FCC & IC Certification Test Report

FCC & Industry Canada Certification Test Report

for

Hetronic International

FCC ID: LW9-CS458TXN

IC ID: 2219B-CS458TXN

October 22, 2004

December 15, 2004 (Rev. 1)

February 15, 2005 (Rev. 2)

Prepared for:

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

Prepared By:

Washington Laboratories, Ltd.
7560 Lindbergh Drive
Gaithersburg, Maryland 20879

FCC & Industry Canada Certification Test Report
for the
Hetronic International
CS458TXN Transmitter Module
FCC ID: LW9-CS458TXN
IC ID: 2219B-CS458TXN

October 22, 2004

WLL JOB# 8321/2

Prepared by: Brian J. Dettling
Documentation Specialist

Reviewed by: Michael F. Violette
President

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 an Intentional Radiator 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 CS458TXN Transmitter Module.

The transmitter was tested under §90.217 of the FCC Rules and Regulations.

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 CS458TXN Transmitter Module complies with the limits for an Intentional Radiator device under FCC Part 90 and Industry Canada RSS-119.

Revision 2 of this test report corrects the Occupied Bandwidth plot by using an input signal equal to the maximum specified data rate of 9600bps. Additionally, the Necessary Bandwidth and emissions designator have been calculated.

Table of Contents

Abstract ii
1 Introduction 1
1.1 Compliance Statement 1
1.2 Test Scope 1
1.3 Contract Information 1
1.4 Test Dates 1
1.5 Test and Support Personnel 1
1.6 Abbreviations 2
2 Equipment Under Test 3
2.1 EUT Identification & Description 3
2.2 Test Configuration 3
2.3 Testing Algorithm 3
2.4 Test Location 4
2.5 Measurements 4
2.5.1 References 4
2.6 Measurement Uncertainty 4
3 Test Equipment 5
4 Test Results 6
4.1 RF Power Output: (FCC Part §2.1046) 6
4.2 Occupied Bandwidth: (FCC Part §2.1049) 8
4.3 Radiated Spurious Emissions: (FCC Part §2.1053) 10
4.3.1 Test Procedure 10
4.4 Frequency Stability: (FCC Part §2.1055) 12

List of Tables

Table 1. Device Summary 3
Table 2: Test Equipment List 5
Table 3. RF Power Output 6
Table 4. Occupied Bandwidth Results 9
Table 5: Radiated Emission Test Data 11
Table 6. Frequency Deviation as a Function of Temperature 12
Table 7. Frequency Deviation as a Function of Voltage 13

List of Figures

Figure 1. Part 90.217 Mask. Unmodulated Carrier 8
Figure 2. Part 90.217 Mask. Modulated Carrier 8
Figure 3. Occupied Bandwidth 9

1 Introduction

1.1 Compliance Statement

The Hetronic International CS458TXN Transmitter Module complies with the limits for an Intentional Radiator device under Part 90 of the FCC Rules and Regulations.

1.2 Test Scope

Tests for radiated emissions were performed. All measurements were performed according to the 2001 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
Purchase Order Number:	14409
Quotation Number:	61833

1.4 Test Dates

Testing was performed from September 2 to September 9, 2004.

1.5 Test and Support Personnel

Washington Laboratories, LTD	Greg Snyder, James Ritter

1.6 Abbreviations

A	Ampere
Ac	alternating current
AM	Amplitude Modulation
Amps	Amperes
b/s	bits per second
BW	Bandwidth
CE	Conducted Emission
cm	centimeter
CW	Continuous Wave
dB	decibel
dc	direct current
EMI	Electromagnetic Interference
EUT	Equipment Under Test
FM	Frequency Modulation
G	giga - prefix for 10^9 multiplier
Hz	Hertz
IF	Intermediate Frequency
k	kilo - prefix for 10^3 multiplier
M	Mega - prefix for 10^6 multiplier
m	Meter
μ	micro - prefix for 10^{-6} multiplier
NB	Narrowband
LISN	Line Impedance Stabilization Network
RE	Radiated Emissions
RF	Radio Frequency
rms	root-mean-square
SN	Serial Number
S/A	Spectrum Analyzer
V	Volt

2 Equipment Under Test

2.1 EUT Identification & Description

The Hetronic International CS458TXN Transmitter Module is an improved version of the previous CS458TX module. It is a synthesized, FM narrow band transmitter module that operates in the frequency range of 458.800 to 459.175 MHz. The module is intended to be used in wireless remote controls for cranes, hoists, etc. The module contains 28 selectable transmit frequencies (25 kHz apart) which are selected by means of a DIP switch. The EUT contains a header for antenna connection and DC power/data input. The unit is powered by an external DC power source that is typically supplied by a battery.

