



Nemko Test Report: 6L0791RUS1

Applicant: STEMCO, LP
300 Industrial Blvd.
Longview, Texas 75604
USA

**Equipment Under Test:
(E.U.T.)** Active TracBat Model 6049999

In Accordance With: **FCC Part 15, Subpart C, 15.247**
Digital Transmission System Transmitter

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

TESTED BY:  **DATE:** 21 December 2006
David Light, Senior Wireless Engineer

APPROVED BY:  **DATE:** 21 December 2006
Abe Cox, Key Account Manager

Number of Pages: 31

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EQUIPMENT: Active TracBat

Section 1. Summary of Test Results

Manufacturer: STEMCO, LP

Model No.: Active TracBat 6049999

Serial No.: None

General: **All measurements are traceable to national standards.**

These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15, Subpart C, Paragraph 15.247 for Digital Transmission Systems. Radiated tests were conducted in accordance with ANSI C63.4-2003. 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".



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Summary Of Test Data

NAME OF TEST	PARA. NO.	RESULT
Powerline Conducted Emissions	15.207(a)	NA
Minimum 6 dB Bandwidth	15.247(a)(2)	Complies
Maximum Peak Power Output	15.247(b)(3)	Complies
Spurious Emissions	15.247(d)/15.209(a)	Complies
Peak Power Spectral Density	15.247(e)	Complies

Footnotes:

The EUT is battery powered.

Section 2. Equipment Under Test (E.U.T.)**General Equipment Information**

Frequency Band (MHz):	902-928	2400-2483.5	5725-5850
	☐	☒	☐

Operating Frequency of Test Sample: 2405 to 2481 MHz

6 dB Bandwidth: 900 kHz

Supply Voltage: 3.6 Vdc

User Frequency Adjustment: Software controlled

Description of EUT

The Active TracBat (mileage counter) operates by sending out a GFSK DSSS data stream which encodes the mileage and other pertinent data at a 1 MBit rate using a 64 bit PN sequence.

EQUIPMENT: Active TracBat

Section 3. Occupied Bandwidth

NAME OF TEST: Occupied Bandwidth	PARA. NO.: 15.247(a)(2)
TESTED BY: David Light	DATE: 21 Dec 2006

Test Results: Complies.

Measurement Data: See 6 dB BW plot

Measured 6 dB bandwidth:

