

Amended
FCC/ISED Test Report

Prepared for: Independent Technologies

Address: 26 1st Ae SE
New London, MN 56273

Product: WESROC Residential LTE Cellular Tank Monitor
MN: MT9104RTMV UG5

Test Report No: R20171128-21A

Approved By: 
Nic S. Johnson, NCE
Technical Manager
iNARTE Certified EMC Engineer #EMC-003337-NE

DATE: 23 January 2018

Total Pages: 31

The Nebraska Center for Excellence in Electronics (NCEE) authorizes the above named company to reproduce this report provided it is reproduced in its entirety for use by the company's employees only. Any use that a third party makes of this report, or any reliance on or decisions made based on it, are the responsibility of such third parties. NCEE accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report. This report applies only to the items tested.

	Report Number:	R20171128-21	Rev	0
	Prepared for:	Independent Technologies		

REVISION PAGE

Rev. No.	Date	Description
0	12 January 2018	Original – NJohnson Prepared by KVepuri
A	23 January 2018	Peak output power, PSD, and bandwidth measurements were repeated as EIRP. –NJ Includes NCEE Labs report R20171128-21 and its amendment in full.

	Report Number:	R20171128-21	Rev	A
	Prepared for:	Independent Technologies		

CONTENTS

Revision Page.....	2
Tables of Figures	4
Table of Tables.....	4
1.0 Summary of test results.....	5
2.0 EUT Description	6
2.1 Equipment under test.....	6
2.2 Description of test modes.....	7
2.3 Description of support units	7
3.0 Laboratory description	8
3.1 Laboratory description	8
3.2 Test Personnel	8
3.3 Test equipment	9
4.0 Detailed results	10
4.1 Duty Cycle	10
4.2 Radiated emissions	11
4.3 Peak Output Power	17
4.4 Bandwidth	19
4.5 Bandedges	23
4.6 Power Spectral Density	25
4.7 Conducted AC Mains Emissions.....	27
Appendix A: Sample Calculation	28
Appendix B – Measurement Uncertainty	30
REPORT END.....	31

	Report Number:	R20171128-21	Rev	A
	Prepared for:	Independent Technologies		

TABLES OF FIGURES

Figure Number	Page
Figure 1 - Radiated Emissions Test Setup.....	13
Figure 2 - Radiated Emissions Plot, Receive.....	14
Figure 3 - Radiated Emissions Plot, Transmit.....	15
Figure 10 - Bandwidth Measurements Test Setup.....	17
Figure 5 – Output Power	18
Figure 10 - Bandwidth Measurements Test Setup.....	20
Figure 7 - 99% Occupied Bandwidth.....	21
Figure 8 – 6dB Bandwidth.....	22
Figure 9 – Power Spectral Density	26

TABLE OF TABLES

Table Number	Page
Table 1 - Radiated Emissions Quasi-peak Measurements, Receive	14
Table 2 - Radiated Emissions Peak Measurements vs. Average Limit, Receive	14
Table 3 - Radiated Emissions Quasi-peak Measurements, Transmit.....	15
Table 4 - Radiated Emissions Peak Measurements vs. Average Limit, Transmit.....	16

	Report Number:	R20171128-21	Rev	A
	Prepared for:	Independent Technologies		

1.0 SUMMARY OF TEST RESULTS

The EUT has been tested according to the following specifications:

APPLIED STANDARDS AND REGULATIONS		
Standard Section	Test Type	Result
FCC Part 15.35 RSS Gen, Issue 4, Section 6.10	Duty Cycle	Pass
FCC Part 15.247(b)(3) RSS-247 Issue 2 Section 5.24	Peak output power	Pass
FCC Part 15.247(a)(2) RSS-247 Issue 2 Section 5.2	Bandwidth	Pass
FCC Part 15.209 RSS-Gen Issue 4, Section 7.1	Receiver Radiated Emissions	Pass
FCC Part 15.209 (restricted bands), 15.247(d) (unrestricted) RSS-247 Issue 2 Section 5.5, RSS-Gen Issue 4, Section 8.9	Transmitter Radiated Emissions	Pass
FCC Part 15.247(a)(2) RSS-247 Issue 2 Section 5.2	Power Spectral Density	Pass
FCC Part 15.209, 15.247(d) RSS-247 Issue 2 Section 11.13	Band Edge Measurement	Pass
FCC Part 15.207 RSS-Gen Issue 4, Section 7.1	Conducted Emissions	NA

See Section 4 for details on the test methods used for each test.

	Report Number:	R20171128-21	Rev	A
	Prepared for:	Independent Technologies		

2.0 EUT DESCRIPTION

2.1 EQUIPMENT UNDER TEST

The Equipment Under Test (EUT) was a tank monitoring equipment. It has transmit and receive capabilities.

EUT	WESROC MN: MT9104RTMV UG5
EUT Received	12/18/2017
EUT Tested	12/18/2017 - 1/8/2018
Serial No.	00004213
Operating Band	902-928 MHz
Device Type	DTS
Power Supply	3.6 VDC internal battery

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

	Report Number:	R20171128-21	Rev	A
	Prepared for:	Independent Technologies		

2.2 DESCRIPTION OF TEST MODES

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

Channel	Frequency
1	916.48

This is the only channel in which the EUT transmits.

This EUT was set to transmit in a worse-case scenario with modulation on. The manufacturer modified the unit to transmit continuously on the one channel it transmits in.

