FCC & Industry Canada Certification Test Report

For the

Primayer Ltd.

EUREKA 3

FCC ID: OABCXG970001

IC ID: 3305A-CXG970001

WLL JOB# 13423-01 Rev 0
June 11, 2014

Re-issued

WLL JOB# 13423-01 Rev 2

February 5, 2015

Prepared for:

Primayer Ltd.
Pryimayer HouseParklands Business Park
Denmead, Hants
PO76XP United Kingdom

Prepared By:

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

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Prepared by: Steven Dovell
Compliance Engineer

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EMC & Wireless Lab Manager

Abstract

This report has been prepared on behalf of Primayer Ltd. 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 Primayer Ltd. Eureka 3.

Testing was performed at Washington Laboratories, Ltd, 7560 Lindbergh Drive, Gaithersburg, MD 20879. Washington Laboratories, Ltd. has been accepted as an EMC Conformity Assessment Body (CAB) under the United States/European Union Memorandum of Agreement. Washington Laboratories, Ltd. is accredited by ACLASS under Certificate AT-1448.

The Primayer Ltd. Eureka 3 complies with the limits for a Licensed Transmitter device under FCC Part 90.

Revision History	Reason	Date
Rev 0	Initial Release	June 11, 2014
Rev 1	Updated to address typographical errors and reviewer observations	June 17, 2014
Rev 2	Corrected model name in Table 1	August 13, 2014
Rev 3	Updated Necessary Bandwidth	February 5, 2015

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1 Introduction

1.1 Compliance Statement

The Primayer Ltd. Eureka 3 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:	Primayer Ltd. Pryimayer House Parklands Business Park Denmead, Hants PO76XP United Kingdom
Quotation Number:	68057

1.4 Test Dates

Testing was performed on the following date(s):	May 7 – May 12, 2014

1.5 Test and Support Personnel

Washington Laboratories, LTD	Steven Dovell
Customer Representative	Steven Peach

2 Equipment Under Test

2.1 EUT Identification & Description

The Primayer Ltd. Eureka 3 provides a wireless system for locating leaks in water pipes.
The system consists of the following main components: (1) the receiver unit and, (2) two transmitters which operate at 469.5MHz and 469.55MHz.

Table 1: Device Summary

ITEM	DESCRIPTION
Manufacturer:	Primayer Ltd.
FCC ID:	OABCXG970001
IC ID:	3305A-CXG970001
Model:	Eureka 3
FCC Rule Parts:	§90.210
IC Rule Part:	RSS-119
Frequency Range:	469.5 – 469.55MHz
Number of channels:	2
Maximum Output Power:	0.454W (26.569dBm)
Modulation:	FM
Occupied Bandwidth:	4.31kHz
Keying:	Manual
Type of Information:	Audio
Power Output Level	Two Levels – Fixed High power and Low power mode
Antenna Type	External 1/2 wave whip antenna (3.8dBi)
Antenna Connector	TNC
Frequency Tolerance:	2.5ppm
Emission Type(s):	F3E
Interface Cables:	None
Power Source & Voltage:	6Vdc from (5) 1.2V batteries

2.2 Test Configuration

The Eureka 3 was tested in a stand-alone configuration. The TNC antenna connector was used for conducted tests performed at the antenna terminal.

2.3 Testing Algorithm

The Eureka 3 was setup to continuously transmit at the selected frequency with the unit modulated. The modulating signal was provided by a Primayer correlation test fixture. The operation of the radio was controlled via the single push button switch located on the top of the unit. The switch allows the unit to be turned on and off and once on, allows the user to change power from High to Low by momentarily pressing the button. Testing was performed in the High power mode.

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

2.4 Test Location

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 ACLASS under Certificate AT-1448 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. The basis for uncertainty calculation uses ANSI/NCSL Z540-2-1997 (R2012) with a type B evaluation of the standard uncertainty. Elements contributing to the standard uncertainty are combined using the method described in Equation 1 to arrive at the total standard uncertainty. The standard uncertainty is multiplied by the coverage factor to determine the expanded uncertainty which is generally accepted for use in commercial, industrial, and regulatory applications and when health and safety are concerned (see Equation 2). A coverage factor was selected to yield a 95% confidence in the uncertainty estimation.

Equation 1: Standard Uncertainty

$$u_c = \pm\sqrt{\frac{a^2}{div_a^{\ 2}} + \frac{b^2}{div_b^{\ 2}} + \frac{c^2}{div_c^{\ 2}} + ...}$$

Where u_c = standard uncertainty

a, b, c,.. = individual uncertainty elements

$Div_{a,\,b,\,c}$ = the individual uncertainty element divisor based on the probability distribution

Divisor = 1.732 for rectangular distribution

Divisor = 2 for normal distribution

Divisor = 1.414 for trapezoid distribution

Equation 2: Expanded Uncertainty

$$U = ku_c$$

Where U	= expanded uncertainty
k	= coverage factor
	$k \leq 2$ for 95% coverage (ANSI/NCSL Z540-2 Annex G)
u_c	= standard uncertainty

The measurement uncertainty complies with the maximum allowed uncertainty from CISPR 16-4-2. Measurement uncertainty is not used to adjust the measurements to determine compliance. The expanded uncertainty values for the various scopes in the WLL accreditation are provided in below.

Table 2: Expanded Uncertainty List

Scope	Standard(s)	Expanded Uncertainty
Radiated Emissions	CISPR11, CISPR22, CISPR14, FCC Part 15	±4.55 dB
Conducted Emissions	CISPR11, CISPR22, CISPR14, FCC Part 15	±2.33 dB

Parameter	Uncertainty	Actual (+/-)	Unit
Radio Frequency	$\pm 1 \times 10^{-7}$	8.64E-08	parts
RF Power conducted (up to 160 W)	±0.75 dB	0.3	dB
Conducted RF Power variations using a test fixture	±0.75 dB	0.3	dB
Radiated RF power	±6 dB	N/A	dB
Adjacent channel power	±5 dB	0.6	dB
Transmitter transient frequency (frequency difference)	±250 Hz	160.7	Hz
Transmitter transient time	±20 %	9.2	%

3 Test Equipment

Table 3 shows a list of the test equipment used for measurements along with the calibration information.

Table 3: Test Equipment List

		Test Date:	**05/7/2014 – 5/13/14**
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
69	HP - 85650A	ADAPTER QP	1/9/2015
802	HP - 8568B	SPECTRUM ANALYZER	1/9/2015
71	HP - 85685A	PRESELECTOR RF	1/9/2015
522	HP - 8449B	PRE-AMPLIFIER 1-26.5GHZ	10/4/2014
220595	AGILENT - 8565EC	SPECTRUM ANALYZER 30HZ - 40GHZ	02/19/2015
4	ARA - DRG-118/A	ANTENNA DRG 1-18GHZ	2/20/2015
477	HP - 8648C	GENERATOR RF SIGNAL	2/11/2015
7	ARA - LPB-2520	ANTENNA BICONILOG ANTENNA	10/10/2014
644	SUNOL SCIENCES CORPORATION - JB1 925-833-9936	BICONALOG ANTENNA	1/17/2016
477	HP - 8648C	GENERATOR RF SIGNAL	2/11/2015
74	HP - 8593A	ANALYZER SPECTRUM	5/9/2015
000771	TEKTRONIX - TDS1012C-EDU	TWO CHANNEL 100MHZ OSCILLOSCOPE	9/16/2014
000480	HP - 8495B/8494B	ATTENUATOR SET	Cal before use
125	SOLAR - 8028-50-TS-24-BNC	LISN	6/11/2014
126	SOLAR - 8028-50-TS-24-BNC	LISN	6/11/2014
53	HP - 11947A	LIMITER TRANSIENT	3/18/2015
69	HP - 85650A	ADAPTER QP	1/9/2015
802	HP - 8568B	SPECTRUM ANALYZER	1/9/2015
000776	TENNY - TJR-A-WS4	1.22 CUFT	1/20/2015
00074	HP - 8593A	ANALYZER SPECTRUM	5/9/2015

4 Test Results

4.1 Final RF Power Requirements (FCC §2.1033 and Industry Canada RSS-119)

(8) The dc voltages applied to and dc currents into the several elements of the final radio frequency amplifying device for normal operation over the power range.

The final RF amplifier of the EUT requires +5VDC @ 0.25Amps for the High power setting and +5VDC @ 0.1Amps for the Low power setting.

4.2 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 4: RF Power Output

Frequency	Level dBm	Level Watts
Low Channel @469.5MHz	26.569	0.454
High Channel @469.55MHz	26.479	0.445

