Washington Laboratories, Ltd.

FCC Certification Test Report
for the
FM300
FCC ID: JLOFM300

WLL REPORT# **16440-01 Rev 0**
March 2020

Prepared for:

Crown Broadcast a division of International Radio & Electronics Corp (IREC)

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FCC Certification Test Report

For the

INTERNATIONAL RADIO AND ELECTRONICS

FM300

WLL REPORT# **16440-01 Rev 0**

Prepared by:

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CEO

Reviewed by:

Steve Koster

Abstract

This report has been prepared on behalf of Crown Broadcast a division of International Radio & Electronics Corp (IREC) to support the attached Application for Equipment Authorization. The test report and application are submitted for a Licensed Transmitter under Part 73 and 74 of the Federal Communications Commission.

Testing was performed at Washington Laboratories, Ltd, 4340 Winchester Boulevard, Frederick, MD.

These tests are accredited and meet the requirements of ISO/IEC 17025 as verified by the ANAB-ACLASS. Refer to certificate and scope of accreditation AT-1448.

Revision History	Reason	Date
Rev 0	Initial Release	March 9, 2020

Table of Contents

List of Tables

List of Figures

1 Introduction

1.1 Compliance Statement

The FM300 complied with the requirements of Parts 73 and 74 of the FCC Rules and Regulations (2/2020).

1.2 Test Standard

ANSI C63.26-2015 American National Standard for Compliance Testing of Transmitters Used in Licensed Radio Services.

1.3 Contract Information

Purchase Order Number:	#200219-LT1
Quotation Number:	71719

1.4 Test Dates

Testing was performed on the following date(s): 27-28 February 2020, 3 March 2020

1.5 Test and Support Personnel

Washington Laboratories, Ltd.	Michael Violette
Client Representative	Beryl Loomis

1.6 EUT Identification

The results obtained relate only to the item(s) tested.

Table 1: Overview of Equipment Under Test

ITEM	DESCRIPTION
Manufacturer:	International Radio & Electronics Corp (dba) Crown Broadcast
EUT Name	FM300T
FCC ID:	JLO300
FCC Rule Parts:	73, 74
Frequency Range:	87.9-107.9 MHz
Measured Output Power:	330W
Modulation:	FM
Emission Bandwidth:	164kHz
Keying:	Automatic
Type of Information:	Audio
Number of Channels:	100
Antenna Connector	N-Type
Antenna Type	N/A
Antenna Gain	N/A
Frequency Tolerance:	<0.2%
Emission Designator:	1K64F
Interface Cables:	Audio in, SCA in, Monitor out, Composite in, RF Monitor out, Remote I/O, Battery in
Power Source & Voltage:	120VAC

1.7 EUT Description

The FM300 (EUT) is a FM Low Power transmitter for broadcasting in the Low Power FCC rules.

1.8 Test Configuration

The EUT was configured at normal operating power. Measurements were performed on the Left/Mono channel of the unit as the Left/Right channels are identical.

1.9 Equipment Configuration

The EUT was comprised of the following equipment. (All Modules, PCBs, etc. listed were considered as part of the EUT, as tested.)

Table 2: Equipment Configuration

Name / Description	Model Number	Part Number	Serial Number	Revision
FM Transmitter	FM300	--		--

1.10 Support Equipment

The following support equipment was used during testing:

Table 3: Support Equipment

Item	Model/Part Number	Serial Number
None	----	----

1.11 Interface Cables

Table 4: Interface Cables

Ref. ID	Port name on EUT	Cable Description or reason for no cable	Qty.	Length (m)	Shielded?	Termination Box ID & Port ID
1	AC in	AC power	1	1	No	Signal analyzer
2	Audio in	XLR			Y	Signal generator
3	RF Out	Coaxial	1	1	Y	Directional Coupler to Dummy load

1.12 EUT Modifications

None

1.13 Test Location

All measurements herein were performed at Washington Laboratories, Ltd. test center in Frederick, MD. Washington Laboratories, Ltd. has been accepted by the FCC and approved by ANAB under Certificate AT-1448 as an independent FCC test laboratory.

1.14 Measurement Uncertainty

All results reported herein relate only to the equipment tested. The basis for uncertainty calculation uses ANSI/NCSL Z540-2-1997 with a type B evaluation of the standard uncertainty. Elements contributing to the standard uncertainty are combined using the method described in Equation 1 to arrive at the total standard uncertainty. The standard uncertainty is multiplied by the coverage factor to determine the expanded uncertainty which is generally accepted for use in commercial, industrial, and regulatory applications and when health and safety are concerned (see Equation 2). A coverage factor was selected to yield a 95% confidence in the uncertainty estimation.

Equation 1: Standard Uncertainty

$$u_c = \pm\sqrt{\frac{a^2}{{div_a}^2} + \frac{b^2}{{div_b}^2} + \frac{c^2}{{div_c}^2} + \ldots\ldots}$$

where u_c = standard uncertainty

a, b, c,.. = individual uncertainty elements

$div_{a,\,b,\,c}$ = the individual uncertainty element divisor based on the probability distribution

divisor = 1.732 for rectangular distribution

divisor = 2 for normal distribution

divisor = 1.414 for trapezoid distribution

Equation 2: Expanded Uncertainty

$$U = ku_c$$

where U = expanded uncertainty

k = coverage factor

$k \leq 2$ for 95% coverage (ANSI/NCSL Z540-2 Annex G)

u_c = standard uncertainty

The measurement uncertainty complies with the maximum allowed uncertainty from CISPR 16-4-2. Measurement uncertainty is not used to adjust the measurements to determine compliance. The expanded uncertainty values for the various scopes in the WLL accreditation are provided in Table 5 below.

Table 5: Expanded Uncertainty List

Scope	Standard(s)	Expanded Uncertainty
Conducted Emissions	FCC Part 15	2.63 dB
Radiated Emissions	FCC Part 15	4.55 dB

2 Test Equipment

Asset #	Manufacturer/Model	Description	Cal. Due
528	Agilent E4446A	Spectrum Analyzer	02/21/2021
735	Hewlett Packard	8920 RF Communications Test Set	02/28/2021
859	Tektronix TBS1102B	Oscilloscope	09/24/2020
NA	Werlatone	High power directional coupler	CNR
599	Tenney	Temperature Chamber	10/7/20
NA	Keysight MXA	Spectrum Analyzer	6/21/2020
00382	SUNOL SCIENCES CORPORATION	JB1	3/21/2020
00823	AGILENT	N9010A	3/21/2020
00558	HP	8447D	4/3/2020
00075	HP	8648C	3/23/2020
00644	SUNOL SCIENCES CORPORATION	JB1 925-833-9936	4/16/2020

3 Test Summar

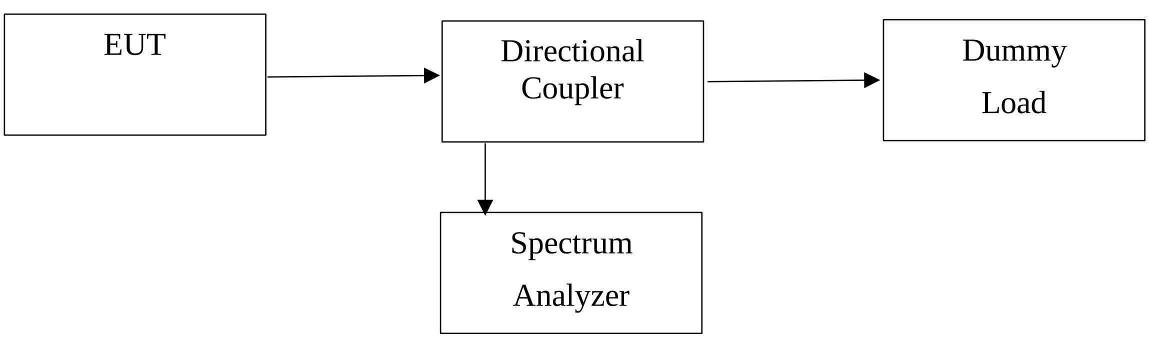
Test	Regulation	Measurement standard	Result
RF Output Power	Part 2.1046, Part 73.267	ANSI C63.26	Complies
Modulation Characteristics	Part 2.1047	ANSI C63.26	Complies
Emission Mask	Part 2.1049, Part 73.317	ANSI C63.26	Complies
Conducted Spurious Emissions (Antenna Terminal)	Part 2.1051	ANSI C63.26	Complies
Frequency Stability	Part 2.1055, Part 73.1545	ANSI C63.26	Complies
Radiated spurious emissions (Cabinet radiation)	Part2.1053	ANSI 63.26	Complies

3.1 Output Power Part 2.1046, Part 73.267

3.1.1 Test Method

To measure the total power the output of the transmitter was connected via a directional coupler to a dummy load. The RF forward power from the directional coupler was input to a spectrum analyzer. The directional coupler factor was applied as an amplitude correction factor to the spectrum analyzer.

Figure 1. Test Setup Conducted Power Measurements



3.1.2 Test Results

Frequency MHz	Power Watts
87.9	328.6
97.9	331.3
107.9	330.2

3.2 Modulation Characteristics, Part 2.1047

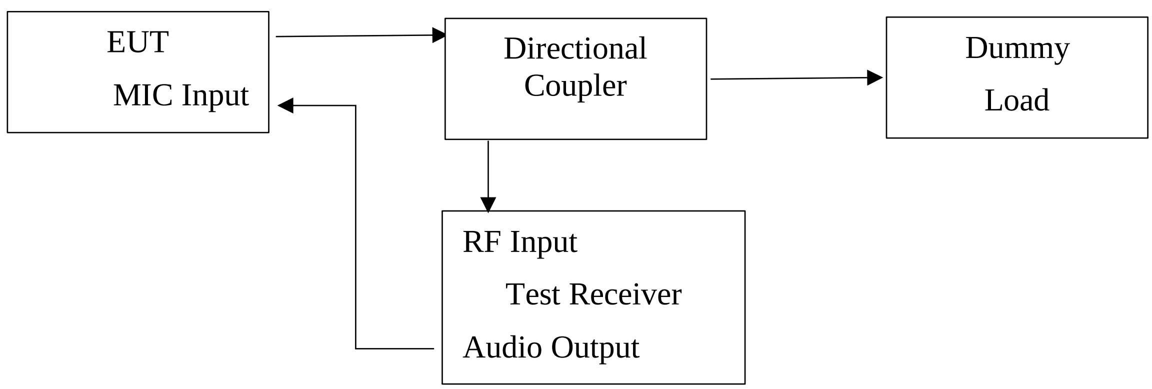
(a) *Voice modulated communication equipment.* A curve or equivalent data showing the frequency response of the audio modulating circuit over a range of 100 to 5000 Hz shall be submitted. For equipment required to have an audio low-pass filter, a curve showing the frequency response of the filter, or of all circuitry installed between the modulation limiter and the modulated stage shall be submitted.

3.2.1 Modulation Limiting

3.2.1.1 Test Method

To measure the modulation limiting the output of the transmitter was connected via a directional coupler to a dummy load. The RF forward power from the directional coupler was input to a test receiver. The modulation characteristics (peak positive, peak negative and peak positive-negative deviation) were plotted as a function of input power to the microphone.

Figure 2. Test Setup Modulation Characteristics



3.2.1.2 Test Results

The test results are provided in the following figures.

