KTL Test Report:	8R00115
Applicant:	Lectron Technologies Inc. 1001 Leon Ringuet Boucherville, Quebec J4B 8E6
Equipment Under Test: **(E.U.T.)**	Lectron 20 Transmitter
FCC ID:	N4S201TRANSMITTER
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:	Russell Grant Russell Grant, Senior Technologist
Date:	April 5, 99
Total Number of Pages:	35

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Section 1. Summary of Test Results

Manufacturer: Lectron Products

Model No.: Lectron 20

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.

Abstract:

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

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: 05 Aug 99
Tom Tidwell

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

General Equipment Information

Model Number: Lectron 20

Serial Number None

☐ Production Unit ☒ Pre-Production Unit

Frequency Range: 315 MHz (fixed)

Operating Frequency(ies) of Sample: 315 MHz

Type of Emission: L1D

Emission Designator: 60K0L1D

Supply Power Requirement: 3 AA Batteries

Duty Cycle Calculation:

Length of Short Pulses = 0.25 msec
Length of Long Pulses = 0.667 msec
Number of Short Pulses = 30
Number of Long Pulses = 20

30 x 0.25 = 7.5 msec
20 x 0.667 = 13.34 msec

$$20Log\frac{20.84m\sec}{400m\sec} = -13.6dB$$

Description of E.U.T.

The E.U.T. is a momentarily operated transmitter that operates in conjunction with the Lectron receiver. This wireless system is used to monitor and report flow conditions on industrial pumps.

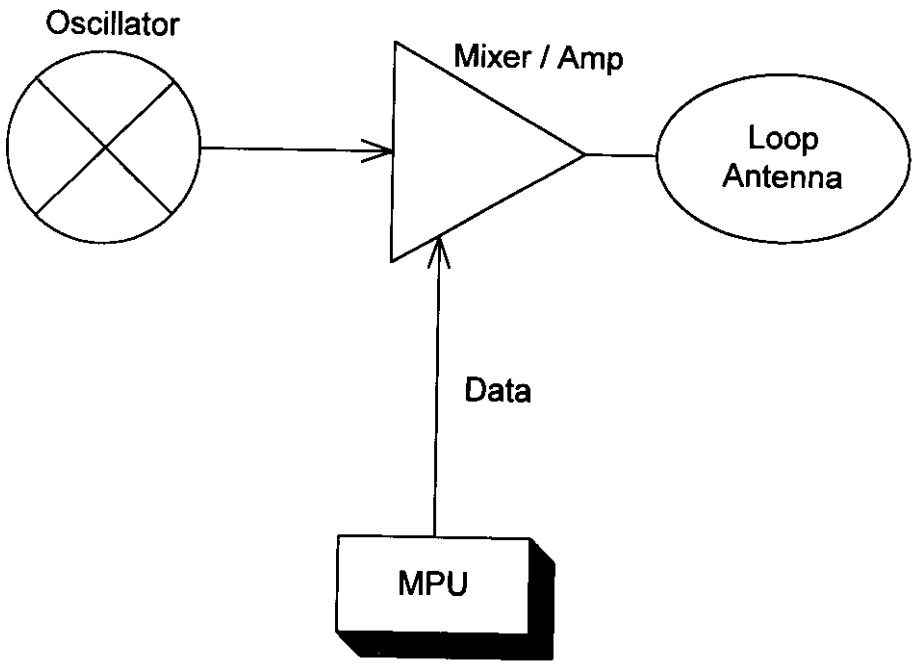
Modifications Incorporated in E.U.T.

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. is a momentarily operated transmitter that operates in conjunction with the Lectron receiver. This wireless system is used to monitor and report flow conditions on industrial pumps.

System Diagram



Justification

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

The following combinations were investigated to establish worst case configuration:

(1) See "Configuration of the Equipment Under Test".

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) The E.U.T. was set to transmit continuously at full power.

Section 3. Equipment Configuration

Equipment Configuration List:

Item	Description	Model No.	Serial.	Rev.
(A)				
(B)				
(C)				
(D)				
(E)				
(F)				
(G)				

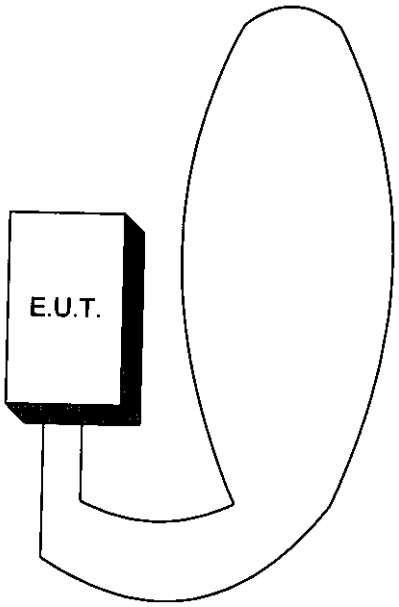
Inter-connection Cables:

