

Nebraska Center for Excellence in Electronics
4740 Discovery Drive
Lincoln, NE 68521
Phone: 402-472-5880
Fax: 402-472-5881



Amendment to EMC Test Report

R032806-01-02

(This report includes the original report)

Company: Holtzbrinck Publishers
41 Madison Ave.
New York, NY 10010

Contact: Lawrence Jankovic

Product: i>clicker Base
FCC ID: T24-TMX13
IC: 6495A-TMX13

Test Report No: R032806-01-02A

APPROVED BY: Doug Kramer
Senior Test Engineer

A handwritten signature of Doug Kramer in black ink, with a horizontal line underneath it.

DATE: 19 May 2006

Total Pages: 49

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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: FCC Part 15, Subpart C			
Standard Section	Test Type and Limit	Result	Remark
15.203	Unique Antenna Requirement	Pass	Antenna is built into EUT. Not replaceable.
15.207	AC Power Conducted Emission	Pass	Meets the requirement of the limit.
15.209	Radiated Emissions	Pass	Meets the requirement of the limit.
15.247(a)(2)	Spectrum Bandwidth of a Direct Sequence Spread Spectrum System, 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.

1.2 *Test Methods*

1.2.1 *Conducted Emissions*

The EUT contains no direct connection to the AC mains supply network. All power is supplied from a host machine via a USB connection. The EUT was found not to effect the host equipment's conducted emissions as shown in Figures 2 and 3.

1.2.2 *Radiated Emissions*

Compliance to CFR 47 Parts 15.209 and 15.247 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. All measurements were taken at a distance of 3m from the EUT for Part 15.209 intentional radiator measurements, and 3m for 15.247 measurements of the fundamental frequency in the 902MHz -928MHz band and subsequent harmonics.

1.3 *Reason for Amendment*

This test report has been amended to clarify data present on the 99% bandwidth, Section 4.4.6, as well as the emissions limits to 47 CFR 15.247 as shown in Section 4.3.6 of this report. Notes were added to clarify the results.

2.0 Description

2.1 Equipment under test

The Equipment Under Test (EUT) was an i>clicker base unit, which is designed to communicate directly with the i>clicker remote unit. The EUT allows instructors in a classroom to poll students for their answers to multiple-choice questions. In use, the students transmit their answers via a separate unit to this device and this device receives the answers and transmits an 'acknowledge' message back to the student's device over a 900MHz wireless link.

EUT Received Date: 26 April 2006

EUT Tested Date: 1 - 5 May, 2006

PRODUCT	i>clicker Base
MODEL	TMX13
POWER SUPPLY	5VDC via USB
MODULATION TYPE	FSK, 240 kHz peak deviation
RADIO TECHNOLOGY	Half-duplex RF Link
TRANSFER RATE	152.34kb/s modulation rate 25 packets per second, maximum 0.4ms packet length
FREQUENCY RANGE	905.5 MHz – 923 MHz
NUMBER OF CHANNELS	16
MAXIMUM OUTPUT POWER	15 dBm,
ANTENNA TYPE	Reverse Polarity SMA Dipole, ½ wave, 3 dBi gain
DATA CABLE	USB, connected to control PC
I/O PORTS	1 USB flash memory port
ASSOCIATED DEVICES	Control PC

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 registered lab. This site has been fully described in a report submitted to the FCC, and accepted in a letter dated May 4, 2001. Laboratory environmental conditions varied slightly throughout the tests:

Relative humidity of $45 \pm 4\%$

Temperature of $20 \pm 3^\circ$ Celsius

2.3 Description of test modes

Channel	Frequency	Channel	Frequency
AA	903.5MHz	CA	914.0MHz
AB	904.5MHz	CB	915.5MHz
AC	906.0MHz	CC	916.5MHz
AD	907.5MHz	CD	918.0MHz
BA	908.5MHz	DA	919.0MHz
BB	910.0MHz	DB	920.5MHz
BC	911.5MHz	DC	922.0MHz
BD	912.5MHz	DD	923.0MHz

NOTE:

1. Channel AA, BD and DD were chosen to represent frequencies at the lowest, middle and highest possible transmitting frequencies, respectively.
1. Below 1 GHz, channels AA, BD, and DD were tested individually
2. Above 1 GHz, channels AA, BD, and DD were tested individually.

2.4 *Applied standards*

The EUT is a digital transmission device operating between 903.5 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 6, Category I Equipment**

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 received 5VDC power from a USB connection to a host PC and was programmed by the manufacturer to transmit continually for testing purposes only. The EUT was tested with a Dell Optiplex GX270 PC, S/N 805P441 and Dell M990 CRT 17" monitor. A mouse and keyboard were also connected to the PC.

3.0 Test equipment used

DESCRIPTION AND MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CALIBRATION DATE
Rohde & Schwarz Test Receiver	ESIB26	100037	10-Aug-05
Rohde & Schwarz Test Receiver	ESIB7	100007	28-Dec-05
EMCO Biconilog Antenna	3142B	1654	13-Mar-06
EMCO Horn Antenna	3115	6416	12-Oct-05
EMCO Horn Antenna	3116	2576	12-Oct-05
Rohde & Schwarz Artificial Mains	836679/010	ESH3-Z5	27-May-05

4.0 Detailed results

4.1 *Unique antenna requirement*

4.1.1 *Standard applicable*

For intentional devices, 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 is permanently attached to the PCB. There is no provision for an antenna other than the one attached by the manufacturer. The test unit was configured with a removable antenna in order to facilitate conducted RF measurements.

4.2 *Conducted emissions*

4.2.1 *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.

4.2.2 *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). Other support units were connected to the power mains through another LISN. The two LISNs provide 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.

4.2.3 *Deviation from the test standard*

No deviation

4.2.4 Test setup

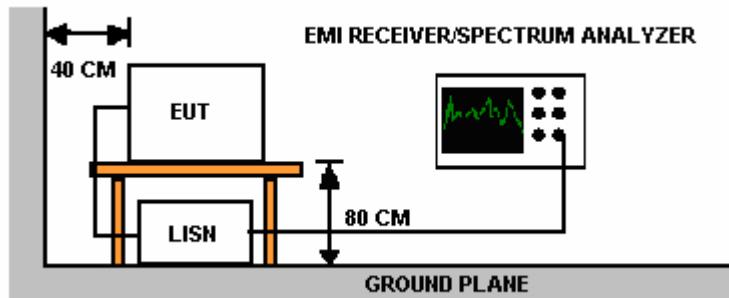


Figure 1 Conducted Emissions Test Setup

For actual test configuration, see photographs in Appendix A

4.2.6 EUT operating conditions

The EUT received 5VDC power from a USB connection to a host PC was programmed by the manufacturer to transmit continually for testing purposes only. The EUT was tested with a Gateway 400VTXLaptop, S/N 0031513168. Results with the laptop connected to the EUT, with the EUT operational were compared with those of the PC operating without the EUT. The EUT did not cause and significant change in the measurements of the PC.

EUT	i>clicker Base	Model	TMX13
MODE	Channel AC Tested PC with EUT	FREQUENCY RANGE	150kHz – 30MHz
INPUT POWER (SYSTEM)	120VAC/60 to PC 5VDC to EUT via USB	PHASE	Line, Neutral, Ground, Floating Ground
ENVIRONMENTAL CONDITIONS	45% \pm 5% RH 20 \pm 3°C	TECHNICIAN	NJohnson

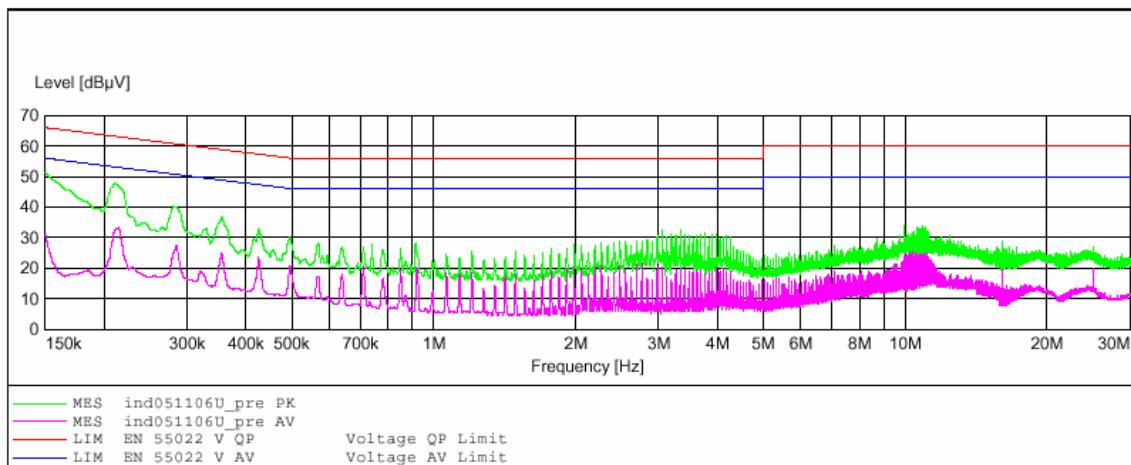


Figure 2 - Conducted Emissions Plot, EUT with PC

REMARKS:

1. Q.P. and AV. Are abbreviations for quasi-peak and average respectively.
2. All emission levels were very low against the limit.

