Nemko Test Report:	1L0374RUS2
Applicant:	Trango Systems
Equipment Under Test: (E.U.T.)	M5800S Subscriber Unit
In Accordance With:	**FCC Part 15, Subpart C, 15.247** Direct Sequence Spread Spectrum Transmitters
Tested By:	Nemko Dallas Inc. 802 N. Kealy Lewisville, Texas 75057-3136
Authorized By:	 Tom Tidwell, RF Group Manager
Date:	12/13/01
Total Number of Pages:	41

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Section 1. Summary of Test Results

Manufacturer: Sunstream (Trango) Systems

Model No.: M5800S

Serial No.: S01

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 Direct Sequence Spread Spectrum devices. Radiated tests were conducted is 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

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

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

NVLAP LAB CODE: 100426-0

Summary Of Test Data

NAME OF TEST	PARA. NO.	SPEC.	RESULT
Powerline Conducted Emissions	15.207(a)	48 dBµV	N/A
Minimum 6 dB Bandwidth	15.247(a)(2)	>500 kHz	Complies
Maximum Peak Power Output	15.247(b)(1)	<1 Watt	Complies
Spurious Emissions (Antenna Conducted)	15.247(c)	-20 dBc/100kHz	N/A
Spurious Emissions (Restricted Bands)	15.247(c)	< 74 dBuV/m Peak < 54 dBuV/m Avg	Complies
Peak Power Spectral Density	15.247(d)	+8 dBm/3kHz	N/A
Processing Gain	15.247(e)	10 dB	N/A

Footnotes:

Due to the Class II Permissive Change not changing any of the radio equipment the Powerline Conducted, Spurious Emissions (Conducted), Peak Power Spectral Density, and Processing Gain portions of the test were not examined. Although the bandedge plots are placed in the Spurious Emissions Conducted portion of this report.

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

General Equipment Information

Frequency Band:

☐ 902 – 928 MHz
☐ 2400 – 2483.5 MHz
☒ 5725 – 5850 MHz

Tuning Range: 5736 - 5836 MHz

User Frequency Adjustment: Software controlled

Description of Modification for Modification Filing

1. Changed RF filters to ceramic type and added one more on transmit side to increase LO and harmonic attenuation.
2. Replaced SAW filters with SMT type.
3. Combined to switches on RF output into a single switch.
4. Replace discrete VCO with a PLL module.
5. Replaced and consolidated IF strip amplifiers.
6. Moved RF connector locations.
7. Replaced Metal shield with copper coated plastic shield.
8. Added resistive heater to heat Ethernet chip at low temperatures.
9. Added temperature sensor.
10. Added EMI filter on 44 MHz clock.
11. Added lightning protection to Ethernet lines.

Section 3. Powerline Conducted Emissions

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

Not Applicable

Test Results: Complies.

Measurement Data: See attached plots.

Measurement Uncertainty: +/- 1.7 dB

Section 4. Minimum 6 dB Bandwidth

NAME OF TEST: Minimum 6 dB Bandwidth	PARA. NO.: 15.247(a)(2)
TESTED BY: Lance Walker	DATE: 12/6/2001

Test Results: Complies.

Measurement Data: See 6 dB BW plot
Measured 6 dB bandwidth:

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Data Plot — 6 dB BW

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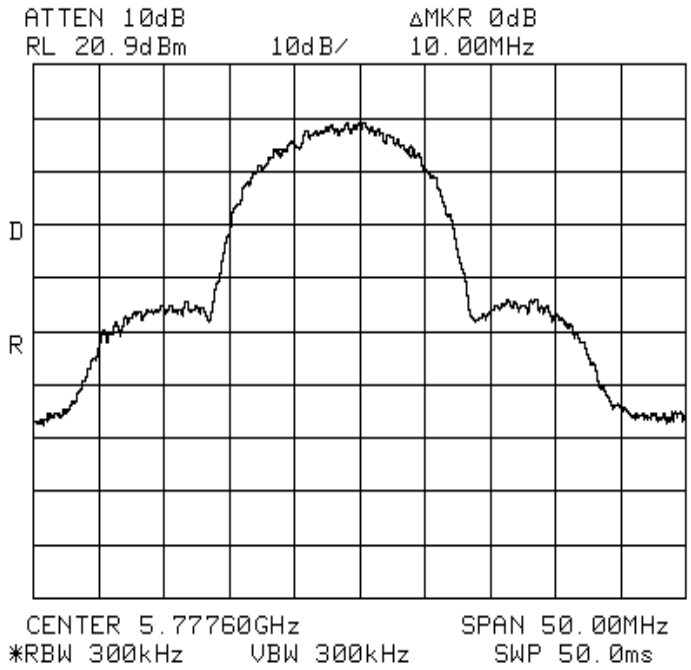
Complete X
Preliminary:

Job No.: 1L0374R Date: 12/6/2001
Specification: FCC15247 Temperature(°C): 22
Tested By: Lance Walker Relative Humidity(%) 50
E.U.T.: Access Point
Configuration: Tx with antenna removed
Sample Number:
Location: Lab 2 RBW: Refer to plots Measurement
Detector Type: Peak VBW: Refer to plots Distance: N/A m

Test Equipment Used

Antenna:		Directional Coupler:	
Pre-Amp:		Cable #1:	1627
Filter:		Cable #2:	
Receiver:	1464	Cable #3:	
Attenuator #1	1469	Cable #4:	
Attenuator #2:	1465	Mixer:	

