KTL Test Report:	8R01147.1
Applicant:	Millennium Enterprises Limited 2402 Bank of America Tower, Suite 3625 12 Harcourt Road, Central Hong Kong
Equipment Under Test: (E.U.T.)	RFTM Transmitter
FCC ID:	OHYRFTM
In Accordance With:	**FCC Part 15, Subpart C** For Low Power Transmitters Operating Periodically In The Band 40.66 - 40.77 MHz And Above 70 MHz
Tested By:	KTL Ottawa Inc. 3325 River Road, R.R. 5 Ottawa, Ontario K1V 1H2
Authorized By:	
	T. Tidwell, Laboratory Manager
Date:	
Total Number of Pages:	32

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Section 1. Summary of Test Results

Manufacturer: Headwaters Research

Model No.: RFTM

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 15.231. All tests were conducted using measurement procedure ANSI C63.4-1992. 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

D	S	C

Equipment Code

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®

NVLAP LAB CODE: 100351-0

TESTED BY: _____ DATE: _____
Kevin Carr, Technologist

Summary Of Test Data

Name of Test	Paragraph Number	Results
Transmission Requirements	15.231(a)	Not Applicable
Radiated Emissions	15.231(b)	Not Applicable
Occupied Bandwidth	15.231(c)	Complies
Frequency Tolerance	15.231(d)	Not Applicable
Periodic Alternate Field Strength Requirements	15.231(e)	Complies
Powerline Conducted Emissions	15.207	Not Applicable

Footnotes For N/A's:

(1) Equipment complies with 15.231(e).
(2) Equipment complies with 15.231(e).
(3) Equipment operates at 315 MHz.
(4) Equipment is battery powered.

Test Conditions:

Indoor Temperature: 21 °C
Humidity: 20 %

Outdoor Temperature: 0 °C
Humidity: 20 %

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

General Equipment Information

Frequency Range: 315 MHz (Fixed)

Operating Frequency(ies) of Sample: 315 MHz

Type of Emission: Pulse Code Modulation

Emission Designator: 108KL1D

Supply Power Requirement: 2 x AA Size Lithium Batteries

Duty Cycle Calculation: Synch Pulse Duration: 9.2 msec
Data Pulse Duration: 4.8 msec

In the worst case 100 msec period there are 4 data pulses and 1 synch. Pulse.

$$\text{Duty Cycle (dB)} = 20 \log \frac{9.2 + (4x4.8)}{100}$$

$$= -10.9 \text{ dB}$$

Description of E.U.T.

The E.U.T. is a low power transmitter used to transmit temperature data periodically to its companion receiver.

Modifications Incorporated in E.U.T.

The EUT has not been modified from what is described by the brand name and unique type identification stated above.

Theory of Operation

The E.U.T. consists of a CPU / logic circuit based on the MSM64162 IC and the transmitter circuit which is based on a 315 MHz SAW resonator.

Justification

The E.U.T. was configured for testing as per typical installation.

The following combinations were investigated to establish worst case configuration:

(1) Transmitter mounted in three orthogonal axis.

(2) Sensor cable manipulated in all possible positions.

(3) Transmitter antenna manipulated in all possible positions.

Exercise Program

The E.U.T. exercise program used during radiated and conducted testing was designed to exercise the various system components in a manner similar to typical use.

Exercise Mode:

(1) E.U.T. transmitting at full power.

Section 3. Equipment Configuration

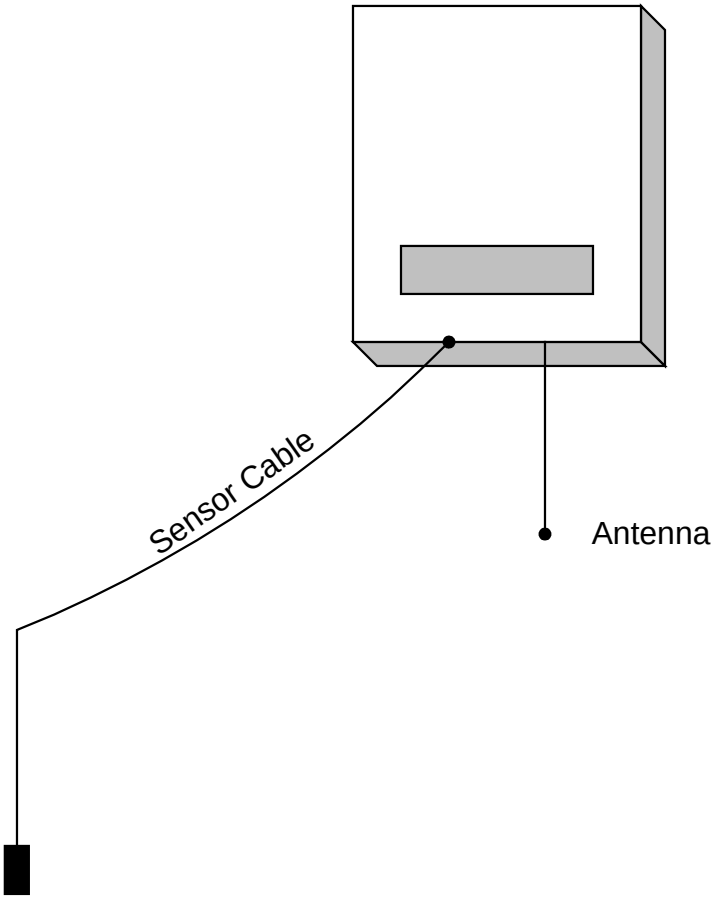
Equipment Configuration List:

