Nebraska Center for Excellence in Electronics
4740 Discovery Drive
Lincoln, NE 68521-5376
Phone: 402.472.5880
Fax: 402.472.5881

Amended Test Report

Company:	KZCO, Inc. 770 County Rd. A Ashland, NE 68003
Contact:	Kyle Vest
Product:	300-0045 Wireless Transceiver
FCC ID:	XNJ-01
Test Report No:	R050809-01B
APPROVED BY:	Nic Johnson Test Engineer
DATE:	5 October 2009
Total Pages:	27

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1.0 Summary of test results

1.1 Test Results

The EUT has been tested according to the following specifications:

APPLIED STANDARDS: 47 CFR Part 15 & RSS-210			
Standard Section	**Test Type and Limit**	**Result**	**Remark**
15.203	Unique Antenna Requirement	Pass	PCB Antenna
15.209	Radiated Emissions	Pass	Meets the requirement of the limit.
15.249	Peak Output Field Strength Limit: 93.98dBμV/m	Pass	Meets the requirement of the limit.
15.249	Bandedge requirements	Pass	All emissions outside of 902-928MHz band are at least 20dB below highest emission.

1.2 Test Methods

1.2.1 Radiated Emissions

Compliance to CFR 47 Parts 15.209 and 15.249 was tested in accordance with the methods of ANSI/IEEE C63.4: 2003. Several configurations were examined and the results presented represent a worst-case scenario. The EUT was placed on a wooden table approximately 80cm high and centered on a 4m diameter turntable. The table was rotated to find the angles of maximum emissions and the receiving antenna was moved from 1m to 4m in both vertical and horizontal positions. The EUT was tested while sitting both vertically and horizontally. The horizontal configuration produced the highest emissions, and that position was used for all radiated testing. All measurements were taken at a distance of 3m from the EUT for Part 15.209 intentional radiator measurements, and 3m for 15.249 measurements of the fundamental frequency in the 902MHz to 928MHz band and subsequent harmonics.

*1.*3 Reason for amendment

Section 4.3 was added to show measurements made to demonstrate compliance at bandedges. Measurements were taken same day as all other measurements and were not included in the first two drafts of this report. This report is intended to include and make obsolete NCEE Labs report R050809-01A.

2.0 Description

2.1 Equipment under test

The Equipment Under Test (EUT) was a wireless transceiver module from KZCO, Inc. It operates in the 902-928MHz band.

EUT Received Date: *8 May, 2009, 31 August 2009
EUT Tested Date: *8 May 2009, 31 August 2009

PRODUCT	300-0045 Wireless Transceiver
MODEL	300-0045
POWER SUPPLY	N/A
MODULATION TYPE	GFSK
FREQUENCY RANGE	902.6 – 927.2MHz
NUMBER OF CHANNELS	50
MAXIMUM OUTPUT POWER	-7.75dBm (0.168mW)
ANTENNA TYPE	internal
I/O PORTS	See user's manual for pin-outs
ASSOCIATED DEVICES	None

*Note: The EUT was tested for pre-compliance on May 8, 2009. Measurements were taken from 7 – 10GHz. According to the manufacturer, the EUT was equivalent to the one tested on 31 August 2009.

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	902.6
26	915.2
50	927.2

2.4 Applied standards

The EUT is a digital transmission device operating on one frequency 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 (15.249) using ANSI/IEEE C63.4: 2003

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

2.5 Configuration of system under test

The EUT was tested in the horizontal and vertical positions in order to determine the position with the greatest emissions. The results of testing in that worst-case orientation are presented here, which was horizontal.

2.6 Duty Cycle and Averaging Factor Calculation

The on air time for a data packet is approximately 3mS. There is multiple operations and delays after one transmission so the minimum time before the next data packet is transmitted is 40mS. This produces a maximum duty cycle of 7%.

*20 * log (0.07) = -23.1dB (averaging factor)*

The maximum allowed averaging factor is -20dB, so the maximum of -20dB was added to peak measurements to calculate the average measurements found in section 4.2.