EUT	i>clicker Base	Model	TMX13
MODE	PC Only	FREQUENCY RANGE	150kHz – 30MHz
INPUT POWER (SYSTEM)	120VAC/60 to PC	PHASE	Line, Neutral, Ground, Floating Ground
ENVIRONMENTAL CONDITIONS	45% \pm 5% RH 20 \pm 3°C	TECHNICIAN	NJohnson

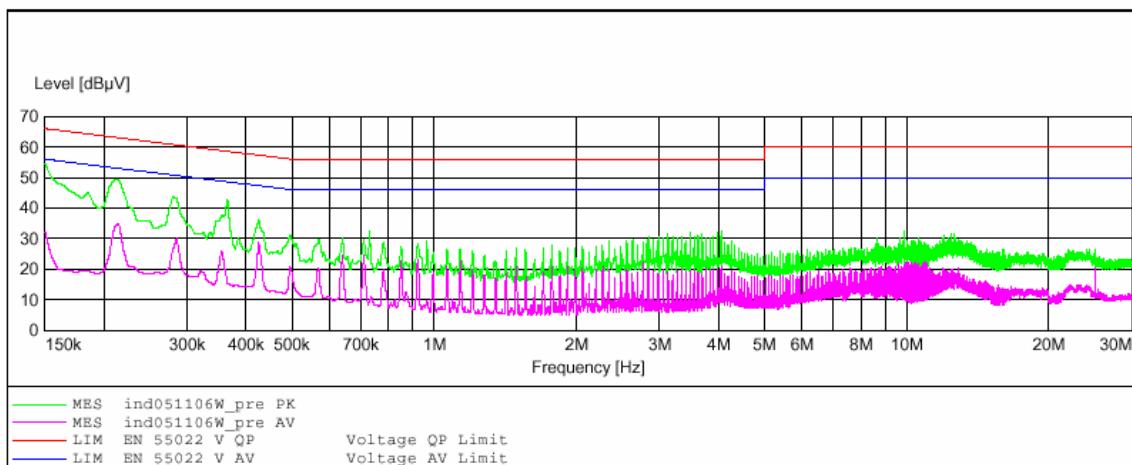


Figure 3 - Conducted Emissions, PC Only

REMARKS:

1. Q.P. and AV. Are abbreviations for quasi-peak and average respectively.
2. All emission levels were very low against the limit

4.3 *Radiated emissions*

4.3.1 *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 (μ 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_uV/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.

4.3.2 *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.

4.3.3 Deviations from test standard

No deviation.

4.3.4 Test setup

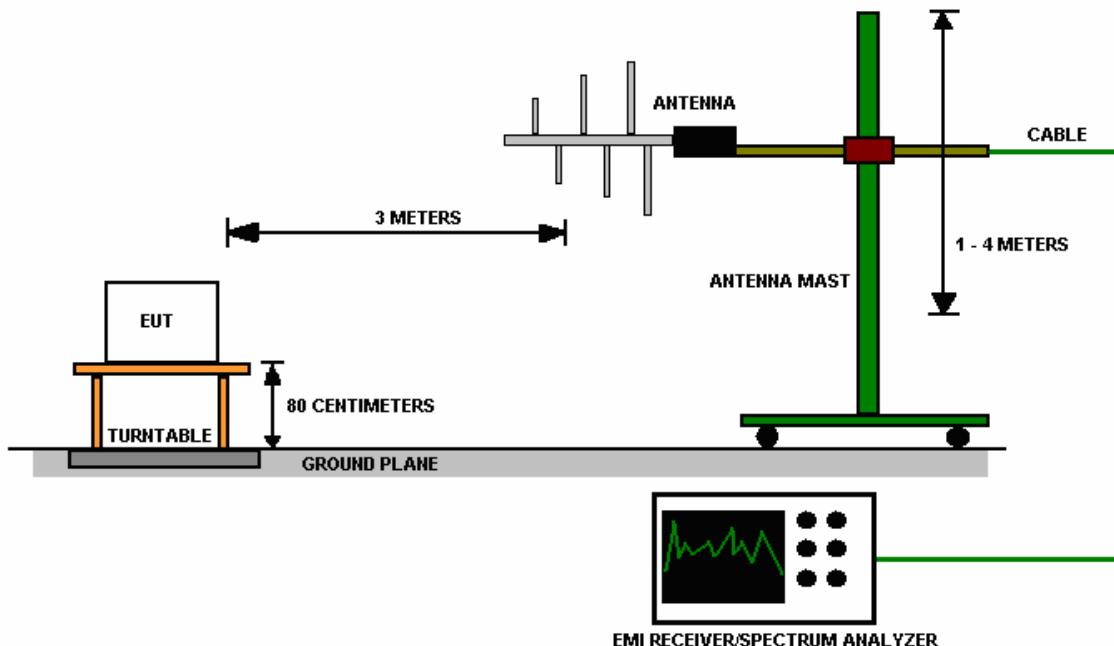


Figure 4 Radiated Emissions Test Setup

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

4.3.5 EUT operating conditions

The EUT received 5VDC power from a USB connection to a host PC and was programmed by the manufacturer to transmit continually for testing purposes only. The EUT was tested with a Dell Optiplex GX270 PC, S/N 805P441 and Dell M990 CRT 17" monitor. A mouse and keyboard were also connected to the PC.

4.3.6 Test results

EUT	i>clicker Base	Model	TMX13
MODE	Channel DA	FREQUENCY RANGE	30MHz – 1GHz
INPUT POWER (SYSTEM)	5VDC via USB	ORIENTATION	Vertical/Horizontal
ENVIRONMENTAL CONDITIONS	45% \pm 5% RH 20 \pm 3°C	TECHNICIAN	NJohnson

Frequency	Level	Limit	Margin	Height	Angle	Pol.
MHz	dB μ V/m	dB μ V/m	dB	cm	deg	
36.000000	29.74	40.0	10.3	100.0	304	VERT
132.840000	36.17	43.5	7.3	150.0	269	HORI
135.360000	36.94	43.5	6.6	149.0	271	HORI
138.060000	37.82	43.5	5.7	150.0	257	HORI
250.020000	33.46	46.0	12.5	106.0	186	VERT
336.000000	30.46	46.0	15.5	100.0	156	HORI
432.000000	33.46	46.0	12.5	106.0	314	HORI
574.680000	34.65	46.0	11.3	201.0	324	VERT
876.000000	35.67	46.0	10.3	181.0	0	VERT
886.980000	46.41	*87.6	41.19	109.0	54	VERT
902.640000	85.74	107.64	N/A	272.0	89	VERT
903.240000	107.20	107.64	N/A	181.0	132	VERT
903.720000	107.64	107.64	N/A	185.0	135	VERT
903.780000	106.93	107.64	N/A	109.0	4	VERT
927.720000	45.67	46.0	0.3	112.0	138	VERT
960.000000	38.82	46.0	7.2	99.0	42	VERT

REMARKS:

1. Emission level (dB μ V/m) = Raw Value (dB μ V) + 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. “*”: Emissions from Tx not in a restricted band. Limit = Highest emission level – 20dB
6. Radiated limits do not apply within the 902MHz to 928MHz band.

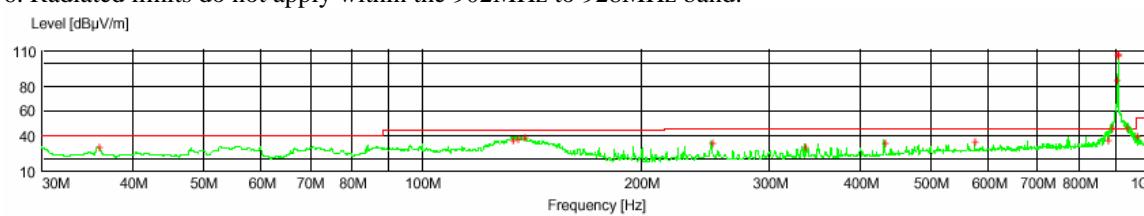


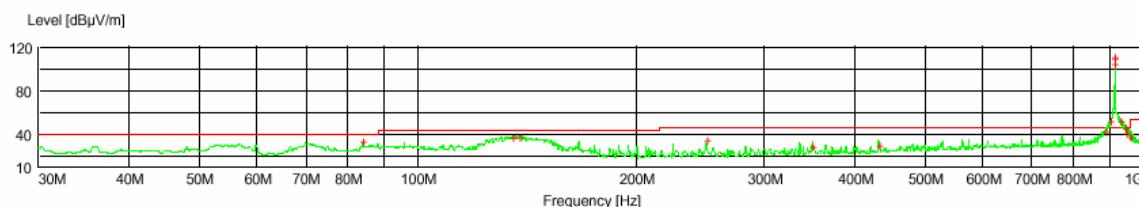
Figure 5 - Radiated Emissions Plot, Channel AA

EUT	i>clicker Base	Model	TMX13
MODE	Channel AC	FREQUENCY RANGE	30MHz – 1GHz
INPUT POWER (SYSTEM)	5VDC via USB	ORIENTATION	Vertical/Horizontal
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3°C	TECHNICIAN	NJohnson

Frequency	Level	Limit	Margin	Height	Angle	Pol.
MHz	dB μ V/m	dB μ V/m	dB	cm	deg	
84.060000	33.64	40.0	6.4	100.0	7	VERT
135.540000	37.75	43.5	5.8	149.0	266	HORI
138.060000	37.75	43.5	5.7	149.0	265	HORI
250.020000	34.55	46.0	11.4	100.0	182	VERT
349.980000	28.58	46.0	17.4	100.0	247	HORI
432.000000	30.43	46.0	15.6	100.0	0	HORI
888.300000	42.37	*90.93	48.56	115.0	49	VERT
902.460000	51.55	110.93	N/A	115.0	186	VERT
912.240000	110.07	110.93	N/A	106.0	3	VERT
912.720000	110.93	110.93	N/A	112.0	197	VERT
912.780000	105.44	110.93	N/A	106.0	47	VERT
927.300000	51.83	110.93	N/A	100.0	45	VERT
945.000000	45.17	*90.93	45.8	100.0	1	VERT
948.300000	40.70	46.0	5.3	106.0	190	VERT
960.420000	37.26	53.9	16.6	100.0	197	VERT

REMARKS:

1. Emission level (dB μ V/m) = Raw Value (dB μ V) + 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. “* “:Emissions from Tx not in a restricted band. Limit = Highest emission level – 20dB
6. Radiated limits do not apply within the 902MHz to 928MHz band.

