

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

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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

Abst	trac	xti	i
1		Introduction1	l
1.	1	Compliance Statement	1
1.	2	Test Standard1	l
1.	3	Contract Information	Ĺ
1.	•	Test Dates 1	
1.		Test and Support Personnel	
1.	0	EUT Identification	
1.		EUT Description	
1.	-	Test Configuration	
1.	-	Equipment Configuration	
	10	Support Equipment	
	11	Interface Cables	
	12 13	EUT Modifications Test Location	
	15 14	Measurement Uncertainty	
2		Test Equipment	
$\frac{2}{3}$		Test Results	
3.		Output Power Part 2.1046, Part 73.267	
3.		Modulation Characteristics, Part 2.1047	
3.		Emission Mask, Part 2.1049, Part 73.317	
3.	-	Conducted Spurious Emissions (Antenna Terminal), Part 2.1051	
3.	5	Frequency Stability, Part 2.1055, Part 73.1545	
3.	6	Radiated spurious emissions (Cabinet radiation), Part2.1053	5
3.	7	Occupied Bandwidth	7
3.	8	Voltage and Current of Final Power Amplifier (FCC Part 2)	2

List of Tables

Table 1: Overview of Equipment Under Test	. 2
Table 2: Equipment Configuration	
Table 3: Support Equipment	
Table 4: Interface Cables	. 3
Table 5: Expanded Uncertainty List	. 4
Table 6. Frequency Stability vs Temperature 2	
Table 7. Spurious Emissions Cabinet Radiation 2	

List of Figures

Figure 1. Test Setup Conducted Power Measurements	6
Figure 2. Test Setup Modulation Characteristics	7
Figure 3. Peak Positive Deviation	
Figure 4. Peak Negative Deviation	9
Figure 5. Peak Positive/Negative Deviation	10
Figure 6. Audio Frequency Response	11
Figure 7. Mask Low Channel 400Hz	
Figure 8. Mask Low Channel 1kHz	14
Figure 9. Mask Low Channel 15kHz	15
Figure 10. Mask Mid Channel 400Hz	
Figure 11. Mask Mid Channel 1kHz	17
Figure 12. Mask Mid Channel 15	18
Figure 13. Mask Hi Channel 400Hz	19
Figure 14. Mask Hi Channel 1kHz	
Figure 15. Mask Hi Channel 15	21
Figure 16. Spurs Low Channel	22
Figure 17. Spurs Mid Channel	23
Figure 18. Spurs High Channel	24
Figure 19. OBW Low Channel 400Hz	
Figure 19. OBW Low Channel 1kHz	28
Figure 19. OBW Low Channel 15kHz	
Figure 19. OBW Mid Channel 400Hz	
Figure 19. OBW Mid Channel 1kHz	
Figure 19. OBW Mid Channel 15kHz	30
Figure 19. OBW High Channel 400Hz	
Figure 19. OBW High Channel 1kHz	
Figure 19. OBW High Channel 15kHz	32

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.

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

Table 1: Overview of Equipment Under Test

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.)

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

Table 2: Equipment Configuration

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

$$u_{c} = \pm \sqrt{\frac{a^{2}}{div_{a}^{2}} + \frac{b^{2}}{div_{b}^{2}} + \frac{c^{2}}{div_{c}^{2}} + \dots}$$

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
		$k \le 2$ for 95% coverage (ANSI/NCSL Z540-2 Annex G)
uc	;	= standard uncertainty

The measurement uncertainty complies with the maximum allowed uncertainty from CISPR 16-4-2. Measurement uncertainty is <u>not</u> 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	НР	8447D	4/3/2020
00075	НР	8648C	3/23/2020
00644	SUNOL SCIENCES CORPORATION	JB1 925-833-9936	4/16/2020

