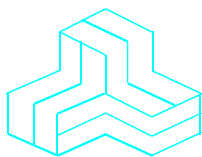


ENGINEERING TEST REPORT



DVRS Vehicular Repeater
Model: DVR-LX 700

FCC ID: LO6-DVRS700
IC: 2098B-DVRS700

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 R), RSS-119, Issue 12

UltraTech's File No.: 20FSG195_FCC90

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

Date: October 8th, 2020

Report Prepared by: Sharly Le

Tested by: Nimisha Desai

Issued Date: October 8, 2020

Test Dates: Sept 21st – Oct 1st, 2020

- *The results in this Test Report apply only to the sample(s) tested, and the sample tested is randomly selected.*
- *This report must not be used by the client to claim product endorsement by any agency of the US Government.*
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APEC TEL CA0001



1309



CA 0001/2049



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 R), RSS-119
Title:	Code of Federal Regulations (CFR) Title 47 Telecommunication, Parts 2 & 90
Purpose of Test:	To gain FCC Equipment Authorization for Radio operating in Part 90.
Test Procedures:	ANSI/TIA-603-E, ANSI C63.26

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

None.

1.3. NORMATIVE REFERENCES

Publication	Year	Title
FCC CFR Parts 0-19, 80-End	2018	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 C63.26	2015	American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services
ANSI/TIA-603-E	2016	Land Mobile FM or PM Communications Equipment Measurement and Performance Standards
RSS-119, Issue 12	2015	Land Mobile and Fixed Radio Transmitters and Receivers Operating in the Frequency Range 27.41-960 MHz
RSS-Gen, Issue 5	2018	General Requirements for Compliance of Radio Apparatus
ICES-003 Issue 6	2016 updated 2019	Information Technology Equipment (Including Digital Apparatus) – Limits

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 700
Serial Number:	Preproduction
Type of Equipment:	Licensed Non-Broadcast Station Transmitter
Power Supply Requirement:	13.8 VDC
Transmitting/Receiving Antenna Type:	Non-integral
Operational Description:	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:	[x] Commercial [x] Light Industry & Heavy Industry
Power Supply Requirement:	13.8 Vdc
RF Output Power Rating:	1 to 20 W
Operating Frequency Range:	764-776 MHz, 794-806 MHz
RF Output Impedance:	50 Ohms
Channel Spacing:	12.5 kHz & 25.0 kHz
Emission Designation:	11K0F3E, 16K0F3E, 7K30F1E, 8K10F1E
Oscillator Frequencies:	Digital signal frequencies: 32.768 kHz, 16.0 MHz, 29.4912 MHz, 144.0 MHz and 120 MHz Analogue signal frequency: LO1: Rx Freq - 109.65 MHz (Rx), LO2: 107.85 MHz & LO3: Tx Freq + 110.51875 MHz Reference Oscillator: 14.4 MHz
Antenna Connector Type:	TNC female

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	Jack	Non-shielded
2	RF IN/OUT Port	2	TNC	Shielded
3	RS-232 Port	1	9 pin male circular	Non-shielded
4	Mobile Radio Port	1	20 pin male circular	Non-shielded
5	USB*	1	USB	Shielded

* The USB port is a service port. It is only used during configuration/programming.

2.5. ANCILLARY EQUIPMENT

The EUT was tested while connected to the following representative configuration of ancillary equipment necessary to exercise the ports during tests:

None.

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 to 24° C
Humidity:	45 to 51%
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 RF Load.

Transmitter Test Signals	
Frequency Band(s):	<ul style="list-style-type: none"> ▪ 764-776 MHz ▪ 794-806 MHz
Frequency(ies) Tested: (near top, near middle and near bottom in the frequency range of operation.)	<ul style="list-style-type: none"> ▪ 764 MHz, 770 MHz and 775 MHz ▪ 794 MHz, 800 MHz and 805 MHz
Transmitter Wanted Output Test Signals:	
<ul style="list-style-type: none"> ▪ RF Power Output (measured maximum output power): ▪ Normal Test Modulation: ▪ Modulating signal source: 	<p>20 W</p> <p>FM Data & Voice</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.

- AC Power Line Conducted Emissions were performed in UltraTech's shielded room, 24'(L) by 16'(W) by 8'(H).
- 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 EMISSION TEST RESULTS

FCC Section(s)	Test Requirements	Applicability (Yes/No)
90.541 & 2.1046 RSS-119 § 5.4	RF Power Output	Yes
1.1307, 1.1310, 2.1091 & 2.1093 RSS-Gen § 3.4 RSS-102	RF Exposure Limit	N/A
90.539 & 2.1055 RSS-119 § 5.3	Frequency Stability	Yes
2.1047(a)	Audio Frequency Response	N/A
2.1047(b)	Modulation Limiting	N/A
2.1049	Occupied Bandwidth	N/A
90.543(a) RSS-19 § 4.3	Adjacent Channel Power	Yes
90.543(c), 2.1057 & 2.1051 RSS-119 § 5.8	Emission Limits - Spurious Emissions at Antenna Terminal	Yes
90.543(c), 2.1057 & 2.1053 RSS-119 § 5.8	Emission Limits - Field Strength of Spurious Emissions	Yes
ICES-003	Radiated Emissions from Digital Devices	Yes
	Conducted Emission from Digital Devices	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

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File #: 20FSG195_FCC90
 October 8, 2020

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

EXHIBIT 5. TEST DATA

5.1. RF POWER OUTPUT [§§ 2.1046 & 90.541], RSS-119 [§§5.4]

5.1.1. Limits

The transmitting power and antenna height of base, mobile, portable and control stations operating in the 769-775 MHz and 799-805 MHz frequency bands must not exceed the maximum limits in this section. Power limits are listed in effective radiated power (ERP).

- (a) The transmitting power and antenna height of base stations must not exceed the limits given in paragraph (a) of §90.635.
- (b) The transmitting power of a control station must not exceed 200 watts ERP.
- (c) The transmitting power of a mobile unit must not exceed 100 watts ERP.
- (d) The transmitting power of a portable (hand-held) unit must not exceed 3 watts ERP.
- (e) Transmitters operating on the narrowband low power channels listed in §90.531(b)(3) and (4), must not exceed 2 watts ERP.

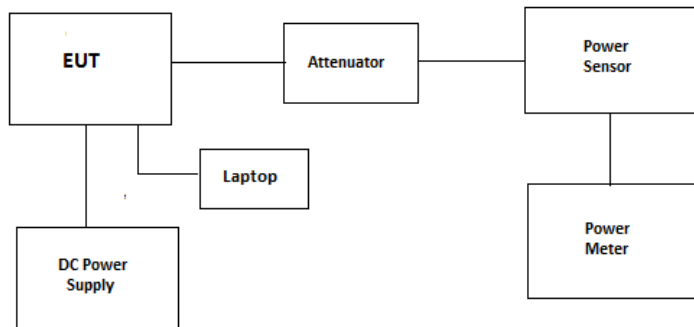
RSS-119

768-776 and 798-806 MHz	30 W
-------------------------	------

5.1.2. Method of Measurements

TIA-603-E, ANSI C63.26, RSS-119

5.1.3. Test Arrangement



5.1.4. Test Equipment List

Test Instrument	Manufacturer	Model No	Serial No	Frequency Range	Cal Due date
Power Meter	HP	436A	210A11242	100KHz-sensor dependant	18 Aug 2021
Power Sensor	HP	8481A	MY41090358	10MHz-18GHz	20 Jul 2021
Attenuator(20dB)	Narda	WA35-20-33	A164	DC-8.5GHz	Cal on use
Attenuator(20dB)	Aeroflex Weinschel	23-20-34	BH7876	DC-18GHz	Cal on use
Power Supply	Tenma	72-6153	--	1-15V, DC 20A	----
Multimeter	Fluke	8842A	5021295	---	19 Dec 2020

Test date: Sept 21, 2020

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File #: 20FSG195_FCC90
 October 8, 2020

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

5.1.5. Test Data

Power Setting	Channel Spacing (kHz)	Frequency MHz	Measured Power		Power Rating	
			(dBm)	(W)	(dBm)	(W)
High 20 W	12.5	764.000	43.04	20.14	43.01	20.0
		770.000	43.04	20.14	43.01	20.0
		775.000	43.02	20.04	43.01	20.0
	25	764.000	43.04	20.14	43.01	20.0
		770.000	43.05	20.18	43.01	20.0
		775.000	43.01	20.00	43.01	20.0
	12.5	794.000	43.03	20.09	43.01	20.0
		800.000	43.02	20.04	43.01	20.0
		805.000	43.00	19.95	43.01	20.0
	25	794.000	43.01	20.00	43.01	20.0
		800.000	43.04	20.14	43.01	20.0
		805.000	43.04	20.14	43.01	20.0
Low 1W	12.5	764.000	30.02	1.00	30.00	1.0
		770.000	30.07	1.02	30.00	1.0
		775.000	30.03	1.01	30.00	1.0
	25	764.000	29.99	1.00	30.00	1.0
		770.000	30.02	1.00	30.00	1.0
		775.000	29.97	0.99	30.00	1.0
	12.5	794.000	30.03	1.01	30.00	1.0
		800.000	29.96	0.99	30.00	1.0
		805.000	30.01	1.00	30.00	1.0
	25	794.000	30.02	1.00	30.00	1.0
		800.000	29.98	1.00	30.00	1.0
		805.000	30.02	1.00	30.00	1.0

5.3. FREQUENCY STABILITY [§§ 2.1055 & 90.539], RSS-119 [§§5.3]

5.3.1. Limits

§ 90.539 Frequency Stability

Transmitters designed to operate in 769-775 MHz and 799-805 MHz frequency bands must meet the frequency stability requirements in this section.

- (a) Mobile, portable and control transmitters must normally use automatic frequency control (AFC) to lock on to the base station signal.
- (b) The frequency stability of base transmitters operating in the narrowband segment must be 100 parts per billion or better.
- (c) The frequency stability of mobile, portable, and control transmitters operating in the narrowband segment must be 400 parts per billion or better when AFC is locked to the base station. When AFC is not locked to the base station, the frequency stability must be at least 1.0 ppm for 6.25 kHz, 1.5 ppm for 12.5 kHz (2 channel aggregate), and 2.5 ppm for 25 kHz (4 channel aggregate).
- (d) The frequency stability of base transmitters operating in the wideband segment must be 1 part per million or better.
- (e) The frequency stability of mobile, portable and control transmitters operating in the wideband segment must be 1.25 parts per million or better when AFC is locked to a base station, and 5 parts per million or better when AFC is not locked.

RSS 119

Frequency Band (MHz)	Channel Bandwidth (kHz)	Frequency Stability (ppm)		
		Base/Fixed	Mobile Station	
			Output Power >2 W	Output Power ≤2 W
768-776 and 798-806 table note3	25	0.1	0.4 table note4	0.4 table note4
	12.5			
	6.25			
	50	1	1.25 table note5	1.25 table note5

Table note 3: Mobile, portable and control transmitters operating in the bands 768-776 MHz and 798-806 MHz must normally use AFC to lock onto the base station signal. The mobile station’s frequency stability values given in Table 1 are for mobile stations operating under this condition.

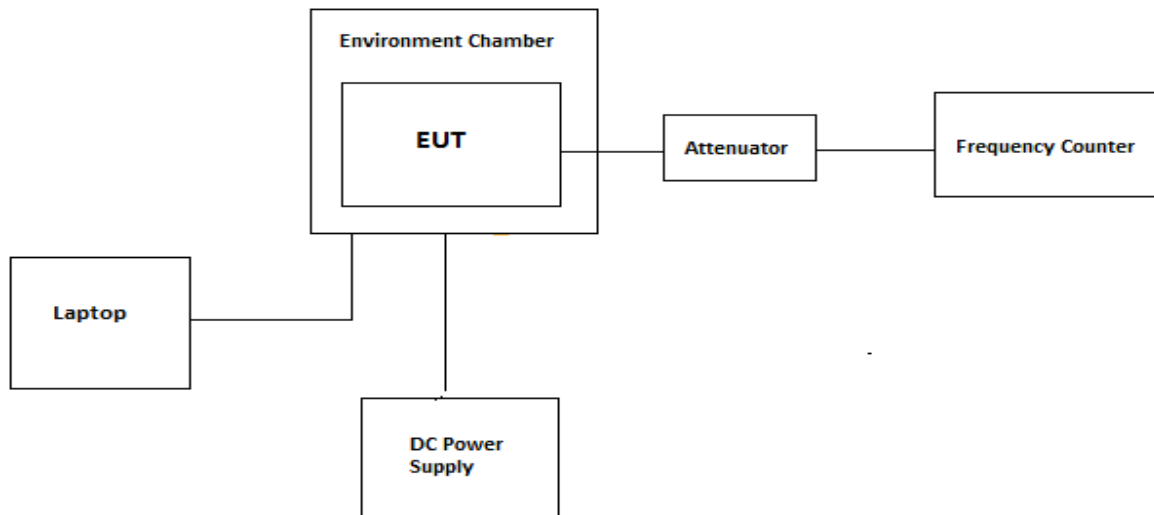
Table note 4: When the mobile, portable and control transmitters are operating with channel bandwidths equal to 6.25 kHz, 12.5 kHz or 25 kHz in the band 768-776 MHz and the AFC is not locked onto the base station signal, the frequency stability must be equal to or better than 1 ppm for 6.25 kHz, 1.5 ppm for 12.5 kHz (2-channel aggregate), and 2.5 ppm for 25 kHz (4-channel aggregate).