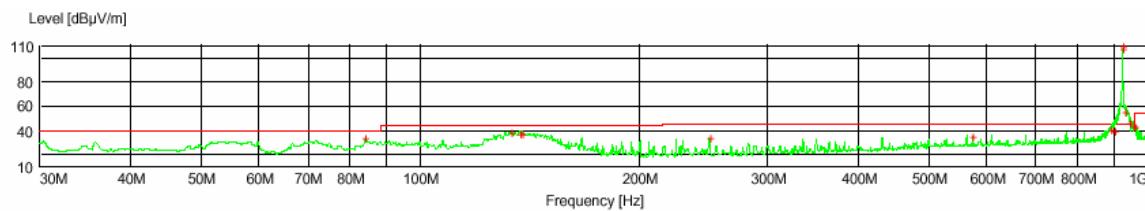
**Figure 6 - Radiated Emission Plot, Channel AC**

EUT	i>clicker Base	Model	TMX13
MODE	Channel CB	FREQUENCY RANGE	30MHz – 1GHz
INPUT POWER (SYSTEM)	5VDC via USB	ORIENTATION	Vertical/Horizontal
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3°C	TECHNICIAN	NJohnson

Frequency MHz	Level dB μ V/m	Limit dB μ V/m	Margin dB	Height cm	Angle deg	Pol.
84.060000	33.57	40.0	6.4	100.0	260	VERT
133.560000	38.02	43.5	5.5	149.0	273	HORI
137.400000	37.39	43.5	6.1	150.0	264	HORI
138.060000	36.85	43.5	6.6	150.0	261	HORI
250.020000	34.10	46.0	11.9	149.0	319	VERT
574.680000	34.92	46.0	11.1	204.0	324	VERT
891.240000	40.47	46.0	5.5	110.0	50	VERT
902.100000	39.89	46.0	6.1	107.0	50	VERT
922.740000	109.41	109.41	N/A	181.0	131	VERT
923.280000	107.43	109.41	N/A	106.0	3	VERT
932.100000	55.53	*89.41	33.88	103.0	3	VERT
945.840000	45.83	*89.41	43.6	106.0	198	VERT
955.800000	44.21	*89.41	45.2	100.0	43	VERT
960.000000	43.03	46.0	3.0	99.0	45	VERT

REMARKS:

1. Emission level (dB μ V/m) = Raw Value (dB μ V) + 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. “* “:Emissions from Tx not in a restricted band. Limit = Highest emission level – 20dB
6. Radiated limits do not apply within the 902MHz to 928MHz band.

**Figure 7 - Radiated Emission Plot, Channel DD**

EUT	i>clicker Base	Model	TMX13
MODE	Channel DA	FREQUENCY RANGE	Above 1000MHz
INPUT POWER (SYSTEM)	5VDC via USB	ORIENTATION	Vertical/Horizontal
ENVIRONMENTAL CONDITIONS	45% \pm 5% RH 20 \pm 3°C	TECHNICIAN	NJohnson

Frequency	Average Level	Average Limit	Average Margin	Peak Level	Peak Limit	Peak Margin	Height	Angle	Pol.
MHz	dB μ V/m	dB μ V/m	dB	dB μ V/m	dB μ V/m	dB	cm	deg	
1805.000000	35.71	53.9	18.2	64.95	73.9	9.0	115.0	330	VERT
2707.500000	39.67	53.9	14.2	61.19	73.9	12.7	150.0	56	VERT
2792.000000	41.80	53.9	12.1	56.56	73.9	17.3	129.0	299	HORI
2792.500000	44.66	53.9	9.2	60.42	73.9	13.5	100.0	358	HORI
2827.500000	39.68	53.9	14.2	52.90	73.9	21.0	366.0	226	VERT
3610.500000	42.49	53.9	11.4	56.19	73.9	17.7	150.0	190	HORI
4520.000000	44.40	53.9	9.5	57.65	73.9	16.2	395.0	359	VERT
5417.000000	48.98	53.9	4.9	62.41	73.9	11.5	389.0	152	VERT
6332.000000	51.61	53.9	2.3	64.87	73.9	9.0	389.0	13	HORI
7210.000000	32.39	53.9	1.5	43.35	73.9	30.5	250.0	188	HORI
8138.500000	33.07	53.9	20.8	46.16	73.9	27.7	395.0	63	HORI
9023.500000	35.05	53.9	18.9	48.78	73.9	25.1	169.0	12	VERT

REMARKS:

1. Emission level (dB μ V/m) = Raw Value (dB μ V) + 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.

EUT	i>clicker Base	Model	TMX13
MODE	Channel AC	FREQUENCY RANGE	Above 1000MHz
INPUT POWER (SYSTEM)	5VDC via USB	ORIENTATION	Vertical/Horizontal
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3°C	TECHNICIAN	NJohnson

Frequency	Average Level	Average Limit	Average Margin	Peak Level	Peak Limit	Peak Margin	Height	Angle	Pol.
MHz	dB μ V/m	dB μ V/m	dB	dB μ V/m	dB μ V/m	dB	cm	deg	
1818.000000	34.84	53.9	19.1	52.14	73.9	21.8	349.0	152	HORI
1823.500000	34.95	53.9	18.9	53.35	73.9	19.4	375.0	329	HORI
1825.500000	47.29	53.9	6.6	56.77	73.9	42.2	292.0	77	VERT
2732.500000	38.87	53.9	15.0	55.45	73.9	18.4	149.0	20	VERT
2735.500000	39.09	53.9	14.8	53.76	73.9	20.1	179.0	60	VERT
2791.500000	43.34	53.9	10.6	59.62	73.9	12.3	106.0	291	HORI
2794.500000	40.31	53.9	13.6	54.48	73.9	19.4	314.0	3	HORI
3640.500000	42.64	53.9	11.3	56.28	73.9	17.6	201.0	358	VERT
4548.500000	44.35	53.9	9.5	57.58	73.9	16.3	120.0	129	VERT
5468.500000	49.30	53.9	4.6	62.39	73.9	11.5	237.0	19	HORI
6377.500000	51.56	53.9	2.3	65.08	73.9	8.8	118.0	80	HORI
7293.000000	30.50	53.9	23.4	43.95	73.9	30.0	375.0	359	HORI
8207.000000	32.72	53.9	21.2	46.51	73.9	25.5	395.0	83	VERT
9108.500000	34.88	53.9	19.0	48.43	73.9	25.5	141.0	157	HORI

REMARKS:

1. Emission level (dB μ V/m) = Raw Value (dB μ V) + 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.

EUT	i>clicker Base	Model	TMX13
MODE	Channel CB	FREQUENCY RANGE	Above 1000MHz
INPUT POWER (SYSTEM)	5VDC via USB	ORIENTATION	Vertical/Horizontal
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3°C	TECHNICIAN	NJohnson

Frequency	Average Level	Average Limit	Average Margin	Peak Level	Peak Limit	Peak Margin	Height	Angle	Pol.
MHz	dB μ V/m	dB μ V/m	dB	dB μ V/m	dB μ V/m	dB	cm	deg	
1839.000000	48.57	53.9	5.3	63.05	73.9	10.8	249.0	29	HORI
1846.500000	43.97	53.9	9.9	61.80	73.9	12.1	279.0	4	VERT
2771.000000	39.32	53.9	14.6	61.19	73.9	12.7	150.0	56	VERT
2791.000000	43.35	53.9	10.6	59.61	73.9	14.3	100.0	358	HORI
2792.500000	44.78	53.9	9.1	61.49	73.9	12.4	100.0	303	HORI
3694.000000	42.92	53.9	11.0	56.60	73.9	17.3	250.0	359	HORI
4612.500000	44.81	53.9	9.1	58.46	73.9	15.4	249.0	98	VERT
5543.000000	50.12	53.9	3.8	63.53	73.9	10.4	375.0	15	HORI
6472.000000	51.73	53.9	2.2	65.31	73.9	8.6	249.0	0	HORI
7400.500000	31.21	53.9	22.7	44.66	73.9	29.2	327.0	203	HORI
8293.000000	32.80	53.9	21.1	46.31	73.9	27.6	375.0	287	HORI
9240.500000	34.29	53.9	19.6	47.86	73.9	26.0	350.0	3	VERT

REMARKS:

1. Emission level (dB μ V/m) = Raw Value (dB μ V) + 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.

4.4 *Bandwidth*

4.4.1 *Limits of bandwidth measurements*

The 6dB bandwidth of the signal needs to be greater than 0.5MHz

4.4.2 *Test procedures*

The transmitter output was connected directly to the spectrum analyzer. This was done by attaching a SMA port to the antenna terminals for testing purposes only. 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 it was found that this power level was equal to that with a 100kHz bandwidth. For this EUT, the 20dB bandwidth of the signal at 100kHz resolution bandwidth is used as the measurement of the 99% occupied bandwidth.

4.4.3 *Deviations from test standard*

No deviation.

4.4.4 *Test setup*



4.4.5 *EUT operating conditions*

The EUT received 5VDC power from a USB connection to a host PC and was programmed by the manufacturer to transmit continually for testing purposes only. The EUT was tested with a Dell Optiplex GX270 PC, S/N 805P441 and Dell M990 CRT 17"monitor. A mouse and keyboard were also connected to the PC.

