Nemko Test Report:	49909RUS1
Applicant:	Nighthawk Systems 6116 North Central Expressway Suite 710 Dallas, TX 75206
Equipment Under Test: (E.U.T.)	MeshERT 006
FCC ID:	YJC-MESHERT006
In Accordance With:	**FCC Part 15, Subpart C, 15.247** Frequency Hopping Transmitters
Tested By:	Nemko USA Inc. 802 N. Kealy Lewisville, Texas 75057-3136

TESTED BY: _____ **DATE:** **11 June 2010**
David Light, Senior Wireless Engineer

APPROVED BY: _____ **DATE:** **22nd June 2010**
Tom Tidwell, Telecom Direct

Total Number of Pages: 33

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Section 1. Summary of Test Results

Manufacturer: Nighthawk Systems

Model No.: MeshERT 006

Serial No.: None

General: **All measurements are traceable to national standards.**

These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15, Subpart C, Paragraph 15.247 for Frequency Hopping Spread Spectrum devices. Radiated tests were conducted is accordance with ANSI C63.4-2003. Radiated emissions are made on an open area test site.
A description of the test facility is on file with the FCC.

☒ New Submission ☒ Production Unit

☐ Class II Permissive Change ☐ Pre-Production Unit

THIS TEST REPORT RELATES ONLY TO THE ITEM(S) TESTED.

THE FOLLOWING DEVIATIONS FROM, ADDITIONS TO, OR EXCLUSIONS FROM THE TEST SPECIFICATIONS HAVE BEEN MADE.
See " Summary of Test Data".

NVLAP Lab Code 100426-0

Summary Of Test Data

NAME OF TEST	PARA. NO.	RESULT
Powerline Conducted Emissions	15.207(a)	Complies
Channel Separation	15.247(a)(1)	Complies
Time of Occupancy	15.247(a)(1)	Complies
20 dB Occupied Bandwidth	15.247(a)(1)	Complies
Peak Power Output	15.247(b)	Complies
Spurious Emissions (Antenna Conducted)	15.247(d)	Not tested
Spurious Emissions (Radiated)	15.247(d)	Complies

Footnotes:

The EUT has an integral antenna. All tests were performed radiated.

Section 2. Equipment Under Test (E.U.T.)

General Equipment Information

Frequency Band:	☒ 902 – 928 MHz ☐ 2400 – 2483.5 MHz ☐ 5725 – 5850 MHz
Operating Frequency Range:	903.0 to 920.0 MHz
Number of Channels:	50 or 55*
Channel Spacing:	100 kHz or 200 kHz
Frequency Adjustment:	Software controlled
Modulation Type:	GFSK (Lower band) or OOK (Upper band)
Input Voltage:	3.3 Vdc (from AC power adapter)

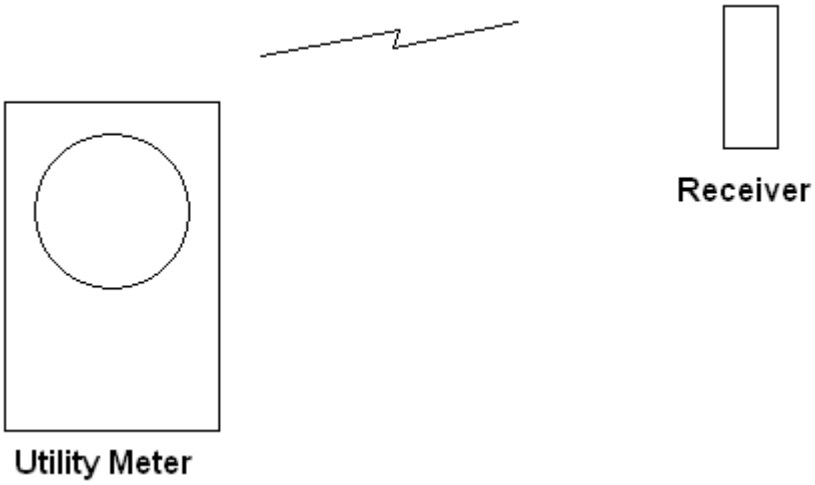
*Refer to description on following page.

Description of EUT

Industrial Packet Radio for utillity consumption data. Itron ERT drive by read emulation and Mesh Network Radio system for multiple Meter networks.

The EUT can be configured to operate on 50 channels from 903 to 908 MHz using GFSK modulation or 55 channels from 909.2 to 920 MHz OOK modulation depending on the network.

System Diagram



Section 3. Channel Separation

NAME OF TEST: Channel Separation	PARA. NO.: 15.247(a)(1)
TESTED BY: David Light	DATE: 10 June 2010

Test Results: Complies.

Measurement Data:

Measured 20 dB BW:	98 kHz low band	137 kHz high band
Channel Separation:	100 kHz low band	200 kHz high band