900 KHZ

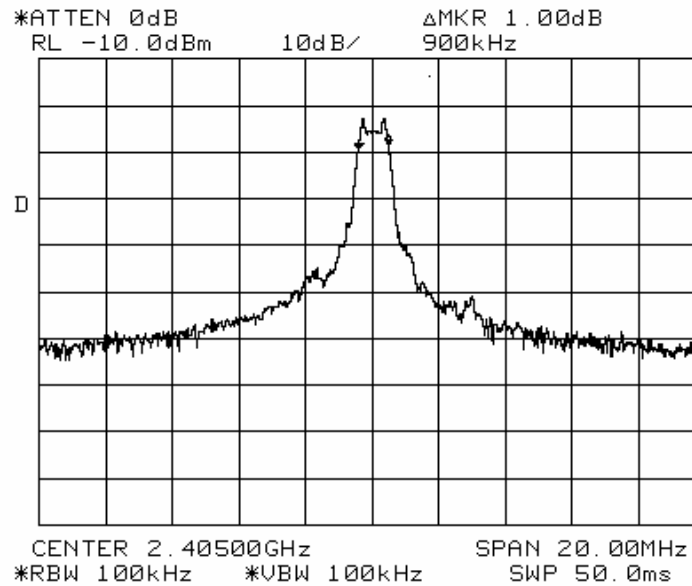
Test Conditions: 45 %RH
22 °C

Measurement Uncertainty: $\pm 1 \times 10^{-7}$ ppm

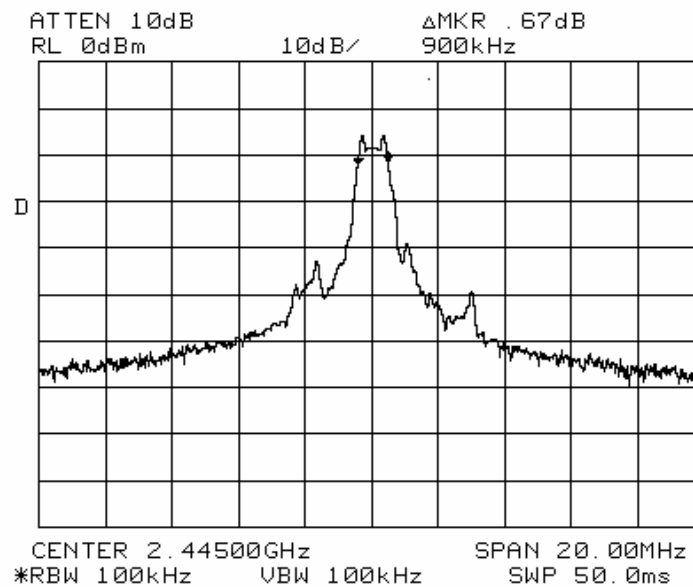
Test Equipment Used: 1464-1016-1484-1485-993

Test Data – Occupied Bandwidth

Low channel



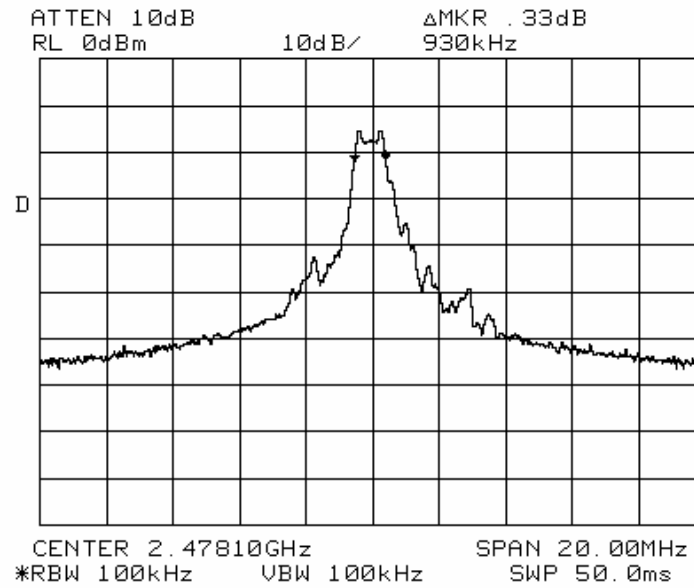
Mid Channel



EQUIPMENT: Active TracBat

Test Data – Occupied Bandwidth

High Channel



EQUIPMENT: Active TracBat**Section 4. Maximum Peak Output Power**

NAME OF TEST: Maximum Peak Output power	PARA. NO.: 15.247(b)(3)
TESTED BY: David Light	DATE: 21 Dec 2006

Test Results: Complies.**Measurement Data:** Refer to attached data**Test Conditions:** 45 %RH
22 °C**Measurement Uncertainty:** +/-1.7 dB**Test Equipment Used:** 1464-1484-1485-1016-993

- ☐ This device was tested at +/- 15% input power per 15.31(e), with no variation in output power.
- ☒ For battery powered equipment, the device was tested with a fresh battery per 15.31(e).
- ☒ The device was tested on three channels per 15.31(l).
- ☒ This test was performed radiated.
- ☒ The device was tested on three orthogonal axis'.

