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Test Report

Company:	Hetronic International 3905 NW 36th St. Oklahoma City, OK 73112
Contact:	Dave Cameron
Product:	RX_MFS-AC16R
FCC ID: IC:	LW9-RXMFS-AC16R 2119B-RXMFSAC16R
Test Report No:	R041511-01F
APPROVED BY:	Nic Johnson Test Engineer, iNARTE certification EMC-003337-NE
DATE:	14 October 2011
Total Pages:	50

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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	PCB 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)(2) RSS-210 Issue 8	Minimum Bandwidth, Limit: Min. 500kHz	Pass	Meets the requirement of the limit.
15.247(b) RSS-210 Issue 8	Maximum Peak Output Power, Limit: Max. 30dBm	Pass	Meets the requirement of the limit.
15.247(c) RSS-210 Issue 8	Transmitter Radiated Emissions, Limit: Table 15.209	Pass	Meets the requirement of the limit.
15.247(d) RSS-210 Issue 8	Power Spectral Density, Limit: Max. 8dBm	Pass	Meets the requirement of the limit.
15.247(c) RSS-210 Issue 8	Band Edge Measurement, Limit: 20dB less than the peak value of fundamental frequency	Pass	Meets the requirement of the limit.

Report was amended for NCEE Labs report R041808-01 to include peak radiated measurements calculated from maximum field strength measurements.

1.2 Test Methods

1.2.1 Conducted Emissions

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. 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.

1.3 Reason for amendment

Amendment B:
The description in Section 4.5 was modified to state that the calculation of peak output power were based on the maximum radiated output power from Section 4.2 and shown as EIRP. This was performed because output power measurements from the PCB trace antenna had too much mismatch loss and could not be accurately measured. The power on Page 5 was modified to match that maximum power listed in Section 4.5. All references to RSS 210 have been changed to Issue 8.

Amendment C:
A bandwidth correction factor was added to the maximum peak power measurements to account for a measurement resolution bandwidth that was less than the signal bandwidth.

Amendment D:
Added radiated measurements to demonstrate compliance to the restricted band at 2483.5MHz in Section 4.2, page 18.

Amendment E:
Added average measurement at fundamental frequency for Channel 15 to Section 4.2. Calculations were added to Section 4.7 to show compliance with restricted bands. Additional description was added to Figure 5 on page 18.

Amendment F: A typo was fixed on the description under Figure 17. Both were listed as average measurements. The one that was a peak measurement was changed to peak.

2.0 Description

2.1 Equipment under test

The Equipment Under Test (EUT) was a RXMFS-AC16R transmitter/receiver from Hetronic International.

EUT Received Date: 24 May 2011
EUT Tested Date: 2, 3 June 2011

MODEL	RXMFS-AC16R
MODULATION TYPE	DSSS
FREQUENCY RANGE	2405-2480MHz
NUMBER OF CHANNELS	16
MAXIMUM OUTPUT POWER	19.28dBm (84.72mW)
ANTENNA TYPE	Internal, PCB Trace
SERIAL NUMBER OF TEST UNIT	6 0311 163336

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	2405MHz
7	2440MHz
15	2480MHz

2.4 Applied standards

The EUT is a digital transmission device operating between 2400 MHz and 2483.5 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 and 15.209)
ANSI/IEEE C63.4: 2003
Industry Canada, RSS 210, Issue 8, Category I Equipment
KDB Publication No. 558074: 2005

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

2.5 Description of support units

None

2.6 Configuration of system under test

The EUT was supplied with 120VAC/60Hz directly to pins 1 (neutral) and 2 (line) of the 24-pin connector. The EUT firmware was modified by the manufacturer to transmit or receive continuously on channel 0, 7 or 15.

3.0 Test equipment used

DESCRIPTION AND MANUFACTURER	MODEL NO.	SERIAL NO.	LAST CALIBRATION DATE
Rohde & Schwarz Test Receiver	ESI26	100037	9/2/2010
EMCO Biconilog Antenna	3142B	1654	1/14/2011
EMCO Horn Antenna	3115	6415	1/12/2011
EMCO Horn Antenna	3116	2576	6/14/2011*
Rohde & Schwarz LISN	ESH3-Z5	100023	1/14/2011
Rohde & Schwarz Preamp	TS-PR18	082001/003	12/15/2010**
Trilithic High Pass Filter	6HC330	23042	12/15/2010**

*Calibrated after testing was complete. Transducer factors did not deviate beyond 0.25dB.
**Internally characterized.

4.0 Detailed results

4.1 Unique antenna requirement

4.1.1 Standard applicable

For intentional radiator 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 supplied with the EUT is an internal PCB trace antenna and is not removable.

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 (uV/m).
3. As shown in 15.35(b), for frequencies above 1000MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits by more than 20dB under any condition of modulation.

REMARKS:
1. Emission level (dBuV/m) = Raw Value (dBuV) + Correction Factor (dB)
2. Correction Factor (dB/m) = Antenna Factor (dB/m) + Cable Factor (dB)
3. The other emission levels were very low against the limit.
4. Margin value = Emission level – Limit value.
5. *Radiated limits according to 15.209 do not apply within the 2400MHz to 2483.5MHz band for transmitters.
6.**For frequencies not in a restricted band as specified in 15.205, spurious emissions shall be at least 20dB less than the field strength at the fundamental frequency.

4.2.2 Test procedures

a. The EUT was placed on the top of a rotating table 0.8 meters above the ground plane in a 10 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.

b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower. For measurements from 30MHz to 1GHz, the test distance was 10m

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. The EUT was tested in both flat and upright orientation (with respect to the circuit board). The flat position was found to produce the highest emissions, so it was used for all measurements. Where measurements were within 4dB of the margin, the EUT was retested in both orientations to find the highest emissions.

d. For each suspected emission, the EUT was arranged to maximize its emissions and then the antenna height was varied from 1 meter to 4 meters and the rotating table was turned from 0 degrees to 360 degrees to find the maximum emission reading.

e. The test-receiver system was set to use a peak detector with a specified resolution bandwidth. For spectrum analyzer measurements, the composite maximum of several analyzer sweeps was used for final measurements.

f. If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10 dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

NOTE:
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Peak detection (PK) and Quasi-peak detection (QP) at frequencies below 1GHz.

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

4.2.3 Deviations from test standard

No deviation.

4.2.4 Test setup

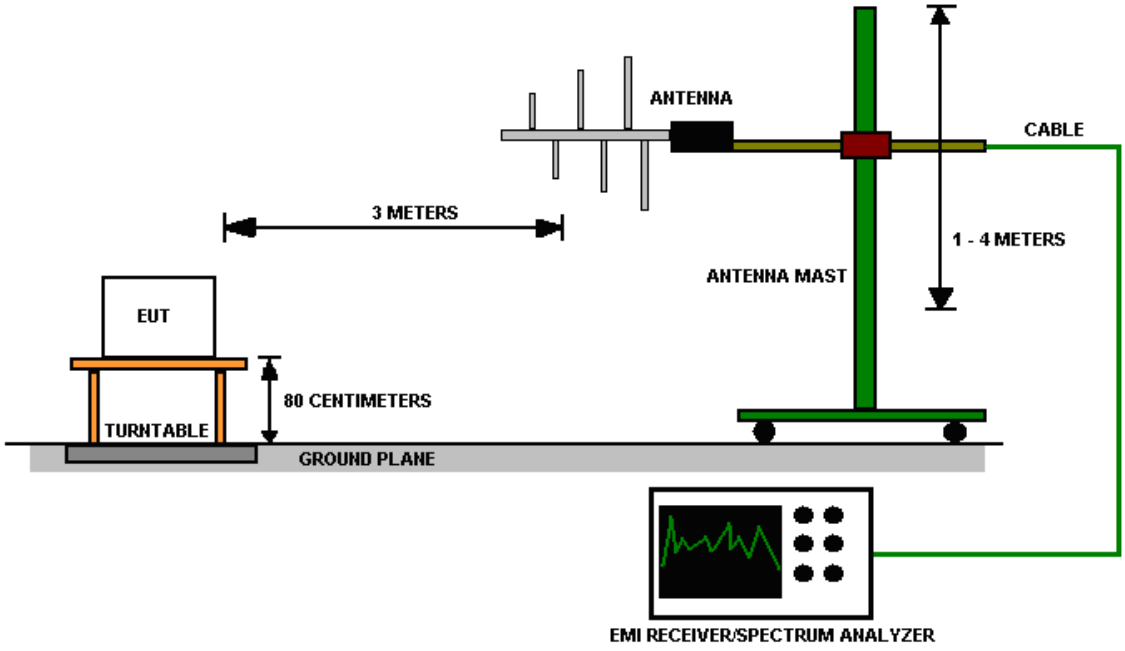


Figure 1 - Radiated Emissions Test Setup

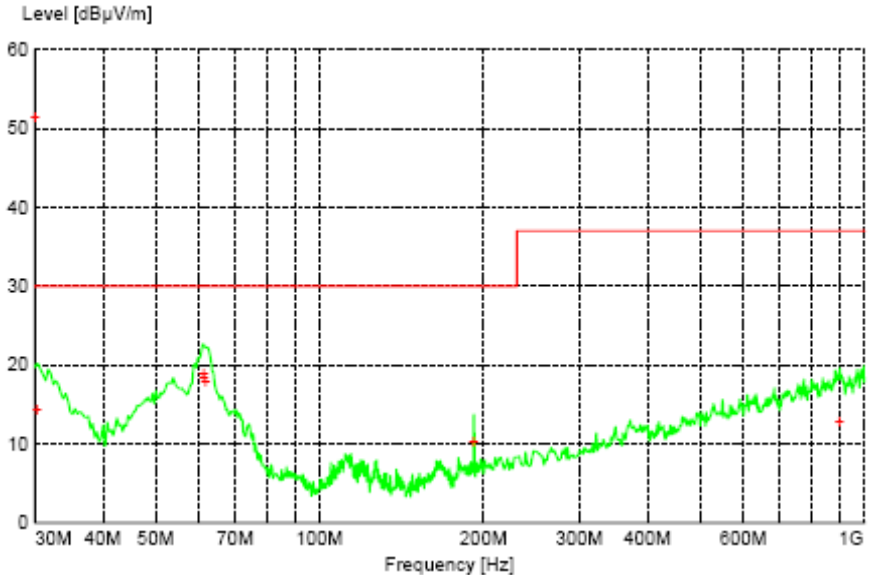
For the actual test configuration, please refer to Appendix A for photographs of the test configuration.

