

KTL Test Report: 9L0325RUS2

Applicant: NATIONAL SEMICONDUCTOR
1351 SOUTH SUNSET
LONGMOUNT, COLORADO 80501

**Equipment Under Test:
(E.U.T.)** GEMINI (Ver. 4.0) Web Pad

FCC ID:

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

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

Authorized By:

Tom Tidwell, RF Group Manager

Date: NOVEMBER, 1999

Total Number of Pages: 45

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EQUIPMENT: Gemini (V4.0) Web Pad

PROJECT NO.: 9L0325RUS2

Section 1. Summary of Test Results

Manufacturer: National Semiconductor

Model No.: Gemini (V4.0)

Serial No.: 0019300C10

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 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

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Summary Of Test Data

NAME OF TEST	PARA. NO.	SPEC.	MEAS.	RESULT
Powerline Conducted Emissions	15.207(a)	48 dBμV	39 dBμV	Complies
Channel Separation	15.247(a)(1)	Greater of 25 kHz or 20 dB Bandwidth	1.063385 MHz	Complies
Pseudorandom Hopping Algorithm	15.247(a)(1)	Separate customer data		Complies
Time of Occupancy	15.247(a)(1)(ii)	≤ 0.4 sec in 30 sec	6.08 msec in 30 sec.	Complies
20 dB Occupied Bandwidth	15.247(a)(1)	≤ 1 MHz	991.983 kHz	Complies
Peak Power Output	15.247(b)	1 Watt	.0378	Complies
Spurious Emissions (Antenna Conducted)	15.247(c)	-20 dBc	N/A	N/A
Spurious Emissions (Radiated)	15.247(c)	Table 15.209(a)	61.3 dBμV/m	Complies

Footnotes: Antenna port spurious emission is not applicable since the EUT antenna is non-detachable.

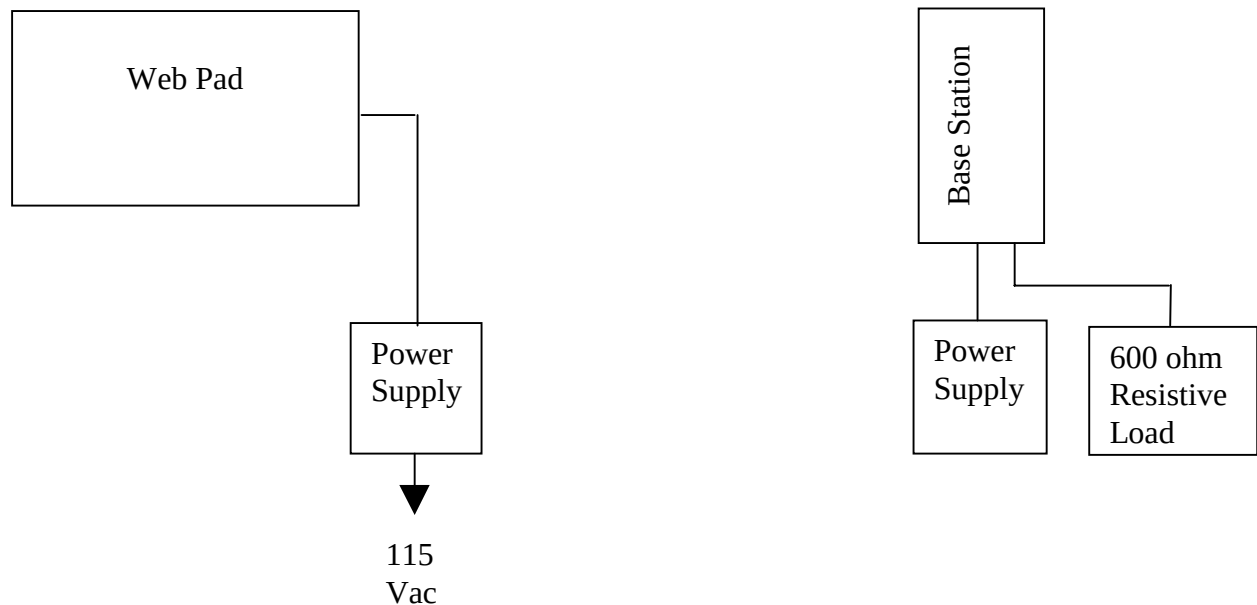
Section 2. Equipment Under Test (E.U.T.)

General Equipment Information

Frequency Band:	☐ 902 – 928 MHz ☒ 2400 – 2483.5 MHz
Number of Channels:	74
Channel Spacing:	1.063385 MHz
Emissions Designator:	991KGXW
User Frequency Adjustment:	Software controlled

Description of Operation

The E.U.T. is a wireless data link. The system consists of a base station and a mobile terminal known as the “web pad”. Each of these devices are fitted with an rf pcb that contains all of the rf transceiver circuitry.

System Diagram

EQUIPMENT: Gemini (V4.0) Web Pad

PROJECT NO.: 9L0325RUS2

Section 3. Powerline Conducted Emissions

NAME OF TEST: Powerline Conducted Emissions	PARA. NO.: 15.207(a)
TESTED BY: Ron Gaytan	DATE: 10/28/99

Test Results: Complies.

Measurement Data: See attached plots.