Item	Description	Model No.	Serial.	Rev.
(A)	Transmitter	RFTM	None	

Inter-connection Cables:

Not Applicable

Configuration of the Equipment Under Test (E.U.T)



Section 4. Transmission Requirements

NAME OF TEST: Transmission Requirements	PARA. NO.: 15.231(a)
TESTED BY: Kevin Carr	DATE: February 15, 1999

Minimum Standard:

15.231(a) Continuous transmissions such as voice, video or data transmissions are not permitted.

15.231(a)(1) A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds after being released.

15.231(a)(2) A transmitter activated automatically shall cease transmission within 5 seconds of activation.

15.231(a)(3) Periodic transmissions at regular pre-determined intervals are not permitted. However polling or supervisory transmissions to determine system integrity of transmitters used in security or safety applications are allowed if the periodic rate of transmission does not exceed one transmission of not more than one second duration per hour for each transmitter.

15.231(a)(4) Intentional radiators which are employed for radio control purposes during emergencies involving fire, security, and safety of life, when activated to signal an alarm, may operate during the pendency of the alarm.

Test Results: Does Not Comply. The E.U.T transmits at regular intervals.

Test Data: Compliance was determined by verification of technical specifications and a functional test on the equipment.

Rationale for Compliance with Transmission Requirements

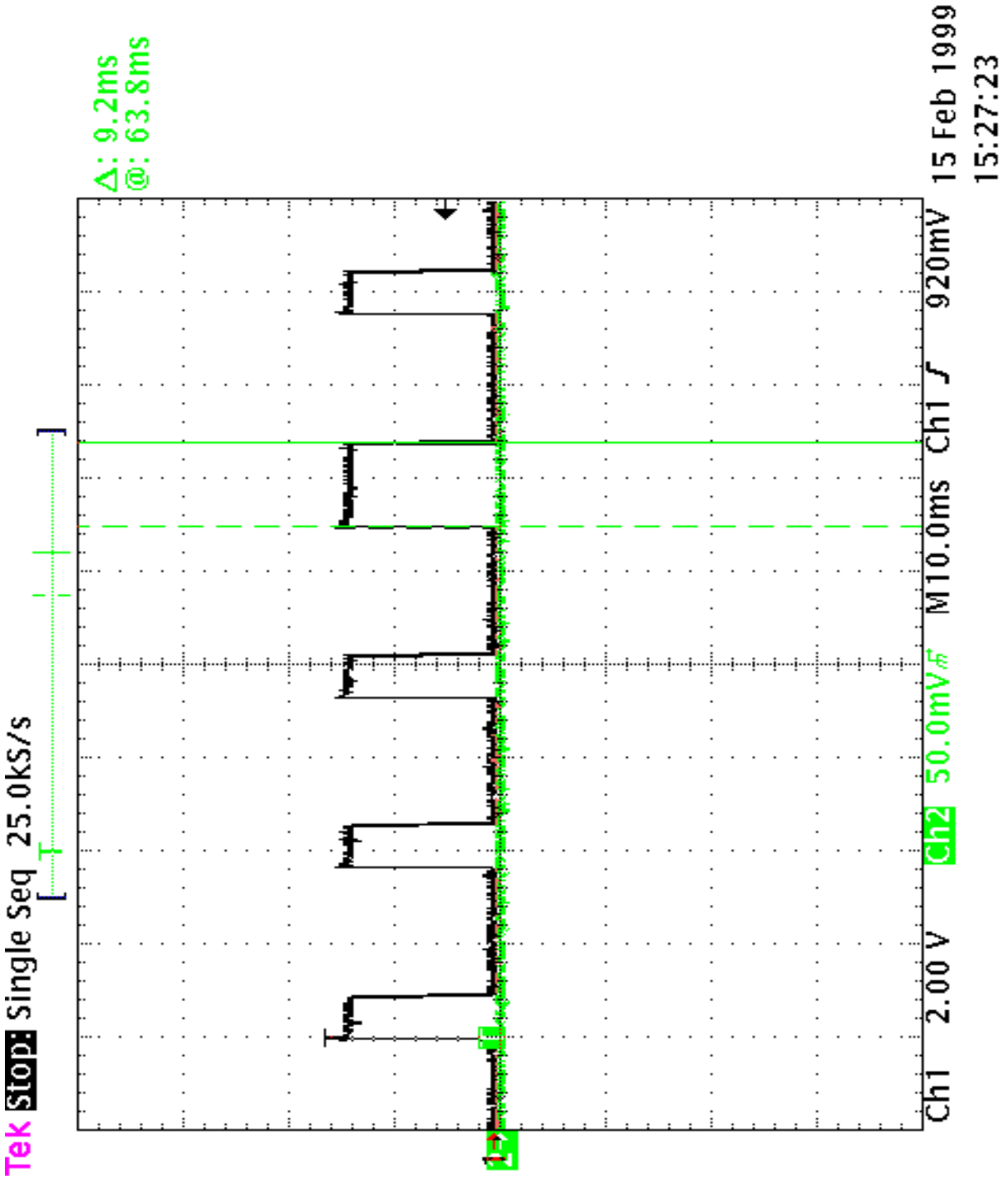
15.231(a)(1) : Not applicable.

