

Nemko Test Report: 2L0092RUS1

Applicant: Internet Telemetry
5311 S.122nd East Avenue
Tulsa, OK 74146

**Equipment Under Test:
(E.U.T.)** Model TIM 15 Version G4

In Accordance With: **FCC Part 15, Subpart C, 15.247**
Frequency Hopping Transmitters

Tested By: Nemko Dallas Inc.
802 N. Kealy
Lewisville, Texas 75057-3136

Authorized By: 
David Light, Wireless Lab Supervisor

Date: 6/25/02

Total Number of Pages: 41

Table of Contents

Section 1. Summary of Test Results.....	3
Section 2. Equipment Under Test (E.U.T.)	5
Section 3. Powerline Conducted Emissions	7
Section 4. Channel Separation.....	10
Section 5. Pseudorandom Hopping Algorithm.....	12
Section 6. Time of Occupancy.....	13
Section 7. Occupied Bandwidth	14
Section 8. Peak Power Output	16
Section 9. Spurious Emissions (Antenna Conducted).....	18
Section 10. Spurious Emissions (Radiated)	21
Section 11. Test Equipment List.....	30
ANNEX A - TEST DETAILS	31
ANNEX B - TEST DIAGRAMS.....	41

Section 1. Summary of Test Results

Manufacturer: Internet Telemetry

Model No.: Model TIM 15 Version G4

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 in accordance with ANSI C63.4-1992. Radiated emissions below 1 GHz 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



Family Listing

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**TESTED BY: Tom Tidwell DATE: 5/19/2002

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Summary Of Test Data

NAME OF TEST	PARA. NO.	SPEC.	RESULT
Powerline Conducted Emissions	15.207(a)	48 dB μ V	Complies
Channel Separation	15.247(a)(1)	Greater of 25 kHz or 20 dB Bandwidth	Complies
Pseudorandom Hopping Algorithm	15.247(a)(1)		Complies
Time of Occupancy	15.247(a)(1)(ii)	≤ 0.4 sec in 30 sec	Complies
20 dB Occupied Bandwidth	15.247(a)(1)	≤ 1 MHz	Complies
Peak Power Output	15.247(b)	<1 Watt	Complies
Spurious Emissions (Antenna Conducted)	15.247(c)	-20 dBc	Complies
Spurious Emissions (Radiated)	15.247(c)	Table 15.209(a)	Complies

Footnotes:

This device is battery powered. Since the device is also intended to be an OEM module, powerline conducted emissions were measured using an off-the-shelf AC/DC adapter.

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

General Equipment Information

Frequency Band: ☒ 902 – 928 MHz
☐ 2400 – 2483.5 MHz

Number of Channels: 50

Channel Spacing: 125 kHz

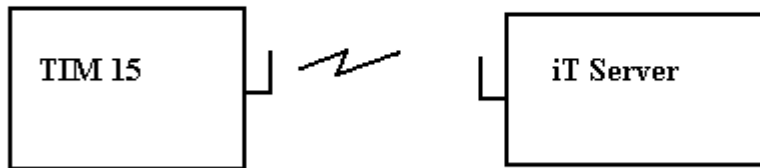
20 dB Bandwidth: 50.8 kHz

User Frequency Adjustment: Software controlled

Theory of Operation

The Telemetry Interface Module (TIM) is a data-collection-wireless-transceiver module.

System Diagram



Section 3. Powerline Conducted Emissions

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

Test Results: Complies.

Measurement Data: See attached plots.

Equipment Used:

Measurement Uncertainty: +/- 0.7 dB

Temperature: °C

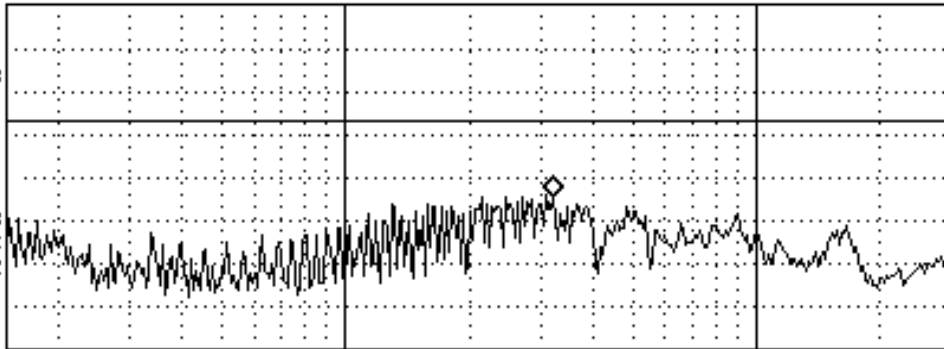
Relative Humidity: %

12:04:03 JUL 02, 2002

MARKER
3.22 MHz
30.15 dBμVACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 3.22 MHz
30.15 dBμV

LOG REF 75.0 dBμV

Phase Conductor 60 Hz/120 Vac

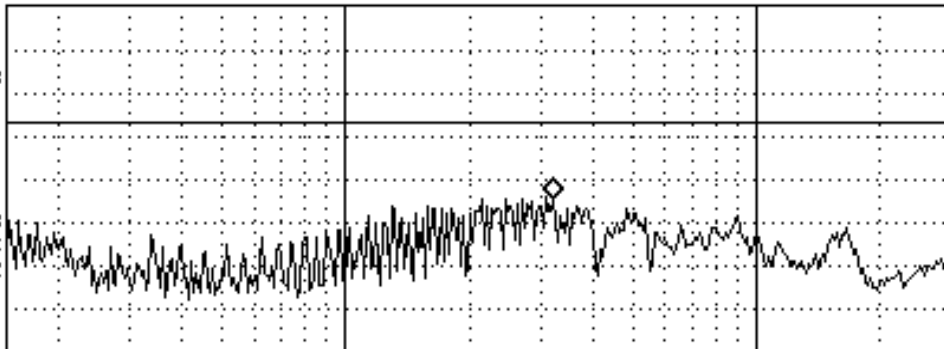
10
dB/
ATN
10 dBDL
48.0
dBμV
VA SB
SC FC
CORRSTART 150 kHz STOP 30.00 MHz
RL #IF BW 9.0 kHz AVG BW 30 kHz SWP 1.40 sec

12:07:11 JUL 02, 2002

MARKER
3.22 MHz
30.15 dBμVACTV DET: PEAK
MEAS DET: PEAK QP AVG
MKR 3.22 MHz
30.15 dBμV

LOG REF 75.0 dBμV

Neutral Conductor 60 Hz120 Vac

10
dB/
ATN
10 dBDL
48.0
dBμV
VA SB
SC FC
CORRSTART 150 kHz STOP 30.00 MHz
RL #IF BW 9.0 kHz AVG BW 30 kHz SWP 1.40 sec



Section 4. Channel Separation

NAME OF TEST: Channel Separation	PARA. NO.: 15.247(a)(1)
TESTED BY: Tom Tidwell	DATE: 5/19/02

Test Results: Complies.