Equipment Used: G2432, G1607, G16007, G1705, C21

Measurement Uncertainty: +/- 1.6 dB

Temperature: 23°C

Relative Humidity: 52%

EQUIPMENT: Gemini (V4.0) Web Pad

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Test Data: (1.5 Web Pad) CE-1

Conducted Emissions Data (CISPR Quasi-Peak Detector) FCC (CFR 47)								
Complete	<u> X </u>							
Preliminary	<u> </u>		Page <u> 1 </u> of <u> 1 </u>					
Client:	<u>National Semiconductor</u>		W.O.#:	<u>9L0325R</u>		Date:	<u>10/28/99</u>	
EUT:	<u>Gemini (1.5 Web Pad)</u>		S/N:	<u>0019300C10</u>		Specification:	<u>CFR47 Part 15.207(a)</u>	
Tech:	<u>Ron Gaytan</u>		Test #:	<u>CE-1</u>		Lab:	<u> 1 </u>	
			Photo ID:	<u>9L0325R CE-1</u>				
Equipment Used: <u>G2632-G1607-G1705-C21</u>								
Configuration: <u>Web Pad and Base Station operating at a fixed frequency. Tx and Rx and both ends.</u>								
IF Bandwidth:	<u> 10 kHz </u>		Video Bandwidth:	<u> 10 kHz </u>		Detector:	<u> X </u> Peak <u> </u> CISPR	
Ambient Temperature:	<u> 23 </u> C		EUT Power:	<u> X </u> 115 V.A.C.		<u> X </u> 60 Hz	<u> X </u> 1 Phase	
Relative Humidity:	<u> 52 </u> %			<u> </u> 230 V.A.C.		<u> </u> 50 Hz	<u> </u> 3 Phase	
Atmospheric Pressure:	<u> 1005 </u> mbar			<u> </u> Other <u> </u>				
Freq. (MHz)	Meter Reading (dBuV)	Attn. (dB)	Cable Loss (dB)	Probe Factor (dB)	Corrected Reading (dBuV)	Spec. limit (dBuV)	Pol.	Comments:
0.568	22.3	0	0	0	22.3	48	N	N = Neutral Side of Line
4.65	21.2	0	0	0	21.2	48	N	
12.9	27.5	0	0	0	27.5	48	N	
20.76	26.8	0	0	0	26.8	48	N	
24.43	26.2	0	0	0	26.2	48	N	
29.88	26.7	0	0	0	26.7	48	N	
0.627	24.4	0	0	0	24.4	48	H	H= Hot Side of Line
3.17	24.1	0	0	0	24.1	48	H	
4	29.1	0	0	0	29.1	48	H	
4.77	26.1	0	0	0	26.1	48	H	
12.58	26.5	0	0	0	26.5	48	H	
13.83	26.9	0	0	0	26.9	48	H	
20.46	32.3	0	0	0	32.3	48	H	
21.76	32.6	0	0	0	32.6	48	H	
27.45	28.7	0	0	0	28.7	48	H	
29.23	30.2	0	0	0	30.2	48	H	
								Scanned from 450 kHz to 30 MHz

Note: Verify that the IF Bandwidth is in the proper setting.

PROJECT NO.: 9L0325RUS2

Conducted Emissions Data
(CISPR Quasi-Peak Detector)
FCC (CFR 47)

Page 1 of 1

Tech: Ron Gaytan Test #: CE-2 Lab: 1 Photo ID: 9L0325R CE-2

Configuration: Web Pad and Base Station operating at a fixed frequency. Tx and Rx and both ends.

Ambient Temperature: 23 C EUT Power: X 115 V.A.C. X 60 Hz X 1 Phase
Relative Humidity: 52 % _____ 230 V.A.C. _____ 50 Hz _____ 3 Phase
Atmospheric Pressure: 1005 mbar _____ Other _____

[illegible]

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EQUIPMENT: Gemini (V4.0) Web PadPROJECT NO.: 9L0325RUS2

