Washington Laboratories, Ltd.

FCC Permissive Change Test Report
For the
Control Chief Corp.
ADVANTAGE LJ45

CBF-ADV LJ45-450
1339A-LJ450001

WLL JOB# 10624
October 29, 2008

Revision 1
December 10, 2008

WLL JOB# 10624-01

Prepared for:
Control Chief Corp.
200 Williams Street
PO Box 141
Bradford, PA 16701

Prepared By:

Washington Laboratories, Ltd.
7560 Lindbergh Drive
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ACCREDITED
Testing Cert. 2675.01

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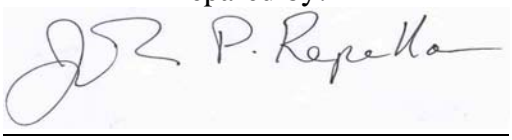

John Repella
QA Manager

Reviewed by:

Steven D. Koster
EMC Operations Manager

Abstract

This report has been prepared on behalf of Control Chief Corp. to support the attached Application for Equipment Authorization. The test report and application are submitted for a Licensed Transmitter 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 Control Chief Corp. ADVANTAGE LJ45.

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 the American Association for Laboratory Accreditation (A2LA) under Certificate 2675.01 as an independent FCC test laboratory.

The Control Chief Corp. ADVANTAGE LJ45 complies with the limits for a Licensed Transmitter device under FCC Part 90 and Industry Canada RSS-119.

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1 Introduction

1.1 Compliance Statement

The Control Chief Corp. ADVANTAGE LJ45 complies with the limits for a Licensed Transmitter device under FCC Part 90 and Industry Canada RSS-119. Verification testing of the LJ45 Transceiver Power Output, Occupied Bandwidth and Spurious Emissions show that this device remains in compliance.

1.2 Test Scope

Tests for radiated spurious emissions and conducted power/bandwidth (at antenna terminal) were performed. The results of the power and bandwidth measurements were then compared to the previous results recorded in WLL document #9805-01 Rev.1 (original certification report) and the FCC grant for this device.

All measurements were performed in accordance with FCC Public Notice DA 00-705 and 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:	Control Chief Corp. 200 Williams Street PO Box 141 Bradford, PA 16701
Purchase Order Number:	63636
Quotation Number:	64359

1.4 Test Dates

Testing was performed on the following date(s):	October 2008 (follow-up testing December 2008)

1.5 Test and Support Personnel

Washington Laboratories, LTD	John Repella
Client Representative	Jake Bryner

1.6 Abbreviations

A	**A**mpere
ac	**a**lternating **c**urrent
AM	Amplitude Modulation
Amps	**Amp**ere**s**
b/s	**b**its per **s**econd
BW	**B**and**W**idth
CE	**C**onducted **E**mission
cm	**c**enti**m**eter
CW	**C**ontinuous **W**ave
dB	**d**eci**B**el
dc	**d**irect **c**urrent
EMI	**E**lectro**m**agnetic **I**nterference
EUT	**E**quipment **U**nder **T**est
FM	**F**requency **M**odulation
G	**g**iga - prefix for 10^9 multiplier
Hz	**H**ertz
IF	**I**ntermediate **F**requency
k	**k**ilo - prefix for 10^3 multiplier
LISN	**L**ine **I**mpedance **S**tabilization **N**etwork
M	**M**ega - prefix for 10^6 multiplier
m	**m**eter
µ	**m**icro - prefix for 10^{-6} multiplier
NB	**N**arrow**b**and
QP	**Q**uasi-**P**eak
RE	**R**adiated **E**missions
RF	**R**adio **F**requency
rms	**r**oot-**m**ean-**s**quare
SN	**S**erial **N**umber
S/A	**S**pectrum **A**nalyzer
V	**V**olt

2 Equipment Under Test

2.1 EUT Identification & Description

The Control Chief Corp. Advantage LM Transmitter provides a wireless operator control for cranes and various materials handling equipment. The object of the Advantage LM transmitter is to bring the fixed mounted controls to whatever location the operator chooses to operate the equipment. The system consists of the following main components: (1) the receiver/controller unit and, (2) the wireless remote-control radio Operator Control Unit (OCU).