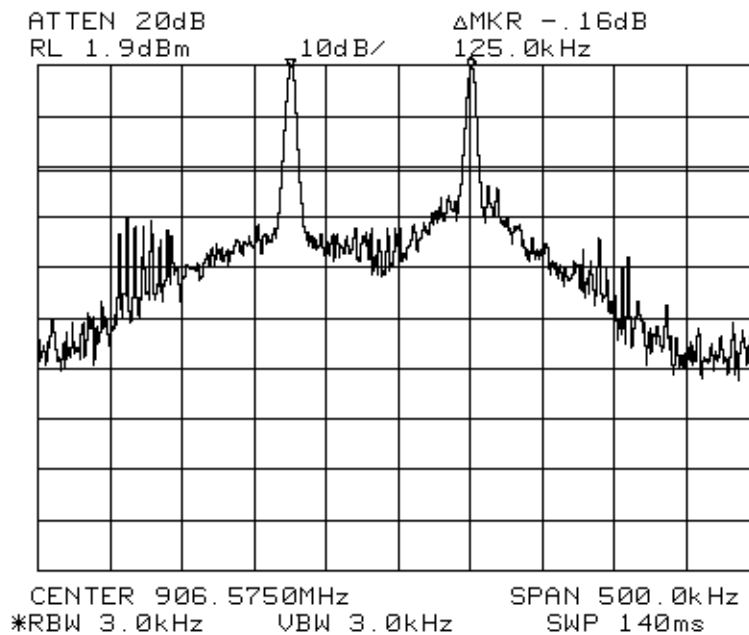
Measurement Data: See 20 dB BW plot
Measured 20 dB bandwidth: 42 kHz
Channel Separation: 125 kHz

Equipment Used: 1464-1484-1485-1304

Measurement Uncertainty: +/- 0.7 dB

Temperature: 22 °C

Relative Humidity: 50 %

Test Plot – Channel Separation**Channel Separation**

Section 5. Pseudorandom Hopping Algorithm

NAME OF TEST: Pseudorandom Hopping Algorithm	PARA. NO.: 15.247(a)(1)
--	-------------------------

Test Results: Complies.

Measurement Data: See sample hopping sequence.

Number of Hopping Frequencies: 50

Number of Hopping Patterns: 6

All hopping patterns contain the same number of channels (50).

[Refer to separate attachment.](#)

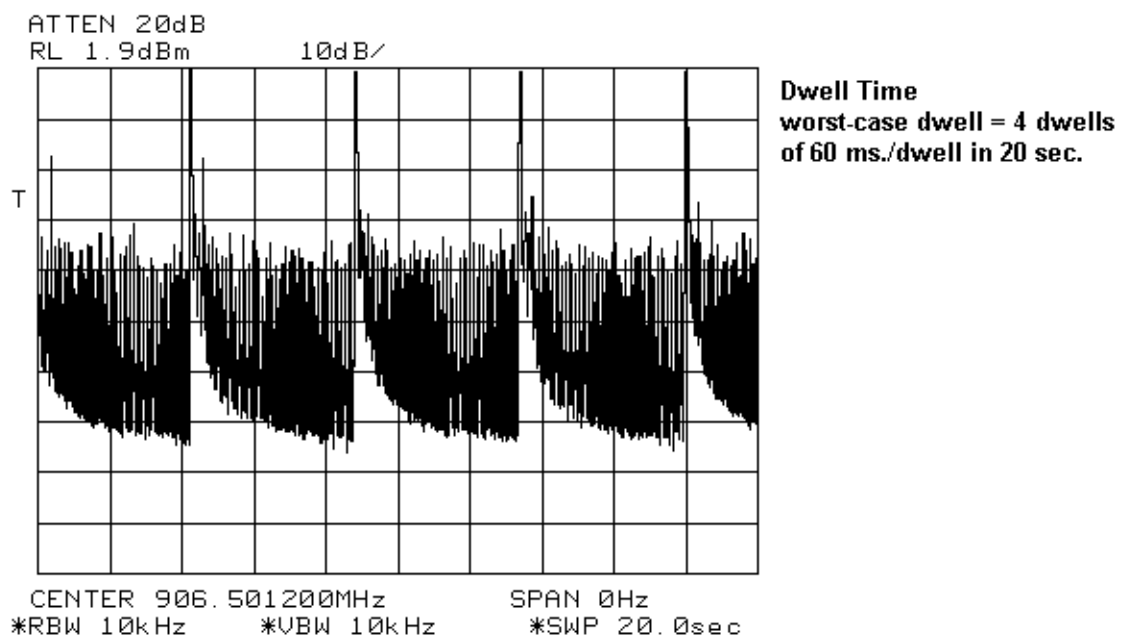
Section 6. Time of Occupancy

NAME OF TEST: Time of Occupancy	PARA. NO.: 15.247(a)(1)
TESTED BY: Tom Tidwell	DATE: 5/19/2002

Test Results: Complies.

Measurement Data:

Maximum Dwell Time On Any Channel: 0.24 S/20 seconds

Test Plot – Time of Occupancy

Section 7. Occupied Bandwidth

NAME OF TEST: Occupied Bandwidth	PARA. NO.: 15.247(a)(1)(i)
TESTED BY: Tom Tidwell	DATE: 5/19/2002

Test Results: Complies.

Measurement Data: See attached plots.