4.2.5 EUT operating conditions

The EUT was supplied with 120VAC/60Hz directly to pins 1 (neutral) and 2 (line) of the 24-pin connector. The EUT firmware was modified by the manufacturer to transmit or receive continuously on channel 0, 7 or 15.

4.2.6 Test results

EUT	AC16R	Model	RXMFS-AC16R
MODE	Transmit, Ch 0	FREQUENCY RANGE	30MHz – 1GHz
INPUT POWER (SYSTEM)	120VAC/60Hz	ORIENTATION	Vertical/Horizontal
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson



Limit Line Shown on plot does not correlate with table below.

Figure 2 - Radiated Emissions Plot, Channel 0, 30MHz – 1GHz

Quasi-peak Measurements, Channel 0

Frequency	Level	Limit	Margin	Height	Angle	Pol.
MHz	dBµV/m	dBµV/m	dB	Cm	deg	
30.3000	14.56	29.50	14.94	169	225	HORI
61.3200	19.13	29.50	10.37	250	0	VERT
61.3800	18.57	29.50	10.93	249	0	VERT
61.7400	18.19	29.50	11.31	250	341	VERT
191.7000	10.47	33.00	22.53	149	45	VERT
901.6000	13.07	35.50	22.43	199	1	VERT

Average Measurements, Channel 0

Frequency	Level	Limit	Margin	Height	Angle	Pol.
MHz	dBµV/m	dBµV/m	dB	Cm	deg	
4809.5000	47.27	54.00	6.70	166	232	VERT
7216.5000	55.43	81.14*	25.71	174	201	VERT
9622.0000	52.32	81.44*	29.12	210	198	VERT

Peak Measurements, Channel 0

Frequency	Level	Limit	Margin	Height	Angle	Pol.
MHz	dBµV/m	dBµV/m	dB	cm	deg	
2405.5000	104.48	NA**	NA	179	133	HORI
4809.5000	60.63	74.00	13.37	166	232	VERT
7216.5000	65.55	104.48*	38.93	174	201	VERT
9622.0000	60.14	104.48*	44.34	210	198	VERT

*Unrestricted bands. Emissions are required to be at least 20dB below the fundamental carrier according to FCC Part 15.247.

**Fundamental Frequency. Field strength limits do not apply.

EUT	AC16R	Model	RXMFS-AC16R
MODE	Transmit, Ch 7	FREQUENCY RANGE	30MHz – 1GHz
INPUT POWER (SYSTEM)	120VAC/60Hz	ORIENTATION	Vertical/Horizontal
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

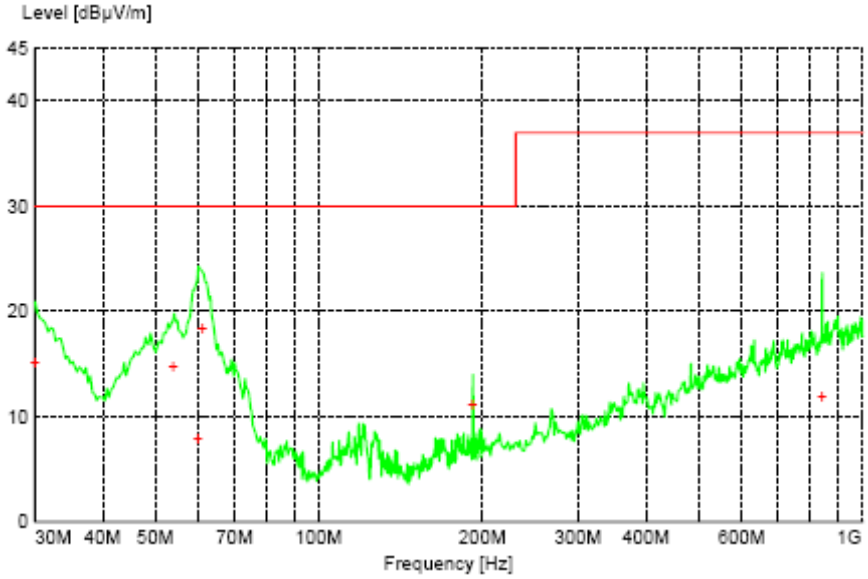


Figure 3 - Radiated Emissions Plot, Channel 7, 30MHz - 1GHz

Limit Line Shown on plot does not correlate with table below.

Quasi-peak Measurements, Channel 7

Frequency	Level	Limit	Margin	Height	Angle	Pol.
MHz	dBµV/m	dBµV/m	dB	cm	deg	
30.0000	15.21	29.50	14.29	129	178	HORI
54.0000	14.84	29.50	14.66	109	87	VERT
59.9400	8.04	29.50	21.46	399	358	VERT
61.0800	18.59	29.50	10.91	250	45	VERT
191.6400	11.29	33.50	22.21	250	9	VERT
842.8600	12.11	35.50	23.39	220	58	VERT

Average Measurements, Channel 7

Frequency	Level	Limit	Margin	Height	Angle	Pol.
MHz	dBµV/m	dBµV/m	dB	Cm	deg	
4881.5000	49.09	54.00	4.90	115	241	VERT
7319.5000	52.78	54.00	1.27	185	106	VERT
9763.0000	51.74	54.00	2.26	100	158	VERT

Peak Measurements, Channel 7

Frequency	Level	Limit	Margin	Height	Angle	Pol.
MHz	dBµV/m	dBµV/m	dB	cm	deg	
2440.0000	105.65	NA	NA	99	240	VERT
4881.5000	55.65	74.00	18.35	115	241	VERT
7319.5000	61.21	74.00	12.79	185	106	VERT
9763.0000	59.26	74.00	14.74	100	158	VERT

*Unrestricted bands. Emissions are required to be at least 20dB below the fundamental carrier according to FCC Part 15.247.

**Fundamental Frequency. Field strength limits do not apply.

EUT	AC16R	Model	RXMFS-AC16R
MODE	Transmit, Ch 15	FREQUENCY RANGE	30MHz – 1GHz
INPUT POWER (SYSTEM)	120VAC/60Hz	ORIENTATION	Vertical/Horizontal
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

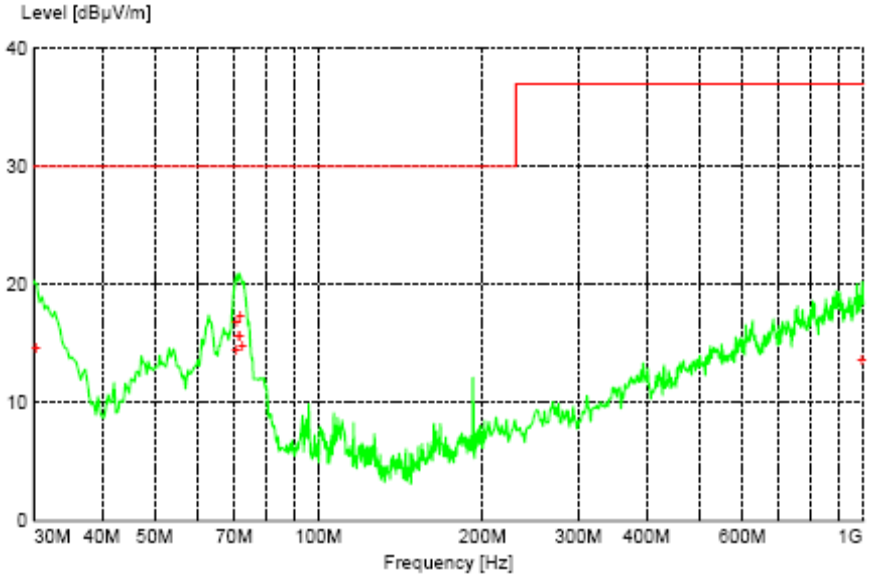


Figure 4 - Radiated Emissions Plot, Channel 15, 30MHz-1GHz

Limit Line Shown on plot does not correlate with table below.

Quasi-peak Measurements, Channel 15

Frequency	Level	Limit	Margin	Height	Angle	Pol.
MHz	dBµV/m	dBµV/m	dB	cm	deg	
30.3000	14.81	29.50	14.69	350	95	HORI
70.6200	14.57	29.50	14.93	220	351	VERT
70.6800	16.89	29.50	12.61	243	0	VERT
71.4000	15.77	29.50	13.73	400	36	VERT
71.6400	15.80	29.50	13.70	352	57	VERT
71.8200	17.39	29.50	12.11	400	1	VERT
72.4200	14.96	29.50	14.54	400	0	VERT
994.1800	13.79	46.00	32.21	150	166	HORI

Average Measurements, Channel 15

Frequency	Level	Limit	Margin	Height	Angle	Pol.
MHz	dBµV/m	dBµV/m	dB	Cm	deg	
2479.0255	87.27**	NA*	NA	138	119	HORI
4961.5000	41.60	54.00	12.40	115	238	VERT
7442.5000	52.57	54.00	1.40	139	185	HORI
9919.0000	51.21	54.00	2.80	131	216	VERT

Peak Measurements, Channel 15

Frequency	Level	Limit	Margin	Height	Angle	Pol.
MHz	dBµV/m	dBµV/m	dB	cm	deg	
2481.0000	100.29	NA*	NA	138	119	HORI
4961.5000	49.39	74.00	24.61	115	238	VERT
7442.5000	60.17	74.00	13.83	139	185	HORI
9919.0000	60.07	74.00	13.93	131	216	VERT

*Fundamental Frequency. Field strength limits do not apply.
**Measured with 1MHz Resolution bandwidth and 10Hz VBW. The transmitter was continuously transmitting, so calculating the average value based on a duty cycle correction factor was not possible. This value is used for the band edge calculations in Section 4.7 to show compliance with the restricted band at 2483.5MHz.

