Electromagnetic Compatibility Test Report

Tests Performed on a Minarik Drives

418 MHz Transmitter, Model RFTX418

Radiometrics Document RP-6565

ACCREDITED
Certification # 1495.01

Product Detail:
FCC ID: WYL-RFTX418
IC: 8350A-RFTX418
Equipment type: Momentarily Operated 418 MHz Transmitter

Test Standards:
US CFR Title 47, Chapter I, FCC Part 15 Subpart C
FCC Part 15 CFR Title 47: 2008
Industry Canada RSS-210, Issue 7: 2007 as required for Category I Equipment

This report concerns: Original Grant for Certification
FCC Part 15.231

Tests Performed For:	*Test Facility:*
Minarik Drives 14300 De La Tour Drive South Beloit 61080	**Radiometrics Midwest Corporation** 12 East Devonwood Romeoville, IL 60446

Test Date(s): (Month-Day-Year)
May 5 to May 20, 2009

Document RP-6565 Revisions:

Rev.	Issue Date	Affected Pages	Revised By
0	June 1, 2009		
1	June 9, 2009	3 & 4	Joseph Strzelecki

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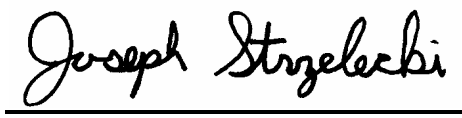
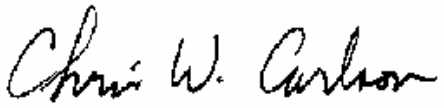
1 ADMINISTRATIVE DATA

Equipment Under Test: A Minarik Drives, 418 MHz transmitter Model: RFTX418, Serial Number: None This will be referred to as the EUT in this Report	
Date EUT Received at Radiometrics: (Month-Day-Year) May 4, 2009	*Test Date(s): (Month-Day-Year)* May 5 to May 20, 2009
Test Report Written By: Joseph Strzelecki Senior EMC Engineer	*Test Witnessed By:* The tests were not witnessed by Minarik Drives
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 418 MHz transmitter, Model RFTX418, manufactured by Minarik Drives. 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
20 dB Bandwidth Test	418 MHz	15.231 A2.9	Pass
RF Radiated Emissions	30-4200 MHz	RSS-210 & FCC Part 15	Pass

2.1 RF Exposure Compliance Requirements

The power output is 0.1 mW. The EUT meets the FCC requirement for RF exposure. Since the EUT is less than 200 mW, it is exempt from RSS-102. There are no power level adjustments and the antenna is permanently attached.

3 EQUIPMENT UNDER TEST (EUT) DETAILS

3.1 EUT Description

The EUT is a 418 MHz transmitter, Model RFTX418, manufactured by Minarik Drives. The EUT was in good working condition during the tests, with no known defects.

The EUT is a manually operated transmitter, which ceases operation within 5 seconds of releasing the buttons as per Part 15.231 (a) (1). The EUT can only transmit with a manual button push. It automatically deactivates with the release of the button.

3.1.1 FCC Section 15.203 & RSS-GEN Antenna Requirements

The antenna in the transmitter is a 50 ohm ¼ wave monopole antenna for operating at 418 MHz range. The antenna is mounted directly to the PCB and the user is not authorized to change it. Therefore, it meets the 15.203 Requirement.

3.2 Related Submittals

The associated receiver is subject to the IC requirements pursuant to the certification equipment authorization under RSS-210. The associated receiver is subject to the IC requirements pursuant to the certification equipment authorization under RSS-210.

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.

The EUT was tested as a stand-alone device. Power was supplied with new batteries. No cables are connected to the EUT.

Tested System Configuration List

Item	Description	Type*	Manufacturer	Model Number	Serial Number
1	418 MHz transmitter	E	Minarik Drives	RFTX418	None

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

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	2008	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)

The test procedures used are in accordance with the 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-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
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 Radiated RF Emissions

Radiated emission measurements were performed with linearly polarized broadband antennas. The results obtained with these antennas can be correlated with results obtained with a tuned dipole antenna. The radiated emission measurements were performed with a spectrum analyzer. The bandwidth used from 150 kHz to 30 MHz is 9 or 10 kHz and the bandwidth from 30 MHz to 1000 MHz is 100 or 120 kHz. Above 1 GHz, a 1 MHz bandwidth is used. A 10 dB linearity check is performed prior to start of testing in order to determine if an overload condition exists.

