Certification Application for FCC ID OZFN22001

EMI Test Report for the Tantalus TUNet NC-2200 Network Controller.

Prepared by:

Tantalus Systems Corporation

100-2955 Virtual Way

Vancouver, BC Canada

V5M 4X6

Document number 960-0004-FCC02

Version 2.0

Table of Contents

1 OBJECTIVE 3

1.1 General Information 3

2 VERIFICATION OF COMPLIANCE 4

3 GENERAL INFORMATION 5

4 RESULTS SUMMARY 6

5 TEST EQUIPMENT LIST 7

5.1 Measurement Uncertainty for Conducted Measurements 7

5.2 Measurement Uncertainty for Power Measurements 8

6 TEST RESULTS 9

6.1 RF Output Power 9

6.2 Occupied Bandwidth 10

6.3 Frequency Stability Over Temperature 13

6.4 Frequency Stability Over Variation In Primary Supply Voltage 25

6.5 Conducted Spurious Emissions At Antenna Terminal 29

REVISION HISTORY 31

APPENDIX A PROTOCOL EMC TEST REPORT 32

1 Objective

The purpose of this document is to present measured data and technical documentation that demonstrates compliance to the requirements listed in Part 15 of the FCC Rules and Regulations.

1.1 General Information

The TUNet NC2200 Network Controller is the heart of the TUNet 220 MHz Wide Area Network. It controls all radio communications over the 220 MHz WAN. The TUNet NC2200 is an intelligent router that receives and buffers upstream messages from 220 MHz WAN Portals and forwards these to the TUNet NS2000 Network Server. Similarly, it also receives downstream messages from the TUNet NS2000 Network Server and transmits these over the 220 MHz WAN to the appropriate endpoint(s). The TUNet NC2200 will have sufficient transmit power and receive sensitivity to communicate with TUNet 3205 WAN Portals within a radius of 20 miles.

The TUNet NC2200 Network Controller communicates over the narrowband 5kHz channel spacing channels allocated in the 220 MHz to 222 MHz frequency band.

The TUNet NC2200 Network Controller is designed to work in conjunction with the TUNet NS2000 Network Server. Messages are received from the 220 MHz WAN and forwarded to the Network Server and vice versa. The TUNet NC2200 assumes a full-time TCP/IP link of sufficient bandwidth to handle the volume of messages received/sent (19,200 baud, full duplex for each active 220 MHz channel). It is acknowledged that in certain harsh installation environments, this TCP/IP link will not always be available; therefore the TUNet NC2200 must be designed in such a way as to operate autonomously when this link is "down". This means that the TUNet NC2200 will continue to arbitrate communications on the 220 MHz WAN and receive upstream messages until such time as the available storage is exhausted. At this point the TUNet NC2200 will shut down the 220 MHz WAN until the TCP/IP link has been restored.

2 Verification of Compliance

Equipment Under Test:	Tantalus Utility Network Controller
Model Number:	TUNet NC-2200
Serial Number:	00001
Applicant:	Tantalus Systems Corporation. 100-2955 Virtual Way. Vancouver BC, Canada. V5M 4X6.
Tested as Per FCC Rules:	FCC Part 15 FCC Part 90 Subpart I and Subpart T
Date of Tests:	June and July 2004.
Tested By:	Robert De Angelis, Tantalus Systems Corporation. Robert Stirling, Protocol Labs.

The above equipment was tested by Tantalus Systems Corporation and Protocol Labs and is in compliance with the requirements in Part 15 and Part 90 of the FCC Rules and Regulations.

Robert De Angelis

Product Development

Tantalus Systems Corporation

3 General Information

Applicant:	Tantalus Systems Corporation. 100-2955 Virtual Way. Vancouver BC, Canada. V5M 4X6
Contact:	Robert De Angelis
Phone:	604-299-0458
Fax:	604-451-4111
Equipment Under Test:	Tantalus Utility Network Controller.
Model Number:	TUNet NC-2200
Serial Number:	00001
Manufacturer:	Tantalus Systems Corporation.
Emissions Designator:	F1D
FCC ID:	OZFN22001

All power line conducted and radiated emission measurements are conducted at the approved test facility mentioned below:

Test Facility:	Protocol Labs 28945 McTavish Road. Abbotsford BC, Canada V4X 2E7 FCC Registration Number 96437 Industry Canada Registration Number IC3384
Contact:	Robert Stirling
Phone:	604-607-0012
Fax:	604-607-0019

4 Results Summary

The following is a summary of the tests and measurements performed to demonstrate compliance.

Test	Standard	Description	Result
RF Output Power	2.1046	The RF output power is measured at the lowest and highest power levels being certified for.	Required Measurement
Occupied Bandwidth	2.1049	The occupied bandwidth is measured and defined as the bandwidth were 99% of the emission power is contained.	Required Measurement
Frequency Stability Over Temperature	2.1055(a)/90.210(f)	The frequency stability is measured over the temperature range of –30 to 50 degrees C and must comply to the emission mask defined in Part 90.210(f)	Complies
Frequency Stability Over Variation in Primary Supply Voltage	2.1055(d)/90.210(f)	The frequency stability is measured over variation in primary supply voltage from 85% to 115% of nominal. The emission must comply to the emission mask defined in part 90.210(f)	Complies
Conducted Spurious Emissions At Antenna Terminal	2.1051/90.210(f)	The conducted spurious emissions at the antenna terminal of the DUT must be less than the limit defined in Part 90.210(f). The level of the spurious emissions with respect to and below the carrier must be 55 + 10log(P)	Complies

5 Test Equipment List

The following is the list of test equipment used for the conducted RF measurements in this report.

Test Site	Test Equipment	Model Number	Serial Number	Last Calibration	Next Calibration.
Tantalus Engineering Lab.	Rubidium Frequency Standard	Stanford Research Systems FS725/1	65279	June 10, 2004	
Tantalus Engineering Lab.	Vector Signal Analyzer	Hewlett Packard 89441A	3416A03552	June 26, 2004	June 26, 2005
Tantalus Engineering Lab.	30 dB Attenuator	Bird Coaxial Attenuator 8323	2156	Purchased July, 2004	
Tantalus Engineering Lab.	Multimeter	Keithly 2002 DMM	0943593	April 29, 2004	
Tantalus Engineering Lab	Temperature Chamber	Burnsco BTHC-3P-3/4-3/4	03-10	April 5, 2004	
Tantalus Engineering Lab	VARIAC	Superior Electric Co. 116B	N/A	Output set with calibrated multimeter	

The test equipment list for the radiated measurements is included in the Protocol EMC test report in appendix A.

5.1 Measurement Uncertainty for Conducted Measurements

The measurement uncertainty is predominantly a result of the frequency response of the 30 dB attenuator listed in the test equipment list. The measurement uncertainty is significantly less than the measured margin of all conducted spurious measurements to their respective allowable conducted limits. The measurement uncertainty for conducted measurements is as follows:

Frequency Range	Measurement Uncertainty
DC to 2 GHz	+/- 1.6 dB
2 GHz to 4 GHz	+/- 2.6 dB
4 GHZ to 10 GHz	Less than +/- 5 dB

5.2 Measurement Uncertainty for Power Measurements

Frequency Range	Measurement Uncertainty
200 MHz to 300 MHz	+/- 0.2 dB

6 Test Results

6.1 RF Output Power

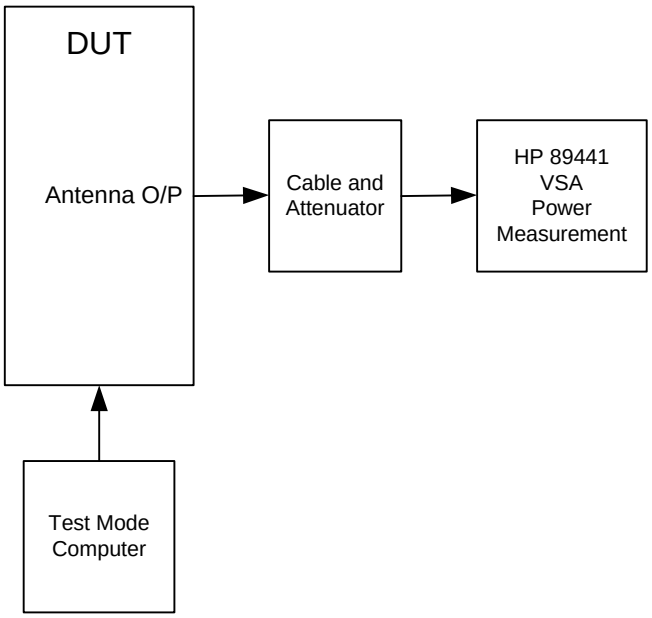
Requirement:

Measured as per the requirement of section 2.1046

Test Procedure:

The output of the transmitter is coupled to the HP 89441A Vector Signal Analyzer through an attenuator and cable that has been precisely measured of its insertion loss with the HP 8735D Network Analyzer. The level is then compared to that of a calibrated signal source of a Rohde and Schwarz SMIQ03B signal generator. The level measured by the Vector Signal Analyzer and the level set by the Signal Generator is within 0.15 dB. The measurements are taken at the lowest and highest channel frequencies and at the lowest and highest power settings.

