Global EMC Inc. Labs

EMC & RF Test Report

As per

RSS 210 Issue 6:2005

&

FCC Part 15 Subpart C:2006

Unlicensed Intentional Radiators

On the

VT7355C5500W Wireless Thermostat

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Testing produced for

See Appendix A for full customer & EUT details.

Industry Canada
LAB REGISTRATION #6844A-1

FCC REGISTRATION #612361

ACCREDITED
TESTING LABORATORY
CERTIFICATE #2565.01

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Report Scope

This report addresses the EMC verification testing and test results of the VT7355C5500W Wireless thermostat, herein referred to as EUT (Equipment Under Test) performed at Global EMC Labs.

The EUT was tested for compliance against the following standards:

RSS 210 Issue 6:2005 / FCC Part 15 Subpart C 15:2006

Test procedures, results, justifications, and engineering considerations, if any, follow later in this report.

The results contained in this report relate only to the item(s) tested.

This report does not imply product endorsement by A2LA or any other accreditation agency, any government, or Global EMC Inc.

Opinions/interpretations expressed in this report, if any, are outside the scope of Global EMC Inc accreditation. Any opinions expressed do not necessarily reflect the opinions of Global EMC Inc, unless otherwise stated.

Summary

The results contained in this report relate only to the item(s) tested.

EUT FCC Certification #, FCC ID:	V95 – VT
EUT Industry Canada Certification #, IC:	7591A – VT
EUT Passed all tests performed.	Yes (see test results summary)
Tests conducted by	Ashwani Malhotra

Client	Viconics
Product	VT7355C5500W
Standard(s)	RSS 210 Issue 6:2005 / FCC Part 15 Subpart C 15:2006

Test Results Summary

Standard/Method	Description	Class/Limit	Result
FCC 15.203	Antenna Requirement	Unique	Pass See Justification
FCC 15.205 RSS 210 (Table 1)	Restricted Bands for intentional operation	QuasiPeak Average	Pass
FCC 15.207	Power line conducted emissions	QuasiPeak Average	Pass
FCC 15.209 RSS-210 (Table 2)	Spurious Radiated emissions	QuasiPeak Average	Pass
FCC 15.247(a)2 RSS-210 A8.2(a)	6 dB Bandwidth	> 500 kHz	Pass
FCC 15.247(b)2 RSS-210 A8.4(4)	Max output power	< 1 Watt	Pass
FCC 15.247(b)(4) RSS-210 A8.4(5)	Antenna Gain	< 6 dBi	Pass See Justification
FCC 15.247(d) RSS-210 A8.5	Antenna conducted spurious	< 20 dBc	Pass
FCC 15.247(e) RSS-210 A8.2(b)	Spectral Density	< 8 dBm (3 kHz BW)	Pass
FCC 15.247(i) IC Safety code 6	Maximum Permissible Exposure	> 20 cm separation.	Pass See justification and calculations
Overall Result			**PASS**

All tests were performed by Ashwani Malhotra

If the product as tested or otherwise complies with the specification, the EUT is deemed to comply with the requirement and is deemed a 'PASS' grade. If not 'FAIL' grade will be issued. Note that 'PASS' / 'FAIL' grade is independent of any measurement uncertainties. A 'PASS' / 'FAIL' grade within measurement uncertainty is marked with a '*'.

Justifications, Descriptions, or Deviations

The following justifications for tests not performed or deviations from the above listed specifications apply:

For the Antenna requirement specified in FCC 15.203 (RSS 210 section 5.5), the unit uses a PCB antenna with a gain of 3 dbi.

For the Restricted Bands of operation, the EUT is designed to only operate between 2400 – 2480MHz.

For the Antenna gain, the unit uses a 3 dbi pcb antenna. There are no means to change or modify this antenna by the user. Models VTxxxxYzzzzW are identical to VT7355C5500W in construction, layout, RF module, enclosure. The only difference being the relays or triacs that are installed in the unit and one 0-10V analog output. For the purpose of certification a unit was installed with all possible relays and triacs on the unit and tested. The variable model numbers specify the internal productions numbers and the company the unit is sold to. The unit however is used as is by the end user and is not allowed to make any modifications to the unit, enclosure or the installation techniques. This unit is not installed in another module whatsoever.

For maximum permissible exposure, this device operates at less then 1 Watt at 2400 – 2480 MHz and is designed to operate greater then 20 cm from personnel during normal operation. No testing is required, however worst case calculated exposure compliance follows later in this report.

Applicable Standards, Specifications and Methods

ANSI C63.4:2003	- Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
CFR 47 FCC 15	- Code of Federal Regulations – Radio Frequency Devices
CISPR 22:1997	- Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement
ICES-003:2004	- Digital Apparatus - Spectrum Management and Telecommunications Policy Interference-Causing Equipment Standard
ISO 17025:2005	- General Requirements for the competence of testing and calibration laboratories
RSS 210:2005	- Issue 6: Spectrum Management and Telecommunications Policy. Radio Standards Specification Low Power Licence-Exempt Radiocommunication Devices

Sample calculation(s)

Margin = limit – (received signal + antenna factor + cable loss – pre-amp gain)
Margin = 50.5dBuV/m – (50dBuV + 10dB + 2.5dB – 20dB)
Margin = 8.5 dB

Document Revision Status

Revision 1 - June 13, 2008 Initial release
Revision 2 - June 16, 2008 Editorial modifications.

Definitions and Acronyms

The following definitions and acronyms are applicable in this report.
See also ANSI C63.14.

AE – Auxiallary Equipment.

BW – Bandwidth. Unless otherwise stated, this is refers to the 6 dB bandwidth.

EMC – Electro-Magnetic Compatibility

EMI – Electro-Magnetic Immunity

EUT – Equipment Under Test

ITE – Information Technology Equipment with a primary function(s) of entry, storage, display, retrieval, transmission, processing, switching, or control, of data.

LISN – Line impedance stabilization network

NCR – No Calibration Required

RF – Radio Frequency

Testing Facility

Testing for EMC on the EUT was carried out at Global EMC labs in Toronto, Ontario, Canada. The testing lab consists of a 3m semi-anechoic chamber calibrated to be able to allow measurements on an EUT with a maximum width or length of up to 2m and height up to 3m. The chamber is equipped with a turn table that is capable of testing devices up to 3300lb in weight. This facility is capable of testing products that are rated for 120 Vac and 240Vac single phase, or 208 Vac 3 phase input. DC capability is also available. The chamber is equipped with an antenna mast that controls polarization and height from the control room adjoining the shielded chamber. Radiated emissions measurements are performed using a Bilog, and Horn antenna where applicable. Conducted emissions, unless otherwise stated, are performed using a LISN.

Calibrations and Accreditations

The measurement site used is registered with Federal Communications Commission (FCC) and Industry Canada (IC). This site is calibrated for Normalized Site Attenuation (NSA) using test procedures outlined in ANSI C63.4 “Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz”. The semi-anechoic chamber is lined with ferrite tiles and absorption cones to minimize any undesired reflections. All measuring equipment is calibrated on an annual or bi-annual basis as listed for each respective test.

Testing Environmental Conditions and Dates

Following were the environmental conditions in the facility during time of testing –

Date	Test	Init.	Temperature (ºC)	Humidity (%)	Pressure (kPa)
May 7 – 21, 2008	All	AM	20-25ºC	30-45%	100 -103kPa

Detailed Test Results Section

Spurious Radiated Emissions

Purpose

The purpose of this test is to ensure that the RF energy unintentionally emitted from the EUT does not exceed the limits listed below as defined in the applicable test standard, as measured from a receiving antenna. This helps protect broadcast radio services such as television, FM radio, pagers, cellular telephones, emergency services, and so on, from unwanted interference.

Limit(s) and Method

The method is as defined in ANSI C63.4:2003.

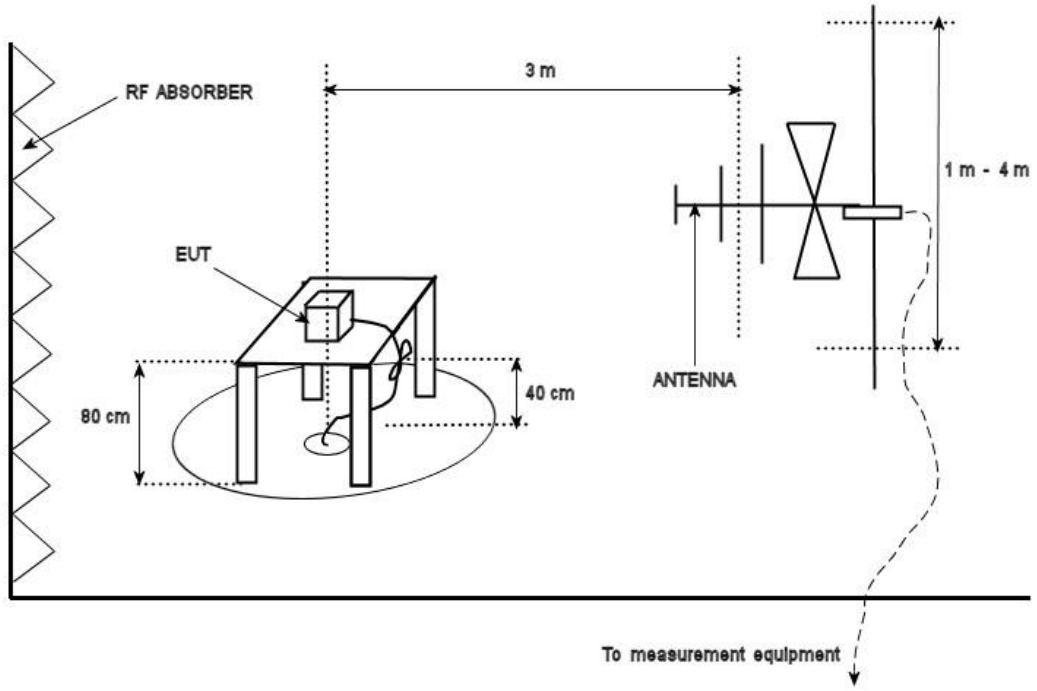
The limits, as defined in 15.247(d) for unintentional radiated emissions apply for those emissions that fall in the restricted bands, as defined in Section 15.205(a). These emissions must comply with the radiated emission limits specified in Section 15.209(a).

All unintentional emissions must also meet the 'Spurious Conducted Emissions' requirements of -20 dBc or greater. See also 'Spurious Conducted Emissions' for further details.

30 MHZ – 88 MHz, 100 uV/m (40.0 dBuV/m[1]) at 3 m
88 MHz – 216 MHz, 150 uV/m (43.5 dBuV/m[1]) at 3 m
216 MHz – 960 MHz, 200 uV/m (46.4 dBuV/m[1]) at 3 m
Above 960 MHz, 500 uV/m (54.0 dBuV/m[1]) at 3 m
Above 1000 MHz, 500 uV/m (54.0 dBuV/m[2]) at 3m

[1]Limit is with 120 kHz measurement bandwidth and a using a Quasi Peak detector.
[2]Limit is with 1 MHz measurement bandwidth and using an Average detector, scanned in accordance with 15.33 to above the 10th harmonic.

Typical Radiated Emissions Setup



Measurement Uncertainty

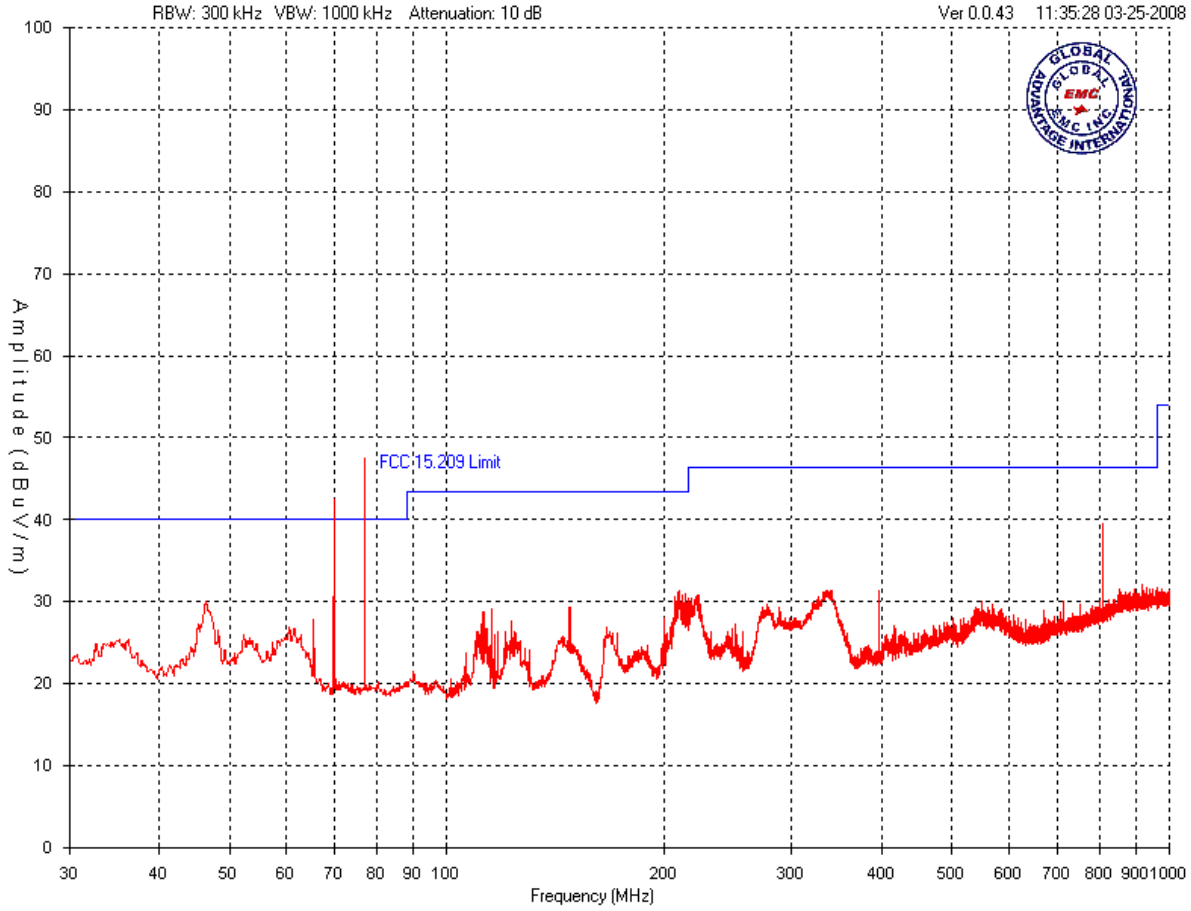
The expanded measurement uncertainty is calculated in accordance with CISPR 16-4-2 and is +/-4.4 dB with a 'k=2' coverage factor and a %95 confidence level.

Preliminary Graphs

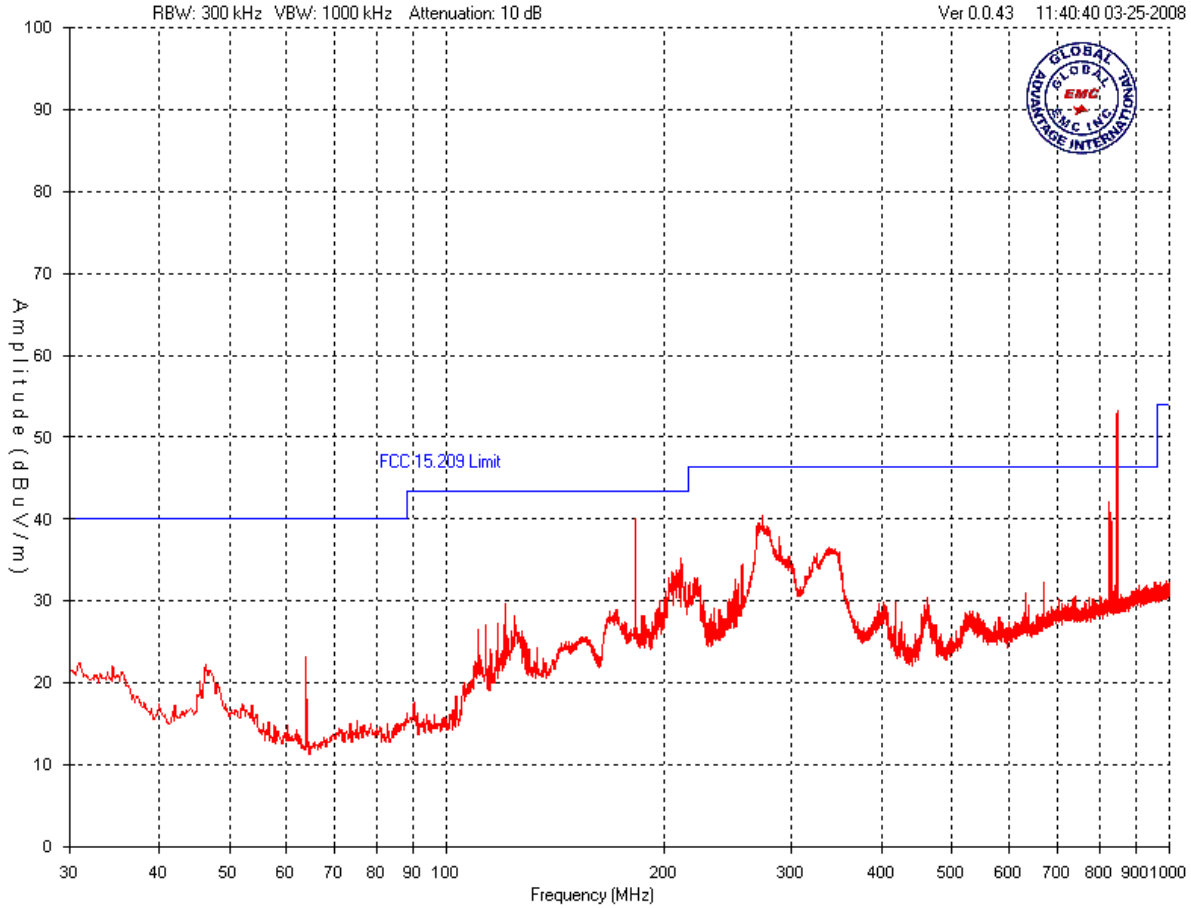
Note the graphs shown below are for graphical illustration only. For final measurements with the appropriate detector, please refer to the final measurement table where applicable. The graph shown below is a maximized peak measurement graph, measured with a resolution bandwidth greater then the final required detector and over a full 0-360 rotation. This peaking process is done as a worst case measurement. This process enables the detection of frequencies of concern for final measurement, and provides considerable time savings.

In accordance with FCC Part 15, Subpart A, Section 15.33, the device was scanned to a minimum of a 25 GHz.

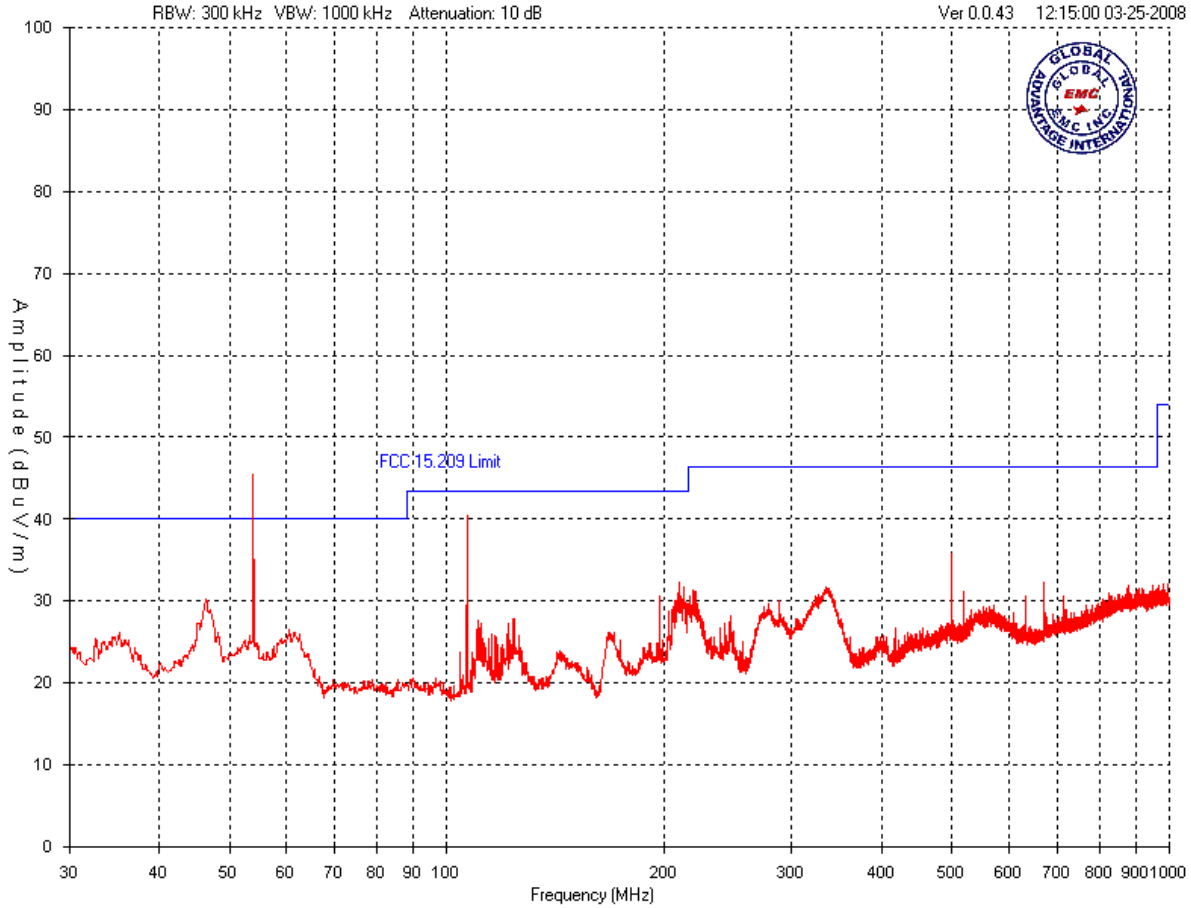
Low Channel –30MHz – 1 GHz
Vertical – Peak Emissions Graph



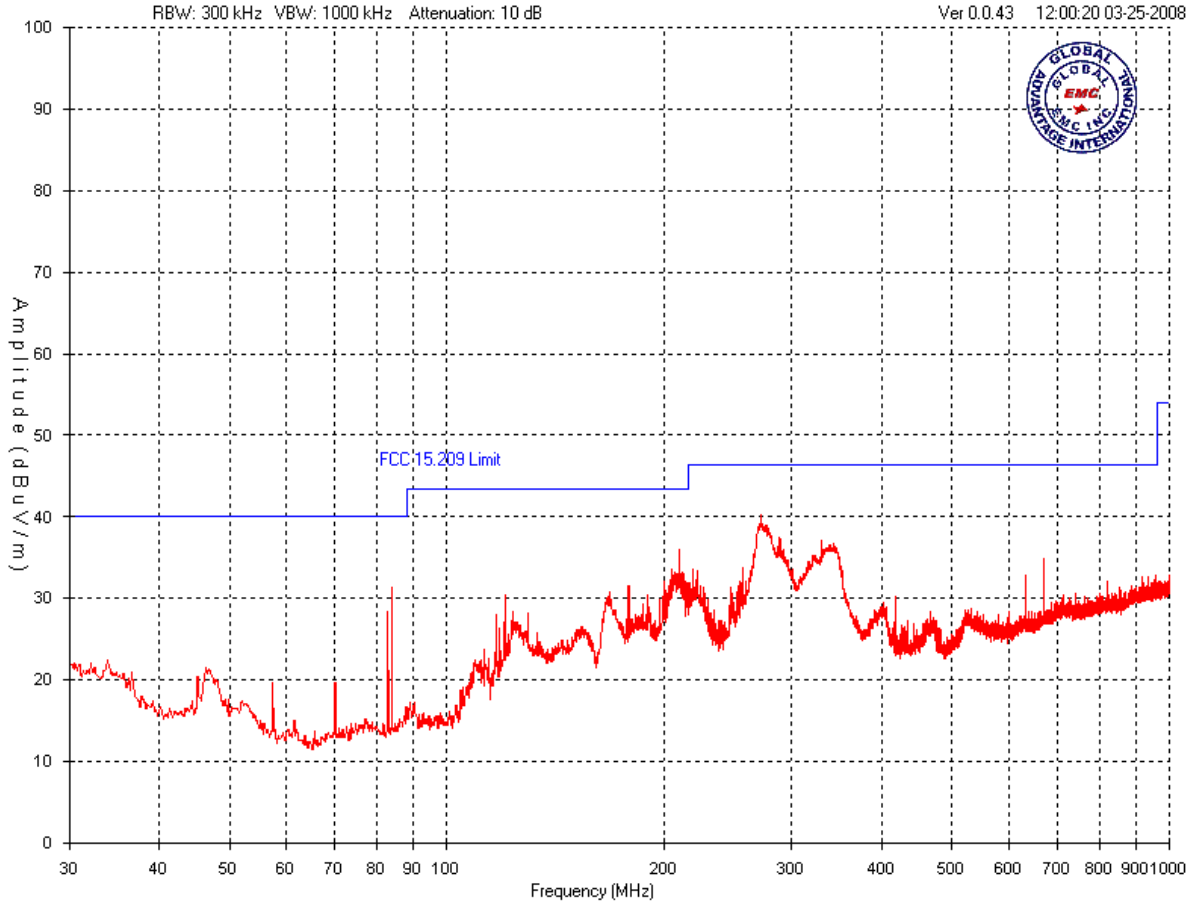
Low Channel – 30MHz – 1 GHz
Horizontal – Peak Emissions Graph



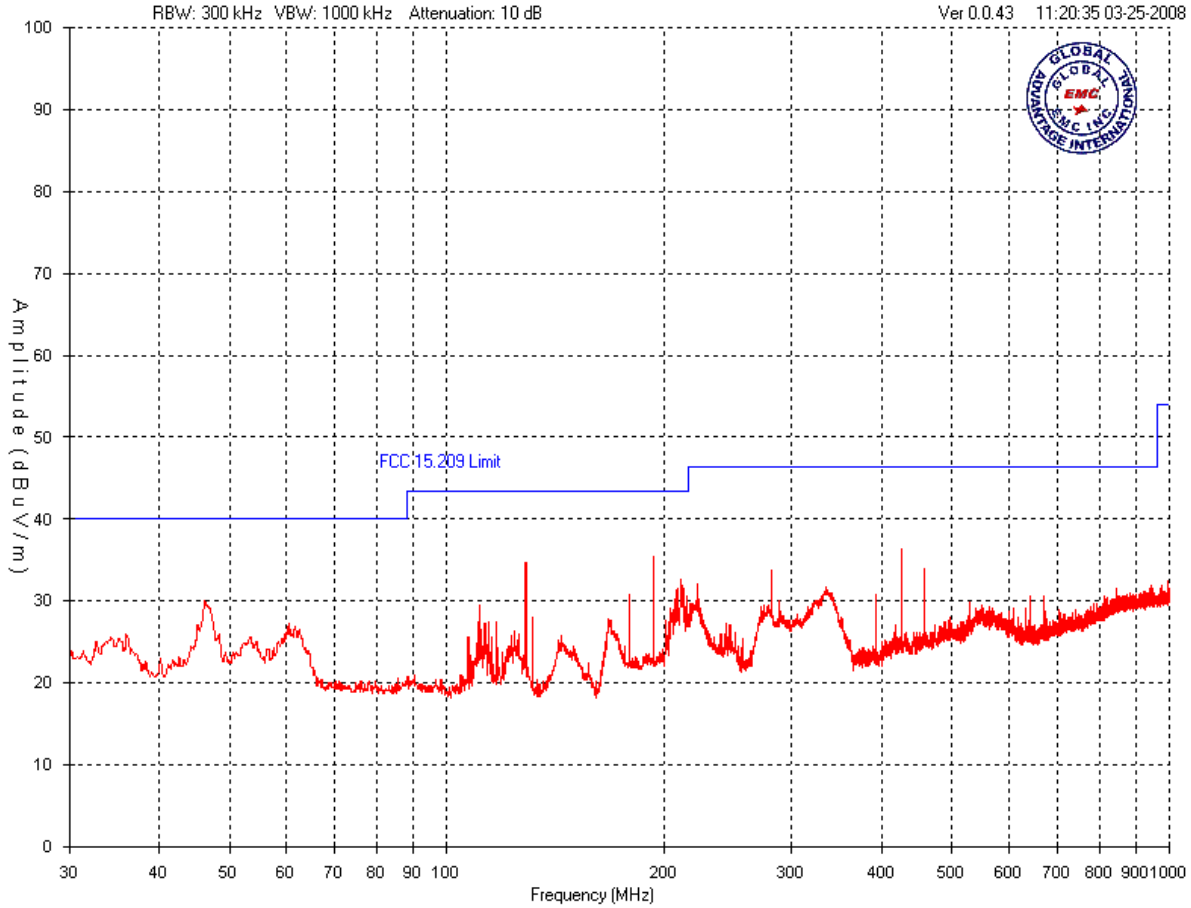
Mid Channel – 30MHz – 1 GHz
Vertical – Peak Emissions Graph



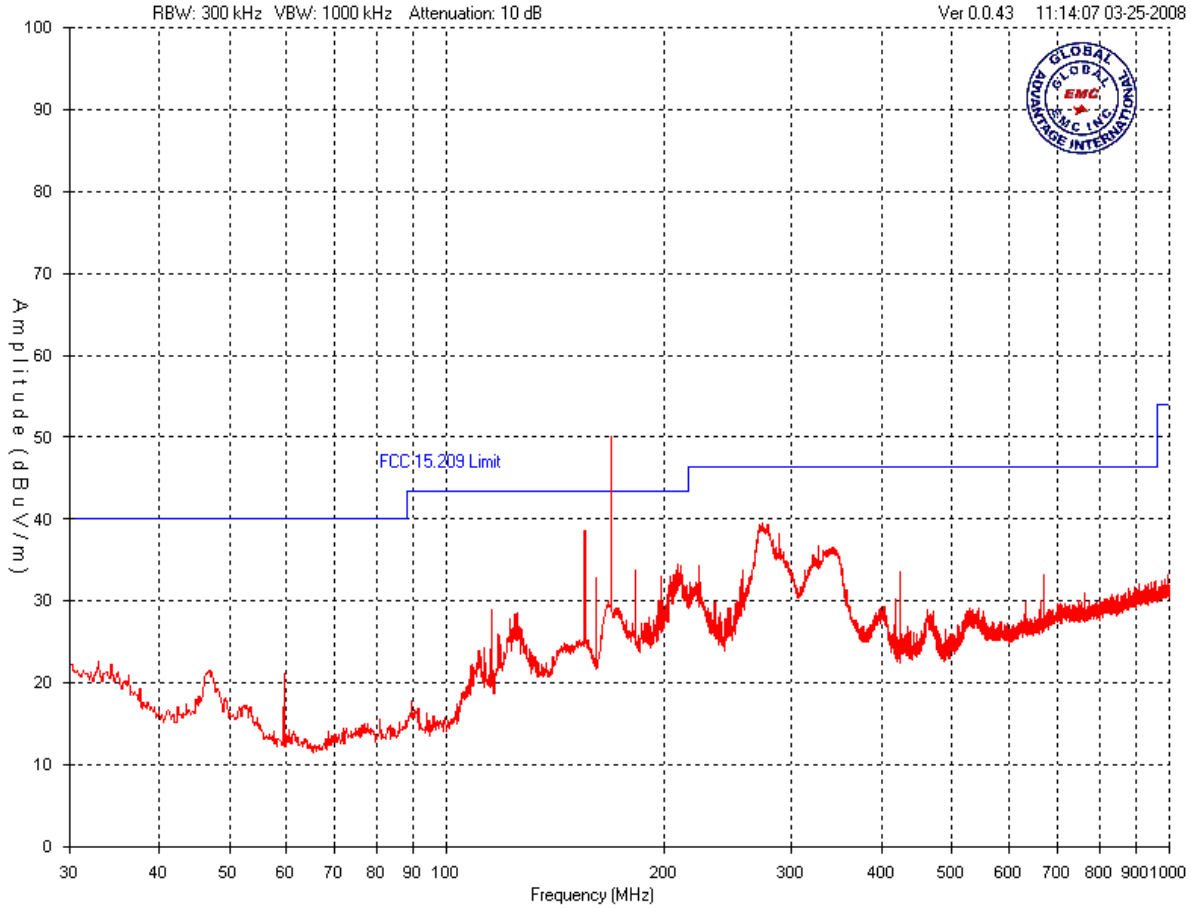
Mid Channel – 30MHz – 1 GHz
Horizontal – Peak Emissions Graph



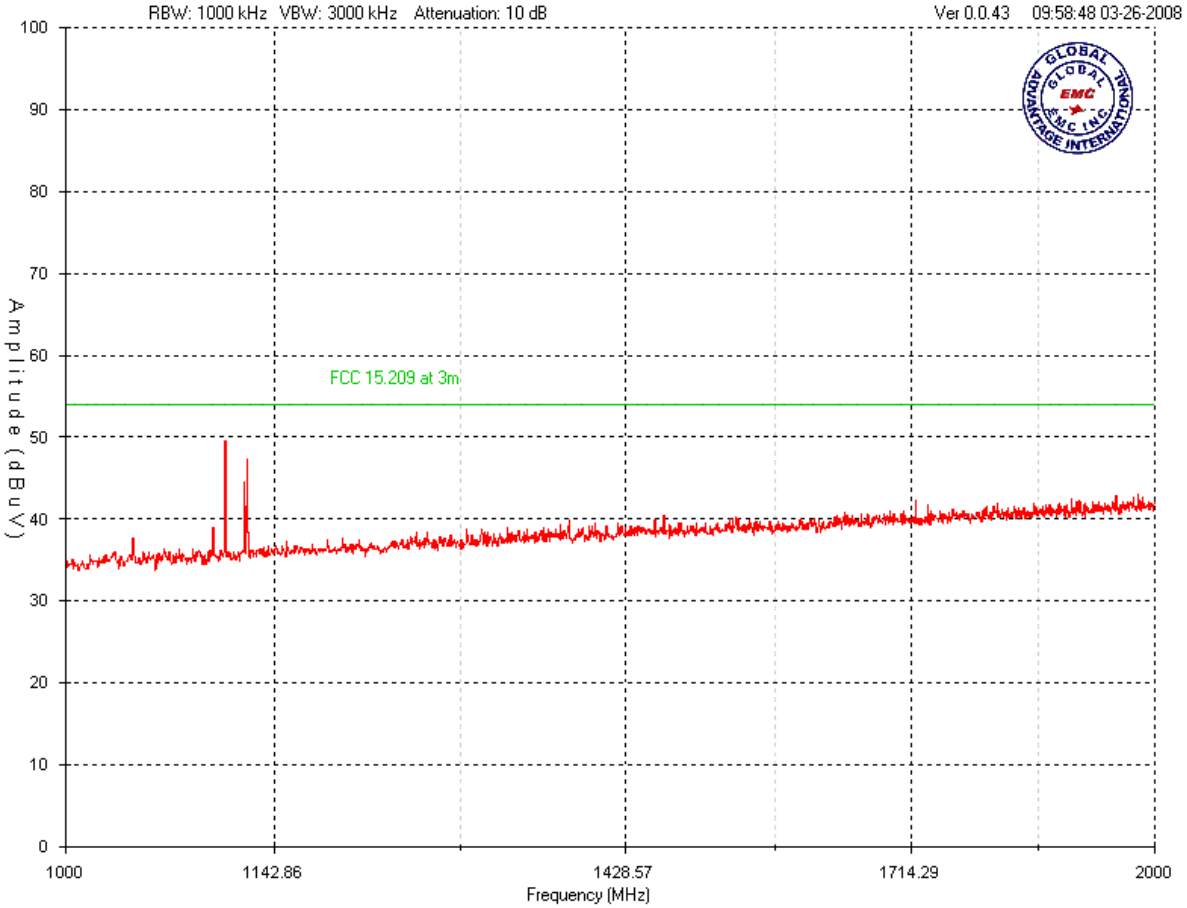
Hi Channel – 30MHz – 1 GHz
Vertical – Peak Emissions Graph



