



**FCC CFR47 PART 15 SUBPART C
CERTIFICATION**

TEST REPORT

FOR

MICROWAVE LINK

MODEL NUMBER: GE60X, FE60X, AR60X*

FCC ID: RWM-GE60X

REPORT NUMBER: 05U3616-1B

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Prepared for

**BRIDGEWAVE COMMUNICATIONS
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Prepared by

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**Details of specific model(s) tested and model differences shall be identified in body of report*



LAB CODE:200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
A	7/25/05	Initial Issue	MH
B	8/11/05	Corrected typos for antenna diameter and subsequent calculations. Corrected typos for measurement distance and field strength limit above 40 GHz, for both system noise floor and test results.	MH

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME: BRIDGEWAVE COMMUNICATIONS
3350 THOMAS ROAD
SANTA CLARA, CA 95054

EUT DESCRIPTION: MICROWAVE LINK TRANSCEIVER

MODEL TESTED: AR60X, AR60

DATE TESTED: JULY 18-20, 2005

APPLICABLE STANDARDS	
STANDARD	TEST RESULTS
FCC PART 15 SUBPART C	NO NON-COMPLIANCE NOTED

Compliance Certification Services, Inc. tested the above equipment in accordance with the requirements set forth in the above standards. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by Compliance Certification Services and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by Compliance Certification Services will constitute fraud and shall nullify the document. No part of this report may be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any government agency.

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2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.4-2003, FCC CFR 47 Part 2 and FCC CFR 47 Part 15.

3. FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 561F Monterey Road, Morgan Hill, California, USA. The sites are constructed in conformance with the requirements of ANSI C63.4, ANSI C63.7 and CISPR Publication 22. All receiving equipment conforms to CISPR Publication 16-1, "Radio Interference Measuring Apparatus and Measurement Methods."

CCS is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at <http://www.ccsemc.com>.

4. CALIBRATION AND UNCERTAINTY

4.1. MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

4.2. MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the apparatus:

PARAMETER	UNCERTAINTY
Radiated Emission, 30 to 200 MHz	+/- 3.3 dB
Radiated Emission, 200 to 1000 MHz	+4.5 / -2.9 dB
Radiated Emission, 1000 to 2000 MHz	+4.5 / -2.9 dB
Power Line Conducted Emission	+/- 2.9 dB

Uncertainty figures are valid to a confidence level of 95%.

5. EUT DESCRIPTION

5.1. DESCRIPTION OF EUT

The EUT is a 60 GHz transceiver intended for microwave link applications.

The transmitter has a maximum peak conducted output power as follows:

Frequency of Operation (GHz)	Maximum output power, dBm	Maximum output power, mW
58.1 - 62.9	-8.1	0.155

The radio utilizes an Integral Directional Cassegrain Antenna with a gain of 46 dBi.

5.2. DESCRIPTION OF MODEL DIFFERENCES

The GE60X operates at a data rate of 1 Gbit/sec, the FE60X operates at a data rate of 100 Mbits/sec, and the AR60X is a dual rate 100 Mbit/sec or 1 Gbit/sec.

The hardware for all three models is identical; changes are made via firmware.

All testing was performed with the dual rate version.

The frequency stability tests were performed using a model AR60. The AR60 uses the identical circuitry as the AR60X; the only difference is that the AR60 has a smaller, lower gain antenna that fits inside the environmental chamber.

All other tests were performed using a model AR60X.

5.3. TEST AND MEASUREMENT EQUIPMENT

The following test and measurement equipment was utilized for the tests documented in this report:

TEST EQUIPMENT LIST				
Description	Manufacturer	Model	Serial Number	Cal Due
Harmonic Mixer, 26.5 ~ 40 GHz	HP	11970A	3008A04190	10/14/05
Harmonic Mixer, 33 ~ 50 GHz	HP	11970Q	3003A03363	4/20/07
Harmonic Mixer, 50 ~ 75 GHz	HP	11970V	2521A01163	10/22/05
Harmonic Mixer, 75 ~ 110 GHz	HP	11970W	2521A01314	10/25/05
Harmonic Mixer, 90 ~ 140 GHz	OML	M08HWA	F90519-2	CNR
Harmonic Mixer, 140 ~ 220 GHz	OML	M05HWA	G90519-1	CNR
Mixer Diplexer for HP	OML	DPL.313B	N02429	CNR
LISN, 10 kHz ~ 30 MHz	FCC	LISN-50/250-25-2	2023	8/30/2005
LISN, 10 kHz ~ 30 MHz	Solar	8012-50-R-24-BNC	8379443	10/21/2005
EMI Test Receiver	R & S	ESHS 20	827129/006	10/22/2005
Spectrum Analyzer 3 Hz ~ 44 GHz	Agilent	E4446A	US42510266	8/25/2005
AC Power Source	Elgar	1751	C01042	CNR
Temperature / Humidity Chamber	Thermotron	SE 600-10-10	29800	6/10/06
Antenna, Horn 1 ~ 18 GHz	ETS	3117	29310	4/22/06
Preamplifier, 1 ~ 26.5 GHz	HP	8449B	3008A00369	8/17/05
Antenna, Horn 18 ~ 26 GHz	ARA	MWH-1826/B	1049	9/12/05
Antenna, Bilog 30MHz ~ 2Ghz	Sunol Sciences	JB1	A121003	3/3/06
EMI Receiver, 9 kHz ~ 2.9 GHz	HP	8542E	3942A00286	3/29/06
RF Filter Section	HP	85420E	3705A00256	3/29/06
Power Meter	Agilent	E4419B	GB40202203	CNR
Power Sensor	Agilent	V8486A	170891	CNR

6. SETUP OF EQUIPMENT UNDER TEST

SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	Manufacturer	Model	Serial Number	FCC ID
AC ADAPTER	Peak Power Supp	PW-070A-1Y24D	N/A	N/A

