



FCC 15.209, RSS 210 TEST REPORT

FOR:

Integrated Vehicular Receiver

MODEL #: PEM (Passive Entry Module)

**Marquardt Switches
2917 Waterview Dr.
Rochester Hills, Michigan 48309
U.S.A**

TEST REPORT #: EMC_MARQU_001_08001_PEM_FCC15_rev4

DATE: 2008-12-31



**FCC listed:
A2LA accredited**

**IC recognized #
3462B**

CETECOM Inc.

411 Dixon Landing Road ♦ Milpitas, CA 95035 ♦ U.S.A.

Phone: + 1 (408) 586 6200 ♦ Fax: + 1 (408) 586 6299 ♦ E-mail: info@cetecomusa.com ♦ <http://www.cetecom.com>

CETECOM Inc. is a Delaware Corporation with Corporation number: 2113686

Board of Directors: Dr. Harald Ansorge, Dr. Klaus Matkey, Hans Peter May

Table of Contents

1	ASSESSMENT	3
	<i>EMC & Radio.....</i>	<i>3</i>
	<i>EMC & Radio.....</i>	<i>3</i>
2	ADMINISTRATIVE DATA.....	4
2.1	IDENTIFICATION OF THE TESTING LABORATORY ISSUING THE EMC TEST REPORT.....	4
2.2	IDENTIFICATION OF THE CLIENT	4
2.3	IDENTIFICATION OF THE MANUFACTURER.....	4
3	EQUIPMENT UNDER TEST (EUT).....	5
3.1	SPECIFICATION OF THE EQUIPMENT UNDER TEST	5
3.2	IDENTIFICATION OF THE EQUIPMENT UNDER TEST (EUT)	5
4	SUBJECT OF INVESTIGATION.....	6
5	MEASUREMENTS.....	7
5.1	RADIATED EMISSION	7
5.2	RESULTS	8
5.3	RECEIVER RADIATED EMISSIONS § 2.1053 / RSS-210	12
5.3.1	<i>Receiver Radiated Emissions</i>	<i>13</i>
6	TEST EQUIPMENT AND ANCILLARIES USED FOR TESTS	20
7	REFERENCES	21
8	BLOCK DIAGRAMS	22
9	REVISION HISTORY.....	23

1 Assessment

The following is in compliance with the applicable criteria specified in FCC rules Parts 15, of Title 47 of the Code of Federal Regulations and in compliance with the applicable criteria specified in Industry Canada rules RSS210.

Company	Description	Model #
Marquardt Switches	Integrated Vehicular Receiver	Passive Entry Module (PEM)

Technical responsibility for area of testing:

Marc Douat

2008-12-31 EMC & Radio (EMC Project Engineer)

Date	Section	Name	Signature
------	---------	------	-----------

This report is prepared by:

Satya Radhakrishna

2008-12-31 EMC & Radio (EMC Project Engineer)

Date	Section	Name	Signature
------	---------	------	-----------

The test results of this test report relate exclusively to the test item specified in Identification of the Equipment under Test. The CETECOM Inc. USA does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item. The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of the CETECOM Inc USA.

2 Administrative Data

2.1 Identification of the Testing Laboratory Issuing the EMC Test Report

Company Name:	CETECOM Inc.
Department:	EMC
Address:	411 Dixon Landing Road Milpitas, CA 95035 U.S.A.
Telephone:	+1 (408) 586 6200
Fax:	+1 (408) 586 6299
Responsible Test Lab Manager:	Lothar Schmidt
Responsible Project Leader:	Satya Radhakrishna

2.2 Identification of the Client

Applicant's Name:	Marquardt Switches
Street Address:	2917 Waterview Dr.
City/State/Zip Code	Rochester Hills, Michigan 48309
Country	U.S.A
Contact Person:	Drake Boroja
Phone No.	248-293-7727
e-mail:	Drake.Boroja@Marqswitch.com

2.3 Identification of the Manufacturer

Same as above client.

3 Equipment under Test (EUT)

3.1 Specification of the Equipment under Test

Marketing Name:	Passive Entry Module (PEM)
Description:	Integrated Vehicular Receiver
Model No:	Passive Entry Module (PEM)
FCC ID:	IYZ-C01A
IC ID:	2701A-C01A
Type(s) of Modulation:	PSK, FSK
Number of Channels:	1
Antenna Type:	Wound coil
Field strength of fundamental:	37.225 dBμV/m @ 300 meters

3.2 Identification of the Equipment Under Test (EUT)

EUT #	TYPE	MANF.	MODEL	SERIAL #
1	Integrated Vehicular Receiver	Marquardt Switches	Passive Entry Module (PEM)	0508000004544002

4 Subject of Investigation

All testing was performed on the EUT listed in Section 3. The EUT was maximized in the X,Y, Z positions , all data in this report shows the worst case between horizontal and vertical polarization for above 1GHz.

The objective of the measurements done by Cetecom Inc. was to measure the performance of the EUT as specified by requirements listed in FCC rules Parts15.209 of Title 47 of the Code of Federal Regulations and Industry Canada rules RSS210. Test methods for FCC 15.209 were based on the procedure mentioned in ANSI C63.4.

5 Measurements

5.1 Radiated emission

(Measurement of the active transponder of the EUT)

Section 15.209 Radiated emission limits, general requirements.

(a) Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 - 0.490	2400/F(kHz)	300
0.490 - 1.705	24000/F(kHz)	30
1.705 - 30.0	30	30
30 - 88	100 **	3
88 - 216	150 **	3
216 - 960	200 **	3
Above 960	500	3

** Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz or 470-806 MHz. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

(b) In the emission table above, the tighter limit applies at the band edges.

(c) The level of any unwanted emissions from an intentional radiator operating under these general provisions shall not exceed the level of the fundamental emission. For intentional radiators which operate under the provisions of other Sections within this Part and which are required to reduce their unwanted emissions to the limits specified in this table, the limits in this table are based on the frequency of the unwanted emission and not the fundamental frequency. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.

(d) The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

(e) The provisions in Sections 15.31, 15.33, and 15.35 for measuring emissions at distances other than the distances specified in the above table, determining the frequency range over which radiated emissions are to be measured, and limiting peak emissions apply to all devices operated under this Part.

(f) In accordance with Section 15.33(a), in some cases the emissions from an intentional radiator must be measured to beyond the tenth harmonic of the highest fundamental frequency designed to be emitted by the intentional radiator because of the incorporation of a digital device. If measurements above the tenth harmonic are so required, the radiated emissions above the tenth harmonic shall comply with the general radiated emission limits applicable to the incorporated digital device, as shown in Section 15.109 and as based on the frequency of the emission being measured, or, except for emissions contained in the restricted frequency bands shown in Section 15.205, the limit on spurious emissions specified for the intentional radiator, whichever is the higher limit. Emissions which must be measured above the tenth harmonic of the highest fundamental frequency designed to be emitted by the intentional radiator and which fall within the restricted bands shall comply with the general radiated emission limits in Section 15.109 that are applicable to the incorporated digital device.

(g) Perimeter protection systems may operate in the 54-72 MHz and 76-88 MHz bands under the provisions of this section. The use of such perimeter protection systems is limited to industrial, business and commercial applications.

5.2 Results

Measurements were performed at 3m distance using loop antenna which was placed a height of 1m from the ground. Software performs extrapolation of result from 3m to 300m.