From 30 to 1000 MHz, an Anritsu spectrum analyzer was used. For tests from 1 to 5 GHz, an HP 8566 spectrum analyzer was used. Figure 4 herein lists the details of the test equipment used during radiated emissions tests.

The EUT is handheld, 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.

Final radiated emissions measurements were performed inside of an anechoic chamber at a test distance of 3 meters. The anechoic chamber is designated as Chamber E. This Chamber meets the Site Attenuation requirements of ANSI C63.4 and CISPR 16-1. Chamber E is located at 12 East Devonwood Ave. Romeoville, Illinois EMI test lab.

The entire frequency range from 30 to 4200 MHz was slowly scanned with particular attention paid to those frequency ranges which appeared high. Measurements were performed using two antenna polarizations, (vertical and horizontal). The worst case emissions were recorded. All measurements may be performed using either the peak, average or quasi-peak detector functions. If the peak detector data exceeds or is marginally close to the limits, the measurements are repeated using a quasi-peak detector or average function as required by the specification for final determination of compliance.

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.

10.1.1 Field Strength 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 + PKA

Where: FS = Field Strength
RA = Receiver Amplitude
AF = Antenna Factor
CF = Cable Attenuation Factor
AG = Amplifier Gain
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).

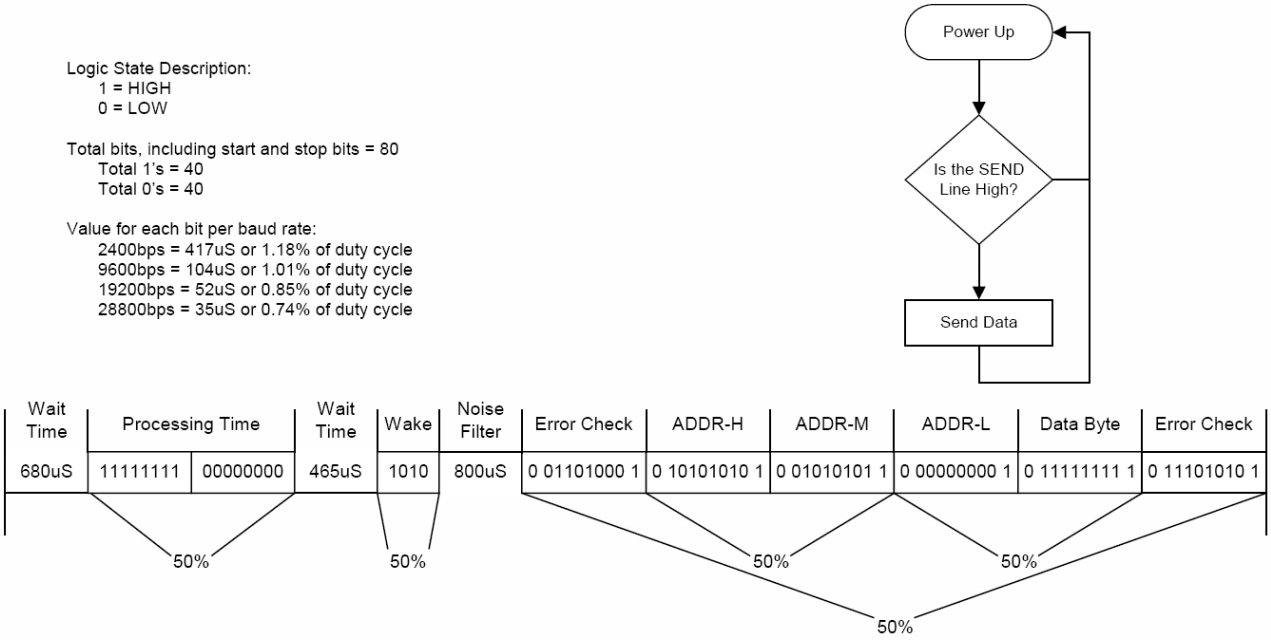
10.1.2 Duty Cycle Calculation

The MS Series algorithm is designed to create a data stream with a 50% duty cycle by using the same number of high bits and low bits. Two wait times reduce this duty cycle to just below 50%.