EQUIPMENT: Active TracBat**Test Data – Peak Power**

Frequency (MHz)	Meter Reading (dBm)	Substitution Level (dBm)		Pre-Amp Gain (dB)	Substitution Antenna Gain (dBd)	EIRP (dBm)	Limit (dBm)	Margin (dB)	Polarity	Comments
										RBW=VBW=1 MHz
										High Channel
2481	-13.7	-11.6		32.8	7.8	-3.8	36.0	-39.8200	V	
2481	-18.0	-14.0		32.8	7.8	-6.2	36.0	-42.2200	H	
										Mid Channel
2445	-15.8	-13.7		32.8	7.8	-5.9	36.0	-41.9000	V	
2445	-19.0	-15.0		32.8	7.8	-7.2	36.0	-43.2000	H	
										Low Channel
2405	-15.7	-13.6		32.8	7.8	-5.8	36.0	-41.8000	V	
2405	-18.9	-14.9		32.8	7.8	-7.1	36.0	-43.1000	H	
Notes: _____										

Section 5 Spurious Emissions

NAME OF TEST: Spurious Emissions at Antenna Terminals PARA. NO.: 15.247 (d)

TESTED BY: David Light

DATE: 21 Dec 2006

Test Results: Complies.

Measurement Data: See attached plots.

Test Conditions: 45 %RH
22 °C

Measurement Uncertainty: +/-3.6 dB

Test Equipment Used: 1464-1484-1485-1016-993791-759-1195

Notes:

- ☒ For handheld devices, the EUT was tested on three orthogonal axis'
- ☒ The device was tested from 30 MHz to the tenth harmonic of the highest fundamental frequency per 15.33
- ☒ The device was tested on three channels per 15.31(l).
- ☐ No emissions were detected within 20 dB of the specification limit therefore none are reported per 15.31(o). Band edge data is presented below.

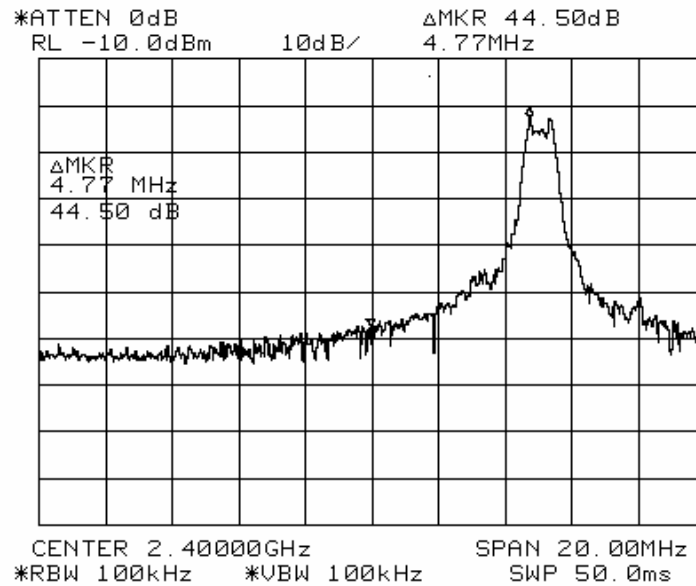
Analyzer Settings:

RBW=VBW=100 kHz below 1000 MHz
RBW=VBW=1 MHz above 1000 MHz
Peak Detector

Duty cycle correction = $20 \log (20.796/100) = -13.6 \text{ dB}$
See plots on page 16

