**DATE: 28 October 2010**

# I.T.L. (PRODUCT TESTING) LTD.

# FCC Radio Test Report

**for**

# Miltel Communications Ltd.

## Equipment under test:

## Transceiver 3A

**Transceiver 3A**

Written by: _____

D. Shidlowsky, Documentation

Approved by: _____

A. Sharabi, Test Engineer

Approved by: _____

I. Raz, EMC Laboratory Manager

# Measurement/Technical Report for

Miltel Communications Ltd.

Transceiver 3A

## FCC ID: MLLGL3RPT450

This report concerns: Original Grant: X
Class II change:
Class I change:

Equipment type: Licensed Non-Broadcast Transmitter
Limits used:
47CFR Part 90, Sections 90.205; 90.213; 90.214; 90.217

Measurement procedure used is ANSI C63.4-2003.
Substitution Method used as in ANSI/TIA-603-C: 2004


Application for Certification prepared by:
Ishaishou Raz
ITL (Product Testing) Ltd.
Kfar Bin Nun
D.N. Shimshon 99780
Israel
e-mail Sraz@itl.co.il

Applicant for this device: (different from "prepared by")
Yarum Locker
Miltel Communications Ltd.
7 Gush Etzion St.
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Israel
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# TABLE OF CONTENTS

# 1. General Information

## *1.1 Administrative Information*

| | |
|---|---|
| Manufacturer: | Miltel Communications Ltd. |
| Manufacturer's Address: | 7 Gush Etzion St.<br>Givat Shmuel, 54030<br>Israel<br>Tel: +972-3-737-1333<br>Fax: +972-3-737-1331 |
| Manufacturer's Representative: | Uri Sabag |
| Equipment Under Test (E.U.T): | Transceiver 3A |
| Equipment Model No.: | Transceiver 3A (See customer's declaration on following page). |
| Equipment Serial No.: | Not Designated |
| Date of Receipt of E.U.T: | 10.10.10 |
| Start of Test: | 10.10.10 |
| End of Test: | 12.10.10 |
| Test Laboratory Location: | I.T.L (Product Testing) Ltd.<br>Kfar Bin Nun,<br>ISRAEL 99780 |
| Test Specifications: | FCC Part 90 Subpart I |

October 14th, 2010

# DECLARATION

FCC ID: **MLLGL3RPT450**

I hereby declare that the following products:

- Galaxy Repeater 3A
- Galaxy Receiver 3A
- Datasense Repeater 3A
- Datasense Receiver 3A
- IrriWise Repeater 3A
- IrriWise Receiver 3A

Are identical electronically, physically, and mechanically to:

**Transceiver 3A**

Please relate to them all (from an EMC point of view) as the same product.

Sincerely yours

Yarum Locker, co-C.E.O.

**Miltel Communications Ltd.**
7 Gush Etzion, 4th Floor
Giva't-Shmuel, Israel 54030
Tel: +972-3-737-1333 Fax:+972-3-737-1331

## 1.2 List of Accreditations

The EMC laboratory of I.T.L. is accredited by the following bodies:

1. The American Association for Laboratory Accreditation (A2LA) (U.S.A.), Certificate No. 1152.01.
2. The Federal Communications Commission (FCC) (U.S.A.), Registration No. 90715.
3. The Israel Ministry of the Environment (Israel), Registration No. 1104/01.
4. The Voluntary Control Council for Interference by Information Technology Equipment (VCCI) (Japan), Registration Numbers: C-1350, R-1285.
5. Industry Canada (Canada), IC File No.: 46405-4025; Site No. IC 4025B-1.
6. TUV Product Services, England, ASLLAS No. 97201.
7. Nemko (Norway), Authorization No. ELA 207.

I.T.L. Product Testing Ltd. is accredited by the American Association for Laboratory Accreditation (A2LA) and the results shown in this test report have been determined in accordance with I.T.L.'s terms of accreditation unless stated otherwise in the report.

## 1.3 Product Description

The E.U.T. is a data link transceiver that is used for data transfer in Miltel's radio telemetry system. The system is used for utility consumption readings collection system as well as for other applications such as in agricultural systems or general purpose sensor telemetry system.

The ***Receiver/Repeater 3A*** system is a computerized fully automatic radio device. It requires no human intervention after initial installation. The device acts as a store-and-forward radio relay. The ***Receiver/Repeater 3A*** operates as a Gateway (backhaul receiver) or as a repeater that captures transmissions from a Miltel transmitter and, after validating the message, transmits the message again. When operating as a Repeater the device relays information from transmitters to a receiver that acts as a Gateway (base station) which is typically deployed with a RS232 connection to a PC or with a LAN connection (TCP/IP) that allows backhauling data to the backoffice management system. The Gateway (Receiver) transfers the data to the central computer for data collection and for further analysis and reporting.

When operating as a Gateway Receiver, the device receives messages transmitted by Miltel transmitters or messages relayed by a repeater. The receiver can also send commands to any of the repeaters.

The Transceiver device is marketed as two models (as a Receiver or as a Repeater) and under three different commercial trade names (***Datasense*** Repeater 3A / Receiver 2A, ***Galaxy*** Repeater 3A / Receiver 3A and ***IrriWise*** Repeater 3A / Receiver 2A).

The Transceiver device (both receiver and repeater) can be hooked up to a PC or to a laptop computer for programming purposes during system setup.

The ***Receiver/Repeater 3A*** is the intermediate link in the wireless telemetry data collection system. It is an independent unit that operates as a repeater (radio relay) or as a gateway backhaul device (receiver).

The device is powered by a 12 volt power supply or by a solar powered battery. The ***Receiver/Repeater 3A*** operates its radio receiver on a continuous basis until it receives a message from a nearby transmitter. After capturing the transmitted data message, it sends out an identical message which is forwarded to the Collector.

## 1.4 Test Methodology

Both conducted and radiated testing were performed according to the procedures in ANSI C63.4: 2003. Radiated testing was performed at an antenna to EUT distance of 3 meters.

## 1.5 Test Facility

Both conducted and radiated emissions tests were performed at I.T.L.'s testing facility at Kfar Bin-Nun, Israel. This site is a FCC listed test laboratory (FCC Registration No. 90715, date of listing September 3, 2009).
I.T.L.'s EMC Laboratory is also accredited by A2LA, certificate No. 1152.01.

## 1.6 Measurement Uncertainty

Conducted Emission

The uncertainty for this test is □2 dB.

Radiated Emission

The Open Site complies with the ±4 dB Normalized Site Attenuation requirements of ANSI C63.4-2003. In accordance with Paragraph 5.4.6.1 of this standard, this tolerance includes instrumentation calibration errors, measurement technique errors, and errors due to site anomalies.

# 2. System Test Configuration

## 2.1 Justification

The E.U.T was tested simulating normal operation in vertical position.

The E.U.T. transmitted continuously from the Tx/Rx port in the frequency band of 450 - 470 MHz.

The E.U.T. was tested at the operating frequencies of 450.00625; 460.00000; and 469.99375 MHz, channel spacing of 12.5 kHz and FSK modulation.

## 2.2 Special Accessories

No special accessories were needed in order to achieve compliance.

## 2.3 Equipment Modifications

No modifications were needed in order to achieve compliance.

## 2.4 Configuration of Tested System

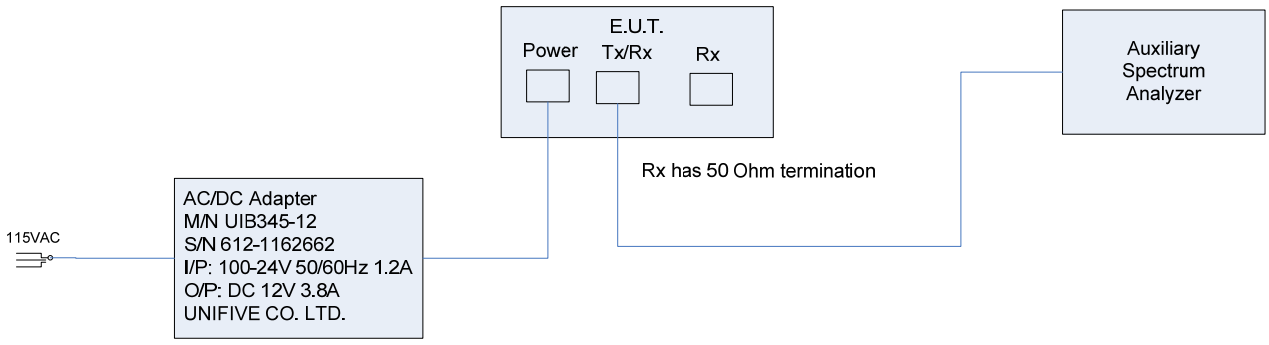



**Figure 1. Tests Set-up**

Note: For the spurious radiated emission test, both the Tx/Rx and Rx ports had 50 Ohm termination.

# 3. Conducted and Radiated Measurement Test Set-ups Photo

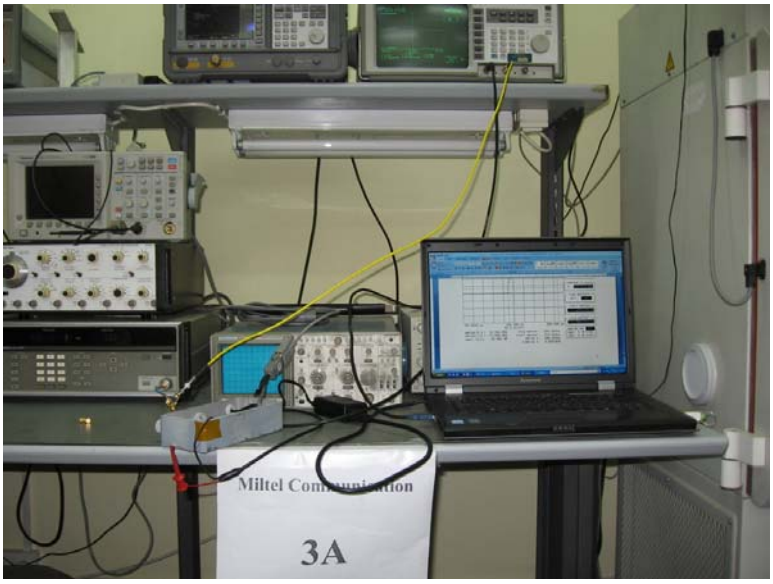



**Figure 2. Conducted Emission From Antenna Ports Tests**

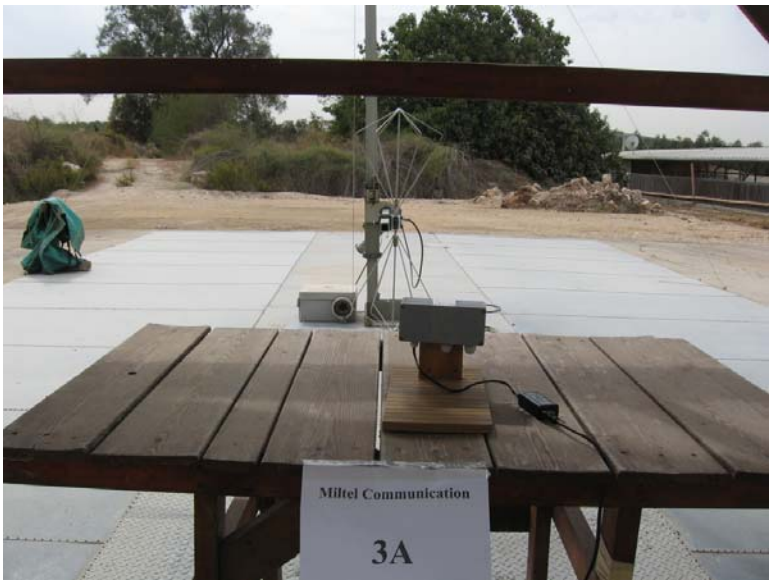



**Figure 3. Radiated Emission Test**


**Figure 4. Frequency Stability Test**

# 4. Peak Output Power

## 4.1 Test Specification

FCC Part 90.205

## 4.2 Test procedure

The E.U.T. antenna terminal was connected to the Spectrum Analyzer through an external attenuator (20 dB) and an appropriate coaxial cable (cable loss = 1 dB). The Spectrum Analyzer was set to 1.0 MHz resolution BW. Peak detector and maximum hold were used.

