Nemko Test Report:	10233152RUS1
Applicant:	Weathermatic 3301 Kingsley Road Garland, TX 75041 USA
Equipment Under Test: (E.U.T.)	SLW5
FCC ID#	OLPSLW5900MZ
In Accordance With:	**FCC Part 15, Subpart C, 15.247** Frequency Hopping Transmitters
Tested By:	Nemko USA Inc. 802 N. Kealy Lewisville, Texas 75057-3136

TESTED BY: _____ **DATE:** **16 November 2012**
David Light, Senior Wireless Engineer

APPROVED BY: _____ **DATE:** **29 April 2013**
Michael Cantwell, Reviewer

Total Number of Pages: 35

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Section 1. Summary of Test Results

Manufacturer: Weathermatic

Model No.: SLW5

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 Frequency Hopping Spread Spectrum devices. Radiated tests were conducted is 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".

NVLAP Lab Code 100426-0

Summary Of Test Data

NAME OF TEST	PARA. NO.	RESULT
Powerline Conducted Emissions	15.207(a)	NA
Channel Separation	15.247(a)(1)	Complies
Time of Occupancy	15.247(a)(1)	Complies
20 dB Occupied Bandwidth	15.247(a)(1)	Complies
Peak Power Output	15.247(b)	Complies
Spurious Emissions (Antenna Conducted)	15.247(d)	Complies
Spurious Emissions (Radiated)	15.247(d)	Complies

Footnotes:

The device is battery powered.

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

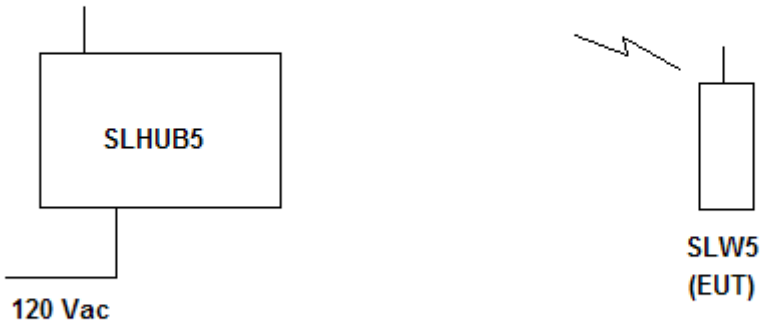
General Equipment Information

Frequency Band:	☒ 902 – 928 MHz ☐ 2400 – 2483.5 MHz ☐ 5725 – 5850 MHz
Operating Frequency Range:	902.35 to 927.6 MHz
Number of Channels:	50
Channel Spacing:	513 kHz
Channel Bandwidth:	178 kHz
User Frequency Adjustment:	None
Input Power:	3 Vdc (2 AAA batteries)

Description of EUT

The SLW 5 is an outdoor weather station that transmits weather conditions to the SLHUB5 to control lawn irrigation system.

System Diagram



Section 3. Channel Separation

NAME OF TEST: Channel Separation	PARA. NO.: 15.247(a)(1)
TESTED BY: David Light	DATE: 15 November 2012

Test Results: Complies.

