RADIO TEST REPORT

For

Unimo Technology Co., Ltd.

UDR-100E

Test Model: UDR-100E

Prepared for	:	Unimo Technology Co., Ltd.
Address	:	6F, Hanshin IT 2nd Tower, 47 Digital-Ro 9-Gil, Gu office 603, Seoul, Rep of Korea, South Korea

Prepared by	:	Shenzhen LCS Compliance Testing Laboratory Ltd.
Address	:	1/F., Xingyuan Industrial Park, Tongda Road, Bao'an Avenue, Bao'an District, Shenzhen, Guangdong, China
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Date of receipt of test sample	:	September 02, 2024
Number of tested samples	:	2
Sample No.	:	A240506123-1, A240506123-2
Serial number	:	Prototype
Date of Test	:	September 02, 2024 ~ November 08, 2024
Date of Report	:	November 08, 2024

RADIO TEST REPORT FCC Part 90	
Report Reference No.	**: LCSA09024031EA**
Date of Issue	: November 08, 2024
Testing Laboratory Name	**: Shenzhen LCS Compliance Testing Laboratory Ltd.**
Address	: 1/F., Xingyuan Industrial Park, Tongda Road, Bao'an Avenue, Bao'an District, Shenzhen, Guangdong, China
Testing Location/ Procedure....	: Full application of Harmonised standards ■ Partial application of Harmonised standards □ Other standard testing method □
Applicant's Name	**: Unimo Technology Co., Ltd.**
Address	: 6F, Hanshin IT 2nd Tower, 47 Digital-Ro 9-Gil, Gu office 603, Seoul, Rep of Korea, South Korea
Test Specification	
Standard.....	: FCC Part 90/FCC Part 2/FCC Part 15B
Test Report Form No.	: LCSEMC-1.0
TRF Originator.....	: Shenzhen LCS Compliance Testing Laboratory Ltd.
Master TRF	: Dated 2011-03

Test Item Description.	**: UDR-100E**
Trade Mark	: UNIMO
Test Model.....	: UDR-100E
Ratings	: Please Refer to Page 6
Result	**: Positive**

Compiled by:	Supervised by:	Approved by:
Martin Lee/ Administrator	Cary Luo/ Technique principal	Gavin Liang/ Manager

RADIO -- TEST REPORT

Test Report No. :	LCSA09024031EA	November 08, 2024 Date of issue

Test Model.....	:	UDR-100E
EUT.....	:	UDR-100E
Applicant.....	**:**	**Unimo Technology Co., Ltd.**
Address.....	:	6F, Hanshin IT 2nd Tower, 47 Digital-Ro 9-Gil, Gu office 603, Seoul, Rep of Korea, South Korea
Telephone.....	:	/
Fax.....	:	/
Manufacturer.....	**:**	**Unimo Technology Co., Ltd.**
Address.....	:	6F, Hanshin IT 2nd Tower, 47 Digital-Ro 9-Gil, Gu office 603, Seoul, Rep of Korea, South Korea
Telephone.....	:	/
Fax.....	:	/
Factory.....	**:**	**Unimo Technology Co., Ltd.**
Address.....	:	6F, Hanshin IT 2nd Tower, 47 Digital-Ro 9-Gil, Gu office 603, Seoul, Rep of Korea, South Korea
Telephone.....	:	/
Fax.....	:	/

Test Result	Positive

The test report merely corresponds to the test sample.
It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

Revision History

Report Version	Issue Date	Revision Content	Revised By
000	November 08, 2024	Initial Issue	---

TABLE OF CONTENTS

Test Report Description Page

1. GENERAL INFORMATION

1.1. Product Description for Equipment Under Test (EUT)

EUT	: UDR-100E
Test Model	: UDR-100E
Ratings	: Main unit: 7.2V, 2600mAh (LI-ION BATTERY PACK) Switching Adapter: 100-240V~, 50/60Hz, 0.5A Output: 12.0V⎓1.0A, 12.0W Charging base: Input: 12V⎓1000mA Output :8.4V⎓850mA
Hardware Version	: V1.0
Software Version	: V1.0
Frequency Range	: 136 MHz-174MHz
Channel Separation	: Analog Voice 12.5KHz Digital Voice/Data 12.5KHz Digital Data 12.5KHz
Modulation Type	: FM for Analog Voice 4FSK for Digital Voice/Digital Data
Antenna Description	: External, 0.5dBi (Max)

Note: The product has the same digital working characters when operating in both two digitized voice/data mode. So only one set of test results for digital modulation modes are provided in this test report.

1.2. Objective

The tests were performed according to following standards:

FCC Rules Part 90: 2015: PRIVATE LAND MOBILE RADIO SERVICES.
47 CFR FCC Part 15 Subpart B: 2015 - Unintentional Radiators
FCC Part 2: FREQUENCY ALLOCA-TIONS AND RADIO TREATY MAT-TERS; GENERAL RULES AND REG-ULATIONS
TIA/EIA 603 E: March 2016: Land Mobile FM or PM Communications Equipment Measurement and Performance Standards.

1.3. Related Submittal(s)/Grant(s)

No Related Submittals.

1.4. Description of Test Facility

NVLAP Accreditation Code is 600167-0.
FCC Designation Number is CN5024.
CAB identifier is CN0071.
CNAS Registration Number is L4595.

Test Firm Registration Number: 254912.

1.5. Support equipment List

Manufacturer	Description	Model	Serial Number	Certificate
UNIMO TECHNOLOGY CO.,LTD	AC DC Adapter	OUSM-1200100	--	FCC

1.6. External I/O

I/O Port Description	Quantity	Cable
Antenna Port	1	N/A
Accessory Jack	1	N/A

1.7. Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

Test Items	Measurement Uncertainty	Notes
Frequency stability	25 Hz	(1)
Transmitter power conducted	0.57 dB	(1)
Transmitter power Radiated	2.20 dB	(1)
Conducted spurious emission 9KHz-40 GHz	1.60 dB	(1)
Conducted Emission 9KHz-30MHz	3.39 dB	(1)
Radiated Emission 30~1000MHz	4.65 dB	(1)
Radiated Emission 1~18GHz	5.16 dB	(1)
Radiated Emission 18-40GHz	5.54 dB	(1)
Occupied Bandwidth	---------	(1)
Emission Mask	---------	(1)
Modulation Characteristic	---------	(1)
Transmitter Frequency Behavior	---------	(1)

(1) This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=1.96.

1.8. Test Environment

Items	Required (IEC 68-1)	Actual
Temperature (°C)	15-35	21
Humidity (%RH)	25-75	50
Barometric pressure (mbar)	860-1060	950-1000

1.9. Description Of Test Modes

The EUT has been tested under typical operating condition and The Transmitter was operated in the normal operating mode. The TX frequency was fixed which was for the purpose of the measurements.

EUT operation mode no.	Description of operation mode	Additional information
Op 1	FM+BW12.5KHz+TX	The equipment is set with FM modulation and 12.5KHz bandwidth at maximum rated power for transmitter, powered by DC 7.2V
Op 2	FM+BW12.5KHz+TX	The equipment is set with FM modulation and 12.5KHz bandwidth at minimum rated power for transmitter, powered by DC 7.2V
Op 3	4FSK+BW12.5KHz+TX	The equipment is set with 4FSK modulation and 12.5KHz bandwidth at maximum rated power for transmitter, powered by DC 7.2V
Op 4	4FSK+BW12.5KHz+TX	The equipment is set with 4FSK modulation and 12.5KHz bandwidth at minimum rated power for transmitter, powered by DC 7.2V
Op 5	FM+BW12.5KHz+RX (Standby)	The equipment is set with FM modulation and 12.5kHz bandwidth at Receiver Standby mode, powered by DC 7.40V(or for charging mode for AC conducted emission)
Op 6	4FSK+BW12.5KHz+RX (Standby)	The equipment is set with 4FSK modulation and 12.5KHz bandwidth at Receiver/Standby mode, powered by DC 7.40V(or for charging mode for AC conducted emission)

Test frequency list

Modulation Type	Channel Separation	Test Channel	Test Frequency (MHz)
Analog/FM	12.5KHz	Ch1	150.825
		Ch2	158.55
		Ch3	173.3875
Digital/4FSK	12.5KHz	Ch4	150.825
		Ch5	158.55
		Ch6	173.3875

2. SYSTEM TEST CONFIGURATION

2.1. Justification

The system was configured for testing in engineering mode.

2.2. EUT Exercise Software

N/A.

2.3. Special Accessories

N/A.

2.4. Block Diagram/Schematics

Please refer to the related document.

2.5. Equipment Modifications

Shenzhen LCS Compliance Testing Laboratory Ltd. has not done any modification on the EUT.

2.6. Configuration of Test Setup

Please refer to the test setup photo.

3. SUMMARY OF TEST RESULT

Test specification clause	Test case	Verdict
FCC Part 15.107	Conducted Emission	PASS
FCC Part 90.205	Maximum Transmitter Power	PASS
FCC Part 90.207	Modulation Characteristic	PASS
FCC Part 90.209	Occupied Bandwidth	PASS
FCC Part 90.210	Emission Mask	PASS
FCC Part 90.213	Frequency Stability	PASS
FCC Part 90.214	Transmitter Frequency Behavior	PASS
FCC Part 90.210	Transmitter Radiated Spurious Emission	PASS
FCC Part 90.210	Spurious Emission On Antenna Port	PASS

Remark: 1. The measurement uncertainty is not included in the test result.

4. TEST CONDITIONS AND RESULTS

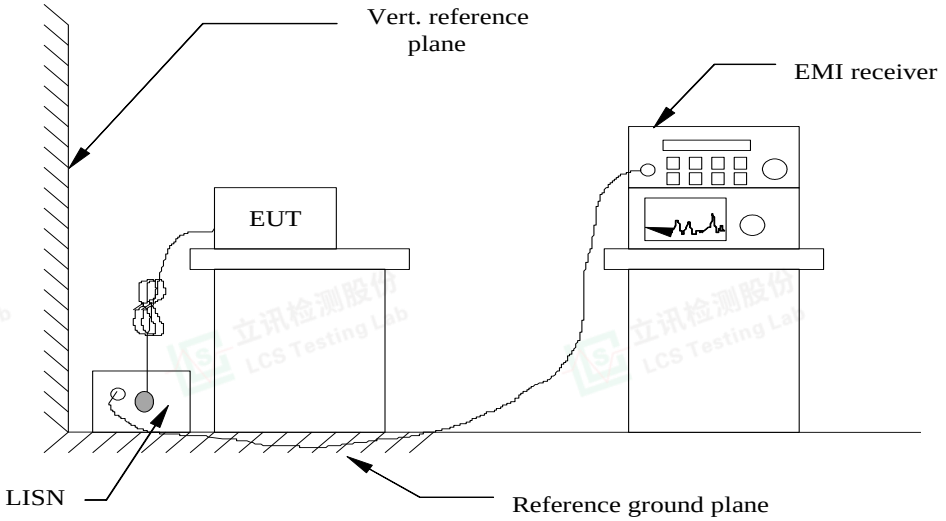
4.1. Conducted Emissions Test

TEST APPLICABLE

The EUT was tested according to ANSI C63.4 - 2014. The frequency spectrum from 0.15 MHz to 30 MHz was investigated. The LISN used was 50 ohm / 50 u Henry as specified by section 5.1 of ANSI C63.4 - 2014. Cables and peripherals were moved to find the maximum emission levels for each frequency.

TEST CONFIGURATION

For AC Power



TEST PROCEDURE

1 The equipment was set up as per the test configuration to simulate typical actual usage per the user's manual. The EUT is a tabletop system; a wooden table with a height of 0.8 meters is used and is placed on the ground plane as per ANSI C63.4-2014.
2 Support equipment, if needed, was placed as per ANSI C63.4-2014.
3 All I/O cables were positioned to simulate typical actual usage as per ANSI C63.4-2014.
4 If a EUT received AC120V/60Hz power through a Line Impedance Stabilization Network (LISN) which supplied power source and was grounded to the ground plane.
5 If a EUT received DC 13.60V power through an Impedance Stabilization Network (ISN) which supplied power source and was grounded to the ground plane.
6 All support equipments received AC power from a second LISN, if any.
7 The EUT test program was started. Emissions were measured on each current carrying line of the EUT using a spectrum Analyzer / Receiver connected to the LISN powering the EUT. The LISN has two monitoring points: Line 1 (Hot Side) and Line 2 (Neutral

Side). Two scans were taken: one with Line 1 connected to Analyzer / Receiver and Line 2 connected to a 50 ohm load; the second scan had Line 1 connected to a 50 ohm load and Line 2 connected to the Analyzer / Receiver.

8 Analyzer / Receiver scanned from 150 KHz to 30MHz for emissions in each of the test modes.

9 During the above scans, the emissions were maximized by cable manipulation.

Conducted Power Line Emission Limit

For intentional device, according to § 15.207(a) and RSS-Gen Section 7.2.4 for AC Power Conducted Emission Limits is as following:

Frequency (MHz)	Maximum RF Line Voltage (dBμV)			
	CLASS A		CLASS B	
	Q.P.	Ave.	Q.P.	Ave.
0.15 - 0.50	79	66	66-56*	56-46*
0.50 - 5.00	73	60	56	46
5.00 - 30.0	73	60	60	50

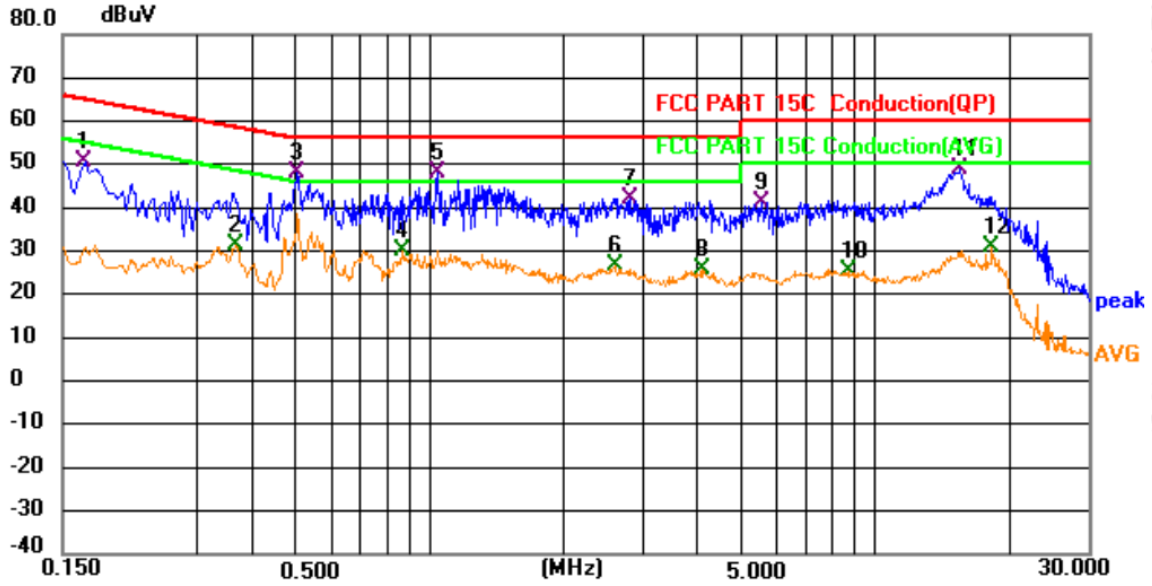
* Decreasing linearly with the logarithm of the frequency

TEST RESULTS

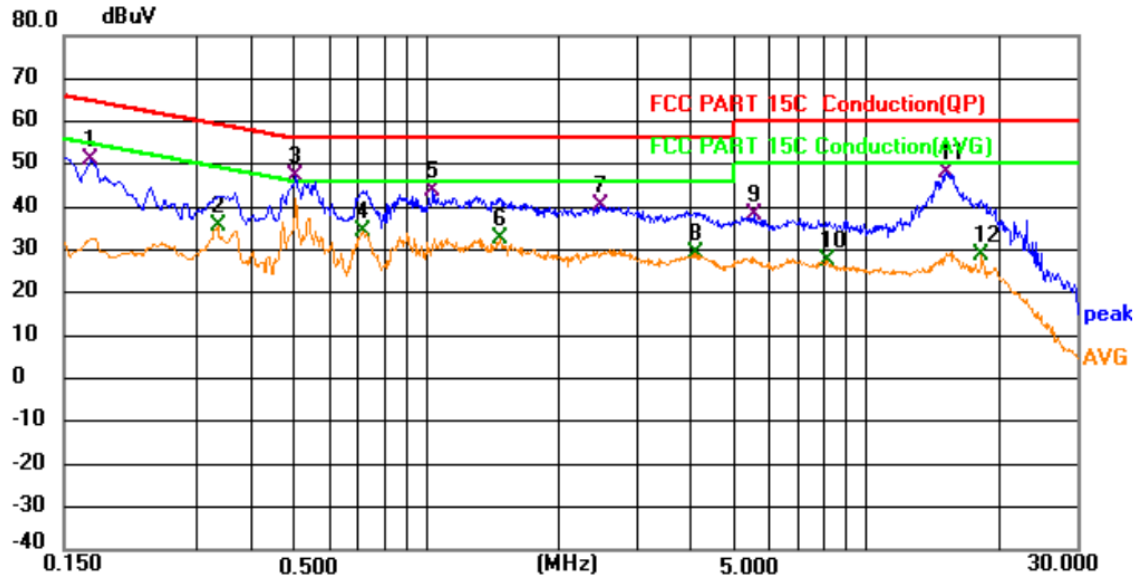
Remark: we tested all Op 5 to Op 6, recorded worst case at Op 5.

Op 5

Test Result For Line Power Input AC 120V/60Hz



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Margin		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		0.168	30.73	19.81	50.54	65.06	-14.52	QP	
2		0.366	11.22	19.94	31.16	48.59	-17.43	AVG	
3		0.505	28.35	19.82	48.17	56.00	-7.83	QP	
4		0.875	11.04	19.05	30.09	46.00	-15.91	AVG	
5	*	1.041	29.04	19.14	48.18	56.00	-7.82	QP	
6		2.598	7.31	19.12	26.43	46.00	-19.57	AVG	
7		2.809	23.01	19.18	42.19	56.00	-13.81	QP	
8		4.096	6.64	19.14	25.78	46.00	-20.22	AVG	
9		5.554	22.35	18.90	41.25	60.00	-18.75	QP	
10		8.713	5.84	19.62	25.46	50.00	-24.54	AVG	
11		15.549	29.27	19.86	49.13	60.00	-10.87	QP	
12		18.244	11.35	19.38	30.73	50.00	-19.27	AVG	



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Margin		
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment
1		0.172	31.20	19.67	50.87	64.86	-13.99	QP	
2		0.335	15.64	19.80	35.44	49.33	-13.89	AVG	
3	*	0.505	27.94	19.38	47.32	56.00	-8.68	QP	
4		0.722	14.88	19.45	34.33	46.00	-11.67	AVG	
5		1.036	25.14	18.80	43.94	56.00	-12.06	QP	
6		1.478	13.62	18.96	32.58	46.00	-13.42	AVG	
7		2.481	21.30	19.07	40.37	56.00	-15.63	QP	
8		4.074	10.18	18.97	29.15	46.00	-16.85	AVG	
9		5.577	19.39	18.91	38.30	60.00	-21.70	QP	
10		8.182	7.78	19.90	27.68	50.00	-22.32	AVG	
11		15.184	28.55	19.71	48.26	60.00	-11.74	QP	
12		18.308	9.42	19.28	28.70	50.00	-21.30	AVG	

4.2. Occupied Bandwidth and Emission Mask Test

TEST APPLICABLE

(a). Occupied Bandwidth: The EUT was connected to the audio signal generator and the spectrum analyzer via the main RF connector, and through an appropriate attenuator. The EUT was controlled to transmit its maximum power. Then the bandwidth of 99% power can be measured by the spectrum analyzer.

(b). Emission Mask B: For transmitters that are equipped with an audio low-pass filter pursuant to §90.211(a), the power of any emission must be below the unmodulated carrier power (P) as follows:

(1) On any frequency removed from the assigned frequency by more than 50 percent, but not more than 100 percent of the authorized bandwidth: At least 25 dB.

(2) On any frequency removed from the assigned frequency by more than 100 percent, but not more than 250 percent of the authorized bandwidth: At least 35 dB.

(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.

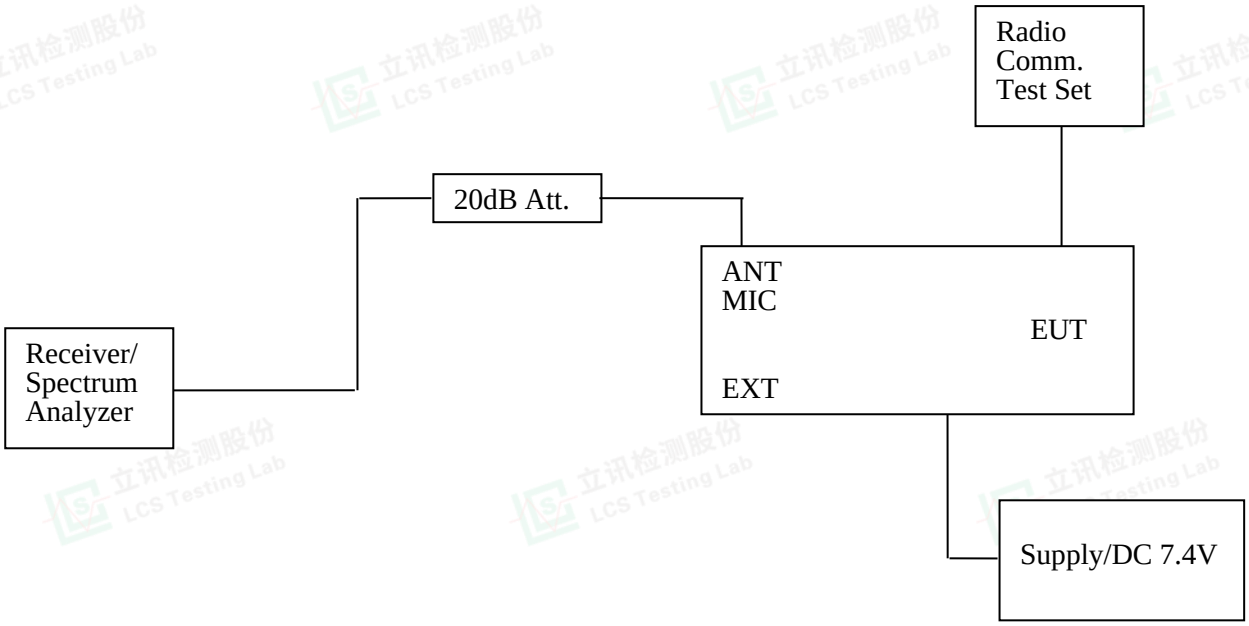
(c). Emission Mask D, 12.5 kHz channel bandwidth equipment: For transmitters designed to operate with a 12.5 kHz channel bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

(1) On any frequency from the centre of the authorized bandwidth f0 to 5.625 kHz removed from f0: Zero dB.

(2) On any frequency removed from the centre of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 5.625 kHz but no more than 12.5 kHz: At least 7.27(f_d - 2.88 kHz) dB.

(3) On any frequency removed from the centre 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.

TEST CONFIGURATION



TEST PROCEDURE

1 The EUT was placed on a turn table which is 0.8m above ground plane.
2 The EUT was modulated by 2.5 KHz Sine wave audio signal; the level of the audio signal employed is 16 dB greater than that necessary to produce 50% of rated system deviation. Rated system deviation is 2.5 kHz (12.5 kHz channel spacing) and 5 kHz (25 kHz channel spacing).
3 Set EUT as normal operation.
4 Set SPA Centre Frequency = fundamental frequency, RBW=300Hz, VBW= 3 KHz, span =50 KHz.
5 Set SPA Max hold. Mark peak, Set 99% Occupied Bandwidth and 26dB Occupied Bandwidth.
6 Set SPA Centre Frequency=fundamental frequency, set =300Hz, VBW=1 KHz, span=50 KHz for 12.5 KHz channel spacing, set =300Hz, VBW=1 KHz, span=150 KHz for 25 KHz channel spacing.

TEST RESULTS

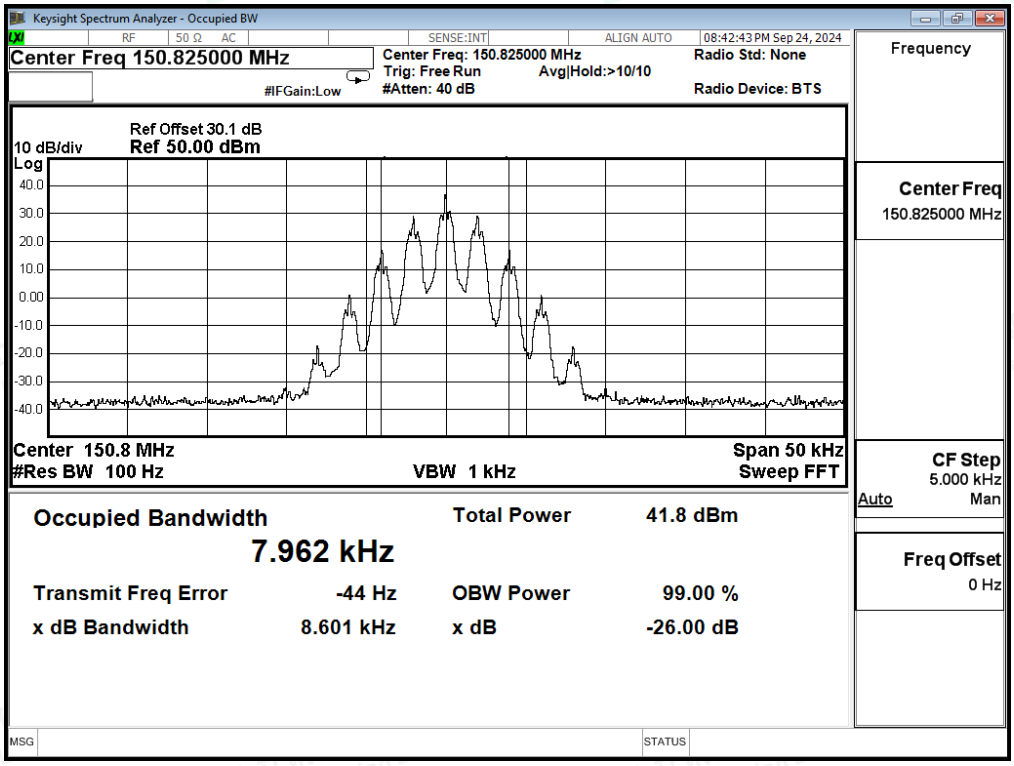
Remark: We tested Op 1 to Op 4, recorded worst case at Op 1 and Op 3.

