REGULATORY COMPLIANCE TEST REPORT

FCC CFR 47 Part 15.247 & ISED RSS-247

Report No.: SATE01-U2 Rev A

Company: SATEL OY

Model Name: SATEL-TR49 SnapOn

REGULATORY COMPLIANCE TEST REPORT

Company Name: SATEL OY

Model Name: SATEL-TR49 SnapOn

To: FCC CFR 47 Part 15.247 & ISED RSS-247

Test Report Serial No.: SATE01-U2 Rev A

This report supersedes: NONE

Applicant: SATEL OY
Meriniitynkatu 17
Salo, 24100
Finland

Issue Date: 23rd September 2021

This Test Report is Issued Under the Authority of:

MiCOM Labs, Inc.
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ACCREDITED
TESTING CERT #2381.01

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 17025:2017. 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

MICOM LABS

Pleasanton, CA

for technical competence in the field of

Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 *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 24th day of February 2020.

Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 2381.01
Valid to November 30, 2021

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

1.2. RECOGNITION

MiCOM Labs, Inc is widely recognized for its wireless testing and certification capabilities. In addition to being recognized for Testing and Certification under Phase 2 Mutual Recognition Agreements (MRA) with Canada, Europe, United Kingdom and Japan, our international recognition includes Conformity Assessment Body (CAB) designation status under agreements with Asia Pacific (APEC) MRA Phase 1 countries giving acceptance of MiCOM Labs test reports. MiCOM Labs test reports are accepted globally.

Country	Recognition Body	Status	MRA Phase	Identification No.
USA	Federal Communications Commission (FCC)	TCB	-	US0159 Test Firm Designation#: US1084
Canada	Industry Canada (ISED)	FCB	APEC MRA 2	US0159 ISED#: 4143A
Japan	MIC (Ministry of Internal Affairs and Communication)	CAB	Japan MRA 2	RCB 210
	Japan Approvals Institute for Telecommunication Equipment (JATE)			
	VCCI	--	--	A-0012
Europe	European Commission	NB	EU MRA 2	NB 2280
United Kingdom	Department for Business, Energy & Industrial Strategy (BEIS)	AB	UK MRA 2	AB 2280
Mexico	Instituto Federal de Telecomunicaciones (IFT)	CAB	Mexico MRA 1	US0159
Australia	Australian Communications and Media Authority (ACMA)	CAB	APEC MRA 1	US0159
Hong Kong	Office of the Telecommunication Authority (OFTA)			
Korea	Ministry of Information and Communication Radio Research Laboratory (RRL)			
Singapore	Infocomm Development Authority (IDA)			
Taiwan	National Communications Commission (NCC) Bureau of Standards, Metrology and Inspection (BSMI)			
Vietnam	Ministry of Communication (MIC)			

TCB – Telecommunications Certification Bodies (TCB)
FCB – Foreign Certification Body
CAB – Conformity Assessment Body
NB – Notified Body
AB – Approved Body
MRA – Mutual Recognition Agreement
MRA Phase I - recognition for product testing
MRA 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

MiCOM LABS

Pleasanton, CA

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 24th day of February 2020

Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 2381.02
Valid to November 30, 2021

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
UK – Approved Body (AB), AB Identifier - 2280
Japan – Recognized Certification Body (RCB), RCB Identifier - 210

2. DOCUMENT HISTORY

Document History		
Revision	Date	Comments
Draft	9th April 2021	Draft report for client review
Rev A	23rd September 2021	Initial release.
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In the above table the latest report revision will replace all earlier versions.

3. TEST RESULT CERTIFICATE

Manufacturer:	SATEL OY Meriniitynkatu 17 Salo 24100 Finland	**Tested By:**	MiCOM Labs, Inc. 575 Boulder Court Pleasanton California 94566 USA
Model:	SATEL-TR49 SnapOn	**Telephone:**	+1 925 462 0304
Type Of Equipment:	Dual Band Radio Modem	**Fax:**	+1 925 462 0306
S/N's:	1906000771		
Test Date(s):	15th – 22nd March 2021 30th March, & 7th April 2021	**Website:**	www.micomlabs.com

STANDARD(S)	TEST RESULTS
FCC CFR 47 Part 15.247 & ISED RSS-247	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.

A2LA ACCREDITED TESTING CERT #2381.01

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 558074 D01 v05r02	2nd April 2019	Guidance for Compliance Measurements on Digital Transmission System, Frequency Hopping Spread Spectrum System, and Hybrid System Devices operating under section 15.247 of the FCC Rules.
II	A2LA	5th October 2020	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 47 CFR Part 15, Subpart B	2020	Title 47: Telecommunication PART 15 B; Unintentional Radiators
VIII	FCC 47 CFR Part 15.247	2020	Radio Frequency Devices; Subpart C – Intentional Radiators
IX	FCC Public Notice DA 00-705	March 2000	Filing and Measurement Guidelines for Frequency Hopping Spread Spectrum Systems
X	ICES-003	Issue 7 ; October 15,2020	Information Technology Equipment (Including Digital Apparatus) – Limits and methods of measurement.
XI	M 3003	Edition 3 Nov.2012	Expression of Uncertainty and Confidence in Measurements
XII	RSS-247 Issue 2	Feb 2017	Digital Transmission Systems (DTSs), Frequency Hopping System (FHSs) and Licence-Exempt Local Area Network (LE-LEN) Devices
XIII	RSS-Gen Issue 5	2018	General Requirements for Compliance of Radio Apparatus With Amendments 1: March 2019 and 2: Feb 2021.
XIV	FCC 47 CFR Part 2.1033	2020	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 SATEL OY SATEL-TR49 SnapOn to FCC CFR 47 Part 15.247 (FHSS) and RSS-247.
Applicant:	SATEL OY Meriniitynkatu 17 Salo 24100, Finland
Manufacturer:	SATEL OY
Laboratory performing the tests:	MiCOM Labs, Inc. 575 Boulder Court Pleasanton California 94566, USA
Test report reference number:	SATE01-U2 Rev A
Date EUT received:	18th March 2021
Standard(s) applied:	FCC CFR 47 Part 15.247 & ISED RSS-247
Dates of test (from - to):	23 - 23 March, 30th March, & 7th April 2021
No of Units Tested:	1
Product Family Name:	SnapOn
Model(s):	SATEL-TR49 SnapOn
Location for use:	Indoor & Outdoor
Declared Frequency Range(s):	902 - 928 MHz;
Type of Modulation:	GFSK
EUT Modes of Operation:	FHSS
Declared Nominal Output Power (dBm):	902 - 928 MHz: 30 dBm
Transmit/Receive Operation:	Transceiver
Rated Input Voltage and Current:	5VDC 2A
Operating Temperature Range:	-47°C to +70 °C.
ITU Emission Designator:	130KF7W
Equipment Dimensions:	51 mm x 30 mm x 4.75 mm
Weight:	0.01 Kg
Hardware Rev:	1.3
Software Rev:	44_2_5_0_2

5.2. Scope Of Test Program

SATEL OY TR49 SnapOn

The scope of the test program was to test the SATEL OY TR49 SnapOn, in the frequency range 902 – 928 MHz; for compliance against the following specifications:

FCC CFR 47 Part 15 Subpart C 15.247 (FHSS)
Radio Frequency Devices; Subpart C – Intentional Radiators

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

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

Type (EUT/ Support)	Equipment Description (Including Brand Name)	Mfr.	Model No.	Serial No.
EUT	SnapOn	SATEL OY	TR49	1906000771
Support	Laptop	Dell	N/A	N/A

5.4. Antenna Details

Type	Manufacturer	Model	Family	Gain (dBi)	BF Gain	Dir BW	X-Pol	Frequency Band (MHz)
external	Laird	Whip	OMNI	6.0	-	360	-	902 - 928
external	PulseLarson	Yagi	Yagi	6.0	-	360	-	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	<3m	1	No	Data	Digital

5.6. Test Configurations

Results for the following configurations are provided in this report:

Operational Mode (GFSK)	Data Rate with Highest Power KBit/s	Channel Frequency (MHz)		
		Low	Mid	High
902 - 928 MHz				
FHSS	115.20	902.2464	915.1488	927.800

5.7. Equipment Modifications

The following modifications were required to bring the equipment into compliance:
1. NONE

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

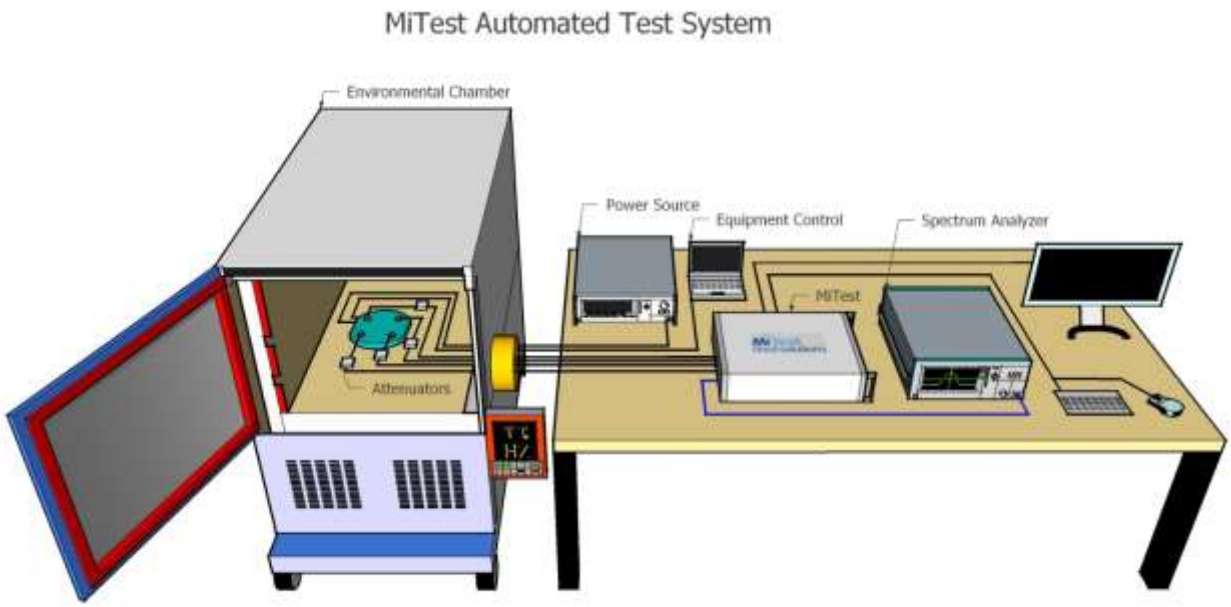
List of Measurements

Test Header	Result	Data Link
20 dB & 99% Bandwidth	Complies	View Data
Frequency Hopping Tests	Complies	-
Number of Hopping Channels	Complies	View Data
Channel Separation	Complies	View Data
Channel Occupancy & Dwell Time	Complies	View Data
Output Power	Complies	View Data
Emissions	Complies	-
(1) Conducted Emissions	Complies	-
(i) Conducted Unwanted Spurious Emissions	Complies	View Data
(ii) Conducted Band-Edge Emissions	Complies	View Data
(2) Radiated Emissions	Complies	-
(i) TX Spurious & Restricted Band Emissions	Complies	View Data
(3) Digital Emissions (0.03 - 1 GHz)	Complies	View Data
**AC Wireline	Not Applicable	-

** Product is a 5VDC device; AC wireline test does not apply per FCC CFR 47 part 15.107(a) EUT does not connect to the public utility (AC) power line.

7. TEST EQUIPMENT CONFIGURATION(S)

7.1. Conducted Test Setup



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

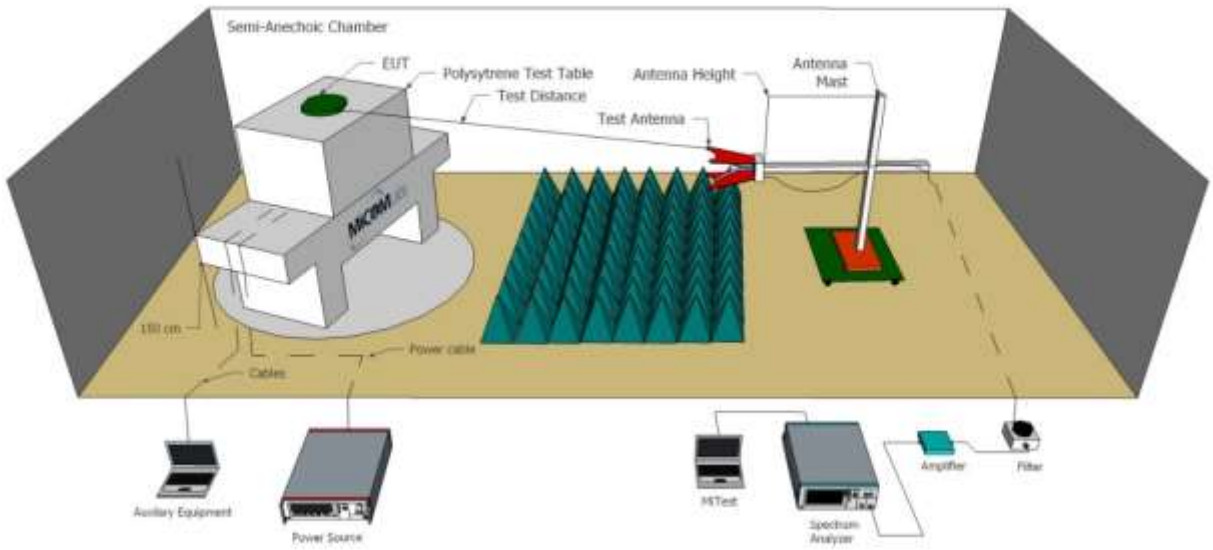
Asset#	Description	Manufacturer	Model#	Serial#	Calibration Due Date
#3 SA	MiTest Box to SA	Fairview Microwave	SCA1814-0101-72	#3 SA	4 Jun 2021
#3P1	EUT to MiTest box port 1	Fairview Microwave	SCA1814-0101-72	#3P1	4 Jun 2021
#3P2	EUT to MiTest box port 2	Fairview Microwave	SCA1814-0101-72	#3P2	4 Jun 2021
#3P3	EUT to MiTest box port 3	Fairview Microwave	SCA1814-0101-72	#3P3	4 Jun 2021
#3P4	EUT to MiTest box port 4	Fairview Microwave	SCA1812-0101-72	#3P4	4 Jun 2021
249	Thermocouple; Resistance Thermometer	Thermotronics	GR2105-02	9340 #2	30 Oct 2021
287	Rohde & Schwarz 40 GHz Receiver	Rhode & Schwarz	ESIB40	100201	8 Oct 2021
378	Rohde & Schwarz 40 GHz Receiver with Generator	Rhode & Schwarz	ESIB40	100107/040	12 Jun 2021
398	MiTest RF Conducted Test Software	MiCOM	MiTest ATS	Version 4.2.3.0	Not Required
405	DC Power Supply 0-60V	Agilent	6654A	MY40018	Cal when

				26	used
408	USB to GPIB interface	National Instruments	GPIB-USB HS	14C0DE9	Not Required
440	USB Wideband Power Sensor	Boonton	55006	9178	22 Jun 2021
441	USB Wideband Power Sensor	Boonton	55006	9179	20 Jun 2021
442	USB Wideband Power Sensor	Boonton	55006	9181	19 Jun 2021
445	PoE Injector	D-Link	DPE-101GL	QTAH1E2000625	Not Required
461	Spectrum Analyzer	Agilent	E4440A	MY46185537	20 Jun 2021
510	Barometer/Thermometer	Control Company	68000-49	170871375	20 Dec 2021
515	MiTest Cloud Solutions RF Test Box	MiCOM	2nd Gen with DFS	515	4 Jun 2021
534	Power Sensor 50 GHz -70dBm to +20dBm	R&S	NRP50SN	1419.0093K02-100888-SB	26 Feb 2022
75	Environmental Chamber	Thermatron	SE-300-2-2	27946	20 Feb 2022

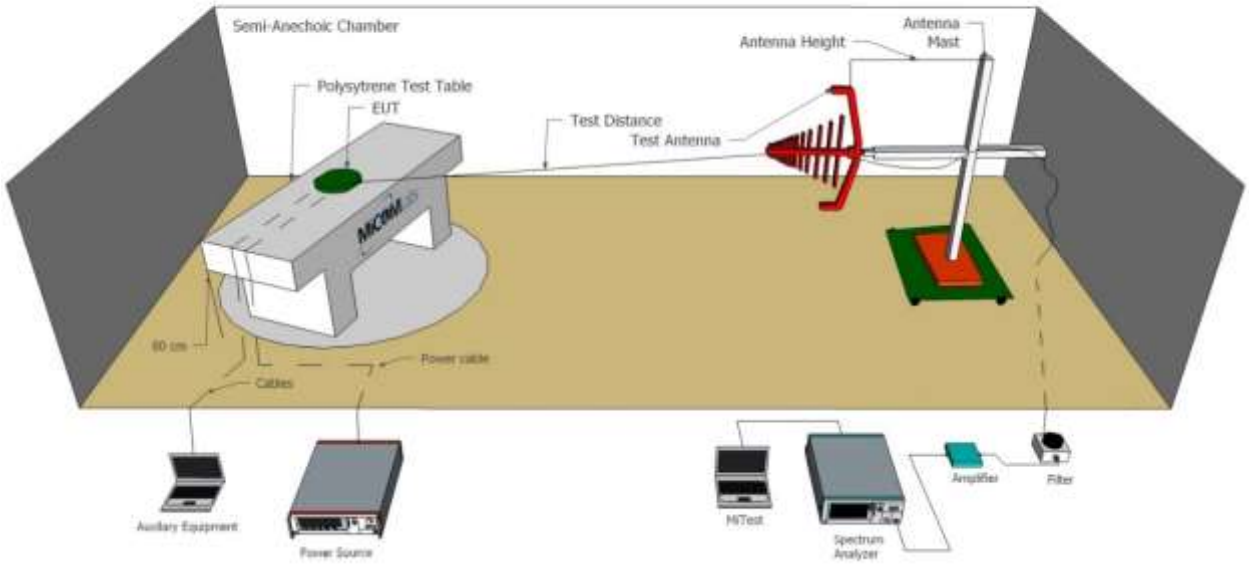
7.2. Radiated Emissions - 3m Chamber

The following tests were performed using the radiated test set-up shown in the diagram below.
Radiated emissions above and below 1GHz.

