FCC CFR47 PART 15 SUBPART C CERTIFICATION

TEST REPORT

FOR

60 GHz TRANSCEIVER

MODEL NUMBER: ME100

FCC ID: RL3ALME100

REPORT NUMBER: 03I2390-1

ISSUE DATE: DECEMBER 19, 2003

Prepared for
COMOTECH CORPORATION
1-908, ULSAN APT-BLDG.
812-1, HYOMUN-DONG, BUK-GU,
ULSAN-CITY
KOREA 683-360

Prepared by
COMPLIANCE CERTIFICATION SERVICES
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TABLE OF CONTENTS

COMPLIANCE CERTIFICATION SERVICES DOCUMENT NO: CCSUP4031A
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1. TEST RESULT CERTIFICATION

COMPANY NAME: ComoTech Corporation
1-908, Ulsan Apt-Bldg.
812-1, Hyomun-Dong, Buk-Gu,
Ulsan-City KOREA 683-360

EUT DESCRIPTION: 60 GHZ TRANSCEIVER

MODEL: ME100

DATE TESTED: 25 NOV 2003 – 16 DEC 2003

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
CHIEF ENGINEER
COMPLIANCE CERTIFICATION SERVICES

TOM N. COKENIAS
DIRECTOR OF ENGINEERING, N.A.
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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
59.47 GHz	5.67	3.69
61.38 GHz	1.46	1.4

The radio utilizes a 43 dBi gain Cassegrain antenna.

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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.

No part of this report may be used to claim or imply product endorsement by NVLAP or any agency of the US Government.

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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%.

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5.3. TEST AND MEASUREMENT EQUIPMENT

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

TEST AND MEASUREMENT EQUIPMENT LIST				
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Due Date
Spectrum Analyzer	HP	8564	3943A01643	06/04/2004
Leveling Preamplifier	HP	11975A	2517A01067	01/16/2005
3 – cables for external mixer/preamplifier setup	HP	Option 009 mixer connection set	n/a	CNR
(a) External Mixer, 26.5-40 GHz	HP	HP11970A	3003A04190	10/14/2005
(b) External Mixer, 33 – 50 GHz	HP	HP11970Q	3003A03363	10/18/2005
(c) External Mixer, 50 - 75 GHz	HP	HP11970V	2521A01183	10/22/2005
(d) External Mixer, 75 – 110 GHz	HP	HP11970W	2521A01314	10/25/2005
(e) External Mixer, 90-140 GHz	OML	M08HW	F90519-2	CNR
(f) External Mixer, 140-220 GHz	OML	MO5HW	G90519-1	CNR
Diplexer for (e) and (f)	OML	DPL	n/a	CNR

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6. SETUP OF EQUIPMENT UNDER TEST

SUPPORT EQUIPMENT

PERIPHERAL SUPPORT EQUIPMENT LIST				
Device Type	Manufacturer	Model	Serial Number	FCC ID
Bridge media converter	Millotek	LFC-100TM	n/a	n/a
AC-DC supply	Millotek	JP12-01	n/a	n/a

I/O CABLES

Cable No.	Port	# of Identical Ports	Connector Type	Cable Type	Cable Length	Remarks
1	100baseT	1	RJ45	CAT5	2m	
2-4	harmonic mixer	3	sma	coax	1 m	low loss cables

TEST SETUP

The optic fiber interface cables were plugged into the Bridge Media Converter, the CAT5 cable was plugged into the Ethernet port of the pc. The Bridge Media converter activated an automatic data transmit routine. Modulation is non-return to zero inverted (NRZI) when data present. Data was at 62.5 Mbps. RF modulation type is 2-ASK.

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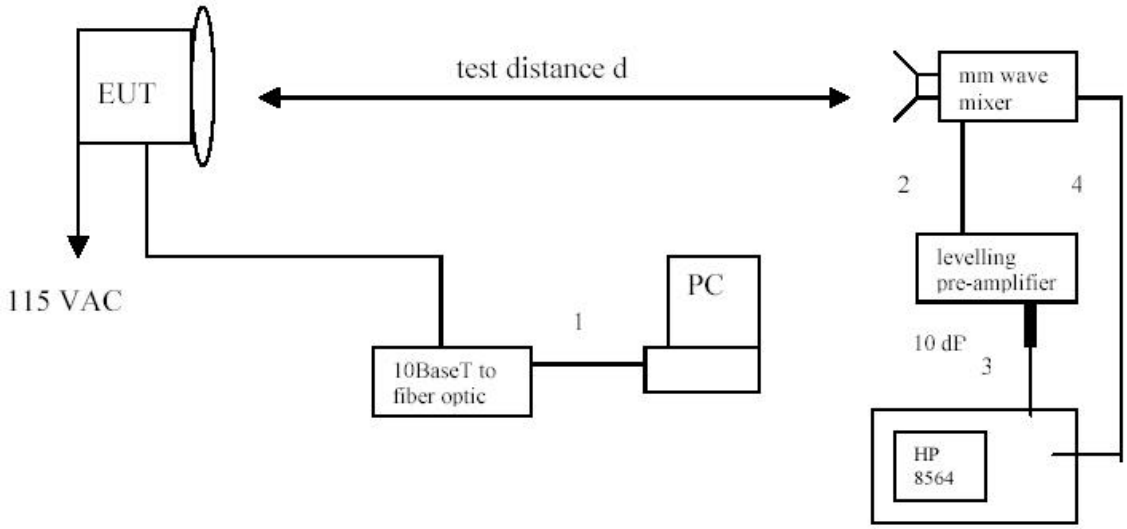
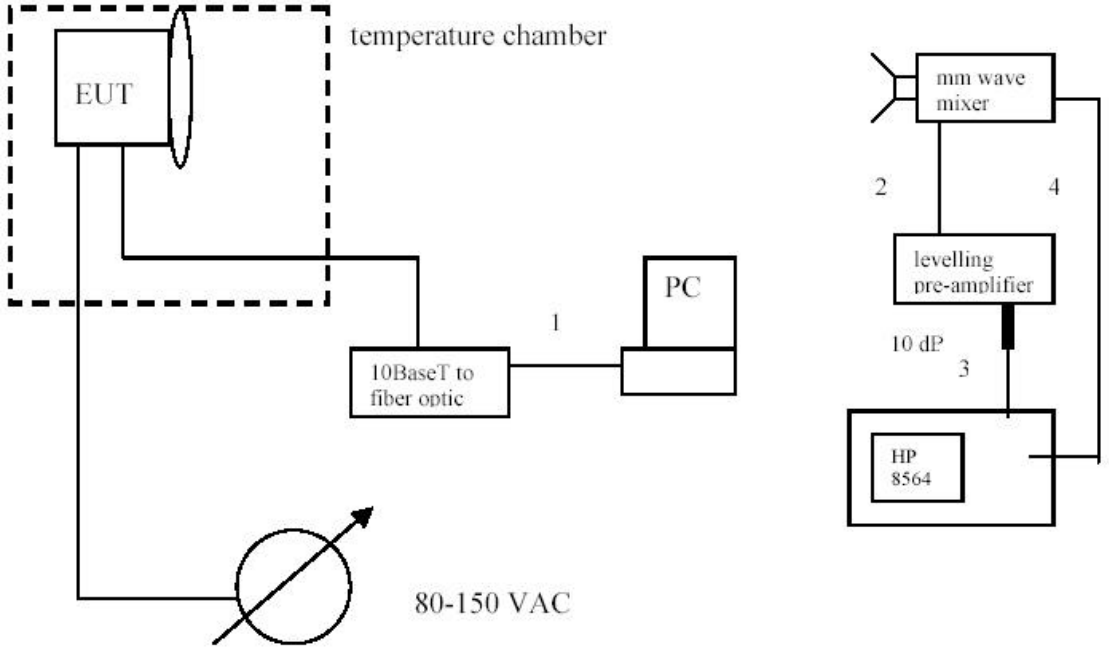
SETUP DIAGRAM FOR TESTS

