FCC CFR47 PART 15 SUBPART C CERTIFICATION

TEST REPORT

FOR

MICROWAVE LINK, HIGH & LOW BAND

MODEL NUMBER: GE60

FCC ID: RWM-GE60

REPORT NUMBER: 04U2574-1

ISSUE DATE: MARCH 18, 2004

Prepared for
BRIDGEWAVE COMMUNICATIONS
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1. TEST RESULT CERTIFICATION

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

EUT DESCRIPTION: MICROWAVE LINK , HIGH & LOW BAND

MODEL: GE60

DATE TESTED: MARCH 03 – 15, 2004

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: This document reports conditions under which testing was conducted and results of tests performed. 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.

Approved & Released For CCS By: Tested By:

MIKE HECKROTTE
ENGINEERING MANAGER
COMPLIANCE CERTIFICATION SERVICES

NEELESH RAJ
TEST TECHNICIAN
COMPLIANCE CERTIFICATION SERVICES

2. EUT DESCRIPTION

The EUT is a 60 GHz transceiver operating under section 15.255 of the Rules.

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

Frequency of Operation	Maximum output power, dBm	Maximum output power, mW
58.1 - 62.9	-0.4	0.912

The radio utilizes an Integral Directional Cassegrain Antenna with a gain of 39 dBi.

3. TEST METHODOLOGY

The tests documented in this report were performed in accordance with ANSI C63.4/2001, FCC CFR 47 Part 2 and FCC CFR 47 Part 15.

4. 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.

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5. CALIBRATION AND UNCERTAINTY

5.1. 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.

5.2. 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%.

5.3. 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**
Site B Antenna, Bilog	Chase	CBL6112B	1/29/1907	3/8/2005
Site B Preamplifier, 1300MHz	HP	8447D	2944A06589	8/18/04
RF Preselector, 20 Hz ~ 2 GHz	HP	85685A	2817A00756	8/22/04
SA RF Section, 1.5 GHz	HP	85680B	2814A04227	2/22/05
SA Display Section 2	HP	85662A	2816A16696	5/24/05
Quasi-Peak Adaptor	HP	85650A	2811A01155	5/24/05
LISN, 10 kHz ~ 30 MHz	Solar	8012-50-R-24-BNC	8379443	10/13/04
LISN, 10 kHz ~ 30 MHz	FCC	LISN-50/250-25-2	2023	10/13/04
Site A Line Stabilizer / Conditioner	Tripplite	LC-1800a	A0051681	CNR
EMI Test Receiver	R & S	ESHS 20	827129/006	7/17/04
Antenna, Horn 1 ~ 18 GHz	EMCO	3117	29301	12/26/04
Preamplifier, 1 ~ 26 GHz	Miteq	NSP10023988	646456	4/25/04
Spectrum Analyzer	HP	E4446A	US42510266	7/23/04
Antenna, Tuned Dipole	CDI	Roberts	116	5/15/04
AC Power Source, 8KVA	APC	AFP2-8KVA	J5061	CNR
Antenna, Horn 26 ~ 40 GHz	ARA	MWH-2640/B	1029	12/3/04
Antenna, Horn, 18 ~ 26 GHz	ARA	MWH-1826/B	1013	2/4/05
Spectrum Analyzer, 40 GHz	HP	8564E	3943A01643	6/4/04
Amplifier, 2 ~ 8 GHz	HP	11975A	2517A01067	1/16/05
Harmonic Mixer Cable	HP	5061-5458	490	Plug-in
Harmonic Mixer, 75 ~ 110 GHz	HP	11970W	2521A01314	10/25/05
Harmonic Mixer, 50 ~ 75 GHz	HP	11970V	2521A01163	10/22/05
Harmonic Mixer, 26.5 ~ 40 GHz	HP	11970A	3008A04190	10/14/05
Harmonic Mixer, 33 ~ 50 GHz	HP	11970Q	3003A03363	10/18/05
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	0	CNR
Power Meter	Agilent	E4419B	GB40202203	10/2/04
Power Sensor	Agilent	V8486A	170891	10/2/04

6. SETUP OF EQUIPMENT UNDER TEST

SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST				
Description	**Manufacturer**	**Model**	**Serial Number**	**FCC ID**
AC ADAPTER #1	CINCO ELECTRONICS CO.,LTD	TR70A24-01A03	70240-0048908	N/A
AC ADAPTER #2	CUI, INC.	EA1050B-240	N/A	N/A
AC ADAPTER #3	ELPAC POWER SYSTEMS	FW10024	9125	N/A

