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Amended Test Report

Company:	MetroTel Corp 26 First Ave SE New London, MN 56273
Contact:	Jim Fangmeier
Product:	WESROC RMS Cellular Tank Monitor
FCC ID: IC :	RWBMT9100CTR 115A-MT9100CTM
Test Report No:	R060311-40A
APPROVED BY:	Nic Johnson Test Engineer, iNARTE Certification EMC-003337-NE
DATE:	21 June 2011
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ACCREDITED
Test Laboratory Certificate 1953.01

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1.0 Summary of test results

The EUT has been tested according to the following specifications:

APPLIED STANDARDS: FCC Part 15, Subpart C			
Standard Section	**Test Type and Limit**	**Result**	**Remark**
15.203	Unique Antenna Requirement	Pass	PCB Antenna
15.207	Conducted Emissions	NA	No provisions for connection to AC Mains
15.209	Radiated Emissions	Pass	Meets the requirement of the limit.
15.247(a)(2)	Minimum Bandwidth, Limit: Min. 500kHz	Pass	Meets the requirement of the limit.
15.247(b)	Maximum Peak Output Power, Limit: Max. 30dBm	Pass	Meets the requirement of the limit.
15.247(c)	Transmitter Radiated Emissions, Limit: Table 15.209	Pass	Meets the requirement of the limit.
15.247(d)	Power Spectral Density, Limit: Max. 8dBm	Pass	Meets the requirement of the limit.
15.247(c)	Band Edge Measurement, Limit: 20dB less than the peak value of fundamental frequency	Pass	Meets the requirement of the limit.

Additions included in amendment:

4.2.2 note g was added.

Section 4.4: The correct bandwidth plot was added.

2.0 Description

2.1 Equipment under test

The Equipment Under Test (EUT) was a WESROC RMS Satellite Repeater (MT-9100CTM. It is used to remotely monitor the level of the contents of a tank. The tank level and additional event and status information are reported to the WESROC RMS Host System (Host) at scheduled intervals. In addition, the CTM will report to the Host immediately to track tank events in real time. The CTM uses the GSM cellular network and the internet to transport this information. Communication with the Host is bi directional which allows for remote configuration of the CTM should the tank monitoring requirements change or in the event that the CTM is moved to another site. The CTM also provides a local tank level display capability. The CTM can be configured to send short range radio data packets to a nearby WESROC RMS Base Unit (Base Unit). Once initialized to the CTM, the Base Unit will provide the customer with a local display of tank level for up to eight tanks (depending on which Base Unit is used).

The EUT contains a pre-approved transmitter (FCC ID: N7NWISM0228). It is a GSM Quad-band cellular module with modular approval.

EUT Received Date: 8 June 2011
EUT Tested Date: 8 June 2011

PRODUCT	WESROC RMS Cellular Tank Monitor
MODEL	MT-9100CTM
POWER SUPPLY	3.6VDC Internal Lithium Vinyl Chloride Battery
MODULATION TYPE	FSK
RADIO TECHNOLOGY	Frequency-Shift Keying (FSK)
TRANSFER RATE	2400 bit per second, transmit and receive
FREQUENCY RANGE	Single channel,
NUMBER OF CHANNELS	1
MAXIMUM OUTPUT POWER	6.63dBm
ANTENNA TYPE	PCB mounted dipole
SERIAL NUMBER OF TEST UNIT	(For radiated measurements) (For conducted measurements)

NOTE:
1. 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 NCEE Lincoln facility, which is a FCC and IC registered lab. This site has been fully described in previously submitted reports. Laboratory environmental conditions varied slightly throughout the tests:

Relative humidity of 45 ± 4%

Temperature of 20 ± 3° Celsius

2.3 Description of test modes

Channel	Frequency
1	916.48MHz

2.4 Applied standards

The EUT is a digital transmission device operating between 902 MHz and 928 MHz. According to the specifications of the manufacturer, it must comply with the requirements of the following standards:

FCC Part 15, Subpart C (15.247) using ANSI/IEEE C63.4: 2003
Industry Canada, RSS 210, Issue 8, Category I Equipment
KDB Publication No. 558074: 2005

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

2.5 Description of support units

None

2.6 Configuration of system under test

The EUT was powered by a non-replaceable 3.6VDC lithium vinyl chloride battery and had no auxiliary devices. It was tested by itself. The EUT was programmed by the manufacturer to transmit continually for testing purposes only. For conducted measurements from the antenna port, an SMA port was soldered in place of the antenna.

The EUT was modified by the manufacturer to test with the device continuously transmitting a series of 1's and 0's, or to set the EUT to continuous receive mode for testing purposes.

3.0 Test equipment used

DESCRIPTION AND MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CALIBRATION DATE
Rohde & Schwarz Test Receiver	ESIB26	100037	9/2/2010
EMCO Biconilog Antenna	3142B	1654	1/14/2011
EMCO Horn Antenna	3115	6415	1/12/2011
Rohde & Schwarz Preamplifier	TS-PR18	082001/003	12/15/2011*

*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 supplied with the EUT is an internal PCB mounted antenna and not interchangeable.