Equipment Used: 1464-1484-1485-1304

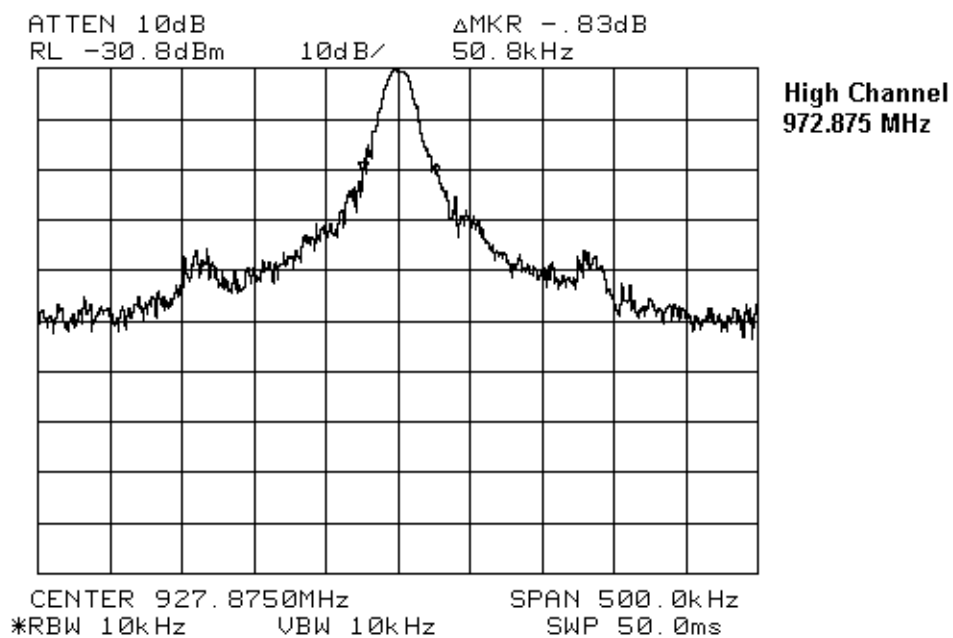
Measurement Uncertainty: +/- 0.7 dB

Temperature: 22 °C

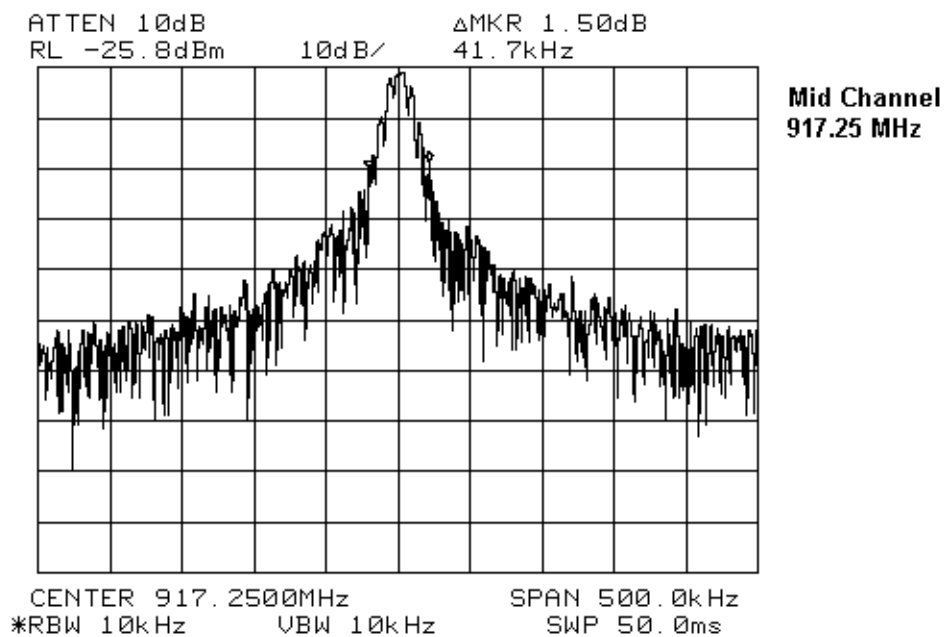
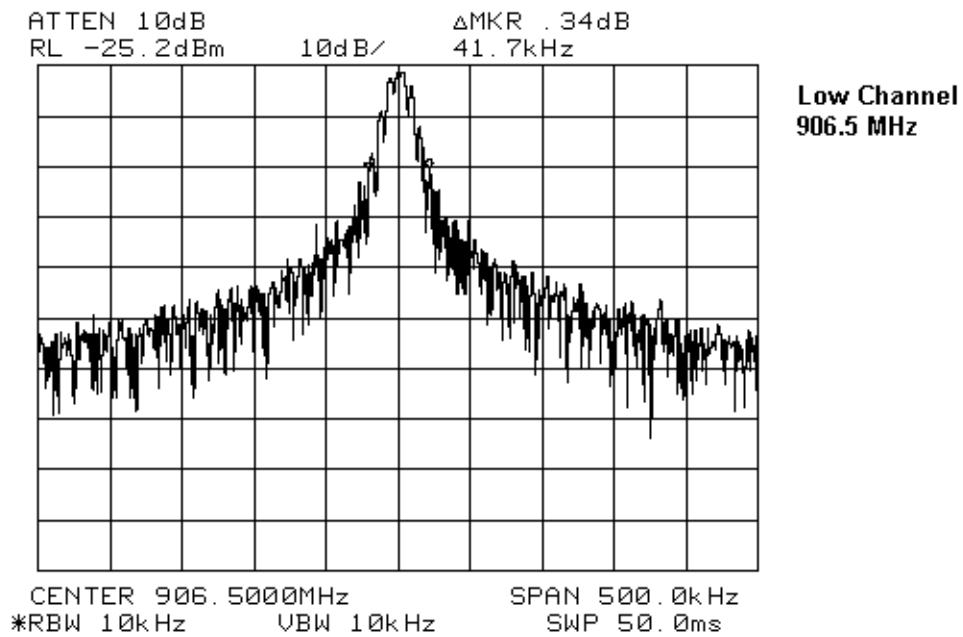
Relative Humidity: 50 %

The device was tested with a fully charged battery

Test Plots – Occupied Bandwidth



Test Plots – Occupied Bandwidth



Section 8. Peak Power Output

NAME OF TEST: Peak Power Output	PARA. NO.: 15.247 (b)
TESTED BY: Tom Tidwell	DATE: 5/19/2002

Test Results: Complies.**Measurement Data:**Detachable antenna? ☒ Yes ☒ No

If yes, state the type of non-standard connector used: Hirose MS-147

Antennas: (1) Integral monopole
 (2) Larsen YA6 900, 6dBi 3-element Yagi

Antenna	Type	E.I.R.P. (dBm)
906.5 MHz (Integral)	Monopole	18 dBm eirp
917.25 MHz (Integral)	Monopole	18.5 dBm eirp
927.875 MHz (Integral)	Monopole	18.8 dBm eirp
External	Yagi	22.8dBm + 6 dBi = 28.8 dBm
External	Yagi	23.1dBm + 6 dBi = 29.1 dBm
External	Yagi	22.9dBm + 6 dBi = 28.9 dBm

See attached data sheets.

The rf power output was determined with the integral antenna by calculating the e.i.r.p. from the received signal strength. An antenna gain of 0 dBi was used for these calculations. This is the rated gain of the integral antenna. According to the test results, the integral antenna exhibits slightly less than 0 dBi gain.

The rf output for the external antenna was determined using a peak power meter and measuring the rf power output at the external antenna port via a special adapter provided by the client (Hirose MS-147 to SMA). A gain of 6 dBi is added.

Equipment Used: 1484-1485-1464-1304-1029**Measurement Uncertainty:** +/- 0.7 dB**Temperature:** 22 °C**Relative Humidity:** 50 %

Field Strength of Spurious Emissions

Page 1 ofComplete X

Job No.: 2L0092R

Date: 5/18/02

Preliminary

Specification:

Temperature(°C): 21

Tested By: Tom Tidwell

Relative Humidity(%) 45

E.U.T.:	TIM15 Version G4
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Configuration: Internal Antenna

Sample Number:	S01
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Location: AC 3

RBW: 1 MHz

Measurement

Detector Type:	Average
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VBW: 1 MHz

Distance 3 m

Test Equipment Used

Antenna: 759

Directional Coupler: #N/A

Pre-Amp:	#N/A
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Cable #1:	1484
-----------	------

Filter:	#N/A
---------	------

Cable #2:	1485
-----------	------

Receiver: 1464

Cable #3: #N/A

Attenuator #1	#N/A
---------------	------

Cable #4: #N/A

Attenuator #2:	#N/A
----------------	------

Mixer: #N/A

Additional

equipment used:

Measurement

Uncertainty: +/-2.6 dB

[illegible]

Notes: EIRP was calculated from the measured field strength by using a gain factor of 0 dBi for the integral antenna.

Section 9. Spurious Emissions (Antenna Conducted)

NAME OF TEST: Spurious Emissions (Antenna Conducted)	PARA. NO.: 15.247(c)
TESTED BY: Tom Tidwell	DATE: 5/19/2002

Test Results: Complies.