Logic State Description:
1 = HIGH
0 = LOW

Total bits, including start and stop bits = 80
Total 1's = 40
Total 0's = 40

Value for each bit per baud rate:
2400bps = 417uS or 1.18% of duty cycle
9600bps = 104uS or 1.01% of duty cycle
19200bps = 52uS or 0.85% of duty cycle
28800bps = 35uS or 0.74% of duty cycle



$$\text{Duty Cycle} = \frac{\text{Time High}}{\text{Total Time}} \rightarrow \frac{\text{40 bits + 800uS}}{\text{80 bits + 680uS + 465uS + 800uS}} \rightarrow \frac{\text{(40*104uS) + 800uS}}{\text{(80*104uS) + 1,945uS}} = \frac{\text{4,960uS}}{\text{10,265uS}} = 48.3\%$$

Note: 20*Log(0.483) = 6.3 dB

10.1.3 Radiated Emissions Test Results

Test Date	May 5, 2009
Test Distance	3 Meters
Specification	FCC Part 15 Subpart C & RSS-210
Notes	
Abbreviations	P = peak; Q = QP Pol = Antenna Polarization; V = Vertical; H = Horizontal; For Antenna Type Bi-Log = (ANT-44); Horn = (ANT-13)
Configuration	Preliminary test in A Chamber

FCC Part 15.231

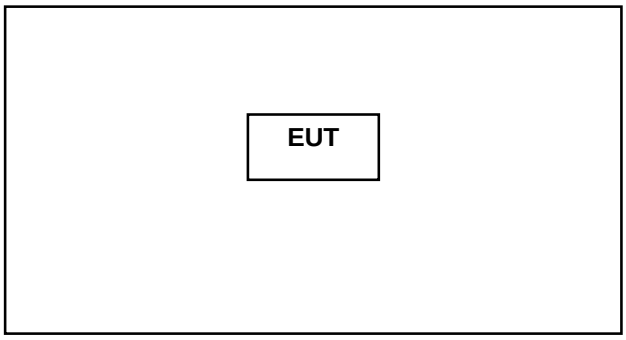
Harm #	EUT Tx Freq	Ant Pol.	Detector Function	Emission Freq. MHz	dBuV/m	Limit	Margin under limit
1	418	V	Ave	418	79.2	80.3	1.1
1	418	H	Ave	418	77.9	80.3	2.4
2	418	V	Ave	836	45.1	60.3	15.2
2	418	H	Ave	836	43.9	60.3	16.4
3	418	V	Ave	1254	40.4	60.3	19.9
3	418	H	Ave	1254	37.5	60.3	22.8
4	418	V	Ave	1672	45.5	54.0	8.5
4	418	H	Ave	1672	44.4	54.0	9.6

Harm #	EUT Tx Freq	Ant Pol.	Detector Function	Emission Freq. MHz	dBuV/m	Limit	Margin under limit
5	418	V	Ave	2090	45	60.3	15.3
5	418	H	Ave	2090	43.9	60.3	16.4
6	418	V	Ave	2508	42.8	60.3	17.5
6	418	H	Ave	2508	43.2	60.3	17.1
7	418	V	Ave	2926	44.7	60.3	15.6
7	418	H	Ave	2926	44.4	60.3	15.9
8	418	V	Ave	3344	44.2	60.3	16.1
8	418	H	Ave	3344	43.9	60.3	16.4
1	418	V	Peak	418	85.5	100.3	14.8
1	418	H	Peak	418	84.2	100.3	16.1
2	418	V	Peak	836	51.4	80.3	28.9
2	418	H	Peak	836	50.2	80.3	30.1
3	418	V	Peak	1254	46.7	80.3	33.6
3	418	H	Peak	1254	43.8	80.3	36.5
4	418	V	Peak	1672	51.8	74.0	22.2
4	418	H	Peak	1672	50.7	74.0	23.3
5	418	V	Peak	2090	51.3	80.3	29.0
5	418	H	Peak	2090	50.2	80.3	30.1
6	418	V	Peak	2508	49.1	80.3	31.2
6	418	H	Peak	2508	49.5	80.3	30.8
7	418	V	Peak	2926	51	80.3	29.3
7	418	H	Peak	2926	50.7	80.3	29.6
8	418	V	Peak	3344	50.5	80.3	29.8
8	418	H	Peak	3344	50.2	80.3	30.1

