community Mutual Recognition Agreement. Recognition agreement under which test lab is accredited to regulatory standards of the APEC member countries.

Phase I - recognition for product testing

Phase II – recognition for both product testing and certification

1.3. PRODUCT CERTIFICATION

MiCOM Labs, Inc. is an accredited Product Certification Body per the international standard ISO/IEC 17065:2012. The company is accredited by the American Association for Laboratory Accreditation (A2LA) www.a2la.org test laboratory number 2381.02. MiCOM Labs test schedule is available at the following URL; <http://www.a2la.org/scopepdf/2381-02.pdf>



Accredited Product Certification Body

A2LA has accredited


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This product certification body is accredited in accordance with the recognized International Standard ISO/IEC 17065:2012 *Requirements for bodies certifying products, processes and services*. This product certification body also meets the A2LA R322 – *Specific Requirements – Notified Body Accreditation Requirements* and A2LA R308 - *Specific Requirements - ISO-IEC 17065 - Telecommunication Certification Body Accreditation Program*. This accreditation demonstrates technical competence for a defined scope and the operation of a management system.

Presented this 14th day of May 2018




Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 2381.02
Valid to February 29, 2020
Revised November 7, 2019

For the product certification schemes to which this accreditation applies, please refer to the organization's Product Certification Scope of Accreditation.

United States of America – Telecommunication Certification Body (TCB)
Industry Canada – Certification Body, CAB Identifier – US0159
Europe – Notified Body (NB), NB Identifier - 2280
Japan – Recognized Certification Body (RCB), RCB Identifier - 210

2. DOCUMENT HISTORY

| Document History | | |
|------------------|--------------------------------|---------------------------------|
| Revision | Date | Comments |
| Draft | 7th November 2019 | Draft report for client review. |
| Rev A | 12 th November 2019 | Initial Release |
| . | | |
| . | | |
| . | | |
| . | | |
| . | | |

In the above table the latest report revision will replace all earlier versions.

3. TEST RESULT CERTIFICATE

| | |
|--|---|
| Manufacturer: Alien Technology, LLC 845 Embedded Way San Jose, 95138 USA | Tested By: MiCOM Labs, Inc. 575 Boulder Court Pleasanton California 94566 USA |
| Model: ALX-2525, ALX-2530, ALR-F800 | Telephone: +1 925 462 0304 |
| Equipment Type: Nexus 8 Port Multiplexer with the ALR-F800 RFID Reader. | Fax: +1 925 462 0306 |
| S/N's: ALNT68-1 | |
| Test Date(s): 14 th – 24 th October 2019 | Website: www.micomlabs.com |

| STANDARD(S) | TEST RESULTS |
|---|--------------------|
| FCC CFR 47 Part 15 Subpart C 15.247 ISED RSS-247 Issue 2 | EQUIPMENT COMPLIES |

MiCOM Labs, Inc. tested the equipment mentioned in accordance with the requirements set forth in the above standards. Test results indicate that the equipment tested is capable of demonstrating compliance with the requirements as documented within this report.

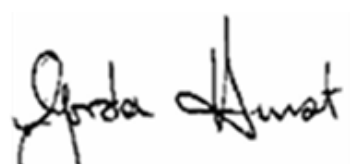
Notes:

1. This document reports conditions under which testing was conducted and the results of testing performed.
2. Details of test methods used have been recorded and kept on file by the laboratory.
3. Test results apply only to the item(s) tested.

Approved & Released for MiCOM Labs, Inc. by:



Graeme Grieve
Quality Manager MiCOM Labs, Inc.



Gordon Hurst
President & CEO MiCOM Labs, Inc.

4. REFERENCES AND MEASUREMENT UNCERTAINTY

4.1. Normative References

| REF. | PUBLICATION | YEAR | TITLE |
|------|------------------------|---|---|
| I | KDB 662911 | 2015 | Guidance for measurement of output emission of devices that employ single transmitter with multiple outputs or systems with multiple transmitters operating simultaneously in the same frequency band |
| II | A2LA | August 2018 | R105 - Requirement's When Making Reference to A2LA Accreditation Status |
| III | ANSI C63.10 | 2013 | American National Standard for Testing Unlicensed Wireless Devices |
| IV | ANSI C63.4 | 2014 | American National Standards for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz |
| V | CISPR 32 | 2015 | Electromagnetic compatibility of multimedia equipment - Emission requirements |
| VI | ETSI TR 100 028 | 2001-12 | Parts 1 and 2 Electromagnetic compatibility and Radio Spectrum Matters (ERM); Uncertainties in the measurement of mobile radio equipment characteristics |
| VII | FCC 06-96 | Jun 30 2006 | Memorandum Opinion and Order |
| VIII | FCC 47 CFR Part 15.247 | 2016 | Radio Frequency Devices; Subpart C – Intentional Radiators |
| IX | ICES-003 | Issue 6 Jan 2016; Updated April 2019 | Information Technology Equipment (Including Digital Apparatus) – Limits and methods of measurement. |
| X | M 3003 | Edition 3 Nov.2012 | Expression of Uncertainty and Confidence in Measurements |
| XI | RSS-247 Issue 2 | Feb 2017 | Digital Transmission Systems (DTSS), Frequency Hopping System (FHSs) and Licence-Exempt Local Area Network (LE-LEN) Devices |
| XII | RSS-Gen Issue 5 | March 2019 Amendment 1 | General Requirements for Compliance of Radio Apparatus |
| XIII | M 3003 | Edition 3 Nov.2012 | Expression of Uncertainty and Confidence in Measurements |
| XIV | FCC 47 CFR Part 2.1033 | 2016 | FCC requirements and rules regarding photographs and test setup diagrams. |

4.2. Test and Uncertainty Procedure

Conducted and radiated emission measurements were conducted in accordance with American National Standards Institute ANSI C63.4, listed in the Normative References section of this report.

Measurement uncertainty figures are calculated in accordance with ETSI TR 100 028 Parts 1 and 2.

Measurement uncertainties stated are based on a standard uncertainty multiplied by a coverage factor $k = 2$, providing a level of confidence of approximately 95 % in accordance with UKAS document M 3003 listed in the Normative References section of this report.

5. PRODUCT DETAILS AND TEST CONFIGURATIONS

5.1. Technical Details

| Details | Description |
|--------------------------------------|---|
| Purpose: | Test of the Alien Technology Nexus Multiplexer to FCC CFR 47 Part 15 Subpart C 15.247 (DTS) and Industry Canada RSS-247 Issue 2 |
| Applicant: | Alien Technology, LLC 845 Embedded Way San Jose California 95138 USA |
| Manufacturer: | As Applicant |
| Laboratory performing the tests: | MiCOM Labs, Inc. 575 Boulder Court Pleasanton California 94566 USA |
| Test report reference number: | ALNT93-U2 |
| Date EUT received: | 14 th October 2019 |
| Standard(s) applied: | FCC CFR 47 Part 15 Subpart C 15.247 ISSED RSS 15.247 Issue 2 |
| Dates of test (from - to): | 14 th – 24 th August 2019 |
| No of Units Tested: | 1 |
| Product Family Name: | Nexus |
| Model(s): | ALR-F800, ALX-2525, ALX-2530 |
| Location for use: | Indoor |
| Declared Frequency Range(s): | 902 - 928 MHz; |
| Type of Modulation: | PR-ASK |
| Declared Nominal Output Power (dBm): | +30 dBm |
| Transmit/Receive Operation: | Transceiver |
| Rated Input Voltage and Current: | AC/ DC adaptor 12V dc 2.5A, DC POE 56Vdc 0.3A Optional for controller: AC/DC adapter 24V dc |
| Operating Temperature Range: | -20 to +55 °C |
| ITU Emission Designator: | 67K0A1D |
| Equipment Dimensions: | ALR-F800: 20.2cm (L) x 19.1cm (W) x 2.8cm (D) ALX-2525: 18.3cm (L) x 11.7cm (W) x 2.8cm (D) ALX-2530: 18.1cm (L) x 10.8cm (W) x 2.9cm (D) |
| Weight: | ALR-F800: 0.85 kg, ALX-2525: 0.18 kg, ALX-2530: 0.18 kg |
| Hardware Rev: | 19.10.24 |
| Software Rev: | Rev A |

5.2. Scope Of Test Program

Alien Technology Nexus Multiplexer

The scope of the test program was to test the Alien Technologies Nexus Multiplexer which consists of the ALR-F800 RFID Reader, ALX-2525 Multiplexer, and ALX-2530 Controller unit for compliance against the following specifications:

FCC CFR 47 Part 15 Subpart C 15.247

Radio Frequency Devices; Subpart C – Intentional Radiators

RSS-247 Issue 2

Digital Transmission Systems (DTSs), Frequency Hopping System (FHSs) and Licence-Exempt Local Area Network (LE-LEN) Devices.

The ALX-2530 Controller has a GPIO connector and is also available as model variant ALX-2535 without the GPIO connector.

The ALX-2530 Controller was tested within the scope of this test program as it represent the worst case model variant in terms of emissions.

System Test and Measurement Configurations

The Nexus Multiplexer system consists of the ALR-F800 RFID Reader, ALX-2525 Multiplexer, and ALX-2530 Controller. The ALR-F800 RFID Reader was previously tested in a stand-alone configuration with results reported in MiCOM Labs test Report ALNT63-U5 Rev A. Conductive RF measurements were spot checked on the ALR-F800 RFID Reader to verify continuing compliance during this test program.

5.3. Equipment Model(s) and Serial Number(s)

| Type (EUT/Support) | Equipment Description | Manufacturer | Model No. | Serial No. |
|--------------------|--|------------------|----------------|------------|
| EUT | RFID Reader | Alien Technology | ALR-F800 | ALNT68-1 |
| EUT | Multiplexer | Alien Technology | ALX-2525 | Prototype |
| EUT | Controller | Alien Technology | ALX-2530 | Prototype |
| Support | 12V AC/DC Power Supply | PhiHong | PSAC30U-120 | - |
| Support | POE Power Supply | Ault | PW180KA4800F01 | -- |
| Support | 24V AC/DC Power Supply (optional for controller) | Meanwell | MDR-60-24 | |
| Support | Laptop | Dell | -- | -- |

5.4. Antenna Details

| Type | Manufacturer | Model | Family | Gain (dBi) | BF Gain | Dir BW | X-Pol | Frequency Band (MHz) |
|----------|------------------|-----------|--------|------------|---------|--------|-------|----------------------|
| external | Alien Technology | ALR-8698 | Panel | 8.5 | - | 70 | - | 902 - 928 |
| external | Alien Technology | ALR-8697 | Panel | 5.5 | - | 70 | - | 902 - 928 |
| external | Times-7 | ALR-A1001 | Panel | 5.5 | - | 68 | - | 902 - 928 |
| external | Broadradio | ALR-0501 | Panel | 3.0 | - | 105 | - | 902 - 928 |

BF Gain - Beamforming Gain
Dir BW - Directional BeamWidth
X-Pol - Cross Polarization

5.5. Cabling and I/O Ports

| Port Type | Max Cable Length | # Of Ports | Screened | Conn Type | Data Type |
|-----------|------------------|------------|----------|----------------|-------------|
| USB | 15m | 1 | Y | USB2.0 Type A | Digital |
| USB | 15m | 1 | Y | USB 2.0 Type B | Digital |
| RS232 | Unknown | 1 | Y | DB9 | Digital |
| Ethernet | 100m | 1 | N | RJ45 | Packet Data |
| dc Jack | Unknown | 1 | N | Power Jack | - |

5.6. Test Configurations

Results for the following configurations are provided in this report:

| Operational Mode(s) (PR-ASK) | Data Rate with Highest Power Tari | Channel Frequency (MHz) | | |
|------------------------------|-----------------------------------|-------------------------|--------|--------|
| | | Low | Mid | High |
| PR-ASK | 25.00 | 902.75 | 915.25 | 927.25 |

5.7. Equipment Modifications

The following modifications were required to bring the equipment into compliance for radiated emissions:

1. A Fair-Rite Type 61 ferrite (Part No 0461164181) was added to the DC cable at the connector to the ALR-F800 with 3 full turns and to the GPIO cable at the F800 connector. A 1 μ F Cap was placed on the GPIO connector interface between 12V and ground to minimize emissions in the 30-1000 MHz range.

5.8. Deviations from the Test Standard

The following deviations from the test standard were required in order to complete the test program:

1. NONE

6. TEST SUMMARY

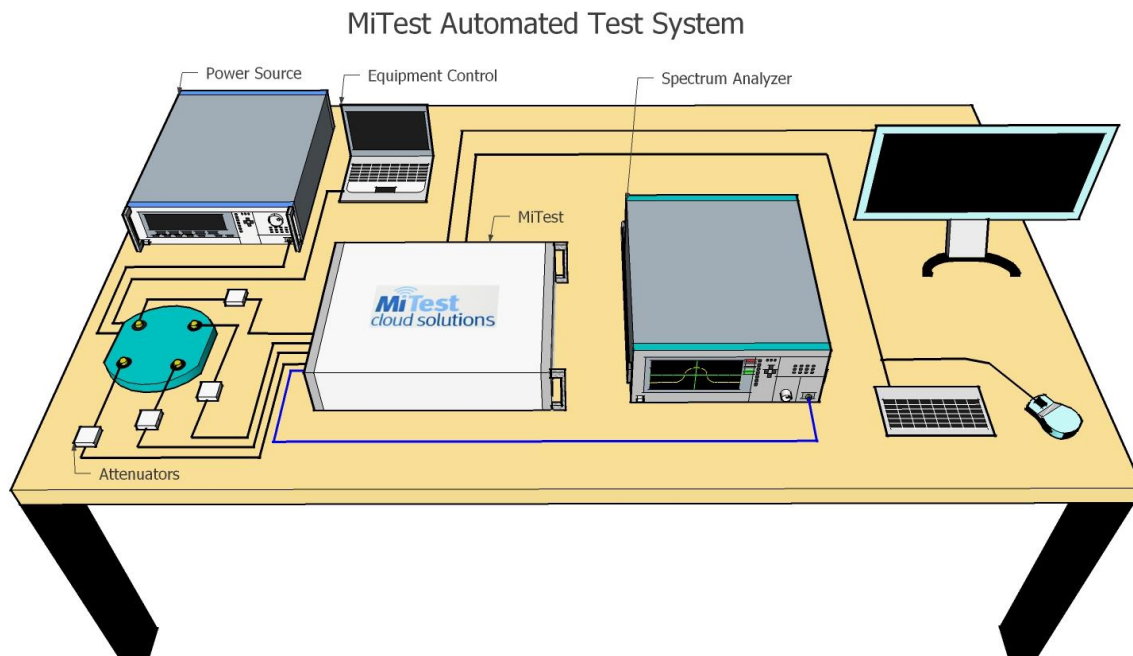
List of Measurements

| Test Header | Result | Data Link |
|--|----------|---------------------------|
| Conducted Test Results | | |
| 15.247(a)(2) 20 dB & 99% Bandwidth | Complies | View Data |
| 15.247(b), 15.31(e) Conducted Output Power | Complies | View Data |
| 15.247(d) Emissions | Complies | - |
| (1) Conducted Emissions | Complies | - |
| (i) Conducted Spurious Emissions | Complies | View Data |
| (ii) Conducted Band-Edge Emissions | Complies | View Data |
| Radiated Test Results | | |
| (i) 15.205 Restricted Band Emissions | Complies | View Data |
| 15.209 Emissions below 1 GHz | Complies | View Data |
| ac Wireline Emissions | | |
| (3) 15.207 ac Wireline Emissions (0.15 – 30 MHz) | Complies | View Data |

Note: Per the note in Section 5.2 of this report, the ALR-F800 RFID Reader used in the Nexus Multiplexer System was spot checked conductively to verify continuing compliance during this test program. The conducted data in this report was previously reported in MiCOM Labs test report ALNT63-U5 Rev A which documents the testing of the ALR-F800 RFID Reader.

7. TEST EQUIPMENT CONFIGURATION(S)

7.1. RF Conducted Testing

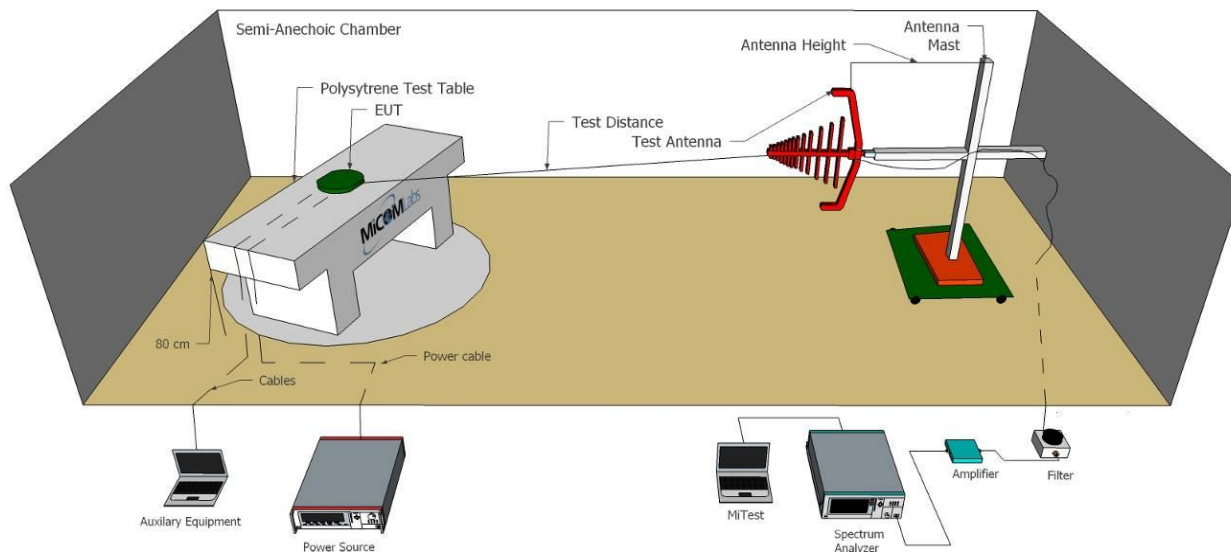


| Asset# | Description | Manufacturer | Model# | Serial# | Calibration Due Date |
|--------|-----------------------------------|----------------------|-----------------|-------------|----------------------|
| #3 SA | MiTest Box to SA | Fairview Microwave | SCA1814-0101-72 | #3 SA | 9 Mar 2020 |
| #3P1 | EUT to MiTest box port 1 | Fairview Microwave | SCA1814-0101-72 | #3P1 | 9 Mar 2020 |
| #3P2 | EUT to MiTest box port 2 | Fairview Microwave | SCA1814-0101-72 | #3P2 | 9 Mar 2020 |
| #3P3 | EUT to MiTest box port 3 | Fairview Microwave | SCA1814-0101-72 | #3P3 | 9 Mar 2020 |
| #3P4 | EUT to MiTest box port 4 | Fairview Microwave | SCA1812-0101-72 | #3P4 | 9 Mar 2020 |
| 249 | Resistance Thermometer | Thermotronics | GR2105-02 | 9340 #2 | 30 Oct 2020 |
| 287 | Rohde & Schwarz 40 GHz Receiver | Rhode & Schwarz | ESIB40 | 100201 | 8 Oct 2020 |
| 398 | MiTest RF Conducted Test Software | MiCOM | MiTest ATS | Version 4.1 | Not Required |
| 405 | DC Power Supply 0-60V | Agilent | 6654A | MY4001826 | Cal when used |
| 408 | USB to GPIB interface | National Instruments | GPIB-USB HS | 14C0DE9 | Not Required |

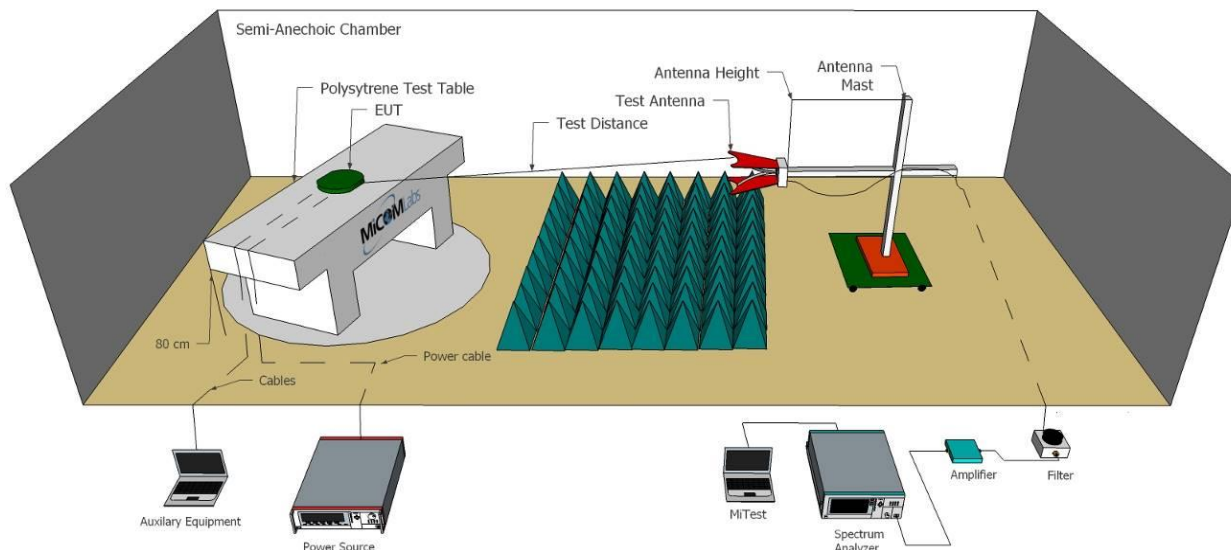
7.2. Radiated Emissions - 3m Chamber

Test Setup for Radiated Emissions for above and below 1 GHz

Radiated Emissions Below 1GHz Test Setup



Radiated Emissions Above 1GHz Test Setup



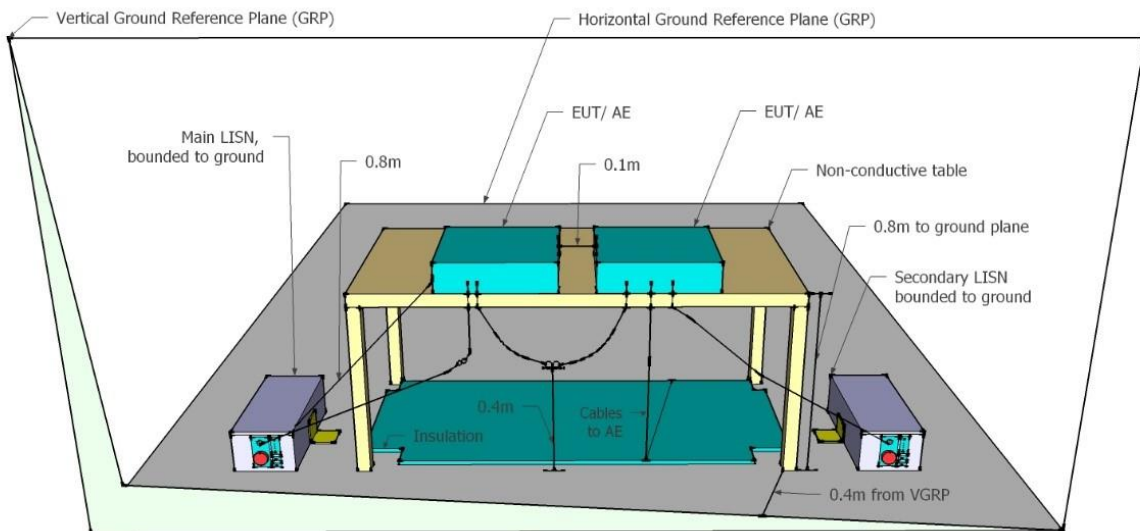
A full system calibration was performed on the test station and any resulting system losses (or gains) were taken into account in the production of all final measurement data.

| Asset# | Description | Manufacturer | Model# | Serial# | Calibration Due Date |
|--------|---|----------------------|---|-------------|----------------------|
| 170 | Video System Controller for Semi Anechoic Chamber | Panasonic | WV-CU101 | 04R08507 | Not Required |
| 298 | 3M Radiated Emissions Chamber Maintenance Check | MiCOM | 3M Chamber | 298 | 25 Jan 2020 |
| 338 | Sunol 30 to 3000 MHz Antenna | Sunol | JB3 | A052907 | 4 Apr 2020 |
| 346 | 1.6 TO 10GHz High Pass Filter | EWT | EWT-57-0112 | H1 | 3 Sep 2020 |
| 373 | 26III RMS Multimeter | Fluke | Fluke 26 series III | 76080720 | 21 Nov 2019 |
| 378 | Rohde & Schwarz 40 GHz Receiver with Generator | Rhode & Schwarz | ESIB40 | 100107/040 | 12 Oct 2020 |
| 397 | Amp 10 - 2500MHz | MiCOM Labs | Amp 10 - 2500 MHz | NA | 6 Sep 2020 |
| 399 | ETS 1-18 GHz Horn Antenna | ETS | 3117 | 00154575 | 12 Nov 2019 |
| 406 | Amplifier for Radiated Emissions | MiCOM Labs | 40dB 1 to 18GHz Amp | 0406 | 9 Sep 2020 |
| 410 | Desktop Computer | Dell | Inspiron 620 | WS38 | Not Required |
| 411 | Mast/Turntable Controller | Sunol Sciences | SC98V | 060199-1D | Not Required |
| 412 | USB to GPIB Interface | National Instruments | GPIB-USB HS | 11B8DC2 | Not Required |
| 413 | Mast Controller | Sunol Science | TWR95-4 | 030801-3 | Not Required |
| 415 | Turntable Controller | Sunol Sciences | Turntable Controller | None | Not Required |
| 416 | Gigabit ethernet filter | ETS-Lingren | Gigafoil 260366 | None | Not Required |
| 447 | MiTest Rad Emissions Test Software | MiCOM | Rad Emissions Test Software Version 1.0 | 447 | Not Required |
| 462 | Schwarzbeck cable from Antenna to Amplifier. | Schwarzbeck | AK 9513 | 462 | 5 Sep 2020 |
| 463 | Schwarzbeck cable from Amplifier to Bulkhead. | Schwarzbeck | AK 9513 | 463 | 5 Sep 2020 |
| 464 | Schwarzbeck cable from Bulkhead to Receiver | Schwarzbeck | AK 9513 | 464 | 9 Sep 2020 |
| 466 | Low Pass Filter DC-1500 MHz | Mini-Circuits | NLP-1750+ | VUU10401438 | 3 Sep 2020 |
| 480 | Cable - Bulkhead to Amp | SRC Haverhill | 157-3050360 | 480 | 9 Sep 2020 |
| 481 | Cable - Bulkhead to Receiver | SRC Haverhill | 151-3050787 | 481 | 9 Sep 2020 |
| 510 | Barometer/Thermometer | Control Company | 68000-49 | 170871375 | 20 Dec 2019 |
| 518 | Cable - Amp to Antenna | SRC Haverhill | 157-3051574 | 518 | 9 Sep 2020 |
| 87 | Uninterruptible Power Supply | Falcon Electric | ED2000-1/2LC | F3471 02/01 | Cal when used |
| CC05 | Confidence Check | MiCOM | CC05 | None | 4 Apr 2020 |

7.3. ac Wireline

The ac Wireline Conducted Emissions test was performed using the conducted test set-up shown in the diagram below.

Test Measurement Set up



Assets Utilized for ac Wireline Emission Testing

A full system calibration was performed on the test station and any resulting system losses (or gains) were taken into account in the production of all final measurement data.

| Asset# | Description | Manufacturer | Model# | Serial# | Calibration Due Date |
|---------|--|------------------------|---|-------------|----------------------|
| 184 | Pulse Limiter | Rhode & Schwarz | ESH3Z2 | 357.8810.52 | 28 Feb 2020 |
| 190 | LISN (two-line V-network) | Rhode & Schwarz | ESH3Z5 | 836679/006 | 18 Oct 2020 |
| 287 | Rohde & Schwarz 40 GHz Receiver | Rhode & Schwarz | ESIB40 | 100201 | 8 Oct 2020 |
| 295 | Conducted Emissions Chamber Maintenance Check | MiCOM | Conducted Emissions Chamber | 295 | 20 Dec 2019 |
| 307 | BNC-CABLE | Megaphase | 1689 1GVT4 | 15F50B002 | 11 Sep 2020 |
| 316 | Dell desktop computer workstation | Dell | Desktop | WS04 | Not Required |
| 372 | AC Variable PS | California Instruments | 1251P | L06951 | Cal when used |
| 378 | Rohde & Schwarz 40 GHz Receiver with Generator | Rhode & Schwarz | ESIB40 | 100107/040 | 12 Oct 2020 |
| 496 | MiTest Conducted Emissions test software. | MiCOM | Conducted Emissions Test Software Version 1.0 | 496 | Not Required |
| 510 | Barometer/Thermometer | Control Company | 68000-49 | 170871375 | 20 Dec 2019 |
| CCEMC01 | Confidence Check. | MiCOM | CCEMC01 | None | 28 Feb 2020 |

8. MEASUREMENT AND PRESENTATION OF TEST DATA

The measurement and graphical data presented in this test report was generated automatically using state-of-the-art technology creating an easy to read report structure. Numerical measurement data is separated from supporting graphical data (plots) through hyperlinks. Numerical measurement data can be reviewed without scrolling through numerous graphical pages to arrive at the next data matrix.

Plots have been relegated into the Appendix 'Graphical Data'.

Test and report automation was performed by [MiTest](#). [MiTest](#) is an automated test system developed by MiCOM Labs. [MiTest](#) is the first cloud based modular test system enabling end-to-end automation of regulatory compliance testing for conducted RF testing.



The MiCOM Labs "[MiTest](#)" Automated Test System" (Patent Pending)

9. TEST RESULTS

9.1. 20 dB & 99% Bandwidth

| Conducted Test Conditions for 6 dB and 99% Bandwidth | | | |
|--|--------------------------|----------------------------|-------------|
| Standard: | FCC CFR 47:15.247 | Ambient Temp. (°C): | 24.0 - 27.5 |
| Test Heading: | 20 dB and 99 % Bandwidth | Rel. Humidity (%): | 32 - 45 |
| Standard Section(s): | 15.247 (a)(2) | Pressure (mBars): | 999 - 1001 |
| Reference Document(s): | See Normative References | | |
| <p>Test Procedure for 20 dB and 99% Bandwidth Measurement The bandwidth at 20 dB and 99 % was measured with a spectrum analyzer connected to the antenna terminal, while EUT is operating in transmission mode at the appropriate center frequency.</p> <p>Testing was performed under ambient conditions at nominal voltage. Where the device operated with multiple antenna ports i.e. MIMO device, each port was measured and reported.</p> <p>Test configuration and setup used for the measurement was per the Conducted Test Set-up specified in this document.</p> <p>Limits for 20 dB and 99% Bandwidth (a) Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions: (i) For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.</p> | | | |

Equipment Configuration for 20 dB & 99% Bandwidth

| | | | |
|--------------------------------|----------------|-----------------------------------|----------------|
| Variant: | PR-ASK | Duty Cycle (%): | 99.00 |
| Data Rate: | 25.00 Tari | Antenna Gain (dBi): | 3.00 |
| Modulation: | FHSS | Beam Forming Gain (Y)(dB): | Not Applicable |
| TPC: | Not Applicable | Tested By: | CC |
| Engineering Test Notes: | | | |

Test Measurement Results

| Test Frequency | Measured 20 dB Bandwidth (MHz) | | | | 20 dB Bandwidth (MHz) | | Limit | Lowest Margin |
|----------------|--------------------------------|----|----|----|-----------------------|--------|--------|---------------|
| | Port(s) | | | | Highest | Lowest | | |
| MHz | a | b | c | d | | | KHz | KHz |
| 902.8 | 0.054 | -- | -- | -- | 0.054 | 0.054 | ≤500.0 | -446.0 |
| 915.3 | 0.058 | -- | -- | -- | 0.058 | 0.058 | ≤500.0 | -442.0 |
| 927.3 | 0.051 | -- | -- | -- | 0.051 | 0.051 | ≤500.0 | -449.0 |

| Test Frequency | Measured 99% Bandwidth (MHz) | | | | Maximum 99% Bandwidth (MHz) | | |
|----------------|------------------------------|----|----|----|-----------------------------|--|--|
| | Port(s) | | | | | | |
| MHz | a | b | c | d | | | |
| 902.8 | 0.059 | -- | -- | -- | 0.059 | | |
| 915.3 | 0.059 | -- | -- | -- | 0.059 | | |
| 927.3 | 0.059 | -- | -- | -- | 0.059 | | |

Traceability to Industry Recognized Test Methodologies

| | |
|--------------------------|----------------------------------|
| Work Instruction: | WI-03 MEASURING RF SPECTRUM MASK |
| Measurement Uncertainty: | ±2.81 dB |

Note: click the links in the above matrix to view the graphical image (plot).

9.2. Number of Channels

| Conducted Test Conditions for Number Of Channels | | | |
|--|--------------------------|----------------------------|-------------|
| Standard: | FCC CFR 47:15.247 | Ambient Temp. (°C): | 24.0 - 27.5 |
| Test Heading: | Number of Channels | Rel. Humidity (%): | 32 - 45 |
| Standard Section(s): | 15.247 (a)(2) | Pressure (mBars): | 999 - 1001 |
| Reference Document(s): | See Normative References | | |

Test Procedure

The number of channels and channel occupancy is measured with a spectrum analyzer connected to the antenna terminal, while the EUT is operating in transmission mode at the appropriate center frequency and modulation.

Testing was performed under ambient conditions at nominal voltage. Where the device operated with multiple antenna ports i.e. MIMO device, each port was measured and reported.

Test configuration and setup used for the measurement was per the Conducted Test Set-up specified in this document.

Limit

For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the system shall use at least 50 hopping frequencies; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies.

Equipment Configuration for Hopping Sequence

| | | | |
|--------------------------------|----------------|-----------------------------------|----------------|
| Variants: | PR-ASK | Duty Cycle (%): | Not Applicable |
| Data Rate: | 25.00 Tari | Antenna Gain (dBi): | Not Applicable |
| Modulation: | FHSS | Beam Forming Gain (Y)(dB): | Not Applicable |
| TPC: | Not Applicable | Tested By: | CC |
| Engineering Test Notes: | | | |

Test Measurement Results

| Modulation | Frequency Range (MHz) | Number of Hopping Channels | Limit | Total Number of Hops | Results |
|------------|-----------------------|---------------------------------------|------------------------|----------------------|---------|
| | | | No of Hopping Channels | | |
| PR-ASK | 900.00 – 912.00 | 19.0 | -- | 19.0 | -- |
| PR-ASK | 912.00 – 928.00 | 31.0 | -- | 31.0 | -- |
| PR-ASK | 902.00 – 928.00 | Total No. of Hopping Channels: | ≥50 | 50.0 | Pass |

Traceability to Industry Recognized Test Methodologies

| | |
|--------------------------|----------------------------------|
| Work Instruction: | WI-03 MEASURING RF SPECTRUM MASK |
| Measurement Uncertainty: | ±2.81 dB |

Note: click the links in the above matrix to view the graphical image (plot).