4.2 Radiated emissions

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 (uV/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.

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. *Radiated limits according to 15.209 do not apply within the 902MHz to 928MHz band for transmitters.
6.**For frequencies not in a restricted band as specified in 15.205, spurious emissions shall be at least 20dB less than the field strength at the fundamental frequency.

4.2.2 Test procedures

a. The EUT was placed on the top of a rotating table 0.8 meters 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.

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 tested in both a horizontal and vertical orientation. The vertical orientation produces the highest emissions, so all measurements were made with the EUT in this orientation.

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 of test receiver/spectrum analyzer is 1 MHz for peak and average detectors at frequencies above 1GHz.

4.2.3 Deviations from test standard

No deviation.

4.2.4 Test setup

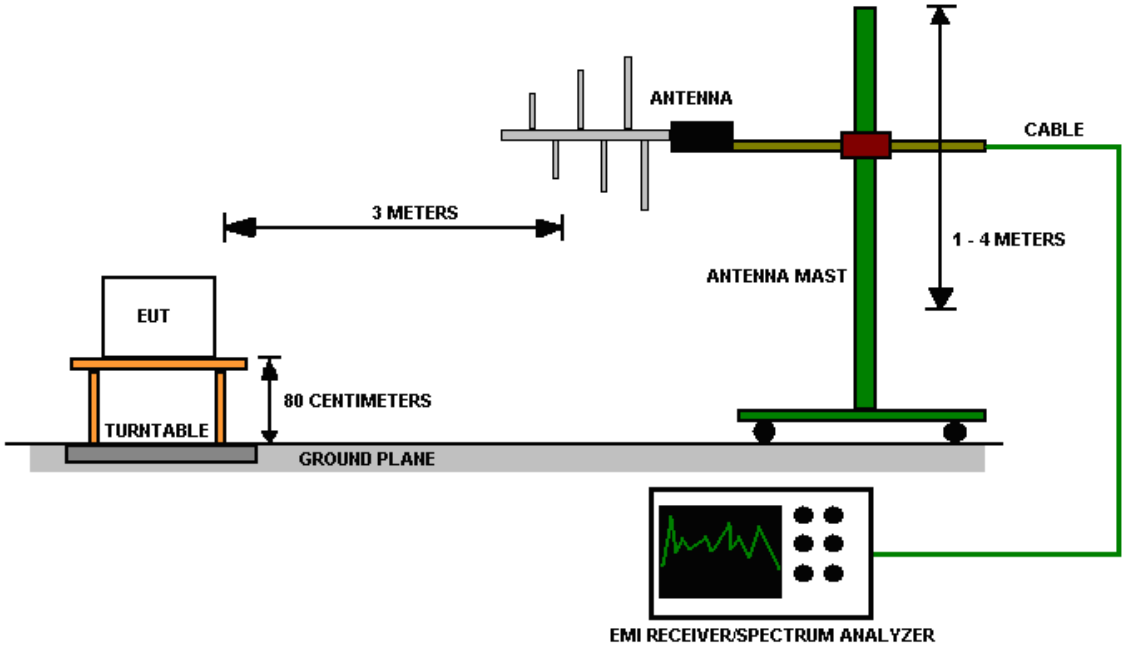

Figure 1 - Radiated Emissions Test Setup

For the actual test configuration, please refer to Appendix A for photographs of the test configuration.

4.2.5 EUT operating conditions

See section 2.6.

4.2.6 Test results

EUT	WESROC RMS Cellular Tank Monitor	Model	MT-9100CTM
MODE	Transmit, Ch. 1	FREQUENCY RANGE	30MHz – 1GHz
INPUT POWER (SYSTEM)	3.6VDC Battery	ORIENTATION	Vertical/Horizontal
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

Quasi-peak Measurements

Frequency	Level	Limit	Margin	Height	Angle	Pol.
MHz	dBµV/m	dBµV/m	dB	cm	deg	
31.0200	13.85	40.00	26.20	373	117	HORI
106.2600	11.83	44.00	32.20	380	182	HORI
549.2400	31.05	46.00	14.90	240	172	HORI
916.2000	101.37	NA*	NA*	100	277	HORI
916.7400	103.15	NA*	NA*	100	272	HORI
917.5800	38.62	46.00	7.40	99	19	HORI