3 Test Summar

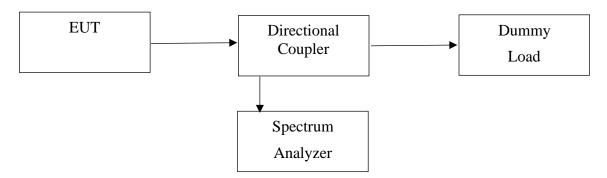
Test	Regulation	Measurement standard	Result
RF Output Power	Part 2.1046, Part 73.267	ANSI C63.26	Complies
Modulation Characteristics	Part 2.1047	ANSI C63.26	Complies
Emission Mask	Part 2.1049, Part 73.317	ANSI C63.26	Complies
Conducted Spurious	Part 2.1051	ANSI C63.26	Complies
Emissions			
(Antenna Terminal)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

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.

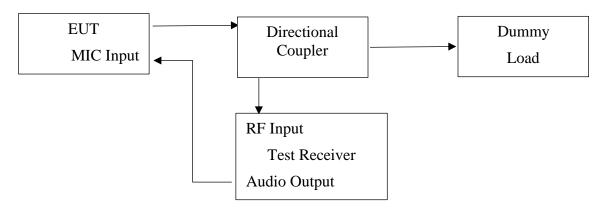


Figure 2. Test Setup Modulation Characteristics

3.2.1.2 Test Results

The test results are provided in the following figures.