Radiated Emissions Above 1GHz Test Setup



Radiated Emissions Below 1GHz Test Setup



A full system calibration was performed on the test station and any resulting system losses (or gains) were considered 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
287	Rohde & Schwarz 40 GHz Receiver	Rhode & Schwarz	ESIB40	100201	8 Oct 2021
330	Variac 0-280 Vac	Staco Energy Co	3PN1020B	0546	Cal when used
336	Active loop Ant 10kHz to 30 MHz	EMCO	EMCO 6502	00060498	29 Nov 2021
338	Sunol 30 to 3000 MHz Antenna	Sunol	JB3	A052907	4 Oct 2021
341	900MHz Notch Filter	EWT	EWT-14-0199	H1	4 May 2021
342	2.4 GHz Notch Filter	EWT	EWT-14-0203	H1	4 May 2021
346	1.6 TO 10GHz High Pass Filter	EWT	EWT-57-0112	H1	4 May 2021
373	26III RMS Multimeter	Fluke	Fluke 26 series III	76080720	21 Jun 2021
378	Rohde & Schwarz 40 GHz Receiver with Generator	Rhode & Schwarz	ESIB40	100107/040	12 Jun 2021
397	Amp 10 - 2500MHz	MiCOM Labs	Amp 10 - 2500 MHz	NA	9 May 2021
399	ETS 1-18 GHz Horn Antenna	ETS	3117	00154575	12 May 2021
406	Amplifier for Radiated Emissions	MiCOM Labs	40dB 1 to 18GHz Amp	0406	9 May 2021
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
414	DC Power Supply 0-60V	HP	6274	1029A01285	Cal when used
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	4 May 2021
463	Schwarzbeck cable from Amplifier to Bulkhead.	Schwarzbeck	AK 9513	463	4 May 2021

464	Schwarzbeck cable from Bulkhead to Receiver	Schwarzbeck	AK 9513	464	4 May 2021
466	Low Pass Filter DC-1500 MHz	Mini-Circuits	NLP-1750+	VUU10401438	4 May 2021
480	Cable - Bulkhead to Amp	SRC Haverhill	157-3050360	480	4 May 2021
481	Cable - Bulkhead to Receiver	SRC Haverhill	151-3050787	481	4 May 2021
510	Barometer/Thermometer	Control Company	68000-49	170871375	20 Dec 2021
518	Cable - Amp to Antenna	SRC Haverhill	157-3051574	518	4 May 2021
87	Uninterruptible Power Supply	Falcon Electric	ED2000-1/2LC	F3471 02/01	Cal when used

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 20 dB and 99% Bandwidth			
Standard:	FCC CFR 47:15.247 RSS-247 Issue 2	**Ambient Temp. (ºC):**	24.0 - 27.5
Test Heading:	20 dB and 99 % Bandwidth	**Rel. Humidity (%):**	32 - 45
Standard Section(s):	15.247 (a)(1)(i)/(ii) RSS-247 5.1(c)	**Pressure (mBars):**	999 - 1001
Reference Document(s):	See Normative References		

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.

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.

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:

(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.

(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.

(ii) Frequency hopping systems operating in the 5725-5850 MHz band shall use at least 75 hopping frequencies. The maximum 20 dB bandwidth of the hopping channel is 1 MHz. The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 30 second period.

Equipment Configuration for 20 dB 99% Bandwidth			
Variant:	FHSS	**Duty Cycle (%):**	99
Data Rate:	115.20 KBit/s	**Antenna Gain (dBi):**	Not Applicable
Modulation:	GFSK	**Beam Forming Gain (Y)(dB):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	SB
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Measured 20 dB Bandwidth (MHz) Port(s)				20 dB Bandwidth (MHz)		Limit	Lowest Margin
MHz	a	b	c	d	Highest	Lowest	MHz	MHz
902.2464	0.134				0.134	0.134	0.5	-0.37
915.1488	0.133				0.133	0.133	0.5	-0.37
927.800	0.136				0.136	0.136	0.5	-0.36

Test Frequency	Measured 99% Bandwidth (MHz) Port(s)				Maximum 99% Bandwidth (MHz)		
MHz	a	b	c	d			
902.2464	0.130				0.130		
915.1488	0.129				0.129		
927.800	0.129				0.129		

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. Frequency Hopping Tests

Conducted Test Conditions for Frequency Hopping Measurements			
Standard:	FCC CFR 47:15.247 RSS-247 Issue 2	**Ambient Temp. (ºC):**	24.0 - 27.5
Test Heading:	Frequency Hopping Tests	**Rel. Humidity (%):**	32 - 45
Standard Section(s):	15.247 (a)(1)(i)/(ii) RSS-247 5.1 (c)	**Pressure (mBars):**	999 - 1001
Reference Document(s):	See Normative References, FCC Public Notice DA 00-705		

Test Procedure for Frequency Hopping Measurements

These tests cover the following measurements:

i) channel separation
ii) channel occupancy
iii) dwell time
iv) number of hopping frequencies

Frequency hopping testing was measured with a spectrum analyzer connected to the antenna terminal, while EUT is operating in transmission mode at the appropriate center frequency or hopping mode.

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.

Limits for Frequency Hopping Measurements

(a) Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

(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.

(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.

(ii) Frequency hopping systems operating in the 5725-5850 MHz band shall use at least 75 hopping frequencies. The maximum 20 dB bandwidth of the hopping channel is 1 MHz. The average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 30 second period.

(iii) Frequency hopping systems in the 2400-2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

9.2.1. Number of Hopping Channels

Equipment Configuration for Number of Hopping Channels

Variant:	FHSS	**Antenna:**	Not Applicable
Data Rate:	115.20 KBit/s	**Antenna Gain (dBi):**	Not Applicable
Modulation:	GFSK	**Beam Forming Gain (Y)(dB):**	Not Applicable
Duty Cycle (%):	99.0	**Tested By:**	SB
Engineering Test Notes:			

Test Measurement Results

Frequency Range (MHz)	Number of Hopping Channels	Limit	Pass / Fail
902.0-910.0	34	--	--
910.0-920.0	44	--	--
920.0-928.0	34	--	--
Total number of Hops	**113**	**50**	**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).

9.2.2. Channel Separation

Equipment Configuration for Channel Separation

Variant:	FHSS	**Antenna:**	Not Applicable
Data Rate:	115.20 KBit/s	**Antenna Gain (dBi):**	Not Applicable
Modulation:	GFSK	**Beam Forming Gain (Y)(dB):**	Not Applicable
Duty Cycle (%):	99.0	**Tested By:**	SB
Engineering Test Notes:			

Test Measurement Results

Center Frequency (MHz)	Chan Separation (MHz)	Limit (MHz)	Pass / Fail
915.1488	0.230	0.134	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).

9.2.3. Channel Occupancy & Dwell Time

Equipment Configuration for Channel Occupancy

Variant:	FHSS	**Antenna:**	Not Applicable
Data Rate:	115.20 KBit/s	**Antenna Gain (dBi):**	Not Applicable
Modulation:	GFSK	**Beam Forming Gain (Y)(dB):**	Not Applicable
Duty Cycle (%):	99.0	**Tested By:**	SB
Engineering Test Notes:			

Test Measurement Results

Channel Frequency(MHz)	Dwell Time (Single Burst) (S)	Channel Occupancy (mS)	Observation Period (S)	Channel Occupancy Limit (mS)	Pass / Fail
915.10	0.007	62.040	20.00	400.000	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. Output Power

Conducted Test Conditions for Fundamental Emission Output Power			
Standard:	FCC CFR 47:15.247 RSS-247	**Ambient Temp. (ºC):**	24.0 - 27.5
Test Heading:	Output Power	**Rel. Humidity (%):**	32 - 45
Standard Section(s):	15.247 (a)(1), (b)(1)/(2)/(3) RSS-247: 5.4(a)	**Pressure (mBars):**	999 - 1001
Reference Document(s):	See Normative References		

Test Procedure for Fundamental Emission Output Power Measurement

In the case of average power measurements an average power sensor was utilized.

For peak power measurements the spectrum analyzer built-in power function was used to integrate peak power over the 20 dB bandwidth.

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

Test configuration and setup used for the measurement was per the Conducted Test Set-up specified in this document.
Supporting Information
Calculated Power = A + G + Y+ 10 log (1/x) dBm

A = Total Power [10*Log10 ($10^{a/10}$ + $10^{b/10}$ + $10^{c/10}$ + $10^{d/10}$)]
G = Antenna Gain
Y = Beamforming Gain
x = Duty Cycle (average power measurements only)

Limits for Fundamental Emission Output Power

(a) Operation under the provisions of this Section is limited to frequency hopping and digitally modulated intentional radiators that comply with the following provisions:

(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.

(b) The maximum peak conducted output power of the intentional radiator shall not exceed the following for frequency hopping systems:

(1) For frequency hopping systems operating in the 2400-2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. For all other frequency hopping systems in the 2400-2483.5 MHz band: 0.125 watts.

(2) For frequency hopping systems operating in the 902-928 MHz band: 1 watt for systems employing at least 50 hopping channels; and, 0.25 watts for systems employing less than 50 hopping channels, but at least 25 hopping channels, as permitted under paragraph (a)(1)(i) of this section.

(3) For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. 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.

Equipment Configuration for Output Power Peak

Variant:	FHSS	**Duty Cycle (%):**	99.0
Data Rate:	115.20 KBit/s	**Antenna Gain (dBi):**	6.00
Modulation:	GFSK	**Beam Forming Gain (Y)(dB):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	SB
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Measured Output Power (dBm) Port(s)				Calculated Total Power Σ Port(s)	Limit	Margin	EUT Power Setting
MHz	a	b	c	d	dBm	dBm	dB	
902.2464	29.10				29.10	30.00	-0.9	Max
915.1488	28.89				28.89	30.00	-1.11	Max
927.8000	28.92				28.92	30.00	-1.08	Max

Traceability to Industry Recognized Test Methodologies	
Work Instruction:	WI-01 MEASURING RF OUTPUT POWER
Measurement Uncertainty:	±1.33 dB

The above measurements are true pulse readings and therefore a Duty Cycling correction factor is not required.

9.4. Emissions

9.4.1. Conducted Emissions

Conducted Test Conditions for Transmitter Conducted Spurious and Band-Edge Emissions			
Standard:	FCC CFR 47:15.247 RSS-247 Issue 2	**Ambient Temp. (ºC):**	24.0 - 27.5
Test Heading:	Transmitter Conducted Spurious and Band-Edge Emissions	**Rel. Humidity (%):**	32 - 45
Standard Section(s):	15.247 (d) RSS-247 5.5 RSS-Gen 6.13, 8.9, 8.10	**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)).

9.4.1.1. Conducted Unwanted Spurious Emissions

Equipment Configuration for Unwanted Emissions Peak			
Variant:	FHSS	**Duty Cycle (%):**	99
Data Rate:	115.20 KBit/s	**Antenna Gain (dBi):**	Not Applicable
Modulation:	GFSK	**Beam Forming Gain (Y):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	SB
Engineering Test Notes:			

Test Measurement Results

Test Frequency	Frequency Range	Unwanted Emissions Peak (dBm)							
		Port a		Port b		Port c		Port d	
MHz	MHz	SE	Limit	SE	Limit	SE	Limit	SE	Limit
902.2464	30.0 - 10000.0	-34.045	7.65						
915.1488	30.0 - 10000.0	-33.072	7.46						
927.8000	30.0 - 10000.0	-19.964	7.49						

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).

9.4.1.2. Conducted Band-Edge Emissions

Equipment Configuration for Conducted Low Band-Edge Emissions (Hopping) Peak

Variant:	FHSS	**Duty Cycle (%):**	99.0
Data Rate:	115.20 KBit/s	**Antenna Gain (dBi):**	Not Applicable
Modulation:	GFSK	**Beam Forming Gain (Y)(dB):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	SB
Engineering Test Notes:			

Test Measurement Results

Channel Frequency:	902.2464 MHz					
Band-Edge Frequency:	902.0 MHz					
Test Frequency Range:	875.0 - 905.0 MHz					
Port(s)	**Band-Edge Markers and Limit**			**Revised Limit**		**Margin**
	M1 Amplitude (dBm)	**Plot Limit (dBm)**	**M2 Frequency (MHz)**	**Amplitude (dBm)**	**M2A Frequency (MHz)**	**(MHz)**
a	0.92	8.16	902.00			**0.000**

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).

Equipment Configuration for Conducted Low Band-Edge Emissions (Static) Peak			

Variant:	FHSS	**Duty Cycle (%):**	99.0
Data Rate:	115.20 KBit/s	**Antenna Gain (dBi):**	Not Applicable
Modulation:	GFSK	**Beam Forming Gain (Y)(dB):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	SB
Engineering Test Notes:			

Test Measurement Results

Channel Frequency:	902.2464 MHz					
Band-Edge Frequency:	902.0 MHz					
Test Frequency Range:	875.0 - 905.0 MHz					
Port(s)	**Band-Edge Markers and Limit**			**Revised Limit**		**Margin**
	M1 Amplitude (dBm)	**Plot Limit (dBm)**	**M2 Frequency (MHz)**	**Amplitude (dBm)**	**M2A Frequency (MHz)**	**(MHz)**
a	3.00	8.02	902.00			**0.000**

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).

Equipment Configuration for Conducted Upper Band-Edge Emissions (Hopping) Peak			
Variant:	FHSS	**Duty Cycle (%):**	99.0
Data Rate:	115.20 KBit/s	**Antenna Gain (dBi):**	Not Applicable
Modulation:	GFSK	**Beam Forming Gain (Y)(dB):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	
Engineering Test Notes:			

Test Measurement Results

Channel Frequency:	927.800 MHz					
Band-Edge Frequency:	928.0 MHz					
Test Frequency Range:	925.0 - 950.0 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	6.96	7.66	928.00			**0.000**

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).

Equipment Configuration for Conducted Upper Band-Edge Emissions (Static) Peak			
Variant:	FHSS	**Duty Cycle (%):**	99.0
Data Rate:	115.20 KBit/s	**Antenna Gain (dBi):**	Not Applicable
Modulation:	GFSK	**Beam Forming Gain (Y)(dB):**	Not Applicable
TPC:	Not Applicable	**Tested By:**	
Engineering Test Notes:			

Test Measurement Results

Channel Frequency:	927.800 MHz					
Band-Edge Frequency:	928.0 MHz					
Test Frequency Range:	925.0 - 950.0 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	5.37	7.60	928.00			**0.000**

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).

9.4.2. Radiated Emissions

Radiated Test Conditions for Radiated Spurious and Band-Edge Emissions (Restricted Bands)			
Standard:	FCC CFR 47:15.247 RSS-247 Issue 2	**Ambient Temp. (ºC):**	20.0 - 24.5
Test Heading:	Radiated Spurious and Band-Edge Emissions	**Rel. Humidity (%):**	32 - 45
Standard Section(s):	15.205, 15.209 RSS-247 5.5. RSS-Gen 6.13, 8.9, 8.10	**Pressure (mBars):**	999 - 1001
Reference Document(s):	See Normative References		

Test Procedure for Radiated Spurious and Band-Edge Emissions (Restricted Bands)

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 and waveguide 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.

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

Limits for Restricted Bands
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 or Waveguide Loss

Example:
Given receiver input reading of 51.5 dBmV; 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 (FS) of the measured emission is:

FS = 51.5 + 8.5 + 1.3 - 26.0 +1 = 36.3 dBmV/m

Conversion between dBmV/m (or dBmV) and mV/m (or mV) are as follows:
Level (dBmV/m) = 20 * Log (level (mV/m))

40 dBmV/m = 100 mV/m
48 dBmV/m = 250 mV/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).