Equipment Used: 1464-993-1083

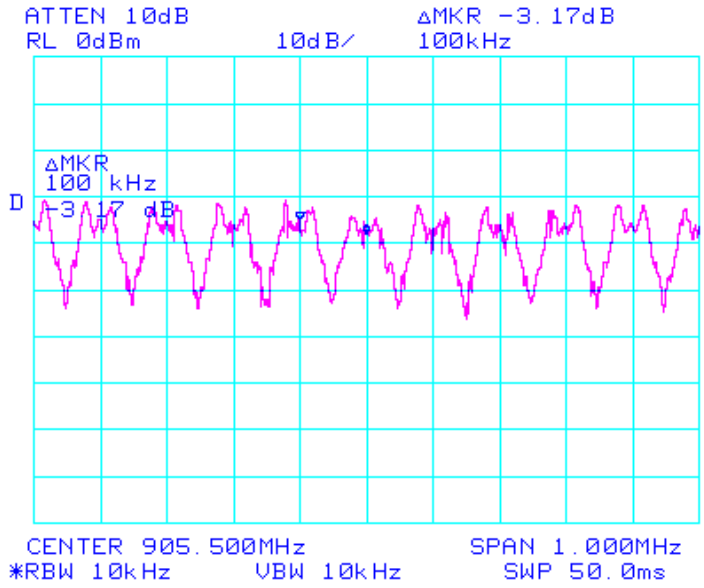
Measurement Uncertainty: $1X10^{-7}$ppm

Temperature: 22 °C

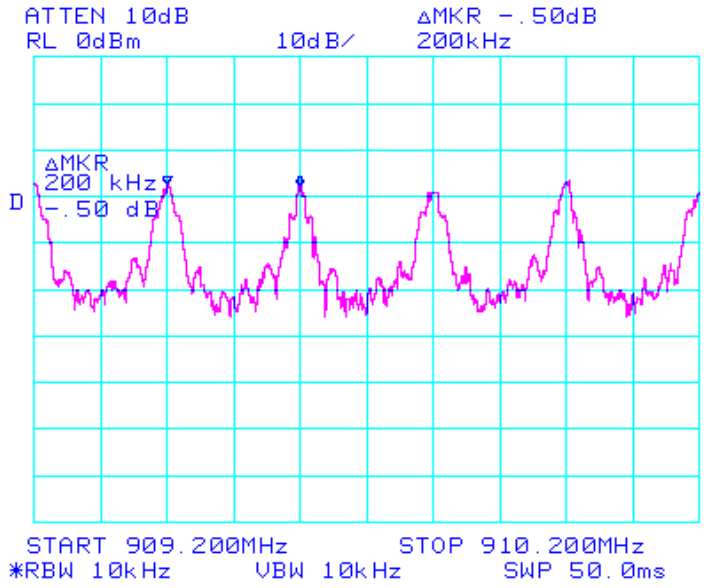
Relative Humidity: 35 %

Test Data – Channel Separation

Lower Band
GFSK

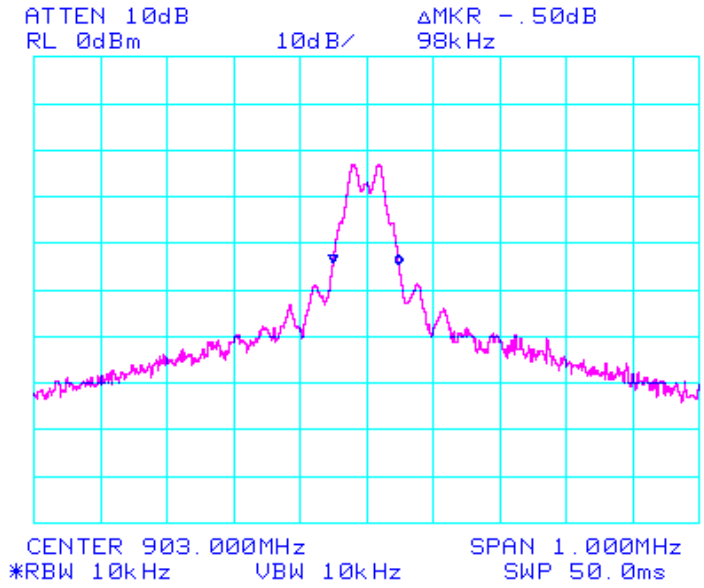


Upper Band
OOK

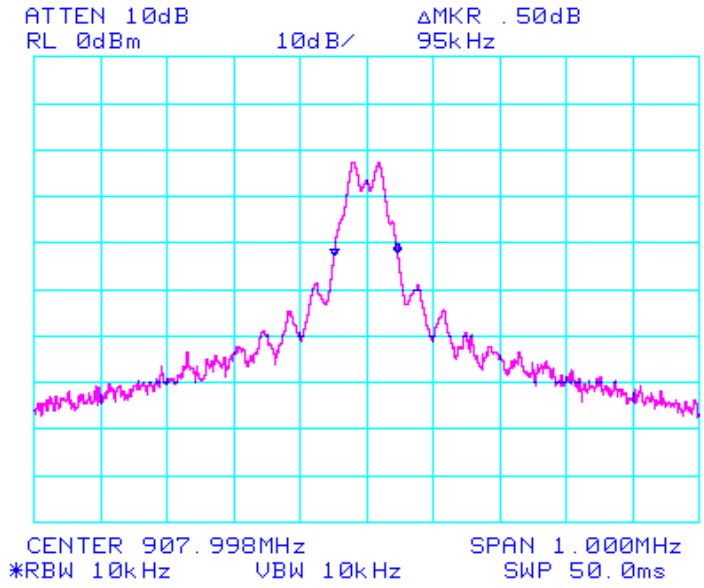


Test Data – 20 dB Bandwidth

Low Channel
Lower Band

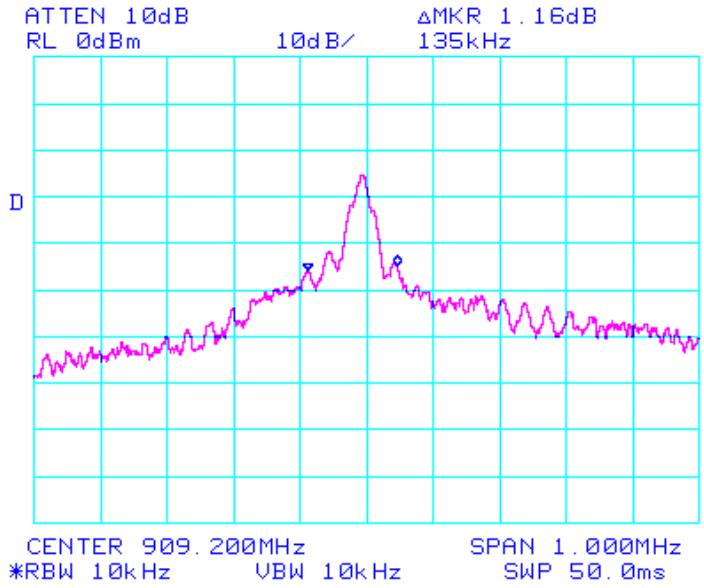


High Channel
Lower Band

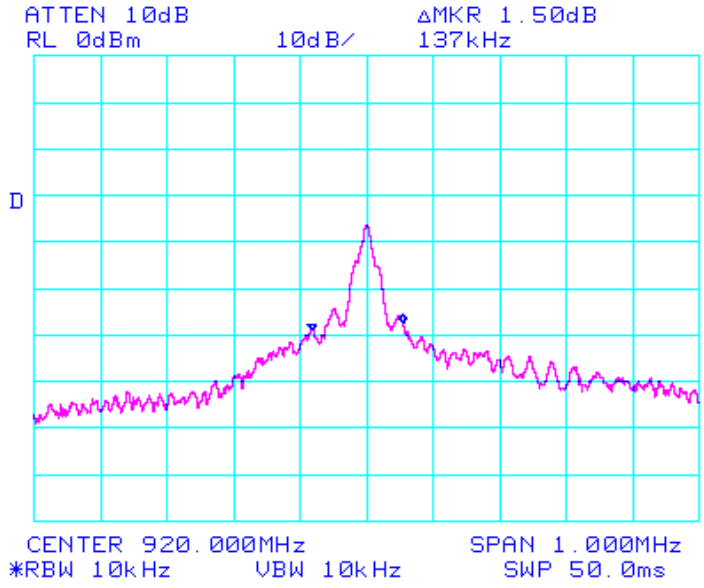


Test Data – 20 dB Bandwidth

Low Channel
Upper Band



High Channel
Upper Band



Section 4. Time of Occupancy

NAME OF TEST: Time of Occupancy	PARA. NO.: 15.247(a)(1)
TESTED BY: David Light	DATE: 10 June 2010

Test Results: Complies.

Measurement Data: Refer to plots.

Maximum Dwell Time On Any Channel: 396 ms in 20 seconds for lower band
46 ms in 20 seconds for upper band