Item	Description	Length (m)
(1)		
(2)		
(3)		
(4)		
(5)		
(6)		
(7)		
(8)		

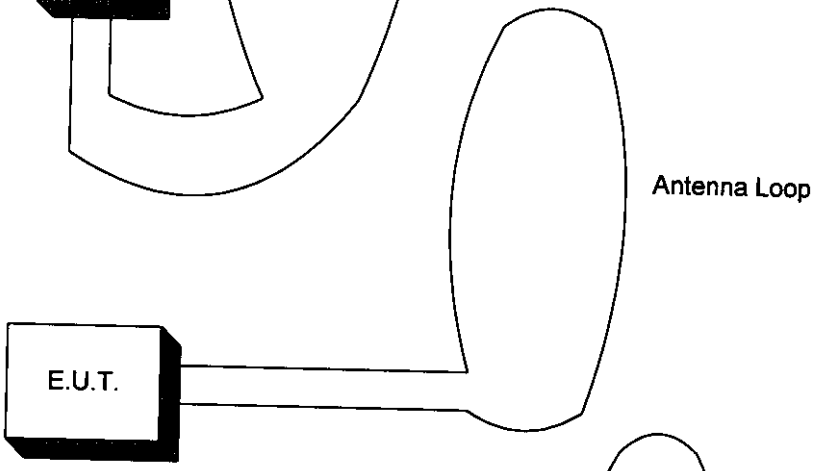
NOT APPLICABLE

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

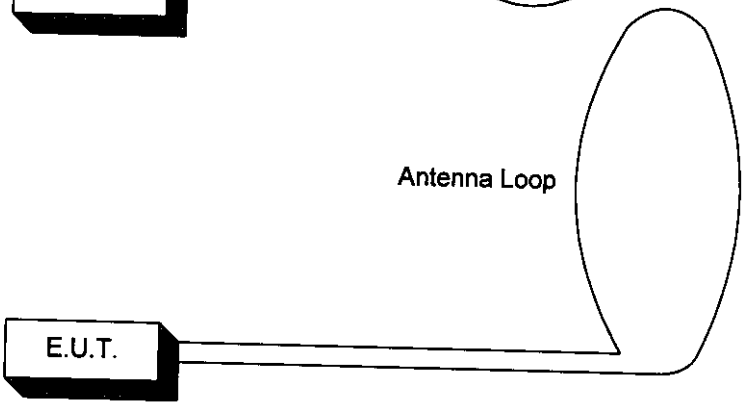
Configuration No.: 1



Configuration No.: 2



Configuration No.: 3



Section 4. Transmission Requirements

NAME OF TEST: Transmission Requirements	PARA. NO.: 15.231(a)
TESTED BY: Tom Tidwell	DATE: June 29, 1998

Test Conditions:

Test Voltage: 4.5 Vdc
Temperature: 25 °C
Humidity: 35 %

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:

Complies. The E.U.T. will operate under 15.231 (e) with reduced limits.

Test Data:

