



Test Report
According to the relevant standard
47 CFR Part 15 C- Intentional Radiator
Measurement Procedure:
ANSI C63.4- 2003
&
RSS 210

FOR:

Remote Keyless Entry Device

MODEL #: FOBIK

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

Measurement of Radio-Noise Emissions
From Low-Voltage Electrical and Electronic Equipment
Technical characteristics and test methods for radio equipment
In the frequency range 9 kHz to 40 GHz

TEST REPORT #: EMC_MARQU_001_08001_FOBIK_FCC15.231_rev4
DATE: 2008-12-18



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

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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 RSS 210.

Company	Description	Model #
Marquardt Switches	Remote Keyless Entry Device	FOBIK

Technical responsibility for area of testing:

Marc Douat
 (EMC Project Engineer)

Date	Section	Name	Signature
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This report is prepared by:

Satya Radhakrishna
 (EMC Project Engineer)

Date	Section	Name	Signature
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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
Date of test:	2008-04-14 to 2008-04-18

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:	FOBIK
Description:	Remote Keyless Entry device
Model No:	FOBIK
FCC ID:	IYZ-C01C
IC ID:	2701A-C01C
Type(s) of Modulation:	ASK, FSK
Number of Channels:	1
Antenna Type:	Loop Antenna
Maximum measured field strength:	85.93 dBμV/m

3.2 Identification of the Equipment Under Test (EUT)

EUT #	TYPE	MANF.	MODEL	SERIAL #
1	Remote Keyless Entry device	Marquardt Switches	FOBIK	Unknown

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.

All testing was performed on EUT with output power of -13 dBm.

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 Parts 15.209 and 15.231 of Title 47 of the Code of Federal Regulations and Industry Canada rules RSS 210, Issue 7, June 2007. The maximization of portable equipment is conducted in accordance with ANSI C63.4.

5 Measurements

CFR Section	Report Chapter	Requirements Headline	Test Results		
			OK		
15.203	10.1	Antenna Requirement	pass	fail	n.a.
15.231(b)	10.2	Field strength limits(fundamental)	pass	fail	n.a.
15.205(b) 15.209	10.2	Radiated spurious emissions	pass	fail	n.a.
15.231(a)	10.3	Periodic operation characteristics	pass	fail	n.a.
15.231(c)	10.4	20 dB bandwidth	pass	fail	n.a.
15.201(a) 15.209	10.5	Equipment authorization requirement	pass	fail	n.a.

Test requirements kept	yes	no
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5.1 Antenna requirement

5.1.1 Regulation

15.203 An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this Section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of Sections 15.211, 15.213, 15.217, 15.219, or 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with Section 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this Part are not exceeded.

5.1.2 Result

The equipment meets the requirements	yes
Test requirements kept	yes

5.2 Radiated Emissions

5.2.1 Regulation FCC15.231/ RSS 210

Fundamental Field Strength of Field Strength of Frequency Fundamental Spurious Emissions
 (MHz) (microvolts/meter)

Fundamental Frequency (MHz)	Field Strength of fundamental ($\mu\text{V/m}$)	Field Strength of Spurious emissions ($\mu\text{V/m}$)
40.66 - 40.70	2,250	225
70 - 130	1,250	125
130 - 174	1,250 to 3,750	125 to 375
174 - 260	3,750	375
260 - 470	3,750 to 12,500	375 to 1,250
Above 470	12,500	1,250

** Linear interpolations

[Where F is the frequency in MHz, the formulas for calculating the maximum permitted fundamental field strengths are as follows: for the band 130-174 MHz, $\mu\text{V/m}$ at 3 meters = $56.81818(F) - 6136.3636$; for the band 260-470 MHz, $\mu\text{V/m}$ at 3 meters = $41.6667(F) - 7083.3333$. The maximum permitted unwanted emission level is 20 dB below the maximum permitted fundamental level.]

- (1) The above field strength limits are specified at a distance of 3 meters. The tighter limits apply at the band edges.
- (2) Intentional radiators operating under the provisions of this Section shall demonstrate compliance with the limits on the field strength of emissions, as shown in the above table, based on the average value of the measured emissions. As an alternative, compliance with the limits in the above table may be based on the use of measurement instrumentation with a CISPR quasi-peak detector. The specific method of measurement employed shall be specified in the application for equipment authorization. If average emission measurements are employed, the provisions in Section 15.35 for averaging pulsed emissions and for limiting peak emissions apply. Further, compliance with the provisions of Section 15.205 shall be demonstrated using the measurement instrumentation specified in that section.
- (3) The limits on the field strength of the spurious emissions in the above table are based on the fundamental frequency of the intentional radiator. Spurious emissions shall be attenuated to the average (or, alternatively, CISPR quasi-peak) limits shown in this table or to the general limits shown in Section 15.209, whichever limit permits higher field strength.

Section 15.33 Frequency range of radiated measurements.

(a) Unless otherwise noted in the specific rule section under which the equipment operates for an intentional radiator the spectrum shall be investigated from the lowest radio frequency signal generated in the device, without going below 9 kHz, up to at least the frequency shown in this paragraph:

(1) If the intentional radiator operates below 10 GHz: to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

5.2.2 Test Procedures

The EUT and the peripheral device (when additional equipment exists) are placed on a turn table which is 0.8 m above the ground. The turn table would be allowed to rotate 360 degrees to determine the position of the maximum emission level. The test distance between the EUT and the receiving antenna are 3m. To find the maximum emission, the polarization of the receiving antenna are changed in horizontal and vertical polarization, the position of the EUT was changed in different orthogonal determinations. ANSI C63.4 1992 Section 8 "Radiated Emissions Testing"

* According to Section 15.31 (f) (1): At frequencies at or above 30 MHz, measurements may be performed at a distance other than what is specified provided: measurements are not made in the near field except where it can be shown that near field measurements are appropriate due to the characteristics of the device; and it can be demonstrated that the signal levels needed to be measured at the distance employed can be detected by the measurement equipment. Measurements shall not be performed at a distance greater than 30 meters unless it can be further demonstrated that measurements at a distance of 30 meters or less are impractical. When performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade (inverse linear-distance for field strength measurements; inverse-linear-distance-squared for power density measurements).

5.2.3 Duty cycle

FOBIK DUTY CYCLE MEASUREMENT PROCEDURE

1. There's a duty cycle in sending the data packets out. Duty cycle in this case means time relation between when RF information is sent and when RF information is not sent.

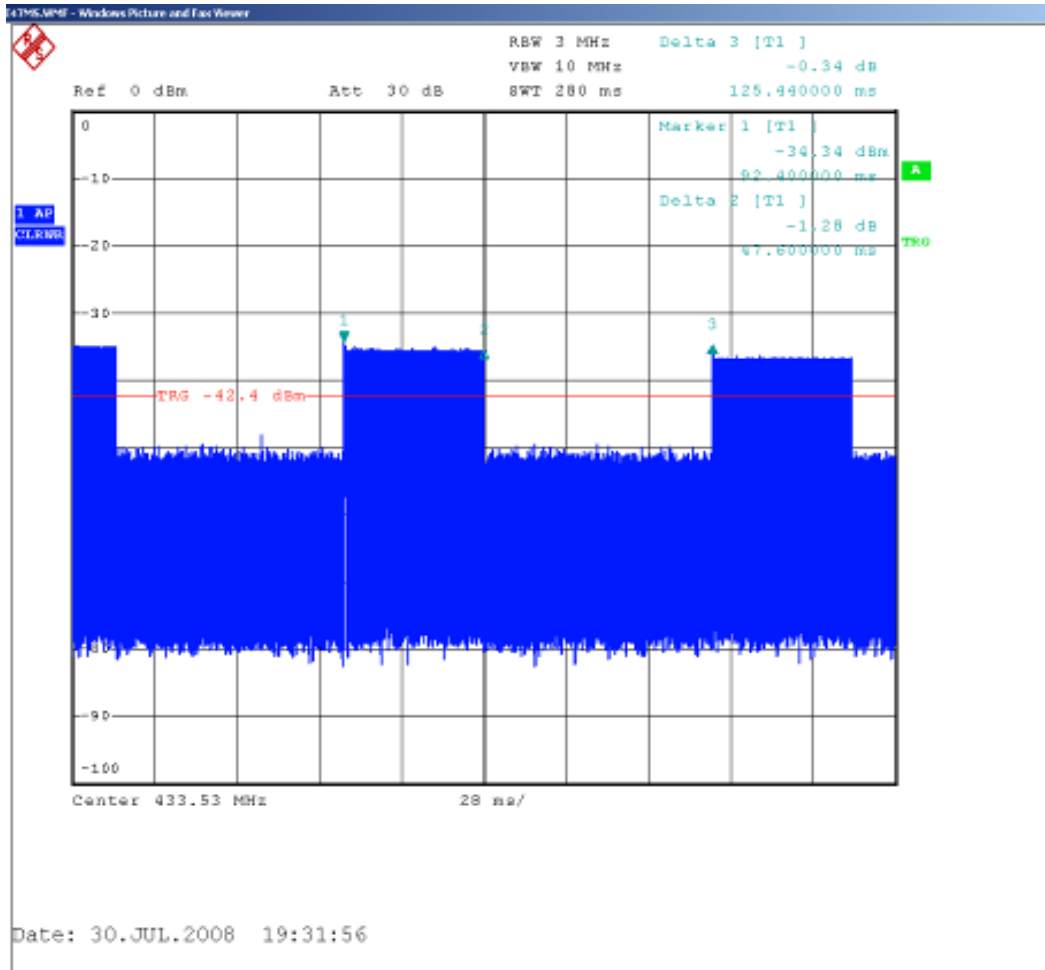
1a. The Duty Cycle for RKE is depending on the CS-XXXX 122806 Specification where the sending of the RKE is described. At the button press 2,4kBaud ASK modulated packets with a length of 48ms in a repeating time every 125ms are sent. The used ASK modulation is a complete on/ off modulation. The key itself has a diagnostic mode, where a constantly sending of the 2,4kBaud modulated ASK Signal can be set over button press (See Point 2 how to activate) to check the ASK Modulation itself.

1b. At the keyless communication which can be started over a door handle activation or a start stop button press, the key sends only a single 10 kBaud FSK modulated signal with a length of 6.45ms The theoretical repeating time is given by the time setting of the PEM, which is 300ms. So theoretical every 300ms the signal can be send.

2. The Duty cycles regarding the ASK and FSK modulated signal.

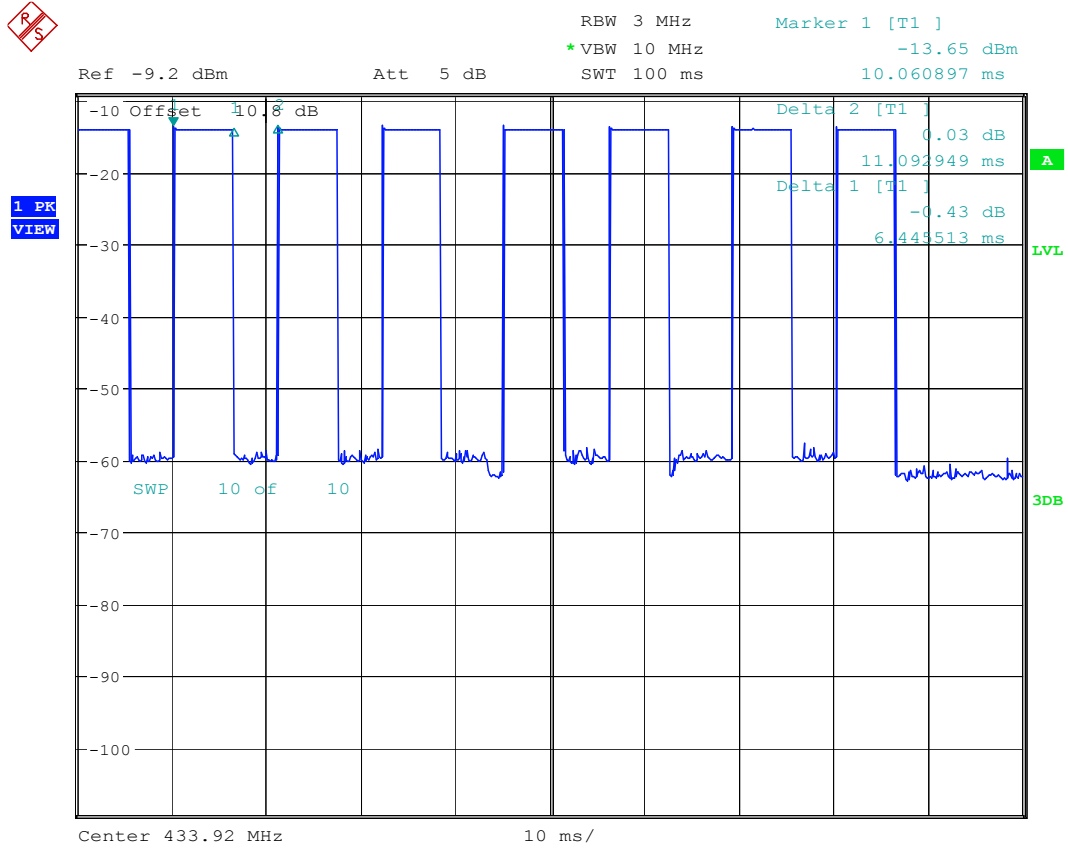
To measure directly the duty cycle of the ASK or FSK modulated signals, the key has an internal diagnostic mode, which can be activated over transponder communications. These measurements are also done at the EOL. (see the abstract from the diagnostic specifications). In this mode the key is continuously transmitting the set mode for 1 minute. So a continuously ASK or FSK modulated signal can be measured. The key can be set into diagnostic mode with the Fobik Tester: -> EEPROM Utility -> Diagnostic -> Set the "RF test bm" insert the key and press the "Write" button. Verify with the "Read" button, if diagnostic mode is activated. After that the diagnostic can be activated by pressing the lock button. A screen shot of the duty cycle measurement is provided in the next page.

PLOT 5.2.3A FOBK DUTY CYCLE- ASK MODULATION



Based on the plot the duty cycle measured is 47.8 ms and is approximated to 48ms throughout this report.

PLOT 5.2.3B FOBK DUTY CYCLE-FSK MODULATION



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5.2.4 Measuring the fundamental

The fundamental of the unit is measured with the unit placed in horizontal, vertical and side orientations with the measuring antenna in horizontal and vertical polarizations. The orientation of the EUT and the antenna polarization at which the maximum is measured is used for the remainder of the radiated spurious measurements.

The measurements were made with a peak detector. They are converted into average values with this formula.

$$\text{Average} = \text{Peak Value} + 20\log((\text{duty cycle}/100))$$

The duty cycle of the EUT for ASK Modulation is 48 ms. The duty cycle of the EUT for FSK Modulation is 6.45 ms

ASK MODULATION

Antenna Polarization	EUT orientation	Average value (dBμV/m)
V	V	79.55
V	H	62.42
V	S	79.13
H	V	70.98
H	H	69.68
H	S	72.15

According to FCC 15.231(b), Where F is the frequency in MHz, the formulas for calculating the maximum permitted fundamental field strengths are as follows:for the band 260-470 MHz, μV/m at 3 meters = 41.6667(F) - 7083.3333 is the limit. Since the fundamental frequency is 433.92 MHz, the limit is 41.6667(433.92) - 7083.3333=10996.68 μV/m= **80.825 dBμV/m**. Based on the table above, the measured values are within the limit.

So the maximum value was measured with the EUT in Vertical position and the Antenna is vertical polarization.