Equipment Used: 1464-1083-993

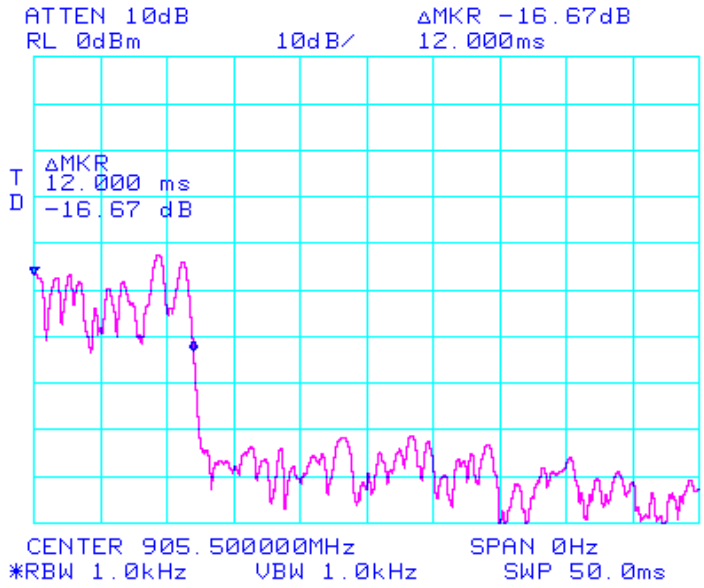
Measurement Uncertainty: $1X10^{-7}$ppm

Temperature: 22 °C

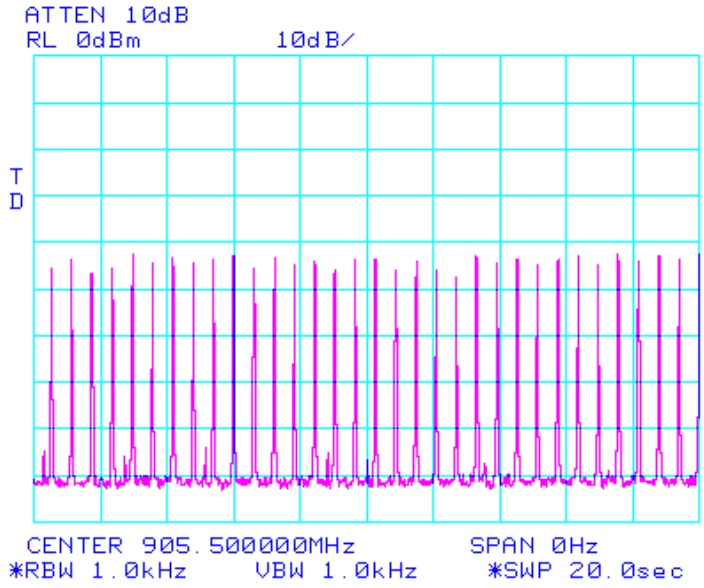
Relative Humidity: 35 %

Test Data – Time of Occupancy

Pulse Width
Lower band



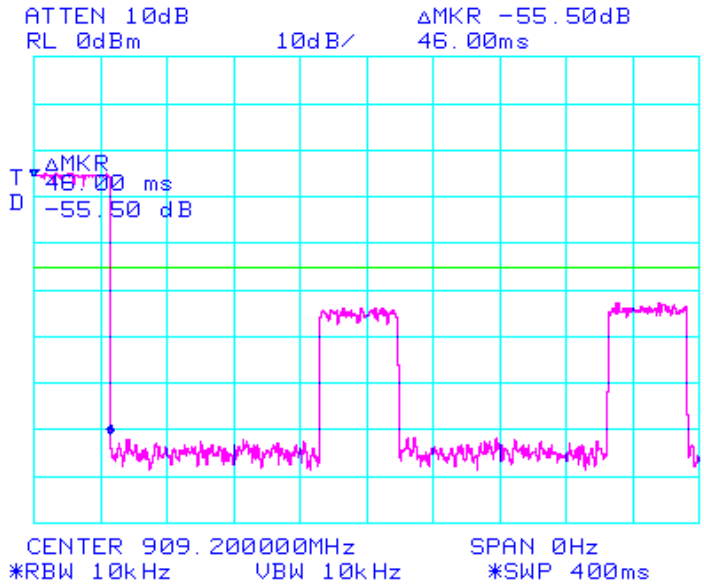
20 seconds



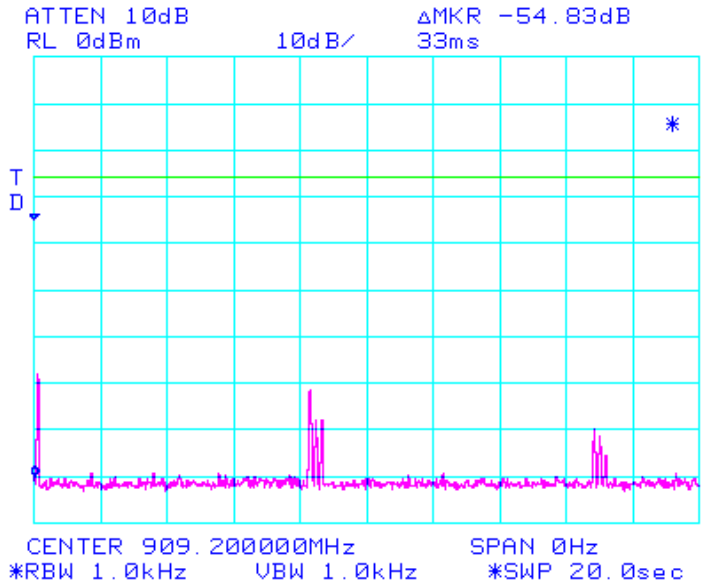
33 hops x 12 ms = 396 ms

Test Data – Time of Occupancy

Pulse Width
Upper band



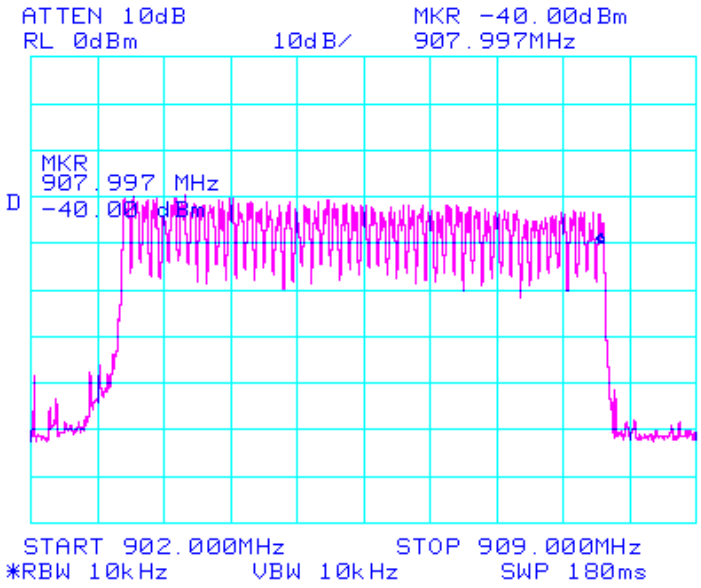
20 second



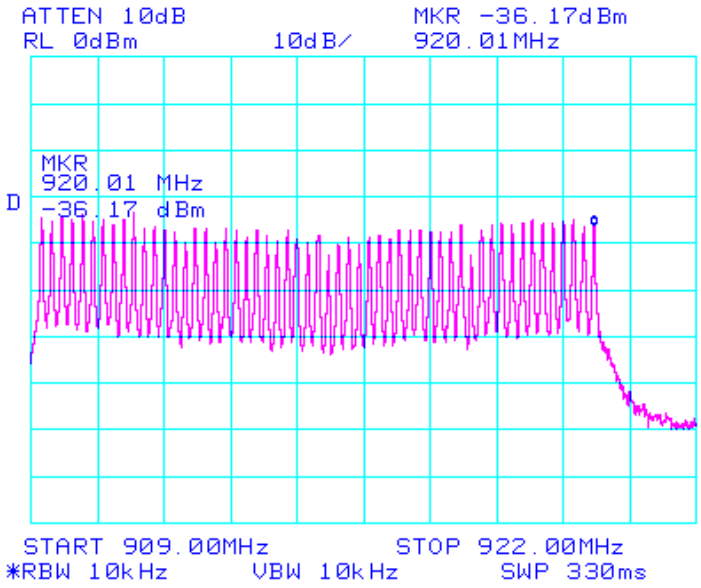
1 46 ms hop in 20 seconds

Test Data – Time of Occupancy

Number of hopping channels
Lower band = 50 channels



Upper band = 55 channels



Section 5. Peak Power Output

NAME OF TEST: Peak Power Output	PARA. NO.: 15.247 (b)
TESTED BY: David Light	DATE: 10 June 2010

Test Results: Complies.

Measurement Data: See attached plots.

Detachable antenna? ☐ Yes ☒ No
If yes, state the type of non-standard connector used:

Frequency (MHz)	Peak Power* (dBm)	Peak Power (mW)	Gain (dBi)	E.I.R.P. (dBm)	E.I.R.P. (mW)
903.0	7.8	6.0	-3	4.8	3.0
908.0	10.3	10.7	-3	7.3	5.4
909.2	4.5	2.8	-3	1.5	1.4
920.0	8.2	6.6	-3	5.2	3.3
Maximum EIRP (mW): 5.4					

RBW/VBW = 1 MHz Peak detector
*Note-This test was performed radiated. Peak output power is calculated using the stated antenna gain from manufacturer.

☒ This device was tested at +/- 15% input power per 15.31(e), with no variation in output power.

☐ For battery powered equipment, the device was tested with a fresh battery per 15.31(e).

☒ This test was performed radiated.