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

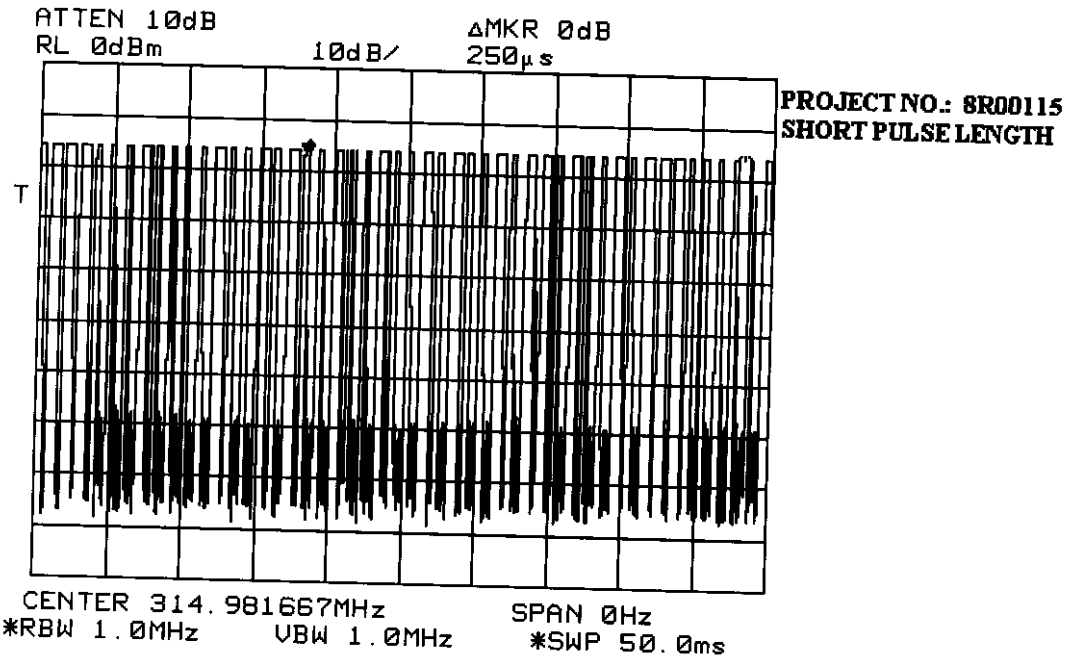
Rationale for Compliance with Transmission Requirements

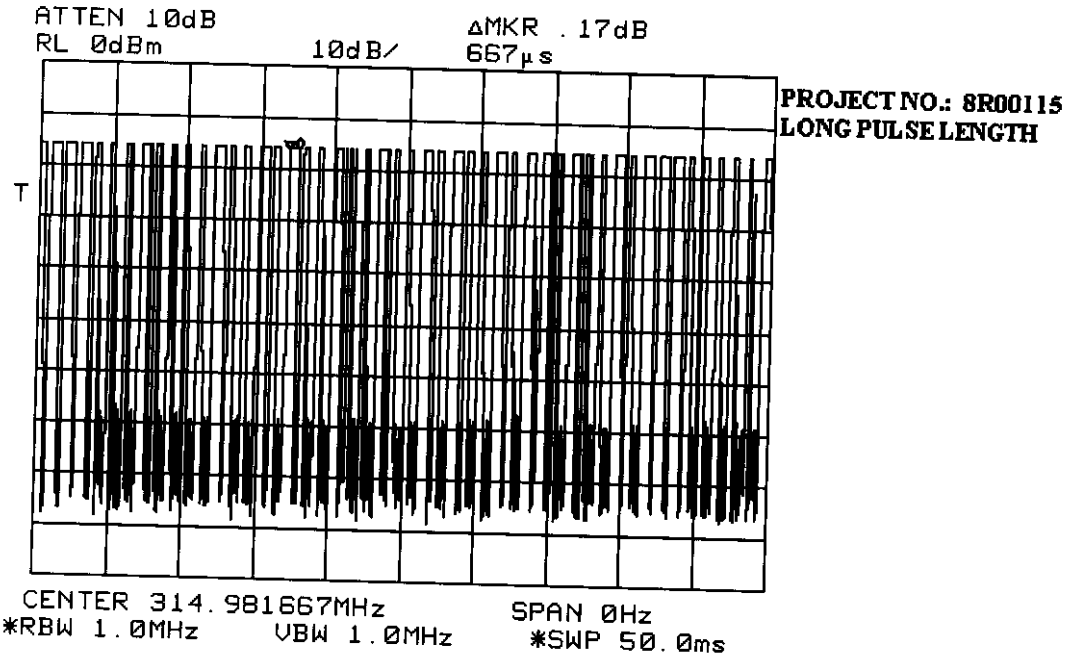
15.231(a)(1) : Not Applicable

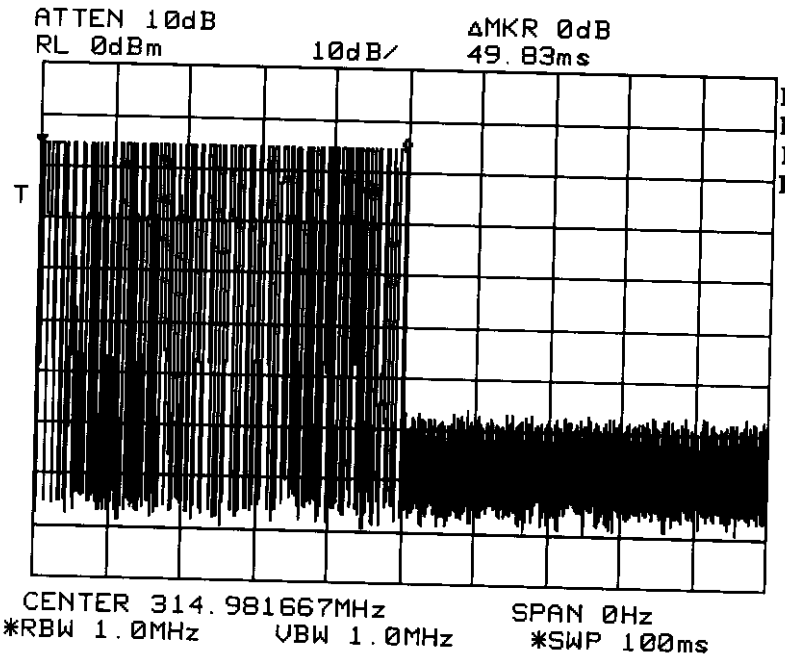
15.231(a)(2) : The E.U.T. ceases transmission within 50 msec.

