FCC & IC Certification Test Report

FCC & Industry Canada Certification Test Report

for

Hetronic International

FCC ID: LW9-CS458TR-1

IC ID: 2119B-CS458TR1

March 3, 2005

Revision 1: June 10, 2005

Prepared for:

Hetronic International
401 E. Memorial Road Suite 300
Oklahoma City, OK 73114

Prepared By:

Washington Laboratories, Ltd.
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FCC & Industry Canada Certification Test Report
for the
Hetronic International
CS458TR-1 Transceiver Module
FCC ID: LW9-CS458TR-1

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WLL JOB# 8360/1

Prepared by: Brian J. Dettling
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Reviewed by: Greg Snyder
Chief EMC Engineer

Abstract

This report has been prepared on behalf of Hetronic International to support the attached Application for Equipment Authorization. The test report and application are submitted for a Remote Control Transceiver under Part 90 of the FCC Rules and Regulations and Spectrum Management and Telecommunications Policy RSS-119 of Industry Canada. This Certification Test Report documents the test configuration and test results for a Hetronic International CS458TR-1 Transceiver Module.

Testing was performed on an Open Area Test Site (OATS) of Washington Laboratories, Ltd, 7560 Lindbergh Drive, Gaithersburg, MD 20879. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. The Industry Canada OATS numbers are 3035A-1 and 3035A-2 for Washington Laboratories, Ltd. Site 1 and Site 2, respectively. Washington Laboratories, Ltd. has been accepted by the FCC and approved by NIST NVLAP (NVLAP Lab Code: 200066-0) as an independent FCC test laboratory.

The Hetronic International CS458TR-1 Transceiver Module complies with the limits for a Remote Control Transceiver device under FCC Part 90 and Industry Canada RSS-119.

Revision 1 of this test report adds radiated emissions data for the receiver as requested by ATCB.

Table of Contents

List of Tables

List of Figures

1 Introduction

1.1 Compliance Statement

The Hetronic International CS458TR-1 Transceiver Module complies with the limits for a Remote Control Transceiver device under Part 90.217 of the FCC Rules and Regulations and RSS-119, Section 6.7 for Industry Canada.

1.2 Test Scope

Tests for radiated and conducted emissions were performed. All measurements were performed according to the 2003 version of ANSI C63.4. The measurement equipment conforms to ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation.

1.3 Contract Information

Customer:	Hetronic International 401 E. Memorial Road Suite 300 Oklahoma City, OK 73114
Quotation Number:	61907

1.4 Test Dates

Testing was performed from September 30, 2004 to October 1, 2004.

1.5 Test and Support Personnel

Washington Laboratories, LTD	James Ritter, Greg Snyder

2 Equipment Under Test

2.1 EUT Identification & Description

The Hetronic International CS458TR-1 is a transceiver RF module using FSK narrow band modulation. This module can work with serial data of 2400 to 9600 baud. The internal voltage regulator supports voltages of 3.4-12VDC with a current consumption of less than 50mA.

The CS458TR-1-1 has a cable with a connector that has Power (VCC) and Ground (GND) to power the module and a TTL signal line. The connector X2 has the following pins; Tx/Rx which determines if the module will function as a transmitter or a receiver; Decrement switch (for selecting frequencies when used as a transmitter)/ Green LED (when used as a receiver, this determines if the module has locked into a frequency and is receiving a signal from a compatible transmitter); and TTL-Out when used as a receiver. The antenna connector should be connected to a 50-Ohm Impedance antenna designed for the frequency in use.

Table 1. Device Summary

ITEM	DESCRIPTION
Manufacturer:	Hetronic International
FCC ID Number	LW9-CS458TR-1
IC ID Number:	2119B-CS458TR1
EUT Name:	Transceiver Module
Model:	CS458TR-1
FCC Rule Parts:	§90.217
IC Rule Parts:	RSS-119
Frequency Range:	458.500 - 459.200MHz
Maximum Output Power:	8.45mW
Modulation:	FM
Occupied Bandwidth:	10.6 kHz
Keying:	Manual
Type of Information:	Control
Number of Channels:	28
Power Output Level	Fixed
Antenna Type	Connector
Frequency Tolerance:	<5ppm
Emission Type(s):	16K2F1D
Interface Cables:	None
Power Source & Voltage:	3.4 -12Vdc (tested at 5Vdc)

2.2 Test Configuration

Transmitter: The transceiver module was tested in a stand-alone configuration and provided 5 Volts input to power the board. The transmit frequency was set to the center channel at 458.9MHz.

2.3 Testing Algorithm

The CS458TR1 was provided 5 Vdc input to the power board. In addition a 4800 Hz TTL signal was injected into the TTL input on board. This input caused a 2.75kHz FM deviation as measured by a Boonton Modulation analyzer.

Worst case emission levels are provided in the test results data.

2.4 Test Location

All measurements herein were performed at Washington Laboratories, Ltd. test center in Gaithersburg, MD. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. The Industry Canada OATS numbers are 3035A-1 and 3035A-2 for Washington Laboratories, Ltd. Site 1 and Site 2, respectively. Washington Laboratories, Ltd. has been accepted by the FCC and approved by NIST NVLAP (NVLAP Lab Code: 200066-0) as an independent FCC test laboratory.

2.5 Measurements

2.5.1 References

ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation

ANSI C63.4 American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

Land Mobile FM or PM Communications Equipment Measurement and Performance Standards (ANSI/TIA/EIA-603-93)

2.6 Measurement Uncertainty

All results reported herein relate only to the equipment tested. For the purposes of the measurements performed by Washington Laboratories, the measurement uncertainty is ±2.3 dB. This has been calculated for a *worst-case situation* (radiated emissions measurements performed on an open area test site).

The following measurement uncertainty calculation is provided:

$$\text{Total Uncertainty} = (A^2 + B^2 + C^2)^{1/2}/(n-1)$$

where:

A = Antenna calibration uncertainty, in dB = 2 dB

B = Spectrum Analyzer uncertainty, in dB = 1 dB

C = Site uncertainty, in dB = 4 dB

n = number of factors in uncertainty calculation = 3

Thus, Total Uncertainty = $0.5\ (2^2 + 1^2 + 4^2)^{1/2} = \pm 2.3$ dB.

3 Test Equipment

Table 2 shows a list of the test equipment used for measurements along with the calibration information.