9.3. Channel Spacing

| Conducted Test Conditions for 6 dB and 99% Bandwidth | | | |
|--|--------------------------|----------------------------|-------------|
| Standard: | FCC CFR 47:15.247 | Ambient Temp. (°C): | 24.0 - 27.5 |
| Test Heading: | Channel Spacing | Rel. Humidity (%): | 32 - 45 |
| Standard Section(s): | 15.247 (a)(2) | Pressure (mBars): | 999 - 1001 |
| Reference Document(s): | See Normative References | | |

Test Procedure

The number of channels and channel occupancy is measured with a spectrum analyzer connected to the antenna terminal, while the EUT is operating in transmission mode at the appropriate center frequency and modulation.

Testing was performed under ambient conditions at nominal voltage. Where the device operated with multiple antenna ports i.e. MIMO device, each port was measured and reported.

Test configuration and setup used for the measurement was per the Conducted Test Set-up specified in this document.

Limit

(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. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

Equipment Configuration for Channel Separation

| | | | |
|--------------------------------|----------------|-----------------------------------|----------------|
| Variant: | PR-ASK | Duty Cycle (%): | Not Applicable |
| Data Rate: | 25.00 Tari | Antenna Gain (dBi): | Not Applicable |
| Modulation: | FHSS | Beam Forming Gain (Y)(dB): | Not Applicable |
| TPC: | Not Applicable | Tested By: | CC |
| Engineering Test Notes: | | | |

Test Measurement Results

| Center Frequency | Packet Type | Chan Separation | Limit (20 dB Occ. BW) | Result |
|------------------|-------------|-----------------------|--------------------------|--------|
| MHz | | MHz | MHz | |
| 915.255 | PR-ASK | 0.502 | > 0.058 | Pass |

Traceability to Industry Recognized Test Methodologies

| | |
|--------------------------|--|
| Measurement Uncertainty: | ± 2.81 dB (Spectrum/Amplitude), ± 0.86 ppm (Frequency) |
|--------------------------|--|

Note: click the links in the above matrix to view the graphical image (plot).

9.4. Dwell Time & Channel Occupancy

| Conducted Test Conditions for Channel Occupancy | | | |
|---|--------------------------------|----------------------------|-------------|
| Standard: | FCC CFR 47:15.247 | Ambient Temp. (°C): | 24.0 - 27.5 |
| Test Heading: | Dwell Time & Channel Occupancy | Rel. Humidity (%): | 32 - 45 |
| Standard Section(s): | 15.247 (a)(2) | Pressure (mBars): | 999 - 1001 |
| Reference Document(s): | See Normative References | | |

Test Procedure

The number of channels and channel occupancy is measured with a spectrum analyzer connected to the antenna terminal, while the EUT is operating in transmission mode at the appropriate center frequency and modulation.

Testing was performed under ambient conditions at nominal voltage. Where the device operated with multiple antenna ports i.e. MIMO device, each port was measured and reported.

Test configuration and setup used for the measurement was per the Conducted Test Set-up specified in this document.

Limit

(i) For frequency hopping systems operating in the 902-928 MHz band: if the 20 dB bandwidth of the hopping channel is less than 250 kHz, the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 20 second period; if the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period.

Equipment Configuration for Dwell Time & Channel Occupancy

| | | | |
|--------------------------------|----------------|-----------------------------------|----------------|
| Variant: | Not Applicable | Duty Cycle (%): | Not Applicable |
| Data Rate: | Not Applicable | Antenna Gain (dBi): | Not Applicable |
| Modulation: | FHSS | Beam Forming Gain (Y)(dB): | Not Applicable |
| TPC: | Not Applicable | Tested By: | CC |
| Engineering Test Notes: | | | |

Test Measurement Results

| Center Frequency MHz | Variant Type | Dwell Time (Single Channel) | Channel Occupancy | Channel Occupancy Limit | Result |
|-------------------------|--------------|--------------------------------|-------------------|----------------------------|--------|
| | | ms | ms | ms | |
| 915.25 | PR-ASK | <u>42.48</u> | <u>84.96</u> | 400.00 | Pass |

Traceability to Industry Recognized Test Methodologies

| | |
|--------------------------|--|
| Measurement Uncertainty: | ± 2.81 dB (Spectrum/Amplitude), ± 0.86 ppm (Frequency) |
|--------------------------|--|

9.5. Conducted Output Power

| Conducted Test Conditions for Fundamental Emission Output Power | | | |
|--|--------------------------|----------------------------|-------------|
| Standard: | FCC CFR 47:15.247 | Ambient Temp. (°C): | 24.0 - 27.5 |
| Test Heading: | Output Power | Rel. Humidity (%): | 32 - 45 |
| Standard Section(s): | 15.247 (b) & (c) | Pressure (mBars): | 999 - 1001 |
| Reference Document(s): | See Normative References | | |
| <p>Test Procedure for Fundamental Emission Output Power Measurement In the case of average power measurements an average power sensor was utilized.</p> <p>For peak power measurements the spectrum analyzer built-in power function was used to integrate peak power over the 20 dB bandwidth.</p> <p>Testing was performed under ambient conditions at nominal voltage only. Where the device operated with multiple antenna ports i.e. MIMO device, each port was measured, summed (Σ) and reported.</p> <p>Test configuration and setup used for the measurement was per the Conducted Test Set-up specified in this document.</p> <p>Supporting Information Calculated Power = A + G + Y + 10 log (1/x) dBm</p> <p>A = Total Power [$10 \cdot \log_{10} (10^{a/10} + 10^{b/10} + 10^{c/10} + 10^{d/10})$] G = Antenna Gain Y = Beamforming Gain x = Duty Cycle (average power measurements only)</p> <p>Limits for Fundamental Emission Output Power (b) The maximum peak conducted output power of the intentional radiator shall not exceed the following for non-frequency hopping systems:</p> <p>(3) For systems using digital modulation in the 902-928 MHz and 2400-2483.5 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. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.</p> <p>(4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.</p> <p>(c) Operation with directional antenna gains greater than 6 dBi. (1) Fixed point-to-point operation: (i) Systems operating in the 2400-2483.5 MHz band that are used exclusively for fixed, point-to-point operations may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum conducted output power of the intentional radiator is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.</p> <p>(iii) Fixed, point-to-point operation, as used in paragraphs (c)(1)(i) and (c)(1)(ii) of this section, excludes the use of point-to-multipoint systems, omnidirectional applications, and multiple co-located intentional radiators transmitting the same information. The operator of the spread spectrum or digitally modulated intentional radiator or, if the equipment is professionally installed, the installer is responsible for ensuring that the system is used exclusively for fixed, point-to-point operations. The instruction manual furnished with the intentional radiator shall contain language in the installation instructions informing the operator and the installer of this responsibility.</p> | | | |

(2) In addition to the provisions in paragraphs (b)(3), (b)(4) and (c)(1)(i) of this section, transmitters operating in the 2400-2483.5 MHz band that emit multiple directional beams, simultaneously or sequentially, for the purpose of directing signals to individual receivers or to groups of receivers provided the emissions comply with the following:

(i) Different information must be transmitted to each receiver.

(ii) If the transmitter employs an antenna system that emits multiple directional beams but does not do emit multiple directional beams simultaneously, the total output power conducted to the array or arrays that comprise the device, i.e., the sum of the power supplied to all antennas, antenna elements, staves, etc. and summed across all carriers or frequency channels, shall not exceed the limit specified in paragraph (b)(1) or (b)(3) of this section, as applicable. However, the total conducted output power shall be reduced by 1 dB below the specified limits for each 3 dB that the directional gain of the antenna/antenna array exceeds 6 dBi. The directional antenna gain shall be computed as follows:

(A) The directional gain shall be calculated as the sum of $10 \log$ (number of array elements or staves) plus the directional gain of the element or staff having the highest gain.

(B) A lower value for the directional gain than that calculated in paragraph (c)(2)(ii)(A) of this section will be accepted if sufficient evidence is presented, e.g., due to shading of the array or coherence loss in the beamforming.

(iii) If a transmitter employs an antenna that operates simultaneously on multiple directional beams using the same or different frequency channels, the power supplied to each emission beam is subject to the power limit specified in paragraph (c)(2)(ii) of this section. If transmitted beams overlap, the power shall be reduced to ensure that their aggregate power does not exceed the limit specified in paragraph (c)(2)(ii) of this section. In addition, the aggregate power transmitted simultaneously on all beams shall not exceed the limit specified in paragraph (c)(2)(ii) of this section by more than 8 dB.

(iv) Transmitters that emit a single directional beam shall operate under the provisions of paragraph (c)(1) of this section.

Equipment Configuration for Average Output Power

| | | | |
|--------------------------------|----------------|-----------------------------------|----------------|
| Variant: | PR-ASK | Duty Cycle (%): | 99.00 |
| Data Rate: | 25.00 Tari | Antenna Gain (dBi): | 3.00 |
| Modulation: | FHSS | Beam Forming Gain (Y)(dB): | Not Applicable |
| TPC: | Not Applicable | Tested By: | CC |
| Engineering Test Notes: | | | |

Test Measurement Results

| Test Frequency | Measured Output Power + DCCF (+0.04 dB) (dBm) | | | | Calculated Total Power Σ Port(s) dBm | Limit dBm | Margin dB | EUT Power Setting |
|----------------|---|----|----|----|--|--------------|--------------|-------------------|
| | Port(s) | | | | | | | |
| MHz | a | b | c | d | | | | |
| 902.8 | 29.94 | -- | -- | -- | 29.94 | 30.00 | -0.06 | 30.00 |
| 915.3 | 29.80 | -- | -- | -- | 29.80 | 30.00 | -0.20 | 30.00 |
| 927.3 | 29.72 | -- | -- | -- | 29.72 | 30.00 | -0.28 | 30.00 |

Traceability to Industry Recognized Test Methodologies

| | |
|--------------------------|---------------------------------|
| Work Instruction: | WI-01 MEASURING RF OUTPUT POWER |
| Measurement Uncertainty: | ± 1.33 dB |

DCCF - Duty Cycle Correction Factor

9.6. Emissions

9.6.1. Conducted Emissions

9.6.1.1. Conducted Spurious Emissions

| Conducted Test Conditions for Transmitter Conducted Spurious and Band-Edge Emissions | | | |
|--|------------------------------|----------------------------|-------------|
| Standard: | FCC CFR 47:15.247 | Ambient Temp. (°C): | 24.0 - 27.5 |
| Test Heading: | Max Unwanted Emission Levels | Rel. Humidity (%): | 32 - 45 |
| Standard Section(s): | 15.247 (d) | Pressure (mBars): | 999 - 1001 |
| Reference Document(s): | See Normative References | | |

Test Procedure for Transmitter Conducted Spurious and Band-Edge Emissions Measurement

Transmitter Conducted Spurious and Band-Edge emissions were measured at a limit of 30 dBc (average detector) or 20 dBc (peak detector) below the highest in-band spectral density measured with a spectrum analyzer connected to the antenna terminal. Measurements were made while EUT was operating in transmit mode of operation at the appropriate centre frequency closest to the band-edge. Emissions were maximized during the measurement and limits derived from the peak spectral power and drawn on each plot.

Where the device operated with multiple antenna ports i.e. MIMO device, each port was measured separately. Testing was performed under ambient conditions at nominal voltage only.

Test configuration and setup used for the measurement was per the Conducted Test Set-up specified in this document.

Limits Transmitter Conducted Spurious and Band-Edge Emissions

(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)).

Equipment Configuration for Transmitter Conducted Spurious Emissions

| | | | |
|--------------------------------|----------------|-------------------------------|----------------|
| Variants: | PR-ASK | Duty Cycle (%): | 99.00 |
| Data Rate: | 25.00 Tari | Antenna Gain (dBi): | Not Applicable |
| Modulation: | FHSS | Beam Forming Gain (Y): | Not Applicable |
| TPC: | Not Applicable | Tested By: | CC |
| Engineering Test Notes: | | | |

Test Measurement Results

| Test Frequency | Frequency Range | Transmitter Conducted Spurious Emissions (dBm) | | | | | | | |
|----------------|-----------------|--|--------|--------|-------|--------|-------|--------|-------|
| | | Port a | | Port b | | Port c | | Port d | |
| MHz | MHz | SE | Limit | SE | Limit | SE | Limit | SE | Limit |
| 902.8 | 30.0 - 26000.0 | -59.023 | -50.96 | -- | -- | -- | -- | -- | -- |
| 915.3 | 30.0 - 26000.0 | -59.023 | -49.59 | -- | -- | -- | -- | -- | -- |
| 927.3 | 30.0 - 26000.0 | -58.923 | -50.33 | -- | -- | -- | -- | -- | -- |

Traceability to Industry Recognized Test Methodologies

| | |
|--------------------------|---|
| Work Instruction: | WI-05 MEASUREMENT OF SPURIOUS EMISSIONS |
| Measurement Uncertainty: | "<=40 GHz ±2.37 dB, > 40 GHz ±4.6 dB" |

Note: click the links in the above matrix to view the graphical image (plot).

9.6.1.2. Conducted Band-Edge Emissions

9.6.1.2.1. Conducted Low Band-Edge Emissions

| |
|--|
| Equipment Configuration for Conducted Low Band-Edge Emissions - Average |
|--|

| | | | |
|--------------------------------|----------------|-----------------------------------|----------------|
| Variant: | PR-ASK | Duty Cycle (%): | 99.00 |
| Data Rate: | 25.00 Tari | Antenna Gain (dBi): | 3.00 |
| Modulation: | FHSS | Beam Forming Gain (Y)(dB): | Not Applicable |
| TPC: | Not Applicable | Tested By: | CC |
| Engineering Test Notes: | | | |

| |
|---------------------------------|
| Test Measurement Results |
|---------------------------------|

| Channel Frequency: | 902.8 MHz | | | | | |
|------------------------------|-----------------------------|------------------|--------------------|-----------------|---------------------|--------------|
| Band-Edge Frequency: | 902.0 MHz | | | | | |
| Test Frequency Range: | 850.0 - 904.0 MHz | | | | | |
| Port(s) | Band-Edge Markers and Limit | | | Revised Limit | | Margin (MHz) |
| | M1 Amplitude (dBm) | Plot Limit (dBm) | M2 Frequency (MHz) | Amplitude (dBm) | M2A Frequency (MHz) | |
| a | -45.00 | -2.00 | 902.50 | -- | -- | -0.500 |

| | |
|---|---|
| Traceability to Industry Recognized Test Methodologies | |
| Work Instruction: | WI-05 MEASUREMENT OF SPURIOUS EMISSIONS |
| Measurement Uncertainty: | "<=40 GHz ±2.37 dB, > 40 GHz ±4.6 dB" |

Note: click the links in the above matrix to view the graphical image (plot).

9.6.1.2.2. Conducted High Band-Edge Emissions

| |
|---|
| Equipment Configuration for Conducted High Band-Edge Emissions - Average |
|---|

| | | | |
|--------------------------------|----------------|-----------------------------------|----------------|
| Variant: | PR-ASK | Duty Cycle (%): | 99.00 |
| Data Rate: | 25.00 Tari | Antenna Gain (dBi): | 3.00 |
| Modulation: | FHSS | Beam Forming Gain (Y)(dB): | Not Applicable |
| TPC: | Not Applicable | Tested By: | CC |
| Engineering Test Notes: | | | |

| |
|---------------------------------|
| Test Measurement Results |
|---------------------------------|

| Channel Frequency: | 927.3 MHz | | | | | |
|------------------------------|-----------------------------|------------------|--------------------|-----------------|---------------------|--------|
| Band-Edge Frequency: | 928.0 MHz | | | | | |
| Test Frequency Range: | 926.0 - 940.0 MHz | | | | | |
| Port(s) | Band-Edge Markers and Limit | | | Revised Limit | | Margin |
| | M3 Amplitude (dBm) | Plot Limit (dBm) | M2 Frequency (MHz) | Amplitude (dBm) | M2A Frequency (MHz) | (MHz) |
| a | -42.50 | -4.00 | 927.50 | -- | -- | -0.500 |

| | |
|---|---|
| Traceability to Industry Recognized Test Methodologies | |
| Work Instruction: | WI-05 MEASUREMENT OF SPURIOUS EMISSIONS |
| Measurement Uncertainty: | "<=40 GHz ±2.37 dB, > 40 GHz ±4.6 dB" |

Note: click the links in the above matrix to view the graphical image (plot).

9.7. Radiated

9.7.1. Restricted Band Emission above 1 GHz

| Radiated Test Conditions for Radiated Spurious and Restricted Band Emissions | | | |
|--|---|----------------------------|-------------|
| Standard: | FCC CFR 47:15.247 | Ambient Temp. (°C): | 20.0 - 24.5 |
| Test Heading: | Radiated Spurious and Band-Edge Emissions | Rel. Humidity (%): | 32 - 45 |
| Standard Section(s): | 15.247 (d), 15.205, 15.209 | Pressure (mBars): | 999 - 1001 |
| Reference Document(s): | See Normative References | | |

Test Procedure for Radiated Spurious and Band-Edge Emissions

Radiated emissions for restricted bands above 1 GHz are measured in the anechoic chamber at a 3-meter distance on every azimuth in both horizontal and vertical polarities. The emissions are recorded and maximized as a function of azimuth by rotation through 360° with a spectrum analyzer in peak hold mode. Depending on the frequency band spanned a notch filter was used to remove the fundamental frequency. The highest emissions relative to the limit are listed for each frequency spanned. Measurements on any restricted band frequency or frequencies above 1 GHz are based on the use of measurement instrumentation employing peak and average detectors. All measurements were performed using a resolution bandwidth of 1 MHz.

Operational Modes

Operational mode(s) tested for spurious emissions were the modes which delivered maximum spectral density

Limits for Restricted Bands (15.205, 15.209)

Peak emission: 74 dBuV/m
 Average emission: 54 dBuV/m

Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Loss, and subtracting Amplifier Gain from the measured reading. All factors are included in the reported data.
 $FS = R + AF + CORR - FO$

where:

FS = Field Strength
 R = Measured Spectrum analyzer Input Amplitude
 AF = Antenna Factor
 CORR = Correction Factor = CL – AG + NFL
 CL = Cable Loss
 AG = Amplifier Gain
 FO = Distance Falloff Factor
 NFL = Notch Filter Loss

For example:

Given receiver input reading of 51.5 dB μ V; Antenna Factor of 8.5 dB; Cable Loss of 1.3 dB; Falloff Factor of 0 dB, an Amplifier Gain of 26 dB and Notch Filter Loss of 1 dB. The Field Strength of the measured emission is:

$$FS = 51.5 + 8.5 + 1.3 - 26.0 + 1 = 36.3 \text{ dB}\mu\text{V/m}$$

Conversion between dB μ V/m (or dB μ V) and μ V/m (or μ V) are done as:

$$\text{Level (dB}\mu\text{V/m)} = 20 * \text{Log (level (\mu\text{V/m}))}$$

$$40 \text{ dB}\mu\text{V/m} = 100 \mu\text{V/m}$$

$$48 \text{ dB}\mu\text{V/m} = 250 \mu\text{V/m}$$

Restricted Bands of Operation (15.205)

(a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

| Frequency Band | | | |
|-------------------|---------------------|---------------|-------------|
| MHz | MHz | MHz | GHz |
| 0.090-0.110 | 16.42-16.423 | 399.9-410 | 4.5-5.15 |
| 0.495-0.505 | 16.69475-16.69525 | 608-614 | 5.35-5.46 |
| 2.1735-2.1905 | 16.80425-16.80475 | 960-1240 | 7.25-7.75 |
| 4.125-4.128 | 25.5-25.67 | 1300-1427 | 8.025-8.5 |
| 4.17725-4.17775 | 37.5-38.25 | 1435-1626.5 | 9.0-9.2 |
| 4.20725-4.20775 | 73-74.6 | 1645.5-1646.5 | 9.3-9.5 |
| 6.215-6.218 | 74.8-75.2 | 1660-1710 | 10.6-12.7 |
| 6.26775-6.26825 | 108-121.94 | 1718.8-1722.2 | 13.25-13.4 |
| 6.31175-6.31225 | 123-138 | 2200-2300 | 14.47-14.5 |
| 8.291-8.294 | 149.9-150.05 | 2310-2390 | 15.35-16.2 |
| 8.362-8.366 | 156.52475-156.52525 | 2483.5-2500 | 17.7-21.4 |
| 8.37625-8.38675 | 156.7-156.9 | 2690-2900 | 22.01-23.12 |
| 8.41425-8.41475 | 162.0125-167.17 | 3260-3267 | 23.6-24.0 |
| 12.29-12.293 | 167.72-173.2 | 3332-3339 | 31.2-31.8 |
| 12.51975-12.52025 | 240-285 | 3345.8-3358 | 36.43-36.5 |
| 12.57675-12.57725 | 322-335.4 | 3600-4400 | Above 38.6 |
| 13.36-13.41 | | | |

(b) Except as provided in paragraphs (d) and (e) of this section, the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in §15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in §15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in §15.35 apply to these measurements.

(c) Except as provided in paragraphs (d) and (e) of this section, regardless of the field strength limits specified elsewhere in this subpart, the provisions of this section apply to emissions from any intentional radiator.

(d) The following devices are exempt from the requirements of this section:

- (1) Swept frequency field disturbance sensors operating between 1.705 and 37 MHz provided their emissions only sweep through the bands listed in paragraph (a) of this section, the sweep is never stopped with the fundamental emission within the bands listed in paragraph (a) of this section, and the fundamental emission is outside of the bands listed in paragraph (a) of this section more than 99% of the time the device is actively transmitting, without compensation for duty cycle.
- (2) Transmitters used to detect buried electronic markers at 101.4 kHz which are employed by telephone companies.
- (3) Cable locating equipment operated pursuant to §15.213.

- (4) Any equipment operated under the provisions of §15.253, 15.255, and 15.256 in the frequency band 75-85 GHz, or §15.257 of this part.
 - (5) Biomedical telemetry devices operating under the provisions of §15.242 of this part are not subject to the restricted band 608-614 MHz but are subject to compliance within the other restricted bands.
 - (6) Transmitters operating under the provisions of subparts D or F of this part.
 - (7) Devices operated pursuant to §15.225 are exempt from complying with this section for the 13.36-13.41 MHz band only.
 - (8) Devices operated in the 24.075-24.175 GHz band under §15.245 are exempt from complying with the requirements of this section for the 48.15-48.35 GHz and 72.225-72.525 GHz bands only, and shall not exceed the limits specified in §15.245(b).
 - (9) Devices operated in the 24.0-24.25 GHz band under §15.249 are exempt from complying with the requirements of this section for the 48.0-48.5 GHz and 72.0-72.75 GHz bands only, and shall not exceed the limits specified in §15.249(a).
- (e) Harmonic emissions appearing in the restricted bands above 17.7 GHz from field disturbance sensors operating under the provisions of §15.245 shall not exceed the limits specified in §15.245(b).

Traceability

| Test Methodology | Measurement Uncertainty |
|---|-------------------------|
| Measurements were made per work instruction WI-03 'Measurement of Radiated Emissions' | +5.6/ -4.5 dB |

Antenna ALR-0501

Equipment Configuration for TX Spurious & Restricted Band Emissions

| | | | |
|---------------------------------|----------------|------------------------|--------|
| Antenna: | ALR-0501 | Variant: | FHSS |
| Antenna Gain (dBi): | 3.00 | Modulation: | PR-ASK |
| Beam Forming Gain (Y): | Not Applicable | Duty Cycle (%): | 99.00 |
| Channel Frequency (MHz): | 902.75 | Data Rate: | |
| Power Setting: | Max | Tested By: | JMH |

Test Measurement Results

1000.00 - 10000.00 MHz

| Num | Frequency MHz | Raw dBµV | Cable Loss dB | AF dB/m | Level dBµV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBµV/m | Margin dB | Pass /Fail |
|-----|---------------|----------|---------------|---------|--------------|------------------|----------|--------|---------|--------------|-----------|------------|
| #1 | 1805.48 | 64.49 | 1.75 | -14.50 | 51.74 | Peak (NRB) | Vertical | 200 | 0 | -- | -- | Pass |

Test Notes: EUT powered by AC/DC PS, connected thru Mux to antenna. Controller powered by 12V GPIO

Equipment Configuration for TX Spurious & Restricted Band Emissions

| | | | |
|---------------------------------|----------------|------------------------|--------|
| Antenna: | ALR-0501 | Variant: | FHSS |
| Antenna Gain (dBi): | 3.00 | Modulation: | PR-ASK |
| Beam Forming Gain (Y): | Not Applicable | Duty Cycle (%): | 99.00 |
| Channel Frequency (MHz): | 915.25 | Data Rate: | |
| Power Setting: | Max | Tested By: | JMH |

1000.00 - 10000.00 MHz

| Num | Frequency MHz | Raw dBµV | Cable Loss dB | AF dB/m | Level dBµV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBµV/m | Margin dB | Pass /Fail |
|-----|---------------|----------|---------------|---------|--------------|------------------|----------|--------|---------|--------------|-----------|------------|
| #1 | 1830.49 | 60.93 | 1.76 | -14.14 | 48.55 | Peak (NRB) | Vertical | 101 | 34 | -- | -- | Pass |
| #2 | 2745.67 | 55.11 | 2.16 | -11.90 | 45.37 | Max Peak | Vertical | 107 | 207 | 74.0 | -28.6 | Pass |
| #3 | 2745.67 | 48.60 | 2.16 | -11.90 | 38.86 | Max Avg | Vertical | 107 | 207 | 54.0 | -15.1 | Pass |

Test Notes: EUT powered by AC/DC PS, connected thru Mux to antenna. Controller powered by 12V GPIO

Equipment Configuration for TX Spurious & Restricted Band Emissions

| | | | |
|---------------------------------|----------------|------------------------|--------|
| Antenna: | ALR-0501 | Variant: | FHSS |
| Antenna Gain (dBi): | 3.00 | Modulation: | PR-ASK |
| Beam Forming Gain (Y): | Not Applicable | Duty Cycle (%): | 99.00 |
| Channel Frequency (MHz): | 927.25 | Data Rate: | |
| Power Setting: | Max | Tested By: | JMH |

1000.00 - 10000.00 MHz

| Num | Frequency MHz | Raw dBµV | Cable Loss dB | AF dB/m | Level dBµV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBµV/m | Margin dB | Pass /Fail |
|-----|---------------|----------|---------------|---------|--------------|------------------|----------|--------|---------|--------------|-----------|------------|
| #1 | 1854.58 | 62.34 | 1.77 | -14.08 | 50.03 | Peak (NRB) | Vertical | 177 | 0 | -- | -- | Pass |

Test Notes: EUT powered by AC/DC PS, connected thru Mux to antenna. Controller powered by 12V GPIO

Antenna ALR-8698

Equipment Configuration for TX Spurious & Restricted Band Emissions

| | | | |
|---------------------------------|----------------|------------------------|--------|
| Antenna: | ALR-8698 | Variant: | FHSS |
| Antenna Gain (dBi): | 8.50 | Modulation: | PR-ASK |
| Beam Forming Gain (Y): | Not Applicable | Duty Cycle (%): | 99.00 |
| Channel Frequency (MHz): | 902.75 | Data Rate: | |
| Power Setting: | Max | Tested By: | JMH |

1000.00 - 10000.00 MHz

| Num | Frequency MHz | Raw dBµV | Cable Loss dB | AF dB/m | Level dBµV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBµV/m | Margin dB | Pass /Fail |
|-----|---------------|----------|---------------|---------|--------------|------------------|------------|--------|---------|--------------|-----------|------------|
| #1 | 1805.44 | 68.25 | 1.75 | -14.50 | 55.50 | Peak (NRB) | Horizontal | 100 | 45 | -- | -- | Pass |
| #2 | 2708.11 | 57.51 | 2.13 | -12.15 | 47.49 | Max Peak | Vertical | 151 | 2 | 74.0 | -26.5 | Pass |
| #3 | 2708.11 | 53.73 | 2.13 | -12.15 | 43.71 | Max Avg | Vertical | 151 | 2 | 54.0 | -10.3 | Pass |

Test Notes: EUT powered by AC/DC Adapter, antenna connected thru Mux, Controller powered by 12V GPIO

Equipment Configuration for TX Spurious & Restricted Band Emissions

| | | | |
|---------------------------------|----------------|------------------------|--------|
| Antenna: | ALR-8698 | Variant: | FHSS |
| Antenna Gain (dBi): | 8.50 | Modulation: | PR-ASK |
| Beam Forming Gain (Y): | Not Applicable | Duty Cycle (%): | 99.00 |
| Channel Frequency (MHz): | 915.25 | Data Rate: | |
| Power Setting: | Max | Tested By: | JMH |

1000.00 - 10000.00 MHz

| Num | Frequency MHz | Raw dBμV | Cable Loss dB | AF dB/m | Level dBμV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBμV/m | Margin dB | Pass /Fail |
|-----|---------------|----------|---------------|---------|--------------|------------------|------------|--------|---------|--------------|-----------|------------|
| #1 | 1830.57 | 61.50 | 1.76 | -14.14 | 49.12 | Peak (NRB) | Horizontal | 100 | 31 | -- | -- | Pass |
| #2 | 2745.75 | 58.63 | 2.16 | -11.90 | 48.89 | Max Peak | Vertical | 108 | 356 | 74.0 | -25.1 | Pass |
| #3 | 2745.75 | 54.58 | 2.16 | -11.90 | 44.84 | Max Avg | Vertical | 108 | 356 | 54.0 | -9.2 | Pass |
| #4 | 5491.49 | 54.11 | 3.12 | -11.67 | 45.56 | Peak (NRB) | Vertical | 100 | 31 | -- | -- | Pass |

Test Notes: EUT powered by AC/DC PS, connected thru Mux to antenna. Controller powered by 12V GPIO

Equipment Configuration for TX Spurious & Restricted Band Emissions

| | | | |
|---------------------------------|----------------|------------------------|--------|
| Antenna: | ALR-8698 | Variant: | FHSS |
| Antenna Gain (dBi): | 8.50 | Modulation: | PR-ASK |
| Beam Forming Gain (Y): | Not Applicable | Duty Cycle (%): | 99.00 |
| Channel Frequency (MHz): | 927.25 | Data Rate: | |
| Power Setting: | Max | Tested By: | JMH |

1000.00 - 10000.00 MHz

| Num | Frequency MHz | Raw dB μ V | Cable Loss dB | AF dB/m | Level dB μ V/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dB μ V/m | Margin dB | Pass /Fail |
|-----|---------------|----------------|---------------|---------|--------------------|------------------|------------|--------|---------|--------------------|-----------|------------|
| #1 | 1854.58 | 62.17 | 1.77 | -14.08 | 49.86 | Peak (NRB) | Horizontal | 151 | 0 | -- | -- | Pass |
| #2 | 2781.81 | 55.52 | 2.16 | -12.01 | 45.67 | Max Peak | Vertical | 120 | 358 | 74.0 | -28.3 | Pass |
| #3 | 2781.81 | 50.43 | 2.16 | -12.01 | 40.58 | Max Avg | Vertical | 120 | 358 | 54.0 | -13.4 | Pass |

Test Notes: EUT powered by AC/DC PS, connected thru Mux to antenna. Controller powered by 12V GPIO

9.7.2. Emissions below 1 GHz

Antenna ALR-0501

Test Notes: EUT powered by AC/DC PS, connected thru Mux to antenna. Controller powered by GPIO. Added Ground. 900 MHz notch in front of amp to prevent overloads. 256 MHz is digital emissions.