4.4.6 Test results

EUT	i>clicker Base	MODEL	TMX13
INPUT POWER (SYSTEM)	5VDC via USB	ENVIRONMENTAL CONDITIONS	45% \pm 5% RH 20 \pm 3°C
TECHNICIAN	NJohnson	MODE	Continuous Transmit

CHANNEL	CHANNEL FREQUENCY (MHz)	6dB BANDWIDTH (kHz)	99% OCCUPIED BANDWIDTH (kHz)	MINIMUM LIMIT (MHz)	RESULT
1	903.5	798.11	2359	0.500	Pass
6	912.5	793.93	2530	0.500	Pass
11	923.0	835.32	2084	0.500	Pass

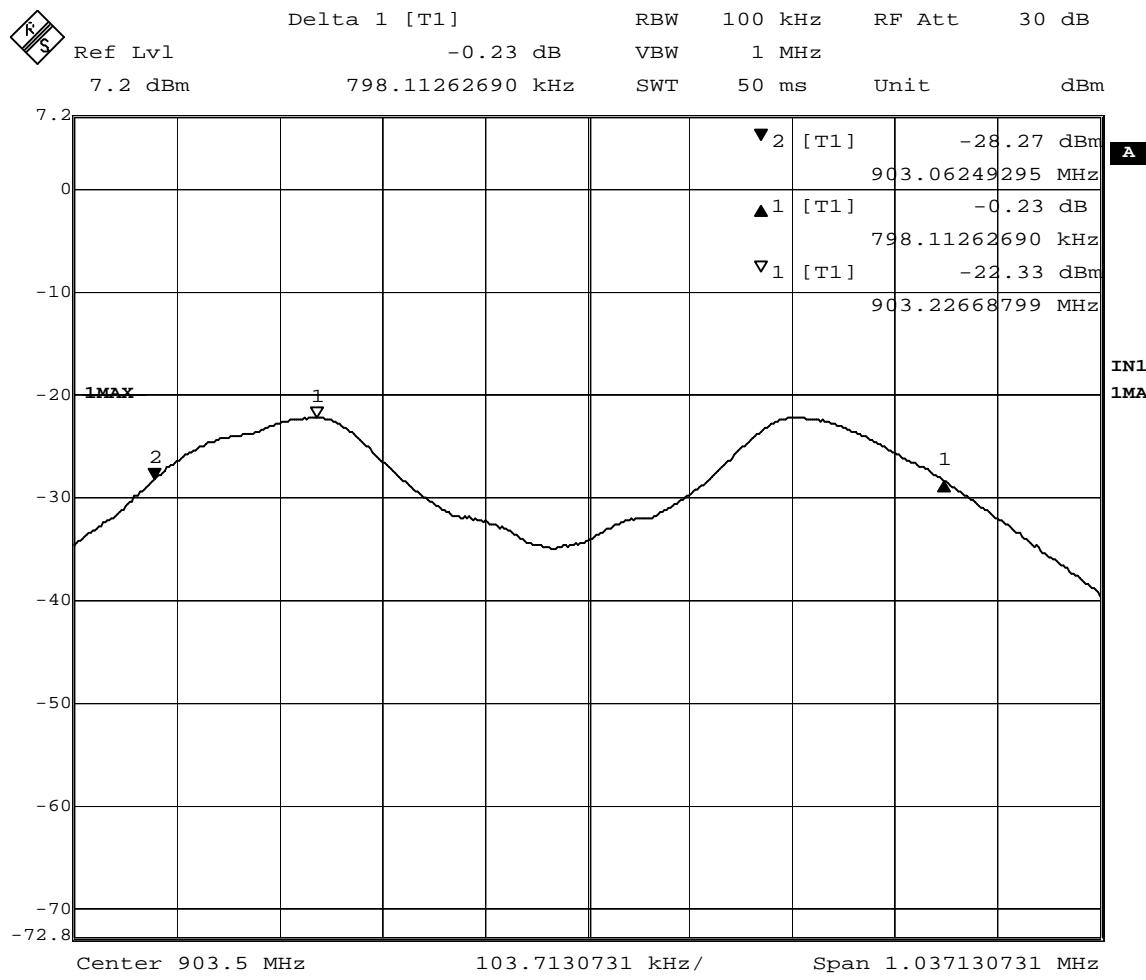
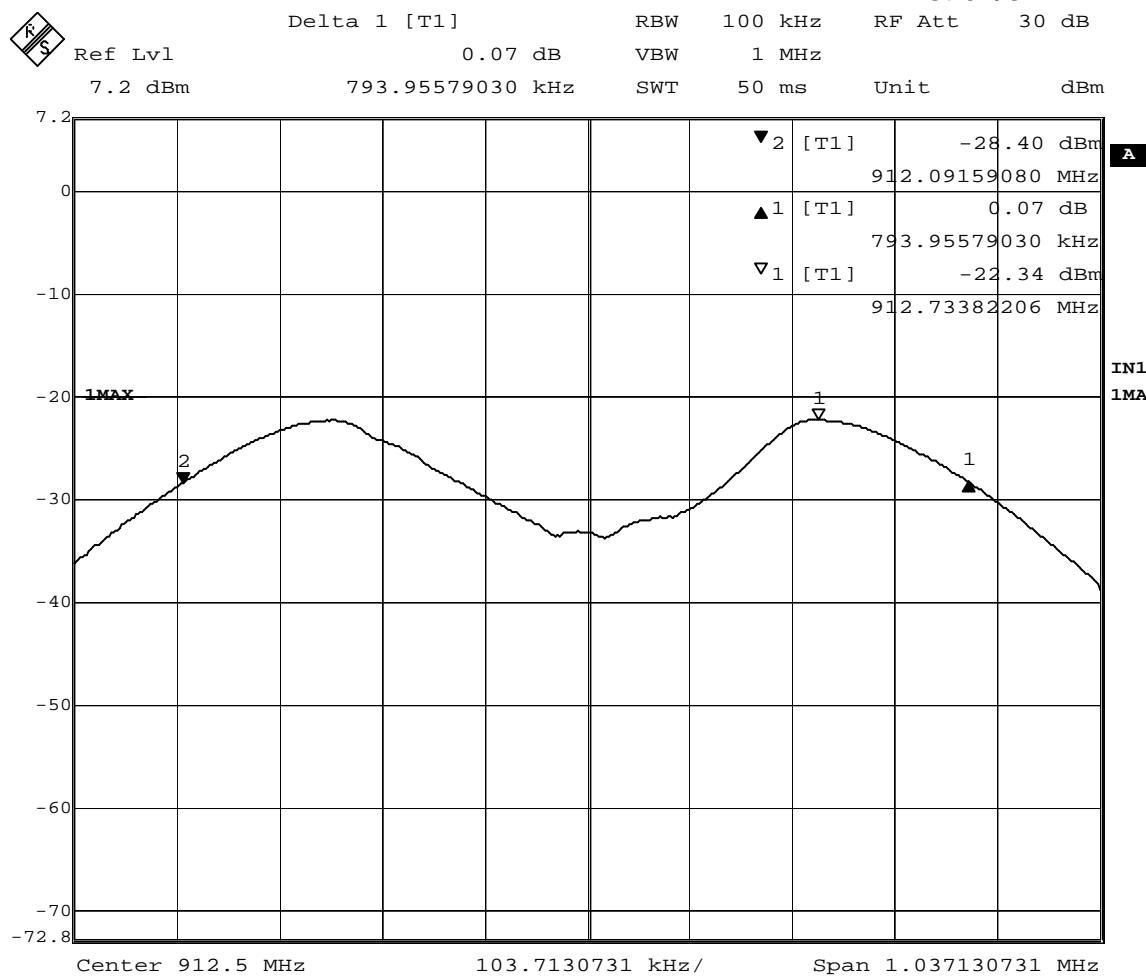


Figure 8 - 6dB Bandwidth, Channel AA, 798.11 kHz



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Figure 9 - 6dB Bandwidth, Channel BD, 793.94 kHz

