EMC Test Report

Application for Grant of Equipment Authorization
pursuant to

FCC Part 15 Subpart C

Model: 950-12LR HHC

FCC ID:	FFW-950-12LR-HHC
APPLICANT:	Memtec Corporation 68 Stiles Road Unit D Salem, NH 3079
TEST SITE(S):	Elliott Laboratories 41039 Boyce Road. Fremont, CA. 94538-2435
IC SITE REGISTRATION #:	2845B-3; 2845B-4, 2845B-5
REPORT DATE:	September 30, 2010
FINAL TEST DATES:	August 19, 20, 24 and 25, 2010

AUTHORIZED SIGNATORY:

David W. Bare
Chief Engineer
Elliott Laboratories

A2LA ACCREDITED
Testing Cert #2016.01

REVISION HISTORY

Rev#	Date	Comments	Modified By
-	09-23-2010	First release	
2	09-30-2010	Corrected modifications to the EUT	dwb

TABLE OF CONTENTS

SCOPE

An electromagnetic emissions test has been performed on the Memtec Corporation model 950-12LR HHC, pursuant to the following rules:

FCC Part 15 Subpart C

Conducted and radiated emissions data has been collected, reduced, and analyzed within this report in accordance with measurement guidelines set forth in the following reference standards and as outlined in Elliott Laboratories test procedures:

ANSI C63.4:2003
FCC DTS Measurement Procedure KDB558074, March 2005

The intentional radiator above has been tested in a simulated typical installation to demonstrate compliance with the relevant Industry Canada performance and procedural standards.

Final system data was gathered in a mode that tended to maximize emissions by varying orientation of EUT, orientation of power and I/O cabling, antenna search height, and antenna polarization.

Every practical effort was made to perform an impartial test using appropriate test equipment of known calibration. All pertinent factors have been applied to reach the determination of compliance.

OBJECTIVE

The primary objective of the manufacturer is compliance with the regulations outlined in the previous section.

Prior to marketing in the USA, all unlicensed transmitters and transceivers require certification. Receive-only devices operating between 30 MHz and 960 MHz are subject to either certification or a manufacturer's declaration of conformity, with all other receive-only devices exempt from the technical requirements.

Certification is a procedure where the manufacturer submits test data and technical information to a certification body and receives a certificate or grant of equipment authorization upon successful completion of the certification body's review of the submitted documents. Once the equipment authorization has been obtained, the label indicating compliance must be attached to all identical units, which are subsequently manufactured.

Maintenance of compliance is the responsibility of the manufacturer. Any modification of the product which may result in increased emissions should be checked to ensure compliance has been maintained (i.e., printed circuit board layout changes, different line filter, different power supply, harnessing or I/O cable changes, etc.).

STATEMENT OF COMPLIANCE

The tested sample of Memtec Corporation model 950-12LR HHC complied with the requirements of the following regulations:

FCC Part 15 Subpart C

Maintenance of compliance is the responsibility of the manufacturer. Any modifications to the product should be assessed to determine their potential impact on the compliance status of the device with respect to the standards detailed in this test report.

The test results recorded herein are based on a single type test of Memtec Corporation model 950-12LR HHC and therefore apply only to the tested sample. The sample was selected and prepared by Dennis Garboski of Memtec Corporation.

DEVIATIONS FROM THE STANDARDS

No deviations were made from the published requirements listed in the scope of this report.

TEST RESULTS SUMMARY

DIGITAL TRANSMISSION SYSTEMS (2400 – 2483.5MHz)

FCC Rule Part		Description	Measured Value / Comments	Limit / Requirement	Result
15.247(a)		Digital Modulation	Systems uses OFDM techniques	System must utilize a digital transmission technology	Complies
15.247 (a) (2)		6dB Bandwidth	Minimum 1.433 MHz	>500kHz	Complies
15.247 (b) (3)		Output Power (multipoint systems)	1.5 dBm (0.0014 Watts) EIRP = .0016 W Note 1	1Watt, EIRP limited to 4 Watts.	Complies
15.247(d)		Power Spectral Density	-13.1 dBm / 3kHz	8dBm/3kHz	Complies
15.247(c)		Antenna Port Spurious Emissions 30MHz – 25 GHz	All emissions below -30dBc	< -30dBc Note 2	Complies
15.247(c) / 15.209		Radiated Spurious Emissions 30MHz – 25 GHz	51.6 dBuV/m @ 2483.5MHz (-2.4dB)	15.207 in restricted bands, all others <-30dBc Note 2	Complies

Note 1: EIRP calculated using antenna gain of 0.5 dBi for the highest EIRP system.
Note 2: Limit of -30dBc used because the power was measured using the UNII test procedure (maximum power averaged over a transmission burst).

GENERAL REQUIREMENTS APPLICABLE TO ALL BANDS

FCC Rule Part		Description	Measured Value / Comments	Limit / Requirement	Result (margin)
15.203		RF Connector	Integral Antenna	Integral antenna or unique connector	Complies
15.109		Receiver spurious emissions	N/A – Tunes above 960 MHz	Refer to Standard	N/A)
15.207		AC Conducted Emissions	N/A – battery powered	-	N/A
15.247 (b) (5) 15.407 (f)		RF Exposure Requirements	Refer to RF Exposure exhibit	Refer to OET 65, FCC Part 1	Complies
-		99% Bandwidth	3.6 MHz	Information only	N/A

MEASUREMENT UNCERTAINTIES

ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report. The measurement uncertainties given below are based on a 95% confidence level and were calculated in accordance with UKAS document LAB 34.

Measurement Type	Measurement Unit	Frequency Range	Expanded Uncertainty
RF power, conducted (power meter)	dBm	25 to 7000 MHz	± 0.52 dB
RF power, conducted (Spectrum analyzer)	dBm	25 to 7000 MHz	± 0.7 dB
Conducted emission of transmitter	dBm	25 to 26500 MHz	± 0.7 dB
Conducted emission of receiver	dBm	25 to 26500 MHz	± 0.7 dB
Radiated emission (substitution method)	dBm	25 to 26500 MHz	± 2.5 dB
Radiated emission (field strength)	dBµV/m	25 to 1000 MHz	± 3.6 dB
		1000 to 40000 MHz	± 6.0 dB
Conducted Emissions (AC Power)	dBµV	0.15 to 30 MHz	± 2.4 dB

EQUIPMENT UNDER TEST (EUT) DETAILS

GENERAL

The Memtec Corporation model 950-12LR HHC is a medical device that is designed to monitor ECG and transmit the data using the 2.4 GHz band to a computer for viewing. Since the EUT would be placed on a table top during operation, the EUT was treated as table-top equipment during testing to simulate the end-user environment. The electrical rating of the EUT is 1.5 Volts supplied from a battery.

The sample was received on August 2, 2010 and tested on August 19, 20, 24 and 25, 2010. The EUT consisted of the following component(s):

Company	Model	Description	Serial Number	FCC ID
Memtec Corporation	M950-12LR-HHC	ECG Monitor	1	FFW-950-12LR-HHC

ANTENNA SYSTEM

The antenna is integral to the device.

ENCLOSURE

The EUT enclosure is primarily constructed of plastic. It measures approximately 6 cm wide by 1.8 cm deep by 8.5 cm high.

MODIFICATIONS

The following modifications were made to the EUT by Memtec during the time the product was at Elliott:

1) Changed L401 from 6.2nh inductor to 3.3nh inductor
2) Removed discrete component harmonic filter (3 components) and replaced it with a Chebyshev Harmonic Filter (one component)

SUPPORT EQUIPMENT

The following equipment was used as support equipment for testing:

Company	Model	Description	Serial Number	FCC ID
Ember	InSight	ZigBee Development Unit	-	-
CUI Inc	3A-161WP12	Switch Mode Power Supply	-	-

The following equipment was used as remote support equipment for emissions testing:

Company	Model	Description	Serial Number	FCC ID
HP Compaq	Presario CQ62	Laptop	CNF0221DS2	DoC
HP	Series PPP009H	Power Supply	F129210200237 79	-

EUT INTERFACE PORTS

The I/O cabling configuration during testing was as follows:

Port	Connected To	Cable(s)		
		Description	Shielded or Unshielded	Length(m)
Serial Adapter Cable	Ember	Multiwire	Unshielded	0.5
Ember Ethernet	Laptop	Crossover Cat 5	Unshielded	3

Note: The EUT normally only has ECG leads. The sample was modified with a custom interface to control the microprocessor to set the radio parameters for testing via an Ember development unit.

EUT OPERATION

During emissions testing the EUT was set to continuously transmit modulated CW.

TEST SITE

GENERAL INFORMATION

Final test measurements were taken at the test sites listed below. Pursuant to section 2.948 of the FCC's Rules and section 3.3 of RSP-100, construction, calibration, and equipment data has been filed with the Commission and with industry Canada.

Site	Registration Numbers		Location
	FCC	Canada	
Chamber 3	769238	2845B-3	41039 Boyce Road Fremont, CA 94538-2435
Chamber 4	211948	2845B-4	
Chamber 5	211948	2845B-5	

ANSI C63.4:2003 recommends that ambient noise at the test site be at least 6 dB below the allowable limits. Ambient levels are below this requirement. The test site(s) contain separate areas for radiated and conducted emissions testing. Considerable engineering effort has been expended to ensure that the facilities conform to all pertinent requirements of ANSI C63.4:2003.

CONDUCTED EMISSIONS CONSIDERATIONS

Conducted emissions testing is performed in conformance with ANSI C63.4:2003. Measurements are made with the EUT connected to the public power network through a nominal, standardized RF impedance, which is provided by a line impedance stabilization network, known as a LISN. A LISN is inserted in series with each current-carrying conductor in the EUT power cord.

RADIATED EMISSIONS CONSIDERATIONS

The FCC has determined that radiation measurements made in a shielded enclosure are not suitable for determining levels of radiated emissions. Radiated measurements are performed in an open field environment or in a semi-anechoic chamber. The test sites are maintained free of conductive objects within the CISPR defined elliptical area incorporated in ANSI C63.4:2003 guidelines and meet the Normalized Site Attenuation (NSA) requirements of ANSI C63.4:2003.

MEASUREMENT INSTRUMENTATION

RECEIVER SYSTEM

An EMI receiver as specified in CISPR 16-1-1 is used for emissions measurements. The receivers used can measure over the frequency range of 9 kHz up to 2000 MHz. These receivers allow both ease of measurement and high accuracy to be achieved. The receivers have Peak, Average, and CISPR (Quasi-peak) detectors built into their design so no external adapters are necessary. The receiver automatically sets the required bandwidth for the CISPR detector used during measurements. If the repetition frequency of the signal being measured is below 20Hz, peak measurements are made in lieu of Quasi-Peak measurements.

For measurements above the frequency range of the receivers, a spectrum analyzer is utilized because it provides visibility of the entire spectrum along with the precision and versatility required to support engineering analysis. Average measurements above 1000MHz are performed on the spectrum analyzer using the linear-average method with a resolution bandwidth of 1 MHz and a video bandwidth of 10 Hz, unless the signal is pulsed in which case the average (or video) bandwidth of the measuring instrument is reduced to onset of pulse desensitization and then increased.

INSTRUMENT CONTROL COMPUTER

The receivers utilize either a Rohde & Schwarz EZM Spectrum Monitor/Controller or contain an internal Spectrum Monitor/Controller to view and convert the receiver measurements to the field strength at an antenna or voltage developed at the LISN measurement port, which is then compared directly with the appropriate specification limit. This provides faster, more accurate readings by performing the conversions described under Sample Calculations within the Test Procedures section of this report. Results are printed in a graphic and/or tabular format, as appropriate. A personal computer is used to record all measurements made with the receivers.