Test Set Up:



Measurement Data:

Frequency, MHz	Low Power, W	High Power, W
220.0025	14.03	68.39
220.9975	13.10	67.14

6.2 Occupied Bandwidth

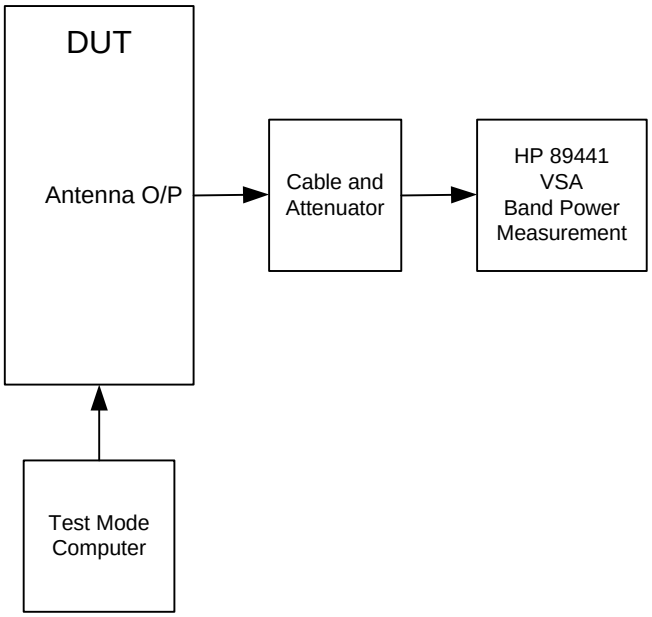
Requirement:

Measured as per the requirement of Part 2.1049

Test Procedure:

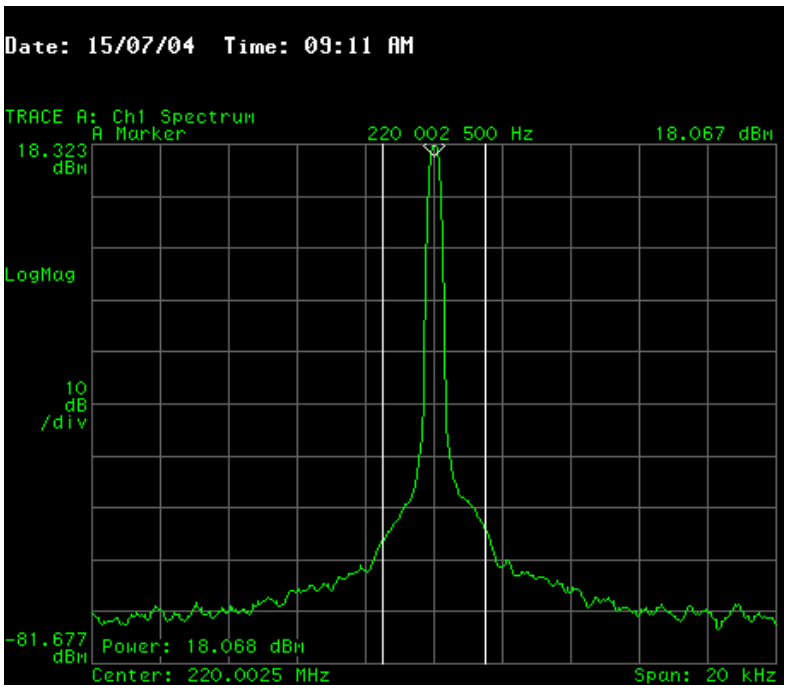
The output of the DUT transmitter is coupled through an attenuator, directly into the HP89441A Vector Signal Analyzer. The bandwidth where 99% of the mean power is transmitted is determined through measurement. The measurement is performed at the lowest and highest channel frequency.

Test Set Up:



Measurement Plots:

Total power reference with the modulation disabled is measured at the lowest channel frequency:



Settings:

Acquisition Mode: Normal

RBW: 300 Hz

Detector type: Positive Peak

Trigger type: Free running

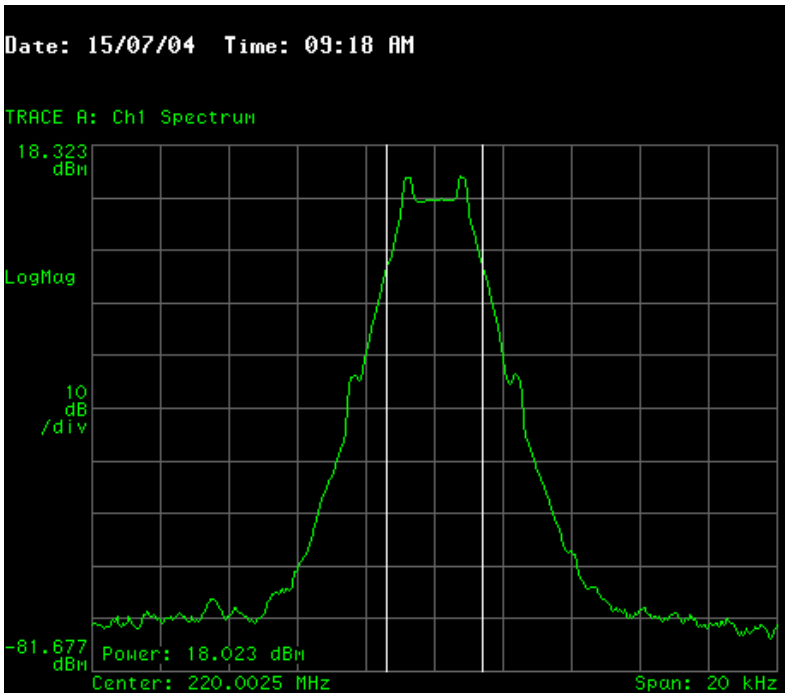
Center: 220.0025 MHz

Span: 20 kHz

Measurement Result:

The constant envelope power is measured as a reference with the modulation disabled. The relative reference level is 18.067 dBm.

The modulation is enabled and the bandwidth where 99% of the total emission power is determined using the band power marker function of the Vector Signal Analyzer.



Settings:

Acquisition Mode: Normal

RBW: 300 Hz

Detector type: Positive Peak

Trigger type: Free running

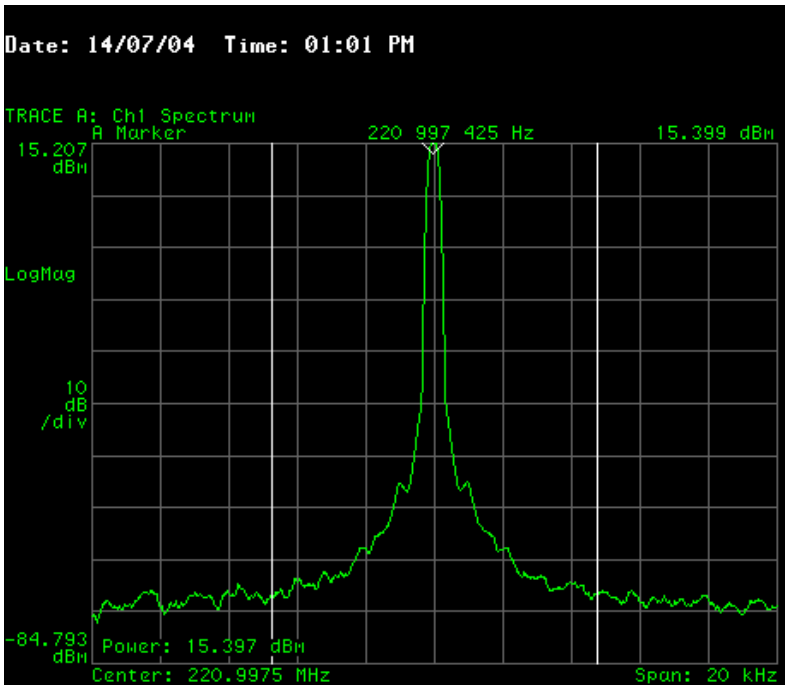
Center: 220.0025 MHz

Span: 20 kHz

Measurement Result:

The 1% of the power not contained in the occupied bandwidth represents a ratio of 0.0436 dB. The bandwidth were 99% of the total emission power is contained is 2.775 kHz. This occurs where the band power is equal to 18.067 dBm – 0.0436 dB.

Total power reference with the modulation disabled is measured at the highest channel frequency:



Settings:

Acquisition Mode: Normal

RBW: 300 Hz

Detector type: Positive Peak

Trigger type: Free running

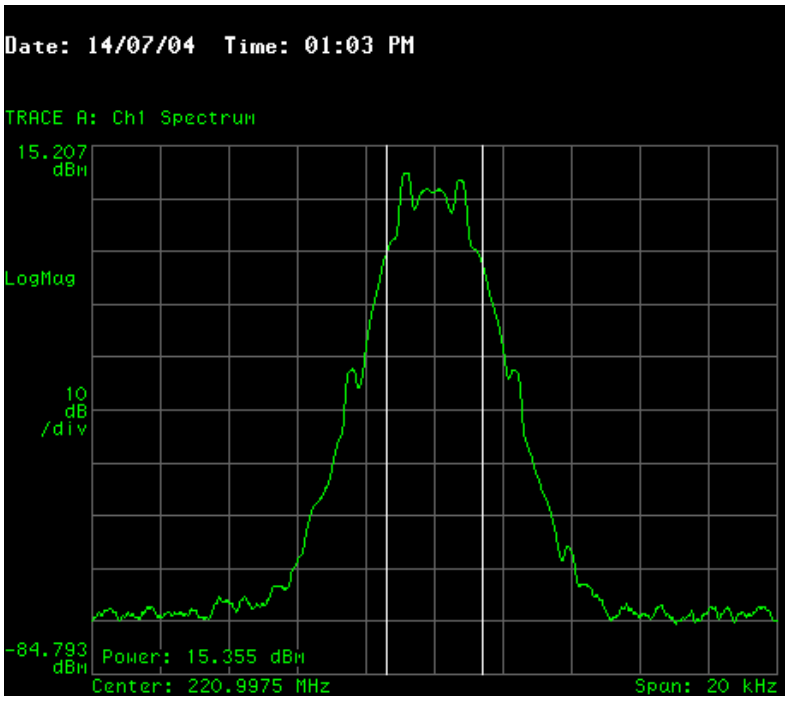
Center: 220.9975 MHz

Span: 20 kHz

Measurement Result:

The constant envelope power is measured as a reference with the modulation disabled. The relative reference level is 15.399 dBm.

The modulation is enabled and the bandwidth where 99% of the total emission power is determined using the band power marker function of the Vector Signal Analyzer.



Settings:

Acquisition Mode: Normal

RBW: 300 Hz

Detector type: Positive Peak

Trigger type: Free running

Center: 220.9975 MHz

Span: 20 kHz

Measurement Result:

The 1% of the power not contained in the occupied bandwidth represents a ratio of 0.0436 dB. The bandwidth were 99% of the total emission power is contained is 2.775 kHz. This occurs where the band power is equal to 15.399 dBm – 0.0436 dB.

Result:

The occupied bandwidth is 2.775 kHz.