Table 1. Device Summary

ITEM	DESCRIPTION
Manufacturer:	Hetronic International
FCC ID Number	LW9-CS458TXN
IC ID Number:	2219B-CS458TXN
EUT Name:	Transmitter Module
Model:	CS458TXN
FCC Rule Parts:	§90.217
IC Rule Parts:	RSS119
Frequency Range:	458.5 to 459.2MHz
Maximum Output Power:	39.8 mW (EIRP)
Modulation:	FM
Occupied Bandwidth:	10.6kHz
Keying:	Manual
Type of Information:	Control
Number of Channels:	28
Power Output Level	Fixed
Antenna Type	Permanently attached
Frequency Tolerance:	<0.03%
Emission Type(s):	FSK
Interface Cables:	None
Power Source & Voltage:	3.4 – 12Vdc from battery – tested at 5.5Vdc

2.2 Test Configuration

The CS458TXN was tested in a stand-alone configuration. A power supply provided 5Vdc and the unit was set to Channel 16 @ 458.9 MHz via board dip switches.

2.3 Testing Algorithm

The CS458TXN was provided 5 Vdc input to the power board. In addition a 4.8kHz TTL signal was injected into the TTL input on board. This input caused a 2.7kHz FM

deviation measured by a Boonton Modulation meter. As the antenna was permanently attached all measurements were performed radiated.

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

Site 2 List:

Equipment	**Identification**	**Calibration Due**
Hewlett-Packard 8563A Spectrum Analyzer	2634A02888	4/14/05
Boonton 82AD/01A/S10/S13 FM/AM Modulation Meter	167219	4/14/05
Hewlett-Packard 8449B Microwave Preamp	3008A00385	9/29/05
B&K Precision 4040A Sweep/Function Generator	0110-0132	N/A
Tektronix Oscilloscope; 1GHz, 4 CH, DPO	B010043	9/5/04
Hewlett-Packard 8672A Synthesized. Signal Generator	2311A03131	3/23/05
A.H. Systems SAS-200/518 Log Periodic Antenna	117	3/11/06
ARA DRG118/A Microwave Horn Antenna	1010	2/17/06
Hewlett-Packard 85685A RF Preselector	3221A01395	7/08/05
Sunol JB1 Biconlog Antenna	A090501	10/21/04
EMCO 3146A Log Periodic Antenna	8912-1129	6/24/05
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)

As the EUT contains a permanently attached antenna the RF power was measured using the signal substitution method to determine the EIRP level.

The EUT was placed on motorized turntable for radiated testing on a 3-meter open field test site. 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. The peripherals were placed on the table in accordance with ANSI C63.4-2001. Cables were varied in position to produce maximum emissions. Both the horizontal and vertical field components were measured. Additionally the EUT and antenna were rotated in 3 orthogonal planes to determine the maximum emission.

The Effective Isotropic Radiated Power (EIRP) levels were measured for determining the output power of the EUT.

Table 3. RF Power Output

Frequency	EIRP Level (worst case)	Limit to claim compliance with 90.217	Pass/Fail
Mid Channel: 458.90MHz	39.8mW	120mW	Pass

The radiated 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.