Equipment Configuration for TX Spurious & Restricted Band Emissions

| | | | |
|---------------------------------|----------------|------------------------|--------|
| Antenna: | ALR-0501 | Variant: | FHSS |
| Antenna Gain (dBi): | 3.00 | Modulation: | PR-ASK |
| Beam Forming Gain (Y): | Not Applicable | Duty Cycle (%): | 99.00 |
| Channel Frequency (MHz): | 902.75 | Data Rate: | |
| Power Setting: | Max | Tested By: | JMH |

Test Measurement Results

30.00 - 1000.00 MHz

| Num | Frequency MHz | Raw dBµV | Cable Loss dB | AF dB/m | Level dBµV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBµV/m | Margin dB | Pass /Fail |
|-----|---------------|----------|---------------|---------|--------------|------------------|------------|--------|---------|--------------|-----------|------------|
| #1 | 256.41 | 54.58 | 4.75 | -16.04 | 43.29 | MaxQP | Horizontal | 105 | 194 | 46.0 | -2.7 | Pass |
| #2 | 380.81 | 55.35 | 5.19 | -12.52 | 48.01 | Peak (NRB) | Horizontal | 100 | 15 | -- | -- | Pass |
| #3 | 595.24 | 46.95 | 5.82 | -8.64 | 44.12 | Peak (NRB) | Horizontal | 100 | 353 | -- | -- | Pass |
| #4 | 613.25 | 44.13 | 5.82 | -8.21 | 41.74 | MaxQP | Vertical | 126 | 223 | 46.0 | -4.3 | Pass |
| #5 | 625.27 | 48.37 | 5.82 | -8.07 | 46.12 | Peak (NRB) | Vertical | 100 | 360 | -- | -- | Pass |
| #6 | 634.31 | 49.21 | 5.82 | -7.52 | 47.51 | Peak (NRB) | Vertical | 100 | 360 | -- | -- | Pass |
| #7 | 724.27 | 48.92 | 6.27 | -6.86 | 48.33 | Peak (NRB) | Horizontal | 100 | 177 | -- | -- | Pass |
| #8 | 790.24 | 48.13 | 6.46 | -5.98 | 48.61 | Peak (NRB) | Horizontal | 100 | 177 | -- | -- | Pass |
| #9 | 856.20 | 46.60 | 6.64 | -5.42 | 47.82 | Peak (NRB) | Horizontal | 100 | 338 | -- | -- | Pass |
| #10 | 880.02 | 43.91 | 6.73 | -5.19 | 45.45 | Peak (NRB) | Horizontal | 100 | 338 | -- | -- | Pass |
| #11 | 902.75 | 54.88 | 6.76 | -4.93 | 56.71 | Fundamental | Vertical | 100 | 0 | -- | -- | |

Test Notes: EUT powered by AC/DC PS, connected thru Mux to antenna. Controller powered by GPIO. Added Ground. 900 MHz notch in front of amp to prevent overloads. 256 MHz is digital emissions

Equipment Configuration for TX Spurious & Restricted Band Emissions

| | | | |
|---------------------------------|----------------|------------------------|--------|
| Antenna: | ALR-0501 | Variant: | FHSS |
| Antenna Gain (dBi): | 3.00 | Modulation: | PR-ASK |
| Beam Forming Gain (Y): | Not Applicable | Duty Cycle (%): | 99.00 |
| Channel Frequency (MHz): | 915.25 | Data Rate: | |
| Power Setting: | Max | Tested By: | JMH |

Test Measurement Results

30.00 - 1000.00 MHz

| Num | Frequency MHz | Raw dBµV | Cable Loss dB | AF dB/m | Level dBµV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBµV/m | Margin dB | Pass /Fail |
|-----|---------------|----------|---------------|---------|--------------|------------------|------------|--------|---------|--------------|-----------|------------|
| #1 | 259.40 | 56.85 | 4.76 | -15.73 | 45.88 | MaxQP | Horizontal | 99 | 191 | 46.0 | -0.1 | Pass |
| #2 | 368.80 | 50.75 | 5.15 | -12.58 | 43.32 | Peak (NRB) | Vertical | 100 | 303 | -- | -- | Pass |
| #3 | 374.80 | 52.77 | 5.17 | -12.65 | 45.29 | Peak (NRB) | Horizontal | 100 | 203 | -- | -- | Pass |
| #4 | 584.71 | 45.74 | 5.82 | -8.70 | 42.86 | Peak (NRB) | Horizontal | 100 | 346 | -- | -- | Pass |
| #5 | 611.71 | 47.67 | 5.82 | -8.25 | 45.24 | MaxQP | Horizontal | 132 | 130 | 46.0 | -0.8 | Pass |
| #6 | 631.19 | 49.00 | 5.82 | -7.69 | 47.13 | Peak (NRB) | Vertical | 100 | 203 | -- | -- | Pass |
| #7 | 640.30 | 48.14 | 5.82 | -7.66 | 46.30 | Peak (NRB) | Vertical | 100 | 203 | -- | -- | Pass |
| #8 | 724.28 | 48.62 | 6.27 | -6.86 | 48.03 | Peak (NRB) | Horizontal | 100 | 1 | -- | -- | Pass |
| #9 | 764.56 | 48.43 | 6.39 | -6.29 | 48.53 | Peak (NRB) | Horizontal | 100 | 1 | -- | -- | Pass |
| #10 | 793.29 | 48.61 | 6.46 | -5.98 | 49.09 | Peak (NRB) | Horizontal | 100 | 1 | -- | -- | Pass |
| #11 | 814.43 | 46.35 | 6.52 | -5.54 | 47.33 | Peak (NRB) | Horizontal | 100 | 1 | -- | -- | Pass |
| #12 | 915.25 | 46.58 | 6.80 | -4.66 | 48.73 | Fundamental | Vertical | 100 | 0 | -- | -- | |

Test Notes: EUT powered by AC/DC PS, connected thru Mux to antenna. Controller powered by GPIO. Added Ground. 900 MHz notch in front of amp to prevent overloads. 259 MHz is digital emissions

Equipment Configuration for TX Spurious & Restricted Band Emissions

| | | | |
|---------------------------------|----------------|------------------------|--------|
| Antenna: | ALR-0501 | Variant: | FHSS |
| Antenna Gain (dBi): | 3.00 | Modulation: | PR-ASK |
| Beam Forming Gain (Y): | Not Applicable | Duty Cycle (%): | 99.00 |
| Channel Frequency (MHz): | 927.25 | Data Rate: | |
| Power Setting: | Max | Tested By: | JMH |

Test Measurement Results

30.00 - 1000.00 MHz

| Num | Frequency MHz | Raw dBµV | Cable Loss dB | AF dB/m | Level dBµV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBµV/m | Margin dB | Pass /Fail |
|-----|---------------|----------|---------------|---------|--------------|------------------|------------|--------|---------|--------------|-----------|------------|
| #1 | 259.39 | 56.74 | 4.76 | -15.73 | 45.77 | MaxQP | Horizontal | 98 | 184 | 46.0 | -0.2 | Pass |
| #2 | 377.83 | 54.13 | 5.18 | -12.55 | 46.76 | Peak (NRB) | Vertical | 100 | 253 | -- | -- | Pass |
| #3 | 385.35 | 53.90 | 5.21 | -12.57 | 46.53 | Peak (NRB) | Horizontal | 100 | 278 | -- | -- | Pass |
| #4 | 595.31 | 46.99 | 5.82 | -8.64 | 44.17 | Peak (NRB) | Horizontal | 100 | 5 | -- | -- | Pass |
| #5 | 611.73 | 48.11 | 5.82 | -8.25 | 45.68 | MaxQP | Horizontal | 131 | 114 | 46.0 | -0.3 | Pass |
| #6 | 721.01 | 47.43 | 6.25 | -6.90 | 46.78 | Peak (NRB) | Horizontal | 100 | 205 | -- | -- | Pass |
| #7 | 787.07 | 46.15 | 6.45 | -5.99 | 46.61 | Peak (NRB) | Horizontal | 100 | 205 | -- | -- | Pass |
| #8 | 833.64 | 45.25 | 6.58 | -5.37 | 46.45 | Peak (NRB) | Horizontal | 100 | 346 | -- | -- | Pass |
| #9 | 927.26 | 54.11 | 6.82 | -4.58 | 56.35 | Fundamental | Vertical | 100 | 0 | -- | -- | |

Test Notes: EUT powered by AC/DC PS, connected thru Mux to antenna. Controller powered by GPIO. Added Ground. 900 MHz notch in front of amp to prevent overloads. 259 MHz is digital emissions

Test Notes: EUT powered by AC/DC PS, connected thru Mux to antenna. Controller powered by 5V USB, 242 MHz signal is digital

Equipment Configuration for TX Spurious & Restricted Band Emissions

| | | | |
|---------------------------------|----------------|------------------------|--------|
| Antenna: | ALR-0501 | Variant: | FHSS |
| Antenna Gain (dBi): | 3.00 | Modulation: | PR-ASK |
| Beam Forming Gain (Y): | Not Applicable | Duty Cycle (%): | 99.00 |
| Channel Frequency (MHz): | 902.75 | Data Rate: | |
| Power Setting: | Max | Tested By: | JMH |

Test Measurement Results

30.00 - 1000.00 MHz

| Num | Frequency MHz | Raw dBµV | Cable Loss dB | AF dB/m | Level dBµV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBµV/m | Margin dB | Pass /Fail |
|-----|---------------|----------|---------------|---------|--------------|------------------|------------|--------|---------|--------------|-----------|------------|
| #1 | 59.98 | 61.95 | 3.80 | -20.97 | 44.77 | Peak (NRB) | Vertical | 100 | 216 | -- | -- | Pass |
| #2 | 133.45 | 51.10 | 4.23 | -14.82 | 40.51 | MaxQP | Vertical | 100 | 276 | 43.0 | -2.5 | Pass |
| #3 | 155.93 | 49.01 | 4.34 | -16.02 | 37.33 | Peak (NRB) | Vertical | 100 | 182 | -- | -- | Pass |
| #4 | 166.48 | 46.71 | 4.39 | -16.34 | 34.76 | MaxQP | Vertical | 98 | 276 | 43.0 | -8.2 | Pass |
| #5 | 196.42 | 57.15 | 4.52 | -15.84 | 45.83 | Peak (NRB) | Vertical | 100 | 182 | -- | -- | Pass |
| #6 | 202.43 | 53.61 | 4.54 | -15.77 | 42.39 | Peak (NRB) | Horizontal | 100 | 182 | -- | -- | Pass |
| #7 | 235.42 | 67.22 | 4.67 | -16.38 | 55.51 | Peak (NRB) | Horizontal | 100 | 216 | -- | -- | Pass |
| #8 | 242.89 | 64.57 | 4.71 | -16.20 | 53.08 | Digital | Horizontal | 128 | 200 | 46.0 | -- | -- |
| #9 | 515.82 | 52.17 | 5.64 | -9.99 | 47.83 | Peak (NRB) | Horizontal | 100 | 182 | -- | -- | Pass |
| #10 | 595.21 | 46.59 | 5.82 | -8.64 | 43.77 | Peak (NRB) | Vertical | 100 | 182 | -- | -- | Pass |
| #11 | 611.72 | 46.47 | 5.82 | -8.25 | 44.04 | MaxQP | Horizontal | 101 | 216 | 46.0 | -2.0 | Pass |
| #12 | 664.25 | 53.77 | 5.82 | -7.58 | 52.00 | Peak (NRB) | Horizontal | 100 | 182 | -- | -- | Pass |
| #13 | 667.19 | 50.49 | 5.82 | -7.58 | 48.73 | Peak (NRB) | Horizontal | 100 | 216 | -- | -- | Pass |
| #14 | 713.66 | 49.59 | 6.24 | -7.00 | 48.82 | Peak (NRB) | Horizontal | 100 | 182 | -- | -- | Pass |
| #15 | 773.67 | 42.41 | 6.41 | -6.24 | 42.58 | Peak (NRB) | Horizontal | 100 | 182 | -- | -- | Pass |
| #18 | 902.76 | 49.31 | 6.76 | -4.93 | 51.14 | Fundamental | Horizontal | 100 | 268 | -- | -- | |

Test Notes: EUT powered by AC/DC PS, connected thru Mux to antenna. Controller powered by 5V USB, 242 MHz signal is digital

Equipment Configuration for TX Spurious & Restricted Band Emissions

| | | | |
|---------------------------------|----------------|------------------------|--------|
| Antenna: | ALR-0501 | Variant: | FHSS |
| Antenna Gain (dBi): | 3.00 | Modulation: | PR-ASK |
| Beam Forming Gain (Y): | Not Applicable | Duty Cycle (%): | 99.00 |
| Channel Frequency (MHz): | 915.25 | Data Rate: | |
| Power Setting: | Max | Tested By: | JMH |

Test Measurement Results

30.00 - 1000.00 MHz

| Num | Frequency MHz | Raw dBμV | Cable Loss dB | AF dB/m | Level dBμV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBμV/m | Margin dB | Pass /Fail |
|-----|---------------|----------|---------------|---------|--------------|------------------|------------|--------|---------|--------------|-----------|------------|
| #1 | 59.99 | 61.79 | 3.80 | -20.97 | 44.62 | Peak (NRB) | Vertical | 100 | 216 | -- | -- | Pass |
| #2 | 133.45 | 50.90 | 4.23 | -14.82 | 40.31 | MaxQP | Vertical | 100 | 281 | 43.0 | -2.7 | Pass |
| #3 | 155.94 | 54.10 | 4.34 | -16.02 | 42.43 | Peak (NRB) | Vertical | 100 | 141 | -- | -- | Pass |
| #4 | 166.42 | 50.27 | 4.39 | -16.34 | 38.32 | MaxQP | Vertical | 100 | 284 | 43.0 | -4.7 | Pass |
| #5 | 196.40 | 54.06 | 4.52 | -15.84 | 42.74 | Peak (NRB) | Vertical | 100 | 305 | -- | -- | Pass |
| #6 | 209.89 | 58.18 | 4.56 | -17.31 | 45.43 | Peak (NRB) | Horizontal | 100 | 286 | -- | -- | Pass |
| #7 | 235.38 | 67.02 | 4.67 | -16.38 | 55.31 | Peak (NRB) | Horizontal | 100 | 216 | -- | -- | Pass |
| #8 | 242.88 | 65.06 | 4.71 | -16.20 | 53.57 | Digital | Horizontal | 122 | 203 | 46.0 | -- | -- |
| #9 | 509.65 | 48.83 | 5.61 | -10.00 | 44.44 | Peak (NRB) | Horizontal | 100 | 305 | -- | -- | Pass |
| #10 | 595.21 | 52.04 | 5.82 | -8.64 | 49.22 | Peak (NRB) | Vertical | 100 | 164 | -- | -- | Pass |
| #11 | 668.74 | 50.16 | 5.82 | -7.58 | 48.39 | Peak (NRB) | Horizontal | 100 | 216 | -- | -- | Pass |
| #12 | 784.17 | 48.86 | 6.44 | -6.04 | 49.26 | Peak (NRB) | Horizontal | 100 | 264 | -- | -- | Pass |
| #13 | 915.26 | 42.95 | 6.80 | -4.66 | 45.10 | Fundamental | Vertical | 100 | 286 | -- | -- | |

Test Notes: EUT powered by AC/DC PS, connected thru Mux to antenna. Controller powered by 5V USB. 242 MHz is digital emission

Equipment Configuration for TX Spurious & Restricted Band Emissions

| | | | |
|---------------------------------|----------------|------------------------|--------|
| Antenna: | ALR-0501 | Variant: | FHSS |
| Antenna Gain (dBi): | 3.00 | Modulation: | PR-ASK |
| Beam Forming Gain (Y): | Not Applicable | Duty Cycle (%): | 99.00 |
| Channel Frequency (MHz): | 927.25 | Data Rate: | |
| Power Setting: | Max | Tested By: | JMH |

Test Measurement Results

30.00 - 1000.00 MHz

| Num | Frequency MHz | Raw dBµV | Cable Loss dB | AF dB/m | Level dBµV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBµV/m | Margin dB | Pass /Fail |
|-----|---------------|----------|---------------|---------|--------------|------------------|------------|--------|---------|--------------|-----------|------------|
| #1 | 59.97 | 62.91 | 3.80 | -20.97 | 45.74 | Peak (NRB) | Vertical | 100 | 270 | -- | -- | Pass |
| #2 | 133.44 | 51.72 | 4.23 | -14.82 | 41.13 | MaxQP | Vertical | 98 | 274 | 43.0 | -1.9 | Pass |
| #3 | 202.40 | 58.11 | 4.54 | -15.77 | 46.89 | Peak (NRB) | Horizontal | 100 | 270 | -- | -- | Pass |
| #4 | 206.90 | 57.50 | 4.55 | -17.17 | 44.88 | Peak (NRB) | Horizontal | 100 | 0 | -- | -- | Pass |
| #5 | 236.85 | 60.69 | 4.68 | -16.28 | 49.09 | Peak (NRB) | Horizontal | 100 | 84 | -- | -- | Pass |
| #6 | 242.90 | 65.13 | 4.71 | -16.20 | 53.64 | Digital | Horizontal | 119 | 199 | 46.0 | -- | |
| #7 | 509.77 | 50.46 | 5.61 | -10.00 | 46.07 | Peak (NRB) | Horizontal | 100 | 270 | -- | -- | Pass |
| #8 | 598.22 | 50.12 | 5.82 | -8.55 | 47.39 | Peak (NRB) | Horizontal | 100 | 270 | -- | -- | Pass |
| #9 | 668.71 | 53.24 | 5.82 | -7.58 | 51.47 | Peak (NRB) | Horizontal | 100 | 172 | -- | -- | Pass |
| #10 | 691.24 | 48.37 | 6.17 | -7.37 | 47.17 | Peak (NRB) | Horizontal | 100 | 270 | -- | -- | Pass |
| #11 | 787.09 | 47.62 | 6.45 | -5.99 | 48.08 | Peak (NRB) | Horizontal | 100 | 270 | -- | -- | Pass |
| #12 | 927.26 | 51.93 | 6.82 | -4.58 | 54.17 | Fundamental | Horizontal | 100 | 0 | -- | -- | |

Test Notes: EUT powered by AC/DC PS, connected thru Mux to antenna. Controller powered by 5V USB. 242 MHz is digital emission

Antenna ALR-8698

Test Notes: EUT powered by AC/DC PS, connected thru Mux to antenna. Controller powered by 12V Added Ground. 900 MHz notch in front of amp to prevent overloads. 262 and 269 are digital emissions

Equipment Configuration for Radiated Digital Emissions

| | | | |
|---------------------------------|---------------------------|------------------------|--------|
| Antenna: | Alien Technology ALR-8698 | Variant: | FHSS |
| Antenna Gain (dBi): | 8.50 | Modulation: | PR-ASK |
| Beam Forming Gain (Y): | Not Applicable | Duty Cycle (%): | 99.00 |
| Channel Frequency (MHz): | 902.75 | Data Rate: | |
| Power Setting: | Max | Tested By: | JMH |

Test Measurement Results

| 30.00 - 1000.00 MHz | | | | | | | | | | | | |
|---------------------|---------------|----------|---------------|---------|--------------|------------------|------------|--------|---------|--------------|-----------|------------|
| Num | Frequency MHz | Raw dBµV | Cable Loss dB | AF dB/m | Level dBµV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBµV/m | Margin dB | Pass /Fail |
| #1 | 30.00 | 44.32 | 3.52 | -7.20 | 40.64 | Peak (NRB) | Vertical | 100 | 0 | -- | -- | Pass |
| #2 | 262.38 | 56.95 | 4.77 | -15.35 | 46.37 | Digital | Horizontal | 126 | 153 | 46.0 | -- | -- |
| #3 | 269.88 | 54.26 | 4.80 | -14.73 | 44.33 | MaxQP | Horizontal | 106 | 157 | 46.0 | -1.7 | Pass |
| #4 | 374.83 | 55.00 | 5.17 | -12.65 | 47.52 | Peak (NRB) | Horizontal | 100 | 16 | -- | -- | Pass |
| #5 | 526.26 | 52.33 | 5.66 | -9.56 | 48.43 | Peak (NRB) | Horizontal | 100 | 16 | -- | -- | Pass |
| #6 | 535.23 | 53.01 | 5.69 | -9.34 | 49.36 | Peak (NRB) | Horizontal | 100 | 16 | -- | -- | Pass |
| #7 | 767.68 | 49.68 | 6.40 | -6.25 | 49.83 | Peak (NRB) | Horizontal | 100 | 355 | -- | -- | Pass |
| #8 | 779.46 | 49.76 | 6.43 | -6.09 | 50.10 | Peak (NRB) | Horizontal | 100 | 355 | -- | -- | Pass |
| #9 | 880.18 | 43.38 | 6.73 | -5.19 | 44.92 | Peak (NRB) | Horizontal | 100 | 355 | -- | -- | Pass |
| #10 | 902.76 | 51.55 | 6.76 | -4.93 | 53.38 | Fundamental | Horizontal | 100 | 0 | -- | -- | |

Test Notes: EUT powered by AC/DC PS, connected thru Mux to antenna. Controller powered by 12V Added Ground. 900 MHz notch in front of amp to prevent overloads. 262 and 269 are digital emissions

Equipment Configuration for Radiated Digital Emissions

| | | | |
|---------------------------------|---------------------------|------------------------|--------|
| Antenna: | Alien Technology ALR-8698 | Variant: | FHSS |
| Antenna Gain (dBi): | 8.50 | Modulation: | PR-ASK |
| Beam Forming Gain (Y): | Not Applicable | Duty Cycle (%): | 99.00 |
| Channel Frequency (MHz): | 915.25 | Data Rate: | |
| Power Setting: | Max | Tested By: | JMH |

Test Measurement Results

30.00 - 1000.00 MHz

| Num | Frequency MHz | Raw dBµV | Cable Loss dB | AF dB/m | Level dBµV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBµV/m | Margin dB | Pass /Fail |
|-----|---------------|----------|---------------|---------|--------------|------------------|------------|--------|---------|--------------|-----------|------------|
| #1 | 30.00 | 44.47 | 3.52 | -7.20 | 40.79 | Peak (NRB) | Vertical | 100 | 0 | -- | -- | Pass |
| #2 | 262.37 | 57.21 | 4.77 | -15.35 | 46.63 | Digital | Horizontal | 120 | 163 | 46.0 | -- | -- |
| #3 | 269.89 | 54.49 | 4.80 | -14.73 | 44.56 | MaxQP | Horizontal | 112 | 158 | 46.0 | -1.4 | Pass |
| #4 | 374.07 | 42.17 | 5.17 | -12.65 | 34.69 | Peak (NRB) | Horizontal | 100 | 359 | -- | -- | Pass |
| #5 | 512.74 | 50.03 | 5.62 | -10.01 | 45.64 | Peak (NRB) | Horizontal | 100 | 359 | -- | -- | Pass |
| #6 | 538.25 | 49.41 | 5.70 | -9.36 | 45.75 | Peak (NRB) | Horizontal | 100 | 359 | -- | -- | Pass |
| #7 | 757.04 | 49.44 | 6.36 | -6.41 | 49.39 | Peak (NRB) | Horizontal | 100 | 10 | -- | -- | Pass |
| #8 | 781.11 | 49.65 | 6.44 | -6.02 | 50.07 | Peak (NRB) | Horizontal | 100 | 10 | -- | -- | Pass |
| #9 | 880.26 | 44.69 | 6.73 | -5.19 | 46.23 | Peak (NRB) | Horizontal | 100 | 10 | -- | -- | Pass |
| #10 | 915.25 | 50.30 | 6.80 | -4.66 | 52.45 | Fundamental | Vertical | 100 | 0 | -- | -- | |

Test Notes: EUT powered by AC/DC PS, connected thru Mux to antenna. Controller powered by 12V Added Ground. 900 MHz notch in front of amp to prevent overloads. 262 and 269 are digital emissions

Equipment Configuration for Radiated Digital Emissions

| | | | |
|---------------------------------|---------------------------|------------------------|--------|
| Antenna: | Alien Technology ALR-8698 | Variant: | FHSS |
| Antenna Gain (dBi): | 8.50 | Modulation: | PR-ASK |
| Beam Forming Gain (Y): | Not Applicable | Duty Cycle (%): | 99.00 |
| Channel Frequency (MHz): | 927.25 | Data Rate: | |
| Power Setting: | Max | Tested By: | JMH |

Test Measurement Results

30.00 - 1000.00 MHz

| Num | Frequency MHz | Raw dBµV | Cable Loss dB | AF dB/m | Level dBµV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBµV/m | Margin dB | Pass /Fail |
|-----|---------------|----------|---------------|---------|--------------|------------------|------------|--------|---------|--------------|-----------|------------|
| #1 | 30.00 | 44.89 | 3.52 | -7.20 | 41.21 | Peak (NRB) | Vertical | 100 | 360 | -- | -- | Pass |
| #2 | 259.43 | 55.70 | 4.76 | -15.73 | 44.73 | MaxQP | Horizontal | 129 | 276 | 46.0 | -1.3 | Pass |
| #3 | 269.91 | 53.81 | 4.80 | -14.73 | 43.88 | MaxQP | Horizontal | 101 | 146 | 46.0 | -2.1 | Pass |
| #4 | 374.90 | 53.35 | 5.17 | -12.65 | 45.87 | Peak (NRB) | Horizontal | 100 | 360 | -- | -- | Pass |
| #5 | 532.25 | 51.49 | 5.68 | -9.41 | 47.76 | Peak (NRB) | Horizontal | 100 | 360 | -- | -- | Pass |
| #6 | 565.22 | 50.08 | 5.79 | -8.88 | 46.99 | Peak (NRB) | Horizontal | 100 | 145 | -- | -- | Pass |
| #7 | 764.79 | 48.51 | 6.39 | -6.29 | 48.61 | Peak (NRB) | Horizontal | 100 | 357 | -- | -- | Pass |
| #8 | 784.23 | 50.73 | 6.44 | -6.04 | 51.13 | Peak (NRB) | Horizontal | 100 | 357 | -- | -- | Pass |
| #9 | 880.10 | 43.08 | 6.73 | -5.19 | 44.62 | Peak (NRB) | Horizontal | 100 | 256 | -- | -- | Pass |
| #10 | 927.26 | 58.65 | 6.82 | -4.58 | 60.89 | Fundamental | Vertical | 100 | 0 | -- | -- | |

Test Notes: EUT powered by AC/DC PS, connected thru Mux to antenna. Controller powered by 12V Added Ground. 900 MHz notch in front of amp to prevent overloads. 262 and 269 are digital emissions

Test Notes: EUT powered by AC/DC PS, connected thru Mux to antenna. Controller powered by 5V USB. 242 MHz is digital emission.

Equipment Configuration for TX Spurious & Restricted Band Emissions

| | | | |
|---------------------------------|----------------|------------------------|--------|
| Antenna: | ALR-8698 | Variant: | FHSS |
| Antenna Gain (dBi): | 8.50 | Modulation: | PR-ASK |
| Beam Forming Gain (Y): | Not Applicable | Duty Cycle (%): | 99.00 |
| Channel Frequency (MHz): | 902.75 | Data Rate: | |
| Power Setting: | Max | Tested By: | JMH |

Test Measurement Results

30.00 - 1000.00 MHz

| Num | Frequency MHz | Raw dBμV | Cable Loss dB | AF dB/m | Level dBμV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBμV/m | Margin dB | Pass /Fail |
|-----|---------------|----------|---------------|---------|--------------|------------------|------------|--------|---------|--------------|-----------|------------|
| #1 | 59.98 | 59.65 | 3.80 | -20.97 | 42.48 | Peak (NRB) | Vertical | 100 | 193 | -- | -- | Pass |
| #2 | 130.46 | 51.46 | 4.21 | -14.63 | 41.04 | MaxQP | Vertical | 101 | 154 | 43.0 | -2.0 | Pass |
| #3 | 155.95 | 55.78 | 4.34 | -16.02 | 44.11 | Peak (NRB) | Vertical | 100 | 158 | -- | -- | Pass |
| #4 | 209.87 | 58.75 | 4.56 | -17.31 | 46.00 | Peak (NRB) | Horizontal | 100 | 140 | -- | -- | Pass |
| #5 | 235.41 | 66.99 | 4.67 | -16.38 | 55.28 | Peak (NRB) | Horizontal | 100 | 193 | -- | -- | Pass |
| #6 | 242.89 | 63.83 | 4.71 | -16.20 | 52.34 | MaxQP | Horizontal | 127 | 196 | 46.0 | -- | -- |
| #7 | 361.32 | 52.92 | 5.12 | -12.69 | 45.34 | Peak (NRB) | Horizontal | 100 | 158 | -- | -- | Pass |
| #8 | 502.30 | 52.10 | 5.59 | -9.99 | 47.70 | Peak (NRB) | Horizontal | 100 | 158 | -- | -- | Pass |
| #9 | 667.13 | 53.79 | 5.82 | -7.58 | 52.02 | Peak (NRB) | Horizontal | 100 | 193 | -- | -- | Pass |
| #10 | 701.64 | 51.33 | 6.20 | -7.23 | 50.30 | Peak (NRB) | Horizontal | 100 | 158 | -- | -- | Pass |
| #11 | 880.00 | 47.76 | 6.73 | -5.19 | 49.30 | Peak (NRB) | Vertical | 100 | 360 | -- | -- | Pass |
| #12 | 902.76 | 68.45 | 6.76 | -4.93 | 70.28 | Fundamental | Vertical | 100 | 0 | -- | -- | |

Test Notes: EUT powered by AC/DC PS, connected thru Mux to antenna. Controller powered by 5V USB. 242 MHz is digital emission

Equipment Configuration for TX Spurious & Restricted Band Emissions

| | | | |
|---------------------------------|----------------|------------------------|--------|
| Antenna: | ALR-8698 | Variant: | FHSS |
| Antenna Gain (dBi): | 8.50 | Modulation: | PR-ASK |
| Beam Forming Gain (Y): | Not Applicable | Duty Cycle (%): | 99.00 |
| Channel Frequency (MHz): | 915.25 | Data Rate: | |
| Power Setting: | Max | Tested By: | JMH |

Test Measurement Results

30.00 - 1000.00 MHz

| Num | Frequency MHz | Raw dBµV | Cable Loss dB | AF dB/m | Level dBµV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBµV/m | Margin dB | Pass /Fail |
|-----|---------------|----------|---------------|---------|--------------|------------------|------------|--------|---------|--------------|-----------|------------|
| #1 | 59.99 | 59.43 | 3.80 | -20.97 | 42.26 | Peak (NRB) | Vertical | 100 | 192 | -- | -- | Pass |
| #2 | 130.44 | 52.69 | 4.21 | -14.63 | 42.27 | MaxQP | Vertical | 98 | 141 | 43.0 | -0.7 | Pass |
| #3 | 155.94 | 56.24 | 4.34 | -16.02 | 44.56 | Peak (NRB) | Vertical | 100 | 159 | -- | -- | Pass |
| #4 | 196.41 | 57.51 | 4.52 | -15.84 | 46.19 | Peak (NRB) | Vertical | 100 | 159 | -- | -- | Pass |
| #5 | 209.90 | 60.05 | 4.56 | -17.31 | 47.30 | Peak (NRB) | Horizontal | 100 | 135 | -- | -- | Pass |
| #6 | 235.40 | 66.60 | 4.67 | -16.38 | 54.89 | Peak (NRB) | Horizontal | 100 | 192 | -- | -- | Pass |
| #7 | 242.90 | 63.51 | 4.71 | -16.20 | 52.02 | MaxQP | Horizontal | 118 | 192 | 46.0 | -- | -- |
| #8 | 512.70 | 53.91 | 5.62 | -10.01 | 49.52 | Peak (NRB) | Horizontal | 100 | 179 | -- | -- | Pass |
| #9 | 584.75 | 49.64 | 5.82 | -8.70 | 46.76 | Peak (NRB) | Vertical | 100 | 179 | -- | -- | Pass |
| #10 | 671.70 | 53.31 | 5.82 | -7.59 | 51.54 | Peak (NRB) | Horizontal | 100 | 192 | -- | -- | Pass |
| #11 | 710.79 | 50.45 | 6.23 | -7.14 | 49.54 | Peak (NRB) | Horizontal | 100 | 179 | -- | -- | Pass |
| #12 | 880.03 | 48.02 | 6.73 | -5.19 | 49.56 | Peak (NRB) | Vertical | 100 | 0 | -- | -- | Pass |
| #13 | 915.26 | 46.34 | 6.80 | -4.66 | 48.48 | Fundamental | Horizontal | 100 | 0 | -- | -- | |

Test Notes: EUT powered by AC/DC PS, connected thru Mux to antenna. Controller powered by 5V USB. 242 MHz is digital emission

Equipment Configuration for TX Spurious & Restricted Band Emissions

| | | | |
|---------------------------------|----------------|------------------------|--------|
| Antenna: | ALR-8698 | Variant: | FHSS |
| Antenna Gain (dBi): | 8.50 | Modulation: | PR-ASK |
| Beam Forming Gain (Y): | Not Applicable | Duty Cycle (%): | 99.00 |
| Channel Frequency (MHz): | 927.75 | Data Rate: | |
| Power Setting: | Max | Tested By: | JMH |

Test Measurement Results

30.00 - 1000.00 MHz

| Num | Frequency MHz | Raw dBµV | Cable Loss dB | AF dB/m | Level dBµV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBµV/m | Margin dB | Pass /Fail |
|-----|---------------|----------|---------------|---------|--------------|------------------|------------|--------|---------|--------------|-----------|------------|
| 1 | 61.48 | 59.60 | 3.81 | -20.98 | 42.43 | Peak (NRB) | Vertical | 100 | 188 | -- | -- | Pass |
| 2 | 130.48 | 50.24 | 4.21 | -14.63 | 39.82 | MaxQP | Vertical | 100 | 142 | 43.0 | -3.2 | Pass |
| 3 | 155.90 | 52.13 | 4.34 | -16.02 | 40.46 | Peak (NRB) | Vertical | 100 | 192 | -- | -- | Pass |
| 4 | 196.42 | 57.17 | 4.52 | -15.84 | 45.85 | Peak (NRB) | Vertical | 100 | 192 | -- | -- | Pass |
| 5 | 209.87 | 59.71 | 4.56 | -17.31 | 46.96 | Peak (NRB) | Horizontal | 100 | 129 | -- | -- | Pass |
| 6 | 236.88 | 66.40 | 4.68 | -16.28 | 54.80 | Peak (NRB) | Horizontal | 100 | 188 | -- | -- | Pass |
| 7 | 242.91 | 58.35 | 4.71 | -16.20 | 46.86 | MaxQP | Vertical | 137 | 231 | 46.0 | -- | -- |
| 8 | 364.33 | 54.19 | 5.13 | -12.59 | 46.73 | Peak (NRB) | Horizontal | 100 | 103 | -- | -- | Pass |
| 9 | 506.77 | 51.35 | 5.60 | -9.99 | 46.96 | Peak (NRB) | Horizontal | 100 | 169 | -- | -- | Pass |
| 10 | 595.28 | 51.50 | 5.82 | -8.64 | 48.68 | Peak (NRB) | Horizontal | 100 | 253 | -- | -- | Pass |
| 11 | 664.12 | 53.96 | 5.82 | -7.58 | 52.20 | Peak (NRB) | Horizontal | 100 | 188 | -- | -- | Pass |
| 12 | 784.00 | 47.96 | 6.44 | -6.04 | 48.36 | Peak (NRB) | Horizontal | 100 | 163 | -- | -- | Pass |
| 13 | 880.04 | 45.98 | 6.73 | -5.19 | 47.52 | Peak (NRB) | Vertical | 100 | 349 | -- | -- | Pass |
| 14 | 927.25 | 56.47 | 6.82 | -4.58 | 58.71 | Fundamental | Horizontal | 100 | 0 | -- | -- | |

Test Notes: EUT powered by AC/DC PS, connected thru Mux to antenna. Controller powered by 5V USB. 242 MHz is digital emission

9.7.3. Digital Emissions (0.03 - 1 GHz)

| Radiated Test Conditions for Radiated Digital Emissions (0.03 – 1 GHz) | | | |
|--|--------------------------|----------------------------|-------------|
| Standard: | FCC CFR 47:15.247 | Ambient Temp. (°C): | 20.0 - 24.5 |
| Test Heading: | Digital Emissions | Rel. Humidity (%): | 32 - 45 |
| Standard Section(s): | 15.209 | Pressure (mBars): | 999 - 1001 |
| Reference Document(s): | See Normative References | | |

Test Procedure for Radiated Digital Emissions (0.03 – 1 GHz)

Testing 30M-1 GHz was performed in a 3-meter anechoic chamber using a CISPR compliant receiver. Preliminary radiated emissions were measured on every azimuth and with the receiving antenna in both horizontal and vertical polarizations. To further maximize emissions the receive antenna was varied between 1 and 4 meters. The emissions are recorded with receiver in peak hold mode. Emissions closest to the limits are measured in the quasi-peak mode with the tuned receiver using a bandwidth of 120 kHz. Only the highest emissions relative to the limit are listed.

Test configuration and setup for Radiated Spurious and Band-Edge Measurement were per the Radiated Test Set-up specified in this document.

Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Loss, and subtracting Amplifier Gain from the measured reading. In this test facility, the Antenna Factor, Cable Loss, and Amplifier Gains are loaded into the Rohde & Schwarz Receiver and the corrected field strength can be read directly on the receiver.

$$FS = R + AF + CORR$$

where:

FS = Field Strength

R = Measured Receiver Input Amplitude

AF = Antenna Factor

CORR = Correction Factor = CL – AG + NFL

CL = Cable Loss

AG = Amplifier Gain

For example:

Given a Receiver input reading of 51.5dBmV; Antenna Factor of 8.5dB; Cable Loss of 1.3dB; Falloff Factor of 0dB, an Amplifier Gain of 26dB and Notch Filter Loss of 1dB. The Field Strength of the measured emission is:

$$FS = 51.5 + 8.5 + 1.3 - 26.0 + 1 = 36.3\text{dBmV/m}$$

Conversion between dBmV/m (or dBmV) and mV/m (or mV) are done as:

$$\text{Level (dBmV/m)} = 20 * \text{Log (level (mV/m))}$$

$$40 \text{ dBmV/m} = 100\text{mV/m}$$

$$48 \text{ dBmV/m} = 250\text{mV/m}$$

Limits for Radiated Digital Emissions (0.03 – 1 GHz)

(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 | | Measurement Distance (m) |
|-----------------|------------------------------------|--|--------------------------|
| | $\mu\text{V/m}$ (microvolts/meter) | $\text{dB}\mu\text{V/m}$ (dB microvolts/meter) | |
| 0.009-0.490 | 2400/F(kHz) | -- | 300 |
| 0.490-1.705 | 24000/F(kHz) | -- | 30 |
| 1.705-30.0 | 30 | 29.5 | 30 |
| 30-88 | 100** | 40 | 3 |
| 88-216 | 150** | 43.5 | 3 |
| 216-960 | 200** | 46.0 | 3 |
| Above 960 | 500 | 54.0 | 3 |

**Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this part, e.g., §§15.231 and 15.241. (b) In the emission table above, the tighter limit applies at the band edges. (c) The level of any unwanted emissions from an intentional radiator operating under these general provisions shall not exceed the level of the fundamental emission. For intentional radiators which operate under the provisions of other sections within this part and which are required to reduce their unwanted emissions to the limits specified in this table, the limits in this table are based on the frequency of the unwanted emission and not the fundamental frequency. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency. (d) The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector. (e) The provisions in §§15.31, 15.33, and 15.35 for measuring emissions at distances other than the distances specified in the above table, determining the frequency range over which radiated emissions are to be measured, and limiting peak emissions apply to all devices operated under this part. (f) In accordance with §15.33(a), in some cases the emissions from an intentional radiator must be measured to beyond the tenth harmonic of the highest fundamental frequency designed to be emitted by the intentional radiator because of the incorporation of a digital device. If measurements above the tenth harmonic are so required, the radiated emissions above the tenth harmonic shall comply with the general radiated emission limits applicable to the incorporated digital device, as shown in §15.109 and as based on the frequency of the emission being measured, or, except for emissions contained in the restricted frequency bands shown in §15.205, the limit on spurious emissions specified for the intentional radiator, whichever is the higher limit. Emissions which must be measured above the tenth harmonic of the highest fundamental frequency designed to be emitted by the intentional radiator and which fall within the restricted bands shall comply with the general radiated emission limits in §15.109 that are applicable to the incorporated digital device. (g) Perimeter protection systems may operate in the 54-72 MHz and 76-88 MHz bands under the provisions of this section. The use of such perimeter protection systems is limited to industrial, business and commercial applications.

Test Notes: EUT Powered by 12V AC/DC PS. Connected to 4 muxes. all ports connected and term. Device is used in class A environment

Equipment Configuration for Radiated Digital Emissions (Class A)

| | | | |
|---------------------------------|----------------|------------------------|-----|
| Antenna: | Not Applicable | Variant: | |
| Antenna Gain (dBi): | Not Applicable | Modulation: | |
| Beam Forming Gain (Y): | Not Applicable | Duty Cycle (%): | |
| Channel Frequency (MHz): | 0.00 | Data Rate: | |
| Power Setting: | max | Tested By: | JMH |

Test Measurement Results

30.00 - 1000.00 MHz

| Num | Frequency MHz | Raw dBµV | Cable Loss dB | AF dB/m | Level dBµV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBµV/m | Margin dB | Pass /Fail |
|-----|---------------|----------|---------------|---------|--------------|------------------|------------|--------|---------|--------------|-----------|------------|
| #1 | 30.00 | 40.72 | 3.52 | -7.20 | 37.04 | MaxQP | Horizontal | 106 | 85 | 49.5 | -12.5 | Pass |
| #2 | 260.90 | 64.84 | 4.76 | -15.63 | 53.97 | MaxQP | Horizontal | 126 | 145 | 57.0 | -3.0 | Pass |
| #3 | 263.90 | 62.69 | 4.78 | -15.27 | 52.20 | MaxQP | Horizontal | 117 | 146 | 57.0 | -4.8 | Pass |
| #4 | 377.86 | 54.41 | 5.18 | -12.55 | 47.04 | MaxQP | Horizontal | 101 | 168 | 57.0 | -10.0 | Pass |
| #5 | 559.24 | 52.08 | 5.76 | -9.15 | 48.69 | MaxQP | Horizontal | 127 | 122 | 57.0 | -8.3 | Pass |
| #6 | 787.04 | 46.65 | 6.45 | -6.00 | 47.10 | MaxQP | Horizontal | 101 | 202 | 57.0 | -9.9 | Pass |

Test Notes: EUT Powered by 12V AC/DC PS. Connected to 4 muxes. all ports connected and term. Device is used in class A environment

Test Notes: EUT Powered by PoE. Connected to 4 muxes. all ports connected and term. Device is used in class A environment

Equipment Configuration for Radiated Digital Emissions (Class A)

| | | | |
|---------------------------------|----------------|------------------------|-----|
| Antenna: | Not Applicable | Variant: | |
| Antenna Gain (dBi): | Not Applicable | Modulation: | |
| Beam Forming Gain (Y): | Not Applicable | Duty Cycle (%): | |
| Channel Frequency (MHz): | 0.00 | Data Rate: | |
| Power Setting: | max | Tested By: | JMH |

Test Measurement Results

30.00 - 1000.00 MHz

| Num | Frequency MHz | Raw dBµV | Cable Loss dB | AF dB/m | Level dBµV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBµV/m | Margin dB | Pass /Fail |
|-----|---------------|----------|---------------|---------|--------------|------------------|------------|--------|---------|--------------|-----------|------------|
| #1 | 50.47 | 53.51 | 3.73 | -20.71 | 36.53 | MaxQP | Vertical | 101 | 271 | 50.0 | -13.5 | Pass |
| #2 | 73.99 | 56.44 | 3.91 | -20.47 | 39.88 | MaxQP | Vertical | 135 | 210 | 50.0 | -10.1 | Pass |
| #3 | 77.21 | 56.39 | 3.93 | -20.63 | 39.69 | MaxQP | Vertical | 139 | 93 | 50.0 | -10.3 | Pass |
| #4 | 97.60 | 57.01 | 4.04 | -19.09 | 41.96 | MaxQP | Vertical | 108 | 106 | 50.0 | -8.0 | Pass |
| #5 | 103.30 | 55.99 | 4.07 | -17.18 | 42.88 | MaxQP | Vertical | 113 | 105 | 50.0 | -7.1 | Pass |
| #6 | 106.77 | 53.38 | 4.09 | -16.45 | 41.02 | MaxQP | Horizontal | 185 | 0 | 50.0 | -9.0 | Pass |

Test Notes: EUT Powered by PoE. Connected to 4 muxes. all ports connected and term. Device is used in class A environment

Test Notes: EUT Powered by 12V AC/DC PS and 24V Ext PS on Controller. Connected to 4 muxes. all ports connected and term. Device is used in class A environment

Equipment Configuration for Radiated Digital Emissions (Class A)

| | | | |
|---------------------------------|----------------|------------------------|-----|
| Antenna: | Not Applicable | Variant: | |
| Antenna Gain (dBi): | Not Applicable | Modulation: | |
| Beam Forming Gain (Y): | Not Applicable | Duty Cycle (%): | |
| Channel Frequency (MHz): | 0.00 | Data Rate: | |
| Power Setting: | max | Tested By: | JMH |

Test Measurement Results

30.00 - 1000.00 MHz

| Num | Frequency MHz | Raw dBµV | Cable Loss dB | AF dB/m | Level dBµV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBµV/m | Margin dB | Pass /Fail |
|-----|---------------|----------|---------------|---------|--------------|------------------|------------|--------|---------|--------------|-----------|------------|
| #1 | 72.45 | 54.40 | 3.90 | -20.49 | 37.81 | MaxQP | Vertical | 105 | 180 | 49.5 | -11.7 | Pass |
| #2 | 81.16 | 55.23 | 3.95 | -20.89 | 38.29 | MaxQP | Vertical | 117 | 204 | 49.5 | -11.2 | Pass |
| #3 | 97.40 | 57.11 | 4.04 | -19.09 | 42.06 | MaxQP | Vertical | 115 | 145 | 54.0 | -11.9 | Pass |
| #4 | 104.68 | 54.83 | 4.08 | -16.77 | 42.14 | MaxQP | Horizontal | 184 | 26 | 54.0 | -11.9 | Pass |
| #5 | 106.70 | 53.40 | 4.09 | -16.45 | 41.04 | MaxQP | Horizontal | 186 | 201 | 54.0 | -13.0 | Pass |
| #6 | 720.00 | 40.29 | 6.25 | -6.88 | 39.66 | MaxQP | Horizontal | 101 | 228 | 57.0 | -17.3 | Pass |

Test Notes: EUT Powered by 12V AC/DC PS and 24V Ext PS on Controller. Connected to 4 muxes. all ports connected and term. Device is used in class A environment

Test Notes: EUT Powered by Poe and 24V Ext PS on Controller. Connected to 4 muxes. all ports connected and term. Device is used in class A environment

Equipment Configuration for Radiated Digital Emissions (Class A)

| | | | |
|---------------------------------|----------------|------------------------|-----|
| Antenna: | Not Applicable | Variant: | |
| Antenna Gain (dBi): | Not Applicable | Modulation: | |
| Beam Forming Gain (Y): | Not Applicable | Duty Cycle (%): | |
| Channel Frequency (MHz): | 0.00 | Data Rate: | |
| Power Setting: | max | Tested By: | JMH |

Test Measurement Results

30.00 - 1000.00 MHz

| Num | Frequency MHz | Raw dBµV | Cable Loss dB | AF dB/m | Level dBµV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBµV/m | Margin dB | Pass /Fail |
|-----|---------------|----------|---------------|---------|--------------|------------------|------------|--------|---------|--------------|-----------|------------|
| #1 | 72.45 | 54.40 | 3.90 | -20.49 | 37.81 | MaxQP | Vertical | 105 | 180 | 49.5 | -11.7 | Pass |
| #2 | 81.16 | 55.23 | 3.95 | -20.89 | 38.29 | MaxQP | Vertical | 117 | 204 | 49.5 | -11.2 | Pass |
| #3 | 97.40 | 57.11 | 4.04 | -19.09 | 42.06 | MaxQP | Vertical | 115 | 145 | 54.0 | -11.9 | Pass |
| #4 | 104.68 | 54.83 | 4.08 | -16.77 | 42.14 | MaxQP | Horizontal | 184 | 26 | 54.0 | -11.9 | Pass |
| #5 | 106.70 | 53.40 | 4.09 | -16.45 | 41.04 | MaxQP | Horizontal | 186 | 201 | 54.0 | -13.0 | Pass |
| #6 | 720.00 | 40.29 | 6.25 | -6.88 | 39.66 | MaxQP | Horizontal | 101 | 228 | 57.0 | -17.3 | Pass |

Test Notes: EUT Powered by Poe and 24V Ext PS on Controller. Connected to 4 muxes. all ports connected and term. Device is used in class A environment

9.8. AC Wireline

| Test Conditions for ac Wireline Emissions (0.15 – 30 MHz) | | | |
|---|-----------------------------------|---------------------|-------------|
| Standard: | FCC CFR 47:15.247 | Ambient Temp. (°C): | 20.0 - 24.5 |
| Test Heading: | Conducted (ac Wireline Emissions) | Rel. Humidity (%): | 32 - 45 |
| Standard Section(s): | 15.207 | Pressure (mBars): | 999 - 1001 |
| Reference Document(s): | See Normative References | | |

Test Procedure for ac Wireline Emissions (0.15 – 30 MHz)

The EUT is configured in accordance with ANSI C63.4. The conducted emissions are measured in a shielded room with a spectrum analyzer in peak hold in the first instance. Emissions closest to the limit are measured in the quasi-peak mode (QP) with the tuned receiver using a bandwidth of 9 kHz. The emissions are maximized further by cable manipulation. The highest emissions relative to the limit are listed.

Test configuration and setup for ac Wireline Emission Measurement were per the ac Wireline Test Set-up specified in this document.

Limits for ac Wireline Emissions

- (a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 μ H/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Limits for conducted disturbance at the mains ports of class B ITE

| Frequency of emission (MHz) | Quasi-peak dBuV | Average dBuV |
|-----------------------------|--|--------------|
| 0.15–0.5 | 66 to 56* | 56 to 46* |
| 0.5–5 | 56 | 46 |
| 5–30 | 60 | 50 |
| Note 1 | * Decreases with the logarithm of the frequency | |
| Note 2 | * The lower limit applies at the boundary between frequency ranges | |

Limits for conducted disturbance at the mains ports of class A ITE

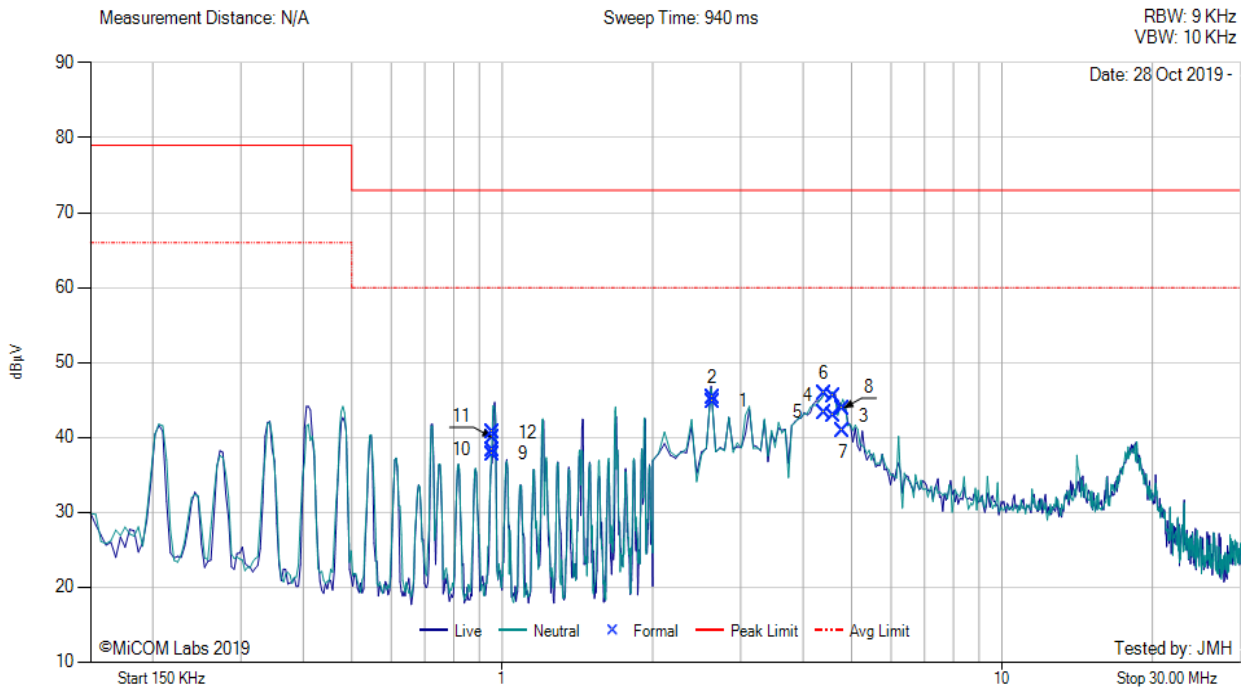
| Frequency of emission (MHz) | Quasi-peak dBuV | Average dBuV |
|-----------------------------|--|--------------|
| 0.15–0.5 | 79 | 66 |
| 0.5–30 | 73 | 60 |
| Note 1 | * The lower limit shall apply at the transition frequency. | |

The limit shown in paragraph (a) of this section shall not apply to carrier current systems operating as intentional radiators on frequencies below 30 MHz. In lieu thereof, these carrier current systems shall be subject to the following standards:

- (1) For carrier current system containing their fundamental emission within the frequency band 535-1705 kHz and intended to be received using a standard AM broadcast receiver: no limit on conducted emissions.
- (2) For all other carrier current systems: 1000 μ V within the frequency band 535-1705 kHz, as measured using a 50 μ H/50 ohms LISN.
- (3) Carrier current systems operating below 30 MHz are also subject to the radiated emission limits in §15.205, §15.209, §15.221, §15.223, or §15.227, as appropriate.

Measurements to demonstrate compliance with the conducted limits are not required for devices which only employ battery power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines. Devices that include, or make provisions for, the use of battery chargers which permit operating while charging, AC adapters or battery eliminators or that connect to the AC power lines indirectly, obtaining their power through another device which is connected to the AC power lines, shall be tested to demonstrate compliance with the conducted limits.

| | | | |
|--------------|--------------------------|-----------------------|-------------|
| Model: | Nexus Multiplexer | Configuration tested: | PoE Powered |
| Input power: | 120V _{AC} /60Hz | Standard: | FCC 15B |



| Num | Frequency MHz | Raw dBµV | Cable Loss dB | Factor dB | Total Correction dBµV | Corrected Value dBµV | Measurement Type | Line | Limit dBµV/m | Margin dB | Pass /Fail |
|-----|---------------|----------|---------------|-----------|-----------------------|----------------------|------------------|---------|--------------|-----------|------------|
| 1 | 2.635 | 34.56 | 0.22 | 10.01 | 10.23 | 44.79 | Max Avg | Live | 60.0 | -15.2 | Pass |
| 2 | 2.635 | 35.04 | 0.22 | 10.01 | 10.23 | 45.27 | Max Qp | Live | 73.0 | -27.7 | Pass |
| 3 | 4.608 | 32.57 | 0.25 | 10.07 | 10.32 | 42.89 | Max Avg | Neutral | 60.0 | -17.1 | Pass |
| 4 | 4.608 | 35.25 | 0.25 | 10.07 | 10.32 | 45.57 | Max Qp | Neutral | 73.0 | -27.4 | Pass |
| 5 | 4.403 | 33.03 | 0.25 | 10.06 | 10.31 | 43.34 | Max Avg | Live | 60.0 | -16.7 | Pass |
| 6 | 4.403 | 35.47 | 0.25 | 10.06 | 10.31 | 45.78 | Max Qp | Live | 73.0 | -27.2 | Pass |
| 7 | 4.810 | 30.45 | 0.26 | 10.08 | 10.34 | 40.79 | Max Avg | Neutral | 60.0 | -19.2 | Pass |
| 8 | 4.810 | 33.54 | 0.26 | 10.08 | 10.34 | 43.88 | Max Qp | Neutral | 73.0 | -29.1 | Pass |
| 9 | 0.958 | 27.76 | 0.08 | 9.93 | 10.01 | 37.77 | Max Avg | Live | 60.0 | -22.2 | Pass |
| 10 | 0.958 | 28.31 | 0.08 | 9.93 | 10.01 | 38.32 | Max Qp | Live | 73.0 | -34.7 | Pass |
| 11 | 0.956 | 29.96 | 0.08 | 9.93 | 10.01 | 39.97 | Max Avg | Neutral | 60.0 | -20.0 | Pass |
| 12 | 0.956 | 30.68 | 0.08 | 9.93 | 10.01 | 40.69 | Max Qp | Neutral | 73.0 | -32.3 | Pass |

Test Notes: EUT powered by POE. Controller powered by USB 5V. 120V 60 Hz

| | | | |
|--------------|--------------------------|-----------------------|----------------------|
| Model: | Nexus Multiplexer | Configuration tested: | 12V AC/DC PS Powered |
| Input power: | 120V _{AC} /60Hz | Standard: | FCC 15B |

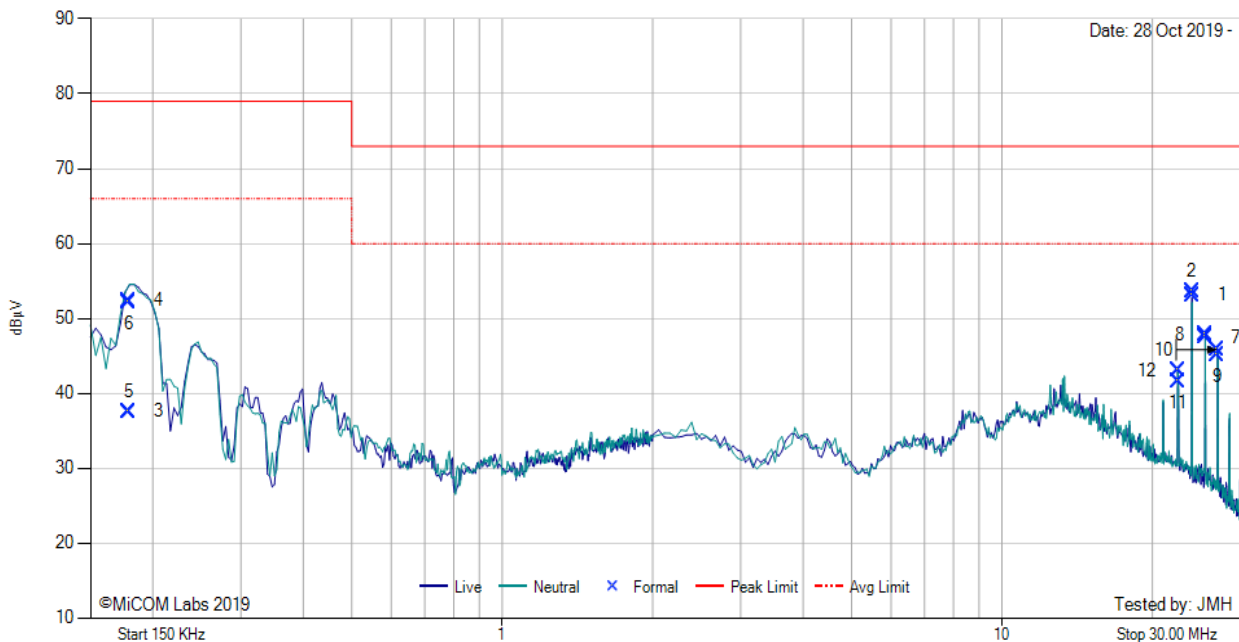


Measurement Distance: N/A

Sweep Time: 940 ms

RBW: 9 KHz
VBW: 10 KHz

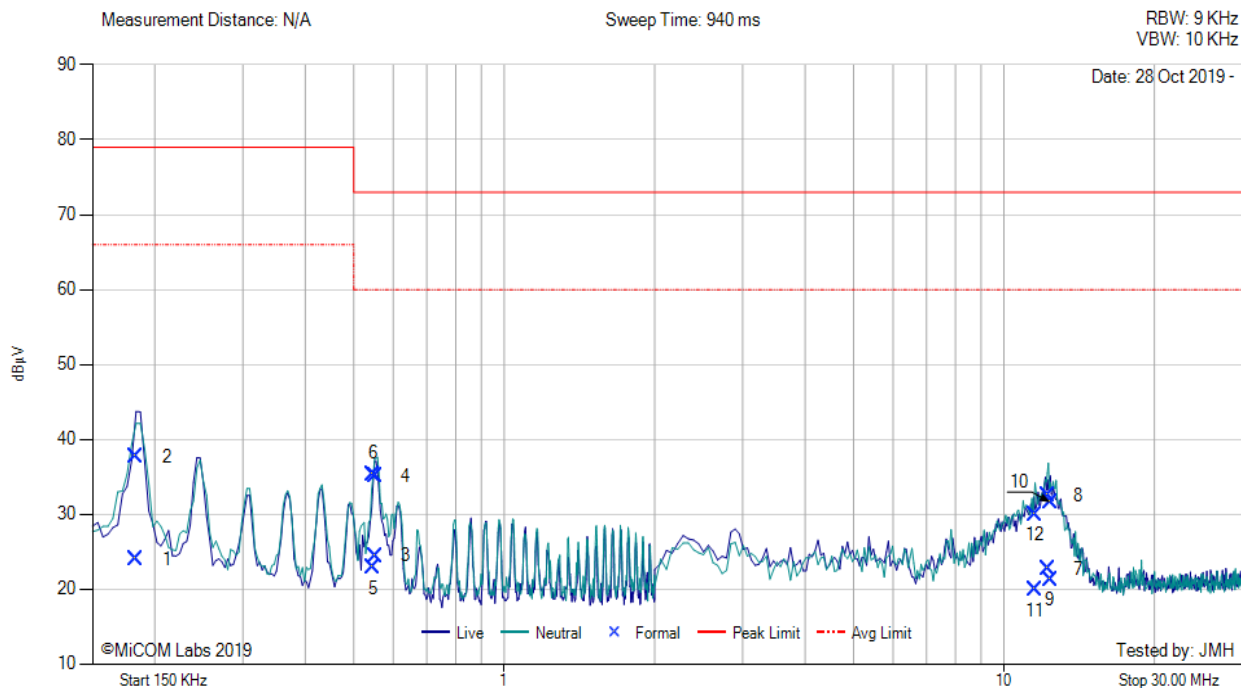
Date: 28 Oct 2019 -



| Num | Frequency MHz | Raw dBµV | Cable Loss dB | Factor dB | Total Correction dBµV | Corrected Value dBµV | Measurement Type | Line | Limit dBµV/m | Margin dB | Pass /Fail |
|-----|---------------|----------|---------------|-----------|-----------------------|----------------------|------------------|---------|--------------|-----------|------------|
| 1 | 23.989 | 41.67 | 0.64 | 10.83 | 11.47 | 53.14 | Max Avg | Live | 60.0 | -6.9 | Pass |
| 2 | 23.989 | 42.09 | 0.64 | 10.83 | 11.47 | 53.56 | Max Qp | Live | 73.0 | -19.4 | Pass |
| 3 | 0.179 | 27.64 | 0.06 | 9.92 | 9.98 | 37.62 | Max Avg | Neutral | 66.0 | -28.4 | Pass |
| 4 | 0.179 | 42.38 | 0.06 | 9.92 | 9.98 | 52.36 | Max Qp | Neutral | 79.0 | -26.6 | Pass |
| 5 | 0.179 | 27.52 | 0.06 | 9.92 | 9.98 | 37.50 | Max Avg | Live | 66.0 | -28.5 | Pass |
| 6 | 0.179 | 42.16 | 0.06 | 9.92 | 9.98 | 52.14 | Max Qp | Live | 79.0 | -26.9 | Pass |
| 7 | 25.487 | 35.96 | 0.70 | 10.85 | 11.55 | 47.51 | Max Avg | Live | 60.0 | -12.5 | Pass |
| 8 | 25.487 | 36.31 | 0.70 | 10.85 | 11.55 | 47.86 | Max Qp | Live | 73.0 | -25.1 | Pass |
| 9 | 26.987 | 33.50 | 0.73 | 10.89 | 11.62 | 45.12 | Max Avg | Live | 60.0 | -14.9 | Pass |
| 10 | 26.987 | 34.22 | 0.73 | 10.89 | 11.62 | 45.84 | Max Qp | Live | 73.0 | -27.2 | Pass |
| 11 | 22.489 | 30.06 | 0.65 | 10.80 | 11.45 | 41.51 | Max Avg | Live | 60.0 | -18.5 | Pass |
| 12 | 22.489 | 31.54 | 0.65 | 10.80 | 11.45 | 42.99 | Max Qp | Live | 73.0 | -30.0 | Pass |

Test Notes: EUT powered by 12V AC/DC PS. Controller powered by 12V GPIO. 120V 60 Hz

| | | | |
|--------------|--------------------------|-----------------------|----------------------|
| Model: | ALX-2530 Controller | Configuration tested: | 24V AC/DC PS Powered |
| Input power: | 120V _{AC} /60Hz | Standard: | FCC 15B |

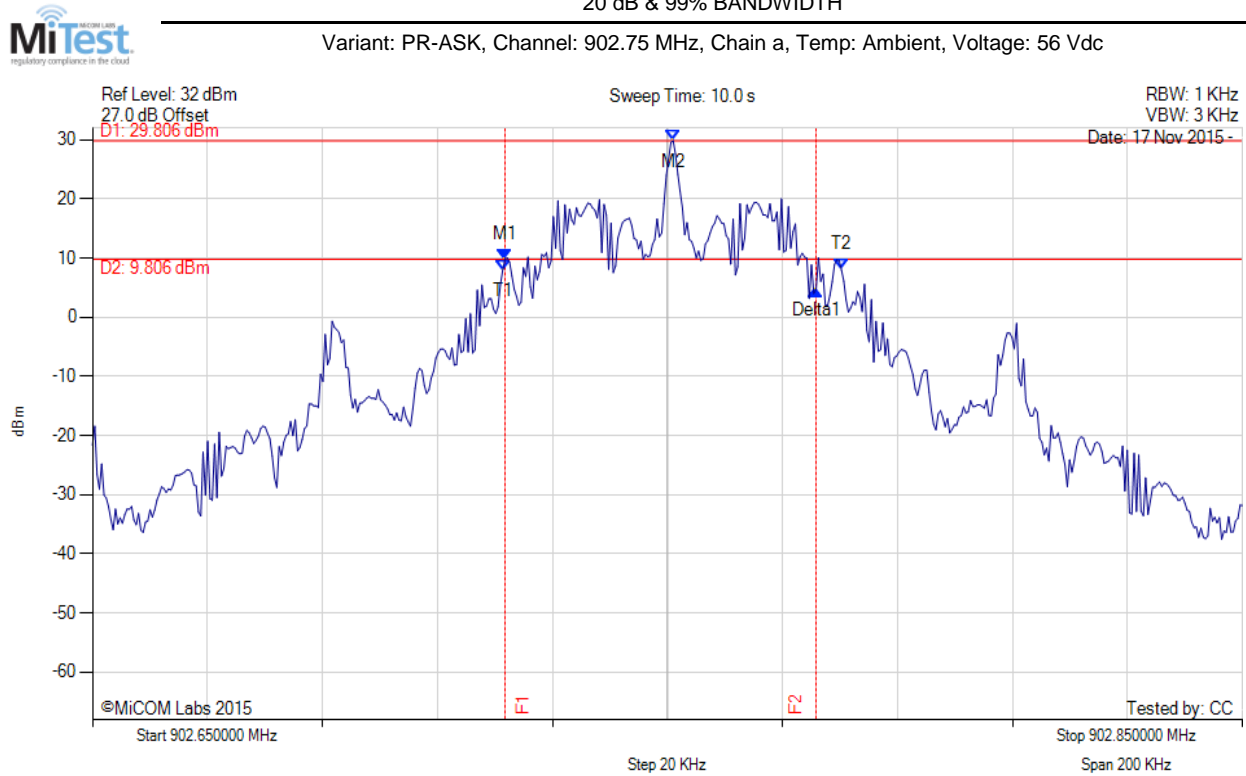


| Num | Frequency MHz | Raw dBµV | Cable Loss dB | Factor dB | Total Correction dBµV | Corrected Value dBµV | Measurement Type | Line | Limit dBµV/m | Margin dB | Pass /Fail |
|-----|---------------|----------|---------------|-----------|-----------------------|----------------------|------------------|---------|--------------|-----------|------------|
| 1 | 0.184 | 14.01 | 0.06 | 9.92 | 9.98 | 23.99 | Max Avg | Live | 66.0 | -42.0 | Pass |
| 2 | 0.184 | 27.69 | 0.06 | 9.92 | 9.98 | 37.67 | Max Qp | Live | 79.0 | -41.3 | Pass |
| 3 | 0.551 | 14.42 | 0.10 | 9.92 | 10.02 | 24.44 | Max Avg | Neutral | 60.0 | -35.6 | Pass |
| 4 | 0.551 | 25.08 | 0.10 | 9.92 | 10.02 | 35.10 | Max Qp | Neutral | 73.0 | -37.9 | Pass |
| 5 | 0.548 | 12.88 | 0.10 | 9.92 | 10.02 | 22.90 | Max Avg | Live | 60.0 | -37.1 | Pass |
| 6 | 0.548 | 25.38 | 0.10 | 9.92 | 10.02 | 35.40 | Max Qp | Live | 73.0 | -37.6 | Pass |
| 7 | 12.243 | 11.91 | 0.45 | 10.38 | 10.83 | 22.74 | Max Avg | Neutral | 60.0 | -37.3 | Pass |
| 8 | 12.243 | 21.62 | 0.45 | 10.38 | 10.83 | 32.45 | Max Qp | Neutral | 73.0 | -40.6 | Pass |
| 9 | 12.368 | 10.48 | 0.46 | 10.36 | 10.82 | 21.30 | Max Avg | Live | 60.0 | -38.7 | Pass |
| 10 | 12.368 | 20.80 | 0.46 | 10.36 | 10.82 | 31.62 | Max Qp | Live | 73.0 | -41.4 | Pass |
| 11 | 11.531 | 9.11 | 0.45 | 10.31 | 10.76 | 19.87 | Max Avg | Neutral | 60.0 | -40.1 | Pass |
| 12 | 11.531 | 19.25 | 0.45 | 10.31 | 10.76 | 30.01 | Max Qp | Neutral | 73.0 | -43.0 | Pass |

Test Notes: Controller powered by 24V AC/DC PS. 120V 60 Hz

A. APPENDIX - GRAPHICAL IMAGES

A.1. 20 dB & 99% Bandwidth



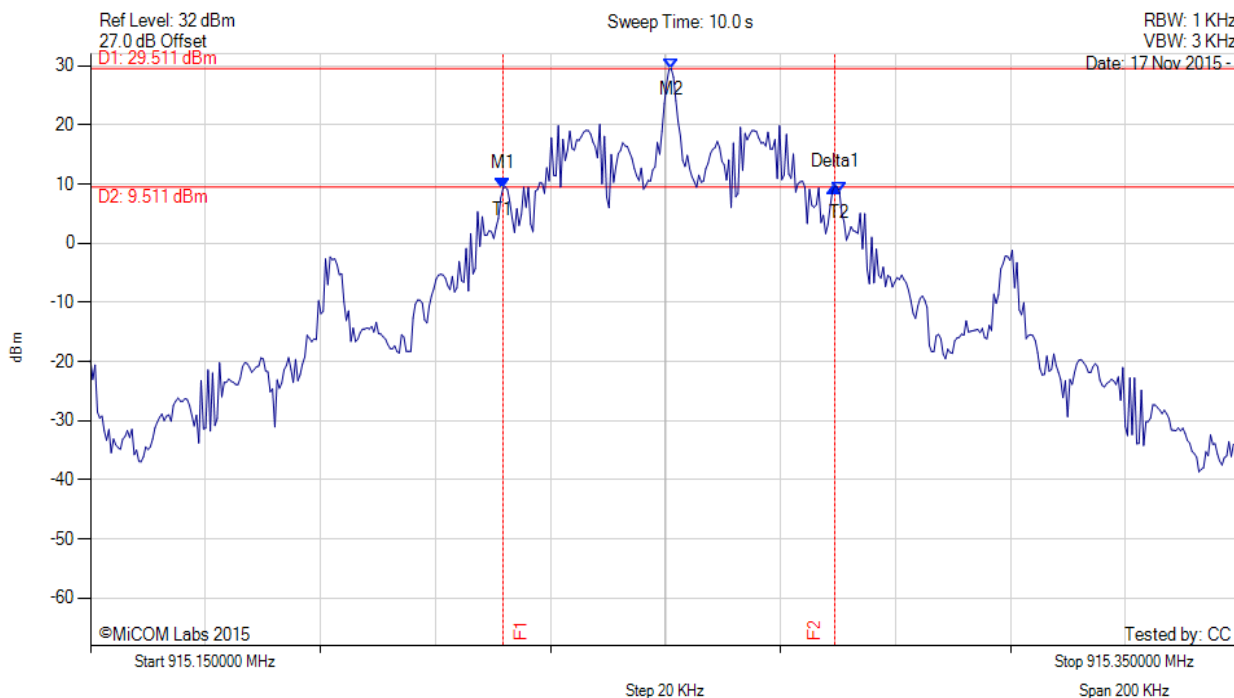
| Analyser Setup | Marker:Frequency:Amplitude | Test Results |
|---|--|---|
| Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 30 Trace Mode = MAX HOLD | M1 : 902.722 MHz : 9.785 dBm M2 : 902.751 MHz : 29.806 dBm Delta1 : 54 KHz : -5.127 dB T1 : 902.721 MHz : 7.902 dBm T2 : 902.780 MHz : 8.002 dBm OBW : 59 KHz | Measured 6 dB Bandwidth: 0.054 MHz Limit: ≥ 500.0 kHz Margin: 0.45 MHz |