FSK MODULATION

Antenna Polarization	EUT orientation	Average value (dBμV/m)
V	V	53.76

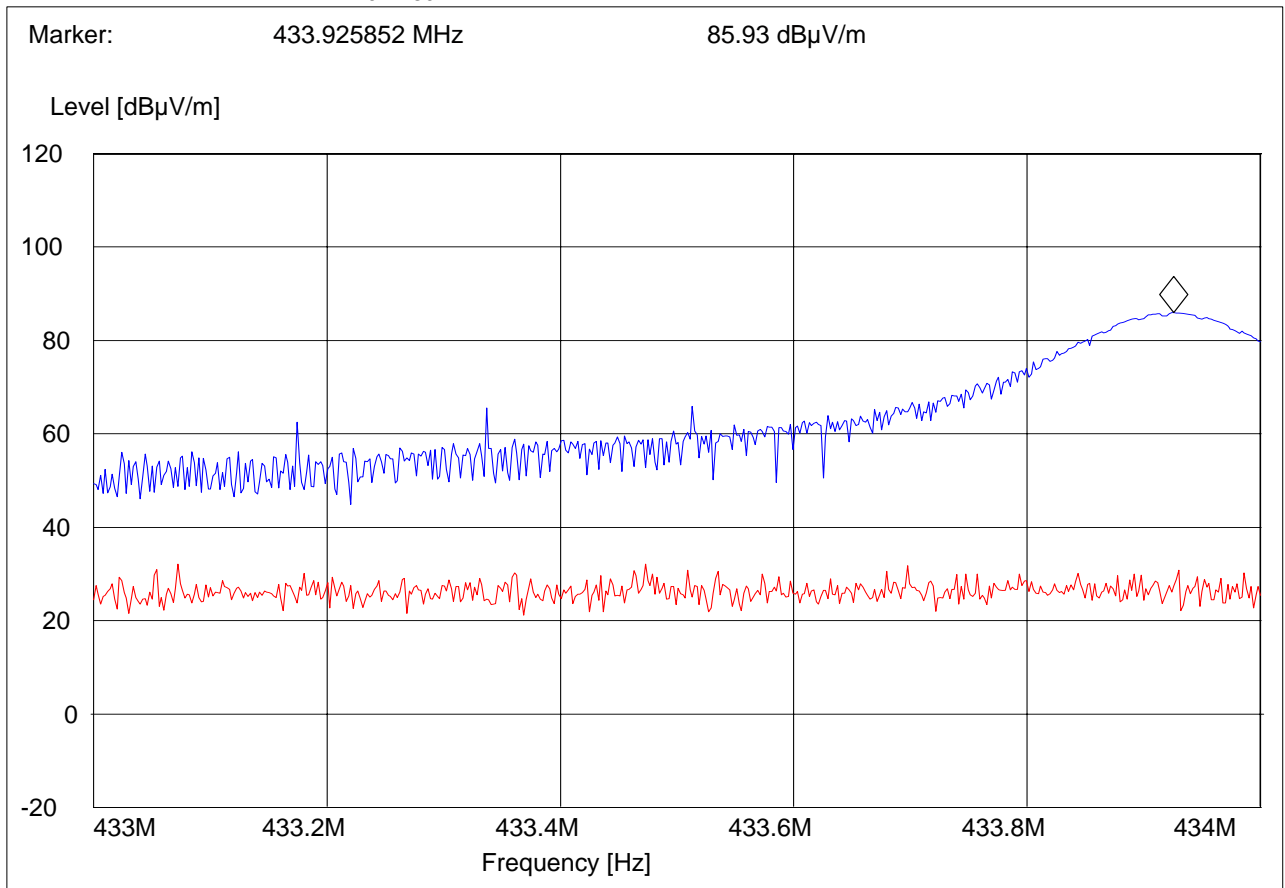


PLOT 5.2.4A – ASK MODULATION
ANTENNA: VERTICAL / EUT: VERTICAL

EUT: FOBK
Customer:: MARQUARDT SWITCHES
Test Mode: tx 433 MHz
ANT Orientation: V
EUT Orientation: V
Test Engineer: SATYA
Voltage: BATTERY
Comments:: -13dBm o/p

SWEEP TABLE: "FCC15.231_433M_Ver"

Start Frequency	Stop Frequency	Detector	Meas. Time	IF Bandw.	Transducer
433.0 MHz	434.0 MHz	MaxPeak MaxPeak	Coupled	100 kHz	3141-#1186_Vert



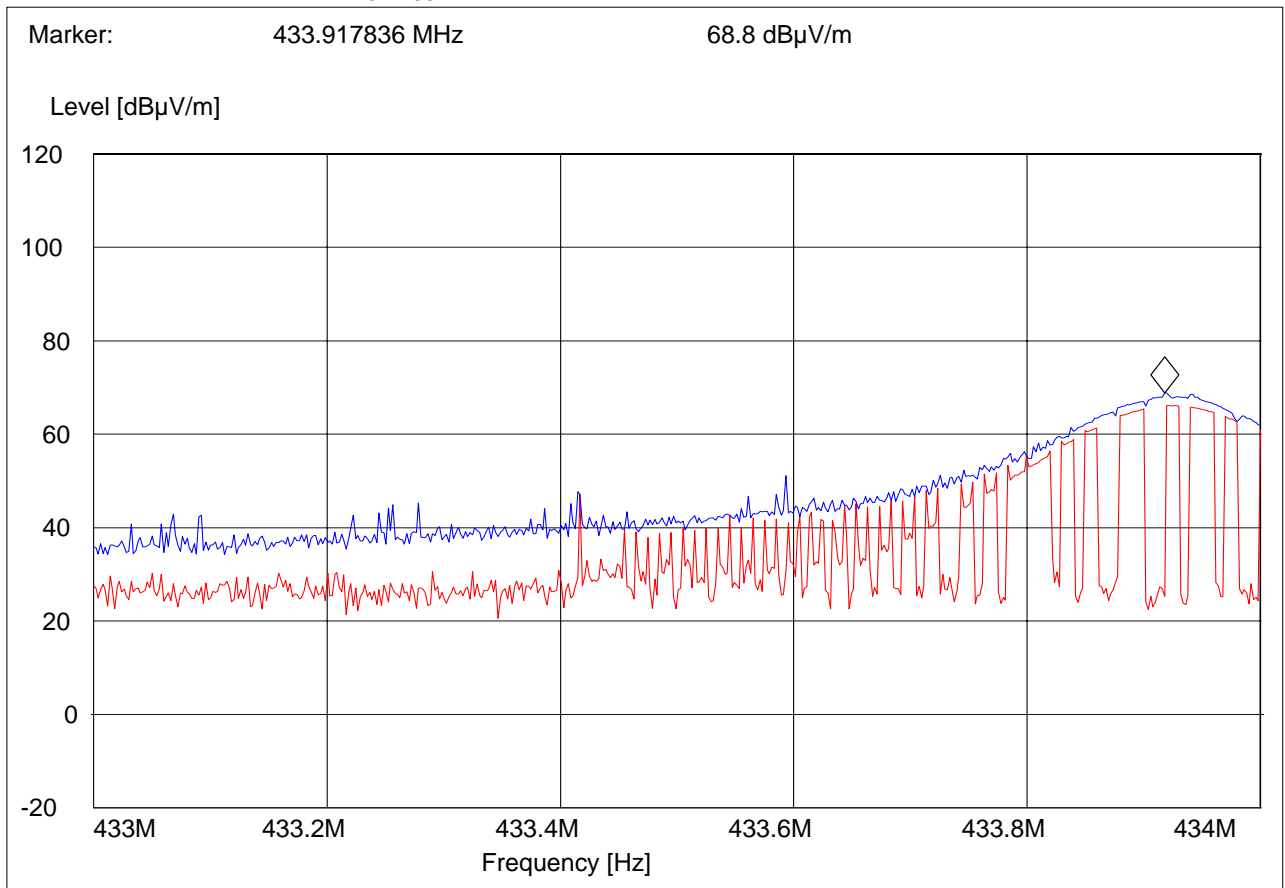


PLOT 5.2.4B - ASK MODULATION
ANTENNA: VERTICAL / EUT: HORIZONTAL

EUT: FOBIK
 Customer:: MARQUARDT SWITCHES
 Test Mode: tx 433 MHz
 ANT Orientation: V
 EUT Orientation: H
 Test Engineer: SATYA
 Voltage: BATTERY
 Comments:: -13dBm o/p

SWEEP TABLE: "FCC15.231_433M_Ver"

Start Frequency	Stop Frequency	Detector	Meas. Time	IF Bandw.	Transducer
433.0 MHz	434.0 MHz	MaxPeak	Coupled	100 kHz	3141-#1186_Vert
		MaxPeak			

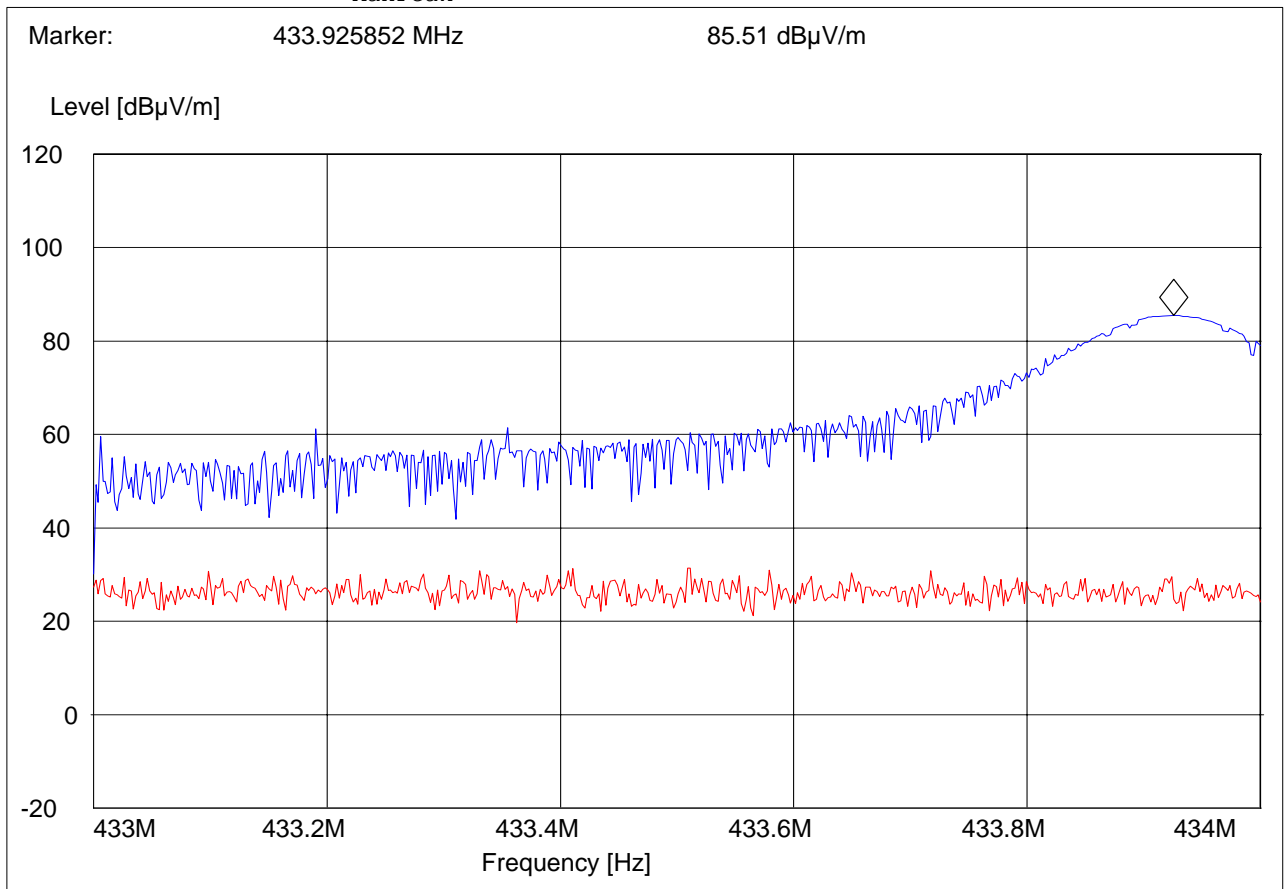


PLOT 5.2.4C -ASK MODULATION
ANTENNA: VERTICAL / EUT: SIDE

EUT: FOBIK
 Customer:: MARQUARDT SWITCHES
 Test Mode: tx 433 MHz
 ANT Orientation: V
 EUT Orientation: SIDE
 Test Engineer: SATYA
 Voltage: BATTERY
 Comments:: -13dBm o/p

SWEEP TABLE: "FCC15.231_433M_Ver"

Start Frequency	Stop Frequency	Detector	Meas. Time	IF Bandw.	Transducer
433.0 MHz	434.0 MHz	MaxPeak	Coupled	100 kHz	3141-#1186_Vert
		MaxPeak			



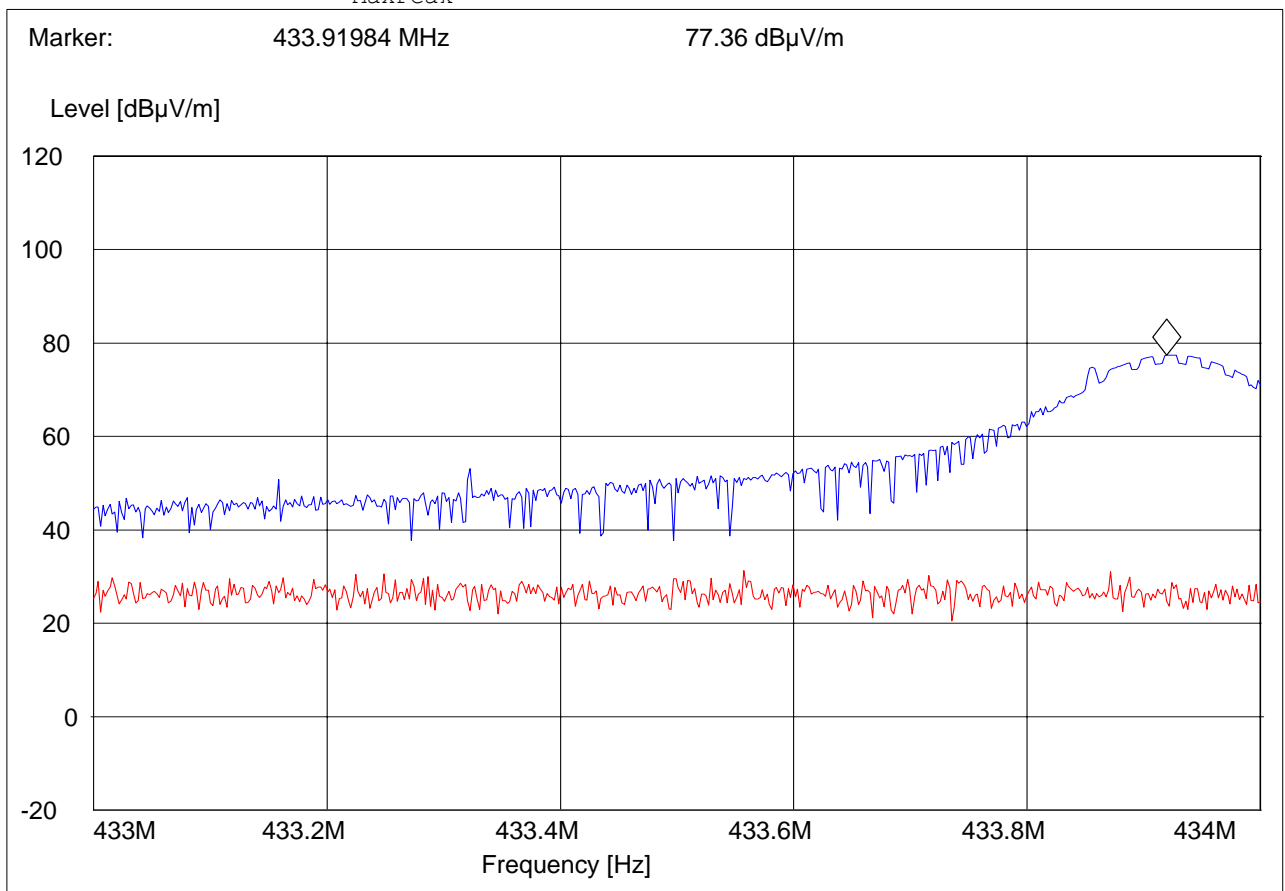


PLOT 5.2.4D- ASK MODULATION
ANTENNA: HORIZONTAL / EUT: VERTICAL

EUT / Description: FOBIK
 Manufacturer: MARQUARDT SWITCHES
 Operation Mode: tx 433 MHz
 ANT Orientation: : H
 EUT Orientation:: V
 Test Engineer: SATYA
 Voltage: BATTERY
 Comments:: -13dBm o/p

SWEEP TABLE: "FCC15.231_433M_Hor"

Start Frequency	Stop Frequency	Detector	Meas. Time	IF Bandw.	Transducer
433.0 MHz	434.0 MHz	MaxPeak	Coupled	100 kHz	3141-#1186_Horz
		MaxPeak			



