



**Nemko Test Report:** 1028167RUS1

**Applicant:** INOVA Geophysical Equipment Limited  
850 Dorothy, Suite 504  
Richardson, Texas 75081  
USA

**Equipment Under Test:** FSU-3 (FCC ID.: MCV-FSU3)  
(E.U.T.)

**In Accordance With:** FCC Part 90, Subpart I

**Tested By:** Nemko USA Inc.  
802 N. Kealy  
Lewisville, TX 75057-3136

**TESTED BY:**

David Light, Senior Wireless Engineer

**DATE:** 7 June, 2011

**APPROVED BY:**

Mike Cantwell, GM

**DATE:** 7 July, 2011

**Total Number of Pages: 30**

## **Table of Contents**

<b>SECTION 1.</b>	<b>SUMMARY OF TEST RESULTS</b>	<b>3</b>
<b>SECTION 2.</b>	<b>GENERAL EQUIPMENT SPECIFICATION</b>	<b>5</b>
<b>SECTION 3.</b>	<b>RF POWER OUTPUT</b>	<b>7</b>
<b>SECTION 4.</b>	<b>OCCUPIED BANDWIDTH</b>	<b>8</b>
<b>SECTION 5.</b>	<b>SPURIOUS EMISSIONS AT ANTENNA TERMINALS</b>	<b>10</b>
<b>SECTION 6.</b>	<b>FIELD STRENGTH OF SPURIOUS EMISSIONS</b>	<b>15</b>
<b>SECTION 7.</b>	<b>FREQUENCY STABILITY</b>	<b>16</b>
<b>SECTION 8.</b>	<b>TRANSIENT FREQUENCY BEHAVIOUR</b>	<b>18</b>
<b>SECTION 9.</b>	<b>TEST EQUIPMENT LIST</b>	<b>21</b>
<b>ANNEX A - TEST METHODOLOGIES</b>		<b>22</b>
<b>ANNEX B - TEST DIAGRAMS</b>		<b>27</b>

**Section 1. Summary of Test Results**

Manufacturer: INOVA Geophysical Equipment Limited

Model No.: FSU-3

Serial No.: None

General: **All measurements are traceable to national standards.**

These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with FCC Part 90, Subpart I.



New Submission



Production Unit



Class II Permissive Change



Pre-Production Unit

THIS TEST REPORT RELATES ONLY TO THE ITEM(S) TESTED.

THE FOLLOWING DEVIATIONS FROM, ADDITIONS TO, OR EXCLUSIONS FROM THE TEST SPECIFICATIONS HAVE BEEN MADE.

See "Summary of Test Data".



NVLAP Lab Code 100426-0

Nemko USA, Inc. authorizes the above named company to reproduce this report provided it is reproduced in its entirety, for use by the company's employees only.

This report must not be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the Federal Government. Nemko USA, Inc. is a NVLAP accredited laboratory.

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Nemko USA, Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report. This report applies only to the items tested.

**Summary Of Test Data**

<b>NAME OF TEST</b>	<b>PARA. NO.</b>	<b>SPEC.</b>	<b>RESULT</b>
RF Power Output	90.205	Table 1	Complies
Occupied Bandwidth	90.210	Mask D	Complies
Spurious Emissions at Antenna Terminals	90.210	Mask D	Complies
Field Strength of Spurious Emissions	90.210	Mask D	Complies
Frequency Stability	90.213	5 ppm	Complies
Transient Frequency Behavior	90.214	Mask	Complies

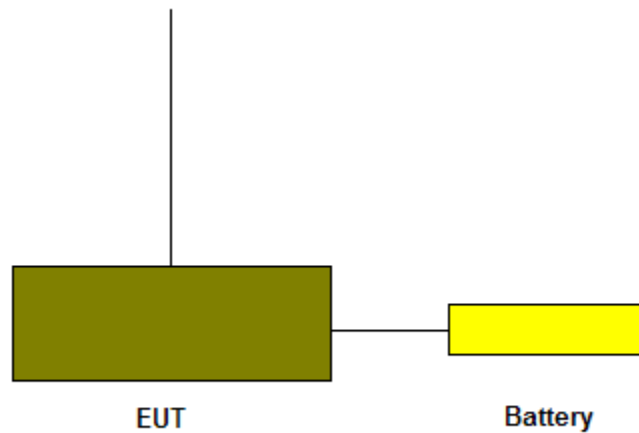
**Section 2. General Equipment Specification**

<b>Supply Voltage Input:</b>	12 Vdc Nominal
<b>Frequency Range:</b>	151.01 to 173.0 MHz
<b>Necessary Bandwidth:</b>	12.5 kHz
<b>Emission Designator:</b>	12K5GXW
<b>Output Impedance:</b>	50 ohms
<b>RF Power Output (rated):</b>	8 Watts
<b>Channel Spacing(s):</b>	12.5 kHz
<b>Operator Selection of Operating Frequency:</b>	Software controlled
<b>Power Output Adjustment Capability:</b>	Software controlled
<b>Necessary BW [(data rate/2) x 2] + [deviation]:</b>	$(9600\text{bps}/2) \times 2 + 2900\text{Hz} = 12.5\text{ kHz}$

**System Description**

Unit is a remote data collection system for Geophysical Survey utilizing a radio channel for command and control.

**System Diagram**



**Section 3. RF Power Output**

NAME OF TEST: RF Power Output	PARA. NO.: 2.985
TESTED BY: David Light	DATE: 24 May 2011

**Measurement Results:** Complies.**Measurement Data:**

Frequency (MHz)	Measured Power (dBm)	Measured Power (Watts)	Rated Power (Watts)
151.01	39.4	8.7	8.0
160.0	38.5	7.1	8.0
173.0	38.1	6.5	8.0

Resolution BW: 300 kHz

Video BW: 300 kHz

**Measurement Conditions:**

Temperature: 20 °C

Humidity: 30 %

**Measurement Uncertainty:** +/- 1.7 dB**Test Equipment:** 1767-1082-1472-1469

**Section 4. Occupied Bandwidth**

NAME OF TEST: Occupied Bandwidth	PARA. NO.: 2.989
TESTED BY: David Light	DATE: 24 May 2011