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20 dB & 99% BANDWIDTH

Variant: PR-ASK, Channel: 915.25 MHz, Chain a, Temp: Ambient, Voltage: 56 Vdc



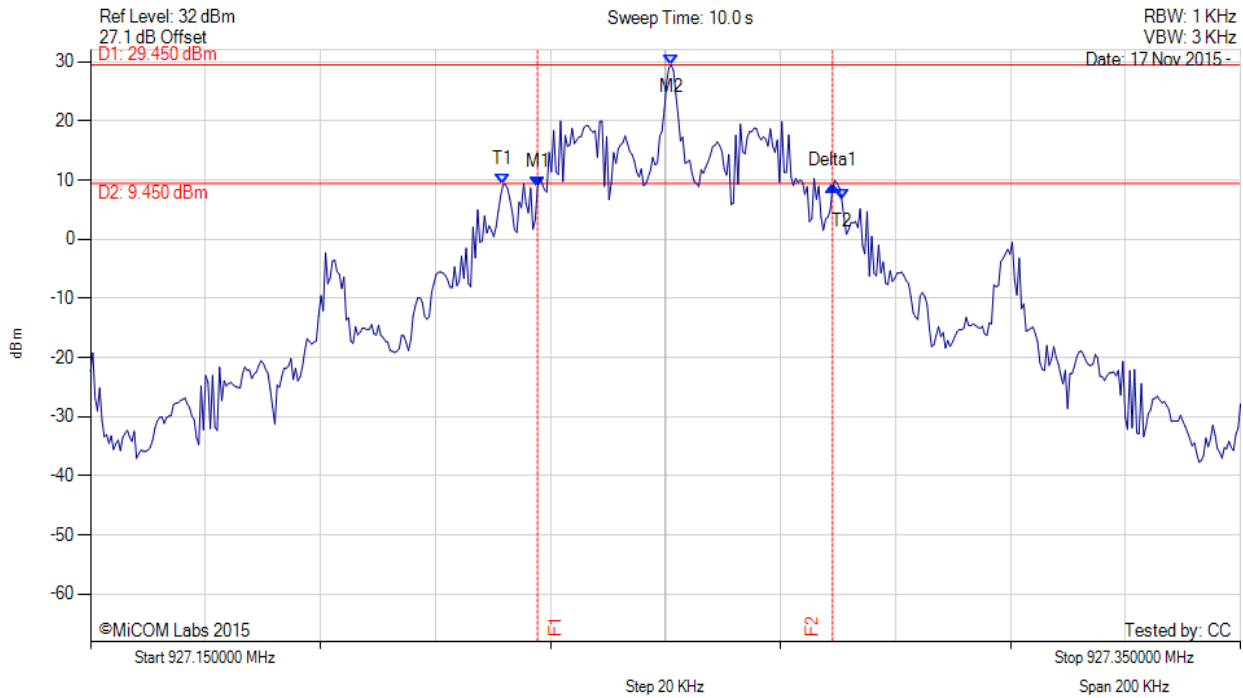
| Analyser Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 30 Trace Mode = MAX HOLD | M1 : 915.222 MHz : 9.226 dBm M2 : 915.251 MHz : 29.511 dBm Delta1 : 58 KHz : 0.368 dB T1 : 915.222 MHz : 9.226 dBm T2 : 915.280 MHz : 8.679 dBm OBW : 59 KHz | Measured 6 dB Bandwidth: 0.058 MHz Limit: ≥ 500.0 kHz Margin: 0.44 MHz |

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20 dB & 99% BANDWIDTH

Variat: PR-ASK, Channel: 927.25 MHz, Chain a, Temp: Ambient, Voltage: 56 Vdc



| Analyser Setup | Marker:Frequency:Amplitude | Test Results |
|---|---|---|
| Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 30 Trace Mode = MAX HOLD | M1 : 927.228 MHz : 8.803 dBm M2 : 927.251 MHz : 29.450 dBm Delta1 : 51 KHz : 0.146 dB T1 : 927.222 MHz : 9.171 dBm T2 : 927.281 MHz : 6.668 dBm OBW : 59 KHz | Measured 6 dB Bandwidth: 0.051 MHz Limit: ≥ 500.0 kHz Margin: 0.45 MHz |

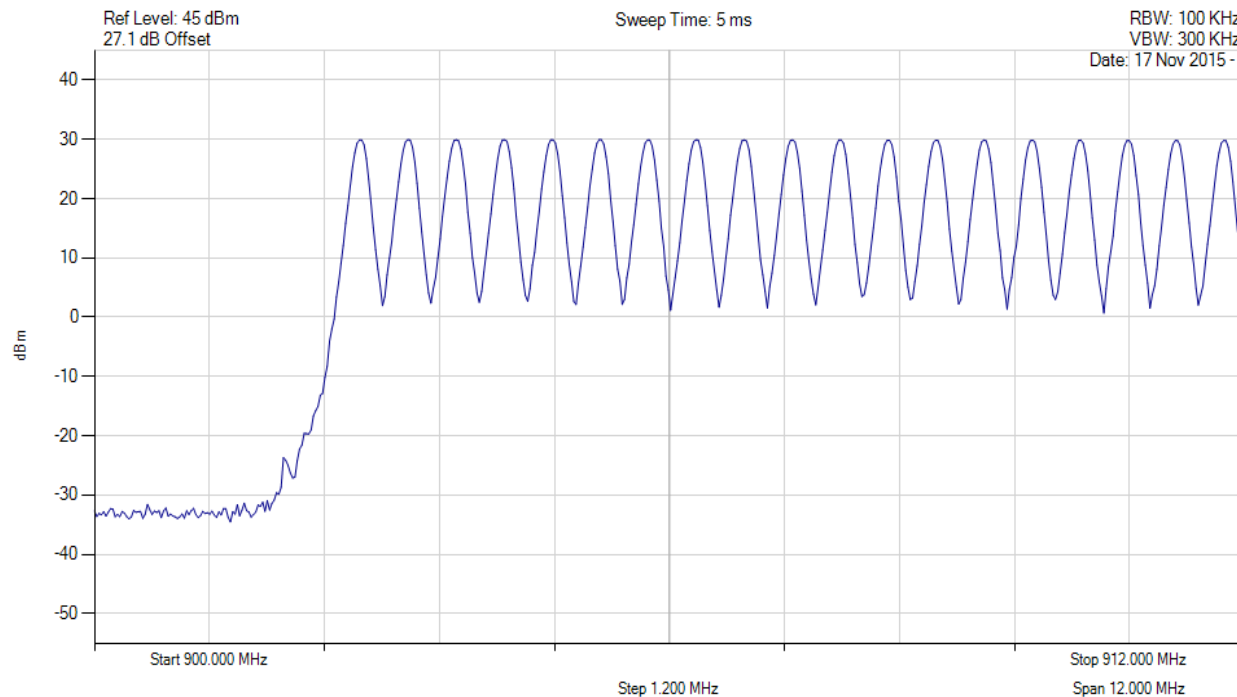
[back to matrix](#)

A.2. Number of Channels



Hopping Sequence 902-912 MHz

Variant: PR-ASK, Channel: Hopping, Chain a, Temp: Ambient, Voltage: 56 Vdc



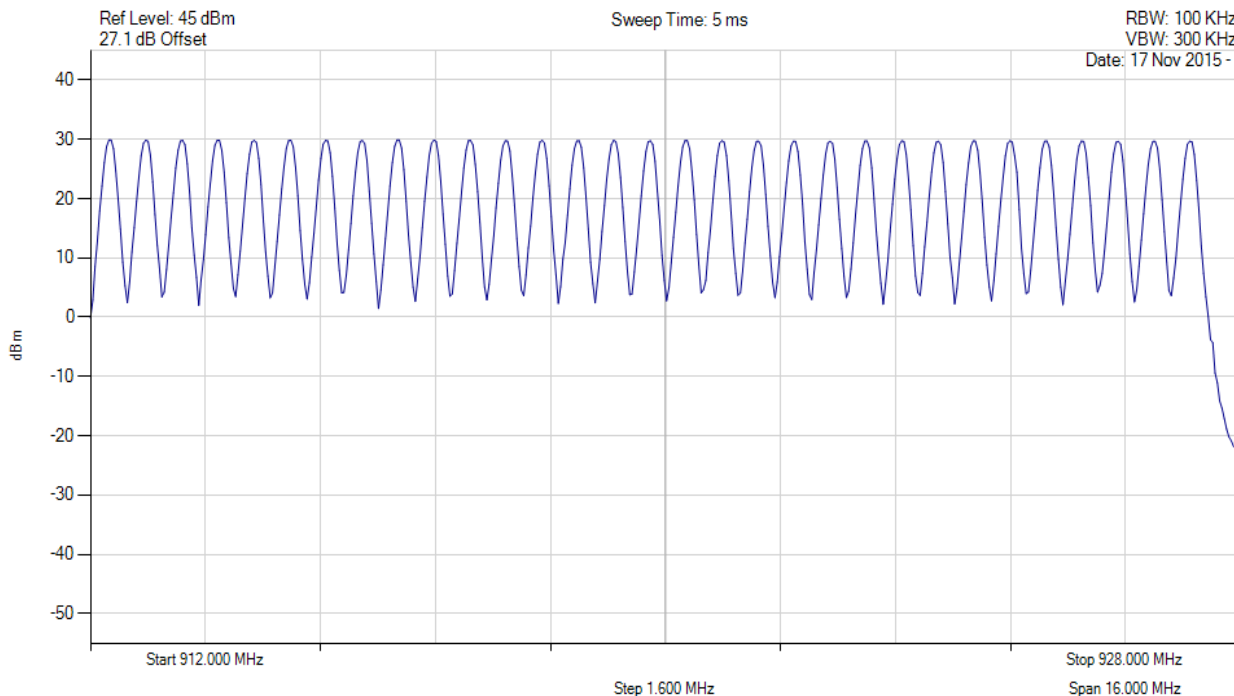
| Analyser Setup | Marker:Frequency:Amplitude | Test Results |
|--|----------------------------|--|
| Detector = POS Sweep Count = 0 RF Atten (dB) = 30 Trace Mode = VIEW | | Channel Frequency: Hopping Number of Hops: 19.0 |

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Hopping Sequence 912-928 MHz



Variant: PR-ASK, Channel: Hopping, Chain a, Temp: Ambient, Voltage: 56 Vdc



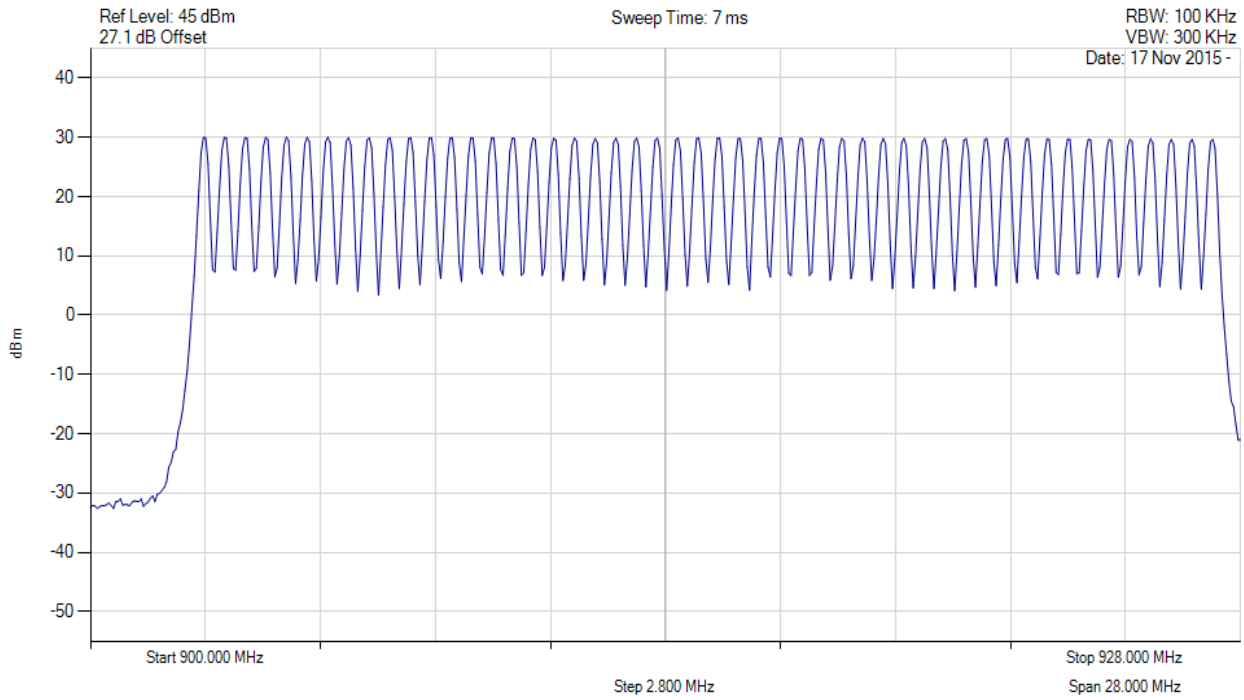
| Analyser Setup | Marker:Frequency:Amplitude | Test Results |
|--|----------------------------|--|
| Detector = POS Sweep Count = 0 RF Atten (dB) = 30 Trace Mode = VIEW | | Channel Frequency: Hopping Number of Hops: 31.0 |

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Hopping Sequence 902-928 MHz



Variants: PR-ASK, Channel: Hopping, Chain a, Temp: Ambient, Voltage: 56 Vdc



| Analyser Setup | Marker:Frequency:Amplitude | Test Results |
|--|----------------------------|--|
| Detector = POS Sweep Count = 0 RF Atten (dB) = 30 Trace Mode = VIEW | | Channel Frequency: Hopping Number of Hops: 50 |

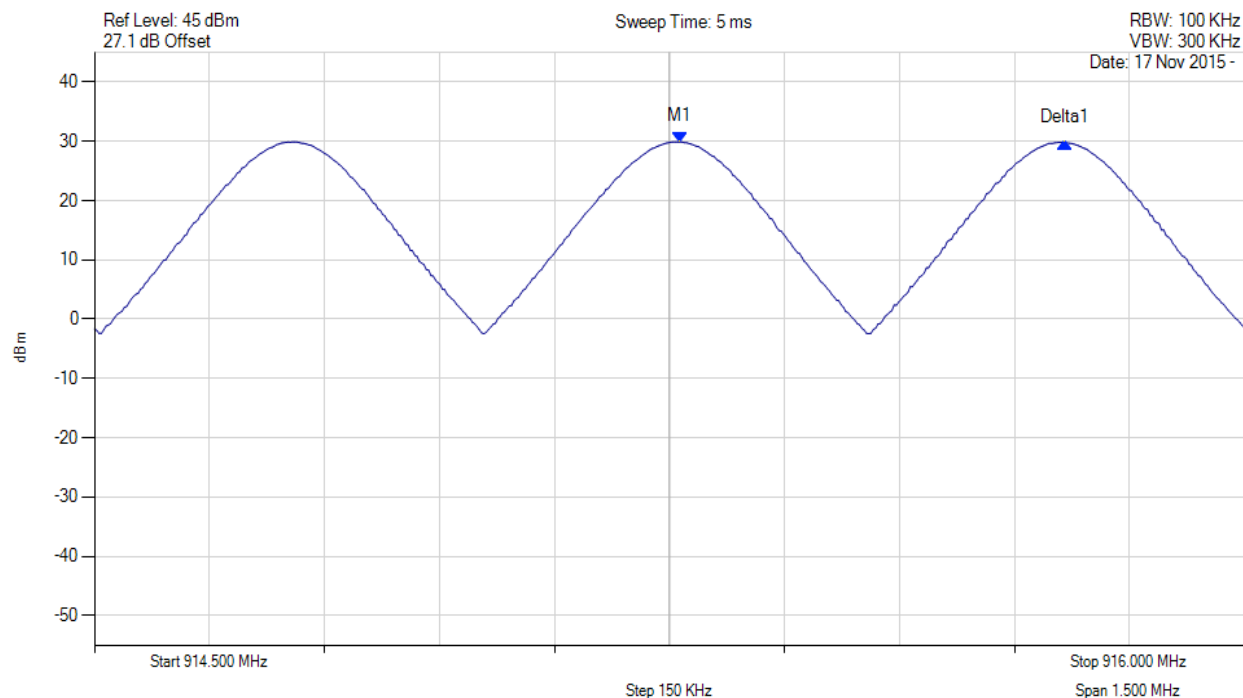
[back to matrix](#)

A.3. Channel Spacing



Channel Spacing

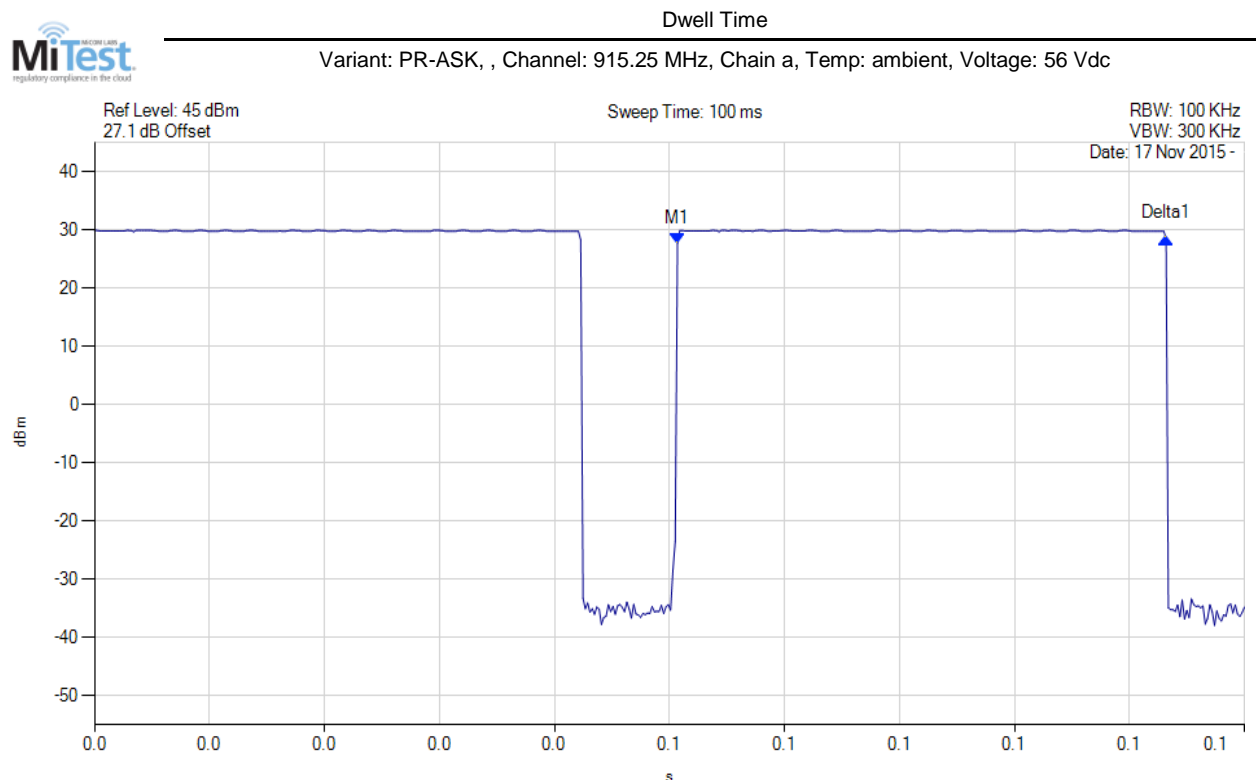
Variant: PR-ASK, Channel: 915.25 MHz, Chain a, Temp: Ambient, Voltage: 56 Vdc



| Analyser Setup | Marker:Frequency:Amplitude | Test Results |
|--|---|-------------------------------|
| Detector = POS Sweep Count = 0 RF Atten (dB) = 30 Trace Mode = MAXH | M1 : 915.264 MHz : 29.901 dBm Delta1 : 502 KHz : -0.112 dB | Channel Frequency: 915.25 MHz |

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A.4. Dwell Time & Channel Occupancy



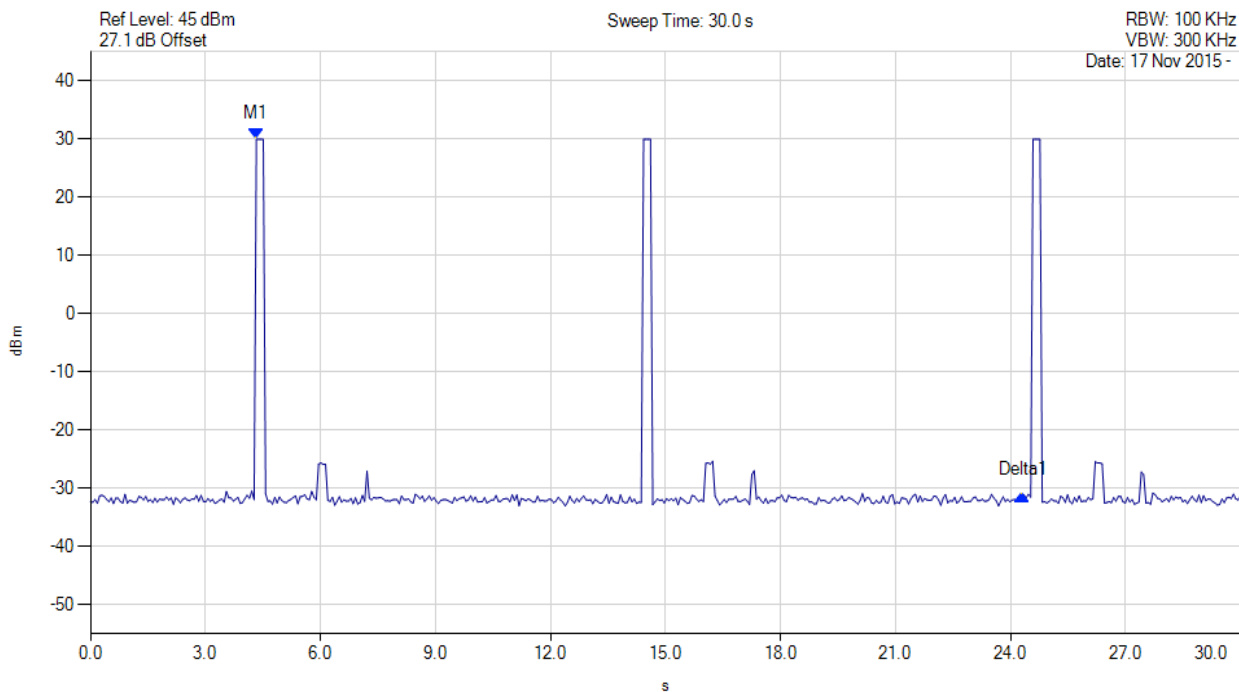
| Analyser Setup | Marker:Time:Amplitude | Test Results |
|---|--|--|
| Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW | M1(915.25 MHz) : 0.051 s : 27.654 dBm Delta1(915.25 MHz) : 0.042 s : 0.848 dB | Channel Frequency: 915.25 MHz Dwell Time: 0.042 s |

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Channel Occupancy



Variant: PR-ASK, , Channel: 915.00 MHz, Chain a, Temp: ambient, Voltage: 56 Vdc



| Analyser Setup | Marker:Time:Amplitude | Test Results |
|---|---|--|
| Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 20 Trace Mode = VIEW | M1(915.00 MHz) : 2.164 s : 29.324 dBm Delta1(915.00 MHz) : 20.000 s : -68.944 dB | Channel Frequency: 902.75 MHz Dwell Time: 42ms Occupancy: 84.96 ms Limit: 400ms/20s |

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A.5. Emissions

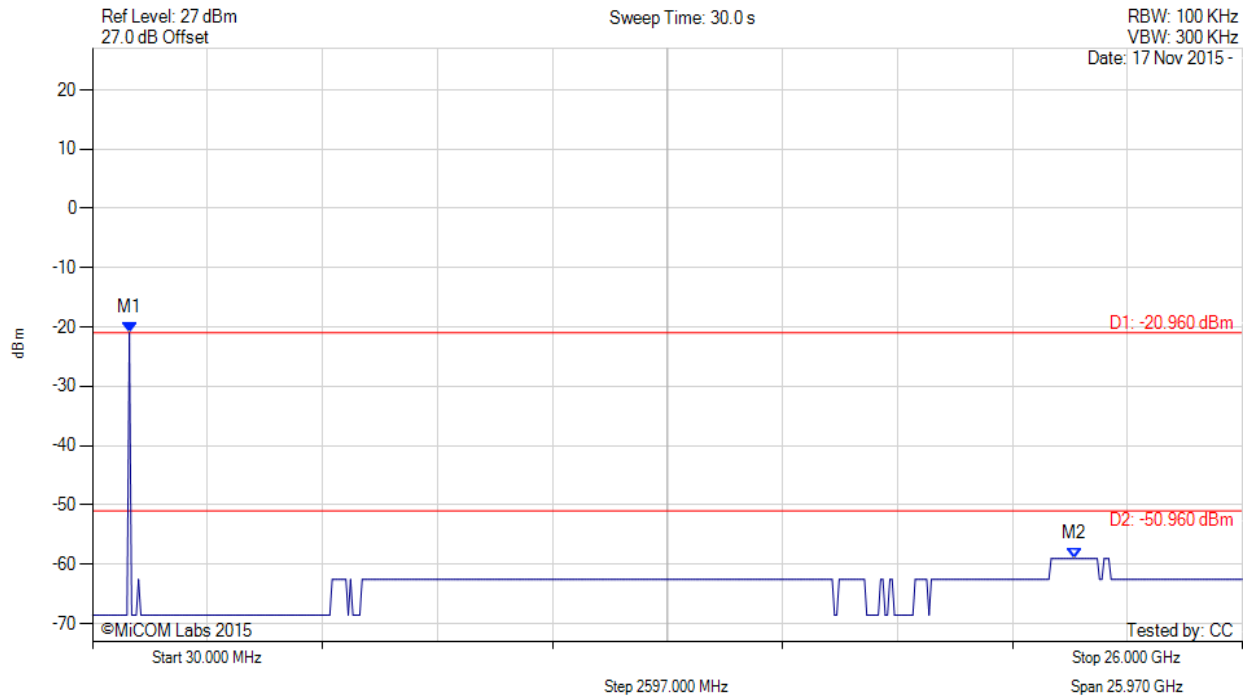
A.5.1. Conducted Emissions

A.5.1.1. Conducted Spurious Emissions



CONDUCTED SPURIOUS EMISSIONS - AVERAGE

Variant: PR-ASK, Channel: 902.75 MHz, Chain a, Temp: Ambient, Voltage: 56 Vdc



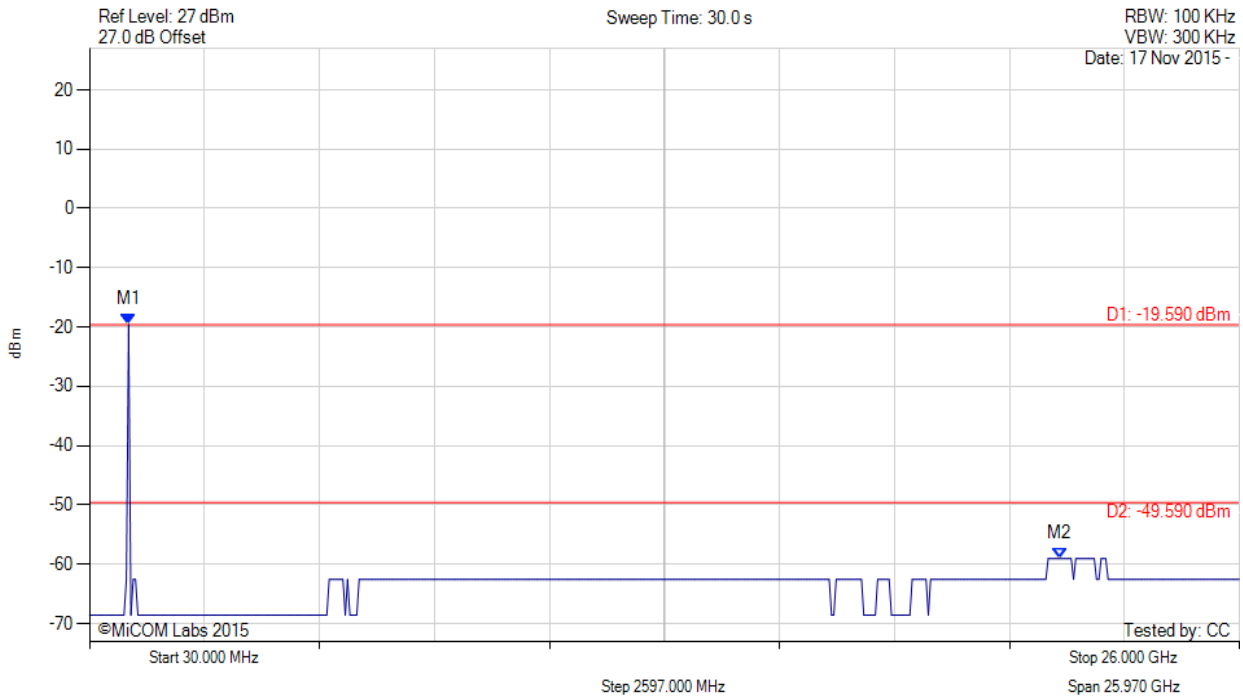
| Analyser Setup | Marker:Frequency:Amplitude | Test Results |
|--|---|---------------------------------------|
| Detector = AVERAGE Sweep Count = 0 RF Atten (dB) = 10 Trace Mode = VIEW | M1 : 862.705 MHz : -20.961 dBm M2 : 22.201 GHz : -59.023 dBm | Limit: -50.96 dBm Margin: -8.06 dB |

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CONDUCTED SPURIOUS EMISSIONS - AVERAGE



Variant: PR-ASK, Channel: 915.25 MHz, Chain a, Temp: Ambient, Voltage: 56 Vdc



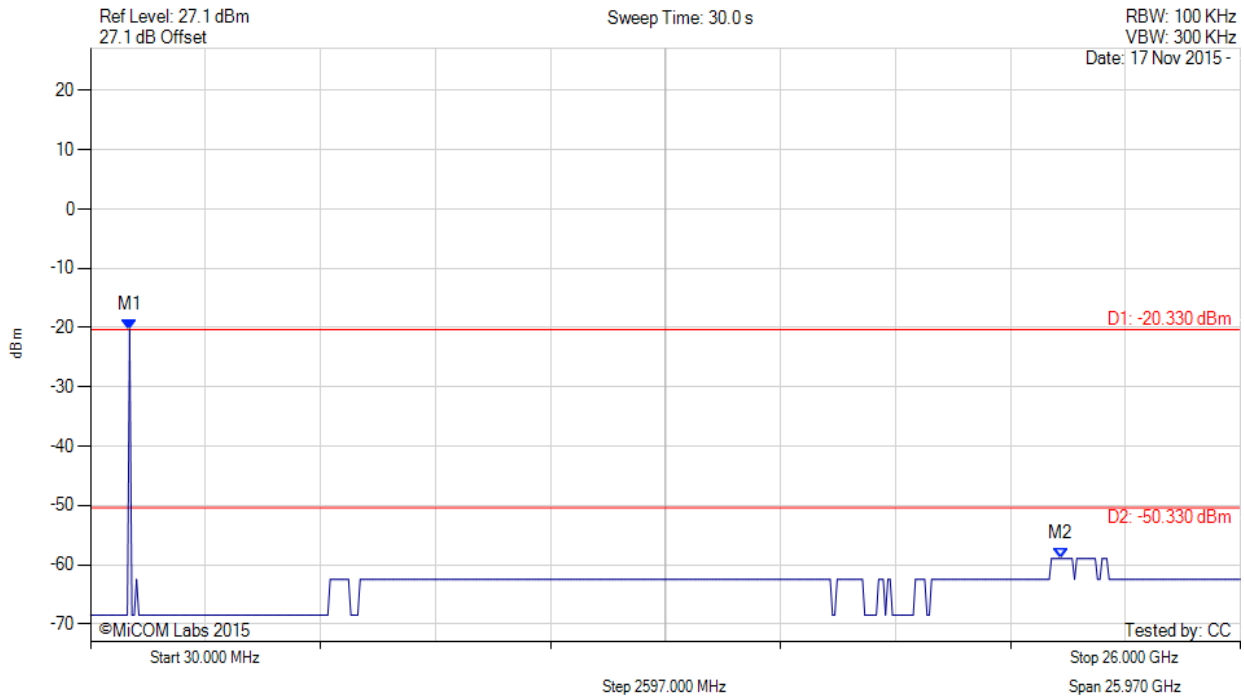
| Analyser Setup | Marker:Frequency:Amplitude | Test Results |
|--|---|---------------------------------------|
| Detector = AVERAGE Sweep Count = 0 RF Atten (dB) = 10 Trace Mode = VIEW | M1 : 914.749 MHz : -19.591 dBm M2 : 21.941 GHz : -59.023 dBm | Limit: -49.59 dBm Margin: -9.43 dB |

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CONDUCTED SPURIOUS EMISSIONS - AVERAGE