Additional equipment used:
Measurement Uncertainty: +/-1.7 dB



Notes: **6 dB BW mid channel**

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Data Plot **6 dB BW**

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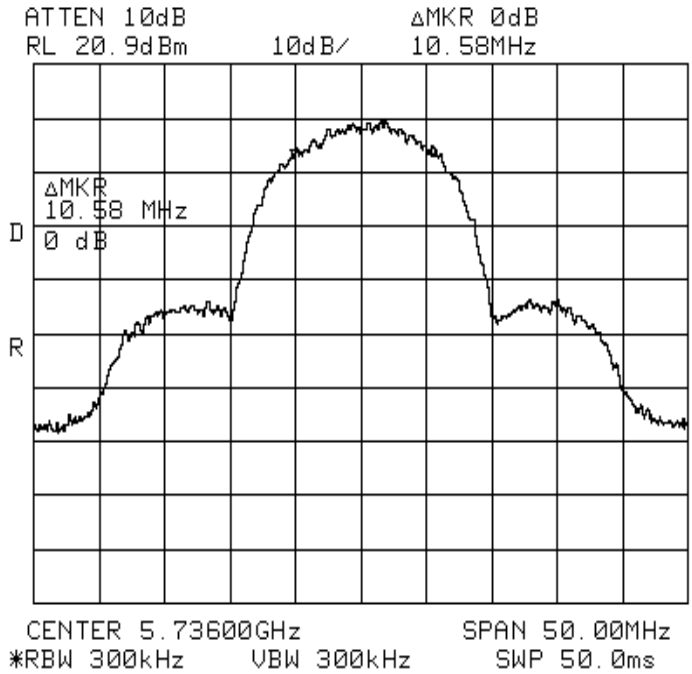
Job No.:	1L0374R	Date:	12/6/2001
Specification:	FCC15247	Temperature(°C):	22
Tested By:	Lance Walker	Relative Humidity(%)	50
E.U.T.:	Access Point		
Configuration:	Tx with antenna removed		



Notes: **6 dB BW Low**

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Test Plot: **6 dB BW**

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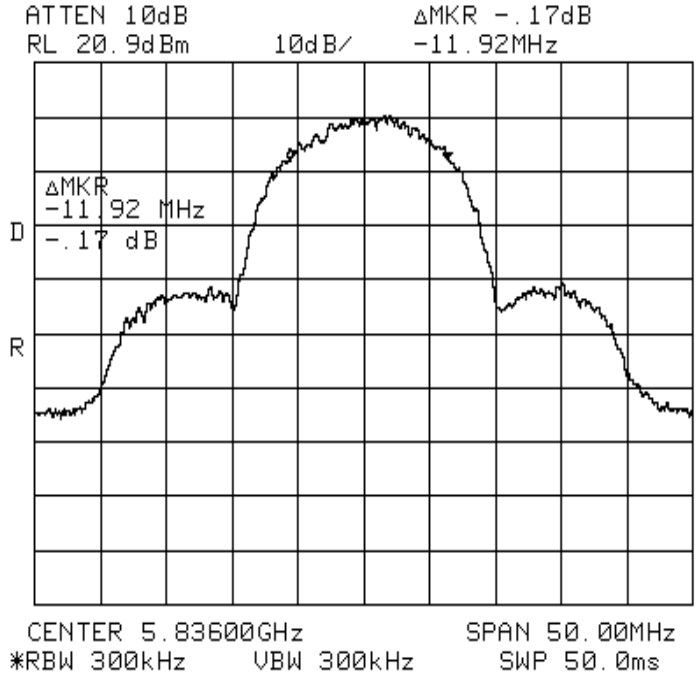
Job No.:	1L0374R	Date:	12/6/2001
Specification:	FCC15247	Temperature(°C):	22
Tested By:	Lance Walker	Relative Humidity(%)	50
E.U.T.:	Access Point		
Configuration:	Tx with antenna removed		



Notes: **6 dB High**

Section 5. Maximum Peak Output Power

NAME OF TEST: Maximum Peak Output power	PARA. NO.: 15.247(b)(1)
TESTED BY: Lance Walker	DATE: 12/6/01

Test Results: Complies.

Measurement Data:

Antennas: **Integral Patch Antenna 17.9 dB gain**

Channel	Limit	Measured at Ant Terminal (mW)	Converted Measurement (dBm)	EIRP (dBm)
Low	18.0 dBm	57.5	17.6	35.5
Mid	18.0 dBm	60.1	17.8	35.7
High	18.0 dBm	61.0	17.9	35.8

Equipment Used: 1029,1030,1626,1469,1465,1470

Measurement Uncertainty: +/- 0.7 dB

Temperature: 22 °C

Relative Humidity: 50 %

Section 6. RF Exposure

NAME OF TEST: RF Exposure	PARA. NO.: 15.247(b)(4)
TESTED BY:	DATE:

Test Results: Complies

Measurement Data:

Section 7. Spurious Emissions (conducted)

NAME OF TEST: Spurious Emissions (conducted)	PARA. NO.: 15.247(c)
TESTED BY: N/A	DATE: N/A

Test Results: N/A

Measurement Data: See attached plots.

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Data Plot — Bandedges

Page 1 of 2 — Complete X — Preliminary:

Job No.:	1L0374R	Date:	12/6/2001
Specification:	FCC15247	Temperature(°C):	22
Tested By:	Lance Walker	Relative Humidity(%)	50
E.U.T.:	Access Point		
Configuration:	Tx with antenna removed		
Sample Number:			
Location:	Lab 2	RBW:	Refer to plots
Detector Type:	Peak	VBW:	Refer to plots