**Measurement Results:** Complies.

**Measurement Data:** See attached data

**Measurement Conditions:** Temperature: 20 °C  
Humidity: 30 %

**Measurement Uncertainty:** +/- 1 X 10<sup>-7</sup> ppm

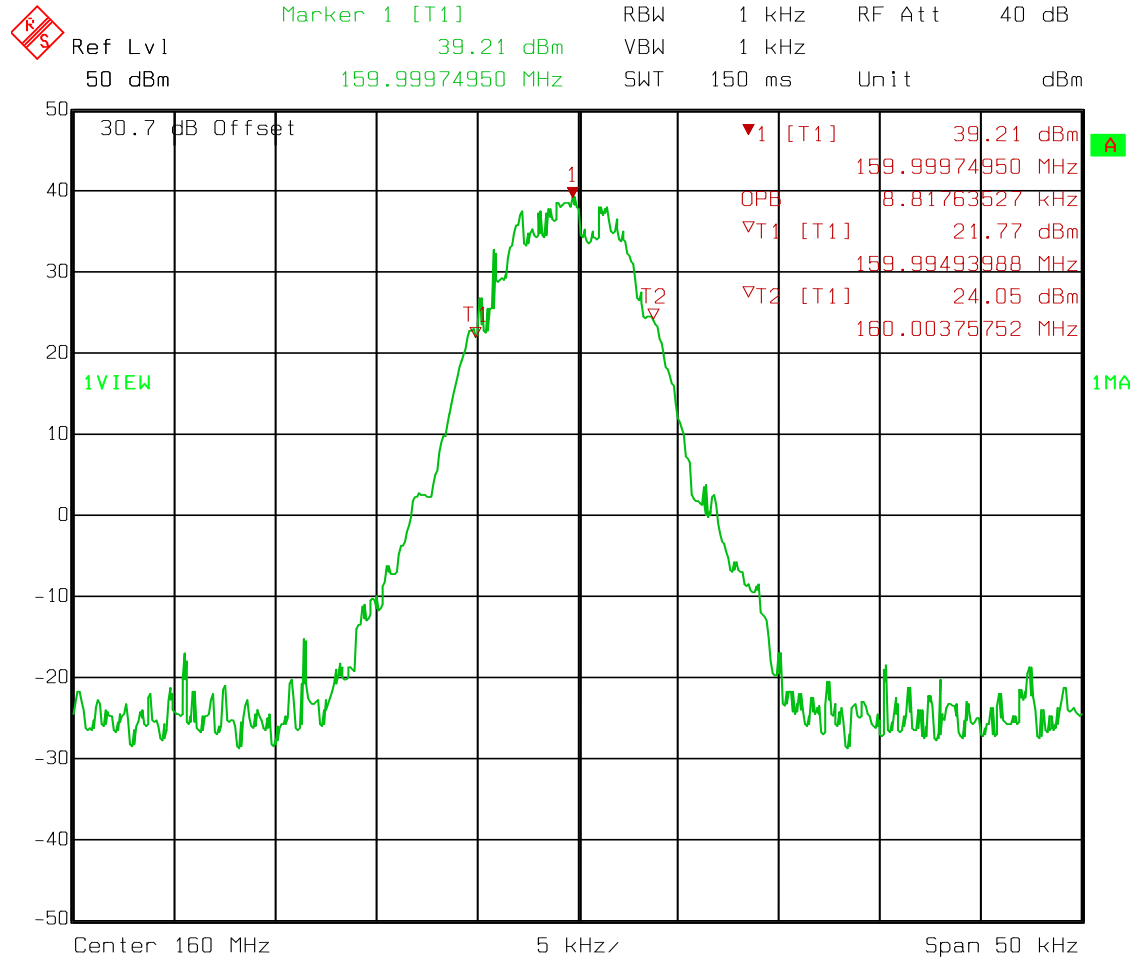
**Test Equipment:** 1767-1082-1472-1469



EQUIPMENT: FSU-3

PROJECT NO.: 1028167RUS1

## Test Data – 99% Occupied Bandwidth



Date: 24.MAY 2011 13:33:38

**Section 5. Spurious Emissions at Antenna Terminals**

NAME OF TEST: Spurious Emissions @ Antenna Terminals	PARA. NO.: 2.991
TESTED BY: David Light	DATE: 24 May 2011

