Electromagnetic Compatibility Test Report

Tests Performed on an ACLARA Power-Line Systems

HAN Module Transciever, Model Y70084-1

Radiometrics Document RP-6558

ACCREDITED
Certification # 1495.01

Product Detail:
FCC ID: PN3Y70084
IC: 7100A-Y70084
Equipment type: 2.4 GHz DTS Transmitter

Test Standards:
US CFR Title 47, Chapter I, FCC Part 15 Subpart C
FCC Part 15 CFR Title 47: 2007
Industry Canada RSS-210, Issue 7: 2007 as required for Category I Equipment

This report concerns: Original Grant for Certification
FCC Part 15.247

Tests Performed For:	*Test Facility:*
ACLARA Power-Line Systems 945 Hornet Drive Hazelwood, Mo 63042-2338	**Radiometrics Midwest Corporation** 12 East Devonwood Romeoville, IL 60446

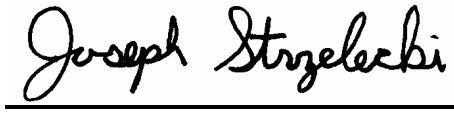
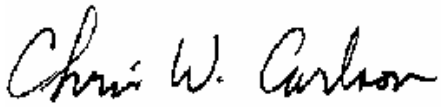
Test Date(s): (Month-Day-Year)
April 24 thru May 11, 2009

Document RP-6558 Revisions:

Rev.	Issue Date	Affected Pages	Revised By
0	June 30, 2009		
1	July 23, 2009	All	Joseph Strzelecki

Table of Contents

1 ADMINISTRATIVE DATA

Equipment Under Test: An ACLARA Power-Line Systems, HAN Module Model: Y70084-1 Serial Number: None This will be referred to as the EUT in this Report	
Date EUT Received at Radiometrics: (Month-Day-Year) April 24, 2009	*Test Date(s): (Month-Day-Year)* April 24 thru May 11, 2009
Test Report Written By: Joseph Strzelecki Senior EMC Engineer	*Test Witnessed By:* The tests were not witnessed by ACLARA Power-Line Systems
Radiometrics' Personnel Responsible for Test:  Joseph Strzelecki Senior EMC Engineer NARTE EMC-000877-NE	*Test Report Approved By*  Chris W. Carlson Director of Engineering NARTE EMC-000921-NE

2 TEST SUMMARY AND RESULTS

The EUT (Equipment Under Test) is a HAN Module, Model Y70084-1, manufactured by ACLARA Power-Line Systems. The detailed test results are presented in a separate section. The following is a summary of the test results.

Emissions Tests Results

Environmental Phenomena	Frequency Range	Basic Standard	Test Result
RF Radiated Emissions	30-25,000 MHz	RSS-210 & FCC Part 15	Pass
Conducted Emissions AC Mains	0.15 - 30 MHz	RSS-210 & FCC Part 15	Note 1

Spread Spectrum Transmitter Requirements

Environmental Phenomena	Frequency Range	FCC Section	RSS-210 Section	Test Result
Time of Occupancy (Dwell Time)	2400 to 2483 MHz	15.247 a	A8.1 (2)	Pass
6 dB Bandwidth Test;	2400 to 2483 MHz	15.247 a	A8.1 (4)	Pass
20 dB Bandwidth Test;	2400 to 2483 MHz	15.247 a	A8.1 (4)	Pass
Peak Output Power	2400 to 2483 MHz	15.247 b	A8.1 (1)	Pass
Band-edge Compliance of RF Conducted Emissions	2400 to 2483 MHz	15.247 d	A8.4 (2)	Pass
Spurious RF Conducted Emissions	30 MHz to 25 GHz	15.247 d	A8.5	Pass
Spurious Radiated Emissions	30 MHz to 25 GHz	15.247 d	A8.5	Pass
Power Spectral Density	2400 to 2483 MHz	15.247 e	A8.2 (1)	Pass

2.1 RF Exposure Compliance Requirements

The EUT meets the FCC requirement for RF exposure. Since the EUT is less than 20 mW, it is exempt from RSS-102. There are no user accessible power level adjustments and the antenna is permanently attached. The detailed calculations for RF Exposure are presented in a separate document.

3 EQUIPMENT UNDER TEST (EUT) DETAILS

3.1 EUT Description

This EUT is an Aclara Power-Line Systems, ZigBee Home Area Network (HAN). The product name is a Focus AX meter containing HAN module Y70084-1. The EUT was in good working condition during the tests, with no known defects.

3.1.1 FCC Section 15.203 & RSS-GEN Antenna Requirements

The antenna is a planar inverted 'F' structure etched on the PCB. The antenna is internal to the EUT and it is not readily available to be modified by the end user. Therefore, it meets the 15.203 Requirement.

3.2 Related Submittals

ACLARA Power-Line Systems is not submitting any other products simultaneously for equipment authorization related to the EUT.

4 TESTED SYSTEM DETAILS

4.1 Tested System Configuration

The system was configured for testing in a typical fashion. The EUT was placed on an 80-cm high, nonconductive test stand. The testing was performed in conditions as close as possible to installed conditions. Wiring was consistent with manufacturer's recommendations.

Since the EUT is wall mounted, it was placed in an upright configuration during the tests. The EUT was tested as a stand-alone device. Power was supplied at 240 VAC, 60 Hz single-phase. The identification for all equipment, plus descriptions of all cables used in the tested system, are:

Tested System Configuration List

Item	Description	Type*	Manufacturer	Model Number	Serial Number
1	HAN Module	E	ACLARA Power-Line Systems	Y70084-1	None
2	Electricity Meter	H	Landis + Gyr	Focus AXR-SD	101 312 199
3	Notebook PC	S	Dell	Latitude D600	CN0G5152-48643-48D-0155
4	Notebook PC Power Supply (Latitude)	S	Dell	NADP-90KB A	TH-0C2894-17971-37J-0BU5

* Type: E = EUT, P = Peripheral, S = Support Equipment; H = Host Computer

List of System Cables

QTY	Length (m)	Cable Description	Connected to (Item #)	Shielded?
1	1.0	3 wire AC input Cable for Electricity meter	#1	No
1	1.0	2-wire AC Output Unterminated Cable	#1	No

4.2 Special Accessories

No special accessories were used during the tests in order to achieve compliance.

4.3 Equipment Modifications

No modifications were made to the EUT at Radiometrics' test facility in order to comply with the standards listed in this report.

5 TEST SPECIFICATIONS AND RELATED DOCUMENTS

Document	Date	Title
FCC CFR Title 47	2007	Code of Federal Regulations Title 47, Chapter 1, Federal Communications Commission, Part 15 - Radio Frequency Devices
ANSI C63.4-2003	2003	Methods of Measurement of Radio Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
IC RSS-210 Issue 7	2007	Low Power Licence-Exempt Radiocommunication Devices (All Frequency Bands) Category I Equipment
IC RSS-Gen Issue 2	2007	General Requirements and Information for the Certification of Radiocommunication Equipment (RSS-Gen)
FCC 558074	2005	Measurement of Digital Transmission Systems Operating under Section 15.247

The test procedures used are in accordance with the FCC 558074, Industry Canada RSS-212 and ANSI document 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". The specific procedures are described herein. Radiated testing was performed at an antenna to EUT distance of 3 meters. The antenna was raised and lowered from 1 to 4 meters.

6 RADIOMETRICS' TEST FACILITIES

The results of these tests were obtained at Radiometrics Midwest Corp. in Romeoville, Illinois, USA. Radiometrics is accredited by A2LA (American Association for Laboratory Accreditation) to conform to ISO/IEC 17025: 2005 "General Requirements for the Competence of Calibration and Testing Laboratories". Radiometrics' Lab Code is 121191 and Certification Number is 1495.01. Radiometrics' scope of accreditation includes all of the test methods listed herein. A copy of the accreditation can be accessed on our web site (www.radiomet.com). Radiometrics accreditation status can be verified at A2LA's web site (www.a2la2.org).

The following is a list of shielded enclosures located in Romeoville, Illinois used during the tests:

Chamber A: Is an anechoic chamber that measures 24' L X 12' W X 12' H. The walls and ceiling are fully lined with ferrite absorber tiles. The floor has a 10' x 10' section of ferrite absorber tiles located in the center. Panashield of Rowayton, Connecticut manufactured the chamber. The enclosure is NAMAS certified.

Chamber E: Is a custom made anechoic chamber that measures 52' L X 30' W X 18' H. The walls and ceiling are fully lined with RF absorber. Pro-shield of Collinsville, Oklahoma manufactured the chamber.

Test Station F: Is an area that measures 10' D X 12' W X 10' H. The floor and back wall are metal shielded. This area is used for conducted emissions measurements.

A separate ten-foot long, brass plated, steel ground rod attached via a 6 inch copper braid grounds each of the above chambers. Each enclosure is also equipped with low-pass power line filters.

The FCC has accepted these sites as test site number US1065. The FCC test site Registration Number is 732175. Details of the site characteristics are on file with the Industry Canada as site number IC3124A-1.

A complete list of the test equipment is provided herein. The calibration due dates are indicated on the equipment list. The equipment is calibrated in accordance to ANSI/NCSL Z540-1 with traceability to the National Institute of Standards and Technology (NIST).

7 DEVIATIONS AND EXCLUSIONS FROM THE TEST SPECIFICATIONS

There were no deviations or exclusions from the test specifications.

8 CERTIFICATION

Radiometrics Midwest Corporation certifies that the data contained herein was taken under conditions that meet or exceed the requirements of the test specification. The results relate only to the EUT listed herein. Any modifications made to the EUT subsequent to the indicated test date will invalidate the data and void this certification.

9 TEST EQUIPMENT TABLE

RMC ID	Manufacturer	Description	Model No.	Serial No.	Frequency Range	Cal Period	Cal Date
AMP-05	RMC/Celeritek	Pre-amplifier	MW110G	1001	1.0-12GHz	12 Mo.	02/01/09
AMP-20	Avantek	Pre-amplifier	SF8-0652	15221	8-18GHz	12 Mo	02/01/09
AMP-22	Anritsu	Pre-amplifier	MH648A	M23969	0.1-1200MHz	12 Mo.	02/03/09
ANT-13	EMCO	Horn Antenna	3115	2502	1.0-18GHz	24 Mo.	10/22/08
ANT-44	Impossible Machine	Super Log Antenna	SL-20M2G	1002	20-2000MHz	24 Mo.	12/26/07
REC-01	Hewlett Packard	Spectrum Analyzer	8566A	2106A02115, 2209A01349	30Hz-22GHz	12 Mo.	10/23/08
REC-03	Anritsu	Spectrum Analyzer	MS2601B	MT94589	0.01-2200MHz	12 Mo.	03/09/09
REC-07	Anritsu	Spectrum Analyzer	MS2601A	MT53067	0.01-2200MHz	12 Mo.	03/09/09
THM-02	Fluke	Temp/Humid Meter	971	93490471	N/A	12 Mo.	02/23/09

Note: All calibrated equipment is subject to periodic checks.