15.231(a)(3) : The E.U.T. transmits regularly once every 4 hours.

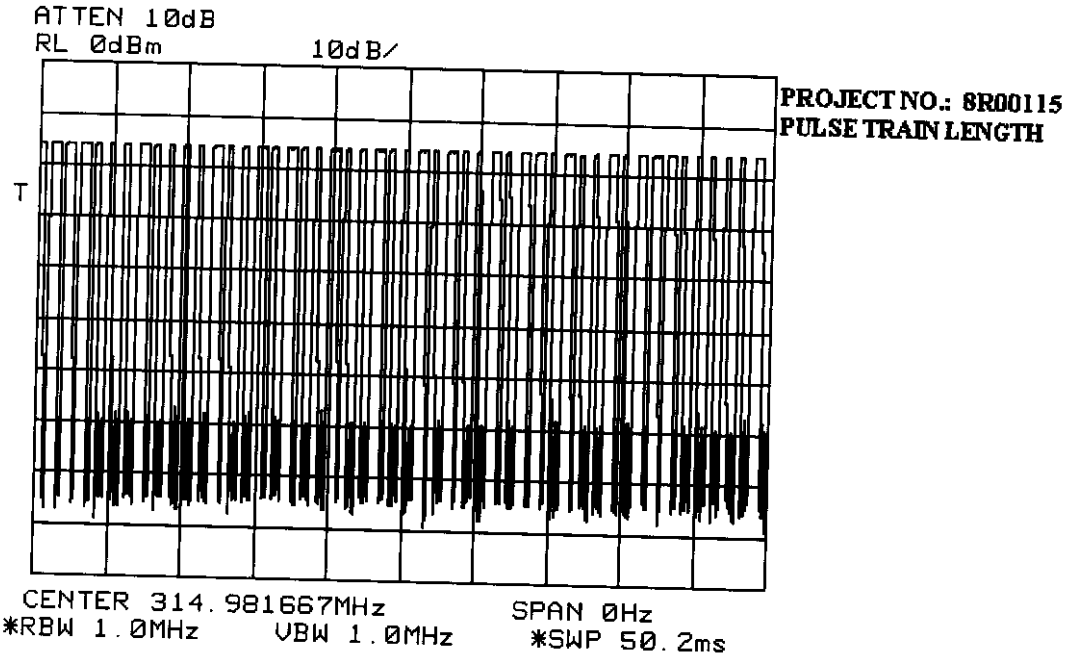
15.231(a)(4) : Not Applicable


ATTEN 10dB
RL 0dBm
10dB/
ΔMKR 0dB
250µs
PROJECT NO.: 8R00115
SHORT PULSE LENGTH
T
CENTER 314.981667MHz
*RBW 1.0MHz
VBW 1.0MHz
SPAN 0Hz
*SWP 50.0ms


ATTEN 10dB
RL 0dBm
10dB/
ΔMKR .17dB
667μs
PROJECT NO.: 8R00115
LONG PULSE LENGTH
T
CENTER 314.981667MHz
*RBW 1.0MHz
VBW 1.0MHz
SPAN 0Hz
*SWP 50.0ms



PROJECT NO.: 8R00115
LENGTH OF 1 TRANSMISSION
1 Transmission occurs every 4 hours.



PROJECT NO.: 8R00115
PULSE TRAIN LENGTH

Section 5. Radiated Emissions

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

Test Conditions:

Test Voltage: _____VAC
Temperature: _____°C
Humidity: _____%

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 [illegible]*	375 to 1,250
Above 470	12,500	1,250

Notes:

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

NOT APPLICABLE

Any emissions that fall within 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. (dB)	Field 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.

