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FCC CFR47 Part 95J Certification Test Report

For the

Specifi-Kali, LLC

Laelaps Dog Tracking System
(Collar Models)

FCC ID: 2AFKF-C01

WLL JOB# 14625-01 Rev 1
September 19, 2016
Revised October 6, 2016

Prepared for:

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Prepared By:

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Testing Certificate AT-1448

FCC & ISED Certification Test Report
for the
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Prepared by:

James Ritter
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Reviewed by:

Steven D. Koster
President

Abstract

This report has been prepared on behalf of Specifi-Kali, LLC to support the attached Application for Equipment Authorization. The test report and application are submitted for a Multi-Use Radio Service (MURS) Transmitter under Part 95J (10/2014) of the FCC Rules and Regulations .This Certification Test Report documents the test configuration and test results for the Specifi-Kali, LLC Laelaps Dog Tracking System (Collar Models).

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 ISED 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 ANAB under Certificate AT-1448 as an independent FCC test laboratory.

The Specifi-Kali, LLC Laelaps Dog Tracking System (Collar Models) complies with the limits for a Multi-Use Radio Service (MURS) Transmitter under FCC Part 95J.

Revision History	Description of Change	Date
Rev 0	Initial Release	September 19, 2016
Rev 1	Corrected typographical errors and clarified attestations	October 6, 2016

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1 Introduction

1.1 Compliance Statement

The Specifi-Kali, LLC Laelaps Dog Tracking System (Collar Models) complies with the limits for a Multi-Use Radio Service (MURS) Transmitter under FCC Part 95J. The device contains 2 models with the same transmitter, a Pointer and a Collar unit,

This device also contains a 2.4GHz Bluetooth Low Energy (BLE) device subject to certification under FCC Part15.247.

1.2 Test Scope

Tests for radiated emissions were performed. All measurements were performed in accordance with TIA -603 -D (2009)

The measurement equipment conforms to ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation.

1.3 Contract Information

Customer:	Specifi-Kali, LLC 11675 Jollyville Road STE 100 Austin, TX 78759
Quotation Number:	68978A

1.4 Test Dates

Testing was performed on the following date(s):	6/28/2016 to 8/18/2016

1.5 Test and Support Personnel

Washington Laboratories, LTD	James Ritter
Customer Representative	Robert Holland

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	**decibel**
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 Laelaps Dog Tracking System (Collar Models) is a Dog collar with GPS that sends positions by MURS to a receiver, which provides positions to a smartphone by Bluetooth Low Energy.

The Laelaps Dog Tracking System consisting of the following models:

• Collar (2 models)

• Pointer

This report covers the collars.

The Specifi-Kali system is comprised of two units a pointer and dog collar (2 models).

Both units use the same PWB, which contains a Bluetooth LE and MURS radio.

The GPS unit is only used in with the dog collar. The GPS module connects to the collar unit, through a 10 wire ribbon cable, to provide location information. The GPS module is receive only and does not transmit.

The housings of the units are identical but different style antennas (same type and gain) are used on the collars and pointer unit.

Table 1: Device Summary

ITEM	DESCRIPTION
Manufacturer:	Specifi-Kali, LLC
FCC ID:	2AFKF-C01
Model Name & Number:	Laelaps Collar model DTC10.0 (tested) Laelaps Collar model DTC10.1
FCC Rule Parts:	§95J
Frequency Range:	151,820MHz, 151.880MHz, 151.940MHz, 154.57MHz, 154.6MHz
Maximum Output Power:	31.86 dBm (1.5W) conducted
Modulation:	2GFSK
Occupied Bandwidth:	5.97kHz for 151MHz channels, 11.19kHz for 154MHz channels
Keying:	Automatic
Type of Information:	Data
Number of Channels:	5
Power Output Level	Fixed
AntennaGain	0 dBm
Antenna Type	Whip
Interface Cables:	None
Power Source & Voltage:	3.7 VDC Lithium Ion battery
Emission Designator	11K2F1D

2.2 Test Configuration

Three devices were submitted for testing, 1 units with the antenna replaced by a temporary antenna port, one with the antenna terminated for radiated testing, and one with the antenna for co-location testing. The EUTs were programmed to transmit at two frequencies (151.88 & 154.57MHz) via a button on the EUT. All units were tested in a stand-alone configuration..

2.3 Testing Algorithm

The Laelaps Dog Tracking System (Collar Models) was programmed for MURS operation by the manufacturer. The EUT was set to transmit PRBS packets continuously at the desired transmit frequency. Worst case emission levels are provided in the test results data.

2.4 Test Channel Selection

As the bands that are less than 1MHz wide only the center channels were tested. Since the bandwidth requirements are different for the 151MHz and the 154MHz channels these were tested as individual bands. Thus the channels tested were 151.88MHz and 154.57MHz.

2.5 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 ISED 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 ANAB under Certificate AT-1448 as an independent FCC test laboratory.

2.6 Measurements

2.6.1 References

- TIA-603-D :2009 Land Mobile FM or PM Communications Equipment Measurement and Performance Standards
- ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation

2.7 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 ≤ 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 table 2 below.

Table 2: Expanded Uncertainty List

Scope	Standard(s)	Expanded Uncertainty
Conducted Emissions	CISPR11, CISPR22, CISPR14, FCC Part 15	±2.63 dB
Radiated Emissions	CISPR11, CISPR22, CISPR14, FCC Part 15	±4.55 dB

Parameter	Uncertainty	Actual (+/-)	Unit
Radio Frequency	±1 x 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
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 Name: **EIRP VHF**			Test Date: **08/18/2016**
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
823	AGILENT - N9010A	EXA SPECTRUM ANALYZER	8/25/2016
4	ARA - DRG-118/A	ANTENNA DRG 1-18GHZ	10/8/2016
7	ARA - LPB-2520	ANTENNA BICONILOG ANTENNA	10/20/2017
644	SUNOL SCIENCES CORPORATION - JB1 925-833-9936	BICONALOG ANTENNA	8/14/2017
425	ARA - DRG-118/A	ANTENNA DRG 1-18GHZ	11/23/2017
559	HP - 8447D	AMPLIFIER	09/30/2016

Test Name: **Bench Tests**			Test Date: **8/16/2016**
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
823	AGILENT – N9010A	EXA Spectrum Analyze	8/25/2016

Test Name: **Frequency Stability**			Test Date: **8/1/2016**
Asset #	**Manufacturer/Model**	**Description**	**Cal. Due**
00528	AGILENT - E4446A	3HZ - 44GHZ ANALYZER SPECTRUM	08/05/2016
00776	TENNY - TJR-A-WS4	1.22 CUFT	05/22/2017
00641	HQ power PS5005U	DC Power Supply	CNR
685	Fluke 115	True RMS Voltmeter	9/9/2016

4 Test Summary

The Table Below shows the results of testing for compliance with a Multi-Use Radio Service (MURS) Transmitter under FCC Part 95J. Full results are shown in section 5.

Table 4: Test Summary Table

FCC Rule Part	Description	Result
95.1307,95.631	Permissible Communications, Emission Types	Pass
95.632(b), 95.633(3)(f)(1)(2), 2.1049	Emission Bandwidth (Occupied Bandwidth)	Pass
95.639(h), 2.1046	Maximum Transmitter Power (RF Power)	Pass
95.635(e), 2.1051, 2,1051	Unwanted Radiation (at antenna terminal)	Pass
95.635(e), 2.1051, 2,1053	Unwanted Radiation – Case Radiated (Radiated Emissions)	Pass
95.637, 2.1047	Modulation Standards (Modulation Characteristics)	Pass
95.632(c), 2.1055	Frequency Stability	Pass

5 Test Results

5.1 Permissible Communications:

5.1.1 Rule Part

Part §95.1307, Permissible communications, States:

(a) MURS stations may transmit voice or data signals as permitted in this subpart.

(b) A MURS station may transmit any emission type listed in §95.631(j) of this chapter.

(c) MURS frequencies may be used for remote control and telemetering functions. MURS transmitters may not be operated in the continuous carrier transmit mode.

(d) MURS users shall take reasonable precautions to avoid causing harmful interference. This includes monitoring the transmitting frequency for communications in progress and such other measures as may be necessary to minimize the potential for causing interference.

5.1.2 Manufacturer Attestations

The EUT transmits only telemetry (positional) data and only transmits intermittent modulated data..

The device sends digitally modulated signals using 2GFSK at 10bps. The emissions type is F1D and is authorized under §95.631 (j).

The EUT uses a "clear to send" (CTS) interrupt that is available in the Silicon Labs 4461B1 radio chip set. The CTS interrupt pin is pulled in one direction if there is another radio transmission in progress on the same frequency. The interrupt is pulled in the other direction if there are no other transmissions in progress. The beacon is only sent if there are no other transmissions already in progress. This meets the requirements of part 95.1307 (d).

5.2 Emission Bandwidth:

5.2.1 Rule Part

95.632(b), 95.633(3)(f)(1)(2), 2.1049:
The 20dB bandwidth is limited to 11.25kHz for 151,820MHz, 151.880MHz, & 151.940MHz.
The 20dB bandwidth is limited to 20kHz for 154,570MHz & 151.600MHz

5.2.2 Measurement Method:

Occupied bandwidth was performed by monitoring the output of the EUT antenna port with a spectrum analyzer corrected for any cable/attenuator losses. The peak of the signal was found and a marker placed 20dB down on each side. The frequency difference between the markers was measured.

Table 5: Occupied Bandwidth Spectrum Analyzer Settings

Channel	Resolution Bandwidth	Video Bandwidth
151.880MHz	100Hz	300Hz
154.570MHz	160Hz	620kHz

5.2.3 Test Summary:

The EUT complied with the requirements.

At full modulation, the occupied bandwidth was measured as shown in Figures 1-2.

Table 6 provides a summary of the Occupied Bandwidth Results.