**Measurement Results:** Complies.

**Measurement Data:** See attached data

**Measurement Conditions:** Temperature: 20 °C  
Humidity: 30 %

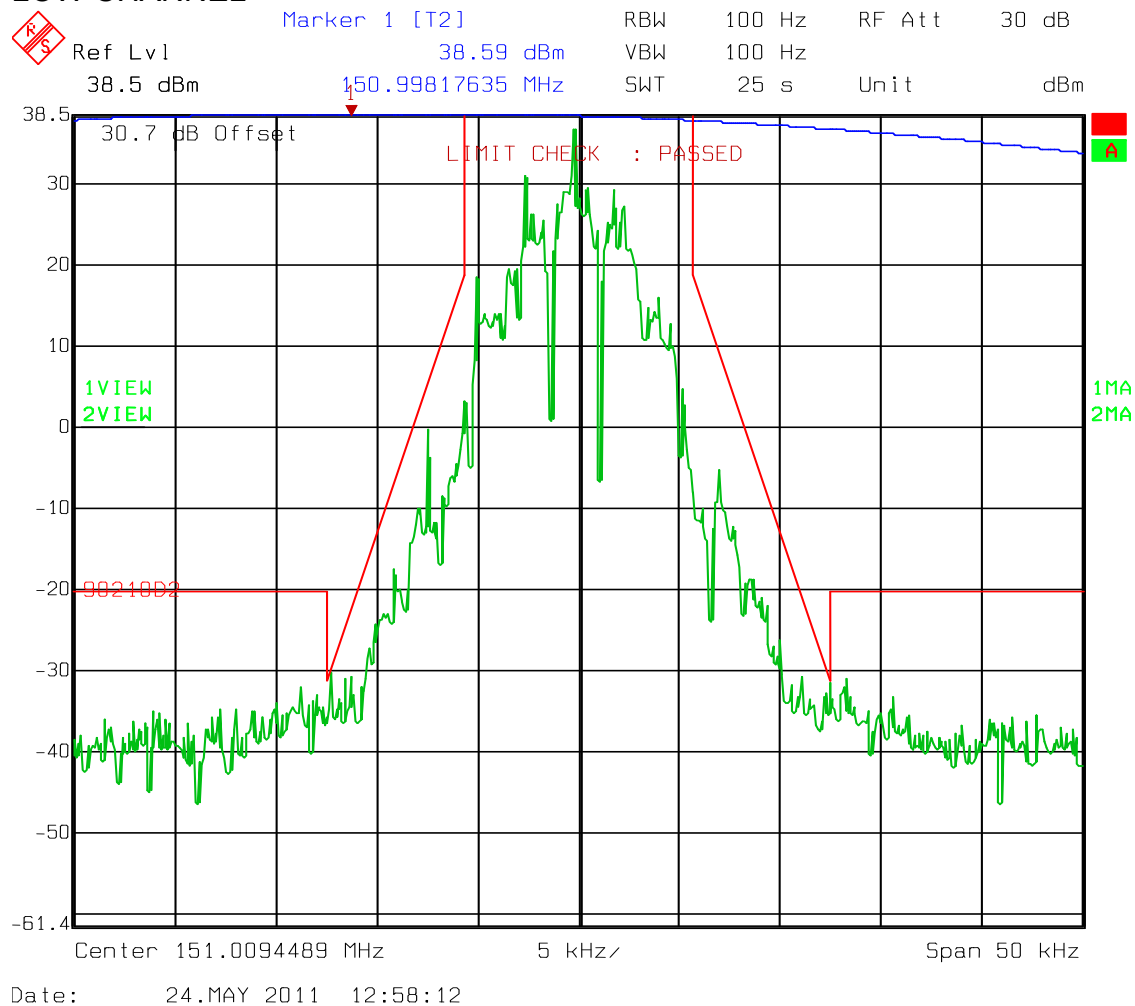
**Measurement Uncertainty:** +/- 1.7 dB

**Test Equipment:** 1767-1082-1472-1469

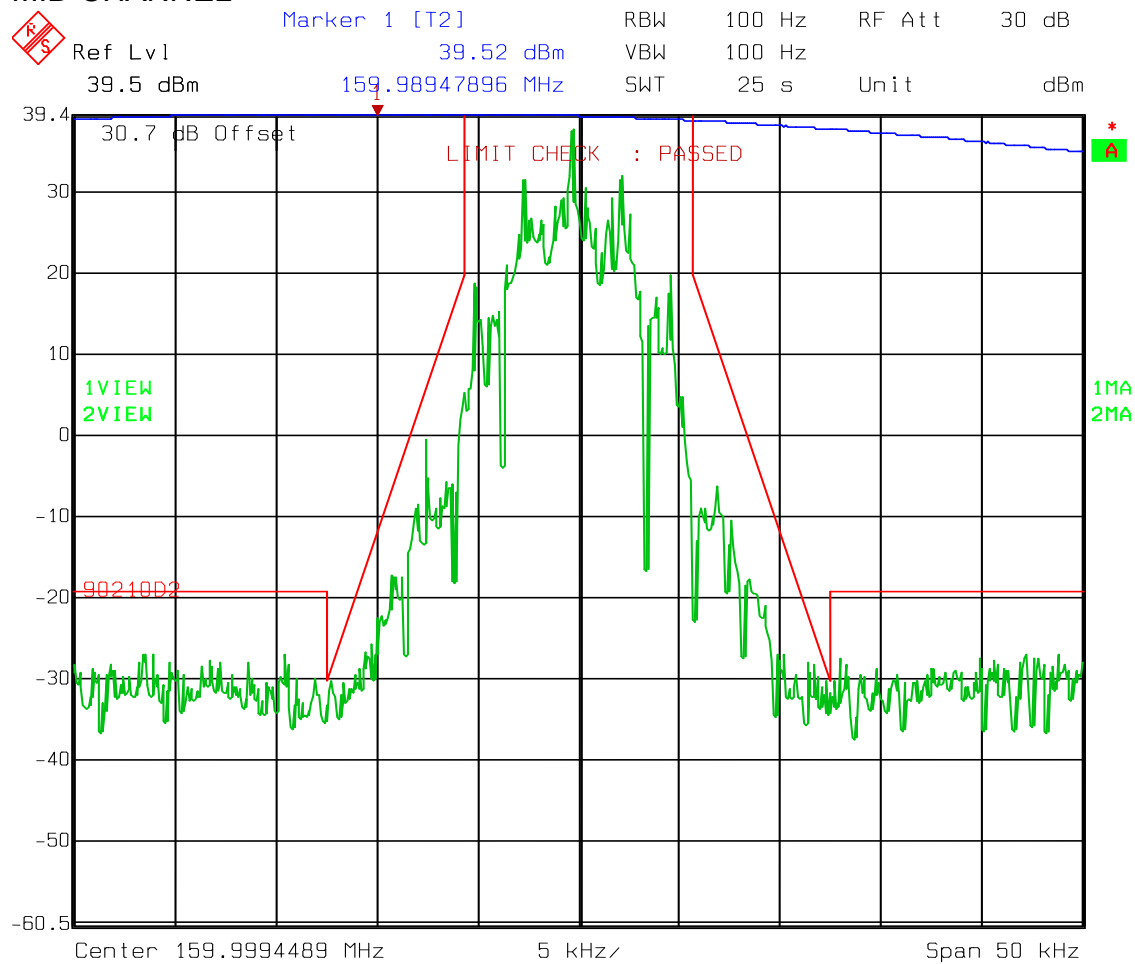
EQUIPMENT: FSU-3

PROJECT NO.: 1028167RUS1

## Test Data – Spurious Emissions

MASK D  
LOW CHANNEL

## Test Data – Spurious Emissions

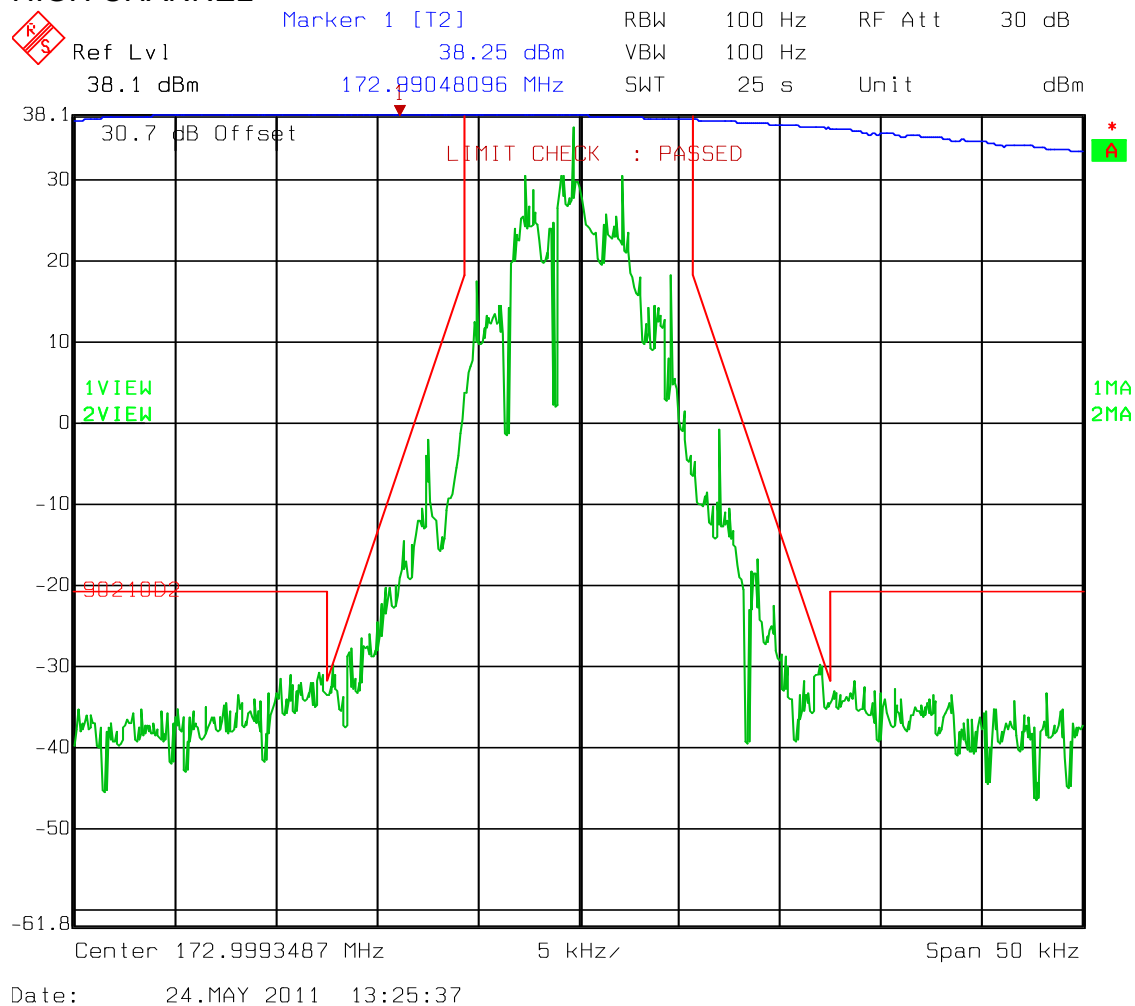
MASK D  
MID CHANNEL

Date: 24.MAY 2011 12:48:43

EQUIPMENT: FSU-3

PROJECT NO.: 1028167RUS1

