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FCC Part 25 Test Report
For the
Comtech Mobile Datacom Corporation
STM3 TRANSMITTER MODULE
FCC ID: UQR-CMDCSTM3

WLL REPORT# **11315-01 Rev 5**

March 2, 2010
Re-issued September 22, 2010

Prepared for:

Comtech Mobile Datacom Corporation
20430 Century Blvd.
Germantown, MD 20874

Prepared By:

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

ACCREDITED TESTING
Testing Certificate AT-1448

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For the
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Prepared by:

James Ritter
EMC Compliance Engineer

Reviewed by:

Steven D. Koster
EMC Operations Manager

Abstract

This report has been prepared on behalf of Comtech Mobile Datacom Corporation STM3 Transmitter Module to support compliance of a Satellite Earth Station under Part 25 of the FCC Rules. This Part 25 Test Report documents the test configuration and test results for a Comtech Mobile Datacom Corporation STM3 Transmitter module.

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. At the initial issuance of this report Washington Laboratories, Ltd. was accepted by the FCC and approved by the American Association for Laboratory Accreditation (A2LA) under Certificate 2675.01 as an independent FCC. As of April 1st 2010, Washington Laboratories, Ltd is accredited by ACLASS under Testing Certificate AT-1448.

The Comtech Mobile Datacom Corporation STM3 Transmitter module complies with the limits for a Satellite Earth Station device under FCC Part 25.

Revision History	Reason	Date
Rev 0	Initial Release	March 2, 2010
Rev 1	Changed Authorized bandwidth to 2.5MHz in Table 1 –page 7 and under heading 4.3 Authorized bandwidth page 25 Replotted Pt25.202 emission mask to reference mean output power Name of unit changed from Chopin to STM3	March 16, 2010
Rev 2	Added section 4.1.3 ‘Conducted Peak RMS Power at Antenna Port’, added Peak RMS Power row to Table 1 ‘Device Summary’	April 23, 2010
Rev 3	Retested the STM 3 to verify the unit for component changes and an antenna change.	July 27, 2010
Rev 4	Corrected typos in Table 1 referencing a 3dBi antenna, should have been 5dBi.	July 29, 2010
Rev 5	Added new sections 2.2 ‘Modulation Description and Emission Designator’ and 2.3 ‘Voltages and Currents of Transmitter Output Amplifier-	September 22, 2010

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1 Introduction

1.1 Compliance Statement

The Comtech Mobile Datacom Corporation STM3 Transmitter Module complies with the limits for a Satellite Earth Station device under FCC Part 25.

1.2 Test Scope

Tests for radiated and conducted (at antenna terminal) emissions were performed. The measurement equipment conforms to ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation.

1.3 Deviations to the Standard

The STM3 Transmitter Module is required to receive a regulated 3.3VDC (-/+5%) from its host unit. Since the power is regulated and the voltage tolerance minimal the frequency stability test was performed for temperature only and without voltage variations.

1.4 Contract Information

Customer:	Comtech Mobile Datacom Corporation 20430 Century Blvd Germantown, MD 20874
Purchase Order Number:	A10096
Quotation Number:	65241

1.5 Test Dates

Testing was performed on the following date(s):	2/1/2010 to 2/19/10, 7/19/2010-7/26/2010

1.6 Test and Support Personnel

Washington Laboratories, LTD	James Ritter, John P. Repella
Client Representative	Saad Anis

1.7 Abbreviations

A	**A**mpere
ac	**a**lternating **c**urrent
AM	Amplitude Modulation
Amps	**Amp**eres
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 STM3 module is a satellite transmitter unit (STU) designed to be mounted onto a user's circuit board, where it will receive and respond to various configuration instructions and queries, as well as transmit message packets through the Simplex Telemetry network (The module is designed for low-power systems). In most target systems the module will only be powered when needed. The STM3 firmware is designed to respond to commands and immediately go back to a "sleep" state, in which it consumes only a few microAmps of current. A low-power timer in the STM3 microprocessor runs during sleep mode using an external 32kHz crystal on the support PCB, and ensures that message retries occur on schedule..

Table 1: Device Summary

ITEM	DESCRIPTION
Manufacturer:	Comtech Mobile Datacom Corporation
Model:	STM3 Transmitter module
FCC ID:	UQR-CMDCSTM3
FCC Rule Parts:	§25
Frequency Range:	1611.25-1618.75MHz
Maximum Peak Output Power (Conducted):	0.125W (20.99dBm)
Maximum Peak RMS Output Power (Conducted):	18.31dBm
Maximum EIRP (in a 4 kHz BW) Conducted (with 5dB antenna)	-19.63dBW (10.37dBm)
Modulation:	BPSK (DSSS)
Occupied Bandwidth (20dB):	2.161MHz
Authorized Bandwidth	2.5MHz
Emission Designator	2M50G1D
Keying:	Automatic
Type of Information:	Data
Power Output Level	Fixed
Antenna Connector	Integral
Antenna	Spectrum Control PA25-1615-025SA 5dB Patch
Power Source & Voltage:	Regulated 3.3VDC +/-5% from host unit

2.2 Modulation Description and Emission Designator

The STM3 transmitter utilizes a Binary Phase Shift Keying (BPSK) modulation scheme at 100.04 bps. The BPSK signal is exclusive-OR'ed with a pseudorandom (PN) pattern at 1.25 Mega chips per second (Mcps) creating a Direct Sequence Spread Spectrum (DSSS) waveform. The unit uses a 255 PN chip sequence with 49 chip sequences equaling 1 bit of the BPSK.

The emission designator for this transmitter will be 2M50G1D and was determined in the following manner:

According to FCC cfr 47 Part 2.201 and 2.202 the emission designator shall be comprised of 7 characters incorporating the necessary bandwidth, type of modulation symbol, nature of the modulating signal symbol, and the type information symbol.

As this unit is BPSK modulated the necessary bandwidth (Bn) was derived from the table presented in FCC part 2.202 for Phase Shift Keying emissions and is as follows:

$Bn = 2RK/Log_2S$

where R = Bit rate
K = 1
S = Number of signaling states

For this device since the emission bandwidth of the signal is controlled by the spreading function of the PN pattern the Bit Rate (R) will be the chip rate of 1.25Mcps. For BFSK systems the number of signaling states (S) is 2. Thus the necessary bandwidth formula is:

$Bn = 2*1.25^{6*1}/Log_2*2 = 2.5^6/1 = 2.5MHz$

This necessary bandwidth is shown as the 2M50 part of the 2M50G1D emission designator.

The type of modulation symbol is 'G' representing Phase Modulation in accordance with FCC part 2.201.

The nature of modulation symbol is '1' representing a single channel containing quantized or digital information without the use of a modulating sub-carrier in accordance with FCC part 2.201.

The type of information symbol is 'D' representing Data transmissions in accordance with FCC part 2.201.

Thus the emission designator for this device is 2M50G1D

2.3 Voltages and Currents of Transmitter Output Amplifier

In accordance with FCC cfr47 Part 2.1033(c)(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' are supplied as follows:

Power Amplifier (U9) at max TX:

Pin 4, V_reg; V = 2.85V +/-5%; I = 1.00 to 3.00 mA
Pins 10,11,12, VCC_RF; (tied together); V=3.3V +/-5%; I = 140mA
Pins 14,15 , VCC; (tied together); V=3.3V +/-5%; I = 31mA
Pin 16; VCC; V = 3.3V; I = 1mA

2.4 Test Configuration

The STM3 transmitter module was soldered to a host test fixture circuit board. This test fixture board had a 3.3VDC regulator, SMA antenna port, VDC input port, 5 pin header for test mode/transmit on switches, and a programming port that provided the required interface to the module. The test fixture board was screwed to a wooden test fixture box that had 2 toggle switches to set the test mode (30 sec

transmit, single transmit, 30 second carrier, no test) and a DB9 connector to attach a remote pushbutton to activate transmit.

The SMA antenna port was connected to a spectrum analyzer through suitable attenuators for the measurements required for this testing.

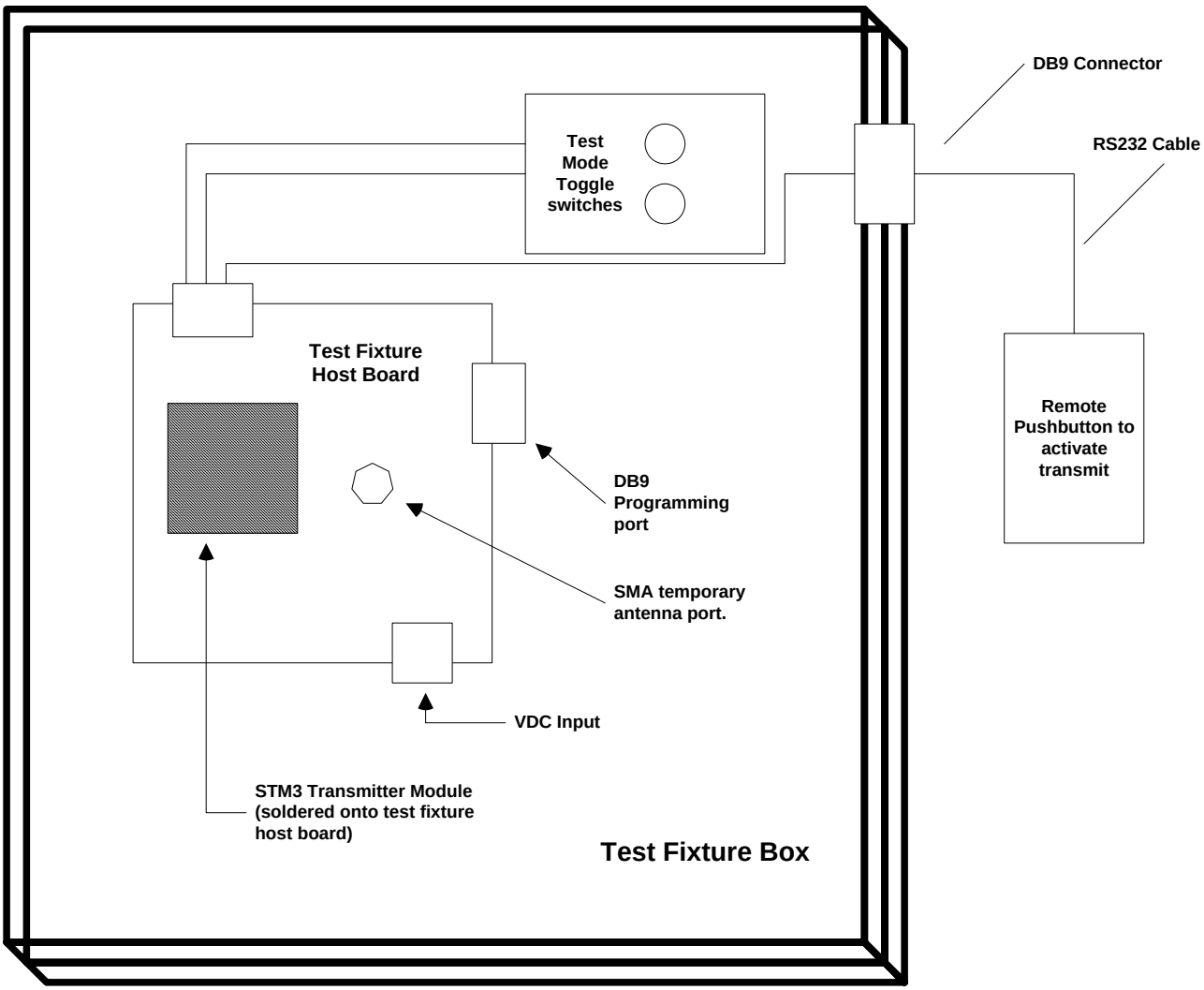


Figure 1: Test Setup Diagram

2.5 Testing Algorithm

The STM3 Transmitter module was configured with a laptop computer connected through the RS232 data port. An external power supply provided DC power to the unit. A Client test program (stxcom.exe) program on the support laptop was used to program the EUT to operate on the test frequencies in a carrier on and carrier off mode. The carrier on mode consisted of transmit bursts of 30seconds every time the remote transmit button was pressed. The EUT was tested at maximum powerand a maximum data rate. The EUT has the capability of transmitting on 4 channels.

- Channel A:1611.25MHz –limited testing (Power, Bandwidth, GPS Band [pt25.216])
- Channel B: 1613.75 MHz- full testing
- Channel C: 1616.25MHz- limited testing (Power, Bandwidth, GPS Band [pt25.216])
- Channel D: 1618.75 MHZ- limited testing (Power, Bandwidth, GPS Band [pt25.216])

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

2.6 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 ACLASS under Certificate AT-1448 as an independent FCC test laboratory.

2.7 Measurements

2.7.1 References

TIA-603-B Land Mobile FM or PM Communications Equipment Measurement and Performance Standard

ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation

2.8 Measurement Uncertainty

All results reported herein relate only to the equipment tested. The basis for uncertainty calculation uses ANSI/NCSL Z540-2-1997 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 Table 2 below.

Table 2: Expanded Uncertainty List

Scope	Standard(s)	Expanded Uncertainty
Radiated Emissions	CISPR11, CISPR22, CISPR14, FCC	4.55 dB

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

WLL Asset #	Manufacturer Model/Type	Function	Cal. Due
	Conducted Antenna Bench Measurements		
00528	Agilent, E4446A	Analyzer, Spectrum	6/10/2011
00474	HP, 8563E	Analyzer, Spectrum	2/3/2011
	Radiated Antenna Measurements		
00080	HP, 8672A	Generator, RF Signal	10/28/2010
00257	HP, 8672A-K22	Frequency Extention Unit	10/28/2010
00066	HP, 8449B	Pre-Amplifier, RF. 1-26.5GHz	07/21/2010
00074	HP, 8593A	Analyzer, Spectrum	03/21/2010
00001	A.H., Systems, SAS-200/518	Antenna, LP, 1-18GHz	04/29/2010
00425	ARA, DRG-118/A	Antenna, DRG, 1-18GHz	09/09/2011
00382	Sunol, JB1	Antenna, Biconlog	12/29/2010
00069	HP, 85650A	Adapter, QP	06/28/2010
00073	HP, 8568B	Analyzer, Spectrum	06/28/2010
00071	HP, 85685A	Preselector, RF	06/28/2010
00159	HP, 8648A	Generator, RF Signal	11/17/2010
00382	Sunol, JB1	Antenna, Biconlog	12/29/2010
00007	ARA, LPB-2520	Antenna, Biconilog Antenna	06/17/2010
	Frequency Stability		
00474	HP, 8563E	Analyzer, Spectrum	2/3/2011
00685	Fluke, 115	Multimeter, Digital	8/19/2010
00641	HQ Power	0-50V 5AMP DC Supply	CNR
00254	Tenney, TR64	Big Blue Environmental Chamber	Cal-in-test
00040	Fluke, 80TK	Meter, Thermocouple Module	2/18/2010

4 Test Results

Note: The 'Chopin Transmitter Module' designation is the Comtech Mobile in-house development name for the STM3. All references in the test results plots to the Chopin are considered to be references to the STM3 Transmitter Module.