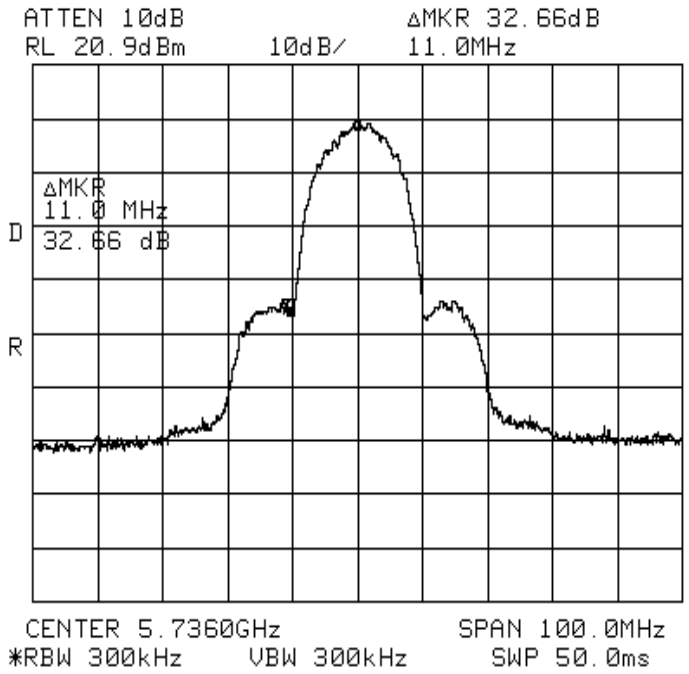
Measurement Distance: N/A m

Test Equipment Used

Antenna:		Directional Coupler:	
Pre-Amp:		Cable #1:	1627
Filter:		Cable #2:	
Receiver:	1464	Cable #3:	
Attenuator #1	1469	Cable #4:	
Attenuator #2:	1465	Mixer:	

Additional equipment used:

Measurement Uncertainty: +/-1.7 dB



Notes: **Low bandedge with signal being more than 20 dBc less than carrier.**

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Data Plot **Bandedges**

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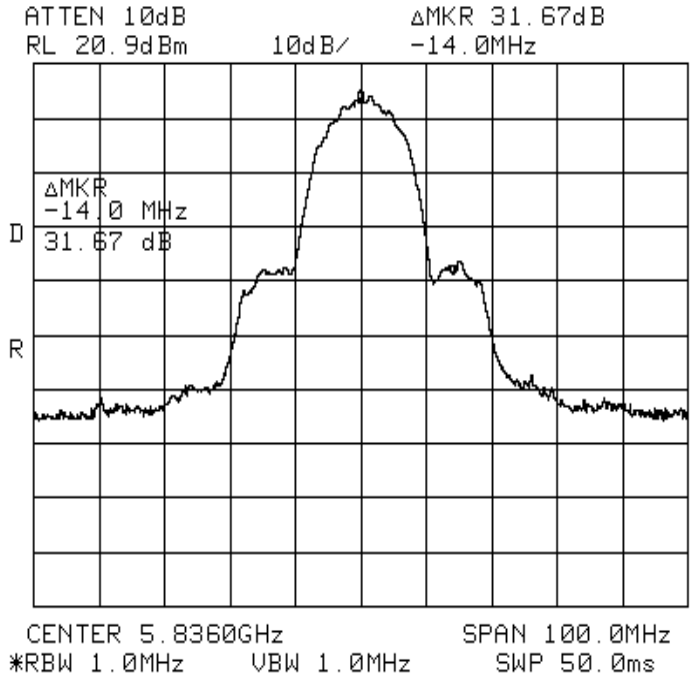
Job No.:	1L0374R	Date:	12/6/2001
Specification:	FCC15247	Temperature(°C):	22
Tested By:	Lance Walker	Relative Humidity(%)	50
E.U.T.:	Access Point		
Configuration:	Tx with antenna removed		



Notes: **Upper bandedges**

Section 8. Spurious Emissions (radiated)

NAME OF TEST: Peak Power Output	PARA. NO.: 15.247 (c)
TESTED BY: Lance Walker	DATE: 12/6/2001

Test Results: Complies.

Measurement Data: See attached table.

Duty Cycle Calculation:

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

Please note that the SPD4-58 model is the four-foot diameter model of a family that has a 1 foot, 2 foot, and 3 foot model in the same family that will be used with this device.

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Radiated Emissions

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Job No.: 1L0374R Date: 12/6/01
Specification: CFR 47, Part 15 Temperature(°C): 22
Tested By: Lance Walker Relative Humidity(%) 50
E.U.T.: Subscriber Unit with Integral Patch Antenna
Configuration: Normal Tx
Sample Number:
Location: AC 3 RBW: 1 MHz
Detector Type: Average VBW: 300Hz

Test Equipment Used

Antenna: 1304 Directional Coupler: #N/A
Pre-Amp: #N/A Cable #1: 1484
Filter: #N/A Cable #2: 1485
Receiver: 1464 Cable #3: 1626
Attenuator #1 #N/A Cable #4: #N/A
Attenuator #2: #N/A Mixer: 989

Additional equipment used: 990
Measurement Uncertainty: +/- .7 dB

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
11.472	46.7	41.1	7.4	35.5	59.7	74	-14.3	Low Ch V NF
11.472	35.2	41.1	7.4	35.5	48.2	54	-5.8	Noise Floor
40.152	29.6	39.6	0	0	69.2	78	-8.3	at 20 cm
45.888	28.8	40.2	0	0	69.0	78	-8.5	at 20 cm
51.624	28.5	41.0	0	0	69.5	78	-8.0	at 20 cm
57.36	28.1	41.7	0	0	69.8	78	-7.7	at 20 cm
11.472	36.8	41.1	7.4	35.5	49.8	54	-4.2	Low Ch H
40.152	29.6	39.6	0	0	69.2	78	-8.3	at 20 cm
45.888	28.8	40.2	0	0	69.0	78	-8.5	at 20 cm
51.624	28.5	41.0	0	0	69.5	78	-8.0	at 20 cm
57.36	28.1	41.7	0	0	69.8	78	-7.7	at 20 cm
11.672	39	41.1	7.4	35.5	52.0	54	-2.0	High Ch H
11.672	52	41.1	7.4	35.5	65.0	74	-9.0	High Ch H Pk
40.852	28.8	39.7	0	0	68.5	78	-9.0	at 20 cm
46.688	27.8	40.4	0	0	68.2	78	-9.3	at 20 cm
52.524	27.6	41.1	0	0	68.7	78	-8.8	at 20 cm
58.36	27.9	41.8	0	0	69.7	78	-7.8	at 20 cm
11.672	35.5	41.1	7.4	35.5	48.5	54	-5.5	High Ch V
40.852	28.8	39.7	0	0	68.5	78	-9.0	at 20 cm
46.688	27.8	40.4	0	0	68.2	78	-9.3	at 20 cm
52.524	27.6	41.1	0	0	68.7	78	-8.8	at 20 cm
58.36	27.9	41.8	0	0	69.7	78	-7.8	at 20 cm