## Test Data – Spurious Emissions

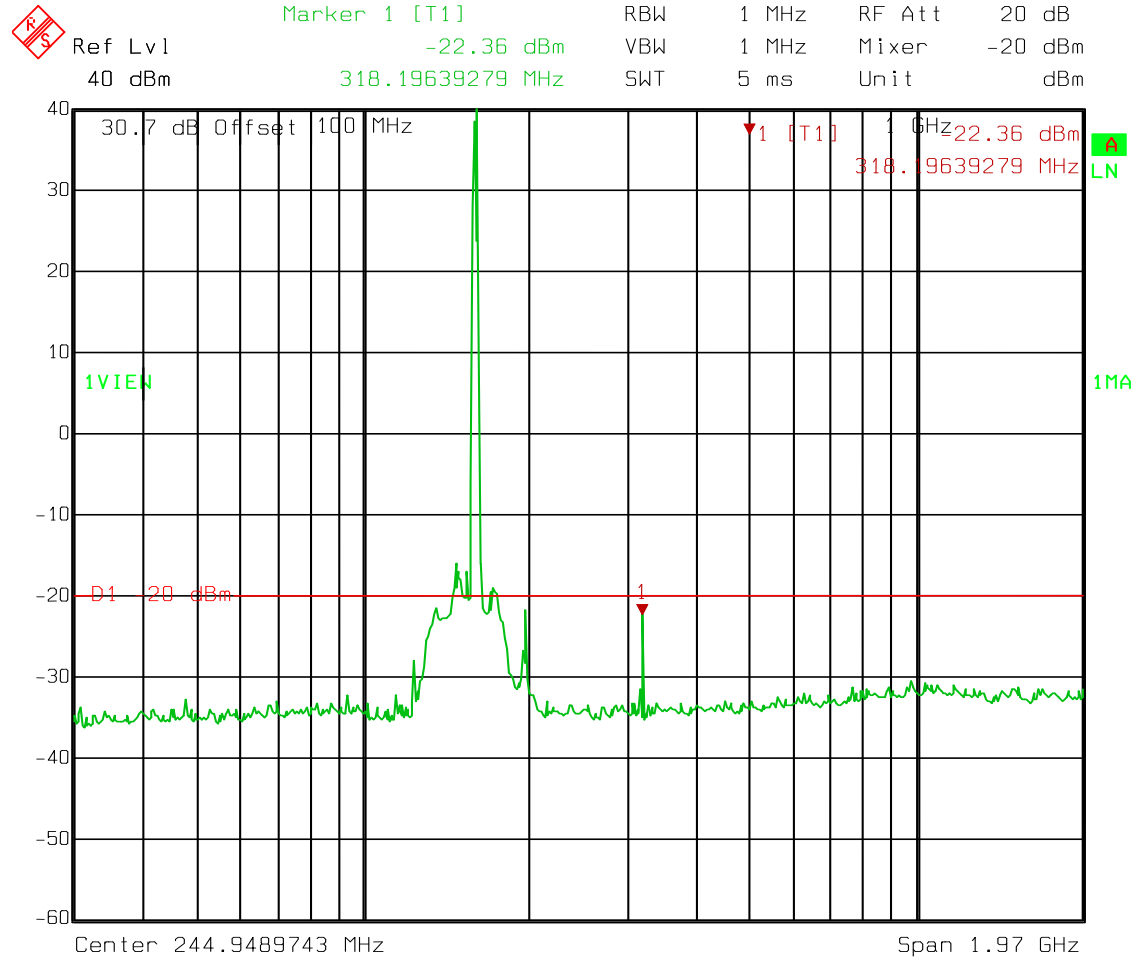
MASK D  
HIGH CHANNEL

EQUIPMENT: FSU-3

PROJECT NO.: 1028167RUS1

## Test Data – Spurious Emissions

## SPURS



Date: 24.MAY 2011 13:36:27

**Section 6. Field Strength of Spurious Emissions**

NAME OF TEST: Field Strength of Spurious Emissions	PARA. NO.: 2.993
TESTED BY: David Light	DATE: 24 May 2011

**Measurement Results:** Complies.

**Measurement Data:** There were no emissions detected within 20 dB of the specification limit of  $50 + 10 \log P$  (watts) therefore none are reported per 2.1051