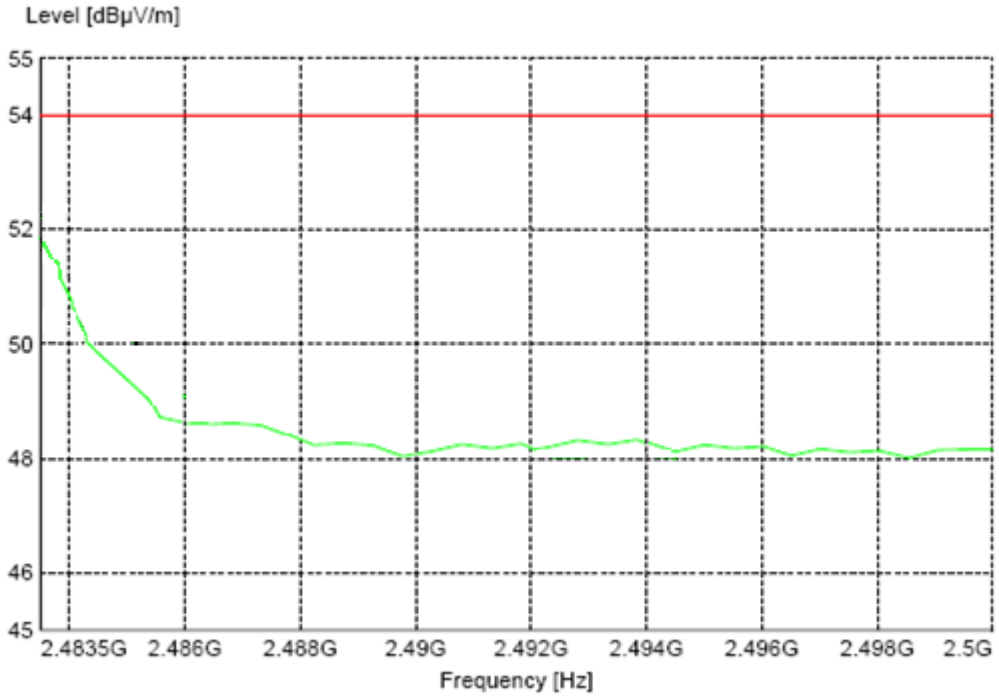


Figure 5 - 2483.5-2500MHz Peak Scan

All measurements taken 1m height and 119deg angle, where the highest emissions were found. The antenna polarization was horizontal. RBW = 1MHz, VBW=1MHz.

Peak measurements were found to be compliant with the average limits. The data in Figure 5 is intended to show compliance across the 2483.5 – 2500.00MHz restricted band.

EUT	AC16R	Model	RXMFS-AC16R
MODE	Receive, Ch. 0	FREQUENCY RANGE	30MHz – 1GHz
INPUT POWER (SYSTEM)	120VAC/60Hz	ORIENTATION	Vertical/Horizontal
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson

Quasi-peak Measurements, Receive

Frequency	Level	Limit	Margin	Height	Angle	Pol.
MHz	dBµV/m	dBµV/m	dB	cm	deg	
30.3000	14.56	29.50	14.94	169	225	HORI
61.3200	19.13	29.50	10.37	250	0	VERT
61.3800	18.57	29.50	10.93	249	0	VERT
61.7400	18.19	29.50	11.31	250	341	VERT
191.7000	10.47	33.00	22.53	149	45	VERT
901.6000	13.07	35.50	22.43	199	1	VERT

Note: The limits were extrapolated to 10m.

Average Measurements, Receive

Frequency	Level	Limit	Margin	Height	Angle	Pol.
MHz	dBµV/m	dBµV/m	dB	cm	deg	
2390.5000	19.80	54.00	34.20	200	280	VERT
4801.5000	25.61	54.00	28.40	163	124	HORI
7181.5000	31.53	54.00	22.50	400	50	HORI
9602.5000	34.96	54.00	19.00	370	97	HORI
12020.5000	37.80	54.00	16.20	100	302	HORI

Peak Measurements, Receive

Frequency	Level	Limit	Margin	Height	Angle	Pol.
MHz	dBµV/m	dBµV/m	dB	cm	deg	
2390.5000	32.55	74.00	41.45	200	280	VERT
4801.5000	39.02	74.00	34.98	163	124	HORI
7181.5000	44.90	74.00	29.10	400	50	HORI
9602.5000	48.46	74.00	25.54	370	97	HORI
12020.5000	50.99	74.00	23.01	100	302	HORI

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

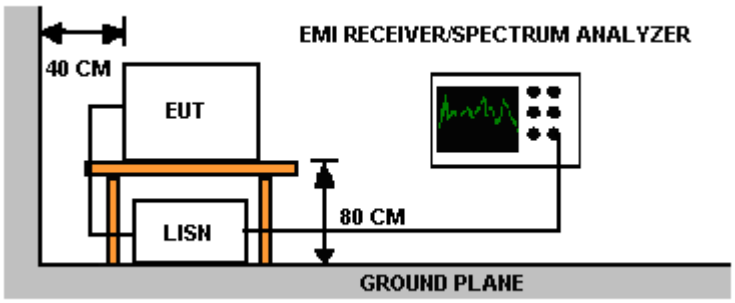


Figure 6 - Conducted Emissions Test Setup

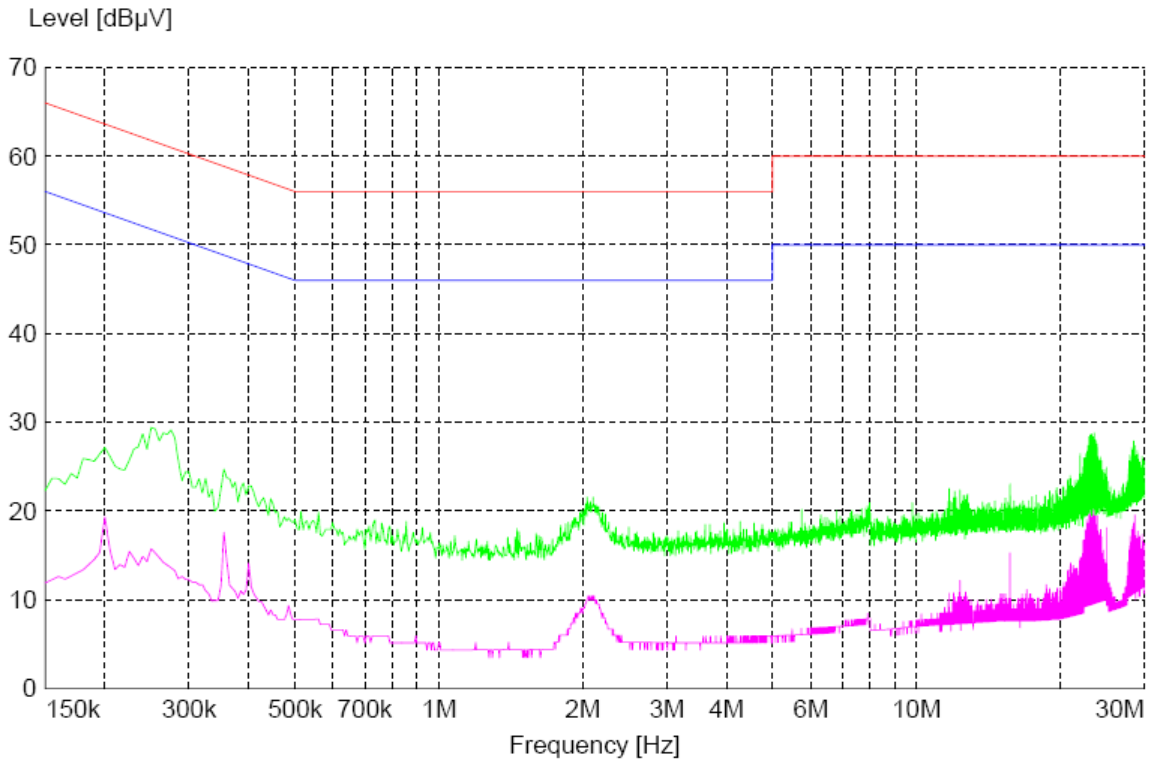
For actual test configuration, see photographs in Appendix A

4.3.5 EUT operating conditions

The EUT was supplied with 120VAC/60Hz directly to pins 1 (neutral) and 2 (line) of the 24-pin connector. The EUT firmware was modified by the manufacturer to transmit or receive continuously on channel 0, 7 or 15.

4.3.6 Test Results

EUT	AC16R	Model	RXMFS-AC16R
MODE	Transmit, Ch 0	FREQUENCY RANGE	150kHz – 30MHz
INPUT POWER (SYSTEM)	120VAC/60	PHASE	Line, Neutral
ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC	TECHNICIAN	NJohnson



REMARKS:
1. Q.P. measurements are in green, average measurements are in magenta.
2.All emission levels were very low against the limit.

4.4 Bandwidth

4.4.1 Limits of bandwidth measurements

The 6dB bandwidth of the signal must be greater than 0.50MHz

4.4.2 Test procedures

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

The 99% occupied is defined as the bandwidth at which 99% of the signal power is found. This corresponds to 20dB down from the maximum power level. The maximum power was measured with the largest resolution bandwidth possible (10MHz) and this value was recorded. The signal was then captured with a 100kHz resolution bandwidth and the frequencies where the measurements were 20dB below the maximum power were marked. The bandwidth between these frequencies was recorded as the 99% occupied bandwidth.

4.4.3 Deviations from test standard

No deviation.

4.4.4 Test setup

4.4.5 EUT operating conditions

The EUT was supplied with 120VAC/60Hz directly to pins 1 (neutral) and 2 (line) of the 24-pin connector. The EUT firmware was modified by the manufacturer to transmit or receive continuously on channel 0, 7 or 15.

