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Test Report

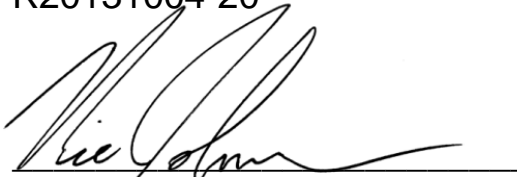
Company: MetroTel Corp
26 First Ave SE
New London, MN 56273

Product: Cellular Base Unit

FCC ID: RWBMT9100CBU
IC : 115A-MT9100CBU

Test Report No: R20131004-20

APPROVED BY:


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iNARTE Certification EMC-003337-NE

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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	Antenna soldered to PCB
15.207	Conducted Emissions	Pass	Meets the requirement of the limit.
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.

2.0 Description**2.1 Equipment under test**

The Equipment Under Test (EUT) was a Cellular Base Unit (MT-9100-CBU). It operates in the 902 – 928 MHz band.

The EUT also contains a pre-approved transmitter (FCC ID:RI7HE910NA, IC:5131A-HE910NA). It is a GSM Quad-band cellular module with modular approval.

EUT Received Date: 19 March 2014

EUT Tested Date: 19 March 2014- 20 March 2014

PRODUCT	Cellular Base Unit
MODEL	MT-9100-CBU
POWER INPUT	120 VAC 60 Hz
MODULATION TYPE	FSK
RADIO TECHNOLOGY	Frequency-Shift Keying (FSK)
FREQUENCY RANGE	912 – 921 MHz
POWER SUPPLY	CONDOR D9300 9W POWER SUPPLY, INPUT 120 VAC 60 Hz OUTPUT 9VDC 300 mA
ANTENNA TYPE	Pair of External Monopole Antenna
SERIAL NUMBER OF TEST UNIT	(For radiated measurements, 1121) (For conducted measurements, 1122)

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 $22 \pm 4\%$

Temperature of $23 \pm 3^\circ$ Celsius

2.3 Description of test modes

Channel	Frequency
1	912.00 MHz
2	916.50 MHz
3	921.00 MHz

2.4 Applied standards

The EUT is a digital transmission 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 (15.247) using ANSI/IEEE C63.4: 2009
Industry Canada, RSS 210, Issue 8, Category I Equipment
KDB Publication No. 558074: 2012**

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 120 VAC 60 Hz for all the tests 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.



Figure 1 - AC/DC Power Supply

3.0 Test equipment used

DESCRIPTION AND MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CALIBRATION DATE
Rohde & Schwarz Test Receiver	ESIB26	100037	21 Jan 2014
EMCO Biconilog Antenna	3142B	1647	07 Aug 2013
EMCO Horn Antenna	3115	6416	14 Jan 2014
Rohde & Schwarz Preamplifier	TS-PR18	NCEEPAHF2	13 Mar 2013*

*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 and soldered to the PCB, making it not easily replaceable.

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

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

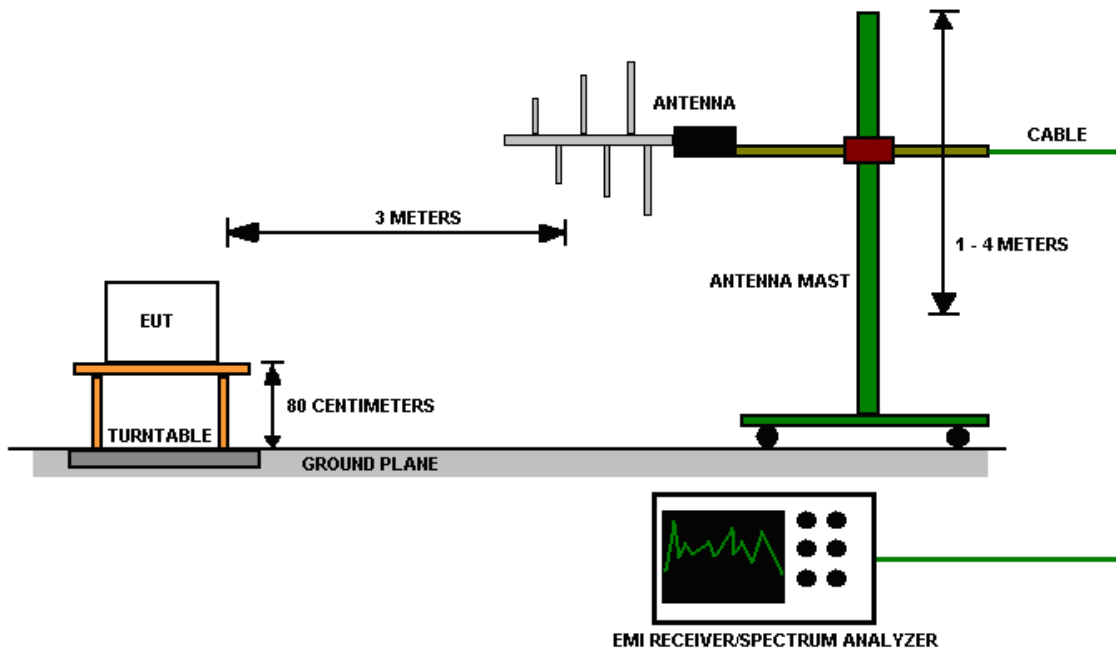


Figure 2 - Radiated Emissions Test Setup

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	Cellular Base Unit	Model	MT-9100-CBU
MODE	Transmit, Ch. 1	FREQUENCY RANGE	30MHz – 10GHz
INPUT POWER (SYSTEM)	120 VAC 60 Hz	ORIENTATION	Vertical/Horizontal
ENVIRONMENTAL CONDITIONS	22% ± 5% RH 23 ± 3°C	TECHNICIAN	Kvepuri

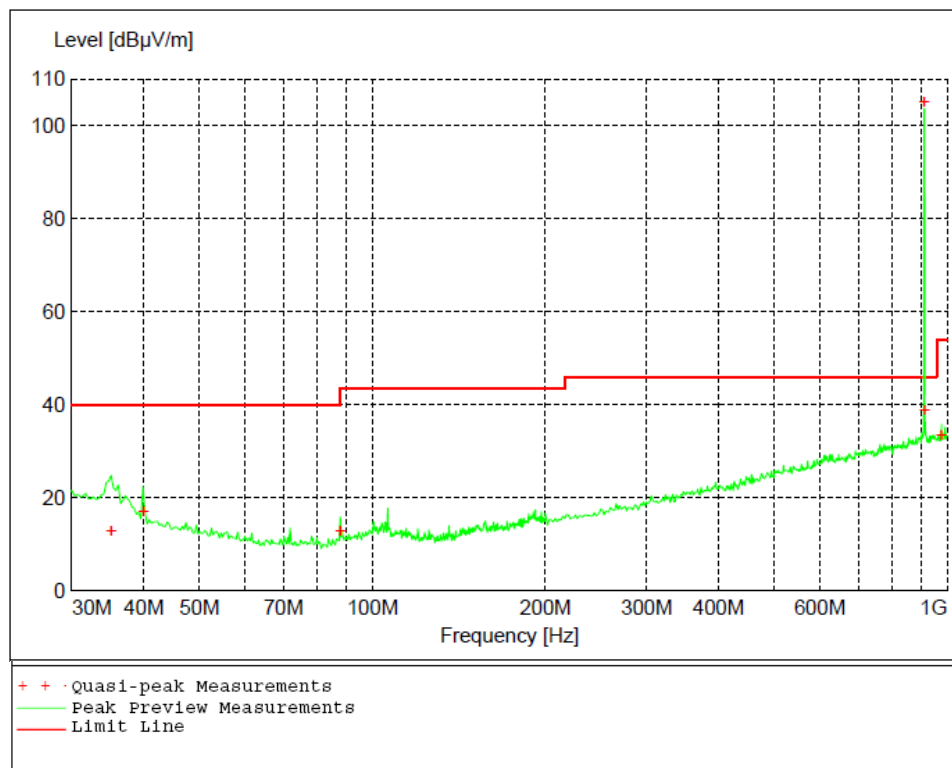


Figure 3 - Radiated Emissions Plot, Ch. 1

Quasi-peak Measurements, Ch. 1

Frequency	Level	Limit	Margin	Height	Angle	Pol.
MHz	dBµV/m	dBµV/m	dB	cm	deg	
35.100000	12.72	40.00	27.30	103	355	VERT
39.960000	16.96	40.00	23.00	115	351	VERT
87.960000	12.62	40.00	27.40	112	360	VERT
912.240000	105.10	N/A	N/A	119	53	VERT
913.320000	38.72	NA	NA	119	41	VERT
976.020000	33.48	54.00	20.50	110	48	VERT