Notes: All measurements taken in worst case scenario Tx all time in normal there will be bursts.

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Radiated Spurious Emissions

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Job No.: Date: 12/10/01

Specification: CFR 47, Part 15 Temperature(°F): 72

Tested By: #N/A Relative Humidity(%) 50

E.U.T.: Subscriber Unit with Integral Patch Antenna

Configuration: Normal Tx

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
11.572	38.5	41.1	7.4	35.5	51.5	54	-2.5	Mid H
11.572	51.5	41.1	7.4	35.5	64.5	74	-9.5	
40.502	28.8	39.7	0	0	68.5	78	-9.0	
46.288	27.8	40.3	0	0	68.1	78	-9.4	
52.074	27.6	41.0	0	0	68.6	78	-8.9	
57.86	27.9	41.8	0	0	69.7	78	-7.8	
11.572	35.5	41.1	7.4	35.5	48.5	54	-5.5	Mid V
11.572	51.3	41.1	7.4	35.5	64.3	74	-9.7	
40.502	28.8	39.7	0	0	68.5	78	-9.0	
46.288	27.8	40.3	0	0	68.1	78	-9.4	
52.074	27.6	41.0	0	0	68.6	78	-8.9	
57.86	27.9	41.8	0	0	69.7	78	-7.8	

Notes: All measurements above 40GHz were Noise Floor to include peak measurements.

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Radiated Emissions

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Job No.: 1L0374R Date: 12/6/01
Specification: CFR 47, Part 15 Temperature(°C): 22
Tested By: Lance Walker Relative Humidity(%) 50
E.U.T.: Subscriber w/AD5800-27-D
Configuration: Normal Tx
Sample Number:
Location: AC 3 RBW: 1 MHz
Detector Type: Average VBW: 300Hz

Test Equipment Used

Antenna: 984 Directional Coupler: #N/A
Pre-Amp: 1016 Cable #1: 1626
Filter: #N/A Cable #2: 1485
Receiver: 1464 Cable #3: 1486
Attenuator #1 #N/A Cable #4: #N/A
Attenuator #2: #N/A Mixer: 989

Additional equipment used: 1650, 1304
Measurement Uncertainty: +/- .7 dB

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
11.472	48.2	41.1	7.4	35.5	61.2	74	-12.8	Low Ch V NF
11.472	35.0	41.1	7.4	35.5	48.0	54	-6.0	Noise Floor
40.152	29.8	39.6	0.0	0.0	69.4	78	-8.1	at 20 cm
45.888	28.5	40.2	0.0	0.0	68.7	78	-8.8	
51.624	28.3	41.0	0.0	0.0	69.3	78	-8.2	
57.360	27.9	41.7	0.0	0.0	69.6	78	-7.9	
11.472	34.8	41.1	7.4	35.5	47.8	54	-6.2	Low Ch H
11.472	47.7	41.1	7.4	35.5	60.7	74	-13.3	
40.152	29.8	39.6	0.0	0.0	69.4	78	-8.1	
45.888	28.5	40.2	0.0	0.0	68.7	78	-8.8	
51.624	28.3	41.0	0.0	0.0	69.3	78	-8.2	
57.360	27.9	41.7	0.0	0.0	69.6	78	-7.9	
11.672	34.5	41.1	7.4	35.5	47.5	54	-6.5	High Ch H
11.672	49.3	41.1	7.4	35.5	62.3	74	-11.7	
40.852	28.8	39.7	0.0	0.0	68.5	78	-9.0	
46.688	27.9	40.4	0.0	0.0	68.3	78	-9.2	
52.524	28.3	41.1	0.0	0.0	69.4	78	-8.1	
58.360	28.5	41.8	0.0	0.0	70.3	78	-7.2	
11.672	36.7	41.1	7.4	35.5	49.7	54	-4.3	High Ch V
11.672	50.5	41.1	7.4	35.5	63.5	74	-10.5	
40.852	28.8	39.7	0.0	0.0	68.5	78	-9.0	
46.688	27.9	40.4	0.0	0.0	68.3	78	-9.2	
52.524	28.3	41.1	0.0	0.0	69.4	78	-8.1	

Notes: Noise Floor seen at everything over 40GHz,

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Radiated Spurious Emissions

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Job No.: Date: 12/10/01

Specification: CFR 47, Part 15 Temperature(°F): 72

Tested By: #N/A Relative Humidity(%) 50

E.U.T.: Subscriber w/AD5800-27-D

Configuration: Normal Tx

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
11.572	34.8	41.1	7.4	35.5	47.8	54	-6.2	Mid H
11.572	46.8	41.1	7.4	35.5	59.8	74	-14.2	
40.502	28.9	39.7	0.0	0.0	68.6	78	-8.9	
46.288	28.1	40.3	0.0	0.0	68.4	78	-9.1	
52.074	28.6	41.0	0.0	0.0	69.6	78	-7.9	
57.860	28.1	41.8	0.0	0.0	69.9	78	-7.6	
11.572	34.8	41.1	7.4	35.5	47.8	54	-6.2	Mid V
11.572	47.5	41.1	7.4	35.5	60.5	74	-13.5	
40.502	28.9	39.7	0.0	0.0	68.6	78	-8.9	
46.288	28.1	40.3	0.0	0.0	68.4	78	-9.1	
52.074	28.6	41.0	0.0	0.0	69.6	78	-7.9	
57.860	28.1	41.8	0.0	0.0	69.9	78	-7.6	