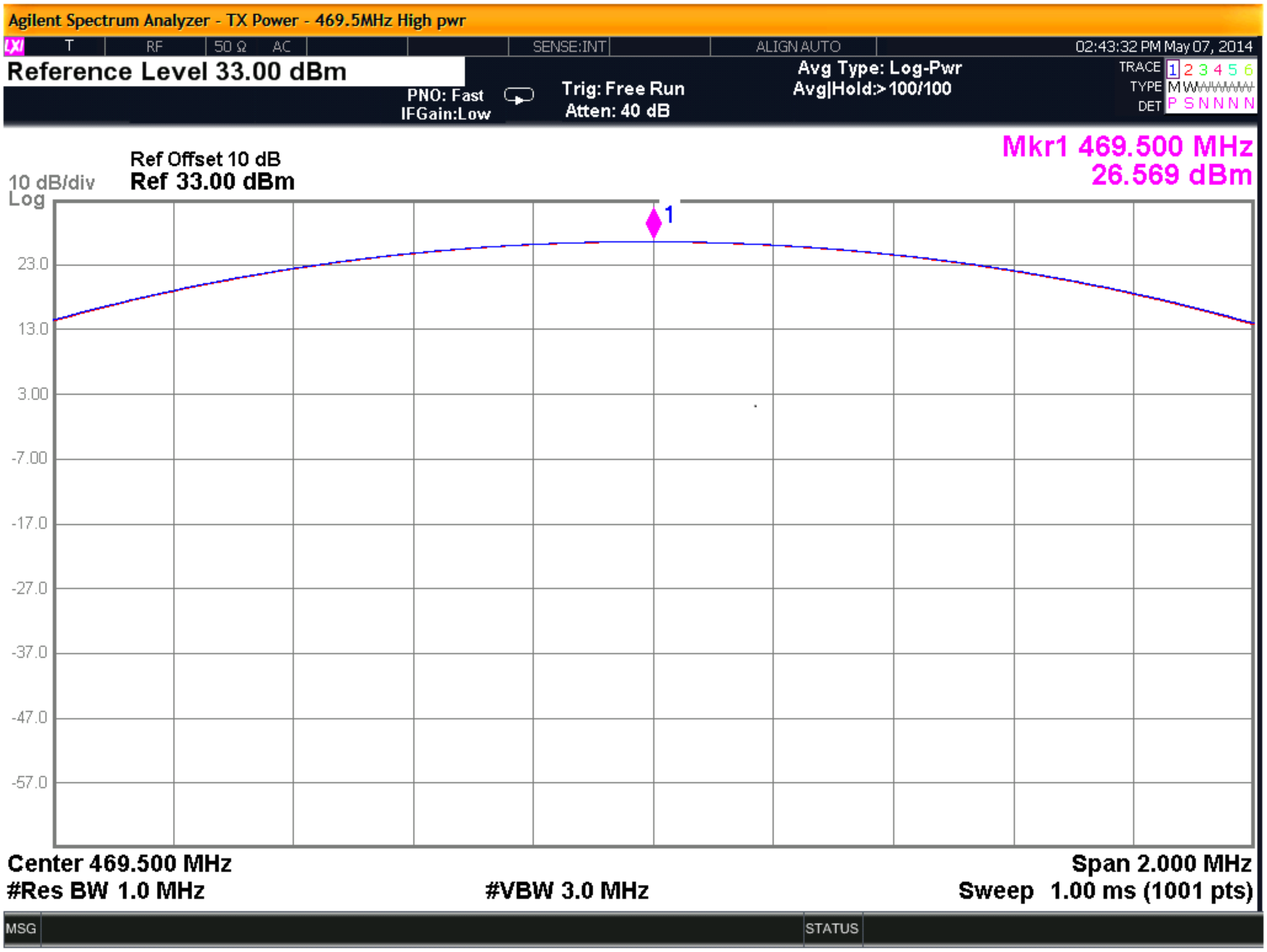


Figure 1: Output Power @469.5MHz

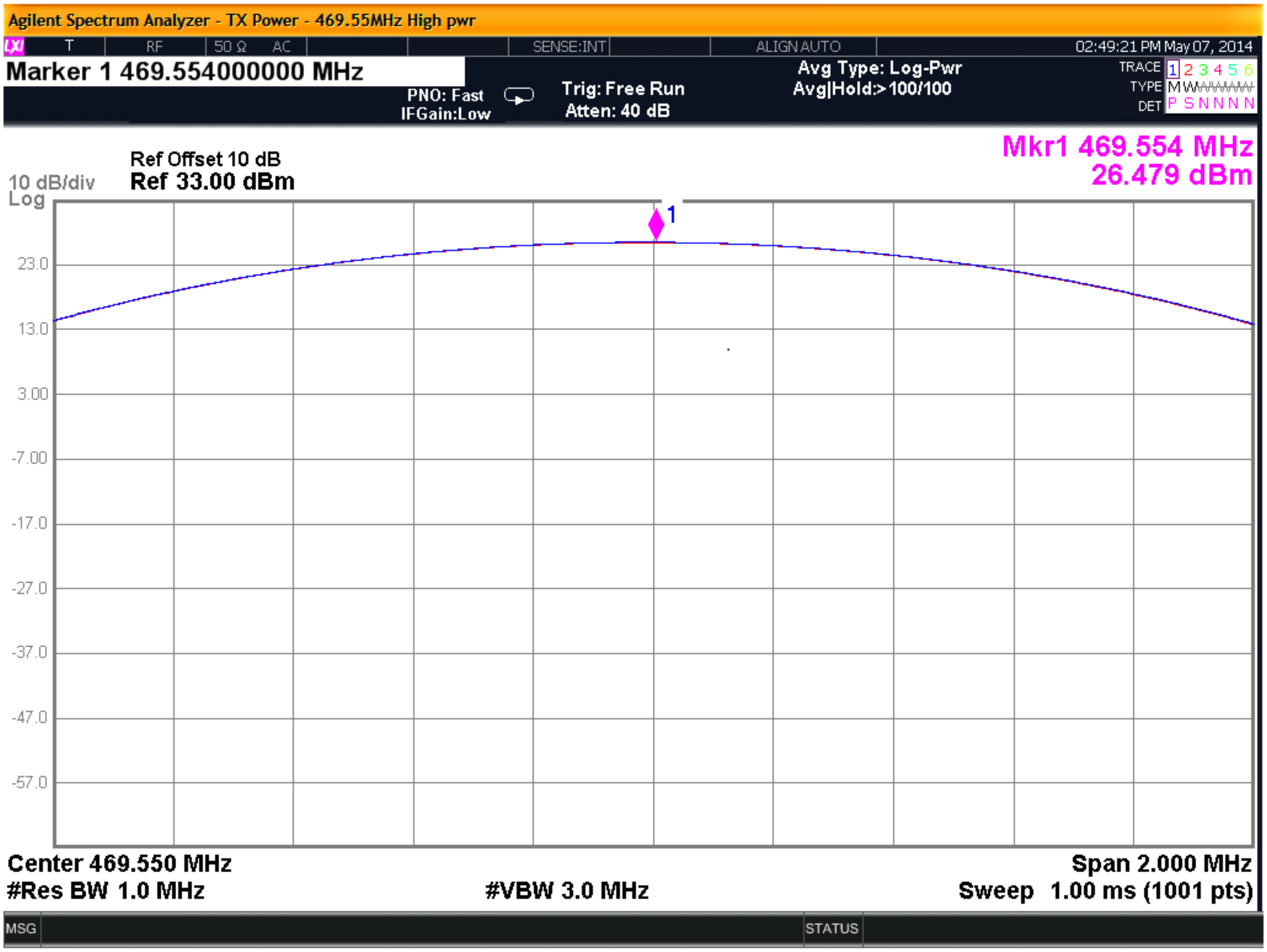


Figure 2: Output Power @469.55MHz

4.3 Modulation Characteristics: (FCC Part §2.1047 and Industry Canada RSS-119, 6.6)

A curve or equivalent data showing the frequency response of the audio modulating circuit over a range of 100 to 5000 Hz shall be submitted. For equipment required to have an audio low-pass filter, a curve showing the frequency response of the filter, or of all circuitry installed between the modulation limiter and the modulated stage shall be submitted.

The audio low pass filter was measured by removing the transducer from the unit and attaching a audio signal generator into the audio feed point of the EUT. The output of the transmit was connected to the input of the HP8909 modulation meter. The HP 8909 audio output was connected to an oscilloscope, which was used to measure the audio level. While maintaining the input level constant, the audio was swept from 100Hz to 7 kHz and the audio response was measured. Figure 3 shows the audio frequency response.

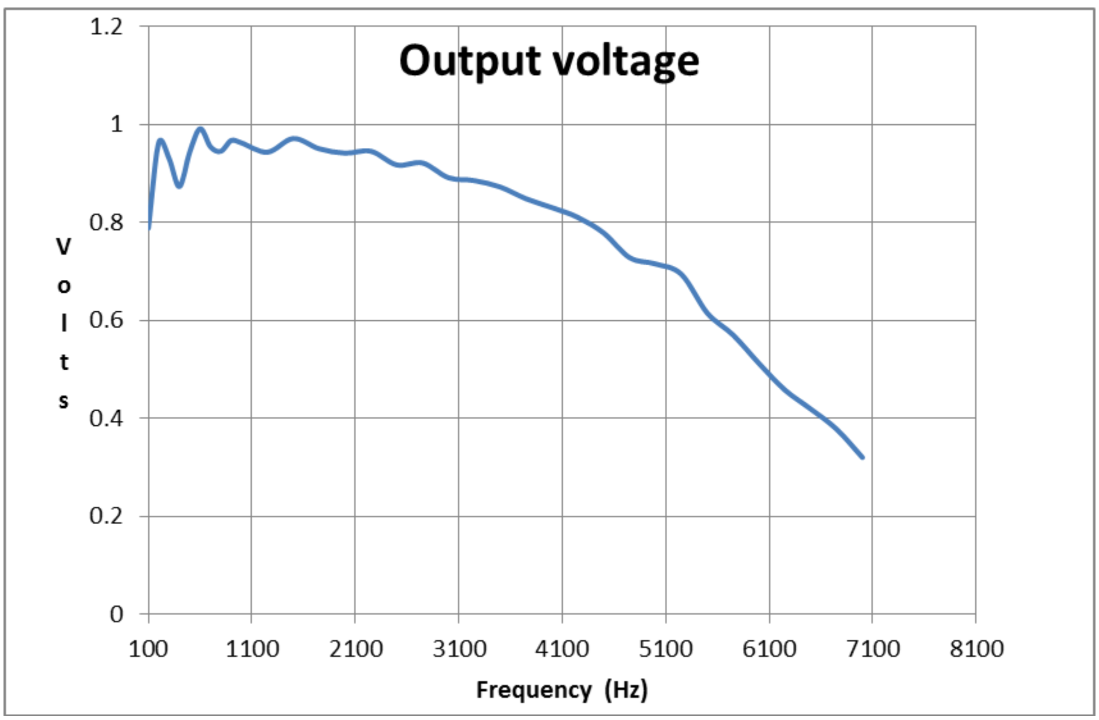
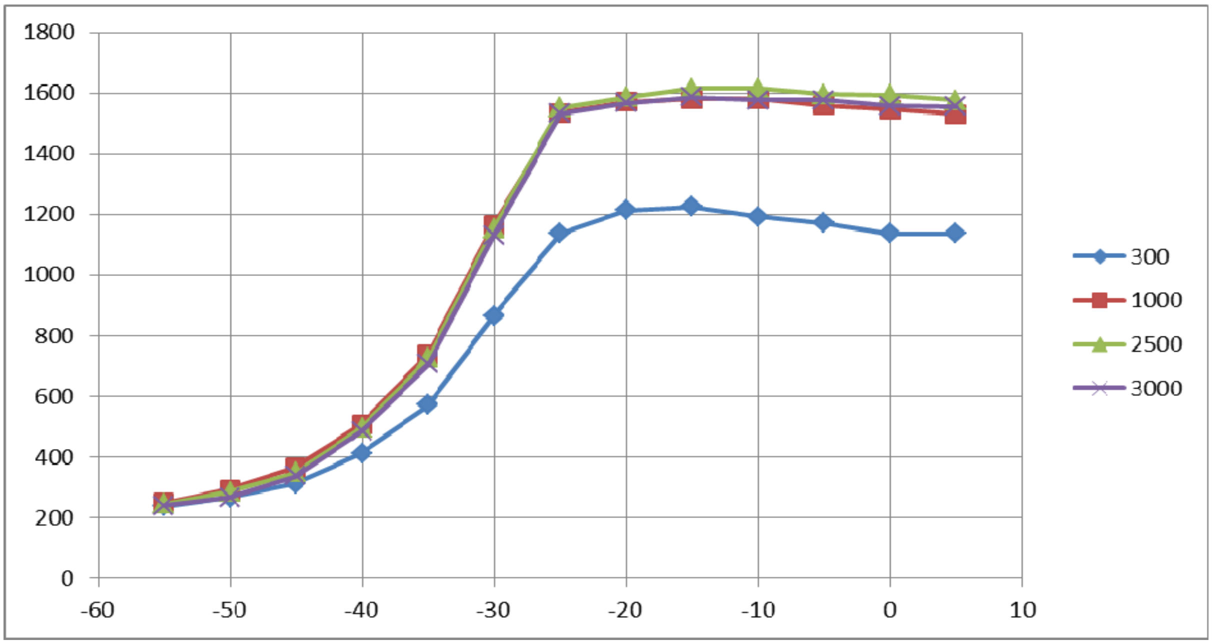