Measurement Data: See 20 dB BW plot

Measured 20 dB bandwidth: 178 kHz
Channel Separation: 513 kHz

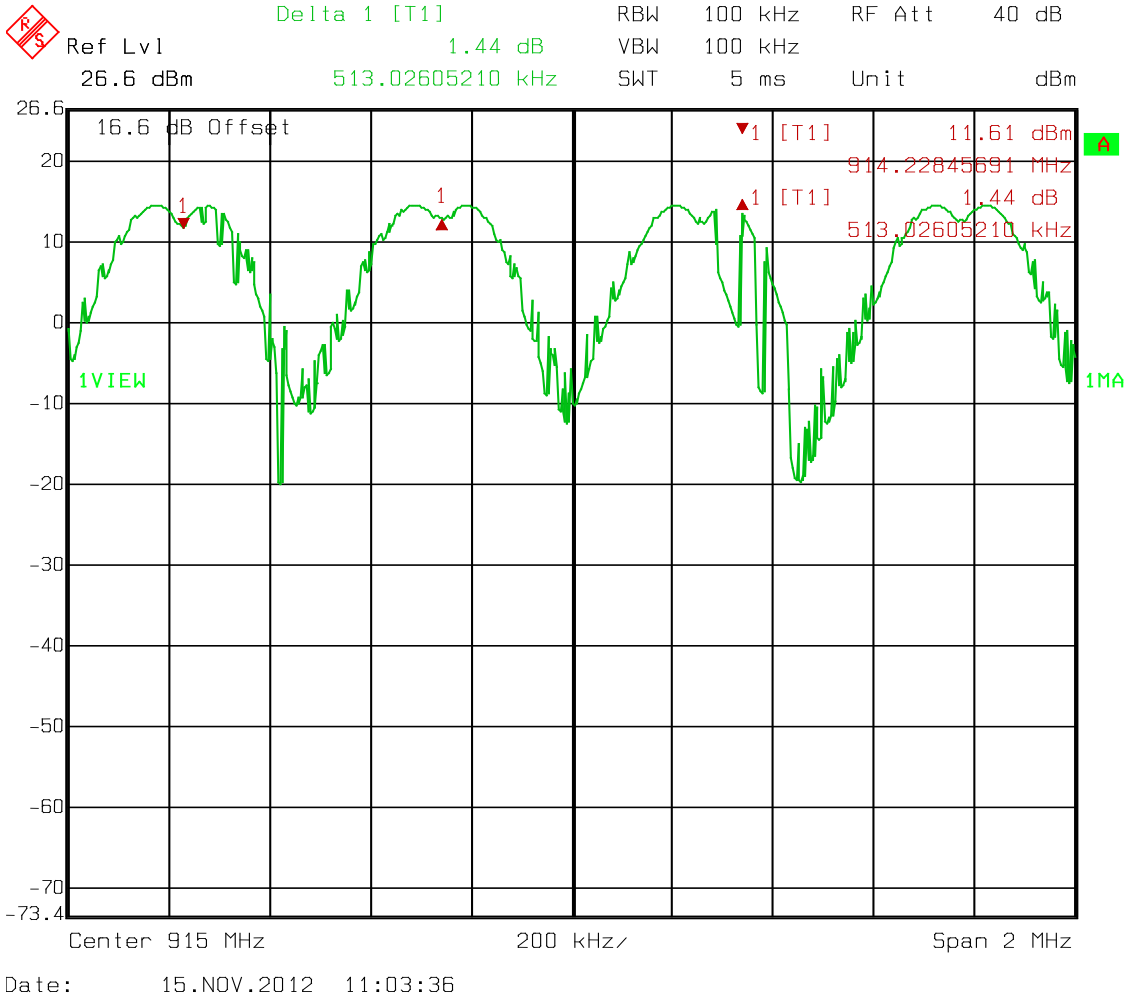
Equipment Used: 1036-1082-1472

Measurement Uncertainty: $1X10^{-7}$ppm

Temperature: 20 °C

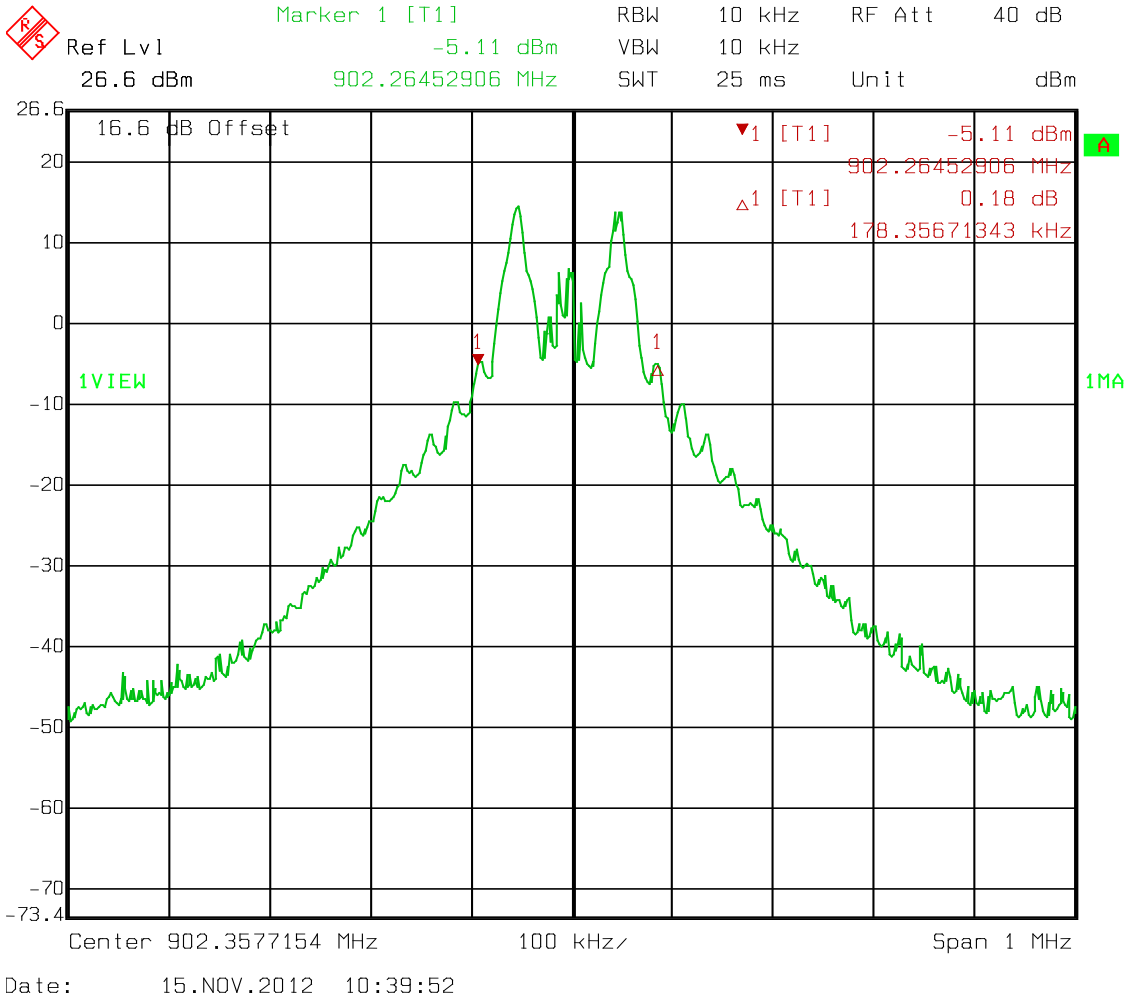
Relative Humidity: 31 %

Test Data – Channel Separation