Equipment Used: 1464-1484-1485-993

Measurement Uncertainty: 1.7 dB

Temperature: 22 °C

Relative Humidity: 35 %

Section 6. Spurious Emissions (Radiated)

NAME OF TEST: Spurious Emissions (Radiated)	PARA. NO.: 15.247(d)
TESTED BY: David Light	DATE: 10 June 2010

Test Results: Complies. The worst case emission was 47.7 dBµV/m at 2724.0 MHz. This is 6.3 dB below the average specification limit of 54 dBµV/m.

Measurement Data: See attached table.

Notes:

☐ For handheld devices, the EUT was tested on three orthogonal axis'

☒ The device was tested from 30 MHz to the tenth harmonic of the highest fundamental frequency per 15.33

Equipment Used: 1464-1484-1485-1480-1016-791-993

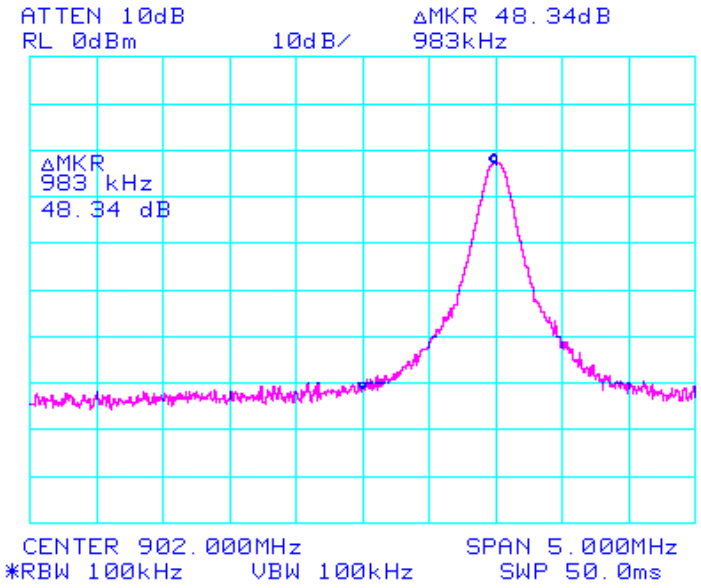
Measurement Uncertainty: +/-3.6 dB

Temperature: 22 °C

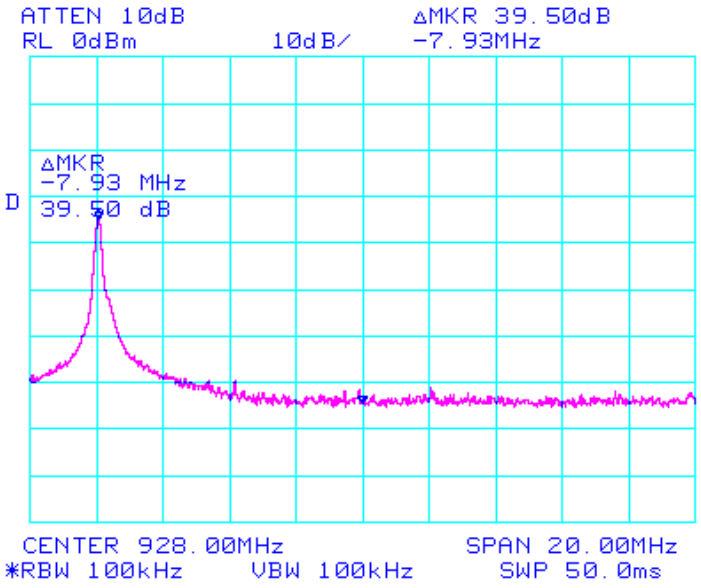
Relative Humidity: 35 %

Test Data - Radiated Emissions

Lower band edge
Tx at lowest channel in lower band



Upper band edge
Tx at highest channel in upper band



Test Data - Radiated Emissions

Measurement Data: Reading listed by frequency. Test Distance: 3 Meters

#	Freq MHz	Rdng dBµV	Cable Pre-A dB	Cable Horn dB	dB	dB	Dist Table	Corr dBµV/m	Spec dBµV/m	Margin dB	Polar Ant
	2709.0	44.7	+0.8	+2.8			+0.0	44.9	54.0	-9.1	Vert
	Average		+32.7	+29.3							TX 903 MHz
	2724.0	47.5	+0.8	+2.8			+0.0	47.7	54.0	-6.3	Vert
	Average		+32.7	+29.3							TX 908 MHz
	2727.6	44.8	+0.8	+2.8			+0.0	45.0	54.0	-9.0	Vert
	Average		+32.7	+29.3							TX 909.2 MHz
	2760.0	45.0	+0.8	+2.9			+0.0	45.4	54.0	-8.6	Vert
	Average		+32.7	+29.4							TX 920 MHz

All measurements within 20 dB of the specification limit are reported per 15.31(o).

The spectrum was searched from 30 MHz to 10 GHz

Analyzer settings:

Peak Measurements RBW=1 MHz VBW=1 MHz Peak detector
Average Measurements RBW=1 MHz VBW=1 kHz Peak detector

Section 7. Powerline Conducted Emissions

NAME OF TEST: Powerline Conducted Emissions	PARA. NO.: 15.207(a)
TESTED BY: David Light	DATE: 10 June 2010

Test Results: Complies. The worst case emission was 36.261 dBµV at 0.180 MHz. This is 18.886 dB below the average specification limit of 55.147 dBµV.