Figure 3. Peak Positive Deviation

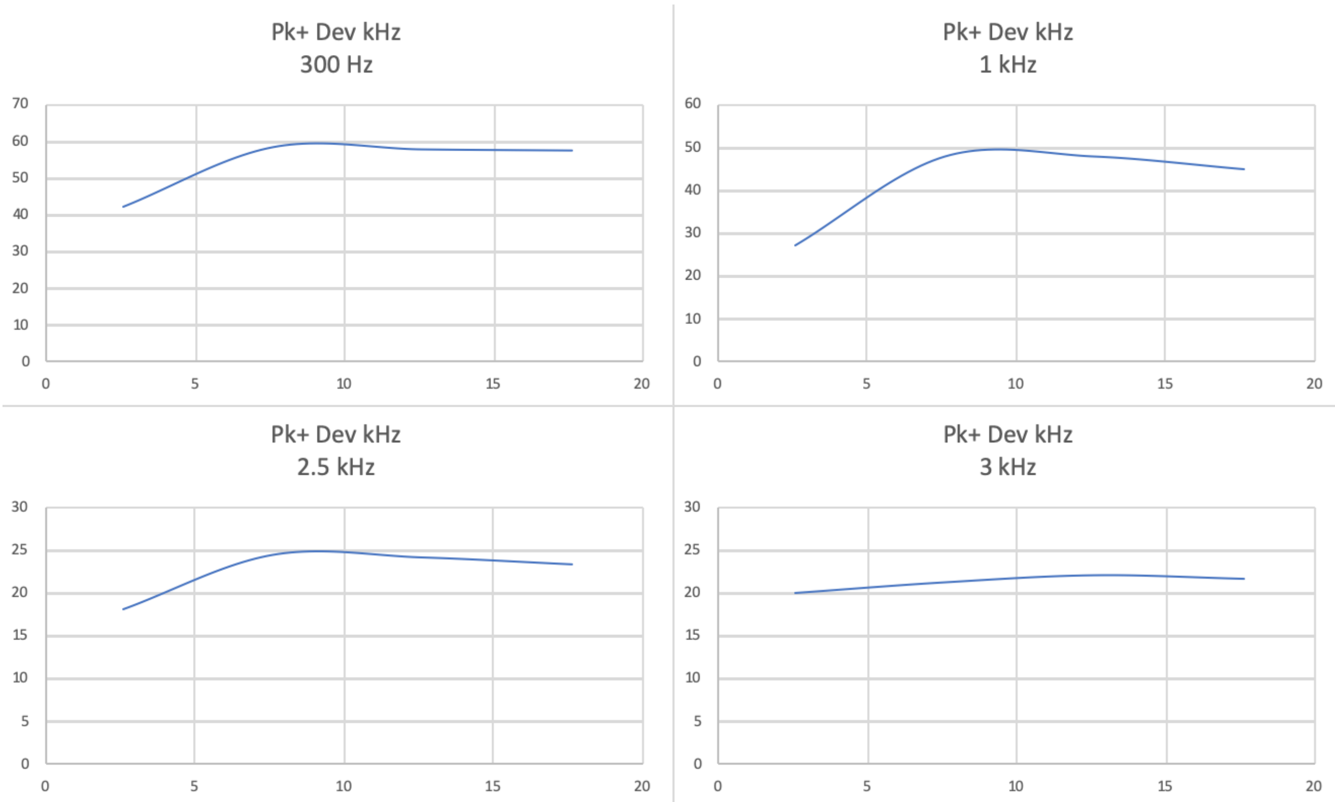


Figure 4. Peak Negative Deviation

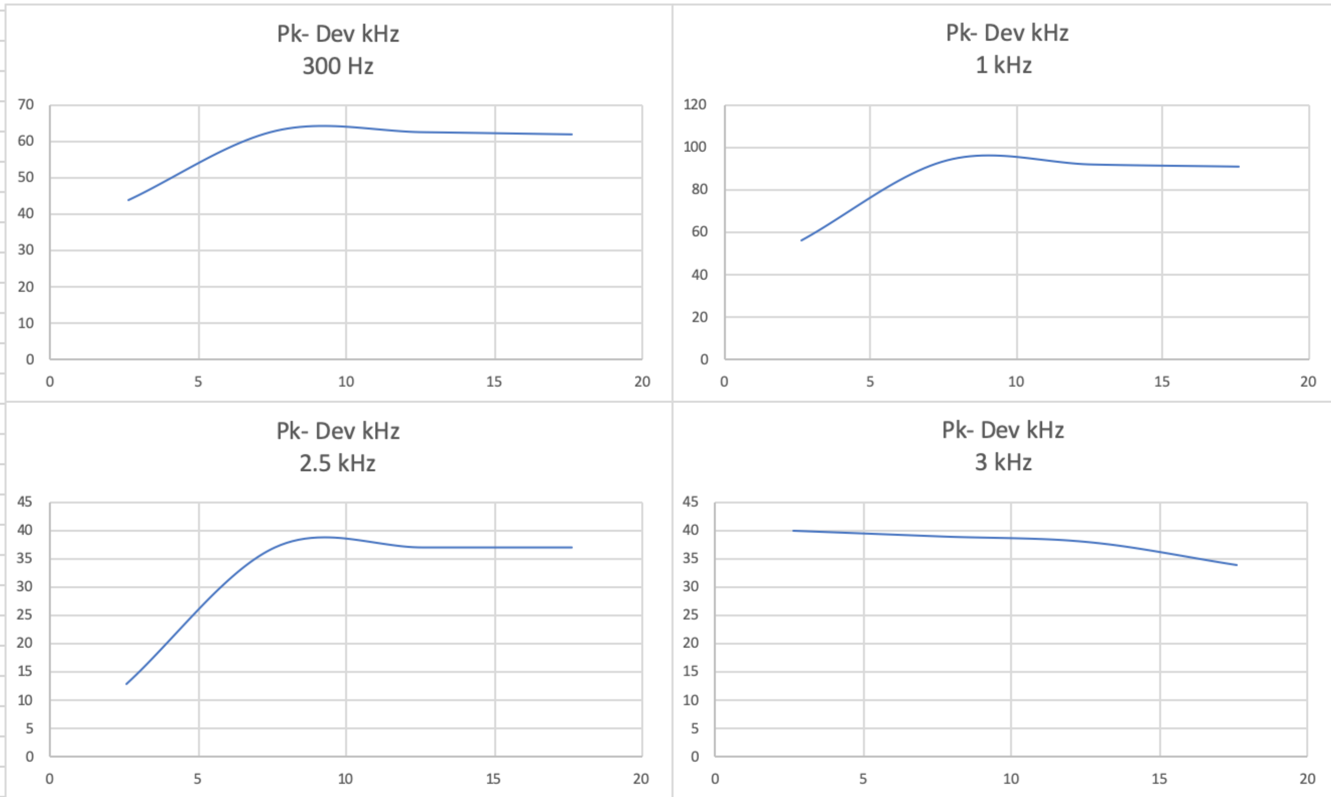
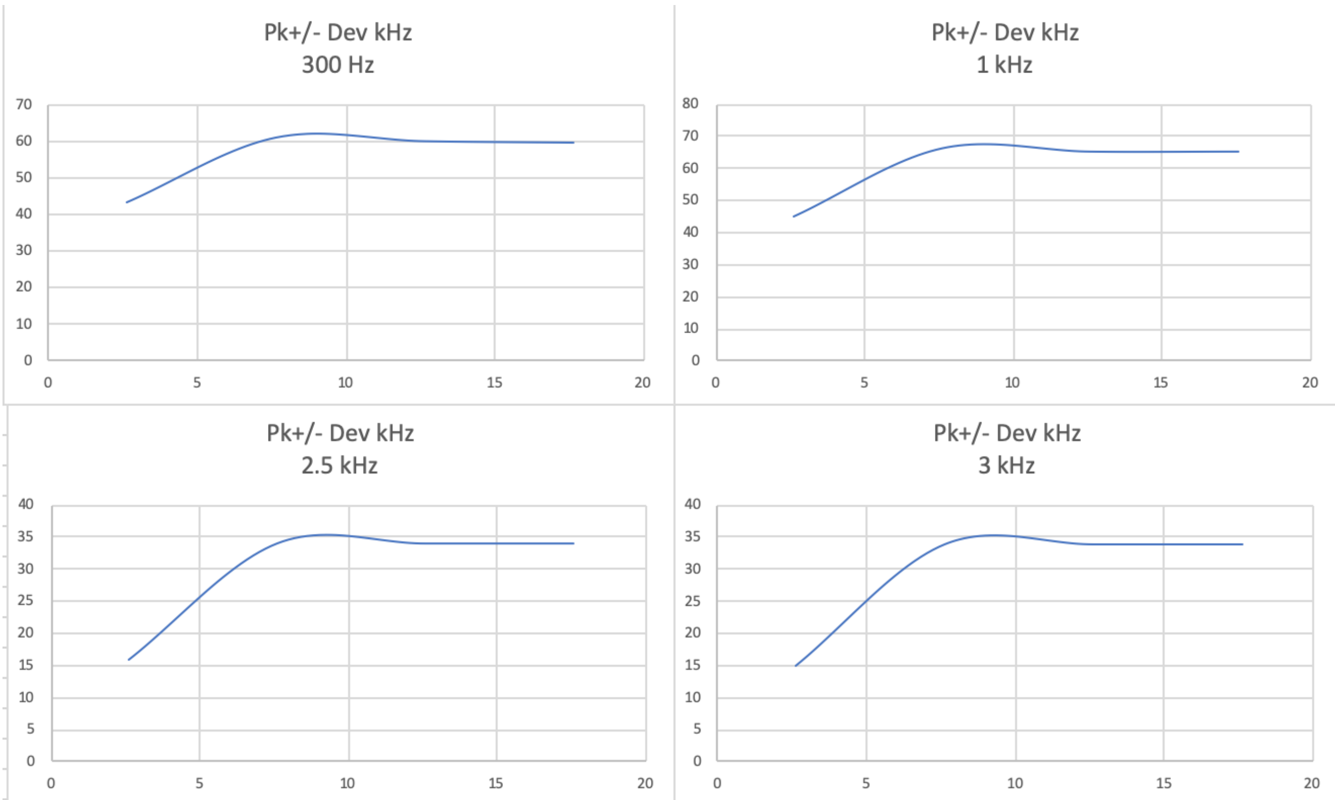


Figure 5. Peak Positive/Negative Deviation



3.2.2 Audio Frequency Response

3.2.2.1 Test Method

The modulation characteristics were performed per Section 5.3.3 of ANSI C63.26. The frequency was stepped from 10Hz to 5 kHz the result is in the following Figure.

3.2.2.2 Test Result

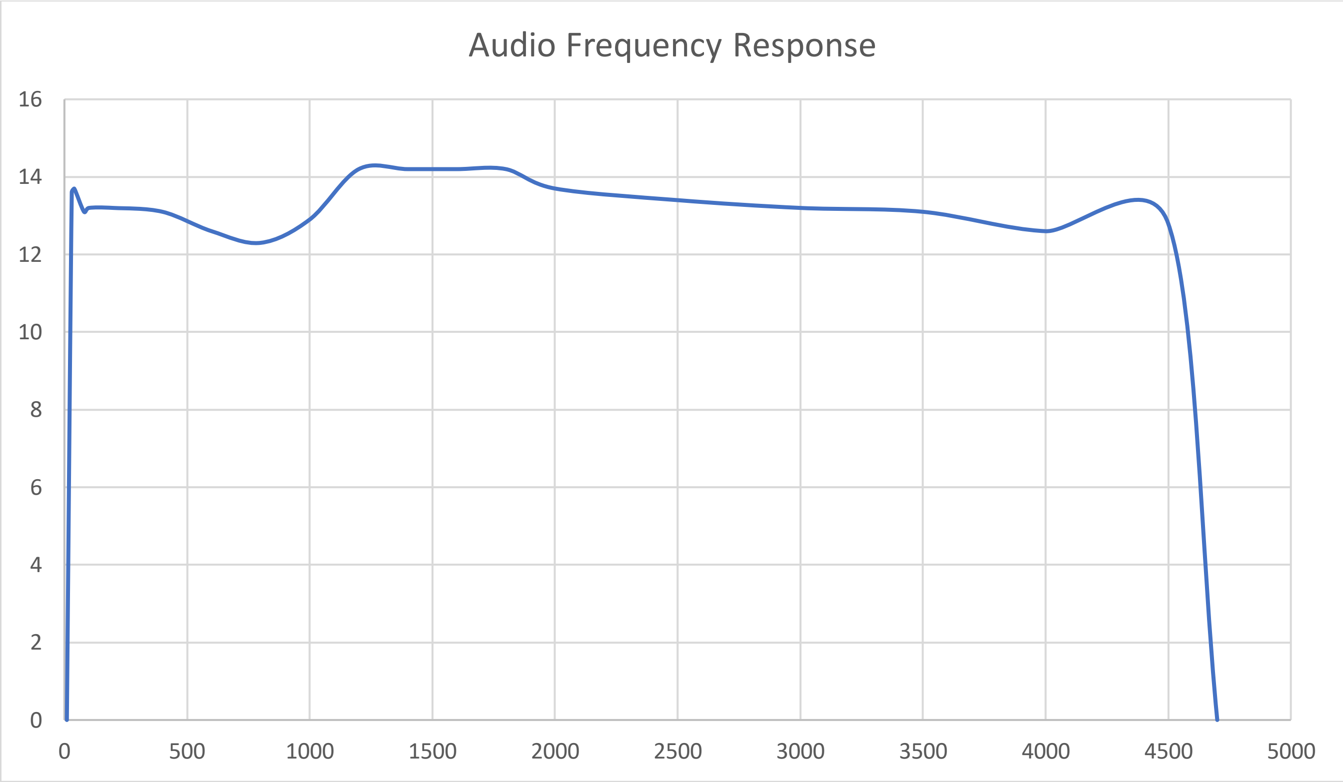


Figure 6. Audio Frequency Response

3.3 Emission Mask, Part 2.1049, Part 73.317

§73.317 FM transmission system requirements.