Measuring the fundamental: Please refer to Plot 1

FCC 15.209 states that the field strength limits for the fundamental in the frequency range 0.009 - 0.490 MHz = $2400/F$ (kHz) for a given test distance of 300 meters. So the limit is $2400/21.85$ kHz = 109.83 μ V/m. In order to convert to dB μ V/m, the formula used is $20 * \log(109.83 \mu\text{V/m}) = \mathbf{40.82 \text{ dB}\mu\text{V/m}}$ at 300 meters..

Measured value of power is -47.66 dBm. To convert to dB μ V, add 107 dB.

Reading in dB μ V = -47.66 dBm+107 dB= 59.34 dB μ V.

Field strength (dB μ V/m)= dB μ V + Antenna Factor+ Correction Loss
= 59.34 dB μ V +80 dB-1.2 dB=138.14 dB μ V/m.

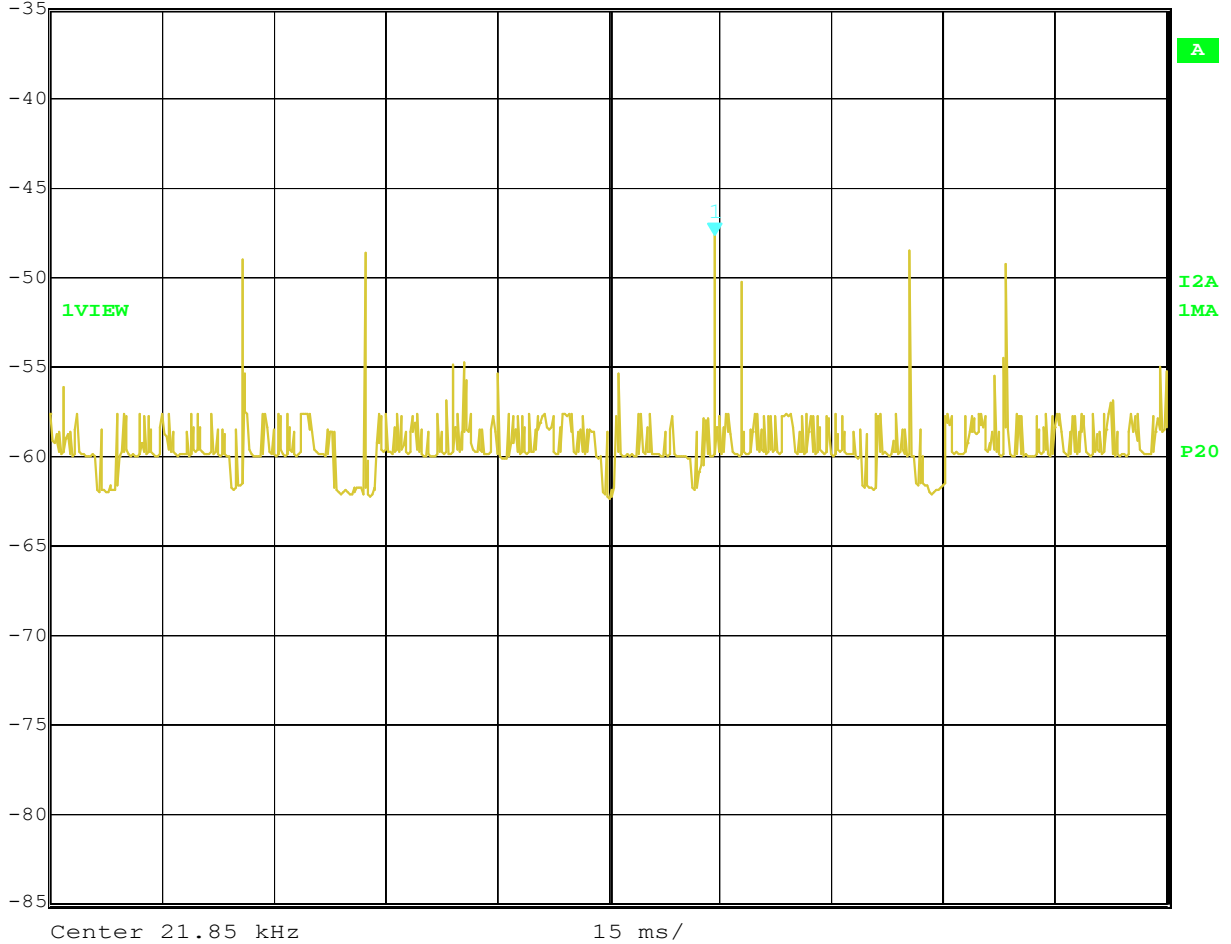
The measurement was made at 1m, in order to extrapolate to 300m add the factor $40\log(1/300) = -99$ dB. [Note: a 40dB/decade can be used below 30 MHz per FCC 15.31 (b)(2). 20dB/decade is to be used above 30 MHz per FCC 15.31(b)(1)].

Extrapolated result will be $138.14 \text{ dB}\mu\text{V/m} - 99\text{dB} = 39.055 \text{ dB}\mu\text{V/m}$. The measurements were made with a peak detector. They are converted into average values (because the limits are average limits) with this formula, $39.055 + 20\log((\text{duty cycle}/100)) = 39.055 + 20\log((81/100)) = \mathbf{37.225 \text{ dB}\mu\text{V/m}}$.

PLOT 1



Marker 1 [T1] RBW 20 kHz RF Att 0 dB
Ref Lvl -47.66 dBm VBW 50 kHz
-35 dBm 89.278557 ms SWT 150 ms Unit dBm