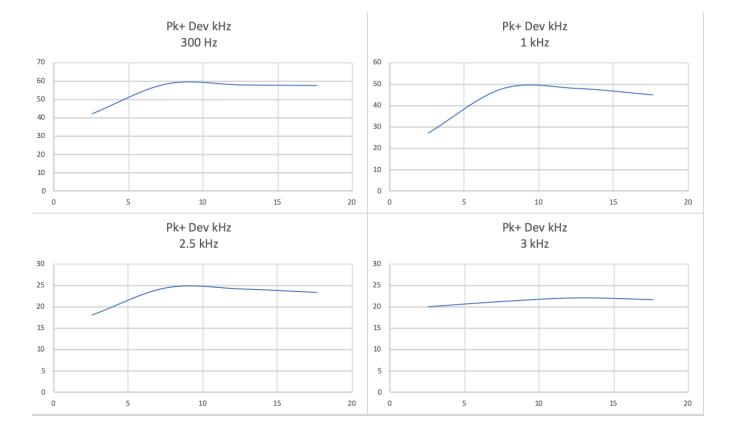


Figure 3. Peak Positive Deviation

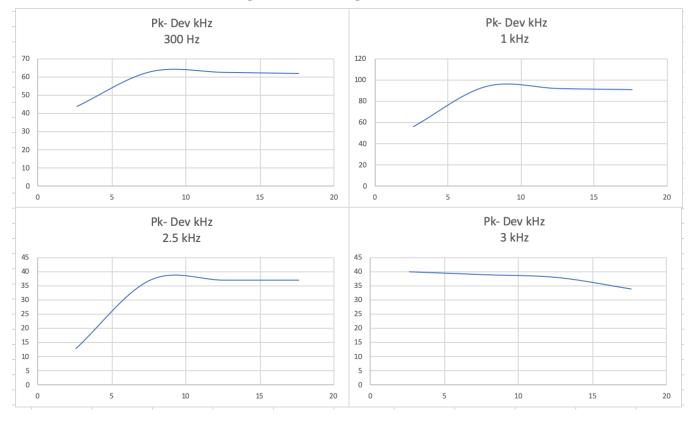


Figure 4. Peak Negative Deviation

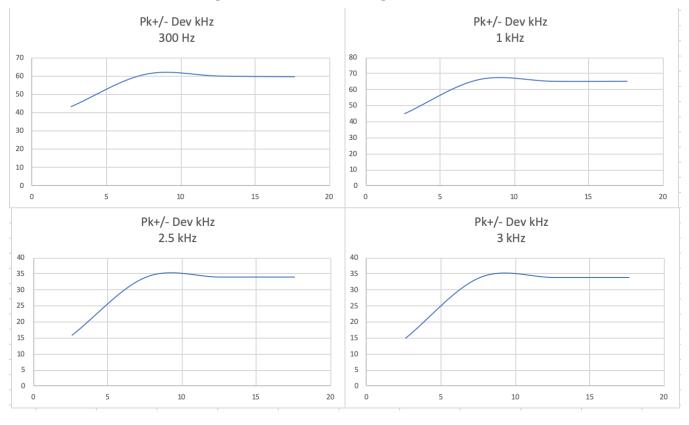


Figure 5. Peak Positive/Negative Deviation

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

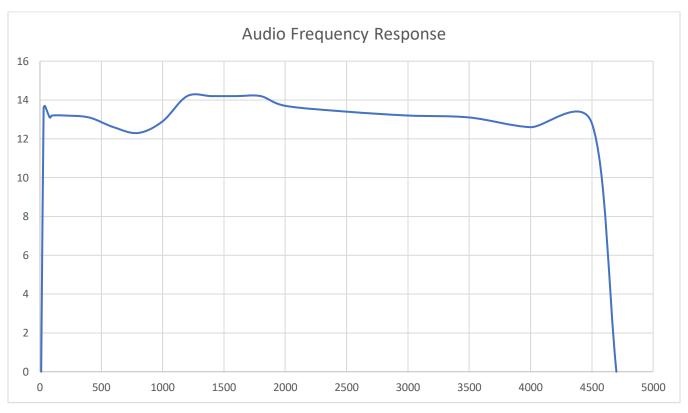


Figure 6. Audio Frequency Response

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.

Spect Swep	rum Analyz t SA	er 1 🔻	+						Marker	▼ <mark>21/</mark>
_		nput: RF Coupling: DC Align: Auto	Input Z: 50 Ω Corrections: Off Freq Ref: Int (S)	#Atten: 30 dB Preamp: Off	PNO: Best Wide Gate: Off IF Gain: Low Sig Track: Off	Avg Type: Lo Avg Hold: 39/ Trig: Free Ru	100	1 2 3 4 5 6	Select Marker Marker 1	
1 Spe	ctrum	T		ef LvI Offset 40		Mkr		00 0 MHz	Marker Frequency 87.900000 MHz	Settings
Scale Log	/Div 10 dE		R	ef Level 60.00 (5	4.24 dBm	Peak Search	Peak Search
50.0					-				Next Peak	Pk Search Config
40.0									Next Pk Right	Properties
30.0									Next Pk Left	Marker Function
20.0					L				Minimum Peak	Marker→
0.00				/h					Pk-Pk Search	Counter
-10.0					1 4				Marker Delta	
-20.0					Thur				Mkr→CF	
-30.0			wardhar all and for all war		KHZ	man May Marine	house and	an an Alan a	Mkr→Ref Lvl	
			'	Video BW 20	kHz				Continuous Peak Search	
#Res	BW 2.0 kH		? Mar 09, 2020 11:23:37 PM			Swi		ns (1001 pts)	On Off	