Table 1: Device Summary

ITEM	DESCRIPTION
Manufacturer:	Control Chief Corp.
FCC ID:	CBF-ADV LJ45-450
IC:	1339A- LJ450001
Model:	LJ45
FCC Rule Parts:	§90
Industry Canada:	RSS-119
Frequency Range:	450 – 470MHz
Maximum Output Power:	16.42 dBm
Modulation:	FSK
Occupied Bandwidth:	7.3684kHz
Keying:	Manual
Type of Information:	Control
Number of Channels:	7
Power Output Level	Fixed
Antenna Connector	Board Mounted
Antenna Type	Grounded Line Planar Antenna
Frequency Tolerance:	2.5ppm
Emission Type(s):	F1D
Interface Cables:	None
Power Source & Voltage:	LI ION Battery @ 7.4VDC

2.2 Test Configuration

The Advantage LM Transmitter was setup in a stand-alone configuration. The internal antenna was replaced with a connector for conducted tests performed at the antenna terminal.

2.3 Testing Algorithm

The Advantage LM Transmitter was setup to continuously transmit at the selected frequency with and without the unit modulated. The operation of the radio was controlled via RS 232 TLL controller attached to a laptop PC running hyper terminal to access the diagnostic menus.

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 the American Association for Laboratory Accreditation (A2LA) under Certificate 2675.01 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

Test Name: **Conducted & Radiated Emissions**		Test Date: **10/28/2008**	
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
69	HP, 85650A	ADAPTER, QP	07/09/2009
73	HP, 8568B	ANALYZER, SPECTRUM	07/08/2009
71	HP, 85685A	PRESELECTOR, RF	07/09/2009
382	SUNOL, JB1	ANTENNA, BICONLOG	01/30/2009
66	HP, 8449B	PRE-AMPLIFIER, RF. 1-26.5GHZ	07/15/2009
67	HP, 8564E	ANALYZER, SPECTRUM	10/10/2009
4	ARA, DRG-118/A	ANTENNA, DRG, 1-18GHZ	02/02/2009
667	MEGAPHASE, LLC EM18-S1NK5-600	TEST CABLE DC TO 18 GHZ SMA MALE	03/17/2009
640	MEGAPHASE, TM40-K1K5-36	0.5M RIGHT ANGLE CABLE, SMA MALE	09.29/2009

4 Test Results

4.1 RF Power Output: (FCC Part §2.1046 & Industry Canada RSS-119 §6.2)

4.2 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.

Table 3: RF Power Output

Frequency	Current Level	Previously Tested Level	Pass/Fail
Low Channel@ 450MHz	16.42 dBm	16.50 dBm	Pass
Mid Channel@ 460MHz	16.26 dBm	16.60 dBm	Pass
High Channel@ 470MHz	16.42 dBm	16.45 dBm	Pass

Table 4: RF Power EIRP

Frequency (MHz)	Polarity H/V	Azimuth Degree	Ant. Height (m)	Spurious Level (dBuV)	Sub. Sig. Gen. Level (dBm)	Sub. Power Level (dBm)	Sub. Ant. Factor (dB/m)	Sub. Ant. Gain (dBi)	EIRP Level (dBm)	EIRP Level (mWatts)
EUT upright										
460.01	V	45.0	1.3	72.40	2.0	-7.8	16.8	6.7	-1.1	0.77898
460.01	H	180.0	2.1	62.10	-9.9	-17.7	16.8	6.7	-11.0	0.07971
EUT on (long side)										
460.01	V	90.0	1.3	67.70	-2.9	-11.1	16.8	6.7	-4.4	0.36436
460.01	H	180.0	1.8	68.70	-3.1	-11.2	16.8	6.7	-4.5	0.35606
EUT side (short)	V									
460.01	V	90.0	1.2	64.80	-6.0	-13.8	16.8	6.7	-7.1	0.19567
460.01	H	90.0	2.1	66.80	-5.1	-12.9	16.8	6.7	-6.2	0.24073

