Application For
Title 47 FCC Part 2, Subpart J, and FCC Part 90, Subpart Y Certification for Private Land Mobile Radio Services
and
ANSI/TIA-603-C-2003, Equipment Measurement and Performance Standards.

Novarum, Inc.
Novarum Mobile 49
4945 - 4985 MHz Transmitter

FCC ID: Z7B-MOBILE49

UST Project No: 11-0222
November 3, 2011

3505 Francis Circle Alpharetta, GA 30004
PH: 770-740-0717 Fax: 770-740-1508
www.ustech-lab.com

I certify that I am authorized to sign for the Test Agency and that all of the statements in this report and in the Exhibits attached hereto are true and correct to the best of my knowledge and belief:

UNITED STATES TECHNOLOGIES, INC. (Agent Responsible For Test):

By: _____

Name: George Yang

Title: Laboratory Manager- Test Engineer

Date: November 30, 2011

3505 Francis Circle Alpharetta, GA 30004
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MEASUREMENT/TECHNICAL REPORT

This report concerns (check one): Original grant X
Class II change_____

Equipment type: Transceiver
Type of Modulation: OFDM
Power Setting: 20 dBm
Antenna Gain: 6 dBi
Peak out power: 22.90 dBm
Max daterate: 100 Mbps
Channel bandwidth: 10 MHz
Note: The EUT was tested with the settings above for all testing.

Deferred grant requested per 47 CFR 0.457(d)(1)(ii)? yes_____ No X

If yes, defer until:_____
date

N.A. agrees to notify the Commission by N.A.

of the intended date of announcement of the product so that the grant can be issued on that date.

Report prepared by:
US Tech
3505 Francis Circle
Alpharetta, GA 30004

Phone Number: (770) 740-0717
Fax Number: (770) 740-1508

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1 General Information

1.1 Product Description

The Equipment Under Test (EUT) is the Novarum Mobile 49 Client Radio System, consisting of radio, antennas, and cabling. The EUT operates as a turn-key, password-protected subsystem which is installed in public safety vehicles to provide nomadic and roaming connection to the network infrastructure

1.2 Related Submittal(s)/Grant(s)

There are no related submittals or grants associated with this project.

2 Test and Measurements

2.1 Configuration of Tested System

A block diagram of the tested system is shown in Figure 1. Test configuration photographs for spurious emissions measurements are shown in Figure 2. All measurements are peak unless stated otherwise. The video filter associated with the spectrum analyzer was off throughout the evaluation process. Interconnecting cables were manipulated as necessary to maximize emissions.

2.2 Characterization of Tested System

The sample used for testing was received by US Tech on October 15, 2011 in good condition.

2.3 Test Facility

Testing was performed at US Tech's measurement facility at 3505 Francis Circle, Alpharetta, GA. Conducted and digital device testing was performed at US Tech's OATS measurement facility. This site has been fully described and registered by the FCC under Registration Number 91037. Additionally this site has also been fully described and submitted to Industry Canada (IC), and has been approved under file number IC2982.

2.4 Test Equipment

Table 2 describes test equipment used to evaluate this product.

2.5 Modifications to Equipment under Test (EUT)

No modifications were made by US Tech to bring the EUT into compliance with the FCC limits for the transmitter portion of the EUT.

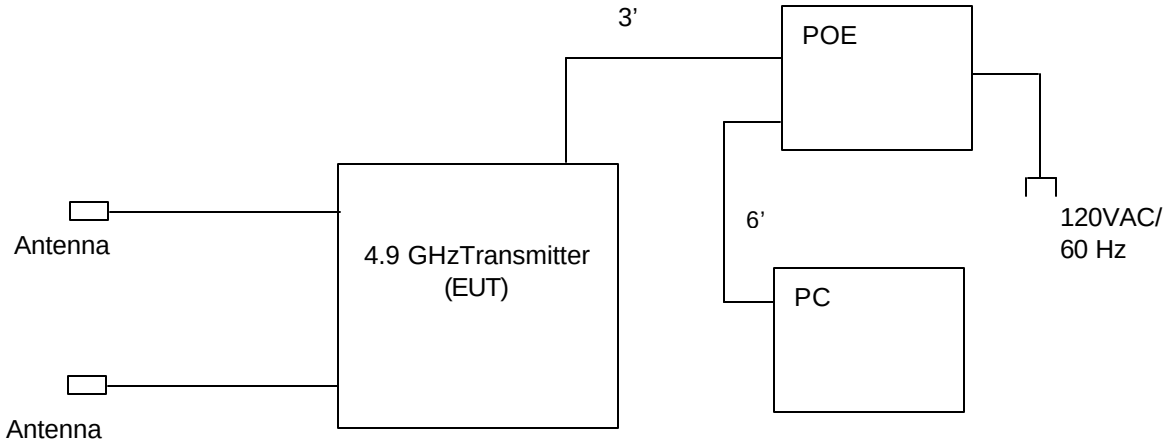

Figure 1 - Test Configuration

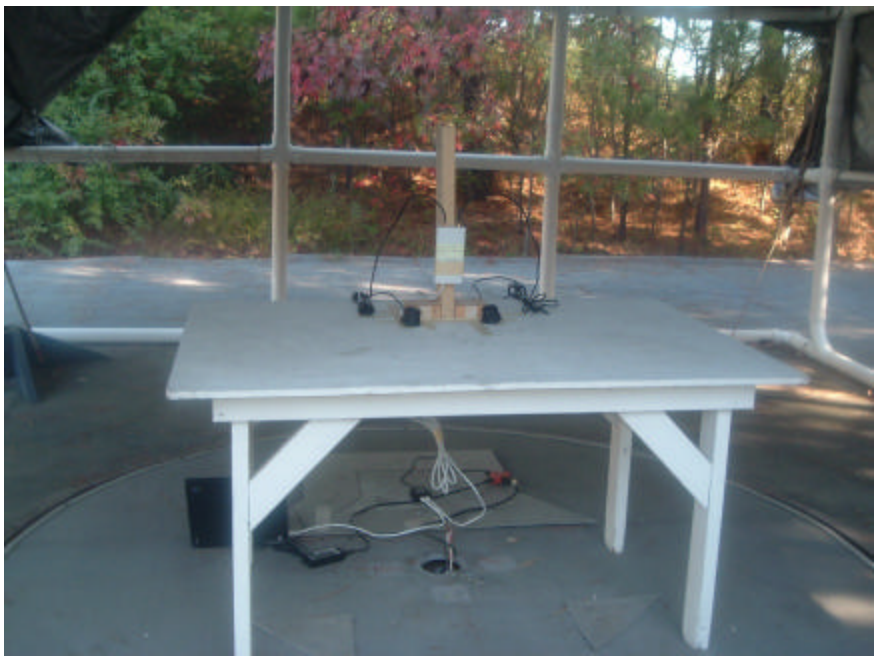

Figure 2 - Photograph of Spurious Radiation Test Setup, (Front View)

Figure 3 - Photograph of Spurious Radiation Test Setup, Rear View

Table 1 - EUT and Peripherals

PERIPHERAL MANUFACTURER	MODEL NUMBER	SERIAL NUMBER	FCC ID:	CABLES P/D
EUT Novarum mobile 49	4945-4985 MHz Transmitter	None	Z7B-MOBILE49	3' U D
UBIQUITI (Carrier POE adaptor)	UBI-POE-24-1	1105-0025546	--	4' U D
Laptop Computer IBM	Various	--	--	6' U -P