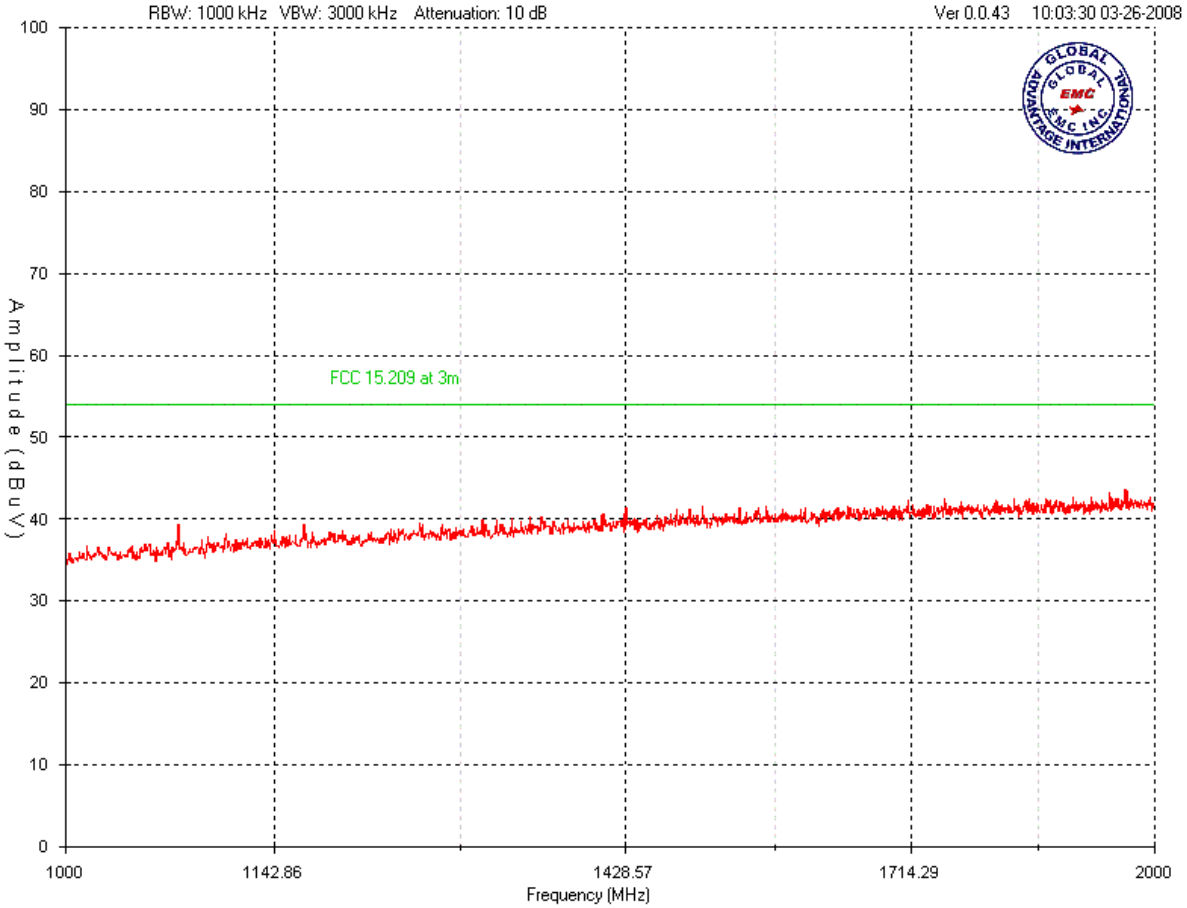
Hi Channel – 30MHz – 1 GHz
Horizontal – Peak Emissions Graph



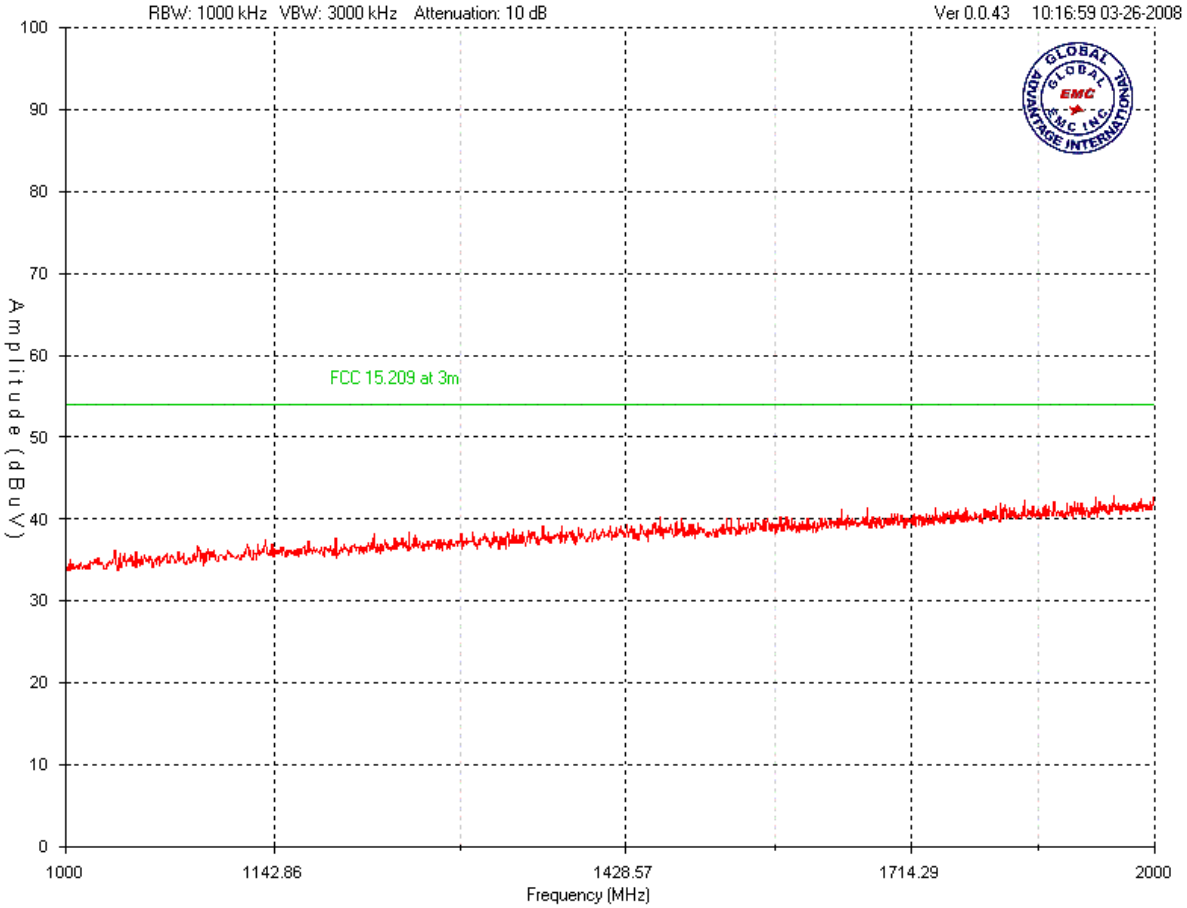
Low Channel 1 – 2GHz
Vertical – Peak Emissions Graph



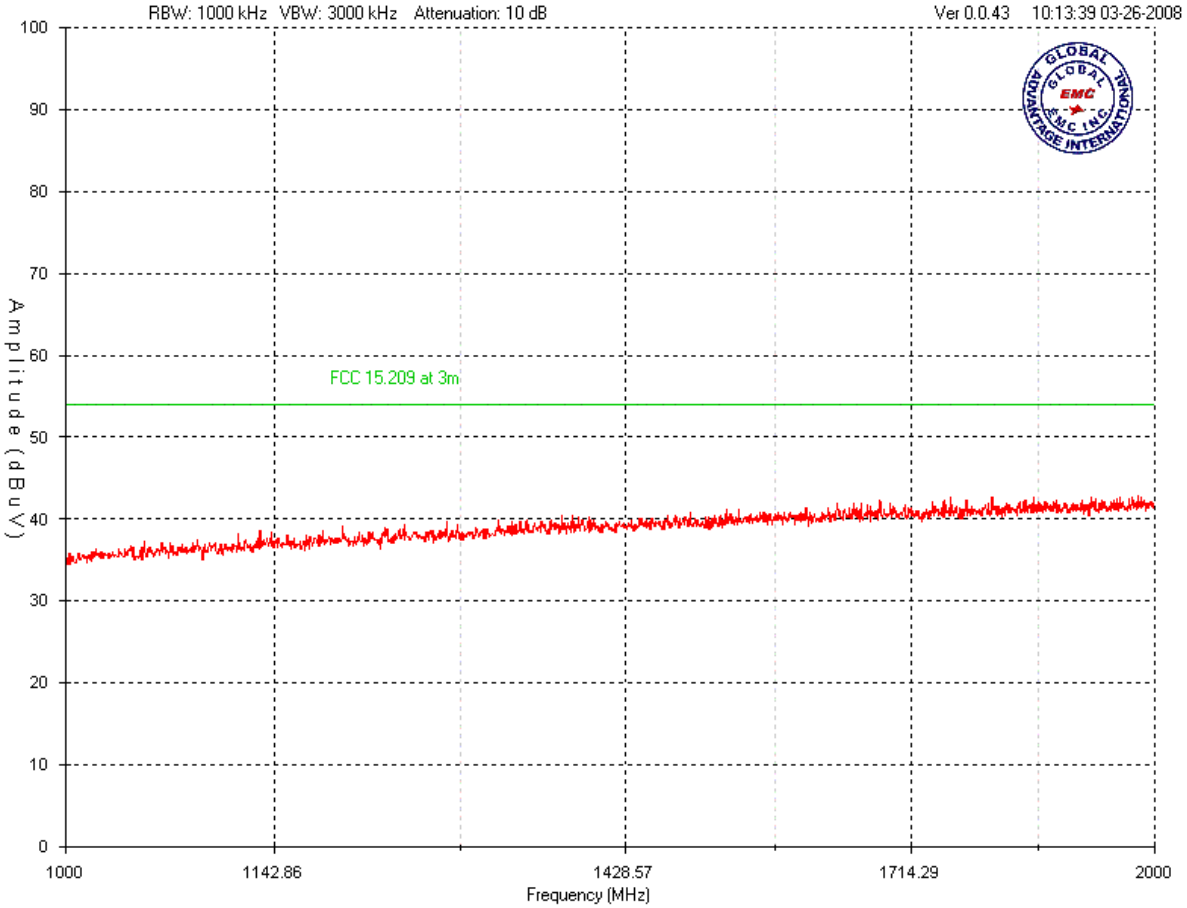
Low Channel 1 – 2GHz
Horizontal – Peak Emissions Graph



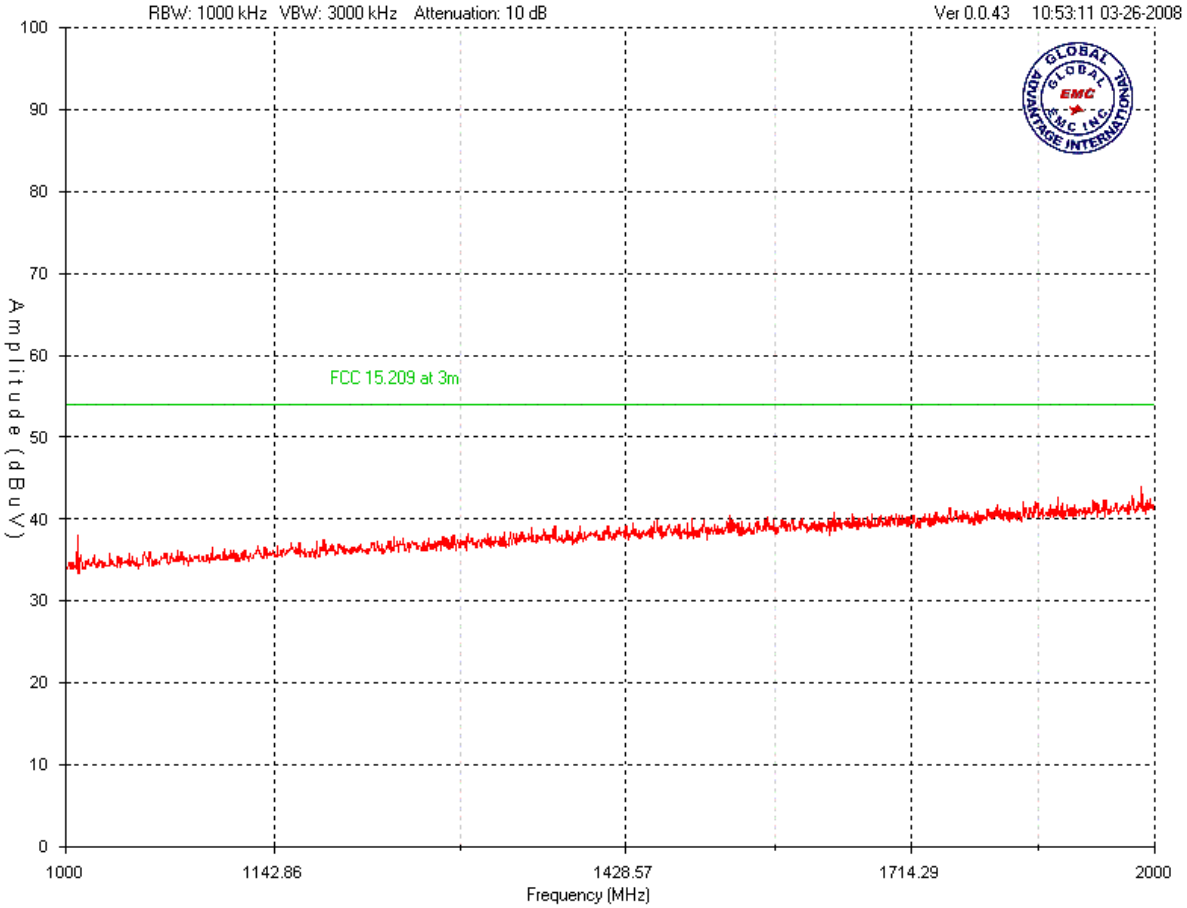
Mid Channel 1 – 2GHz
Vertical – Peak Emissions Graph



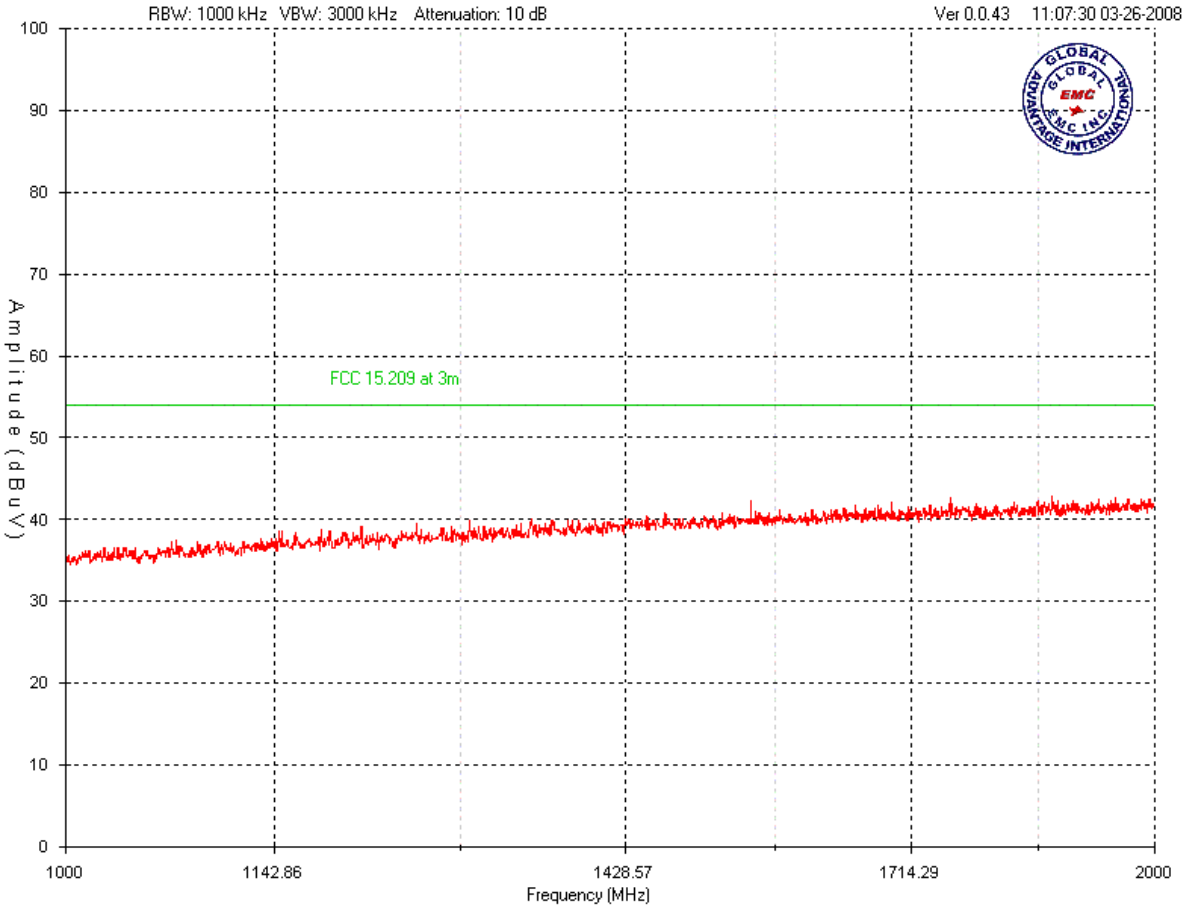
Mid Channel 1 – 2GHz
Horizontal – Peak Emissions Graph



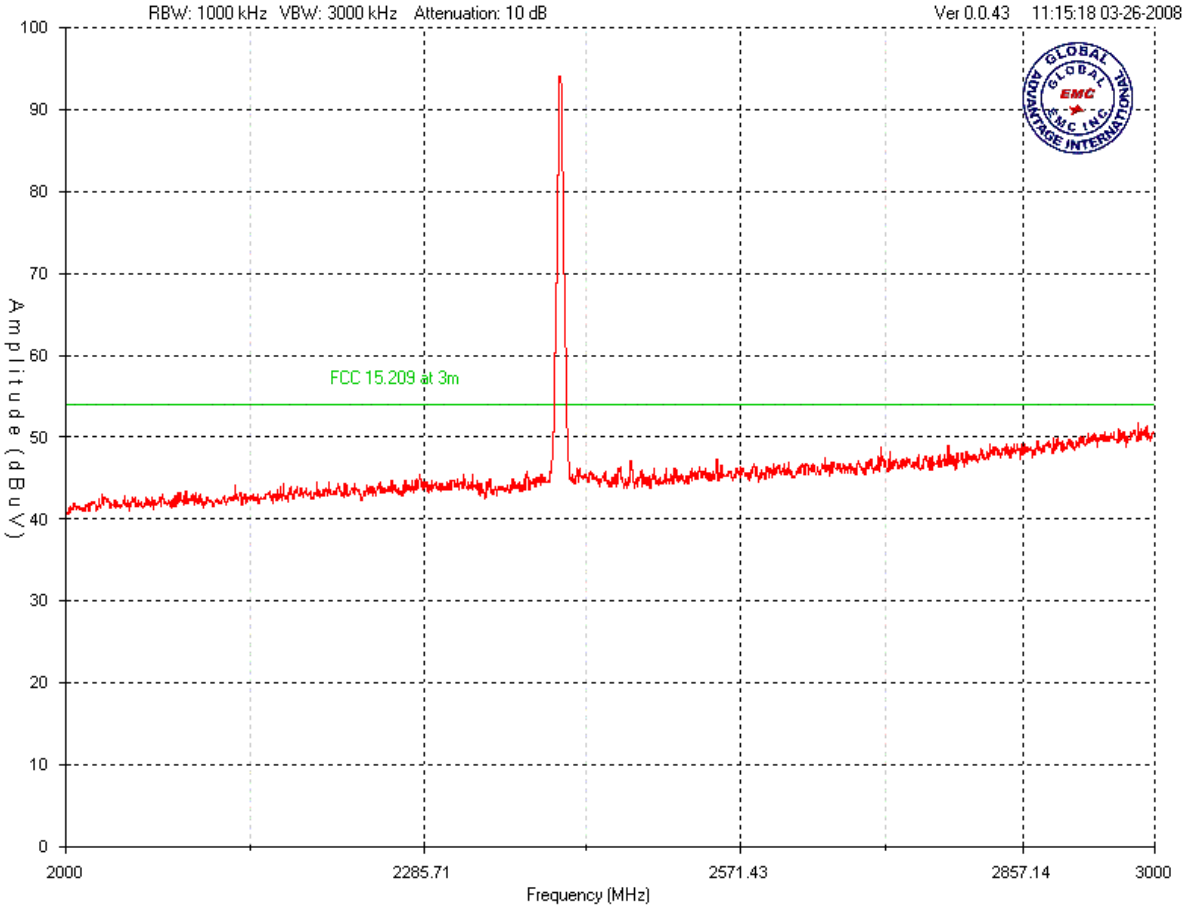
Hi Channel 1 – 2GHz
Vertical – Peak Emissions Graph



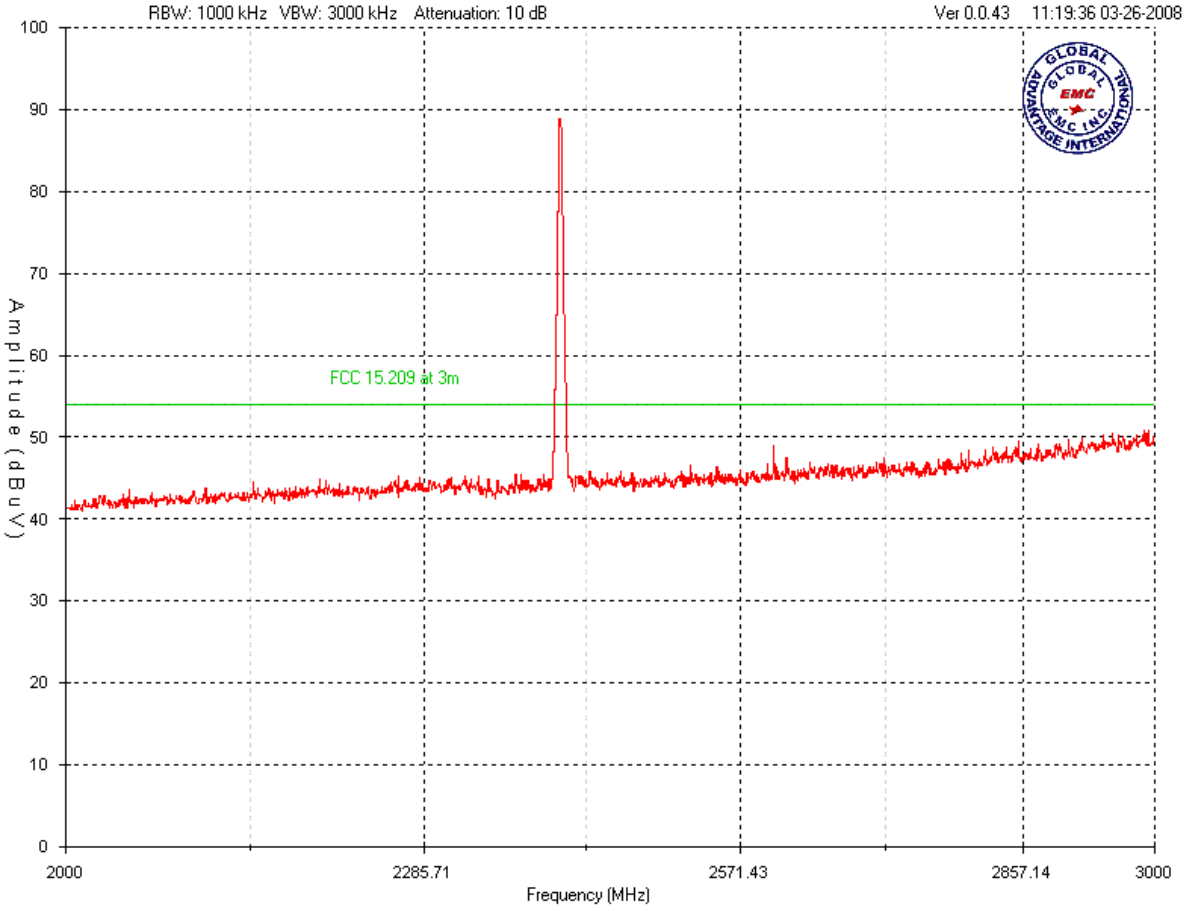
Hi Channel 1 – 2GHz
Horizontal – Peak Emissions Graph



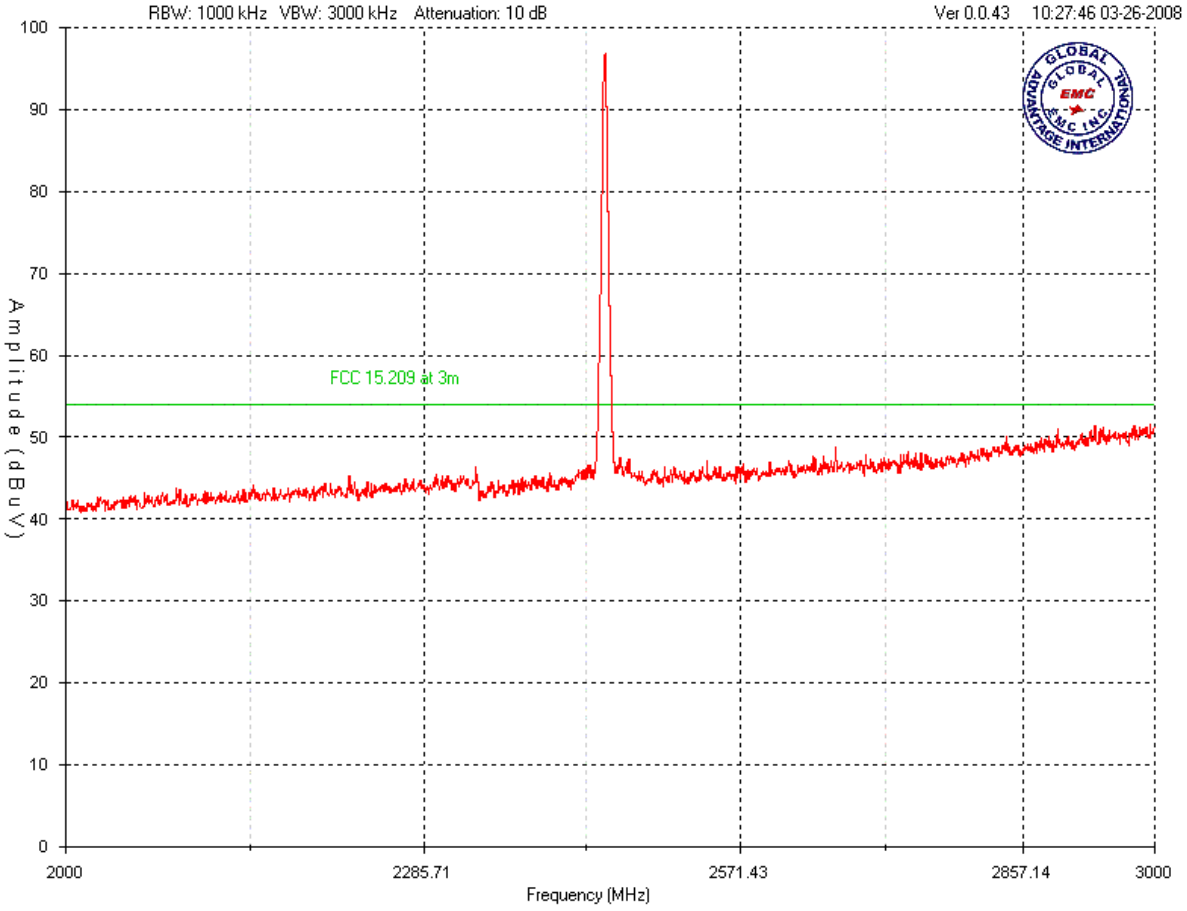
Low Channel 2 – 3GHz
Vertical – Peak Emissions Graph



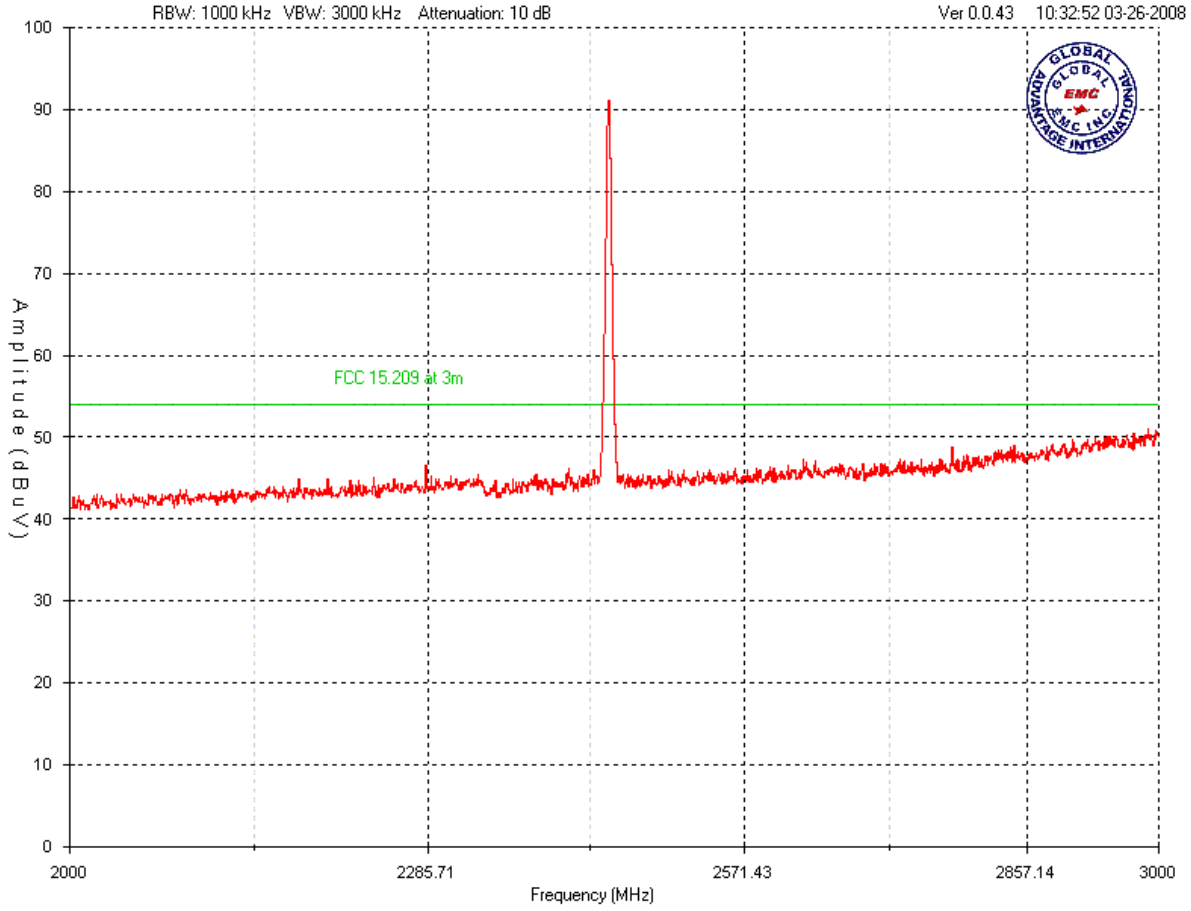
Low Channel 2 – 3GHz
Horizontal – Peak Emissions Graph



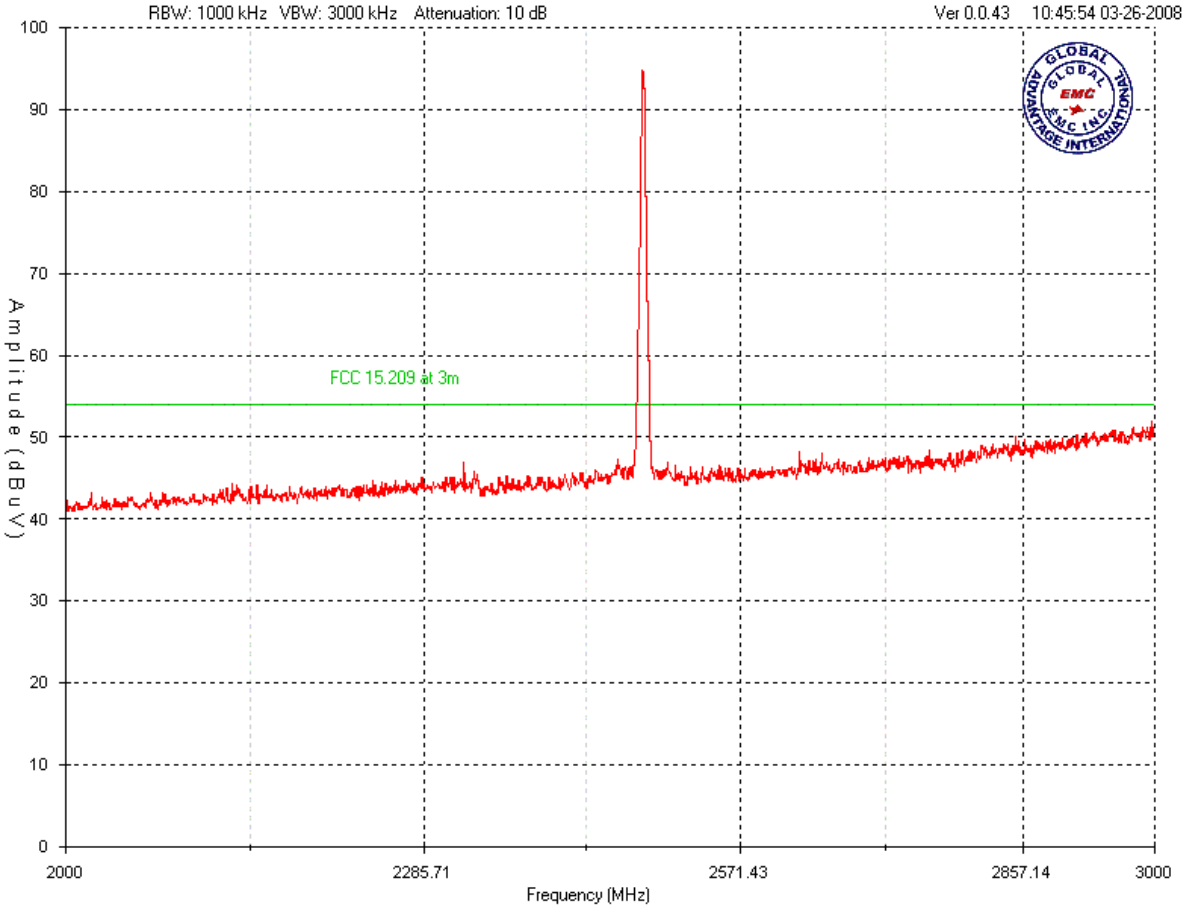
Mid Channel 2 – 3GHz
Vertical – Peak Emissions Graph