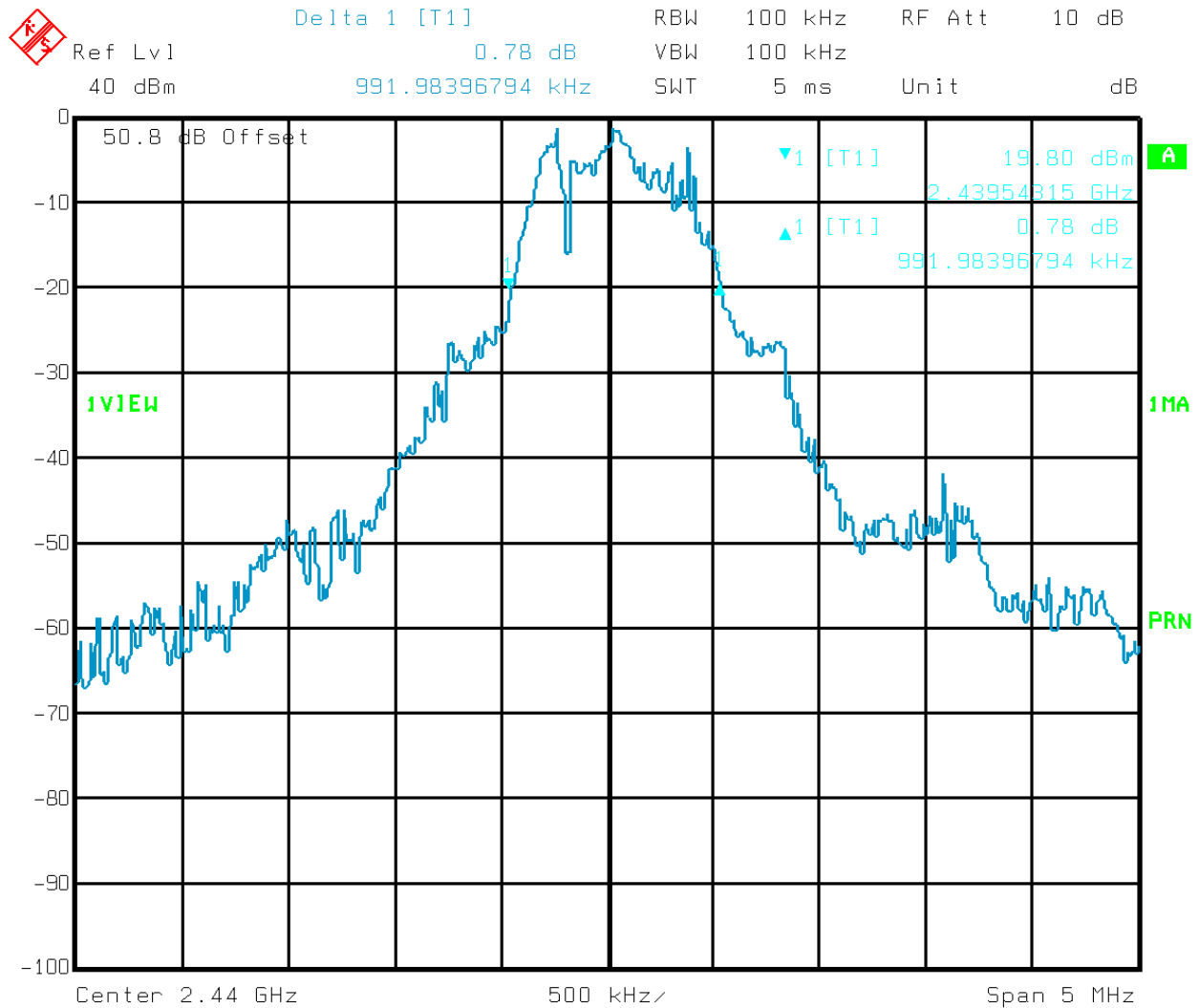
Section 4. Channel Separation

NAME OF TEST: Channel Separation	PARA. NO.: 15.247(a)(1)
TESTED BY: Ron Gaytan	DATE: 10/13/99

Test Results: Complies.**Measurement Data:** See 20 dB BW plotMeasured 20 dB bandwidth: 992 kHzChannel Separation: 1.063385 MHz**Equipment Used:** G2632, G1017B, G1018, CF44**Measurement Uncertainty:** +/- 1.6 dB**Temperature:** 22°C**Relative Humidity:** 42%

EQUIPMENT: Gemini (V4.0) Web Pad

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Title: 9L0325R 20 dB Bandwidth
Comment A: 20dB BW
Date: 13.OCT.1999 10:14:56

Section 5. Pseudorandom Hopping Algorithm

NAME OF TEST: Pseudorandom Hopping Algorithm	PARA. NO.: 15.247(a)(1)
TESTED BY: N/A	DATE: N/A

Test Results: Complies.

Measurement Data: See sample hopping sequence.

Number of Hopping Frequencies: 75

Standard DECT protocol was modified to comply with 15.247 requirements. More detail, including a sample hop table, is provided in a separate document.

Section 6. Time of Occupancy

NAME OF TEST: Time of Occupancy	PARA. NO.: 15.247(a)(1)
TESTED BY: Ron Gaytan	DATE: 10/14/99

Test Results: Complies.

Measurement Data:

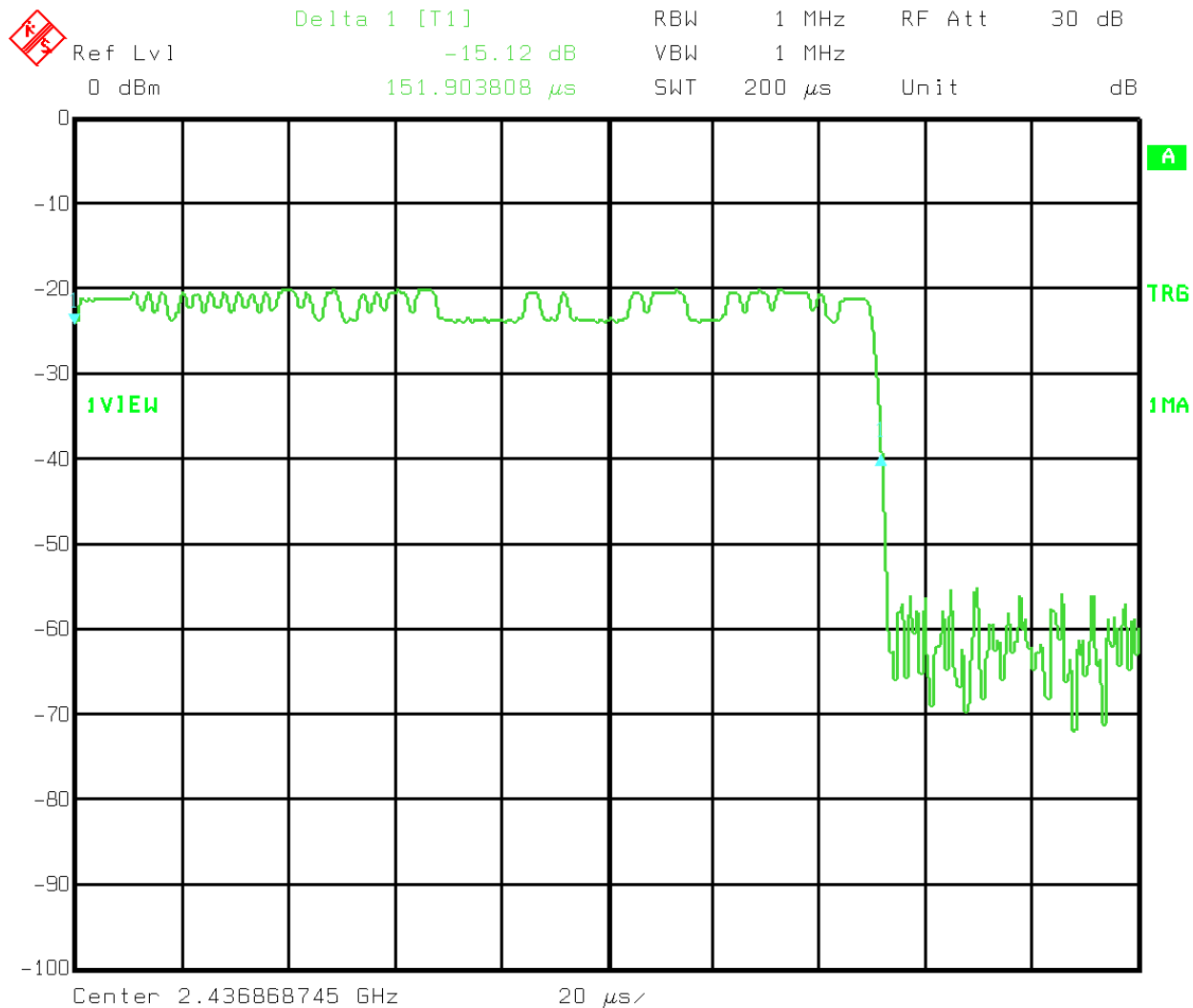
Measured Dwell Time on Channel: 152 μ sec.