EUT	Cellular Base Unit	Model	MT-9100-CBU
MODE	Transmit, Ch. 1	FREQUENCY RANGE	30MHz – 10GHz
INPUT POWER (SYSTEM)	120 VAC 60 Hz	ORIENTATION	Vertical/Horizontal
ENVIRONMENTAL CONDITIONS	22% ± 5% RH 23 ± 3°C	TECHNICIAN	Kvepuri

Average Measurements – Transmit Mode, Ch. 1

Frequency	Level	Limit	Margin	Height	Angle	Pol.
MHz	dB μ V/m	dB μ V/m	dB	cm	deg	
1823.400000	46.11	85.10*	38.99	126	140	VERT
2736.200000	44.40	54.00	9.60	197	70	HORI
3658.400000	31.97	54.00	22.00	143	262	VERT
4559.800000	38.94	54.00	15.10	99	33	HORI
5461.200000	37.46	54.00	16.50	398	313	HORI
6381.000000	39.53	54.00	14.50	397	335	HORI
7282.600000	35.09	54.00	18.90	136	276	HORI
8206.000000	37.09	54.00	16.90	173	221	HORI
9137.400000	39.65	54.00	14.40	115	280	HORI

Peak Measurements – Transmit Mode, Ch. 1

Frequency	Level	Limit	Margin	Height	Angle	Pol.
MHz	dB μ V/m	dB μ V/m	dB	cm	deg	
1823.400000	55.63	105.10*	49.47	126	140	VERT
2736.200000	50.94	74.00	23.06	197	70	HORI
3658.400000	45.72	74.00	28.28	143	262	VERT
4559.800000	49.78	74.00	24.22	99	33	HORI
5461.200000	51.40	74.00	22.60	398	313	HORI
6381.000000	52.78	74.00	21.22	397	335	HORI
7282.600000	48.26	74.00	25.74	136	276	HORI
8206.000000	50.15	74.00	23.85	173	221	HORI
9137.400000	53.20	74.00	20.80	115	280	HORI

*Note: Limit in unrestricted bands is 20dB below the peak fundamental emission

EUT	Cellular Base Unit	Model	MT-9100-CBU
MODE	Transmit, Ch. 2	FREQUENCY RANGE	30MHz – 1GHz
INPUT POWER (SYSTEM)	120 VAC 60 Hz	ORIENTATION	Vertical/Horizontal
ENVIRONMENTAL CONDITIONS	22% \pm 5% RH 23 \pm 3°C	TECHNICIAN	Kvepuri

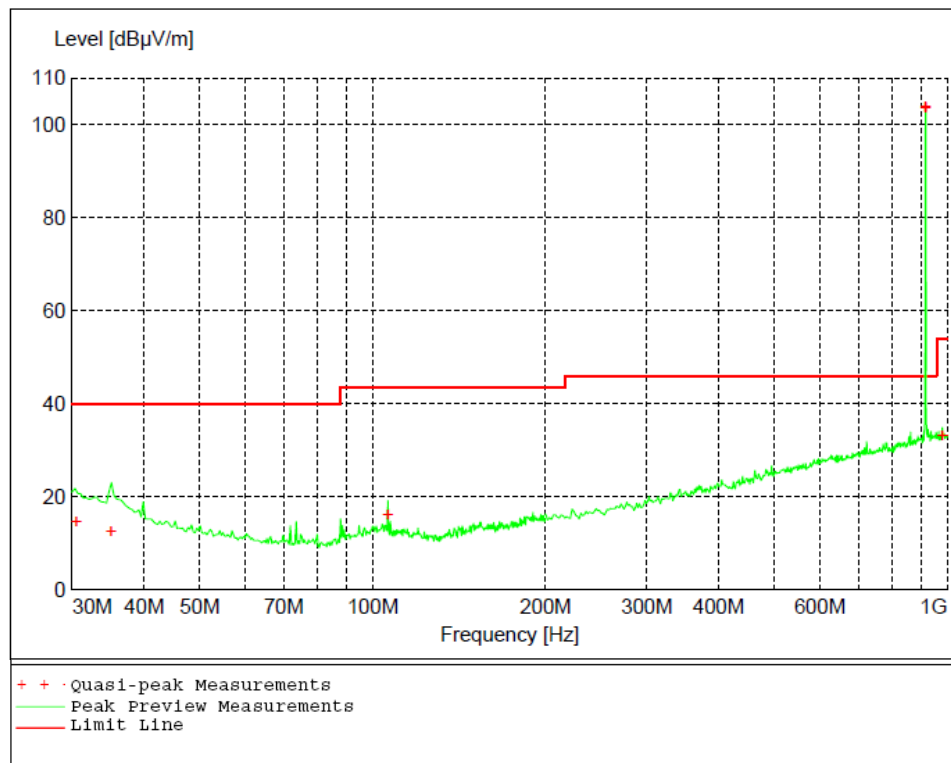


Figure 4 - Radiated Emissions Plot, Ch. 2

Quasi-peak Measurements, Ch. 2

Frequency	Level	Limit	Margin	Height	Angle	Pol.
MHz	dBμV/m	dBμV/m	dB	cm	deg	
30.480000	14.61	40.00	25.40	99	0	VERT
35.040000	12.49	40.00	27.50	303	360	VERT
106.260000	16.08	43.50	27.40	227	88	HORI
916.560000	103.77	NA	NA	119	13	VERT
916.740000	103.59	NA	NA	123	72	VERT
980.520000	32.99	54.00	21.00	106	165	VERT

*Note: Limit in unrestricted bands is 20dB below the peak fundamental emission

EUT	Cellular Base Unit	Model	MT-9100-CBU
MODE	Transmit, Ch. 2	FREQUENCY RANGE	30MHz – 10GHz
INPUT POWER (SYSTEM)	120 VAC 60 Hz	ORIENTATION	Vertical/Horizontal
ENVIRONMENTAL CONDITIONS	22% ± 5% RH 23 ± 3°C	TECHNICIAN	Kvepuri

Average Measurements – Transmit Mode, Ch. 2

Frequency	Level	Limit	Margin	Height	Angle	Pol.
MHz	dB μ V/m	dB μ V/m	dB	cm	deg	
1832.800000	52.50	83.77*	31.57	129	136	VERT
2750.200000	36.05	54.00	18.00	197	62	HORI
3666.200000	38.01	54.00	16.00	133	89	HORI
4575.600000	34.15	54.00	19.90	133	48	HORI
5502.600000	37.69	54.00	16.30	264	356	HORI
6422.200000	39.74	54.00	14.30	139	352	VERT
7320.000000	35.71	54.00	18.30	295	148	VERT
8265.800000	37.06	54.00	16.90	274	322	HORI
9159.000000	39.85	54.00	14.20	385	132	HORI

Peak Measurements – Transmit Mode, Ch. 2

Frequency	Level	Limit	Margin	Height	Angle	Pol.
MHz	dB μ V/m	dB μ V/m	dB	cm	deg	
1832.800000	55.77	103.77*	48.00	129	136	VERT
2750.200000	49.44	74.00	24.56	197	62	HORI
3666.200000	49.77	74.00	24.23	133	89	HORI
4575.600000	47.49	74.00	26.51	133	48	HORI
5502.600000	52.08	74.00	21.92	264	356	HORI
6422.200000	53.14	74.00	20.86	139	352	VERT
7320.000000	49.03	74.00	24.97	295	148	VERT
8265.800000	50.07	74.00	23.93	274	322	HORI
9159.000000	53.15	74.00	20.85	385	132	HORI

*Note: Limit in unrestricted bands is 20dB below the peak fundamental emission

EUT	Cellular Base Unit	Model	MT-9100-CBU
MODE	Transmit, Ch. 3	FREQUENCY RANGE	30MHz – 10GHz
INPUT POWER (SYSTEM)	120 VAC 60 Hz	ORIENTATION	Vertical/Horizontal
ENVIRONMENTAL CONDITIONS	22% ± 5% RH 23 ± 3°C	TECHNICIAN	Kvepuri