Notes: Noise Floor seen at everything over 40GHz, worst case full Tx device will be bursting on/off

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Radiated Emissions

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Job No.: 1L0374R Date: 12/6/01
Specification: CFR 47, Part 15 Temperature(°C): 22
Tested By: Lance Walker Relative Humidity(%) 50
E.U.T.: Subscriber w/SPD4-58
Configuration: Normal Tx
Sample Number:
Location: AC 3 RBW: 1 MHz
Detector Type: Average VBW: 300Hz

Test Equipment Used

Antenna: 984 Directional Coupler: #N/A
Pre-Amp: 1016 Cable #1: 1626
Filter: #N/A Cable #2: 1485
Receiver: 1464 Cable #3: 1486
Attenuator #1 #N/A Cable #4: #N/A
Attenuator #2: #N/A Mixer: 989

Additional equipment used: 1650, 1304
Measurement Uncertainty: +/- .7 dB

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
11.472	48.2	41.1	7.4	35.5	61.2	74	-12.8	Low Ch V NF
11.472	35.0	41.1	7.4	35.5	48.0	54	-6.0	Noise Floor
40.152	29.8	39.6	0.0	0.0	69.4	78	-8.1	at 20 cm
45.888	28.5	40.2	0.0	0.0	68.7	78	-8.8	
51.624	28.3	41.0	0.0	0.0	69.3	78	-8.2	
57.360	27.9	41.7	0.0	0.0	69.6	78	-7.9	
11.472	36.7	41.1	7.4	35.5	49.7	54	-4.3	Low Ch H
11.472	60.7	41.1	7.4	35.5	73.7	74	-0.3	worst case scenario full Tx
40.152	29.8	39.6	0.0	0.0	69.4	78	-8.1	
45.888	28.5	40.2	0.0	0.0	68.7	78	-8.8	
51.624	28.3	41.0	0.0	0.0	69.3	78	-8.2	
57.360	27.9	41.7	0.0	0.0	69.6	78	-7.9	
11.672	35.5	41.1	7.4	35.5	48.5	54	-5.5	High Ch H
11.672	58.3	41.1	7.4	35.5	71.3	74	-2.7	
40.852	28.8	39.7	0.0	0.0	68.5	78	-9.0	
46.688	27.9	40.4	0.0	0.0	68.3	78	-9.2	
52.524	28.3	41.1	0.0	0.0	69.4	78	-8.1	
58.360	28.5	41.8	0.0	0.0	70.3	78	-7.2	
11.672	36.7	41.1	7.4	35.5	49.7	54	-4.3	High Ch V
11.672	50.5	41.1	7.4	35.5	63.5	74	-10.5	
40.852	28.8	39.7	0.0	0.0	68.5	78	-9.0	
46.688	27.9	40.4	0.0	0.0	68.3	78	-9.2	
52.524	28.3	41.1	0.0	0.0	69.4	78	-8.1	

