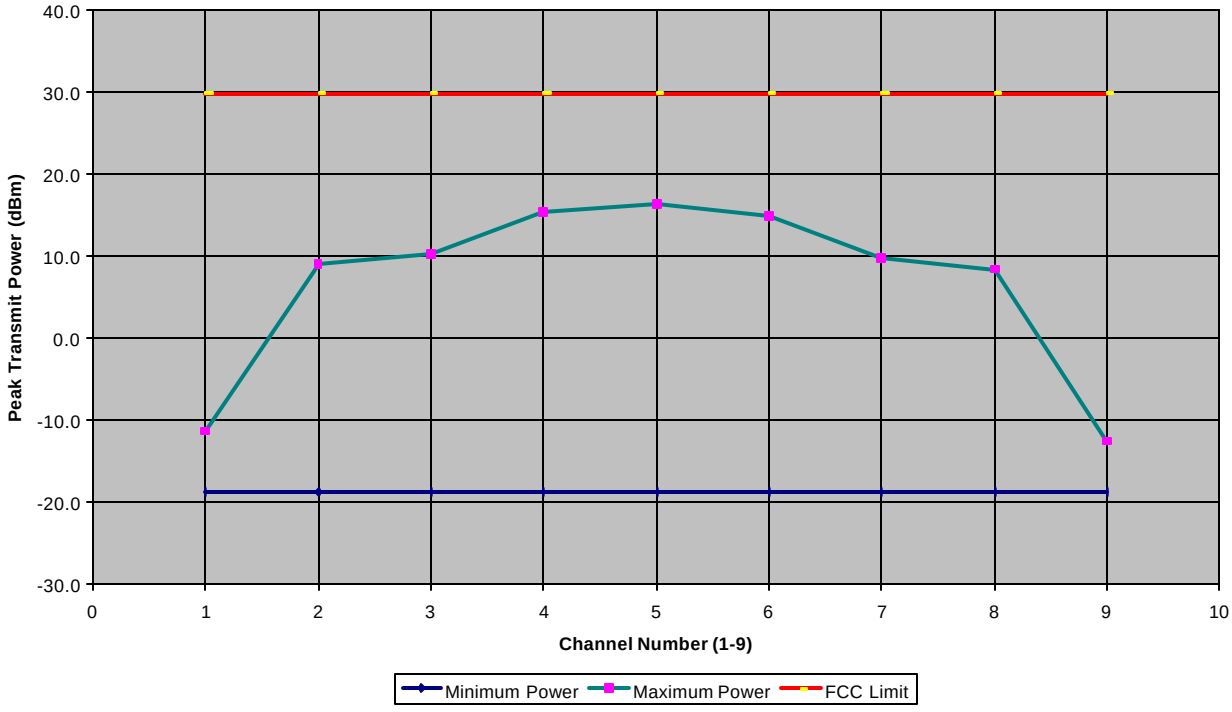
6.8.5.4.2. Maximum Peak Transmit Power

		PEAK TRANSMIT POWER (Measured a Peak Power Meter) (dBm)				
Transmitter Channel	Frequency (MHz)	64QAM (54 Mb/s)	16QAM (36 Mb/s)	QPSK (18 Mb/s)	BPSK (9 Mb/s)	Limit (dBm)
1	5.735	-7.4	-7.4	-7.4	-7.4	29.9
2	5.745	16.6	16.6	16.6	16.6	29.9
3	5.755	17.3	17.3	17.3	17.3	29.9
4	5.765	20.0	20.0	20.0	20.0	29.9
5	5.775	20.5	20.5	20.5	20.5	29.9
6	5.785	20.0	20.0	20.0	20.0	29.9
7	5.795	17.3	17.3	17.3	17.3	29.9
8	5.805	16.6	16.6	16.6	16.6	29.9
9	5.815	-7.4	-7.4	-7.4	-7.4	29.9
Notes: The transmitter was measured at stable temperature after 1 hour warn-up on transmit mode.						

6.8.5.4.3. Peak Transmit EIRP & Antenna Gains

Since maximum EIRP = 20.5 dBm (Maximum Peak Transmit Power) + 28 dBi - 23 dBi = 25.5 dBm, which is less than 30 dBm., there will be no reduction in the maximum conducted output power is required for use with 23 dBi and 28 dBi gain antennas..

Peak Transmit Power
Redline Communications Inc.
Access Node, Model AN-50



6.9. RF EXPOSURE REQUIRMENTS @ FCC 15.407(F), 1.1310 & 2.1091

6.9.1. Limits

- **FCC 15.407(f):** U-NII devices are subject to the radio frequency radiation exposure requirements specified in Sec. 1.1307(b), Sec. 2.1091 and Sec. 2.1093 of this chapter, as appropriate. All equipment shall be considered to operate in a ``general population/uncontrolled'' environment. Applications for equipment authorization of devices operating under this section must contain a statement confirming compliance with these requirements for both fundamental emissions and unwanted emissions. Technical information showing the basis for this statement must be submitted to the Commission upon request.
- **FCC 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).

LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Average Time (minutes)
(B) Limits for General Population/Uncontrolled Exposure				
1500-100,000	...	...	1.0	30

F = Frequency in MHz

6.9.2. Method of Measurements

Refer to FCC @ 1.1310, 2.1091 and Public Notice DA 00-705 (March 30, 2000)

- Spread spectrum transmitters operating under section 15.407 are categorically from routine environmental evaluation to demonstrating RF exposure compliance with respect to MPE and/or SAR limits. These devices are not exempted from compliance (As indicated in Section 15.407(b)(4), these transmitters are required to operate in a manner that ensures that exposure to public users and nearby persons) does not exceed the Commission's RF exposure guidelines (see Section 1.1307 and 2.1093). Unless a device operates at substantially low power levels, with a low gain antenna(s), supporting information is generally needed to establish the various potential operating configurations and exposure conditions of a transmitter and its antenna(s) in order to determine compliance with the RF exposure guidelines.