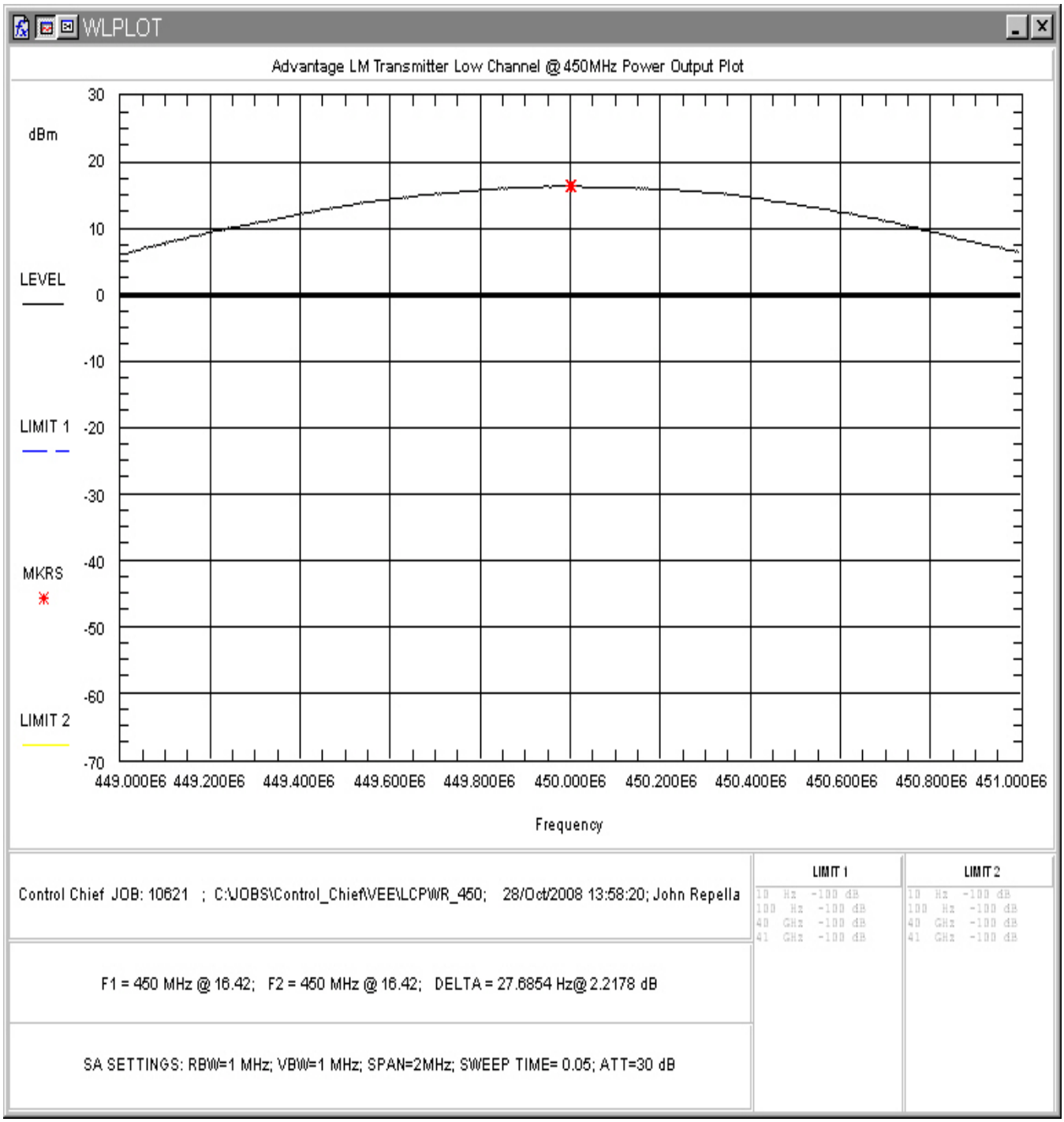

Figure 4-1: RF Peak Power, Low Channel

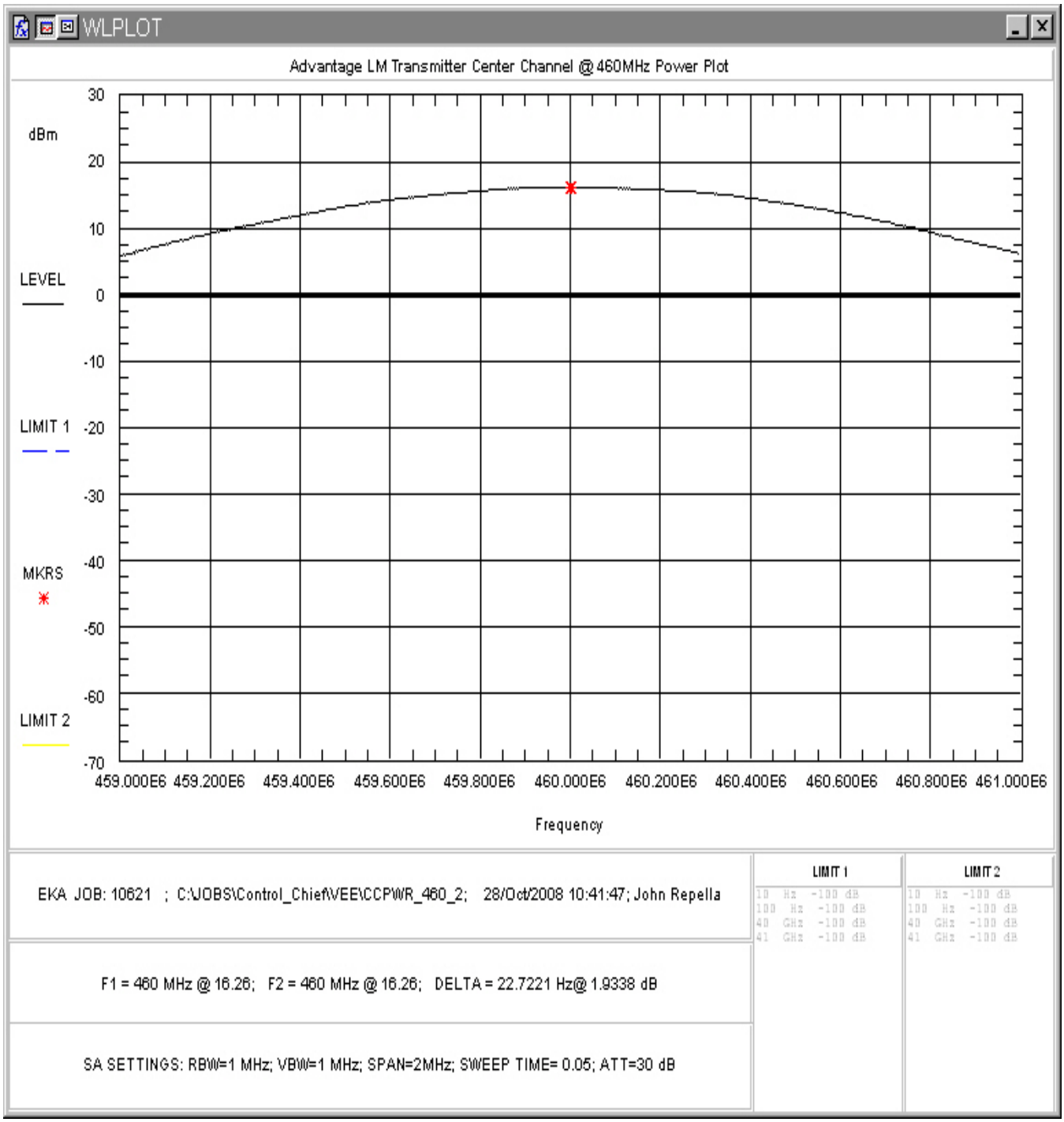

Figure 4-2: RF Peak Power, Mid Channel