U= Unshielded, S= Shielded, P= Power cable, D= Data cable

Table 2 - Test Instruments

EQUIPMENT	MODEL NUMBER	MANUFACTURER	SERIAL NUMBER	DATE OF LAST CALIBRATION
SPECTRUM ANALYZER	8566B	HEWLETT-PACKARD	2410A00109	10/29/10
SPECTRUM ANALYZER	8593E	HEWLETT-PACKARD	3205A00124	10/18/2010
RF PREAMP 100 kHz to 1.3 GHz	8447D	HEWLETT-PACKARD	2944A06291	10/6/11
LOOP ANTENNA 0.09 MHz to 30 MHz	SAS-200/562	Electro-Metrics	142	08/09/11 2 Year
BICONICAL ANTENNA	3110B	EMCO	9306-1708	04/29/11
LOG PERIODIC 100 MHz to 1000 MHz	3146	EMCO	3110-3236	1/22/10 2 Year
HORN ANTENNA	3115	EMCO	9107-3723	08/10/11
HORN ANTENNA	SAS-571	A. H. SYSTEMS	605	02/09/2010 2yr.
PREAMP	8449B	HEWLETT PACKARD	3008A00480	10/21/10
SIGNAL GENERATOR	8672A	HEWLETT-PACKARD	1733A00389	Not Required
GRAPHICAL MULIT-METER	867B	FLUKE	DM7060268	02/23/11
TEMPERATURE CHAMBER	SM16/DR450 0A	THERMOTRON/ HONEYWELL	17095	03/14/2011
CALCULATION PROGRAM	N/A	N/A	Ver. 6.0	N/A
MODULATION ANALYZER	8091B	HP/ AGILENT	3749A06049	01/08/2011

Note: The calibration interval of the above test instruments is 12 months and all calibrations are traceable to NIST/USA.

2.6 Antenna Description

Radio antennas are connected through SMA reverse female connectors. An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. Only the antenna(s) listed in Table 4 will be used with this module.

Table 3 - Allowed Antenna(s)

MANUFACTURER	TYPE OF ANTENNA	MODEL	REPORT REFERENCE	GAIN dB_i	TYPE OF CONNECTOR
MP Antenna (x2)	Omni	08-ANT-0904	08-ANT-0904	6 dBi	Reverse sex SMA

2.7 RF Power Output (FCC Section 2.1046, 90.1215)

The transmitter (EUT) was programmed to continuously generate maximum power. RF output power was measured by connecting the output of the transmitter directly to the input of a calibrated spectrum analyzer through a power attenuator whose loss had been measured and was entered into the spectrum analyzer as offset. The spectrum analyzer was set for an impedance of 50 O with the RBW set greater than the 6 dB bandwidth of the EUT, and the VBW = RBW. This measurement was done at Low Channel, Mid Channel and High Channel frequencies.

Table 4 - RF Conducted Output Power

Frequency of Fundamental (MHz)	ERP Measurement		FCC Limit (dBm)
	(dBm)* Peak	(Watts)* Peak	10 MHz bandwidth
4945	22.50	0.177	30
4965	22.10	0.162	30
4985	22.90	0.195	30