Notes:	Noise Floor seen at everything over 40GHz,

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Radiated Spurious Emissions

Page 1 of **Continuation Page**

Job No.: Date: 12/10/01

Specification: CFR 47, Part 15 Temperature(°F): 72

Tested By: #N/A Relative Humidity(%) 50

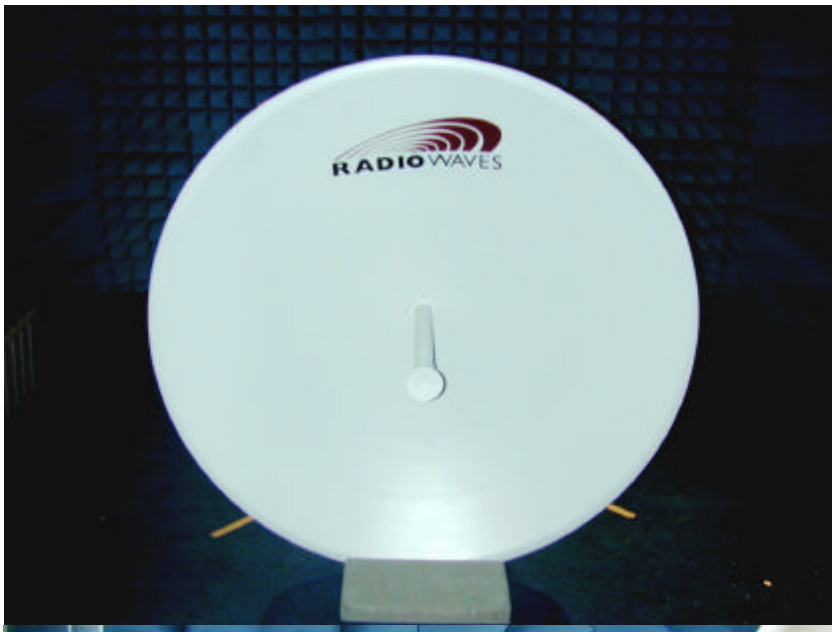
E.U.T.: Subscriber w/SPD4-58

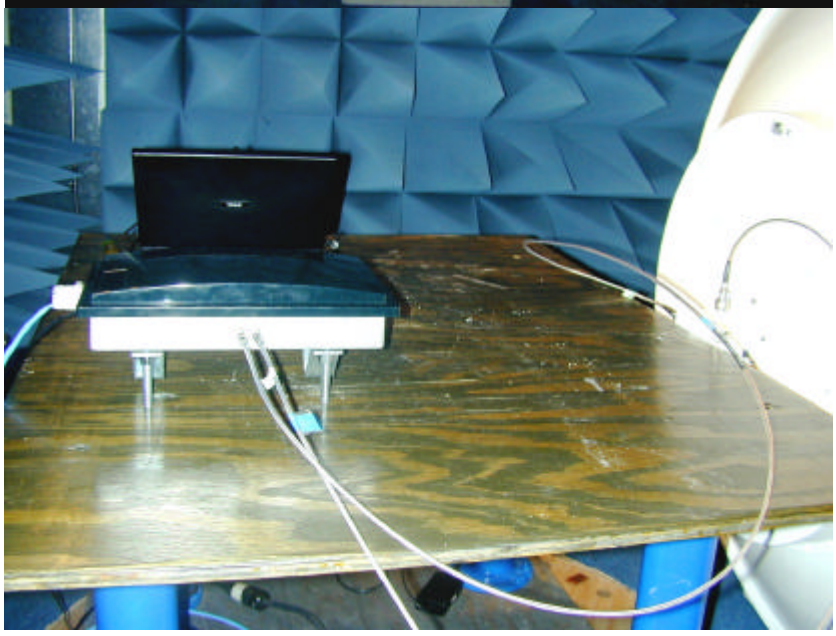
Configuration: Normal Tx

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
11.572	34.5	41.1	7.4	35.5	47.5	54	-6.5	Mid H
11.572	50.2	41.1	7.4	35.5	63.2	74	-10.8	
40.502	28.9	39.7	0.0	0.0	68.6	78	-8.9	
46.288	28.1	40.3	0.0	0.0	68.4	78	-9.1	
52.074	28.6	41.0	0.0	0.0	69.6	78	-7.9	
57.860	28.1	41.8	0.0	0.0	69.9	78	-7.6	
11.572	34.3	41.1	7.4	35.5	47.3	54	-6.7	Mid V
11.572	58.7	41.1	7.4	35.5	71.7	74	-2.3	
40.502	28.9	39.7	0.0	0.0	68.6	78	-8.9	
46.288	28.1	40.3	0.0	0.0	68.4	78	-9.1	
52.074	28.6	41.0	0.0	0.0	69.6	78	-7.9	
57.860	28.1	41.8	0.0	0.0	69.9	78	-7.6	

Notes: Noise Floor seen at everything over 40GHz, worst case full Tx device will be bursting on/off

Radiated Photographs (Worst Case Configuration)





Section 9. Peak Power Spectral Density

NAME OF TEST: Peak Power Spectral Density	PARA. NO.: 15.247(d)
TESTED BY:	DATE:

Test Results: Complies.

Measurement Data: See attached plots

Not Applicable

Equipment Used:

Measurement Uncertainty: +/- 0.7 dB

Temperature: °C

Relative Humidity: %

Section 10. Minimum Processing Gain

NAME OF TEST: Minimum Processing Gain	PARA. NO.: 15.247(e)
TESTED BY:	DATE:

Test Results: Compliance. The processing gain of the system is ____ dB.

Measurement Data: See attached data.

BER:
S/N_{out}:
J/S Ratio:
L_{sys}:

Equipment Used:

Measurement Uncertainty: +/- 0.7 dB

Temperature: °C

Relative Humidity: %

Section 11. Test Equipment List

Nemko ID	Description	Manufacturer Model Number	Serial Number	Calibration Date
1016	Pre-Amp	HEWLETT PACKARD 8449A	2749A00159	05/30/01
1464	Spectrum analyzer	Hewlett Packard 8563E	3551A04428	01/02/01
1626	CABLE, 5 ft	MEGAPHASE 10311 1GVT4	N/A	CBU
1484	Cable 2.0-18.0 Ghz	Storm PR90-010-072	N/A	06/01/01
1485	Cable 2.0-18.0 Ghz	Storm PR90-010-216	N/A	06/01/01
1650	12-18 GHz BP Filter	#N/A #N/A	#N/A	12/06/01
1029	PEAK POWER METER	HP 8900D	3303U0012	03/12/01
1030	PEAK POWER SENSOR	HP 84811A	2539A03573	03/12/01
1465	10 db Attenuator DC 8.0 Ghz	Midwest Microwave 292/10db	NONE	CBU
1469	10 db Attenuator DC 18 Ghz	MCL Inc. BW-S10W2 10db-2WDC	NONE	CBU
1470	10 db Attenuator DC 18 Ghz	MCL Inc. BW-S10W2 10db-2WDC	NONE	CBU
984	HORN ANTENNA	MILLITECH NONE	NONE	CNR
989	HARMONIC MIXER	Hewlett Packard 11970U	2332A00116	01/00/00

ANNEX A - TEST DETAILS

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

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 250µV (48 dBµV) across 50 ohms.

NAME OF TEST: Minimum 6 dB bandwidth	PARA. NO.: 15.247(a)(2)

Minimum Standard: The minimum 6 dB bandwidth shall be at least 500 kHz

NAME OF TEST: Maximum Peak Output Power	PARA. NO.: 15.247(b)(1)

Minimum Standard: The maximum peak output power shall not exceed 1 watt.

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

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

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

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

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

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

where,

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

The RBW of the spectrum analyzer shall be set to a value greater than the measured 6 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: RF Exposure	PARA. NO.: 15.247(b)(4)

Minimum Standard: Systems operating under the provisions of this section shall be operated in a manner that ensures the public is not exposed to radio frequency energy levels in excess of the Commission's guidelines stipulated in 1.1307(b)(1) of CFR 47.