- In order to demonstrate compliance with MPE requirements (see Section 2.1091), the following information is typically needed:

(1) Calculation that estimates the minimum separation distance (20 cm or more) between an antenna and persons required to satisfy power density limits defined for free space.
(2) Antenna installation and device operating instructions for installers (professional/unskilled users), and the parties responsible for ensuring compliance with the RF exposure requirement
(3) Any caution statements and/or warning labels that are necessary in order to comply with the exposure limits
(4) Any other RF exposure related issues that may affect MPE compliance

Calculation Method of RF Safety Distance:

$S = PG/4\Pi r^2 = EIRP/4\Pi r^2$

Where: P: power input to the antenna in mW
EIRP: Equivalent (effective) isotropic radiated power.
S: power density mW/cm^2
G: numeric gain of antenna relative to isotropic radiator
r: distance to centre of radiation in cm

FCC radio frequency exposure limits may be exceeded at distances closer than r cm from the antenna of this device

$r = \sqrt{PG/4\Pi S}$

FCC radio frequency exposure limits may not be exceeded at distances closer than r cm from the antenna of this device

- For portable transmitters (see Section 2.1093), or devices designed to operate next to a person's body, compliance is determined with respect to the SAR limit (define in the body tissues) for near-field exposure conditions. If the maximum average output power, operating condition configurations and exposure conditions are comparable to those of existing cellular and PCS phones., an SAR evaluation may be required in order to determine if such a device complies with SAR limit. When SAR evaluation data is not available, and the additional supporting information cannot assure compliance, the Commission may request that a SAR evaluation be performed, as provided for in Section 1.1307(d)

6.9.3. Test Data

Frequency of Maximum Peak Transmit Power sin Sec. 6.8 (GHz)	Measured Peak Conducted Transmit Power in Sec. 6.8 (dBm)	Maximum Antenna Gain (dBi)	Maximum EIRP (dBi)	Laboratory's Recommended Minimum RF Safety Distance r (cm)
5.775	19.7	28	47.7	68.5

Note 1: **RF EXPOSURE DISTANCE LIMITS:** $r = (PG/4 \pi S)^{1/2} = (EIRP/4 \pi S)^{1/2}$
$S = 1.0 \text{ mW/cm}^2$

Evaluation of RF Exposure Compliance Requirements	
RF Exposure Requirements	**Compliance with FCC Rules**
Minimum calculated separation distance between antenna and persons required: 68.5 cm	Manufacturer' instruction for separation distance between antenna and persons required: 1.5 meters Please refer to Page 12-19 of Users Manual for detailed information of equipment and antenna installation for compliance with RF Exposure Requirements.
Antenna installation and device operating instructions for installers (professional/unskilled users), and the parties responsible for ensuring compliance with the RF exposure requirement	Required Professional Installation for compliance with RF Exposure and FCC 15.203 & 15.204 Please refer to Page 12-19 of Users Manual for detailed information of equipment and antenna installation.
Caution statements and/or warning labels that are necessary in order to comply with the exposure limits	Please refer to Page 12-19 of Users Manual for detailed information of equipment and antenna installation.
Any other RF exposure related issues that may affect MPE compliance	N/A

6.10. BAND-EDGE & UNDESIRED EMISSIONS (CONDUCTED), FCC CFR 47, PARA. 15.407(B)

6.10.1. Limits

Undesirable emission limits: the PEAK emissions outside of the frequency bands of operation shall be attenuated in accordance with the following limits:

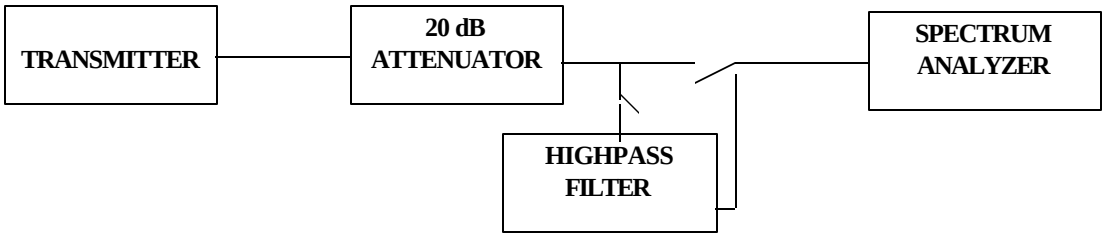
(1) For transmitters operating in the 5.725-5.825 GHz band: all emissions within the frequency range from the band edge to 10 MHz above or below the band edge shall not exceed an EIRP of -17 dBm/MHz; for frequencies 10 MHz or greater above or below the band edge, emissions shall not exceed an EIRP of -27 dBm/MHz.

(2) The emission measurements shall be performed using a minimum resolution bandwidth of 1 MHz. A lower resolution bandwidth may be employed near the band edge, when necessary, provided the measured energy is integrated to show the total power over 1 MHz.

6.10.2. Method of Measurements

Refer to Exhibit 8, Sec. 8.4 of this test report, FCC 15.407(b) & ANSI C63-4:1992

6.10.3. Test Arrangement



6.10.4. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer/ EMI Receiver	Hewlett Packard	HP 8593EM	3412A00103	9 kHz – 26.5 GHz

6.10.5. Test Data

6.10.5.1. BAND-EDGE (CONDUCTED)

- Plots # 68 to 70 in Annex 1 show Band-Edge Emissions of lowest, middle and highest channel frequencies at lowest power setting (-18.6 dBm Peak Transmit Power), modulation: 64QAM (data rate: 54 Mb/s max.)
- Plots # 71 through 79 in Annex 1 show Band-Edge Emissions set at maximum Peak Transmit Power, Modulation: 64QAM (54 Mb/s max.). Tests were performed on every channel frequency since the maximum rf output power ratings are different with respect to channel frequencies.
- Plots # 80 through 81 in Annex 1 show Band-Edge Emissions of middle channel frequency at its highest power setting, modulations: 16QAM (36 Mb/s), QPSK (18 Mb/s) and BPSK (9 Mb/s). These plots are performed to prove that the rf output spectrums are the same for all modulations at their maximum data rate. Therefore, it was Band-Edge Emissions tests for every channel with different modulation are not necessary.

Comments:

It is more desirable to review the Band-Edge Radiated Emissions since the out-of-band limit is specified in EIRP. The conversion from EIRP to Conducted Power can not be appropriately done since the antenna gain outside the permitted band may not be necessary the specified antenna gain and it is unknown. Please refer Sec. 6.10 of this test report for details of Band-Edge Radiated Emissions.

6.10.5.2. TRANSMITTER CONDUCTED SPURIOUS/HARMONIC EMISISONS AT LOWEST FREQUENCY (5.735 GHZ), MODULATION: 64QAM (54 MB/S)

6.10.5.2.1. Minimum Peak Transmit Power Setting (-18.6 dBm)

- The emissions were scanned from 10 MHz to 40 GHz and no emissions were found less 30 dB below the limits (-27 dBm/MHz) were. Please to Plots # 95 to 98 in Annex 1

6.10.5.2.2. Maximum Peak Transmit Power Setting (-7.4 dBm)

- The emissions were scanned from 10 MHz to 40 GHz and no emissions were found less 30 dB below the limits (-27 dBm/MHz) were. Please to Plots # 83 to 86 in Annex 1

6.10.5.3. TRANSMITTER CONDUCTED SPURIOUS/HARMONIC EMISISONS AT MIDDLE FREQUENCY (5.775 GHZ), MODULATION: 64QAM (54 MB/S)

6.10.5.3.1. Minimum Peak Transmit Power Setting (-18.6 dBm)

- The emissions were scanned from 10 MHz to 40 GHz and no emissions were found less 30 dB below the limits (-27 dBm/MHz) were. Please to Plots # 99 to 102 in Annex 1