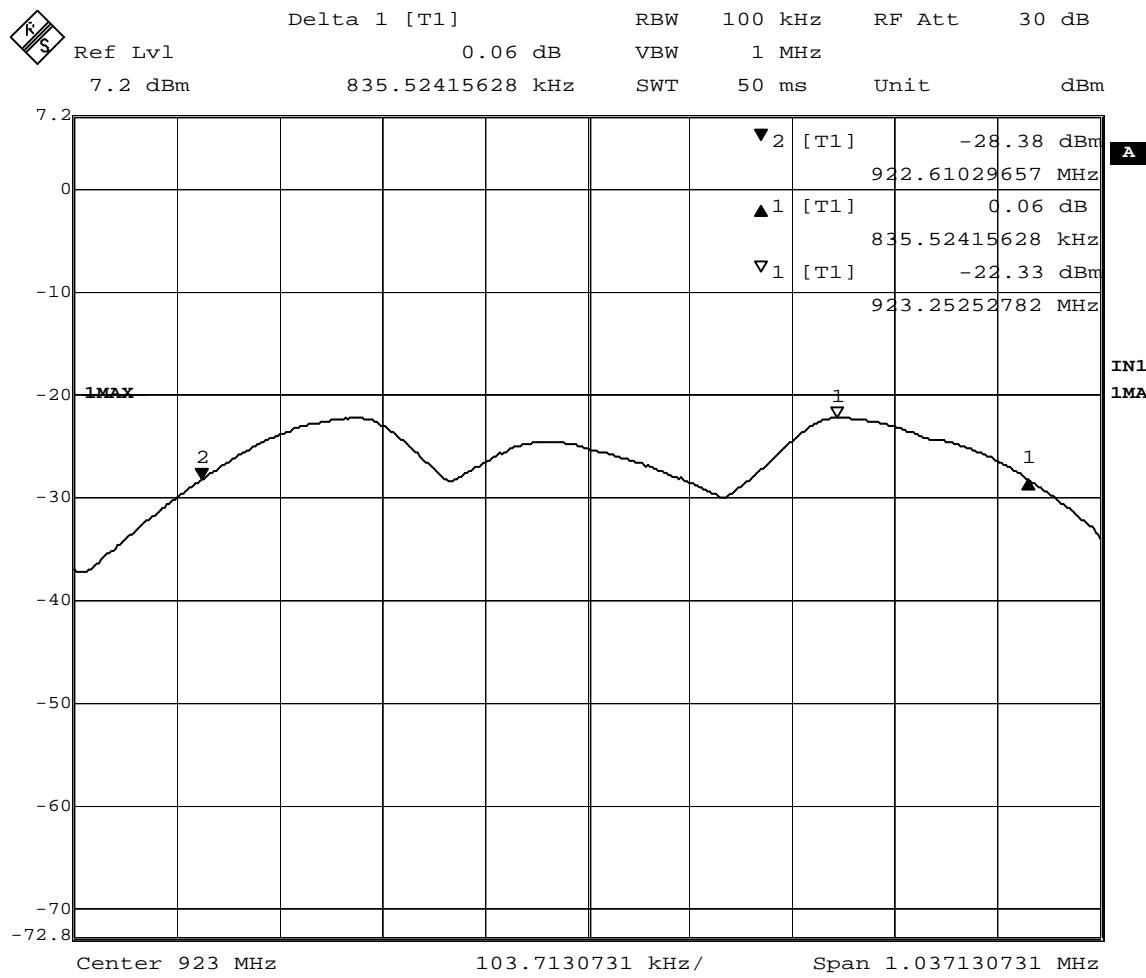


Figure 10 - 6dB Bandwidth, Channel DD, 835.32 kHz

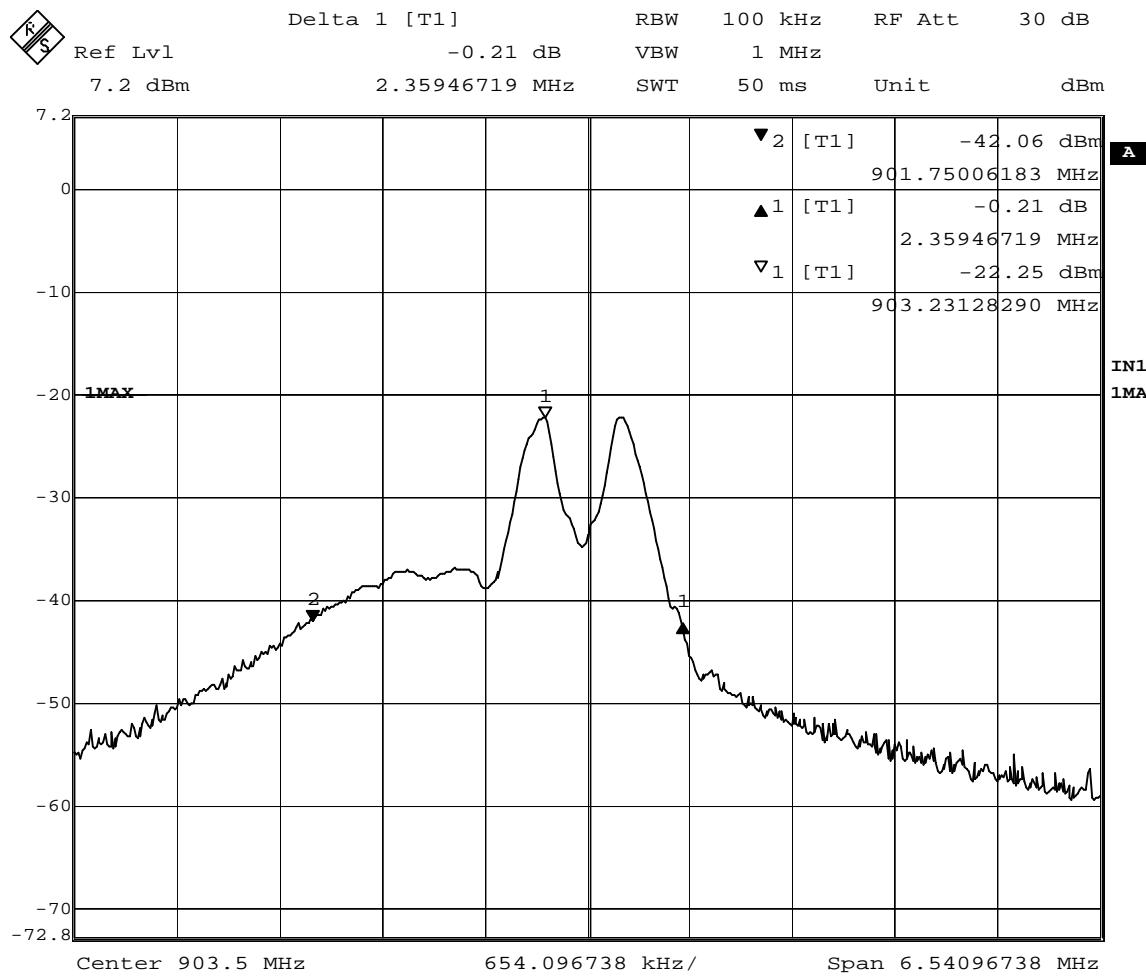
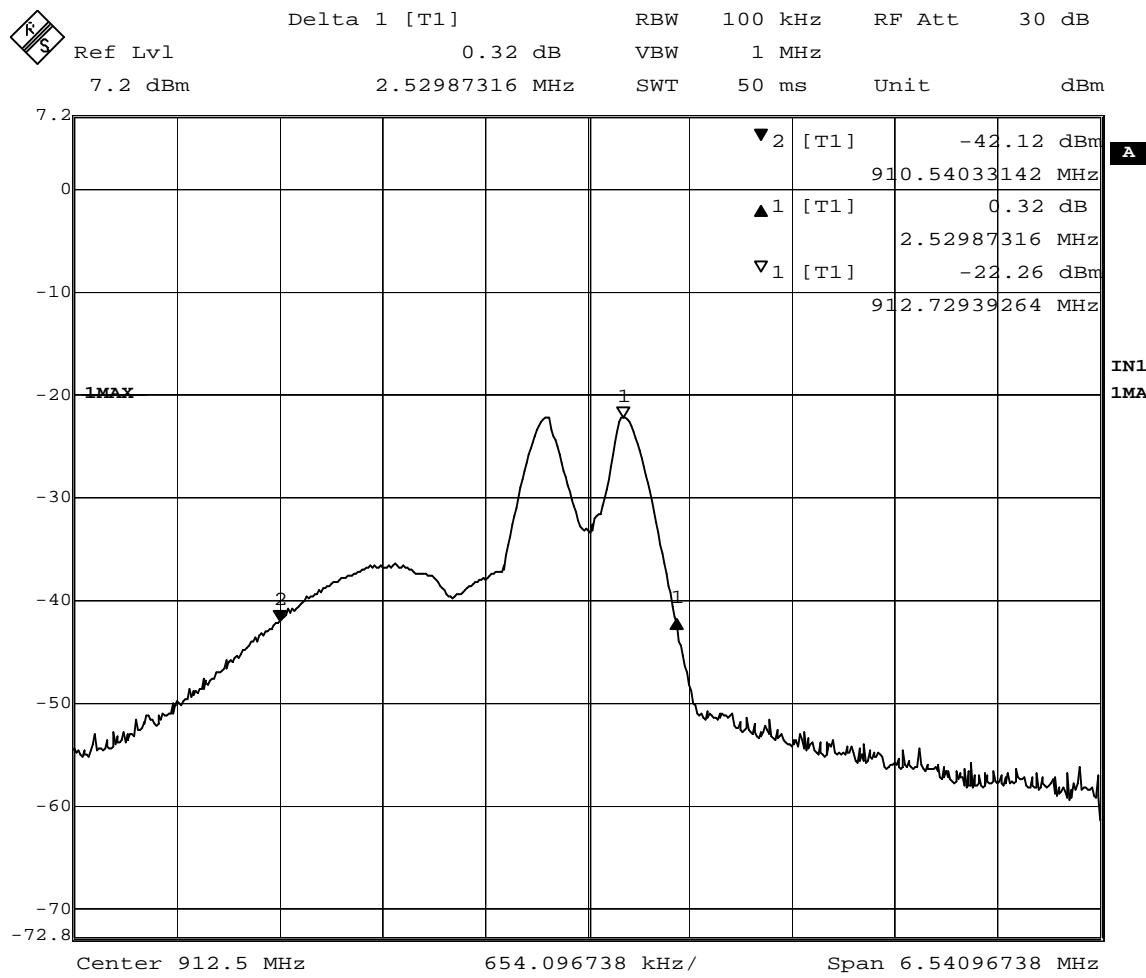


Figure 11 – 99% Occupied Bandwidth, Channel AA, 2359 kHz



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Figure 12 – 99% Occupied Bandwidth, Channel BD, 2530 kHz

