Washington Laboratories, Ltd.

FCC & Industry Canada Certification Test Report
For the
Control Chief Corporation
ADVANTAGE LJ45 TRANSCEIVER
FCC ID: CBF-ADVLJ45-450
IC ID: 1339A-LJ450001

WLL JOB# **9805**
November 30, 2007
Revision 1 issued March 14, 2008

Prepared for:

Control Chief Corporation
200 Williams Street
Bradford, PA 16701

Prepared By:

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

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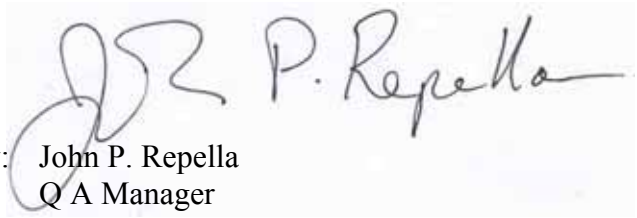

Prepared by: John P. Repella
Q A Manager

Reviewed by: Steven D. Koster
EMC Operations Manager

Abstract

This report has been prepared on behalf of Control Chief Corporation 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 Corporation Advantage LJ45 Transceiver.

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 Control Chief Corporation Advantage LJ45 Transceiver complies with the limits for a Licensed Transmitter device under FCC Part 90 and Industry Canada RSS-119.

Revision 1 was issued on March 14, 2008 to address a typographical error that inadvertently created concern for a reported test result.

Table of Contents

List of Tables

List of Figures

List of Photos

1 Introduction

1.1 Compliance Statement

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

1.2 Test Scope

Tests for radiated and conducted (at antenna terminal) emissions were performed. All measurements were performed in accordance with ANSI TIA-603-C. The measurement equipment conforms to ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation.

1.3 Contract Information

Customer:	Control Chief Corporation 200 Williams Street Bradford, PA 16701
Quotation Number:	63433

1.4 Test Dates

Testing was performed on the following date(s):	September 04, 2007 - September 10, 2007

1.5 Test and Support Personnel

Washington Laboratories, LTD	John P. Repella
Client Representative	Jake Bryner

2 Equipment Under Test

2.1 EUT Identification & Description

The Control Chief Corporation Advantage LJ transmitter provides a wireless operator control for cranes and various material handling equipment. The object of the Advantage LJ 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 Corporation
FCC ID:	CBF-ADVLJ45-450
IC:	1339A-LJ450001
Model:	LJ45
FCC Rule Parts:	§90.210
Industry Canada:	RSS-119
Frequency Range:	450 – 470MHz
Number of channels:	7
Maximum Output Power:	45.708mW (16.6dBm)
Modulation:	FSK
Occupied Bandwidth:	7.3684kHz
Keying:	Manual
Type of Information:	Control
Power Output Level	Fixed
Antenna Type	Internal ¼ wave whip antenna
Frequency Tolerance:	2.5ppm
Emission Type(s):	F1D
Interface Cables:	None
Power Source & Voltage:	7.4vdc from battery

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2.2 Test Configuration

The Advantage LJ45 Transceiver was tested 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 LJ45 Transceiver was setup to continuously transmit at the selected frequency with and without the unit modulated. The operation of the radio was controlled via an infrared controller attached to a PC running a diagnostic program provided by Control Chief.

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

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:	**FCC Part 90, FCC B and RSS-119**	Test Date:	**09/10/2007**
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
00068	HP, 85650A	ADAPTER, QP	07/06/2008
00072	HP, 8568B	ANALYZER, SPECTRUM	07/06/2008
00070	HP, 85685A	PRESELECTOR, RF W/OPT 8ZE	07/06/2008
00382	SUNOL, JB1	ANTENNA, BICONLOG	02/02/2008
00618	HP 8563A	ANALYZER, SPECTRUM	02/09/2008
00627	AGILENT 8449B	AMPLIFIER 1-26GHZ	01/07/2008
00542	MEGAPHASE, LLC TM40-K1K1-660	CABLE, COAXIAL, 660"	09/26/2008
00004	ARA, DRG-118/A	ANTENNA, DRG, 1-18GHZ	02/02/2008
00562	EMCO, 3110B	ANTENNA, BICONICAL	12/12/2008
00521	MEGAPHASE, LLC F230-S1S1-246	CABLE, COAXIAL	11/17/2007
00478	RHODE & SCHWARZ, SMT 06	SIGNAL GENERATOR	12/20/2007
00029	EMCO, 3146A	ANTENNA, LOG PERIODIC	07/19/2008
00621	MEGAPHASE LLC	COXIAL CABLE-F230-S1S1-246	01/08/2008
00607	WLL	CABLE, COXIAL, BNC - 10M	09/26/2008
00461	TEKTRONIX, TDS-5104	OSCILLOSCOPE; 1GHZ, 4 CH, DPO	07/27/2008
00074	HP, 8593A	ANALYZER, SPECTRUM	02/07/2008
00480	HP, 8495B/8494B	ATTENUATOR, SET	07/26/2008
00528	AGILENT, E4446A	ANALYZER, SPECTRUM	02/15/2008

4 Test Results

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

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. The EUT was setup to transmit an un-modulated signal.

Table 3. RF Power Output

Frequency	Level dBm	Level Watts
Low Channel @450MHz	16.50	0.0447W
Mid Channel @460MHz	16.60	0.0457W
High Channel @470MHz	16.45	0.0442W

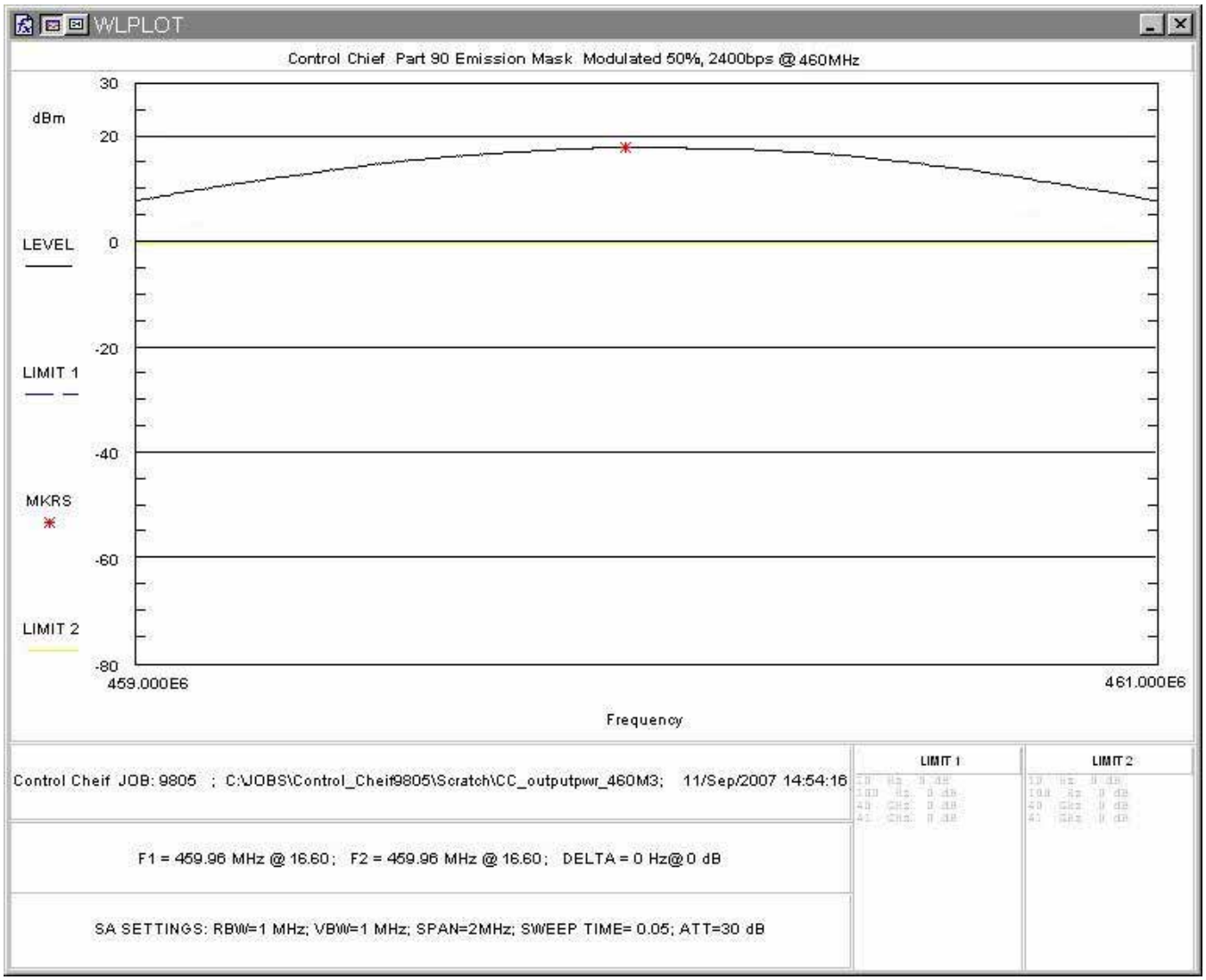


Figure 4-1. Output Power @460MHz

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 2400bps, provided internally via the Advantage LJ45 Transceiver, the occupied bandwidth was measured as shown in Figure 4-3. A Boonton Modulation analyzer was then connected to the output and the FM deviation was measured at 2.02kHz. Calculations of the necessary bandwidth follow the bandwidth plot. Table 4 provides a summary of the Occupied Bandwidth Results.