I/O CABLES

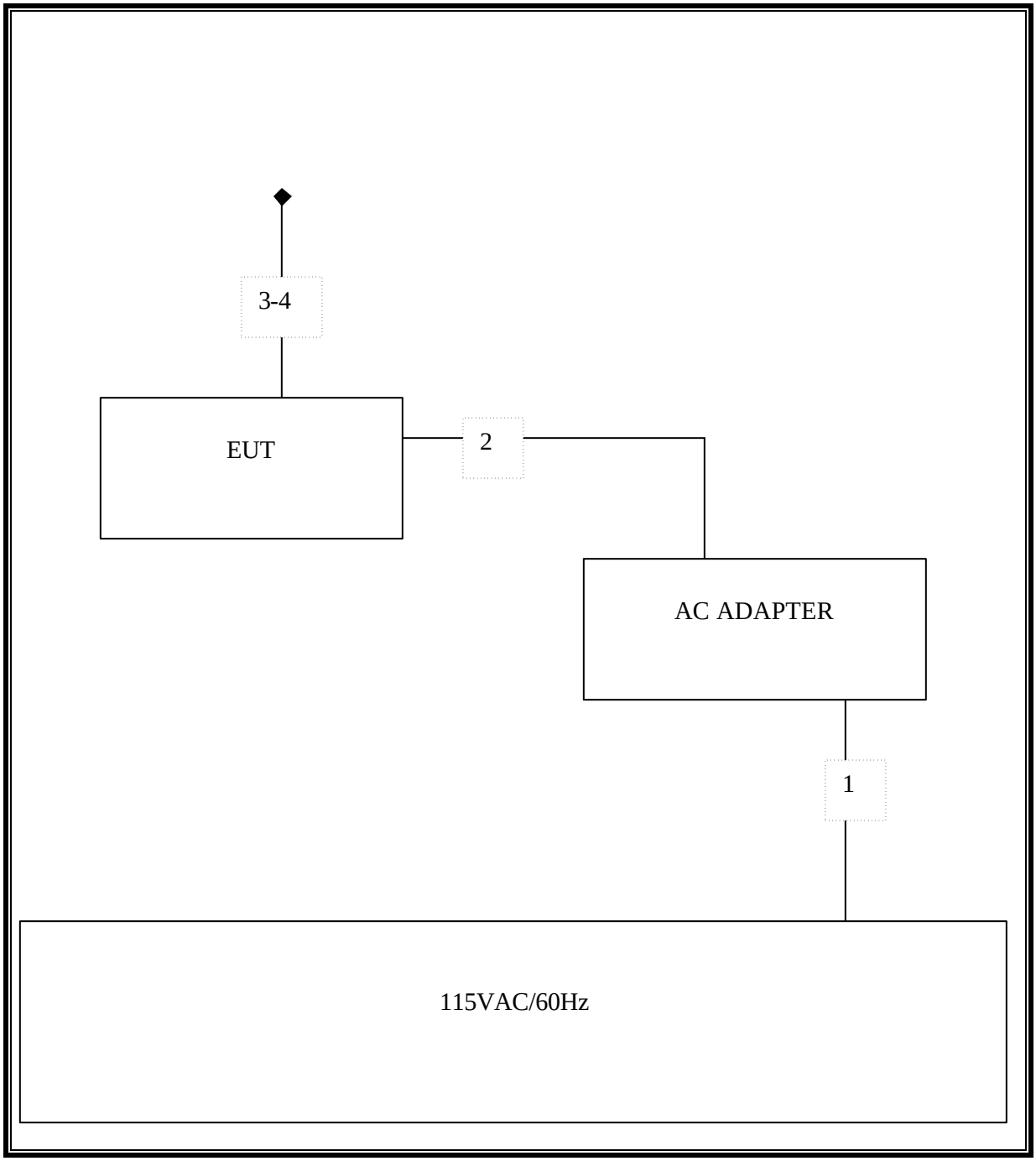
I/O CABLE LIST						
Cable No.	**Port**	**# of Identical Ports**	**Connector Type**	**Cable Type**	**Cable Length**	**Remarks**
1	AC PWR	1	AC PWR	UNSHIELDED	1.86M	US (3 PRONG)
2	DC PWR	1	TERMINAL	UNSHIELDED	1.86M	N/A
3&4	FIBEROPTIC	2	FIBEROPTIC	UNSHIELDED	15M	UNTERMINATED

TEST SETUP

During the testing process the EUT was in continuous transmit mode. The EUT was tested with three different AC Adapter's. The worst case (AC ADAPTER#3) was determined by AC line conduction and all the tests were done with that power supply.

Note: data for all three power supplies are located in the AC Line Conduction section of this report.

SETUP DIAGRAM FOR TESTS



7. APPLICABLE LIMITS AND TEST RESULTS

7.1. MEASUREMENT FUNDAMENTALS

TEST PROCEDURE

The EUT was placed on a non-conductive table, measurements were made at the far field boundary. The far field distance was determined from calculations described below.

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(near field) = (D^2) / (4 * λ)

where
D = Largest Antenna Dimension, including the reflector, in meters
λ = wavelength in meters

For a parabolic reflector antenna with D = 0.275 m and λ = 300 / f (MHz) equation (3) predicts a near-field boundary of

R (near field) = 3.66 m at 58.1 GHz, and 3.96 m at 62.9 GHz.

FAR FIELD BOUNDARY CALCULATIONS

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

(16) R(far field) = (0.6 * D^2) / λ

where
D = Largest Antenna Dimension, including the reflector, in meters
λ = wavelength in meters

For a parabolic reflector antenna with D = 0.275 m and λ = 300 / f (MHz) equation (16) predicts a far-field boundary of

R (far field) = 8.79 m at 58.1 GHz, and 9.51 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(surface) = 4P/A

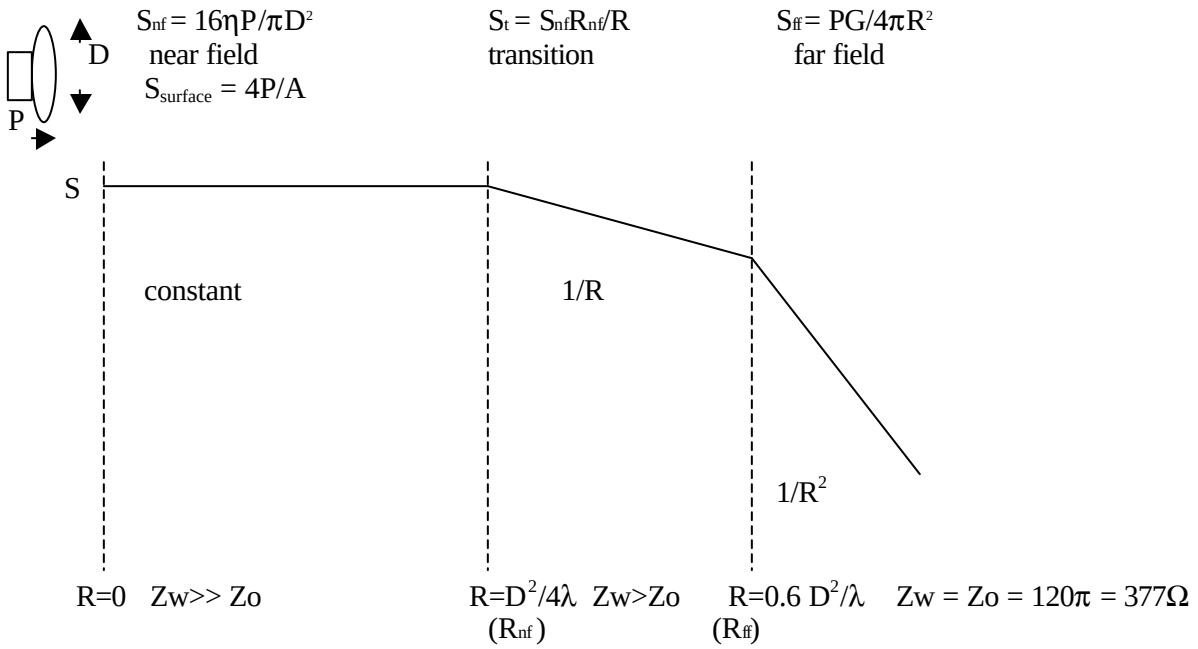
(6) in the near field, with antenna maximum dimension D:
S(near field) = 16ηP/πD^2
where η = aperture efficiency