4.2.1 Occupied Bandwidth

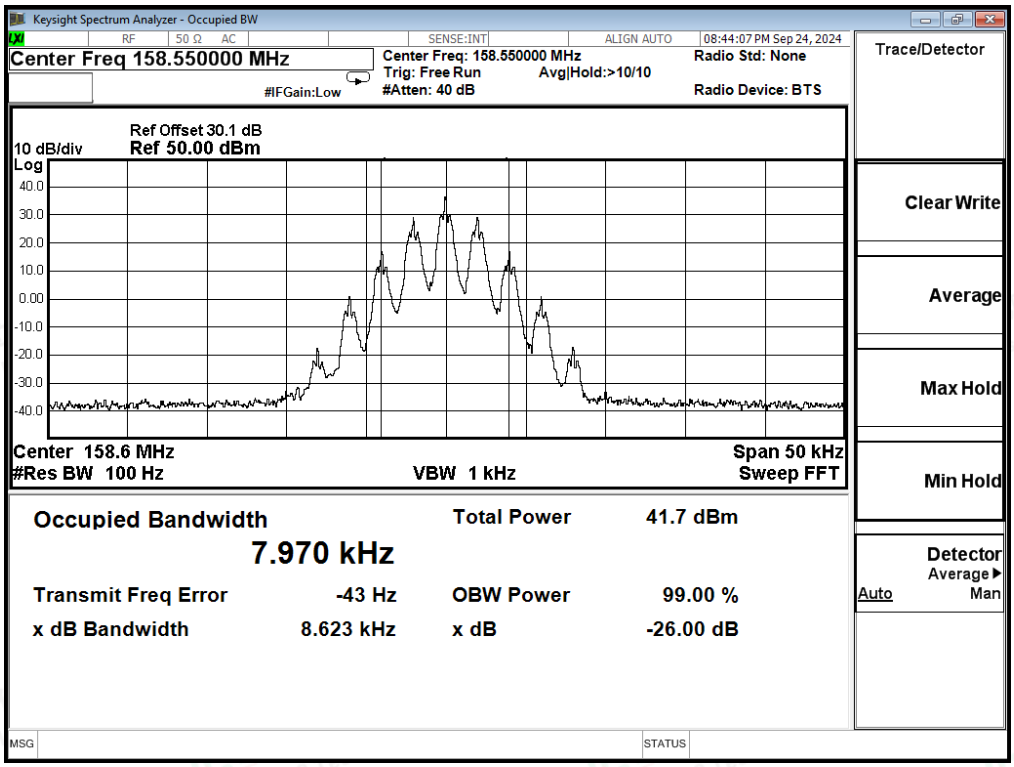
Modulation Type	Channel Separation	Operation Mode	Test Channel	Test Frequency (MHz)	Occupied Bandwidth (KHz)	
					99%	26dB
Analog/FM	12.5KHz	Op 1	Ch1	150.825	7.96	8.60
			Ch2	158.55	7.97	8.62
			Ch3	173.3875	7.98	8.62
Digital/4FSK	12.5KHz	Op 3	Ch4	150.825	7.55	9.85
			Ch5	158.55	7.82	9.72
			Ch6	173.3875	7.63	9.46
Limit			11.25KHz for 12.5KHz Channel Separation			
Test Results			PASS			

Plots of 99% and 26dB Bandwidth Measurement

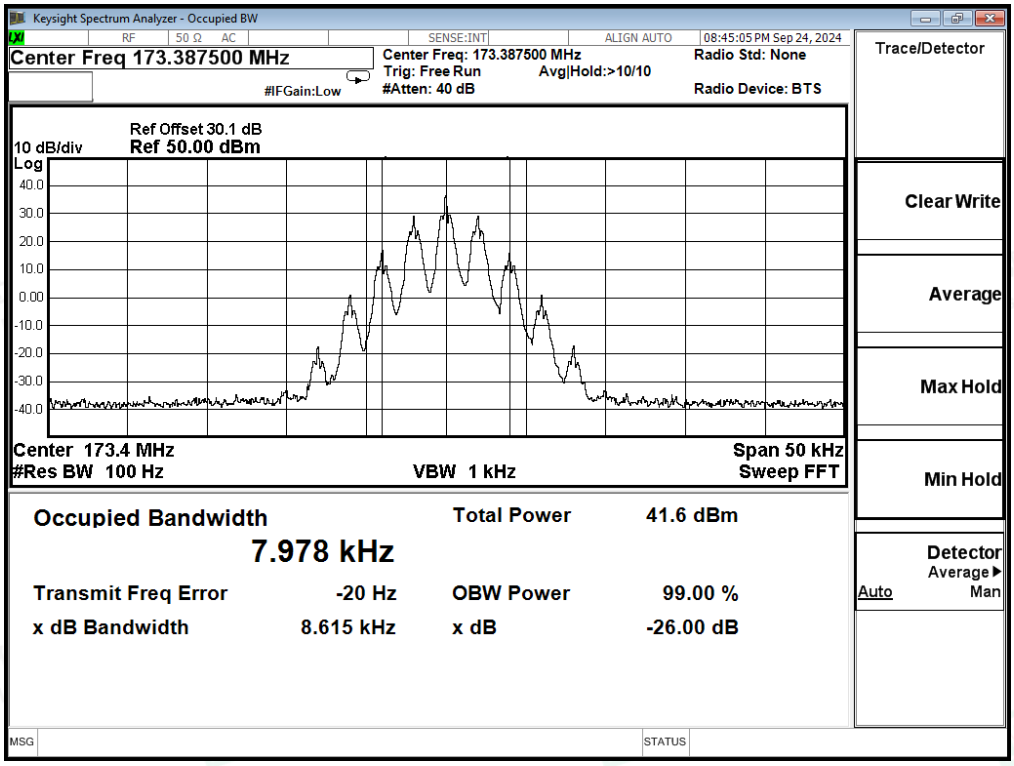
Modulation Type	Channel Separation	Operation Mode	Test Channel	Test Frequency (MHz)	Occupied Bandwidth (KHz)		Limit (KHz)	Results
					99%	26dB		
FM	12.5 KHz	Op 1	Ch1	150.825	7.96	8.60	11.25	PASS



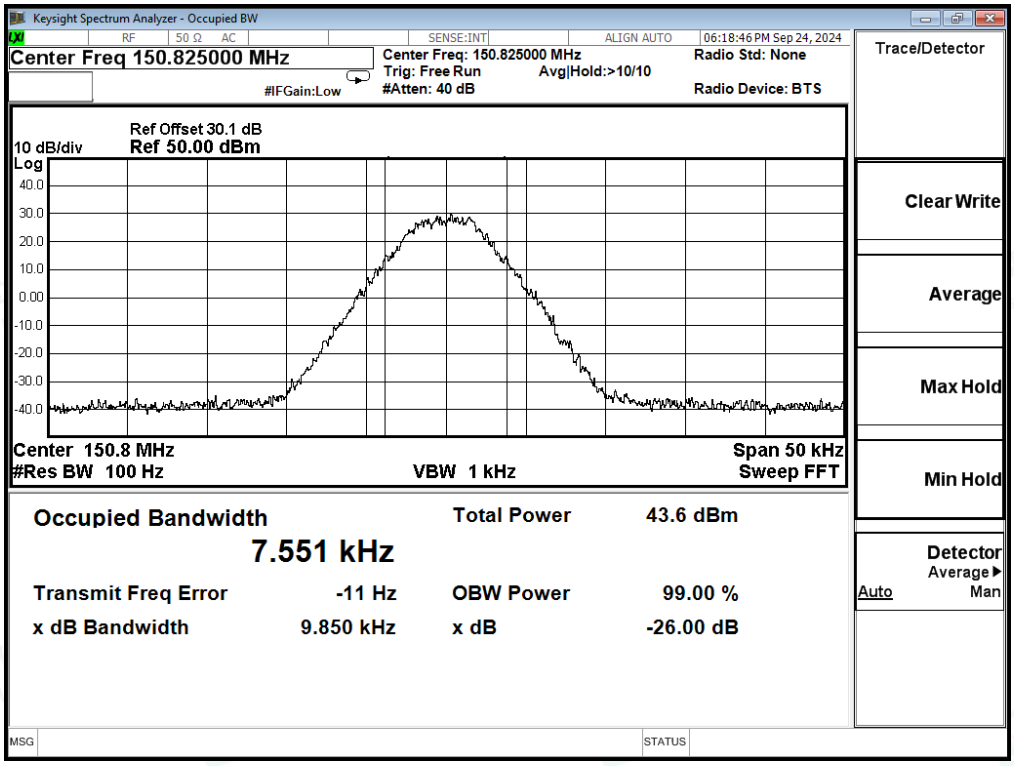
Modulation Type	Channel Separation	Operation Mode	Test Channel	Test Frequency (MHz)	Occupied Bandwidth (KHz)		Limit (KHz)	Results
					99%	26dB		
FM	12.5 KHz	Op 1	Ch2	158.55	7.97	8.62	11.25	PASS



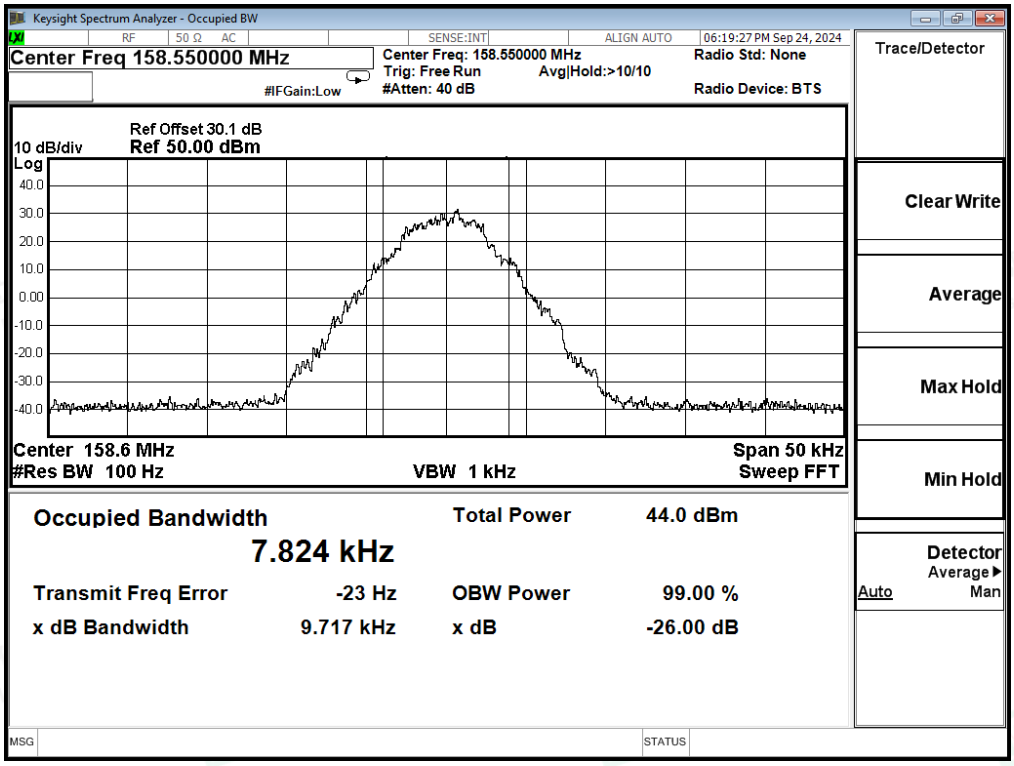
Modulation Type	Channel Separation	Operation Mode	Test Channel	Test Frequency (MHz)	Occupied Bandwidth (KHz)		Limit (KHz)	Results
					99%	26dB		
FM	12.5 KHz	Op 1	Ch3	173.3875	7.98	8.62	11.25	PASS



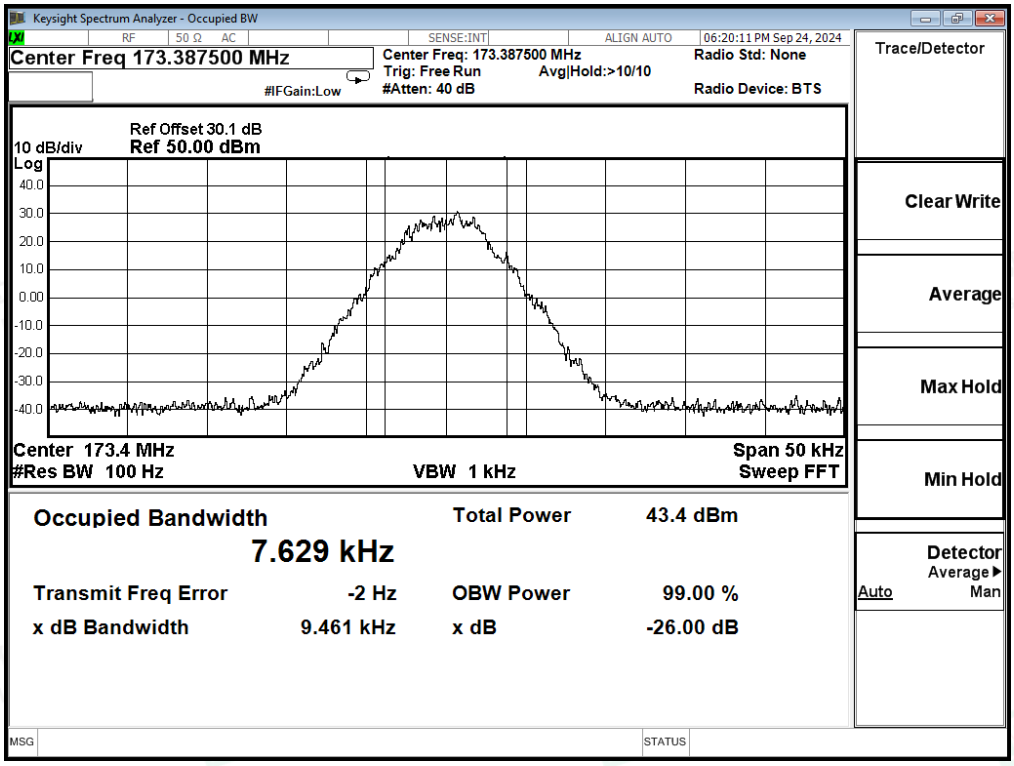
Modulation Type	Channel Separation	Operation Mode	Test Channel	Test Frequency (MHz)	Occupied Bandwidth (KHz)		Limit (KHz)	Results
					99%	26dB		
4FSK	12.5 KHz	Op 3	Ch1	150.825	7.55	9.85	11.25	PASS



Modulation Type	Channel Separation	Operation Mode	Test Channel	Test Frequency (MHz)	Occupied Bandwidth (KHz)		Limit (KHz)	Results
					99%	26dB		
4FSK	12.5 KHz	Op 3	Ch2	158.55	7.82	9.72	11.25	PASS



Modulation Type	Channel Separation	Operation Mode	Test Channel	Test Frequency (MHz)	Occupied Bandwidth (KHz)		Limit (KHz)	Results
					99%	26dB		
4FSK	12.5 KHz	Op 3	Ch3	173.3875	7.63	9.46	11.25	PASS



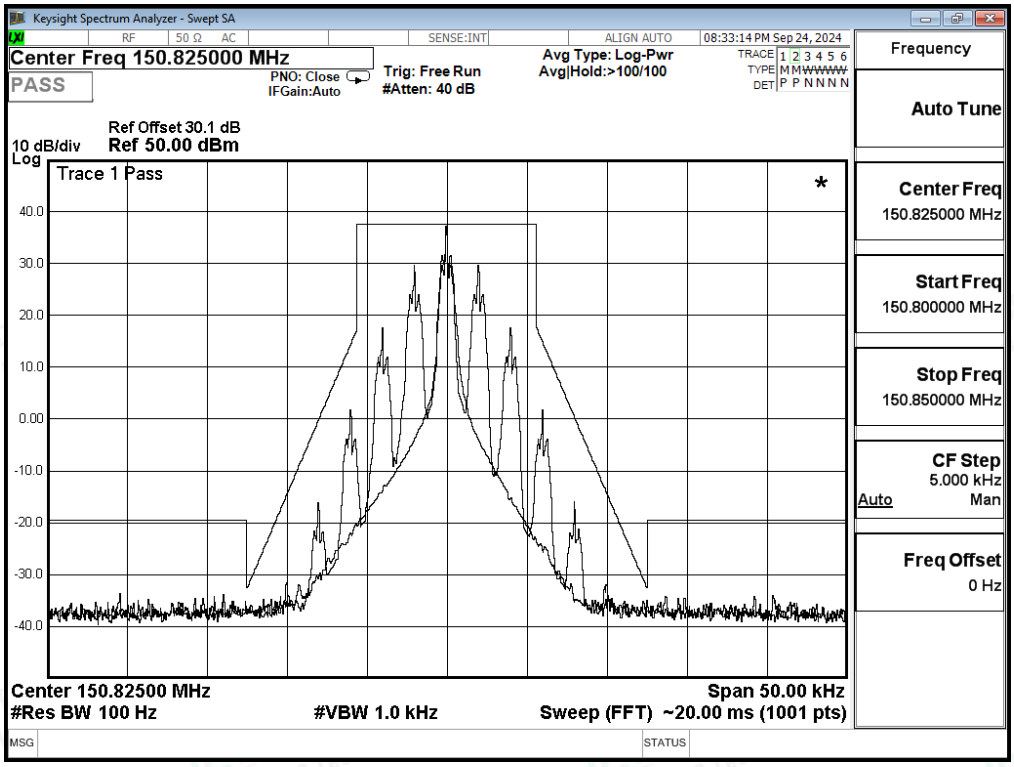
4.2.2 Emission Mask

Modulation Type	Channel Separation	Operation Mode	Test Channel	Test Frequency (MHz)	Applicable Mask	RBW (Hz)
Analog/FM	12.5 KHz	Op 1	Ch1	150.825	D	300
			Ch2	158.55	D	300
			Ch3	173.3875	D	300
Digital/4FSK	12.5 KHz	Op 3	Ch4	150.825	D	300
			Ch5	158.55	D	300
			Ch6	173.3875	D	300
Test Results			**PASS**			

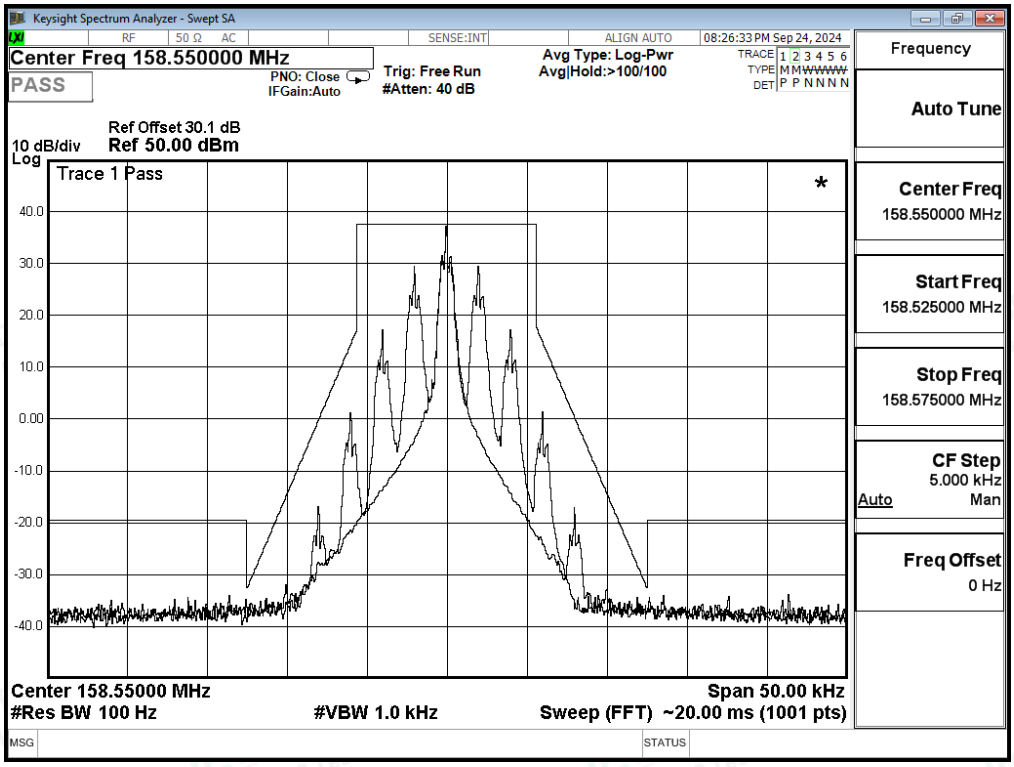
Plots of Emission Mask Measurement

Referred as the attached plot hereinafter
Note: The Black curve represents unmodulated signal.
The Blue curve represents modulated signal.

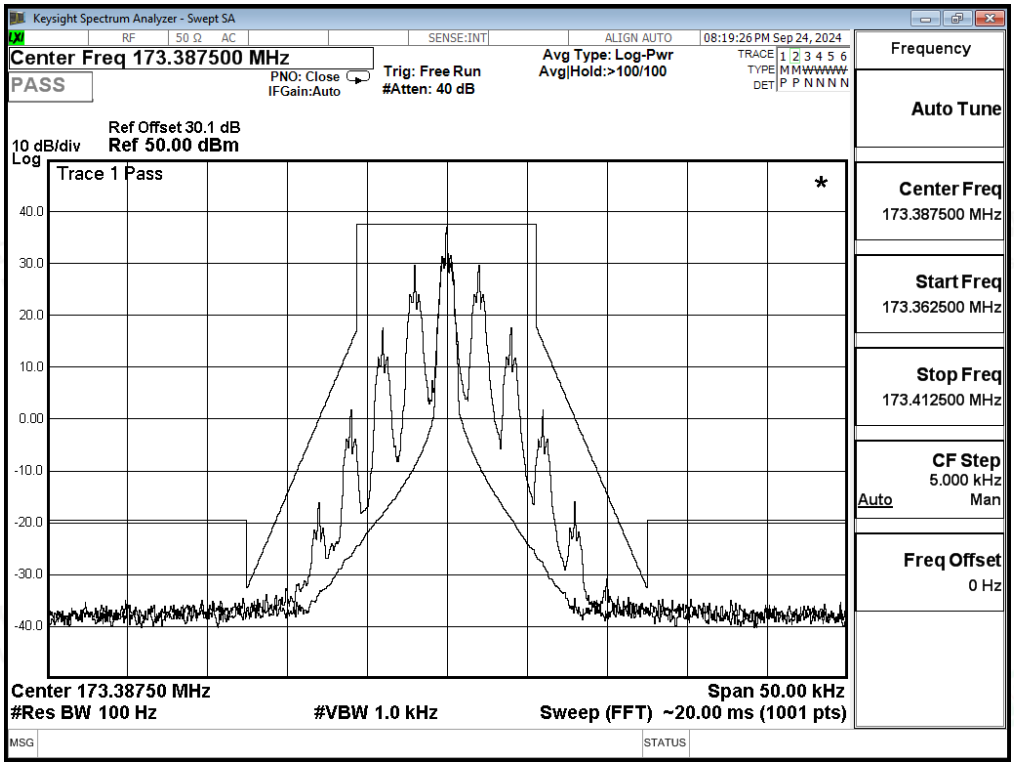
Modulation Type	Channel Separation	Operation Mode	Test Channel	Test Frequency (MHz)	Applicable Mask	RBW (Hz)	Audio Freq. (KHz)	Results
FM	12.5KHz	Op 1	Ch1	150.825	D	300	2.5	PASS



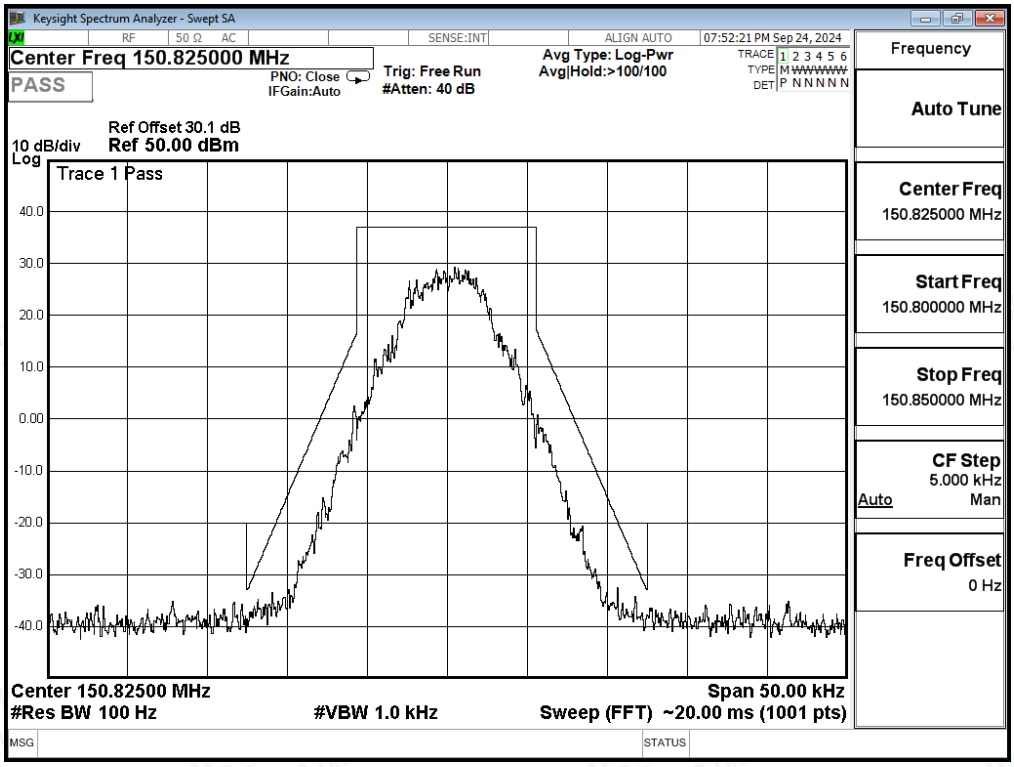
Modulation Type	Channel Separation	Operation Mode	Test Channel	Test Frequency (MHz)	Applicable Mask	RBW (Hz)	Audio Freq. (KHz)	Results
FM	12.5KHz	Op 1	Ch2	158.55	D	300	2.5	PASS



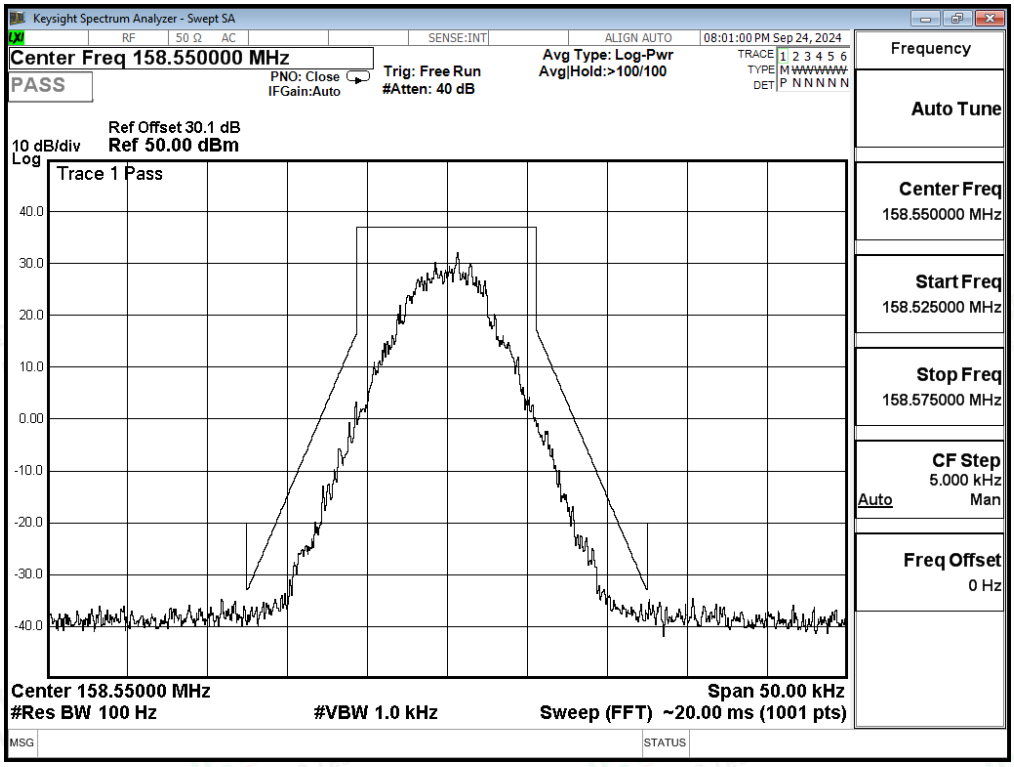
Modulation Type	Channel Separation	Operation Mode	Test Channel	Test Frequency (MHz)	Applicable Mask	RBW (Hz)	Audio Freq. (KHz)	Results
FM	12.5KHz	Op 1	Ch3	173.3875	D	300	2.5	PASS