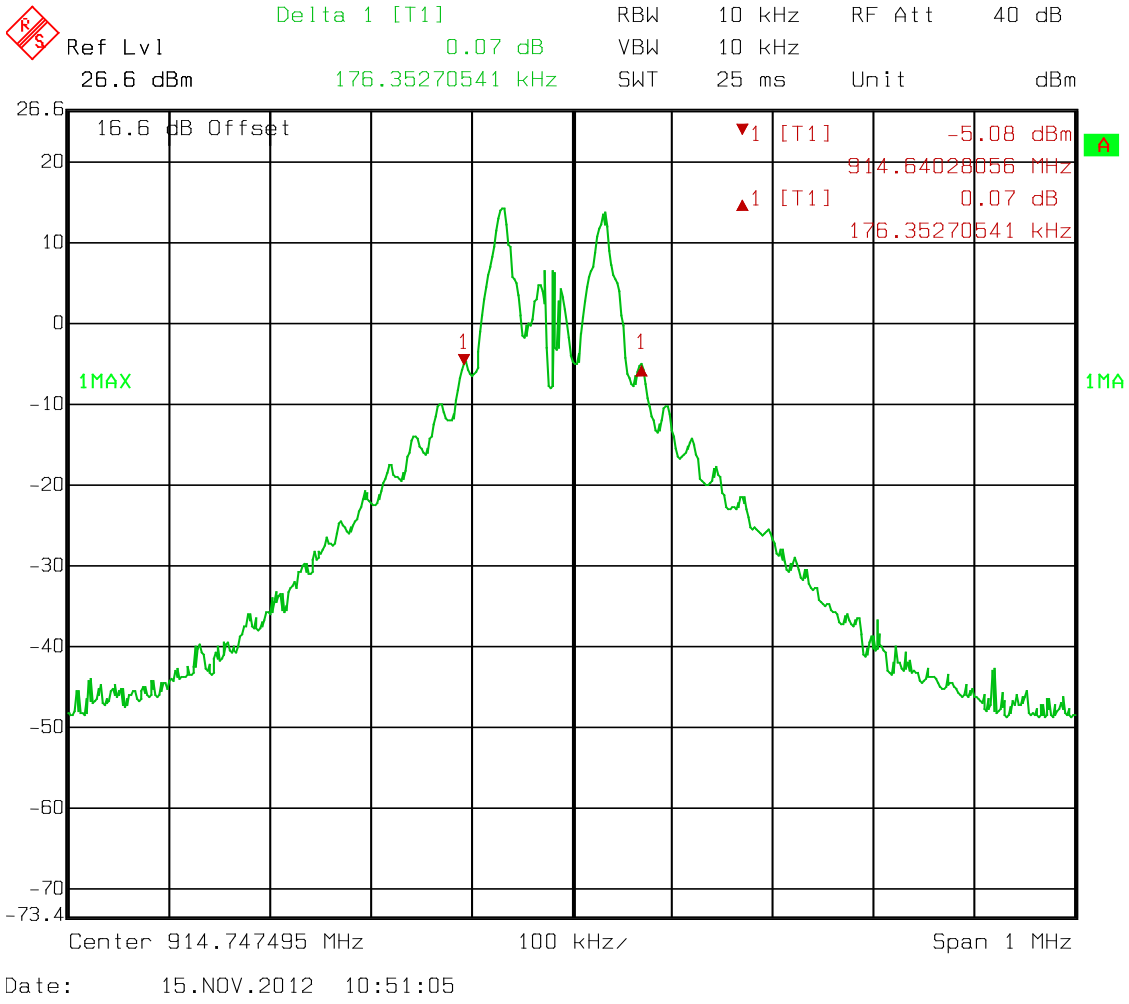
Test Data – 20 dB Bandwidth

Low Channel



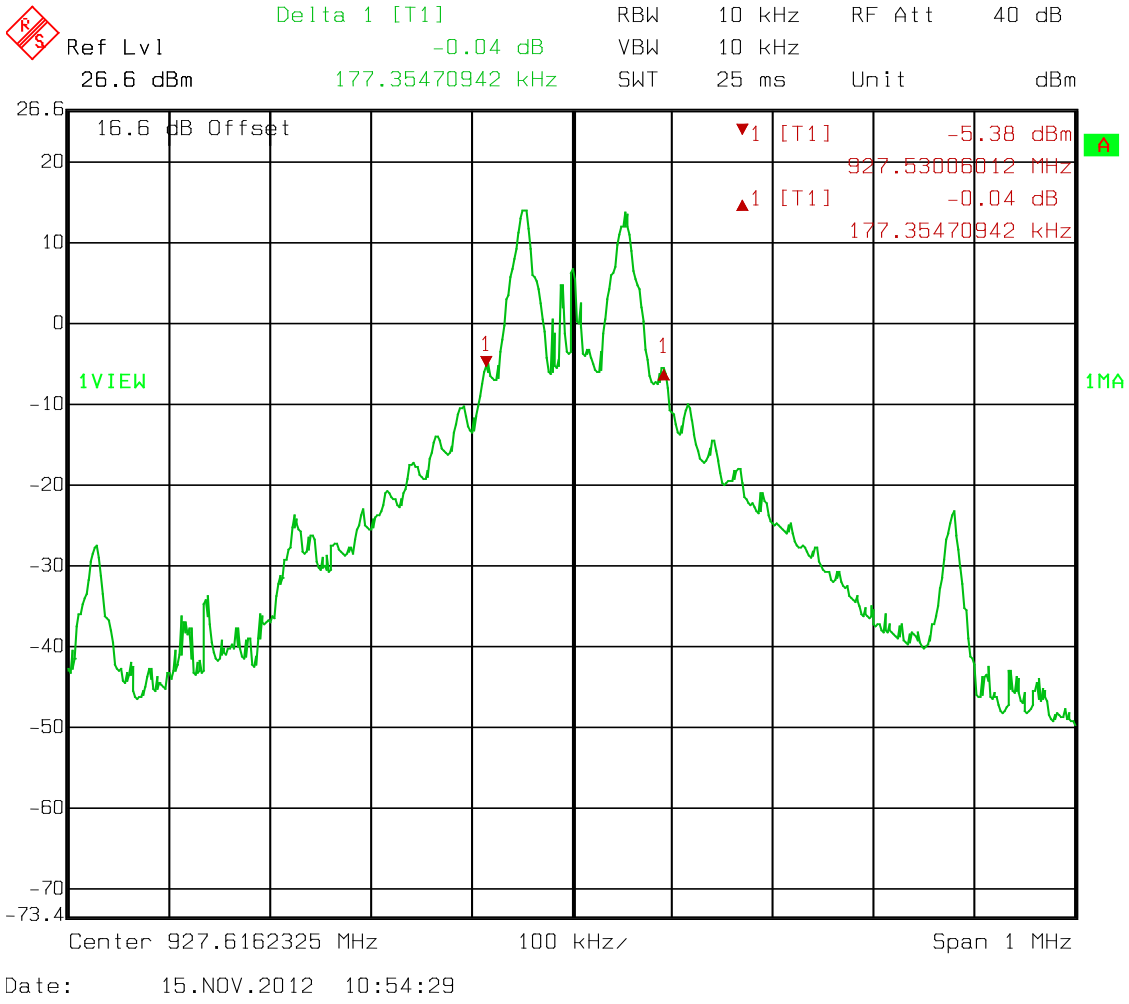
Test Data – 20 dB Bandwidth

Mid Channel



Test Data – 20 dB Bandwidth

High Channel



Section 4. Time of Occupancy

NAME OF TEST: Time of Occupancy	PARA. NO.: 15.247(a)(1)
TESTED BY: David Light	DATE: 15 November 2012

Test Results: Complies.