The Spectrum Monitor provides a visual display of the signal being measured. In addition, the controller or a personal computer run automated data collection programs which control the receivers. This provides added accuracy since all site correction factors, such as cable loss and antenna factors are added automatically.

LINE IMPEDANCE STABILIZATION NETWORK (LISN)

Line conducted measurements utilize a fifty microhenry Line Impedance Stabilization Network as the monitoring point. The LISN used also contains a 250 uH CISPR adapter. This network provides for calibrated radio frequency noise measurements by the design of the internal low pass and high pass filters on the EUT and measurement ports, respectively.

FILTERS/ATTENUATORS

External filters and precision attenuators are often connected between the receiving antenna or LISN and the receiver. This eliminates saturation effects and non-linear operation due to high amplitude transient events.

ANTENNAS

A loop antenna is used below 30 MHz. For the measurement range 30 MHz to 1000 MHz either a combination of a biconical antenna and a log periodic or a bi-log antenna is used. Above 1000 MHz, horn antennas are used. The antenna calibration factors to convert the received voltage to an electric field strength are included with appropriate cable loss and amplifier gain factors to determine an overall site factor, which is then programmed into the test receivers or incorporated into the test software.

ANTENNA MAST AND EQUIPMENT TURNTABLE

The antennas used to measure the radiated electric field strength are mounted on a non-conductive antenna mast equipped with a motor-drive to vary the antenna height. Measurements below 30 MHz are made with the loop antenna at a fixed height of 1m above the ground plane.

ANSI C63.4:2003 specifies that the test height above ground for table mounted devices shall be 80 centimeters. Floor mounted equipment shall be placed on the ground plane if the device is normally used on a conductive floor or separated from the ground plane by insulating material from 3 to 12 mm if the device is normally used on a non-conductive floor. During radiated measurements, the EUT is positioned on a motorized turntable in conformance with this requirement.

INSTRUMENT CALIBRATION

All test equipment is regularly checked to ensure that performance is maintained in accordance with the manufacturer's specifications. All antennas are calibrated at regular intervals with respect to tuned half-wave dipoles. An exhibit of this report contains the list of test equipment used and calibration information.

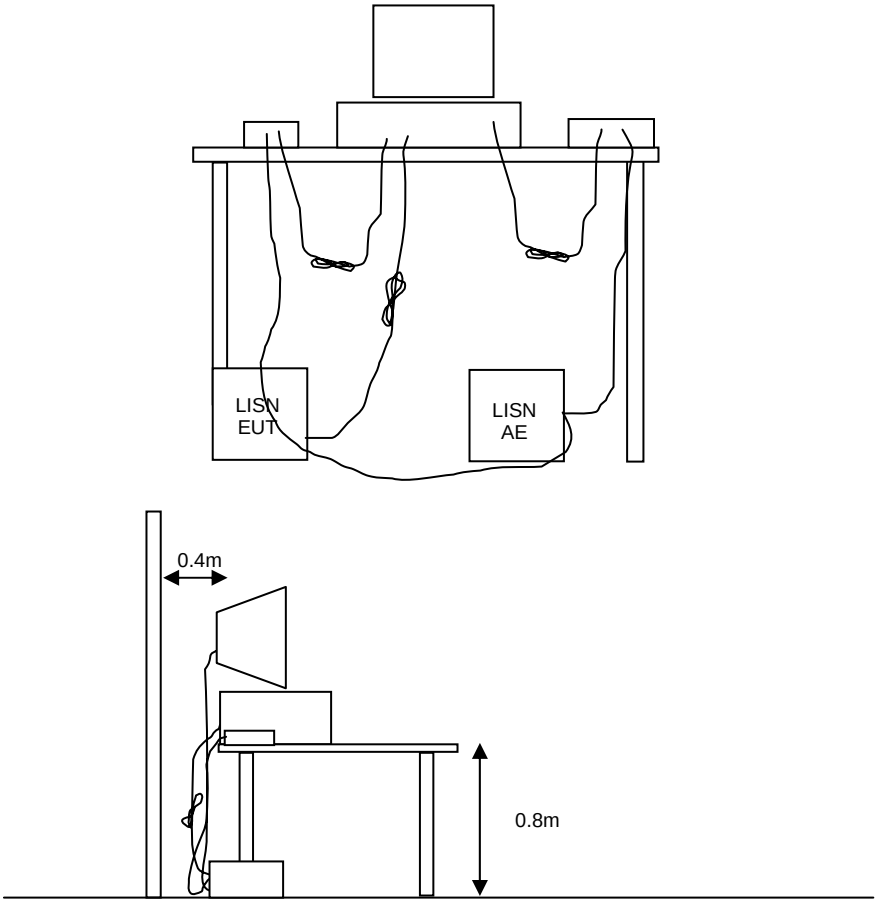
TEST PROCEDURES

EUT AND CABLE PLACEMENT

The regulations require that interconnecting cables be connected to the available ports of the unit and that the placement of the unit and the attached cables simulate the worst case orientation that can be expected from a typical installation, so far as practicable. To this end, the position of the unit and associated cabling is varied within the guidelines of ANSI C63.4:2003, and the worst-case orientation is used for final measurements.

CONDUCTED EMISSIONS

Conducted emissions are measured at the plug end of the power cord supplied with the EUT. Excess power cord length is wrapped in a bundle between 30 and 40 centimeters in length near the center of the cord. Preliminary measurements are made to determine the highest amplitude emission relative to the specification limit for all the modes of operation. Placement of system components and varying of cable positions are performed in each mode. A final peak mode scan is then performed in the position and mode for which the highest emission was noted on all current carrying conductors of the power cord.



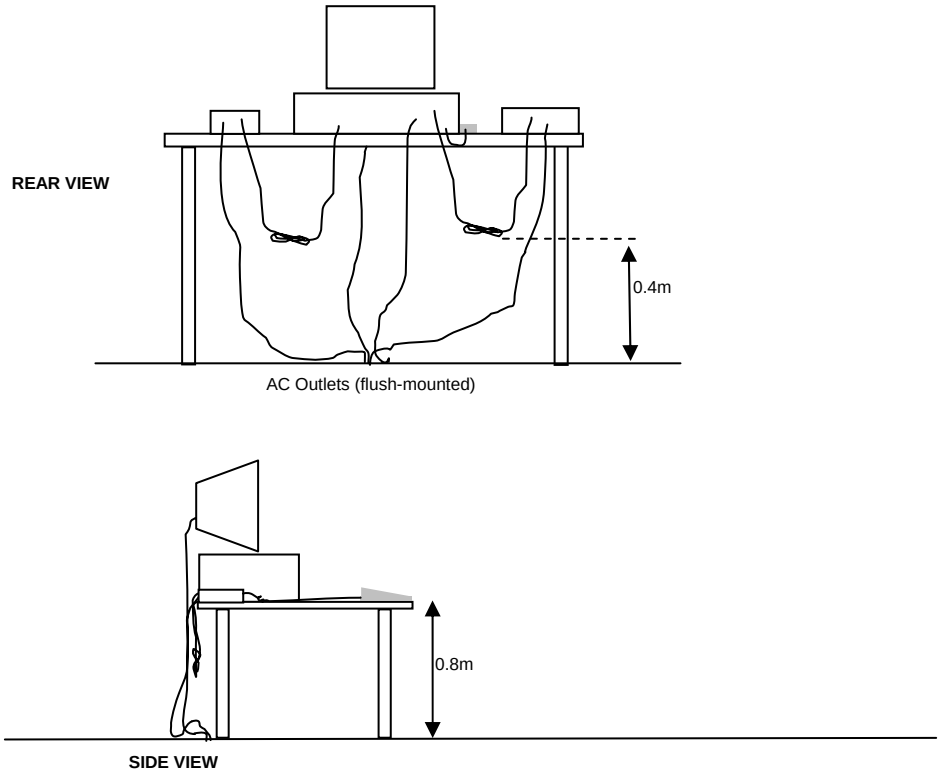
RADIATED EMISSIONS

A preliminary scan of the radiated emissions is performed in which all significant EUT frequencies are identified with the system in a nominal configuration. At least two scans are performed, one scan for each antenna polarization (horizontal and vertical; loop parallel and perpendicular to the EUT). During the preliminary scans, the EUT is rotated through 360˚, the antenna height is varied (for measurements above 30 MHz) and cable positions are varied to determine the highest emission relative to the limit. Preliminary scans may be performed in a fully anechoic chamber for the purposes of identifying the frequencies of the highest emissions from the EUT.

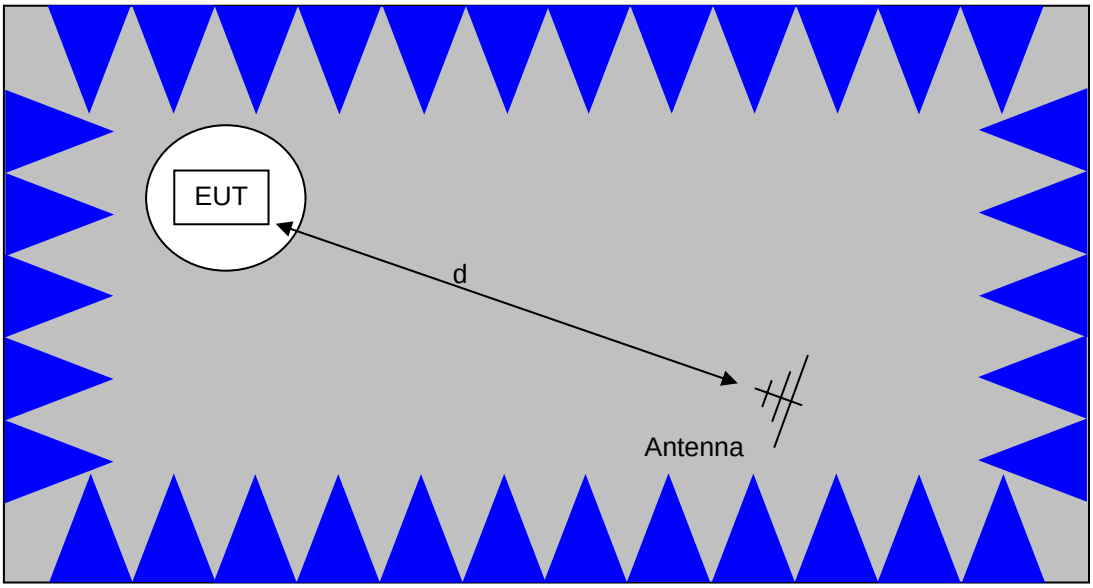
A speaker is provided in the receiver to aid in discriminating between EUT and ambient emissions. Other methods used during the preliminary scan for EUT emissions involve scanning with near field magnetic loops, monitoring I/O cables with RF current clamps, and cycling power to the EUT.

Final maximization is a phase in which the highest amplitude emissions identified in the spectral search are viewed while the EUT azimuth angle is varied from 0 to 360 degrees relative to the receiving antenna. The azimuth, which results in the highest emission is then maintained while varying the antenna height from one to four meters (for measurements above 30 MHz, measurements below 30 MHz are made with the loop antenna at a fixed height of 1m). The result is the identification of the highest amplitude for each of the highest peaks. Each recorded level is corrected in the receiver using appropriate factors for cables, connectors, antennas, and preamplifier gain.