(a) FM broadcast stations employing transmitters authorized after January 1, 1960, must maintain the bandwidth occupied by their emissions in accordance with the specification detailed below. FM broadcast stations employing transmitters installed or type accepted before January 1, 1960, must achieve the highest degree of compliance with these specifications practicable with their existing equipment. In either case, should harmful interference to other authorized stations occur, the licensee shall correct the problem promptly or cease operation.

(b) Any emission appearing on a frequency removed from the carrier by between 120 kHz and 240 kHz inclusive must be attenuated at least 25 dB below the level of the unmodulated carrier. Compliance with this requirement will be deemed to show the occupied bandwidth to be 240 kHz or less.

(c) Any emission appearing on a frequency removed from the carrier by more than 240 kHz and up to and including 600 kHz must be attenuated at least 35 dB below the level of the unmodulated carrier.

(d) Any emission appearing on a frequency removed from the carrier by more than 600 kHz must be attenuated at least 43 + 10 Log10 (Power, in watts) dB below the level of the unmodulated carrier, or 80 dB, whichever is the lesser attenuation.

3.3.1 Test Method

The transmitter was modulated at the following frequencies per ANSI C63.26: 400 Hz, 1 kHz and 15 kHz. The masks were plotted against the modulated carriers at the high, middle and low channels of the transmitter.

3.3.2 Test Result

The following figures show the mask for the various modulations and channels.