Radiated Emissions



Frequency Stability



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7. APPLICABLE LIMITS AND TEST RESULTS

7.1. MEASUREMENT FUNDAMENTALS

TEST PROCEDURE

The EUT was connected to the media converter (Ethernet to optic TX/RX), media converter was connected to the Ethernet port of the media converter. An internal modulation routine generates data for "10101 01010 ....." coding, NRZI(Non-Return to Zero Inverted).

The EUT was placed on a non-conductive table placed 11.15 m from the measurement horn antenna. This distance was determined to be in the far field for the EUT, based on calculations described below. The horn/mixer/levelling pre-amplifier were connected to the spectrum analyzer, the analyzer EXTERNAL MIXER function was activated, and a MAX HOLD and CLEAR WRITE trace were enabled on the analyzer display.

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(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 = 30 cm and λ = 300 / f (MHz) equation (3) predicts a near-field boundary of

R (near field) = 4.46 m at 59.47 GHz, and 4.6 m at 61.38 GHz.

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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 30 cm diameter antenna at 60 GHz, equation (4) predicts a far-field or plane-wave boundary of

R (far field) = 10.7 m at 59.47 GHz, and 11.04 m at 61.38 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

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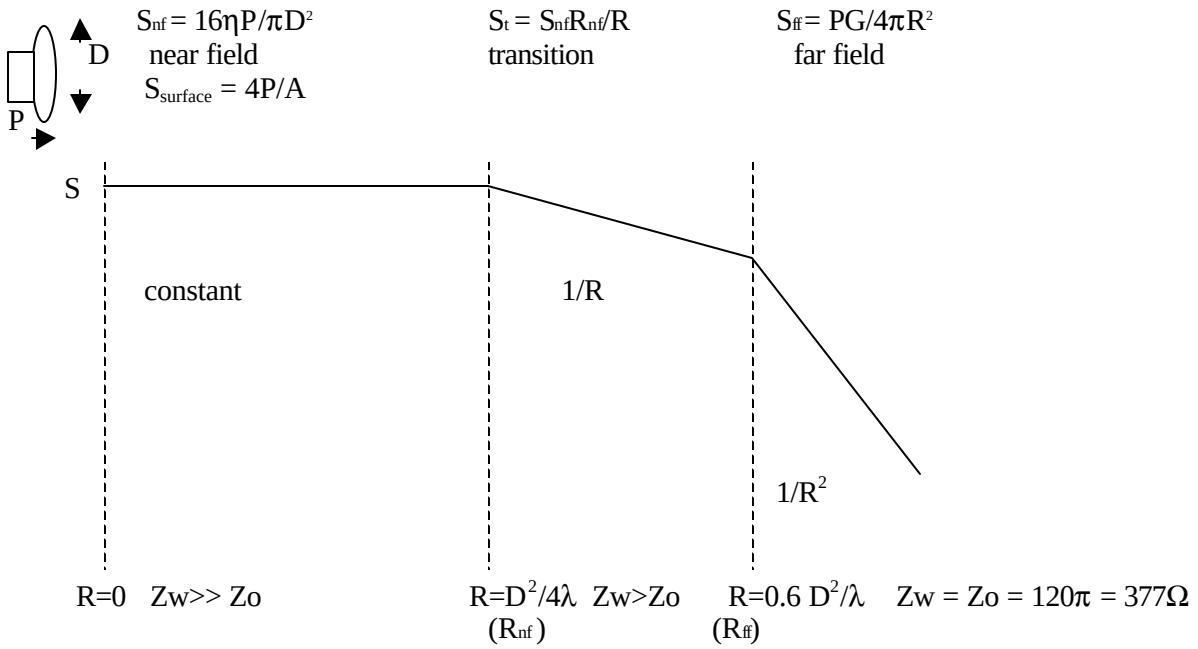
The equations (5) – (8) indicate that the variation of power density with distance R from the Cassegrain antenna is:

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

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POWER DENSITY AND FIELD STRENGTH RELATIONSHIP

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

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

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7.2. 6 dB BANDWIDTH

APPLICABLE RULES

§ 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; reporting purposes only.

TEST SETUP

Refer to Test Set-up drawing in the Measurement Fundamentals section of this report.

TEST PROCEDURE

The EUT was placed on a non-conductive table placed 30 cm from the measurement horn antenna, EUT was transmitting modulated signal. The horn/mixer/levelling pre-amplifier were connected to the spectrum analyzer, the analyzer EXTERNAL MIXER function was activated. The RBW is set to 100 kHz and the VBW is set to 100 kHz. The sweep time is coupled. The MAX HOLD function of the analyzer was used to capture the 6 dB bandwidth of the emission around the fundamental carrier.

RESULTS

6 dB BW = 747 kHz.