Test Date: October 3, 2011

Tester Signature: Keyvan Muvahhid **Name: Keyvan Muvahhid**

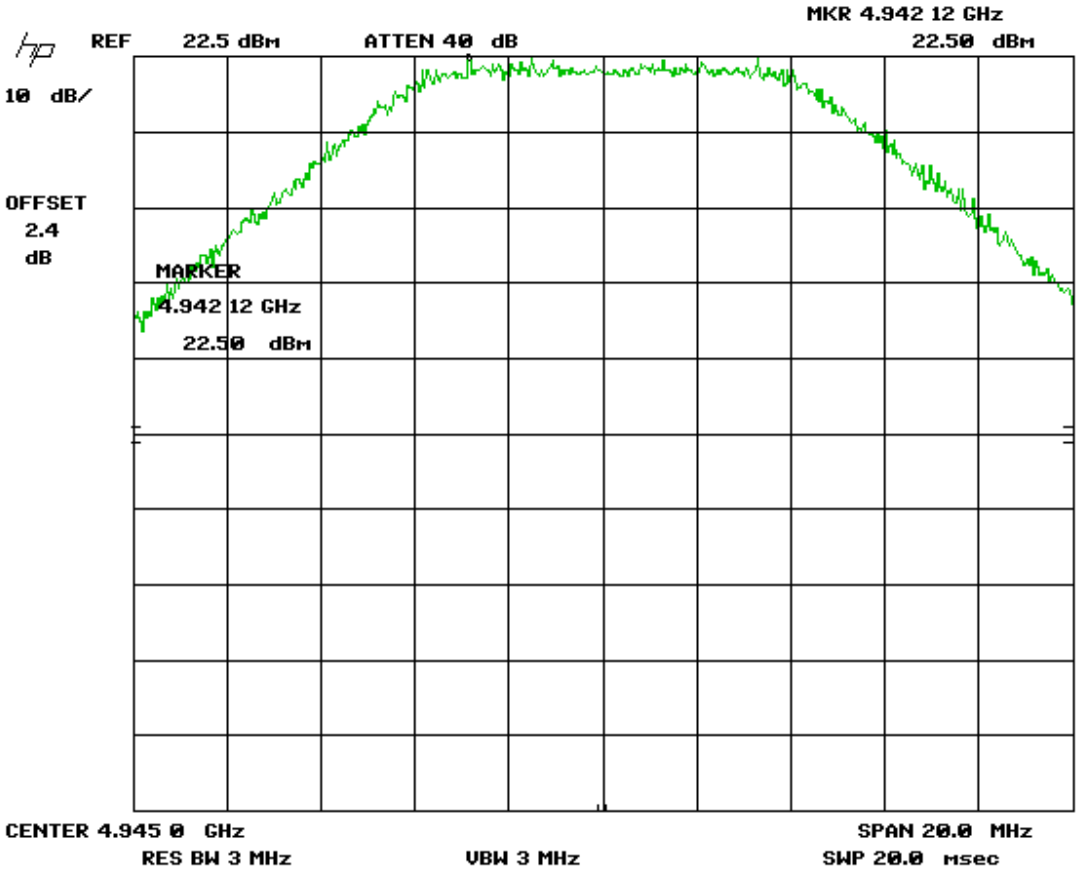

Figure 4 - Conducted Power - Low Channel

Note: Peak measurement

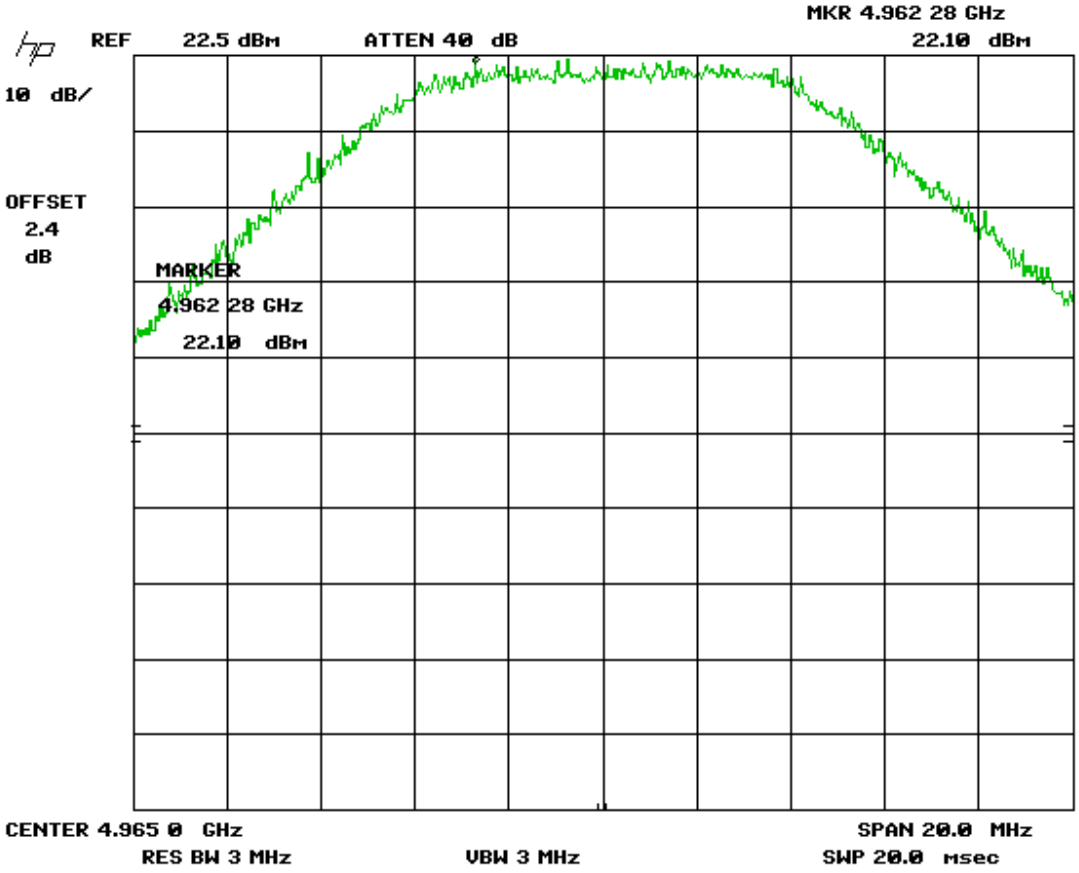

Figure 5 - Conducted Power- Mid Channel

Note: Peak measurement

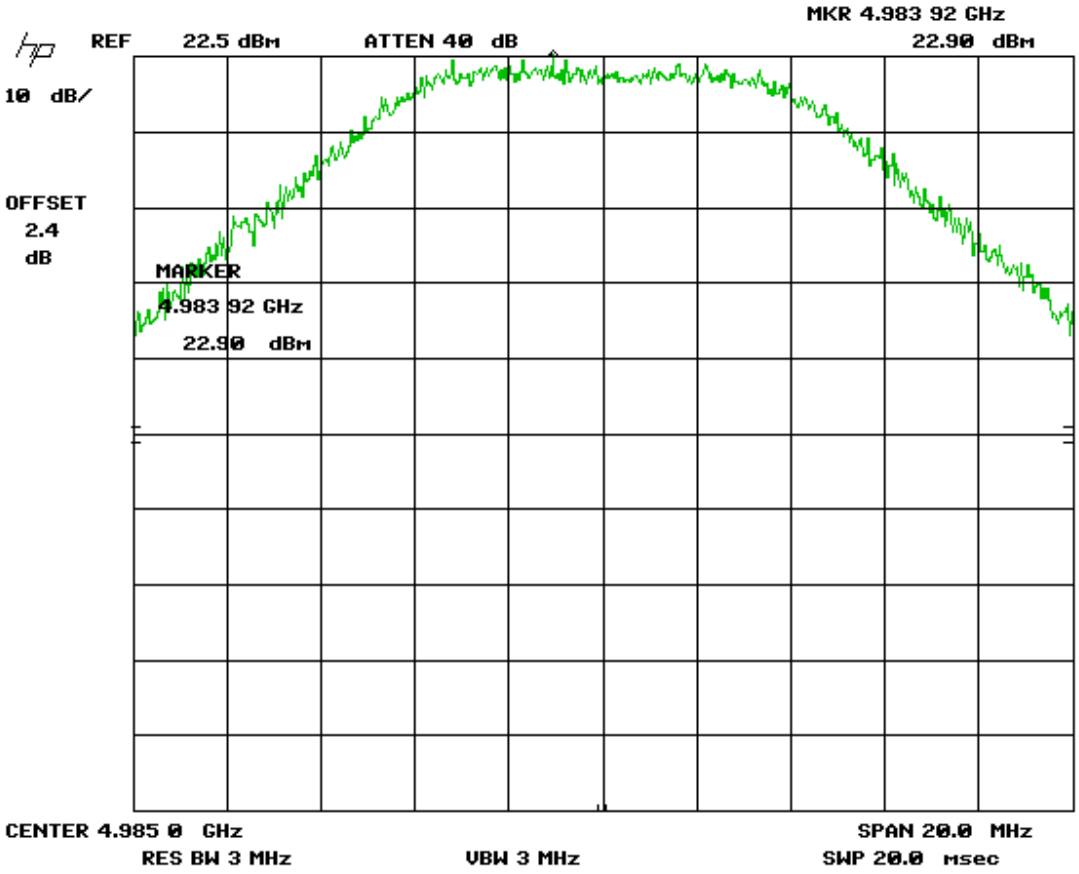

Figure 6 - Conducted Power- High Channel

Note: Peak measurement

2.8 Power Spectral Density (2.1047(a) & 90.242(b) (8))

The peak power spectral density is measured as conducted emissions. Measurements are made over a bandwidth of one MHz.

Table 5 – Conducted Power Spectral Density

Frequency of Fundamental (MHz)	ERP Measurement (dBm)*	ERP Measurement (Watts)*	FCC Limit (dBm)
4945	17.6	0.057	21
4965	17.8	0.060	21
4985	17.8	0.060	21