6.3 Frequency Stability Over Temperature

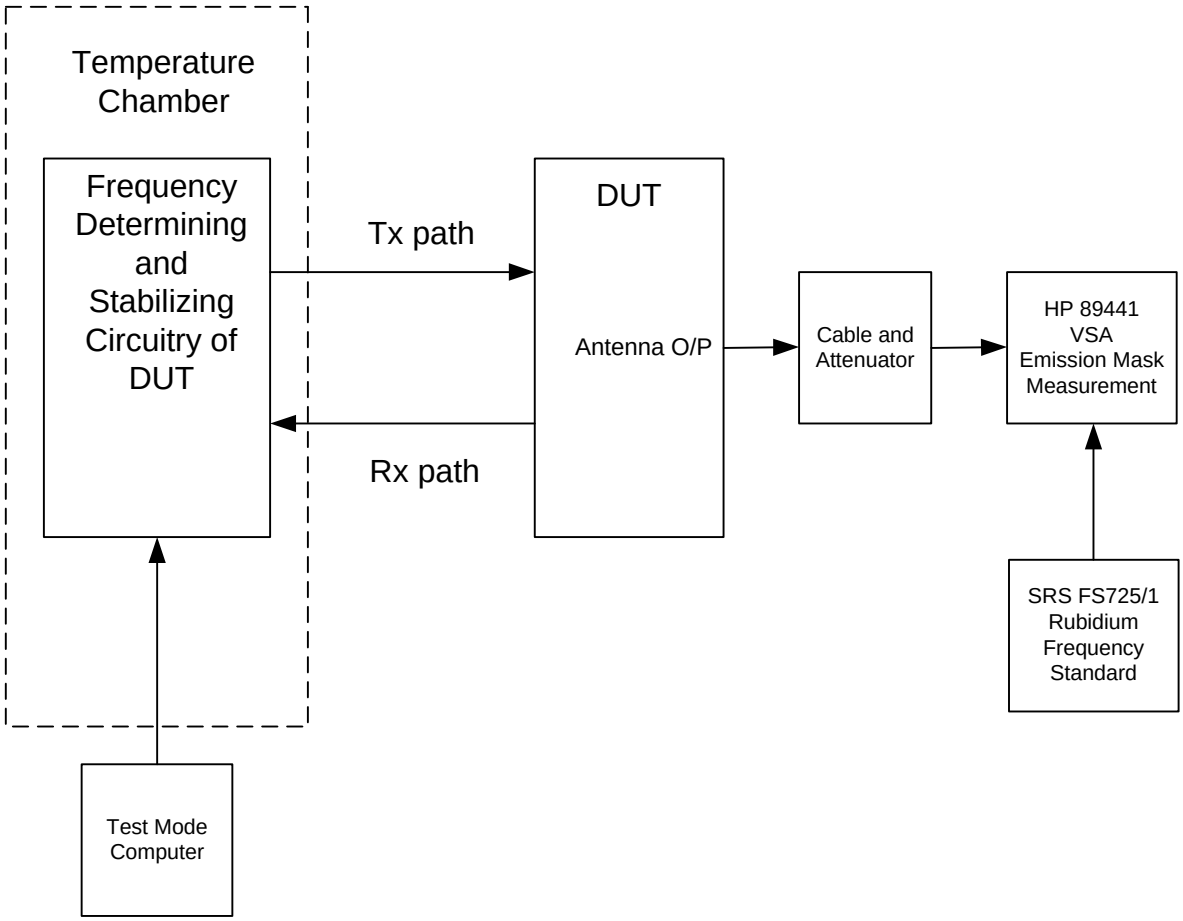
Requirement:

Measured as per the requirement of Part 2.1055 and Part 90.210 emission mask F. Since the bandwidth of the emission is less than 4kHz, the frequency stability requirement is that the emission must comply with the emission mask over a temperature range of –30 to 50 degrees C.

Test Procedure:

The frequency determining and stabilizing circuitry of the DUT is placed in a temperature chamber and interfaced back to the main DUT rack via extender RF and interface cables. The antenna output of the DUT is connected to the Vector Signal Analyzer via cables and a high power attenuator. The frequency reference for the Vector Signal Analyzer is a precision rubidium frequency standard. The Vector Signal Analyzer display is calibrated to display the emission mask limit of Part 90.210 mask F. Measurements that show compliance to the emission mask are performed at the lowest and highest channels of operation and at the highest power level where the emission mask is the most stringent.

Test Set Up:

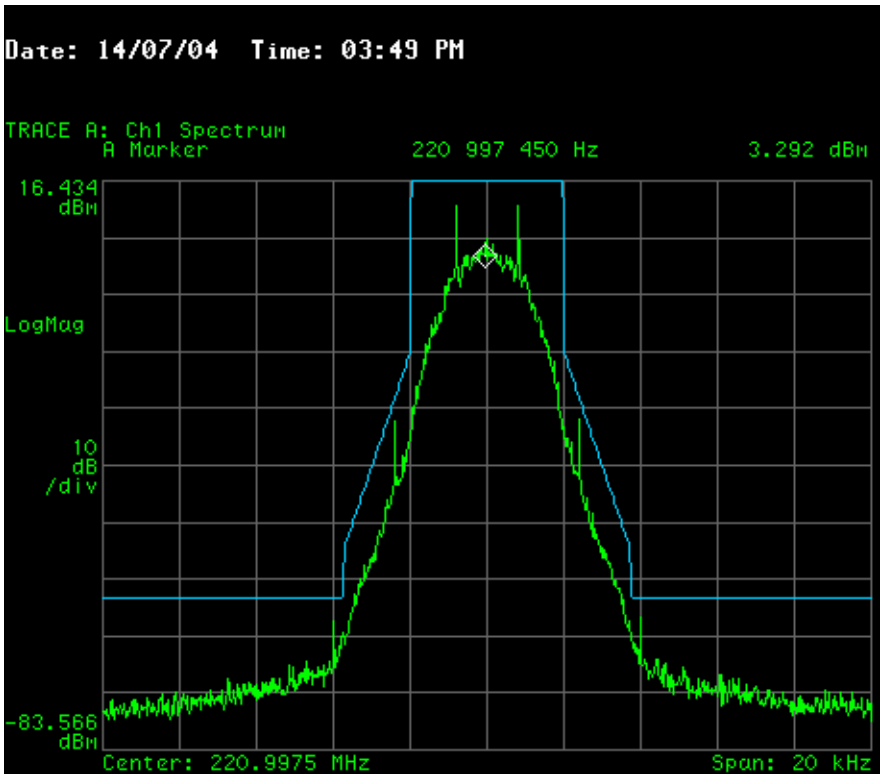


The settings for the Vector Signal Analyzer are as follows for all the emission mask measurements:

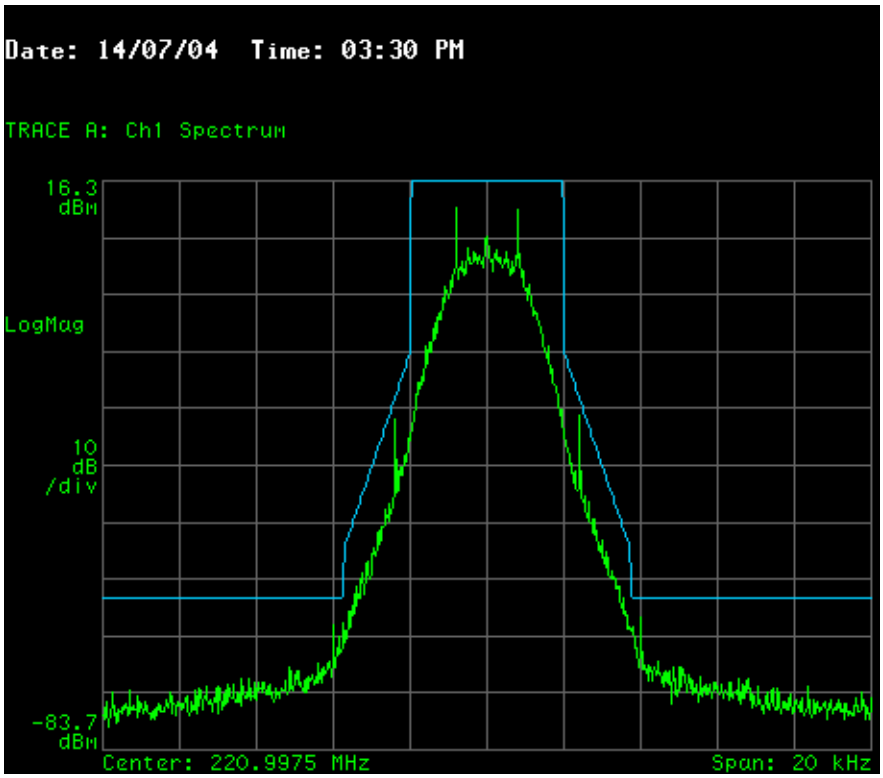
Settings:
Acquisition Mode: Continuous Peak Hold
RBW: 30 Hz
Detector type: Positive Peak
Trigger type: Free running
Center: 220.0025 MHz for the lowest channel. 220.9975 MHz for the highest channel
Span: 20 kHz
Part 90.210 emission mask F with ultimate attenuation based on 69 Watts at the antenna terminal.

Measurement Plots At The Highest Channel:

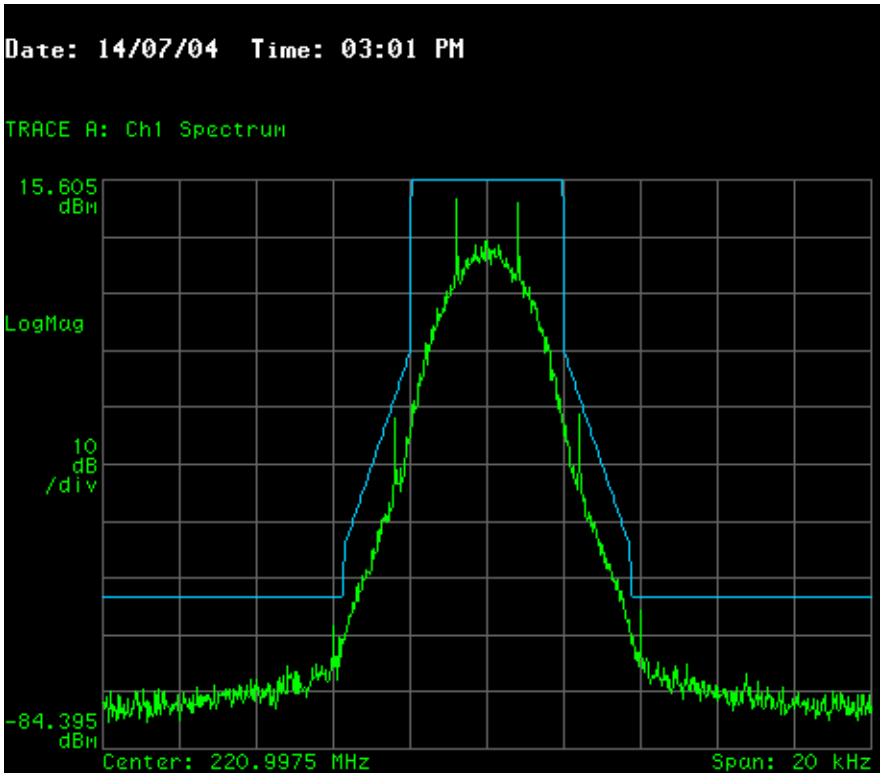
–30 degrees C.