2.3 DESCRIPTION OF SUPPORT UNITS

None

	Report Number:	R20171128-21	Rev	A
	Prepared for:	Independent Technologies		

3.0 LABORATORY DESCRIPTION

3.1 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 $35 \pm 4\%$
Temperature of $22 \pm 3^{\circ}$ Celsius



3.2 TEST PERSONNEL

No.	PERSONNEL	TITLE	ROLE
1	Karthik Vepuri	EMC Test Engineer	Testing
3	Nic Johnson	Technical Manager	Review of Results

Notes:

All personnel are permanent staff members of NCEE Labs. No testing or review was sub-contracted or performed by sub-contracted personnel.

	Report Number:	R20171128-21	Rev	A
	Prepared for:	Independent Technologies		

3.3 TEST EQUIPMENT

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 2017	02 Aug 2018
EMCO Horn Antenna	3115	6416	25 Jan 2016	25 Jan 2018
Rohde & Schwarz Preamplifier	TS-PR18	3545700803	9 Feb 2017*	9 Feb 2018*
Mini Circuits 1700 – 5000Mhz High Pass Filter***	15542	31618	9 Feb 2017*	9 Feb 2018*
Trilithic High Pass Filter	6HC330	23042	9 Feb 2017*	9 Feb 2018*
Rohde & Schwarz LISN	ESH3-Z5	100023	23 Jan 2017	23 Jan 2018
RF Cable (preamplifier to antenna)	MFR-57500	01-07-002	09 Feb 2017*	09 Feb 2018*
RF Cable (antenna to 10m chamber bulkhead)	FSCM 64639	01E3872	09 Feb 2017*	09 Feb 2018*
RF Cable (10m chamber bulkhead to control room bulkhead)	FSCM 64639	01E3874	09 Feb 2017*	09 Feb 2018*
RF Cable (Control room bulkhead to RF switch)	FSCM 64639	01E3871	09 Feb 2017*	09 Feb 2018*
RF Cable (RF switch to test receiver)	FSCM 64639	01F1206	09 Feb 2017*	09 Feb 2018*
RF switch – Rohde and Schwarz	TS-RSP	1113.5503.14	09 Feb 2017*	09 Feb 2018*
N connector bulkhead (10m chamber)	PE9128	NCEEBH1	09 Feb 2017*	09 Feb 2018*
N connector bulkhead (control room)	PE9128	NCEEBH2	09 Feb 2017*	09 Feb 2018*

*Internal Characterization

	Report Number:	R20171128-21	Rev	A
	Prepared for:	Independent Technologies		

4.0 DETAILED RESULTS

4.1 DUTY CYCLE

Duty cycle measurements were not performed. Peak detector measurements were compliant with average limits so it was not necessary.

	Report Number:	R20171128-21	Rev	A
	Prepared for:	Independent Technologies		

4.2 RADIATED EMISSIONS

Test Method: ANSI C63.10:2013, Section 6.5, 6.6, 11.11, 11.12

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 ($\mu\text{V/m}$)	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 (dB $\mu\text{V/m}$) = 20 * log * Emission level ($\mu\text{V/m}$).
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.

	Report Number:	R20171128-21	Rev	A
	Prepared for:	Independent Technologies		

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 from 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. The results are presented for the axis that had the highest emissions.

	Report Number:	R20171128-21	Rev	A
	Prepared for:	Independent Technologies		

NOTE:

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.

Deviations from test standard:

No deviation.

Test setup:

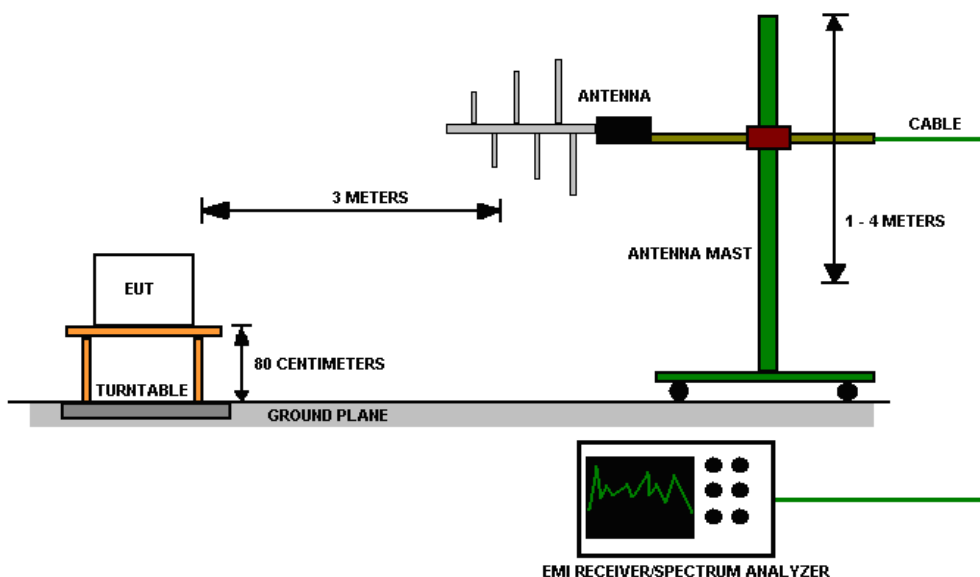


Figure 1 - Radiated Emissions Test Setup

EUT operating conditions

The EUT was powered by 3.6 VDC internal battery, unless specified and set to transmit continuously on the only frequency channel it operates.