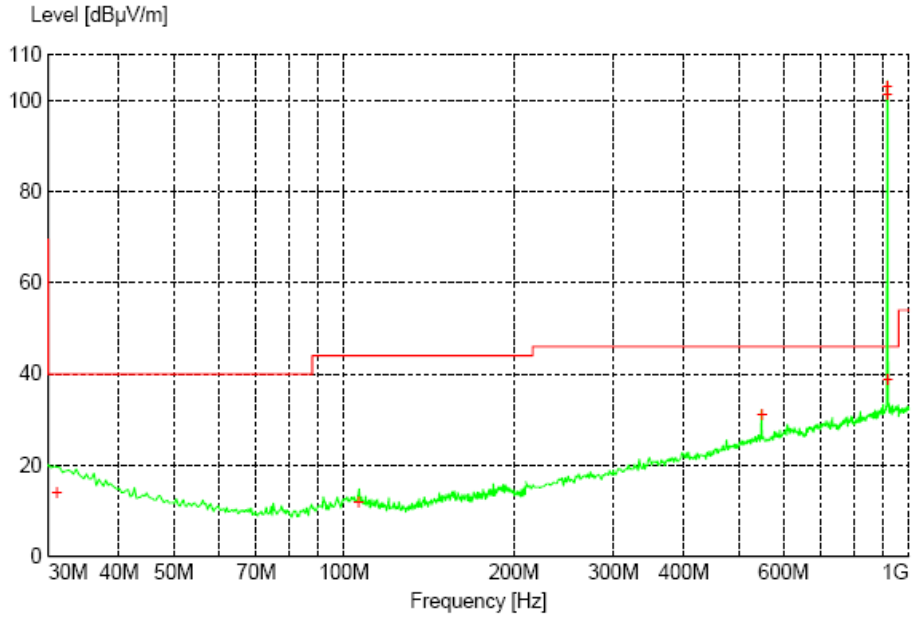

Figure 2 - Radiated Emissions Plot

Red Line: Part 15.209 Limit Green Line: Peak Preview Measurements
Red Crosses: Quasi-peak Measurements

EUT	WESROC RMS Cellular Tank Monitor	Model	MT-9100CTM
MODE	Transmit, Ch. 1	FREQUENCY RANGE	30MHz – 1GHz
INPUT POWER (SYSTEM)	3.6VDC Battery	ORIENTATION	Vertical/Horizontal
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

Average Measurements – Transmit Mode

Frequency	Level	Limit	Margin	Height	Angle	Pol.
MHz	dBµV/m	dBµV/m	dB	cm	deg	
1833.5000	36.85	54.00	17.20	190	171	VERT
2749.5000	51.32	54.00	2.70	199	162	VERT
3665.0000	30.91	54.00	23.10	106	74	VERT
4581.0000	33.86	54.00	20.10	106	332	VERT
5500.5000	37.47	54.00	16.50	139	287	VERT
6415.0000	60.14	83.15*	23.01	143	301	VERT
7331.5000	44.16	54.00	9.80	120	279	VERT
8246.0000	39.87	54.00	14.10	115	11	VERT
9167.5000	35.50	54.00	18.50	99	263	VERT
10078.5000	37.65	54.00	16.40	201	46	VERT

.

Peak Measurements – Transmit Mode

Frequency	Level	Limit	Margin	Height	Angle	Pol.
MHz	dBµV/m	dBµV/m	dB	cm	deg	
1833.5000	50.17	74.00	23.80	190	171	VERT
2749.5000	59.63	74.00	14.40	199	162	VERT
3665.0000	50.58	74.00	30.50	106	74	VERT
4581.0000	46.34	74.00	27.70	106	332	VERT
5500.5000	50.58	74.00	23.40	139	287	VERT
6415.0000	70.64	103.15*	32.51	143	301	VERT
7331.5000	56.10	74.00	17.90	120	279	VERT
8246.0000	52.68	74.00	21.30	115	11	VERT
9167.5000	49.64	74.00	24.40	99	263	VERT
10078.5000	53.62	74.00	20.40	201	46	VERT

*6415MHz does not fall within a restricted band, so the emissions level is required to be at least 20dB below the emissions level of the fundamental frequency per FCC Part 15.247

EUT	WESROC RMS Cellular Tank Monitor	Model	MT-9100CTR
MODE	Receive, Ch. 1	FREQUENCY RANGE	1MHz – 10GHz
INPUT POWER (SYSTEM)	3.6VDC Battery	ORIENTATION	Vertical/Horizontal
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

Quasi-peak Measurements – Receive Mode

Frequency	Level	Limit	Margin	Height	Angle	Pol.
MHz	dBµV/m	dBµV/m	dB	cm	deg	
30.0600	14.51	46.00	31.49	399	170	HORI
106.2600	13.11	46.00	32.89	224	294	HORI
196.8600	10.03	46.00	35.97	363	359	HORI
549.2400	30.19	46.00	15.81	287	126	HORI
890.1000	26.38	46.00	19.62	400	145	HORI
916.3800	26.30	46.00	19.70	195	265	HORI