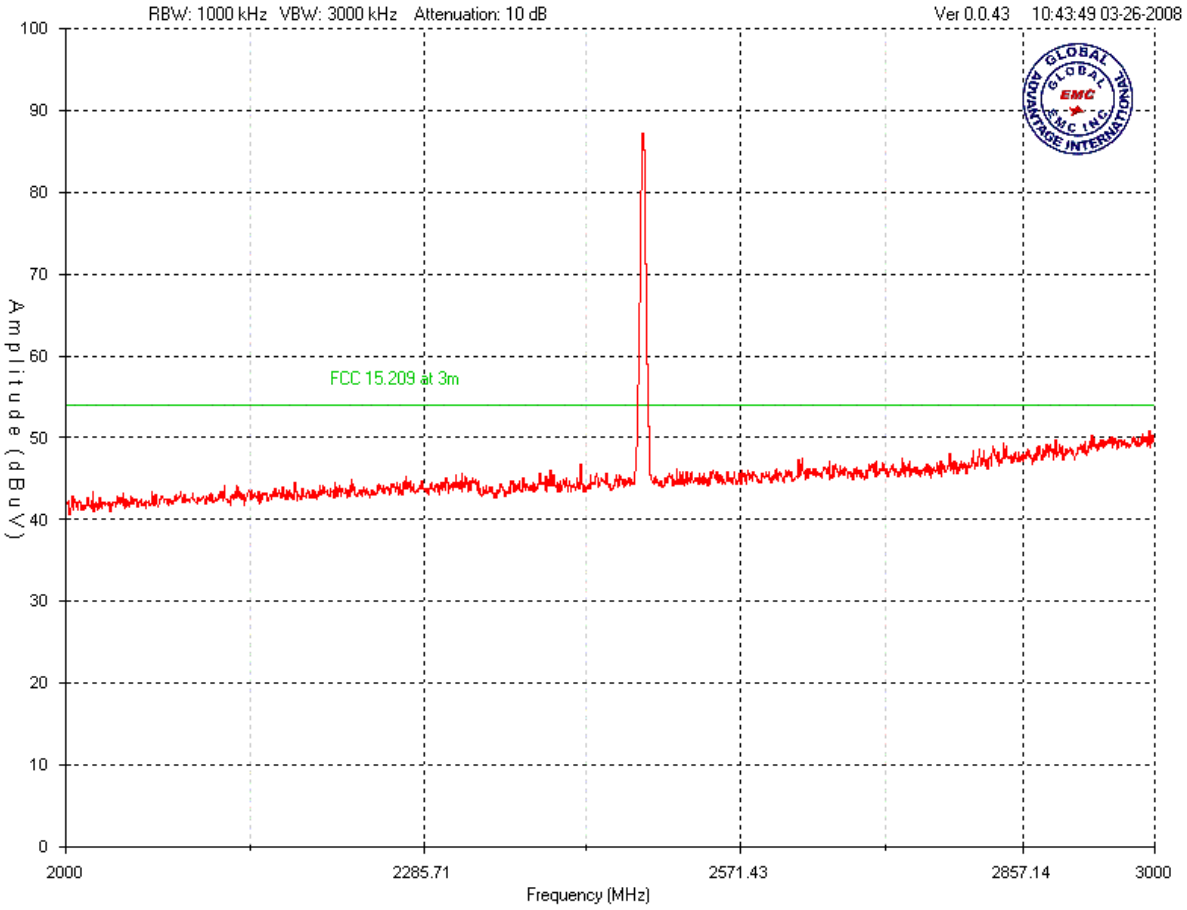
Mid Channel 2 – 3GHz
Horizontal – Peak Emissions Graph



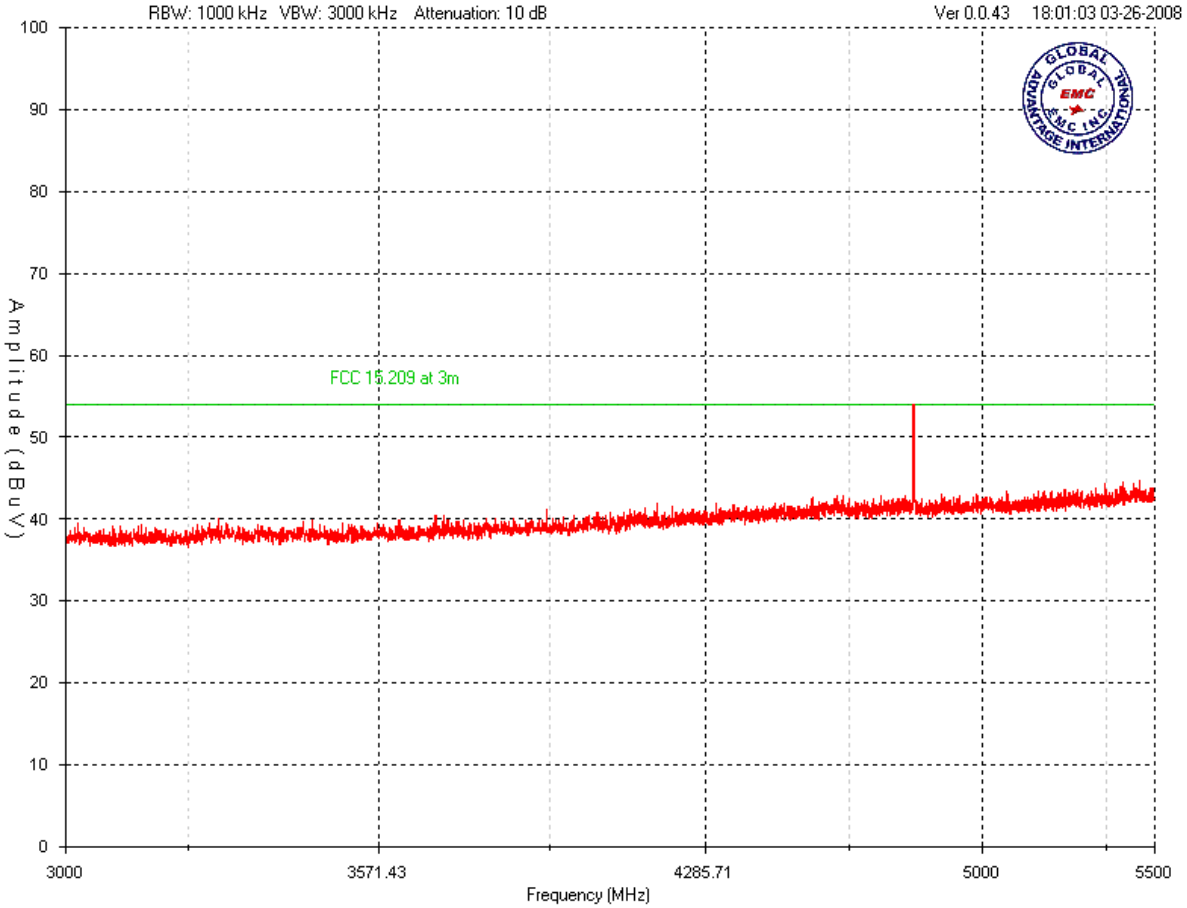
Hi Channel 2 – 3GHz
Vertical – Peak Emissions Graph



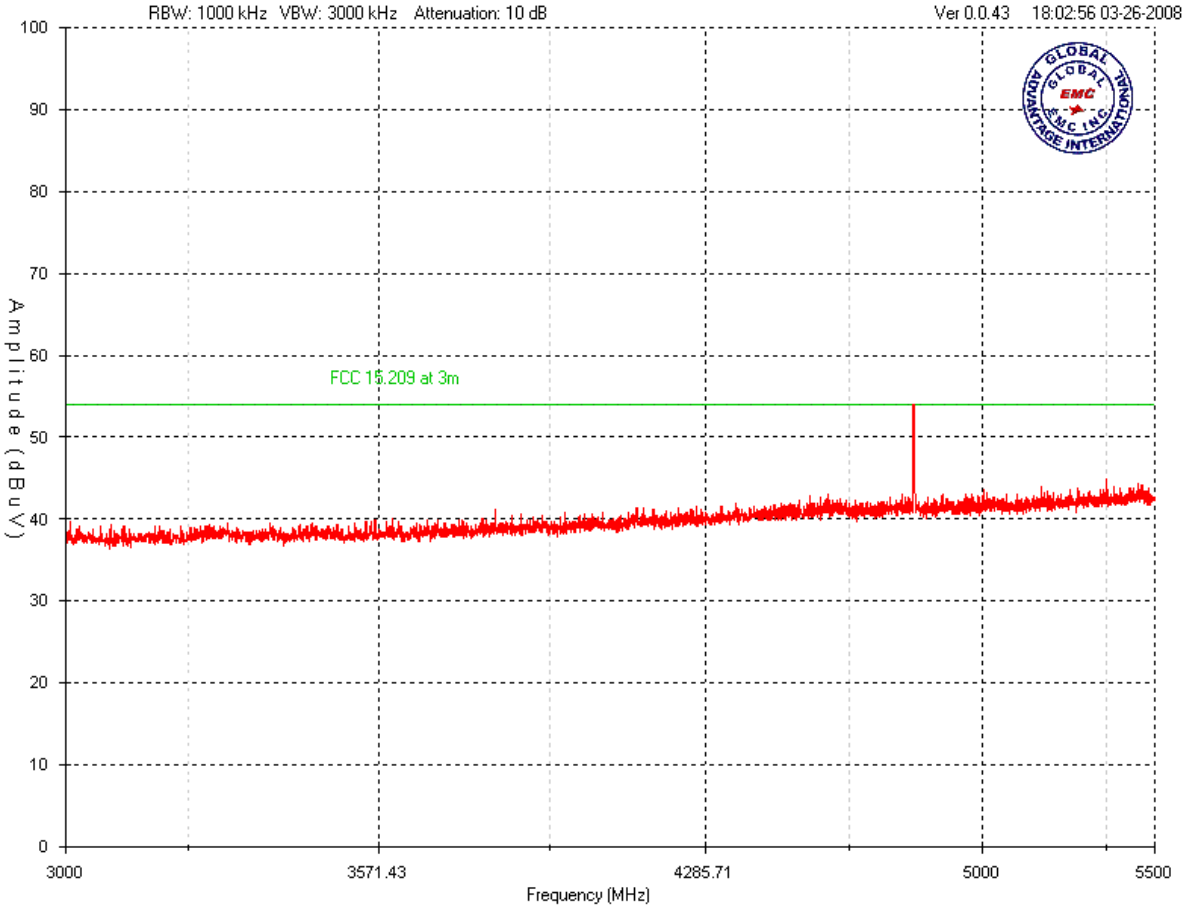
Hi Channel 2 – 3GHz
Horizontal – Peak Emissions Graph



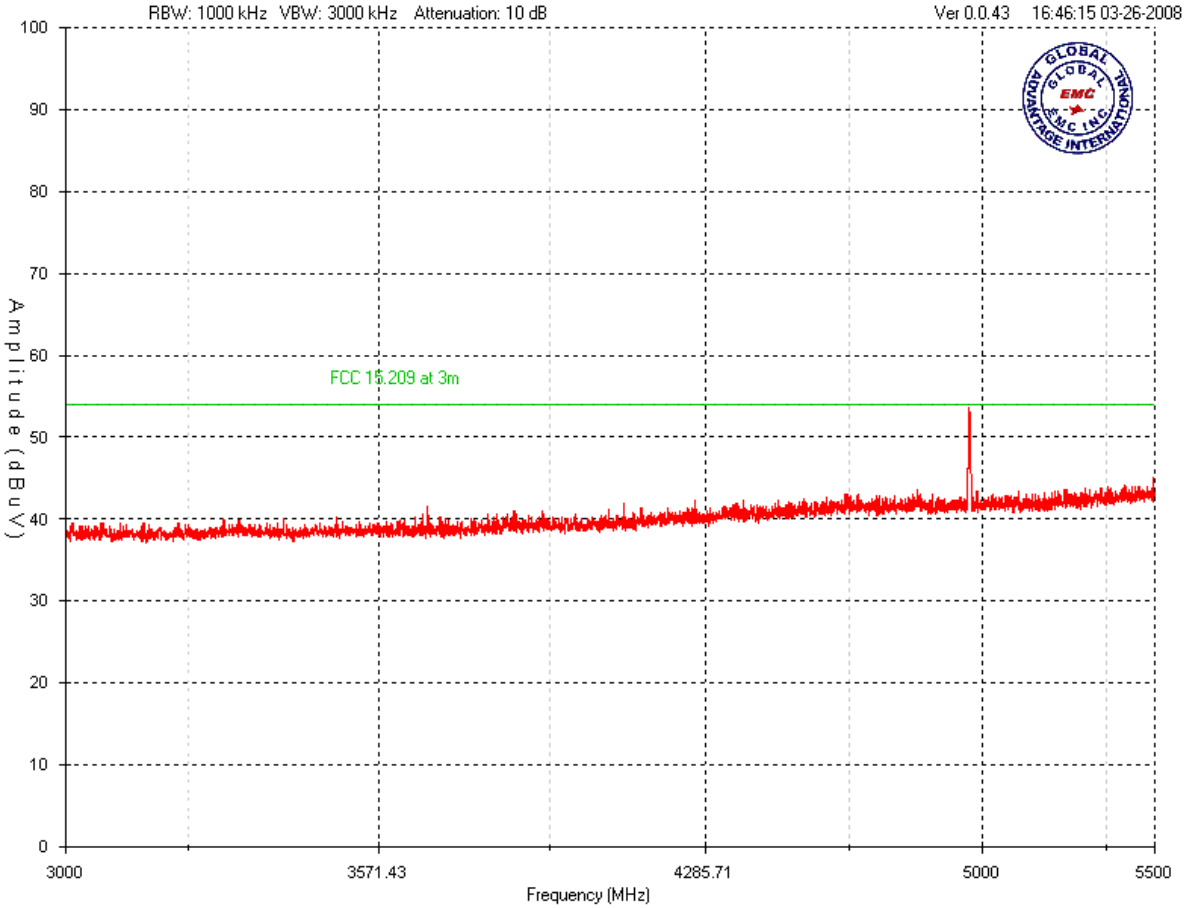
Low Channel 3 – 5.5GHz
Vertical – Peak Emissions Graph



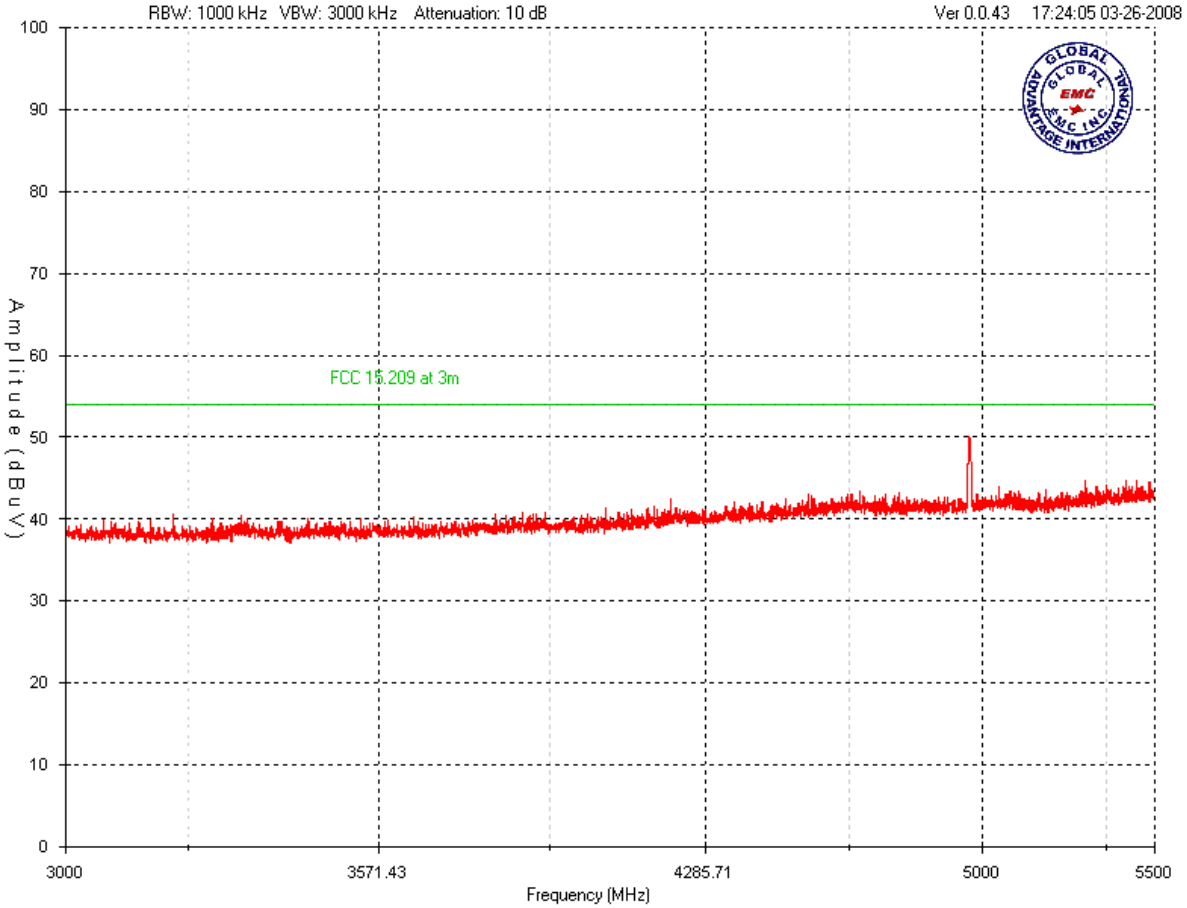
Low Channel 3 – 5.5GHz
Horizontal – Peak Emissions Graph



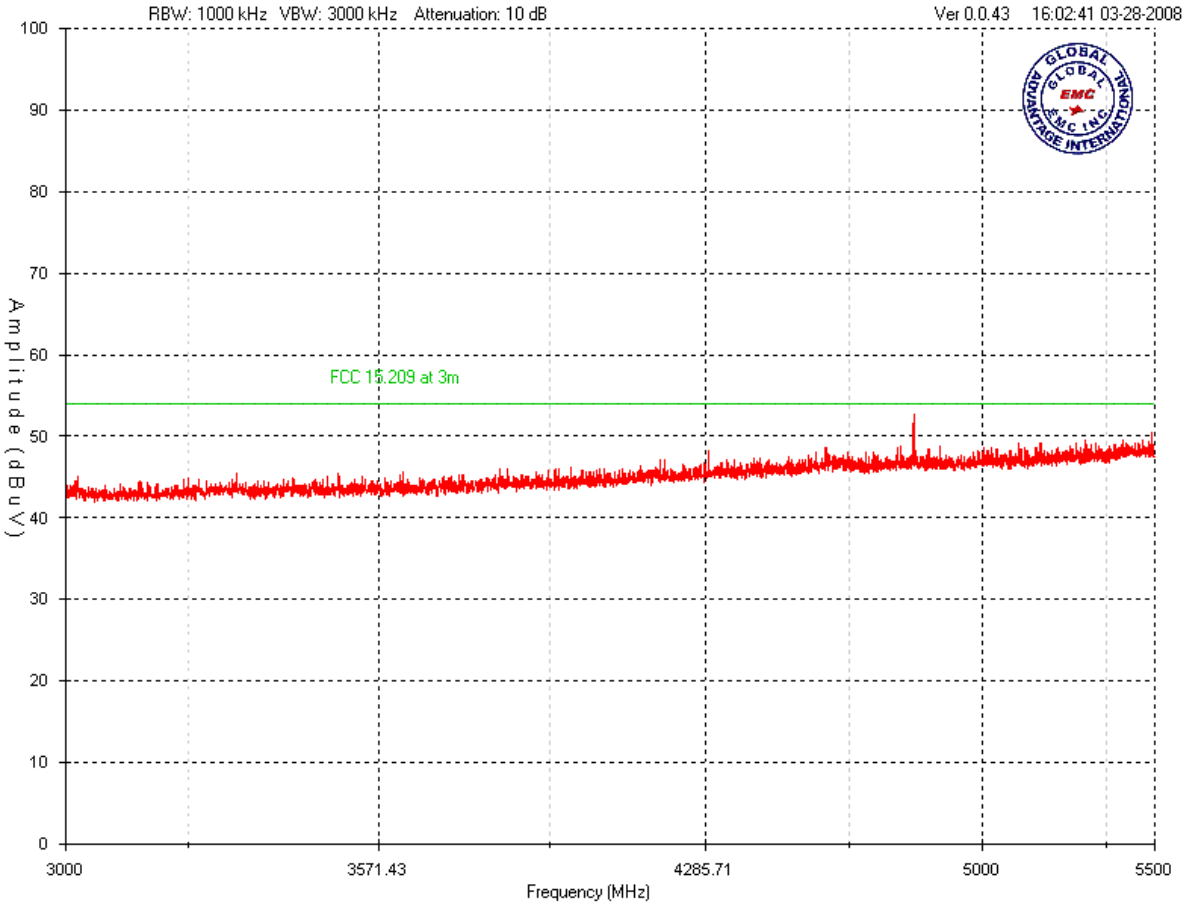
Mid Channel 3 – 5.5GHz
Vertical – Peak Emissions Graph



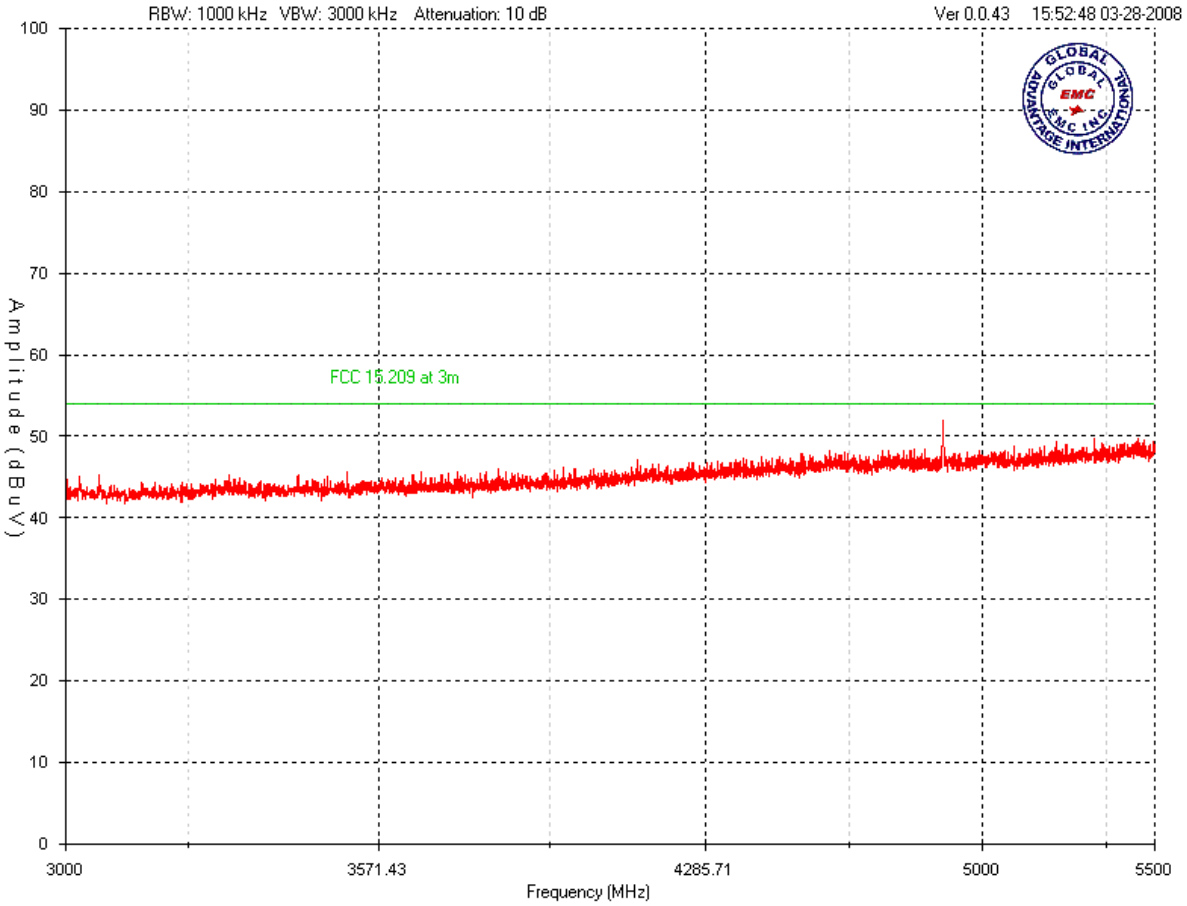
Mid Channel 3 – 5.5GHz
Horizontal – Peak Emissions Graph



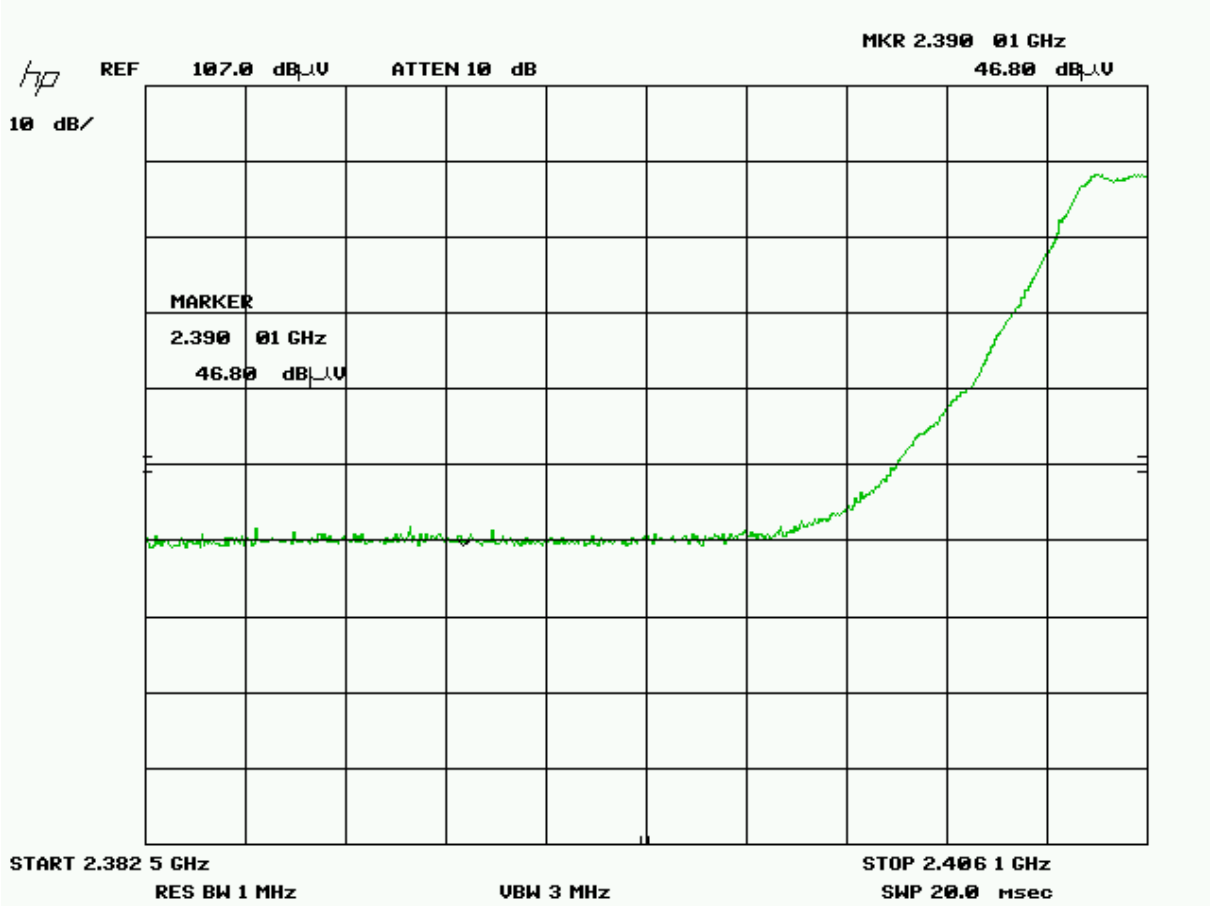
Hi Channel 3 – 5.5GHz
Vertical – Peak Emissions Graph



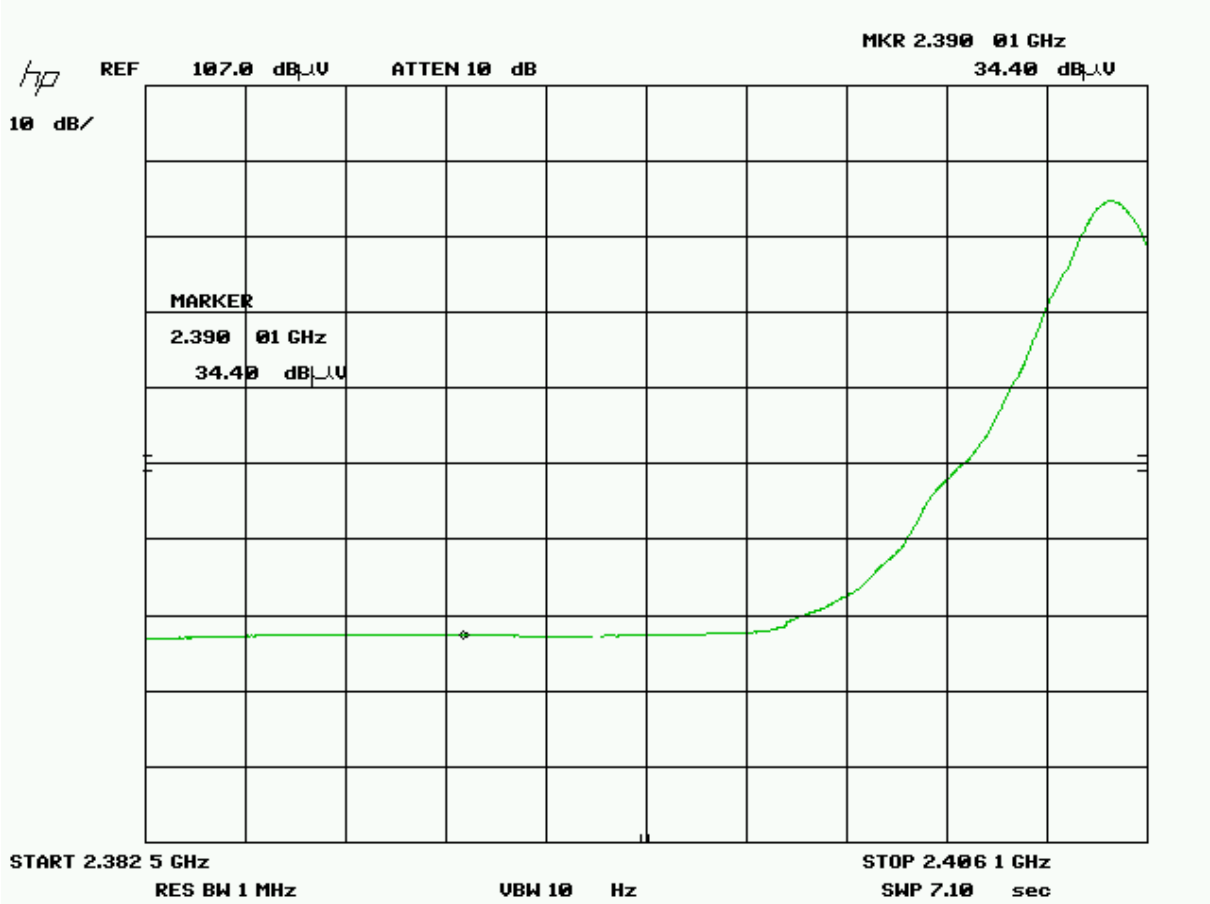
Hi Channel 3 – 5.5GHz
Horizontal – Peak Emissions Graph



