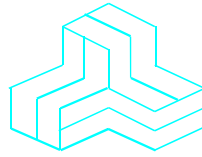


ENGINEERING TEST REPORT



**DVRS Vehicular Repeater
Model: DVR-LX 800
FCC ID: LO6-DVRS800**

Applicant:

Futurecom Systems Group ULC.
3277 Langstaff Road
Concord, Ontario
Canada, L4K 5P8

Tested in Accordance With

**Federal Communications Commission (FCC)
47 CFR, Parts 2 and 90 (Subpart S)**

UltraTech's File No.: 20FSG191_FCC90S

This Test report is Issued under the Authority of
Tri M. Luu
Vice President of Engineering
UltraTech Group of Labs

Date: September 30, 2020

Report Prepared by: Dan Huynh

Tested by: Hung Trinh

Issued Date: September 30, 2020

Test Dates: August 21, 2020
September 4, 8, & 15 2020

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UltraTech

3000 Bristol Circle, Oakville, Ontario, Canada, L6H 6G4
Tel.: (905) 829-1570 Fax.: (905) 829-8050

Website: www.ultratech-labs.com, Email: vic@ultratech-labs.com, Email: tri@ultratech-labs.com



1309



CA0001-2049



AT-1945



SL2-IN-E-1119R



Korea KCC-RRR

CA0001

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EXHIBIT 1. INTRODUCTION

1.1. SCOPE

Reference:	FCC Parts 2 and 90 (Subpart S)
Title:	Code of Federal Regulations (CFR), Title 47 Telecommunication – Parts 2 & 90
Purpose of Test:	<p>Class II Permissive Change Certification Authorization for Radio operating in the frequency bands 806-825 MHz and 851-870 MHz to address the following changes declared by the Applicant:</p> <ol style="list-style-type: none">1. The enclosure outside features is changing. There are no changes on the enclosure inside, only the outside appearance on the ends is changing.2. The TNC RF connectors are changing to a different part number.3. Two strips of finger stock are added to better electrically connect the internal partition to the enclosure.4. The front and rear covers are 4mm larger and 2 screws are added to mount the covers to the enclosure. <p>In addition, NPSPAC mask is being added.</p>
Test Procedures:	<ul style="list-style-type: none">• ANSI C63.26-2015• ANSI C63.4

1.2. RELATED SUBMITTAL(S)/GRANT(S)

None.

1.3. NORMATIVE REFERENCES

Publication	Year	Title
FCC CFR Parts 0-19, 80-End	2019	Code of Federal Regulations, Title 47 – Telecommunication
ANSI C63.4	2014	American National Standard for Methods of Measurement of Radio- Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
ANSI/TIA-603-E	2016	Land Mobile FM or PM Communications Equipment Measurement and Performance Standards
ANSI C63.26	2015	American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services

ULTRATECH GROUP OF LABS

3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
Tel. #: 905-829-1570, Fax. #: 905-829-8050, Email: vic@ultratech-labs.com, Website: <http://www.ultratech-labs.com>

File #: 20FSG191_FCC90S
September 30, 2020

All test results contained in this engineering test report are traceable to National Institute of Standards and Technology (NIST)

EXHIBIT 2. PERFORMANCE ASSESSMENT

2.1. CLIENT INFORMATION

Applicant	
Name:	Futurecom Systems Group ULC.
Address:	3277 Langstaff Road Concord, ON Canada L4K 5P8
Contact Person:	Mr. Tony Bombera Phone #: 905 532 1114 Fax #: 905 660 6858 Email Address: tony.bombera@futurecom.com

Manufacturer	
Name:	Futurecom Systems Group ULC.
Address:	3277 Langstaff Road Concord, ON Canada L4K 5P8
Contact Person:	Mr. Tony Bombera Phone #: 905 532 1114 Fax #: 905 660 6858 Email Address: tony.bombera@futurecom.com

2.2. EQUIPMENT UNDER TEST (EUT) INFORMATION

The following information (with the exception of the Date of Receipt) has been supplied by the applicant.

Brand Name:	Futurecom Systems Group ULC.
Product Name:	DVRS Vehicular Repeater
Model Name or Number:	DVR-LX 800
Serial Number:	Preproduction
Type of Equipment:	Licensed Non-Broadcast Station Transmitter
Power Supply Requirement:	None
Transmitting/Receiving Antenna Type:	Non-Integral
Primary User Functions of EUT:	The Futurecom DVRS Vehicular Repeater is designed to interface to a range of mobile radios. It permits expanded operation of portable radios. The DVRS Vehicular Repeater communicates with the mobile radio using a serial data protocol.

2.3. EUT'S TECHNICAL SPECIFICATIONS

Transmitter	
Equipment Type:	Mobile
Intended Operating Environment:	Commercial, industrial or business environment
Power Supply Requirement:	13.8 VDC
RF Output Power Rating:	1 to 20 W (programmable per channel)
Operating Frequency Range:	806-824 MHz, 851-869 MHz
RF Output Impedance:	50 Ω
Channel Spacing:	12.5 kHz & 25.0 kHz
Modulation Employed:	Analog Voice and P25 Digital (voice, data)
Emission Designator*:	<ul style="list-style-type: none"> ▪ 11K0F3E for 12.5 kHz channel spacing (Analog Voice) ▪ 16K0F3E for 25 kHz channel spacing (Analog Voice) ▪ 8K10F1E, 8K10F2E, 8K10F1D & 8K10F2D for 12.5kHz & 25kHz Channel spacing (Digital Voice, Data)
Antenna Connector Type:	TNC female

* For an average case of commercial telephony, the Necessary Bandwidth is calculated as follows:

For FM Voice Modulation:

Channel Spacing = 12.5 KHz, D = 2.5 KHz max., K = 1, M = 3 KHz

$B_n = 2M + 2DK = 2(3) + 2(2.5)(1) = \mathbf{11\ KHz}$

emission designator: 11K0F3E

Channel Spacing = 25 KHz, D = 5 KHz max., K = 1, M = 3 KHz

$B_n = 2M + 2DK = 2(3) + 2(5)(1) = \mathbf{16\ KHz}$

emission designator: 16K0F3E

For P25 Digital Modulation:

Emission Designation: Voice: 8K10F1E, 8K10F2E & Data: 8K10F1D, 8K10F2D

2.4. LIST OF EUT'S PORTS

Port Number	EUT's Port Description	Number of Identical Ports	Connector Type	Cable Type (Shielded/Non-shielded)
1	DC Input Port	1	6 pin male circular	Non-shielded
2	RF IN/OUT Port	2	TNC female	Shielded
3	AUX Port (RS-232)	1	9 pin male circular	Non-shielded
4	Mobile Radio Port	1	20 pin male circular	Non-shielded
5	USB Port	1	USB	Non-shielded

2.5. ANCILLARY EQUIPMENT

None.