Test Data: Refer to attached plots

Equipment Used: 1188-1990-674-1464

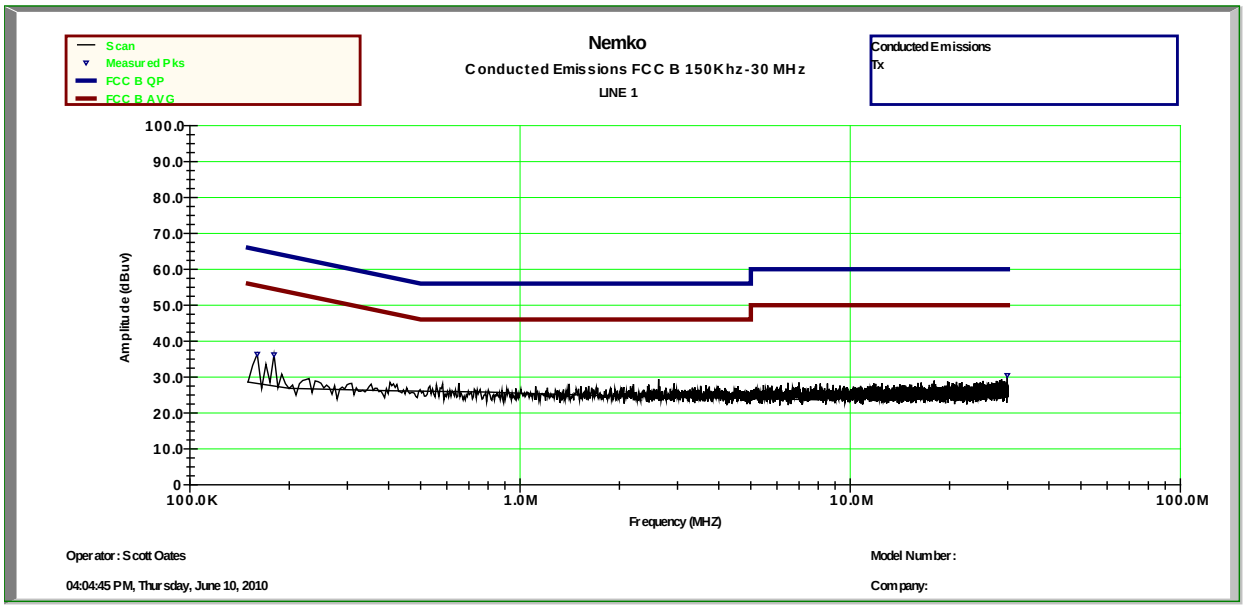
Measurement Uncertainty: +/- 1.7 dB

Temperature: 22 °C

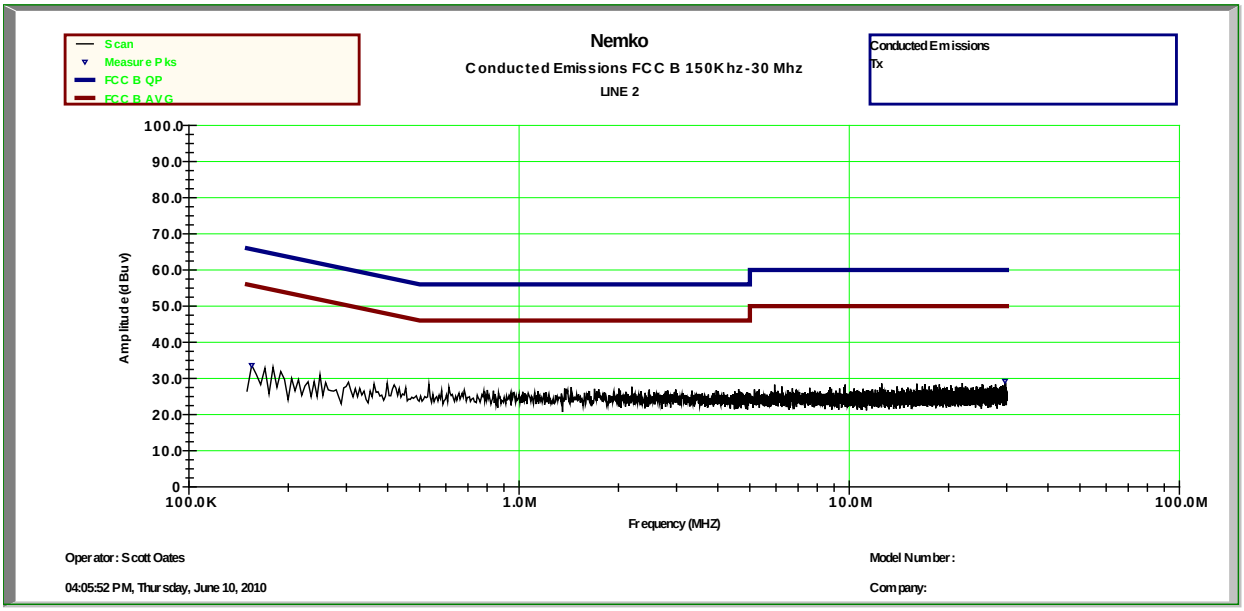
Relative Humidity: 35 %

Test Data – Powerline Conducted Emissions

L1



L2



Section 8. Test Equipment List

Asset Tag	Description	Manufacturer	Model	Serial #	Last Cal	Next Cal
674	Limiter	Hewlett Packard	11947A	3107A02200	30-Sep-2009	30-Sep-2010
993	Antenna, Horn	A.H. Systems	SAS-200/571	162	09-Sep-2009	09-Sep-2011
1016	Preamplifier	Hewlett Packard	8449A	2749A00159	23-Jun-2009	23-Jun-2010
1083	Cable, 2m	Astrolab	32027-2-29094-72TC		CBU	NA
1188	LISN	EMCO	3825/2	1214	23-Sep-2009	23-Sep-2010
1464	Spectrum Analyzer	Hewlett Packard	8563E	3551A04428	27-Feb-2009	27-Feb-2011
1480	Antenna, Bilog	Schaffner-Chase	CBL6111C	2572	17-Oct-2008	17-Oct-2009
1484	Cable	Storm	PR90-010-072		23-Jun-2009	23-Jun-2010
1485	Cable	Storm	PR90-010-216		23-Jun-2009	23-Jun-2010
1990	Cable, Coaxial	Nemko USA, Inc.			29-Sep-2009	29-Sep-2010

ANNEX A - TEST DETAILS

NAME OF TEST: Powerline Conducted Emissions	PARA. NO.: 15.207(a)

Minimum Standard: §15.207 Conducted limits.