The spectrum was searched from 30 MHz to 2 GHz

Analyzer settings were RBW/VBW = 1 MHz, Peak detector

**Measurement Conditions:** Temperature: 20 °C  
Humidity: 30 %

**Measurement Uncertainty:** +/- 1.7 dB

**Test Equipment:** 1464-1484-1485-993-1016-791-1480

**Section 7. Frequency Stability**

NAME OF TEST: Frequency Stability	PARA. NO.: 2.995
TESTED BY: David Light	DATE: 03 June 2011

**Measurement Results:** Complies.

**Measurement Data:** See attached data

**Measurement Conditions:** Temperature: 20 °C  
Humidity: 30 %

**Measurement Uncertainty:** +/- 1 X 10<sup>-7</sup> ppm

**Test Equipment:** 1767-1082-1472-1469-619



## Test Data – Frequency Stability

Measurement Uncertainty:	$1 \times 10^{-17}$ ppm		Standard Test Frequency			160.000000	MHz
Temp (°C)	Measured Frequency (MHz)		Test Voltage	Frequency Error (Hz)	Limit (+/-Hz)	Error (ppm)	Comment
20	160.000231		12.0	231	800.0	1.4	Nominal
20	160.000147		4.0	147	800.0	0.9	Battery Cutoff
20	160.000225		15.0	225	800.0	1.4	Battery fully charged
50	159.999762		12.0	-238	800.0	-1.5	
40	159.999825		12.0	-175	800.0	-1.1	
30	159.999984		12.0	-16	800.0	-0.1	
10	159.999901		12.0	-99	800.0	-0.6	
0	160.000168		12.0	168	800.0	1.1	
-10	160.000254		12.0	254	800.0	1.6	
-20	160.000095		12.0	95	800.0	0.6	
-30	160.000215		12.0	215	800.0	1.3	
Notes:	Limit = 5 ppm						

**Section 8.        Transient Frequency Behavior**

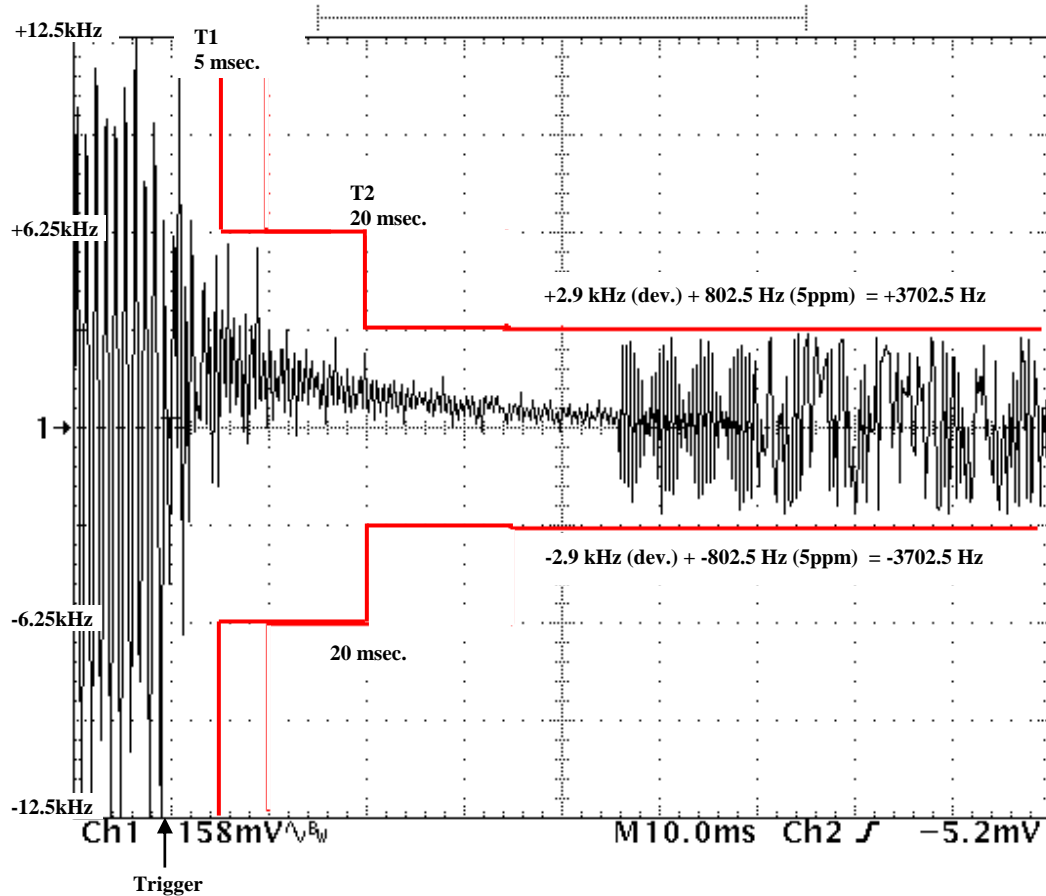
NAME OF TEST: Transient Frequency Behavior	PARA. NO.: 90.214
TESTED BY: David Light	DATE: 24 May 2011

