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FCC Test Report

Company:	Novation Wireless 5743 Corsa Way Westlake Village, CA 91362
Contact:	Tim McCarthy
Product:	nHUB - Wireless Access Hub nPORT-R1 – Wireless Portal Controller nPORT-I/O – Wireless I/O Controller
FCC ID:	U4NNHUB
Test Report No:	R091206-30-01
APPROVED BY:	Doug Kramer Senior Test Engineer
DATE:	24 May 2007
Total Pages:	58

ACCREDITED
Certificate Number 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	Unique Antenna Requirement	Pass	PCB Antenna
15.207	Conducted Emissions	Pass	Meets the requirement of the limit.
15.209	Radiated Emissions	Pass	Meets the requirement of the limit.
15.247(a)(1)	Minimum Bandwidth, Limit 6dB Min.500kHz	Pass	Meets the requirement of the limit.
15.247(b)	Maximum Peak Output Power, Limit: Max. 30.0dBm	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(c)	Band Edge Measurement, Limit: 20dB less than the peak value of fundamental frequency	Pass	Meets the requirement of the limit.
15.247(d)	Power Spectral Density, Limit: Max. 8dBm	Pass	Meets the requirement of the limit.

1.2 Test Methods

1.2.1 Conducted AC Emissions

The EUT was powered by an AC adapter that converted 120VAC/60Hz to 9VDC. Conducted emissions measurements were made according to ANSI/IEEE C63.4: 2003 and compared to the limits as found in 47 CFR 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. 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 vertical 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

The following report covers 3 devices, the nHUB Wireless Access Hub, the Portal Controller and the I/O Module. All three EUT's utilize the same RF circuit, PCB layout and antennas; therefore, the nHUB Wireless Access Hub was tested for all transmitter related tests. All three were tested for spurious radiated and conducted emissions. The EUT utilizes digital modulation scheme. The EUT was therefore tested under part 15.247 of the rules as a digitally modulated system.

The nHUB Wireless Access Hub connects via an RS-232 serial port to communicate with a PC. The nHUB is designed to be able to communicate with up to 64 nSERIES Wireless Locksets (FCC ID: U4NNSERIES). The EUT's RF activity is confined to 32 frequencies within the 902 to 928MHz band.

The nPORT-R1 Wireless Portal Controller functions similarly to the wireless lockset but is designed for use with door controllers that don't allow use of the standard lockset or use already existing door locks. The Wireless Portal Controller activates a set of relays which in turn control the non-wireless lockset. It will also monitor activity in the lock.

The nPORT-I/O Wireless I/O Module also functions similarly to the wireless lockset and it is used when there is a need to monitor or control a device that is not associated with a portal equipped with a card reader. An example is an emergency fire exit. If this door is provided with a set of monitor contacts they can be wired to a Wireless Input/Output Module. This unit reports to the Wireless Access Point when this door has been opened and closed.

Note: The Wireless Access Hub, Portal Controller and I/O Module contain no radio adjustments. The channel selection is controlled automatically by the EUT.

EUT Received Date: March 13, 2007
EUT Tested Dates: March 21 – March 26, 2007

PRODUCT	Wireless Access Hub Wireless Portal Controller Wireless I/O Controller
MODEL	nHUB nPORT-R1 nPORT-I/O
POWER SUPPLY	$5V_{DC}$ class 2 Transformer
MODULATION TYPE	QFSK
RADIO TECHNOLOGY	Half-duplex RF Link
FREQUENCY RANGE	902 – 928MHz
NUMBER OF CHANNELS	32
MAX OUTPUT POWER	10.3mW
ANTENNA TYPE	Dipole (Antenna 1) or Whip (Antenna 2)
DATA CABLE	RS-232 Serial, Ethernet
ASSOCIATED DEVICES	None

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
0	902.971
16	915.000
31	926.277

2.4 Applied standards

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

FCC Part 15, Subpart C (15.247) using ANSI/IEEE C63.4: 2003

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

2.5 Description of support units

Dipole antenna or Whip antenna

2.6 Configuration of system under test

The EUT was tested while continuously transmitting, and 3 frequencies were examined. One frequency was the lowest possible transmitting frequency and one the highest. The third was in the middle of the operating range. The EUT was also tested in receive mode where noted. The test mode was provided by the manufacturer and was intended to provide continuous transmission. It was powered by a 5VDC power supply from CUI Inc., model number KA12D050055033U, Part number DPD050055-P13P-TK. The same power supply was used by all three EUT's. The nHUB was used for all transmitter related testing as the RF portions of the circuits are identical in all three EUT's. All three EUT's were tested individually for spurious radiated and conducted emissions.

3.0 Test equipment used

DESCRIPTION AND MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CALIBRATION DATE
Rohde & Schwarz Test Receiver	ESIB26	100037	15-Aug-2006
EMCO Biconilog Antenna	3142B	1647	29-Jan-2007
EMCO Horn Antenna	3115	6416	29-Jan-2007
Preamplifier	TR-PR18	082001/003	6-Dec-2006
Rohde & Schwarz LISN	ESH3-Z5	100023	24-May-2006

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 antennas connect at a point internal to the EUT and are not interchangeable without disassembling the EUT. The devices are intended to be installed by trained personnel and are not available through normal consumer channels.

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

3. The angles and antenna heights/polarities were adjusted to produce the highest emissions for all measurements above 1GHz.

4.2.3 Deviations from test standard

No deviation.

4.2.4 Test setup

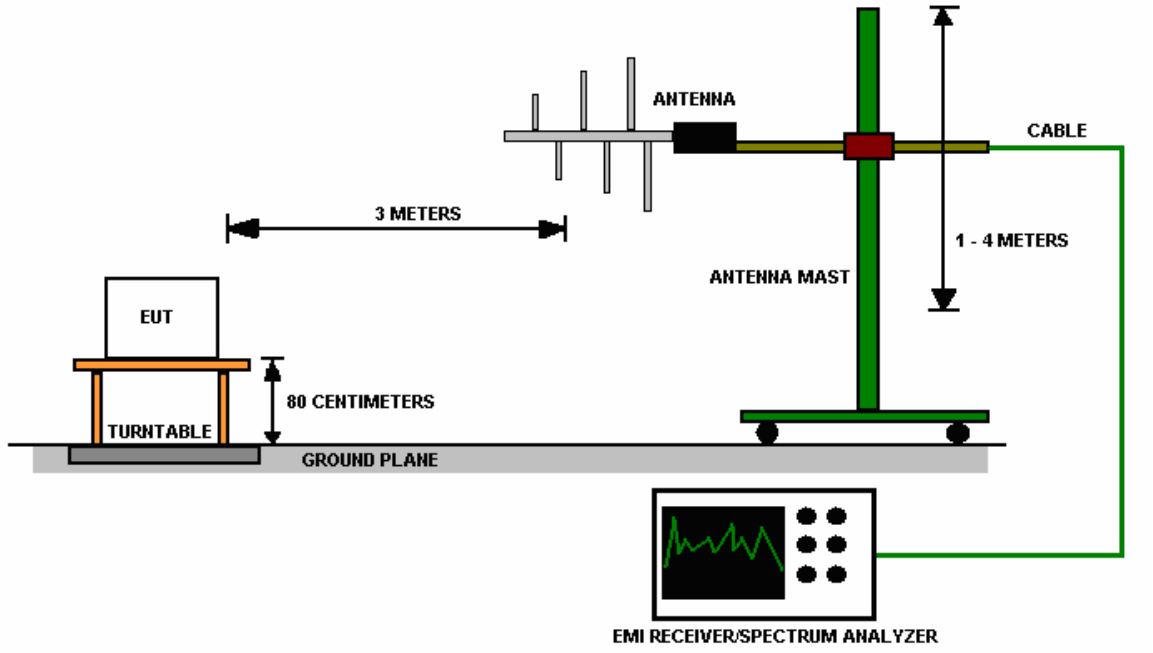


Figure 1 - Radiated Emissions Test Setup

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 programmed to operate at the lowest frequency and the highest frequency of its operational band and one frequency in the middle. It was powered by a 9VDC power supply and tested in the upright position with each of two antenna options.

4.2.6 Test results

EUT	Wireless Access Hub	Model	nHUB
MODE	Channel 0 Dipole Antenna	FREQUENCY RANGE	30MHz – 1GHz
INPUT POWER (SYSTEM)	$5V_{DC}$	ORIENTATION	Vertical/Horizontal
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

Quasi-peak Measurements*

Frequency	Level	Angle	Height	Pol.
MHz	dBµV/m	deg	cm	
902.1643	31.55	341	100	HOR
902.3447	65.9	182	100	HOR
902.4048	58.12	4	100	HOR
902.4649	51.78	360	200	HOR
902.5251	56.18	150	200	VER
902.5852	72.31	283	100	VER
902.6453	48.91	40	200	VER
902.7054	71.41	164	200	VER
902.7655	107.29	197	200	HOR
902.8257	62.42	236	100	HOR
902.8858	36.9	310	200	VER
903.006	38.52	169	200	HOR

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.

EUT	Wireless Access Hub	Model	nHUB
MODE	Channel 16 Dipole Antenna	FREQUENCY RANGE	30MHz – 1GHz
INPUT POWER (SYSTEM)	$5V_{DC}$	ORIENTATION	Vertical/Horizontal
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

Quasi-peak Measurements*

Frequency	**Level**	**Angle**	**Height**	**Pol.**
MHz	**dBµV/m**	**deg**	**cm**	
914.7295	48.71	35	100	HOR
914.9699	53.74	212	100	VER
915.3307	44.55	35	100	HOR
915.3908	70.92	266	100	VER
915.4509	46.42	182	200	VER
915.511	46.92	212	100	VER
915.5711	107.57	133	100	HOR
915.8717	107.69	249	100	HOR
915.9319	35.13	35	100	HOR
915.992	42.1	212	100	VER

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.