Table note 5: When the mobile, portable and control transmitters are operating with channel bandwidths equal to 50 kHz in the band 768-776 MHz and the AFC is not locked onto the base station signal, the frequency stability must be equal to or better than 5 ppm.

5.3.2. Method of Measurements

FCC 47 CFR 2.1055, TIA-603-E, ANSI C63.26, RSS-119

5.3.3. Test Arrangement



5.3.4. Test Equipment List

Test Instrument	Manufacturer	Model No	Serial No	Frequency Range	Cal Due date
Environmental Chamber	Envirotronics	SSH32C	11994847-S-11059	-60 to 177° C	10 Jun 2021
Frequency Counter	EIP	545A	2683	10MHz-1GHz	06 Sep 2022
Attenuator(20dB)	Weinschel	WA 35-20-33	A164	DC-8.5GHz	Cal on use
Attenuator(20dB)	Aeroflex\Weinschel	34-20-34	BP6023	DC-18GHz	Cal on use
Power Supply	Dr. meter	HY5020E	013141252	1-40V, DC 20A	----
Multimeter	Fluke	8842A	5021295	---	19 Dec 2020

Test date: Oct 1st, 2020

ULTRATECH GROUP OF LABS

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File #: 20FSG195_FCC90
 October 8, 2020

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

5.3.5. Test Data

Test Frequency:		764 MHz	
Full Power Level:		20.14 W	
Frequency Tolerance Limit:		1.5 ppm or 1146 Hz	
Max. Frequency Tolerance Measured:		-387 Hz (-0.51 ppm)	
Input Voltage Rating:		13.8 VDC (Nominal)	
Ambient Temperature (°C)	Frequency Drift (Hz)		
	Supply Voltage (Nominal) 13.8 VDC	Supply Voltage (85% of Nominal) 11.73 VDC	Supply Voltage (115% of Nominal) 15.87 VDC
-30	-330	--	--
-20	-387	--	--
-10	-380	--	--
0	-384	--	--
10	-296	--	--
20	-231	-306	-230
30	-292	--	--
40	-133	--	--
50	-217	--	--
60	-180	--	--

5.5. EMISSION LIMITATIONS [§90.543], RSS-119 [5.8.9.1]

5.5.1. Limits

§ 90.543 Emission Limitations

Transmitters designed to operate in 769-775 MHz and 799-805 MHz frequency bands must meet the emission limitations in paragraphs (a) through (d) of this section. Class A and Class B signal boosters retransmitting signals in the 769-775 MHz and 799-805 MHz frequency bands are exempt from the limits listed in paragraph (a) of this section when simultaneously retransmitting multiple signals and instead shall be subject to the limit listed in paragraph (c) of this section when operating in this manner. Transmitters operating in 758-768 MHz and 788-798 MHz bands must meet the emission limitations in (e) of this section.

(a) The adjacent channel power (ACP) requirements for transmitters designed for various channel sizes are shown in the following tables. Mobile station requirements apply to handheld, car mounted and control station units. The tables specify a value for the ACP as a function of the displacement from the channel center frequency and measurement bandwidth. In the following tables, “(s)” indicates a swept measurement may be used.

12.5 kHz Mobile Transmitter ACP Requirements

Offset from center frequency (kHz)	Measurement bandwidth (kHz)	Maximum ACP relative (dBc)
9.375	6.25	-40
15.625	6.25	-60
21.875	6.25	-60
37.50	25.00	-60
62.50	25.00	-65
87.50	25.00	-65
150.00	100	-65
250.00	100	-65
350.00	100	-65
>400 to 12 MHz	30 (s)	-75
12 MHz to paired receive band	30 (s)	-75
In the paired receive band	30 (s)	-100

25 kHz Mobile Transmitter ACP Requirements

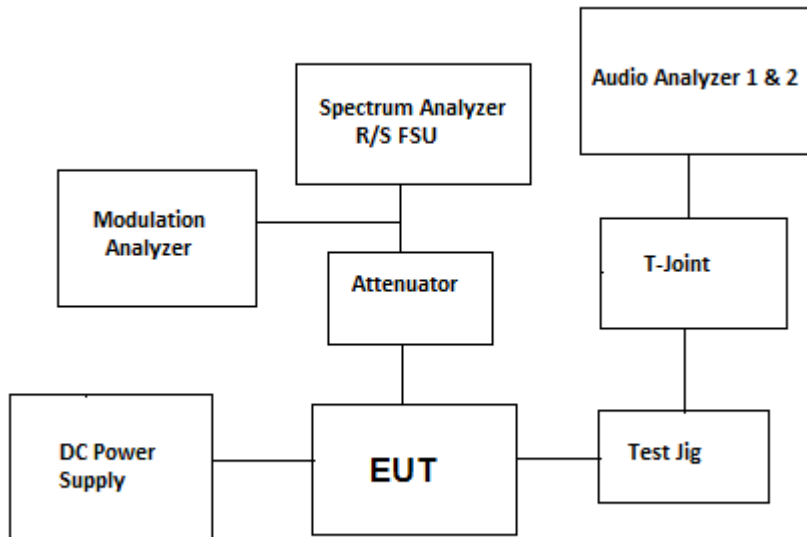
Offset from center frequency (kHz)	Measurement bandwidth (kHz)	Maximum ACP relative (dBc)
15.625	6.25	-40
21.875	6.25	-60
37.50	25	-60
62.50	25	-65
87.50	25	-65
150.00	100	-65
250.00	100	-65
350.00	100	-65
>400 kHz to 12 MHz	30 (s)	-75
12 MHz to paired receive band	30 (s)	-75
In the paired receive band	30 (s)	-100

5.5.2. Method of Measurements

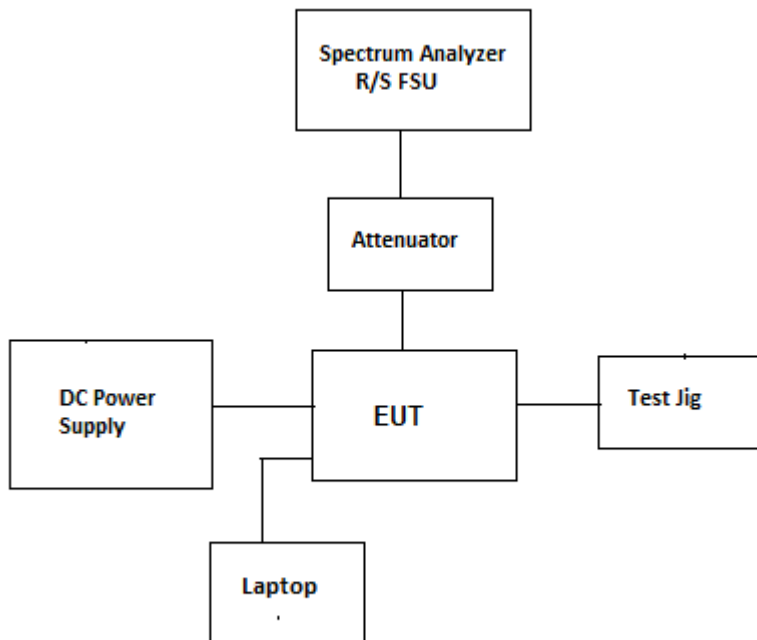
TIA-603-E & ANSI 63.26

5.5.3. Test Arrangement

Analog Test Setup



Digital Test Setup



5.5.4. Test Equipment List

Test Instrument	Manufacturer	Model No	Serial No	Frequency Range	Cal Due date
Spectrum Analyzer	Rohde & Schwarz	FSU	100398	20Hz-26.5GHz	23 Oct 2021
Modulation Analyzer	HP	HP-8901B	3226A04606	150KHz-1300MHz	17 Mar 2022
Dual Channel Arbitrary Waveform Generator	Kuman	FY6600-60M	170966000106	DC-60MHz	02 Oct 2020
Attenuator(20dB)	Narda	WA35-20-33	A164	DC-8.5GHz	Cal on use
Attenuator(20dB)	Aeroflex>Weinschel	23-20-34	BH7876	DC-18GHz	Cal on use
Power Supply	Tenma	72-6153	--	1-15V, DC 20A	----
Multimeter	Fluke	8842A	5021295	---	19 Dec 2020

Test date: Sept 22-23, 2020

5.5.5. Test Data

Mode Frequency (MHz) Channel Spacing (kHz)		Analog 770 12.5			
Offset (kHz)	Resolution BW (Hz)	Measurement BW (KHz)	Lower ACP (dBc)	Upper ACP (dBc)	Maximum ACP Relative (dBc)
9.375	100	6.25	-43.05	-46.47	-40
15.625	100	6.25	-67.91	-68.69	-60
21.875	100	6.25	-71.22	-71.37	-60
37.5	300	25	-69.50	-69.44	-60
62.5	300	25	-71.25	-71.97	-65
87.5	300	25	-73.61	-74.20	-65
150	1000	100	-69.93	-69.94	-65
250	1000	100	-73.41	-74.00	-65
350	1000	100	-76.40	-76.75	-65
400	500	30(Swept)	-84.40	-84.16	-75
12M	500	30(Swept)	-90.80	-88.68	-75

Mode Frequency (MHz) Channel Spacing (kHz)		Analog 775 12.5			
Offset (kHz)	Resolution BW (Hz)	Measurement BW (kHz)	Lower ACP (dBc)	Upper ACP (dBc)	Maximum ACP Relative (dBc)
9.375	100	6.25	-43.17	-46.24	-40
15.625	100	6.25	-68.36	-68.13	-60
21.875	100	6.25	-71.50	-71.70	-60
37.5	300	25	-68.65	-68.71	-60
62.5	300	25	-71.52	-71.61	-65
87.5	300	25	-70.76	-70.60	-65
150	1000	100	-69.75	-69.78	-65
250	1000	100	-73.25	-73.73	-65
350	1000	100	-76.06	-76.00	-65
400	500	30(Swept)	-84.09	-84.18	-75
12M	500	30(Swept)	-89.86	-88.48	-75

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File #: 20FSG195_FCC90
 October 8, 2020

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Mode		Analog			
Frequency (MHz)		800			
Channel Spacing (kHz)		12.5			
Offset (kHz)	Resolution BW (Hz)	Measurement BW (kHz)	Lower ACP (dBc)	Upper ACP (dBc)	Maximum ACP Relative (dBc)
9.375	100	6.25	-42.80	-46.17	-40
15.625	100	6.25	-62.97	-64.67	-60
21.875	100	6.25	-67.48	-68.43	-60
37.5	300	25	-65.92	-65.21	-60
62.5	300	25	-69.26	-68.96	-65
87.5	300	25	-72.05	-71.57	-65
150	1000	100	-69.36	-69.31	-65
250	1000	100	-73.22	-73.65	-65
350	1000	100	-75.91	-75.68	-65
400	500	30(Swept)	-83.29	-83.85	-75
12M	500	30(Swept)	-89.35	-90.80	-75

Mode		Analog			
Frequency (MHz)		805			
Channel Spacing (kHz)		12.5			
Offset (kHz)	Resolution BW (Hz)	Measurement BW (kHz)	Lower ACP (dBc)	Upper ACP (dBc)	Maximum ACP Relative (dBc)
9.375	100	6.25	-42.85	-45.90	-40
15.625	100	6.25	-64.21	-64.17	-60
21.875	100	6.25	-67.56	-67.86	-60
37.5	300	25	-65.56	-66.02	-60
62.5	300	25	-69.46	-70.25	-65
87.5	300	25	-72.25	-72.40	-65
150	1000	100	-69.18	-69.18	-65
250	1000	100	-73.34	-73.66	-65
350	1000	100	-75.91	-75.88	-65
400	500	30(Swept)	-83.57	-84.14	-75
12M	500	30(Swept)	-89.25	-90.39	-75

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 October 8, 2020

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Mode		Analog			
Frequency (MHz)		770			
Channel Spacing (kHz)		25			
Offset (kHz)	Resolution BW (Hz)	Measurement BW (kHz)	Lower ACP (dBc)	Upper ACP (dBc)	Maximum ACP Relative (dBc)
15.625	100	6.25	-67.25	-67.33	-40
21.875	100	6.25	-69.79	-70.14	-60
37.5	300	25	-67.76	-68.38	-60
62.5	300	25	-70.20	-70.51	-65
87.5	300	25	-72.01	-72.70	-65
150	1000	100	-69.52	-70.00	-65
250	1000	100	-72.96	-73.41	-65
350	1000	100	-76.28	-76.18	-65
400	500	30(Swept)	-84.92	-84.87	-75
12M	500	30(Swept)	-89.89	-89.22	-75