Band Edge – Low channel
Vertical peak emissions

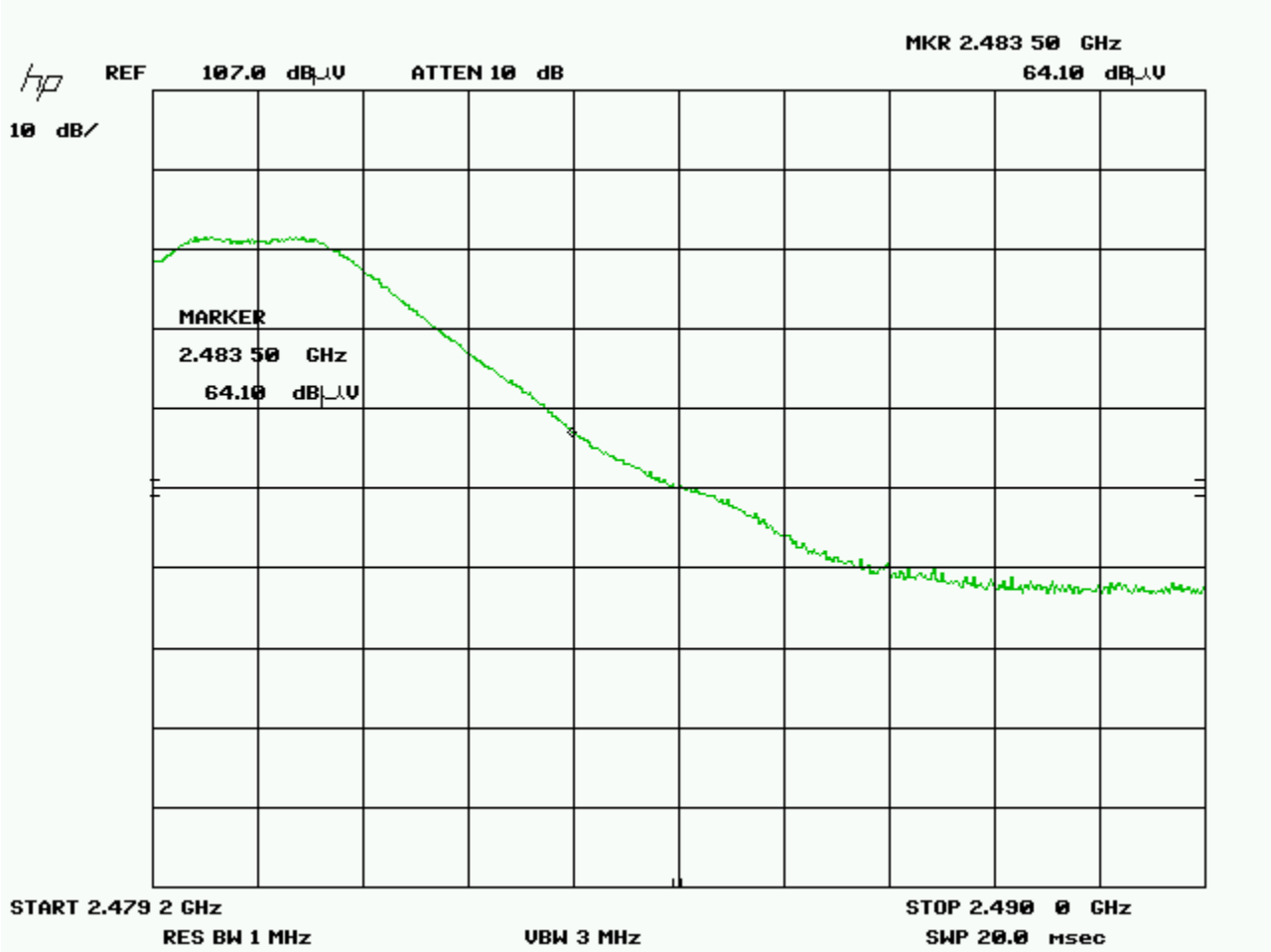


Band Edge – Low channel
Vertical Average emissions

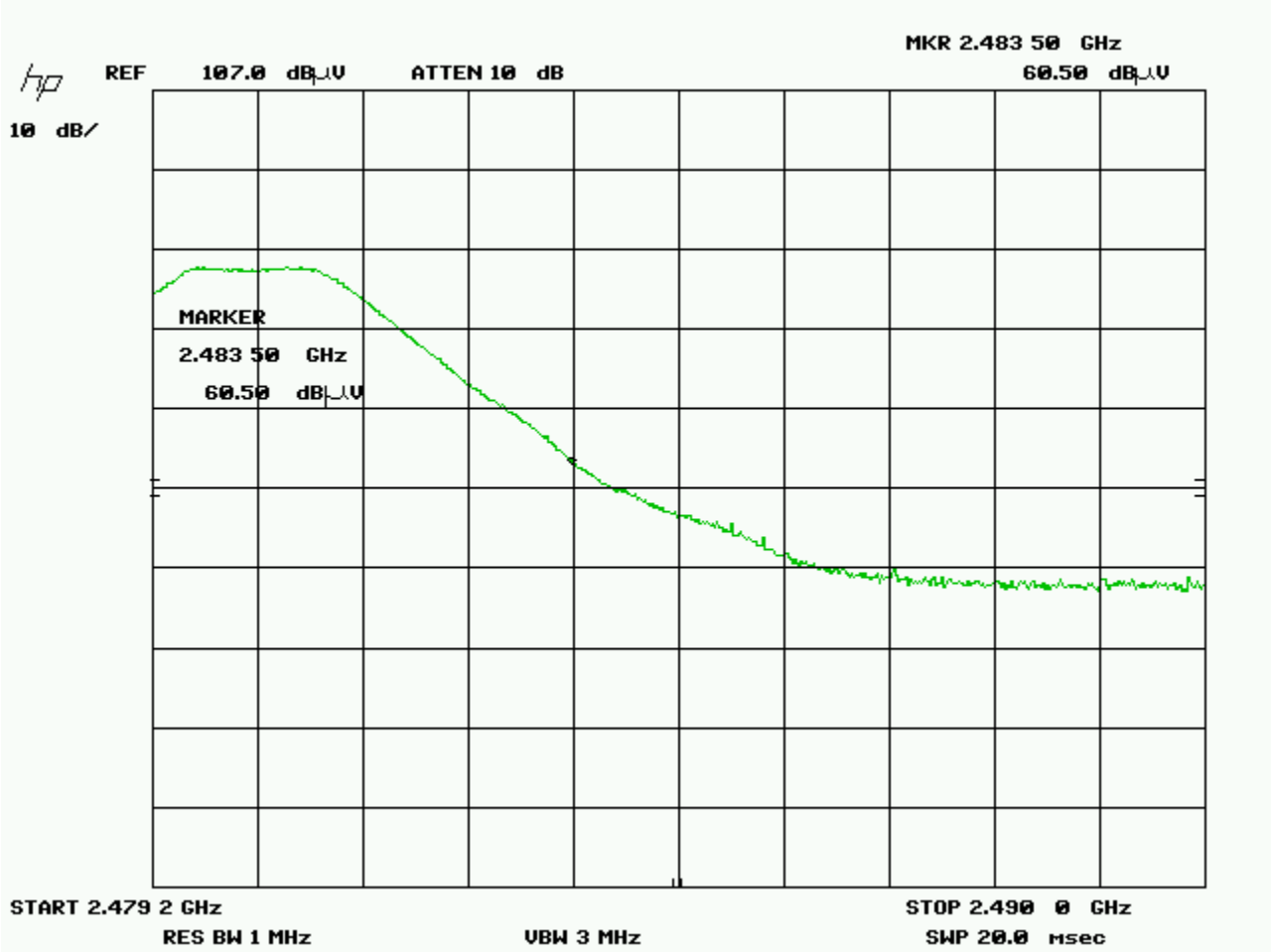


Band Edge – Low channel
Horizontal Average emissions

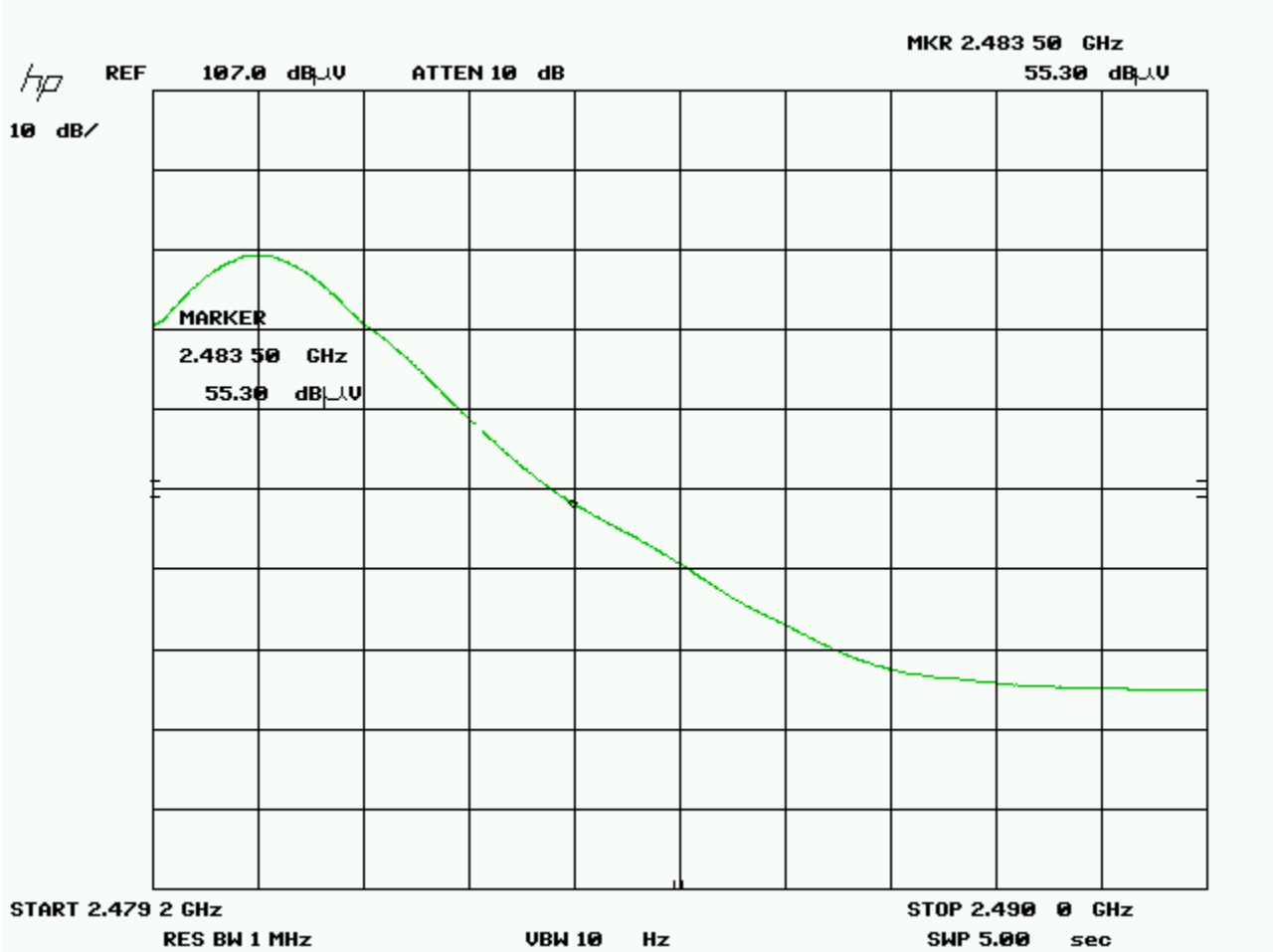
Band Edge – Hi channel
Vertical peak emissions



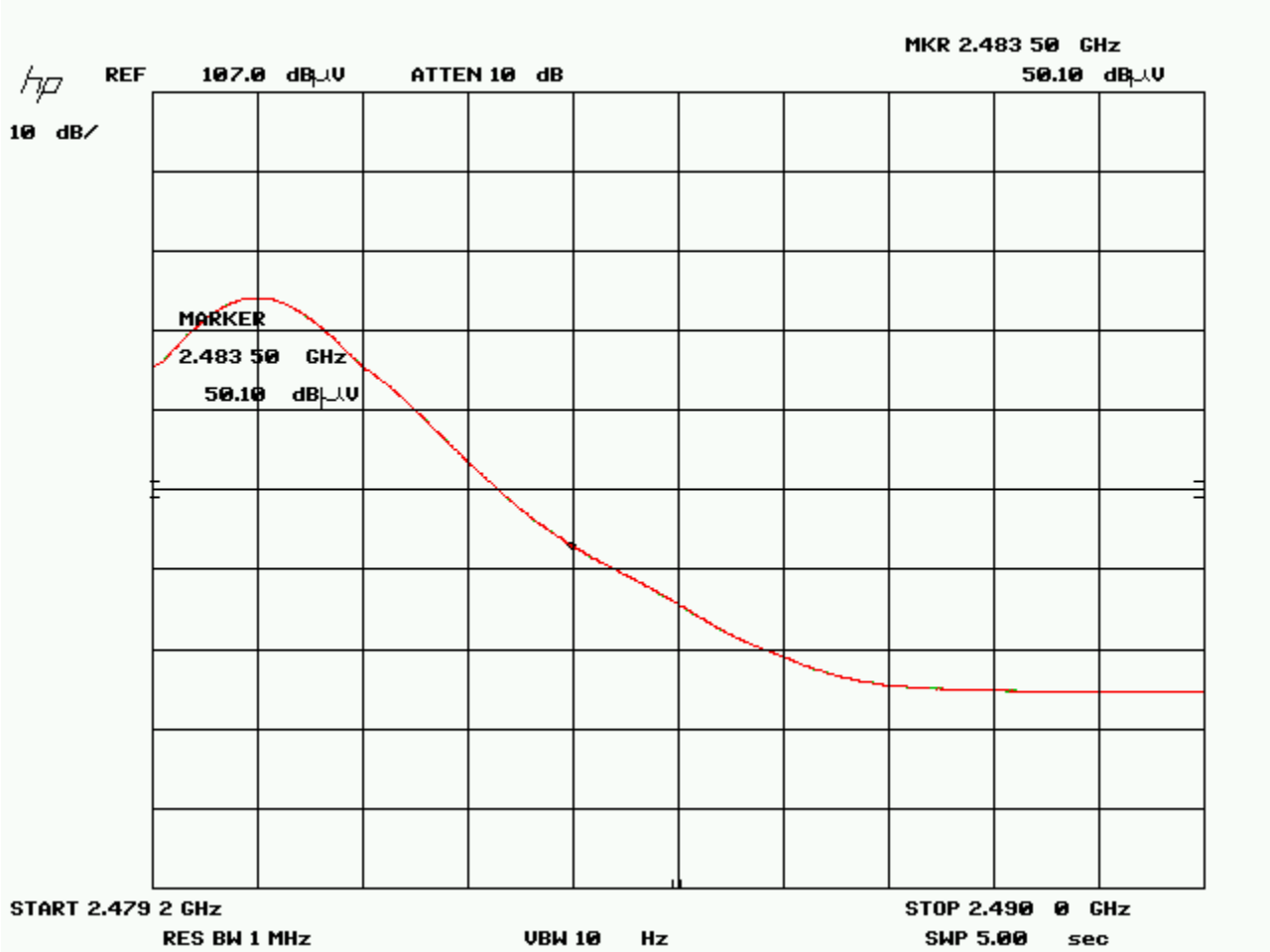
Band Edge – Hi channel
Horizontal peak emissions



Band Edge – Hi channel
Vertical Average emissions



Band Edge – Hi channel
Horizontal Average emissions



Final Measurements

Note: In accordance with 15.247(d), only radiated emissions exceeding the 15.209 limit that occur within the bands listed in 15.205, need to be verified with a quasi-peak detector or an average detector.

The requirement of -20dBc is verified by the raidated method, please see 'Spurious Conducted/Radiate Emissions' section of this report.

Some of the frequencies shown on the peak graph do not fall within a restricted band as listed in FCC 15.205 and does not need to be verified.

Plot for Low channel horizontal peak emissions at band edge of 2390 MHz was measured to be lower than vertical orientation, hence is not shown above. The average reading is however shown for completeness.

For information purposes, the fundamental was measured to be 94.0 dBuV/m at 3 meters, and none of the unintentional radiated emissions that fall outside of the restricted bands exceeded the -20dBc (or 74.0dBuV/m) requirement.

The following measurements were made at the harmonics shown in the above graphs.

See 'Spurious Antenna Conducted Emissions' measurements for -20 dBc requirements.

A reduced power level of -4 dbm was used at channel 26 (Centered around 2480 MHz), all other channel had the maximum output channel power as defined in the clauses below.

Client	Viconics
Product	VT7355C5500W
Standard(s)	RSS 210 Issue 6:2005 / FCC Part 15 Subpart C 15:2006

Radiated Emissions Measurements

Project Name / Number						RF Module - VT7355C5500W					
Test Frequency (MHz)	**Detection mode (Q-Peak)**	**Antenna polarity (Horz/Vert)**	**Raw signal dB(µV)**	**Antenna factor dB**	**Cable loss dB**	**Attenuator dB**	**Pre-Amp Gain dB**	**Received signal dB(µV/m)**	**Emission limit dB(µV/m)**	**Margin dB(µV)**	**Result**
Low channel											
270.6	Peak	Horz	55.6	12.9	1.1	0.0	32.0	37.6	66.0	28.4	PASS
270.6	Avg	Horz	44.4	12.9	1.1	0.0	32.0	26.4	46.0	19.6	PASS
154.2	Peak	Vert	58.1	9.0	1.1	0.0	32.0	36.2	63.5	27.3	PASS
154	Avg	Vert	26.0	9.0	1.1	3.0	32.0	7.1	43.5	36.4	PASS
208.5	Peak	Vert	51.4	11.7	1.1	0.0	32.0	32.2	66.0	33.8	PASS
208	Avg	Vert	36.7	11.7	1.1	0.0	32.0	17.5	46.0	28.5	PASS
1100	Peak	Vert	60.5	23.6	2.4	0.0	36.8	49.7	74.0	24.3	PASS
1100	Avg	Vert	42.5	23.6	2.4	0.0	36.8	31.7	54.0	22.3	PASS
2826	Peak	Vert	46.6	34.8	2.4	0.0	36.8	47.0	74.0	27.0	PASS
2826	Avg	Vert	35.2	34.8	2.4	3.0	36.8	38.6	54.0	15.4	PASS
2740	Peak	Horz	46.4	33.2	2.4	0.0	36.8	45.2	74.0	28.8	PASS

2743	Avg	Horz	34.8	33.2	2.4	0.0	36.8	33.6	54.0	20.4	PASS
Low channel											
2405	Peak	Vert	95.8	31.5	2.4	0.0	36.8	92.9			
2405	Avg	Vert	92.2	31.5	2.4	0.0	36.8	89.3			
2390	Peak	Vert	46.8	31.5	2.4	0.0	36.8	43.9	74.0	30.1	PASS
2390	Avg	Vert	34.4	31.5	2.4	0.0	36.8	31.5	54.0	22.5	PASS
2405	Peak	Horz	90.7	31.6	2.4	0.0	36.8	87.9			
2405	Avg	Horz	88.0	31.6	2.4	0.0	36.8	85.2			
2390	Peak	Horz	45.7	31.6	2.4	0.0	36.8	42.9	74.0	31.1	PASS
2390	Avg	Horz	33.4	31.6	2.4	0.0	36.8	30.6	54.0	23.4	PASS
Mid channel											
2444	Peak	Horz	92.2	31.6	2.4	0.0	36.8	89.4			
2445	Avg	Horz	86.4	31.6	2.4	0.0	36.8	83.6			
2445	Peak	Vert	96.9	31.5	2.4	0.0	36.8	94.0			
2445	Avg	Vert	91.9	31.5	2.4	0.0	36.8	89.0			
Hi Channel with reduced power of -4 dbm											
2480	Peak	Horz	84.9	31.6	2.4	0.0	36.8	82.1			
2480	Avg	Horz	81.3	31.6	2.4	0.0	36.8	78.5			
2483.5	Peak	Horz	60.5	31.6	2.4	0.0	36.8	57.7	74.0	16.3	PASS
2483.5	Avg	Horz	50.1	31.6	2.4	0.0	36.8	47.3	54.0	6.7	PASS

2480	Peak	Vert	88.5	31.5	2.4	0.0	36.8	85.6			
2480	Avg	Vert	86.4	31.5	2.4	0.0	36.8	83.5			
2483.5	Peak	Vert	64.1	31.5	2.4	0.0	36.8	61.2	74.0	12.8	PASS
2483.5	Avg	Vert	55.3	31.5	2.4	0.0	36.8	52.4	54.0	1.6	PASS
Mid channel											
4890	Peak	Vert	52.0	33.0	4.0	0.0	36.0	53.0	74.0	21.0	PASS
4890	Avg	Vert	48.6	33.0	4.0	0.0	36.0	49.6	54.0	4.4	PASS
7337	Peak	Vert	51.1	37.0	5.0	0.0	35.5	57.6	74.0	16.4	PASS
7336	Avg	Vert	40.2	37.0	5.0	0.0	35.5	46.7	54.0	7.3	PASS
4890	Peak	Horz	49.0	33.0	4.0	0.0	36.0	50.0	74.0	24.0	PASS
4890	Avg	Horz	46.3	33.0	4.0	0.0	36.0	47.3	54.0	6.7	PASS
Low channel											
4809.8	Peak	Vert	54.4	33.0	4.0	0.0	36.0	55.4	74.0	18.6	PASS
4810	Avg	Vert	47.9	33.0	4.0	0.0	36.0	48.9	54.0	5.1	PASS
7215	Peak	Vert	47.3	37.0	5.0	0.0	35.5	53.8	74.0	20.2	PASS
7215	Avg	Vert	36.4	37.0	5.0	0.0	35.5	42.9	54.0	11.1	PASS
4810	Peak	Horz	50.7	33.0	4.0	0.0	36.0	51.7	74.0	22.3	PASS
4810	Avg	Horz	41.5	33.0	4.0	0.0	36.0	42.5	54.0	11.5	PASS

Note: Radiated emissions measurements above 3.0 GHz were performed at a 1 meter test distance, and in accordance with FCC 15.31(f)(1) an extrapolation factor of 9.5 dB was applied. No emissions above the 3rd harmonic were detected at 1 meter. For high channel (26) the output power was further reduced to -4dbm in order to comply with the restricted band edge measurements.

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Spectrum Analyzer	8566B	HP	2006-08-09	2008-08-09	GEMC 6
Quasi Peak Adapter	85650A	HP	2006-08-07	2008-08-07	GEMC 7
BiLog Antenna	3142-C	ETS	2006-08-06	2008-08-06	GEMC 8
Horn Antenna	6878/24	Q-Par	On file	2008-08-01	GEMC 65
1-26G pre-amp	HP 8449B	HP	On file	2008-08-01	GEMC 68
Attenuator 3 dB	FP-50-3	Trilithic	NCR	NCR	GEMC 40
Pre-Amplifier	PA-2.5-26	Vican	2006-09-12	2008-09-12	GEMC 9
IFR Spectrum Analyzer	AN940	IFR	May 4/2006	May 4/2008	GEMC 6350
Horn Antenna	SAS-572	AH	NCR	NCR	GEMC 6371
RF Cable 7m	LMR-400-7M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 28
RF Cable 1m	LMR-400-1M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 29
RF Cable 0.5M	LMR-400-0.5M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 31

This report module is based on GEMC template “FCC - 15.209 - Radiated Emissions_Rev2.doc”

6dB Bandwidth of Digitally Modulated Systems

Purpose

The purpose of this test is to ensure that the bandwidth occupied exceeds a stated minimum. This helps ensure the utilization of the frequency allocation is sufficiently wide. This also helps prevent corruption of data by ensuring adequate data separation to distinguish the reception of the intended information.

Limits

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. This should be measured with a 100 kHz RBW and a 300 kHz VBW.

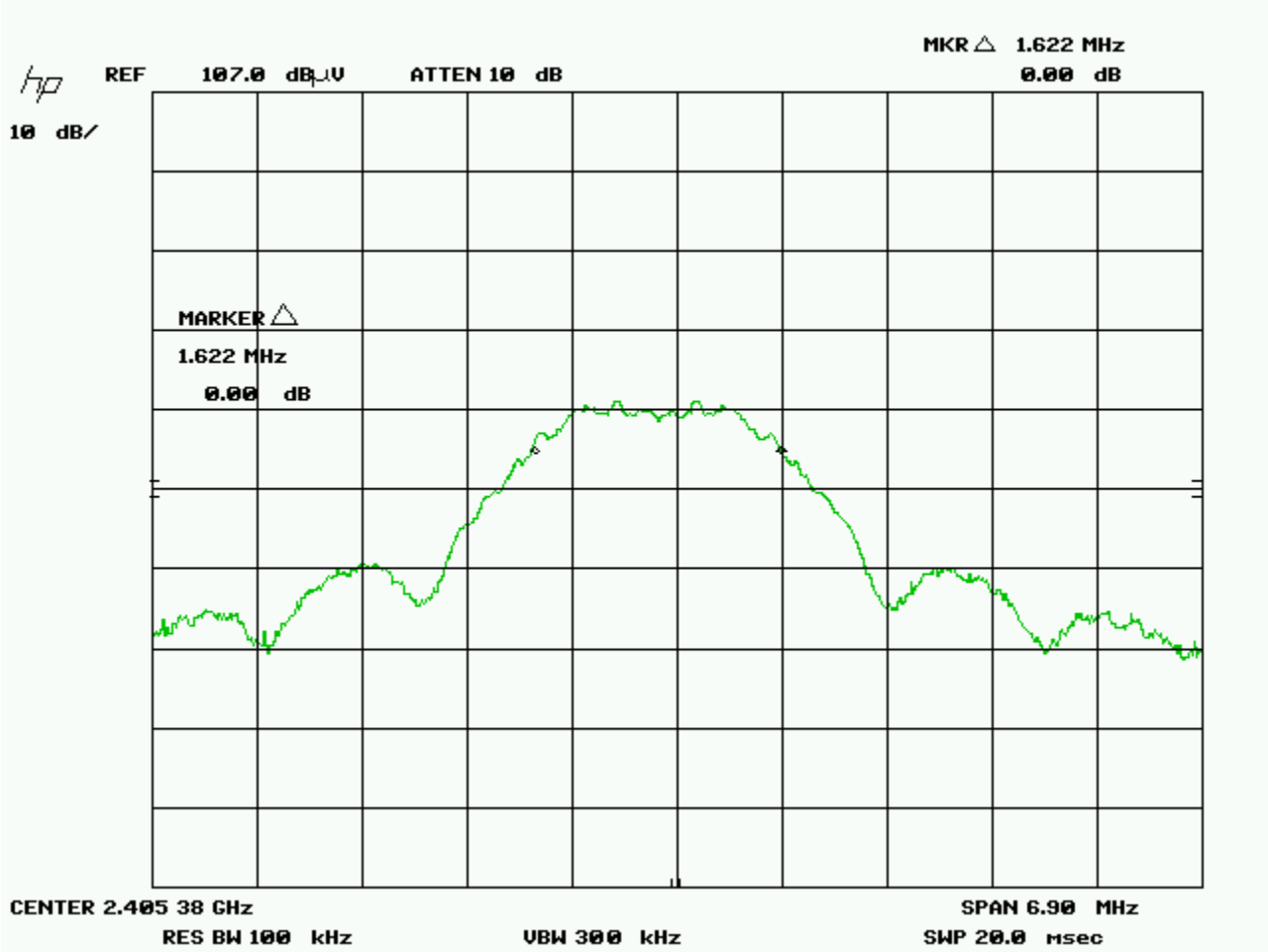
Results

The EUT passed. The6 dB BW measured was 1.622MHz.

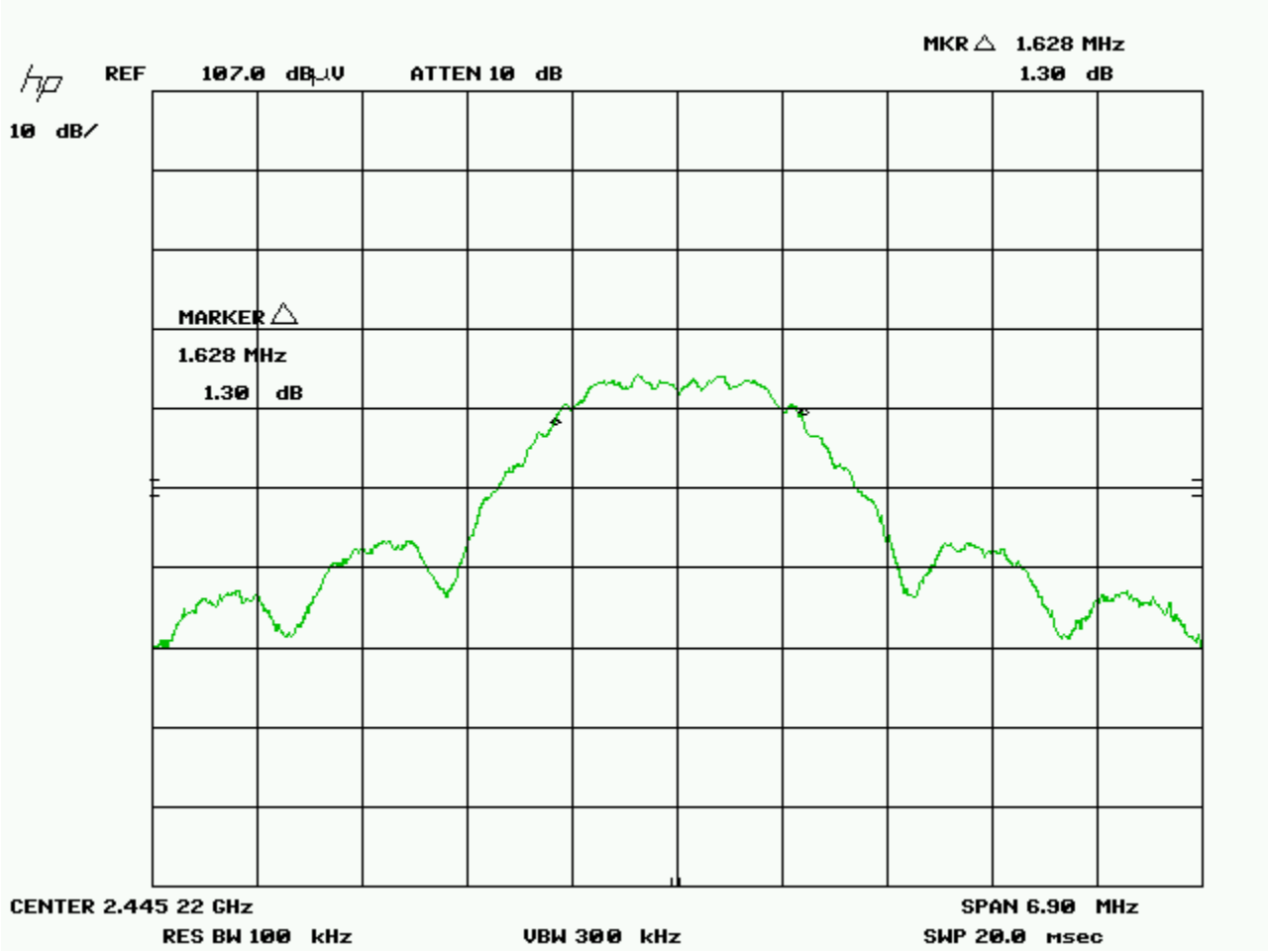
Graph(s)

The graphs shown below show the channel spacing during the operation of the device. This is measured by a max hold on the spectrum analyzer. This measurement is a peak measurement. Max hold is performed for a duration of not less then 1 minute.

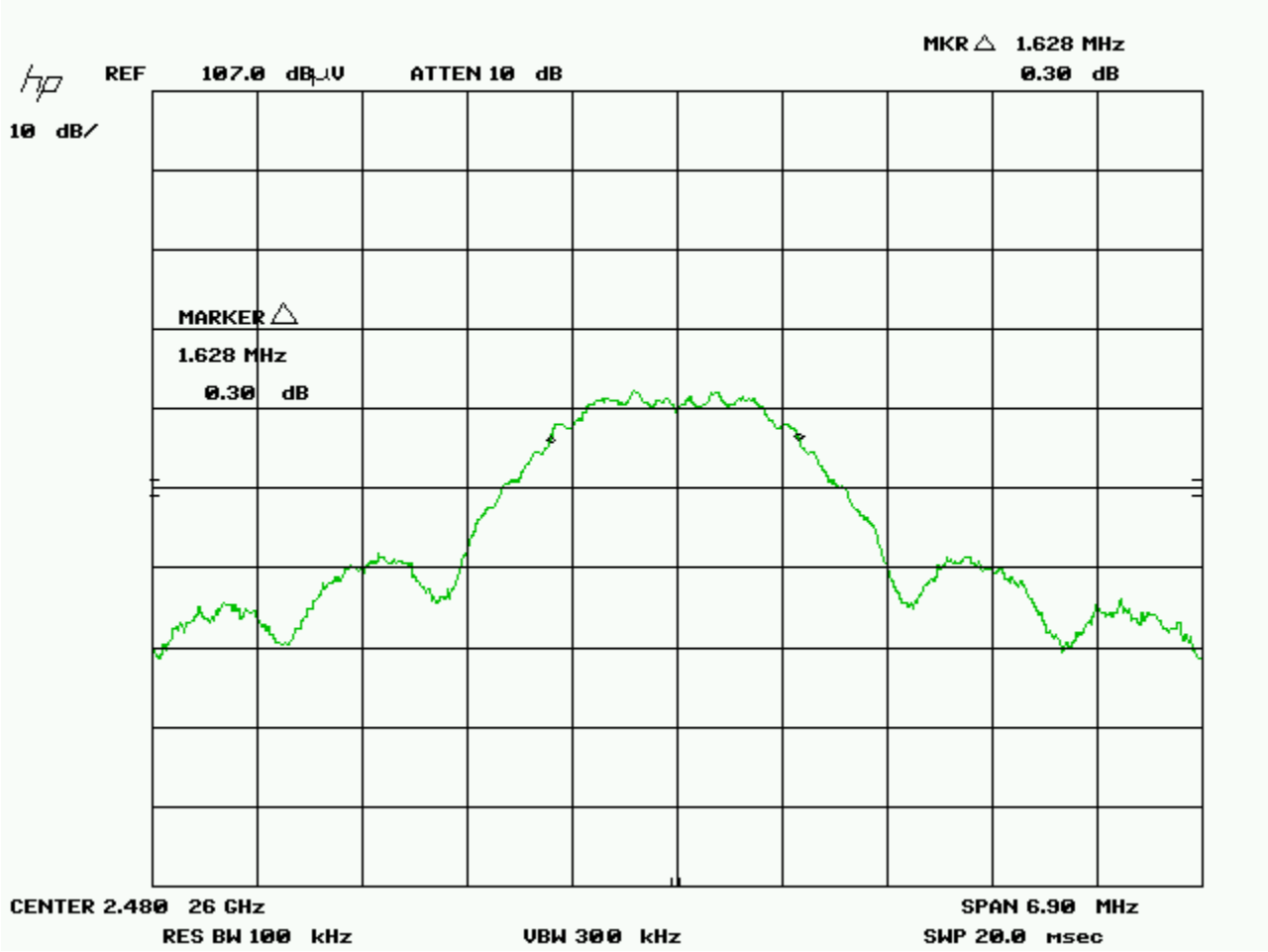
Low Channel



Medium Channel



High Channel



Note: See 'Appendix B – EUT & Test Setup Photographs' for photos showing the test set-up.

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Attenuator 20 dB	FP-50-20	Trilithic	NCR	NCR	GEMC 43
Spectrum Analyzer	8566B	HP	2006-08-09	2008-08-09	GEMC 6
Quasi Peak Adapter	85650A	HP	2006-08-07	2008-08-07	GEMC 7
RF Cable 1m	LMR-400-1M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 29
Power Attenuator 20 dB	25-A-FFN-20	Bird / Hutton	NCR	NCR	GEMC 49

This report module is based on GEMC template "FCC – Power Line Conducted Emissions Class B_Rev1"

Maximum Peak Envelope Power

Purpose

The purpose of this test is to ensure that the maximum power conducted to the radiating element does not exceed the limits specified. This ensures that if the end-user replaces the antenna, that the maximum power does not exceed an amount which may create an excessive power level.

