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Amended

FCC/IC Test Report

Includes NCEE Labs report R20170115-20-01D and its amendment in full

Prepared for:	**Inovonics Wireless Corp.**
Address:	**397 S. Taylor Ave. Louisville, CO 80027**
Product:	**EN1252**
Test Report No:	**R20170105-20-01E**
Approved By:	**Nic S. Johnson, NCE Technical Manager iNARTE Certified EMC Engineer #EMC-003337-NE**
DATE:	**19 May 2017**
Total Pages:	**42**

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1.0 Summary of test results

1.1 Test Results

The EUT has been tested according to the following specifications:

SUMMARY			
Standard Section	**Test Type and Limit**	**Result**	**Remark**
FCC 15.203	Unique Antenna Requirement	Pass	Internal Antenna
FCC 15.209 RSS-Gen, 7.1.2	Receiver Radiated Emissions	NA	The EUT has no receiver functionality
FCC 15.247(a)(1)(i) RSS-247, 5.1(c)	Minimum Bandwidth, Limit: Min. 250kHz	Pass	Meets the requirement of the limit.
FCC 15.247(b)(1) RSS-247, 5.4	Maximum Peak Output Power, Limit: Max. 24 dBm	Pass	Meets the requirement of the limit.
FCC 15.209 RSS-Gen, 8.9	Transmitter Radiated Emissions	Pass	Meets the requirement of the limit.
FCC 15.247(a) (1) (i) RSS-247, 5.1(c)	Frequency hopping system, Limit: Max. 0.4 Seconds in 10 Second Period	Pass	Meets the requirement of the limit.
FCC 15.209 RSS-247, 5.5 RSS-Gen, 8.9	Band Edge Measurement, Limit: 20dB less than the peak value of fundamental frequency	Pass	Meets the requirement of the limit.

2.0 Description

2.1 Equipment under test

The Equipment Under Test (EUT) was a long range dual input universal transmitter. It is designed for use with any standard contact or sensor that provides a contact closure. It operates from 902 to 928 MHz and has transmit capabilities only.

EUT Received Date: 11 April 2017
EUT Tested Dates: 11 April 2017 – 28 April 2017,

MODEL	EN1252
Serial No.	11123971 (Used in Continuous Transmit Mode) 11123995 (Standard user code)
POWER SUPPLY	3 VDC (CR123A)
ANTENNA TYPE	Antenna is not user replaceable

NOTE: For more detailed features description, please refer to the manufacturer's specifications or user's manual.

2.2 Laboratory description

All testing was performed at the following Facility:

The Nebraska Center for Excellence in Electronics (NCEE Labs)
4740 Discovery Drive
Lincoln, NE 68521

A2LA Certificate Number :	1953.01
FCC Accredited Test Site Designation No:	US1060
Industry Canada Test Site Registration No:	4294A-1
NCC CAB Identification No:	US0177

Environmental conditions varied slightly throughout the tests:
Relative humidity of 32 ± 4%
Temperature of 22 ± 3° Celsius

2.3 Description of test modes

The EUT operates on, and was tested at the frequencies below:

Channel	Frequency
Low	902.4
Middle	914.8
High	927.6

These are the only three representative channels tested in the frequency range according to FCC Part 15.31 and RSS-Gen Table A1. See the operational description for a list of all channel frequency and designations.

2.4 Applied standards

The EUT is a frequency hopping device operating in the 902 MHz to 928 MHz amateur band. According to the specifications of the manufacturer, it must comply with the requirements of the following standards:

FCC Part 15, Subpart C; 15.209 and 15.247
Industry Canada, RSS-247, Issue 1
Industry Canada, RSS-Gen, Issue 4
ANSI C63.10:2013
ANSI C63.4:2014

All test items have been performed and recorded as per the above.

2.5 Description of support units

None

2.6 Configuration of system under test

This EUT was set to transmit in a worse-case scenario with modulation on. The manufacturer modified the unit to transmit continuously on the lowest, highest and one channel in the middle.

3.0 Test equipment used

DESCRIPTION AND MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CALIBRATION DATE	CALIBRATION DUE DATE
Rohde & Schwarz Test Receiver	ES126	100037	24 Jan 2017	24 Jan 2018
EMCO Biconilog Antenna	3142B	1647	02 Aug 2016	02 Aug 2017
EMCO Horn Antenna	3115	6416	25 Jan 2016	25 Jan 2018
EMCO Horn Antenna	3116	2576	26 Jan 2016	26 Jan 2018
Rohde & Schwarz Preamplifier	TS-PR18	3545700803	9 Feb 2017*	9 Feb 2018*
Trilithic High Pass Filter	6HC330	23042	9 Feb 2017*	9 Feb 2018*

*Internal Characterization

4.0 Detailed results

4.1 Unique antenna requirement

4.1.1 Standard applicable

For intentional device, according to FCC 47 CFR Section 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device.

4.1.2 Antenna description

The antenna on the EUT is an antenna on the PCB so it’s not user replaceable.

4.2 Radiated emissions

Test Method: ANSI C63.10, Section(s) 6.5
ANSI C63.4, Section(s) 8.3

4.2.1 Limits for radiated emissions measurements

Emissions radiated outside of the specified bands shall be applied to the limits in 15.209 as followed:

FREQUENCIES (MHz)	FIELD STRENGTH (μV/m)	MEASUREMENT DISTANCE (m)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	3
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

NOTE:
1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 * log * Emission level (μV/m).
3. As shown in 15.35(b), for frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits by more than 20dB under any condition of modulation.

4.2.2 Test procedures

a. The EUT was placed on the top of a rotating table above the ground plane in a 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation. The table was 0.8m high for measurements form 30MHz-1Ghz and 1.5m for measurements from 1GHz and higher.

b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.

c. The antenna was a broadband antenna, and its height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are used to make the measurement.

d. For each suspected emission, the EUT was arranged to maximize its emissions and then the antenna height was varied from 1 meter to 4 meters and the rotating table was turned from 0 degrees to 360 degrees to find the maximum emission reading.

e. The test-receiver system was set to use a peak detector with a specified resolution bandwidth. For spectrum analyzer measurements, the composite maximum of several analyzer sweeps was used for final measurements.

f. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10 dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

g. The EUT was maximized in all 3 orthogonal positions.

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Peak detection (PK) and Quasi-peak detection (QP) at frequencies below 1GHz.

2. The resolution bandwidth 1 MHz for all measurements and at frequencies above 1GHz, A peak detector was used for all measurements above 1GHz. Measurements were made with an EMI Receiver.

4.2.3 Deviations from test standard

No deviation.

4.2.4 Test setup

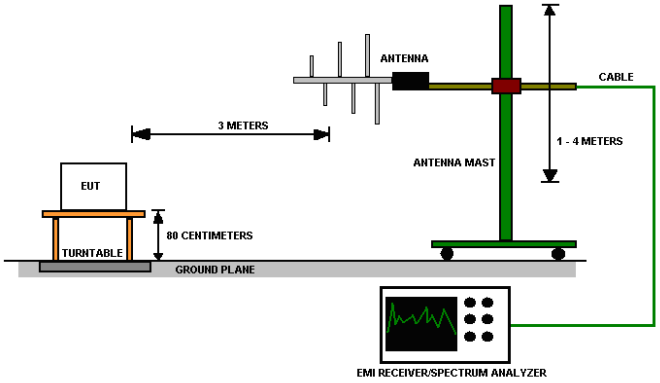

Figure 1 - Radiated Emissions Test Setup

The EUT was tested in all 3 orthogonal axis to meet the requirements from ANSI C63.10:2013, Section 5.10.1 and Annex H.2.

For measurements above 1GHz, the antenna was pointed in the direction of the EUT.

4.2.5 EUT operating conditions

The EUT was powered by 3 VDC unless specified and set to transmit continuously on the lowest frequency channel, highest frequency channel and one in the middle of its operating range.

4.2.6 Test results

EUT MODULE	EN1252	MODE	Transmit, Low Channel
INPUT POWER	3 VDC	FREQUENCY RANGE	30MHz – 10GHz
ENVIRONMENTAL CONDITIONS	32 % ± 5% RH 23 ± 3ºC	TECHNICIAN	KVepuri

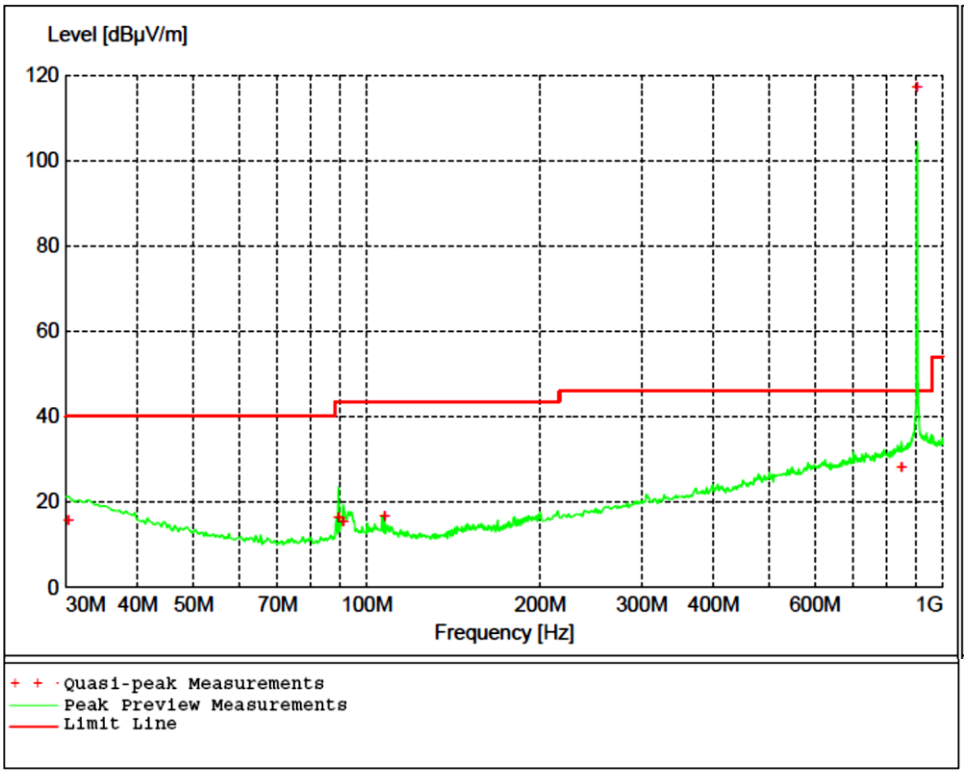

Figure 2 - Radiated Emissions Plot, Low Channel

REMARKS:
1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB)
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission level – Limit value
5. The EUT was measured in both the horizontal and vertical orientation. It was found that the Horizontal position produced the highest emissions, and this orientation was used for all testing. See Annex A for test photos.

Table 1 - Radiated Emissions Quasi-peak Measurements, Low Channel

Frequency	Level	Limit	Margin	Height	Angle	Pol	Axis
MHz	dBµV/m	dBµV/m	dB	cm.	deg.		
30.300000	15.68	40.00	24.30	390	51	VERT	Z
89.280000	16.35	43.50	27.20	139	121	VERT	Z
91.080000	15.42	43.50	28.10	176	0	HORI	Z
107.340000	16.42	43.50	27.10	146	307	VERT	Z
849.240000	28.03	46.00	18.00	152	0	VERT	Z
902.380000	117.06	NA	NA	128	139	VERT	Z

The EUT was maximized in all 3 orthogonal axis. The worst-case is shown in the table above.

Table 2 - Radiated Emissions Average Measurements, Low Channel

Frequency	Level	Limit	Margin	Height	Angle	Pol	Axis
MHz	dBµV/m	dBµV/m	dB	cm.	deg.		
1804.800000	47.63	54.00	6.37	101	160	HORI	X
2707.200000	37.58	54.00	16.42	99	209	VERT	X
3609.400000	42.54	54.00	11.46	100	195	HORI	X
4511.800000	36.82	54.00	17.18	190	121	HORI	X
5414.200000	29.97	54.00	24.03	101	288	VERT	X
6316.600000	38.72	54.00	15.28	99	74	HORI	X
7210.600000	30.30	54.00	23.70	278	360	HORI	X
8121.400000	37.47	54.00	16.53	99	52	HORI	X
9023.800000	36.12	54.00	17.88	110	360	VERT	X

Note: Average Level = Peak Level – Duty Cycle Correction Factor
Duty Cycle Correction Factor is calculated in Figures 5 and 6.