Table 2: Test Equipment List

Equipment	WLL Asset #	Calibration Due
Hewlett-Packard 8568B Spectrum Analyzer	0073	7/08/05
Hewlett-Packard 85650A Quasi-Peak Adapter	0069	7/08/05
Hewlett-Packard 8593A Spectrum Analyzer	0074	8/17/05
Hewlett-Packard 8449B Microwave Preamp	0066	2/11/05
ARA LPB-2520 BiconiLog Antenna	0007	9/14/05
ARA DRG118/A Microwave Horn Antenna	0004	2/17/06
Hewlett-Packard 85685A RF Preselector	0071	7/08/05
EMCO 3110B Biconical Antenna	0026	6/22/05
A.H. Systems SAS-200/518 Log Periodic Antenna	0001	3/11/06
Rhode & Schwarz SMT 06 Signal Generator	0478	7/15/05
Racal-Dana 1992 Frequency Counter	0117	5/10/05
Hewlett-Packard 8563A Spectrum Analyzer	2634A02888	4/14/05
Boonton 82AD/01A/S10/S13 FM/AM Modulation Meter	167219	4/14/05
B&K Precision 4040A Sweep/Function Generator	0110-0132	N/A
Tektronix Oscilloscope; 1GHz, 4 CH, DPO	B010043	9/5/04
ARA DRG118/A Microwave Horn Antenna	1010	2/17/06
Sunol JB1 Biconlog Antenna	A090501	10/21/04
DANA- RACAL 1992 Frequency Counter	2806	5/10/05
Global specialties 1337 DC Power Supply	99503012	N/A

4 Test Results

4.1 RF Power Output: (FCC Part §2.1046, Industry Canada RSS-119, 6.7)

The output from the transmitter was connected to an attenuator and then to the input of the RF Spectrum Analyzer. The analyzer offset was adjusted to compensate for the attenuator and other losses in the system.

Bandreject and or high pass filters were installed to suppress the carrier to assure that measuring instrumentation would remain linear and that dynamic range requirements were met.

Table 3. RF Power Output

Frequency	Level	Limit (Part 90.217, RSS-119, 6.7)	Pass/Fail
Mid Channel: 458.9MHz	9.27dBm (8.45mW)	120mW	Pass

4.2 Occupied Bandwidth: (FCC Part §2.1049 and Industry Canada RSS-119, 6.7)

Occupied bandwidth was performed by coupling the output of the EUT to the input of a spectrum analyzer via a direct connection through an attenuator.

At the maximum data rate of 9600bps the occupied bandwidth was measured as shown in Figure 1. The modulating signal used to supply the 9600bps was a 4800 Hz TTL signal. This input caused a 2.75kHz FM deviation measured by a Boonton Modulation analyzer. Calculations of the necessary bandwidth follow the bandwidth plot.

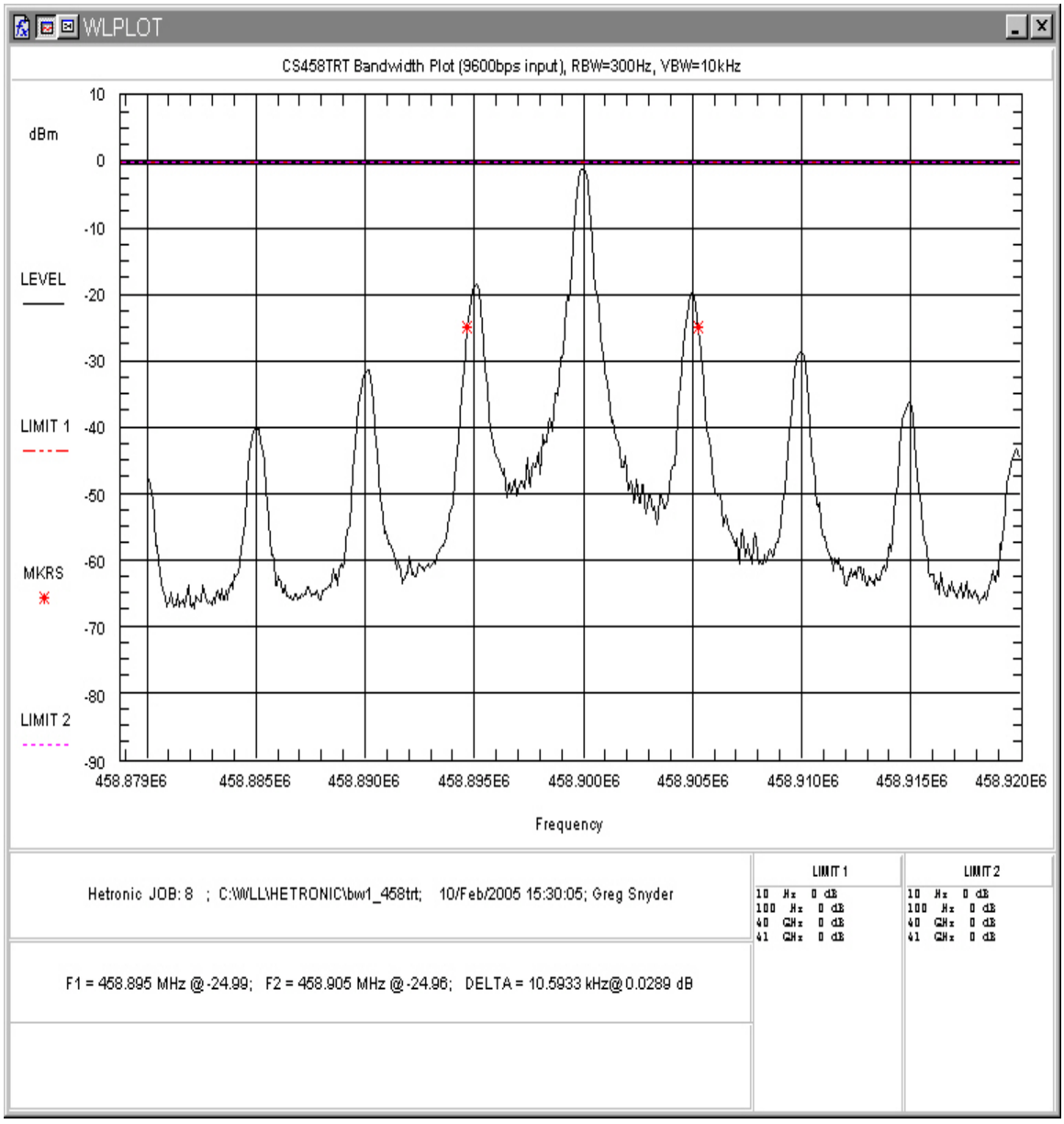

Figure 1. Occupied Bandwidth

Table 4 provides a summary of the Occupied Bandwidth Results.