Figure 3: Audio Frequency response

The modulation limiter was characterized using the four recommended frequencies of 300Hz, 1000Hz, 2500Hz and 3000Hz. The frequency deviation was measured as each of four frequencies were injected while increasing the level to a point greater than 16dB above the level required to achieve 50% modulation.

Figure 4: Modulation Limiting vs Amplitude



The plot shows the modulation limited to 1.616 kHz. 50% of the attainable modulation level is 808Hz for a frequency of 2500Hz. From the plot this occurs at an input level of -35dB (relative amplitude). The modulation input level of 16 dB higher than -35 dB is -19 dB. At this level the expected modulation level for a 2.5 kHz input is extrapolated to be 1567Hz. The maximum deviation occurs at 1616Hz.

The necessary bandwidth is then calculated as follows:

Bn = 2M + 2DK

Where:

M is the maximum modulation Frequency based on the modulation limiting curve = 2500

D is the Peak Frequency Deviation, D = 1616Hz a measured on the HP 8901B

(K = 1)

2(2500) + 2(1616)(1) = 8232Hz

The emission designator is then determined to be: 8K2F3E.

4.4 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.

The occupied bandwidth was measured as shown below. A Boonton Modulation analyzer was then connected to the output and the FM deviation was measured at 1.597kHz. Calculations of the necessary bandwidth follow the bandwidth plot. Table 5 provides a summary of the Occupied Bandwidth Results.

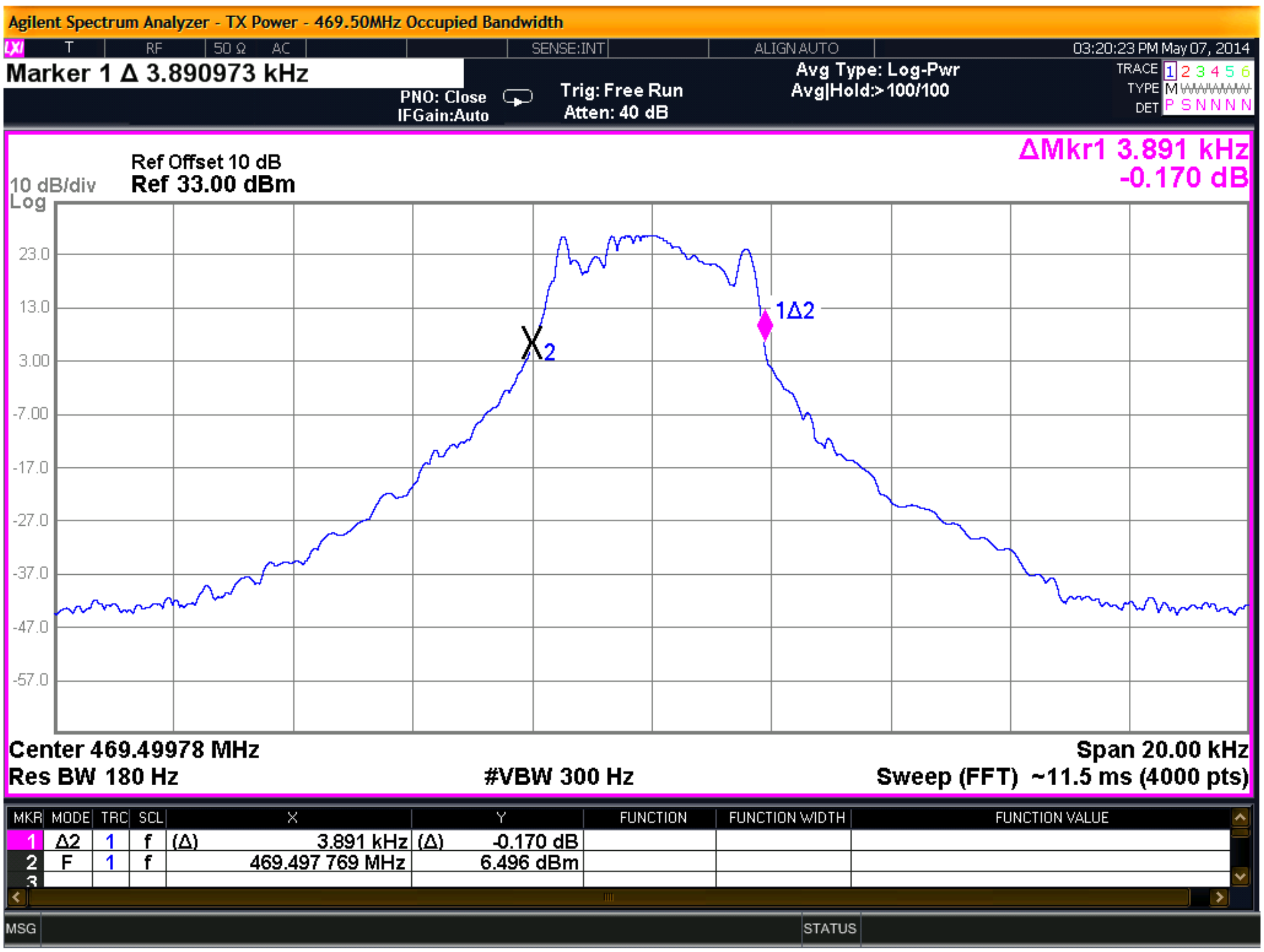


Figure 5: Low Channel Occupied Bandwidth @469.5MHz

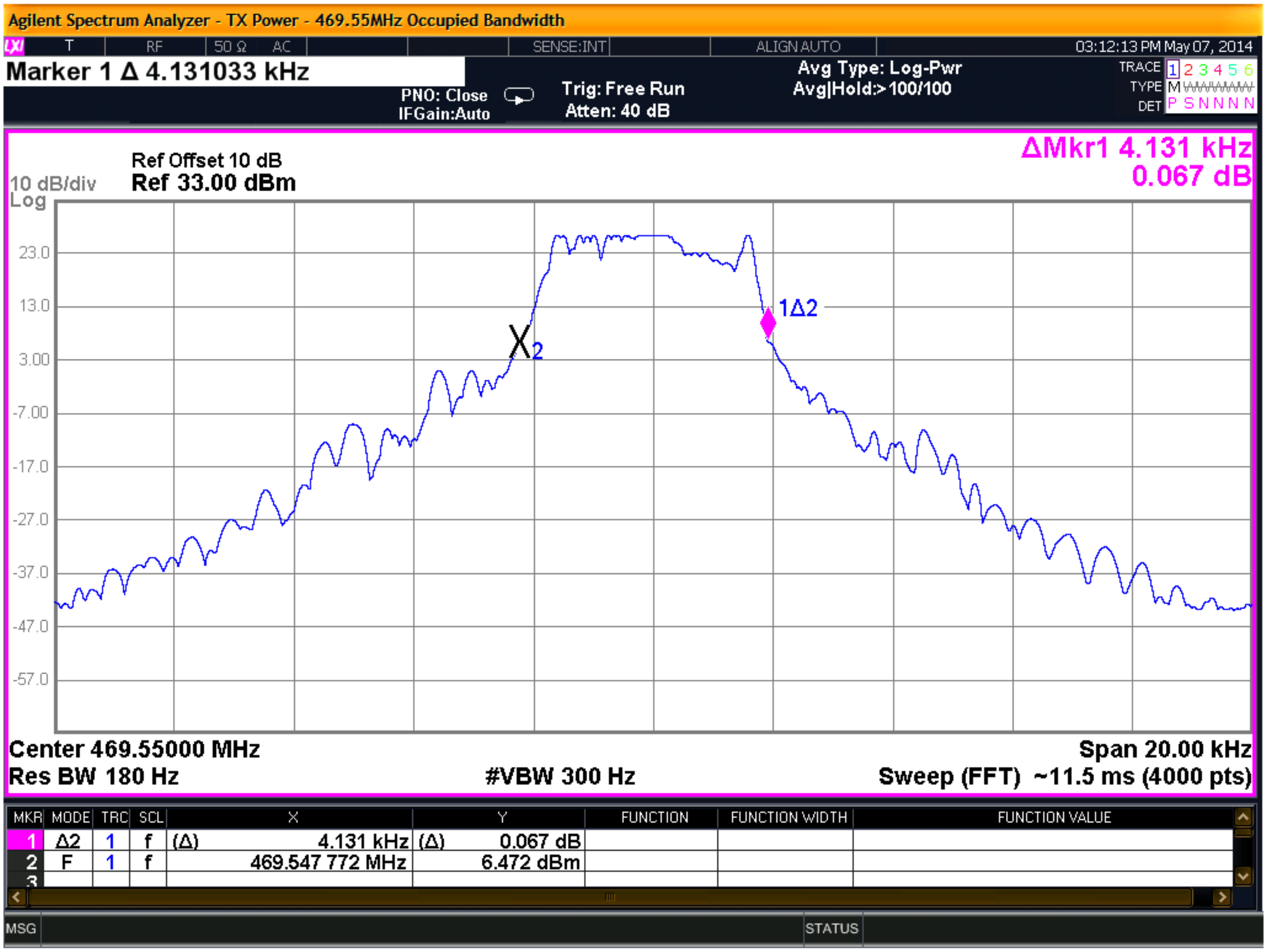


Figure 6: High Channel Occupied Bandwidth @469.55MHz

Table 5: Occupied Bandwidth Results

Frequency	Bandwidth
Low Channel: 469.50MHz	3.891 kHz
High Channel: 470MHz	4.131 kHz