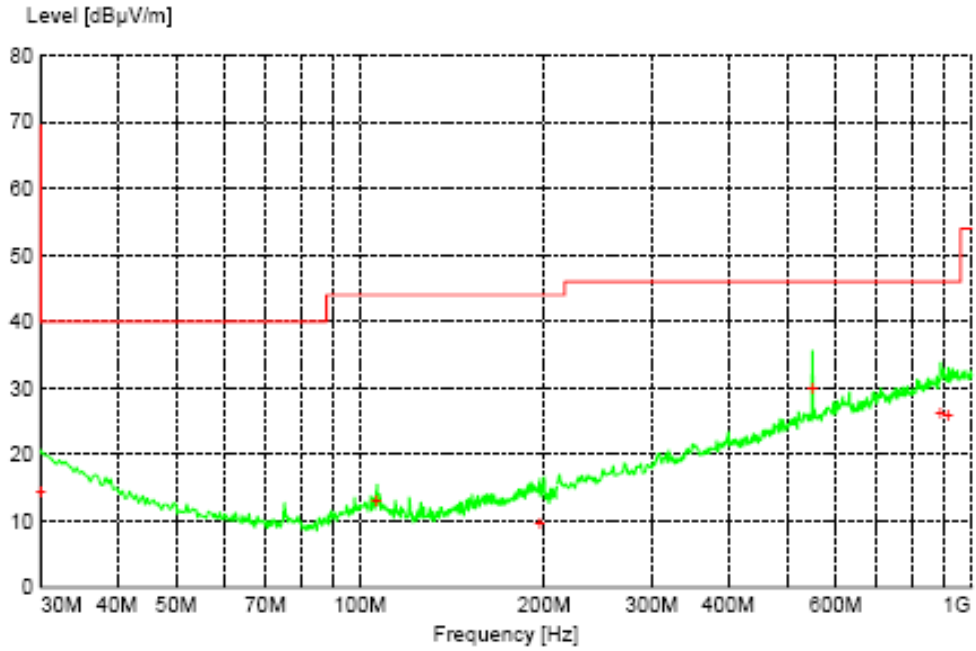

Figure 3 - Radiated Emissions Plot, Receive Mode

Red Line: Part 15.209 Limit Green Line: Peak Preview Measurements
Red Crosses: Quasi-peak Measurements

Average Measurements – Receive Mode

Frequency	Level	Limit	Margin	Height	Angle	Pol.
MHz	dBµV/m	dBµV/m	dB	cm	deg	
1838.0000	17.13	54.00	36.90	99	236	VERT
2753.0000	20.21	54.00	33.80	126	360	VERT
3665.0000	23.57	54.00	30.40	149	331	HORI
6404.0000	27.13	54.00	26.90	100	354	HORI

Peak Measurements – Receive Mode

Frequency	Level	Limit	Margin	Height	Angle	Pol.
MHz	dBµV/m	dBµV/m	dB	cm	deg	
1838.0000	30.66	74.00	43.34	99	236	VERT
2753.0000	33.47	74.00	40.53	126	360	VERT
3665.0000	36.91	74.00	37.09	149	331	HORI
6404.0000	40.51	74.00	33.50	100	354	HORI

4.4 Bandwidth

4.4.1 Limits of bandwidth measurements

The 6dB bandwidth of the signal must be greater than 0.50MHz

4.4.2 Test procedures

The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with 100 kHz RBW and 100 kHz VBW. The 6 dB bandwidth is defined as the bandwidth of which is higher than peak power minus 6dB.

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 100kHz 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.

4.4.4 Test setup

The cable used to go from the spectrum analyzer to the EUT had a loss of 0.25dB. This was not taken into account on the plot below because it is a relative measurement.

4.4.5 EUT operating conditions

See section 2.6.

4.4.6 Test results

EUT	WESROC RMS Cellular Tank Monitor	Model	MT-9100CTR
INPUT POWER (SYSTEM)	3.6VDC Battery	ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC
TECHNICIAN	NJohnson	MODE	Continuous Transmit

CHANNEL	CHANNEL FREQUENCY (MHz)	6dB BW (kHz)	6dB MINIMUM LIMIT (kHz)	99% Occupied BW (kHz)	RESULT
1	916.54	655.31kHz	500.00	781.39811kHz	PASS