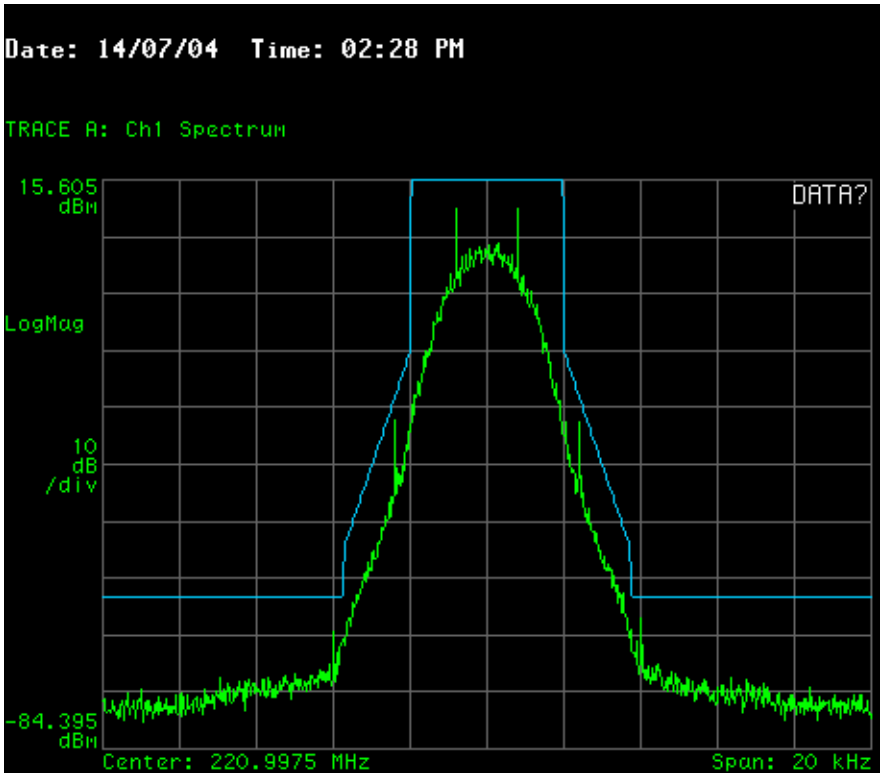
-25 degrees C



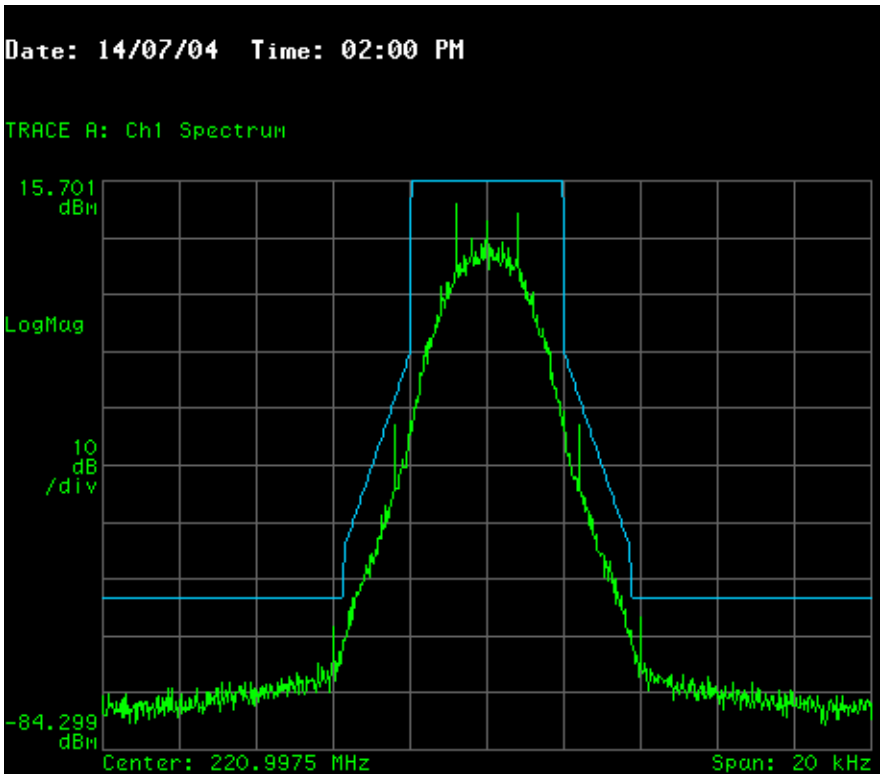
-15 degrees C.