Variant: PR-ASK, Channel: 927.25 MHz, Chain a, Temp: Ambient, Voltage: 56 Vdc

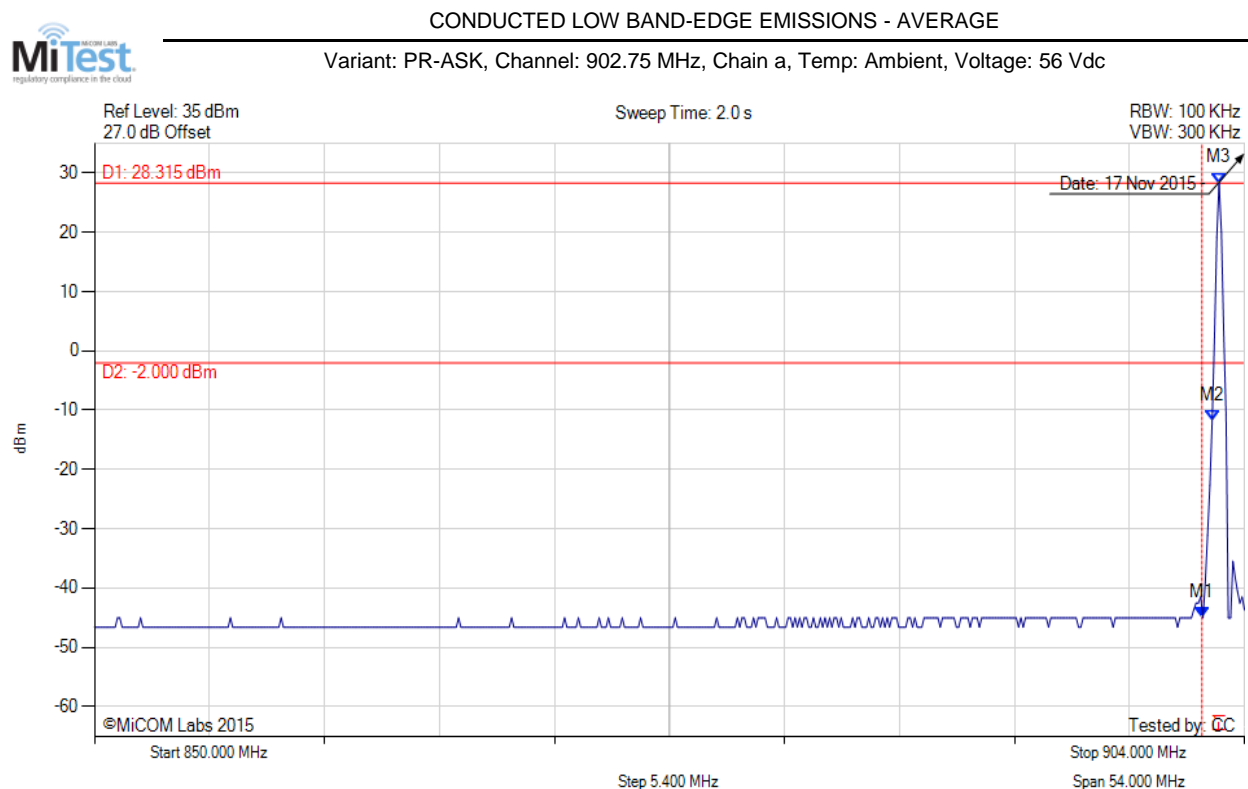


| Analyser Setup | Marker:Frequency:Amplitude | Test Results |
|--|---|---------------------------------------|
| Detector = AVERAGE Sweep Count = 0 RF Atten (dB) = 10 Trace Mode = VIEW | M1 : 914.749 MHz : -20.335 dBm M2 : 21.941 GHz : -58.923 dBm | Limit: -50.33 dBm Margin: -8.59 dB |

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A.5.1.2. Conducted Band-Edge Emissions

A.5.1.2.1. Conducted Low Band-Edge Emissions



| Analyser Setup | Marker:Frequency:Amplitude | Test Results |
|--|---|-------------------------------|
| Detector = AVERAGE Sweep Count = 0 RF Atten (dB) = 30 Trace Mode = VIEW | M1 : 902.000 MHz : -45.002 dBm M2 : 902.485 MHz : -11.716 dBm M3 : 902.810 MHz : 28.315 dBm | Channel Frequency: 902.75 MHz |

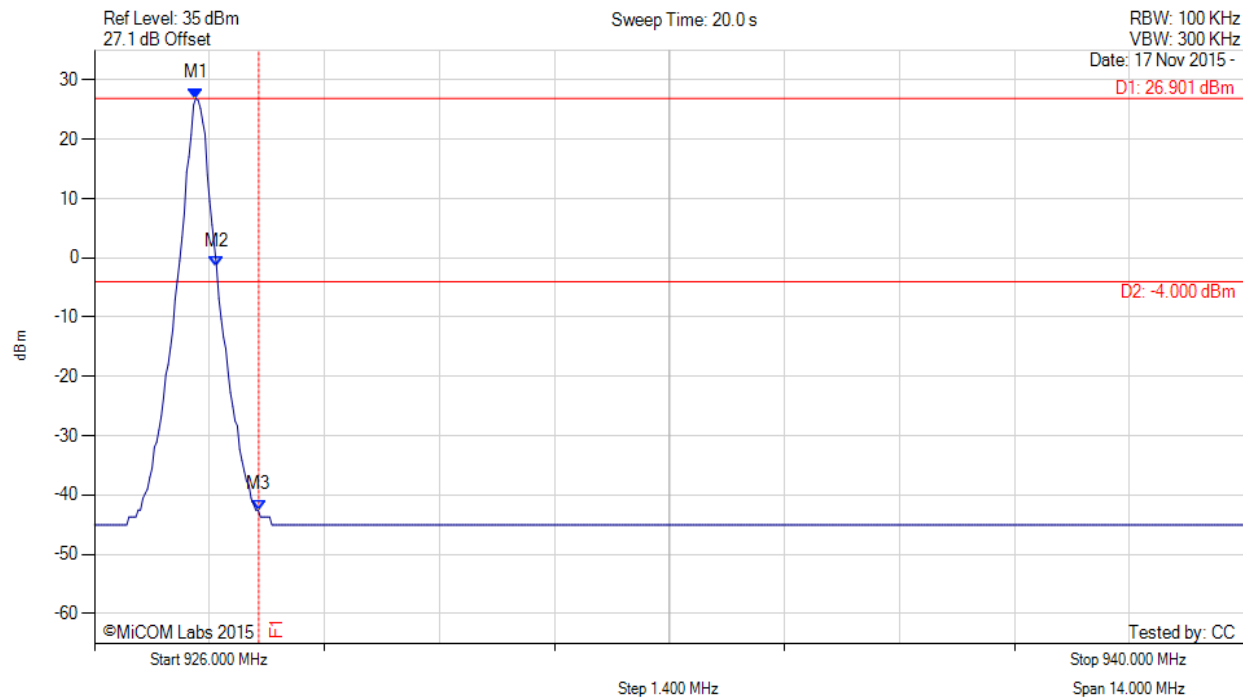
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A.5.1.2.2. Conducted High Band-Edge Emissions



CONDUCTED HIGH BAND-EDGE EMISSIONS - AVERAGE

Variant: PR-ASK, Channel: 927.25 MHz, Chain a, Temp: Ambient, Voltage: 56 Vdc



| Analyser Setup | Marker:Frequency:Amplitude | Test Results |
|--|--|-------------------------------|
| Detector = AVERAGE Sweep Count = 0 RF Atten (dB) = 30 Trace Mode = VIEW | M1 : 927.234 MHz : 26.901 dBm M2 : 927.487 MHz : -1.519 dBm M3 : 928.000 MHz : -42.504 dBm | Channel Frequency: 927.25 MHz |

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A.5.1.3. Radiated Spurious Emissions

Antenna ALR-0501



TX SPURIOUS & RESTRICTED BAND EMISSIONS

Variant: PR-ASK, Test Freq: 902.75 MHz, Antenna: Broadradio ALR-0501, Power Setting: Max, Duty Cycle (%): 100

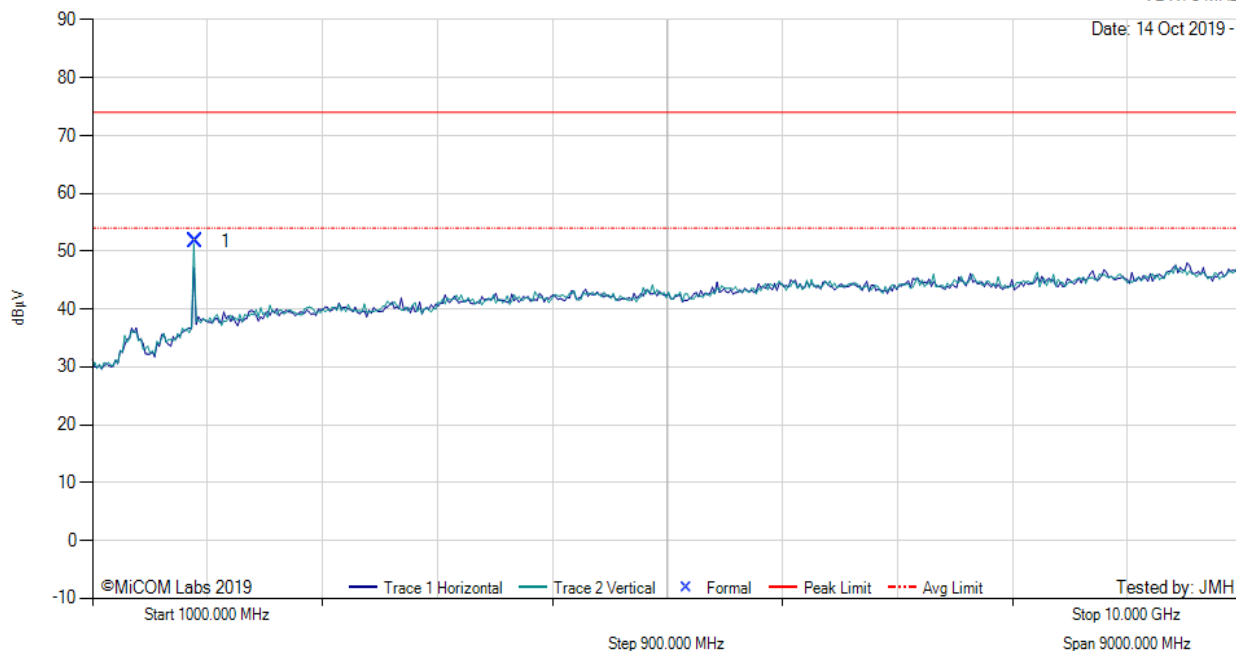
Measurement Distance: 3m

Sweep Time: 90 ms

RBW: 1 MHz

VBW: 3 MHz

Date: 14 Oct 2019 -



| 1000.00 - 10000.00 MHz | | | | | | | | | | | | |
|------------------------|---------------|----------|---------------|---------|--------------|------------------|----------|--------|---------|--------------|-----------|------------|
| Num | Frequency MHz | Raw dBµV | Cable Loss dB | AF dB/m | Level dBµV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBµV/m | Margin dB | Pass /Fail |
| 1 | 1805.48 | 64.49 | 1.75 | -14.50 | 51.74 | Peak (NRB) | Vertical | 200 | 0 | -- | -- | Pass |

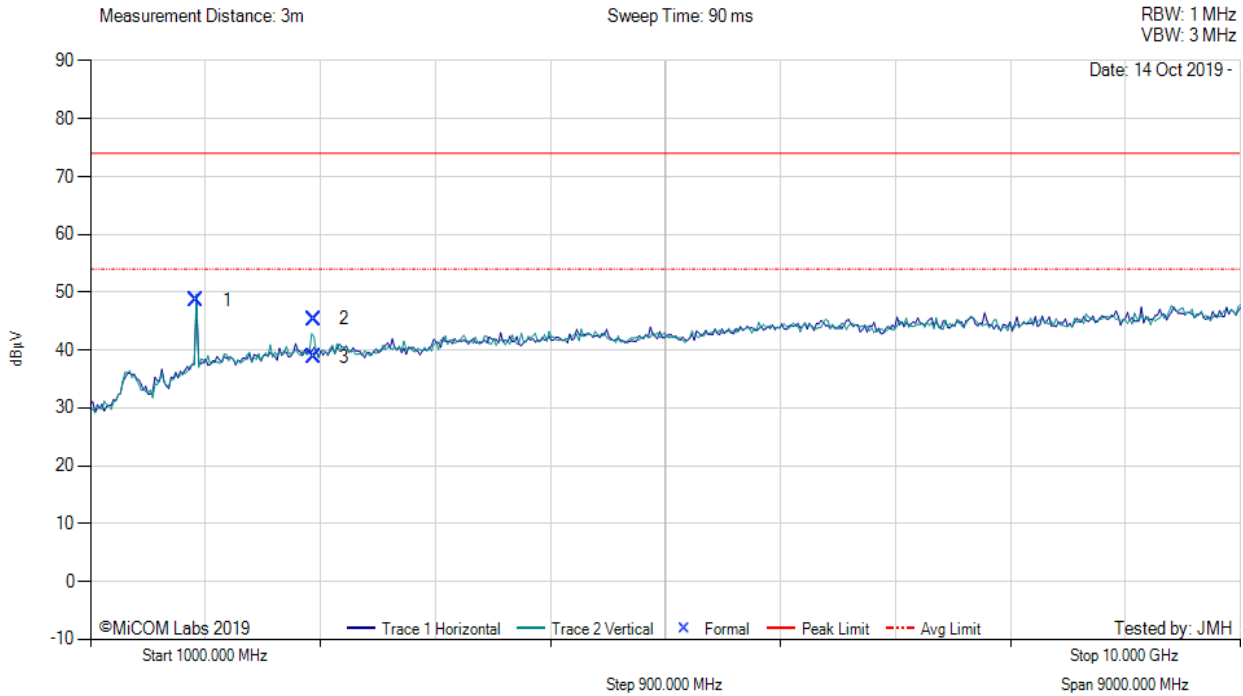
Test Notes: EUT powered by AC/DC PS, connected thru Mux to antenna. Controller powered by 12V GPIO

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TX SPURIOUS & RESTRICTED BAND EMISSIONS

Variant: PR-ASK, Test Freq: 915.25 MHz, Antenna: Broadradio ALR-0501, Power Setting: Max, Duty Cycle (%): 100



| 1000.00 - 10000.00 MHz | | | | | | | | | | | | |
|------------------------|---------------|----------|---------------|---------|--------------|------------------|----------|--------|---------|--------------|-----------|------------|
| Num | Frequency MHz | Raw dBµV | Cable Loss dB | AF dB/m | Level dBµV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBµV/m | Margin dB | Pass /Fail |
| 1 | 1830.49 | 60.93 | 1.76 | -14.14 | 48.55 | Peak (NRB) | Vertical | 101 | 34 | -- | -- | Pass |
| 2 | 2745.67 | 55.11 | 2.16 | -11.90 | 45.37 | Max Peak | Vertical | 107 | 207 | 74.0 | -28.6 | Pass |
| 3 | 2745.67 | 48.60 | 2.16 | -11.90 | 38.86 | Max Avg | Vertical | 107 | 207 | 54.0 | -15.1 | Pass |

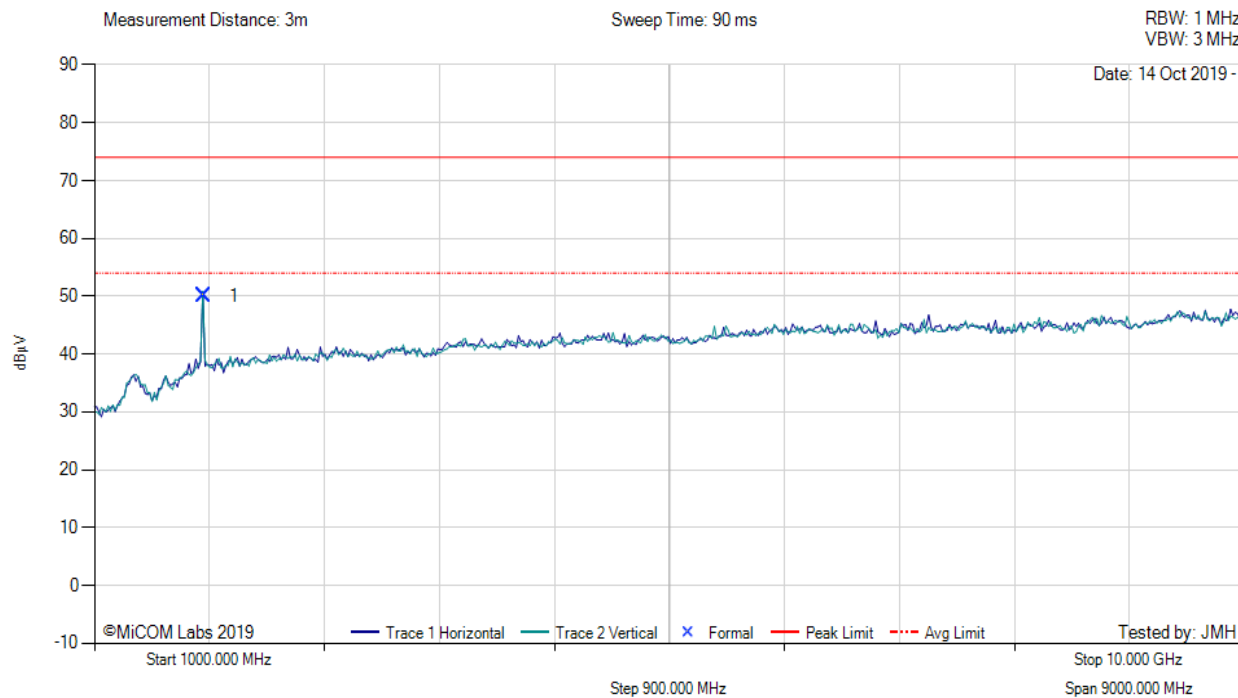
Test Notes: EUT powered by AC/DC PS, connected thru Mux to antenna. Controller powered by 12V GPIO

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TX SPURIOUS & RESTRICTED BAND EMISSIONS

Variant: PR-ASK, Test Freq: 927.25 MHz, Antenna: Broadradio ALR-0501, Power Setting: Max, Duty Cycle (%): 100



| 1000.00 - 10000.00 MHz | | | | | | | | | | | | |
|------------------------|---------------|----------|---------------|---------|--------------|------------------|----------|--------|---------|--------------|-----------|------------|
| Num | Frequency MHz | Raw dBµV | Cable Loss dB | AF dB/m | Level dBµV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBµV/m | Margin dB | Pass /Fail |
| 1 | 1854.58 | 62.34 | 1.77 | -14.08 | 50.03 | Peak (NRB) | Vertical | 177 | 0 | -- | -- | Pass |

Test Notes: EUT powered by AC/DC PS, connected thru Mux to antenna. Controller powered by 12V GPIO

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Antenna ALR-8698

TX SPURIOUS & RESTRICTED BAND EMISSIONS

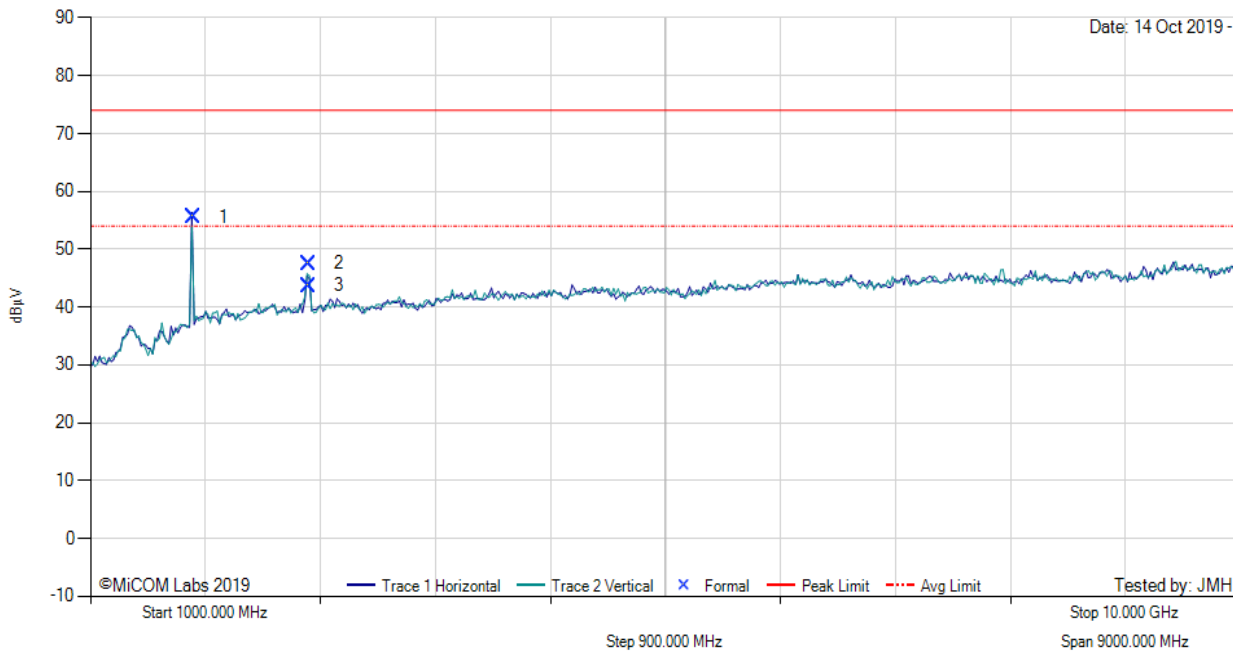


Variant: PR-ASK, Test Freq: 902.75 MHz, Antenna: Alien Technology ALR-8698, Power Setting: Max, Duty Cycle (%): 100

Measurement Distance: 3m

Sweep Time: 90 ms

RBW: 1 MHz
VBW: 3 MHz



| 1000.00 - 10000.00 MHz | | | | | | | | | | | | |
|------------------------|---------------|----------|---------------|---------|--------------|------------------|------------|--------|---------|--------------|-----------|------------|
| Num | Frequency MHz | Raw dBµV | Cable Loss dB | AF dB/m | Level dBµV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBµV/m | Margin dB | Pass /Fail |
| 1 | 1805.44 | 68.25 | 1.75 | -14.50 | 55.50 | Peak (NRB) | Horizontal | 100 | 45 | -- | -- | Pass |
| 2 | 2708.11 | 57.51 | 2.13 | -12.15 | 47.49 | Max Peak | Vertical | 151 | 2 | 74.0 | -26.5 | Pass |
| 3 | 2708.11 | 53.73 | 2.13 | -12.15 | 43.71 | Max Avg | Vertical | 151 | 2 | 54.0 | -10.3 | Pass |

Test Notes: EUT powered by AC/DC Adapter, antenna connected thru Mux, Controller powered by 12V GPIO

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TX SPURIOUS & RESTRICTED BAND EMISSIONS

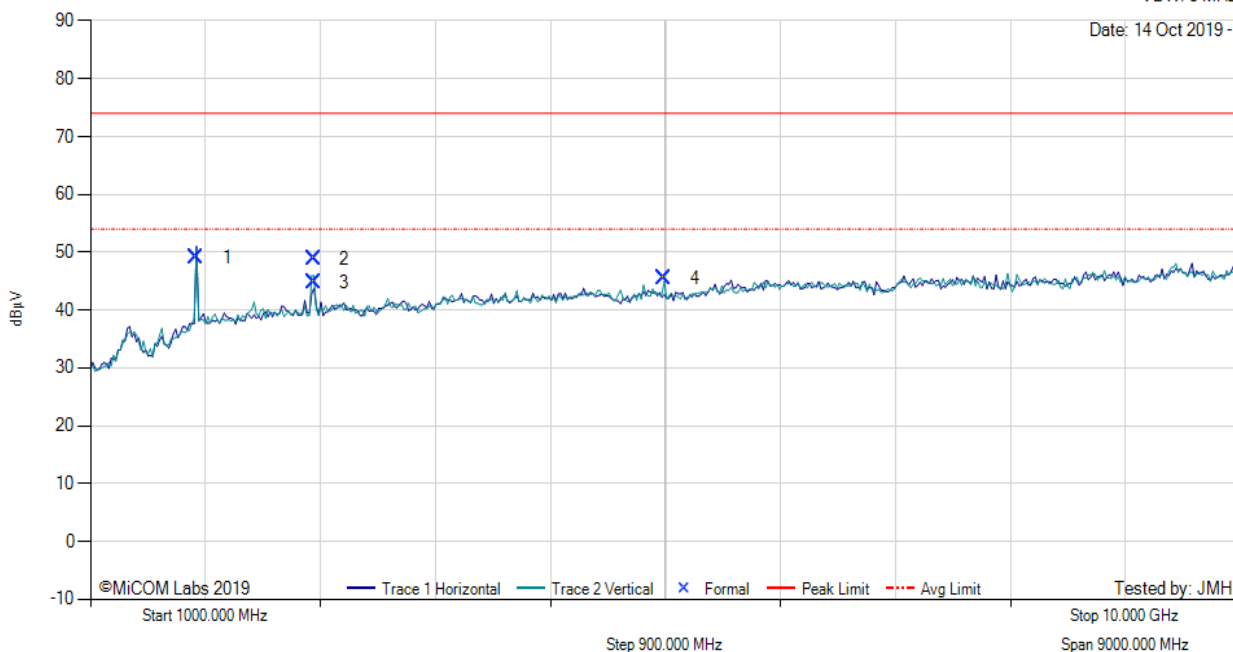


Variant: PR-ASK, Test Freq: 915.25 MHz, Antenna: Alien Technology ALR-8698, Power Setting: Max, Duty Cycle (%): 100

Measurement Distance: 3m

Sweep Time: 90 ms

RBW: 1 MHz
VBW: 3 MHz



| 1000.00 - 10000.00 MHz | | | | | | | | | | | | |
|------------------------|---------------|----------|---------------|---------|--------------|------------------|------------|--------|---------|--------------|-----------|------------|
| Num | Frequency MHz | Raw dBµV | Cable Loss dB | AF dB/m | Level dBµV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBµV/m | Margin dB | Pass /Fail |
| 1 | 1830.57 | 61.50 | 1.76 | -14.14 | 49.12 | Peak (NRB) | Horizontal | 100 | 31 | -- | -- | Pass |
| 2 | 2745.75 | 58.63 | 2.16 | -11.90 | 48.89 | Max Peak | Vertical | 108 | 356 | 74.0 | -25.1 | Pass |
| 3 | 2745.75 | 54.58 | 2.16 | -11.90 | 44.84 | Max Avg | Vertical | 108 | 356 | 54.0 | -9.2 | Pass |
| 4 | 5491.49 | 54.11 | 3.12 | -11.67 | 45.56 | Peak (NRB) | Vertical | 100 | 31 | -- | -- | Pass |

Test Notes: EUT powered by AC/DC PS, connected thru Mux to antenna. Controller powered by 12V GPIO

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TX SPURIOUS & RESTRICTED BAND EMISSIONS

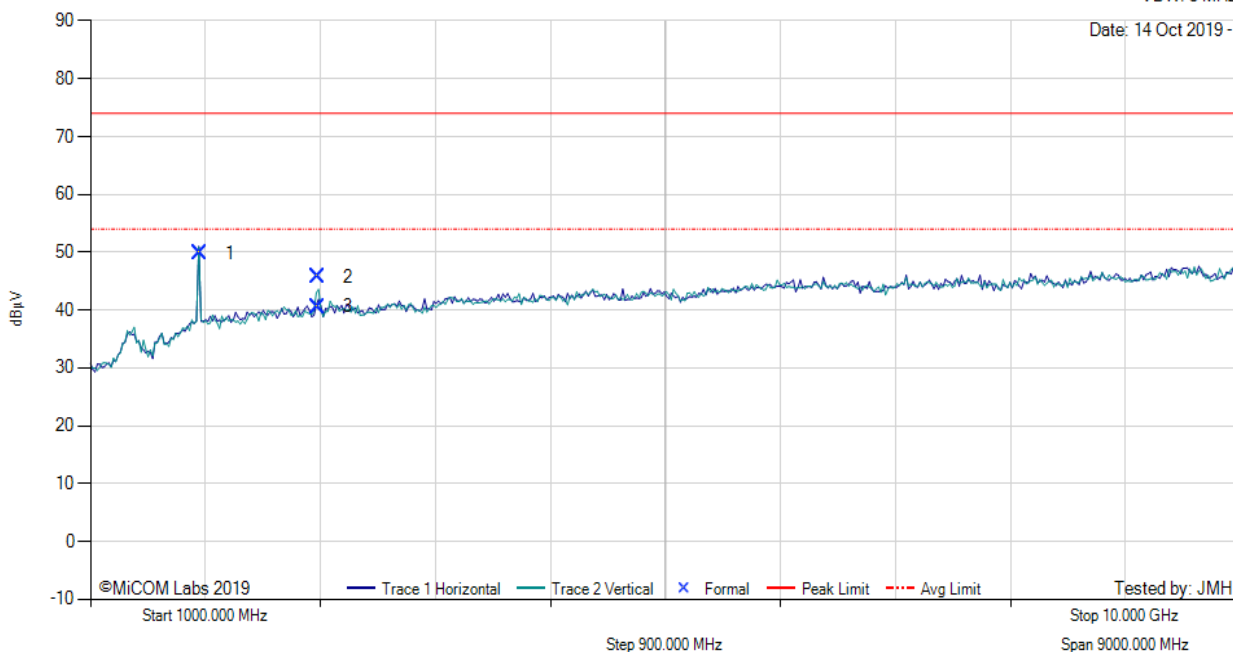


Variant: PR-ASK, Test Freq: 927.25 MHz, Antenna: Alien Technology ALR-8698, Power Setting: Max, Duty Cycle (%): 100

Measurement Distance: 3m

Sweep Time: 90 ms

RBW: 1 MHz
VBW: 3 MHz



| 1000.00 - 10000.00 MHz | | | | | | | | | | | | |
|------------------------|---------------|----------|---------------|---------|--------------|------------------|------------|--------|---------|--------------|-----------|------------|
| Num | Frequency MHz | Raw dBµV | Cable Loss dB | AF dB/m | Level dBµV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBµV/m | Margin dB | Pass /Fail |
| 1 | 1854.58 | 62.17 | 1.77 | -14.08 | 49.86 | Peak (NRB) | Horizontal | 151 | 0 | -- | -- | Pass |
| 2 | 2781.81 | 55.52 | 2.16 | -12.01 | 45.67 | Max Peak | Vertical | 120 | 358 | 74.0 | -28.3 | Pass |
| 3 | 2781.81 | 50.43 | 2.16 | -12.01 | 40.58 | Max Avg | Vertical | 120 | 358 | 54.0 | -13.4 | Pass |

Test Notes: EUT powered by AC/DC PS, connected thru Mux to antenna. Controller powered by 12V GPIO

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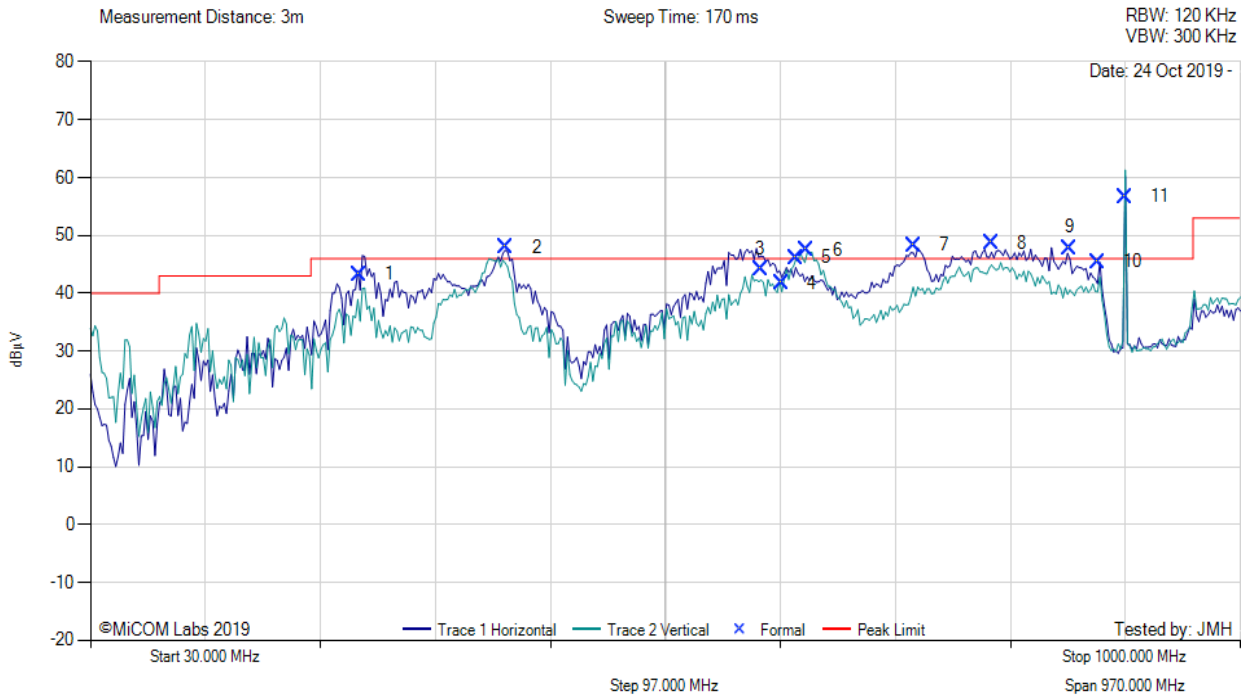
A.5.1.4. Radiated Emissions Below 1 Ghz

Antenna ALR-0501



RADIATED DIGITAL EMISSIONS

Variant: PR-ASK, Test Freq: 902.75 MHz, Antenna: Broadradio ALR-0501, Power Setting: Max, Duty Cycle (%): 100



| 30.00 - 1000.00 MHz | | | | | | | | | | | | |
|---------------------|---------------|----------|---------------|---------|--------------|------------------|------------|--------|---------|--------------|-----------|------------|
| Num | Frequency MHz | Raw dBµV | Cable Loss dB | AF dB/m | Level dBµV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBµV/m | Margin dB | Pass /Fail |
| 1 | 256.41 | 54.58 | 4.75 | -16.04 | 43.29 | MaxQP | Horizontal | 105 | 194 | 46.0 | -2.7 | Pass |
| 2 | 380.81 | 55.35 | 5.19 | -12.52 | 48.01 | Peak (NRB) | Horizontal | 100 | 15 | -- | -- | Pass |
| 3 | 595.24 | 46.95 | 5.82 | -8.64 | 44.12 | Peak (NRB) | Horizontal | 100 | 353 | -- | -- | Pass |
| 4 | 613.25 | 44.13 | 5.82 | -8.21 | 41.74 | MaxQP | Vertical | 126 | 223 | 46.0 | -4.3 | Pass |
| 5 | 625.27 | 48.37 | 5.82 | -8.07 | 46.12 | Peak (NRB) | Vertical | 100 | 360 | -- | -- | Pass |
| 6 | 634.31 | 49.21 | 5.82 | -7.52 | 47.51 | Peak (NRB) | Vertical | 100 | 360 | -- | -- | Pass |
| 7 | 724.27 | 48.92 | 6.27 | -6.86 | 48.33 | Peak (NRB) | Horizontal | 100 | 177 | -- | -- | Pass |
| 8 | 790.24 | 48.13 | 6.46 | -5.98 | 48.61 | Peak (NRB) | Horizontal | 100 | 177 | -- | -- | Pass |
| 9 | 856.20 | 46.60 | 6.64 | -5.42 | 47.82 | Peak (NRB) | Horizontal | 100 | 338 | -- | -- | Pass |
| 10 | 880.02 | 43.91 | 6.73 | -5.19 | 45.45 | Peak (NRB) | Horizontal | 100 | 338 | -- | -- | Pass |
| 11 | 902.75 | 54.88 | 6.76 | -4.93 | 56.71 | Fundamental | Vertical | 100 | 0 | -- | -- | |