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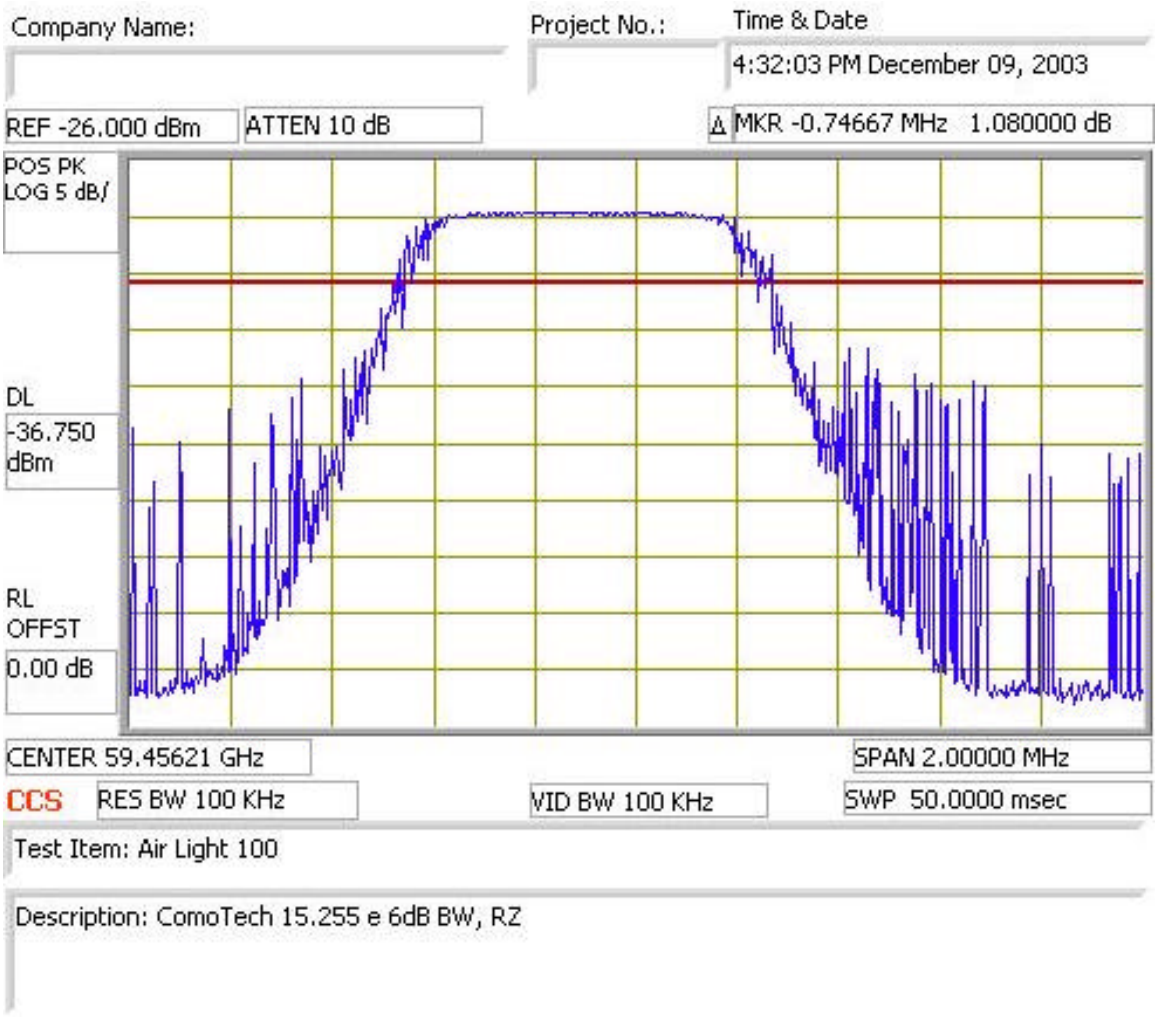
6 dB BW



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7.3. POWER DENSITY

APPLICABLE RULES

§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 SETUP

Refer to Test Set-up drawing in the Measurement Fundamentals section of this report.

TEST PROCEDURE

Refer to Measurement Fundamentals section of this report.

The spectrum analyzer RBW and VBW were both set to 1 MHz. This bandwidth is adequate for full energy capture because all energy is concentrated around carrier and around amplitude modulated (2ASK) sidebands which each occupy less than 1 MHz spectrum.

The highest recorded fundamental emission level was recorded for each transmit channel measured.

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Field strength is calculated from the received power at the far field distance. Far-field power density can be predicted from the field strength E (V/m) and the far-field impedance of free space

S = E^2 / 377

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

or, when the transmitter power in ERP is known, from the equation given in OET 65 page 21,

S = 33.4 * ERP / (R^2)

where
S is power density in units of uW/cm^2
ERP is the effective radiated power in units of W
and
R = the distance in meters from the transmitter antenna to the measuring antenna in meters

The FCC specification distance for maximum power density is 3m.

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CALCULATIONS

Refer to Measurement Fundamentals section for details of calculations.

For a parabolic reflector antenna with D = 30cm and λ = 300/f(MHz) the near field boundaries are

Rnf = 4.46 m at 59.47 GHz, and 4.6 m at 61.38 GHz.

The far field boundaries are

Rff = 10.7 m at 59.47 GHz, and 11.04 m at 61.38 GHz.

The far field E-field is used to calculate the far field power density. Using the relationships between near field and far field boundaries as derived in the Measurement Fundamentals section, and knowing the near field and far field boundary distances, peak power density can be calculated at the 3m specification distance.

RESULTS

Peak Power Density at 59 47 GHz (includes sidebands): 12.26 uW/cm2
15.255 limit: 18 uW/cm2 peak

Average PD at 59.47 GHz: 12.26 x 50% duty cycle = 6.13 uW/cm2
15.255 limit: 9.0 uW/cm2

Peak Power Density at 61.38 GHz (includes sidebands): 4.35 uW/cm2
Average PD at 61.38 GHz: 4.35 x 50% duty cycle = 2.18 uW/cm2

Spectrum analyzer plots for 11.15 m far field readings are below, along with spreadsheet showing data reduction