Table 4. Occupied Bandwidth Results

Frequency	Bandwidth
Mid Channel: 458.9MHz	10.6kHz

The necessary bandwidth is then calculated as follows:

Bn = 2M + 2DK (K = 1.2)

2(4800) + 2(2750)(1.2) = 16.2kHz

The emission designator is then determined to be:

16K2F1D

4.3 Spurious Emissions at Antenna Terminals (FCC Part §90.217 and Industry Canada RSS-119, 6.7)

The EUT must comply with requirements for spurious emissions at antenna terminals per the limit specified in §90.217 and IC RSS-119 Section 6.7.

The power output from this device is less than 120 mW and hence the device need only comply with the requirements of FCC Part 90.217, following:

> Except as noted herein, transmitters used at stations licensed below 800 MHz on any frequency listed in subparts B and C of this part or licensed on a business category channel above 800 MHz which have an output power not exceeding 120 milliwatts are exempt from the technical requirements set out in this subpart, but must instead comply with the following:
>
> (a) For equipment designed to operate with a 25 kHz channel bandwidth, the sum of the bandwidth occupied by the emitted signal plus the bandwidth required for frequency stability shall be adjusted so that any emission appearing on a frequency 40 kHz or more removed from the assigned frequency is attenuated at least 30 dB below the unmodulated carrier.
>
> (b) For equipment designed to operate with a 12.5 kHz channel bandwidth, the sum of the bandwidth occupied by the emitted signal plus the bandwidth required for frequency stability shall be adjusted so that any emission appearing on a frequency 25 kHz or more removed from the assigned frequency is attenuated at least 30 dB below the unmodulated carrier.
>
> (c) For equipment designed to operate with a 6.25 kHz channel bandwidth, the sum of the bandwidth occupied by the emitted signal plus the bandwidth required for frequency stability shall be adjusted so that any emission appearing on a frequency 12.5 kHz or more removed from the assigned frequency is attenuated at least 30 dB below the unmodulated carrier.
>
> (d) Transmitters may be operated in the continuous carrier transmit mode.

As this device is designed to operate with a 25kHz channel the spurious emissions appearing on a frequency 40kHz or more removed form the assigned frequency must be attenuated 30dB below the unmodulated carrier.

The output of the EUT was connected to the input of a spectrum analyzer and the spectrum was investigated up to the 10 harmonic. Attenuators and cable losses were accounted for in the obtained level. The limit was calculated as follows:

Spurious emission limit = Unmodulated carrier power – 30dB

Spurious emission limit = 9.45dBm – 30dB = -20.55dBm

Plots of the conducted spurious emissions follow.