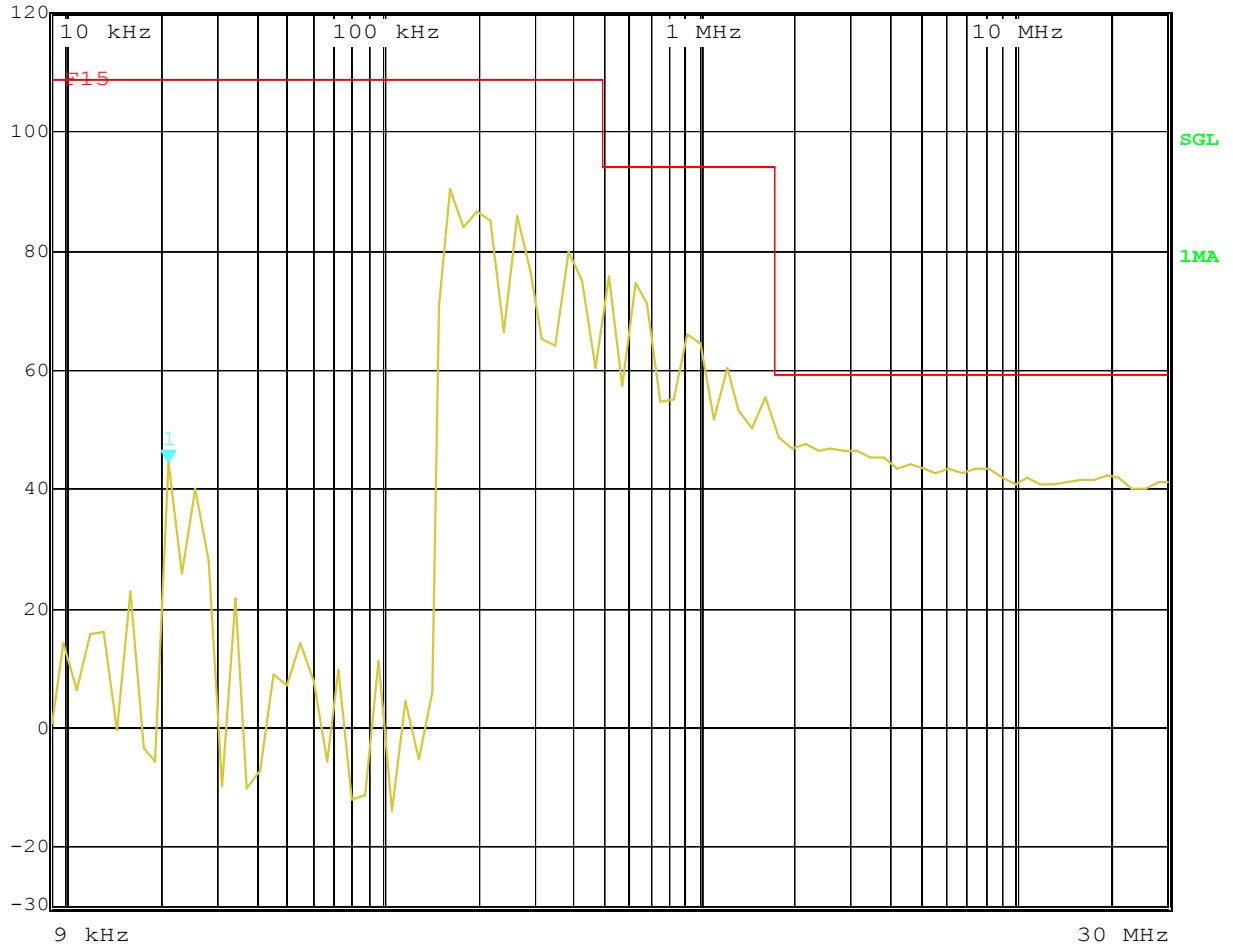


Date: 31.DEC.2008 14:16:28

PLOT 2

9 kHz- 30 MHz Tx mode

 Att 10 dB Marker 1 [T1] Det MA Trd 6512E
INPUT 2 21.22152922 kHz ResBW 200 Hz
Meas T 5 s Unit dB μ V/m



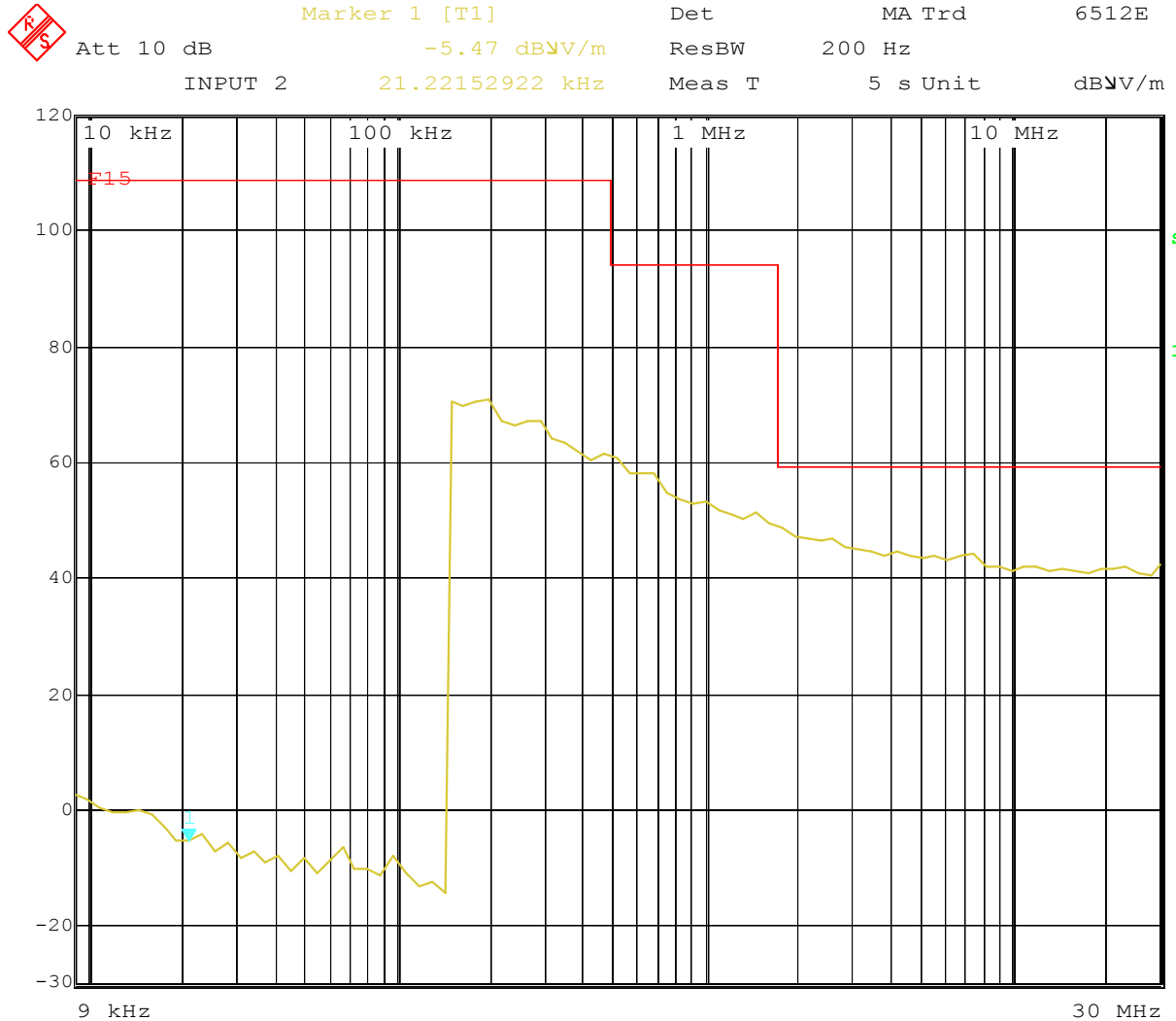
Date: 26.MAY.2008 20:32:24

Noise Floor at 30 MHz: 41.33 dB μ V/m



PLOT 3

9 kHz- 30 MHz Rx mode



Date: 26.MAY.2008 20:33:27

Noise Floor at 30 MHz: 41.33 dBμV/m

5.3 RECEIVER RADIATED EMISSIONS § 2.1053 / RSS-210

NOTE:

1. The radiated emissions were done with different settings, using the relevant pre-amplifiers for the relevant frequency ranges. This is the reason that the graphs show different noise levels. In the range between 3GHz and 26.5GHz very short cable connections to the antenna was used to minimize the noise level.