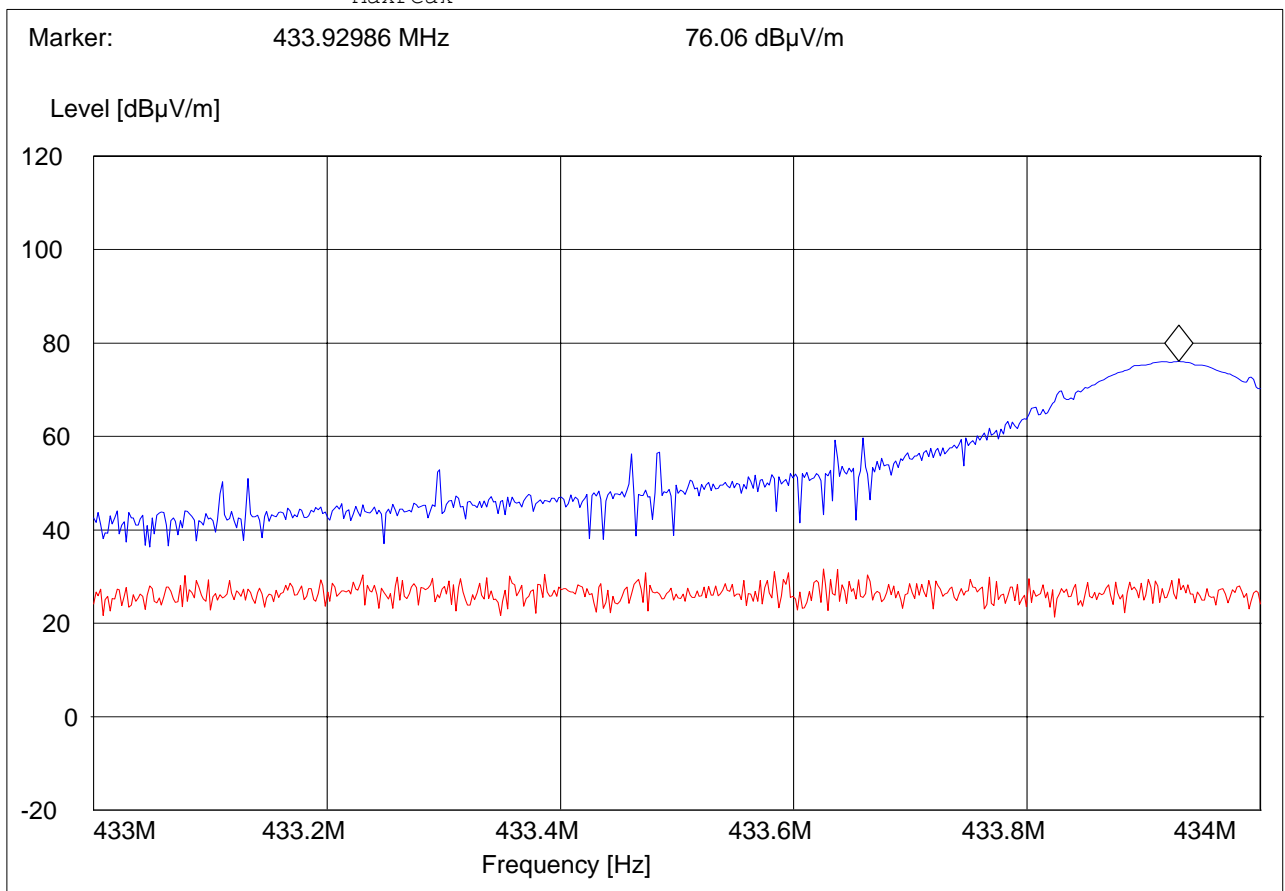


PLOT 5.2.4E –ASK MODULATION
ANTENNA: HORIZONTAL / EUT: HORIZONTAL

EUT / Description: FOBIK
 Manufacturer: MARQUARDT SWITCHES
 Operation Mode: tx 433 MHz
 ANT Orientation: : H
 EUT Orientation:: H
 Test Engineer: SATYA
 Voltage: BATTERY
 Comments:: -13dBm o/p

SWEEP TABLE: "FCC15.231_433M_Hor"

Start Frequency	Stop Frequency	Detector	Meas. Time	IF Bandw.	Transducer
433.0 MHz	434.0 MHz	MaxPeak	Coupled	100 kHz	3141-#1186_Horz
		MaxPeak			



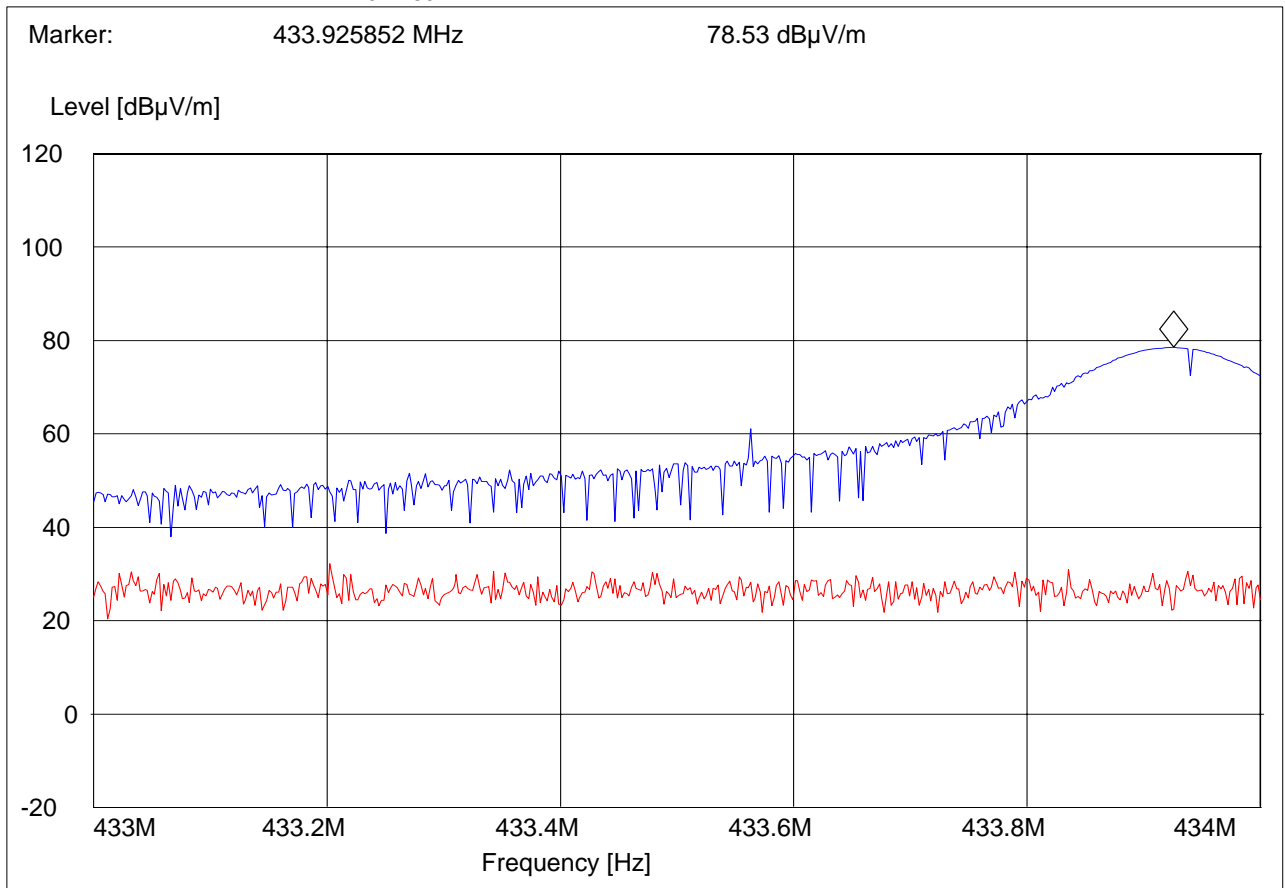


PLOT 5.2.4F –ASK MODULATION
ANTENNA: HORIZONTAL / EUT: SIDE

EUT / Description: FOBK
Manufacturer: MARQUARDT SWITCHES
Operation Mode: tx 433 MHz
ANT Orientation: : H
EUT Orientation:: SIDE
Test Engineer: SATYA
Voltage: BATTERY
Comments:: -13dBm o/p

SWEEP TABLE: "FCC15.231_433M_Hor"

Start Frequency	Stop Frequency	Detector	Meas. Time	IF Bandw.	Transducer
433.0 MHz	434.0 MHz	MaxPeak MaxPeak	Coupled	100 kHz	3141-#1186_Horz

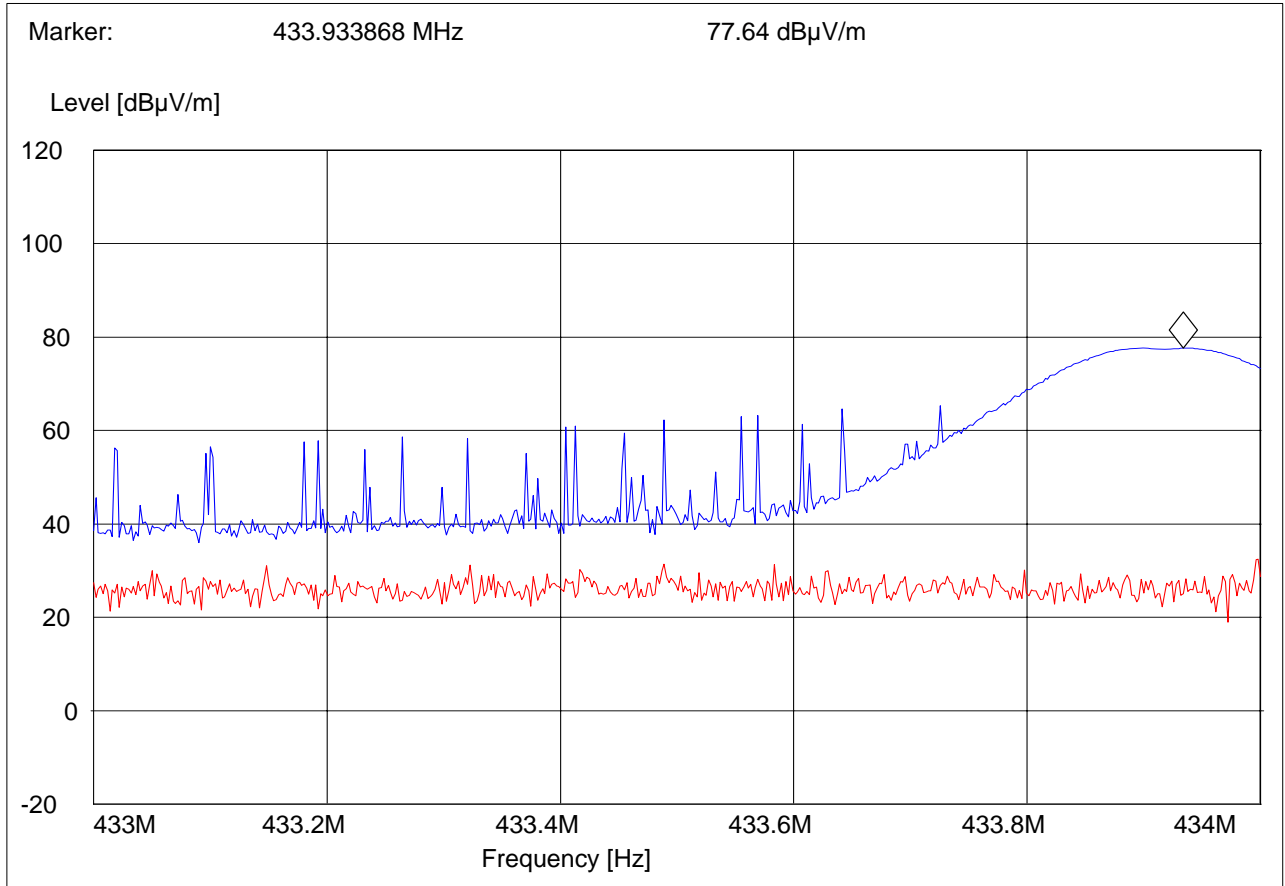




PLOT 5.2.4G –FSK MODULATION
ANTENNA: VERTICAL / EUT: VERTICAL

EUT: FOBIK
 Customer:: MARQUARDT SWITCHES
 Test Mode: TX 433.92 MHz FSK Modulation
 ANT Orientation: V
 EUT Orientation: V
 Test Engineer: Satya
 Voltage: Battery
 Comments:
SWEEP TABLE: "FCC15.231_433M_Ver"

Start Frequency	Stop Frequency	Detector	Meas. Time	IF Bandw.	Transducer
433.0 MHz	434.0 MHz	MaxPeak	Coupled	100 kHz	3141-#1186_Vert
		MaxPeak			



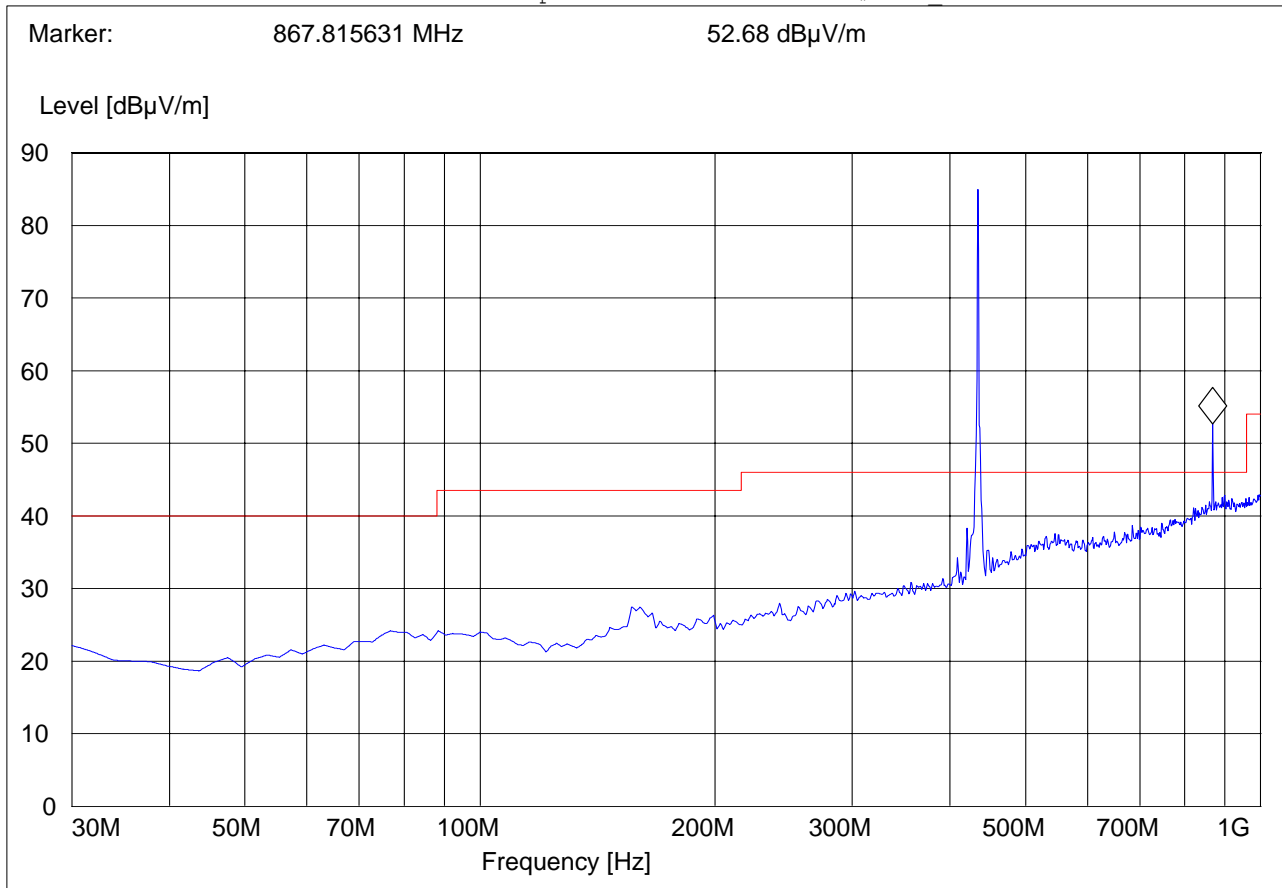
PLOT 5.2.4H :30 M-1G (Vertical)-ASK MODULATION

EUT: FOBIK
 Customer:: MARQUARDT
 Test Mode: TX 433 MHz
 ANT Orientation: V / EUT Orientation: V
 Voltage: BATTERY

Comments: Unmarked peak over limit is fundamental. According to FCC 15.231(b), Where F is the frequency in MHz, the formulas for calculating the maximum permitted fundamental field strengths are as follows:for the band 260-470 MHz, $\mu\text{V}/\text{m}$ at 3 meters = $41.6667(F) - 7083.3333$ is the limit. Since the fundamental frequency is 433.92 MHz, the limit is $41.6667(433.92) - 7083.3333=10996.68 \mu\text{V}/\text{m}= 80.825 \text{ dB}\mu\text{V}/\text{m}$. The maximum permitted unwanted emission level is 20 dB below the maximum permitted fundamental level. So this is **60.825 dB $\mu\text{V}/\text{m}$** . The unmarked fundamental is approximated to be 86 dB $\mu\text{V}/\text{m}$. The measurements were made with a peak detector. They are converted into average values (because the limits are average limits) with this formula, $86+20\log((\text{duty cycle}/100))=79.62 \text{ dB}\mu\text{V}/\text{m}$. The harmonic@ 867.8156 MHz and 52.68 dB $\mu\text{V}/\text{m}$ is below the 60.825 dB $\mu\text{V}/\text{m}$ limit.