Section 6. Occupied Bandwidth

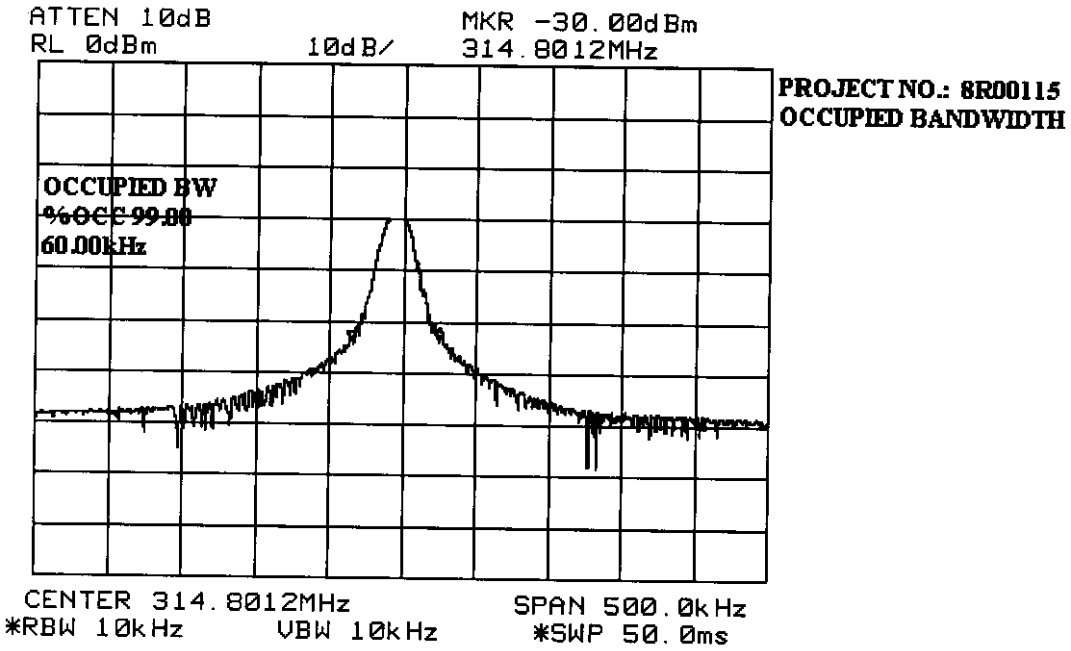
NAME OF TEST: Occupied Bandwidth	PARA. NO.: 15.231(c)
TESTED BY: Tom Tidwell	DATE: June 25, 1998

Test Conditions: Test Voltage: 4.5 Vdc
Temperature: 25 °C
Humidity: 35 %

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.


ATTEN 10dB
RL 0dBm
10dB/
MKR -30.00dBm
314.8012MHz
PROJECT NO.: 8R00115
OCCUPIED BANDWIDTH
OCCUPIED BW
%OCC 99.00
60.00kHz
CENTER 314.8012MHz
*RBW 10kHz
VBW 10kHz
SPAN 500.0kHz
*SWP 50.0ms

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:

Test Conditions:

Test Voltage: _____VAC
Temperature: _____°C
Humidity: _____%

Minimum Standard:

15.231(d) For devices operating within the frequency band 40.66 - 40.70 MHz, the bandwidth of the emission 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 from 0 degrees to +50 degrees C at normal supply voltage, and for a 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(d)
TESTED BY: Tom Tidwell	DATE: June 29, 1998

Test Conditions:

Test Voltage: 4.5 Vdc
Temperature: 24.4 °C
Humidity: 52 %

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.

Note: The E.U.T. transmits one 50 msec transmission every 4 hours.

Test Data - Radiated Emissions (Average)