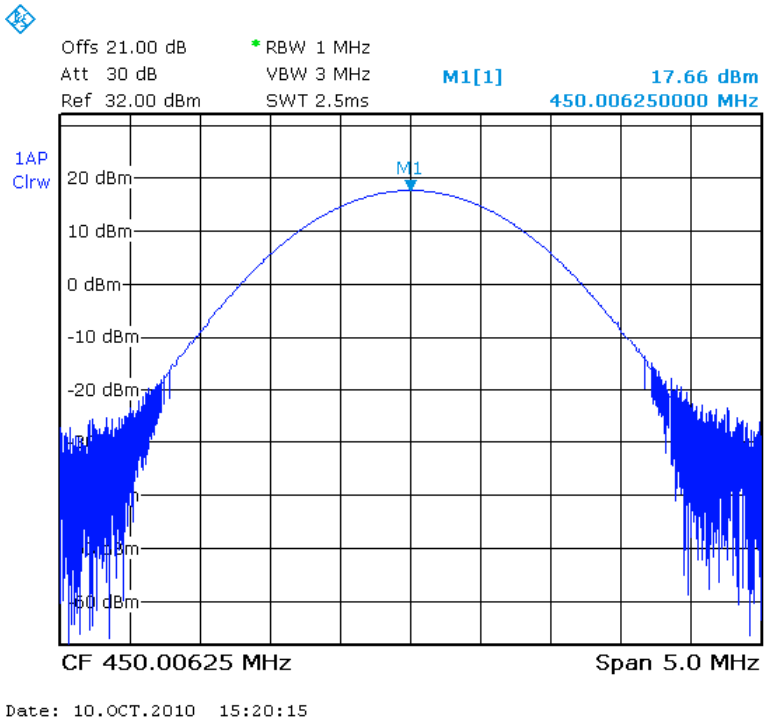



**Figure 5.— 450.00 MHz**

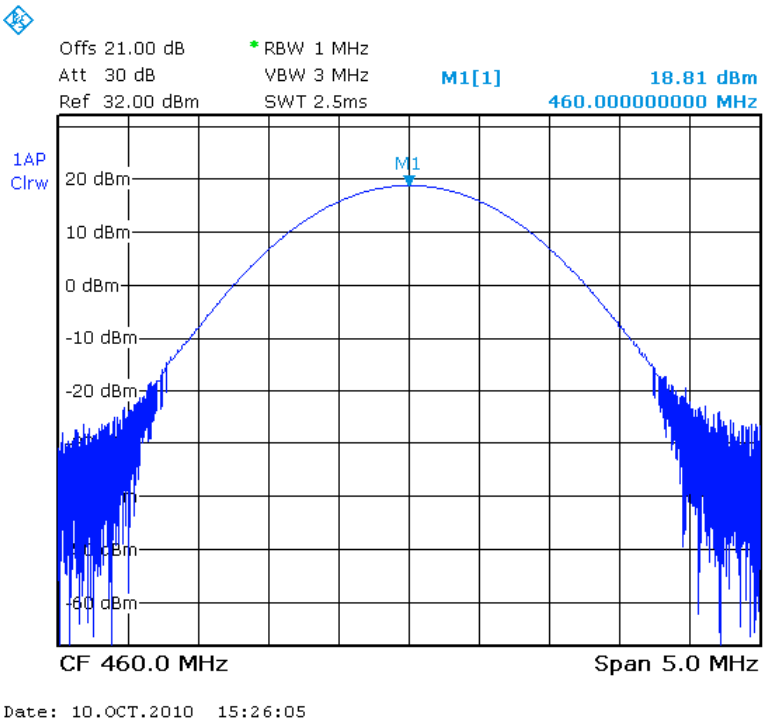



**Figure 6.— 460.00 MHz**

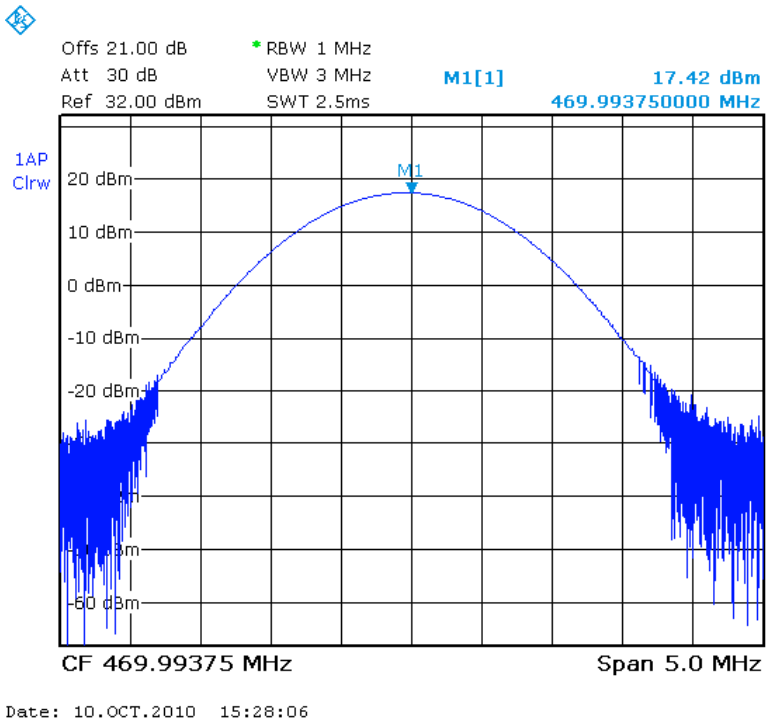



**Figure 7.— 469.99 MHz**

## 4.3 Test Results

E.U.T. Description: Transceiver 3A
Model No.: Transceiver 3A
Serial Number: Not Designated
Specification: FCC Part 90 Section 90.205

| Modulation | Operation Frequency (MHz) | Reading (dBm) | Specification (dBm) | Margin (dB) |
|---|---|---|---|---|
| FSK | 450.01 | 17.66 | 20.8 | -3.14 |
| | 460.00 | 18.81 | 20.8 | -1.99 |
| | 469.99 | 17.42 | 20.8 | -3.38 |

**Figure 8 Peak Output Power**

JUDGEMENT: Passed by 1.99 dB

TEST PERSONNEL:
Tester Signature: _____ Date: 20.1.10
Typed/Printed Name: A. Sharabi

## 4.4 Test Equipment Used, Peak Output Power

| Instrument | Manufacturer | Model | Serial Number | Calibration | |
|---|---|---|---|---|---|
| | | | | Last Calibration | Period |
| Spectrum Analyzer | RHODE & SCHWARZ | FSL6 | 100194 | July 22, 2010 | 1 year |
| Attenuator | Jyebo | - | FAT-AM5AF5G6G2W20 | October 19, 2009 | 1 year |
| Cable | Mini Circuit | CBL-4ST-SMNM | 30084 | October 07, 2010 | 1 year |

**Figure 9 Test Equipment Used**

# 5. Occupied Bandwidth

## 5.1 Test Specification

FCC Part 90, Section 90.209

## 5.2 Test Procedure

The E.U.T. was set to the applicable test frequency. The E.U.T. antenna terminal was connected to the spectrum analyzer through an external attenuator (20 dB) and appropriate coaxial cable (1dB). The spectrum analyzer was set to 1kHz resolution BW. The spectrum bandwidth of the E.U.T. was measured and recorded.

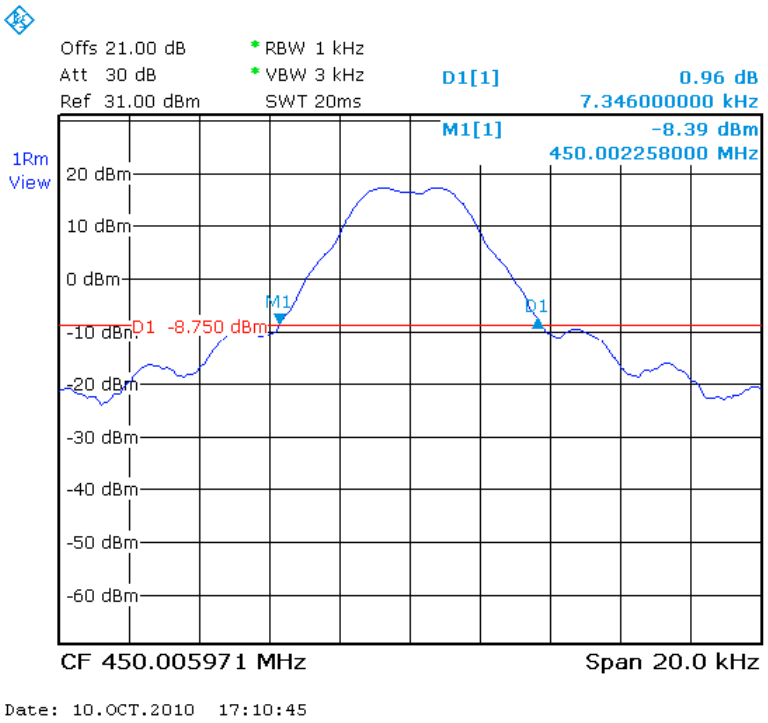



**Figure 10.— 450.00 MHz**

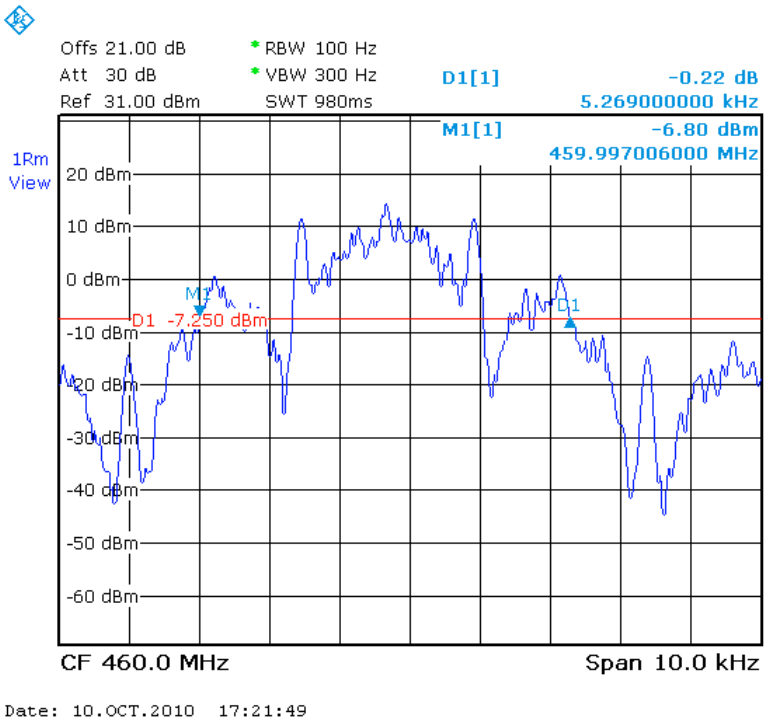



**Figure 11.— 460.00 MHz**

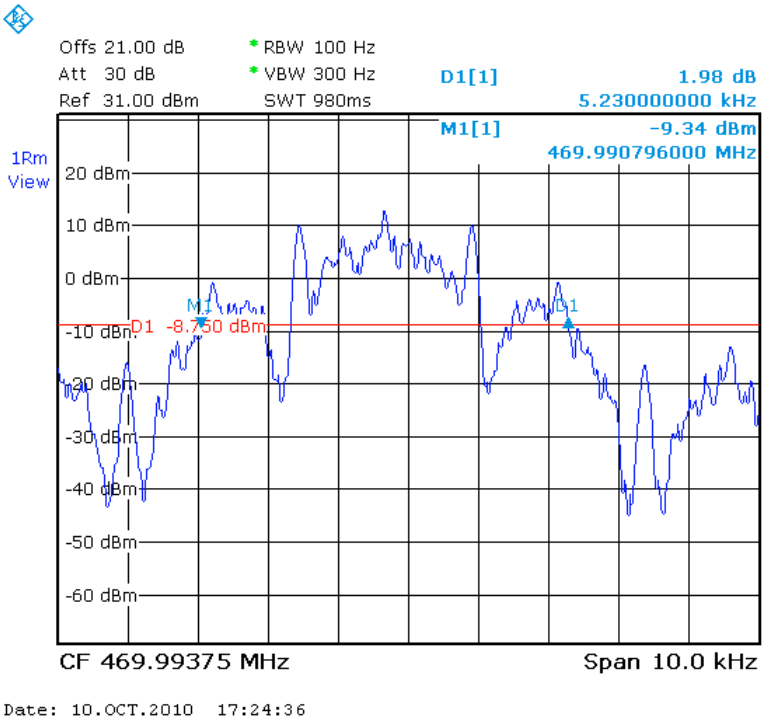



**Figure 12.— 469.99 MHz.**

## 5.3 Test Results

E.U.T. Description: Transceiver 3A
Model No.: Transceiver 3A
Serial Number: Not Designated
Specification: FCC Part 90 Section 90.209

| Modulation | Operating Frequency | Reading (kHz) | Limit (kHz) | Margin (kHz) |
|---|---|---|---|---|
| FSK | 450.00 | 7.35 | 11.25 | -3.90 |
| FSK | 460.00 | 5.27 | 11.25 | -5.98 |
| FSK | 469.99 | 5.23 | 11.25 | -6.02 |

**Figure 13 Occupied Bandwidth**

JUDGEMENT: Passed by 3.9 kHz

TEST PERSONNEL:

Tester Signature: _____ Date: 20.10.10

Typed/Printed Name: A. Sharabi

## 5.4 Test Equipment Used, Occupied Bandwidth

| Instrument | Manufacturer | Model | Serial Number | Calibration | |
|---|---|---|---|---|---|
| | | | | Last Calibration | Period |
| Spectrum Analyzer | RHODE & SCHWARZ | FSL6 | 100194 | July 22, 2010 | 1 year |
| Attenuator | Jyebo | - | FAT-AM5AF5G6G2W20 | October 19, 2009 | 1 year |
| Cable | Mini Circuit | CBL-4ST-SMNM | 30084 | October 07, 2010 | 1 year |

**Figure 14 Test Equipment Used**

# 6. Frequency Stability

## 6.1 Test Specification

Part 90 Section 90.213

## 6.2 Test Procedure

The E.U.T operation mode and test setup are as described in Section 2. The E.U.T. was operated with a CW signal in the downlink path.

The E.U.T. was placed inside a temperature chamber. The E.U.T. was operated from 115 VAC at normal temperature and the chamber temperature was set to +24°C.

The spectrum analyzer was set to 50.0 kHz span and 1.0 kHz resolution B.W.

The carrier frequency was measured and recorded (reference frequency reading).

The carrier frequency measurement was repeated for:

(a). +50°C and 90 VAC

(b). +50°C and 127 VAC

(c). -30°C and 90 VAC

(d). -30°C and 127 VAC

The carrier frequency was measured and recorded after at least 20 minutes of exposing the E.U.T. to the temperature.

The E.U.T. was operated at 450.00; 460.00 and 469.99 MHz.