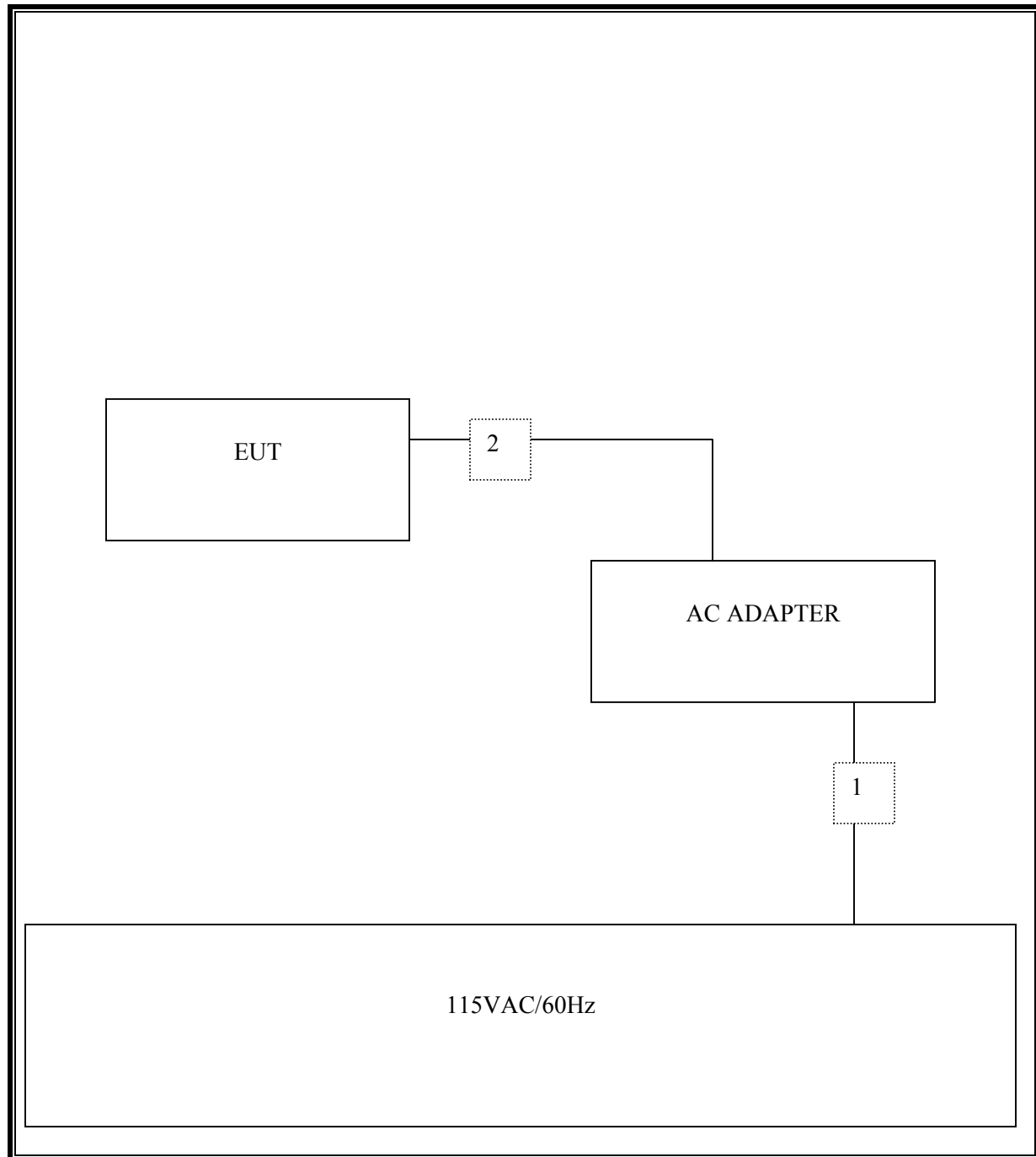
I/O CABLES

I/O CABLE LIST						
Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length	Remarks
1	AC PWR	1	AC PWR	UNSHIELDED	1.86M	US (3 PRONG)
2	DC PWR	1	TERMINAL	UNSHIELDED	1.86M	N/A

TEST SETUP

During the testing process the EUT was set to transmit continuously.

SETUP DIAGRAM FOR TESTS



7. APPLICABLE LIMITS AND TEST RESULTS

7.1. MEASUREMENT FUNDAMENTALS

TEST PROCEDURE

The EUT was mounted on a tower and the measurement instrumentation was placed in the far field. The far field distance was determined from calculations described below.

Using a level and a laser pointer, the EUT antenna and measurement antennas were brought into alignment. The measurement antenna/mixer assembly was hand held and was very slowly moved with small horizontal and vertical motions to capture the maximum signal level from the EUT.

NEAR FIELD BOUNDARY CALCULATIONS

For the high-gain antenna used with the EUT, the 3m distance is within the antenna's near field or Fresnel region. This is confirmed from the equation for near-field boundary given in OET 65 (p. 27):

$$(12) R(\text{near field}) = (D^2) / (4 * \lambda)$$

where

D = Largest Antenna Dimension, including the reflector, in meters

λ = wavelength in meters

For a parabolic reflector antenna with D = 0.6096 m and $\lambda = 300 / f$ (MHz) equation (3) predicts a near-field boundary of

R (near field) = 17.99 m at 58.1 GHz, and 19.48 m at 62.9 GHz.

FAR FIELD BOUNDARY CALCULATIONS

The far-field boundary is given in OET 65 (page 29) as:

$$(16) R(\text{far field}) = (0.6 * D^2) / \lambda$$

where

D = Largest Antenna Dimension, including the reflector, in meters

λ = wavelength in meters

For a parabolic reflector antenna with D = 0.6096 m and $\lambda = 300 / f$ (MHz) equation (16) predicts a far-field boundary of

R (far field) = 43.18 m at 58.1 GHz, and 46.75 m at 62.9 GHz.

POWER DENSITY AS A FUNCTION OF DISTANCE FROM ANTENNA

The equations are given in OET 65 pages 27 – 29 as follows:

(5) at the surface of the antenna with aperture area A:

$$S(\text{surface}) = 4P/A$$

(6) in the near field, with antenna maximum dimension D:

$$S(\text{near field}) = 16\eta P / \pi D^2$$

where η = aperture efficiency

(7) in the transition region $R(\text{near field}) < R < R(\text{far field})$ at distance R:

$$S(\text{transition}) = (S(\text{near field}) * R(\text{near field})) / R$$

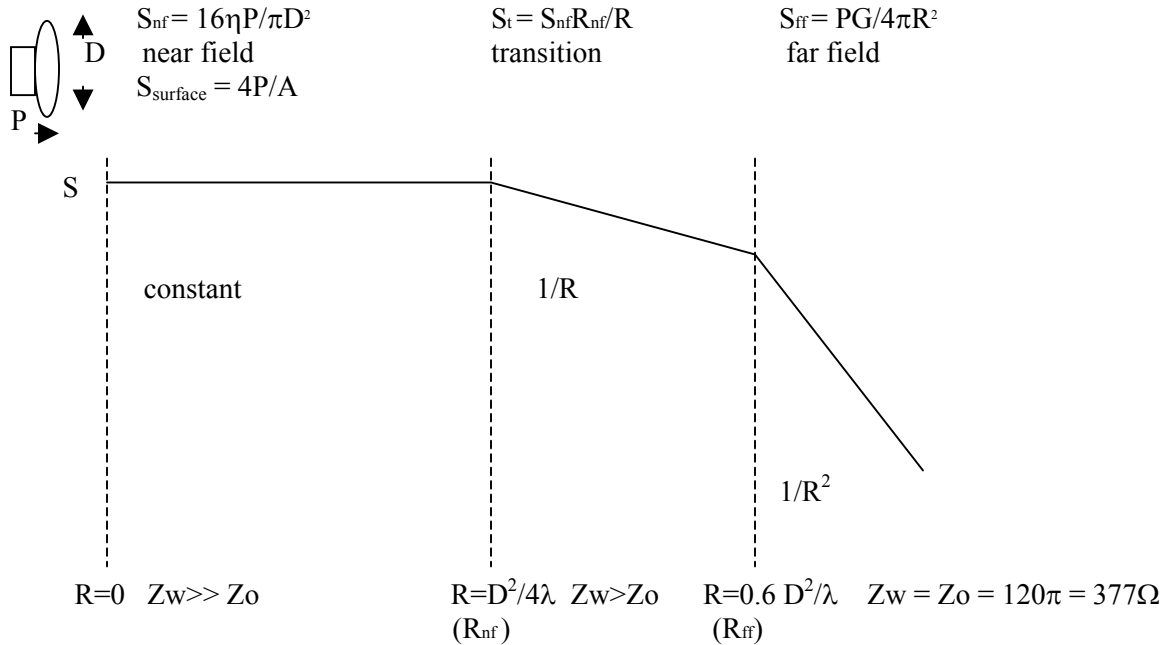
(8) in the far field or Fraunhofer region:

$$S(\text{far field}) = PG / 4\pi R^2$$

where G = transmitter antenna gain

The equations (5) – (8) indicate that the variation of power density with distance R from the Cassegrain antenna is:

- constant from the antenna surface to the near-field boundary R_{nf} ;
- decreases as $1/R$ in the transition region $R_{nf} < R < R_{ff}$;
- decreases as $1/R^2$ in the far field, for $R > R_{ff}$.



When the near field boundary is greater than 3m, as it is for this EUT, the power density can be calculated from far field measurements according to the following relationship:

$$S(\text{at } 3\text{m}) = S(\text{at measurement distance}) + 20\log(R/R(\text{far field})) + 10\log(R(\text{far field}) / R(\text{near field}))$$

where S = Power Density in dBuW/cm^2
 R = measurement distance in far field
 $R(\text{far field})$ = from equation (16) and
 $R(\text{near field})$ = from equation (12) above

$$\text{Correction Factor from far field boundary to near field region} = 10 * \log(R(\text{far field}) / R(\text{near field}))$$

Correction Factor from far field boundary to near field region (the near field region includes 3 meters) = 3.8 dB at 58.1 GHz and 62.9 GHz.

The correction Factor from the 50 meter measuring distance to near field region (the near field region includes 3 meters) = 5.1 dB at 58.1 GHz and 4.4 dB at 62.9 GHz.

POWER DENSITY AND FIELD STRENGTH RELATIONSHIP

From OET 40, the relationship between field strength, power at the spectrum analyzer input, and test antenna gain is given by

$$E = (2\pi/\lambda) * (120Prx/Grx)^{1/2}$$

where

Prx = power at receiver input, watts

Grx = antenna gain with impedance matching receiver, numeric

λ = wavelength, meters

Power density in the far field is related to field strength:

$$S = (E^2) / 120 \pi = (E^2) / 377$$

where

S is the Power Density in W/m²

and

E is the Field Strength in V/m

POWER DENSITY LIMITS EXPRESSED AS FIELD STRENGTH

Rearranging terms from above,

$$E = \text{Sqrt}(377 * S)$$

where E is the field strength in V/m and S is the power density in W/m²

For S = 18 uW/cm²,

S = 0.18 W/m² and E = 8.24 V/m or 138 dBuV/m

For S = 9 uW/cm²,

S = 0.09 W/m² and E = 5.82 V/m or 135 dBuV/m

For S = 90 pW/cm²,

S = 9 * 10⁻¹¹ W/m² and E = 0.000184 V/m or 45.3 dBuV/m

7.2. 6 dB BANDWIDTH

APPLICABLE RULE

§ 15.255 (e)For the purposes of this paragraph, emission bandwidth is defined as the instantaneous frequency range occupied by a steady state radiated signal with modulation, outside which the radiated power spectral density never exceeds 6 dB below the maximum radiated power spectral density in the band, as measured with a 100 kHz resolution bandwidth spectrum analyzer. The center frequency must be stationary during the measurement interval, even if not stationary during normal operation (e.g. for frequency hopping devices).