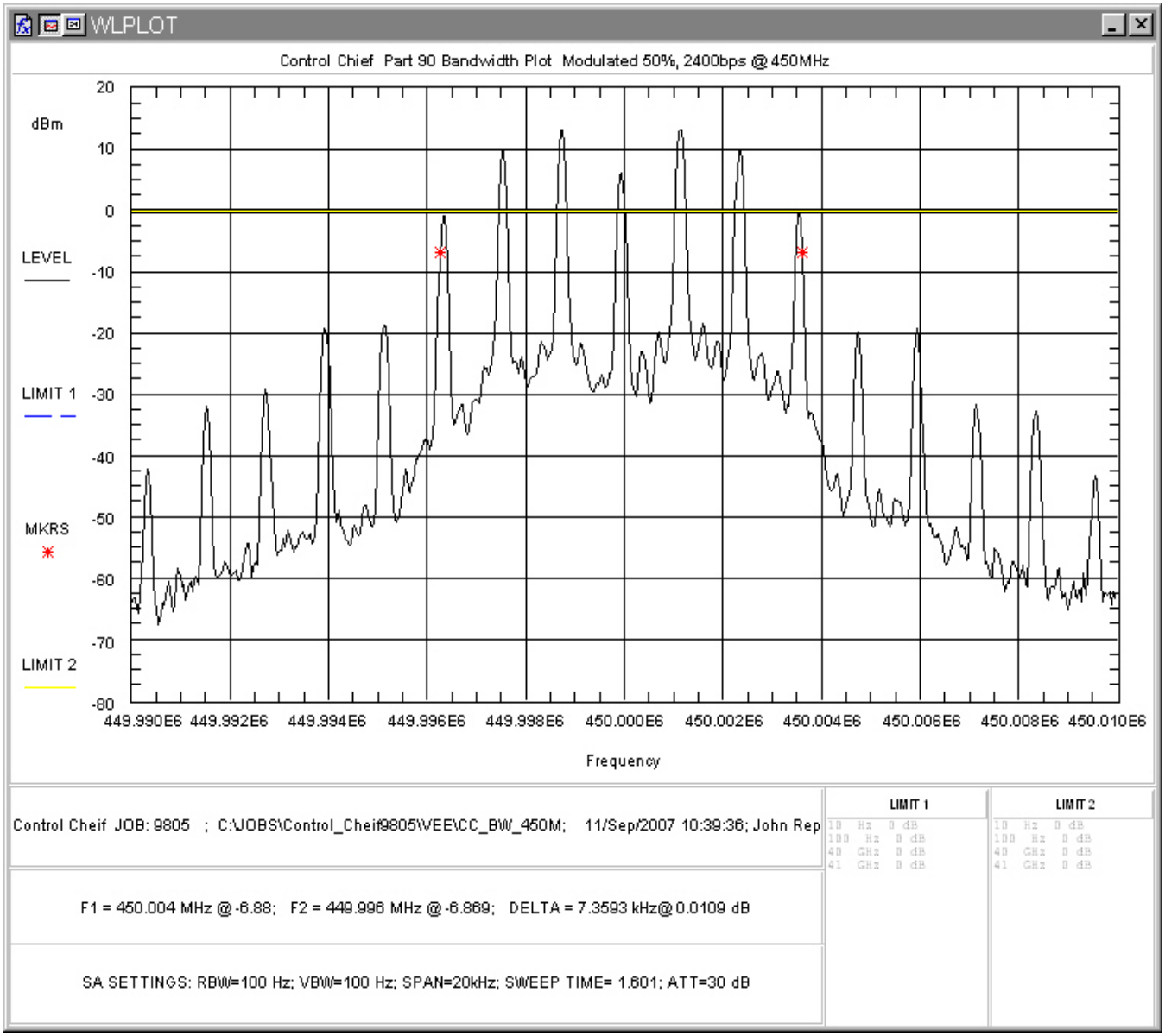


Figure 4-2. Low Channel Occupied Bandwidth @450MHz

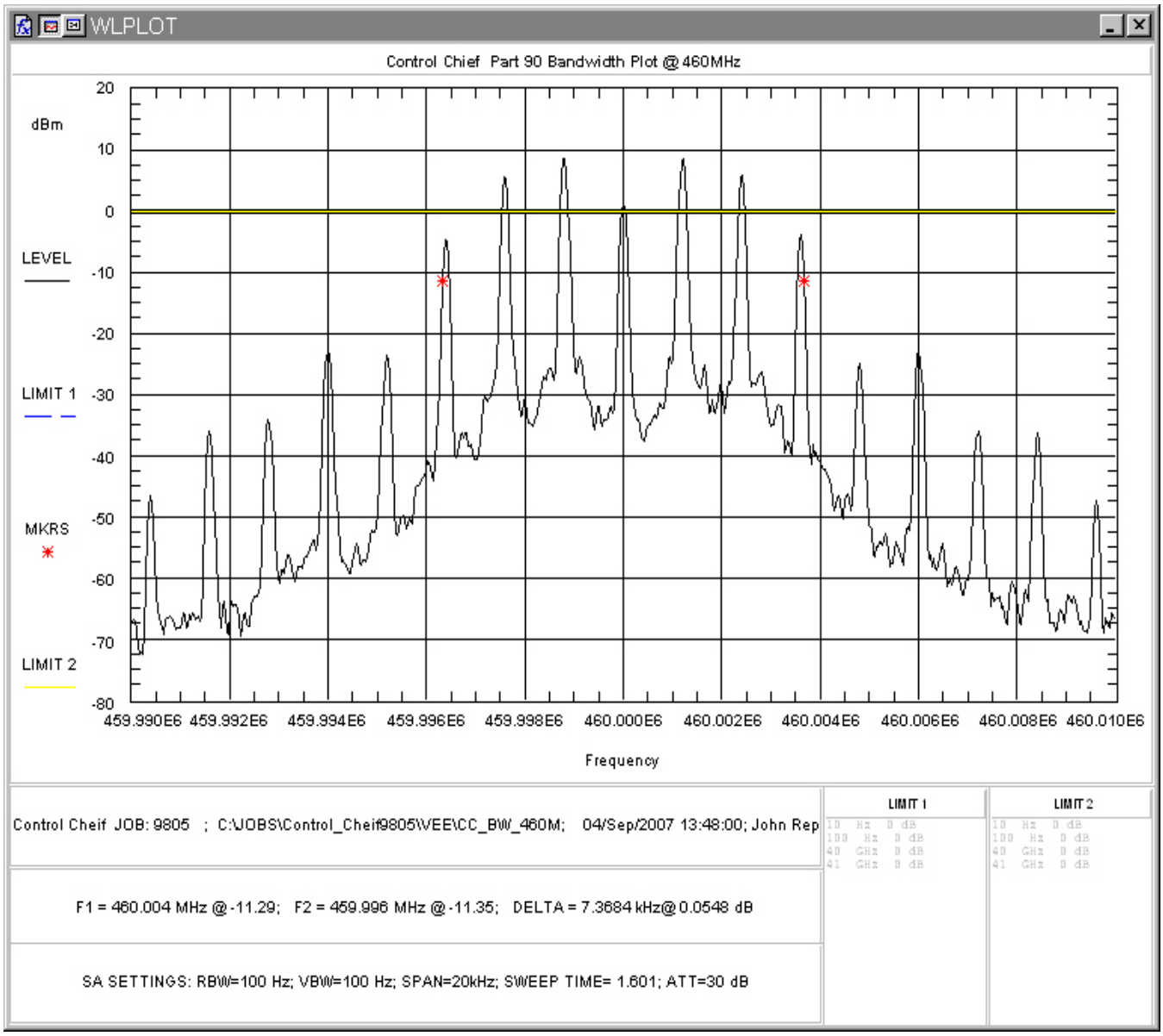


Figure 4-3. Mid Channel Occupied Bandwidth @460MHz

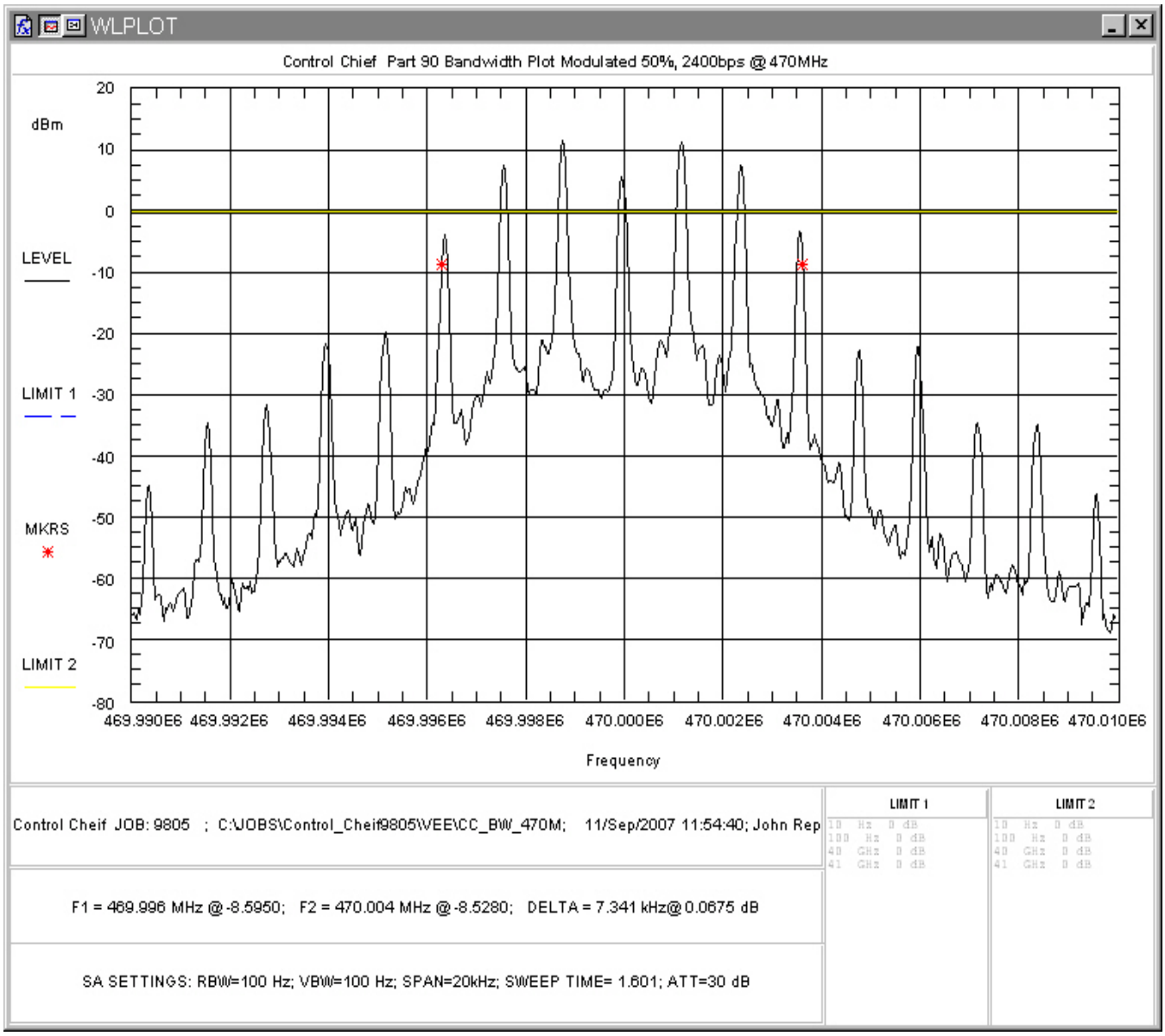


Figure 4-4. High Channel Occupied Bandwidth @470MHz

Table 4. Occupied Bandwidth Results

Frequency	Bandwidth
Low Channel: 450MHz	7.3593kHz
Mid Channel: 460MHz	7.3684kHz
High Channel: 470MHz	7.3410kHz

The necessary bandwidth is then calculated as follows:

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

2(2400) + 2(2020)(1.2) = 9.648kHz

The emission designator is then determined to be:

9K65F1D

4.3 Conducted Spurious Emissions at Antenna Terminals (FCC Part §2.1051 and Industry Canada RSS-119)

The EUT must comply with requirements for spurious emissions at antenna terminals per the limit specified in §90.210(d) and IC RSS-119 Section 6.4(d). The following specifies the limit for Emissions Mask D:

Emission Mask D: 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:

(1) On any frequency from the center of the authorized bandwidth f_0 to 5.625 kHz removed from f_0: Zero dB.

(2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 5.625 kHz but no more than 12.5 kHz: At least 7.27(f_d–2.88 kHz) dB.

(3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 12.5 kHz: At least 50 + 10 log (P) dB or 70 dB, whichever is the lesser attenuation.

The EUT antenna was removed and the cable was connected directly into a spectrum analyzer through a 10 dB attenuator. An offset was programmed into the spectrum analyzer to compensate for the loss of the external attenuator. The spurious emissions and the emissions mask (in-band) emissions were then measured and recorded. Refer to Photograph 1.

Photograph 1. Conducted Spurious Emissions Setup

The following are plots of the conducted spurious emissions data.