Measurement Data: See attached plots

Maximum Dwell Time On Any Channel: 29.7 ms in 20 seconds

Equipment Used: 1036-1082-1472

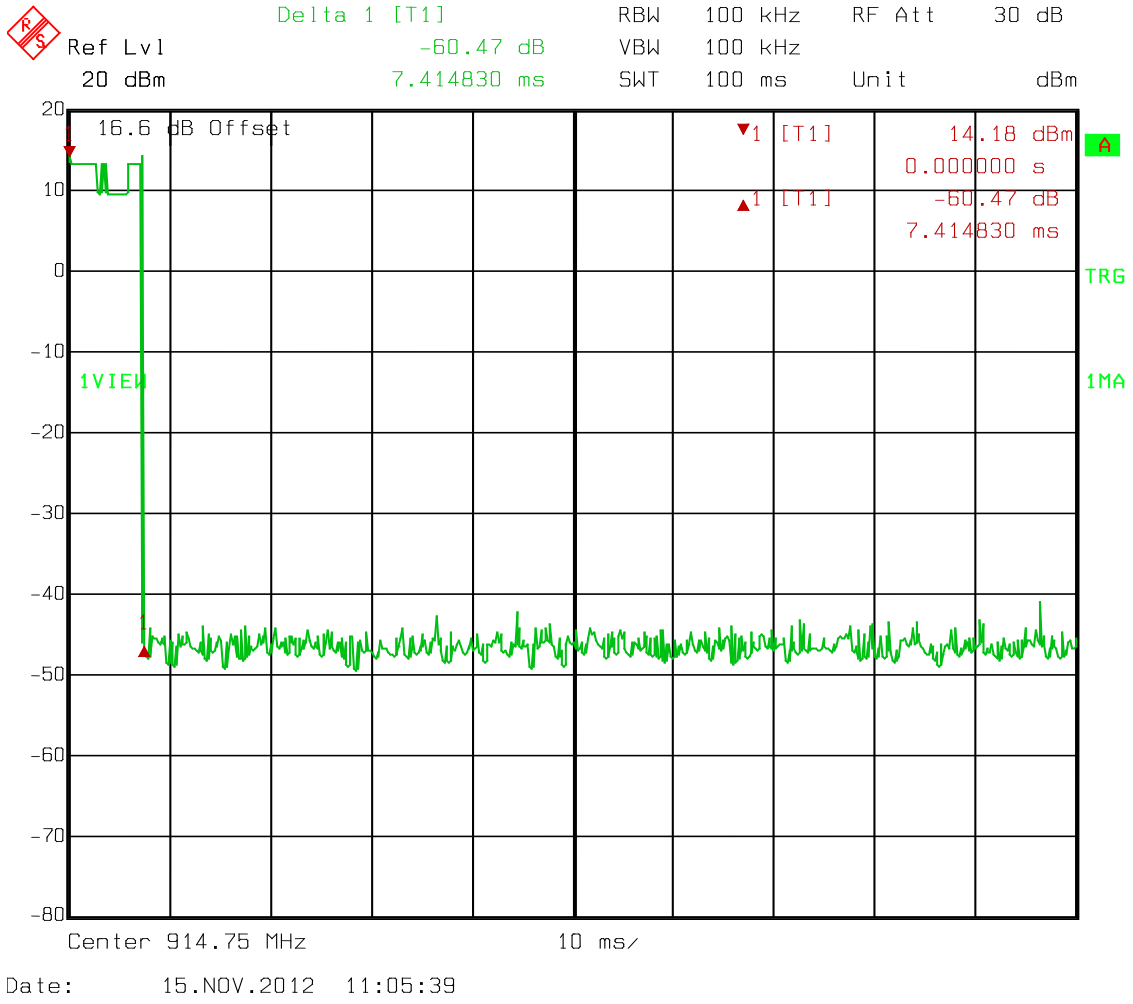
Measurement Uncertainty: $1X10^{-7}$ppm

Temperature: 20 °C

Relative Humidity: 31 %

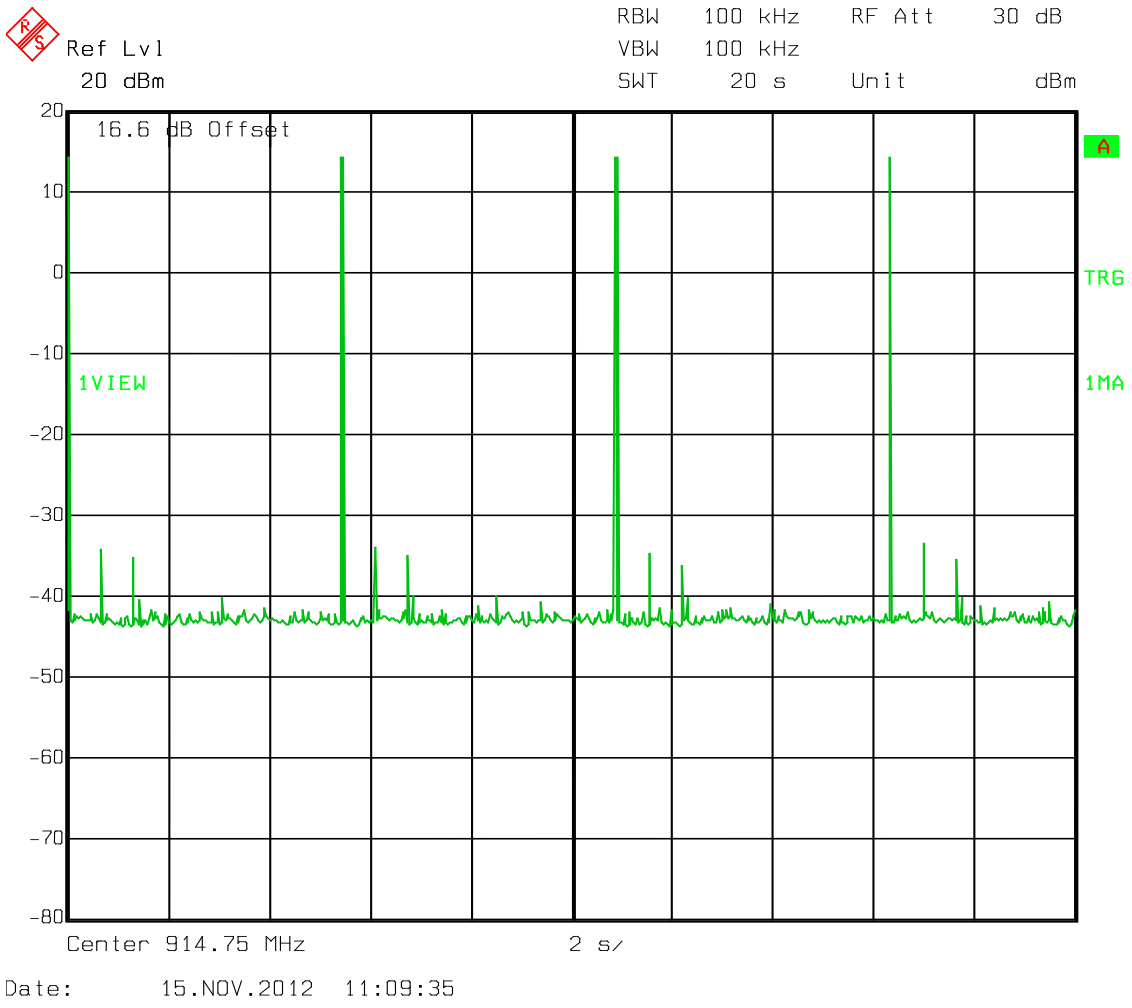
Test Data – Time of Occupancy

Pulse Width



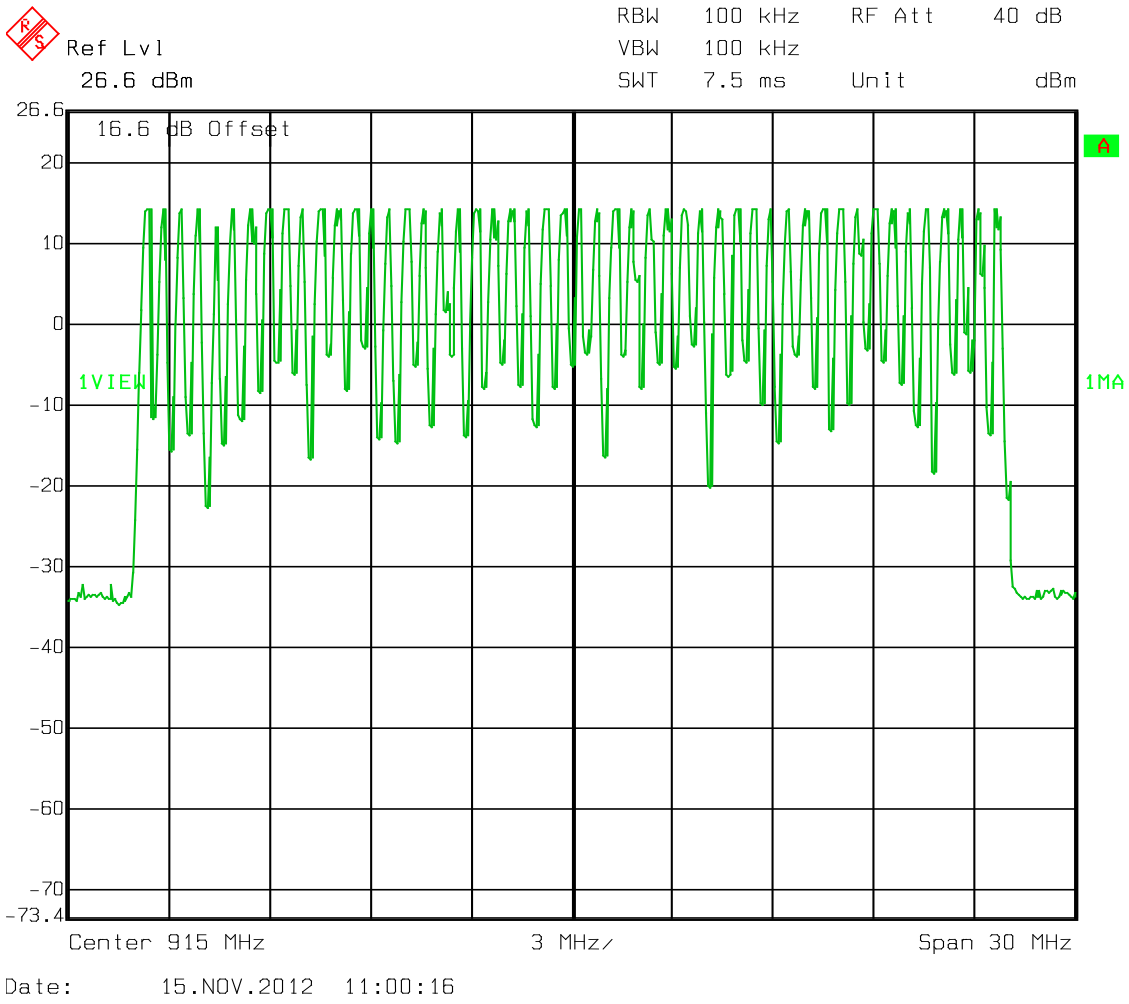
Test Data – Time of Occupancy

Pulse Width
4 hops at 7.42 ms each = 29.68 ms within 20 seconds
Limit = 400 ms within 20 seconds



Test Data – Time of Occupancy

Number of hopping channels = 50



Section 5. Peak Power Output

NAME OF TEST: Peak Power Output	PARA. NO.: 15.247 (b)
TESTED BY: David Light	DATE: 15 November 2012

Test Results: Complies.

Measurement Data: See attached plots.

Detachable antenna? ☐ Yes ☒ No
If yes, state the type of non-standard connector used:
The antenna is permanently attached to the enclosure. A temporary connector was used for testing.

Frequency (MHz)	Peak Power (dBm)	Peak Power (W)	Antenna Type	Gain (dBi)	E.I.R.P. (dBm)	E.I.R.P. (W)
902.35	14.6	0.029	Monopole	0	14.6	0.029
914.75	14.4	0.028	Monopole	0	14.4	0.028
927.60	14.3	0.027	Monopole	0	14.3	0.027
Maximum EIRP (W): 0.029						

☒ 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.