4.1 RF Power Output (FCC 25.204)

FCC 25.204 specifies the limits for Satellite Earth Stations as +40dBW (+70dBm) in any 4 kHz band at 0 degrees azimuth.

4.1.1 Maximum Peak Power in any 4 kHz bandwidth

The power was measured conducted into a spectrum analyzer. The RBW was set to 3 kHz (a correction of 10Log (4kHz/3kHz) =1.3 dB was added). 5dB was added for the Spectrum Control PA25-1615-025SA 5DB Patch Antenna. The results are in the following table and figures.

Table 4: RF Peak Power Output per 4 kHz Bandwidth

Channel	Frequency	Peak power/4kHz (dBm)	Peak power/4kHz (dBW)	Limit (dBW)	Pass/Fail
A	1611.25MHz	10.37	-19.63	40	Pass
B	1613.75MHz	8.559	-21.44	40	Pass
C	1616.25MHz	8.593	-21.407	40	Pass
D	1618.75MHz	9.616	-20.384	40	Pass

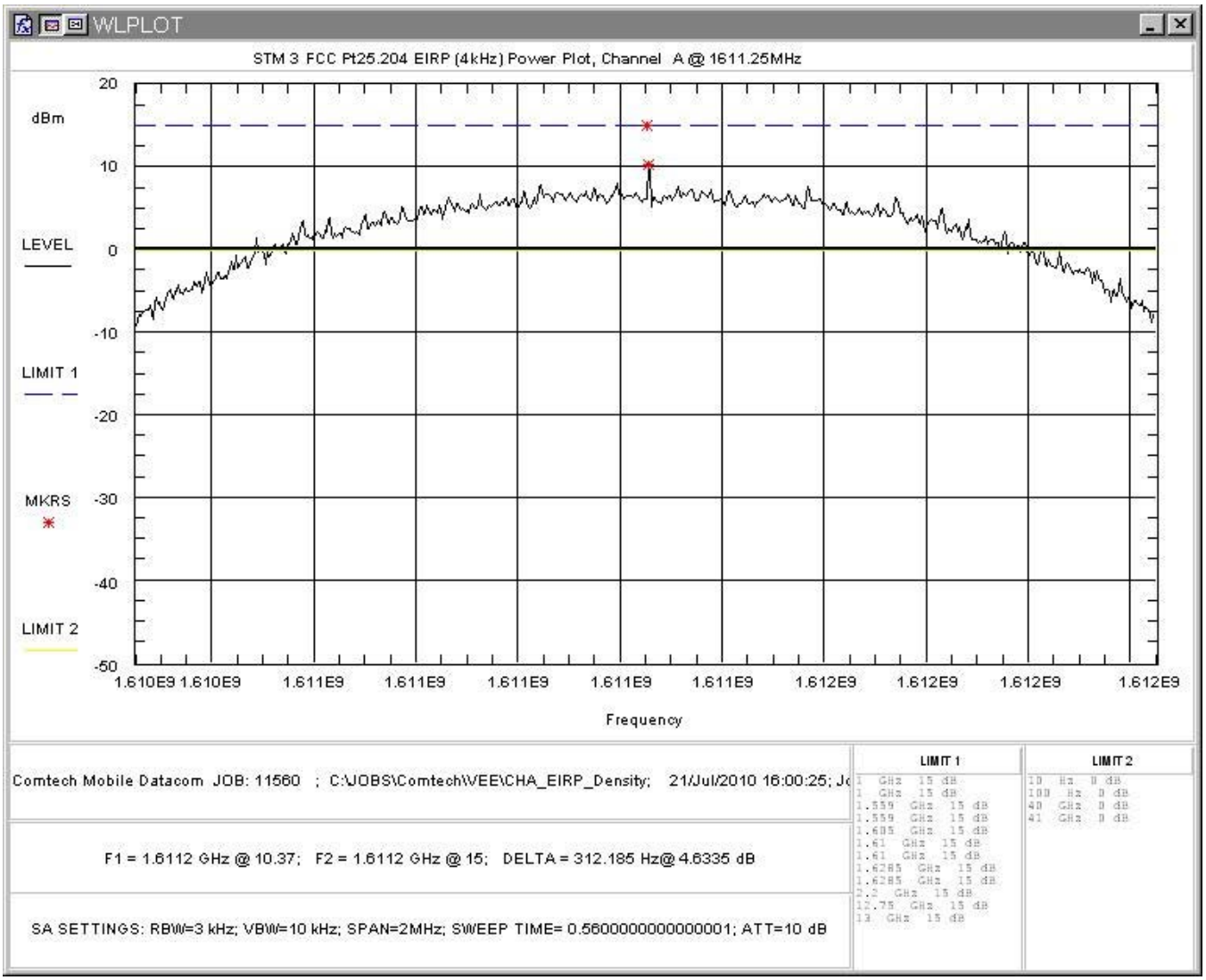


Figure 2: Peak Power in any 4 kHz: Channel A @ 1611.25MHz

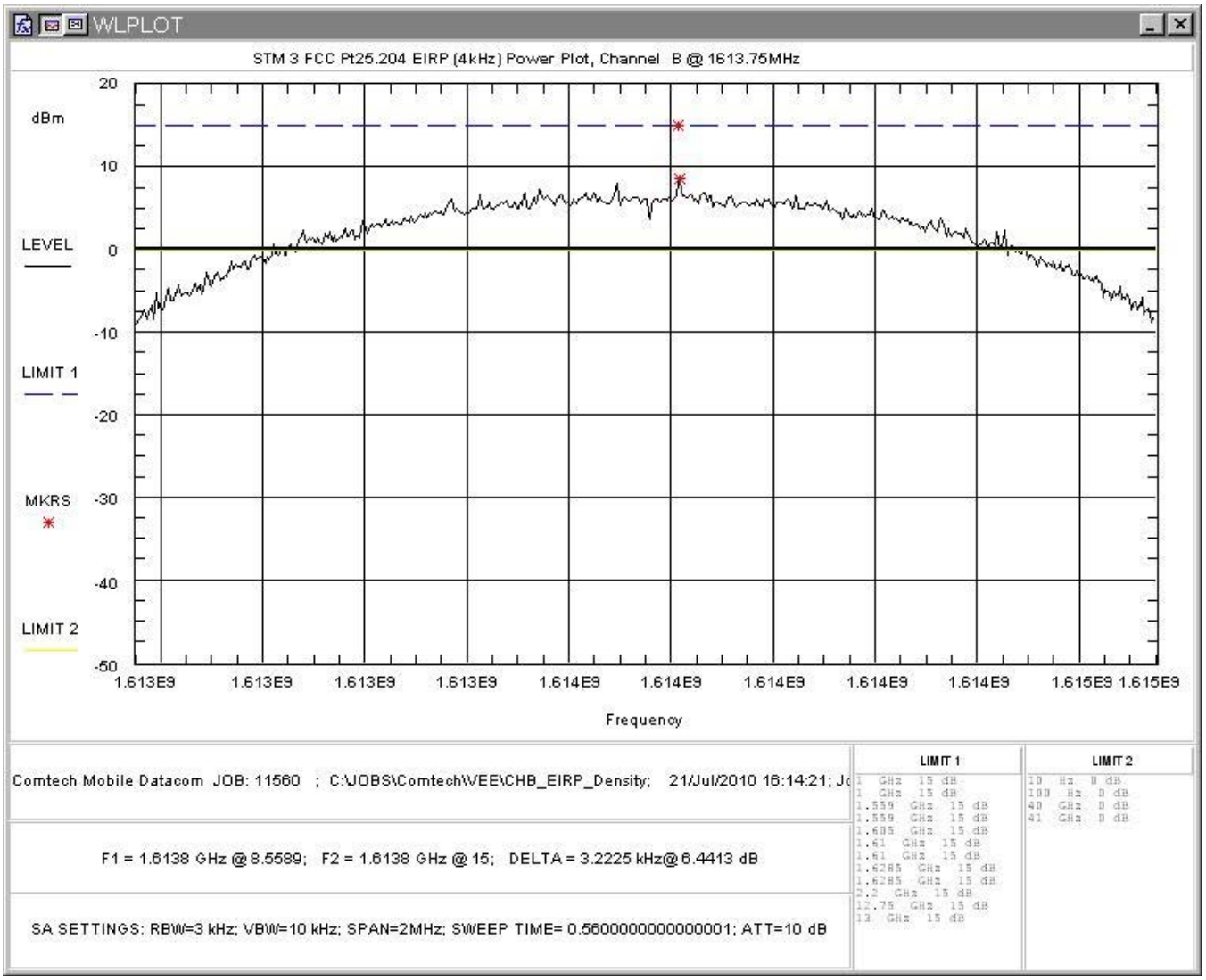


Figure 3: Peak Power in any 4 kHz: Channel B @ 1613.75MHz

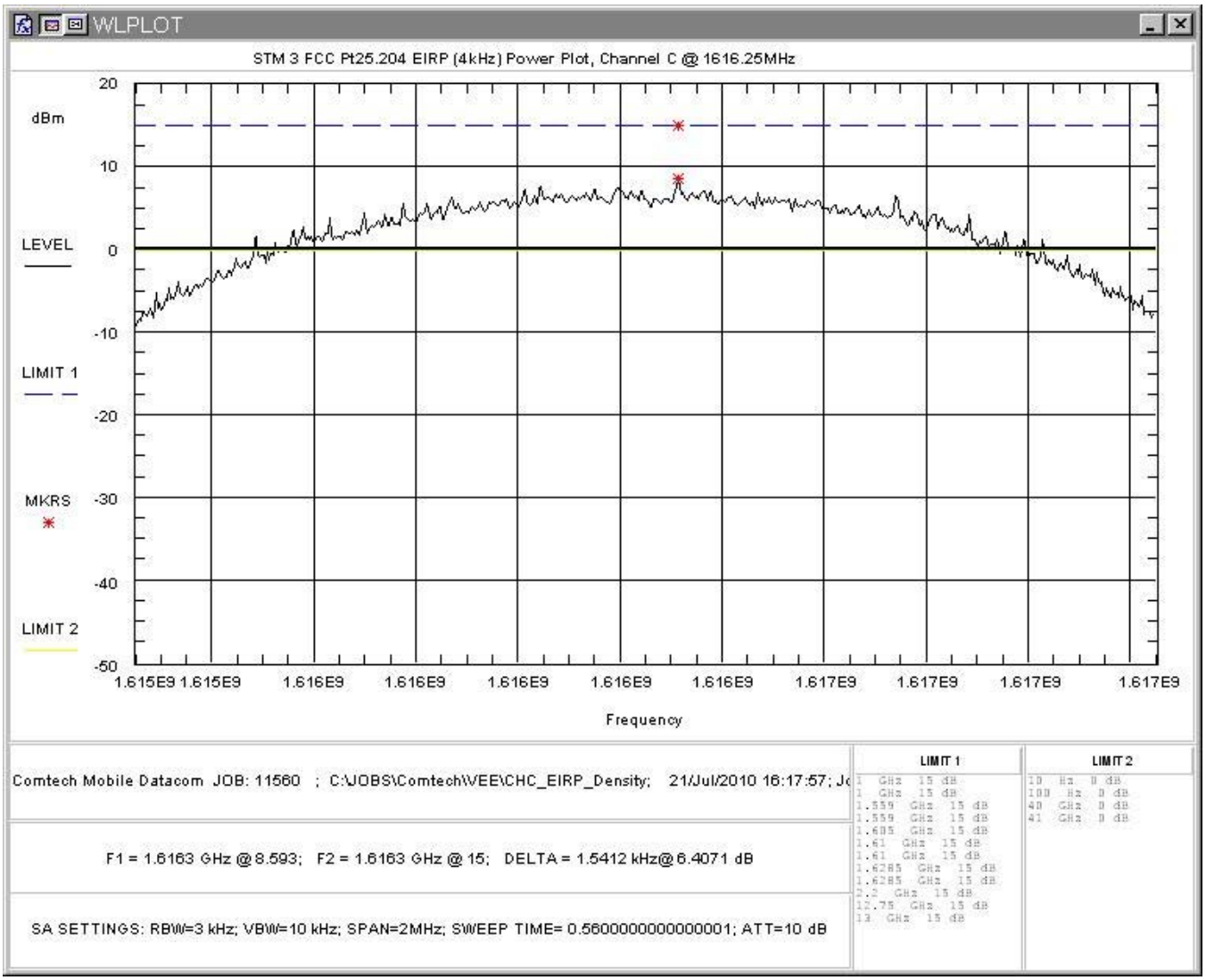


Figure 4: Peak Power in any 4 kHz: Channel C @ 1616.25MHz

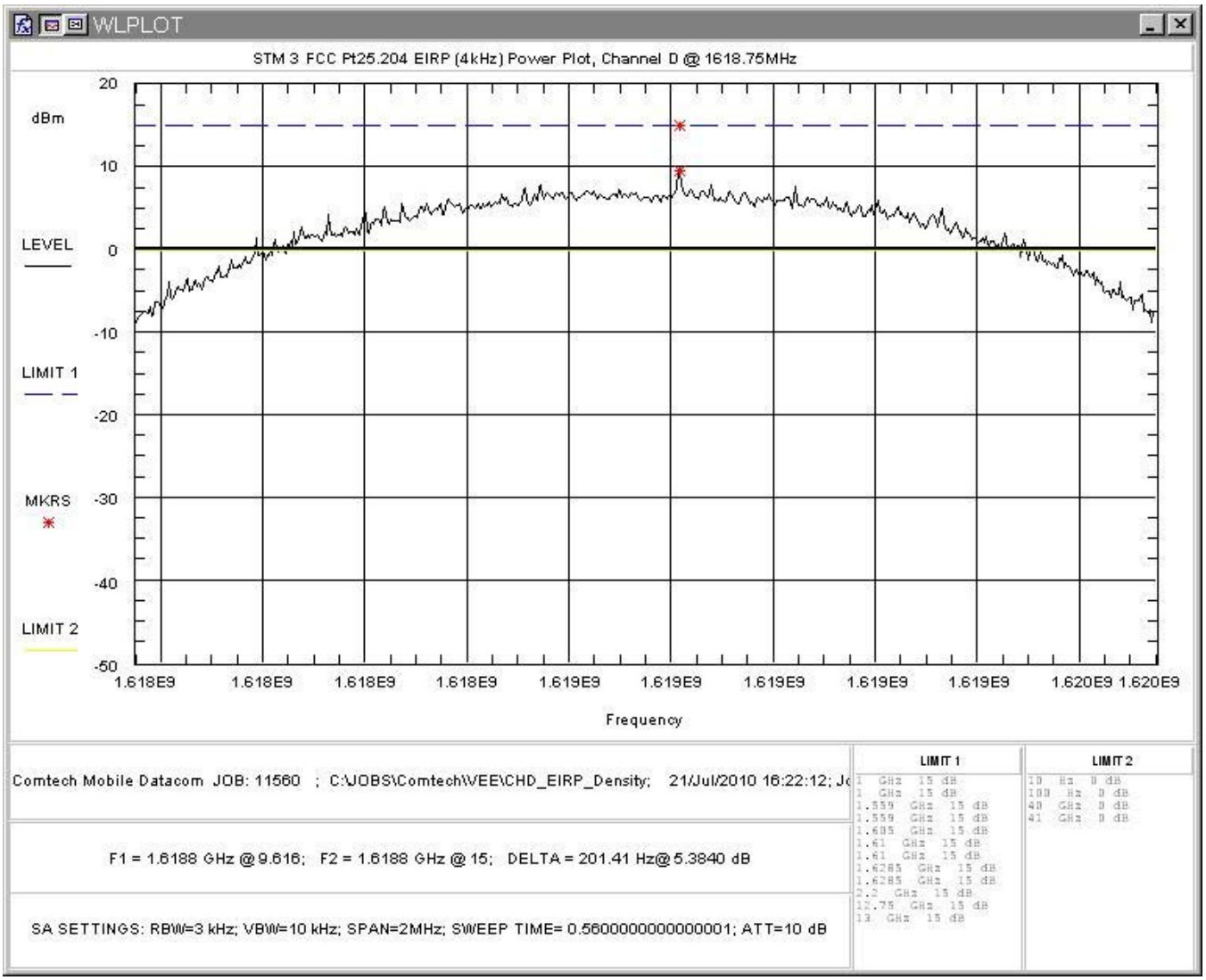


Figure 5: Peak Power in any 4 kHz: Channel D @ 1618.75MHz

4.1.2 Power measurement (3MHz bandwidth)