NAME OF TEST: Spurious Emissions(conducted) 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 (µV/m @ 3m)	Field Strength (dB @ 3m)
30 - 88	100	40.0
88 - 216	150	43.5
216 - 960	200	46.0
Above 960	500	54.0

THE SPECTRUM IS SEARCHED TO THE 10th HARMONIC OF THE HIGHEST FREQUENCY GENERATED IN THE EUT.

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 (mV/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

NAME OF TEST: Transmitter Power Density	PARA. NO.: 15.247(d)

Minimum Standard: The transmitted power density averaged over any 1 second interval shall not be greater than +8 dBm in any 3 kHz bandwidth.

Method Of Measurement: The spectrum analyzer is set as follows:

RBW: 3 kHz
VBW: >3 kHz
Span: => measured 6 dB bandwidth
Sweep: Span(kHz)/3 (i.e. for a span of 1.5 MHz the sweep rate is 1500/3 = 500 sec.
LOG dB/div.: 2 dB

Note: For devices with spectrum line spacing =< 3 kHz, the RBW of the analyzer is reduced until the spectral lines are resolved. The measurement data is normalized to 3 kHz by summing the power of all the individual spectral lines within a 3 kHz band in linear power units.

For Devices With Integral Antenna:

For devices with non-detachable antennas, the received field strength is peaked and the spectrum analyzer is set as above. The peak emission level is then measured and converted to a field strength by adding the appropriate antenna factor and cable loss. This field strength is then converted to an equivalent isotropic radiated power using the same method as described for Peak Power output.

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: Processing Gain	PARA. NO.: 15.247(e)

Minimum Standard: The processing gain shall be at least 10 dB.

Method Of Measurement: The CW jamming margin method was used to determine the processing gain. A CW signal generator is stepped across the passband of the receiver in 50 kHz increments. At each point the signal generator level required to obtain the recommended bit error rate is recorded. The jammer to signal ratio (J/S) is then calculated. The worst 20% of the J/S points is discarded. The lowest remaining J/S ratio is used to calculate the processing gain.

Calculation Of Processing Gain:

The processing gain was determined by measuring the jamming margin of the E.U.T. and using the following formula:

Jamming Margin = G_p - $(S/N)_{out}$ - L_{sys}

For a receiver using non-coherent detection the value $(S/N)_{out}$ is calculated using the formula:

$P_e = (1/2)EXP\{-E/2N_o\}$ where P_e is the probability of error (minimum Bit Error Rate required for proper operation).

E/N_o is $(S/N)_{out}$
for example, for a bit error rate of 10^{-4} a S/N ratio of 12.3 dB is required.

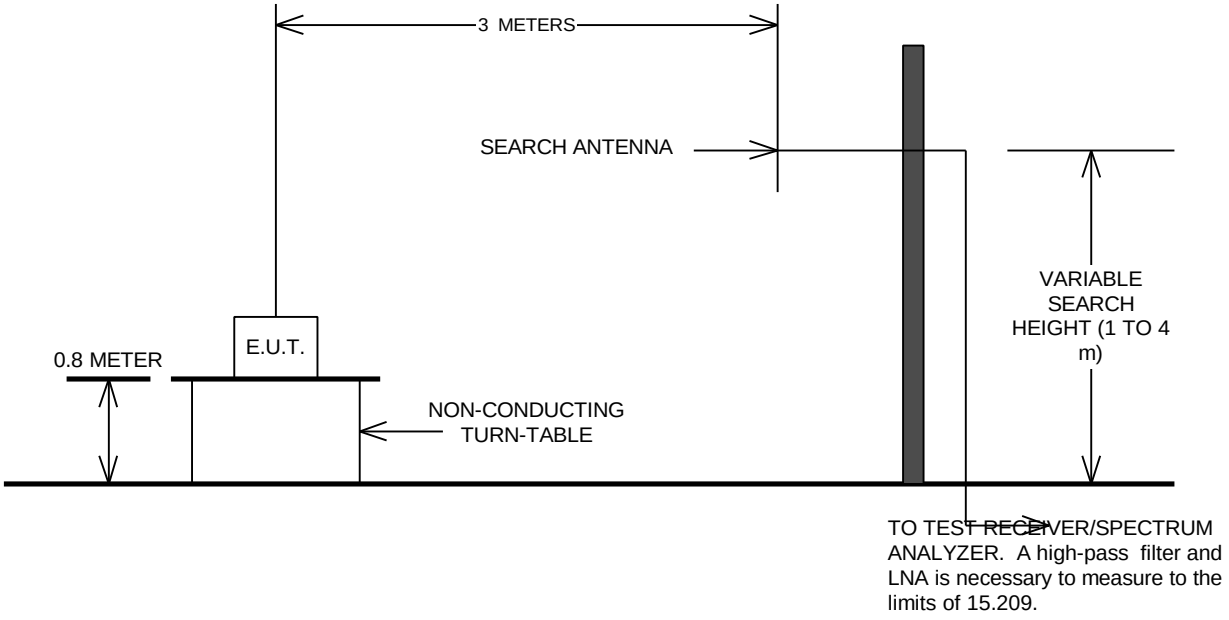
$L_{sys\ (system\ losses)}$ is assumed to be 2 dB.