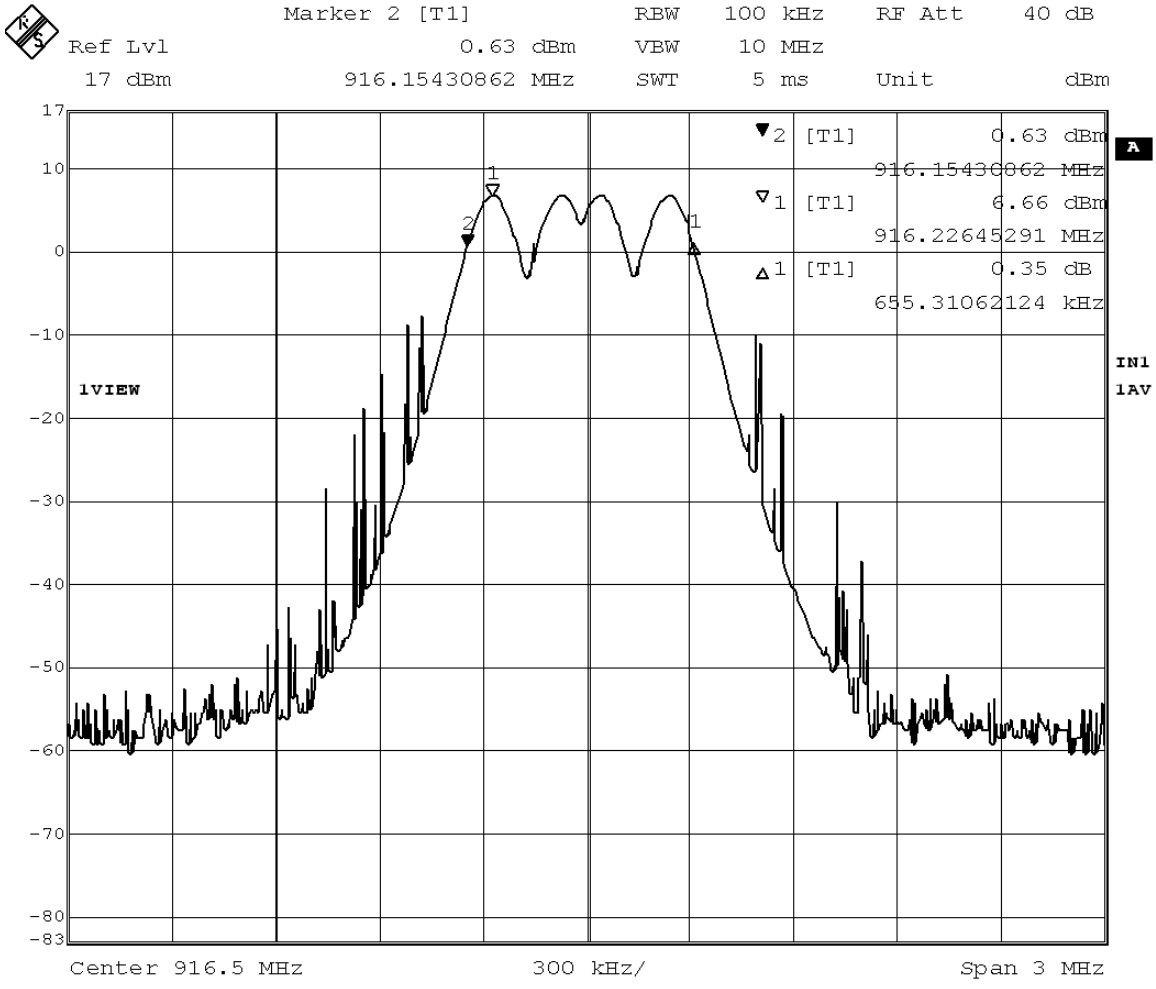

Figure 4 - 6dB Bandwidth

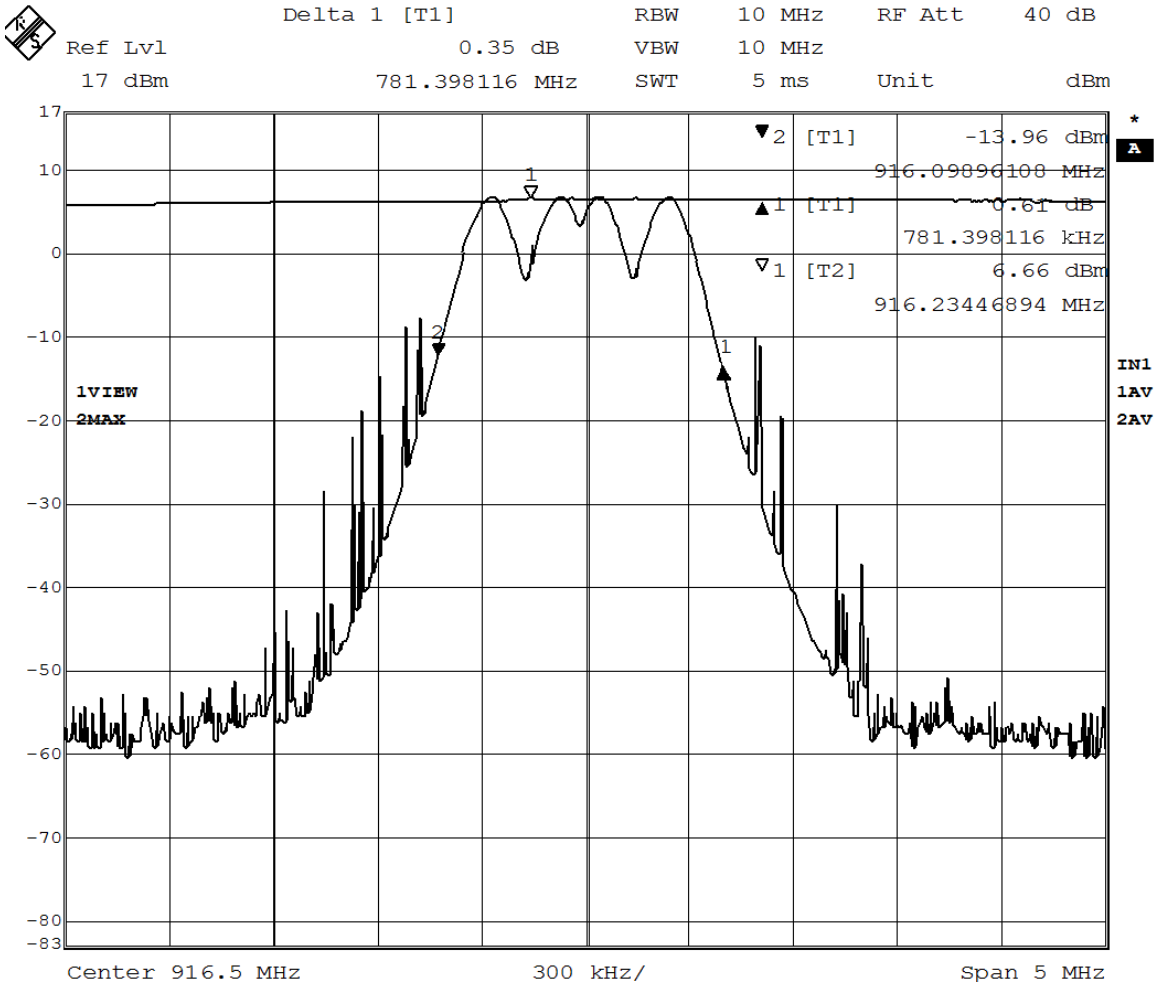

Figure 5 - 99% Occupied Bandwidth

4.5 Maximum peak output power

4.5.1 Limits of power measurements

The maximum peak output power allowed is 30dBm

4.5.2 Test procedures

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

2. The channel power function of the spectrum analyzer was used to calculate the cumulative power output per MHz over the range of the set channel bandwidth. The channel bandwidth was set to 30MHz.

3. The resolution bandwidth was set to 10MHz and the video bandwidth was set to 10MHz to capture the maximum amount of signal. The analyzer used a peak detector in max hold mode. This represented the maximum output power.

4.5.3 Deviations from test standard

No deviation.

4.5.4 Test setup