SWEEP TABLE: "FCC15.247_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 line		
No.	Frequency (MHz)	Peak value (dB $\mu\text{V}/\text{m}$)
1	821.81816	41.2
2	839.9996	41.2
3	854.5454	41.6
4	863.6363	42
5	898.23	42.7
6	954.5454	42.5



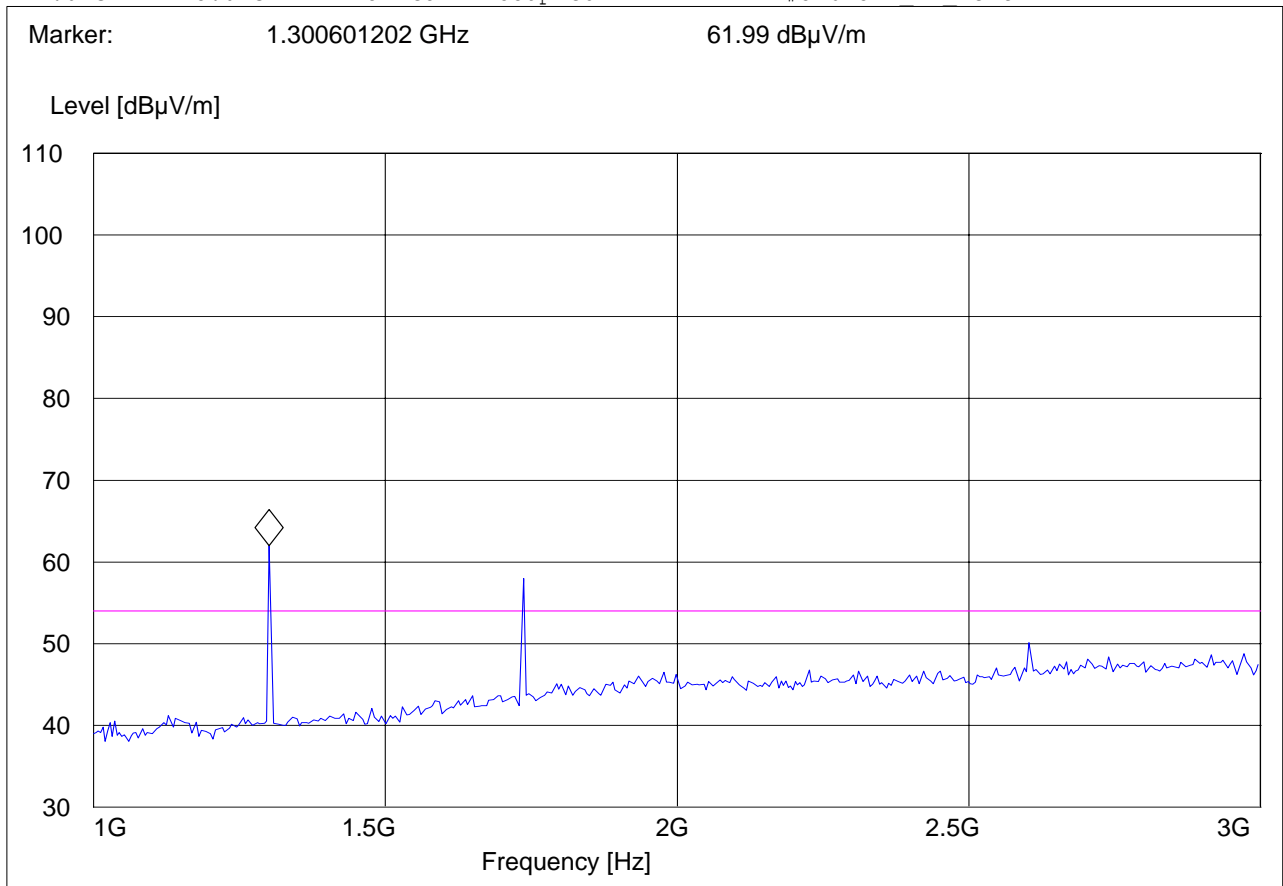
PLOT 5.2.4I
1-3G -ASK MODULATION

EUT: FOBIK
Customer:: Marquardt Switches
Test Mode: Tx@ 433.92
ANT Orientation: V
EUT Orientation: V
Test Engineer: Satya
Voltage: Battery

Comments: According to FCC 15.231(b), for the band 260-470 MHz, $\mu\text{V/m}$ at 3 meters = $41.6667(F) - 7083.3333$ is the limit. Since the fundamental frequency is 433.92 MHz, the limit is $41.6667(433.92) - 7083.3333=10996.68 \mu\text{V/m}= 80.825 \text{ dB}\mu\text{V/m}$. Since the measurement was made at 1 meter, the limit is extrapolated from 3 meters to 1 meter by adding a factor of 9.5 dB. The limit is therefore **80.825 dB $\mu\text{V/m}$ + 9.5 dB=90.325 dB $\mu\text{V/m}$** . The maximum permitted unwanted emission level is 20 dB below the maximum permitted fundamental level. So the limit is **70.325 dB $\mu\text{V/m}$** . So the emission at 61.99 dB $\mu\text{V/m}$ is below the limit.

SWEEP TABLE: "FCC15.247_1-3G"

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



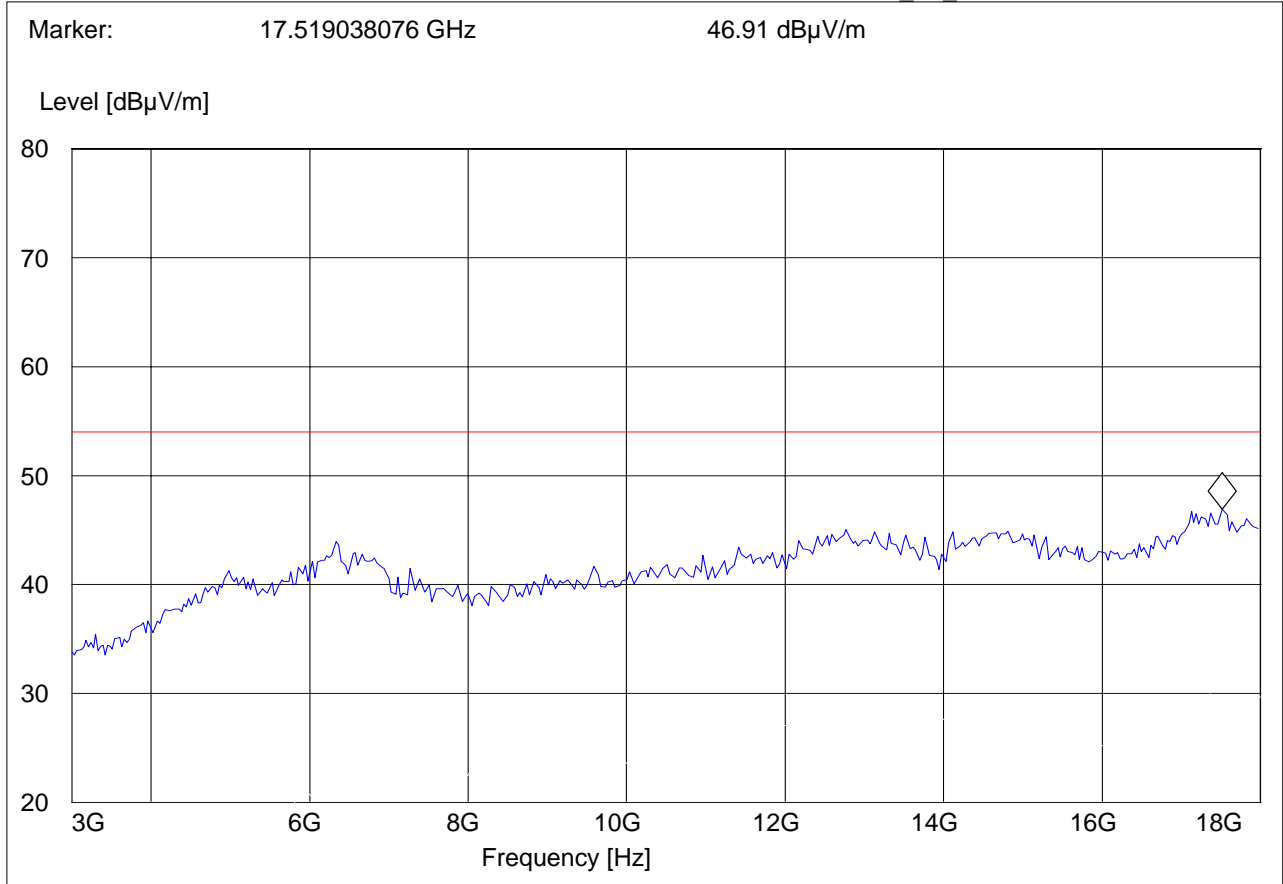
Peaks less than 20 dB from the limit line		
No.	Frequency (MHz)	Peak value (dB $\mu\text{V/m}$)
1	1737.705	58.261 [Emissions limit is 70.325 dB $\mu\text{V/m}$. See comments]
2	2225.6	46.0869
3	2603.615	50.21562
4	2670.66	47.82625
5	2743.8	48.261
6	2916.898	48.4349

PLOT 5.2.4J
3-18 G- ASK MODULATION

EUT: FOBIK
 Customer:: MARQUARDT SWITCHES
 Test Mode: tx 433 MHz
 ANT Orientation: V
 EUT Orientation: V
 Test Engineer: SATYA
 Voltage: Battery

SWEEP TABLE: "FCC15.247_3-18G"

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



Peaks less than 20 dB from the limit		
No.	Frequency (MHz)	Peak value (dBµV/m)
1	17519.038076	46.91
2	17316.36364	46.57
3	17226.362	46.45162
4	17386.3624	46.50
5	17680.90759	45.80646
6	18099.99813	45.8



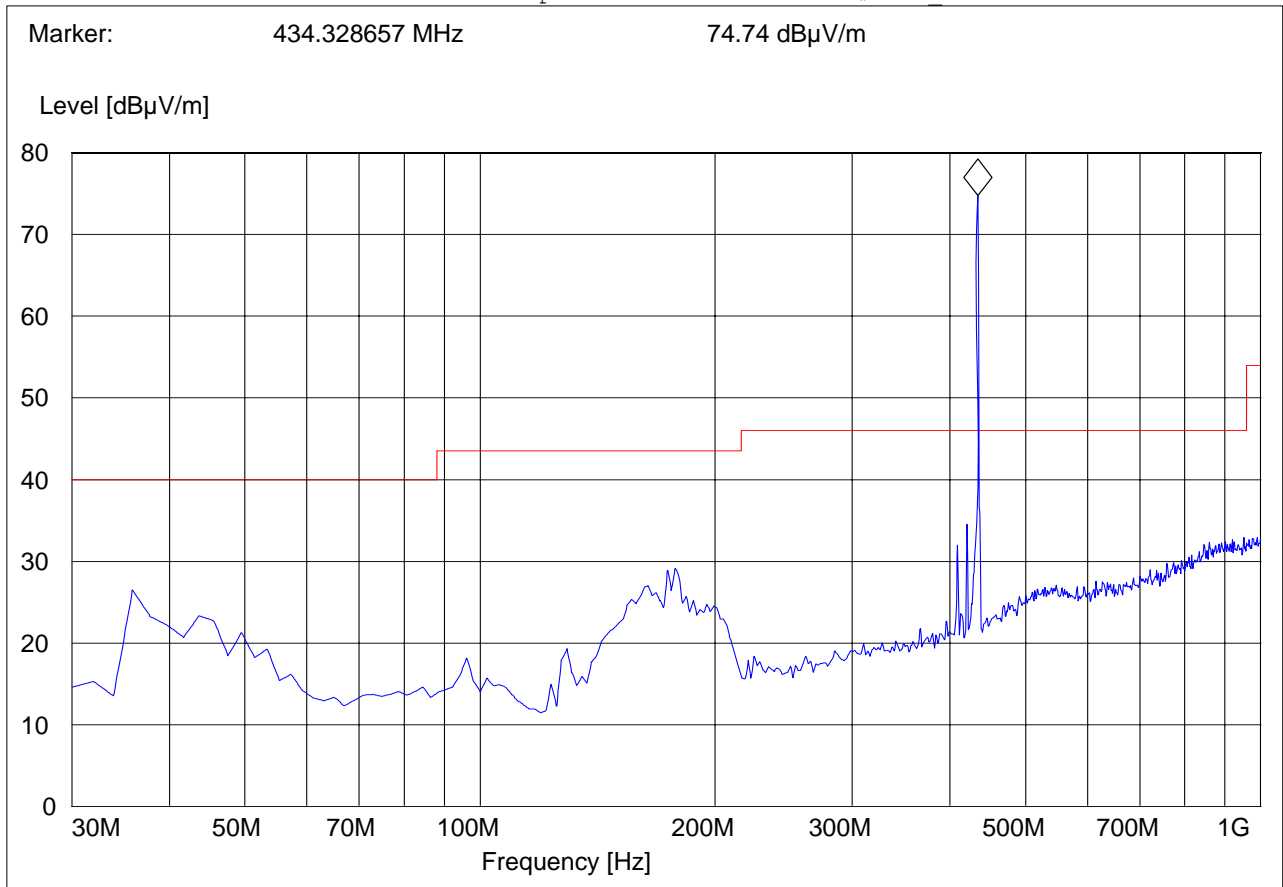
PLOT 5.2.4K
30MHz -1GHz FSK MODULATION

EUT: FOBIK
Customer:: MARQUARDT SWITCHES
Test Mode: TX 433 MHz: FSK MODULATION
ANT Orientation: V
EUT Orientation: V
Test Engineer: SATYA
Voltage: BATTERY

Comments: Marker placed on fundamental. According to FCC 15.231(b), Where F is the frequency in MHz, the formulas for calculating the maximum permitted fundamental field strengths are as follows:for the band 260-470 MHz, $\mu\text{V/m}$ at 3 meters = $41.6667(F) - 7083.3333$ is the limit. Since the fundamental frequency is 433.92 MHz, the limit is $41.6667(433.92) - 7083.3333=10996.68 \mu\text{V/m} = 80.825 \text{ dB}\mu\text{V/m}$

SWEEP TABLE: "FCC15.247_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 (dB $\mu\text{V/m}$)
1	535.41082	37.04
2	688.9779	38.32
3	799.779	40.50
4	828.937876	41.82
5	908.637275	43.27
6	974.729459	42.82