Figure 7. Unmodulated Carrier

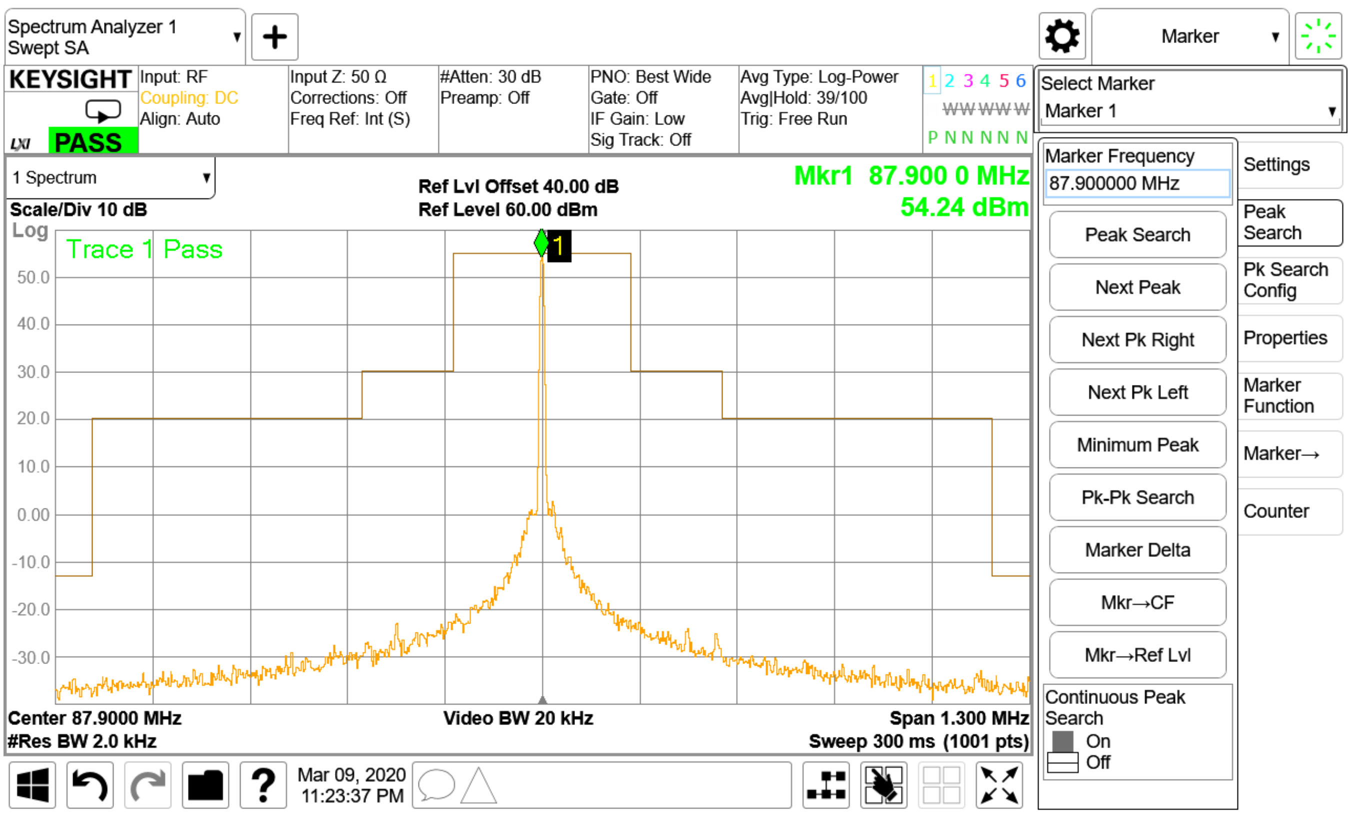


Figure 8. Mask Low Channel 400Hz

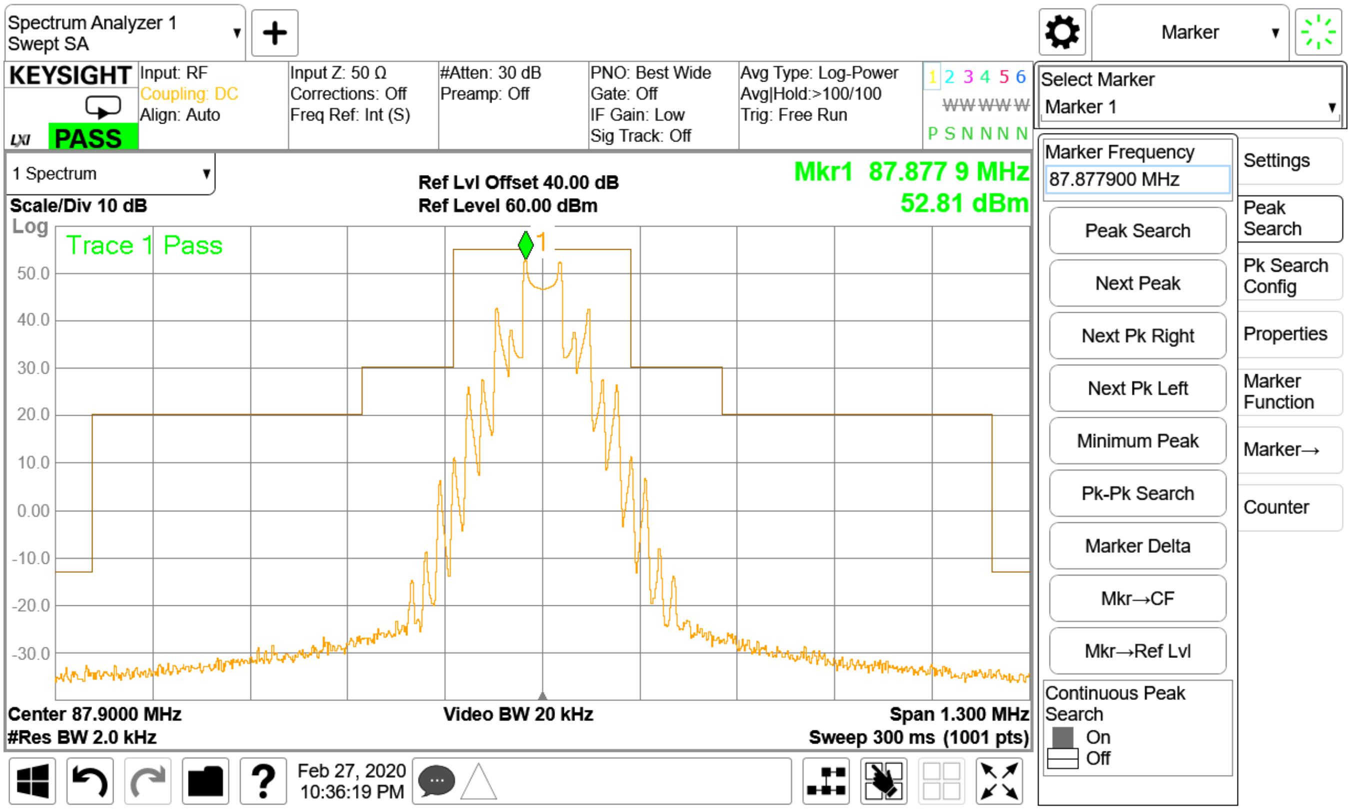


Figure 9. Mask Low Channel 1kHz

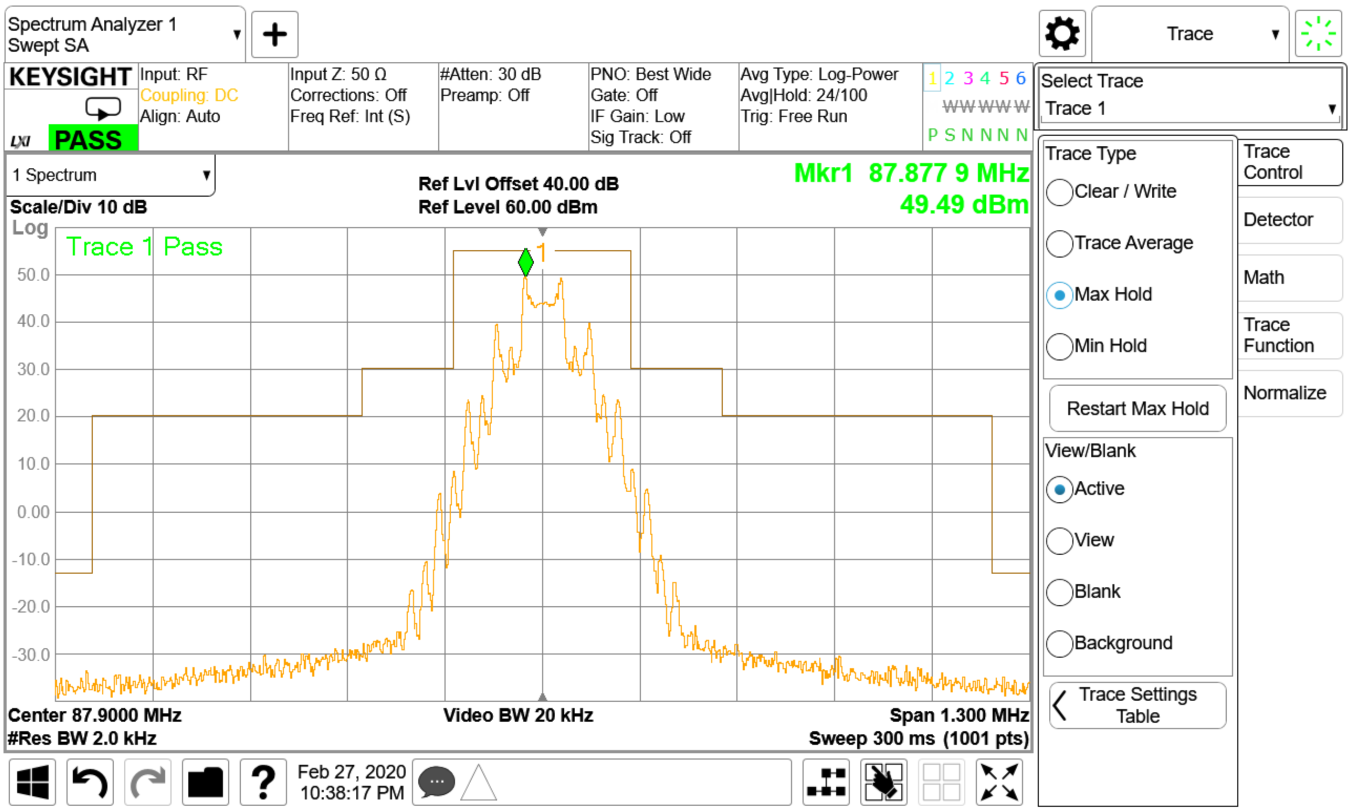


Figure 10. Mask Low Channel 15kHz

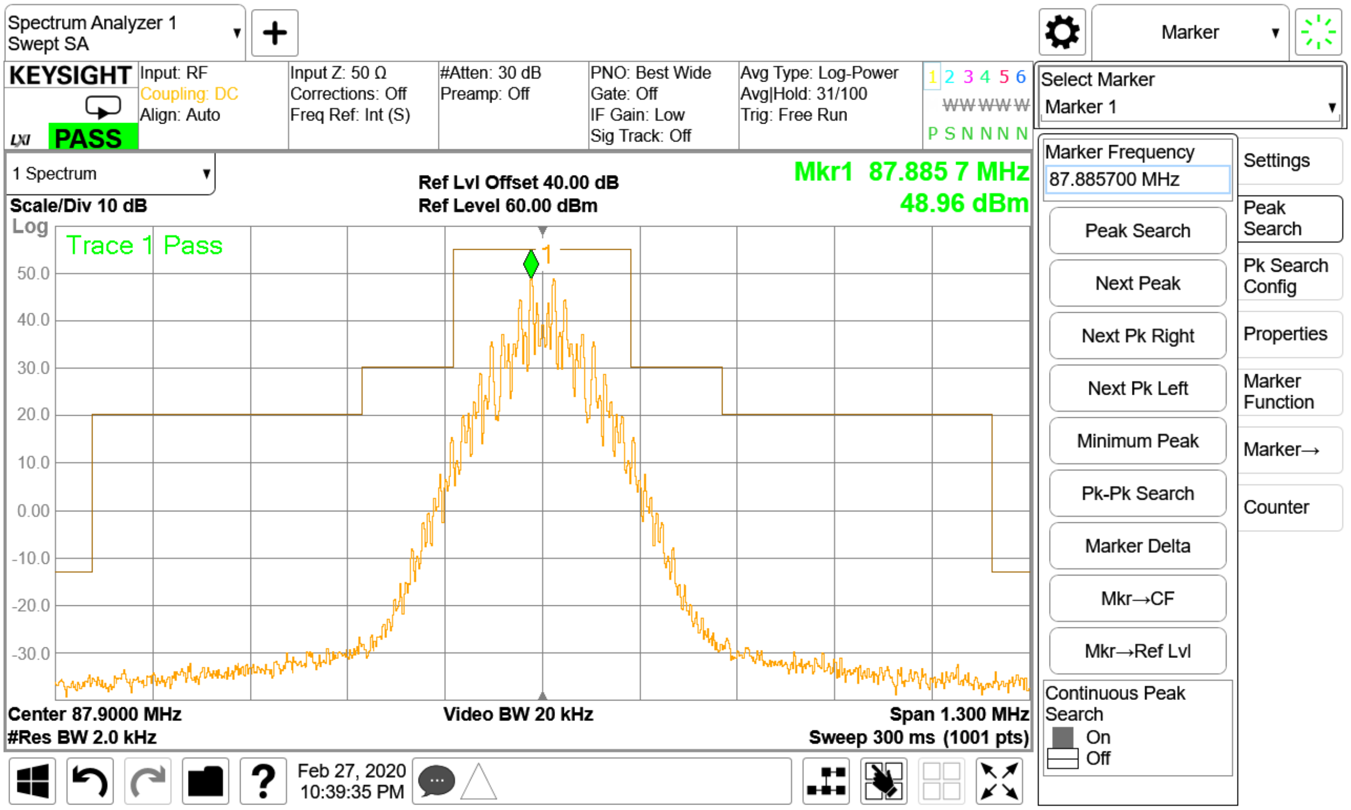


Figure 11. Mask Mid Channel 400Hz

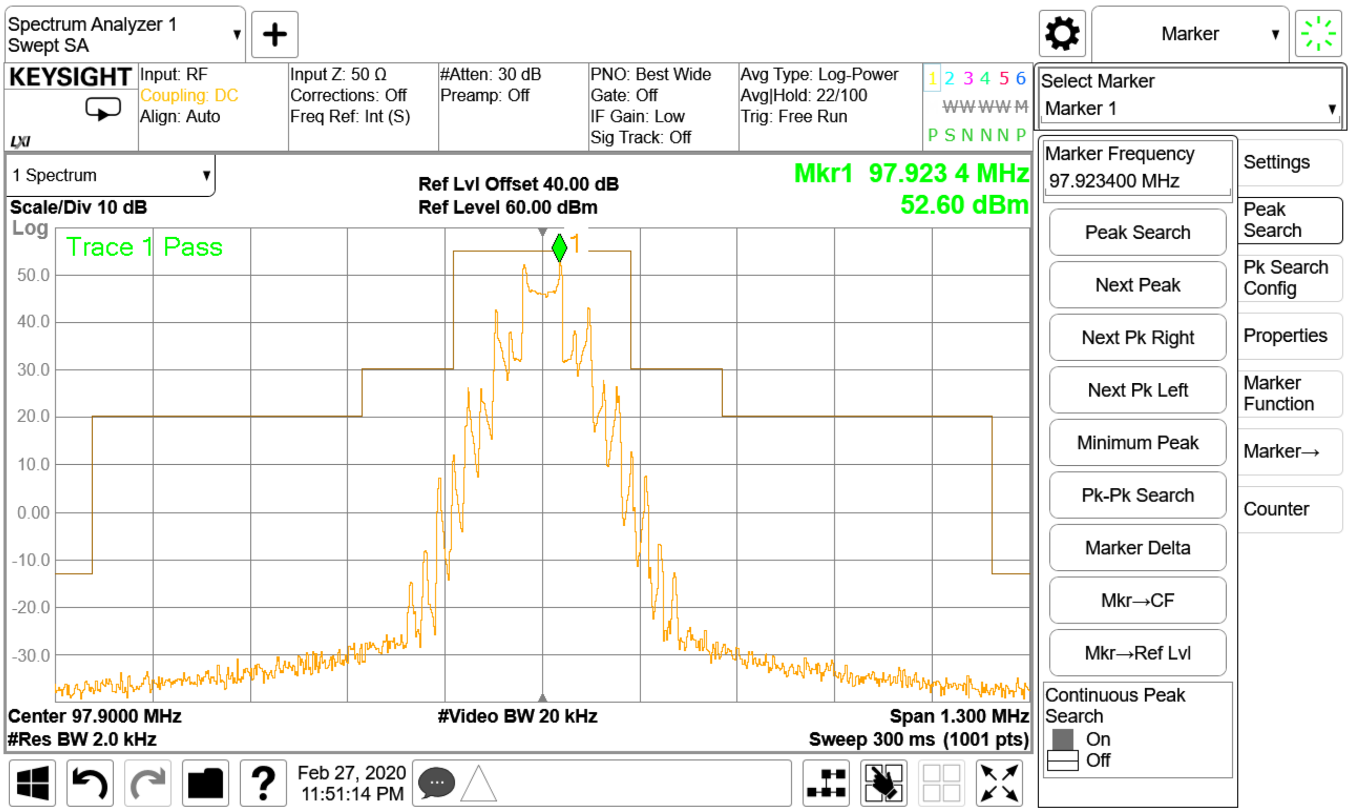