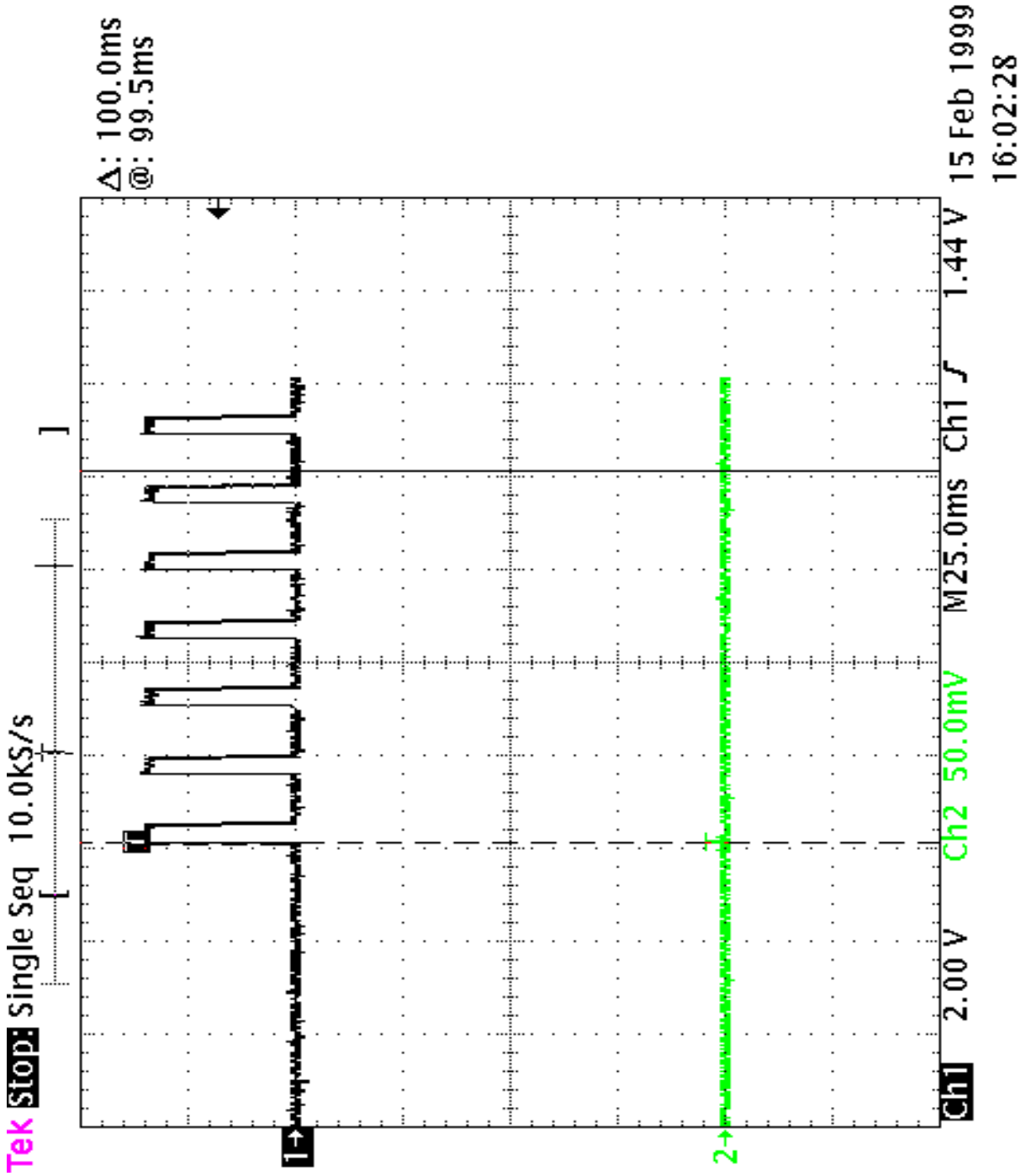
15.231(a)(2) : Transmitter is 984 milliseconds.