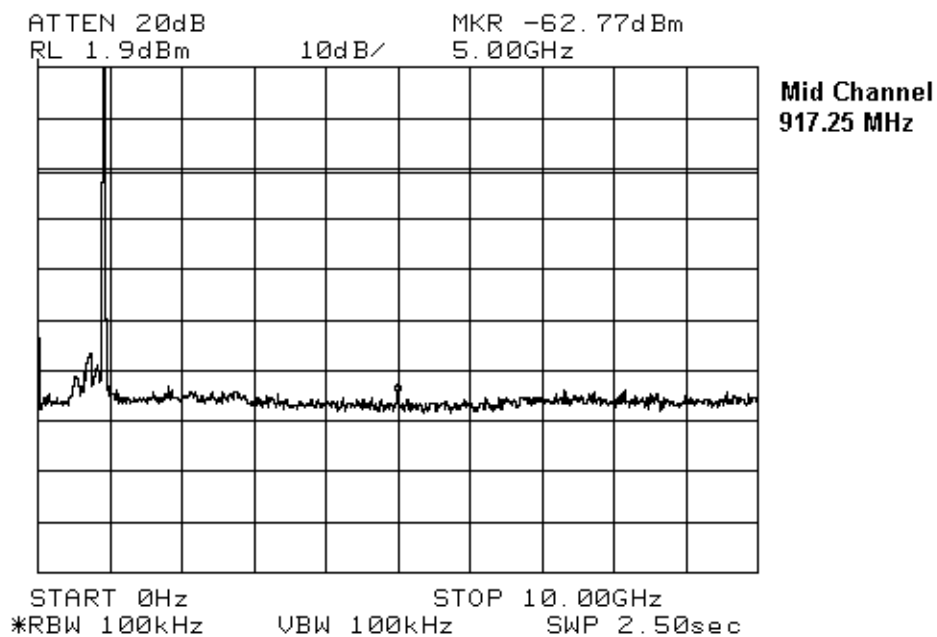
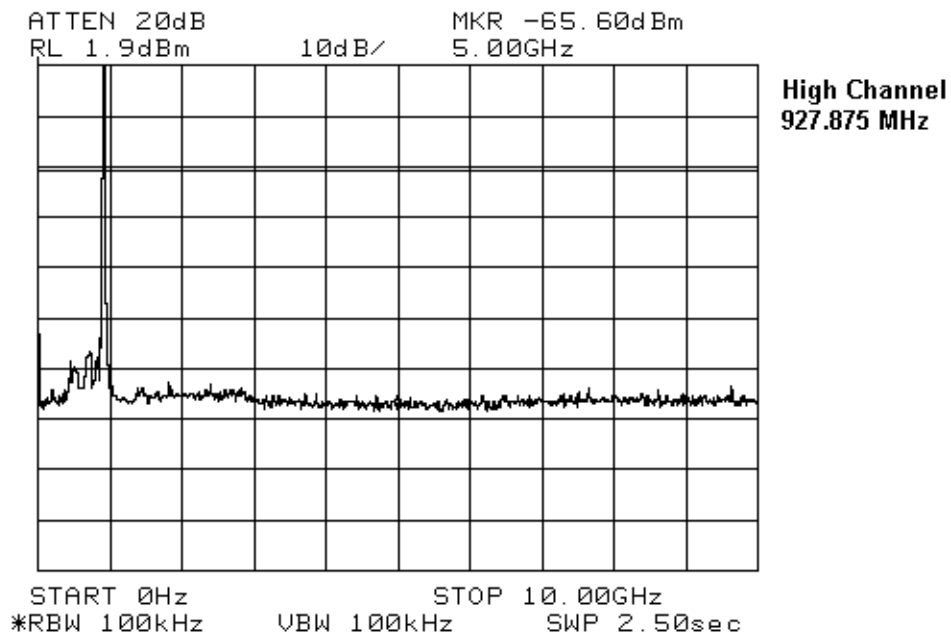
Measurement Data: See attached plots.

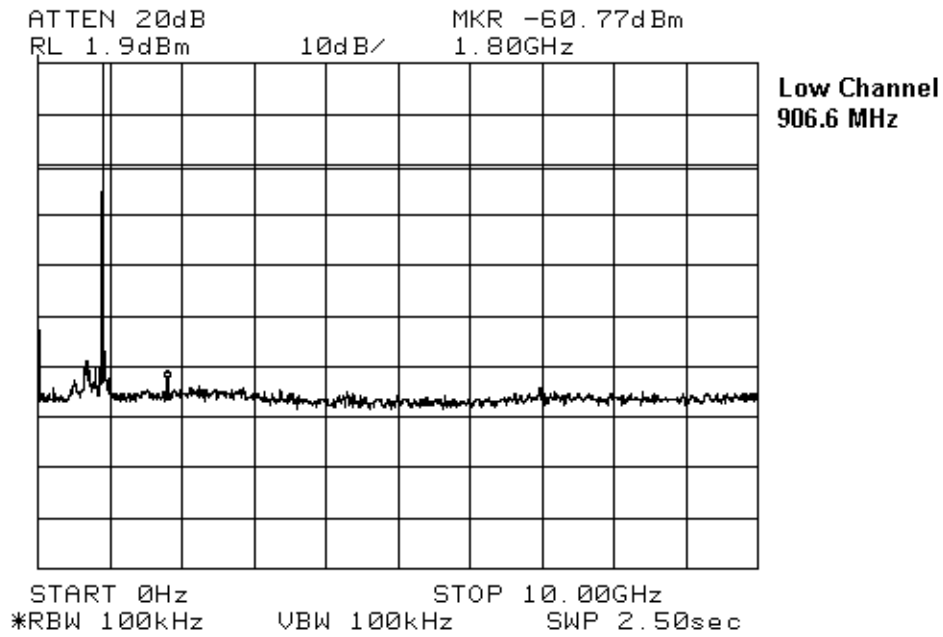
Equipment Used: 1464-1629

Measurement Uncertainty: +/- 0.7 dB

Temperature: 20 °C

Relative Humidity: 50 %

Test Plots – Spurious Emissions at Antenna Terminals



Section 10. Spurious Emissions (Radiated)

NAME OF TEST: Spurious Emissions (Radiated)	PARA. NO.: 15.247(c)
TESTED BY: Tom Tidwell / Kevin Rose	DATE:5/19/2002