Test results:

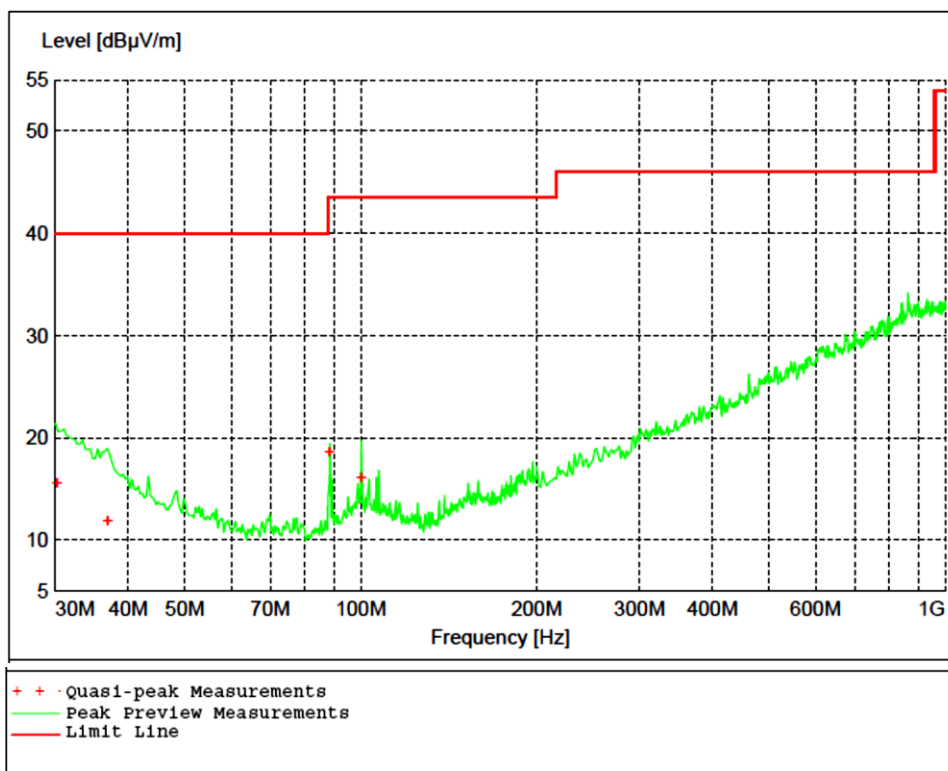


Figure 2 - Radiated Emissions Plot, Receive

Table 1 - Radiated Emissions Quasi-peak Measurements, Receive

Frequency	QP Level	QP Limit	Margin	Height	Angle	Pol	Axis
MHz	dBµV/m	dBµV/m	dB	cm.	deg.		
30.180000	15.55	40.00	24.50	349	133	VERT	Y
36.900000	11.85	40.00	28.10	371	295	VERT	Y
88.500000	18.54	43.50	25.00	390	329	HORI	Y
100.260000	16.03	43.50	27.50	226	36	VERT	Y

Table 2 - Radiated Emissions Peak Measurements vs. Average Limit, Receive

Frequency	PK Level	AV Limit	Margin	Height	Angle	Pol	Axis
MHz	dBµV/m	dBµV/m	dB	cm.	deg.		
1832.800000	33.20	54.00	20.80	99	349	VERT	Y
2753.600000	35.28	54.00	18.70	369	99	VERT	Y
3677.000000	38.71	54.00	15.30	401	207	HORI	Y
4594.400000	40.85	54.00	13.20	234	182	VERT	Y

Peak measurements were compared to average limit and found to be compliant so average measurements were not performed

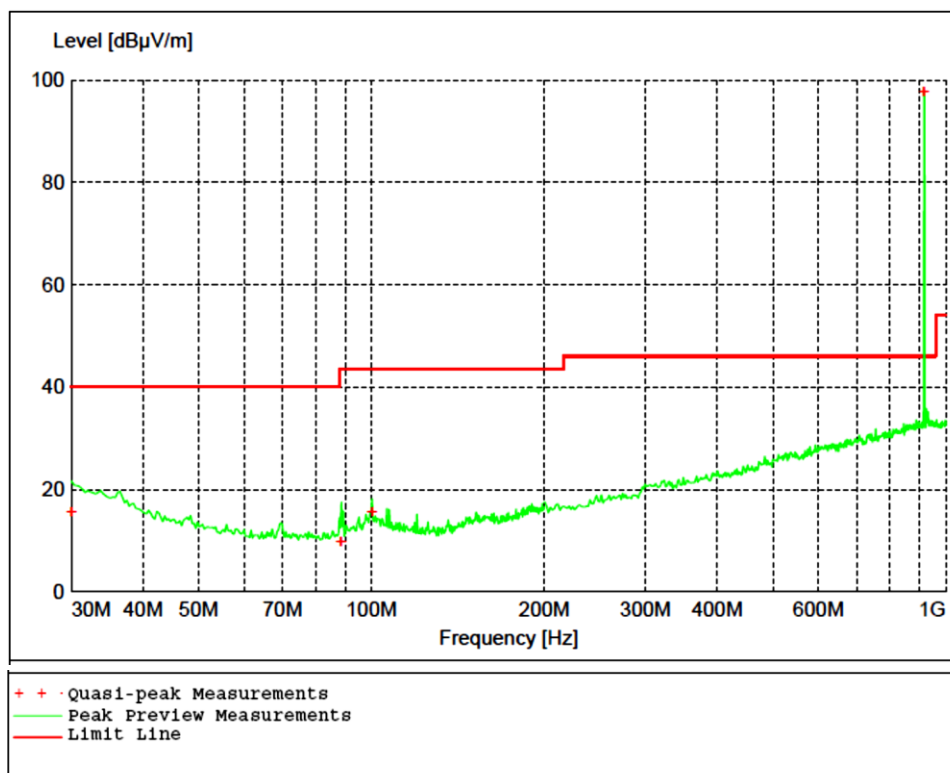


Figure 3 - Radiated Emissions Plot, Transmit

Table 3 - Radiated Emissions Quasi-peak Measurements, Transmit

Frequency	QP Level	QP Limit	Margin	Height	Angle	Pol	Axis
MHz	dBμV/m	dBμV/m	dB	cm.	deg.		
30.060000	15.63	40.00	24.40	322	11	VERT	Y
88.500000	9.83	43.50	33.70	356	312	HORI	Y
100.260000	15.52	43.50	28.00	383	35	HORI	Y
916.480000	97.48	NA	NA	100	65	HORI	Y