4.4.6 Test results

EUT	AC16R	Model	RXMFS-AC16R
INPUT POWER (SYSTEM)	120VAC/60Hz	ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC
TECHNICIAN	NJohnson	MODE	Continuous Transmit

CHANNEL	CHANNEL FREQUENCY (MHz)	6dB BW (kHz)	6dB MINIMUM LIMIT (kHz)	99% Occupied BW (kHz)	RESULT
0	2405	1.6032	500.00	2485	PASS
7	2440	1.6834	500.00	2645	PASS
15	2480	1.3226	500.00	2645	PASS

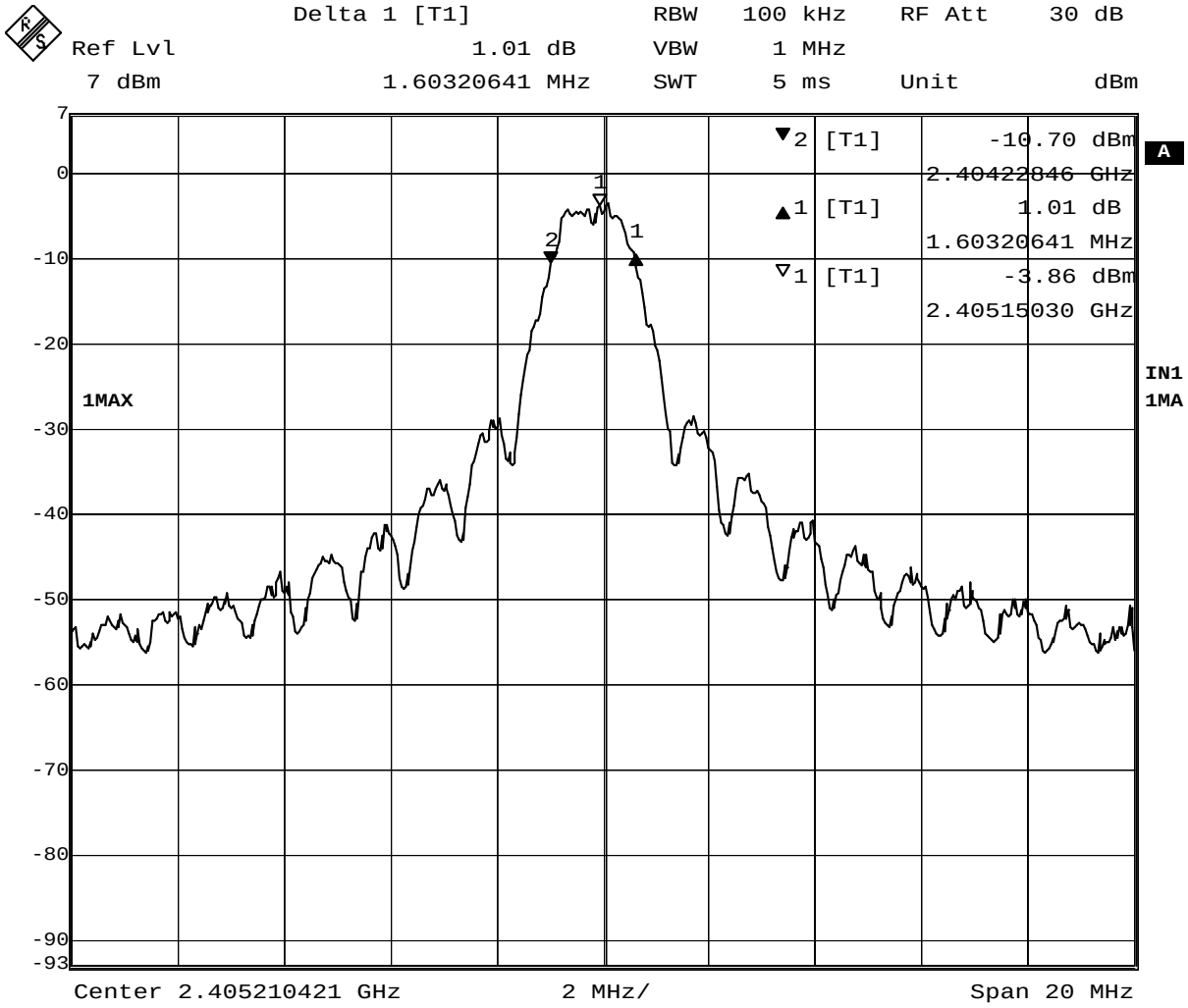


Figure 7 - 6dB Bandwidth, Channel 0

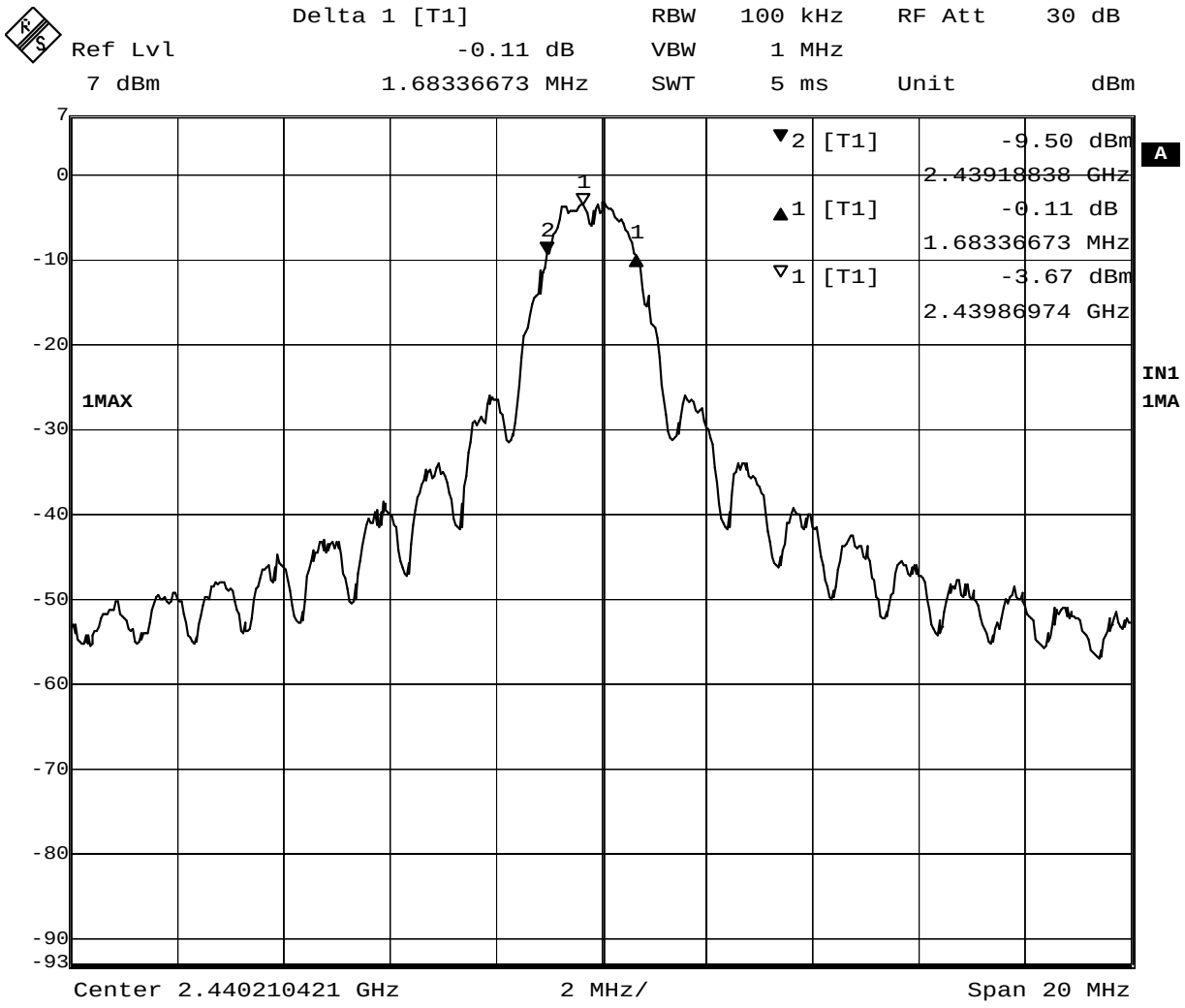


Figure 8 - 6dB Bandwidth, Channel 7

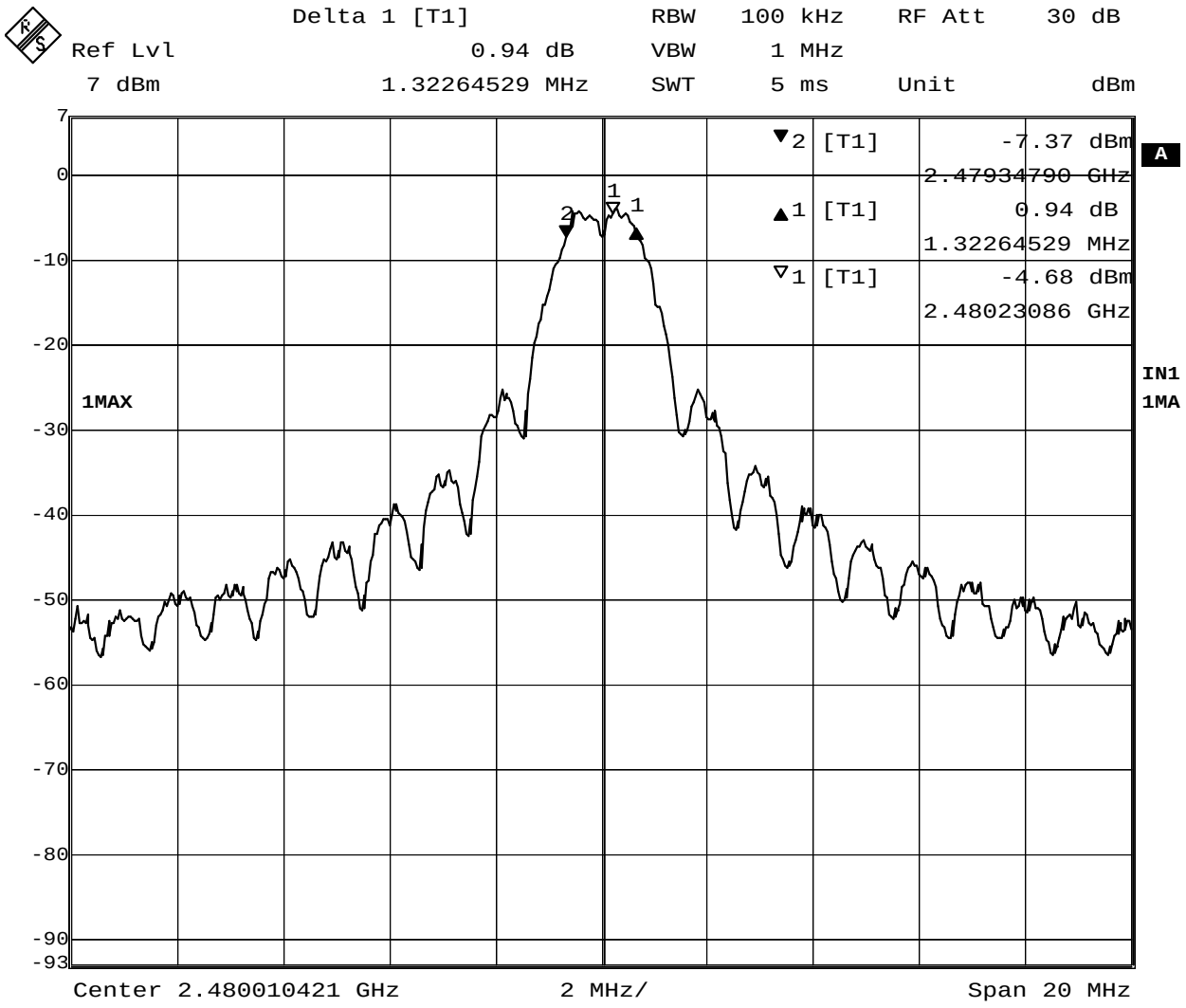


Figure 9 - 6dB Bandwidth, Channel 15

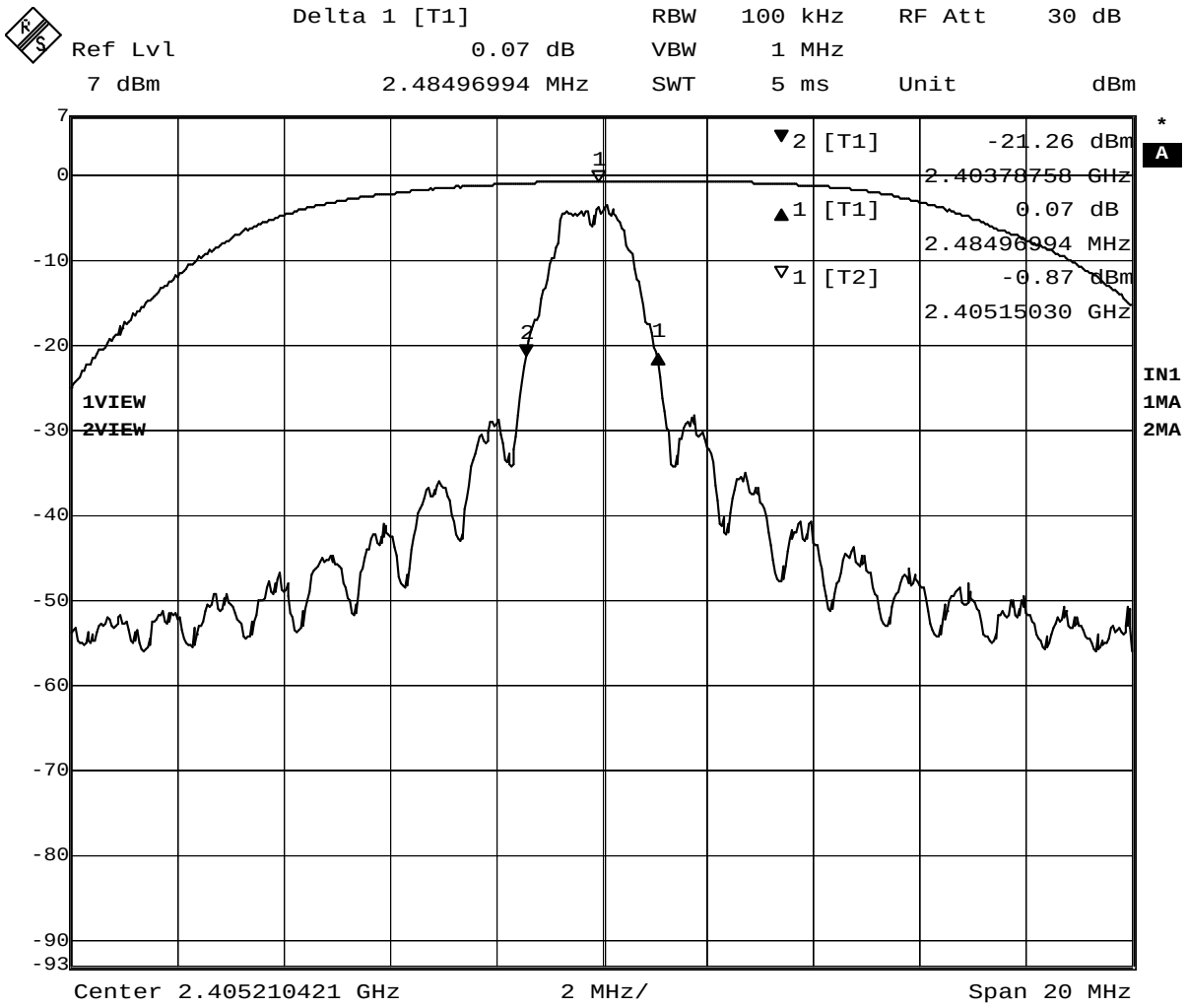


Figure 10 - 99% Occupied Bandwidth, Channel 0

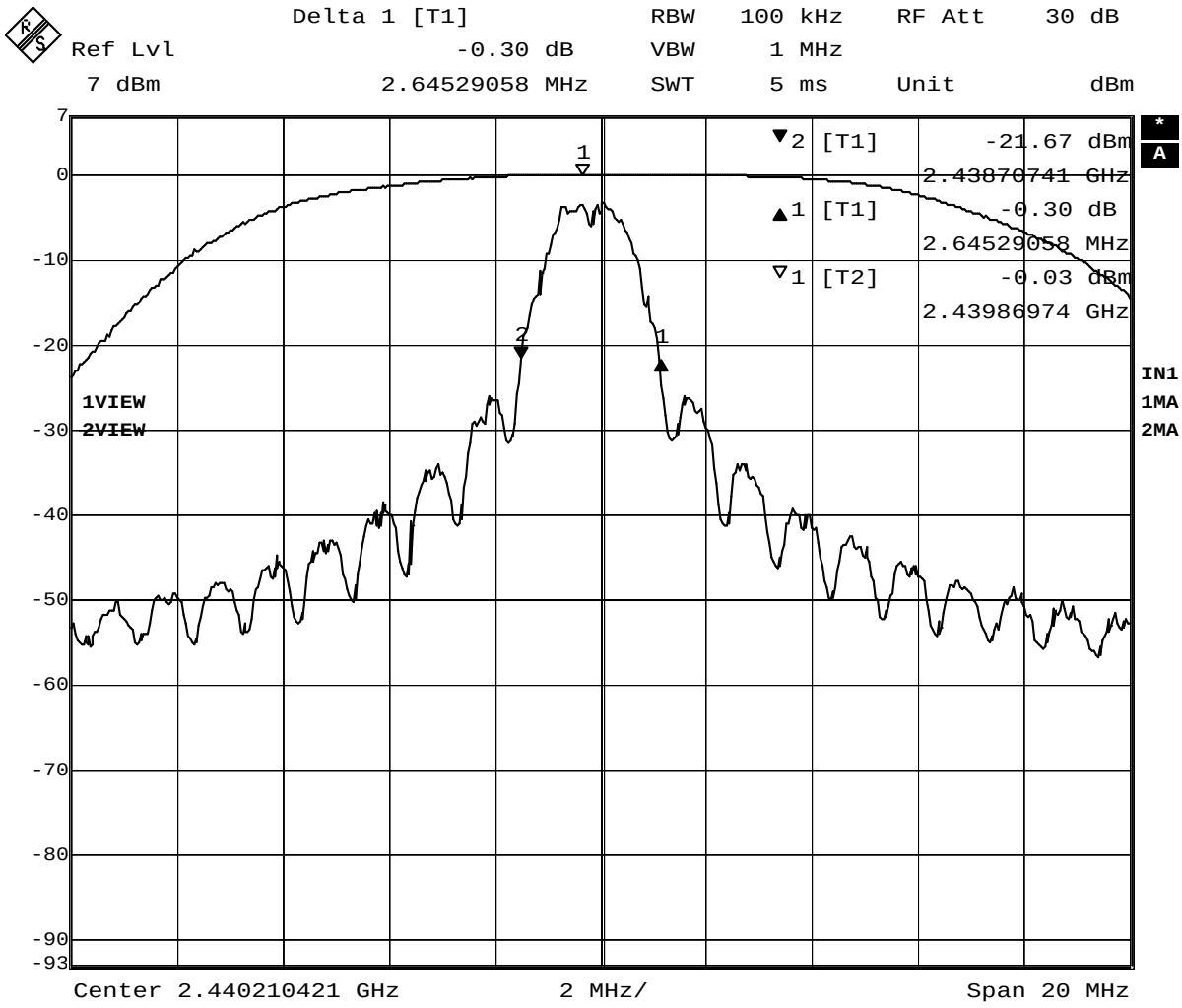


Figure 11 - 99% Occupied Bandwidth, Channel 7

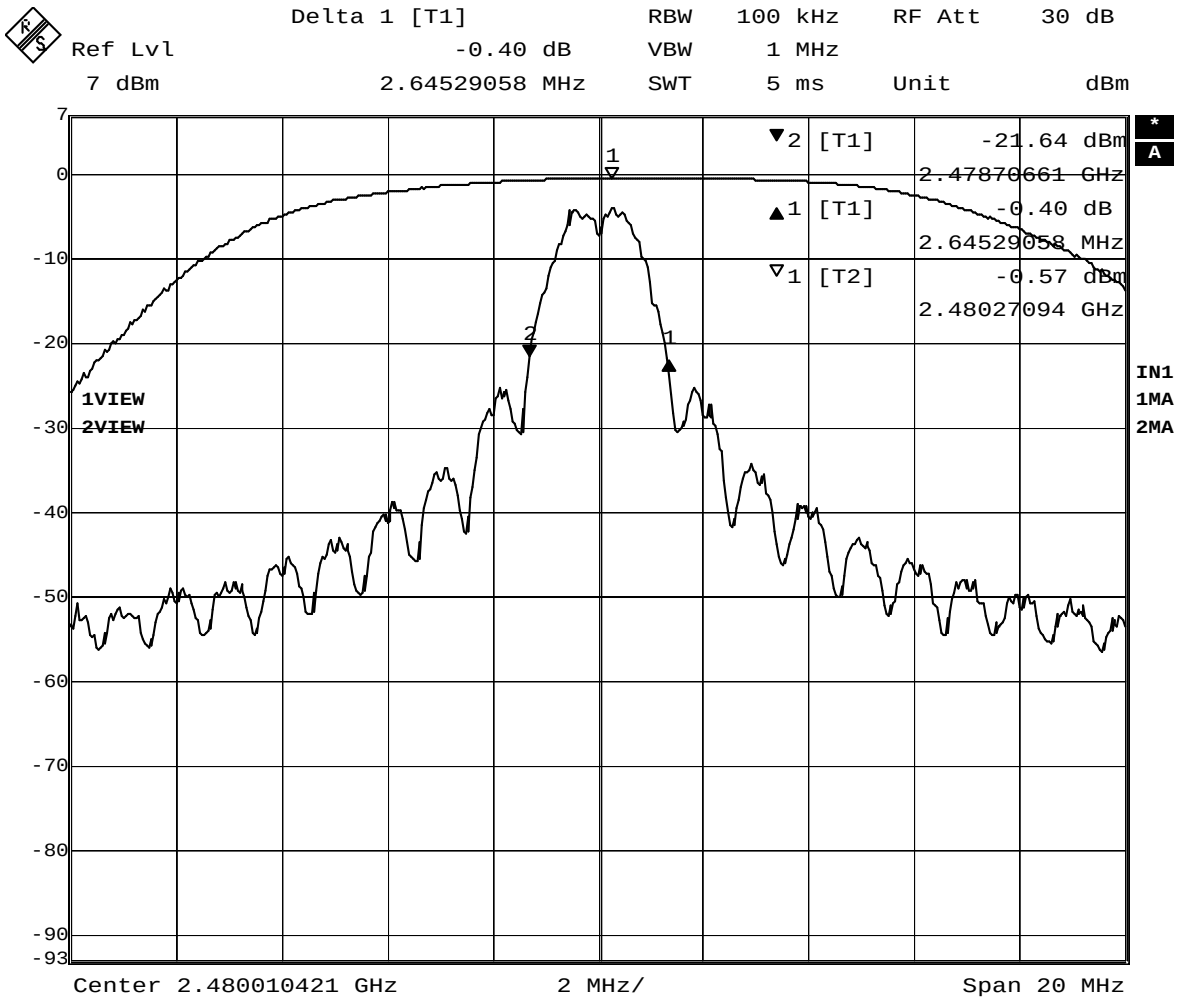


Figure 12 - 99% Occupied Bandwidth, Channel 15

4.5 Maximum peak output power

4.5.1 Limits of power measurements

The maximum peak output power allowed is 30dBm.

4.5.2 Test procedures

Measurements of peak field strength were taken from Section 4.2. The Friis transmission equation was then used to calculate the output power in EIRP.