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EXHIBIT 3. EUT OPERATING CONDITIONS AND CONFIGURATIONS DURING TESTS

3.1. CLIMATE TEST CONDITIONS

The climate conditions of the test environment are as follows:

Temperature:	21°C - 24°C
Humidity:	45% to 58%
Pressure:	102 kPa
Power input source:	13.8 VDC

3.2. OPERATIONAL TEST CONDITIONS & ARRANGEMENT FOR TEST SIGNALS

Operating Modes:	The transmitter was operated in a continuous transmission mode with the carrier modulated as specified in the Test Data.
Special Test Software:	Operating software provided by Futurecom for selecting operating channel frequency and power
Special Hardware Used:	N/A
Transmitter Test Antenna:	The EUT is tested with the transmitter antenna port terminated to a 50 Ω Load.

Transmitter Test Signals	
Frequency Band(s):	<ul style="list-style-type: none"> ▪ 806-824 MHz ▪ 851-869 MHz
Test Frequency(ies): (near top, near middle and near bottom in the frequency range of operation.)	<ul style="list-style-type: none"> ▪ 806.1, 808.9, 815.1 and 823.9 MHz ▪ 851.1, 853.9, 860.1 and 868.9 MHz
Transmitter Wanted Output Test Signals:	
<ul style="list-style-type: none"> • Transmitter Power (measured maximum output power): • Normal Test Modulation: • Modulating signal source: 	<p>19.91 W</p> <p>FM Voice & Data</p> <p>External</p>

EXHIBIT 4. SUMMARY OF TEST RESULTS

4.1. LOCATION OF TESTS

All of the measurements described in this report were performed at Ultratech Group of Labs located in the city of Oakville, Province of Ontario, Canada.

Radiated Emissions were performed at the Ultratech's 3-10 TDK Semi-Anechoic Chamber situated in the Town of Oakville, province of Ontario. This test site been calibrated in accordance with ANSI C63.4, and found to be in compliance with the requirements of Sec. 2.948 of the FCC Rules. The descriptions and site measurement data of the Oakville 3-10 TDK Semi-Anechoic Chamber has been filed with ANAB File No.: AT-1945.

4.2. APPLICABILITY & SUMMARY OF EMC EMISSION TEST RESULTS

FCC Section(s)	Test Requirements	Applicability (Yes/No)
2.1046 & 90.635	RF Power Output	Yes
2.1047(a)	Modulation Characteristics - Audio Frequency Response	N/A
2.1047(b)	Modulation Characteristics - Modulation Limiting	N/A
2.1049, 90.209 & 90.210	Occupied Bandwidth and Emission Masks	Yes
2.1051, 2.1057, 90.210 & 90.669	Spurious Emissions at Antenna Terminals	N/A
2.1053, 2.1057, 90.210 & 90.669	Field Strength of Spurious Radiation	Yes
2.1055 & 90.213	Frequency Stability	N/A
1.1307, 1.1310 & 2.1091	Radiofrequency Radiation Exposure Evaluation	N/A

4.3. MODIFICATIONS INCORPORATED IN THE EUT FOR COMPLIANCE PURPOSES

None.

4.4. DEVIATION OF STANDARD TEST PROCEDURES

None.

ULTRATECH GROUP OF LABS

3000 Bristol Circle, Oakville, Ontario, Canada L6H 6G4
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EXHIBIT 5. TEST DATA

5.1. RF POWER OUTPUT [§§ 2.1046 & 90.635]

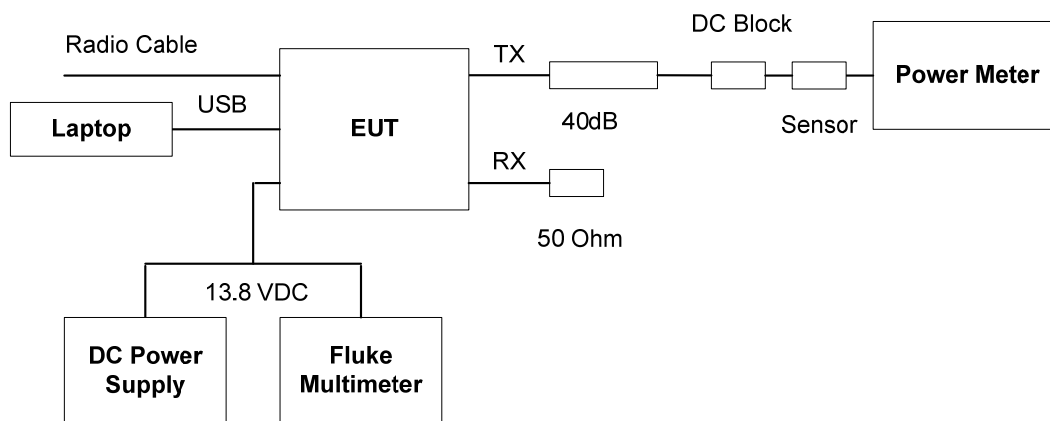
5.1.1. Limits

§ 90.635(b) The maximum output power of the transmitter for mobile stations is 100 watts (20 dBw).

5.1.2. Method of Measurements

ANSI C63.26 Section 5.2.

5.1.3. Test Arrangement



5.1.4. Test Data

Fundamental Frequency (MHz)	Measured Power (dBm)	Measured Power (Watts)	Output Power Rating (Watts)
High RF Output Power Setting			
806.100	42.99	19.91	20
815.100	42.54	17.95	20
823.900	42.23	16.71	20
851.100	42.99	19.91	20
860.100	42.83	19.19	20
868.900	42.96	19.77	20
Low RF Output Power Setting			
806.100	29.97	0.99	1
815.100	29.55	0.90	1
823.900	29.41	0.87	1
851.100	29.82	0.96	1
860.100	29.69	0.93	1
868.900	29.98	1.00	1

5.2. OCCUPIED BANDWIDTH AND EMISSION MASKS/LIMITATIONS [§§ 2.1049, 90.209, 90.210 & 90.691]

5.2.1. Limits

§90.209(b)(5) - Standard Channel Spacing/Bandwidth		
Frequency band (MHz)	Channel spacing (kHz)	Authorized bandwidth (kHz)
806-809/851-854	12.5	20
809-817/854-862	12.5	*20/11.25
817-824/862-869	25	*20

*Operations using equipment designed to operate with a 25 kilohertz channel bandwidth may be authorized up to a 20 kilohertz bandwidth unless the equipment meets the Adjacent Channel Power limits of §90.221 in which case operations may be authorized up to a 22 kilohertz bandwidth. Operations using equipment designed to operate with a 12.5 kilohertz channel bandwidth may be authorized up to an 11.25 kilohertz bandwidth.