(7) in the transition region R (near field) < R < R (far field) at distance R:
S(transition) = (S(near field) * R(near field)) / R

(8) in the far field or Fraunhofer region:
S(far field) = PG/4πR^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:

a) constant from the antenna surface to the near-field boundary R_{nf};
b) decreases as 1/R in the transition region $R_{nf} < R < R_{ff}$;
c) 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(at 3m) = S(at measurement distance) + 20log(R/R(far field)) + 10log (R(far field) / R(near field))

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

Correction Factor from far field boundary to near field region = 10 * log (R(far field) / R(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.

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 π = (E^2) / 377
where
S is the Power Density in W/m^2
and
E is the Field Strength in V/m

POWER DENSITY LIMITS EXPRESSED AS FIELD STRENGTH

Rearranging terms from above,

E = Sqrt (377 * S)

where E is the field strength in V/m and S is the power density in W/m^2

For S = 18 uW/cm^2,
S = 0.18 W/m^2 and E = 8.24 V/m or 138 dBuV/m

For S = 9 uW/cm^2,
S = 0.09 W/m^2 and E = 5.82 V/m or 135 dBuV/m

For S = 90 pW/cm^2,
S = 9 * 10 ^ (-11) W/m^2 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.

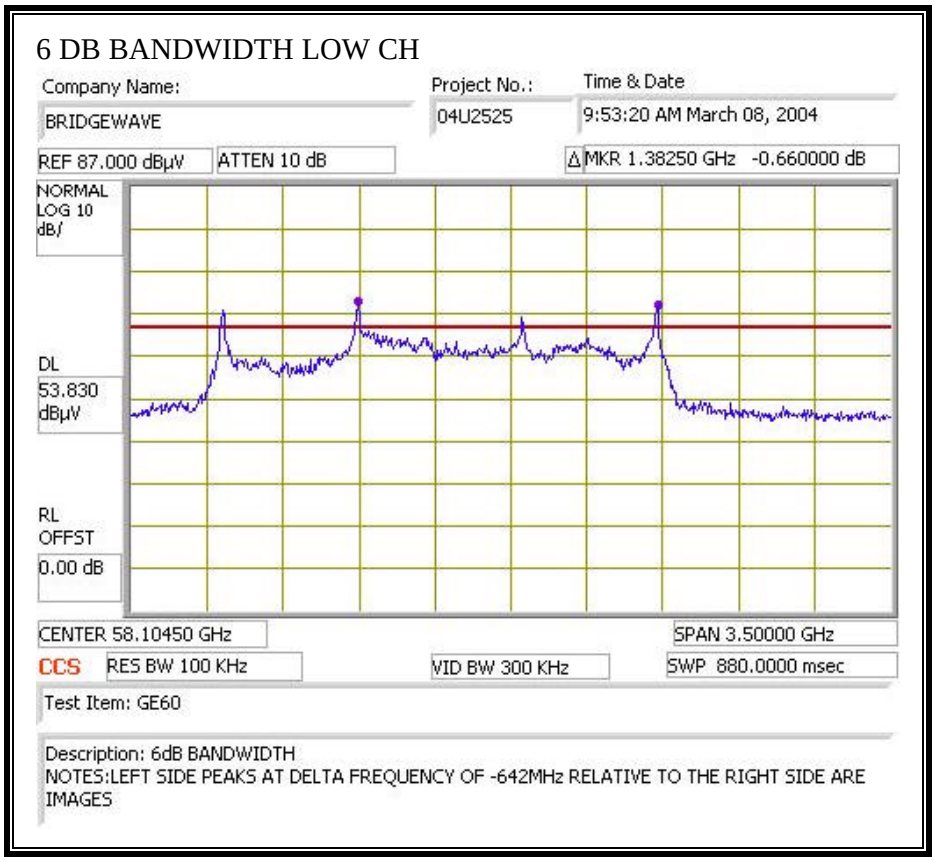
For this EUT the emission bandwidth is greater than the image frequency separation of the external mixer. Therefore, the actual signal and the image signal overlap. On the analyzer display the actual signal is to the right and the image signal is to the left. The portion of the display that shows the image signal is ignored when placing the delta markers for the emission bandwidth measurement.