Table 6: Occupied Bandwidth Results

Frequency	Bandwidth	Limit	Pass/Fail
151.880MHz	5.973kHz	≤11.25kHz	Pass
154.570MHz	11.186kHz	≤20kHz	Pass

5.2.4 Bandwidth Plots

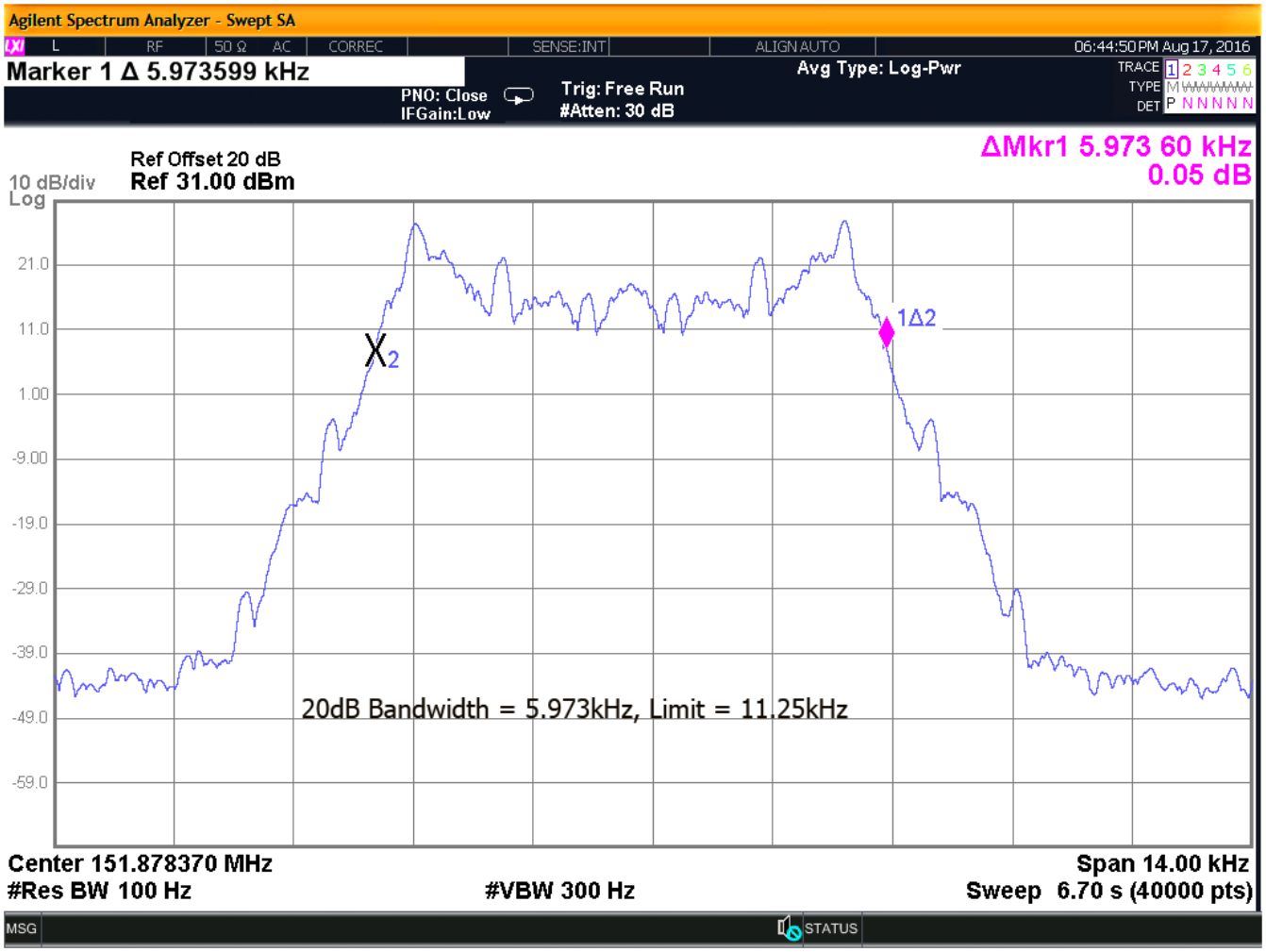

Figure 1: Occupied Bandwidth, 151.880MHz

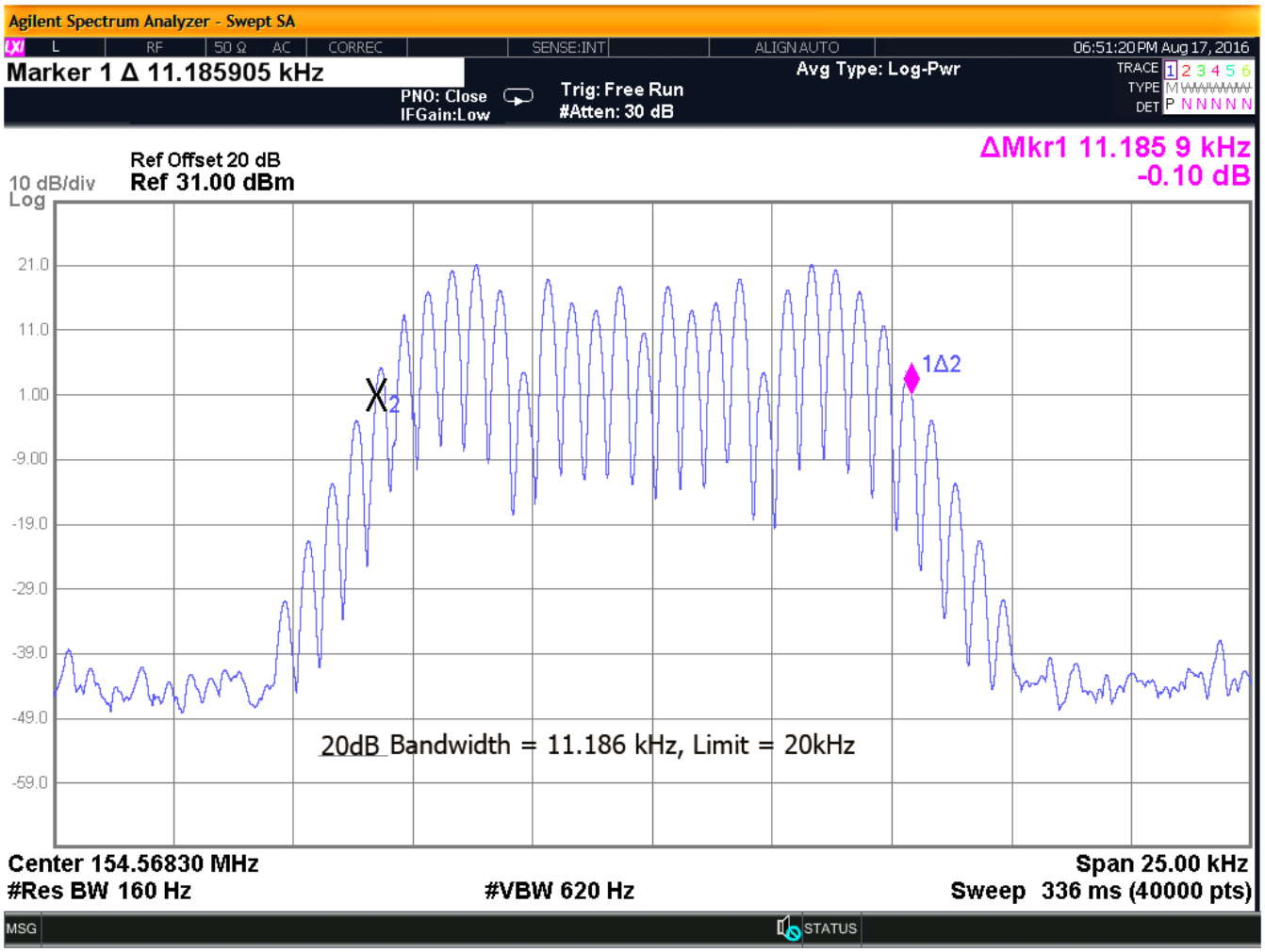

Figure 2: Occupied Bandwidth, 154.570MHz

5.3 Maximum Transmitter Power:

5.3.1 Rule Part:

95.639(h), 2.1046: No MURS unit, under any condition of modulation, shall exceed 2 Watts transmitter power output.

5.3.2 Test Method:

Occupied bandwidth was performed by monitoring the output of the EUT antenna port with a spectrum analyzer corrected for any cable/attenuator losses

To measure the output power the unit was set to dwell on one channel from each band.. Testing was performed by setting analyzer RBW greater than the occupied bandwidth. The EUT was allowed to collect peak reading for 5minutes on each channel.

5.3.3 Test Summary:

The EUT complied with the requirements

Table 7: RF Power Output Summary

Frequency	Level	Limit	Pass/Fail
151.880MHz	31.86dBm	33 dBm	Pass
154.570MHz	31.50dBm	33 dBm	Pass