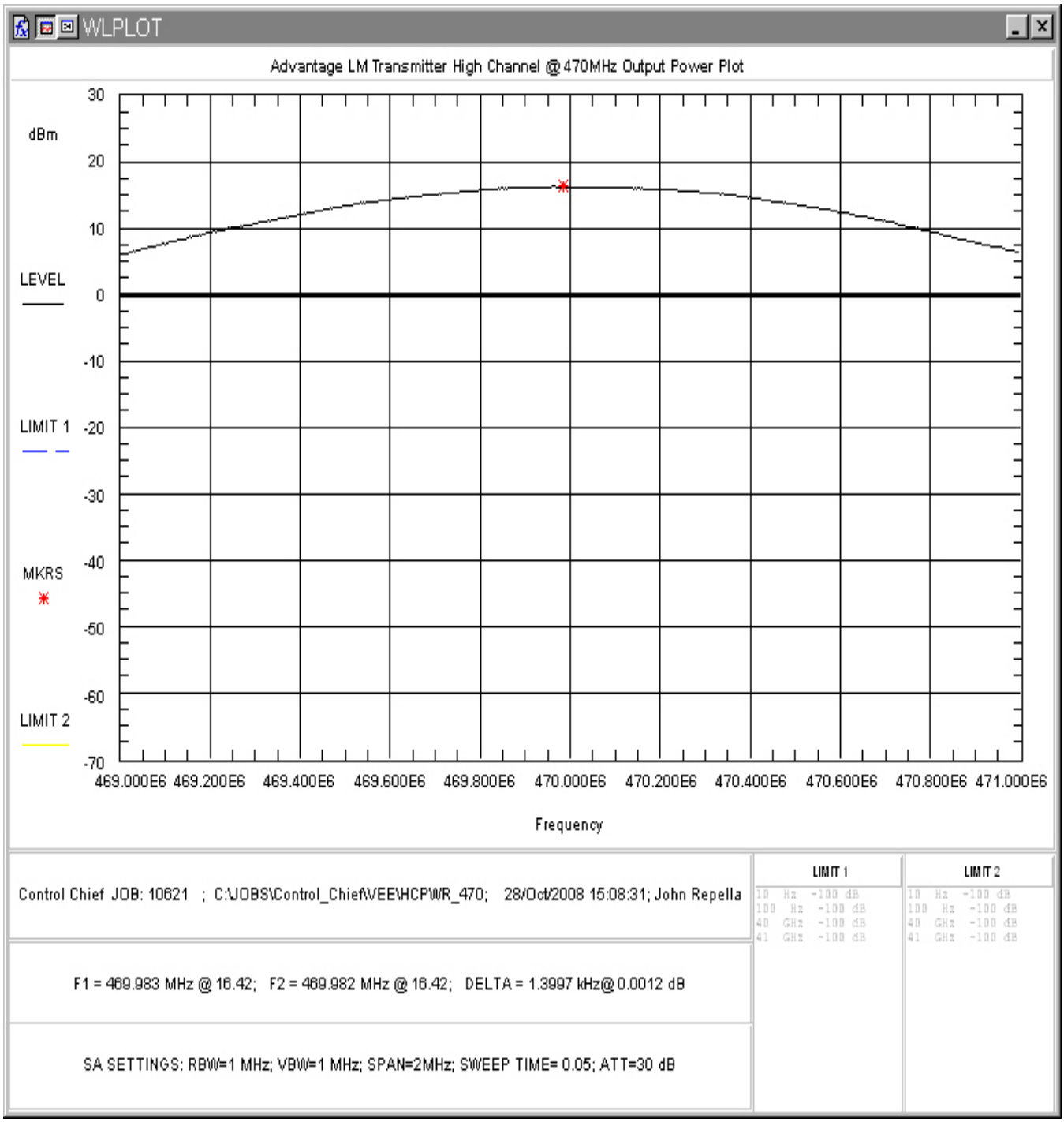

Figure 4-3: RF Peak Power, High Channel

4.3 Occupied Bandwidth: (FCC Part §2.1049 & Industry Canada RSS-119 §6.7)

Occupied bandwidth was performed by coupling the output of the EUT to the input of a spectrum analyzer. At full modulation, the occupied bandwidth was measured as shown:

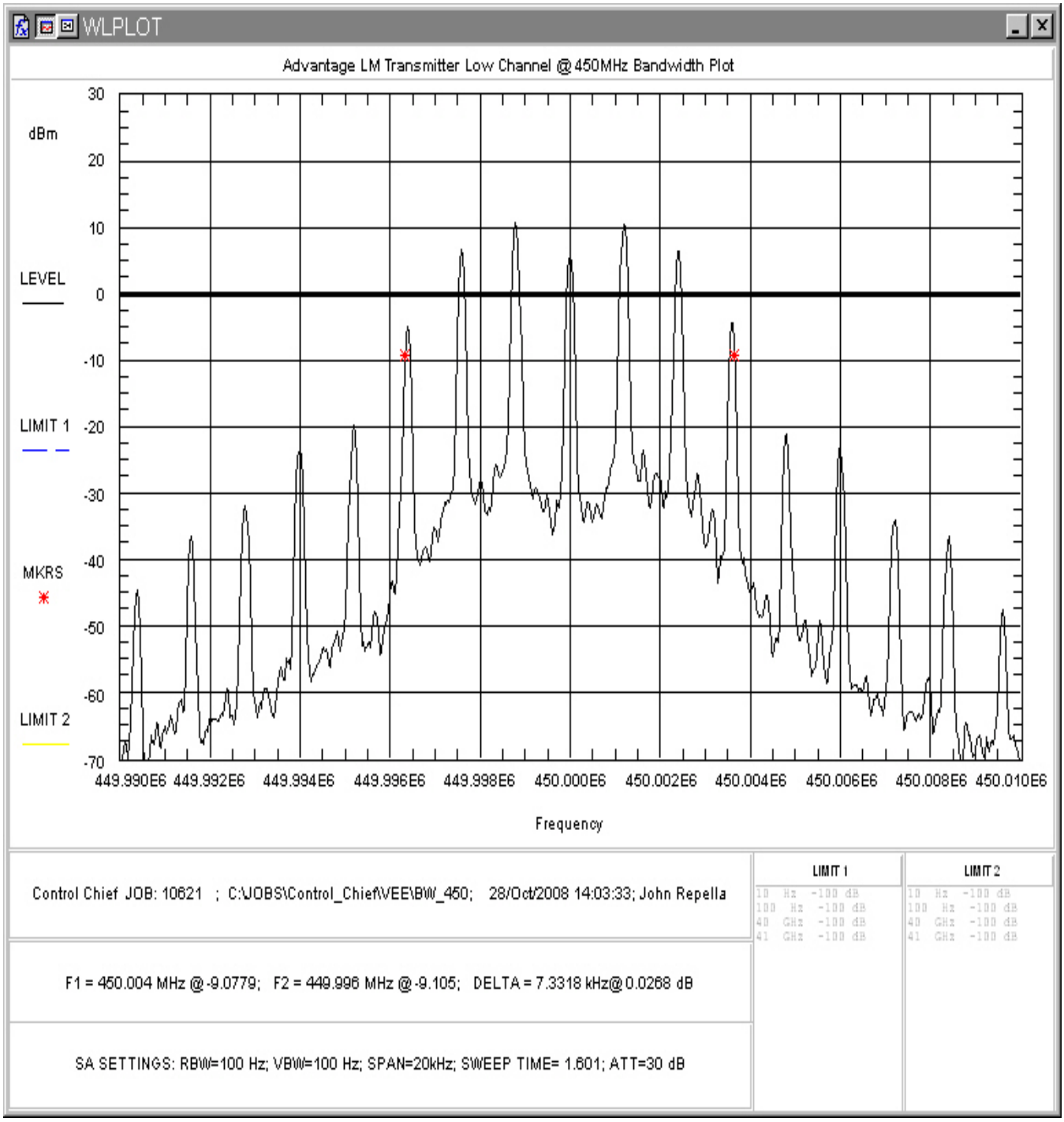

Figure 4-4: Occupied Bandwidth, Low Channel

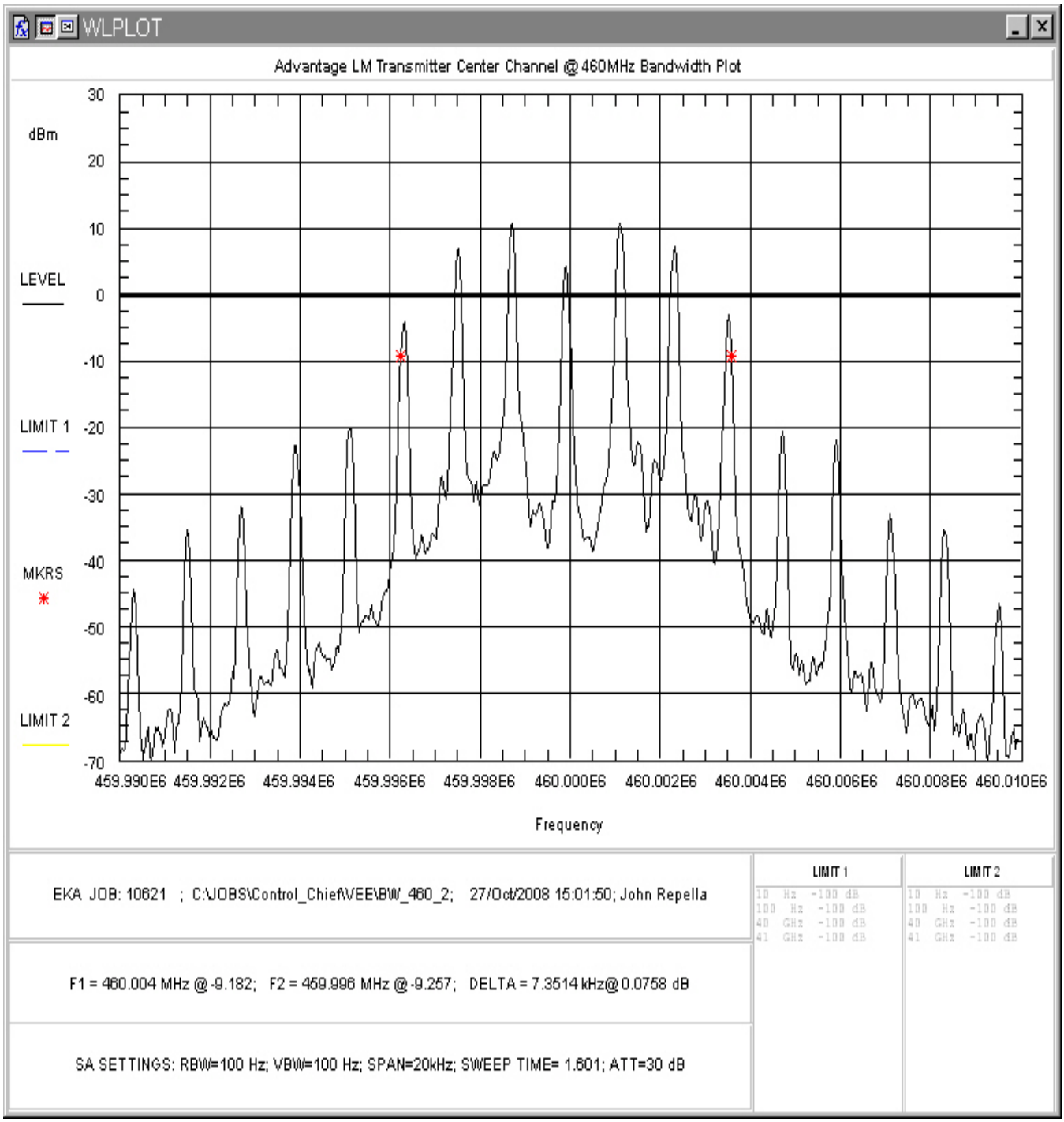

Figure 4-5: Occupied Bandwidth, Mid Channel

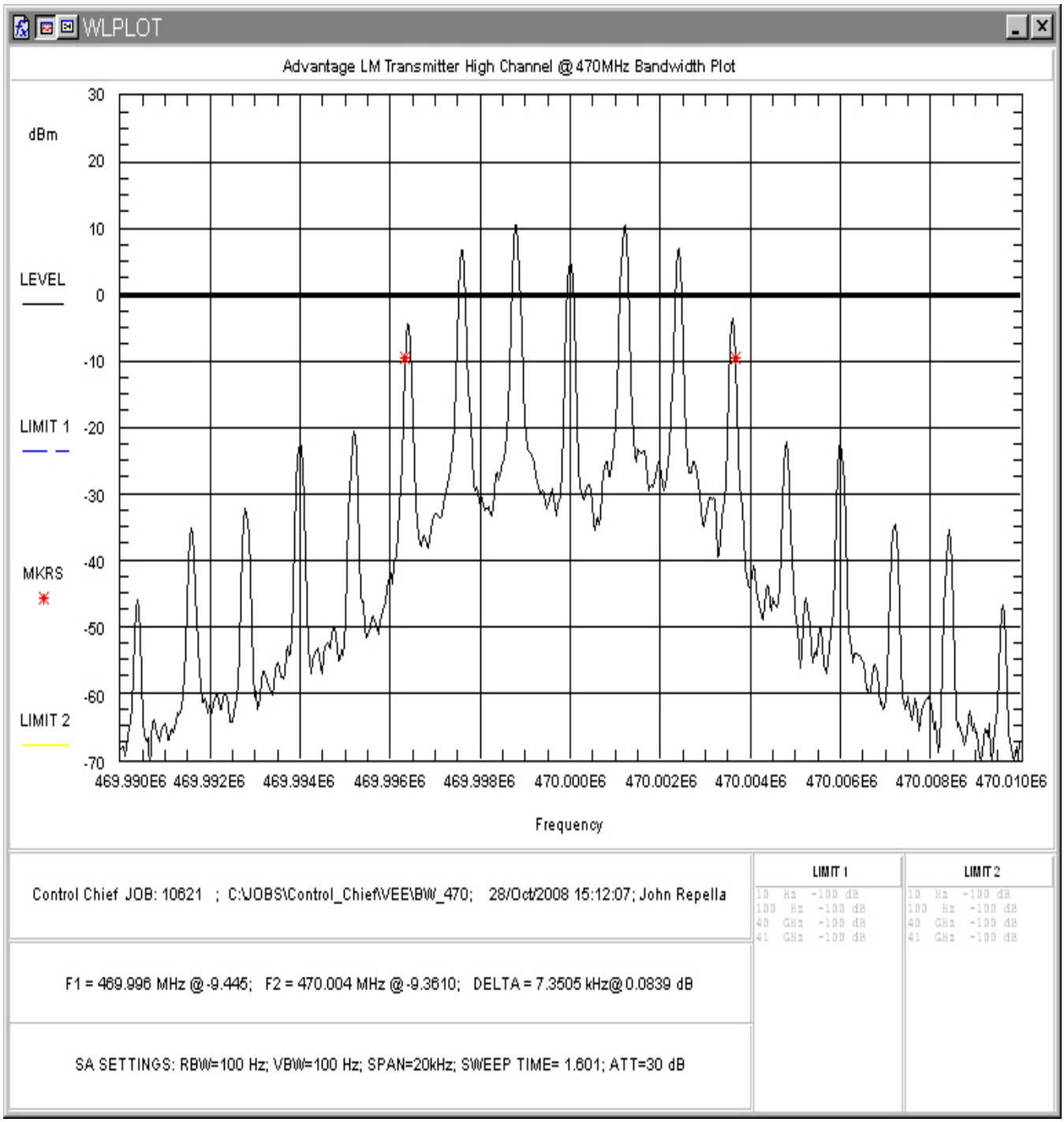

Figure 4-6: Occupied Bandwidth, High Channel

Table 5 provides a summary of the Occupied Bandwidth Results.

Table 5: Occupied Bandwidth Results

Frequency	Bandwidth from Current testing	Bandwidth from Previous testing	Pass/Fail
Low Channel@ 450MHz	7.332kHz	7.3593kHz	Pass
Mid Channel@ 460MHz	7.351kHz	7.3684kHz	Pass
High Channel@ 470MHz	7.305kHz	7.3410kHz	Pass

4.4 Radiated Spurious Emissions: (FCC Part §2.1053 & Industry Canada RSS-119 §6.3)

The EUT must comply with the requirements for radiated spurious emissions that fall within the restricted bands.