4.5.3 Deviations from test standard

No deviation.

4.5.4 Test setup

Measurements were taken from peak field strength measurements in Section 4.2.

4.5.5 EUT operating conditions

The EUT was supplied with 120VAC/60Hz directly to pins 1 (neutral) and 2 (line) of the 24-pin connector. The EUT firmware was modified by the manufacturer to transmit or receive continuously on channel 0, 7 or 15.

4.5.6 Test results

Maximum peak output power

EUT	AC16R	Model	RXMFS-AC16R
INPUT POWER (SYSTEM)	120VAC/60Hz	ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC
TECHNICIAN	NJohnson	MODE	Continuous transmit

CHANNEL	CHANNEL FREQUENCY (MHz)	Peak Radiated Level at 3m (dBµV/m)	PEAK POWER OUTPUT EIRP (dBm)	PEAK POWER LIMIT (dBm)	RESULT
0	2405	104.48	13.47	30	PASS
7	2440	105.65	14.64	30	PASS
15	2480	100.29	9.28	30	PASS

All measurements were calculated from the maximum field strength measurements from Section 4.2 using the following equation:

$$E = \frac{\sqrt{30 P_T G_T}}{r} \text{ V/m}$$

A bandwidth correction factor was added to the measurements made at 1MHz resolution bandwidth to account for the 99% occupied bandwidth of 2.645MHz.

BW Correction Factor10*Log(2.645/1) = +4.22dB