3.0 Test equipment used

DESCRIPTION AND MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CALIBRATION DATE
*Rohde & Schwarz Test Receiver	ESIB26	100037	6/9/2009
Rohde & Schwarz Test Receiver	ESI7	100007	8/19/2008
EMCO Biconilog Antenna	3142B	1654	2/6/2009
EMCO Horn Antenna	3115	6416	2/6/2009
Rohde & Schwarz Preamplifier	TS-PR18	082001/003	12/15/2008
Trilithic Inc. High Pass Filter	200332488	6HC6600-1.5-KK	12/15/2008

*Used for measurements from 7 – 10GHz only. These measurements were made on May 8, 2009 when the receiver was under calibration.

4.0 Detailed results

4.1 15.203 Unique antenna requirement

4.1.1 Standard applicable

For intentional radiating devices, according to 47 CFR Part 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 is not interchangeable.

4.2 15.209, 15.249 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.
4. The the radiated emissions limit according to FCC Part 15.249(a) is 93.98dBμV/m at a 3m test distance. These are marked with an asterisk on the tables below.

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 receive 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. The EUT was a portable device/module and was therefore testing was required in 3 major axis. These orientations in addition to the rotation of the turntable provide measurements in all 3 of the major axis of the EUT. It was found that the horizontal configuration produced the highest emissions, and that configuration was used for all tests. A setup picture of this configuration can be seen in Appendix A.

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

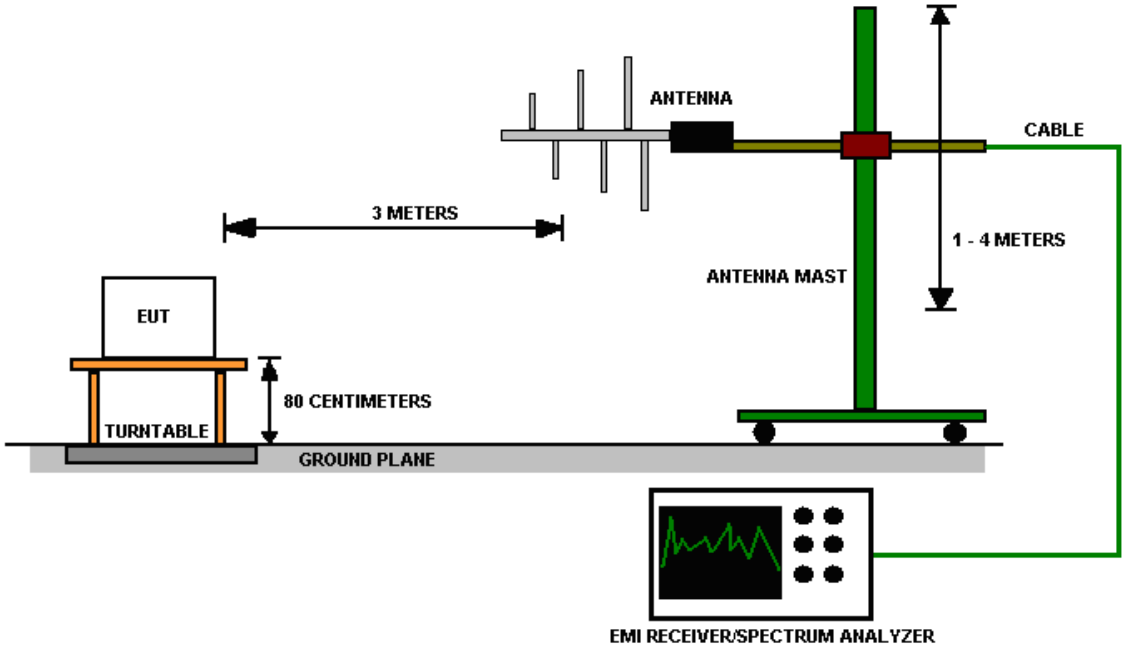


Figure 1 - Radiated Emissions Test Setup

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

4.2.5 EUT operating conditions

The EUT was powered by an internal battery and was programmed by the manufacturer to operate continuously on channel 1, 26, and 50, and to operate in normal mode, in which it sits and waits to send or receive a signal. The continuous operation is used for testing purposes only and cannot occur in normal operation. See section 2.6 of this report for details on EUT duty cycle.