EUT	Wireless Access Hub	Model	nHUB
MODE	Channel 31 Dipole Antenna	FREQUENCY RANGE	30MHz – 1GHz
INPUT POWER (SYSTEM)	$5V_{DC}$	ORIENTATION	Vertical/Horizontal
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

Quasi-peak Measurements*

Frequency	Level	Angle	Height	Pol.
MHz	dBµV/m	deg	cm	
925.8517	54.96	79	100	VER
925.9118	62.81	141	100	VER
925.9719	78.47	21	200	VER
926.0321	104.51	164	100	HOR
926.0922	108.01	164	100	HOR
926.1523	52.57	84	100	HOR
926.2124	92.26	141	100	VER
926.2725	53.11	53	100	HOR
926.3327	57.01	60	100	VER
926.3928	35.41	146	100	HOR
926.8136	66.2	303	100	HOR
926.8737	42.92	53	100	HOR
927.2946	65.46	303	100	HOR
927.3547	39.58	79	100	VER
927.4148	49.06	176	100	VER
927.5952	42.15	275	200	VER
927.6553	63.46	164	100	HOR
927.7756	49.15	141	100	VER
927.8357	31.53	260	100	HOR

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.

EUT	Wireless Access Hub	Model	nHUB
MODE	Channel 0 Whip Antenna	FREQUENCY RANGE	30MHz – 1GHz
INPUT POWER (SYSTEM)	$5V_{DC}$	ORIENTATION	Vertical/Horizontal
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

Quasi-peak Measurements*

Frequency	Level	Angle	Height	Pol.
MHz	dBµV/m	deg	cm	
901.923**	61.34	178	200	VER
901.984**	60.8	277	100	VER
902.0441	65.75	352	200	VER
902.1042	66.73	62	200	VER
902.1643	71.3	215	100	VER
902.2244	60.08	178	200	VER
902.2846	38.12	258	200	VER
902.4649	73.06	202	100	VER
902.5251	68.21	277	100	VER
902.5852	81.8	86	100	VER
902.6453	31.31	28	200	HOR
902.7054	72.37	103	100	VER
902.7655	108.35	86	100	VER
902.9459	108.36	202	100	VER
903.006	70.2	277	100	VER
903.0661	93.76	216	100	HOR
903.1263	60.09	178	200	VER
903.1864	69.32	215	100	VER
903.2465	91.6	86	100	VER

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. **Measurements that are not in a restricted band are required to be 20dB less than the peak emission (108.36dBµV/m – 20.00dB = 88.36dBµV/m)

EUT	Wireless Access Hub	Model	nHUB
MODE	Channel 16 Whip Antenna	FREQUENCY RANGE	30MHz – 1GHz
INPUT POWER (SYSTEM)	$5V_{DC}$	ORIENTATION	Vertical/Horizontal
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

Quasi-peak Measurements*

Frequency	**Level**	**Angle**	**Height**	**Pol.**
MHz	**dBµV/m**	**deg**	**cm**	
914.0681	42.5	0	200	VER
914.1283	61.27	359	200	VER
914.1884	69.42	73	100	VER
914.2485	68.66	32	100	VER
914.3086	70.91	264	100	VER
914.3687	32.02	345	100	VER
914.4289	62.67	245	200	VER
914.5491	68.77	93	200	VER
914.6092	66.93	330	200	HOR
914.6693	69.39	264	100	VER
914.7295	71.02	148	100	VER
914.7896	105.2	93	200	VER
914.9699	108.32	357	100	VER
915.0301	35.87	325	200	VER
915.1503	88.44	41	200	HOR
915.2104	60.75	245	200	VER
915.4509	49.36	330	200	HOR

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.

EUT	Wireless Access Hub	Model	nHUB
MODE	Channel 31 Whip Antenna	FREQUENCY RANGE	30MHz – 1GHz
INPUT POWER (SYSTEM)	$5V_{DC}$	ORIENTATION	Vertical/Horizontal
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

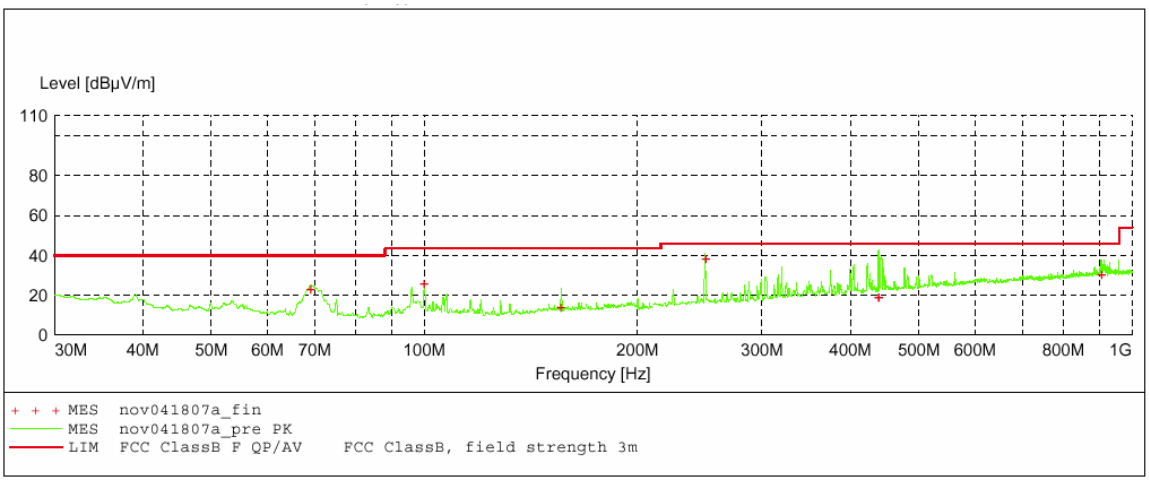
Quasi-peak Measurements*

Frequency	Level	Angle	Height	Pol.
MHz	dBµV/m	deg	cm	
926.2124	40.57	279	100	HOR
926.2725	44.49	317	200	HOR
926.3928	51.57	34	100	HOR
926.4529	104.73	44	200	VER
926.5130	60.65	8	200	VER
926.5731	65.59	327	100	VER
926.6333	46.19	10	200	HOR
926.6934	78.47	233	100	VER
926.7535	50.66	313	100	VER
926.8136	57.93	345	100	VER
926.8737	69.47	1	100	VER
927.1142	40.45	299	200	HOR

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.

EUT	Wireless Access Hub	Model	nHUB
MODE	Receive Dipole Antenna	FREQUENCY RANGE	30MHz – 1GHz
INPUT POWER (SYSTEM)	$5V_{DC}$	ORIENTATION	Vertical/Horizontal
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

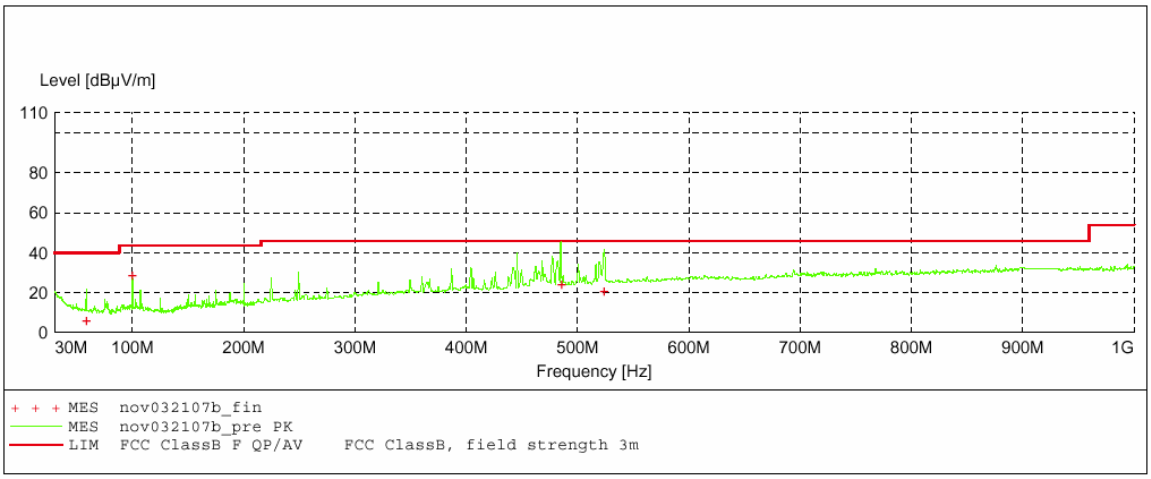


Frequency MHz	Level dBµV/m	Limit dBµV/m	Margin dB	Height cm	Angle deg	Pol.
69.120000	22.79	40.0	17.2	106.0	149	VERT
99.960000	25.74	43.5	17.8	112.0	319	VERT
156.000000	13.98	43.5	29.5	100.0	52	VERT
249.960000	37.91	46.0	8.1	99.0	165	VERT
438.840000	18.55	46.0	27.5	211.0	233	HORI
439.200000	18.61	46.0	27.4	233.0	239	HORI
906.180000	29.87	46.0	16.1	99.0	265	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.