Therefore $G_p = Mj + (S/N)_{out} + L_{sys}$

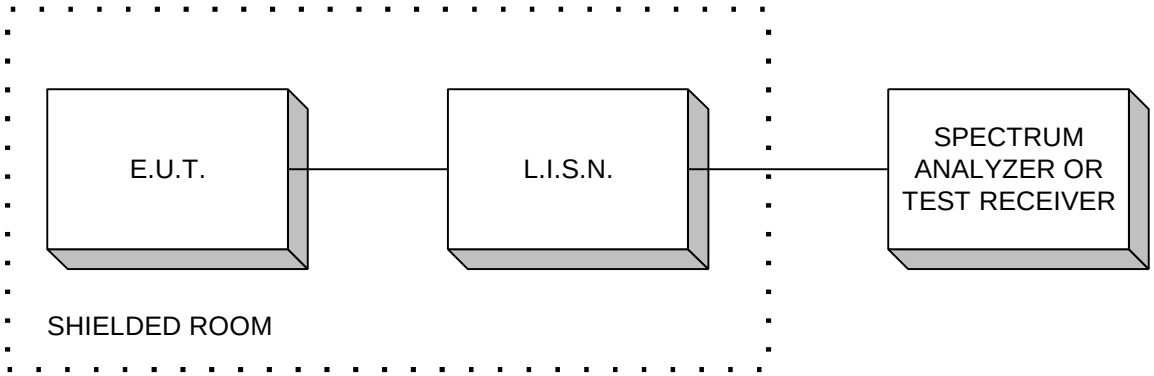
Measurement performed at a channel in the center of the operating band of the EUT.

ANNEX B - TEST DIAGRAMS

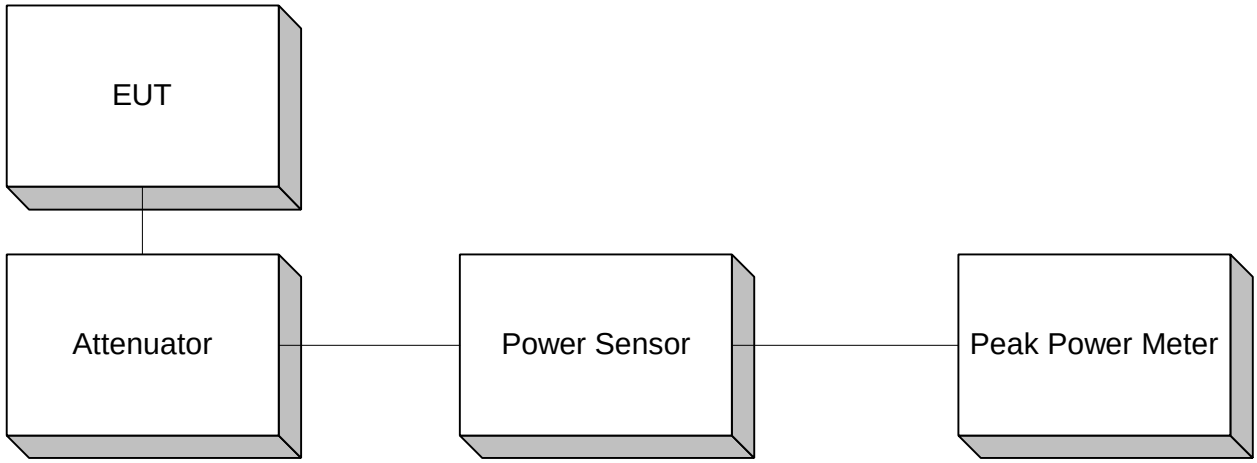
Test Site For Radiated Emissions



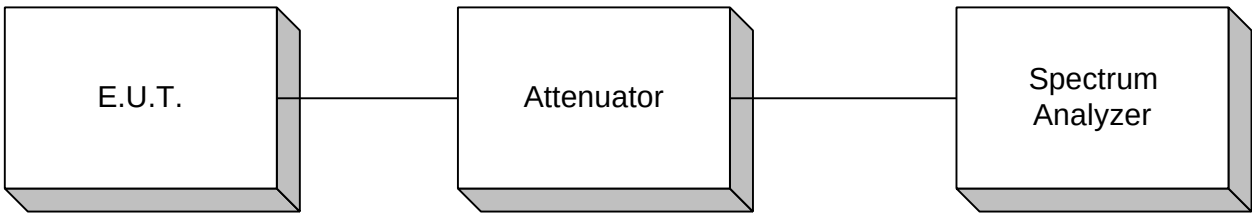
Conducted Emissions



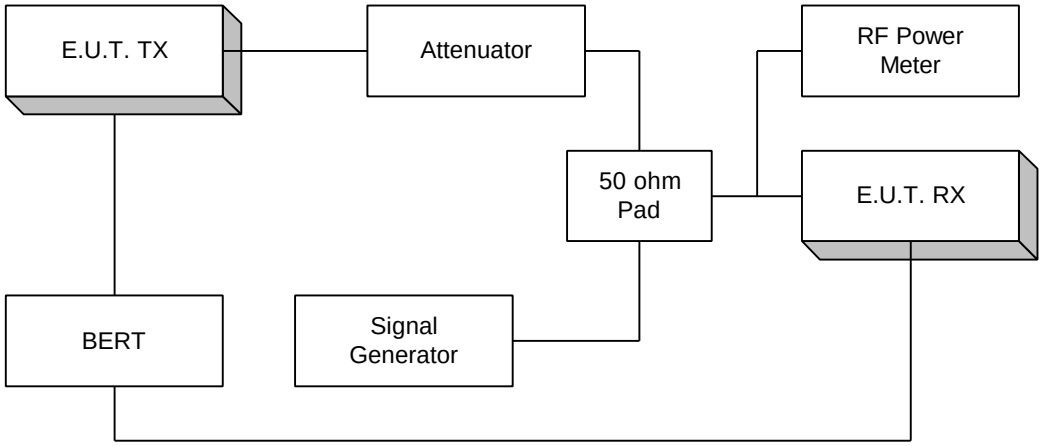
Peak Power At Antenna Terminals



Minimum 6 dB Bandwidth
Peak Power Spectral Density
Spurious Emissions (conducted)



Processing Gain



NOTE: This is a typical setup. The setup may vary slightly since many devices have BER test functions built into the device.