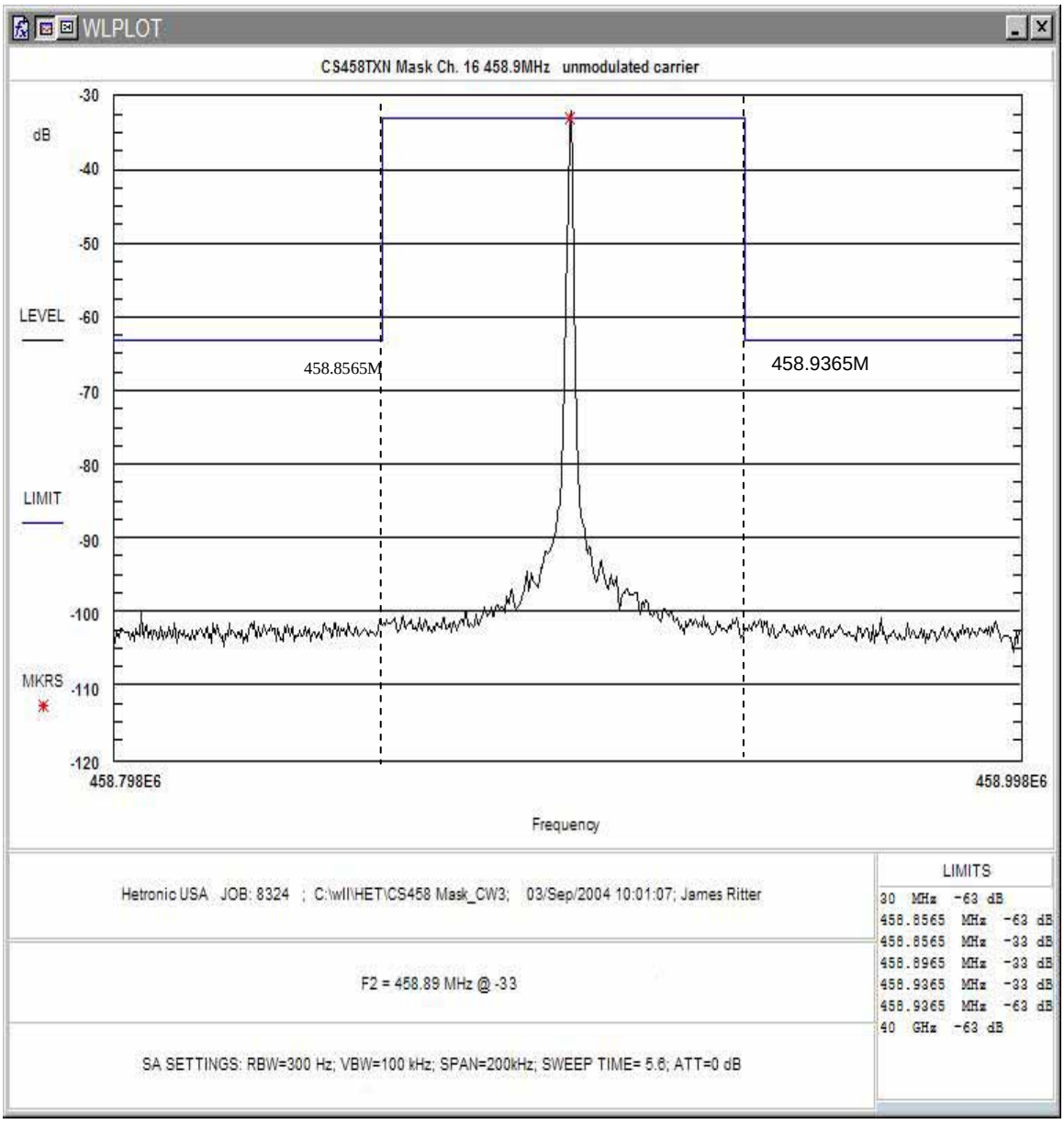

Figure 1. Part 90.217 Mask. Unmodulated Carrier

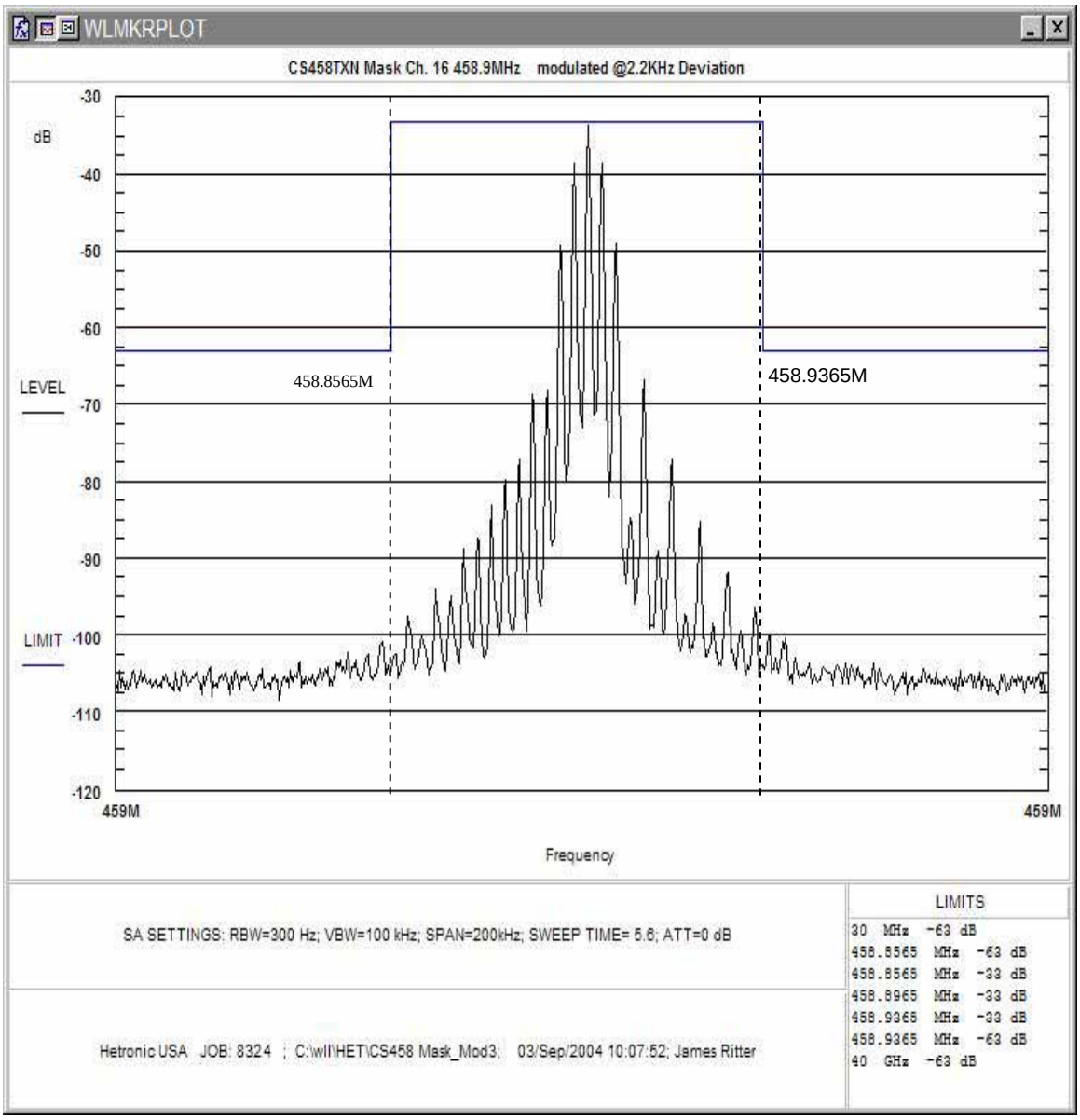

Figure 2. Part 90.217 Mask. Modulated Carrier

4.2 Occupied Bandwidth: (FCC Part §2.1049)

Occupied bandwidth was performed by coupling the output of the EUT to the input of a spectrum analyzer via an antenna.

At the maximum data rate of 9600bps the occupied bandwidth was measured as shown in Figure 3. The modulating signal used to supply the 9600bps was a 4800 Hz TTL signal.