15.231(a)(3) : Not compliant. The transmitter is approved under 15.231(e) emission limits. See note below.

15.231(a)(4) : Not applicable.

Note: Operation of the equipment is limited so that the duration of each transmission is 984 milliseconds at a rate of approximately less than 30 seconds between transmission.


Tek Stop: Single Seq 25.0kS/s
Ch1 2.00 V
Ch2 50.0mV
M10.0ms Ch1 ƒ 920mV
Δ: 9.2ms
@: 63.8ms
15 Feb 1999
15:27:23


Tek Stop: Single Seq 10.0kS/s
Δ: 100.0ms
@: 99.5ms
15 Feb 1999
16:02:28
Ch1 2.00 V
Ch2 50.0mV
M25.0ms Ch1 ƒ 1.44 V

Section 5. Radiated Emissions

NAME OF TEST: Radiated Emissions	PARA. NO.: 15.231(b)
TESTED BY:	DATE:

NOT APPLICABLE

Minimum Standard:

Permissible Field Strength Limits (Momentarily Operated Devices

Fundamental Frequency (MHz)	Field Strength of Fundamental Microvolts/Meter at 3 meters; (watts)	Field Strength of Unwanted Emissions Microvolts/Meter at 3 meters; (watts)
40.66 - 40.70	2,250	225
70-130	1,250	125
130-174	1,250 to 3,750*	125 to 375
174-260 (note 1)	3,750	375
260-470 (note 1)	3,750 to 12,500*	375 to 1,250
Above 470	12,500	1,250

Notes:

# Use quasi-peak or averaging meter.	*For 130 - 174 MHz: FS (microvolts/m) = (56.82 x F) - 6136*
** Linear interpolation with frequency F in MHz*	*For 260 - 470 MHz: FS (microvolts/m) = (41.67 x F) - 7083*

Any emissions that fall within the restricted bands of 15.205 shall not exceed the following 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

Test Results: Complies/Does Not Comply. The worst-case emission level is _____ dBµV/m @ 3m at _____ MHz. This is _____ dB above/below the specification limit.

Test Data: See attached table.

Above 1 GHz a spectrum analyzer and low noise amplifier are used to measure emission levels. The spectrum analyzer resolution bandwidth was set to 1 MHz and video bandwidth was 3 MHz.

In the case of handheld equipment, the E.U.T. is rotated in three planes to obtain worst-case results.

Test Data - Radiated Emissions

Test Distance (meters) :		Range:		Receiver:		RBW(kHz):		Detector:			
Freq. (MHz)	Ant. *	Pol. (V/H)	Ant. HGT. (m)	Table (deg.)	RCVD Signal (dBµV/m)	Ant. Factor (dB)**	Amp. Gain (dB)***	Dist. Corr.	Corr. Strength (dBµV/m)	Limit (dBµV/m)	Margin (dB)

NOT APPLICABLE

Notes:
B/C = Biconical, B/L = Biconilog, L/P = Log-Periodic, H = Horn, D/P = Dipole
* Re-measured using dipole antenna.
** Includes cable loss when amplifier is not used.
*** Includes cable loss.
( ) Denotes failing emission level.

Radiated Photographs (Worst Case Configuration)