6.10.5.3.2. Maximum Peak Transmit Power Setting (+20.5 dBm)

- The emissions were scanned from 10 MHz to 40 GHz and no emissions were found less 30 dB below the limits (-27 dBm/MHz) were. Please to Plots # 87 to 90 in Annex 1

6.10.5.4. TRANSMITTER CONDUCTED SPURIOUS/HARMONIC EMISISONS AT HIGHEST FREQUENCY (5.815 GHZ), MODULATION: 64QAM (54 MB/S)

6.10.5.4.1. Minimum Peak Transmit Power Setting (-18.6 dBm)

- The emissions were scanned from 10 MHz to 40 GHz and no emissions were found less 30 dB below the limits (-27 dBm/MHz) were. Please to Plots # 103 to 106 in Annex 1

6.10.5.4.2. Maximum Peak Transmit Power Setting (-7.4 dBm)

- The emissions were scanned from 10 MHz to 40 GHz and no emissions were found less 30 dB below the limits (-27 dBm/MHz) were. Please to Plots # 91 to 94 in Annex 1

6.10.5.5. TRANSMITTER SPURIOUS/HARMONIC CONDUCTED EMISISONS FOR MODULAITONS: 16QAM, QPSK & BPSK

- Our prescans show difference for spurious/harmonic emissions with different modulation; therefore, final tests are not necessary to be performed.

6.11. BAND-EDGE AND UNDESIRED EMISSIONS (RADIATED @ 3 METERS), FCC 15.407(B)

6.11.1. Limits

Undesirable emission limits: the PEAK emissions outside of the frequency bands of operation shall be attenuated in accordance with the following limits:

(3) For transmitters operating in the 5.725-5.825 GHz band: all emissions within the frequency range from the band edge to 10 MHz above or below the band edge shall not exceed an EIRP of -17 dBm/MHz; for frequencies 10 MHz or greater above or below the band edge, emissions shall not exceed an EIRP of -27 dBm/MHz.

(4) The emission measurements shall be performed using a minimum resolution bandwidth of 1 MHz. A lower resolution bandwidth may be employed near the band edge, when necessary, provided the measured energy is integrated to show the total power over 1 MHz.

(5) Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in Sec. 15.209.

(6) The provisions of Sec. 15.205 apply to intentional radiators operating under this section. (7) When measuring the emission limits, the nominal carrier frequency shall be adjusted as close to the upper and lower frequency block edges as the design of the equipment permits.

Remarks:

FCC CFR 47, Part 15, Subpart E, Para. 15.205(a) - Restricted Frequency Bands

MHz	MHz	MHz	GHz
0.090 - 0.110	162.0125 - 167.17	2310 - 2390	9.3 - 9.5
0.49 – 0.51	167.72 - 173.2	2483.5 - 2500	10.6 - 12.7
2.1735 - 2.1905	240 - 285	2655 - 2900	13.25 - 13.4
8.362 - 8.366	322 - 335.4	3260 - 3267	14.47 - 14.5
13.36 - 13.41	399.9 - 410	3332 - 3339	14.35 - 16.2
25.5 – 25.67	608 - 614	3345.8 - 3358	17.7 - 21.4
37.5 – 38.25	960 - 1240	3600 - 4400	22.01 - 23.12
73 - 75.4	1300 - 1427	4500 - 5250	23.6 - 24.0
108 – 121.94	1435 - 1626.5	5350 - 5460	31.2 - 31.8
123 – 138	1660 - 1710	7250 - 7750	36.43 - 36.5
149.9 – 150.05	1718.8 - 1722.2	8025 - 8500	Above 38.6
156.7 – 156.9	2200 - 2300	9000 - 9200	

FCC CFR 47, Part 15, Subpart E, Para. 15.209(a)
-- Field Strength Limits within Restricted Frequency Bands --

FREQUENCY (MHz)	FIELD STRENGTH LIMITS (microvolts/m)	DISTANCE (Meters)
0.009 - 0.490	2,400 / F (KHz)	300
0.490 - 1.705	24,000 / F (KHz)	30
1.705 - 30.0	30	30
30 – 88	100	3
88 – 216	150	3
216 – 960	200	3
Above 960	500	3

6.11.2. Method of Measurements

Refer to Exhibit 8, Sec. 8.4 of this test report and **ANSI 63.4-1992, Para. 8** for detailed radiated emissions measurement procedures.

The following measurement procedures were also applied:

- Applies to harmonics/spurious that fall in the restricted bands listed in Section 15.205. the maximum permitted average field strength is listed in Section 15.209. A Pre-Amp and highpass filter are used for this measurement.
- For measurement below 1 GHz, set RBW = 100 KHz, VBW $\geq$ 100 KHz, SWEEP=AUTO.
- For measurement above 1 GHz, set RBW = 1 MHz, VBW = 1 MHz (Peak), SWEEP=AUTO.

6.11.3. Test Arrangement

Please refer to Test Arrangement in Sec. 5.5.3 for details of test setup for emission measurements.

6.11.4. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer/ EMI Receiver	Advantest	R3271	15050203	100 Hz to 32 GHz with external mixer for frequency above 32 GHz
Microwave Amplifier	Hewlett Packard	HP 83017A		1 GHz to 26.5 GHz
Biconilog Antenna	EMCO	3143	1029	20 MHz to 2 GHz
Horn Antenna	EMCO	3155	9701-5061	1 GHz – 18 GHz
Horn Antenna	EMCO	3160-09	..	18 GHz – 26.5 GHz
Horn Antenna	EMCO	3160-10	..	26.5 GHz – 40 GHz
Mixer	Tektronix	118-0098-00	..	18 GHz – 26.5 GHz
Mixer	Tektronix	119-0098-00	..	26.5 GHz – 40 GHz

6.11.5. Photographs of Test Setup

Refer to photos # 1 and 2 in Annex 2 for photos of test setup.

6.11.6. Test Data

Theory of Conversion From EIRP Limits to E-Field Limits:

FCC specifies the limit of an EIRP of -17 dBm/MHz; for frequencies 10 MHz or greater above or below the band edge, and an EIRP of -27 dBm/MHz. For other emissions outside 5.725 GHz - 10 MHz and 5.825 GHz + 10 MHz. In addition, the FCC E-Field Limits @ 15.209 in dBuV/m are applied for spurious and harmonic emissions which fall in the restricted band specified in FCC 15.205. In order to uniform our measurements, all EIRP limits (dBm/MHz) converted into E-Field Limits [dB(uV/m)/MHz} as follows:

$P = (Ed)^2/30G$
$EIRP = PG = (Ed)^2/30$
$E = (30*EIRP)^{0.5}/d$

Where:
P: Conducted power at the antenna in Watts
G: Transmitter's isotropic gain in numeric
EIRP: Equivalent isotropic radiated power in Watts
E: Electric Field in uV/m
D: Distance in meters (3 meters)