## 6.3 Test Results

E.U.T. Description: Transceiver 3A
Model No.: Transceiver 3A
Serial Number: Not Designated
Specification: FCC Part 90 Section 90.213

| Temperature (°C) | Voltage (VAC) | Frequency (MHz) | Frequency Drift (Hz) | Frequency Drift (ppm) | Specification (ppm) | Margin (ppm) |
|---|---|---|---|---|---|---|
| +24 | 115 | 450.006250 | - | - | - | - |
| +50 | 90 | 450.006669 | +419 | 0.93 | 1.5 | -0.57 |
| | 127 | 450.006669 | +419 | 0.93 | 1.5 | -0.57 |
| -30 | 90 | 450.006230 | -20 | 0.04 | 1.5 | -1.46 |
| | 127 | 450.006230 | -20 | 0.04 | 1.5 | -1.46 |

**Figure 15. Frequency Stability Lower Channel**

| Temperature (°C) | Voltage (VAC) | Frequency (MHz) | Frequency Drift (Hz) | Frequency Drift (ppm) | Specification (ppm) | Margin (ppm) |
|---|---|---|---|---|---|---|
| +24 | 115 | 460.000000 | - | - | - | - |
| +50 | 90 | 460.000389 | +389 | 0.84 | 1.5 | -0.66 |
| | 127 | 460.000389 | +389 | 0.84 | 1.5 | -0.66 |
| -30 | 90 | 459.999985 | -15 | 0.33 | 1.5 | -1.17 |
| | 127 | 459.999985 | -15 | 0.33 | 1.5 | -1.17 |

**Figure 16. Frequency Stability Middle Channel**

| Temperature (°C) | Voltage (VAC) | Frequency (MHz) | Frequency Drift (Hz) | Frequency Drift (ppm) | Specification (ppm) | Margin (ppm) |
|---|---|---|---|---|---|---|
| +24 | 115 | 469.993750 | - | - | - | - |
| +50 | 90 | 469.994152 | +402 | 0.85 | 1.5 | -0.65 |
| | 127 | 469.994152 | +402 | 0.85 | 1.5 | -0.65 |
| -30 | 90 | 469.993740 | -10 | 0.02 | 1.5 | -1.48 |
| | 127 | 469.993740 | -10 | 0.02 | 1.5 | -1.48 |

**Figure 17. Frequency Stability Upper Channel**

JUDGEMENT: Passed

The E.U.T met the requirements of the FCC, Part 90, Section 90.213 specifications.

TEST PERSONNEL:

Tester Signature: _____ Date: 20.10.10

Typed/Printed Name: A. Sharabi

### *6.4 Test Instrumentation Used, Frequency Stability*

| Instrument | Manufacturer | Model | Serial Number | Calibration | Period |
|---|---|---|---|---|---|
| Environmental Chamber | THERMOTRON CORP | SM 32C Mini Max | 25-1030 | March 4, 2009 | 2 Years |
| Digital Voltage Meter | Escort | EDM1111A | 10313121 | November 3, 2008 | 2 Years |
| Variable Voltage Transformer | Variac Voltage Co. | - | - | N/A | N/A |
| Spectrum Analyzer | RHODE & SHWARZ | FSL6 | 100194 | July 22, 2010 | 1 Year |

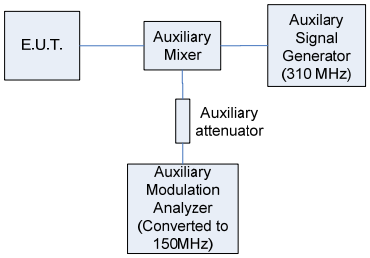
# 7. Transient Frequency Behavior

## 7.1 Test Specification

FCC Part 90, Section 90.214

## 7.2 Test procedure

The E.U.T. was connected to a peak power meter in order to determine the start time of measurement, $T_{on}$.




The time between the trigger and the point where the power output reaches -30 dB below its maximum, was called $T_{on}$ (90.214). Then the RF port was connected to a mixer and a local oscillator of 310 MHz from a signal generator, in order to convert the RF signal to 150 MHz (maximum range of the modulation analyzer is 200 MHz). The frequency behavior was observed according to the duration listed in the standard (only $T_2$ for equipment transmitting less than 6 W and with channel spacing of 12.5 kHz ).

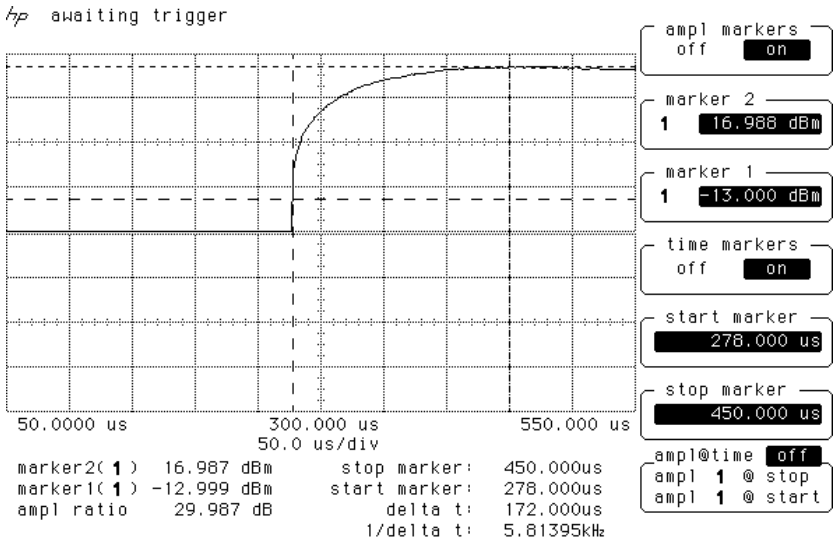



**Figure 18. Transient Frequency Behavior 450.00 MHz -30dB point ($T_{on}$)**

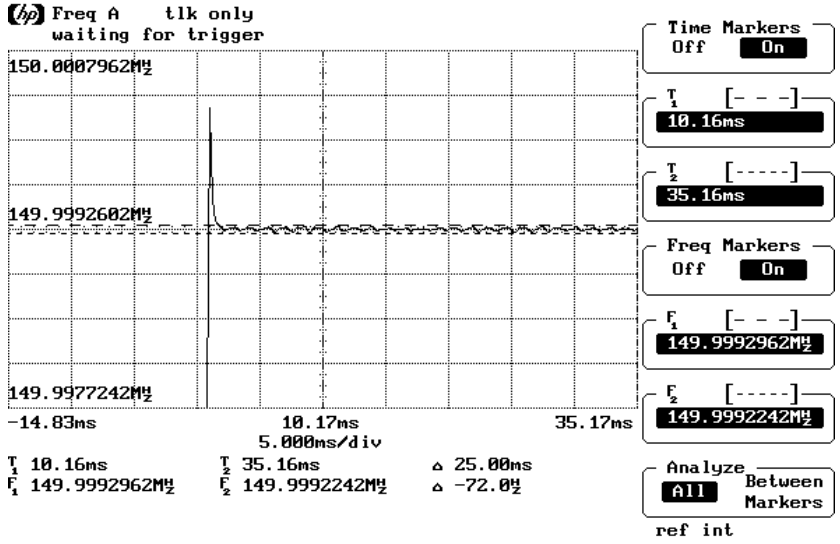



**Figure 19. Transient Frequency Behavior 450.00 MHz $T_2$ Measurement**

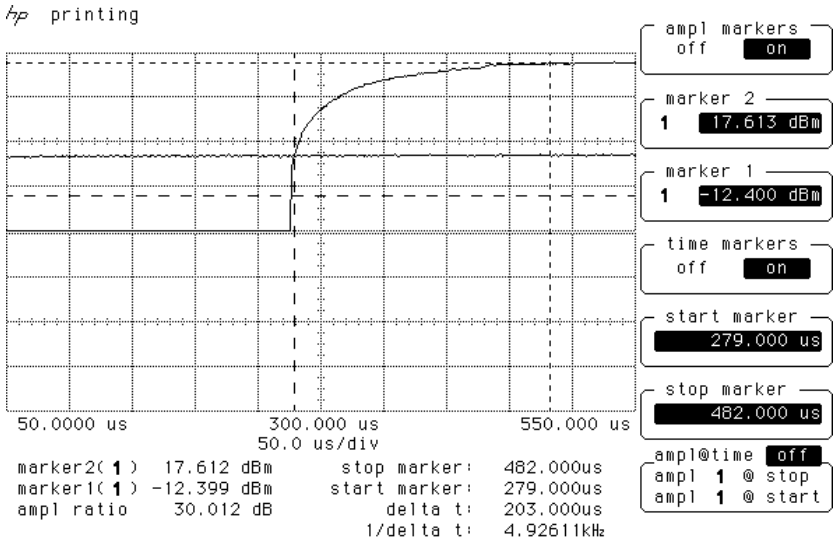



**Figure 20. Transient Frequency Behavior 460.00 MHz-30dB point ($T_{on}$)**

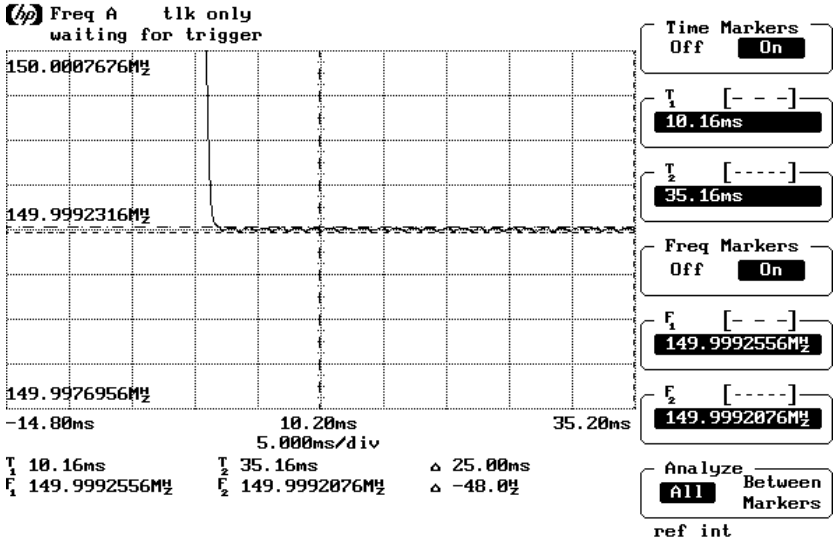



**Figure 21. Transient Frequency Behavior 460.00 MHz $T_2$ Measurement**

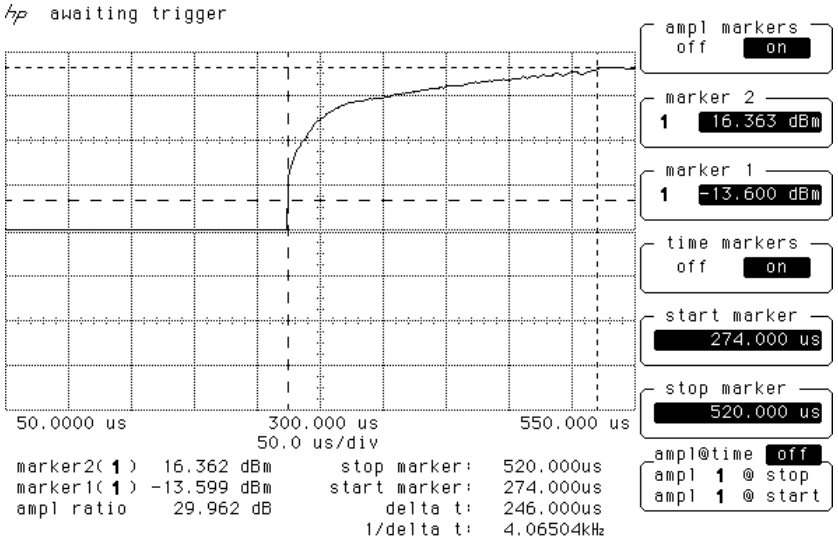



**Figure 22. Transient Frequency Behavior 469.9 MHz-30dB point ($T_{on}$)**

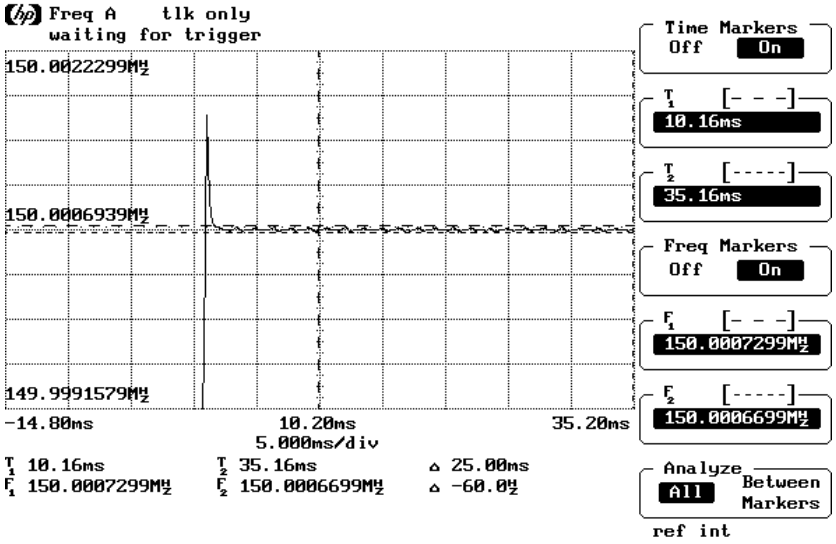



**Figure 23. Transient Frequency Behavior 469.99 MHz $T_2$ Measurement**

## 7.1 Test Results

E.U.T. Description: Transceiver 3A
Model No.: Transceiver 3A
Serial Number: Not Designated
Specification: FCC Part 90 Section 90.214

| Frequency | Time Interval | $T_{on}$ | Duration | Frequency Tolerance | Limit | Margin |
|---|---|---|---|---|---|---|
| MHz | | µsec | msec | kHz | kHz | kHz |
| 450.00625 | T2 | 172 | 25 | -0.072 | ±6.25 | -6.178 |
| 460.00000 | T2 | 203 | 25 | -0.048 | ±6.25 | -6.202 |
| 469.99835 | T2 | 246 | 25 | -0.060 | ±6.25 | -6.16 |

JUDGEMENT: Passed by 6.16 kHz

The E.U.T met the requirements of the FCC, Part 90, Section 90.214 specifications.