Test Distance (meters) : 3		Range: A Tower		Receiver: Other		RBW(kHz): 120		Detector: As Per Table			
Freq. (MHz)	Ant. *	Pol. (V/H)	BW & Det.**	Table (deg.)	RCVD Signal (dBμV/m)	Ant. Factor (dB)**	Amp. Gain (dB)***	Duty Cycle	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
315.06	L/P	V	3		47.6	18.7		-13.5	52.8	67.7	14.9
315.06	L/P	H	3		45.9	18.7		-13.5	51.1	67.7	16.6
630.06	L/P	V	3		22.1	25.6		-13.5	34.2	47.7	13.5
630.06	L/P	H	3		19.8	25.6		-13.5	31.9	47.7	15.8
945.09	L/P	V	3		21.5	30.8		-13.5	38.8	47.7	8.9
945.09	L/P	H	5		19.8	30.8		-13.5	37.1	47.7	10.6
1260.06	Hrn2	V	5		0.9	29.0		-13.5	16.4	47.7	31.3
1260.06	Hrn2	H	5		0.5	29.0		-13.5	16.0	47.7	31.7
1575.0	Hrn2	V	5		36.8	29.4	-42.2	-13.5	10.5	47.7	37.2
1575.0	Hrn2	H	5		35.4	29.4	-42.2	-13.5	9.1	47.7	38.6
2205.0	Hrn2	V	5		38.3	32.3	-46.6	-13.5	10.5	47.7	37.2
2205.0	Hrn2	H	5		37.8	32.3	-46.6	-13.5	10.0	47.7	37.7
2519.24	Hrn2	V	5		48.6	33.2	-46.4	-13.5	21.9	47.7	25.8
2519.24	Hrn2	H	5		44.5	33.2	-46.4	-13.5	17.8	47.7	29.9
2835.0	Hrn2	V	5		37.4	34.6	-45.8	-13.5	12.7	47.7	35.0
2835.0	Hrn2	H	5		38.0	34.6	-45.8	-13.5	13.3	47.7	34.4
3150.06	Hrn2	V	5		36.4	37.6	-45.5	-13.5	15.0	47.7	32.7
3150.06	Hrn2	H	5		36.5	37.6	-45.5	-13.5	15.1	47.7	32.6

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.
(1) 120 kHz, Q-Peak, (2) 10 kHz, Peak (3) 100 kHz RBW, 300 kHz VBW, Peak (4) 300 kHz RBW, 1 MHz VBW, Peak
(5) 1 MHz RBW, 3 MHz VBW, Peak (6) 1 MHz RBW, 10 Hz VBW, Peak

Test Data - Radiated Emissions (Peak)

Test Distance (meters) : 3		Range: A Tower		Receiver: Other		RBW(kHz): 120		Detector: As Per Table			
Freq. (MHz)	Ant. *	Pol. (V/H)	BW & Det.**	Table (deg.)	RCVD Signal (dBμV/m)	Ant. Factor (dB)**	Amp. Gain (dB)***	Dist. Corr. (dB)	Field Strength (dBμV/m)	Limit (dBμV/m)	Margin (dB)
315.06	L/P	V	3		47.6	18.7			66.3	87.7	21.4
315.06	L/P	H	3		45.9	18.7			64.6	87.7	23.1
630.06	L/P	V	3		22.1	25.6			47.7	67.7	20.0
630.06	L/P	H	3		19.8	25.6			45.4	67.7	22.3
945.09	L/P	V	3		21.5	30.8			52.3	67.7	15.0
945.09	L/P	H	3		19.8	30.8			50.6	67.7	17.1
1260.06	Hrn2	V	5		0.9	29.0			29.9	67.7	37.8
1260.06	Hrn2	H	5		0.5	29.0			29.5	67.7	38.2
1575.0	Hrn2	V	5		36.8	29.4			24.0	67.7	43.7
1575.0	Hrn2	H	5		35.4	29.4	-42.2		22.6	67.7	45.1
2205.0	Hrn2	V	5		38.3	32.3	-42.2		24.0	67.7	43.7
2205.0	Hrn2	H	5		37.8	32.3	-46.6		23.5	67.7	44.2
2519.24	Hrn2	V	5		48.6	33.2	-46.6		35.4	67.7	32.3
2519.24	Hrn2	H	5		44.5	33.2	-46.4		31.3	67.7	36.4
2835.0	Hrn2	V	5		37.4	34.6	-45.8		26.2	67.7	41.5
2835.0	Hrn2	H	5		38.0	34.6	-45.8		26.8	67.7	40.9
3150.06	Hrn2	V	5		36.4	37.6	-45.5		28.5	67.7	39.2
3150.06	Hrn2	H	5		36.5	37.6	-45.5		28.6	67.7	39.1

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.

Section 9. Powerline Conducted Emissions

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

Test Conditions:

Test Voltage: _____VAC
Temperature: _____°C
Humidity: _____%

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 Measurement: (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.