FRONT VIEW

NOT APPLICABLE

REAR VIEW

Section 6. Occupied Bandwidth

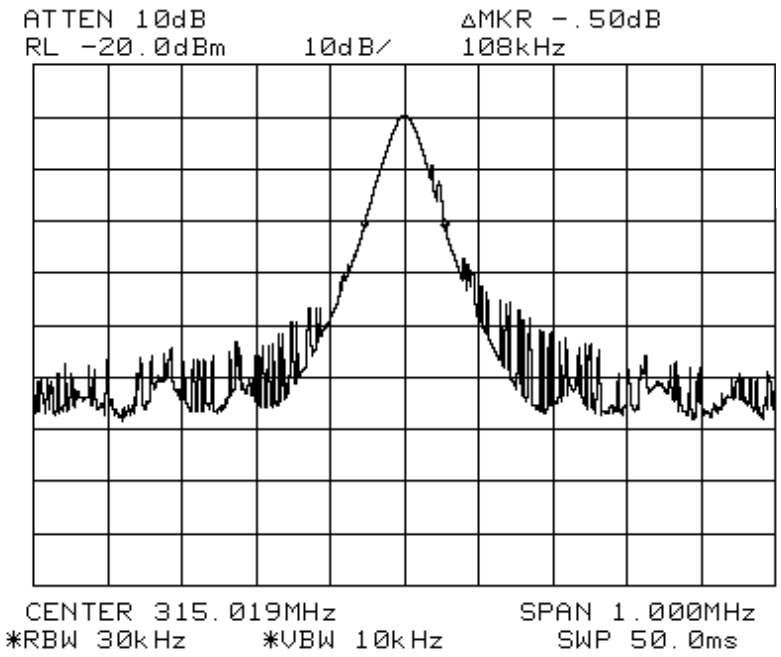
NAME OF TEST: Occupied Bandwidth	PARA. NO.: 15.231(c)
TESTED BY: Kevin Carr	DATE: March 22, 1999

Minimum Standard: 15.231(c) The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.

Test Results: Complies. See attached graph.

Test Data: See attached graph.

Maximum Bandwidth: 315 MHz x 0.25% = 788 kHz



PROJECT: 8R01147.1
OCCUPIED BANDWIDTH

Section 7. Frequency Tolerance
Devices in the Frequency Band 40.66 - 40.77 MHz

NAME OF TEST: Frequency Tolerance	PARA. NO.: 15.231(d)
TESTED BY:	DATE:

Minimum Standard: 15.231(d) For devices operating within the frequency band 40.66 - 40.70 MHz, the bandwidth of the emissions shall be confined within the band edges and the frequency tolerance of the carrier shall be ±0.01%. This frequency tolerance shall be maintained for a temperature variation of -20 degrees to +50 degrees C at normal supply voltage, and for variation in the primary power supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

NOT APPLICABLE

Test Results: Complies/Does Not Comply. See attached graph and data.

Test Data: See attached graph.

Section 8. Periodic Alternate Field Strength Requirements

NAME OF TEST: Periodic Alternate Field Strength Requirements	PARA. NO.: 15.231(e)
TESTED BY: Kevin Carr	DATE: March 10, 1999

Minimum Standard: 15.231(e) Intentional radiators may operate at a periodic rate exceeding that specified in paragraph (a) of this section and may be employed for any type of operation, including operation prohibited in paragraph (a) of this section, provided the intentional radiator complies with the provisions of paragraphs (b) through (d) of this section, except the field strength table in paragraph (b) of this section is replaced by the following.

Fundamental Frequency (MHz)	Field Strength of Fundamental (microvolts/meter)	Field Strength of Spurious Emissions (microvolts/meter)
40.66 - 40.70	1,000	100
70 - 130	500	50
130 - 174	500 to 1,500	50 to 150
174 - 260	1,500	150
260-470	1,500 to 5,000	150 to 500
Above 470	5,000	500

In addition, devices operated under the provisions of this paragraph shall be provided with a means for automatically limiting operation so that the duration of each transmission shall not be greater than one second and the silent period between transmissions shall be at least 30 times the duration of the transmission but in no case less than 10 seconds.

Test Results: Complies.

Test Data: See attached table.