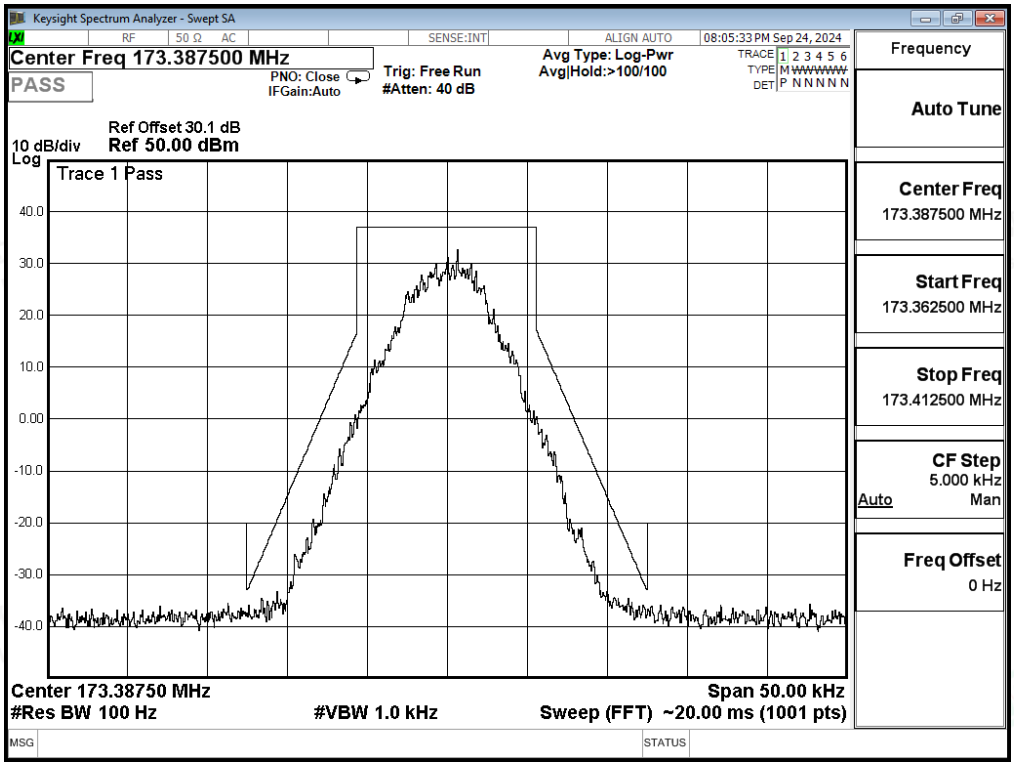
Modulation Type	Channel Separation	Operation Mode	Test Channel	Test Frequency (MHz)	Applicable Mask	RBW (Hz)	Audio Freq. (KHz)	Results
4FSK	12.5KHz	Op 3	Ch1	150.825	D	300	2.5	PASS



Modulation Type	Channel Separation	Operation Mode	Test Channel	Test Frequency (MHz)	Applicable Mask	RBW (Hz)	Audio Freq. (KHz)	Results
4FSK	12.5KHz	Op 3	Ch2	158.55	D	300	2.5	PASS



Modulation Type	Channel Separation	Operation Mode	Test Channel	Test Frequency (MHz)	Applicable Mask	RBW (Hz)	Audio Freq. (KHz)	Results
4FSK	12.5KHz	Op 3	Ch3	173.3875	D	300	2.5	PASS



4.3. Transmitter Radiated Spurious Emission

TEST APPLICABLE

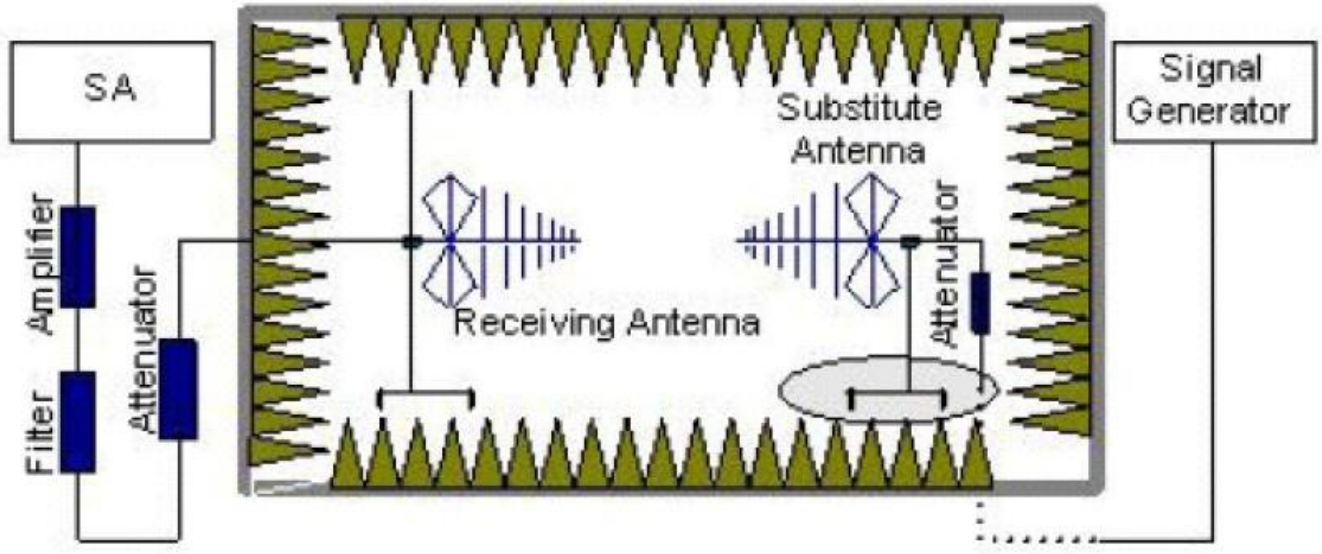
According to the TIA/EIA 603 test method, and according to Section 90.210, the power of each unwanted emission shall be less than Transmitted Power as specified below for transmitters designed to operate with 12.5 KHz channel bandwidth:

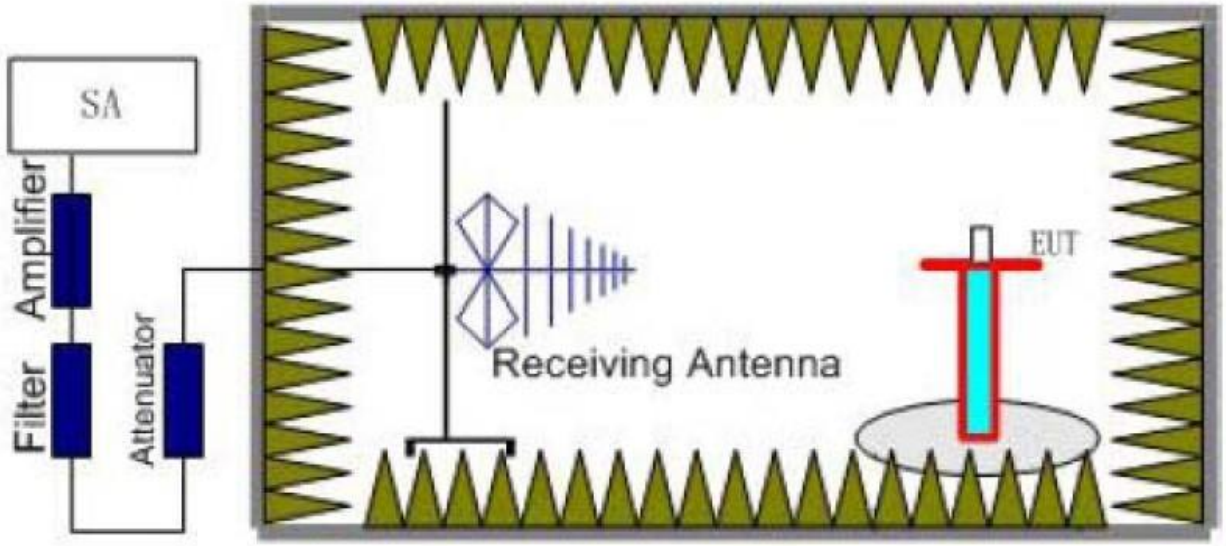
1 On any frequency removed from the centre of the authorized bandwidth f_o to 5.625 KHz removed from f_o: Zero dB
2 On any frequency removed from the centre of the authorized bandwidth by a displacement frequency (f_d in KHz) f_o of more than 5.625 KHz but no more than 12.5 KHz: At least 7.27dB
3 On any frequency removed from the centre of the authorized bandwidth by a displacement frequency (f_d in KHz) f_o of more than 12.5 KHz: At least 50+10 log (P) dB or 70 dB, which ever is lesser attenuation.

For transmitters designed to transmit with 25 KHz channel separation and equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier power (P) as following:

1 On any frequency removed from the assigned frequency by more than 50 percent, but no more than 100 percent of the authorized bandwidth: At least 25 dB.
2 On any frequency removed from the assigned frequency by more than 100 percent, but no more than 250 percent of the authorized bandwidth: At least 35 dB.
3 On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43+10Log (P) dB.

TEST CONFIGURATION





TEST PROCEDURE

1. EUT was placed on a 1.50 meter high non-conductive stand at a 3 meter test distance from the receive antenna. A receiving antenna was placed on the antenna mast 3 meters from the EUT for emission measurements. The height of receiving antenna is 1.50 m. Detected emissions were maximized at each frequency by rotating the EUT through 360° and adjusting the receiving antenna polarization. The radiated emission measurements of all transmit frequencies in six channels were measured with peak detector.
2. A log-periodic antenna or double-ridged waveguide horn antenna shall be substituted in place of the EUT. The log-periodic antenna will be driven by a signal generator and the level will be adjusted till the same power value on the spectrum analyzer or receiver. The level of the spurious emissions can be calculated through the level of the signal generator, cable loss, the gain of the substitution antenna and the reading of the spectrum analyzer or receiver.
3. The EUT is then put into continuously transmitting mode at its maximum power level during the test. Set Test Receiver or Spectrum RBW=1MHz, VBW=3MHz for above 1GHz and RBW=100 KHz, VBW=300 KHz for 30MHz to 1GHz, and the maximum value of the receiver should be recorded as (P_r).
4. The EUT shall be replaced by a substitution antenna. In the chamber, a substitution antenna for the frequency band of interest is placed at the reference point of the chamber. An RF Signal source for the frequency band of interest is connected to the substitution antenna with a cable that has been constructed to not interfere with the radiation pattern of the antenna. A power (P_{Mea}) is applied to the input of the substitution antenna, and adjust the level of the signal generator output until the value of the receiver reach the previously recorded (P_r). The power of signal source (P_{Mea}) is recorded. The test should be performed by rotating the test item and adjusting the receiving antenna polarization.

5. An amplifier should be connected to the Signal Source output port. And the cable should be connect between the Amplifier and the Substitution Antenna. The cable loss (P_{cl}), the Substitution Antenna Gain (G_a) and the Amplifier Gain (P_{Ag}) should be recorded after test.
   The measurement results are obtained as described below:
   Power (EIRP) = P_{Mea}- P_{Ag} - P_{cl} - G_a
   We used SMF100A microwave signal generator which signal level can up to 33dBm, so we not used power
   Amplifier for substituation test; The measurement results are amend as described below:
   Power (EIRP) = P_{Mea}- P_{cl} - G_a
6. This value is EIRP since the measurement is calibrated using an antenna of known gain (2.15 dBi) and known input power.
7. ERP can be calculated from EIRP by subtracting the gain of the dipole, ERP = EIRP-2.15dBi.

LIMIT

Modulation Type: FM

FCC Part 22.359, 74.462, 80.211 and 90.210 and RSS Gen, RSS 119 Issue 11:
For 12.5 kHz bandwidth:
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:
Low: 50 + 10 log (Pwatts) = 50 + 10 log (4.83) =56.83 dB
High: 50 + 10 log (Pwatts) = 50 + 10 log (4.97) =56.96 dB
Note: In general, the worst case attenuation requirement shown above was applied.
Calculation: Limit (dBm) =EL-50-10log (TP)

Notes: EL is the emission level of the Output Power expressed in dBm,

In this application, the EL is 36.53 dBm.
Limit (dBm) =36.53-50-10log (4.97) = -20 dBm

Modulation Type: 4FSK

FCC Part 22.359, 74.462, 80.211 and 90.210 and RSS Gen, RSS 119 Issue 11 (12.5 kHz Bandwidth only):
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:
Low: 50 + 10 log (Pwatts) = 50 + 10 log (4.83) =56.83 dB
High: 50 + 10 log (Pwatts) = 50 + 10 log (4.97) =56.96 dB
Note: In general, the worst case attenuation requirement shown above was applied.
Calculation: Limit (dBm) =EL-50-10log (TP)

Notes: EL is the emission level of the Output Power expressed in dBm,

In this application, the EL is 36.53 dBm.

Limit (dBm) =36.53-50-10log (4.97) = -20 dBm

Note: 1. In general, the worse case attenuation requirement shown above was applied.

2. The measurement frequency range from 30 MHz to 5 GHz.

3. *** means that the emission level is too low to be measured or at least 20 dB down than the limit.

TEST RESULTS

Remark: We tested Op 1 to Op 4, recorded worst case at *Op 1 and Op 3.*

Modulation Type: FM							
Operation Mode: Op 1				Channel Separation:12.5KHz			
Test Channel: Ch1				Test Frequency:150.825MHz			
Frequency (MHz)	P_{Mea} (dBm)	Path Loss	Antenna Gain	Correction (dB)	Peak ERP(dBm)	Limit (dBm)	Polarization
301.650	-44.02	0.87	6.42	2.15	-40.62	-20.00	H
452.475	-47.66	1.02	7.35	2.15	-43.48	-20.00	H
754.125	-36.44	1.1	8.26	2.15	-31.43	-20.00	H
…	…	…	…	…	…	…	H
301.650	-42.91	0.87	6.42	2.15	-39.51	-20.00	V
452.475	-49.59	1.02	7.35	2.15	-45.41	-20.00	V
754.125	-37.49	1.1	8.26	2.15	-32.48	-20.00	V
…	…	…	…	…	…	…	V

Modulation Type: FM							
Operation Mode: Op 1				Channel Separation:12.5KHz			
Test Channel: Ch2				Test Frequency: 158.55MHz			
Frequency (MHz)	P_{Mea} (dBm)	Path Loss	Antenna Gain	Correction (dB)	Peak ERP(dBm)	Limit (dBm)	Polarization
317.10	-42.17	0.92	6.8	2.15	-38.44	-20.00	H
475.65	-47.92	1.06	7.89	2.15	-43.24	-20.00	H
792.75	-36.61	1.12	8.12	2.15	-31.76	-20.00	H
…	…	…	…	…	…	…	H
317.10	-43.29	0.92	6.8	2.15	-39.56	-20.00	V
475.65	-48.28	1.06	7.89	2.15	-43.60	-20.00	V
792.75	-39.52	1.12	8.12	2.15	-34.67	-20.00	V
…	…	…	…	…	…	…	V

Modulation Type: FM							
Operation Mode: Op 1				Channel Separation:12.5KHz			
Test Channel: Ch3				Test Frequency: 173.3875MHz			
Frequency (MHz)	P_{Mea} (dBm)	Path Loss	Antenna Gain	Correction (dB)	Peak ERP (dBm)	Limit (dBm)	Polarization
346.7750	-43.09	0.95	6.8	2.15	-39.39	-20.00	H
520.1625	-49.25	1.1	7.91	2.15	-44.59	-20.00	H
866.9375	-38.93	1.21	8.25	2.15	-34.04	-20.00	H
…	…	…	…	…	…	…	H
346.7750	-41.14	0.95	6.8	2.15	-37.44	-20.00	V
520.1625	-49.34	1.1	7.91	2.15	-44.68	-20.00	V
866.9375	-37.47	1.21	8.25	2.15	-32.58	-20.00	V
…	…	…	…	…	…	…	V

Modulation Type: 4FSK							
Operation Mode: Op 3				Channel Separation:12.5KHz			
Test Channel: Ch1				Test Frequency:150.825MHz			
Frequency (MHz)	P_{Mea} (dBm)	Path Loss	Antenna Gain	Correction (dB)	Peak ERP(dBm)	Limit (dBm)	Polarization
301.650	-42.09	0.87	6.42	2.15	-38.69	-20.00	H
452.475	-46.62	1.02	7.35	2.15	-42.44	-20.00	H
754.125	-38.87	1.1	8.26	2.15	-33.86	-20.00	H
…	…	…	…	…	…	…	H
301.650	-41.48	0.87	6.42	2.15	-38.08	-20.00	V
452.475	-46.01	1.02	7.35	2.15	-41.83	-20.00	V
754.125	-37.01	1.1	8.26	2.15	-32.00	-20.00	V
…	…	…	…	…	…	…	V

Modulation Type: 4FSK							
Operation Mode: Op 3				Channel Separation:12.5KHz			
Test Channel: Ch2				Test Frequency: 158.55MHz			
Frequency (MHz)	P_{Mea} (dBm)	Path Loss	Antenna Gain	Correction (dB)	Peak ERP(dBm)	Limit (dBm)	Polarization
317.10	-42.71	0.92	6.8	2.15	-38.98	-20.00	H
475.65	-47.60	1.06	7.89	2.15	-42.92	-20.00	H
792.75	-37.41	1.12	8.12	2.15	-32.56	-20.00	H
…	…	…	…	…	…	…	H
317.10	-41.41	0.92	6.8	2.15	-37.68	-20.00	V
475.65	-47.15	1.06	7.89	2.15	-42.47	-20.00	V
792.75	-38.28	1.12	8.12	2.15	-33.43	-20.00	V
…	…	…	…	…	…	…	V

Modulation Type: 4FSK							
Operation Mode: Op 3				Channel Separation:12.5KHz			
Test Channel: Ch3				Test Frequency: 173.3875MHz			
Frequency (MHz)	P_{Mea} (dBm)	Path Loss	Antenna Gain	Correction (dB)	Peak ERP(dBm)	Limit (dBm)	Polarization
346.7750	-43.78	0.95	6.8	2.15	-40.08	-20.00	H
520.1625	-48.90	1.1	7.91	2.15	-44.24	-20.00	H
866.9375	-36.55	1.21	8.25	2.15	-31.66	-20.00	H
…	…	…	…	…	…	…	H
346.7750	-41.44	0.95	6.8	2.15	-37.74	-20.00	V
520.1625	-47.81	1.1	7.91	2.15	-43.15	-20.00	V
866.9375	-36.10	1.21	8.25	2.15	-31.21	-20.00	V
…	…	…	…	…	…	…	V

4.4. Spurious Emission on Antenna Port

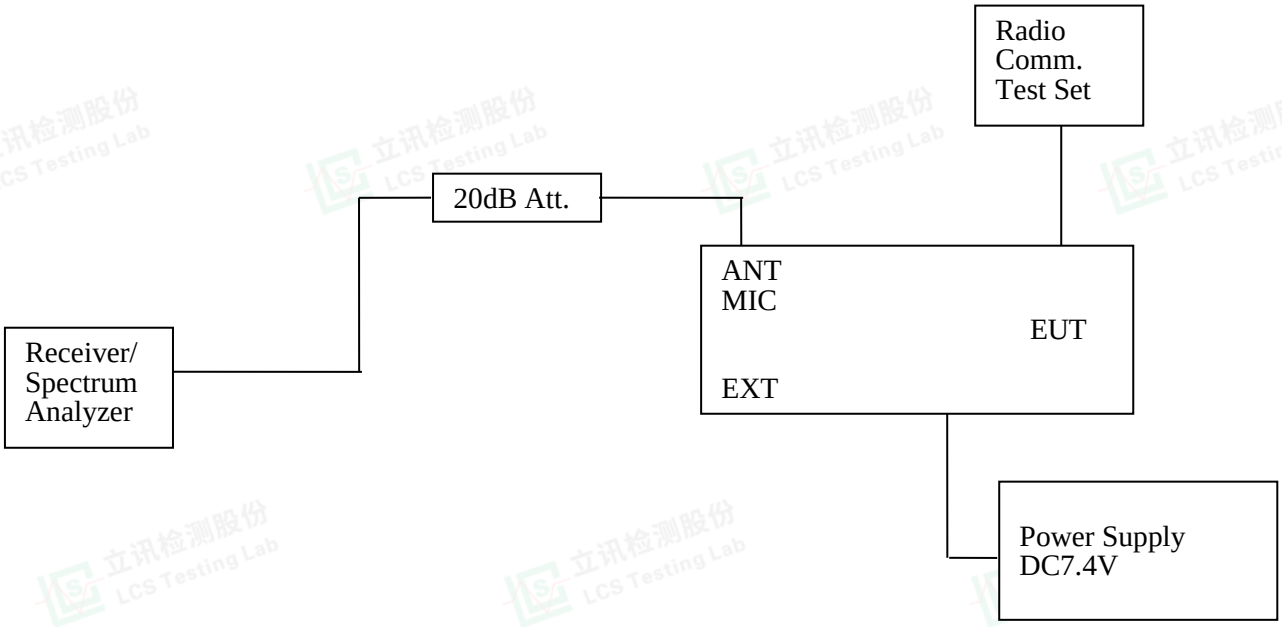
TEST APPLICABLE

The same as Section 4.3

TEST PROCEDURE

The RF output of the EUT was connected to a spectrum analyzer through appropriate attenuation. The resolution bandwidth of the spectrum analyzer was set to 100 kHz. Sufficient scans were taken to show any out of band emission up to 10th. Harmonic for the lower and the highest frequency range. Set RBW 1KHz, VBW 3KHz in the frequency band 9KHz to 150KHz, set RBW 10KHz, VBW 30 KHz in the frequency band 150KHz to 30 MHz, set RBW 100 kHz, VBW 300 kHz in the frequency band 30MHz to 1GHz,while set RBW=1MHz.VBW=3MHz from the 1GHz to 10th Harmonic.
The audio input was set to 0 to get the unmodulated carrier, the resulting picture is print out for each channel separation.

TEST CONFIGURATION



LIMIT

Modulation Type: FM

FCC Part 22.359, 74.462, 80.211 and 90.210 and RSS Gen, RSS 119 Issue 11:
For 12.5 kHz bandwidth:
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:
Low: 50 + 10 log (Pwatts) = 50 + 10 log (4.83) =56.83 dB

High: 50 + 10 log (Pwatts) = 50 + 10 log (4.97) =56.96 dB
Note: In general, the worst case attenuation requirement shown above was applied.
Calculation: Limit (dBm) =EL-50-10log (TP)
Notes: EL is the emission level of the Output Power expressed in dBm,
In this application, the EL is 36.53 dBm.
Limit (dBm) =36.53-50-10log (4.97) = -20 dBm

Modulation Type: 4FSK

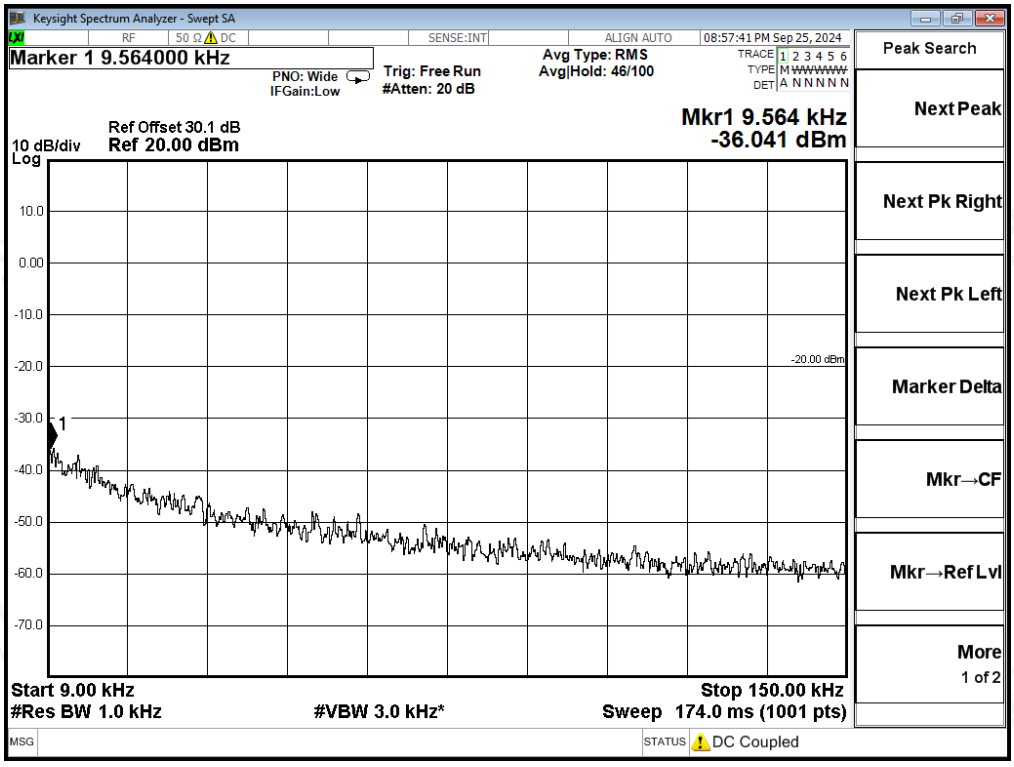
FCC Part 22.359, 74.462, 80.211 and 90.210 and RSS Gen, RSS 119 Issue 11:
For 12.5 kHz bandwidth:
On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 12.5 kHz at least:
Low: 50 + 10 log (Pwatts) = 50 + 10 log (4.83) =56.83 dB
High: 50 + 10 log (Pwatts) = 50 + 10 log (4.97) =56.96 dB
Note: In general, the worst case attenuation requirement shown above was applied.
Calculation: Limit (dBm) =EL-50-10log (TP)
Notes: EL is the emission level of the Output Power expressed in dBm,
In this application, the EL is 36.53 dBm.
Limit (dBm) =36.53-50-10log (4.97) = -20 dBm
Note: 1. In general, the worse case attenuation requirement shown above was applied.
2. The measurement frequency range from 9 KHz to 2GHz.

