Testing Tomorrow's Technology

Application
For

Part 2, Subpart J, Paragraph 2.907 Equipment Authorization of Certification for an Intentional Radiator per Part 95, Subpart J and TIA/EIA 603-C-2004

For the

Radio Systems

Model(s): TEK H

FCC ID: KE3-3001089

UST Project: 11-0041

Issue Date: April 18, 2011

Total Pages: 32

3505 Francis Circle Alpharetta, GA 30004
PH: 770-740-0717 Fax: 770-740-1508
www.ustech-lab.com

I certify that I am authorized to sign for the Test Agency and that all of the statements in this report and in the Exhibits attached hereto are true and correct to the best of my knowledge and belief:

US TECH (Agent Responsible For Test):

By: Alan Ghasiani

Name: Alan Ghasiani

Title: Consulting Engineer President

Date: April 18, 2011

This report shall not be reproduced except in full. This report may be copied in part only with the prior written approval of US Tech. The results contained in this report are subject to the adequacy and representative character of the sample provided.

MEASUREMENT TECHNICAL REPORT

COMPANY NAME: Radio Systems

MODEL: TEK H

FCC ID KE3-3001089

DATE: April 18, 2011

This report concerns (check one): Original grant [X]
Class II change

Equipment type: FSK Transceiver Module

Deferred grant requested per 47 CFR 0.457(d)(1)(ii)? yes_____ No X

If yes, defer until: ______N/A___________
date

agrees to notify the Commission by N/A
date

of the intended date of announcement of the product so that the grant can be issued on that date.

Report prepared by:

US Tech
3505 Francis Circle
Alpharetta, GA 30004

Phone Number: (770) 740-0717
Fax Number: (770) 740-1508

Table of Contents

1 General Information 6
1.1 Purpose of this Report 6
1.2 Characterization of Test Sample 6
1.3 Product Description 7
1.4 Configuration of Tested System 7
1.5 Test Facility 8
2 Tests and Measurements 9
2.1 Test Equipment 9
2.2 Modifications to EUT Hardware 9
2.3 Number of Measurements for Intentional Radiators (15.31(m)) 10
2.4 Frequency Range of Radiated Measurements (Part 15.33) 10
2.4.1 Intentional Radiator 10
2.4.2 Unintentional Radiator 10
2.5 Measurement Detector Function and Bandwidth (CFR 15.35) 10
2.6 EUT Antenna Requirements 11
2.7 RF power output (CFR 2.1046 & 95.639(h)) 13
2.8 Occupied bandwidth and emission mask (CFR 2.1049 & 95.633 & 95.635) 14
2.9 Unwanted radiation - emission mask (95.635) 20
Field strength of spurious radiation (2.1053) 23
2.10 Frequency stability (CFR 2.1055 & CFR 95.632(c)) 24
2.11 Measurement Uncertainty 26
2.11.1 Conducted Emissions Measurement Uncertainty: 26
2.11.2 Radiated Emissions Measurement Uncertainty: 26
2.12 Power conducted Output (CFR 15.247(b) & 95.639(h)) 26

List of Tables

Table 1 - EUT and Peripherals 8
Table 2 - Test Instruments 9
Table 3 - Number of Test Frequencies for Intentional Radiators 10
Table 4 - Allowed Antenna(s) 11
Table 5 - Peak Radiated Harmonic & Spurious Emissions 13
Table 6 – Bandwidth per CFR 95.633(f) 14
Table 7 - Peak Radiated Harmonic & Spurious Emissions 23
Table 8 – Frequency Stability Table 24
Table 9 – Peak Antenna Conducted Output Power per Part 15.247 (b) (3) (Same as EIRP) 27

List of Figures

Figure 1 - Test Configuration 12
Figure 2 – Channel 1 Occupied Bandwidth 15
Figure 3 – Channel 2 -Occupied Bandwidth 16
Figure 4 – Channel 3 -Occupied Bandwidth 17
Figure 5 – Channel 4 -Occupied Bandwidth 18
Figure 6 – Channel 5 -Occupied Bandwidth 19
Figure 7 – Emissions Mask 1 21
Figure 8 – Emissions Mask 3 22
Figure 9 – Frequency Stability Chart (limit at 5.0 ppm) 25
Figure 10 – Ch. 1 Conducted Output Power 28
Figure 11 – Ch 2. Conducted Output Power 29
Figure 12 – Ch 3. Conducted Output Power 30
Figure 13 – Ch 4. Conducted Output Power 31
Figure 14 – Ch 5. Conducted Output Power 32

1 General Information

1.1 Purpose of this Report

The purpose of this report is to demonstrate compliance with Part 95 MURS band of the FCC's Code of Federal Regulations for a Certification. The EUT has been evaluated and found to be in compliance with FCC Part 95 Subpart E.

1.2 Characterization of Test Sample

The sample used for testing was received by US Tech on March 4, 2011 in good operating condition.

1.3 Product Description

This device is a GPS based tracking system for locating dogs. The system uses MURS band to send small amounts of data between the collar and handheld unit. This location data enables the handheld unit to display relative location of the dog to the handheld unit, including vector information, thereby allowing the user to track the dog.

1.4 Configuration of Tested System

The Test Sample was tested per *ANSI C63.4, Methods of Measurement of Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (2003)*

Digital RF conducted and radiated Verification emissions data (FCC 15.107 and 109) below 1 GHz were taken with the measuring receiver (or spectrum analyzer's) resolution bandwidth adjusted to 9 kHz and 120 kHz, respectively. All measurements performed above 1.0 GHz were made with a RBW of 1 MHz. All measurements are peak unless stated otherwise. The video filter associated with the spectrum analyzer was off throughout the evaluation process.

A list of EUT and Peripherals is found in Table 1 below. A block diagram of the tested system is shown in Figure 1. Test configuration photographs for spurious and fundamental emissions are provided in separate Appendices.

1.5 Test Facility

Testing was performed at US Tech's measurement facility at 3505 Francis Circle, Alpharetta, GA 30004. This site has been fully described and registered with the FCC. Its designation number is US5117. Additionally this site has also been fully described and submitted to Industry Canada (IC), and has been approved under file number 2982A-1.

Table 1 - EUT and Peripherals

PERIPHERAL MANUFACTURER.	MODEL NUMBER	SERIAL NUMBER	FCC ID:	CABLES P/D
(EUT) Radio systems	TEK H	None	KE3-3001089	none

2 Tests and Measurements

2.1 Test Equipment

Table 2 below lists test equipment used to evaluate this product. Model numbers, serial numbers and their calibration status are included herewith.