Test Data – Periodic Alternate Field Strength Requirements

Test Distance (meters) : 3		Range: A Tower		Receiver: ESVP, HP8565E		RBW 120 kHz, 1 MHz		Detector: CISPR, Q-Peak, Peak			
Freq. (MHz)	**Ant. ***	**Pol. (V/H)**	**RBW & Det.**	**Table (deg.)**	**RCVD Signal (dBµV/m)**	**Ant. Factor (dB)****	**Amp. Gain (dB)*****	**Duty Cycle**	**Field Strength (dBµV/m)**	**Limit (dBµV/m)**	**Margin (dB)**
315.0	L/P	V			57.5	18.9		-10.9	65.5	67.7	2.2
315.0	L/P	H			58.0	18.9		-10.9	66.0	67.7	1.7
630.0	L/P	V			15.7	25.7		-10.9	30.5	47.7	17.2
630.0	L/P	H			15.4	25.7		-10.9	30.2	47.7	17.5
945.0	L/P	V			17.9	31.0		-10.9	38.0	47.7	8.7
945.0	L/P	H			15.3	31.0		-10.9	35.4	47.7	12.3
1260.0	Hrn2	V			20.7	27.8		-10.9	37.6	54.0	16.4
1260.0	Hrn2	H			26.3	27.8		-10.9	43.2	54.0	10.8
1575.0	Hrn2	V			57.8	28.8	-40.1	-10.9	35.6	54.0	18.4
1575.0	Hrn2	H			52.7	28.8	-40.1	-10.9	30.5	54.0	23.5
1890.0	Hrn2	V			56.3	30.4	-45.2	-10.9	30.6	54.0	23.4
1890.0	Hrn2	H			53.2	30.4	-45.2	-10.9	27.5	54.0	26.5
2205.0	Hrn2	V			55.4	31.1	-46.5	-10.9	29.1	54.0	24.9
2205.0	Hrn2	H			56.3	31.1	-46.5	-10.9	30.0	54.0	24.0
2520.0	Hrn2	V			49.0	31.2	-45.9	-10.9	23.4	54.0	30.6
2520.0	Hrn2	H			49.2	31.2	-45.9	-10.9	23.6	54.0	30.4
2835.0	Hrn2	V			50.0	32.2	-44.8	-10.9	20.5	54.0	27.5
2835.0	Hrn2	H			49.7	32.2	-44.8	-10.9	27.2	54.0	27.8
3150.0	Hrn2	V			47.0	33.4	-43.6	-10.9	25.9	54.0	28.1
3150.0	Hrn2	H			47.7	33.4	-43.6	-10.9	21.6	54.0	27.4

Notes:
B/C = Biconical, B/L = Biconilog, L/P = Log-Periodic, H = Horn, D/P = Dipole
* Re-measured using dipole antenna.
** Includes cable loss when amplifier is not used.
*** Includes cable loss.
( ) Denotes failing emission level.

Radiated Photographs (Worst Case Configuration)

Front View

Rear View

Section 9. Powerline Conducted Emissions

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

Minimum Standard:

Frequency(MHz)	Maximum Powerline Conducted RF Voltage	
	μV	dBμV
0.45 - 30.0	250	48

NOT APPLICABLE

Test Results: Complies/Does Not Comply. See attached graphs and table.

Test Data: See attached graphs and table.

Method Of Measurements: (Procedure ANSI C63.4-1992)

Measurements were made using a spectrum analyzer with 10 kHz RBW, Peak detector. Any emissions that are close to the limit are measured using a test receiver with 10 kHz bandwidth, CISPR Quasi-Peak detector.

Broadband emissions are identified by switching the receiver detector function from Quasi-Peak to Average. If the amplitude of the emission drops by 6 dB or more then the emission is classified as broadband and the Quasi-Peak level is reduced by a factor of 13 dB.

All emissions within 10 dB of limit have been recorded.

Measurement Data:

Conductor	Frequency (MHz)	CISPR (dBµV)	Average (dBµV)	BB/NB	BB Correction (dB)	Result (dBµV)

NOT APPLICABLE

Conducted Photographs (Worst Case Configuration)