When testing above 18 GHz, the receive antenna is located at 1meter from the EUT and the antenna height is restricted to a maximum of 2.5 meters.

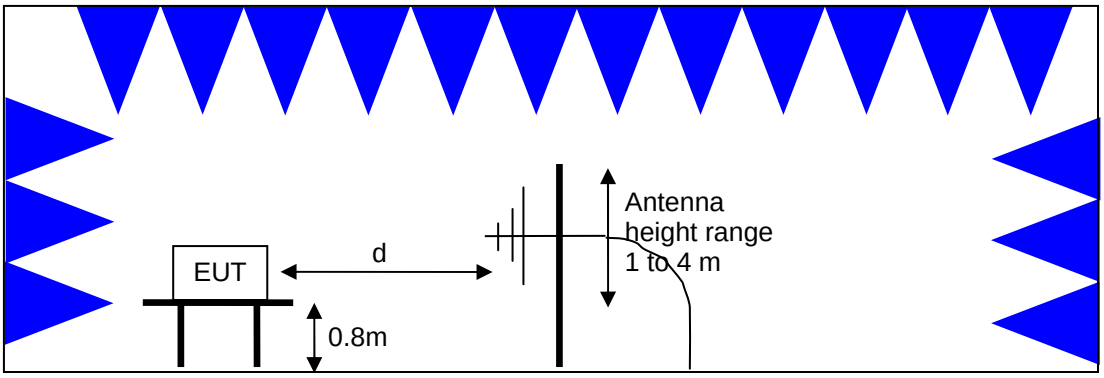


Typical Test Configuration for Radiated Field Strength Measurements



The anechoic materials on the walls and ceiling ensure compliance with the normalized site attenuation requirements of CISPR 16 / CISPR 22 / ANSI C63.4 for an alternate test site at the measurement distances used.

Floor-standing equipment is placed on the floor with insulating supports between the unit and the ground plane.



Test Configuration for Radiated Field Strength Measurements
Semi-Anechoic Chamber, Plan and Side Views

BANDWIDTH MEASUREMENTS

The 6dB, 20dB and/or 26dB signal bandwidth is measured in using the bandwidths recommended by ANSI C63.4. When required, the 99% bandwidth is measured using the methods detailed in RSS GEN.

SPECIFICATION LIMITS AND SAMPLE CALCULATIONS

The limits for conducted emissions are given in units of microvolts, and the limits for radiated emissions are given in units of microvolts per meter at a specified test distance. Data is measured in the logarithmic form of decibels relative to one microvolt, or dB microvolts (dBuV). For radiated emissions, the measured data is converted to the field strength at the antenna in dB microvolts per meter (dBuV/m). The results are then converted to the linear forms of uV and uV/m for comparison to published specifications.

For reference, converting the specification limits from linear to decibel form is accomplished by taking the base ten logarithm, then multiplying by 20. These limits in both linear and logarithmic form are as follows:

CONDUCTED EMISSIONS SPECIFICATION LIMITS: FCC 15.207; FCC 15.107(a), RSS GEN

The table below shows the limits for the emissions on the AC power line from an intentional radiator and a receiver.

Frequency (MHz)	Average Limit (dBuV)	Quasi Peak Limit (dBuV)
0.150 to 0.500	Linear decrease on logarithmic frequency axis between 56.0 and 46.0	Linear decrease on logarithmic frequency axis between 66.0 and 56.0
0.500 to 5.000	46.0	56.0
5.000 to 30.000	50.0	60.0

GENERAL TRANSMITTER RADIATED EMISSIONS SPECIFICATION LIMITS

The table below shows the limits for the spurious emissions from transmitters that fall in restricted bands[1] (with the exception of transmitters operating under FCC Part 15 Subpart D and RSS 210 Annex 9), the limits for all emissions from a low power device operating under the general rules of RSS 310 (tables 3 and 4), RSS 210 (table 2) and FCC Part 15 Subpart C section 15.209.

Frequency Range (MHz)	Limit (uV/m)	Limit (dBuV/m @ 3m)
0.009-0.490	$2400/F_{KHz}$ @ 300m	$67.6-20*\log_{10}(F_{KHz})$ @ 300m
0.490-1.705	$24000/F_{KHz}$ @ 30m	$87.6-20*\log_{10}(F_{KHz})$ @ 30m
1.705 to 30	30 @ 30m	29.5 @ 30m
30 to 88	100 @ 3m	40 @ 3m
88 to 216	150 @ 3m	43.5 @ 3m
216 to 960	200 @ 3m	46.0 @ 3m
Above 960	500 @ 3m	54.0 @ 3m

OUTPUT POWER LIMITS – DIGITAL TRANSMISSION SYSTEMS

The table below shows the limits for output power and output power density. Where the signal bandwidth is less than 20 MHz the maximum output power is reduced to the power spectral density limit plus 10 times the log of the bandwidth (in MHz).

Operating Frequency (MHz)	Output Power	Power Spectral Density
902 – 928	1 Watt (30 dBm)	8 dBm/3kHz
2400 – 2483.5	1 Watt (30 dBm)	8 dBm/3kHz
5725 – 5850	1 Watt (30 dBm)	8 dBm/3kHz

The maximum permitted output power is reduced by 1dB for every dB the antenna gain exceeds 6dBi. Fixed point-to-point applications using the 5725 – 5850 MHz band are not subject to this restriction.

TRANSMIT MODE SPURIOUS RADIATED EMISSIONS LIMITS – FHSS and DTS SYSTEMS

The limits for unwanted (spurious) emissions from the transmitter falling in the restricted bands are those specified in the general limits sections of FCC Part 15 and RSS 210. All other unwanted (spurious) emissions shall be at least 20dB below the level of the highest in-band signal level (30dB if the power is measured using the sample detector/power averaging method).

[1] The restricted bands are detailed in FCC 15.203, RSS 210 Table 1 and RSS 310 Table 2

SAMPLE CALCULATIONS - CONDUCTED EMISSIONS

Receiver readings are compared directly to the conducted emissions specification limit (decibel form) as follows:

$$R_r - S = M$$

where:

R_r = Receiver Reading in dBuV

S = Specification Limit in dBuV

M = Margin to Specification in +/- dB

SAMPLE CALCULATIONS - RADIATED EMISSIONS

Receiver readings are compared directly to the specification limit (decibel form). The receiver internally corrects for cable loss, preamplifier gain, and antenna factor. The calculations are in the reverse direction of the actual signal flow, thus cable loss is added and the amplifier gain is subtracted. The Antenna Factor converts the voltage at the antenna coaxial connector to the field strength at the antenna elements.

A distance factor, when used for electric field measurements above 30MHz, is calculated by using the following formula:

$$F_d = 20*LOG_{10} (D_m/D_s)$$

where:

F_d = Distance Factor in dB

D_m = Measurement Distance in meters

D_s = Specification Distance in meters

For electric field measurements below 30MHz the extrapolation factor is either determined by making measurements at multiple distances or a theoretical value is calculated using the formula:

$$F_d = 40*LOG_{10} (D_m/D_s)$$

Measurement Distance is the distance at which the measurements were taken and Specification Distance is the distance at which the specification limits are based. The antenna factor converts the voltage at the antenna coaxial connector to the field strength at the antenna elements.

The margin of a given emission peak relative to the limit is calculated as follows:

$$R_c = R_r + F_d$$

and

$$M = R_c - L_s$$

where:

R_r = Receiver Reading in dBuV/m

F_d = Distance Factor in dB

R_c = Corrected Reading in dBuV/m

L_s = Specification Limit in dBuV/m

M = Margin in dB Relative to Spec

SAMPLE CALCULATIONS - FIELD STRENGTH TO EIRP CONVERSION

Where the radiated electric field strength is expressed in terms of the equivalent isotropic radiated power (eirp), or where a field strength measurement of output power is made in lieu of a direct measurement, the following formula is used to convert between eirp and field strength at a distance of d (meters) from the equipment under test:

$$E = \frac{1000000 \sqrt{30 P}}{d} \text{ microvolts per meter}$$

where P is the eirp (Watts)

For a measurement at 3m the conversion from a logarithmic value for field strength (dBuV/m) to an eirp power (dBm) is -95.3dB.

Appendix A Test Equipment Calibration Data

Antenna conducted Measurements, 02-Aug-10

Manufacturer	Description	Model	Asset #	Cal Due
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	785	5/26/2011
Hewlett Packard	SpecAn 30 Hz -40 GHz, SV (SA40) Red	8564E (84125C)	1148	7/12/2011
Rohde & Schwarz	EMI Test Receiver, 20 Hz-7 GHz	ESIB7	1630	3/31/2011

Radiated Emissions, 1000 - 18,000 MHz, 03-Aug-10

Manufacturer	Description	Model	Asset #	Cal Due
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	785	5/26/2011
EMCO	Antenna, Horn, 1-18GHz	3115	868	6/8/2012
Hewlett Packard	SpecAn 30 Hz -40 GHz, SV (SA40) Red	8564E (84125C)	1148	7/12/2011
Micro-Tronics	Band Reject Filter, 2400-2500 MHz	BRM50702-02	1731	11/4/2010

Radiated Emissions, 1,000 - 18,000 MHz, 12-Aug-10

Manufacturer	Description	Model	Asset #	Cal Due
Hewlett Packard	Microwave Preamplifier, 1-26.5GHz	8449B	263	12/15/2010
EMCO	Antenna, Horn, 1-18GHz	3115	868	6/8/2012
Hewlett Packard	SpecAn 9 kHz - 40 GHz, FT (SA40) Blue	8564E (84125C)	1393	4/14/2011
Micro-Tronics	Band Reject Filter, 2400-2500 MHz	BRM50702-02	1683	8/10/2011

Fundamental and BE, 25-Aug-10

Manufacturer	Description	Model	Asset #	Cal Due
Hewlett Packard	SpecAn 30 Hz -40 GHz, SV (SA40) Red	8564E (84125C)	1148	7/12/2011
EMCO	Antenna, Horn, 1-18 GHz (SA40-Blu)	3115	1386	9/2/2010

Antenna Conducted Emissions, 26-Aug-10

Manufacturer	Description	Model	Asset #	Cal Due
Hewlett Packard	SpecAn 30 Hz -40 GHz, SV (SA40) Red	8564E (84125C)	1148	7/12/2011

Appendix B Test Data

T80090 20 Pages

Client:	Memtec Corporation	Job Number:	J79780
Model:	M950-12LR-HHC	T-Log Number:	T80090
		Account Manager:	Sheareen Washington
Contact:	Dennis Garboski		-
Emissions Standard(s):	FCC 15.247	Class:	-
Immunity Standard(s):		Environment:	Radio

EMC Test Data

For The

Memtec Corporation

Model

M950-12LR-HHC

Date of Last Test: 8/26/2010

Client:	Memtec Corporation	Job Number:	J79780
Model:	M950-12LR-HHC	T-Log Number:	T80090
		Account Manager:	Sheareen Washington
Contact:	Dennis Garboski		
Standard:	FCC 15.247	Class:	N/A

RSS 210 and FCC 15.247 (DTS) Antenna Port Measurements

Power, PSD, Bandwidth and Spurious Emissions

Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

Date of Test: 8/25/2010
Test Engineer: Rafael Varelas
Test Location: Fremont Chamber #5

Config. Used: 1
Config Change: None
EUT Voltage: 1.5Vdc

General Test Configuration

The EUT was connected to the spectrum analyzer or power meter via a suitable attenuator. All measurements were made on a single chain.