Mode		Analog			
Frequency (MHz)		775			
Channel Spacing (kHz)		25			
Offset (kHz)	Resolution BW (Hz)	Measurement BW (kHz)	Lower ACP (dBc)	Upper ACP (dBc)	Maximum ACP Relative (dBc)
15.625	100	6.25	-67.61	-67.56	-40
21.875	100	6.25	-70.12	-70.54	-60
37.5	300	25	-68.21	-67.79	-60
62.5	300	25	-70.46	-70.80	-65
87.5	300	25	-69.99	-69.90	-65
150	1000	100	-69.69	-69.73	-65
250	1000	100	-73.10	-73.52	-65
350	1000	100	-75.60	-75.77	-65
400	500	30(Swept)	-83.88	-84.29	-75
12M	500	30(Swept)	-89.56	-89.14	-75

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File #: 20FSG195_FCC90
 October 8, 2020

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

Mode		Analog			
Frequency (MHz)		800			
Channel Spacing (kHz)		25			
Offset (kHz)	Resolution BW (Hz)	Measurement BW (kHz)	Lower ACP (dBc)	Upper ACP (dBc)	Maximum ACP Relative (dBc)
15.625	100	6.25	-62.57	-63.47	-40
21.875	100	6.25	-65.99	-66.58	-60
37.5	300	25	-66.03	-66.58	-60
62.5	300	25	-69.74	-70.27	-65
87.5	300	25	-72.54	-73.51	-65
150	1000	100	-69.22	-69.50	-65
250	1000	100	-73.33	-73.52	-65
350	1000	100	-75.92	-75.87	-65
400	500	30(Swept)	-83.06	-83.53	-75
12M	500	30(Swept)	-90.05	-89.89	-75

Mode		Analog			
Frequency (MHz)		805			
Channel Spacing (kHz)		25			
Offset (kHz)	Resolution BW (Hz)	Measurement BW (kHz)	Lower ACP (dBc)	Upper ACP (dBc)	Maximum ACP Relative (dBc)
15.625	100	6.25	-63.50	-63.61	-40
21.875	100	6.25	-66.71	-66.72	-60
37.5	300	25	-66.02	-66.37	-60
62.5	300	25	-69.89	-70.05	-65
87.5	300	25	-71.91	-73.10	-65
150	1000	100	-69.18	-69.51	-65
250	1000	100	-73.61	-73.78	-65
350	1000	100	-75.55	-75.87	-65
400	500	30(Swept)	-83.67	-84.46	-75
12M	500	30(Swept)	-89.32	-90.04	-75

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File #: 20FSG195_FCC90
 October 8, 2020

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Mode		Digital 12.5 kHz			
Frequency (MHz)		770			
Channel Spacing (kHz)		12.5			
Offset (kHz)	Resolution BW (Hz)	Measurement BW (kHz)	Lower ACP (dBc)	Upper ACP (dBc)	Maximum ACP Relative (dBc)
9.375	100	6.25	-40.75	-41.65	-40
15.625	100	6.25	-68.78	-68.85	-60
21.875	100	6.25	-71.56	-72.12	-60
37.5	300	25	-68.41	-68.37	-60
62.5	300	25	-71.34	-71.20	-65
87.5	300	25	-73.01	-72.68	-65
150	1000	100	-69.79	-69.79	-65
250	1000	100	-74.02	-73.98	-65
350	1000	100	-76.30	-76.06	-65
400	500	30(Swept)	-84.49	-85.63	-75
12M	500	30(Swept)	-90.01	-88.08	-75

Mode		Digital 12.5 kHz			
Frequency (MHz)		775			
Channel Spacing (kHz)		12.5			
Offset (kHz)	Resolution BW (Hz)	Measurement BW (kHz)	Lower ACP (dBc)	Upper ACP (dBc)	Maximum ACP Relative (dBc)
9.375	100	6.25	-40.44	-41.82	-40
15.625	100	6.25	-69.10	-69.00	-60
21.875	100	6.25	-71.06	-71.58	-60
37.5	300	25	-68.33	-68.05	-60
62.5	300	25	-70.51	-70.87	-65
87.5	300	25	-68.99	-68.55	-65
150	1000	100	-69.03	-69.17	-65
250	1000	100	-73.07	-73.40	-65
350	1000	100	-75.73	-75.41	-65
400	500	30(Swept)	-84.65	-85.11	-75
12M	500	30(Swept)	-89.86	-88.73	-75

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Mode		Digital 12.5 kHz			
Frequency (MHz)		800			
Channel Spacing (kHz)		12.5			
Offset (kHz)	Resolution BW (Hz)	Measurement BW (kHz)	Lower ACP (dBc)	Upper ACP (dBc)	Maximum ACP Relative (dBc)
9.375	100	6.25	-41.50	-42.04	-40
15.625	100	6.25	-64.08	-64.41	-60
21.875	100	6.25	-66.58	-68.25	-60
37.5	300	25	-66.27	-66.68	-60
62.5	300	25	-69.95	-70.37	-65
87.5	300	25	-72.40	-72.47	-65
150	1000	100	-68.89	-68.48	-65
250	1000	100	-73.06	-72.72	-65
350	1000	100	-75.14	-75.59	-65
400	500	30(Swept)	-84.26	-84.76	-75
12M	500	30(Swept)	-89.61	-90.11	-75

Mode		Digital 12.5 kHz			
Frequency (MHz)		805			
Channel Spacing (kHz)		12.5			
Offset (kHz)	Resolution BW (Hz)	Measurement BW (kHz)	Lower ACP (dBc)	Upper ACP (dBc)	Maximum ACP Relative (dBc)
9.375	100	6.25	-41.27	-40.68	-40
15.625	100	6.25	-65.39	-64.97	-60
21.875	100	6.25	-67.74	-68.20	-60
37.5	300	25	-66.64	-66.33	-60
62.5	300	25	-70.49	-70.57	-65
87.5	300	25	-72.69	-73.15	-65
150	1000	100	-68.78	-69.23	-65
250	1000	100	-73.45	-73.56	-65
350	1000	100	-76.42	-76.13	-65
400	500	30(Swept)	-84.95	-84.66	-75
12M	500	30(Swept)	-89.83	-90.38	-75

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File #: 20FSG195_FCC90
 October 8, 2020

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**5.6. TRANSMITTER ANTENNA POWER SPURIOUS/HARMONIC CONDUCTED EMISSIONS [§ 90.543(c)],
RSS-119 [5.8]**

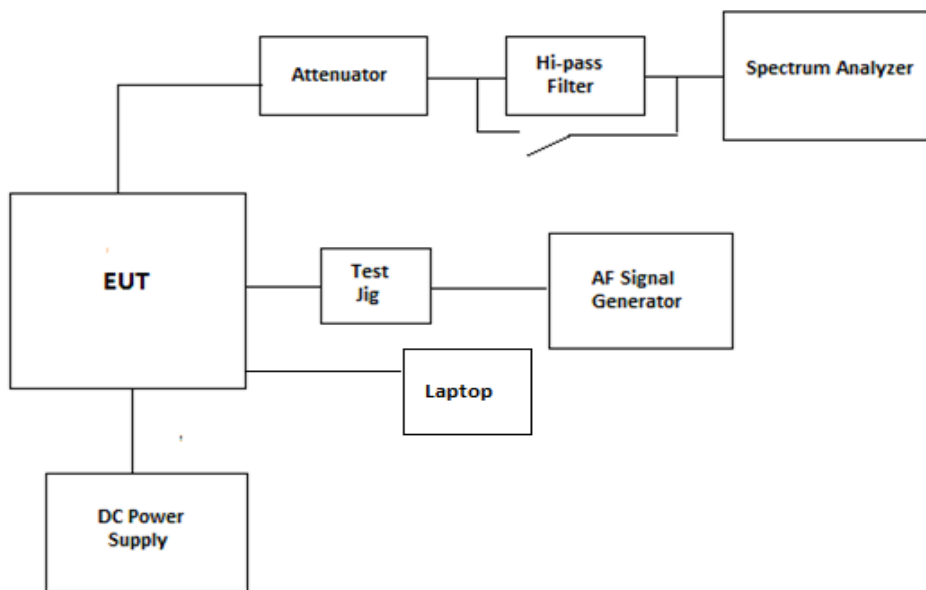
5.6.1. Limits

§ 90.543(c) Out-of-band emission limit. On any frequency outside of the frequency ranges covered by the ACP tables in this section, the power of any emission must be reduced below the mean output power (P) by at least $43 + 10\log(P)$ dB measured in a 100 kHz bandwidth for frequencies less than 1 GHz, and in a 1 MHz bandwidth for frequencies greater than 1 GHz.

5.6.2. Method of Measurements

TIA-603-E, ANSI C63.26

5.6.3. Test Arrangement



5.6.4. Test Equipment List

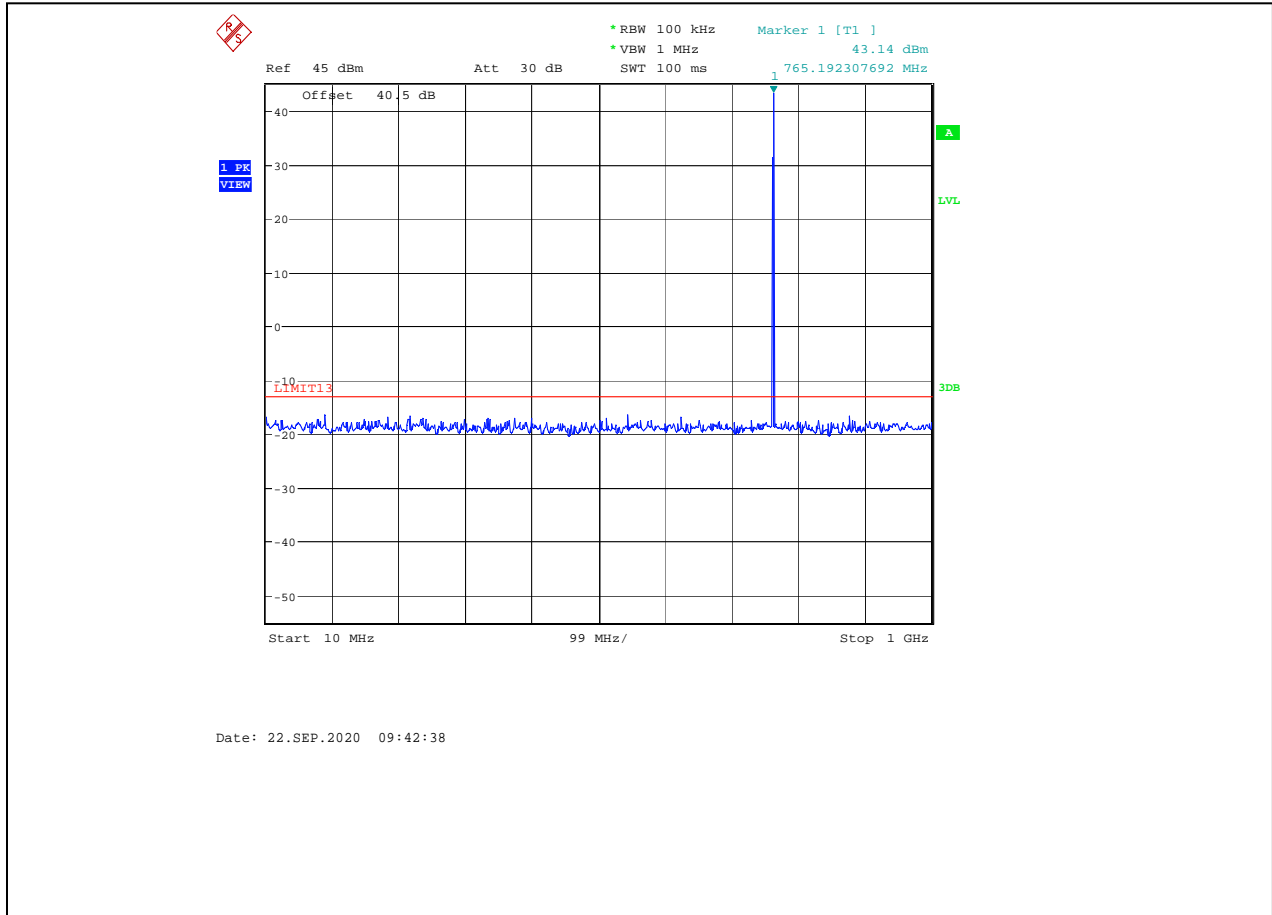
Test Instrument	Manufacturer	Model No	Serial No	Frequency Range	Cal Due date
Spectrum Analyzer	Rohde & Schwarz	FSU	100398	20Hz-26.5GHz	23 Oct 2021
AF Signal Generator	HP	HP-8920B	US39064699	30MHz-1GHz	17 Mar 2022
Hi-pass filter	K&L	11SH10-1500/T8000-0/0	2	Cut off 1500MHz	Cal on use
Attenuator(20dB)	Narda	WA35-20-33	A164	DC-8.5GHz	Cal on use
Attenuator(20dB)	Aeroflex\Weinschel	23-20-34	BH7876	DC-18GHz	Cal on use
Power Supply	Tenma	72-6153	--	1-15V, DC 20A	----
Multimeter	Fluke	8842A	5021295	---	19 Dec 2020