Figure 12. Mask Mid Channel 1kHz

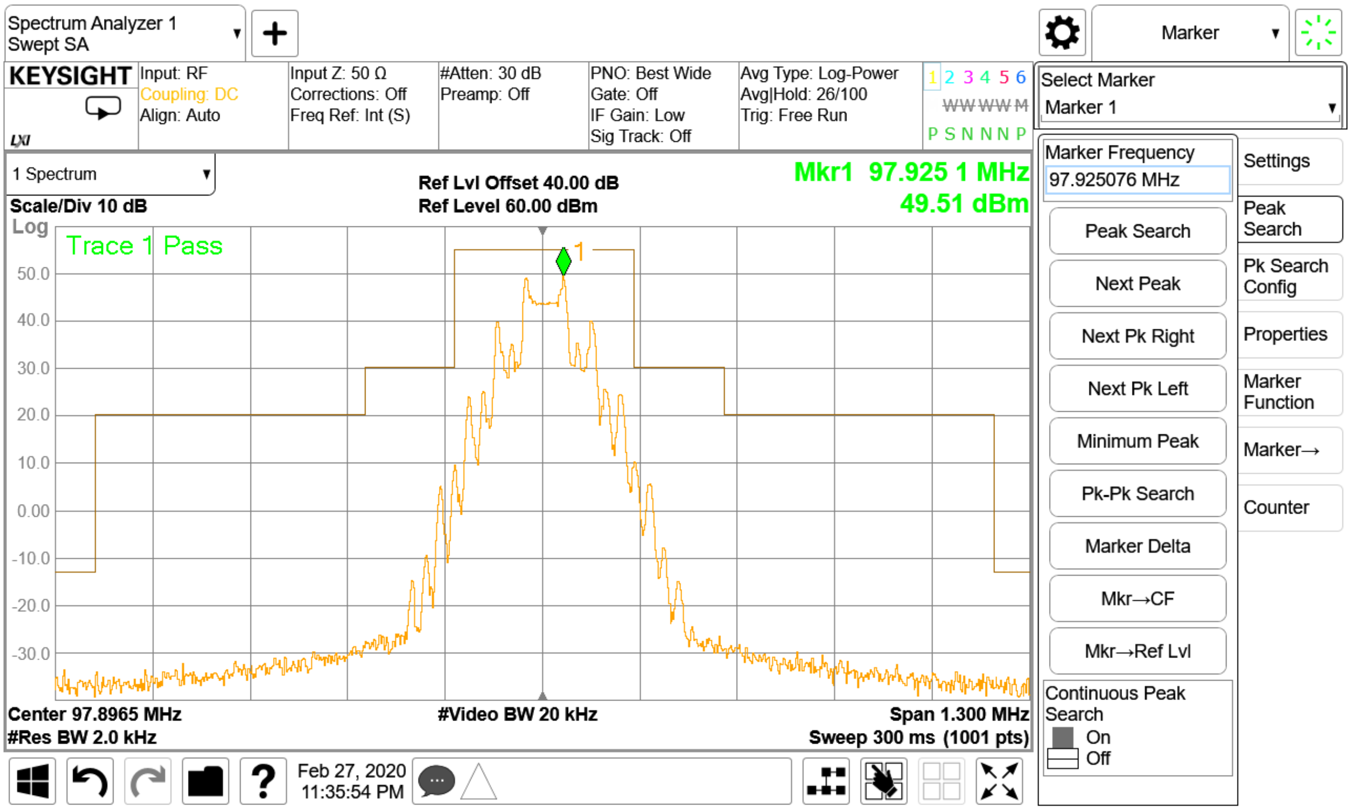


Figure 13. Mask Mid Channel 15

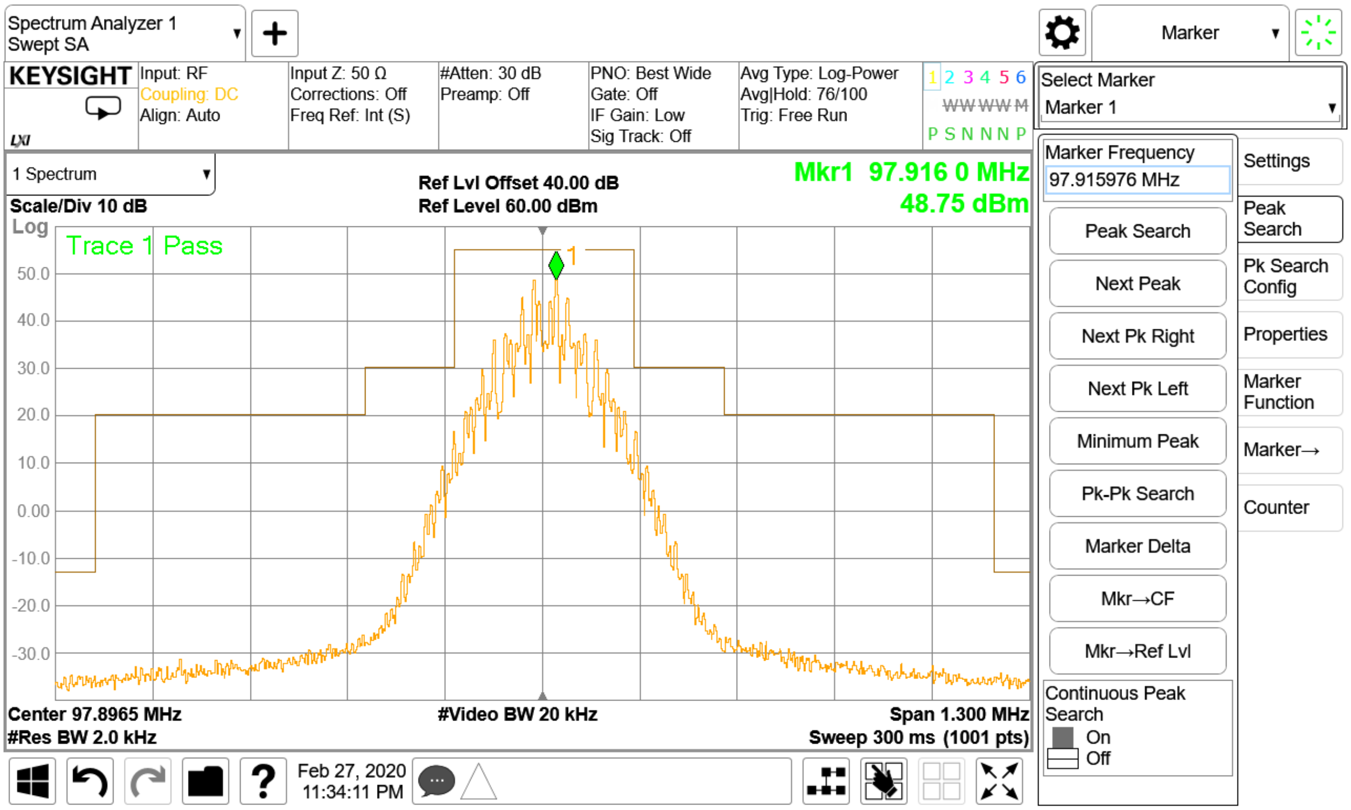


Figure 14. Mask Hi Channel 400Hz

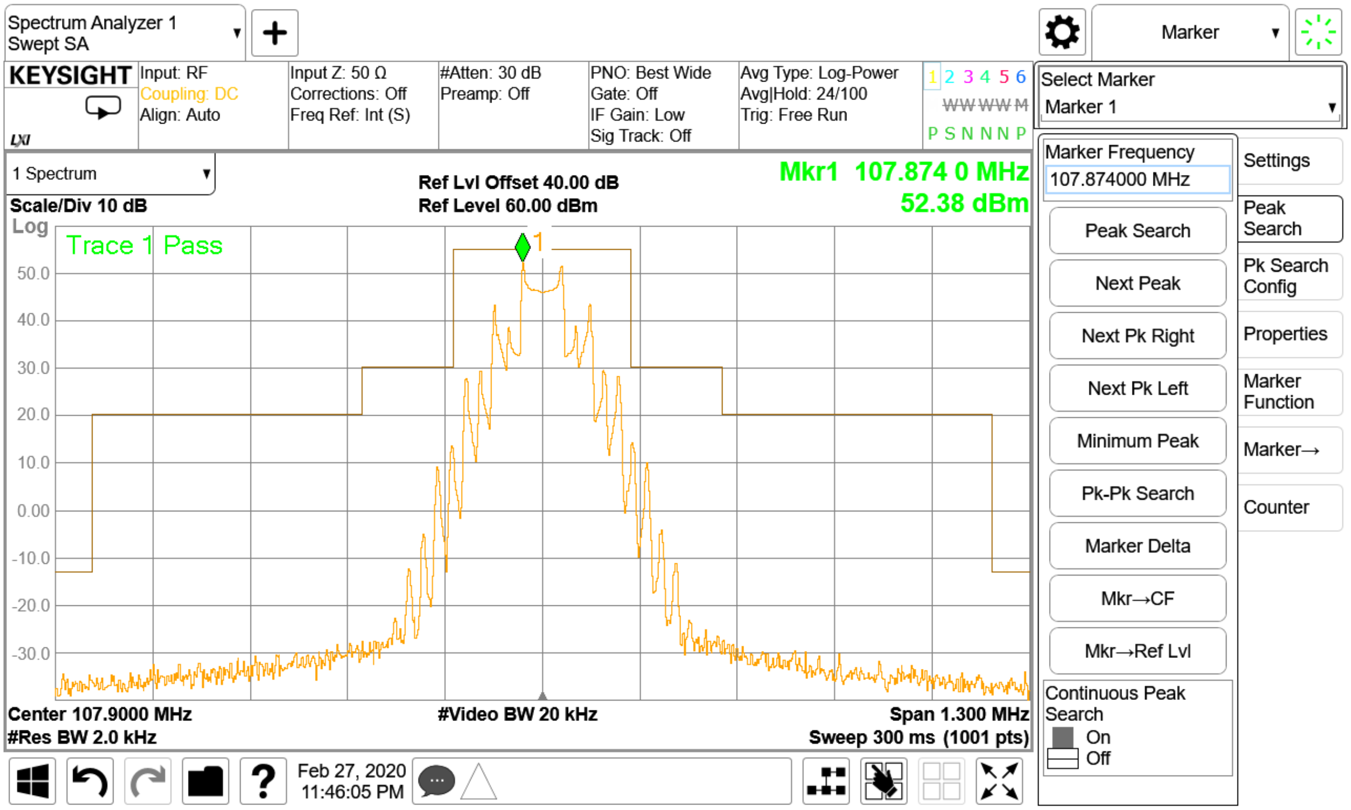


Figure 15. Mask Hi Channel 1kHz

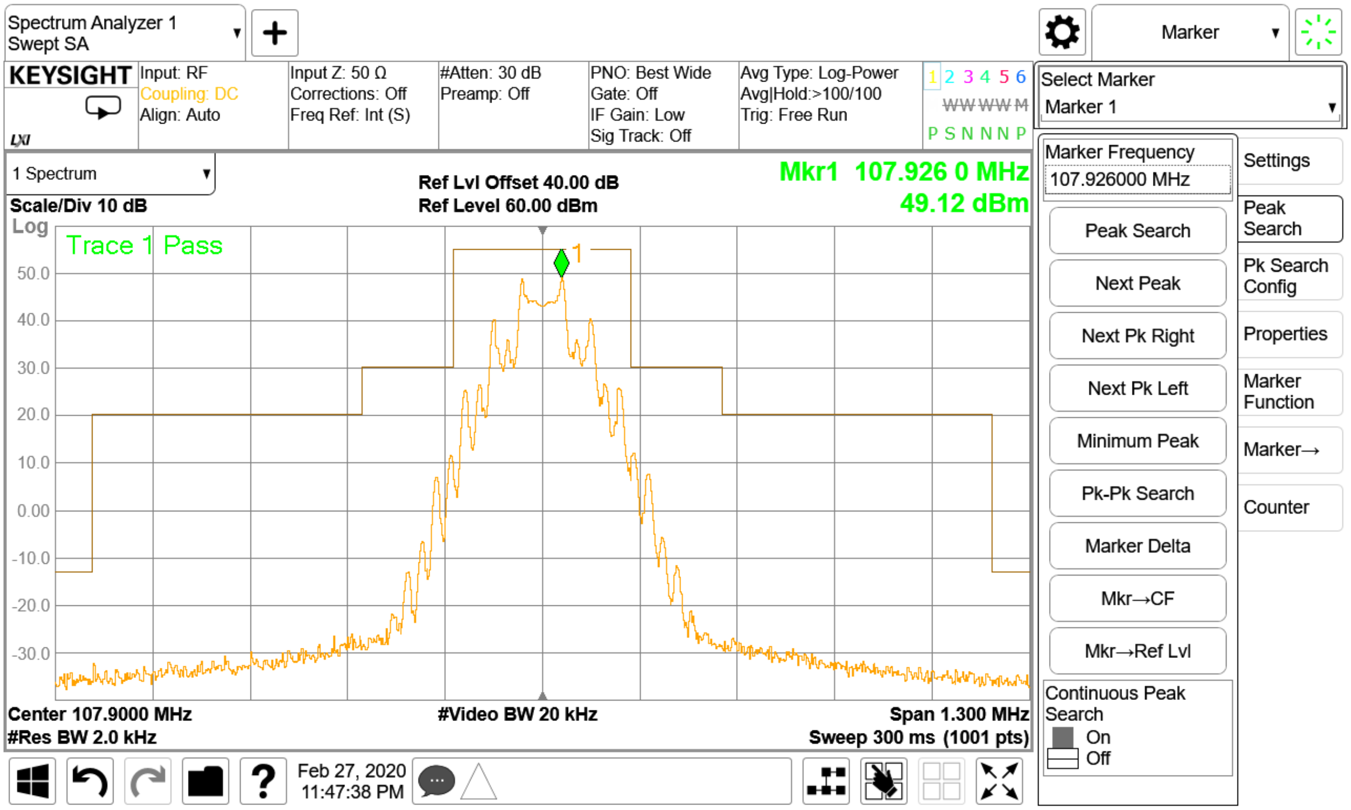
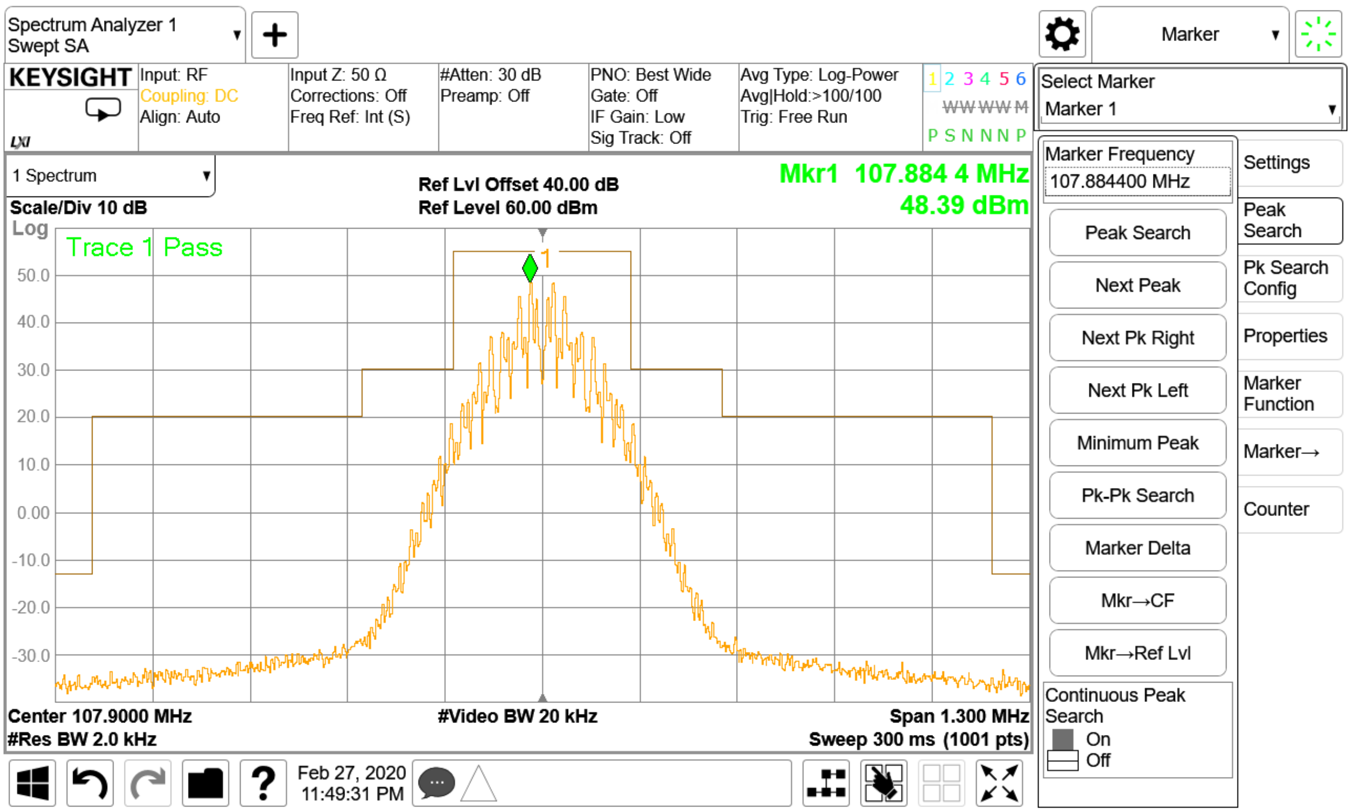