Limits		SUBCLAUSE § RSS-210
Frequency (MHz)	Field strength ($\mu\text{V}/\text{m}$)	Measurement distance (m)
0.009 - 0.490	2400/F (kHz)	300
0.490 - 1.705	24000/F (kHz)	30
1.705 - 30.0	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

5.3.1 Receiver Radiated Emissions

PLOT 4

EUT in Idle Mode: 30MHz – 1GHz : Antenna: horizontal

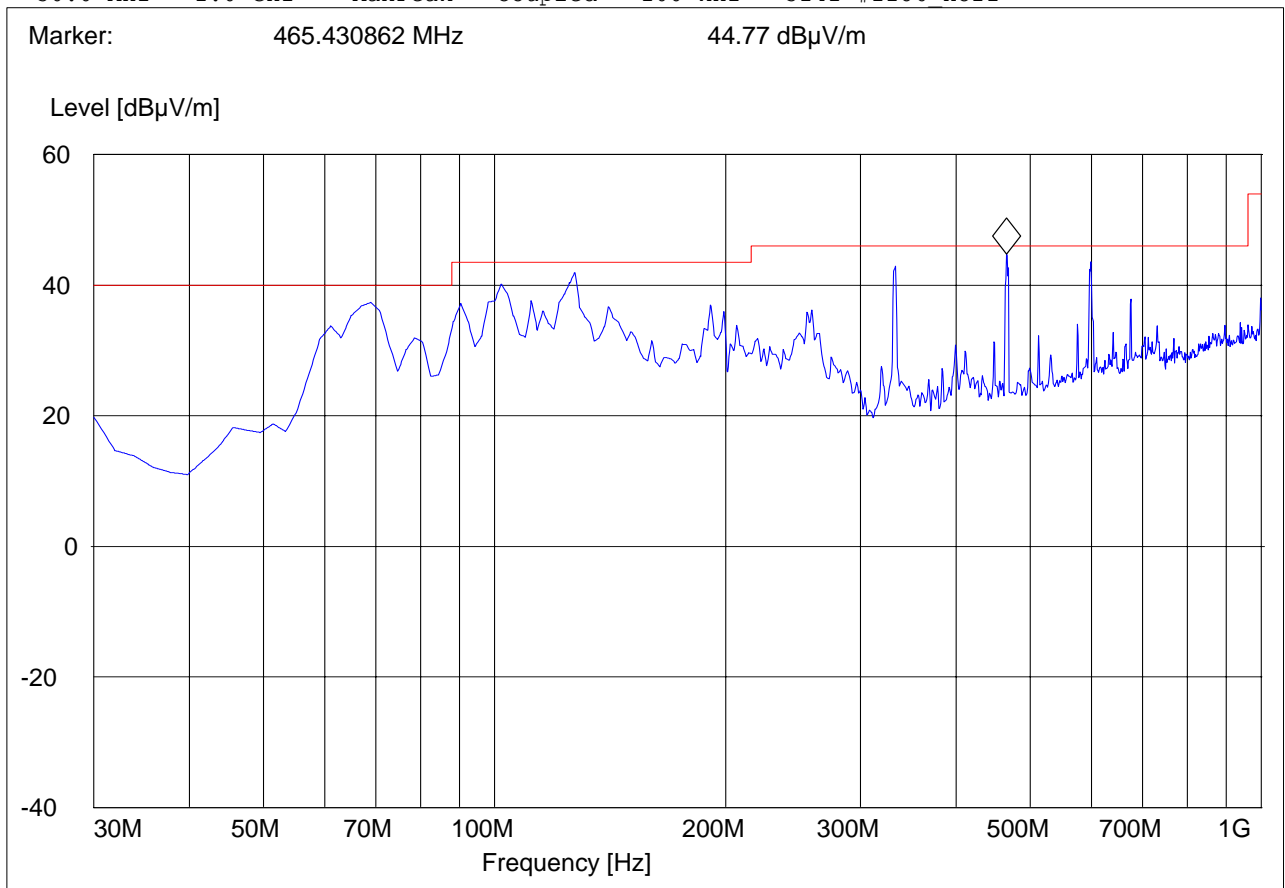
Note: Peak Reading Vs. Quasi-Peak Limit.

CETECOM Inc., 411 Dixon Landing Road, Milpitas CA 95035, USA

EUT: PEM
 Customer:: MARQUARDT SWITCHES
 Test Mode: Rx mode
 ANT Orientation: H
 EUT Orientation: H
 Test Engineer: Chris
 Voltage: car battery

SWEEP TABLE: "CANDA RE_30M-1G_Hor"

Start Frequency	Stop Frequency	Detector	Meas. Time	IF Bandw.	Transducer
30.0 MHz	1.0 GHz	MaxPeak	Coupled	100 kHz	3141-#1186 Horz



Peaks less than 20 dB from the limit		
No.	Frequency (MHz)	Peak value (dBµV/m)
1	90	36.48
2	104.57	40.07
3	137.63	41.76
4	334.375	42.895
5	599.78	43.01
6	676.20	37.47

PLOT 5

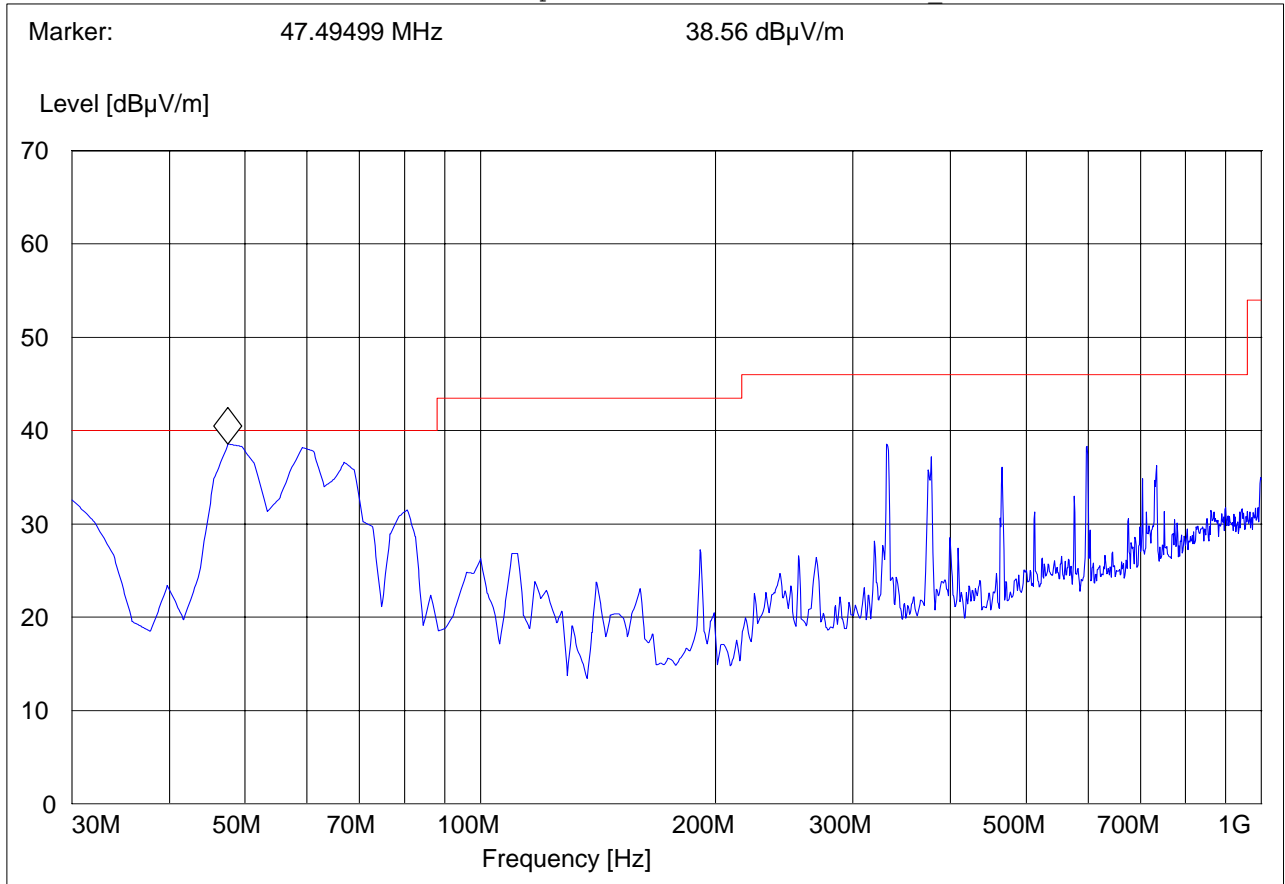
EUT in Idle Mode: 30MHz – 1GHz

Antenna: vertical

EUT: PEM
 Customer:: MARQUARDT SWITCHES
 Test Mode: Rx mode
 ANT Orientation: V
 EUT Orientation: H
 Test Engineer: Chris
 Voltage: car battery