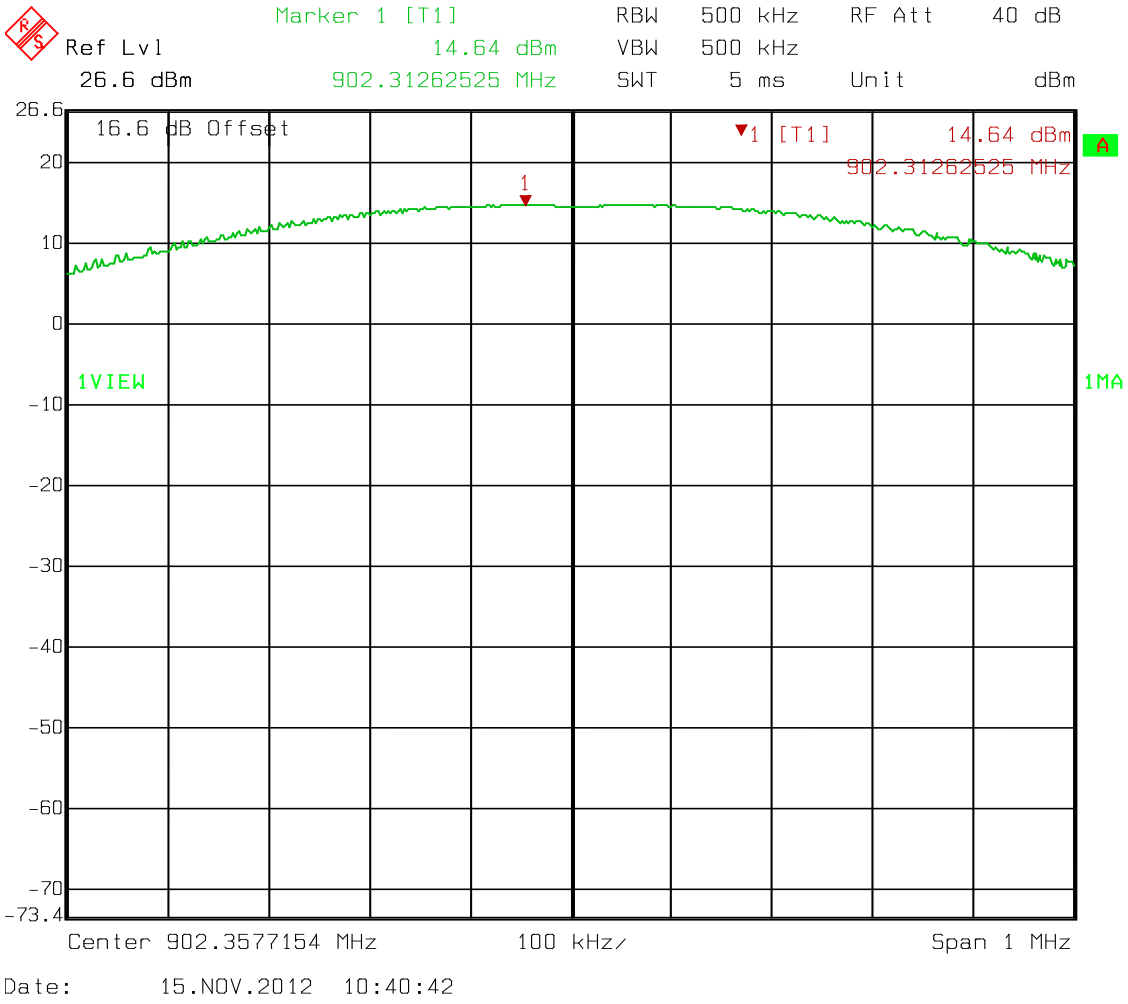
Equipment Used: 1036-1082-1472

Measurement Uncertainty: 1.7 dB

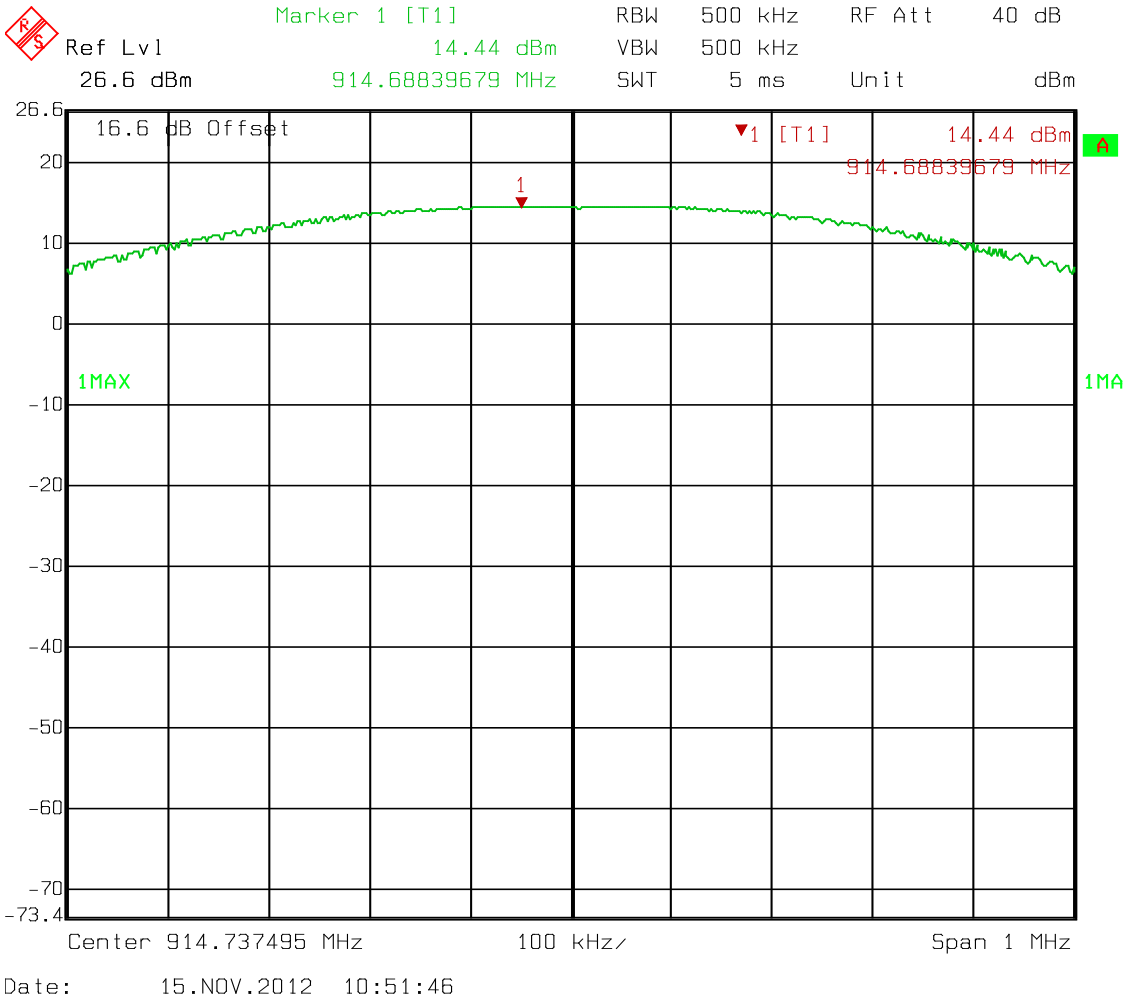
Temperature: 20 °C

Relative Humidity: 31 %

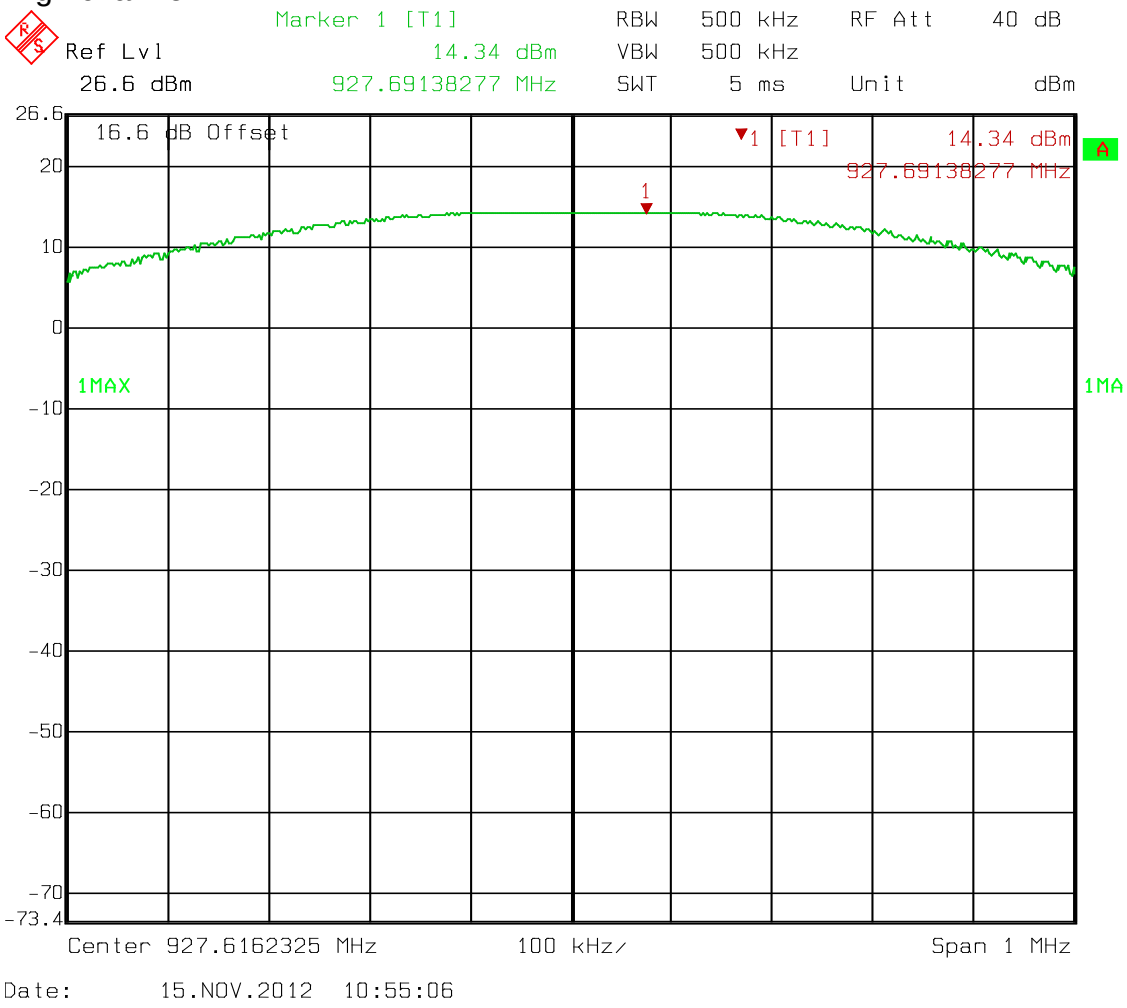
Low channel


Marker 1 [T1]
RBW 500 kHz
RF Att 40 dB
Ref Lvl
14.64 dBm
VBW 500 kHz
26.6 dBm
902.31262525 MHz
SWT 5 ms
Unit dBm
16.6 dB Offset
1 [T1]
14.64 dBm
902.31262525 MHz
1VIEW
1MA
26.6
20
10
0
-10
-20
-30
-40
-50
-60
-70
-73.4
Center 902.3577154 MHz
100 kHz/
Span 1 MHz
Date: 15.NOV.2012 10:40:42

Mid channel


Marker 1 [T1]
RBW 500 kHz
RF Att 40 dB
Ref Lvl
14.44 dBm
VBW 500 kHz
26.6 dBm
914.68839679 MHz
SWT 5 ms
Unit dBm
16.6 dB Offset
1 [T1]
14.44 dBm
914.68839679 MHz
1MAX
1MA
26.6
20
10
0
-10
-20
-30
-40
-50
-60
-70
-73.4
Center 914.737495 MHz
100 kHz/
Span 1 MHz
Date: 15.NOV.2012 10:51:46

High channel



Section 6. Spurious Emissions (Antenna Conducted)

NAME OF TEST: Spurious Emissions (Antenna Conducted)	PARA. NO.: 15.247(d)
TESTED BY: David Light	DATE: 15 Nov 2012

Test Results: Complies.