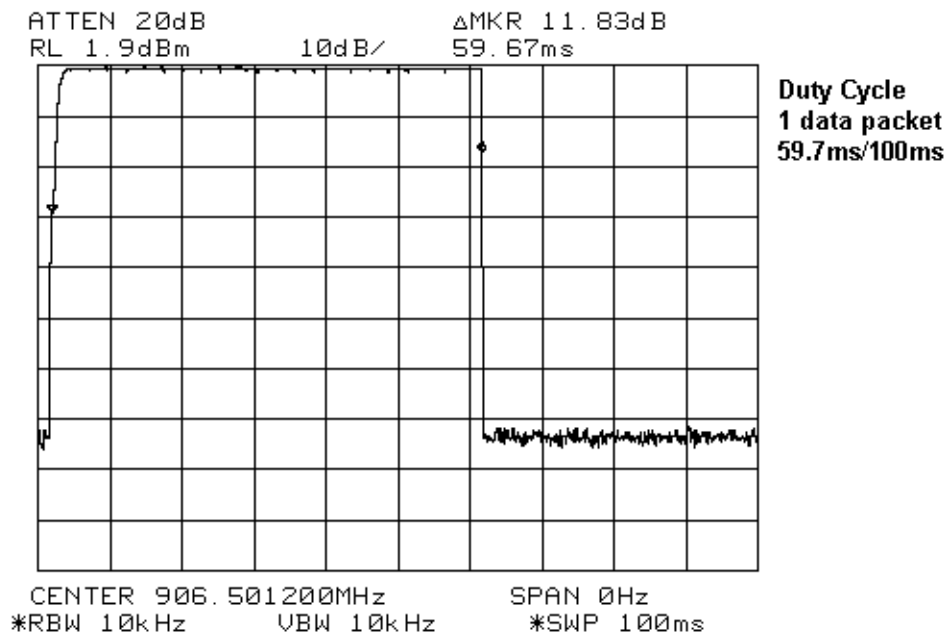
Test Results: Complies.

Measurement Data: See attached table.

Duty Cycle Calculation:

Duty Cycle correction factor(dB) = $20 \log (rf_{ON} \text{ in ms}/100\text{ms})$

$$20 \log (59.7/100) = -4.48 \text{ dB}$$



Measurement Uncertainty: +/- 0.7 dB

Temperature: °C

Relative Humidity: %

Test Data - Radiated Emissions – Low Channel (Integral Antenna)



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Radiated Emissions									
Page 1 of 1									
Job No.:	2L0092R			Date: 5/18/02					
Specification:	15.247			Temperature(°C): 20					
Tested By:	Tom Tidwell			Relative Humidity(%) 50					
E.U.T.:	TIM 15G3/4								
Configuration:									
Sample Number:									
Location:	AC 3			RBW:		1 MHz			
Detector Type:	Average			VBW:		1 MHz		Peak	
	Peak			VBW:		10 Hz		Average	
Test Equipment Used									
Antenna:	1304			Directional Coupler:		#N/A			
Pre-Amp:	1016			Cable #1:		1484			
Filter:	1481			Cable #2:		1485			
Receiver:	1464			Cable #3:		#N/A			
Attenuator #1:	#N/A			Cable #4:		#N/A			
Attenuator #2:	#N/A			Mixer:		#N/A			
Measurement Uncertainty:	+/-3.6								
Frequency (GHz)	Meter Reading (dBuV)	Antenna Factor (dB)	Cable Loss (dB)	Pre-Amp Gain (dB)	Duty Cycle Factor (dB)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Delta (dB)	Comment
2.720	52	28.2	3.7	33.5		50.4	74	-23.6	Horizontal(Peak)
2.720	45.8	28.2	3.7	33.5	-4	40.2	54	-13.8	Horizontal(Average)
2.720	51	28.2	3.7	33.5		49.4	74	-24.6	Vertical(Peak)
2.720	46.3	28.2	3.7	33.5	-4	40.7	54	-13.3	Vertical(Average)
3.626	48.2	30.3	3.5	33.6		48.4	74	-25.6	Horizontal(NF)
3.626	40	30.3	3.5	33.6	-4	36.2	54	-17.8	Horizontal
3.626	50.1	30.3	3.5	33.6		50.3	74	-23.7	Vertical
3.626	43.8	30.3	3.5	33.6	-4	40.0	54	-14.0	Vertical
4.533	56.5	32.0	3.7	33.8		58.4	74	-15.6	Vertical
4.533	54	32.0	3.7	33.8	-4	51.9	54	-2.1	Vertical
4.533	51.7	32.0	3.7	33.8		53.6	74	-20.4	Horizontal
4.533	47	32.0	3.7	33.8	-4	44.9	54	-9.1	Horizontal(NF)
8.159	49	37.5	4.6	34		57.1	74	-16.9	Vertical
8.159	43.2	37.5	4.6	34	-4	47.3	54	-6.7	Vertical
8.159	47.7	37.5	4.6	34		55.8	74	-18.2	Horizontal
8.159	40.5	37.5	4.6	34	-4	44.6	54	-9.4	Horizontal
9.066	50.7	37.0	5.8	34.8		58.7	74	-15.3	Vertical
9.066	42.8	37.0	5.8	34.8	-4	46.8	54	-7.2	Vertical
9.066	46	37.0	5.8	34.8		54.0	74	-20.0	Horizontal
9.066	38.1	37.0	5.8	34.8	-4	42.1	54	-11.9	Horizontal
Notes: 906.6 MHz Carrier									

Test Data - Radiated Emissions – Mid Channel (Integral Antenna)

Frequency (GHz)	Meter Reading (dBuV)	Antenna Factor (dB)	Cable Loss (dB)	Pre-Amp Gain (dB)	Duty Cycle Factor (dB)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Delta (dB)	Comment
2.764	52	28.2	3.7	33.5		50.4	74	-23.6	Horizontal(Peak)
2.764	45.8	28.2	3.7	33.5	-4	40.2	54	-13.8	Horizontal(Average)
2.764	51	28.2	3.7	33.5		49.4	74	-24.6	Vertical(Peak)
2.764	46.3	28.2	3.7	33.5	-4	40.7	54	-13.3	Vertical(Average)
3.685	48.2	30.3	3.5	33.6		48.4	74	-25.6	Horizontal(NF)
3.685	40	30.3	3.5	33.6	-4	36.2	54	-17.8	Horizontal
3.685	50.1	30.3	3.5	33.6		50.3	74	-23.7	Vertical
3.685	43.8	30.3	3.5	33.6	-4	40.0	54	-14.0	Vertical
4.606	56.5	32.0	3.7	33.8		58.4	74	-15.6	Vertical
4.606	54	32.0	3.7	33.8	-4	51.9	54	-2.1	Vertical
4.606	51.7	32.0	3.7	33.8		53.6	74	-20.4	Horizontal
4.606	47	32.0	3.7	33.8	-4	44.9	54	-9.1	Horizontal(NF)
8.291	49	37.5	4.6	34		57.1	74	-16.9	Vertical
8.291	43.2	37.5	4.6	34	-4	47.3	54	-6.7	Vertical
8.291	47.7	37.5	4.6	34		55.8	74	-18.2	Horizontal
8.291	40.5	37.5	4.6	34	-4	44.6	54	-9.4	Horizontal
9.211	50.7	37.0	5.8	34.8		58.7	74	-15.3	Vertical
9.211	42.8	37.0	5.8	34.8	-4	46.8	54	-7.2	Vertical
9.211	46	37.0	5.8	34.8		54.0	74	-20.0	Horizontal
9.211	38.1	37.0	5.8	34.8	-4	42.1	54	-11.9	Horizontal
Notes: 921.125 MHz Carrier									

Test Data – Radiated Emissions – High Channel (Integral Antenna)