**Measurement Results:**            Complies.

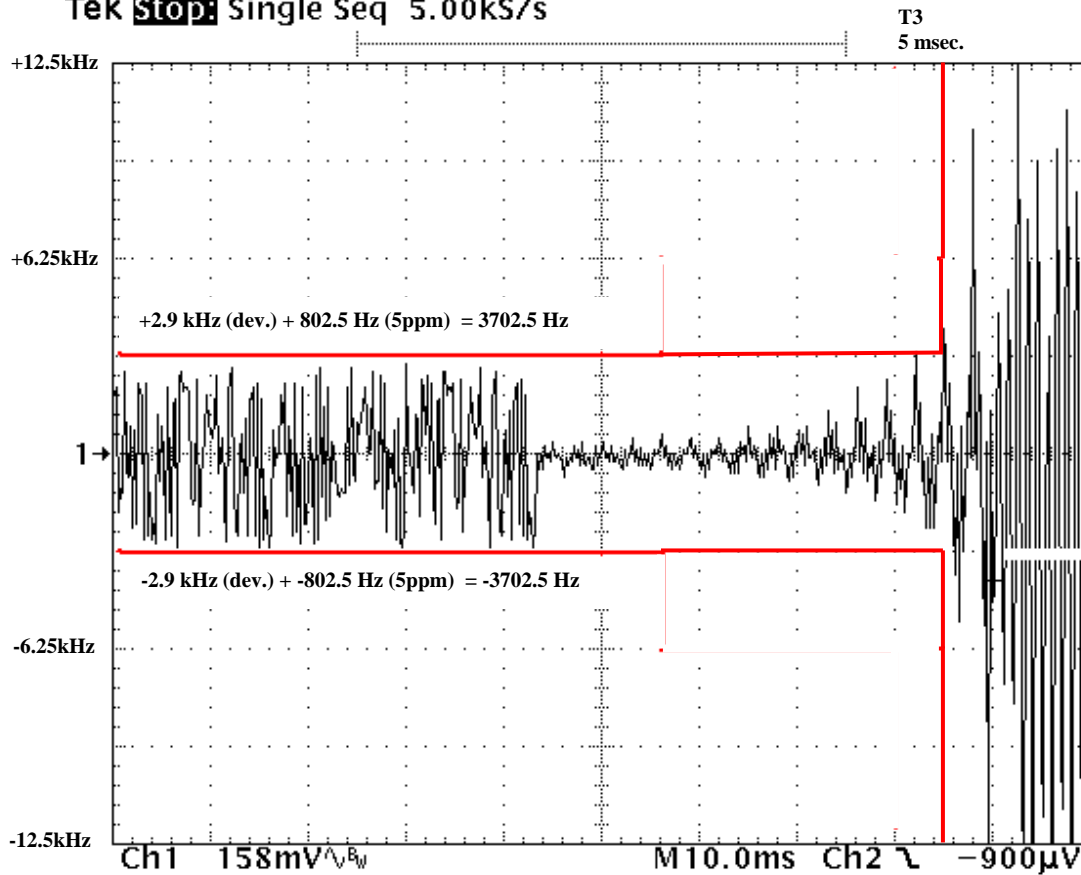
**Measurement Data:**            See attached data

**Measurement Conditions:**      Temperature:    20 °C  
   Humidity:       30 %

## Test Data – Transient Frequency Behavior

Tek **Stop** Single Seq 5.00kS/s

## Test Data – Transient Frequency Behavior

Tek **Stop** Single Seq 5.00kS/s

**Section 9. Test Equipment List**

Asset Tag	Description	Manufacturer	Model	Serial #	Last Cal	Next Cal
1	3m Semi-Anechoic Chamber	Nemko USA, Inc.	Chamber	1	04-Oct-2010	04-Oct-2011
1016	Preamplifier	Hewlett Packard	8449A	2749A00159	19-Jun-2010	19-Jun-2011
1082	Cable, 2m	Astrolab	32027-2-29094-72TC		N/R	
1469	Attenuator,	MCL Inc.	BW-S10W2 10db-2WDC		N/R	
1472	Attenuator,	Omni Spectra	20600-20db		N/R	
1480	Antenna, Bilog	Schaffner-Chase	CBL6111C	2572	19-Jan-2011	19-Jan-2012
1767	Receiver,	Rohde & Schwartz	ESIB26	837491/0002	01-Dec-2010	01-Dec-2011
619	Digital Thermometer	Fluke	51	4520028	16-Sep-2010	16-Sep-2011
993	Antenna, Horn	A.H. Systems	SAS-200/571	162	09-Sep-2009	09-Sep-2011
1016	Preamplifier	Hewlett Packard	8449A	2749A00159	19-Jun-2010	19-Jun-2011
1464	Spectrum Analyzer	Hewlett Packard	8563E	3551A04428	16-May-2011	16-May-2013
1484	Cable	Storm	PR90-010-072		19-Jun-2010	19-Jun-2011
1485	Cable	Storm	PR90-010-216		19-Jun-2010	19-Jun-2011
791	Watkins Johnson 30MHz to 1GHz Pre Amplifier	Nemko, USA	CRA69 321003 9605	119	19-May-2011	19-May-2012

## **ANNEX A - TEST METHODOLOGIES**

**NAME OF TEST: RF Power Output****PARA. NO.: 2.985**

**Minimum Standard:** Para. No. 90.205(a). The maximum allowable station ERP is dependent upon the stations HAAT and required service area and will be authorized in accordance with Table 1 of 90.205(d).

**Method Of Measurement:**

Detachable Antenna:

The peak power at antenna terminals is measured using an in-line peak power meter or spectrum analyzer. If a spectrum analyzer is used, the resolution bandwidth is set to at least 3 x the 99% occupied bandwidth of the transmitted waveform. Power output is measured with the maximum rated input level.

**NAME OF TEST: Occupied Bandwidth****PARA. NO.: 2.989****Minimum Standard:**  
mask.

Para. No. 90.210, see table 1 below for applicable

**Table 1**

Frequency Band (MHz)	Mask for equipment with Low Pass Filter	Mask for equipment without Low Pass Filter
Below 25	A or B	A or C
25 - 50	B	C
72 - 76	B	C
150 - 174	B, D or E	C, D or E
150 Paging only	B	C
220 - 222	F	F
421 - 512	B, D or E	C, D or E
450 paging only	B	H
806 - 821/ 851 - 866	B	G
821 - 824/ 866 - 869	B	H
896 - 901/ 935 - 940	I	J
902 - 928	K	K
929 - 930	B	G
Above 940	B	C
All other bands	B	C

**Test Method:**

RBW: 1% of emission bandwidth in 0 - 1 GHz range. 1 MHz at frequencies above 1 GHz.

VBW:  $\geq$  RBW

The spectrum is search up to 10 times the fundamental frequency.



<b>NAME OF TEST: Field Strength of Spurious</b>	<b>PARA. NO.: 2.993</b>
---	-------------------------

**Minimum Standard:**

Para. No. 90.210, see table 1 for applicable mask.

The substitution antenna method described in TIA-603C was used to determine the erp of spurious emissions. The EUT was placed on a turntable at a distance of 3 meters from the receive antenna. The turntable and the antenna were adjusted to obtain the worst-case orientations. The received signal level was recorded. The EUT was then replaced with a reference antenna with known gain. The reference antenna was fed with a signal generator. The signal generator output was adjusted to the frequency of the emission in question and the level was adjusted to repeat the above measurement. The erp is the signal generator output level after adjustment for gain of the reference antenna and cable loss.

EQUIPMENT: FSU-3

PROJECT NO.: 1028167RUS1

**NAME OF TEST: Frequency Stability****PARA. NO.: 2.995**

**Minimum Standard:** Para. No. 990.213. The transmitter carrier frequency shall remain

within the assigned frequency below in ppm.