LIMIT

None; for reporting purposes only.

TEST PROCEDURE

The spectrum analyzer and external mixer are set up to measure the radiated output of the transmitter. The RBW is set to 100 kHz and the VBW is set to 100 kHz. The sweep time is coupled.

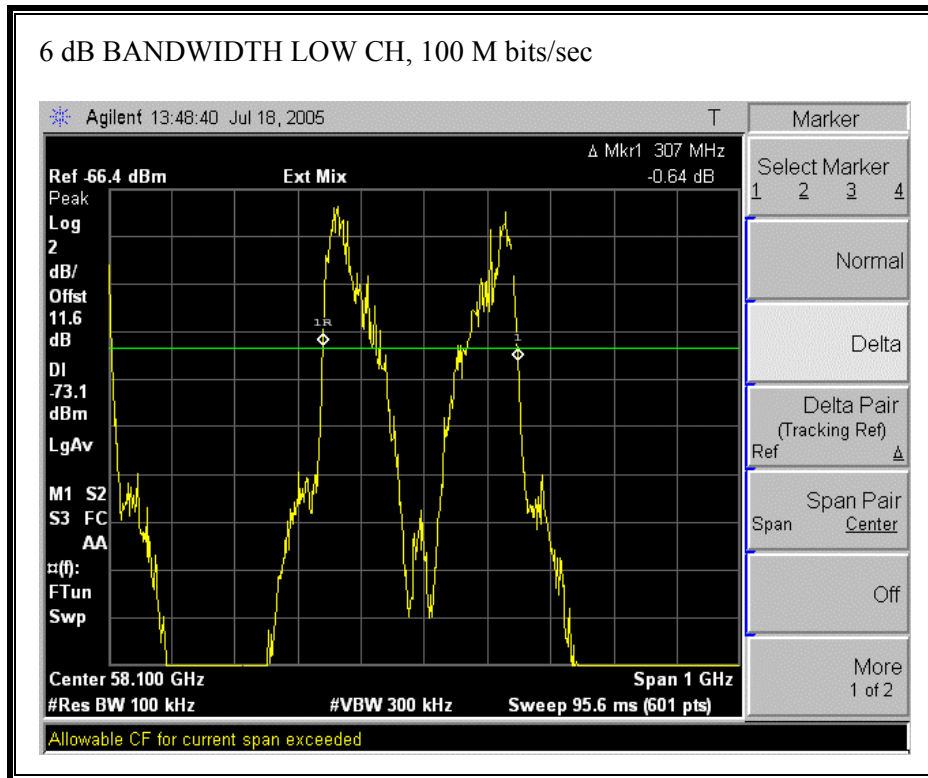
In the 1 Mb/s data rate mode, the falloff from the peak to 6 dB below the peak occurs in less than one horizontal bin on the spectrum analyzer. Therefore, the markers are set to the signal peaks corresponding to the maximum frequency deviation. Also the emission bandwidth is greater than the image frequency separation of the external mixer. Therefore, the actual signal and the image signal overlap. On the analyzer display the actual signal is to the right and the image signal is to the left. The Signal ID trace only displays the actual signal, however the Max Hold function is not supported in the Signal ID mode. The portion of the display that shows the image signal is ignored when placing the delta markers for the emission bandwidth measurement.

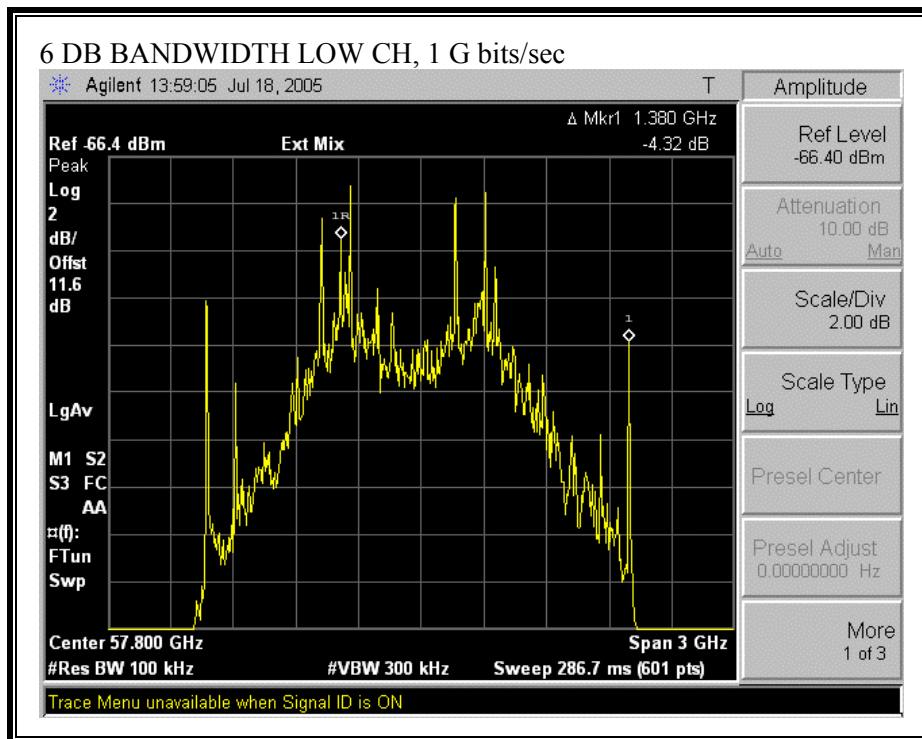
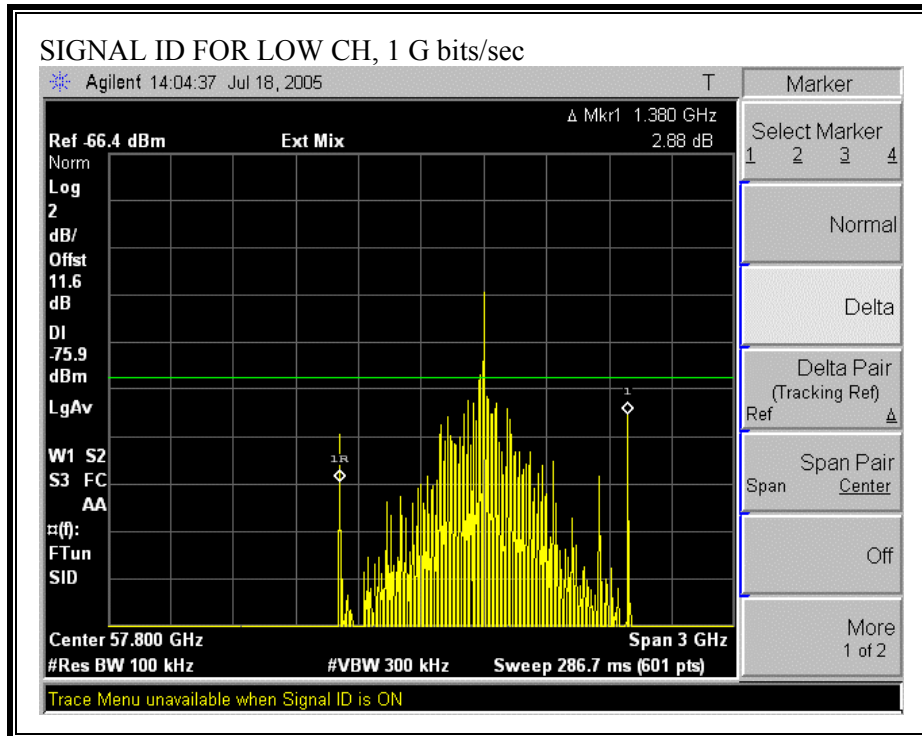
RESULTS