5.3.4 RF Power Plots

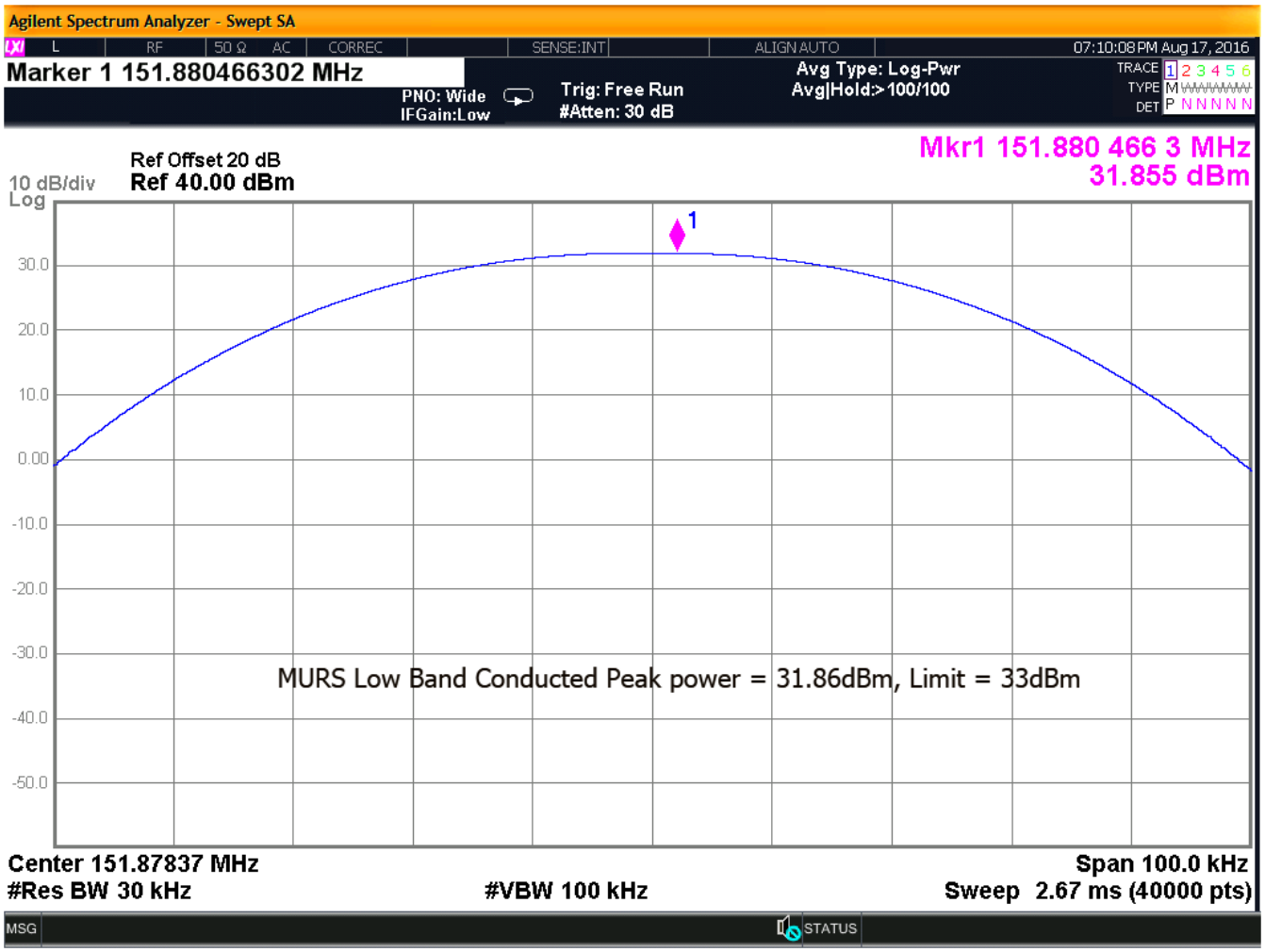

Figure 3: RF Peak Power, 151.880MHz

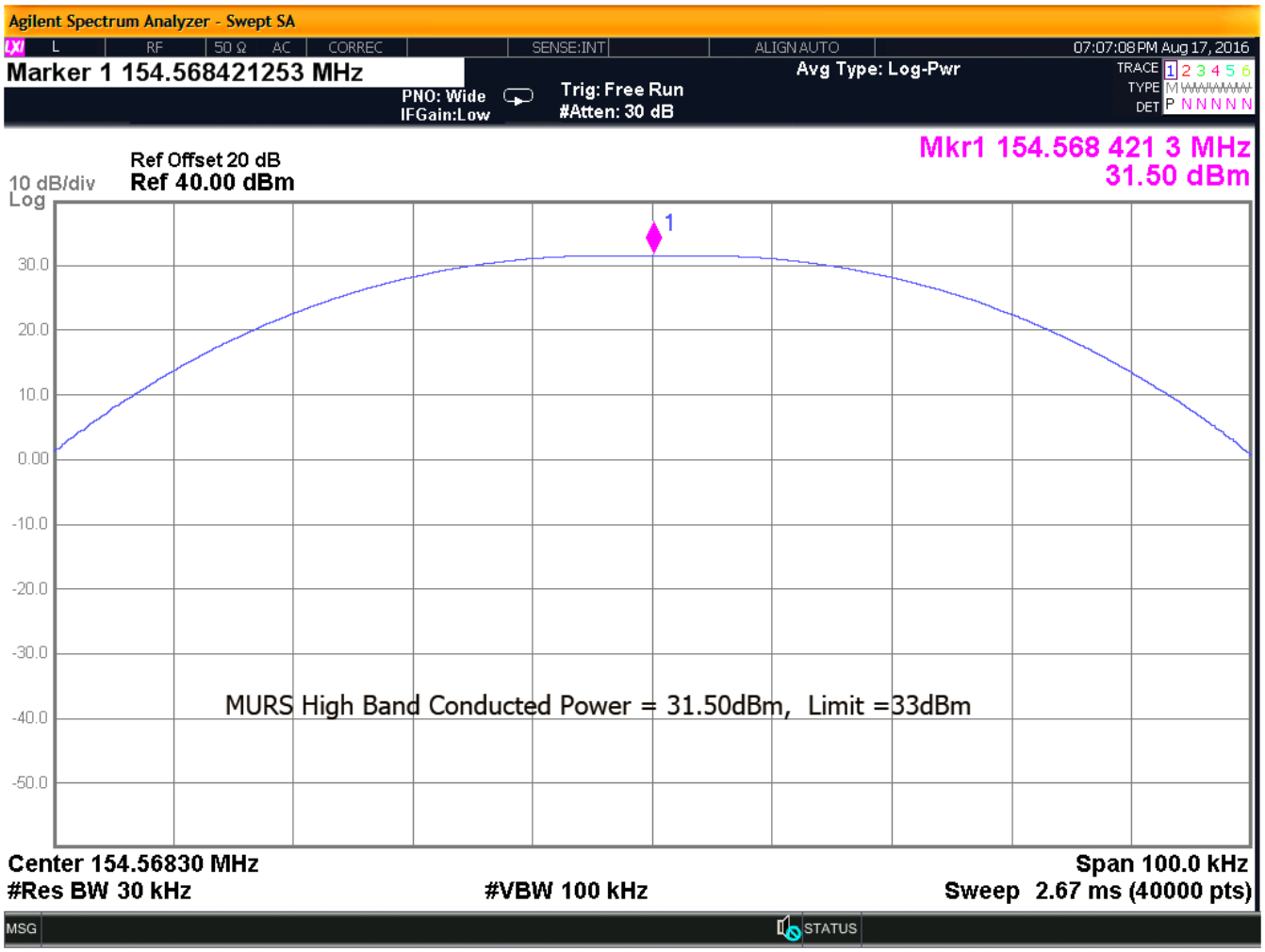

Figure 4: RF Peak Power, 154.570MHz

5.4 Unwanted Radiation (at antenna terminal)

5.4.1 Rule Part:

95.635(e), 2.1051, 2,1051

5.4.2 Test method

The EUT antenna was removed and the cable was connected directly into a spectrum analyzer through a 20 dB attenuator. An offset was programmed into the spectrum analyzer to compensate for the loss of the external attenuator. The spectrum analyzer resolution bandwidth was set as required and the video bandwidth was set to 3times the RBW. The amplitude of the EUT carrier frequency was measured to determine the emissions limit (per the applicable mask below). The emissions outside of the allocated frequency band were then scanned from 30 MHz up to the tenth harmonic of the carrier. Out of band RBW was increased (without any RBW corrections) in order to reduce test time.

Per part 95.635(e):

e) For transmitters designed to operate in the MURS, transmitters shall comply with the following:

Frequency	Mask with audio low pass filter	Mask without audio low pass filter
151.820 MHz, 151.880 MHz and 151.940 MHz	(1)	(1)
154.570 MHz and 154.600 MHz	(2)	(3)

(1) *Emission Mask 1*—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:

(i) On any frequency from the center of the authorized bandwidth f_o to 5.625 kHz removed from fo: Zero dB.

(ii) 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.

(iii) 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.

(3) *Emission Mask 3*—For transmitters designed to operate with a 25 kHz channel bandwidth that are not equipped with an audio low-pass filter, the power of any emission must be attenuated below the unmodulated carrier output power (P) as follows:

(i) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 5 kHz, but not more than 10 kHz: at least 83 log (f_d/5) dB.

(ii) On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 10 kHz, but not more than 250 percent of the authorized bandwidth: at least 29 log (f_d^2/11) dB or 50 dB, whichever is the lesser attenuation.

(iii) On any frequency removed from the center of the authorized bandwidth by more than 250 percent of the authorized bandwidth: at least 43 + 10 log (P) dB.

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5.4.3 Unwanted Radiation Plots