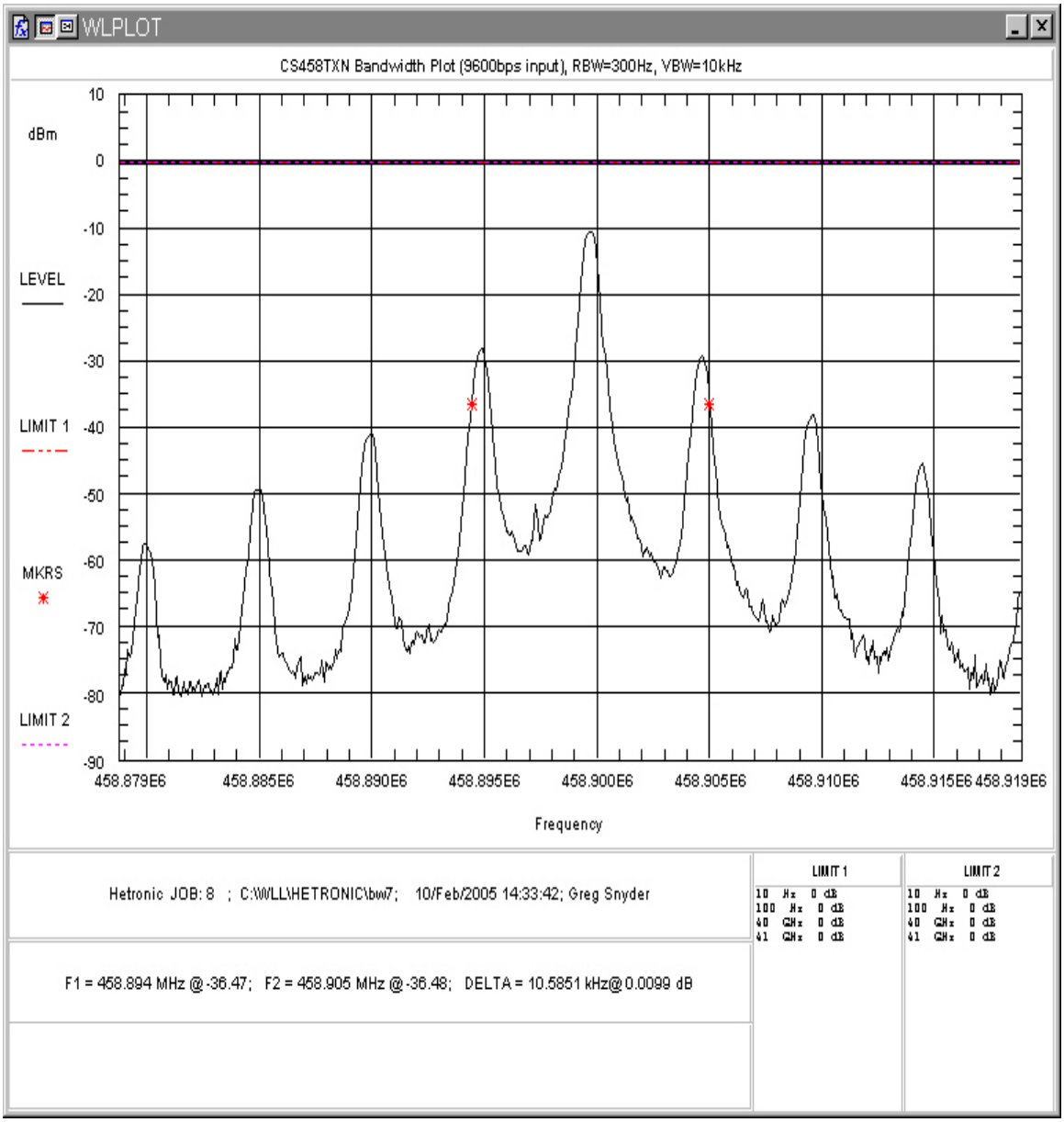

Figure 3. Occupied Bandwidth

Table 4 provides a summary of the Occupied Bandwidth Results.

Table 4. Occupied Bandwidth Results

Frequency	Bandwidth
Mid Channel: 458.9MHz	10.6 kHz

The necessary bandwidth is then calculated as follows:

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

2(4800) + 2(2700)(1.2) = 16.08kHz

The emission designator is then determined to be:

16K1F1D

4.3 Radiated Spurious Emissions: (FCC Part §2.1053)

The EUT must comply with requirements for radiated spurious emissions. The limits are as shown in the following table.

4.3.1 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. The peripherals were placed on the table in accordance with ANSI C63.4-2001. Cables were varied in position to produce maximum emissions. Both the horizontal and vertical field components were measured.

The Effective Isotropic Radiated Power (EIRP) levels were measured and compared with the limit of 30 dBc per FCC Part 90. Based on an output power of 39.8mW the limit for spurious radiated emissions is calculated to be -14dBm.

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 was used to obtain EIRP levels.

Table 5: Radiated Emission Test Data

CLIENT:	Hetronic International	DATE:	9/3/04
TESTER:	James Ritter	JOB #:	8321
EUT Information:		**Test Requirements:**	
EUT:	CS458TXN	TEST STANDARD:	FCC Part 90.217
CONFIGURATION:	Transmit at 458.9MHz CH 16	DISTANCE:	3m
Test Equipment/Limit:			
ANTENNA:	A_00382	LIMIT:	EIRP
CABLE:	CSITE2_3m	AMPLIFIER (dB)	#0066