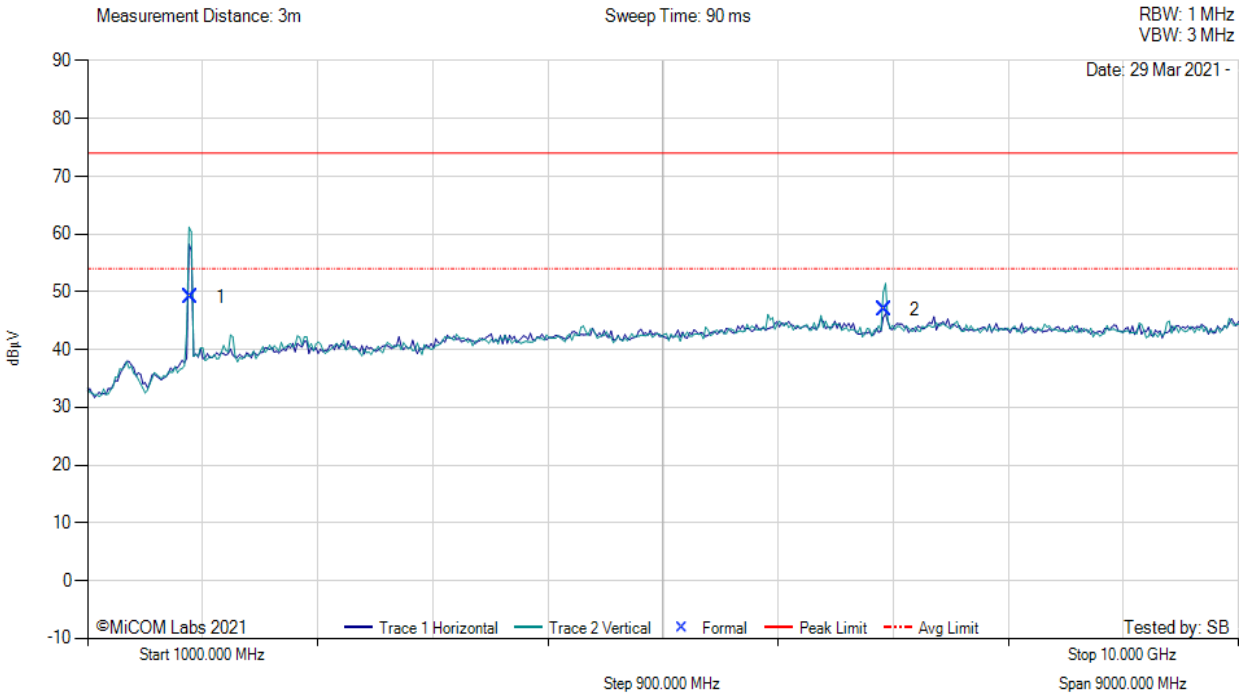
9.4.2.3. TX Spurious & Restricted Band Emissions

9.4.2.3.1. Omni Antenna 1GHz-10GHz

Equipment Configuration for Restricted Band Spurious Emissions			
Antenna:	Whip	**Variant:**	FHSS
Antenna Gain (dBi):	6.0	**Modulation:**	FSK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	99
Channel Frequency (MHz):	902.25	**Data Rate:**	Not Applicable
Power Setting:	Max	**Tested By:**	SB

Test Measurement Results

Variant: FHSS, Test Freq: 902.25 MHz, Power Setting: Max, Duty Cycle (%): 99



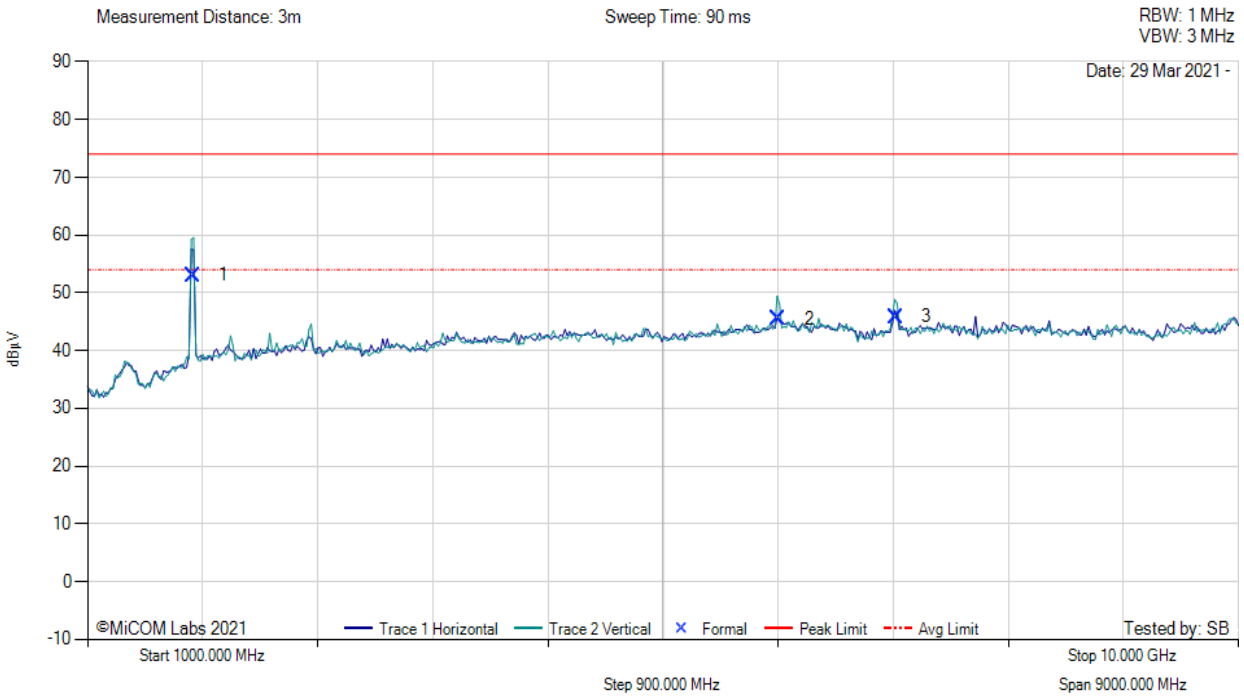
1000.00 - 10000.00 MHz												
Num	**Frequency MHz**	**Raw dBµV**	**Cable Loss dB**	**AF dB/m**	**Level dBµV/m**	**Measurement Type**	**Pol**	**Hgt cm**	**Azt Deg**	**Limit dBµV/m**	**Margin dB**	**Pass /Fail**
1	1804.79	61.82	1.75	-14.51	49.06	Peak (NRB)	Vertical	100	0	--	--	Pass
2	7230.87	51.37	3.57	-8.06	46.88	Peak (NRB)	Vertical	100	0	--	--	Pass

Equipment Configuration for Restricted Band Spurious Emissions

Antenna:	Whip	**Variant:**	FHSS
Antenna Gain (dBi):	6.0	**Modulation:**	FSK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	99
Channel Frequency (MHz):	915.15	**Data Rate:**	Not Applicable
Power Setting:	Max	**Tested By:**	SB

Test Measurement Results

Variant: FHSS, Test Freq: 915.15 MHz, Power Setting: Max, Duty Cycle (%): 99



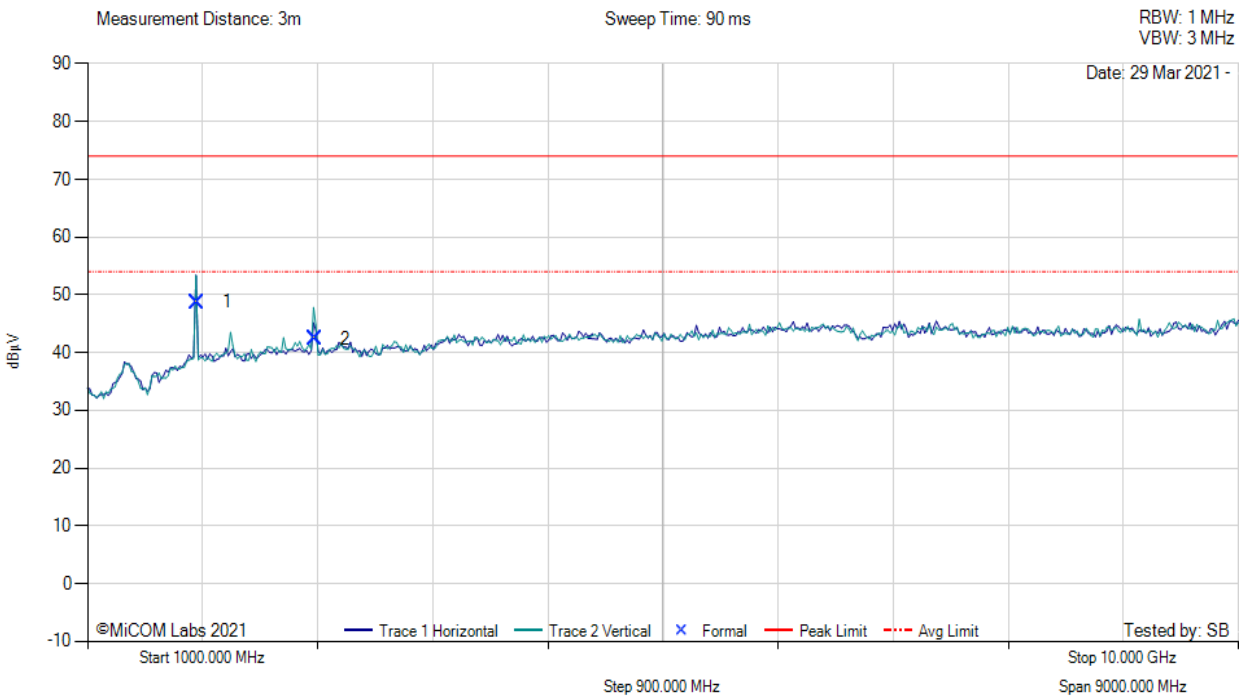
1000.00 - 10000.00 MHz												
Num	**Frequency MHz**	**Raw dBµV**	**Cable Loss dB**	**AF dB/m**	**Level dBµV/m**	**Measurement Type**	**Pol**	**Hgt cm**	**Azt Deg**	**Limit dBµV/m**	**Margin dB**	**Pass /Fail**
1	1825.16	65.50	1.76	-14.18	53.08	Peak (NRB)	Vertical	100	0	--	--	Pass
2	6404.47	51.17	3.35	-9.07	45.45	Peak (NRB)	Vertical	100	0	--	--	Pass
3	7317.81	49.97	3.61	-7.75	45.83	Peak (Scan)	Vertical	125	0	74.0	-28.2	Pass

Equipment Configuration for Restricted Band Spurious Emissions

Antenna:	Whip	**Variant:**	FHSS
Antenna Gain (dBi):	6.0	**Modulation:**	FSK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	99
Channel Frequency (MHz):	927.80	**Data Rate:**	Not Applicable
Power Setting:	Max	**Tested By:**	SB

Test Measurement Results

Variant: FHSS, Test Freq: 927.80 MHz, Power Setting: Max, Duty Cycle (%): 99



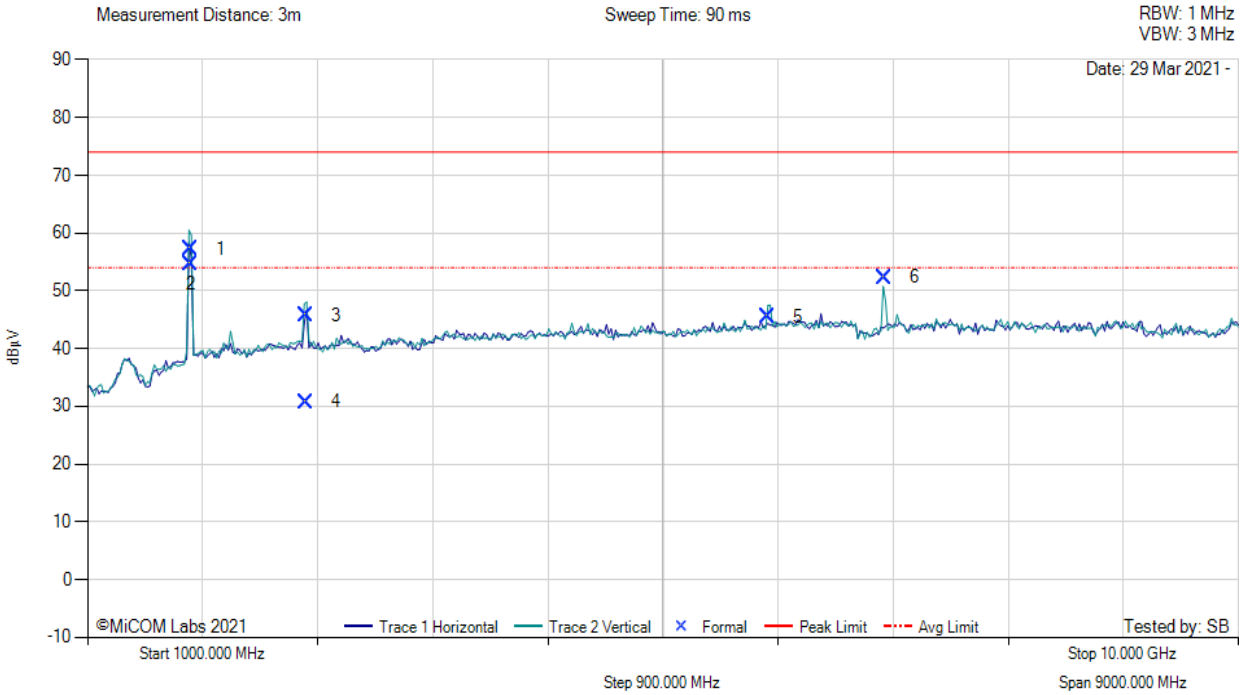
1000.00 - 10000.00 MHz												
Num	**Frequency MHz**	**Raw dBµV**	**Cable Loss dB**	**AF dB/m**	**Level dBµV/m**	**Measurement Type**	**Pol**	**Hgt cm**	**Azt Deg**	**Limit dBµV/m**	**Margin dB**	**Pass /Fail**
1	1853.26	61.08	1.77	-14.08	48.77	Peak (NRB)	Vertical	100	0	--	--	Pass
2	2779.70	52.25	2.16	-12.03	42.38	Peak (Scan)	Vertical	154	46	74.0	-31.6	Pass

9.4.2.3.2. Yagi Antenna 1GHz-10GHz

Equipment Configuration for Restricted Band Spurious Emissions			
Antenna:	Yagi	**Variant:**	FHSS
Antenna Gain (dBi):	6.0	**Modulation:**	FSK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	99
Channel Frequency (MHz):	902.25	**Data Rate:**	
Power Setting:	Max	**Tested By:**	SB

Test Measurement Results

Variant: FHSS, Test Freq: 902.25 MHz, Power Setting: Max, Duty Cycle (%): 99



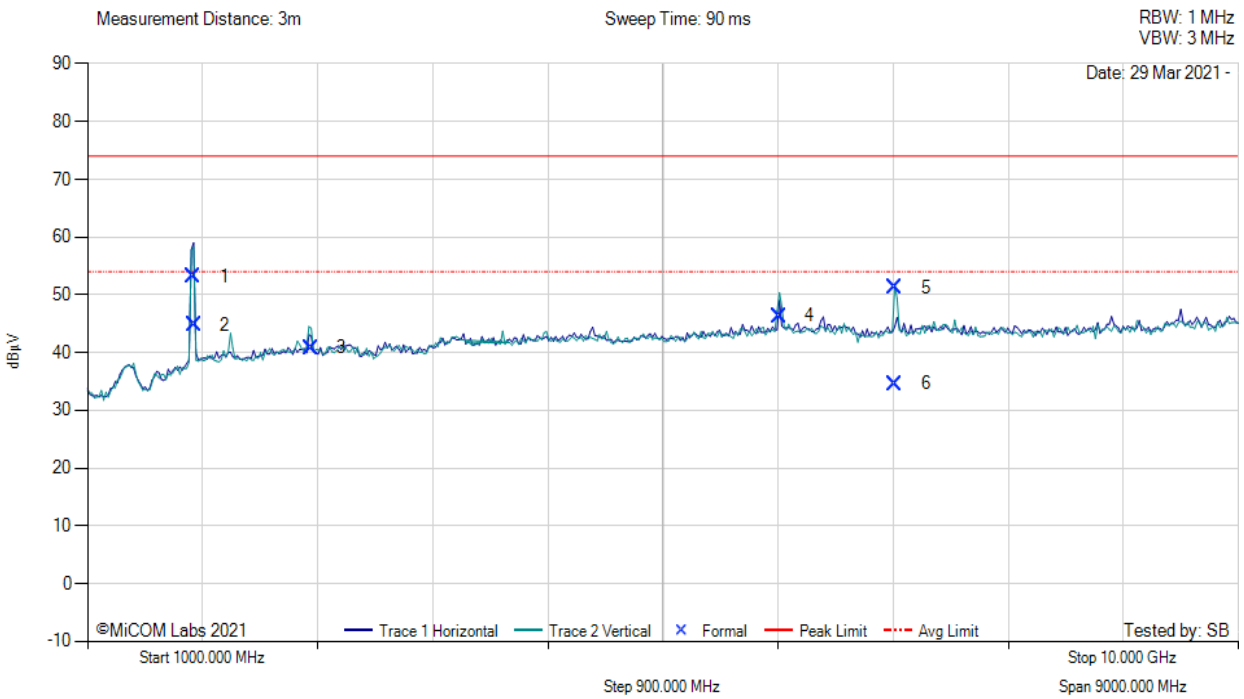
1000.00 - 10000.00 MHz												
Num	**Frequency MHz**	**Raw dBµV**	**Cable Loss dB**	**AF dB/m**	**Level dBµV/m**	**Measurement Type**	**Pol**	**Hgt cm**	**Azt Deg**	**Limit dBµV/m**	**Margin dB**	**Pass /Fail**
1	1804.89	70.03	1.75	-14.51	57.27	Peak (NRB)	Vertical	100	0	--	--	Pass
2	1807.53	67.46	1.76	-14.48	54.74	Peak (NRB)	Horizontal	100	0	--	--	Pass
3	2707.94	55.67	2.13	-12.14	45.66	Max Peak	Vertical	165	282	74.0	-28.3	Pass
4	2707.94	40.80	2.13	-12.14	30.79	Max Avg	Vertical	165	282	54.0	-23.2	Pass
5	6317.25	51.31	3.35	-9.18	45.48	Peak (NRB)	Vertical	199	187	--	--	Pass
6	7227.53	56.80	3.58	-8.08	52.30	Peak (NRB)	Vertical	199	187	--	--	Pass