Test Date: October 3, 2011

Tester Signature:  **Name: Keyvan Muvahhid**

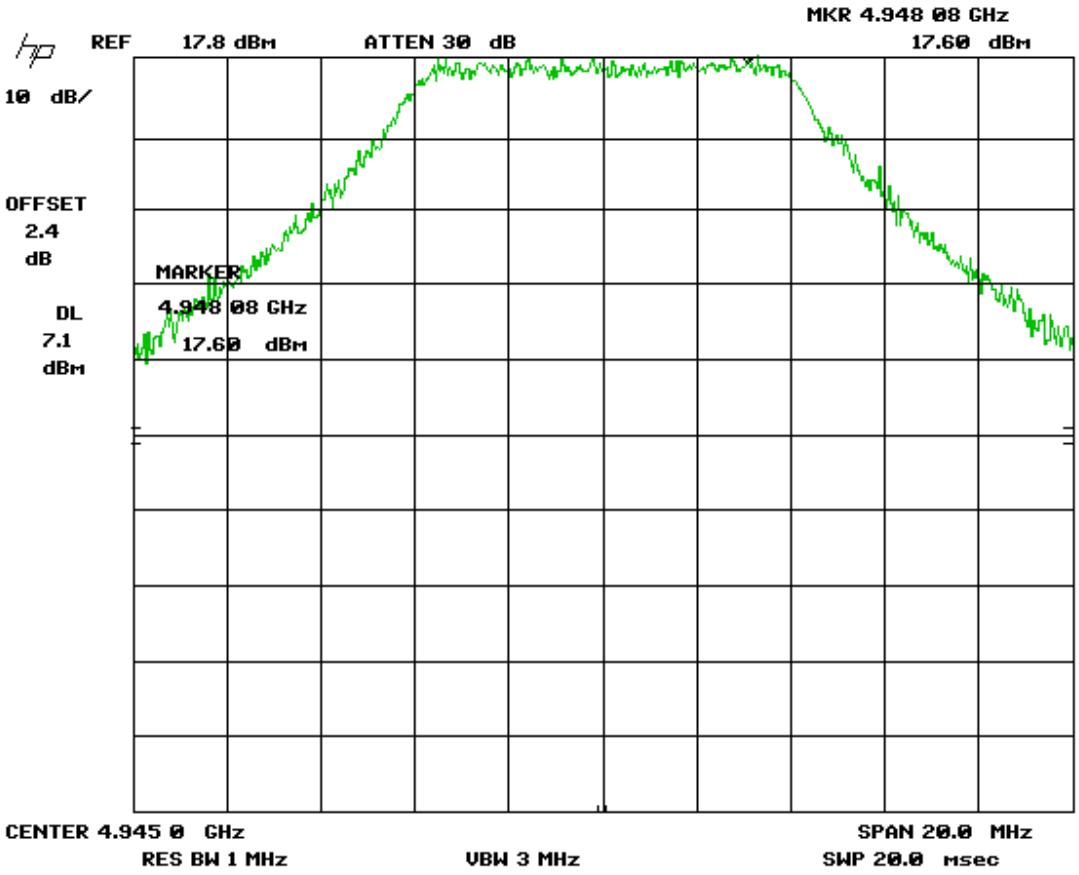

Figure 7 - Peak Power Spectral Density- Low channel

Note: Peak measurement

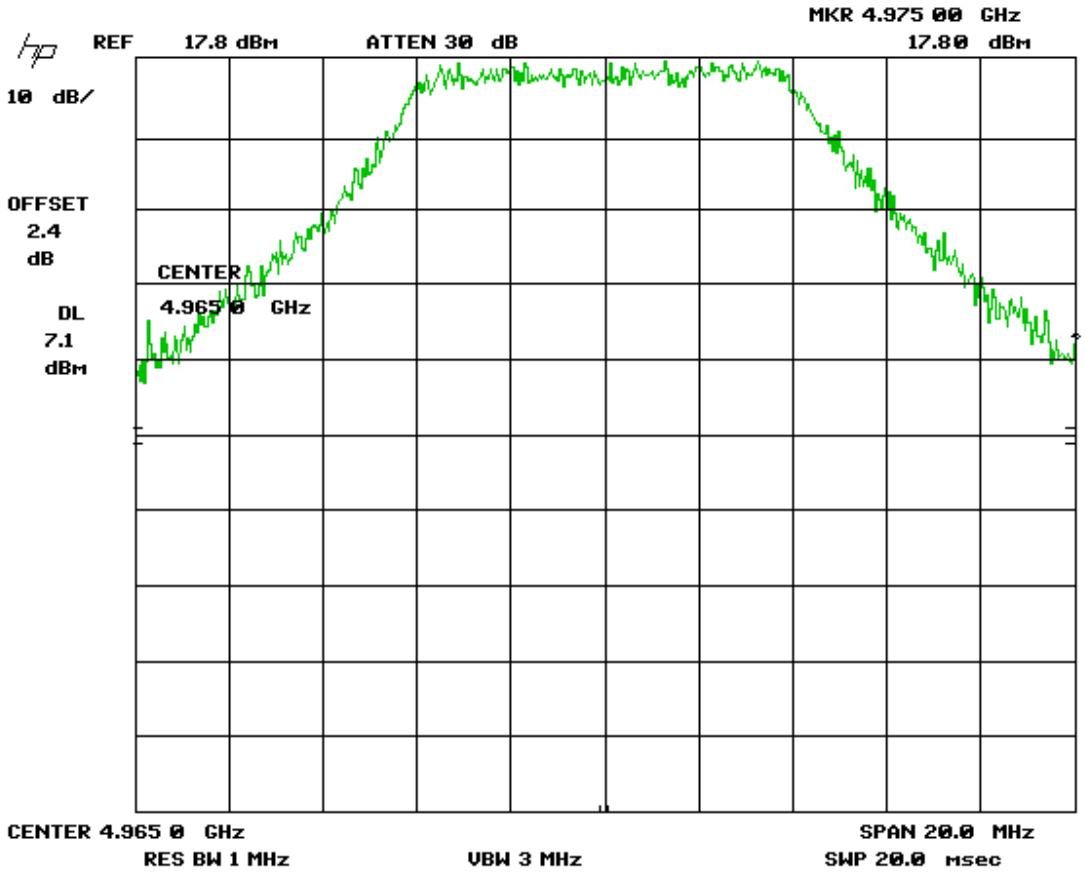

Figure 8 - Peak Power Spectral Density- Mid Channel

Note: Peak measurement

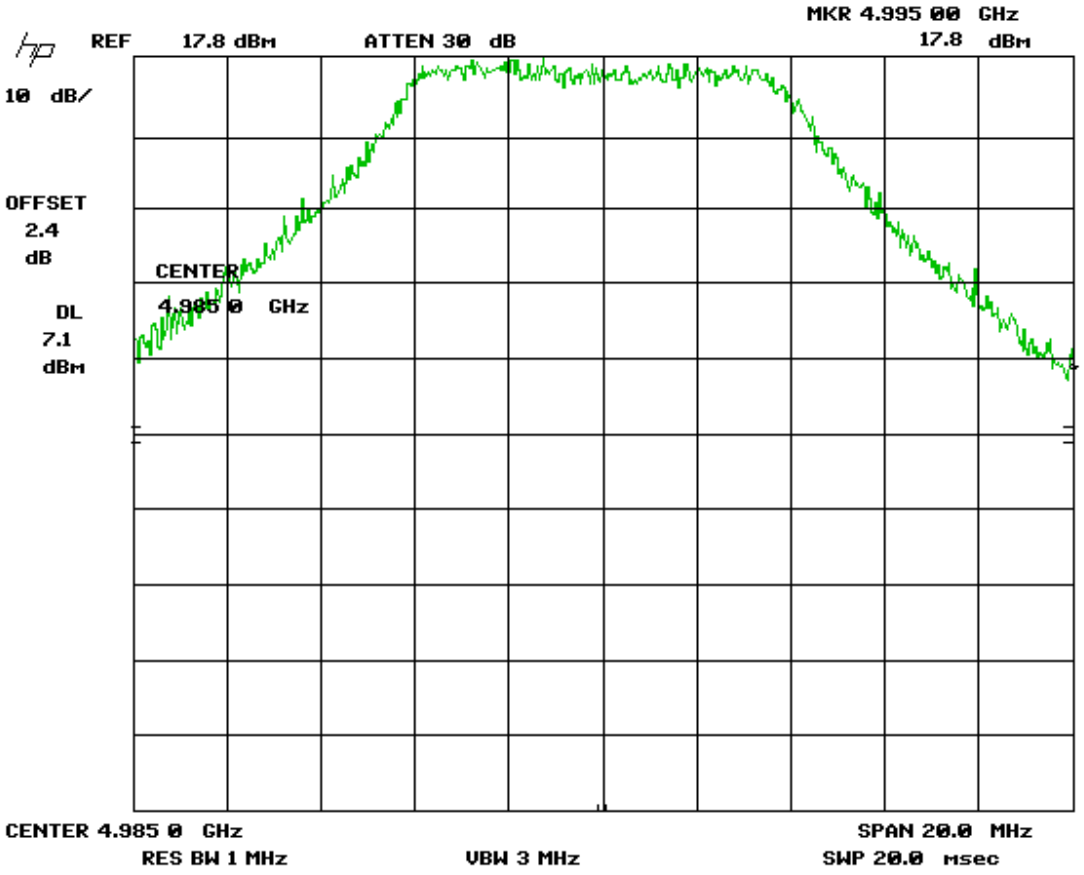

Figure 9 - Peak Power Spectral Density- High Channel

Note: Peak measurement

2.9 Occupied Bandwidth (FCC Section 2.1049, 90.209, 90.210)

The transmitter was modulated by a 2.5 KHz tone signal at an input level 16 dB greater than that required to produce 50% modulation (e.g.: +2.5 KHz peak deviation at 1 KHz modulating frequency). The input level was established at the frequency of maximum response of the audio modulating circuit.

The occupied bandwidth of the fundamental was measured using a spectrum analyzer, as shown in Figures 9 through 11.

2.10 Mask M per FCC Part 90.210

(1) On any frequency removed from the assigned frequency between 0–45% of the authorized bandwidth (BW): 0 dB.

(2) On any frequency removed from the assigned frequency between 45–50% of the authorized bandwidth: 568 log (% of (BW)/45) dB.

(3) On any frequency removed from the assigned frequency between 50–55% of the authorized bandwidth: 26 + 145 log (% of BW/50) dB.

(4) On any frequency removed from the assigned frequency between 55–100% of the authorized bandwidth: 32 + 31 log (% of (BW)/55) dB.

(5) On any frequency removed from the assigned frequency between 100–150% of the authorized bandwidth: 40 + 57 log (% of (BW)/100) dB.

(6) On any frequency removed from the assigned frequency between above 150% of the authorized bandwidth: 50 dB or 55 + 10 log (P) dB, whichever is the lesser attenuation.