Figure 16. Mask Hi Channel 15



3.4 Conducted Spurious Emissions (Antenna Terminal), Part 2.1051

3.4.1 Test Method

The output of the EUT was connected through a series of high power attenuators. The output of the attenuators was connected to the input of the spectrum analyzer. The conducted spurious emissions were measured from 9kHz to 1100 MHz.

3.4.2 Test Result

The results are provided in the following figures.

Figure 17. Spurs Low Channel

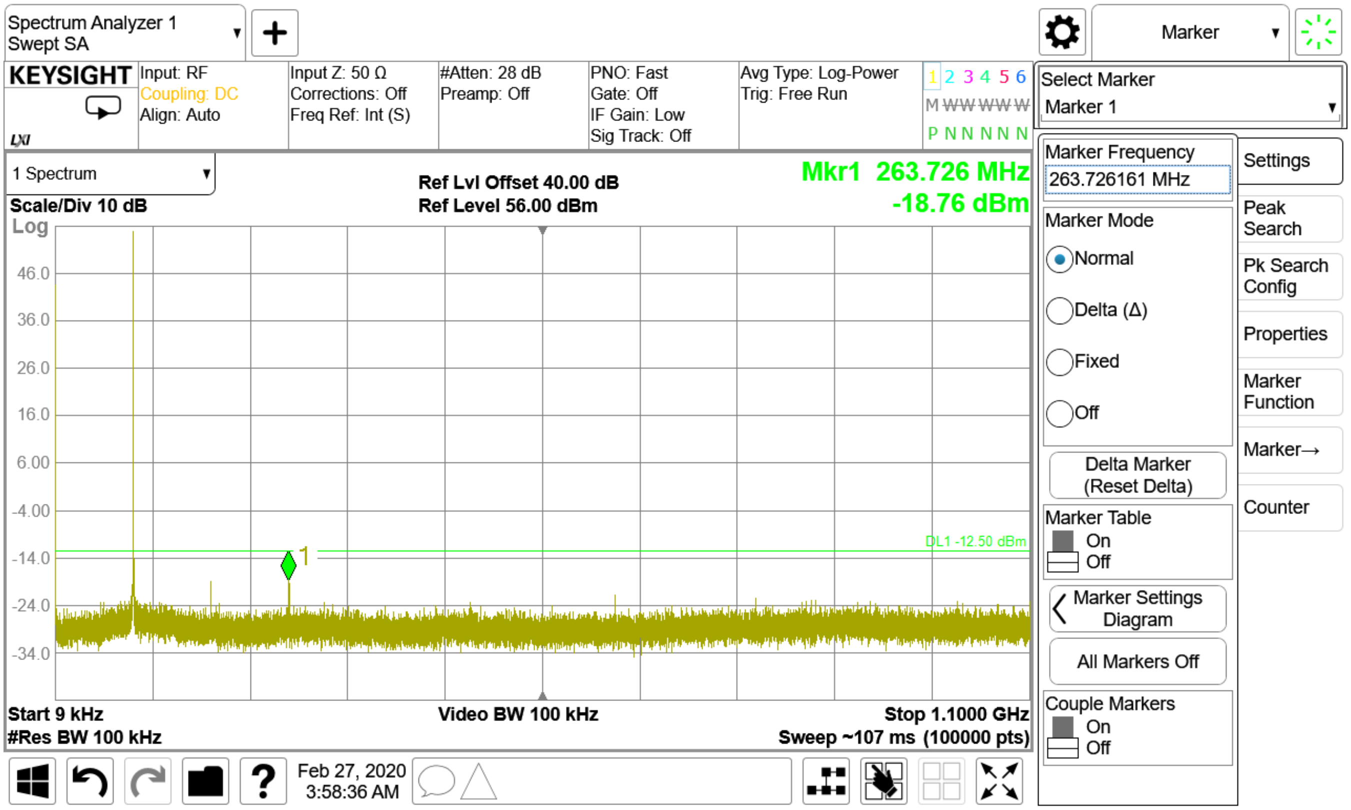


Figure 18. Spurs Mid Channel

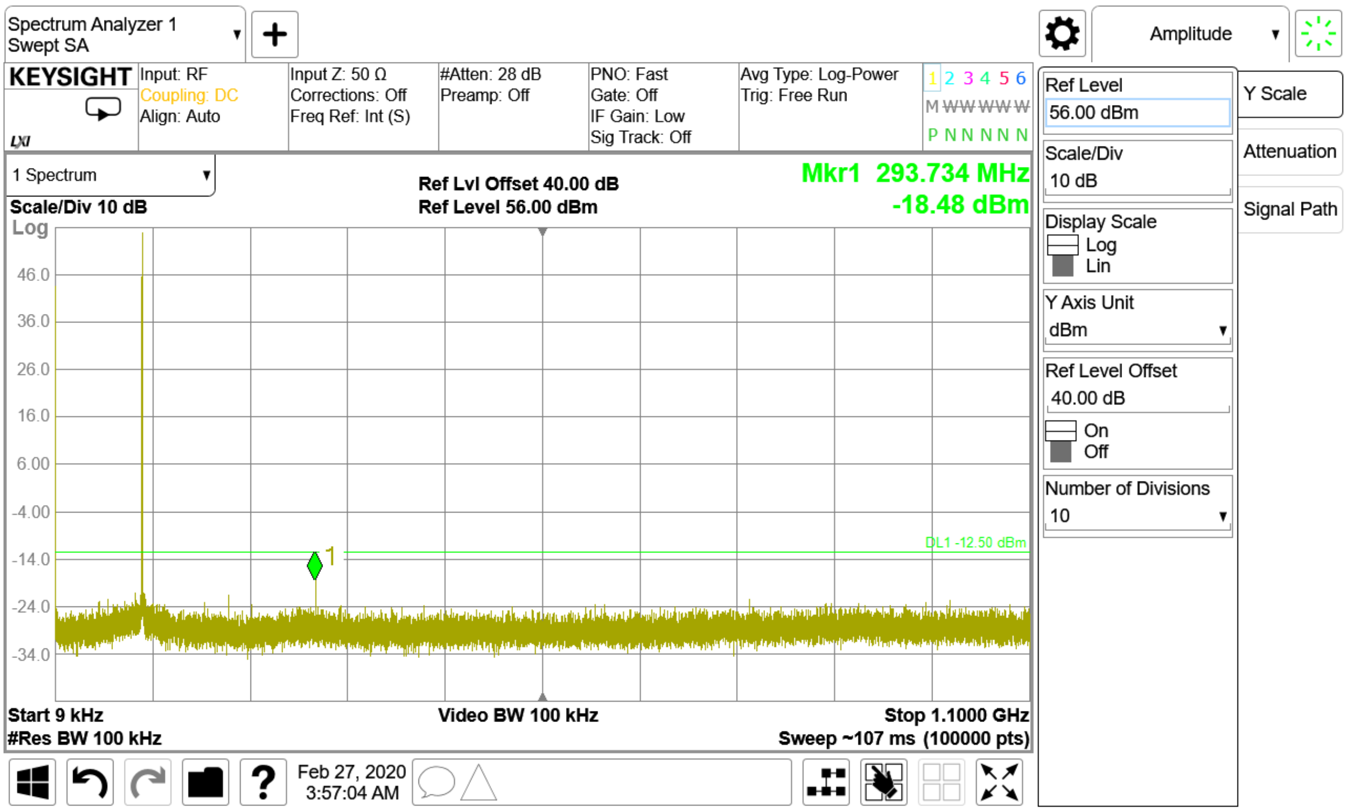
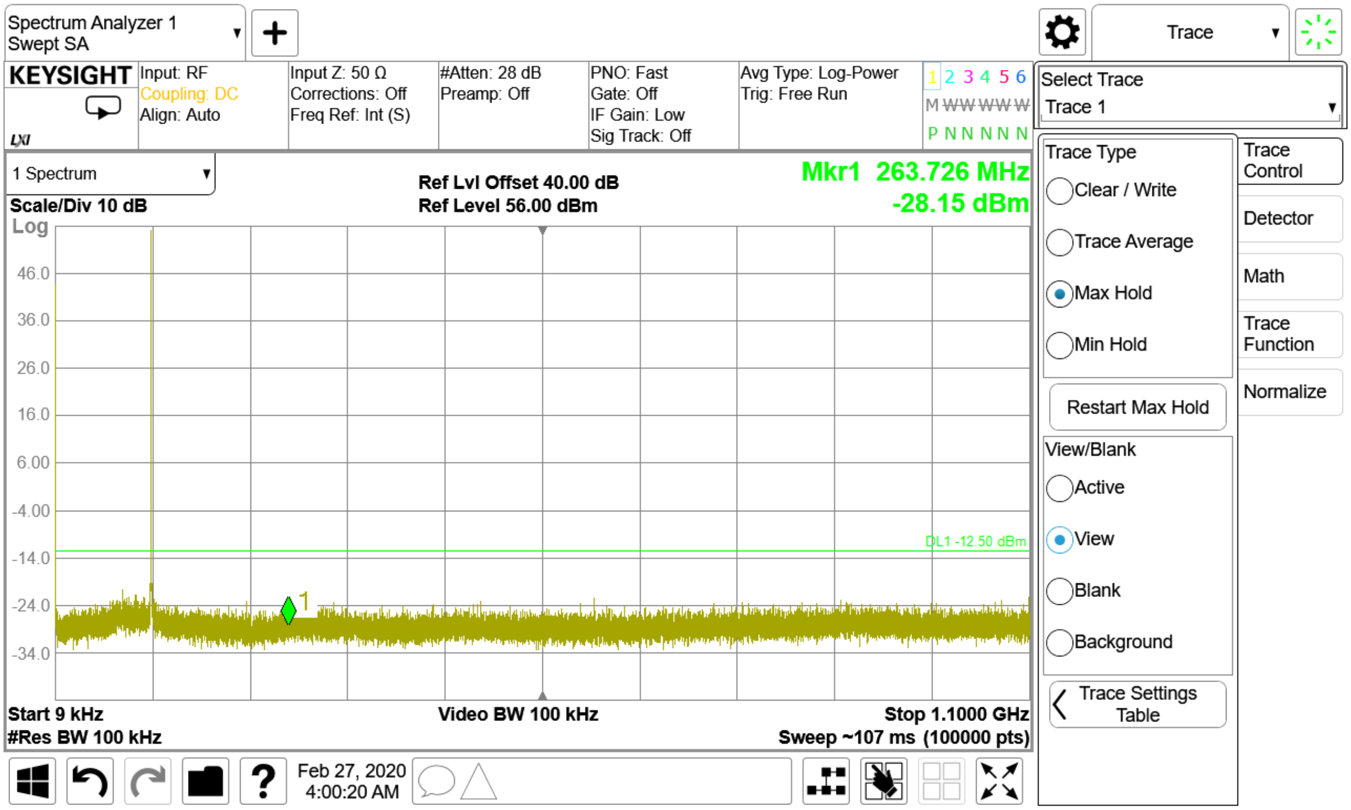


Figure 19. Spurs High Channel



3.5 Frequency Stability, Part 2.1055, Part 73.1545

Per §73.1545 Carrier frequency departure tolerances (b) *FM stations.* (1) The departure of the carrier or center frequency of an FM station with an authorized transmitter output power more than 10 watts may not exceed ±2000 Hz from the assigned frequency.