Table 2 - Test Instruments

TEST INSTRUMENT	MODEL NUMBER	MANUFACTURER	SERIAL NUMBER	DATE OF LAST CALIBRATION
SPECTRUM ANALYZER	8593E	HEWLETT-PACKARD	3205A00124	10/18/2010
SPECTRUM ANALYZER	8566B	HEWLETT-PACKARD	2410A00109	10/29/10
RF PREAMP 100 kHz to 1.3 GHz	8447D	HEWLETT-PACKARD	2944A06291	9/7/10
BICONICAL ANTENNA 25 MHz to 200 MHz	BIA-25	Electro-Metrics	2451	12/29/2009 2 Year
LOG PERIODIC 100 MHz to 1000 MHz	3146	EMCO	3110-3236	1/22/10 2 Year
HORN ANTENNA 1 GHz to 18 GHz	SAS-571	A. H. Systems	605	2/9/2010 2 Year
PREAMP 1 GHz to 26.5 GHz	8449B	HEWLETT-PACKARD	3008A00480	9/21/10
CALCULATION PROGRAM	N/A	N/A	Ver. 6.0	N/A

Note: The calibration interval of the above test instruments is 12 months unless stated otherwise and all calibrations are traceable to NIST/USA.

2.2 Modifications to EUT Hardware

No modifications were made by US Tech in order to bring the EUT into compliance with FCC Part 15, Subpart C Intentional Radiator Limits for the transmitter portion of the EUT or the Subpart B Unintentional Radiator Limits (Receiver and Digital Device) Requirements.

2.3 Number of Measurements for Intentional Radiators (15.31(m))

Measurements of intentional radiators or receivers shall be performed and reported for each band in which the device can be operated with the device operating at the number of frequencies in each band specified in Table 3 as follows:

Table 3 - Number of Test Frequencies for Intentional Radiators

Frequency Range over which the device operates	Number of Frequencies	Location in the Range of operation
1 MHz or less	1	Middle
1 to 10 MHz	2	1 near the top 1 near the bottom
Greater than 10 MHz	3	1 near top 1 near middle 1 near bottom

Because the EUT operates over 151.8 MHz to 154.60 MHz, 2 test frequencies will be used.

2.4 Frequency Range of Radiated Measurements (Part 15.33)

2.4.1 Intentional Radiator

The spectrum shall be investigated for the intentional radiator from the lowest RF signal generated in the EUT, without going below 9 kHz to the 10^{th} harmonic of the highest fundamental frequency generated or 40 GHz, whichever is the lowest.

2.4.2 Unintentional Radiator

For the digital device, an unintentional radiator, the frequency range shall be 30 MHz to 1000 MHz, or to the range specified in 2.4.1 above, whichever is the higher range of investigation.

2.5 Measurement Detector Function and Bandwidth (CFR 15.35)

The radiated and conducted emissions limits shown herein are based on the requirements in CFR 15.35 as described in section 1.4 of this report.

2.6 EUT Antenna Requirements

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. Radio Systems will sell the RF Module with the following antenna:

Table 4 - Allowed Antenna(s)

MANUFACTURER	TYPE OF ANTENNA	MODEL	REPORT REFERENCE	GAIN dB_i
Radio Systems	Coil Antenna	ASM ANTENNA TEK-100H	Antenna 1	0

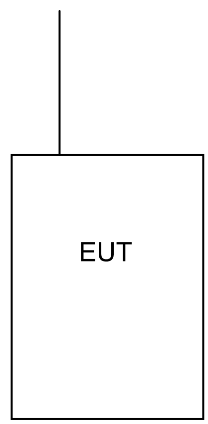


Figure 1 - Test Configuration

2.7 RF power output (CFR 2.1046 & 95.639(h))

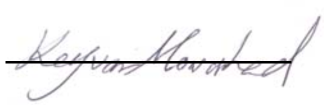
No MURS unit, under any condition of modulation, shall exceed 2 Watts transmitter power output. In Order to calculate the output power at the transmitter connector, substitution method was used (see table below).

Table 5 - Peak Radiated Harmonic & Spurious Emissions

Frequency MHz	Maximum RX Reading (Units A)	Recreated Reading During Substitution (Using Same Units A) - Ideally 0	Difference Column A - B	TX Gain (dBi)	TX Gain Relative to Dipole (dB)	RF Power into TX antenna (Corrected for any CL and Pads to antenna Feed Point) (dBm) (SG Value-CL)	RF Power into substitution TX antenna corrected by TX Gain Relative to Dipole (dBm)	Limit (dBm)	Margin Below Limit (dB)
The following applies information from test as performed									
151.804	100.8	70.7	30.1	1.1	-1.04	-14.8	14.26	33	18.74
154.588	100.6	70.7	29.9	1.1	-1.04	-14.8	14.06	33	18.94

SAMPLE CALCULATION:
Results = Power into TX antenna – Cable loss + substitution antenna gain + Difference Column A –B
Results at 151.804 MHz: -14.8 + (-1.04) + (30.1) = 14.26 dBm

Test Date: April 8, 2011

Tested By
Signature: 

Name: **Keyvan Muvahhid**

2.8 Occupied bandwidth and emission mask (CFR 2.1049 & 95.633 & 95.635)

The EUT was modulated by its own internal sources. All Low and High Channels were tested. The bandwidth of the fundamental was measured using a spectrum analyzer. The results are shown below. Long sweep times were applied at frequencies near the fundamental to ensure that a good signal was obtained. The EUT passes the following requirements:

Table 6 – Bandwidth per CFR 95.633(f)

Channel	Frequency (MHz)	Bandwidth (KHz)	BW limit (KHz)
1	151.82	6.05	11.25
2	151.88	6.10	11.25
3	151.94	6.20	11.25
4	154.57	6.15	20.0
5	154.60	6.10	20.0