The EUT was maximized in all 3 orthogonal axis. The worst-case is shown in the table above.

Table 3 - Radiated Emissions Peak Measurements, Low Channel

Frequency	Level	Limit	Margin	Height	Angle	Pol	Axis
MHz	dBµV/m	dBµV/m	dB	cm.	deg.		
1804.800000	61.03	74.00	12.97	101	160	HORI	X
2707.200000	50.98	74.00	23.02	99	209	VERT	X
3609.400000	55.94	74.00	18.06	100	195	HORI	X
4511.800000	50.22	74.00	23.78	190	121	HORI	X
5414.200000	43.37	74.00	30.63	101	288	VERT	X
6316.600000	52.12	74.00	21.88	99	74	HORI	X
7210.600000	43.70	74.00	30.30	278	360	HORI	X
8121.400000	50.87	74.00	23.13	99	52	HORI	X
9023.800000	49.52	74.00	24.48	110	360	VERT	X

The EUT was maximized in all 3 orthogonal axis. The worst-case is shown in the table above.

Average measurement values = Peak measurement values – averaging factor (-13.4 dB). See Figures 6 and 7 for details.

EUT MODULE	EN1252	MODE	Transmit, Mid Channel
INPUT POWER	3 VDC	FREQUENCY RANGE	30MHz – 10GHz
ENVIRONMENTAL CONDITIONS	32 % ± 5% RH 23 ± 3ºC	TECHNICIAN	KVepuri

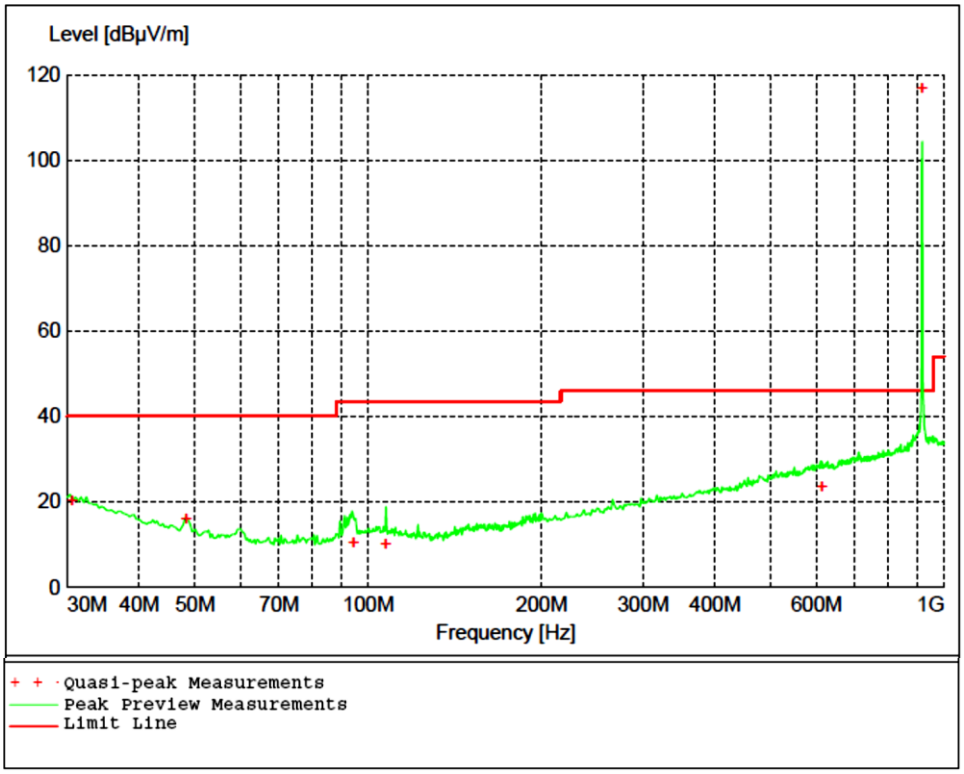

Figure 3 - Radiated Emissions Plot, Mid Channel

REMARKS:
1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB)
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission level – Limit value.
5. The EUT was measured in both the horizontal and vertical orientation. It was found that the Horizontal position produced the highest emissions, and this orientation was used for all testing. See Annex A for test photos.

Table 4 - Radiated Emissions Quasi-peak Measurements, Mid Channel

Frequency	Level	Limit	Margin	Height	Angle	Pol	Axis
MHz	dBµV/m	dBµV/m	dB	cm.	deg.		
30.600000	20.14	40.00	19.90	363	243	HORI	Z
48.300000	15.88	40.00	24.10	141	115	VERT	Z
94.260000	10.44	43.50	33.10	381	87	HORI	Z
107.280000	9.97	43.50	33.60	399	314	VERT	Z
613.200000	23.44	46.00	22.60	295	0	VERT	Z
914.800000	116.90	NA	NA	118	101	VERT	Z

The EUT was maximized in all 3 orthogonal axis. The worst-case is shown in the table above.

Table 5 - Radiated Emissions Average Measurements, Mid Channel

Frequency	Level	Limit	Margin	Height	Angle	Pol	Axis
MHz	dBµV/m	dBµV/m	dB	cm.	deg.		
1830.400000	47.10	54.00	6.90	99	349	HORI	X
2745.600000	37.88	54.00	16.12	217	344	VERT	X
3660.600000	39.00	54.00	15.00	98	25	HORI	X
4575.800000	37.31	54.00	16.69	101	17	HORI	X
5491.000000	35.62	54.00	18.38	98	153	VERT	X
6406.200000	33.90	54.00	20.10	264	33	VERT	X
7317.400000	29.63	54.00	24.37	257	179	HORI	X
8211.000000	33.10	54.00	20.90	315	70	HORI	X
9169.600000	33.07	54.00	20.93	250	31	HORI	X

The EUT was maximized in all 3 orthogonal axis. The worst-case is shown in the table above.

Note: Average Level = Peak Level – Duty Cycle Correction Factor
Duty Cycle Correction Factor is calculated in Figures 5 and 6.

Table 6 - Radiated Emissions Peak Measurements, Mid Channel

Frequency	Level	Limit	Margin	Height	Angle	Pol	Axis
MHz	dBµV/m	dBµV/m	dB	cm.	deg.		
1830.400000	60.50	74.00	13.50	99	349	HORI	X
2745.600000	51.28	74.00	22.72	217	344	VERT	X
3660.600000	52.40	74.00	21.60	98	25	HORI	X
4575.800000	50.71	74.00	23.29	101	17	HORI	X
5491.000000	49.02	74.00	24.98	98	153	VERT	X
6406.200000	47.30	74.00	26.70	264	33	VERT	X
7317.400000	43.03	74.00	30.97	257	179	HORI	X
8211.000000	46.50	74.00	27.50	315	70	HORI	X
9169.600000	46.47	74.00	27.53	250	31	HORI	X

The EUT was maximized in all 3 orthogonal axis. The worst-case is shown in the table above.

Average measurement values = Peak measurement values – averaging factor (-13.4 dB). See Figures 6 and 7 for details.

EUT MODULE	EN1252	MODE	Transmit, High Channel
INPUT POWER	3 VDC	FREQUENCY RANGE	30MHz – 10GHz
ENVIRONMENTAL CONDITIONS	32 % ± 5% RH 23 ± 3ºC	TECHNICIAN	KVepuri

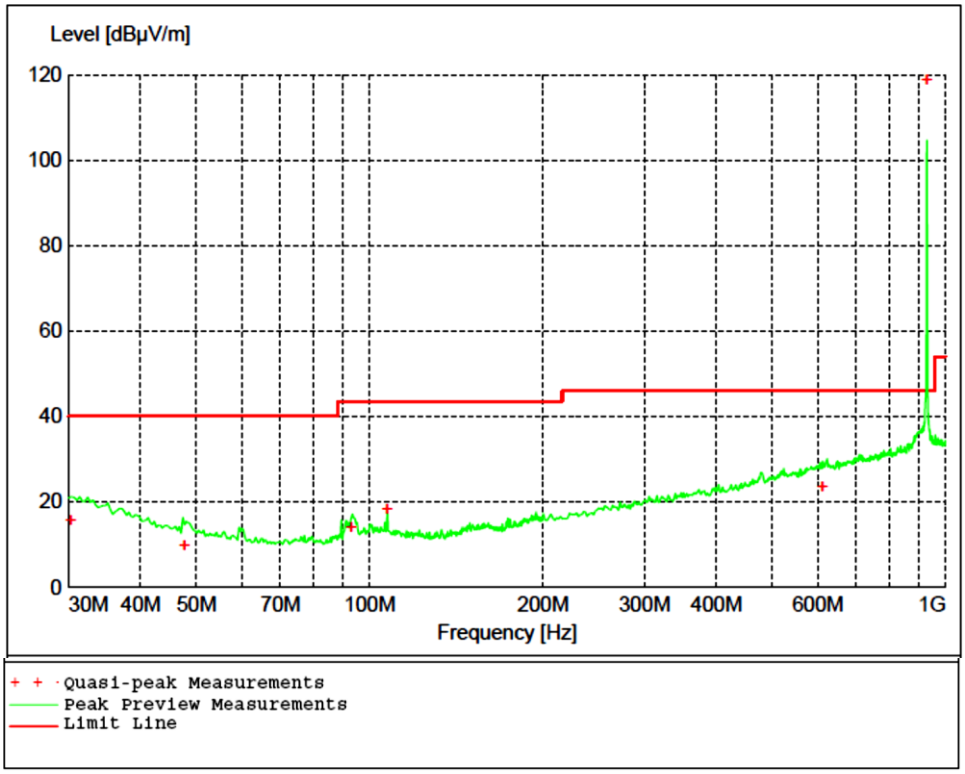

Figure 4 - Radiated Emissions Plot, High Channel

REMARKS:
1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB)
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission level – Limit value.
5. The EUT was measured in both the horizontal and vertical orientation. It was found that the Horizontal position produced the highest emissions, and this orientation was used for all testing. See Annex A for test photos.

Table 7 - Radiated Emissions Quasi-peak Measurements, High Channel

Frequency	Level	Limit	Margin	Height	Angle	Pol	Axis
MHz	dBµV/m	dBµV/m	dB	cm.	deg.		
30.240000	15.65	40.00	24.30	100	99	VERT	Z
47.640000	9.69	40.00	30.30	99	331	VERT	Z
92.880000	13.98	43.50	29.50	163	174	HORI	Z
107.280000	18.24	43.50	25.30	126	344	VERT	Z
611.700000	23.41	46.00	22.60	227	111	VERT	Z
927.560000	118.68	NA	NA	114	91	VERT	Z

The EUT was maximized in all 3 orthogonal axis. The worst-case is shown in the table above.

Table 8 - Radiated Emissions Average Measurements, High Channel

Frequency	Level	Limit	Margin	Height	Angle	Pol	Axis
MHz	dBµV/m	dBµV/m	dB	cm.	deg.		
1855.200000	41.85	54.00	12.15	140	192	HORI	X
2782.800000	31.13	54.00	22.87	100	51	HORI	X
3710.400000	32.32	54.00	21.68	98	212	HORI	X
4637.800000	37.51	54.00	16.49	157	152	HORI	X
5565.400000	39.10	54.00	14.90	150	349	VERT	X
6493.000000	34.35	54.00	19.65	102	349	VERT	X
7400.200000	29.51	54.00	24.49	370	202	VERT	X
8348.400000	33.69	54.00	20.31	157	31	VERT	X
9302.600000	32.05	54.00	21.95	99	111	VERT	X

The EUT was maximized in all 3 orthogonal axis. The worst-case is shown in the table above.
Note: Average Level = Peak Level – Duty Cycle Correction Factor
Duty Cycle Correction Factor is calculated in Figures 5 and 6.

Table 9 - Radiated Emissions Peak Measurements, High Channel

Frequency	Level	Limit	Margin	Height	Angle	Pol	Axis
MHz	dBµV/m	dBµV/m	dB	cm.	deg.		
1855.200000	55.25	74.00	18.75	140	192	HORI	X
2782.800000	44.53	74.00	29.47	100	51	HORI	X
3710.400000	45.72	74.00	28.28	98	212	HORI	X
4637.800000	50.91	74.00	23.09	157	152	HORI	X
5565.400000	52.50	74.00	21.50	150	349	VERT	X
6493.000000	47.75	74.00	26.25	102	349	VERT	X
7400.200000	42.91	74.00	31.09	370	202	VERT	X
8348.400000	47.09	74.00	26.91	157	31	VERT	X
9302.600000	45.45	74.00	28.55	99	111	VERT	X

The EUT was maximized in all 3 orthogonal axis. The worst-case is shown in the table above.