EUT	Wireless Portal Controller	Model	nPORT-R1
MODE	Receive Dipole antenna	FREQUENCY RANGE	30MHz – 1GHz
INPUT POWER (SYSTEM)	$5V_{DC}$	ORIENTATION	Vertical/Horizontal
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

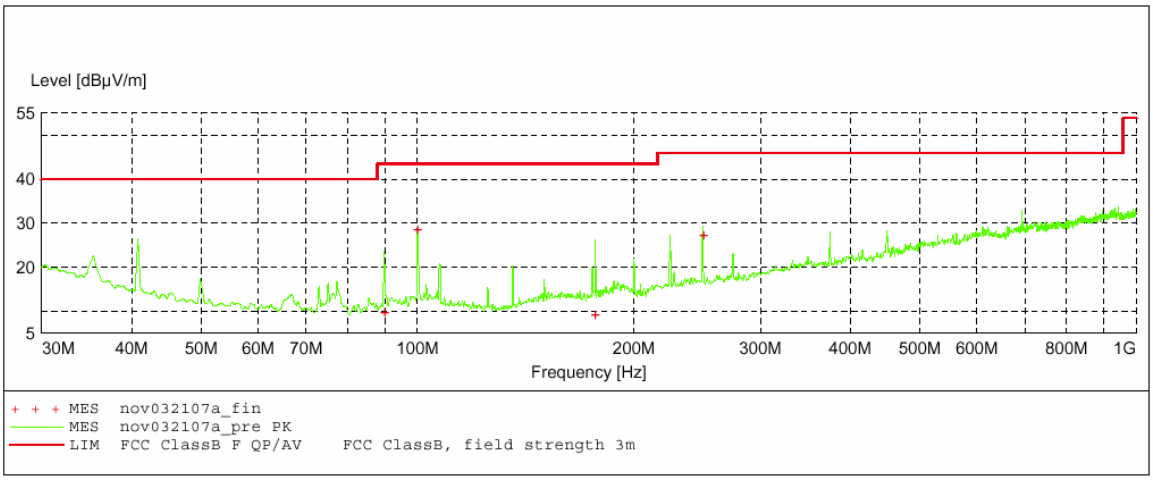


Frequency MHz	Level dBµV/m	Limit dBµV/m	Margin dB	Height cm	Angle deg	Pol.
58.680000	5.77	40.0	34.2	223.0	351	HORI
100.020000	28.66	43.5	14.8	102.0	219	VERT
485.700000	23.85	46.0	22.1	99.0	86	VERT
523.800000	20.64	46.0	25.4	101.0	35	VERT

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.

EUT	Wireless I/O Controller	Model	nPORT-I/O
MODE	Receive Dipole antenna	FREQUENCY RANGE	30MHz – 1GHz
INPUT POWER (SYSTEM)	$5V_{DC}$	ORIENTATION	Vertical/Horizontal
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson



Frequency MHz	Level dBµV/m	Limit dBµV/m	Margin dB	Height cm	Angle deg	Pol.
90.000000	9.70	43.5	33.8	333.0	10	VERT
100.020000	28.52	43.5	15.0	99.0	21	VERT
176.760000	9.16	43.5	34.3	150.0	26	HORI
250.020000	27.17	46.0	18.8	100.0	176	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.

EUT	Wireless Access Hub	Model	nHUB
MODE	Channel 0 Dipole Antenna	FREQUENCY RANGE	1GHz – 10GHz
INPUT POWER (SYSTEM)	$5V_{DC}$	ORIENTATION	Vertical/Horizontal
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

Radiated Emissions Average and Peak Data

Frequency	Average	Limit	Margin	Peak	Limit	Margin
MHz	dBµV/m	dBµV/m	dB	dBµV/m	dBµV/m	dB
1805.942	52.09	54.0	1.91	60.83	74.0	13.17
2708.913	50.21	54.0	3.79	55.79	74.0	18.21
3611.884	42.26	54.0	11.74	54.94	74.0	19.06
4514.855	44.00	54.0	10.00	56.26	74.0	17.74
5417.826	48.46	54.0	5.54	61.41	74.0	12.59

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.

EUT	Wireless Access Hub	Model	nHUB
MODE	Channel 16 Dipole Antenna	FREQUENCY RANGE	1GHz – 10GHz
INPUT POWER (SYSTEM)	$5V_{DC}$	ORIENTATION	Vertical/Horizontal
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

Radiated Emissions Average and Peak Data

Frequency	Average	Limit	Margin	Peak	Limit	Margin
MHz	dBµV/m	dBµV/m	dB	dBµV/m	dBµV/m	dB
1830.00	52.12	54.0	1.88	61.04	74.0	12.96
2745.00	51.01	54.0	2.99	60.33	74.0	13.67
3611.884	42.49	54.0	11.51	54.31	74.0	19.69
4514.855	44.12	54.0	9.88	56.23	74.0	17.77
5417.826	49.29	54.0	4.71	61.48	74.0	12.52

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.

EUT	Wireless Access Hub	Model	nHUB
MODE	Channel 31 Dipole Antenna	FREQUENCY RANGE	1GHz – 10GHz
INPUT POWER (SYSTEM)	$5V_{DC}$	ORIENTATION	Vertical/Horizontal
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

Radiated Emissions Average and Peak Data

Frequency	Average	Limit	Margin	Peak	Limit	Margin
MHz	dBµV/m	dBµV/m	dB	dBµV/m	dBµV/m	dB
1852.554	49.52	54.0	4.48	60.76	74.0	13.24
2708.913	49.77	54.0	4.23	62.74	74.0	11.26
3611.884	45.84	54.0	8.16	56.06	74.0	17.94
4514.855	53.25	54.0	0.75	61.79	74.0	12.21
5417.826	51.96	54.0	2.04	63.10	74.0	10.90

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.

EUT	Wireless Access Hub	Model	nHUB
MODE	Receive Dipole Antenna	FREQUENCY RANGE	1GHz – 10GHz
INPUT POWER (SYSTEM)	$5V_{DC}$	ORIENTATION	Vertical/Horizontal
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

Average Measurements

Frequency	Level	Limit	Margin	Height	Angle	Pol.
MHz	dBµV/m	dBµV/m	dB	cm	deg	
1940.000000	39.87	54.0	14.1	111.0	274	VERT
2495.500000	21.94	54.0	32.1	155.0	276	VERT

Peak Measurements

Frequency	Level	Limit	Margin	Height	Angle	Pol.
MHz	dBµV/m	dBµV/m	dB	Cm	Deg	
1940.000000	45.93	74.0	28.1	113.0	275	VERT
2495.500000	36.09	74.0	37.9	166.0	275	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.

EUT	Wireless Access Hub	Model	nHUB
MODE	Channel 0 Whip Antenna	FREQUENCY RANGE	1GHz – 10GHz
INPUT POWER (SYSTEM)	$5V_{DC}$	ORIENTATION	Vertical/Horizontal
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

Radiated Emissions Average and Peak Data

Frequency	Average	Limit	Margin	Peak	Limit	Margin
MHz	dBµV/m	dBµV/m	dB	dBµV/m	dBµV/m	dB
1805.942	61.3	87.3*	26.0	66.9	87.3*	20.4
2708.913	49.5	54.0	4.5	63.1	74.0	10.9
3611.884	42.5	54.0	11.5	55.8	74.0	18.2
4514.855	43.9	54.0	10.1	57.2	74.0	16.8
5417.826	48.3	54.0	5.7	61.0	74.0	13.0

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. "*" 1805.942 falls in an unrestricted band. Spurious emissions are then required to be 20dB below the value of the peak emission at the fundamental frequency. In this case, the peak emissions is 107.3dBµV/m, so the limit is 87.3 dBµV/m. All measurements made in restricted bands that were below the limits in 15.209 were referenced to those limits.

EUT	Wireless Access Hub	Model	nHUB
MODE	Channel 16 Whip Antenna	FREQUENCY RANGE	1GHz – 10GHz
INPUT POWER (SYSTEM)	$5V_{DC}$	ORIENTATION	Vertical/Horizontal
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

Radiated Emissions Average and Peak Data

Frequency	Average	Limit	Margin	Peak	Limit	Margin
MHz	dBµV/m	dBµV/m	dB	dBµV/m	dBµV/m	dB
1805.942	60.9	*87.7	26.8	66.4	*87.7	21.3
2708.913	49.3	54.0	4.71	62.0	74.0	12.0
3611.884	42.4	54.0	11.63	55.2	74.0	18.8
4514.855	43.9	54.0	10.11	57.8	74.0	16.2
5417.826	49.0	54.0	4.99	62.8	74.0	11.2

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. "*" 1830.000MHz falls in an unrestricted band. Spurious emissions are then required to be 20dB below the value of the peak emission at the fundamental frequency. In this case, the peak emissions is 107.7dBµV/m, so the limit is 87.7 dBµV/m. All measurements made in restricted bands that were below the limits in 15.209 were referenced to those limits.

EUT	Wireless Access Hub	Model	nHUB
MODE	Channel 31 Whip antenna	FREQUENCY RANGE	1GHz – 10GHz
INPUT POWER (SYSTEM)	$5V_{DC}$	ORIENTATION	Vertical/Horizontal
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

Radiated Emissions Average and Peak Data

Frequency	Average	Limit	Margin	Peak	Limit	Margin
MHz	dBµV/m	dBµV/m	dB	dBµV/m	dBµV/m	dB
1805.942	60.2	*88.0	27.8	66.4	*88.0	21.6
2708.913	49.8	54.0	4.2	63.2	74.0	10.8
3611.884	42.7	54.0	11.3	55.5	74.0	18.5
4514.855	44.4	54.0	9.6	56.6	74.0	17.4
5417.826	49.8	54.0	4.2	62.2	74.0	11.8

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. "*" 1852.554.5MHz falls in an unrestricted band. Spurious emissions are then required to be 20dB below the value of the peak emission at the fundamental frequency. In this case, the peak emissions is 108.0dBµV/m, so the limit is 88.0 dBµV/m. All measurements made in restricted bands that were below the limits in 15.209 were referenced to those limits.