RESULTS

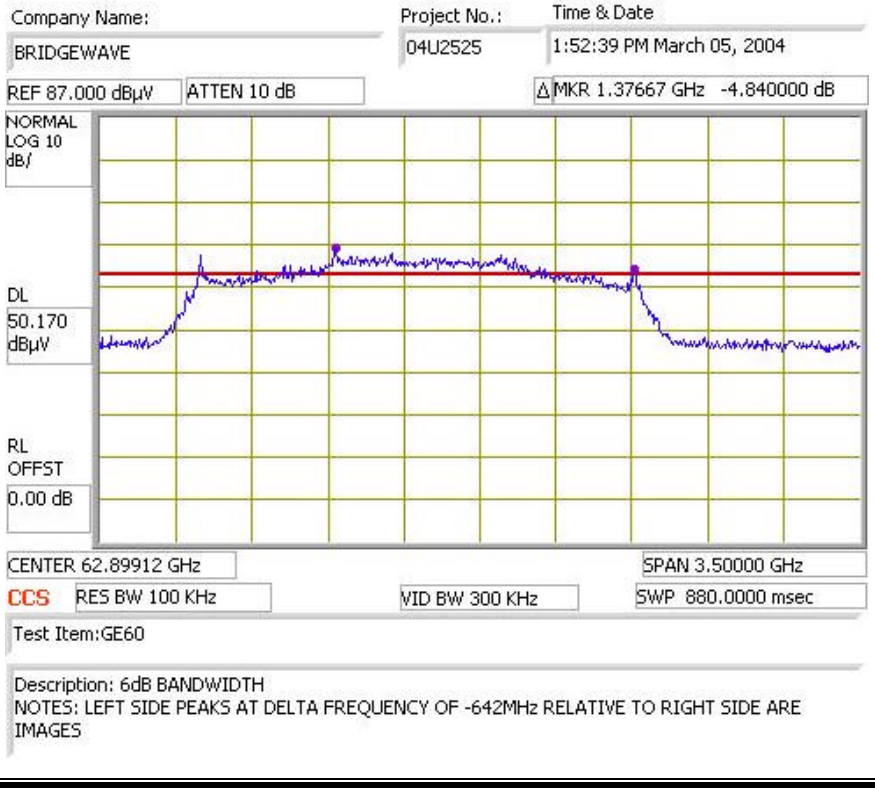
No non-compliance noted:

Channel	Frequency (GHz)	6 dB Bandwidth (MHz)
Low	58.1	1383
High	62.9	1377

6 DB BANDWIDTH



6 DB BANDWIDTH HIGH CH



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 each device 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 = Power (dBuV) + Antenna Factor (dB/m).

This field strength is extrapolated to the field strength at 3 meters using the 3.8 dB near field correction factor derived in the Measurement Fundamentals section of this report.

The 3 meter field strength is then compared to the field strength corresponding to the 3 meter power density limit.

Result

No non-compliance noted:

Freqeuncy (GHz)	Measured Power (dBm)	Antenna Factor (dB/m)	Far Field Strength (dBuV/m)	3 m Field Strength (dBuV/m)	3 m Average F.S. Limit (dBuV/m)	Margin (dB)
58.1	-22.8	45.50	129.7	133.5	135	-1.5
62.9	-23.2	46.20	130.0	133.8	135	-1.2

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

Freqeuncy (GHz)	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	133.5	5.9	18.0	9.0
62.9	133.8	6.4	18.0	9.0

The Peak Power Density is less than both the Peak and Average Power Density 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:

EIRP (dBm) = field strength (dBuV) – 95.2

Output Power (dBm) = EIRP - Antenna Gain (dBi)

RESULT

No non-compliance noted:

Freqeuncy (GHz)	3 m Field Strength (dBuV/m)	Measured EIRP (dBm)	Antenna Gain (dBi)	Output Power (dBm)	Output Power (mW)	Power Limit (mW)
58.1	133.5	38.3	39.00	-0.7	0.851	500.0
62.9	133.8	38.6	39.00	-0.4	0.912	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 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 6.4 uW/cm2 at 59.47 GHz.

S = 6.4 uW/cm^2 = 0.064 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

LOW CHANNEL				
Temp.(celius)	Voltage (AC)	Hz	Freq (GHz)	Freq (GHz) (Delta)
25	115	60	58.145035	Reference
25	97.75	60	58.145035	0
25	132.25	60	58.145035	0
-20	115	60	58.140080	-0.004955
-10	115	60	58.147850	0.002815
0	115	60	58.148226	0.003191
10	115	60	58.148523	0.003488
20	115	60	58.138534	-0.006501
30	115	60	58.146735	0.001700
40	115	60	58.139400	-0.005635
50	115	60	58.133199	-0.011836

HIGH CHANNEL				
Temp.(celius)	Voltage (AC)	Hz	Freq (GHz)	Freq (GHz) (Delta)
25	115	60	62.909917	Reference
25	97.75	60	62.909917	0
25	132.25	60	62.909917	0
-20	115	60	62.900000	-0.009917
-10	115	60	62.896318	-0.013599
0	115	60	62.852268	-0.057649
10	115	60	62.932700	0.022783
20	115	60	62.895398	-0.014519
30	115	60	62.909602	-0.000315
40	115	60	62.909559	-0.000358
50	115	60	62.907767	-0.002150

The delta frequencies combined with the emission bandwidths demonstrate that all emissions will remain within 57 – 64 GHz authorized bands.

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 placed on the 0.8 m high non-conducting tabletop. The EUT is continuously transmitting.

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 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 10 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 ABOVE 1 GHZ