Measurement Data: See attached plots.

Equipment Used: 1036-1082-1472

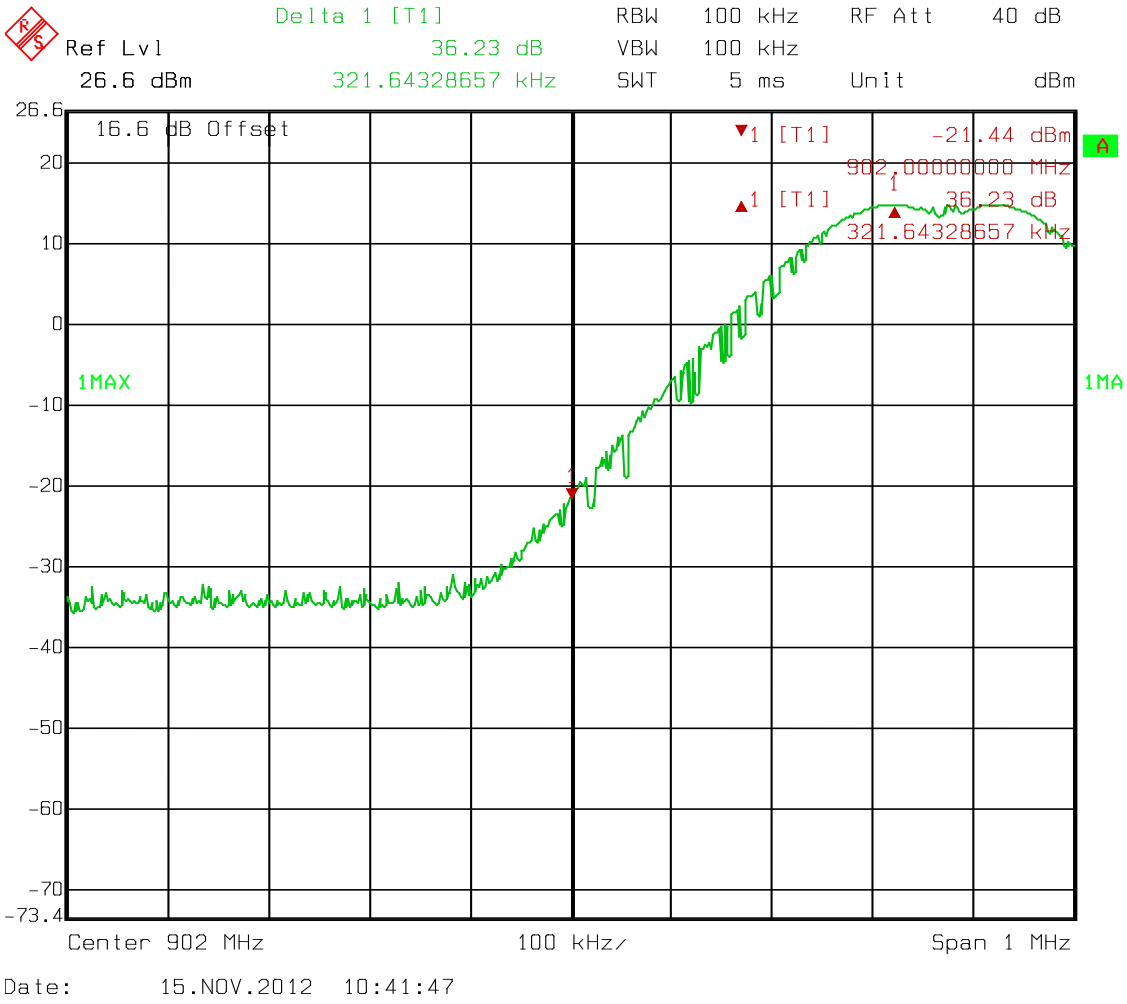
Measurement Uncertainty: $1X10^{-7}$ppm

Temperature: 20 °C

Relative Humidity: 31 %

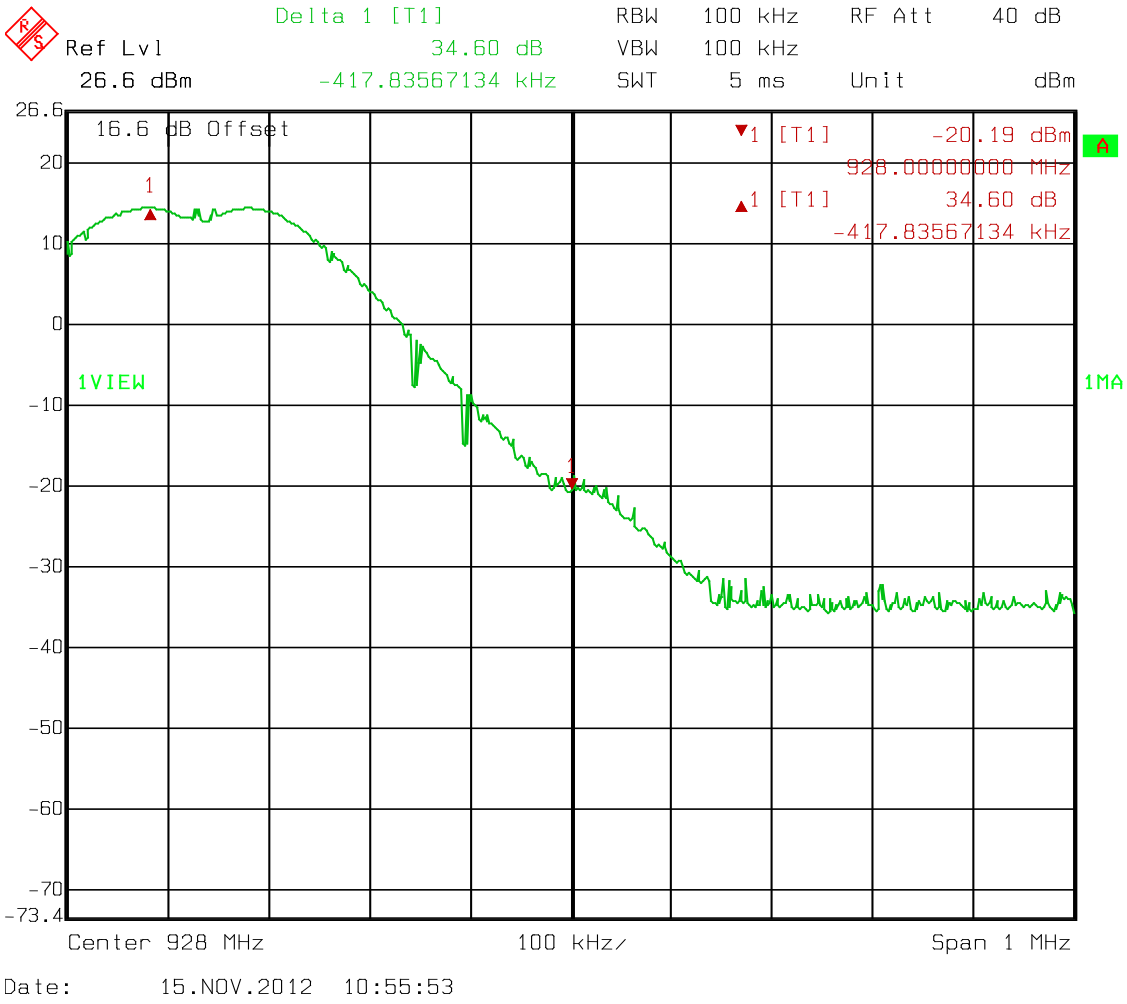
Test Data – Spurious Emissions at Antenna Terminals