Test date: Sep 22, 2020

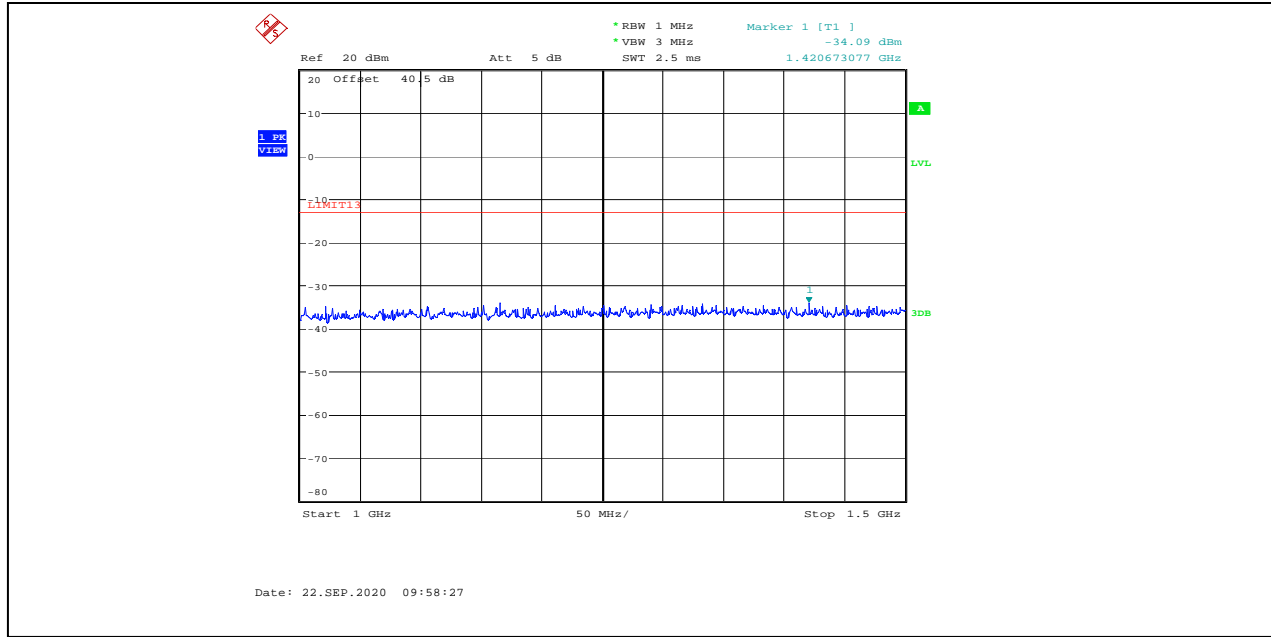
5.6.5. Test Data

5.6.5.1. 764 – 776 MHz Band

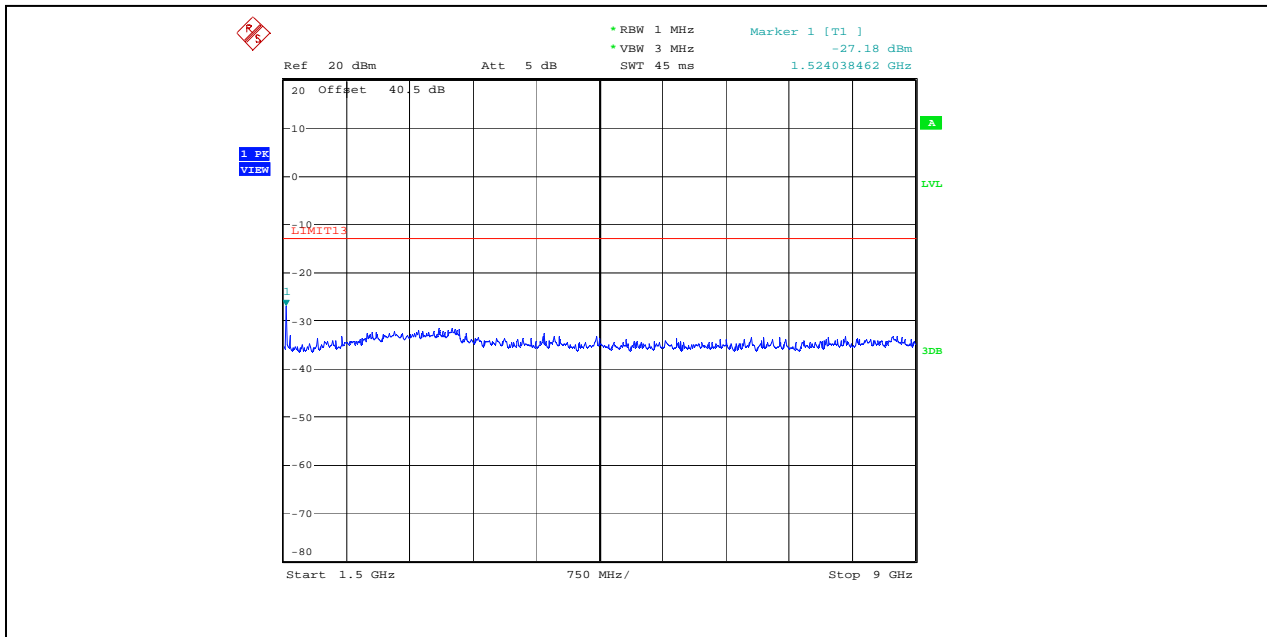
Plot 5.6.5.1.1. Transmitter Spurious Emissions at Antenna Terminal, Analog 12.5 kHz Channel Spacing
High Power, 764 MHz, 10 MHz – 1 GHz



Plot 5.6.5.1.2.
Transmitter Spurious Emissions at Antenna Terminal, Analog 12.5 kHz Channel Spacing
High Power, 764 MHz, 1 GHz – 1.5 GHz



Plot 5.6.5.1.3. Transmitter Spurious Emissions at Antenna Terminal, Analog 12.5 kHz Channel Spacing
High Power, 764 MHz, 1.5 GHz – 9GHz



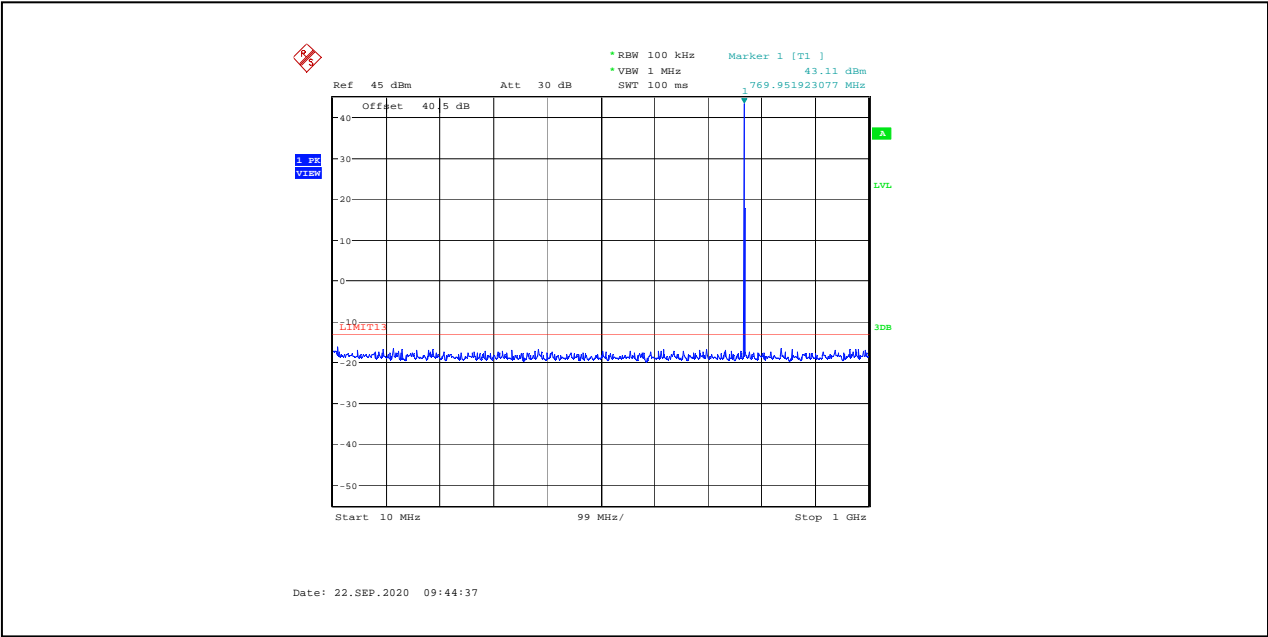
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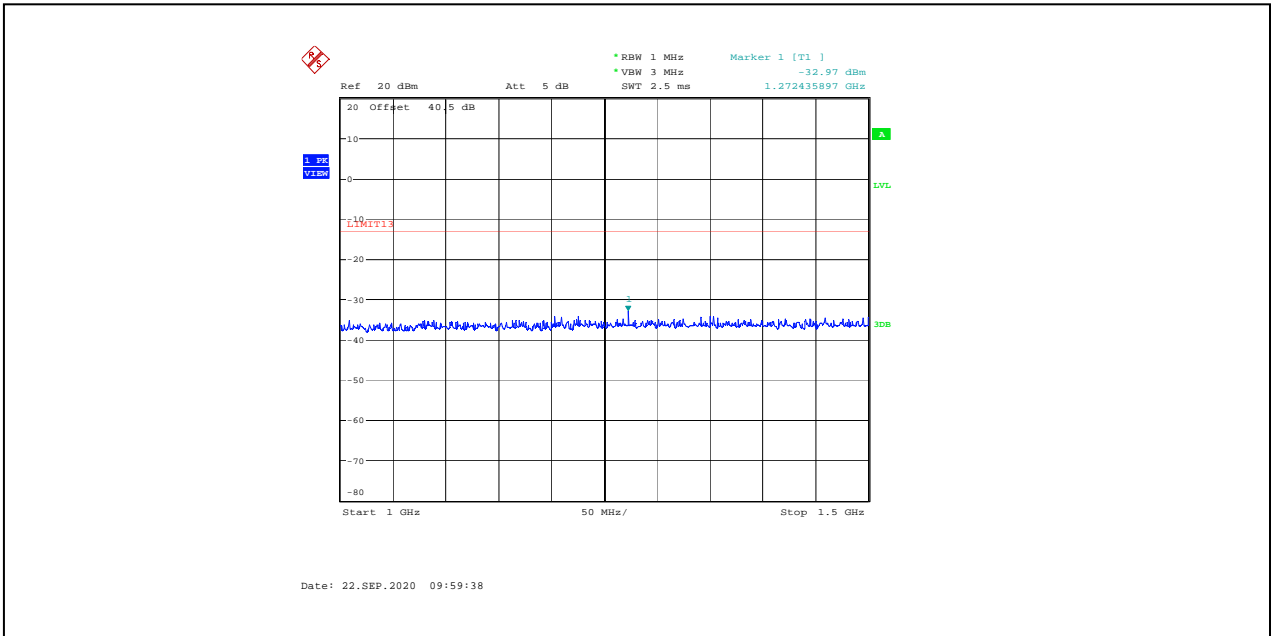
File #: 20FSG195_FCC90
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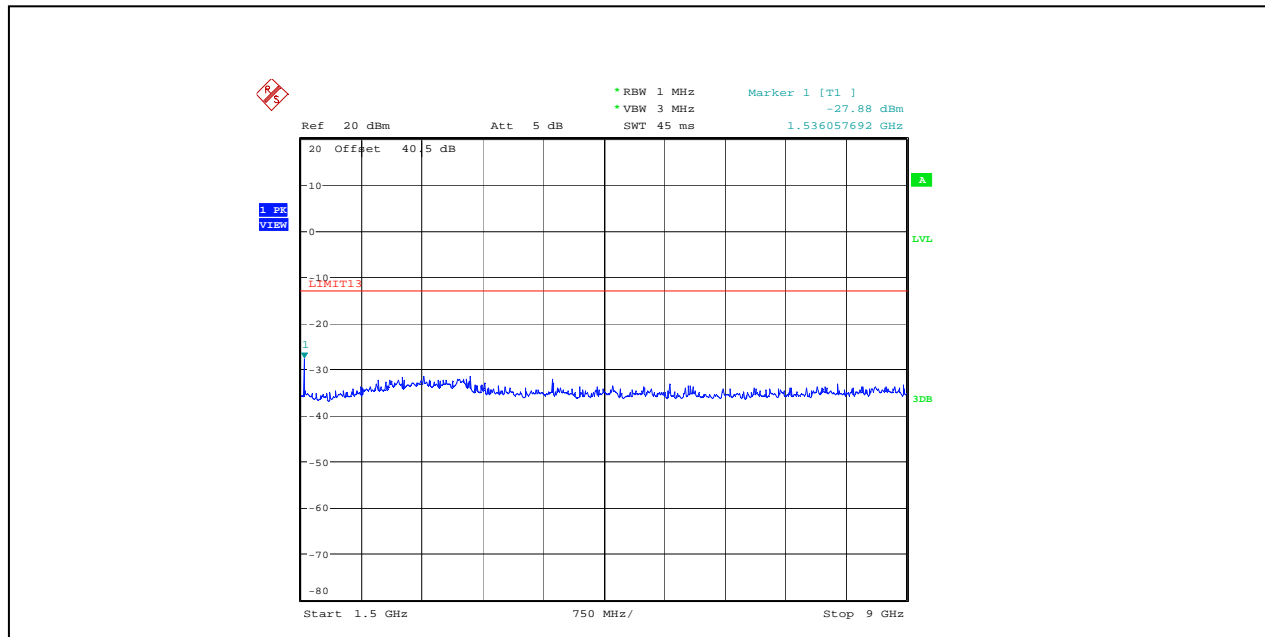
Plot 5.6.5.1.4. Transmitter Spurious Emissions at Antenna Terminal, Analog 12.5 kHz Channel Spacing
High Power, 770 MHz, 10 MHz – 1 GHz