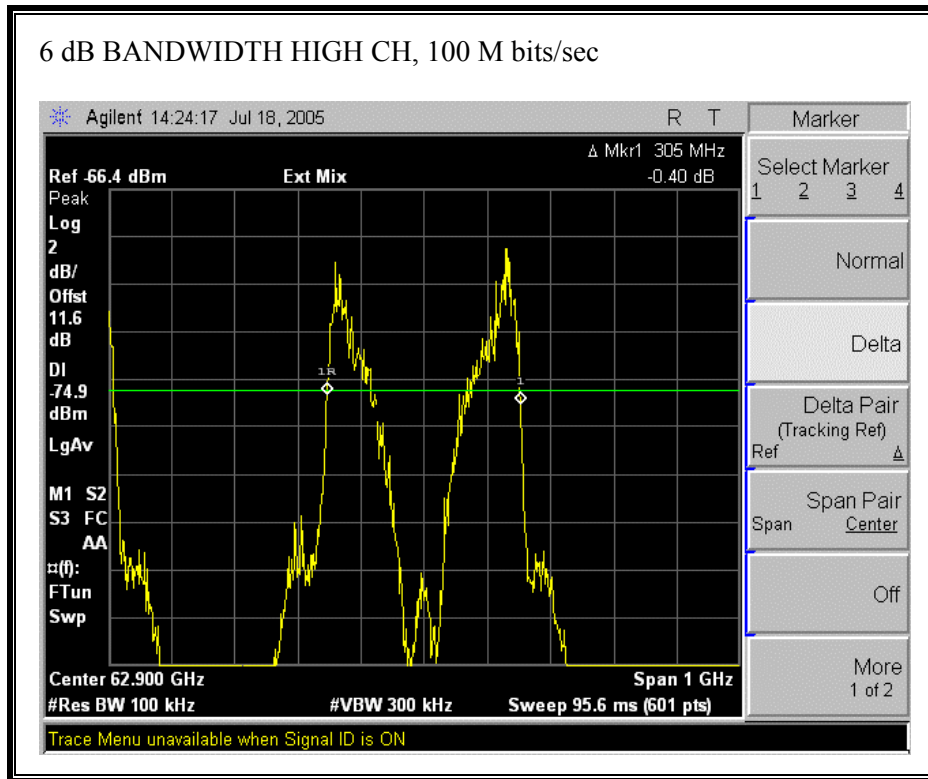
No non-compliance noted:

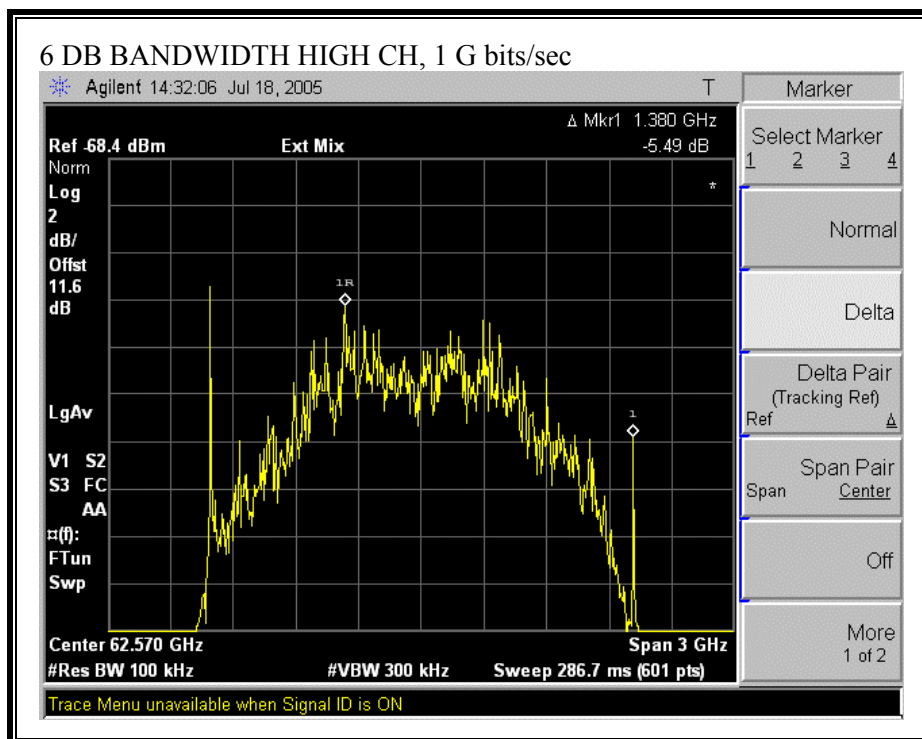
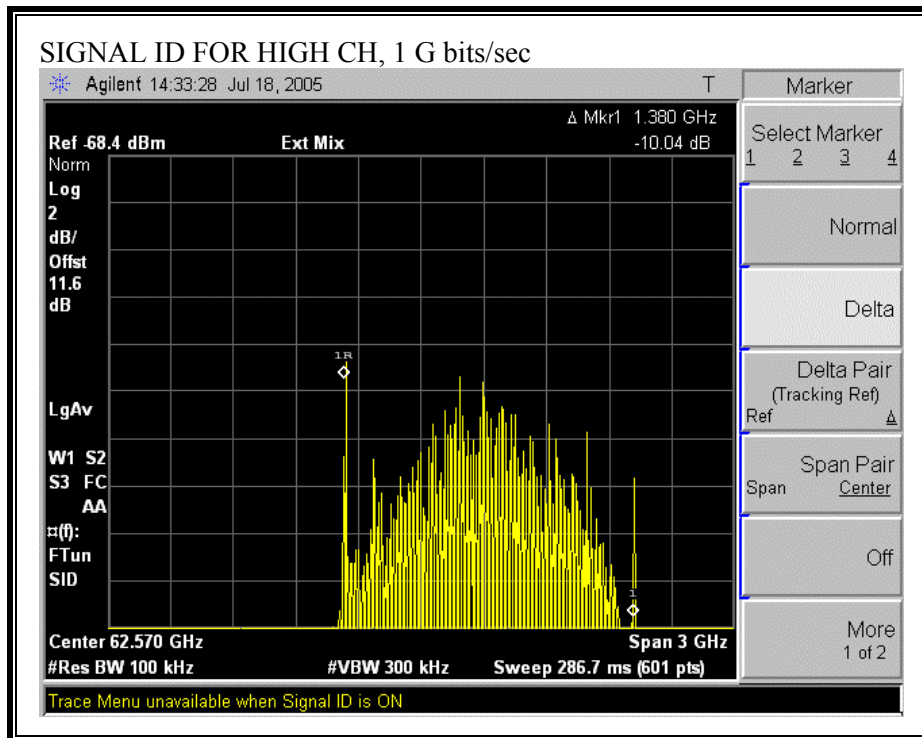
Channel	Frequency (GHz)	Data rate (bits/sec)	6 dB Bandwidth (MHz)
Low	58.1	100 M	307
Low	58.1	1 G	1380
High	62.9	100 M	305
High	62.9	1 G	1380

6 dB BANDWIDTH









7.3. POWER DENSITY

LIMIT

§15.255 (b) Within the 57-64 GHz band, emission levels shall not exceed the following:

(1) For products other than fixed field disturbance sensors, the average power density of any emission, measured during the transmit interval, shall not exceed 9 uW/cm^2 , as measured 3 meters from the radiating structure, and the peak power density of any emission shall not exceed 18 uW/cm^2 , as measured 3 meters from the radiating structure.

(4) Peak power density shall be measured with an RF detector that has a detection bandwidth that encompasses the 57-64 GHz band and has a video bandwidth of at least 10 MHz, or using an equivalent measurement method.

(5) The average emission limits shall be calculated, based on the measured peak levels, over the actual time period during which transmission occurs.

TEST PROCEDURE

Refer to the Measurement Fundamentals section of this report for the derivation of equations and calculations.

The power meter mount and corresponding horn antenna are set up at the far field distance to measure the radiated output of the transmitter. The frequency range of the measuring instrumentation is 50 to 75 GHz, which encompasses the authorized band of 57 to 64 GHz. No video filtering is used.

The measured power level at the far field distance is converted to field strength using:

Power (dBuV) = Power (dBm) + 107

and

Field strength (dBuV/m) = Power (dBuV) + Antenna Factor (dB/m).

This field strength is extrapolated to the field strength at 3 meters using the near field correction factors derived in the Measurement Fundamentals section of this report.

The 3 meter field strength is then converted to power density for comparison to the 3 meter power density limit.