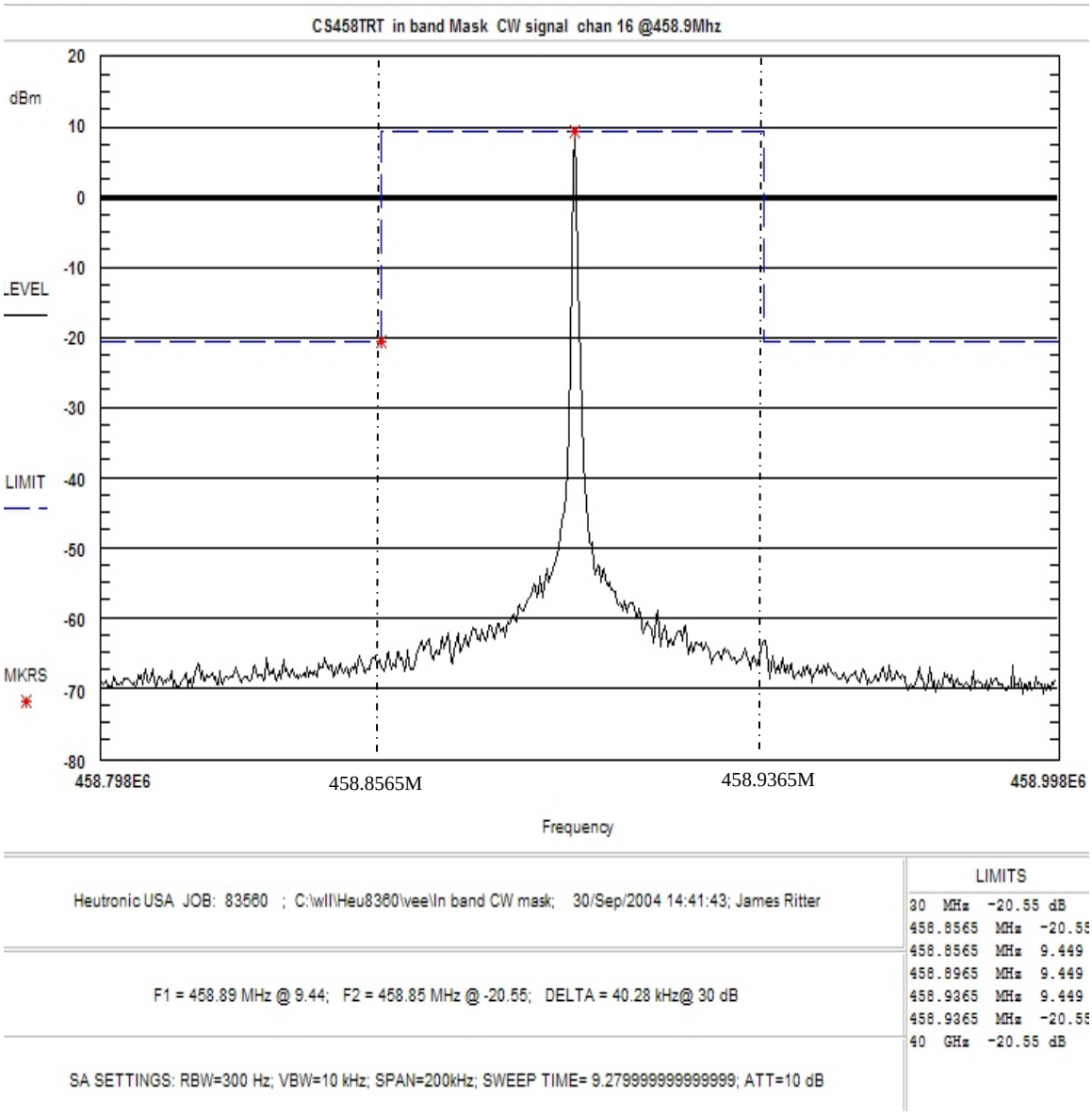

Figure 2. Part 90.217 and RSS-119 Mask. Unmodulated Carrier

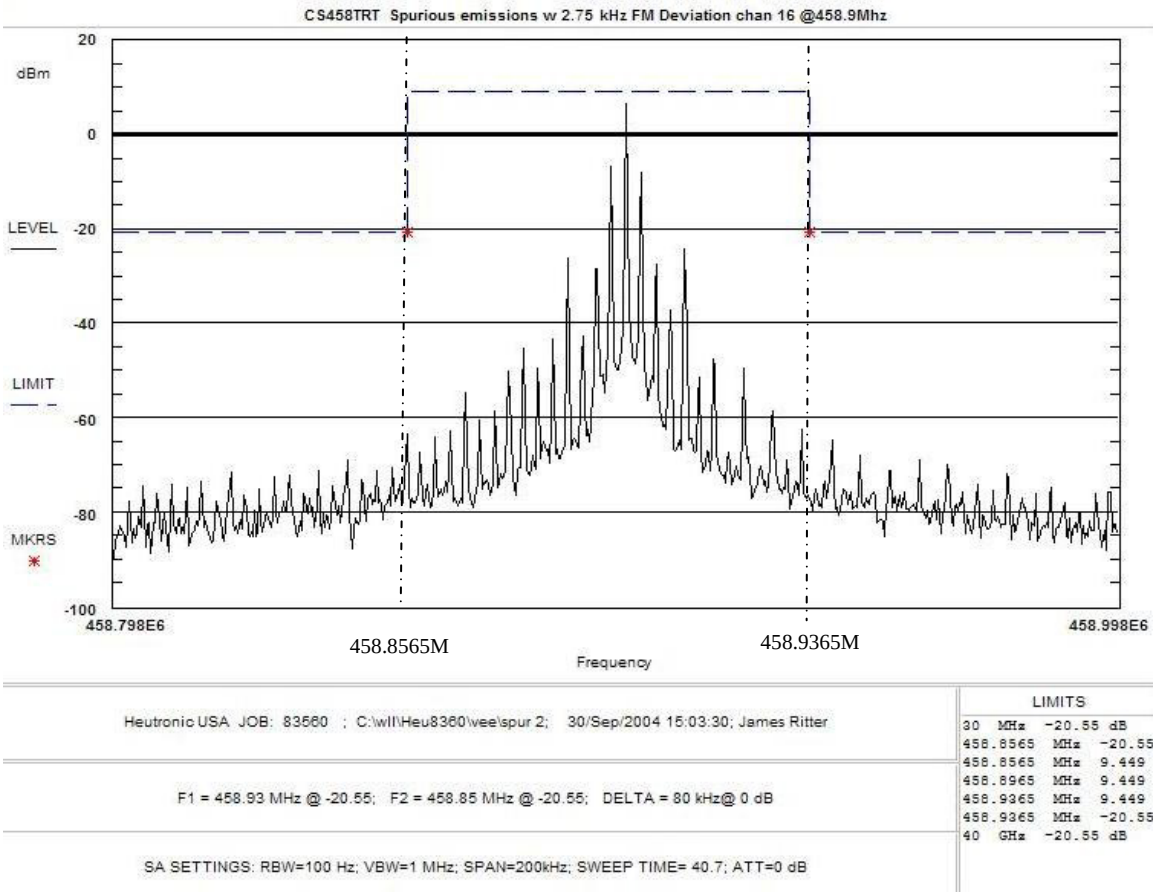

Figure 3. Conducted Spurious Emissions, Mask

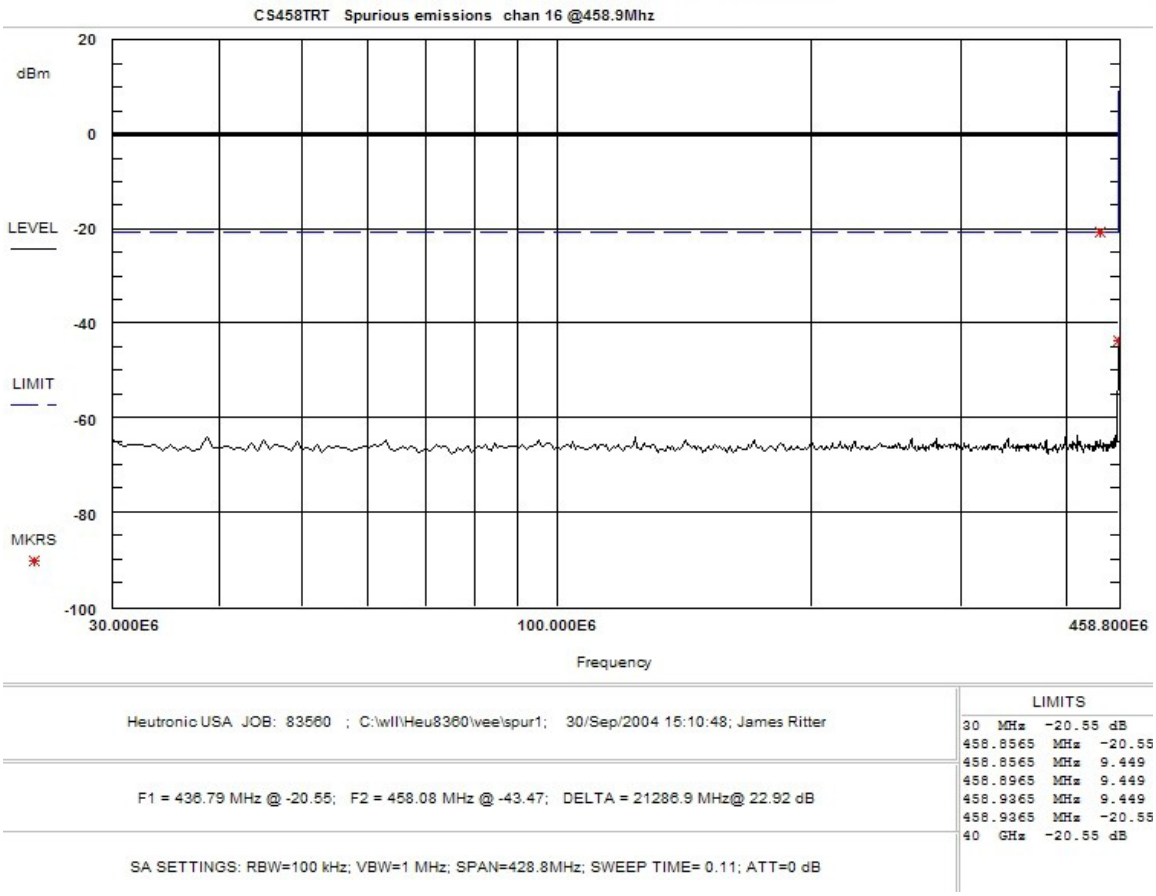

Figure 4. Conducted Spurious Emissions, 30M – 458.8MHz

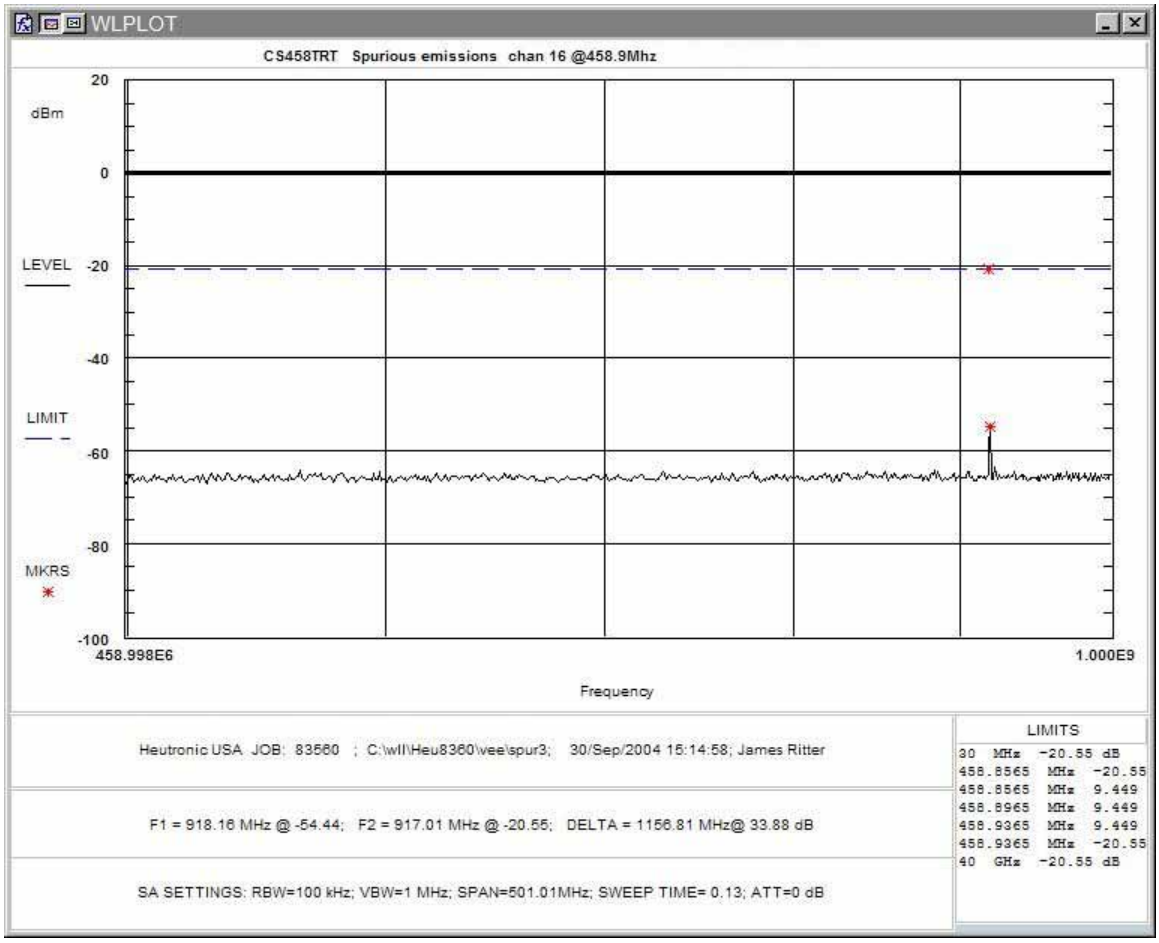

Figure 5. Conducted Spurious Emissions, 459M – 1GHz

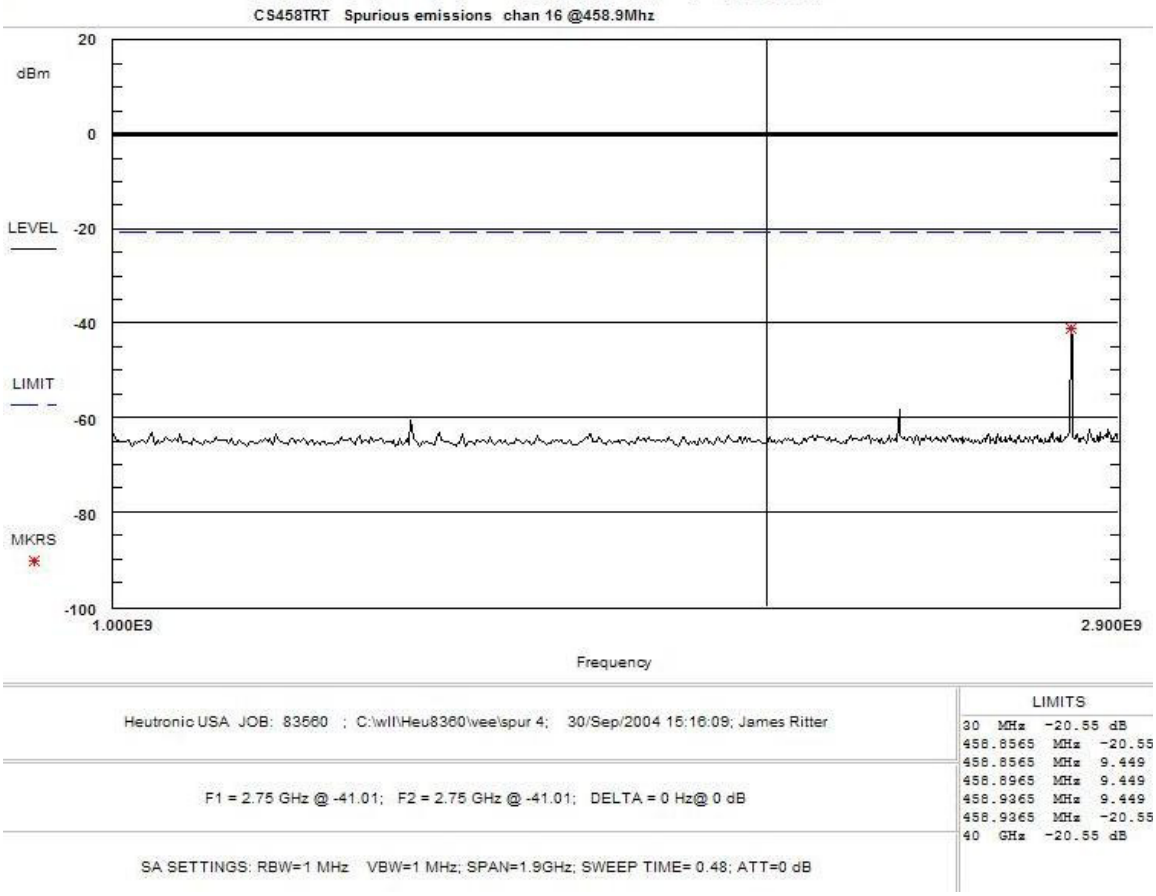

Figure 6. Conducted Spurious Emissions, 1G – 2.9GHz

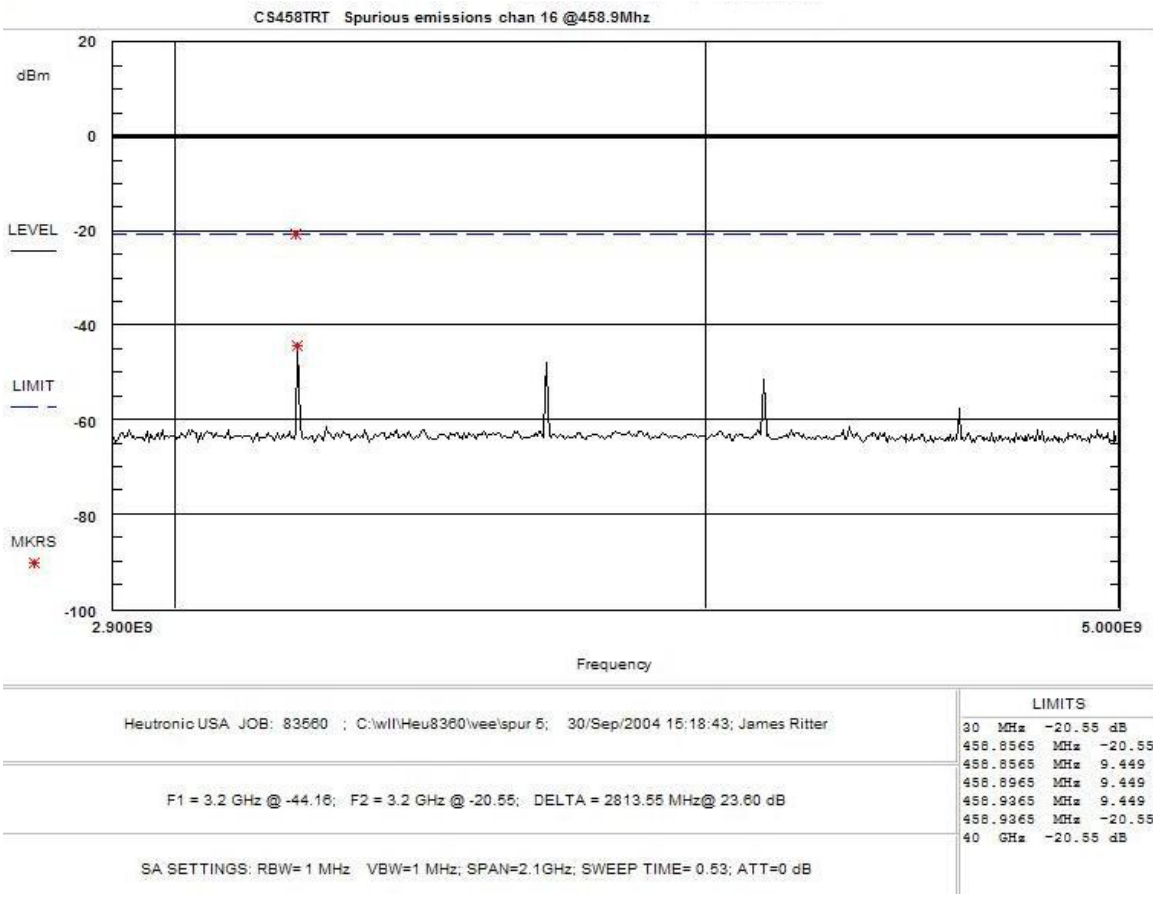

Figure 7. Conducted Spurious Emissions, 2.9G – 5GHz

4.4 Radiated Spurious Emissions: (FCC Part §90.217 and Industry Canada RSS-119, 6.7)

The EUT must comply with requirements for radiated spurious emissions emanating from the case.

4.4.1 Test Procedure

The EUT was placed on motorized turntable for radiated testing on a 3-meter open field test site. The output of the transmitter was terminated into a 50ohm load. The emissions from the EUT were measured continuously at every azimuth by rotating the turntable. Receiving antennas were mounted on an antenna mast to determine the height of maximum emissions. The height of the antenna was varied between 1 and 4 meters. Cables were varied in position to produce maximum emissions. Both the horizontal and vertical field components were measured.

The spurious emission levels were measured and compared with the limit of FCC Part 90. As the unit was tested with the output terminated the absolute limit for the spurious emissions was calculated using 50+10Log(TP).

Emissions were scanned up to the 10^{th} harmonic of the fundamental. The unit was tested in three orthogonal planes with the highest emissions for each emission detected reported. The signal substitution method per TIA/EIA-603 was used to obtain EIRP levels.