All measurements have been corrected to allow for the external attenuators used.

Ambient Conditions:

Temperature: 22.4 °C
Rel. Humidity: 44 %

Summary of Results

Run #	Pwr setting	Avg Pwr	Test Performed	Limit	Pass / Fail	Result / Margin
1	3dB	-	Output Power	15.247(b)	Pass	1.5 dBm
2	3dB	-	Power spectral Density (PSD)	15.247(d)	Pass	-13.1 dBm/3kHz
3	3dB	-	Minimum 6dB Bandwidth	15.247(a)	Pass	1.4 MHz
3	3dB	-	99% Bandwidth	RSS GEN	-	3.6 MHz
4	3dB	-	Spurious emissions	15.247(b)	Pass	All emissions below -30dBc

Modifications Made During Testing

No modifications were made to the EUT during testing

Deviations From The Standard

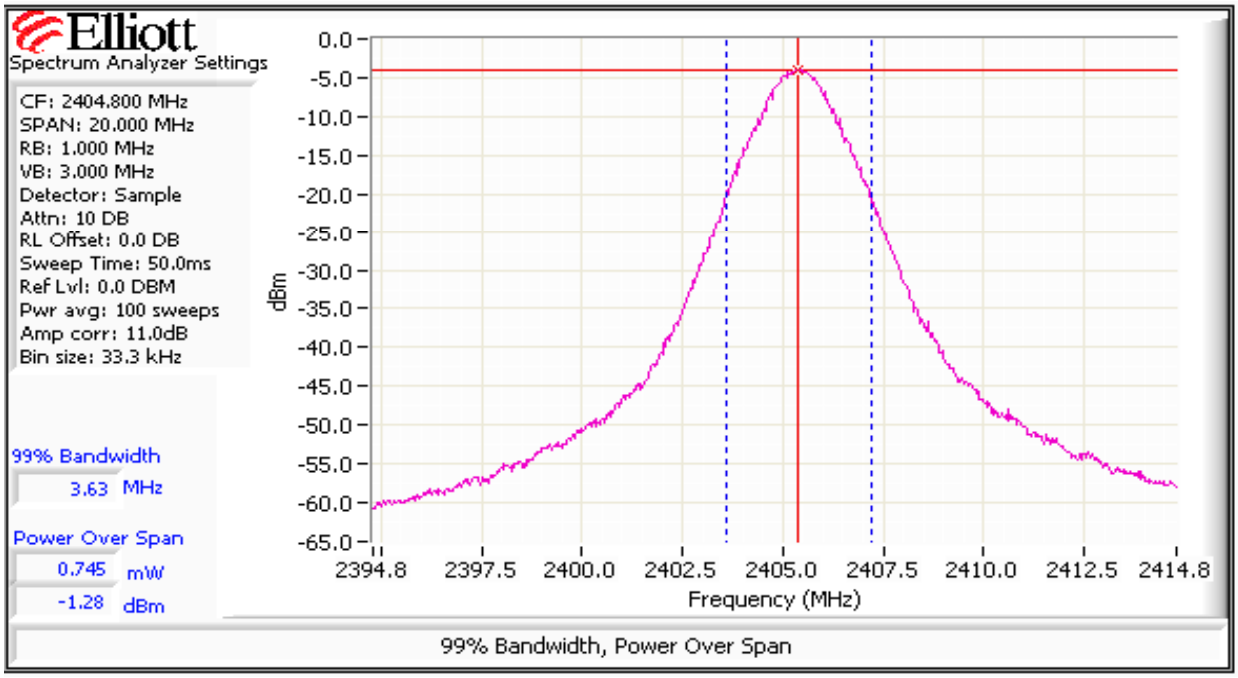
No deviations were made from the requirements of the standard.

Client:	Memtec Corporation	Job Number:	J79780
Model:	M950-12LR-HHC	T-Log Number:	T80090
		Account Manager:	Sheareen Washington
Contact:	Dennis Garboski		
Standard:	FCC 15.247	Class:	N/A

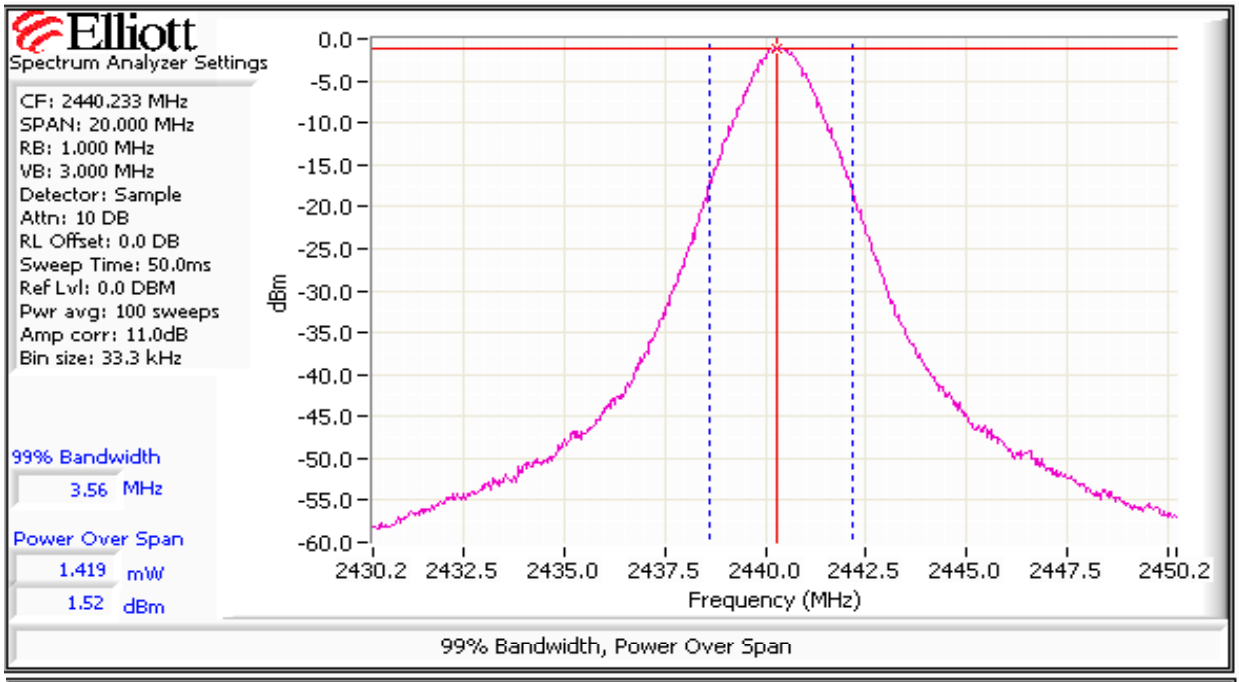
Run #1: Output Power

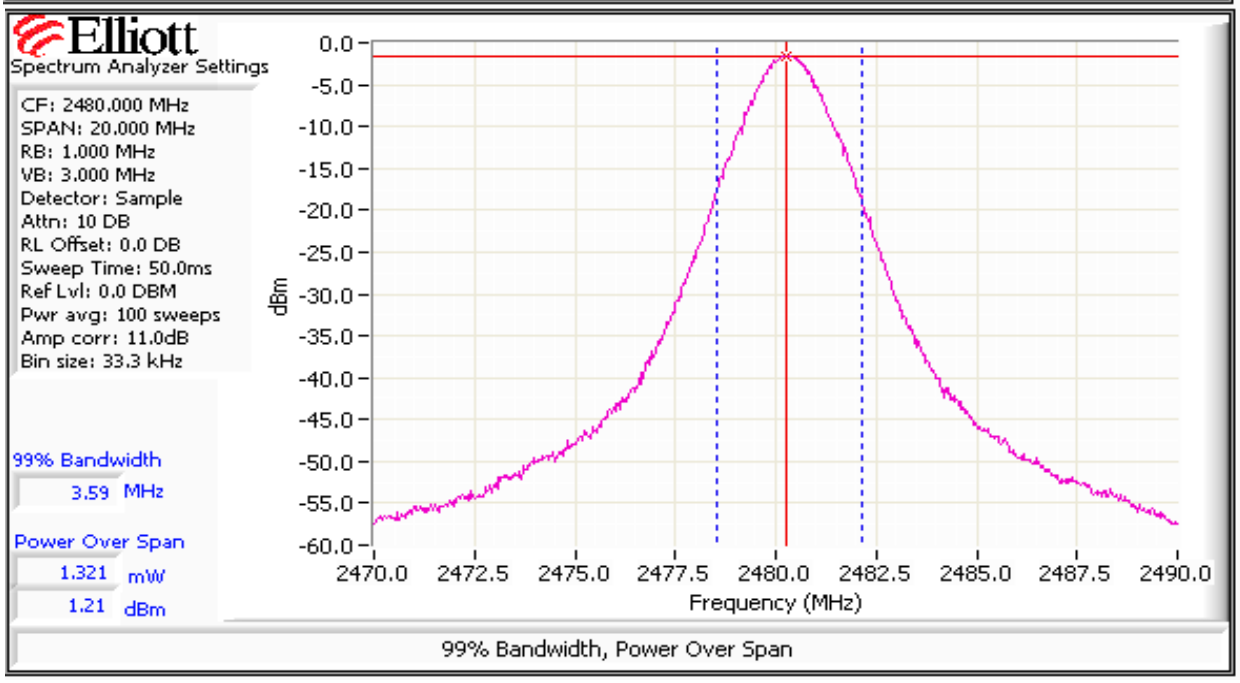
Power Setting[2]	Frequency (MHz)	Output Power (dBm) [1]	Output Power mW	Antenna Gain (dBi)	Result	EIRP [Note 2] dBm	EIRP [Note 2] W	Output Power (dBm) [3]	Output Power mW
3dBm	2404.8	-1.3	0.7	0.5	Pass	-0.8	0.001		
3dBm	2440	1.5	1.4	0.5	Pass	2.0	0.002		
3dBm	2480	1.2	1.3	0.5	Pass	1.7	0.001		

Note 1:	Output power measured using a spectrum analyzer (see plots below) with RBW=1MHz, VB=3 MHz, sample detector, power averaging on (transmitted signal was continuous) and power integration over **20 MHz** (option #2, method 1 in KDB 558074, equivalent to method 1 of DA-02-2138A1 for U-NII devices). Spurious limit becomes **-30dBc.**
Note 2:	Power setting - the software power setting used during testing, included for reference only.