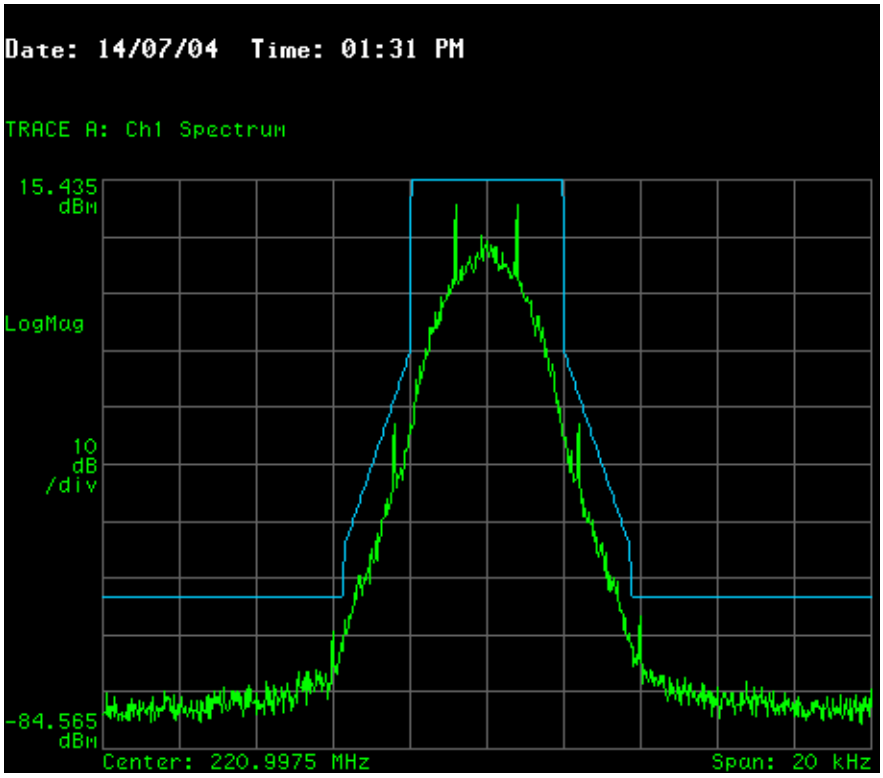
-5 degrees C



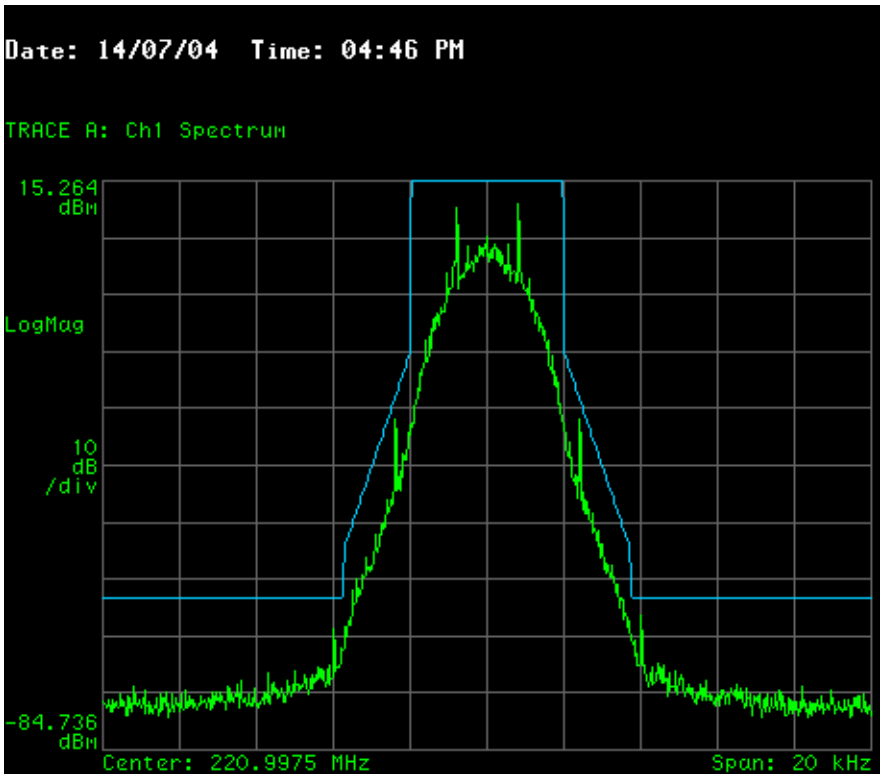
5 degrees C



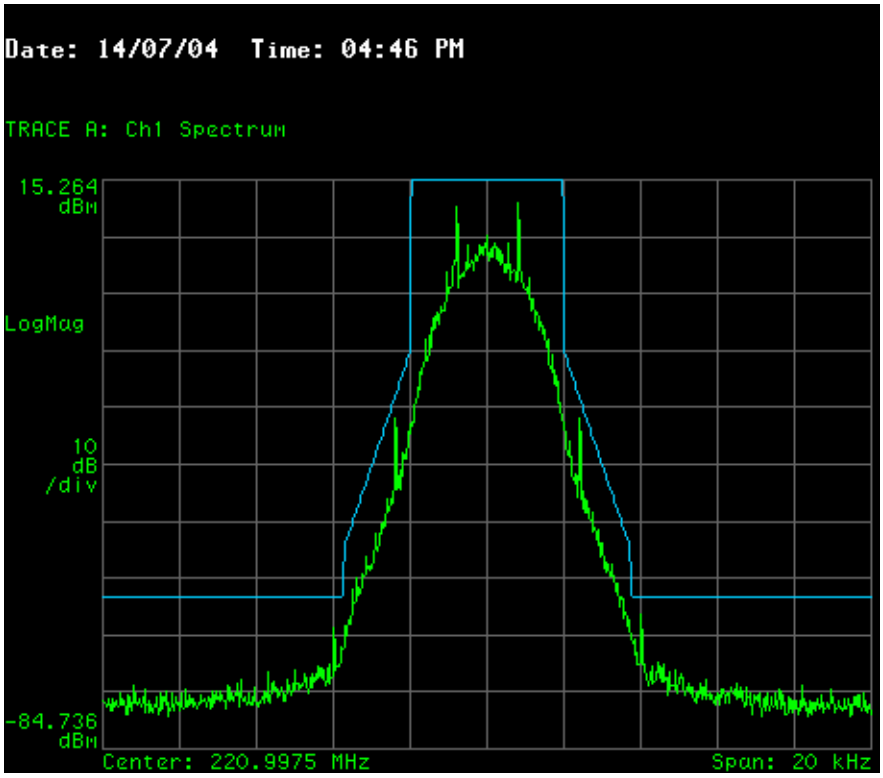
15 degrees C



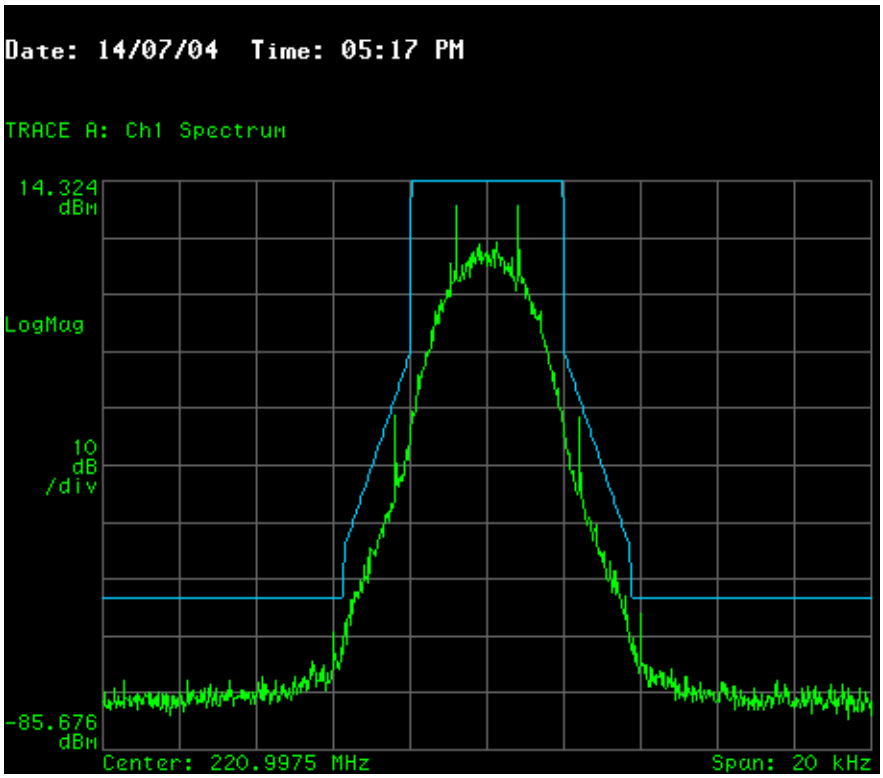
25 degrees C



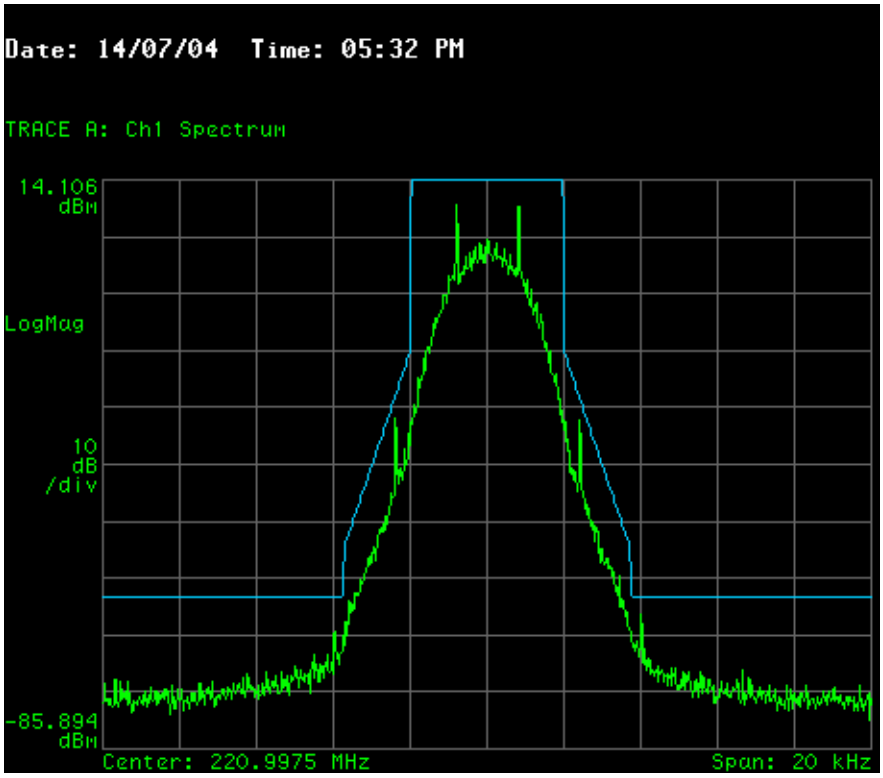
35 degrees C



45 degrees C

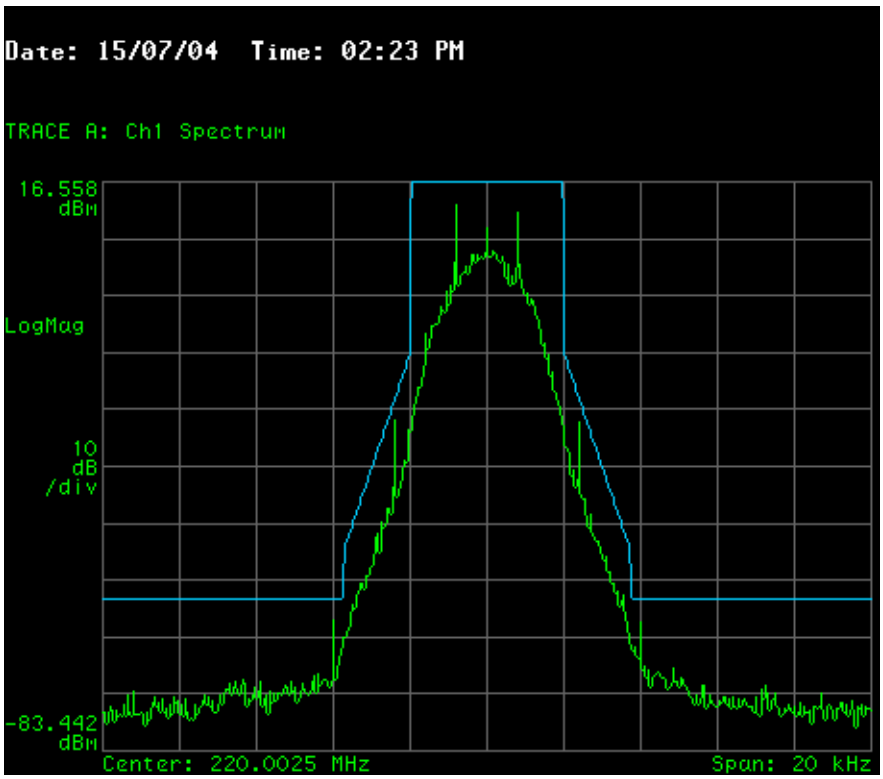


50 degrees C

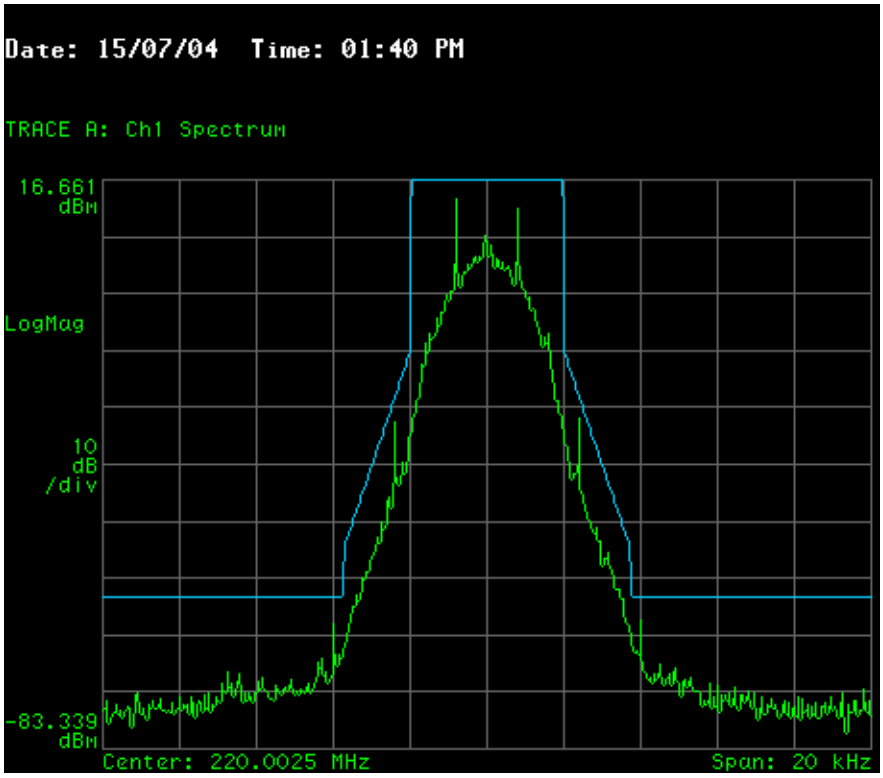


Measurement Plots At The Lowest Channel

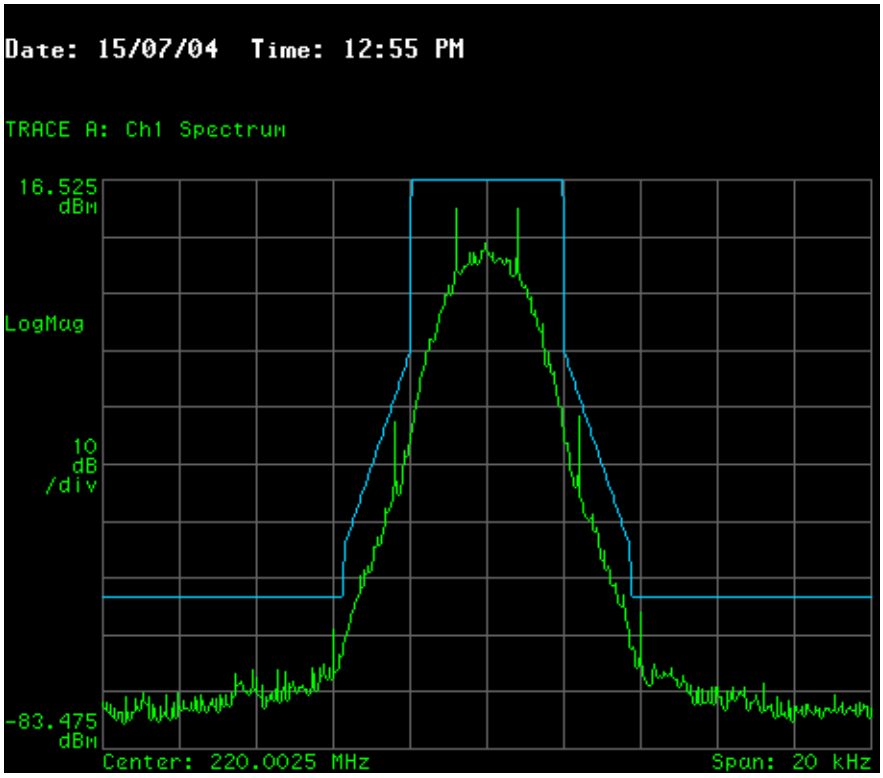
-30 degrees C



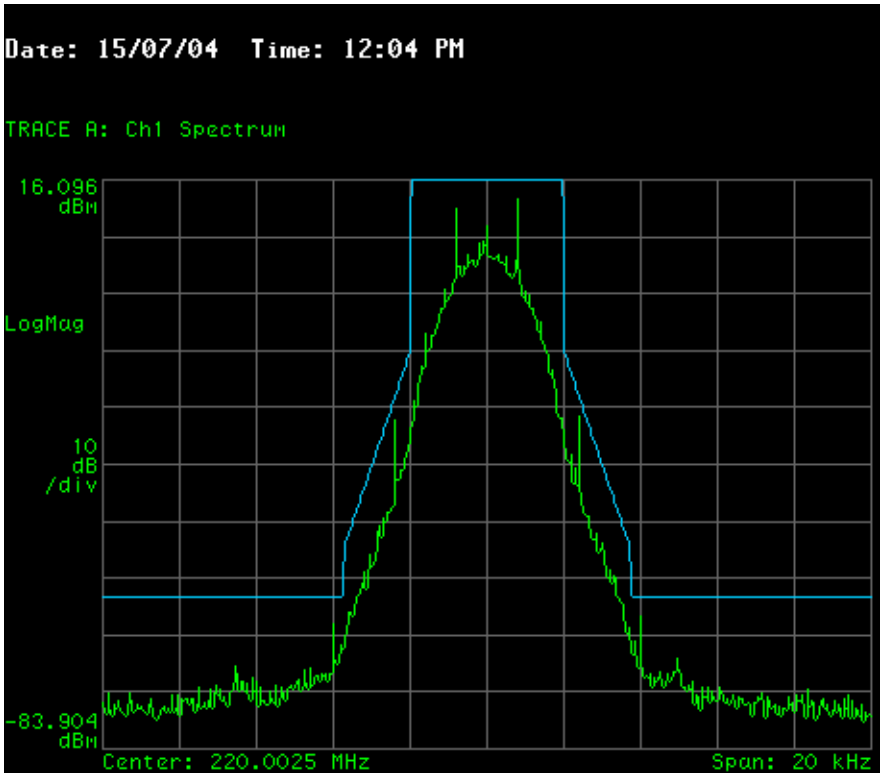
-25 degrees C



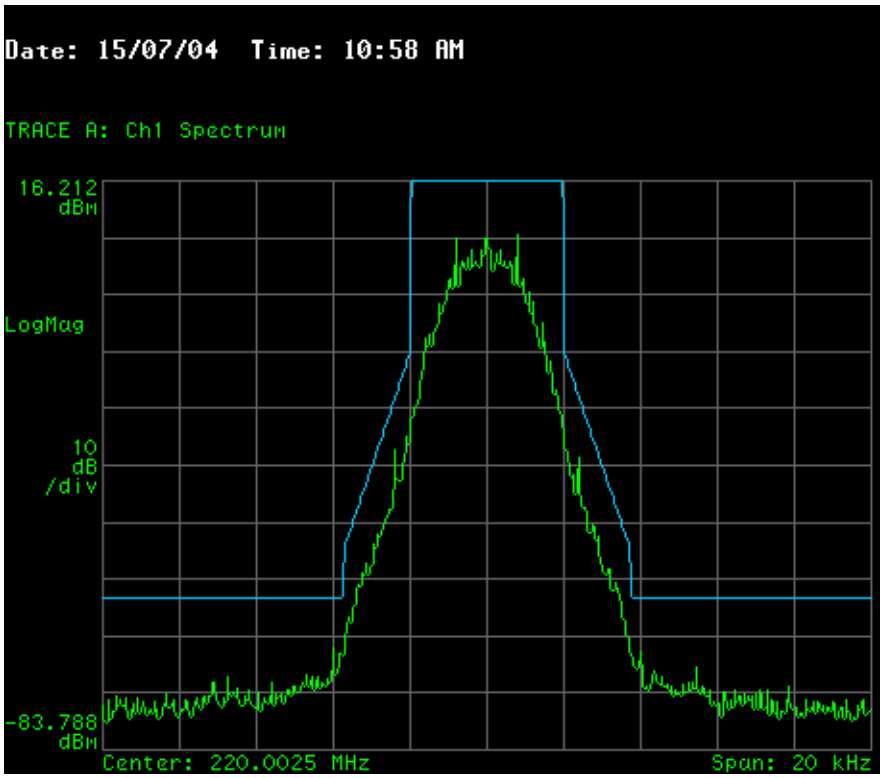
-15 degrees C



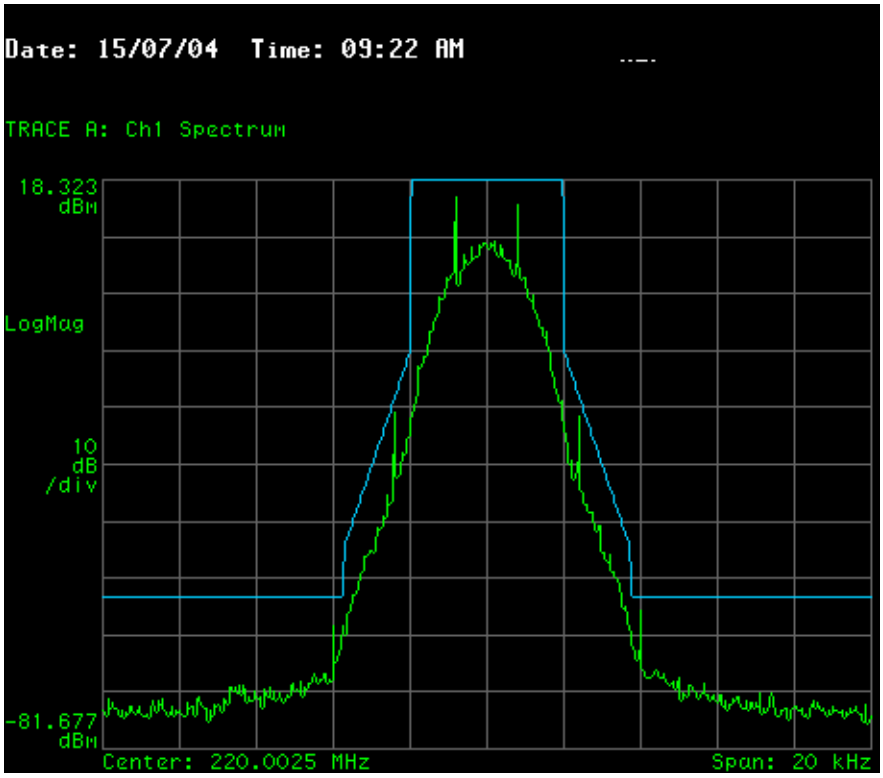
-5 degrees C



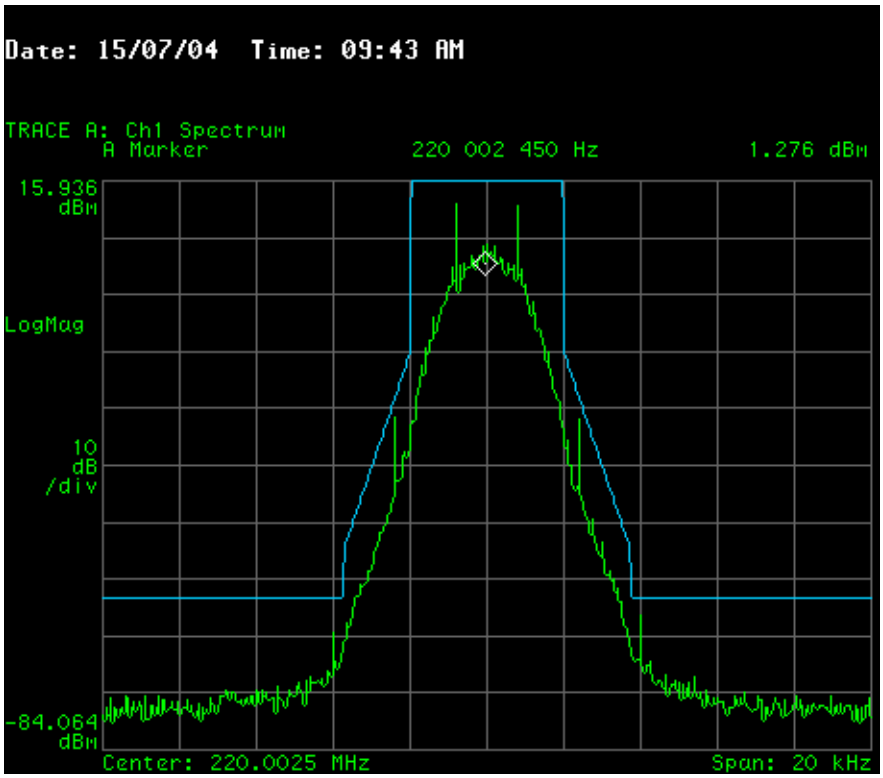
15 degrees C



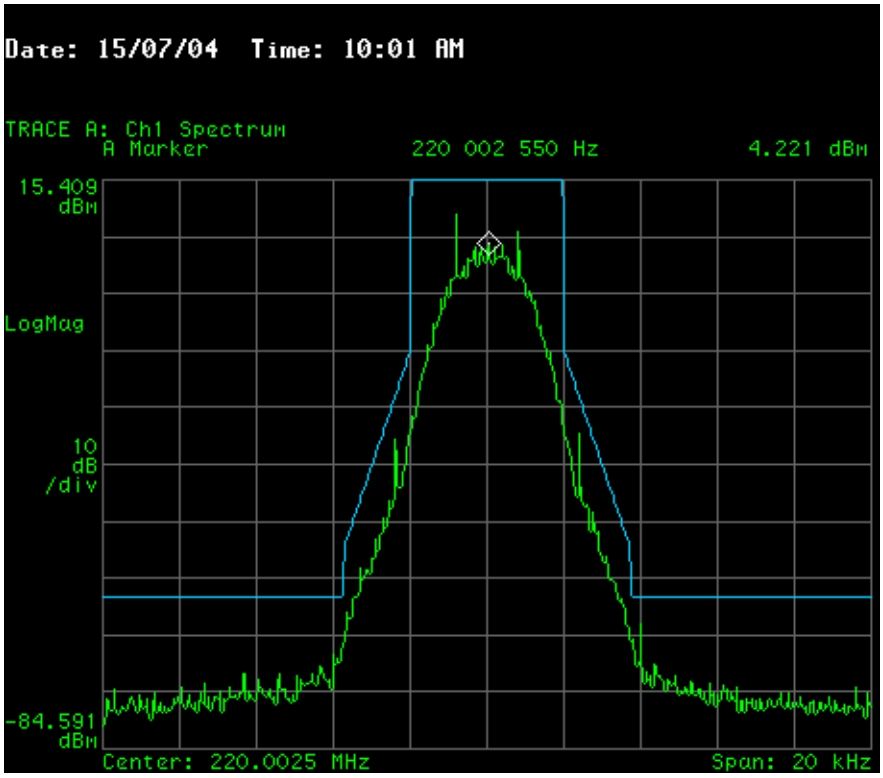
25 degrees C