Average measurement values = Peak measurement values – averaging factor (-13.4 dB). See Figures 6 and 7 for details.

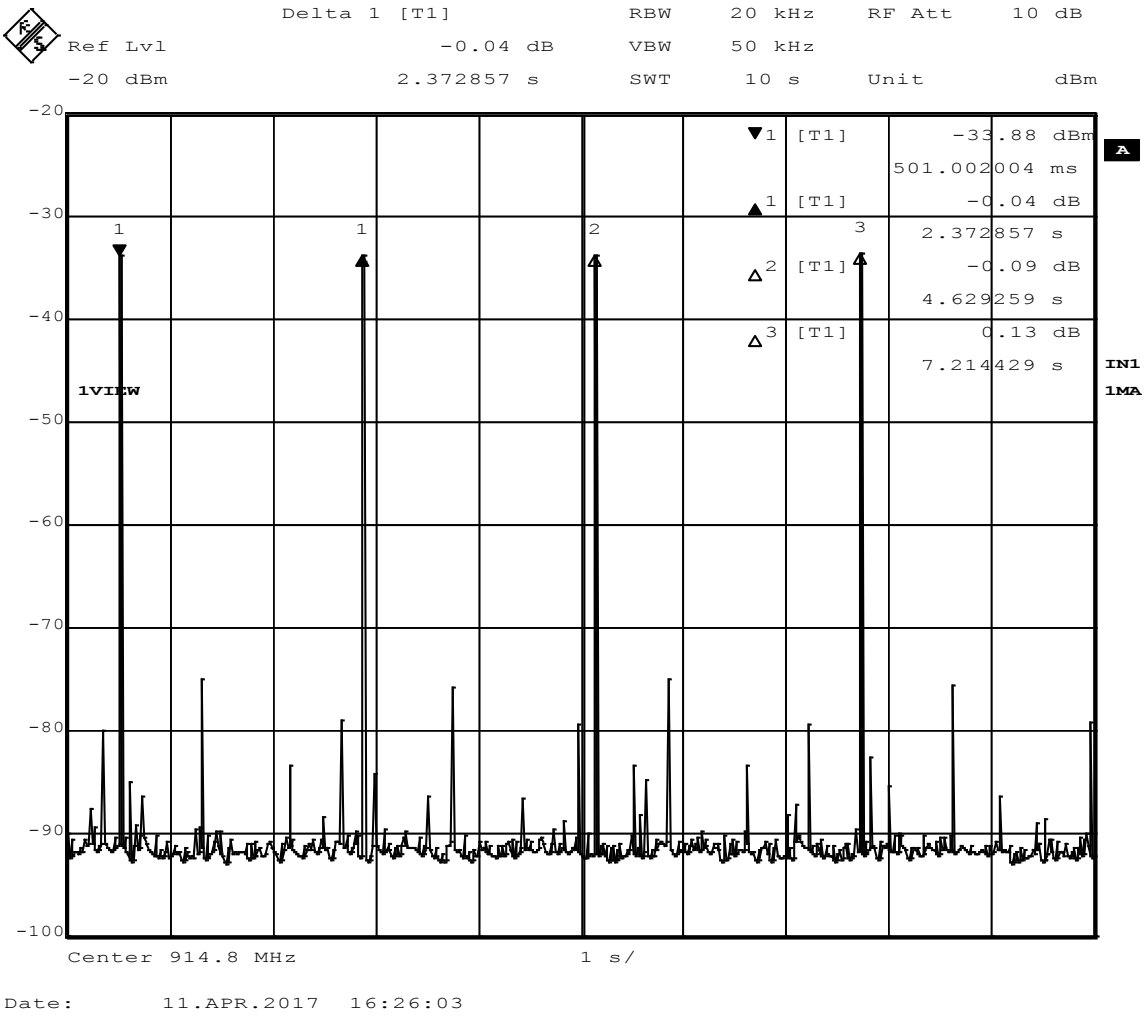

Figure 5 – Period

A maximum of 1 pulses can occur in any 100 ms window

The pulse train seen above is the result of manually triggering the transmitter as fast as possible. This is the fastest possible transmission rate.

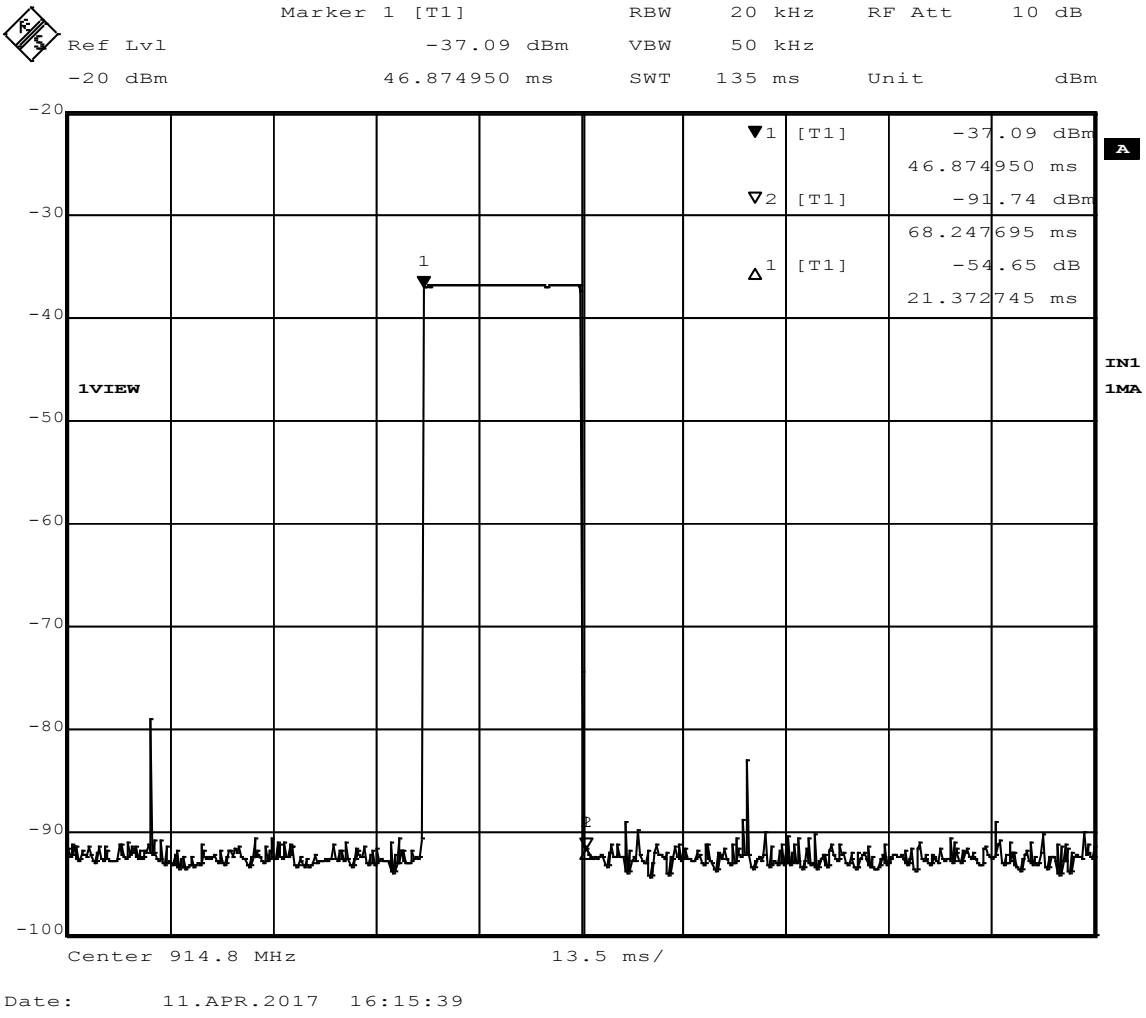

Figure 6 – Maximum Pulse Width

Duty cycle correction factor = 20*log(21.37/100) = -13.40 dB

Note 1: 100ms is the longest allowed period per FCC Part 15.35

Note 2: there was only one 21.37 ms pulses per 100ms period.

4.3 Output Power

Test Method: ANSI C63.10, Section(s) 7.8.5

4.3.1 Limits of bandwidth measurements

The peak EIRP was measured using a 500 kHz RBW. For an FHSS system with 25 channels, the output power is required to be less than 250 mW or 24 dBm.

EIRP was calculated from field strength measurements using ANSI C63.10:2013, Section 9.5, Equation (22). The field strength was measured at a 3m distance and maximized. The EUT was placed on an 80cm foam table.

4.3.2 Test procedures

All measurements were taken at a distance of 3m from the EUT. The bandwidth of the fundamental frequency was measured by spectrum analyzer with 100 kHz RBW and 300 kHz VBW.

The EUT was maximized in all 3 orthogonal positions in a similar manner as described in Section 4.2.

4.3.3 Deviations from test standard

No deviation

4.3.4 Test setup

See Section 4.2.4

4.3.5 EUT operating conditions

The EUT was powered by 3 VDC unless specified and set to transmit continuously on the lowest frequency channel, highest frequency channel and one in the middle of its operating range.

4.3.6 Test results

EUT MODULE	EN1252	MODE	Transmit
INPUT POWER	3 VDC	FREQUENCY RANGE	902MHz – 928 MHz
ENVIRONMENTAL CONDITIONS	32 % ± 5% RH 23 ± 3ºC	TECHNICIAN	KVepuri

Peak EIRP

CHANNEL	CHANNEL FREQUENCY (MHz)	EIRP PEAK POWER OUTPUT (dBm)	RESULT
1	902.4	21.9	PASS
2	914.8	21.9	PASS
3	927.6	23.6	PASS

EIRP was calculated from field strength measurements using ANSI C63.10:2013, Section 9.5, Equation (22). A peak detector was used in “Max Hold” mode.