10 TEST SECTIONS

10.1 AC Conducted Emissions

The tests and limits are in accordance with FCC section 15.207 and RSS Gen section 7.2.2.

A computer-controlled analyzer was used to perform the conducted emissions measurements. The frequency range was divided into 500 subranges equally spaced on a logarithmic scale. The computer recorded the peak of each subrange. This data was then plotted on semi-log graph paper generated by the computer and plotter. Adjusting the positions of the cables and orientation of the test system then maximizes the highest emissions.

Mains Conducted emission measurements were performed using a 50 Ohm/50 uH Line Impedance Stabilization Network (LISN) as the pick-up device. Measurements were repeated on both leads within the power cord. If the EUT power cord exceeded 80 cm in length, the excess length of the power cord was made into a 30 to 40 cm bundle near the center of the cord. The LISN was placed on the floor at the base of the test platform and electrically bonded to the ground plane.

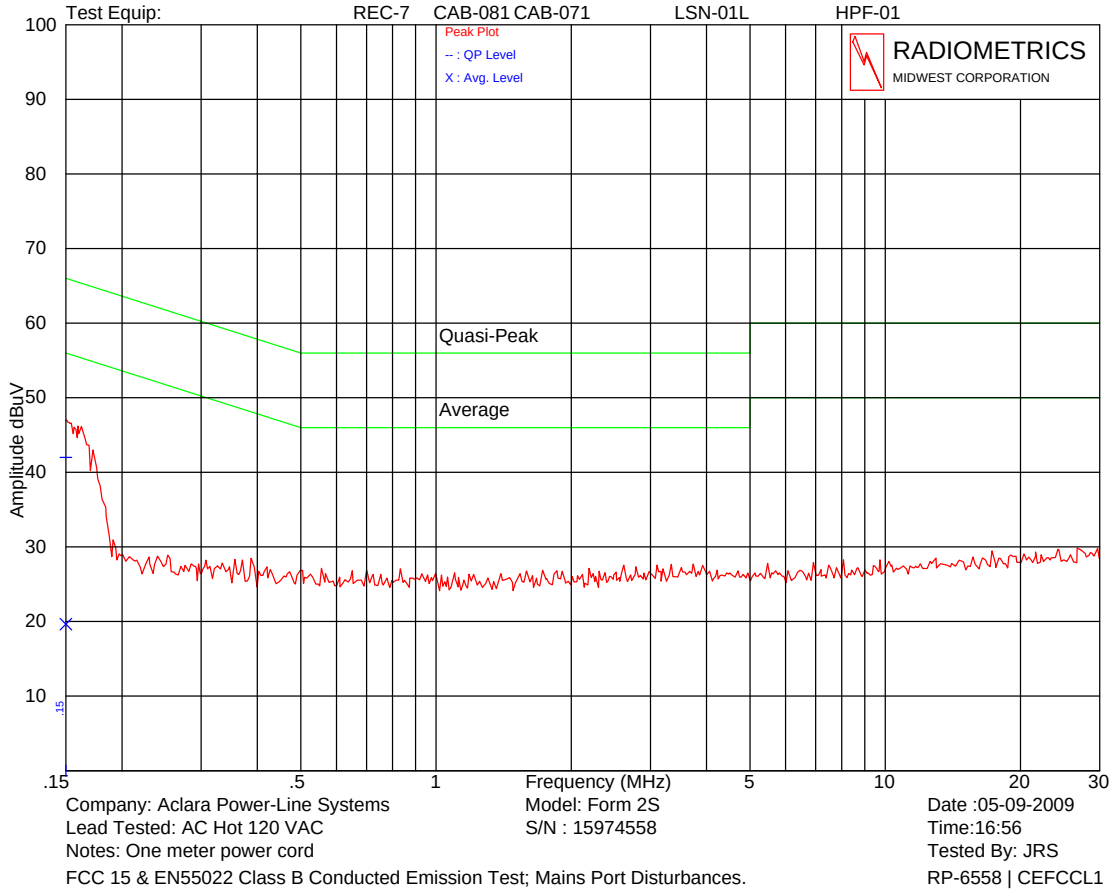
Broadband conducted emissions may exceed the following limits by no more than 13 dB. An emission is defined as broadband if the average detector amplitude is 6 dB or more under the quasi-peak detector amplitude.

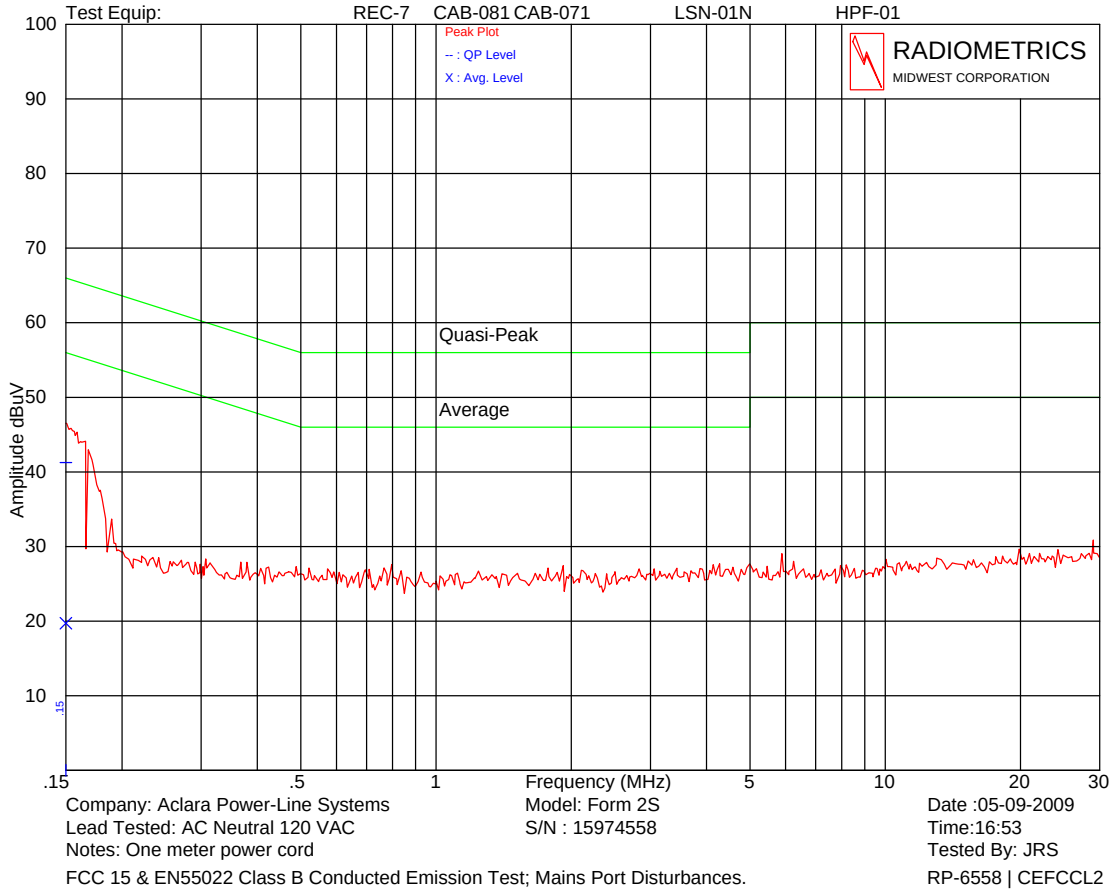
FCC Limits of Conducted Emissions at the AC Mains Ports

Frequency Range (MHz)	Class B Limits (dBuV)	
	Quasi-Peak	Average
0.150 - 0.50*	66 - 56	56 - 46
0.5 – 5.0	56	46
5.0 - 30	60	50
* The limit decreases linearly with the logarithm of the frequency in this range.		

The initial step in collecting conducted data is a peak detector scan and the plotting of the measurement range. Significant peaks are then marked as shown on the following table, and these signals are then measured with the quasi-peak detector. The following represents the worst case emissions from the Meter power cord, after testing all modes of operation.

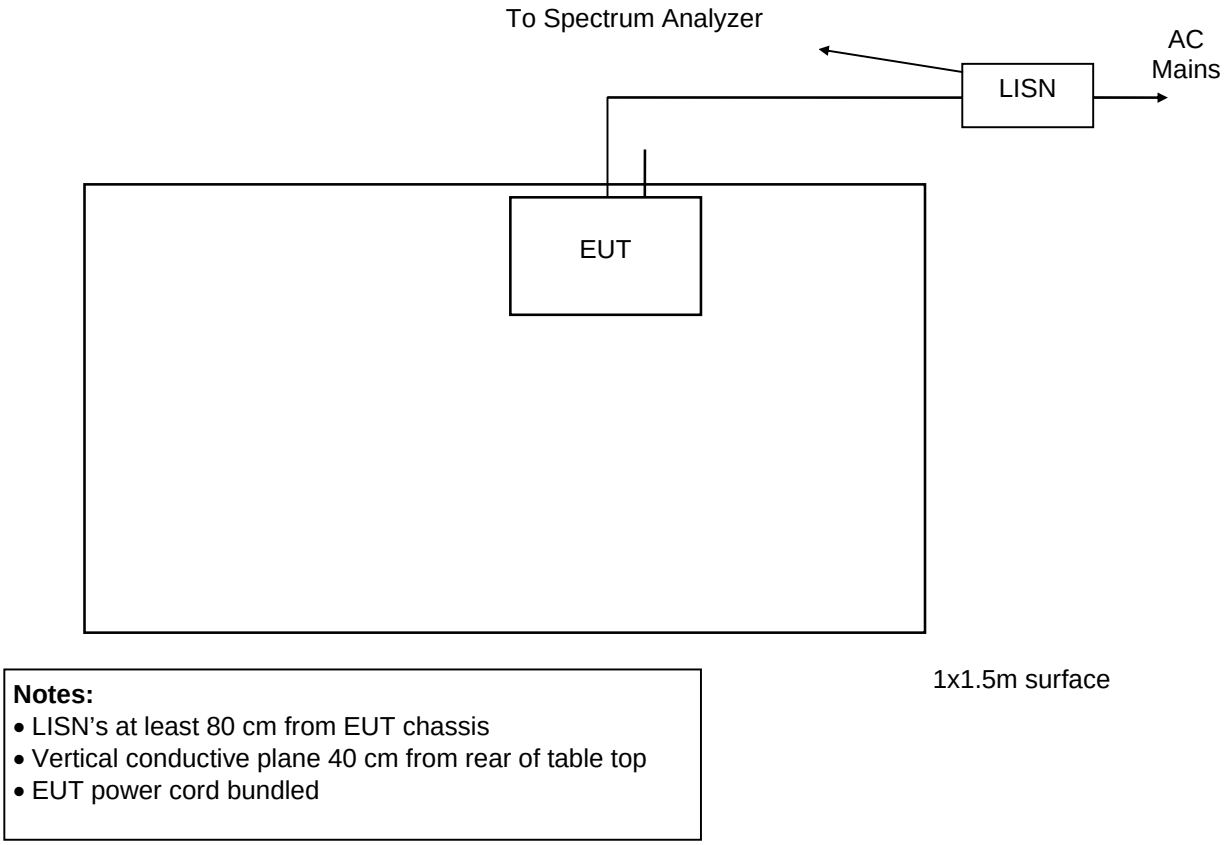
The Data in red is with the peak detector function. The dashed line in blue is the QP level and the "X" is the Average level.