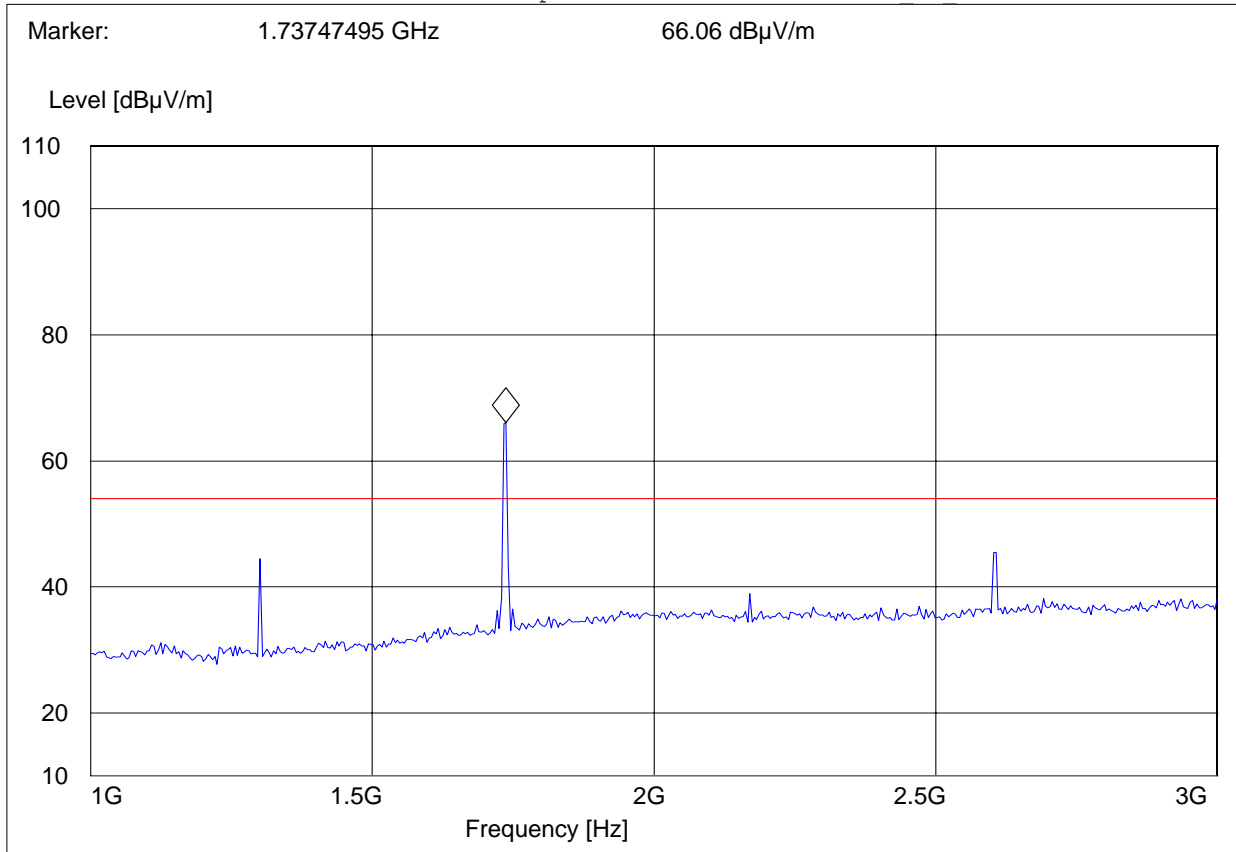
PLOT 5.2.4L
1-3 GHz FSK MODULATION

EUT: FOBK
Customer:: MARQUARDT SWITCHES
Test Mode: TX FSK
ANT Orientation: V
EUT Orientation: V
Test Engineer: Satya
Voltage: Battery

According to FCC 15.231(b), for the band 260-470 MHz, $\mu\text{V/m}$ at 3 meters = $41.6667(F) - 7083.3333$ is the limit. Since the fundamental frequency is 433.92 MHz, the limit is $41.6667(433.92) - 7083.3333=10996.68 \mu\text{V/m}= 80.825 \text{ dB}\mu\text{V/m}$. Since the measurement was made at 1 meter, the limit is extrapolated from 3 meters to 1 meter by adding a factor of 9.5 dB. The limit is therefore **80.825 dB $\mu\text{V/m}$ + 9.5 dB=90.325 dB $\mu\text{V/m}$** . The maximum permitted unwanted emission level is 20 dB below the maximum permitted fundamental level. So the limit is **70.325 dB $\mu\text{V/m}$** . So the emission at 66.06 dB $\mu\text{V/m}$ is below the limit.

SWEEP TABLE: "FCC15.247_1-3G"

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



Peaks less than 20 dB from the limit		
No.	Frequency (MHz)	Peak value (dB $\mu\text{V/m}$)
1	1300.6	44.18
2	2170.34	38.92
3	2603.2064	45.47
4	2691.3827	38.20
5	2935.87	38.09
6	2955.911824	37.81



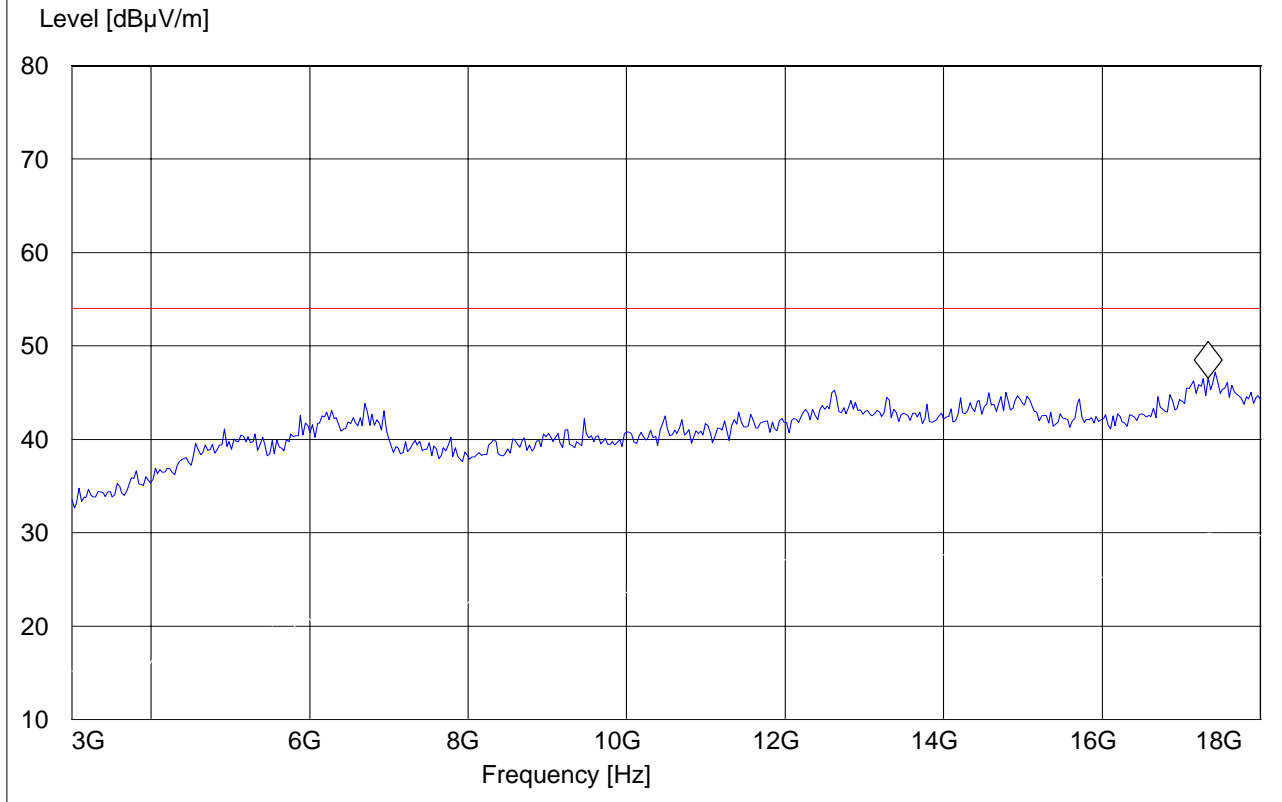
PLOT 5.2.4M
3-18 GHz FSK MODULATION

EUT: FOBK
 Customer:: MARQUARDT SWITCHES
 Test Mode: TX FSK
 ANT Orientation: V
 EUT Orientation: V
 Test Engineer: Satya
 Voltage: Battery

SWEEP TABLE: "FCC15.247_3-18G"

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

Marker: 17.338677355 GHz 46.55 dBµV/m



Peaks less than 20 dB from the limit		
No.	Frequency (MHz)	Peak value (dBµV/m)
1	14573.14629	44.11
2	15685.370741	43.88
3	16857.715431	44.77
4	17248.496994	45.69
5	17698.19639	45.42
6	17879.759	45.06

5.3 Periodic operation characteristics

5.3.1 Periodic operation

5.3.1.1 Regulation

15.231 (a) The provisions of this Section are restricted to periodic operation within the band 40.66-40.70 MHz and above 70 MHz. Except as shown in paragraph (e) of this Section, the intentional radiator is restricted to the transmission of a control signal such as those used with alarm systems, door openers, remote switches, etc. Continuous transmissions, voice, video and the radio control of toys are not permitted. Data is permitted to be sent with a control signal.

5.3.1.2 Result

The equipment meets the requirements	n. a.
Further test results are attached	n. a.

5.3.2 Manually operated transmitter deactivation

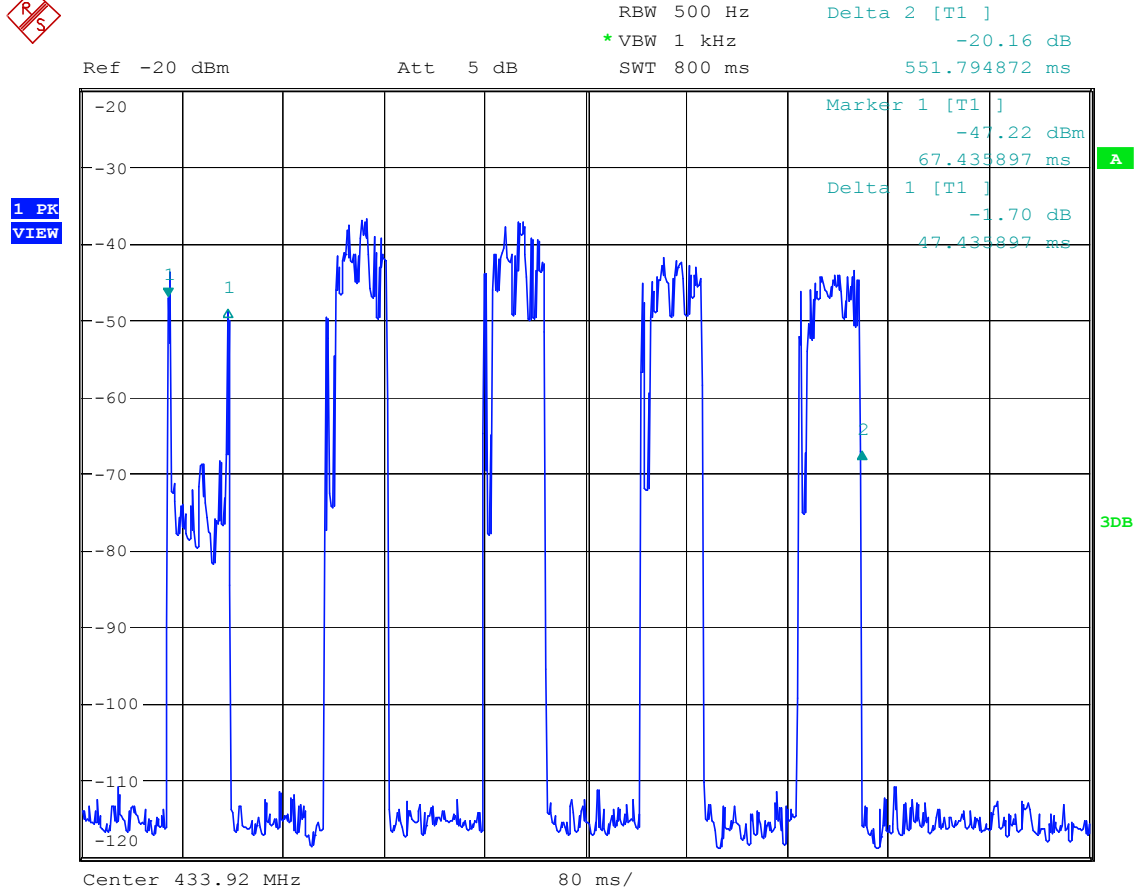
5.3.2.1 Regulation

15.231 (a1) A manually operated transmitter shall employ a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released.

5.3.2.2 Result

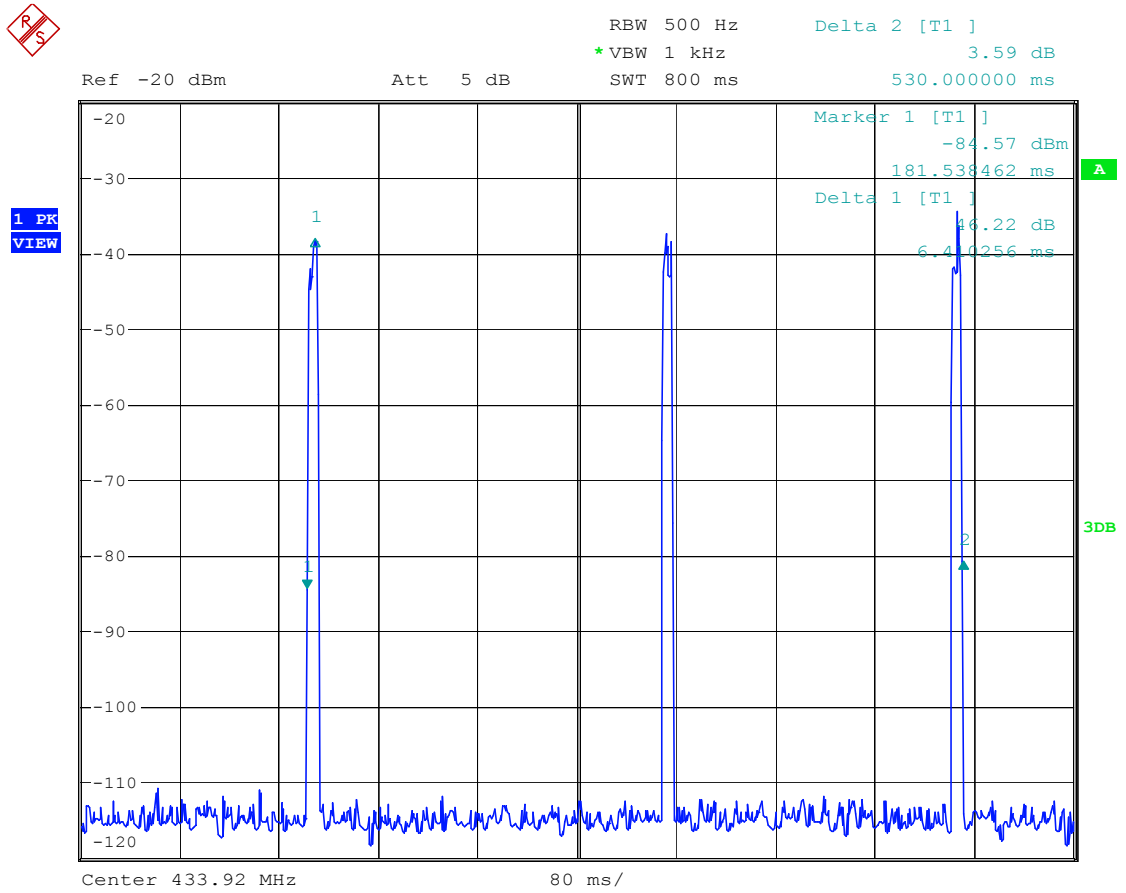
The equipment meets the requirements	yes
Further test results are attached	Yes

PLOT 5.3.2.2A – ASK MODULATION



Date: 18.DEC.2008 19:08:29

PLOT 5.3.2.2C-FSK MODULATION



Date: 18.DEC.2008 19:07:00

5.3.3 Automatically operated transmitter deactivation

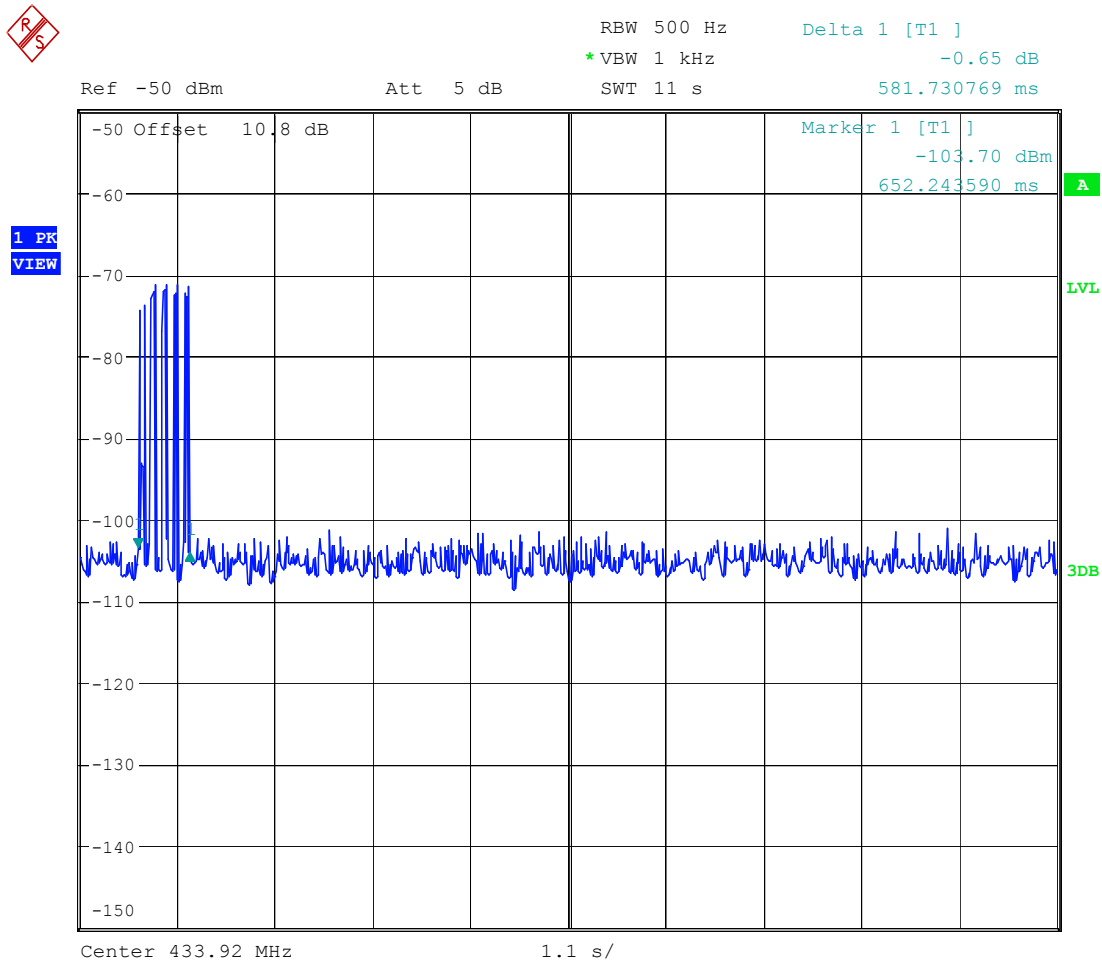
5.3.3.1 Regulation

15.231 (a2) A transmitter activated automatically shall cease transmission within 5 seconds after activation.