Client:	Memtec Corporation	Job Number:	J79780
Model:	M950-12LR-HHC	T-Log Number:	T80090
		Account Manager:	Sheareen Washington
Contact:	Dennis Garboski		
Standard:	FCC 15.247	Class:	N/A



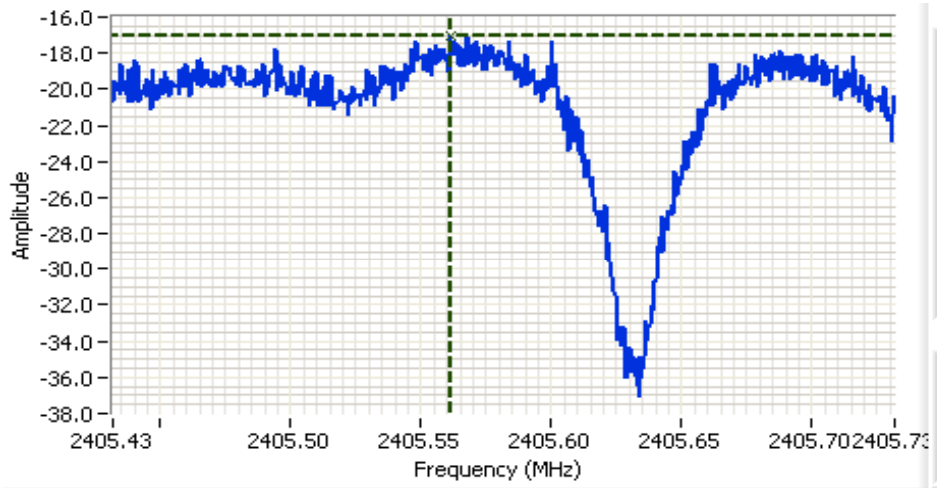


Client:	Memtec Corporation	Job Number:	J79780
Model:	M950-12LR-HHC	T-Log Number:	T80090
		Account Manager:	Sheareen Washington
Contact:	Dennis Garboski		
Standard:	FCC 15.247	Class:	N/A

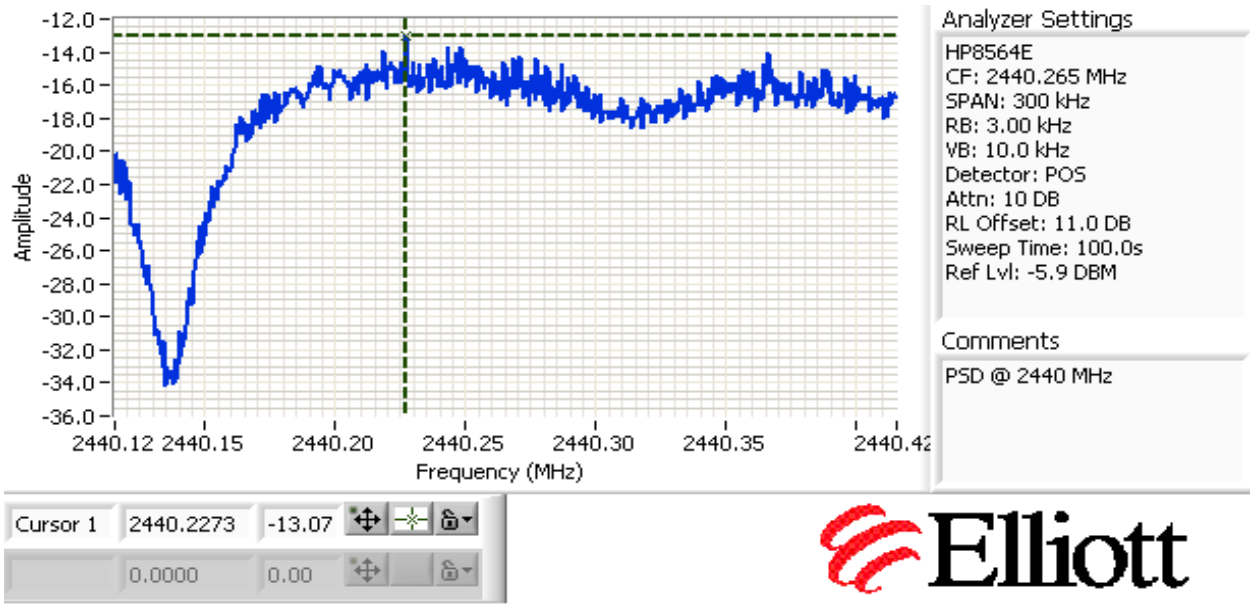
Run #2: Power spectral Density

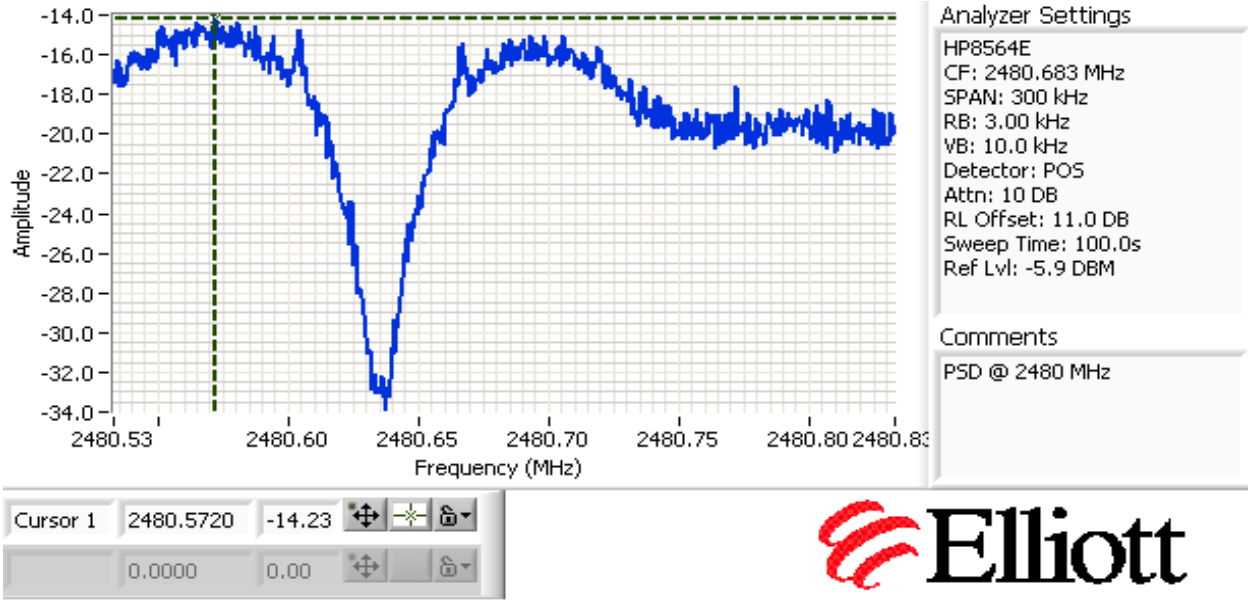
Power Setting	Frequency (MHz)	PSD (dBm/3kHz) Note 1	Limit dBm/3kHz	Result
3dB	2404.8	-17.1	8.0	Pass
3dB	2440	-13.1	8.0	Pass
3dB	2480	-14.2	8.0	Pass

Note 1:	Power spectral density measured using RB=3 kHz, VB=10kHz, analyzer with peak detector and with a sweep time set to ensure a dwell time of at least 1 second per 3kHz. The measurement is made at the frequency of PPSD determined from preliminary scans using RB=3kHz using multiple sweeps at a faster rate over the 6dB bandwidth of the signal.



Client:	Memtec Corporation	Job Number:	J79780
Model:	M950-12LR-HHC	T-Log Number:	T80090
		Account Manager:	Sheareen Washington
Contact:	Dennis Garboski		
Standard:	FCC 15.247	Class:	N/A



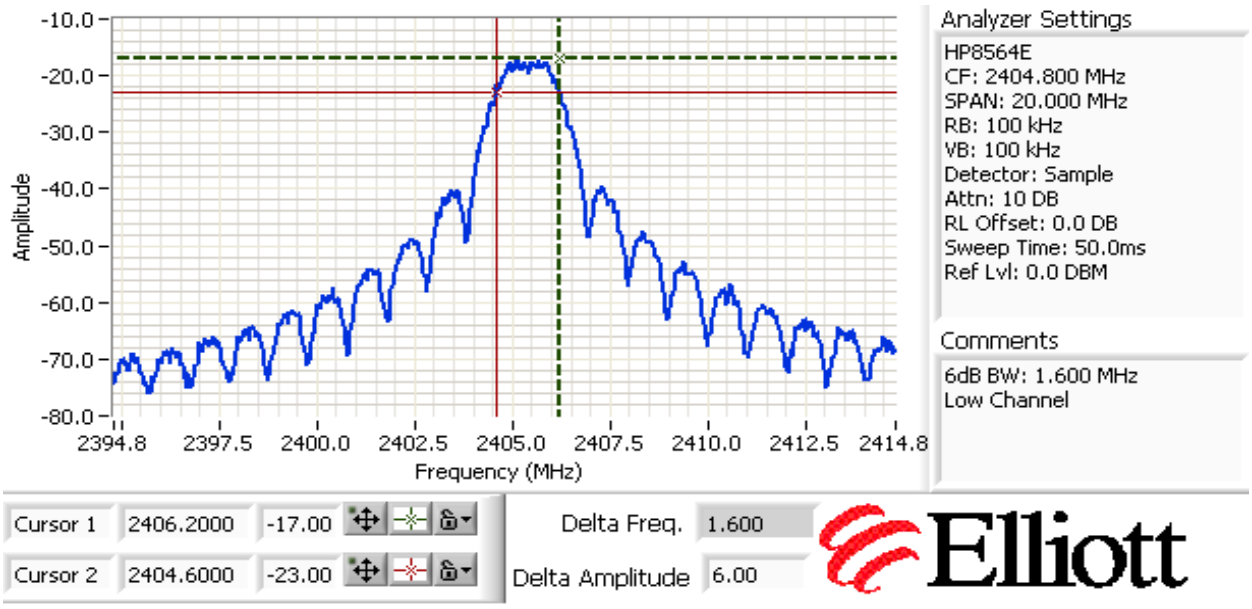


Client:	Memtec Corporation	Job Number:	J79780
Model:	M950-12LR-HHC	T-Log Number:	T80090
		Account Manager:	Sheareen Washington
Contact:	Dennis Garboski		
Standard:	FCC 15.247	Class:	N/A