Judgment: Passed by more than 10 dB

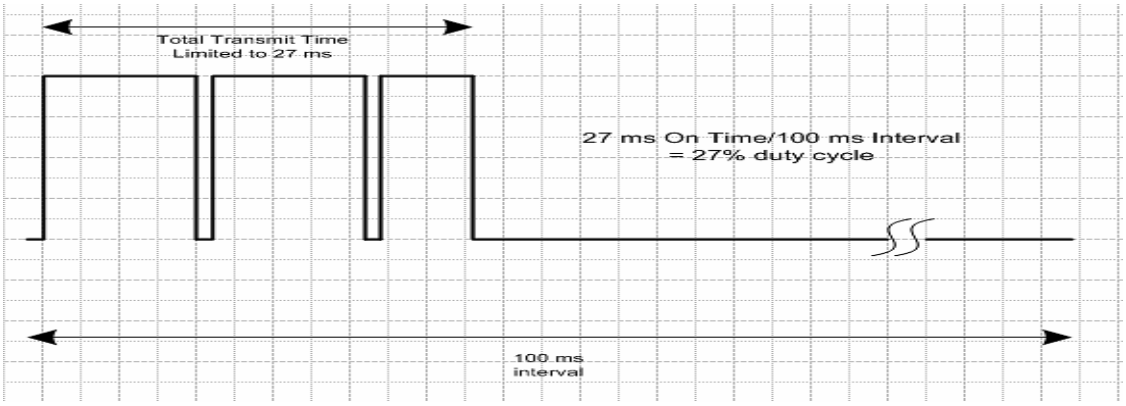
Figure 1. Conducted Emissions Test Setup



10.2 Time of Occupancy (Dwell Time)

The spectrum analyzer was set to the MAX HOLD mode to read peak emissions. The span was set to zero. The marker-delta function to determine the dwell time. The Peak to average factor is calculated by the highest duty cycle in percent over any 100mS transmission. The factor in dB is 20 * Log(Duty cycle/100).

The transmitter operates for a maximum duration of 27 ms in a 100 ms interval for a 27% maximum duty cycle, as shown below:



The the maximum total on time for any 100 mSec time period is 27 mSec. The peak to average factor is 20*Log(27/100) = -11.4 dB. This is Peak to average Correction factor

This factor is only used for Average measurements.

10.3 Occupied Bandwidth

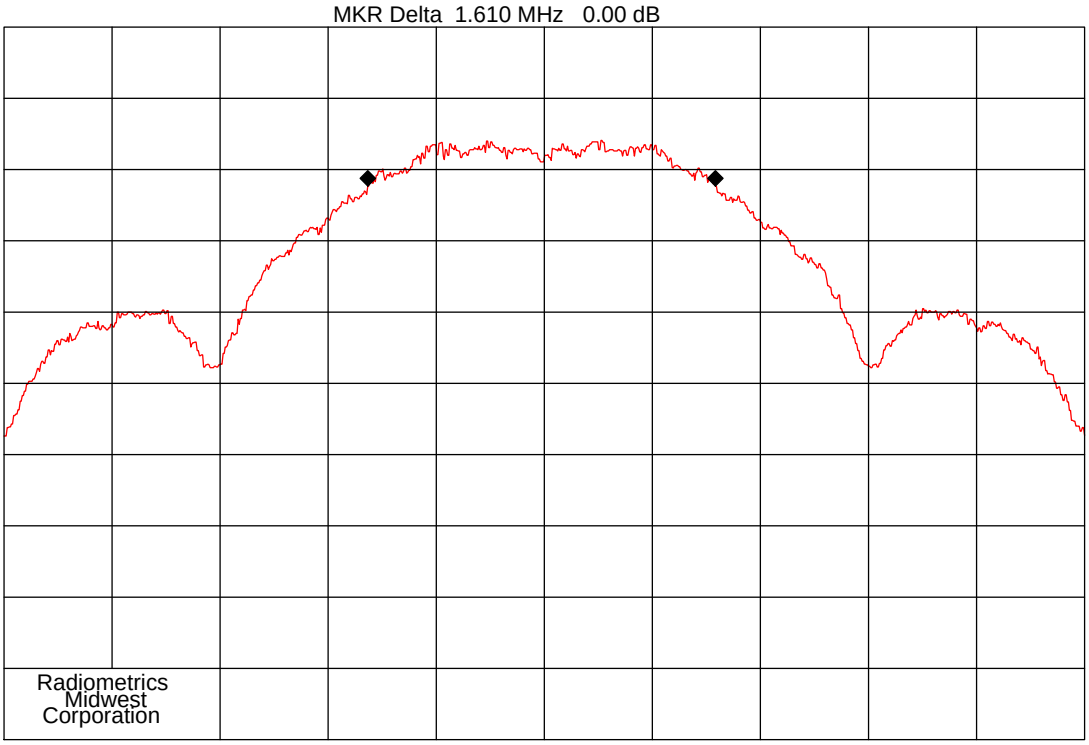
The spectrum analyzer was set to the MAX HOLD mode to record the worst case of the modulation. The EUT was transmitting at its maximum data rate. The trace was allowed to stabilize.

The marker-to-peak function was set to the peak of the emission. Then the marker-delta function was used to measure 20 dB down one side of the emission. The marker-delta function was reset and then moved to the other side of the emission, until it is (as close as possible to) even with the reference marker level. The marker-delta reading at this point is the 20 dB bandwidth of the emission.

Analyzer RBW	100 kHz RBW	30 kHz RBW
Channel	6 dB EBW MHz	20 dB EBW MHz
2405	1.61 MHz	2.60 MHz
2440	1.60 MHz	2.60 MHz
2480	1.61 MHz	2.56 MHz

The bandwidth must be at least 0.5 MHz

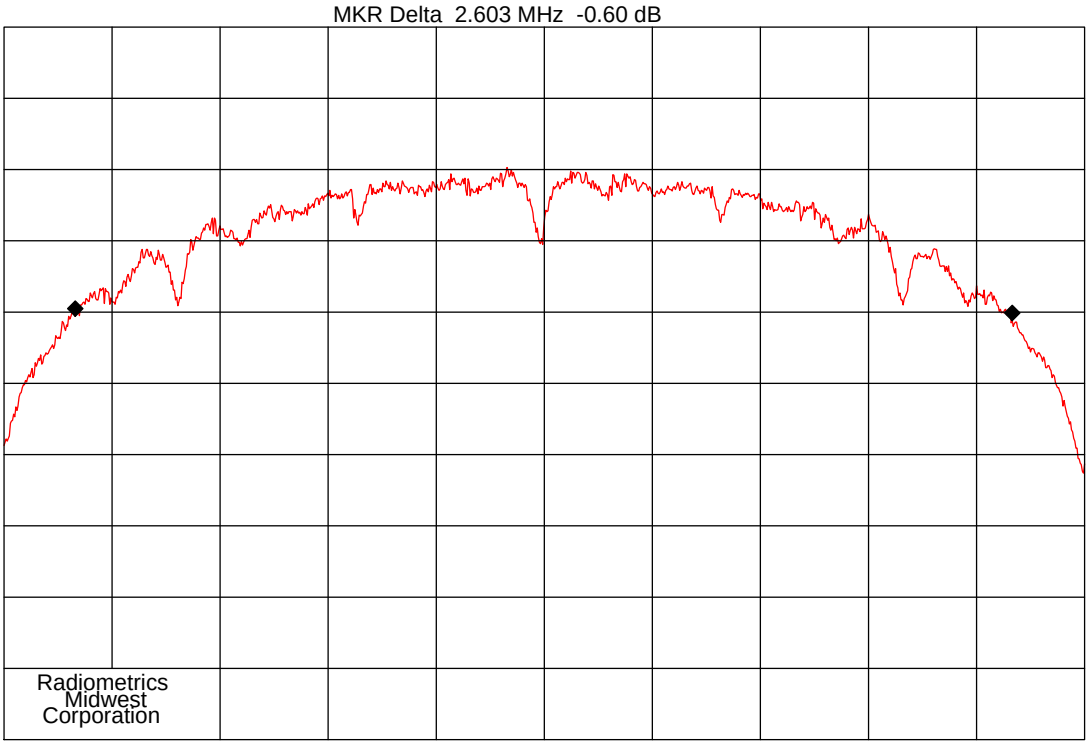
Judgement: Pass by 1.1 MHz



Company: Aclara
CENTER 2.405 00 GHz
RES BW 100 kHz
10 dB/
Notes: 6 dB Bandwidth, Low Channel