No non-compliance noted:

Frequency (GHz)	Data rate (bits/sec)	Measured Power (dBm)	Antenn Factor (dB/m)	Far Field Strength (dBuV/m)	3 m Field Strength (dBuV/m)	3 m Limit (dBuV/m)	Margin (dB)
58.1	100 M	-24.80	45.50	127.7	132.8	135	-2.2
58.1	1 G	-24.20	45.50	128.3	133.4	135	-1.6
62.9	100 M	-24.30	46.20	128.9	133.3	135	-1.7
62.9	1 G	-25.50	46.20	127.7	132.1	135	-2.9

For reference, the measured field strength is also converted to power density for direct comparison to the power density limit:

Frequency (GHz)	Data Rate (bits/sec)	3 m Field Strength (dBuV/m)	Peak Power Density (uW/cm ²)	Power Density Peak Limit (uW/cm ²)	Power Density Avg Limit (uW/cm ²)
58.1	100 M	132.8	5.1	18.0	9.0
58.1	1 G	133.4	5.8	18.0	9.0
62.9	100 M	133.3	5.7	18.0	9.0
62.9	1 G	132.1	4.3	18.0	9.0

The Peak Power Density is less than both the Peak and Average limits.

7.4. PEAK POWER

LIMIT

15.255(e) Except as specified below, the total peak transmit output power shall not exceed 500 mW.

(2) Peak transmit output power shall be measured with an RF detector that has a detection bandwidth that encompasses the 57-64 GHz band and has a video bandwidth of at least 10 MHz, or using an equivalent measurement method.

(3) For the purpose of demonstrating compliance with this paragraph, corrections to the transmitter output power may be made due to the antenna and circuit loss.

PROCEDURE

The 3 meter field strengths from the peak power density measurements are converted to EIRP and peak output power using the following formulas:

$$\text{EIRP (dBm)} = \text{field strength (dBuV)} - 95.2$$

$$\text{Output Power (dBm)} = \text{EIRP} - \text{Antenna Gain (dBi)}$$

RESULT

No non-compliance noted:

Frequency (GHz)	3 m Field Strength (dBuV/m)	Measured EIRP (dBm)	Antenna Gain (dBi)	Output Power (dBm)	Output Power (mW)	Power Limit (mW)
58.1	133.4	38.2	46.00	-7.8	0.166	500.0
62.9	133.3	38.1	46.00	-7.9	0.162	500.0

7.5. RF EXPOSURE

LIMITS

§1.1310 The criteria listed in Table 1 shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in §1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of §2.1093 of this chapter.

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm ²)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposures				
0.3–3.0	614	1.63	*(100)	6
3.0–30	1842/f	4.89/f	*(900/f ²)	6
30–300	61.4	0.163	1.0	6
300–1500			f/300	6
1500–100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*(180/f ²)	30

TABLE 1—LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)—Continued

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm ²)	Averaging time (minutes)
30–300	27.5	0.073	0.2	30
300–1500			f/1500	30
1500–100,000			1.0	30

f = frequency in MHz

* = Plane-wave equivalent power density

NOTE 1 TO TABLE 1: Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.

NOTE 2 TO TABLE 1: General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.

CALCULATIONS

From §1.1310 Table 1 (B), $S = 1.0 \text{ mW/cm}^2$

The maximum allowed exposure for uncontrolled exposure is 1 mW/cm^2 .

RESULTS

No non-compliance noted:

Maximum power density at 3m is 5.5 uW/cm^2 at 62.9 GHz and 100 Mbit/sec data rate.

$$S = 5.8 \text{ uW/cm}^2 = 0.0058 \text{ mW/cm}^2$$

This is constant from the antenna surface to the near field boundary (3.66 m at 58.1 GHz, and 3.96 m at 62.9 GHz.)

NOTE: For mobile or fixed location transmitters, the minimum separation distance is 20 cm, even if calculations indicate that the MPE distance would be less.

7.6. FREQUENCY STABILITY

APPLICABLE RULES

15.255(f) Fundamental emissions must be contained within the frequency bands specified in this section during all conditions of operation. Equipment is presumed to operate over the temperature range -20 to +50 degrees Celsius with an input voltage variation of 85% to 115% of rated input voltage, unless justification is presented to demonstrate otherwise.

TEST PROCEDURE

The EUT is placed in an environmental chamber and set for CW operation. The EUT frequency was measured over the specified ranges of temperature and operating voltages.

RESULTS

Temp (°C)	Voltage (AC)	Hz	Freq (GHz)	Δ from 25 deg C, 115V (MHz)
-20	115	60	57.55850	-6.30
-10	115	60	57.55417	-10.63
0	115	60	57.55292	-11.88
10	115	60	57.55308	-11.72
20	115	60	57.55317	-11.63
25	97.75	60	57.56484	0.04
25	115	60	57.56480	0.00
25	132	60	57.56417	-0.63
30	115	60	57.55359	-11.21
40	115	60	57.55684	-7.96
50	115	60	57.56184	-2.96

The maximum carrier frequency delta is +0.04 / -11.88 MHz. All emissions remain within the 57 to 64 GHz authorized band for both modulation rates.

7.7. FIELD STRENGTH

7.7.1. APPLICABLE RULES

§15.255 Operation within the band 57-64 GHz.

(c) Limits on spurious emissions:

- (1) The power density of any emissions outside the 57-64 GHz band shall consist solely of spurious emissions.
- (2) Radiated emissions below 40 GHz shall not exceed the general limits in Section 15.209 of this part.
- (3) Between 40 GHz and 200 GHz, the level of these emissions shall not exceed 90 pW/cm² at a distance of 3 meters.
- (4) The levels of the spurious emissions shall not exceed the level of the fundamental emission.

§15.205 (a) Except as shown in paragraph (d) of this section, only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
¹ 0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2655 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	(²)
13.36 - 13.41			

¹ Until February 1, 1999, this restricted band shall be 0.490-0.510 MHz.

² Above 38.6

§15.205 (b) Except as provided in paragraphs (d) and (e), the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in Section 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in Section 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in Section 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in Section 15.35 apply to these measurements.

§15.209 (a) Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
30 - 88	100 **	3
88 - 216	150 **	3
216 - 960	200 **	3
Above 960	500	3

** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

§15.209 (b) In the emission table above, the tighter limit applies at the band edges.

7.7.2. TEST PROCEDURE

The EUT is mounted on a tower. It is set to the worst-case operating condition; worst-case is determined as the frequency and data rate which yields the highest fundamental power density.

For measurements below 1 GHz the resolution bandwidth is set to 100 kHz for peak detection measurements or 120 kHz for quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

For measurements above 1 GHz the resolution bandwidth is set to 1 MHz, then the video bandwidth is set to 1 MHz for peak measurements and 10 Hz for average measurements.

The spectrum from 30 MHz to 200 GHz is investigated.

The frequency range of interest is monitored at a fixed antenna height and EUT azimuth. The frequency span is set small enough to easily differentiate between broadcast stations, intermittent ambient signals and EUT emissions. The EUT is rotated through 360 degrees to maximize emissions received. The antenna is scanned from 1 to 4 meters above the ground plane to further maximize the signal. Measurements are made with the antenna polarized in both the vertical and the horizontal positions.

For spurious measurements above 26.5 GHz, the maximum distance from the EUT that yields a minimum system noise floor at least 6 dB below the 15.209 limit, or 15.255 limit, whichever is lower, is calculated for each separate harmonic mixer band. This distance is shown in the noise floor calculations below. The antenna is scanned around the entire perimeter surface of the EUT, in both horizontal and vertical polarizations. During this perimeter scan, the antenna is kept no further from the EUT than the maximum distance calculated for each mixer band.

For harmonic measurements above 26.5 GHz, the above scanning procedure is used to detect harmonic emissions. For all emissions detected, the antenna is moved away from the EUT in a 1/3/10 sequence, as far as possible to maintain a 6 dB signal to noise ratio. Each emission is then maximized by rotating the EUT and varying the antenna height.

7.7.3. SYSTEM NOISE FLOOR WITH EXTERNAL MIXERS

SYSTEM NOISE FLOOR FROM 26.5 TO 200 GHz

Worst Case Radiated Emissions System Noise Floor, 26.5 to 200 GHz.

External Harmonic Mixers are used for this frequency range. The preamplifier is internal to the spectrum analyzer, with gain factors built into firmware. The antenna is mounted directly on the harmonic mixer therefore there is no cable loss.

Each band below corresponds to each harmonic mixer band.