**Table 2**

Frequency Band (MHz)	Fixed And Base Stations	Mobile Stations	
		> 2 Watts o/p pwr	< 2 Watts o/p pwr
Below 25	100	100	200
25 - 50	20	20	50
72 - 76	5	-	50
150 - 174	5	5	5
220 - 222	0.1	1.5	1.5
421 - 512	2.5	5	5
806 - 821	1.5	2.5	2.5
821 - 824	1.0	1.5	15
851 - 866	1.5	2.5	2.5
866 - 869	1.0	1.5	1.5
869 - 901	0.1	1.5	1.5
902 - 928	2.5	2.5	2.5
929 - 930	1.5	-	-
935 - 940	0.1	1.5	1.5
1427 - 1435	300	300	300
Above 2450	-	-	-

**NAME OF TEST: Transient Frequency Behaviour****PARA. NO.: 2.214****Minimum Standard:****Transient Frequency Behaviour for Equipment Designed to Operate on 25 kHz Channels**

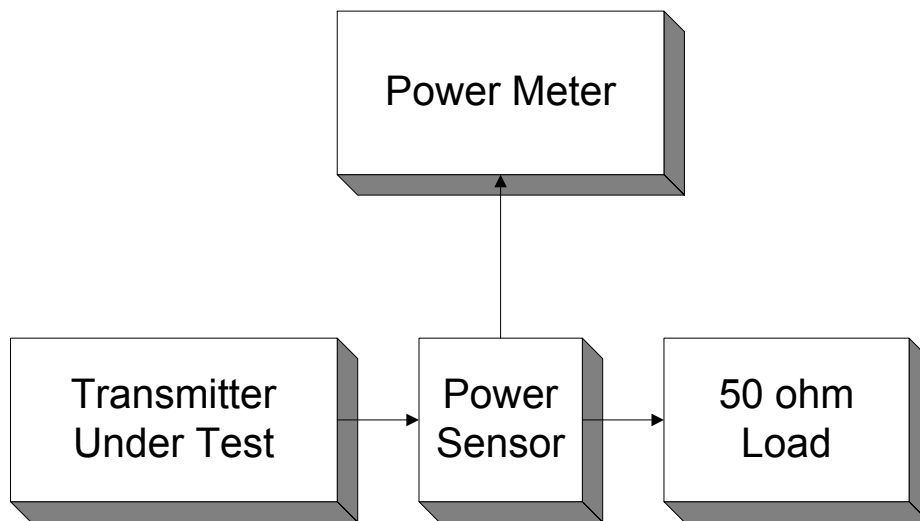
Time intervals <sup>1,2</sup>	Maximum Frequency difference <sup>3</sup> (kHz)	Frequency ranges (MHz) All equipment					
		Base station and portable radios			Mobile Radios		
		150 - 174 (ms)	450 - 500 (ms)	500 - 512 (ms)	150 - 174 (ms)	450 - 500 (ms)	500 - 512 (ms)
t <sub>1</sub> <sup>4</sup>	± 25	5.0	10.0	20.0	5.0 10.0		5.0
t <sub>2</sub>	± 12	20.0	25.0	50.0	20.0 25.0		20.0
t <sub>3</sub> <sup>4</sup>	± 25	5.0	10.0	10.0	5.0 10.0		5.0

**Transient Frequency Behaviour for Equipment Designed to Operate on 12.5 kHz & 6.25 kHz Channels**

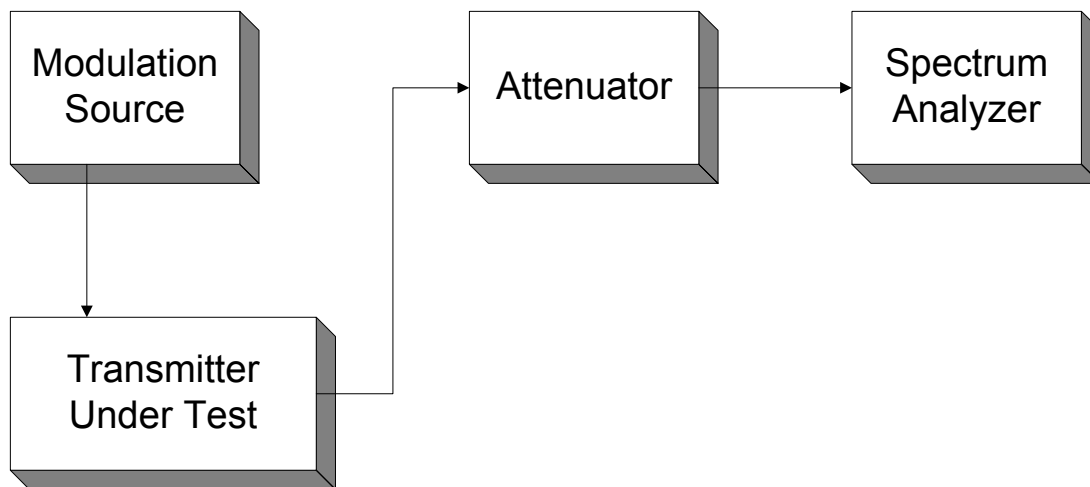
Time intervals <sup>1,2</sup>	Maximum Frequency difference <sup>3</sup> (kHz)	Frequency ranges (MHz) All equipment		
		150 - 174 (ms)	450 - 500 (ms)	500 - 512 (ms)
t <sub>1</sub> <sup>4</sup>	± 12.5 / ± 6.25	5.0	10.0	20.0
t <sub>2</sub>	± 6.25 / ± 3.125	20.0	25.0	50.0
t <sub>3</sub> <sup>4</sup>	± 12.5 / ± 6.25	5.0	10.0	10.0