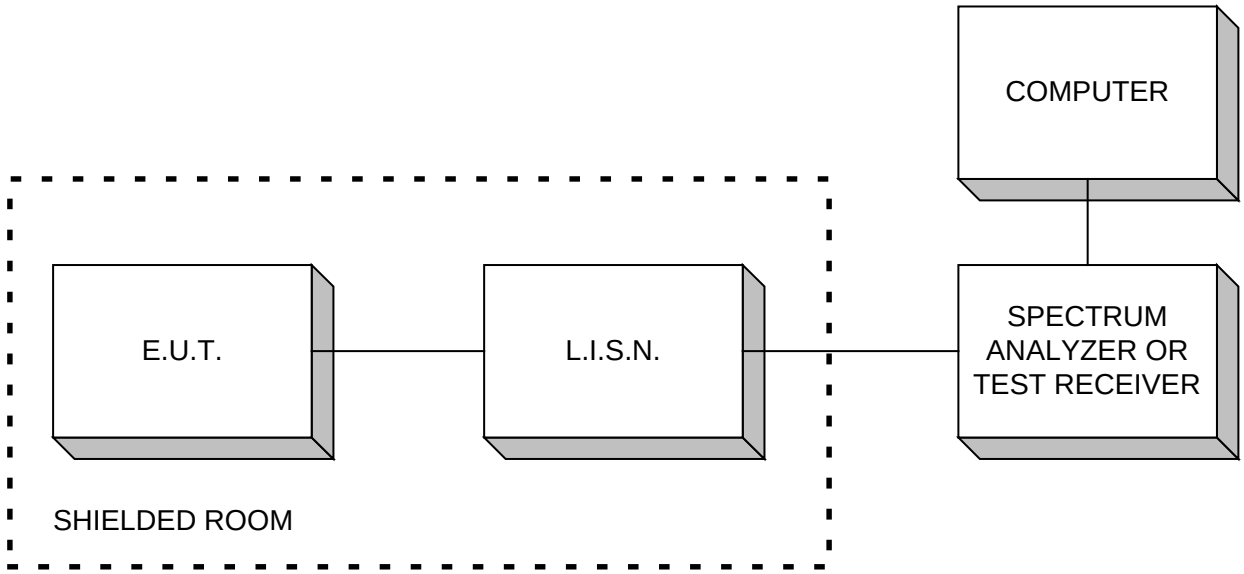
SIDE VIEW

NOT APPLICABLE

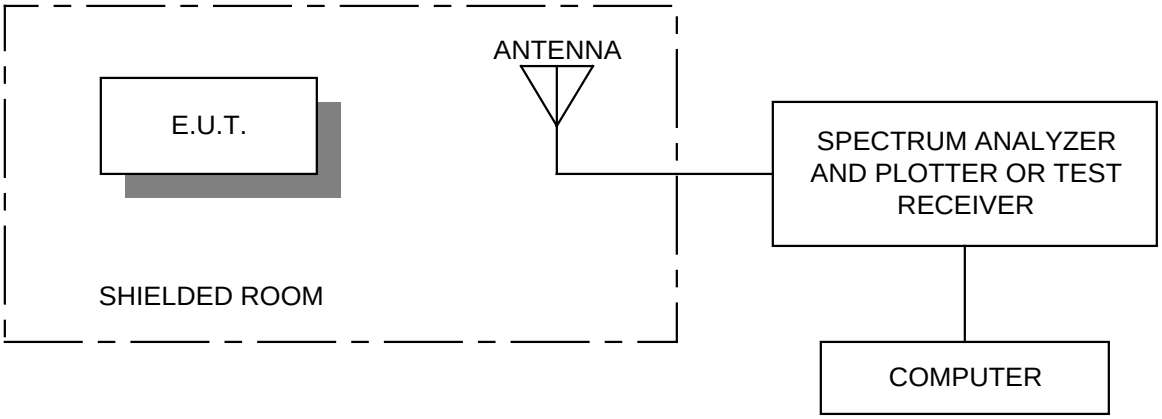
FRONT VIEW

Section 10. Block Diagrams

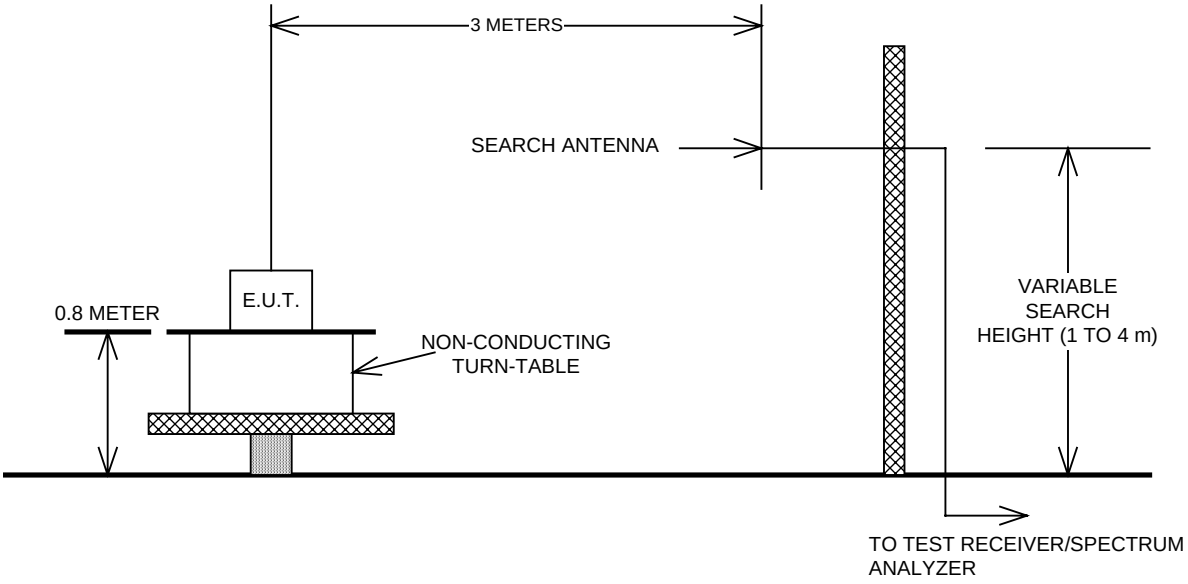
Conducted Emissions



Radiated Prescan

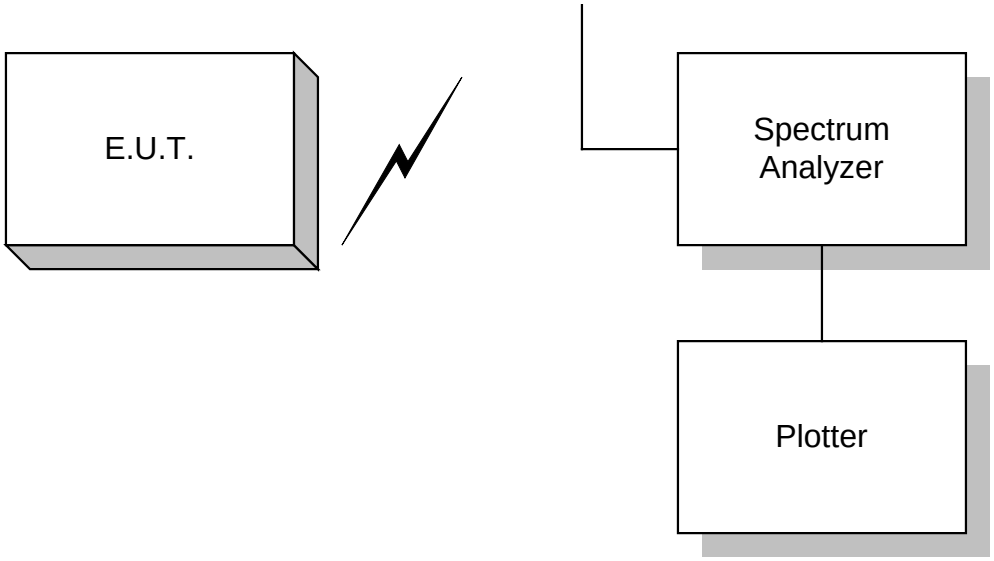


Outdoor Test Site For Radiated Emissions



The spectrum was searched up to the 10th harmonic of the fundamental frequency of operation.

Occupied Bandwidth



Section 11. Test Equipment List

CAL CYCLE	EQUIPMENT	MANUFACTURER	MODEL	SERIAL	LAST CAL.	NEXT CAL.	
1 Year	Spectrum Analyzer	Hewlett Packard	8565E	FA000981	May 20/98	May 20/99	
1 Year	Spectrum Analyzer-**2**	Hewlett Packard	8566B	1950A00400	July 22/98	July 22/99	
1 Year	Spectrum Analyzer Display-**2**	Hewlett Packard	85662A	1950A01177	July 22/98	July 22/99	
1 Year	Receiver	Rohde & Schwarz	ESVP	892661/014	Mar. 31/98	Mar. 31/99	
1 Year	Receiver	Rohde & Schwarz	ESVS-30	843710/002	Oct. 27/98	Oct. 27/99	
	Biconilog Antenna	EMCO	3143	1038	NCR	NCR	
2 Year	Horn Antenna	EMCO #2	3115	4336	Oct. 30/97	Oct. 30/99	