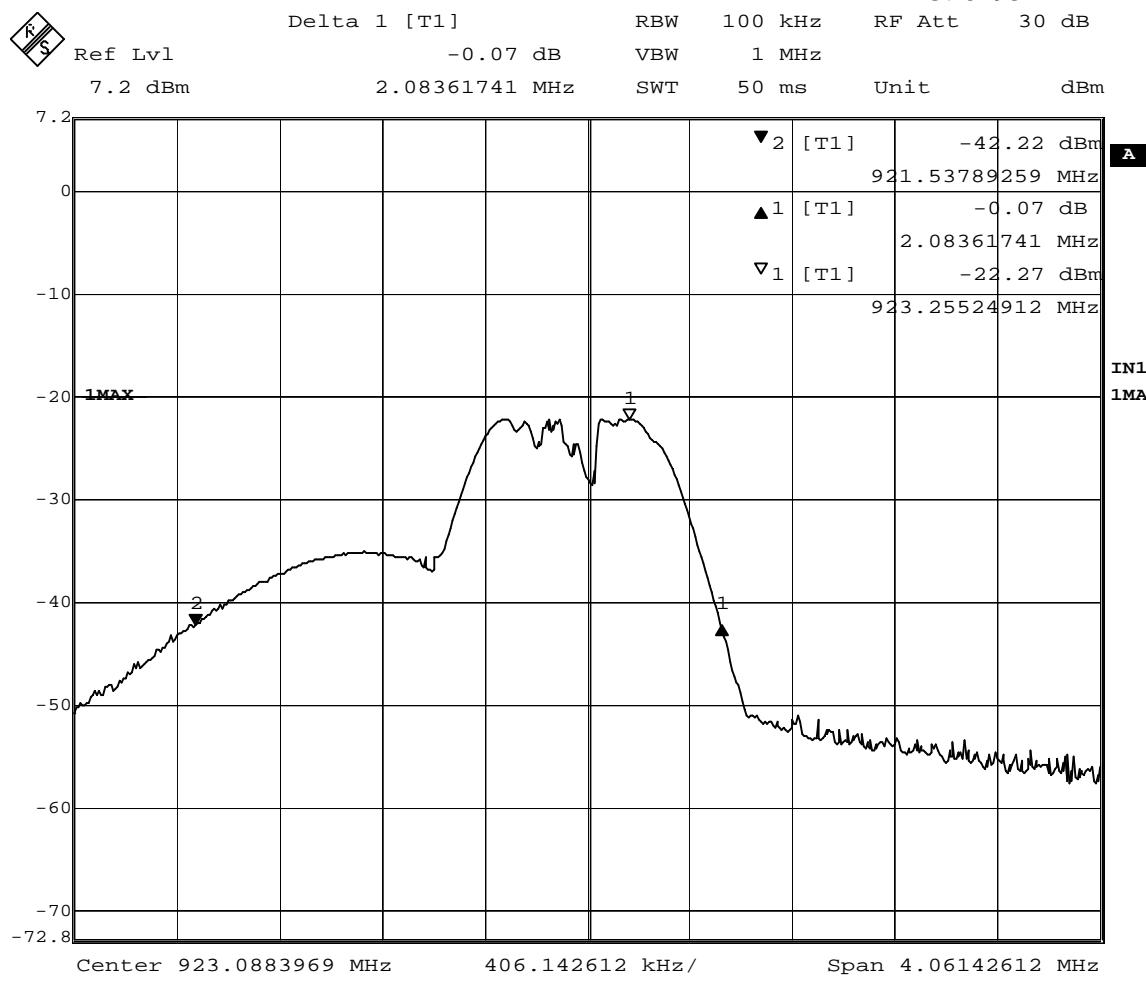


Figure 13 – 99% Occupied Bandwidth, Channel DD, 2084 kHz

4.5 Maximum peak output power

4.5.1 Limits of bandwidth measurements

The maximum peak output 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. This was done using a SMA port attached directly to the antenna terminals for testing purposes only.
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.

4.4.5 Test setup



4.5.5 EUT operating conditions

The EUT received 5VDC power from a USB connection to a host PC and was programmed by the manufacturer to transmit continually for testing purposes only. The EUT was tested with a Dell Optiplex GX270 PC, S/N 805P441 and Dell M990 CRT 17" monitor. A mouse and keyboard were also connected to the PC.

4.5.6 *Test results***Maximum peak output power**

EUT	i>clicker Base	MODEL	TMX13
INPUT POWER (SYSTEM)	5VDC via USB	ENVIRONMENTAL CONDITIONS	45% \pm 5% RH 20 \pm 3°C
TECHNICIAN	NJohnson	MODE	Continuous transmit

CHANNEL	CHANNEL FREQUENCY (MHz)	PEAK POWER OUTPUT (dBm)	PEAK POWER LIMIT (dBm)	RESULT
1	903.5	14.11	30	Pass
6	912.5	14.05	30	Pass
11	923.0	14.12	30	Pass

4.6 *Power spectral density*

4.6.1 *Limits of bandwidth measurements*

The maximum power spectral density allowed is 8dBm.

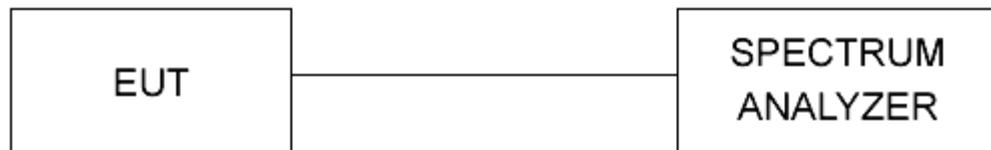
4.6.2 *Test procedures*

The transmitter output was connected to the spectrum analyzer. This was done using an SMA port attached directly to the antenna terminals for testing purposes only. 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*



4.6.5 *EUT operating conditions*

The EUT received 5VDC power from a USB connection to a host PC and was programmed by the manufacturer to transmit continually for testing purposes only. The EUT was tested with a Dell Optiplex GX270 PC, S/N 805P441 and Dell M990 CRT 17" monitor. A mouse and keyboard were also connected to the PC.

4.6.6 *Test results***Power Spectral Density**

EUT	i>clicker Base	MODEL	TMX13
INPUT POWER (SYSTEM)	5VDC via USB	ENVIRONMENTAL CONDITIONS	45% \pm 5% RH 20 \pm 3°C
TECHNICIAN	NJohnson	MODE	Continuous transmit

CHANNEL	CHANNEL FREQUENCY (MHz)	RF POWER LEVEL IN # KHz BW (dBm)	MAXIMUM POWER LIMIT (dBm)	RESULT
DA	903.5	2.10	8	Pass
AC	912.5	1.16	8	Pass
CB	923.0	2.80	8	Pass