4.2.6 Test results

EUT	300-0045	DATE	31 August 2009
MODE	Transmit Continuously Receive/Standby	FREQUENCY RANGE	1MHz – 10GHz
INPUT POWER (SYSTEM)	3VDC, Battery	ORIENTATION	Vertical/Horizontal
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

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 the radiated emissions limit according to FCC Part 15.249(a) is 93.98dBµV/m at a 3m test distance. These are marked with an asterisk on the tables below.

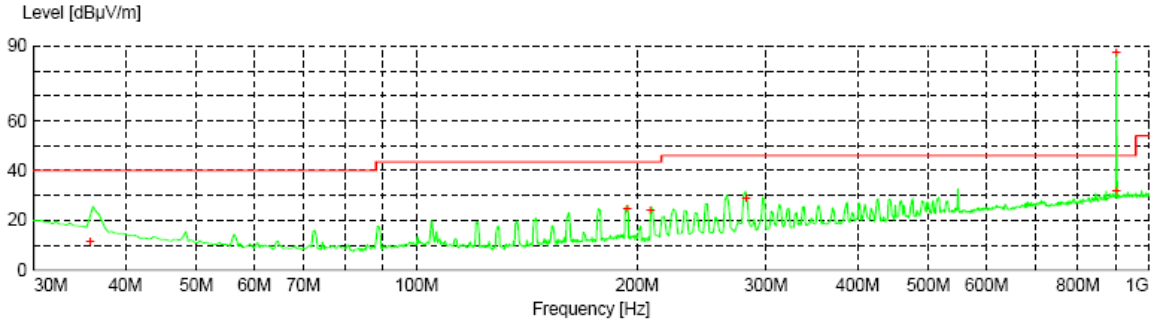


Figure 2 - Radiated Emissions Plot, 30MHz - 1GHz, Channel 1

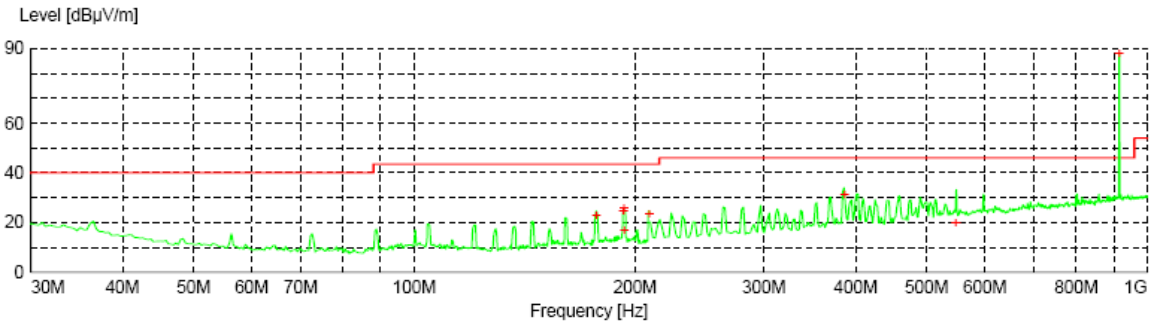


Figure 3 - Radiated Emissions Plot, 30MHz - 1GHz, Channel 26

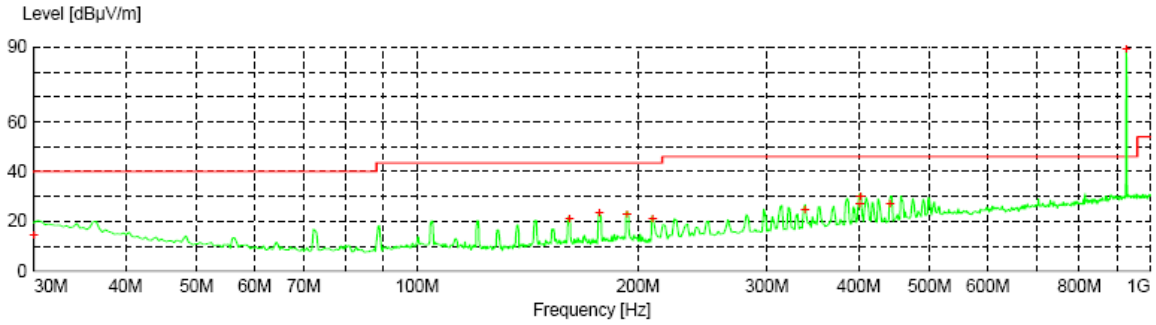


Figure 4 - Radiated Emissions Plot, 30MHz - 1GHz, Channel 50

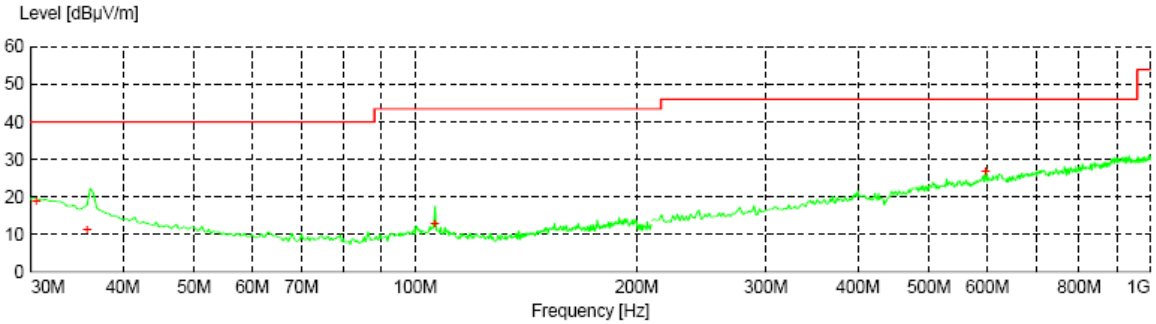


Figure 5 - Radiated Emissions Plot, 30MHz - 1GHz, Receive/Standby Mode