4.5 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:

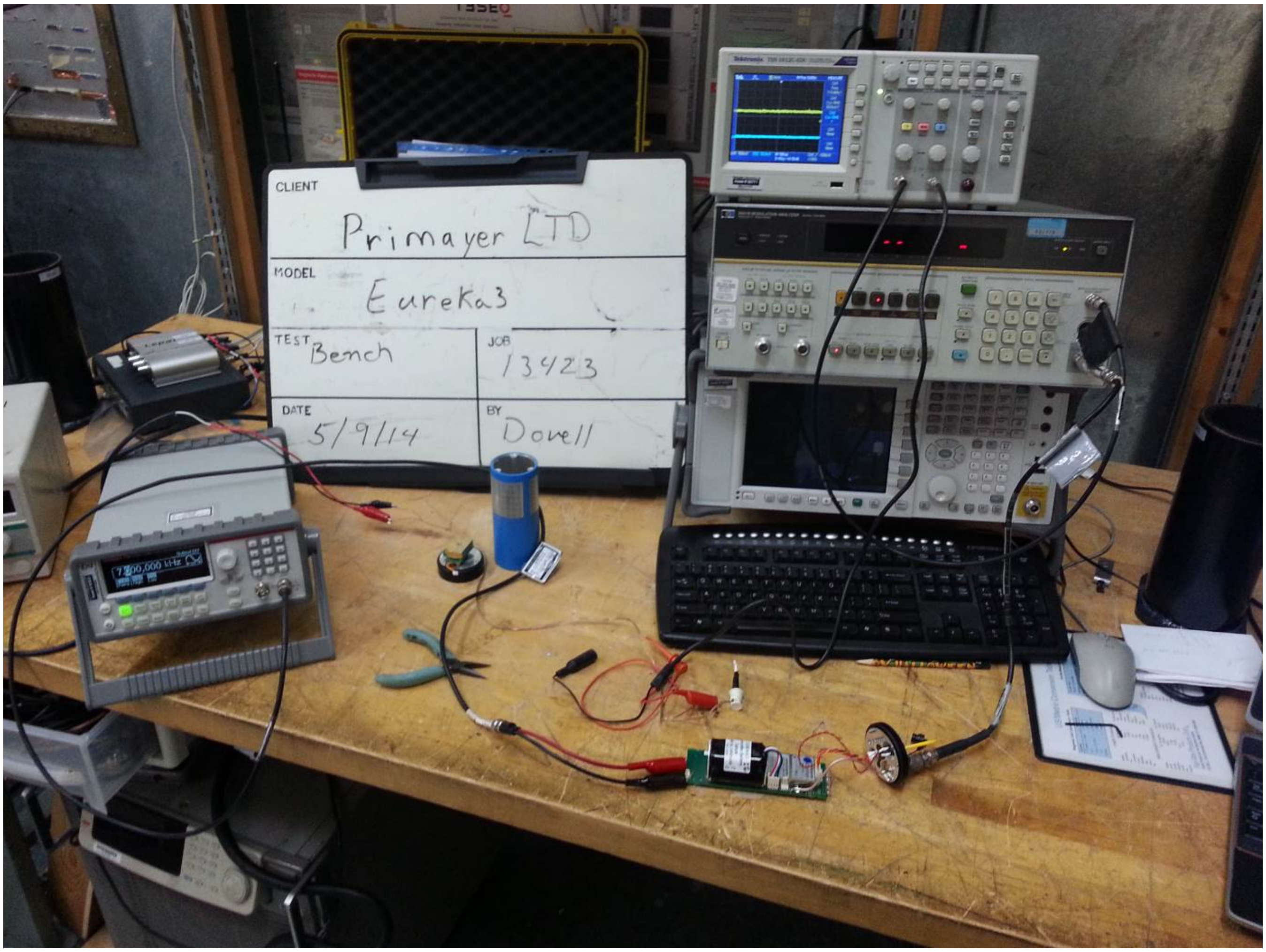
Emission Mask D: For transmitters designed to operate with a 12.5 kHz channel bandwidth, any emission must be attenuated below the power (P) of the highest emission contained within the authorized bandwidth as follows:

(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 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.