§90.210 - Applicable Emission Masks		
Frequency band (MHz)	Mask for equipment with audio low pass filter	Mask for equipment without audio low pass filter
806-809/851-854 ³	B	H
809-824/854-869 ^{1,2}	B, D	D, G

¹Equipment used in this licensed to EA or non-EA systems shall comply with the emission mask provisions of §90.691 of this chapter.
²Equipment designed to operate on 25 kilohertz bandwidth channels must meet the requirements of either Emission Mask B or G, whichever is applicable, while equipment designed to operate on 12.5 kilohertz bandwidth channels must meet the requirements of Emission Mask D. Equipment designed to operate on 25 kilohertz bandwidth channels may alternatively meet the Adjacent Channel Power limits of §90.221.
³Transmitters utilizing analog emissions that are equipped with an audio low-pass filter must meet Emission Mask B. All transmitters utilizing digital emissions and those transmitters using analog emissions without an audio low-pass filter must meet Emission Mask H.

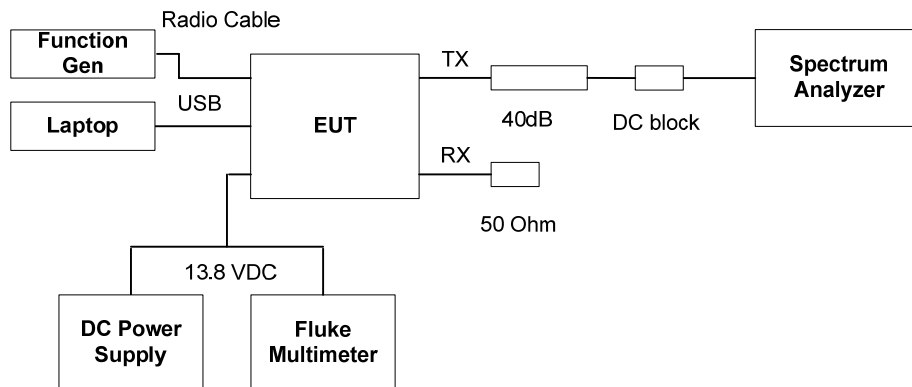
§90.691 Emission mask requirements for EA-based systems

- (a) Out-of-band emission requirement shall apply only to the “outer” channels included in an EA license and to spectrum adjacent to interior channels used by incumbent licensees. The emission limits are as follows:
- (1) For any frequency removed from the EA licensee's frequency block by up to and including 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least $116 \log_{10}(f/6.1)$ decibels or $50 + 10 \log_{10}(P)$ decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 12.5 kHz.
 - (2) For any frequency removed from the EA licensee's frequency block greater than 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least $43 + 10 \log_{10}(P)$ decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 37.5 kHz.

