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

Amended FCC Test Report

(Containing R073108-02-01C)

Company:	Worth Data 623 Swift St. Santa Cruz, CA 95060
Contact:	Steve Luzovich
Product:	7000 Series RF Terminal
FCC ID: IC ID:	JWSLT7001 4724A-LT7001
Test Report No:	R073108-02-01D
APPROVED BY:	Nic Johnson Test Engineer
DATE:	12 March 2008
Total Pages:	45

Test Laboratory Certificate 1953.01

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 RSS-Gen	Unique Antenna Requirement	Pass	Permanently attached antenna
15.207 RSS-Gen	Conducted Emissions	Pass	Meets the requirement of the limit.
15.209 RSS-Gen	Radiated Emissions	Pass	Meets the requirement of the limit.
15.247(a)(1) RSS-210 Issue 7	Minimum Bandwidth, Limit: Max. 500kHz Limit Min. 250kHz	Pass	Meets the requirement of the limit.
15.247(b) RSS-210 Issue 7	Maximum Peak Output Power, Limit: Max. 23.9dBm	Pass	Meets the requirement of the limit.
15.247(c) RSS-210 Issue 7	Transmitter Radiated Emissions, Limit: Table 15.209	Pass	Meets the requirement of the limit.
15.247(c) RSS-210 Issue 7	Band Edge Measurement, Limit: 20dB less than the peak value of fundamental frequency	Pass	Meets the requirement of the limit.
15.247(a) RSS-210 Issue 7	Number of hopping channels	Pass	Meets the requirement from the standard.
15.247(a) RSS-210 Issue 7	Frequency hopping channel spacing	Pass	Meets the requirement from the standard.

1.2 Test Methods

1.2.1 Conducted AC Emissions

The EUT was battery powered and had to provisions for connection to the AC mains network. Conducted emissions are therefore not applicable according to FCC Part 15.207.

1.2.2 Radiated Emissions

Compliance to 47 CFR Parts 15.209 and 15.247 was tested in accordance with the methods of ANSI/IEEE C63.4: 2003 and FCC Public Notice DA 00-705, March 30, 2000. 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 in all three axis. 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 15.247 measurements of the fundamental frequency in the 902MHz to 928MHz band and subsequent harmonics.

2.0 Description

2.1 Equipment under test

EUT Received Date: 22 September 2008
EUT Tested Dates: 22 - 24, 29 September 2008
Conducted Emissions Test: 5 March 2009
*Conducted emissions test was performed later than others due to comments from TCB review which were received later that original testing. The same unit was used for all tests.

22, 23 January 2009: (RF emissions from 1GHz to 10GHz, peak power and bandwidth).

PRODUCT	7000 Series RF Terminal
POWER SUPPLY	3.7V Li-ion rechargeable battery
MODULATION TYPE	QFSK
RADIO TECHNOLOGY	Half-duplex RF Link
TRANSFER RATE	152.34 kb/sec maximum data rate
FREQUENCY RANGE	902.971 – 926.277MHz
NUMBER OF CHANNELS	32
MAX OUTPUT POWER	22.51dBm (178.23mW) The EUT has no provisions for changing the power output.
ANTENNA TYPE	Whip
DATA CABLE	Serial, USB, Ethernet
ASSOCIATED DEVICES	B5001, BS5002 Base Station

NOTE:
1. For more detailed features description, please refer to the manufacturer's specifications or User's Manual.

The unit comes in 6 different configurations:

USA and Canada models: T7001, LT7001, LT7001H
USA only models: T7002, LT7002, LT7002H

The "L" is for models that have the internal laser bar code scanner.
The "H" is for models that have the "gun" handle.
The "xx2" models have the Bluetooth radio installed (only included in USA models).

The unit tested was an LT7001H; this USA only model includes a Bluetooth radio with FCC ID POOWML-C46. The Bluetooth radio has been certified for modular approval and includes an integrated antenna. No testing was done

relating to the transmitting functionality of this radio. The spectrum was examined for evidence of intermodulation products; no products were observed.

2.2 Laboratory description

All testing was performed at the NCEE Lincoln facility. Laboratory environmental conditions varied slightly throughout the tests:

Relative humidity of 45 ± 4%
Temperature of 20 ± 3° Celsius

2.3 Description of test modes

The EUT was tested at the frequencies below:

Channel	Frequency
1	902.971
16	915.000
32	926.277

2.4 Applied standards

The EUT uses digital modulation and operates between 902 MHz and 928 MHz. It has no AC mains connection. According to the specifications of the manufacturer, it must comply with the requirements of the following standards:

FCC Part 15, Subpart C (15.247)
FCC Part 15, Subpart C (15.209)
RSS-210, Issue 7
RSS-GEN

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

2.5 Description of support units

None

2.6 Configuration of system under test

This EUT was set to transmit in a worse-case scenario with modulation on. The manufacturer modified the unit to transmit continuously on a selected frequency. The EUT was tested with a handle and trigger attached and without. The configuration with the handle attached was found to produce the highest emissions results and these results are recorded in this report.

All data in this test report was measured using EUT firmware modified to allow continuous transmission. In normal operation, the unit is only capable of transmitting every 500ms, with a pulse length of 40ms. This is a function of the EUT firmware and cannot be changed by the user, limiting the duty cycle to a maximum of 8%.

3.0 Test equipment used

DESCRIPTION AND MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CALIBRATION DATE
Rohde & Schwarz Test Receiver	ESIB26	100037	9 June 2008
EMCO Biconilog Antenna	3142B	1647	8 Feb 2008
EMCO Horn Antenna	3115	6416	5 Feb 2008
Rohde & Schwarz LISN	ESH3-Z5	100023	6 Feb 2008
Hewlett Packard Power Meter	4378	100307	20 Jan 2009
Hewlett Packard Power Sensor	8481A	2702A63981	20 Jan 2009
Rohde & Schwarz Preamp*	TS-PR18	082001/003	6 Dec 2008
Trilithic High Pass Filter*	6HC330	23042	6 Dec 2008

*Used for radiated measurements above 3GHz

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 is permanently attached to the EUT and not 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 (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 (μV/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.

4.2.2 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 and video bandwidth of test receiver/spectrum analyzer is 1 MHz for peak and average measurements at frequencies above 1GHz. The video bandwidth for peak measurements was 3MHz and 10Hz for average measurements

4.2.3 Deviations from test standard

No deviation.