Equipment Configuration for Restricted Band Spurious Emissions

Antenna:	Yagi	**Variant:**	FHSS
Antenna Gain (dBi):	6.0	**Modulation:**	FSK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	99
Channel Frequency (MHz):	915.15	**Data Rate:**	
Power Setting:	Max	**Tested By:**	SB

Test Measurement Results

Variant: FHSS, Test Freq: 915.15 MHz, Power Setting: Max, Duty Cycle (%): 99



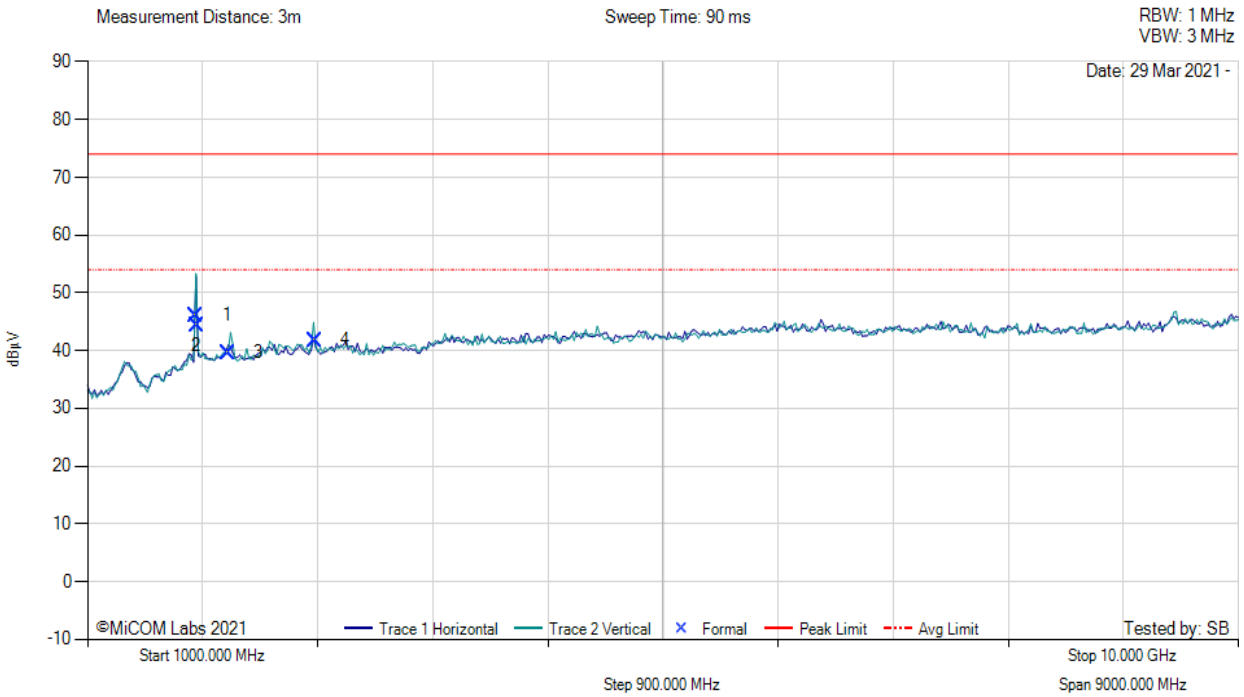
1000.00 - 10000.00 MHz												
Num	**Frequency MHz**	**Raw dBµV**	**Cable Loss dB**	**AF dB/m**	**Level dBµV/m**	**Measurement Type**	**Pol**	**Hgt cm**	**Azt Deg**	**Limit dBµV/m**	**Margin dB**	**Pass /Fail**
1	1830.39	65.60	1.76	-14.14	53.22	Peak (NRB)	Vertical	100	0	--	--	Pass
2	1833.68	57.14	1.76	-14.14	44.76	Peak (NRB)	Horizontal	100	0	--	--	Pass
3	2747.07	50.55	2.15	-11.92	40.78	Peak (Scan)	Vertical	100	0	74.0	-33.2	Pass
4	6411.10	51.95	3.47	-9.08	46.34	Peak (NRB)	Vertical	100	0	--	--	Pass
5	7316.19	55.45	3.61	-7.76	51.30	Max Peak	Vertical	178	160	74.0	-22.7	Pass
6	7316.19	38.72	3.61	-7.76	34.57	Max Avg	Vertical	178	160	54.0	-19.4	Pass

Equipment Configuration for Restricted Band Spurious Emissions

Antenna:	Yagi	**Variant:**	FHSS
Antenna Gain (dBi):	6.0	**Modulation:**	FSK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	99
Channel Frequency (MHz):	927.80	**Data Rate:**	
Power Setting:	Max	**Tested By:**	SB

Test Measurement Results

Variant: FHSS, Test Freq: 927.80 MHz, Power Setting: Max, Duty Cycle (%): 99



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	1850.53	58.38	1.77	-14.06	46.09	Peak (NRB)	Horizontal	100	0	--	--	Pass
2	1851.52	56.68	1.77	-14.07	44.38	Peak (NRB)	Vertical	100	0	--	--	Pass
3	2098.91	50.76	1.89	-13.03	39.62	Peak (NRB)	Horizontal	100	0	--	--	Pass
4	2777.00	51.71	2.16	-12.08	41.79	Peak (Scan)	Vertical	100	0	74.0	-32.2	Pass

9.4.3. 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. (ºC):**	20.0 - 24.5
Test Heading:	Digital Emissions	**Rel. Humidity (%):**	32 - 45
Standard Section(s):	15.205, 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.

Limits for Radiated Digital Emissions (0.03 – 1 GHz)

Radiated emission limits; general requirements (15.209)

(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)
	µV/m (microvolts/meter)	dBµV/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.

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).

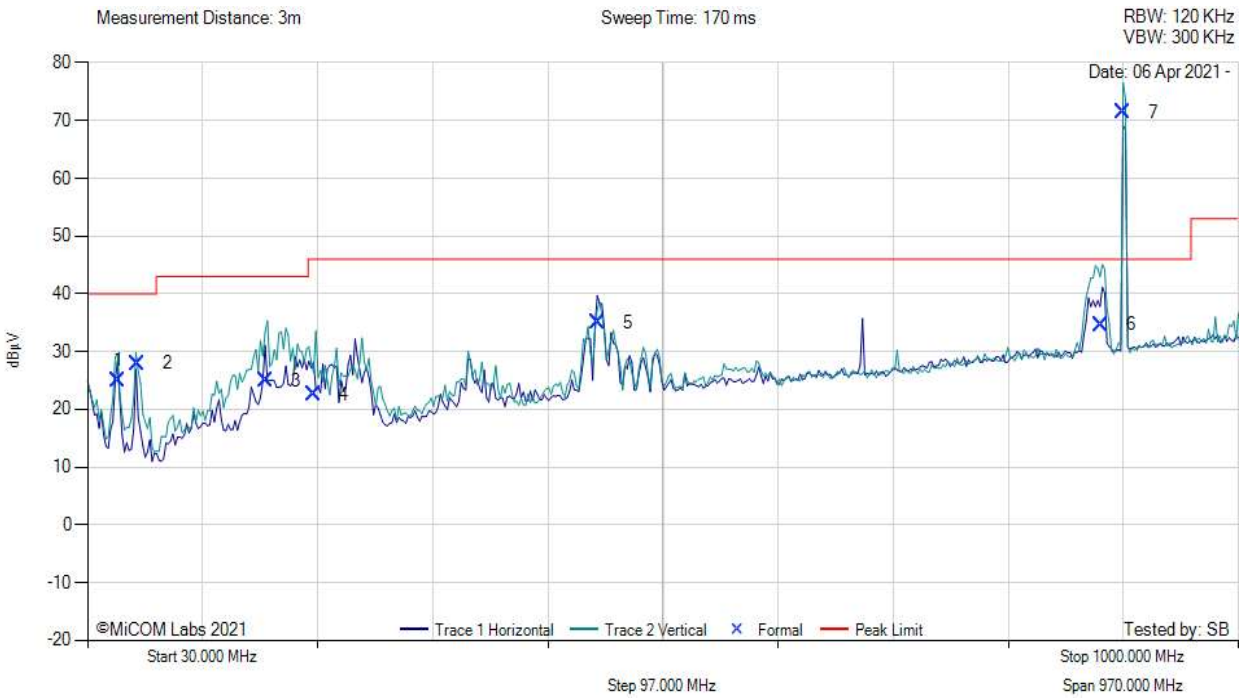
(e) Harmonic emissions appearing in the restricted bands above 17.7 GHz from field disturbance sensors operating under the provisions of §15.245 shall not exceed the limits specified in §15.245(b).

9.4.3.3.1. Whip Antenna 30MHz-1GHz

Equipment Configuration for Radiated Digital Emissions			
Antenna:	Whip	**Variant:**	FHSS
Antenna Gain (dBi):	6.0	**Modulation:**	FSK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	99
Channel Frequency (MHz):	902.25	**Data Rate:**	Not Applicable
Power Setting:		**Tested By:**	SB

Test Measurement Results

Variant: FHSS, Test Freq: 902.25 MHz, Duty Cycle (%): 99

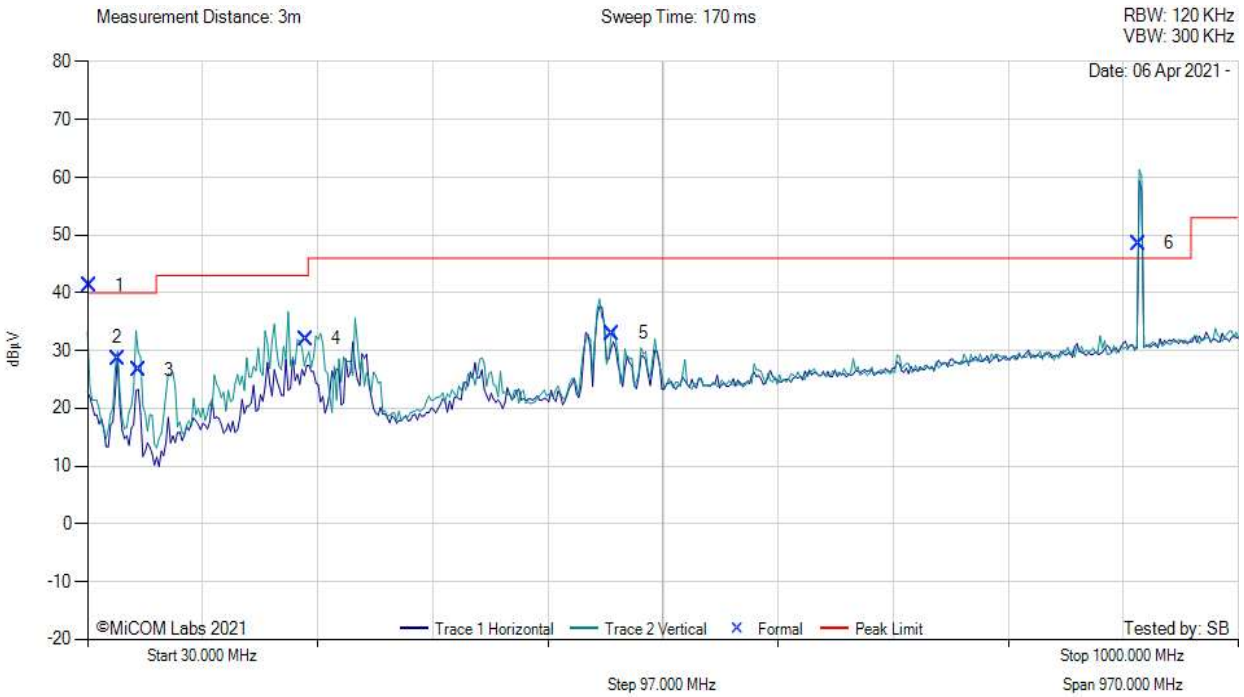


30.00 - 1000.00 MHz												
Num	**Frequency MHz**	**Raw dBµV**	**Cable Loss dB**	**AF dB/m**	**Level dBµV/m**	**Measurement Type**	**Pol**	**Hgt cm**	**Azt Deg**	**Limit dBµV/m**	**Margin dB**	**Pass /Fail**
1	55.80	42.44	3.77	-21.25	24.96	MaxQP	Vertical	123	33	40.0	-15.0	Pass
2	71.96	44.47	3.89	-20.42	27.94	MaxQP	Vertical	147	30	40.0	-12.1	Pass
3	180.32	37.63	4.45	-17.12	24.96	MaxQP	Vertical	101	349	43.0	-18.0	Pass
4	220.96	34.90	4.62	-16.98	22.54	MaxQP	Vertical	101	336	46.0	-23.5	Pass
5	459.83	40.39	5.45	-10.77	35.07	MaxQP	Horizontal	189	223	46.0	-10.9	Pass
6	884.17	33.00	6.71	-5.02	34.69	MaxQP	Vertical	113	123	46.0	-11.3	Pass
7	902.51	69.66	6.76	-4.93	71.49	Fundamental	Vertical	100	0	--	--	

Equipment Configuration for Radiated Digital Emissions			
Antenna:	Whip	**Variant:**	FHSS
Antenna Gain (dBi):	6.0	**Modulation:**	FSK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	99
Channel Frequency (MHz):	915.15	**Data Rate:**	Not Applicable
Power Setting:		**Tested By:**	SB

Test Measurement Results

Variant: FHSS, Test Freq: 915.15 MHz, Duty Cycle (%): 99



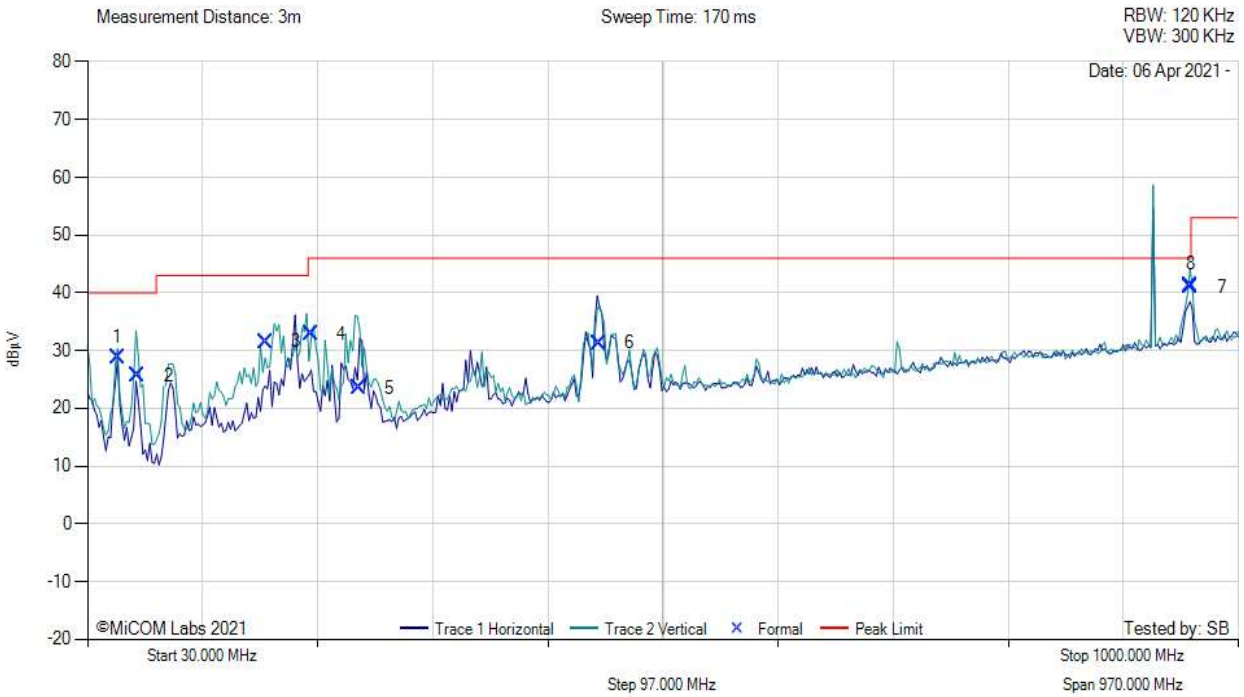
30.00 - 1000.00 MHz												
Num	**Frequency MHz**	**Raw dBµV**	**Cable Loss dB**	**AF dB/m**	**Level dBµV/m**	**Measurement Type**	**Pol**	**Hgt cm**	**Azt Deg**	**Limit dBµV/m**	**Margin dB**	**Pass /Fail**
1	31.79	46.32	3.55	-8.70	41.17	Peak (NRB)	Vertical	100	160	--	--	Pass
2	55.21	46.16	3.77	-21.25	28.68	Peak (NRB)	Vertical	100	160	--	--	Pass
3	73.38	43.18	3.91	-20.47	26.62	MaxQP	Vertical	108	240	40.0	-13.4	Pass
4	214.03	44.67	4.59	-17.20	32.06	Peak (NRB)	Vertical	100	160	--	--	Pass
5	472.41	37.70	5.49	-10.23	32.96	Peak (NRB)	Vertical	100	160	--	--	Pass
6	915.31	46.44	6.80	-4.66	48.58	Peak (NRB)	Vertical	100	0	--	--	Pass