The limit is calculated as follows:

Output Power = 8.45mW = 9.27dBm

Limit = 9.27dBm – (50+10Log(00845W)) = -20dBm (ERP)

Table 5: Radiated Emission Test Data

CLIENT:	Hetronic USA	DATE:	10/1/04
TESTER:	James Ritter	JOB #:	8360
EUT Information:		**Test Requirements:**	
EUT:	CS458TRT	TEST STANDARD:	FCC 90.217, RSS-119
CONFIGURATION:	TX at 458.9MHz CH 16	DISTANCE:	3m
Test Equipment/Limit:			
ANTENNA:	A_00007	LIMIT:	ERP
CABLE:	CSITE2_3m	AMPLIFIER (dB)	0066

Frequency (MHz)	Polarity H/V	Az Deg	Ant. Hght (m)	SA Level (dBµV)	Ant. Gain dBd	Sig. Gen. Level dBm	ERP Level dBm	Limit dBm	Margin dB
371.85	V	90.0	1.4	4.4	4.6	-70.5	-65.9	-20	-45.9
399.83	V	0.0	3.0	3.6	5	-74.4	-69.4	-20	-49.4
917.85	V	0.0	1.5	2.2	4.1	-68.8	-64.7	-20	-44.7
1835.59	V	10.0	1.0	40.8	3.7	-67.6	-63.9	-20	-43.9
2294.50	V	0.0	1.0	38.5	3.3	-45.9	-42.6	-20	-22.6
2753.40	V	350.0	1.0	52.7	2.3	-45.9	-43.6	-20	-23.6
3212.30	V	0.0	1.0	47.3	3	-48.3	-45.3	-20	-25.3
3671.16	V	350.0	1.0	44.7	4.2	-44.9	-40.7	-20	-20.7
4130.11	V	0.0	1.0	52.0	4.1	-40.2	-36.1	-20	-16.1
4589.00	V	0.0	1.0	47.5	5.3	-46.2	-40.9	-20	-20.9
371.85	H	90.0	1.5	4.0	4.6	-74.6	-70	-20	-50
399.83	H	0.0	1.2	0.5	3.5	-76.7	-73.2	-20	-53.2
917.85	H	20.0	3.2	3.2	4.1	-68	-63.9	-20	-43.9
1835.59	H	0.0	1.0	40.8	3.7	-59.7	-56	-20	-36
2294.50	H	350.0	1.0	39.2	3.3	-57.7	-54.4	-20	-34.4
2753.40	H	350.0	1.0	53.3	2.3	-48.5	-46.2	-20	-26.2
3212.30	H	270.0	1.0	48.5	3	-52.7	-49.7	-20	-29.7
3671.16	H	0.0	1.0	45.0	4.2	-46.1	-41.9	-20	-21.9
4130.11	H	0.0	1.0	48.5	4.1	-45.7	-41.6	-20	-21.6
4589.00	H	10.0	1.0	49.3	5.3	-45.2	-39.9	-20	-19.9

4.5 Receiver Spurious Emissions

The EUT must comply with requirements for receiver spurious emissions. The limits for spurious emissions are defined in section 8 of RSS-119.

4.5.1 Test Procedure

To measure the spurious emissions of the receiver the output of the EUT was connected to the input of a spectrum analyzer. The frequency was swept from 30M – 1GHz and the emissions were compared to the limit of 2nW. For radiated spurious emissions the same procedure as described in Section 4.4.1 was used.