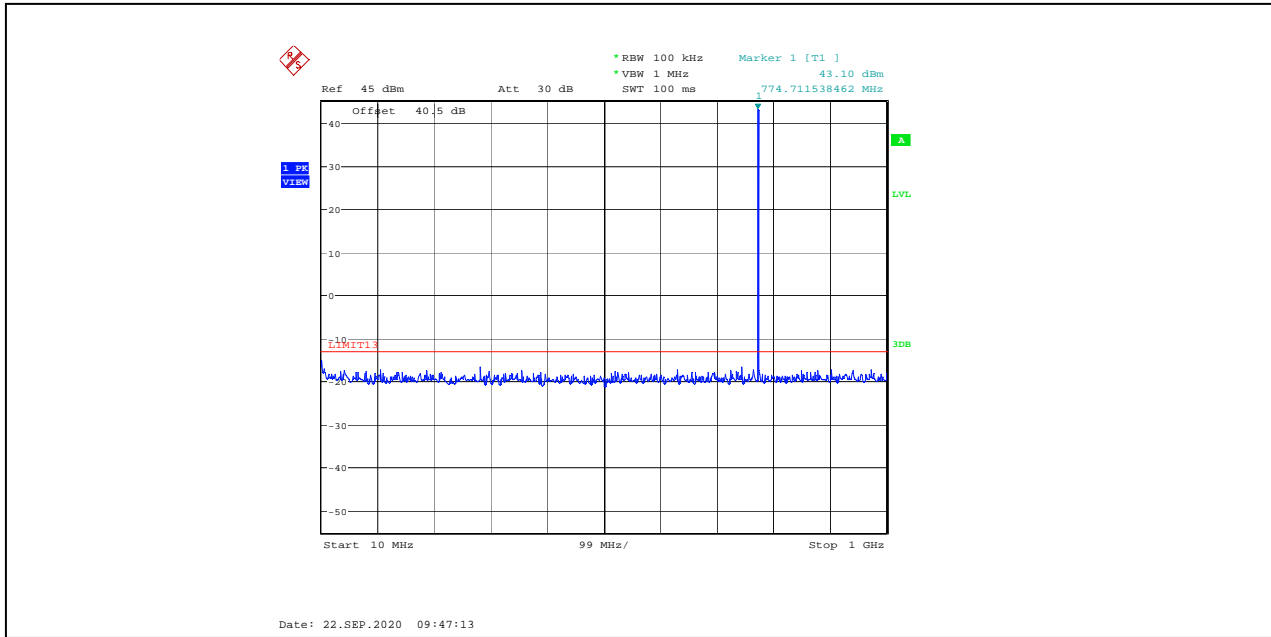
Plot 5.6.5.1.5. Transmitter Spurious Emissions at Antenna Terminal, Analog 12.5 kHz Channel Spacing
High Power, 770 MHz, 1 GHz – 1.5 GHz



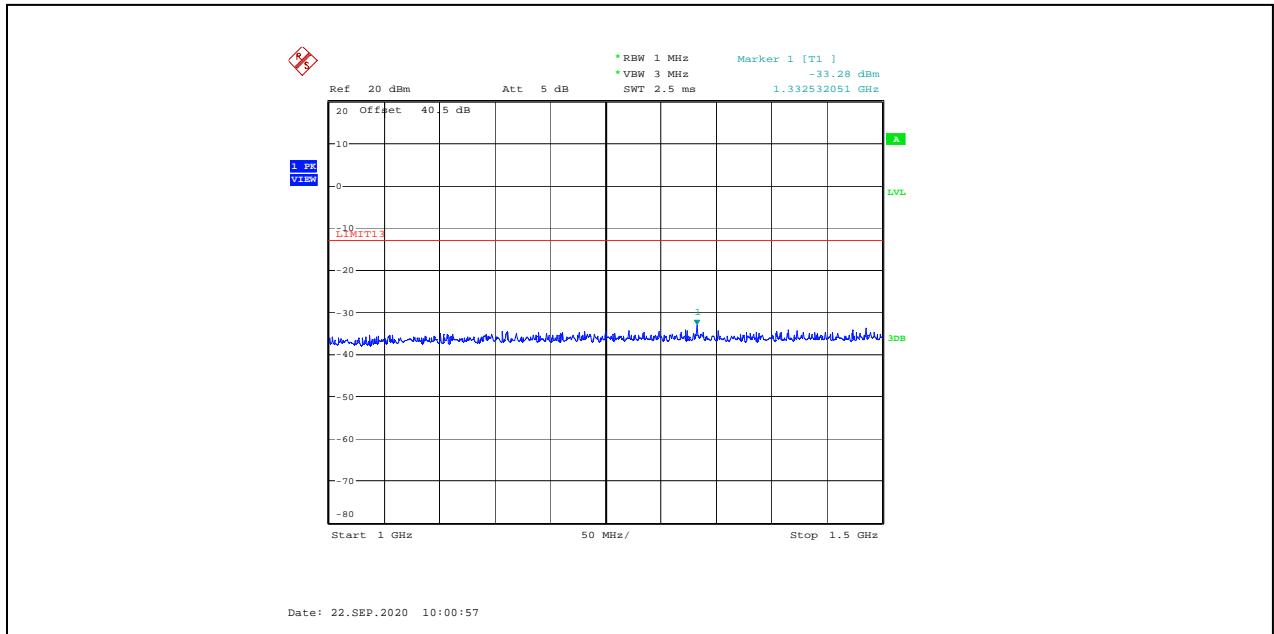
Plot 5.6.5.1.6. Transmitter Spurious Emissions at Antenna Terminal, Analog 12.5 kHz Channel Spacing
High Power, 770 MHz, 1.5 GHz – 9 GHz



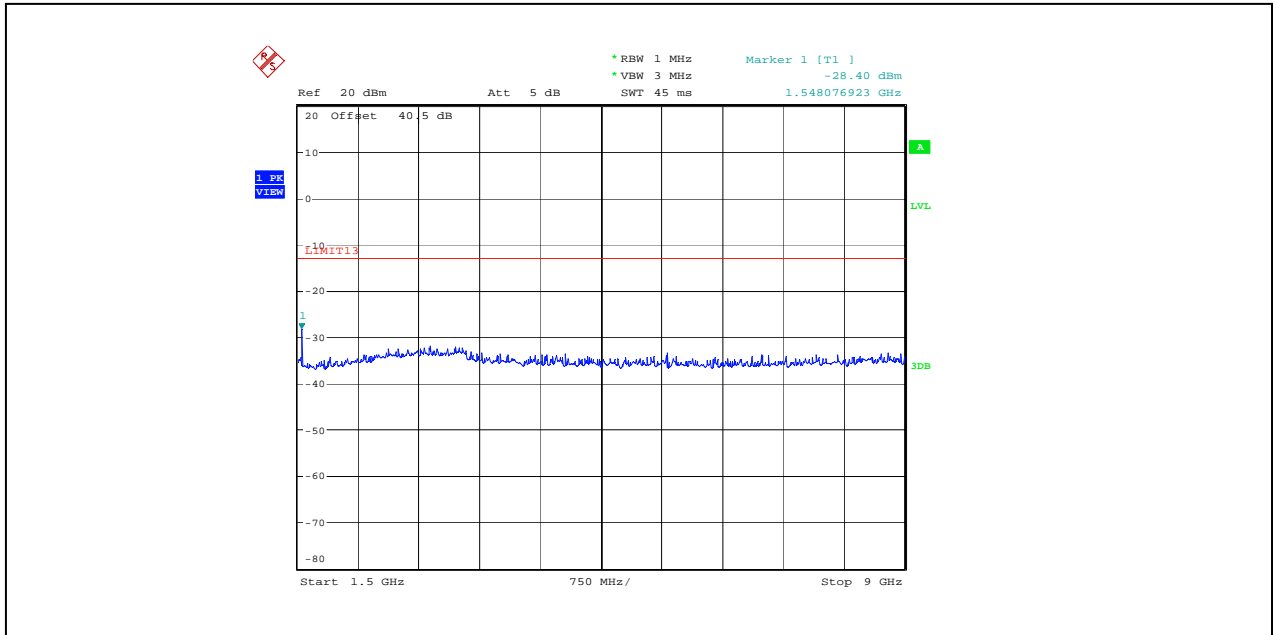
Plot 5.6.5.1.7. Transmitter Spurious Emissions at Antenna Terminal, Analog 12.5 kHz Channel Spacing
High Power, 775 MHz, 10 MHz – 1.0 GHz



Plot 5.6.5.1.8. Transmitter Spurious Emissions at Antenna Terminal, Analog 12.5 kHz Channel Spacing
High Power, 775 MHz, 1.0 GHz – 1.5 GHz

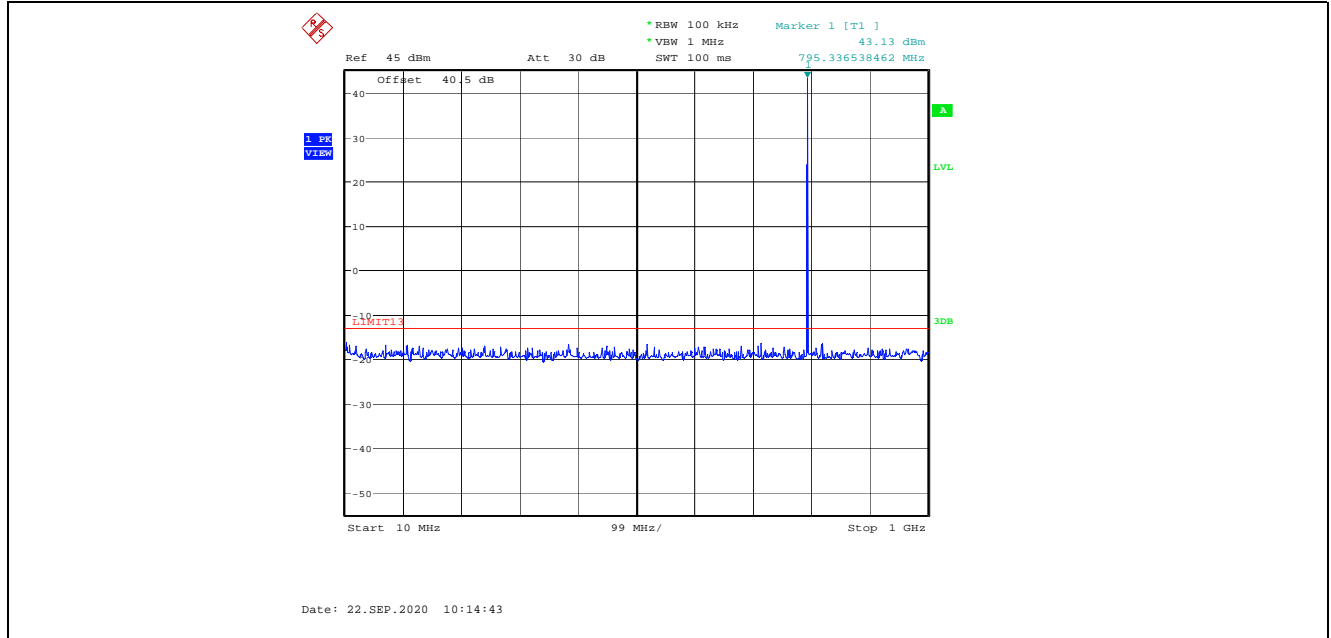


Plot 5.6.5.1.9. Transmitter Spurious Emissions at Antenna Terminal, Analog 12.5 kHz Channel Spacing
High Power, 775 MHz, 1.5 GHz – 9.0 GHz