Equipment Configuration for Radiated Digital Emissions

Antenna:	Whip	**Variant:**	FHSS
Antenna Gain (dBi):	6.0	**Modulation:**	FSK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	99
Channel Frequency (MHz):	927.80	**Data Rate:**	Not Applicable
Power Setting:		**Tested By:**	SB

Test Measurement Results

Variant: FHSS, Test Freq: 927.80 MHz, Duty Cycle (%): 99

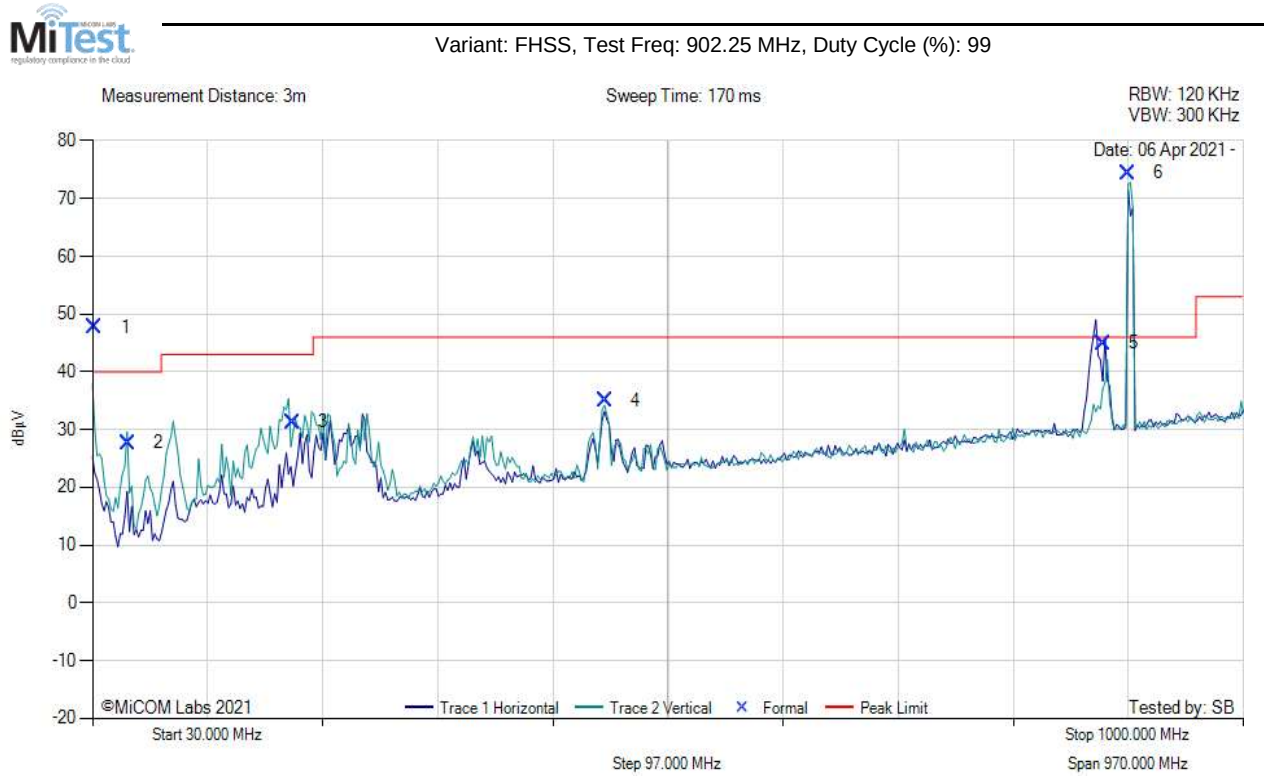


30.00 - 1000.00 MHz												
Num	**Frequency MHz**	**Raw dBµV**	**Cable Loss dB**	**AF dB/m**	**Level dBµV/m**	**Measurement Type**	**Pol**	**Hgt cm**	**Azt Deg**	**Limit dBµV/m**	**Margin dB**	**Pass /Fail**
1	55.22	46.26	3.77	-21.25	28.78	Peak (NRB)	Vertical	100	163	--	--	Pass
2	72.36	42.27	3.90	-20.49	25.68	Peak (NRB)	Vertical	100	163	--	--	Pass
3	179.93	44.24	4.45	-17.13	31.56	Peak (NRB)	Vertical	100	163	--	--	Pass
4	218.43	45.29	4.61	-16.99	32.92	Peak (NRB)	Vertical	100	163	--	--	Pass
5	259.18	34.54	4.76	-15.73	23.57	MaxQP	Vertical	101	255	46.0	-22.4	Pass
6	461.36	36.52	5.46	-10.64	31.34	Peak (NRB)	Horizontal	100	163	--	--	Pass
7	960.02	38.21	6.94	-4.09	41.06	MaxQP	Vertical	132	268	46.0	-4.9	Pass
8	960.02	38.49	6.94	-4.09	41.34	MaxQP	Vertical	125	311	46.0	-4.7	Pass

9.4.3.3.2. Yagi Antenna 30MHz-1GHz

Equipment Configuration for Radiated Digital Emissions			
Antenna:	Yagi	**Variant:**	FHSS
Antenna Gain (dBi):	6.0	**Modulation:**	FSK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	99
Channel Frequency (MHz):	902.25	**Data Rate:**	Not Applicable
Power Setting:		**Tested By:**	SB

Test Measurement Results



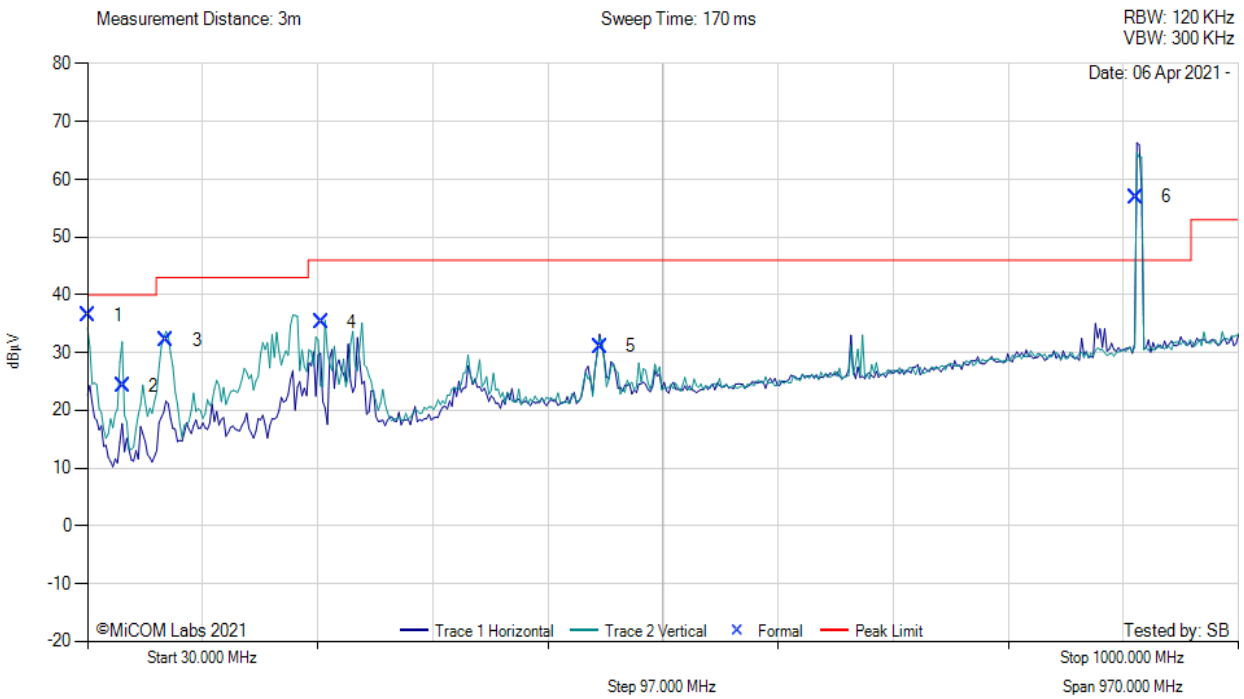
30.00 - 1000.00 MHz												
Num	**Frequency MHz**	**Raw dBµV**	**Cable Loss dB**	**AF dB/m**	**Level dBµV/m**	**Measurement Type**	**Pol**	**Hgt cm**	**Azt Deg**	**Limit dBµV/m**	**Margin dB**	**Pass /Fail**
1	31.97	52.81	3.55	-8.70	47.65	Peak (NRB)	Vertical	194	126	--	--	Pass
2	60.08	44.97	3.80	-21.08	27.69	Peak (NRB)	Vertical	100	126	--	--	Pass
3	198.48	42.23	4.53	-15.44	31.32	Peak (NRB)	Vertical	100	126	--	--	Pass
4	462.05	40.17	5.46	-10.65	34.98	Peak (NRB)	Horizontal	100	217	--	--	Pass
5	882.26	43.36	6.72	-5.16	44.92	Peak (NRB)	Horizontal	100	217	--	--	Pass
6	902.26	72.61	6.76	-4.92	74.45	Fundamental	Vertical	100	217	--	--	

Equipment Configuration for Radiated Digital Emissions

Antenna:	Yagi	**Variant:**	FHSS
Antenna Gain (dBi):	6.0	**Modulation:**	FSK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	99
Channel Frequency (MHz):	915.15	**Data Rate:**	Not Applicable
Power Setting:		**Tested By:**	SB

Test Measurement Results

Variant: FHSS, Test Freq: 915.15 MHz, Duty Cycle (%): 99



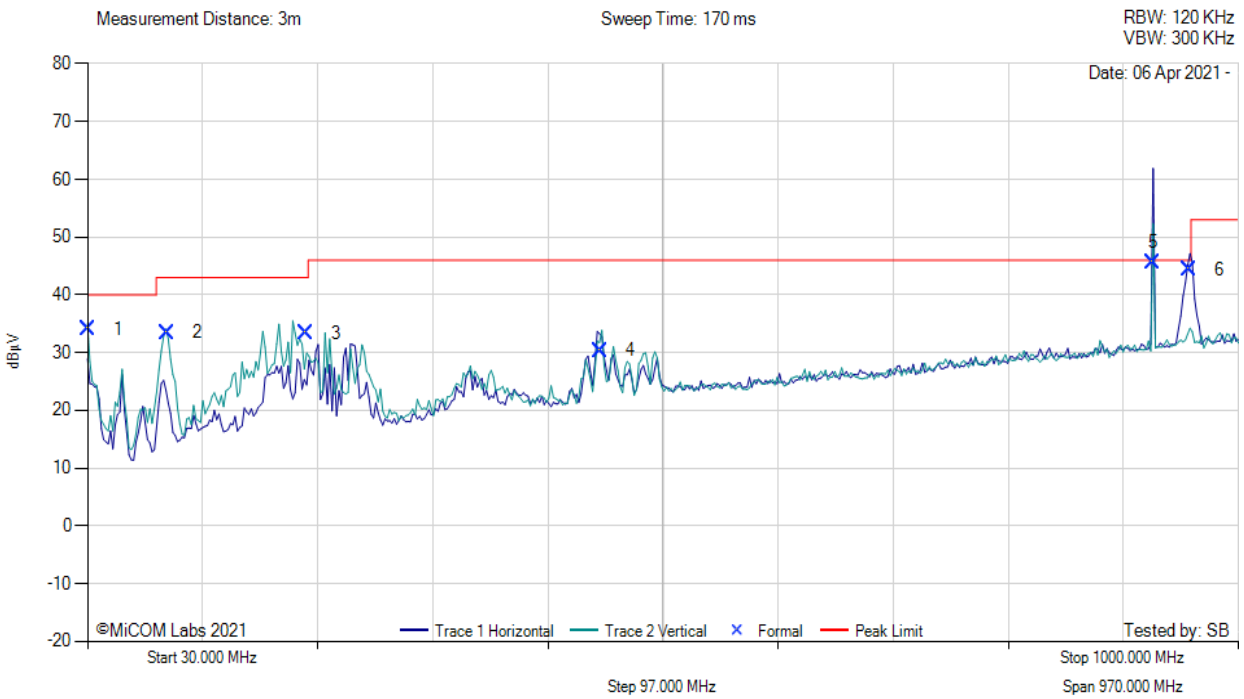
30.00 - 1000.00 MHz												
Num	**Frequency MHz**	**Raw dBµV**	**Cable Loss dB**	**AF dB/m**	**Level dBµV/m**	**Measurement Type**	**Pol**	**Hgt cm**	**Azt Deg**	**Limit dBµV/m**	**Margin dB**	**Pass /Fail**
1	30.00	40.11	3.52	-7.20	36.43	Peak (NRB)	Vertical	100	172	--	--	Pass
2	60.06	41.51	3.80	-21.08	24.23	Peak (NRB)	Vertical	100	172	--	--	Pass
3	96.52	47.53	4.03	-19.39	32.17	Peak (NRB)	Vertical	100	172	--	--	Pass
4	227.00	47.21	4.65	-16.68	35.18	Peak (NRB)	Vertical	100	172	--	--	Pass
5	461.97	36.22	5.46	-10.64	31.04	Peak (NRB)	Horizontal	100	172	--	--	Pass
6	913.79	54.82	6.79	-4.65	56.97	Fundamental	Horizontal	100	172	--	--	

Equipment Configuration for Radiated Digital Emissions

Antenna:	Yagi	**Variant:**	FHSS
Antenna Gain (dBi):	6.0	**Modulation:**	FSK
Beam Forming Gain (Y):	Not Applicable	**Duty Cycle (%):**	99
Channel Frequency (MHz):	927.80	**Data Rate:**	Not Applicable
Power Setting:		**Tested By:**	SB