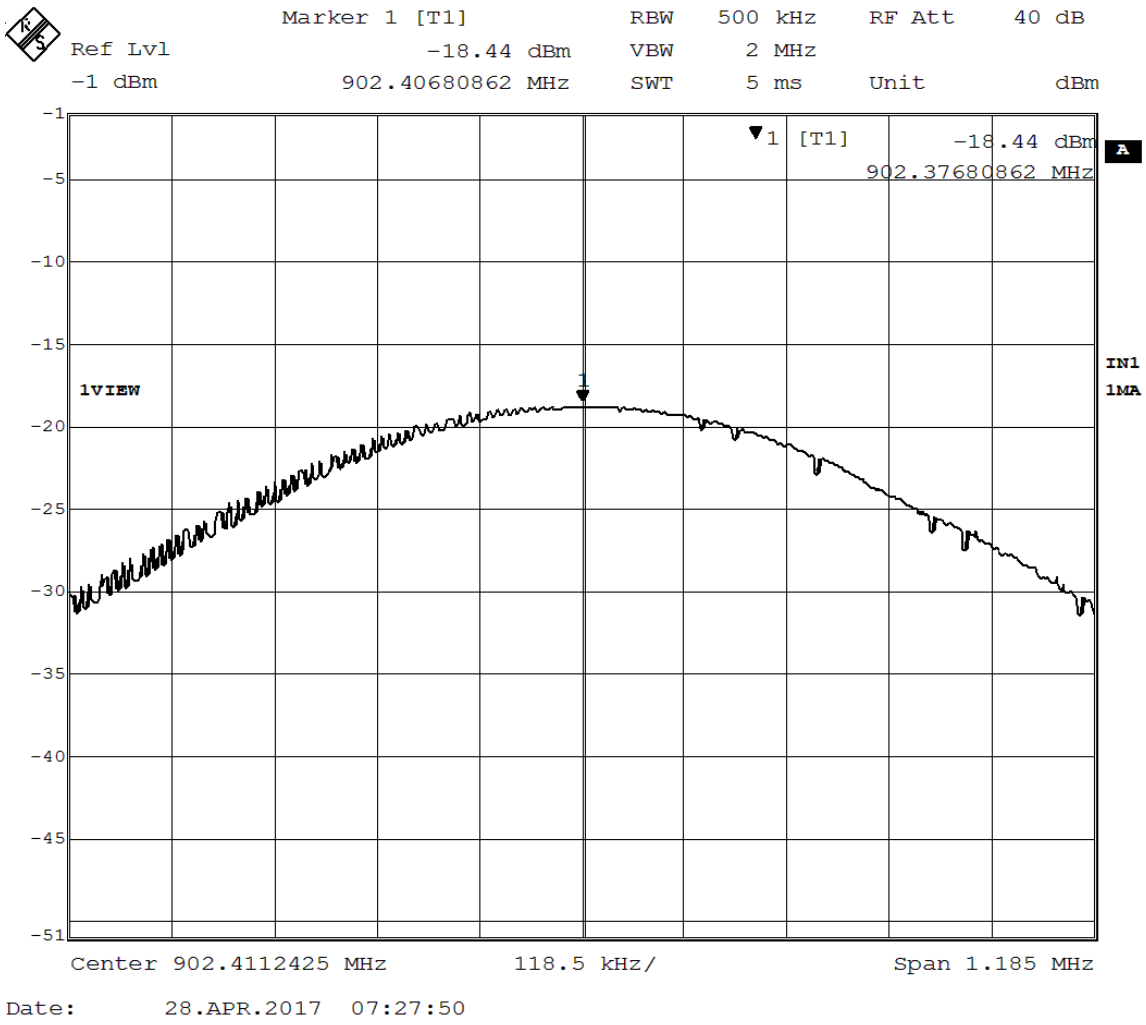

Figure 7 – Output Power, Low Channel

Maximum power = -18.44 dBm + 107 + CL + AF - 95.23 = 21.93 dBm*

CL = cable loss = 4.70 dB
AF = antenna factor = 23.90 dB
107 = conversion from dBm to dBµV on a 50Ω measurement system
-95.23 = Conversion from field strength (dBµV/m) to EIRP (dBm) at a 3m measurement distance.

Note: the trace at the top where Marker 1 is located was made with a 10MHz resolution bandwidth and saved on the screen. The trace on the bottom was made with a 100 kHz RBW.

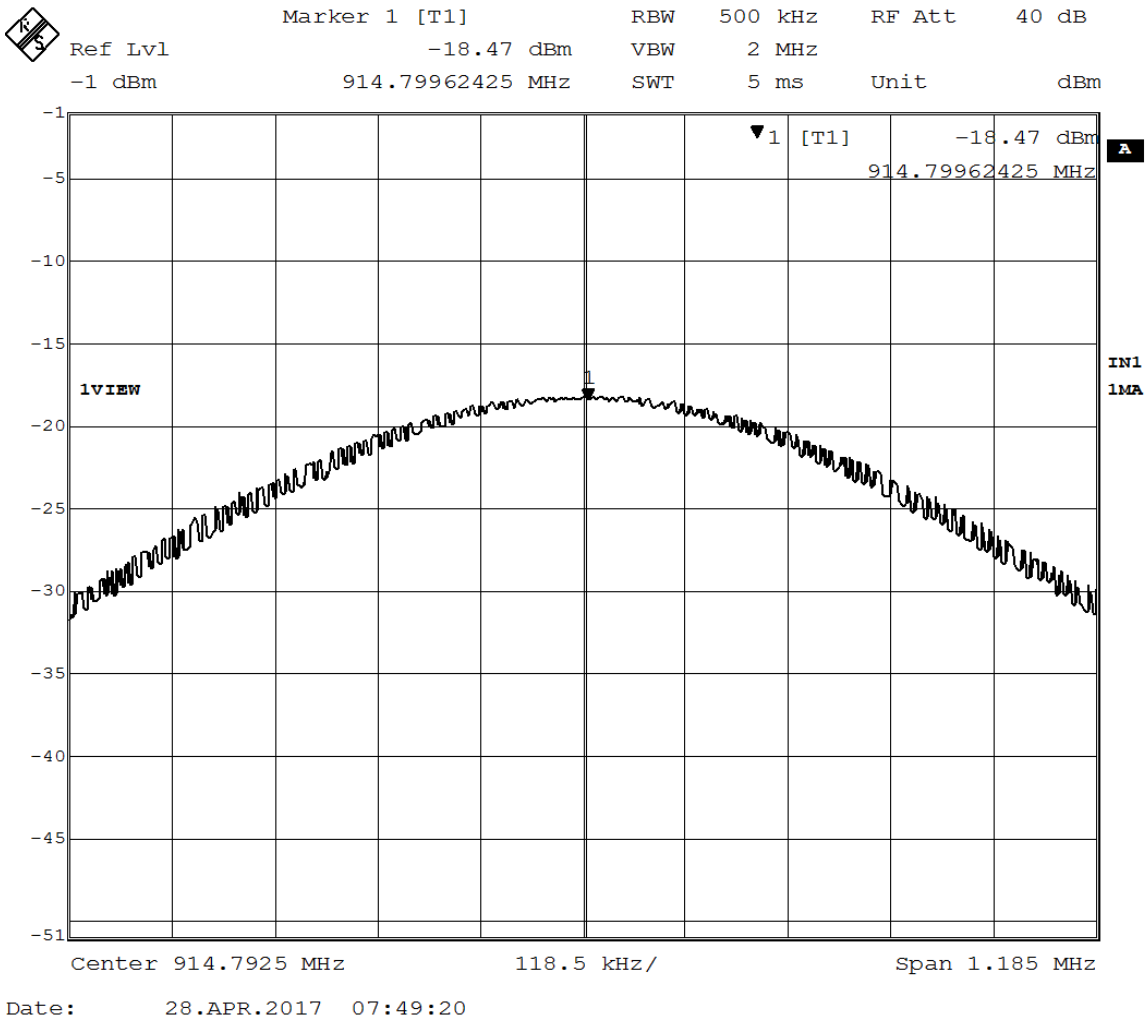

Figure 8 – Output Power, Mid Channel

Maximum power = -18.47 dBm + 107 + CL + AF - 95.23 = 21.90 dBm*

CL = cable loss = 4.80 dB
AF = antenna factor = 23.80 dB
107 = conversion from dBm to dBµV on a 50Ω measurement system
-95.23 = Conversion from field strength (dBµV/m) to EIRP (dBm) at a 3m measurement distance.

Note: the trace at the top where Marker 1 is located was made with a 10MHz resolution bandwidth and saved on the screen. The trace on the bottom was made with a 100 kHz RBW.

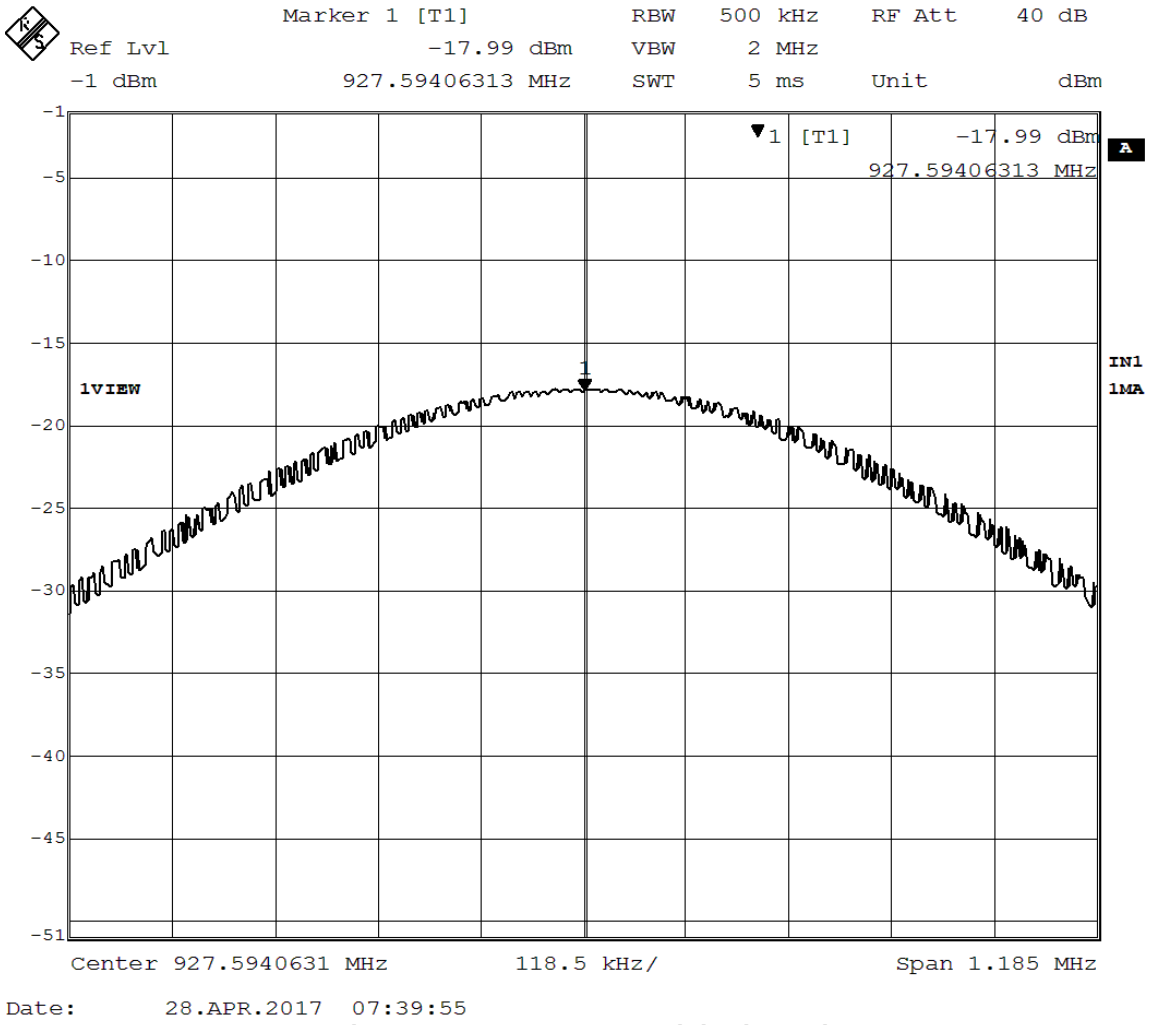

Figure 9 – Output Power, High Channel

Maximum power = -17.99 dBm + 107 + CL + AF - 95.23 = 22.58 dBm

CL = cable loss = 4.90 dB
AF = antenna factor = 23.90 dB
107 = conversion from dBm to dBµV on a 50Ω measurement system
-95.23 = Conversion from field strength (dBµV/m) to EIRP (dBm) at a 3m measurement distance.

Note: the trace at the top where Marker 1 is located was made with a 10MHz resolution bandwidth and saved on the screen. The trace on the bottom was made with a 100 kHz RBW.

4.4 Bandwidth

Test Method: ANSI C63.10, Section(s) 6.9, 7.8.5

4.4.1 Limits of bandwidth measurements

From FCC Part 15.247 (1) (i) and RSS-247 5.1(c)

If the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

4.4.2 Test procedures

All measurements were taken at a distance of 3m from the EUT. The bandwidth of the fundamental frequency was measured by spectrum analyzer with 100 kHz RBW and 300 kHz VBW.

The 99% occupied is defined as the bandwidth at which 99% of the signal power is found. This corresponds to 20dB down from the maximum power level. The maximum power was measured with the largest resolution bandwidth possible (10MHz) and this value was recorded. The signal was then captured with a 100 kHz resolution bandwidth and the frequencies where the measurements were 20dB below the maximum power were marked. The bandwidth between these frequencies was recorded as the 99% occupied bandwidth.

4.4.3 Deviations from test standard

No deviation

4.3.4 Test setup

See Section 4.2.4

4.4.5 EUT operating conditions

The EUT was powered by 3 VDC unless specified and set to transmit continuously on the lowest frequency channel, highest frequency channel and one in the middle of its operating range.

4.4.6 Test results

EUT MODULE	EN1252	MODE	Transmit
INPUT POWER	3 VDC	FREQUENCY RANGE	902MHz – 928 MHz
ENVIRONMENTAL CONDITIONS	32 % ± 5% RH 23 ± 3ºC	TECHNICIAN	KVepuri

99% Occupied Bandwidth

CHANNEL	CHANNEL FREQUENCY (MHz)	99% Occupied BW (kHz)
1	902.4	394.38
2	914.8	391.98
3	927.6	376.35

*The limit is 250 kHz minimum. The measurements were conducted at 100 kHz RBW and 300 kHz VBW according to FCC Report and Order FCC 14-208 from December 30, 2014, Paragraph 83.