1 Year	Log Periodic Antenna	EMCO	LPA-25	1141	July 27/98	July 27/99	
1 Year	Dipole Antenna Set	EMCO	3121C	1029	Nov. 18/98	Nov. 18/99	
1 Year	Biconical (1) Antenna	EMCO	3109	9204-2708	July 27/98	July 27/99	
1 Year	Digital Storage Oscilloscope	Tektronix	TDS544A	B012005	July 23/98	July 23/99	
1 Year	Low Noise Amplifier	Avantek	AWT-8035	1005	Aug. 4/98	Aug. 4/99	
1 Year	Low Noise Amplifier	DBS Microwave	DWT-13035	9623	Aug. 4/98	Aug. 4/99	

NA: Not Applicable
NCR: No Cal Required

ANNEX A

RESTRICTED BANDS

Section A Restricted Bands of Operation

(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
0.49 - 0.51	16.69475-16.69525	608-614	5.35-5.46
2.1735 - 2.1905	16.80425-16.80475	960-1240	7.25-7.75
3.020 - 3.026	25.5-25.67	1300-1427	8.025-8.5
4.125 - 4.128	37.5-38.25	1435-1626.6	9.0-9.2
4.17725 - 4.17775	73-74.6	1645.5-1646.5	9.3-9.5
4.20725 - 4.20775	74.8-75.2	1660-1710	10.6-12.7
6.215 - 6.218	108-121.94	1718.8-1722.2	13.25-13.4
6.31175 - 6.31225	123-138	2220-2300	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			