Test Measurement Results

Variant: FHSS, Test Freq: 927.80 MHz, Duty Cycle (%): 99



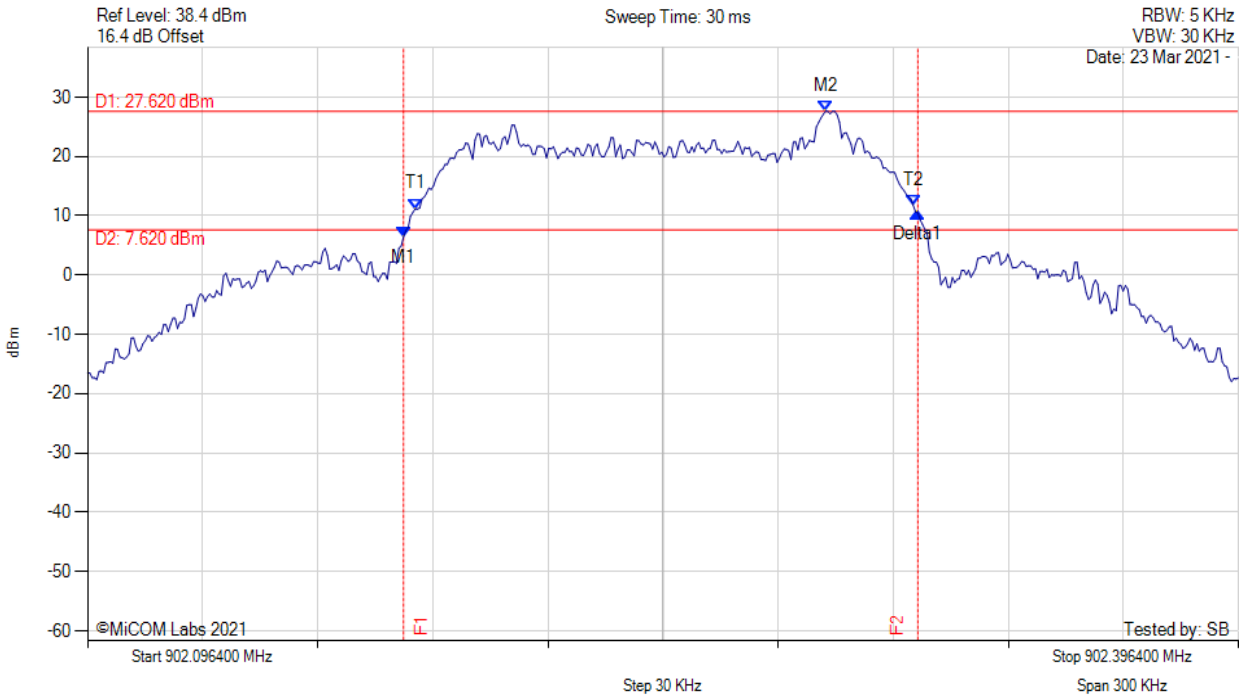
30.00 - 1000.00 MHz												
Num	**Frequency MHz**	**Raw dBµV**	**Cable Loss dB**	**AF dB/m**	**Level dBµV/m**	**Measurement Type**	**Pol**	**Hgt cm**	**Azt Deg**	**Limit dBµV/m**	**Margin dB**	**Pass /Fail**
1	30.62	38.79	3.54	-8.20	34.13	Peak (NRB)	Vertical	100	172	--	--	Pass
2	96.96	48.86	4.03	-19.39	33.50	Peak (NRB)	Vertical	100	172	--	--	Pass
3	214.02	45.97	4.59	-17.20	33.36	Peak (NRB)	Vertical	100	172	--	--	Pass
4	462.08	35.52	5.46	-10.65	30.33	Peak (NRB)	Horizontal	100	172	--	--	Pass
5	927.69	43.29	6.83	-4.58	45.54	Peak (NRB)	Horizontal	100	172	--	--	Pass
6	958.67	41.64	6.94	-4.21	44.37	MaxQP	Horizontal	98	263	46.0	-1.6	Pass

A. APPENDIX - GRAPHICAL IMAGES

A.1. 20 dB & 99% Bandwidth

20 dB 99% BANDWIDTH

Variant: FHSS, Channel: 902.25 MHz, Chain a, Temp: 20, Voltage: 5.0 Vdc

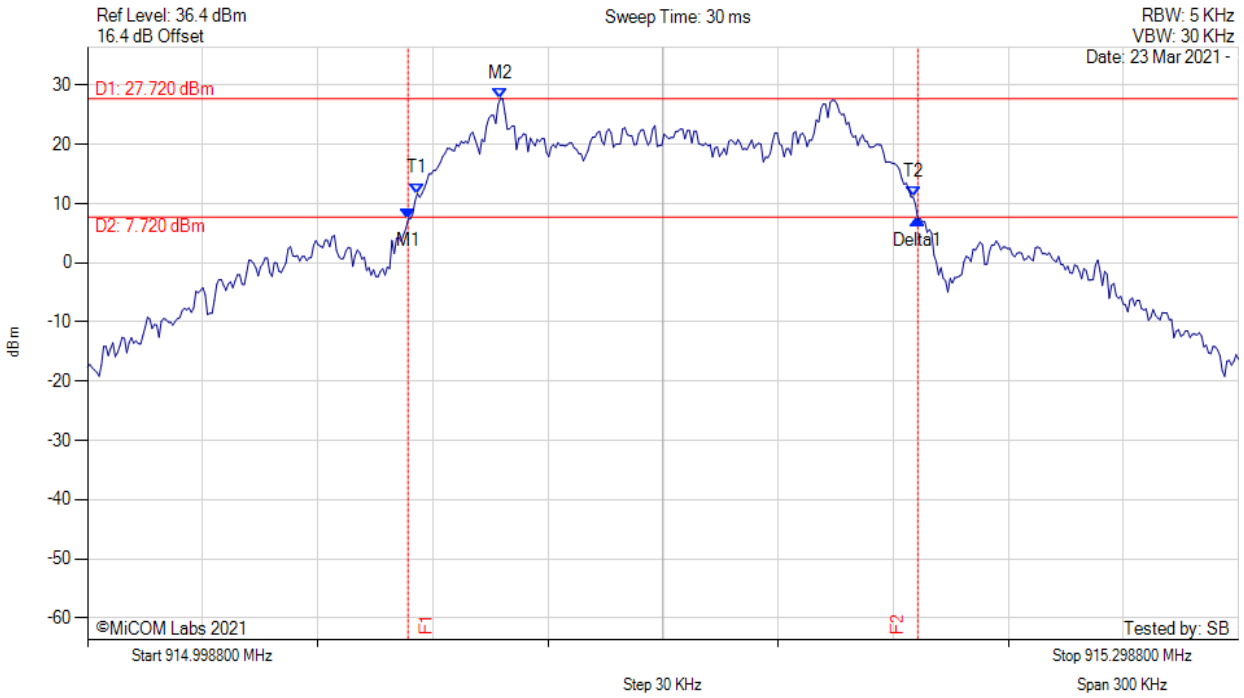


Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 40 Trace Mode = VIEW	M1 : 902.179 MHz : 6.482 dBm M2 : 902.289 MHz : 27.623 dBm Delta1 : 134 KHz : 4.035 dB T1 : 902.182 MHz : 11.134 dBm T2 : 902.312 MHz : 11.752 dBm OBW : 130 KHz	Measured 20 dB Bandwidth: 0.134 MHz Limit: 0.5 kHz Margin: 0.37 MHz

back to matrix

20 dB 99% BANDWIDTH

Variant: FHSS, Channel: 915.15 MHz, Chain a, Temp: 20, Voltage: 5.0 Vdc

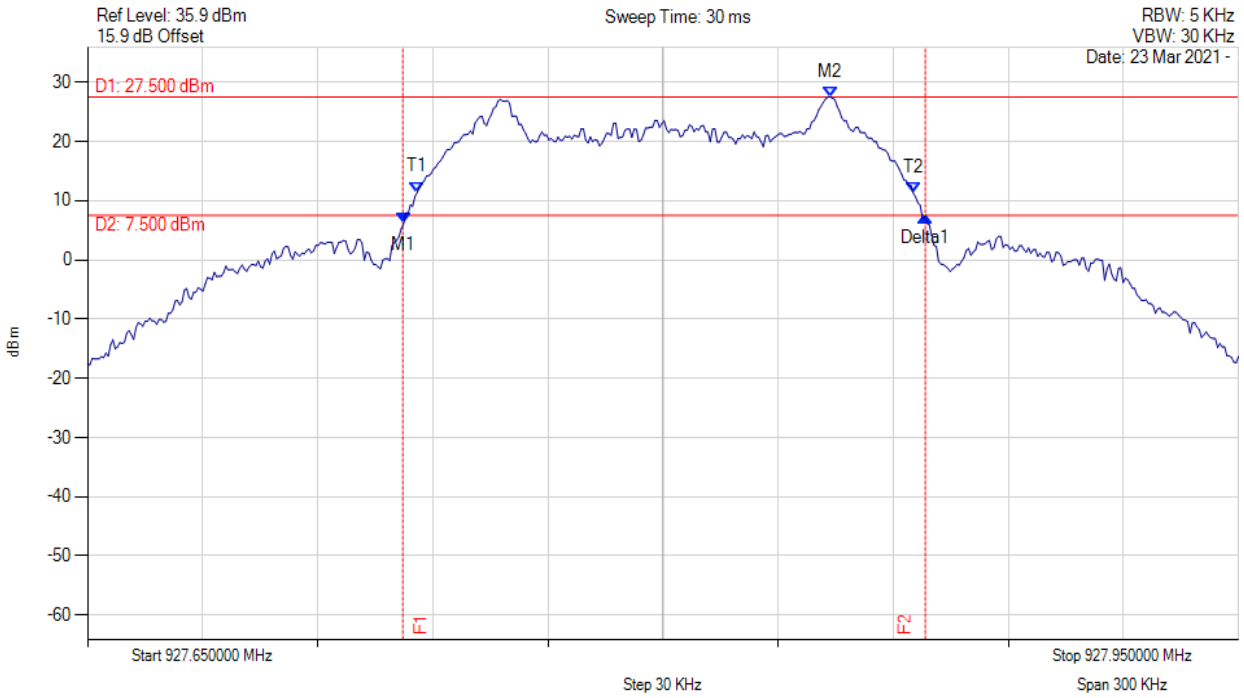


Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 30 Trace Mode = VIEW	M1 : 915.082 MHz : 7.334 dBm M2 : 915.106 MHz : 27.716 dBm Delta1 : 133 KHz : -0.014 dB T1 : 915.085 MHz : 11.710 dBm T2 : 915.214 MHz : 11.082 dBm OBW : 129 KHz	Measured 20 dB Bandwidth: 0.133 MHz Limit: 0.5 kHz Margin: 0.37 MHz

back to matrix

20 dB 99% BANDWIDTH

Variant: FHSS, Channel: 927.80 MHz, Chain a, Temp: 20, Voltage: 5.0 Vdc



Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 30 Trace Mode = VIEW	M1 : 927.732 MHz : 6.100 dBm M2 : 927.844 MHz : 27.505 dBm Delta1 : 136 KHz : 1.287 dB T1 : 927.736 MHz : 11.438 dBm T2 : 927.865 MHz : 11.316 dBm OBW : 129 KHz	Measured 20 dB Bandwidth: 0.136 MHz Limit: 0.5 kHz Margin: 0.36 MHz

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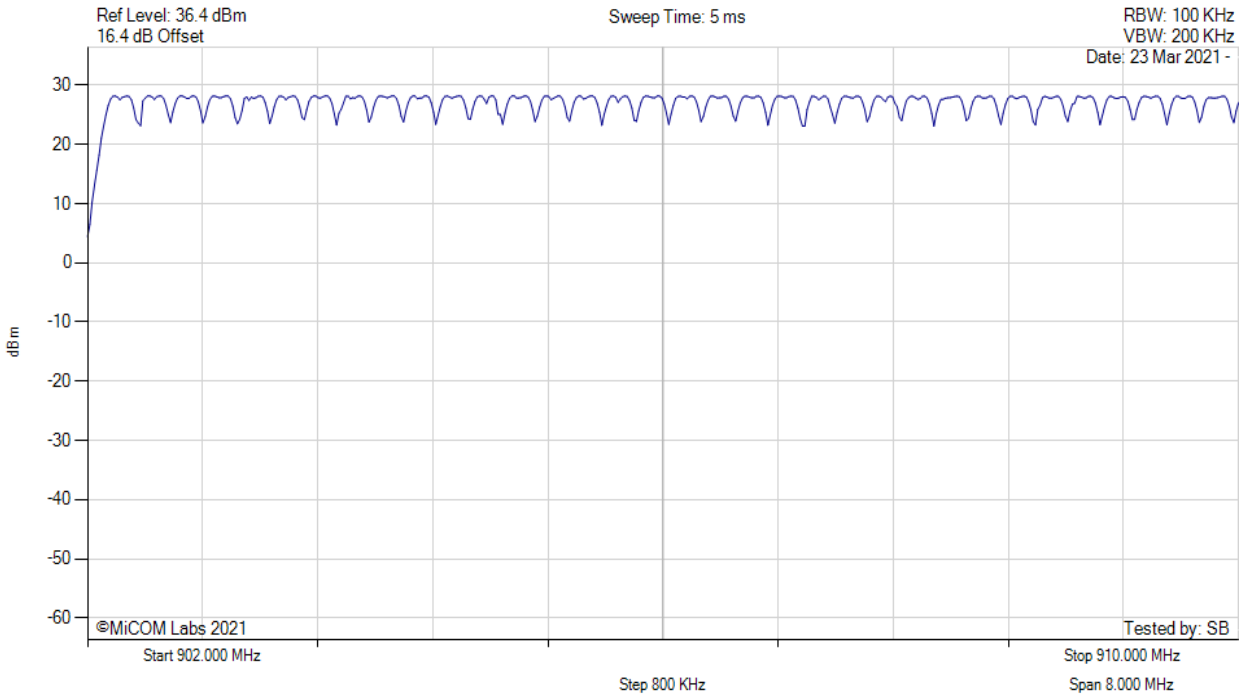
A.2. Frequency Hopping Tests

A.2.1. Number of Hopping Channels

NUMBER OF HOPPING CHANNELS

Variant: FHSS, Channel: 915.15 MHz, Chain a, Temp: 20, Voltage: 5.0 Vdc



Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 30 Trace Mode = VIEW		Channel Frequency: 915.15 MHz

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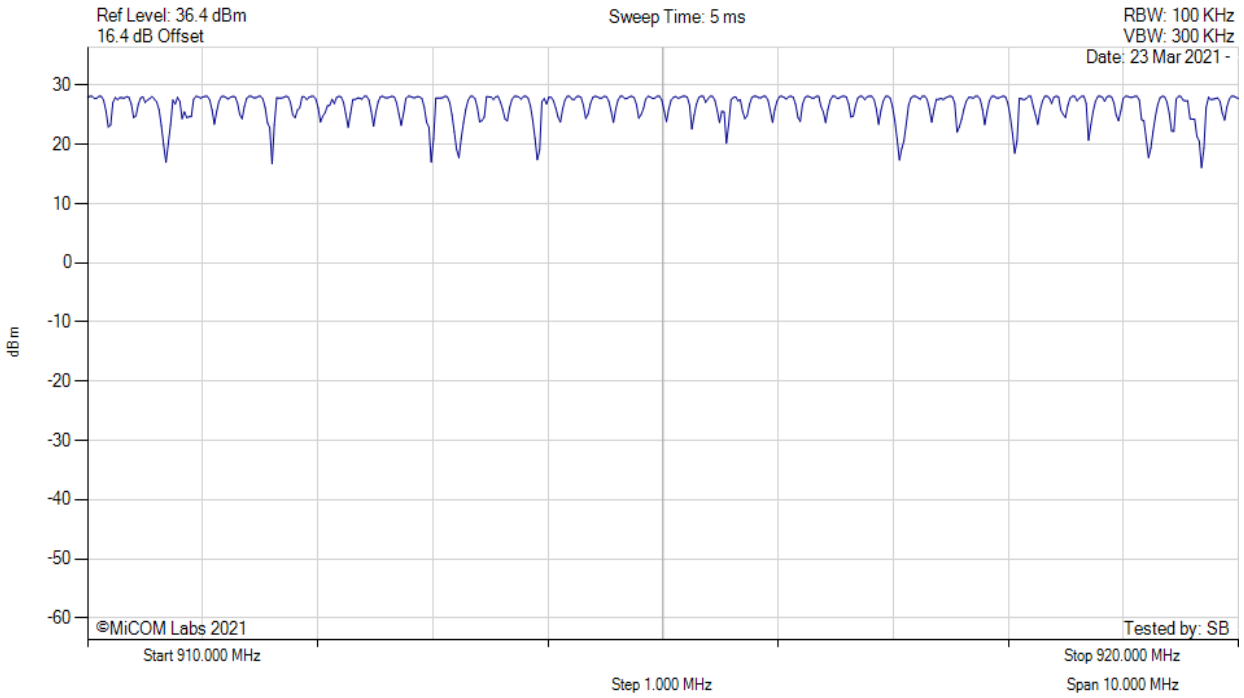
NUMBER OF HOPPING CHANNELS

Variant: FHSS, Channel: 915.15 MHz, Chain a, Temp: 20, Voltage: 5.0 Vdc



Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 30 Trace Mode = VIEW		Channel Frequency: 915.15 MHz