E = Peak field strength measurements from Section 4.2
R = 3m (test distance)
P_T = Transmitter Power (Peak Output Power)
G_T = 1, for EIRP

4.6 Power spectral density (PSD)

4.6.1 Limits of PSD measurements

The maximum power spectral density allowed is 8dBm.

4.6.2 Test procedures

The transmitter output was connected directly to the spectrum analyzer. the bandwidth of the fundamental frequency was measured with the spectrum analyzer using 3 kHz RBW and 30 kHz VBW, the sweep time was 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 supplied with 120VAC/60Hz directly to pins 1 (neutral) and 2 (line) of the 24-pin connector. The EUT firmware was modified by the manufacturer to transmit or receive continuously on channel 0, 7 or 15.

4.6.6 Test results

Power Spectral Density

EUT	AC16R	Model	RXMFS-AC16R
INPUT POWER (SYSTEM)	120VAC/60Hz	ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC
TECHNICIAN	NJohnson	MODE	Continuous transmit

CHANNEL	CHANNEL FREQUENCY (MHz)	RF POWER LEVEL IN # KHz BW (dBm)	MAXIMUM POWER LIMIT (dBm)	RESULT
0	2405	-15.73	8.0	PASS
7	2440	-14.73	8.0	PASS
15	2480	-15.18	8.0	PASS

0.25dB was added to account for the cable used to connect to the spectrum analyzer.