The Peak power was measured at the antenna port using a spectrum analyzer. The RBW was set to 3MHz and the VBW set to 8MHz. The results are in the following table and figures (antenna gain not included).

Table 5: RF Power Output

Channel	Frequency	Power Output (dBm)	Power Output (W)	Power Output (dBm)/(W) Previously Measured
A	1611.25MHz	20.62	0.115	20.99/0.125
B	1613.75MHz	20.78	0.119	20.92/0.123
C	1616.25MHz	20.90	0.123	20.92/0.123
D	1618.75MHz	20.99	0.125	20.98/0.125

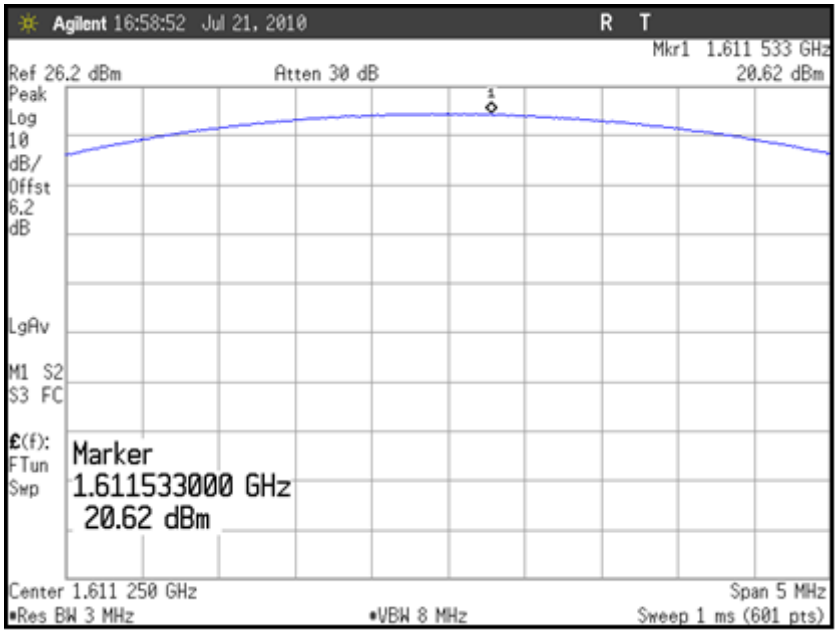


Figure 6: RF Peak Power, Channel A @ 1611.25MHz

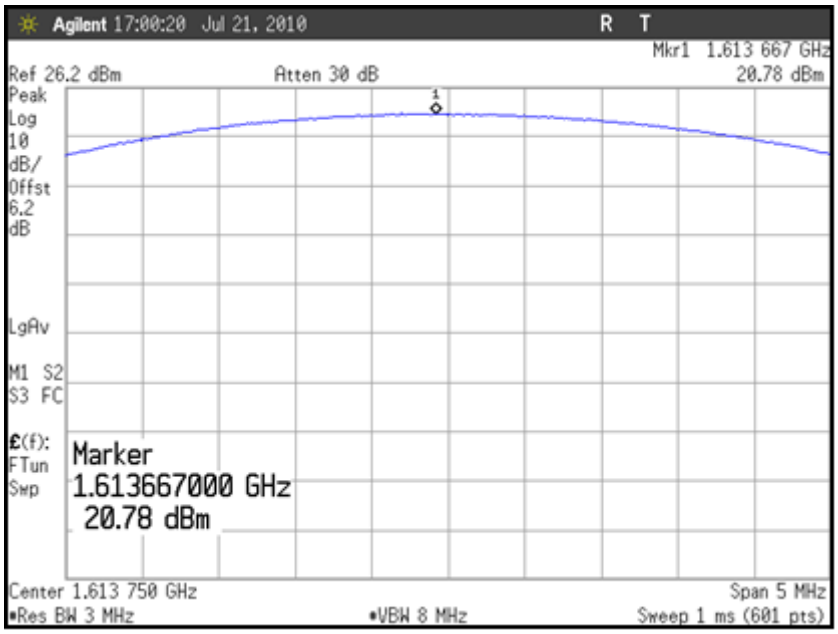


Figure 7: RF Peak Power, Channel B @ 1613.75MHz

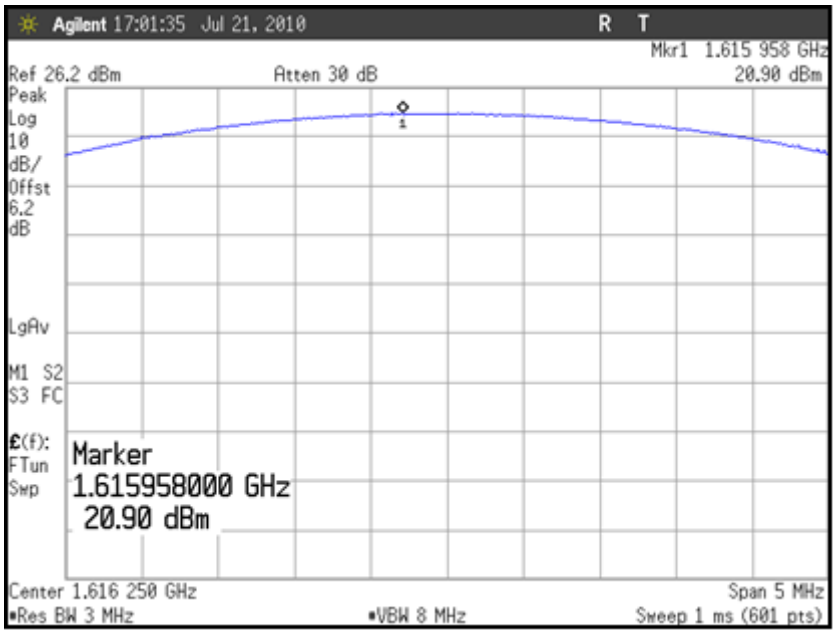


Figure 8: RF Peak Power, Channel C @ 1616.25MHz

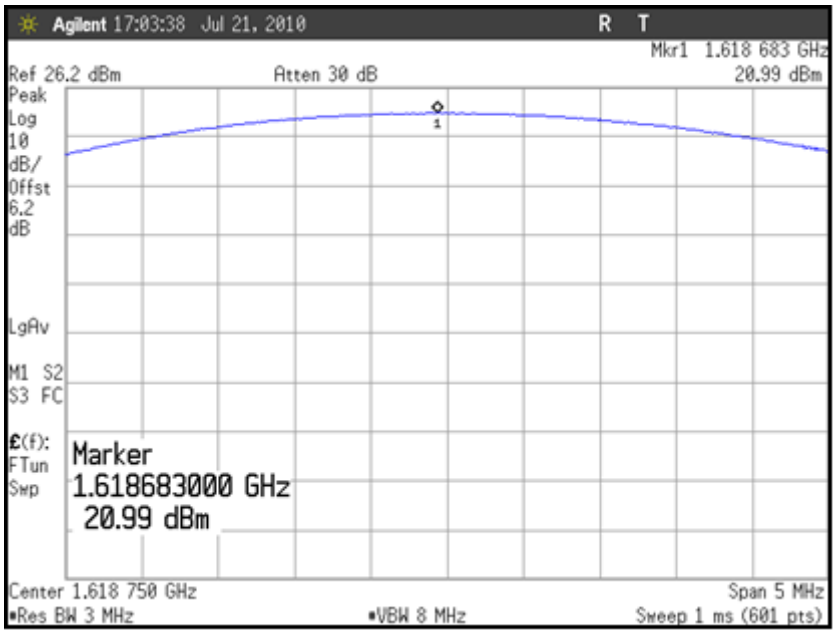


Figure 9: RF Peak Power, Channel D @ 1618.75MHz

4.1.3 Conducted Peak RMS Power at Antenna Port

The Peak RMS power was measured at the antenna port using a spectrum analyzer. The RBW was set to 3MHz and the VBW set to 8MHz. An RMS detector setting was used with a 1 second sweep time. The results are in the following table and figures (antenna gain not included).

Table 6: RF Power Output

Channel	Frequency	Peak RMS Power Output (dBm)	Peak RMS Power Output (dBm) Previously Measured
A	1611.25MHz	17.90	18.11
B	1613.75MHz	18.04	18.17
C	1616.25MHz	18.31	18.30
D	1618.75MHz	18.31	18.52