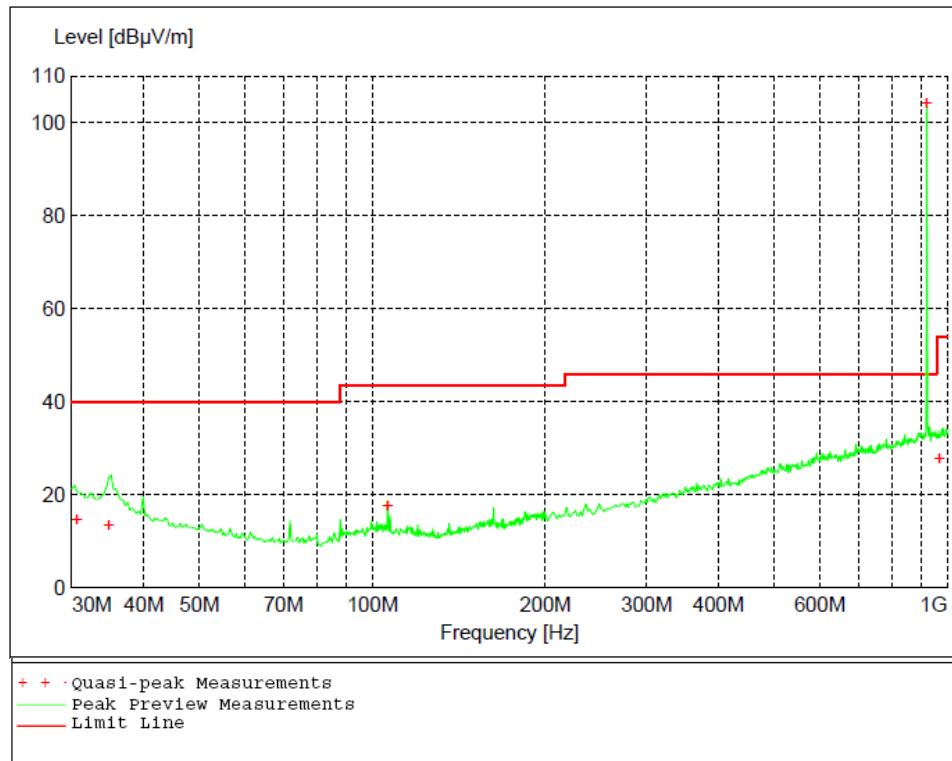


Figure 5 - Radiated Emissions Plot, Ch. 3

Quasi-peak Measurements, Ch. 3

Frequency	Level	Limit	Margin	Height	Angle	Pol.
MHz	dBμV/m	dBμV/m	dB	cm	deg	
30.600000	14.56	40.00	25.40	219	292	VERT
34.800000	13.27	40.00	26.70	160	360	VERT
106.260000	17.46	43.50	26.10	243	91	HORI
920.940000	104.03	NA	NA	119	80	VERT
969.900000	27.65	54.00	26.40	121	360	HORI

EUT	Cellular Base Unit	Model	MT-9100-CBU
MODE	Transmit, Ch. 3	FREQUENCY RANGE	30MHz – 10GHz
INPUT POWER (SYSTEM)	120 VAC 60 Hz	ORIENTATION	Vertical/Horizontal
ENVIRONMENTAL CONDITIONS	22% ± 5% RH 23 ± 3°C	TECHNICIAN	Kvepuri

Average Measurements – Transmit Mode, Ch. 3

Frequency	Level	Limit	Margin	Height	Angle	Pol.
MHz	dBμV/m	dBμV/m	dB	cm	deg	
1842.000000	53.12	84.03*	30.91	119	139	VERT
2762.800000	43.28	54.00	10.70	227	72	HORI
3685.000000	33.06	54.00	20.90	101	313	HORI
4605.200000	38.21	54.00	15.80	99	34	HORI
5522.200000	38.04	54.00	16.00	99	222	VERT
6436.400000	39.69	54.00	14.30	119	152	HORI
7406.000000	36.37	54.00	17.60	337	360	VERT
8274.600000	37.01	54.00	17.00	338	0	VERT
9204.200000	39.33	54.00	14.70	399	203	VERT

Peak Measurements – Transmit Mode, Ch. 3

Frequency	Level	Limit	Margin	Height	Angle	Pol.
MHz	dBμV/m	dBμV/m	dB	cm	deg	
1842.000000	55.62	104.83*	49.21	119	139	VERT
2762.800000	49.80	74.00	24.20	227	72	HORI
3685.000000	47.52	74.00	26.48	101	313	HORI
4605.200000	50.18	74.00	23.82	99	34	HORI
5522.200000	51.38	74.00	22.62	99	222	VERT
6436.400000	52.98	74.00	21.02	119	152	HORI
7406.000000	50.94	74.00	23.06	337	360	VERT
8274.600000	50.22	74.00	23.78	338	0	VERT
9204.200000	52.20	74.00	21.80	399	203	VERT

*Note: Limit in unrestricted bands is 20dB below the peak fundamental emission

EUT	Cellular Base Unit	Model	MT-9100-CBU
MODE	Receive	FREQUENCY RANGE	30MHz – 10GHz
INPUT POWER (SYSTEM)	120 VAC 60 Hz	ORIENTATION	Vertical/Horizontal
ENVIRONMENTAL CONDITIONS	22% ± 5% RH 23 ± 3°C	TECHNICIAN	Kvepuri

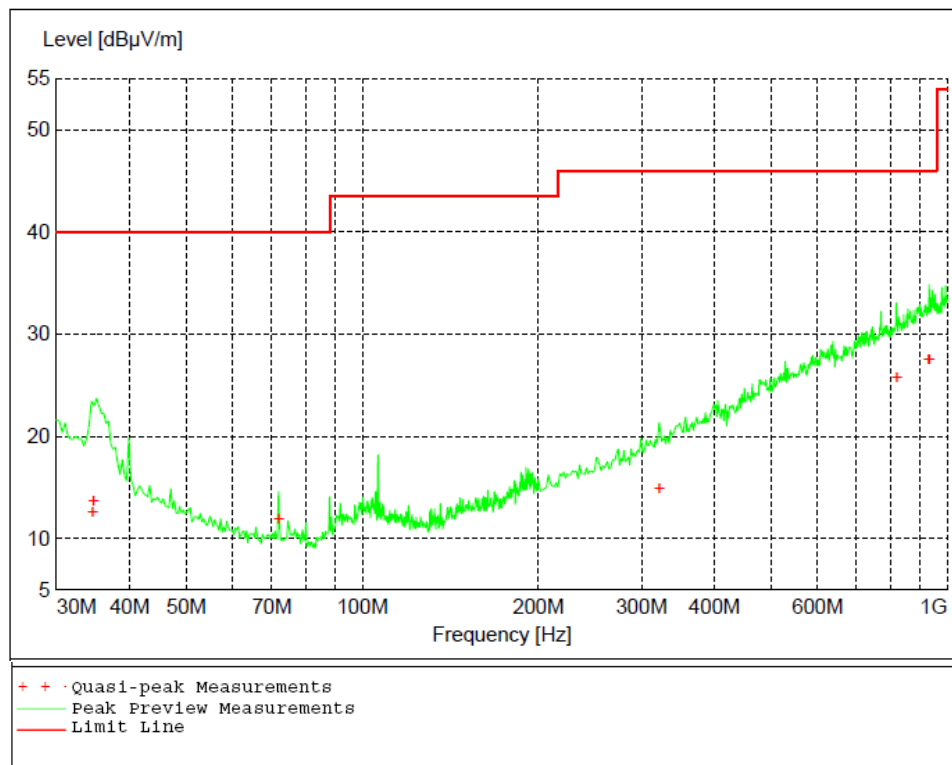


Figure 6 - Radiated Emissions Plot– Receive Mode

Quasi-peak Measurements– Receive Mode

Frequency	Level	Limit	Margin	Height	Angle	Pol.
MHz	dBμV/m	dBμV/m	dB	cm	deg	
34.560000	12.59	40.00	27.40	372	355	VERT
34.740000	13.67	40.00	26.30	100	360	VERT
72.000000	11.86	40.00	28.10	99	321	VERT
321.900000	14.80	46.00	31.20	399	150	HORI
820.440000	25.70	46.00	20.30	356	172	VERT
931.140000	27.47	46.00	18.50	399	246	VERT
932.340000	27.45	46.00	18.60	99	351	VERT

EUT	Cellular Base Unit	Model	MT-9100-CBU
MODE	Receive	FREQUENCY RANGE	30MHz – 1GHz
INPUT POWER (SYSTEM)	120 VAC 60 Hz	ORIENTATION	Vertical/Horizontal
ENVIRONMENTAL CONDITIONS	22% \pm 5% RH 23 \pm 3°C	TECHNICIAN	Kvepuri

Average Measurements – Receive Mode

Frequency	Level	Limit	Margin	Height	Angle	Pol.
MHz	dB μ V/m	dB μ V/m	dB	cm	deg	
1824.400000	26.40	54.00	27.60	399	297	VERT
2754.800000	28.60	54.00	25.40	317	0	HORI
3634.000000	31.77	54.00	22.20	375	226	VERT
4568.800000	46.39	54.00	7.60	143	217	VERT
5485.200000	37.37	54.00	16.60	221	281	VERT

Peak Measurements – Receive Mode

Frequency	Level	Limit	Margin	Height	Angle	Pol.
MHz	dB μ V/m	dB μ V/m	dB	cm	deg	
1824.400000	40.19	74.00	33.81	399	297	VERT
2754.800000	42.09	74.00	31.91	317	0	HORI
3634.000000	45.49	74.00	28.51	375	226	VERT
4568.800000	47.89	74.00	26.11	143	217	VERT
5485.200000	50.41	74.00	23.59	221	281	VERT

4.3 Conducted AC Mains Emissions

4.3.1 Limits for conducted emissions measurements

FREQUENCY OF EMISSION (MHz)	CONDUCTED LIMIT (dB μ V)	
	Quasi-peak	Average
0.15-0.5	66 to 56	56 to 46
0.5-5	56	46
5-30	60	50

- NOTE:**
1. The lower limit shall apply at the transition frequencies.
 2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50 MHz.
 3. All emanations from a class A/B digital device or system, including any network of conductors and apparatus connected thereto, shall not exceed the level of field strengths specified above.