SYSTEM NOISE FLOOR FROM 1 TO 40 GHz

Compliance Certification Services									
Worst Case Radiated Emissions System Noise Floor									
Each band below corresponds to each horn antenna band									
Uses the lowest gain preamplifier; actual preamp used may have higher gain									
Uses the longest typical cable configuration; actual cables used may have less loss									
Noise floor field strength results are compared to the FCC 15.205 Restricted Band limit									
Specification Distance:			3	meters					
Freq	**SA**	**AF**	**Distance**	**Distance**	**Preamp**	**Cable**	**Field**	**Limit**	**Margin**
GHz	**dBuV**	**dB/m**	**m**	**dB**	**dB**	**dB**	**dBuV/m**	**dBuV/m**	**dB**
1 to 18 GHz band									
RBW = 1 MHz, peak detection									
18	41.9	47.8	1	-9.5	32.6	13.5	61.06	74	-12.94
RBW = 1 MHz, average detection									
18	28.7	47.8	1	-9.5	32.6	13.5	47.86	54	-6.14
18 to 26 GHz band									
RBW = 1 MHz, peak detection									
26	44.6	33.4	1	-9.5	35.0	19.5	52.96	74	-21.04
RBW = 1 MHz, average detection									
26	32.4	33.4	1	-9.5	35.0	19.5	40.76	54	-13.24
26 to 40 GHz band									
External mixer is used for this band									
Preamplifier is internal to Spectrum Analyzer, with gain factor built into firmware									
Antenna is mounted directly on external mixer, therefore cable = 0 dB									
RBW = 1 MHz, peak detection									
40	39.2	44.5	0.1	-29.5	0.0	0	54.16	74	-19.84
RBW = 1 MHz, average detection									
40	27.2	44.5	0.1	-29.5	0.0	0	42.16	54	-11.84

SYSTEM NOISE FLOOR FROM 40 TO 200 GHz

Compliance Certification Services

Worst Case Radiated Emissions System Noise Floor, 40 to 200 GHz

External Harmonic Mixers are used for this frequency range
The preamplifier is internal to Spectrum Analyzer, with the gain factor 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
Noise floor field strength results are compared to the applicable FCC 15.255 limit

Specification Distance: 3 meters

Freq	SA	AF	Distance	Distance	Field	Limit	Margin
GHz	dBuV	dB/m	m	dB	dBuV/m	dBuV/m	dB
33 to 50 GHz							
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, average detection							
75	35.4	47.7	0.01	-49.5	33.56	45.3	-11.74
75 to 100 GHz							
RBW = 1 MHz, average detection							
100	42.5	50.2	0.003	-60.0	32.70	45.3	-12.60
100 to 200 GHz							
RBW = 1 MHz, average detection							
200	39	53.3	0.003	-60.0	32.30	45.3	-13.00

7.7.4. SPURIOUS FIELD STRENGTH RESULTS 1 GHz to 200 GHz

03/04/04 High Frequency Measurement
Compliance Certification Services, Morgan Hill Open Field Site

Test Engr: NEELESH RAJ
Project #: 04U2525
Company: BRIDGEWAVE
EUT Descrip.: MICROWAVE LINK DEVICE
EUT M/N: GE60
Test Target: FCC
Mode Oper: TX

Test Equipment:

EMCO Horn 1-18GHz	Spectrum Analyzer	Pre-amplifer 1-26GHz	Pre-amplifer 26-40GHz	Horn > 18GHz
T119; S/N: 29301 @3m		T63 Miteq 646456		

Hi Frequency Cables: ☑ (2 ft) ☐ (2 ~ 3 ft) ☐ (4 ~ 6 ft) ☑ (12 ft)

Limit: FCC 15.205

Peak Measurements: 1 MHz Resolution Bandwidth, 1MHz Video Bandwidth

Average Measurements: 1 MHz Resolution Bandwidth, 10Hz Video Bandwidth

f GHz	Dist feet	Read Pk dBuV	Read Avg. dBuV	AF dB/m	CL dB	Amp dB	D Corr dB	HPF	Peak dBuV/m	Avg dBuV/m	Pk Lim dBuV/m	Avg Lim dBuV/m	Pk Mar dB	Avg Mar dB	Notes
2.760	9.8	54.7	47.1	33.3	2.2	-35.9	0.0	1.0	55.3	47.7	74.0	54.0	-18.7	-6.3	V
2.874	9.8	48.7	38.0	33.4	2.3	-35.8	0.0	1.0	49.6	38.9	74.0	54.0	-24.4	-15.1	V
2.760	9.8	51.6	44.6	33.3	2.2	-35.9	0.0	1.0	52.2	45.2	74.0	54.0	-21.8	-8.8	H
2.874	9.8	46.0	37.9	33.4	2.3	-35.8	0.0	1.0	46.9	38.8	74.0	54.0	-27.1	-15.2	H
			NO OTHER SPURIOUS EMISSIONS DETECTED ABOVE THE SYSTEM NOISE FLOOR												

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		

7.7.5. WORST-CASE RADIATED EMISSIONS BELOW 1 GHz

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

COMPLIANCE Certification Services

FCC, VCCI, CISPR, CE, AUSTEL, NZ
UL, CSA, TUV, BSMI, DHHS, NVLAP

561F MONTEREY ROAD, SAN JOSE, CA 95037-9001
PHONE: (408) 463-0885 FAX: (408) 463-0888

Project #: 04U2525
Report #: 030304B01
Date& Time: 03/03/04 10:11 AM
Test Engr: Frank Ibrahim

Company: Bridgewave
EUT Description: Microwave Link Device, model: GE60
Test Configuration : EUT, Power Supply
Type of Test: FCC Class B
Mode of Operation: TX ON

( ) A-Site (•) B-Site ( ) C-Site ( ) F-Site 6 Worst Data Descending

Freq. (MHz)	Reading (dBuV)	AF (dB)	Closs (dB)	Pre-amp (dB)	Level (dBuV/m)	Limit FCC_B	Margin (dB)	Pol (H/V)	Az (Deg)	Height (Meter)	Mark (P/Q/A)
47.50	50.00	10.81	1.44	29.31	32.94	40.00	-7.06	3mV	0.00	1.00	P
450.00	42.00	16.72	5.26	29.04	34.94	46.00	-11.06	3mV	0.00	1.00	P
643.00	41.20	19.11	6.24	28.99	37.56	46.00	-8.44	3mV	0.00	1.00	P
263.00	40.50	12.79	3.73	28.46	28.56	46.00	-17.44	3mH	0.00	1.00	P
489.60	41.30	17.58	5.56	29.16	35.28	46.00	-10.72	3mH	0.00	1.00	P
540.00	38.50	18.25	5.79	29.21	33.33	46.00	-12.67	3mH	0.00	1.00	P
All readings above are noise floor and not related to EUT											
Total data #: 6											