Test Date: April 8, 2011

Tested By
Signature: Name: **Keyvan Muvahhid**

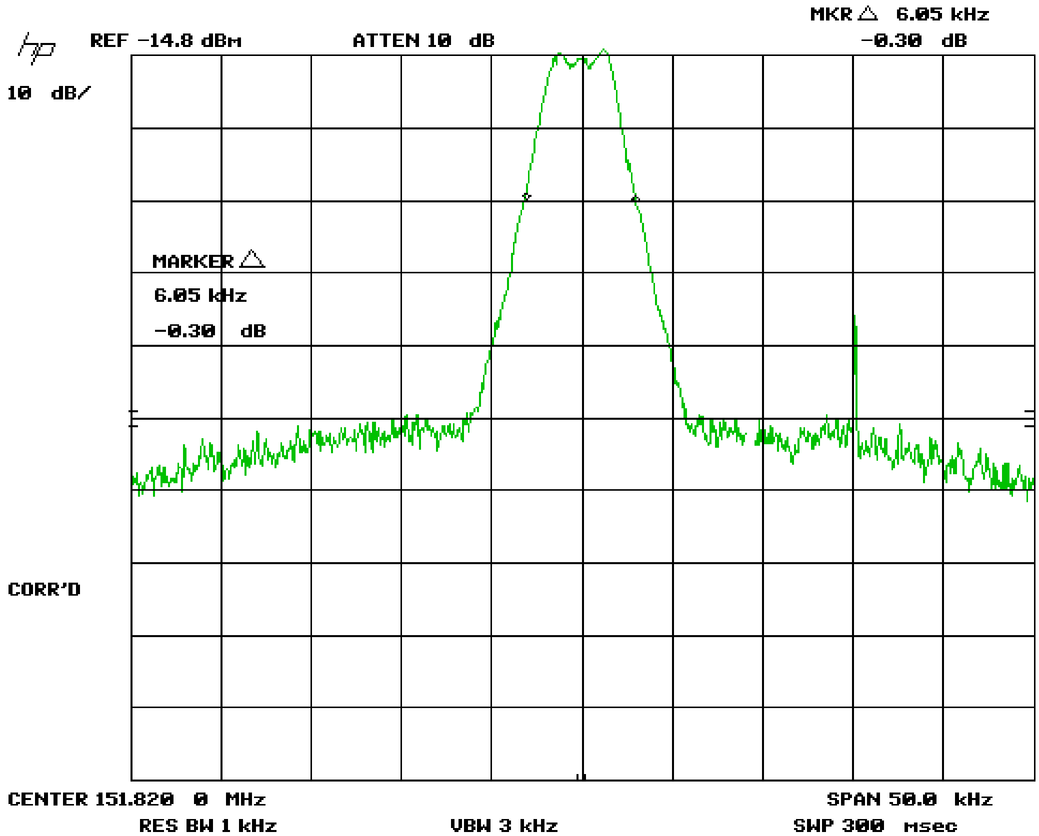


Figure 2 – Channel 1 Occupied Bandwidth

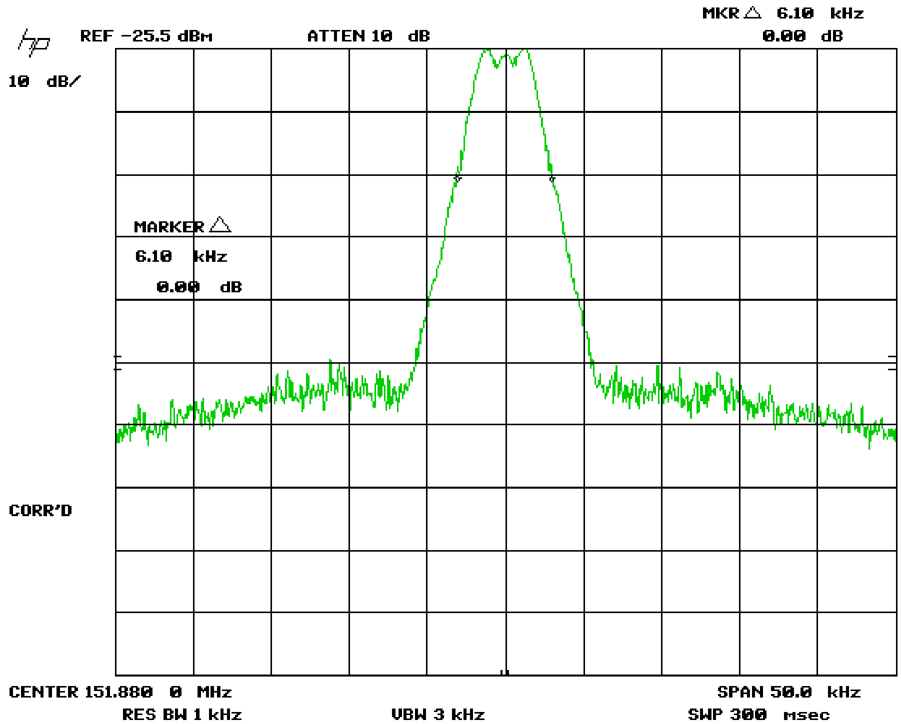


Figure 3 – Channel 2 -Occupied Bandwidth

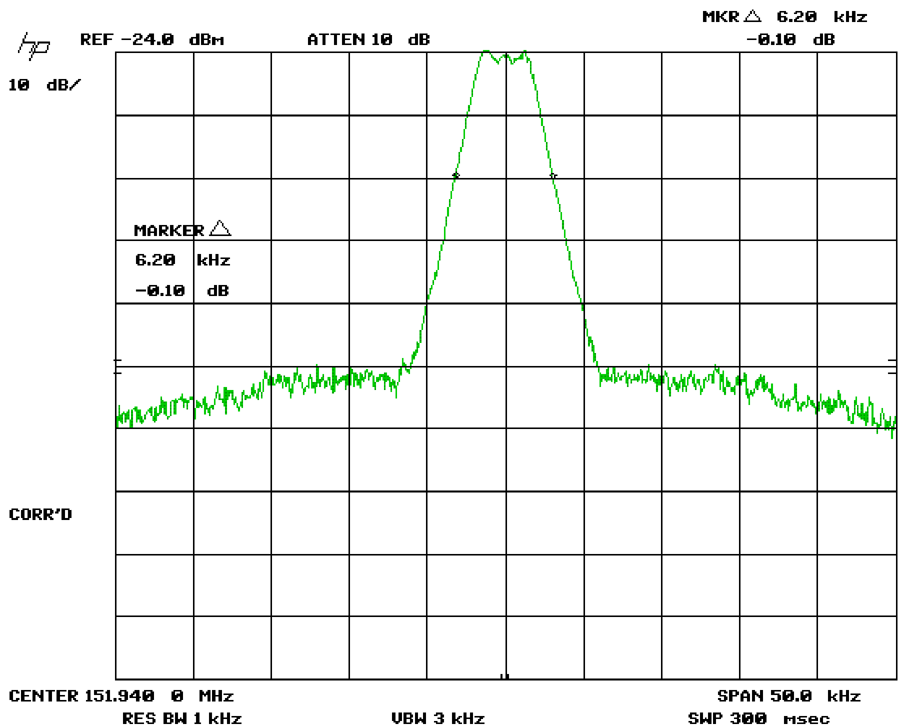


Figure 4 – Channel 3 -Occupied Bandwidth

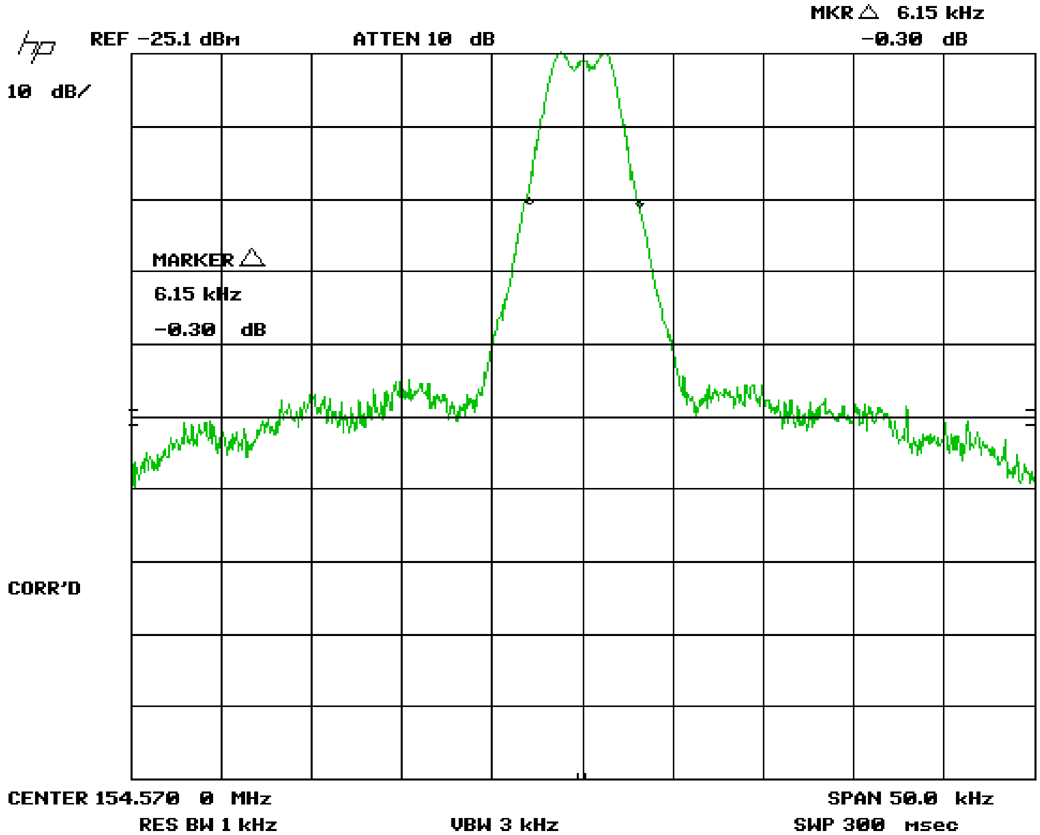


Figure 5 – Channel 4 -Occupied Bandwidth

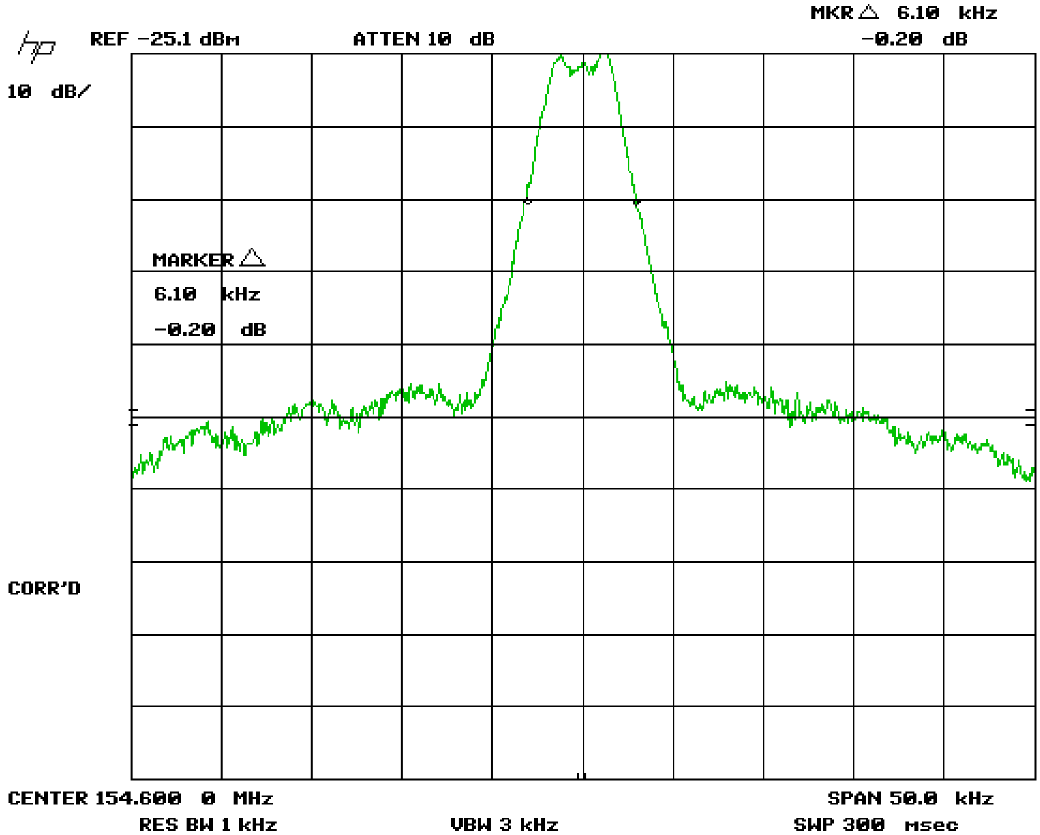


Figure 6 – Channel 5 -Occupied Bandwidth

2.9 Unwanted radiation - emission mask (95.635)

The EUT was modulated by its own internal sources. Both Low and High Channels were tested. The bandwidth of the fundamental was measured using a spectrum analyzer. The results are shown below. Long sweep times were applied at frequencies near the fundamental to ensure that a good signal was obtained. The EUT passes the following requirements:

(1) **Emission Mask 1** — 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:
(i) On any frequency from the center of the authorized bandwidth f_o to 5.625 kHz removed from f_o: Zero dB.
(ii) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_{din} kHz) of more than 5.625 kHz but no more than 12.5 kHz: at least 7.27(f_d−2.88 kHz) dB.
(iii) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_{din} kHz) of more than 12.5 kHz: at least 50 + 10 log (P) dB or 70 dB, whichever is the lesser attenuation.

(3) **Emission Mask 3** —For transmitters designed to operate with a 25 kHz channel bandwidth that are not equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier output power (P) as follows:
(i) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fdin kHz) of more than 5 kHz, but not more than 10 kHz: at least 83 log (fd/5) dB.
(ii) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (fdin kHz) of more than 10 kHz, but not more than 250 percent of the authorized bandwidth: at least 29 log (fd2 /11) dB or 50 dB, whichever is the lesser attenuation.
(iii) On any frequency removed from the center of the authorized bandwidth by more than 250 percent of the authorized bandwidth: at least 43 + 10 log (P) dB.