Measured Number of Hops to Channel in 30 sec.: 40

Time Occupancy: $40 \times 152 \mu\text{sec.} = \mathbf{6.08 \text{ msec. in } 30 \text{ sec}}$

EQUIPMENT: Gemini (V4.0) Web Pad

PROJECT NO.: 9L0325RUS2



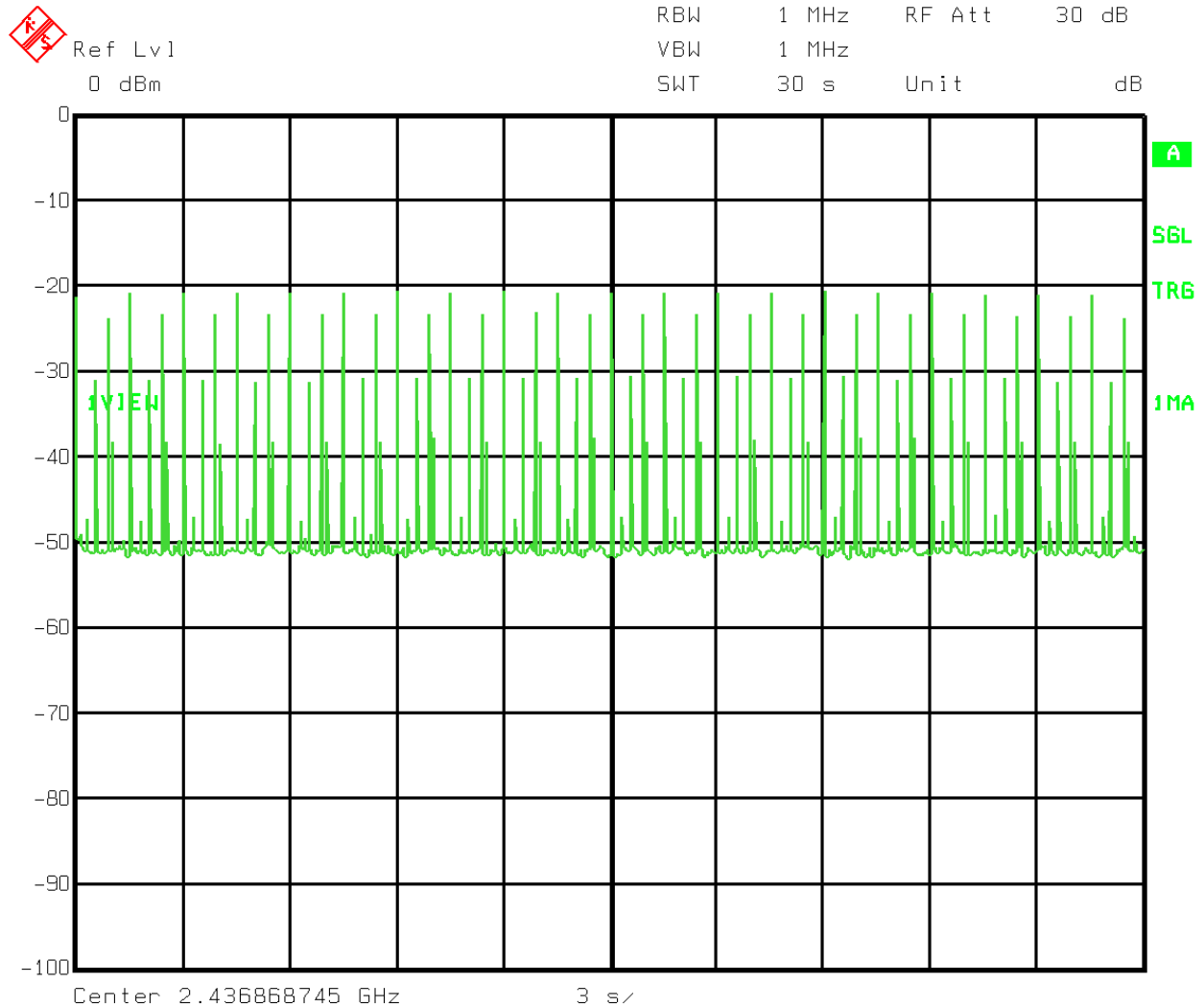
Title: 9L0325R TIME OCCUPANCY #1

Comment A: TIME1.PCX

Date: 14.OCT.1999 11:10:39

EQUIPMENT: Gemini (V4.0) Web Pad

PROJECT NO.: 9L0325RUS2



Title: 9L0325R TIME OCCUPANCY #2
Comment A: TIME2.PCX
Date: 14.OCT.1999 11:14:25

EQUIPMENT: Gemini (V4.0) Web Pad

PROJECT NO.: 9L0325RUS2

Section 7. Occupied Bandwidth

NAME OF TEST: Occupied Bandwidth	PARA. NO.: 15.247(a)(1)(i)
TESTED BY: Ron Gaytan	DATE: 10/13/99

Test Results: Complies.