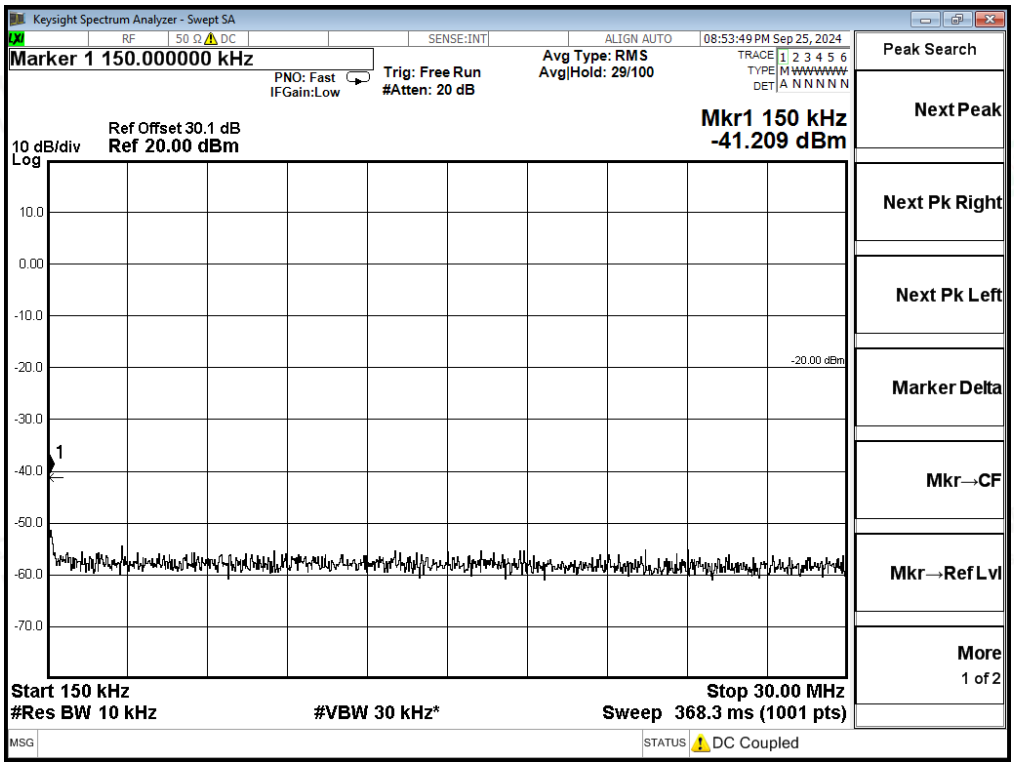
TEST RESULTS

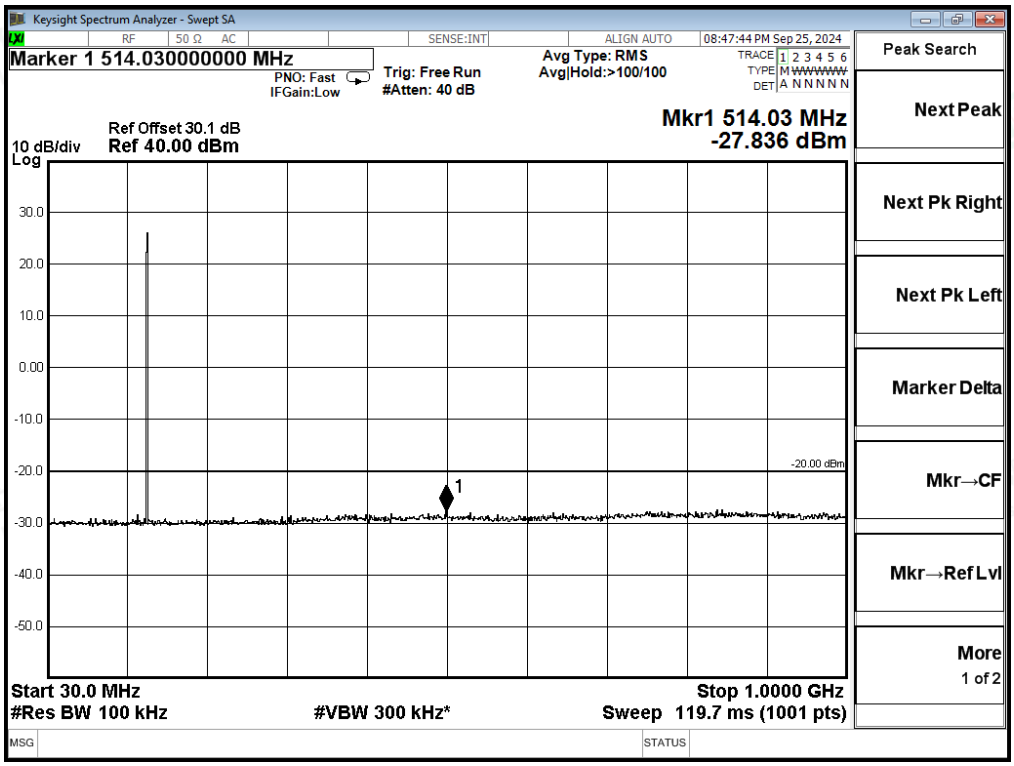
Operation Mode	Test Channel	Test Frequency (MHz)	Maximum Conducted Spurious Emissions Below 1GHz		Maximum Conducted Spurious Emissions Above 1GHz	
			Frequency (MHz)	Datum (dBm)	Frequency (MHz)	Datum (dBm)
Op 1	Ch1	150.825	301.60	-28.10	1688.00	-31.15
	Ch2	158.55	317.12	-27.55	1092.00	-31.11
	Ch3	173.3875	346.22	-27.30	1844.00	-31.35
Op 3	Ch4	150.825	310.60	-27.30	1766.00	-31.12
	Ch5	158.55	317.12	-27.65	1888.00	-30.89
	Ch6	173.3875	346.22	-27.08	1804.00	-30.69
Limit			-20dBm for 12.5KHz Channel Separation			
Test Results			PASS			

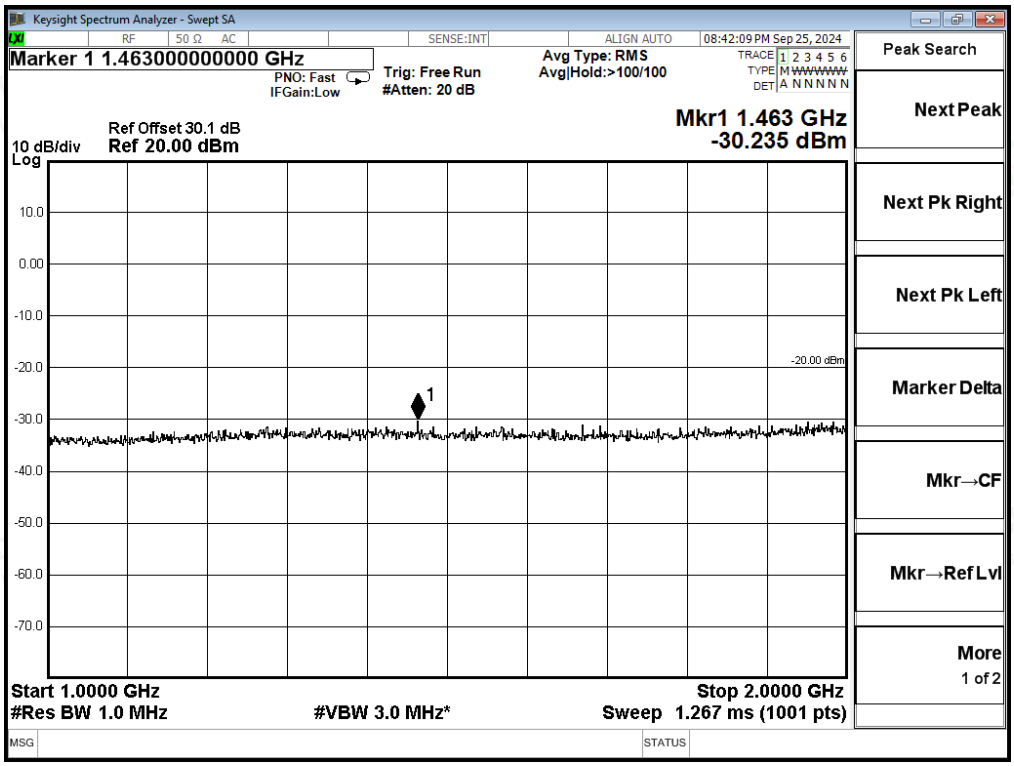
Plots of Spurious Emission on Antenna Port Measurement

Operation Mode	Test Channel	Test Frequency (MHz)	Maximum Conducted Spurious Emissions Below 1GHz		Maximum Conducted Spurious Emissions Above1GHz		Limit (dBm)
			Frequency (MHz)	Datum (dBm)	Frequency (MHz)	Datum (dBm)	
Op 1	Ch1	150.825	301.60	-28.10	1688.00	-27.84	-20.00

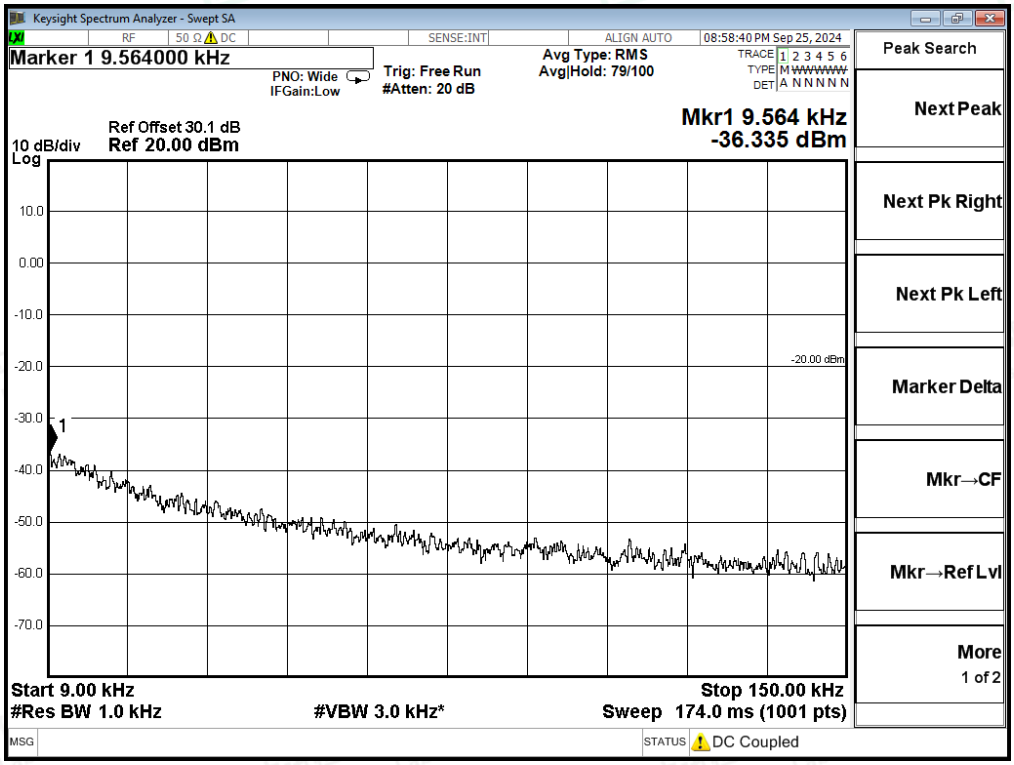


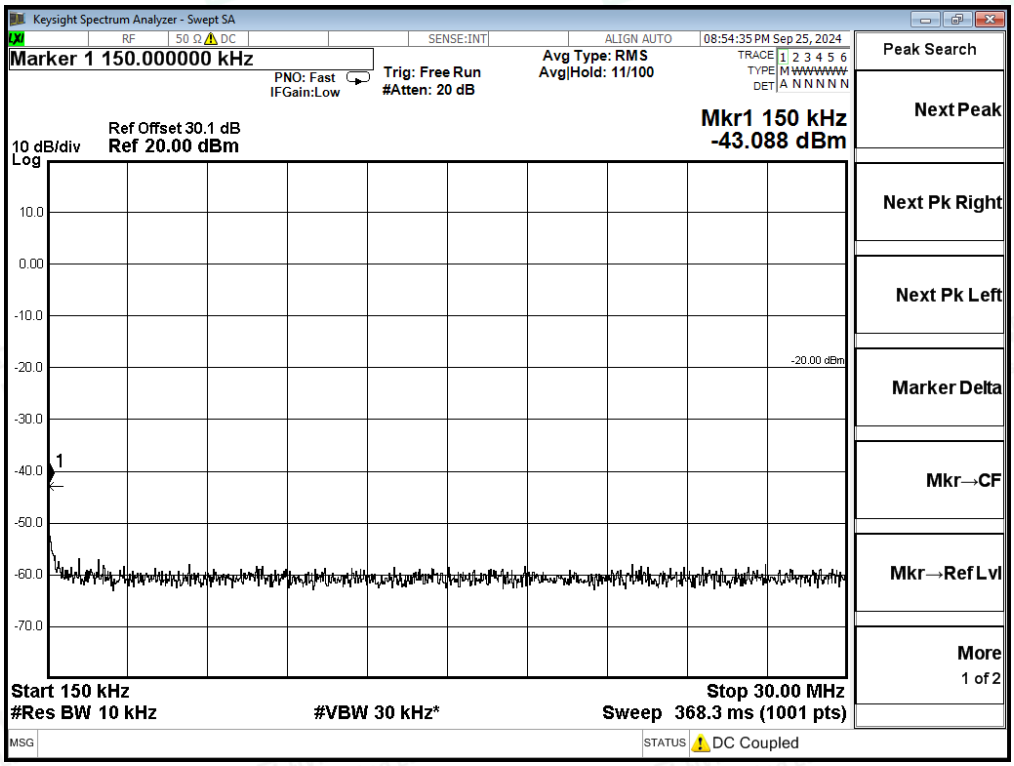

Keysight Spectrum Analyzer - Swept SA
RF 50 Ω DC
SENSE:INT
ALIGN AUTO
08:53:49 PM Sep 25, 2024
Marker 1 150.000000 kHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
Avg Type: RMS
Avg|Hold: 29/100
TRACE 1 2 3 4 5 6
TYPE M WWWWW
DET A N N N N N
Mkr1 150 kHz
-41.209 dBm
Ref Offset 30.1 dB
10 dB/div
Ref 20.00 dBm
Log
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-20.00 dBm
1
Start 150 kHz
#Res BW 10 kHz
#VBW 30 kHz*
Stop 30.00 MHz
Sweep 368.3 ms (1001 pts)
MSG
STATUS
DC Coupled
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2

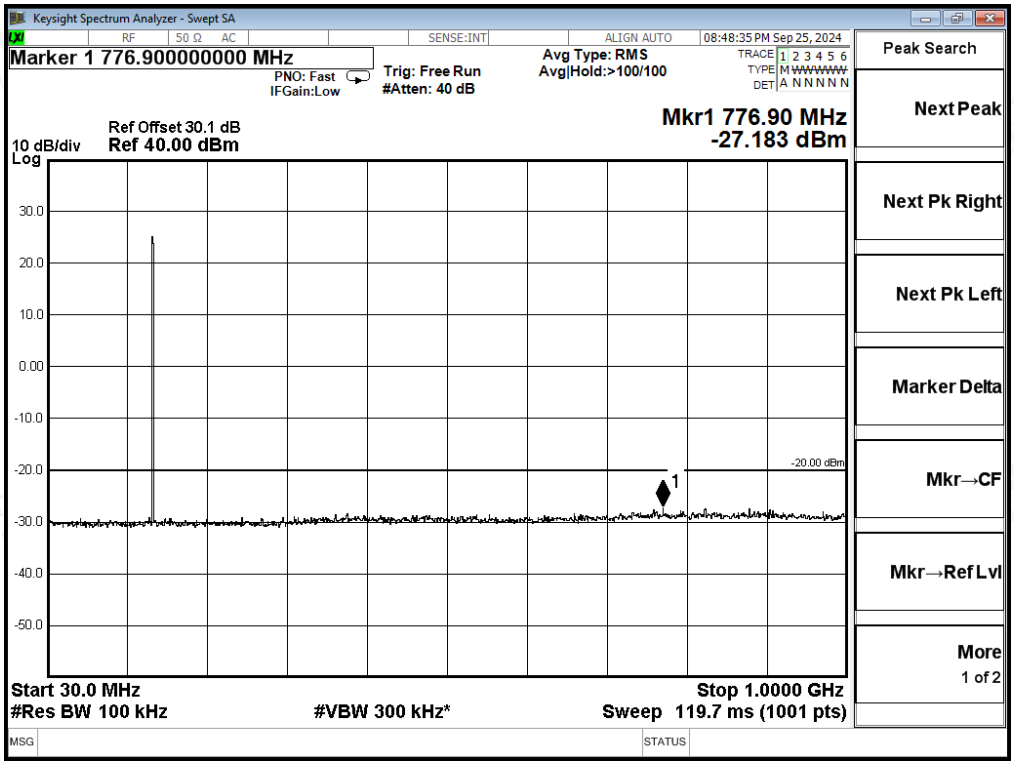

Keysight Spectrum Analyzer - Swept SA
RF 50 Ω AC
SENSE:INT
ALIGN AUTO
08:47:44 PM Sep 25, 2024
Marker 1 514.030000000 MHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 40 dB
Avg Type: RMS
Avg|Hold:>100/100
TRACE 1 2 3 4 5 6
TYPE M WWWWW
DET A N N N N N
Mkr1 514.03 MHz
-27.836 dBm
Ref Offset 30.1 dB
10 dB/div
Ref 40.00 dBm
Log
30.0
20.0
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-20.00 dBm
1
Start 30.0 MHz
#Res BW 100 kHz
#VBW 300 kHz*
Stop 1.0000 GHz
Sweep 119.7 ms (1001 pts)
MSG
STATUS
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2

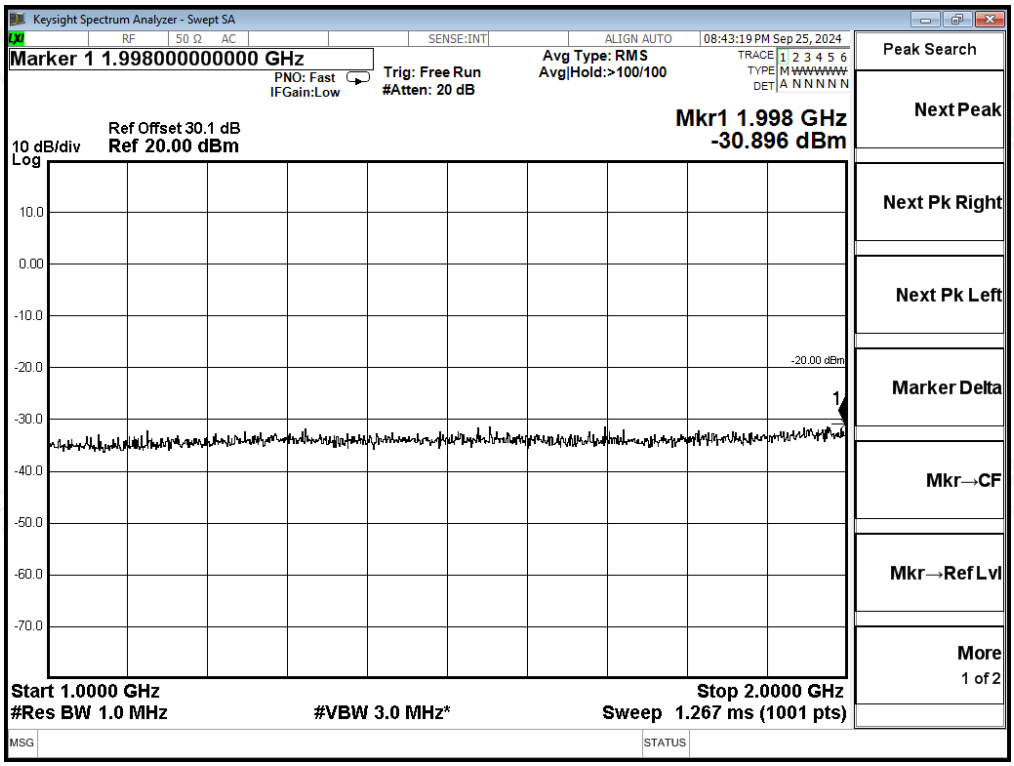

Keysight Spectrum Analyzer - Swept SA
RF
50 Ω AC
SENSE:INT
ALIGN AUTO
08:42:09 PM Sep 25, 2024
Marker 1 1.463000000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
Avg Type: RMS
Avg|Hold:>100/100
TRACE 1 2 3 4 5 6
TYPE M WWWWW
DET A N N N N N
Mkr1 1.463 GHz
-30.235 dBm
Ref Offset 30.1 dB
10 dB/div
Ref 20.00 dBm
Log
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-20.00 dBm
1
Start 1.0000 GHz
#Res BW 1.0 MHz
#VBW 3.0 MHz*
Stop 2.0000 GHz
Sweep 1.267 ms (1001 pts)
MSG
STATUS
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2

Operation Mode	Test Channel	Test Frequency (MHz)	Maximum Conducted Spurious Emissions Below 1GHz		Maximum Conducted Spurious Emissions Above1GHz		Limit (dBm)
			Frequency (MHz)	Datum (dBm)	Frequency (MHz)	Datum (dBm)	
Op 1	Ch2	158.55	317.12	-27.55	1092.00	-31.11	-20.00

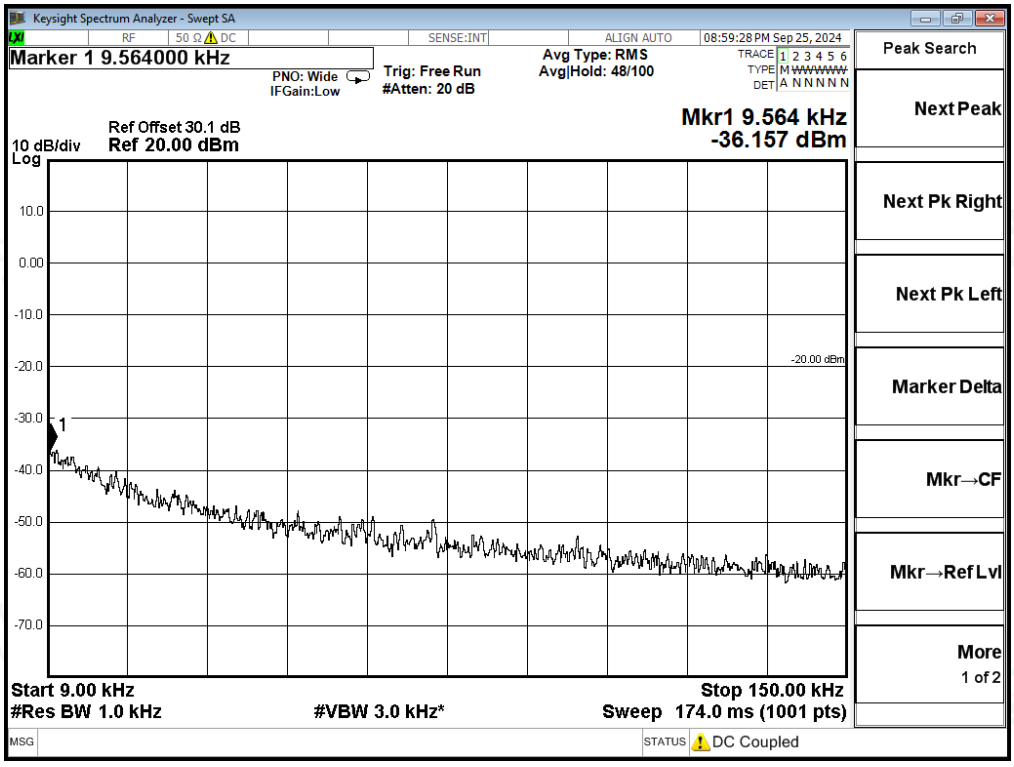


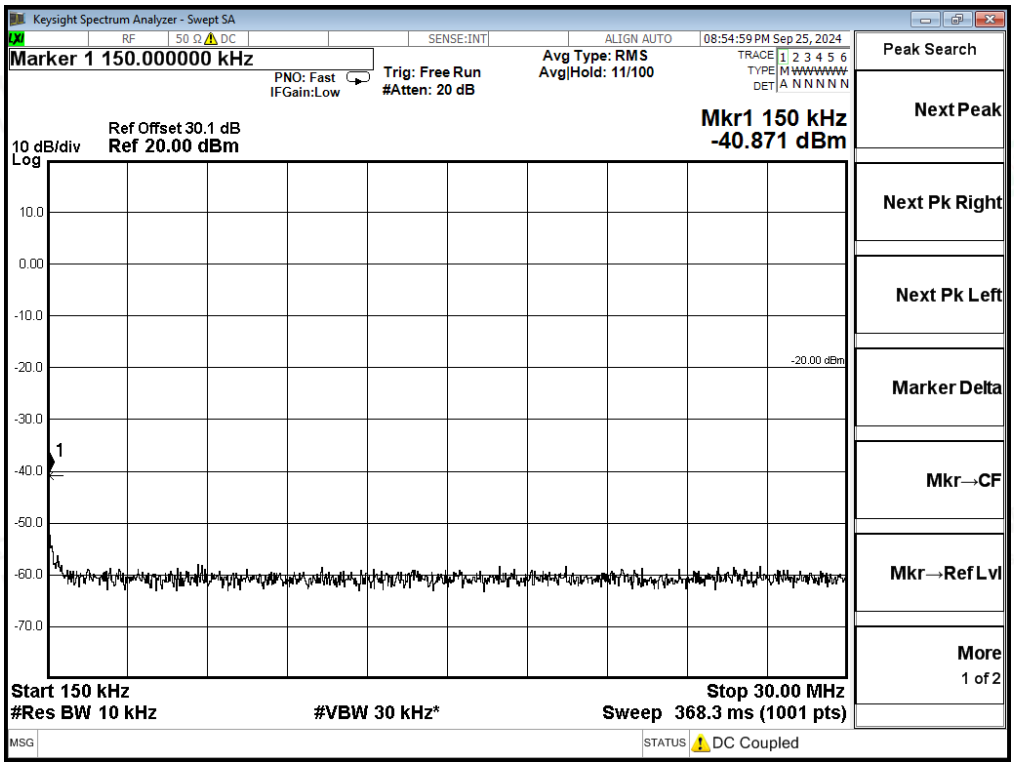


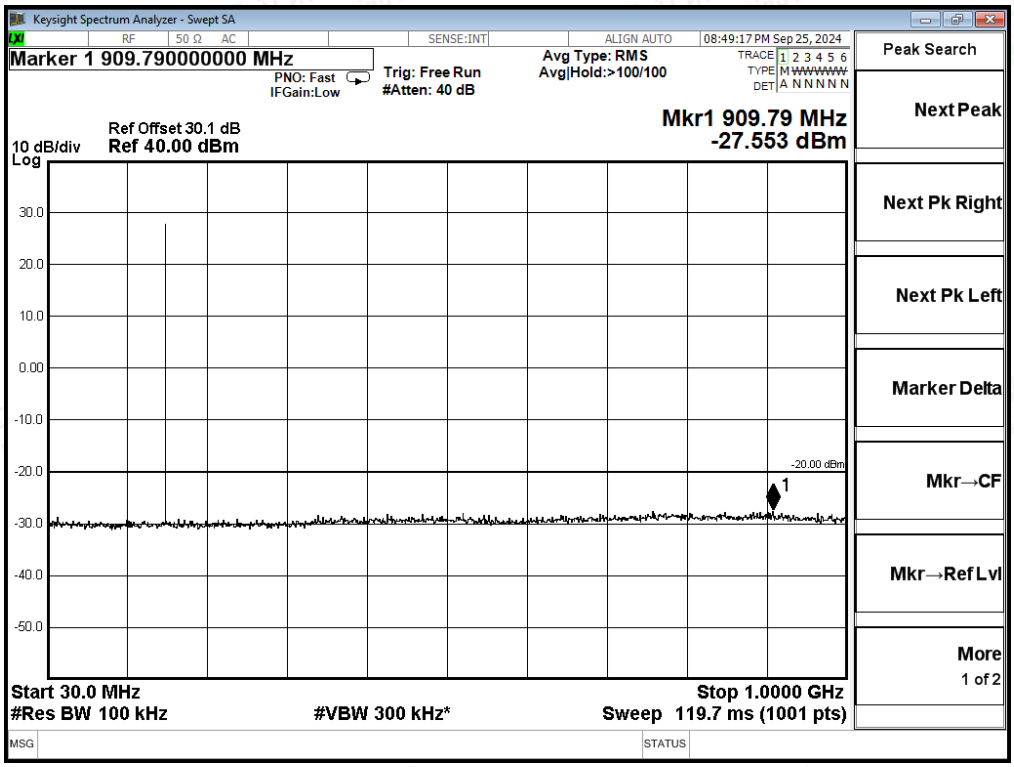

Keysight Spectrum Analyzer - Swept SA
Marker 1 776.900000000 MHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 40 dB
Avg Type: RMS
Avg|Hold:>100/100
08:48:35 PM Sep 25, 2024
Ref Offset 30.1 dB
10 dB/div
Log
Ref 40.00 dBm
Mkr1 776.90 MHz
-27.183 dBm
-20.00 dBm
Start 30.0 MHz
#Res BW 100 kHz
#VBW 300 kHz*
Stop 1.0000 GHz
Sweep 119.7 ms (1001 pts)
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2