Measurement Data:

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

NOT APPLICABLE

Conducted Photographs (Worst Case Configuration)

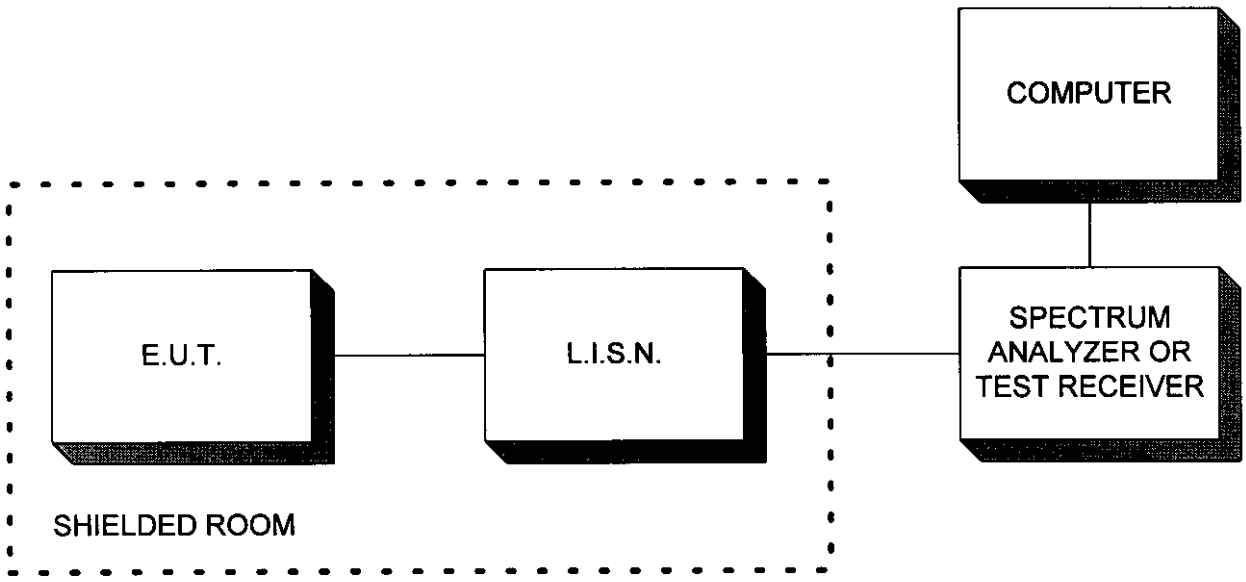
SIDE VIEW

NOT APPLICABLE

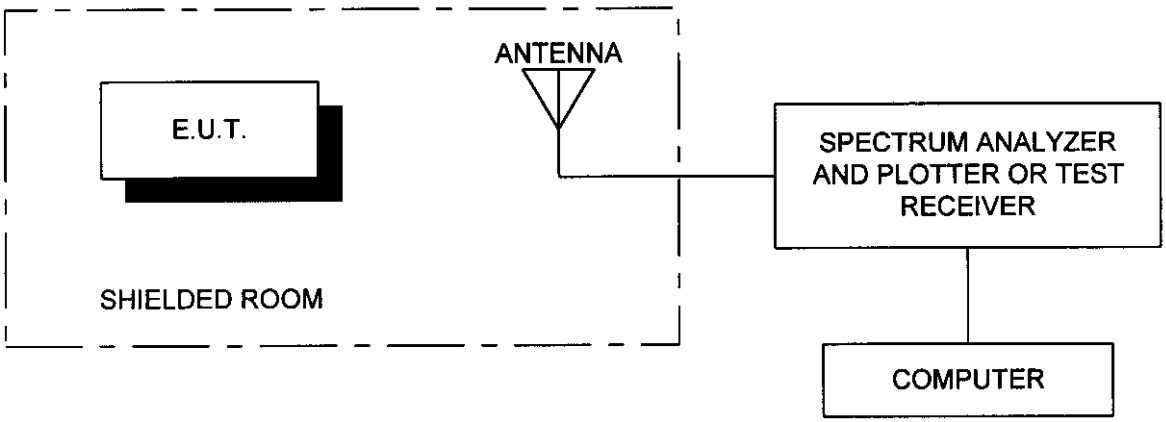
FRONT VIEW

Section 10. Block Diagrams

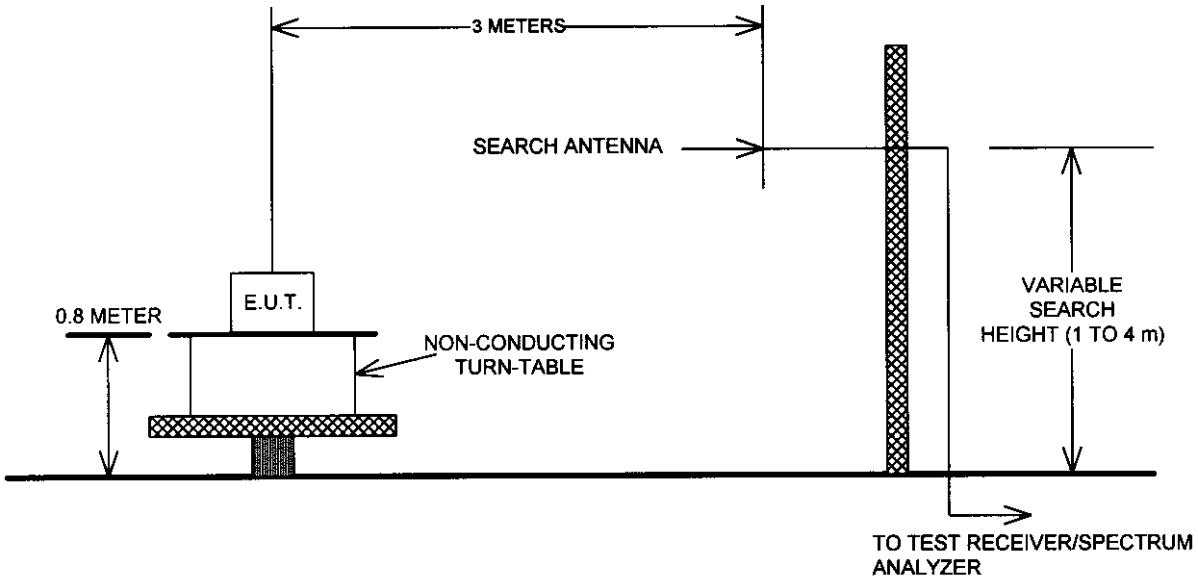
Conducted Emissions



Radiated Prescan

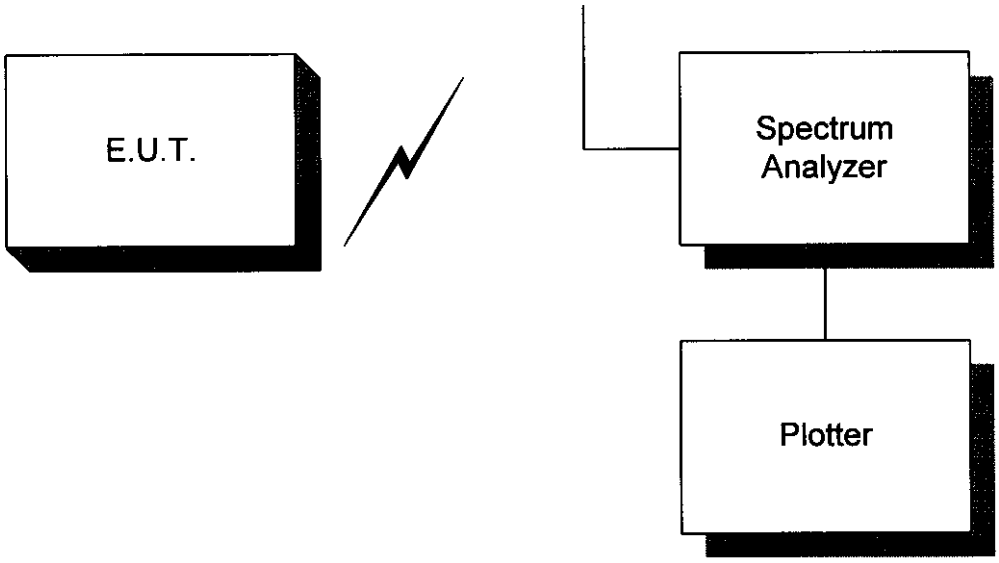


Outdoor Test Site For Radiated Emissions



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

Occupied Bandwidth



Section 11. Test Equipment List

Equipment List - Radiated Emissions

CAL Cycle	Equipment	Manufacturer	Model #	Serial/Asset #	Last Cal.	Next Cal.
1Year	Receiver	Rohde & Schwarz	ESVP	892661/014	Mar. 31/98	Mar. 31/99
1Year	Spectrum Analyzer	Hewlett-Packard	8566B	2311A02238	Sept. 30/97	Sept. 30/98
1Year	Spectrum Analyzer Display	Hewlett-Packard	8566B	2314A04759	Sept. 30/97	Sept. 30/98
1 Year	Biconical (2) Antenna	EMCO	3109	9503-2894	June 2/98	June 2/99
2 Year	Horn Antenna	EMCO	3115	3132	Feb. 9/98	Feb.9/00
1 Year	Low Noise Amplifier	Avantek	AWT-8035	1005	Oct. 24/97	Oct. 24/98

Note: N/A = 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			