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 µH/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

PWR. SUPPPLY #1

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
5.19	46.62	--	--	0.00	60.00	50.00	-13.38	-3.38	L1
5.56	47.48	--	--	0.00	60.00	50.00	-12.52	-2.52	L1
6.06	48.00	--	--	0.00	60.00	50.00	-12.00	-2.00	L1
5.19	44.14	--	--	0.00	60.00	50.00	-15.86	-5.86	L2
5.56	45.76	--	--	0.00	60.00	50.00	-14.24	-4.24	L2
6.06	46.14	--	--	0.00	60.00	50.00	-13.86	-3.86	L2
6 Worst Data									

PWR. SUPPPLY #2

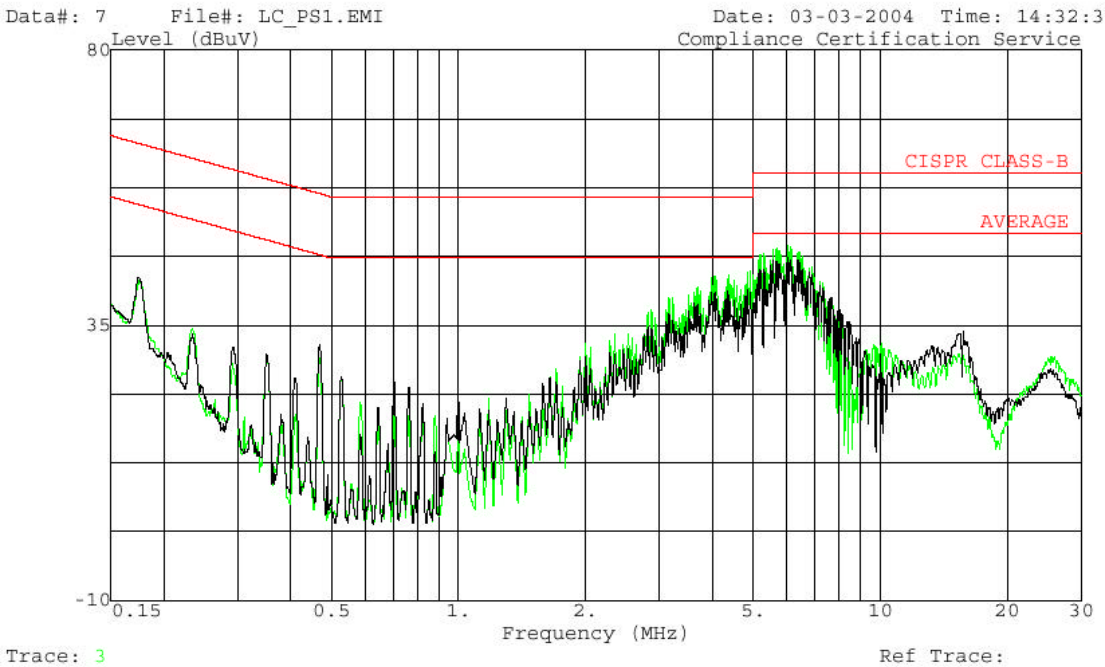
CONDUCTED EMISSIONS DATA (115VAC 60Hz)									
Freq.	Reading			Closs	Limit	EN_B	Margin		Remark
(MHz)	PK (dBuV)	QP (dBuV)	AV (dBuV)	(dB)	QP	AV	QP (dB)	AV (dB)	L1 / L2
0.19	52.06	--	--	0.00	65.00	55.00	-12.94	-2.94	L1
0.25	44.20	--	--	0.00	63.23	53.23	-19.03	-9.03	L1
6.06	48.00	--	--	0.00	60.00	50.00	-12.00	-2.00	L1
0.19	48.20	--	--	0.00	65.00	55.00	-16.80	-6.80	L2
5.56	45.76	--	--	0.00	60.00	50.00	-14.24	-4.24	L2
6.06	46.14	--	--	0.00	60.00	50.00	-13.86	-3.86	L2
6 Worst Data									

PWR. SUPPLY #3

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
0.18	62.14	--	48.89	0.00	65.23	55.23	-3.09	-6.34	L1
0.24	52.34	--	37.19	0.00	63.51	53.51	-11.17	-16.32	L1
6.06	48.00	--	23.35	0.00	60.00	50.00	-12.00	-26.65	L1
0.18	57.18	--	46.37	0.00	65.26	55.26	-8.08	-8.89	L2
0.24	46.40	--	34.97	0.00	63.51	53.51	-17.11	-18.54	L2
0.29	42.92	--	31.07	0.00	61.89	51.89	-18.97	-20.82	L2
6 Worst Data									