Keysight Spectrum Analyzer - Swept SA
Marker 1 1.998000000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
Avg Type: RMS
Avg|Hold:>100/100
08:43:19 PM Sep 25, 2024
Ref Offset 30.1 dB
10 dB/div
Log
Ref 20.00 dBm
Mkr1 1.998 GHz
-30.896 dBm
-20.00 dBm
Start 1.0000 GHz
#Res BW 1.0 MHz
#VBW 3.0 MHz*
Stop 2.0000 GHz
Sweep 1.267 ms (1001 pts)
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2

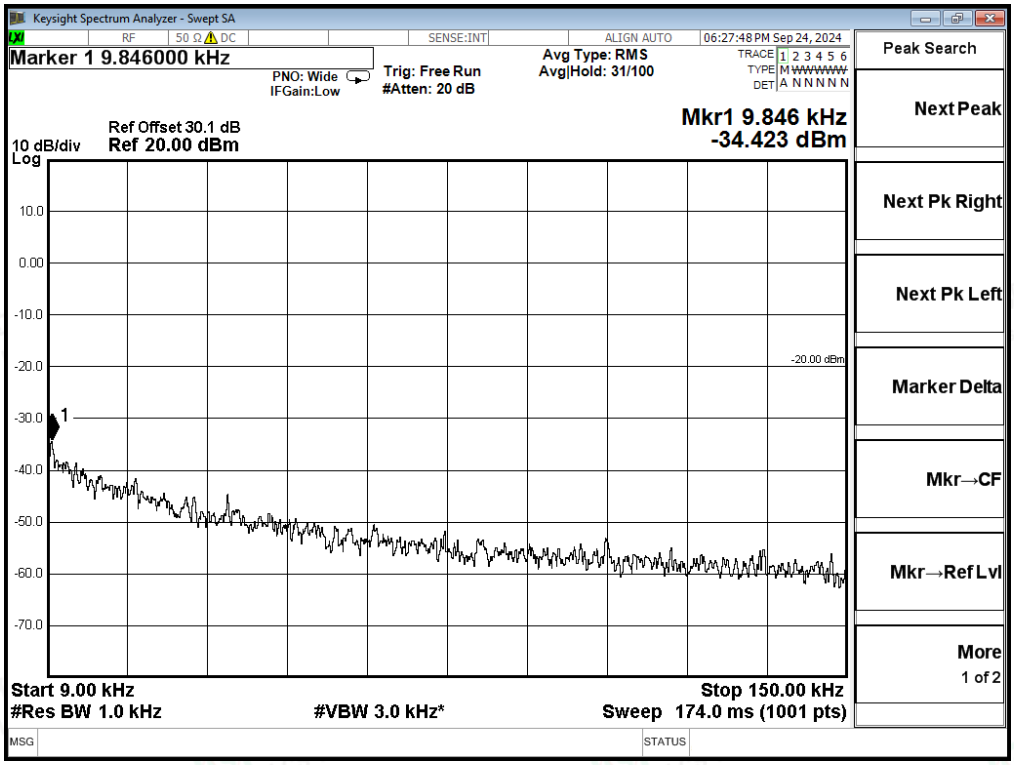
Operation Mode	Test Channel	Test Frequency (MHz)	Maximum Conducted Spurious Emissions Below 1GHz		Maximum Conducted Spurious Emissions Above1GHz		Limit (dBm)
			Frequency (MHz)	Datum (dBm)	Frequency (MHz)	Datum (dBm)	
Op 1	Ch3	173.3875	346.22	-27.30	1844.00	-31.35	-20.00

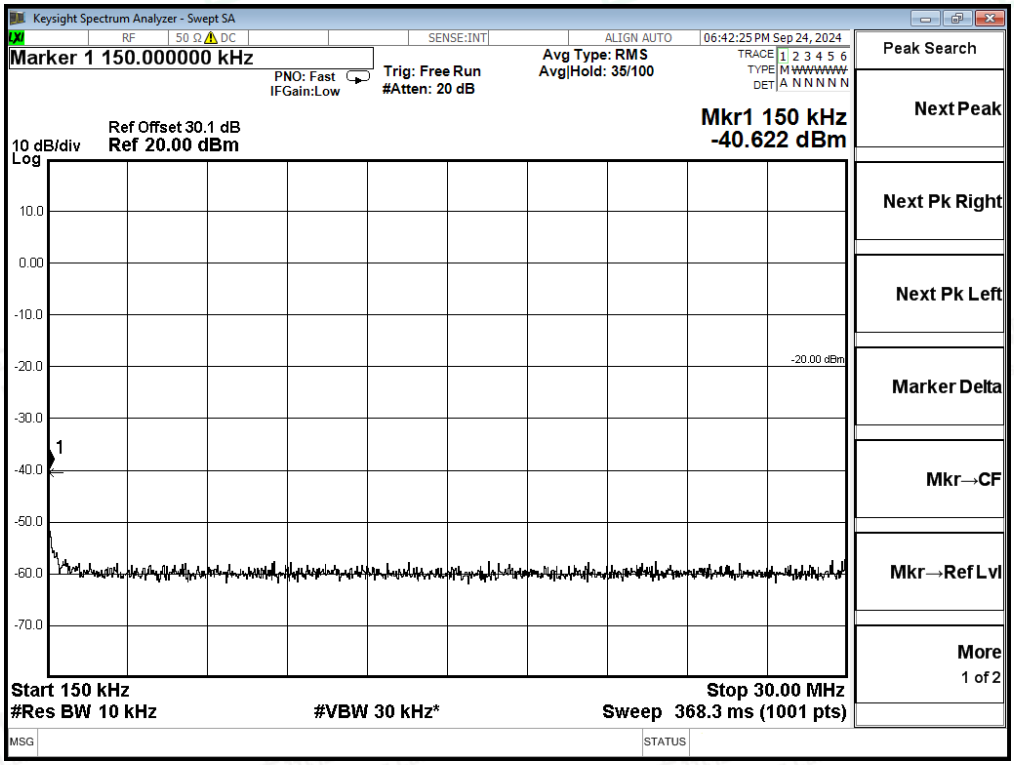


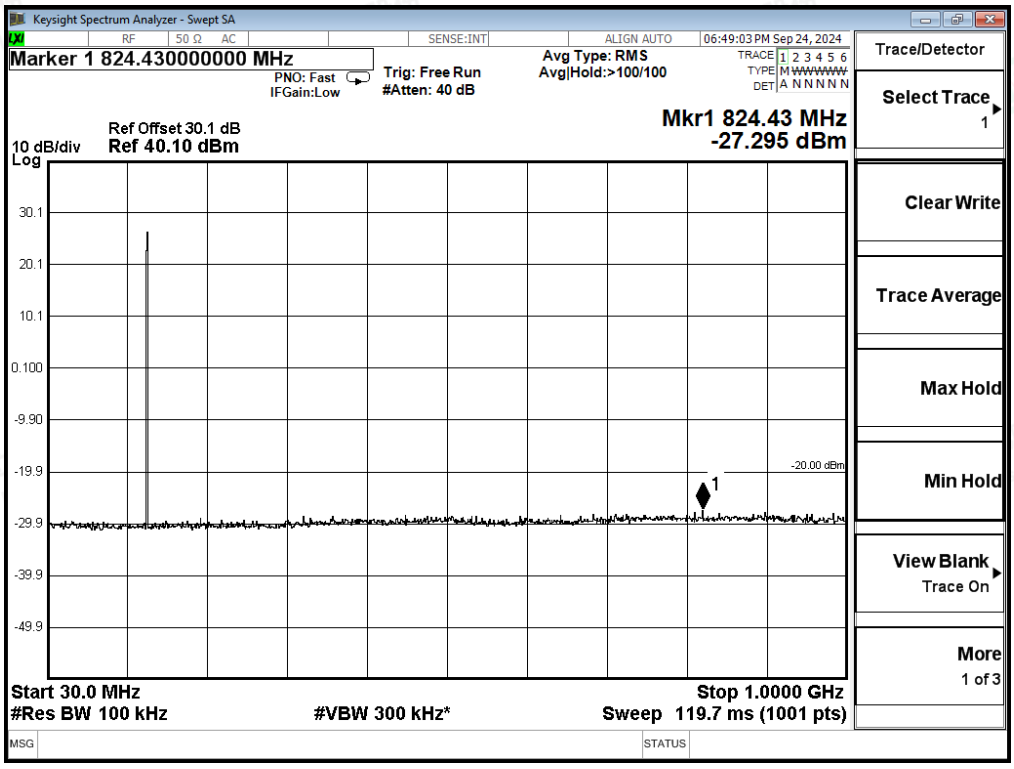

Keysight Spectrum Analyzer - Swept SA
RF 50 Ω DC
SENSE:INT
ALIGN AUTO
08:54:59 PM Sep 25, 2024
Marker 1 150.000000 kHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
Avg Type: RMS
Avg|Hold: 11/100
TRACE 1 2 3 4 5 6
TYPE M WWWWW
DET A N N N N N
Mkr1 150 kHz
-40.871 dBm
Ref Offset 30.1 dB
10 dB/div
Ref 20.00 dBm
Log
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-20.00 dBm
1
Start 150 kHz
#Res BW 10 kHz
#VBW 30 kHz*
Stop 30.00 MHz
Sweep 368.3 ms (1001 pts)
MSG
STATUS
DC Coupled
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2

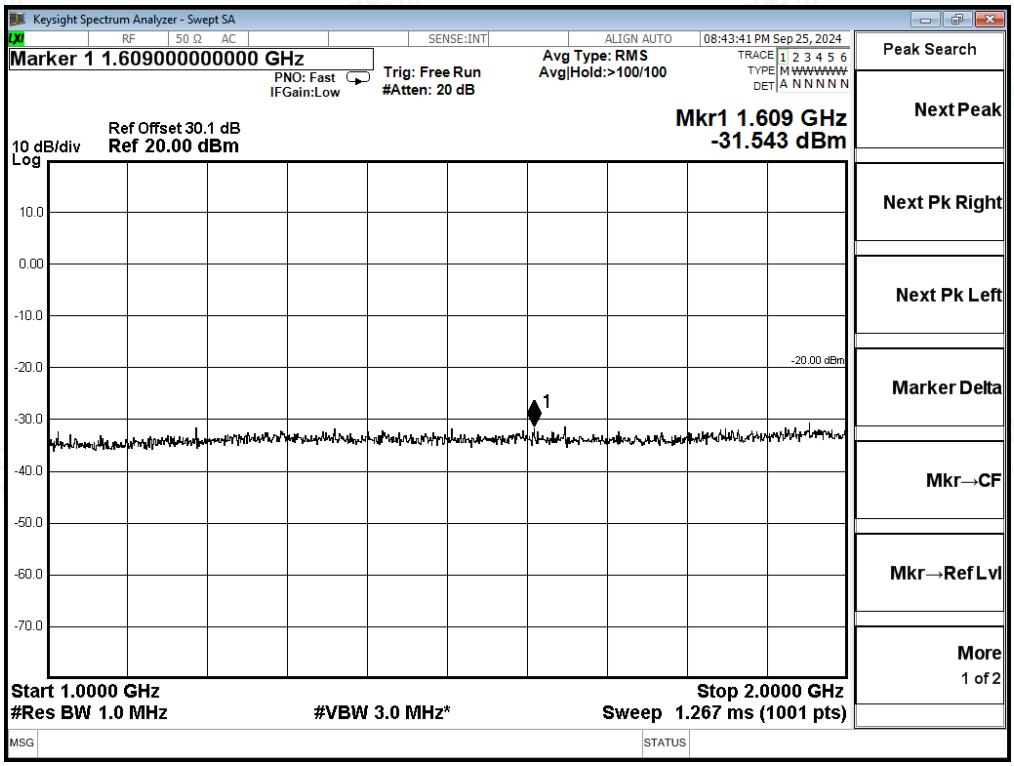

Keysight Spectrum Analyzer - Swept SA
RF 50 Ω AC
SENSE:INT
ALIGN AUTO
08:49:17 PM Sep 25, 2024
Marker 1 909.790000000 MHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 40 dB
Avg Type: RMS
Avg|Hold:>100/100
TRACE 1 2 3 4 5 6
TYPE M WWWWW
DET A N N N N N
Mkr1 909.79 MHz
-27.553 dBm
Ref Offset 30.1 dB
10 dB/div
Ref 40.00 dBm
Log
30.0
20.0
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-20.00 dBm
1
Start 30.0 MHz
#Res BW 100 kHz
#VBW 300 kHz*
Stop 1.0000 GHz
Sweep 119.7 ms (1001 pts)
MSG
STATUS
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2

Operation Mode	Test Channel	Test Frequency (MHz)	Maximum Conducted Spurious Emissions Below 1GHz		Maximum Conducted Spurious Emissions Above1GHz		Limit (dBm)
			Frequency (MHz)	Datum (dBm)	Frequency (MHz)	Datum (dBm)	
Op 3	Ch4	150.825	301.60	-27.30	1682.00	-31.12	-13.00

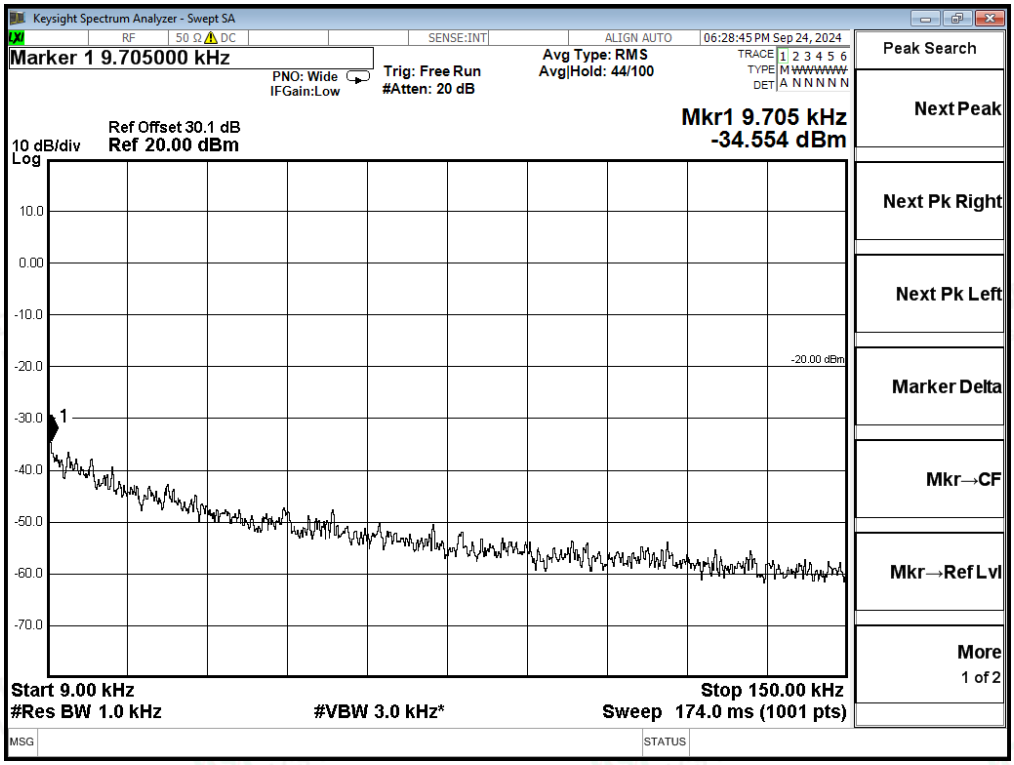


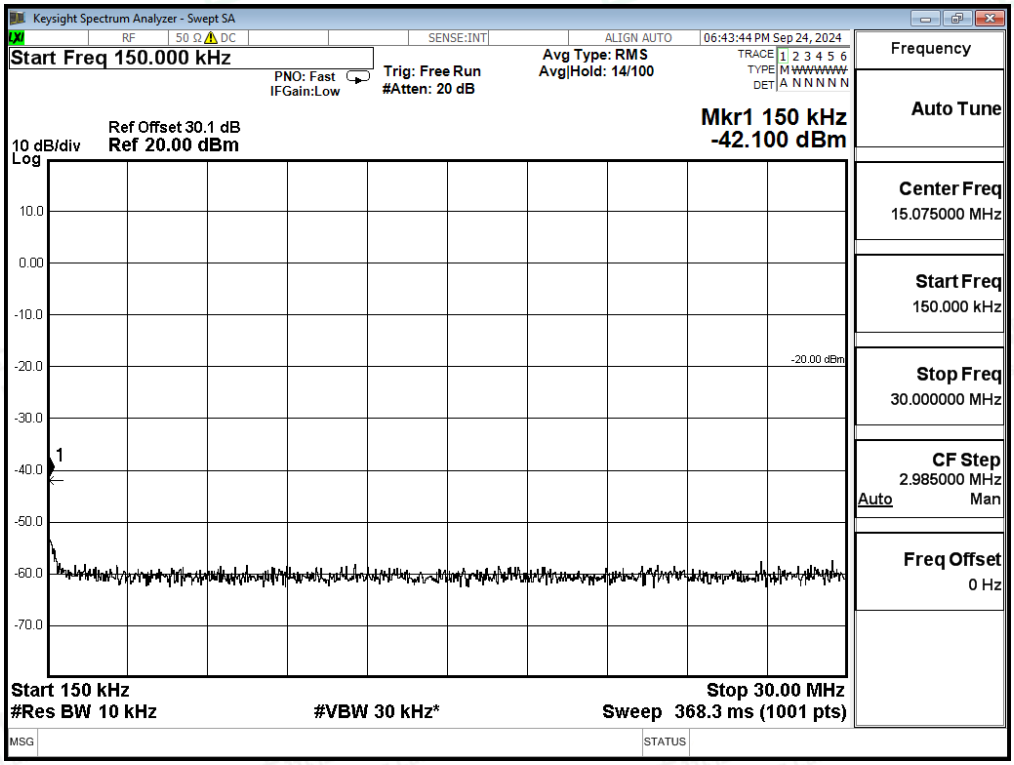


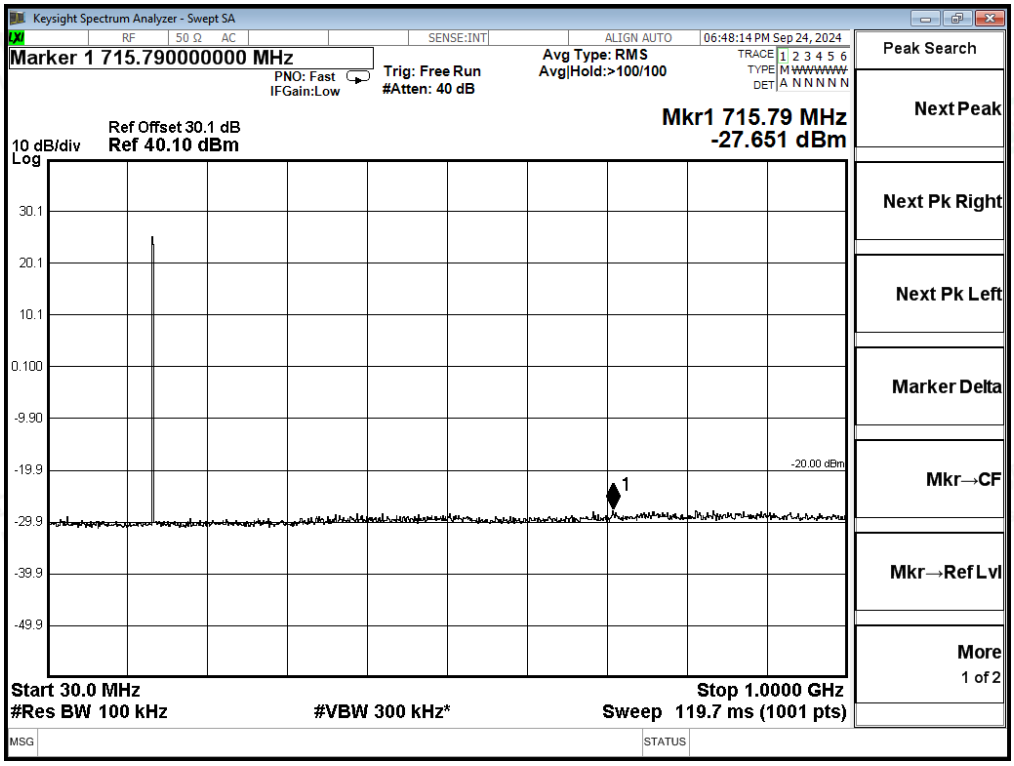

Keysight Spectrum Analyzer - Swept SA
RF 50 Ω AC
SENSE:INT
ALIGN AUTO
06:49:03 PM Sep 24, 2024
Marker 1 824.430000000 MHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 40 dB
Avg Type: RMS
Avg|Hold:>100/100
TRACE 1 2 3 4 5 6
TYPE M WWWWW
DET A N N N N N
Mkr1 824.43 MHz
-27.295 dBm
Ref Offset 30.1 dB
10 dB/div
Ref 40.10 dBm
Log
30.1
20.1
10.1
0.100
-9.90
-19.9
-29.9
-39.9
-49.9
-20.00 dBm
Start 30.0 MHz
#Res BW 100 kHz
#VBW 300 kHz*
Stop 1.0000 GHz
Sweep 119.7 ms (1001 pts)
MSG
STATUS
Trace/Detector
Select Trace 1
Clear Write
Trace Average
Max Hold
Min Hold
View Blank Trace On
More 1 of 3

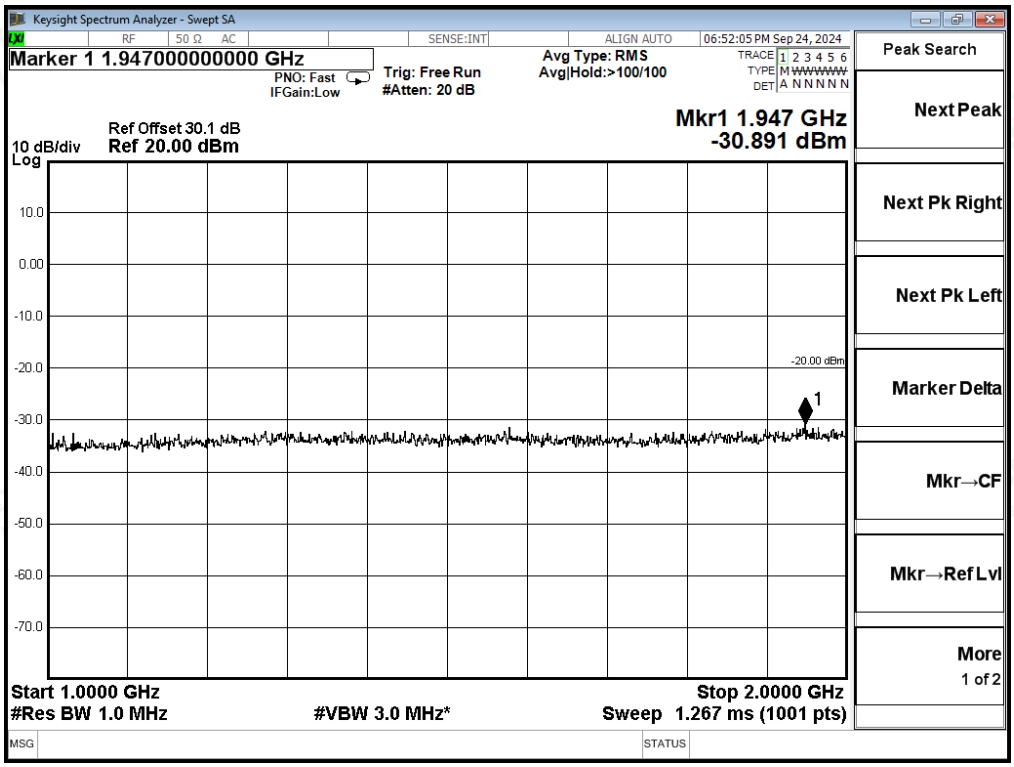

Keysight Spectrum Analyzer - Swept SA
RF 50 Ω AC
SENSE:INT
ALIGN AUTO
08:43:41 PM Sep 25, 2024
Marker 1 1.609000000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
Avg Type: RMS
Avg|Hold:>100/100
TRACE 1 2 3 4 5 6
TYPE M WWWWW
DET A N N N N N
Mkr1 1.609 GHz
-31.543 dBm
Ref Offset 30.1 dB
10 dB/div
Ref 20.00 dBm
Log
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-20.00 dBm
Start 1.0000 GHz
#Res BW 1.0 MHz
#VBW 3.0 MHz*
Stop 2.0000 GHz
Sweep 1.267 ms (1001 pts)
MSG
STATUS
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More 1 of 2

Operation Mode	Test Channel	Test Frequency (MHz)	Maximum Conducted Spurious Emissions Below 1GHz		Maximum Conducted Spurious Emissions Above1GHz		Limit (dBm)
			Frequency (MHz)	Datum (dBm)	Frequency (MHz)	Datum (dBm)	
Op 3	Ch5	158.55	317.12	-29.64	1440.00	-27.65	-13.00