$10^6*E_{V/m}/10^6 = [30*EIRP_W*10^3/10^3]^{0.5}/d$
$20*\log[10^6*E_{V/m}/10^6] = 20*\log\{[30*EIRP_W*10^3/10^3]^{0.5}/d\}$
$20*\log[E_{uV/m}] - 20*\log[10^6] = 10*\log[EIRP_{mW}] + 10*\log[30] + 10*\log[10^{-3}] - 20*\log(d)$
$E_{dBuV/m} = EIRP_{dBm} + 14.77 - 30 - 9.54 + 120$

$E_{dBuV/m} = EIRP_{dBm} + 95.25$ dB

The FCC Equivalent E-Field Limits are:

-17 dB/MHz ⇐=> 78.24 dB(uV/m)/MHz
-27 dBm/MHz ⇐=> 68.24 dB(uV/m)/MHz

6.11.6.1. BAND-EDGE (RADIATED)

- Plots # 30 through 67 in Annex 1 show Radiated Band-Edge Emissions set at maximum Peak Transmit Power, Modulation: 64QAM (54 Mb/s max.). Tests were performed on every channel frequency since the maximum rf output power ratings are different with respect to channel frequencies.

Comments:

(1) Radiated Band-Edge Emissions Tests performed for lowest power setting are not necessary since the Conducted Band-Edge Emission tests in 6.9 show much better results for lower power output.
(2) Radiated Band-Edge Emissions for different modulations such as 16QAM, QPSK, BPSK are not necessary since the Conducted Band-Edge Emission tests in 6.9 show the same results for different modulations.

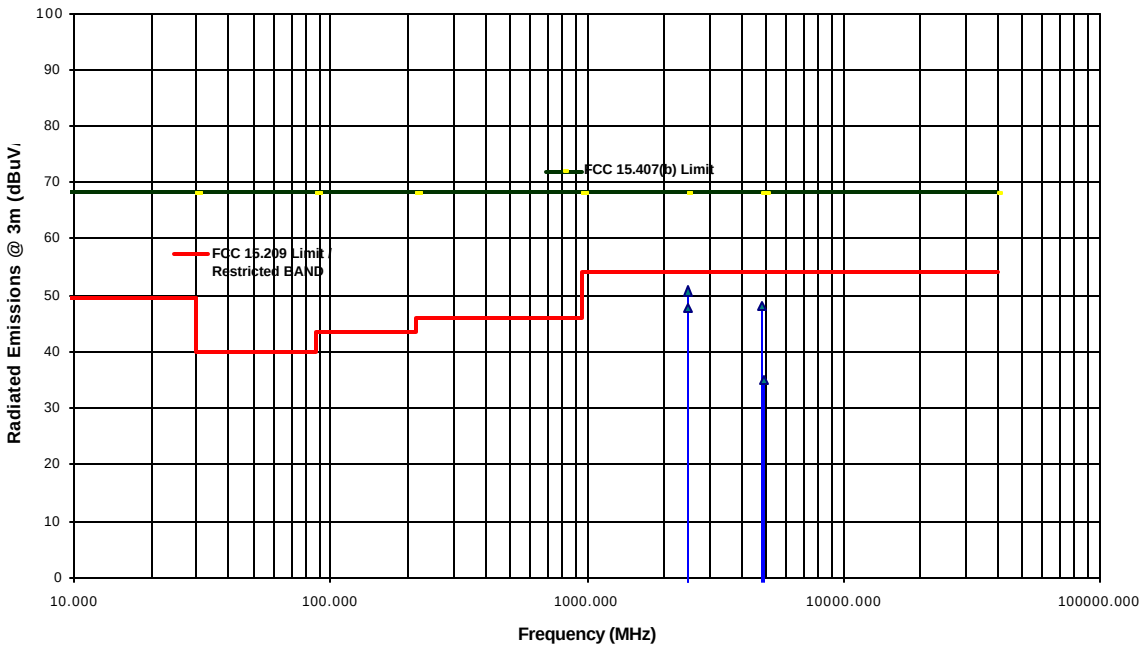
6.11.6.2. TRANSMITTER SPURIOUS & HARMONIC RADIATED EMISSIONS

Remarks: Since there is no difference power and signal spectrum among modulations (64QAM, 16QAM, QPSK and PBSK), the transmitter was set with 64 QAM at maximum data rate of 54 Mb/s at its maximum rf output power, and the test results will represent for all other modulation operation.

6.11.6.2.1. Lowest Frequency (5.735 GHz, Modulation 64QAM with 54 Mb/s Data Rate, Power Output: Maximum Setting)

FREQUENCY (MHz)	RF PEAK LEVEL (dBuV/m)	RF AVG LEVEL (dBuV/m)	ANTENNA PLANE (H/V)	LIMIT 15.209 (dBuV/m)	LIMIT 15.407(b) dB(uV/m)/MHz	MARGIN (dB)	PASS/ FAIL
2460.00	51.6	47.8	V	54.0	68.2	-20.4	PASS
2460.00	53.4	50.8	H	54.0	68.2	-17.4	PASS
4920.00	46.8	35.1	H	54.0	68.2	-18.9	PASS
4820.00	52.1	48.2	H	54.0	68.2	-5.8	PASS
The emissions were scanned from 10 MHz to 40 GHz and all emissions less 20 dB below the limits were recorded.							

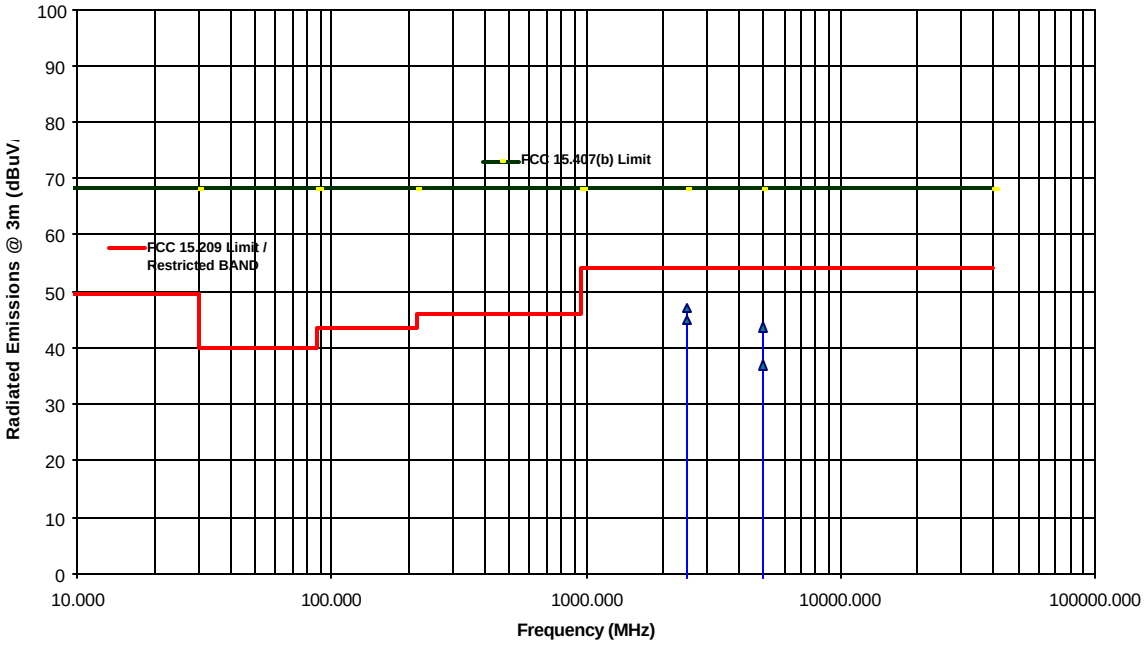
Transmitter Radiated Emissions Measurements at 3 Meter OFTS
Redline Comnunications Inc.
Access Node, Model AN-50, Tx Freq.: 5.725 GHz, RF Ouptut Power: Maximum