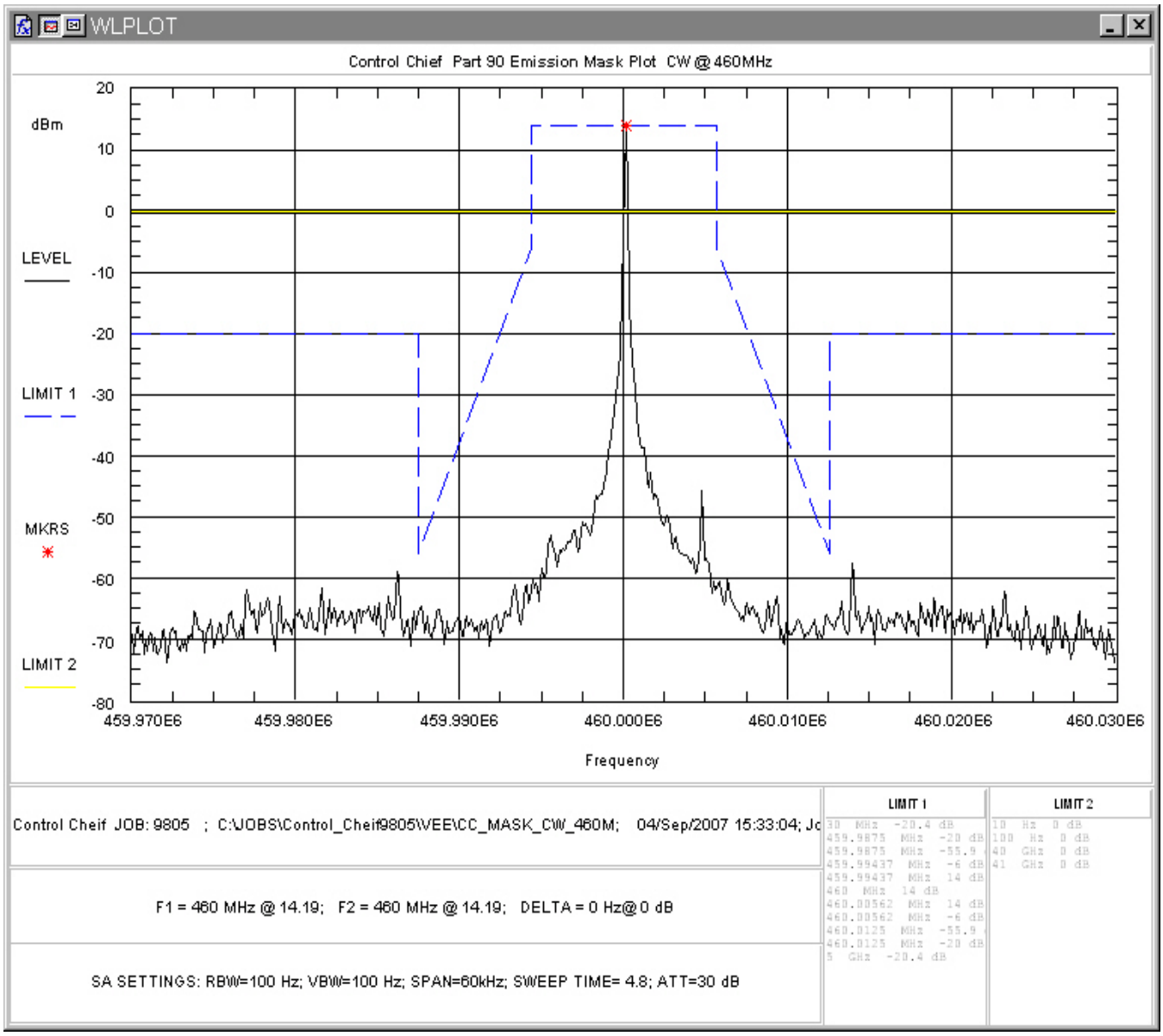


Figure 4-5. Emission Mask, CW Signal

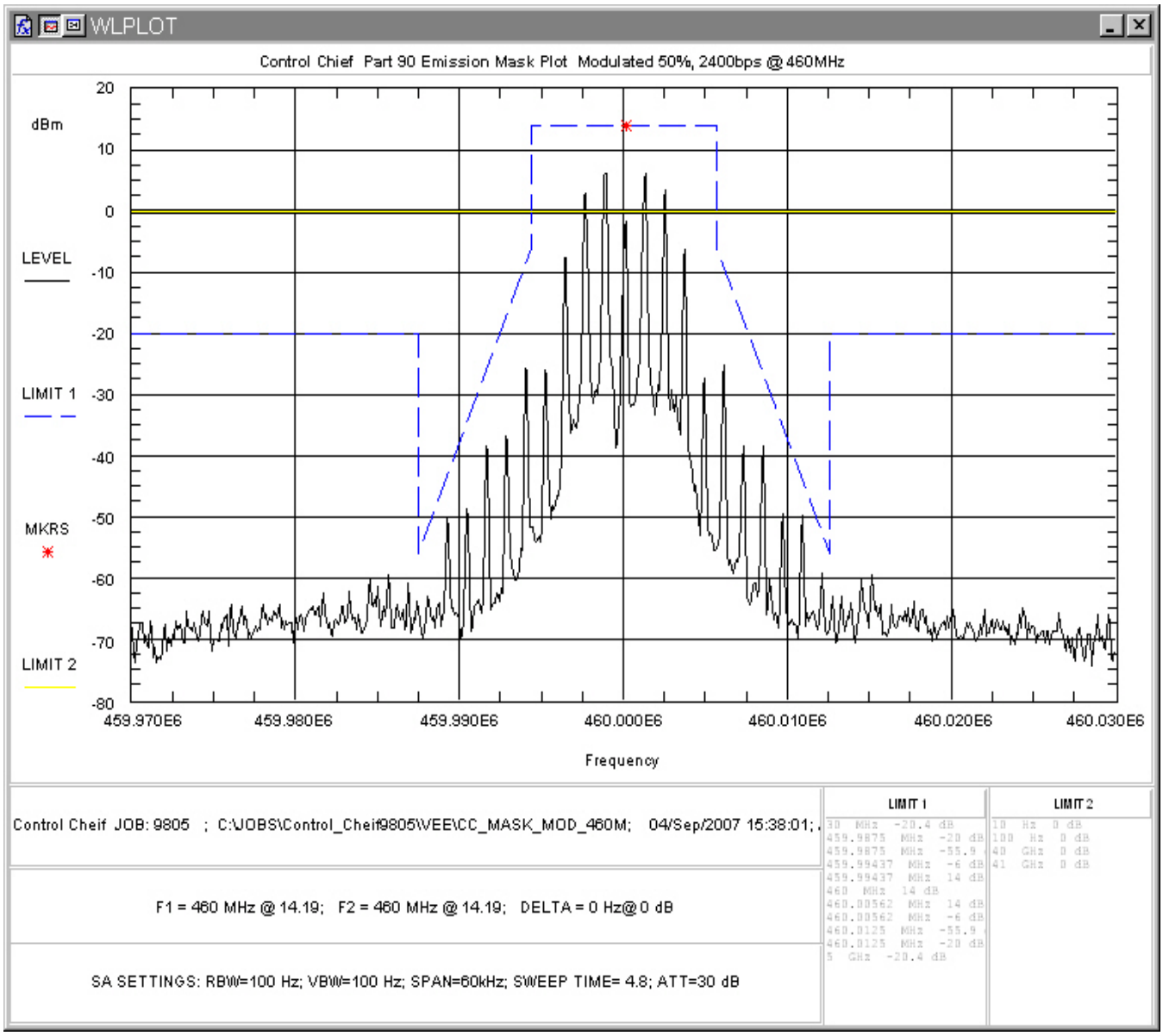


Figure 4-6. Emissions Mask, Mid Channel 460MHz, Modulated Signal

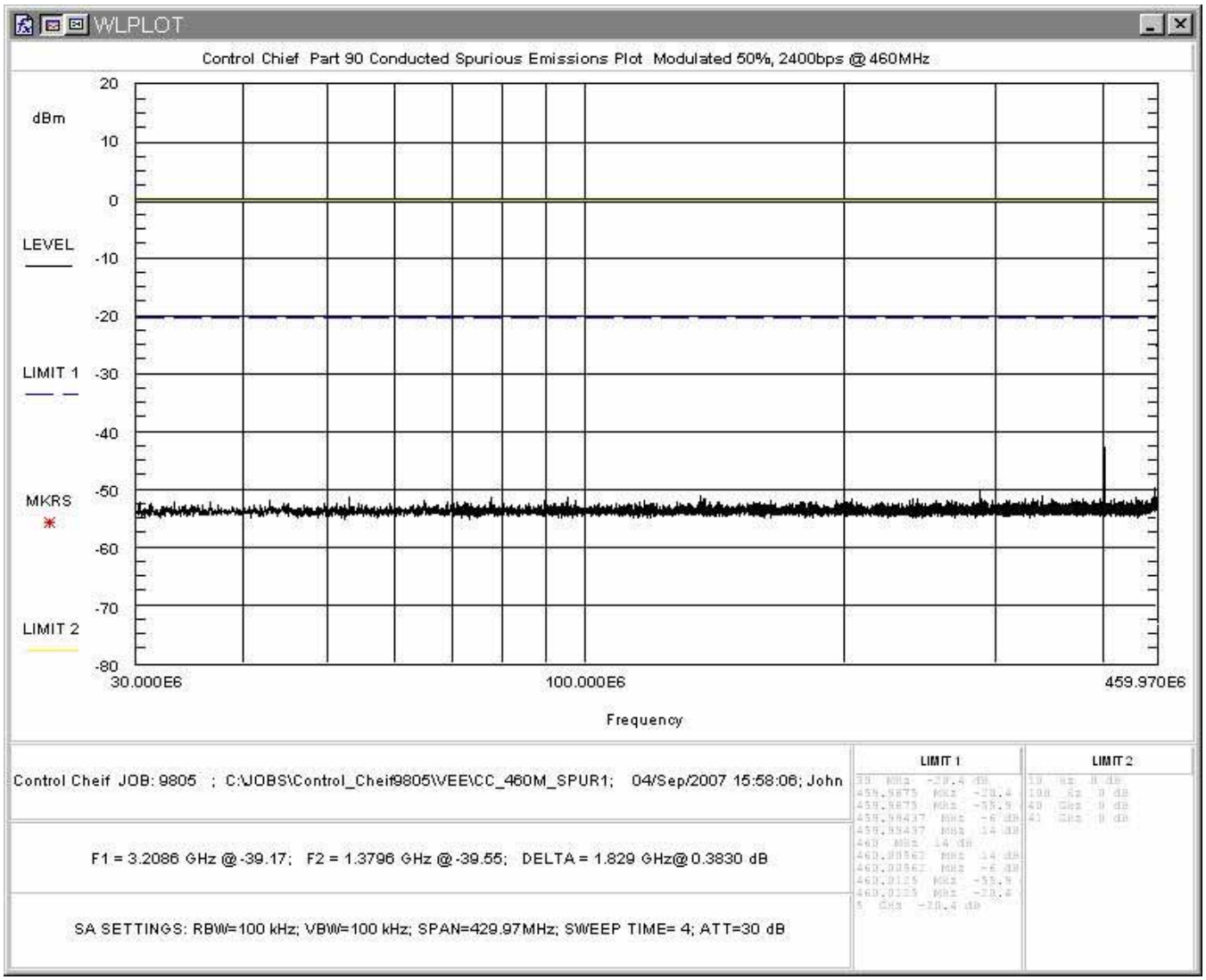


Figure 4-7. Conducted Spurious Emissions, Mid Channel, 30M – 459.97MHz

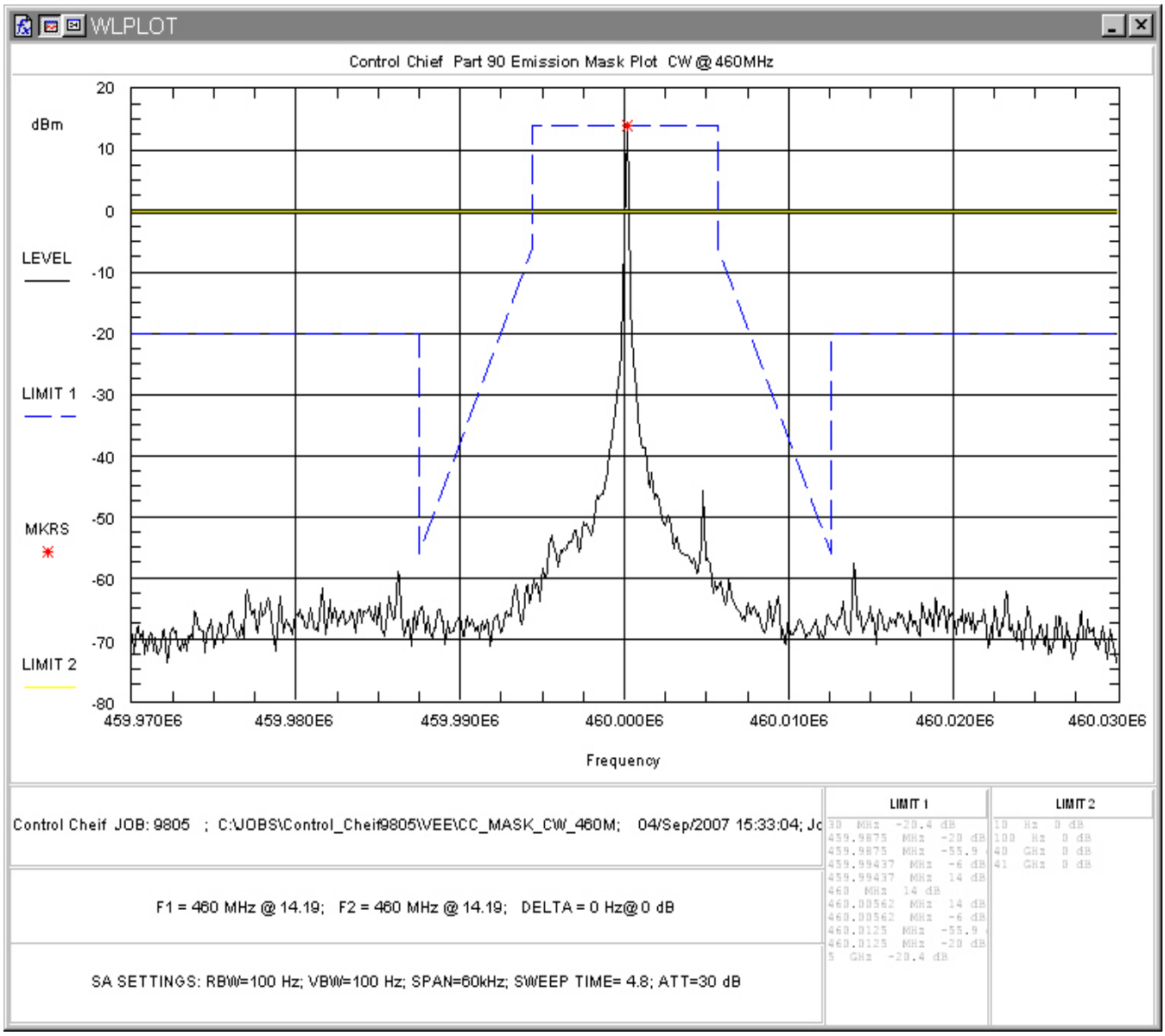