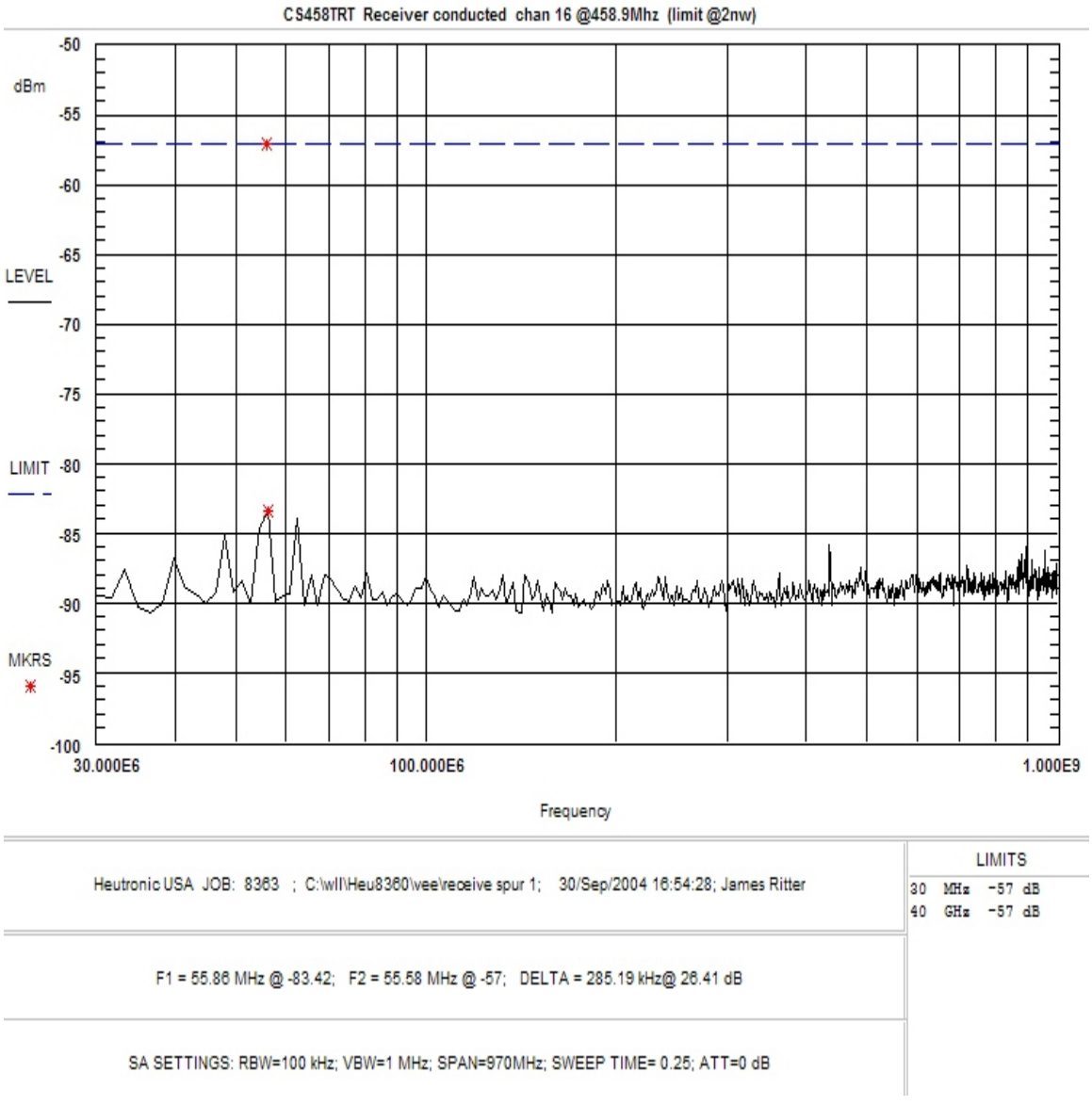

Figure 8. Receiver Spurious Emissions

Table 6: Receiver Radiated Spurious Emissions

CLIENT: *Heutronic USA* DATE: *10/18/04*
TESTER: *James Ritter* JOB #: *8361*

EUT Information: **Test Requirements:**
EUT: *CS458TRT* TEST STANDARD: *FCC Part 15/RSS-210*
CONFIGURATION: *Receive mode* DISTANCE: *3m*
CLOCKS: *3.686, 8 Mhz, LO@ 437.193MHz* CLASS: *B*

Test Equipment/Limit:
ANTENNA: A_00007 LIMIT: LFCC_3m_Class_B
CABLE: CSITE2_3m AMPLIFIER (dB) None

Frequency (MHz)	Polarity H/V	Azimuth Degree	Ant. Height (m)	SA Level (dBµV)	Ant. Corr. (dB/m)	Cable Corr. (dB)	Corr. Level dBµV/m	Corr. Level µV/m	Limit µV/m	Margin dB
47.96	H	0.0	4.0	8.5	14.4	1.3	24.2	16.1	100.0	-15.8
61.95	H	270.0	3.2	4.9	9.4	1.4	15.7	6.1	100.0	-24.3
114.41	H	10.0	1.5	12.9	10.8	1.7	25.4	18.7	150.0	-18.1
123.93	H	0.0	1.5	15.5	10.6	1.8	27.9	24.8	150.0	-15.6
221.17	H	0.0	3.0	4.7	11.2	2.3	18.2	8.1	200.0	-27.9
235.91	H	270.0	1.8	7.4	11.7	2.4	21.5	11.9	200.0	-24.5
314.64	H	0.0	2.7	2.5	13.1	2.7	18.3	8.2	200.0	-27.7
390.91	H	320.0	2.5	7.2	14.5	3.0	24.6	17.0	200.0	-21.4
437.20	**H**	**270.0**	**3.0**	**11.8**	**15.4**	**4.1**	**31.2**	**36.4**	**200.0**	**-14.8**
735.23	H	0.0	1.3	5.7	19.5	4.0	29.2	28.8	200.0	-16.8
874.38	H	0.0	1.5	2.8	20.5	4.4	27.7	24.3	200.0	-18.3
47.96	V	0.0	1.0	9.2	14.4	1.3	24.9	17.5	100.0	-15.1
61.95	V	45.0	1.2	6.7	9.4	1.4	17.5	7.5	100.0	-22.5
114.41	V	270.0	1.0	12.8	10.8	1.7	25.3	18.5	150.0	-18.2
120.00	V	0.0	1.2	4.2	10.9	1.8	16.9	7.0	150.0	-26.6
123.93	V	350.0	1.2	14.9	10.6	1.8	27.3	23.1	150.0	-16.2
221.17	V	90.0	1.5	9.4	11.2	2.3	22.9	13.9	200.0	-23.2
314.64	V	45.0	3.0	4.9	13.1	2.7	20.7	10.8	200.0	-25.3
390.91	V	180.0	2.4	4.3	14.5	3.0	21.7	12.2	200.0	-24.3
437.20	**V**	**0.0**	**2.5**	**12.4**	**15.4**	**4.1**	**31.8**	**39.0**	**200.0**	**-14.2**
735.23	V	0.0	2.5	1.6	19.5	4.0	25.1	18.0	200.0	-20.9
874.38	V	0.0	3.0	5.2	20.5	4.4	30.1	32.0	200.0	-15.9

4.6 Frequency Stability: (FCC Part §2.1055 and Industry Canada RSS-119, 6.7)

Frequency as a function of temperature and voltage variation shall be maintained within the FCC-prescribed tolerances.

The temperature stability was measured with the unit in an environmental chamber used to vary the temperature of the sample. The sample was held at each temperature step to allow the temperature of the sample to stabilize.

The EUT is powered by DC voltage supplied externally. The manufacturer's power requirements for the EUT include the following:

Low DC Voltage of 3.4Vdc (manufacturer's specification)

High DC Voltage of 12Vdc (manufacturer's specifications)

The frequency stability of the transmitter was examined at the voltage extremes and for the temperature range of -30°C to +50°C. The carrier frequency was measured while the EUT was in the temperature chamber. The reference frequency of the EUT was measured at the ambient room temperature with the frequency counter. The EUT was tested at Mid Channel, 458.9MHz.

Frequency Stability: 5ppm = 5 * 458.9 MHz = 2295 Hz

Table 7. Frequency Deviation as a Function of Temperature

Temperature (Celsius)	Frequency (MHz)	Difference (Hz)	Deviation (%)
Mid Channel	458.897825	0.0	0
-30	458.896690	-1135.0	0.000247
-20	458.898433	608.0	0.000132
-10	458.899034	1209.0	0.000263
0	458.899156	1331.0	0.000290
10	458.898865	1040.0	0.000227
20	458.898212	387.0	0.000084
30	458.897434	-391.0	0.000085
40	458.896642	-1183.0	0.000258
50	458.896023	-1802.0	0.000393

Table 8. Frequency Deviation as a Function of Voltage

Voltage Volts	Frequency MHz	Difference Hz	Deviation (%)
At rated (5VDC)	458.897317	0	0.0
3.4 VDC	458.897327	-10	0.000002
12VDC	458.897335	-18	0.000004