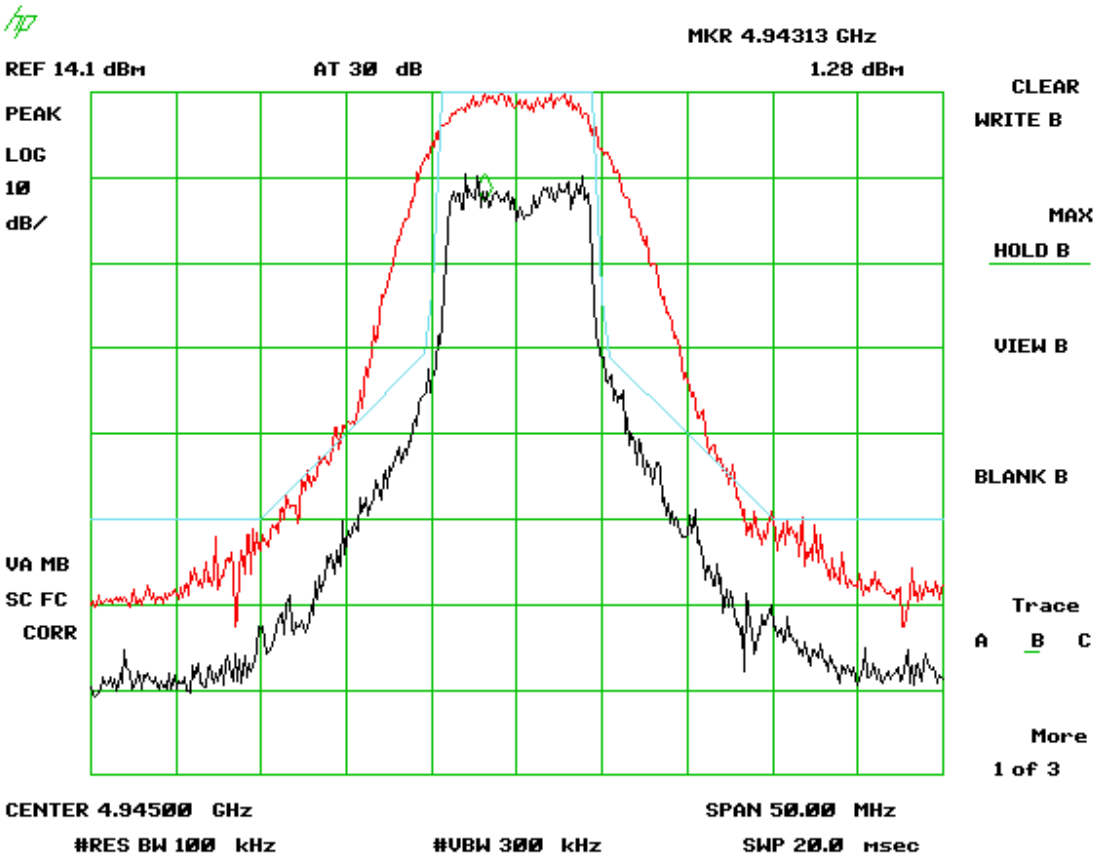

Figure 10 - Occupied Bandwidth of Transmitter Tuned to 4945 MHz

Note: The red waveform is at higher measurement Resolution Bandwidth (3 MHz) and it is used as the maximum power indicator. The black waveform is at 100 KHz measurement Resolution Bandwidth. The Black waveform must meet the limits.
Note: Peak measurement

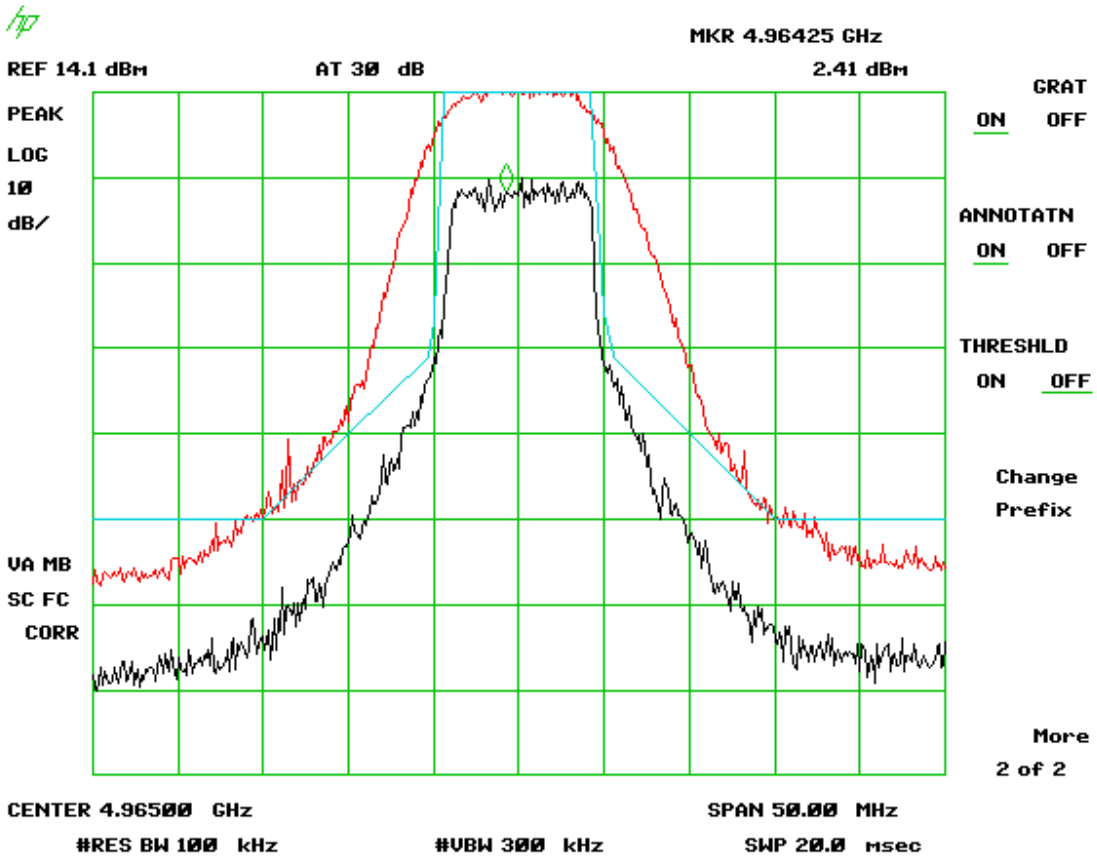

Figure 11 - Occupied Bandwidth of Transmitter Tuned to 4965 MHz

Note: The red waveform is at higher measurement Resolution Bandwidth (3 MHz) and it is used as the maximum power indicator. The black waveform is at 100 KHz measurement Resolution Bandwidth. The Black waveform must meet the limits.
Note: Peak measurement