	Report Number:	R20171128-21	Rev	A
	Prepared for:	Independent Technologies		

Table 4 - Radiated Emissions Peak Measurements vs. Average Limit, Transmit

Frequency	PK Level	AV Limit	Margin	Height	Angle	Pol	Axis
MHz	dBμV/m	dBμV/m	dB	cm.	deg.		
1720.800000	34.04	54.00	20.00	178	343	VERT	Y
1833.600000	34.28	54.00	19.70	101	92	VERT	Y
2750.200000	42.10	54.00	11.90	157	209	HORI	Y
3656.200000	39.78	54.00	14.20	100	283	VERT	Y
4581.200000	44.17	54.00	9.80	147	219	HORI	Y
5498.400000	44.32	54.00	9.70	100	0	VERT	Y
6406.600000	43.83	54.00	10.20	400	258	VERT	Y
7349.000000	43.15	54.00	10.80	99	0	VERT	Y
8233.000000	46.78	54.00	7.20	174	253	VERT	Y

Peak measurements were compared to average limit and found to be compliant so average measurements were not performed

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 all 3 orthogonal axis. It was found that the Y-axis produced the highest emissions, and this orientation was used for all testing. See the test setup photo exhibit for details on the orientations.

	Report Number:	R20171128-21	Rev	A
	Prepared for:	Independent Technologies		

4.3 PEAK OUTPUT POWER

Test Method: ANSI C63.10, Section(s) 11.9.1.1

Limits of bandwidth measurements:

The maximum allowed peak output power is 30 dBm.

Test procedures:

The EUT was at a distance of 3m from the EUT with 10 MHz RBW and 10 MHz VBW. The RBW was set to a value larger than the DTS bandwidth.

Deviations from test standard:

No deviation.

Test setup:

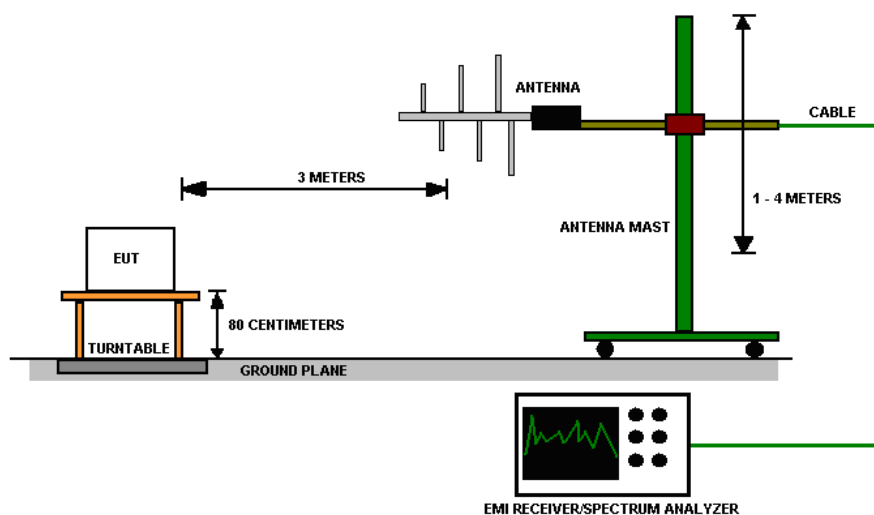


Figure 4 - Bandwidth Measurements Test Setup

EUT operating conditions:

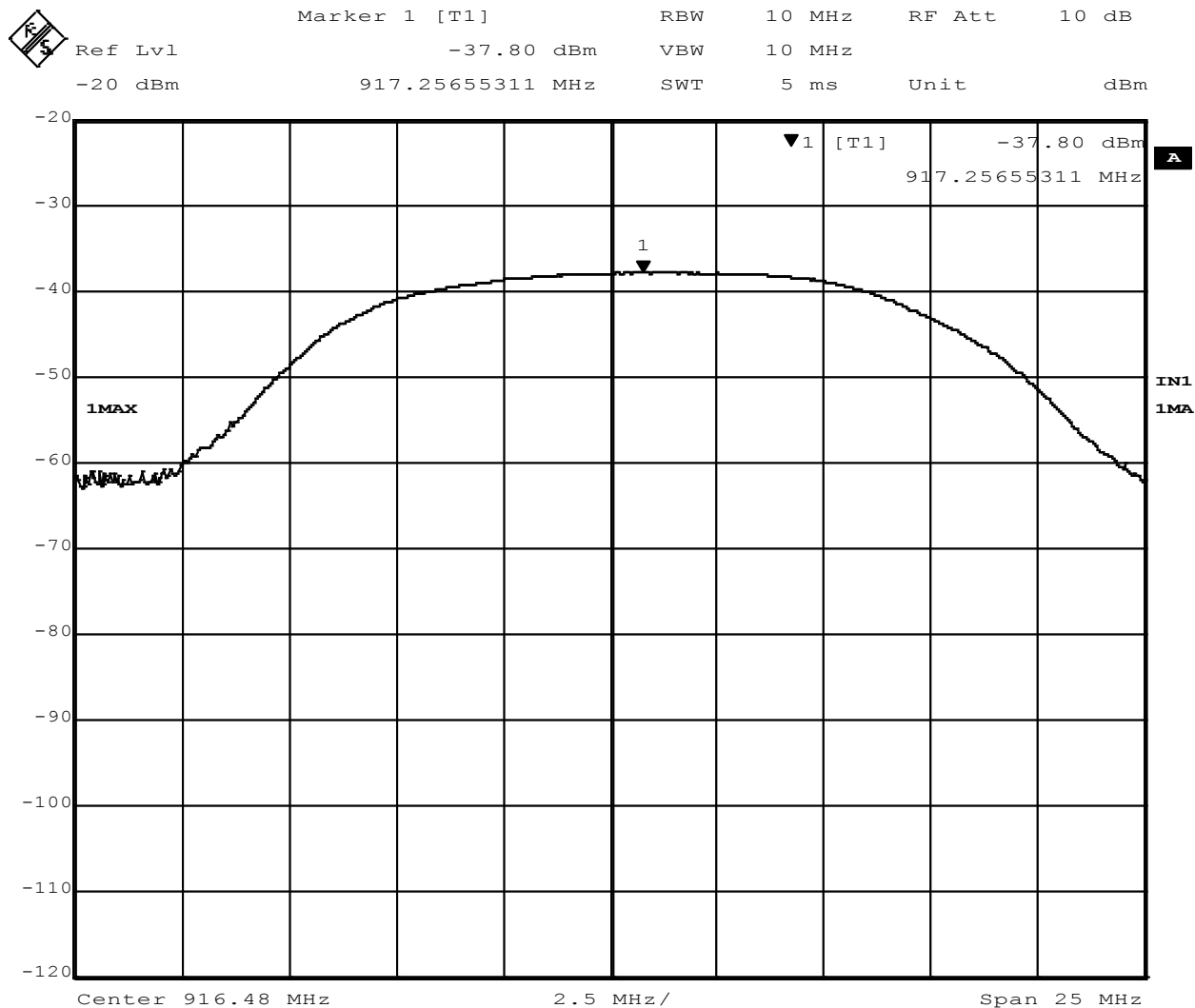
The EUT was powered by 3.6 VDC unless specified and set to transmit continuously on the only frequency channel it operates.

Test results:

Peak Output Power

CHANNEL	CHANNEL FREQUENCY (MHz)	PEAK OUTPUT POWER (dBm)	Method	RESULT
Middle	916.48	2.27	EIRP	PASS

	Report Number:	R20171128-21	Rev	A
	Prepared for:	Independent Technologies		



Date: 8.JAN.2018 10:59:14

Figure 5 – Output Power

Maximum power = -37.80 dBm + 107 + CL + AF - 95.23 = 2.27 dBm

CL = cable loss = 4.80 dB

AF = antenna factor = 23.50 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.

	Report Number:	R20171128-21	Rev	A
	Prepared for:	Independent Technologies		

4.4 BANDWIDTH

Test Method: ANSI C63.10, Section(s) 11.8.1, 6.9

Limits of bandwidth measurements:

The 6dB bandwidth of the signal must be greater than 500 kHz.

Test procedures:

Bandwidth measurement was 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 for 6dB bandwidth and 30 KHz RBW and 100 kHz VBW for occupied bandwidth measurements per C63.10.

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 30 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.

The 6 dB bandwidth is defined as the bandwidth of which is higher than peak power minus 6dB.

Deviations from test standard:

No deviation.

Test setup:

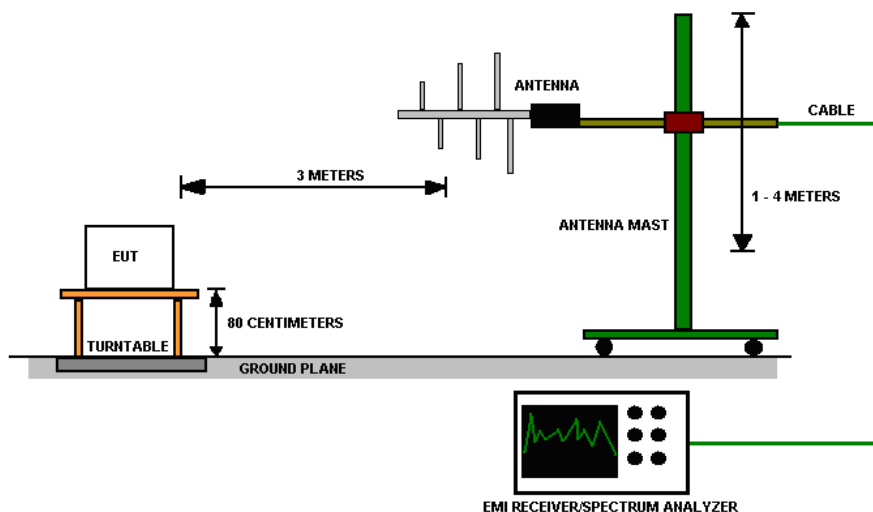


Figure 6 - Bandwidth Measurements Test Setup

EUT operating conditions:

The EUT was powered by 3.6 VDC unless specified and set to transmit continuously on the only frequency channel it operates.