The cable used to go from the spectrum analyzer to the EUT had a loss of 0.25dB. The plot shows the uncorrected value. The corrected value was recorded from this plot with 0.25dB added.

4.5.5 EUT operating conditions

See Section 2.6

4.5.6 Test results

Maximum peak output power

EUT	WESROC RMS Cellular Tank Monitor	Model	MT-9100CTM
INPUT POWER (SYSTEM)	3.6VDC Battery	ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC
TECHNICIAN	NJohnson	MODE	Continuous transmit

CHANNEL	CHANNEL FREQUENCY (MHz)	PEAK POWER OUTPUT (dBm)	PEAK POWER LIMIT (dBm)	RESULT
1	916.219	6.88*	30	PASS

*Corrected (0.25dB of attenuation from RF cable)

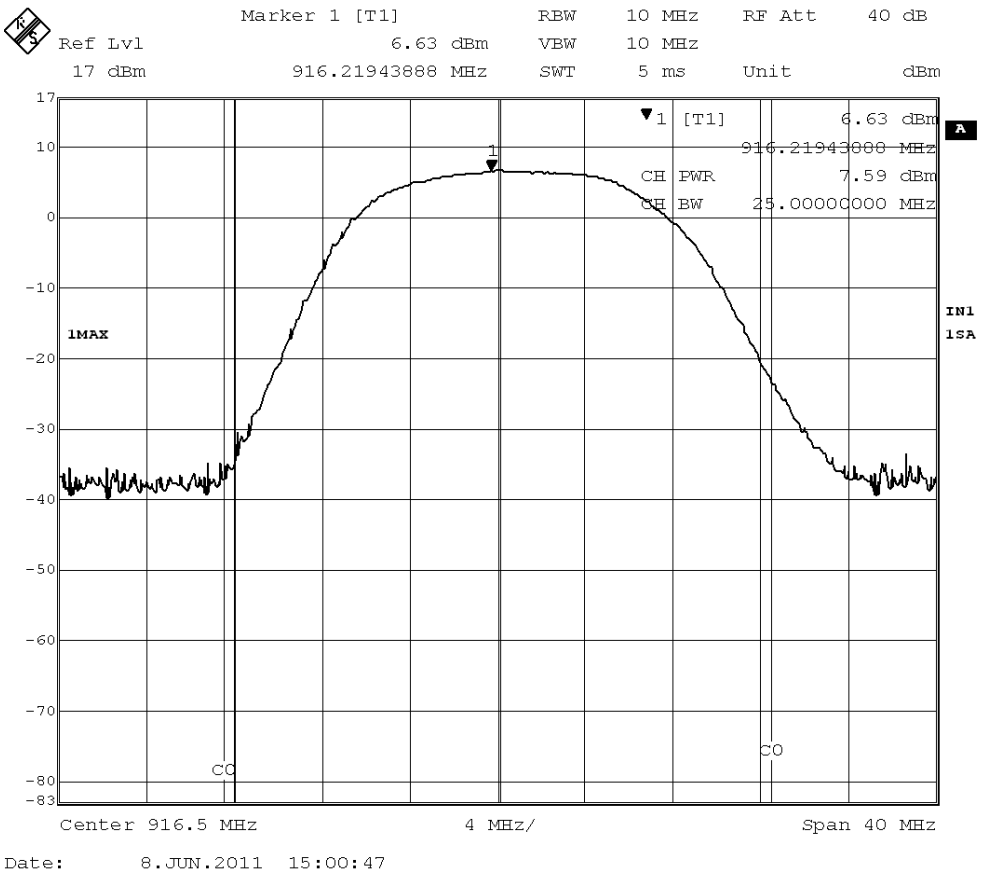

Figure 6 - Maximum Power Measurement

4.6 Power spectral density (PSD)

4.6.1 Limits of PSD measurements

The maximum power spectral density allowed is 8dBm.