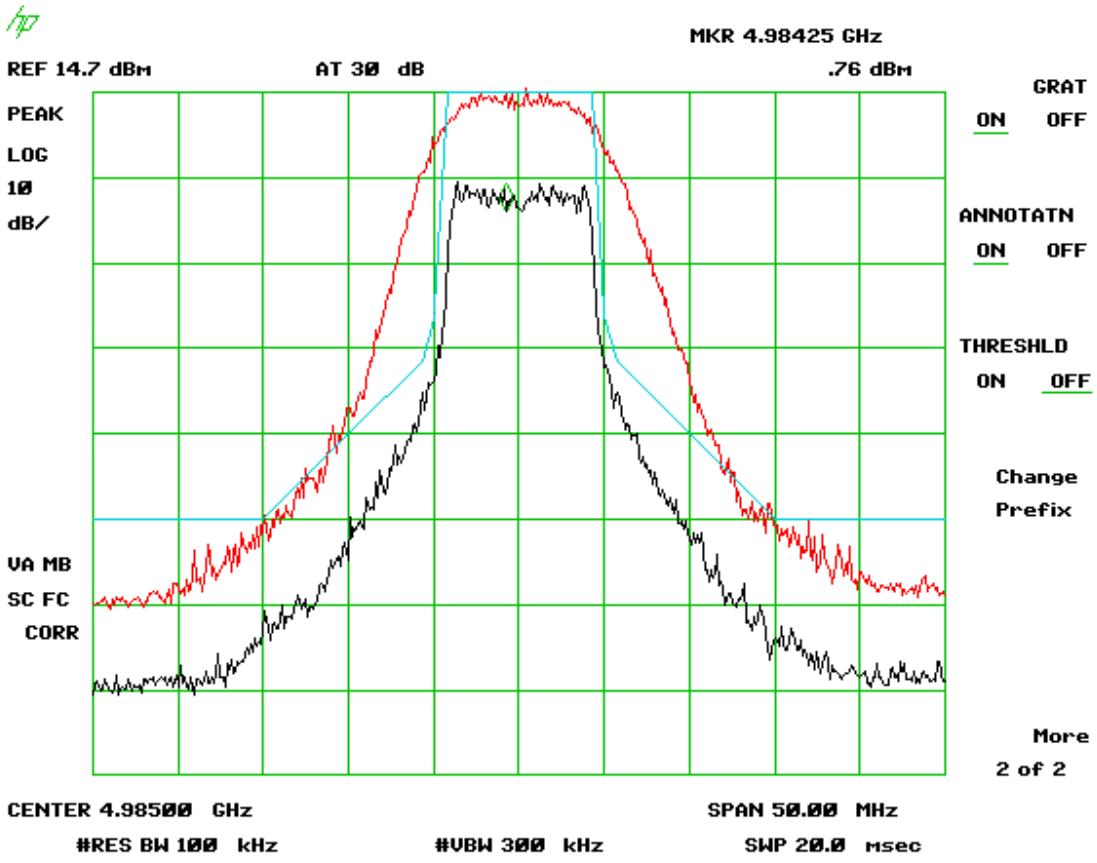

Figure 12 - Occupied Bandwidth of Transmitter Tuned to 4985 MHz

Note: The red waveform is at higher measurement Resolution Bandwidth (3 MHz) and it is used as the maximum power indicator. The black waveform is at 100 KHz measurement Resolution Bandwidth. The Black waveform must meet the limits.
Note: Peak measurement

2.11 Spurious Emissions at Antenna Terminals (FCC 2.1051, 2.1057, 90.210)

Spurious emissions in the frequency range 30 MHz – 5 GHz have been measured with a spectrum analyzer by connecting the spectrum analyzer directly via a short cable and attenuator (whose loss was entered in the spectrum analyzer as offset) to the antenna output terminals. The spectrum analyzer was set for a 50? impedance with the RBW = 100 kHz and VBW> RBW.

2.11.1 Spurious Emissions Limits

At least 50 + 10 log (P watt) dB or 70 dB, whichever is the lesser attenuation.

2.11.2 Test data

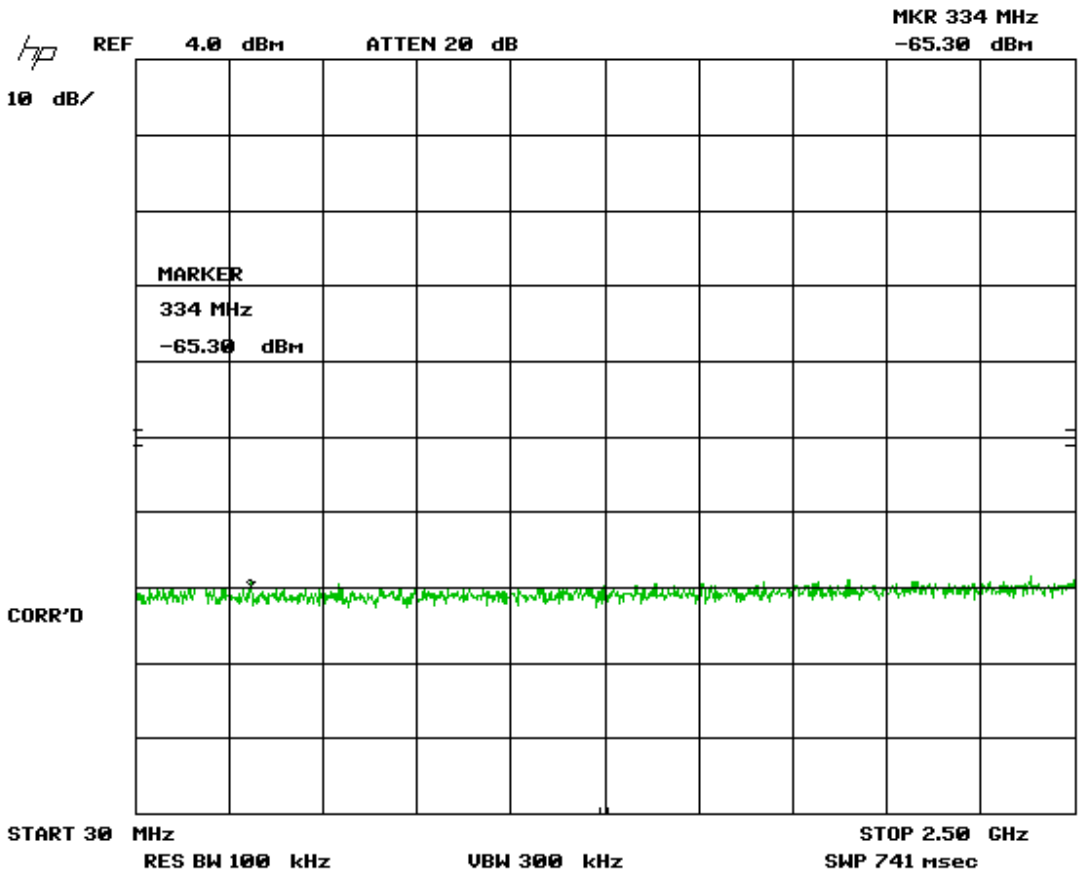

Figure 13 - Antenna Conducted Spurious Emissions

Attenuation = 45.1 dBm - (-26 dBm) = 71.1 > Limit = 50 + 10 log (P_{watt}) = 64.8 dB