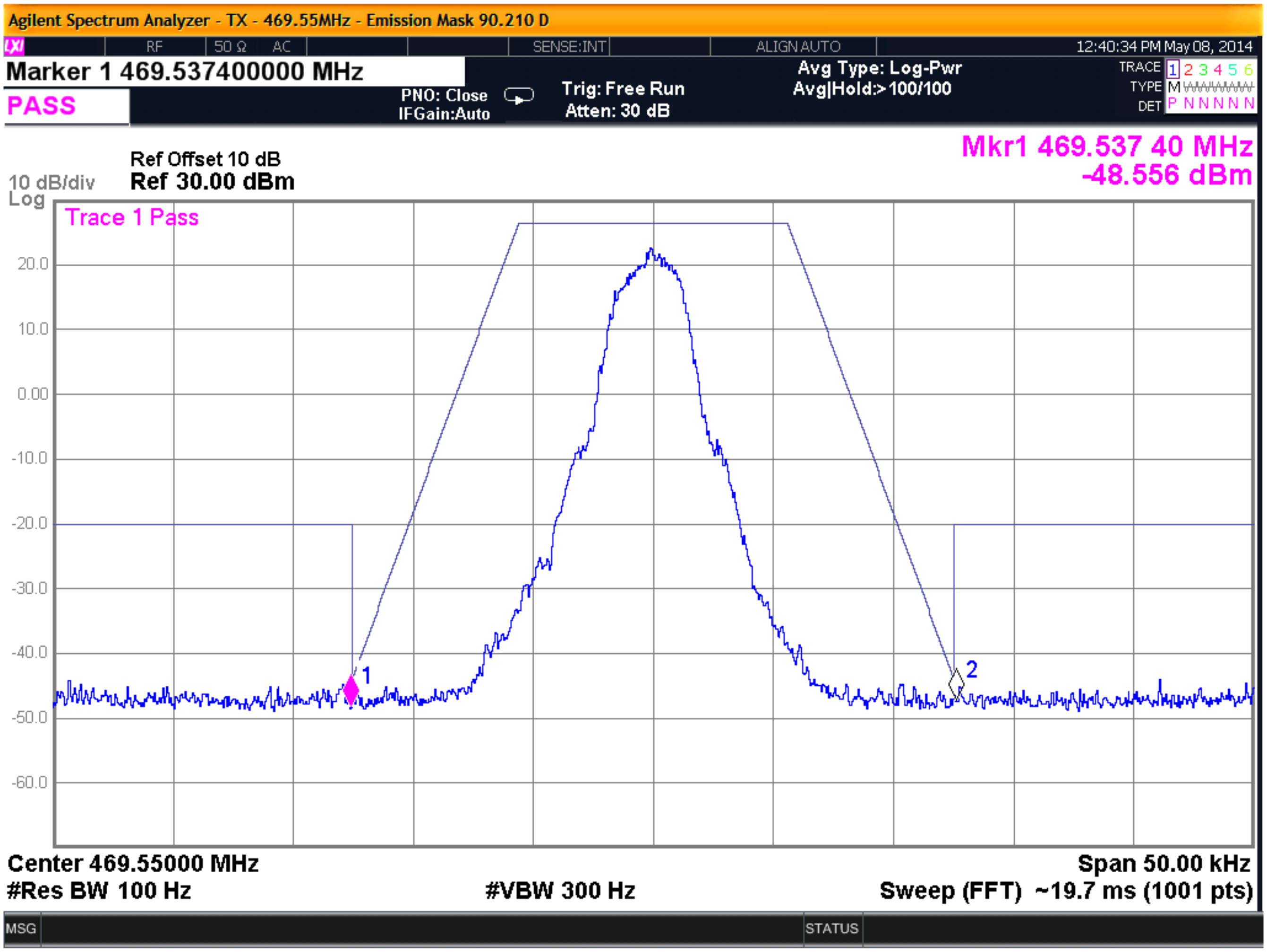


Figure 7: Emissions Mask, High Channel 469.55MHz, Modulated Signal

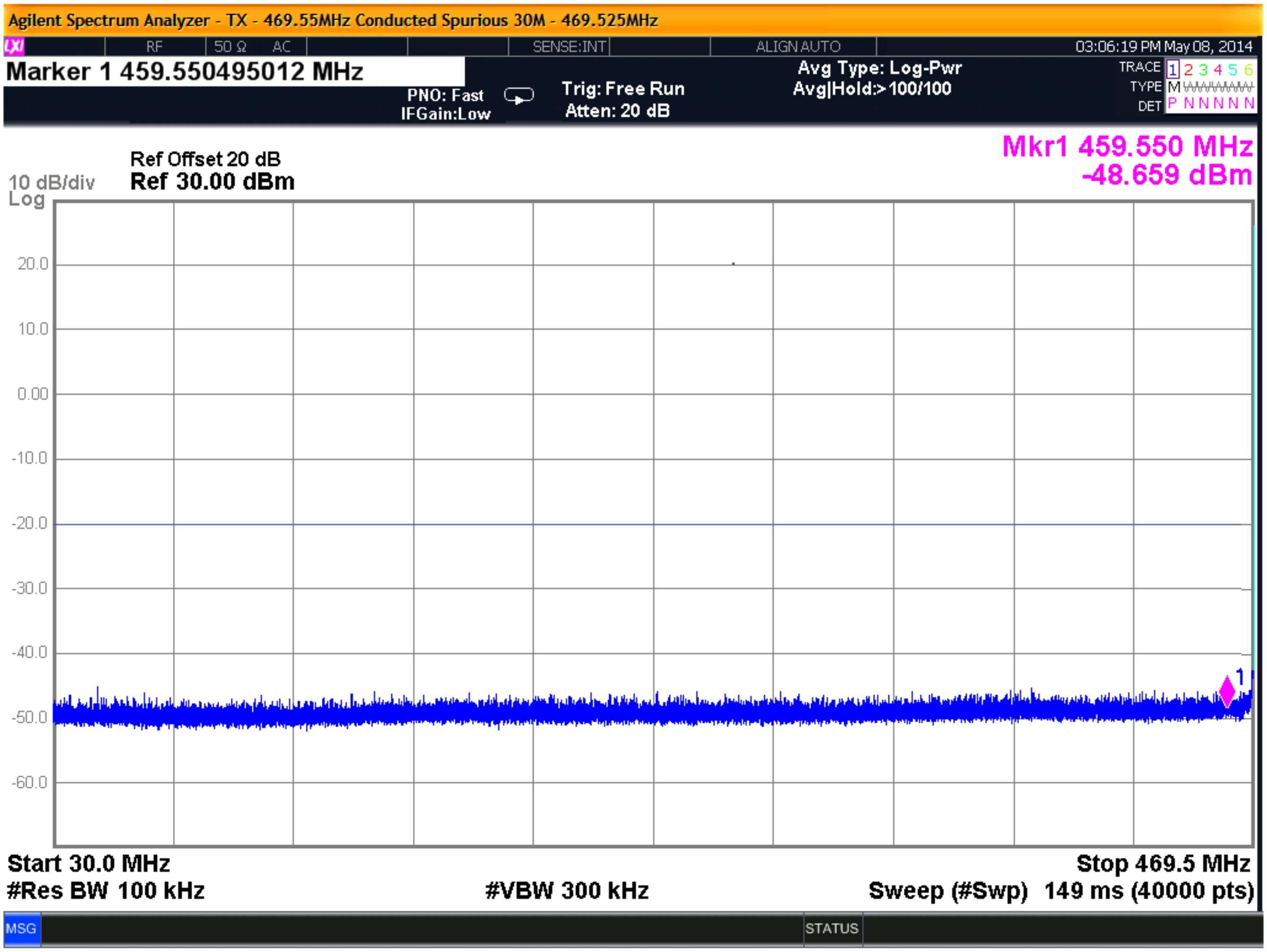


Figure 8: Conducted Spurious Emissions, Mid Channel, 30M – 469.525MHz

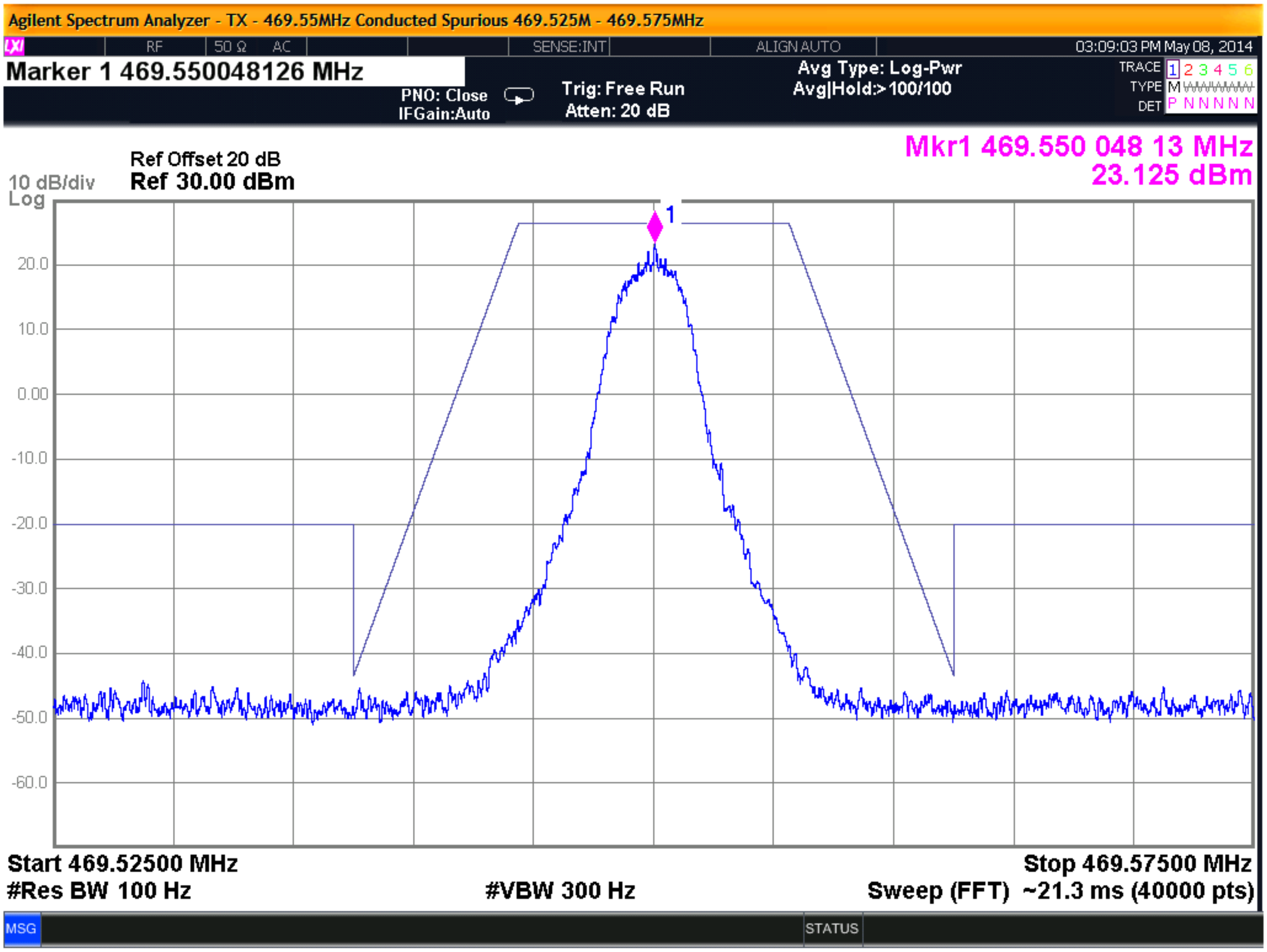


Figure 9: Conducted Spurious Emissions, Mid Channel, 469.525M – 469.575MHz

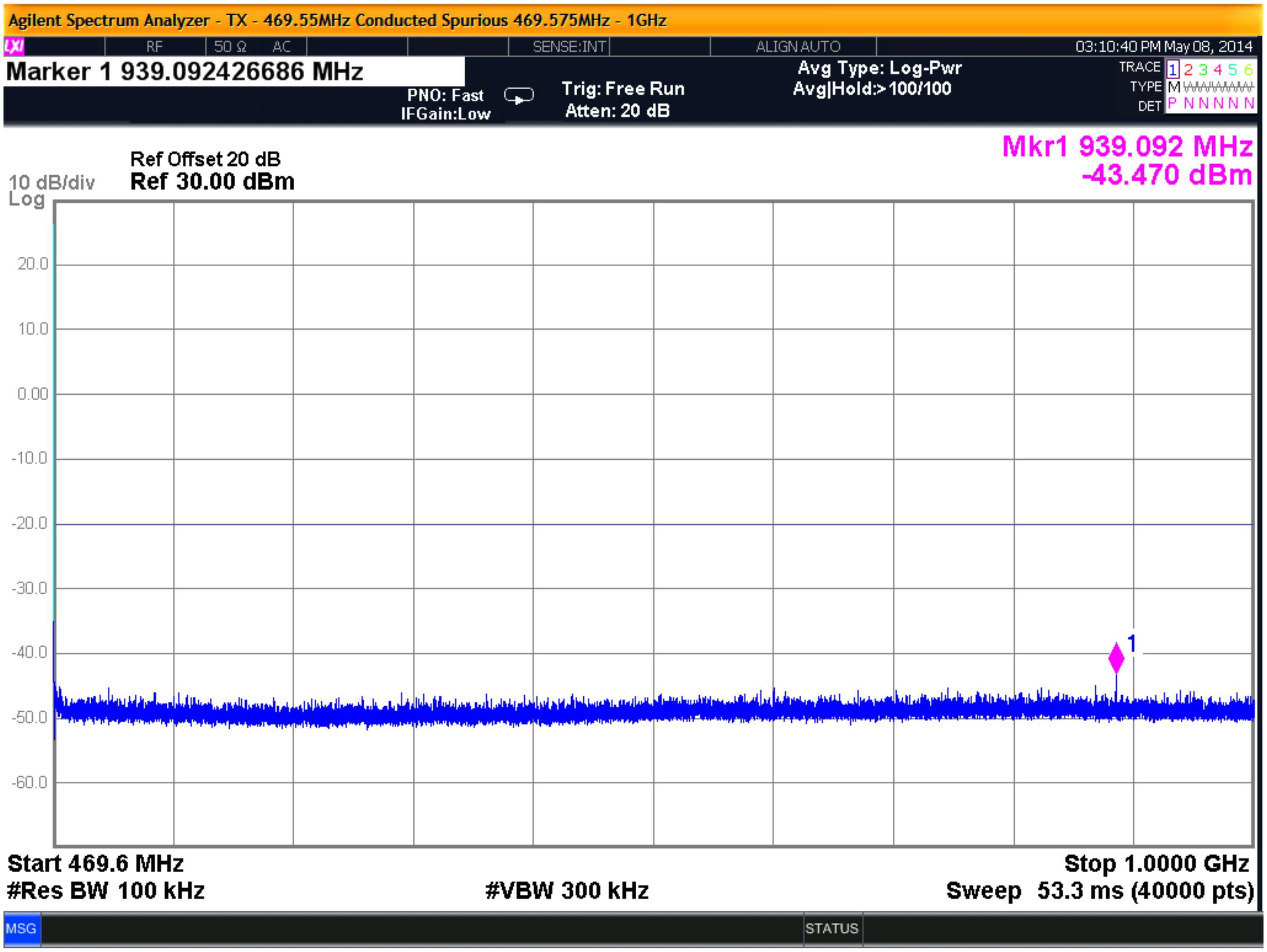


Figure 10: Conducted Spurious Emissions, Mid Channel, 469.575M – 1000MHz

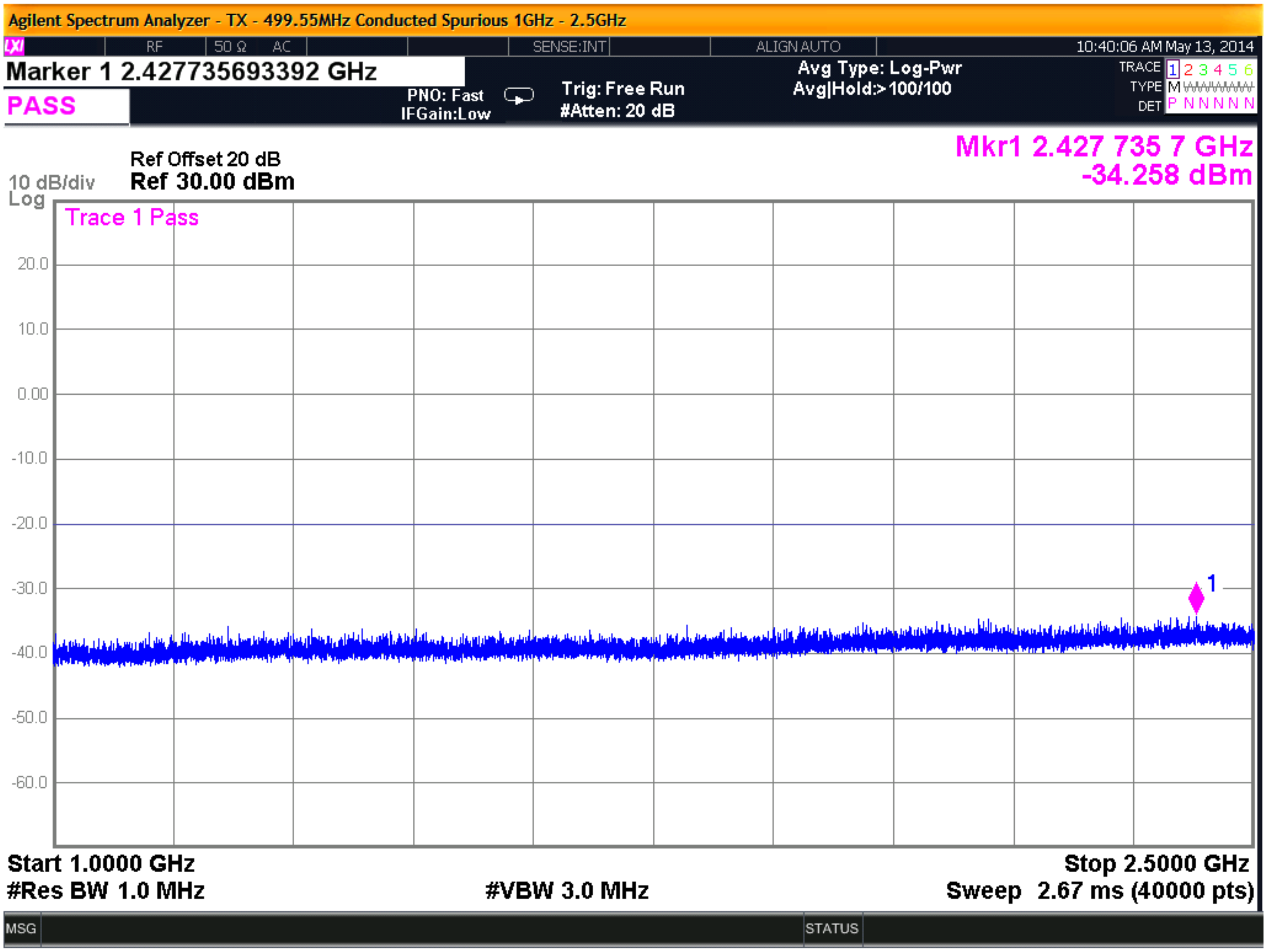


Figure 11: Conducted Spurious Emissions, Mid Channel, 1 – 2.5GHz