ITEM : HAN Tx
REF 107.0 dBuV
VBW 300 kHz
Time: 15:56

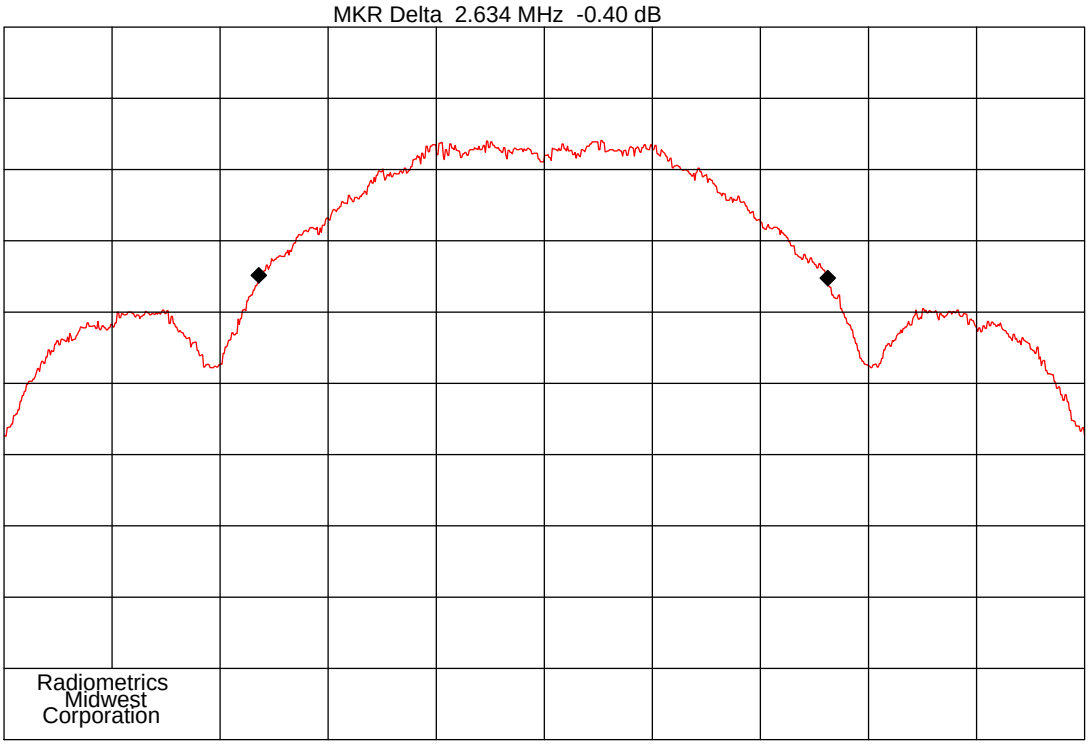
Date : 05-26-2009
SPAN 5.00 MHz
ATTEN 10 dB
SWP 20.0 msec



Company: Aclara
CENTER 2.405 00 GHz
RES BW 30 kHz
10 dB/
Notes: 20 dB Bandwidth, Low Channel

ITEM : HAN Tx
REF 107.0 dBuV
VBW 100 kHz
Time: 16:00

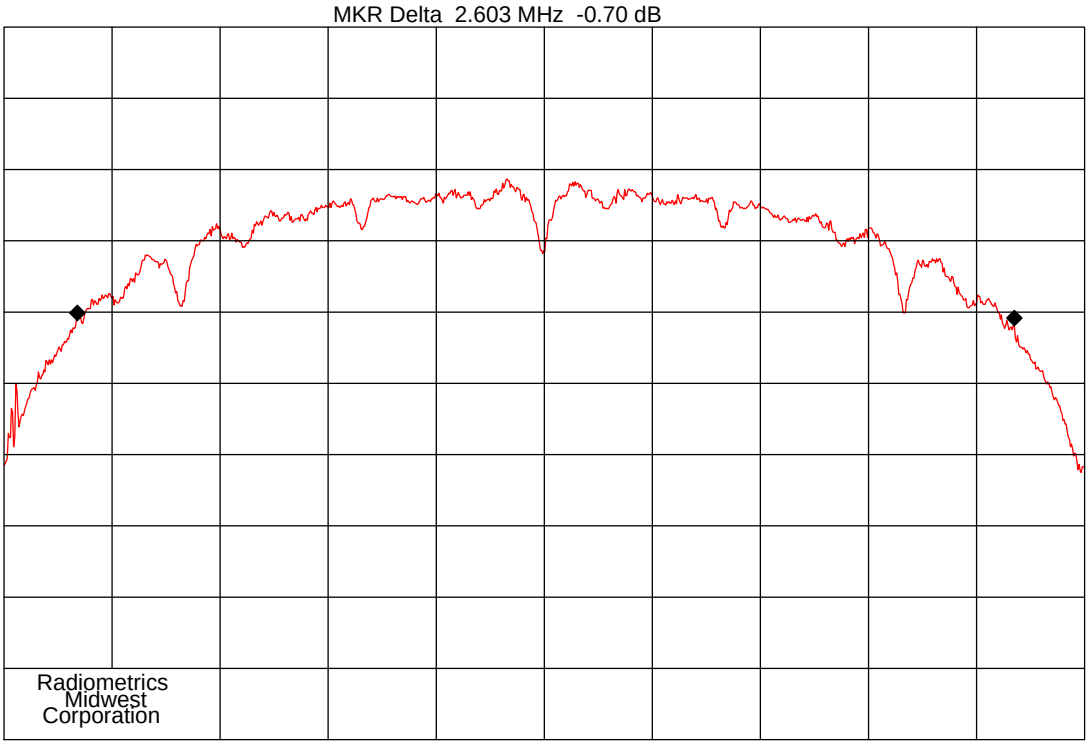
Date : 05-26-2009
SPAN 3.00 MHz
ATTEN 10 dB
SWP 20.0 msec



Company: Aclara
CENTER 2.405 00 GHz
RES BW 100 kHz
10 dB/
Notes: 20 dB Bandwidth, Low Channel

ITEM : HAN Tx
REF 107.0 dBuV
VBW 300 kHz
Time: 15:57

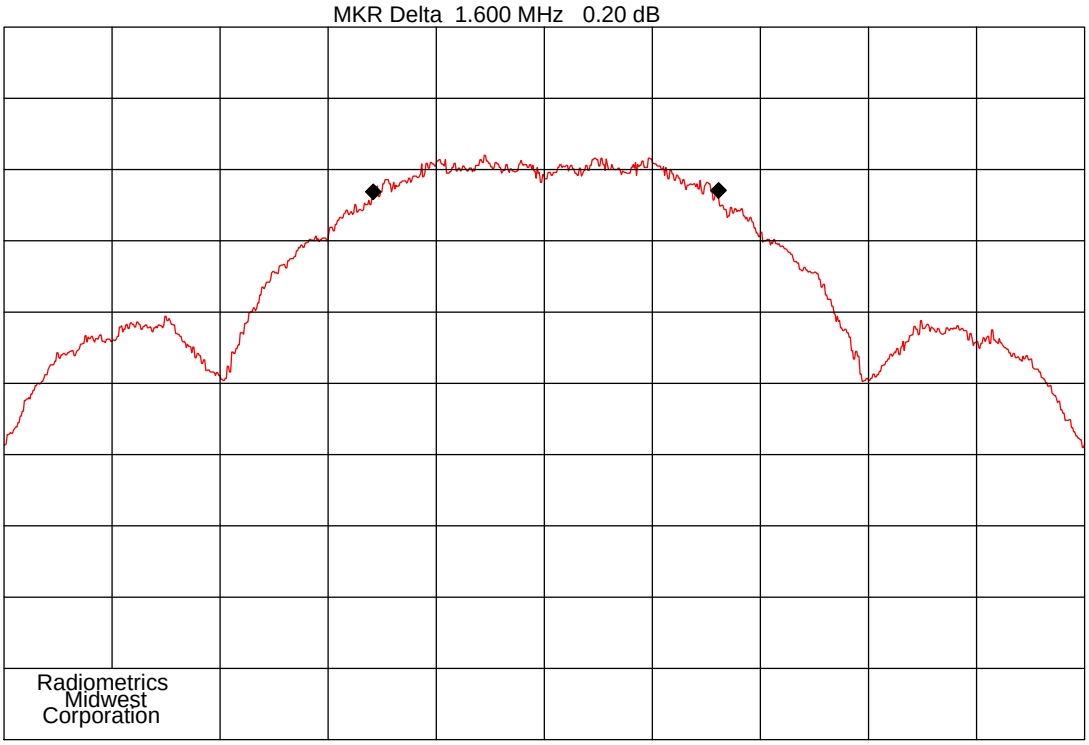
Date : 05-26-2009
SPAN 5.00 MHz
ATTEN 10 dB
SWP 20.0 msec



Company: Aclara
CENTER 2.440 00 GHz
RES BW 30 kHz
10 dB/
Notes: 20 dB Bandwidth, Mid Channel

ITEM : HAN Tx
REF 107.0 dBuV
VBW 100 kHz
Time: 16:03

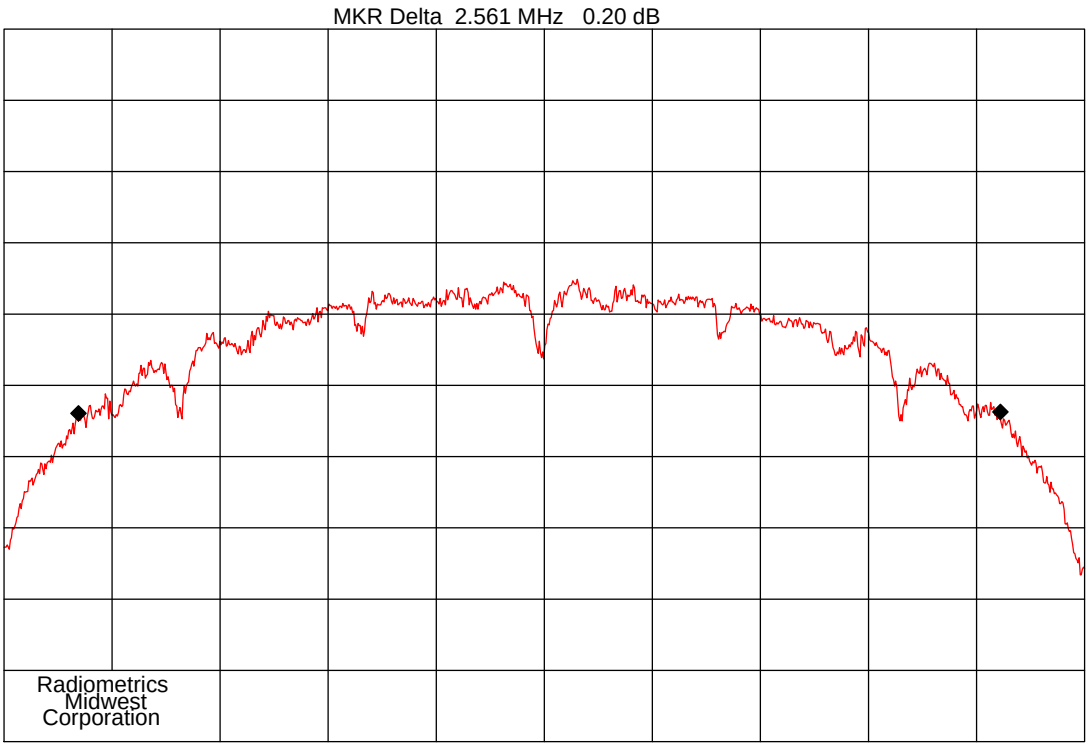
Date : 05-26-2009
SPAN 3.00 MHz
ATTEN 10 dB
SWP 20.0 msec



Company: Aclara
CENTER 2.440 00 GHz
RES BW 100 kHz
10 dB/
Notes: 6 dB Bandwidth, Mid Channel