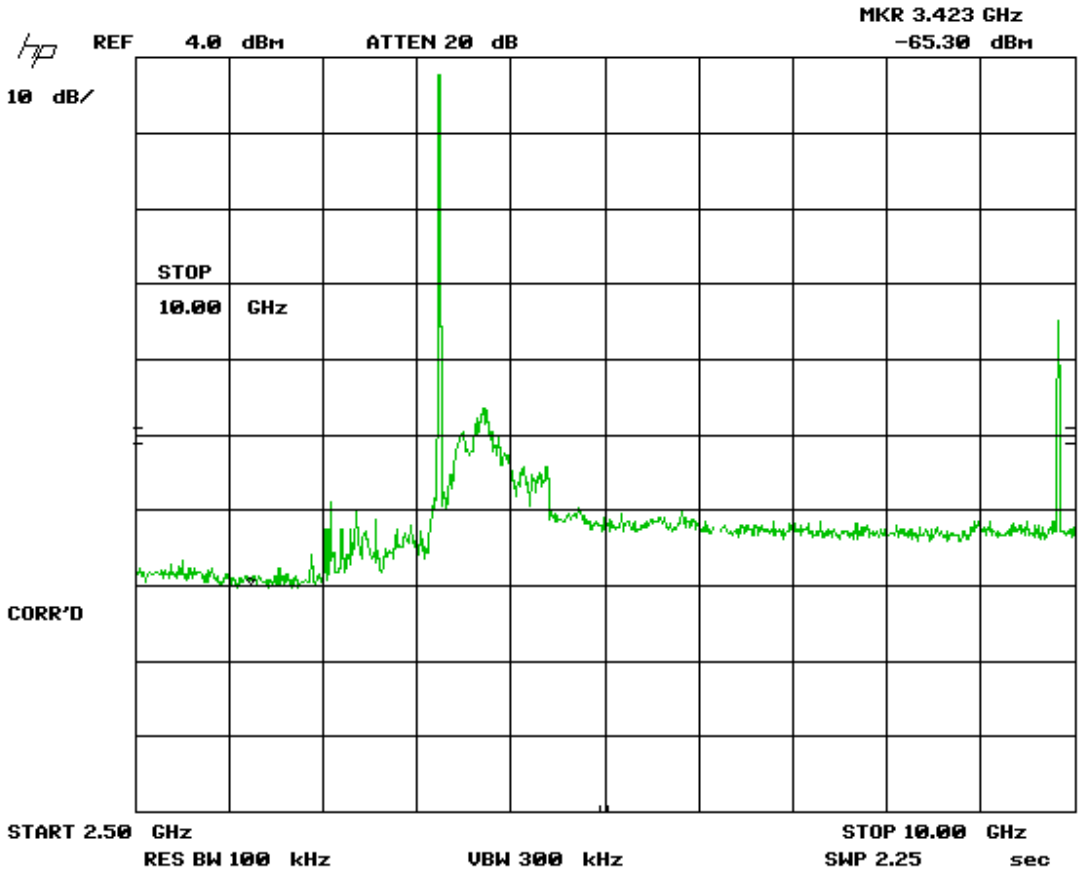

Figure 14 - Antenna Conducted Spurious Emissions

Attenuation = 45.1 dBm -(-19.9 dBm) = 65 > Limit = 50 + 10 log (P_{watt}) = 64.8 dB

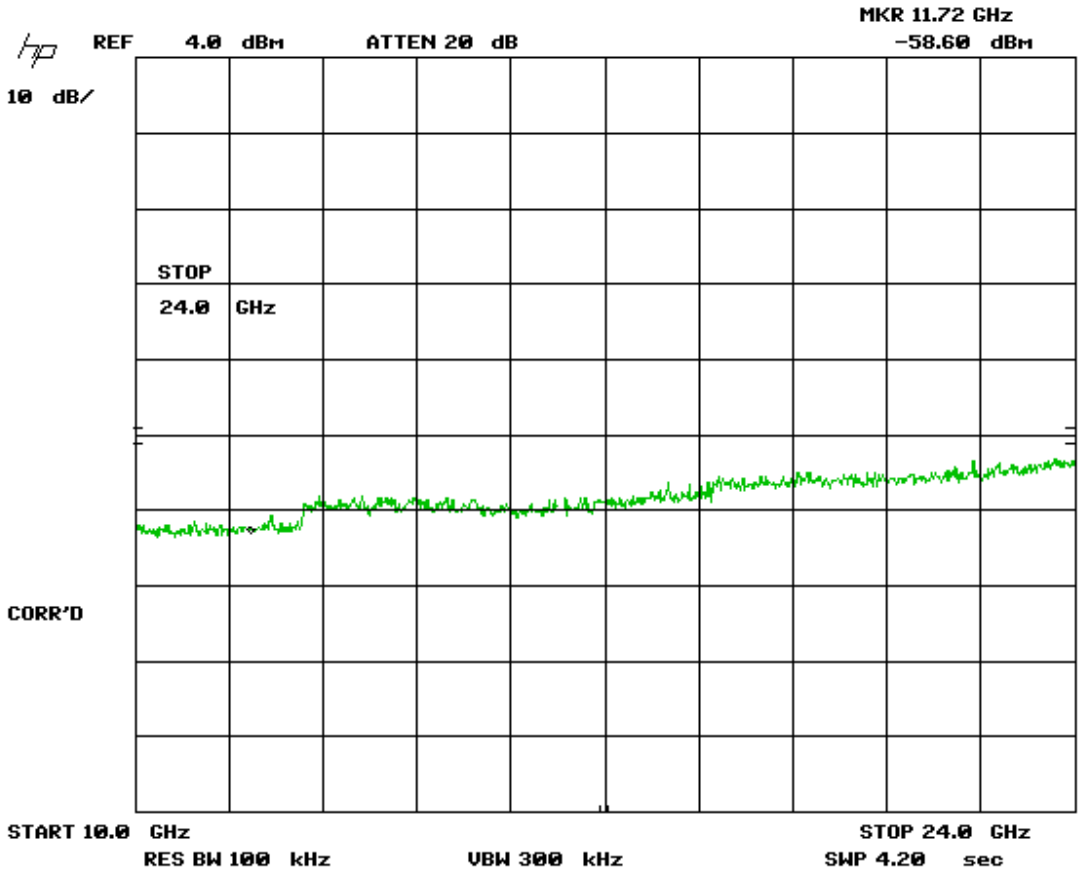

Figure 15 - Antenna Conducted Spurious Emissions

Attenuation = 45.1 dBm -(-27.5 dBm) = 72.6 > Limit = 50 + 10 log (P_{watt}) = 64.8 dB

2.12 Frequency Stability (FCC 2.1055, 90.213(a))

The EUT RF output was measured as its input bias voltages were changed from 4.5 VDC to 5.0 VDC and to 5.5 VDC while the temperature was varied from -30ºC to +50 ºC. Each soak period was 10 minutes. The EUT frequency stability versus temperature and DC bias variation was within the FCC 2.1055 requirements. Frequency change was less than 1 ppm (part per million).

2.12.1 Frequency Stability Requirements

Over the temperature range of -30 ºC to +50 ºC, for fixed and based stations operating in the frequency range of 4945 MHz with channel bandwidth of 10 MHz, transmitters used must have a minimum frequency stability of 2.0 ppm. For mobile products the limit is 2.5 KHz.

2.12.2 Frequency Stability Test Data

Table 6 - Transmitter Frequency Stability

Center Frequency:	4945.0
Full Power Level:	0.195 W
Frequency Tolerance Limit:	10.0 ppm
Max. Frequency Tolerance Measured:	2.0 ppm
Measured Input Voltage:	24 V
Measured Input Current:	1.0 A

Table 7 - Frequency Stability Measurement at Nominal Voltage

Temperature (degrees C)	Measured Frequency (MHz)	Deviation (ppm)
-30	4940.9060	1.6
-20	4940.9080	2.0
-10	4940.9040	1.2
0	4940.9000	0.4
10	4940.9000	0.4
20	4940.8980	0.0
30	4940.8980	0.0
40	4940.9060	1.6
50	4940.9080	2.0

Table 8 - Frequency Stability Measurement Voltage Variation

Temperature (degrees C)	Measured Frequency (MHz)	Deviation (ppm)
85%	4940.9040	1.2
100%	4940.8980	0.0
115%	4940.9080	2.0

2.13 Field Strength of Spurious Radiation (FCC Section 2.1053, 2.1057, 90.210)

Spurious emissions were evaluated from 30 MHz to 5 GHz at a distance of 3 meters from the EUT.

The EUT was placed on an open area test site and the spurious emissions tested with the EUT antenna terminated with a 50 Ohm load. Measurements for 30 to 1000 MHz were made with the analyzer's bandwidth at 10 kHz and video bandwidth set to 300 kHz.

The EUT's emissions were recreated with a signal generator and transmit antenna and the power was measured and recorded by the substitution method. Measurements above 1 GHz were made with the analyzer's resolution bandwidth set to 1 MHz.

Table 9 - Field Strength of Spurious Radiation

Frequency	Maximum RX Reading (Units A)	Recreated Reading During Substitution (Using Same Units A) - Ideally 0	Difference Column A - B	TX Gain (dBi)	TX Gain Relative to Dipole (dB)	RF Power into TX antenna (Corrected (dBm) (SG Value-CL)	RF Power into substitution TX antenna corrected by TX Gain Relative to Dipole (dBm)	Limit (dBm)	Margin Below Limit (dB)
The following applies information from test as performed									
9892	57.6	57	0.6	12.3	10.16	-33.42	-22.66	-13	9.66
9932	56.9	56.7	0.2	12.3	10.16	-34.42	-24.06	-13	11.06
9971	55.3	55.8	-0.5	12.3	10.16	-36.82	-27.16	-13	14.16

Test Date: October 4, 2011

Tester Signature: Keyvan Muvahhid **Name: Keyvan Muvahhid**

2.14 RF Exposure Requirements (1.1310 & 2.1091)

Limits § **1.1310:** The criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in 1.1307(b).