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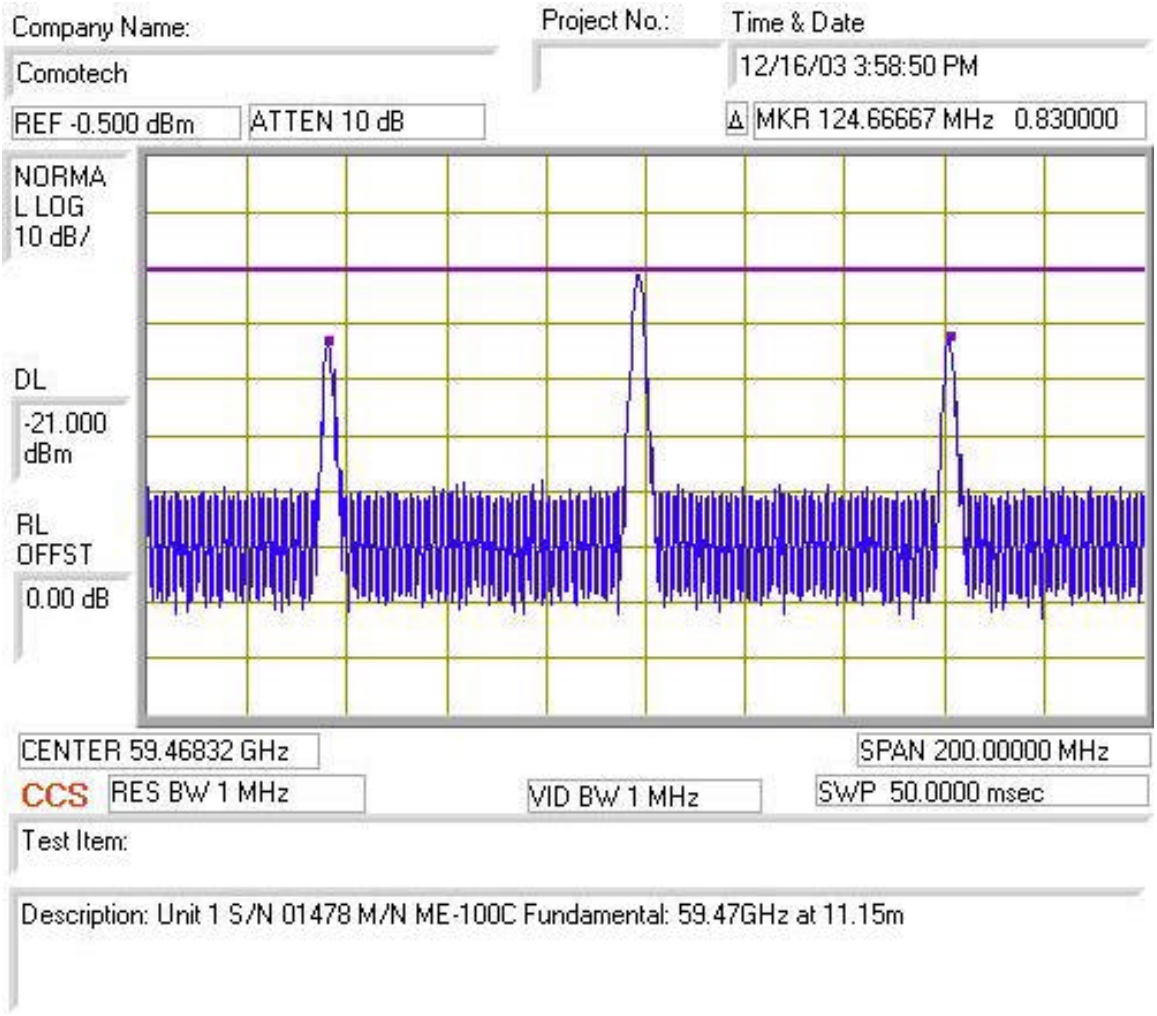
Radiated Emissions, 59.47 GHz Fundamental, 11.15m



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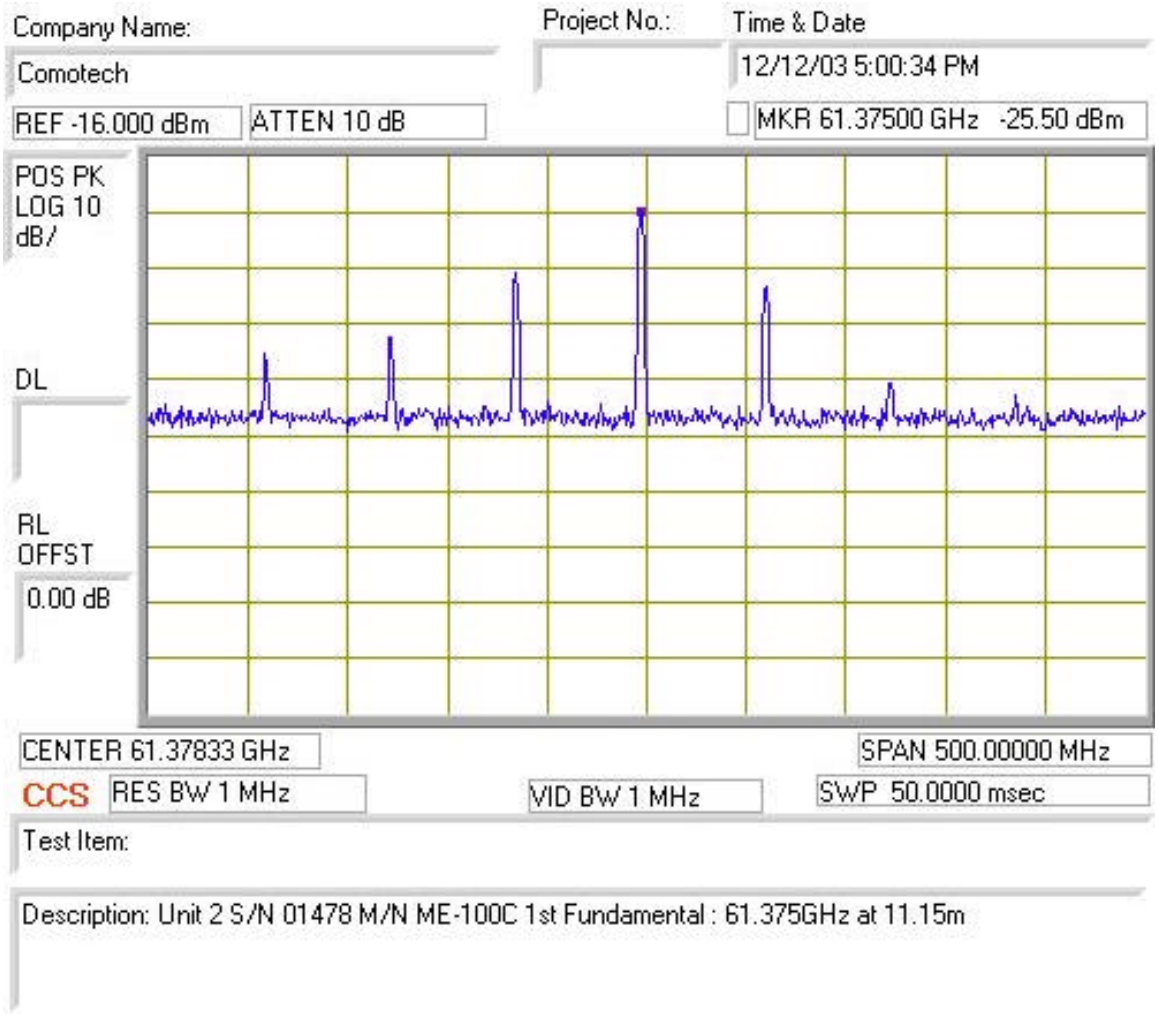
Radiated Emissions, 61.38 GHz Fundamental, 11.15m