Judgment: Passed by 1.1 dB
No Emissions were detected from 3345 to 4200 MHz within 15 dB of the limits.

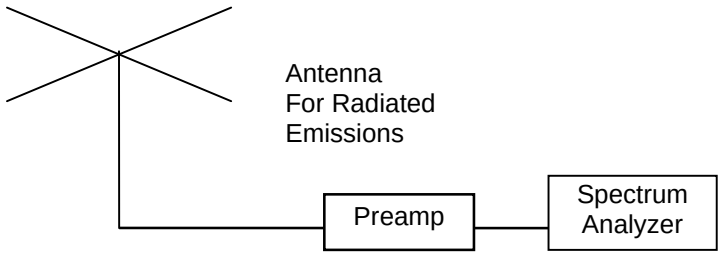
Note: The average readings were derived from the peak readings using the correction factor as shown in 10.2.1.

Figure 1. 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



Frequency Range	Receive Antenna	Pre-Amplifier	Spectrum Analyzer
30 to 1000 MHz	ANT-44	AMP-22	REC-03
1 to 5 GHz	ANT-13	AMP-05	REC-01

10.2 Occupied Bandwidth Data

The occupied bandwidth of the RF output was measured using a spectrum analyzer. The bandwidth was measured using the peak detector function and a narrow resolution bandwidth.

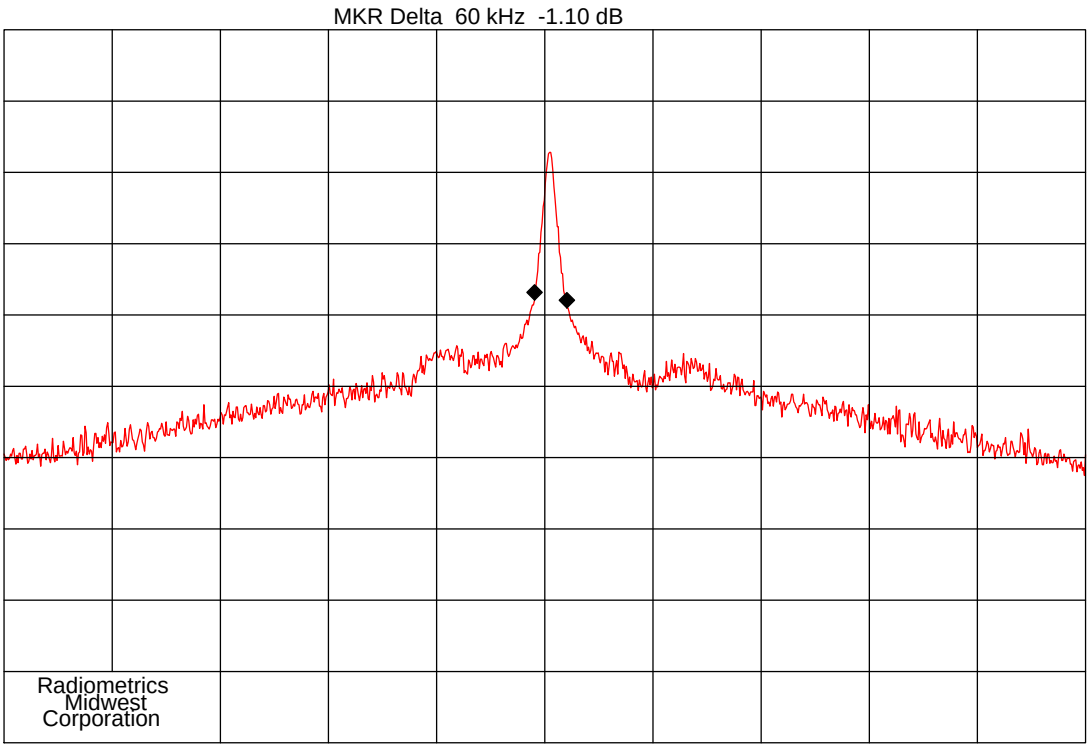
A broadband antenna was used to receive the modulated signal. The spectrum analyzer was set to the MAX HOLD mode to record the worst case of the modulation. The spectrum analyzer display was digitized and plotted. A limit was drawn on the plots based on the level of the modulated carrier. The plots of the occupied bandwidth for the EUT are supplied on the following page.