Specification Distance: 3 meters							
Freq GHz	SA dBuV	AF dB/m	Distance m	Distance dB	Field dBuV/m	Limit dBuV/m	Margin dB
26.5 to 40 GHz							
RBW = 1 MHz, peak detection							
40	39.2	42.3	0.3	-20.0	61.50	74	-12.50
RBW = 1 MHz, average detection							
40	27.2	42.3	0.3	-20.0	49.50	54	-4.50
33 to 50 GHz							
RBW = 1 MHz, peak detection							
50	39.2	44.2	0.1	-29.5	53.86	65.3	-11.44
RBW = 1 MHz, average detection							
50	27.2	44.2	0.03	-40.0	31.40	45.3	-13.90
50 to 75 GHz							
RBW = 1 MHz, peak detection							
75	39.2	47.7	0.1	-29.5	57.36	65.3	-7.94
RBW = 1 MHz, average detection							
75	27.2	47.7	0.03	-40.0	34.90	45.3	-10.40
75 to 110 GHz							
RBW = 1 MHz, peak detection							
110	39.2	51.0	0.1	-29.5	60.66	65.3	-4.64
RBW = 1 MHz, average detection							
110	27.2	51.0	0.03	-40.0	38.20	45.3	-7.10
90 to 140 GHz							
RBW = 1 MHz, peak detection							
140	39.2	50.2	0.1	-29.5	59.86	65.3	-5.44
RBW = 1 MHz, average detection							
140	27.2	50.2	0.03	-40.0	37.40	45.3	-7.90
140 to 200 GHz							
RBW = 1 MHz, peak detection							
200	39.2	53.3	0.03	-40.0	52.50	65.3	-12.80
RBW = 1 MHz, average detection							
200	27.2	53.3	0.01	-49.5	30.96	45.3	-14.34

7.7.4. SPURIOUS FIELD STRENGTH RESULTS ABOVE 1 GHz

1 to 18 GHz

07/19/05 High Frequency Measurement
Compliance Certification Services, Morgan Hill Open Field Site

Test Engr: Joseph Chung
Project #:05U3616-1
Company: BridgeWave
EUT Descrip.: Microwave link
EUT M/N: GE60X, FE60X, AR60X
Test Target: 15.209
Mode Oper: Worst Case

Test Equipment:

EMCO Horn 1-18GHz T120; S/N: 29310 @3m	Pre-amplifier 1-26GHz T34 HP 8449B	Pre-amplifier 26-40GHz	Horn > 18GHz	Limit FCC 15.209
---	---------------------------------------	------------------------	--------------	---------------------

Hi Frequency Cables

2 foot cable	3 foot cable 3_David	4 foot cable	12 foot cable 12_Yan
--------------	-------------------------	--------------	-------------------------

HPF Reject Filter

Peak Measurements
RBW=VBW=1MHz

Average Measurements
RBW=1MHz ; VBW=10Hz

f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fldr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
1.040	3.0	72.3	60.8	27.8	1.9	-37.9	0.0	0.0	64.1	52.6	74	54	-9.9	-1.4	H
1.625	3.0	65.6	52.6	30.1	2.5	-36.9	0.0	0.0	61.3	48.3	74	54	-12.7	-5.7	H
1.040	3.0	73.5	61.7	27.8	1.9	-37.9	0.0	0.0	65.3	53.5	74	54	-8.7	-0.5	V
1.678	3.0	64.1	52.4	30.4	2.5	-36.8	0.0	0.0	60.2	48.5	74	54	-13.8	-5.5	V

f	Measurement Frequency	Amp	Preamp Gain	Avg Lim	Average Field Strength Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters	Pk Lim	Peak Field Strength Limit
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m	Avg Mar	Margin vs. Average Limit
AF	Antenna Factor	Peak	Calculated Peak Field Strength	Pk Mar	Margin vs. Peak Limit
CL	Cable Loss	HPF	High Pass Filter		

18 to 26 GHz

07/19/05 High Frequency Measurement
Compliance Certification Services, Morgan Hill Open Field Site

Test Engr: Joseph Chung
Project #:05U3616-1
Company: BridgeWave
EUT Descrip.: Microwave link
EUT M/N: GE60X, FE60X, AR60X
Test Target: FCC 15.209
Mode Oper: Worst Case

Test Equipment:

EMCO Horn 1-18GHz	Pre-amplifier 1-26GHz	Pre-amplifier 26-40GHz	Horn > 18GHz	Limit
	T34 HP 8449B		T39; ARA 18-26GHz; S/N:1013	FCC 15.209

Hi Frequency Cables				HPF	Reject Filter	Peak Measurements RBW=VBW=1MHz
2 foot cable	3 foot cable	4 foot cable	12 foot cable			Average Measurements RBW=1MHz ; VBW=10Hz
	3_David		12_Yan			

f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
25.460	3.0	56.0	38.0	33.9	12.7	-32.4	0.0	0.0	70.2	52.2	74	54	-3.8	-1.8	V
25.050	3.0	59.2	39.5	33.8	12.6	-32.2	0.0	0.0	73.3	53.6	74	54	-0.7	-0.4	H

f	Measurement Frequency	Amp	Preamp Gain	Avg Lim	Average Field Strength Limit
Dist	Distance to Antenna	D Corr	Distance Correct to 3 meters	Pk Lim	Peak Field Strength Limit
Read	Analyzer Reading	Avg	Average Field Strength @ 3 m	Avg Mar	Margin vs. Average Limit
AF	Antenna Factor	Peak	Calculated Peak Field Strength	Pk Mar	Margin vs. Peak Limit
CL	Cable Loss	HPF	High Pass Filter		

26.5 to 200 GHz

07/19/05 High Frequency Measurement

Compliance Certification Services, Morgan Hill Open Field Site

Test Engr: Joseph Chung

Project #:05U3616-1

Company:BridgeWave

EUT Descrip.:Microwave link

EUT M/N:GE60X, FE60X, AR60X

Test Target: FCC 15.209 below 40GHz, 15.255 above 40GHz

Mode Oper: Worst Case

Test Equipment: External Harmonic mixers

Peak Measurements

RBW=VBW=1MHz

Average Measurements

RBW=1MHz ; VBW=10Hz

f GHz	Dist (m)	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	Fltr dB	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes (V/H)
44.960	0.10	44.0		43.5			-29.5		58.0		65.3		-7.3		H
44.960	0.03		36.1	43.5			-40.0			39.6		45.3		-5.7	H

f Measurement Frequency

Dist Distance to Antenna

Read Analyzer Reading

AF Antenna Factor

CL Cable Loss

Amp Preamp Gain

D Corr Distance Correct to 3 meters

Avg Average Field Strength @ 3 m

Peak Calculated Peak Field Strength

HPF High Pass Filter

Avg Lim

Pk Lim Peak Field Strength Limit

Avg Mar Margin vs. Average Limit

Pk Mar Margin vs. Peak Limit

7.7.5. WORST-CASE RADIATED EMISSIONS BELOW 1 GHz

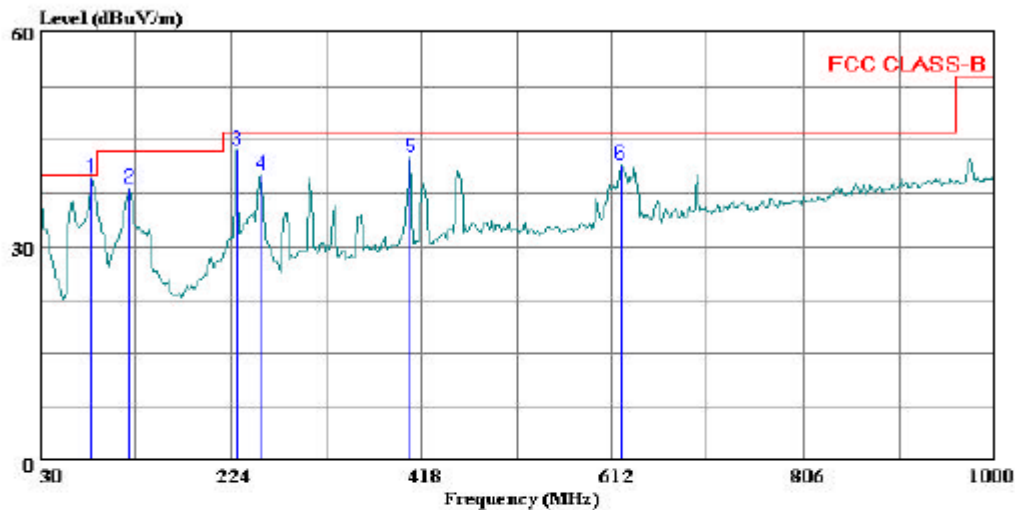
SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION,)

Vertical



561F Monterey Road
Morgan Hill, CA 95037
Tel: (408) 463-0888
Fax: (408) 463-0885

Data#: 28 File#: BWGE60X-72005.EMI Date: 07-21-2005 Time: 14:46:15



(Auxiliary ATC)