REMARKS:
None

EIRP was calculated from field strength measurements using ANSI C63.10:2013, Section 9.5, Equation (22).

All measurements were taken from the 99% occupied bandwidth screen captures.

REMARKS:
None

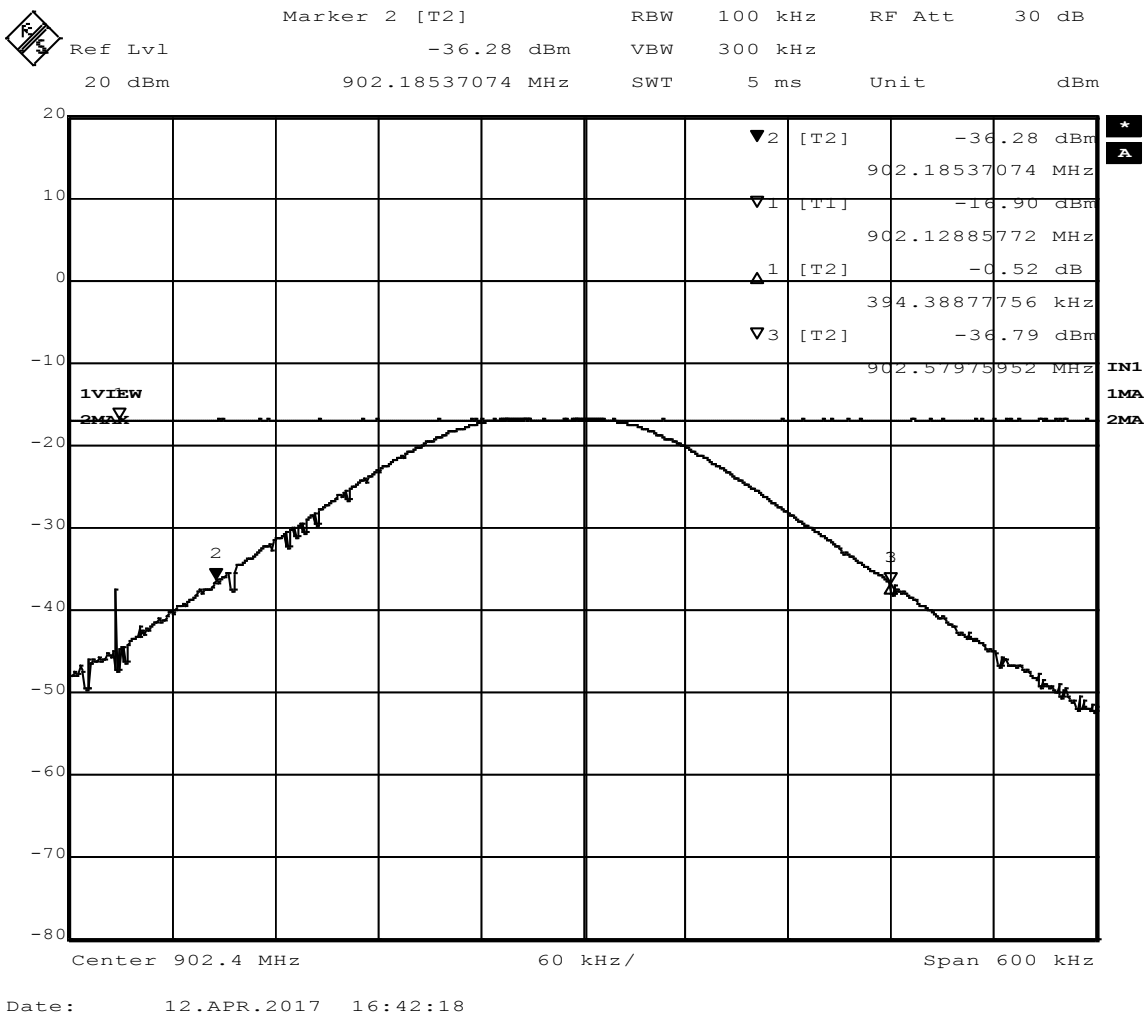

Figure 10 - 99% Occupied Bandwidth, Low Channel. 394.38 kHz

Note: the trace at the top where Marker 1 is located was made with a 10MHz resolution bandwidth and saved on the screen. The trace on the bottom was made with a 100 kHz RBW.

The plot shows an uncorrected measurement, used for relative measurements only.

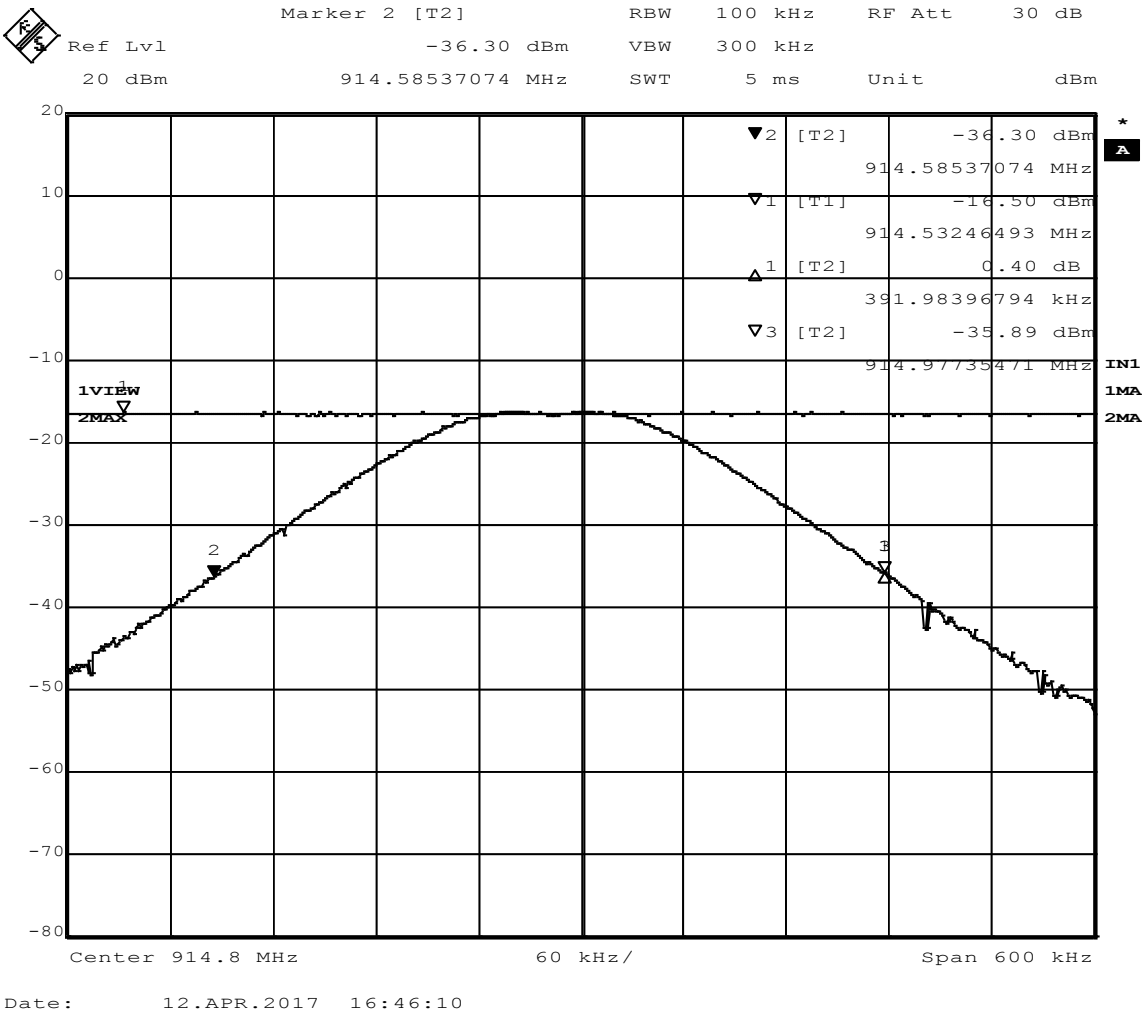

Figure 11 - 99% Occupied Bandwidth, Mid Channel, 391.98 kHz

Note: the trace at the top where Marker 1 is located was made with a 10MHz resolution bandwidth and saved on the screen. The trace on the bottom was made with a 100 kHz RBW.

The plot shows an uncorrected measurement, used for relative measurements only.

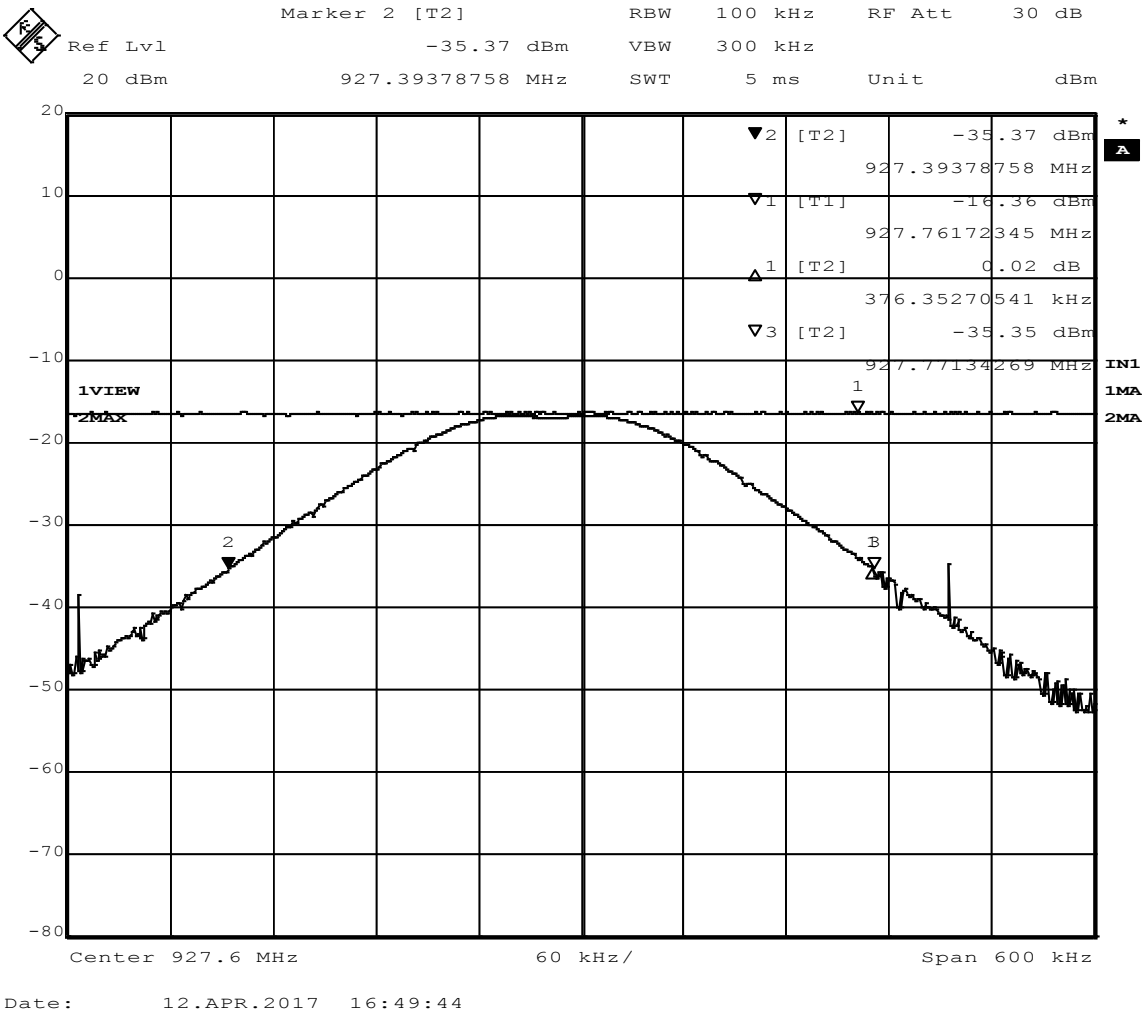

Figure 12 - 99% Occupied Bandwidth, High Channel, 376.35 kHz

Note: the trace at the top where Marker 1 is located was made with a 10MHz resolution bandwidth and saved on the screen. The trace on the bottom was made with a 100 kHz RBW.