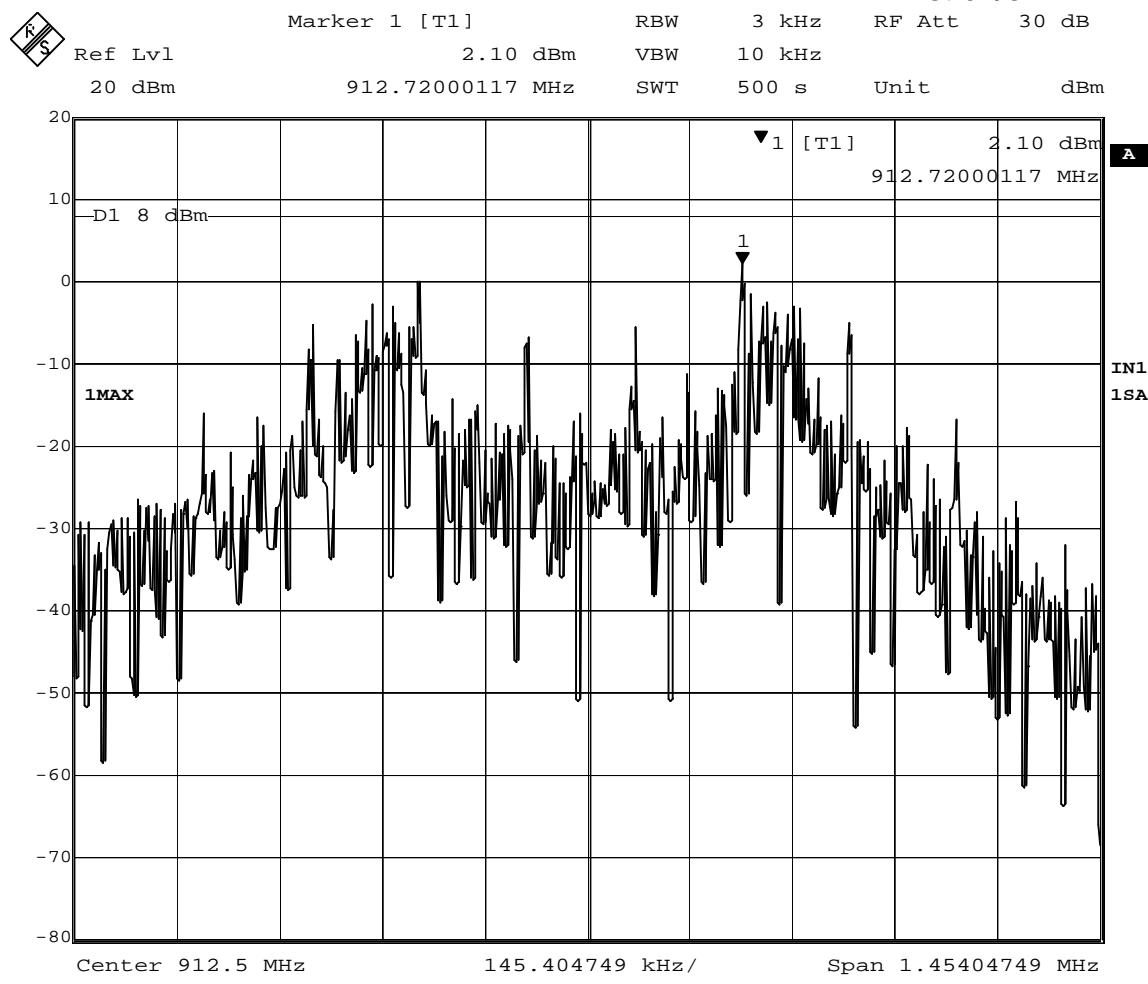


Figure 14 - PSD, Channel AA, 2.10dBm

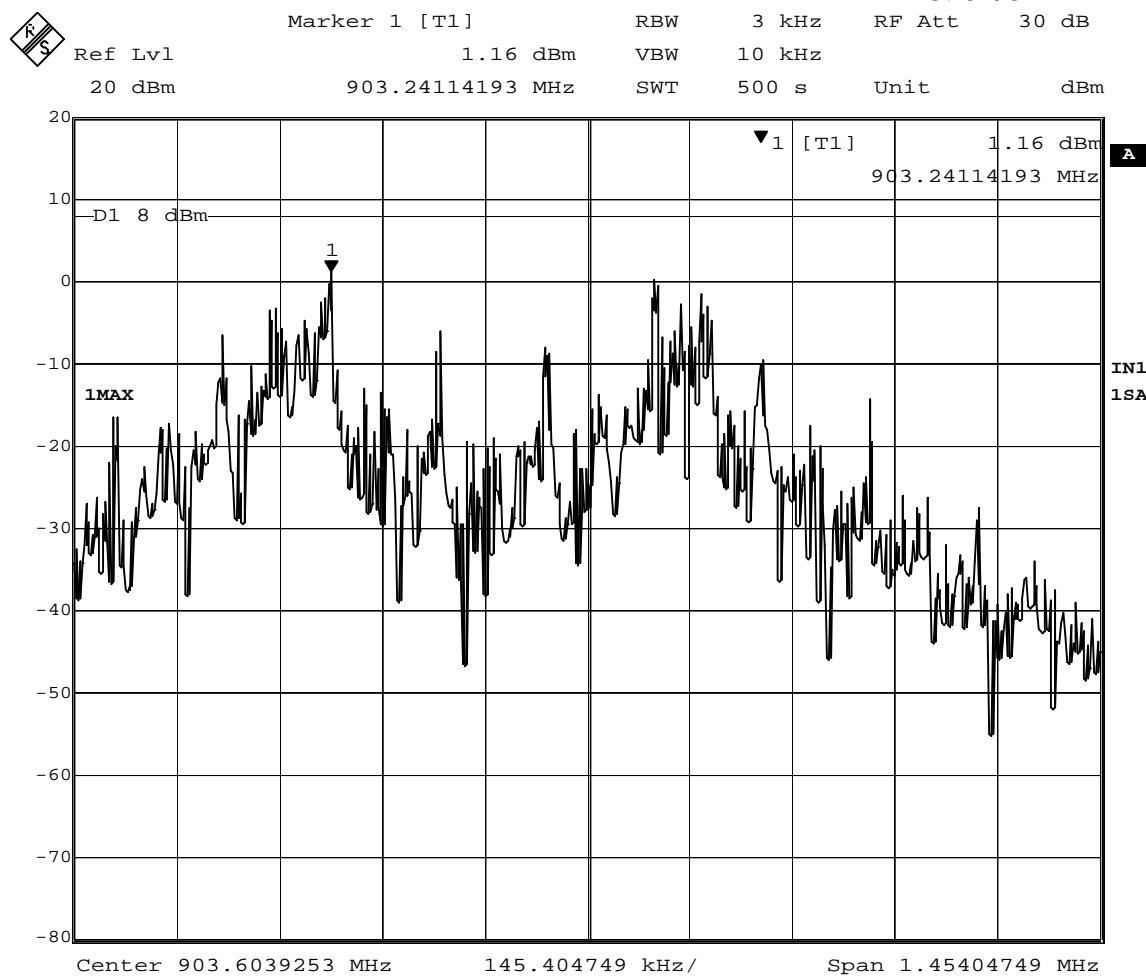


Figure 15 - PSD, Channel BD, 1.16dBm

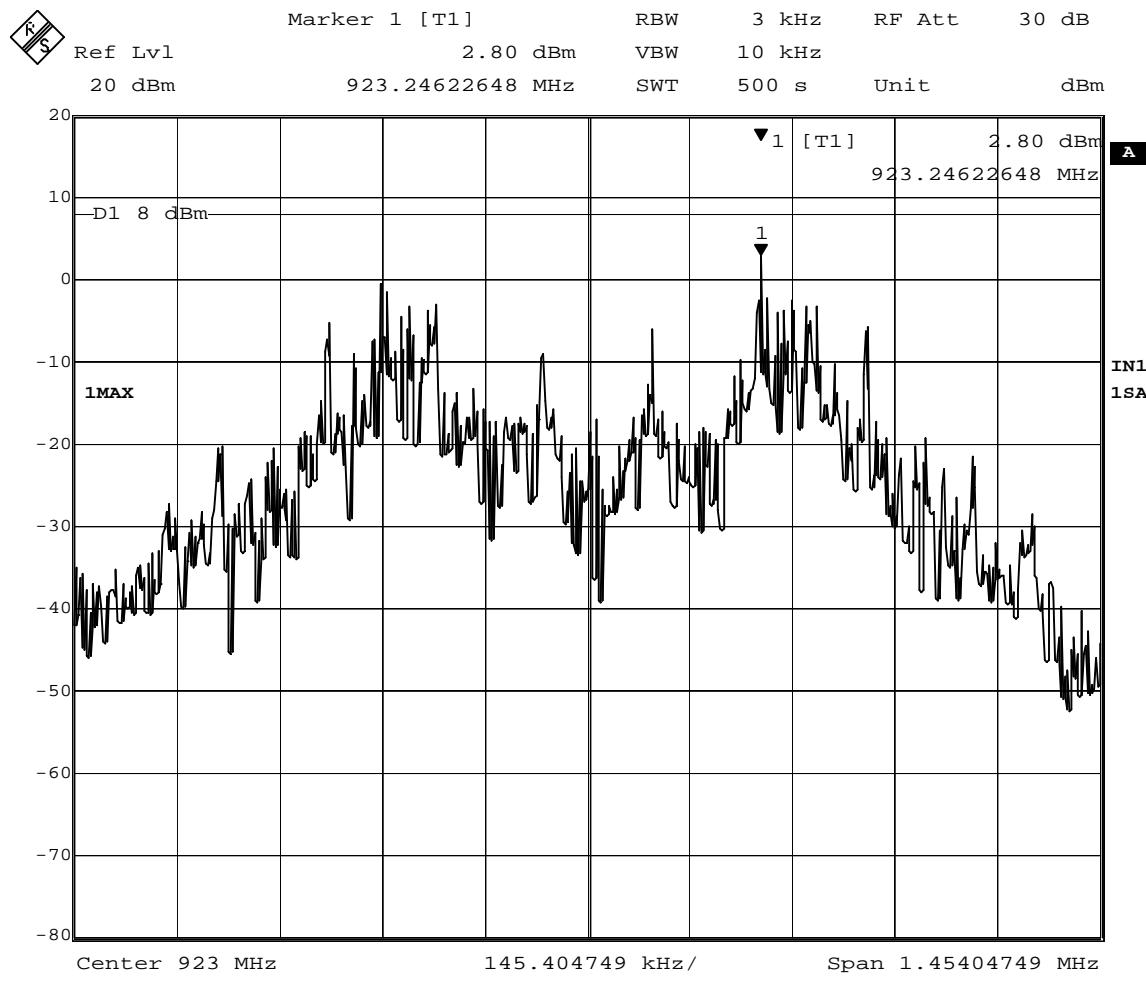


Figure 16 - PSD, Channel DD, 2.80dBm

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.

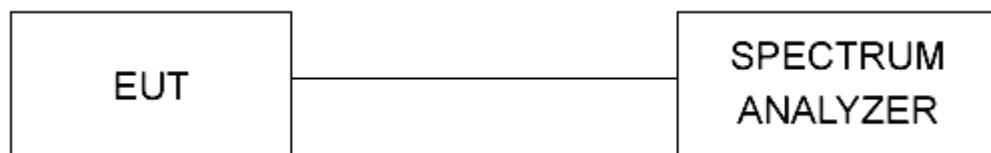
4.7.2 *Test procedures*

The 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 120kHz and the EMI receiver was used to scan from the bandedge to the fundamental frequency with a quasi-peak detector. The highest emissions level beyond the bandedge was measured and recorded. 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 received 5VDC power from a USB connection to a host PC and was programmed by the manufacturer to transmit continually for testing purposes only. The EUT was tested with a Dell Optiplex GX270 PC, S/N 805P441 and Dell M990 CRT 17"monitor. A mouse and keyboard were also connected to the PC.

4.7.6 *Test results*

EUT	i>clicker Base	MODEL	TMX13
INPUT POWER (SYSTEM)	5VDC via USB	ENVIRONMENTAL CONDITIONS	45% \pm 5% RH 20 \pm 3°C
TECHNICIAN	NJohnson	MODE	Continuous transmit

Highest Out of Band Emissions

CHANNEL	Bandedge/Measurement Frequency (MHz)	QP Level (dB μ V/m)	Fund. QP Level	Delta
DA	902 MHz	68.15	101.06	32.91
CB	928 MHz	67.20	99.67	32.47

The spectrum plots can be seen in Figures 11 and 12 on the following page. The lowest frequency channel, channel DA, was tested at the low end of the frequency band (902MHz) and the highest channel, channel CB, was tested at the upper end of the frequency band (928MHz). The quasi-peak measurements are shown in the plots and markers were placed on the fundamental frequency emission, the band edge frequency. The markers reflect the quasi-peak measurements.

NOTE:

The plots show corrected measurements. All values listed include all transducer and cable loss factors and reflect actual field strength levels.