Figure 4-8. Conducted Spurious Emissions, Mid Channel, 459.97-460.030MHz

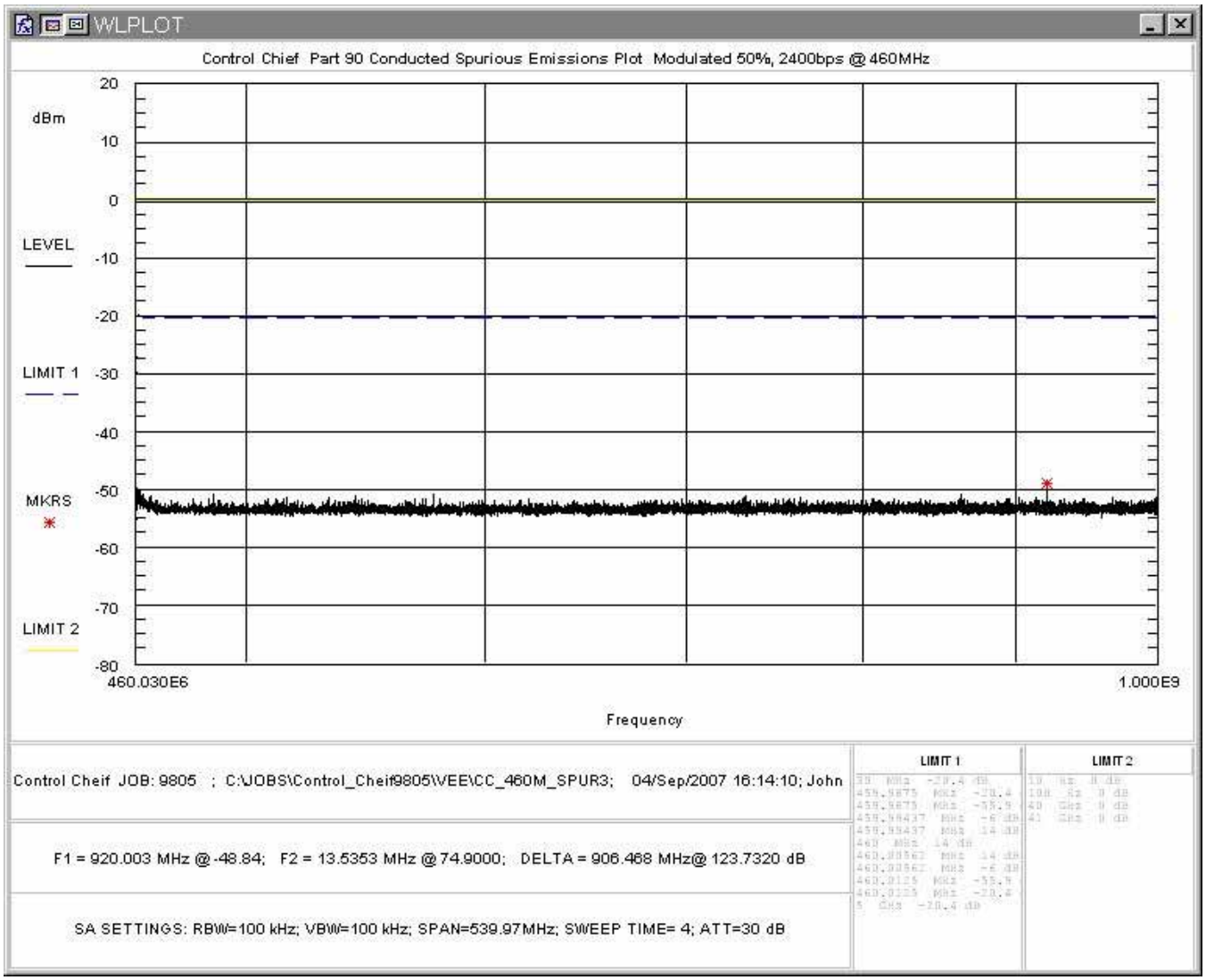


Figure 4-9. Conducted Spurious Emissions, Mid Channel, 460.030 – 1000MHz

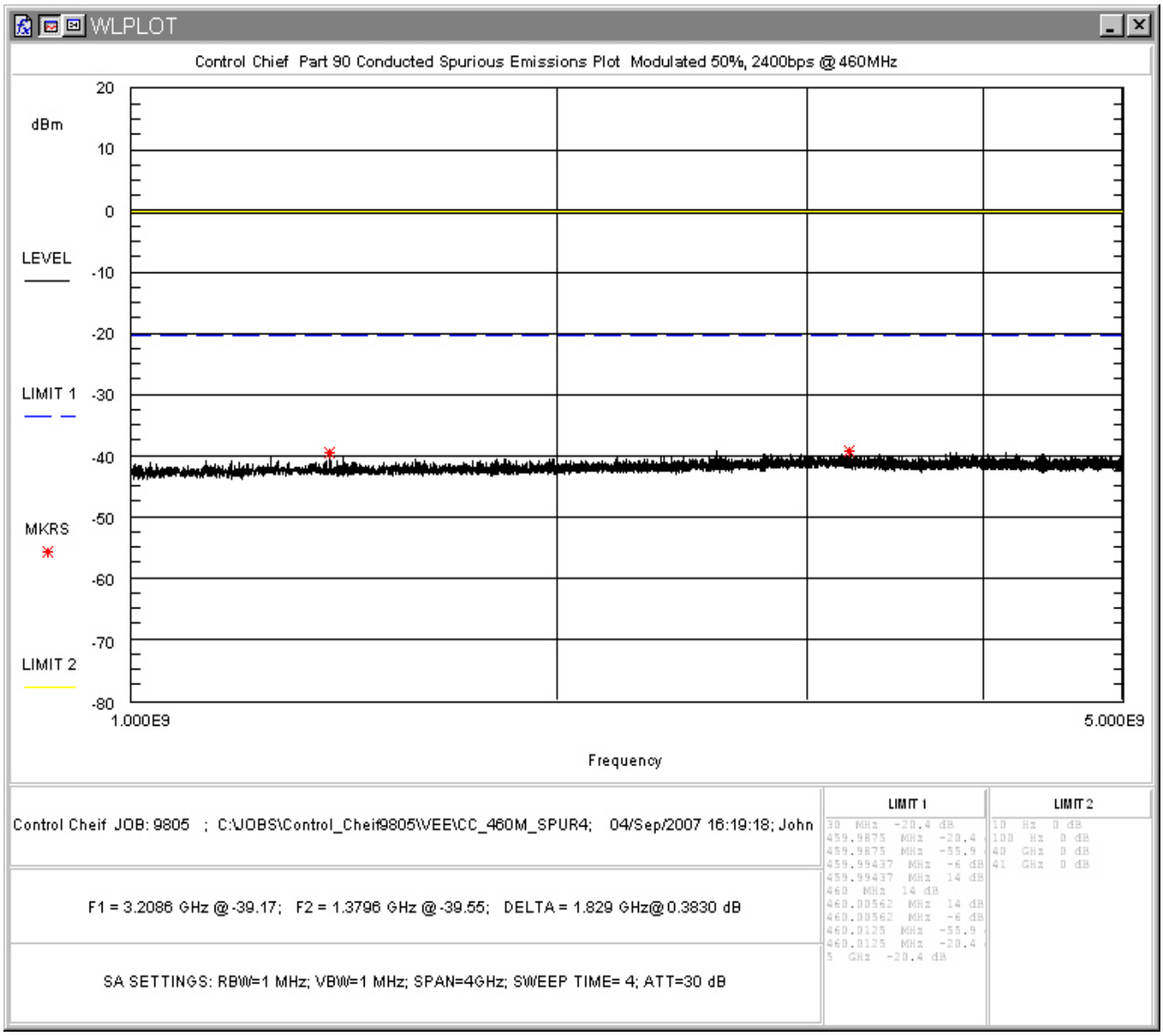


Figure 4-10. Conducted Spurious Emissions, Mid Channel, 1 - 5GHz

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

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-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)

Table 5: Radiated Emission Test Data

CLIENT:	Control Chief	DATE:	09/09/07
TESTER:	John P. Repella	JOB #:	9805
EUT Information:		**Test Requirements:**	
EUT:	Advantage LJ45 Transceiver	TEST STANDARD:	FCC Part 90
Configuration:	Transmitting into dummy load	DISTANCE:	3m
Tx Frequency:	460 MHz	LIMIT:	Part 90 Mask D
Power (Watts)	0.1		