4.2.4 Test setup

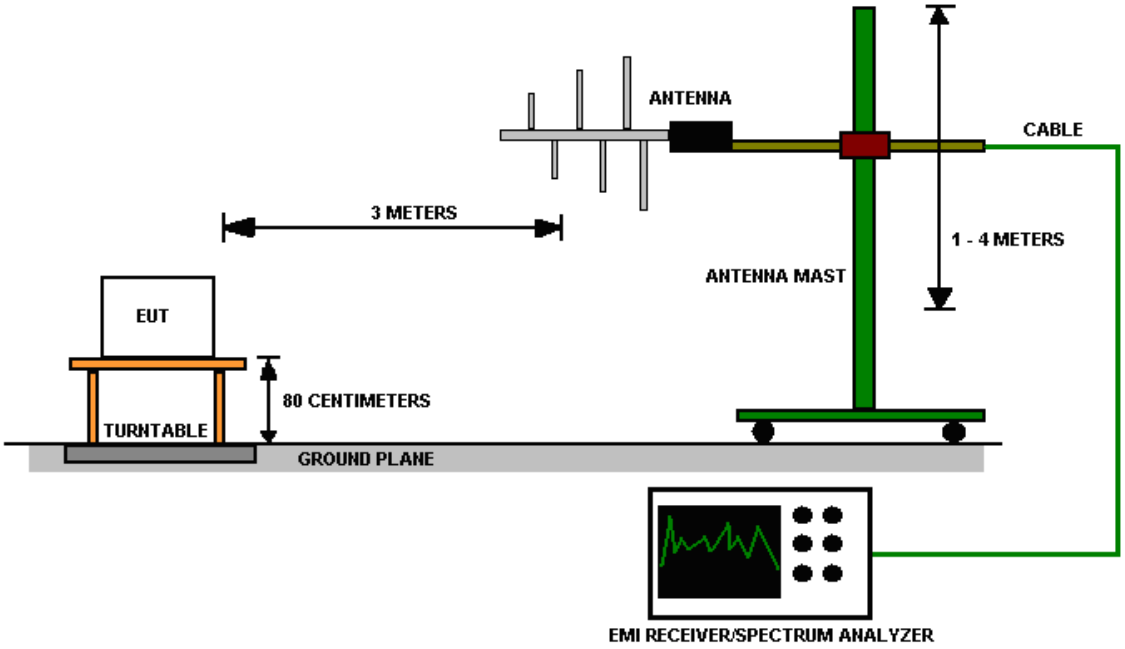


Figure 1 - Radiated Emissions Test Setup

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 3.7VDC battery and set to transmit continuously on the lowest frequency channel, highest frequency channel and one in the middle of its operating range.

4.2.6 Test results

EUT	7001 RF Terminal	MODE	Channel 1, Transmit
INPUT POWER	3.7VDC, Internal Battery	FREQUENCY RANGE	30MHz – 1GHz
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.	
139.98	27.12	44.00	16.9	103	145	VERT
210.00	28.26	44.00	15.7	150	234	HORI
300.00	31.9	46.00	14.1	100	229	HORI
420.00	32.23	46.00	13.8	188	67	HORI
871.98	47.33	101.43**	54.1	100	359	HORI
878.10	26.91	46.00	19.1	114	0	HORI
902.94	120.92	NA*	NA*	106	226	HORI
903.00	121.43	NA*	NA*	106	229	HORI
917.76	48.56	NA*	NA*	100	227	HORI
921.54	47.82	NA*	NA*	100	0	HORI
927.84	27.45	46.00	18.6	100	0	HORI
933.96	27.31	46.00	18.7	150	2	HORI
946.38	30.56	46.00	15.4	106	0	HORI

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 do not apply within the 902MHz to 928MHz band.
6. ** Radiated emissions outside of the 902MHz to 928MHz band must be at least 20dB below the highest emission

EUT	7001 RF Terminal	MODE	Channel 16, Transmit
INPUT POWER	3.7VDC, Internal Battery	FREQUENCY RANGE	30MHz – 1GHz
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.	
102.66	25.60	44.00	18.4	350	219	VERT
139.98	23.54	44.00	20.5	100	358	VERT
210.00	28.43	44.00	15.6	150	30	HORI
300.00	28.30	46.00	17.7	100	33	HORI
420.00	27.25	46.00	18.7	149	229	HORI
883.92	32.70	46.00	13.3	100	39	HORI
890.22	35.39	46.00	10.6	100	38	HORI
914.94	119.88	NA*	NA*	100	179	HORI
929.70	44.07	46.00	1.9	150	64	HORI
933.60	37.29	46.00	8.7	100	34	HORI

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 do not apply within the 902MHz to 928MHz band.
6. ** Radiated emissions outside of the 902MHz to 928MHz band must be at least 20dB below the highest emission

EUT	7001 RF Terminal	MODE	Channel 32, Transmit
INPUT POWER	3.7VDC, Internal Battery	FREQUENCY RANGE	30MHz – 1GHz
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.	
102.72	24.96	44.00	19	285	188	VERT
140.04	27.83	44.00	16.2	98	359	VERT
180.00	20.57	44.00	23.4	103	134	VERT
210.00	28.33	44.00	15.7	149	31	HORI
300.00	28.15	46.00	17.8	100	32	HORI
420.06	27.58	46.00	18.4	150	236	HORI
901.38	41.49	46.00	4.5	100	36	HORI
911.58	40.05	46.00	5.9	100	48	HORI
926.22	117.93	NA*	NA*	100	72	HORI
940.98	49.21	97.93**	48.02	100	35	HORI

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 do not apply within the 902MHz to 928MHz band.
6. **All emissions outside of the 902MHZ to 928MHZ bands are required to be 20dB below the highest emission

EUT	7001 RF Terminal	MODE	Receive
INPUT POWER	3.7VDC, Internal Battery	FREQUENCY RANGE	30MHz – 1GHz
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.	
102.66	20.67	44.00	23.33	191	345	VERT
140.04	23.28	44.00	20.72	100	359	VERT
180.00	18.52	44.00	25.48	147	159	VERT
210.00	28.13	44.00	15.87	150	28	HORI
420.00	31.44	46.00	14.56	99	233	HORI
880.08	31.19	46.00	14.81	100	98	HORI

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 do not apply within the 902MHz to 928MHz band.
6. ** Radiated emissions outside of the 902MHz to 928MHz band must be at least 20dB below the highest emission