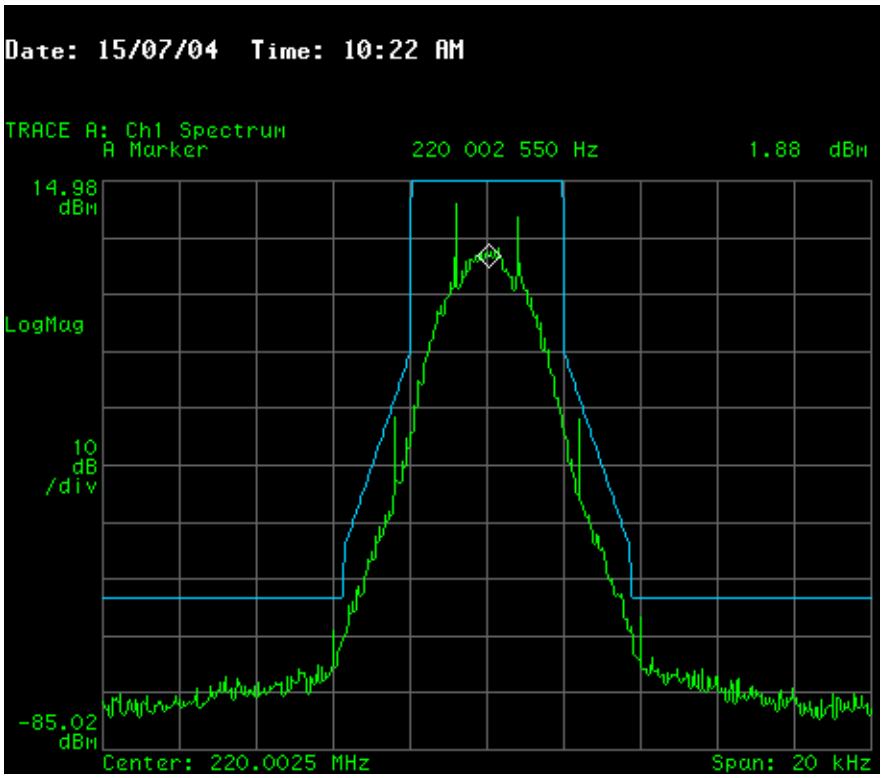
35 degrees C



45 degrees C



50 degrees C



Result:

Requirement	Measured Results Comply
The frequency stability over temperature complies with the requirement in Part 90.210 for the emission to fit under emission mask F.	

6.4 Frequency Stability Over Variation In Primary Supply Voltage

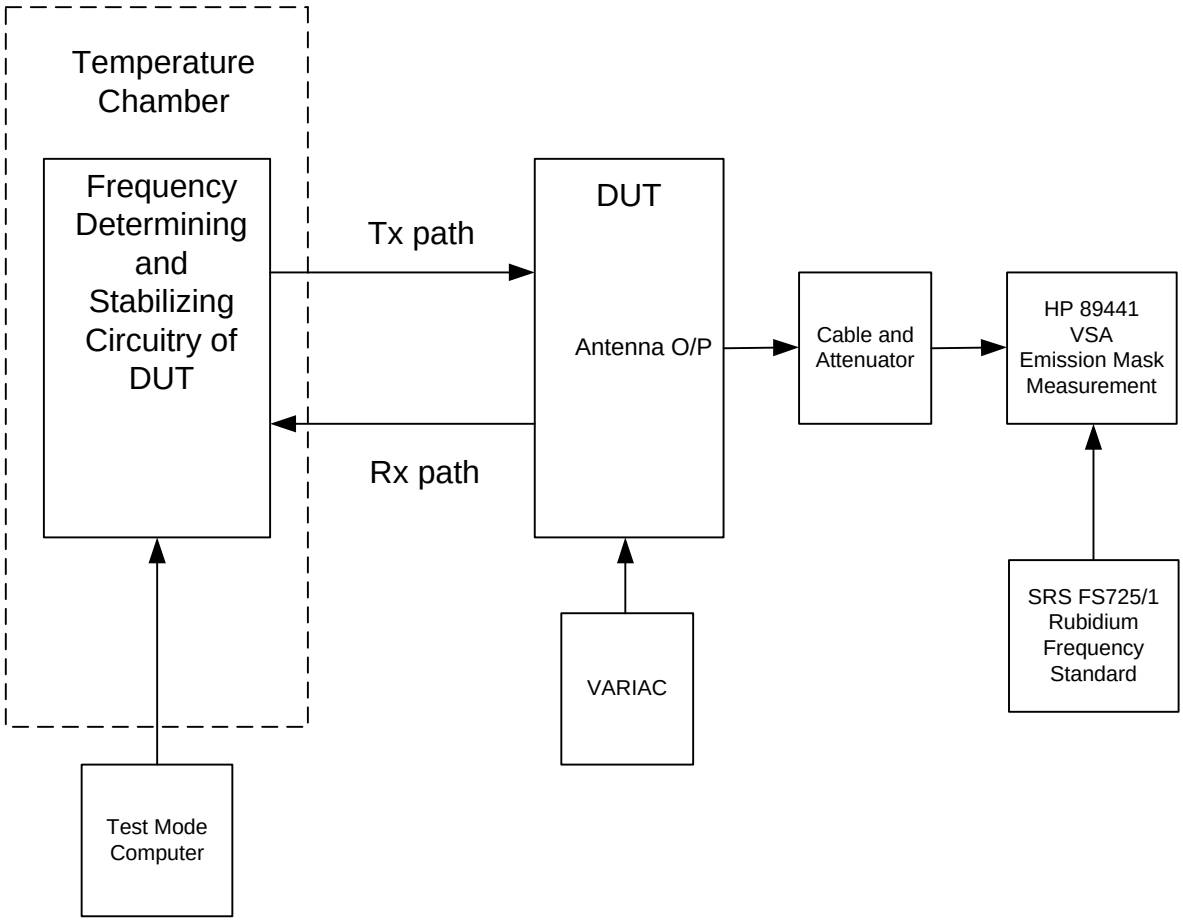
Requirement:

As per part 2.1055, the frequency stability is verified over variation in primary supply voltage. The frequency stability requirement is that the emission complies with the emission mask defined in Part 90.210, mask F. Measurement of compliance to the emission mask shall be performed at 85% and 115% of the primary supply voltage.

Test Procedure:

The antenna output of the DUT is connected to the Vector Signal Analyzer via cables and a high power attenuator. The frequency reference for the Vector Signal Analyzer is a precision rubidium frequency standard. The Vector Signal Analyzer display is calibrated to display the emission mask limit of Part 90.210 mask F. Measurements that show compliance to the emission mask are performed at the lowest and highest channels of operation and at the highest power level where the emission mask is the most stringent. The primary supply voltage is adjusted by the means of a variac to enable measurements at 85% and 115% of the primary supply voltage. The temperature chamber is set to nominal room temperature.

Test Setup:

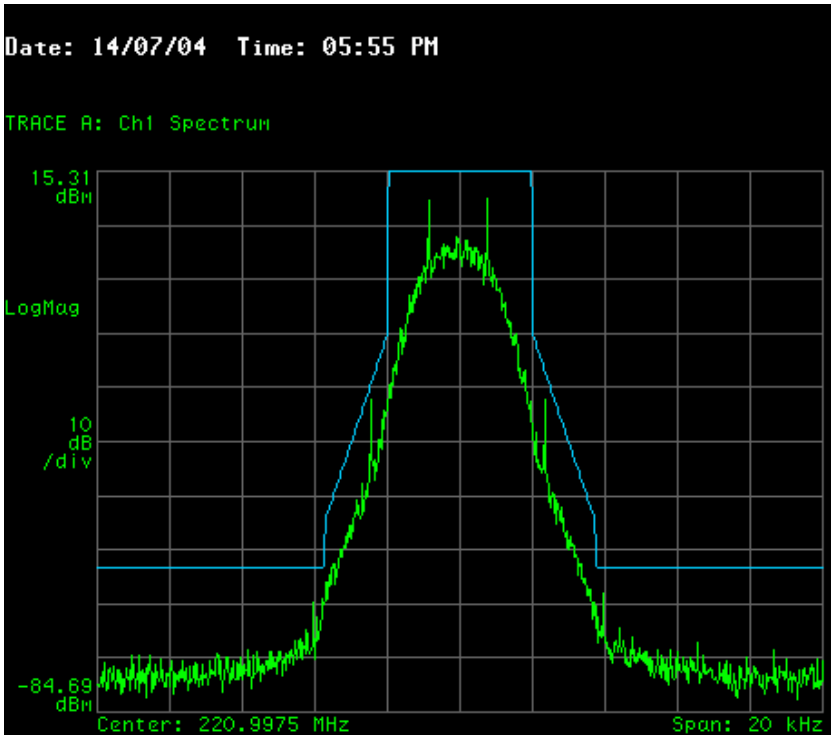


The settings for the Vector Signal Analyzer are as follows for all the emission mask measurements:

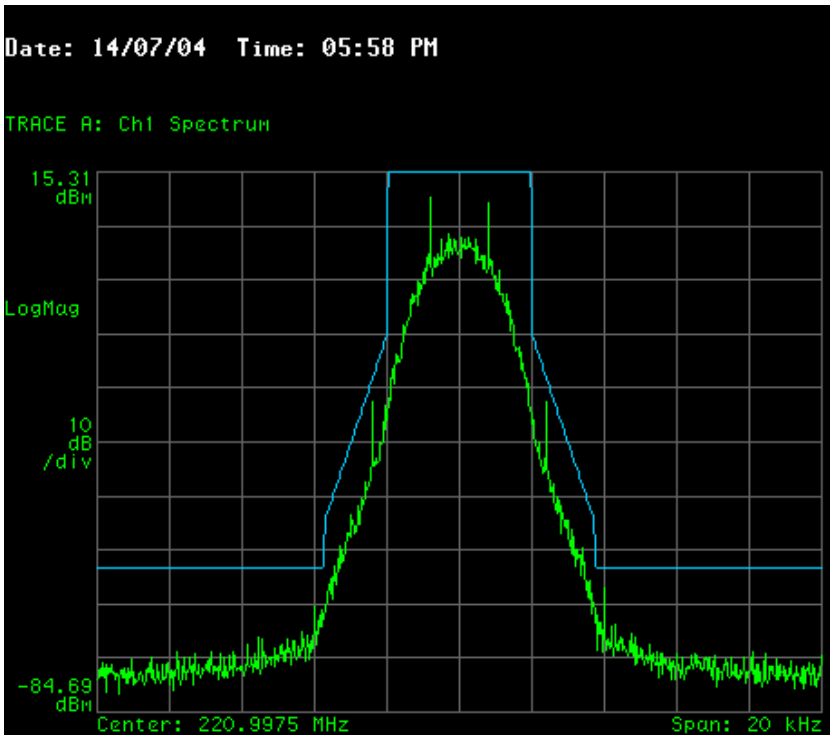
Settings:
Acquisition Mode: Continuous Peak Hold
RBW: 30 Hz
Detector type: Positive Peak
Trigger type: Free running
Center: 220.0025 MHz for the lowest channel. 220.9975 MHz for the highest channel
Span: 20 kHz
Part 90.210 emission mask F with ultimate attenuation based on 69 Watts at the antenna terminal.

Measurement Results At The Highest Channel:

85% of primary supply voltage, 97 VAC

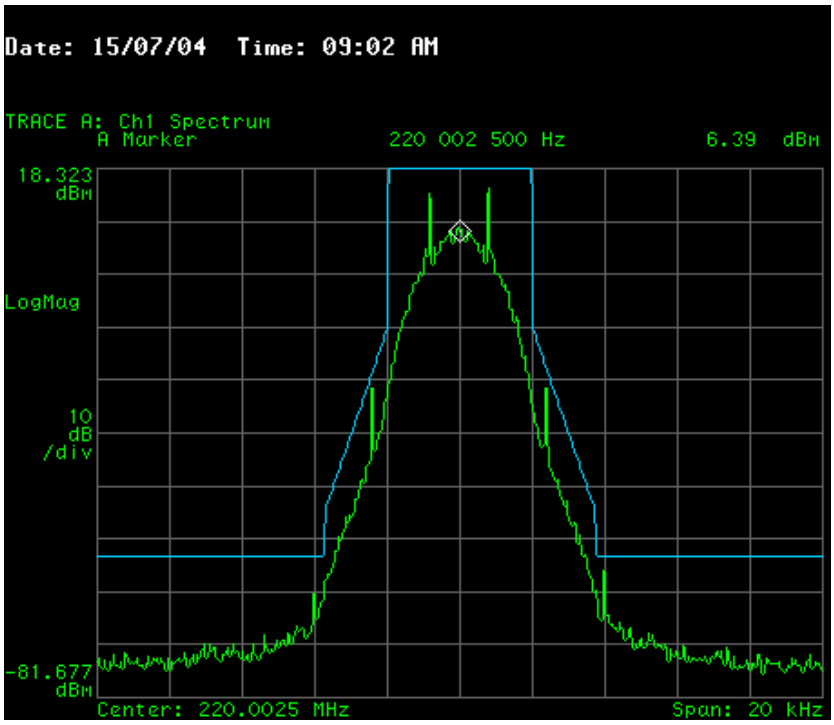


115% of primary supply voltage, 133 VAC

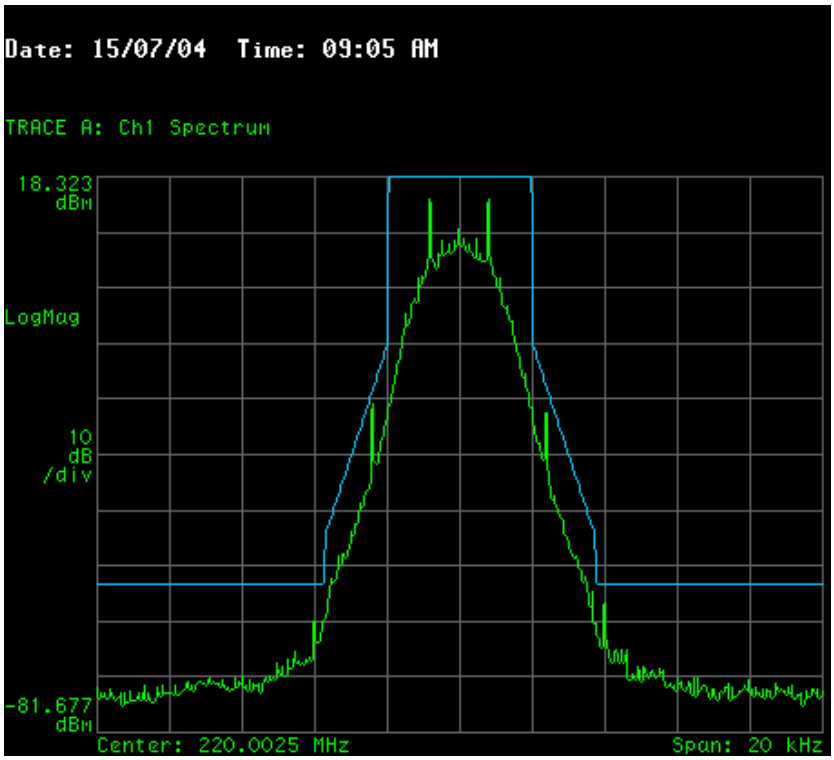


Measurement Results At The Lowest Channel

85% of primary supply voltage, 97 VAC



115% of primary supply voltage, 133 VAC



Result:

Requirement	Measured Results Comply
The frequency stability over variation in primary supply voltage complies with the requirement in Part 90.210 for the emission to fit under emission mask F.	

6.5 Conducted Spurious Emissions At Antenna Terminal

Requirement:

Conducted spurious emissions are measured as per the requirement in 2.1051. The limits for the conducted spurious emissions are calculated by using the formulas as follows:

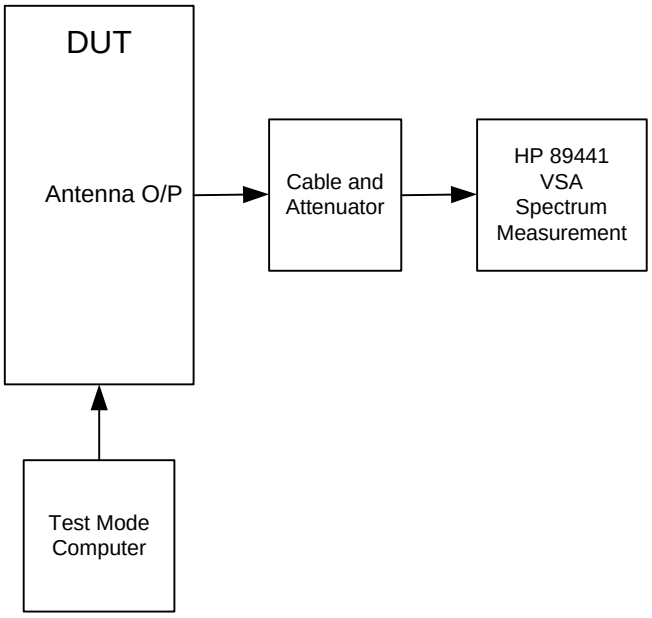
For High Power: 55+10log(Phigh) = 55+10log(68.39) = 73.35 dBc

For Low Power: 55+10log(Plow) = 55+10log(14.03) = 66.47 dBc

Test Procedure:

The output of the DUT transmitter is coupled through an attenuator, directly into the HP89441A Vector Signal Analyzer. The spectrum is searched from 100 kHz to 2.65 GHz. This range exceeds the minimum requirement of search up to the 10^{th} harmonic of the fundamental emission. The measurement is performed at the highest and lowest power levels measured in section 6.1 of this report at the lowest channel frequency of 220.0025 MHz.

Test Setup:



Measurement Data:

In all cases the conducted spurious and/or harmonics are greater than 20 dB below the permissible value.

FREQUENCY, MHz	dB WITH RELATIVE TO CARRIER, LOW POWER, dBc	dB RELATIVE TO CARRIER, HIGH POWER, dBc
220.0025	0	0
440.0005	-114	-104
660.0075	-119	-105
880.0100	<-120	-113
1100.0125	<-120	-114
1320.0150	<-120	-114
1540.0175	<-120	-114
1670.0200	<-120	<-115
1980.0225	<-120	<-115
2200.0250	<-120	<-115
2420.0275	<-120	<-115

Result:

Requirement	Measured Results Comply
The conducted spurious emissions at the antenna terminal of the DUT must be less than the limit defined in Part 90.210(f). The level of the spurious emissions with respect to and below the carrier must be 55 + 10log(P)	

Revision History

The following table shows the revision history of this document.

Date dd/mm/yy	Author	Changes	Version
15/07/04	Robert De Angelis	Original	1.0
22/07/04	Robert De Angelis	Added Conducted Spurious Emissions at Antenna Terminal	2.0

Appendix A Protocol EMC Test Report

The test report prepared by Protocol EMC for all radiated measurements that require an open area test site is filed as TestRpt_2.pdf.

Protocol EMC has put in security features in their test report document that prevented it to be merged with this one.