TEST PERSONNEL:

Tester Signature: _____ Date: 20.10.10

Typed/Printed Name: A. Sharabi

## 7.1 Test Instrumentation Used, Transient Frequency Behavior

| Instrument | Manufacturer | Model | Serial Number | Calibration | Period |
|---|---|---|---|---|---|
| Signal Generator | Fluke | 60608 | 5365219 | September 10, 2010 | 1 Year |
| Modulation Analyzer | HP | 53310A | 3121A02651 | September 10, 2010 | 1 Year |
| Peak Power Meter | HP | 8991A | 3314A00219 | September 10, 2010 | |

# 8. Band Edge

## 8.1 Test Specification

FCC Part 90, FCC Part 90.217

## 8.2 Test procedure

The E.U.T. antenna terminal was connected to the spectrum analyzer through an external attenuator (20 dB) and an appropriate coaxial cable (cable loss = 1 dB). The spectrum analyzer was set to 100 Hz resolution BW. Maximum power level below 55 kHz and above 55 kHz from the authorized bandwidth was measured

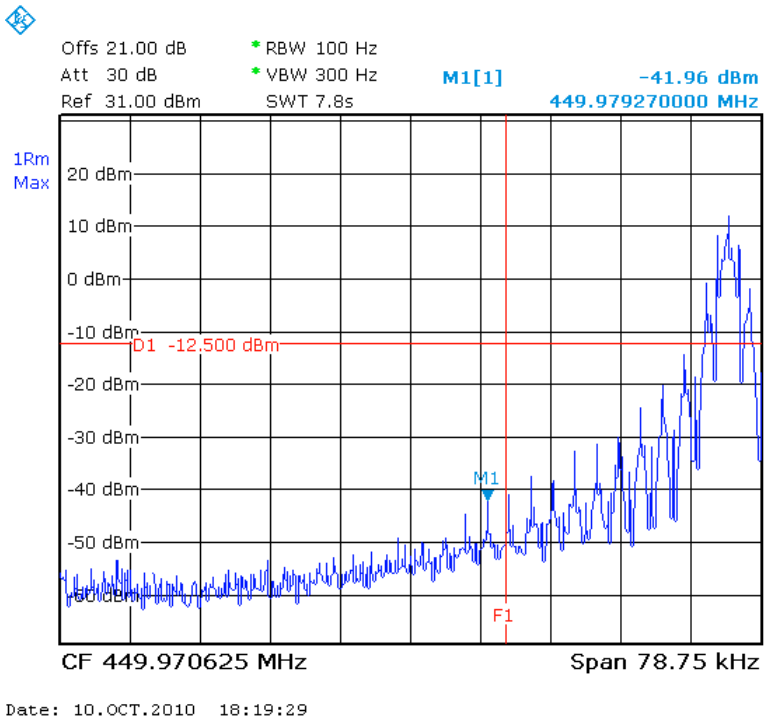



**Figure 24.— 450.00 MHz**

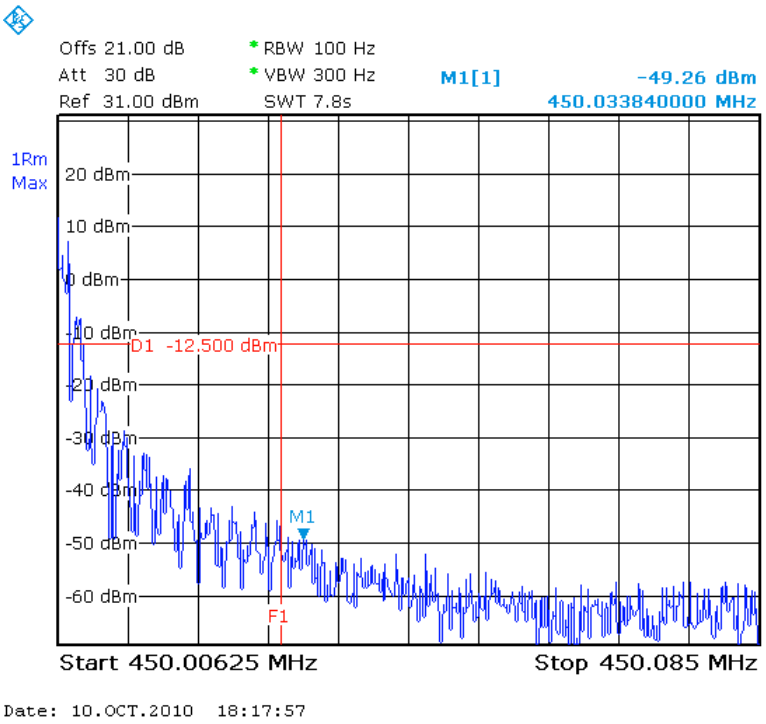



**Figure 25.— 450.00 MHz**

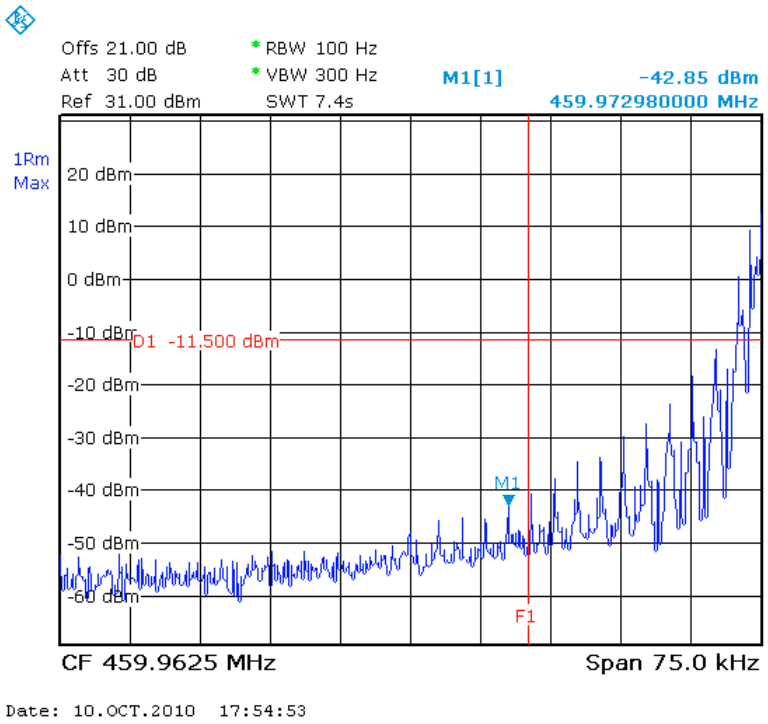



**Figure 26.— 460.00 MHz**

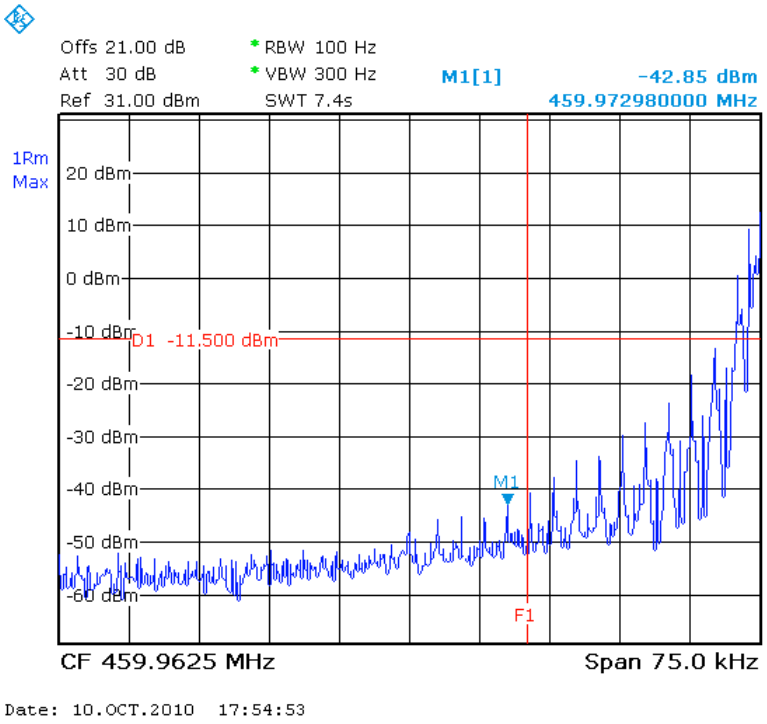



**Figure 27.— 460.00 MHz**

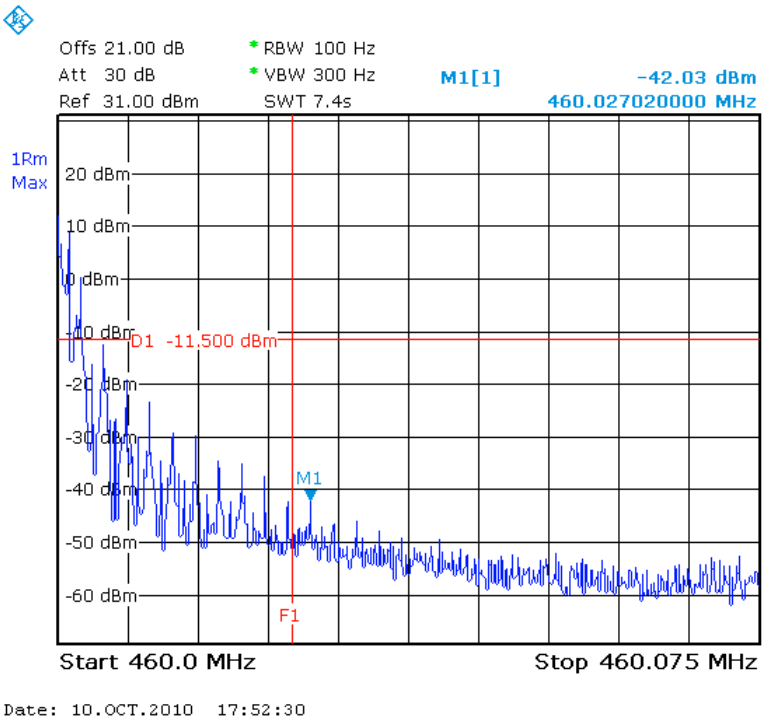



**Figure 28.— 469.99 MHz**

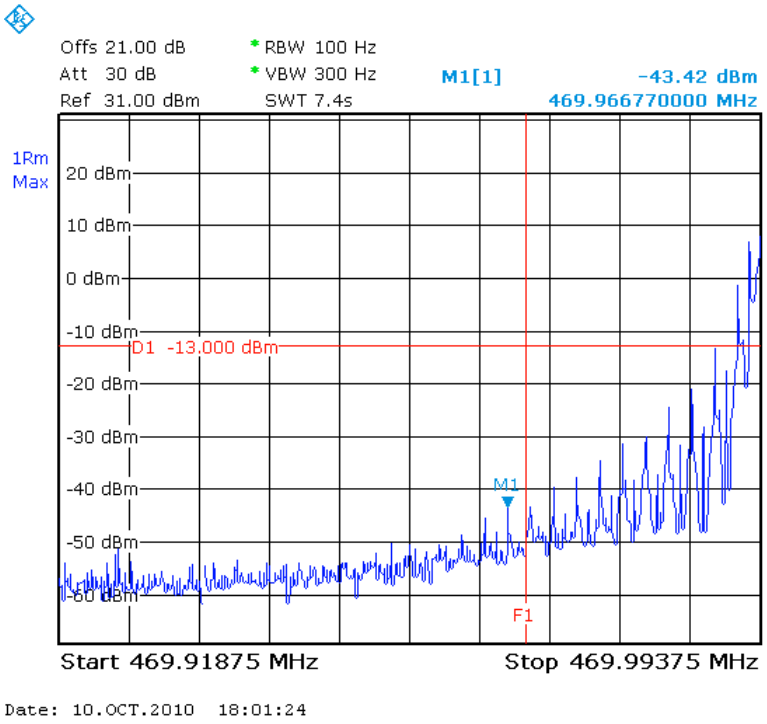



**Figure 29.— 469.99 MHz**

### 8.3 Results table

E.U.T. Description: Transceiver 3A
Model No.: Transceiver 3A
Serial Number: Not Designated
Specification: FCC Part 90 Section 90.217

| Modulation | Operation Frequency (MHz) | Band Edge Frequency (MHz) | Reading (dBm) | Specification (dBm) | Margin (dB) |
|---|---|---|---|---|---|
| FSK | 450.00 | 449.97927 | -41.96 | -12.50 | -29.46 |
| | 450.00 | 450.03384 | -49.26 | -12.50 | -36.76 |
| | 460.00 | 459.97298 | -42.85 | -11.50 | -31.35 |
| | 460.00 | 460.02702 | -42.03 | -11.50 | -30.53 |
| | 469.99 | 469.96677 | -43.42 | -13.00 | -30.42 |
| | 469.99 | 470.02075 | -45.56 | -13.00 | -32.56 |

**Figure 30 Band Edge**

JUDGEMENT: Passed by 29.46 dB

TEST PERSONNEL:
Tester Signature: _____ Date: 20.10.10
Typed/Printed Name: A. Sharabi

### 8.4 Test Equipment Used, Band Edge

| Instrument | Manufacturer | Model | Serial Number | Calibration | |
|---|---|---|---|---|---|
| | | | | Last Calibration | Period |
| Spectrum Analyzer | RHODE & SCHWARZ | FSL6 | 100194 | July 22, 2010 | 1 year |
| Attenuator | Jyebo | - | FAT-AM5AF5G6G2W20 | October 19, 2009 | 1 year |
| Cable | Mini Circuit | CBL-4ST-SMNM | 30084 | October 07, 2010 | 1 year |

**Figure 31 Test Equipment Used**

# 9. Conducted Spurious Emission

## 9.1 Test Specification

FCC Part 90, Section 90.217

## 9.2 Test procedure

The E.U.T. antenna terminal was connected to the spectrum analyzer through an appropriate coaxial cable. The spectrum analyzer was set to 1 MHz resolution BW except for the frequency range 9 kHz-150 kHz where the RBW was set to 1 kHz and the frequency range 150 kHz-10.0 MHz where the RBW was set to 10 kHz. The frequency range from 9 kHz to 5 GHz was scanned. Level of spectrum components out of the operational channels was measured at the selected operation frequencies.