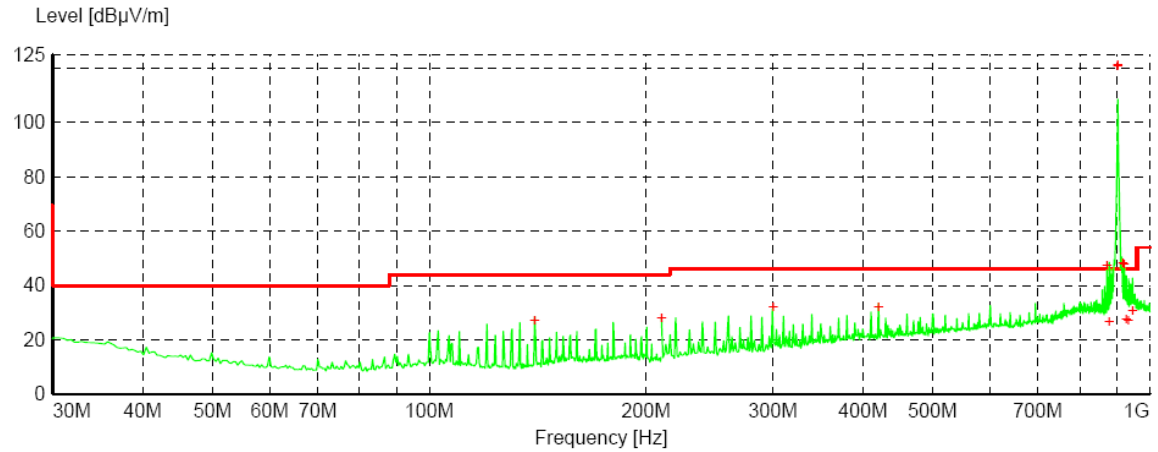


Figure 2 - Radiated Emissions Plot, channel 1

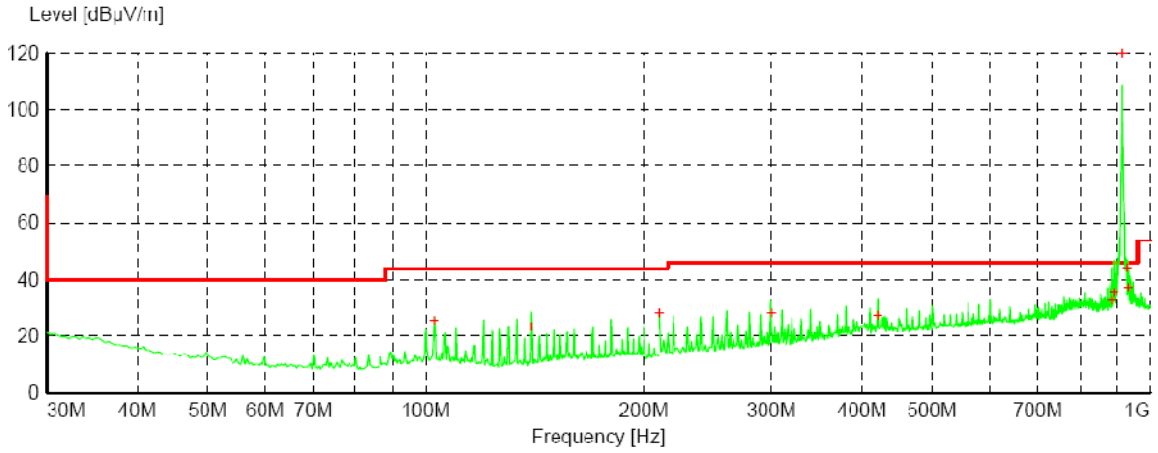


Figure 3 - Radiated Emissions Plot, Channel 16

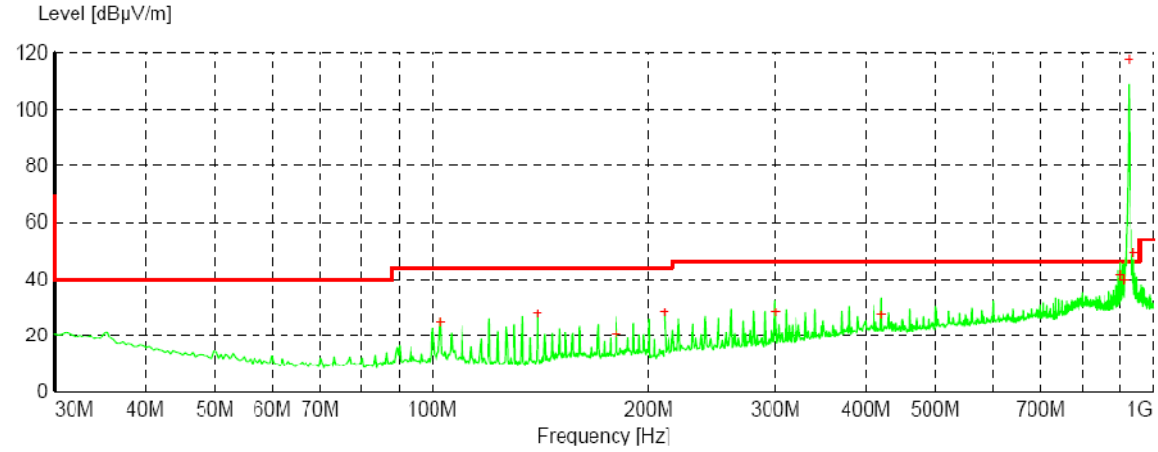


Figure 4 - Radiated Emissions Plot, Channel 32

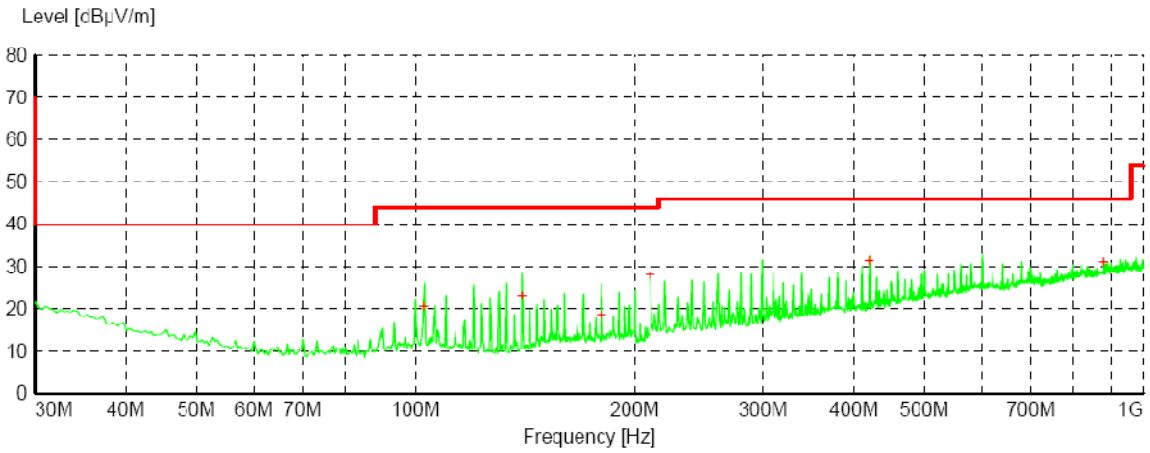


Figure 5 - Radiated Emissions plot, Receive Mode

EUT	7001 RF Terminal	MODE	Channel 1
INPUT POWER	3.7VDC, Internal Battery	FREQUENCY RANGE	1GHz – 10GHz
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