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

Frequency	Level	Limit	Margin	Height	Angle	Pol.
MHz	dBµV/m	dBµV/m	dB	cm	deg	
35.82	11.21	40.00	28.80	200	139	VERT
193.86	24.23	43.50	19.30	153	359	HORI
208.62	23.58	43.50	19.90	109	19	HORI
281.88	28.93	46.00	17.10	100	0	HORI
902.58	86.97	93.98*	7.01	100	118	HORI
903.30	31.39	46.00	14.60	103	195	HORI

*Limit according to FCC Part 15.249

Table 2 - Radiated Emissions Quasi-peak Measurements, Channel 26

Frequency	Level	Limit	Margin	Height	Angle	Pol.
MHz	dBµV/m	dBµV/m	dB	cm	deg	
177.12	22.90	43.50	20.60	194	349	HORI
192.84	24.49	43.50	19.00	160	338	HORI
193.02	24.62	43.50	18.90	163	345	HORI
193.14	25.74	43.50	17.80	146	353	HORI
193.56	16.75	43.50	26.70	153	342	HORI
209.28	23.20	43.50	20.30	119	0	HORI
386.10	31.07	46.00	14.90	100	129	HORI
548.16	19.67	46.00	26.30	153	32	VERT
915.18	87.64	93.98*	6.340	99	173	HORI