3.5.1 Stability vs Voltage

3.5.1.1 Test Method

A variac was used to vary the voltage on the 120VAC input while the transmitter was connected to the input of the spectrum analyzer. The frequency was measured at each of the +/- 15% of the nominal input voltage.

3.5.1.2 Test Result

Voltage	Frequency (MHz)	Deviation (Hz)	Limit (+/- Hz)	Pass/Fail
Nominal Voltage (120VAC)	97.899909	0	2000	**NA**
115% of Nominal Voltage (132 VAC)	97.900182	273	2000	Pass
85% of Nominal Voltage (102 VAC)	97.900000	91	2000	Pass

3.5.2 Stability vs Temperature

3.5.2.1 Test Method

The EUT was placed in a calibrated temperature chamber with the dummy load located outside the chamber. A receive near field probe was placed along the dummy load to send the RF signal.

The EUT was set to transmit at 97.9MHz with an unmodulated carrier.

A frequency reading was taken with the temperature at ambient (22C). The EUT was turned off and the temperature chamber set to -30 Celsius after 1 hour at this temperature the unit was turned on and a frequency reading was taken. The unit was turned back off and the temperature changed to -20 C. This process was repeated in 10 degree increments up to 50 Degrees Celsius allowing the unit to stabilize for 1 hour at each level before turning on the unit and recording the frequency. At each level the frequency recorded was compared to the ambient reading with the amount of deviation in Hz compared to the limit.

3.5.2.2 Test Result

Table 6. Frequency Stability vs Temperature

Temperature (C)	Frequency (MHz)	Deviation (Hz)	Limit (+/- Hz)	Pass/Fail
22 (ambient)	97.899920	0	2000	**NA**
-30	97.900018	98	2000	Pass
-20	97.900020	100	2000	Pass
-10	97.900027	107	2000	Pass
0	97.900390	470	2000	Pass

10	97.900300	380	2000	Pass
20	97.900270	350	2000	Pass
30	97.900380	460	2000	Pass
40	97.899940	20	2000	Pass
50	97.900060	140	2000	Pass

3.6 Radiated spurious emissions (Cabinet radiation), Part2.1053

3.6.1 Test Method

The test method of Section 5.5.3 of ANSI C63.26 was performed. The unit was put on an Open Area Test Site and connected to a dummy load. The peak measurements of the spurious emissions were determined at a distance of 3 meters. The unit was removed from the site and replaced with an antenna with known gain characteristics. A signal generator was connected to the transmit antenna and the level adjusted until the same reading was obtained on the receive antenna. At each frequency, the measurement of the signal generator was verified. The effective radiated isotropic power was determined by the following formula:

EIRP dBm = Substitution power + Antenna gain

3.6.2 Test Result

The results are found in the following table:

Table 7. Spurious Emissions Cabinet Radiation

Freq (MHz)	Pol	Az	Ant. Ht m	Spur Level dBuV	Sub Sig. Gen dBm	Sub Power dBm	Sub Ant Gain dB	EIRP dBm	Limit dBm	Mrgn dB
97.90	V	90.0	4.0	64.3	-11.3	-28.2	0.6	-27.6	-13.0	-14.6
195.80	V	350.0	1.0	49.8	-25.3	-41.9	4.4	-37.6	-13.0	-24.6
293.70	V	90.0	1.0	37.5	-40.9	-55.1	6.3	-48.8	-13.0	-35.8
391.61	V	180.0	1.0	44.6	-41.9	-53.5	6.9	-46.6	-13.0	-33.6
489.50	V	180.0	1.0	36.9	-50.0	-60.2	6.4	-53.8	-13.0	-40.8
587.40	V	80.0	1.0	39.6	-45.8	-55.3	6.9	-48.4	-13.0	-35.4
685.31	V	80.0	1.0	47.1	-33.2	-42.8	7.1	-35.6	-13.0	-22.6
783.21	V	90.0	1.0	47.7	-36.9	-44.3	7.3	-37.0	-13.0	-24.0
881.11	V	90.0	1.0	47.2	-37.9	-44.5	7.1	-37.4	-13.0	-24.4
979.00	V	180.0	1.0	50.6	-29.1	-35.8	7.4	-28.3	-13.0	-15.3
97.90	H	180.0	2.7	71.9	-9.9	-26.9	0.6	-26.3	-13.0	-13.3
195.80	H	95.0	1.0	46.8	-39.0	-55.7	4.4	-51.4	-13.0	-38.4
293.70	H	95.0	1.0	36.7	-52.3	-66.5	6.3	-60.2	-13.0	-47.2
391.61	H	185.0	1.0	50.5	-33.1	-44.8	6.9	-37.9	-13.0	-24.9
489.50	H	180.0	4.0	35.2	-48.7	-58.9	6.4	-52.5	-13.0	-39.5
587.42	H	246.0	3.0	43.7	-42.3	-52.0	6.9	-45.1	-13.0	-32.1
685.30	H	214.0	1.0	51.1	-35.1	-44.7	7.1	-37.6	-13.0	-24.6
783.21	H	195.0	1.0	50.8	-31.6	-39.1	7.3	-31.8	-13.0	-18.8
881.11	H	90.0	2.0	49.1	-26.4	-32.9	7.1	-25.8	-13.0	-12.8
979.00	H	350.0	4.0	52.8	-24.8	-31.6	7.4	-24.1	-13.0	-11.1

3.7 Occupied Bandwidth

3.7.1 Test Method

The unit was set up as in Figure 1 and measurements of the -20 dBc measurements were made at 400 Hz, 1 kHz and 15 kHz.

3.7.2 Test Result

The results in in the following figures.