Test Data – Spurious Emissions at Antenna Terminals

Lower Band Edge



EQUIPMENT: Active TracBat

Test Data – Spurious Emissions

Low Channel

Measurement Data:											
Test Distance: 3 Meters											
#	Freq	Rdng	Cable Duty Cycle	Cable	Pre-A	Horn	Dist	Corr	Spec	Margin	Polar
	MHz	dBμV	dB	dB	dB	dB	Table	dBμV/m	dBμV/m	dB	Ant
	4804.670	59.0	+1.0	+3.2	-32.5	+33.1	+0.0	63.8	74.0	-10.2	Vert
	Peak – Lo Channel										
	6400.826	47.8	+1.3	+3.9	-30.9	+35.0	+0.0	57.1	74.0	-16.9	Vert
	Peak – Lo Channel										
	7210.145	54.8	+1.2	+3.9	-32.1	+35.8	+0.0	63.6	74.0	-10.4	Vert
	Peak – Lo Channel										
	1601.333	60.2	+0.6	+1.9	-32.0	+25.3	+0.0	42.4	54.0	-11.6	Vert
	Avg. – Lo Channel										
	4804.670	59.0	+1.0	+3.2	-32.5	+33.1	+0.0	50.2	54.0	-3.8	Vert
	Avg. – Lo Channel										
	6400.826	47.8	+1.3	+3.9	-30.9	+35.0	+0.0	43.5	54.0	-10.5	Vert
	Avg. – Lo Channel										
	7210.145	54.8	+1.2	+3.9	-32.1	+35.8	+0.0	50.0	54.0	-4.0	Vert
	Avg. – Lo Channel										
	4804.670	60.0	+1.0	+3.2	-32.5	+33.1	+0.0	64.8	74.0	-9.2	Horiz
	Peak – Lo channel										
	1600.167	54.3	+0.6	+1.9	-32.0	+25.2	+0.0	36.4	54.0	-17.6	Horiz
	Avg. – Lo Channel										
	4804.670	60.0	+1.0	+3.2	-32.5	+33.1	+0.0	51.2	54.0	-2.8	Horiz
	Avg. – Lo Channel										

EQUIPMENT: Active TracBat

Test Data – Spurious Emissions

Mid Channel

Test Distance: 3 Meters											
Measurement Data:											
#	Freq	Rdng	Cable Duty Cycle	Cable	Pre-A	Horn	Dist	Corr	Spec	Margin	Polar
	MHz	dBμV	dB	dB	dB	dB	Table	dBμV/m	dBμV/m	dB	Ant
4887.101	59.2	+1.0	+3.3	+32.6	+33.4	+0.0	64.3	74.0	-9.7	Vert	
Mid Ch - Peak											
7337.538	53.3	+1.2	+4.0	+32.3	+35.8	+0.0	62.0	74.0	-12.0	Vert	
Mid Ch - Peak											
4887.101	59.2	+1.0	+3.3	+32.6	+33.4	+0.0	50.7	54.0	-3.3	Vert	
Mid Ch - Average											
7337.538	53.3	+1.2	+4.0	+32.3	+35.8	+0.0	48.4	54.0	-5.6	Vert	
Mid Ch - Average											
4887.101	61.5	+1.0	+3.3	+32.6	+33.4	+0.0	66.6	74.0	-7.4	Horiz	
Mid Ch - Peak											
7330.043	47.8	+1.2	+4.0	+32.3	+35.8	+0.0	56.5	74.0	-17.5	Horiz	
Mid Ch - Peak											
4887.101	61.5	+1.0	+3.3	+32.6	+33.4	+0.0	53.0	54.0	-1.0	Horiz	
Mid Ch - Average											
7330.043	47.8	+1.2	+4.0	+32.3	+35.8	+0.0	42.9	54.0	-11.1	Horiz	
Mid Ch - Average											