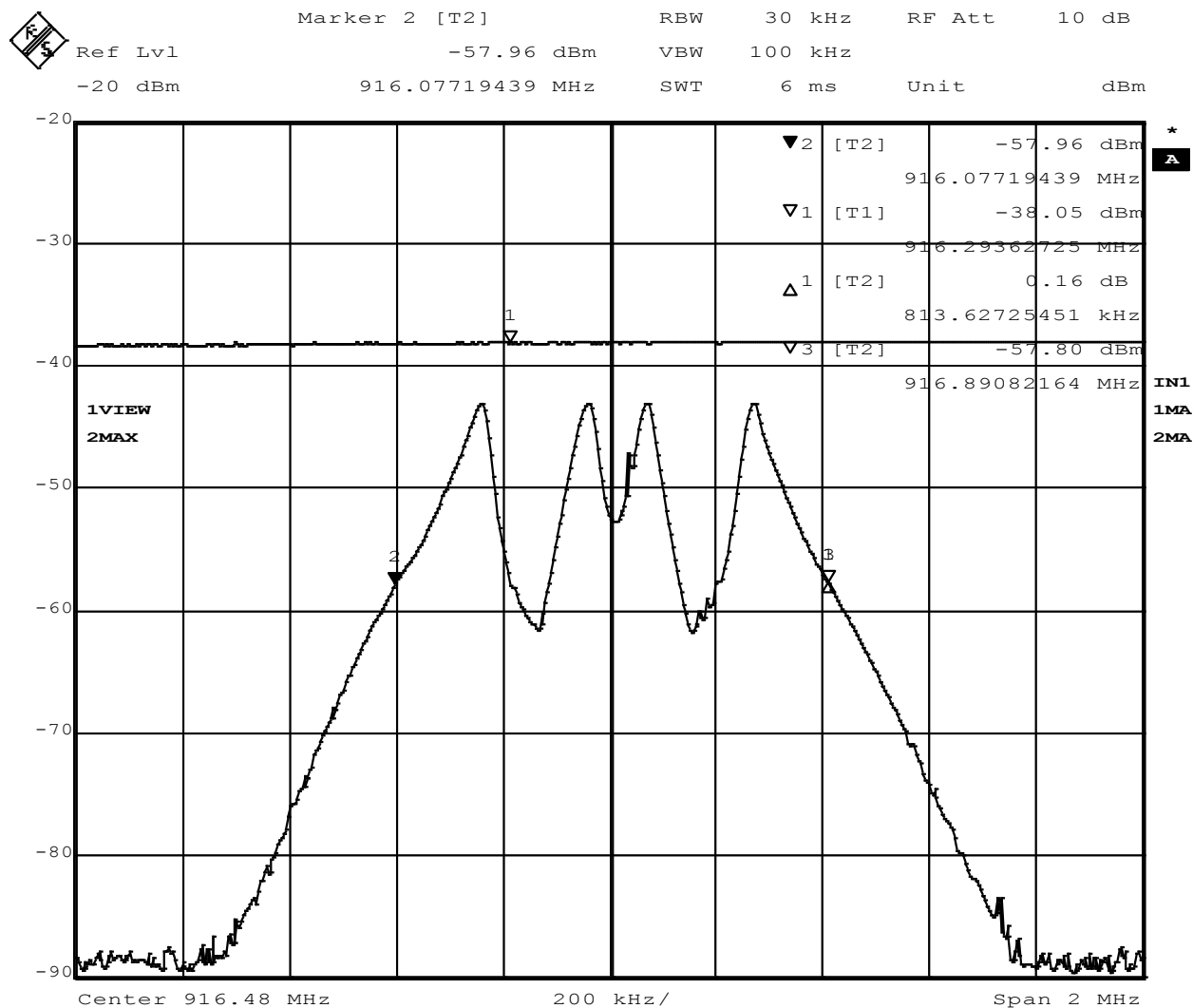
Test results:

99% Occupied Bandwidth

CHANNEL	CHANNEL FREQUENCY (MHz)	99% Occupied BW (kHz)
1	916.48	813.62

6dB Bandwidth

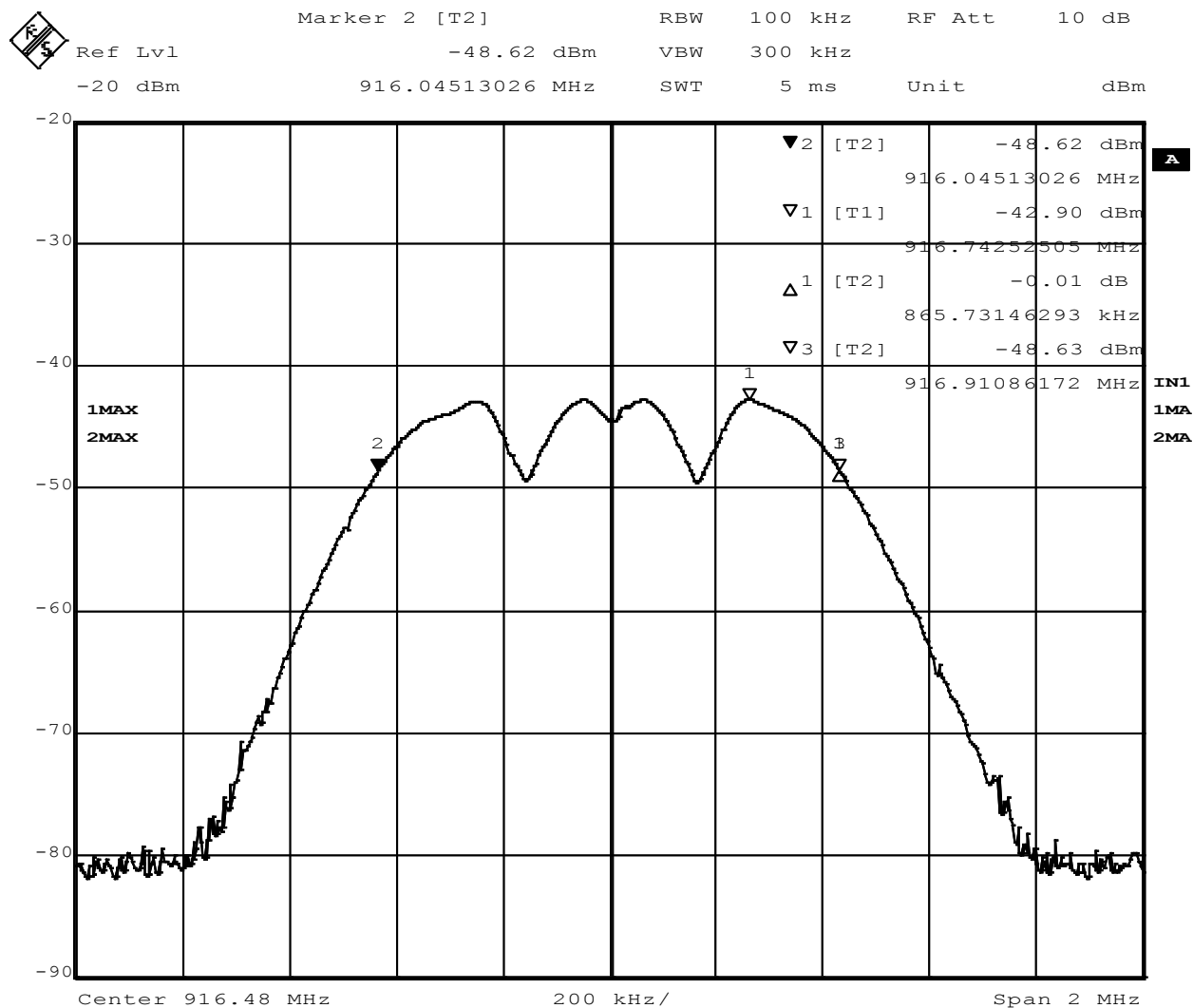
CHANNEL	CHANNEL FREQUENCY (MHz)	6 dB BW (kHz)
1	916.48	865.73