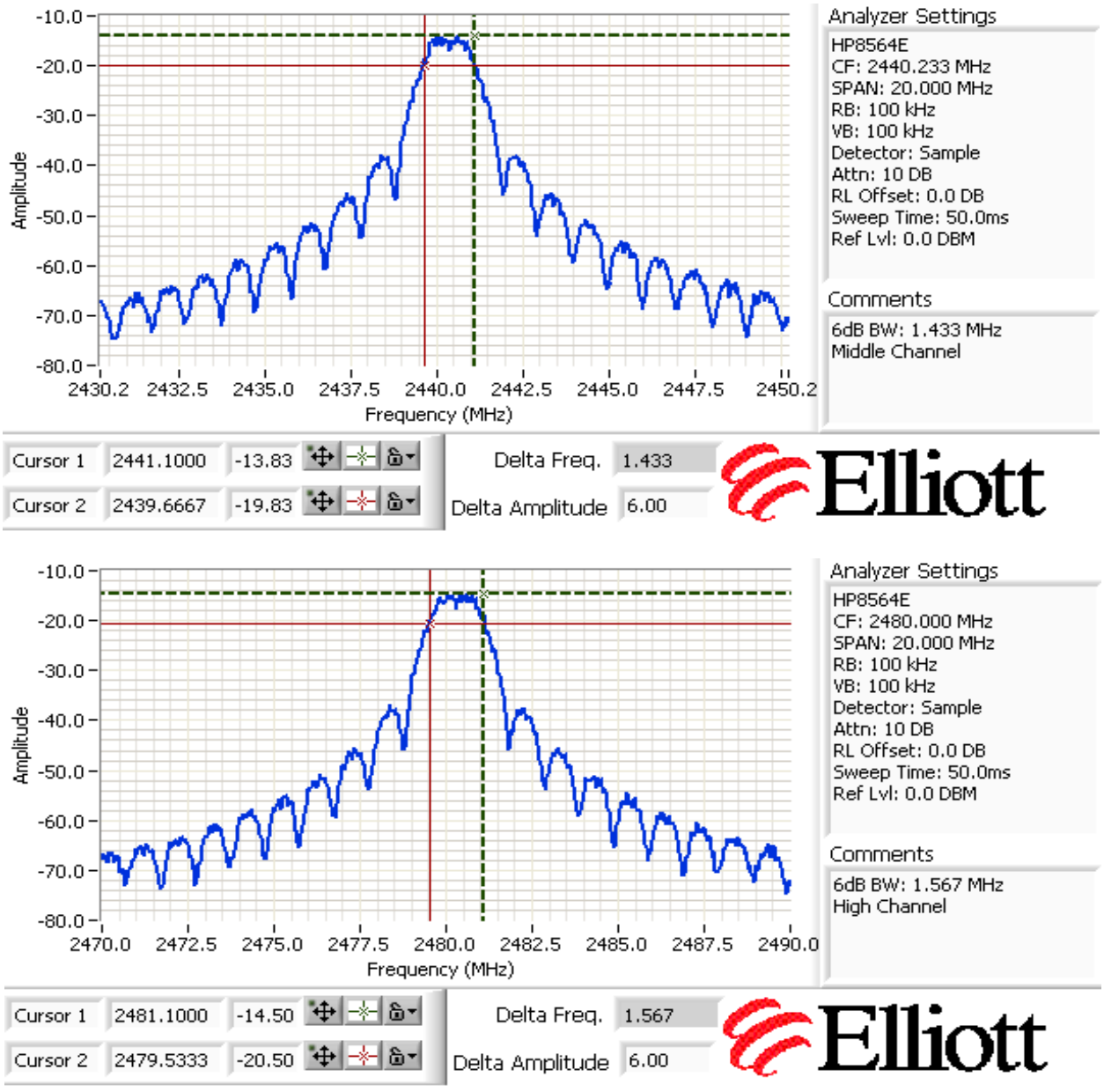
Run #3: Signal Bandwidth

Power Setting	Frequency (MHz)	Resolution Bandwidth	Bandwidth (MHz) 6dB	99%
3dB	2404.8	100kHz	1.6	3.6
3dB	2440	100kHz	1.4	3.6
3dB	2480	100kHz	1.6	3.6

Note 1:	99% bandwidth measured in accordance with RSS GEN, with RB > 1% of the span and VB > 3xRB



Client:	Memtec Corporation	Job Number:	J79780
Model:	M950-12LR-HHC	T-Log Number:	T80090
		Account Manager:	Sheareen Washington
Contact:	Dennis Garboski		
Standard:	FCC 15.247	Class:	N/A

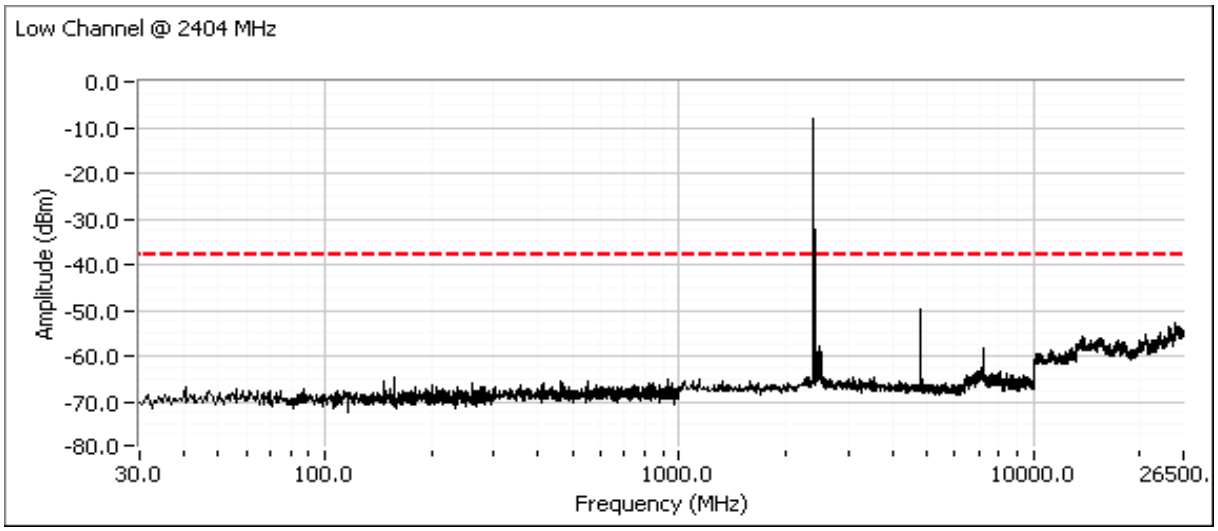


Client:	Memtec Corporation	Job Number:	J79780
Model:	M950-12LR-HHC	T-Log Number:	T80090
		Account Manager:	Sheareen Washington
Contact:	Dennis Garboski		
Standard:	FCC 15.247	Class:	N/A

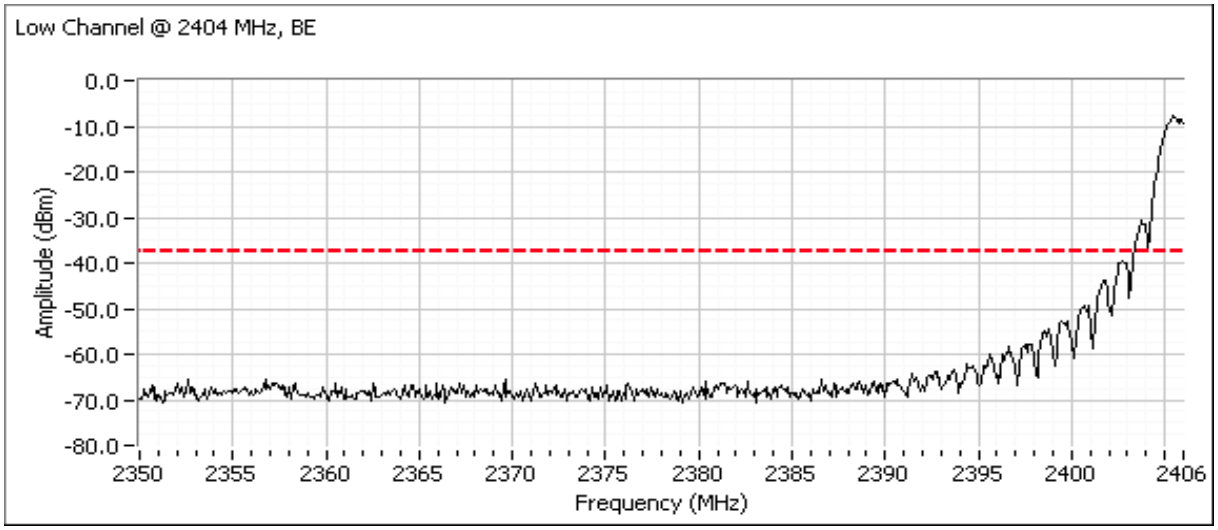
Run #4: Out of Band Spurious Emissions

Frequency (MHz)	Limit	Result
2404	-30dBc	Pass
2440	-30dBc	Pass
2480	-30dBc	Pass

Plots for low channel, power setting(s) = 3dB

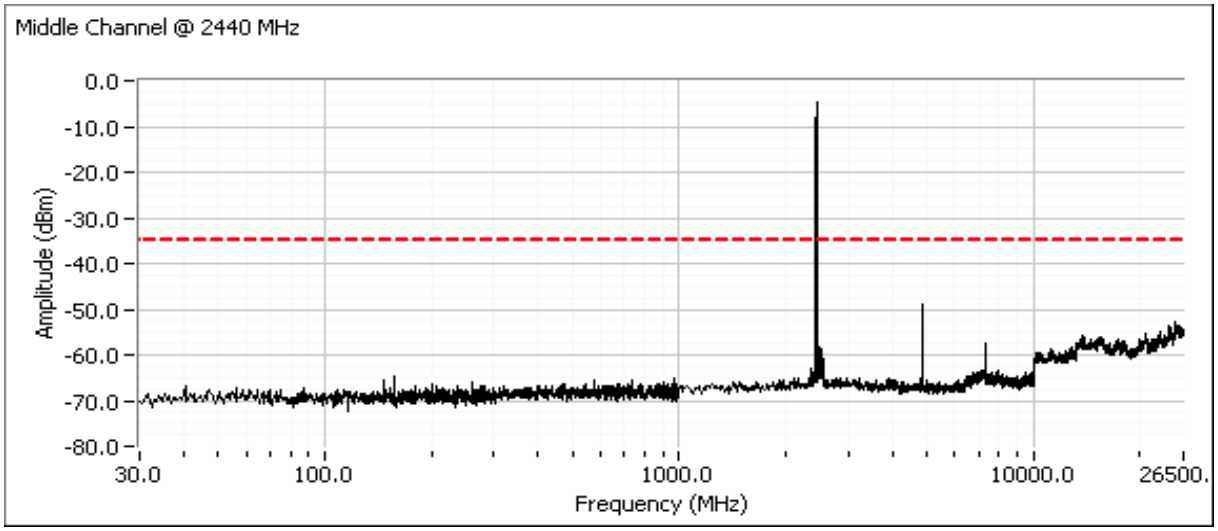


Additional plot showing compliance with -30dBc limit from 2390 MHz to 2400 MHz. Radiated measurements used to show compliance with the limits in the restricted band below 2390 MHz.

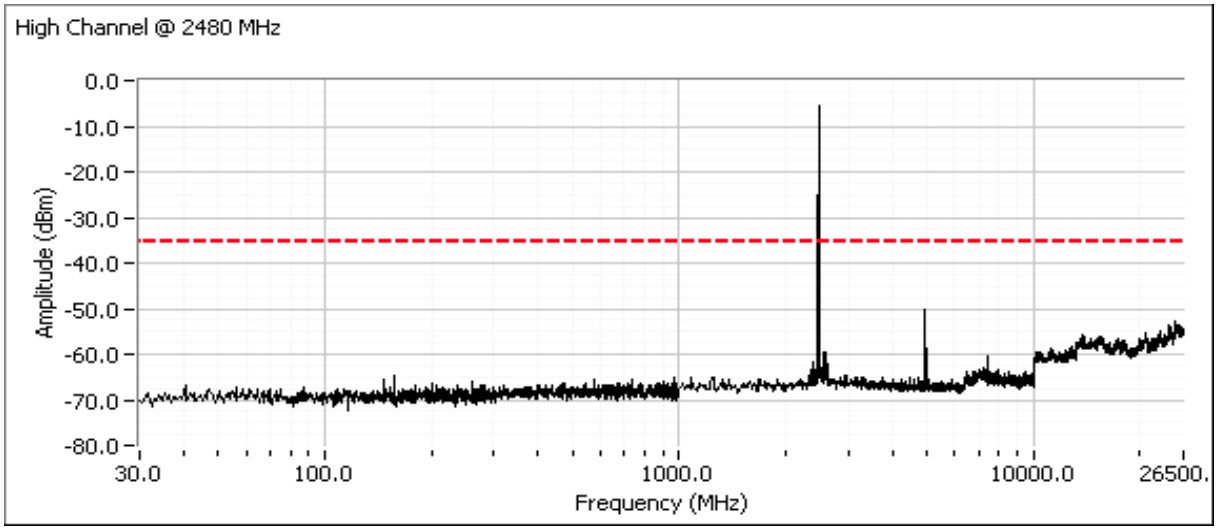


Client:	Memtec Corporation	Job Number:	J79780
Model:	M950-12LR-HHC	T-Log Number:	T80090
		Account Manager:	Sheareen Washington
Contact:	Dennis Garboski		
Standard:	FCC 15.247	Class:	N/A

Plots for center channel, power setting(s) = 3dB



Plots for high channel, power setting(s) = 3dB



Client:	Memtec Corporation	Job Number:	J79780
Model:	M950-12LR-HHC	T-Log Number:	T80090
		Account Manager:	Sheareen Washington
Contact:	Dennis Garboski		
Standard:	FCC 15.247	Class:	N/A

RSS 210 and FCC 15.247 (DTS) Radiated Spurious Emissions

Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

General Test Configuration

The EUT and all local support equipment were located on the turntable for radiated spurious emissions testing.