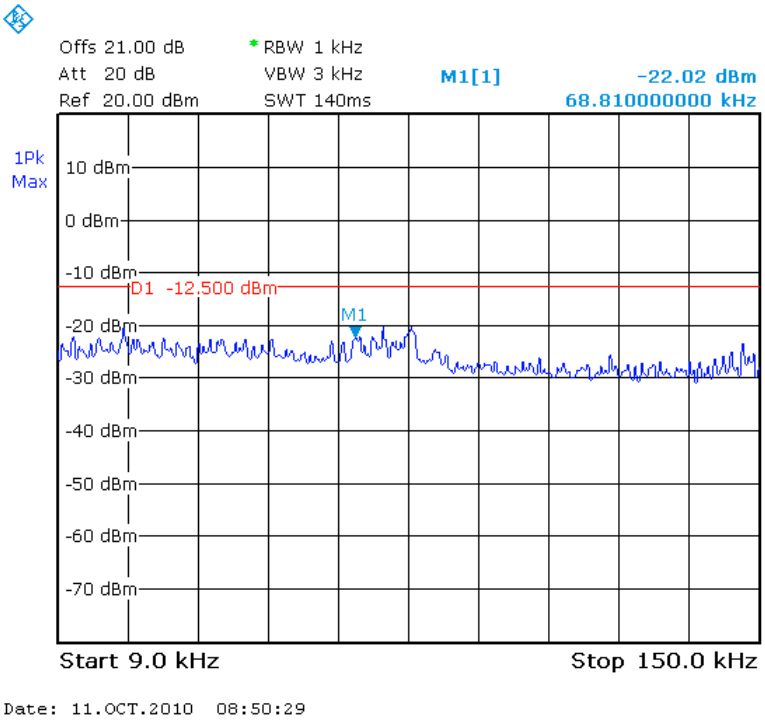



**Figure 32.— 450.0 MHz**

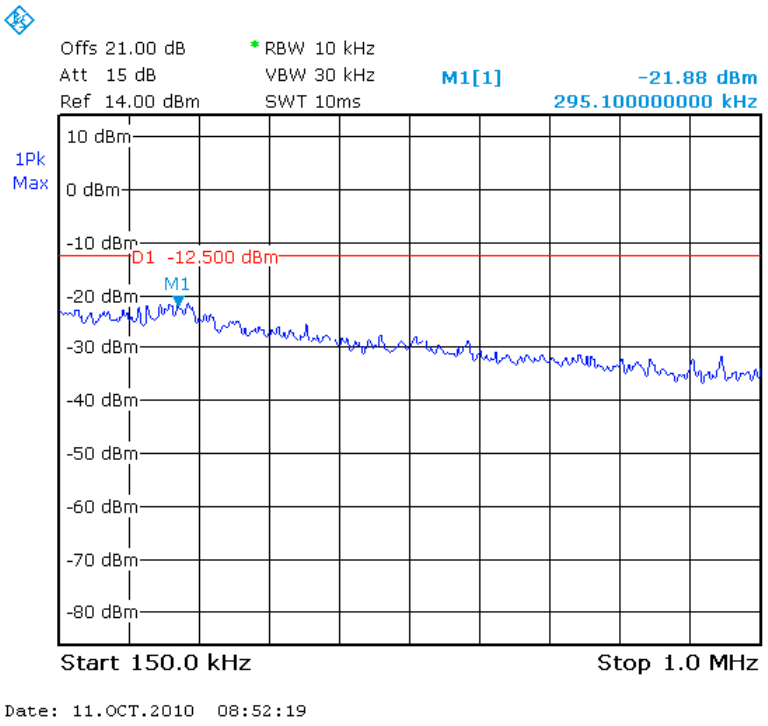



**Figure 33.— 450.00 MHz**

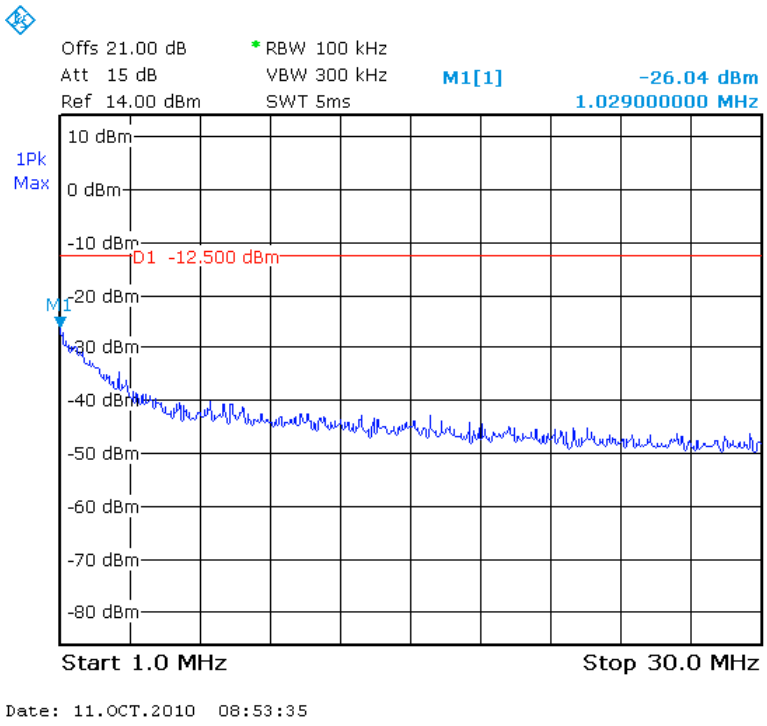



**Figure 34.— 450.00 MHz**

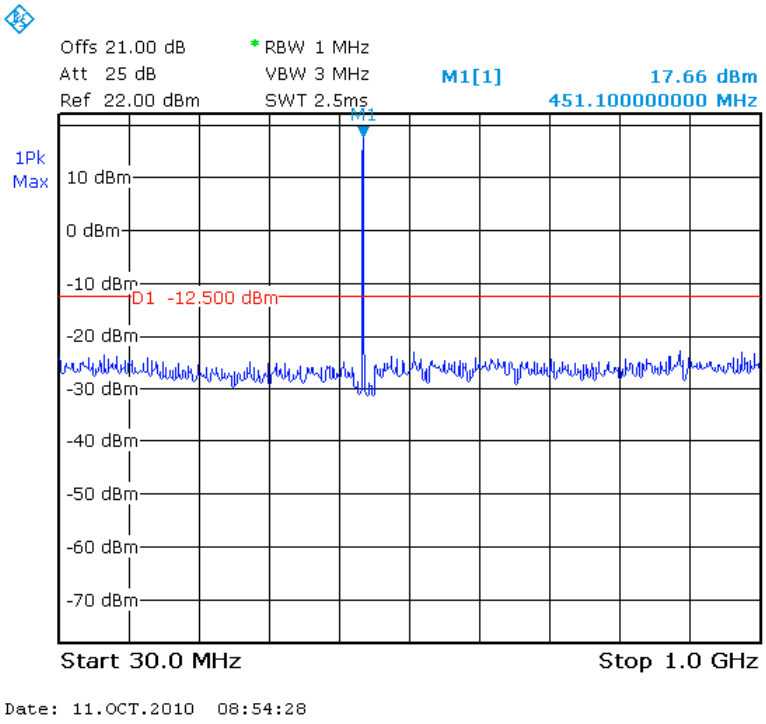



**Figure 35.— 450.00 MHz**

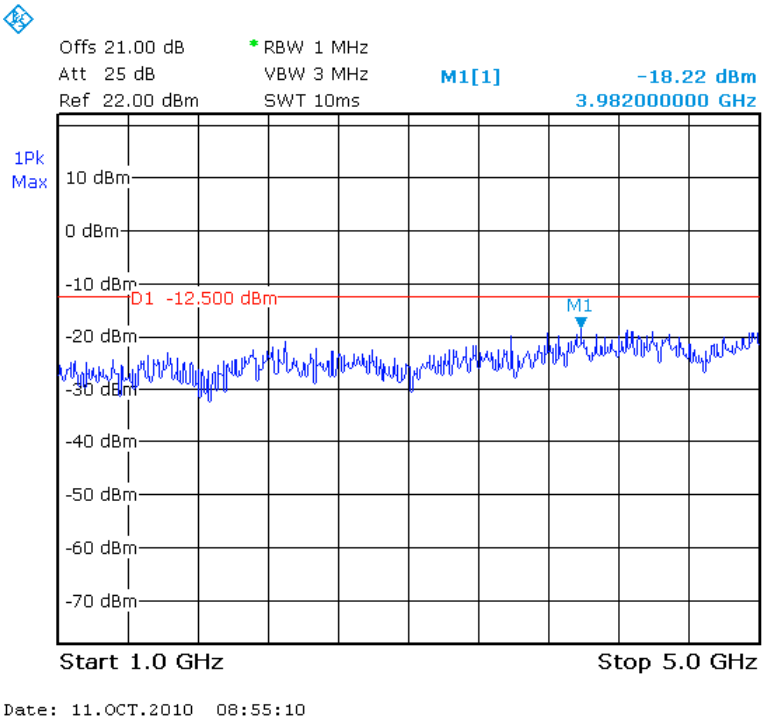



**Figure 36.— 450.00 MHz**

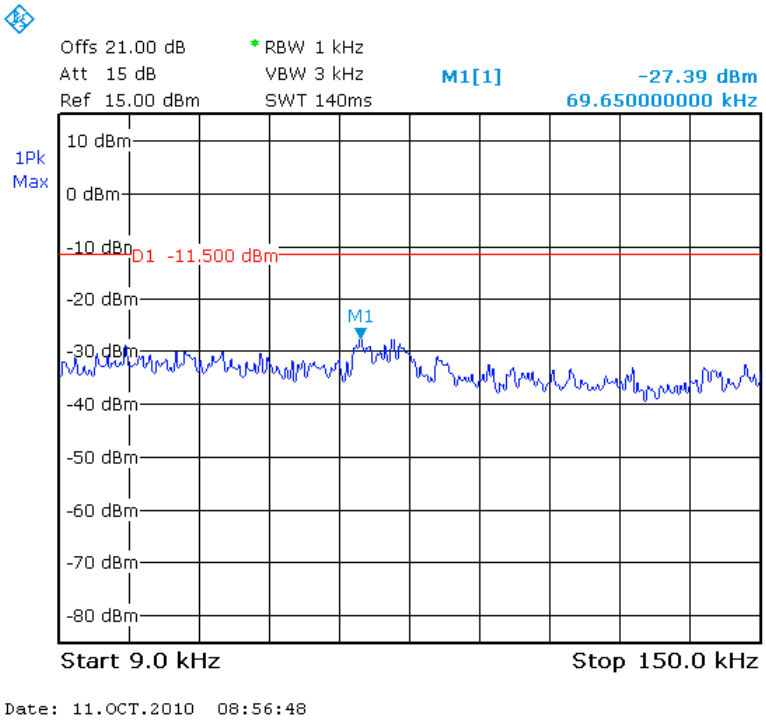



**Figure 37.— 460.00 MHz**

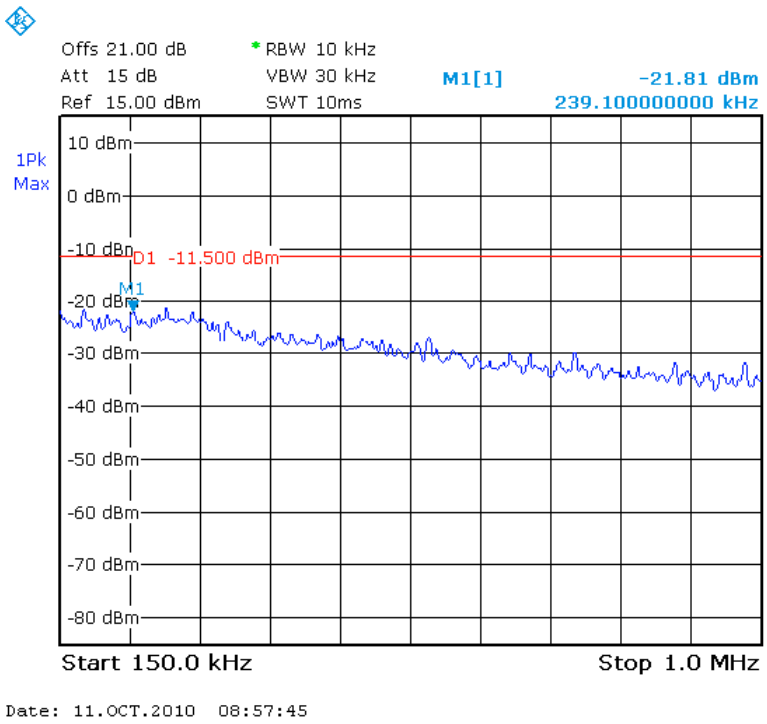



**Figure 38.— 460.00 MHz**

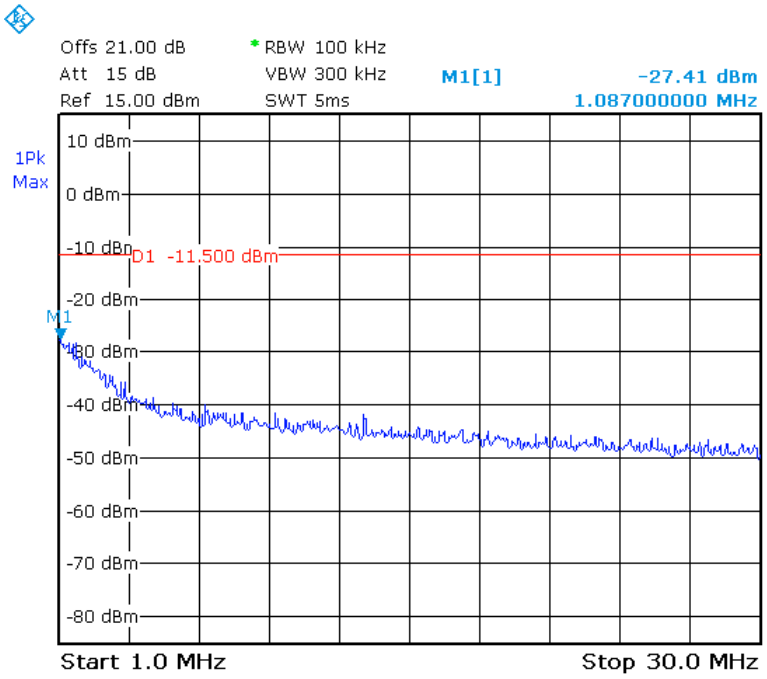



**Figure 39.— 460.00 MHz**

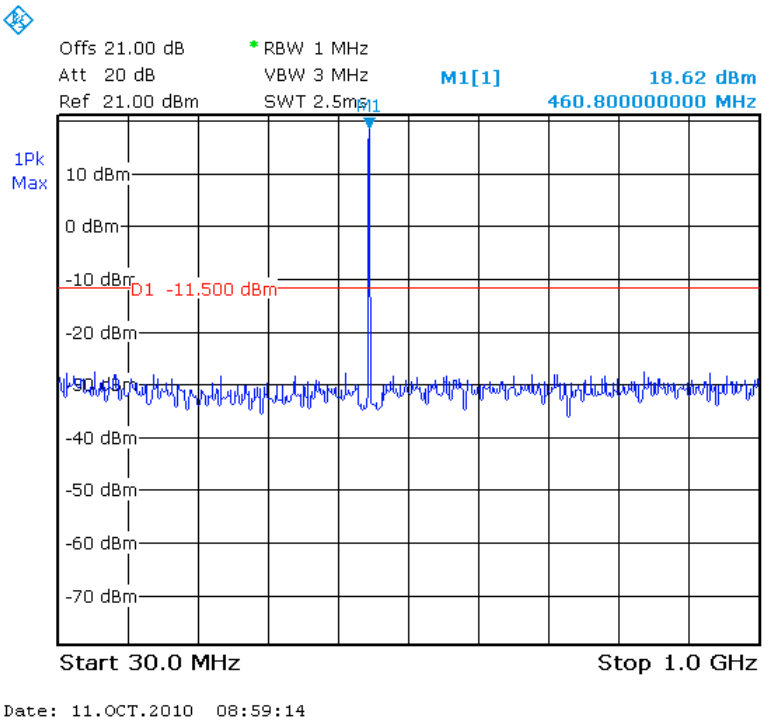



**Figure 40.— 460.00 MHz**

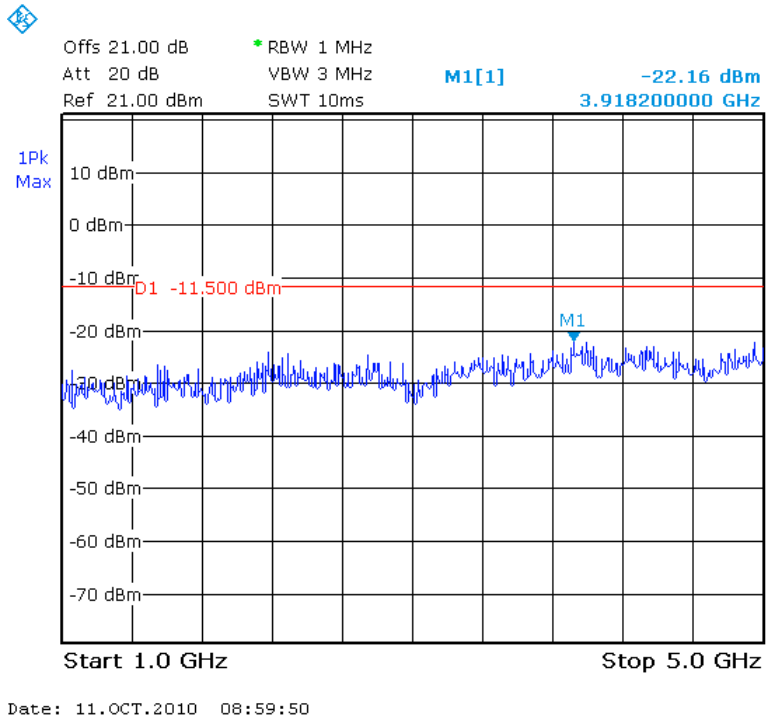



**Figure 41.— 460.00 MHz**

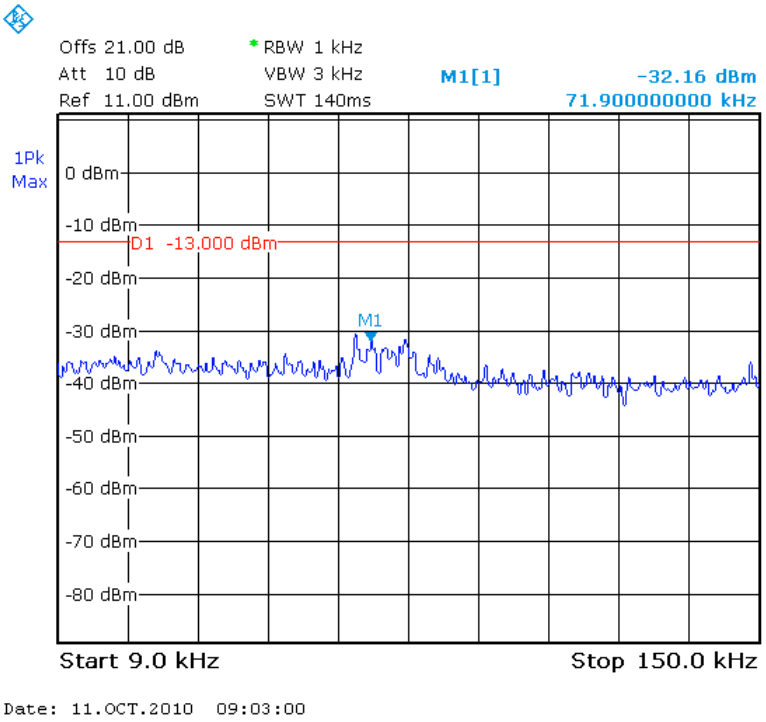