The plot shows an uncorrected measurement, used for relative measurements only.

4.5 Bandedges

Test Method: ANSI C63.10, Section(s) 6.10.5.2

4.5.1 Limits of bandedge measurements

For emissions outside of the allowed band of operation (902 – 928MHz), the emission level needs to be 20dB under the maximum fundamental field strength. However, if the emissions fall within one of the restricted bands from 15.205 the field strength levels need to be under that of the limits in 15.209.

4.5.2 Test procedures

The EUT was tested in the same method as described in section *4.3 - Bandwidth*. The EUT was oriented as to produce the maximum emission levels. The resolution bandwidth was set to 30kHz and the EMI receiver was used to scan from the bandedge to the fundamental frequency with a quasi-peak detector. The highest emissions level beyond the bandedge was measured and recorded. All band edge measurements were evaluated to the general limits in Part 15.209.

4.5.3 Deviations from test standard

No deviation.

4.5.4 Test setup

See Section 4.3

4.5.5 EUT operating conditions

The EUT was powered by 3 VDC unless specified and set to transmit continuously on the lowest frequency channel, highest frequency channel and one in the middle of its operating range.

4.4.6 Test results

EUT MODULE	EN1252	MODE	Transmit
INPUT POWER	3 VDC	FREQUENCY RANGE	902MHz – 928 MHz
ENVIRONMENTAL CONDITIONS	32 % ± 5% RH 23 ± 3ºC	TECHNICIAN	KVepuri

Highest Out of Band Emissions

CHANNEL	Band edge Measurement Frequency (MHz)	Relative Highest out of band level dBm	Relative Fundamental Level (dBm)	Delta	Min (dBc)	Result
1	902	-91.13	-16.92	74.21	71.06	PASS
3	928	-90.99	-16.85	74.14	72.68	PASS

*Minimum delta = [highest fundamental peak field strength from Section 4.2] – [Part 15.209 radiated emissions limit.]

From Section 4.2

Fundamental peak field strength at 902MHz for low channel = 117.06 dBµV/m
Fundamental peak field strength at 928MHz for high channel = 118.68 dBµV/m

Channel 1 minimum delta = 117.06 - 46.0 dBµV/m = 71.06 dBc
Channel 3 minimum delta = 118.68 - 46.0 dBµV/m = 72.68 dBc

Measurements do not include correction factors and are intended to be relative measurements only.

The field strength values at the band edges meet the spurious emissions requirements of Part 15.209 and also meet the requirement to be 20dB below the maximum fundamental field strength requirement.

The restricted bands at 614 MHz and 960 MHz where investigated in Section 4.2 of this test report and found to be at least 20 dB below the limits of FCC Part 15.209.

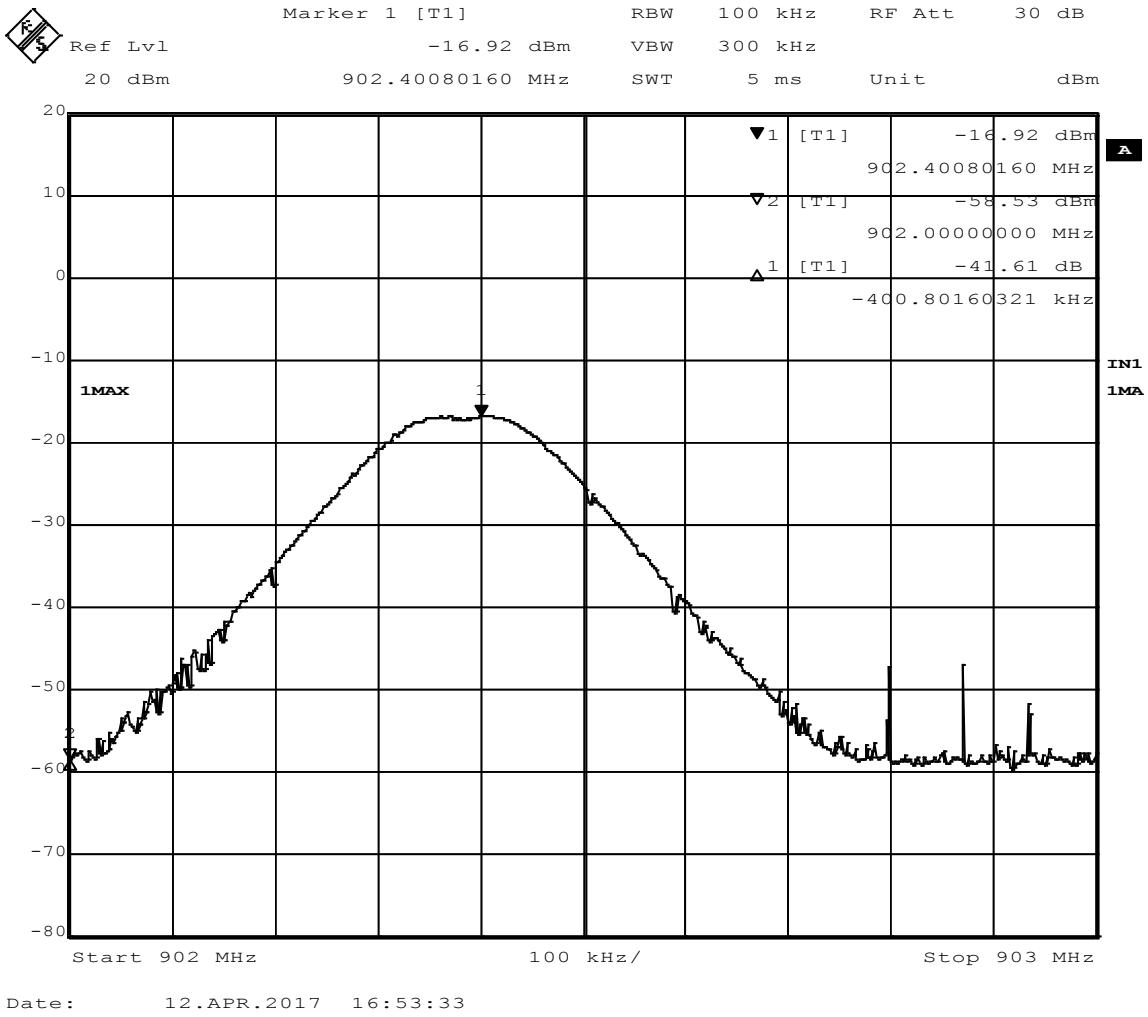

Figure 13 - Band-edge Measurement, Low Channel

The plot shows an uncorrected measurement, used for relative measurements only.

Delta = 38.53 dB Min = 20 dB

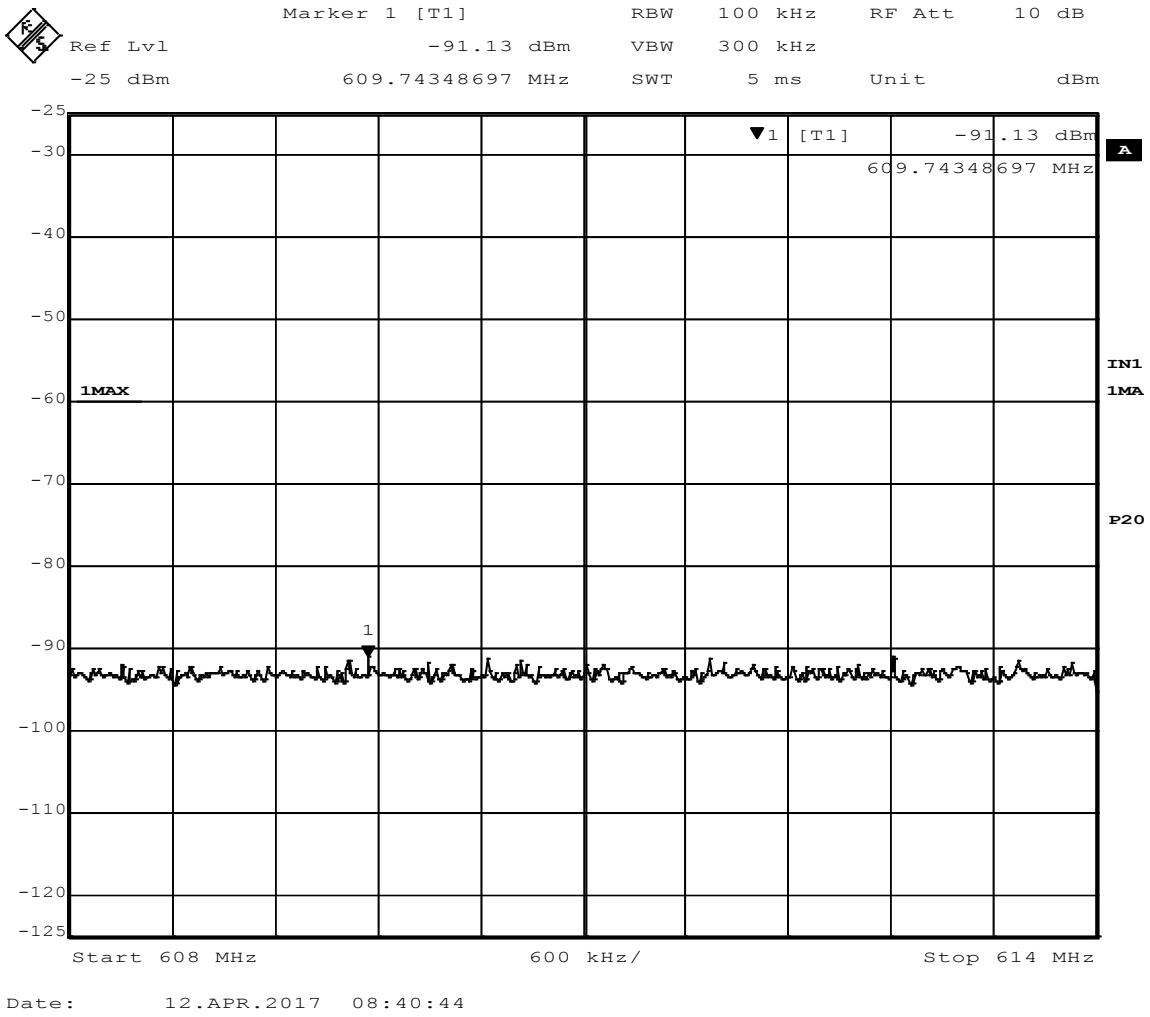

Figure 14 - Band-edge Measurement, Low Channel, Restricted

The plot shows an uncorrected measurement, used for relative measurements only.