Frequency (GHz)	Meter Reading (dBuV)	Antenna Factor (dB)	Cable Loss (dB)	Pre-Amp Gain (dB)	Duty Cycle Factor (dB)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Delta (dB)	Comment
2.784	52	28.2	3.7	33.5		50.4	74	-23.6	Horizontal(Peak)
2.784	45.8	28.2	3.7	33.5	-4	40.2	54	-13.8	Horizontal(Average)
2.784	47.6	28.2	3.7	33.5		46.0	74	-28.0	Vertical(Peak)
2.784	41	28.2	3.7	33.5	-4	35.4	54	-18.6	Vertical(Average)
3.712	50	30.3	3.5	33.6		50.2	74	-23.8	Horizontal(NF)
3.712	46.5	30.3	3.5	33.6	-4	42.7	54	-11.3	Horizontal
3.712	55	30.3	3.5	33.6		55.2	74	-18.8	Vertical
3.712	53.7	30.3	3.5	33.6	-4	49.9	54	-4.1	Vertical
4.640	52	32.0	3.7	33.8		53.9	74	-20.1	Vertical
4.640	47.8	32.0	3.7	33.8	-4	45.7	54	-8.3	Vertical
4.640	49.2	32.0	3.7	33.8		51.1	74	-22.9	Horizontal
4.640	45.8	32.0	3.7	33.8	-4	43.7	54	-10.3	Horizontal
8.351	42	37.5	4.6	34		50.1	74	-23.9	Vertical
8.351	32	37.5	4.6	34	-4	36.1	54	-17.9	Vertical
8.351	42	37.5	4.6	34		50.1	74	-23.9	Horizontal
8.351	32.2	37.5	4.6	34	-4	36.3	54	-17.7	Horizontal
9.279	42	37.0	5.8	34.8		50.0	74	-24.0	Vertical
9.279	32	37.0	5.8	34.8	-4	36.0	54	-18.0	Vertical
9.279	42	37.0	5.8	34.8		50.0	74	-24.0	Horizontal
9.279	32	37.0	5.8	34.8	-4	36.0	54	-18.0	Horizontal
Notes: 927.875 MHz Carrier									

Test Data – Radiated Emissions – Low Channel (Yagi Antenna)



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Radiated Emissions								
Page <u>1</u> of <u>1</u>								
Job No.:	2L0092R		Date: 5/28/02					
Specification:	15.247		Temperature(°C): <u>20</u>					
Tested By:	Kevin Rose		Relative Humidity(%) <u>50</u>					
E.U.T.:	TIM 1500 Rev G4							
Configuration:	low channel transmit external antenna							
Sample Number:	3							
Location:	AC 3		RBW:		1 MHz			
Detector Type:	Average		VBW:		1 MHz		Peak	
	Peak		VBW:		10 Hz		Average	
Test Equipment Used								
Antenna:	1304		Directional Coupler:		#N/A			
Pre-Amp:	1016		Cable #1:		1484			
Filter:	1481		Cable #2:		1485			
Receiver:	1464		Cable #3:		#N/A			
Attenuator #1:	#N/A		Cable #4:		#N/A			
Attenuator #2:	#N/A		Mixer:		#N/A			
Measurement Uncertainty:	+/-3.6							
Frequency (GHz)	Meter Reading (dBuV)	Antenna Factor (dB)	Cable Loss (dB)	Pre-Amp Gain (dB)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Delta (dB)	Comment
2.720	48.7	28.2	3.7	33.5	47.1	74	-26.9	Horizontal(Peak)
2.720	31.7	28.2	3.7	33.5	30.1	54	-23.9	Horizontal(Average)
2.720	47	28.2	3.7	33.5	45.4	74	-28.6	Vertical(Peak)
2.720	31.5	28.2	3.7	33.5	29.9	54	-24.1	Vertical(Average)
3.626	48.7	30.3	3.5	33.6	48.9	74	-25.1	Horizontal
3.626	33	30.3	3.5	33.6	33.2	54	-20.8	Horizontal
3.626	51.2	30.3	3.5	33.6	51.4	74	-22.6	Vertical
3.626	40.5	30.3	3.5	33.6	40.7	54	-13.3	Vertical
4.533	47.3	32.0	3.7	33.8	49.2	74	-24.8	Vertical
4.533	30	32.0	3.7	33.8	31.9	54	-22.1	Vertical
4.533	47.2	32.0	3.7	33.8	49.1	74	-24.9	Horizontal
4.533	30.2	32.0	3.7	33.8	32.1	54	-21.9	Horizontal(nosie floor)
8.159	47	37.5	4.6	34	55.1	74	-18.9	Vertical
8.159	29.5	37.5	4.6	34	37.6	54	-16.4	Vertical
8.159	47.3	37.5	4.6	34	55.4	74	-18.6	Horizontal
8.159	30	37.5	4.6	34	38.1	54	-15.9	Horizontal
9.066	48	37.0	5.8	34.8	56.0	74	-18.0	Vertical
9.066	30.5	37.0	5.8	34.8	38.5	54	-15.5	Vertical
9.066	48.7	37.0	5.8	34.8	56.7	74	-17.3	Horizontal
9.066	30.5	37.0	5.8	34.8	38.5	54	-15.5	Horizontal
Notes: 906.6 MHz Carrier 6dbi antenna power level 255 regular								
4dB duty cycle adjustment on the Average Measurements								

Test Data – Radiated Emissions – Mid Channel (Yagi Antenna)