4.3.2 Test Procedures

- a. The EUT was placed 0.8m above a ground reference plane and 0.4 meters from the conducting wall of a shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). The LISN provides 50 ohm/ 50uH of coupling impedance for the measuring instrument.
- b. Both lines of the power mains connected to the EUT were checked for maximum conducted interference as well as the ground.
- c. The frequency range from 150 kHz to 30 MHz was searched. Emission levels over 10dB under the prescribed limits could not be reported
- d. Results of testing a PC alone and with the EUT connected were compared to verify that the EUT does not cause the emissions of the PC to go over the 15.207 limits.

4.3.3 Deviation from the test standard

No deviation

4.3.4 Test setup

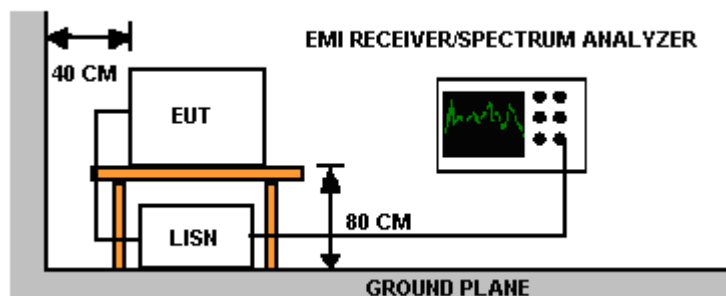


Figure 7 - Conducted Emissions Test Setup

For actual test configuration, see photographs in Appendix A

4.3.5 EUT operating conditions

The EUT was powered by a 9VDC power supply and had no auxiliary devices, so it was tested by itself. The EUT was programmed by the manufacturer to transmit continually for testing purposes only.

4.3.6 Test Results

EUT	Cellular Base Unit	Model	MT-9100-CBU
MODE	Transmit	FREQUENCY RANGE	150kHz – 30MHz
INPUT POWER (SYSTEM)	120 VAC 60 Hz	ORIENTATION	Vertical/Horizontal
ENVIRONMENTAL CONDITIONS	22% \pm 5% RH 23 \pm 3°C	TECHNICIAN	Kvepuri

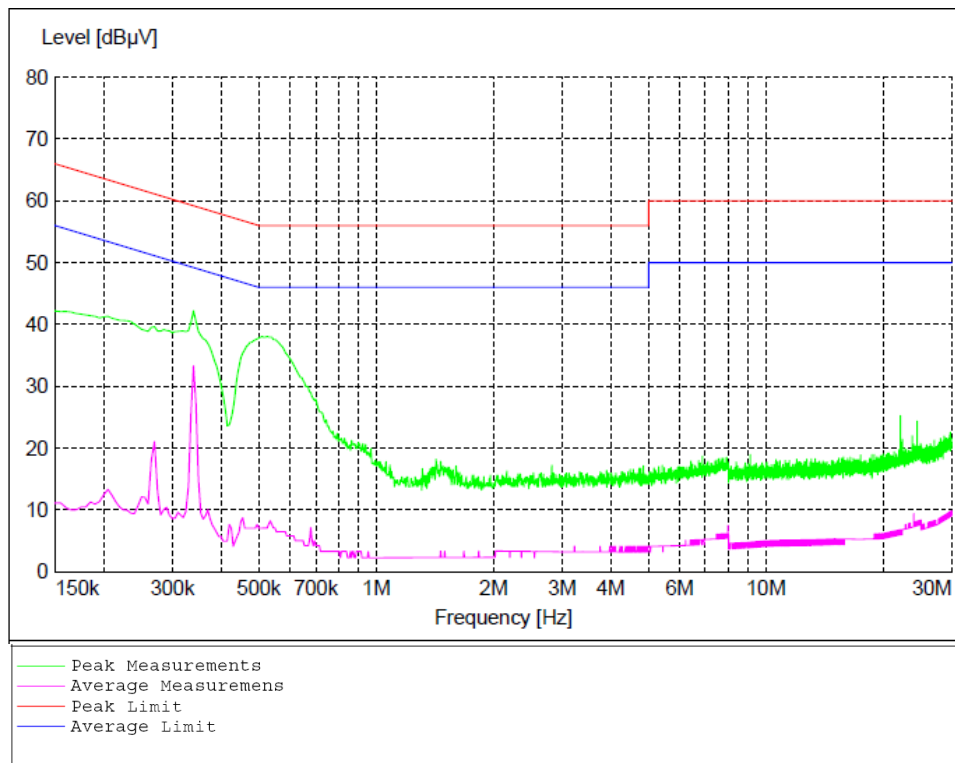


Figure 8 - Conducted Emissions Plot

All measurements were found to be at least 10dB below the applicable limit.

4.4 Bandwidth

4.4.1 Limits of bandwidth measurements

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

4.4.2 Test procedures

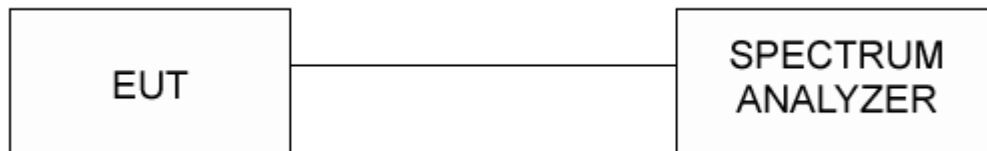
The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with 100 kHz RBW and 100 kHz VBW. The 6 dB bandwidth is defined as the bandwidth of which is higher than peak power minus 6dB.

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	Cellular Base Unit	Model	MT-9100-CBU
MODE	Continuous Transmit	FREQUENCY RANGE	30MHz – 10GHz
INPUT POWER (SYSTEM)	120 VAC 60 Hz	ORIENTATION	N/A
ENVIRONMENTAL CONDITIONS	22% ± 5% RH 23 ± 3°C	TECHNICIAN	Kvepuri

CHANNEL	CHANNEL FREQUENCY (MHz)	6dB BW (kHz)	6dB MINIMUM LIMIT (kHz)	99% Occupied BW (kHz)	RESULT
1	912.00	937.87 kHz	500.00	1.24 MHz	PASS