Figure 20. OBW Low Channel 400Hz

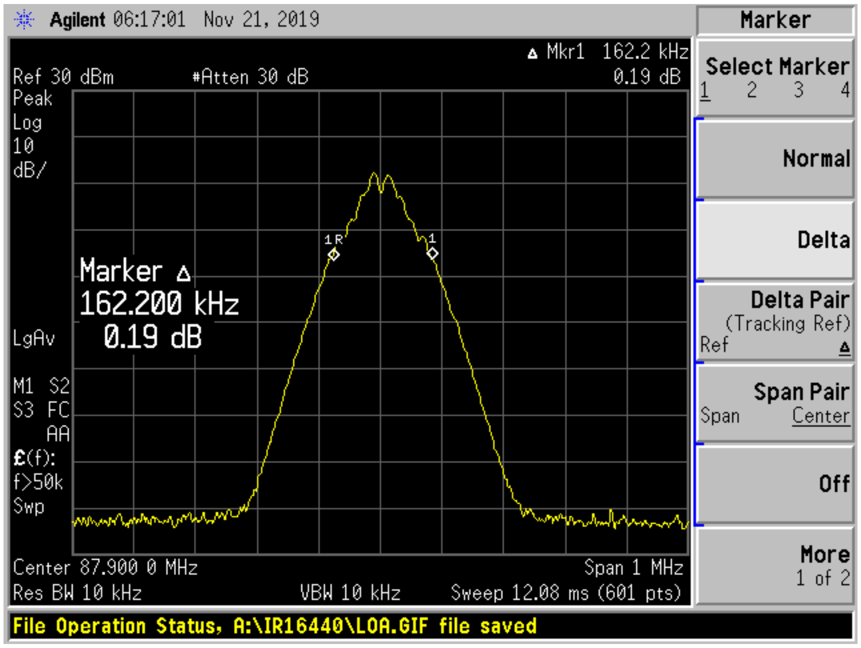


Figure 21. OBW Low Channel 1kHz

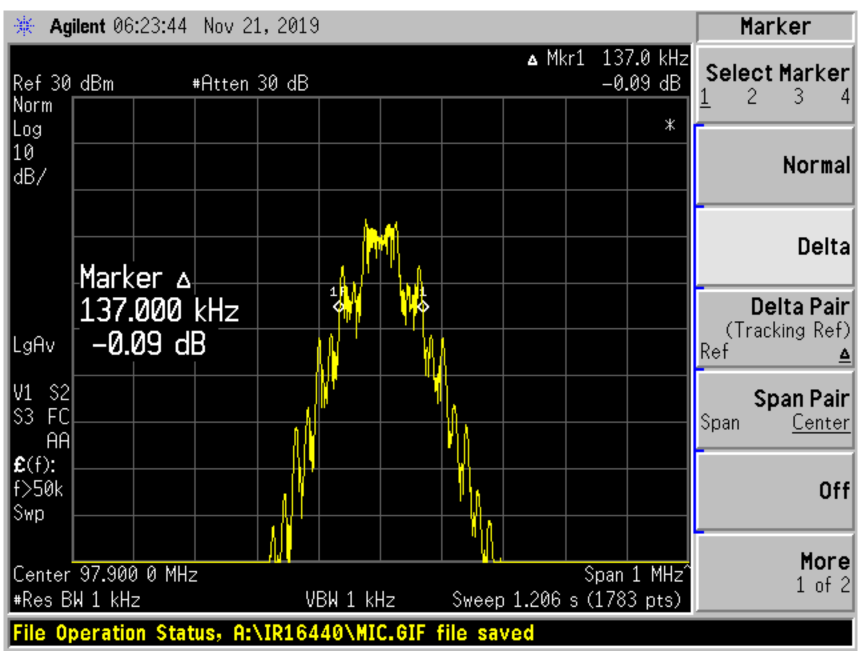


Figure 22. OBW Low Channel 15kHz

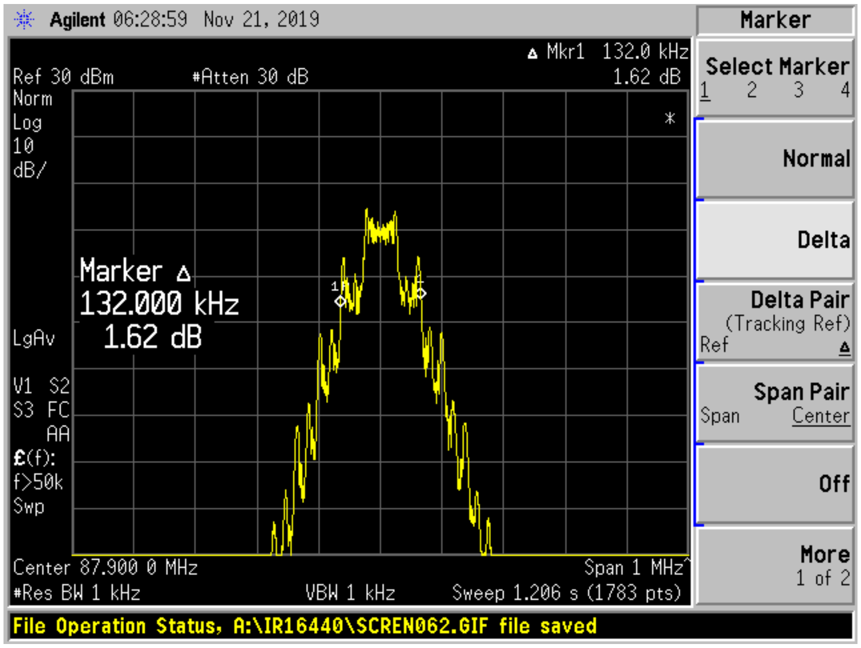


Figure 23. OBW Mid Channel 400Hz

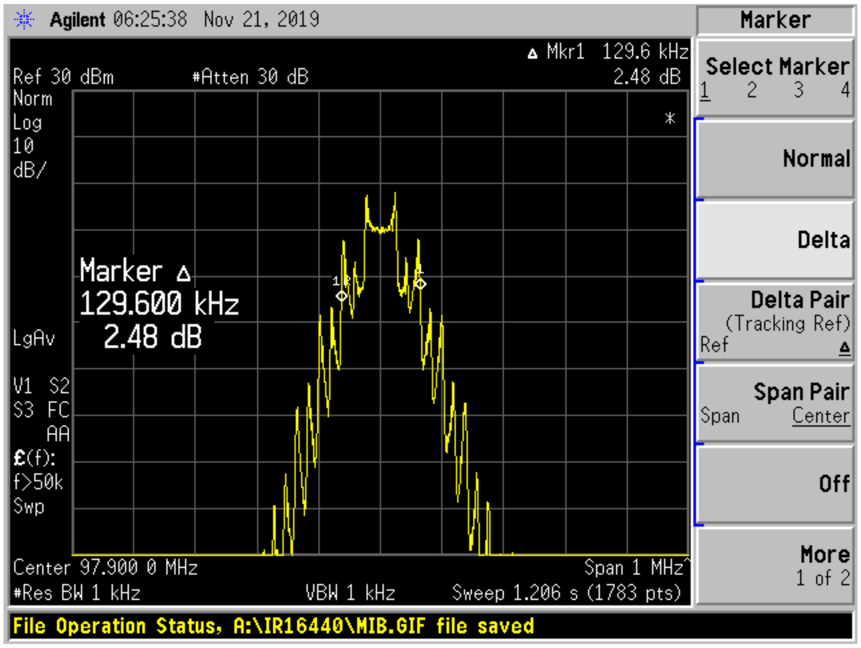


Figure 24. OBW Mid Channel 1kHz

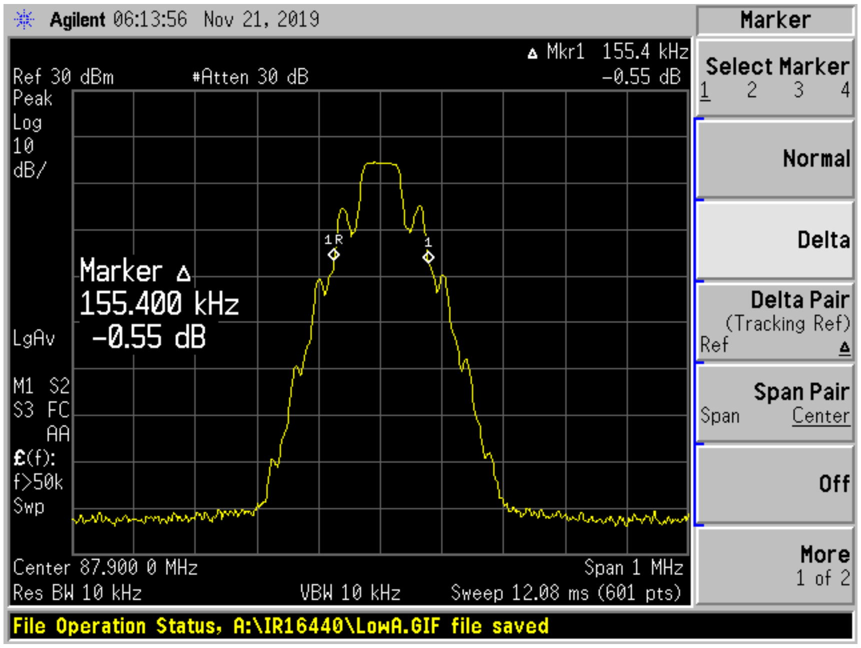


Figure 25. OBW Mid Channel 15kHz

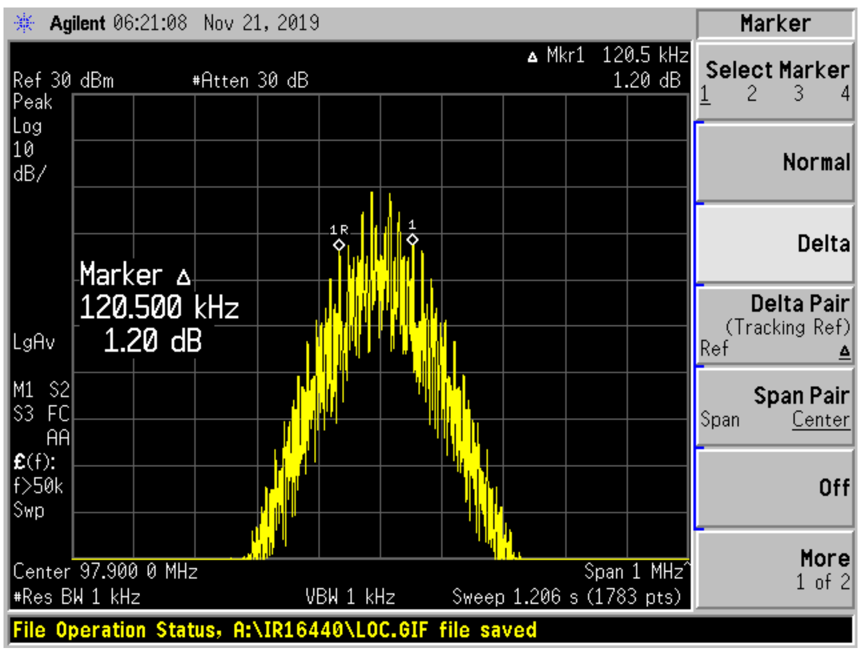


Figure 26. OBW High Channel 400Hz

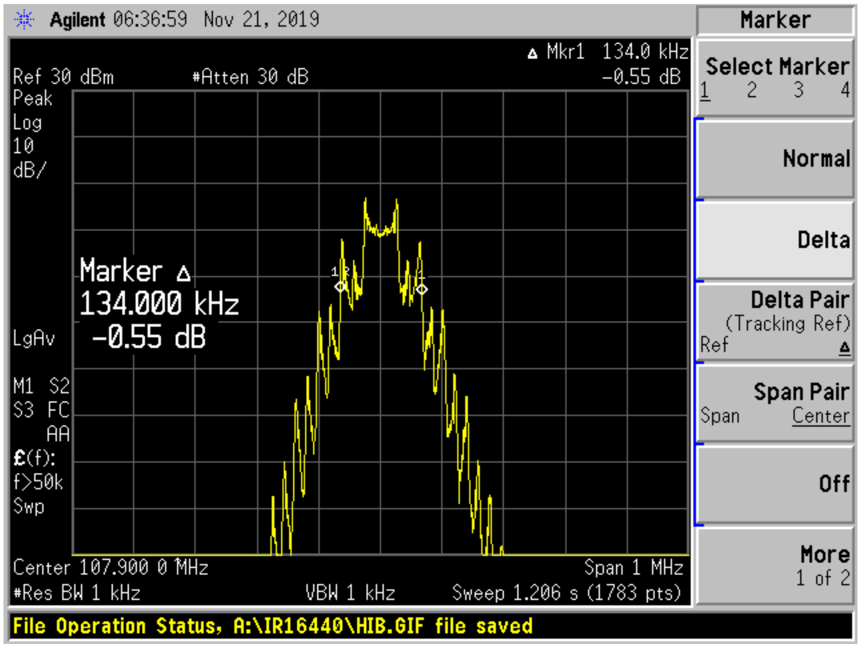


Figure 27. OBW High Channel 1kHz

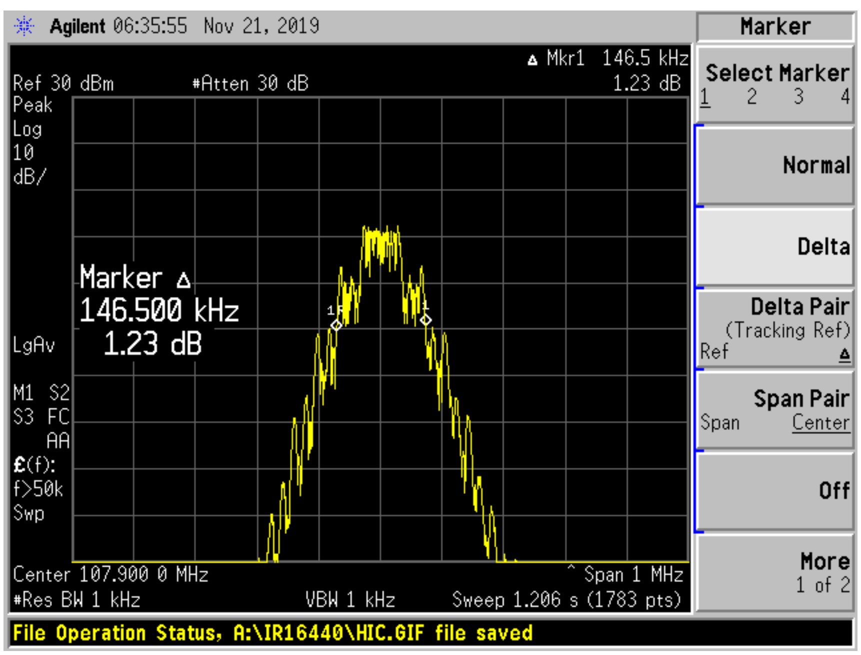
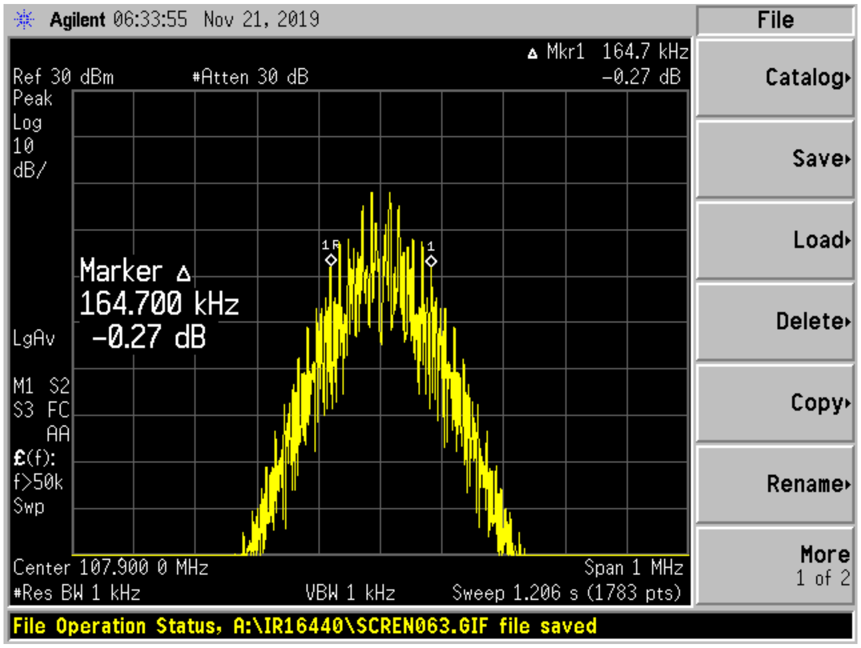


Figure 28. OBW High Channel 15kHz



3.8 Voltage and Current of Final Power Amplifier (FCC Part 2)

The voltage and current present at the transmitter final RF power amplifier is as follows:

Voltage = 50VDC
Current = 8 A