Test Data – Spurious Emissions

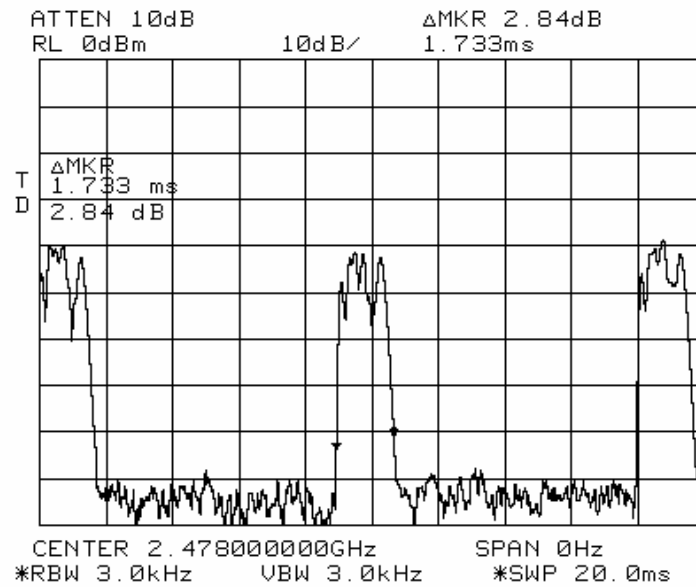
High Channel

Measurement Data:							Test Distance: 3 Meters				
#	Freq MHz	Rdng dBμV	Cable dB	Cable dB	Pre-A dB	Horn dB	Dist Table	Corr dBμV/m	Spec dBμV/m	Margin dB	Polar Ant
	1651.757	60.2	+0.7	+1.9	+31.9	+25.7	+0.0	56.6	74.0	-17.4	Vert
	Hi Ch - Peak										
	2483.500	60.0	+0.8	+2.3	+32.8	+29.0	+0.0	59.3	74.0	-14.7	Vert
	Hi Ch – Peak										
	4947.050	53.3	+1.0	+3.3	+32.6	+33.6	+0.0	58.6	Band edge 74.0	-15.4	Vert
	Hi Ch – Peak										
	7434.956	48.2	+1.2	+4.1	+32.5	+35.9	+0.0	56.9	74.0	-17.1	Vert
	Hi Ch – Peak										
	1651.757	60.2	+0.7	+1.9	+31.9	+25.7	+0.0	43.0	54.0	-11.0	Vert
	Hi Ch - Average										
	2483.500	60.0	+0.8	+2.3	+32.8	+29.0	+0.0	45.7	54.0	-8.3	Vert
	Hi Ch – Average										
	4947.050	53.3	+1.0	+3.3	+32.6	+33.6	+0.0	45.0	Band edge 54.0	-9.0	Vert
	Hi Ch – Average										
	7434.956	48.2	+1.2	+4.1	+32.5	+35.9	+0.0	43.3	54.0	-10.7	Vert
	Hi Ch – Average										
	4947.050	59.2	+1.0	+3.3	+32.6	+33.6	+0.0	64.5	74.0	-9.5	Horiz
	Hi Ch – Peak										
	1652.750	56.8	+0.7	+1.9	+31.9	+25.7	+0.0	39.6	54.0	-14.4	Horiz
	Hi Ch – Average										
	4947.050	59.2	+1.0	+3.3	+32.6	+33.6	+0.0	50.9	54.0	-3.1	Horiz
	Hi Ch - Average										
			-13.6								