Frequency	Level	Limit	Margin	Height	Angle	Pol.
MHz	dBµV/m	dBµV/m	dB	Cm	Deg.	
Average						
1806.0	70.94	101.43**	30.49	100	115	HORI
2709.0	50.64	54.00	3.36	150	198	HORI
3612.0	50.27	54.00	3.73	119	2	HORI
5417.5	51.26	54.00	2.74	100	356	VERT
Peak						
1806.0	74.05	101.43**	27.38	100	115	HORI
2709.0	56.81	74.00	17.19	150	198	HORI
3612.0	59.42	74.00	14.58	119	2	HORI
5417.5	63.12	74.00	10.88	100	356	VERT

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. **All emissions outside of the 902MHZ to 928MHZ bands are required to be 20dB below the highest emission if they are not in a restricted band.

EUT	7001 RF Terminal	MODE	Channel 16
INPUT POWER	3.7VDC, Internal Battery	FREQUENCY RANGE	1GHz – 10GHz
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	Njohnson

Frequency	Level	Limit	Margin	Height	Angle	Pol.
MHz	dBµV/m	dBµV/m	dB	Cm	Deg.	
Average						
1830.0	70.23	99.88**	29.65	99	92	HORI
2745.0	50.23	54.00	3.77	150	151	HORI
3660.0	51.36	54.00	2.64	126	305	HORI
5490.5	52.81	54.00	1.19	100	41	VERT
Peak						
1830.0	76.20	99.88**	23.68	99	92	HORI
2745.0	54.61	74.00	13.39	150	151	HORI
3660.0	57.12	74.00	16.88	126	305	HORI
5490.5	66.66	74.00	7.34	100	41	VERT

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. **All emissions outside of the 902MHZ to 928MHZ bands are required to be 20dB below the highest emission if they are not in a restricted band.

EUT	7001 RF Terminal	MODE	Channel 32
INPUT POWER	3.7VDC, Internal Battery	FREQUENCY RANGE	1GHz – 10GHz
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

Frequency	Level	Limit	Margin	Height	Angle	Pol.
MHz	dBµV/m	dBµV/m	dB	Cm	Deg.	
Average						
1852.5	69.88	97.93**	28.05	145	122	HORI
2779.0	50.03	54.00	3.97	147	114	HORI
3705.0	51.58	54.00	2.42	113	301	HORI
5558.0	57.97	97.93**	39.96	100	311	HORI
Peak						
1852.5	77.05	97.93**	20.88	145	122	HORI
2779.0	53.94	74.00	20.06	147	114	HORI
3705.0	58.21	74.00	15.79	113	301	HORI
5558.0	70.75	74.00	3.25	100	311	HORI

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. **All emissions outside of the 902MHZ to 928MHZ bands are required to be 20dB below the highest emission if they are not in a restricted band.

EUT	7001 RF Terminal	MODE	Receive
INPUT POWER	3.7VDC, Internal Battery	FREQUENCY RANGE	1GHz – 10GHz
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

Frequency	Level	Limit	Margin	Height	Angle	Pol.
MHz	dBµV/m	dBµV/m	dB	Cm	Deg.	
Average						
1852.5	33.06	54.00	20.90	147	63	HORI
3846.0	40.35	54.00	13.60	178	272	HORI
Peak						
1852.5	47.65	74.00	26.40	147	63	HORI
3846.0	53.98	74.00	20.00	178	272	HORI

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. **All emissions outside of the 902MHZ to 928MHZ bands are required to be 20dB below the highest emission if they are not in a restricted band.

4.3 Bandwidth

4.3.1 Limits of bandwidth measurements

The 20dB bandwidth of the signal must be less than 0.50MHz and greater than 0.25MHz for systems using fewer than 50 hop frequencies.

4.3.2 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 10 kHz RBW and 10 MHz VBW. The 20 dB bandwidth is defined as the bandwidth of which is higher than peak power minus 20dB.

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.

It was found that the 20dB and 99% bandwidths were equivalent for the EUT, so only one set of results is reported.

4.3.3 Deviations from test standard

No deviation.

4.3.4 Test setup

4.3.5 EUT operating conditions

The EUT was powered by an internal 3.7VDC battery and set to transmit continuously on the lowest frequency channel, highest frequency channel and one in the middle of its operating range.

4.3.6 Test results

EUT	7001 RF Terminal	MODE	Channel 1, 16, 32
INPUT POWER	3.7VDC, Internal Battery	FREQUENCY RANGE	902.971 – 926.277MHz
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

CHANNEL	CHANNEL FREQUENCY (MHz)	20dB BW (kHz)	20dB Limit Max (kHz)	RESULT
1	902.971	298.60	500.00	PASS
16	915.000	284.57	500.00	PASS
32	926.277	332.67	500.00	PASS

REMARKS:

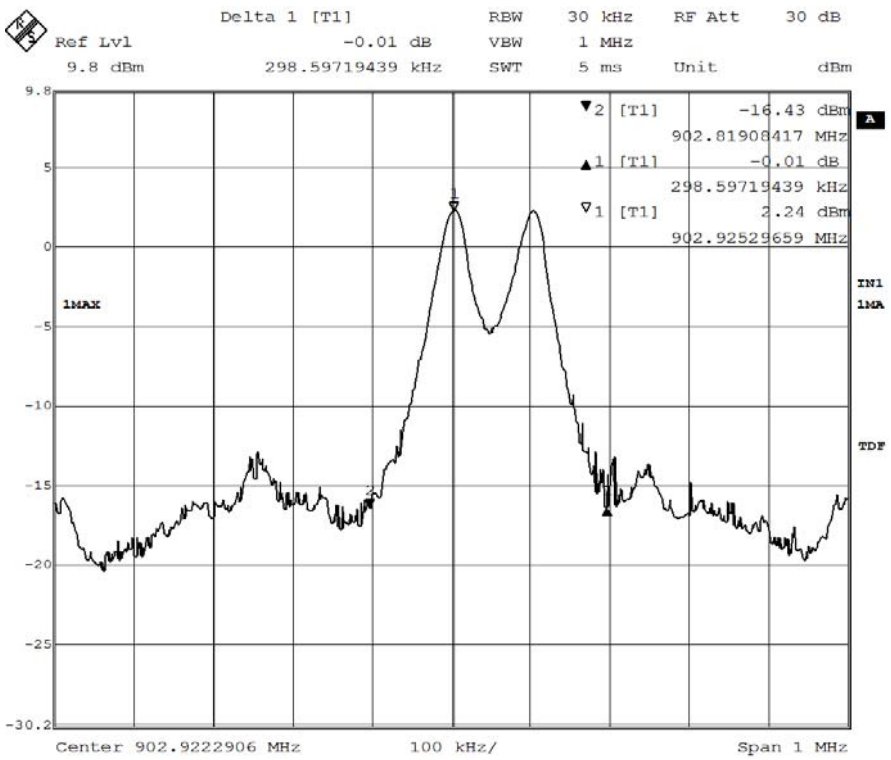


Figure 6 - Channel 1, 20dB Bandwidth

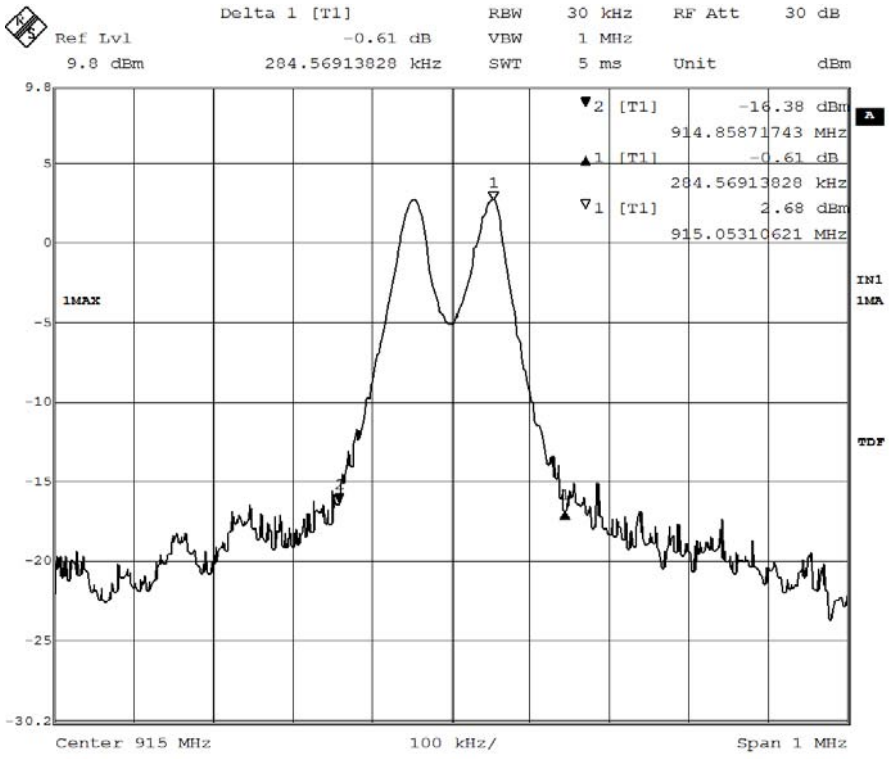


Figure 7 - Channel 16, 20dB Bandwidth

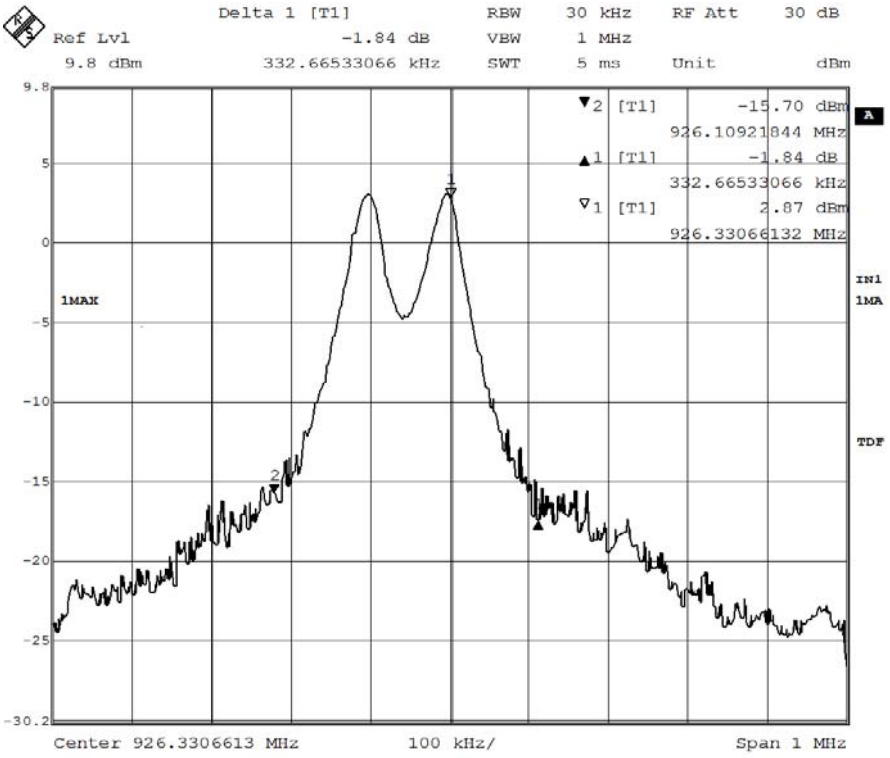


Figure 8 - Channel 32, 20dB Bandwidth

4.4 Maximum peak output power

4.4.1 Limits of power measurements

The maximum peak output power allowed is 30dBm (1000mW).

4.4.2 Test procedures

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

2. 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.

4.4.3 Deviations from test standard

No deviation.

4.4.4 Test setup

The RF output of the EUT was connected to a power sensor with the appropriate attenuation. Power readings were taken from a power meter.

4.4.5 EUT operating conditions

The EUT was powered by an internal 3.7VDC battery and set to transmit continuously on the lowest frequency channel, highest frequency channel and one in the middle of its operating range.