Limits

The limits are defined in 15.247(b).
For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands, the peak limit is 1 watt.

Results

Since the EUT has a patch antenna and there was no provision to perform this measurement using the conducted power method, a radiated peak dbuV/m reading was captured and recorded. Vertical orientations of the antenna at 3m yielded the worst case readings. The maximum reading recorded was at vertical orientation at low channel, raw signal was measured to be 96.9 dbuV/m.

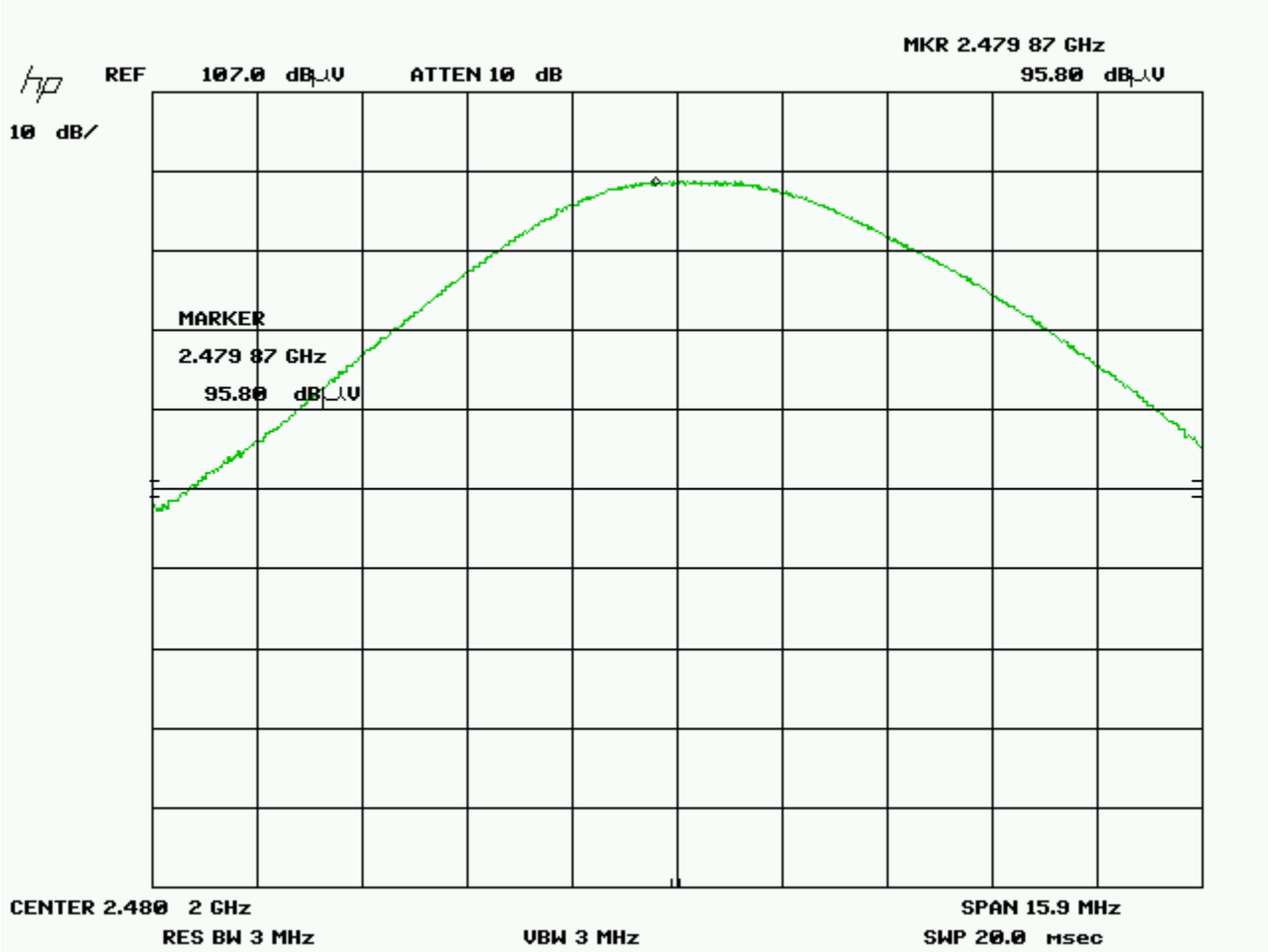
Equivalent plots are shown below.

As per manufacturers setting the power output on the VT7355C5500W was 0dbm. Calculated value of -2.5 dbm is within the +/-3 db tolerance for radiated measurement. This measures to approximately 0.56 mW conducted power which is well within the 30 dbm or 1W limit.

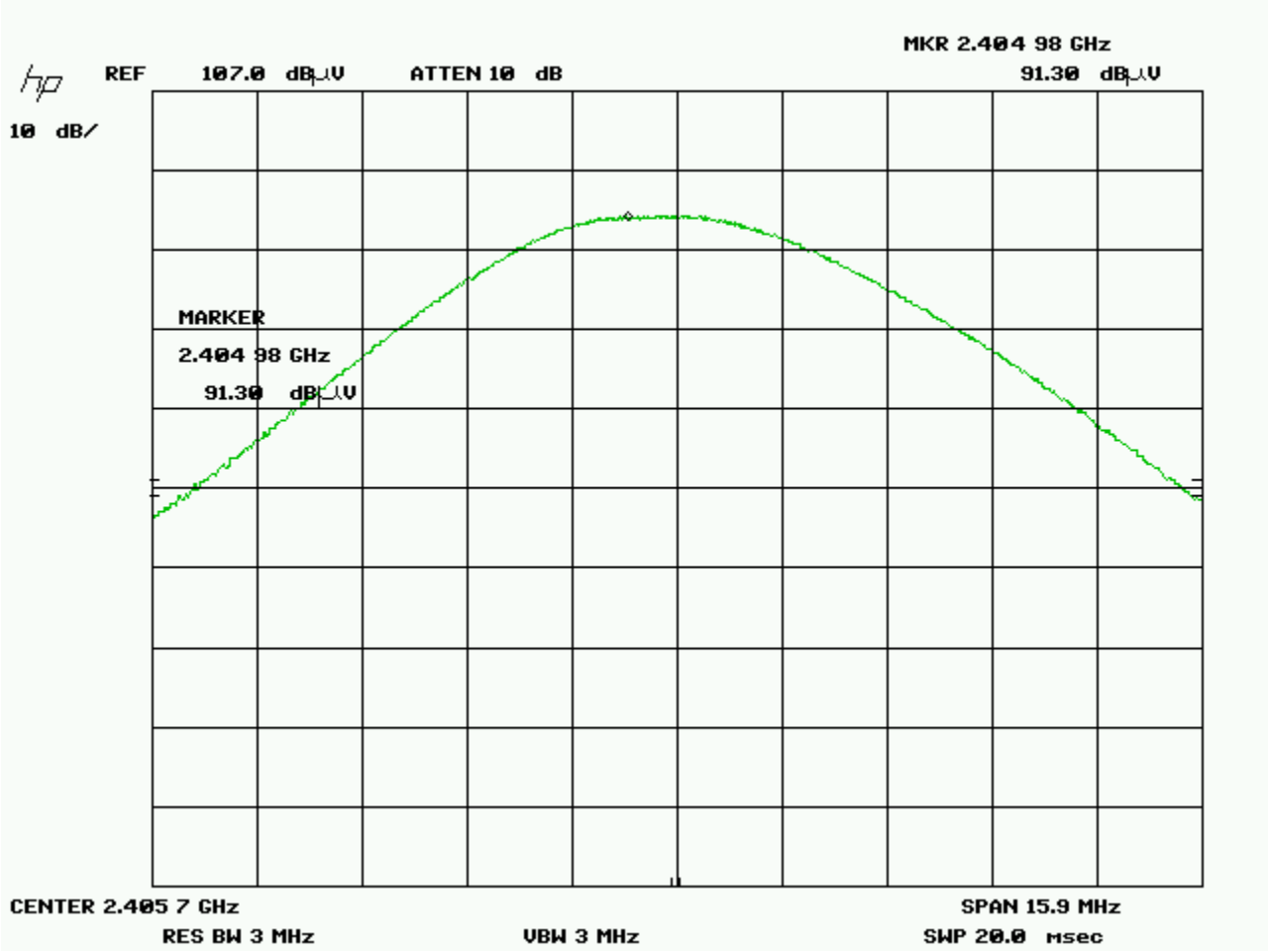
Table(s)

The tables shown below shows the peak power output of the device during the antenna conducted measurement during transmit operation of the EUT.

Hi channel
Vertical peak emissions.

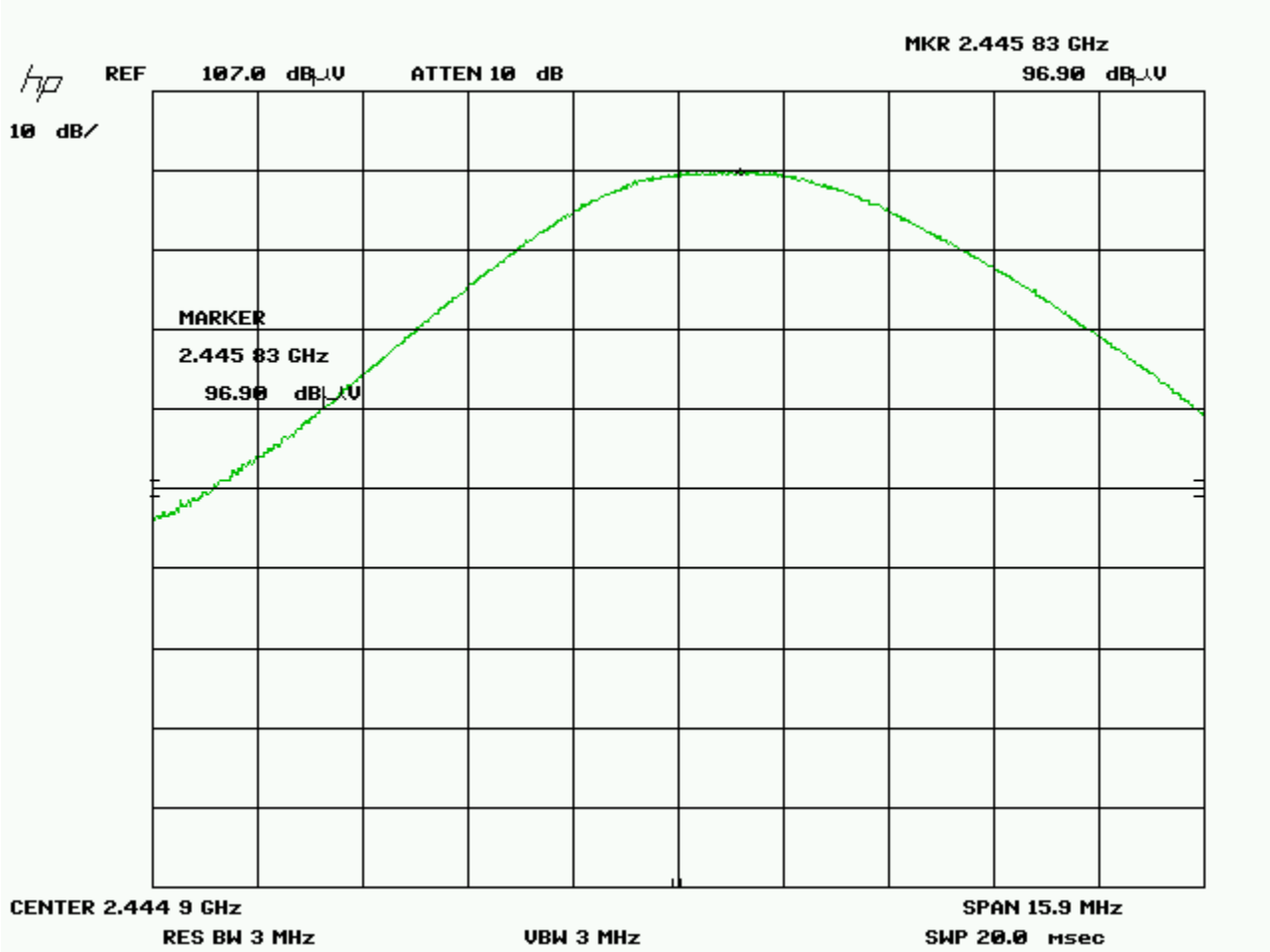


Low Channel
Horizontal peak emissions



This plot is to proof that the horizontal readings were lower than vertical readings.

Medium channel
Vertical peak emissions



High channel power was not recorded for this test as that was reduced to -4 dbm at the output of the unit (before the antenna gain is accounted for).

The calculated value using Friss`s free space equation is:
Path losses = 32.45 – Gain Tx Antenna (db) – Gain Rx Atnenna (db) + 20 log (f MHz) + 20 log (d km)
= 32.45 – 3 – 4.8 + 67.76 – 50.45
= 41.958 db
The raw received signal was 96.9 dbuV /m. Taking into account pre-amp gain and cable losses (antenna gain is already accounted for in the free space equation) the equivalent signal is ➔

96.9 + 2.4 (cable loss) – 36.8 (gain) =
62.5 dbuV/m.

Converting this to power (Pr) = -44.5 dbm.

Pt(db) - Pr(db) = 41.958
➔ Pt (db) = 41.958 + Pr (db)
➔ Pt(db) = 41.958 – 44.5
= -2.5 dbm

As per manufacturers setting the power output on the VT7355C5500W was 0dbm. Calculated value of -2.5 dbm is within the +/-3 db tolerance for radiated measurement.

Note: See 'Appendix B – EUT & Test Setup Photographs' for photos showing the test set-up.

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Power Head	PH 2000	AR	2006-10-13	2008-10-13	GEMC 15
Power meter	PM 2002	AR	2006-10-13	2008-10-13	GEMC 16
RF Cable 1m	LMR-400-1M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 29
Power Attenuator 20 dB	25-A-FFN-20	Bird / Hutton	NCR	NCR	GEMC 49

This report module is based on GEMC template "FCC – Power Line Conducted Emissions Class B_Rev1"

Spurious Conducted/Radiated Emissions

Purpose

The purpose of this test is to ensure that the maximum power conducted to the radiating element at frequencies outside of the authorized spectrum does not exceed the limits specified. This ensures that the only the intended signal is delivered to the radiating element.

Limits

The limits are defined in 15.247(d). In any 100 kHz band, the peak spurious harmonics emissions must be at least 20 dB below the fundamental. Spurious Conducted emissions are to be evaluated up to the 10^{th} harmonic. This -20 dBc requirement also applies at the 'band edge' or 2.4 GHz and 2.4835 GHz.

Results

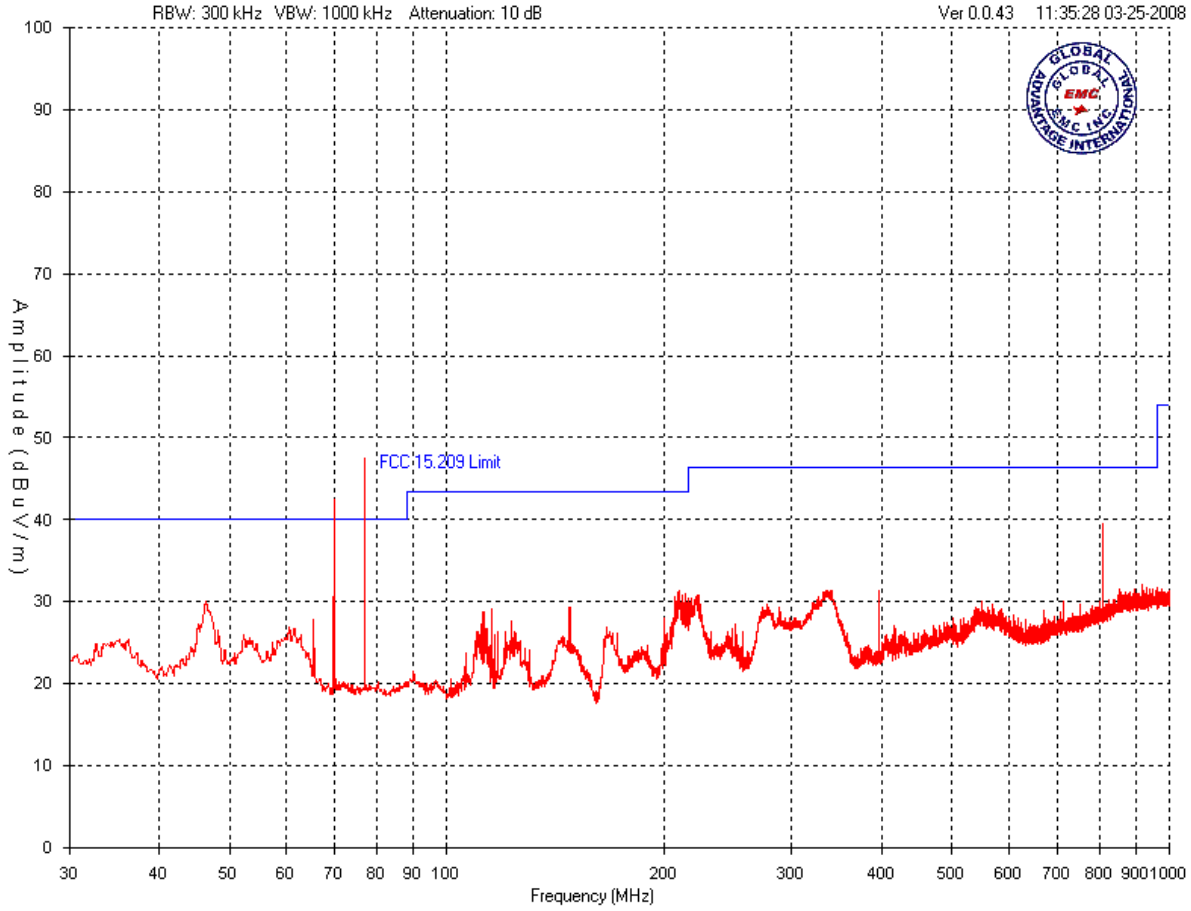
The EUT passed the limits. Low, middle and high band was measured. The worst case for each mode is presented as a graph for the spectrum. The -20 dBc requirement is shown for the lower band edge at 2.4 GHz in the low band. The -20 dBc requirement is also shown for the higher band edge at 2.4835 GHz in the high band.

Graph(s)

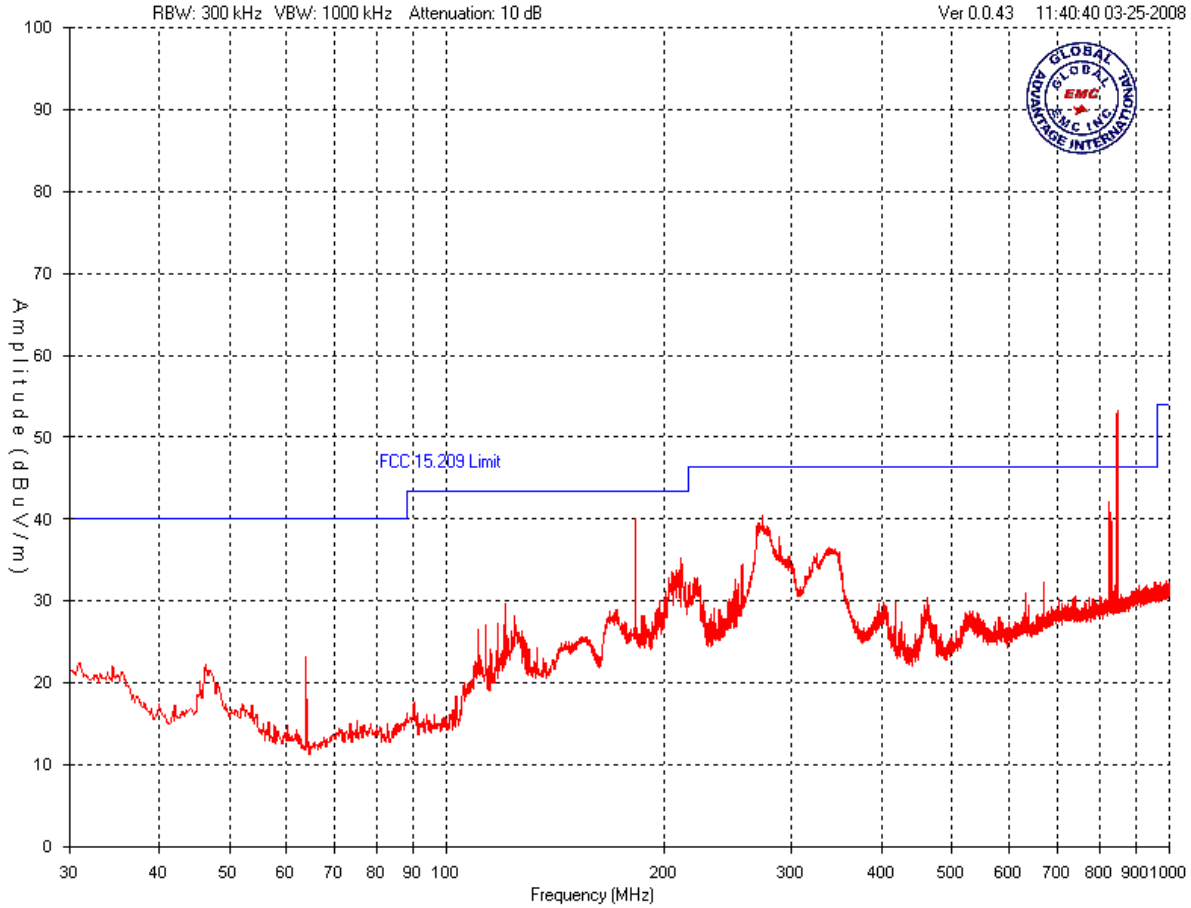
The graphs shown below shows the peak power output of the device during the radiated measurement at 300 kHz bandwidth during transmit operation of the EUT from 30 MHz – 2 GHz, since the RBW used is greater than the value required by the standard (100 kHz) this is a worst case reading and still complied with the limits. These plots were used as they are similar to the once used for spurious radiated emission scans. None of the spurious exceeded the 75 dbuV/m limit (-20dbc from max reading of 95 dbuV/m).

Readings above 2 GHz were plotted using 100 khz RBW as required by the standard. None of the spurious emissions emitted from the EUT exceeded the 20dbc rule.

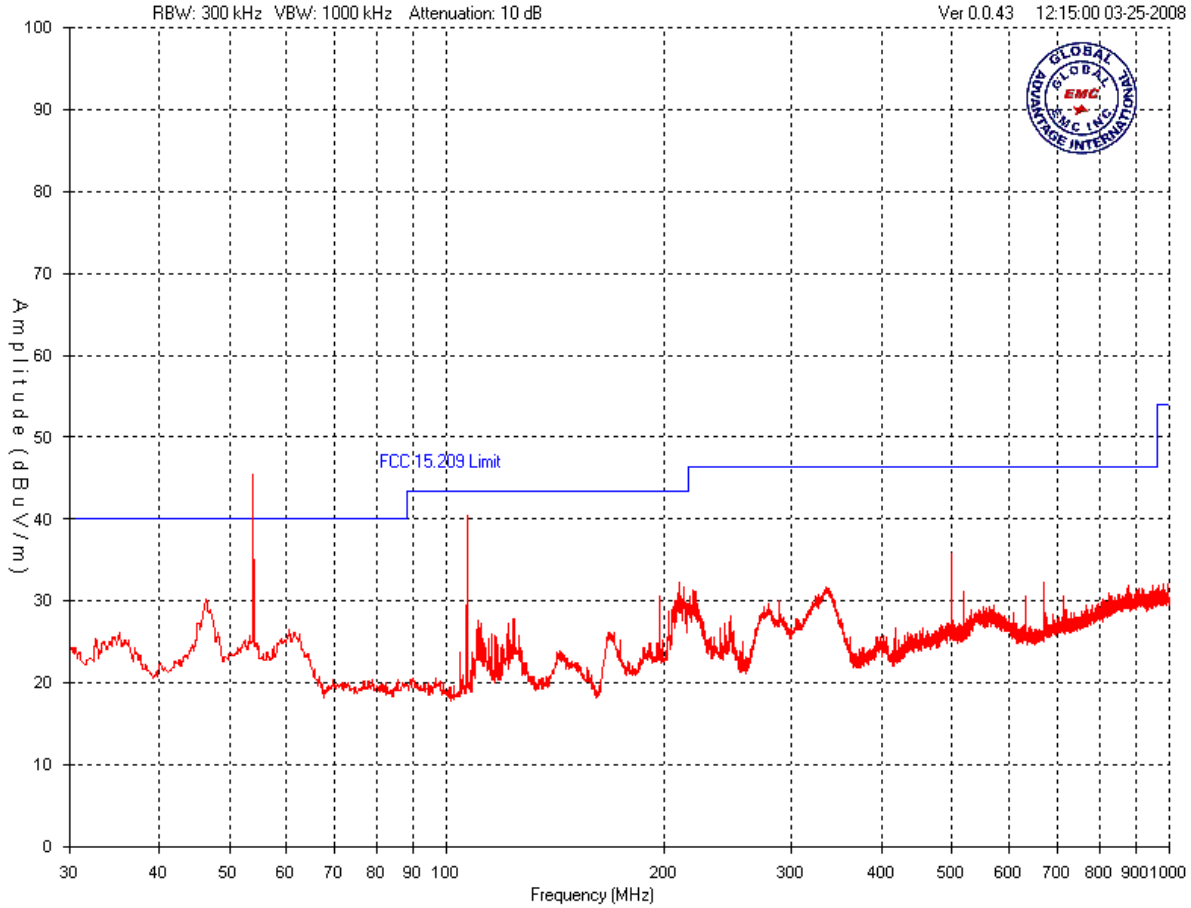
Low Channel –30MHz – 1 GHz
Vertical – Peak Emissions Graph



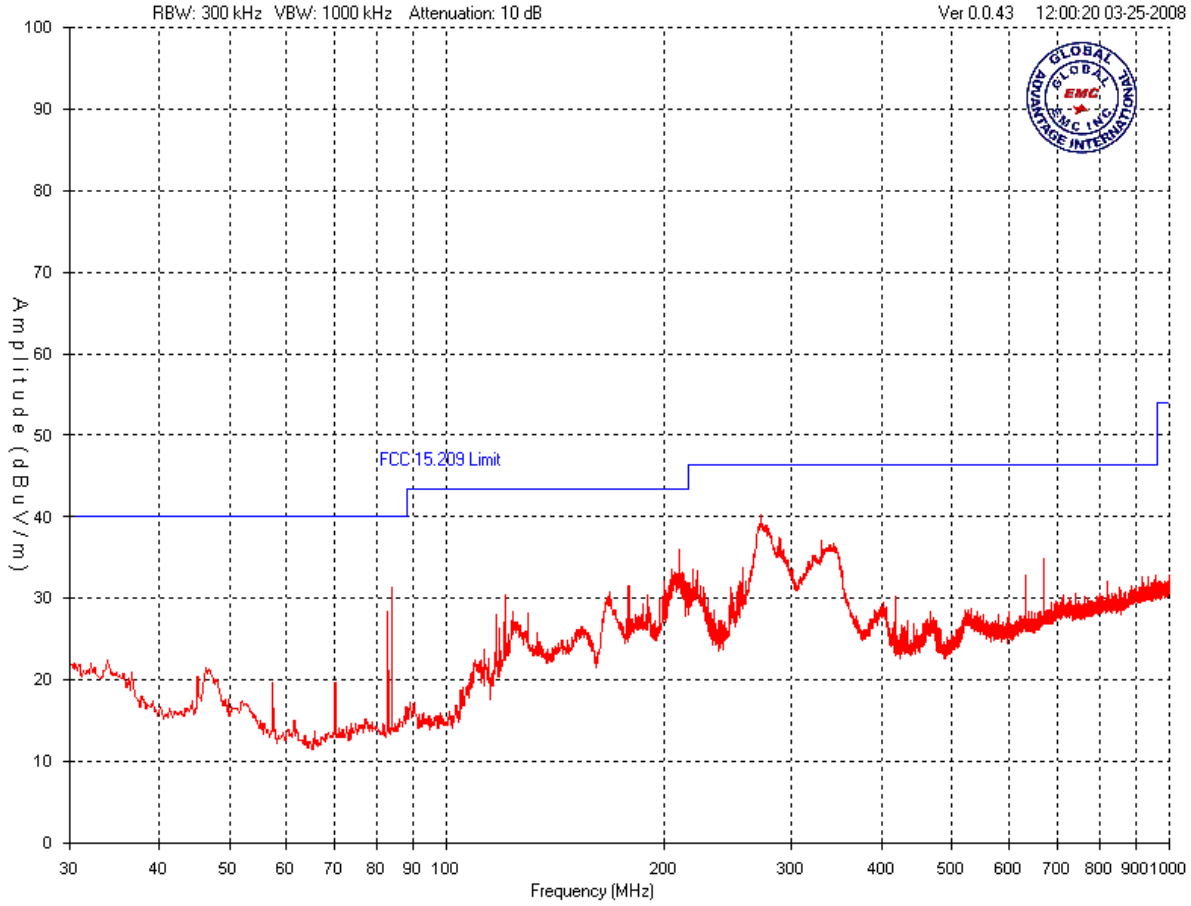
Low Channel – 30MHz – 1 GHz
Horizontal – Peak Emissions Graph



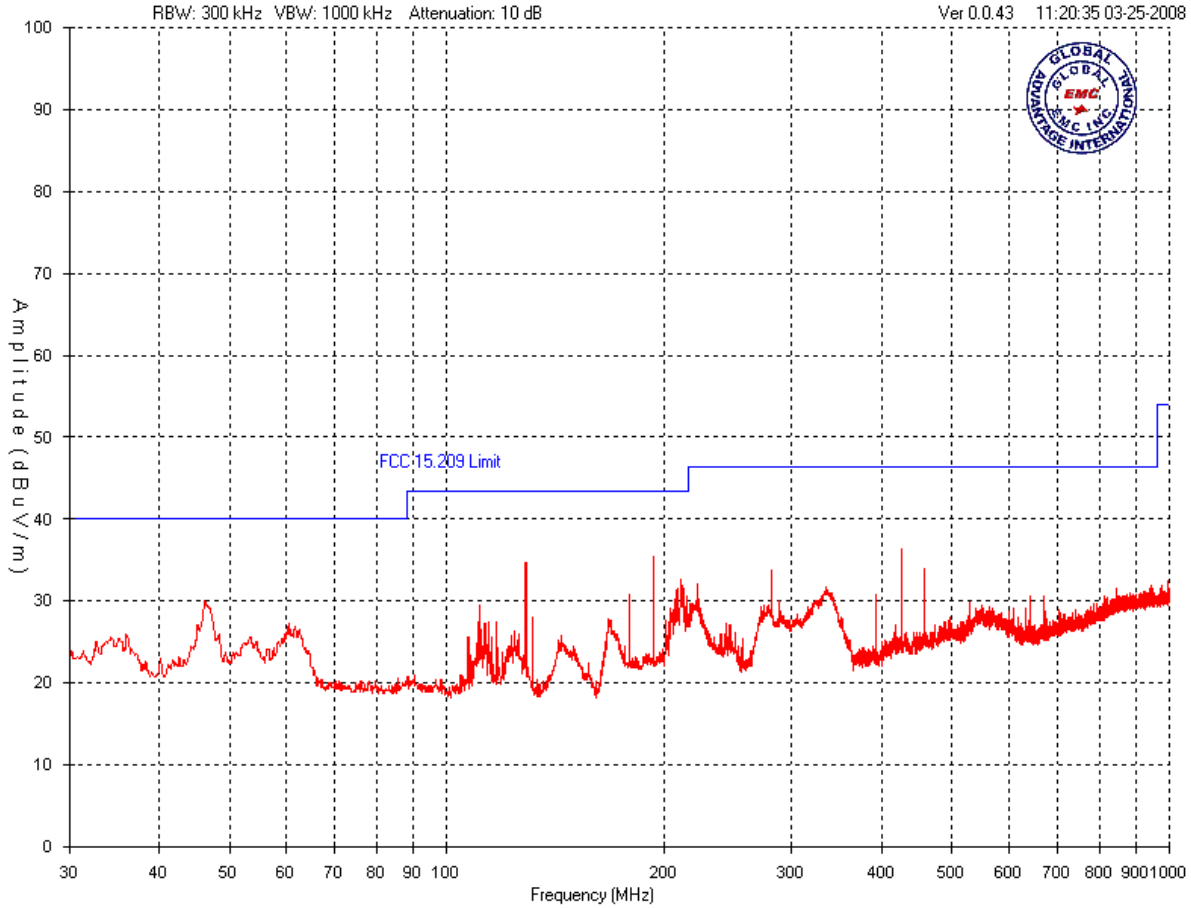
Mid Channel – 30MHz – 1 GHz
Vertical – Peak Emissions Graph



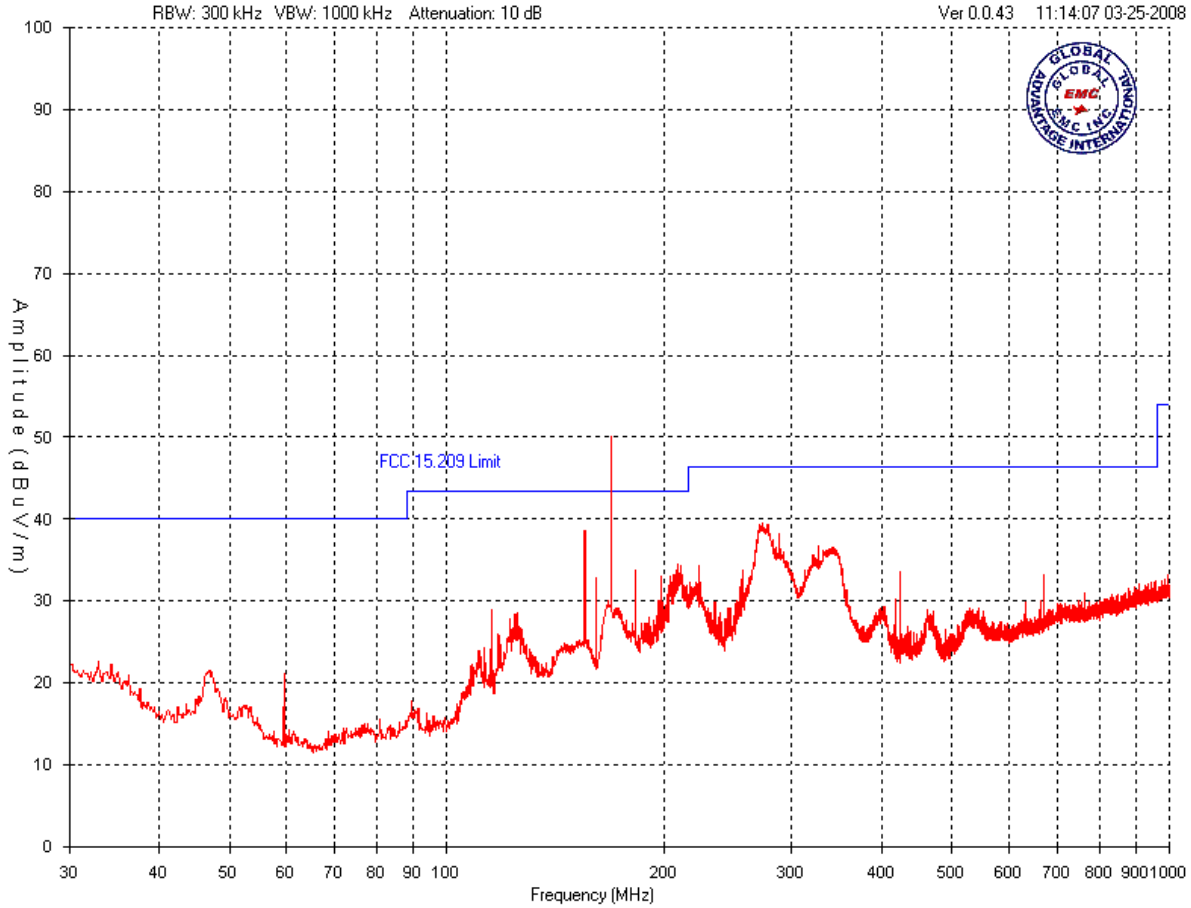
Mid Channel – 30MHz – 1 GHz
Horizontal – Peak Emissions Graph