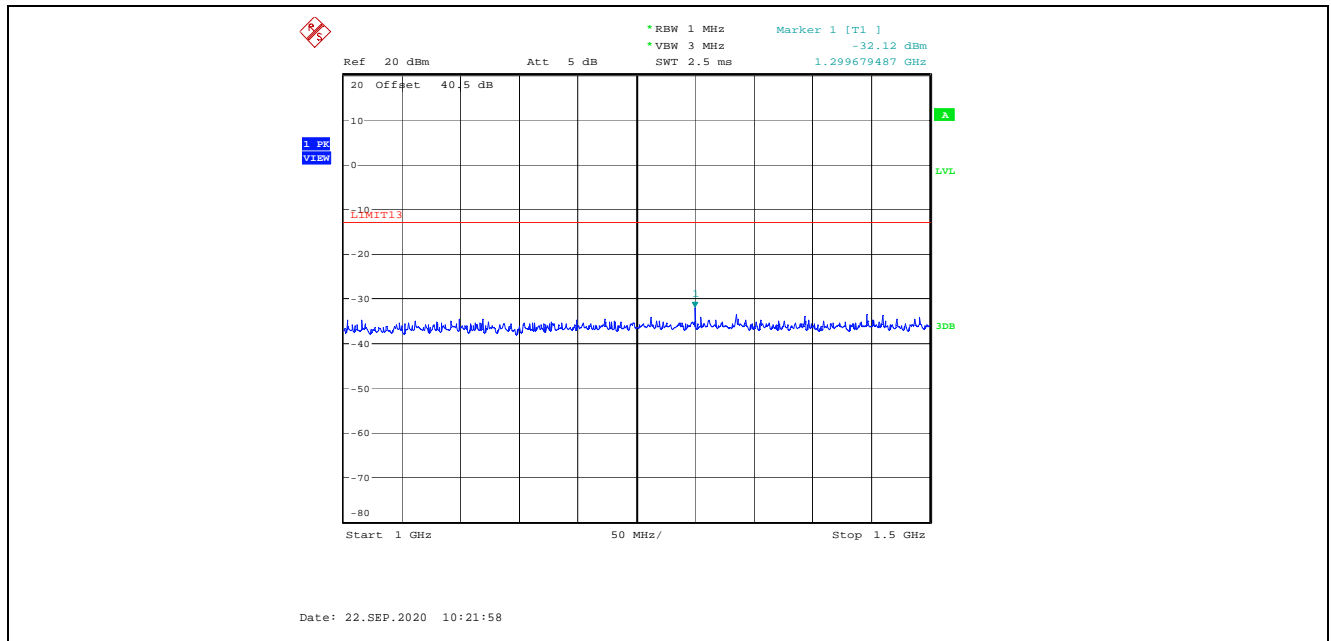


5.6.5.2. 794 – 806 MHz Band

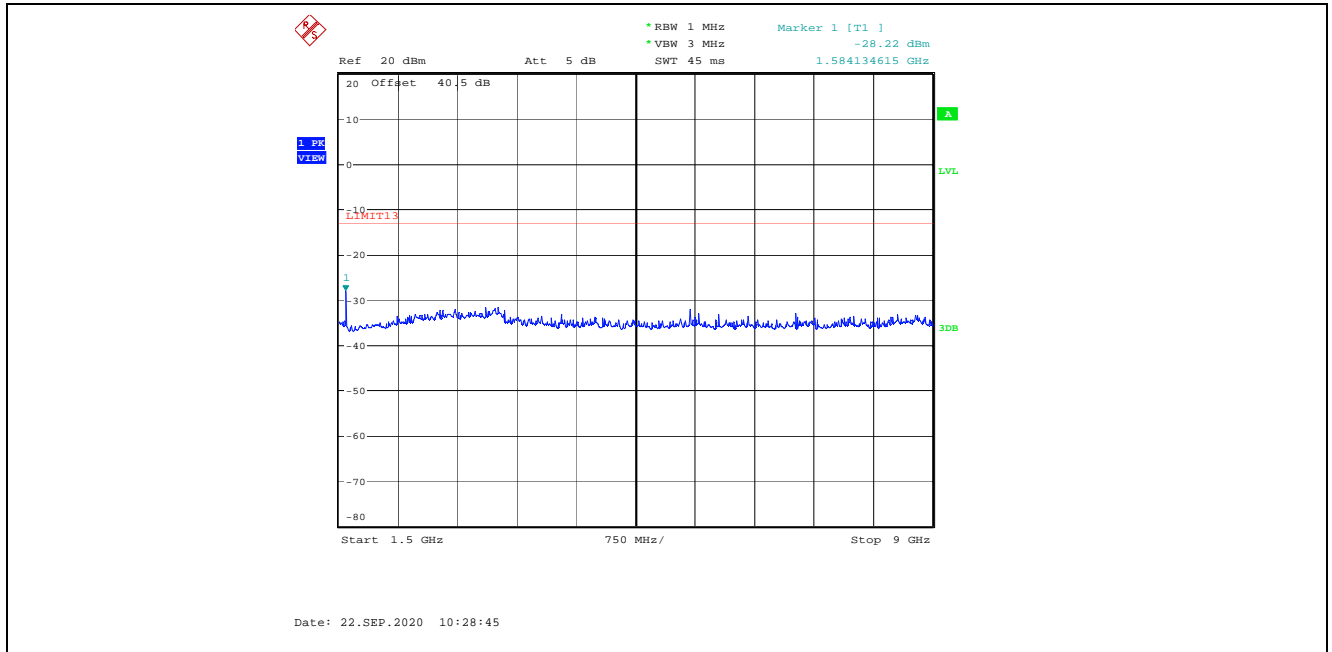
Plot 5.6.5.2.1. Transmitter Spurious Emissions at Antenna Terminal, Analog 12.5 kHz Channel Spacing
High Power, 794 MHz, 10 MHz – 1 GHz



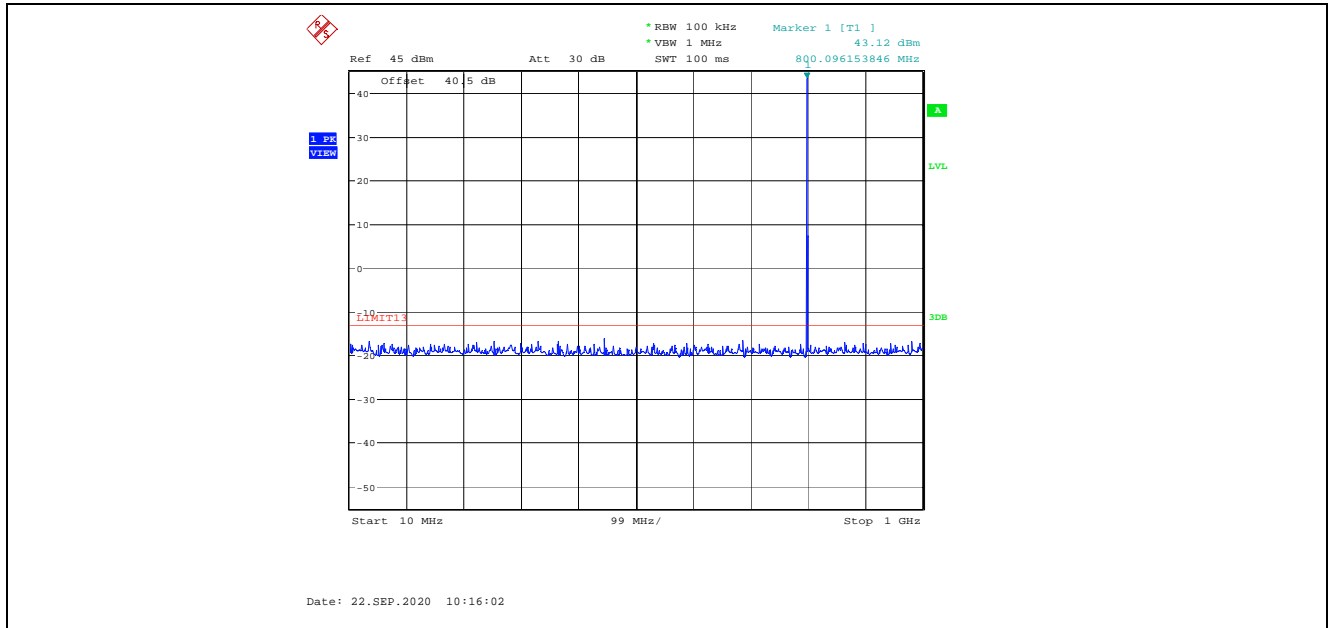
Plot 5.6.5.2.2. Transmitter Spurious Emissions at Antenna Terminal, Analog 12.5 kHz Channel Spacing
High Power, 794 MHz, 1 GHz – 1.5 GHz



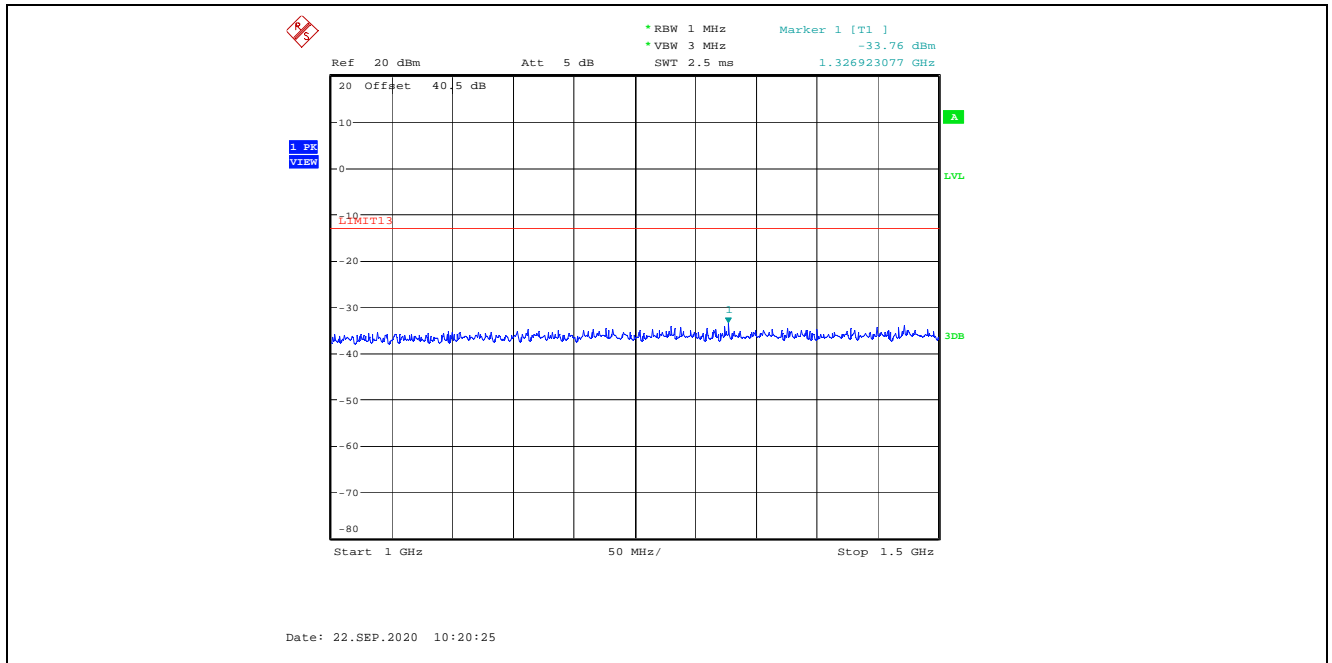
Plot 5.6.5.2.3. Transmitter Spurious Emissions at Antenna Terminal, Analog 12.5 kHz Channel Spacing
High Power, 794 MHz, 1.5 GHz – 9 GHz