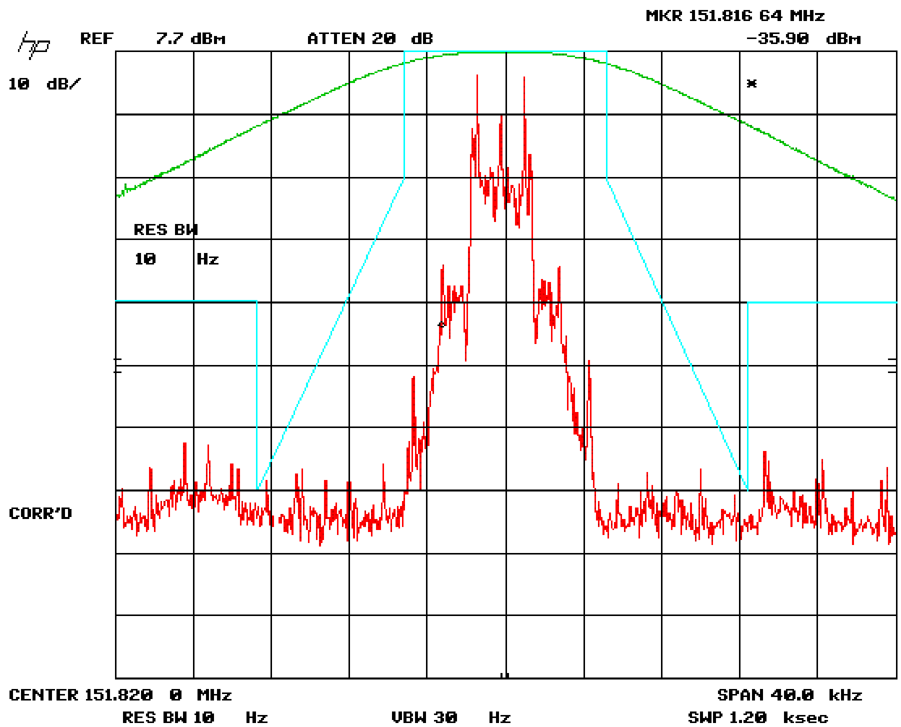


Figure 7 – Emissions Mask 1

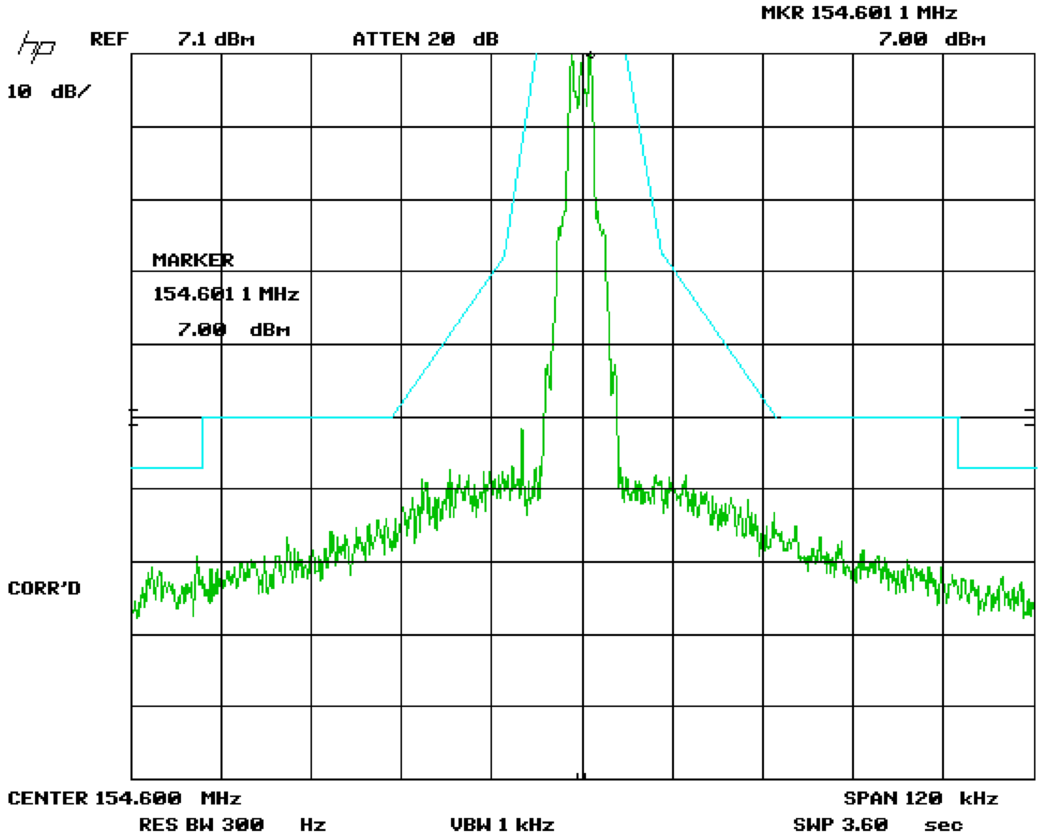


Figure 8 – Emissions Mask 3

Field strength of spurious radiation (2.1053)

Table 7 - Peak Radiated Harmonic & Spurious Emissions

Frequency MHz	Maximum RX Reading (Units A)	Recreated Reading During Substitution (Using Same Units A) - Ideally 0	Difference Column A - B	TX Gain (dBi)	TX Gain Relative to Dipole (dB)	RF Power into TX antenna (Corrected for any CL and Pads to antenna Feed Point) (dBm) (SG Value-CL)	RF Power into substitution TX antenna corrected by TX Gain Relative to Dipole (dBm)
The following applies information from test as performed							
303.63	45.2	45.2	0	4	1.86	-37.2	-35.34
455.46	40.5	40.5	0	6.1	3.96	-45	-41.04
607.278	42.7	42.7	0	6.5	4.36	-41	-36.64
759.104	36.8	36.8	0	6.1	3.96	-44	-40.04
910.88	28.5	28.5	0	6.1	3.96	-50	-46.04
1062.75	80.45	80.79	-0.34	5.5	3.36	-31	-27.98
1214.56	77.53	79.35	-1.82	5.7	3.56	-33	-31.26
1366.34	71.89	72.96	-1.07	6.3	4.16	-39	-35.91
1518.15	69.4	72.2	-2.8	7.8	5.66	-40	-37.14
309.18	43.2	45.2	-2	4	1.86	-37.2	-37.34
463.78	30.5	40.5	-10	6.1	3.96	-45	-51.04
618.38	38.16	42.7	-4.54	6.5	4.36	-41	-41.18
772.987	30.43	36.8	-6.37	6.1	3.96	-44	-46.41
927.6	32.56	28.5	4.06	6.1	3.96	-50	-41.98
1082.13	82.98	80.79	2.19	5.5	3.36	-31	-25.45
1236.73	76.55	79.35	-2.8	5.7	3.56	-33	-32.24
1391.3	70.91	72.96	-2.05	6.3	4.16	-39	-36.89
1545.9	69.27	72.2	-2.93	7.8	5.66	-40	-37.27

SAMPLE CALCULATION:
Results = Power into TX antenna – Cable loss + substitution antenna gain + Difference Column A –B
Results at 309.18 Mhz= -37.2 + 1.86 + (-2) = -37.34 dBm
Test Date: April 8, 2011
Tested By
Signature: ____________ Name: **Keyvan Muvahhid**

2.10 Frequency stability (CFR 2.1055 & CFR 95.632(c))

The frequency tolerance of the carrier signal was measured while the ambient temperature was varied from -30 to + 50 degrees centigrade. The frequency tolerance was verified at 10 degree increments. The frequency was measured within one minute after application of primary power to the transmitter and at intervals of one minute thereafter until frequency was stabilized. Additionally, the supply voltage was varied from 85% to 115% of the nominal value (except for hand carried, battery powered equipment that was measured at battery endpoint). MURS transmitters must maintain a frequency stability of 5.0 ppm, or 2.0 ppm if designed to operate with a 6.25 kHz bandwidth. Test data can be seen below. Because of the modulation, the measurements were done for frequencies below the center of the high channel where response was 3 dB down.