*Limit according to FCC Part 15.249

Table 3 - Radiated Emissions Quasi-peak Measurements, Channel 50

Frequency	Level	Limit	Margin	Height	Angle	Pol.
MHz	dBµV/m	dBµV/m	dB	cm	deg	
30.00	14.28	40.00	25.70	200	246	HORI
161.28	20.68	43.50	22.80	200	349	HORI
177.06	23.09	43.50	20.40	160	333	HORI
193.08	22.87	43.50	20.60	163	349	HORI
209.40	21.00	43.50	22.50	103	0	HORI
338.16	24.52	46.00	21.50	99	144	HORI
401.70	26.59	46.00	19.40	101	284	HORI
402.72	29.54	46.00	16.50	100	127	HORI
441.72	26.64	46.00	19.40	100	114	HORI
927.24	89.00	93.98*	4.98	101	171	HORI

*Limit according to FCC Part 15.249

Table 4 - Radiated Emissions Quasi-peak Measurements, Receive/Standby Mode

Frequency	Level	Limit	Margin	Height	Angle	Pol.
MHz	dBµV/m	dBµV/m	dB	cm	deg	
30.48	18.78	40.00	21.2	156	174	HORI
35.76	11.32	40.00	28.7	113	325	VERT
106.32	12.59	43.50	30.9	146	135	VERT
597.24	26.58	46.00	19.4	142	198	VERT

EUT	300-0045	Date	31 August 2009
MODE	Transmit Continuously Receive/Standby	FREQUENCY RANGE	1GHz – 10GHz
INPUT POWER (SYSTEM)	3VDC battery	ORIENTATION	Vertical/Horizontal
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

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. All measurements were made after finding the angle, antenna height, and receiving antenna polarization of the highest emission.
5. Margin value = Emission level – Limit value.
6. According to part 15.35(b) of the FCC rules, the peak limit is 20dB above the average limit specified in part 15.209. Where an -20dB averaging factor is used to compute the average, peak limits are not shown because compliance to the average limit implies compliance to the peak limits which are 20dB above the average limts.

Table 5 - Radiated Emissions Peak Measurements and Average Calculations, Channel 1

Frequency	Peak Level	Level + Av Factor (-20dB)	Average Limit	Margin	Height	Angle	Pol.
MHz	dBµV/m	dBµV/m	dBµV/m	dB	cm	deg	
1805.50	71.89	51.89	54.00	2.11	106	135	VERT
2708.00	68.56	48.56	54.00	5.44	106	335	HORI
3620.50	51.88	31.88	54.00	22.12	100	117	VERT
4517.00	54.21	34.21	54.00	19.79	170	304	VERT

*See section 2.6 of this report for the calculation of the duty cycle factor

Table 6 - Radiated Emissions Peak Measurements and Average Calculations, Channel 26

Frequency	Peak Level	Level + Av Factor	Average Limit	Margin	Height	Angle	Pol.
MHz	dBµV/m	dBµV/m	dBµV/m	dB	cm	deg	
1830.50	72.43	52.43	54.00	1.57	100	129	VERT
2745.50	69.90	49.90	54.00	4.10	99	320	HORI

*See section 2.6 of this report for the calculation of the duty cycle factor

Table 7 - Radiated Emissions Peak Measurements and Average Calculations, Channel 50

Frequency	Peak Level	Level +Av Factor (-20dB)	Average Limit	Margin	Height	Angle	Pol.
MHz	dBµV/m	dBµV/m	dBµV/m	dB	cm	deg	
1854.50	73.47	53.47	54.00	0.53	101	131	VERT
2781.50	69.70	49.70	54.00	4.30	98	335	HORI
3710.50	52.74	32.74	54.00	21.26	99	19	VERT
4644.00	55.85	35.85	54.00	18.15	156	296	VERT

*See section 2.6 of this report for the calculation of the duty cycle factor

Table 8 - Radiated Emissions Peak and Average Measurements, Receive/Standby Mode

Frequency	Level	Limit	Margin	Height	Angle	Pol.	Detector
MHz	dBµV/m	dBµV/m	dB	cm	deg		
1822.00	32.23	54.00	21.80	106	95	VERT	Av
2705.50	35.75	54.00	18.20	184	309	HORI	Av
1822.00	45.70	74.00	8.30	106	95	VERT	Pk
2705.50	49.51	74.00	4.50	184	309	HORI	Pk

4.3 15.249, 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 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 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. If the out of band emission falls with a restricted band from 15.205, then it is required that the emission be below the limits from 15.209.