5.2.2. Method of Measurements

47 CFR 2.1049 and ANSI C63.26 Sections 5.4 and 5.7.

5.2.3. Test Arrangement

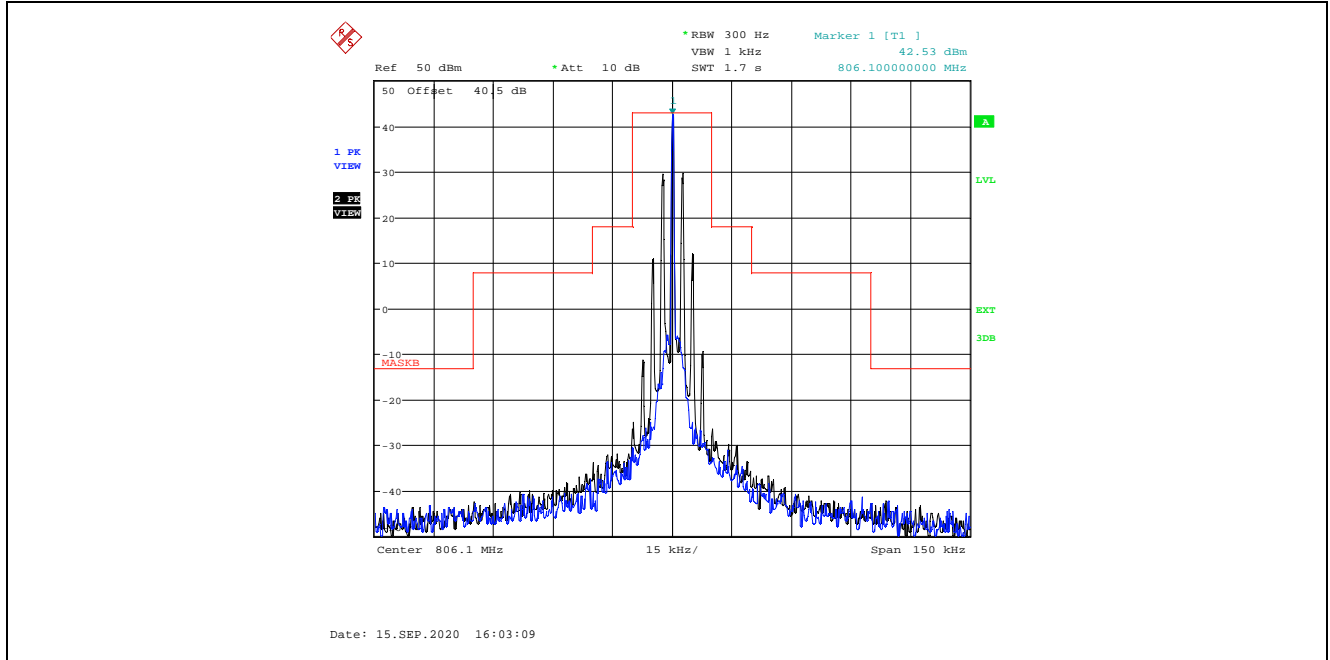


5.2.4. Test Data

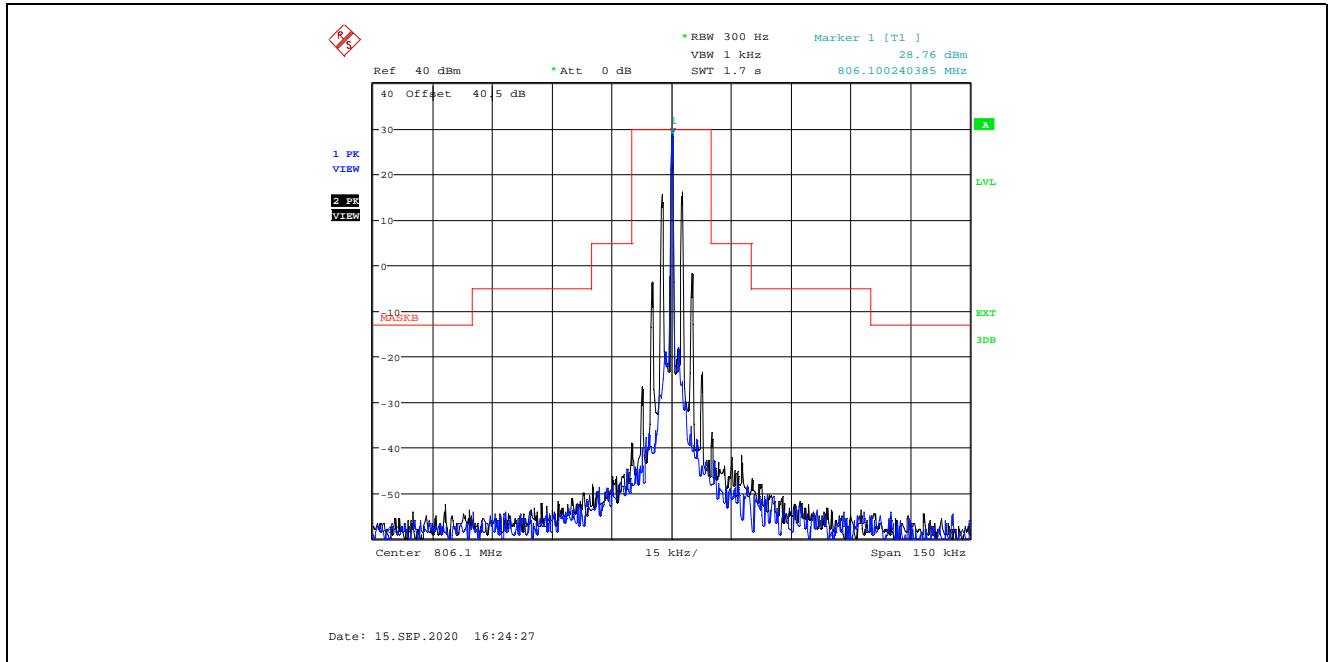
Remark: Emission Mask B was conducted to address the operation in the 806-809/851-854 MHz NPSPAC band.

5.2.4.1. Emission Mask B

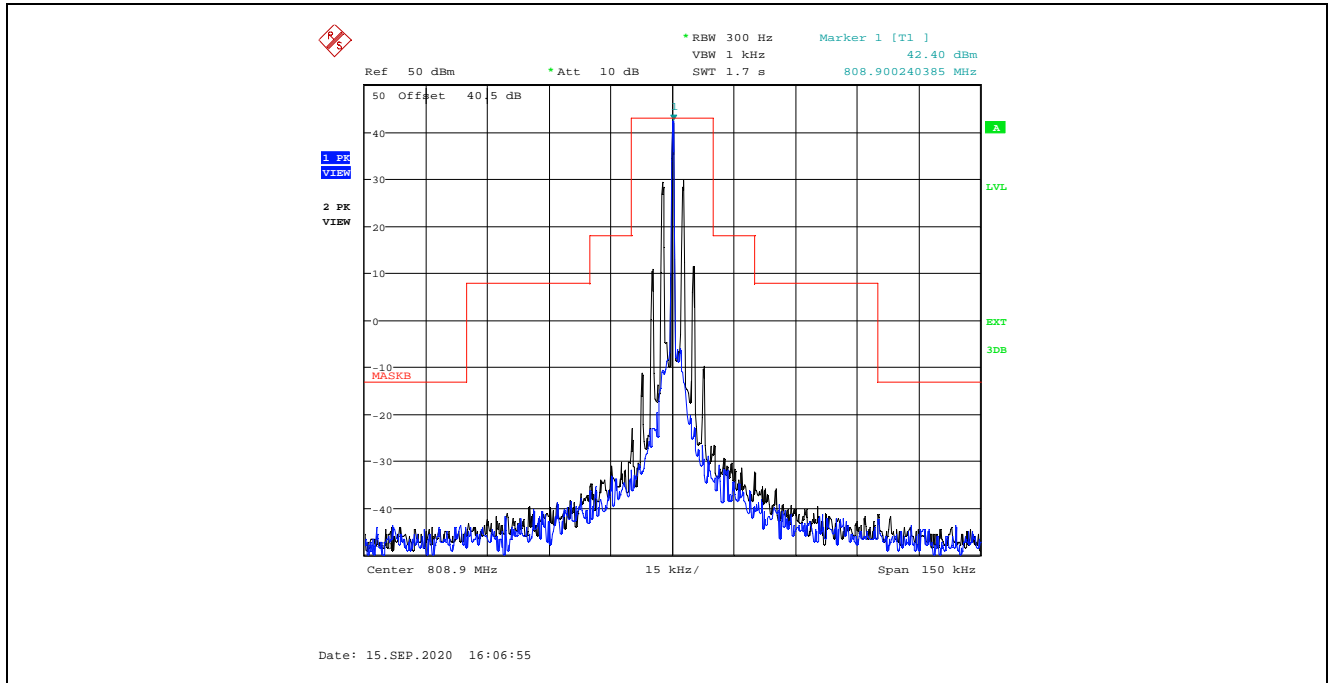
Plot 5.2.4.1.1. Emission Mask B, High Power
806.1 MHz, 2.5 kHz Sine Wave, 0.8 Vrms, 12.5 kHz Channel Spacing with 4 kHz Deviation