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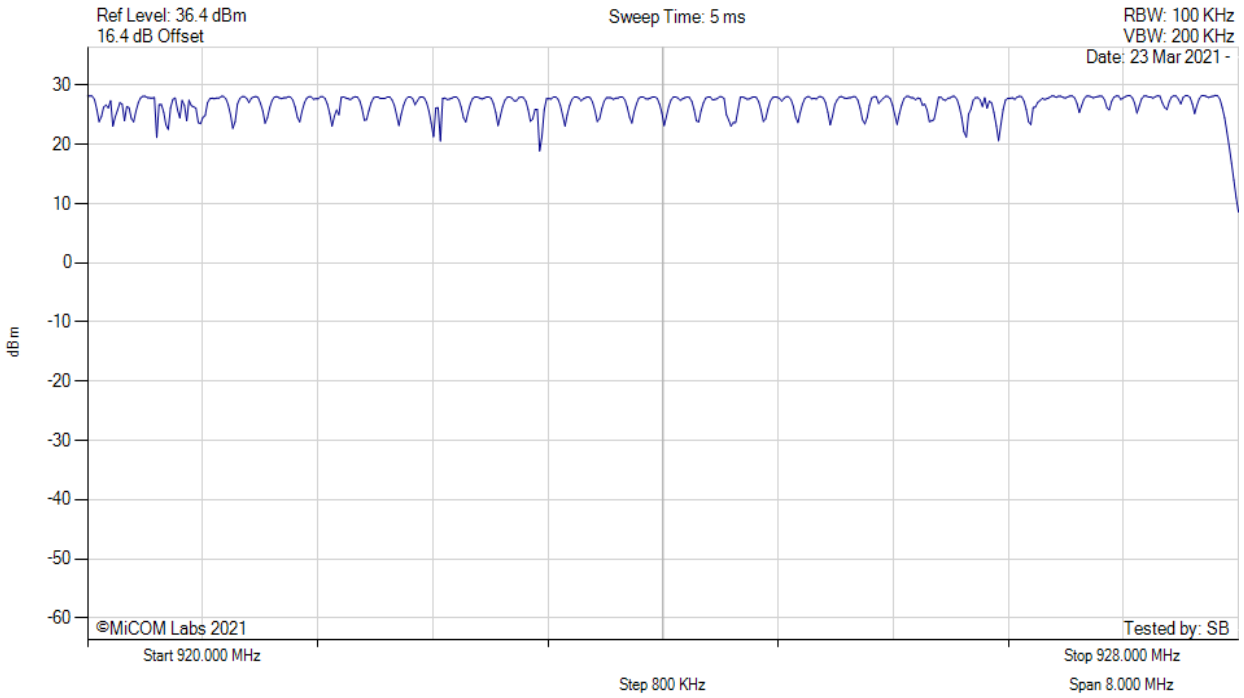
NUMBER OF HOPPING CHANNELS

Variant: FHSS, Channel: 915.15 MHz, Chain a, Temp: 20, Voltage: 5.0 Vdc



Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 30 Trace Mode = VIEW		Channel Frequency: 915.15 MHz

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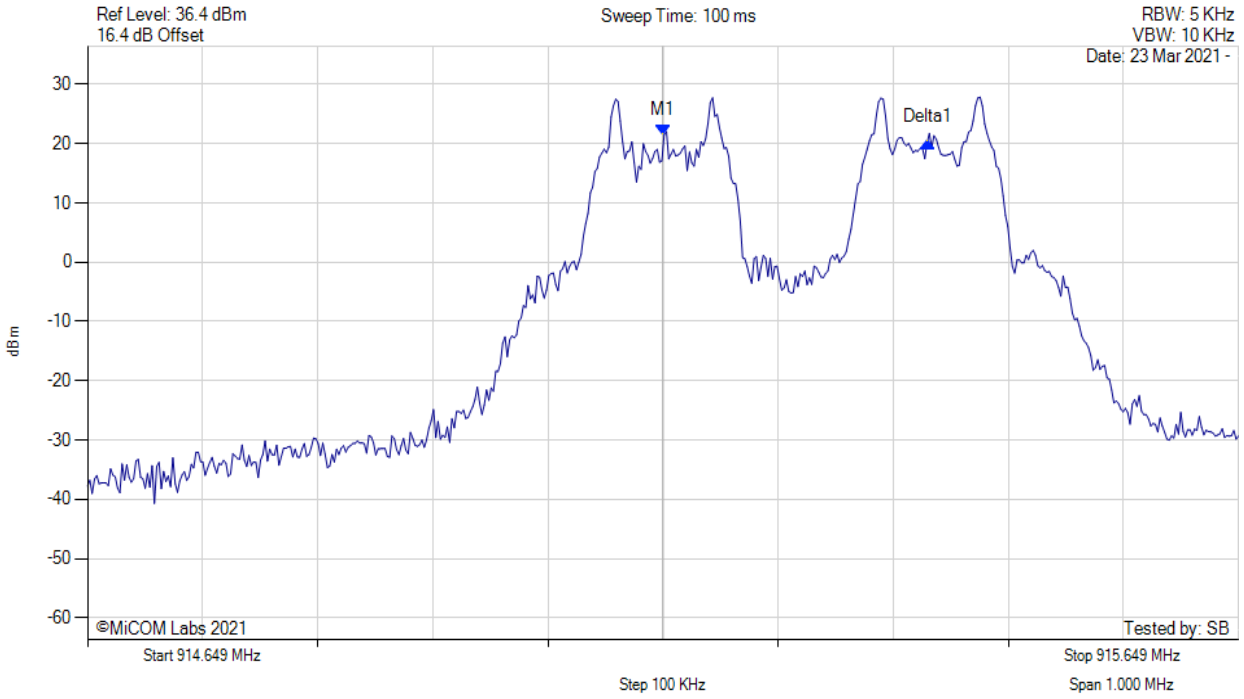
A.2.2. Channel Separation

CHANNEL SEPARATION

Variant: FHSS, Channel: 915.15 MHz, Chain a, Temp: 20, Voltage: 5.0 Vdc



Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 30 Trace Mode = VIEW	M1 : 915.149 MHz : 21.421 dBm Delta1 : 230 KHz : -1.249 dB	Channel Frequency: 915.15 MHz

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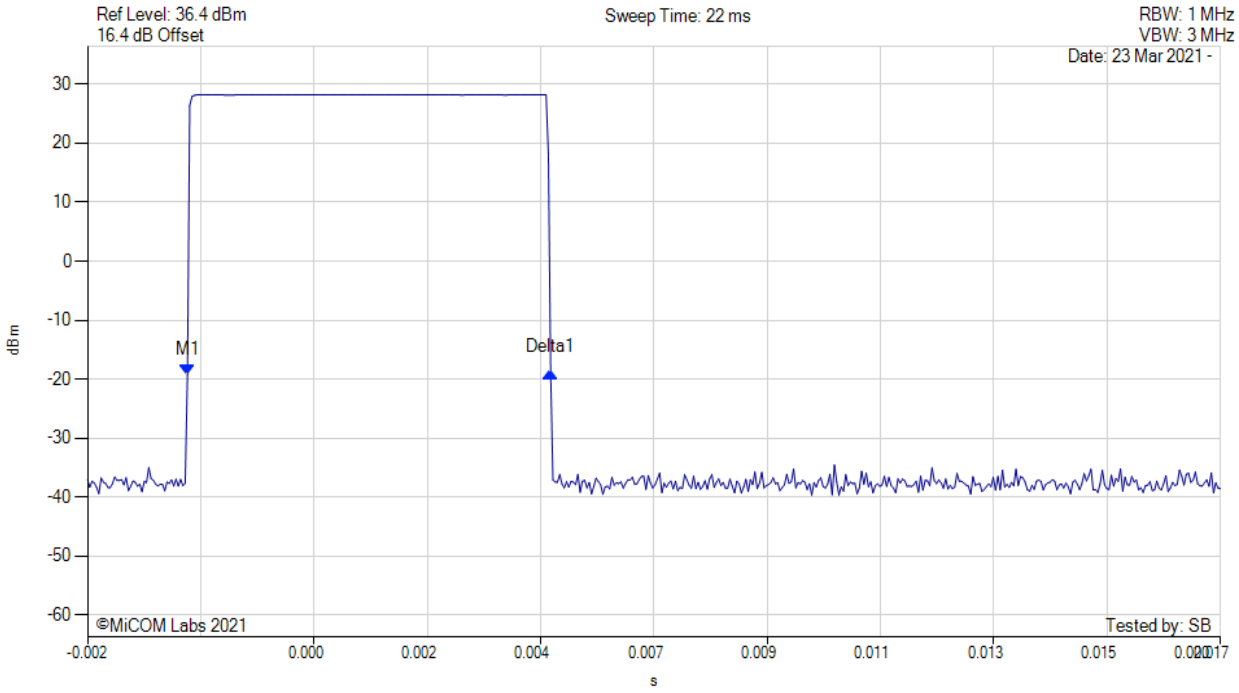
A.2.3. Dwell Time

DWELL TIME

Variant: FHSS, Channel: 915.15 MHz, Chain a, Temp: 20, Voltage: 5.0 Vdc



Analyzer Setup	Marker:Time:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 30 Trace Mode = VIEW	M1(915.15 MHz) : 0.000 s : -19.290 dBm Delta1(915.15 MHz) : 0.007 s : 0.449 dB	Channel Frequency: 915.15 MHz

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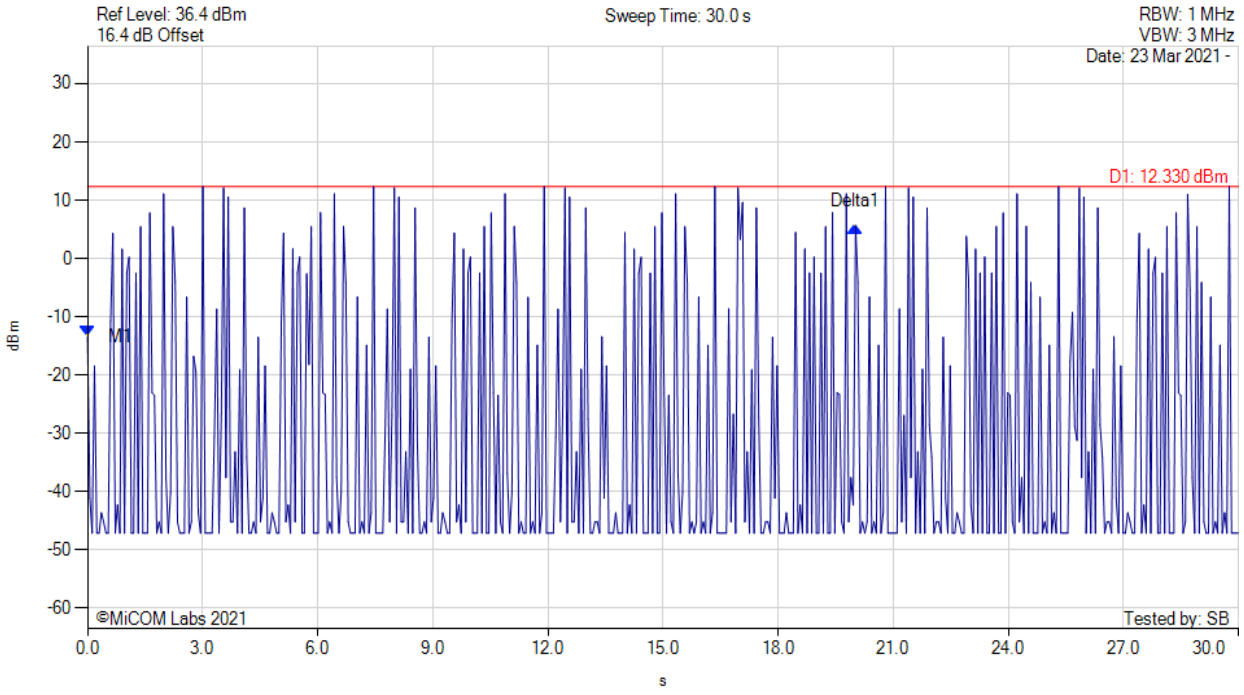
A.2.4. Channel Occupancy

CHANNEL OCCUPANCY

Variant: FHSS, Channel: 915.15 MHz, Chain a, Temp: 20, Voltage: 5.0 Vdc



Analyzer Setup	Marker:Time:Amplitude	Test Results
Detector = RMS Sweep Count = 0 RF Atten (dB) = 30 Trace Mode = VIEW	M1(915.00 MHz) : 0.000 s : -13.409 dBm Delta1(915.00 MHz) : 20.000 s : 18.894 dB	Channel Frequency: 915.15 MHz

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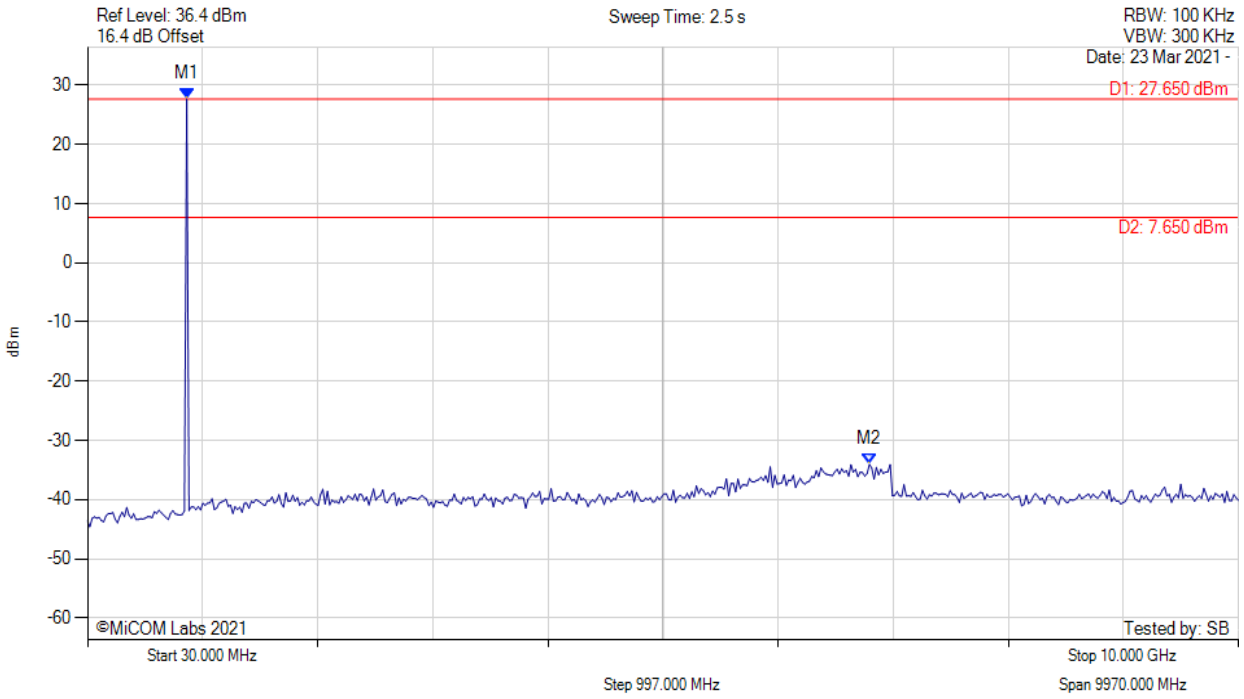
A.3. Emissions

A.3.1. Conducted Emissions

A.3.1.1. Conducted Unwanted Spurious Emissions

UNWANTED EMISSIONS PEAK

Variant: FHSS, Channel: 902.25 MHz, Chain a, Temp: 20, Voltage: 5.0 Vdc



Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 30 Trace Mode = VIEW	M1 : 889.138 MHz : 27.655 dBm M2 : 6803.206 MHz : -34.045 dBm	Limit: 7.65 dBm Margin: -41.70 dB

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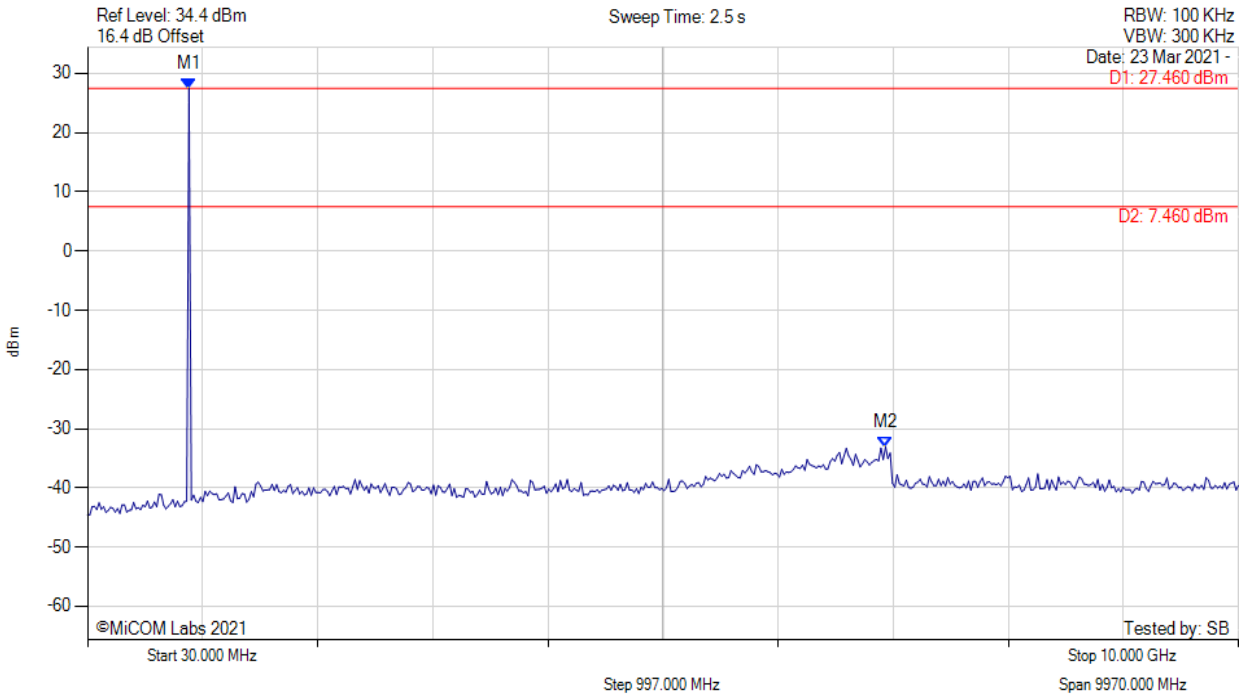
UNWANTED EMISSIONS PEAK