4.7.3 Deviations from test standard

No deviation.

4.7.4 Test setup

4.7.5 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.

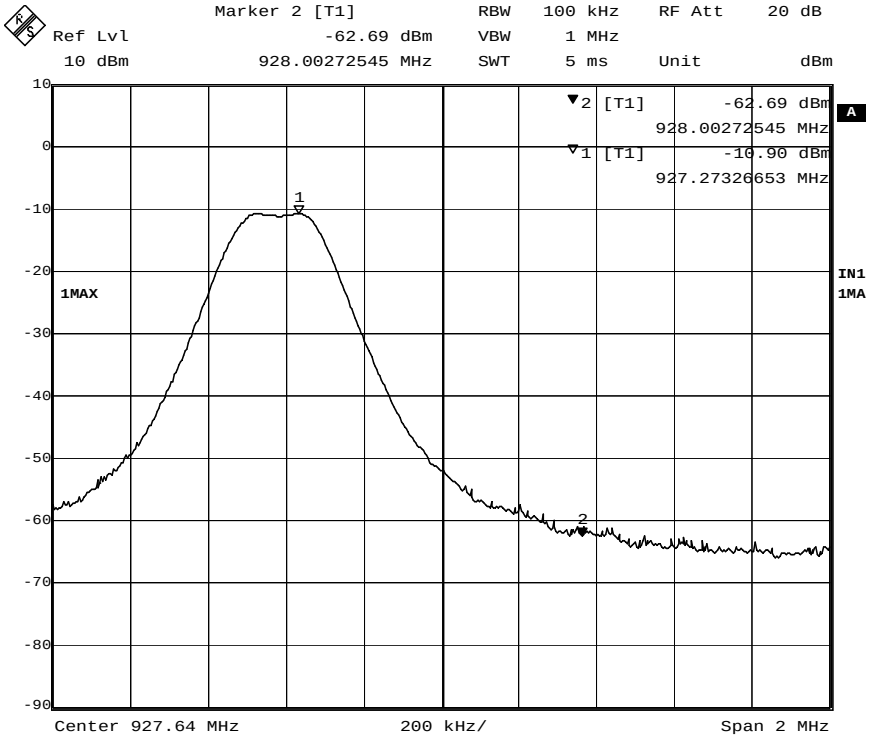
4.7.6 Test results

EUT	300-0045	DATE	31 August 2009
MODE	Transmit Continuously Receive/Standby	FREQUENCY RANGE	1MHz – 10GHz
INPUT POWER (SYSTEM)	3VDC, Battery	ORIENTATION	Vertical/Horizontal
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

Highest Out of Band Emissions

CHANNEL	Bandedge/Measurement Frequency (MHz)	Pk Level (dBm)	Fund. Pk Level (dBm)	Delta	Minimum Delta
1	902 MHz	-8.83	-68.64	59.81	20.00
19	928 MHz	-10.90	-62.69	51.79	20.00