2.14.1 Maximum Public Exposure to RF (MPE), Minimum Distance requirements

The maximum exposure level to the public from the RF power of the EUT shall not exceed the following:

Occupational/Controlled Exposure, $\mathbf{S}_{\mathbf{controlled}}$ [mW/cm^2] =450/300=
1.50 mW/cm^2= 15W/m^2

General population/Uncontrolled Exposure, $\mathbf{S}_{\mathbf{uncontrolled}}$ [mW/cm^2] =450/1500=
0.3 mW/cm^2= 3W/m^2

Therefore, for: Gain Antenna= 6 dBi (3.981numeric)

Peak Power (Watts) = 0.195 (from Table 3 of Test Report)
Gain of Transmit Antenna = 6 dB_i = 3.981 numeric,
$\mathbf{r}_{\mathbf{controlled}}$ = v(PG/ 4? S)= v (0.195(3.981)/4*p*15)= 0.06 m= 6 cm

$\mathbf{r}_{\mathbf{uncontrolled}}$ = v(PG/ 4? S)= v (0.195(3.981)/4*p*3)= 0.14 m= 14 cm

2.15 Unintentional Radiator, Radiated Emissions (CFR 15.109 (a))

The test data provided herein supports the verification requirement for digital devices. Radiated emissions coming from the EUT in a non-transmit state per 15.109 and radiated emissions coming for the EUT in a transmitting state per 15.209 were evaluated from 30 MHz to the 5th harmonic of the highest frequency generated as detailed in ANSI C63.4, Paragraph 8. The worst case is presented herein.

For EUT with oscillator circuits that generate a frequency below 30 MHz, measurements were made with the analyzer's resolution bandwidth set to 9 KHz and a calibrated Loop Antenna was used. At frequencies below 30 MHz, measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field. Pending the development of an appropriate measurement procedure for measurements performed below 30 MHz, when performing measurements at a closer distance than specified, the results shall be extrapolated to the specified distance by either making measurements at a minimum of two distances on at least one radial to determine the proper extrapolation factor or by using the square of an inverse linear distance extrapolation factor (40 dB/decade) (CFR15.31f(2)).

All emission within the range of 1.705 MHz to 30 MHz was less than 20 dBm from the applicable limit. The test was conducted using a calibrated loop antenna on US Tech's OATS site at a distance of 3 meters.

For measurements above 30 MHz measurements were made with the analyzer's resolution bandwidth set to 120 kHz for measurements made below 1 GHz and 1 MHz for measurements made above 1 GHz. The video bandwidth was set to three times the resolution bandwidth: 1 MHz RBW and 3 MHz VBW. The test data was maximized for magnitude by rotating the turn-table through 360 degrees and raising and lowering the receiving antenna between 1 to 4 meters in height as a part of the measurement procedure.

All measured signals were at least 12.3 dB below the specification limit. The results are shown in Table 10 following.

Table 10 - Unintentional Radiator, Radiated Emissions

Unintentional Radiator, Radiated Emissions- 30 MHz to 24 GHz							
Test By: J.W.	Test: FCC Part 15.109, 15.209			Client: Novarum, Inc.			
	Project: 11-0222 Class: A			Model: Novarum Mobile 49			
Frequency (MHz)	**Test Data (dBuV)**	**AF+CL-PA (dB)**	**Results (dBuV/m)**	**Limits (dBuV/m)**	**Distance /**	**Margin (dB)**	**DETECTOR PK / QP**
Tested from 30 MHz to 24 GHz							
64.7940	52.70	-27.63	25.07	39.0	3.0m./	13.9	**PK**
108.7900	52.20	-25.08	27.12	43.5	3.0m./	16.4	**QP**
79.2520	48.90	-27.05	21.86	39.0	3.0m./	17.1	**PK**
108.7520	51.00	-25.38	25.62	43.5	3.0m./	17.9	**PK**
631.4100	41.10	-14.17	26.93	46.4	3.0m./	19.5	**PK**
779.9960	44.70	-11.12	33.58	46.4	3.0m./	12.8	**QP**
780.0000	45.70	-11.62	34.08	46.4	3.0m./	12.3	**QP**
213.2300	49.20	-22.99	26.21	43.5	3.0m./	17.3	**PK**
780.0000	46.10	-11.62	34.48	46.4	3.0m./	11.9	**QP**
1169.92	52.20	-19.00	33.20	49.5	3.0m./	16.3	**PK**

-No other emissions detected within 20 dB of the FCC Part 15.109 and 15.209 limits
-Measurements made at 3 m were extrapolated to 10 m using an extrapolation factor of -10.5 dBm
-AF = Antenna Factor CL = Cable Loss PA = Preamplifier Gain

SAMPLE CALCULATION:
RESULTS: At 64.7940 MHz: 52.70 + (-27.63) = 25.07 dBuV/m @ 3m
Margin = (24.86-40.0) = 15.1 dB

Test Date: October 5, 2011
Tested by Signature:  Name: John Wynn

2.16 Unintentional Radiator Power Lines Conducted Emissions (CFR 15.107)

The test data provided herein is to support the Verification requirement for the digital apparatus. The power line conducted voltage measurements for Receiver and Digital Devices have been carried out in accordance with CFR 15.107 and ANSI C63.4, Paragraph 7, with a spectrum analyzer connected to an LISN and the EUT placed into an idle condition or a continuous mode of receive (non-transmitting). Please refer to the results as shown in Table 11 below.

Table 11 - Power Line Conducted Emissions Data

CONDUCTED EMISSIONS						
Tested By: JW	Specification Requirement: FCC Part 15, Para 15.107 Class A		Project No.: 11-0222	Manufacturer/Model: Novarum Mobile 49		
Frequency (MHz)	**Test Data (dBuV)**	**LISN+CL-PA (dB)**	**Corrected Results (dBuV)**	**Avg Limits (dBuV)**	**Margin (dB)**	**Detector**
120 VAC, 60 Hz, Supply Line						
0.1612	60.60	0.46	61.06	66.0	4.9	PK
0.5300	36.60	0.14	36.74	60.0	23.3	PK
1.3920	29.50	0.26	29.76	60.0	30.2	PK
7.0050	29.90	0.53	30.43	60.0	29.6	PK
15.1300	38.10	0.75	38.85	60.0	21.2	PK
29.2300	41.10	1.06	42.16	60.0	17.8	PK
120 VAC, 60 Hz, Neutral Line						
0.1682	58.60	0.46	59.06	66.0	6.9	PK
0.5260	29.90	0.24	30.14	60.0	29.9	PK
3.7480	28.00	0.33	28.33	60.0	31.7	PK
7.9600	28.40	0.53	28.93	60.0	31.1	PK
15.7800	38.60	0.75	39.35	60.0	20.7	PK
29.2400	39.70	1.06	40.76	60.0	19.2	PK

Test Date: October 5, 2011
Tested by Signature: _____ Name: John Wynn

2.17 Measurement Uncertainty

2.17.1 Conducted Emissions Measurement Uncertainty

Measurement Uncertainty (within a 95% confidence level) for this test is ±2.8 dB. The data listed in this test report does have sufficient margin to negate the effects of uncertainty, therefore, the EUT unconditionally meets this requirement.

2.17.2 Radiated Emissions Measurement Uncertainty

For a measurement distance of 3 m the measurement uncertainty (with a 95% confidence level) for this test using a Biconical Antenna (30 MHz to 200 MHz) is ±5.3 dB. This value includes all elements of measurement.

The measurement uncertainty (with a 95% confidence level) for this test using a Log Periodic Antenna (200 MHz to 1000 MHz) is ±5.1 dB.

The measurement uncertainty (with a 95% confidence level) for this test using a Horn Antenna is ±5.1 dB.

The data listed in this test report does have sufficient margin to negate the effects of uncertainty, therefore, the EUT unconditionally meets this requirement.