Note: This unit is a handheld battery powered and operated device.

Table 8 – Frequency Stability Table

Temperature (degrees C)	Measured Frequency (MHz)	Deviation (ppm)
-30	154.59925	-0.2
-20	154.59925	-0.2
-10	154.59930	0.1
0	154.59923	-0.3
10	154.59930	0.1
20	154.59928	0.0
30	154.59928	0.0
40	154.59930	0.1
50	154.59932	0.3

20 (degrees C)	Measured Freq At 20*C Fully charge	Measured Freq At 20*C End point
1 min after	151.82115	151.82110
15 min after	151.82115	151.82115
Deviation (ppm)	0.0	0.3

Test Date: April 8, 2011
Tested By
Signature: ____________ **Name:** Keyvan Muvahhid

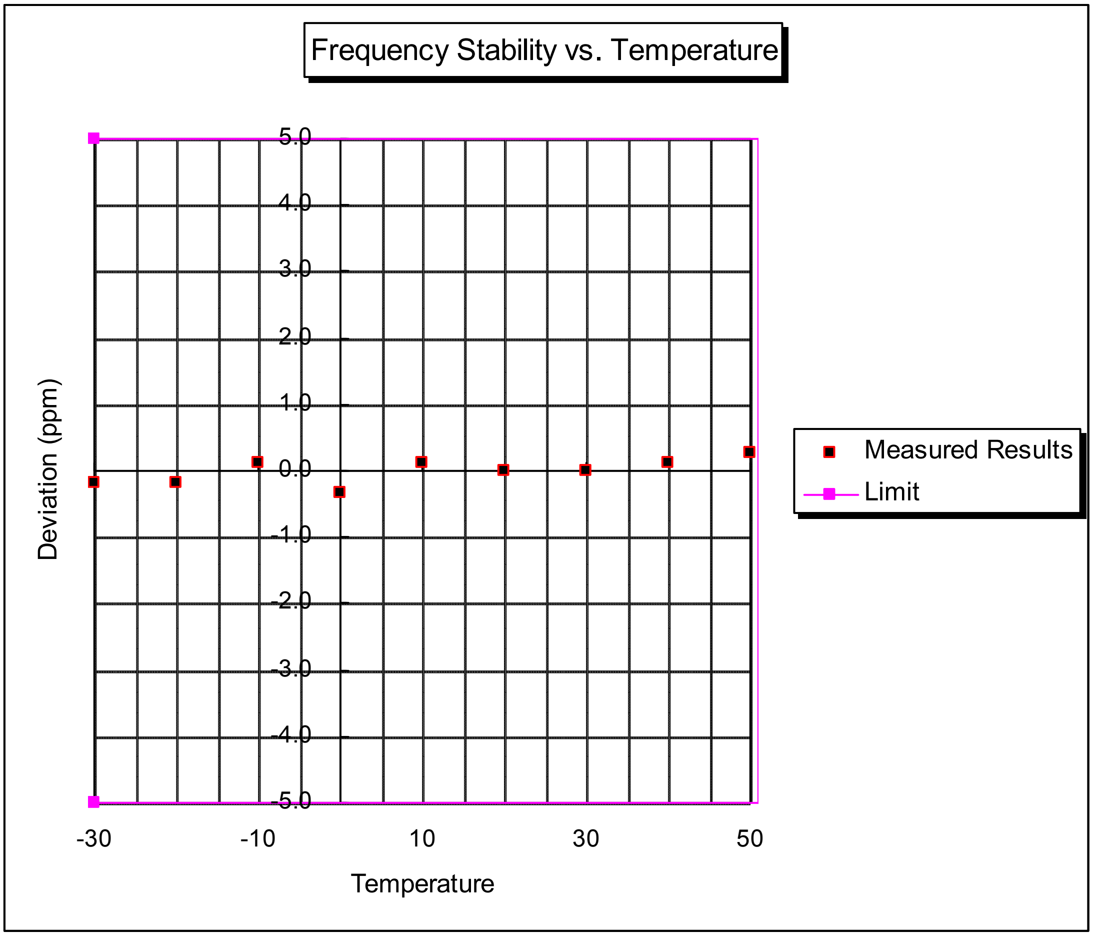


Figure 9 – Frequency Stability Chart (limit at 5.0 ppm)

2.11 Measurement Uncertainty

2.11.1 Conducted Emissions Measurement Uncertainty:

Measurement Uncertainty (within a 95% confidence level) for this test is ±2.8 dB.

2.11.2 Radiated Emissions Measurement Uncertainty:

For a measurement distance of 3 m the measurement uncertainty (with a 95% confidence level) for this test using a Biconical Antenna (30 MHz to 200 MHz) is ±5.3 dB. This value includes all elements of measurement.

The measurement uncertainty (with a 95% confidence level) for this test using a Log Periodic Antenna (200 MHz to 1000 MHz) is ±5.1 dB.

The measurement uncertainty (with a 95% confidence level) for this test using a Horn Antenna is ±5.1 dB.

2.12 Power conducted Output (CFR 15.247(b) & 95.639(h))

Peak power at each individual channel was measured per FCC KDB Publication DA 00-705 as an Antenna Conducted test with a spectrum analyzer by connecting the spectrum analyzer directly, via a short RF cable, to the antenna output terminals on the EUT. The spectrum analyzer was set for an impedance of 50 Ω with the RBW set greater than the 6 dB bandwidth of the EUT, and the VBW ≥ RBW. The loss of the short cable is 0.5 dB, and was included in spectrum analyzer reading as can be see in the offset. The final measured value is the actual corrected measurement including the 0.5 dB loss which can be seen below.

No MURS unit, under any condition of modulation, shall exceed 2 Watts transmitter power output.

Table 9 – Peak Antenna Conducted Output Power per Part 15.247 (b) (3) (Same as EIRP)

Frequency of Fundamental (MHz)	Corrected Measurement (dBm)	(mW)	FCC Limit (mW Maximum)
151.82	27.6	0.575	2000
151.88	27.7	0.589	2000
151.94	27.6	0.575	2000
154.57	27.6	0.575	2000
154.60	27.6	0.575	2000

Test Date: April 20, 2011
Tested By
Signature: ________________ Name: George Yang