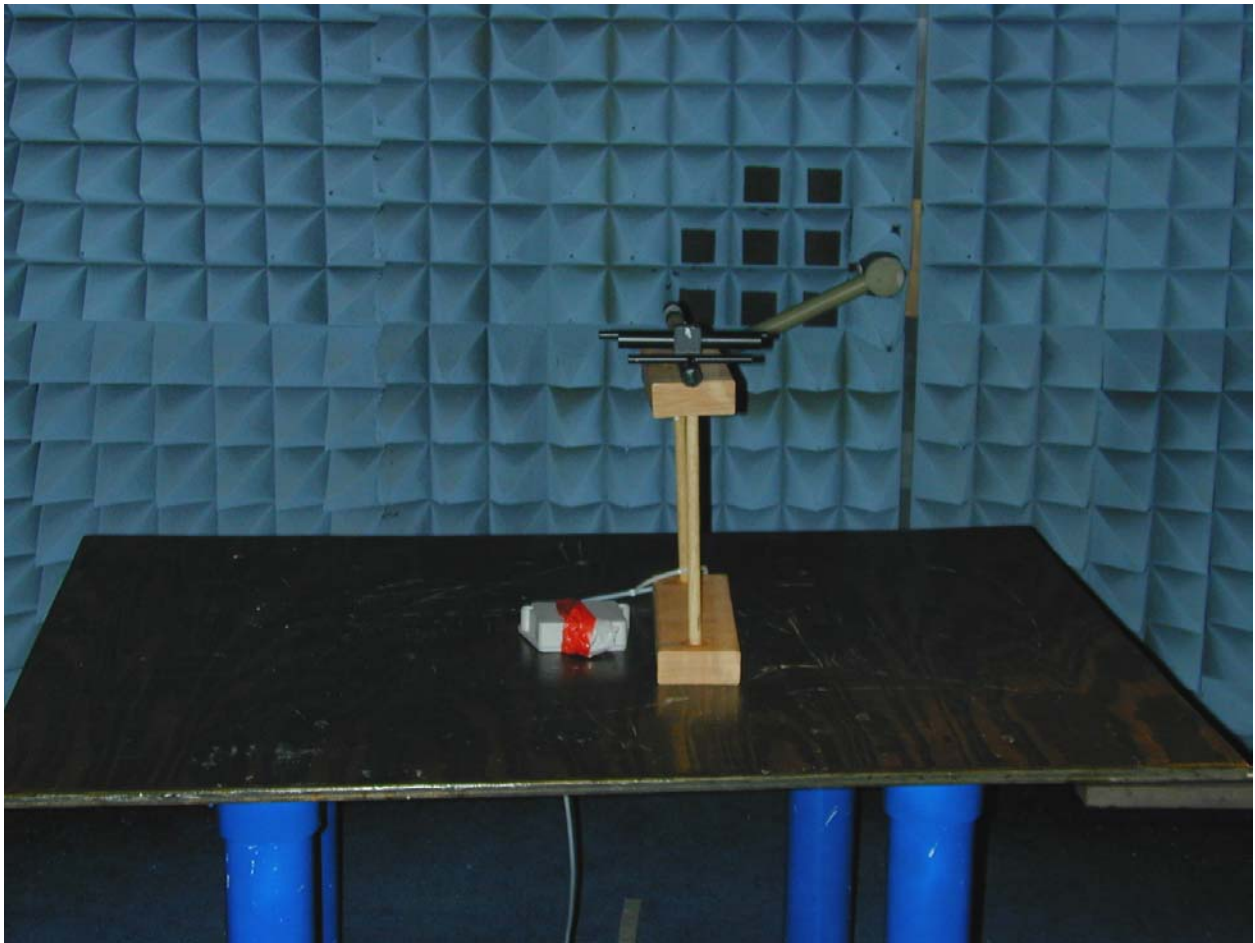
Frequency (GHz)	Meter Reading (dBuV)	Antenna Factor (dB)	Cable Loss (dB)	Pre-Amp Gain (dB)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Delta (dB)	Comment
2.751	48.8	28.2	3.7	33.5	47.2	74	-26.8	Horizontal(Peak)
2.751	31.3	28.2	3.7	33.5	29.7	54	-24.3	Horizontal(Average)
2.751	49.3	28.2	3.7	33.5	47.7	74	-26.3	Vertical(Peak)
2.751	31.8	28.2	3.7	33.5	30.2	54	-23.8	Vertical(Average)
3.669	48.2	30.3	3.5	33.6	48.4	74	-25.6	Horizontal
3.669	33.8	30.3	3.5	33.6	34.0	54	-20.0	Horizontal
3.669	50	30.3	3.5	33.6	50.2	74	-23.8	Vertical
3.669	39	30.3	3.5	33.6	39.2	54	-14.8	Vertical
4.586	47.6	32.0	3.7	33.8	49.5	74	-24.5	Vertical
4.586	30.5	32.0	3.7	33.8	32.4	54	-21.6	Vertical
4.586	47	32.0	3.7	33.8	48.9	74	-25.1	Horizontal
4.586	30.8	32.0	3.7	33.8	32.7	54	-21.3	Horizontal(nosie floor)
8.254	48.2	37.5	4.6	34	56.3	74	-17.7	Vertical
8.254	32	37.5	4.6	34	40.1	54	-13.9	Vertical
8.254	46.7	37.5	4.6	34	54.8	74	-19.2	Horizontal
8.254	30.3	37.5	4.6	34	38.4	54	-15.6	Horizontal
9.17125	47.2	37.0	5.8	34.8	55.2	74	-18.8	Vertical
9.17125	31	37.0	5.8	34.8	39.0	54	-15.0	Vertical
9.17125	46.5	37.0	5.8	34.8	54.5	74	-19.5	Horizontal
9.17125	30.8	37.0	5.8	34.8	38.8	54	-15.2	Horizontal
Notes: 917.125 MHz Carrier 6dbi antenna power level 255 regular								
4dB duty cycle adjustment on the Average Measurements								

Test Data – Radiated Emissions – High Channel (Yagi Antenna)

Frequency (GHz)	Meter Reading (dBuV)	Antenna Factor (dB)	Cable Loss (dB)	Pre-Amp Gain (dB)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Delta (dB)	Comment
2.784	48.8	28.2	3.7	33.5	47.2	74	-26.8	Horizontal(Peak)
2.784	31.3	28.2	3.7	33.5	29.7	54	-24.3	Horizontal(Average)
2.784	49.2	28.2	3.7	33.5	47.6	74	-26.4	Vertical(Peak)
2.784	33.2	28.2	3.7	33.5	31.6	54	-22.4	Vertical(Average)
3.712	49	30.3	3.5	33.6	49.2	74	-24.8	Horizontal
3.712	34.8	30.3	3.5	33.6	35.0	54	-19.0	Horizontal
3.712	50.8	30.3	3.5	33.6	51.0	74	-23.0	Vertical
3.712	40.5	30.3	3.5	33.6	40.7	54	-13.3	Vertical
4.639	47.3	32.0	3.7	33.8	49.2	74	-24.8	Vertical
4.639	30.5	32.0	3.7	33.8	32.4	54	-21.6	Vertical
4.639	46.8	32.0	3.7	33.8	48.7	74	-25.3	Horizontal
4.639	29.5	32.0	3.7	33.8	31.4	54	-22.6	Horizontal(nosie floor)
8.351	47.2	37.5	4.6	34	55.3	74	-18.7	Vertical
8.351	30	37.5	4.6	34	38.1	54	-15.9	Vertical
8.351	47.5	37.5	4.6	34	55.6	74	-18.4	Horizontal
8.351	29.8	37.5	4.6	34	37.9	54	-16.1	Horizontal
9.27875	47.3	37.0	5.8	34.8	55.3	74	-18.7	Vertical
9.27875	30.3	37.0	5.8	34.8	38.3	54	-15.7	Vertical
9.27875	47.2	37.0	5.8	34.8	55.2	74	-18.8	Horizontal
9.27875	29.7	37.0	5.8	34.8	37.7	54	-16.3	Horizontal
Notes: 927.875 MHz Carrier 6dbi antenna power level 255 regular								
4dB duty cycle adjustment on the Average Measurements								