LINE 1 & LINE 2 RESULTS FOR PWR. SUPPLY #1

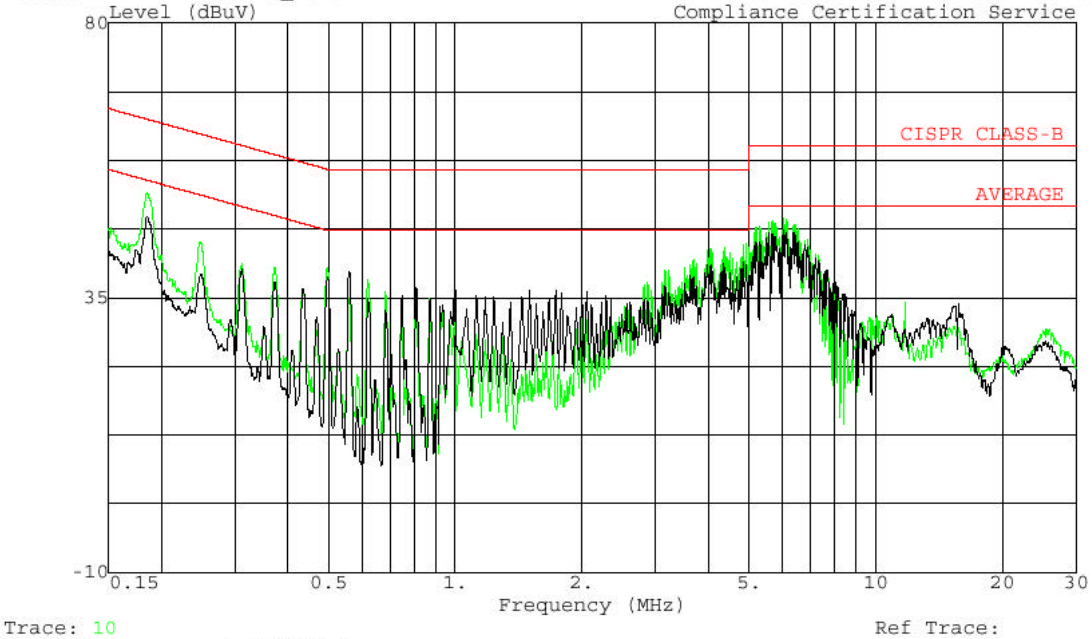
COMPLIANCE Engineering Service, Inc.
561F Monterey Road,
San Jose, CA 95037 USA
Tel: (408) 463-0885
Fax: (408) 463-0888



Trace: 3 Ref Trace:
Project # : 04U2574-1
Test Operator : Frank Ibrahim
Company : Bridgewave
EUT : Microwave Link Device
Model : GE60, Low Band and High Band
Configuration : EUT / Power Supply
Mode of Operation: Transmit
Target of Test : FCC Class B
Voltage : 115 VAC / 60 Hz
: PK: L1(Green), L2(Black)
: PS 1

LINE 1 & LINE 2 RESULTS FOR PWR. SUPPLY #2

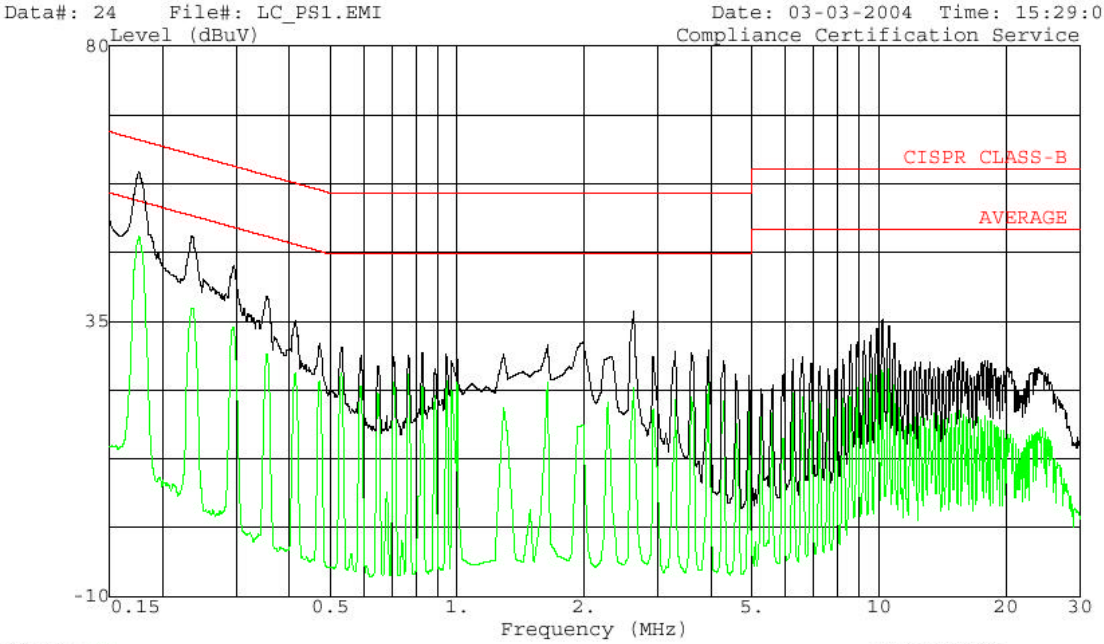
COMPLIANCE Engineering Service, Inc.
561F Monterey Road,
San Jose, CA 95037 USA
Tel: (408) 463-0885
Fax: (408) 463-0888



Trace: 10 Ref Trace:
Project # : 04U2574-1
Test Operator : Frank Ibrahim
Company : Bridgewave
EUT : Microwave Link Device
Model : GE60, Low Band and High Band
Configuration : EUT / Power Supply
Mode of Operation: Transmit
Target of Test : FCC Class B
Voltage : 115 VAC / 60 Hz
: PK: L1(Green), L2(Black)
: PS 2