NOTE:
All values listed include all transducer and cable loss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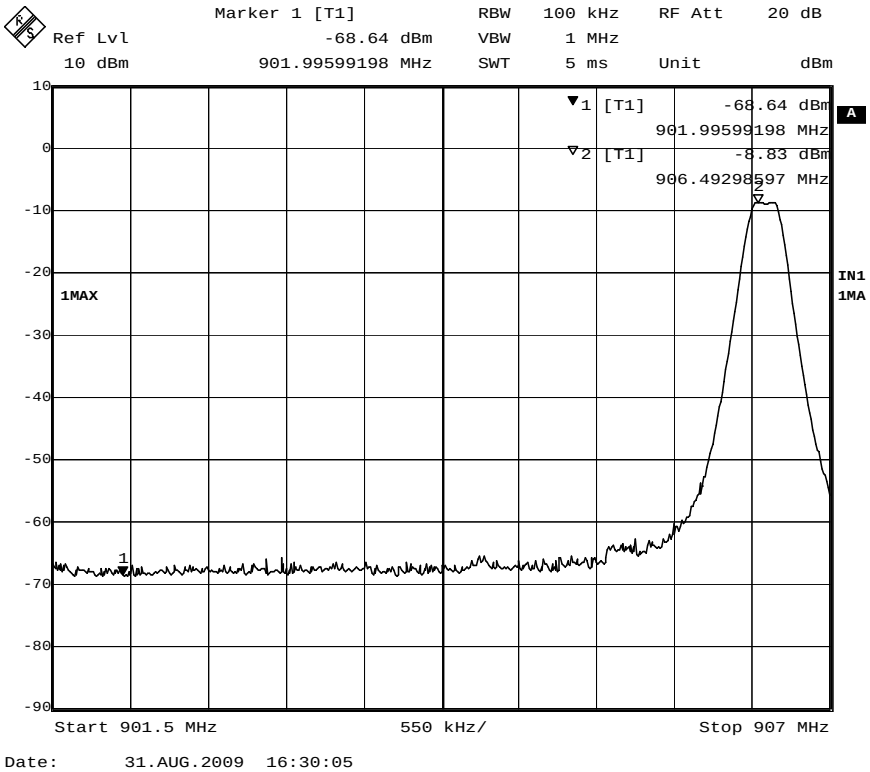
RBW 100 kHz
RF Att 20 dB
Ref Lvl -62.69 dBm
VBW 1 MHz
10 dBm 928.00272545 MHz
SWT 5 ms
Unit dBm
2 [T1] -62.69 dBm
928.00272545 MHz
1 [T1] -10.90 dBm
927.27326653 MHz
1MAX
A
IN1
1MA
Center 927.64 MHz
200 kHz/
Span 2 MHz
Date: 31.AUG.2009 16:28:54


Marker 1 [T1]
RBW 100 kHz
RF Att 20 dB
Ref Lvl -68.64 dBm
VBW 1 MHz
10 dBm 901.99599198 MHz
SWT 5 ms
Unit dBm
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901.99599198 MHz
2 [T1] -8.83 dBm
906.49298597 MHz
1MAX
A
IN1
1MA
Start 901.5 MHz
550 kHz/
Stop 907 MHz
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Appendix A: Test Photos