ITEM : HAN Tx
REF 107.0 dBuV
VBW 300 kHz
Time: 16:05

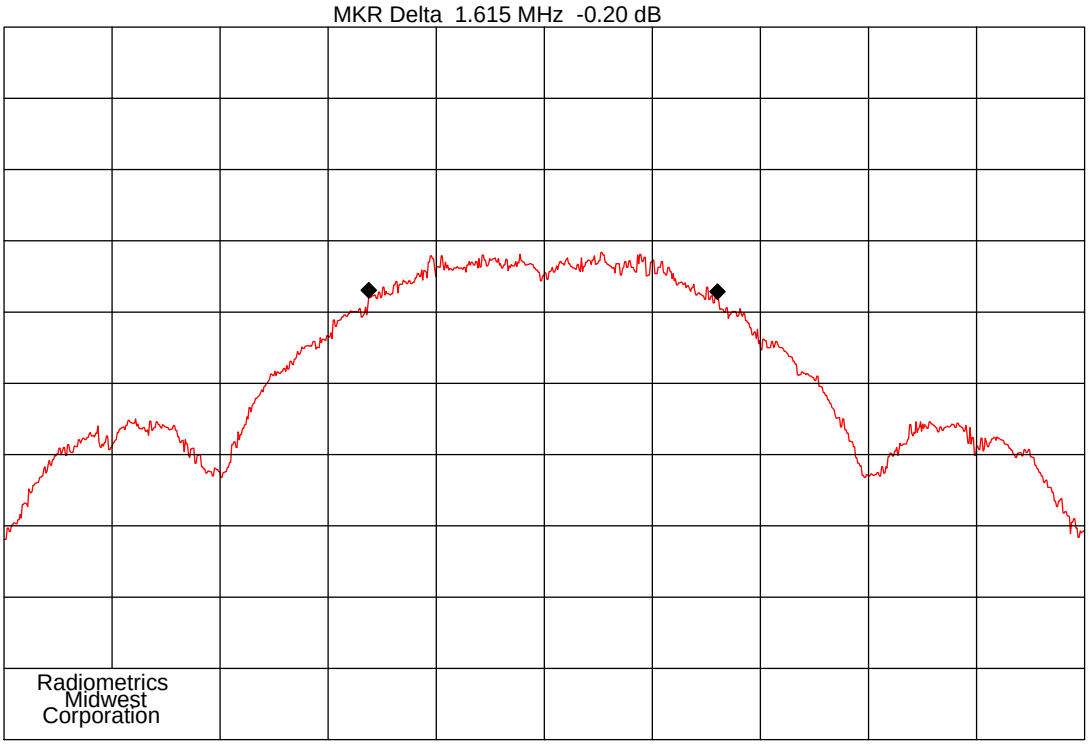
Date : 05-26-2009
SPAN 5.00 MHz
ATTEN 10 dB
SWP 20.0 msec



Company: Aclara
CENTER 2.480 00 GHz
RES BW 30 kHz
10 dB/
Notes: 20 dB Bandwidth, Upper Channel

ITEM : HAN Tx
REF 107.0 dBuV
VBW 100 kHz
Time: 16:18

Date : 05-26-2009
SPAN 3.00 MHz
ATTEN 10 dB
SWP 20.0 msec



10.4 Peak Output Power

Since antenna conducted tests cannot be performed on the EUT, radiated tests were performed to show compliance with this requirement. The FCC procedures from power output option 1 was used.

The transmitter's peak power was calculated using the following equation:

P = (E x d)^2 / (30 x G)

Where: E = the measured maximum peak field strength in V/m.
G = The numeric gain of the transmitting antenna over an isotropic radiator.
d = Distance in meters from which the field strength was measured. (3 meters)
P = The EUT power in watts

The field Strength was measured using the procedures described in section 10.9, with the exception of the resolution and video bandwidths. The spectrum analyzer was set to the following settings:

Span = 3 MHz ; RBW = 3 MHz (> the 20 dB bandwidth of the emission being measured)
VBW = 3 MHz; Sweep = auto; Detector function = peak; Trace = max hold

Since the gain of the antenna is always less than 6dB, the limit is not reduced.

Freq	Peak Field Strength		Ant gain	Test Distance	Output power from EUT		Limit
MHz	dBuV/m	V/m	Numeric	Meters	Watts	dBm	dBm
2405	117.1	0.716	1	3	0.154	21.9	30
2440	116.5	0.668	1	3	0.134	21.3	30
2475	116.2	0.645	1	3	0.125	21.0	30
2480	99.7	0.0966	1	3	0.00280	4.5	30

Overall Test result: Pass by 8.1 dB

Note that this test was performed on the Lowest, middle channel, the Highest channel and the second highest channel. The extra test was performed since the highest channel has a lower power than the rest of the channels.

10.5 Power Spectral Density

Since antenna conducted tests cannot be performed on the EUT, radiated tests were performed to show compliance with this requirement. The FCC procedures from PSD option 1 was used. The power spectral density was measured as follows.

The field strength was measured using the procedures described in section 10.9, with the following exceptions: The analyzer was tuned to the highest point of the maximized fundamental emission. Using this peak level, the transmitter's power spectral density was calculated using the following equation:

$P = (E \times d)^2 / (30 \times G)$

Where: E = the measured maximum peak field strength in V/m, using the bandwiths in this section.
G = The numeric gain of the transmitting antenna over an isotropic radiator.
d = Distance in meters from which the field strength was measured. (3 meters)
P = The EUT power in watts

Span = 500 kHz ; RBW = 3 kHz ; VBW = 10 kHz; Sweep = 167 Seconds
Detector function = Peak

Freq	3kHz PSD Field Strength		Ant gain	Test Distance	3 kHz Spectral Density from EUT		Limit
MHz	dBuV/m	V/m	Numeric	Meters	Watts	dBm	dBm
2405	100.2	0.10233	1	3	0.0031	5.0	8.0
2440	100.2	0.10233	1	3	0.0031	5.0	8.0
2475	99.9	0.09886	1	3	0.0029	4.7	8.0
2480	84.4	0.0166	1	3	0.0001	-10.8	8.0

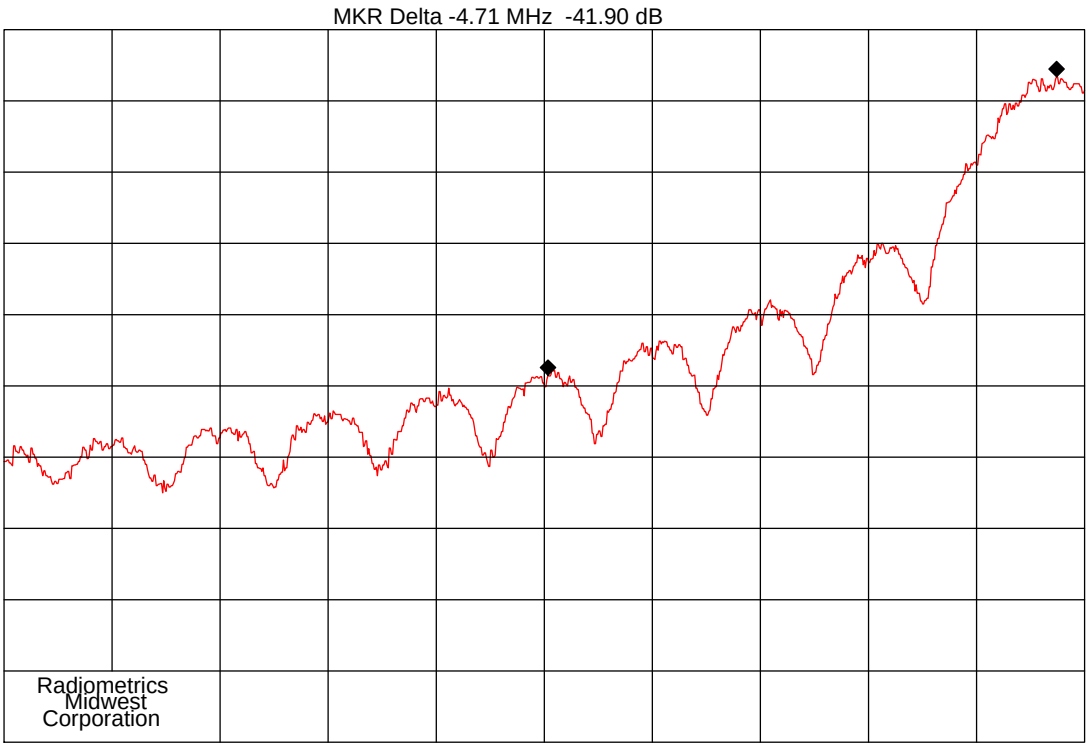
Overall Test result: Pass by 3.0 dB

Note that this test was performed on the Lowest, middle channel, the Highest channel and the second highest channel. The extra test was performed since the highest channel has a lower power than the rest of the channels.

10.6 Band-edge Compliance of RF Conducted Emissions

The spectrum analyzer was set to the MAX HOLD mode to record the worst case of the modulation at the band-edge, with the EUT set to the lowest frequency. The trace was allowed to stabilize.

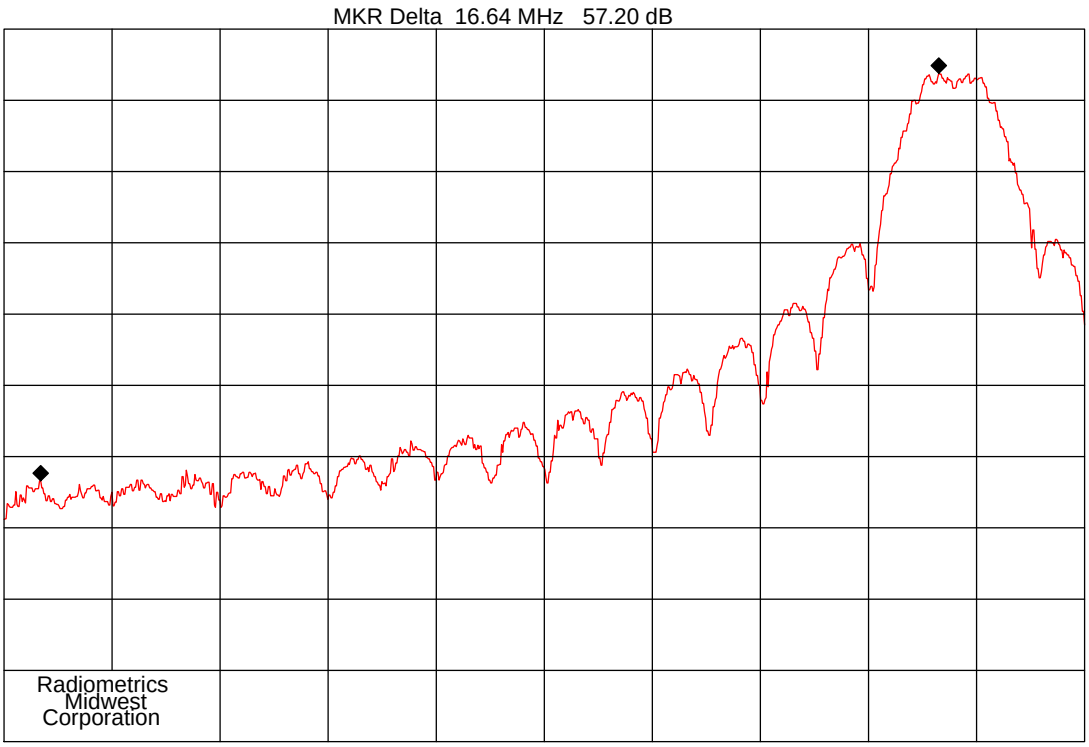
Note that the Band edge was performed on the Lowest channel, the Highest channel and the second highest channel. The extra test was performed since the highest channel has a lower power than the rest of the channels.