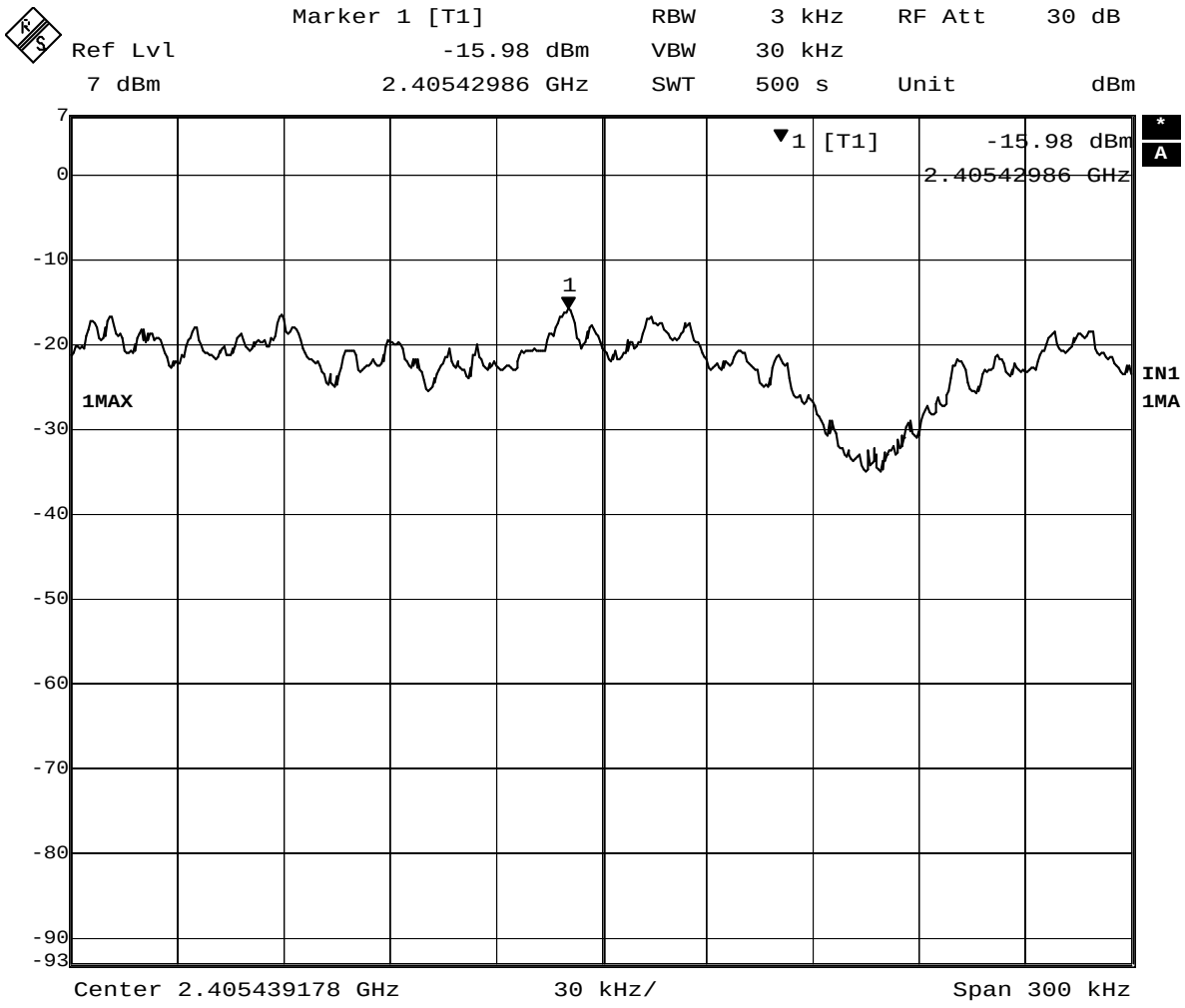


Figure 13 - Power Spectral Density Measurement, Channel 0

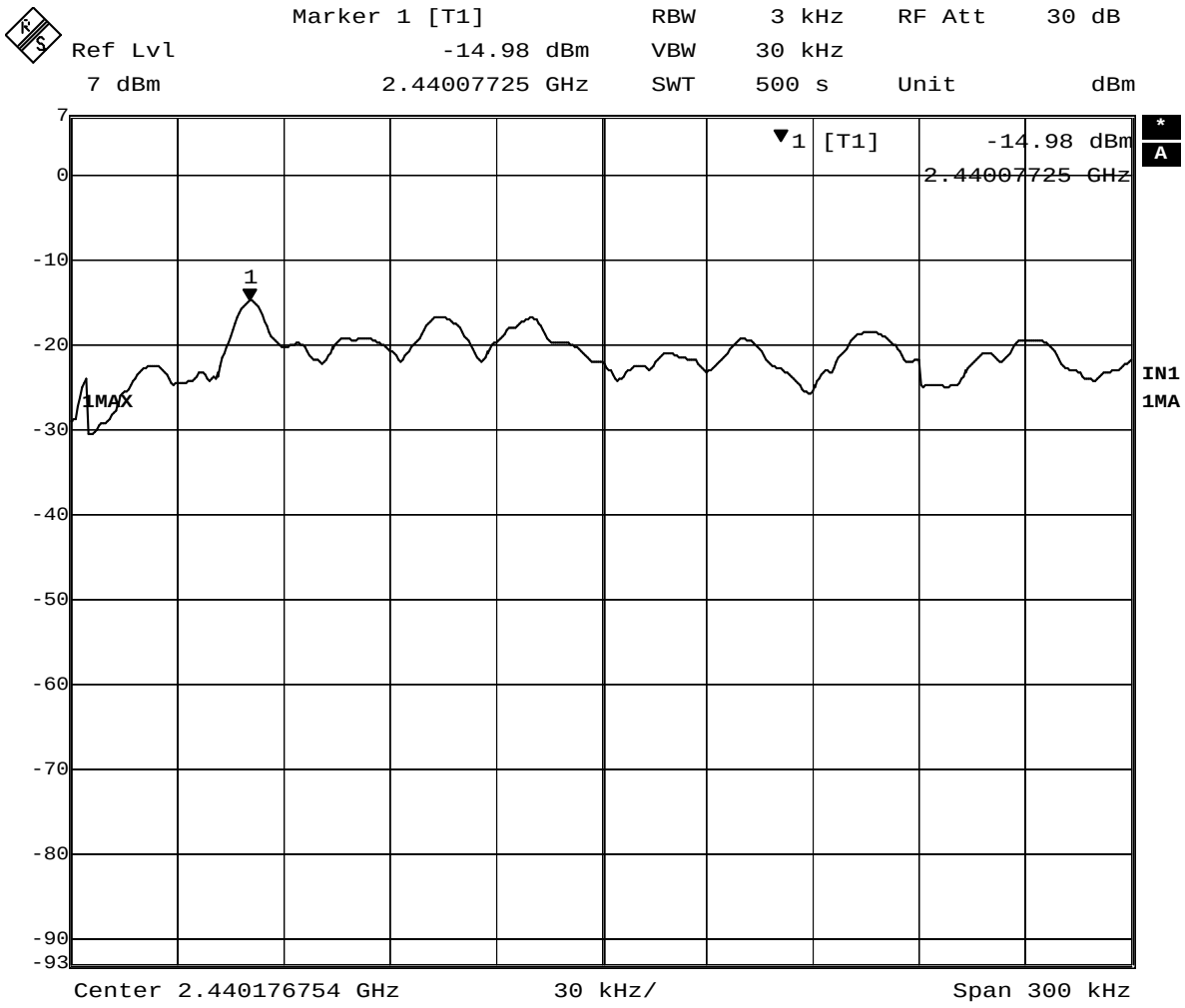


Figure 14 - Power Spectral Density Measurement, Channel 7

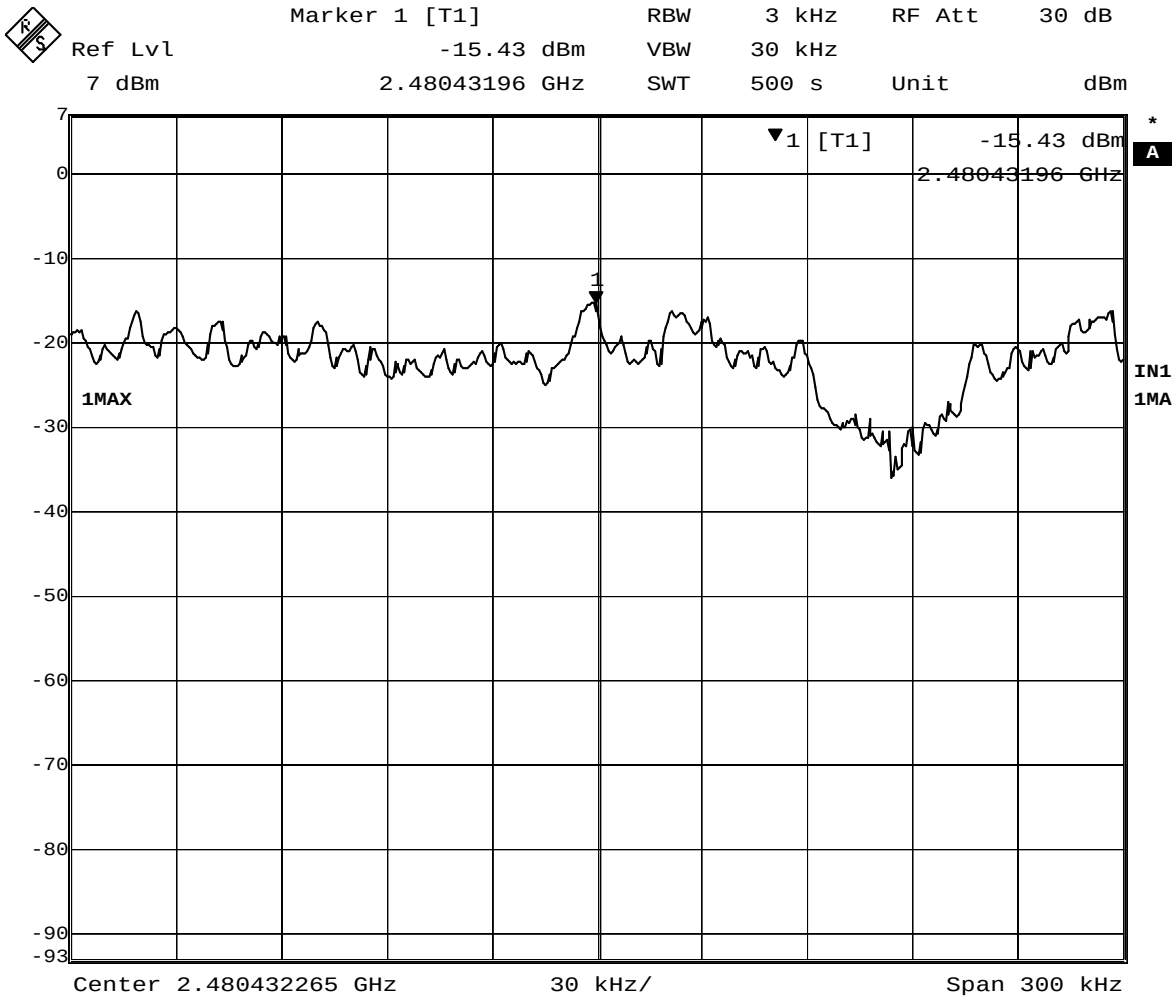


Figure 15 - Power Spectral Density Measurement, Channel 15

4.7 Bandedges

4.7.1 Limits of bandedge measurements

For emissions outside of the allowed band of operation (2400MHz – 2483.5MHz), 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 was supplied with 120VAC/60Hz directly to pins 1 (neutral) and 2 (line) of the 24-pin connector. The EUT firmware was modified by the manufacturer to transmit or receive continuously on channel 0, 7 or 15.

4.7.6 Test results

EUT	AC16R	Model	RXMFS-AC16R
INPUT POWER (SYSTEM)	120VAC/60Hz	ENVIRONMENTAL CONDITIONS	45% ± 5% RH 20 ± 3ºC
TECHNICIAN	NJohnson	MODE	Continuous transmit

Highest Out of Band Emissions

CHANNEL	Bandedge/Measurement Frequency (MHz)	Level (dBm)	Fund. Level	Delta
0	2399	-55.04	-10.44	44.60
15	2484	-46.35	-10.42	35.93