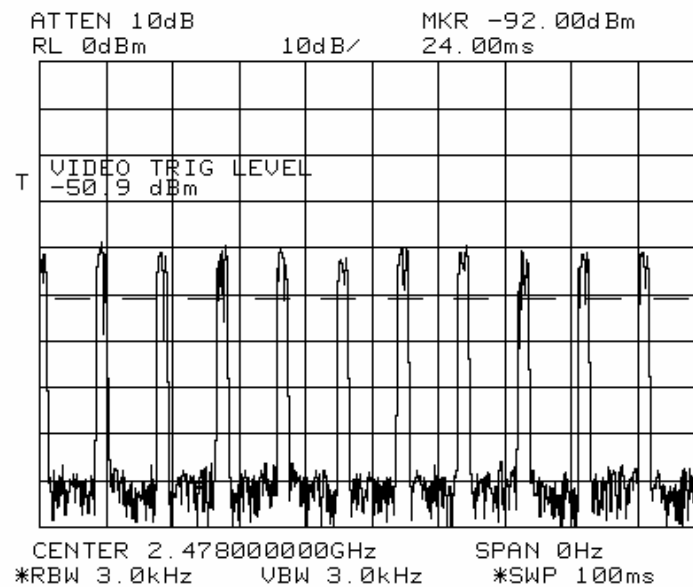
EQUIPMENT: Active TracBat

Duty Cycle

Pulse = 1.733 mS each



12 Pulses in 100 mS



Duty cycle correction = $20 \log (20.796/100) = -13.6 \text{ dB}$

EQUIPMENT: Active TracBat

Radiated Photographs



EQUIPMENT: Active TracBat

Section 6. Peak Power Spectral Density

NAME OF TEST: Peak Power Spectral Density	PARA. NO.: 15.247(e)
TESTED BY: David Light	DATE: 21 Dec 2006

Test Results: Complies.

Measurement Data: See attached data..

Test Conditions: 45 %RH
22 °C

Measurement Uncertainty: +/-1.7 dB

Test Equipment Used: 1464-1484-1485-1016-993

Note: This test was performed radiated.

EQUIPMENT: Active TracBat**Peak Power Spectral Density**

Frequency (MHz)	Meter Reading (dBm)	Substitution Level (dBm)		Pre-Amp Gain (dB)	Substitution Antenna Gain (dBd)	EIRP (dBm)			Polarity	Comments
										Density
										RBW=VBW=3 kHz
										Span = 1 MHz
										Sweep = 350 seconds
2478	-27.5	-25.4		32.8	7.8	-17.6			V	High Channel
2445	-27.8	-25.7		32.8	7.8	-17.9			V	Mid Channel
2405	-29.2	-27.1		32.8	7.8	-19.3			V	Low Channel
Notes: _____										

EQUIPMENT: Active TracBat

Section 7. Test Equipment List

Nemko ID	Description	Manufacturer Model Number	Serial Number	Calibration Date	Calibration Due
1464	Spectrum analyzer	Hewlett Packard 8563E	3551A04428	01/14/05	01/15/07
1484	Cable	Storm PR90-010-072	N/A	10/02/06	10/02/07
1485	Cable	Storm PR90-010-216	N/A	10/02/06	10/02/07
1016	Pre-Amp	HEWLETT PACKARD 8449A	2749A00159	04/20/06	04/20/07
791	PREAMP, 25dB	Nemko USA, Inc. LNA25	398	04/20/06	04/20/07
759	ANTENNA, LOG PERIODIC	A.H. SYSTEMS SAS-200/510	556	02/13/06	02/13/07
1195	ANTENNA,BICONICAL	A.H. SYSTEMS SAS-200/542	235	02/10/06	02/10/07
993	Horn antenna	A.H. Systems SAS-200/571	XXX	08/01/05	08/02/07

ANNEX A - TEST DETAILS

NAME OF TEST: Powerline Conducted Emissions

PARA. NO.: 15.207(a)

Minimum Standard: §15.207 Conducted limits.

(a) Except as shown in paragraphs (b) and (c) of this section, for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in the following table, as measured using a 50 mH/50 ohms line impedance stabilization network (LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

Frequency of Conducted Emission (MHz)	Limit (dBmV)	
	Quasi-peak	Average
0.15-0.5	66 to 56*	56 to 46*
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency.

(b) The limit shown in paragraph (a) of this section shall not apply to carrier current systems operating as intentional radiators on frequencies below 30 MHz. In lieu thereof, these carrier current systems shall be subject to the following standards:

(1) For carrier current systems containing their fundamental emission within the frequency band 535-1705 kHz and intended to be received using a standard AM broadcast receiver: no limit on conducted emissions.

(2) For all other carrier current systems: 1000 mV within the frequency band 535-1705 kHz, as measured using a 50 mH/50 ohms LISN.

(3) Carrier current systems operating below 30 MHz are also subject to the radiated emission limits as provided in §15.205 and §§15.209, 15.221, 15.223, 15.225 or 15.227, as appropriate.