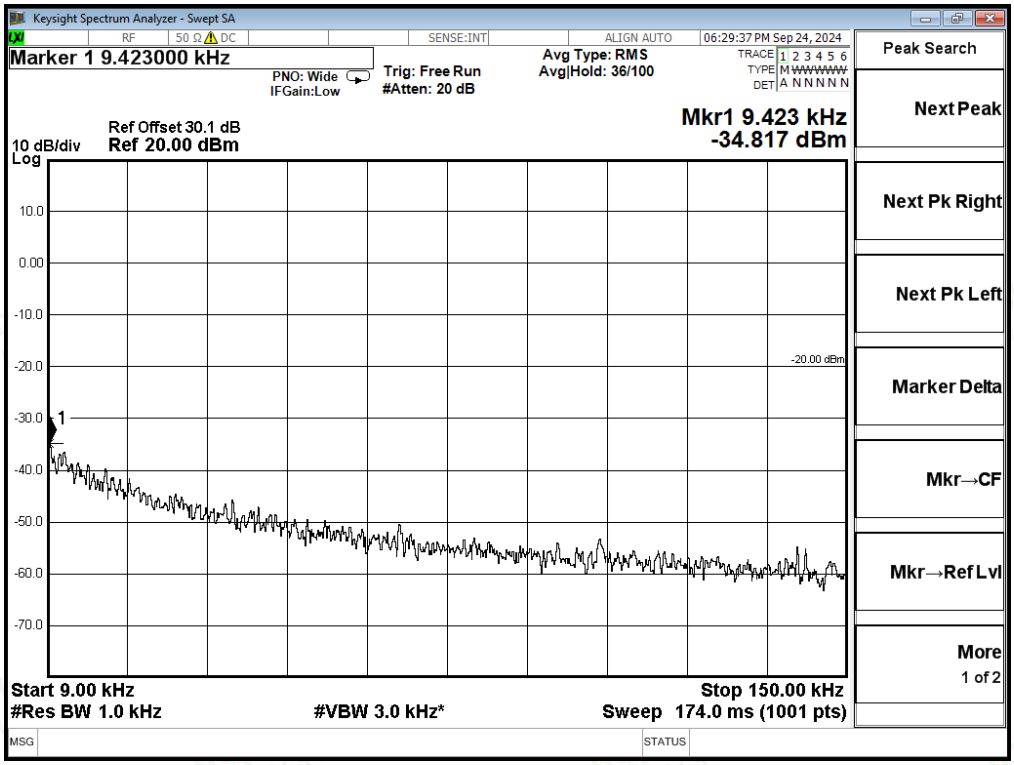


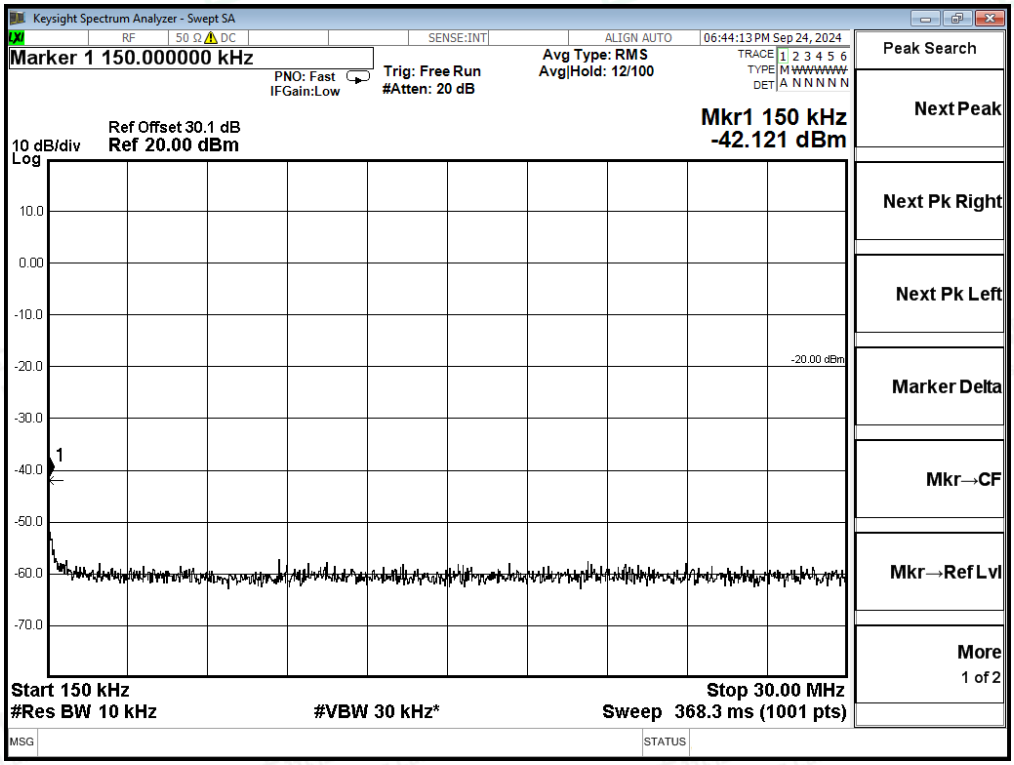


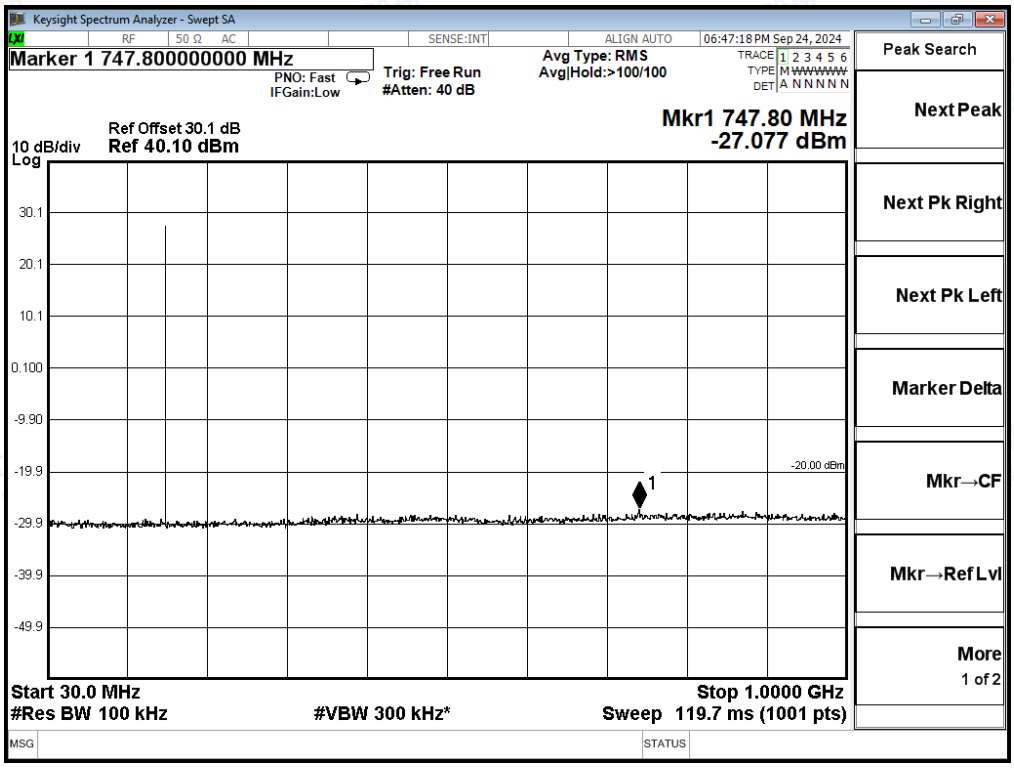

Keysight Spectrum Analyzer - Swept SA
RF 50 Ω AC
SENSE:INT
ALIGN AUTO
06:48:14 PM Sep 24, 2024
Marker 1 715.790000000 MHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 40 dB
Avg Type: RMS
Avg|Hold:>100/100
TRACE 1 2 3 4 5 6
TYPE M WWWWW
DET A N N N N N
Ref Offset 30.1 dB
10 dB/div
Log
Ref 40.10 dBm
Mkr1 715.79 MHz
-27.651 dBm
30.1
20.1
10.1
0.100
-9.90
-19.9
-29.9
-39.9
-49.9
-20.00 dBm
Start 30.0 MHz
#Res BW 100 kHz
#VBW 300 kHz*
Stop 1.0000 GHz
Sweep 119.7 ms (1001 pts)
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2
MSG
STATUS

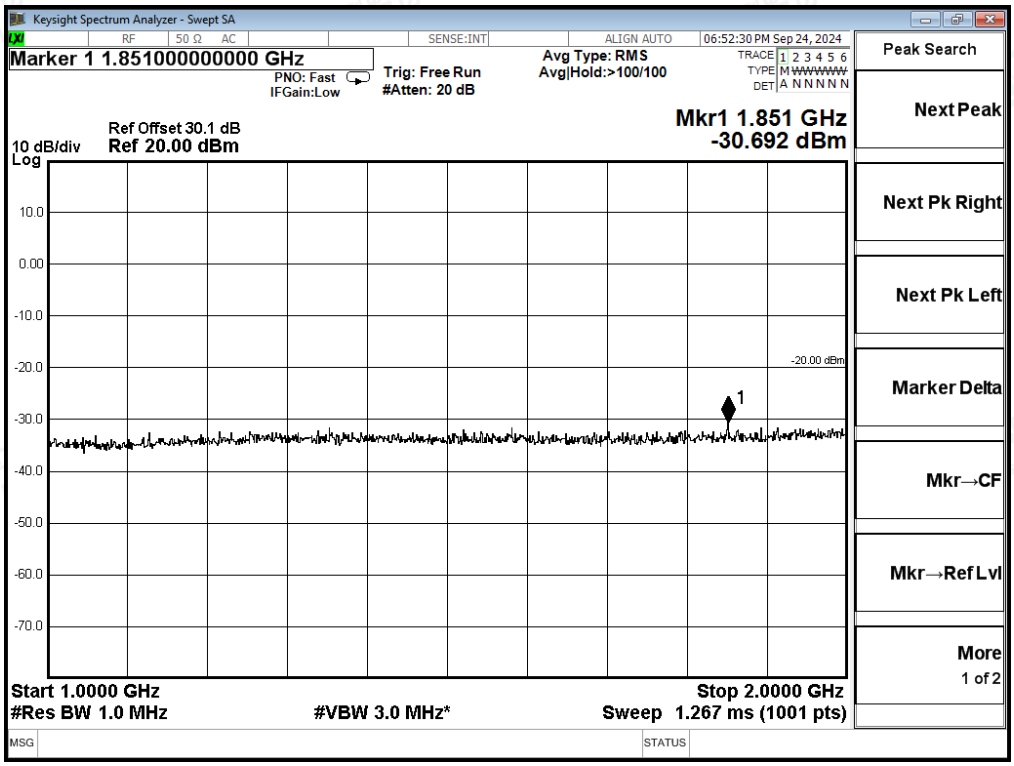

Keysight Spectrum Analyzer - Swept SA
RF 50 Ω AC
SENSE:INT
ALIGN AUTO
06:52:05 PM Sep 24, 2024
Marker 1 1.947000000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
Avg Type: RMS
Avg|Hold:>100/100
TRACE 1 2 3 4 5 6
TYPE M WWWWW
DET A N N N N N
Ref Offset 30.1 dB
10 dB/div
Log
Ref 20.00 dBm
Mkr1 1.947 GHz
-30.891 dBm
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-20.00 dBm
Start 1.0000 GHz
#Res BW 1.0 MHz
#VBW 3.0 MHz*
Stop 2.0000 GHz
Sweep 1.267 ms (1001 pts)
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2
MSG
STATUS

Operation Mode	Test Channel	Test Frequency (MHz)	Maximum Conducted Spurious Emissions Below 1GHz		Maximum Conducted Spurious Emissions Above1GHz		Limit (dBm)
			Frequency (MHz)	Datum (dBm)	Frequency (MHz)	Datum (dBm)	
Op 3	Ch6	173.3875	346.22	-27.08	1264.00	-27.11	-13.00






Keysight Spectrum Analyzer - Swept SA
RF 50 Ω AC
SENSE:INT
ALIGN AUTO
06:47:18 PM Sep 24, 2024
Marker 1 747.800000000 MHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 40 dB
Avg Type: RMS
Avg|Hold:>100/100
TRACE 1 2 3 4 5 6
TYPE M WWWWW
DET A N N N N N
Mkr1 747.80 MHz
-27.077 dBm
Ref Offset 30.1 dB
10 dB/div
Ref 40.10 dBm
Log
30.1
20.1
10.1
0.100
-9.90
-19.9
-29.9
-39.9
-49.9
-20.00 dBm
Start 30.0 MHz
#Res BW 100 kHz
#VBW 300 kHz*
Stop 1.0000 GHz
Sweep 119.7 ms (1001 pts)
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2
MSG
STATUS


Keysight Spectrum Analyzer - Swept SA
RF 50 Ω AC
SENSE:INT
ALIGN AUTO
06:52:30 PM Sep 24, 2024
Marker 1 1.851000000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 20 dB
Avg Type: RMS
Avg|Hold:>100/100
TRACE 1 2 3 4 5 6
TYPE M WWWWW
DET A N N N N N
Mkr1 1.851 GHz
-30.692 dBm
Ref Offset 30.1 dB
10 dB/div
Ref 20.00 dBm
Log
10.0
0.00
-10.0
-20.0
-30.0
-40.0
-50.0
-60.0
-70.0
-20.00 dBm
Start 1.0000 GHz
#Res BW 1.0 MHz
#VBW 3.0 MHz*
Stop 2.0000 GHz
Sweep 1.267 ms (1001 pts)
Peak Search
Next Peak
Next Pk Right
Next Pk Left
Marker Delta
Mkr→CF
Mkr→Ref Lvl
More
1 of 2
MSG
STATUS

4.5. Modulation Characteristics

TEST APPLICABLE

According to CFR47 section 2.1047(a), for Voice Modulation Communication Equipment, the frequency response of the audio modulation circuit over a range of 100 to 5000Hz shall be measured.

TEST PROCEDURE

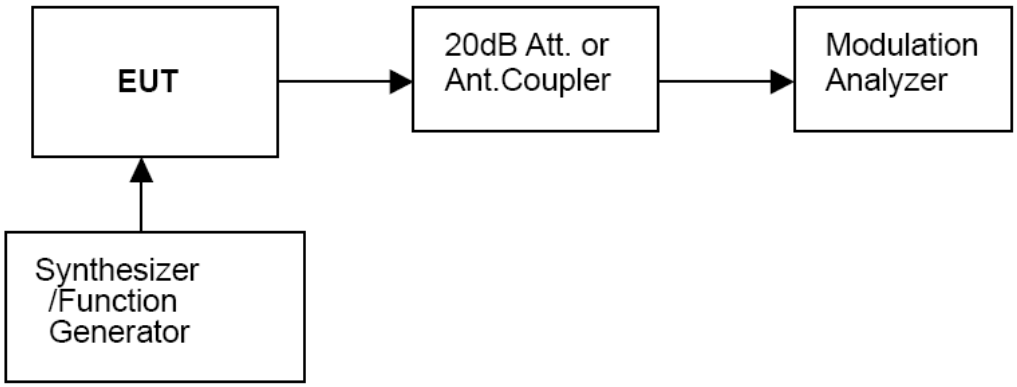
Modulation Limit

1 Configure the EUT as shown in figure 1, adjust the audio input for 60% of rated system deviation at 1 KHz using this level as a reference (0dB) and vary the input level from –20 to +20dB. Record the frequency deviation obtained as a function of the input level.
2 Repeat step 1 with input frequency changing to 300, 1004, 1500 and 2500Hz in sequence.

Audio Frequency Response

1 Configure the EUT as shown in figure 1.
2 Adjust the audio input for 20% of rated system deviation at 1 KHz using this level as a reference (0dB).
3 Vary the Audio frequency from 100 Hz to 3 KHz and record the frequency deviation.
4 Audio Frequency Response =20log10 (Deviation of test frequency/Deviation of 1 KHz reference).

TEST CONFIGURATION



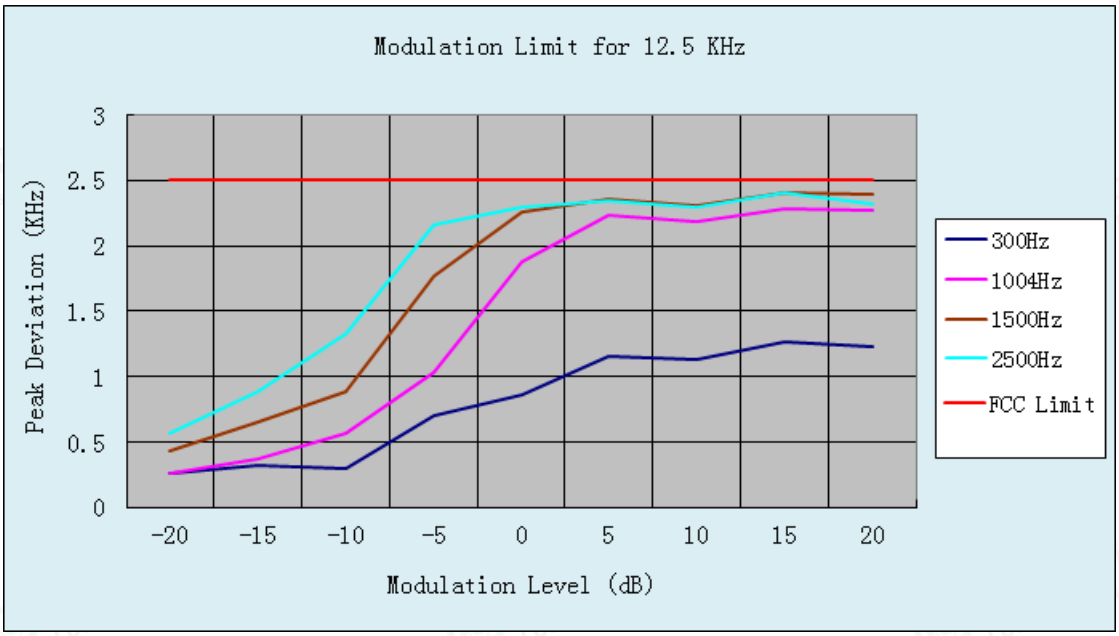
TEST RESULTS

Remark: We tested Op 1 to Op 2 recorded worst case at Op 1.

Modulation Type: FM

12.5 KHz Channel Separation Op1

Modulation Level (dB)	Peak Freq. Deviation At 300 Hz (KHz)	Peak Freq. Deviation At 1004 Hz (KHz)	Peak Freq. Deviation At 1500 Hz (KHz)	Peak Freq. Deviation At 2500 Hz (KHz)
-20	0.26	0.26	0.43	0.57
-15	0.32	0.37	0.65	0.88
-10	0.30	0.57	0.88	1.33
-5	0.70	1.03	1.77	2.16
0	0.86	1.88	2.26	2.30
+5	1.15	2.23	2.35	2.34
+10	1.13	2.18	2.31	2.29
+15	1.26	2.28	2.40	2.40
+20	1.23	2.27	2.39	2.32



Modulation type: 4FSK

Channel bandwidth: 12.5 kHz

It is not applicable for devices which operate with the digitized voice/data modulation type.

b). Audio Frequency Response:

Rule Part No.: Part 2.1407(a) (b)

Method of Measurement:

The audio frequency response was measured in accordance with TIA/EIA Specification 603 with no exception.

A curve or equivalent data showing the frequency response of the audio modulating circuit over a range of 300-3000Hz shall be submitted and Audio Post Limiter Low Pass Filter Response from 3.0 KHz to 50KHz.However, the audio frequency response should test from 100Hz to 5.0 KHz according to FCC Part 90.

Modulation Type: FM

The audio frequency response curve is show below.

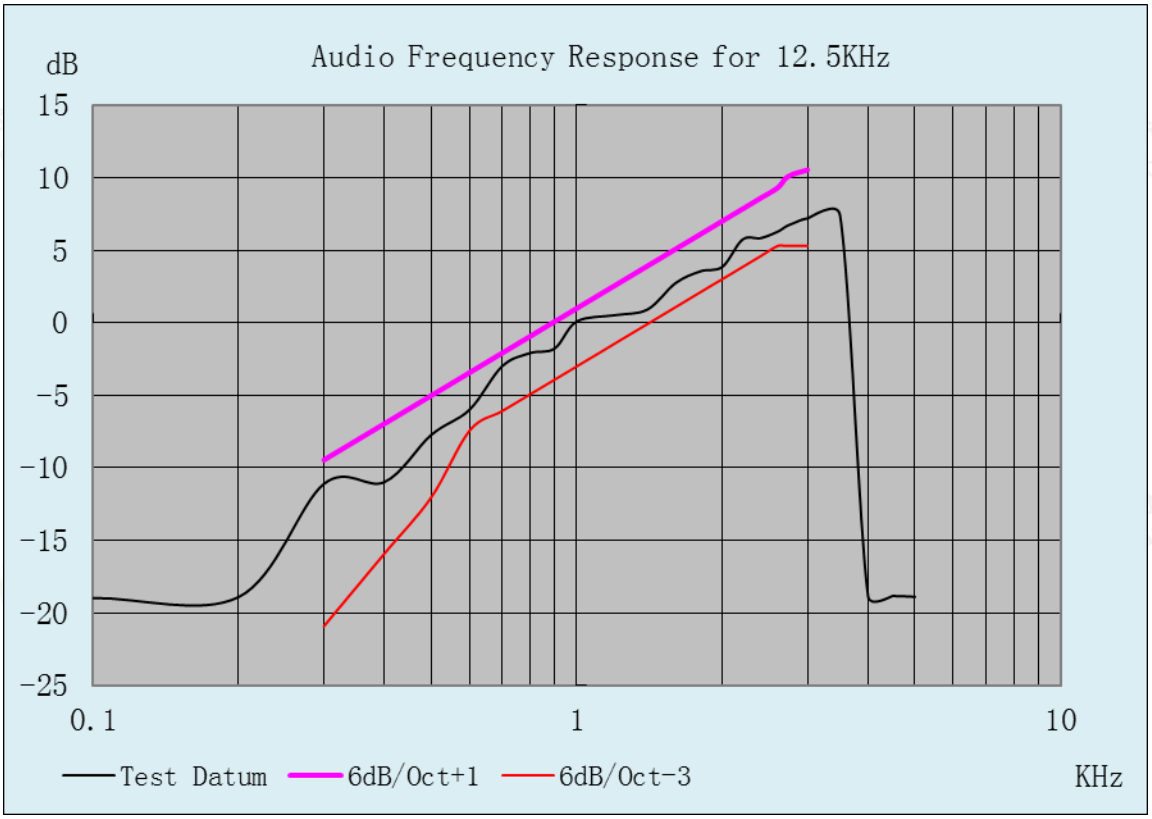
Test Audio Level 1 KHz and 20% maximum deviation.

Note:

1. Not applicable to new standard. However, tests are conducted under FCC's recommendation.
2. The Audio Frequency Response is identical for 12.5 KHz channel separation

12.5 KHz Channel Separation Op1

Frequency (KHz)	Frequency Deviation (KHz)	1KHz Reference Deviation (KHz)	Audio Frequency Response (dB)
0.1	0.06	0.55	-18.97
0.2	0.06	0.55	-18.90
0.3	0.15	0.55	-11.10
0.4	0.15	0.55	-10.98
0.5	0.22	0.55	-7.73
0.6	0.27	0.55	-5.99
0.7	0.38	0.55	-3.01
0.8	0.42	0.55	-2.09
0.9	0.43	0.55	-1.77
1.0	0.55	0.55	0.10
1.2	0.58	0.55	0.53
1.4	0.6	0.55	0.92
1.6	0.74	0.55	2.74
1.8	0.81	0.55	3.55
2.0	0.84	0.55	3.87
2.2	1.05	0.55	5.74
2.4	1.07	0.55	5.84
2.6	1.1	0.55	6.28
2.7	1.17	0.55	6.62
2.8	1.2	0.55	6.86
3.0	1.25	0.55	7.20
3.5	1.25	0.55	7.43
4.0	0.06	0.55	-18.86
4.5	0.06	0.55	-18.83
5.0	0.06	0.55	-18.89



Modulation type: 4FSK

Channel bandwidth: 12.5 kHz

It is not applicable for devices which operate with the digitized voice/data modulation type.

4.6. Frequency Stability Test

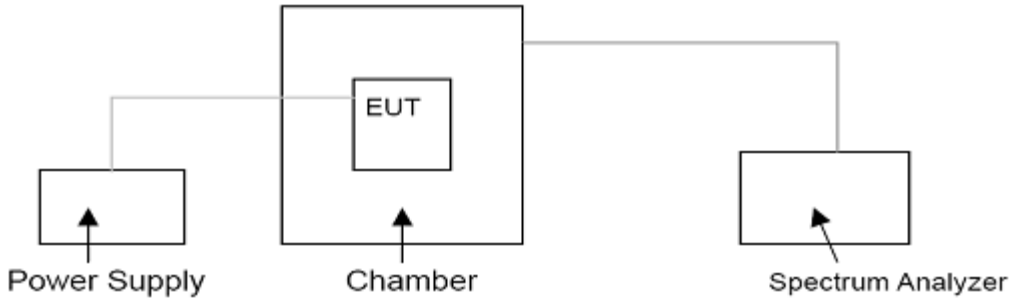
TEST APPLICABLE

1 According to FCC Part 2 Section 2.1055 (a)(1), the frequency stability shall be measured with variation of ambient temperature from -30℃ to +60℃ centigrade.
2 According to FCC Part 2 Section 2.1055 (e) (2), for battery powered equipment, the frequency stability shall be measured with reducing primary supply voltage to the battery operating end point, which is specified by the manufacture.
3 Vary primary supply voltage from 85 to 115 percent of the nominal value.
4 According to §90.213, the frequency stability limit is 5.0 ppm for 12.5KHz and 25KHz channel separation

TEST PROCEDURE

The EUT was set in the climate chamber and connected to an external DC power supply. The RF output was directly connected to Spectrum Analyzer ESI 26. The coupling loss of the additional cables was recorded and taken in account for all the measurements. After temperature stabilization (approx. 20 min for each stage), the frequency for the lower, the middle and the highest frequency range was recorded. For Frequency stability Vs. Voltage the EUT was connected to a DC power supply and the voltage was adjusted in the required ranges. The result was recorded.

TEST CONFIGURATION



TEST LIMITS

According to 90.213, Transmitters used must have minimum frequency stability as specified in the following table.

Frequency Range (MHz)	Channel Bandwidth (KHz)	Frequency Tolerance (ppm)		
		Fixed and Base Stations	Mobile Stations	
			> 2 W	≤ 2 W
150-174 MHz	6.25 12.5 25	1.0 2.5 5.0	2.0 5.0 5.0	2.0 5.0 50.0*
421-512 MHz	6.25 12.5 25	0.5 1.5 2.5	1.0 2.5 5.0	1.0 2.5 5.0

- Stations operating in the 154.45 to 154.49 MHz or the 173.2 to 173.4 MHz bands must have a frequency stability of 5 ppm.
- Paging transmitters operating on paging-only frequencies must operate with frequency stability of 5 ppm in the 150-174 MHz band and 2.5 ppm in the 421-512 MHz band.

TEST RESULTS

Remark: We tested Op 1 to Op 4, recorded worst case at Op 1 and Op 3.