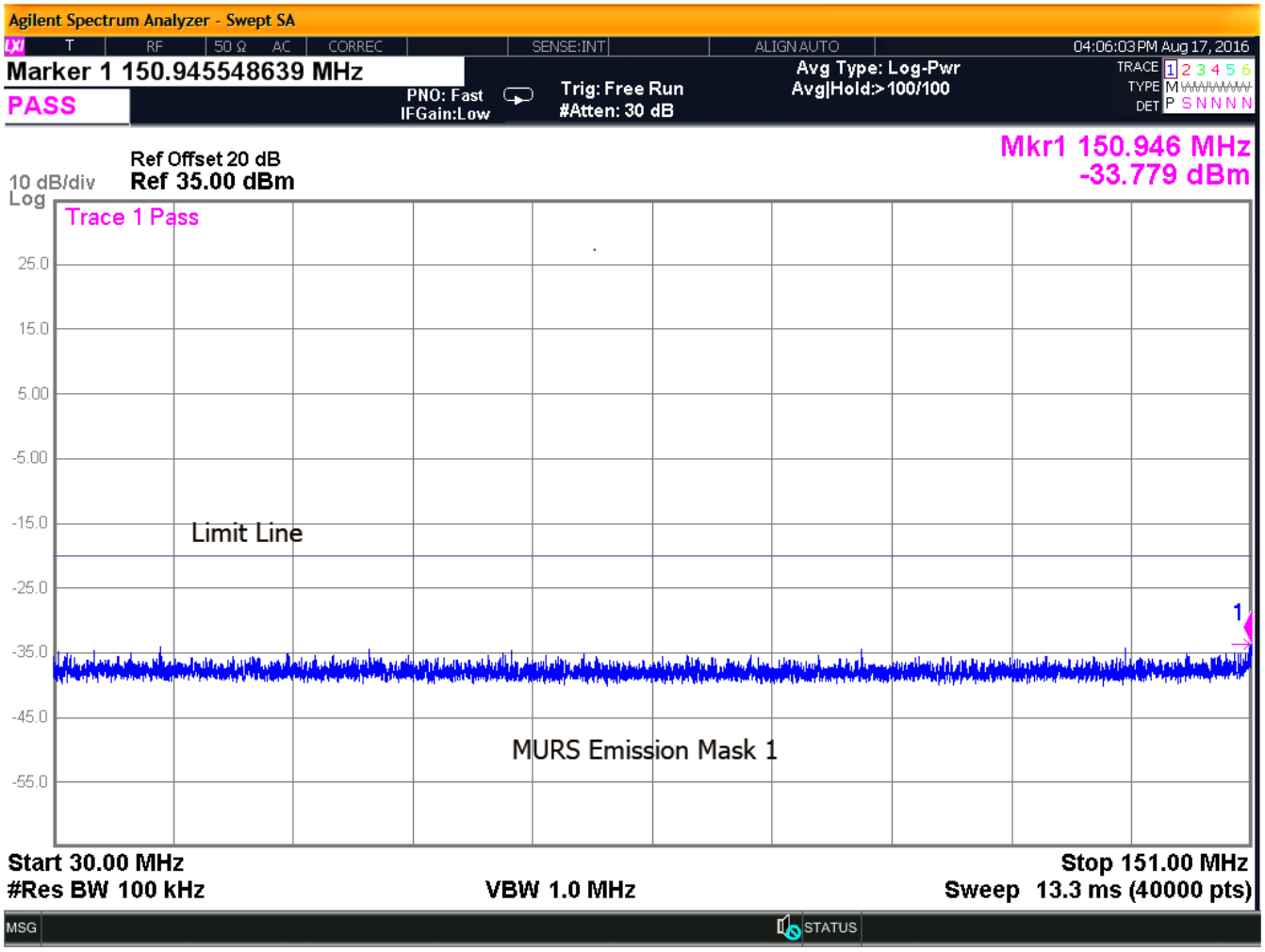

Figure 5: Mask 1, 151.88MHz, Plot 1

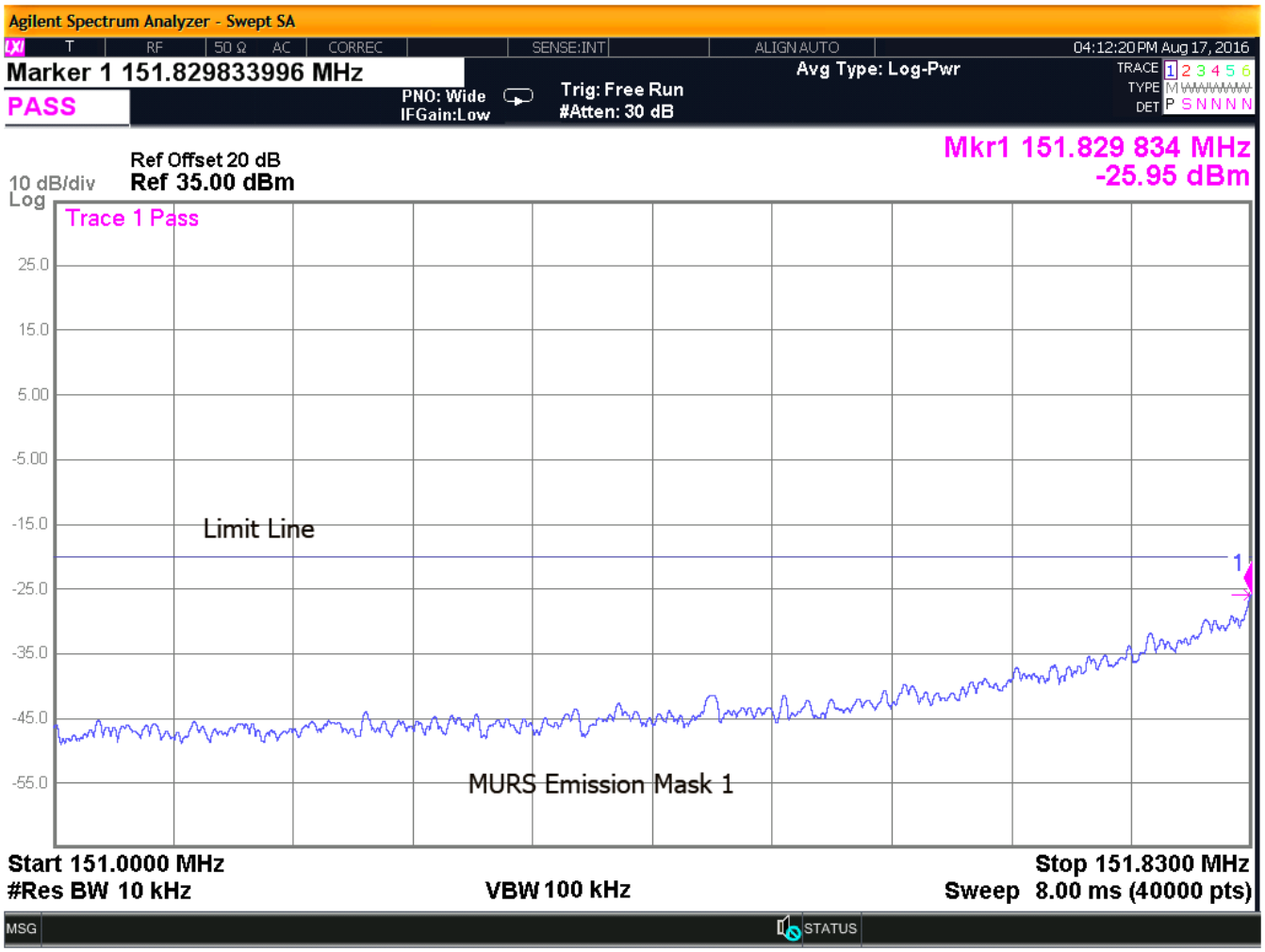

Figure 6: Mask 1, 151.88MHz, 30-151MHz, Plot 2

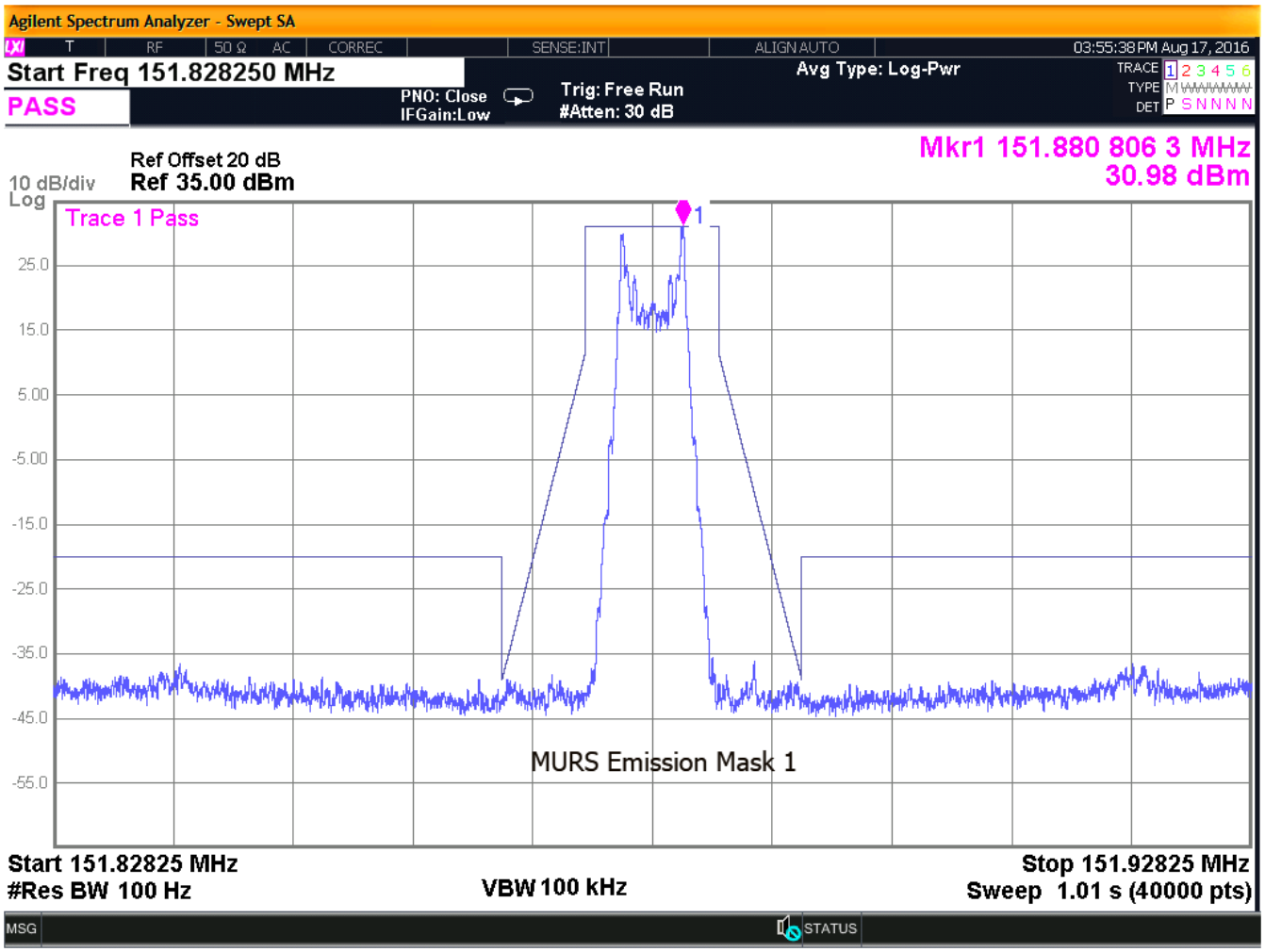

Figure 7: Mask 1, 151.88MHz, Plot 3

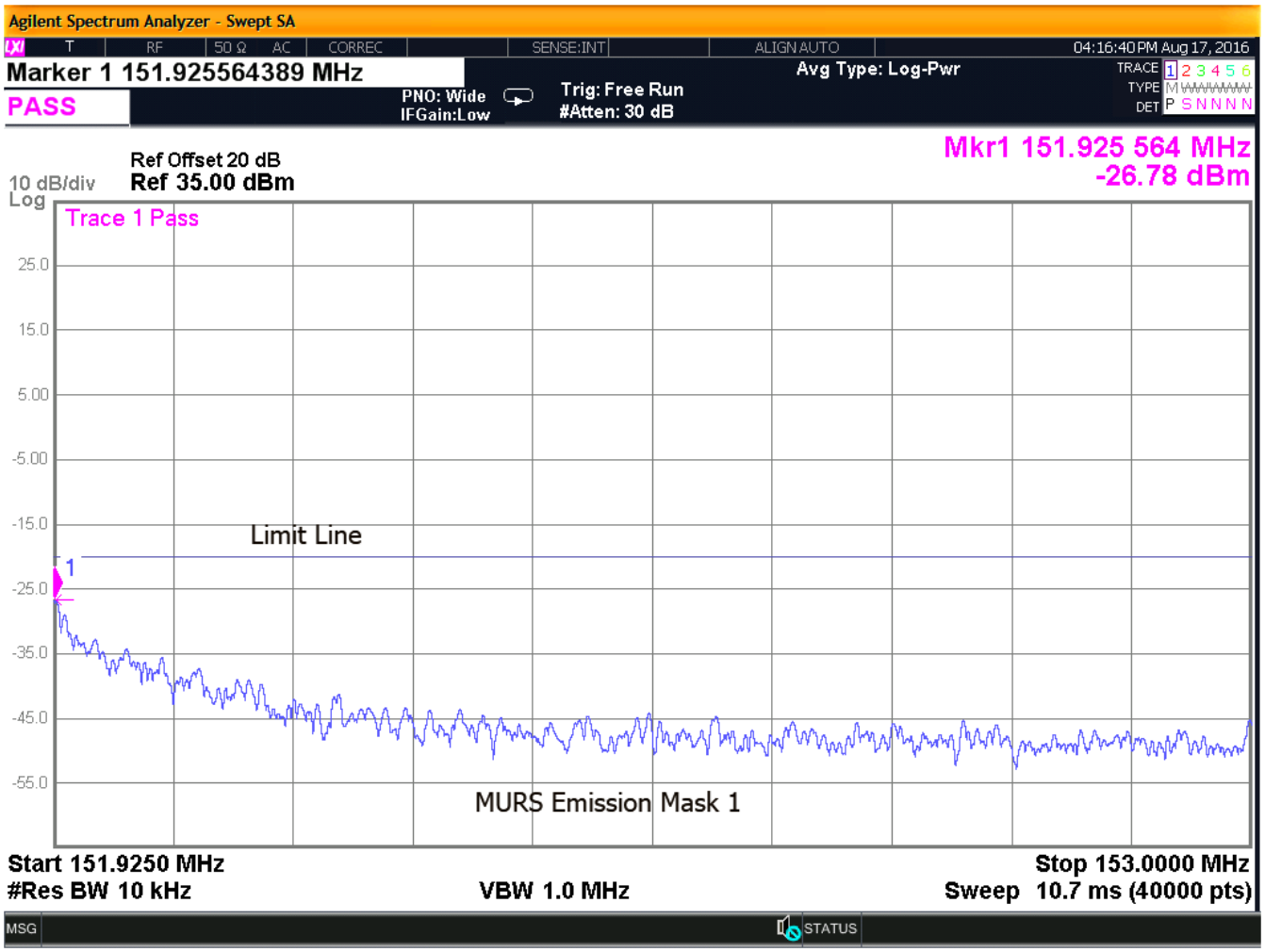

Figure 8: Mask 1, 151.88MHz, Plot 4

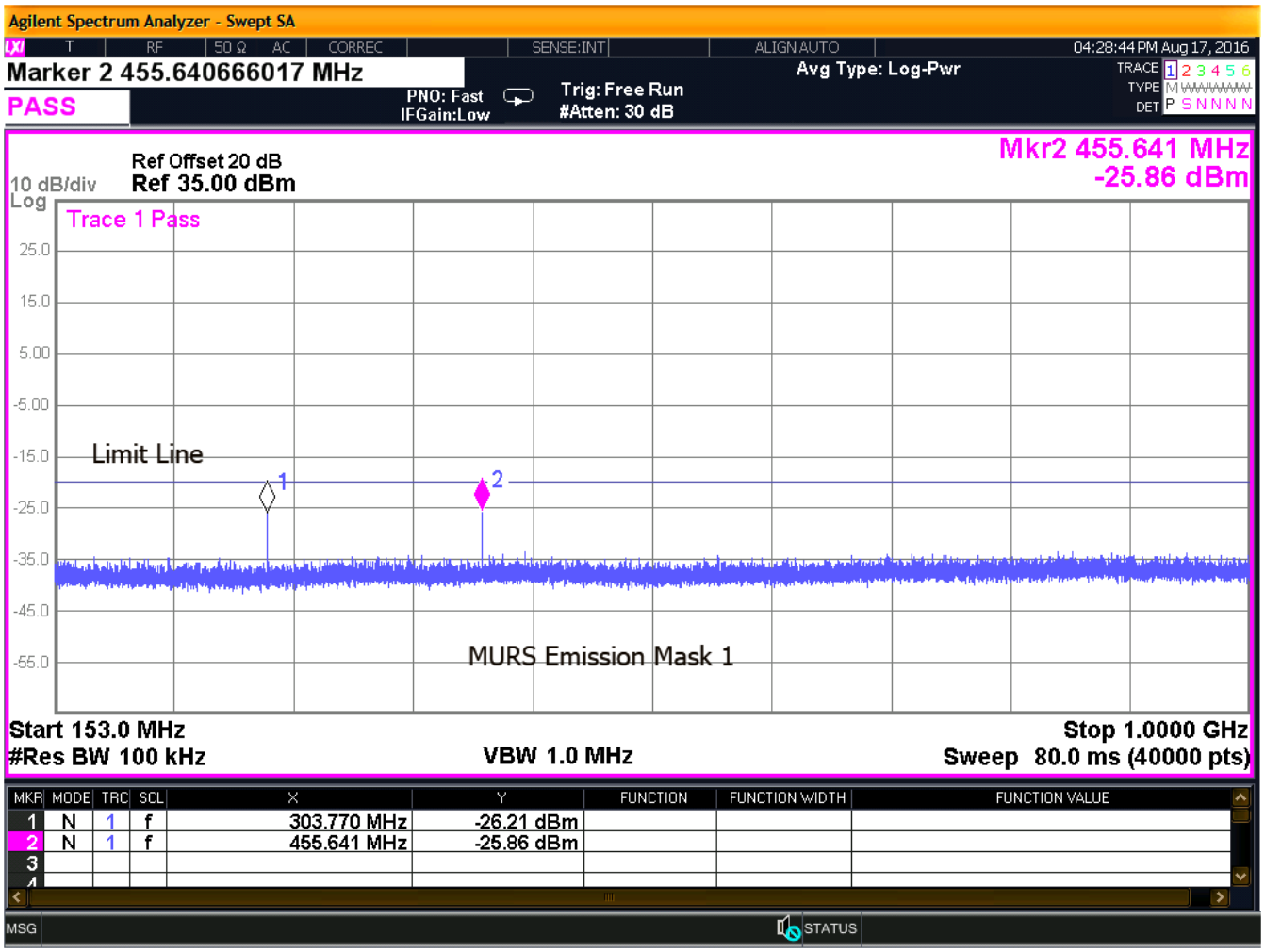

Figure 9: Mask 1, 151.88MHz, Plot 5

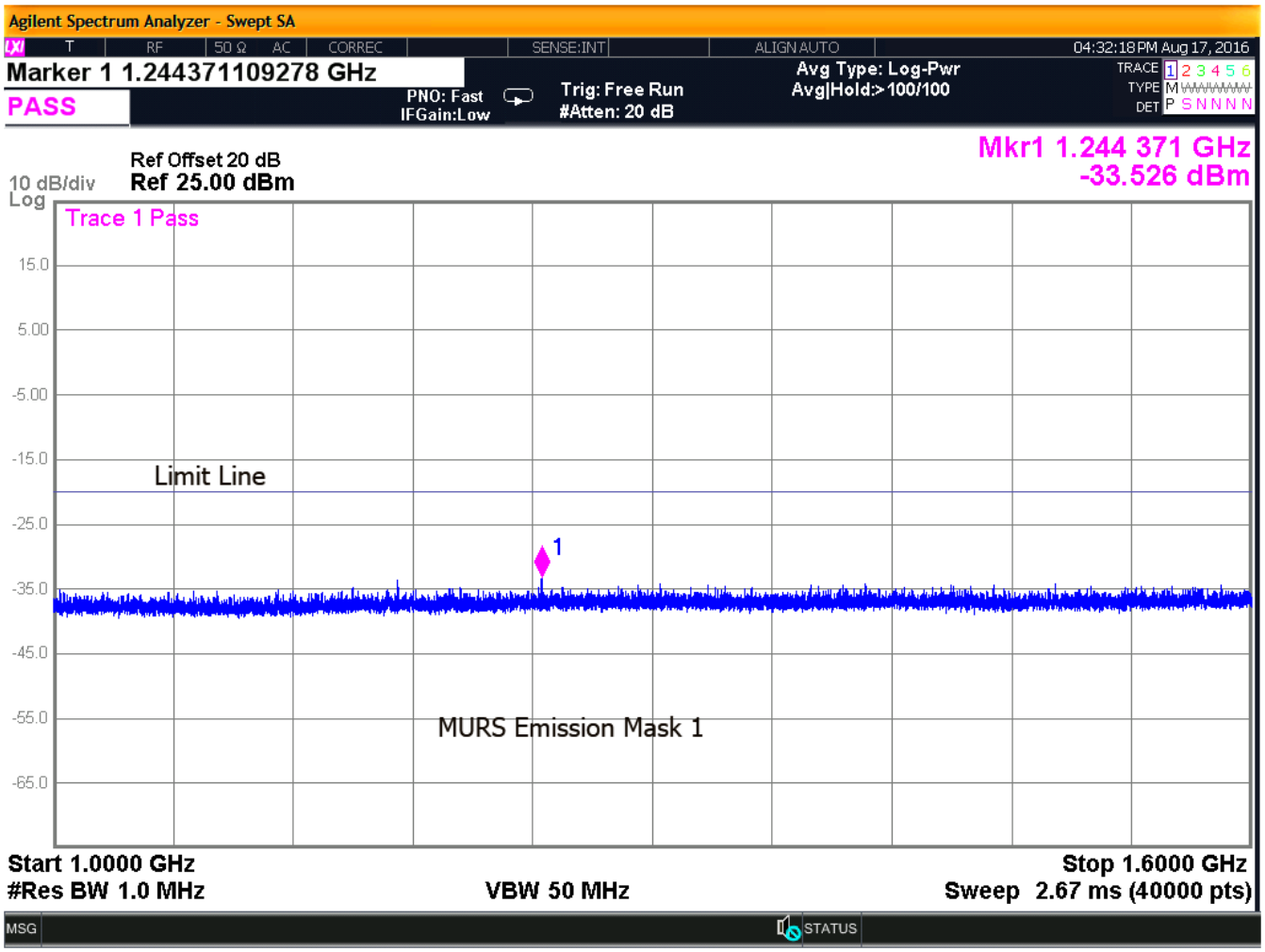

Figure 10: Mask 1, 151.88MHz, Plot 6