6.11.6.2.2. Middle Frequency (5.775 GHz, Modulation 64QAM with 54 Mb/s Data Rate, Power Output: Maximum Setting)

FREQUENCY (MHz)	RF PEAK LEVEL (dBuV/m)	RF AVG LEVEL (dBuV/m)	ANTENNA PLANE (H/V)	LIMIT 15.209 (dBuV/m)	LIMIT 15.407(b) dB(uV/m)/MHz	MARGIN (dB)	PASS/ FAIL
2480.00	51.6	47.0	V	54.0	68.2	-21.2	PASS
2480.00	48.8	44.9	H	54.0	68.2	-23.3	PASS
4960.00	48.8	36.9	H	54.0	68.2	-17.1	PASS
4960.00	47.6	43.7	H	54.0	68.2	-10.3	PASS
The emissions were scanned from 10 MHz to 40 GHz and all emissions less 20 dB below the limits were recorded.							

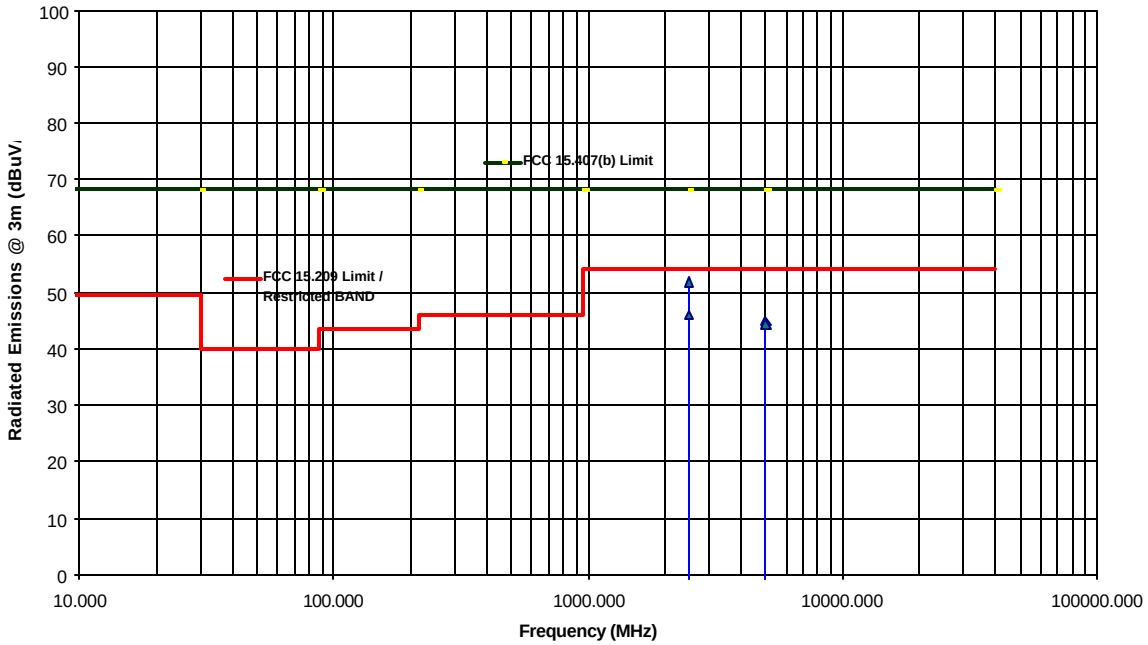
Transmitter Radiated Emissions Measurements at 3 Meter OFTS
Redline Comnunications Inc.
Access Node, Model AN-50, Tx Freq.: 5.775 GHz, RF Ouptut Power: Maximum



6.11.6.2.3. Highest Frequency (5.815 GHz, Modulation 64QAM with 54 Mb/s Data Rate, Power Output: Maximum Setting)

FREQUENCY (MHz)	RF PEAK LEVEL (dBuV/m)	RF AVG LEVEL (dBuV/m)	ANTENNA PLANE (H/V)	LIMIT 15.209 (dBuV/m)	LIMIT 15.407(b) dB(uV/m)/MHz	MARGIN (dB)	PASS/ FAIL
2500.00	54.2	51.9	V	54.0	68.2	-2.1	PASS
2500.00	49.7	45.9	H	54.0	68.2	-8.1	PASS
5000.00	51.4	44.9	H	54.0	68.2	-9.1	PASS
5000.00	50.3	44.4	H	54.0	68.2	-9.6	PASS
The emissions were scanned from 10 MHz to 40 GHz and all emissions less 20 dB below the limits were recorded.							

Transmitter Radiated Emissions Measurements at 3 Meter OFTS
Redline Comnunications Inc.
Access Node, Model AN-50, Tx Freq.: 5.815 GHz, RF Ouptut Power: Maximum



6.12. AC POWERLINE CONDUCTED EMISSIONS @ FCC PART 15, SUBPART B, PARA.15.107(A)

6.12.1. Limits

The equipment shall meet the limits of the following table:

Test Frequency Range	Test Limits	EMI Detector Used	Measuring Bandwidth
0.45 to 30 MHz	48 dBµV 51 dBµV	Quasi-Peak (Narrow band) Quasi-Peak (Broad band)	B = 10 kHz B = 10 kHz

6.12.2. Method of Measurements

Refer to Exhibit 8, Sec. 8.2 of this test report & ANSI C63-4:1992

6.12.3. Test Equipment List

Test Instruments	Manufacturer	Model No.	Serial No.	Frequency Range
Spectrum Analyzer/ EMI Receiver	Hewlett Packard	HP 8593EM	3412A00103	9 kHz – 26.5 GHz
Transient Limiter	Hewlett Packard	11947A	310701998	9 kHz – 200 MHz 10 dB attenuation
L.I.S.N.	EMCO	3825/2	89071531	9 kHz – 200 MHz 50 Ohms / 50 µH
12'x16'x12' RF Shielded Chamber	RF Shielding	…	..	…

6.12.4. Photographs of Test Setup

Refer to Photographs # 2 & 3 in Annex 2 for setup and arrangement of equipment under tests and its ancillary equipment.