Frequency (MHz)	Polarity H/V	Azimuth Degree	Ant. Ht (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)	Limit (dBm)	Margin (dB)
142.06	V	245.0	1.0	15.8	-57.3	-60.8	12.5	0.8	-60.0	-20	-40.0
167.62	V	177.0	1.0	14.2	-59.3	-63.4	12.9	1.8	-61.6	-20	-41.6
185.13	V	210.0	1.0	13.5	-61.0	-65.2	13.5	2.1	-63.1	-20	-43.1
222.08	V	270.0	1.0	10.2	-63.2	-67.8	16.8	0.3	-67.5	-20	-47.5
400.24	V	335.0	1.0	4.1	-72.6	-77.9	16.5	5.8	-72.1	-20	-52.1
455.29	V	90.0	1.0	4.8	-69.1	-75.9	17.0	6.4	-69.5	-20	-49.5
1380.00	V	315.0	1.0	54.0	-47.2	-50.5	26.5	6.5	-44.0	-20	-24.0
1840.00	V	90.0	1.0	57.0	-42.6	-46.5	27.5	8.0	-38.5	-20	-18.5
2300.00	V	315.0	1.0	46.7	-50.1	-54.2	28.6	8.8	-45.3	-20	-25.3
2760.00	V	300.0	1.0	43.5	-51.5	-55.5	29.6	9.4	-46.1	-20	-26.1
3220.00	V	0.0	1.0	45.5	-48.4	-53.7	30.6	9.8	-43.9	-20	-23.9
3680.00	V	0.0	1.0	42.7	-48.9	-53.8	30.6	10.9	-42.9	-20	-22.9
4140.00	V	0.0	1.0	48.3	-43.3	-48.7	31.3	11.3	-37.4	-20	-17.4
4600.00	V	0.0	1.0	38.5	-51.2	-58.0	32.1	11.4	-46.6	-20	-26.6
142.06	H	90.0	3.0	22.2	-50.9	-54.3	12.5	0.8	-53.5	-20	-33.5
167.63	H	90.0	3.0	15.8	-57.7	-61.7	12.9	1.8	-59.9	-20	-39.9
185.12	H	180.0	3.0	14.2	-58.9	-63.2	13.5	2.1	-61.1	-20	-41.1
222.07	H	50.0	3.0	7.6	-60.5	-65.0	16.8	0.3	-64.7	-20	-44.7
400.26	H	315.0	3.0	7.1	-55.8	-60.9	16.5	5.8	-55.1	-20	-35.1
455.29	H	16.0	3.0	9.1	-65.5	-72.2	17.0	6.4	-65.8	-20	-45.8
1380.00	H	315.0	1.0	55.0	-44.5	-47.7	26.5	6.5	-41.2	-20	-21.2
1840.00	H	290.0	1.0	55.7	-43.7	-47.5	27.5	8.0	-39.5	-20	-19.5
2300.00	H	315.0	1.0	51.7	-45.6	-48.8	28.6	8.8	-40.0	-20	-20.0
2760.00	H	315.0	1.0	44.0	-52.0	-56.0	29.6	9.4	-46.6	-20	-26.6
3220.00	H	300.0	1.0	46.2	-47.2	-52.3	30.6	9.8	-42.6	-20	-22.6
3680.00	H	180.0	1.0	49.3	-42.7	-47.8	30.6	10.9	-36.9	-20	-16.9
4140.00	H	0.0	1.0	48.2	-43.9	-49.3	31.3	11.3	-38.1	-20	-18.1
4600.00	H	0.0	1.0	38.8	-51.3	-57.8	32.1	11.4	-46.5	-20	-26.5

4.5 Receiver Spurious Emissions

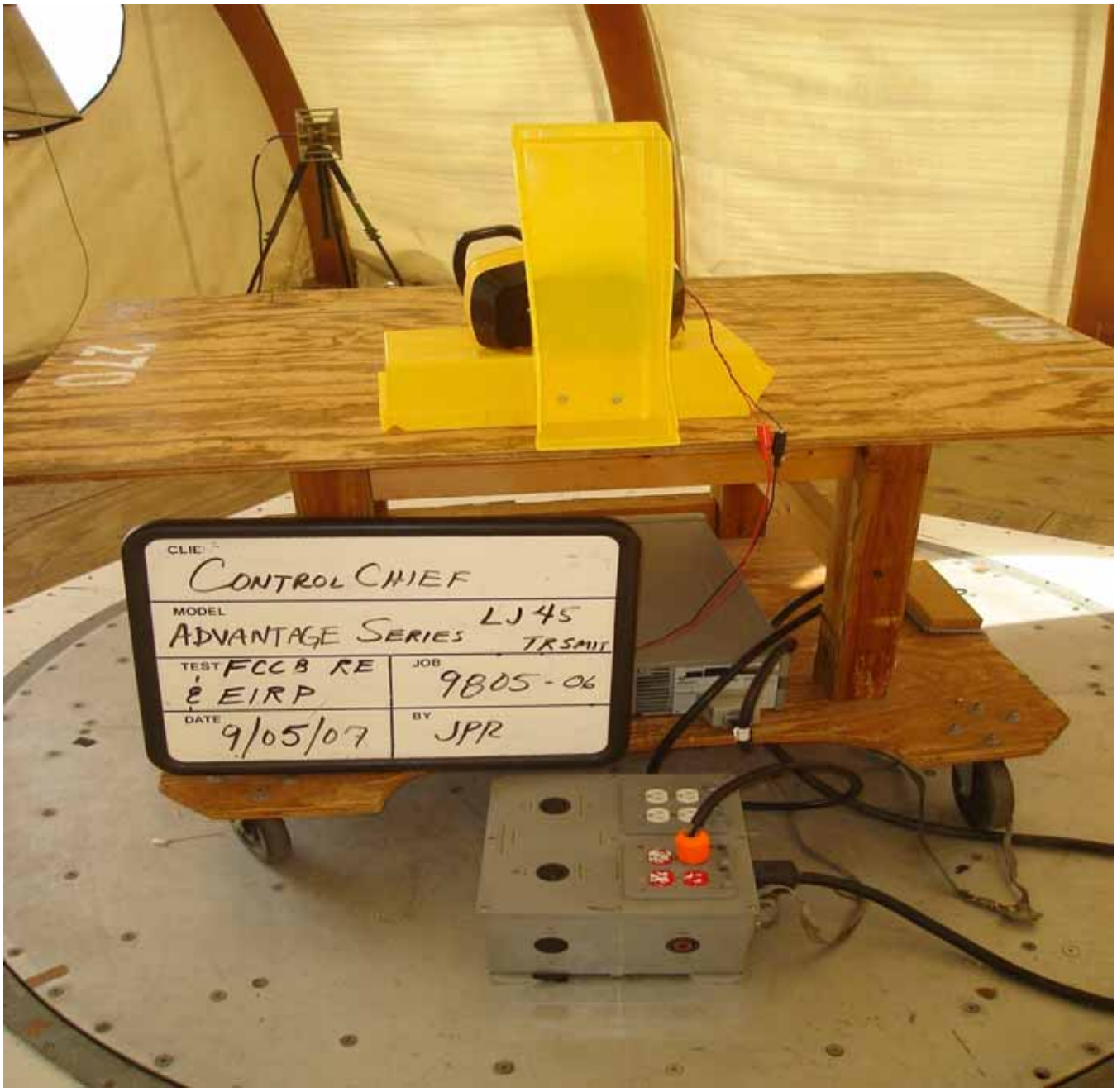
The EUT must comply with requirements for receiver spurious emissions. The limits for spurious emissions are defined in section 8 of RSS-119.

4.5.1 Test Procedure

To measure the spurious emissions of the EUT was placed into receive mode and tuned to 460MHz. The antenna was connected to the EUT during testing. The frequency was scanned from 30M – 1GHz and the emissions were recorded and compared to the limit of specified in Section 8 of RSS-119.

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.

Photograph 2. Radiated Emissions Setup, Front of EUT



Photograph 3. Radiated Emissions Setup, Rear of EUT

The following is a sample calculation used in the data tables for calculating the final field strength of spurious emissions and comparing these levels to the specified limits.

Sample Calculation:

Spectrum Analyzer Voltage (SA Level):	V dBµV
Antenna Factor (Ant Corr):	AFdB/m
Cable Loss Correction (Cable Corr):	CCdB
Amplifier Gain:	GdB
Electric Field (Corr Level):	EdBµV/m = VdBµV + AfdB/m + CCdB – GdB
To convert to linear units:	EµV/m = antilog (EdBµV/m/20)

Data are supplied in the following tables. Testing was performed to 5GHz. No emissions were detected above 1GHz. All detected emissions are reported in the following table.

Table 6: Radiated Emissions – Receiver

CLIENT:	Control Chief	DATE:	09/09/07
TESTER:	John Repella	JOB #:	9805
EUT Information:		**Test Requirements:**	
EUT:	Advantage LJ45 Transceiver	TEST STANDARD:	RSS-119
Configuration:	Rx tuned to 460 MHz- TX disabled	DISTANCE:	3m
CLOCKS:	45 MHz, 455 kHz	CLASS:	B
Test Equipment/Limit:			
ANTENNA:	A_00382	LIMIT:	LFCC_3m_Class_B
CABLE:	CSITE1_3m	AMPLIFIER (dB)	None

Frequency (MHz)	Polarity H/V	Az Deg	Ant. Ht. (m)	SA Level (QP) (dBµV)	Ant. Corr. (dB/m)	Cable Corr. (dB)	Corr. Level (dBµV/m)	Corr. Level (µV/m)	Limit (µV/m)	Margin dB
114.426	V	120.0	1.0	4.5	13.5	2.0	20.0	10.0	150.0	-23.5
154.200	V	0.0	1.0	7.0	12.3	2.3	21.6	12.0	150.0	-21.9
163.700	V	166.0	1.0	4.8	12.1	2.4	19.2	9.2	150.0	-24.3
166.700	V	263.0	1.4	8.4	12.0	2.4	22.8	13.8	150.0	-20.7
172.710	V	8.1	1.2	8.1	11.8	2.4	22.3	13.0	150.0	-21.2
182.495	V	181.0	1.0	8.4	11.5	2.5	22.4	13.2	150.0	-21.1
184.002	V	200.0	1.2	8.9	11.5	2.5	22.9	14.0	150.0	-20.6
196.027	V	350.0	1.0	5.5	11.9	2.6	20.0	10.0	150.0	-23.5
247.940	V	189.0	1.3	8.4	11.8	3.0	23.2	14.5	200.0	-22.8
324.216	V	323.0	2.0	12.5	14.1	3.5	30.1	32.0	200.0	-15.9
343.300	V	252.0	1.3	4.8	14.2	3.6	22.7	13.6	200.0	-23.4
413.700	V	190.0	2.2	8.0	16.2	4.0	28.1	25.5	200.0	-17.9
457.730	V	137.0	1.7	13.9	16.7	4.3	34.9	55.5	200.0	-11.1