SWEEP TABLE: "CANADA RE_30M-1G_Ver"

Start Frequency	Stop Frequency	Detector	Meas. Time	IF Bandw.	Transducer
30.0 MHz	1.0 GHz	MaxPeak	Coupled	100 kHz	3141-#1186 Vert



Peaks less than 20 dB from the limit		
No.	Frequency (MHz)	Peak value (dBµV/m)
1	58.76	38.19
2	67.23	36.41
3	334.375	38.47
4	374.82	37.36
5	471.72	35.62
6	697.50	38.21

RECEIVER RADIATED EMISSIONS

PLOT 6

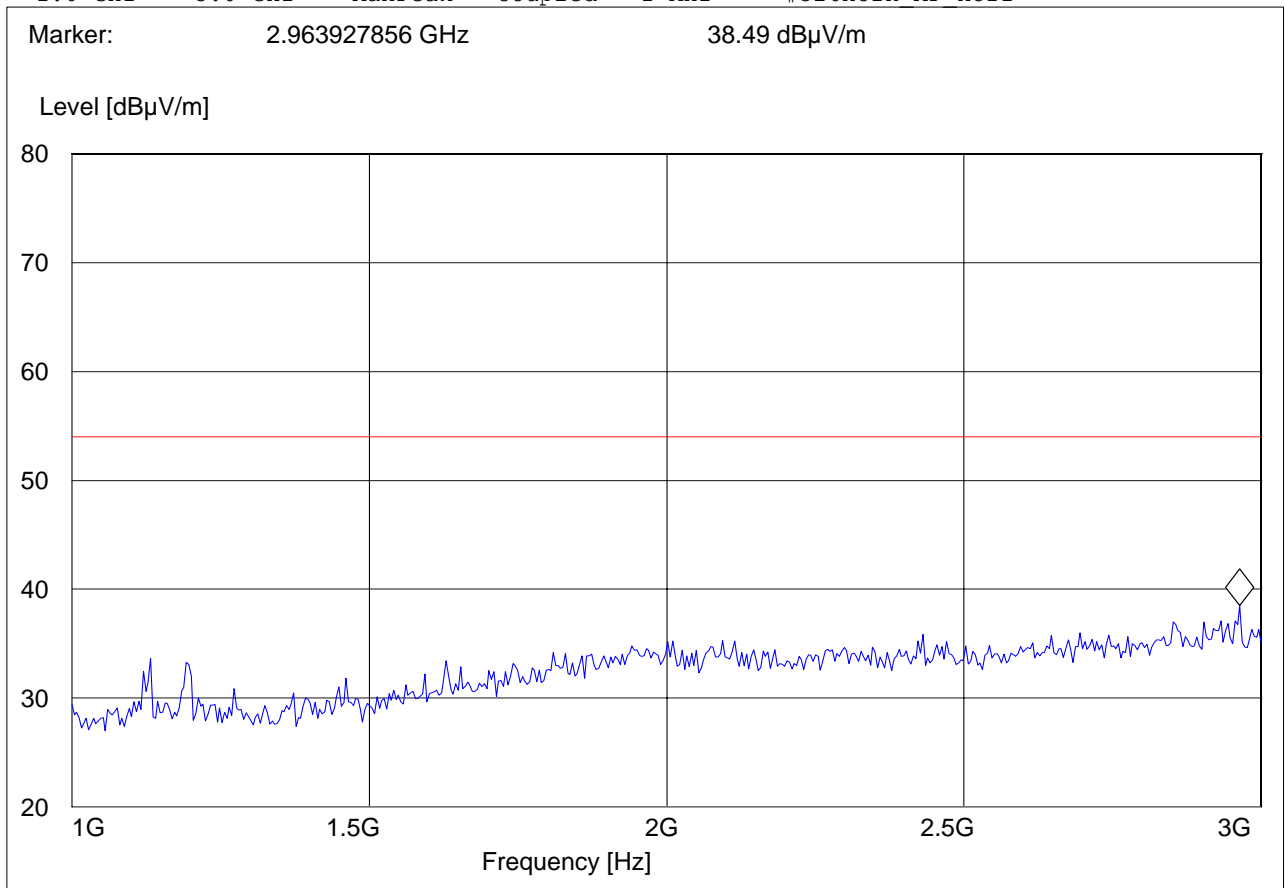
EUT in Idle Mode: 1GHz – 3GHz

Note: Peak Reading Vs. Average Limit. This plot is valid for Horizontal and Vertical polarization (worst-case plot)

EUT: PEM
 Customer:: MARQUARDT SWITCHES
 Test Mode: Rx mode
 ANT Orientation: H
 EUT Orientation: H
 Test Engineer: Chris
 Voltage: car battery

SWEEP TABLE: "CANADA RE_1-3G"

Start Frequency	Stop Frequency	Detector	Meas. Time	IF Bandw.	Transducer
1.0 GHz	3.0 GHz	MaxPeak	Coupled	1 MHz	#326horn AF horz



Peaks less than 20 dB from the limit		
No.	Frequency (MHz)	Peak value (dBµV/m)
1	2425	35.71
2	2687.5	35.87
3	2737.5	35.76
4	2834.7	37.03
5	2906.2	37.14
6	2937.5	37.52