4.4.6 Test results

EUT	7001 RF Terminal	MODE	Channel 1, 16, 32
INPUT POWER	3.7VDC, Internal Battery	FREQUENCY RANGE	902.971 – 926.277MHz
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

Maximum peak output power

CHANNEL	CHANNEL FREQUENCY (MHz)	PEAK POWER OUTPUT (dBm)	PEAK POWER LIMIT (dBm)	RESULT
1	902.971	21.77	30	PASS
16	915.000	22.19	30	PASS
32	926.277	22.51	30	PASS

REMARKS:
None

4.5 Bandedges

4.5.1 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.

4.5.2 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.

4.5.3 Deviations from test standard

No deviation.

4.5.4 Test setup

See Section 4.4

4.5.5 EUT operating conditions

The EUT was powered by an internal 3.7VDC battery and set to transmit continuously on the lowest frequency channel and the highest frequency channel.

4.5.6 Test results

EUT	7001 RF Terminal	MODE	Channel 1, 32
INPUT POWER	3.7VDC, Internal Battery	FREQUENCY RANGE	902.971 – 926.277MHz
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

Highest Out of Band Emissions

CHANNEL	Band edge /Measurement Frequency (MHz)	Highest out of band level dBm	Highest in band level dBµV/m	Delta	Limit (dBc)	Result
0 (902.971MHZ)	901.94	-12.46	12.67	25.13	20.00	PASS
32(926.277MHz)	928.04	-25.45	13.24	38.69	20.00	PASS

NOTE:
EUT was tested as described in section 4.2. All measurements above were taken from section 4.2. The highest out of band measurement was maximized in a 5MHz frequency band, so the frequency may be slightly within the frequency band, but represents a worse-case scenario for all out of band measurements.

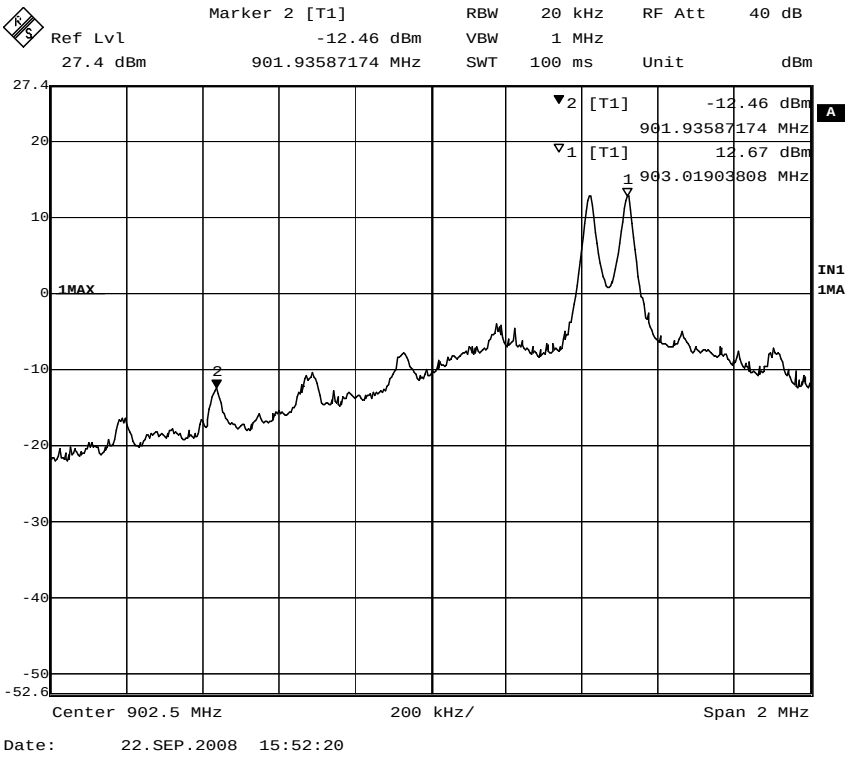


Figure 9 - Bandedge Measurements, 902MHz

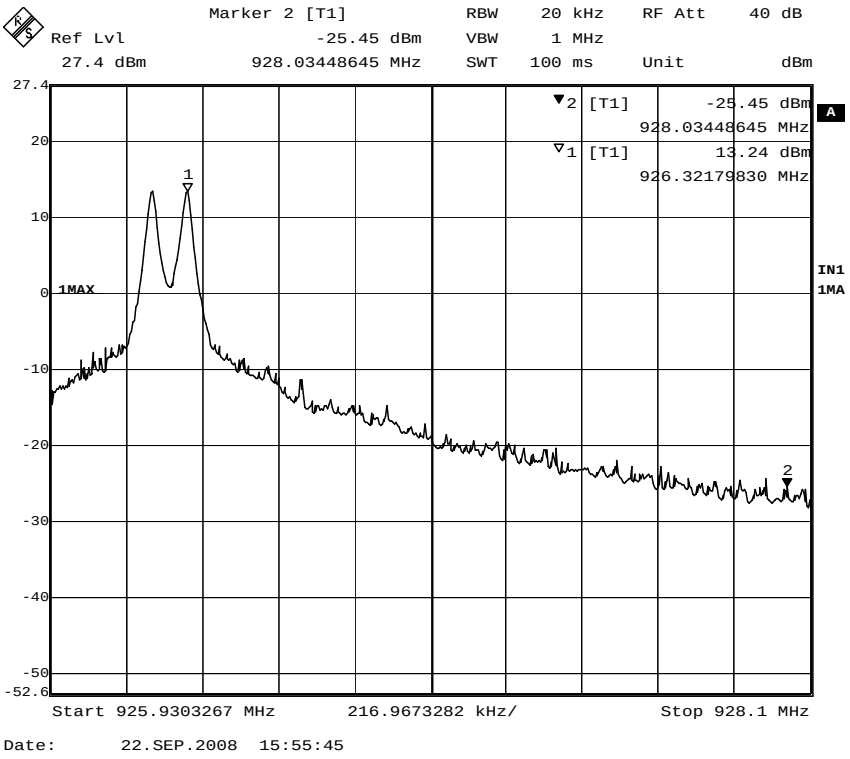


Figure 10 - Bandedge Measurements, 928MHz

4.6 Number of hopping frequencies

4.6.1 Hopping frequency measurements

For frequency hopping systems with a 20dB bandwidth greater than 250kHz, the system shall use at least 25 hopping channels.

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 100 kHz RBW and 300 kHz VBW. The spectrum analyzer was set in max hold mode and held until all hopping channels were captured.

4.6.3 Deviations from test standard

No deviation.

4.6.4 Test setup

See Section 4.4

4.6.5 EUT operating conditions

The EUT was powered by an internal 3.7VDC battery and set to transmit continuously on the lowest frequency channel and the highest frequency channel.