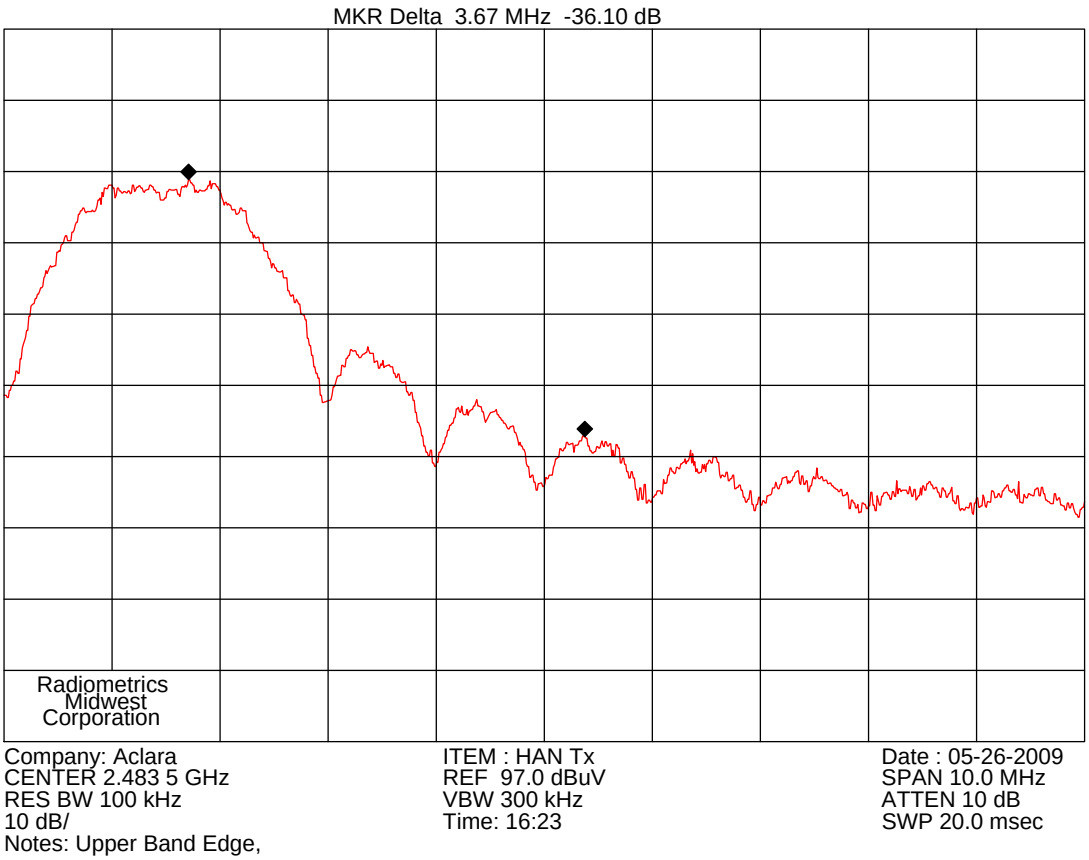
Company: Aclara
CENTER 2.400 0 GHz
RES BW 100 kHz
10 dB/
Notes: Lower Band Edge,

ITEM : HAN Tx
REF 97.0 dBuV
VBW 300 kHz
Time: 16:27

Date : 05-26-2009
SPAN 10.0 MHz
ATTEN 10 dB
SWP 20.0 msec



Company: Aclara
CENTER 2.397 5 GHz
RES BW 100 kHz
10 dB/
ITEM : HAN Tx
REF 97.0 dBuV
VBW 300 kHz
Time: 16:29
Date : 05-26-2009
SPAN 20.0 MHz
ATTEN 10 dB
SWP 20.0 msec
Notes: Lower Band Edge, Restricted Band at 2390 MHz

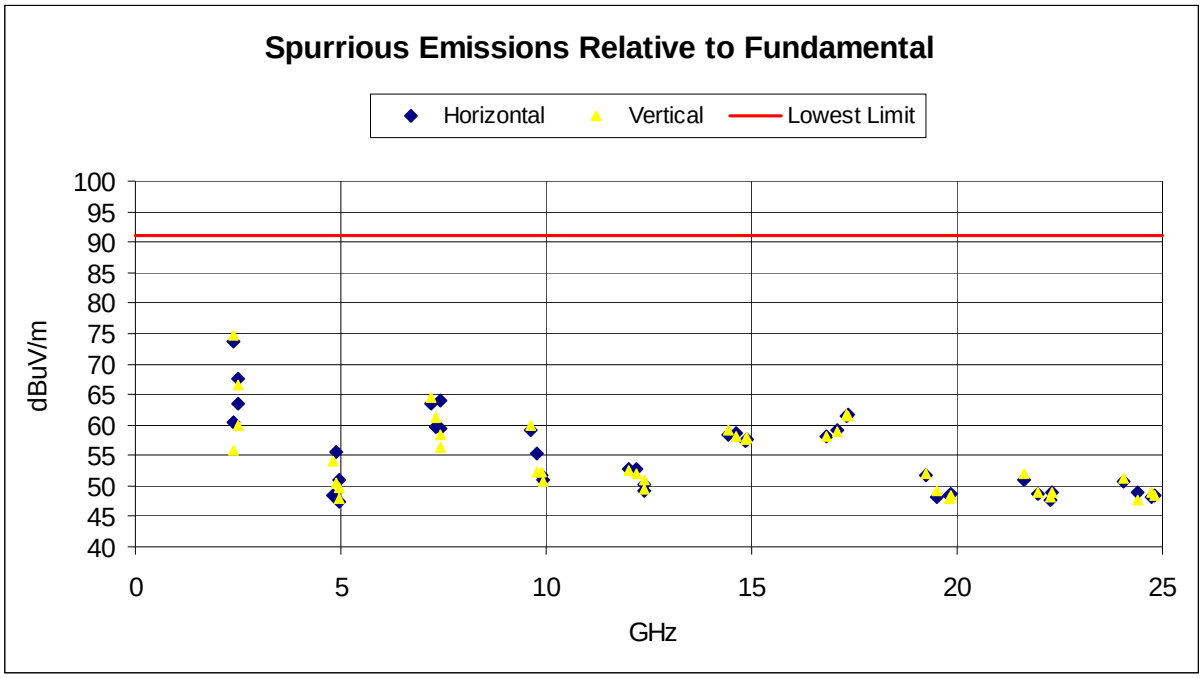


Judgement Pass by dB

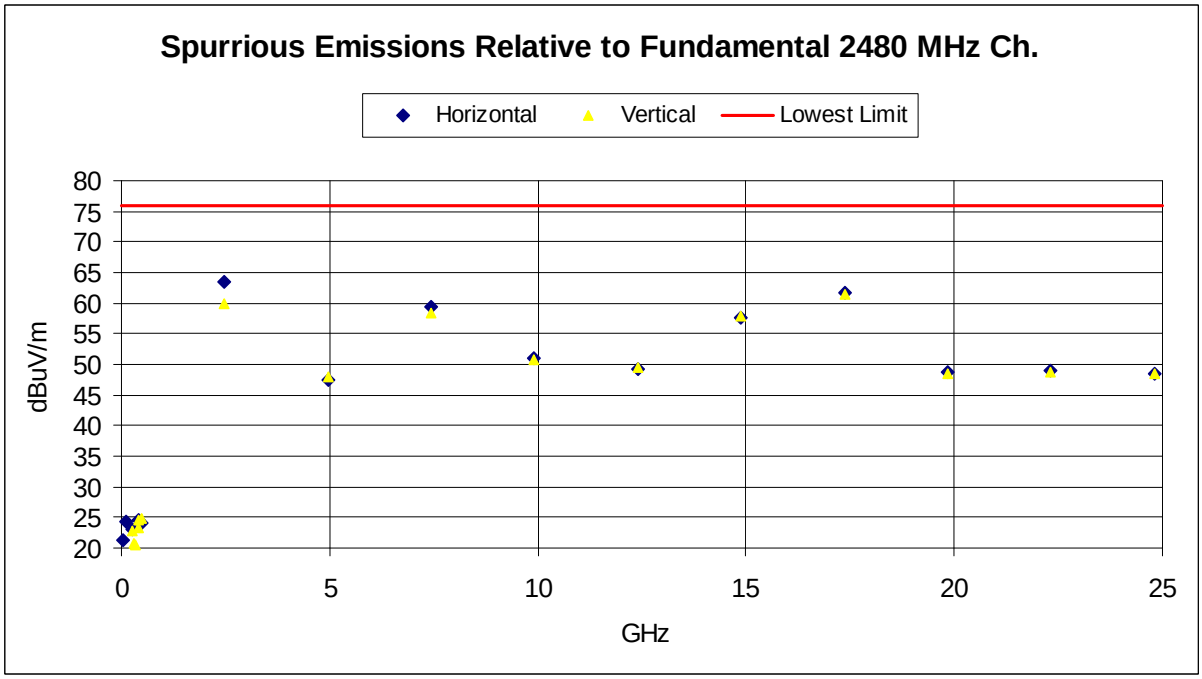
10.7 Spurious RF Conducted Emissions

Since antenna conducted tests cannot be performed on the EUT, radiated tests were performed to show compliance with this requirement.

The EUT was tested in continous mode and peak readings were made from the lowest frequency generated in the EUT up through the 10th harmonic. The limit is 20 dB lower than the peak of the lowest fundamental. The data is shown graphically and in tabular form.



The above chart includes 2405, 2440, and 2475 MHz Channels compared to the lowest limit of those Channels.



The above chart includes 2480 MHz Channel compared to the lowest limit of that Channel.