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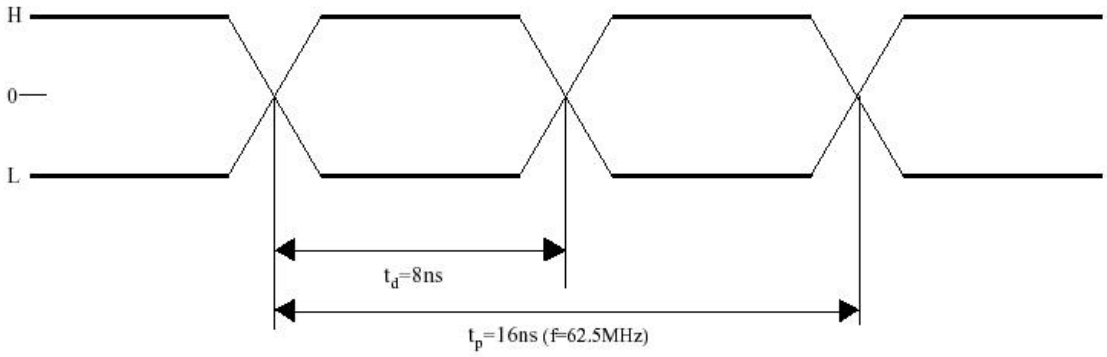
NON-RETURN-TO-ZERO INVERTED TIMING

Tx Timing Diagram



Duty Cycle: 8 nsec ON in 16 nsec period = 0.5 = 50% duty cycle

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Power Density S, E-field, and Peak Power Output Calculations

Measurement distance, m:	11.15
Antenna diameter, m:	0.30
TX ant gain, dBi	43
TX ant gain, linear	19952.62315
RX antenna gain, dBi:	20
RX antenna gain, linea	100

F(MHz)	lamda, m	Rnf, m	Rff, m	P rx, dBm	P rx, watts	E, V/m	S, dBuW/cm2 at 3m	S, uW/cm2	Pout EUT mW
59470	0.0050	4.460	10.70	-21	7.94328E-06	3.85	10.1	10.21	3.07
59407.5	0.0050	4.456	10.69	-31	7.94328E-07	1.21	0.1	1.02	0.31
59532.5	0.0050	4.465	10.72	-31	7.94328E-07	1.22	0.1	1.02	0.31
Peak Sum of fundamental and sidebands								12.26	3.69
Average Sum of fundamental and sidebands (50 % duty cycle)								6.13	
61380	0.0049	4.604	11.05	-25.5	2.81838E-06	2.36	5.6	3.62	1.16
61317.5	0.0049	4.599	11.04	-35.5	2.81838E-07	0.75	-4.4	0.36	0.12
61442.5	0.0049	4.608	11.06	-35.5	2.81838E-07	0.75	-4.4	0.36	0.12
Peak Sum of fundamental and sidebands								4.35	1.39
Average Sum of fundamental and sidebands (50 % duty cycle)								2.18	

Where:

λ= lamda, m = 300/f(MHz) Rnf = $D^2/4\lambda$ Rff = 0.6 D^2/λ

Prx = received power (spectrum analyzer reading)

E, V/m = field strength at measurement distance = $(2\pi/\lambda)^* (120Prx/Grx)^{1/2}$ from OET 40

S, dBuW/cm2 at 3m = S dBuW/m far field + 20 log (11.15 m/Rff) + 10 log(Rff/Rnf)

S in far field calculated from E in far field: S, W/m^2 = $(E, V/m)^2/120\pi$

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7.4. PEAK OUTPUT POWER

APPLICABLE RULES

§ 15.255 (e) Except as specified below, the total peak transmitter output power shall not exceed 500 mW.
(1) Transmitters with an emission bandwidth of less than 100 MHz must limit their peak transmitter output power to the product of 500 mW times their emission bandwidth divided by 100 MHz. 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).
(2) Peak transmitter output power shall be measured with an RF detector that has a detection bandwidth that encompasses the 57-64 GHz band and that has a video bandwidth of at least 10 MHz, or using an equivalent measurement method.

TEST SETUP

Refer to Test Set-up drawing in the Measurement Fundamentals section of this report.

TEST PROCEDURE

Peak transmit output power is calculated from the Field Strength measured in the far field using the equation:

P = ((ED)^2) /30G

P=transmitter power, watts,
E=measured field strength, V/m
D= measurement distance, meters
G = transmitter antenna gain over isotropic (numeric)

The EUT antenna gain is 43 dBi (numeric 19,953).

Field Strength measurement data is shown in the Power Density section of this report.

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LIMITS

Peak power is limited to (EBW/100)*500 mW, where EBW is the 6 dB bandwidth.

The 6 dB EBW is 747 kHz.

Therefore the maximum allowed power = (.747/100)*500 **= 3.74 mW**

RESULTS

No non-compliance noted:

The EUT operates on two frequencies: 59.47 GHz and 61.38 GHz.

Peak power was calculated from electric field strength measured at far field distance of 11.15 m., as the sum of the center frequency power plus the two sidebands power.

The total Peak Power at 59.47 GHz = (3.07 + 0.31 + 0.31) mW = **3.69 mW**

The total Peak Power at 61.38 GHz = (1.16 + 0.12 + 0.12) mW = **1.4 mW**

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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.

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CALCULATIONS

From §1.1310 Table 1 (B), S = 1.0 mW/cm^2

The maximum allowed exposure for uncontrolled exposure is 1 mW/cm2. Converting this to power density in units of dBuW/cm2 yields:

S_{MPE}, dBuW/cm2 = 10log(1000 uW/cm2) = 30 dBuW/cm2

RESULTS

No non-compliance noted:

Maximum power density at 3m was 12.26 uW/cm2 at 59.47 GHz.

S = 12.6 uW/cm2= 11 dBuW/cm2

Limit: 1mW/cm2 = 1000 uW/cm2 = 30 dBuW/cm2

This is constant from antenna surface to near field boundary (4.5m)

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.

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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 SETUP

Refer to Test Set-up drawing in the Measurement Fundamentals section of this report.