RECEIVER RADIATED EMISSIONS

PLOT 7

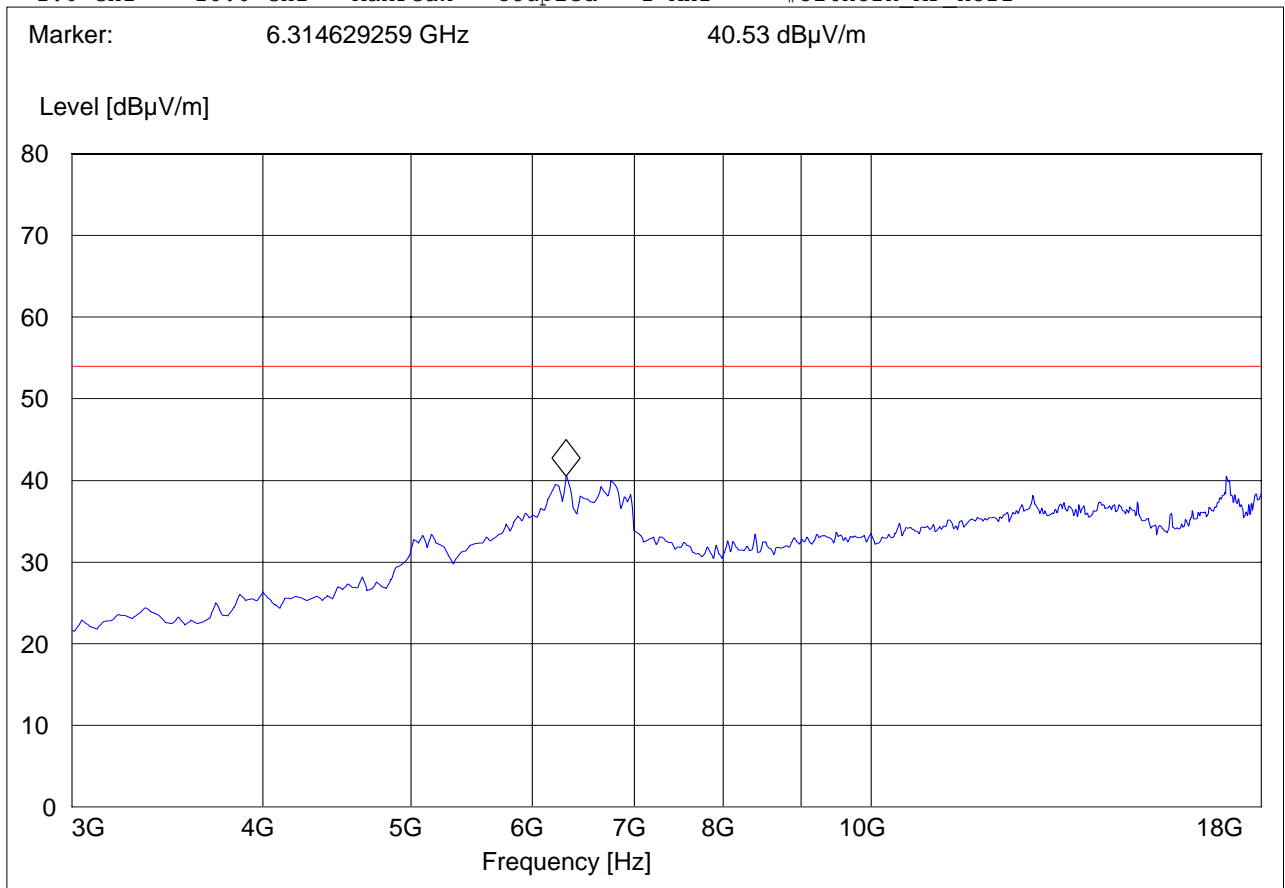
EUT in Idle Mode: 3GHz – 18GHz

Note: Peak Reading Vs. Average Limit. This plot is valid for Horizontal and Vertical polarization (worst-case plot)

EUT: PEM
 Customer:: MARQUARDT SWITCHES
 Test Mode: Rx mode
 ANT Orientation: H
 EUT Orientation: H
 Test Engineer: Chris
 Voltage: car battery

SWEEP TABLE: "CANADA RE_3-18G"

Start Frequency	Stop Frequency	Detector	Meas. Time	IF Bandw.	Transducer
1.0 GHz	18.0 GHz	MaxPeak	Coupled	1 MHz	#326horn AF horz

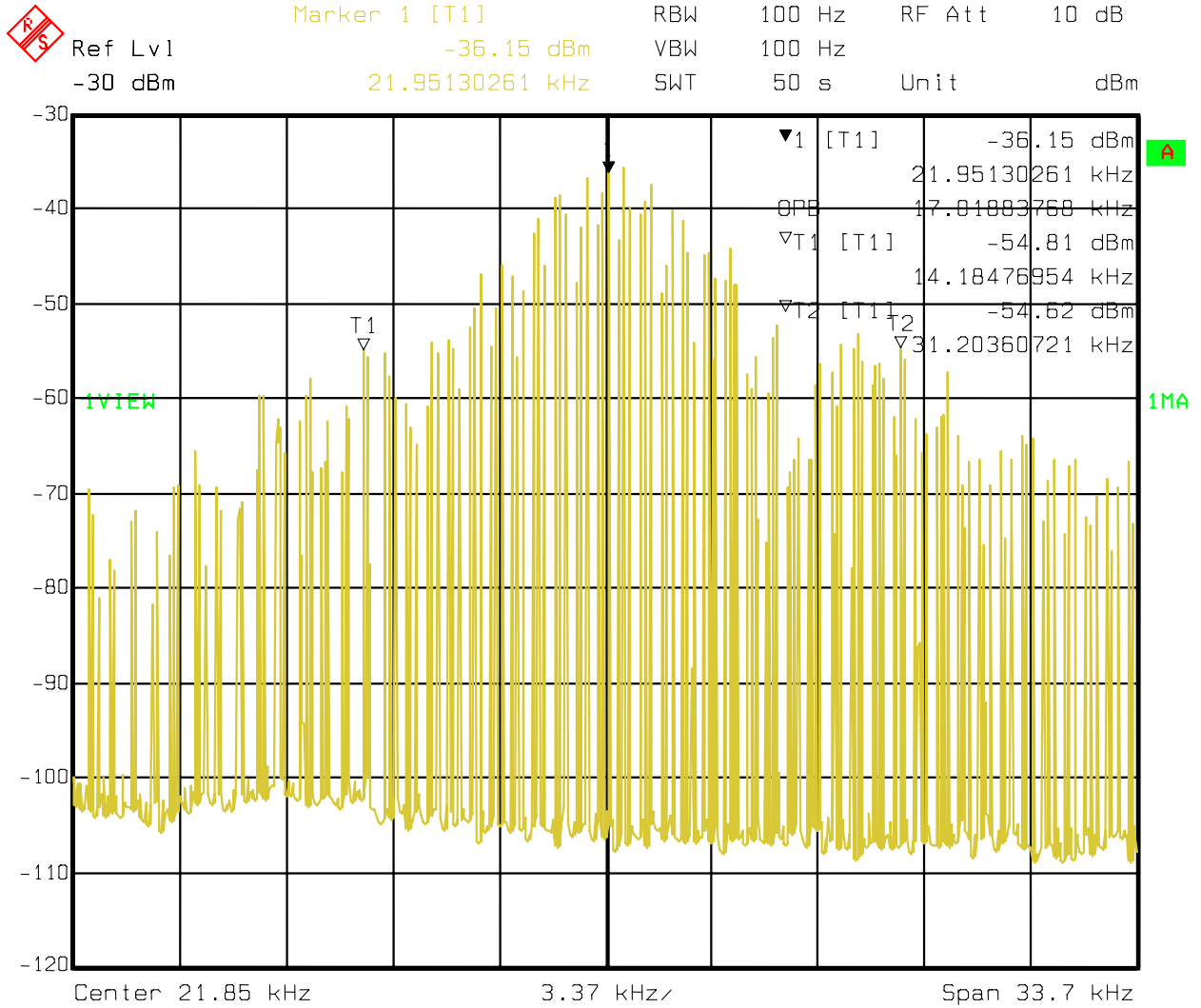


Peaks less than 20 dB from the limit		
No.	Frequency (MHz)	Peak value (dBµV/m)
1	6203.7	39.091
2	6692.31	38.182
3	6769.23	40
4	14923	37.73
5	15385	37.272
6	17230.8	40.91