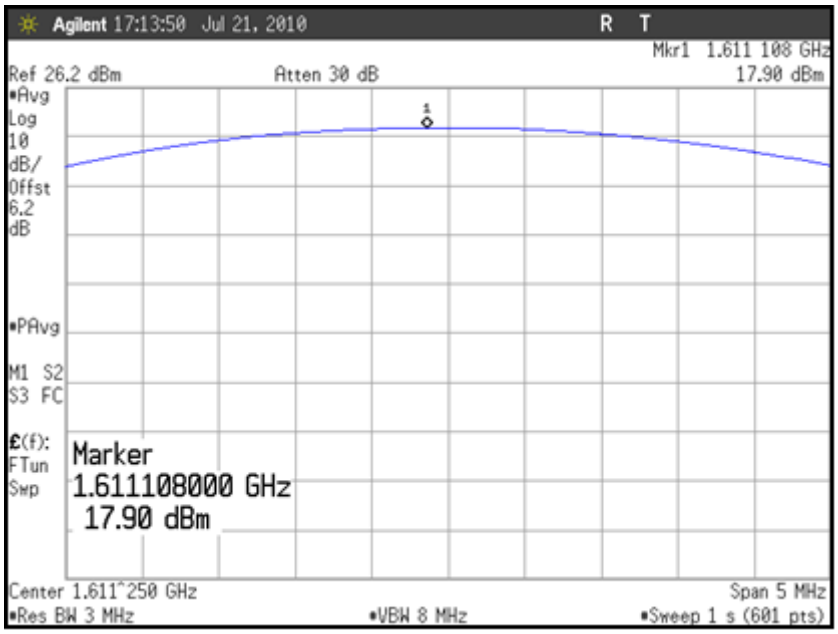


Figure 10: Peak RMS Power, Channel A @ 1611.25 MHz

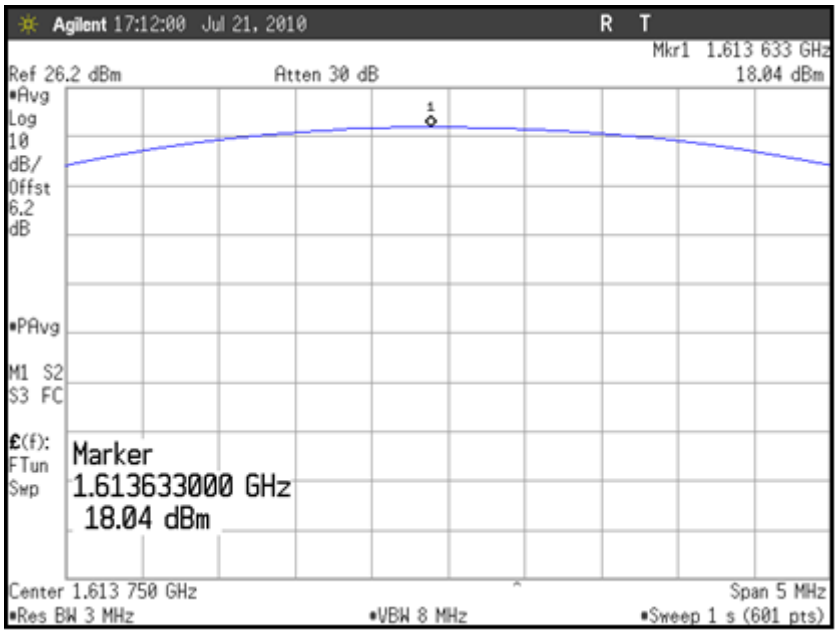


Figure 11: Peak RMS Power, Channel B @ 1613.75 MHz

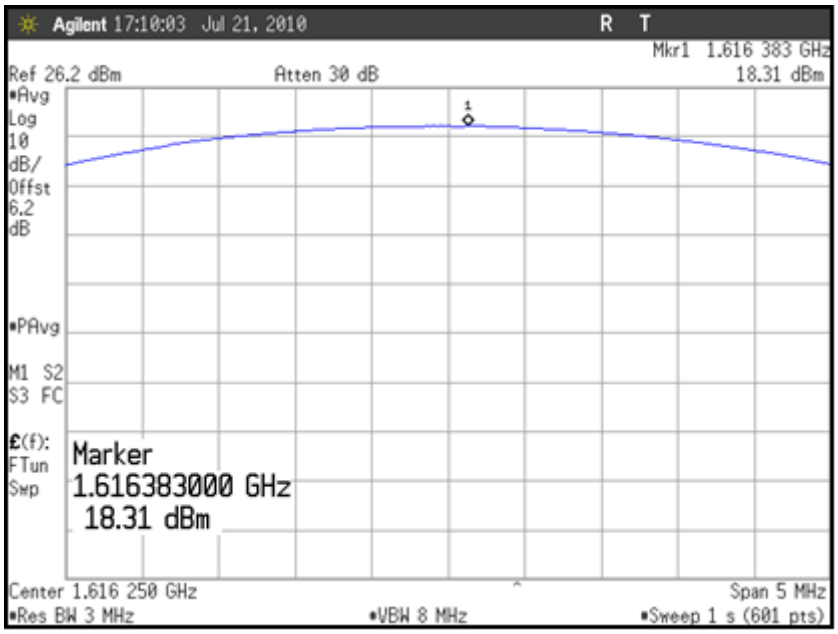


Figure 12: Peak RMS Power, Channel C @ 1616.25 MHz

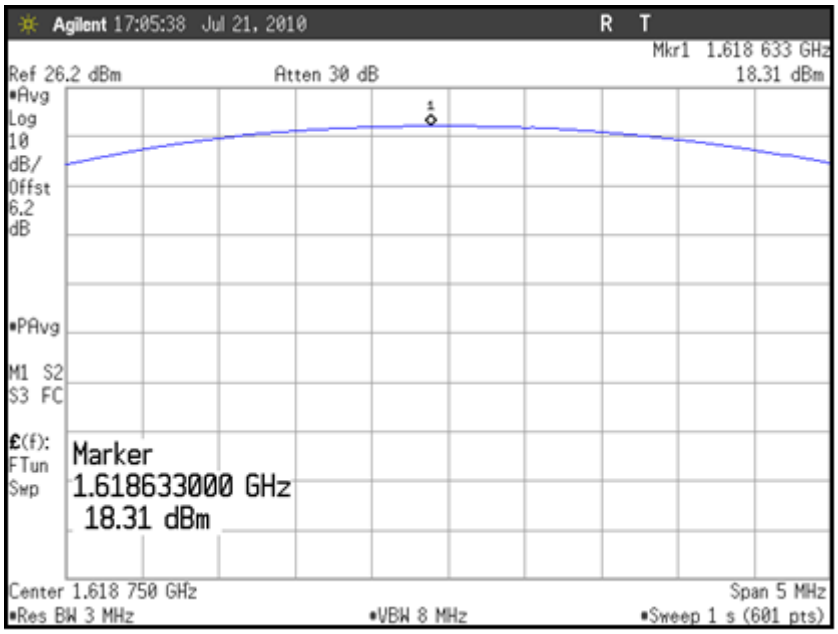


Figure 13: Peak RMS Power, Channel D @ 1618.75 MHz

4.2 20dB Occupied Bandwidth

Occupied bandwidth (20dB) was performed by coupling the output of the EUT antenna port to the input of a spectrum analyzer.

Table 7: 20dB Occupied Bandwidth Results

Frequency	Bandwidth	Bandwidth (Previously Measured)
Channel A 1611.25 MHz	2.161MHz	2.175MHz
Channel B 1613.75 MHz	2.148MHz	2.173MHz
Channel C 1616.25 MHz	2.150MHz	2.174MHz
Channel D 1618.75 MHz	2.147MHz	2.177MHz

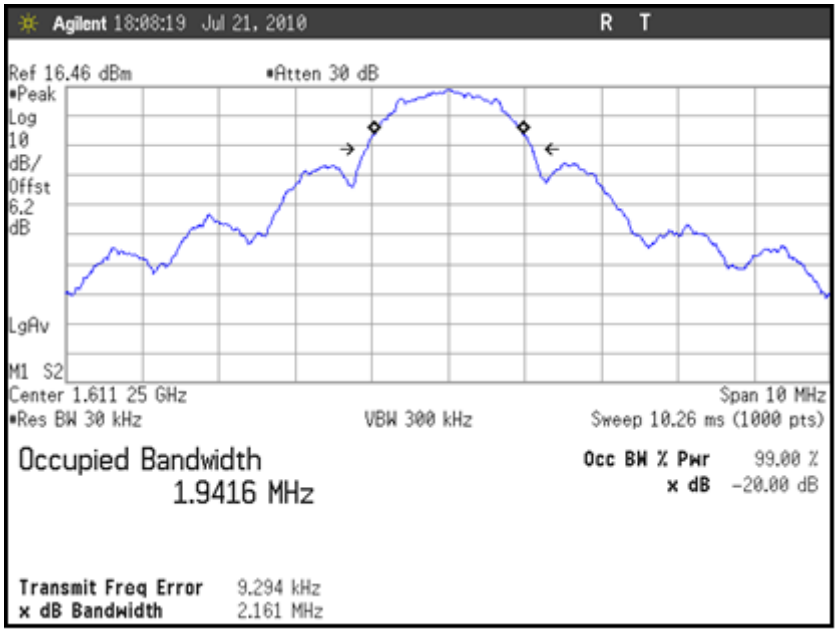


Figure 14: Occupied Bandwidth, Channel A @ 1611.25MHz

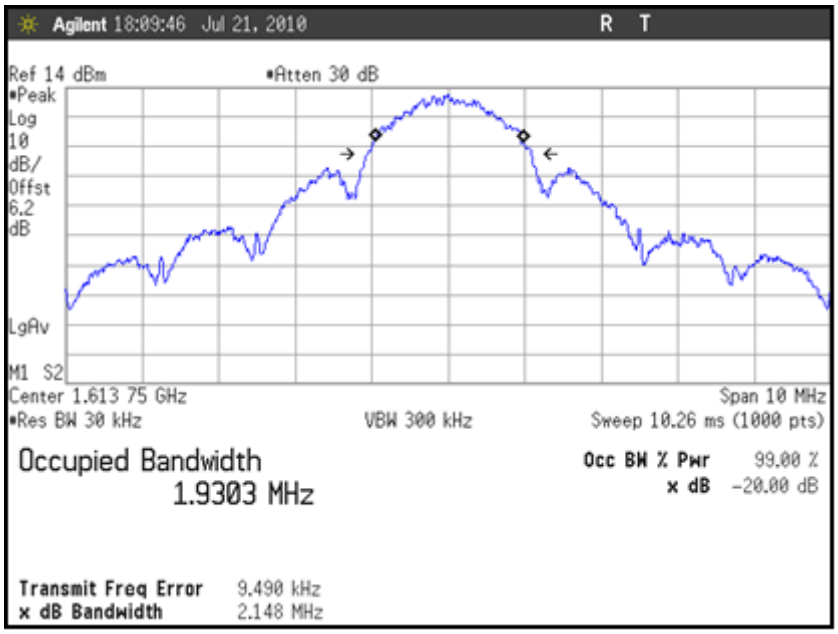


Figure 15: Occupied Bandwidth, Channel B @ 1613.75MHz

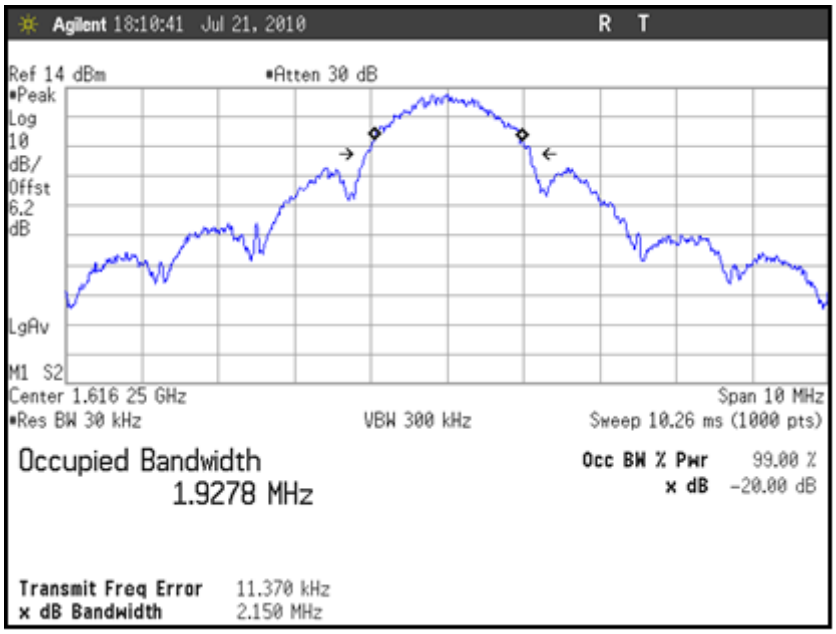


Figure 16: Occupied Bandwidth, Channel C @ 1616.25MHz

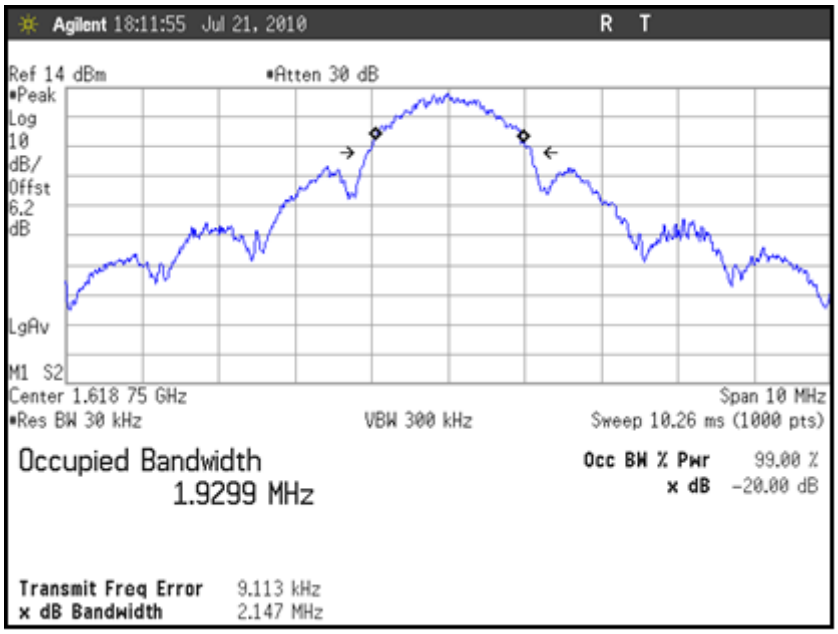


Figure 17: Occupied Bandwidth, Channel D @ 1618.75MHz

4.3 Authorized Bandwidth

The authorized bandwidth was declared by the manufacturer as 2.5MHz. This value includes the necessary spectral components of the transmission signal.

4.4 Conducted Spurious Emission Limitations per FCC Part 25.202(f)

Spurious emissions must comply with the requirements of §25.202 (f) of FCC. The limits for the spurious emissions for FCC Part 25 are as follows:

FCC Part 25.202(f):

Spurious emissions must comply with the requirements of §25.202(f). The limits for the spurious emissions are as follows:

The mean power of emissions shall be attenuated below the mean output power of the transmitter in accordance with the following schedule:

(1) In any 4 kHz band, the center frequency of which is removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: 25 dB;

(2) In any 4 kHz band, the center frequency of which is removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth: 35 dB;

(3) In any 4 kHz band, the center frequency of which is removed from the assigned frequency by more than 250 percent of the authorized bandwidth: An amount equal to 43 dB plus 10 times the logarithm (to the base 10) of the transmitter power in watts.

4.4.1 Test Procedure

For the FCC Part 25 requirements the unit was set to transmit at 1613.75MHz and the emissions were measured at the antenna port from 30MHz to the tenth Harmonic of the transmit frequency and compared to the emission mask specified in FCC Part 25.202(f). The authorized bandwidth used in the calculations for the limit was 2.5MHz. For signals located outside of 250 percent away from the authorized bandwidth a larger RBW was used as this would present a worst case reading, any signals in this range within 6dB of the limit was investigated at the 4kHz required bandwidth.

Channel B @ 1613.25MHz was investigated for compliance with this section.

4.4.2 Test Results

The EUT complies with the emissions mask requirements FCC Part 25.202(f). Figure 18 through Figure 24 show the plots of the emissions mask for FCC Part 25.202(f).