TEST PROCEDURE

The EUT frequency was measured at normal conditions. The EUT frequency was measured at the extremes of temperature and operating voltage at the "four corner" limits of temperature and operating voltage.

RESULTS

Setting	F (GHz) 59 GHz unit	F(GHz) 61 GHz unit
Normal: 23C, 115 VAC	59.462008	61.361875
-20 C, 97.75 VAC (85%)	59.494755	61.411242
-20C, 132.3 VAC (115%)	59.494758	61.411242
50 C, 97.75 VAC (85%)	59.456515	61.406235
50 C, 132.3 VAC (115%)	59.457122	61.406235

All emissions remain within 57 – 64 GHz authorized bands.

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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/cm^2 at a distance of 3 meters.
(4) The levels of the spurious emissions shall not exceed the level of the fundamental emission.

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§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.

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§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.

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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.

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7.7.3. SYSTEM NOISE FLOOR ABOVE 1 GHZ

SYSTEM NOISE FLOOR FROM 1 TO 26.5 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 GHz	SA dBuV	AF dB/m	Distance m	Distance dB	Preamp dB	Cable dB	Field dBuV/m	Limit dBuV/m	Margin 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 26.5 GHz band									
RBW = 1 MHz, peak detection									
26.5	44.6	33.4	1	-9.5	35.0	19.5	52.96	74	-21.04
RBW = 1 MHz, average detection									
26.5	32.4	33.4	1	-9.5	35.0	19.5	40.76	54	-13.24

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SYSTEM NOISE FLOOR FROM 26.5 TO 200 GHz

Compliance Certification Services

Worst Case Radiated Emissions System Noise Floor, 26.5 to 100 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 15.245 limit

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	0.3	-20.0	63.40	74	-10.60
RBW = 1 MHz, average detection							
50	27.2	44.2	0.1	-29.5	41.86	54	-12.14
50 to 75 GHz							
RBW = 1 MHz, peak detection							
75	48	47.7	0.1	-29.5	66.16	74	-7.84
RBW = 1 MHz, average detection							
75	35.4	47.7	0.03	-40.0	43.10	54	-10.90
75 to 100 GHz							
RBW = 1 MHz, peak detection							
100	55.8	50.2	0.03	-40.0	66.00	74	-8.00
RBW = 1 MHz, average detection							
100	42.5	50.2	0.01	-49.5	43.16	54	-10.84
100 to 200 GHz							
RBW = 1 MHz, peak detection							
200	51.7	53.3	0.03	-40.0	65.00	74	-9.00
RBW = 1 MHz, average detection							
200	39	53.3	0.01	-49.5	42.76	54	-11.24

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7.7.4. SPURIOUS FIELD STRENGTH RESULTS ABOVE 1 GHz

No spurious or harmonic emissions detected above system noise floor.

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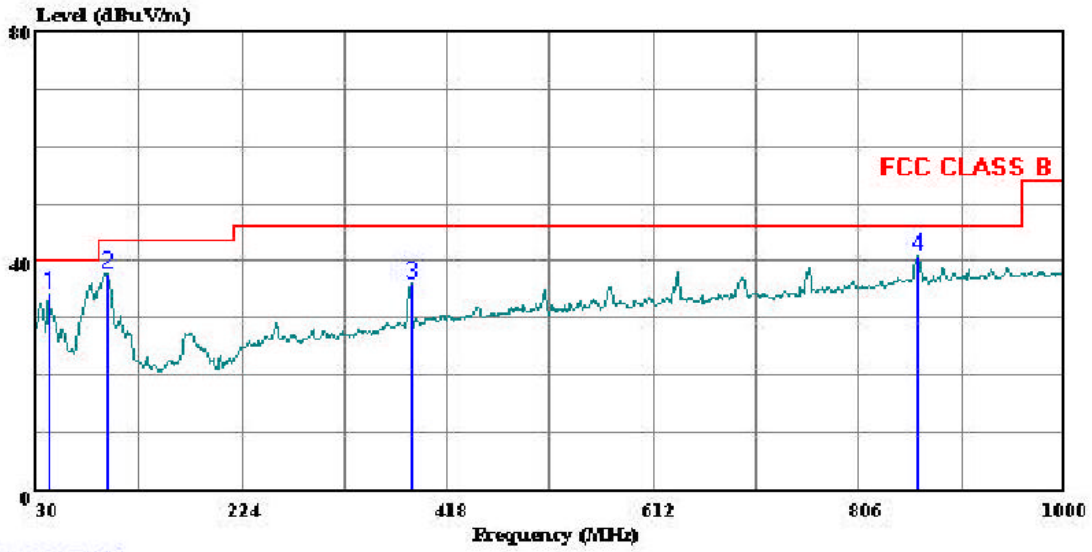
7.7.5. WORST-CASE RADIATED EMISSIONS BELOW 1 GHz

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

HORIZONTAL PLOT

COMPLIANCE Engineering Services, Inc.
561F Monterey Road
San Jose, CA 95131
Tel: (408) 463-0888
Fax: (408) 463-0885

Data#: 6 File#: emi.EMI Date: 12-02-2003 Time: 08:32:11



Trace: 5 Ref Trace:

Condition: FCC CLASS B CHAMBER 030306 1185 HORIZONTAL
Test Eng: : Blair Wright
Project #: : 03I2390
Company: : Comotech
EUT: : Wireless Fast Ethernet Transceiver
Model No: : ME100
Configuration: : EUT and Support
Target of Test: : FCC Class B
Mode of Operation: Transmitting
: EUT#1
: Horizontal

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HORIZONTAL DATA

	Freq	Remark	Read Level	Factor	Level	Limit Line	Over Limit
	MHz		dBuV	dB	dBuV/m	dBuV/m	dB
1	41.640	Peak	17.13	17.10	34.24	40.00	-5.76
2	96.930	Peak	28.16	9.54	37.70	43.50	-5.80
3	383.080	Peak	19.87	16.06	35.93	46.00	-10.07
4	861.290	Peak	17.46	23.39	40.85	46.00	-5.15