Figure 7. Unmodulated Carrier

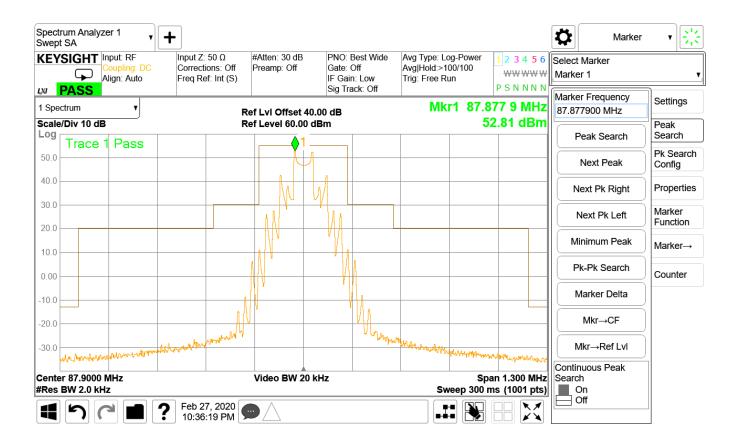
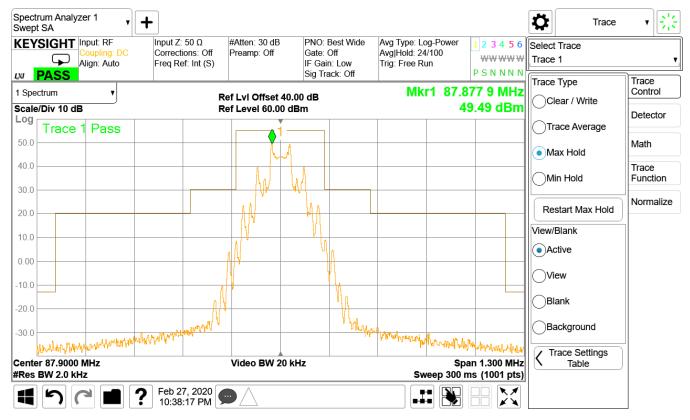