**Figure 42.— 469.99 MHz**

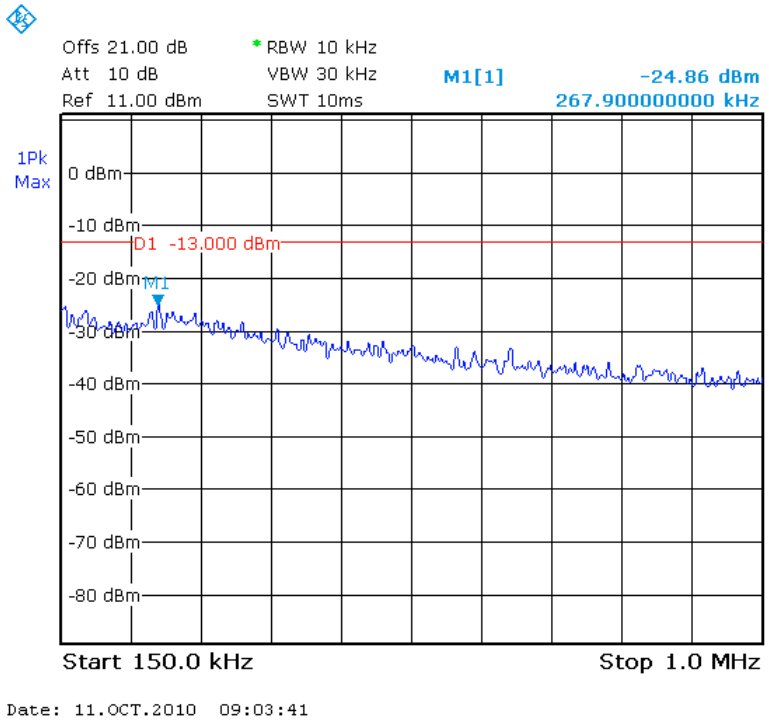



**Figure 43.— 469.99 MHz**

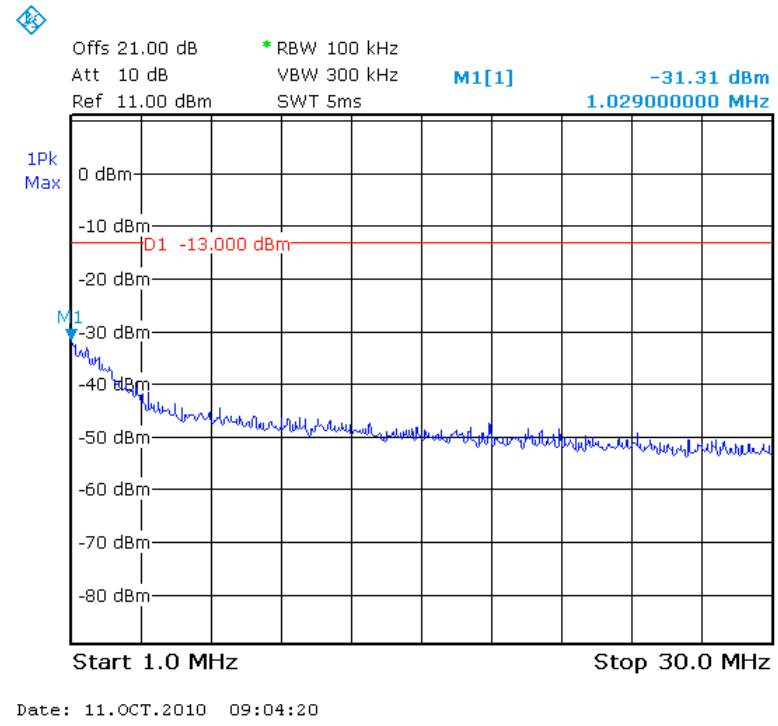



**Figure 44.— 469.99 MHz**

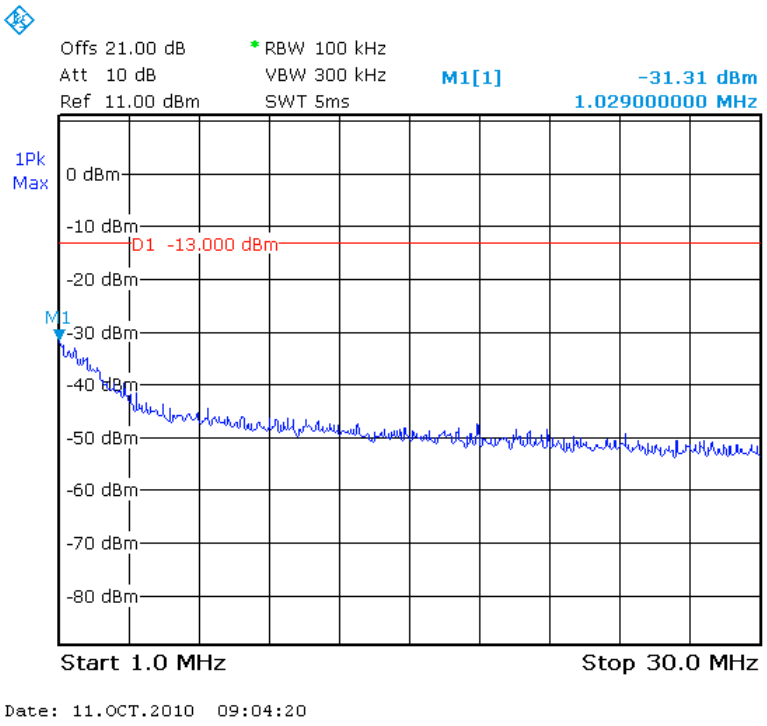



**Figure 45.— 469.99 MHz**

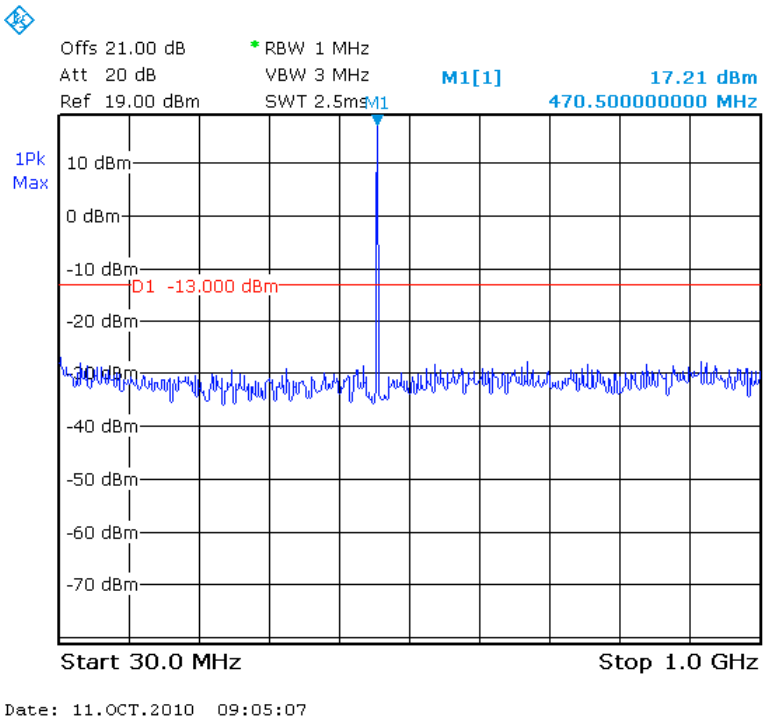



**Figure 46.— 469.99 MHz**

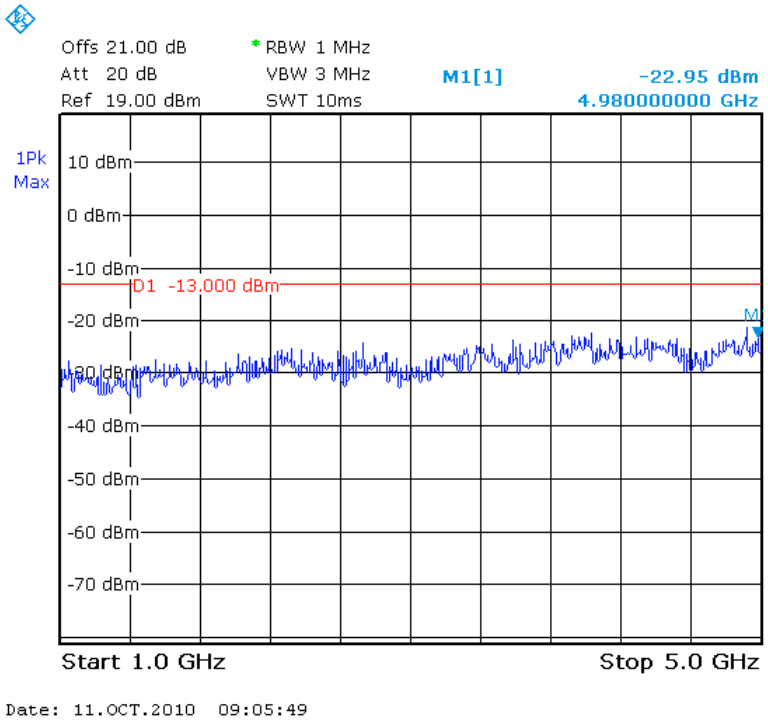



**Figure 47.— 469.99 MHz**

## 9.3 Test Results

E.U.T. Description: Transceiver 3A
Model No.: Transceiver 3A
Serial Number: Not Designated
Specification: FCC Part 90 Section 90. 217

| Modulation | Operation Frequency (MHz) | Frequency (MHz) | Reading (dBm) | Specification (dBm) | Margin (dB) |
|---|---|---|---|---|---|
| FSK | 450.00 | 3982.00 | -18.22 | -12.50 | -5.72 |
| | 460.00 | 0.2391 | -21.81 | -11.50 | -10.31 |
| | 469.99 | 4980.00 | -22.95 | -13.00 | -9.95 |