## **ANNEX B - TEST DIAGRAMS**

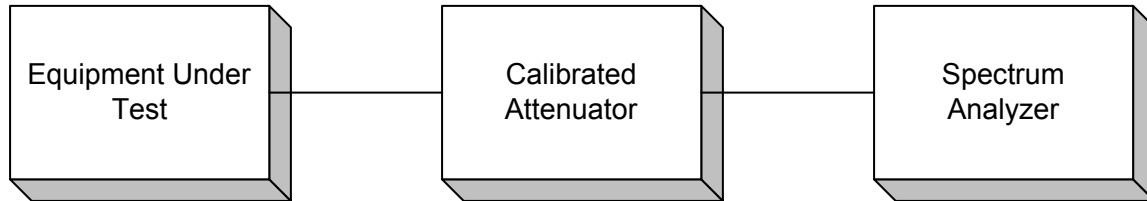
**Para. No. 2.985 - R.F. Power Output**



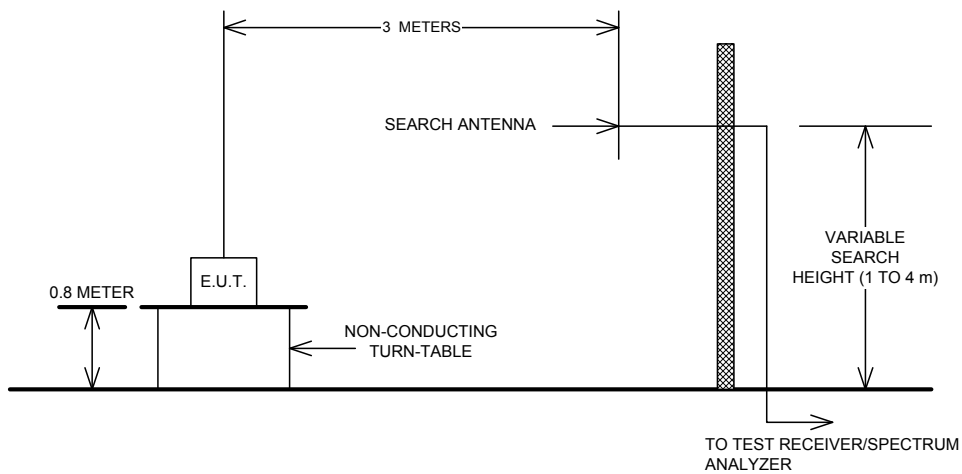
**Para. No. 2.989 - Occupied Bandwidth**



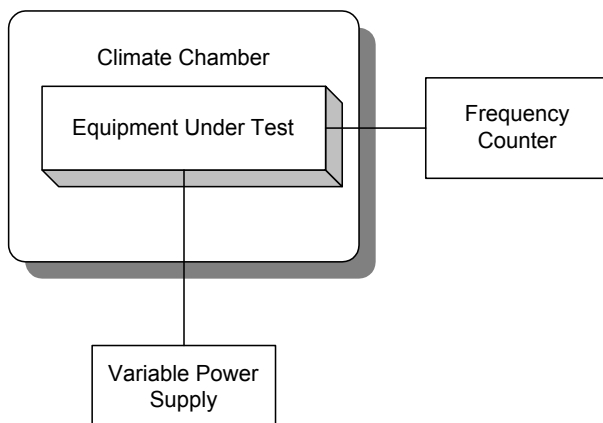
**Para. No. 2.991 - Spurious Emissions at Antenna Terminals**

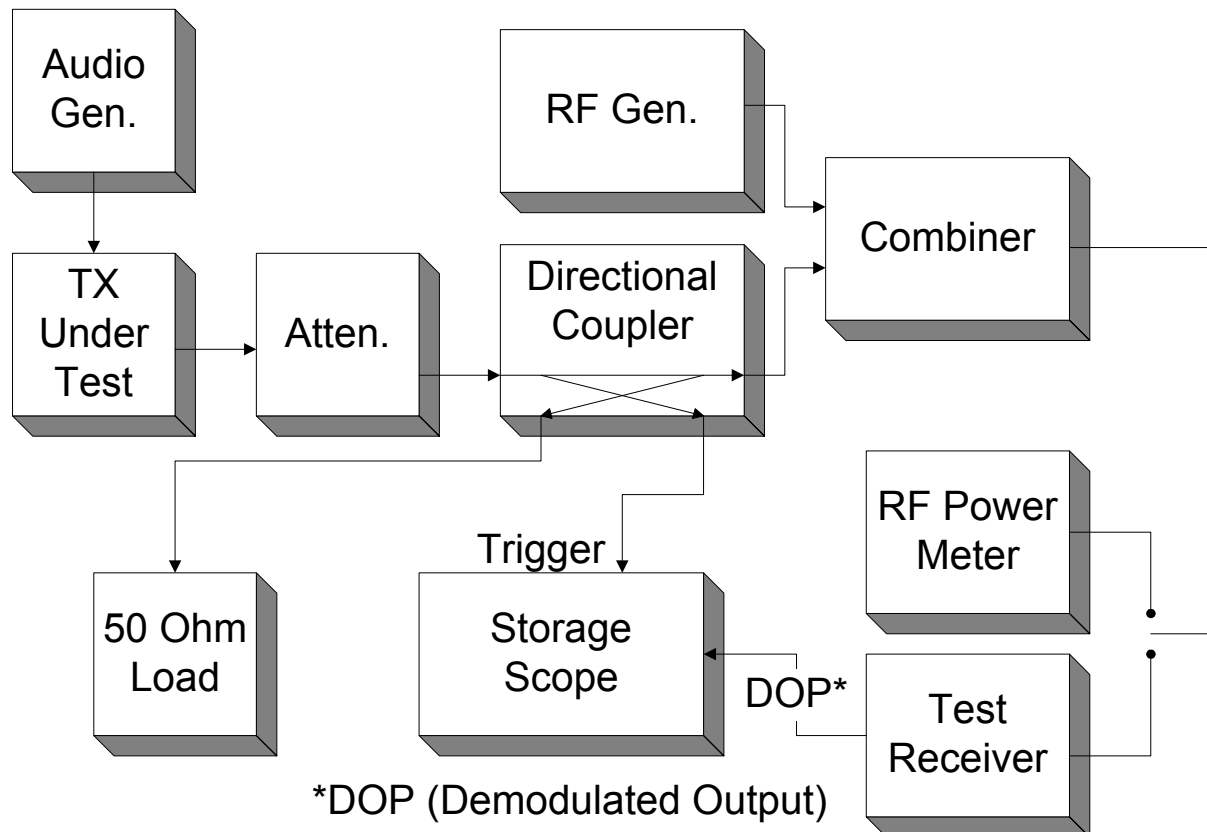


**Para. No. 2.993 - Field Strength of Spurious Radiation**



**Para. No. 2.995 - Frequency Stability**



**Para. No. 90.214 - Transient Frequency Behaviour****Voice**

This measurement was made using measurement procedure TIA/EIA Land Mobile FM or PM Communications Equipment Measurement and Performance Standards TIA/EIA-603 February 1993 Telecommunications Industry Association (American National Standard ANSI/TIA/EIA-603-1992 Approved: October 27, 1992) Para. no. 2.2 Methods of Measurement for Transmitters

Para. no. 2.2.19 Transient Frequency Behaviour (page no. 83).

**Data**

This measurement was made using measurement procedure TIA/EIA Digital C4FM/CQPSK Transceiver Measurement Methods TSB102.CAAA Para. no. 2.2.17 Transient Frequency Behaviour (page no. 74).