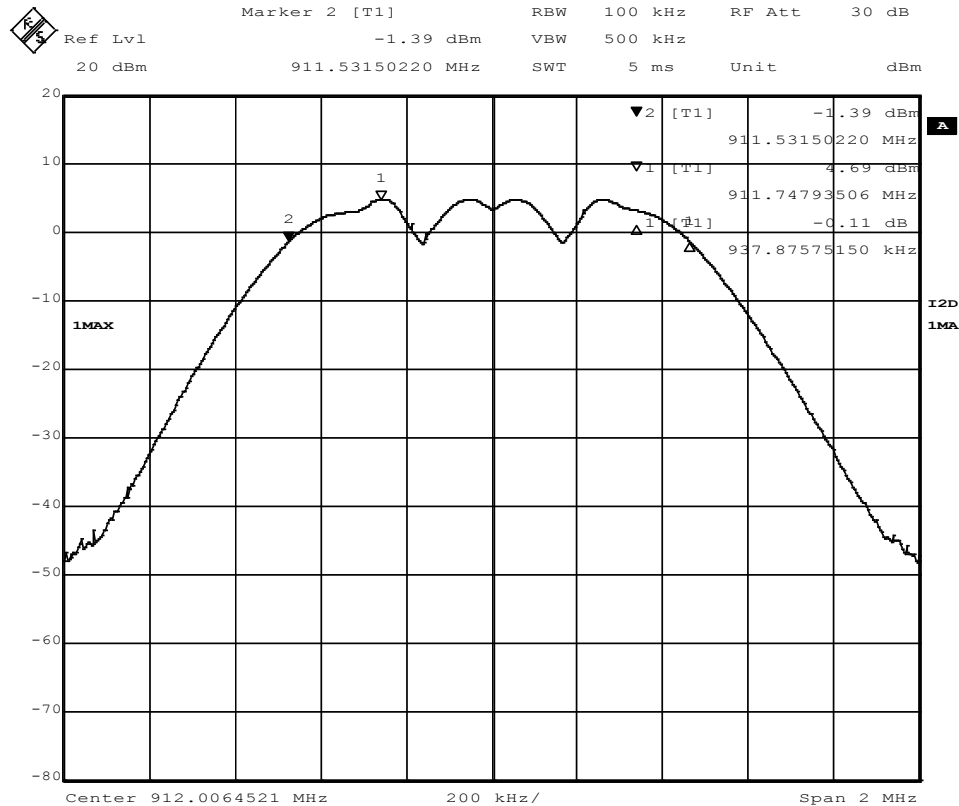
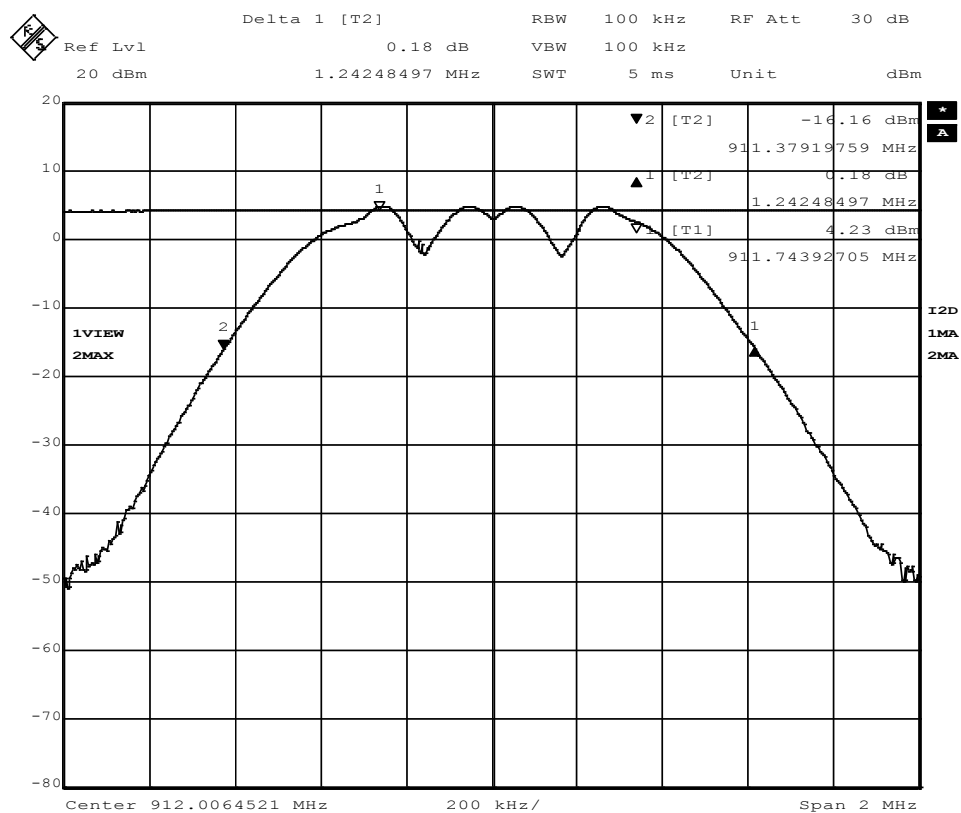


Figure 9 - 6dB Bandwidth



EUT	Cellular Base Unit	Model	MT-9100-CBU
MODE	Continuous Transmit	FREQUENCY RANGE	30MHz – 10GHz
INPUT POWER (SYSTEM)	120 VAC 60 Hz	ORIENTATION	N/A
ENVIRONMENTAL CONDITIONS	22% ± 5% RH 23 ± 3°C	TECHNICIAN	Kvepuri

CHANNEL	CHANNEL FREQUENCY (MHz)	6dB BW (kHz)	6dB MINIMUM LIMIT (kHz)	99% Occupied BW (kHz)	RESULT
2	916.50	921.60 kHz	500.00	1.27 MHz	PASS

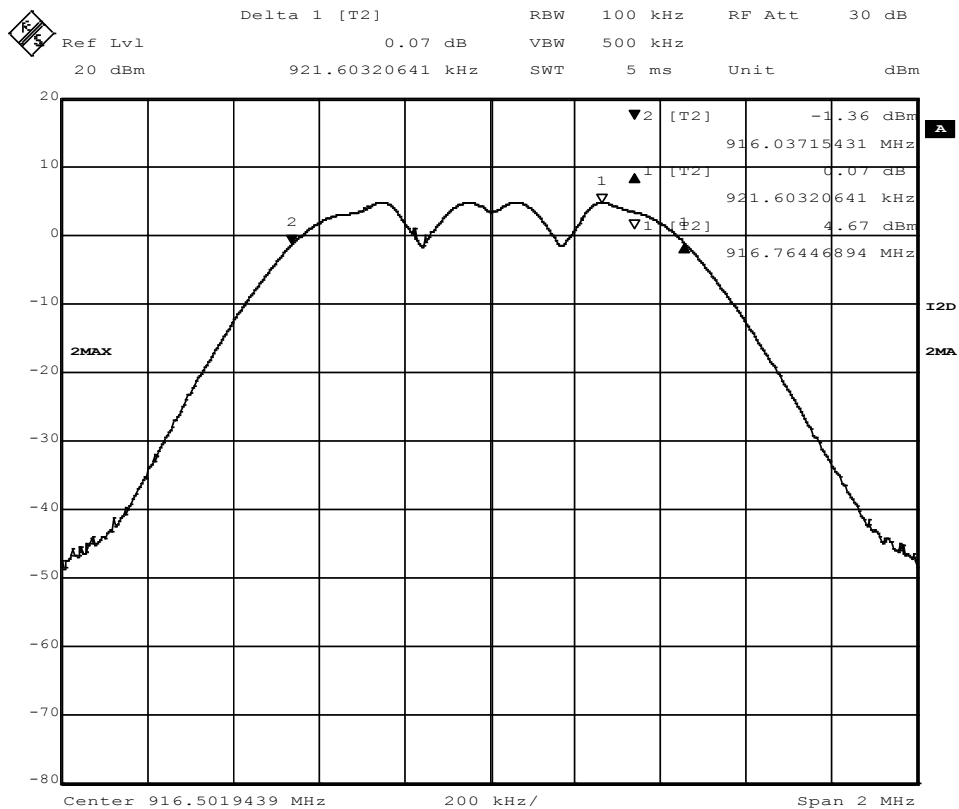


Figure 11 - 6dB Bandwidth

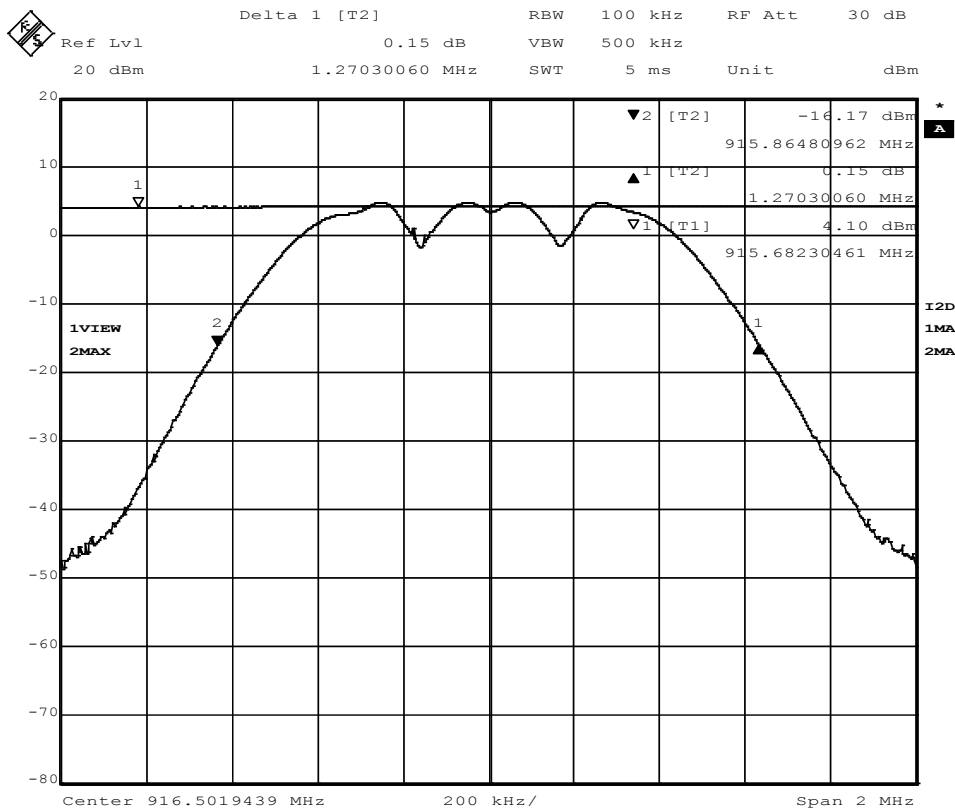


Figure 12 - 99% Occupied Bandwidth

EUT	Cellular Base Unit	Model	MT-9100-CBU
MODE	Continuous Transmit	FREQUENCY RANGE	30MHz – 10GHz
INPUT POWER (SYSTEM)	120 VAC 60 Hz	ORIENTATION	N/A
ENVIRONMENTAL CONDITIONS	22% ± 5% RH 23 ± 3°C	TECHNICIAN	Kvepuri