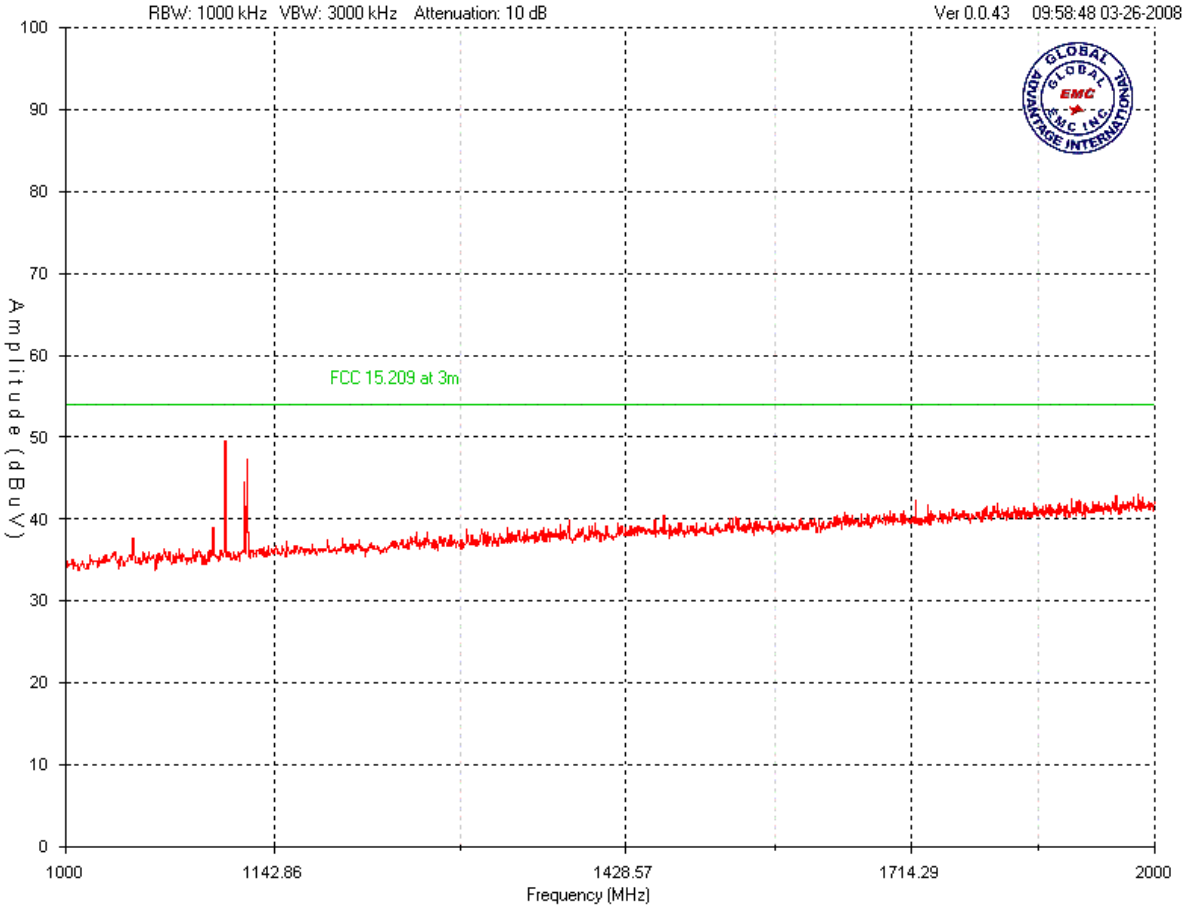
Hi Channel – 30MHz – 1 GHz
Vertical – Peak Emissions Graph



Hi Channel – 30MHz – 1 GHz
Horizontal – Peak Emissions Graph

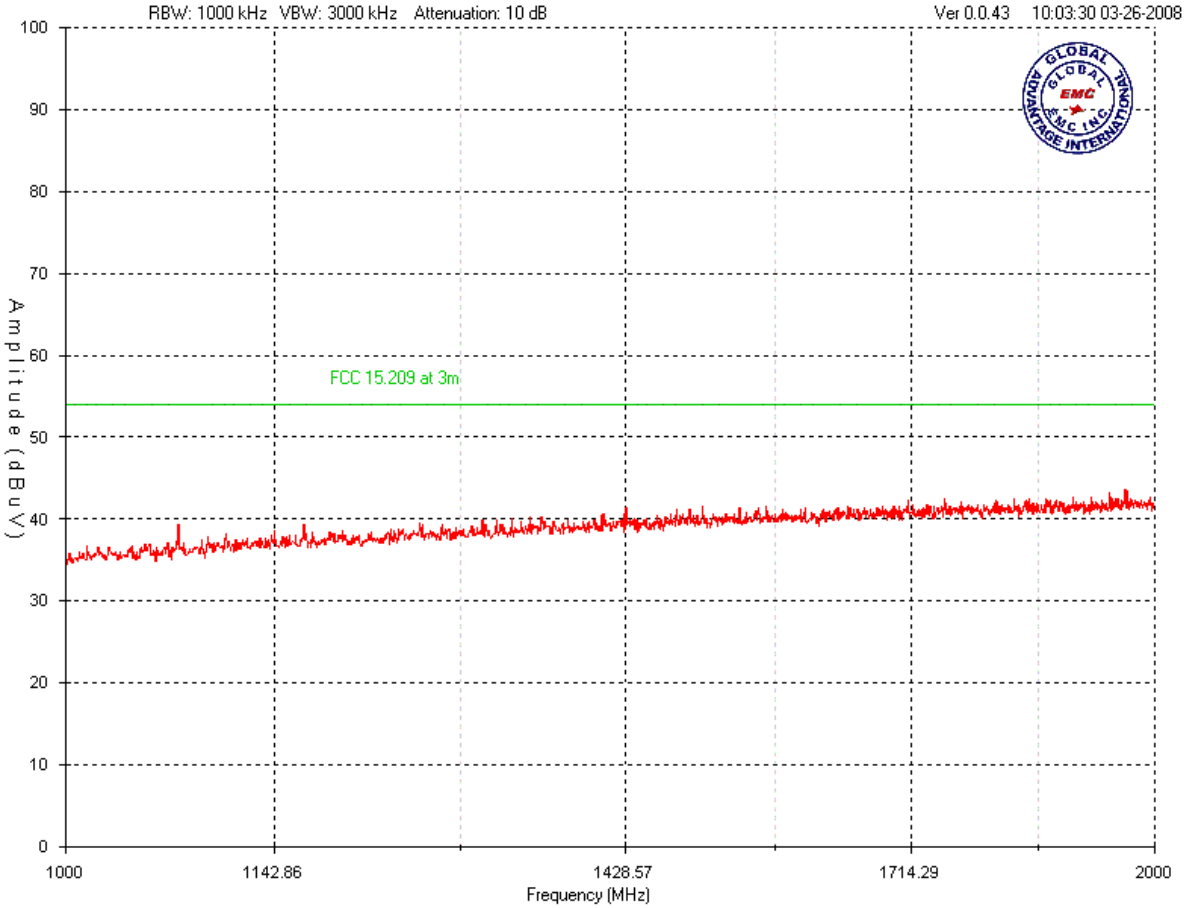


Low Channel 1 – 2GHz
Vertical – Peak Emissions Graph

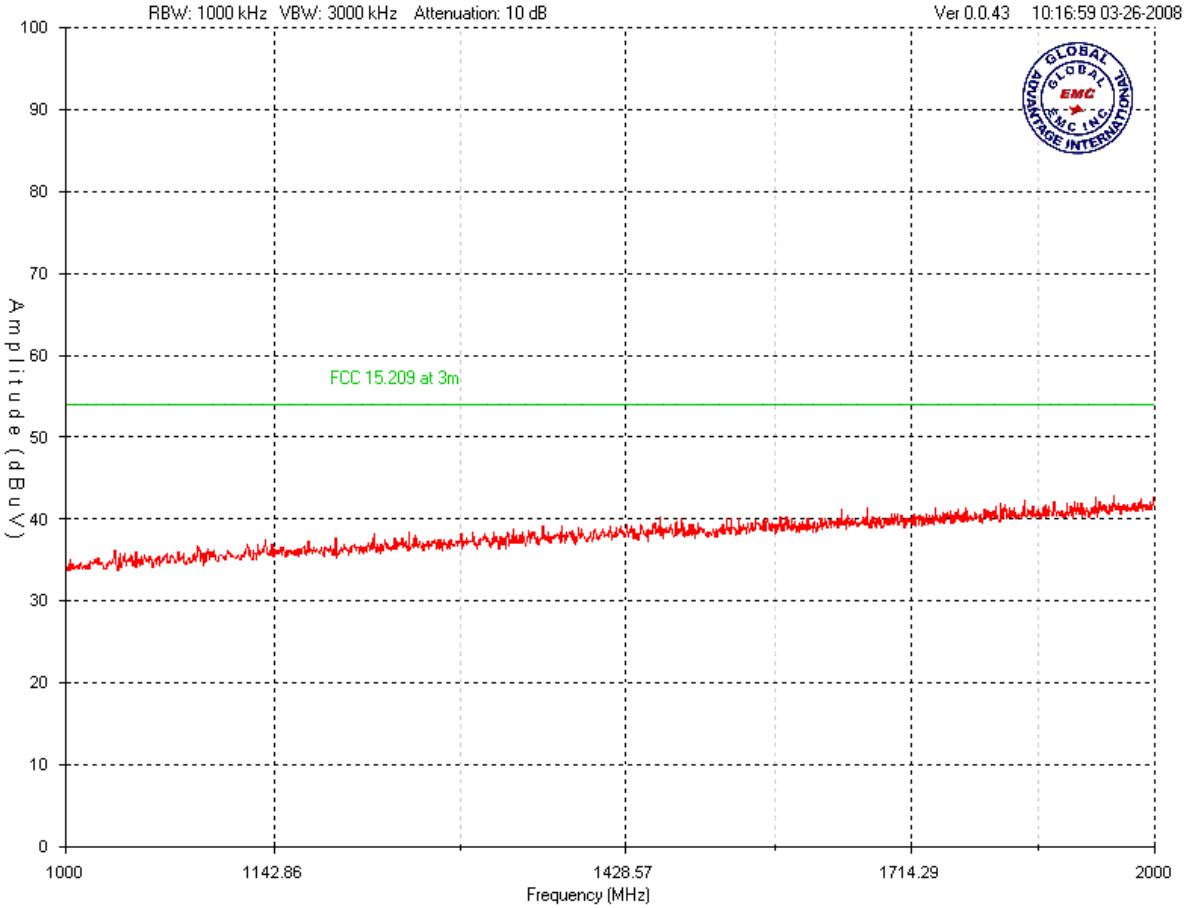


Note: Isolated spikes shown in all the above plots in this section were transient in nature and could not be repeated again, they comply with the 20db peak limit and the -20dbc limit from the peak intentional signal recorded.

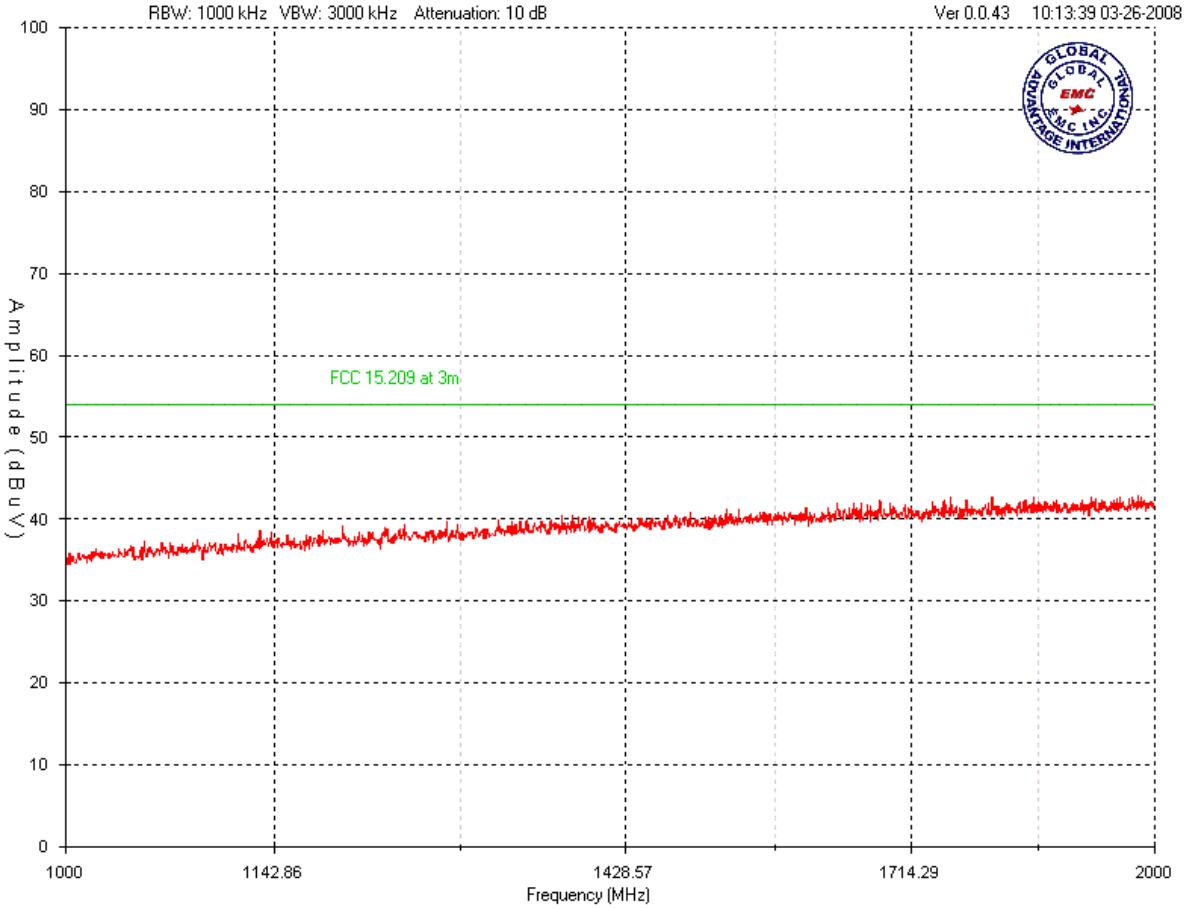
Low Channel 1 – 2GHz
Horizontal – Peak Emissions Graph



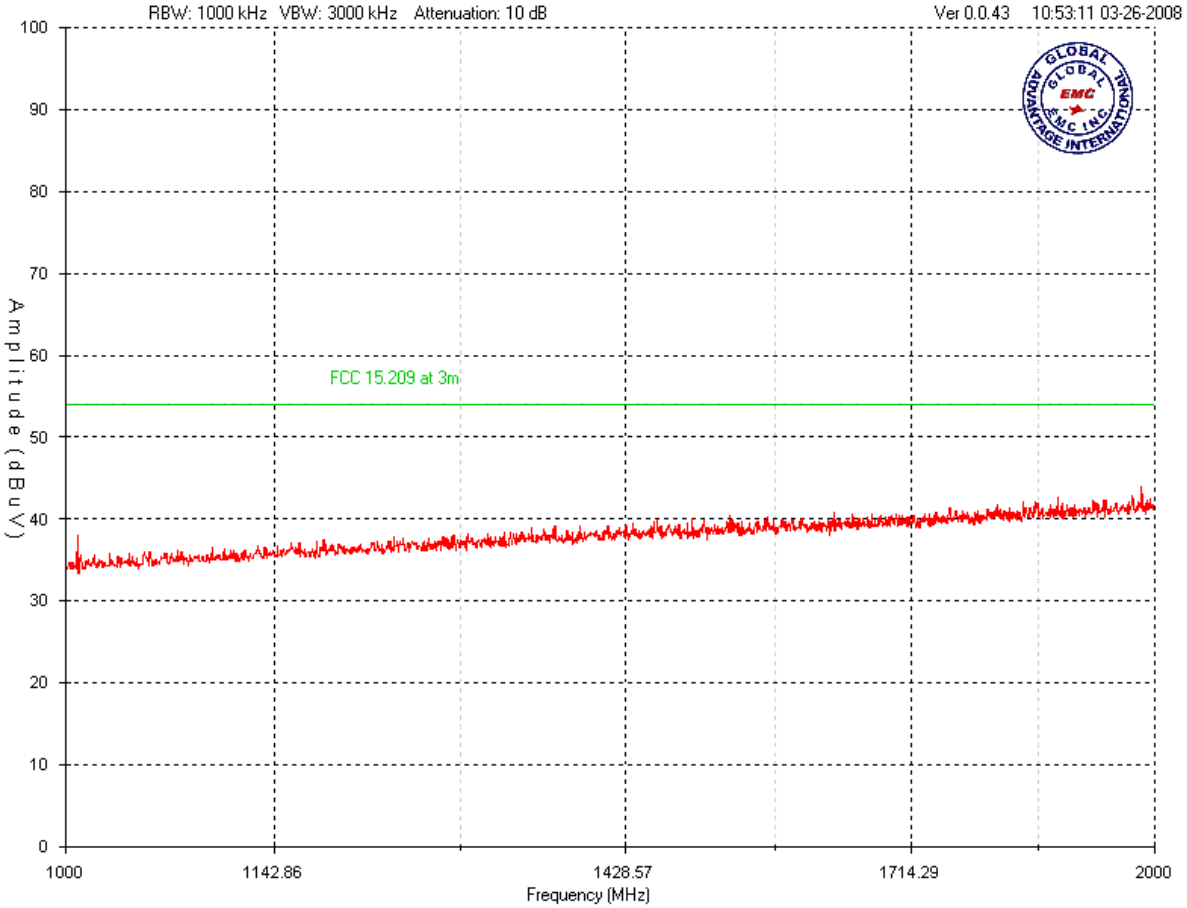
Mid Channel 1 – 2GHz
Vertical – Peak Emissions Graph



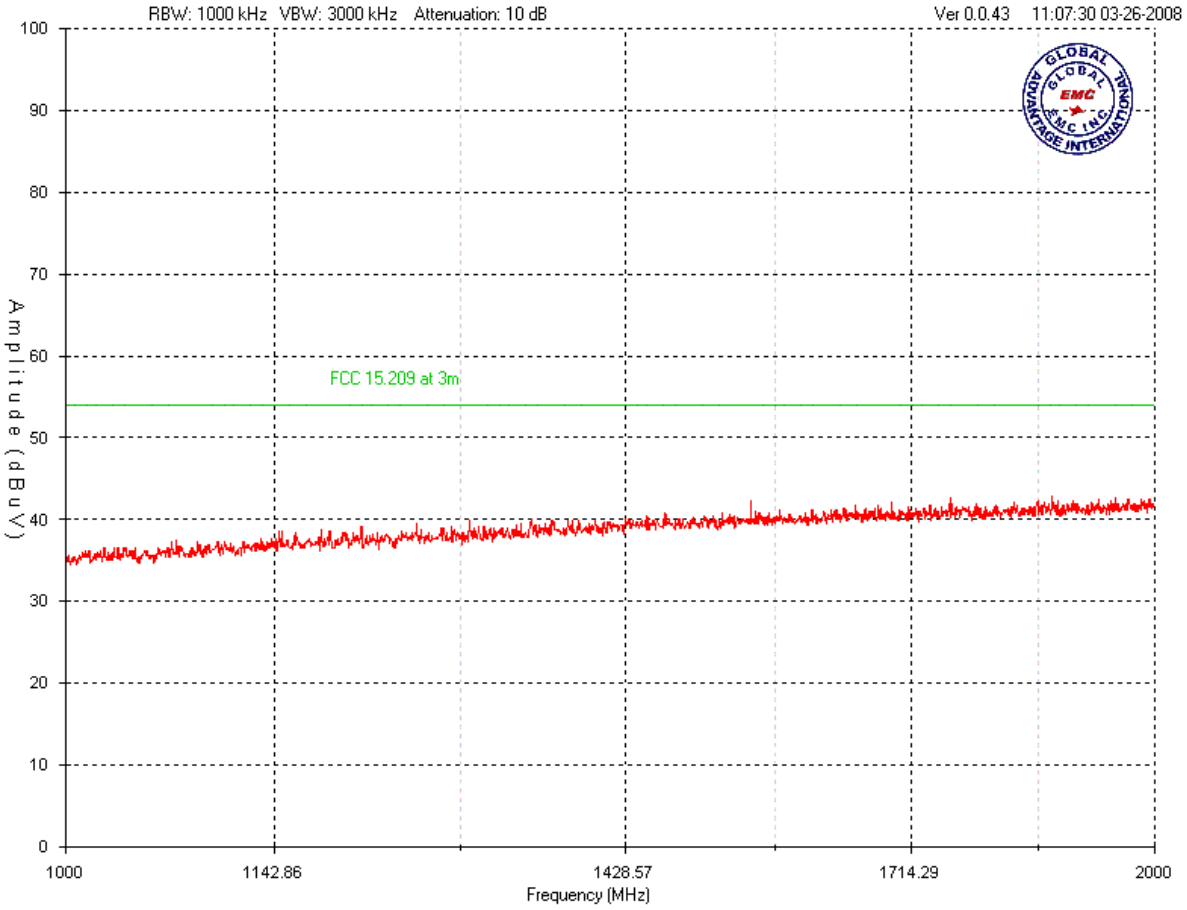
Mid Channel 1 – 2GHz
Horizontal – Peak Emissions Graph



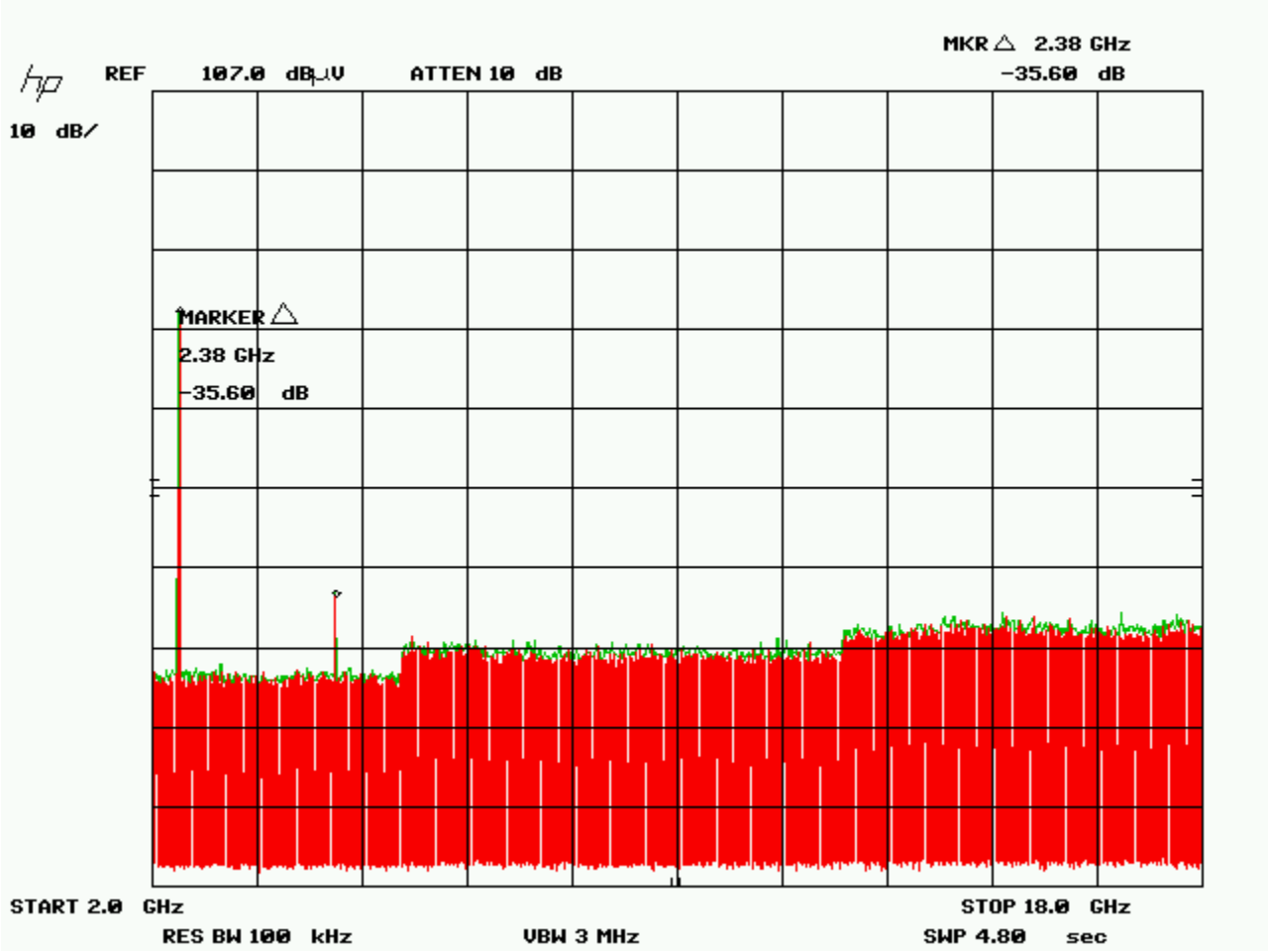
Hi Channel 1 – 2GHz
Vertical – Peak Emissions Graph



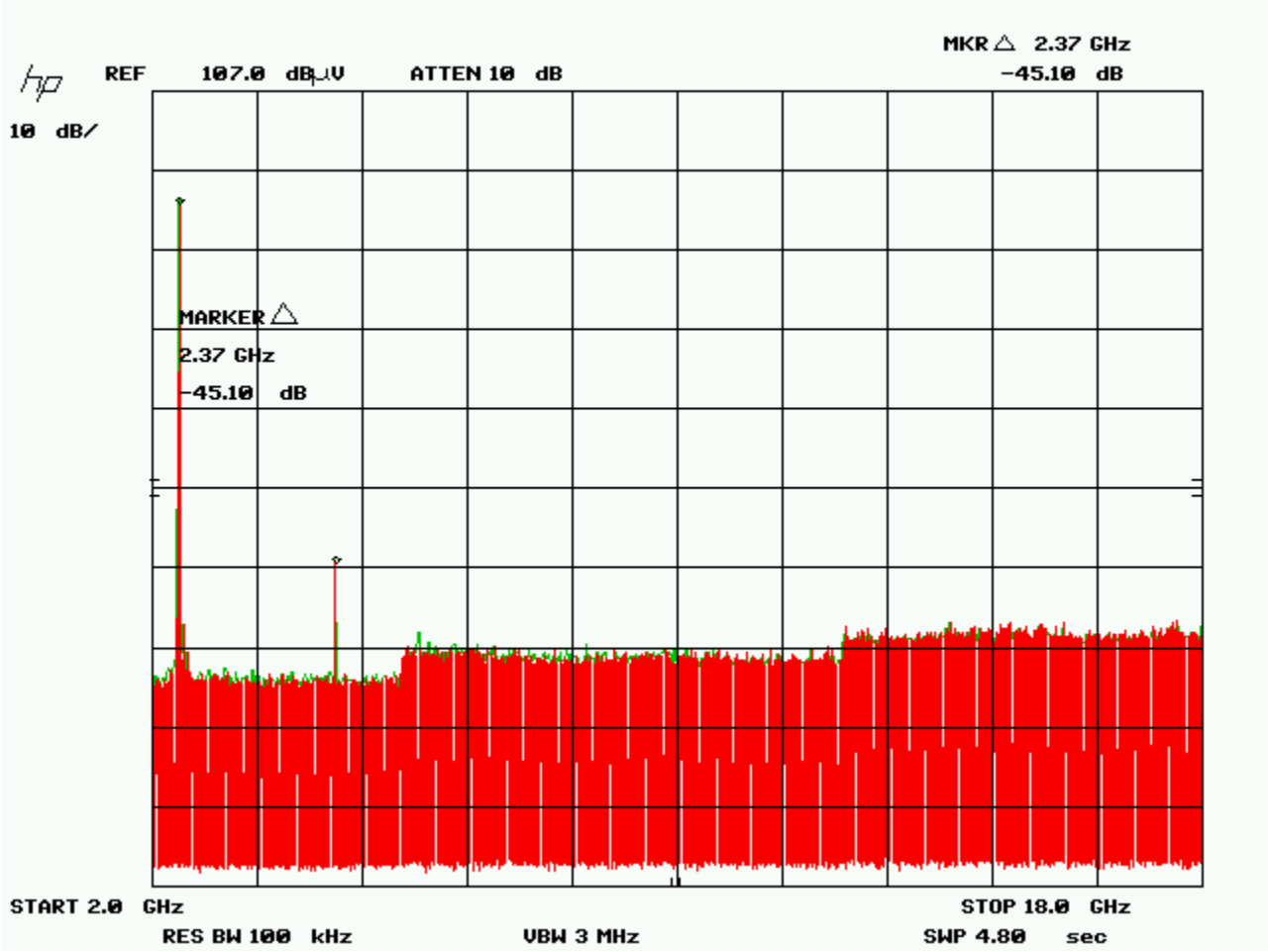
Hi Channel 1 – 2GHz
Horizontal – Peak Emissions Graph



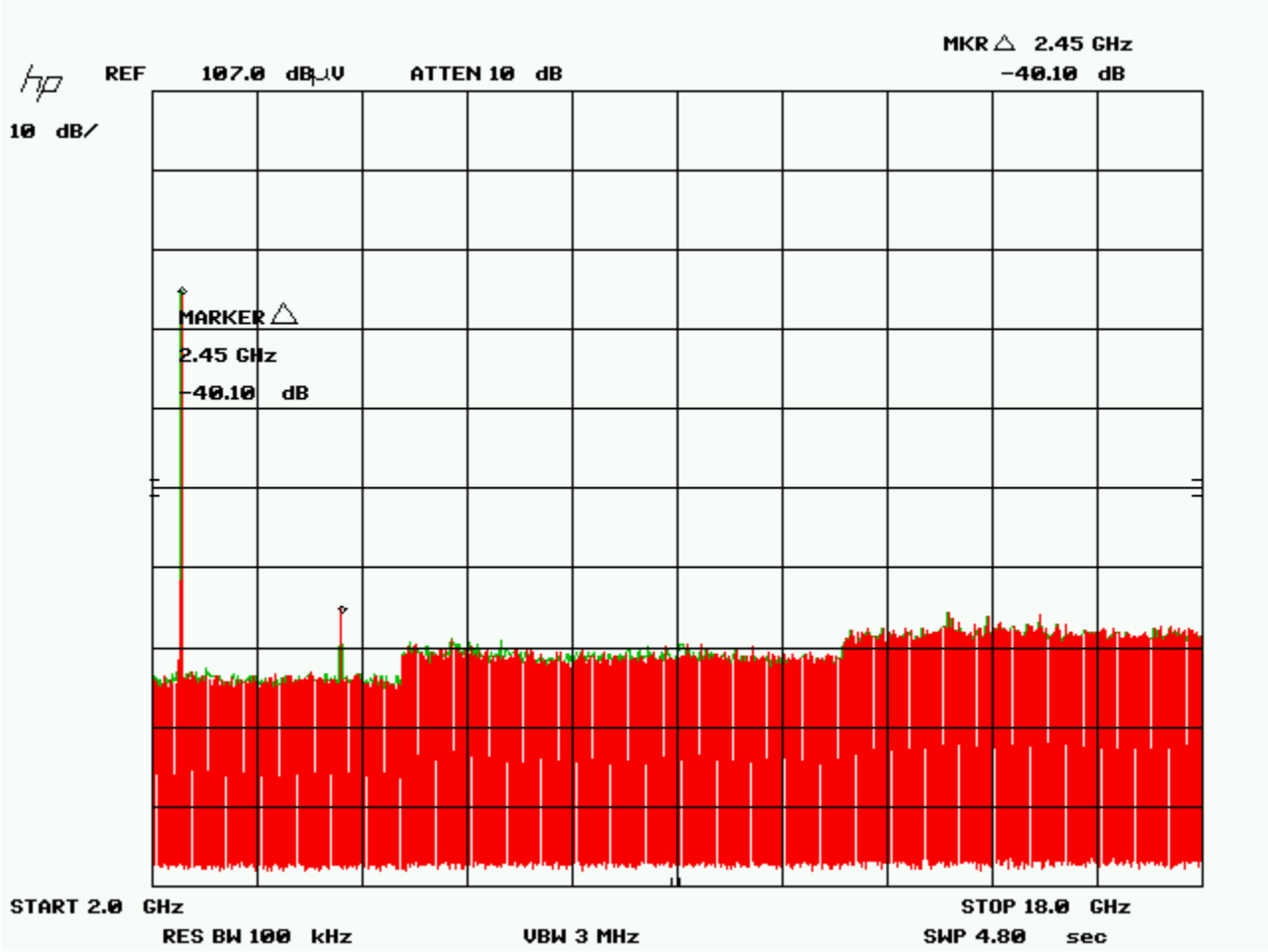
Low channel 2-18 GHz
Horizontal emissions plot