Measurement Data: See attached plots.

Equipment Used: G2632, G1017B, G1018, CF44

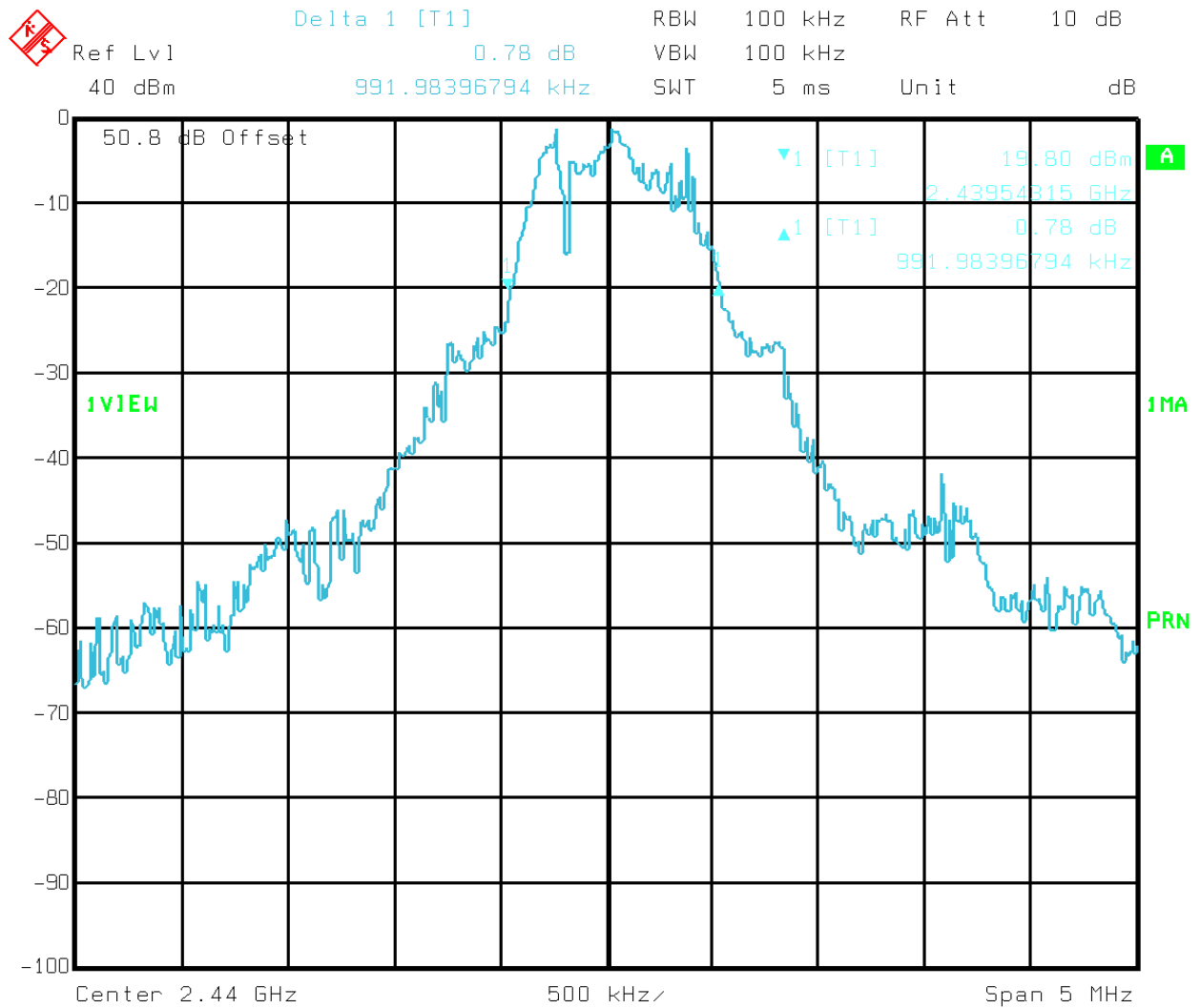
Measurement Uncertainty: +/- 1.6 dB

Temperature: 22 °C

Relative Humidity: 42 %

EQUIPMENT: Gemini (V4.0) Web Pad

PROJECT NO.: 9L0325RUS2



Title: 9L0325R 20 dB Bandwidth
Comment A: 20dB BW
Date: 13.OCT.1999 10:14:56

EQUIPMENT: Gemini (V4.0) Web Pad

PROJECT NO.: 9L0325RUS2

Section 8. Peak Power Output

NAME OF TEST: Peak Power Output	PARA. NO.: 15.247 (b)
TESTED BY: Ron Gaytan	DATE: 10/12/99

Test Results: Complies.**Measurement Data:** See attached plots.Detachable antenna? ☐ Yes ☒ NoIf yes, state the type of non-standard connector used:**Antennas:** The antenna used is a ¼ wave dipole permanently affixed to the PCB

Model	Type	Manufacturer	Gain (dBi)	E.I.R.P. (dBm)

Peak power output at antenna port(dBm):

Field Strength: **111 dBµV/m @ 3m or .355V/m @ 3m.**Peak Power (E.I.R.P): .0378 W**Equipment Used:** G2624, 677, CF31, G2023**Temperature:** 23°C**Relative Humidity:** 46%