Date: 8.JAN.2018 11:10:57

Figure 7 - 99% Occupied Bandwidth

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 30 kHz RBW.



Date: 8.JAN.2018 11:14:01

Figure 8 – 6dB Bandwidth

	Report Number:	R20171128-21	Rev	A
	Prepared for:	Independent Technologies		

4.5 BANDEDGES

Test Method: ANSI C63.10, Section(s) 6.10.6, 11.13.2

Limits of bandedge measurements:

For emissions outside of the allowed band of operation (902 MHz – 928 MHz), 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.

Test procedures:

The EUT was tested in the same method as described in section 4.2 – *Radiated Emissions*. The EUT was oriented as to produce the maximum emission levels. The resolution bandwidth was set to 120 kHz and the EMI receiver was used to scan from the band edge to the fundamental frequency with a quasi-peak detector. The highest emissions level beyond the band edge was measured and recorded. All band edge measurements were evaluated to the general limits in Part 15.209.

Deviations from test standard:

No deviation.

Test setup:

See Section 4.3

EUT operating conditions:

The EUT was powered by 3.6 VDC unless specified and set to transmit continuously on the only frequency channel it operates.

	Report Number:	R20171128-21	Rev	A
	Prepared for:	Independent Technologies		

Test results:

Highest Out of Band Emissions-Restricted

CHANNEL	Band edge /Measurement Frequency (MHz)	Relative Highest out of band level dB μ V/m	Relative Fundamental Level dB μ V/m	Delta	Min (dBc)	Result
Low	614.0	28.37	97.48	69.11	51.48	PASS
High	960.0	32.90	97.48	64.58	51.48	PASS

Highest Out of Band Emissions-Unrestricted

CHANNEL	Band edge /Measurement Frequency (MHz)	Relative Highest out of band level dB μ V/m	Relative Fundamental Level dB μ V/m	Delta	Min Per 15.247	Result
Low	902	32.39	97.48	65.09	20	PASS
High	928	34.42	97.48	63.06	20	PASS

All data was taken from the plot shown in Figure 3.

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

From Section 4.2

Fundamental average field strength at 916.48MHz for low channel = 97.48 dB μ V/m

Low channel & High Channel minimum delta = 97.48 – 46.0 dB μ V/m = 51.48 dBc

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

	Report Number:	R20171128-21	Rev	A
	Prepared for:	Independent Technologies		

4.6 POWER SPECTRAL DENSITY

Test Method: ANSI C63.10, Section 11.10.2

Limits of power measurements:

The maximum PSD allowed is 8 dBm.

Test procedures:

1. All measurements were taken as EIRP at 3m test distance.
2. The resolution bandwidth was set to 3 kHz and the video bandwidth was set to 10 kHz to capture the signal. The analyzer used a peak detector in max hold mode.

Test setup:

The EUT was connected to the spectrum analyzer directly with a low-loss shielded coaxial cable.