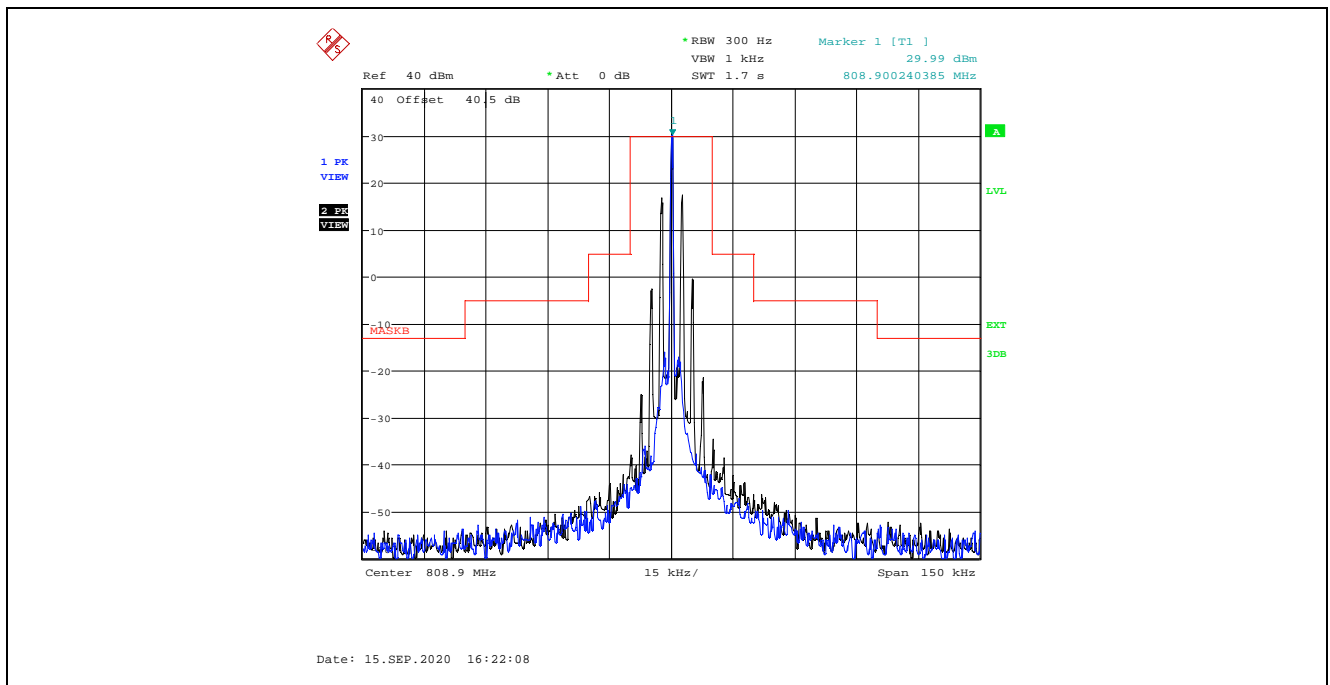
Plot 5.2.4.1.2. Emission Mask B, Low Power
806.1 MHz, 2.5 kHz Sine Wave, 0.8 Vrms, 12.5 kHz Channel Spacing with 4 kHz Deviation



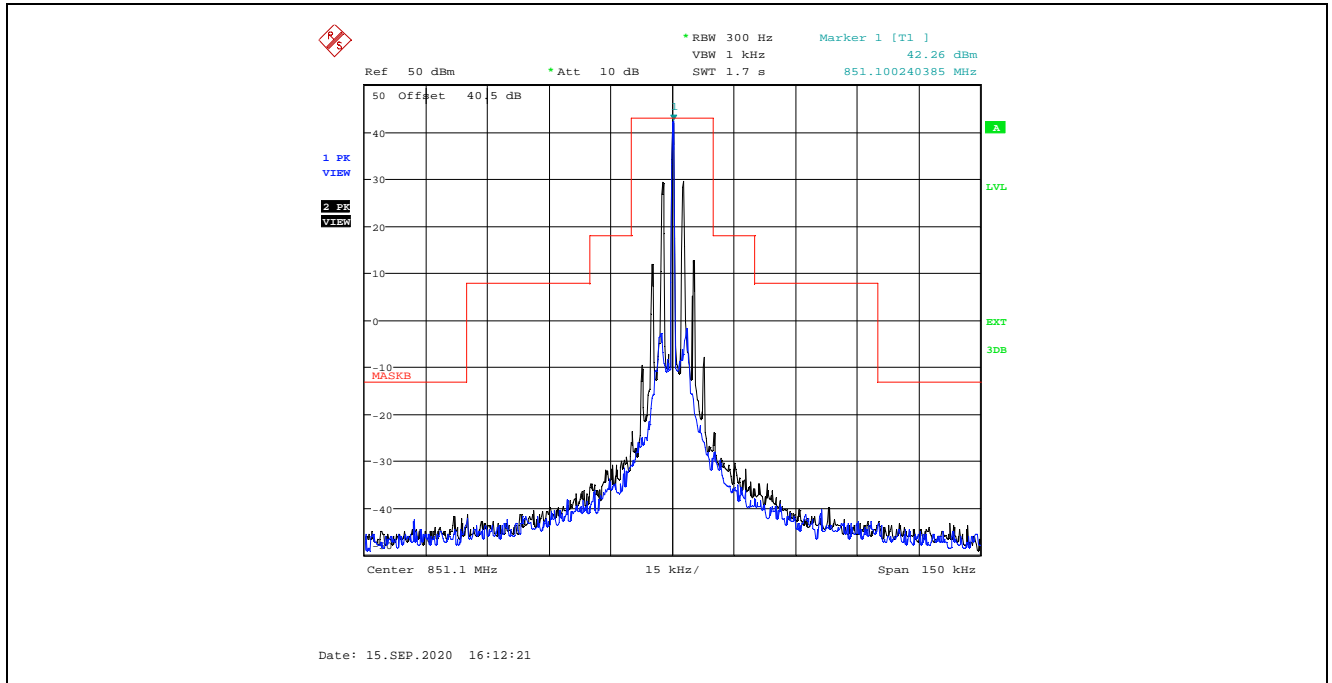
Plot 5.2.4.1.3. Emission Mask B, High Power
808.9 MHz, 2.5 kHz Sine Wave, 0.8 Vrms, 12.5 kHz Channel Spacing with 4 kHz Deviation