Trace: 27

Ref Trace:

Condition: FCC CLASS-B VERTICAL
Test Operator: : Joseph Chung
Project #: : 05U3616-1
Company: : BridgeWave
EUT: : Microwave link
Model No. : GE/FE/AR 60X
Configuration : Pole Stand
Target of Test : FCC, Class B
Mode of Operation: 1 G bits/sec

Page: 1

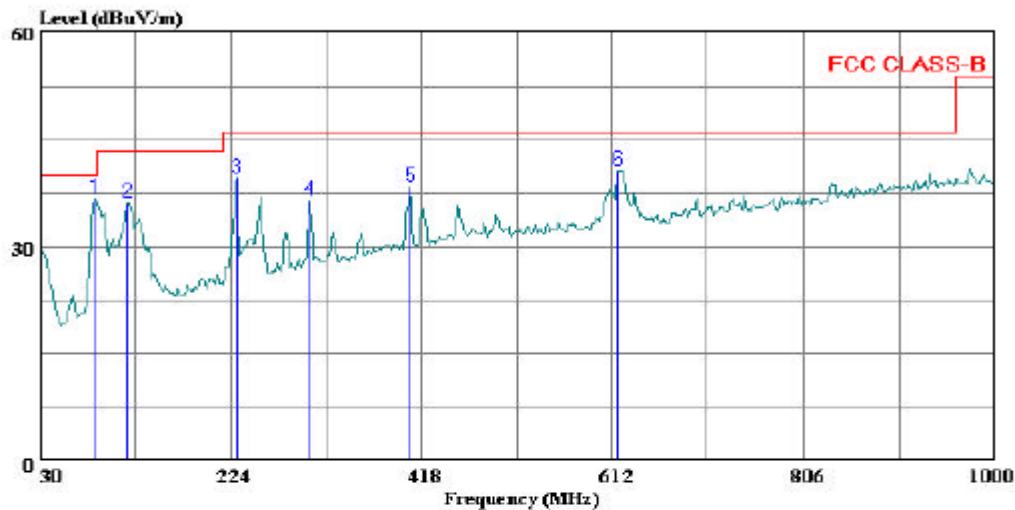
	Read			Limit	Over	
	Freq	Level	Factor	Level	Line	Limit Remark
	MHz	dBuV	dB	dBuV/m	dBuV/m	dB
1	82.380	30.97	8.60	39.57	40.00	-0.43 Peak
2	121.180	23.00	15.16	38.16	43.50	-5.34 Peak
3	230.790	30.60	13.08	43.68	46.00	-2.32 Peak
4	255.040	25.97	14.09	40.06	46.00	-5.94 Peak
5	407.330	24.26	18.21	42.47	46.00	-3.53 Peak
6	620.730	19.66	21.88	41.54	46.00	-4.46 Peak

Horizontal



561F Monterey Road
Morgan Hill, CA 95037
Tel: (408) 463-0888
Fax: (408) 463-0885

Data#: 30 File#: BWGE60X-72005.EMI Date: 07-21-2005 Time: 14:58:21



(Auxiliary)

Trace: 29

Ref Trace:

Condition: FCC CLASS-B HORIZONTAL
Test Operator: : Joseph Chung
Project #: : 05U3616-1
Company: : BridgeWave
EUT: : Microwave link
Model No. : GE/FE/AR 60X
Configuration : Pole Stand
Target of Test : FCC, Class B
Mode of Operation: 1 G bits/sec

Page: 1

	Freq	Read		Limit	Over	
		Level	Factor	Line	Limit	Remark
	MHz	dBuV	dB	dBuV/m	dB	
1	85.290	28.56	8.25	36.81	40.00	-3.19 Peak
2	119.240	21.11	15.05	36.16	43.50	-7.34 Peak
3	230.790	26.59	13.08	39.67	46.00	-6.33 Peak
4	303.540	20.89	15.75	36.64	46.00	-9.36 Peak
5	407.330	20.19	18.21	38.40	46.00	-7.60 Peak
6	618.790	18.91	21.85	40.76	46.00	-5.24 Peak

7.8. POWERLINE CONDUCTED EMISSIONS

LIMIT

§15.207 (a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 μ H/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal.

The lower limit applies at the boundary between the frequency ranges.

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15-0.5	66 to 56 *	56 to 46 *
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency.

TEST PROCEDURE

The EUT is placed on a non-conducting table 40 cm from the vertical ground plane and 80 cm above the horizontal ground plane. The EUT is configured in accordance with ANSI C63.4. EUT was continually transmitting modulated signal during test.

The resolution bandwidth is set to 9 kHz for both peak detection and quasi-peak detection measurements. Peak detection is used unless otherwise noted as quasi-peak.

Line conducted data is recorded for both NEUTRAL and HOT lines.

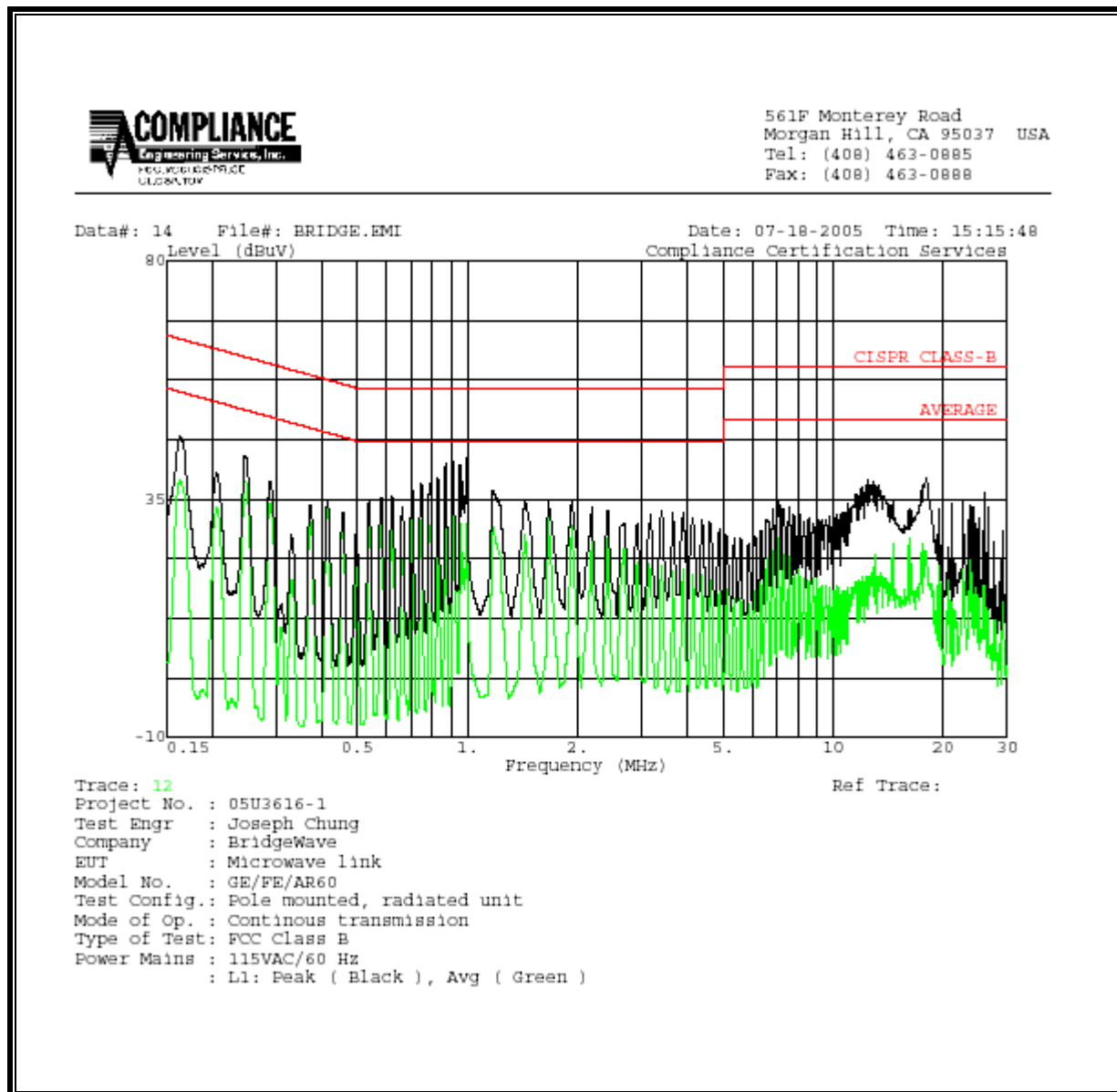
RESULTS

No non-compliance noted:

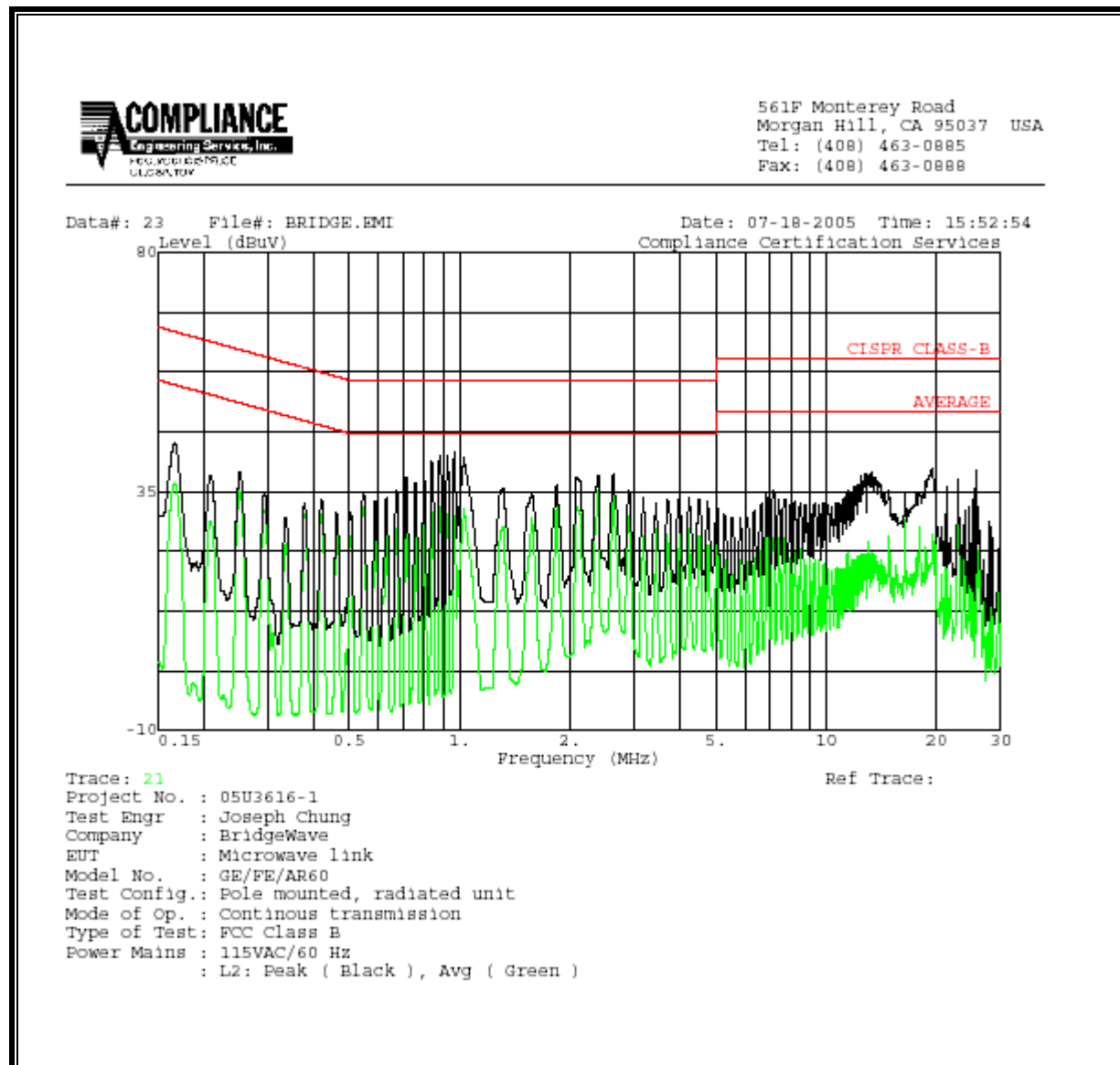
6 WORST EMISSIONS

CONDUCTED EMISSIONS DATA (115VAC 60Hz)									
Freq.	Reading			Closs	Limit	EN_B	Margin		Remark
(MHz)	PK (dBuV)	QP (dBuV)	AV (dBuV)	(dB)	QP	AV	QP (dB)	AV (dB)	L1 / L2
0.15	46.86	--	38.39	0.00	66.00	56.00	-19.14	-17.61	L1
0.25	43.02	--	38.40	0.00	61.89	51.89	-18.87	-13.49	L1
21.15	34.32	--	33.12	0.00	60.00	50.00	-25.68	-16.88	L1
0.17	43.95	--	36.48	0.00	65.11	55.11	-21.16	-18.63	L2
0.54	33.84	--	31.16	0.00	56.00	46.00	-22.16	-14.84	L2
25.59	39.18	--	37.86	0.00	60.00	50.00	-20.82	-12.14	L2
6 Worst Data									

LINE 1 RESULTS



LINE 2 RESULTS

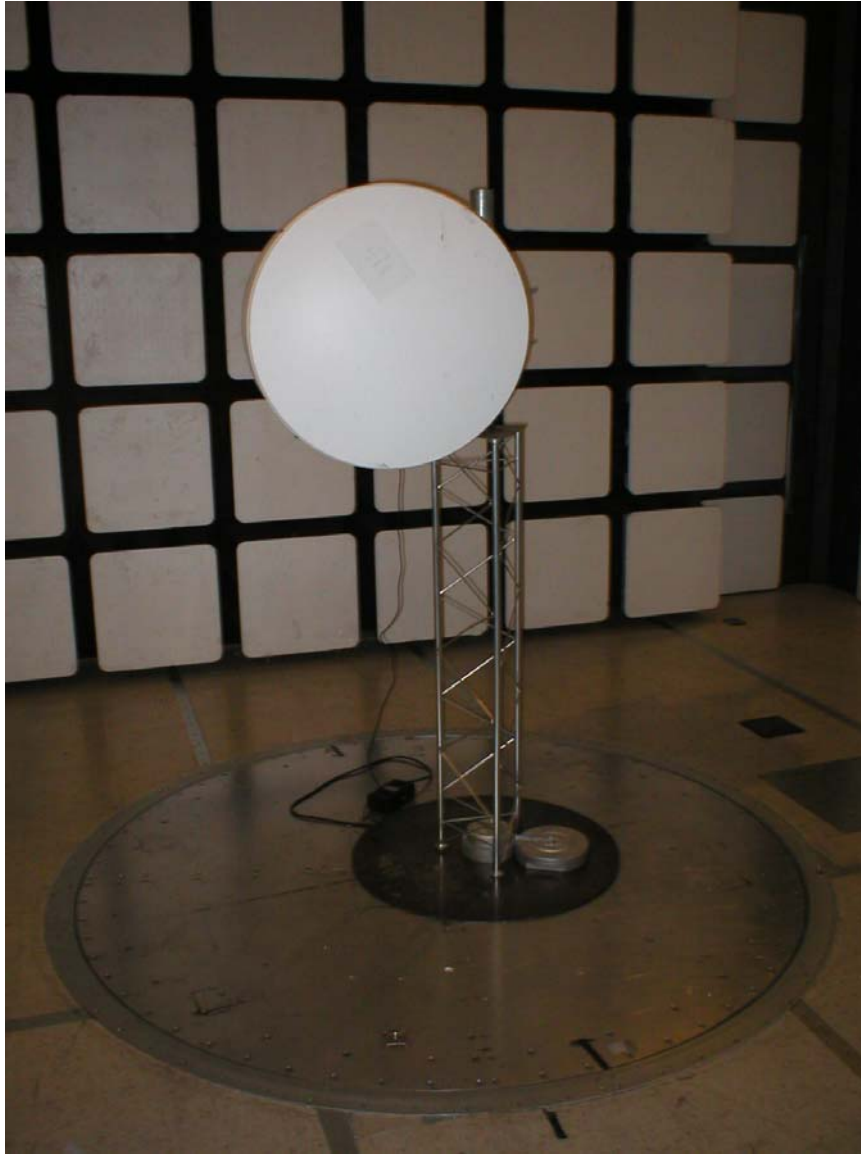


8. SETUP PHOTOS

RADIATED RF MEASUREMENT SETUP



RADIATED SPURIOUS FRONT PHOTO



RADIATED SPURIOUS BACK PHOTO



FREQUENCY STABILITY MEASUREMENT SETUP



POWERLINE CONDUCTED EMISSIONS MEASUREMENT SETUP

LINE CONDUCTED FRONT PHOTO



LINE CONDUCTED BACK PHOTO



END OF REPORT