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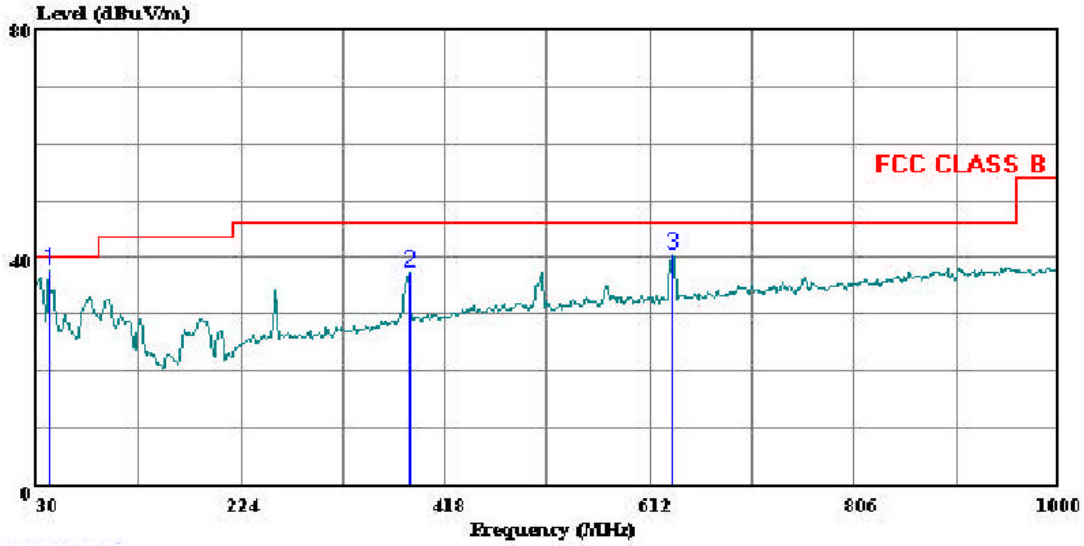
SPURIOUS EMISSIONS 30 TO 1000 MHz (WORST-CASE CONFIGURATION, VERTICAL)

VERTICAL PLOT

561F Monterey Road
San Jose, CA 95131
Tel: (408) 463-0888
Fax: (408) 463-0885

Data#: 8 File#: emi.EMI Date: 12-02-2003 Time: 08:40:07



(Audix ATC)

Trace: 7 Ref Trace:

Condition: FCC CLASS B CHAMBER 030306 1185 VERTICAL
Test Eng: : Blair Wright
Project #: : 03I2390
Company: : Comotech
EUT: : Wireless Fast Ethernet Transceiver
Model No: : ME100
Configuration: : EUT and Support
Target of Test: : FCC Class B
Mode of Operation: Transmitting
: EUT#1
: Vertical

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VERTICAL DATA

	Freq	Remark	Read Level	Factor	Level	Limit Line	Over Limit
	MHz		dBuV	dB	dBuV/m	dBuV/m	dB
1	41.640	Peak	20.61	17.10	37.72	40.00	-2.28
2	383.080	Peak	21.34	16.06	37.40	46.00	-8.60
3	634.310	Peak	19.79	20.63	40.42	46.00	-5.58

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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:

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6 WORST EMISSIONS

CONDUCTED EMISSIONS DATA									
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	62.62	--	49.82	0.00	65.06	55.06	-2.44	-5.24	L1
2.37	52.26	--	37.47	0.00	56.00	46.00	-3.74	-8.53	L1
13.55	42.06	--	41.51	0.00	60.00	50.00	-17.94	-8.49	L1
0.17	64.72	--	49.24	0.00	65.57	55.57	-0.85	-6.33	L2
3.33	37.77	--	23.66	0.00	56.00	46.00	-18.23	-22.34	L2
21.49	39.14	--	21.80	0.00	60.00	50.00	-20.86	-28.20	L2
6 Worst Data									

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LINE 1 RESULTS

561F Monterey Road
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Tel: (408) 463-0888
Fax: (408) 463-0885

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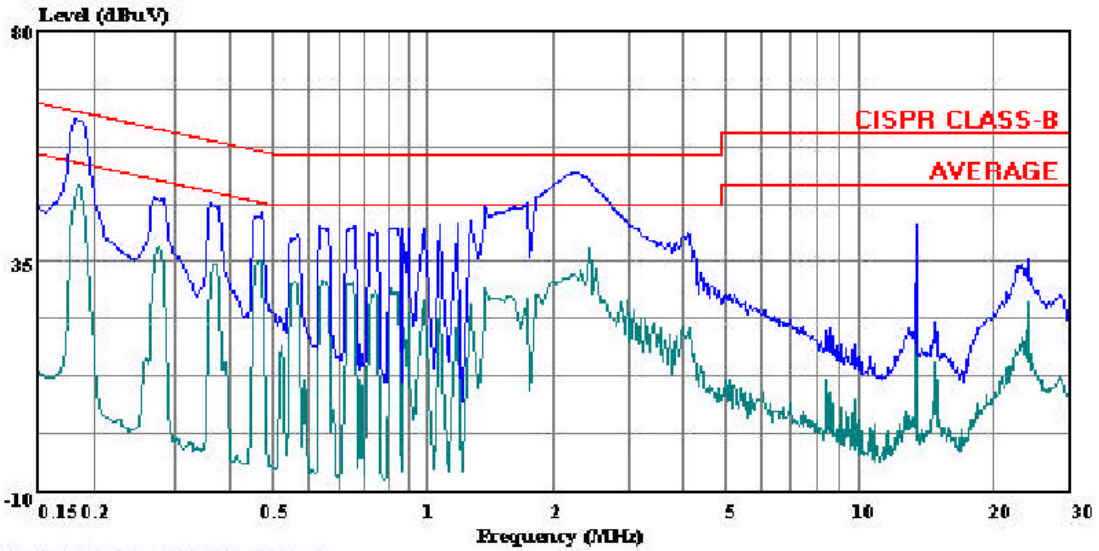

Trace: 12 Ref Trace:

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Project #          : 03I2390
Test Operator      : Blair Wright
Company            : Comotech
EUT                : Wireless Fast Ethernet Transceiver
                   : S/N:01479
Model              : ME100
Configuration      : EUT/Support Equipment
Mode of Operation: Tx
Target of Test     : FCC Class B
Voltage            : 115VAC/60Hz
                   : L1: Peak ( Black )  Avg ( Green )
```


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LINE 2 RESULTS

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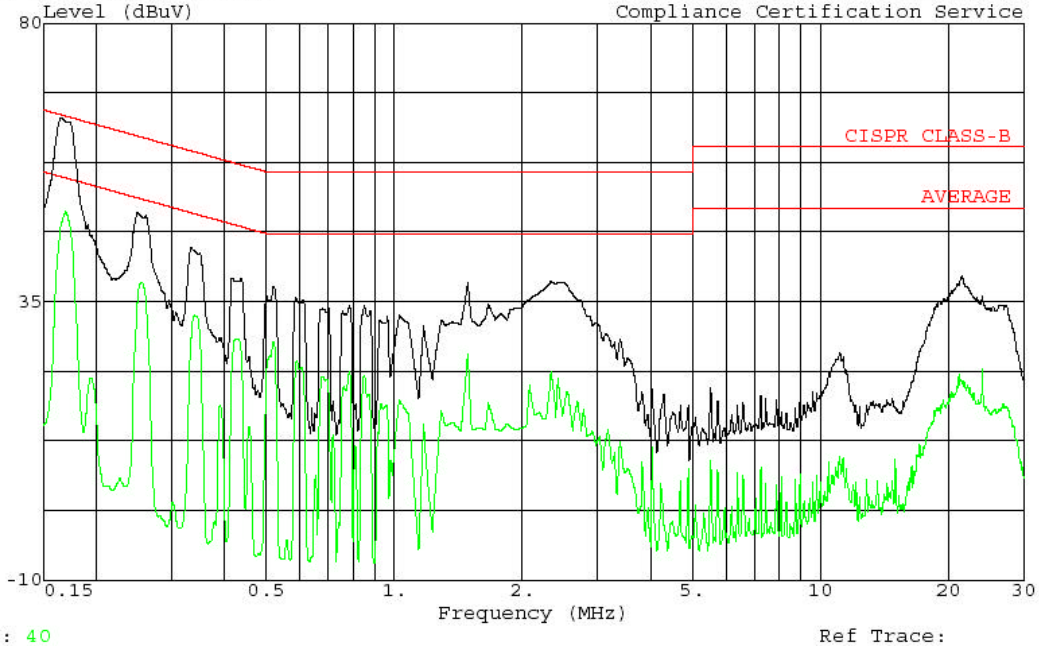
San Jose, CA 95037 USA
Tel: (408) 463-0885
Fax: (408) 463-0888

Data#: 42 File#: LC.EMI Date: 12-03-2003 Time: 09:01:58



Trace: 40 Ref Trace:
Project # : 03I2390
Test Operator : Blair Wright
Company : Comotech
EUT : Wireless Fast Ethernet Transceiver
: S/N:01478
Model : ME100
Configuration : EUT/Support Equipment
Mode of Operation: Tx
Target of Test : FCC Class B
Voltage : 115VAC/60Hz
: L2: Peak (Black) Avg (Green)

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8. SETUP PHOTOS

FREQUENCY STABILITY MEASUREMENT SETUP

ENVIRONMENTAL CHAMBER PHOTO

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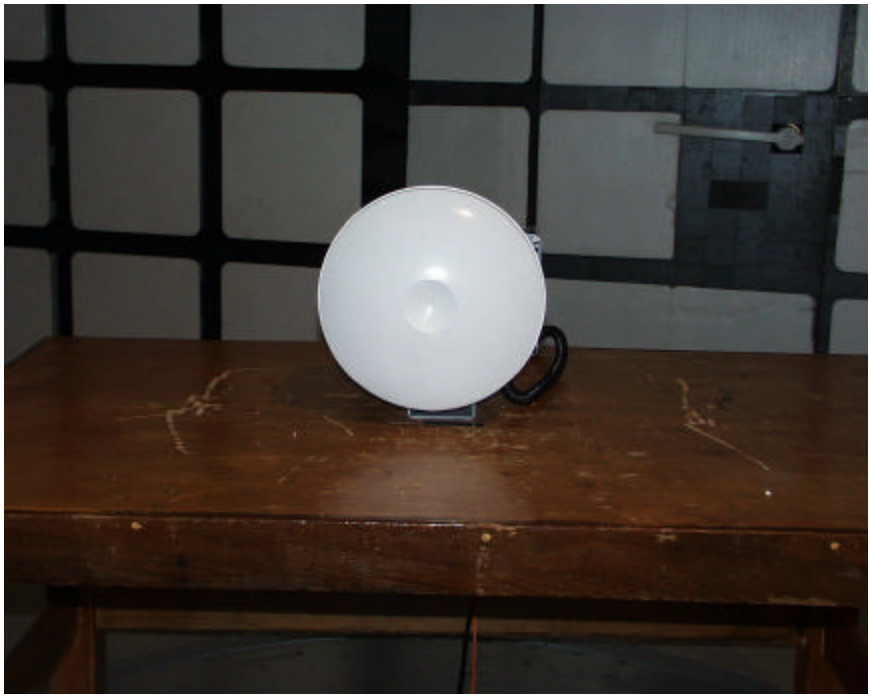
RADIATED RF MEASUREMENT SETUP

RADIATED FRONT PHOTO



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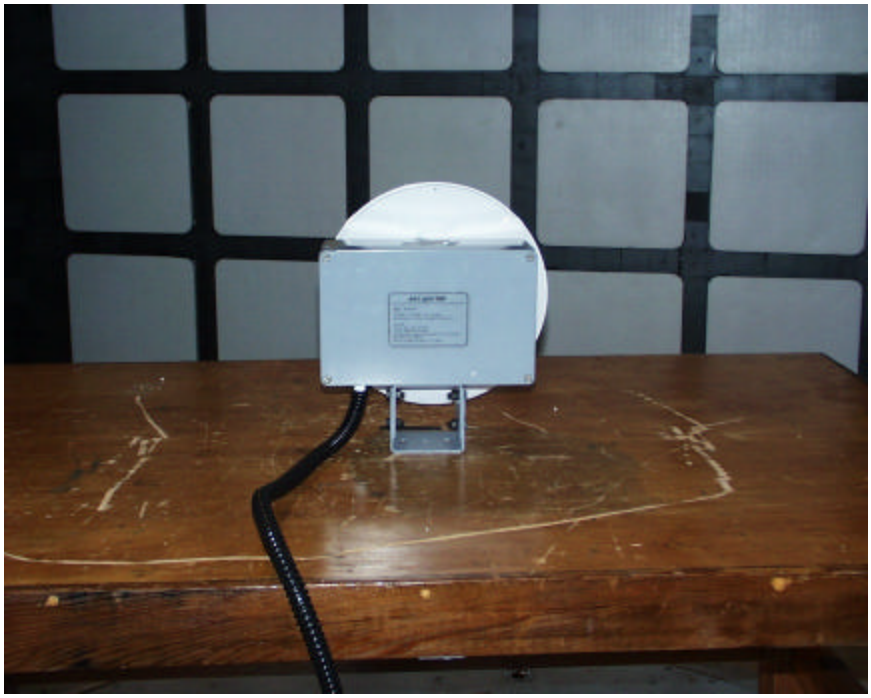
RADIATED BACK PHOTO



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POWERLINE CONDUCTED EMISSIONS MEASUREMENT SETUP

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