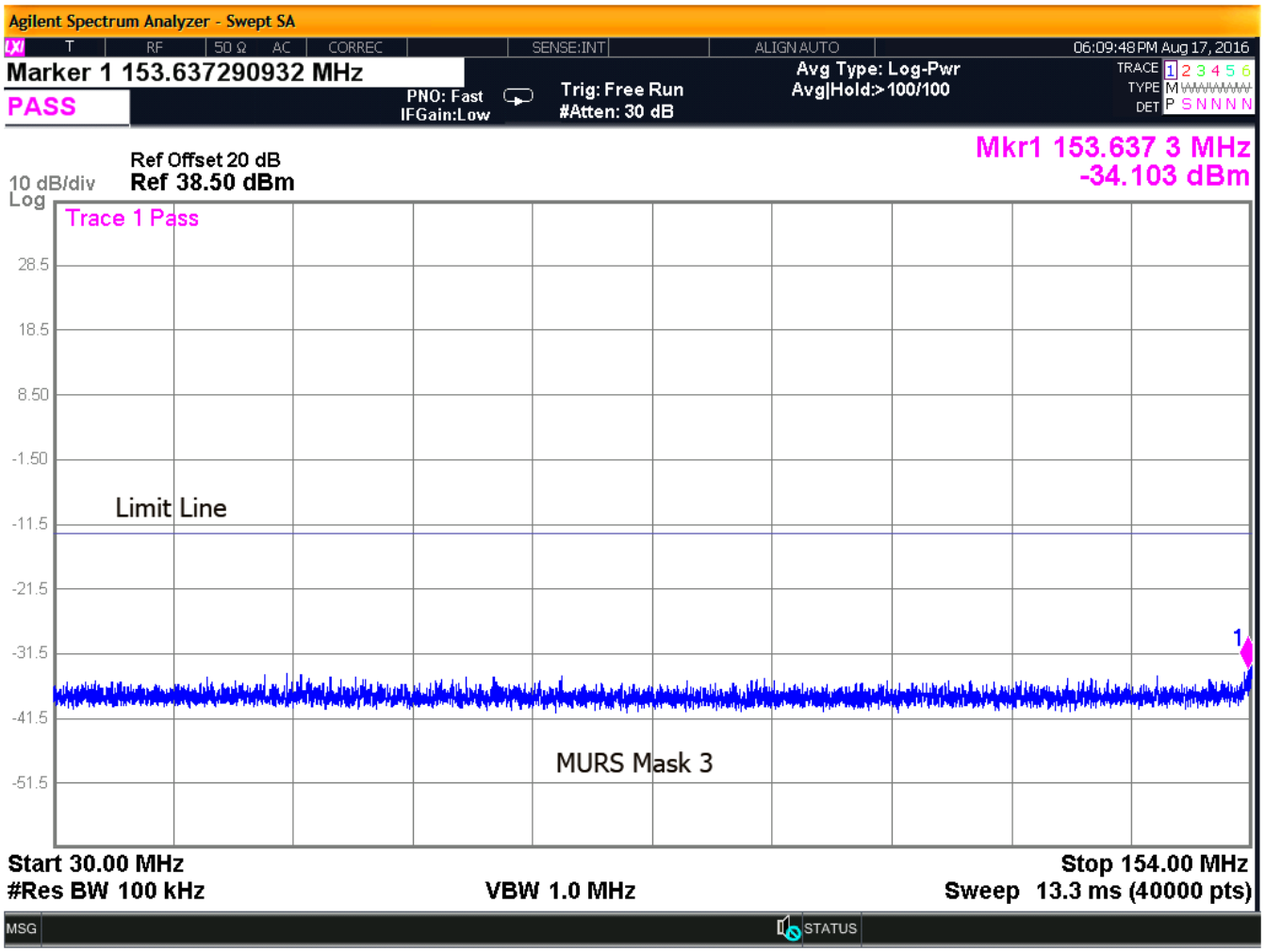

Figure 11: Mask 3, 154.57MHz, Plot 1

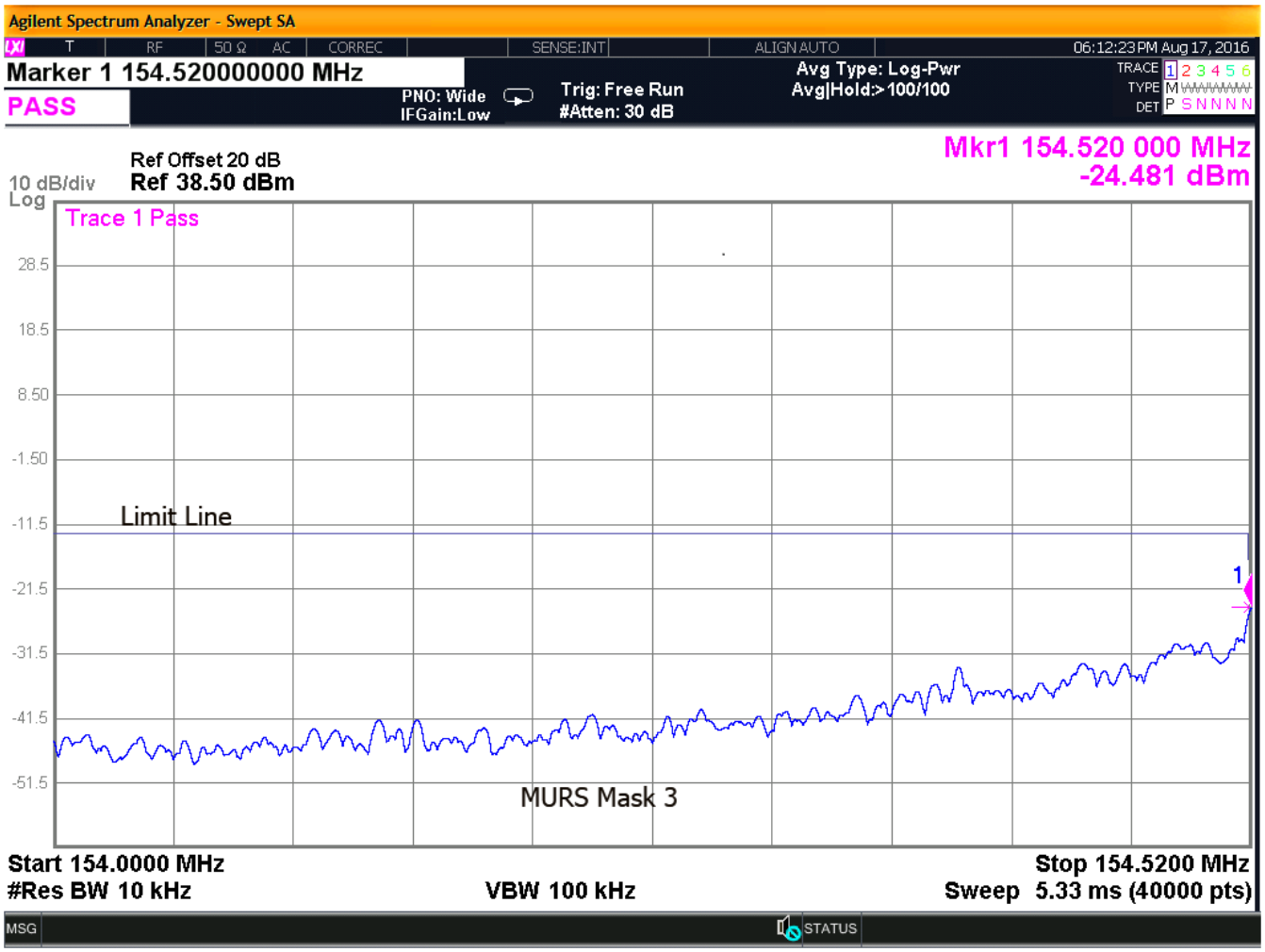

Figure 12: Mask 3, 154.57MHz, Plot 2

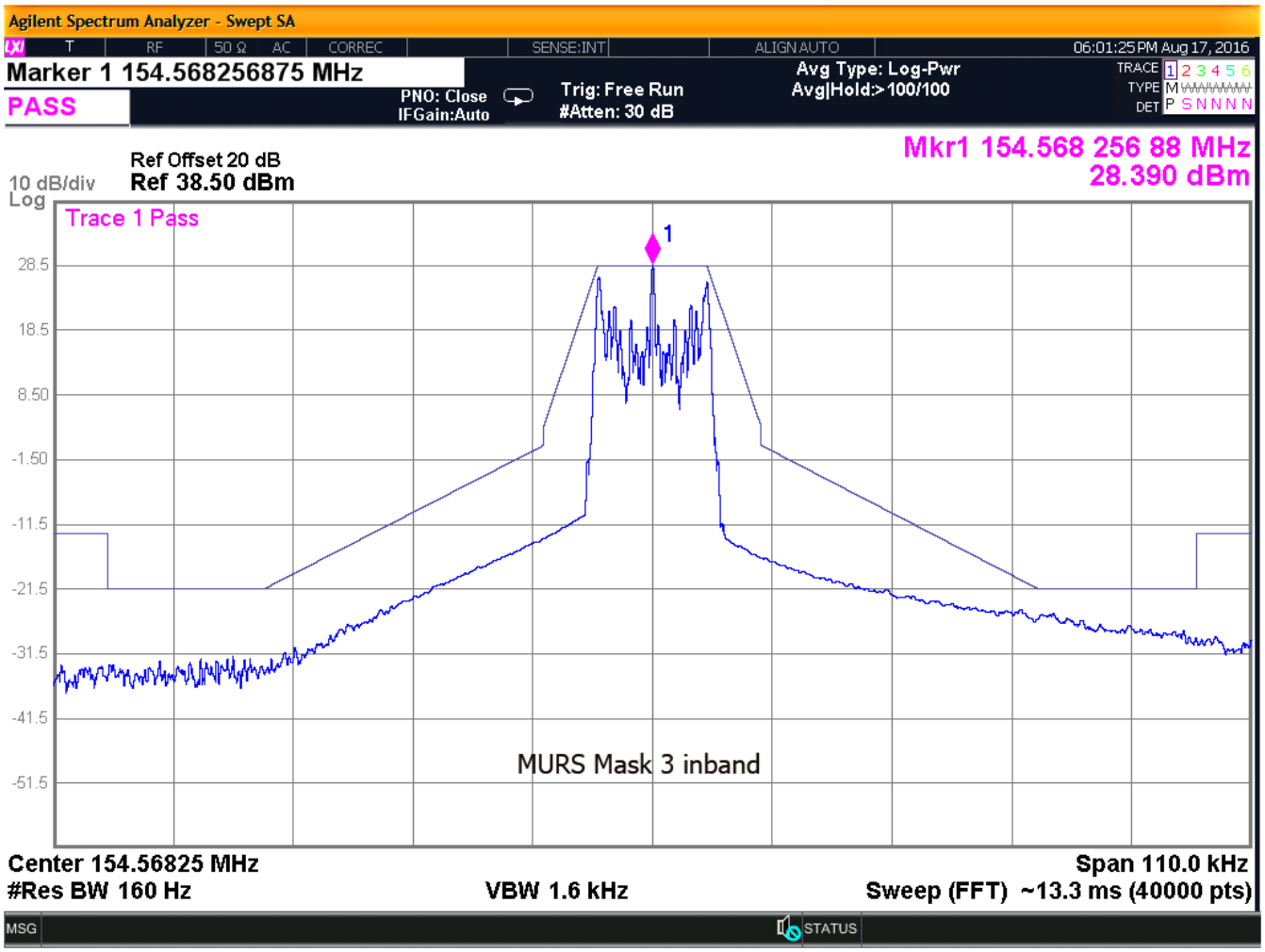

Figure 13: Mask 3, 154.57MHz, Plot 3

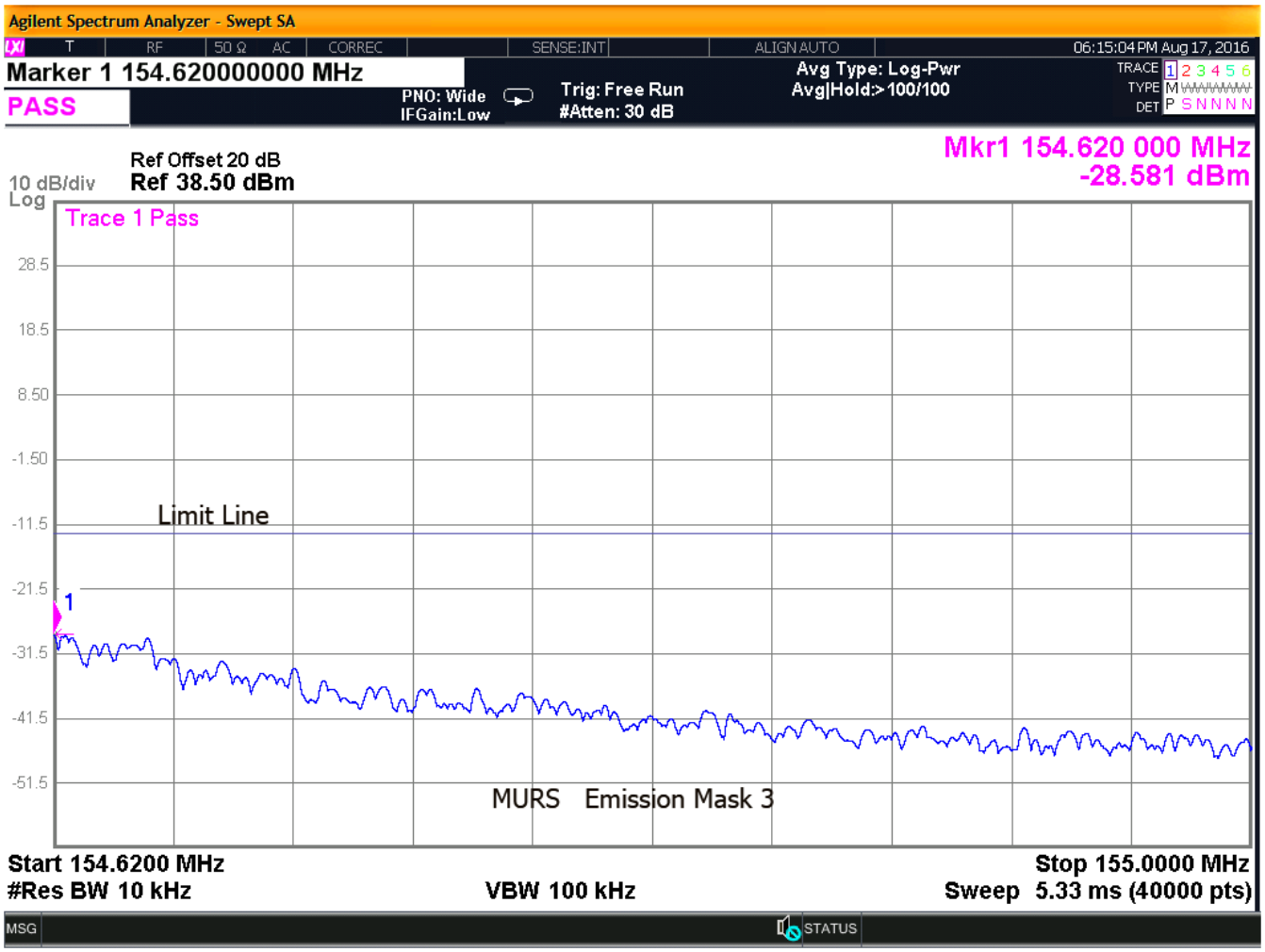

Figure 14: Mask 3, 154.57MHz, Plot 4

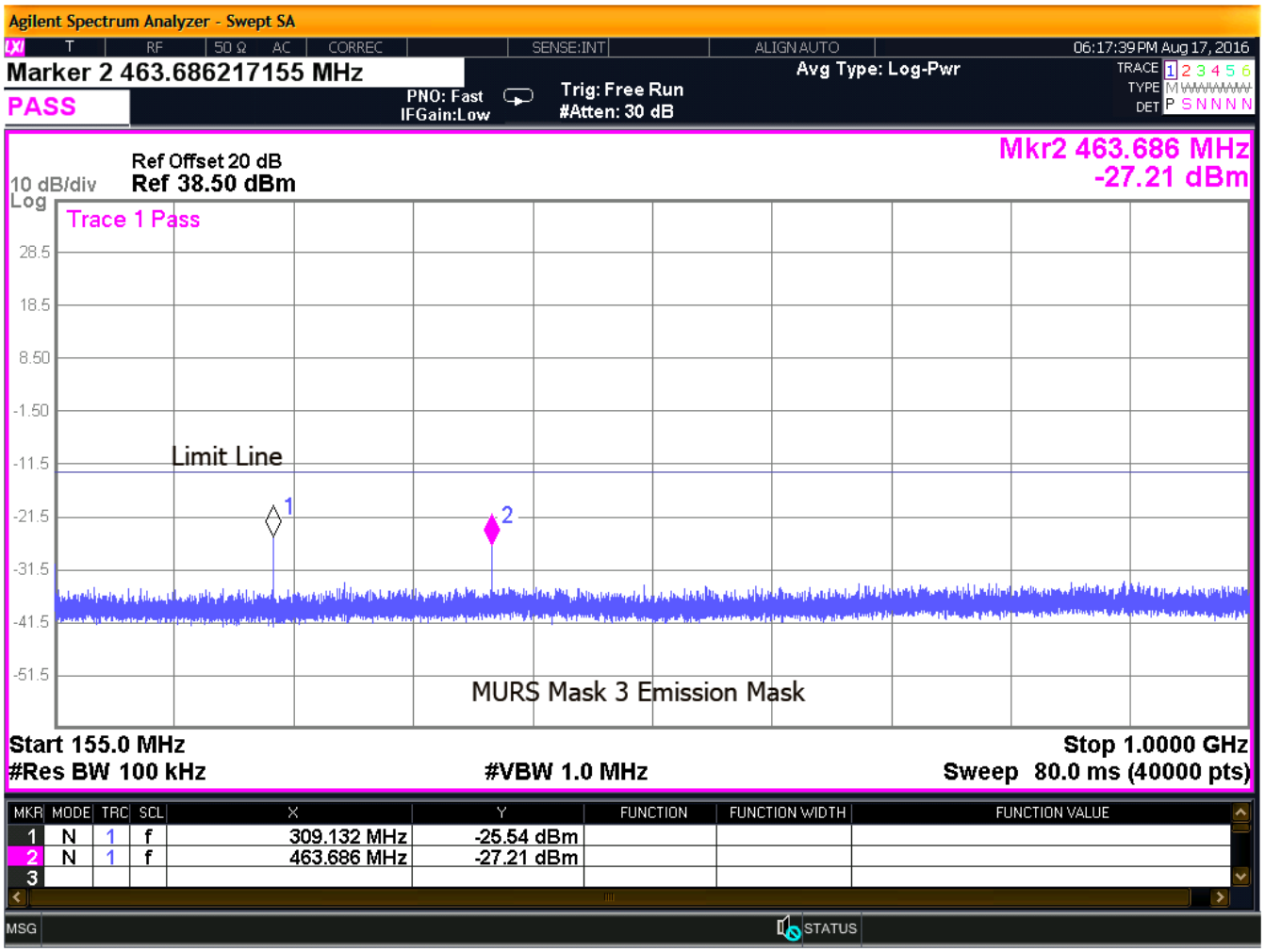

Figure 15: Mask 3, 154.57MHz, Plot 5

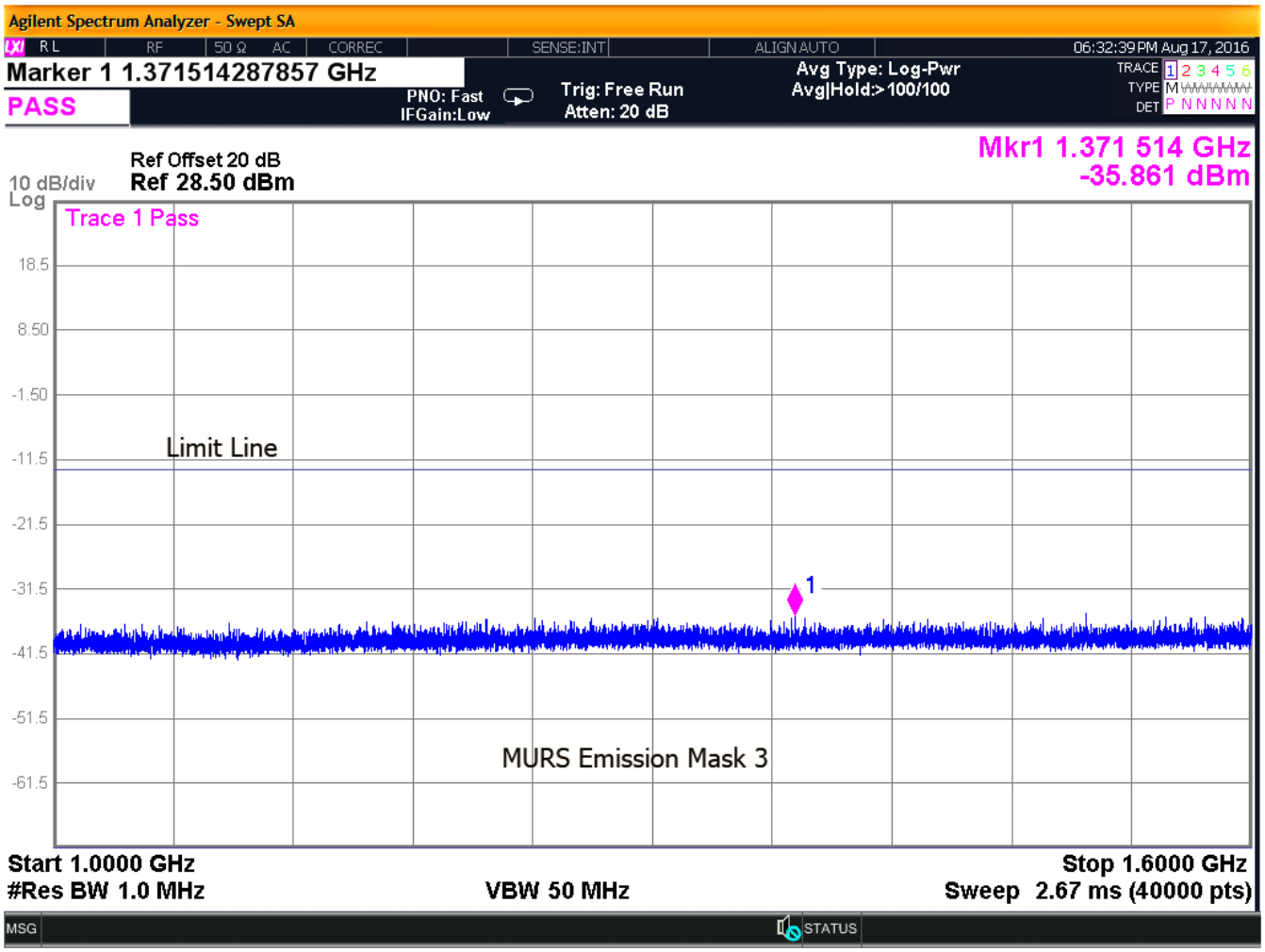

Figure 16: Mask 3, 154.57MHz, Plot 6

5.5 Unwanted Radiation-Case Radiated (Radiated Spurious Emissions):

The EUT was placed on an Open Air Test Site with the EUT antenna terminated and transmitting.

5.5.1 Test Procedure

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. Both the horizontal and vertical field components were measured.

The substitution method from TIA 603-D was used to convert field strength to power (dBm). This was compared to the appropriate 95.635 (e) mask

The EUT was tested in 3 orthogonals with the worst case readings reported.

The emissions were measured using the following resolution bandwidths:

Table 8: Spectrum Analyzer Settings

Frequency Range	Resolution Bandwidth	Video Bandwidth
30MHz-1000 MHz	100kHz	300k
>1000 MHz	1 MHz	3MHz

Correction factors were then applied and the resulting value was compared to the limit.

5.5.2 Test Summary

The EUT complied with the requirements for radiated spurious emissions.