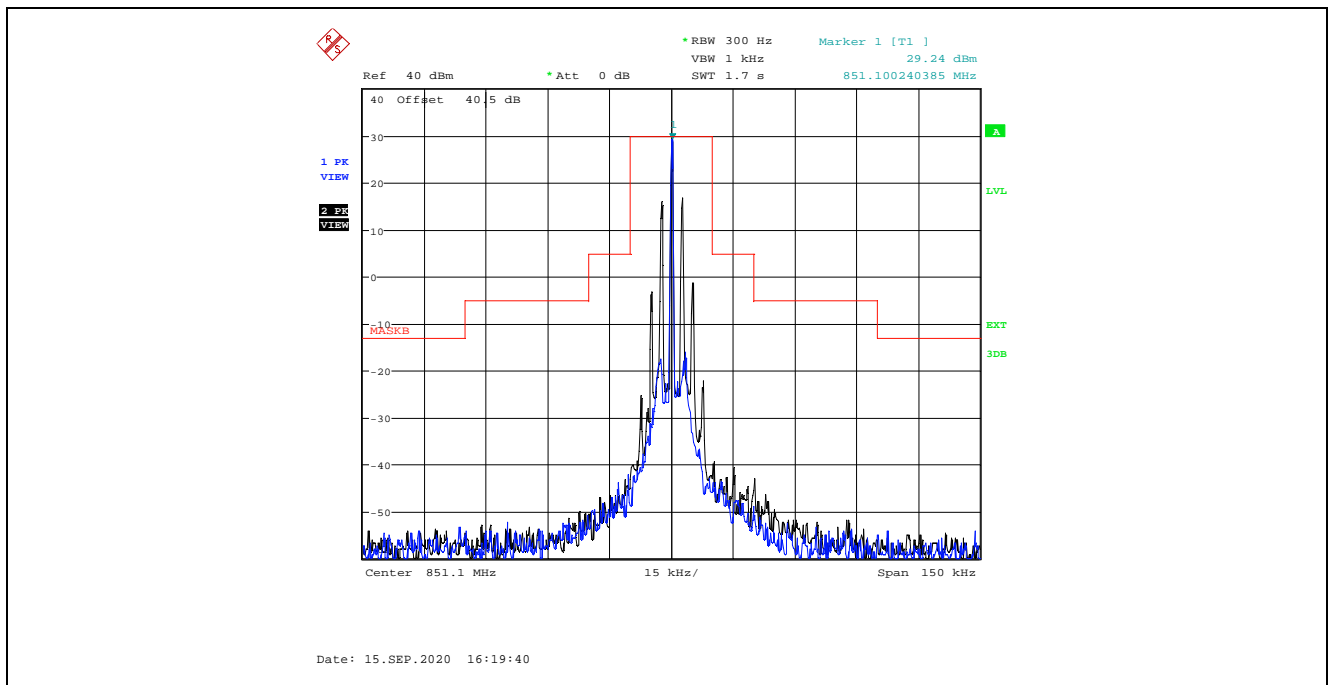
Plot 5.2.4.1.4. Emission Mask B, Low Power
808.9 MHz, 2.5 kHz Sine Wave, 0.8 Vrms, 12.5 kHz Channel Spacing with 4 kHz Deviation



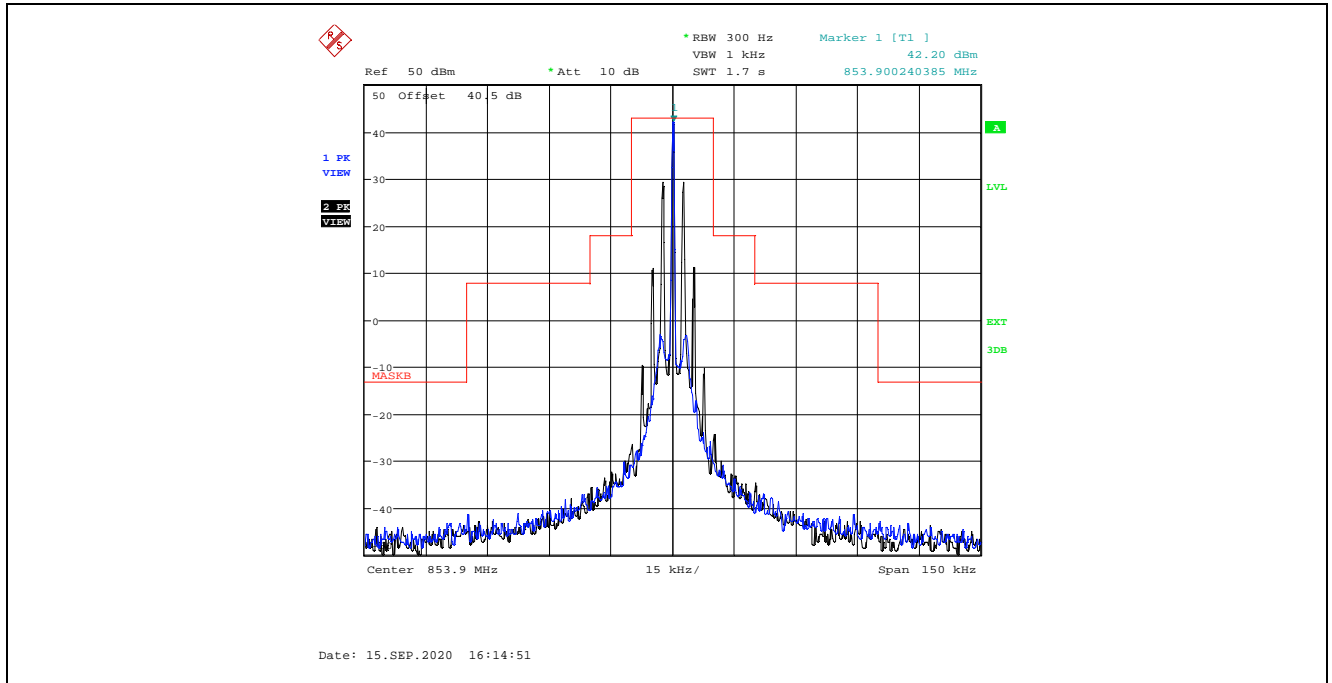
Plot 5.2.4.1.5. Emission Mask B, High Power
851.1 MHz, 2.5 kHz Sine Wave, 0.8 Vrms, 12.5 kHz Channel Spacing with 4 kHz Deviation