Figure 8. Mask Low Channel 400Hz





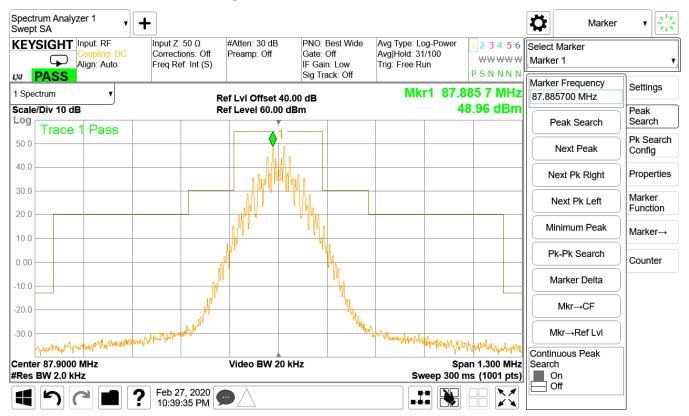


Figure 10. Mask Low Channel 15kHz

Figure 11. Mask Mid Channel 400Hz

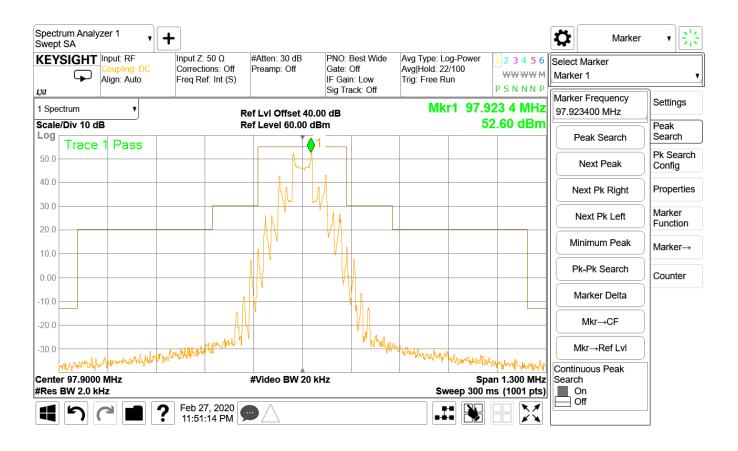


Figure 12. Mask Mid Channel 1kHz

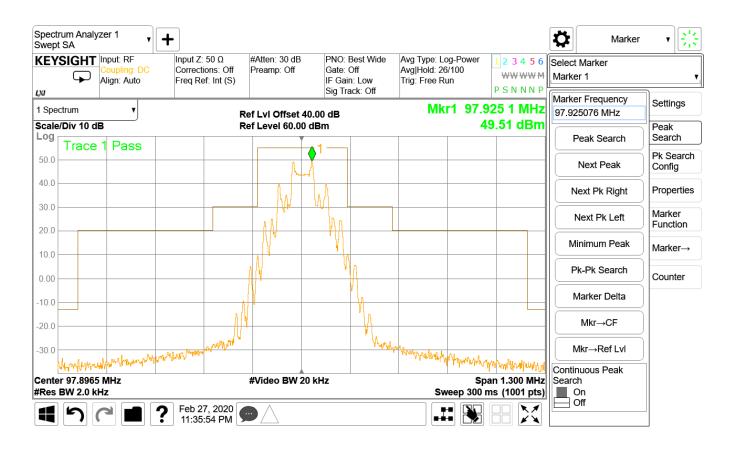
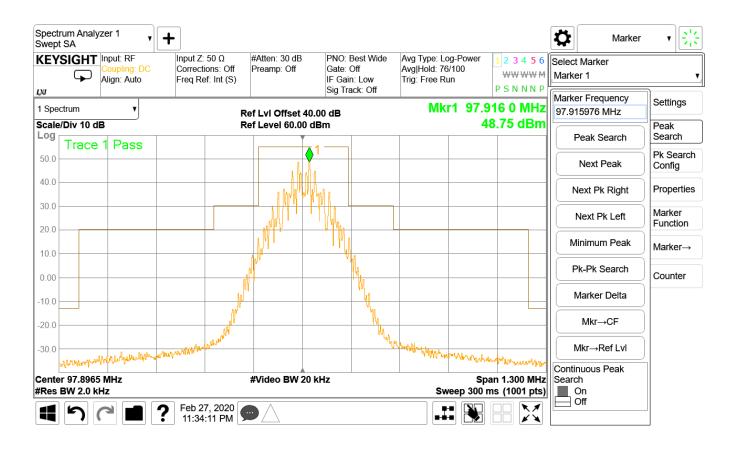