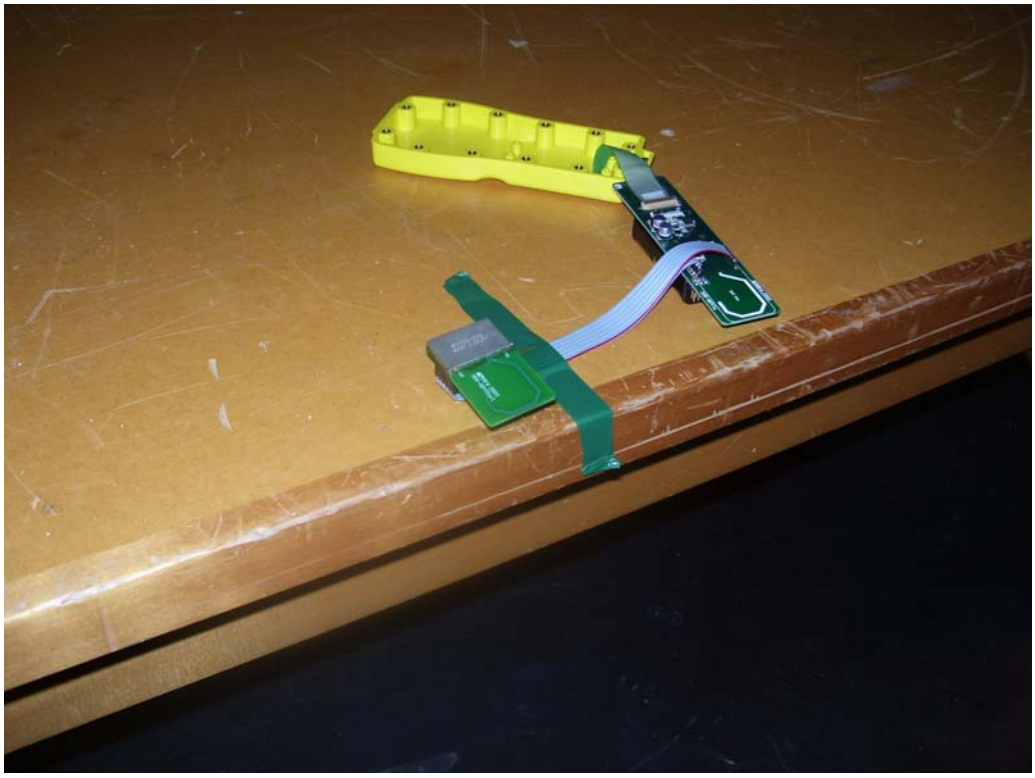

Figure 6 - Radiated Emissions Test Setup, EUT Horizontal

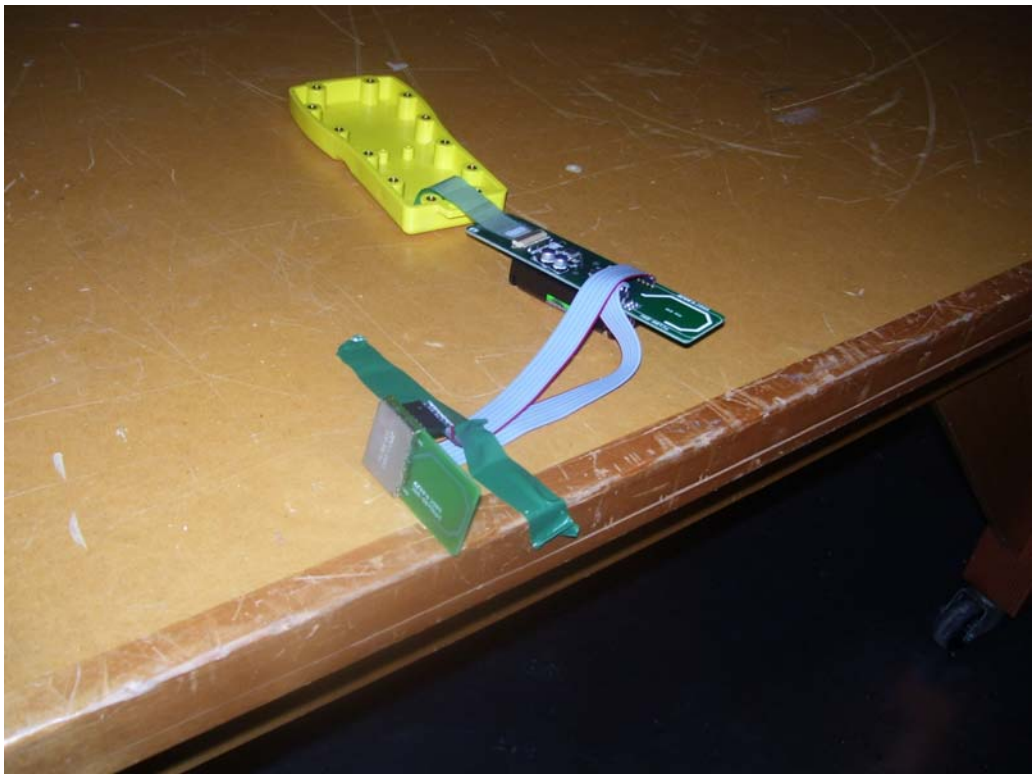

Figure 7 - Radiated Emissions Test Setup, EUT Vertical

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.

In this case, T_{on} = 4ms, AV = 20dB.

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