Frequency (MHz)	Polarity H/V	Az Deg	Ant. Ht. (m)	SA Level (QP) (dBµV)	Ant. Corr. (dB/m)	Cable Corr. (dB)	Corr. Level (dBµV/m)	Corr. Level (µV/m)	Limit (µV/m)	Margin dB
114.426	H	260.0	3.2	5.1	13.5	2.0	20.6	10.7	150.0	-22.9
166.700	H	250.0	3.4	3.8	12.0	2.4	18.2	8.1	150.0	-25.3
172.710	H	327.0	2.3	7.3	11.8	2.4	21.5	11.9	150.0	-22.0
182.495	H	238.0	3.3	6.8	11.5	2.5	20.8	11.0	150.0	-22.7
184.002	H	0.0	3.6	6.3	11.5	2.5	20.3	10.4	150.0	-23.2
196.027	H	140.0	2.6	3.7	11.9	2.6	18.2	8.1	150.0	-25.3
247.940	H	258.0	2.8	12.0	11.8	3.0	26.8	21.9	200.0	-19.2
324.216	H	119.0	2.7	9.7	14.1	3.5	27.3	23.2	200.0	-18.7
343.300	H	227.0	2.6	7.4	14.2	3.6	25.3	18.3	200.0	-20.8
413.700	H	235.0	1.9	5.7	16.2	4.0	25.8	19.6	200.0	-20.2
450.000	H	109.0	2.7	10.0	16.7	4.2	30.9	35.0	200.0	-15.1
457.730	H	176.0	2.5	10.9	16.7	4.3	31.9	39.3	200.0	-14.1

4.6 Frequency Stability: (FCC Part §2.1055 and Industry Canada RSS-119, Section 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 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 table is the data for the frequency deviation testing.

Table 7. Frequency Deviation as a Function of Temperature

Temperature (Centigrade)	Frequency (MHz)	Difference (Hz)	Deviation (%)	Limit (in Hz)
Ambient (24C)	459.998014	0.0	0	
-30	459.998619	605.0	0.000132	1150
-20	459.998484	470.0	0.000102	1150
-10	459.998403	389.0	0.000085	1150
0	459.998366	352.0	0.000077	1150
10	459.998278	264.0	0.000057	1150
20	459.998122	108.0	0.000023	1150
30	459.997933	-81.0	0.000018	1150
40	459.997792	-222.0	0.000048	1150
50	459.997742	-272.0	0.000059	1150

Table 8. Frequency Deviation as a Function of Voltage

Voltage (Volts)	Frequency (MHz)	Difference (Hz)	Deviation (%)	Limit (in Hz)
At rated 7.4 VDC	459.998035		0.0	
at 5 VDC (unit stops below 5.25 VDC)	459.997888	-147.0	0.000032	1150

4.7 Transient Frequency Behavior (FCC §90.214 and RSS-119 Section 6.5)

For transmitters operation in the 450M to 470MHz frequency range the transient frequency behavior must be measured and comply with the requirements of FCC §90.214 and Industry Canada Section 6.5.

4.7.1 Procedure

To perform the transient frequency behavior testing the antenna was removed and the output was connected to test setup. The procedure described in TIA-603-C was used for performing the testing.

The EUT was tuned to 460MHz and the output was fed into a variable attenuator. This output was then connected through a directional coupler into a combiner input port. The 2nd port of the combiner was connected to the output of a signal generator which was programmed to the center frequency of the transmitter with a 1kHz FM modulated signal at 12.5kHz deviation. The output of the combiner was fed into the spectrum analyzer. The video output of the spectrum analyzer was then connected to the channel 1 of the oscilloscope while the coupled output of the EUT transmit signal was fed into a RF detector and then to channel 2 of the oscilloscope for triggering the scope upon the EUT being keyed. (Reference Figure 4-11 for the general test setup and Photograph X)

The spectrum analyzer and oscilloscope were then setup per TIA-603-C so that the oscilloscope would display the +/-12.5kHz deviation across the entire display. The EUT was modulated during this test. Upon keying the transmitter the oscilloscope triggered capturing the results of the Tx turn-on (t1 and t2). The scope was then adjusted so the triggering would occur on the Tx turn-off (t3). The limits applied between the t2 and t3 are per the frequency stability requirements as reported in Section 4.6.

The following oscilloscope plots show the results of the transient frequency behavior test.

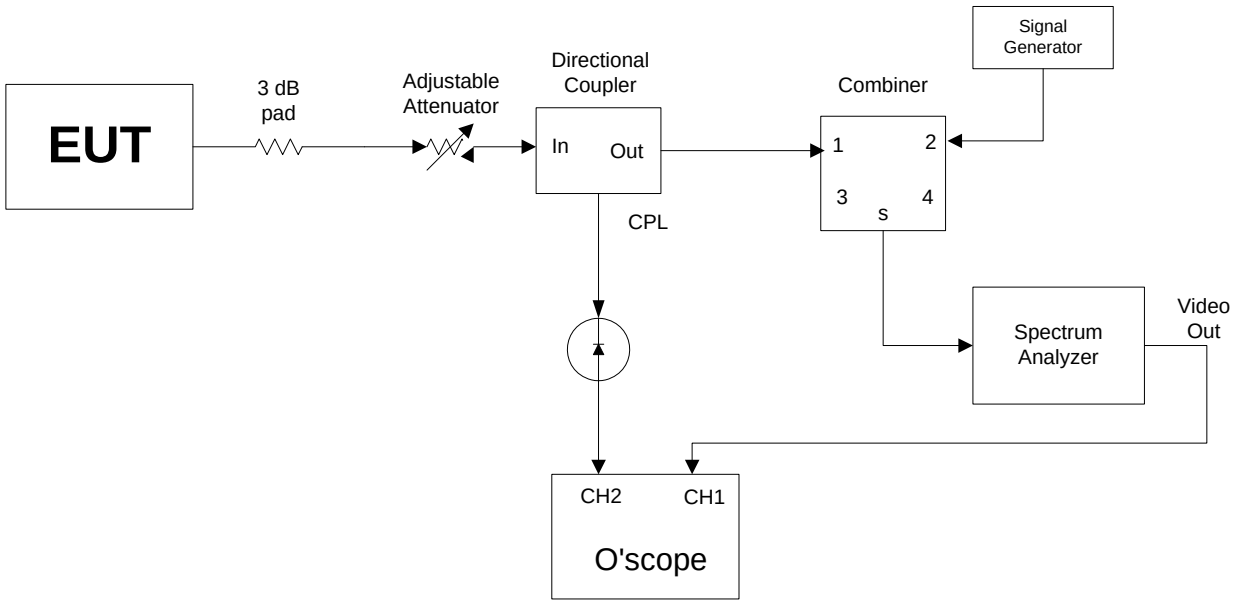
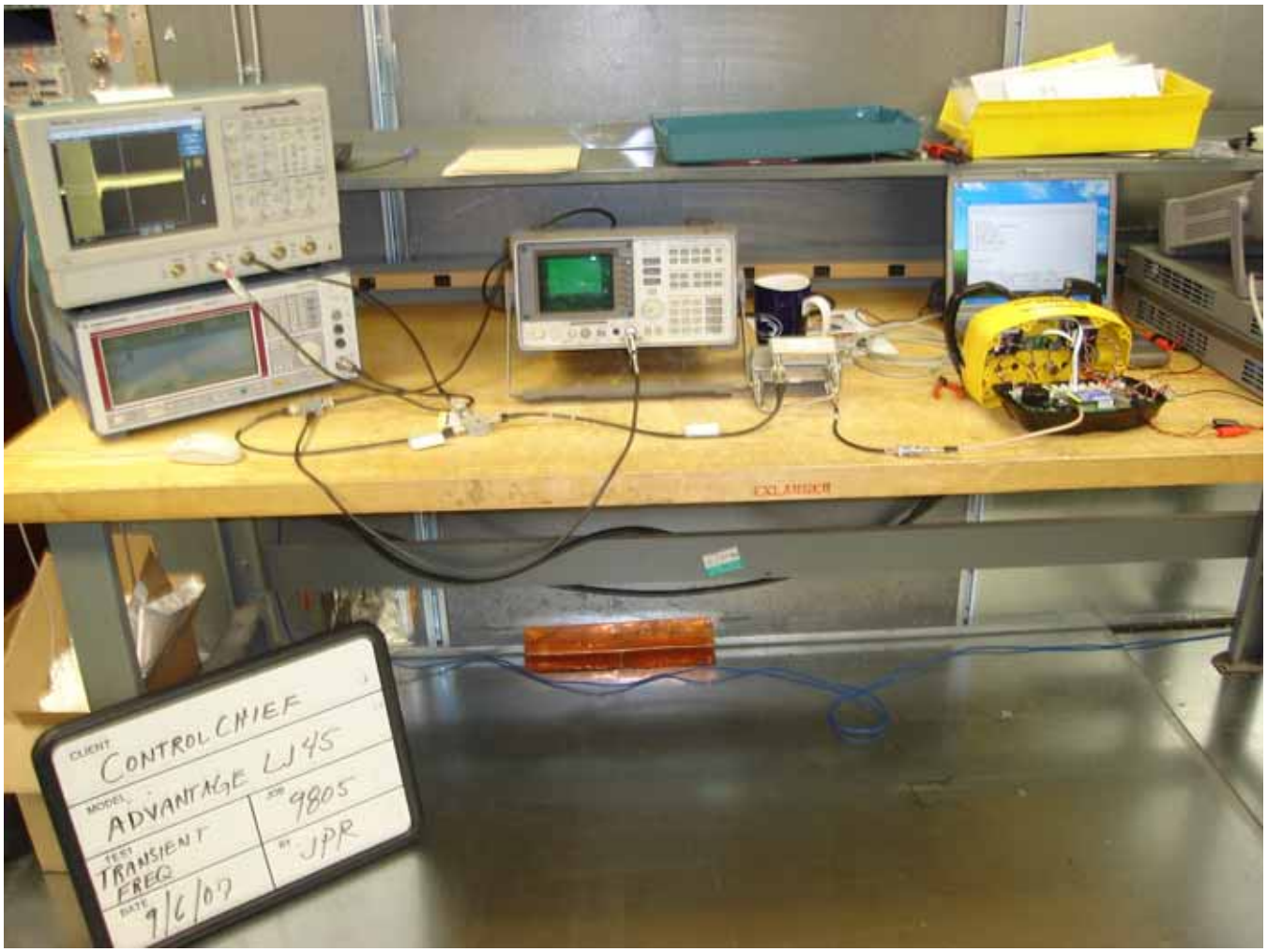