Figure 13. Mask Mid Channel 15



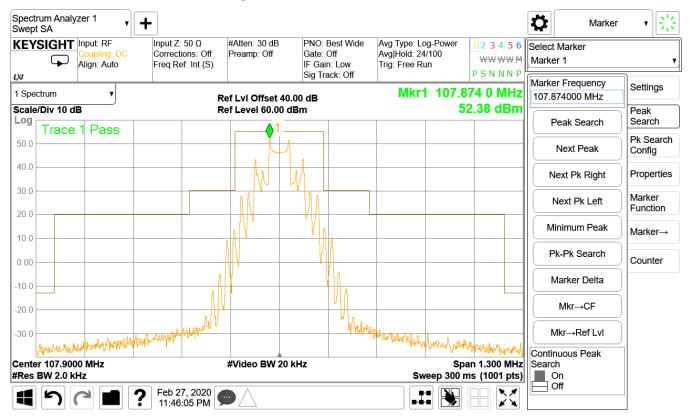


Figure 14. Mask Hi Channel 400Hz

Figure 15. Mask Hi Channel 1kHz

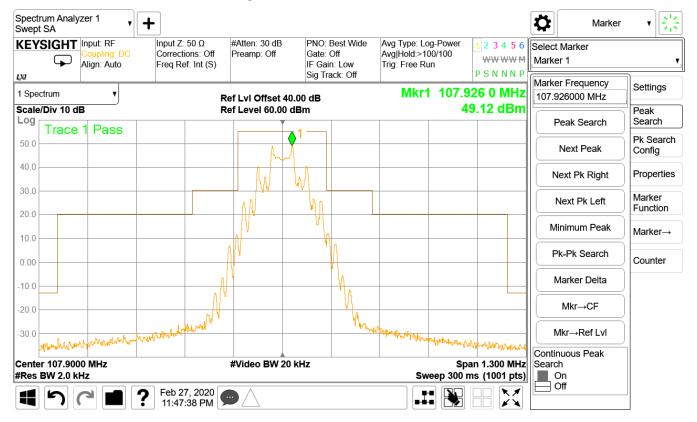
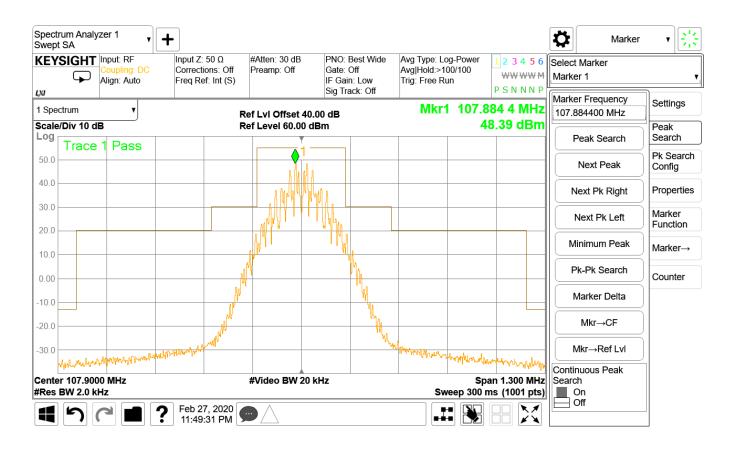


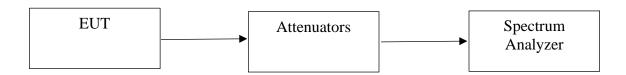
Figure 16. Mask Hi Channel 15



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.

Spectrum Anal Swept SA	yzer 1 🔻	+					Marker	۲ ۲
	Input: RF Coupling: DC Align: Auto	Input Z: 50 Ω Corrections: Off Freq Ref: Int (S)	#Atten: 28 dB Preamp: Off	PNO: Fast Gate: Off IF Gain: Low Sig Track: Off	Avg Type: Log-P Trig: Free Run	ower 123456 MWWWWW PNNNNN	Marker 1	
1 Spectrum Scale/Div 10 c	V V		Ref LvI Offset 40 Ref Level 56.00 d		Mkr1	263.726 MHz -18.76 dBm	200.12010110112	Settings
Log			Kei Levei 50.00 u			-10.70 0.011	Marker Mode	Peak Search
46.0							Normal	Pk Search Config
36.0							Delta (Δ)	Properties
26.0							- Fixed	Marker Function
6.00							Delta Marker (Reset Delta)	Marker→
-4.00							Marker Table	Counter
-14.0		1				DL1 -12.50 dBm	On Off	
-24.0	A second s	Arrestan and a shirt to the state free of					Marker Settings Diagram	
-34.0	Child Calification of Arthurs	renewender hjählende jählend produktion konse	n alt die Alfred Kantol die als die die die seit die Alfred in Alfred Internet die State in Alfred Internet die Nationalise die State in Alfred Internet die State in Alfred Internet die State in Alfred Internet die State in	<u>a pitale and Ding</u> 14. Ma <mark>phinis ba</mark> th	n dia manang di king kan ding kan ding Kan ding kan	l Almany Andia Leanning (printenenen, auch Alman Hill, anti-auch).	All Markers Off	
Start 9 kHz #Res BW 100	kHz		Video BW 100	kHz	Sweep ~1	Stop 1.1000 GHz 07 ms (100000 pts)		
1		Peb 27, 2020 3:58:36 AM	$\Box \Delta$			N X		-