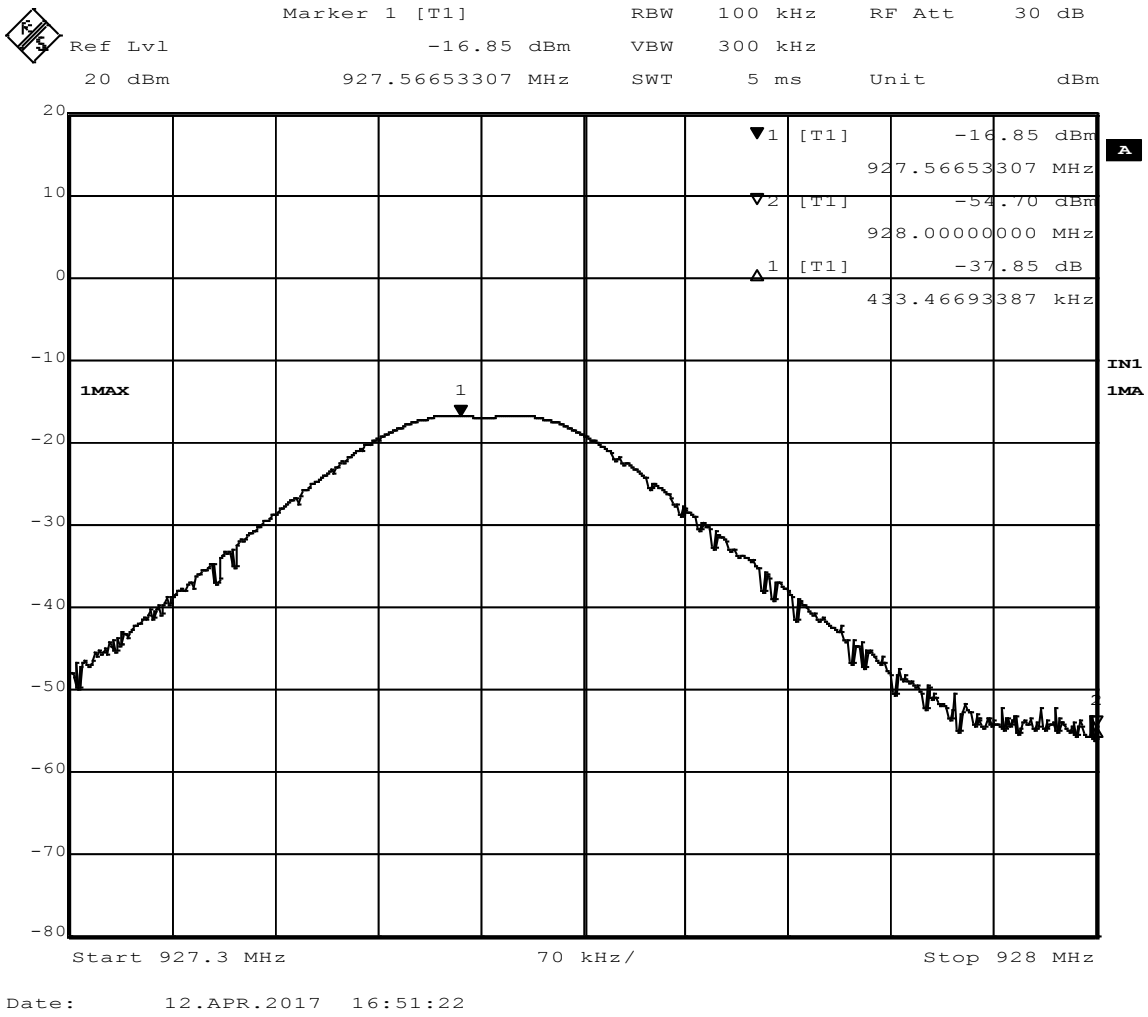

Figure 15 - Band-edge Measurement, High Channel, Restricted Frequency

The plot shows an uncorrected measurement, used for relative measurements only.

Delta = 38.53 dB Min = 20 dB

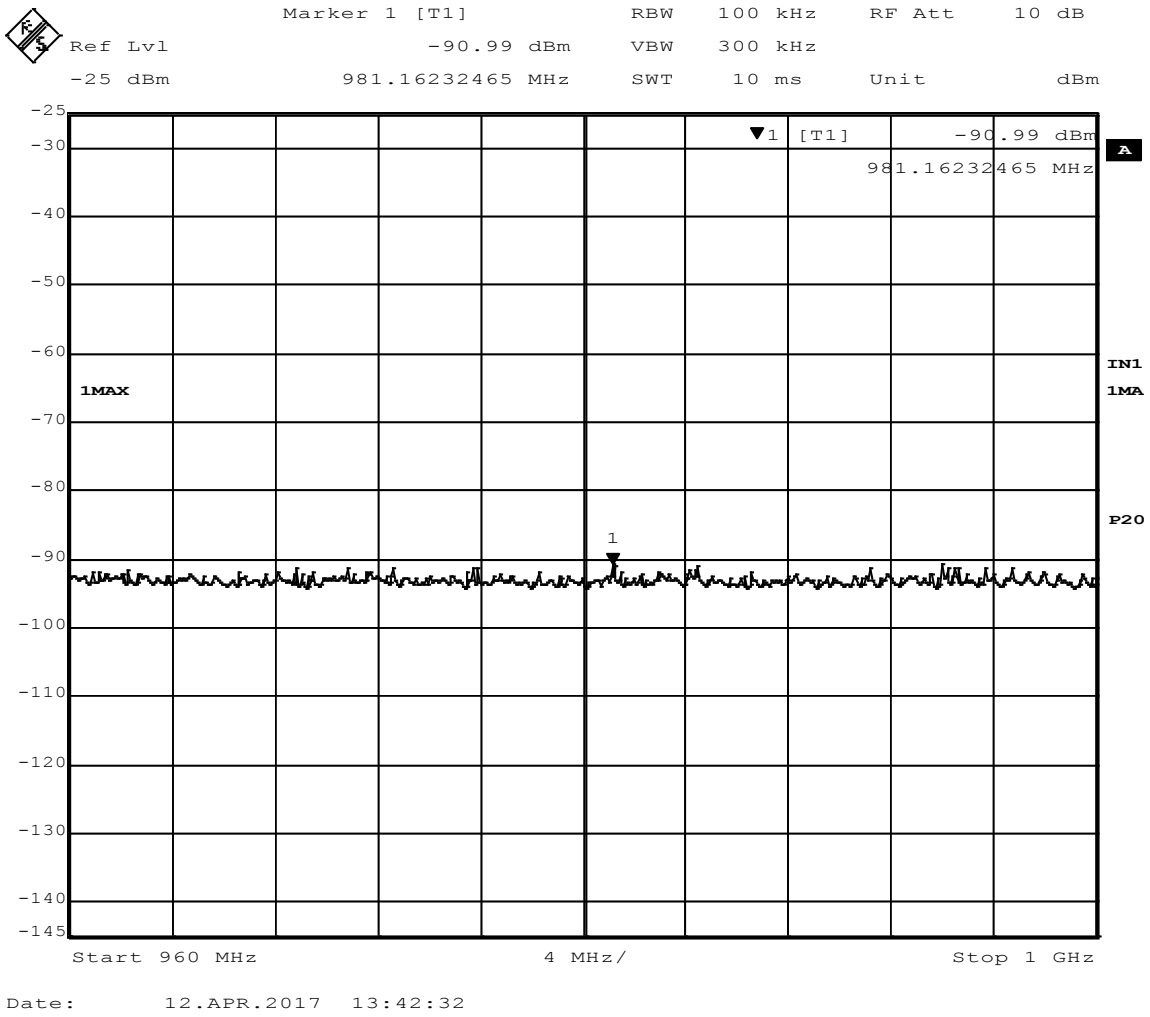

Figure 16 - Band-edge Measurement, High Channel, Fundamental

The plot shows an uncorrected measurement, used for relative measurements only.

4.6 Carrier frequency separation, Number of hopping channels, Time of Occupancy

4.6.1 Limits for Time of Occupancy

Average time of occupancy on any frequency not to exceed 0.4 seconds

4.6.2 Test procedures

The method from FCC DA 00-705

All measurements were taken at a distance of 3m from the EUT.

4.6.3 Deviations from test standard

No deviation.

4.6.4 Test setup

See Section 4.2.4

4.7.5 EUT operating conditions

The EUT was powered by 3 VDC unless specified and set to transmit continuously on the lowest frequency channel, highest frequency channel and one in the middle of its operating range.

4.6.6 Test results

EUT MODULE	EN1252	MODE	Continuous Hop
INPUT POWER	3 VDC	FREQUENCY RANGE	902MHz – 928 MHz
ENVIRONMENTAL CONDITIONS	32 % ± 5% RH 23 ± 3ºC	TECHNICIAN	KVepuri

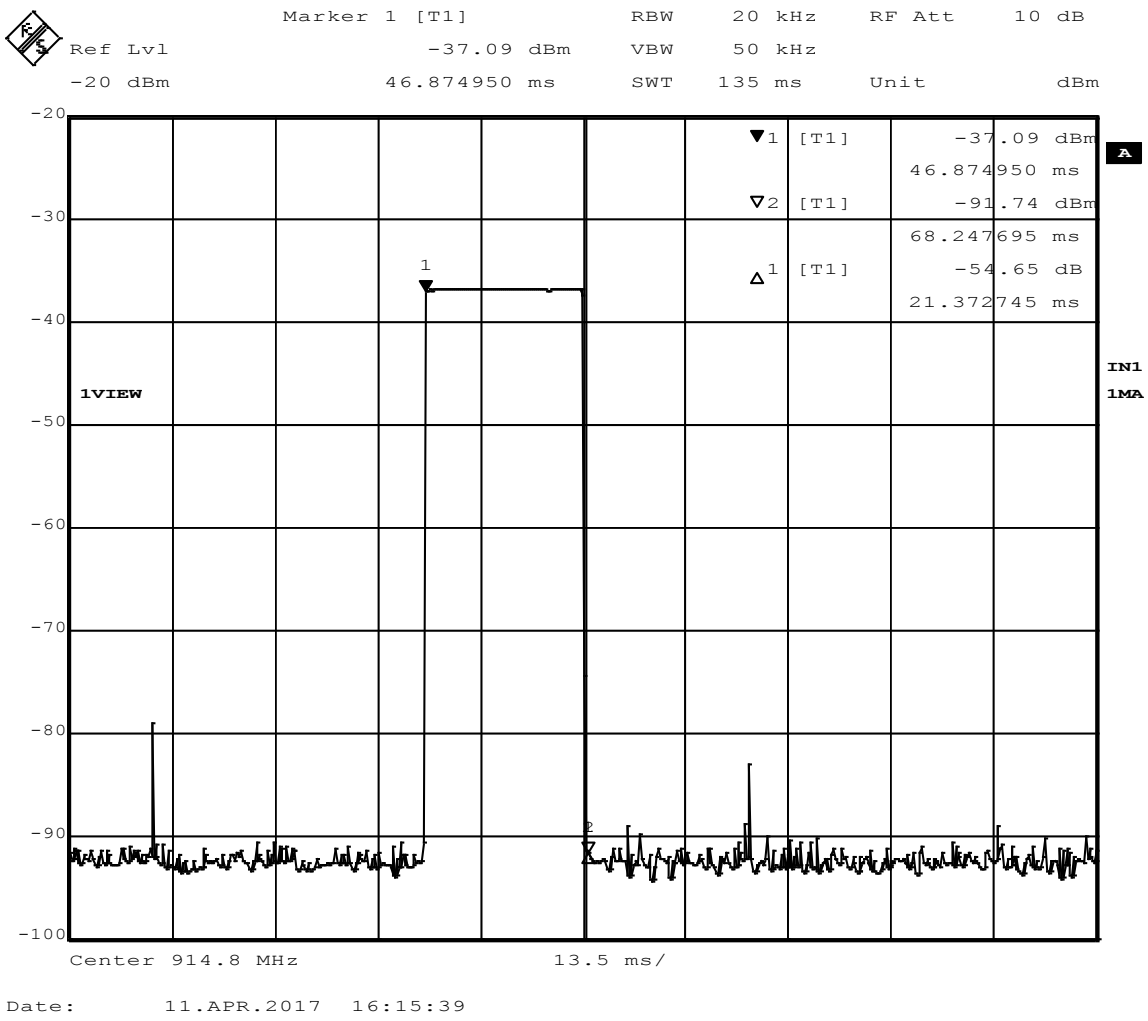

Figure 17 – Time of Occupancy (21.37 ms per Hop - Pass)
Max = 0.4 sec in 10 sec window