(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 mH/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 Conducted Emission (MHz)	Limit (dBmV) 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.

(b) The limit shown in paragraph (a) of this section shall not apply to carrier current systems operating as intentional radiators on frequencies below 30 MHz. In lieu thereof, these carrier current systems shall be subject to the following standards:

(1) For carrier current systems containing their fundamental emission within the frequency band 535-1705 kHz and intended to be received using a standard AM broadcast receiver: no limit on conducted emissions.

(2) For all other carrier current systems: 1000 mV within the frequency band 535-1705 kHz, as measured using a 50 mH/50 ohms LISN.

(3) Carrier current systems operating below 30 MHz are also subject to the radiated emission limits as provided in §15.205 and §§15.209, 15.221, 15.223, 15.225 or 15.227, as appropriate.

(c) Measurements to demonstrate compliance with the conducted limits are not required for devices which only employ battery power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines. Devices that include, or make provision for, the use of battery chargers which permit operating while charging, AC adaptors or battery eliminators or that connect to the AC power lines indirectly, obtaining their power through another device which is connected to the AC power lines, shall be tested to demonstrate compliance with the conducted limits.

NAME OF TEST: Channel Separation	PARA. NO.: 15.247(a)(1)

Minimum Standard:

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

NAME OF TEST: Time of Occupancy	PARA. NO.: 15.247(a)(1)

Minimum Standard:

Frequency Band (MHz)	20 dB Bandwidth	No. of Hopping Channels	Average Time of Occupancy
902 - 928	<250 kHz	50	=<0.4 sec. in 20 sec.
902 – 928	=>250 kHz	25	=<0.4 sec. in 10 sec.
2400 – 2483.5	-----	75	=<0.4 sec. in 0.4 seconds multiplied by the number of hopping channels employed.
5725 – 5850	-----	75	=<0.4 sec. in 30 sec.

Method Of Measurement:

The spectrum analyzer is set as follows:

RBW: 1 MHz
VBW: = RBW
Span: 0 Hz
LOG dB/div.: 10 dB
Sweep: Sufficient to see one hop time sequence.
Trigger: Video

The occupancy time of one hop is measured as above. The average time of occupancy is calculated over the appropriate period of time from above table

Avg. time of occupancy = (period from table/duration of one hop)/no. of channels multiplied by the duration of one hop.

For instance:

If a 2.4 GHz system has a measured hop duration time of 1 msec. and uses 75 channels, then the average time of occupancy would be:

(30 sec./.001 sec.)/75 chan. = 400 x 1 msec. = 400 msec. or 0.4 sec. in 30 sec.

NAME OF TEST: Occupied Bandwidth	PARA. NO.: 15.247(a)(1)

Minimum Standard:

Frequency Band (MHz)	Maximum 20 dB Bandwidth
902 - 928	500 kHz
2400 – 2483.5	Not defined
5725 – 5850	1 MHz

Method Of Measurement:

The spectrum analyzer is set as follows:

RBW: At least 1% of span/div.
VBW: >RBW
Span: Sufficient to display 20 dB bandwidth
LOG dB/div.: 10 dB
Sweep: Auto

Number of channels tested:

Tuning range	Number of channels tested	Channel location in band
1 MHz or less	1	middle
1 to 10 MHz	2	top and bottom
more than 10 MHz	3	top, middle, bottom

NAME OF TEST: Peak Power Output	PARA. NO.: 15.247(b)

Minimum Standard:

Frequency Band (MHz)	No. of Hopping Channels	Maximum Peak Power Output at Antenna Port
902 - 928	at least 50	1 watt
902 – 928	25 - 49	0.25 watts
2400 – 2483.5	75	1 watt
5725 – 5850	75	1 watt

If transmitting antennas of directional gain greater than 6 dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Systems operating in the 2400-2483.5 MHz band that are used exclusively for fixed, point to point operation may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceed 6 dBi.

Systems operating in the 5725 – 5850 MHz band that are used exclusively for fixed, point-to-point operation may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter peak output power.

Direct Measurement Method For Detachable Antennas:
If the antenna is detachable, a peak power meter is used to measure the power output with the transmitter operating into a 50 ohm load. The dBi gain of the antenna(s) employed shall be reported.

Calculation Of EIRP For Integral Antenna:
If the antenna is not detachable from the circuit then the Peak Power Output is derived from the peak radiated field strength of the fundamental emission by using the plane wave relation $GP/4\pi R^2 = E^2/120\pi$ and proceeding as follows:

$$P = \frac{E^2 R^2}{30G} = \frac{E^2 3^2}{30G}$$

where,

P = the equivalent isotropic radiated power in watts
E = the maximum measured field strength in V/m
R = the measurement range (3 meters)
G = the numeric gain of the transmit antenna in relation to an isotropic radiator

The RBW of the spectrum analyzer shall be set to a value greater than the measured 20 dB occupied bandwidth of the E.U.T.

Number of channels tested:

Tuning range	Number of channels tested	Channel location in band
1 MHz or less	1	middle
1 to 10 MHz	2	top and bottom
more than 10 MHz	3	top, middle, bottom

NAME OF TEST: Spurious Emissions at Antenna Terminals PARA. NO.: 15.247(d)

Minimum Standard: In any 100kHz bandwidth outside the frequency band in which the transmitter is operating, emissions shall be at least 20 dB below the fundamental emission or shall not exceed the following field strength limits. Emissions falling in the restricted bands of 15.205 shall not exceed the following field strength limits:

Frequency (MHz)	Field Strength (μV/m @ 3m)	Field Strength (dB @ 3m)
30 - 88	100	40.0
88 - 216	150	43.5
216 - 960	200	46.0
Above 960	500	54.0

THE SPECTRUM WAS SEARCHED TO THE 10th HARMONIC

Method Of Measurement:

30 MHz - 10th harmonic plot
RBW: 100 kHz
VBW: 300 kHz
Sweep: Auto
Display line: -20 dBc

Lower Band Edge
RBW: At least 1% of span/div.
VBW: >RBW
Span: As necessary to display any spurious at band edge.
Sweep: Auto
Center Frequency: 902 MHz, 2400 MHz, or 5725 MHz
Marker: Peak of fundamental emission
Marker Δ: Peak of highest spurious level below center frequency.