Figure 17. Spurs Low Channel

Figure 18. Spurs Mid Channel

Spectrum Analy Swept SA	zer 1 🔻	+							♥	Amplitude	•	;; ;
	Input: RF Coupling: DC Align: Auto	Input Z: 50 Ω Corrections: Off Freq Ref: Int (S)	#Atten: 28 dB Preamp: Off	PNO: Fast Gate: Off IF Gain: L Sig Track:	Trig:	Type: Log-Po Free Run		1 2 3 4 5 6 M W W W W P N N N N N	Ref Le	dBm	Y Sc	
1 Spectrum Scale/Div 10 d	T B		Ref Lvi Offset 40 Ref Level 56.00 d		· ·	Mkr1		734 MHz .48 dBm	Scale 10 dE			nuation al Path
46.0										.og .in		
36.0									Y Axis dBm	vel Offset		
16.0									40.00			
6.00									Numb	off er of Divisions		
-14.0		1						DL1 -12.50 dBm	10	•		
-24.0		y ny powego tang da transmit ng mga pang mga pan 1999 ng mga pang pang pang pang pang pang pang pa										
-34.0			Video BW 100					1.1000 GHz				
#Res BW 100 H	(Hz	7 Feb 27, 2020				Sweep ~10		(100000 pts)				
		3:57:04 AM	$\Omega \Delta$			== = [S					

Spectrum Analy Swept SA	/zer 1	+						*	Trace	▼]] ;;
	Input: RF Coupling: DC Align: Auto	Input Z: 50 Ω Corrections: O Freq Ref: Int (\$		PNO: F Gate: 0 IF Gair Sig Tra	Off	Avg Type: Lo Trig: Free Ru	1 2 3 4 5 6 M WW WW W P N N N N N			۲ آ
1 Spectrum Scale/Div 10 d	v B		Ref LvI Offset Ref Level 56.00			Mk	.726 MHz 8.15 dBm	Trace Ty Clea	/pe r / Write	Trace Control
46.0								Trac	e Average Hold	Math
36.0								Min I		Trace Function
16.0								Resta	art Max Hold	Normalize
6.00										
-14.0							 DL1 -12.50 dBm	 View Blan 		
-24.0			a y han an a						ground	
Start 9 kHz #Res BW 100 I	۲. KHz		Video BW 10)0 kHz		Sweep	p 1.1000 GHz (100000 pts)		e Settings Table	
		Feb 27, 202 4:00:20 AM								

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

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	

Table 6. Frequency Stability vs Temperature

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:

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	Н	180.0	2.7	71.9	-9.9	-26.9	0.6	-26.3	-13.0	-13.3
195.80	Н	95.0	1.0	46.8	-39.0	-55.7	4.4	-51.4	-13.0	-38.4
293.70	Н	95.0	1.0	36.7	-52.3	-66.5	6.3	-60.2	-13.0	-47.2
391.61	Н	185.0	1.0	50.5	-33.1	-44.8	6.9	-37.9	-13.0	-24.9
489.50	Н	180.0	4.0	35.2	-48.7	-58.9	6.4	-52.5	-13.0	-39.5
587.42	Н	246.0	3.0	43.7	-42.3	-52.0	6.9	-45.1	-13.0	-32.1
685.30	Н	214.0	1.0	51.1	-35.1	-44.7	7.1	-37.6	-13.0	-24.6
783.21	Н	195.0	1.0	50.8	-31.6	-39.1	7.3	-31.8	-13.0	-18.8
881.11	Н	90.0	2.0	49.1	-26.4	-32.9	7.1	-25.8	-13.0	-12.8
979.00	Н	350.0	4.0	52.8	-24.8	-31.6	7.4	-24.1	-13.0	-11.1

Table 7. Spurious Emissions Cabinet Radiation

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.