Test Notes: EUT powered by AC/DC PS, connected thru Mux to antenna. Controller powered by GPIO. Added Ground. 900 MHz notch in front of amp to prevent overloads. 256 MHz is digital emissions

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RADIATED DIGITAL EMISSIONS

Variant: PR-ASK, Test Freq: 915.25 MHz, Antenna: Broadradio ALR-0501, Power Setting: Max, Duty Cycle (%): 100



| 30.00 - 1000.00 MHz | | | | | | | | | | | | |
|---------------------|---------------|----------|---------------|---------|--------------|------------------|------------|--------|---------|--------------|-----------|------------|
| Num | Frequency MHz | Raw dBµV | Cable Loss dB | AF dB/m | Level dBµV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBµV/m | Margin dB | Pass /Fail |
| 1 | 259.40 | 56.85 | 4.76 | -15.73 | 45.88 | MaxQP | Horizontal | 99 | 191 | 46.0 | -0.1 | Pass |
| 2 | 368.80 | 50.75 | 5.15 | -12.58 | 43.32 | Peak (NRB) | Vertical | 100 | 303 | -- | -- | Pass |
| 3 | 374.80 | 52.77 | 5.17 | -12.65 | 45.29 | Peak (NRB) | Horizontal | 100 | 203 | -- | -- | Pass |
| 4 | 584.71 | 45.74 | 5.82 | -8.70 | 42.86 | Peak (NRB) | Horizontal | 100 | 346 | -- | -- | Pass |
| 5 | 611.71 | 47.67 | 5.82 | -8.25 | 45.24 | MaxQP | Horizontal | 132 | 130 | 46.0 | -0.8 | Pass |
| 6 | 631.19 | 49.00 | 5.82 | -7.69 | 47.13 | Peak (NRB) | Vertical | 100 | 203 | -- | -- | Pass |
| 7 | 640.30 | 48.14 | 5.82 | -7.66 | 46.30 | Peak (NRB) | Vertical | 100 | 203 | -- | -- | Pass |
| 8 | 724.28 | 48.62 | 6.27 | -6.86 | 48.03 | Peak (NRB) | Horizontal | 100 | 1 | -- | -- | Pass |
| 9 | 764.56 | 48.43 | 6.39 | -6.29 | 48.53 | Peak (NRB) | Horizontal | 100 | 1 | -- | -- | Pass |
| 10 | 793.29 | 48.61 | 6.46 | -5.98 | 49.09 | Peak (NRB) | Horizontal | 100 | 1 | -- | -- | Pass |
| 11 | 814.43 | 46.35 | 6.52 | -5.54 | 47.33 | Peak (NRB) | Horizontal | 100 | 1 | -- | -- | Pass |
| 12 | 915.25 | 46.58 | 6.80 | -4.66 | 48.73 | Fundamental | Vertical | 100 | 0 | -- | -- | |

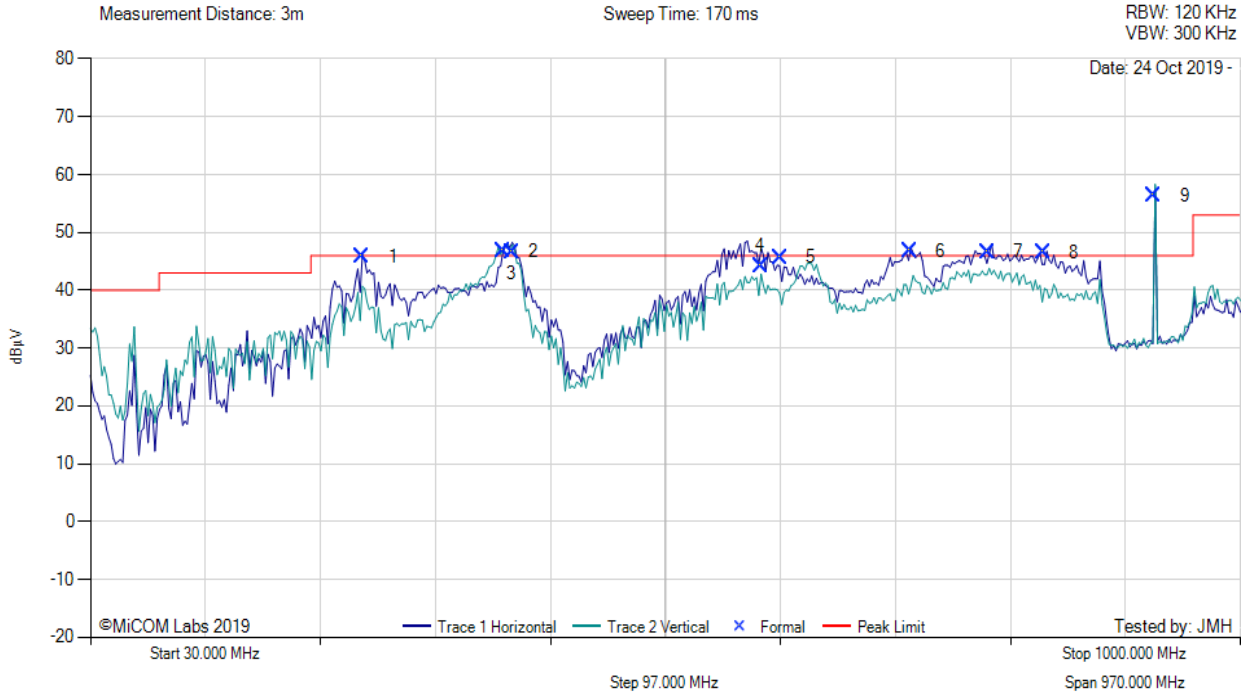
Test Notes: EUT powered by AC/DC PS, connected thru Mux to antenna. Controller powered by GPIO. Added Ground. 900 MHz notch in front of amp to prevent overloads. 259 MHz is digital emissions

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RADIATED DIGITAL EMISSIONS

Variant: PR-ASK, Test Freq: 927.25 MHz, Antenna: Broadradio ALR-0501, Power Setting: Max, Duty Cycle (%): 100



| 30.00 - 1000.00 MHz | | | | | | | | | | | | |
|---------------------|---------------|----------|---------------|---------|--------------|------------------|------------|--------|---------|--------------|-----------|------------|
| Num | Frequency MHz | Raw dBµV | Cable Loss dB | AF dB/m | Level dBµV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBµV/m | Margin dB | Pass /Fail |
| 1 | 259.39 | 56.74 | 4.76 | -15.73 | 45.77 | MaxQP | Horizontal | 98 | 184 | 46.0 | -0.2 | Pass |
| 2 | 377.83 | 54.13 | 5.18 | -12.55 | 46.76 | Peak (NRB) | Vertical | 100 | 253 | -- | -- | Pass |
| 3 | 385.35 | 53.90 | 5.21 | -12.57 | 46.53 | Peak (NRB) | Horizontal | 100 | 278 | -- | -- | Pass |
| 4 | 595.31 | 46.99 | 5.82 | -8.64 | 44.17 | Peak (NRB) | Horizontal | 100 | 5 | -- | -- | Pass |
| 5 | 611.73 | 48.11 | 5.82 | -8.25 | 45.68 | MaxQP | Horizontal | 131 | 114 | 46.0 | -0.3 | Pass |
| 6 | 721.01 | 47.43 | 6.25 | -6.90 | 46.78 | Peak (NRB) | Horizontal | 100 | 205 | -- | -- | Pass |
| 7 | 787.07 | 46.15 | 6.45 | -5.99 | 46.61 | Peak (NRB) | Horizontal | 100 | 205 | -- | -- | Pass |
| 8 | 833.64 | 45.25 | 6.58 | -5.37 | 46.45 | Peak (NRB) | Horizontal | 100 | 346 | -- | -- | Pass |
| 9 | 927.26 | 54.11 | 6.82 | -4.58 | 56.35 | Fundamental | Vertical | 100 | 0 | -- | -- | |

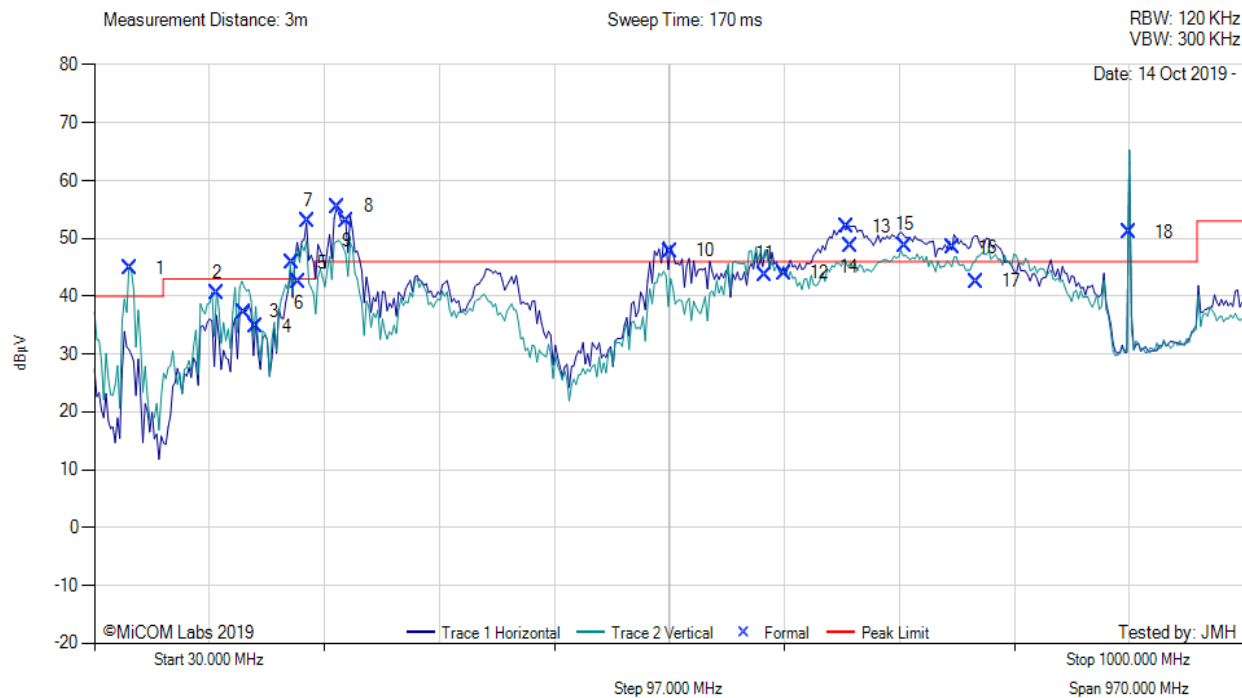
Test Notes: EUT powered by AC/DC PS, connected thru Mux to antenna. Controller powered by GPIO. Added Ground. 900 MHz notch in front of amp to prevent overloads. 259 MHz is digital emissions

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RADIATED DIGITAL EMISSIONS

Variant: PR-ASK, Test Freq: 902.75 MHz, Antenna: Broadradio ALR-0501, Power Setting: Max, Duty Cycle (%): 100



| 30.00 - 1000.00 MHz | | | | | | | | | | | | |
|---------------------|---------------|----------|---------------|---------|--------------|------------------|------------|--------|---------|--------------|-----------|------------|
| Num | Frequency MHz | Raw dBµV | Cable Loss dB | AF dB/m | Level dBµV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBµV/m | Margin dB | Pass /Fail |
| 1 | 59.98 | 61.95 | 3.80 | -20.97 | 44.77 | Peak (NRB) | Vertical | 100 | 216 | -- | -- | Pass |
| 2 | 133.45 | 51.10 | 4.23 | -14.82 | 40.51 | MaxQP | Vertical | 100 | 276 | 43.0 | -2.5 | Pass |
| 3 | 155.93 | 49.01 | 4.34 | -16.02 | 37.33 | Peak (NRB) | Vertical | 100 | 182 | -- | -- | Pass |
| 4 | 166.48 | 46.71 | 4.39 | -16.34 | 34.76 | MaxQP | Vertical | 98 | 276 | 43.0 | -8.2 | Pass |
| 5 | 196.42 | 57.15 | 4.52 | -15.84 | 45.83 | Peak (NRB) | Vertical | 100 | 182 | -- | -- | Pass |
| 6 | 202.43 | 53.61 | 4.54 | -15.77 | 42.39 | Peak (NRB) | Horizontal | 100 | 182 | -- | -- | Pass |
| 7 | 235.42 | 67.22 | 4.67 | -16.38 | 55.51 | Peak (NRB) | Horizontal | 100 | 216 | -- | -- | Pass |
| 8 | 242.89 | 64.57 | 4.71 | -16.20 | 53.08 | Digital | Horizontal | 128 | 200 | 46.0 | -- | -- |
| 9 | 515.82 | 52.17 | 5.64 | -9.99 | 47.83 | Peak (NRB) | Horizontal | 100 | 182 | -- | -- | Pass |
| 10 | 595.21 | 46.59 | 5.82 | -8.64 | 43.77 | Peak (NRB) | Vertical | 100 | 182 | -- | -- | Pass |
| 11 | 611.72 | 46.47 | 5.82 | -8.25 | 44.04 | MaxQP | Horizontal | 101 | 216 | 46.0 | -2.0 | Pass |
| 12 | 664.25 | 53.77 | 5.82 | -7.58 | 52.00 | Peak (NRB) | Horizontal | 100 | 182 | -- | -- | Pass |
| 13 | 667.19 | 50.49 | 5.82 | -7.58 | 48.73 | Peak (NRB) | Horizontal | 100 | 216 | -- | -- | Pass |
| 14 | 713.66 | 49.59 | 6.24 | -7.00 | 48.82 | Peak (NRB) | Horizontal | 100 | 182 | -- | -- | Pass |
| 15 | 773.67 | 42.41 | 6.41 | -6.24 | 42.58 | Peak (NRB) | Horizontal | 100 | 182 | -- | -- | Pass |
| 18 | 902.76 | 49.31 | 6.76 | -4.93 | 51.14 | Fundamental | Horizontal | 100 | 268 | -- | -- | |

Test Notes: EUT powered by AC/DC PS, connected thru Mux to antenna. Controller powered by 5V USB, 242 MHz signal is digital



RADIATED DIGITAL EMISSIONS

Variant: PR-ASK, Test Freq: 915.25 MHz, Antenna: Broadradio ALR-0501, Power Setting: Max, Duty Cycle (%): 100



| 30.00 - 1000.00 MHz | | | | | | | | | | | | |
|---------------------|---------------|----------|---------------|---------|--------------|------------------|------------|--------|---------|--------------|-----------|------------|
| Num | Frequency MHz | Raw dBµV | Cable Loss dB | AF dB/m | Level dBµV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBµV/m | Margin dB | Pass /Fail |
| 1 | 59.99 | 61.79 | 3.80 | -20.97 | 44.62 | Peak (NRB) | Vertical | 100 | 216 | -- | -- | Pass |
| 2 | 133.45 | 50.90 | 4.23 | -14.82 | 40.31 | MaxQP | Vertical | 100 | 281 | 43.0 | -2.7 | Pass |
| 3 | 155.94 | 54.10 | 4.34 | -16.02 | 42.43 | Peak (NRB) | Vertical | 100 | 141 | -- | -- | Pass |
| 4 | 166.42 | 50.27 | 4.39 | -16.34 | 38.32 | MaxQP | Vertical | 100 | 284 | 43.0 | -4.7 | Pass |
| 5 | 196.40 | 54.06 | 4.52 | -15.84 | 42.74 | Peak (NRB) | Vertical | 100 | 305 | -- | -- | Pass |
| 6 | 209.89 | 58.18 | 4.56 | -17.31 | 45.43 | Peak (NRB) | Horizontal | 100 | 286 | -- | -- | Pass |
| 7 | 235.38 | 67.02 | 4.67 | -16.38 | 55.31 | Peak (NRB) | Horizontal | 100 | 216 | -- | -- | Pass |
| 8 | 242.88 | 65.06 | 4.71 | -16.20 | 53.57 | Digital | Horizontal | 122 | 203 | 46.0 | -- | -- |
| 9 | 509.65 | 48.83 | 5.61 | -10.00 | 44.44 | Peak (NRB) | Horizontal | 100 | 305 | -- | -- | Pass |
| 10 | 595.21 | 52.04 | 5.82 | -8.64 | 49.22 | Peak (NRB) | Vertical | 100 | 164 | -- | -- | Pass |
| 11 | 668.74 | 50.16 | 5.82 | -7.58 | 48.39 | Peak (NRB) | Horizontal | 100 | 216 | -- | -- | Pass |
| 12 | 784.17 | 48.86 | 6.44 | -6.04 | 49.26 | Peak (NRB) | Horizontal | 100 | 264 | -- | -- | Pass |
| 13 | 915.26 | 42.95 | 6.80 | -4.66 | 45.10 | Fundamental | Vertical | 100 | 286 | -- | -- | |

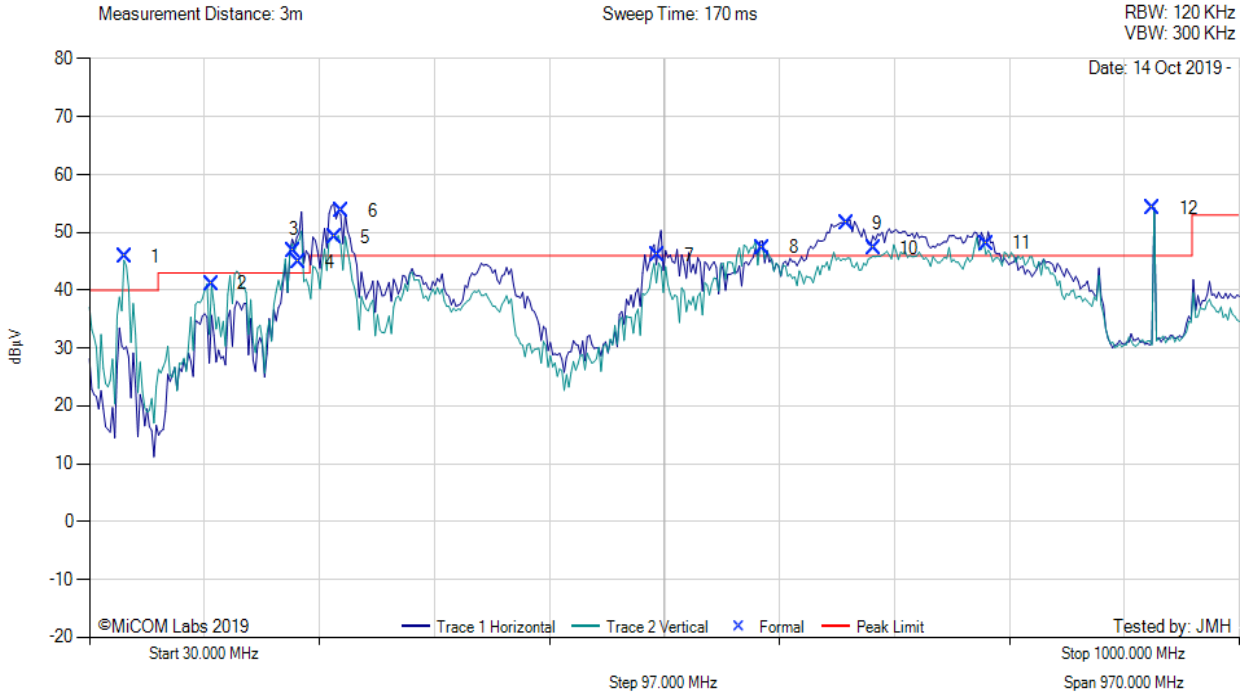
Test Notes: EUT powered by AC/DC PS, connected thru Mux to antenna. Controller powered by 5V USB. 242 MHz is digital emission

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RADIATED DIGITAL EMISSIONS

Variant: PR-ASK, Test Freq: 927.25 MHz, Antenna: Broadradio ALR-0501, Power Setting: Max, Duty Cycle (%): 100



| 30.00 - 1000.00 MHz | | | | | | | | | | | | |
|---------------------|---------------|----------|---------------|---------|--------------|------------------|------------|--------|---------|--------------|-----------|------------|
| Num | Frequency MHz | Raw dBµV | Cable Loss dB | AF dB/m | Level dBµV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBµV/m | Margin dB | Pass /Fail |
| 1 | 59.97 | 62.91 | 3.80 | -20.97 | 45.74 | Peak (NRB) | Vertical | 100 | 270 | -- | -- | Pass |
| 2 | 133.44 | 51.72 | 4.23 | -14.82 | 41.13 | MaxQP | Vertical | 98 | 274 | 43.0 | -1.9 | Pass |
| 3 | 202.40 | 58.11 | 4.54 | -15.77 | 46.89 | Peak (NRB) | Horizontal | 100 | 270 | -- | -- | Pass |
| 4 | 206.90 | 57.50 | 4.55 | -17.17 | 44.88 | Peak (NRB) | Horizontal | 100 | 0 | -- | -- | Pass |
| 5 | 236.85 | 60.69 | 4.68 | -16.28 | 49.09 | Peak (NRB) | Horizontal | 100 | 84 | -- | -- | Pass |
| 6 | 242.90 | 65.13 | 4.71 | -16.20 | 53.64 | Digital | Horizontal | 119 | 199 | 46.0 | -- | |
| 7 | 509.77 | 50.46 | 5.61 | -10.00 | 46.07 | Peak (NRB) | Horizontal | 100 | 270 | -- | -- | Pass |
| 8 | 598.22 | 50.12 | 5.82 | -8.55 | 47.39 | Peak (NRB) | Horizontal | 100 | 270 | -- | -- | Pass |
| 9 | 668.71 | 53.24 | 5.82 | -7.58 | 51.47 | Peak (NRB) | Horizontal | 100 | 172 | -- | -- | Pass |
| 10 | 691.24 | 48.37 | 6.17 | -7.37 | 47.17 | Peak (NRB) | Horizontal | 100 | 270 | -- | -- | Pass |
| 11 | 787.09 | 47.62 | 6.45 | -5.99 | 48.08 | Peak (NRB) | Horizontal | 100 | 270 | -- | -- | Pass |
| 12 | 927.26 | 51.93 | 6.82 | -4.58 | 54.17 | Fundamental | Horizontal | 100 | 0 | -- | -- | |

Test Notes: EUT powered by AC/DC PS, connected thru Mux to antenna. Controller powered by 5V USB. 242 MHz is digital emission

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Antenna ALR-8698

RADIATED DIGITAL EMISSIONS

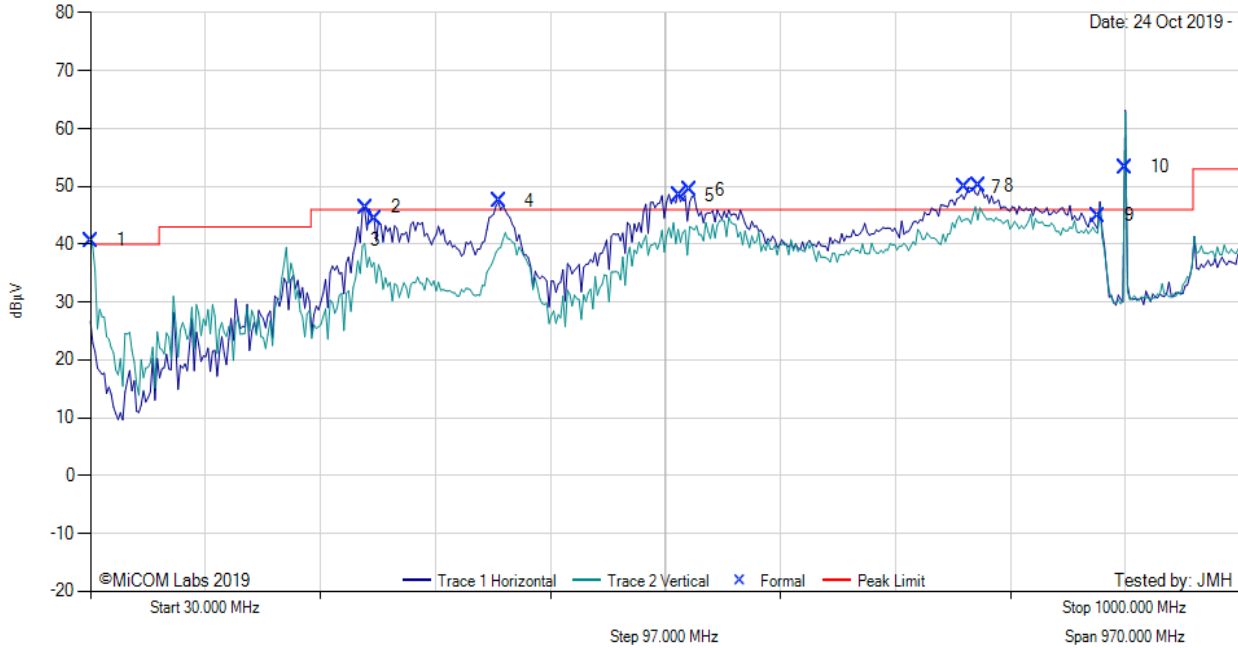


Variant: PR-ASK, Test Freq: 902.75 MHz, Antenna: Alien Technology ALR-8698, Power Setting: Max, Duty Cycle (%): 100

Measurement Distance: 3m

Sweep Time: 170 ms

RBW: 120 KHz
VBW: 300 KHz



30.00 - 1000.00 MHz

| Num | Frequency MHz | Raw dBµV | Cable Loss dB | AF dB/m | Level dBµV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBµV/m | Margin dB | Pass /Fail |
|-----|---------------|----------|---------------|---------|--------------|------------------|------------|--------|---------|--------------|-----------|------------|
| 1 | 30.00 | 44.32 | 3.52 | -7.20 | 40.64 | Peak (NRB) | Vertical | 100 | 0 | -- | -- | Pass |
| 2 | 262.38 | 56.95 | 4.77 | -15.35 | 46.37 | MaxQP | Horizontal | 126 | 153 | 46.0 | -- | -- |
| 3 | 269.88 | 54.26 | 4.80 | -14.73 | 44.33 | MaxQP | Horizontal | 106 | 157 | 46.0 | -1.7 | Pass |
| 4 | 374.83 | 55.00 | 5.17 | -12.65 | 47.52 | Peak (NRB) | Horizontal | 100 | 16 | -- | -- | Pass |
| 5 | 526.26 | 52.33 | 5.66 | -9.56 | 48.43 | Peak (NRB) | Horizontal | 100 | 16 | -- | -- | Pass |
| 6 | 535.23 | 53.01 | 5.69 | -9.34 | 49.36 | Peak (NRB) | Horizontal | 100 | 16 | -- | -- | Pass |
| 7 | 767.68 | 49.68 | 6.40 | -6.25 | 49.83 | Peak (NRB) | Horizontal | 100 | 355 | -- | -- | Pass |
| 8 | 779.46 | 49.76 | 6.43 | -6.09 | 50.10 | Peak (NRB) | Horizontal | 100 | 355 | -- | -- | Pass |
| 9 | 880.18 | 43.38 | 6.73 | -5.19 | 44.92 | Peak (NRB) | Horizontal | 100 | 355 | -- | -- | Pass |
| 10 | 902.76 | 51.55 | 6.76 | -4.93 | 53.38 | Fundamental | Horizontal | 100 | 0 | -- | -- | |

Test Notes: EUT powered by AC/DC PS, connected thru Mux to antenna. Controller powered by 12V Added Ground. 900 MHz notch in front of amp to prevent overloads. 262 and 269 are digital emissions

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RADIATED DIGITAL EMISSIONS



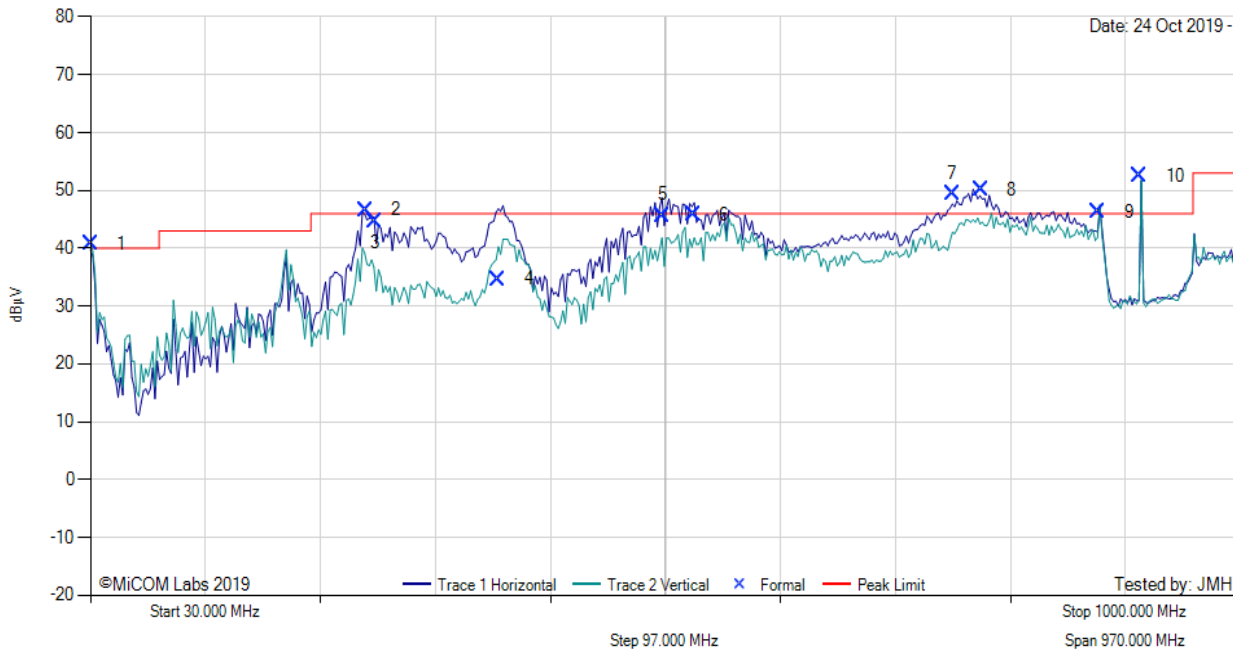
Variant: PR-ASK, Test Freq: 915.25 MHz, Antenna: Alien Technology ALR-8698, Power Setting: Max, Duty Cycle (%): 100

Measurement Distance: 3m

Sweep Time: 170 ms

RBW: 120 KHz
VBW: 300 KHz

Date: 24 Oct 2019 -



| 30.00 - 1000.00 MHz | | | | | | | | | | | | |
|---------------------|---------------|----------|---------------|---------|--------------|------------------|------------|--------|---------|--------------|-----------|-----------|
| Num | Frequency MHz | Raw dBµV | Cable Loss dB | AF dB/m | Level dBµV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBµV/m | Margin dB | Pass/Fail |
| 1 | 30.00 | 44.47 | 3.52 | -7.20 | 40.79 | Peak (NRB) | Vertical | 100 | 0 | -- | -- | Pass |
| 2 | 262.37 | 57.21 | 4.77 | -15.35 | 46.63 | Digital | Horizontal | 120 | 163 | 46.0 | -- | -- |
| 3 | 269.89 | 54.49 | 4.80 | -14.73 | 44.56 | MaxQP | Horizontal | 112 | 158 | 46.0 | -1.4 | Pass |
| 4 | 374.07 | 42.17 | 5.17 | -12.65 | 34.69 | Peak (NRB) | Horizontal | 100 | 359 | -- | -- | Pass |
| 5 | 512.74 | 50.03 | 5.62 | -10.01 | 45.64 | Peak (NRB) | Horizontal | 100 | 359 | -- | -- | Pass |
| 6 | 538.25 | 49.41 | 5.70 | -9.36 | 45.75 | Peak (NRB) | Horizontal | 100 | 359 | -- | -- | Pass |
| 7 | 757.04 | 49.44 | 6.36 | -6.41 | 49.39 | Peak (NRB) | Horizontal | 100 | 10 | -- | -- | Pass |
| 8 | 781.11 | 49.65 | 6.44 | -6.02 | 50.07 | Peak (NRB) | Horizontal | 100 | 10 | -- | -- | Pass |
| 9 | 880.26 | 44.69 | 6.73 | -5.19 | 46.23 | Peak (NRB) | Horizontal | 100 | 10 | -- | -- | Pass |
| 10 | 915.25 | 50.30 | 6.80 | -4.66 | 52.45 | Fundamental | Vertical | 100 | 0 | -- | -- | |

Test Notes: EUT powered by AC/DC PS, connected thru Mux to antenna. Controller powered by 12V. Added Ground. 900 MHz notch in front of amp to prevent overloads. 262 and 269 MHz are digital emissions