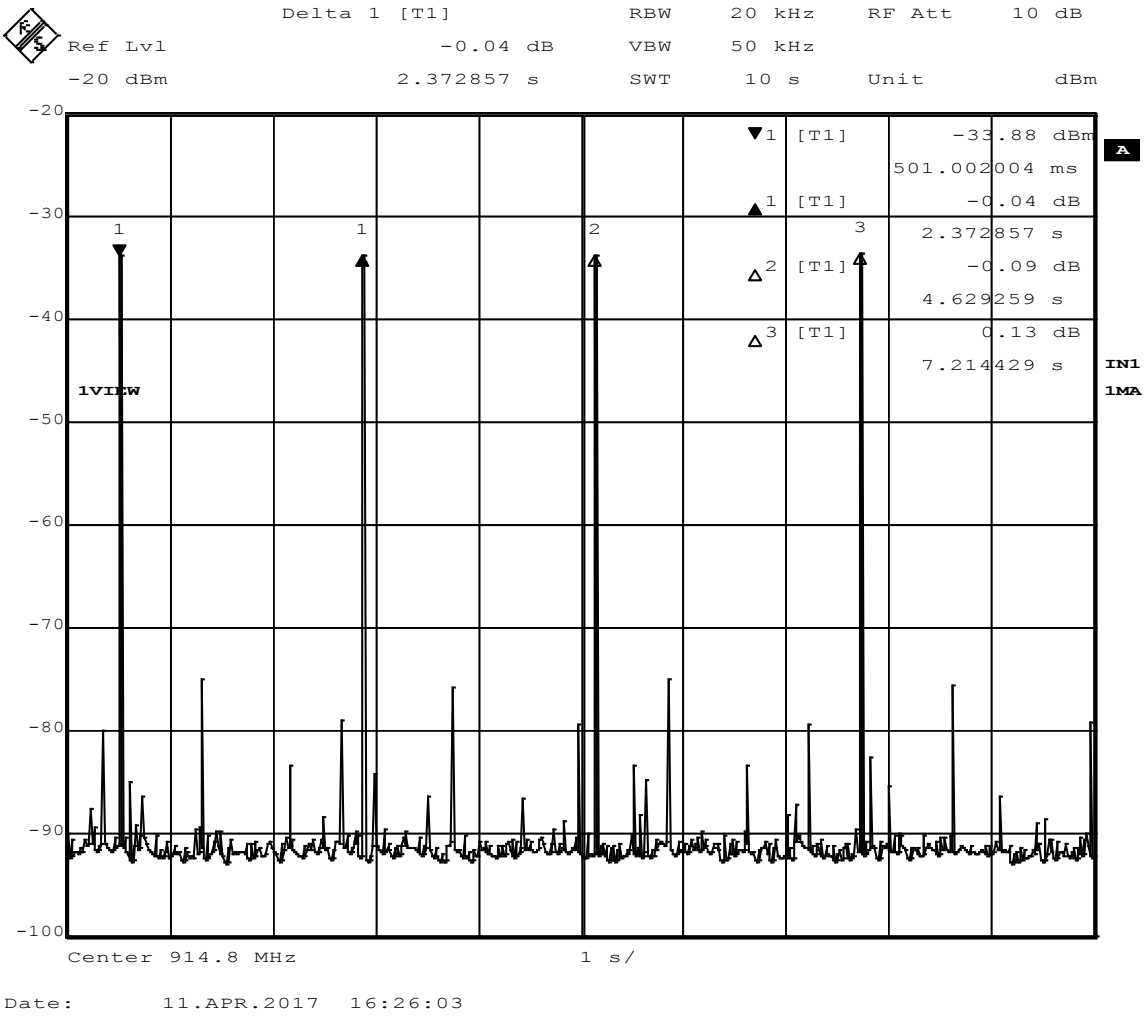

Figure 18 – Time of Occupancy - Period (Max – 4 peaks in 10 seconds window)

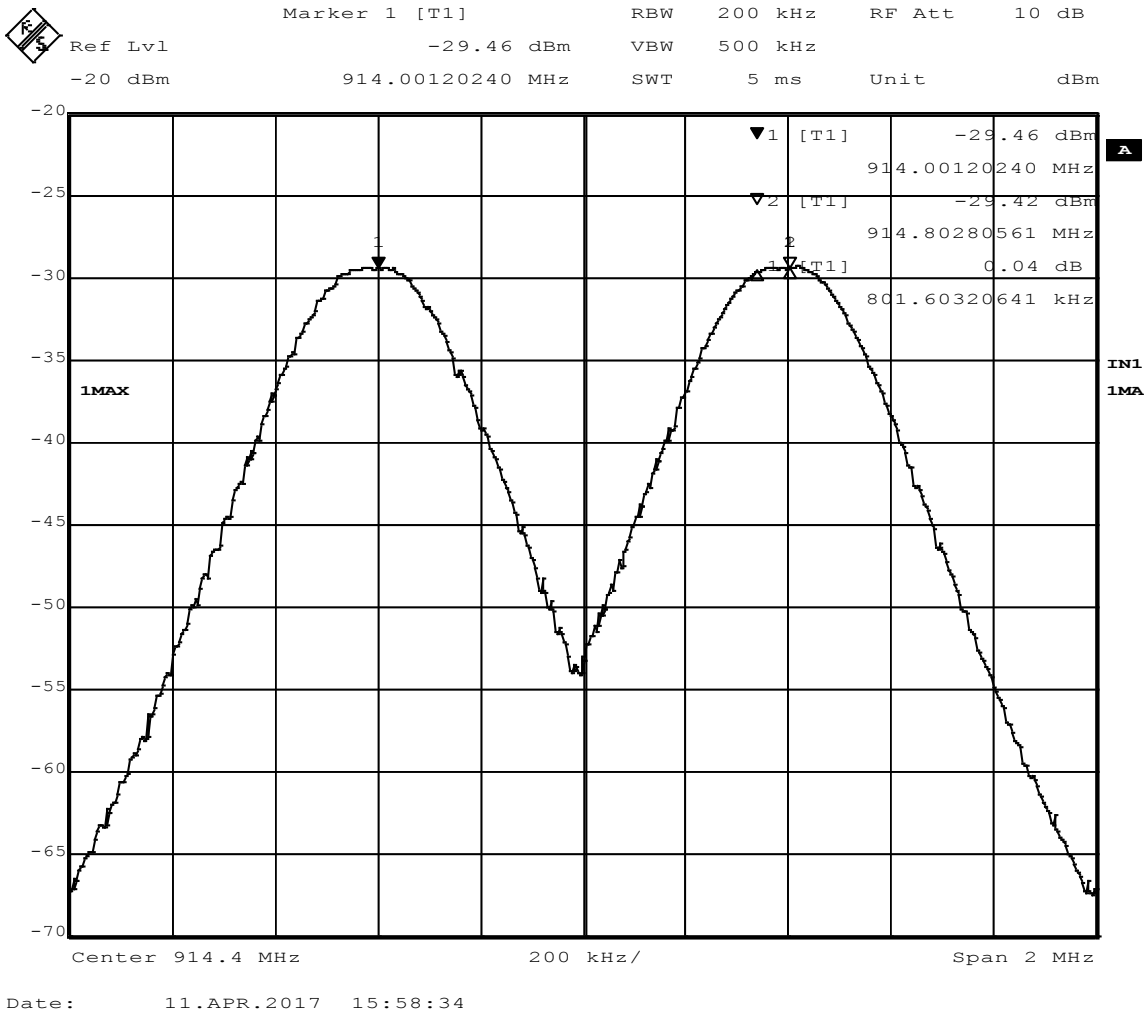

Figure 19 – Frequency Separation (801.60 kHz)

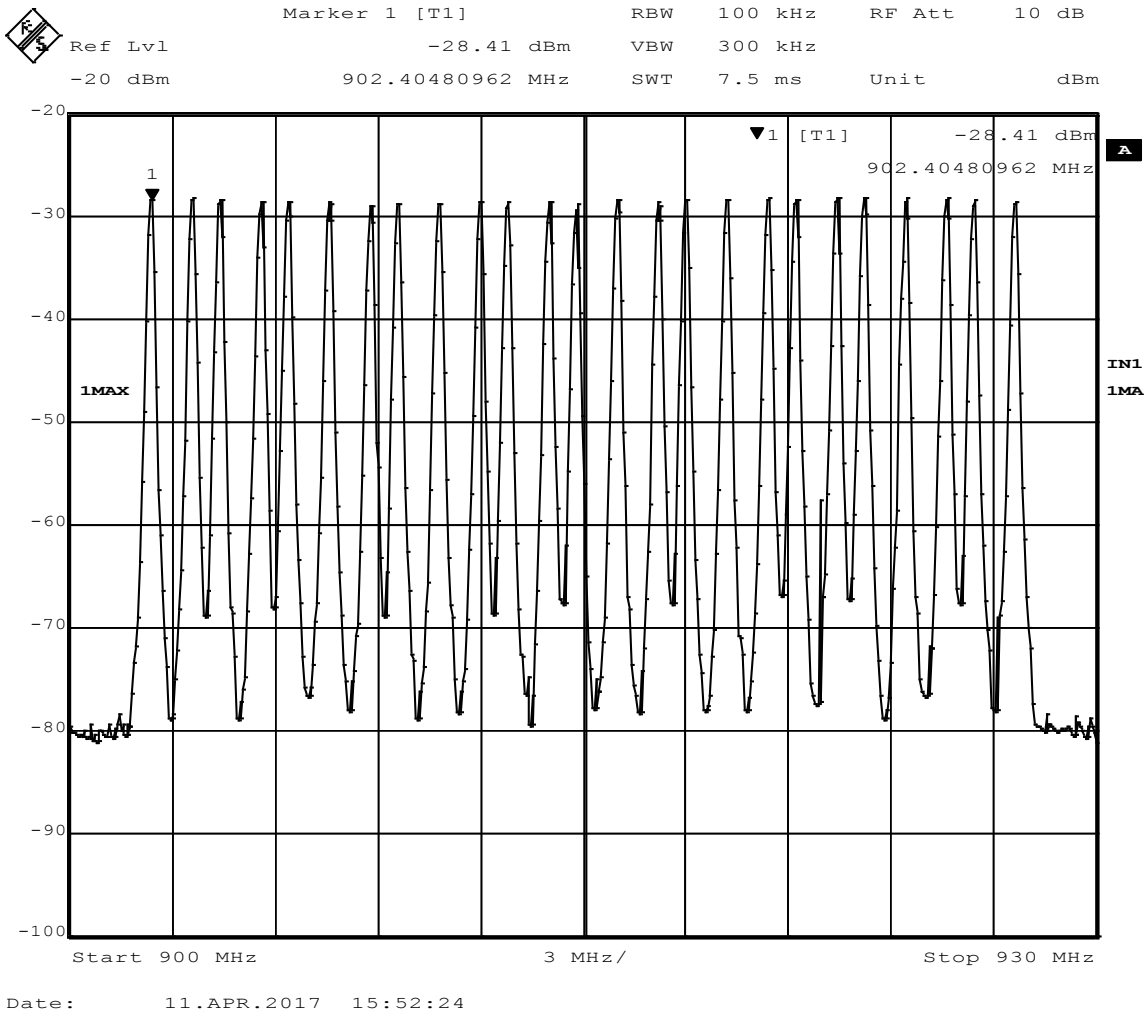

Figure 20 – Hopping Channel Count (25 Channels)

Appendix A: Sample Calculation

Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:
FS = RA + AF – (-CF + AG) + AV

where FS = Field Strength

RA = Receiver Amplitude

AF = Antenna Factor

CF = Cable Attenuation Factor

AG = Amplifier Gain

AV = Averaging Factor (if applicable)

Assume a receiver reading of 55 dBμV is obtained. The Antenna Factor of 12 and a Cable Factor of 1.1 is added. The Amplifier Gain of 20 dB is subtracted, giving a field strength of 48.1 dBμV/m.

FS = 55 + 12 – (-1.1 + 20) + 0 = 48.1 dBμV/m

The 48.1 dBμV/m value can be mathematically converted to its corresponding level in μV/m.

Level in μV/m = Common Antilogarithm [(48.1 dBμV/m)/20]= 254.1 μV/m

AV is calculated by the taking the 20*log(T_{on}/100) where T_{on} is the maximum transmission time in any 100ms window.

EIRP Calculations

In cases where direct antenna port measurement is not possible or would be inaccurate, output power is measured in EIRP. The maximum field strength is measured at a specified distance and the EIRP is calculated using the following equation;

EIRP (Watts) = [Field Strength (V/m) x antenna distance (m)]^2 / [30 x Gain (numeric)]

Power (watts) = 10^[Power (dBm)/10] x 1000

Field Strength (dBµV/m) = Field Strength (dBm) + 107 (for 50Ω measurement systems)

Field Strength (V/m) = 10^[Field Strength (dBµV/m) / 20] / 10^6

Gain = 1 (numeric gain for isotropic radiator)

Conversion from 3m field strength to EIRP (d=3):

EIRP = (FS x d^2)/30 = FS [(d^2)/30] = FS [0.3}

EIRP(dBm) = FS(dBµV/m) – 10(log 10^9)+ 10log[0.3] = -95.23

10log(10^) is the conversion from micro to milli

Annex B – Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been for tests performed in this test report:

Test	Frequency Range	Uncertainty Value (dB)
Radiated Emissions, 3m	30MHz - 1GHz	3.82
Radiated Emissions, 3m	1GHz - 18GHz	4.44
Emissions limits, conducted	150kHz – 18GHz	±3.30 dB

Expanded uncertainty values are calculated to a confidence level of 95%.

CISPR 16-4-2:2011 was used to calculate the above values.