Figure 4-11. General Transient Frequency Behavior Test Setup



Photograph 4. Transient Frequency Behavior Setup

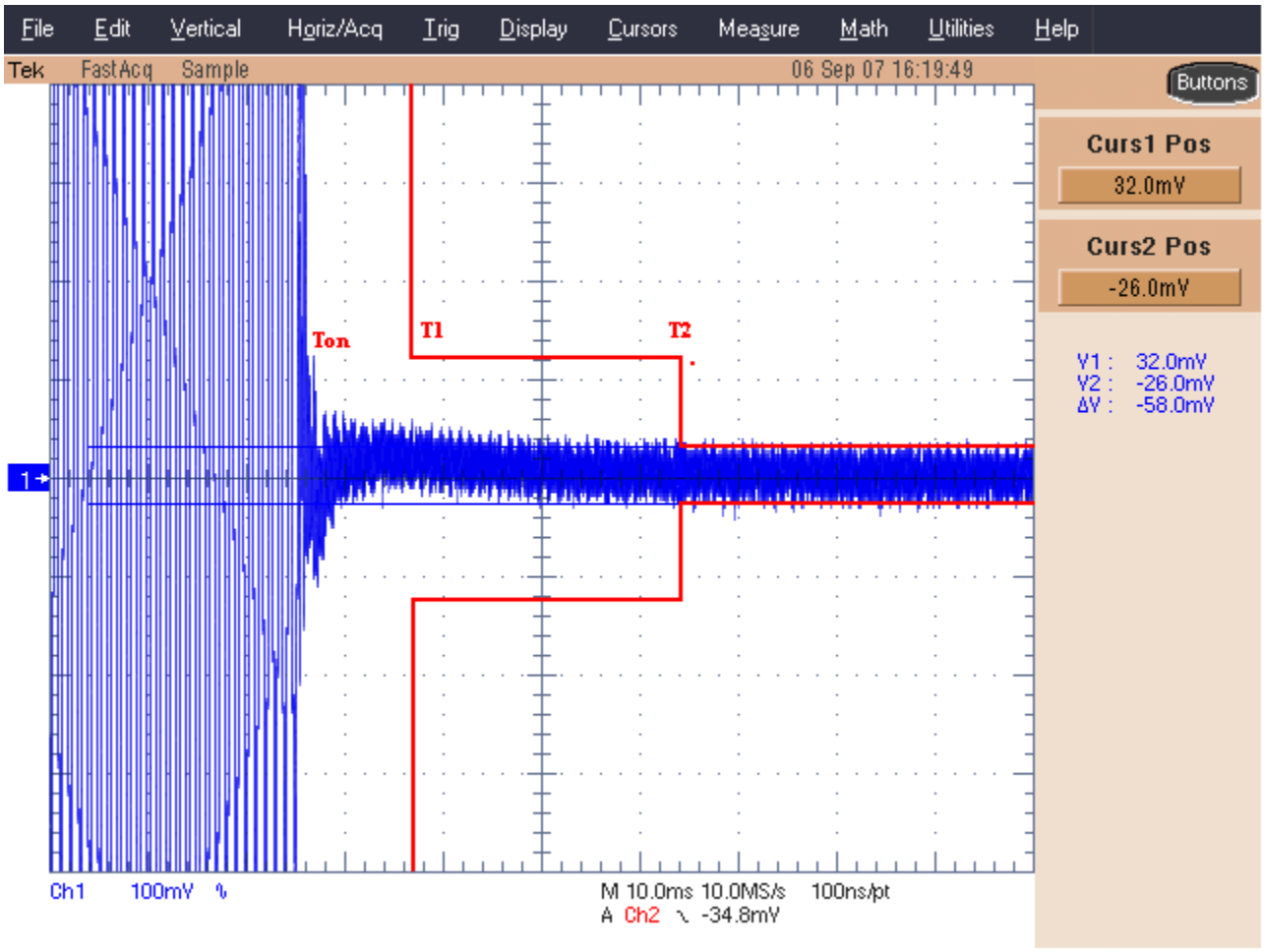


Figure 4-12. Transient Frequency Behavior, Turn-on

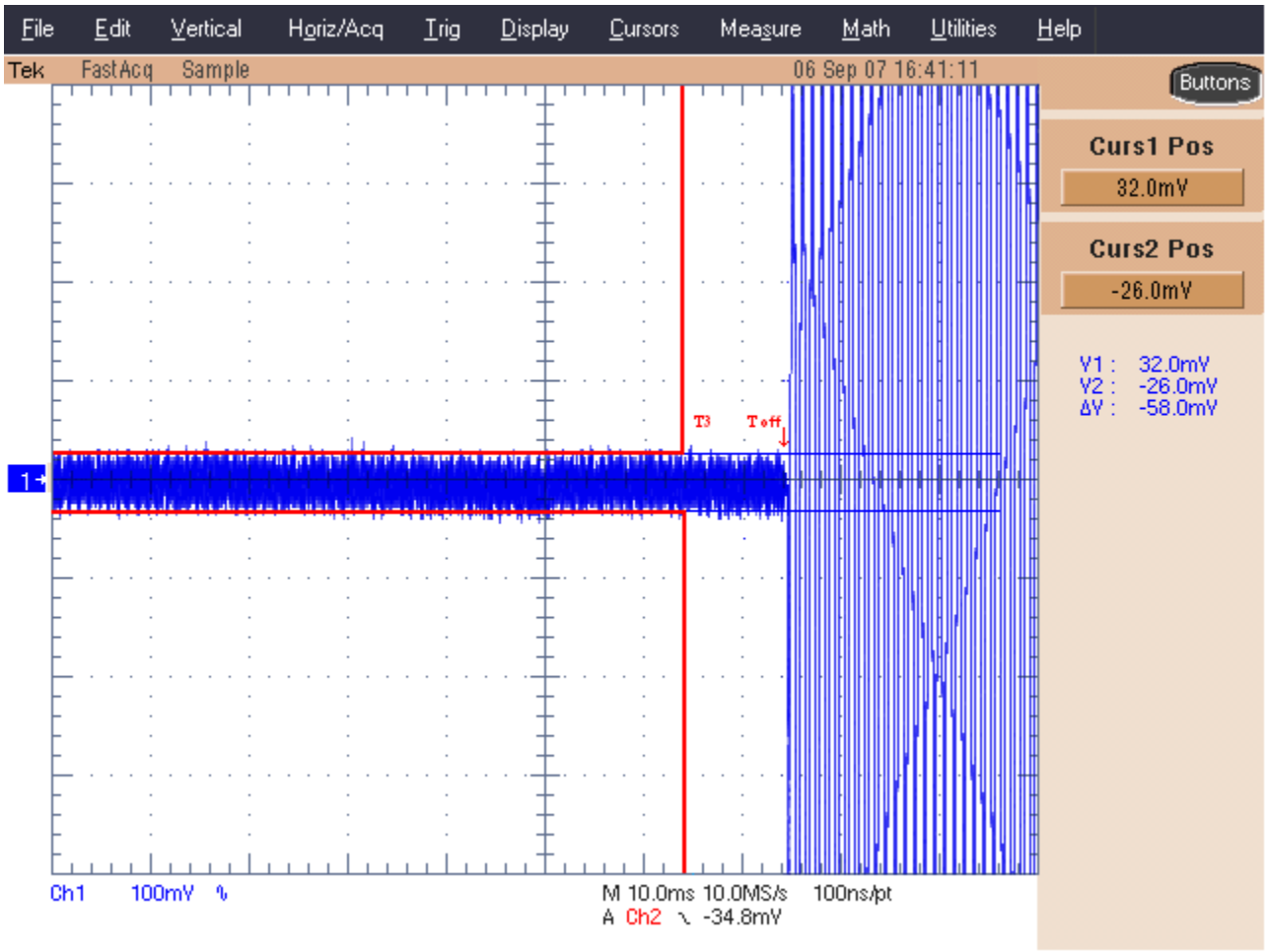


Figure 4-13. Transient Frequency Behavior, Turn-off