CHANNEL	CHANNEL FREQUENCY (MHz)	6dB BW (kHz)	6dB MINIMUM LIMIT (kHz)	99% Occupied BW (kHz)	RESULT
3	921.00	879.75 kHz	500.00	1.18 MHz	PASS

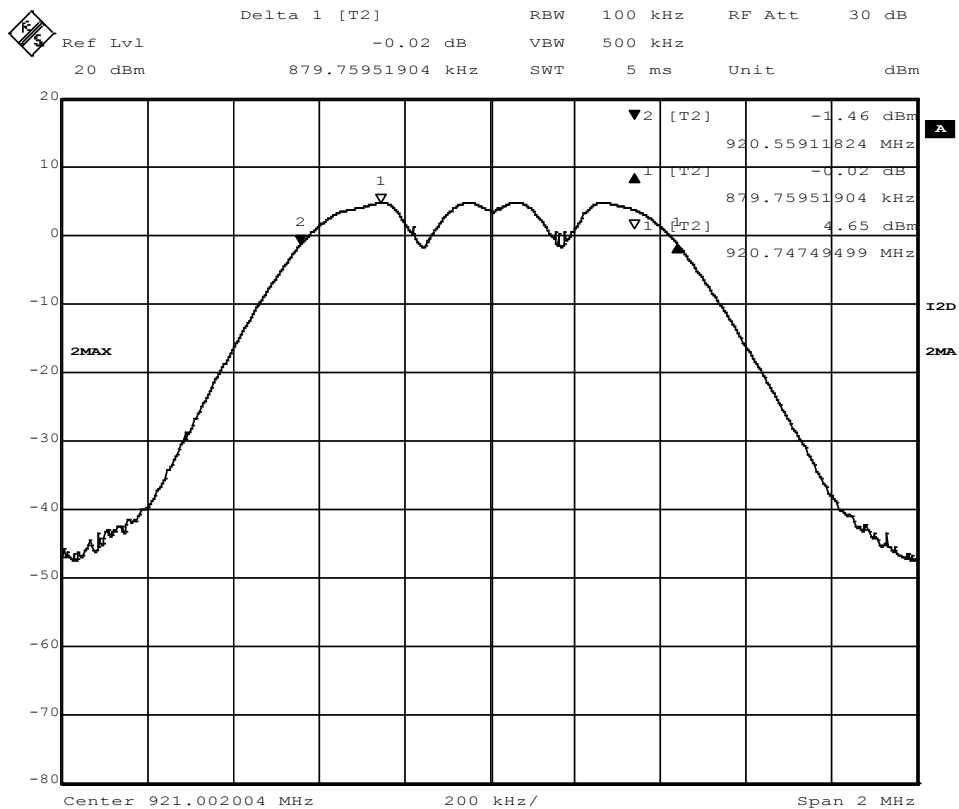


Figure 13 - 6dB Bandwidth

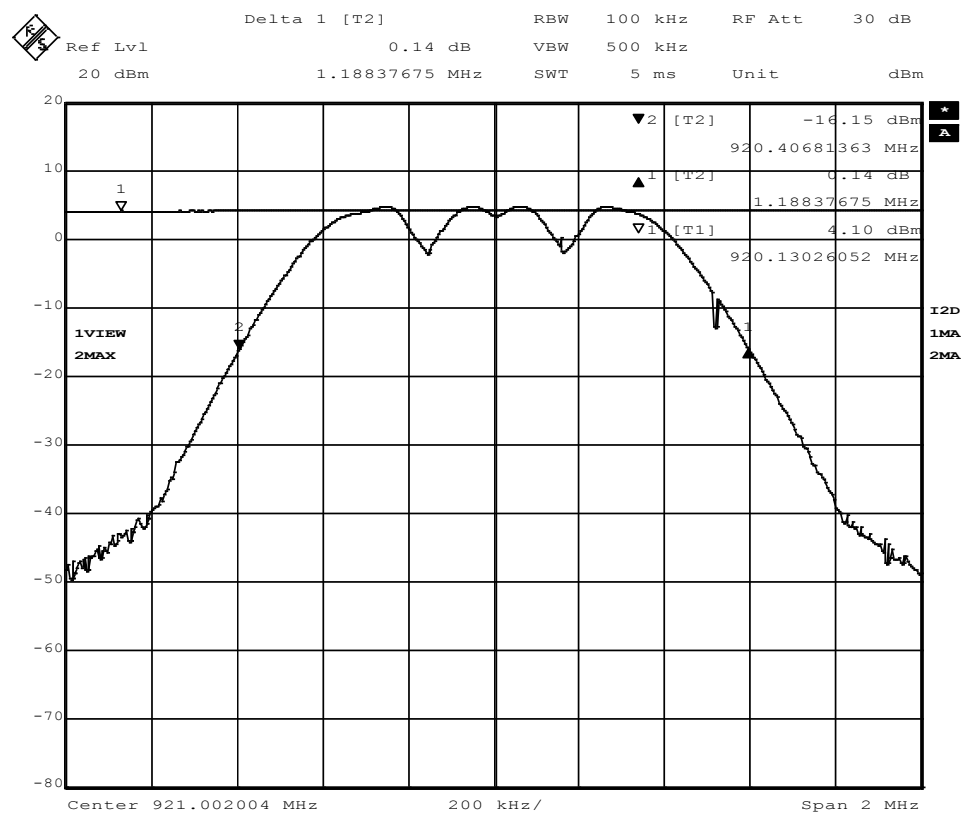


Figure 14 - 99% Occupied Bandwidth

4.5 Maximum peak output power

4.5.1 Limits of power measurements

The maximum peak output power allowed is 30dBm

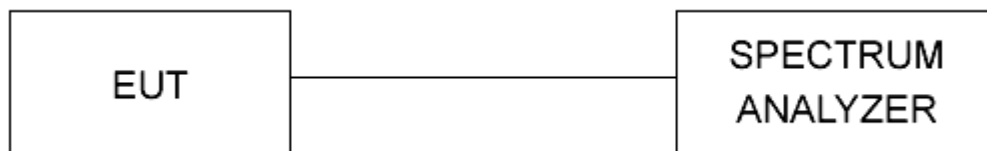
4.5.2 Test procedures

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	Cellular Base Unit	Model	MT-9100-CBU
MODE	Continuous Transmit	FREQUENCY RANGE	30MHz – 10GHz
INPUT POWER (SYSTEM)	120 VAC 60 Hz	ORIENTATION	N/A
ENVIRONMENTAL CONDITIONS	22% ± 5% RH 23 ± 3°C	TECHNICIAN	Kvepuri

CHANNEL	CHANNEL FREQUENCY (MHz)	PEAK POWER OUTPUT (dBm)	PEAK POWER LIMIT (dBm)	RESULT
1	912.00	4.48	30	PASS
2	916.50	4.35	30	PASS
3	921.00	4.35	30	PASS

*Corrected (0.25dB of attenuation added to account for RF cable)

Note: Screen captures of the measurements can be found in Section 4.4. The maximum power measurement with a 10MHz resolution bandwidth can be seen in the 99% occupied bandwidth plots.

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 set to auto. 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	Cellular Base Unit	Model	MT-9100-CBU
MODE	Continuous Transmit	FREQUENCY RANGE	30MHz – 10GHz
INPUT POWER (SYSTEM)	120 VAC 60 Hz	ORIENTATION	N/A
ENVIRONMENTAL CONDITIONS	22% ± 5% RH 23 ± 3°C	TECHNICIAN	Kvepuri

CHANNEL	CHANNEL FREQUENCY (MHz)	RF POWER LEVEL IN # KHz BW (dBm)	MAXIMUM POWER LIMIT (dBm)	RESULT
1	912.00	4.29	8.0	PASS
2	916.50	4.29	8.0	PASS
3	921.00	4.26	8.0	PASS

*Corrected (0.25dB of attenuation added to account for RF cable)