EUT	Wireless Access Hub	Model	nHUB
MODE	Receive Whip antenna	FREQUENCY RANGE	1GHz – 10GHz
INPUT POWER (SYSTEM)	$5V_{DC}$	ORIENTATION	Vertical/Horizontal
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

Average Measurements

Frequency	Level	Limit	Margin	Height	Angle	Pol.
MHz	**dBµV/m**	**dBµV/m**	**dB**	**cm**	**deg**	
1940.000000	41.22	54.0	12.8	101.0	276	VERT
2495.500000	21.98	54.0	32.0	149.0	275	VERT

Peak Measurements

Frequency	Level	Limit	Margin	Height	Angle	Pol.
MHz	**dBµV/m**	**dBµV/m**	**dB**	**cm**	**deg**	
1940.000000	46.88	74.0	27.1	101.0	276	VERT
2495.500000	36.03	74.0	38.0	149.0	275	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.

EUT	Wireless Portal Controller	Model	nPORT-R1
MODE	Receive Whip antenna	FREQUENCY RANGE	1GHz – 10GHz
INPUT POWER (SYSTEM)	$5V_{DC}$	ORIENTATION	Vertical/Horizontal
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

Average Measurements

Frequency	Level	Limit	Margin	Height	Angle	Pol.
MHz	dBµV/m	dBµV/m	dB	cm	deg	
5769.000000	30.04	53.9	23.9	249.0	140	VERT
9626.500000	34.85	53.9	19.0	149.0	30	VERT

Peak Measurements

Frequency	Level	Limit	Margin	Height	Angle	Pol.
MHz	dBµV/m	dBµV/m	dB	cm	deg	
5769.000000	43.84	53.9	10.1	249.0	140	VERT
9626.500000	48.23	53.9	5.7	149.0	30	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.

EUT	Wireless I/O Controller	Model	nPORT-I/O
MODE	Receive Whip antenna	FREQUENCY RANGE	1GHz – 10GHz
INPUT POWER (SYSTEM)	$5V_{DC}$	ORIENTATION	Vertical/Horizontal
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

Average Measurements

Frequency	Level	Limit	Margin	Height	Angle	Pol.
MHz	**dBµV/m**	**dBµV/m**	**dB**	**cm**	**deg**	
6684.500000	26.24	53.9	27.7	249.0	112	VERT
8816.500000	34.63	53.9	19.3	101.0	178	HORI

Peak Measurements

Frequency	Level	Limit	Margin	Height	Angle	Pol.
MHz	**dBµV/m**	**dBµV/m**	**dB**	**cm**	**deg**	
6684.500000	39.96	53.9	13.9	249.0	112	VERT
8816.500000	48.07	53.9	5.8	101.0	178	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.

4.3 Conducted AC Mains Emissions

4.3.1 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.

4.3.2 Test Procedures

a. The EUT was placed 0.8m above a ground reference plane and 0.4 meters from the conducting wall of a shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). The LISN provides 50 ohm/ 50uH of coupling impedance for the measuring instrument.

b. Both lines of the power mains connected to the EUT were checked for maximum conducted interference as well as the ground.

c. The frequency range from 150 kHz to 30 MHz was searched. Emission levels over 10dB under the prescribed limits could not be reported

4.3.3 Deviation from the test standard

No deviation

4.3.4 Test setup

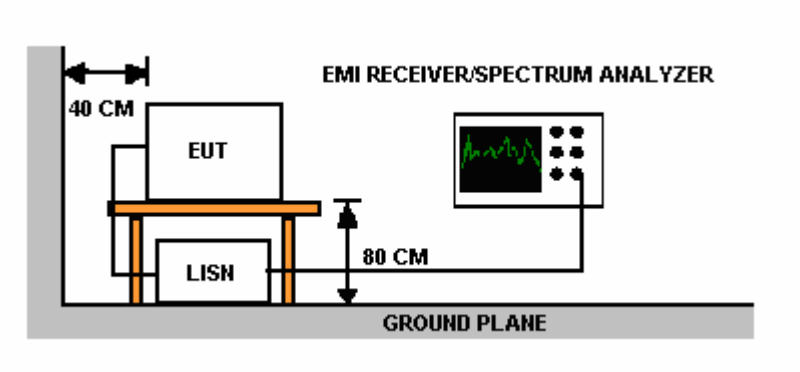


Figure 2 - Conducted Emissions Test Setup

For actual test configuration, see photographs in Appendix A

4.3.5 EUT operating conditions

The EUT was powered by a 5VDC power supply from CUI Inc., model number KA12D050055033U, Part number DPD050055-P13P-TK. Conducted emissions were measured on the input of this power supply while powering the EUT.

4.3.6 Test Results

EUT	Wireless Access Hub Wireless Portal Controller Wireless I/O Module	Model	nHUB nPORT-R1 nPORT-I/O
MODE	normal operation	FREQUENCY RANGE	150kHz – 30MHz
INPUT POWER (SYSTEM)	$5V_{DC}$	PHASE	Line, Neutral
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.