6.12.5. Test Data

FREQUENCY (MHz)	RF LEVEL (dBuV)	RECEIVER DETECTOR (P/QP/AVG)	QP/NB LIMIT (dBuV)	QP/BB LIMIT (dBuV)	MARGIN (dB)	PASS/ FAIL	LINE TESTED (L1/L2)
0.45	29.0	QP	48.0	61.0	-19.0	PASS	L1
8.33	36.9	QP	48.0	61.0	-11.1	PASS	L1
18.24	39.5	QP	48.0	61.0	-8.5	PASS	L1
25.00	42.2	QP	48.0	61.0	-5.8	PASS	L1
8.33	36.8	QP	48.0	61.0	-11.2	PASS	L2
18.24	39.2	QP	48.0	61.0	-8.8	PASS	L2
25.00	41.9	QP	48.0	61.0	-6.1	PASS	L2

- The AC powerline conducted emissions were scanned from 450 kHz to 30 MHz, and all emissions less than 20 dB below the limit were recorded.
- Please refer to Plots # 107 and 108 in Annex 1 for detailed measurements

EXHIBIT 7. MEASUREMENT UNCERTAINTY

The measurement uncertainties stated were calculated in accordance with the requirements of NIST Technical Note 1297 and NIS 81 (1994)

7.1. LINE CONDUCTED EMISSION MEASUREMENT UNCERTAINTY

CONTRIBUTION (Line Conducted)	PROBABILITY DISTRIBUTION	UNCERTAINTY (dB)	
		9-150 kHz	0.15-30 MHz
EMI Receiver specification	Rectangular	±1.5	±1.5
LISN coupling specification	Rectangular	±1.5	±1.5
Cable and Input Transient Limiter calibration	Normal (k=2)	±0.3	±0.5
Mismatch: Receiver VRC $\Gamma_1 = 0.03$ LISN VRC $\Gamma_R = 0.8$(9 kHz) 0.2 (30 MHz) Uncertainty limits $20\text{Log}(1 \pm \Gamma_1\Gamma_R)$	U-Shaped	±0.2	±0.3
System repeatability	Std. deviation	±0.2	±0.05
Repeatability of EUT	--	--	--
Combined standard uncertainty	Normal	±1.25	±1.30
Expanded uncertainty U	Normal (k=2)	±2.50	±2.60

Sample Calculation for Measurement Accuracy in 450 kHz to 30 MHz Band:

$$u_c(y) = \sqrt{\sum_{I=1}^{m} u_i^2(y)} = \pm \sqrt{(1.5^2 + 1.5^2)/3 + (0.5/2)^2 + (0.05/2)^2 + 0.35^2} = \pm 1.30 \text{ dB}$$

$$U = 2u_c(y) = \pm 2.6 \text{ dB}$$

7.2. RADIATED EMISSION MEASUREMENT UNCERTAINTY

CONTRIBUTION (Radiated Emissions)	PROBABILITY DISTRIBUTION	UNCERTAINTY (± dB)	
		3 m	10 m
Antenna Factor Calibration	Normal (k=2)	±1.0	±1.0
Cable Loss Calibration	Normal (k=2)	±0.3	±0.5
EMI Receiver specification	Rectangular	±1.5	±1.5
Antenna Directivit	Rectangular	+0.5	+0.5
Antenna factor variation with height	Rectangular	±2.0	±0.5
Antenna phase center variation	Rectangular	0.0	±0.2
Antenna factor frequency interpolation	Rectangular	±0.25	±0.25
Measurement distance variation	Rectangular	±0.6	±0.4
Site imperfections	Rectangular	±2.0	±2.0
Mismatch: Receiver VRC $\Gamma_1 = 0.2$ Antenna VRC $\Gamma_R = 0.67$(Bi) 0.3 (Lp) Uncertainty limits 20Log(1±$\Gamma_1\Gamma_R$)	U-Shaped	+1.1 -1.25	±0.5
System repeatability	Std. Deviation	±0.5	±0.5
Repeatability of EUT		-	-
Combined standard uncertainty	Normal	+2.19 / -2.21	+1.74 / -1.72
Expanded uncertainty U	Normal (k=2)	+4.38 / -4.42	+3.48 / -3.44

Calculation for maximum uncertainty when 3m biconical antenna including a factor of k=2 is used:

$U = 2u_c(y) = 2x(+2.19) = +4.38$ dB And $U = 2u_c(y) = 2x(-2.21) = -4.42$ dB

EXHIBIT 8. MEASUREMENT METHODS

8.1. GENERAL TEST CONDITIONS

The following test conditions shall be applied throughout the tests covered in this report.

8.1.1. Normal temperature and humidity

- Normal temperature: +15°C to +35°C
- Relative Humidity: +20% to 75%

The actual values during tests shall be recorded in the test report.

8.1.2. Normal power source

8.1.2.1. MAINS VOLTAGE

The nominal test voltage of the equipment to be connected to mains shall be the nominal mains voltage which is the declared voltage or any of the declared voltages for which the equipment was designed.

The frequency of test power source corresponding to the AC mains shall be between 59 Hz and 61 Hz.

8.1.2.2. BATTERY POWER SOURCE.

For operation from battery power sources, the nominal test voltage shall be as declared by the equipment manufacturer. This shall be recorded in the test report.

8.1.3. Operating Condition of Equipment under Test

- All tests were carried out while the equipment operated at the following frequencies:
  - The lowest operating frequency,
  - The middle operating frequency and
  - The highest operating frequency

- Modulation were applied using the Test Data sequence
- The transmitter was operated at the highest output power, or in the case the equipment able to operate at more than one power level, at the lowest and highest output powers

8.2. METHOD OF MEASUREMENTS - AC MAINS CONDUCTED EMISSIONS

- AC Mains conducted emissions measurements were performed in accordance with the standard against appropriate limits for each detector function.
- The test was performed in the shielded room, 16'(L) by 16'(W) by 12'(H).
- The test was performed were made over the frequency range from 450 kHz to 30 MHz to determine the line-to-ground radio noise voltage which was conducted from the EUT power-input terminals that were directly connected to a public power network.
- The EUT normally received power from another device that connects to the public utility ac power lines, measurements would be made on that device with the EUT in operation to ensure that the device continues to comply with the appropriate limits while providing the EUT with power.
- If the EUT operates only from internal or dedicated batteries, with no provisions for connection to the public utility ac power lines, AC Mains conducted measurements are not required.
- Table-top devices were placed on a platform of nominal size 1 m by 1.5m raised 80 cm above the conducting ground plane.
- The EUT current-carrying power lead, except the ground (safety) lead, was individually connected through a LISN to the power source. All unused 50-Ohm connectors of the LISN was terminated in 50-ohm when not connected to the measuring instruments.
- The line cord of the EUT connected to one LISN which was connected to the measuring instrument. Those power cords for the units of devices not under measurement were connected to a separate multiple ac outlet. Drawings and photographs of typically conducted emission test setups were shown in the Test Report. Each current-carrying conductor of the EUT shall be individually tested.
- The EUT was normally operated with a ground (safety) connection, the EUT was connected to the ground at the LISN through a conductor provided in the lead from the ac power mains to the LISN.
- The excess length of the power cord was folded back and forth in an 8-shape on a wooden strip with a vertical prong located on the top of the LISN case.
- The EUT was set-up in its typical configuration and operated in its various modes as described in 3.2 of the test report.
- A preliminary scan was made by using spectrum analyzer system with the detector function set to PEAK mode (9 KHz RBW, VBW > RBW), frequency span 450 kHz to 30 MHz.