Lower Band Edge



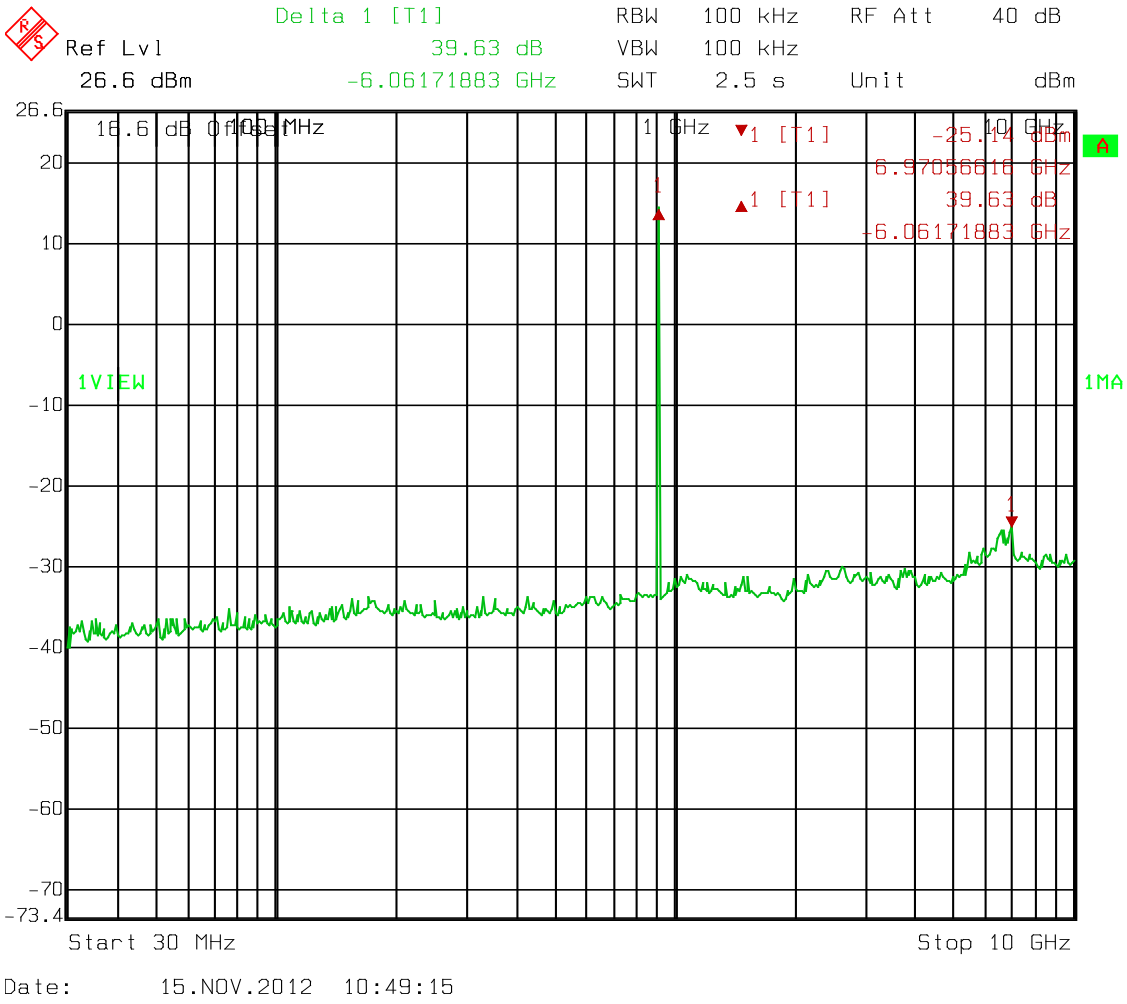
Test Data – Spurious Emissions at Antenna Terminals

Upper Band Edge



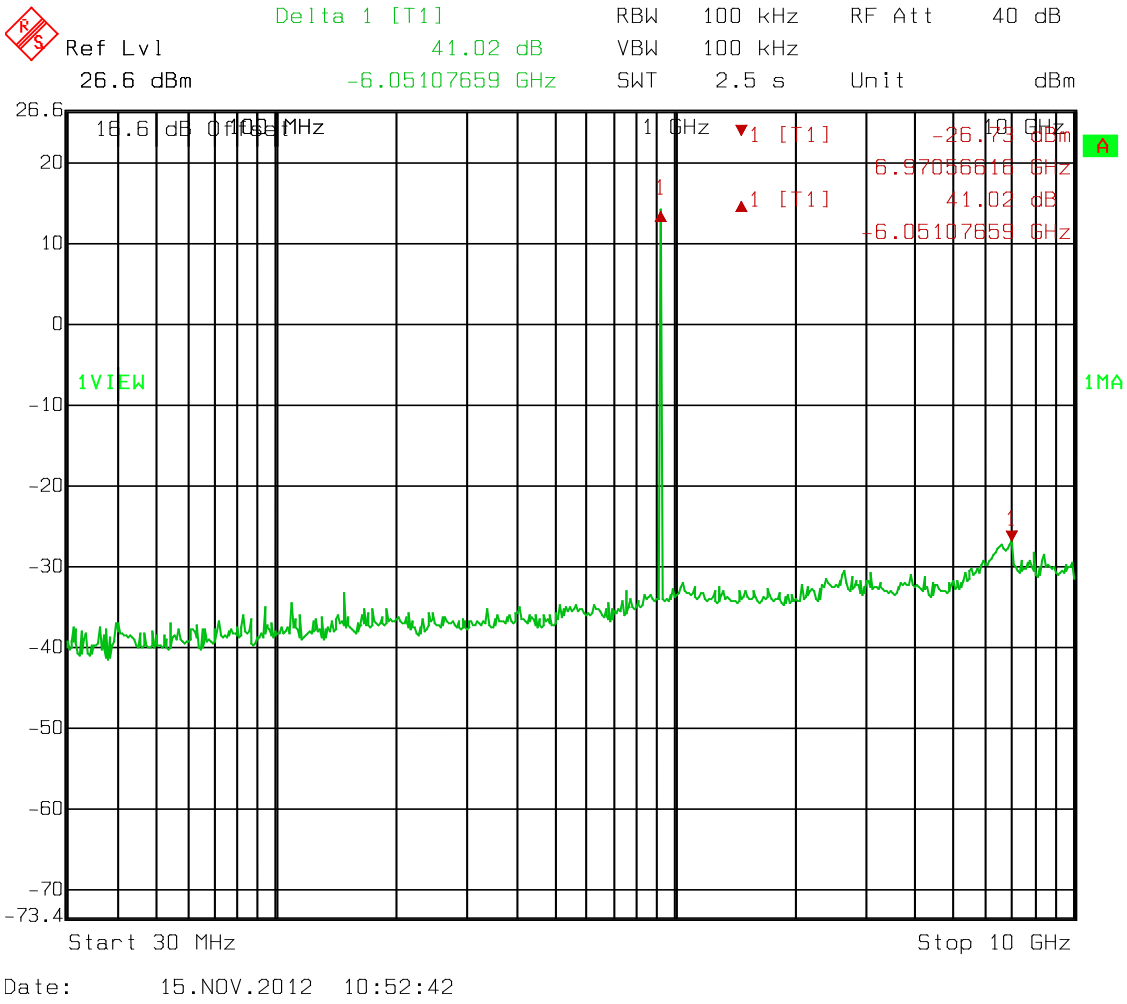
Test Data – Spurious Emissions at Antenna Terminals

Spurs – Low Channel



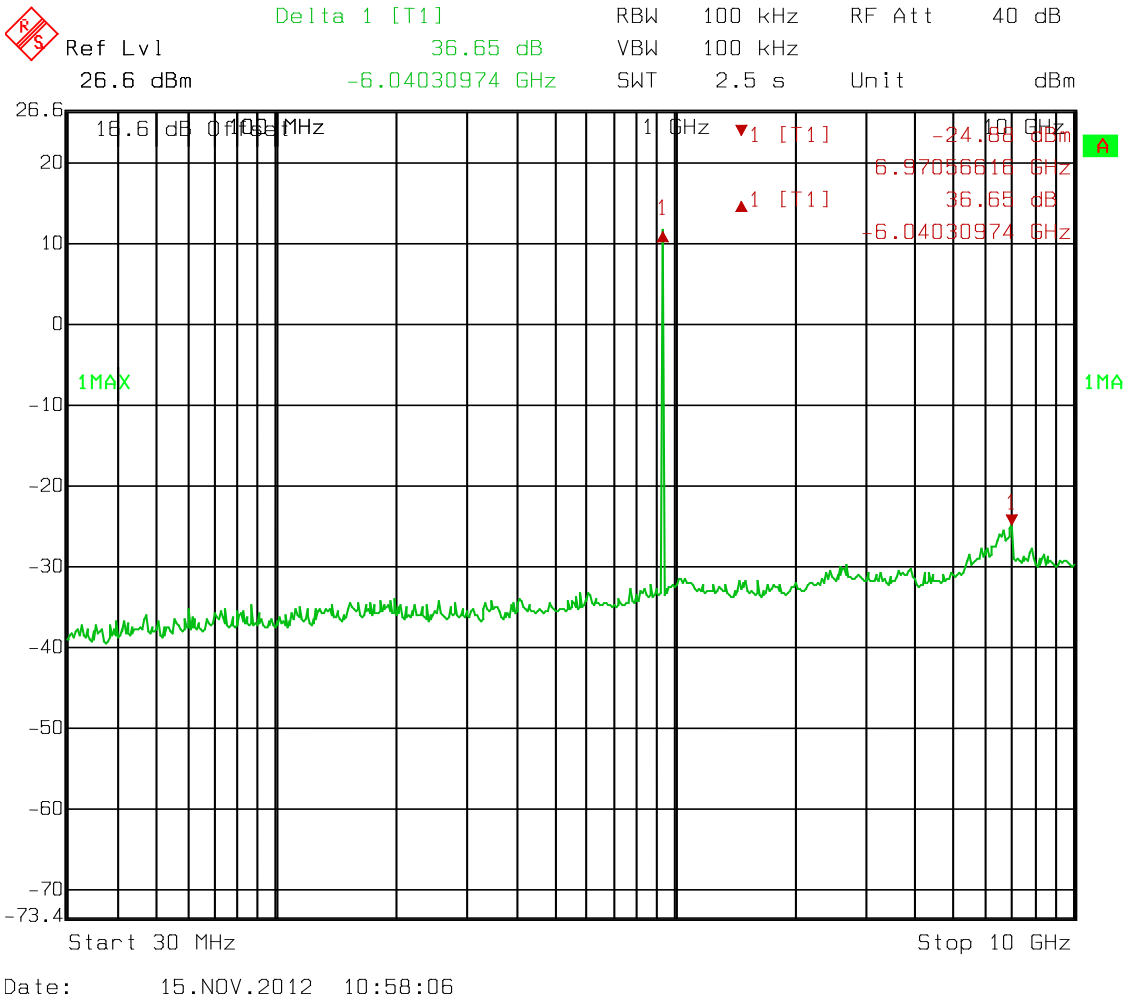
Test Data – Spurious Emissions at Antenna Terminals