99% BANDWIDTH

PLOT 8

99% BANDWIDTH MEASURED: 17.01883768 kHz

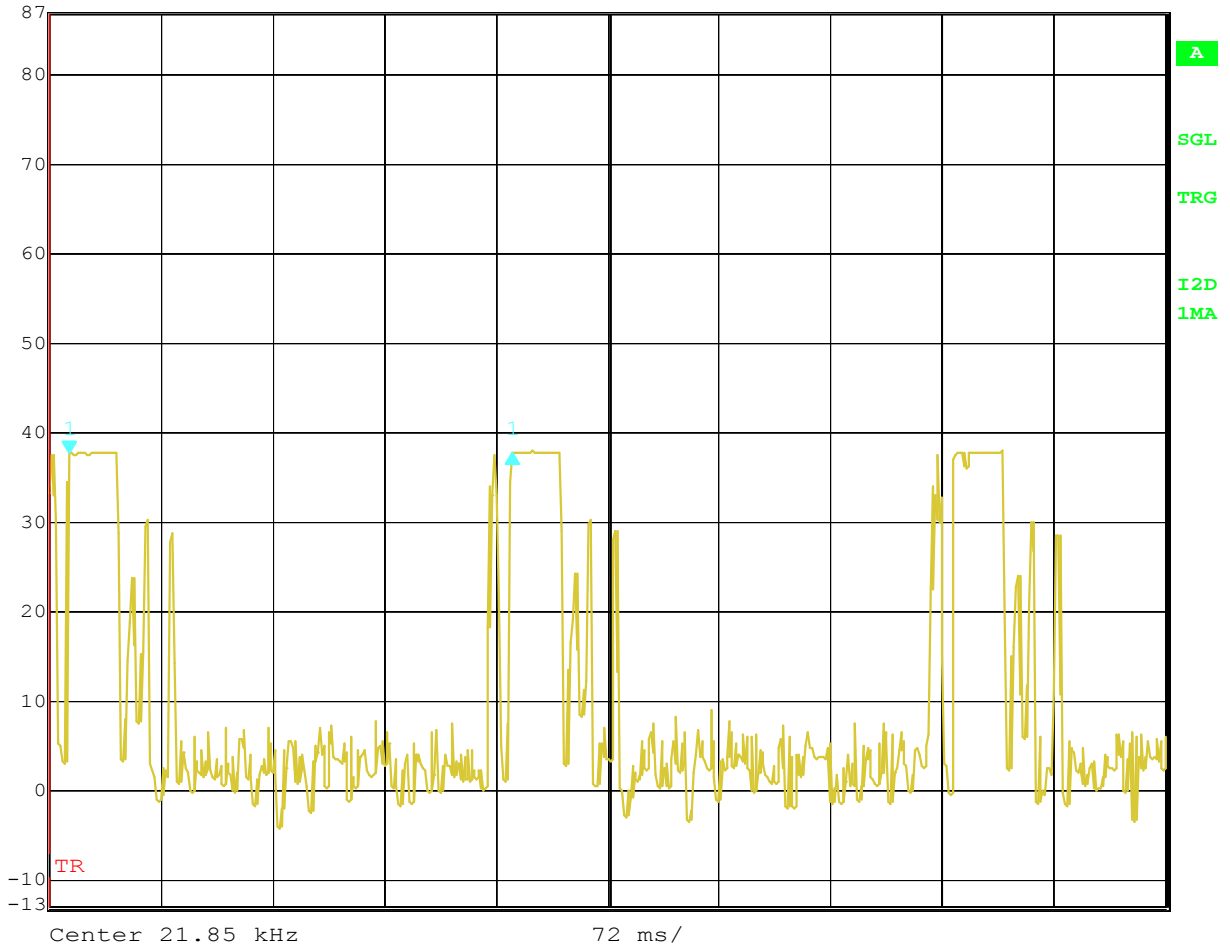


Date: 20.JUN.2008 15:15:20

PLOT 9




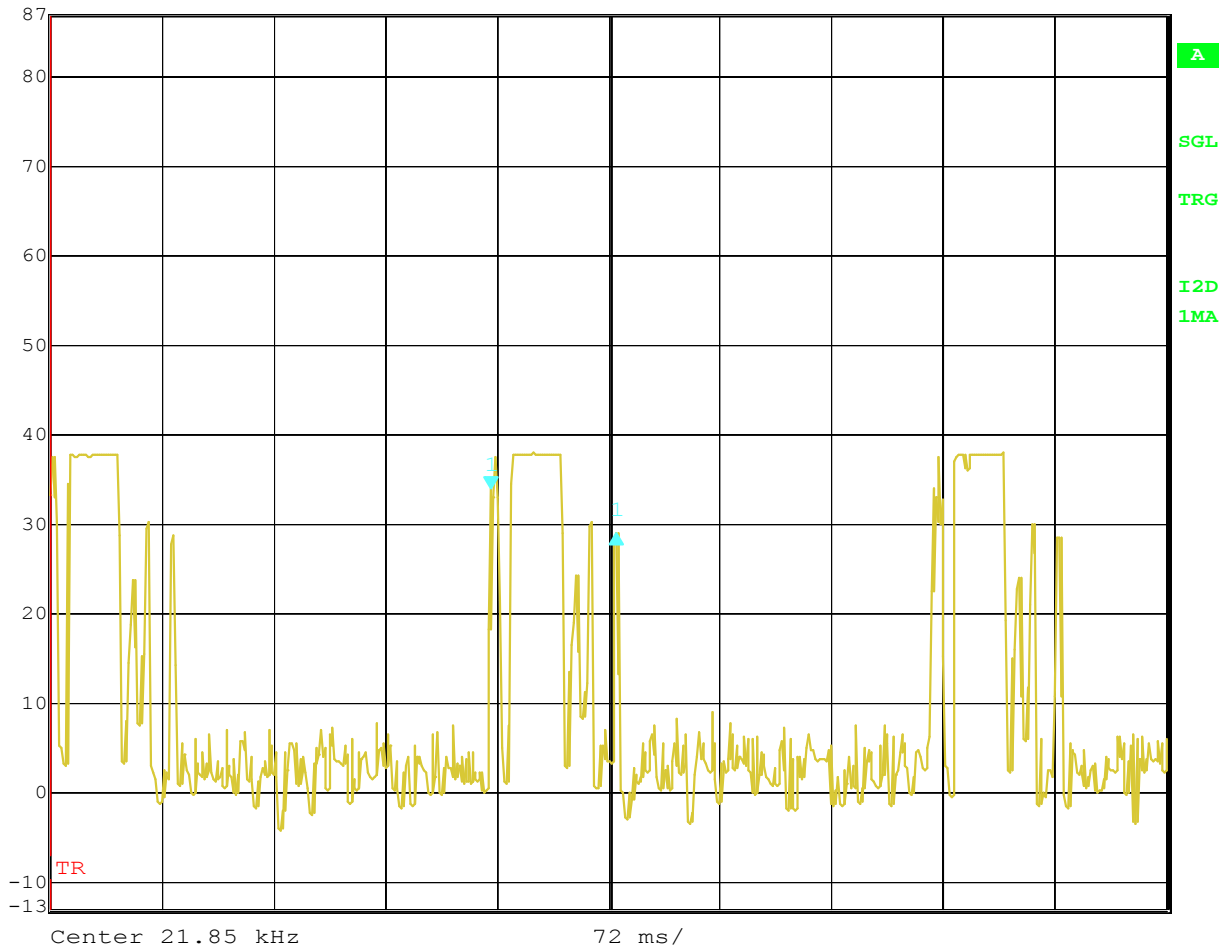
Delta 1 [T1] RBW 1 kHz RF Att 10 dB
Ref Lvl 0.09 dB VBW 1 kHz
87 dB μ V 285.691383 ms SWT 720 ms Unit dB μ V



Date: 18.NOV.2008 15:50:52

PLOT 10

 Delta 1 [T1] RBW 1 kHz RF Att 10 dB
Ref Lvl -5.08 dB VBW 1 kHz
87 dB μ V 80.801603 ms SWT 720 ms Unit dB μ V



Date: 18.NOV.2008 15:53:16

Duty cycle measured is 80.801603 ms, this is approximated to 81 ms and is used in calculations.