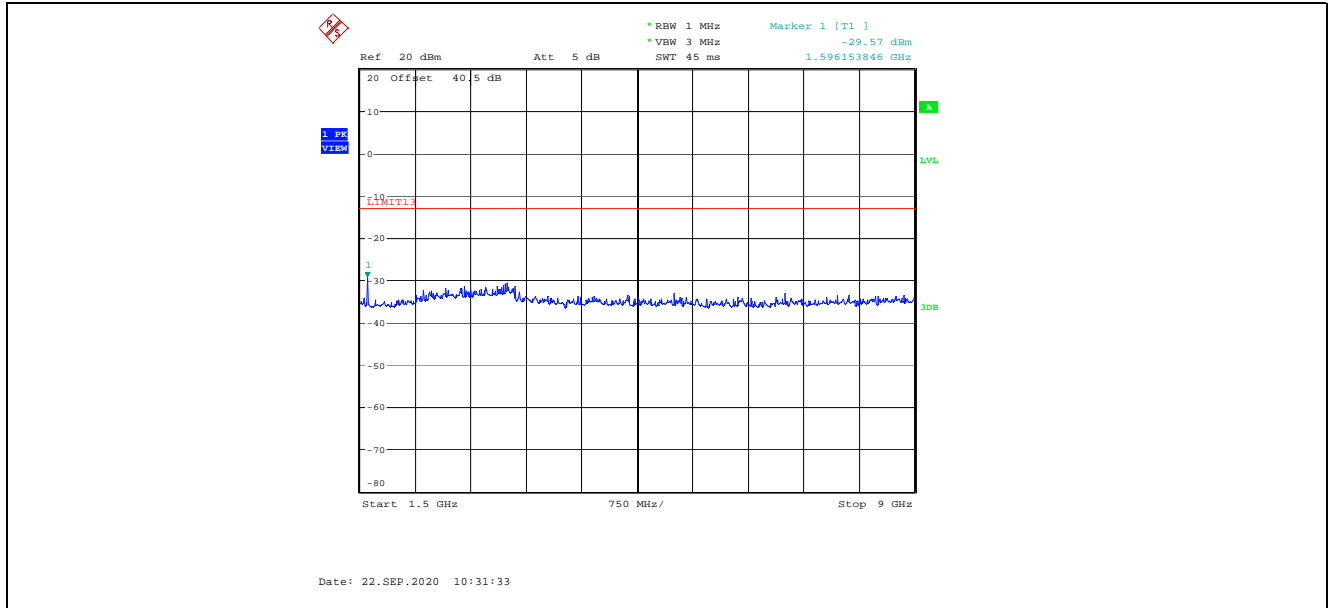
Plot 5.6.5.2.4. Transmitter Spurious Emissions at Antenna Terminal, Analog 12.5 kHz Channel Spacing
High Power, 800 MHz, 10 MHz – 1 GHz



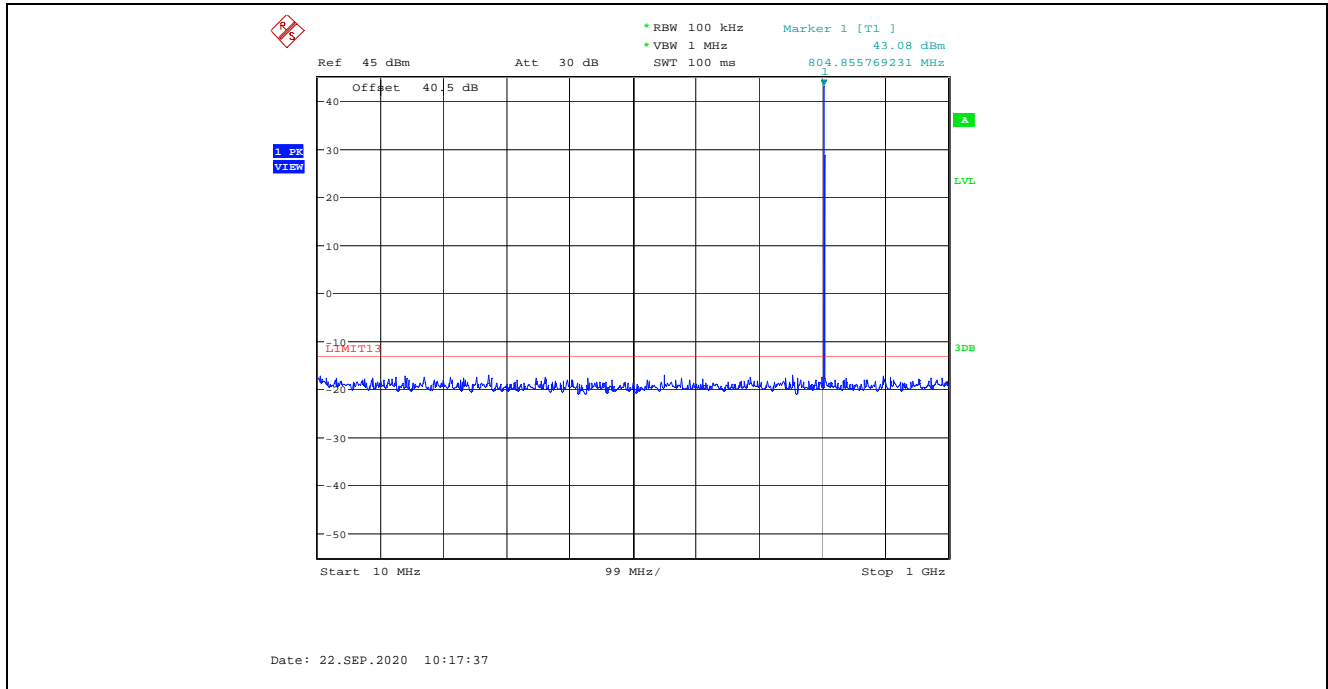
Plot 5.6.5.2.5. Transmitter Spurious Emissions at Antenna Terminal, Analog 12.5 kHz Channel Spacing
High Power, 800 MHz, 1 GHz – 1.5 GHz



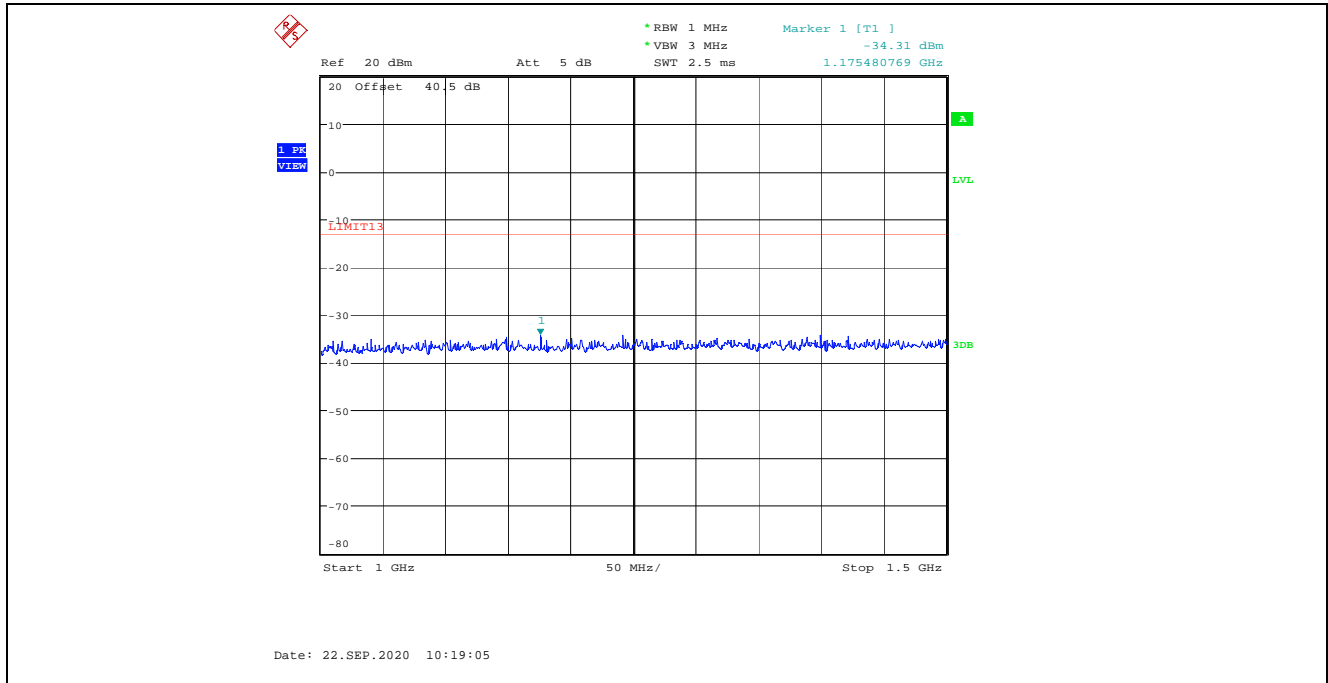
Plot 5.6.5.2.6. Transmitter Spurious Emissions at Antenna Terminal, Analog 12.5 kHz Channel Spacing
High Power, 800 MHz, 1.5 GHz – 9 GHz



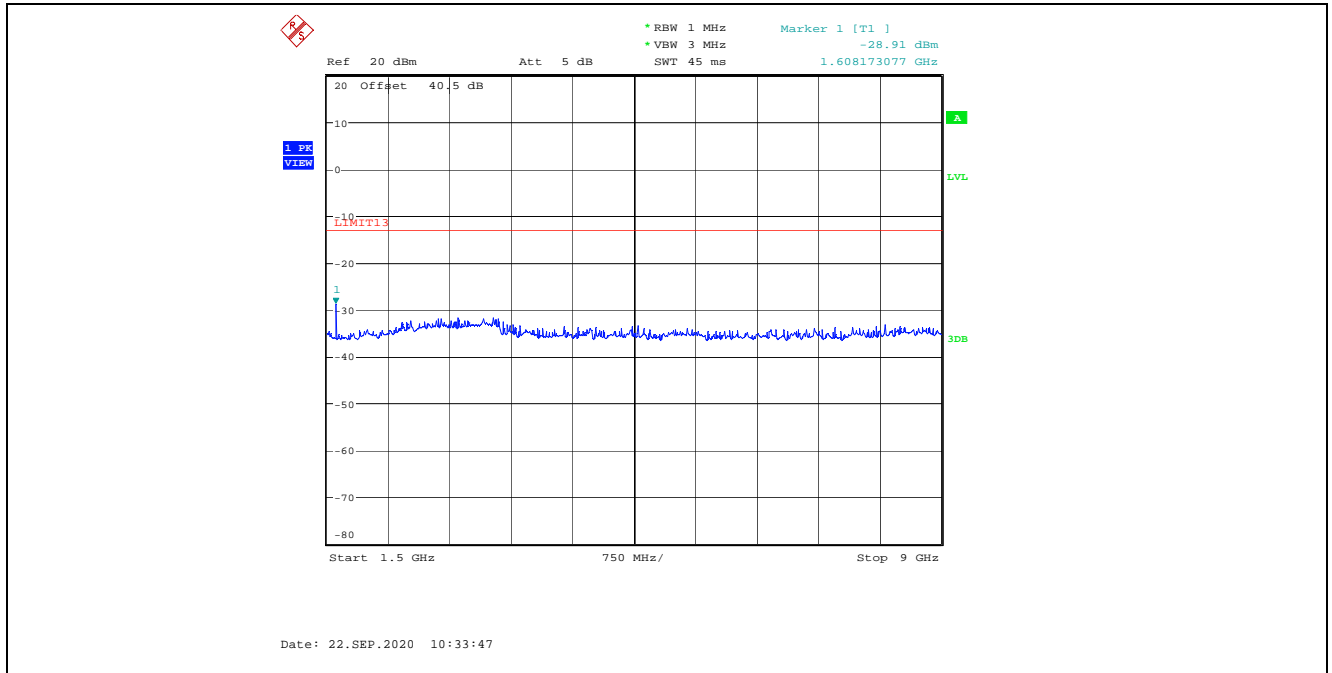
Plot 5.6.5.2.7. Transmitter Spurious Emissions at Antenna Terminal, Analog 12.5 kHz Channel Spacing
High Power, 805 MHz, 10 MHz – 1 GHz



Plot 5.6.5.2.8. Transmitter Spurious Emissions at Antenna Terminal, Analog 12.5 kHz Channel Spacing
High Power, 805 MHz, 1 GHz – 1.5 GHz



Plot 5.6.5.2.9. Transmitter Spurious Emissions at Antenna Terminal, Analog 12.5 kHz Channel Spacing
High Power, 805 MHz, 1.5 GHz –9 GHz



5.7. TRANSMITTER SPURIOUS/HARMONIC RADIATED EMISSIONS [§ 90.543(c) & (e)], RSS-119 [5.8]

5.7.1. Limits

§ 90.543

c) *Out-of-band emission limit.* On any frequency outside of the frequency ranges covered by the ACP tables in this section, the power of any emission must be reduced below the mean output power (P) by at least $43 + 10 \log(P)$ dB measured in a 100 kHz bandwidth for frequencies less than 1 GHz, and in a 1 MHz bandwidth for frequencies greater than 1 GHz.

- (e) For operations in the 758-768 MHz and the 788-798 MHz bands, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following:
- (1) On all frequencies between 769-775 MHz and 799-805 MHz, by a factor not less than $76 + 10 \log(P)$ dB in a 6.25 kHz band segment, for base and fixed stations.
 - (2) On all frequencies between 769-775 MHz and 799-805 MHz, by a factor not less than $65 + 10 \log(P)$ dB in a 6.25 kHz band segment, for mobile and portable stations.
 - (3) On any frequency between 775-788 MHz, above 805 MHz, and below 758 MHz, by at least $43 + 10 \log(P)$ dB.
 - (4) Compliance with the provisions of paragraphs (e)(1) and (2) of this section is based on the use of measurement instrumentation such that the reading taken with any resolution bandwidth setting should be adjusted to indicate spectral energy in a 6.25 kHz segment.
 - (5) Compliance with the provisions of paragraph (e)(3) of this section is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of 30 kHz may be employed.
- (f) For operations in the 758-775 MHz and 788-805 MHz bands, all emissions including harmonics in the band 1559-1610 MHz shall be limited to -70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals, and -80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth. For the purpose of equipment authorization, a transmitter shall be tested with an antenna that is representative of the type that will be used with the equipment in normal operation.