Spurs – Mid Channel



Test Data – Spurious Emissions at Antenna Terminals

Spurs – High Channel



Section 7. Spurious Emissions (Radiated)

NAME OF TEST: Spurious Emissions (Radiated)	PARA. NO.: 15.247(d)
TESTED BY: David Light	DATE: 15 November 2012

Test Results: Complies. The worst case emission was 41.5 dBµV/m at 6492.3 MHz. This is 12.5 dB below the specification limit of 54.0 dBµV/m.

Measurement Data: See attached table.

Duty Cycle Calculation:

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

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).

☒ All emissions within 20 dB of the specification limit are reported per 15.31(o).

Equipment Used: 1036-1025-1016-993-1480-1783

Measurement Uncertainty: +/-3.6 dB

Temperature: 20 °C

Relative Humidity: 31 %

Test Data - Radiated Emissions

Meas. Freq. (MHz)	Ant. Pol. (H/V)	Duty Cycle (dB)	Meter Reading (dBuV)	Antenna Factor (dB)	Path Loss (dB)	RF Gain (dB)	Corrected Reading (dBuV/m)	Spec. limit (dBuV/m)	CR/SL Diff. (dB)	Pass Fail Unc.	Comments	
											Low Ch.	SLW5
6316.45	H	0	45	35.2	5.3	30	55.5	74	-18.5	Pass	Peak	
6316.45	H	-20	45	35.2	5.3	30	35.5	54	-18.5	Pass	Average	
											Mid Ch.	SLW5
6403.25	H	0	45.3	35.2	5.3	30	55.8	74	-18.2	Pass	Peak	
6403.25	H	-20	45.3	35.2	5.3	30	35.8	54	-18.2	Pass	Average	
6403.25	V	0	44.3	35.2	5.3	30	54.8	74	-19.2	Pass	Peak	
6403.25	V	-20	44.3	35.2	5.3	30	34.8	54	-19.2	Pass	Average	
											High Ch.	SLW5
6493.2	V	0	45.6	35.2	5.3	30	56.1	74	-17.9	Pass	Peak	
6493.2	V	-20	45.6	35.2	5.3	30	36.1	54	-17.9	Pass	Average	
6493.2	H	0	51	35.2	5.3	30	61.5	74	-12.5	Pass	Peak	
6493.2	H	-20	51	35.2	5.3	30	41.5	54	-12.5	Pass	Average	

Section 8. Test Equipment List

Asset Tag	Description	Manufacturer	Model	Serial #	Last Cal	Next Cal
993	Antenna, Horn	A.H. Systems	SAS-200/571	162	22-Sep-2011	22-Sep-2013
1016	Preamplifier	Hewlett Packard	8449A	2749A00159	23-Jul-2012	23-Jul-2013
1025	Preamplifier, 25dB	Nemko USA, Inc.	LNA25	399	27-Feb-2012	27-Feb-2013
1036	Spectrum Analyzer	Rohde & Schwartz	FSEK30	830844/006	23-Dec-2011	23-Dec-2013
1082	Cable, 2m	Astrolab	32027-2-29094-72TC		N/R	
1472	Attenuator	Omni Spectra	20600-20db		N/R	
1480	Antenna, Bilog	Schaffner-Chase	CBL6111C	2572	07-Feb-2012	07-Feb-2013
1783	Cable Assy,	Nemko	Chamber		26-Sep-2012	26-Sep-2013

ANNEX A - TEST DETAILS

NAME OF TEST: Channel Separation	PARA. NO.: 15.247(a)(1)

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. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

NAME OF TEST: Time of Occupancy	PARA. NO.: 15.247(a)(1)

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 0.4 seconds multiplied by the number of hopping channels employed.
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

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 sec./.001 sec.)/75 chan. = 400 x 1 msec. = 400 msec. or 0.4 sec. in 30 sec.

NAME OF TEST: Occupied Bandwidth PARA. NO.: 15.247(a)(1)

Minimum Standard:

Frequency Band (MHz)	Maximum 20 dB Bandwidth
902 - 928	500 kHz
2400 – 2483.5	Not defined
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

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.

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

NAME OF TEST: Spurious Emissions at Antenna Terminals 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 (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 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

NAME OF TEST: Radiated Spurious Emissions 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 (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 WAS SEARCHED TO THE 10th HARMONIC

15.205 Restricted Bands

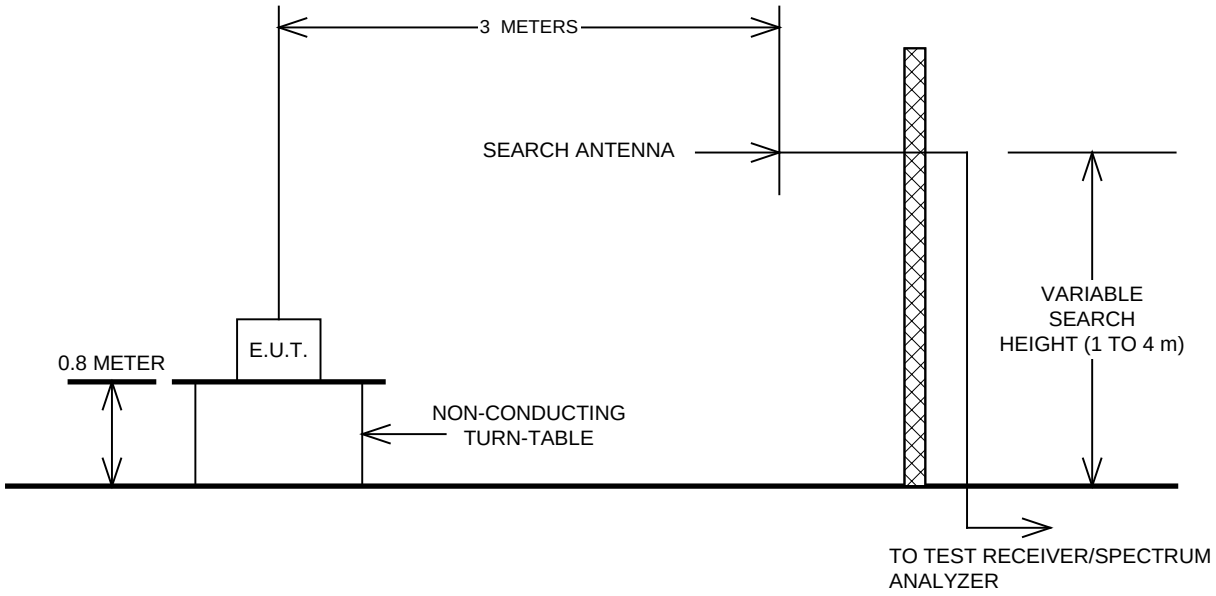
MHz	MHz	MHz	GHz
0.09-0.11	16.42-16.423	399.9-410	4.5-5.25
0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.125-6.218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