- The maximum conducted emission for a given mode of operation was found by using the following step-by-step procedure:

  Step1. Monitor the frequency range of interest at a fixed EUT azimuth.

  Step2. Manipulate the system cables and peripheral devices to produce highest amplitude signal relative to the limit. Note the amplitude and frequency of the suspect signal.

  Step3. The effects of various modes of operation is examined. This is done by varying equipment operation modes as step 2 is being performed.

  Step4. After completing step 1 through 3, record EUT and peripheral device configuration, mode of operation, cable configuration, signal levels and frequencies for final test.

- Each highest signal level at the maximized test configuration was zoomed in a small frequency span on the spectrum analyzer's display (the manipulation of cables and peripheral devices and EUT operation modes might have to be repeated to obtain the highest signal level with the spectrum analyzer set to PEAK detector mode 10 KHz RBW and VBW > RBW). The spectrum analyzer was then set to CISPR QUASI-PEAK detector mode (9 KHz RBW, 1 MHz

VBW) and AVERAGE detector mode (10 kHz RBW, 1 Hz VBW). The final highest RF signal levels and frequencies were record.

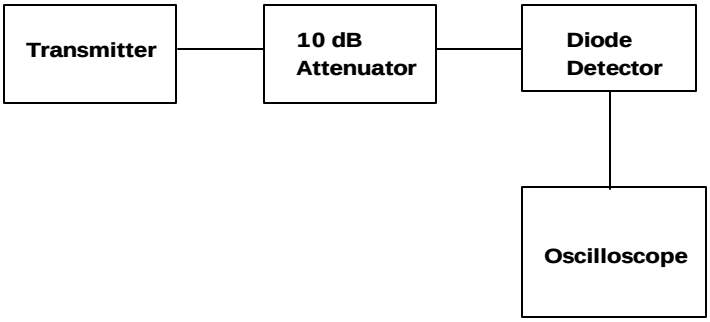
- ***Broad-band ac Powerline conducted emissions***:- If the EUT exhibits ac Powerline conducted emissions that exceed the limit with the instrument set to the quasi-peak mode, then measurements should be made in the average mode. If the amplitude measured in the quasi-peak mode is at least 6 dB higher than the amplitude measured in the average mode, the level measured in quasi peak mode may be reduced by 13 dB before comparing it to the limit.

8.3. ALTERNATIVE PEAK CONDUCTED TRANSMIT POWER

Test procedure shall be as follows:

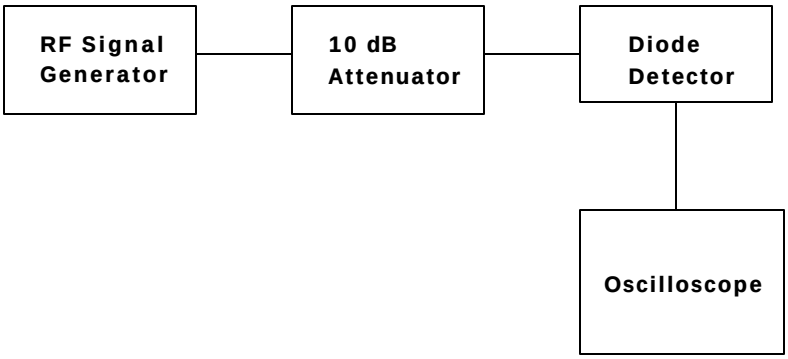
Step 1:

- Connect the transmitter output to a diode detector through an attenuator
- Connect the diode detector to the vertical channel of an oscilloscope.
- The observed duty cycle of the transmitter, x = Tx on / (Tx on + Tx off) with $0<x<1$, is measure and recorded in the test report. For the purpose of testing, the equipment shall be operated with a duty cycle that is equal or more than 0.1.
- Observe and record the y parameter of the DC level on the oscilloscope.



Step 2: Peak Power Measurements

- Replace the transmitter by a RF signal generator
- Set the signal generator frequency be the same as the transmitter frequency
- Adjust the rf output level of the RF signal generator until the DC level on the oscilloscope is same as that (y) recorded in step 1.
- Measure the RF signal generator output level using a power meter
- Calculate the total peak power (Pp) by adding the signal generator level with the attenuator value and the cable loss.



8.4. SPURIOUS EMISSIONS (CONDUCTED & RADIATED)

For both conducted and radiated measurements, the spurious emissions were scanned from the lowest frequency generated by the EUT or 10 MHz whichever is lower to 10th harmonic of the highest frequency generated by the EUT.

8.4.1. Band-edge and Spurious Emissions (Conducted)

Band-edge Compliance of RF Conducted Emissions:

Use the following spectrum analyzer settings:

- The radio was connected to the measuring equipment via a suitable attenuator.
- Span = wide enough to capture the peak level of the emission operating on the channel closest to the band-edge, as well as any modulation products which fall outside of the authorized band of operation.
- RBW = 1 % of the span
- VBW = RBW
- Sweep = auto
- Detector function = peak
- Trace = max hold
- Allow the trace to stabilize
- Set the marker on the emission at the band-edge, or on the highest modulation product outside of the band, if this level is greater than that at the band-edge
- Enable the marker-delta function, then use the marker-to-peak function to move the marker to the peak of the in-band emission.
- The marker-delta value now displayed must comply with the limit specified
- Submit this plot

Spurious RF Conducted Emissions:

Use the following spectrum analyzer settings:

- The radio was connected to the measuring equipment via a suitable attenuator.
- Span = wide enough to capture the peak level of the in-band-emission and all spurious emissions (e.g. harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, sevral plots are required to cover this entire span.
- RBW = 100 kHz
- VBW = RBW
- Sweep = auto
- Detector function = peak
- Trace = max hold
- Allow the trace to stabilize
- Set the marker on the any spurious emission recorded. The level displayed must comply with the limit specified in this Section.
- Submit this plot

8.4.2. Spurious Emissions (Radiated)

- The radiated emission measurements were performed at the UltraTech's 3 Meter Open Field Test Site (OFTS) situated in the Town of Oakville, province of Ontario. The Attenuation Characteristics of OFTS have been filed to FCC, Industry Canada, ACA/Austel, NVLap and ITI.