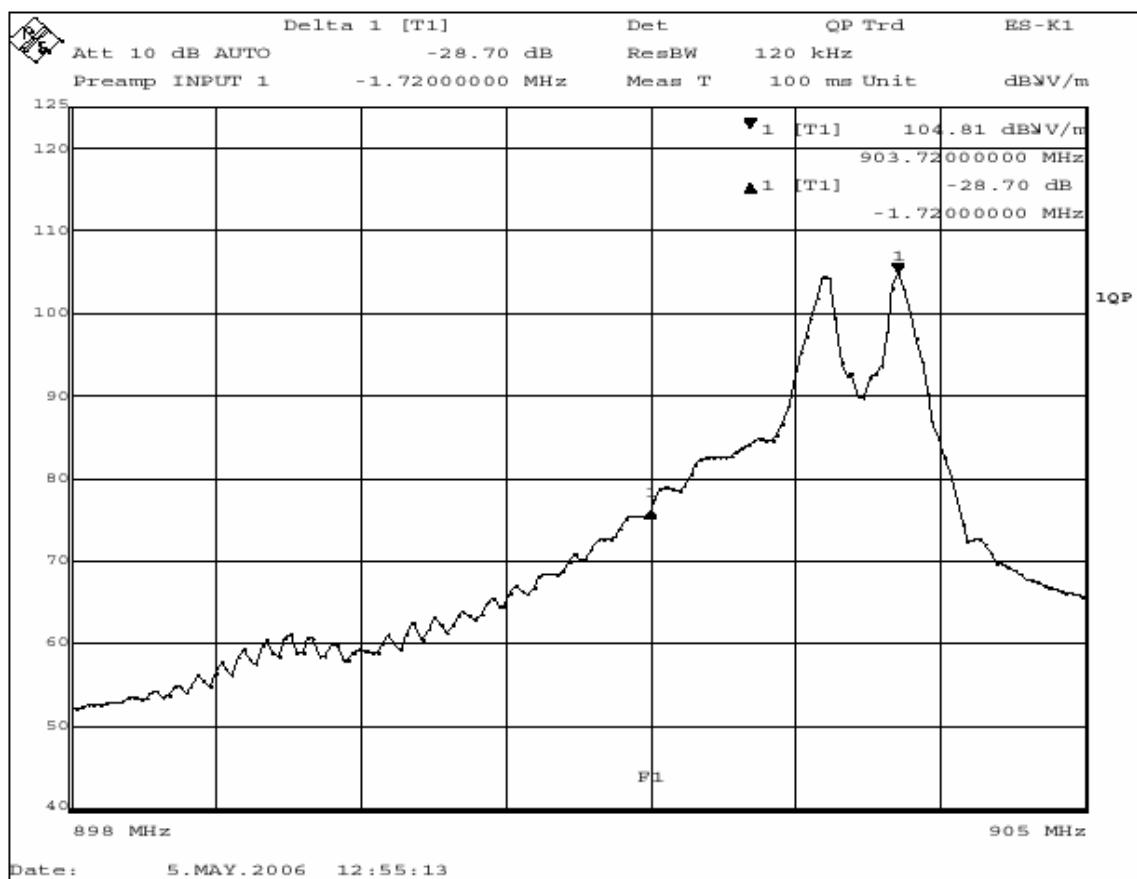


Figure 17 - Bandedge Measurements, Channel AA, 28.70 Delta

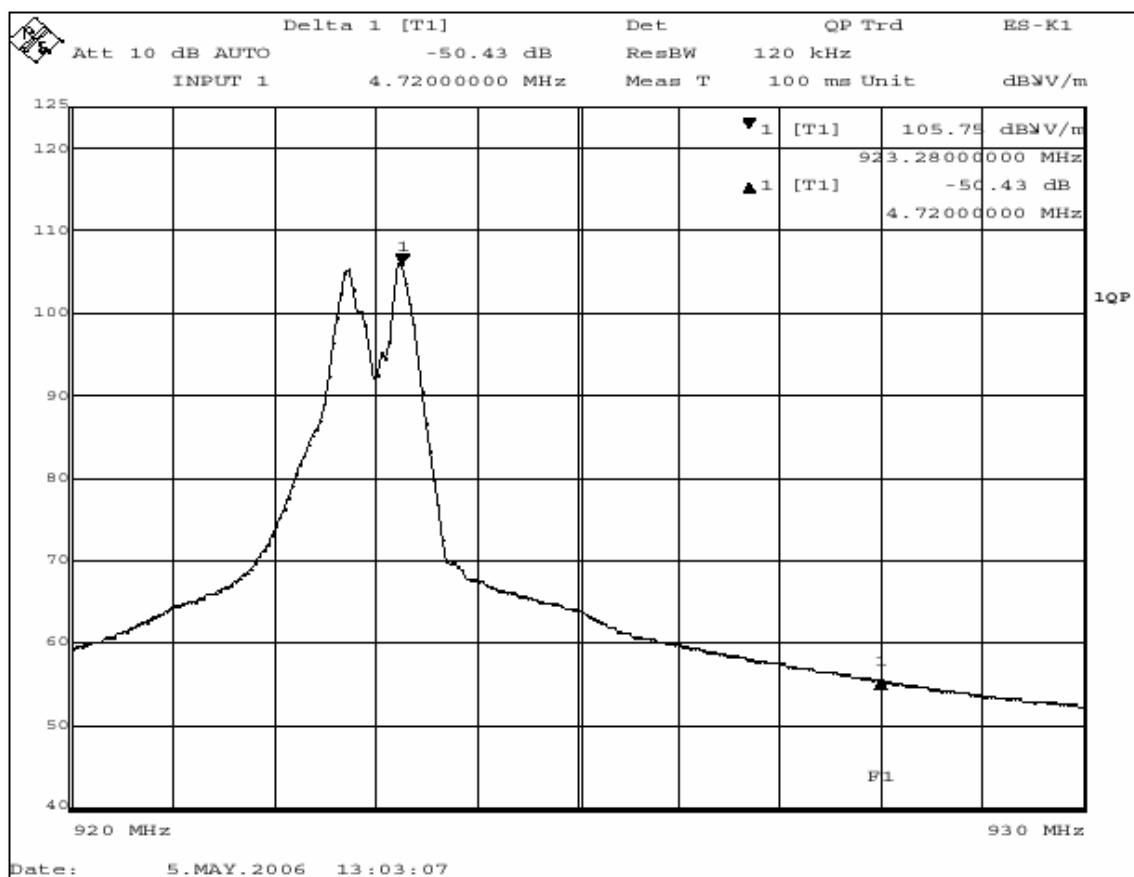


Figure 18 - Bandedge Measurements, Channel DD, -50.43 Delta

Appendix A: Test Photos



Figure 19 - Radiated Emissions Test Setup



Figure 20 - Radiated Emissions Test Setup



Figure 21 - Conducted Emissions Test Setup

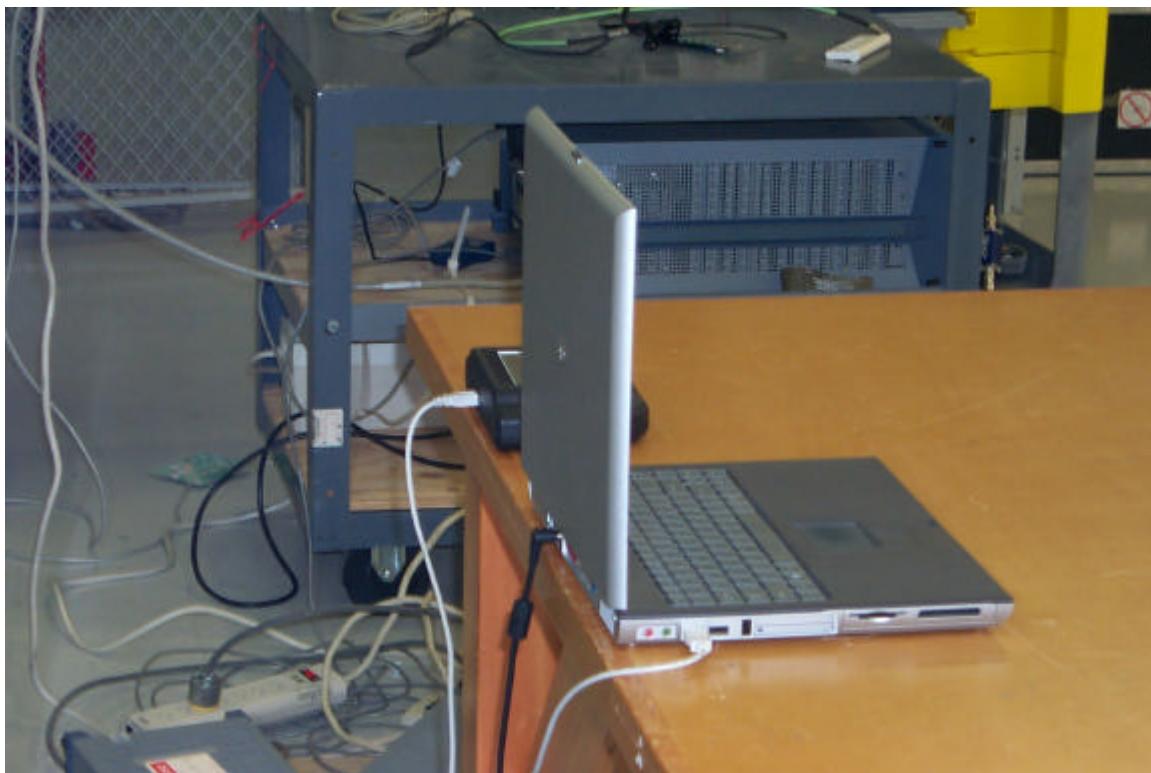


Figure 22 - Conducted Emissions Test Setup

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.

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

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

Appendix C: RF Exposure Evaluation

FCC ID: T24-TMX13**RF Exposure Statement for i>clicker base unit:****Notice in Installation Manual:**

FCC Radiation Exposure Statement

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 2.33cm (0.92 inches) between the radiator and your body.

RF Exposure Calculations:

The following information provides the minimum separation distances for the two major antenna types used in this system.

Directional Antenna:

The 3 dBi antenna is the maximum gain antenna certified for use with the product. The minimum separation distance is calculated from **FCC OET 65 Appendix B, Table 1B** Guidelines for General Population/Uncontrolled Exposure. This calculation is based on the highest EIRP possible from the system, considering maximum power and antenna gain. The exposure limit for a transmitter operating at 905.5MHz is found in mW/cm² using the equations f/1200. Since the operating frequency in channel DA produced the lowest limit, that limit will be used in calculation. (905.5/1200 = 0.75mW/cm²)

$$S = (Po * G) / (4 * Pi * r^2) \text{ or } r = \text{SQRT} [(Po * G) / (4 * Pi * S)]$$

Where S = 0.75 mW/cm² for 905.5 MHz

Where Po = 25.82 mW (Peak RF, 14.12dBm)

Where G = 1.99 (numeric equivalent to 3 dBi antenna gain with 0.0 dB cable loss)

Where r = Minimum Safe Distance from antenna (cm)

For Po = 25.82mW, r = 2.33 cm (0.92 inches)

For a distance [r] of 20cm from this antenna, the field density S = 0.010 mW/cm²

Notes:

1. The minimum safe distance is based on a conservative “worse case” prediction, i.e. using the formula shown above and no duty factor. In practice the minimum distance will be much shorter. (Ref. 2)
2. The minimum safe distance has been calculated for the maximum allowed Power Density (S) limit of 0.75 mW/cm² for the frequency 905.5 MHz for uncontrolled environments (Ref. 2).

References:

1. FCC Part 15, sub-clause 15.247 (b) (4) (i)
2. FCC OET Bulletin 65, Edition 97-01
3. FCC Supplement C to OET Bulletin 65, edition 01-01

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