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

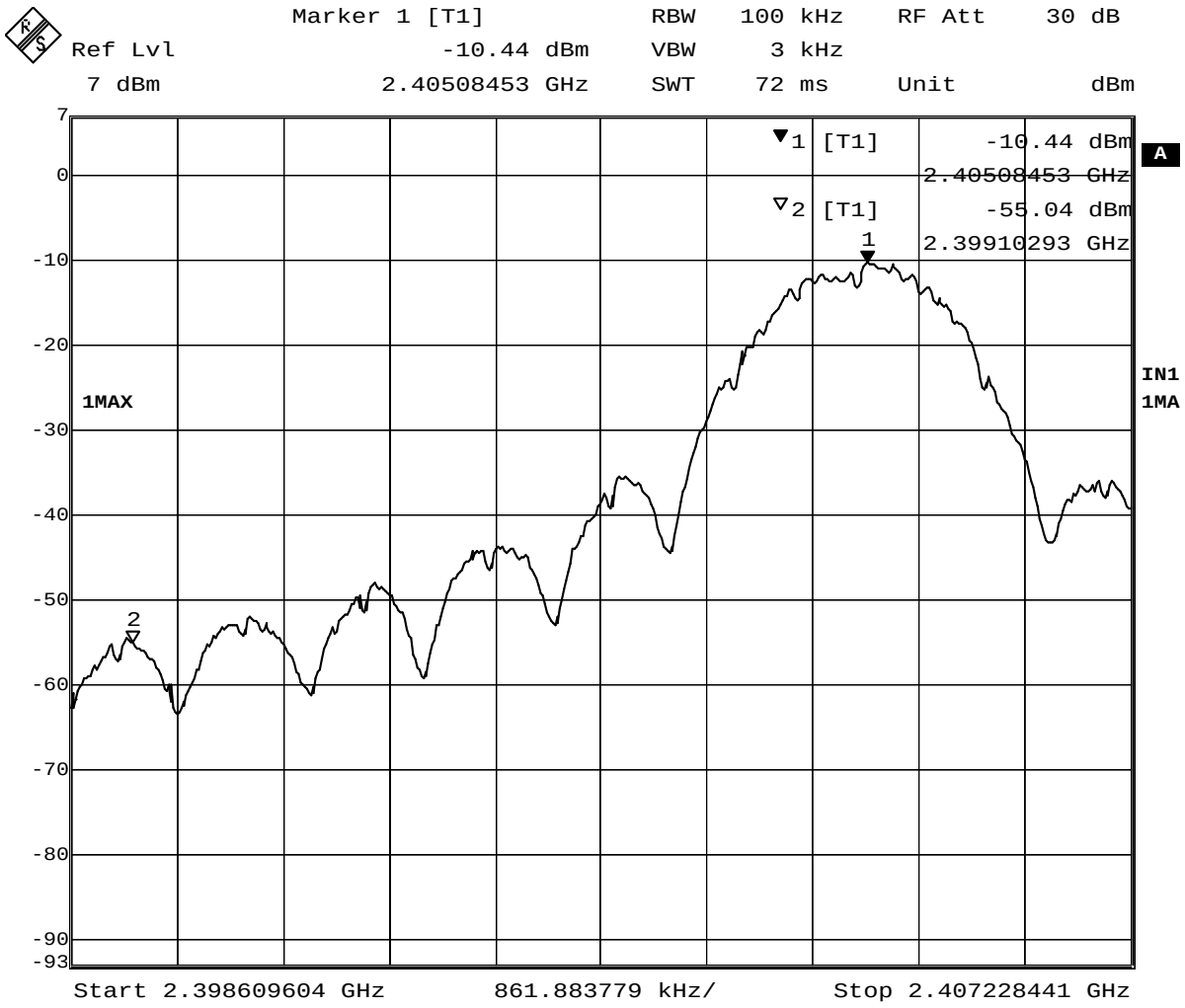


Figure 16 - Band Edge Measurements, Channel 0

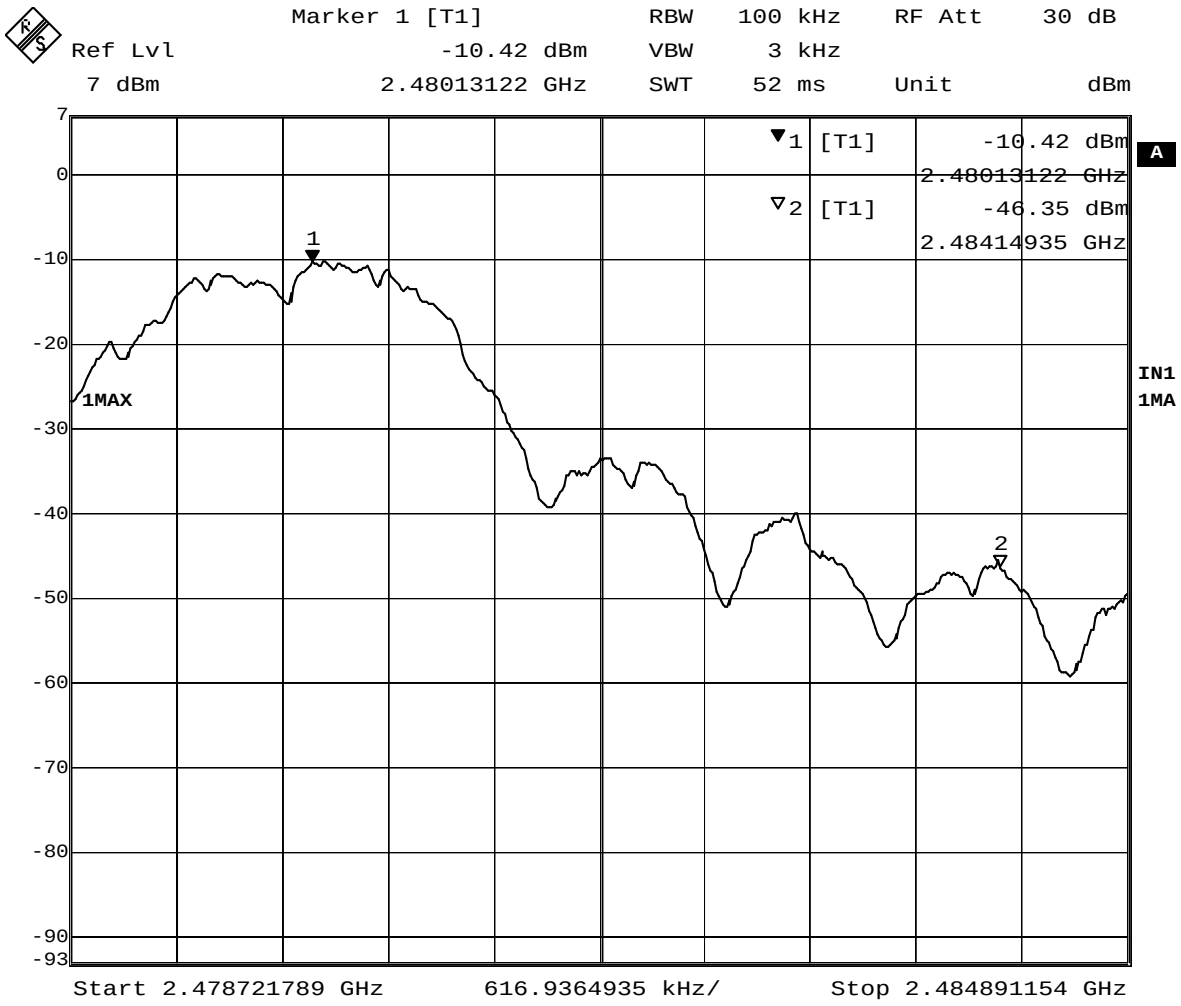


Figure 17 - Band Edge Measurements, Channel 15

Delta = (-10.42) – (-46.35) = 35.93

87.27 dBµV/m (average field strength) – 35.93dB (delta) =
51.34 dBµV/m (average value at band edge)

100.29 dBµV/m (peak field strength) – 35.93dB (delta) =
64.36 dBµV/m (peak value at band edge)

Average Limit per 15.209 = 54.00 dBµV/m
Margin = 54.00 dBµV/m – 51.34 dBµV/m = 2.66

Peak Limit per 15.209 = 74.00 dBµV/m
Margin = 74.00 dBµV/m – 64.32 dBµV/m = 9.68

Appendix A: Test Photos

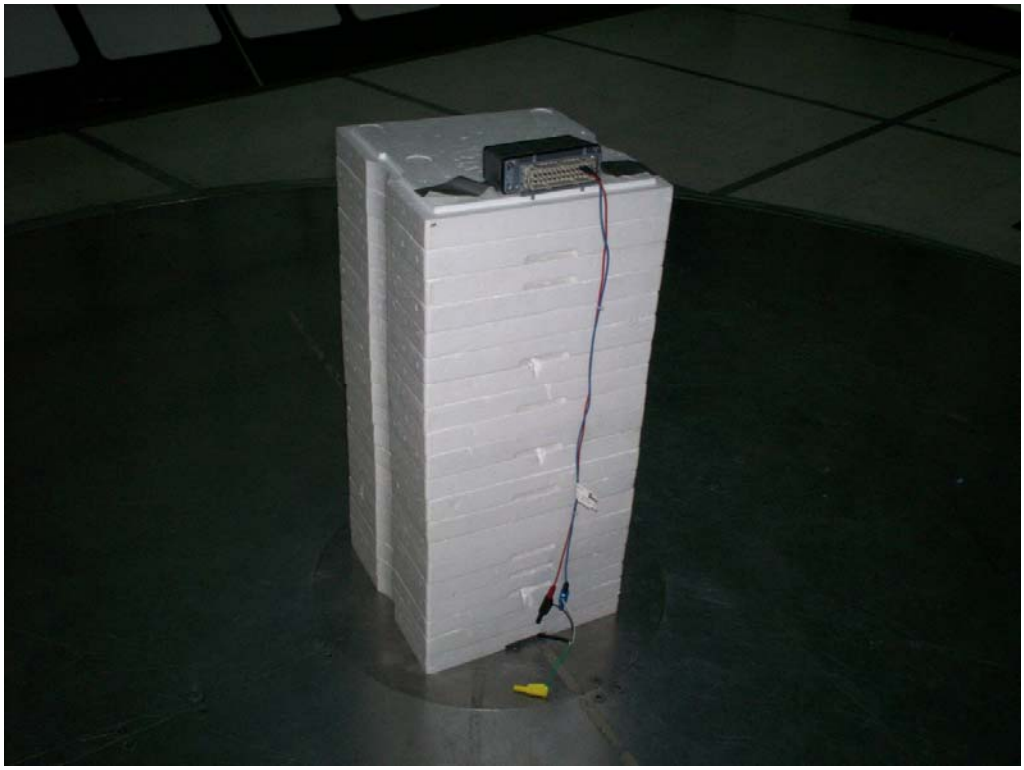


Figure 18 - Radiated Emissions Test Setup, 1-26GHz

Figure 19 - Radiated Emissions Test Setup, 1-26GHz

Figure 20 - Conducted Emissions Test Setup

Figure 21 - 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: Table of Figures

Figure **Page Number**