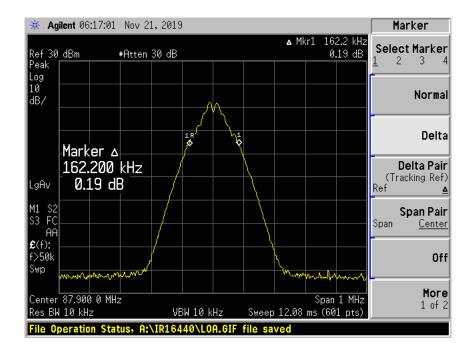


Figure 20. OBW Low Channel 400Hz

Figure 21. OBW Low Channel 1kHz

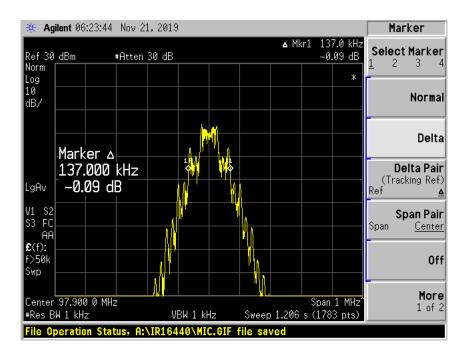
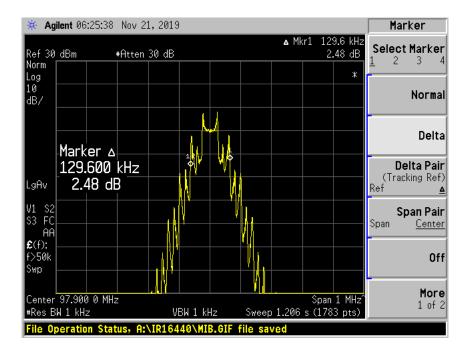




Figure 22. OBW Low Channel 15kHz

Figure 23. OBW Mid Channel 400Hz



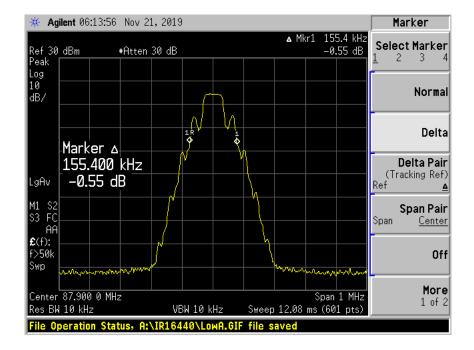
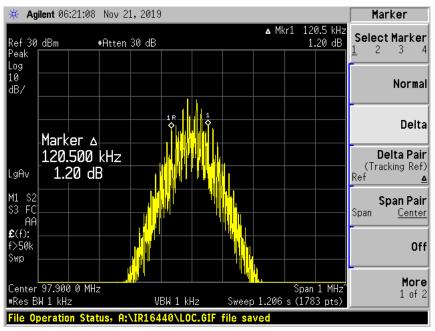


Figure 24. OBW Mid Channel 1kHz





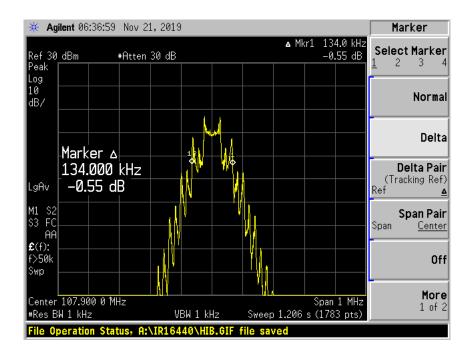
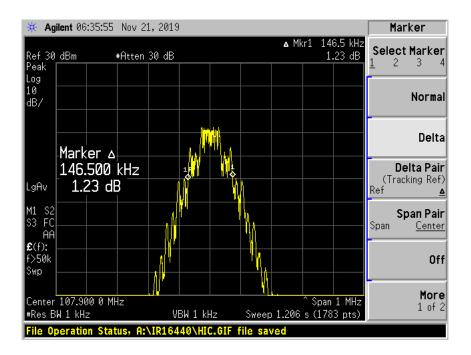


Figure 26. OBW High Channel 400Hz

Figure 27. OBW High Channel 1kHz



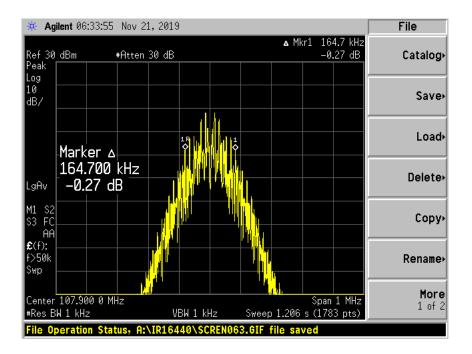


Figure 28. OBW High Channel 15kHz

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