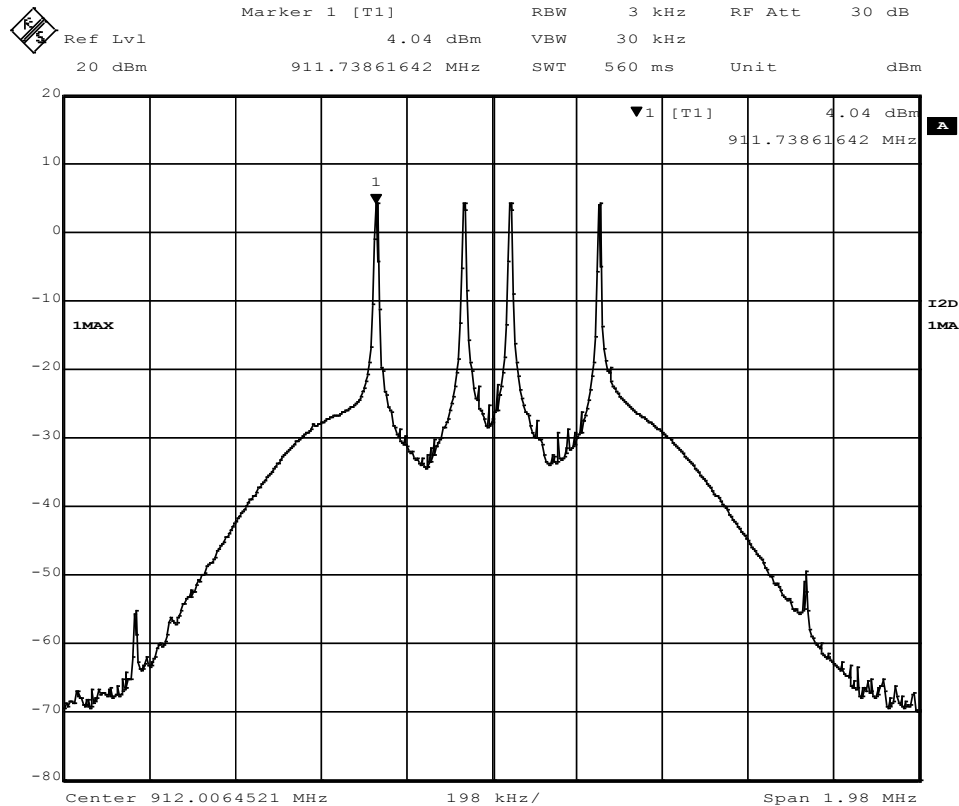


Figure 15 - Power Spectral Density Measurement, Ch. 1

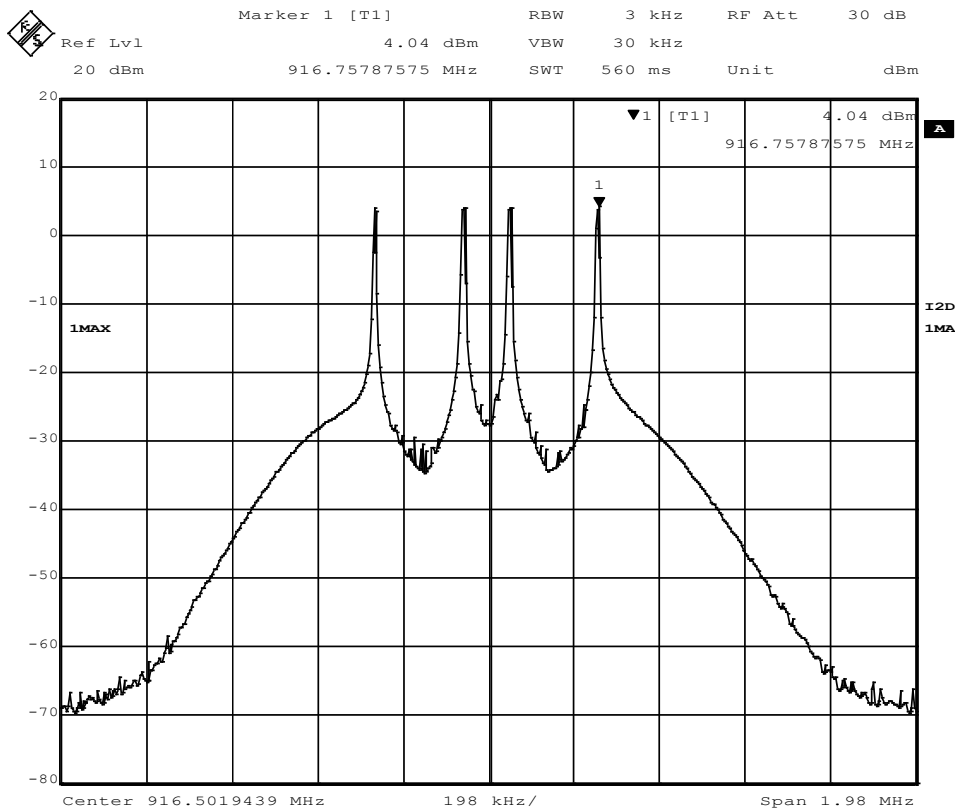


Figure 16 - Power Spectral Density Measurement, Ch. 2

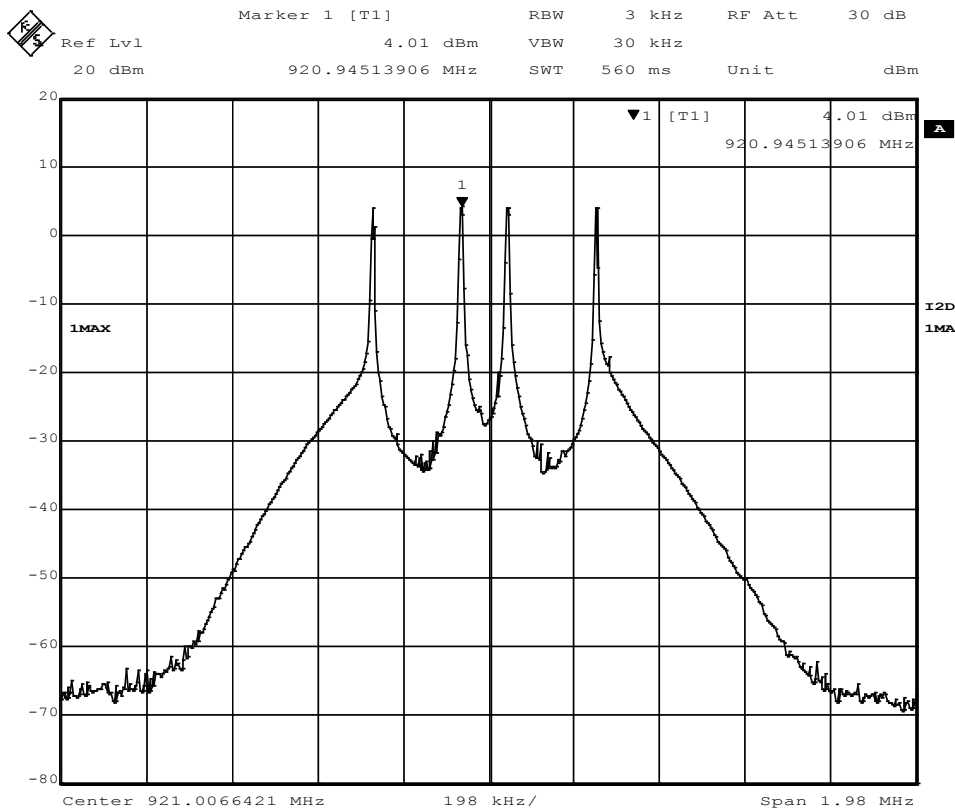


Figure 17 - Power Spectral Density Measurement, Ch. 3

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.

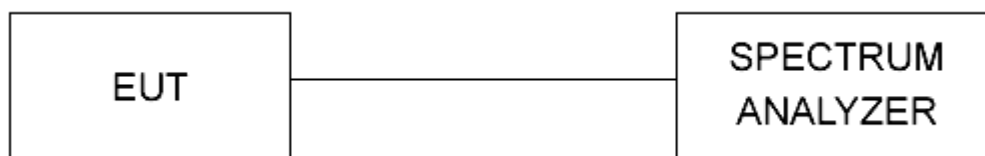
4.7.2 *Test procedures*

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	Cellular Base Unit	Model	MT-9100-CBU
MODE	Continuous Transmit	FREQUENCY RANGE	30MHz – 10GHz
INPUT POWER (SYSTEM)	120 VAC 60 Hz	ORIENTATION	N/A
ENVIRONMENTAL CONDITIONS	22% ± 5% RH 23 ± 3°C	TECHNICIAN	Kvepuri

Highest Out of Band Emissions

CHANNEL	Bandedge/Measurement Frequency (MHz)	Level (dBm)	Fund. Level (dBm)	Delta
1	902 MHz	-54.91	4.62	59.53
3	928 MHz	-55.58	4.61	60.91