Radiated Photographs





Section 11. Test Equipment List

Nemko ID	Description	Manufacturer Model Number	Serial Number	Calibration Date	Calibration Due
969	LISN	Schwarzbeck 8120	8120281	07/18/01	07/18/02
1553	CABLE 1m	KTL RG223	N/A	08/06/01	08/06/02
1555	Filter high pass 5KHz	Solar Electronics 7930-5.0	933125	06/06/02	06/06/03
1114	CABLE, 7m	KTL RG223	N/A	06/06/02	06/06/03
1603	LIMITER	FISCHER FCC-450-1.25-N	447	01/17/02	01/17/03
718	HP SPECTRUM ANALYZER	HEWLETT PACKARD 8591EM	3639A00980	12/17/01	12/17/02
1029	PEAK POWER METER	HP 8900D	3303U0012	04/04/02	04/04/03
1030	PEAK POWER SENSOR	HP 84811A	2539A03573	04/04/02	04/04/03
1484	Cable 2.0-18.0 Ghz	Storm PR90-010-072	N/A	06/01/02	06/01/03
1485	Cable 2.0-18.0 Ghz	Storm PR90-010-216	N/A	06/01/02	06/01/03
1016	Pre-Amp	HEWLETT PACKARD 8449A	2749A00159	05/30/02	05/30/03
1304	HORN ANTENNA	ELECTRO METRICS RGA-60	6151	07/30/01	07/30/03
1629	CABLE, 6 ft	MEGAPHASE 10311 1GVT4	N/A	CBU	CPU
1481	Microwave Highpass Filter	K & L 3DH1-2000/T8000-0/0	4	CBU	CBU

CBU = Calibrate Before Use

ANNEX A - TEST DETAILS

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

The R.F. that is conducted back onto the AC power line on any frequency within the band 0.45 to 30 MHz shall not exceed 250 μ V (48 dB μ V) across 50 ohms.

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

NAME OF TEST: Pseudorandom Hopping Algorithm	PARA. NO.: 15.247(a)(1)
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Minimum Standard:

The system shall hop to channel frequencies that are selected from a pseudorandomly ordered list of hopping frequencies. Each frequency must be used equally on average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their transmitters and shall shift frequencies in synchronization with the transmitted signals.

NAME OF TEST: Time of Occupancy

PARA. NO.: 15.247(a)(1)(ii)

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 30 sec.
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 (10, 20, or 30 seconds).

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:

$(30 \text{ sec.} / .001 \text{ sec.}) / 75 \text{ chan.} = 400 \times 1 \text{ msec.} = 400 \text{ msec. or } 0.4 \text{ sec. in } 30 \text{ sec.}$

NAME OF TEST: Occupied Bandwidth

PARA. NO.: 15.247(a)(2)

Minimum Standard:

Frequency Band (MHz)	Maximum 20 dB Bandwidth
902 - 928	500 kHz
2400 – 2483.5	1 MHz
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.

Measurement of EIRP For Integral Antenna:

If the antenna is not detachable from the circuit then the field strength of the fundamental emission is measured. The equivalent isotropic radiated power is then determined using the plane wave formula:

$$P = V^2 R^2 / 30G$$

Where:

P = power

V = Field Strength

R = Test distance

G = Gain of the TX antenna over isotropic.

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(c)
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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 ($\mu\text{V/m @ 3m}$)	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(c)

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 ($\mu\text{V/m}$ @ 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

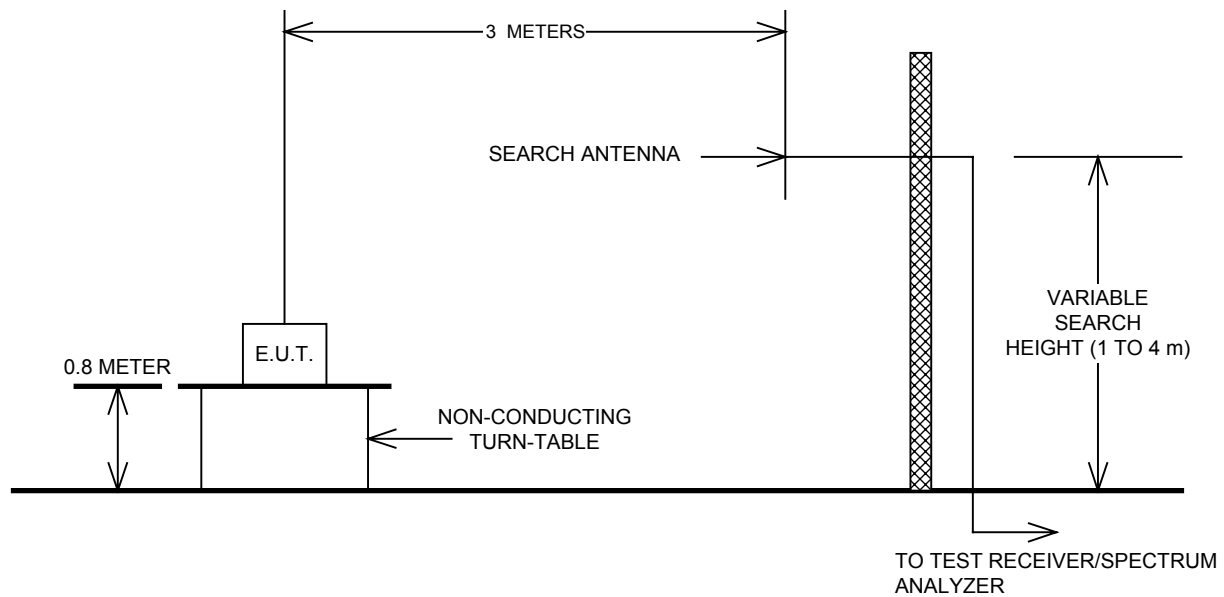
MHz	MHz	MHz	GHz
0.09-0.11	16.42-16.423	399.9-410	4.5-5.25
0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.125-6.218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

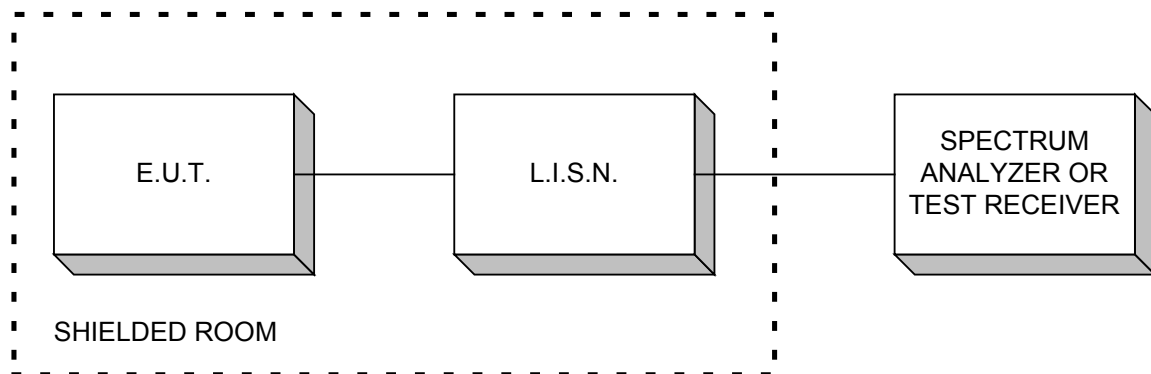
Tuning range	Number of channels tested	Channel location in band
1 MHz or less	1	middle
1 to 10 MHz	2	top and bottom
more than 10 MHz	3	top, middle, bottom

ANNEX B - TEST DIAGRAMS

Test Site For Radiated Emissions



Conducted Emissions



Peak Power At Antenna Terminals