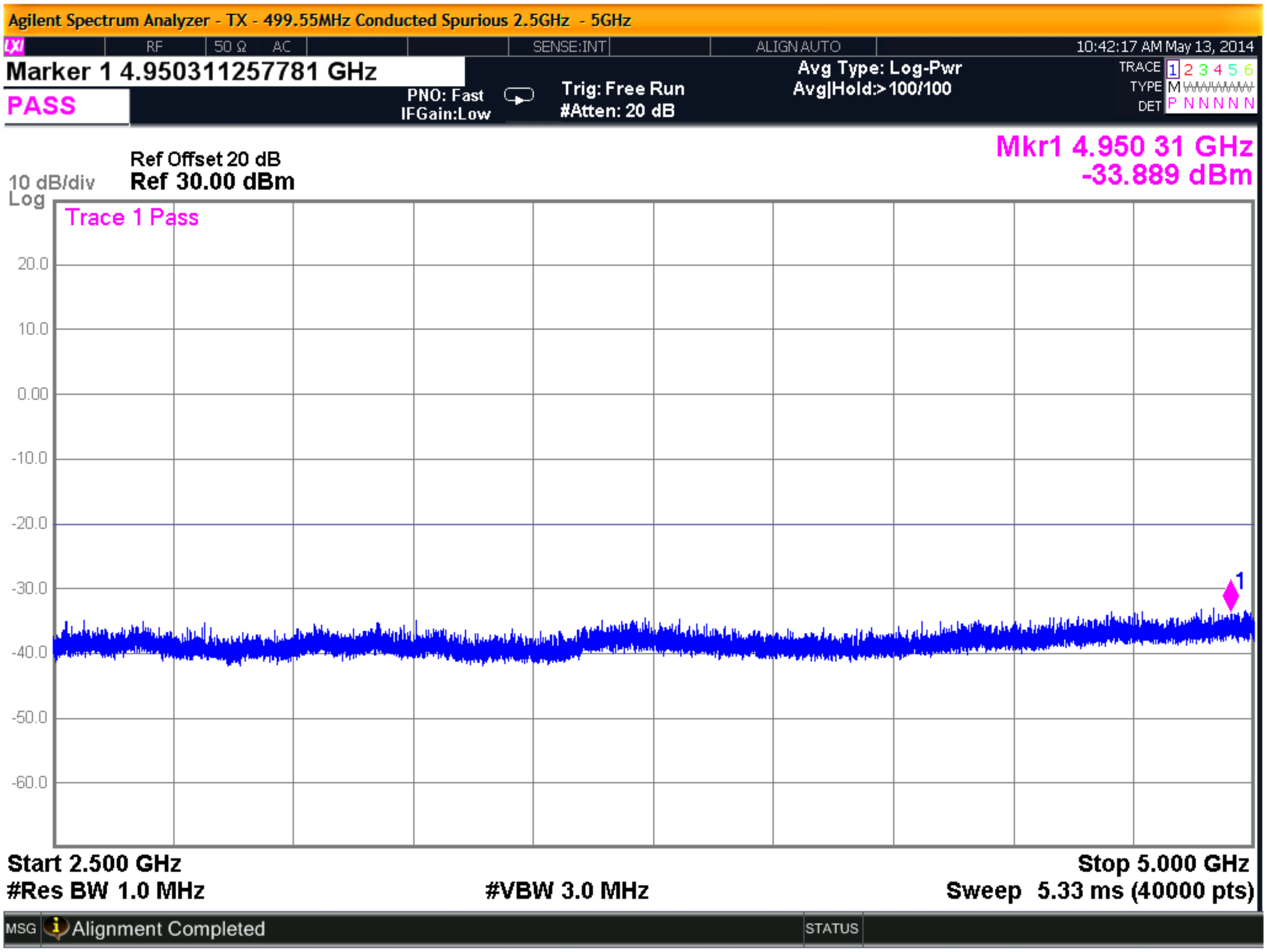


Figure 12: Conducted Spurious Emissions, Mid Channel, 2.5 - 5GHz

4.6 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.

4.6.1 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 50 Ω 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+10*Log(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 = 0.454W = 26.569dBm

Limit = 26.569dBm – (50+10*Log(0.454W)) = -20dBm (ERP)

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.

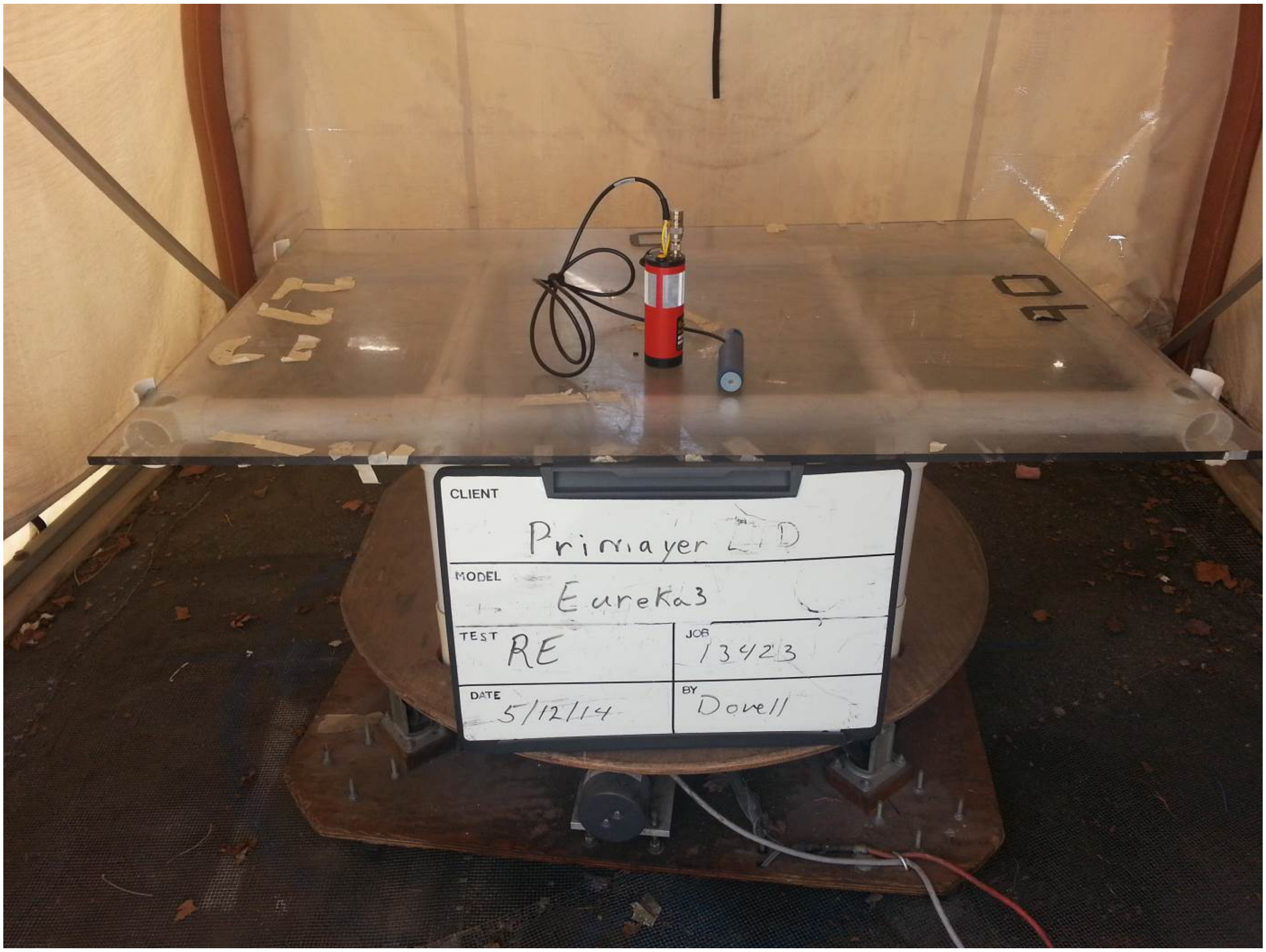
Sample Calculation:

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

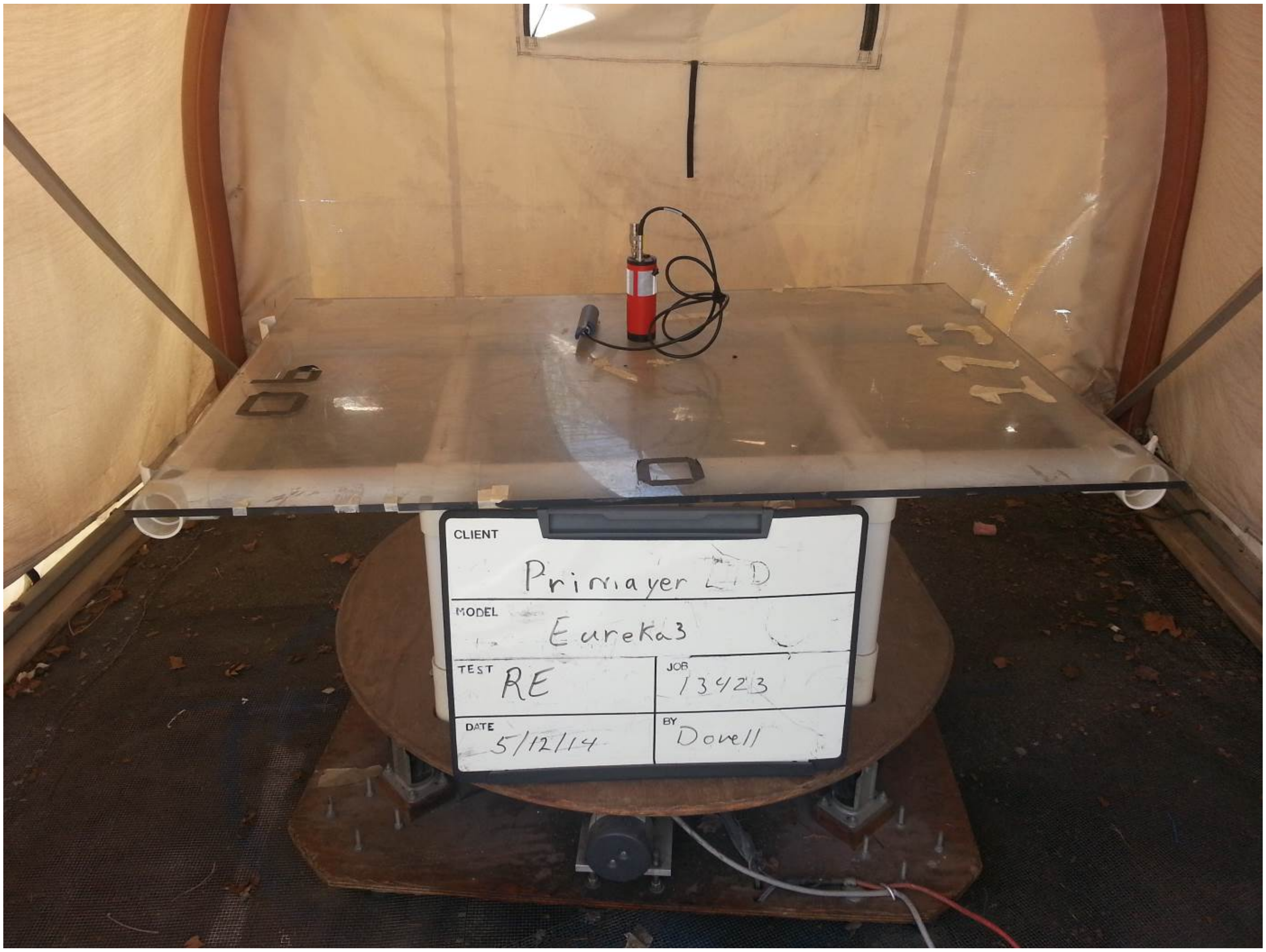
Testing was performed to 5GHz. No emissions were detected above 1GHz. All detected emissions are reported in Table 6.

Table 6: Radiated Emission Test Data

Frequency (MHz)	Polarity	Azimuth	Ant. Height (m)	Spurious Level (dBuV)	Sub. Sig. Gen. Level (dBm)	Sub. Power Level (dBm)	Sub. Ant. Factor (dB)	Sub. Ant. Gain (dB)	EIRP Level (dBm)	Limit (dBm)	Margin (dB)
85.40	V	90.0	1.0	11.6	-77.6	-79.6	7.5	1.3	-78.3	-20	-58.3
145.32	V	0.0	1.0	8.9	-75.3	-77.4	12.2	1.3	-76.1	-20	-56.1
228.80	V	90.0	1.0	3.7	-75.3	-77.4	10.9	6.5	-70.9	-20	-50.9
936.96	V	180.0	1.0	11.4	-75.5	-77.6	22.0	7.6	-70.0	-20	-50.0
938.97	V	125.0	1.0	24.7	-40.1	-42.2	22.0	7.7	-34.6	-20	-14.6
85.40	H	180.0	4.0	10.9	-77.4	-79.4	7.5	1.3	-78.1	-20	-58.1
228.80	H	0.0	4.0	9.5	-70.2	-72.3	10.9	6.5	-65.8	-20	-45.8
936.96	H	90.0	1.9	7.0	-60.0	-62.1	22.0	7.6	-54.5	-20	-34.5
938.97	H	355.0	1.8	21.7	-43.8	-45.9	22.0	7.7	-38.3	-20	-18.3



Photograph 2: Radiated Emissions Setup, Front of EUT



Photograph 3: Radiated Emissions Setup, Rear of EUT

4.7 Conducted Emissions

4.7.1 Requirements

Compliance Standard: FCC Part 15 (10/2013) and ICES-003, Class B

FCC Compliance Limits		
Frequency	**Quasi-peak**	**Average**
0.15-0.5MHz	66 to 56dBμV	56 to 46dBμV
0.5 to 5MHz	56dBμV	46dBμV
0.5-30MHz	60dBμV	50dBμV

4.7.2 Test Procedure

The EUT Transmitters are battery powered but an in-the-case charger is provided. The EUT cannot transmit when the charger is in use. The EUT batteries were depleted prior to testing the conducted emissions of the charger.

The requirements of FCC Part 15 (10/2013) and ICES-003 call for the EUT to be placed on an 80 cm high 1 X 1.5 m non-conductive table above a ground plane. Power to the EUT was provided through a Solar Corporation 50 Ω/50 μH Line Impedance Stabilization Network bonded to a 3 X 2 meter ground plane. The LISN has its AC input supplied from a filtered AC power source. Power was supplied to the peripherals through a second LISN. The peripherals were placed on the table in accordance with ANSI C63.4-2003. Power and data cables were moved about to obtain maximum emissions.

The 50 Ω output of the LISN was connected to the input of the spectrum analyzer and the emissions in the frequency range of 150 kHz to 30 MHz were measured. The detector function was set to quasi-peak, peak, or average as appropriate, and the resolution bandwidth during testing was at least 9 kHz, with all post-detector filtering no less than 10 times the resolution bandwidth. For average measurements the post-detector filter was set to 10 Hz.

At frequencies where quasi-peak or peak measurements comply with the average limit, no average measurements need be performed.

4.7.3 Conducted Data Reduction and Reporting

At frequencies where quasi-peak or peak measurements comply with the average limit, no average measurements need be performed. The Conducted emissions level to be compared to the FCC limit is calculated as shown in the following example.

Example:

Spectrum Analyzer Voltage: VdBμV

LISN Correction Factor: LISN dB

Cable Correction Factor: CF dB

Electric Field: EdBμV = V dBμV + LISN dB + CF dB

Table 7: Conducted Emission Test Data

NEUTRAL

Frequency (MHz)	Level QP (dBµV)	Level AVG (dBµV)	Cable Loss (dB)	LISN Corr (dB)	Level QP Corr (dBµV)	Level Corr Avg (dBµV)	Limit QP (dBµV)	Limit AVG (dBµV)	Margin QP (dB)	Margin AVG (dB)
0.189	40.0	27.0	10.1	0.2	50.3	37.3	64.1	54.1	-13.8	-16.8
0.242	31.0	10.0	10.1	0.3	41.4	20.4	62.0	52.0	-20.7	-31.7
3.109	24.7	6.8	10.6	0.3	35.6	17.7	56.0	46.0	-20.4	-28.3
11.310	24.5	5.9	11.2	0.3	36.0	17.4	60.0	50.0	-24.0	-32.6
15.080	32.4	16.6	11.5	0.6	44.5	28.7	60.0	50.0	-15.5	-21.3
25.460	22.0	10.1	12.0	1.2	35.1	23.2	60.0	50.0	-24.9	-26.8
26.390	22.5	7.8	12.1	1.2	35.8	21.1	60.0	50.0	-24.2	-28.9

PHASE

Frequency (MHz)	Level QP (dBµV)	Level AVG (dBµV)	Cable Loss (dB)	LISN Corr (dB)	Level QP Corr (dBµV)	Level Corr Avg (dBµV)	Limit QP (dBµV)	Limit AVG (dBµV)	Margin QP (dB)	Margin AVG (dB)
0.189	40.9	27.0	10.1	0.1	51.1	37.2	64.1	54.1	-13.0	-16.9
0.242	31.7	10.3	10.1	0.1	41.9	20.5	62.0	52.0	-20.1	-31.5
3.201	22.3	4.9	10.6	0.3	33.2	15.8	56.0	46.0	-22.8	-30.2
12.150	22.4	6.0	11.3	0.3	34.0	17.6	60.0	50.0	-26.0	-32.4
15.460	29.9	13.9	11.5	0.5	41.8	25.8	60.0	50.0	-18.2	-24.2
21.280	20.0	3.7	11.8	0.7	32.5	16.2	60.0	50.0	-27.5	-33.8
29.250	22.2	9.2	12.4	1.5	36.1	23.1	60.0	50.0	-23.9	-26.9

Photograph 4: Conducted Emission Test Configuration, Front

Photograph 5: Conducted Emission Test Configuration, Side

4.8 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. As specified in FCC Part §90.213, “In the 421–512 MHz band, mobile stations designed to operate with a 12.5 kHz channel bandwidth must have a frequency stability of 2.5 ppm.”