EQUIPMENT: Gemini (V4.0) Web Pad

PROJECT NO.: 9L0325RUS2

Microwave Radiated Emissions DataComplete X Preliminary Page 1 of 1Client: National SemiconductorTest #: MW-1W.O.#: 9L0325REUT: Gemini (1.5)S/N: 0019300C10Photo ID: 9L0325R MW-1Technician: Ron GaytanSpecification: CFR 47 Part 15.247Lab: ANC1Date: 10/12/99Equipment Used: G2624-677-CF31-G2023Configuration: Web Pad and Base Station operating at a fixed Frequency. Tx and Rx at both ends.Bandwidth: 1 MHzVideo Bandwidth: 1 MHzAntenna Distance 3 m

Detector:

Climatic Conditions:

EUT Power: X 115 V.A.C.X 60 HzX PeakTemperature: 23 C 208 V.A.C. 50 Hz AverageRelative Humidity: 46 % 230 V.A.C.Atmospheric Pressure: 998 mbar Other 1 Phase 3 Phase

Freq. (GHz)	Meter Reading (dBuV)	Antenna Factor (dB)	Cable Loss (dB)	RF Gain (dB)	Conver. Factor	Corrected Reading (dBuV/m)	Spec. Limit (dBuV/m)	Pol.	Comments:
2.44	78.5	27.6	3.1	0	0	109	N/A	V	
2.439	78	27.6	3.1	0	0	109	N/A	V	KTL # 677
4.878	14	32.7	4.6	0	0	51.3	54	V	
7.317	17	35.9	5.7	0	0	58.6	91	V	Noise Floor
9.756	18	37.4	6.9	0	0	62.3	91	V	Noise Floor
12.195	18	38.5	8.0	0	0	64.5	54	V	Noise Floor
12.195	4	38.5	8.0	0	0	50.5	54	V	AVG. (N.F.)
14.634	18	41	8.7	0	0	67.7	91	V	Noise Floor
2.44	80.3	27.6	3.1	0	0	111	N/A	H	
2.437	80	27.6	3.1	0	0	111	N/A	H	KTL # 677
4.888	15	32.7	4.6	0	0	52.3	54	H	
7.317	19	35.9	5.7	0	0	60.6	91	H	Noise Floor
9.756	19	37.4	6.9	0	0	63.3	91	H	Noise Floor
12.195	4	38.5	8.0	0	0	50.5	54	H	AVG. (N.F.)
14.634	18	41	8.7	0	0	67.7	91	H	Noise Floor
									Scanned from
									1.0 -18 GHz.
									Center Channel
									(2.44 GHz)

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REV 030597



EQUIPMENT: Gemini (V4.0) Web Pad

PROJECT NO.: 9L0325RUS2

Section 9. Spurious Emissions (Antenna Conducted)

NAME OF TEST: Spurious Emissions (Antenna Conducted)	PARA. NO.: 15.247(c)
TESTED BY:	DATE:

Test Results: Complies.

Measurement Data: See attached plots.

Equipment Used:

Measurement Uncertainty: +/- dB

Temperature: °C

Relative Humidity: %

Not Applicable

Section 10. Spurious Emissions (Radiated)

NAME OF TEST: Spurious Emissions (Radiated)	PARA. NO.: 15.247(c)
TESTED BY: Ron Gaytan	DATES: 10/12/99, 10/13/99

Test Results: Complies.

Measurement Data: See attached table.

Duty Cycle Calculation:

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

Equipment Used: G2624, 677, CF31, G2023

Temperature: 23°C

Relative Humidity: 46%

EQUIPMENT: Gemini (V4.0) Web Pad

PROJECT NO.: 9L0325RUS2

Test Data - Radiated Emissions MW-1:

Microwave Radiated Emissions Data

Complete X Preliminary Page 1 of 1Client: National Semiconductor Test #: MW-1 W.O.#: 9L0325REUT: Gemini (1.5) S/N: 0019300C10 Photo ID: 9L0325R MW-1Technician: Ron Gaytan Specification: CFR 47 Part 15.247 Lab: ANC1 Date: 10/12/99Equipment Used: G2624-677-CF31-G2023Configuration: Web Pad and Base Station operating at a fixed Frequency. Tx and Rx at both ends.Bandwidth: 1 MHz Video Bandwidth: 1 MHz Antenna Distance 3 m Detector:

Climatic Conditions: EUT Power: X 115 V.A.C. X 60 Hz X Peak
 Temperature: 23 C 208 V.A.C. 50 Hz Average
 Relative Humidity: 46 % 230 V.A.C.
 Atmospheric Pressure: 998 mbar Other 1 Phase 3 Phase

Freq. (GHz)	Meter Reading (dBuV)	Antenna Factor (dB)	Cable Loss (dB)	RF Gain (dB)	Conver. Factor	Corrected Reading (dBuV/m)	Spec. Limit (dBuV/m)	Pol.	Comments:
2.44	78.5	27.6	3.1	0	0	109	N/A	V	
2.439	78	27.6	3.1	0	0	109	N/A	V	KTL # 677
4.878	14	32.7	4.6	0	0	51.3	54	V	
7.317	17	35.9	5.7	0	0	58.6	91	V	Noise Floor
9.756	18	37.4	6.9	0	0	62.3	91	V	Noise Floor
12.195	18	38.5	8.0	0	0	64.5	54	V	Noise Floor
12.195	4	38.5	8.0	0	0	50.5	54	V	AVG. (N.F.)
14.634	18	41	8.7	0	0	67.7	91	V	Noise Floor
2.44	80.3	27.6	3.1	0	0	111	N/A	H	
2.437	80	27.6	3.1	0	0	111	N/A	H	KTL # 677
4.888	15	32.7	4.6	0	0	52.3	54	H	
7.317	19	35.9	5.7	0	0	60.6	91	H	Noise Floor
9.756	19	37.4	6.9	0	0	63.3	91	H	Noise Floor
12.195	4	38.5	8.0	0	0	50.5	54	H	AVG. (N.F.)
14.634	18	41	8.7	0	0	67.7	91	H	Noise Floor
									Scanned from
									1.0 -18 GHz.
									Center Channel
									(2.44 GHz)