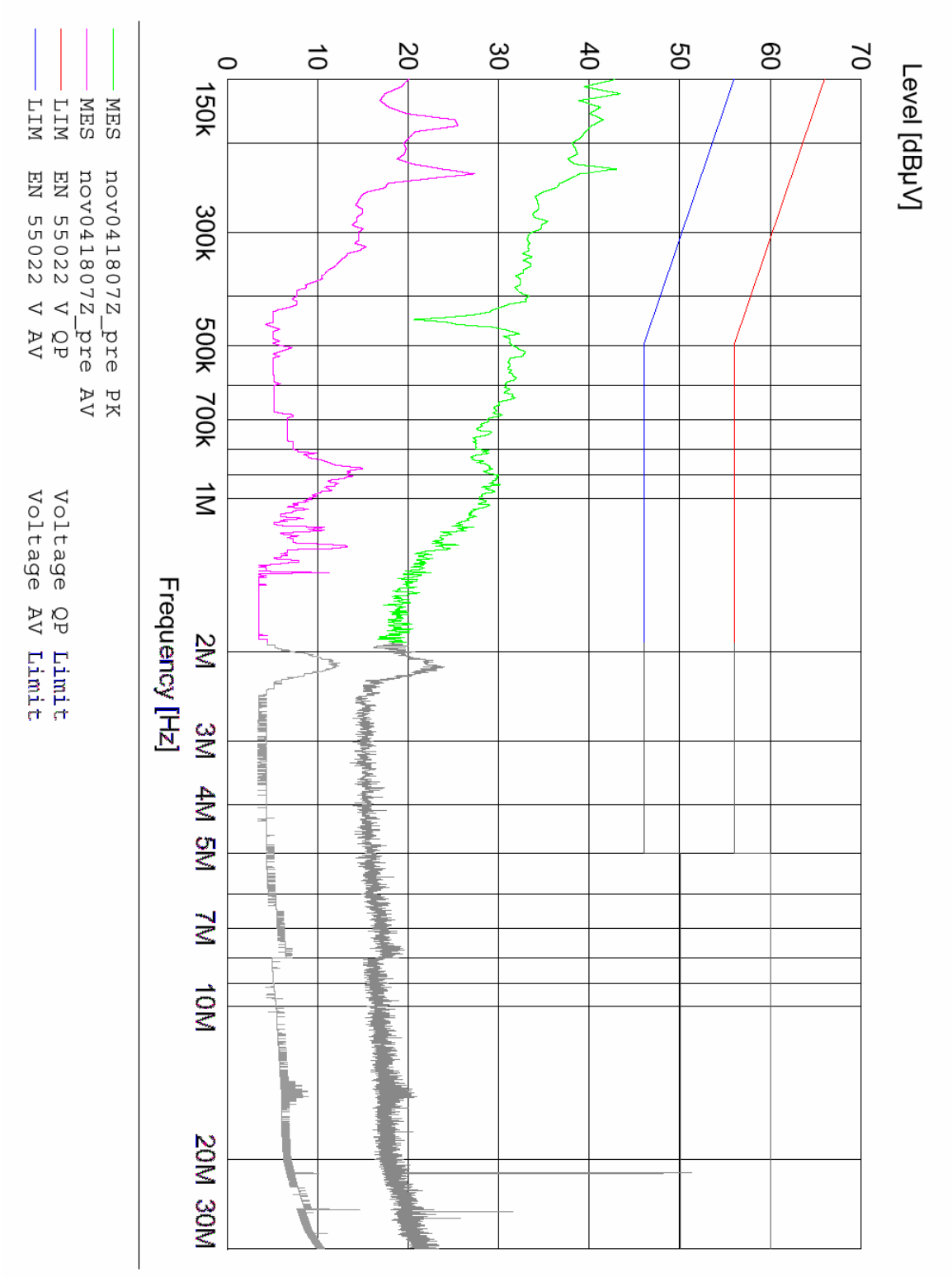


Figure 3 - Conducted Emissions Plot, nHUB

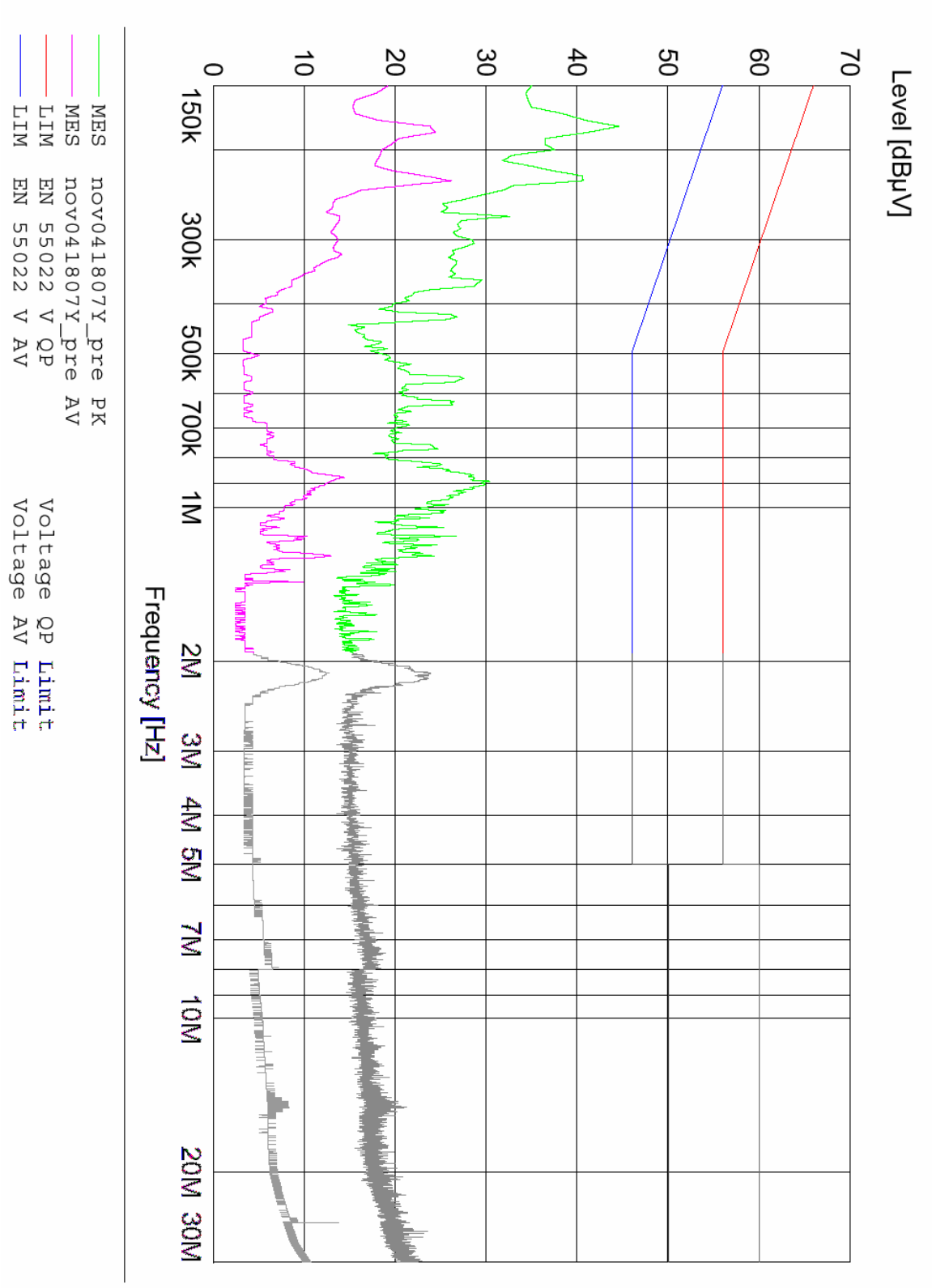


Figure 4 - Conducted Emissions Plot, Portal Controller

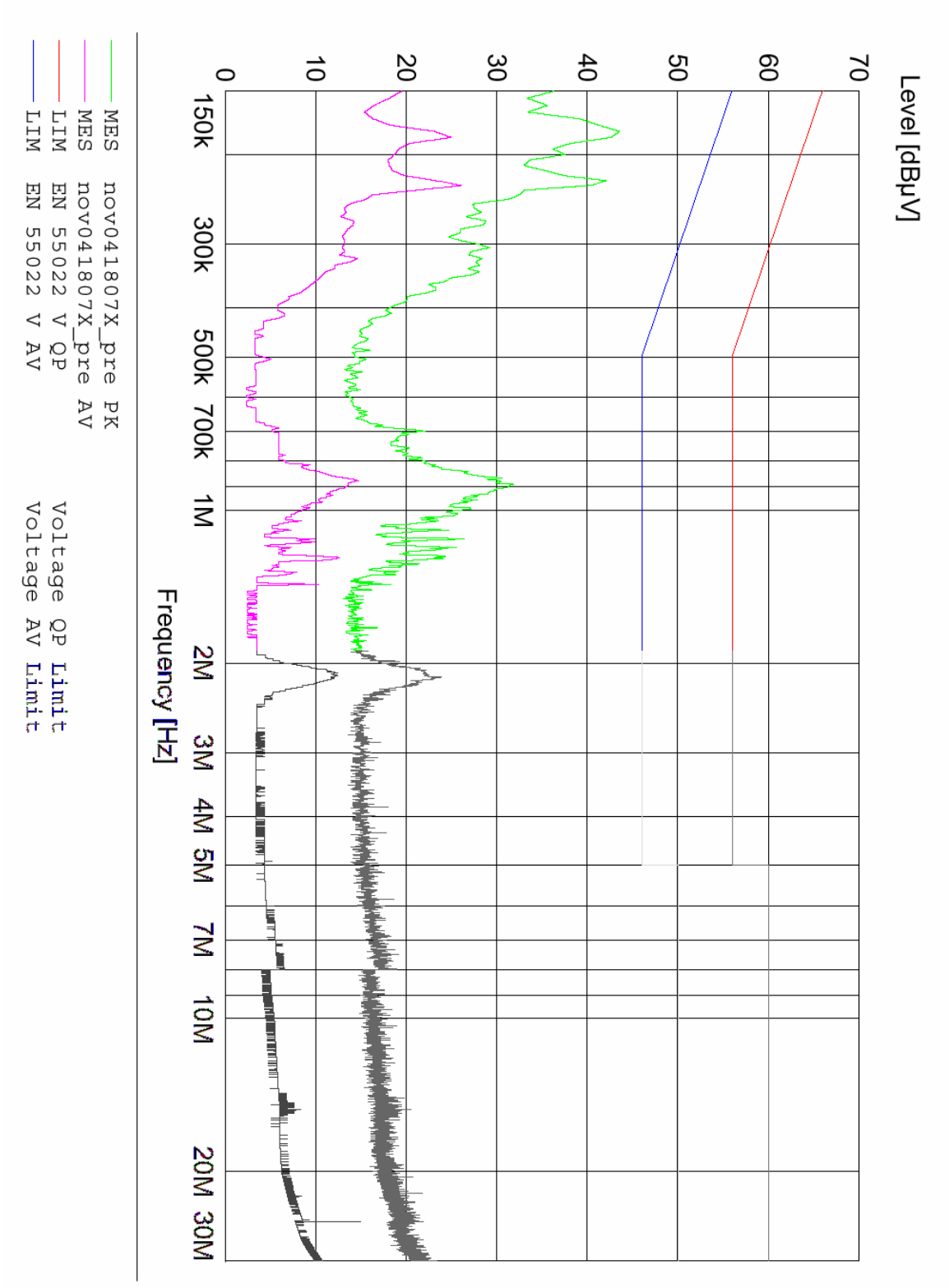


Figure 5 - Conducted Emissions Plot, I/O Controller

4.4 Bandwidth

4.4.1 Limits of bandwidth measurements

Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

4.4.2 Test procedures

The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with 100kHz RBW and 10MHz VBW. The 6dB bandwidth is defined as the bandwidth of which is higher than peak power minus 6dB.

4.4.3 Deviations from test standard

No deviation.

4.4.4 Test setup

4.4.5 EUT operating conditions

The EUT was programmed to operate at frequency at the lowest frequency and the highest frequency of its operational band and one frequency in the middle. It was powered by a 9VDC power supply.

4.4.6 Test results

EUT	Wireless Access Hub	MODEL	nHUB
INPUT POWER (SYSTEM)	$5V_{DC}$	ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC
TECHNICIAN	NJohnson	MODE	Continuous Transmit

CHANNEL	CHANNEL FREQUENCY (MHz)	6dB BW (kHz)	6dB Minimum LIMIT (kHz)	RESULT
0	902.769	629.969	500.00	PASS
16	914.806	630.506	500.00	PASS
31	926.090	633.530	500.00	PASS

REMARKS:

None

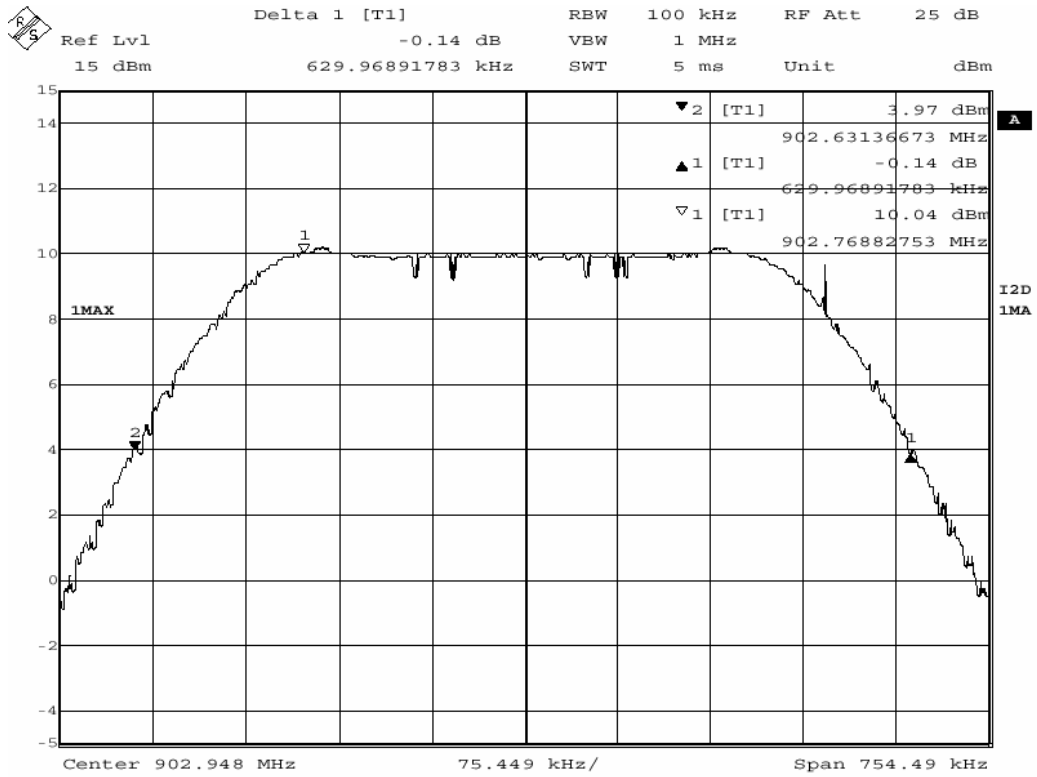


Figure 6 - 6dB Bandwidth, Channel 0

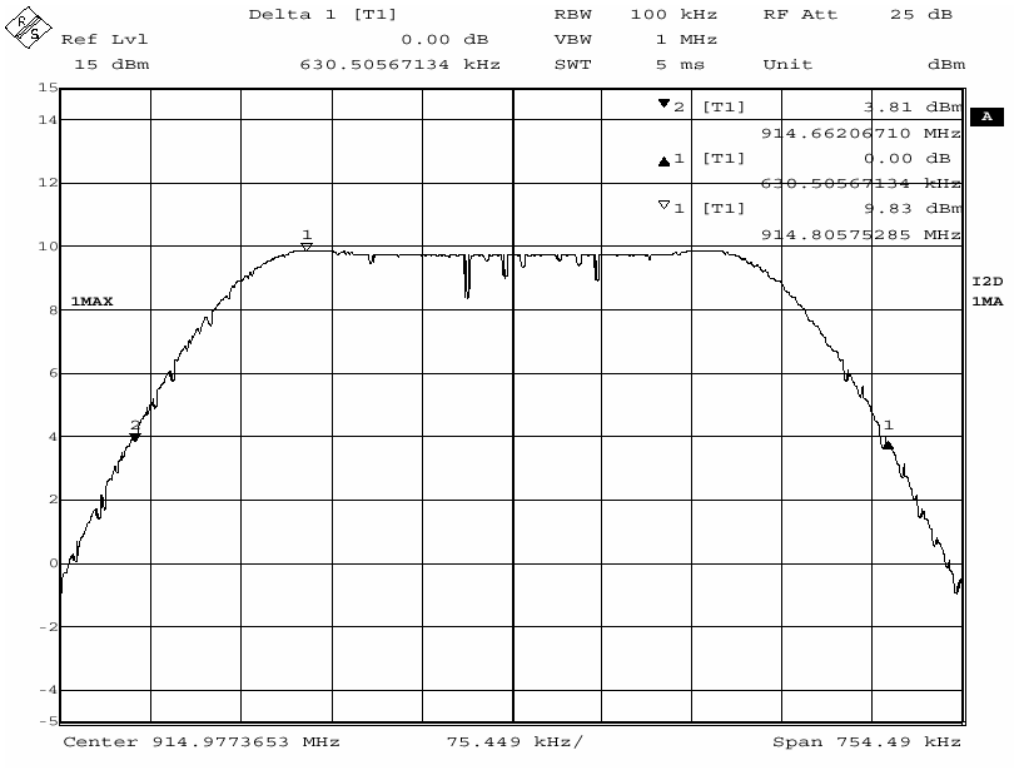


Figure 7 - 6dB Bandwidth, Channel 16

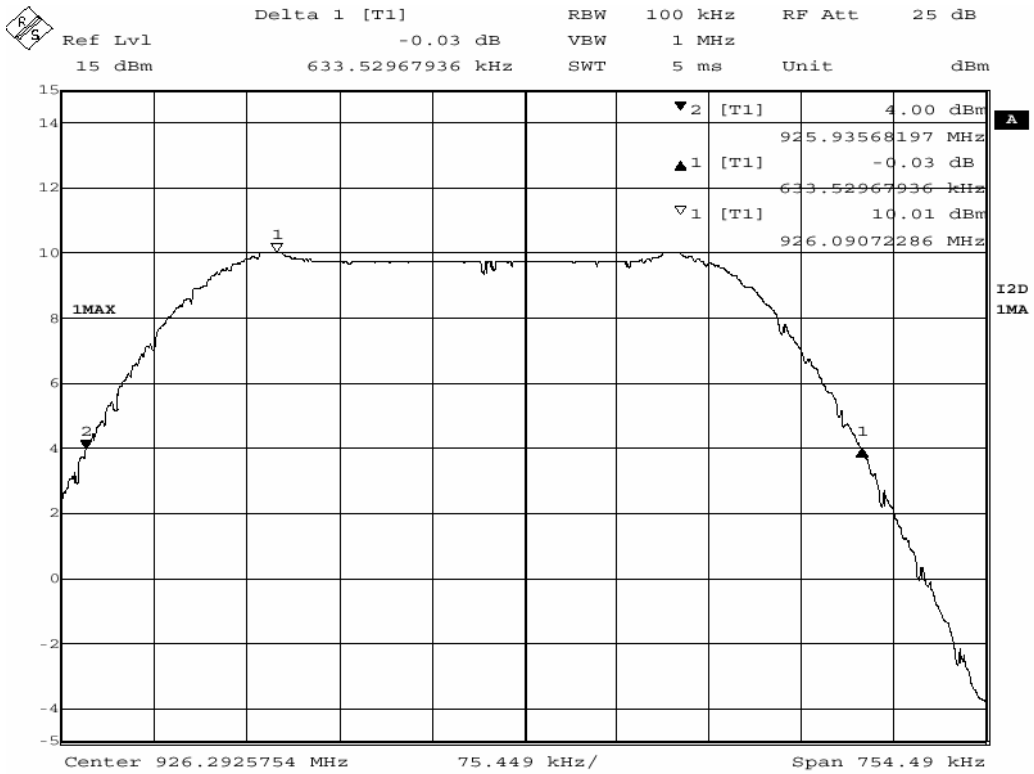


Figure 8 - 6dB Bandwidth, Channel 31

4.5 Maximum peak output power

4.5.1 Limits of power measurements

The maximum peak output power allowed is 30.0dBm (1W).

4.5.2 Test procedures

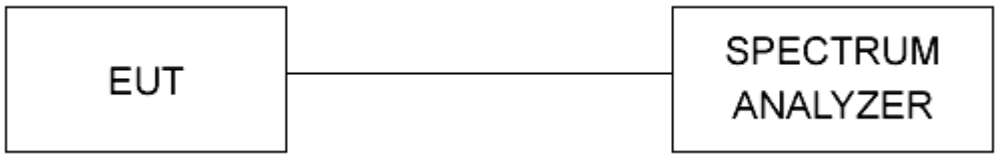
1. The EUT was connected to the spectrum analyzer directly with a low-loss shielded coaxial cable.

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.

4.5.3 Deviations from test standard

No deviation.

4.5.4 Test setup



4.5.5 EUT operating conditions

The EUT was programmed to operate at frequency at the lowest frequency and the highest frequency of its operational band and one frequency in the middle. It was powered by a 9VDC power supply.

4.5.6 Test results

Maximum peak output power

EUT	Wireless Access Hub	MODEL	nHUB
INPUT POWER (SYSTEM)	$5V_{DC}$	ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC
TECHNICIAN	NJohnson	MODE	Continuous transmit

CHANNEL	CHANNEL FREQUENCY (MHz)	PEAK POWER OUTPUT (dBm)	PEAK POWER LIMIT (dBm)	RESULT
0	902.777	10.13	30	PASS
16	914.803	9.99	30	PASS
31	926.091	9.86	30	PASS

REMARKS:

None

4.6 Bandedges

4.6.1 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.

4.6.2 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.

4.6.3 Deviations from test standard

No deviation.

4.6.4 Test setup

See 4.2.4

4.6.5 EUT operating conditions

The EUT was programmed to operate at frequency at the lowest frequency and the highest frequency of its operational band and one frequency in the middle. It was powered by a 9VDC power supply and tested in the upright position with each of two antenna options.

4.6.6 Test results

EUT	Wireless Access Hub	MODEL	nHUB
INPUT POWER (SYSTEM)	$5V_{DC}$	ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC
TECHNICIAN	NJohnson	MODE	Continuous transmit

Highest Out of Band Emissions

CHANNEL	Band edge/Measurement Frequency (MHz)	Edge QP Level	Delta	Limit (dBc)	Result
0	902 MHz, Fig. 9	80.59	42.75	20	PASS
32	928 MHz, Fig. 10	77.42	43.84	20	PASS

NOTE: The measurements above are uncorrected.