**Figure 48 Conducted Spurious Emission**

JUDGEMENT: Passed by 5.72 dB

TEST PERSONNEL:
Tester Signature: _____ Date: 20.10.10
Typed/Printed Name: A. Sharabi

## 9.4 Test Equipment Used, Conducted Spurious Emission

| Instrument | Manufacturer | Model | Serial Number | Calibration | |
|---|---|---|---|---|---|
| | | | | Last Calibration | Period |
| Spectrum Analyzer | RHODE & SCHWARZ | FSL6 | 100194 | July 22, 2010 | 1 year |
| Attenuator | Jyebo | - | FAT-AM5AF5G6G2W20 | October 19, 2009 | 1 year |
| Cable | Mini Circuit | CBL-4ST-SMNM | 30084 | October 07, 2010 | 1 year |

**Figure 49 Test Equipment Used**

# 10. Radiated Spurious Emission

## *10.1 Test Specification*

FCC Part 90, Section 90.217

## *10.2 Test Procedure*

The test method was based on ANSI/TIA-603-C: 2004, Unwanted Emissions: Radiated Spurious.
The power of any emission outside of the authorized operating frequency ranges (450 - 470 MHz) must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log (P) dB, yielding –13dBm.

(a) The E.U.T. operation mode and test set-up are as described in Section 3. A preliminary measurement to characterize the E.U.T was performed inside the shielded room at a distance of 3 meters, using peak detection mode and broadband antennas. The preliminary measurements produced a list of the highest emissions. The E.U.T was then transferred to the open site, and placed on a remote-controlled turntable. The E.U.T was placed on a non-metallic table, 1.5 meters above the ground. The configuration tested is shown in Figure 3.1.
The frequency range 9 kHz-5 GHz was scanned, and the list of the highest emissions was verified and updated accordingly.
The readings were maximized by adjusting the antenna height between 1-4 meters, the turntable azimuth between 0-360°, and the antenna polarization.
The emissions were measured at a distance of 3 meters.

(b) The E.U.T. was replaced by a substitution antenna (dipole 30MHz-1GHz, Horn Antenna above 1GHz) driven by a signal generator. The height was readjusted for maximum reading. The signal generator level was adjusted to obtain the same reading on the EMI receiver as in step (a).
The signals observed in step (a) were converted to radiated power using:
$P_d$(dBm) = $P_g$(dBm) – Cable Loss (dB) + Substitution Antenna Gain (dB)
$P_d$ = Dipole equivalent power (result).
$P_g$ = Signal generator output level.

## *10.3 Test Results*

| Carrier Channel (MHz) | Freq. (MHz) | Antenna Pol. | E (dBµV/m) | Signal Generator RF Output (dBm) | Cable Loss (dB) | Antenna Gain (dBi) | Effective Radiated Power Level (dBm) | Spec. (dBm) | Margin (dB) |
|---|---|---|---|---|---|---|---|---|---|
| 450.0625 | 900.01 | V | 69.11 | -23.82 | 3.9 | 0.49 | -27.23 | -12.34 | -14.89 |
| 450.0625 | 900.01 | H | 70.55 | -21.75 | 3.9 | 0.49 | -25.16 | -12.34 | -12.82 |
| 450.0625 | 1350.15 | V | 46.61 | -55.57 | 5 | 7.16 | -53.41 | -12.34 | -41.07 |
| 450.0625 | 1350.15 | H | 47.66 | -54.07 | 5 | 7.16 | -51.91 | -12.34 | -39.51 |
| 460.000 | 920.00 | V | 59.98 | -34.95 | 3.9 | 0.49 | -38.36 | -11.19 | -27.17 |
| 460.000 | 920.00 | H | 54.14 | -38.16 | 3.9 | 0.49 | -41.57 | -11.19 | -30.38 |
| 460.000 | 1380.00 | V | 50.09 | -52.09 | 5 | 7.16 | -49.93 | -11.19 | -38.74 |
| 460.000 | 1380.00 | H | 50.18 | -51.76 | 5 | 7.16 | -49.6 | -11.19 | -38.41 |
| 469.99375 | 940.00 | V | 60.75 | -32.18 | 3.9 | 0.49 | -35.59 | -12.58 | -23.01 |
| 469.99375 | 940.00 | H | 62.15 | -30.15 | 3.9 | 0.49 | -33.56 | -12.58 | -20.98 |
| 469.99375 | 1410.00 | V | 47.56 | -54.62 | 5 | 7.16 | -52.46 | -12.58 | -39.88 |
| 469.99375 | 1410.00 | H | 47.20 | -23.82 | 3.9 | 0.49 | -27.23 | -12.34 | -14.89 |

The E.U.T met the requirements of the FCC Part 90, Section 90.217 specifications.

TEST PERSONNEL:

Tester Signature: _____ Date: 20.10.10

Typed/Printed Name: A. Sharabi

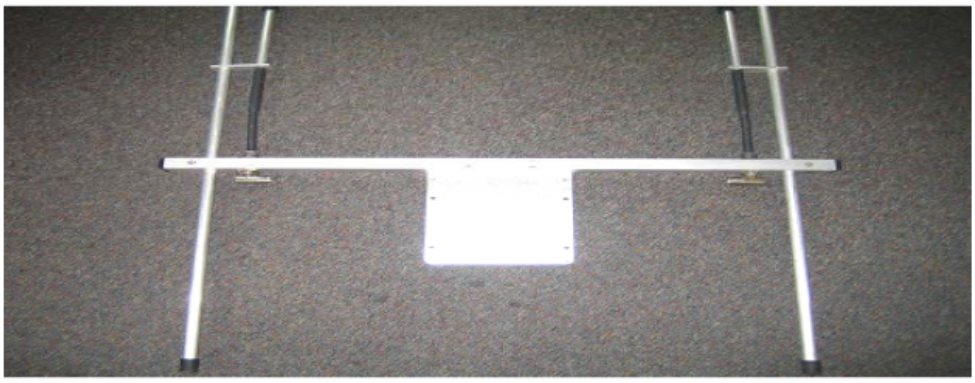
### *10.4 Test Instrumentation Used, Radiated Spurious Emission*

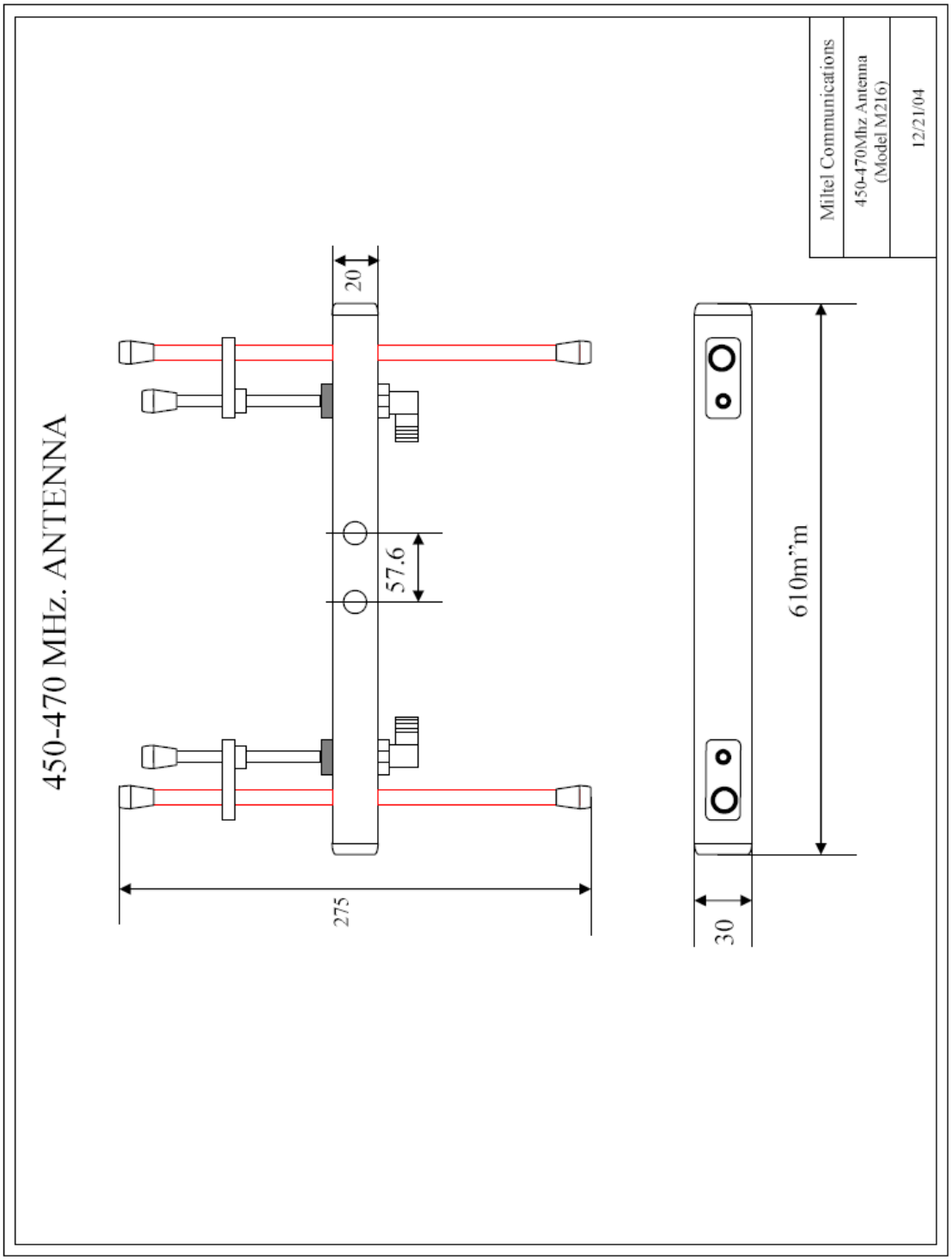
| Instrument | Manufacturer | Model | Serial Number | Calibration | Period |
|---|---|---|---|---|---|
| EMI Receiver | HP | 85422E | 3906A00276 | November 10, 2009 | 1 year |
| RF Section | HP | 85420E | 3705A00248 | November 10, 2009 | 1 year |
| Antenna Bioconical | ARA | BCD 235/B | 1041 | August 1, 2010 | 1 year |
| Antenna Log Periodic | ARA | LPD-2010/A | 1038 | March 24, 2010 | 1 year |
| Active Loop Antenna | EMCO | 6502 | 9506-2950 | October 19, 2009 | 1 year |
| Antenna Log Periodic | A.H. Systems | SAS-200/511 | 253 | January 29, 2009 | 2 year |
| Antenna Mast | ARA | AAM-4A | 1001 | N/A | N/A |
| Turntable | ARA | ART-1001/4 | 1001 | N/A | N/A |
| Mast & Table Controller | ARA | ACU-2/5 | 1001 | N/A | N/A |
| Printer | HP | ThinkJet 2225 | 2738508357.0 | N/A | N/A |
| Spectrum Analyzer | HP | 8592L | 3826A01204 | March 14, 2010 | 1 year |
| Low Noise Amplifier | DBS MICROWAVE | LNA-DBS-0411N313 | 013 | January 13, 2010 | 1 year |
| Low Noise Amplifier | Sophia Wireless | LNA 28-B | 232 | January 13, 2010 | 1 year |
| Signal Generator | HP | 8648C | 3623A04126 | March 14, 2010 | 2 years |
| Double Ridged Waveguide Horn Antenna | EMCO | 3115 | 29845 | March 16, 2010 | 2 years |

# 11. Antenna Information

## 1. Mars Antenna - Model M216

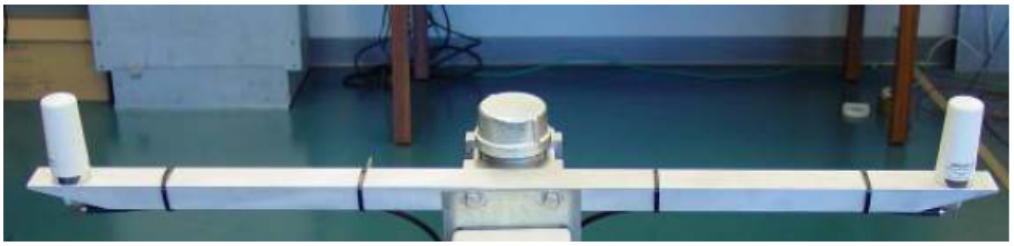
| | |
|---|---|
| **Frequency Range:** | 450-470 Mhz. |
| **Peak Gain:** | 2.2dBi |
| **VSWR,** maximum: | 2:1 |
| **Polarization:** | Vertical |
| **Patterns:** | Azimuth - Omni<br>Elevation - Omni |
| **Nominal Input Impedance:** | 50 Ohms |