4.6.6 Test results

EUT	7001 RF Terminal	MODE	Hopping
INPUT POWER	3.7VDC, Internal Battery	FREQUENCY RANGE	902.971 – 926.277MHz
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

Number of frequency hopping channels

CHANNELS	MINIMUM
26	25

NOTE:
The EUT is capable of transmitting on 32 channels, there are six pseudo randomly ordered hopping sequences selectable. Each hopping sequence uses 26 of the 32 channels. The operational description provides this information.

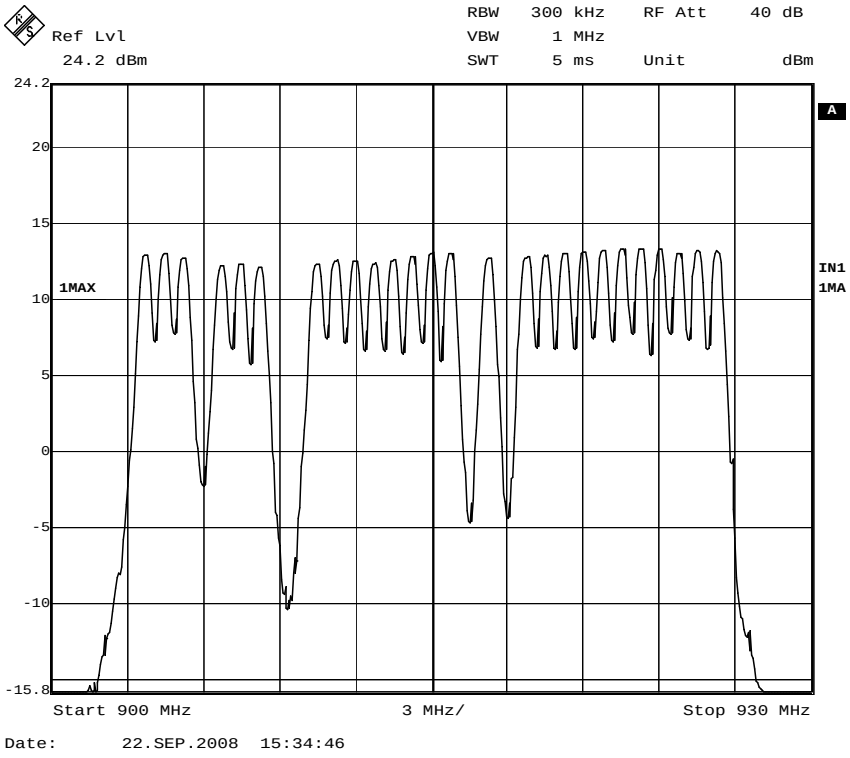


Figure 11 - Number of Hopping Frequencies

4.7 Time of occupancy

4.7.1 Requirements for time of occupancy

If the 20 dB bandwidth of the hopping channel is 250 kHz or greater, the system shall use at least 25 hopping frequencies and the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a 10 second period. The maximum allowed 20 dB bandwidth of the hopping channel is 500 kHz.

4.7.2 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 100 kHz RBW and 1 MHz VBW.

4.7.3 Deviations from test standard

No deviation.

4.7.4 Test setup

See Section 4.4

4.7.5 EUT operating conditions

The EUT was powered by an internal 3.7VDC battery and set to transmit continuously on the lowest frequency channel and the highest frequency channel.

4.7.6 Test results

EUT	7001 RF Terminal	MODE	Channel 16
INPUT POWER	3.7VDC, Internal Battery	FREQUENCY RANGE	902.971 – 926.277MHz
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

Frequency hopping channel separation

CHANNEL	Time between hops (s)	Hop timing (ms)	Duty Cycle (Sec on/Sec off)	Duty Cycle Limit (Max)	RESULT
16	10.00	320.00	0.0382	0.040	PASS

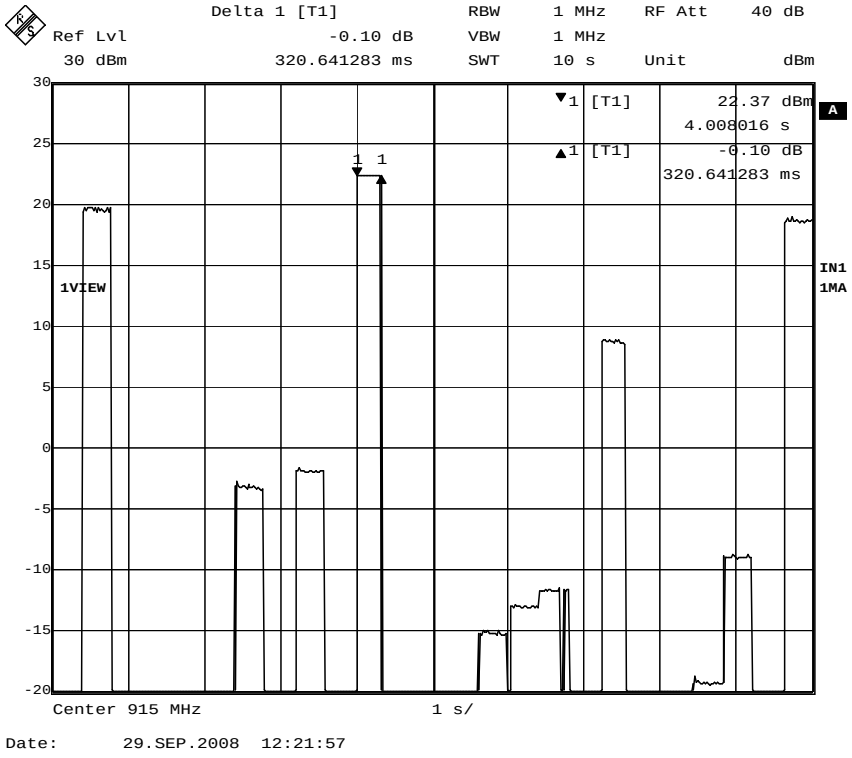


Figure 12 - Time of Occupancy Plot, 320ms

4.8 Carrier frequency separation

4.8.1 Requirements for carrier frequency separation

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

4.8.2 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 100 kHz RBW and 1 MHz VBW.

4.8.3 Deviations from test standard

No deviation.

4.8.4 Test setup

4.8.5 EUT operating conditions

The EUT was powered by an internal 3.7VDC battery and set to transmit continuously on the lowest frequency channel and the highest frequency channel.