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-C was used to obtain EIRP levels.

The limit is calculated as follows:

Output Power = 45.708mW = 16.60dBm

Limit = 16.60dBm – (50+10Log (0.046W)) = -20dBm (ERP)

The emissions were measured using the following resolution bandwidths:

Frequency Range	Resolution Bandwidth	Video Bandwidth
30MHz-1000 MHz	120kHz	>100 kHz
>1000 MHz	1 MHz	<30 Hz (Avg) 1MHz (Peak)

Table 6: Radiated Emission Test Data

Frequency (MHz)	Polarity H/V	Azimuth Degree	Ant Height (m)	Spurious Level (dBuV)	Sub. Sig. Gen. Level (dBm)	Sub. Power Level (dBm)	Sub. Ant. Factor (dB/m)	Sub. Ant. Gain dBi	EIRP Level dBm	EIRP Level mWatts	Limit (dBm)	Margin
114.40	V	180	1	6.20	-66.7	-68.0	14.3	-2.9	-70.9	8.09E-08	-20.0	-50.9
185.75	V	270	1	5.20	-81.3	-83.9	16.9	-1.3	-85.2	3.01E-09	-20.0	-65.2
209.75	V	0	1	9.30	-71.2	-73.5	16.8	-0.2	-73.7	4.31E-08	-20.0	-53.7
249.18	V	0	1	6.20	-80.1	-82.8	15.9	2.2	-80.6	8.79E-09	-20.0	-60.6
343.25	V	0	1	5.40	-81.3	-85.5	14.5	6.4	-79.1	1.24E-08	-20.0	-59.1
450.02	V	0	1	6.20	-82.9	-88.5	16.6	6.7	-81.8	6.57E-09	-20.0	-61.8
114.40	H	180	1	3.60	-79.2	-80.8	14.3	-2.9	-83.7	4.24E-09	-20.0	-63.7
185.75	H	0	3	13.00	-75.0	-77.6	16.9	-1.3	-78.9	1.28E-08	-20.0	-58.9
209.75	H	0	3	4.60	-82.3	-84.8	16.8	-0.2	-85.0	3.19E-09	-20.0	-65.0
249.18	H	0	3	5.40	-81.5	-84.2	15.9	2.2	-82.0	6.37E-09	-20.0	-62.0
343.25	H	0	3.5	6.30	-75.7	-79.9	14.5	6.4	-73.5	4.49E-08	-20.0	-53.5
450.02	H	0	3.5	8.60	-77.5	-83.2	16.6	6.7	-76.5	2.23E-08	-20.0	-56.5

Note: The EUT was scanned to the 10^{th} harmonic of the fundamental frequency and no other emissions were detected.