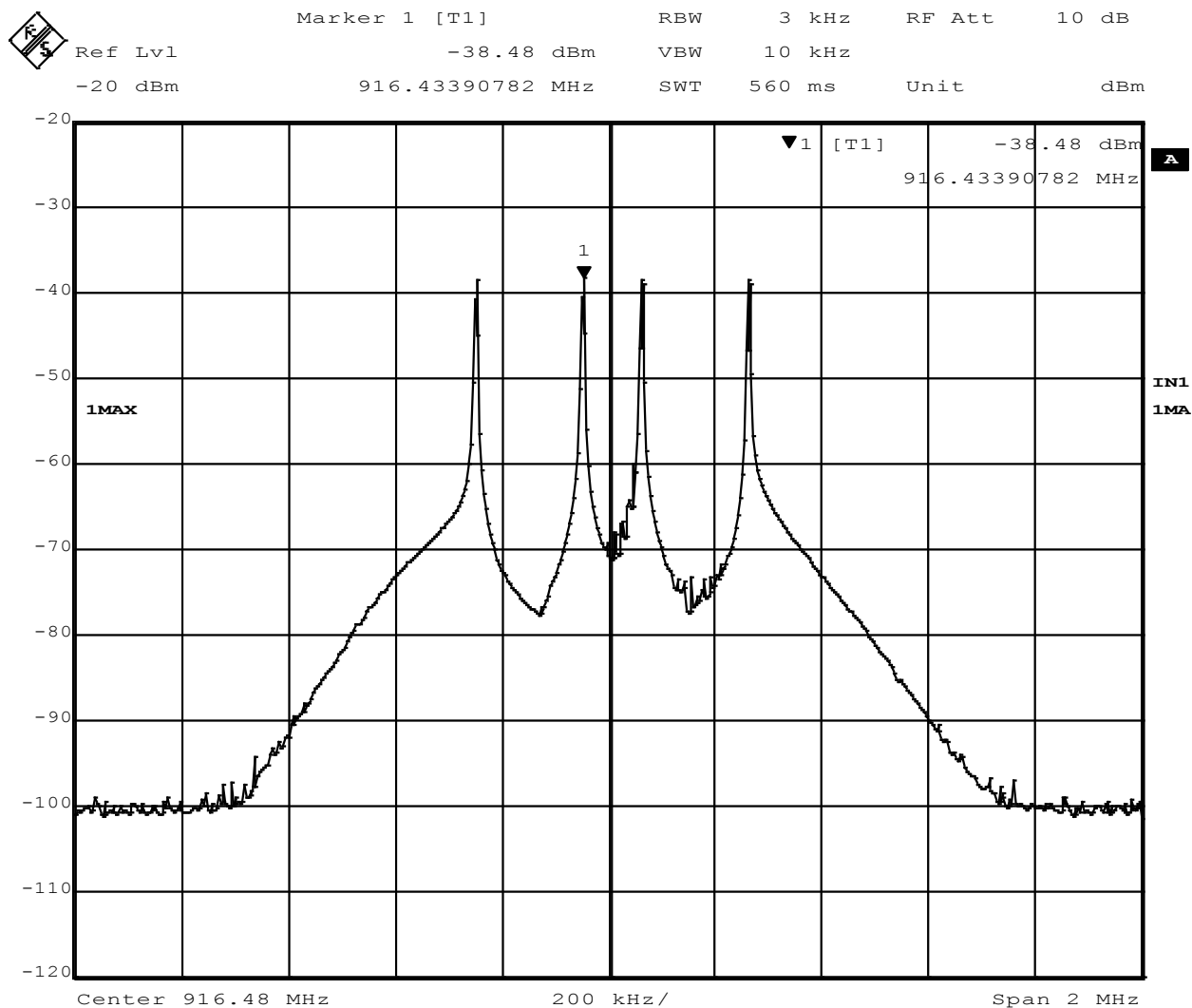
EUT operating conditions:

The EUT was powered by 3.6 VDC unless specified and set to transmit continuously on the only frequency channel it operates.

Test results:

Power Spectral Density

CHANNEL	CHANNEL FREQUENCY (MHz)	EIRP RF POWER LEVEL IN # KHz BW (dBm)	MAXIMUM POWER LIMIT (dBm)	RESULT
1	916.48	1.59	8.00	PASS



Date: 8.JAN.2018 11:02:51

Figure 9 – Power Spectral Density

Maximum power = -38.48 dBm + 107 + CL + AF - 95.23 = 1.59 dBm

CL = cable loss = 4.80 dB

AF = antenna factor = 23.50 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.

	Report Number:	R20171128-21	Rev	A
	Prepared for:	Independent Technologies		

4.7 CONDUCTED AC MAINS EMISSIONS

The EUT is battery powered and there are no provisions for connecting to an AC mains supply network. The batteries are not rechargeable.

	Report Number:	R20171128-21	Rev	A
	Prepared for:	Independent Technologies		

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 dB μ V 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 dB μ V/m.

$$FS = 55 + 12 - (-1.1 + 20) + 0 = 48.1 \text{ dB}\mu\text{V/m}$$

The 48.1 dB μ V/m value can be mathematically converted to its corresponding level in μ V/m.

$$\text{Level in } \mu\text{V/m} = \text{Common Antilogarithm} [(48.1 \text{ dB}\mu\text{V/m})/20] = 254.1 \mu\text{V/m}$$

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

	Report Number:	R20171128-21	Rev	A
	Prepared for:	Independent Technologies		

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;

$$EIRP \text{ (Watts)} = [Field \text{ Strength (V/m)} \times antenna \text{ distance (m)}]^2 / 30$$

$$Power \text{ (watts)} = 10^{[Power \text{ (dBm)}/10]} / 1000$$

$$Voltage \text{ (dB}\mu\text{V)} = Power \text{ (dBm)} + 107 \text{ (for } 50\Omega \text{ measurement systems)}$$

$$Field \text{ Strength (V/m)} = 10^{[Field \text{ Strength (dB}\mu\text{V/m)} / 20]} / 10^6$$

$$Gain = 1 \text{ (numeric gain for isotropic radiator)}$$

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

$$EIRP = [FS(V/m) \times d^2]/30 = FS [0.3] \quad \text{for } d = 3$$

$$EIRP(dBm) = FS(dB\mu V/m) - 10(\log 10^9) + 10\log[0.3] = FS(dB\mu V/m) - 95.23$$

10log(10^9) is the conversion from micro to milli

	Report Number:	R20171128-21	Rev	A
	Prepared for:	Independent Technologies		

APPENDIX 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	30MHz – 18GHz	±3.30 dB

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

	Report Number:	R20171128-21	Rev	A
	Prepared for:	Independent Technologies		

REPORT END