5.3.3.2 Result

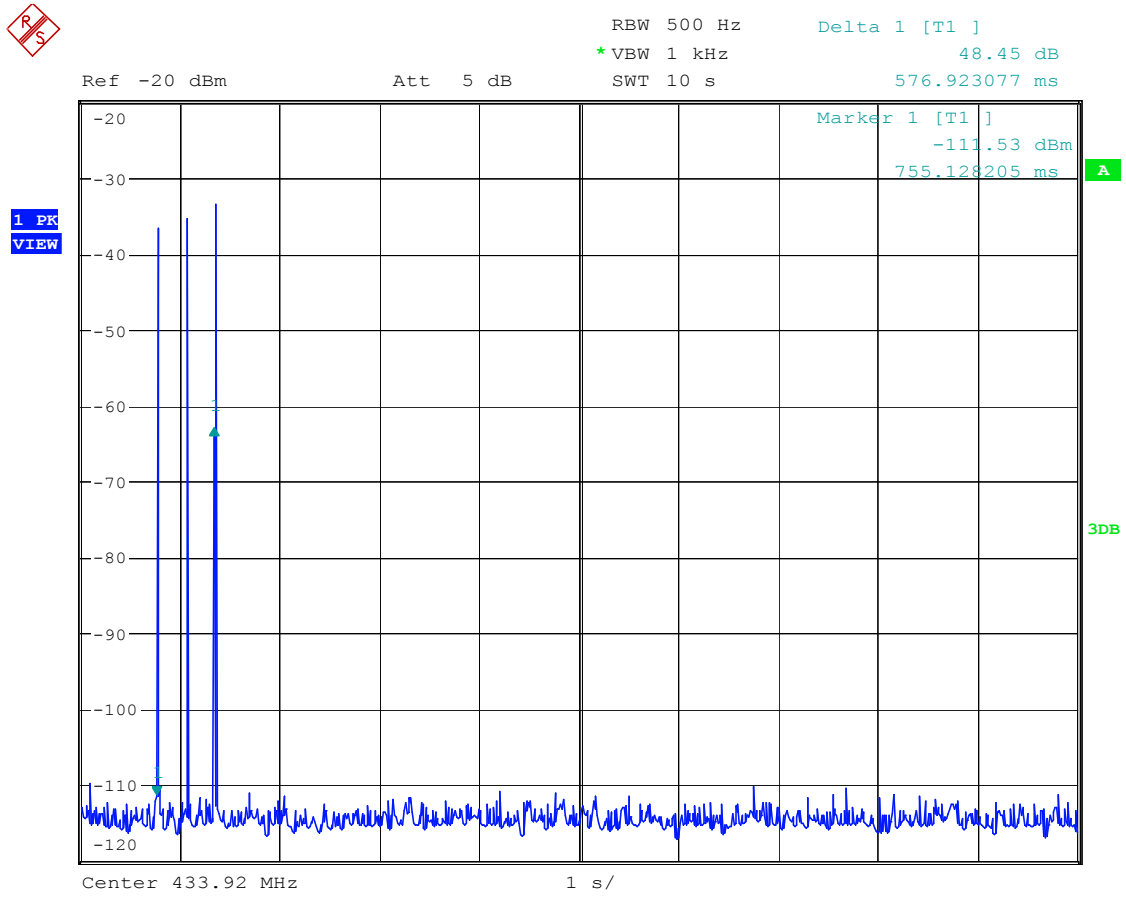
The equipment meets the requirements	yes
Further test results are attached	yes

PLOT 5.3.3.1A-ASK MODULATION



Date: 18.DEC.2008 18:17:02

PLOT 5.3.3.2B-FSK MODULATION



Date: 18.DEC.2008 19:04:09

5.3.4 Prohibition of periodic transmission

5.3.4.1 Regulation

15.231(a3) Periodic transmissions at regular predetermined intervals are not permitted. However, polling or supervision transmissions, including data, to determine system integrity of transmitters used in security or safety applications are allowed if the total duration of transmissions does not exceed more than two seconds per hour for each transmitter. There is no limit on the number of individual transmissions, provided the total transmission time does not exceed two seconds per hour.

5.3.4.2 Result

The equipment meets the requirements	n. a.
---	-------

Further test results are attached	n. a.
--	-------

5.3.5 Continuous transmission during an alarm condition

5.3.5.1 Regulation

15.231 (a4) Intentional radiators which are employed for radio control purposes during emergencies involving fire, security, and safety of life, when activated to signal an alarm, may operate during the pendency of the alarm condition

5.3.5.2 Result

The equipment meets the requirements	n. a.
---	-------

Further test results are attached	n. a.
--	-------

5.4 Bandwidth

5.4.1 Regulation

15. 231 (c) The bandwidth of the emission shall be no wider than 0.25% of the center frequency for devices operating above 70 MHz and below 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the center frequency. Bandwidth is determined at the points 20 dB down from the modulated carrier.

5.4.2 Calculation of the 20dB bandwidth limit

The 20dB bandwidth limit=0.0025* 433.92 MHz = 1.0848 MHz

5.4.3 Test procedure

ANSI C63.4 Section 13.1.7

The bandwidth is measured at an amplitude level reduced from the reference level by a specified ratio. The reference level is the level of the highest amplitude signal observed from the transmitter at either the fundamental frequency or the first-order modulation products in all typical modes of operation, including the unmodulated carrier, even if atypical. Once the reference level is established, the equipment is conditioned with typical modulating signals to produce the worst-case (i.e., the widest) bandwidth. If no bandwidth requirement is specified by the procuring or regulatory agency, measure the bandwidth at -26 dB with respect to the reference level. In order to measure the modulated signal properly, a resolution bandwidth that is small compared with the bandwidth required by the procuring or regulatory agency shall be used on the measuring instrument. However, the resolution bandwidth of the measuring instrument shall be set to a value greater than 5% of the bandwidth requirements.

5.4.4 Test result

Value of measured 20 dB bandwidth ASK Modulation	48.096 kHz
Value of measured 20 dB bandwidth FSK Modulation	82.97 kHz

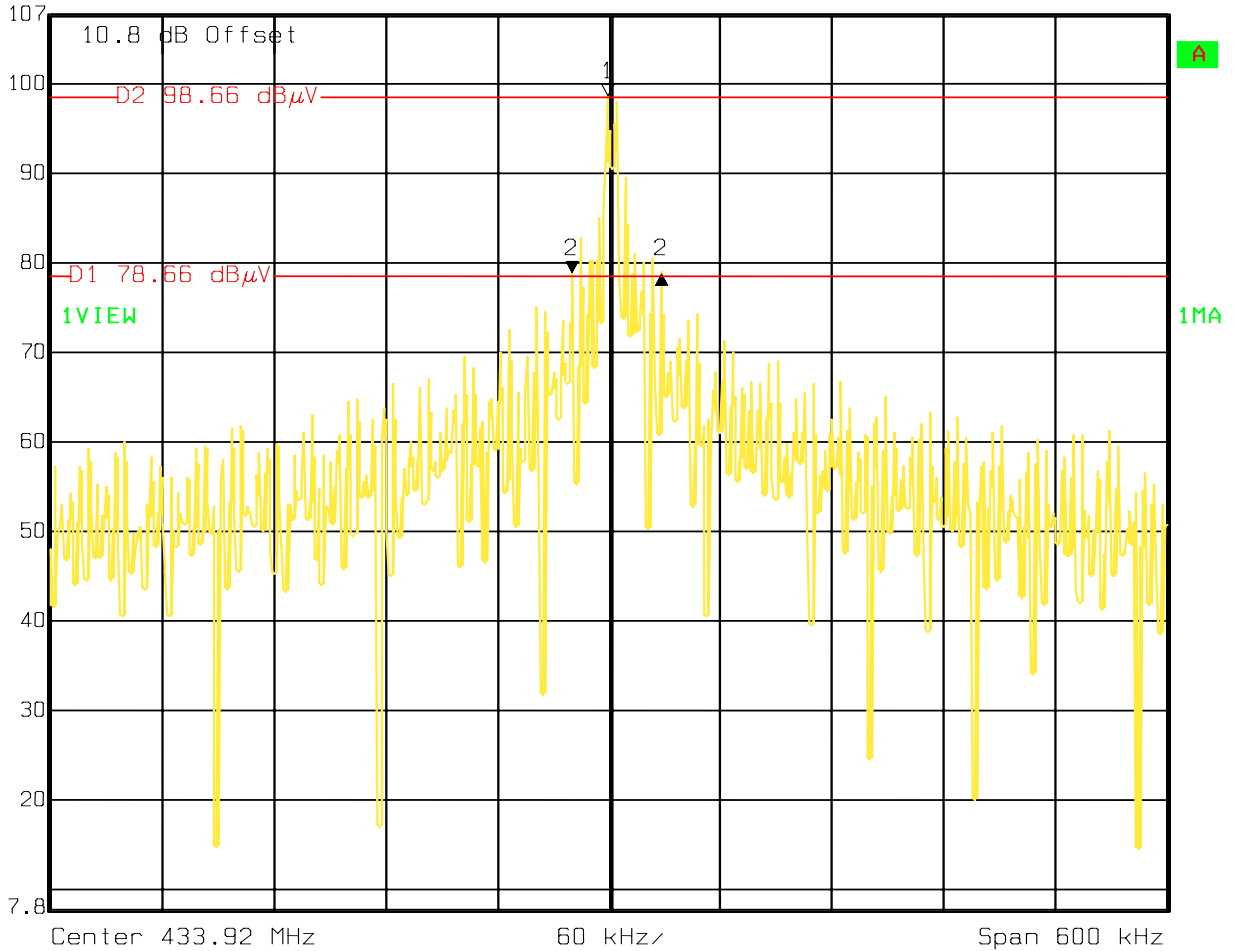
The equipment meets the requirements	yes	no	n. a.
---	-----	----	-------

Further test results are attached	yes	no	n. a.
--	-----	----	-------

PLOT 5.4.4 A -20 dB BANDWIDTH
ASK MODULATION



Delta 2 [T1] RBW 500 Hz RF Att 10 dB
Ref Lvl -0.04 dB VBW 1 kHz TG Lvl 0 dBm
107.8 dB μ V 48.09619238 kHz SWT 12 s Unit dB μ V

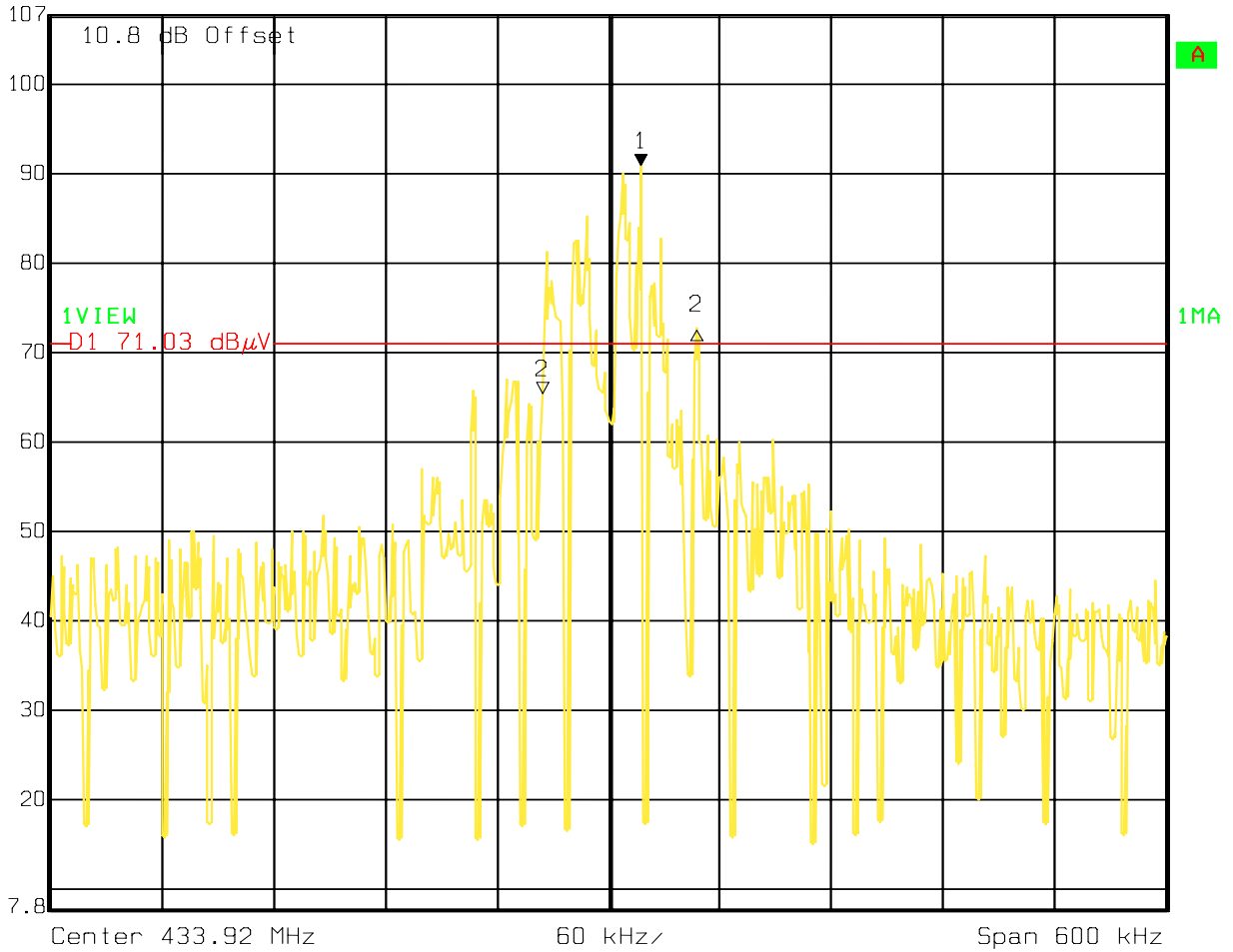


Date: 09.DEC.2008 12:01:33

PLOT 5.4.4 C-20 dB BANDWIDTH: ILLUSTRATION OF PEAK AT 91.03 dBμV



Ref Lvl 107.8 dBμV
Marker 1 [T1] 91.03 dBμV
433.93743487 MHz
RBW 1 kHz RF Att 10 dB
VBW 3 kHz TG Lvl 0 dBm
SWT 1.5 s Unit dBμV



Date: 09.DEC.2008 11:49:31

5.5 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.