Frequency (MHz)	Polarity H/V	Az Deg	Ant. Hght (m)	SA Level (dBµV)	Ant. Gain dBi	Sig. Gen. Level dBm	EIRP Level dBm	Limit dBm	Margin dB
328.68	V	270.0	1.7	7.5	6.9	-77.1	-70.2	-14	-56.2
372.09	V	90.0	2.0	16.0	6.7	-63.4	-56.7	-14	-42.7
415.48	V	90.0	1.9	22.8	5.6	-48.3	-42.7	-14	-28.7
437.18	V	90.0	1.8	21.0	6.6	-51.2	-44.6	-14	-30.6
480.57	V	100.0	1.7	19.7	6.9	-48.8	-41.9	-14	-27.9
775.74	V	270.0	2.0	8.4	7.1	-69.6	-62.5	-14	-48.5
893.68	V	270.0	2.0	12.4	6.3	-58.6	-52.3	-14	-38.3
917.77	V	75.0	1.6	14.5	6.2	-58.4	-52.2	-14	-38.2
1376.70	V	0.0	1.0	52.7	6.1	-53.5	-47.4	-14	-33.4
1835.64	V	270.0	1.0	52.7	5.8	-53.5	-47.7	-14	-33.7
2294.50	V	0.0	1.0	47.7	5.4	-60.5	-55.1	-14	-41.1
2753.40	V	0.0	1.0	57.2	4.4	-49.0	-44.6	-14	-30.6
3212.28	V	0.0	1.0	54.2	5.1	-48.5	-43.4	-14	-29.4
3671.22	V	10.0	1.0	49.8	6.3	-54.0	-47.7	-14	-33.7
4130.11	V	10.0	1.0	38.7	6.2	-61.5	-55.3	-14	-41.3
4589.00	V	0.0	1.0	34.8	7.4	-65.0	-57.6	-14	-43.6
328.68	H	180.0	2.8	8.6	6.9	-68.4	-61.5	-14	-47.5
372.09	H	180.0	3.0	15.2	6.7	-63.5	-56.8	-14	-42.8
415.48	H	90.0	2.5	22.6	5.6	-55.0	-49.4	-14	-35.4
437.18	H	90.0	2.4	19.8	6.6	-60.5	-53.9	-14	-39.9
480.57	H	90.0	2.4	16.2	6.9	-59.1	-52.2	-14	-38.2
775.74	H	270.0	2.2	15.4	7.1	-56.6	-49.5	-14	-35.5
917.77	H	45.0	2.4	9.6	6.2	-65.2	-59.0	-14	-45.0
1376.70	H	90.0	1.0	48.2	6.1	-66.5	-60.4	-14	-46.4
1835.64	H	90.0	1.0	42.2	5.8	-52.5	-46.7	-14	-32.7
2294.50	H	45.0	1.0	42.3	5.4	-67.5	-62.1	-14	-48.1
2753.40	H	0.0	1.0	48.5	4.4	-59.5	-55.1	-14	-41.1
3212.28	H	90.0	1.0	47.8	5.1	-50.0	-44.9	-14	-30.9
3671.22	H	45.0	1.0	39.7	6.3	-62.0	-55.7	-14	-41.7
4130.11	H	90.0	1.0	35.2	6.2	-67.0	-60.8	-14	-46.8
4589.00	H	0.0	1.0	33.3	7.4	-65.5	-58.1	-14	-44.1

4.4 Frequency Stability: (FCC Part §2.1055)

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 3.4 VDC (manufacturer's specification)

High DC Voltage of 12 VDC (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 following are the reference frequencies at ambient for the channel tested.

Mid Channel: 458.9MHz

Frequency Stability: 5ppm = 5 * 4598. MHz = 2290 Hz

Table 6. Frequency Deviation as a Function of Temperature

Temperature Degrees C	Frequency MHz	Difference Hz	Limit Max Deviation Hz
Ambient	458.897610	0.0	0
-30	458.895400	-2210.0	2290
-20	458.896990	-620.0	2290
-10	458.897970	360.0	2290
0	458.898370	760.0	2290
10	458.898290	680.0	2290
20	458.897840	230.0	2290
30	458.897250	-360.0	2290
40	458.896680	-930.0	2290
50	458.896390	-1220.0	2290

Table 7. Frequency Deviation as a Function of Voltage

Voltage Volts	Frequency MHz	Difference Hz	Deviation Hz
At rated (5V)	458.896230	0	2290
3.4 VDC	458.896680	-450	2290
12VDC	458.897330	-1100	2290