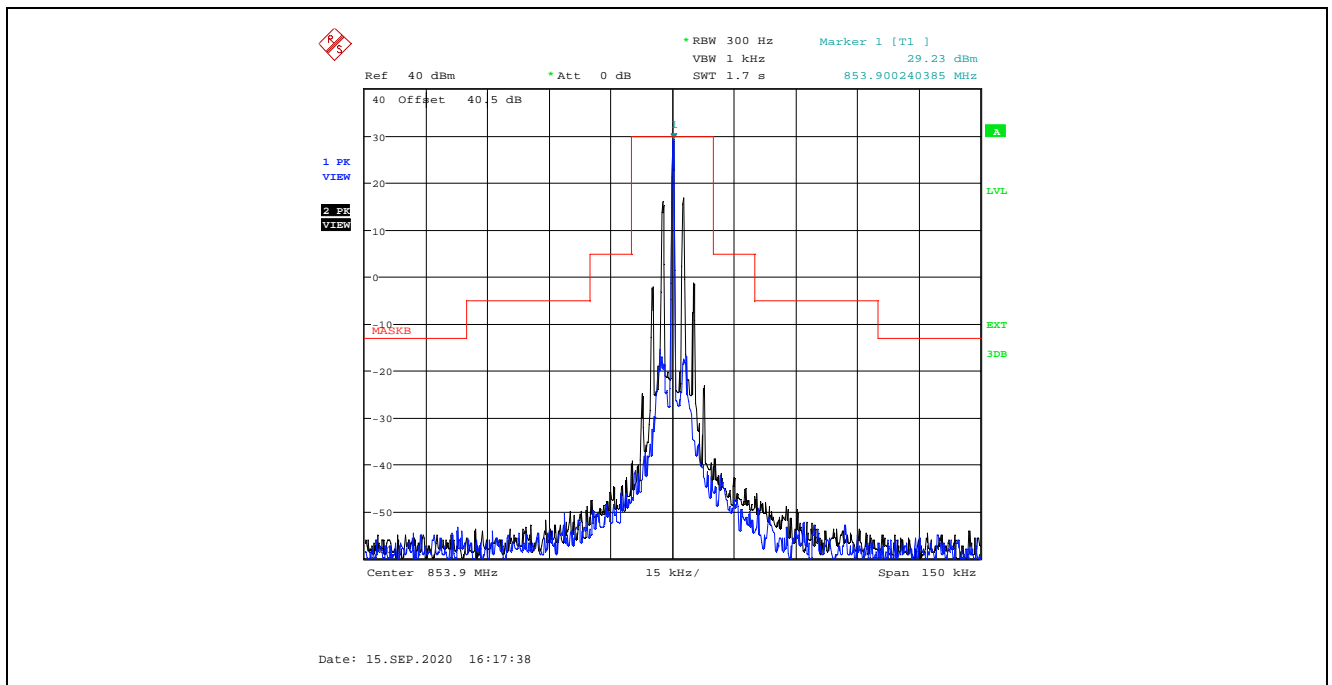
Plot 5.2.4.1.6. Emission Mask B, Low Power
851.1 MHz, 2.5 kHz Sine Wave, 0.8 Vrms, 12.5 kHz Channel Spacing with 4 kHz Deviation



Plot 5.2.4.1.7. Emission Mask B, High Power
853.9 MHz, 2.5 kHz Sine Wave, 0.8 Vrms, 12.5 kHz Channel Spacing with 4 kHz Deviation



Plot 5.2.4.1.8. Emission Mask B, Low Power
853.9 MHz, 2.5 kHz Sine Wave, 0.8 Vrms, 12.5 kHz Channel Spacing with 4 kHz Deviation



5.3. TRANSMITTER SPURIOUS/HARMONIC RADIATED EMISSIONS [§§ 2.1053, 90.210 & 90.669]

5.3.1. Limits

§90.210(b)(3) On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least $43 + 10 \log (P)$ dB.

§90.210(d)(3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 12.5 kHz: At least $50 + 10 \log (P)$ dB or 70 dB, whichever is the lesser attenuation.

§90.210(g)(2) On any frequency removed from the center of the authorized bandwidth by more than 250 percent of the authorized bandwidth: At least $43 + 10 \log (P)$ dB.

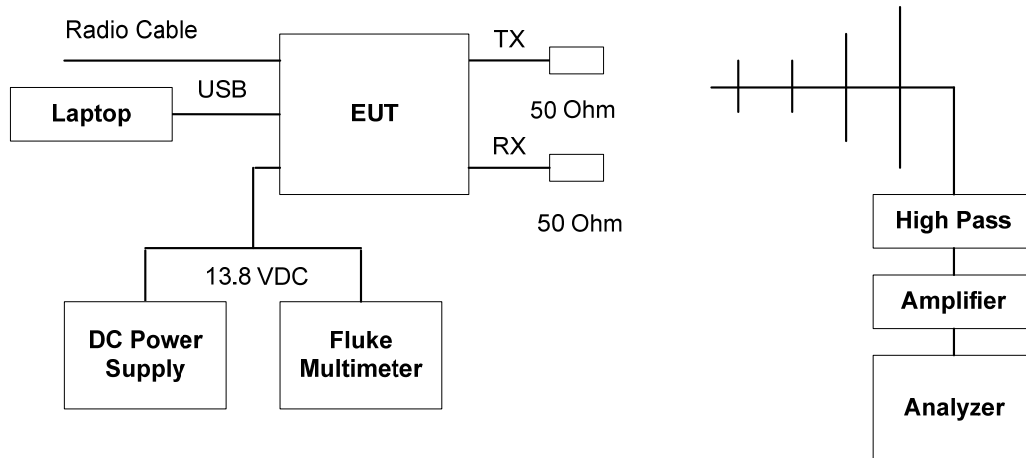
§90.210(h)(5) On any frequency removed from the center of the authorized bandwidth by more than 25 kHz: At least $43 + 10 \log (P)$ dB.

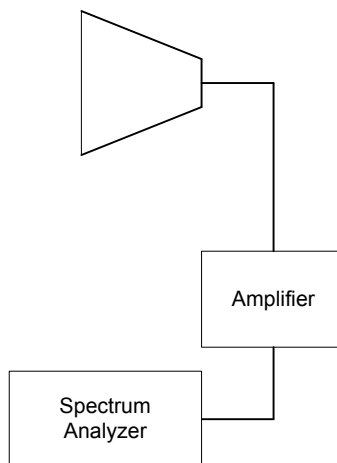
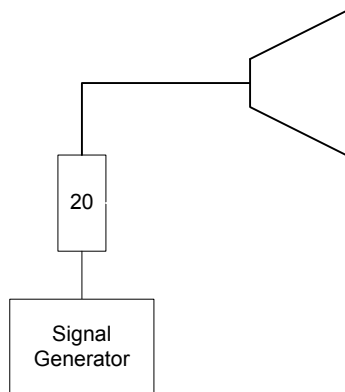
§90.691(a)(2) For any frequency removed from the EA licensee's frequency block greater than 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least $43 + 10 \log (P)$ decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 37.5 kHz.

5.3.2. Method of Measurements

ANSI C63.26 Section 5.5.

5.3.3. Test Arrangement





5.3.4. Test Data

Remark(s):

- The stringent limit shall be applied for compliance.
- The emissions were scanned from 30 MHz to 9 GHz; all spurious emissions that are in excess of 20dB below the specified limit shall be recorded.