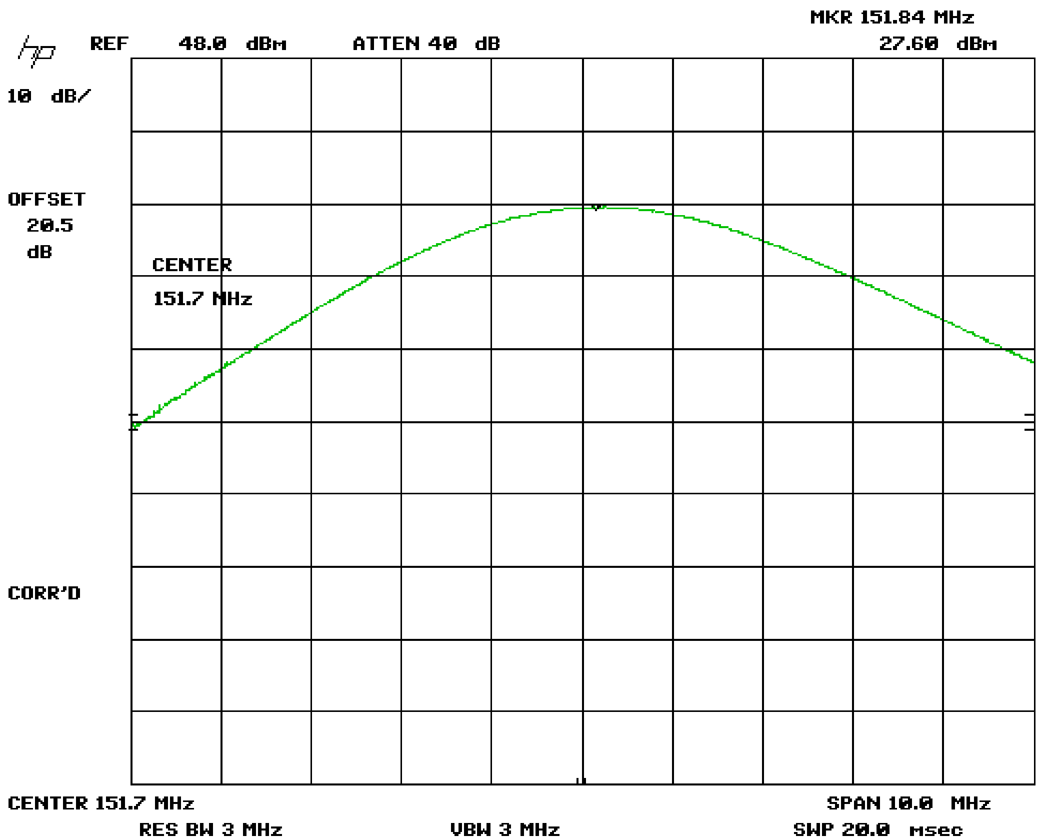


Figure 10 – Ch. 1 Conducted Output Power

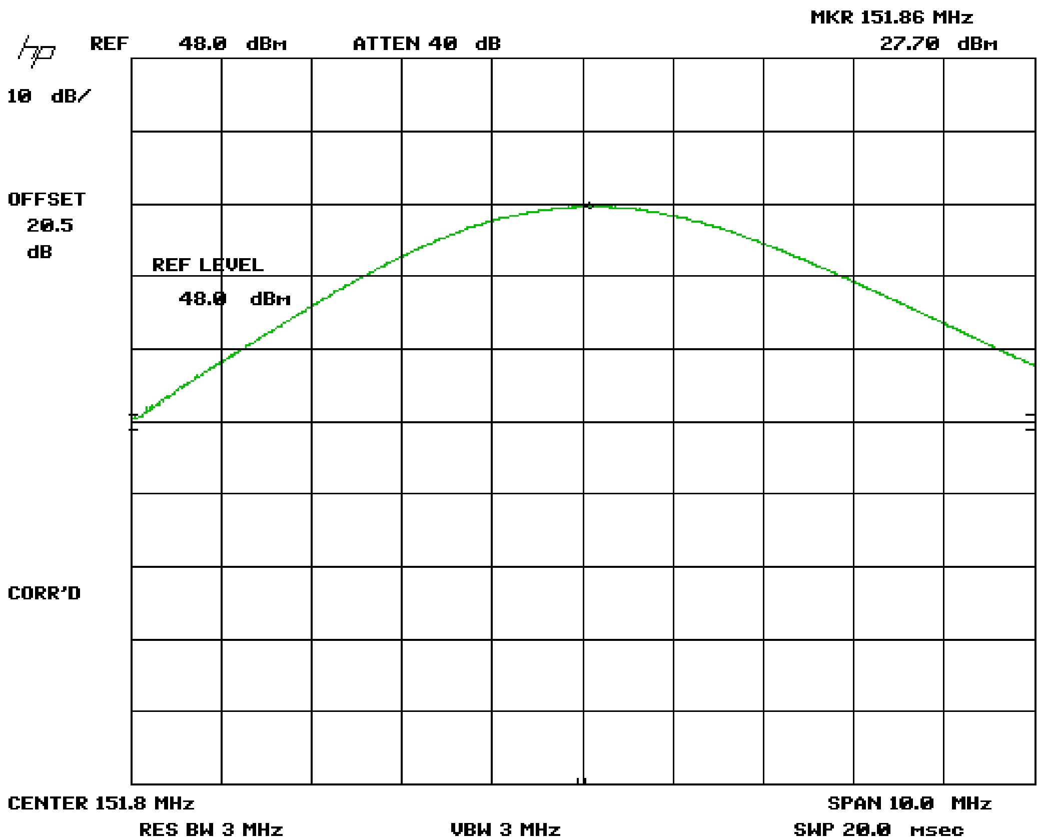


Figure 11 – Ch 2. Conducted Output Power

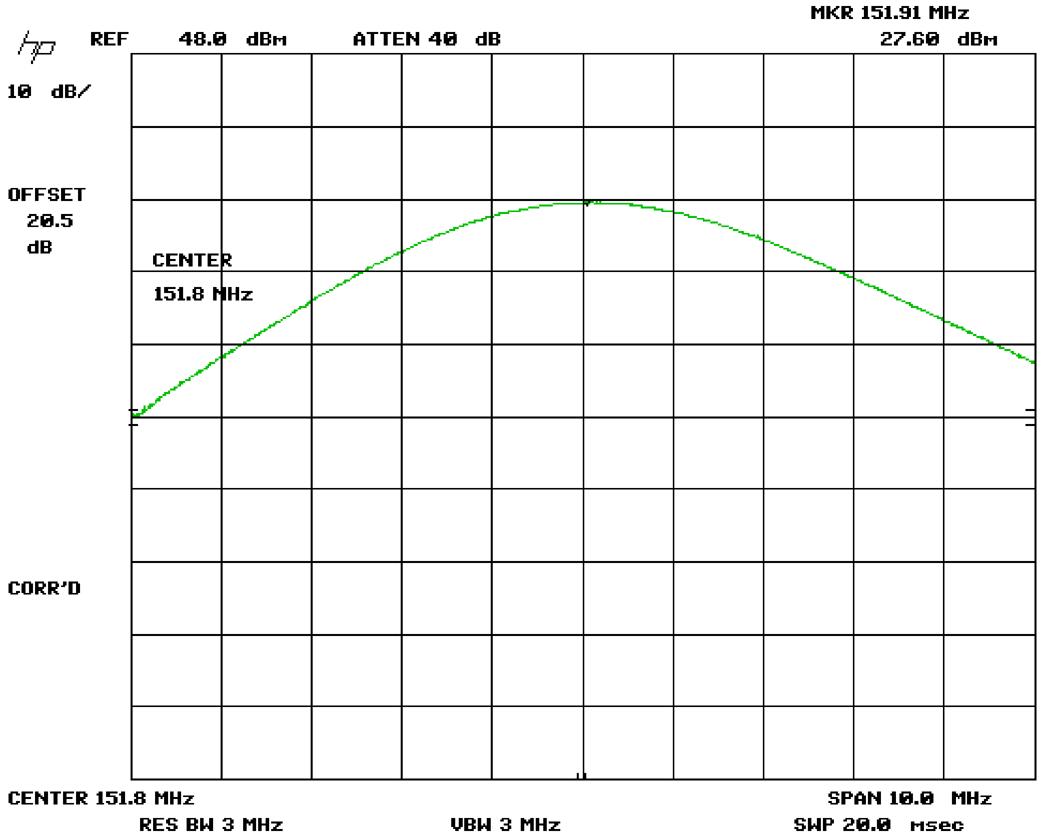