For radiated emissions testing the measurement antenna was located 3 meters from the EUT.

Ambient Conditions:

Temperature: 21.4 °C

Rel. Humidity: 39 %

Summary of Results - Device Operating in the 2400-2483.5 MHz Band

Run #	Mode	Channel	Power Setting	Measured Power	Test Performed	Limit	Result / Margin
1a	-	Low	3dB	-	Restricted Band Edge (2390 MHz)	FCC Part 15.209 / 15.247(c)	47.0dBµV/m @ 2387.5MHz (-7.0dB)
1b	-	High	3dB	-	Restricted Band Edge (2483.5 MHz)	FCC Part 15.209 / 15.247(c)	51.6dBµV/m @ 2483.5MHz (-2.4dB)

Modifications Made During Testing

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.

Client:	Memtec Corporation	Job Number:	J79780
Model:	M950-12LR-HHC	T-Log Number:	T80090
		Account Manager:	Sheareen Washington
Contact:	Dennis Garboski		
Standard:	FCC 15.247	Class:	N/A

Run #1: Radiated Spurious Emissions, 1000 - 18000 MHz.

Date of Test: 8/24/2010 Test Location: Chamber #4

Test Engineer: Rafael Varelas

Run #1a: Low Channel @ 2404.8 MHz

Fundamental Signal Field Strength: Peak and average values measured in 1 MHz, and peak value measured in 100kHz

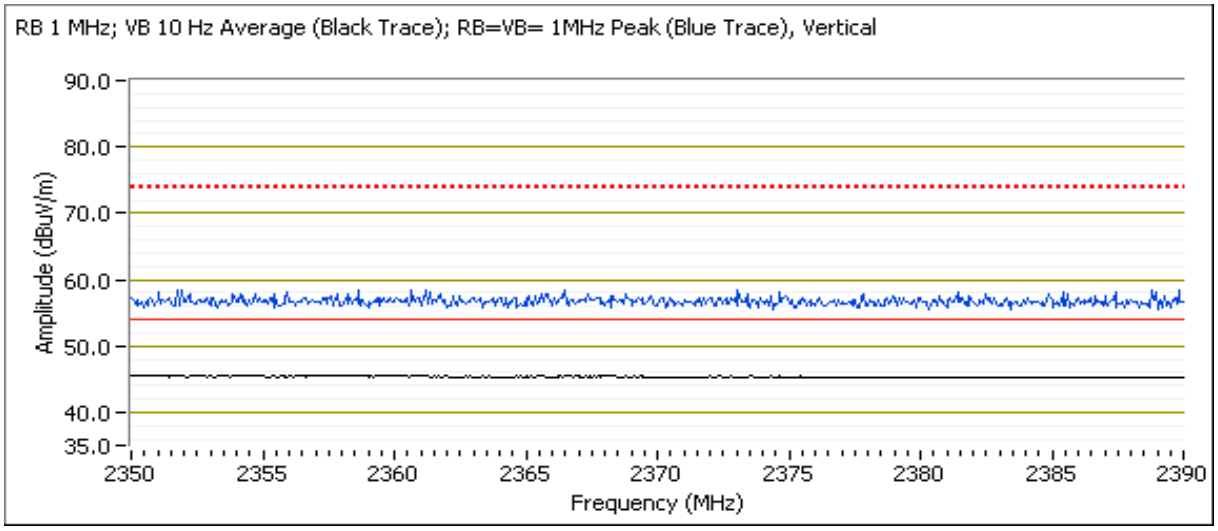
Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments	Orientation
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters		
2405.160	75.2	V	-	-	AVG	271	1.1	RB 1 MHz;VB 10 Hz;Pk	Upright
2405.760	77.6	V	-	-	PK	271	1.1	RB 1 MHz;VB 3 MHz;Pk	Upright
2405.130	76.3	H	-	-	AVG	270	1.5	RB 1 MHz;VB 10 Hz;Pk	Upright
2404.760	78.7	H	-	-	PK	270	1.5	RB 1 MHz;VB 3 MHz;Pk	Upright
2405.140	81.7	V	-	-	AVG	269	1.3	RB 1 MHz;VB 10 Hz;Pk	Side
2404.780	83.8	V	-	-	PK	269	1.3	RB 1 MHz;VB 3 MHz;Pk	Side
2405.430	80.0	V	-	-	PK	269	1.3	RB 100 kHz;VB 100 kHz	Side
2405.150	76.2	H	-	-	AVG	98	1.5	RB 1 MHz;VB 10 Hz;Pk	Side
2405.720	78.6	H	-	-	PK	98	1.5	RB 1 MHz;VB 3 MHz;Pk	Side
2405.190	74.1	V	-	-	AVG	161	1.6	RB 1 MHz;VB 10 Hz;Pk	Flat
2405.710	76.6	V	-	-	PK	161	1.6	RB 1 MHz;VB 3 MHz;Pk	Flat
2405.170	72.5	H	-	-	AVG	0	1.2	RB 1 MHz;VB 10 Hz;Pk	Flat
2404.750	75.2	H	-	-	PK	0	1.2	RB 1 MHz;VB 3 MHz;Pk	Flat

Fundamental emission level @ 3m in 100kHz RBW:	80.0 dBµV/m	
Limit for emissions outside of restricted bands:	50.0 dBµV/m	Limit is -30dBc (UNII power measurement)

Band Edge Signal Field Strength - Direct measurement of field strength

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments	Orientation
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters		
2387.490	47.0	V	54.0	-7.0	AVG	236	1.5	RB 1 MHz;VB 10 Hz;Pk	Side
2387.760	58.6	V	74.0	-15.4	PK	236	1.5	RB 1 MHz;VB 3 MHz;Pk	Side
2387.120	46.9	H	54.0	-7.1	AVG	214	1.6	RB 1 MHz;VB 10 Hz;Pk	Side
2389.640	59.1	H	74.0	-14.9	PK	214	1.6	RB 1 MHz;VB 3 MHz;Pk	Side

Client:	Memtec Corporation	Job Number:	J79780
Model:	M950-12LR-HHC	T-Log Number:	T80090
		Account Manager:	Sheareen Washington
Contact:	Dennis Garboski		
Standard:	FCC 15.247	Class:	N/A



Client:	Memtec Corporation	Job Number:	J79780
Model:	M950-12LR-HHC	T-Log Number:	T80090
		Account Manager:	Sheareen Washington
Contact:	Dennis Garboski		
Standard:	FCC 15.247	Class:	N/A

Run #1b: High Channel @ 2480 MHz

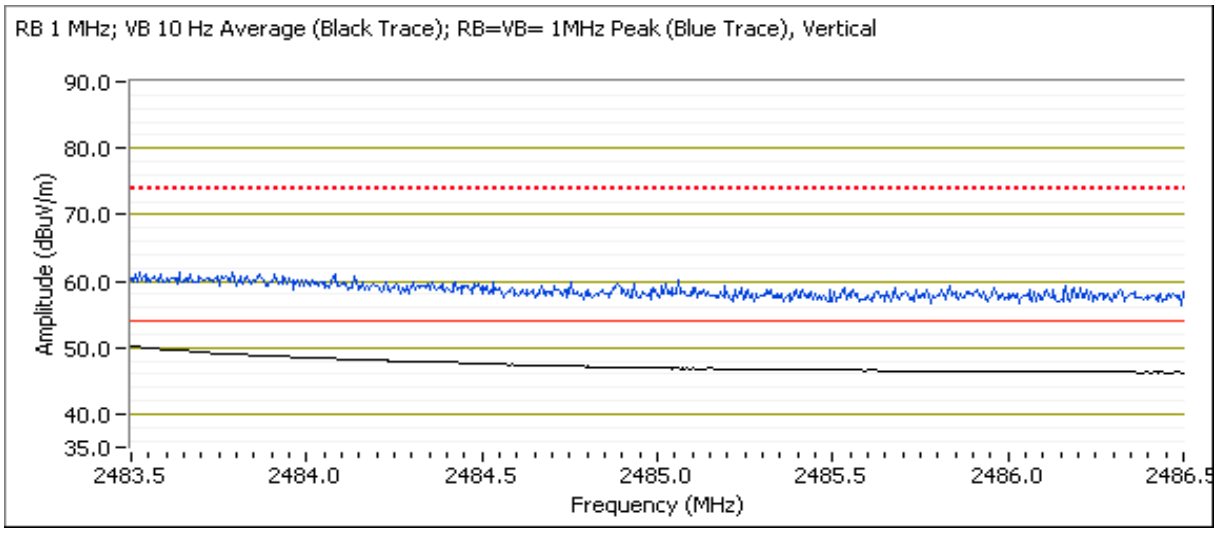
Fundamental Signal Field Strength: Peak and average values measured in 1 MHz, and peak value measured in 100kHz

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments	Orientation
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters		
2480.210	83.3	V	-	-	AVG	263	1.0	RB 1 MHz;VB 10 Hz;Pk	Side
2480.750	85.6	V	-	-	PK	263	1.0	RB 1 MHz;VB 3 MHz;Pk	Side
2479.930	81.2	V	-	-	PK	263	1.0	RB 100 kHz;VB 100 kHz	Side
2480.090	77.1	H	-	-	AVG	250	1.1	RB 1 MHz;VB 10 Hz;Pk	Side
2480.680	79.8	H	-	-	PK	250	1.1	RB 1 MHz;VB 3 MHz;Pk	Side

Fundamental emission level @ 3m in **100kHz RBW**:	81.2 dBµV/m	
Limit for emissions outside of restricted bands:	51.2 dBµV/m	Limit is -30dBc (UNII power measurement)

Band Edge Signal Field Strength - Direct measurement of field strength

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments	Orientation
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters		
2483.500	51.6	V	54.0	-2.4	AVG	275	1.0	RB 1 MHz;VB 10 Hz;Pk	Side
2483.550	61.4	V	74.0	-12.6	PK	275	1.0	RB 1 MHz;VB 3 MHz;Pk	Side
2483.500	49.2	H	54.0	-4.8	AVG	250	1.0	RB 1 MHz;VB 10 Hz;Pk	Side
2484.230	60.0	H	74.0	-14.0	PK	250	1.0	RB 1 MHz;VB 3 MHz;Pk	Side



Client:	Memtec Corporation	Job Number:	J79780
Model:	M950-12LR-HHC	T-Log Number:	T80090
		Account Manager:	Sheareen Washington
Contact:	Dennis Garboski		
Standard:	FCC 15.247	Class:	N/A

RSS 210 and FCC 15.247 (DTS) Radiated Spurious Emissions

Test Specific Details

Objective: The objective of this test session is to perform final qualification testing of the EUT with respect to the specification listed above.