			Peak		EUT	Peak	Peak	Margin
hrm	Tx	Ant	Reading	Corr.	Emission	Level	FCC	Under Limit
#	Freq	Pol	dBuV	Fact.	Freq MHz	dBuV/m	Limit	dB
1	2405	V	101.8	9.3	2405	111.1	N/A	N/A
1	2405	H	107.8	9.3	2405	117.1	N/A	N/A
be	**2405**	V	**65.5**	9.3	2400	74.8	91.1	16.3
be	**2405**	H	**64.5**	9.3	2400	73.8	91.1	17.3
2	2405	V	42.3	11.8	4810	54.1	91.1	37
2	2405	H	36.5	11.8	4810	48.3	91.1	42.8
3	2405	V	45.6	18.9	7215	64.5	91.1	26.6
3	2405	H	44.6	18.9	7215	63.5	91.1	27.6
4	2405	V	49.2	10.6	9620	59.8	91.1	31.3
4	2405	H	48.5	10.6	9620	59.1	91.1	32
5	2405	V	40.6	11.8	12025	52.4	91.1	38.7
5	2405	H	41.0	11.8	12025	52.8	91.1	38.3
6	2405	V	43.2	15.9	14430	59.1	91.1	32
6	2405	H	42.4	15.9	14430	58.3	91.1	32.8
7	2405	V	42.7	15.5	16835	58.2	91.1	32.9
7	2405	H	42.6	15.5	16835	58.1	91.1	33
8	2405	V	36.0	21.6	19240	57.6	91.1	33.5
8	2405	H	36.0	21.6	19240	57.6	91.1	33.5
9	2405	V	36.0	21.6	21645	57.6	91.1	33.5
9	2405	H	36.0	21.6	21645	57.6	91.1	33.5
10	2405	V	36.0	21.6	24050	57.6	91.1	33.5
10	2405	H	36.0	21.6	24050	57.6	91.1	33.5
1	2440	V	103.3	9.5	2440	112.8	N/A	N/A
1	2440	H	107.0	9.5	2440	116.5	N/A	N/A
2	2440	V	38.6	11.8	4880	50.4	92.8	42.4
2	2440	H	43.8	11.8	4880	55.6	92.8	37.2
3	2440	V	41.9	19.3	7320	61.2	92.8	31.6
3	2440	H	40.3	19.3	7320	59.6	92.8	33.2
4	2440	V	41.7	10.5	9760	52.2	92.8	40.6
4	2440	H	44.7	10.5	9760	55.2	92.8	37.6
5	2440	V	41.0	11.1	12200	52.1	92.8	40.7
5	2440	H	41.7	11.1	12200	52.8	92.8	40
6	2440	V	42.2	16	14640	58.2	92.8	34.6
6	2440	H	42.6	16	14640	58.6	92.8	34.2
7	2440	V	42.1	16.7	17080	58.8	92.8	34
7	2440	H	42.5	16.7	17080	59.2	92.8	33.6
8	2440	V	36.0	21.6	19520	57.6	92.8	35.2
8	2440	H	36.0	21.6	19520	57.6	92.8	35.2
9	2440	V	36.0	21.6	21960	57.6	92.8	35.2
9	2440	H	36.0	21.6	21960	57.6	92.8	35.2
10	2440	V	36.0	21.6	24400	57.6	92.8	35.2
10	2440	H	36.0	21.6	24400	57.6	92.8	35.2
1	2475	V	101.8	9.8	2475	111.6	N/A	N/A
1	2475	H	106.4	9.8	2475	116.2	N/A	N/A
be	2475	**V**	**56.7**	9.8	2483.5	66.5	91.6	25.1

			Peak		EUT	Peak	Peak	Margin
hrm	Tx	Ant	Reading	Corr.	Emission	Level	FCC	Under Limit
#	Freq	Pol	dBuV	Fact.	Freq MHz	dBuV/m	Limit	dB
be	2475	**H**	**57.7**	9.8	2483.5	67.5	91.6	24.1
2	2475	V	37.7	11.9	4950	49.6	91.6	42
2	2475	H	39.1	11.9	4950	51	91.6	40.6
3	2475	V	36.4	20	7425	56.4	91.6	35.2
3	2475	H	44.1	20	7425	64.1	91.6	27.5
4	2475	V	41.6	10.6	9900	52.2	91.6	39.4
4	2475	H	41.1	10.6	9900	51.7	91.6	39.9
5	2475	V	41.1	10	12375	51.1	91.6	40.5
5	2475	H	40.2	10	12375	50.2	91.6	41.4
6	2475	V	42.2	15.3	14850	57.5	91.6	34.1
6	2475	H	42.0	15.3	14850	57.3	91.6	34.3
7	2475	V	43.2	18.5	17325	61.7	91.6	29.9
7	2475	H	43.0	18.5	17325	61.5	91.6	30.1
8	2475	V	36.0	21.6	19800	57.6	91.6	34
8	2475	H	36.0	21.6	19800	57.6	91.6	34
9	2475	V	36.0	21.6	22275	57.6	91.6	34
9	2475	H	36.0	21.6	22275	57.6	91.6	34
10	2475	V	36.0	21.6	24750	57.6	91.6	34
10	2475	H	36.0	21.6	24750	57.6	91.6	34
1	2480	V	86.4	9.8	2480	96.2	N/A	N/A
1	2480	H	89.9	9.8	2480	99.7	N/A	N/A
be	**2480**	**V**	**50.2**	9.8	2483.5	60	76.2	16.2
be	**2480**	**H**	**53.7**	9.8	2483.5	63.5	76.2	12.7
2	2480	V	36.0	11.9	4960	47.9	76.2	28.3
2	2480	H	35.6	11.9	4960	47.5	76.2	28.7
3	2480	V	38.5	20	7440	58.5	76.2	17.7
3	2480	H	39.5	20	7440	59.5	76.2	16.7
4	2480	V	40.1	10.6	9920	50.7	76.2	25.5
4	2480	H	40.4	10.6	9920	51	76.2	25.2
5	2480	V	39.5	10	12400	49.5	76.2	26.7
5	2480	H	39.3	10	12400	49.3	76.2	26.9
6	2480	V	42.5	15.3	14880	57.8	76.2	18.4
6	2480	H	42.3	15.3	14880	57.6	76.2	18.6
7	2480	V	42.9	18.5	17360	61.4	76.2	14.8
7	2480	H	43.2	18.5	17360	61.7	76.2	14.5
8	2480	V	36.0	21.6	19840	57.6	76.2	18.6
8	2480	H	36.0	21.6	19840	57.6	76.2	18.6
9	2480	V	36.0	21.6	22320	57.6	76.2	18.6
9	2480	H	36.0	21.6	22320	57.6	76.2	18.6
10	2480	V	36.0	21.6	24800	57.6	76.2	18.6
10	2480	H	36.0	21.6	24800	57.6	76.2	18.6

Notes: 1. hrm = Harmonic; BE = Band Edge emissions; V = Vertical; H = Horizontal
2. The margin (last column) is the worst case margin under the limits.
3. Corr. Factors = Cable Loss – Preamp Gain + Antenna Factor + High pass Filter

Judgement: Pass by 12.7 dB

10.8 Spurious Radiated Emissions (Restricted Band)

Radiated emission measurements in the Restricted bands were performed with linearly polarized broadband antennas. The results obtained with these antennas can be correlated with results obtained with a tuned dipole antenna. Below 1 GHz, when a radiated emission is detected approaching the specification limit, the measurement of the emission is repeated using a tuned dipole antenna with a Roberts Balun. A 10 dB linearity check is performed prior to start of testing in order to determine if an overload condition exists. Measurements were performed using two antenna polarizations, (vertical and horizontal). The worst case emissions were recorded.

From 30 to 1000 MHz, an Anritsu Spectrum analyzer and a preamplifier with a 10 dB attenuator connected to the input were used. The out of band emissions and the ambient emissions were below the level of input overload (80 dBuV).

For tests from 1 to 25 GHz, an HP8566 spectrum analyzer was used with a preamplifier. The out of band emissions and the ambient emissions were below the level of input overload (72 dBuV). In addition, a high pass filter was used to reduce the fundamental emission.

Final radiated emissions measurements were performed in the Anechoic Chamber at a test distance of 3 meters. The entire frequency range from 30 to 25 MHz was slowly scanned and the emissions in the restricted frequency bands were recorded. Measurements were performed using the peak detector function. The detected emission levels were maximized by rotating the EUT, adjusting the positions of all cables, and by scanning the measurement antenna from 1 to 4 meters above the ground. The open field test site has a metal ground screen. All other tests are performed at 12 East Devonwood Ave. Romeoville, Illinois EMI test lab.

The was device was rotated through three orthogonal axis as per 13.1.4.1 of ANSI C63.4 during the prescans and during final radiated tests.

10.8.1 Radiated Emissions Field Strength Sample Calculation

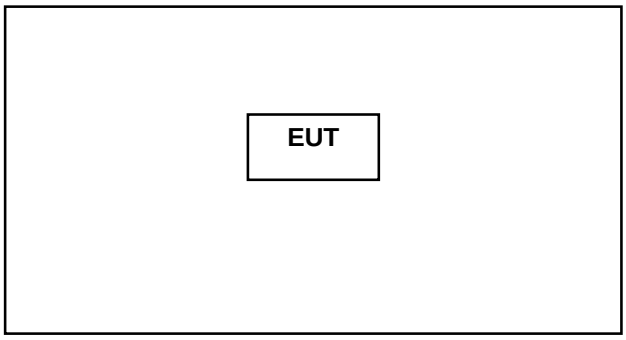
The field strength is calculated by adding the Antenna Factor and Cable Loss, and by subtracting the Amplifier Gain from the measured reading. The basic equation is as follows:

FS = RA + AF + CF - AG

Where: FS = Field Strength
RA = Receiver Amplitude
AF = Antenna Factor
CF = Cable Attenuation Factor
AG = Amplifier Gain
HPF = High pass Filter Loss
PKA = Peak to Average Factor (This is zero for non-average measurements)

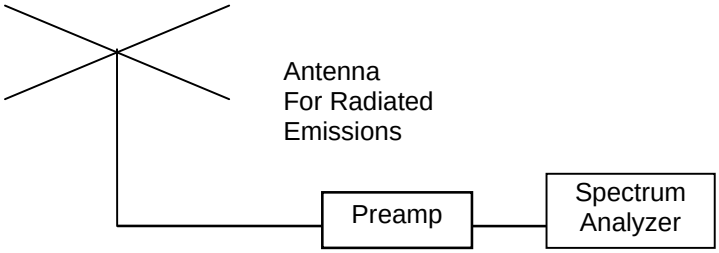
The Peak to average factor is used when average measurements are required. It is calculated by the highest duty cycle in percent over any 100mS transmission. The factor in dB is 20 * Log(Duty cycle/100).