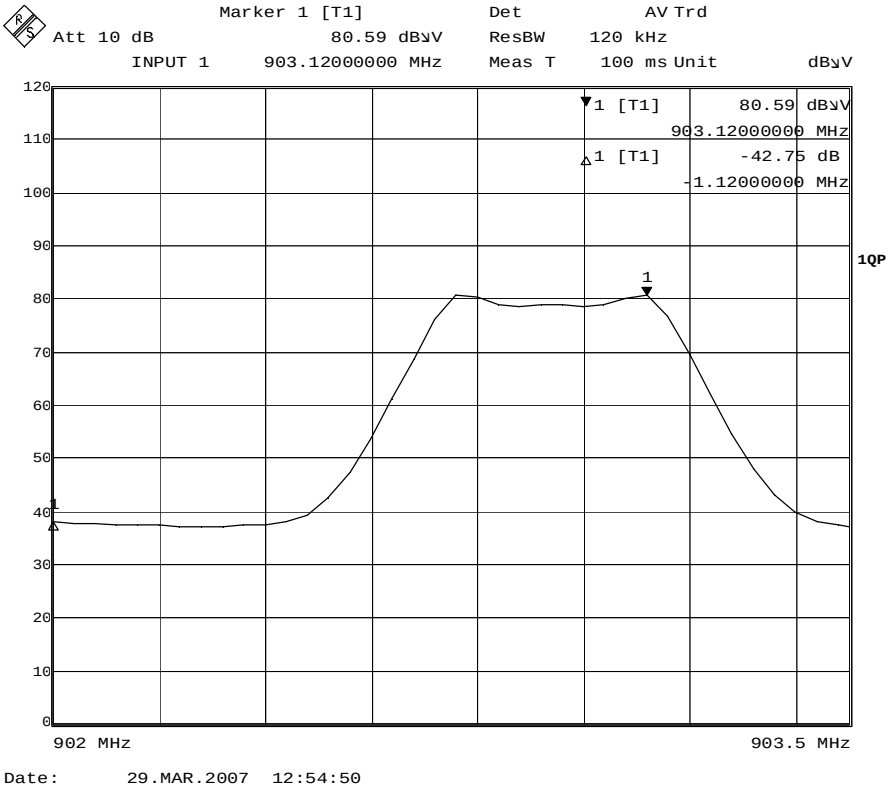


Figure 9 – Bandedge Measurement, 902MHz

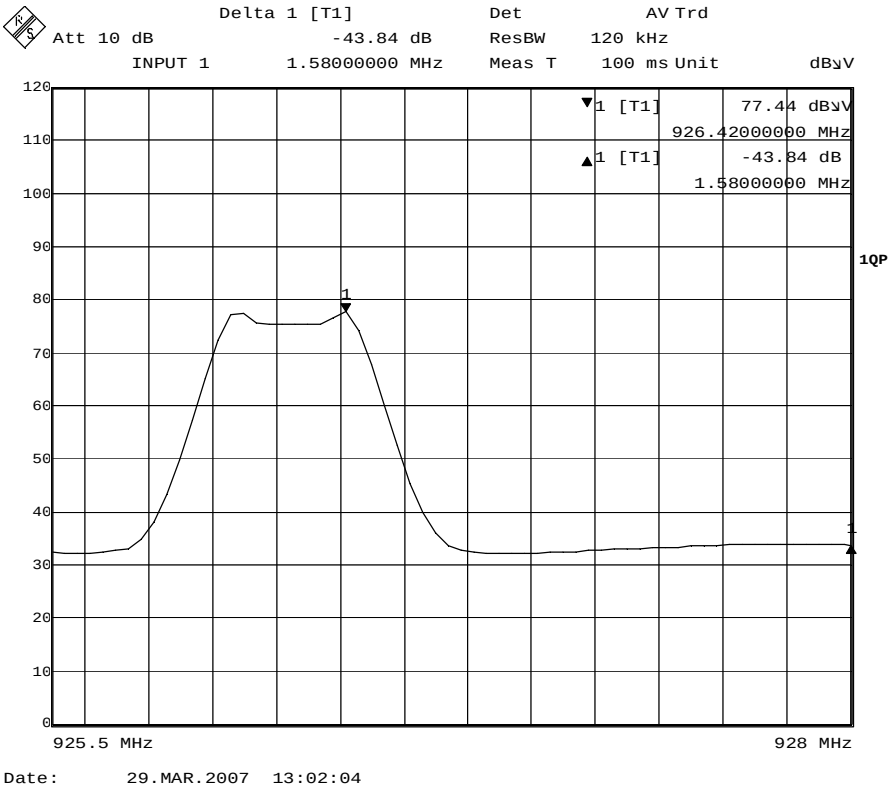


Figure 10 - Bandedge Measurement, 928Mhz

4.7 Power Spectral Density

4.6.1 Power spectral density measurements

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

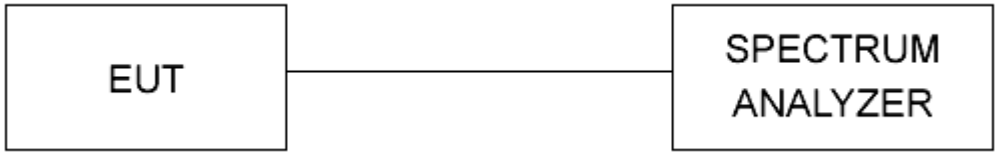
4.6.2 Test procedures

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

4.6.3 Deviations from test standard

No deviation.

4.6.4 Test setup



4.6.5 EUT operating conditions

The EUT was programmed to operate at frequency at the lowest frequency and the highest frequency of its operational band and one frequency in the middle. It was powered by a 9VDC power supply and tested in the upright position with each of two antenna options.

EUT	Wireless Access Hub	MODEL	nHUB
INPUT POWER (SYSTEM)	$5V_{DC}$	ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC
TECHNICIAN	NJohnson	MODE	Continuous transmit

Power Spectral Density

CHANNEL	CHANNEL FREQUENCY (MHz)	RF POWER LEVEL IN # KHz BW (dBm)	MAXIMUM POWER LIMIT (dBm)	RESULT
0	903.118	3.26	8.00	PASS
16	915.145	2.93	8.00	PASS
31	926.420	3.07	8.00	PASS