- Radiated emissions measurements were made using the following test instruments:

1. Calibrated EMCO BiconiLog antenna in the frequency range from 30 MHz to 2000 MHz.
2. Calibrated Emco Horn antennas in the frequency range above 1000 MHz (1GHz - 40 GHz).
3. The test is required for any spurious emission or modulation product that falls in a Restricted Band, as defined in Section 15.205. It must be performed with the highest gain of each type of antenna proposed for use with the EUT. Use the following spectrum analyzer settings:

   - RBW = 100 kHz for f < 1GHz and RBW = 1 MHz for f ≥ 1 GHz
   - VBW = RBW
   - Sweep = auto
   - Detector function = peak
   - Trace = max hold
   - Follows the guidelines in ANSI C63.4-1992 with respect to maximizing the emission by rotating the EUT, measuring the emission while the EUT is situated in three orthogonal planes (if appropriate), adjusting the measurement antenna height and polarization, etc.. A pre-amp and highpass filter are required for this test, in order to provide the measuring system with sufficient sensitivity.
   - Allow the trace to stabilize.
   - The peak reading of the emission, after being corrected by the antenna correction factor, cable loss, pre-amp gain, etc…. is the peak field strength which comply with the limit specified in Section 15.35(b)

   Calculation of Field Strength:

   The field strength is calculated by adding the calibrated antenna factor and cable factor, and subtracting the Amplifier gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

   $$FS = RA + AF + CF - AG$$

   Where FS = Field Strength
   RA = Receiver/Analyzer Reading
   AF = Antenna Factor
   CF = Cable Attenuation Factor
   AG = Amplifier Gain

   Example: If a receiver reading of 60.0 dBuV is obtained, the antenna factor of 7.0 dB/m and cable factor of 1.0 dB are added, and the amplifier gain of 30 dB is subtracted. The actual field strength will be:
   Field Level = 60 + 7.0 + 1.0 - 30 = 38.0 dBuV/m.
   Field Level = $10^{(38/20)}$ = 79.43 uV/m.

   - Submit this test data
   - Now set the VBW to 10Hz, while maintaining all of the other instrument settings. This peak level, once corrected, must comply with the limit specified in Section 15.209. If the dwell time of the each channel is less than 100ms, then the reading obtained may be further adjusted by a “duty cycle correction factor”, derived from 10log(dwell time/100mS) in an effort to demonstrate compliance with the 15.209.
   - Submit test data

Maximizing The Radiated Emissions:

- The frequencies of emissions was first detected. Then the amplitude of the emissions was measured at the specified measurement distance using required antenna height, polarization, and detector characteristics.
- During this process, cables and peripheral devices were manipulated within the range of likely configuration.
- For each mode of operation required to be tested, the frequency spectrum was monitored. Variations in antenna heights (from 1 meter to 4 meters above the ground plane), antenna polarization (horizontal plane and vertical plane), cable placement and peripheral placement were explored to produce the highest amplitude signal relative to the limit.

The maximum radiated emission for a given mode of operation was found by using the following step-by-step procedure:

Step1: Monitor the frequency range of interest at a fixed antenna height and EUT azimuth.

Step2: Manipulate the system cables to produce highest amplitude signal relative to the limit. Note the amplitude and frequency of the suspect signal.

Step3: Rotate the EUT 360 degrees to maximize the suspected highest amplitude signal. If the signal or another at a different frequency is observed to exceed the previously noted highest amplitude signal by 1 dB or more, go back to the azimuth and repeat Step 2. Otherwise, orient the EUT azimuth to repeat the highest amplitude observation and proceed.

Step4: Move the antenna over its full allowable range of travel (1 to 4 meters) to maximize the suspected highest amplitude signal. If the signal or another at a different frequency is observed to exceed the previously noted highest amplitude signal by 1 dB or more, return to Step 2 with the highest amplitude observation and proceed.

Step5: Change the polarization of the antenna and repeat Step 2 through 4. Compare the resulting suspected highest amplitude signal with that found for the other polarization. Select and note the higher of the two signals. This signal is termed the highest observed signal with respect to the limit for this EUT operational mode.

Step6: The effects of various modes of operation is examined. This is done by varying the equipment modes as steps 2 through 5 are being performed.

Step7: After completing steps 1 through 6, record the final highest emission level, frequency, antenna polarization and detector mode of the measuring instrument.

8.4.3. Peak Power Measurements

Calculate the transmitter's peak power using the following equation:

$E = (30PG)^{0.5}/d$
$P = (Ed)^2/30G$

Where:

- E: measured maximum fundamental field strength in V/m. Utilizing a RBW, the 20 dB bandwidth of the emission VBW >RBW, peak detector function. Follow the procedures in C63.4-1992 with respect to maximizing the emission
- G is numeric gain of the transmitting antenna with reference to an isotropic radiator
- D is the distance in meters from which the field strength was measured
- P is Conducted Power at the antenna port

8.4.4. Spurious RF Conducted Emissions

The demonstrate compliance with the spurious RF conducted emission requirement of Section 15.407©, use the following spectrum analyzer settings:

- Span = wide enough to fully capture the emission being measured
- RBW = 100 kHz for $f \leq 1$ GHz and RBW = 1 MHz for $f \geq 1$GHz
- VBW > RBW
- Sweep = auto
- Detector function = peak
- Trace = max hold
- Measure the field strength of both the fundamental and all spurious emissions with these settings.

8.5. FREQUENCY STABILITY

Refer to FCC @ 2.1055.

(a) The frequency stability shall be measured with variation of ambient temperature as follows: From lowest and highest temperatures specified by the manufacturer in the EUT's Users Manual..

(b) Frequency measurements shall be made at extremes of the specified temperature range and at intervals of not more than 10 centigrade through the range. A period of time sufficient to stabilize all of the components of the oscillator circuit at each temperature level shall be allowed prior to frequency measurement. The short-term transient effects on the frequency of the transmitter due to keying (except for broadcast transmitters) and any heating element cycling normally occurring at each ambient temperature level also shall be shown. Only the portion or portions of the transmitter containing the frequency determining and stability circuitry need be subjected to the temperature variation test.

(d) The frequency stability supply shall be measured with variation of primary supply voltage as follows:

(1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.

(2) For hand carried, battery powered equipment, reduce primary supply voltage to the battery operating end point which shall be specified by the manufacturer.

(3) The supply voltage shall be measured at the input to the cable normally provide with the equipment, or at the power supply terminals if cables are not normally provided. Effects on frequency of transmitter keying (except for broadcast transmitters) and any heating element cycling at the nominal supply voltage and at each extreme also shall be shown.

(e) When deemed necessary, the Commission may require tests of frequency stability under conditions in addition to those specifically set out in paragraphs (a), (b), (c) and (d) of this section. (For example, measurements showing the effect of proximity to large metal objects, or of various types of antennas, may be required for portable equipment).