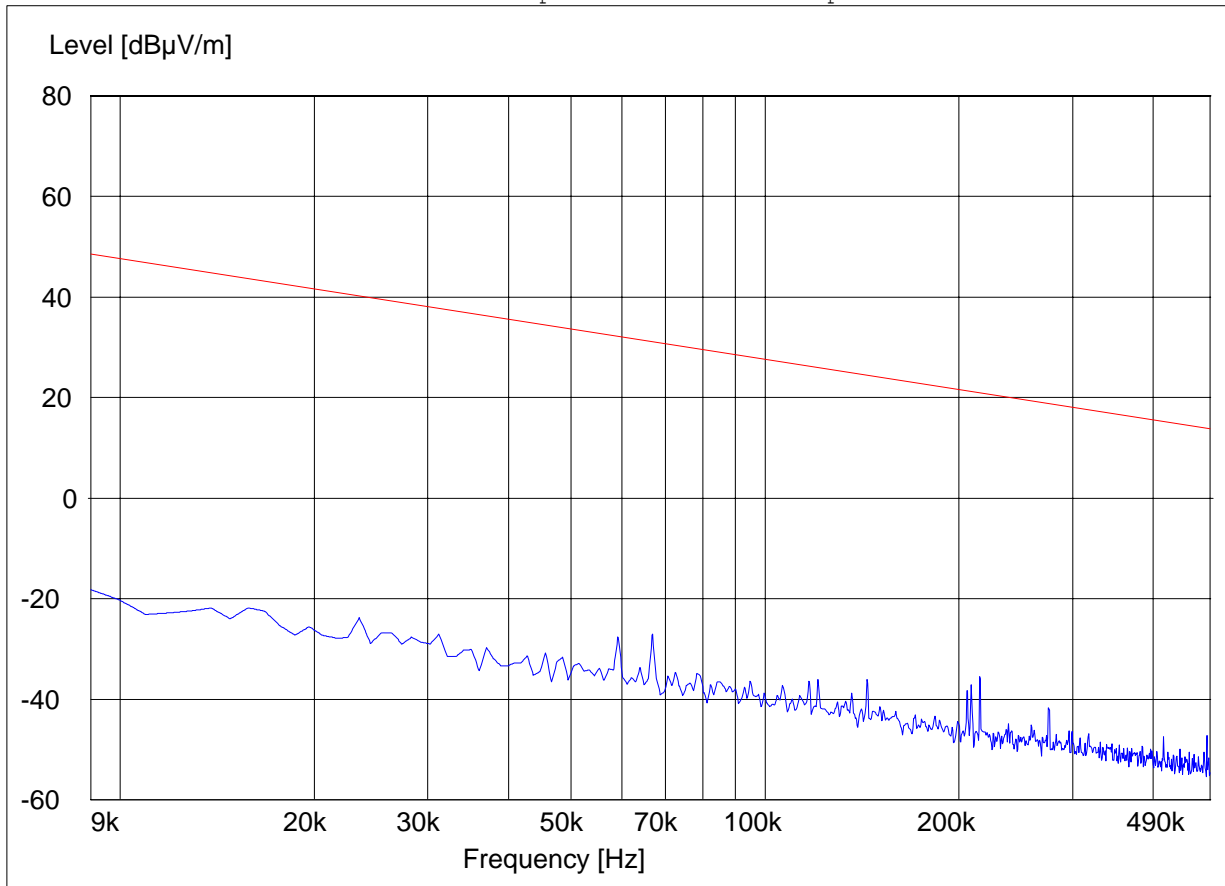


PLOT 5.5B FSK MODULATION (9kHz - 490kHz)

EUT: FOBIK
Customer:: MARQUARDT SWITCHES
Test Mode: TX FSK
ANT Orientation: V
EUT Orientation: V
Test Engineer: Satya
Voltage: Battery
Comments:

SWEEP TABLE: "FCC15.209<490k_Loop"

Start Frequency	Stop Frequency	Detector	Meas. Time	IF Bandw.	Transducer
9.0 kHz	490.0 kHz	MaxPeak	Coupled	200 Hz	Loop 6512E

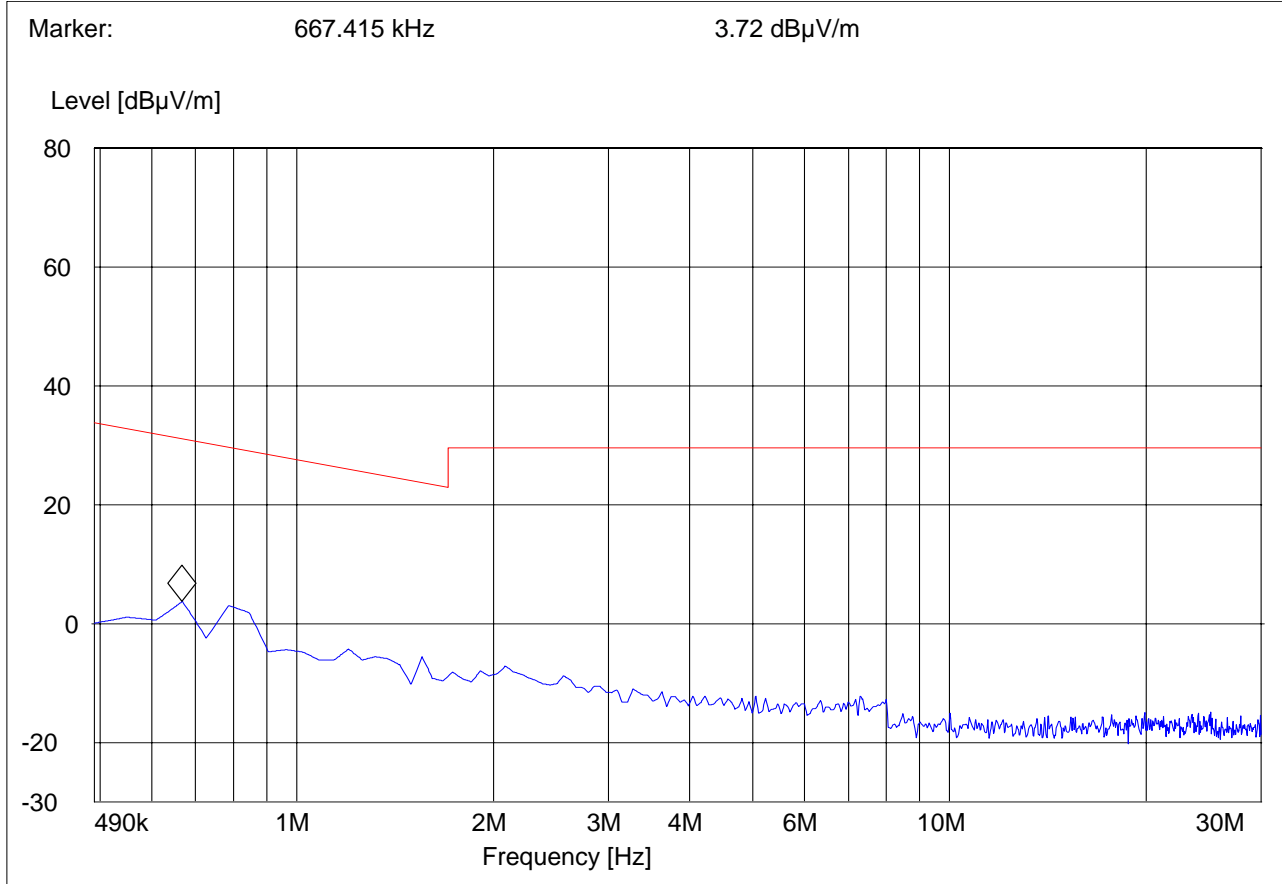


PLOT 5.5C FSK MODULATION (490kHz – 30MHz)

EUT: FOBIK
Customer:: MARQUARDT SWITCHES
Test Mode: TX FSK
ANT Orientation: V
EUT Orientation: V
Test Engineer: Satya
Voltage: Battery
SWEEP TABLE: "FCC15.209>490k_Loop"

Start Frequency	Stop Frequency	Detector	Meas. Time	IF Bandw.	Transducer
490.0 kHz	30.0 MHz	MaxPeak	Coupled	10 kHz	Loop 6512E

Marker: 667.415 kHz 3.72 dBµV/m



-

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

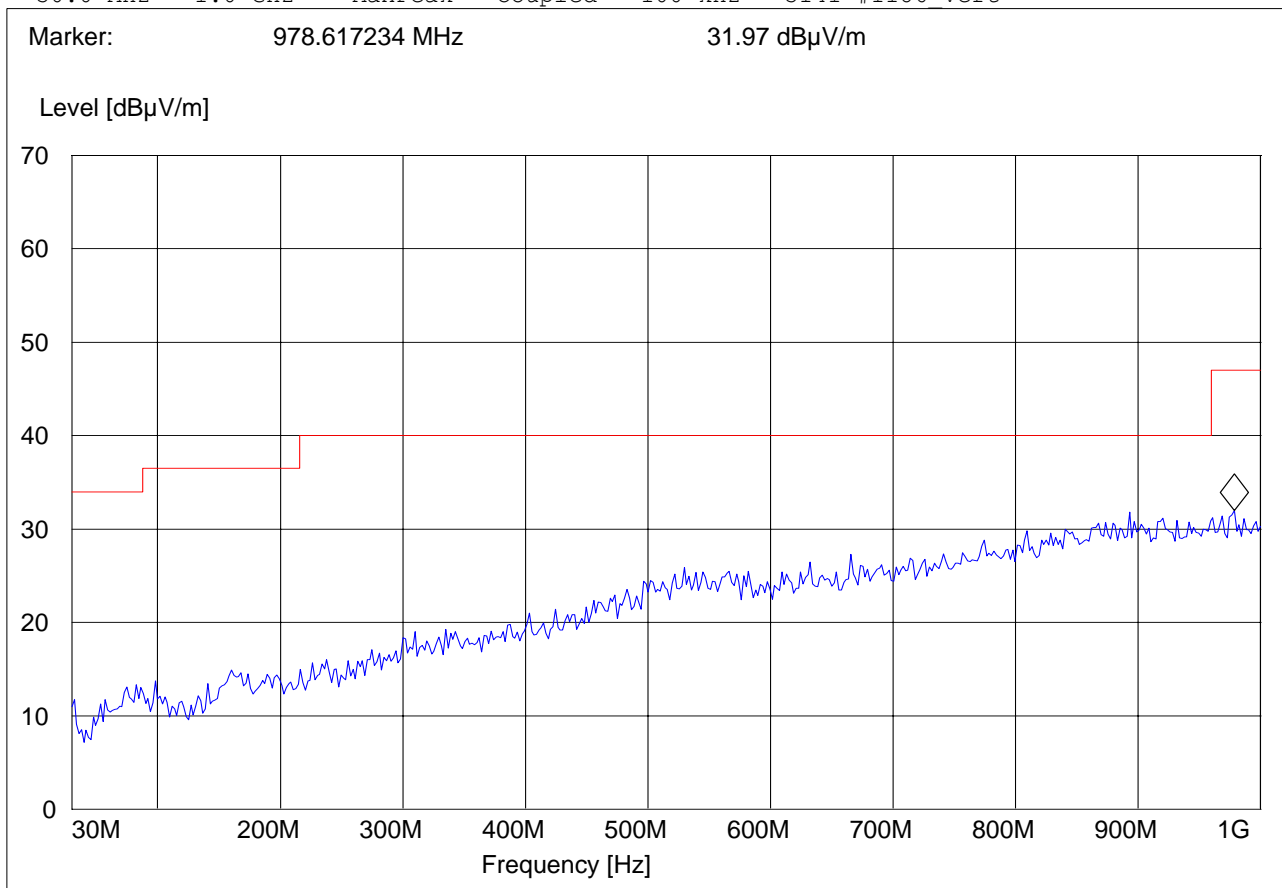
Frequency (MHz)	Field strength (µV/m)	Measurement distance (m)
0.009 - 0.490	2400/F (kHz)	300
0.490 - 1.705	24000/F (kHz)	30
1.705 - 30.0	30	30
30 - 88	100	3
88 - 216	150	3
216 - 960	200	3
Above 960	500	3

5.5.1 Receiver Radiated Emissions

PLOT 5.5.1A
30MHz-1GHz (ANTENNA: VERTICAL)

EUT: FOBIK
 Customer:: MARQUARDT SWITCHES
 Test Mode: RX
 ANT Orientation: V
 EUT Orientation: V
 Test Engineer: Satya
 Voltage: 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	893.086172	31.77
2	920.300601	31.18
3	931.963928	30.91
4	941.683367	30.73
5	961.122244	31.23
6	968.897796	31.42

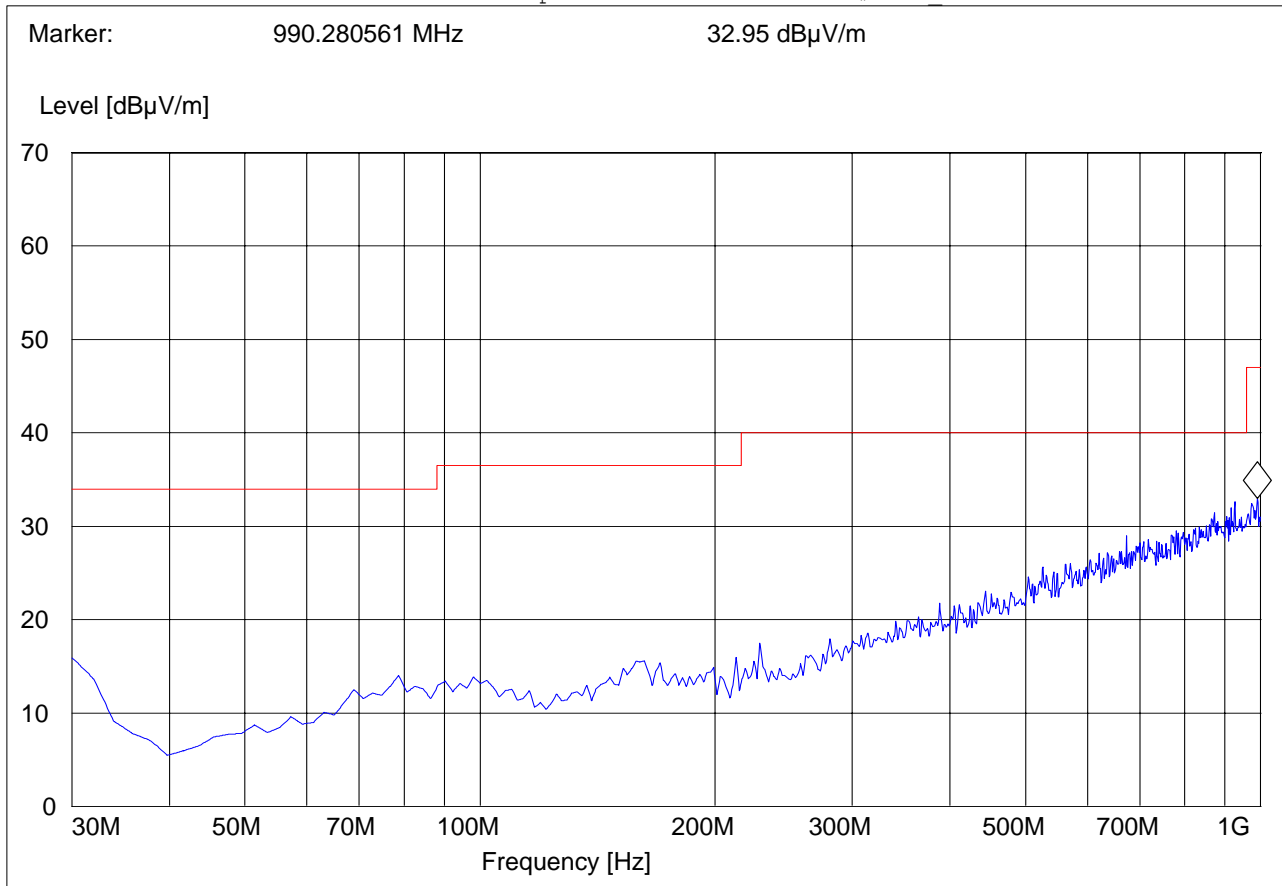


PLOT 5.5.1B
30MHz-1GHz (ANTENNA: HORIZONTAL)

EUT: FOBIK
 Customer:: MARQUARDT SWITCHES
 Test Mode: RX
 ANT Orientation: H
 EUT Orientation: V
 Test Engineer: Satya
 Voltage: Battery
 Comments:

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 (dB μ V/m)
1	620.941884	27.08
2	673.426854	28.99
3	865.871743	30.80
4	873.647295	31.44
5	916.412826	31.96
6	928.076152	32.62

PLOT 5.5.1C
1-3 GHz (ANTENNA: VERTICAL)