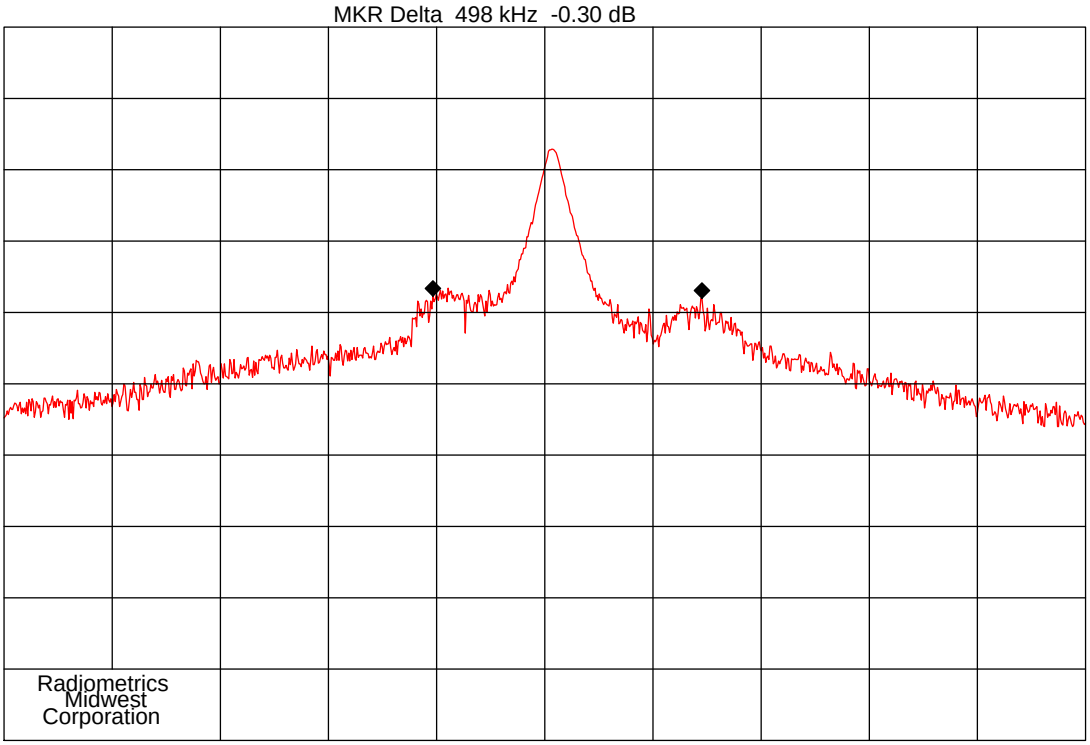
The marker-to-peak function was set to the peak of the emission. Then the marker-delta function was used to measure 20 dB down one side of the emission. The marker-delta function was reset and then moved to the other side of the emission, until it is (as close as possible to) even with the reference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

The limit = 0.25% of the Emission frequency

Frequency (MHz)	Analyzer RBW	BW MHz	BW Limit
418	10 kHz	0.06	1.045 MHz
418	30 kHz	0.50	1.045 MHz

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.





Company: Minerak Drives
CENTER 418.00 MHz
RES BW 30 kHz
10 dB/
Notes: Occupied Bandwidth,

ITEM : 1200 Series Tx
REF 0.0 dBm
VBW 100 kHz
Time: 16:37

Date : 05-20-2009
SPAN 2.00 MHz
ATTEN 10 dB
SWP 20.0 msec