Operation Mode	Channel Separation	Test conditions		Frequency error (ppm)		
		Voltage(V)	Temp(℃)	150.825	158.55	173.3875
Op1	12.5KHz	7.2 V	-30	0.67	0.17	0.29
			-20	0.63	0.45	0.90
			-10	0.81	0.35	0.56
			0	0.44	0.52	0.80
			10	0.68	0.16	0.64
			20	0.53	0.77	0.59
			30	0.77	0.61	0.85
			40	0.85	0.72	0.15
			50	0.27	0.09	0.14
		6.29 (85% Rated)	20	0.88	0.02	0.68
		8.51(115% Rated)	20	0.649	0.48	0.60
Limit			**5.0 ppm**			
Test Results			**PASS**			

Operation Mode	Channel Separation	Test conditions		Frequency error (ppm)		
		Voltage(V)	Temp(℃)	150.825	158.55	173.3875
Op3	12.5KHz	7.2 V	-30	0.44	0.11	0.58
			-20	0.06	0.66	0.86
			-10	0.44	0.24	0.35
			0	0.90	0.94	0.74
			10	0.03	0.25	0.75
			20	0.94	0.75	0.76
			30	0.36	0.30	0.96
			40	0.36	0.24	0.19
			50	0.71	0.91	0.85
		6.29 (85% Rated)	20	0.97	0.03	0.73
		8.51(115% Rated)	20	0.72	0.19	0.80
Limit			5.0 ppm			
Test Results			PASS			

4.7. Maximum Transmitter Power

TEST APPLICABLE

Per FCC Part 2.1046 and Part 90.205: Maximum ERP is dependent upon the station's antenna HAAT and required service area.
Per RSS-119 Section 5.4 and 5.4.1: The output power shall be within ±1.0 dB of the manufacturer's rated power. Typical transmitter output powers are 110 watts for base and/or fixed stations (paging transmitters excepted), and 30 watts for mobile stations. Higher powers may be certified, but it should be noted that mobile stations are normally only licensed up to 30 watts. See the SRSP relevant to the operating frequency for equipment power limits.

TEST PROCEDURE

Measurements shall be made to establish the radio frequency power delivered by the transmitter the standard output termination. The power output shall be monitored and recorded and no adjustment shall be made to the transmitter after the test has begun, except as noted bellow:
If the power output is adjustable, measurements shall be made for the highest and lowest power levels.
The EUT connect to the Receiver through 20 dB attenuator.
Measurement with Spectrum Analyzer FSP40 conducted, external power supply with 7.2 V or AC 120V/60Hz stabilized supply voltage.

TEST CONFIGURATION

<table>
<tr><td rowspan="2">EUT</td><td></td><td rowspan="2">Attenuator</td><td></td><td rowspan="2">Spectrum Analyzer/Receiver</td></tr>
<tr><td></td><td></td></tr>
</table>

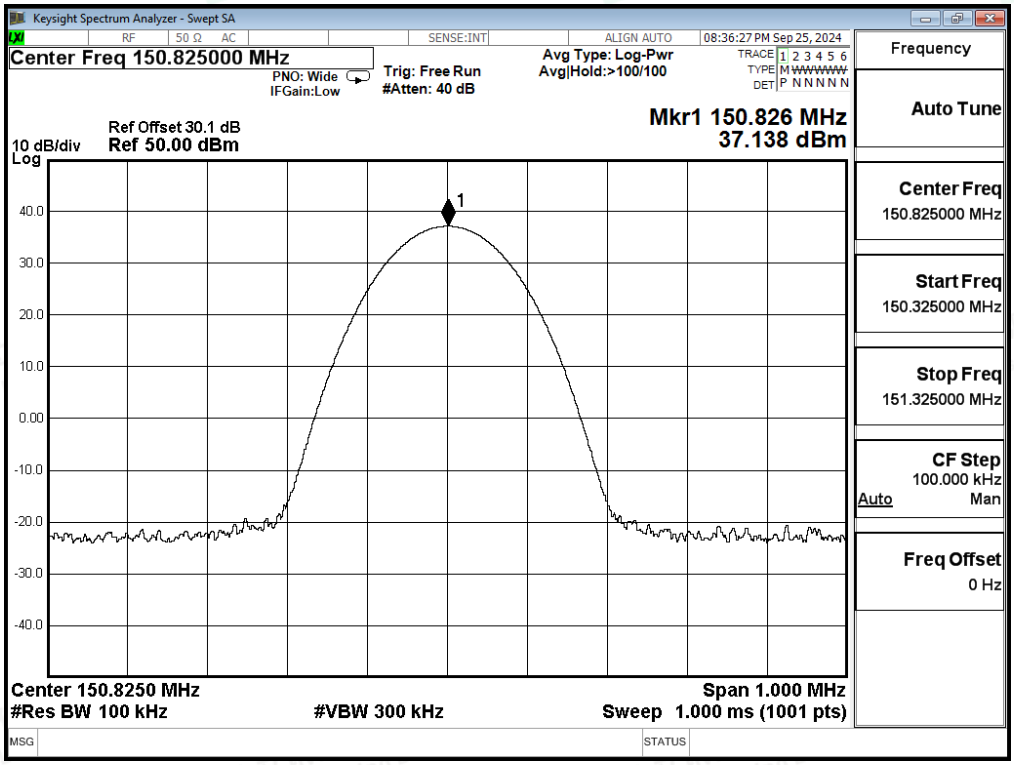
The EUT was directly connected to a RF Communication Test set by a 20 dB attenuator

TEST RESULTS

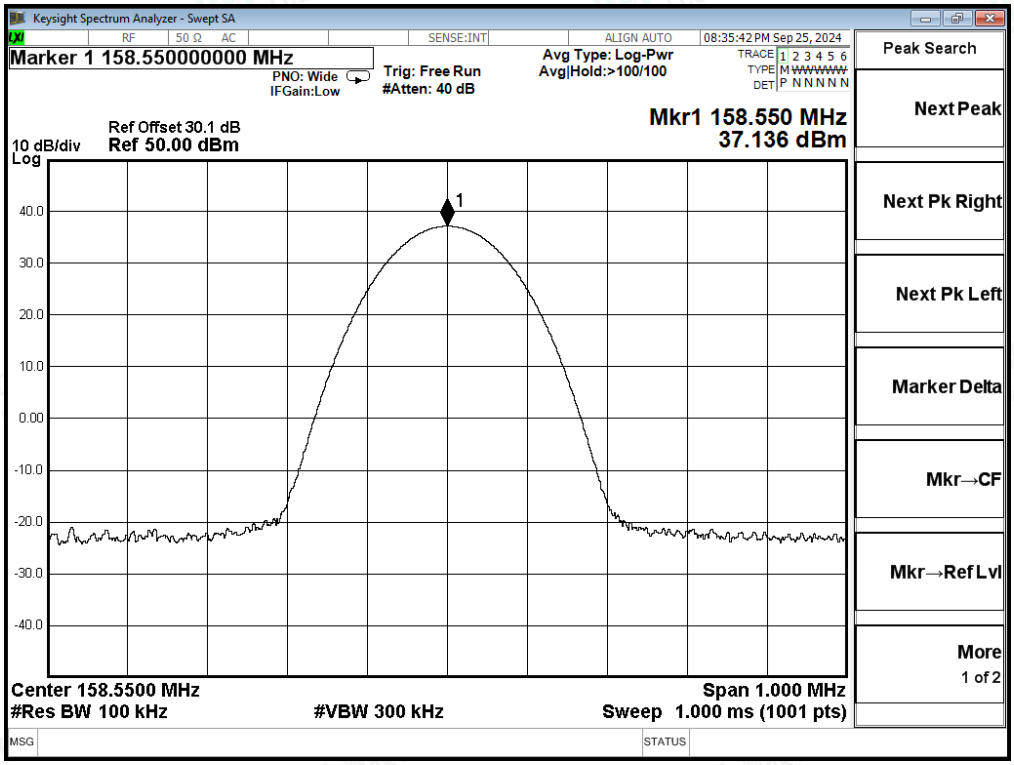
Modulation Type	Channel Separation	Operation Mode	Test Channel	Test Frequency (MHz)	Test Results (dBm)
Analog/FM	12.5KHz	Op 1	Ch1	150.825	37.14
			Ch2	158.55	37.14
			Ch3	173.3875	37.41
		Op 2	Ch1	150.825	33.37
			Ch2	158.55	33.55
			Ch3	173.3875	33.74
Digital/4FSK	12.5KHz	Op 3	Ch4	150.825	37.33
			Ch5	158.55	37.31
			Ch6	173.3875	37.48
		Op 4	Ch4	150.825	33.80
			Ch5	158.55	34.13
			Ch6	173.3875	33.73
Limit	**The limit is dependent upon the station's antenna HAAT and required service area.**				
Test Results	**PASS**				

Plots of Transmitter Power Measurement

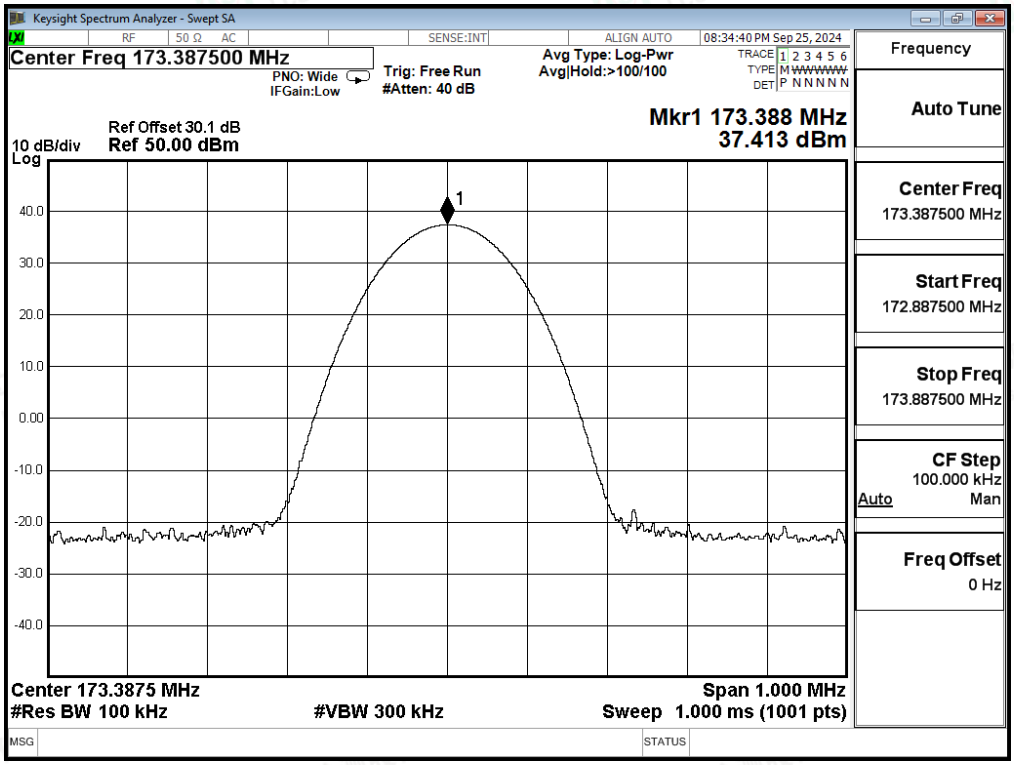
Modulation Type	Channel Separation	Operation Mode	Test Channel	Test Frequency (MHz)	Rated Power (Watt)	Measurement (dBm)	Limit	Results
FM	12.5KHz	Op 1	Ch1	150.825	5	37.14	Varies	PASS



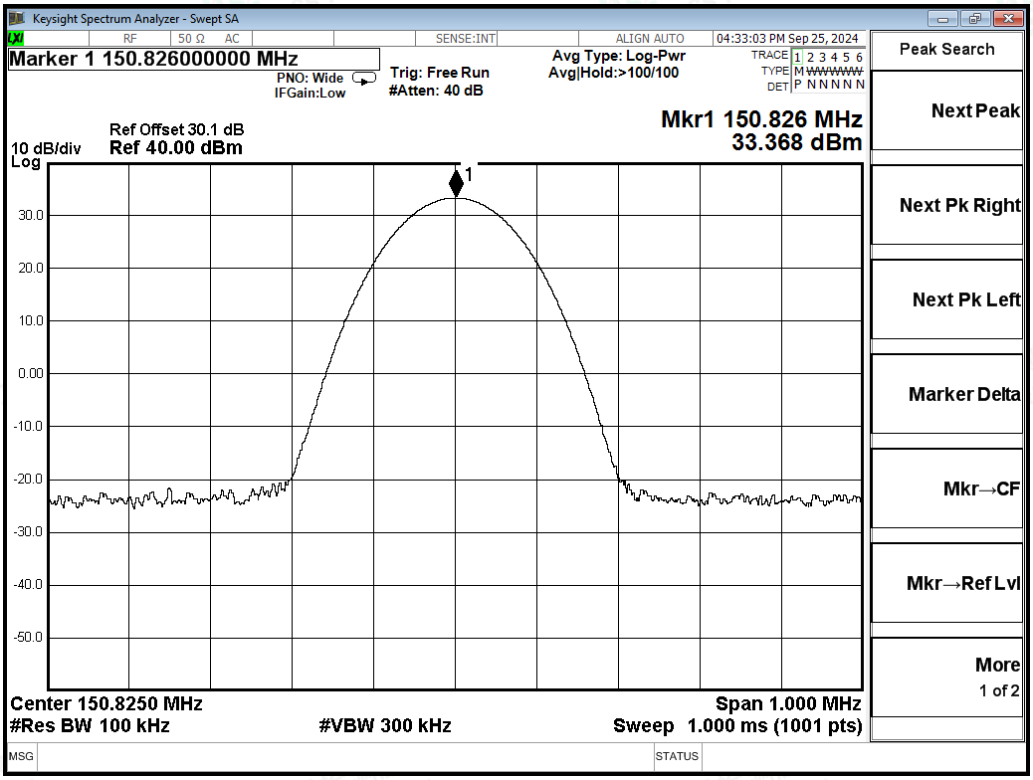
Modulation Type	Channel Separation	Operation Mode	Test Channel	Test Frequency (MHz)	Rated Power (Watt)	Measurement (dBm)	Limit	Results
FM	12.5KHz	Op 1	Ch2	158.55	5	37.14	Varies	PASS



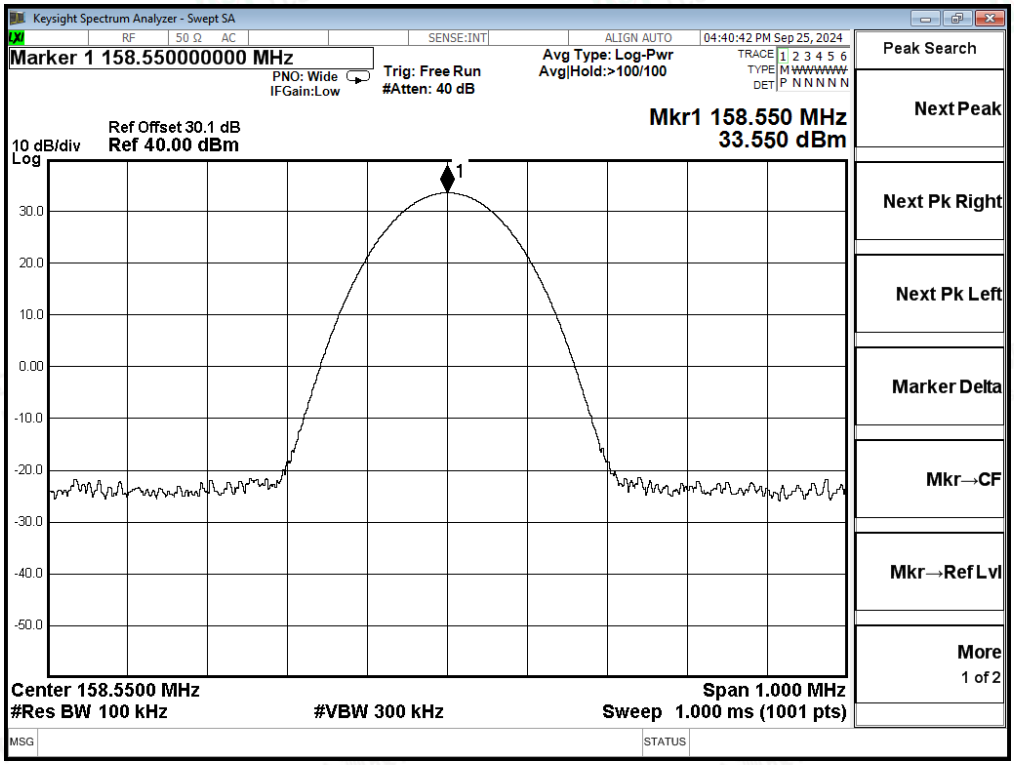
Modulation Type	Channel Separation	Operation Mode	Test Channel	Test Frequency (MHz)	Rated Power (Watt)	Measurement (dBm)	Limit	Results
FM	12.5KHz	Op 1	Ch3	173.3875	5	37.41	Varies	PASS



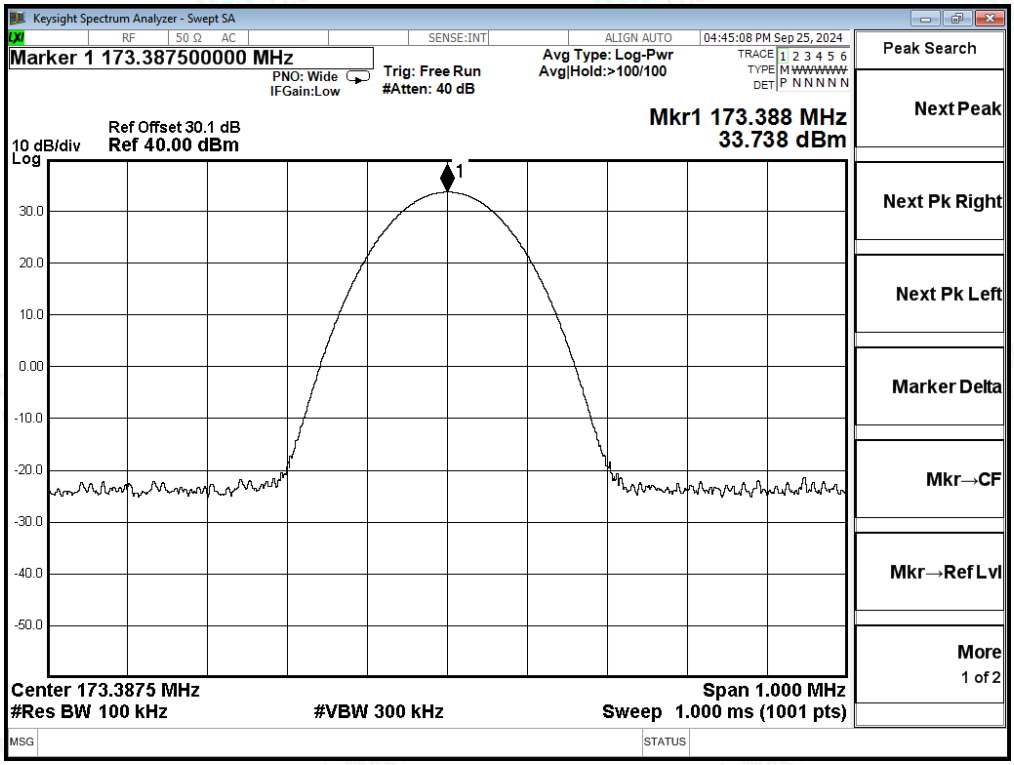
Modulation Type	Channel Separation	Operation Mode	Test Channel	Test Frequency (MHz)	Rated Power (Watt)	Measurement (dBm)	Limit	Results
FM	12.5KHz	Op 2	Ch1	150.825	2	33.37	Varies	PASS



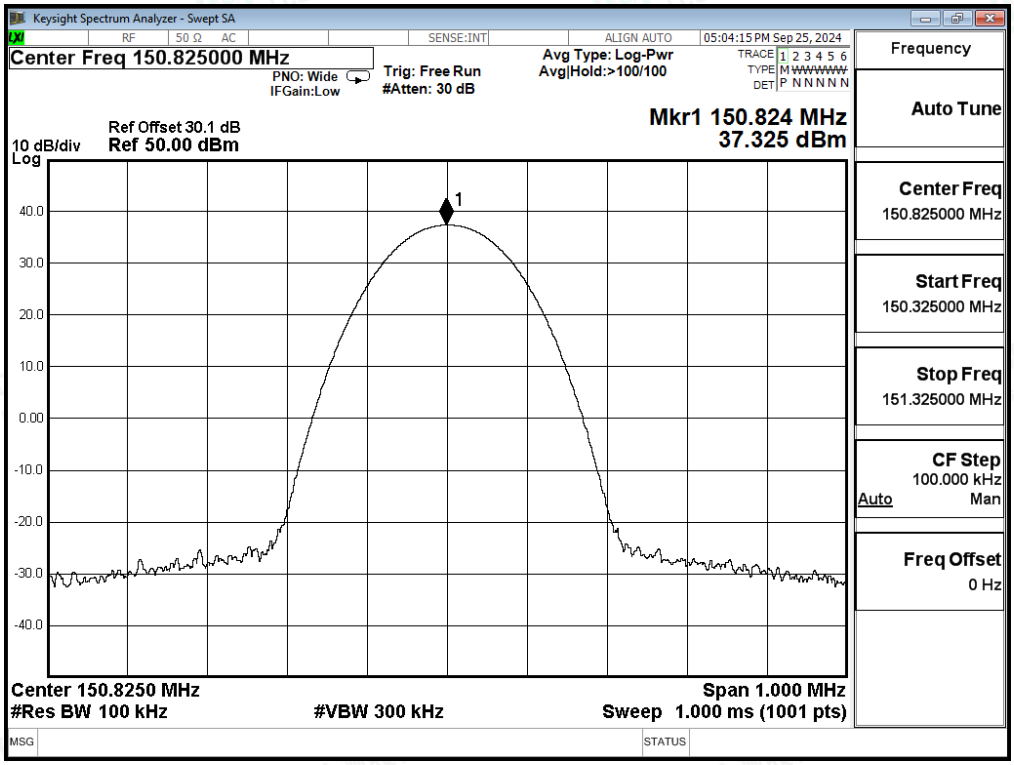
Modulation Type	Channel Separation	Operation Mode	Test Channel	Test Frequency (MHz)	Rated Power (Watt)	Measurement (dBm)	Limit	Results
FM	12.5KHz	Op 2	Ch2	158.55	2	33.55	Varies	PASS



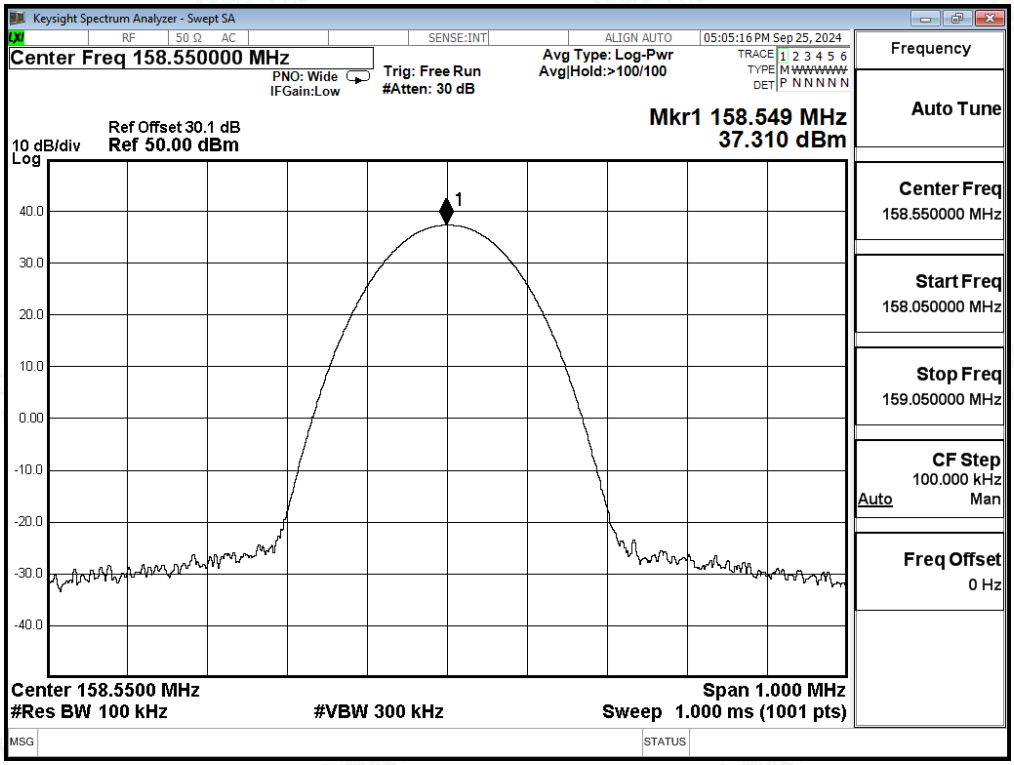
Modulation Type	Channel Separation	Operation Mode	Test Channel	Test Frequency (MHz)	Rated Power (Watt)	Measurement (dBm)	Limit	Results
FM	12.5KHz	Op 2	Ch3	173.3875	2	33.74	Varies	PASS



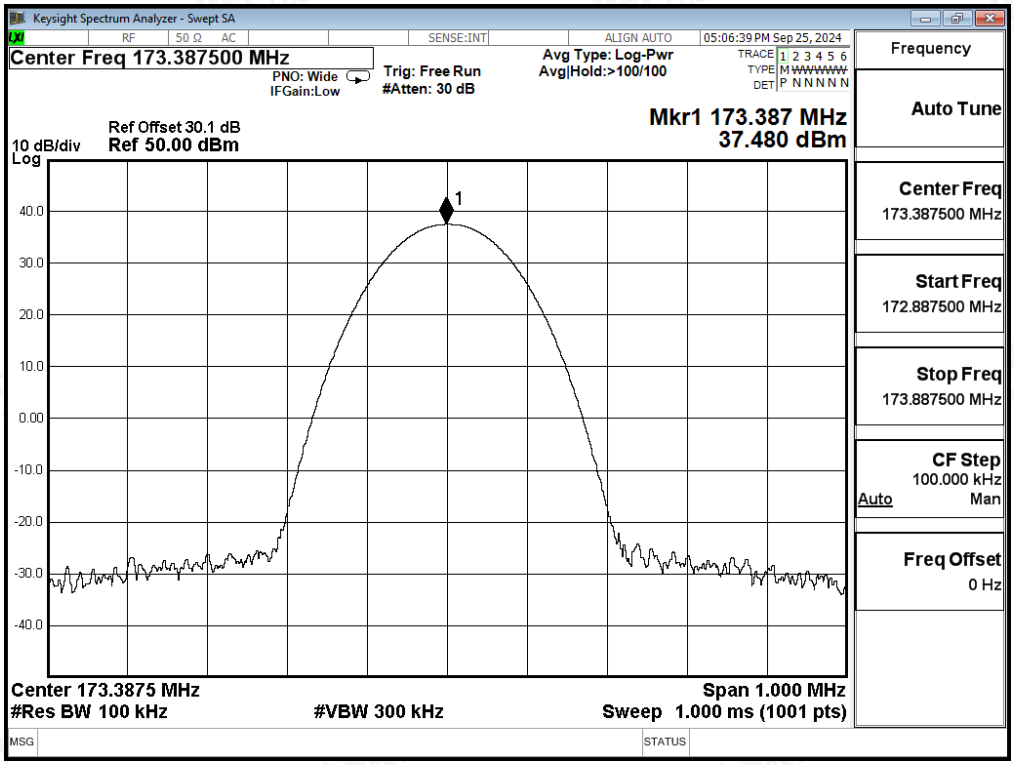
Modulation Type	Channel Separation	Operation Mode	Test Channel	Test Frequency (MHz)	Rated Power (Watt)	Measurement (dBm)	Limit	Results
4FSK	12.5KHz	Op 3	Ch4	150.825	5	37.33	Varies	PASS