(c) Measurements to demonstrate compliance with the conducted limits are not required for devices which only employ battery power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines. Devices that include, or make provision for, the use of battery chargers which permit operating while charging, AC adaptors or battery eliminators or that connect to the AC power lines indirectly, obtaining their power through another device which is connected to the AC power lines, shall be tested to demonstrate compliance with the conducted limits.

EQUIPMENT: Active TracBat

NAME OF TEST: Occupied Bandwidth	PARA. NO.: 15.247(a)(2)
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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)(3)

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.

Substitution Antenna Method for Integral Antennas:

The peak field strength of the carrier is measured in a worst-case configuration with a RBW > 5 times the occupied bandwidth of the transmitted waveform. For cases where the RBW of the test instrument is not sufficient, the power is measured using a peak power meter instead of the spectrum analyzer.

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

EQUIPMENT: Active TracBat

NAME OF TEST: Occupied Bandwidth

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

Minimum Standard:

Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

Method Of Measurement:

The spectrum analyzer is set as follows:

RBW = VBW = 100 kHz.

Span: Sufficient to display 6 dB bandwidth

LOG dB/div.: 10 dB

Sweep: Auto

Number of channels tested:

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

NAME OF TEST: Spurious Emissions(conducted)

PARA. NO.: 15.247(d)

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

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.

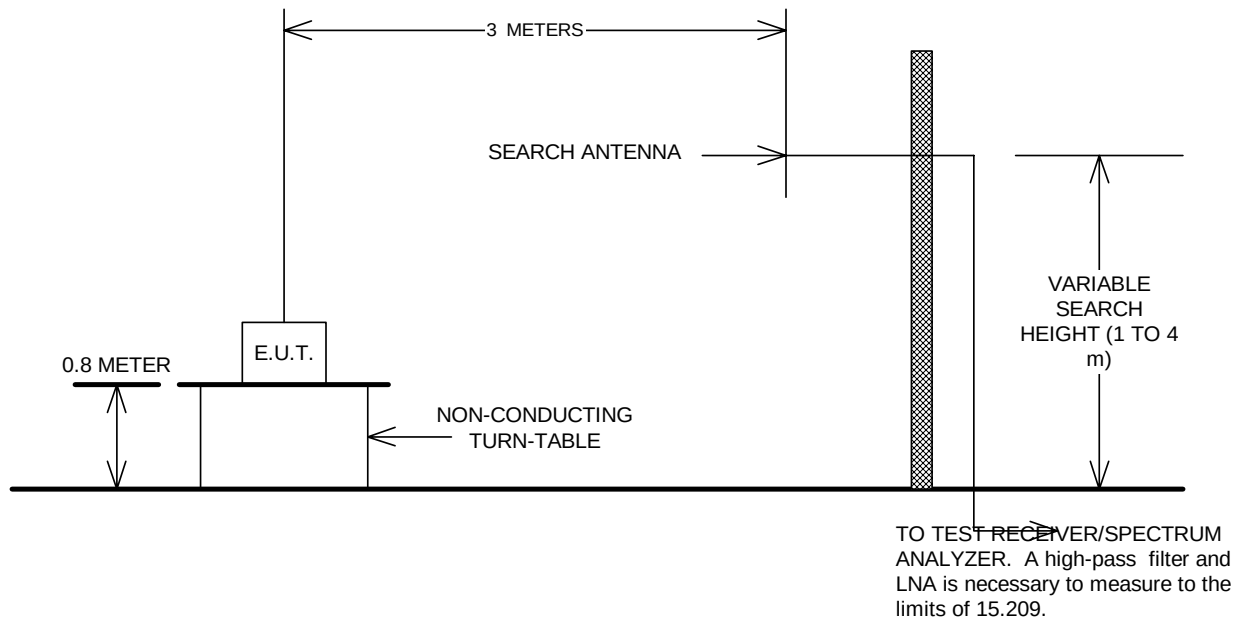
Number of channels tested:

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

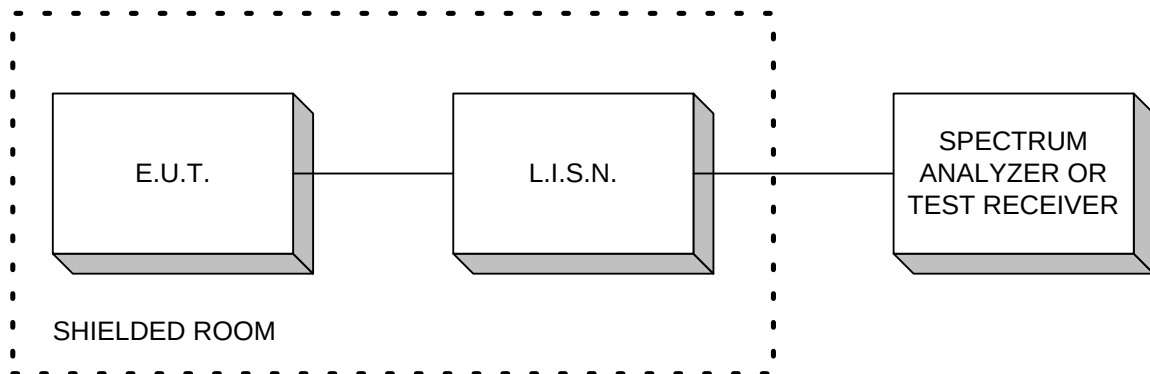
ANNEX B - TEST DIAGRAMS

EQUIPMENT: Active TracBat

Test Site For Radiated Emissions

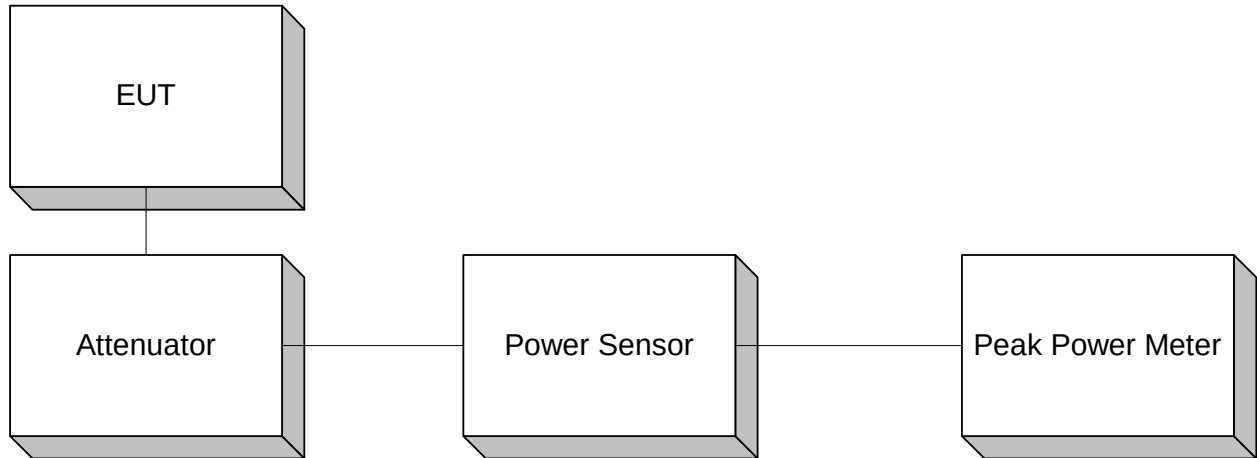


Conducted Emissions



EQUIPMENT: Active TracBat

Peak Power At Antenna Terminals



Note: A spectrum analyzer may be substituted for Peak Power Meter given that the measurement bandwidth is sufficient to capture the 60 dB bandwidth of the transmitter.

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