4.6.2 Test procedures

The transmitter output was connected directly to the spectrum analyzer. the bandwidth of the fundamental frequency was measured with the spectrum analyzer using 3 kHz RBW and 30 kHz VBW, the sweep time was 500s. The power spectral density was measured and recorded at the frequency with the highest emission. The sweep time is allowed to be longer than span/3KHz for a full response of the mixer in the spectrum analyzer.

4.6.3 Deviations from test standard

No deviation.

4.6.4 Test setup

The cable used to go from the spectrum analyzer to the EUT had a loss of 0.25dB. The plot shows the uncorrected value. The corrected value was recorded from this plot with 0.25dB added.

4.6.5 EUT operating conditions

See Section 2.6.

4.6.6 Test results

Power Spectral Density

EUT	WESROC RMS Cellular Tank Monitor	Model	MT-9100CTM
INPUT POWER (SYSTEM)	3.6VDC Battery	ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC
TECHNICIAN	NJohnson	MODE	Continuous transmit

CHANNEL	CHANNEL FREQUENCY (MHz)	RF POWER LEVEL IN # KHz BW (dBm)	MAXIMUM POWER LIMIT (dBm)	RESULT
1	911.980	6.54*	8.0	PASS

*Corrected (0.25dB of attenuation from RF cable)

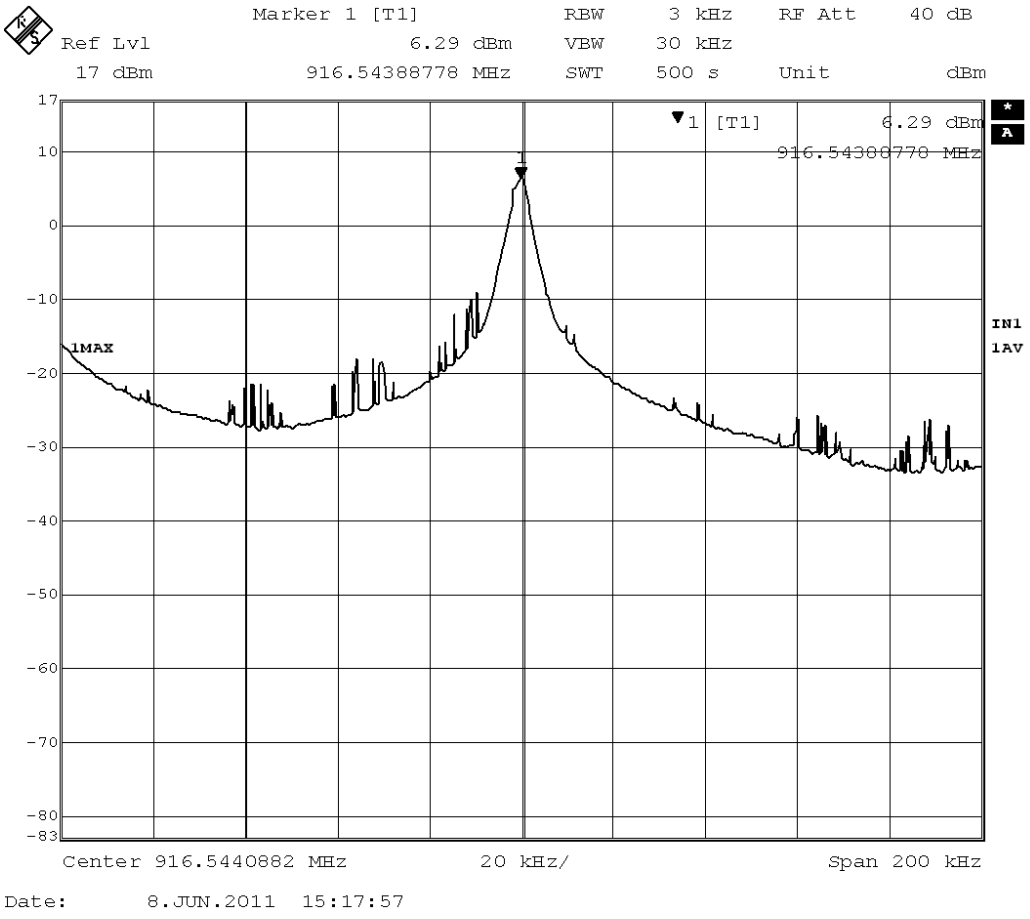

Figure 7 - Power Spectral Density Measurement

4.7 Bandedges

4.7.1 Limits of bandedge measurements

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

4.7.2 Test procedures

The transmitter output was connected to the spectrum analyzer through an attenuator. The resolution bandwidth was set to 100kHz and the EMI receiver was used to scan from the bandedge to the fundamental frequency with a peak detector. The highest emissions level beyond the bandedge was measured and recorded. If the out of band emissions do not fall within a restricted band from 15.205, then it is required that the out of band emission be 20dB below that of the fundamental emission level.