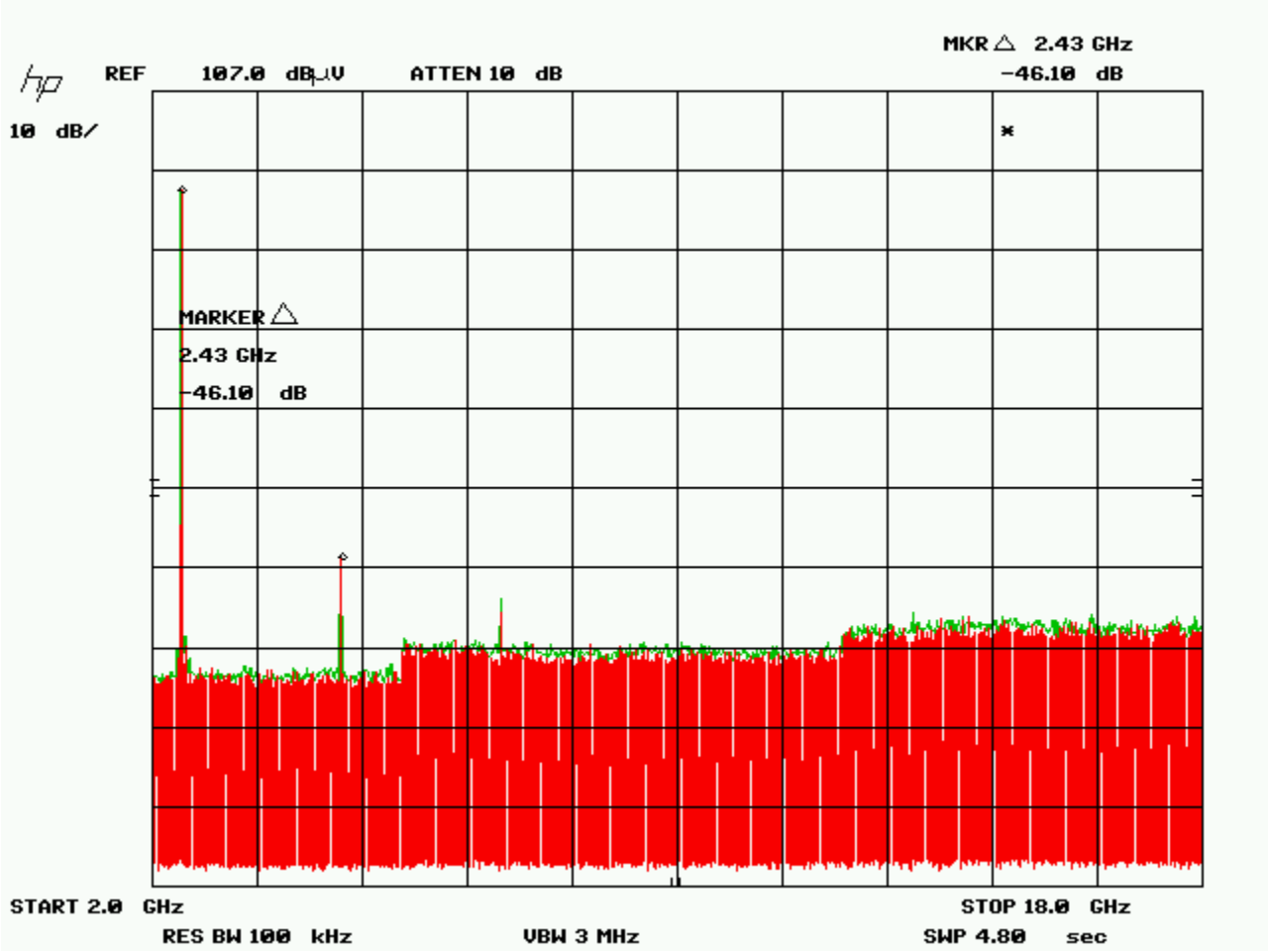
Low channel 2-18 GHz
Vertical emissions plot



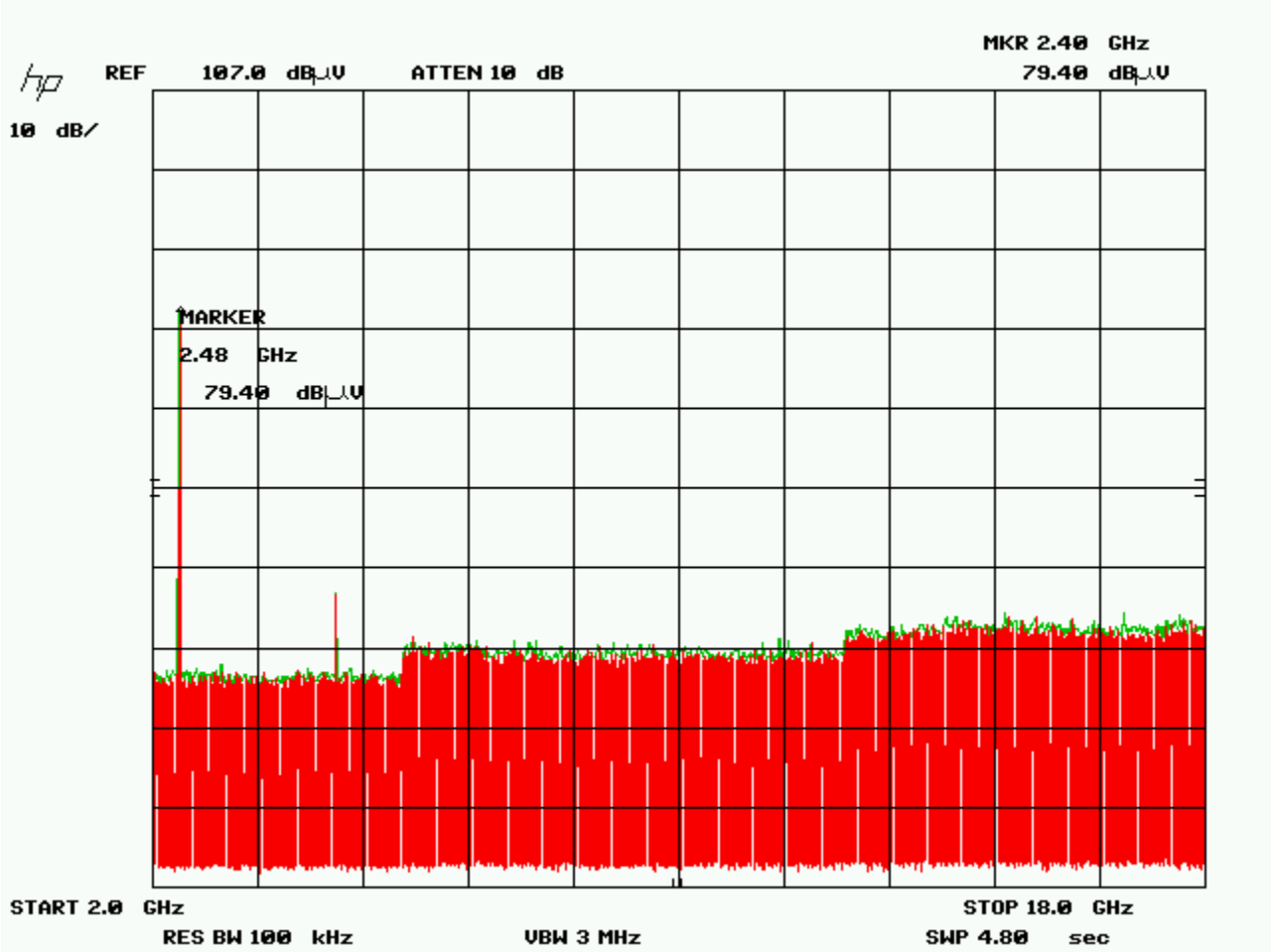
Mid channel 2-18 GHz
Horizontal emissions plot



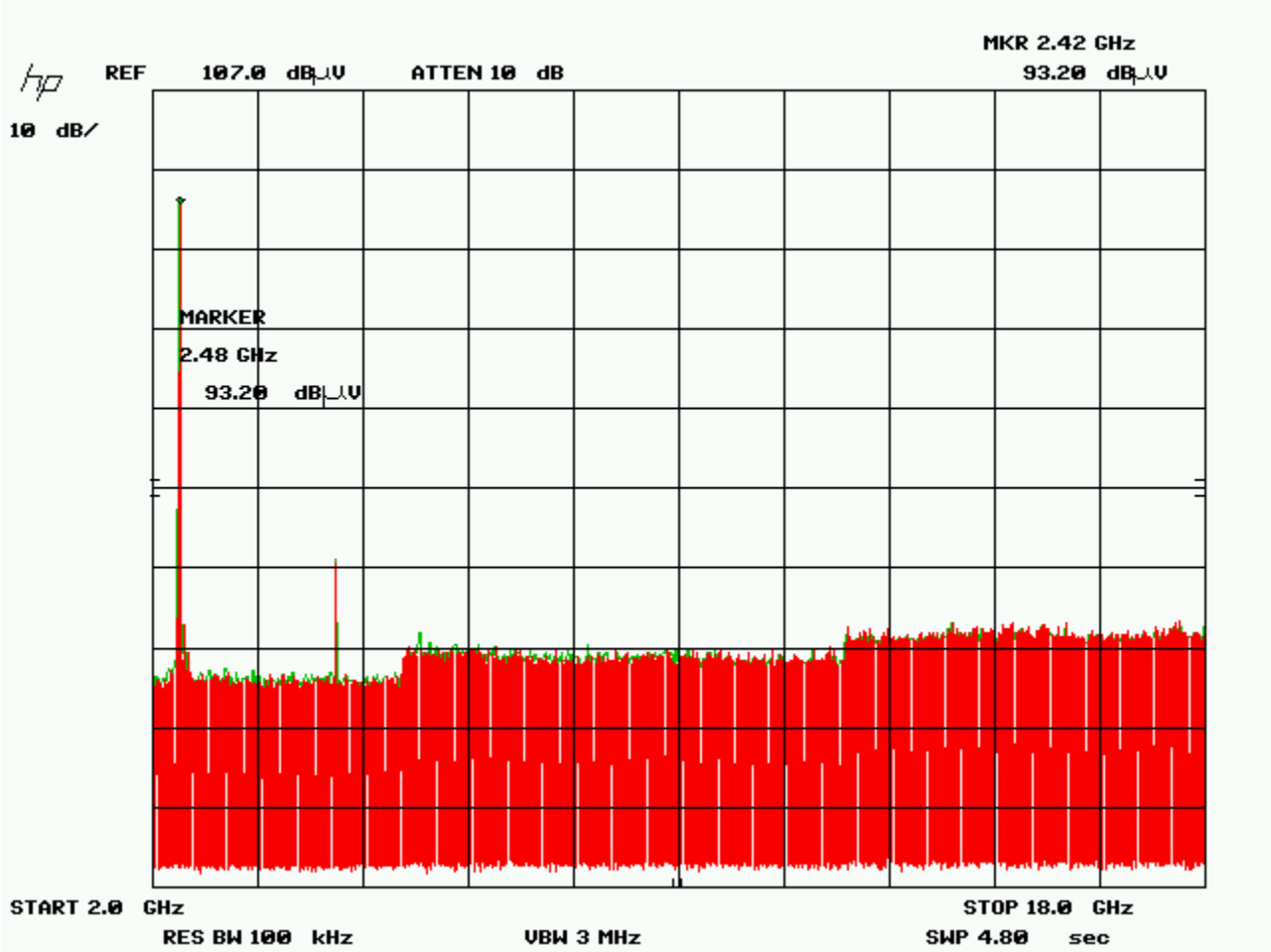
Mid channel 2-18 GHz
Vertical emissions plot



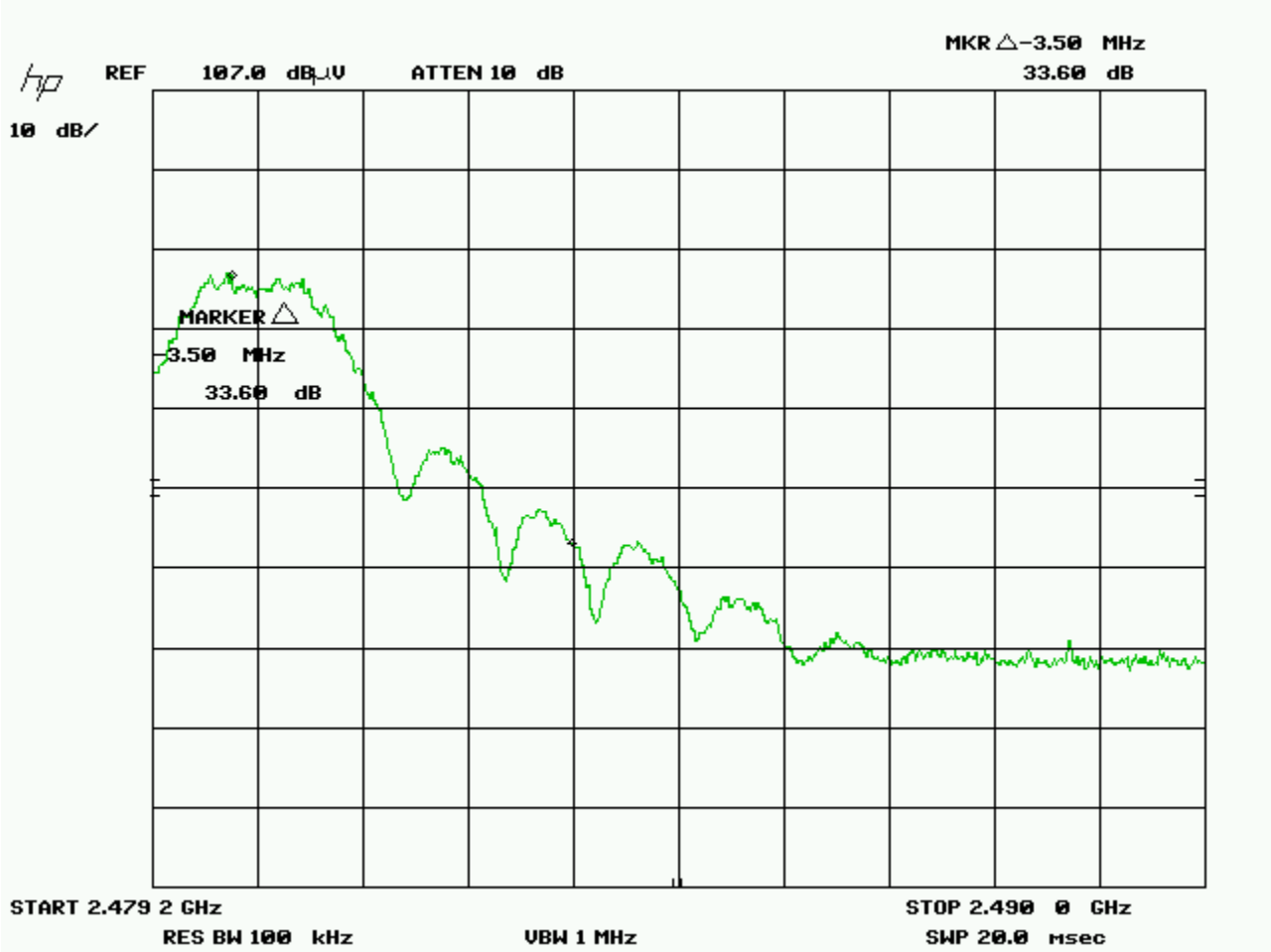
Hi channel 2-18 GHz
Horizontal emissions plot



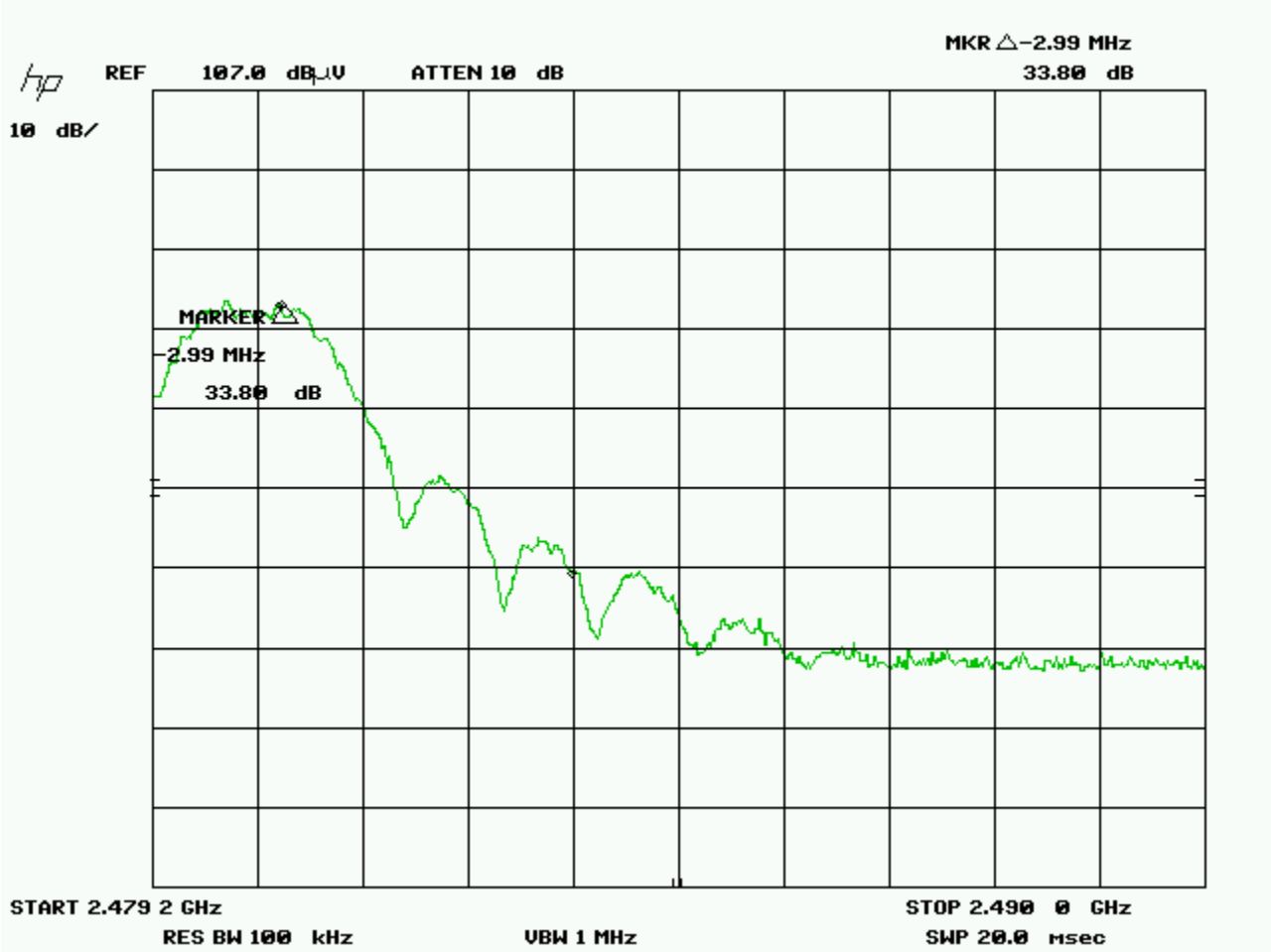
Hi channel 2-18 GHz
Vertical emissions plot



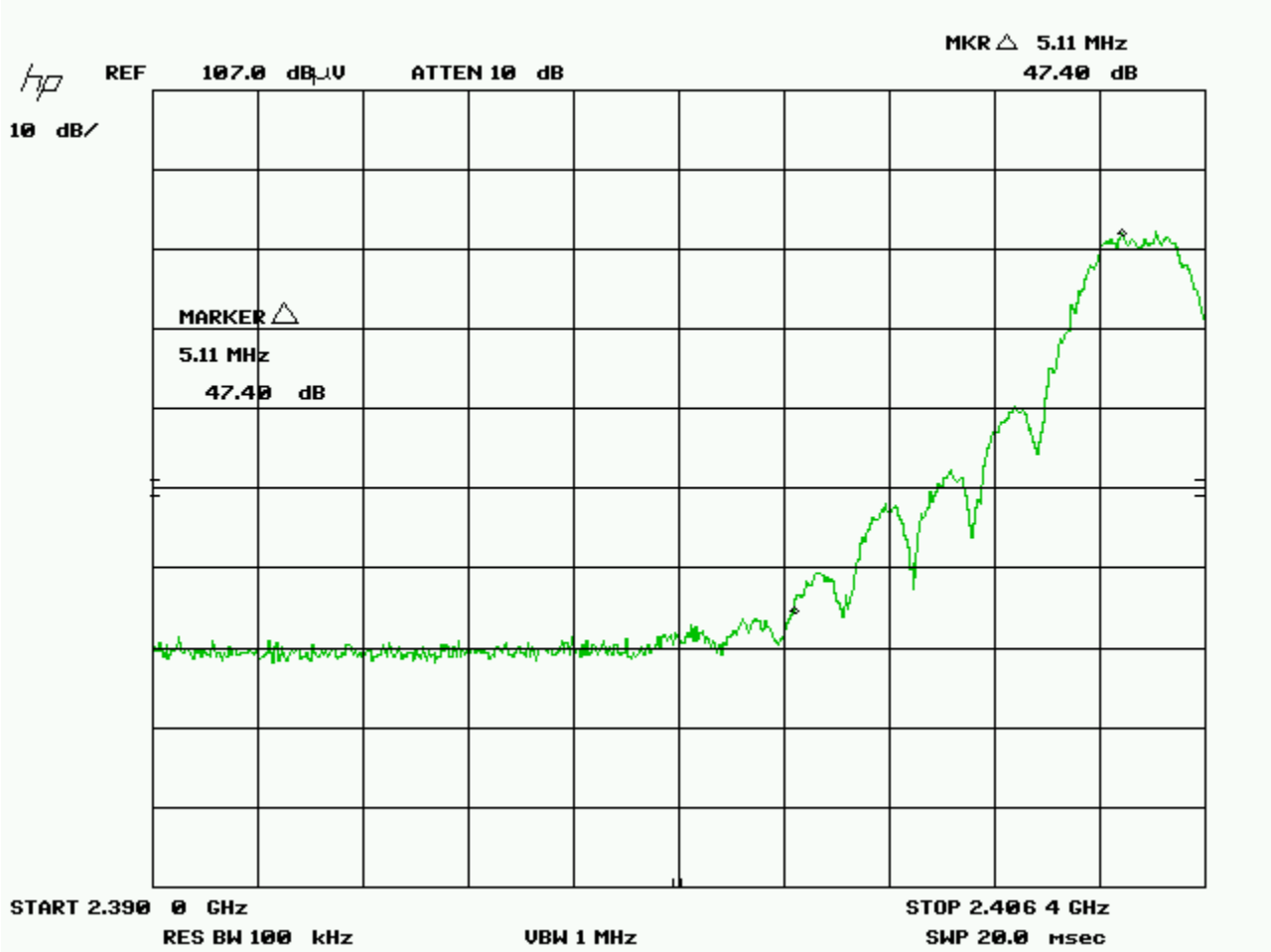
2483.5 MHz Band edge
Vertical peak emissions



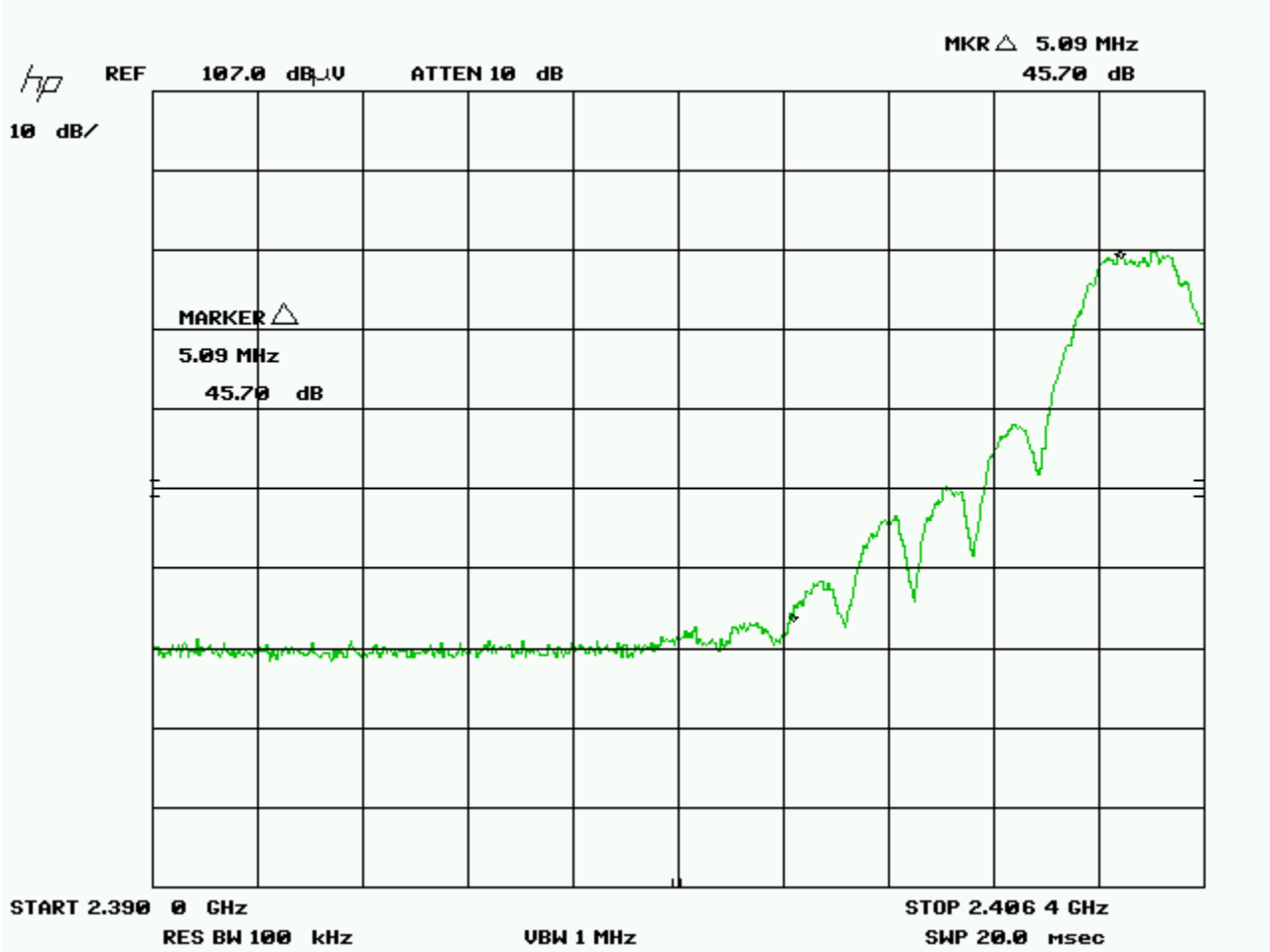
2483.5 MHz Band edge
Horizontal peak emissions



2390 MHz Band edge
Vertical peak emissions



2390 MHz Band edge
Horizontal peak emissions



The frequency range of 18 – 25 GHz, up to the 10th harmonic where applicable, was additionally scanned using an alternate spectrum analyzer, in low, middle and high band for each mode. No emissions were detected past 3rd harmonic.

The band edge requirement was conducted using the radiated emission setup. The plots show raw data and no correction factors are applied. They simply show a 20dbc differential between the peak and the band edge. For actual values measured refer to spurious emissions section above in this report.

Note: See 'Appendix B – EUT & Test Setup Photographs' for photos showing the test set-up.

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Attenuator 1 dB	FP-50-1	Trilithic	NCR	NCR	GEMC 38
Attenuator 3 dB	FP-50-3	Trilithic	NCR	NCR	GEMC 40
Attenuator 6 dB	FP-50-6	Trilithic	NCR	NCR	GEMC 41
Attenuator 10 dB	FP-50-10	Trilithic	NCR	NCR	GEMC 42
Attenuator 20 dB	FP-50-20	Trilithic	NCR	NCR	GEMC 43
Spectrum Analyzer	8566B	HP	2006-08-09	2008-08-09	GEMC 6
Quasi Peak Adapter	85650A	HP	2006-08-07	2008-08-07	GEMC 7
IFR Spectrum Analyzer	AN940	IFR	May 4/2006	May 4/2008	GEMC 6350
RF Cable 1m	LMR-400-1M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 29
Power Attenuator 20 dB	25-A-FFN-20	Bird / Hutton	NCR	NCR	GEMC 49

This report module is based on GEMC template "FCC – Power Line Conducted Emissions Class B_Rev1"

Power Spectral Density

Purpose

The purpose of this test is to ensure that the maximum power spectral density to the radiating element does not exceed the limits specified. This ensures that the modulation is significantly wide enough, or low enough in power that it will allow for co-operation of other wireless devices operating within this frequency allocation.

Limits

The limits are defined in 15.247(e).

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.

Results

The EUT passed. Each mode was tested at low, medium, and high band. The worst case value was -20.42 dbm which is well within the 8dbm limit.

Worst case voltage received was 79dbuV/m at 3m distance in Mid channel Vertical orientation.
Using Friss equation again –

Path losses = 32.45 – Gain Tx Antenna (db) – Gain Rx Atnenna (db) +20 log (f MHz) + 20 log (d km)
= 32.45 – 3 – 4.8 + 67.76 – 50.45
= 41.958 db

The raw received signal was 79.0 dbuV /m. Taking into account pre-amp gain and cable losses (antenna gain is already accounted for in the free space equation) the equivalent signal is ➔

79.0 + 2.4 (cable loss) – 36.8 (gain) =
44.6 dbuV/m.

Converting this to power (Pr) = -62.4 dbm.

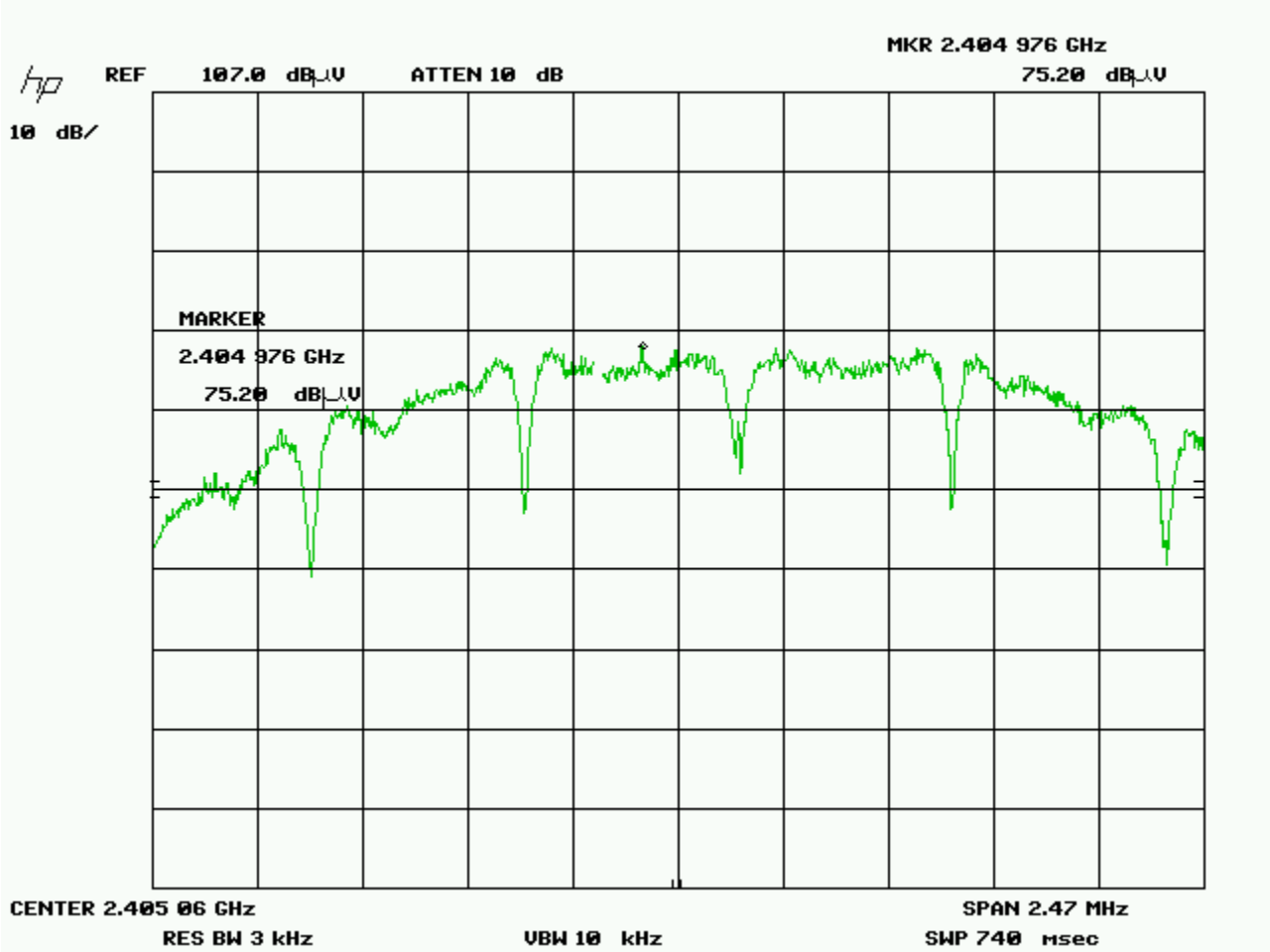
Pt(db) - Pr(db) = 41.958

➔ Pt (db) = 41.958 + Pr (db)
➔ Pt(db) = 41.958 – 62.4
= -20.4 dbm

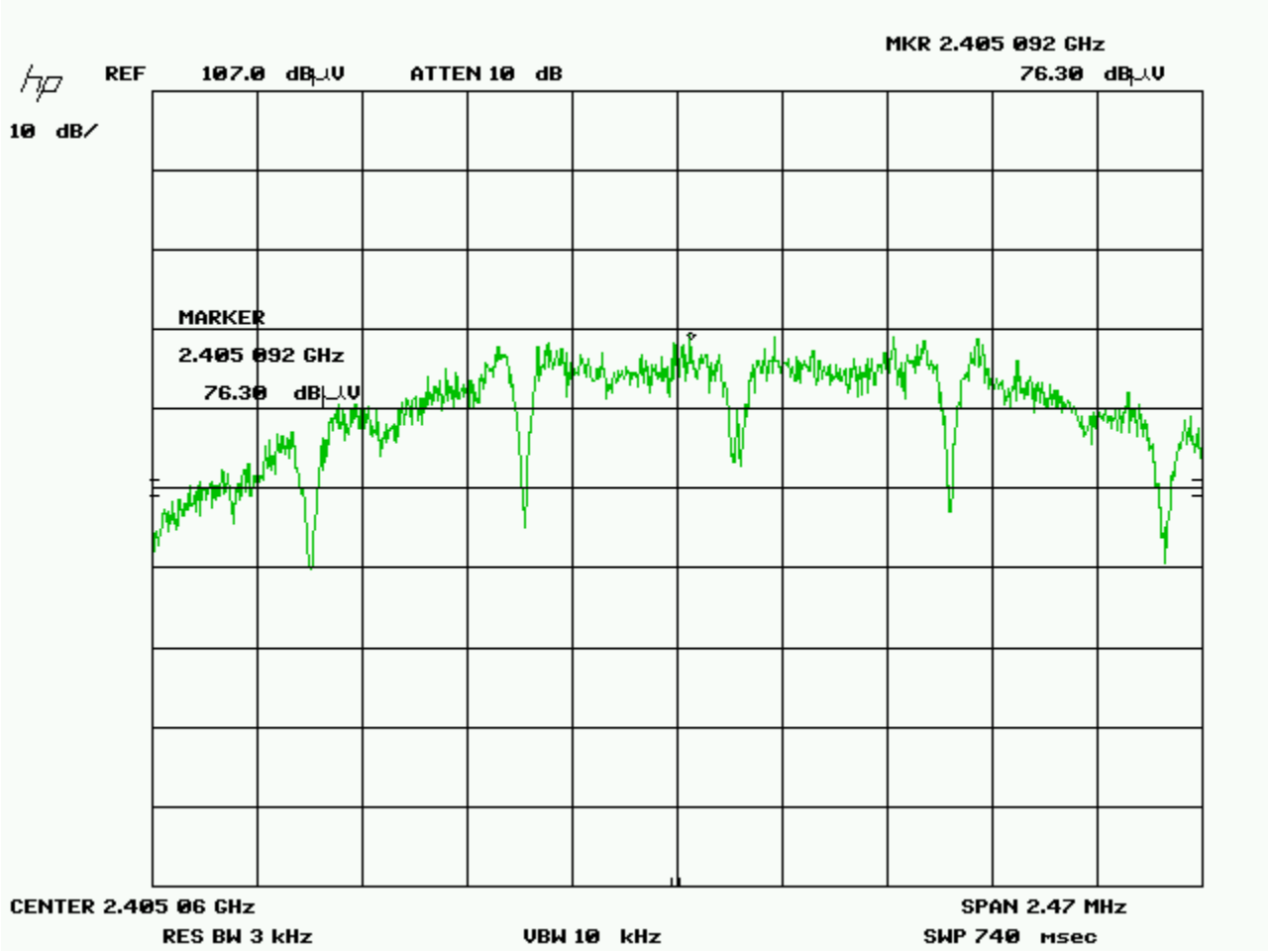
Graph(s)

The graphs shown below show the power spectral density of the device during the conducted measurement operation of the EUT. Low, middle, and high channel was investigated in each mode.