RSS 119

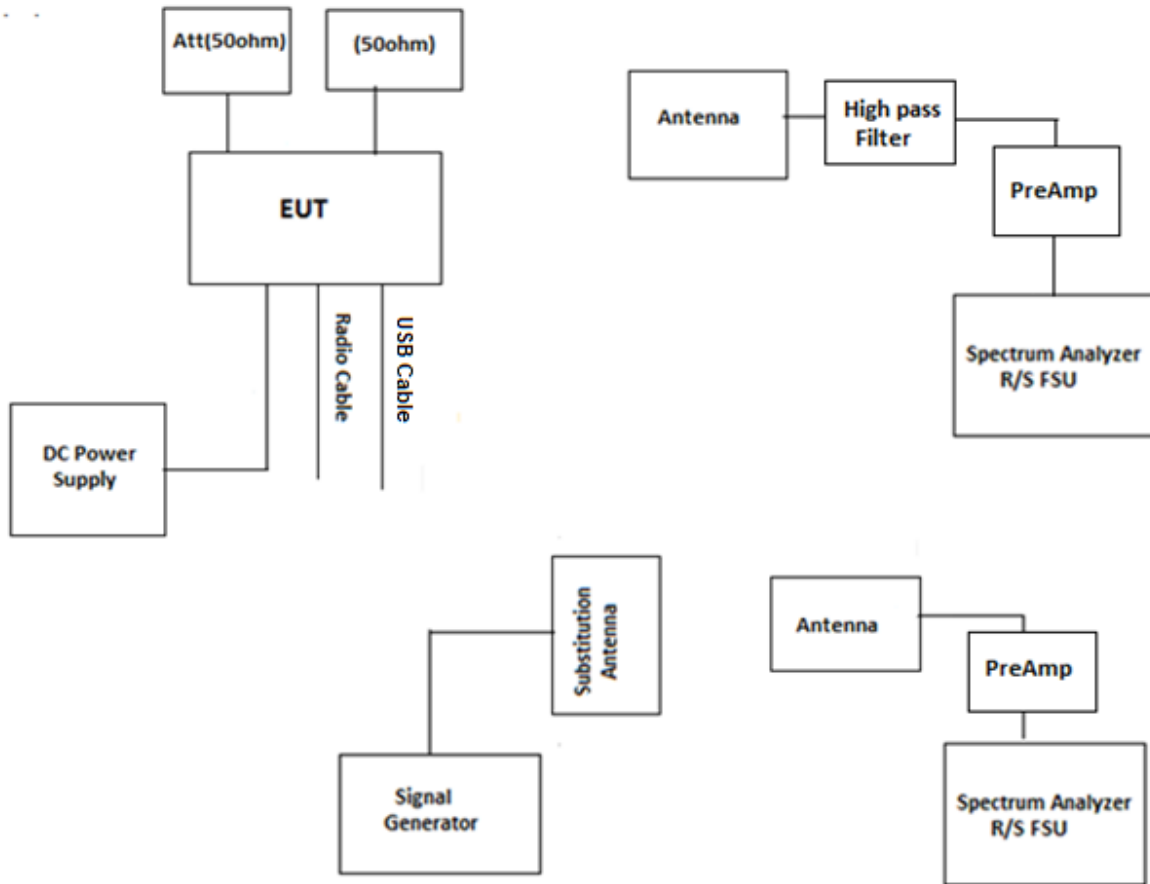
In addition, for operations in the bands 768-776 MHz and 798-806 MHz, all emissions (including harmonics in the band 1559-1610 MHz), shall not exceed:

- -70 dBW/MHz equivalent isotropically radiated power (e.i.r.p.) for wideband emissions, and
- -80 dBW/kHz e.i.r.p. for discrete emissions of less than 700 Hz bandwidth.

5.7.2. Method of Measurements

TIA-603-E / ANSI C63.26

5.7.3. Test Arrangement



5.7.4. Test Equipment List

Test Instrument	Manufacturer	Model No	Serial No	Frequency Range	Cal Due date
Spectrum Analyzer	Rohde & Schwarz	FSU	100398	20Hz-26.5GHz	23 Oct 2021
Biconilog Antenna	EMCO	3142C	00034792	26-2000MHz	16 May 2022
Preamplifier	Com-Power	PAM-118A	551016	500MHz-18GHz	17 Mar 2021
Horn Antenna	ETS	3117	00119425	1-18GHz	25 July 2021
Horn Antenna	ETS-Lindgren	3115	5061	1-18GHz	10 Jun 2022
Signal Generator	Rhode Schwarz	SMIQ06L	100059	300KHz-6.4GHz	11 Sep 2021
Hi-pass filter	K&L	11SH10-1500/T8000-0/0	2	Cut off 1500MHz	Cal on use
Attenuator(20dB)	Narda	WA35-20-33	A164	DC-8.5GHz	Cal on use
Attenuator(20dB)	Aeroflex\Weinschel	23-20-34	BH7876	DC-18GHz	Cal on use
50 ohm termination	Mini-Circuits	KARN-50+	00834	DC-18GHz	Cal on use
Power Supply	Tenma	72-6153	--	1-15V, DC 20A	----
Multimeter	Fluke	8842A	5021295	---	19 Dec 2020

Test date: Sept 28, 2020

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File #: 20FSG195_FCC90
 October 8, 2020

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

5.7.5. Test Data

Remarks:

- FCC 90.543(e) is not applicable for this device, transmit signals are not wideband or discrete signals.
- The rf spurious/harmonic emission characteristics between 2 different channel spacing operations and different modulations (voice/digital) are identical. Therefore, the following radiated emissions were performed on the radio set with 12.5 kHz channel spacing operation.
- The radiated emissions were performed at 3 meters distance. At its maximum power for worst case.
- 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.

5.7.5.1. 764 - 776 MHz Band

Carrier Frequency:		764 MHz				
Limit:		-13 dBm				
Frequency (MHz)	E-Field (dBµV/m)	EMI Detector (Peak/QP)	Antenna Polarization (H/V)	ERP (dBm)	Limit (dBm)	Margin (dB)
30 - 9000	*	Peak	H/V	*	-13	*

* All harmonics and spurious emissions are more than 20 dB below the specified attenuation limit.

Carrier Frequency:		770 MHz				
Limit:		-13 dBm				
Frequency (MHz)	E-Field (dBµV/m)	EMI Detector (Peak/QP)	Antenna Polarization (H/V)	ERP (dBm)	Limit (dBm)	Margin (dB)
30 - 9000	*	Peak	H/V	*	-13	*

* All harmonics and spurious emissions are more than 20 dB below the specified attenuation limit.

Carrier Frequency:		775 MHz				
Limit:		-13 dBm				
Frequency (MHz)	E-Field (dBµV/m)	EMI Detector (Peak/QP)	Antenna Polarization (H/V)	ERP (dBm)	Limit (dBm)	Margin (dB)
2325	74.72	Peak	V	-25.35	-13	-12.35
2325	69.66	Peak	H	-30.35	-13	-17.35

* All other harmonics and spurious emissions are more than 20 dB below the specified attenuation limit.

5.7.5.2. 794 - 806 MHz Band

Carrier Frequency:		794 MHz				
Limit:		-13 dBm				
Frequency (MHz)	E-Field (dB μ V/m)	EMI Detector (Peak/QP)	Antenna Polarization (H/V)	ERP (dBm)	Limit (dBm)	Margin (dB)
2382	73.26	Peak	V	-26.35	-13	-13.5
2382	71.26	Peak	H	-28.75	-13	-15.75

* All other harmonics and spurious emissions are more than 20 dB below the specified attenuation limit.

Carrier Frequency:		800 MHz				
Limit:		-13 dBm				
Frequency (MHz)	E-Field (dB μ V/m)	EMI Detector (Peak/QP)	Antenna Polarization (H/V)	ERP (dBm)	Limit (dBm)	Margin (dB)
30 - 9000	*	Peak	H/V	*	-13	*

* All harmonics and spurious emissions are more than 20 dB below the specified attenuation limit.

Carrier Frequency:		805 MHz				
Limit:		-13 dBm				
Frequency (MHz)	E-Field (dB μ V/m)	EMI Detector (Peak/QP)	Antenna Polarization (H/V)	ERP (dBm)	Limit (dBm)	Margin (dB)
30 - 9000	*	Peak	H/V	*	-13	*

* All harmonics and spurious emissions are more than 20 dB below the specified attenuation limit.

5.8. RADIATED EMISSIONS FROM UNINTENTIONAL RADIATORS [ICES-003]

5.8.1. Limits

The equipment shall meet the limits of the following table:

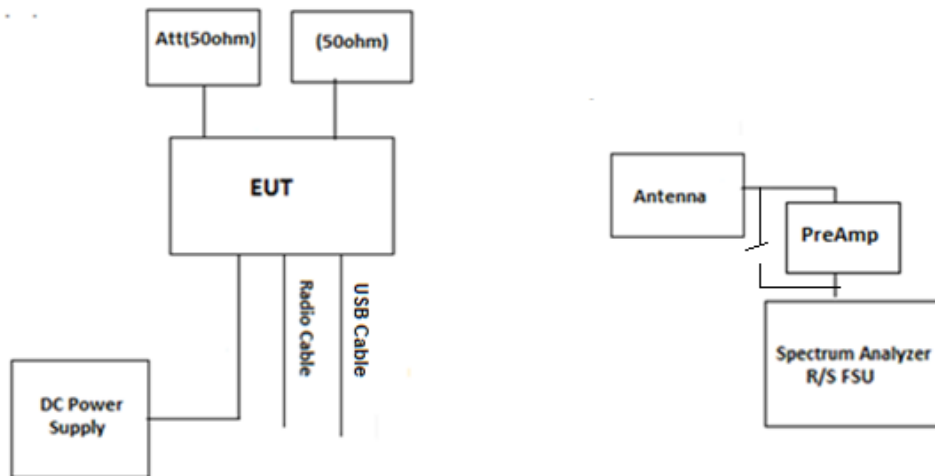
Frequency of emission (MHz)	Class B Limits	
	(dB μ V/m at 3 m)	(dB μ V/m at 10 m)
30 – 88	40.0	29.5
88 – 216	43.5	33.1
216 – 960	46.0	35.6
Above 960	54.0	43.5

5.8.2. Method of Measurements

Refer to Ultratech Test Procedures ULTR-P001-2004 & ANSI C63.4 for method of measurements.

5.8.3. Test Arrangement

Block Diagram of Unintentional Radiated @ 3m



5.8.4. Test Equipment List

Test Instrument	Manufacturer	Model No	Serial No	Frequency Range	Cal Due date
EMI Receiver	Rohde & Schwarz	ESU40	100037	20Hz-40GHz	Mar 18, 2021
Biconilog Antenna	EMCO	3142C	00034792	26-2000 MHz	May 16, 2022
Pre-Amplifier	Com-Power	Pam-0118A	551052	500MHz-18GHz	Jul 19, 2021
Horn-Antenna	EMCO	3115	5061	1-18GHz	June 10, 2022

Test date: Sept 29, 2020

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5.8.5. Test Data

The emissions were scanned from 30 MHz to 6 GHz at 3m. All emissions found above than 20 dB below the permissible limits were recorded

FREQUENCY (MHz)	RF LEVEL (dBuV/m)	DETECTOR USED (PEAK/QP)	ANTENNA PLANE (H/V)	LIMIT (dBuV/m)	MARGIN (dB)	PASS/ FAIL
87.51	32.59	PEAK	V	40	-7.41	PASS
87.51	18.33	PEAK	H	40	-21.67	PASS
140.36	29.12	PEAK	V	43.5	-14.38	PASS
140.36	27.63	PEAK	H	43.5	-15.87	PASS
864.75	38.29	PEAK	H	46	-7.71	PASS
888.07	37.69	PEAK	V	46	-8.31	PASS
888.07	36.33	PEAK	H	46	-9.67	PASS
912.94	38.06	PEAK	V	46	-7.94	PASS
912.94	35.72	PEAK	H	46	-10.28	PASS

EXHIBIT 6. MEASUREMENT UNCERTAINTY

Test description		Uncertainty
Conducted Output Power		+/- 0.62 dB
Conducted Out of Band/Spurious Emissions		+/- 0.72 dB
Transmitter ACP Requirements		+/- 0.62 dB
Radiated Out of Band/Spurious Emissions	<30 MHz	+/-2.69dB
	30-1000 MHz	+/-4.20dB
	>1 GHz	+/-2.70dB

All uncertainty values are expanded standard uncertainty to give a confidence level of 95%, based on coverage factor k=2