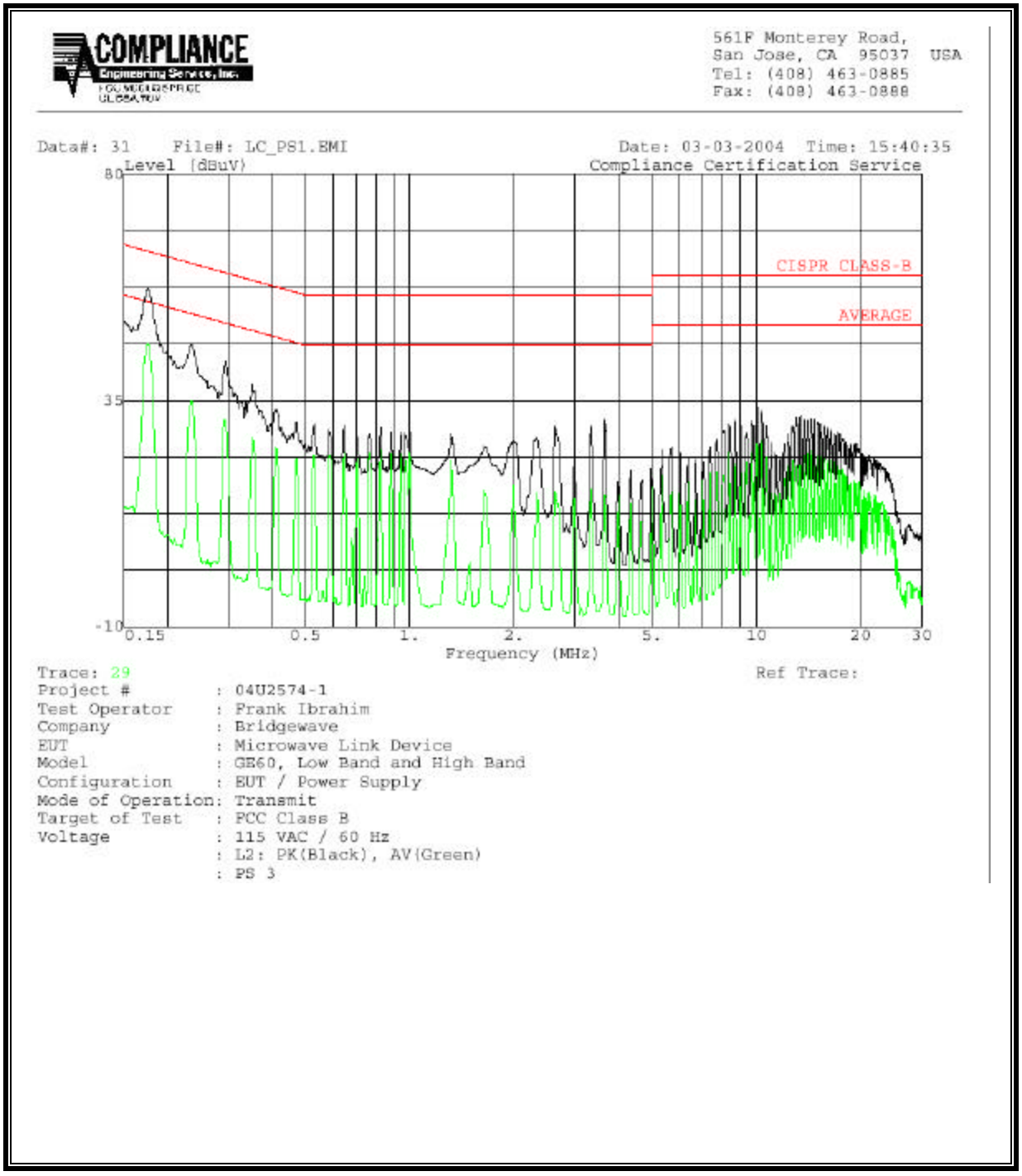
LINE 1 RESULTS FOR PWR SUPPLY #3

COMPLIANCE Engineering Services, Inc.
561F Monterey Road,
San Jose, CA 95037 USA
Tel: (408) 463-0885
Fax: (408) 463-0888



Trace: 22 Ref Trace:
Project # : 04U2574-1
Test Operator : Frank Ibrahim
Company : Bridgewave
EUT : Microwave Link Device
Model : GE60, Low Band and High Band
Configuration : EUT / Power Supply
Mode of Operation: Transmit
Target of Test : FCC Class B
Voltage : 115 VAC / 60 Hz
: L1: PK(Black), AV(Green)
: PS 3

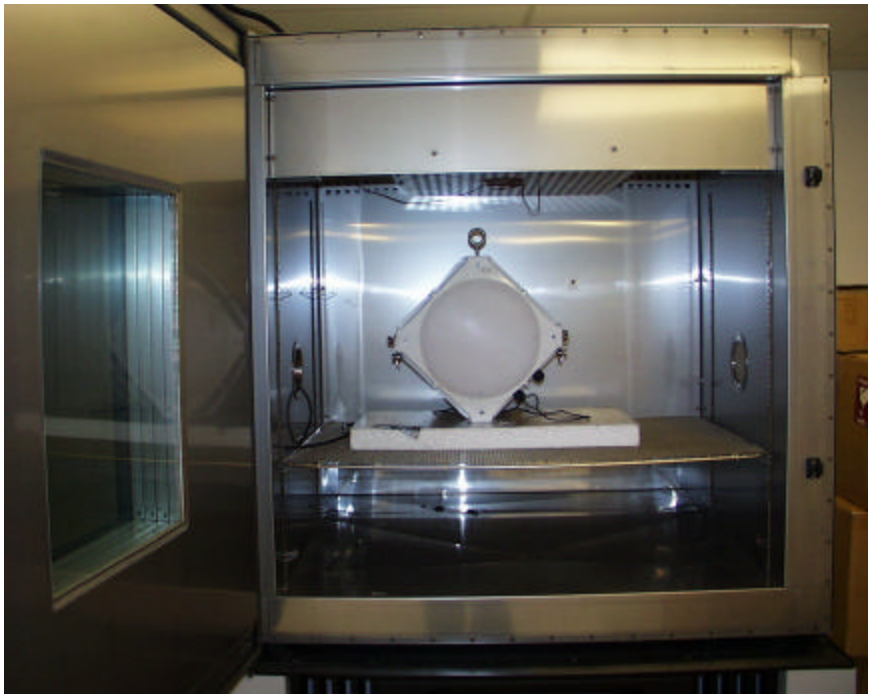
LINE 2 RESULTS FOR PWR SUPPLY #3



8. SETUP PHOTOS

FREQUENCY STABILITY MEASUREMENT SETUP

ENVIRONMENTAL CHAMBER PHOTO



RADIATED RF MEASUREMENT SETUP

RADIATED FRONT PHOTO

RADIATED BACK PHOTO

POWERLINE CONDUCTED EMISSIONS MEASUREMENT SETUP

LINE CONDUCTED FRONT PHOTO

LINE CONDUCTED BACK PHOTO

END OF REPORT