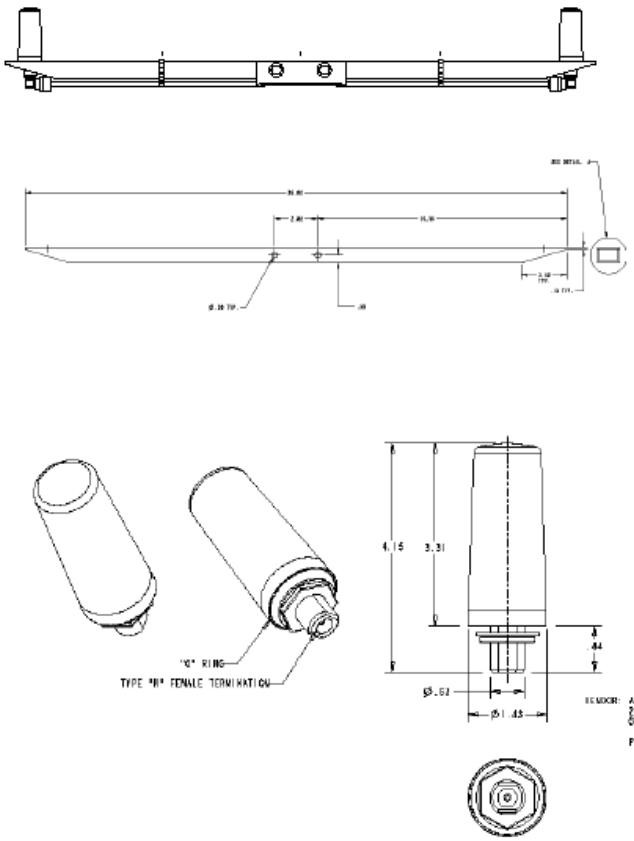

Miltel Communications
450-470Mhz Antenna
(Model M216)
12/21/04
450-470 MHz. ANTENNA
20
57.6
275
610mm
30

## 2. Phantom Antenna - Model OEM2326-110

| | |
|---|---|
| **Frequency Range:** | 450-470 Mhz. |
| **Peak Gain:** | 2.2dBi |
| **VSWR,** maximum: | 2.0:1 |
| **Polarization:** | Vertical |
| **Patterns:** | Azimuth - Omni<br>Elevation - Omni |
| **Nominal Input Impedance:** | 50 Ohms |



## *Phantom Antenna 450-470 MHz.*




| Miltel Communications | |
|---|---|
| | Phantom Antenna 450-470 MHz. |

# 12. APPENDIX A - CORRECTION FACTORS

## *12.1 Correction factors for CABLE*

**from EMI receiver to test antenna at 3 meter range.**

| FREQUENCY (MHz) | CORRECTION FACTOR (dB) |
|---|---|
| 10.0 | 0.3 |
| 20.0 | 0.6 |
| 30.0 | 0.8 |
| 40.0 | 0.9 |
| 50.0 | 1.1 |
| 60.0 | 1.2 |
| 70.0 | 1.3 |
| 80.0 | 1.4 |
| 90.0 | 1.6 |
| 100.0 | 1.7 |
| 150.0 | 2.0 |
| 200.0 | 2.3 |
| 250.0 | 2.7 |
| 300.0 | 3.1 |
| 350.0 | 3.4 |
| 400.0 | 3.7 |
| 450.0 | 4.0 |
| 500.0 | 4.3 |
| 600.0 | 4.7 |
| 700.0 | 5.3 |
| 800.0 | 5.9 |
| 900.0 | 6.3 |
| 1000.0 | 6.7 |

| FREQUENCY (MHz) | CORRECTION FACTOR (dB) |
|---|---|
| 1200.0 | 7.3 |
| 1400.0 | 7.8 |
| 1600.0 | 8.4 |
| 1800.0 | 9.1 |
| 2000.0 | 9.9 |
| 2300.0 | 11.2 |
| 2600.0 | 12.2 |
| 2900.0 | 13.0 |

*NOTES:*

1. *The cable type is RG-214.*
2. *The overall length of the cable is 27 meters.*
3. *The above data is located in file 27MO3MO.CBL on the disk marked "Radiated Emission Tests EMI Receiver".*

### *12.2 Correction factors for CABLE*

**from EMI receiver to test antenna at 3 meter range.**

| FREQUENCY (GHz) | CORRECTION FACTOR (dB) |
|---|---|
| 1.0 | 1.2 |
| 2.0 | 1.6 |
| 3.0 | 2.0 |
| 4.0 | 2.4 |
| 5.0 | 3.0 |
| 6.0 | 3.4 |
| 7.0 | 3.8 |
| 8.0 | 4.2 |
| 9.0 | 4.6 |
| 10.0 | 5.0 |
| 12.0 | 5.8 |

*NOTES:*

*1. The cable type is RG-8.*

*2. The overall length of the cable is 10 meters.*

### *12.3 Correction factors for CABLE*

**from spectrum analyzer to test antenna above 2.9 GHz**

| FREQUENCY (GHz) | CORRECTION FACTOR (dB) | FREQUENCY (GHz) | CORRECTION FACTOR (dB) |
|---|---|---|---|
| 1.0 | 1.9 | 14.0 | 9.1 |
| 2.0 | 2.7 | 15.0 | 9.5 |
| 3.0 | 3.5 | 16.0 | 9.9 |
| 4.0 | 4.2 | 17.0 | 10.2 |
| 5.0 | 4.9 | 18.0 | 10.4 |
| 6.0 | 5.5 | 19.0 | 10.7 |
| 7.0 | 6.0 | 20.0 | 10.9 |
| 8.0 | 6.5 | 21.0 | 11.2 |
| 9.0 | 7.0 | 22.0 | 11.6 |
| 10.0 | 7.5 | 23.0 | 11.9 |
| 11.0 | 7.9 | 24.0 | 12.3 |
| 12.0 | 8.3 | 25.0 | 12.6 |
| 13.0 | 8.7 | 26.0 | 13.0 |

*NOTES:*

*1. The cable type is SUCOFLEX 104 E manufactured by SUHNER.*

*2. The cable is used for measurements above 2.9 GHz.*

*3. The overall length of the cable is 10 meters.*

### *12.4 Correction factors for LOG PERIODIC ANTENNA*

**Type LPD 2010/A**
**at 3 and 10 meter ranges.**

**Distance of 3 meters**

| FREQUENCY (MHz) | AFE (dB/m) |
|---|---|
| 200.0 | 9.1 |
| 250.0 | 10.2 |
| 300.0 | 12.5 |
| 400.0 | 15.4 |
| 500.0 | 16.1 |
| 600.0 | 19.2 |
| 700.0 | 19.4 |
| 800.0 | 19.9 |
| 900.0 | 21.2 |
| 1000.0 | 23.5 |

**Distance of 10 meters**

| FREQUENCY (MHz) | AFE (dB/m) |
|---|---|
| 200.0 | 9.0 |
| 250.0 | 10.1 |
| 300.0 | 11.8 |
| 400.0 | 15.3 |
| 500.0 | 15.6 |
| 600.0 | 18.7 |
| 700.0 | 19.1 |
| 800.0 | 20.2 |
| 900.0 | 21.1 |
| 1000.0 | 23.2 |

*NOTES:*

1. *Antenna serial number is 1038.*
2. *The above lists are located in file number 38M3O.ANT for a 3 meter range, and file number 38M100.ANT for a 10 meter range.*
3. *The files mentioned above are located on the disk marked "Radiated Emission Test EMI Receiver".*

## *12.5 Correction factors for LOG PERIODIC ANTENNA*

**Type SAS-200/511**
**at 3 meter range.**

| FREQUENCY (GHz) | ANTENNA FACTOR (dB) |
|---|---|
| 1.0 | 24.9 |
| 1.5 | 27.8 |
| 2.0 | 29.9 |
| 2.5 | 31.2 |
| 3.0 | 32.8 |
| 3.5 | 33.6 |
| 4.0 | 34.3 |
| 4.5 | 35.2 |
| 5.0 | 36.2 |
| 5.5 | 36.7 |
| 6.0 | 37.2 |
| 6.5 | 38.1 |

| FREQUENCY (GHz) | ANTENNA FACTOR (dB) |
|---|---|
| 7.0 | 38.6 |
| 7.5 | 39.2 |
| 8.0 | 39.9 |
| 8.5 | 40.4 |
| 9.0 | 40.8 |
| 9.5 | 41.1 |
| 10.0 | 41.7 |
| 10.5 | 42.4 |
| 11.0 | 42.5 |
| 11.5 | 43.1 |
| 12.0 | 43.4 |
| 12.5 | 44.4 |
| 13.0 | 44.6 |

*NOTES:*

1. *Antenna serial number is 253.*
2. *The above lists are located in file number SAS3M0.ANT for a 3 meter range.*
3. *The files mentioned above are located on the disk marked "Antenna Factors".*

## 12.6 Correction factors for BICONICAL ANTENNA

**Type BCD-235/B,**
**at 3 meter range**

| FREQUENCY (MHz) | AFE (dB/m) |
|---|---|
| 20.0 | 19.4 |
| 30.0 | 14.8 |
| 40.0 | 11.9 |
| 50.0 | 10.2 |
| 60.0 | 9.1 |
| 70.0 | 8.5 |
| 80.0 | 8.9 |
| 90.0 | 9.6 |
| 100.0 | 10.3 |
| 110.0 | 11.0 |
| 120.0 | 11.5 |
| 130.0 | 11.7 |
| 140.0 | 12.1 |
| 150.0 | 12.6 |
| 160.0 | 12.8 |
| 170.0 | 13.0 |
| 180.0 | 13.5 |
| 190.0 | 14.0 |
| 200.0 | 14.8 |
| 210.0 | 15.3 |
| 220.0 | 15.8 |
| 230.0 | 16.2 |
| 240.0 | 16.6 |
| 250.0 | 17.6 |
| 260.0 | 18.2 |
| 270.0 | 18.4 |
| 280.0 | 18.7 |
| 290.0 | 19.2 |
| 300.0 | 19.9 |
| 310 | 20.7 |
| 320 | 21.9 |
| 330 | 23.4 |
| 340 | 25.1 |
| 350 | 27.0 |

*NOTES:*

*1. Antenna serial number is 1041.*

*2. The above list is located in file 19BC10M1.ANT on the disk marked "Radiated Emissions Tests EMI Receiver".*

### *12.7 Correction factors for Double-Ridged Waveguide Horn*

**Model: 3115, S/N 29845**
**at 3 meter range.**

| FREQUENCY (GHz) | ANTENNA FACTOR (dB 1/m) | ANTENNA Gain (dBi) | FREQUENCY (GHz) | ANTENNA FACTOR (dB 1/m) | ANTENNA Gain (dBi) |
|---|---|---|---|---|---|
| 1.0 | 24.8 | 5.4 | 10.0 | 38.8 | 11.4 |
| 1.5 | 26.1 | 7.6 | 10.5 | 38.9 | 11.8 |
| 2.0 | 28.6 | 7.7 | 11.0 | 39.0 | 12.1 |
| 2.5 | 29.8 | 8.4 | 11.5 | 39.6 | 11.8 |
| 3.0 | 31.4 | 8.4 | 12.0 | 39.8 | 12.0 |
| 3.5 | 32.4 | 8.7 | 12.5 | 39.6 | 12.5 |
| 4.0 | 33.7 | 8.6 | 13.0 | 40.0 | 12.5 |
| 4.5 | 33.4 | 9.9 | 13.5 | 39.8 | 13.0 |
| 5.0 | 34.5 | 9.7 | 14.0 | 40.2 | 13.0 |
| 5.5 | 35.1 | 9.9 | 14.5 | 40.6 | 12.9 |
| 6.0 | 35.4 | 10.4 | 15.0 | 41.3 | 12.4 |
| 6.5 | 35.6 | 10.8 | 15.5 | 39.5 | 14.6 |
| 7.0 | 36.2 | 10.9 | 16.0 | 38.8 | 15.5 |
| 7.5 | 37.3 | 10.4 | 16.5 | 40.0 | 14.6 |
| 8.0 | 37.7 | 10.6 | 17.0 | 41.4 | 13.4 |
| 8.5 | 38.3 | 10.5 | 17.5 | 44.8 | 10.3 |
| 9.0 | 38.5 | 10.8 | 18.0 | 47.2 | 8.1 |
| 9.5 | 38.7 | 11.1 | | | |

## *12.8 Correction factors for ACTIVE LOOP ANTENNA*

**Model 6502**
**S/N 9506-2950**

| FREQUENCY (MHz) | Magnetic Antenna Factor (dB) | Electric Antenna Factor (dB) |
|---|---|---|
| .009 | -35.1 | 16.4 |
| .010 | -35.7 | 15.8 |
| .020 | -38.5 | 13.0 |
| .050 | -39.6 | 11.9 |
| .075 | -39.8 | 11.8 |
| .100 | -40.0 | 11.6 |
| .150 | -40.0 | 11.5 |
| .250 | -40.0 | 11.6 |
| .500 | -40.0 | 11.5 |
| .750 | -40.1 | 11.5 |
| 1.000 | -39.9 | 11.7 |
| 2.000 | -39.5 | 12.0 |
| 3.000 | -39.4 | 12.1 |
| 4.000 | -39.7 | 11.9 |
| 5.000 | -39.7 | 11.8 |
| 10.000 | 40.2 | 11.3 |
| 15.000 | -40.7 | 10.8 |
| 20.000 | -40.5 | 11.0 |
| 25.000 | -41.3 | 10.2 |
| 30.000 | 42.3 | 9.2 |