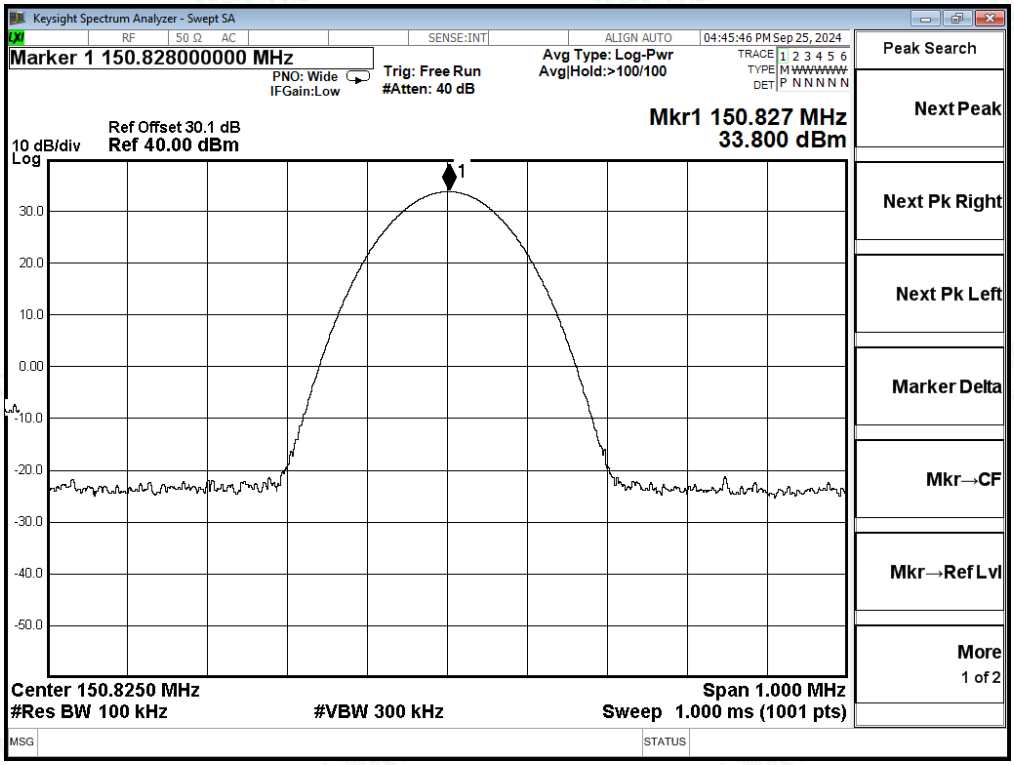
Modulation Type	Channel Separation	Operation Mode	Test Channel	Test Frequency (MHz)	Rated Power (Watt)	Measurement (dBm)	Limit	Results
4FSK	12.5KHz	Op 3	Ch5	158.55	5	37.31	Varies	PASS



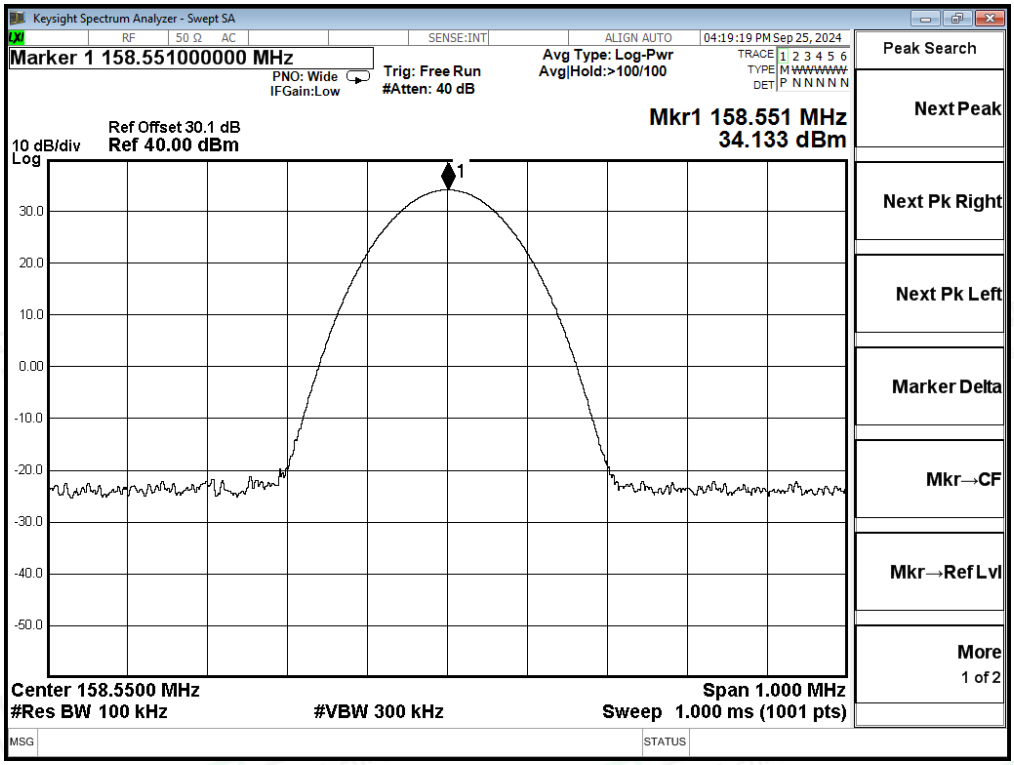
Modulation Type	Channel Separation	Operation Mode	Test Channel	Test Frequency (MHz)	Rated Power (Watt)	Measurement (dBm)	Limit	Results
4FSK	12.5KHz	Op 3	Ch6	173.3875	5	37.48	Varies	PASS



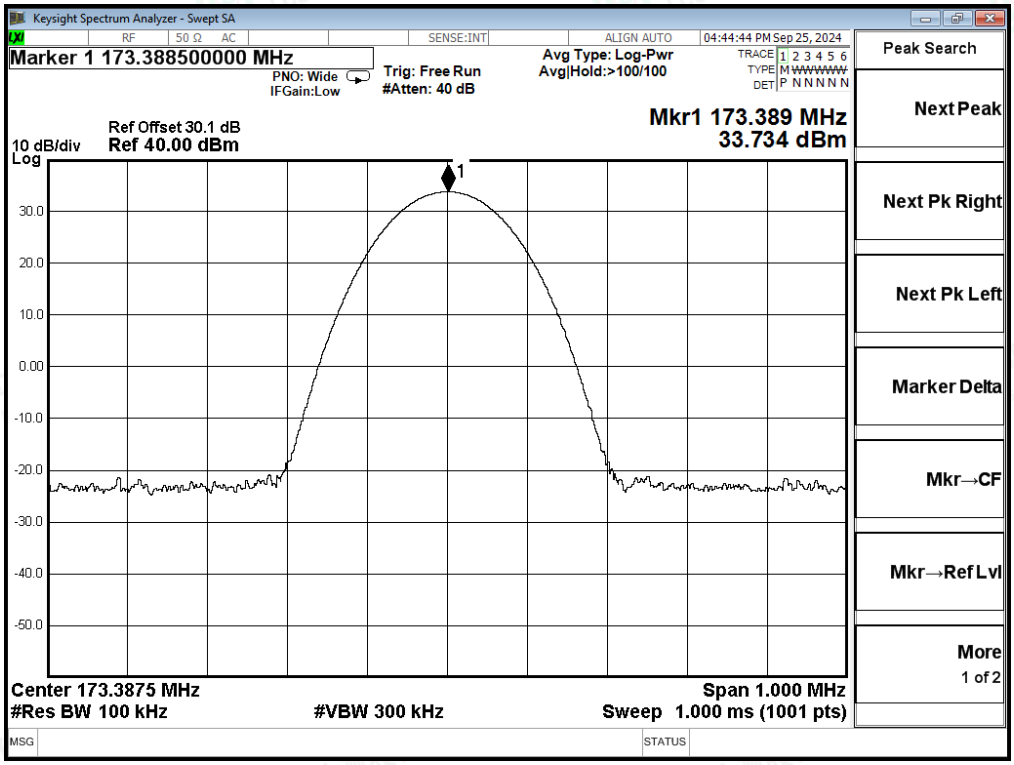
Modulation Type	Channel Separation	Operation Mode	Test Channel	Test Frequency (MHz)	Rated Power (Watt)	Measurement (dBm)	Limit	Results
4FSK	12.5KHz	Op 4	Ch4	150.825	2	33.80	Varies	PASS



Modulation Type	Channel Separation	Operation Mode	Test Channel	Test Frequency (MHz)	Rated Power (Watt)	Measurement (dBm)	Limit	Results
4FSK	12.5KHz	Op 4	Ch5	158.55	2	34.13	Varies	PASS



Modulation Type	Channel Separation	Operation Mode	Test Channel	Test Frequency (MHz)	Rated Power (Watt)	Measurement (dBm)	Limit	Results
4FSK	12.5KHz	Op 4	Ch6	173.3875	2	33.73	Varies	PASS



4.8. Transmitter Frequency Behavior

TEST APPLICABLE

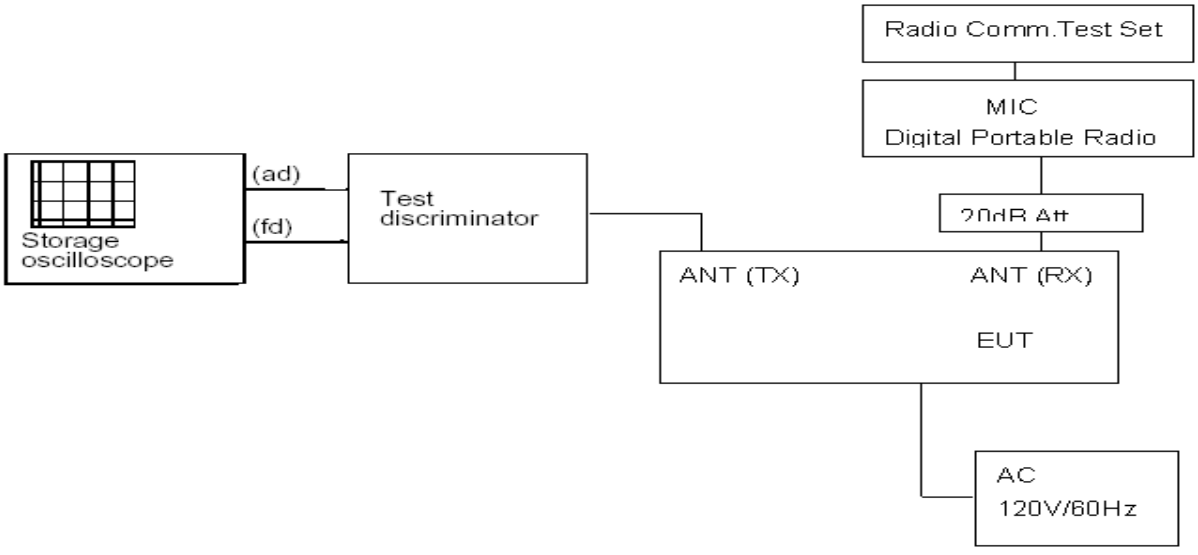
Section 90.214

Transient frequencies must be within the maximum frequency difference limits during the time intervals indicated:

Time intervals [1, 2]	Maximum frequency difference [3]	All equipment	
		150 to 174 MHz	421 to 512MHz
Transient Frequency Behavior for Equipment Designed to Operate on 25 KHz Channels			
t_1 [4]	± 25.0 KHz	5.0 ms	10.0 ms
t_2	± 12.5 KHz	20.0 ms	25.0 ms
t_3 [4]	± 25.0 KHz	5.0 ms	10.0 ms
Transient Frequency Behavior for Equipment Designed to Operate on 12.5 KHz Channels			
t_1 [4]	± 12.5 KHz	5.0 ms	10.0 ms
t_2	± 6.25 KHz	20.0 ms	25.0 ms
t_3 [4]	± 12.5 KHz	5.0 ms	10.0 ms
Transient Frequency Behavior for Equipment Designed to Operate on 6.25 KHz Channels			
t_1 [4]	±6.25 KHz	5.0 ms	10.0 ms
t_2	±3.125 KHz	20.0 ms	25.0 ms
t_3 [4]	±6.25 KHz	5.0 ms	10.0 ms

1. t_{on} is the instant when a 1 KHz test signal is completely suppressed, including any capture time due to phasing.
   t_1 is the time period immediately following t_{on}.
   t_2 is the time period immediately following t_1.
   t_3 is the time period from the instant when the transmitter is turned off until t_{off}.
   t_{off} is the instant when the 1 KHz test signal starts to rise.
2. During the time from the end of t_2 to the beginning of t_3, the frequency difference must not exceed the limits specified in § 90.213.
3. Difference between the actual transmitter frequency and the assigned transmitter frequency.
4. If the transmitter carrier output power rating is 6 watts or less, the frequency difference during this time period may exceed the maximum frequency difference for this time period.

TEST CONFIGURATION



TEST PROCEDURE

According to TIA/EIA-603 2.2.19 requirement. As for the product different from PTT, we use test steps as follows:

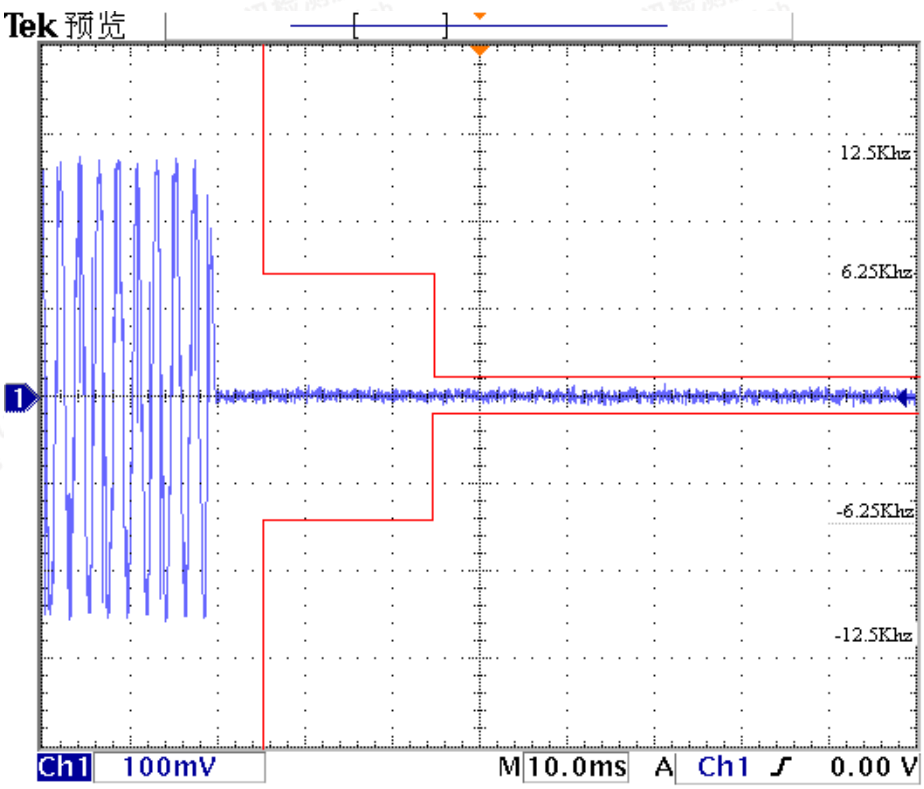
1. Use Digital portable radio which manufactured by Victel Global Communications Corporation Limited which uses same protocol as the DUT connect to RX antenna by 20Att in order to avoid damaging DUT;
2. Connect DUT into Test discriminator and Storage Oscilloscope and keep DUT stats ON;
3. Input 1KHz signal into digital portable radio;
4. Set the modulation domain analyzer to trigger on the rising edge of the waveform in order to capture a single-shot turn-on of the transmitter signals;
5. Keep the digital portable radio in OFF state and Key the PTT of digital portable radio;
6. Observe the stored oscilloscope of modulation domain analyzer. The signal trace shall be maintained within the allowable limits during the periods t_1 and t_2,and shall also remain within limits following t_2;
7. Adjust the modulation domain analyzer to trigger on the falling edge of the transmitter waveform in order to capture a single-shot turn-off transmitter of the transmitter signal.
8. Keep the digital portable radio in ON state and Unkey the PTT of digital portable radio;
9. Observe the stored oscilloscope of modulation domain analyzer. The signal trace shall be maintained within the allowable limits during the period t_3.

TEST RESULTS

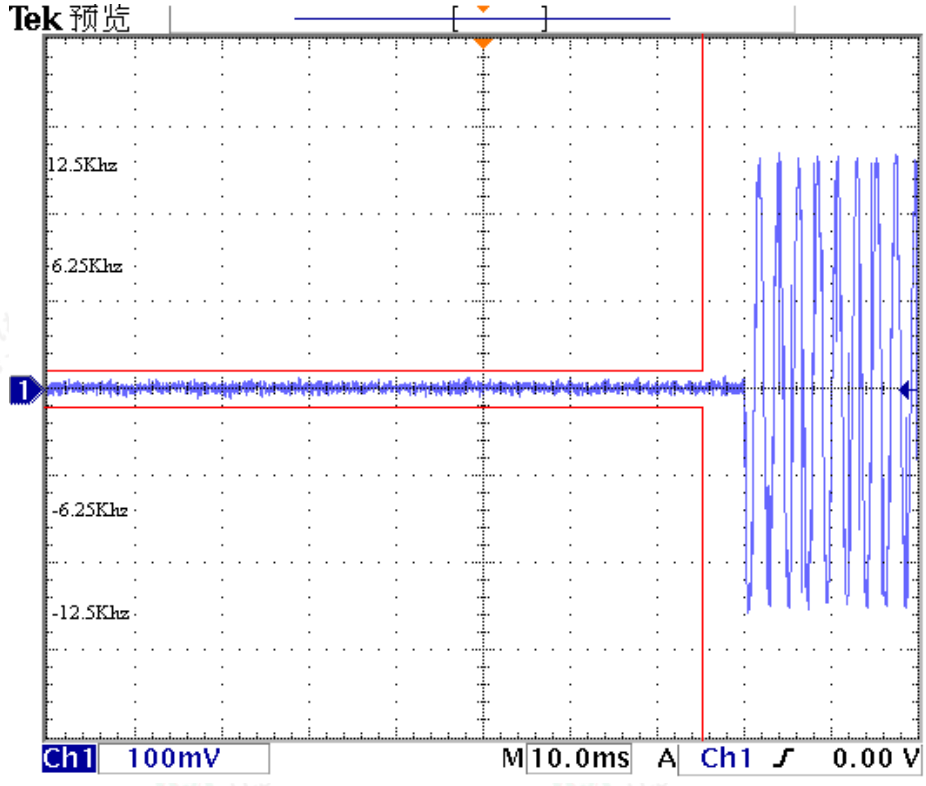
Please refer to the following plots.

Modulation Type: FM

Transmitter Frequency Behavior @ 12.5 KHz Channel Separation------Off – On

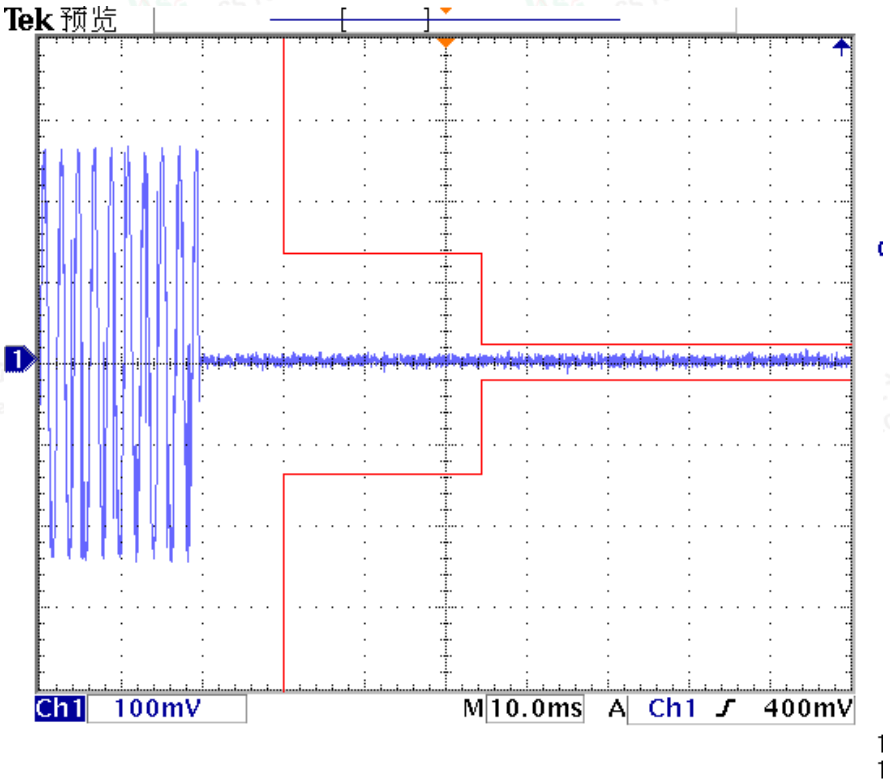


Transmitter Frequency Behavior @ 12.5 KHz Channel Separation------On – Off

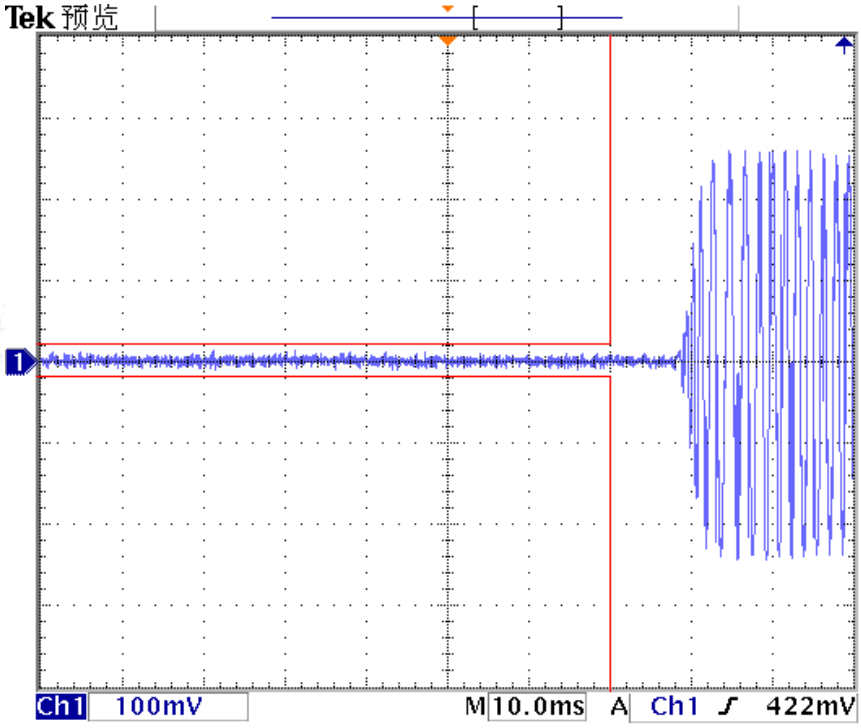


Modulation Type: 4FSK

Transmitter Frequency Behavior @ 12.5 KHz Channel Separation------Off – On



Transmitter Frequency Behavior @ 12.5 KHz Channel Separation------On – Off



5. LIST OF MEASURING EQUIPMENT

Item	Equipment	Manufacturer	Model No.	Serial No.	Cal Date	Due Date
1	MXA Signal Analyzer	Agilent	N9020A	MY49100060	2023-10-18 2024-10-08	2024-10-17 2025-10-07
2	DC Power Supply	Agilent	E3642A	N/A	2023-10-18 2024-10-08	2024-10-17 2025-10-07
3	Temperature & Humidity Chamber	Baro	/	/	2024-06-12	2025-06-11
4	Signal Analyzer	R&S	SL3	101507	2024-06-06	2025-06-05
5	MXG Vector Signal Generator	Agilent	E4438C	MY42081396(6G)	2024-06-06	2025-06-05
6	ESG Vector Signal Generator	Agilent	E4438C	MY49072627(3G)	2024-06-06	2025-06-05
8	Audio Analyzer	R&S	UPV	1146.2003K02-10 1721-UW	2023-10-18 2024-10-08	2024-10-17 2025-10-07
9	EMI Test Software	Farad	EZ	/	N/A	N/A
7	3m Semi Anechoic Chamber	SIDT FRANKONIA	SAC-3M	03CH03-HY	2024-06-06	2025-06-05
10	Positioning Controller	Max-Full	MF7802BS	MF780208586	N/A	N/A
11	Active Loop Antenna	SCHWARZBECK	FMZB 1519B	00005	2024-07-13	2027-07-12
12	By-log Antenna	SCHWARZBECK	VULB9163	9163-470	2024-08-03	2027-08-02
13	Horn Antenna	SCHWARZBECK	BBHA 9120D	9120D-1925	2024-07-13	2027-07-12
14	Broadband Horn Antenna	SCHWARZBECK	BBHA 9170	791	2024-07-13	2027-07-12
15	Broadband Preamplifier	SCHWARZBECK	BBV9719	9719-025	2024-07-30	2025-07-29
16	EMI Test Receiver	R&S	ESR 7	101181	2024-06-06	2025-06-05
17	RS SPECTRUM ANALYZER	R&S	FSP40	100503	2024-06-06	2025-06-05
18	Low-frequency amplifier	SchwarzZBECK	BBV9745	00253	2023-10-18 2024-10-08	2024-10-17 2025-10-07
19	High-frequency amplifier	JS Denki Pte	PA0118-43	JSPA21009	2023-10-18 2024-10-08	2024-10-17 2025-10-07
20	6dB Attenuator	/	100W/6dB	1172040	2024-06-06	2025-06-05
21	3dB Attenuator	/	2N-3dB	/	2023-10-18 2024-10-08	2024-10-17 2025-10-07
22	EMI Test Receiver	R&S	ESPI	101940	2024-06-06	2025-06-05
23	Artificial Mains	R&S	ENV216	101288	2024-06-06	2025-06-05
24	10dB Attenuator	SCHWARZBECK	MTS-IMP-136	261115-001-0032	2024-06-06	2025-06-05
25	EMI Test Software	Farad	EZ	/	N/A	N/A
26	Antenna Mast	Max-Full	MFA-515BSN	1308572	N/A	N/A
27	Pulse Limiter	R&S	ESH3-Z2	102750-NB	2024-06-06	2025-06-05

.....The End of Report.....