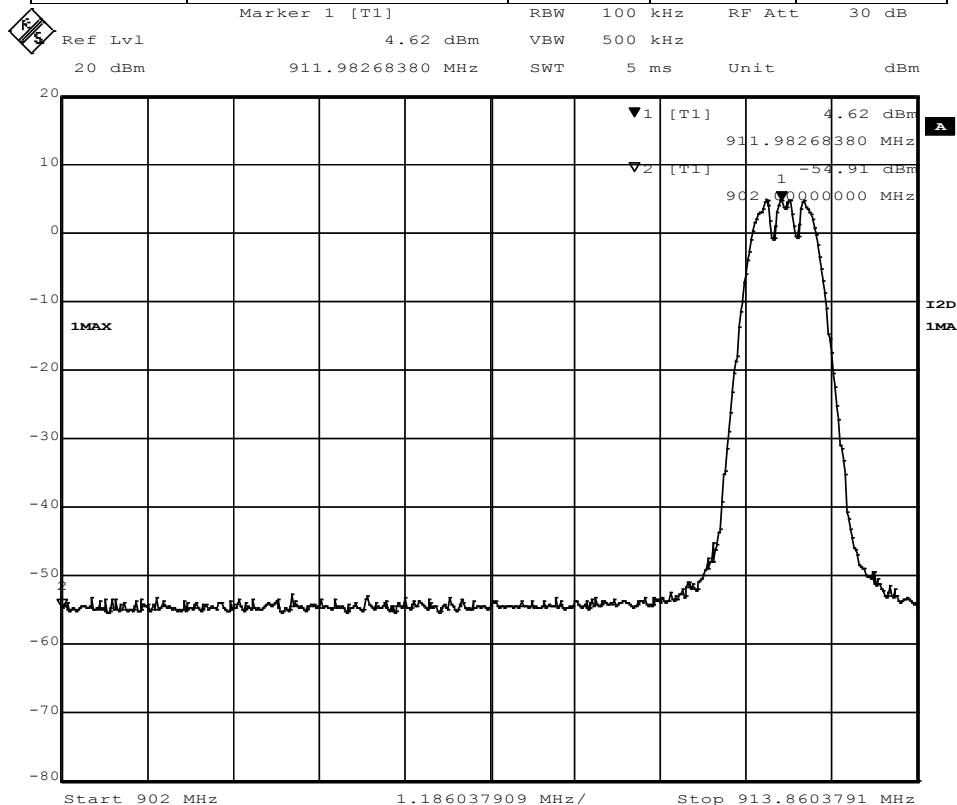


Figure 18 – Lower Band-edge Measurements

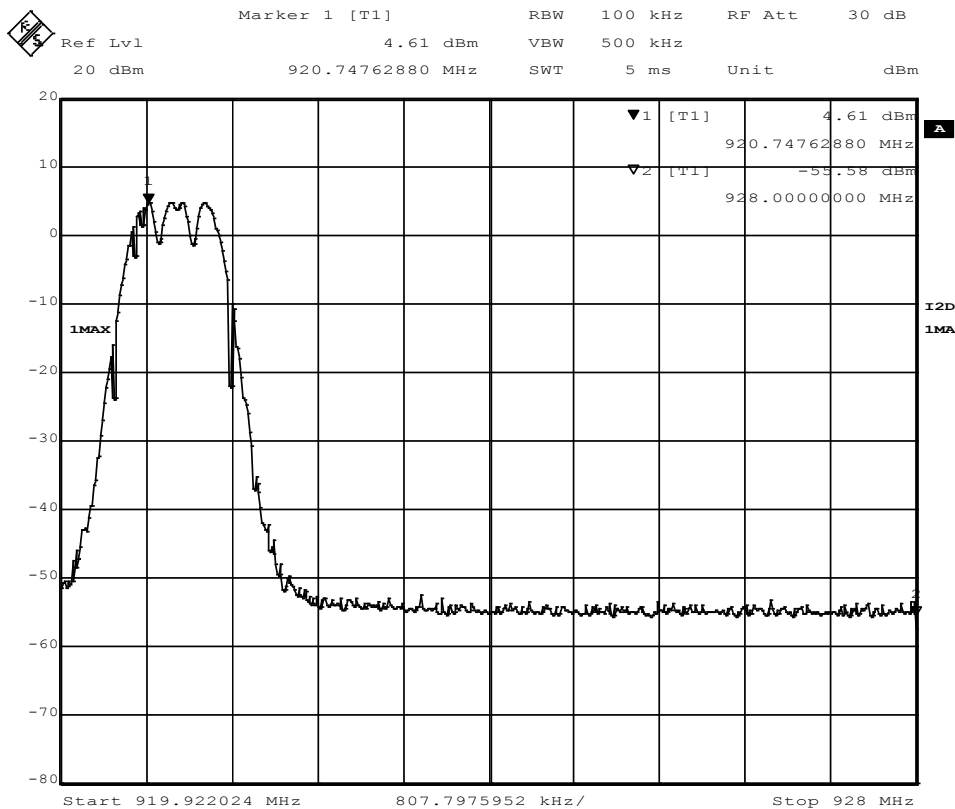


Figure 19 –Higher Band-edge Measurements

Appendix A: Test Photos

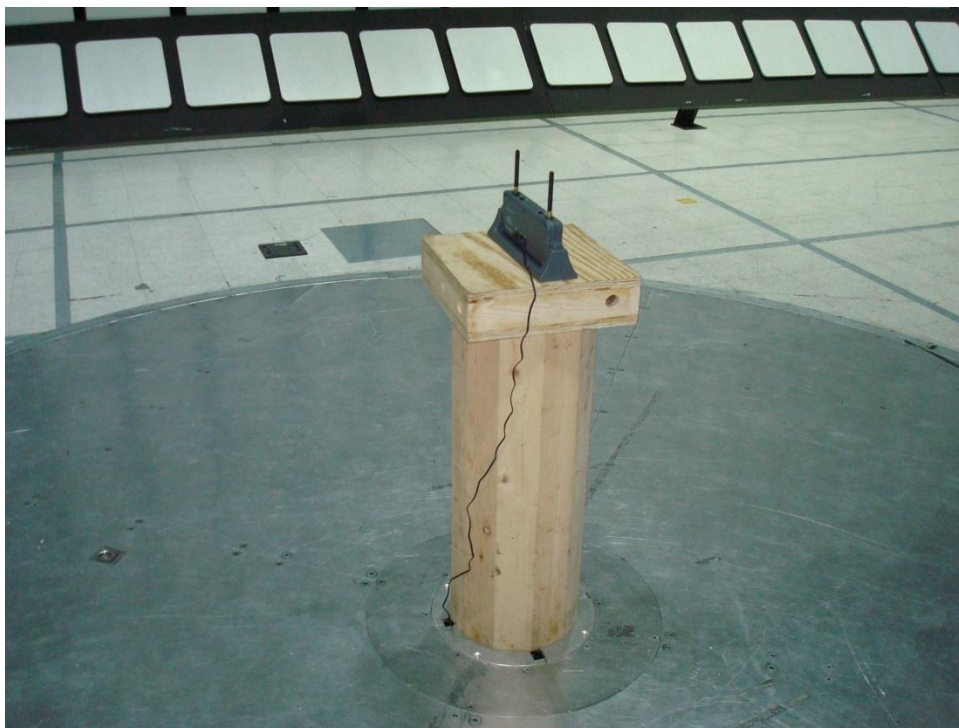


Figure 20 - Radiated Emissions Test Setup



Figure 21 - Radiated Emissions Test Setup

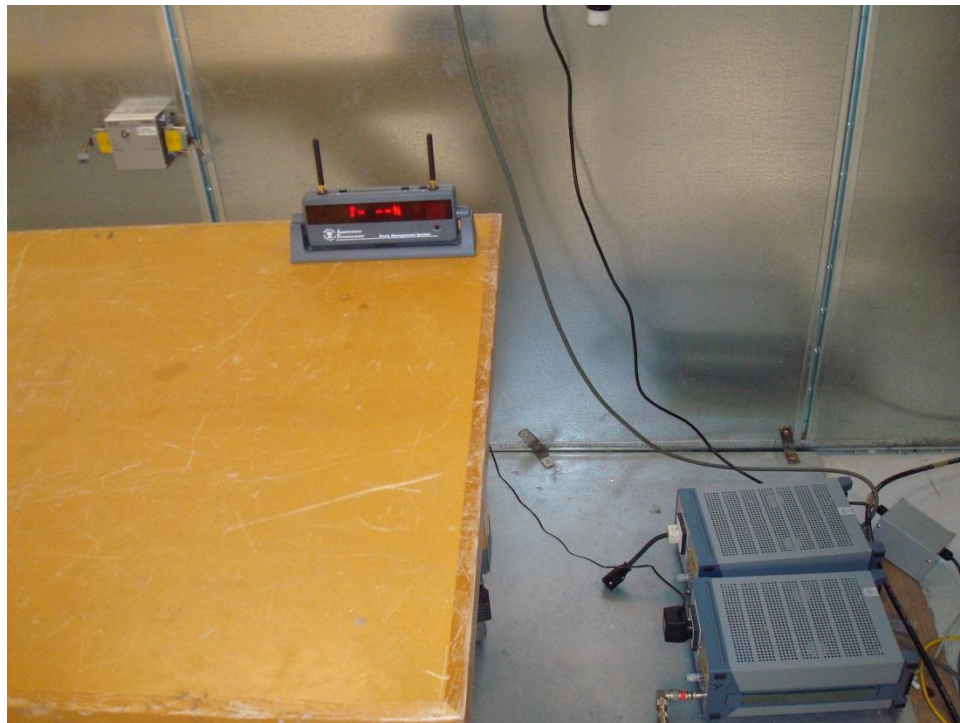


Figure 22 - Conducted Emissions Test Setup



Figure 23 - Conducted 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 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.

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

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