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 8: Frequency Deviation as a Function of Temperature

Temperature (Centigrade)	Frequency (MHz)	Difference (Hz)	Deviation (ppm)	Limit (in Hz)
Ambient (24C)	469.550800	0	0	
-30	469.550530	-270	-0.575017655	1174
-20	469.550650	-150	-0.319454253	1174
-10	469.550480	-320	-0.681502406	1174
0	469.550950	150	0.319454253	1174
10	469.550800	0	0	1174
20	469.550800	0	0	1174
30	469.550850	50	0.106484751	1174
40	469.550730	-70	-0.149078651	1174
50	469.551130	330	0.702799356	1174

Table 9: Frequency Deviation as a Function of Voltage

Voltage (Volts)	Frequency (MHz)	Difference (Hz)	Deviation (ppm)	Limit (in Hz)
At rated 6.0 VDC	469.550800			
At 5.1VDC (unit stops below 5.25 VDC	469.550805	5	0.0106	1174

4.9 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.

4.9.1 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 469.55MHz 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 1 kHz FM modulated signal at 12.5 kHz 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 2 of the oscilloscope while the coupled output of the EUT transmit signal was fed into a RF detector and then to channel 1 of the oscilloscope for triggering the scope upon the EUT being powered.

The spectrum analyzer and oscilloscope were then setup per TIA-603-C so that the oscilloscope would display the +/-12.5 kHz deviation across the entire display. The EUT was modulated during this test. Upon powering 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.

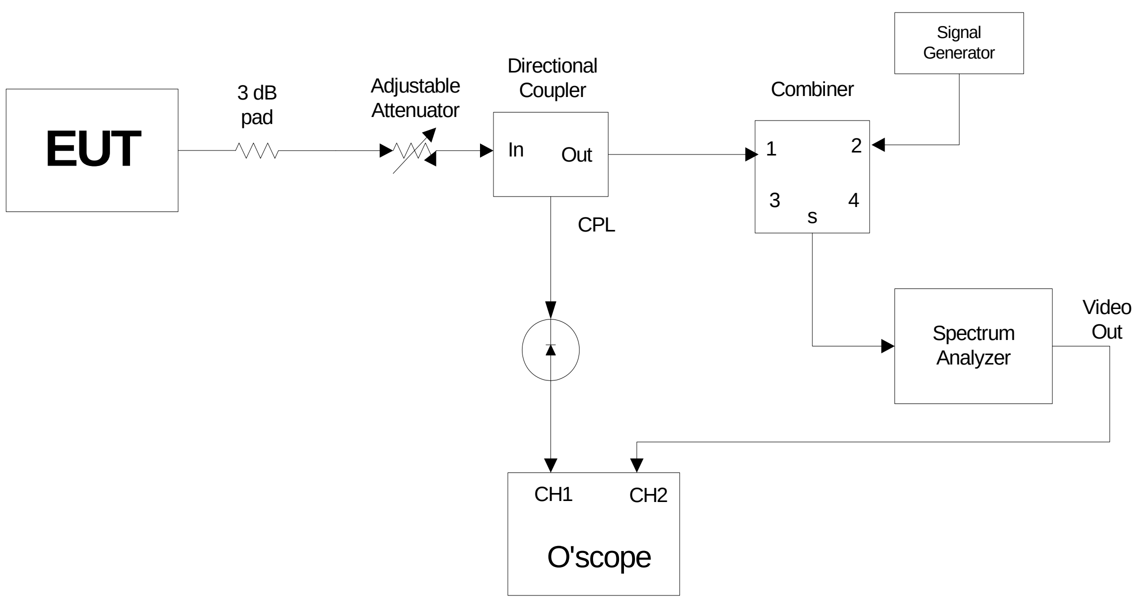


Figure 13: General Transient Frequency Behavior Test Setup

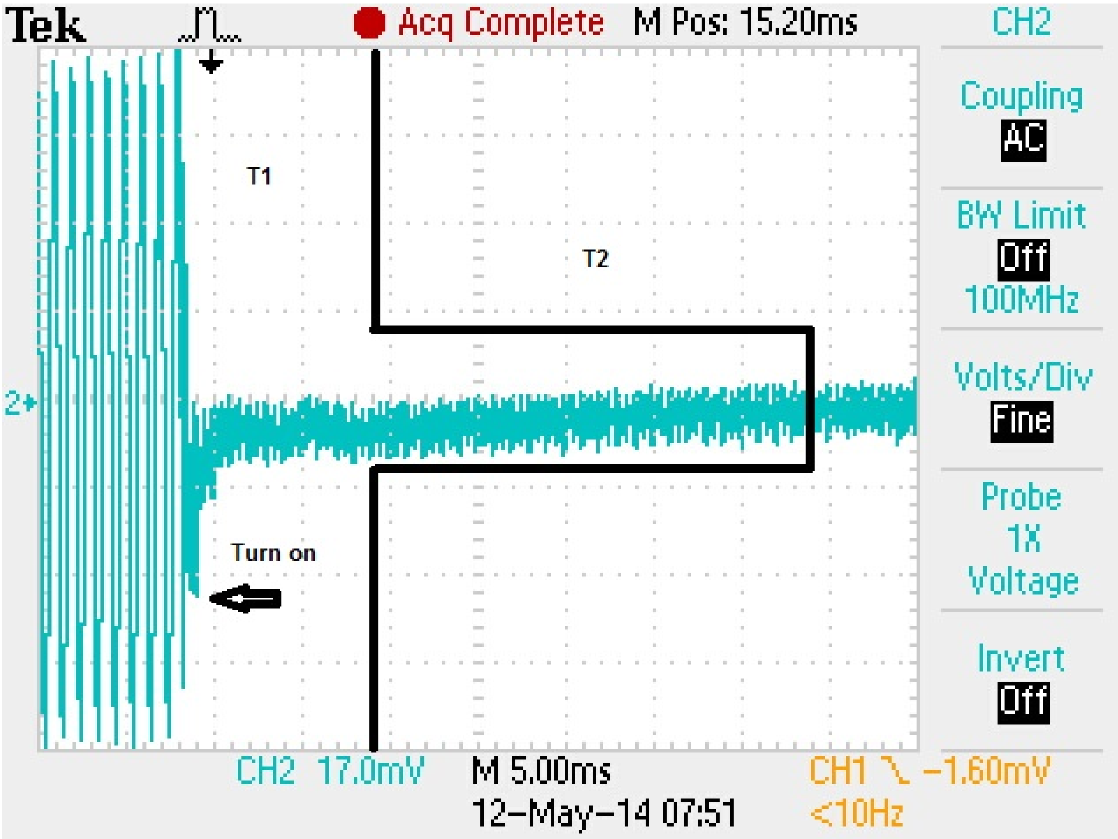


Figure 14: Transient Frequency Behavior, Turn-on

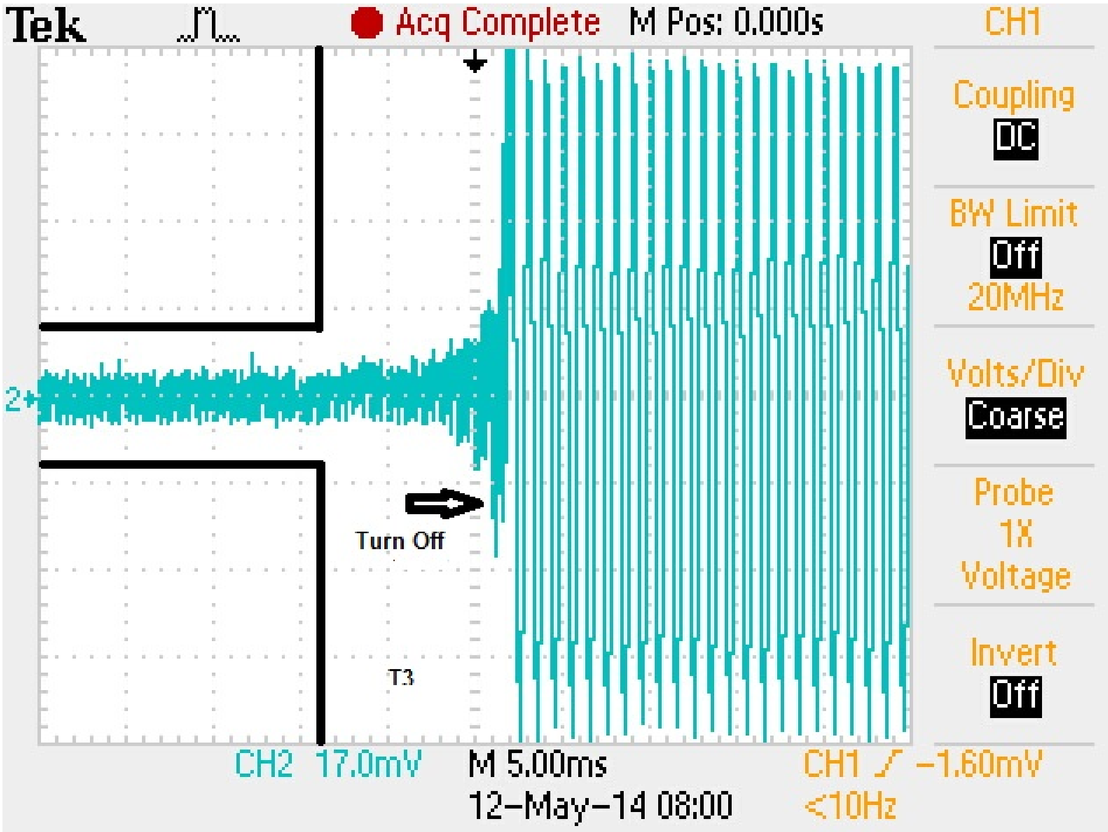


Figure 15: Transient Frequency Behavior, Turn-off