Upper Band Edge
RBW: At least 1% of span/div.
VBW: >RBW
Span: As necessary to display any spurious at band edge.
Sweep: Auto
Center Frequency: 928 MHz, 2483.5 MHz, or 5850 MHz
Marker: Peak of fundamental emission
Marker Δ: Peak of highest spurious level above center frequency.

Number of channels tested:

Tuning range	Number of channels tested	Channel location in band
1 MHz or less	1	middle
1 to 10 MHz	2	top and bottom
more than 10 MHz	3	top, middle, bottom

NAME OF TEST: Radiated Spurious Emissions PARA. NO.: 15.247(d)

Minimum Standard: In any 100kHz bandwidth outside the frequency band in which the transmitter is operating, emissions shall be at least 20 dB below the fundamental emission or shall not exceed the following field strength limits:

Emissions falling in the restricted bands of 15.205 shall not exceed the following field strength limits:

Frequency (MHz)	Field Strength (μV/m @ 3m)	Field Strength (dB @ 3m)
30 - 88	100	40.0
88 - 216	150	43.5
216 - 960	200	46.0
Above 960	500	54.0

THE SPECTRUM WAS SEARCHED TO THE 10th HARMONIC

15.205 Restricted Bands

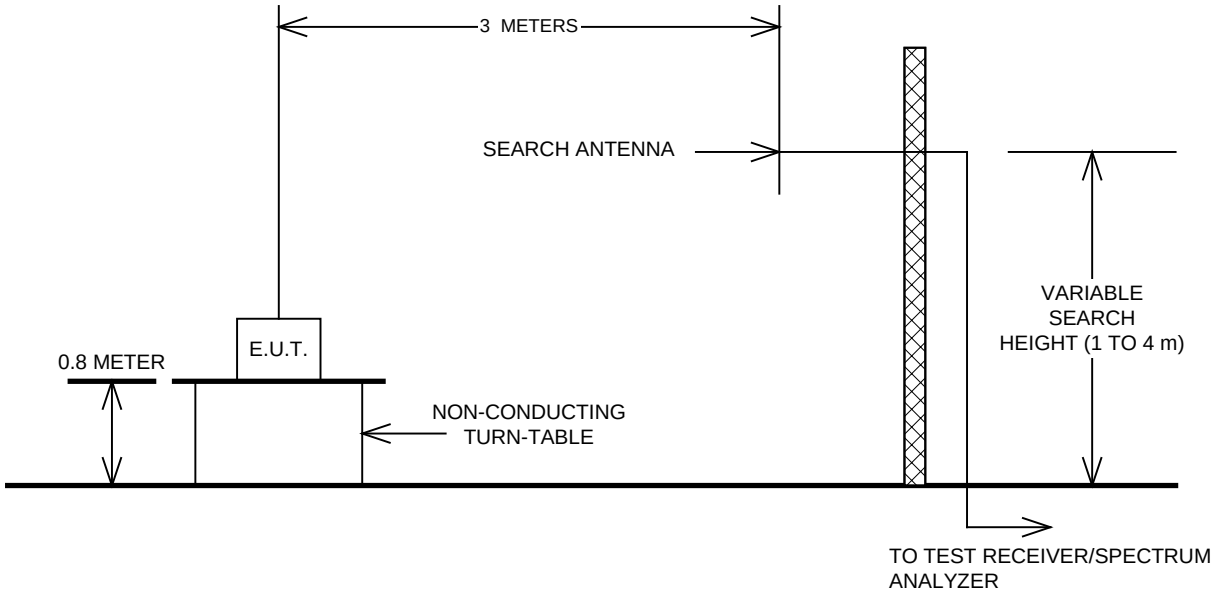
MHz	MHz	MHz	GHz
0.09-0.11	16.42-16.423	399.9-410	4.5-5.25
0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.125-6.218	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	Above 38.6
13.36-13.41	1718		

Number of channels tested:

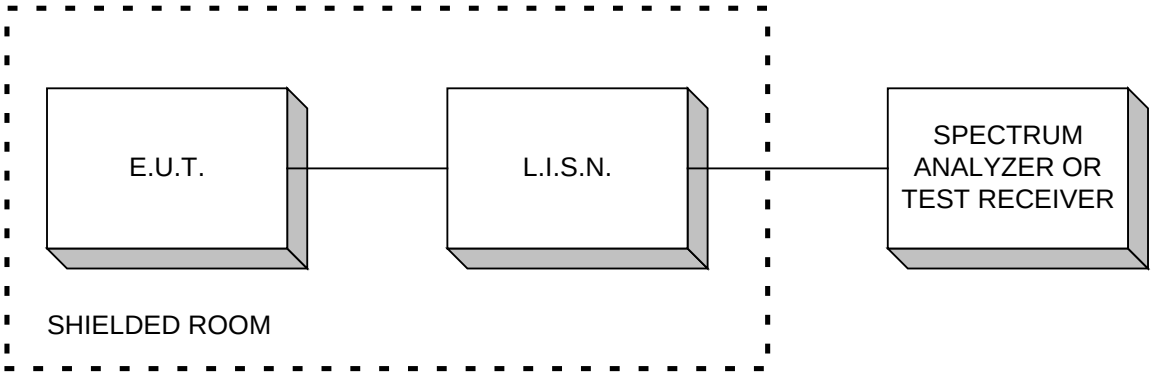
Tuning range	Number of channels tested	Channel location in band
1 MHz or less	1	middle
1 to 10 MHz	2	top and bottom
more than 10 MHz	3	top, middle, bottom

ANNEX B - TEST DIAGRAMS

Test Site For Radiated Emissions



Conducted Emissions



Peak Power at Antenna Terminals