6 TEST EQUIPMENT AND ANCILLARIES USED FOR TESTS

No	Instrument/Ancillary	Type	Manufacturer	Serial No.	Cal Due	Interval
01	Spectrum Analyzer	ESIB 40	Rohde & Schwarz	100107	May 2009	1 year
02	Spectrum Analyzer	FSEM 30	Rohde & Schwarz	100017	May 2009	1 year
03	Signal Generator	SMY02	Rohde & Schwarz	836878/011	May 2009	1 year
04	Power-Meter	NRVD	Rohde & Schwarz	0857.8008.02	May 2009	1 year
05	Biconilog Antenna	3141	EMCO	0005-1186	June 2009	1 year
06	Horn Antenna (1-18GHz)	SAS-200/571	AH Systems	325	June 2009	1 year
07	Horn Antenna (18-26.5GHz)	3160-09	EMCO	1240	June 2009	1 year
08	Power Splitter	11667B	Hewlett Packard	645348	n/a	n/a
09	Climatic Chamber	VT4004	Voltsch	G1115	May 2009	1 year
10	High Pass Filter	5HC2700	Trilithic Inc.	9926013	n/a	n/a
11	High Pass Filter	4HC1600	Trilithic Inc.	9922307	n/a	n/a
12	Pre-Amplifier	JS4-00102600	Miteq	00616	May 2009	1 year
13	Power Sensor	URV5-Z2	Rohde & Schwarz	DE30807	May 2009	1 year
14	Universal Radio Comm. Tester	CMU 200	Rohde & Schwarz	832221/06	May 2009	1 year
15	LISN	ESH3-Z5	Rohde & Schwarz	836679/003	May 2009	1 year
16	Loop Antenna	6512	EMCO	00049838	July 2010	2 years

7 References

Title 47—Telecommunication, CHAPTER I--FEDERAL COMMUNICATIONS COMMISSION, PART 15--RADIO FREQUENCY DEVICES September 20, 2007.

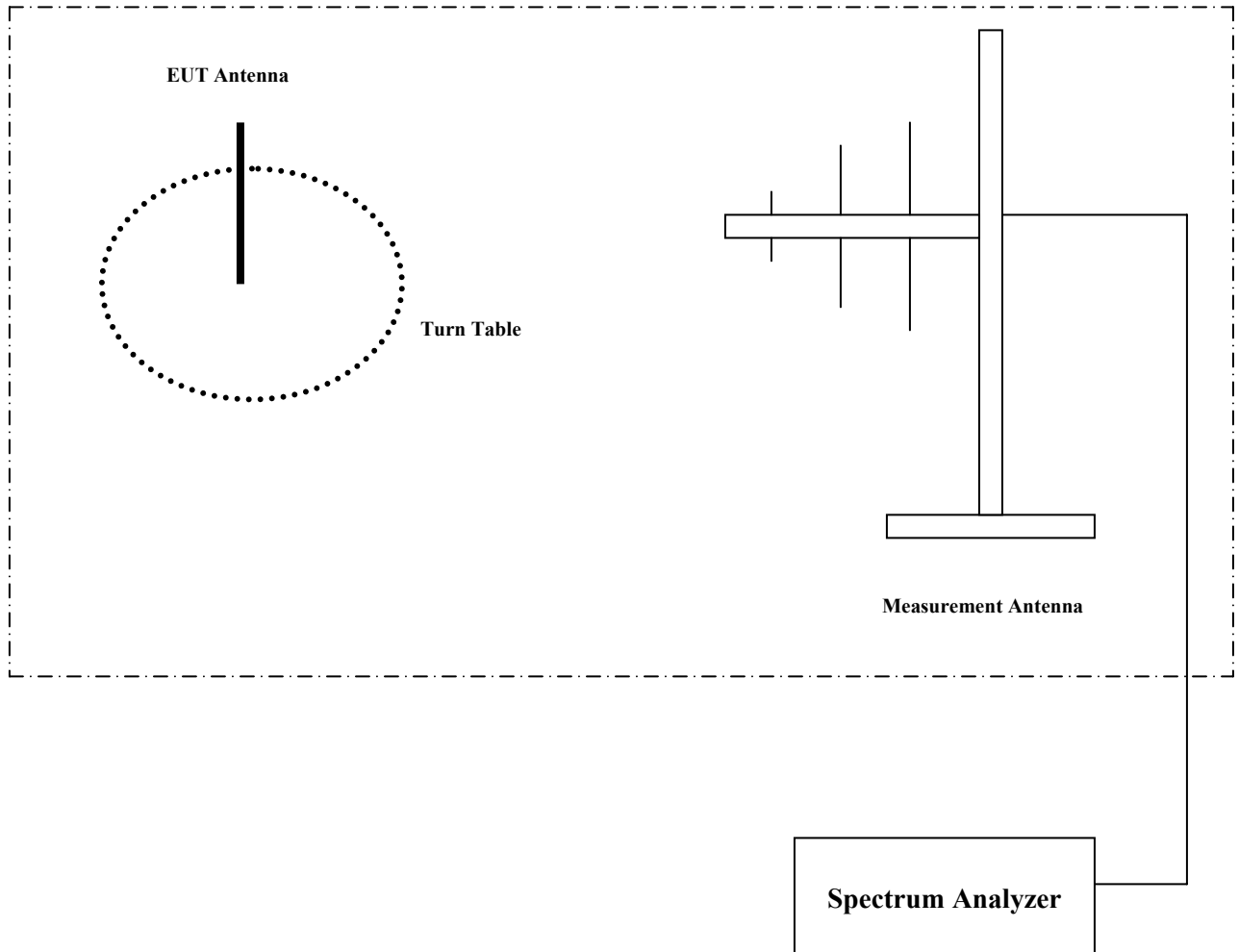
ANSI C63.4: American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz 30th January, 2004

RSS-210 Low-power Licence-exempt Radio communication Devices (All Frequency Bands): Category I Equipment

8 BLOCK DIAGRAMS

Radiated Testing

ANECHOIC CHAMBER



9 Revision History

2008-06-12- EMC_MARQU_001_08001_PEM_FCC15- Original report

2008-07-11- EMC_MARQU_001_08001_PEM_FCC15_rev1- Field strength measurement included

2008-11-06- EMC_MARQU_001_08001_PEM_FCC15_rev2- Field strength measurement result changed and tables listing peaks included.

2008-11-20- EMC_MARQU_001_08001_PEM_FCC15_rev3- Field strength measurement result changed, plots 9 and 10 added.

2008-12-31- EMC_MARQU_001_08001_PEM_FCC15_rev4- Field strength measurement result, plot 1 changed.