Table 9: Radiated Emission Test Data , 151.88MHz

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)
150.00	V	90.0	1.2	34.8	-56.7	-60.6	8.7	5.0	-55.5	-20	-35.5
151.88	V	90.0	1.2	81.0	-23.0	-26.9	8.8	5.0	-21.9	NA	Fundamental
303.75	V	10.0	1.5	60.1	-41.2	-46.6	14.5	5.4	-41.2	-20	-21.2
455.63	V	350.0	1.5	50.8	-47.0	-53.8	16.3	7.1	-46.7	-20	-26.7
569.61	V	270.0	2.5	36.8	-56.9	-64.6	18.7	6.6	-58.0	-20	-38.0
607.51	V	350.0	1.6	52.9	-43.5	-51.5	18.3	7.6	-43.9	-20	-23.9
759.40	V	340.0	1.6	53.5	-35.9	-44.9	20.4	7.4	-37.5	-20	-17.5
911.26	V	180.0	1.4	43.7	-38.9	-48.8	22.2	7.2	-41.6	-20	-21.6
1063.13	V	45.0	3.2	61.9	-45.4	-50.5	25.0	5.8	-44.7	-20	-24.7
1214.97	V	90.0	2.7	59.0	-46.3	-51.5	25.7	6.2	-45.3	-20	-25.3
1366.88	V	0.0	3.2	61.9	-44.2	-49.8	25.5	7.4	-42.4	-20	-22.4
1518.75	V	200.0	2.7	67.9	-38.3	-44.6	25.4	8.4	-36.2	-20	-16.2
150.00	H	90.0	3.6	29.8	-69.0	-72.9	8.7	5.0	-67.8	-20	-47.8
151.88	H	350.0	3.6	81.2	-29.4	-33.3	8.8	5.0	-28.3	NA	Fundamental
240.00	H	100.0	2.8	30.9	-69.8	-74.7	13.0	4.8	-69.8	-20	-49.8
290.75	H	270.0	2.4	35.0	-68.5	-73.8	13.7	5.8	-68.0	-20	-48.0
303.75	H	325.0	2.6	58.3	-44.2	-49.6	14.5	5.4	-44.2	-20	-24.2
455.63	H	180.0	2.1	53.4	-44.0	-50.8	16.3	7.1	-43.7	-20	-23.7
569.61	H	0.0	1.8	33.9	-58.2	-65.9	18.7	6.6	-59.3	-20	-39.3
607.51	H	180.0	2.0	61.1	-31.5	-39.5	18.3	7.6	-31.9	-20	-11.9
759.40	H	90.0	1.9	57.8	-32.0	-41.0	20.4	7.4	-33.6	-20	-13.6
911.26	H	90.0	1.3	44.8	-38.9	-48.8	22.2	7.2	-41.6	-20	-21.6
1063.13	H	45.0	2.8	59.8	-45.6	-50.7	25.0	5.8	-44.9	-20	-24.9
1214.97	H	45.0	1.9	59.5	-45.3	-50.5	25.7	6.2	-44.3	-20	-24.3
1366.88	H	180.0	1.8	65.9	-40.4	-46.0	25.5	7.4	-38.6	-20	-18.6
1518.75	H	0.0	2.4	68.1	-38.0	-44.3	25.4	8.4	-35.9	-20	-15.9

Table 10: Radiated Emission Test Data, 154.57MHz

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)
150.00	V	90.0	1.2	34.8	-56.7	-60.6	8.7	5.0	-55.5	-13	-42.5
154.57	V	0.0	1.2	78.9	-17.0	-20.9	9.2	4.8	-16.1	NA	Fundamental
290.75	V	90.0	2.3	31.7	-70.1	-75.4	13.7	5.8	-69.6	-13	-56.6
309.14	V	45.0	1.5	56.8	-42.2	-47.7	15.8	4.3	-43.4	-13	-30.4
463.71	V	190.0	1.8	51.6	-45.0	-51.8	16.9	6.6	-45.2	-13	-32.2
569.61	V	270.0	2.5	36.8	-56.9	-64.6	18.7	6.6	-58.0	-13	-45.0
618.28	V	10.0	1.8	51.9	-40.3	-48.4	18.9	7.2	-41.2	-13	-28.2
772.85	V	10.0	1.5	53.6	-33.6	-42.7	21.5	6.5	-36.2	-13	-23.2
927.42	V	10.0	1.2	43.8	-38.7	-48.7	22.1	7.4	-41.3	-13	-28.3
1081.93	V	45.0	2.4	60.6	-47.3	-52.5	25.1	5.8	-46.7	-13	-33.7
1236.62	V	90.0	2.5	59.4	-45.8	-51.5	25.7	6.4	-45.1	-13	-32.1
1391.13	V	190.0	2.4	69.9	-36.8	-42.8	25.5	7.6	-35.2	-13	-22.2
1545.70	V	10.0	2.6	67.3	-38.1	-44.4	25.4	8.6	-35.8	-13	-22.8
150.00	H	90.0	3.6	29.8	-69.0	-72.9	8.7	5.0	-67.8	-13	-54.8
154.57	H	10.0	2.8	78.9	-23.7	-27.6	9.2	4.8	-22.8	NA	Fundamental
290.75	H	270.0	2.4	35.0	-68.5	-73.8	13.7	5.8	-68.0	-13	-55.0
309.14	H	90.0	2.4	57.9	-39.3	-44.8	15.8	4.3	-40.5	-13	-27.5
463.71	H	0.0	1.9	57.5	-40.0	-46.8	16.9	6.6	-40.2	-13	-27.2
569.61	H	0.0	1.8	33.9	-58.2	-65.9	18.7	6.6	-59.3	-13	-46.3
618.28	H	10.0	1.6	63.3	-31.6	-39.7	18.9	7.2	-32.5	-13	-19.5
772.85	H	45.0	1.2	59.5	-30.6	-39.7	21.5	6.5	-33.2	-13	-20.2
927.42	H	190.0	1.0	46.6	-36.3	-46.3	22.1	7.4	-38.9	-13	-25.9
1081.93	H	190.0	2.4	67.8	-40.5	-45.7	25.1	5.8	-39.9	-13	-26.9
1236.62	H	180.0	2.8	63.6	-43.9	-49.6	25.7	6.4	-43.2	-13	-30.2
1391.13	H	10.0	2.1	71.5	-34.8	-40.8	25.5	7.6	-33.2	-13	-20.2
1545.70	H	90.0	1.8	74.7	-32.9	-39.2	25.4	8.6	-30.6	-13	-17.6

5.6 Frequency Stability: (FCC Part §2.1055 & FCC Part §95.632)

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 by a 3.7Vdc Lion battery.. The manufacturer's power requirements for the EUT include the following:

Low DC Voltage of 3.0 VDC-unit cuts off below this level.

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 limits is 5.0ppm.

5.6.1 Test Procedure

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.

5.6.2 Test Results

The EUT complied with the requirements for frequency stability. Table 11shows the results.

Table 11: Frequency Stability Results

Limit: 5 PPM

Freq=151.880MHz

Temperature Variations

Temperature (Centigrade)	Frequency (MHz)	Deviation (Hz)	Deviation (PPM)	Limit (PPM)	Pass/Fail
26 (ambient)	151.879210	0	NA	NA	NA
-30	151.879721	511	3.36	5	Pass
-20	151.879646	436	2.87	5	Pass
-10	151.879806	596	3.92	5	Pass
0	151.879686	476	3.13	5	Pass
10	151.879556	346	2.28	5	Pass
20	151.879231	21	0.14	5	Pass
30	151.879006	-204	1.34	5	Pass
40	151.878916	-294	1.94	5	Pass
50	151.878516	-694	4.57	5	Pass

Nominal voltage Level = 3.7VDC

Voltage Variations

Voltage (Volts)	Frequency (MHz)	Deviation (Hz)	Deviation (PPM)	Limit (PPM)	Pass/Fail
Nominal Voltage 3.7VDC	151.879066	0	NA	NA	NA
Battery ENDPOINT (3.0vdc)	151.879216	150	0.99	5	Pass

5.7 Receiver Radiated Spurious Emissions

The EUT must comply with the requirements for radiated spurious emissions that fall within the restricted bands. These emissions must meet the limits specified in §15.209 and §15.35(b) for peak measurements.

5.7.1 Test Procedure

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. Cables were varied in position to produce maximum emissions. Both the horizontal and vertical field components were measured.

Measurements above 1GHz were performed with RF absorber material placed on the site between the receive antenna and the EUT unit.

The emissions were measured using the following resolution bandwidths:

Table 12: Spectrum Analyzer Settings

Frequency Range	Resolution Bandwidth	Video Bandwidth
30MHz-1000 MHz	120kHz	>100 kHz
>1000 MHz	1 MHz	10 Hz (Avg.), 1MHz (Peak)

Average measurements above 1GHz were made with the Spectrum analyzer set to the linear mode with a Video bandwidth of 10Hz, and the resultant reading mathematically converted to dBuV. Correction factors were then applied and the resulting value was compared to the limit.

Table 13: Radiated Emission Test Data, Receiver

Frequency (MHz)	Polarity H/V	Azimuth (Degree)	Ant. Height (m)	SA Level (dBuV)	Corr Factors (dB)	Duty Cycle Correction (dB)	Corr. Level (uV/m)	Limit (uV/m)	Margin (dB)
60.00	V	45.00	1.00	38.90	-13.4	0.0	18.7	100.0	-14.5
64.00	V	90.00	1.00	33.87	-15.0	0.0	8.8	100.0	-21.1
80.00	V	120.00	1.00	32.90	-16.8	0.0	6.4	100.0	-23.9
150.00	V	90.00	1.20	34.80	-14.1	0.0	10.8	150.0	-22.9
240.00	V	270.00	2.50	31.20	-9.8	0.0	11.7	200.0	-24.6
270.00	V	90.00	1.80	34.87	-8.1	0.0	21.9	200.0	-19.2
290.75	V	90.00	2.30	31.70	-9.2	0.0	13.3	200.0	-23.5
569.61	V	270.00	2.50	36.80	-3.5	0.0	46.4	200.0	-12.7
60.00	H	180.00	4.00	33.57	-13.4	0.0	10.1	100.0	-19.9
64.00	H	10.00	3.80	33.90	-15.0	0.0	8.8	100.0	-21.1
80.00	H	10.00	3.80	36.80	-16.8	0.0	10.0	100.0	-20.0
150.00	H	90.00	3.60	29.80	-14.1	0.0	6.1	150.0	-27.9
240.00	H	100.00	2.80	30.90	-9.8	0.0	11.3	200.0	-24.9
270.00	H	180.00	2.80	29.70	-8.1	0.0	12.1	200.0	-24.4
290.75	H	270.00	2.40	34.97	-9.2	0.0	19.4	200.0	-20.3
569.61	H	0.00	1.80	33.94	-3.5	0.0	33.4	200.0	-15.5