4.7.3 Deviations from test standard

No deviation.

4.7.4 Test setup

The cable used to go from the spectrum analyzer to the EUT had a loss of 0.25dB. This was not taken into account on the plot below because it is a relative measurement.

4.7.5 EUT operating conditions

See Section 2.6.

4.7.6 Test results

EUT	WESROC RMS Cellular Tank Monitor	Model	MT-9100CTR
INPUT POWER (SYSTEM)	3.6VDC Battery	ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC
TECHNICIAN	NJohnson	MODE	Continuous transmit

Highest Out of Band Emissions

CHANNEL	Bandedge/Measurement Frequency (MHz)	Level (dBm)	Fund. Level (dBm)	Delta
1	902 MHz	-56.29	6.07	62.36
1	928 MHz	-54.48	6.07	60.55

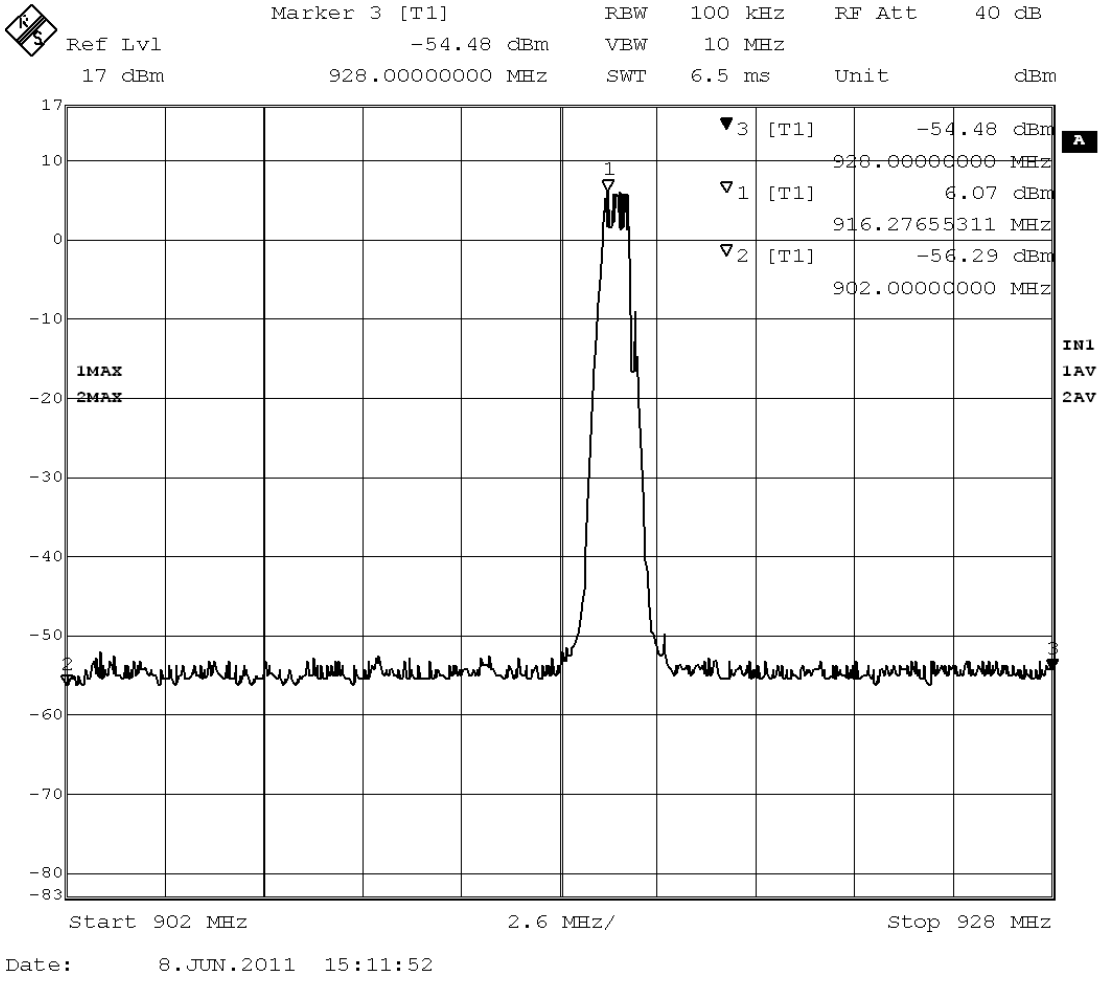

Figure 8 - Band-edge Measurements

Appendix A: Test Photos

Figure 9 - Radiated Emissions Test Setup

Figure 10 - Radiated Emissions Test Setup

Appendix B: 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.