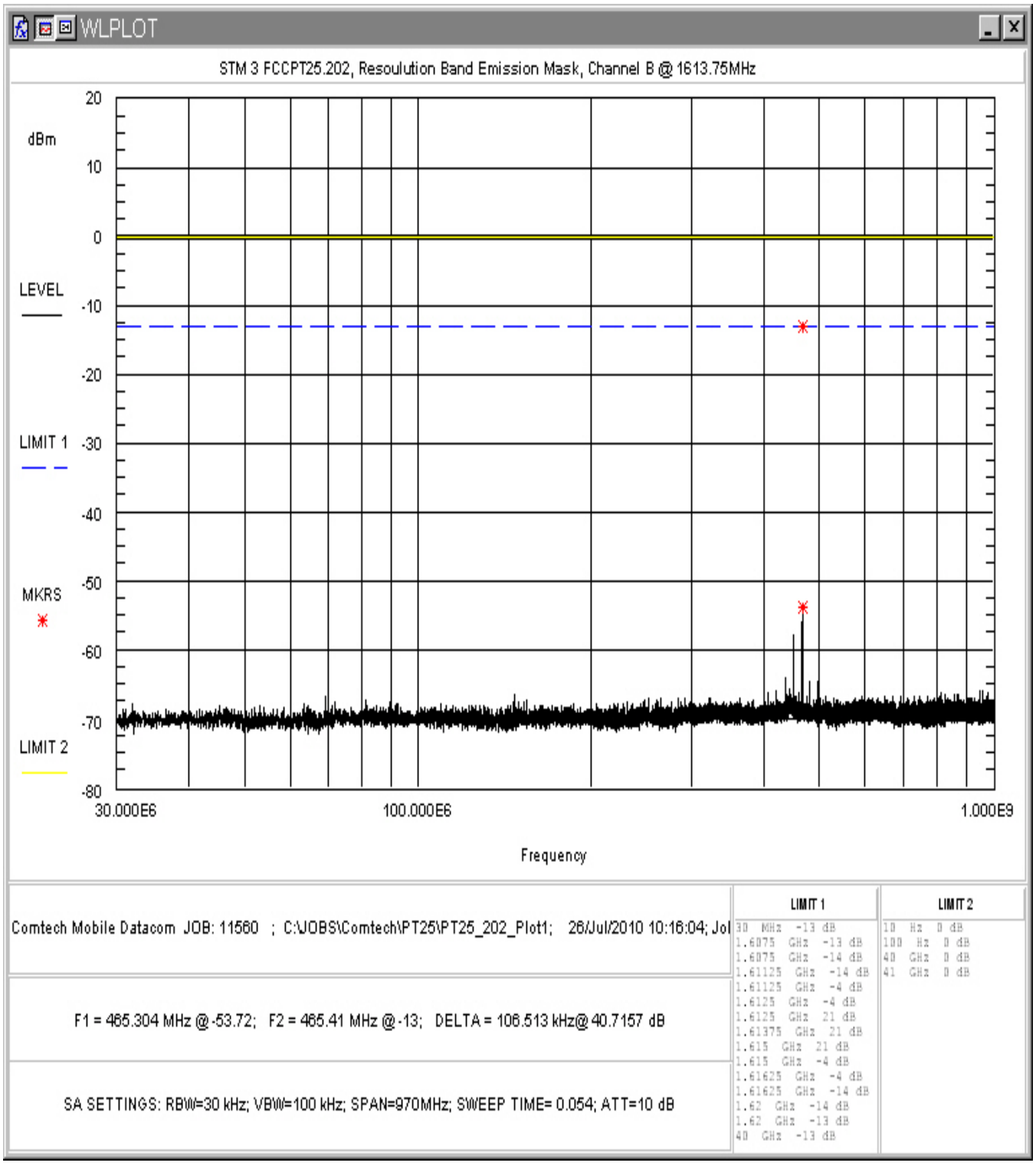


Figure 18: Conducted Spurious Emissions Data, 30 -1000 MHz

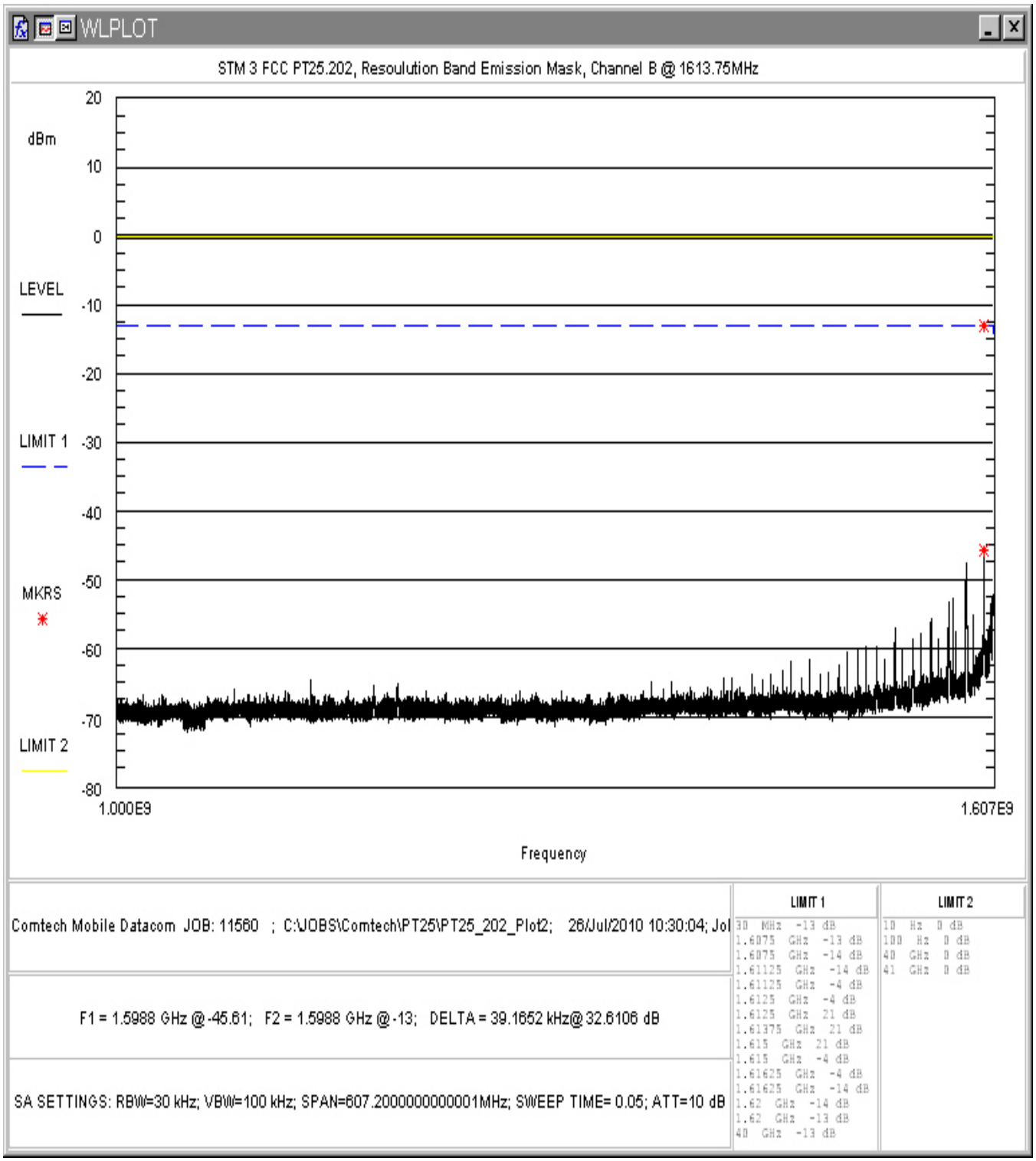


Figure 19: Conducted Spurious Emissions Data 1000 -1607.2 MHz

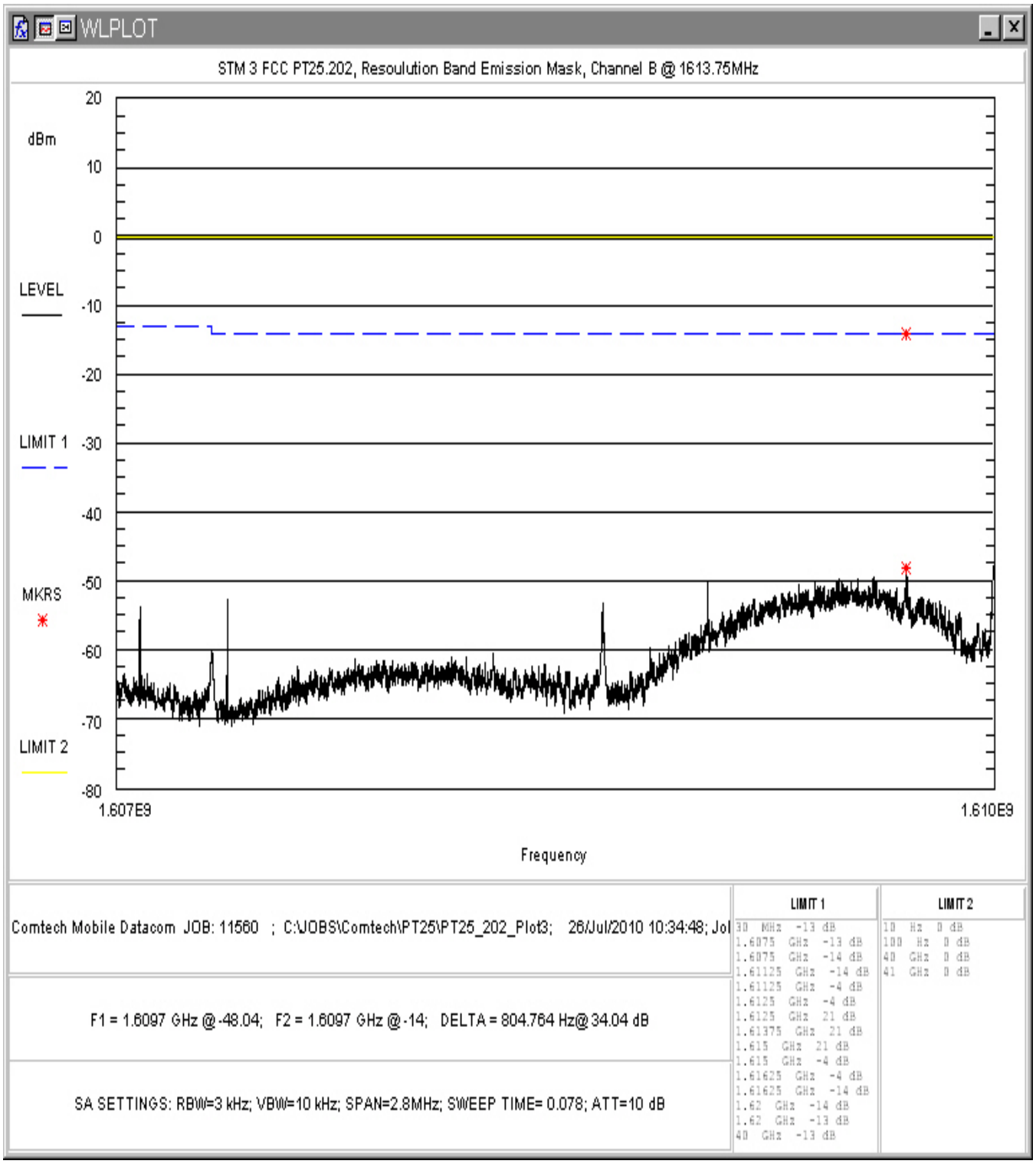


Figure 20: Conducted Spurious Emissions Data, 1.6072 – 1.610 GHz

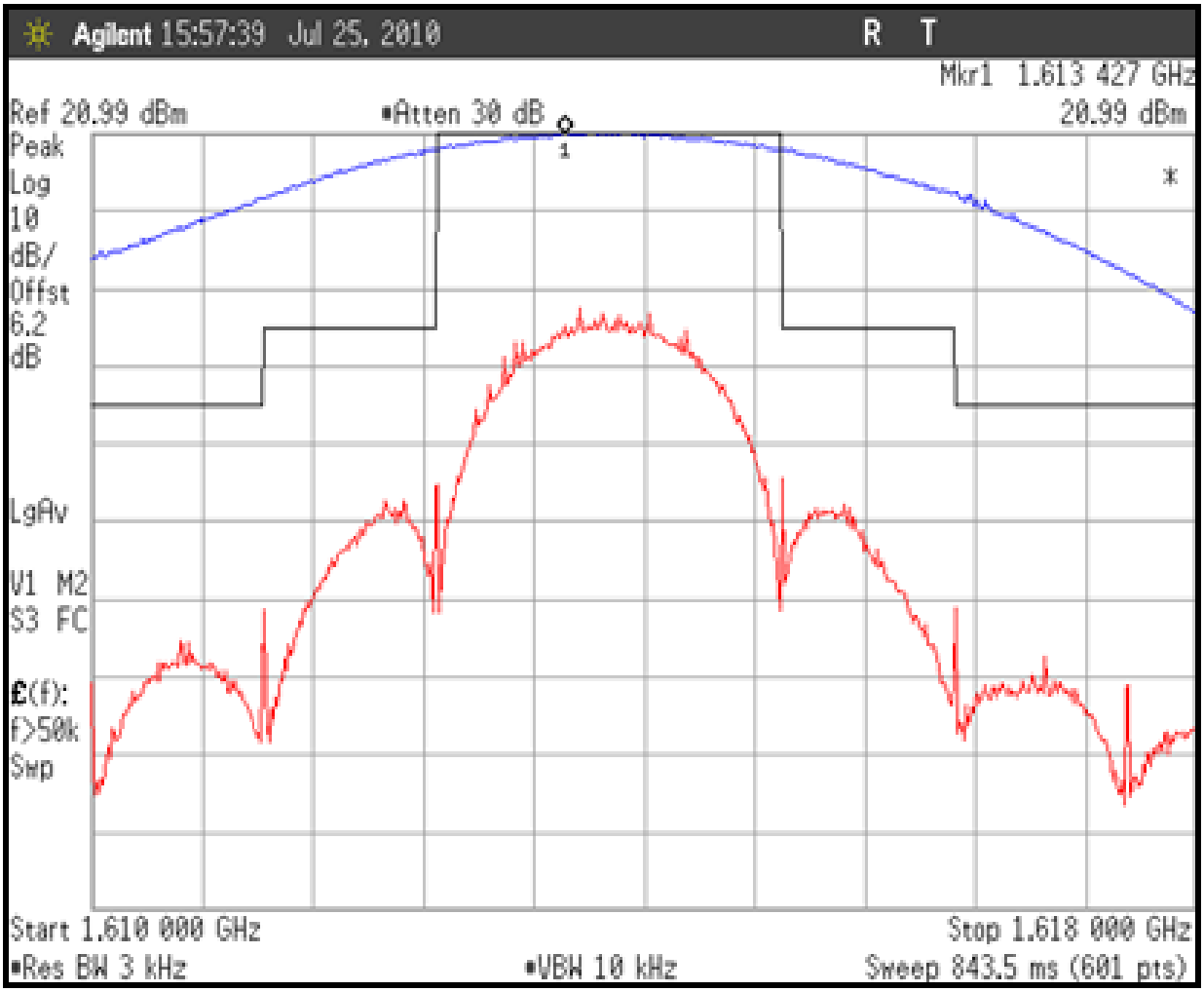


Figure 21: Conducted Spurious Emissions Data, 1.610-1.618GHz

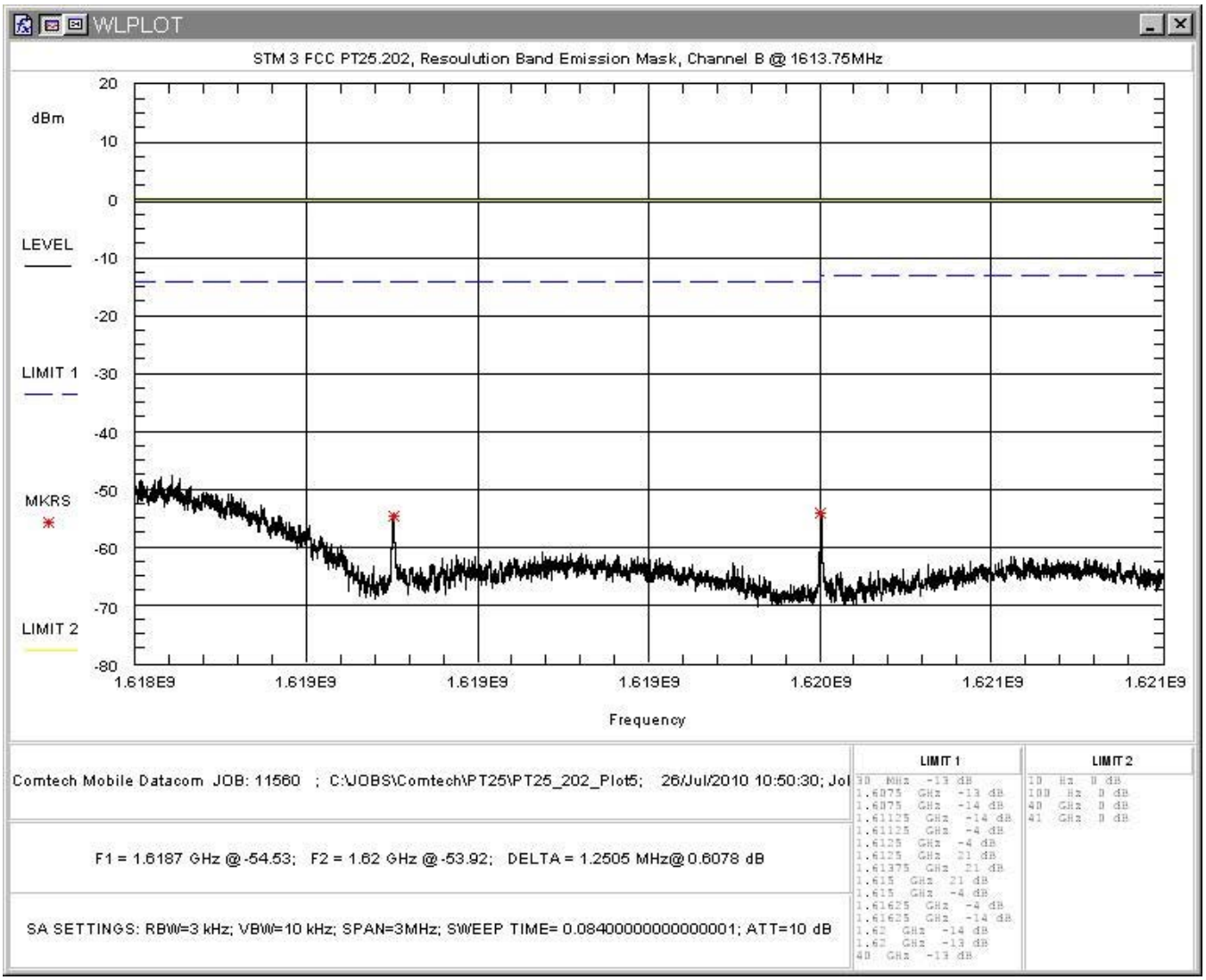


Figure 22: Conducted Spurious Emissions Data, 1.618 – 1.621GHz