Variant: FHSS, Channel: 915.15 MHz, Chain a, Temp: 20, Voltage: 5.0 Vdc



Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 30 Trace Mode = VIEW	M1 : 909.118 MHz : 27.458 dBm M2 : 6943.066 MHz : -33.072 dBm	Limit: 7.46 dBm Margin: -40.53 dB

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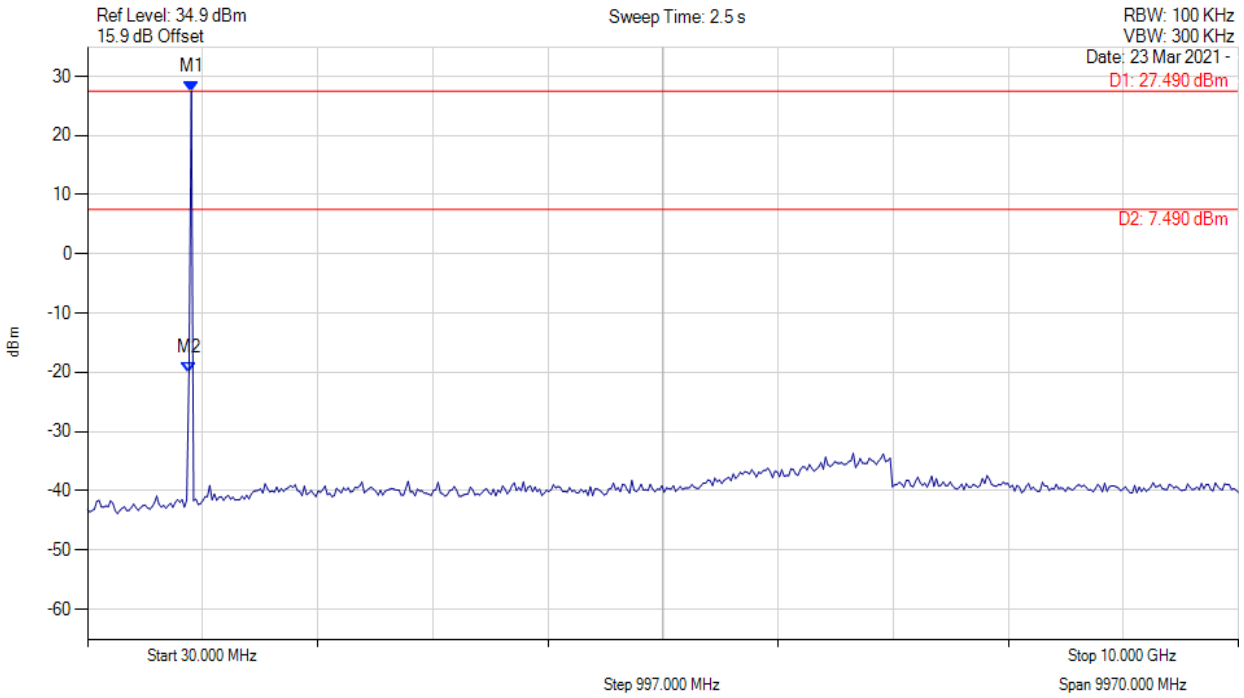
UNWANTED EMISSIONS PEAK

Variant: FHSS, Channel: 927.80 MHz, Chain a, Temp: 20, Voltage: 5.0 Vdc



Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 30 Trace Mode = VIEW	M1 : 929.098 MHz : 27.493 dBm M2 : 909.118 MHz : -19.964 dBm	Limit: 7.49 dBm Margin: -27.45 dB

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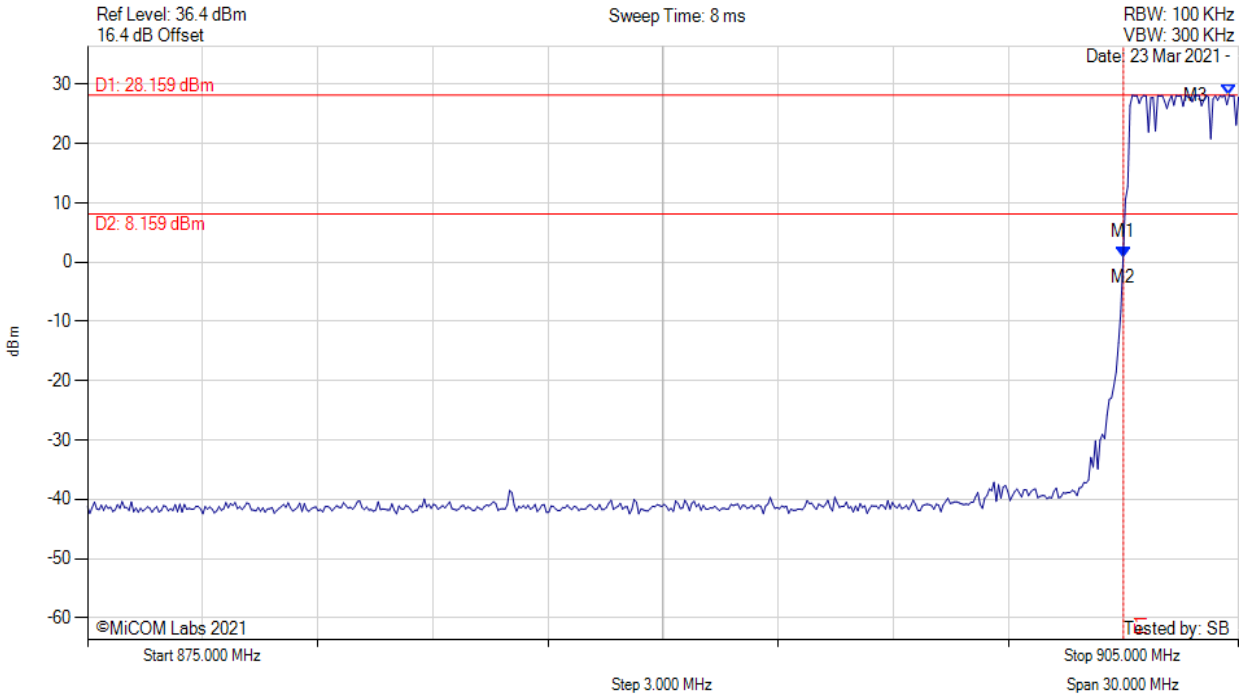
A.3.1.2. Conducted Band-Edge Emissions

CONDUCTED LOW BAND-EDGE EMISSIONS (HOPPING) PEAK

Variant: FHSS, Channel: 902.25 MHz, Chain a, Temp: 20, Voltage: 5.0 Vdc



Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 30 Trace Mode = VIEW	M1 : 902.000 MHz : 0.921 dBm M2 : 901.994 MHz : 0.921 dBm M3 : 904.760 MHz : 28.159 dBm	Channel Frequency: 902.25 MHz

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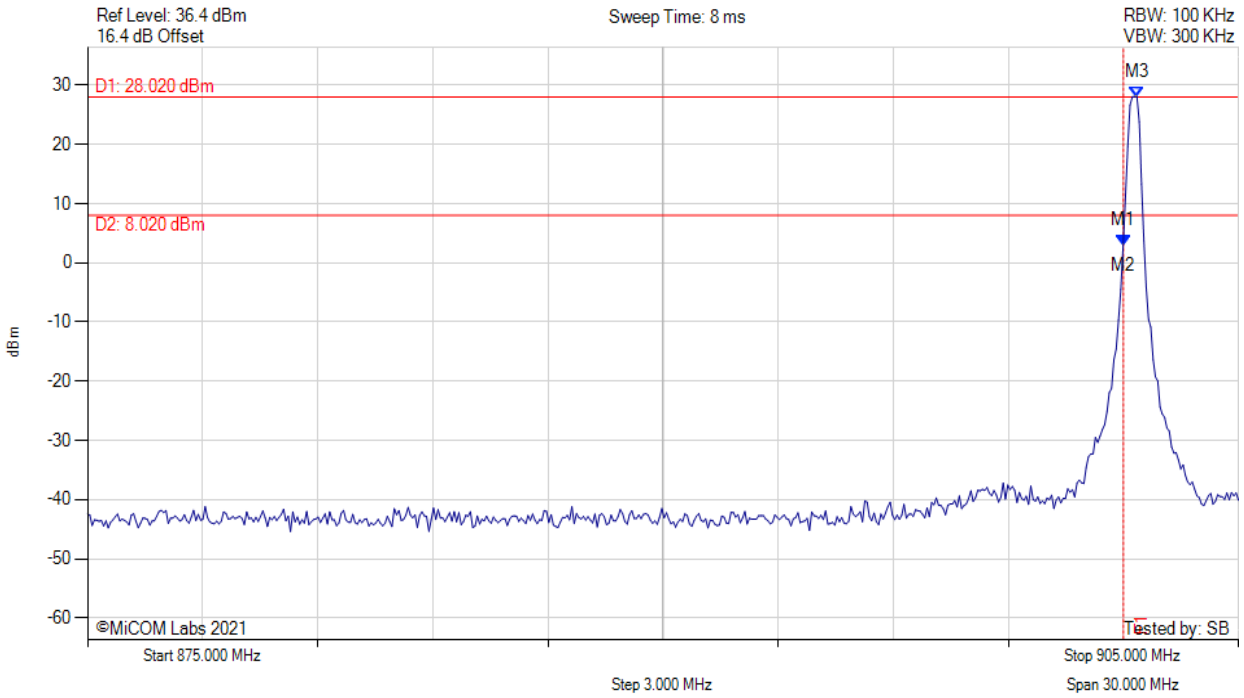
CONDUCTED LOW BAND-EDGE EMISSIONS (STATIC) PEAK

Variant: FHSS, Channel: 902.25 MHz, Chain a, Temp: 20, Voltage: 5.0 Vdc



Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 30 Trace Mode = VIEW	M1 : 902.000 MHz : 3.000 dBm M2 : 901.994 MHz : 3.000 dBm M3 : 902.355 MHz : 28.056 dBm	Channel Frequency: 902.25 MHz

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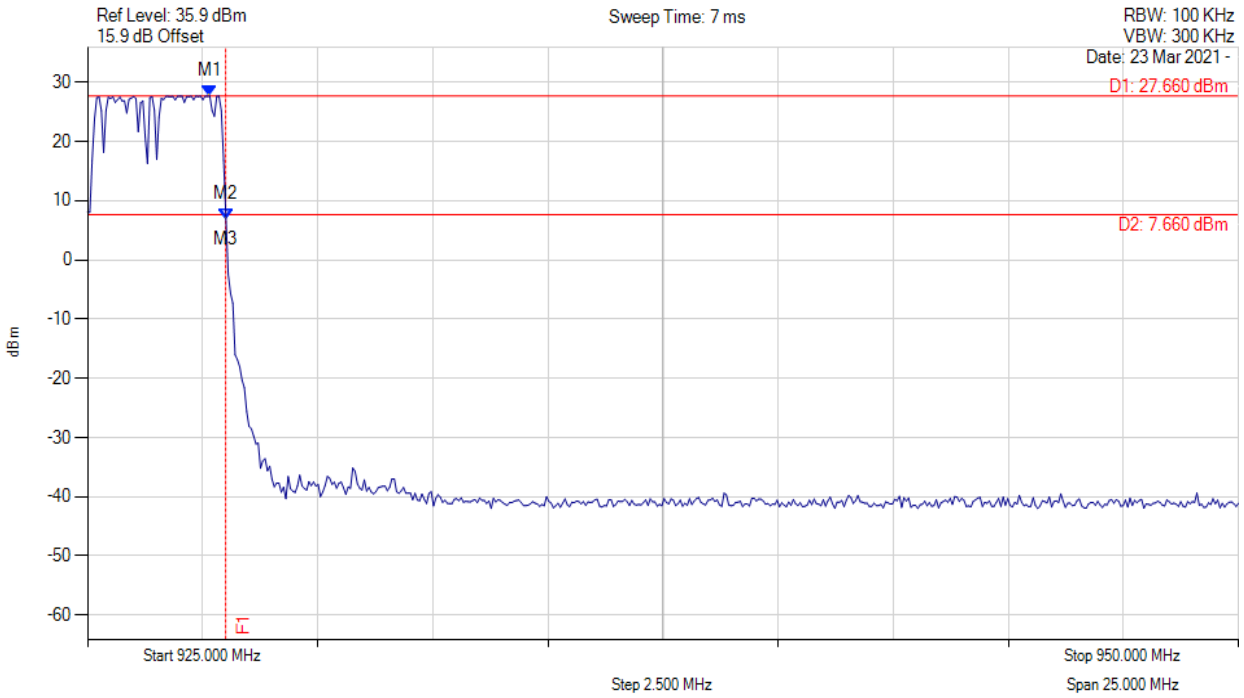
CONDUCTED UPPER BAND-EDGE EMISSIONS (HOPPING) PEAK

Variant: FHSS, Channel: 927.80 MHz, Chain a, Temp: 20, Voltage: 5.0 Vdc



Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 30 Trace Mode = VIEW	M1 : 927.655 MHz : 27.663 dBm M2 : 928.006 MHz : 6.962 dBm M3 : 928.000 MHz : 6.962 dBm	Channel Frequency: 927.80 MHz

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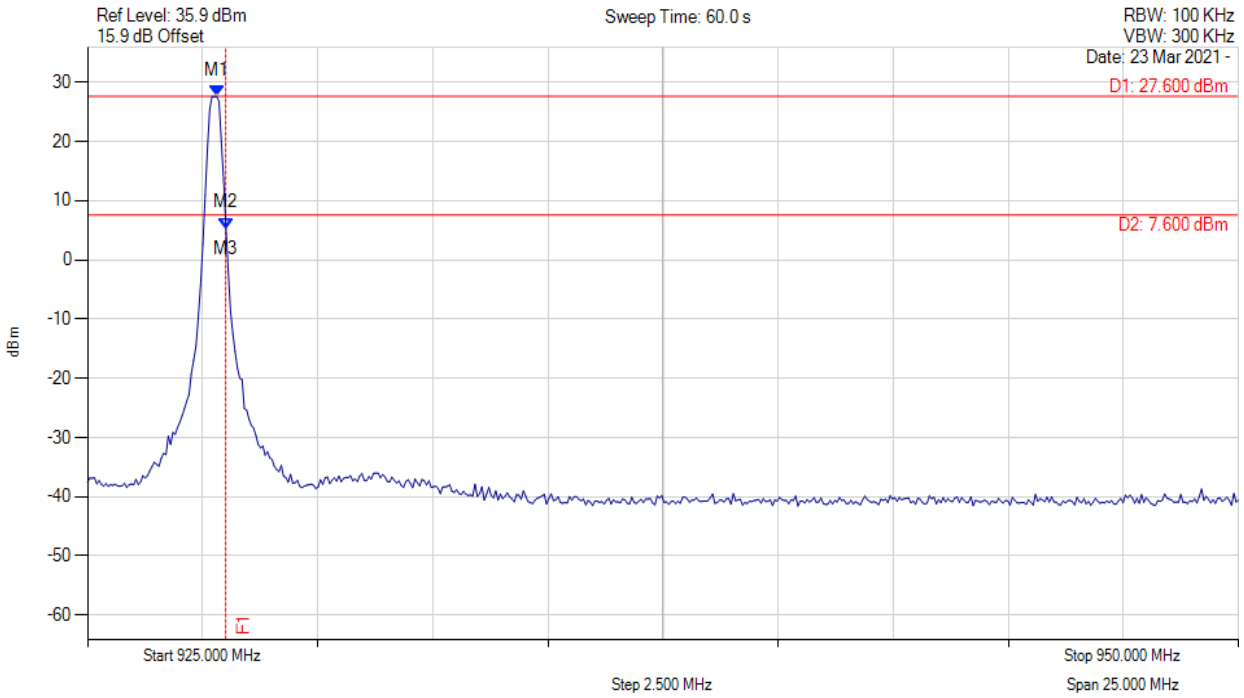
CONDUCTED UPPER BAND-EDGE EMISSIONS (STATIC) PEAK

Variant: FHSS, Channel: 927.80 MHz, Chain a, Temp: 20, Voltage: 5.0 Vdc



Analyzer Setup	Marker:Frequency:Amplitude	Test Results
Detector = MAX PEAK Sweep Count = 0 RF Atten (dB) = 30 Trace Mode = VIEW	M1 : 927.806 MHz : 27.600 dBm M2 : 928.006 MHz : 5.369 dBm M3 : 928.000 MHz : 5.369 dBm	Channel Frequency: 927.80 MHz

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