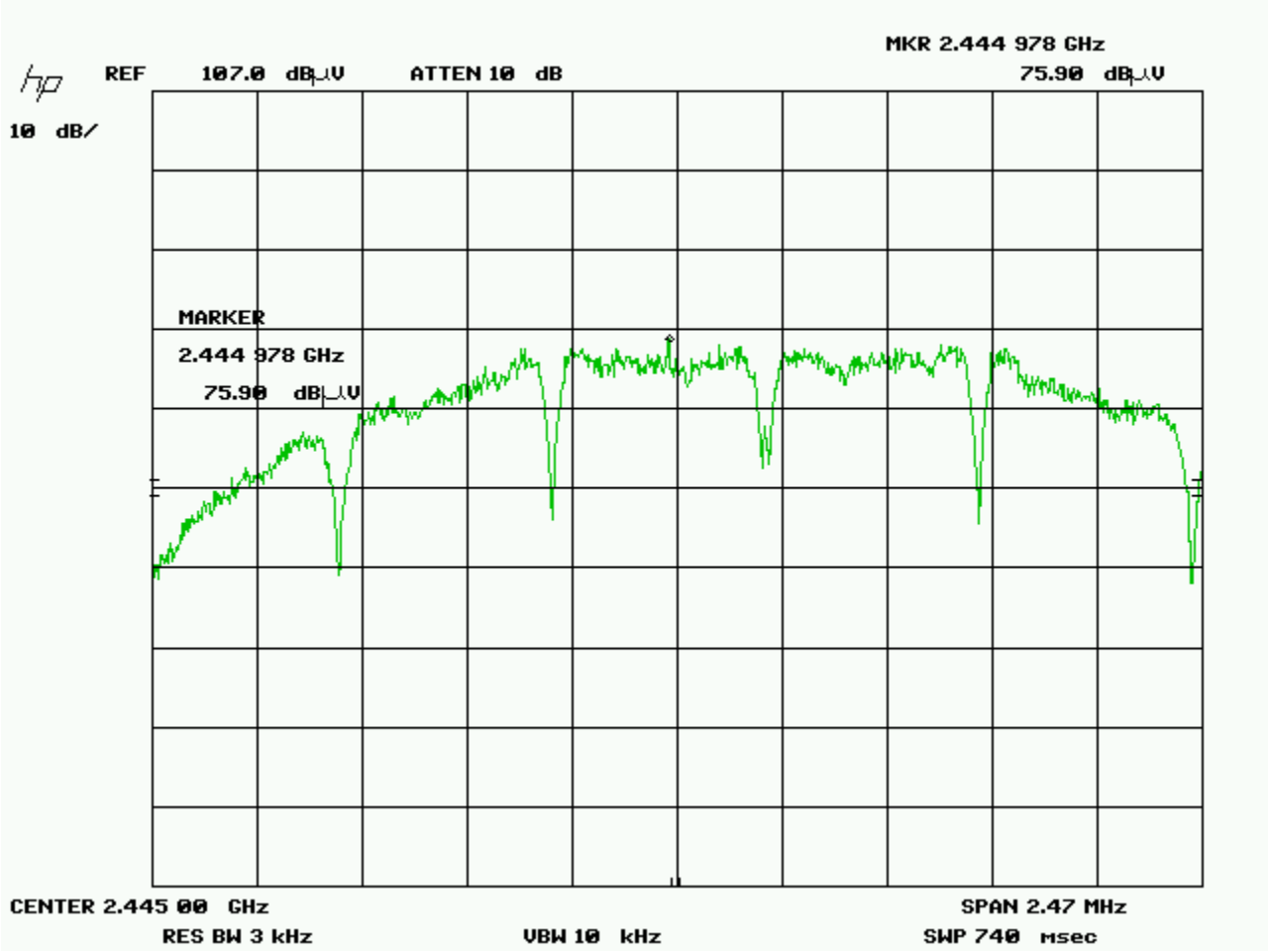
Low channel – Horizontal



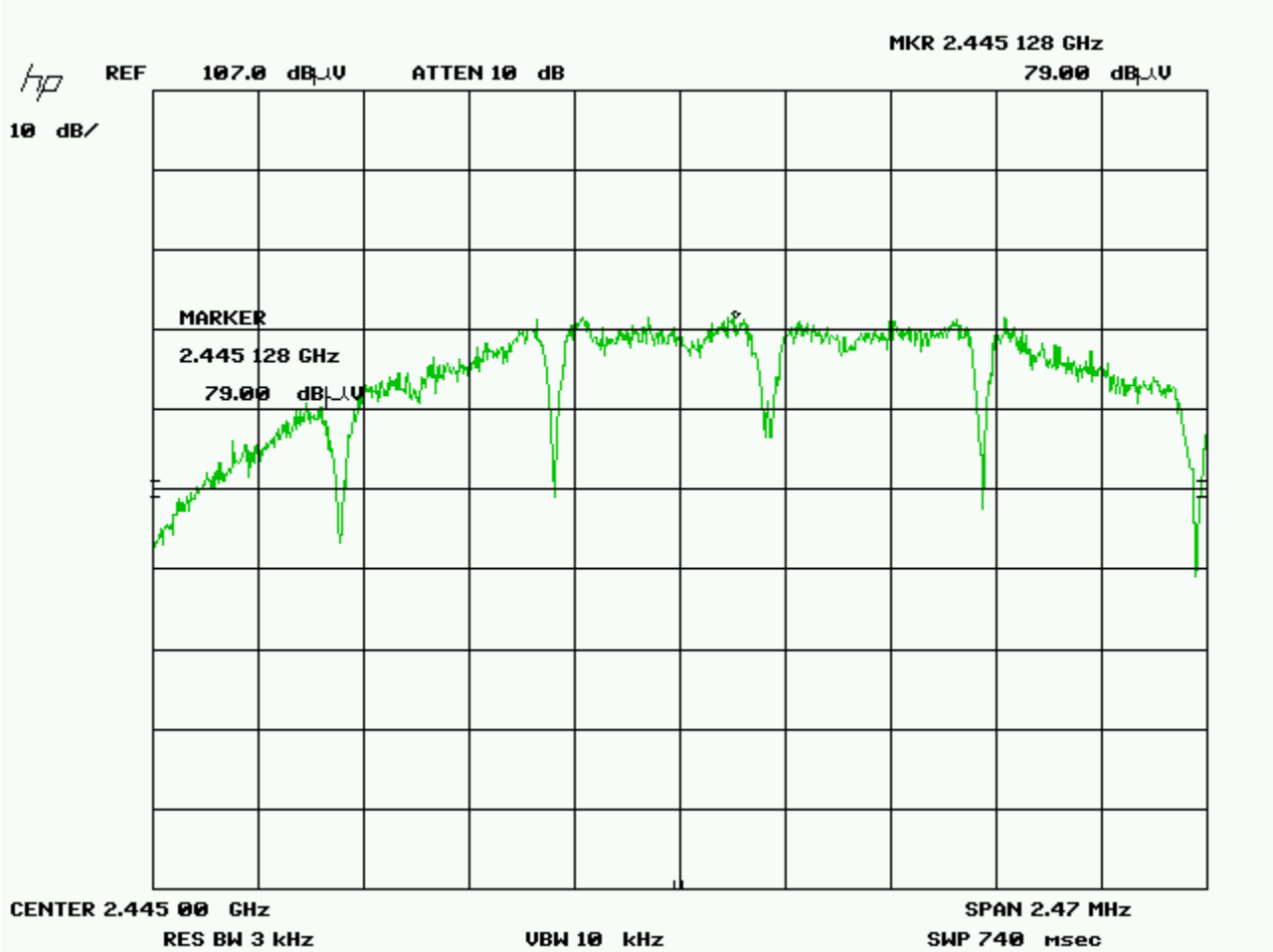
Low channel – Vertical



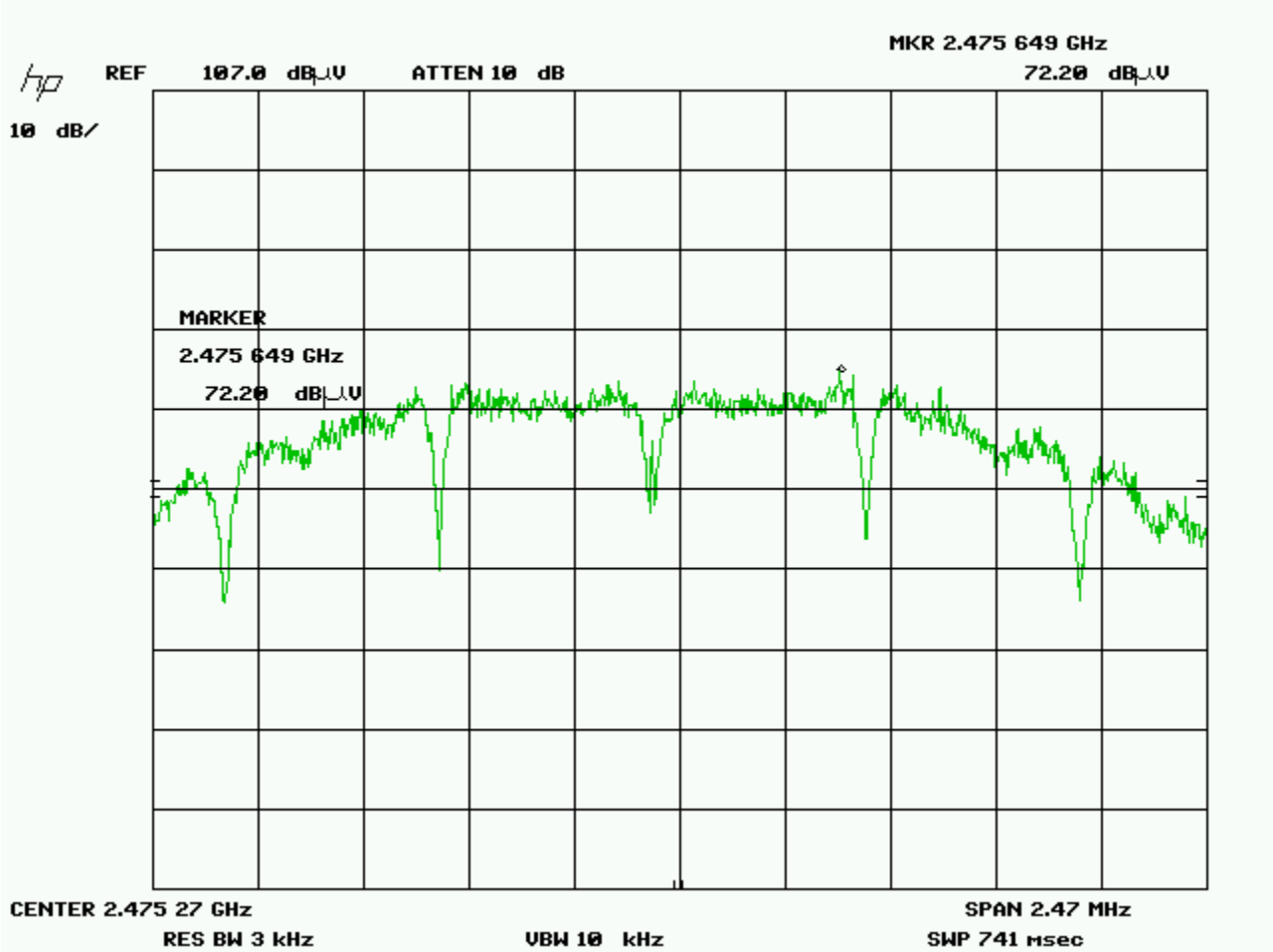
Mid channel – Horizontal



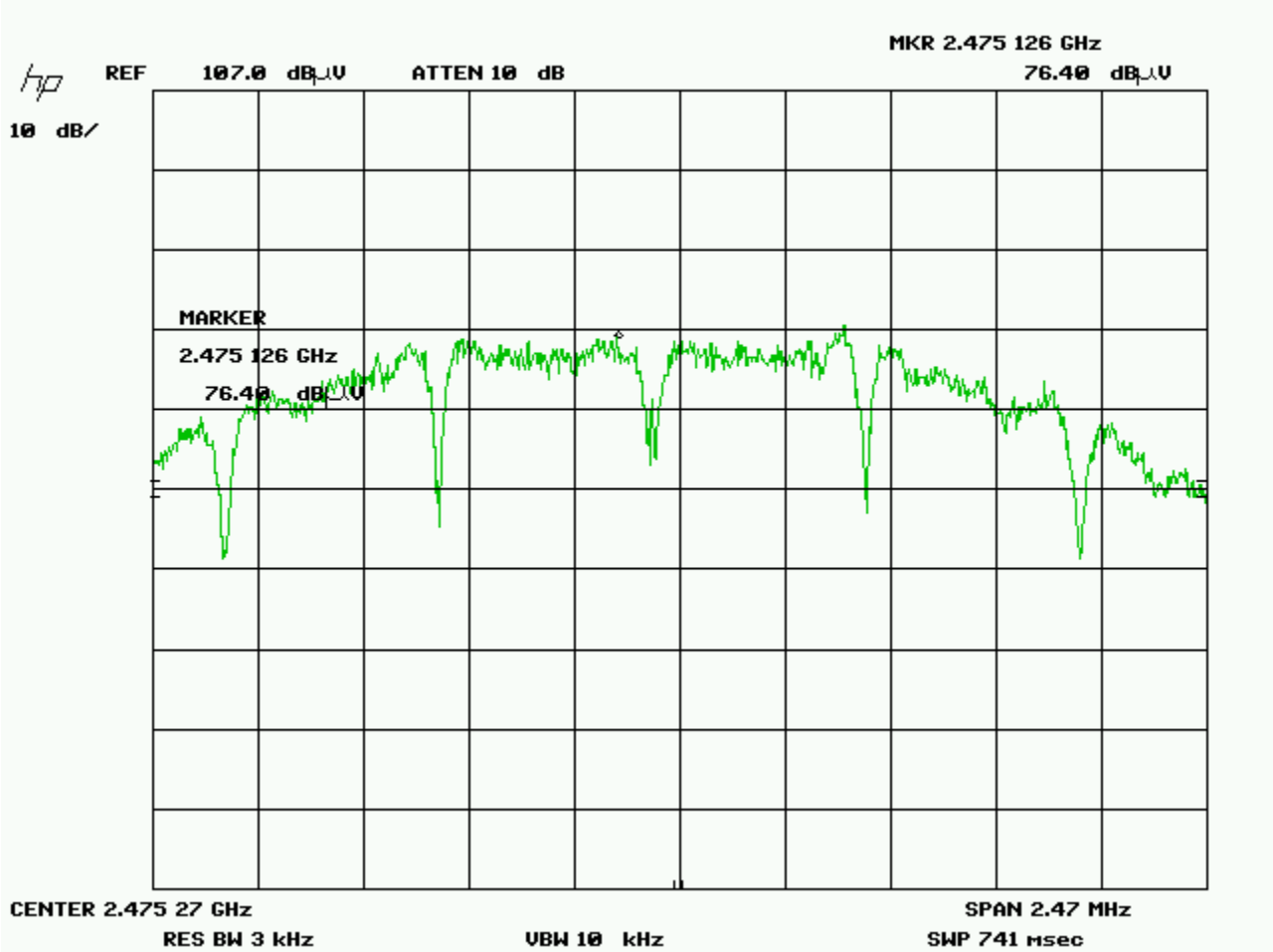
Med channel – Vertical



High channel – Horizontal



High Channel – Vertical



Note: See 'Appendix B – EUT & Test Setup Photographs' for photos showing the test set-up.

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Spectrum Analyzer	8566B	HP	2006-08-09	2008-08-09	GEMC 6
RF Cable 1m	LMR-400-1M-	LexTec	NCR	NCR	GEMC 29

	50OHM-MN-MN				
Power Attenuator 20 dB	25-A-FFN-20	Bird / Hutton	NCR	NCR	GEMC 49

This report module is based on GEMC template "FCC – Power Line Conducted Emissions Class B_Rev1"

Maximum Permissible Exposure

Purpose

The purpose of this test is to ensure that the RF energy intentionally transmitted, in terms of power density emitted from the EUT at a stated operating distance does not exceed the limits listed below as defined in the applicable test standard, as calculated based upon readings obtained during testing. This helps protect human exposure to excessive RF fields.

Limit(s) and Method

The limits, as defined in FCC 15.247(i) and FCC 1.1310 Table 1 (B) limits for general public exposure was applied. The limit for the frequency range of 1.5 GHz to 100 GHz was applied. This is a limit of 1.0 mW/ cm^2. The distance used for calculations was 20cm, as this is the minimum distance an operator will be from the EUT during normal operation, as stated by the manufacturer.

Results

The EUT passed the requirements. The worst case calculated power density was 0.0004 mW/cm^2 , this is significantly under the 1.0 mW/cm^2 requirement.

Calculations

Method 1 (conducted power)

$P_d = (P_t*G) / (4*pi*R^2)$
Where Pt = -2.5 dbm or 0.56 mW as per Peak power radiated measurement
To establish a worst case reading the output power was 0dbm as per manufacturers setting which is 1mW.
Where G = 3 dBi, or numerically 2
Where R = 20 cm

$P_d = (1.000 mW * 2) / (4 * pi * 20cm^2)$
$P_d = 2.0mW / 5026 cm^2$
$P_d = 0.0004 mW/cm^2$

Power Line Conducted Emissions

Purpose

The purpose of this test is to ensure that the RF energy unintentionally emitted from the EUT's power line does not exceed the limits listed below as defined in the applicable test standard, as measured from a LISN. This helps protect lower frequency radio services such as AM radio, shortwave radio, amateur radio operators, maritime radio, CB radio, and so on, from unwanted interference.

Limits & Method

The limits are as defined in 47 CFR FCC Part 15 Section 15.207
Method is as defined in ANSI C64:2003

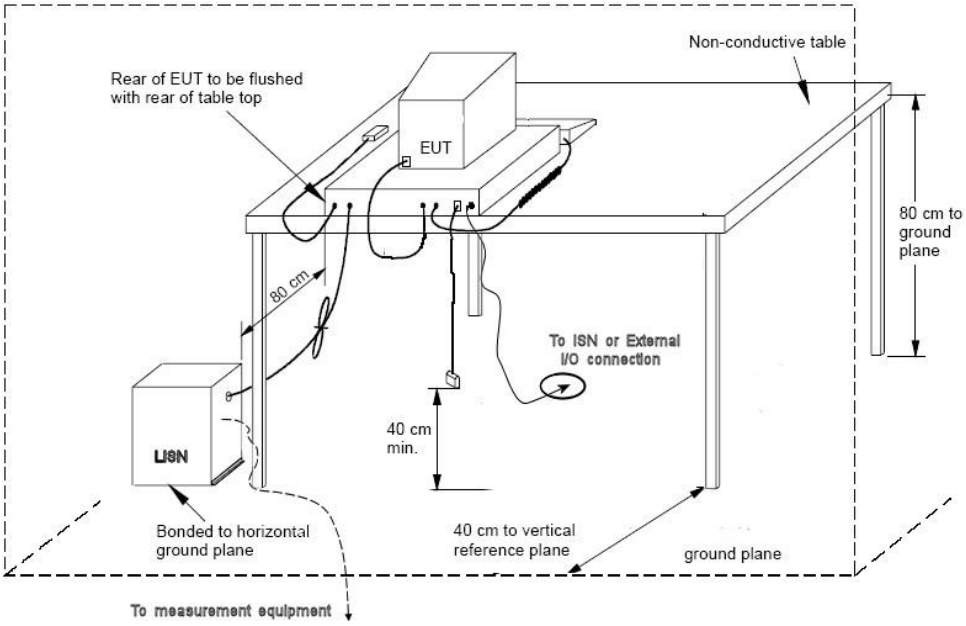
Average Limits		QuasiPeak Limits	
150 kHz – 500 kHz	56 to 46 dBuV	150 kHz – 500 kHz	66 to 56 dBuV
500 kHz – 5 MHz	46 dBuV	500 kHz – 5 MHz	56 dBuV
5 MHz – 30 MHz	50 dBuV	500 kHz – 30 MHz	60 dBuV

The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.

Note: If the Peak or Quasi Peak detector measurements do not exceed the Average limits, then the EUT is deemed to have passed the requirements.

Both limits are applicable, and each is specified as being measured with a 9 kHz measurement bandwidth.

Typical Setup Diagram



Note: The vertical reference plane is optional as per ANSI C63.4 section 5.2.2

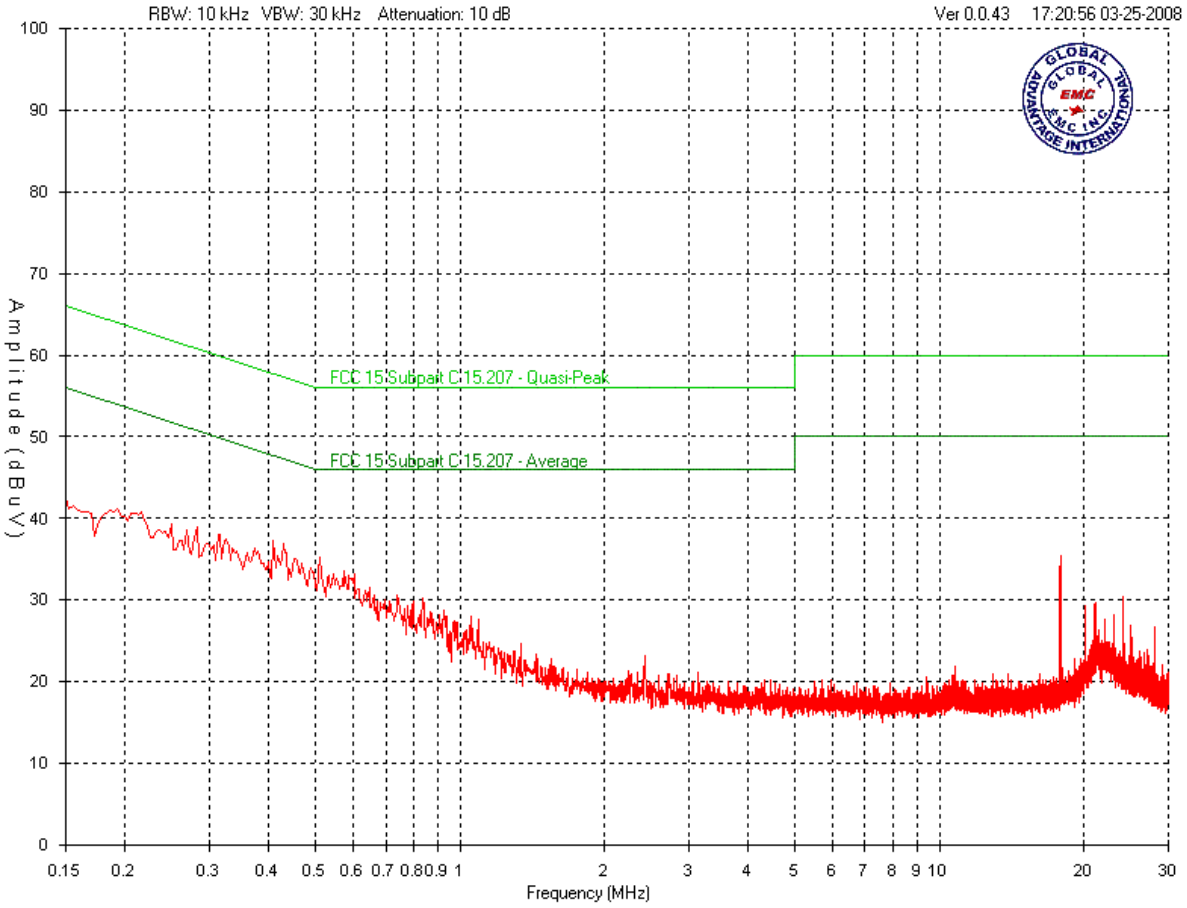
Measurement Uncertainty

The expanded measurement uncertainty is calculated in accordance with CISPR 16-4-2 and is +/-3.6 dB with a 'k=2' coverage factor and a %95 confidence level.

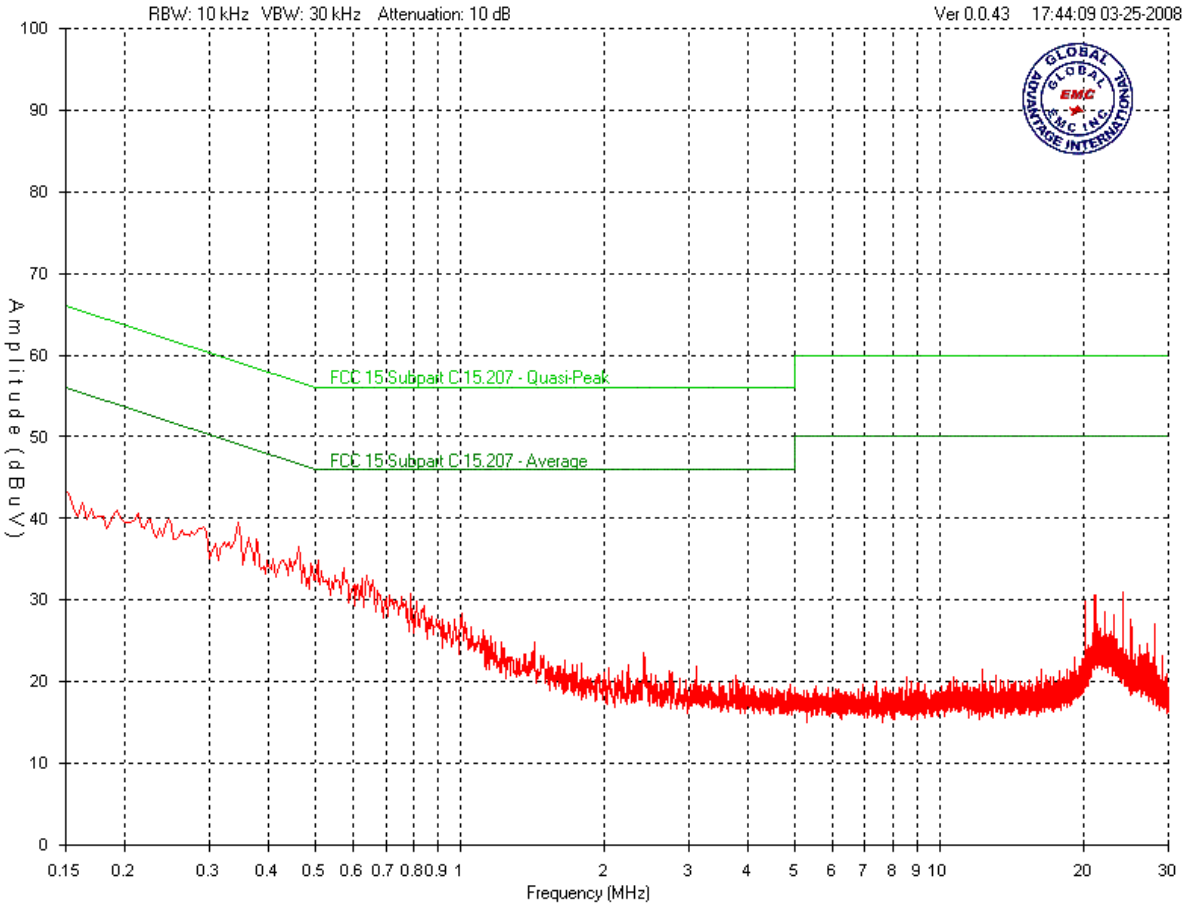
Preliminary Graphs

Note the graphs shown below are for graphical illustration only. For final measurements with the appropriate detector where applicable, please refer to the table. The graph shown below is a peak measurement graph, measured with a resolution bandwidth greater then or equal to the final required detector. These graphs are performed as a worst case measurement to enable the detection of frequencies of concern and for considerable time savings.

120V Line
Peak emissions



120V Neutral
Peak emissions



Client	Viconics
Product	VT7355C5500W
Standard(s)	RSS 210 Issue 6:2005 / FCC Part 15 Subpart C 15:2006

Final Measurements

Average Emissions Table

Product category	Class B Avg								
Project	Viconics RF Module								
Test Frequency (MHz)	**Detection mode (Q-Peak / Avg)**	**Raw signal (dBuV)**	**Cable loss (dB)**	**Attenuator (dB)**	**LISN factor (dB)**	**Received signal (dBuV)**	**Emission limit (dBuV)**	**Margin (dBuV)**	**Result**
120V 60Hz Line									
0.189	QP	42.7	0.2	0	1.75	44.65	55	10.35	PASS
0.298	QP	35.7	0.2	0	1	36.9	52	15.1	PASS
0.15	QP	40.2	0.2	0	1.75	42.15	56	13.85	PASS
21.123	QP	27.9	0.2	0	0.45	28.55	50	21.45	PASS
24.14	QP	28.1	0.2	0	0.45	28.75	50	21.25	PASS
20.19	QP	27.9	0.2	0	0.45	28.55	50	21.45	PASS
120V 60Hz Neutral									

Client	Viconics
Product	VT7355C5500W
Standard(s)	RSS 210 Issue 6:2005 / FCC Part 15 Subpart C 15:2006

0.189	QP	42.5	0.2	0	1.75	44.45	55	10.55	PASS
0.298	QP	35.7	0.2	0	1	36.9	52	15.1	PASS
0.15	QP	40.2	0.2	0	1.75	42.15	56	13.85	PASS
21.126	QP	28.6	0.2	0	0.45	29.25	50	20.75	PASS
24.15	QP	28.4	0.2	0	0.45	29.05	50	20.95	PASS
20.19	QP	27.8	0.2	0	0.45	28.45	50	21.55	PASS

Note:

1. All readings were recorded using QP detector and compared against Average limits.
2. See 'Appendix B – EUT & Test Setup Photographs' for photos showing the test set-up for the highest line conducted emission

Test Equipment List

Equipment	Model No.	Manufacturer	Last calibration date	Next calibration due date	Asset #
Spectrum Analyzer	8566B	HP	2006-08-09	2008-08-09	GEMC 6
Quasi Peak Adapter	85650A	HP	2006-08-07	2008-08-07	GEMC 7
LISN	LISN 275-25-1	Vican	2006-09-12	2008-09-12	GEMC 12
RF Cable 7m	LMR-400-7M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 28
RF Cable 1m	LMR-400-1M-50OHM-MN-MN	LexTec	NCR	NCR	GEMC 29
Attenuator 10 dB	FP-50-10	Trilithic	NCR	NCR	GEMC 42

This report module is based on GEMC template "FCC – Power Line Conducted Emissions Class B_Rev1"

Appendix A – EUT Summary

General EUT Description

Client	
Organization	Viconics
Contact	Paolo Primiani
Phone	1-800-563-5660
Email	paolo@viconics.com
EUT Details	
EUT Model number	VT7355C5500W
Equipment Category	Thermostat control equipment.
Basic EUT Functionality	The VT7600 PI thermostat family is specifically designed for single stage and multi-stage control of heating/cooling equipment such as rooftop and self-contained units. The product features an intuitive, menu-driven, back-lit LCD display which walks users through the programming steps, making the process extremely simple. Accurate temperature control is achieved due to the product's PI time proportional control algorithm, which virtually eliminates temperature offset associated with traditional, differential-based thermostats. All models contain two digital inputs, which can be set by the user to monitor filter status, activate a remote temporary occupancy switch, and/or used as a general purpose service indicator. In addition, depending on the model, up to three remote sensor inputs are available. All models contain a SPST auxiliary switch, which can be used to control lighting or disable the economizer function and a discharge air sensor input. For more advanced applications, an economizer control logic has been integrated onto the thermostat for use with proportional damper economizer actuators.
Input Voltage and Frequency	120V 60Hz
Connectors available on EUT	No external connectors available on the EUT.

Peripherals Required for Test	RJ-45 connected to a laptop to program the EUT for operation. The unit does not connect to the computer directly, but through a BACnet module.
Release type	Final
Intentional Radiator Frequency	2400 – 2480 MHz for Zigbee protocol.
I/O cable description	No protocol I/O cables are used. Relay and triac control signals from the unit run out to controlled equipment.

Note the EUT is considered to have been received the date of the commencement of the first test, unless otherwise stated. For a close-up picture of the EUT, see 'Appendix B – EUT & Test Setup Photographs'.

Appendix B – EUT and Test Setup Photographs

Figure 1 – Radiated emission setup

Figure 2 – Power line conducted emissions

Note: These photos are for information purposes only. Also refer to PDF files that are separate from this test report.