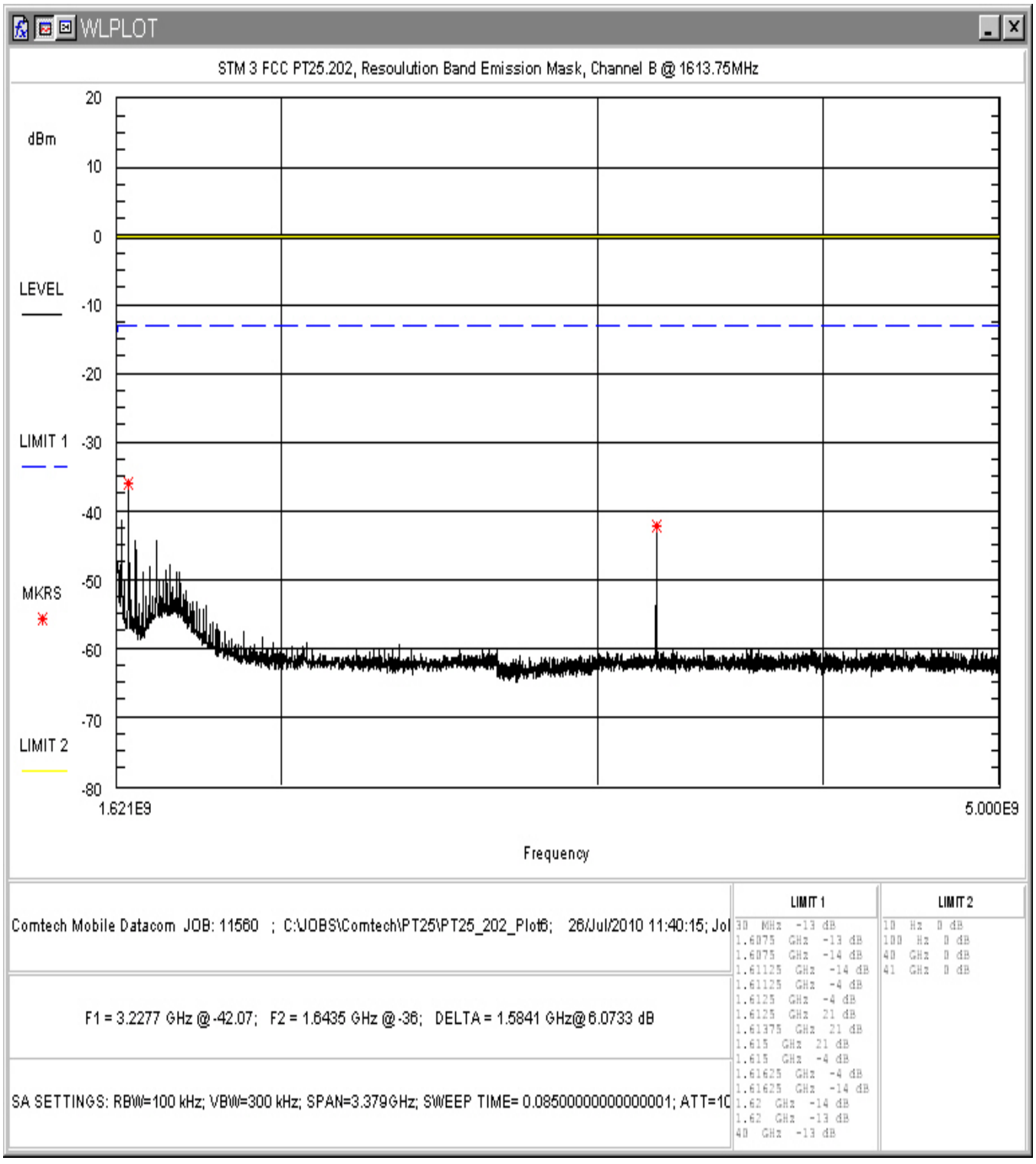


Figure 23: Conducted Spurious Emissions Data, 1.621 – 5GHz

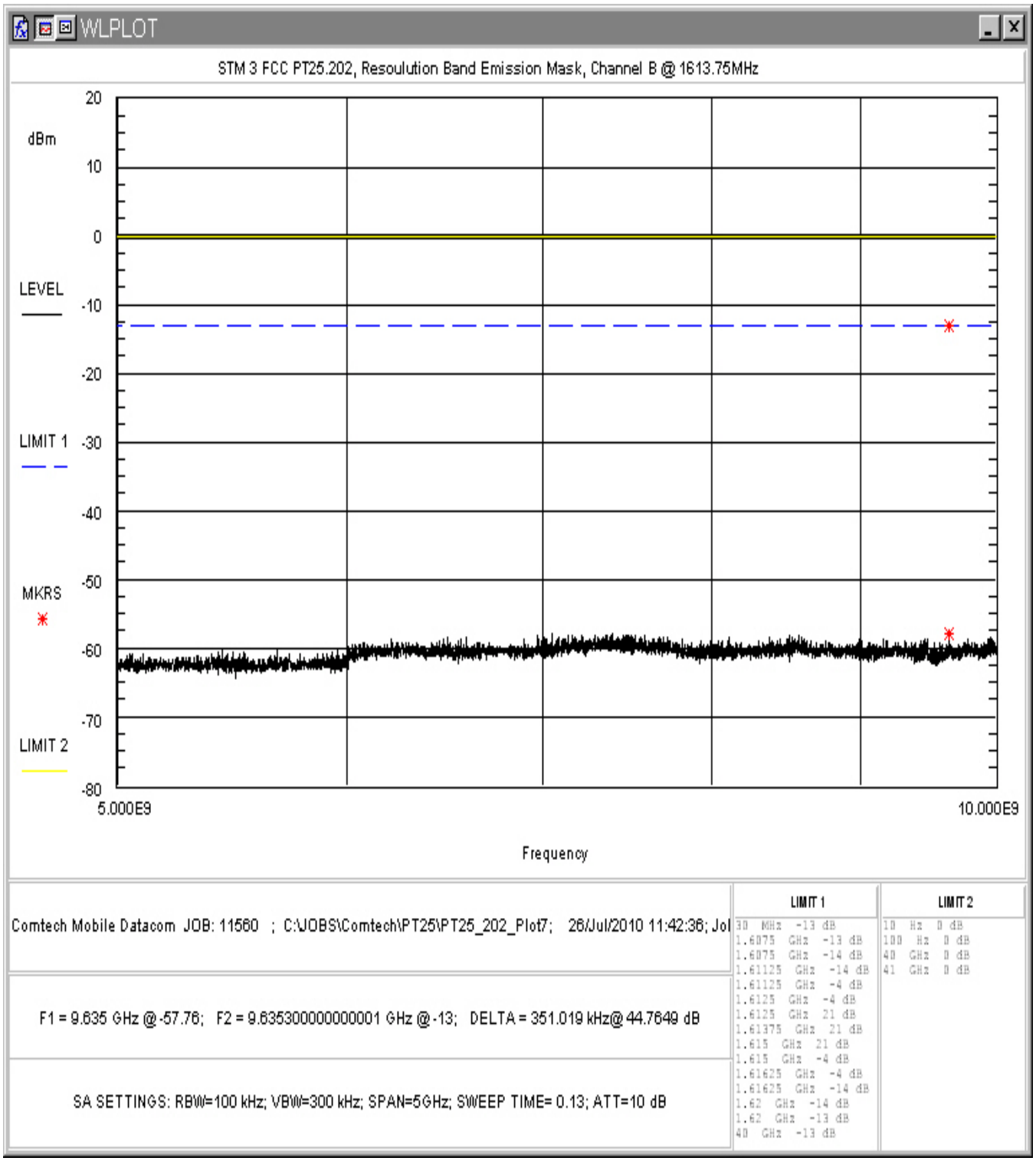


Figure 24: Conducted Spurious Emissions Data, 5 – 10GHz

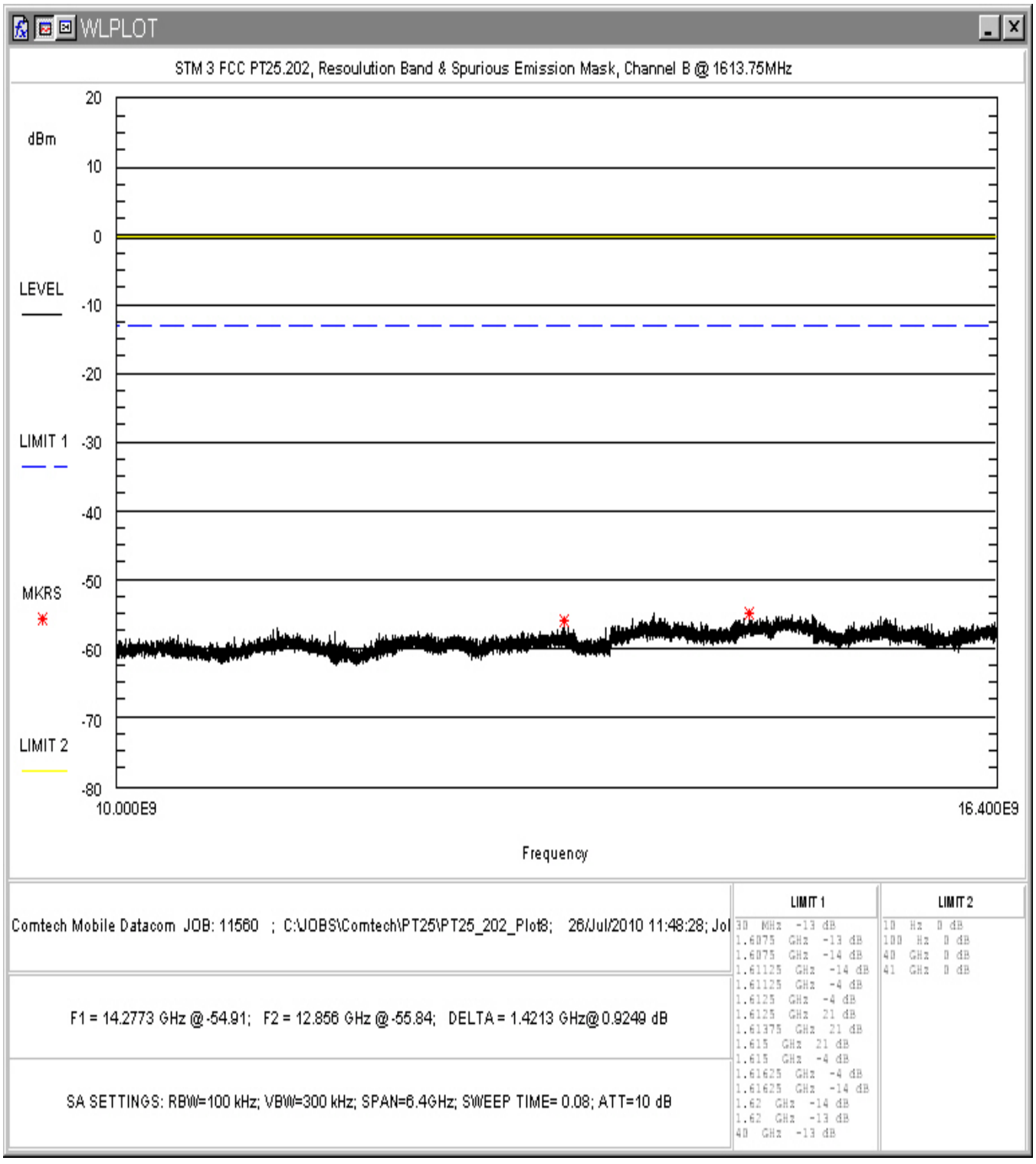


Figure 25: Conducted Spurious Emissions Data, 10 – 16.14GHz

4.5 Radiated Spurious Emissions: EIRP Data (FCC §25.202(f))

Case radiated spurious emissions must comply with the requirements of §25.202 (f) of FCC. The limits for the spurious emissions are as follows:

FCC Part 25.202(f):

Radiated spurious emissions must comply with the requirements of §25.202(f). The limits for the spurious emissions are as follows:

The mean power of emissions shall be attenuated below the mean output power of the transmitter in accordance with the following schedule:

(1) In any 4 kHz band, the center frequency of which is removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: 25 dB;

(2) In any 4 kHz band, the center frequency of which is removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth: 35 dB;

(3) In any 4 kHz band, the center frequency of which is removed from the assigned frequency by more than 250 percent of the authorized bandwidth: An amount equal to 43 dB plus 10 times the logarithm (to the base 10) of the transmitter power in watts;

Based on the power measured, the limit for emissions removed from the center frequency by more than 250% of the authorized bandwidth will be:

$$\text{Limit (dBm)} = 20.99(\text{dBm}) - (43 + 10\text{Log}(.125\text{W})) = -13\text{dBm}$$

This section covers emissions detected at more than 250% removed from the authorized bandwidth.

4.5.1 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. The peripherals were placed on the table in accordance with ANSI C63.4-2003. Cables were varied in position to produce maximum emissions. Both the horizontal and vertical field components were measured.

Where emissions were detected, the EIRP levels were determined using the method of signal substitution. The unit was verified in 3 orthogonals with the worst case displayed.

4.5.2 Test Results

The frequency range of 30 MHz to 16.5 GHz was measured and the data presented below. The EUT complied with this limit.

Table 8: Below 1GHz Radiated Emissions

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)
60.51	V	45.0	1.0	7.3	-78.6	-79.0	10.1	-4.3	-83.2	-13	-70.2
64.51	V	180.0	1.1	9.2	-75.0	-75.4	8.6	-2.2	-77.6	-13	-64.6
74.98	V	90.0	1.1	8.5	-79.7	-80.2	6.6	1.1	-79.1	-13	-66.1
84.44	V	90.0	1.3	6.0	-82.3	-82.8	7.0	1.8	-81.1	-13	-68.1
112.37	V	50.0	1.7	7.0	-78.5	-79.2	10.7	0.5	-78.7	-13	-65.7
180.96	V	180.0	1.0	10.2	-74.4	-75.3	9.5	5.9	-69.4	-13	-56.4
224.53	V	200.0	1.3	8.6	-75.6	-76.7	12.1	5.2	-71.5	-13	-58.5
255.00	V	0.0	2.2	10.0	-75.0	-76.1	12.5	5.8	-70.3	-13	-57.3
449.98	V	0.0	1.9	10.0	-70.4	-71.8	15.9	7.4	-64.4	-13	-51.4
509.97	V	45.0	2.5	12.2	-62.6	-64.1	17.0	7.4	-56.7	-13	-43.7
764.98	V	180.0	2.6	4.9	-71.6	-73.3	20.8	7.1	-66.2	-13	-53.2
794.98	V	0.0	1.4	3.3	-72.3	-74.0	20.3	7.9	-66.1	-13	-53.1
62.10	H	330.0	3.8	5.0	-79.3	-79.7	9.5	-3.4	-83.1	-13	-70.1
64.51	H	20.0	4.0	7.2	-78.1	-78.5	8.6	-2.2	-80.7	-13	-67.7
74.98	H	190.0	3.9	6.7	-80.0	-80.5	6.6	1.1	-79.4	-13	-66.4
112.37	H	90.0	3.7	3.7	-77.8	-78.5	10.7	0.5	-78.0	-13	-65.0
224.53	H	170.0	2.8	3.5	-80.1	-81.2	12.1	5.2	-76.0	-13	-63.0
255.00	H	200.0	2.4	11.3	-74.4	-75.5	12.5	5.8	-69.7	-13	-56.7
449.98	H	45.0	2.2	11.7	-68.8	-70.2	15.9	7.4	-62.8	-13	-49.8
509.97	H	190.0	2.0	14.9	-66.3	-67.8	17.0	7.4	-60.4	-13	-47.4
764.98	H	180.0	1.5	4.1	-73.5	-75.2	20.8	7.1	-68.1	-13	-55.1
794.98	H	0.0	1.7	6.0	-70.0	-71.7	20.3	7.9	-63.8	-13	-50.8

Table 9: Above 1GHz Radiated Emissions

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)
1050.00	H	10.0	3.0	47.2	-60.0	-62.1	24.7	5.9	-56.2	-13	-43.2
1080.25	H	350.0	3.1	45.7	-64.0	-66.0	25.0	5.9	-60.1	-13	-47.1
1125.13	H	45.0	3.2	48.7	-60.0	-62.0	25.4	5.9	-56.1	-13	-43.1
1140.00	H	90.0	3.2	49.9	-61.0	-63.0	25.5	5.9	-57.2	-13	-44.2
1155.15	H	270.0	3.2	49.3	-62.5	-64.7	25.6	5.9	-58.8	-13	-45.8
1170.05	H	270.0	3.1	49.2	-66.0	-68.2	25.7	5.8	-62.3	-13	-49.3
1613.75	H	0.0	3.1	90.2	-15.5	-17.8	28.7	5.7	-12.2	NA	Fundamental
3227.50	H	90.0	3.4	51.8	-47.5	-52.0	35.6	4.8	-47.2	-13	-34.2
4841.25	H	165.0	3.4	50.8	-42.5	-49.3	36.7	7.2	-42.1	-13	-29.1
6455.00	H	190.0	3.2	51.8	-39.0	-44.3	39.2	7.2	-37.1	-13	-24.1
1050.00	V	0.0	2.9	48.1	-58.5	-60.6	24.7	5.9	-54.7	-13	-41.7
1080.25	V	45.0	3.0	49.1	-60.0	-62.0	25.0	5.9	-56.1	-13	-43.1
1140.00	V	20.0	2.9	49.2	-58.0	-60.0	25.5	5.9	-54.2	-13	-41.2
1155.15	V	45.0	2.9	48.2	-59.5	-61.7	25.6	5.9	-55.8	-13	-42.8
1170.05	V	60.0	2.8	47.7	-59.0	-61.2	25.7	5.8	-55.3	-13	-42.3
1613.75	V	45.0	3.2	97.1	-10.0	-12.3	28.7	5.7	-6.7	NA	Fundamental
3227.50	V	350.0	3.1	55.8	-40.5	-45.0	35.6	4.8	-40.2	-13	-27.2
4841.25	V	340.0	3.0	54.1	-40.0	-46.8	36.7	7.2	-39.6	-13	-26.6
6455.00	V	270.0	3.2	51.4	-39.5	-44.8	39.2	7.2	-37.6	-13	-24.6

4.6 Spurious Emissions per FCC §25.216

FCC Part 25 limits the emissions from mobile earth stations for the protection of aeronautical radio navigation-satellite service. The EIRP density of spurious emissions which fall within the frequency range of 1559M to 1610MHz were measured in accordance with §25.216.

In accordance with §25.216(c) the EIRP density of emissions from mobile earth stations operating between 1610MHz and 1660.5MHz shall not exceed -70dBW/MHz, averaged over any 2ms active transmission interval, in the band 1559M – 1605MHz. The EIRP of discrete emissions of less than 700Hz bandwidth from such stations shall not exceed -80 dBW, averaged over any 2ms active transmission interval, in the 1559M – 1605MHz band.

In accordance with §25.216(f) Mobile earth stations placed in service after July 21, 2002 with assigned uplink frequencies in the 1610–1660.5 MHz band shall suppress the power density of emissions in the 1605–1610 MHz band to an extent determined by linear interpolation from -70 dBW/MHz at 1605 MHz to -10 dBW/MHz at 1610 MHz

In accordance with §25.216(i) the peak e.i.r.p density of carrier-off state emissions from mobile earth stations manufactured more than six months after Federal Register publication of the rule changes adopted in FCC 03–283 with assigned uplink frequencies between 1 and 3 GHz shall not exceed -80 dBW/MHz in the 1559– 1610 MHz band averaged over any 2 millisecond active transmission interval.

4.6.1 Test Procedure

The output of the EUT was connected to the input of measurement receiver with a RMS detector and the capability of performing the measurements as specified in §25.216. The following was used to calculate the limit and the corrected emissions levels for obtaining the plots shown in Figure 26 through Figure 31.

For emissions from 1559M – 1605MHz: Limit = -70dBW/MHz = -40dBm/MHz

For discrete emissions with bandwidths less than 700Hz from 1559M – 1605MHz: Limit = -80dBW = -50dBm

For emissions from 1605M – 1610MHz: Limit = -70dBW/MHz (-40dBm/MHz) to -10dBW/MHz (20dBm/MHz)

For discrete emissions with bandwidths less than 700Hz from 1605M – 1610MHz: Limit = -80dBW/MHz (-50dBm/MHz) to -20dBW/MHz (10dBm/MHz)

For emissions in the Carrier –Off State from 1559M – 1610MHz: Limit = -80dBW/MHz (-50dBm/MHz)

The receiver emissions levels were adjusted for correction factors as follows:

Emission Level = RXL + ATT+CBL+ANT
Where: RXL = Raw received level
ATT = Attenuator = 5.6dB
CBL = Cable loss = 0.6
ANT= Spectrum Control PA25-1615-025SA 5dB Patch Antenna

These correction factors were entered into the receiver as an offset; he plots display corrected data for comparison to the limit.

4.6.2 Test Results

The following plots show the maximum emissions detected with the band of 1559M – 1610MHz in both a Carrier on and Carrier off mode. No Spurs observed had a bandwidth of less than 700Hz.

In order to show compliance with the discrete signal limit the analyzer resolution bandwidth was reduced to 3kHz and compared to the discrete limit. The EUT complied with this standard.

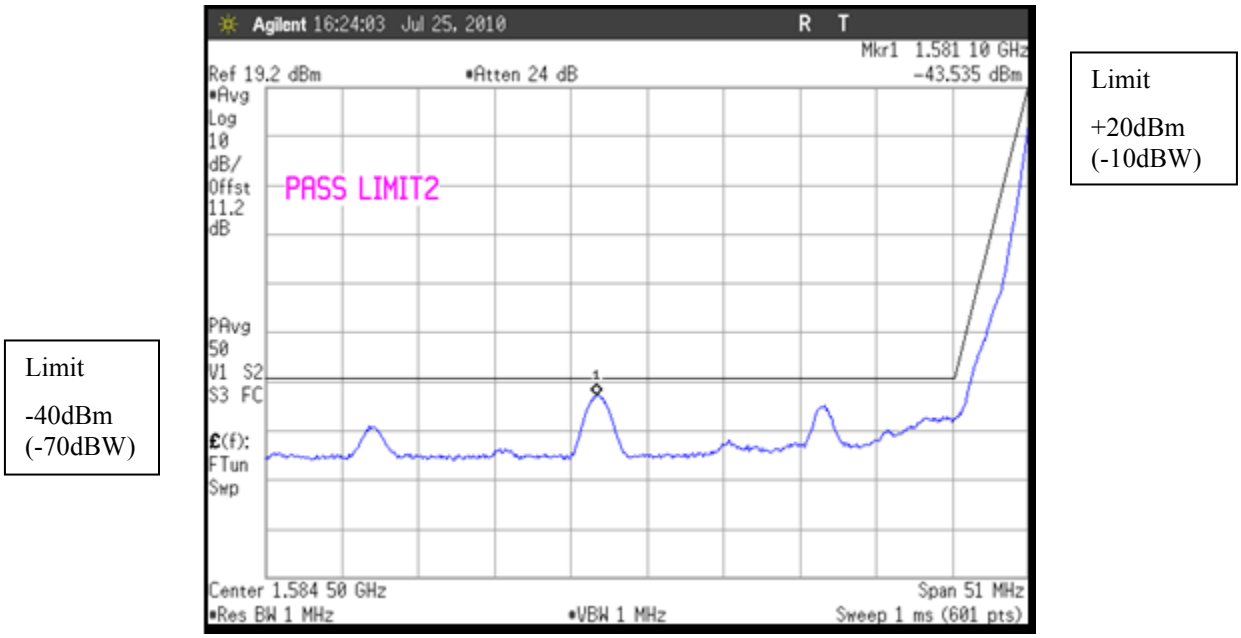


Figure 26: GPS Band Emissions Channel A @1611.25MHz, 1559 – 1610MHz

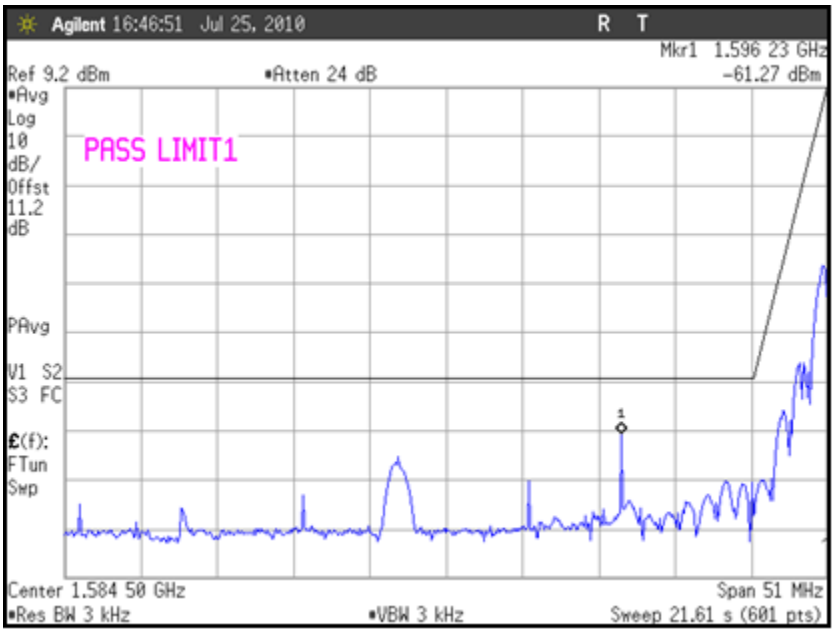


Figure 27: GPS Band, Channel A, reduced bandwidth showing compliance with discrete limits