Figure 2. Drawing of Radiated Emissions Setup



1x1.5m surface 80 cm above
Flush-mount Turntable

Notes:
- AC outlet with low-pass filter at the base of the turntable
- Antenna height varied from 1 to 4 meters
- Distance from antenna to tested system is 3 meters
- Not to Scale



10.8.2 Spurious Radiated Emissions Test Results (Restricted Band)

The following spectrum analyzer settings were used.

Span = wide enough to fully capture the emission being measured
RBW = 1 MHz for f ≥ 1 GHz, 100 kHz for f < 1 GHz
VBW ≥ RBW
Sweep = auto
Detector function = peak
Trace = max hold
A Video Bandwidth of 10 Hz was used for Average measurements above 1 GHz.

All Emissions Below 2 GHz

Manufacturer	ACLARA Power-Line Systems	Specification	FCC Part 15 Subpart C & RSS-210
Model	Y70084-1	Test Date	
Serial Number	None	Test Distance	3 Meters
Abbreviations	Pol = Antenna Polarization; V = Vertical; H = Horizontal; P = peak; Q = QP		
Notes	Corr. Factors = Cable Loss – Preamp Gain – Duty Cycle Factor + HP Filter Loss		

Freq. MHz	Meter Reading dBuV	Antenna Factor dB	Antenna Pol/ ID	Corr. Factors dB	Field Strength dBuV/m EUT	Field Strength dBuV/m Limit	Margin Under Limit dB
33.2	30.6 P	15.7	V/44	-27.9	18.4	40.0	21.6
43.6	29.9 P	14.2	V/44	-27.7	16.4	40.0	23.6
88.8	33.2 P	9.2	V/44	-27.1	15.3	43.5	28.2
78.4	32.1 P	6.8	V/44	-27.2	11.6	40.0	28.4
128.8	30.7 P	15.1	V/44	-26.7	19.1	43.5	24.4
214.8	30.2 P	11.3	V/44	-26.1	15.4	43.5	28.1
224.8	32.3 P	11.6	V/44	-26.1	17.8	46.0	28.2
226.7	33.2 P	11.6	V/44	-26.1	18.7	46.0	27.3
264.8	35.2 P	13.3	V/44	-25.8	22.8	46.0	23.2
286.1	33.9 P	12.7	V/44	-25.8	20.9	46.0	25.1
347.1	31.3 P	14.7	V/44	-25.4	20.5	46.0	25.5
412.1	31.9 P	16.2	V/44	-24.9	23.2	46.0	22.8
417.1	32.9 P	16.5	V/44	-24.9	24.5	46.0	21.5
499.4	32.3 P	16.8	V/44	-24.2	24.8	46.0	21.2
48.4	33.6 P	15.4	H/44	-27.7	21.3	40.0	18.7
113.6	29.9 P	13.7	H/44	-26.9	16.7	43.5	26.8
126.8	36.1 P	15.0	H/44	-26.8	24.3	43.5	19.2
160.8	35.6 P	10.5	H/44	-26.5	19.6	43.5	23.9
176.8	35.6 P	9.4	H/44	-26.4	18.6	43.5	24.9
184.0	35.4 P	9.5	H/44	-26.3	18.6	43.5	24.9
224.8	34.0 P	11.8	H/44	-26.1	19.7	46.0	26.3
226.7	33.9 P	11.8	H/44	-26.1	19.6	46.0	26.4
275.4	35.6 P	13.2	H/44	-25.8	23.1	46.0	22.9
412.1	33.1 P	16.3	H/44	-24.9	24.4	46.0	21.6
479.3	30.9 P	17.7	H/44	-24.5	24.1	46.0	21.9

Judgment: Passed by 18.7 dB

All Radiated Emissions above 2 GHz

hrm	Tx	Ant	Analyzer Reading in dBuV		Corr.	EUT Emission Frequency	Peak Tot. FS	Ave Tot. FS	Peak FCC	Ave Limit	Worst Case Margin Under limit
#	Freq	Pol	Pk	Avg	Fact.	MHz	dBuV/m	dBuV/m	dBuV/m	dBuV/m	dB
1	2405	V	101.8	N/A	9.3	2405	111.1	9.3	125	125	13.9
1	2405	H	107.8	N/A	9.3	2405	117.1	9.3	125	125	7.9
be	2405	V	46.5	27.0	9.3	2390	55.8	36.3	74	54	17.7
be	2405	H	51.2	29.9	9.3	2390	60.5	39.2	74	54	14.8
be	2405	V	65.5	45.6	9.3	2400	74.8	54.9	94	74	19.1
be	2405	H	64.5	42.0	9.3	2400	73.8	51.3	94	74	22.7
2	2405	V	42.3	21.8	11.8	4810	54.1	33.6	74	54	20.4
2	2405	H	36.5	18.9	11.8	4810	48.3	30.7	74	54	23.3
3	2405	V	45.6	29.7	18.9	7215	64.5	48.6	74	54	5.4
3	2405	H	44.6	27.0	18.9	7215	63.5	45.9	74	54	8.1
4	2405	V	49.2	33.0	10.6	9620	59.8	43.6	74	54	10.4
4	2405	H	48.5	31.9	10.6	9620	59.1	42.5	74	54	11.5
5	2405	V	40.6	23.3	11.8	12025	52.4	35.1	74	54	18.9
5	2405	H	41.0	24.1	11.8	12025	52.8	35.9	74	54	18.1
6	2405	V	43.2	26.2	15.9	14430	59.1	42.1	74	54	11.9
6	2405	H	42.4	26.2	15.9	14430	58.3	42.1	74	54	11.9
7	2405	V	42.7	25.5	15.5	16835	58.2	41	74	54	13.0
7	2405	H	42.6	25.6	15.5	16835	58.1	41.1	74	54	12.9
1	2440	V	103.3	N/A	9.5	2440	112.8	9.5	125	125	12.2
1	2440	H	107.0	N/A	9.5	2440	116.5	9.5	125	125	8.5
2	2440	V	38.6	24.2	11.8	4880	50.4	36	74	54	18.0
2	2440	H	43.8	27.6	11.8	4880	55.6	39.4	74	54	14.6
3	2440	V	41.9	26.2	19.3	7320	61.2	45.5	74	54	8.5
3	2440	H	40.3	23.8	19.3	7320	59.6	43.1	74	54	10.9
4	2440	V	41.7	25.2	10.5	9760	52.2	35.7	74	54	18.3
4	2440	H	44.7	28.2	10.5	9760	55.2	38.7	74	54	15.3
5	2440	V	41.0	24.2	11.1	12200	52.1	35.3	74	54	18.7
5	2440	H	41.7	25.7	11.1	12200	52.8	36.8	74	54	17.2
6	2440	V	42.2	26.0	16	14640	58.2	42	74	54	12.0
6	2440	H	42.6	26.4	16	14640	58.6	42.4	74	54	11.6
7	2440	V	42.1	24.8	16.7	17080	58.8	41.5	74	54	12.5
7	2440	H	42.5	25.7	16.7	17080	59.2	42.4	74	54	11.6
1	2475	V	101.8	N/A	9.8	2475	111.6	109.8	125	125	13.4
1	2475	H	106.4	N/A	9.8	2475	116.2	114.1	125	125	8.8
be	2475	V	56.7	38.5	9.8	2483.5	66.5	48.3	74	54	5.7
be	2475	H	57.7	41.0	9.8	2483.5	67.5	50.8	74	54	3.2
2	2475	V	37.7	17.3	11.9	4950	49.6	29.2	74	54	24.8
2	2475	H	39.1	20.1	11.9	4950	51	32	74	54	22.0
3	2475	V	36.4	16.9	20	7425	56.4	36.9	74	54	17.1
3	2475	H	44.1	19.3	20	7425	64.1	39.3	74	54	14.7
4	2475	V	41.6	24.2	10.6	9900	52.2	34.8	74	54	19.2
4	2475	H	41.1	24.9	10.6	9900	51.7	35.5	74	54	18.5

hrm	Tx	Ant	Analyzer Reading in dBuV		Corr.	EUT Emission Frequency	Peak Tot. FS	Ave Tot. FS	Peak FCC	Ave Limit	Worst Case Margin Under limit
#	Freq	Pol	Pk	Avg	Fact.	MHz	dBuV/m	dBuV/m	dBuV/m	dBuV/m	dB
5	2475	V	41.1	24.5	10	12375	51.1	34.5	74	54	19.5
5	2475	H	40.2	23.2	10	12375	50.2	33.2	74	54	20.8
6	2475	V	42.2	25.5	15.3	14850	57.5	40.8	74	54	13.2
6	2475	H	42.0	25.6	15.3	14850	57.3	40.9	74	54	13.1
7	2475	V	43.2	26.8	18.5	17325	61.7	45.3	74	54	8.7
7	2475	H	43.0	27.0	18.5	17325	61.5	45.5	74	54	8.5
1	2480	V	86.4	N/A	9.8	2480	96.2	94.2	125	125	28.8
1	2480	H	89.9	N/A	9.8	2480	99.7	97.9	125	125	27.1
be	2480	V	50.2	36.8	9.8	2483.5	60	46.6	74	54	7.4
be	2480	H	53.7	40.5	9.8	2483.5	63.5	50.3	74	54	3.7
2	2480	V	36.0	21.8	11.9	4960	47.9	33.7	74	54	20.3
2	2480	H	35.6	22.5	11.9	4960	47.5	34.4	74	54	19.6
3	2480	V	38.5	26.1	20	7440	58.5	46.1	74	54	7.9
3	2480	H	39.5	23.6	20	7440	59.5	43.6	74	54	10.4
4	2480	V	40.1	23.3	10.6	9920	50.7	33.9	74	54	20.1
4	2480	H	40.4	23.7	10.6	9920	51	34.3	74	54	19.7
5	2480	V	39.5	23.4	10	12400	49.5	33.4	74	54	20.6
5	2480	H	39.3	22.8	10	12400	49.3	32.8	74	54	21.2
6	2480	V	42.5	25.2	15.3	14880	57.8	40.5	74	54	13.5
6	2480	H	42.3	26.2	15.3	14880	57.6	41.5	74	54	12.5
7	2480	V	42.9	26.8	18.5	17360	61.4	45.3	74	54	8.7
7	2480	H	43.2	26.6	18.5	17360	61.7	45.1	74	54	8.9

The margin is the worst case for ave or peak.

Judgment: Passed by 3.2 dB
No other Radiated emissions were detected up to 25 GHz.

Notes: 1. hrm = Harmonic; BE = Band Edge emissions; V = Vertical; H = Horizontal
2. The margin (last column) is the worst case margin under the limits.
3. Corr. Factors = Cable Loss – Preamp Gain + Antenna Factor + High pass Filter