Figure 12 – Ch 3. Conducted Output Power

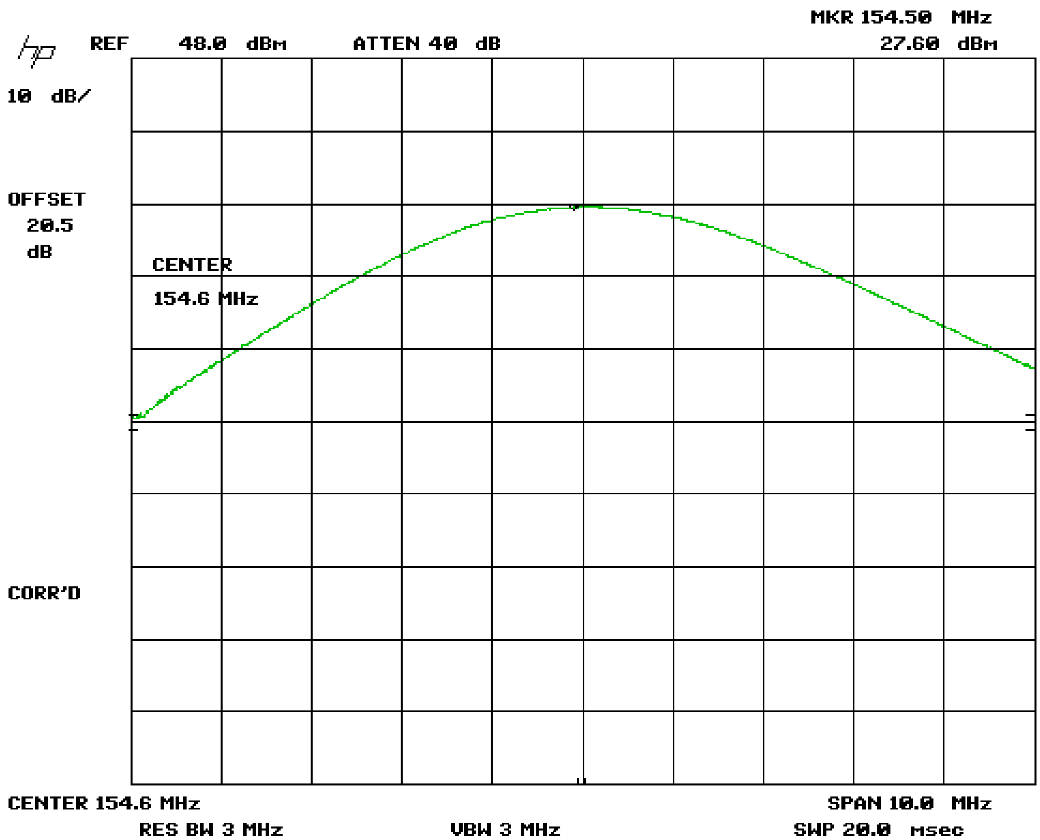


Figure 13 – Ch 4. Conducted Output Power

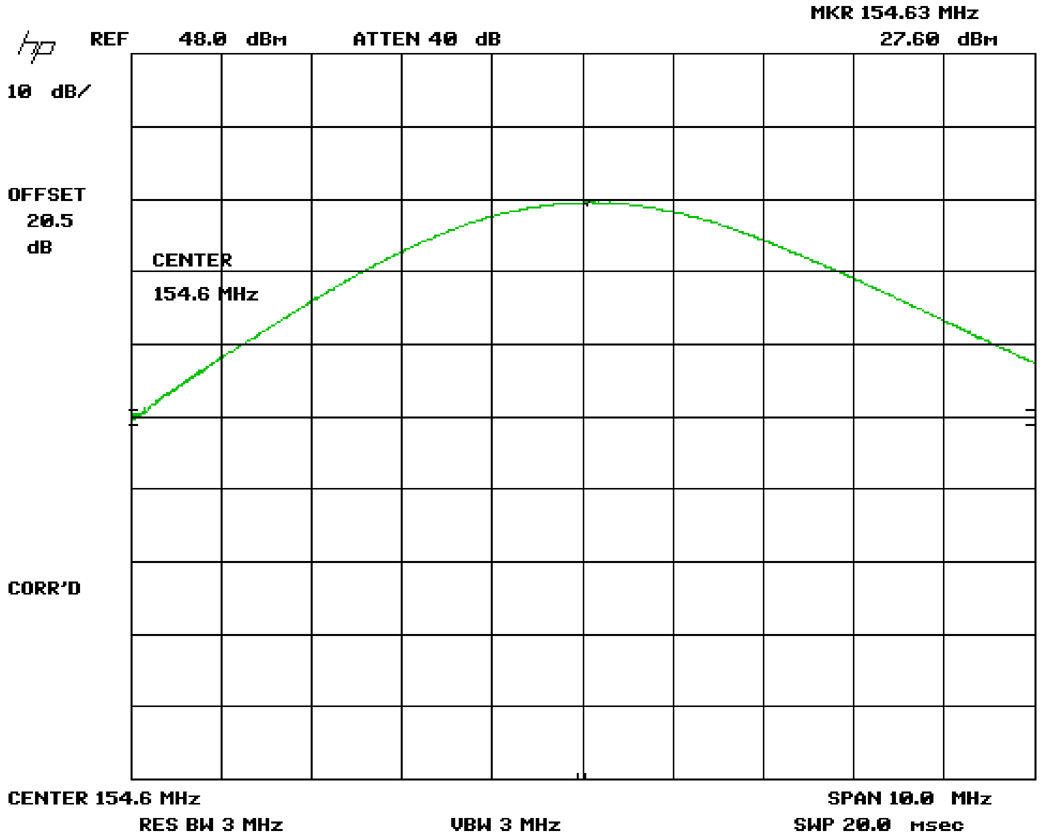


Figure 14 – Ch 5. Conducted Output Power