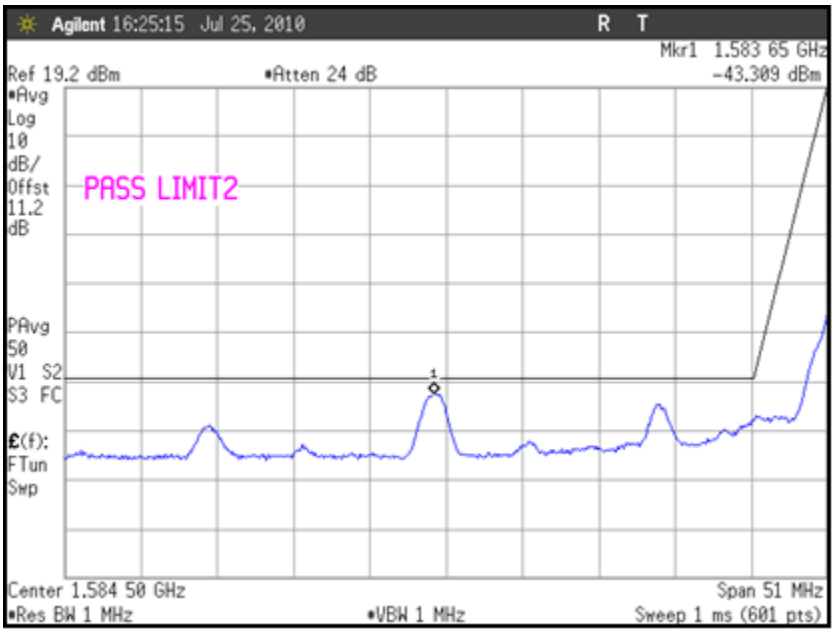


Figure 28: GPS Band Emissions, Channel B @1613.75, 1559 – 1610MHz

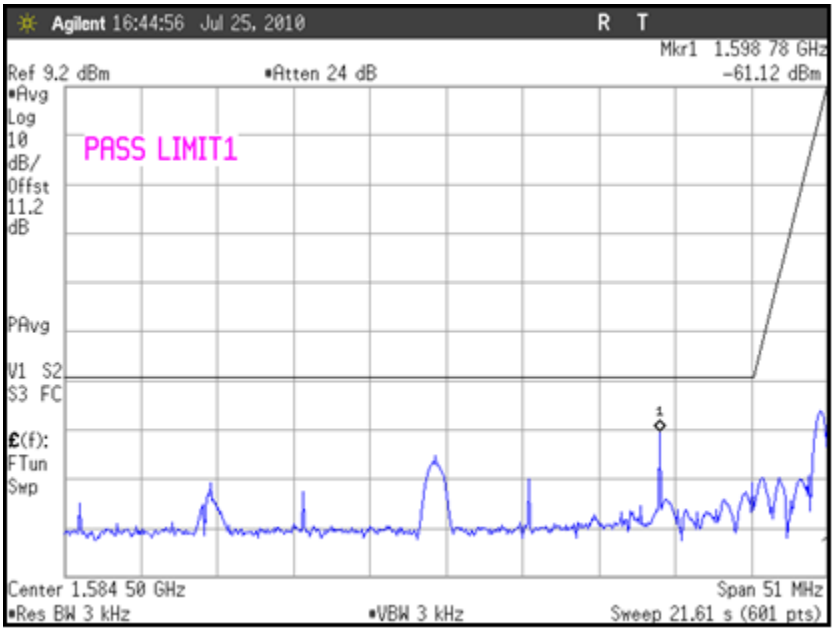


Figure 29: GPS Band, Channel B, reduced bandwidth showing compliance with discrete limits

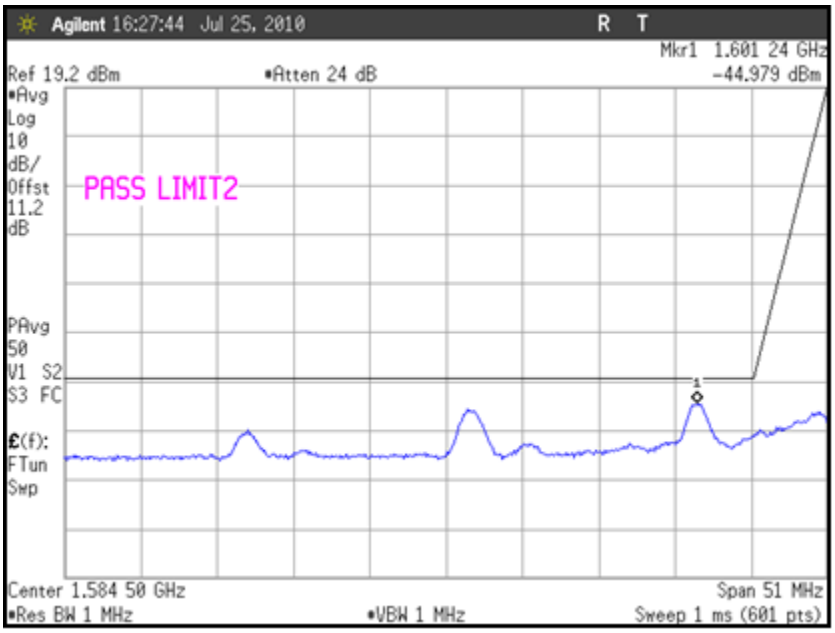


Figure 30: GPS Band Emissions, Channel C @ 1616.25MHz, 1559 – 1610MHz

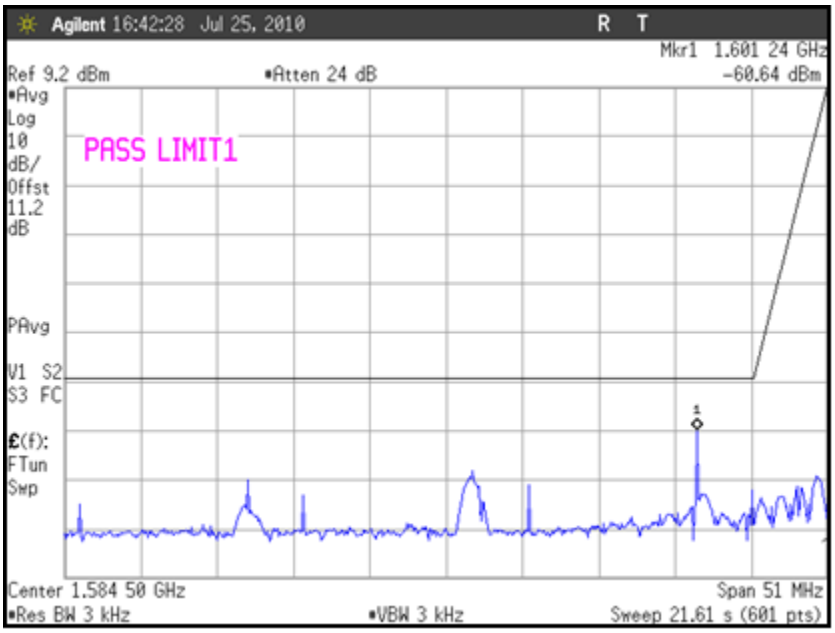


Figure 31: GPS Band, Channel C, reduced bandwidth showing compliance with discrete limits

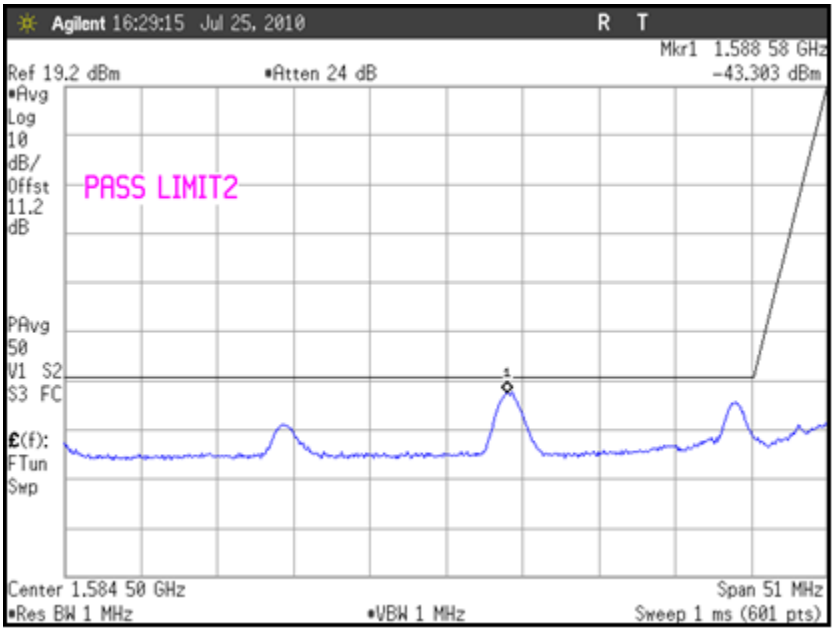
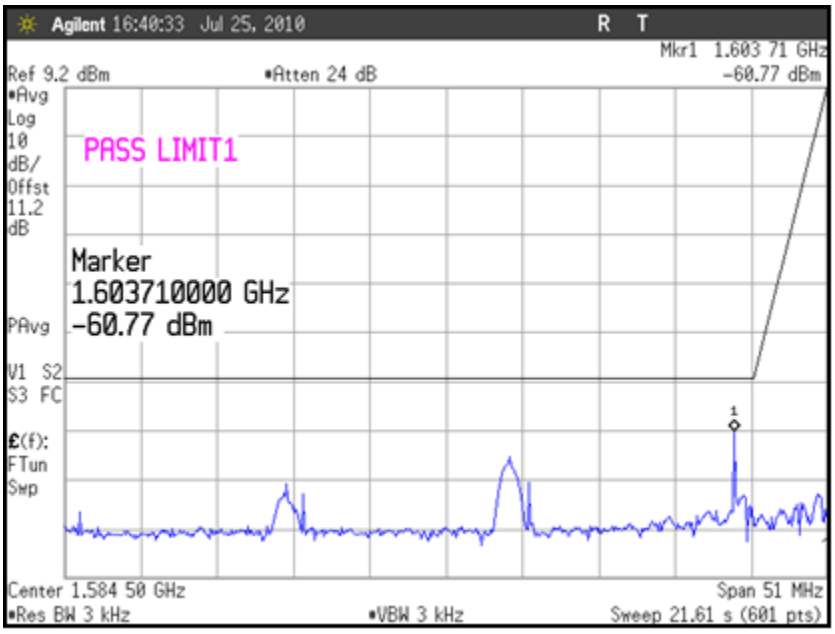


Figure 32: GPS Band Emissions, Channel D @ 1618.75MHz, 1559 – 1610MHz

Limit

-50dBm
(-80dBW)



Limit

+10dBm
(-20dBW)

Figure 33: GPS Band, Channel D, reduced bandwidth showing compliance with discrete limits

4.7 Frequency Stability: (FCC Part §2.1055)

Frequency as a function of temperature and voltage variation shall be maintained within the FCC-prescribed tolerances. Per §25.202(d) the frequency tolerance shall be maintained within 0.001% of the reference frequency.

Note: The STM3 Transmitter Module is required to receive a regulated 3.3VDC (-/+5%) from its host unit. Since the power is regulated and the voltage tolerance minimal the frequency stability test was performed for temperature only and without voltage variations

4.7.1 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.

The frequency stabilities can be maintained to a lesser temperature range provided that the transmitter is automatically inhibited from operating outside the lesser temperature range.

The RF carrier frequency shall not depart from the reference frequency (reference frequency is the frequency at 20ºC and rated supply voltage) in excess of 0.001% (16425Hz)

The unit was tested on Channel A transmitting at 1611.25MHz.

4.7.2 Test Results

The EUT complies with the temperature stability requirements of FCC §25.202. Test results are given in Table 10.

Table 10: Frequency Stability Test Data

Temperature (Centigrade)	Frequency (MHz)	Difference (Hz)	Deviation (%) FCC Part 25
Ambient (20C)	1611.252930	0.0	0
-30	1611.253770	840.0	0.000052
-20	1611.252830	-100.0	0.000006
-10	1611.252900	-30.0	0.000002
0	1611.252230	-700.0	0.000043
10	1611.252530	-400.0	0.000025
20	1611.252930	0.0	0.000000
30	1611.252530	-400.0	0.000025
40	1611.252200	-730.0	0.000045
50	1611.252400	-530.0	0.000033