4.8.6 Test results

EUT	7001 RF Terminal	MODE	Hopping
INPUT POWER	3.7VDC, Internal Battery	FREQUENCY RANGE	902.971 – 926.277MHz
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

Frequency hopping channel separation

CHANNEL A-B	CHANNEL A FREQ. (MHz)	CHANNEL B FREQ. (MHz)	DELTA (kHz)	MINIMUM (kHz)	RESULT
0 - 1	902.964	903.719	755	332.67	PASS
1 – 2	903.719	904.463	744	332.67	PASS
2 – 3	904.463	905.224	761	332.67	PASS
3 – 4	905.224	905.970	746	332.67	PASS
4 – 5	905.970	906.717	747	332.67	PASS
6 - 7	906.717	907.473	756	332.67	PASS
7 – 8	907.473	908.228	755	332.67	PASS
8 – 9	908.228	908.962	734	332.67	PASS
9 – 10	908.962	909.721	759	332.67	PASS
10 – 11	909.721	910.481	760	332.67	PASS
11 - 12	910.481	911.222	741	332.67	PASS
12 – 13	911.222	911.979	757	332.67	PASS
13 – 14	911.979	912.740	761	332.67	PASS
14 - 15	912.740	913.484	744	332.67	PASS
15 – 16	913.484	914.237	753	332.67	PASS
16 – 17	914.237	914.986	749	332.67	PASS
17 – 18	914.986	915.735	749	332.67	PASS
18 – 19	915.735	916.484	749	332.67	PASS
19 – 20	916.484	917.241	757	332.67	PASS
20 – 21	917.241	917.992	751	332.67	PASS
21 – 22	917.992	918.747	755	332.67	PASS
22 – 23	918.747	919.507	760	332.67	PASS
23 – 24	919.507	920.258	751	332.67	PASS
24 – 25	920.258	921.005	747	332.67	PASS
25 - 26	921.005	921.754	749	332.67	PASS
26 – 27	921.754	922.511	757	332.67	PASS
27 - 28	922.511	923.268	757	332.67	PASS
28 – 29	924.010	924.757	747	332.67	PASS
29 - 30	924.757	925.513	756	332.67	PASS
30 - 31	925.513	926.261	748	332.67	PASS

4.9 Conducted AC Mains Emissions

4.9.1 Limits for conducted emissions measurements

FREQUENCY OF EMISSION (MHz)	CONDUCTED LIMIT (dBµV)	
	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.

4.9.2 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

4.9.3 Deviation from the test standard

No deviation

4.9.4 Test setup

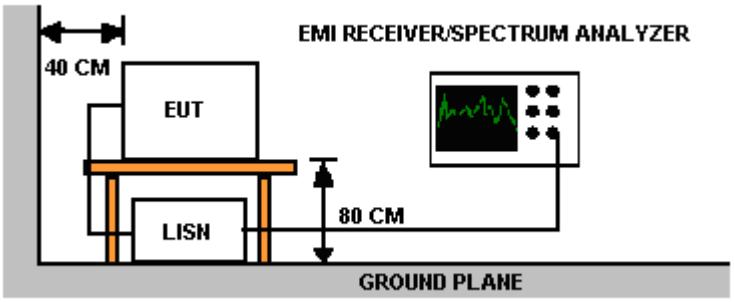


Figure 13 - Conducted Emissions Test Setup

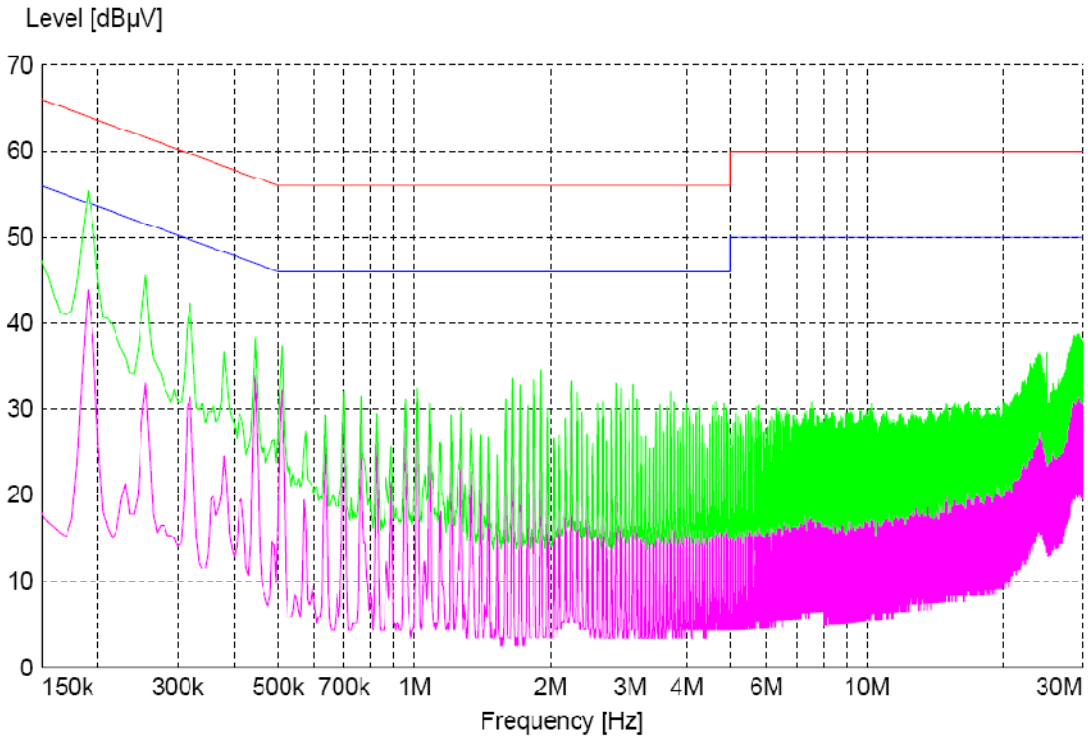
For actual test configuration, see photographs in Appendix A

4.9.5 EUT operating conditions

The EUT was connected to a 5VDC AC-DC power converter, which was powered by 120VAC/60Hz from the AC mains. The EUT is not capable of operating while connected to the power converter, and the connection is only used to charge the battery.

4.9.6 Test Results

EUT	7001 RF Terminal	MODE	Charging
INPUT POWER	5V, 3A	FREQUENCY RANGE	150kHz – 30MHz
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson



REMARKS:
1. Q.P. and AV. are abbreviations for quasi-peak and average respectively.
2. All emission levels were greater than 20dB below the limit.

Appendix A: Test Photos

Figure 14 - Radiated Emissions Test Setup

Figure 15 - Radiated Emissions Test Setup

Figure 16 - Conducted Emissions Test Setup

Figure 17 - 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 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.

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