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EQUIPMENT: Gemini (V4.0) Web Pad

PROJECT NO.: 9L0325RUS2

Test Data - Radiated Emissions MW-2:

Microwave Radiated Emissions Data

Complete X Preliminary Page 1 of 1Client: National Semiconductor Test #: MW-2 W.O.#: 9L0325REUT: Gemini (1.5) S/N: 0019300C10 Photo ID: 9L0325R MW-2Technician: Ron Gaytan Specification: CFR 47 Part 15.247 Lab: ANC1 Date: 10/12/99Equipment Used: G2624-677-CF31-G2023Configuration: Web Pad and Base Station operating at a fixed Frequency. Tx and Rx at both ends.Bandwidth: 1 MHz Video Bandwidth: 1 MHz Antenna Distance 1 m Detector:

Climatic Conditions: EUT Power: X 115 V.A.C. X 60 Hz X Peak
 Temperature: 23 C 208 V.A.C. 50 Hz Average
 Relative Humidity: 46 % 230 V.A.C.
 Atmospheric Pressure: 998 mbar Other 1 Phase 3 Phase

Freq. (GHz)	Meter Reading (dBuV)	Antenna Factor (dB)	Cable Loss (dB)	RF Gain (dB)	Conver. Factor	Corrected Reading (dBuV/m)	Spec. Limit (dBuV/m)	Pol.	Comments:
2.401	94.7	27.6	3.1	0	0	125	N/A	V	
2.395	95	27.6	3.1	0	0	126	N/A	V	KTL # 677
4.79	14	32.7	4.6	0	0	51.3	63.5	V	
7.185	17	35.9	5.7	0	0	58.6	105.7	V	Noise Floor
9.580	18	37.4	6.9	0	0	62.3	105.7	V	Noise Floor
11.975	18	38.5	8.0	0	0	64.5	63.5	V	Noise Floor
11.975	4	38.5	8.0	0	0	50.5	63.5	V	AVG. (N.F.)
14.37	18	41	8.7	0	0	67.7	105.7	V	Noise Floor
2.401	90	27.6	3.1	0	0	121	N/A	H	
2.395	89.8	27.6	3.1	0	0	121	N/A	H	KTL # 677
4.79	22	32.7	4.6	0	0	59.3	63.5	H	
7.185	19	35.9	5.7	0	0	60.6	105.7	H	Noise Floor
9.580	19	37.4	6.9	0	0	63.3	105.7	H	Noise Floor
11.975	4	38.5	8.0	0	0	50.5	63.5	H	AVG. (N.F.)
14.37	18	41	8.7	0	0	67.7	105.7	H	Noise Floor
									Scanned from
									1.0 -18 GHz.
									Lower Channel
									(2.401 GHz)

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EQUIPMENT: Gemini (V4.0) Web Pad

PROJECT NO.: 9L0325RUS2

Test Data - Radiated Emissions MW-3:

Microwave Radiated Emissions Data

Complete X Preliminary Page 1 of 1Client: National Semiconductor Test #: MW-3 W.O.#: 9L0325REUT: Gemini (1.5) S/N: 0019300C10 Photo ID 9L0325R MW-3Technician: Ron Gaytan Specification: CFR 47 Part 15.247 Lab: ANC1 Date: 10/13/99Equipment Used: G2624-677-CF31-G2023Configuration: Web Pad and Base Station operating at a fixed Frequency. Tx and Rx at both ends.Bandwidth: 1 MHz Video Bandwidth: 1 MHz Antenna Distance 1 m Detector:

Climatic Conditions: EUT Power: X 115 V.A.C. X 60 Hz X Peak
 Temperature: 23 C 208 V.A.C. 50 Hz Average
 Relative Humidity: 46 % 230 V.A.C.
 Atmospheric Pressure: 998 mbar Other 1 Phase 3 Phase

Freq. (GHz)	Meter Reading (dBuV)	Antenna Factor (dB)	Cable Loss (dB)	RF Gain (dB)	Conver. Factor	Corrected Reading (dBuV/m)	Spec. Limit (dBuV/m)	Pol.	Comments:
2.4800	93.4	27.6	3.1	0	0	124.1	N/A	V	
2.475	94	27.6	3.1	0	0	124.7	N/A	V	KTL # 677
4.95	21	32.7	4.6	0	0	58.3	63.5	V	
7.425	17	35.9	5.7	0	0	58.6	104.7	V	Noise Floor
9.90	18	37.4	6.9	0	0	62.3	104.7	V	Noise Floor
11.975	18	38.5	8.0	0	0	64.5	63.5	V	Noise Floor
11.975	4	38.5	8.0	0	0	50.5	63.5	V	AVG. (N. F.)
14.37	18	41	8.7	0	0	67.7	104.7	V	Noise Floor
2.4800	91	27.6	3.1	0	0	121.7	N/A	H	
2.477	91	27.6	3.1	0	0	121.7	N/A	H	KTL # 677
4.950	24	32.7	4.6	0	0	61.3	63.5	H	
7.431	19	35.9	5.7	0	0	60.6	104.7	H	Noise Floor
9.908	19	37.4	6.9	0	0	63.3	104.7	H	Noise Floor
11.975	4	38.5	8.0	0	0	50.5	63.5	H	AVG. (N. F.)
14.37	18	41	8.7	0	0	67.7	104.7	H	Noise Floor
									Scanned from
									1.0 -18 GHz.
									High Channel
									(2.480 GHz)

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Radiated Photographs Test # MW-3:

FRONT VIEW



REAR VIEW



EQUIPMENT: Gemini (V4.0) Web Pad

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Section 11. Test Equipment List

<u>KTL ID</u>	<u>Description</u>	<u>Manufacturer Model Number</u>	<u>Serial Number</u>	<u>Calibration Date</u>
1A	CABLE	KTL Site A OATS	N/A	04/01/99
C21	CABLE, 9.5m	KTL RG223	N/A	08/04/99
CF31	CABLE, 7.6m	KTL Semi-Flex, Storm	N/A	01/29/99
CF44	CABLE, 4M	STORM PR90-010-144	N/A	10/15/99
677	RECEIVER, 1-18 GHz	ELECTRO METRICS EMC 50	185	08/31/99
G1017	ATTENUATOR	NARDA 776B-20	NONE	08/14/98
G1018	ATTENUATOR	NARDA 776B-10	NONE	10/27/98
G1607	LISN	SCHWARZBECK 8120	8120281	07/20/99
G1705	FILTER, HIGH PASS, 5 KHz	SOLAR 7930-5.0	933124	11/16/98
G2019	ANTENNA, LP	A.H. SYSTEMS SAS-200/510	821	01/25/99
G2021	ANTENNA,BICONICAL	A.H. SYSTEMS SAS-200/540	496	01/21/99
G2023	ANTENNA,HORN	EMCO 3115	8812-3035	07/16/99
G2406	RECEIVER	ROHDE & SCHWARZ ESH2	880370/029	04/14/99
G2624	SPECTRUM ANALYZER	HP 8563E	3551A04428	11/03/99
G2632	SPECTRUM ANALYZER	ROHDE & SCHWARZ FSEK30	830844/006	06/14/99
G2208	PREAMP, 25dB	ICC LNA25	399	03/04/99

ANNEX A - TEST DETAILS

KTL Dallas, Inc.

FCC PART 15, SUBPART C
FREQUENCY HOPPING TRANSMITTERS

EQUIPMENT: Gemini (V4.0) Web Pad

PROJECT NO.: 9L0325RUS2

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.

KTL Dallas, Inc.

FCC PART 15, SUBPART C
FREQUENCY HOPPING TRANSMITTERS

EQUIPMENT: Gemini (V4.0) Web Pad

PROJECT NO.: 9L0325RUS2

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.

EQUIPMENT: Gemini (V4.0) Web Pad

PROJECT NO.: 9L0325RUS2

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.

EQUIPMENT: Gemini (V4.0) Web PadPROJECT NO.: 9L0325RUS2

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:

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

EQUIPMENT: Gemini (V4.0) Web Pad

PROJECT NO.: 9L0325RUS2

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

EQUIPMENT: Gemini (V4.0) Web Pad

PROJECT NO.: 9L0325RUS2

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.

EQUIPMENT: Gemini (V4.0) Web PadPROJECT NO.: 9L0325RUS2

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

EQUIPMENT: Gemini (V4.0) Web Pad

PROJECT NO.: 9L0325RUS2

NAME OF TEST: Spurious Emissions at Antenna Terminals 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**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

EQUIPMENT: Gemini (V4.0) Web Pad

PROJECT NO.: 9L0325RUS2

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

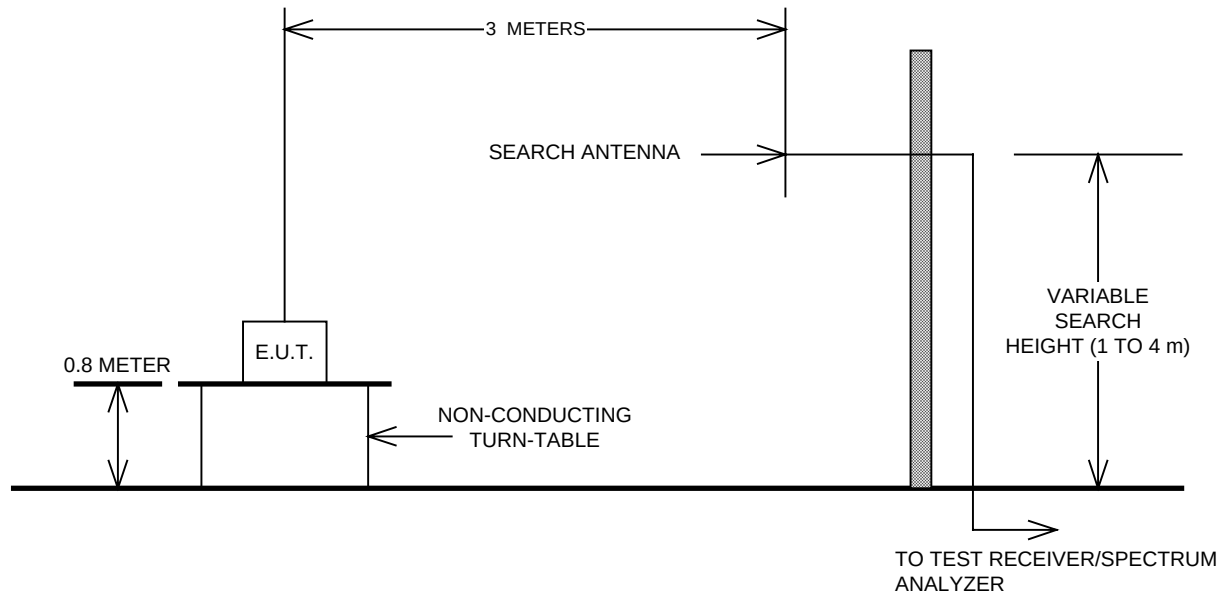
MHz	MHz	MHz	GHz
0.09-0.11	16.42-16.423	399.9-410	4.5-5.25
0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.125-6.218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