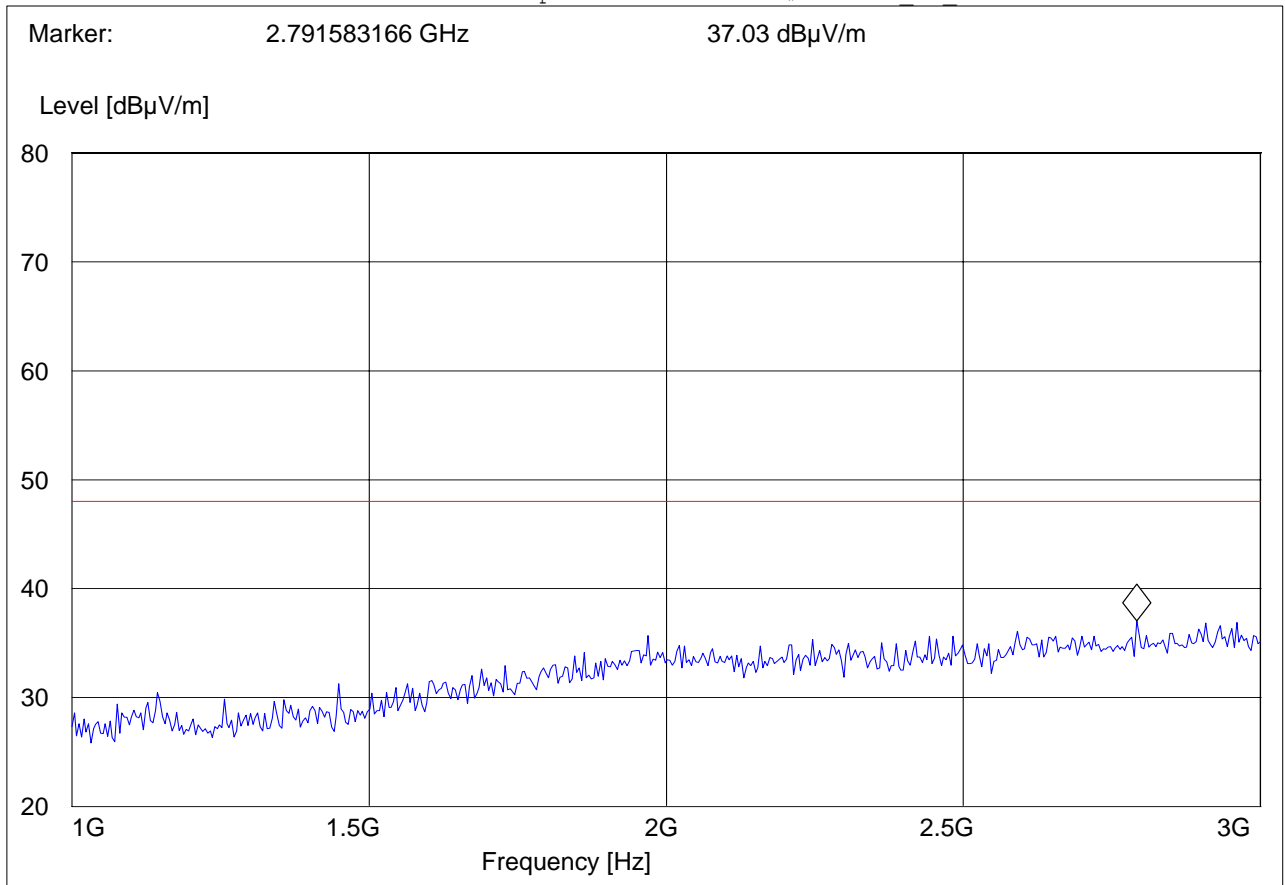
Note: Peak Reading Vs. Average Limit.

This plot is valid for Horizontal and Vertical polarization (worst-case plot)

EUT: FOBIK
 Customer:: MARQUARDT SWITCHES
 Test Mode: RX
 ANT Orientation: V
 EUT Orientation: V
 Test Engineer: Satya
 Voltage: Battery
 Comments:

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	2807.61523	35.69
2	2847.695391	35.88
3	2895.791583	36.29
4	2907.8156	36.84
5	2931.863727	36.58
6	2959.91984	36.89

PLOT 5.5.1F
3-18 GHz (ANTENNA: VERTICAL)

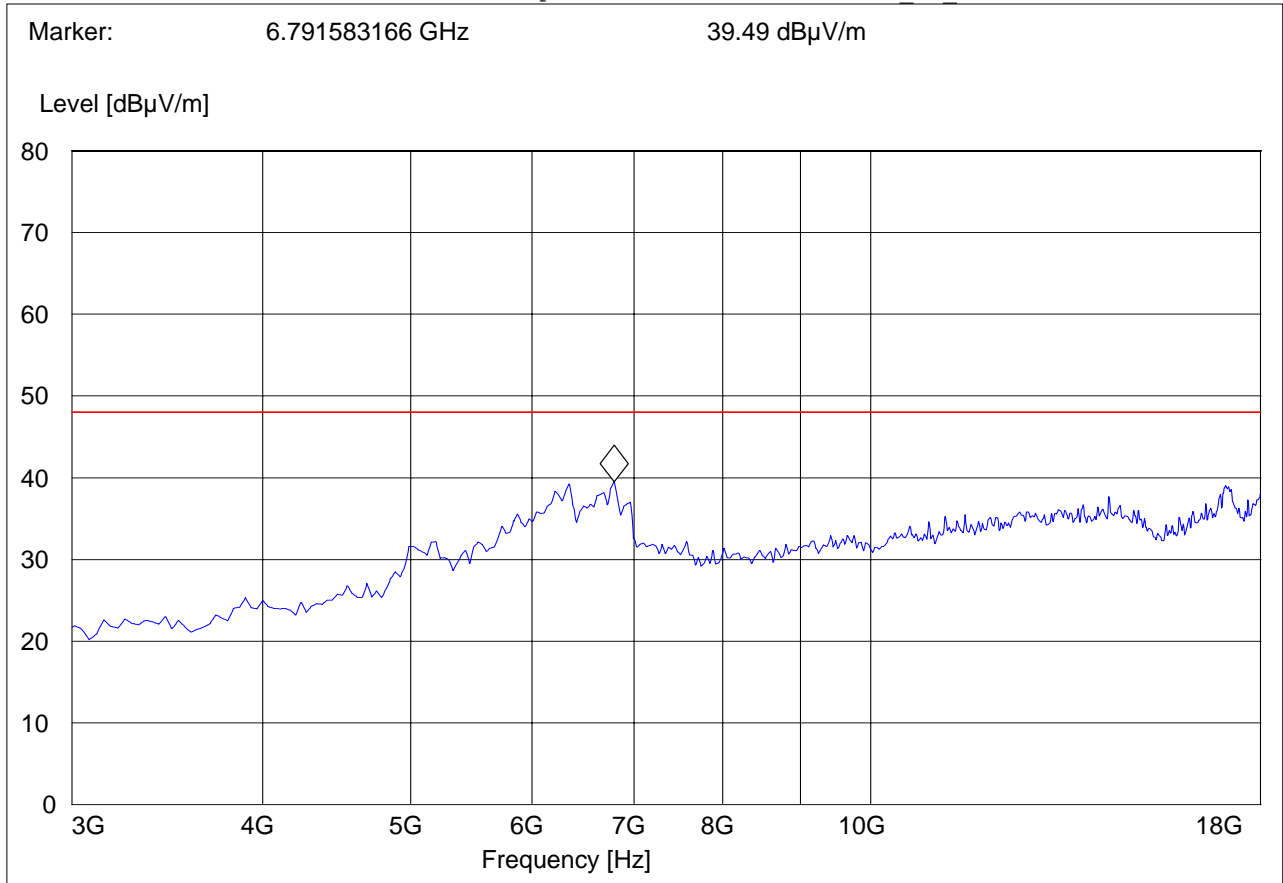
Note: Peak Reading Vs. Average Limit.

This plot is valid for Horizontal and Vertical polarization (worst-case plot)

EUT: FOBIK
 Customer:: MARQUARDT SWITCHES
 Test Mode: RX
 ANT Orientation: V
 EUT Orientation: V
 Test Engineer: Satya
 Voltage: Battery
 Comments:

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	6348.69739	39.25
2	6212.424850	38.25
3	6961.923848	36.99
4	14320.641283	37.71
5	17659.318637	37.26
6	17216.432866	38.58

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	Voltch	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	Digital Radio Comm. Tester	CMD-55	Rohde & Schwarz	847958/008	May 2009	1 year
15	Universal Radio Comm. Tester	CMU 200	Rohde & Schwarz	832221/06	May 2009	1 year
16	LISN	ESH3-Z5	Rohde & Schwarz	836679/003	July 2010	2 years
17	Loop Antenna	6512	EMCO	00049838	May 2009	1 year

7 References

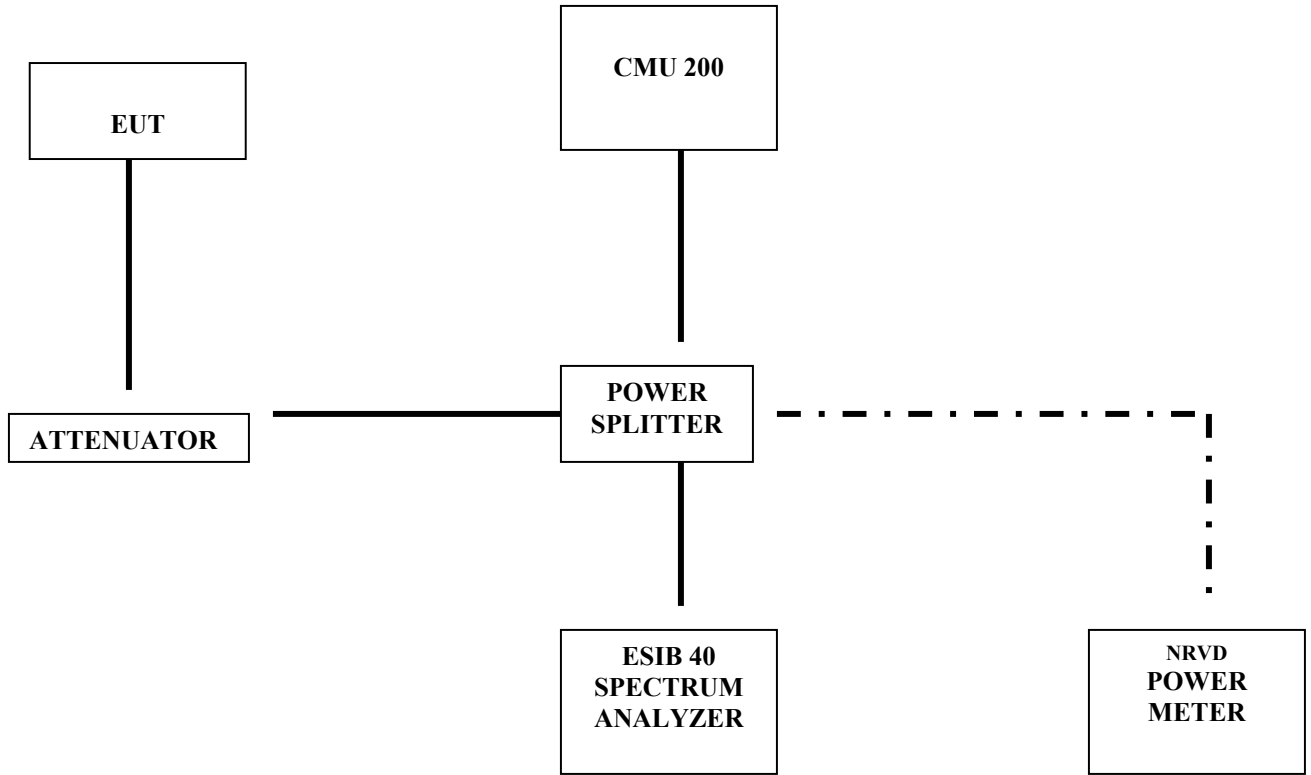
Title 47—Telecommunication, CHAPTER I--FEDERAL COMMUNICATIONS
COMMISSION,
PART 15--RADIO FREQUENCY DEVICES September 20, 2007.

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 License-exempt Radio communication Devices (All Frequency Bands):
Category I Equipment

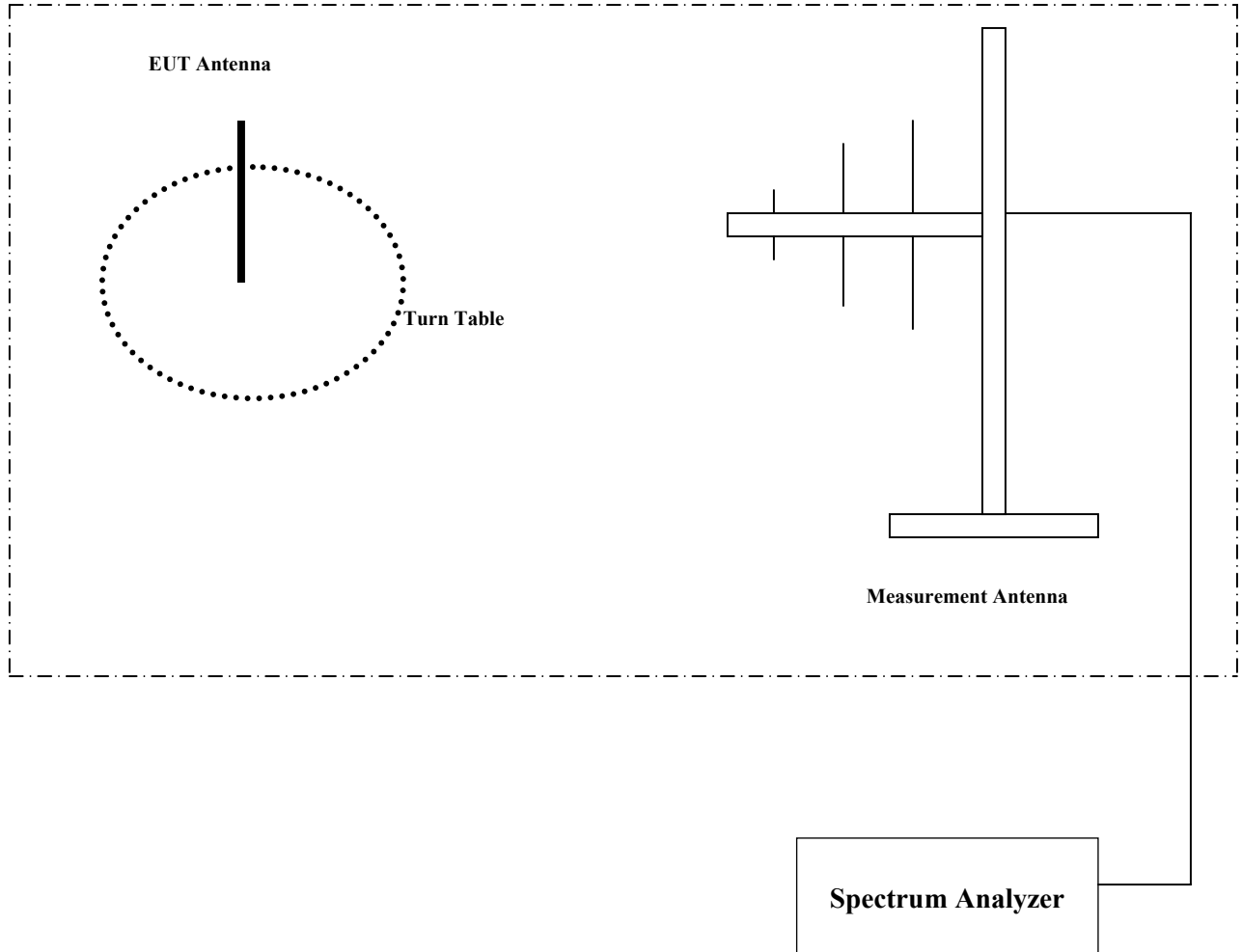
8 BLOCK DIAGRAMS

Conducted Testing



Radiated Testing

ANECHOIC CHAMBER



9 Revision History

Date	Report name	Revisions
2008-6-13	EMC_MARQU_001_08001_FOBIF_FCC15.231	Original report
2008-7-11	EMC_MARQU_001_08001_FOBIF_FCC15.231_rev1	Field strength measurement included in section 3.1 table. Plot 17 removed.
2008-8-18	EMC_MARQU_001_08001_FOBIF_FCC15.231_rev2	a. Duty cycle 47.8 ms rounded up to 48 ms instead of 47ms. b. Duty cycle measurement procedure and plot included. c. Worst case plot comment added to plot15 and plot 16.
2008-11-20	EMC_MARQU_001_08001_FOBIF_FCC15.231_rev3	FSK modulation results added.
2008-12-18	EMC_MARQU_001_08001_FOBIF_FCC15.231_rev4	OBW plots changed and transmitter deactivation plots changed