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RADIATED DIGITAL EMISSIONS

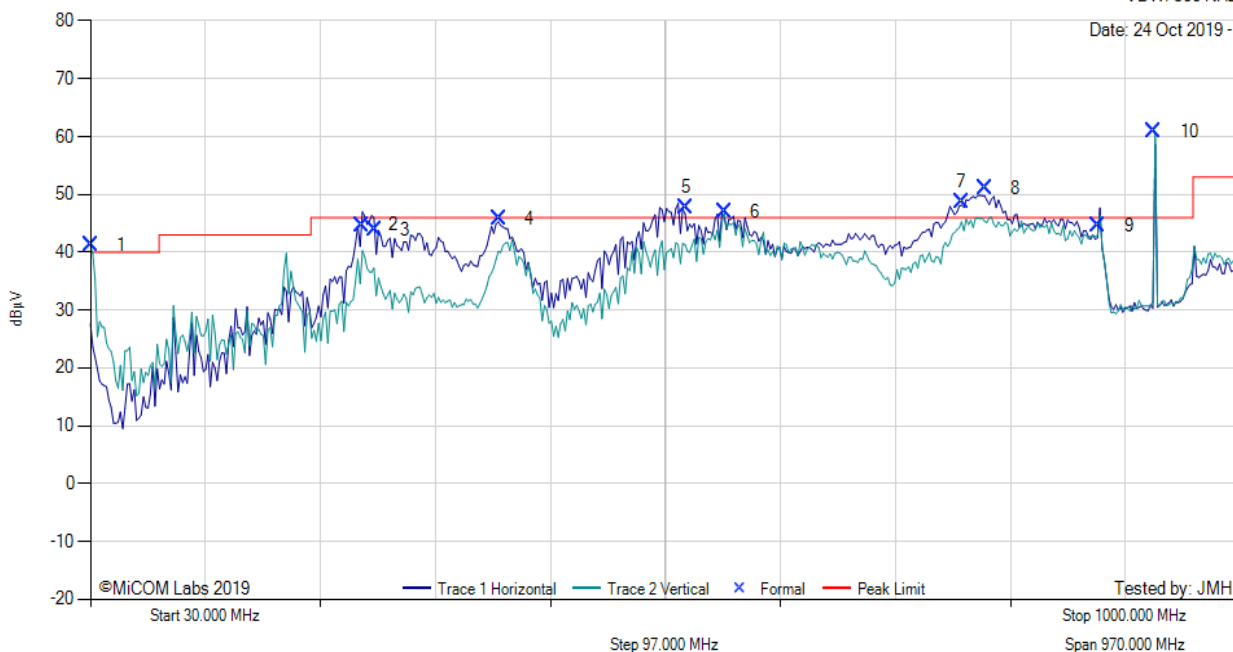


Variant: PR-ASK, Test Freq: 927.25 MHz, Antenna: Alien Technology ALR-8698, Power Setting: Max, Duty Cycle (%): 100

Measurement Distance: 3m

Sweep Time: 170 ms

RBW: 120 KHz
VBW: 300 KHz



| 30.00 - 1000.00 MHz | | | | | | | | | | | | |
|---------------------|---------------|----------|---------------|---------|--------------|------------------|------------|--------|---------|--------------|-----------|-----------|
| Num | Frequency MHz | Raw dBµV | Cable Loss dB | AF dB/m | Level dBµV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBµV/m | Margin dB | Pass/Fail |
| 1 | 30.00 | 44.89 | 3.52 | -7.20 | 41.21 | Peak (NRB) | Vertical | 100 | 360 | -- | -- | Pass |
| 2 | 259.43 | 55.70 | 4.76 | -15.73 | 44.73 | MaxQP | Horizontal | 129 | 276 | 46.0 | -1.3 | Pass |
| 3 | 269.91 | 53.81 | 4.80 | -14.73 | 43.88 | MaxQP | Horizontal | 101 | 146 | 46.0 | -2.1 | Pass |
| 4 | 374.90 | 53.35 | 5.17 | -12.65 | 45.87 | Peak (NRB) | Horizontal | 100 | 360 | -- | -- | Pass |
| 5 | 532.25 | 51.49 | 5.68 | -9.41 | 47.76 | Peak (NRB) | Horizontal | 100 | 360 | -- | -- | Pass |
| 6 | 565.22 | 50.08 | 5.79 | -8.88 | 46.99 | Peak (NRB) | Horizontal | 100 | 145 | -- | -- | Pass |
| 7 | 764.79 | 48.51 | 6.39 | -6.29 | 48.61 | Peak (NRB) | Horizontal | 100 | 357 | -- | -- | Pass |
| 8 | 784.23 | 50.73 | 6.44 | -6.04 | 51.13 | Peak (NRB) | Horizontal | 100 | 357 | -- | -- | Pass |
| 9 | 880.10 | 43.08 | 6.73 | -5.19 | 44.62 | Peak (NRB) | Horizontal | 100 | 256 | -- | -- | Pass |
| 10 | 927.26 | 58.65 | 6.82 | -4.58 | 60.89 | Fundamental | Vertical | 100 | 0 | -- | -- | |

Test Notes: EUT powered by AC/DC PS, connected thru Mux to antenna. Controller powered by 12V Added Ground. 900 MHz notch in front of amp to prevent overloads. 259 and 269 MHz are digital emissions

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RADIATED DIGITAL EMISSIONS

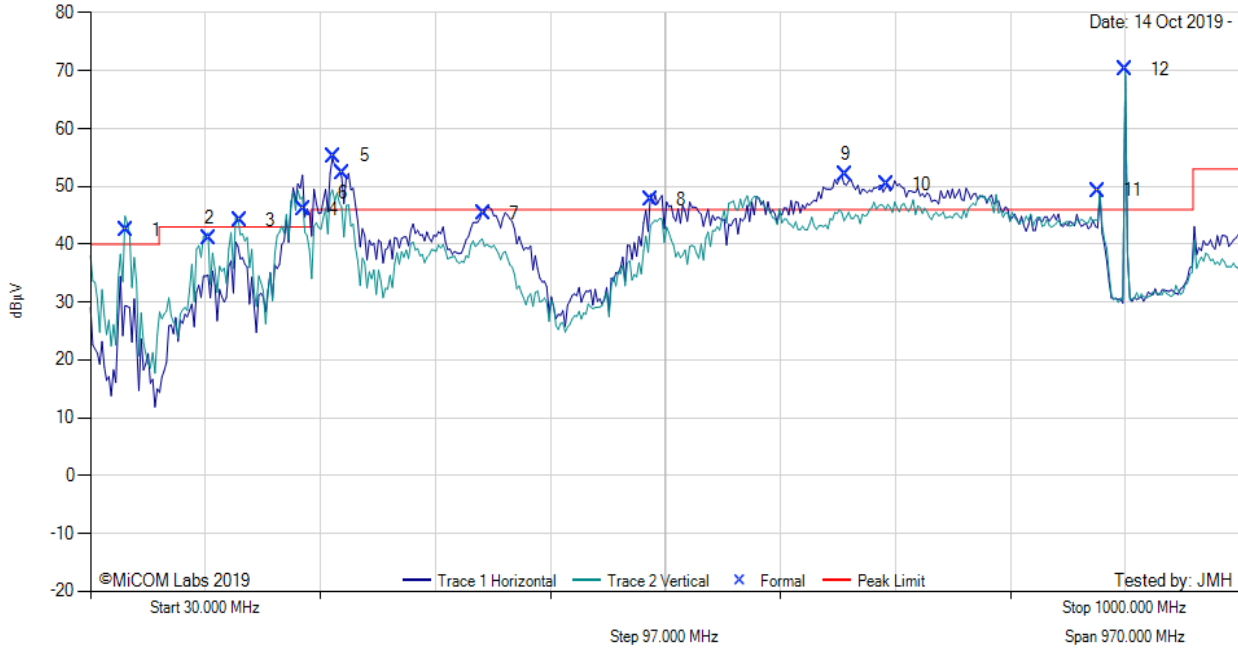


Variant: PR-ASK, Test Freq: 902.75 MHz, Antenna: Alien Technology ALR-8698, Power Setting: Max, Duty Cycle (%): 100

Measurement Distance: 3m

Sweep Time: 170 ms

RBW: 120 KHz
VBW: 300 KHz



| 30.00 - 1000.00 MHz | | | | | | | | | | | | |
|---------------------|---------------|----------|---------------|---------|--------------|------------------|------------|--------|---------|--------------|-----------|------------|
| Num | Frequency MHz | Raw dBµV | Cable Loss dB | AF dB/m | Level dBµV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBµV/m | Margin dB | Pass /Fail |
| 1 | 59.98 | 59.65 | 3.80 | -20.97 | 42.48 | Peak (NRB) | Vertical | 100 | 193 | -- | -- | Pass |
| 2 | 130.46 | 51.46 | 4.21 | -14.63 | 41.04 | MaxQP | Vertical | 101 | 154 | 43.0 | -2.0 | Pass |
| 3 | 155.95 | 55.78 | 4.34 | -16.02 | 44.11 | Peak (NRB) | Vertical | 100 | 158 | -- | -- | Pass |
| 4 | 209.87 | 58.75 | 4.56 | -17.31 | 46.00 | Peak (NRB) | Horizontal | 100 | 140 | -- | -- | Pass |
| 5 | 235.41 | 66.99 | 4.67 | -16.38 | 55.28 | Peak (NRB) | Horizontal | 100 | 193 | -- | -- | Pass |
| 6 | 242.89 | 63.83 | 4.71 | -16.20 | 52.34 | MaxQP | Horizontal | 127 | 196 | 46.0 | -- | -- |
| 7 | 361.32 | 52.92 | 5.12 | -12.69 | 45.34 | Peak (NRB) | Horizontal | 100 | 158 | -- | -- | Pass |
| 8 | 502.30 | 52.10 | 5.59 | -9.99 | 47.70 | Peak (NRB) | Horizontal | 100 | 158 | -- | -- | Pass |
| 9 | 667.13 | 53.79 | 5.82 | -7.58 | 52.02 | Peak (NRB) | Horizontal | 100 | 193 | -- | -- | Pass |
| 10 | 701.64 | 51.33 | 6.20 | -7.23 | 50.30 | Peak (NRB) | Horizontal | 100 | 158 | -- | -- | Pass |
| 11 | 880.00 | 47.76 | 6.73 | -5.19 | 49.30 | Peak (NRB) | Vertical | 100 | 360 | -- | -- | Pass |
| 12 | 902.76 | 68.45 | 6.76 | -4.93 | 70.28 | Fundamental | Vertical | 100 | 0 | -- | -- | |

Test Notes: EUT powered by AC/DC PS, connected thru Mux to antenna. Controller powered by 5V USB. 242 MHz is digital emission

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RADIATED DIGITAL EMISSIONS



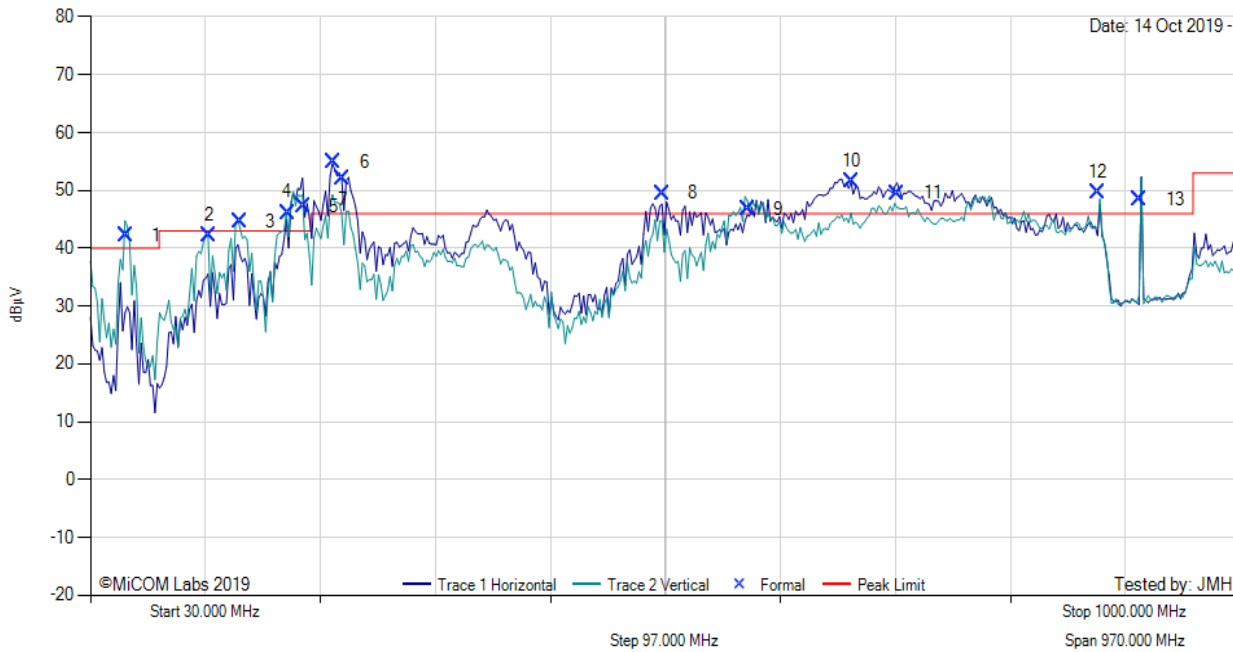
Variant: PR-ASK, Test Freq: 915.25 MHz, Antenna: Alien Technology ALR-8698, Power Setting: Max, Duty Cycle (%): 100

Measurement Distance: 3m

Sweep Time: 170 ms

RBW: 120 KHz
 VBW: 300 KHz

Date: 14 Oct 2019 -



30.00 - 1000.00 MHz

| Num | Frequency MHz | Raw dBµV | Cable Loss dB | AF dB/m | Level dBµV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBµV/m | Margin dB | Pass /Fail |
|-----|---------------|----------|---------------|---------|--------------|------------------|------------|--------|---------|--------------|-----------|------------|
| 1 | 59.99 | 59.43 | 3.80 | -20.97 | 42.26 | Peak (NRB) | Vertical | 100 | 192 | -- | -- | Pass |
| 2 | 130.44 | 52.69 | 4.21 | -14.63 | 42.27 | MaxQP | Vertical | 98 | 141 | 43.0 | -0.7 | Pass |
| 3 | 155.94 | 56.24 | 4.34 | -16.02 | 44.56 | Peak (NRB) | Vertical | 100 | 159 | -- | -- | Pass |
| 4 | 196.41 | 57.51 | 4.52 | -15.84 | 46.19 | Peak (NRB) | Vertical | 100 | 159 | -- | -- | Pass |
| 5 | 209.90 | 60.05 | 4.56 | -17.31 | 47.30 | Peak (NRB) | Horizontal | 100 | 135 | -- | -- | Pass |
| 6 | 235.40 | 66.60 | 4.67 | -16.38 | 54.89 | Peak (NRB) | Horizontal | 100 | 192 | -- | -- | Pass |
| 7 | 242.90 | 63.51 | 4.71 | -16.20 | 52.02 | MaxQP | Horizontal | 118 | 192 | 46.0 | -- | -- |
| 8 | 512.70 | 53.91 | 5.62 | -10.01 | 49.52 | Peak (NRB) | Horizontal | 100 | 179 | -- | -- | Pass |
| 9 | 584.75 | 49.64 | 5.82 | -8.70 | 46.76 | Peak (NRB) | Vertical | 100 | 179 | -- | -- | Pass |
| 10 | 671.70 | 53.31 | 5.82 | -7.59 | 51.54 | Peak (NRB) | Horizontal | 100 | 192 | -- | -- | Pass |
| 11 | 710.79 | 50.45 | 6.23 | -7.14 | 49.54 | Peak (NRB) | Horizontal | 100 | 179 | -- | -- | Pass |
| 12 | 880.03 | 48.02 | 6.73 | -5.19 | 49.56 | Peak (NRB) | Vertical | 100 | 0 | -- | -- | Pass |
| 13 | 915.26 | 46.34 | 6.80 | -4.66 | 48.48 | Fundamental | Horizontal | 100 | 0 | -- | -- | |

Test Notes: EUT powered by AC/DC PS, connected thru Mux to antenna. Controller powered by 5V USB. 242 MHz is digital emission

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RADIATED DIGITAL EMISSIONS



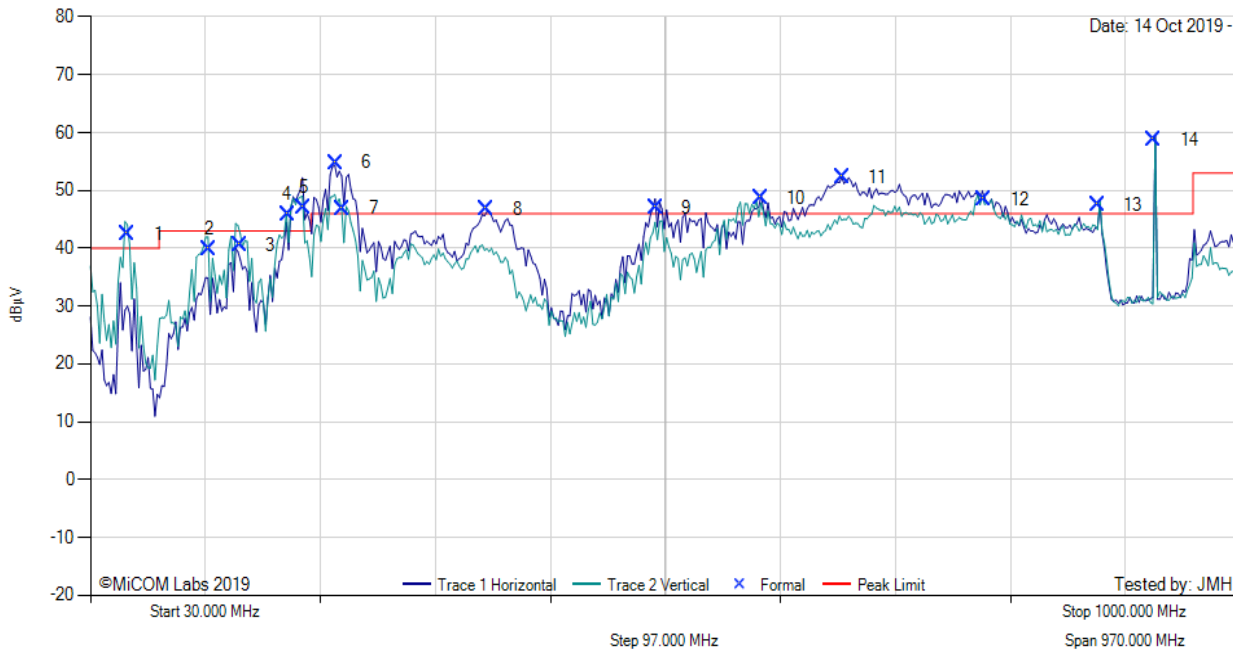
Variant: PR-ASK, Test Freq: 927.25 MHz, Antenna: Alien Technology ALR-8698, Power Setting: Max, Duty Cycle (%): 100

Measurement Distance: 3m

Sweep Time: 170 ms

RBW: 120 KHz
VBW: 300 KHz

Date: 14 Oct 2019 -



| 30.00 - 1000.00 MHz | | | | | | | | | | | | |
|---------------------|---------------|----------|---------------|---------|--------------|------------------|------------|--------|---------|--------------|-----------|------------|
| Num | Frequency MHz | Raw dBµV | Cable Loss dB | AF dB/m | Level dBµV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBµV/m | Margin dB | Pass /Fail |
| 1 | 61.48 | 59.60 | 3.81 | -20.98 | 42.43 | Peak (NRB) | Vertical | 100 | 188 | -- | -- | Pass |
| 2 | 130.48 | 50.24 | 4.21 | -14.63 | 39.82 | MaxQP | Vertical | 100 | 142 | 43.0 | -3.2 | Pass |
| 3 | 155.90 | 52.13 | 4.34 | -16.02 | 40.46 | Peak (NRB) | Vertical | 100 | 192 | -- | -- | Pass |
| 4 | 196.42 | 57.17 | 4.52 | -15.84 | 45.85 | Peak (NRB) | Vertical | 100 | 192 | -- | -- | Pass |
| 5 | 209.87 | 59.71 | 4.56 | -17.31 | 46.96 | Peak (NRB) | Horizontal | 100 | 129 | -- | -- | Pass |
| 6 | 236.88 | 66.40 | 4.68 | -16.28 | 54.80 | Peak (NRB) | Horizontal | 100 | 188 | -- | -- | Pass |
| 7 | 242.91 | 58.35 | 4.71 | -16.20 | 46.86 | MaxQP | Vertical | 137 | 231 | 46.0 | -- | -- |
| 8 | 364.33 | 54.19 | 5.13 | -12.59 | 46.73 | Peak (NRB) | Horizontal | 100 | 103 | -- | -- | Pass |
| 9 | 506.77 | 51.35 | 5.60 | -9.99 | 46.96 | Peak (NRB) | Horizontal | 100 | 169 | -- | -- | Pass |
| 10 | 595.28 | 51.50 | 5.82 | -8.64 | 48.68 | Peak (NRB) | Horizontal | 100 | 253 | -- | -- | Pass |
| 11 | 664.12 | 53.96 | 5.82 | -7.58 | 52.20 | Peak (NRB) | Horizontal | 100 | 188 | -- | -- | Pass |
| 12 | 784.00 | 47.96 | 6.44 | -6.04 | 48.36 | Peak (NRB) | Horizontal | 100 | 163 | -- | -- | Pass |
| 13 | 880.04 | 45.98 | 6.73 | -5.19 | 47.52 | Peak (NRB) | Vertical | 100 | 349 | -- | -- | Pass |
| 14 | 927.25 | 56.47 | 6.82 | -4.58 | 58.71 | Fundamental | Horizontal | 100 | 0 | -- | -- | |

Test Notes: EUT powered by AC/DC PS, connected thru Mux to antenna. Controller powered by 5V USB. 242 MHz is digital emission

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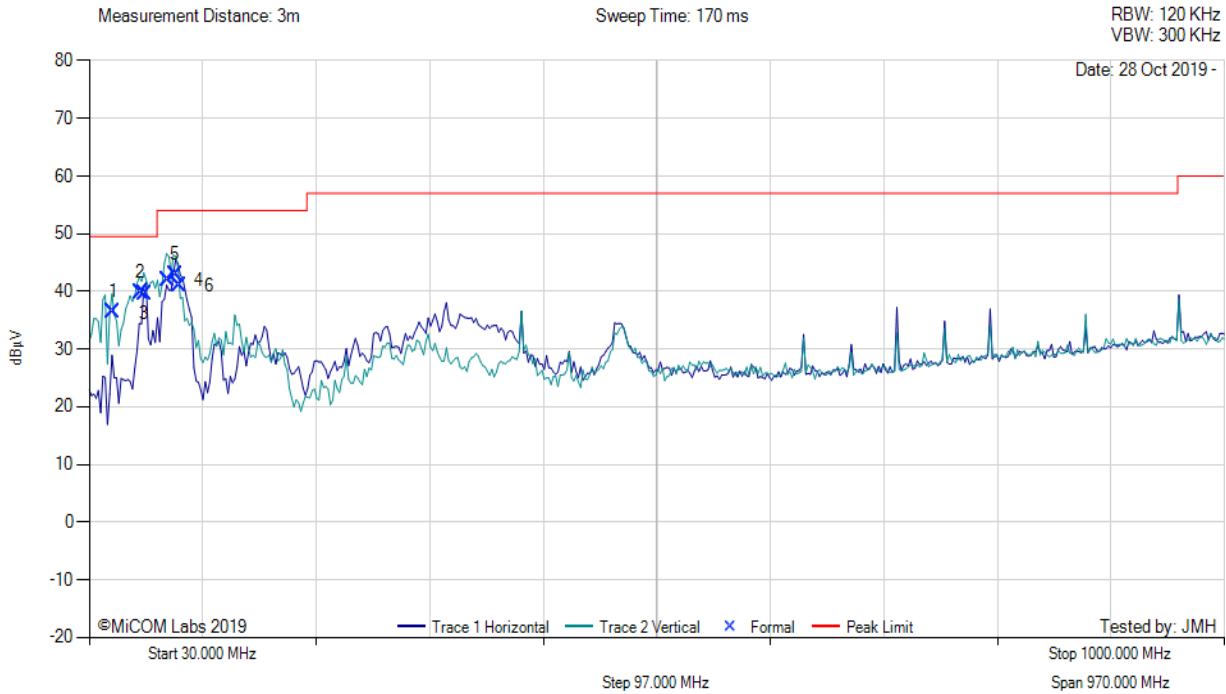
A.5.2. Digital Emissions (0.03 - 1 GHz)



| 30.00 - 1000.00 MHz | | | | | | | | | | | | |
|---------------------|---------------|----------|---------------|---------|--------------|------------------|------------|--------|---------|--------------|-----------|------------|
| Num | Frequency MHz | Raw dBµV | Cable Loss dB | AF dB/m | Level dBµV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBµV/m | Margin dB | Pass /Fail |
| 1 | 30.00 | 40.72 | 3.52 | -7.20 | 37.04 | MaxQP | Horizontal | 106 | 85 | 49.5 | -12.5 | Pass |
| 2 | 260.90 | 64.84 | 4.76 | -15.63 | 53.97 | MaxQP | Horizontal | 126 | 145 | 57.0 | -3.0 | Pass |
| 3 | 263.90 | 62.69 | 4.78 | -15.27 | 52.20 | MaxQP | Horizontal | 117 | 146 | 57.0 | -4.8 | Pass |
| 4 | 377.86 | 54.41 | 5.18 | -12.55 | 47.04 | MaxQP | Horizontal | 101 | 168 | 57.0 | -10.0 | Pass |
| 5 | 559.24 | 52.08 | 5.76 | -9.15 | 48.69 | MaxQP | Horizontal | 127 | 122 | 57.0 | -8.3 | Pass |
| 6 | 787.04 | 46.65 | 6.45 | -6.00 | 47.10 | MaxQP | Horizontal | 101 | 202 | 57.0 | -9.9 | Pass |

Test Notes: EUT Powered by 12V AC/DC PS. Connected to 4 muxes. all ports connected and term.

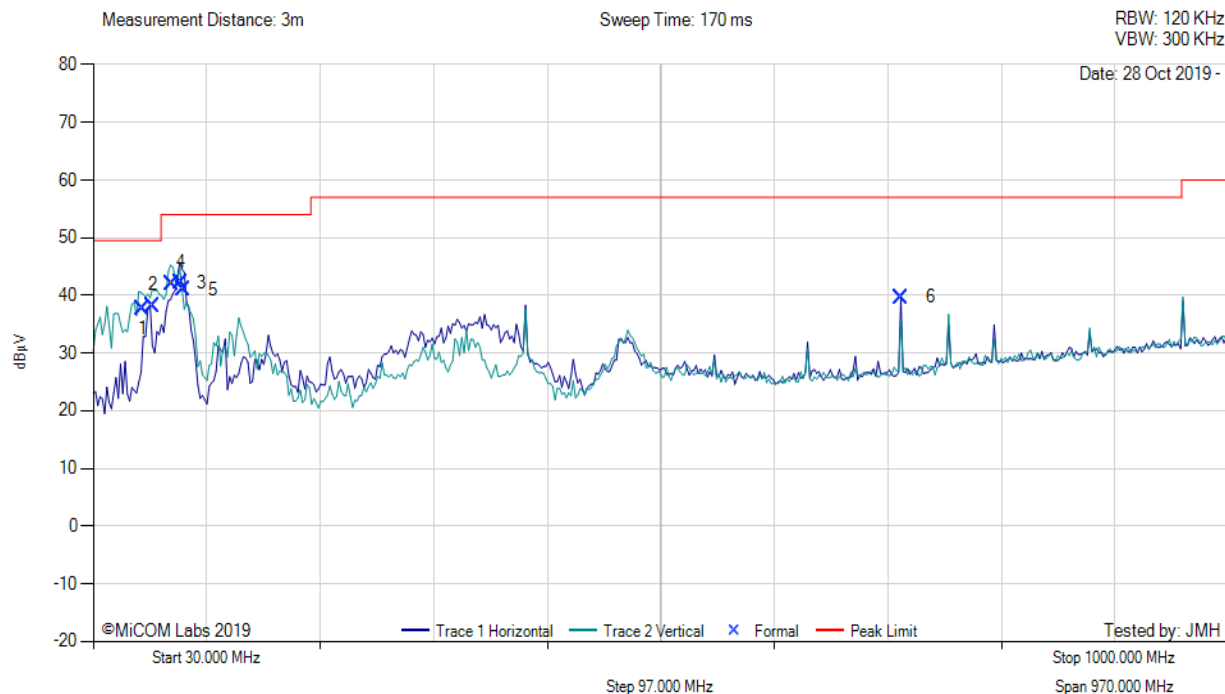
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| 30.00 - 1000.00 MHz | | | | | | | | | | | | |
|---------------------|---------------|----------|---------------|---------|--------------|------------------|------------|--------|---------|--------------|-----------|------------|
| Num | Frequency MHz | Raw dBµV | Cable Loss dB | AF dB/m | Level dBµV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBµV/m | Margin dB | Pass /Fail |
| 1 | 50.47 | 53.51 | 3.73 | -20.71 | 36.53 | MaxQP | Vertical | 101 | 271 | 50.0 | -13.5 | Pass |
| 2 | 73.99 | 56.44 | 3.91 | -20.47 | 39.88 | MaxQP | Vertical | 135 | 210 | 50.0 | -10.1 | Pass |
| 3 | 77.21 | 56.39 | 3.93 | -20.63 | 39.69 | MaxQP | Vertical | 139 | 93 | 50.0 | -10.3 | Pass |
| 4 | 97.60 | 57.01 | 4.04 | -19.09 | 41.96 | MaxQP | Vertical | 108 | 106 | 50.0 | -8.0 | Pass |
| 5 | 103.30 | 55.99 | 4.07 | -17.18 | 42.88 | MaxQP | Vertical | 113 | 105 | 50.0 | -7.1 | Pass |
| 6 | 106.77 | 53.38 | 4.09 | -16.45 | 41.02 | MaxQP | Horizontal | 185 | 0 | 50.0 | -9.0 | Pass |

Test Notes: EUT Powered by Poe. Connected to 4 muxes. all ports connected and term.

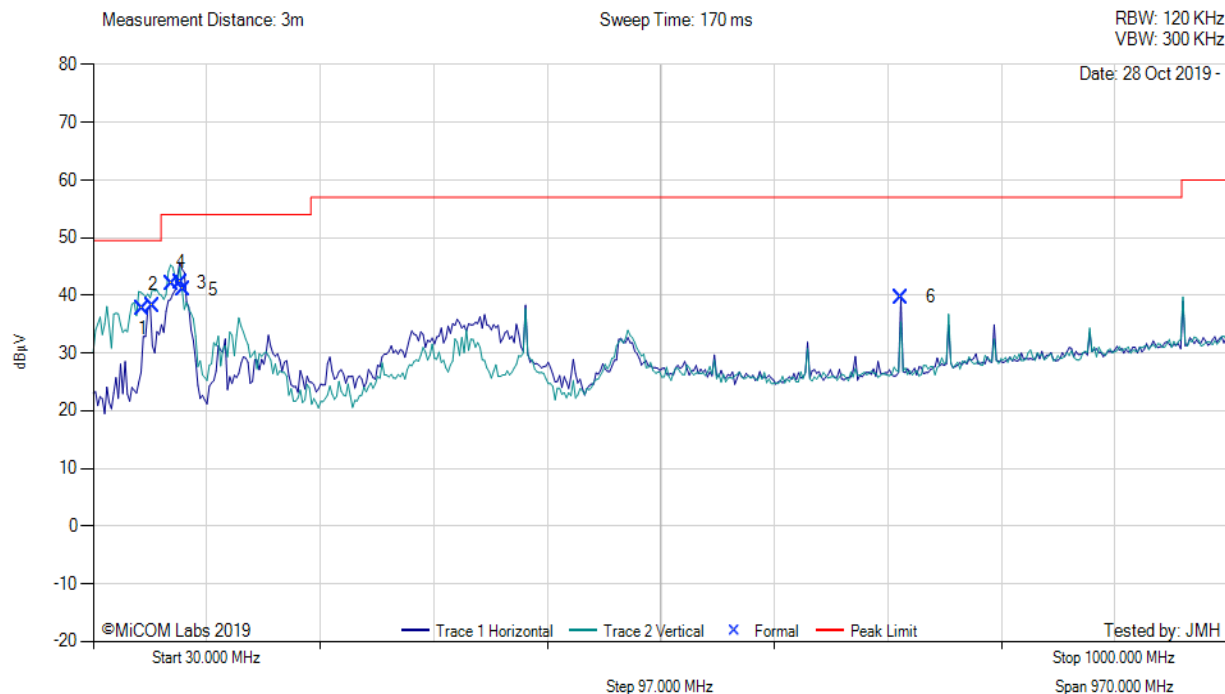
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| 30.00 - 1000.00 MHz | | | | | | | | | | | | |
|---------------------|---------------|----------|---------------|---------|--------------|------------------|------------|--------|---------|--------------|-----------|------------|
| Num | Frequency MHz | Raw dBµV | Cable Loss dB | AF dB/m | Level dBµV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBµV/m | Margin dB | Pass /Fail |
| 1 | 72.45 | 54.40 | 3.90 | -20.49 | 37.81 | MaxQP | Vertical | 105 | 180 | 49.5 | -11.7 | Pass |
| 2 | 81.16 | 55.23 | 3.95 | -20.89 | 38.29 | MaxQP | Vertical | 117 | 204 | 49.5 | -11.2 | Pass |
| 3 | 97.40 | 57.11 | 4.04 | -19.09 | 42.06 | MaxQP | Vertical | 115 | 145 | 54.0 | -11.9 | Pass |
| 4 | 104.68 | 54.83 | 4.08 | -16.77 | 42.14 | MaxQP | Horizontal | 184 | 26 | 54.0 | -11.9 | Pass |
| 5 | 106.70 | 53.40 | 4.09 | -16.45 | 41.04 | MaxQP | Horizontal | 186 | 201 | 54.0 | -13.0 | Pass |
| 6 | 720.00 | 40.29 | 6.25 | -6.88 | 39.66 | MaxQP | Horizontal | 101 | 228 | 57.0 | -17.3 | Pass |

Test Notes: EUT Powered by 12V AC/DC PS and 24V Ext PS on Controller. Connected to 4 muxes. all ports connected and term. Device is used in class A environment

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| 30.00 - 1000.00 MHz | | | | | | | | | | | | |
|---------------------|---------------|----------|---------------|---------|--------------|------------------|------------|--------|---------|--------------|-----------|------------|
| Num | Frequency MHz | Raw dBµV | Cable Loss dB | AF dB/m | Level dBµV/m | Measurement Type | Pol | Hgt cm | Azt Deg | Limit dBµV/m | Margin dB | Pass /Fail |
| 1 | 72.45 | 54.40 | 3.90 | -20.49 | 37.81 | MaxQP | Vertical | 105 | 180 | 49.5 | -11.7 | Pass |
| 2 | 81.16 | 55.23 | 3.95 | -20.89 | 38.29 | MaxQP | Vertical | 117 | 204 | 49.5 | -11.2 | Pass |
| 3 | 97.40 | 57.11 | 4.04 | -19.09 | 42.06 | MaxQP | Vertical | 115 | 145 | 54.0 | -11.9 | Pass |
| 4 | 104.68 | 54.83 | 4.08 | -16.77 | 42.14 | MaxQP | Horizontal | 184 | 26 | 54.0 | -11.9 | Pass |
| 5 | 106.70 | 53.40 | 4.09 | -16.45 | 41.04 | MaxQP | Horizontal | 186 | 201 | 54.0 | -13.0 | Pass |
| 6 | 720.00 | 40.29 | 6.25 | -6.88 | 39.66 | MaxQP | Horizontal | 101 | 228 | 57.0 | -17.3 | Pass |

Test Notes: EUT Powered by Poe and 24V Ext PS on Controller. Connected to 4 muxes. all ports connected and term. Device is used in class A environment

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