General Test Configuration

The EUT and all local support equipment were located on the turntable for radiated spurious emissions testing. All remote support equipment was located approximately 30 meters from the EUT with all I/O connections running on top of the groundplane or routed in overhead in the GR-1089 test configuration.

For radiated emissions testing the measurement antenna was located 3 meters from the EUT.

Ambient Conditions:

Temperature: 23 °C
Rel. Humidity: 45 %

Summary of Results - Device Operating in the 2400-2483.5 MHz Band

Run #	Mode	Channel	Power Setting	Measured Power	Test Performed	Limit	Result / Margin
1a	-	low	3dB	-	Radiated Emissions, 1 - 26 GHz	FCC Part 15.209 / 15.247(c)	53.2dBµV/m @ 4809.4MHz (-0.8dB)
1b	-	center	3dB	-	Radiated Emissions, 1 - 26 GHz	FCC Part 15.209 / 15.247(c)	48.9dBµV/m @ 4879.5MHz (-5.1dB)
1c	-	high	3dB	-	Radiated Emissions, 1 - 26 GHz	FCC Part 15.209 / 15.247(c)	50.1dBµV/m @ 4959.3MHz (-3.9dB)

Modifications Made During Testing

No modifications were made to the EUT during testing

Deviations From The Standard

No deviations were made from the requirements of the standard.

Modifications made by Memtec prior to testing

1) Changed L401 from 6.2nh inductor to 3.3nh inductor
2) Removed discrete component harmonic filter (3 components) and replaced it with a Chebyshev Harmonic Filter (one component)

Client:	Memtec Corporation	Job Number:	J79780
Model:	M950-12LR-HHC	T-Log Number:	T80090
		Account Manager:	Sheareen Washington
Contact:	Dennis Garboski		
Standard:	FCC 15.247	Class:	N/A

Run #1: Radiated Spurious Emissions, 1000 - 18000 MHz.

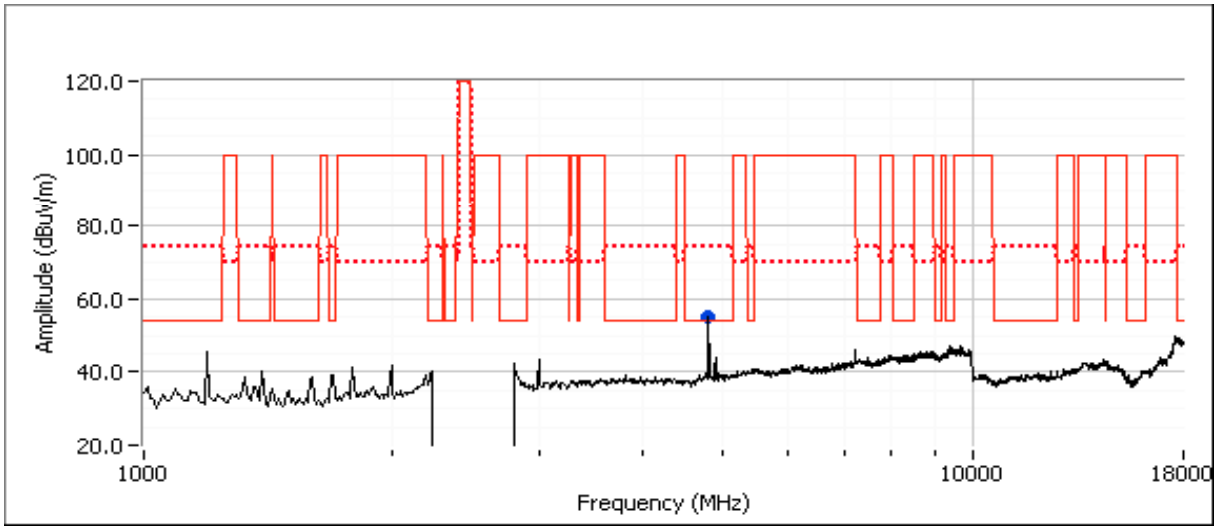
Date of Test: 8/19/2010 Test Location: Chamber #5

Test Engineer: Peter Sales

Run #1a: Low Channel @ 2404.8 MHz

Other Spurious Emissions

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
4809.390	**53.2**	V	54.0	**-0.8**	AVG	316	1.5	Upright
4811.310	48.8	H	54.0	-5.2	AVG	236	1.3	Upright
4809.290	59.4	V	74.0	-14.6	PK	316	1.5	Upright
4811.240	55.8	H	74.0	-18.2	PK	236	1.3	Upright



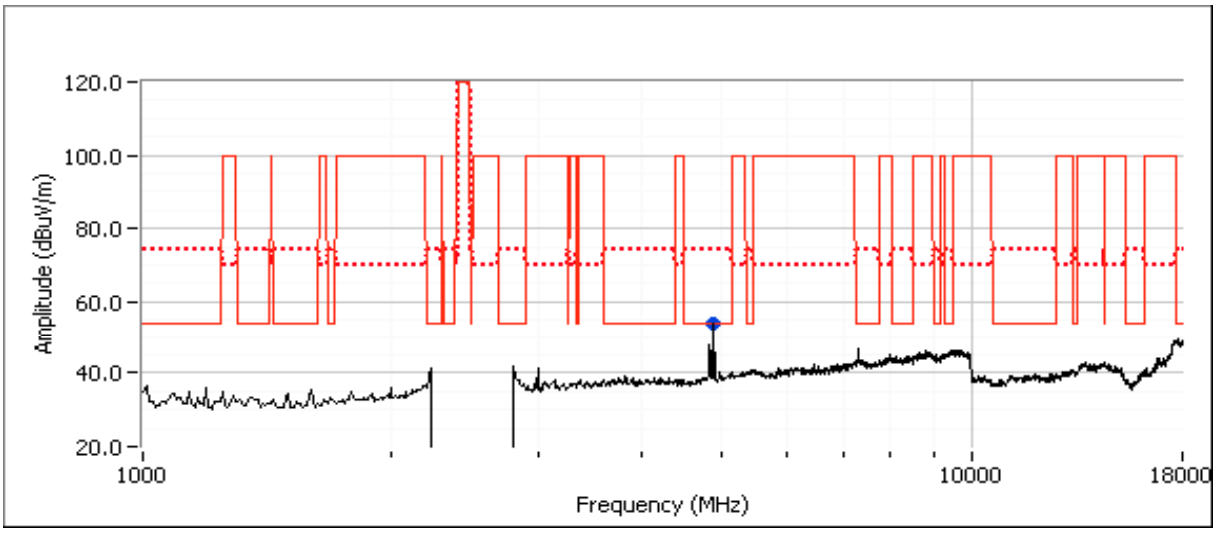
Note 1:	Preliminary testing showed that the worst case emissions from the device were observed with the device placed in an upright position. So final tests were performed with the unit upright.

Client:	Memtec Corporation	Job Number:	J79780
Model:	M950-12LR-HHC	T-Log Number:	T80090
		Account Manager:	Sheareen Washington
Contact:	Dennis Garboski		
Standard:	FCC 15.247	Class:	N/A

Run #1b: Center Channel @ 2440 MHz

Other Spurious Emissions

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
4879.490	**48.9**	V	54.0	**-5.1**	AVG	218	1.3	Upright
4879.400	43.2	H	54.0	-10.8	AVG	218	1.0	Upright
4879.290	55.8	V	74.0	-18.2	PK	218	1.3	Upright
4879.280	51.2	H	74.0	-22.8	PK	218	1.0	Upright



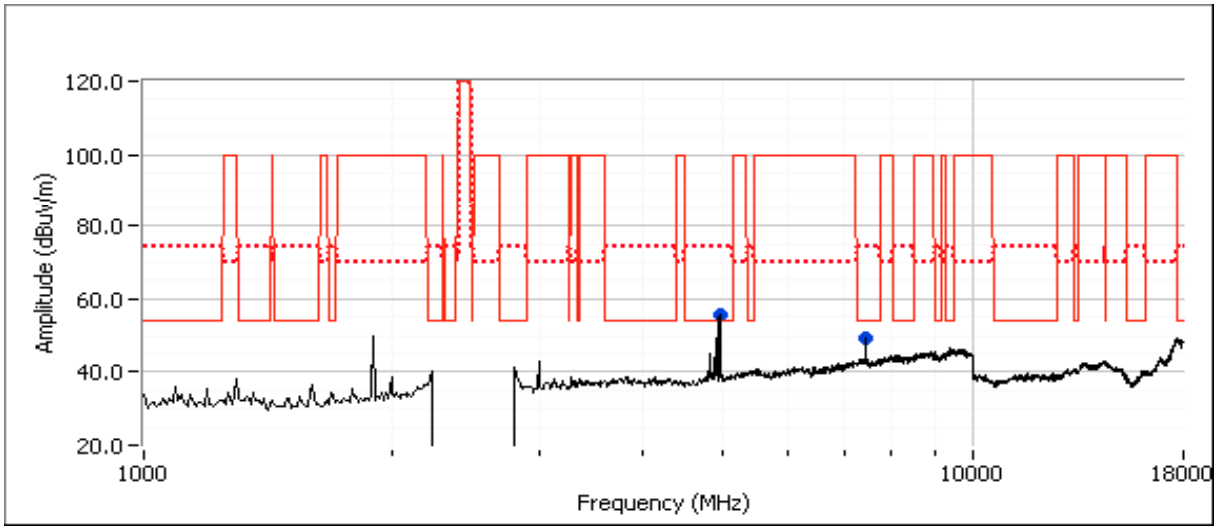
Note 1:	Preliminary testing showed that the worst case emissions from the device were observed with the device placed in an upright position. So final tests were performed with the unit upright.

Client:	Memtec Corporation	Job Number:	J79780
Model:	M950-12LR-HHC	T-Log Number:	T80090
		Account Manager:	Sheareen Washington
Contact:	Dennis Garboski		
Standard:	FCC 15.247	Class:	N/A

Run #1c: High Channel @ 2480 MHz

Other Spurious Emissions

Frequency	Level	Pol	15.209 / 15.247		Detector	Azimuth	Height	Comments
MHz	dBµV/m	v/h	Limit	Margin	Pk/QP/Avg	degrees	meters	
4959.250	**50.1**	H	54.0	**-3.9**	AVG	102	1.6	RB 1 MHz;VB 10 Hz;Pk, Upright
4959.420	47.6	V	54.0	-6.4	AVG	317	1.6	RB 1 MHz;VB 10 Hz;Pk, Upright
7447.340	38.5	V	54.0	-15.5	AVG	70	1.0	RB 1 MHz;VB 10 Hz;Pk, Upright
7447.910	38.3	H	54.0	-15.7	AVG	121	1.6	RB 1 MHz;VB 10 Hz;Pk, Upright
4959.480	56.5	H	74.0	-17.5	PK	102	1.6	RB 1 MHz;VB 3 MHz;Pk, Upright
4959.380	54.8	V	74.0	-19.2	PK	317	1.6	RB 1 MHz;VB 3 MHz;Pk, Upright
7448.210	50.6	H	74.0	-23.4	PK	121	1.6	RB 1 MHz;VB 3 MHz;Pk, Upright
7448.830	50.4	V	74.0	-23.6	PK	70	1.0	RB 1 MHz;VB 3 MHz;Pk, Upright



Note 1:	Preliminary testing showed that the worst case emissions from the device were observed with the device placed in an upright position. So final tests were performed with the unit upright.