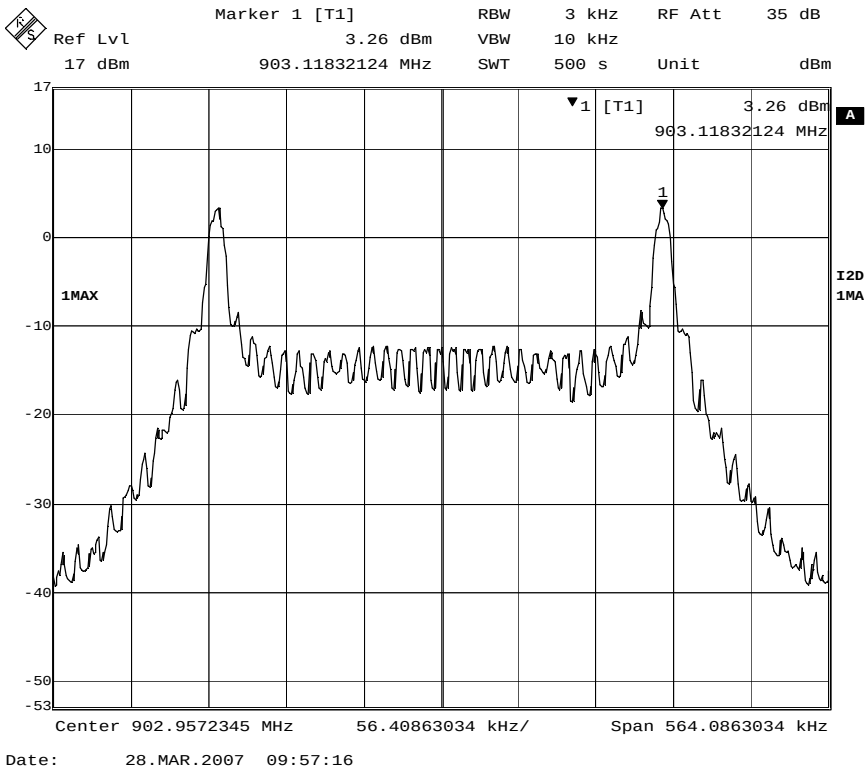


Figure 11 - PSD Measurement, Channel 0

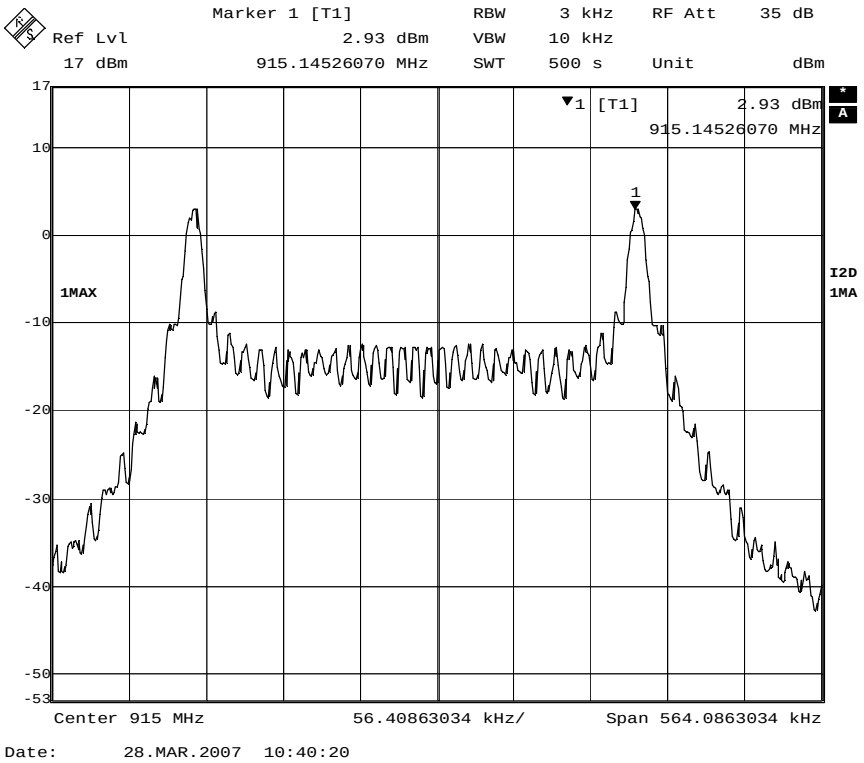


Figure 12 - PSD Measurement, Channel 16

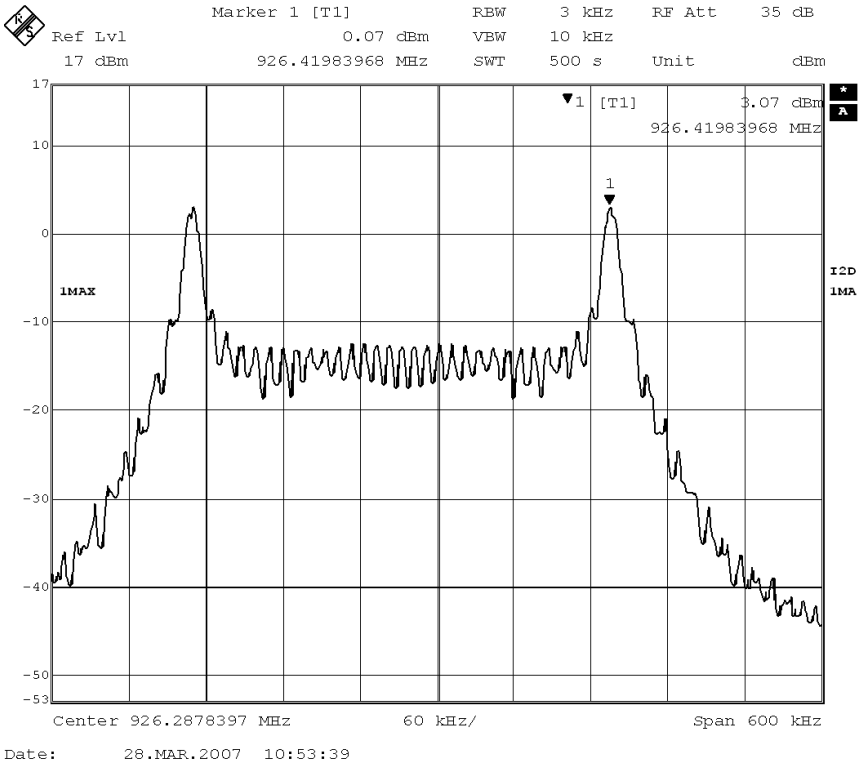


Figure 13 - PSD Measurement, Channel 31

Appendix A: Test Photos

Figure 14 - Radiated Emissions Test Setup, Dipole Antenna

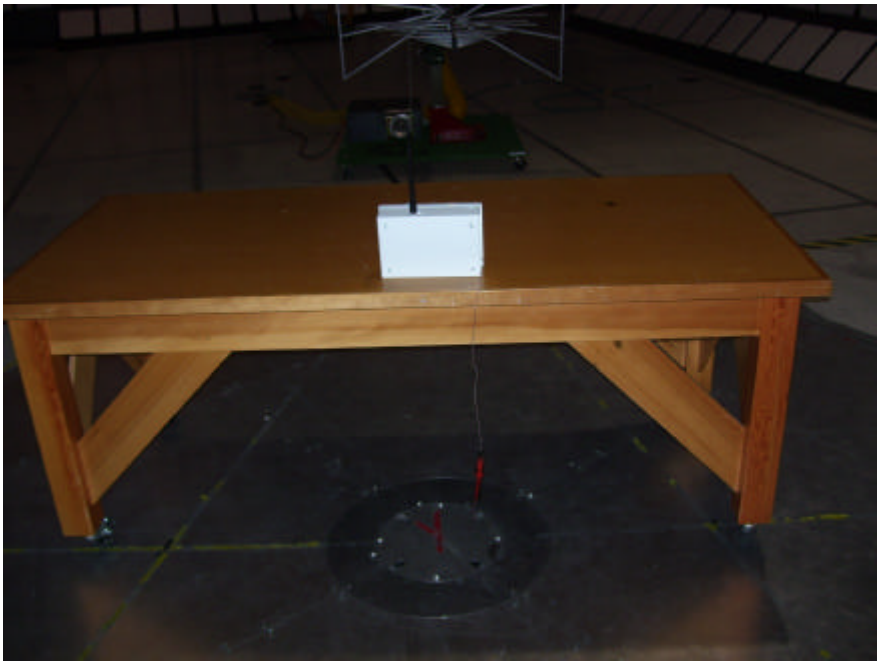


Figure 15 - Radiated Emissions Test Setup, Dipole Antenna

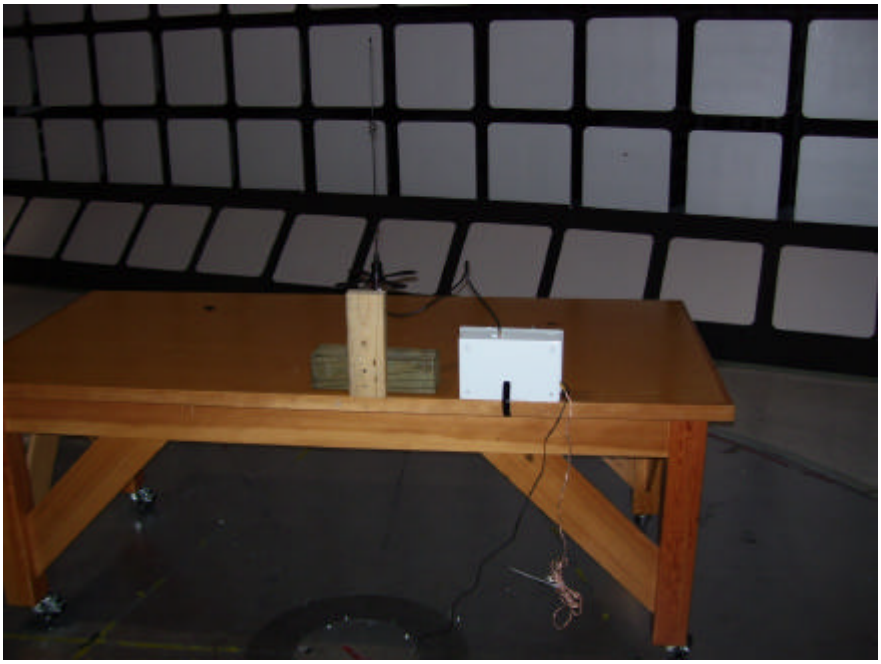


Figure 16 - Radiated Emissions, Whip Antenna

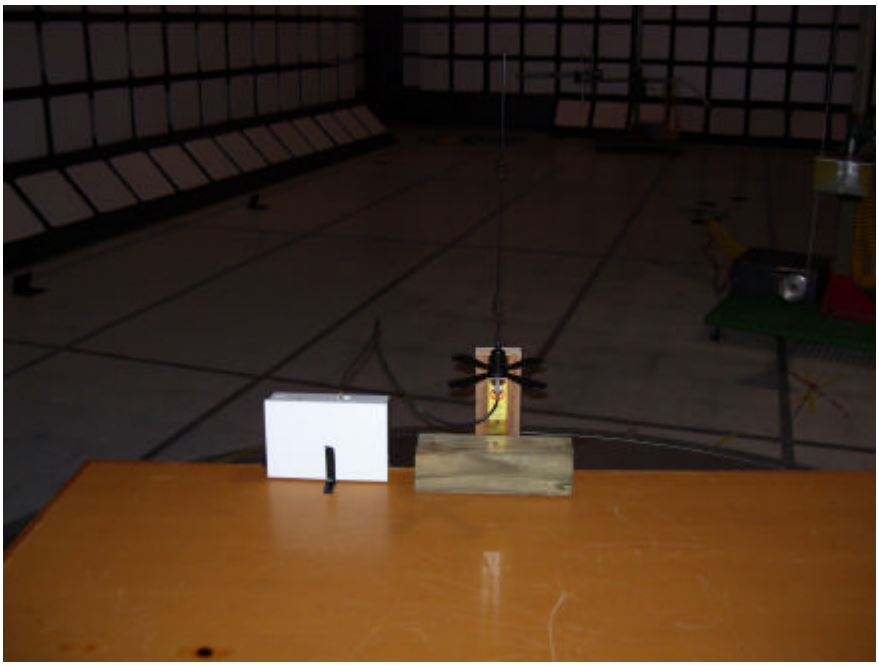


Figure 17 - Radiated Emissions, Whip Antenna

Figure 18 - 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.

Appendix C: RF Exposure Evaluation

FCC ID: U4NNHUB
RF Exposure Statement for U4NNHUB:

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 2.63cm (1.04 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 8dBi whip 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 902.78 MHz is found in mW/cm^2 using the equations f/1200. Since the operating frequency for channel 0 produced the lowest limit, that limit will be used in calculation. (902.78/1200 = 0.75mW/cm^2)

S = (Po * G) / (4 * Pi * r^2) or r = SQRT [(Po * G) / (4 * Pi * S)]

Where S = 0.75 mW/cm^2 for 915 MHz
Where Po = 10.3mW (Peak RF, 10.13dBm)
Where G = 6.31 (numeric equivalent to 8dBi antenna gain with 0.0 dB cable loss)
Where r = Minimum Safe Distance from antenna (cm)

For Po = 10.3mW, r = 2.63cm (1.04 inches)

For a distance [r] of 20cm from this antenna, the field density S = 0.013 mW/cm^2

Notes:
1. The minimum safe distance is based on a conservative “worst 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/cm^2 for the frequency 902.78 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

Appendix D: Table of Figures

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