Carrier Frequency:		806.1 MHz						
Power:		20 W						
Limit:		-20 dBm						
Frequency (MHz)	E-Field (dBµV/m)	EMI Detector (Peak/QP/Avg)	Antenna Polarization (V/H)	Power from Signal Gen. (dBm)	Subs. Horn Ant. Gain (dBi)	ERP (dBm)	Limit (dBm)	Margin (dB)
1612.2	62.25	Peak	V	-41.53	6.1	-37.58	-20	-17.58
1612.2	61.09	Peak	H	-42.50	6.1	-38.55	-20	-18.55
2418.3	67.54	Peak	V	-34.44	5.7	-30.91	-20	-10.91
2418.3	66.25	Peak	H	-36.25	5.7	-32.72	-20	-12.72

Carrier Frequency:		815.1 MHz						
Power:		20 W						
Limit:		-20 dBm						
Frequency (MHz)	E-Field (dBµV/m)	EMI Detector (Peak/QP/Avg)	Antenna Polarization (V/H)	Power from Signal Gen. (dBm)	Subs. Horn Ant. Gain (dBi)	ERP (dBm)	Limit (dBm)	Margin (dB)
1630.2	62.75	Peak	H	-40.96	5.9	-37.21	-20	-17.21
2445.3	72.16	Peak	V	-30.77	5.7	-27.26	-20	-7.26
2445.3	67.89	Peak	H	-34.35	5.7	-30.84	-20	-10.84

Carrier Frequency:		823.9 MHz						
Power:		20 W						
Limit:		-20 dBm						
Frequency (MHz)	E-Field (dBµV/m)	EMI Detector (Peak/QP/Avg)	Antenna Polarization (V/H)	Power from Signal Gen. (dBm)	Subs. Horn Ant. Gain (dBi)	ERP (dBm)	Limit (dBm)	Margin (dB)
2471.7	64.28	Peak	V	-38.74	5.7	-35.23	-20	-15.23
2471.7	60.23	Peak	H	-42.10	5.7	-38.59	-20	-18.59
3295.6	62.79	Peak	H	-41.48	7.5	-36.09	-20	-16.09

Carrier Frequency:		851.1 MHz						
Power:		20 W						
Limit:		-20 dBm						
Frequency (MHz)	E-Field (dBμV/m)	EMI Detector (Peak/QP/Avg)	Antenna Polarization (V/H)	Power from Signal Gen. (dBm)	Subs. Horn Ant. Gain (dBi)	ERP (dBm)	Limit (dBm)	Margin (dB)
Spurious emissions are more than 20 dB below the applicable limit.								

Carrier Frequency:		860.1 MHz						
Power:		20 W						
Limit:		-20 dBm						
Frequency (MHz)	E-Field (dBμV/m)	EMI Detector (Peak/QP/Avg)	Antenna Polarization (V/H)	Power from Signal Gen. (dBm)	Subs. Horn Ant. Gain (dBi)	ERP (dBm)	Limit (dBm)	Margin (dB)
1720.2	59.91	Peak	V	-41.76	5.9	-37.99	-20	-17.99
1720.2	63.98	Peak	H	-38.00	5.9	-34.23	-20	-14.23
2580.3	63.13	Peak	H	-40.09	5.9	-36.32	-20	-16.32
3440.4	62.10	Peak	V	-43.91	8.0	-38.04	-20	-18.04
3440.4	63.18	Peak	H	-41.95	8.0	-36.08	-20	-16.08

Carrier Frequency:		868.9 MHz						
Power:		20 W						
Limit:		-20 dBm						
Frequency (MHz)	E-Field (dBμV/m)	EMI Detector (Peak/QP/Avg)	Antenna Polarization (V/H)	Power from Signal Gen. (dBm)	Subs. Horn Ant. Gain (dBi)	ERP (dBm)	Limit (dBm)	Margin (dB)
2606.7	68.85	Peak	V	-34.61	5.9	-30.84	-20	-10.84
2606.7	61.31	Peak	H	-41.94	5.9	-38.17	-20	-18.17
4344.5	60.52	Peak	V	-46.69	9.3	-39.59	-20	-19.59
4344.5	65.03	Peak	H	-41.63	9.3	-34.53	-20	-14.53
6082.3	62.43	Peak	H	-45.62	10.6	-37.20	-20	-17.20

EXHIBIT 6. TEST EQUIPMENT LIST

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range	Cal. Due Date
Power Meter	Hewlett Packard	436A	2016A07747	100 kHz sensor dependent	14 Apr 2021
Power Sensor	Agilent	8482A	MY44175182	100 kHz – 4.2 GHz	15 Nov 2020
Attenuator (20dB)	Weinschel	46-20-34	BM1347	DC – 18 GHz	See Note 1
Attenuator (20dB)	Weinschel	24-20-34	BH0740	DC – 8.5 GHz	See Note 1
DC Power Supply	HQ Power	PS613U	NSN	0 – 30V 3A	See Note 1
Multi-meter	Fluke	8842A	4142055	20mV - 1kV	17 May 2021
Laptop EMC1	Lenovo	ThinkPad Edge 0578	IS057882ULRBXKBG	---	See Note 1
EMI Receiver	Rohde & Schwarz	ESU40	100037	20Hz–40 GHz	18 Mar 2021
Spectrum Analyzer	Rohde & Schwarz	FSU26	200946	20Hz–26.5 GHz	25 Jan 2021
RF Amplifier	Com-Power	PAM-0118A	551052	0.5 – 18 GHz	29 Jul 2021
RF Amplifier	Hewlett Packard	84498	3008A00769	1 – 26.5 GHz	07 Jan 2021
Biconilog	EMCO	3142C	34792	26-2000 MHz	16 May 2022
Horn Antenna	EMCO	3155	6570	1 – 18 GHz	11 Oct 2020
Horn Antenna	EMCO	3117	00119425	1 – 18 GHz	25 Jul 2021
High Pass Filter	K & L	11SH10-1500/T8000	2	Cut off 900 MHz	See Note 1
Attenuator	Pasternack	PE7024-20	6	DC-26.5 GHz	See Note 1
DC Block	Hewlett Packard	11742A	12460	0.045 – 26.5 GHz	See Note 1
DC Power Supply	HQ Power	PS613U	NSN	0 – 30V 3A	See Note 1
Function Generator	SRS	DS345	34591	1 μ Hz – 30 MHz	29 Mar 2021
Note 1: Internal Verification/Calibration check					

EXHIBIT 7. MEASUREMENT UNCERTAINTY

The measurement uncertainties stated were calculated in accordance with the requirements of CISPR 16-4-2 @ IEC:2003 and JCGM 100:2008 (GUM 1995) – Guide to the Expression of Uncertainty in Measurement.

Test Description	Combined Standard Uncertainty (U(mx))	Expanded Uncertainty, K=2 for 95% Confidence Level (dB)
Conducted Power	± 0.31	± 0.62
Emission Mask	± 0.62	± 0.63
Transmitter Spurious Radiated Emissions	30 MHz – 1 GHz	
	± 2.10	± 4.20
	1 – 18 GHz	
	± 1.35	± 2.70