



Nemko Test Report: 11785RUS1

Applicant: ION Geophysical Corporation
850 Dorothy, Suite 504
Richardson, Texas 75081
USA

Equipment Under Test: FSU-2
(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:

A handwritten signature in black ink, appearing to read "David Light".

David Light, Senior Wireless Engineer

DATE: 31 March, 2008

APPROVED BY:

A handwritten signature in black ink, appearing to read "Mike Cantwell".

Mike Cantwell, Frontline Manager

DATE: 31 March, 2008

Total Number of Pages: 32

Table of Contents

SECTION 1. SUMMARY OF TEST RESULTS	3
SECTION 2. GENERAL EQUIPMENT SPECIFICATION	5
SECTION 3. RF POWER OUTPUT	7
SECTION 4. OCCUPIED BANDWIDTH	8
SECTION 5. SPURIOUS EMISSIONS AT ANTENNA TERMINALS	10
SECTION 6. FIELD STRENGTH OF SPURIOUS EMISSIONS	17
SECTION 7. FREQUENCY STABILITY	18
SECTION 8. TRANSIENT FREQUENCY BEHAVIOUR	20
SECTION 9. TEST EQUIPMENT LIST	23
ANNEX A - TEST METHODOLOGIES	24
ANNEX B - TEST DIAGRAMS	29

Section 1. Summary of Test Results

Manufacturer: ION Geophysical Corporation

Model No.: FSU-2

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".

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

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

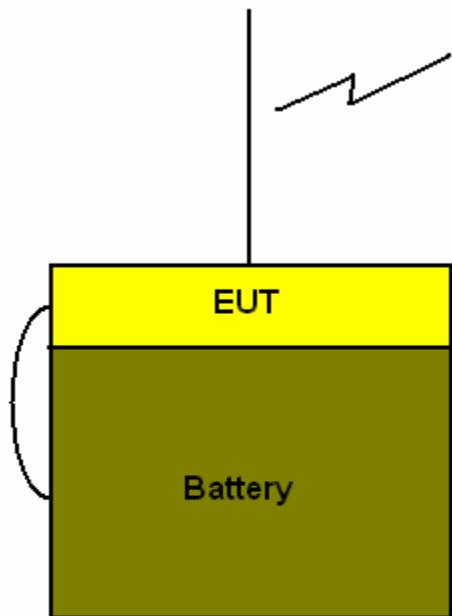
NAME OF TEST	PARA. NO.	SPEC.	RESULT
RF Power Output	90.205	Table 1	Complies
Occupied Bandwidth	90.210	Mask D	Complies
Spurious Emissions at Antenna Terminals	90.210	Mask D	Complies
Field Strength of Spurious Emissions	90.210	Mask D	Complies
Frequency Stability	90.213	5 ppm	Complies
Transient Frequency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

Section 2. General Equipment Specification

Supply Voltage Input:	12 Vdc Nominal
Frequency Range:	151.25 to 173.5 MHz
Necessary Bandwidth:	12.5 kHz
Emission Designator:	12K5GXW
Output Impedance:	50 ohms
RF Power Output (rated):	2 Watts
Channel Spacing(s):	12.5 kHz
Operator Selection of Operating Frequency:	Software controlled
Power Output Adjustment Capability:	Software controlled

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: 26 March 2008

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

Frequency (MHz)	Measured Power (dBm)	Measured Power (Watts)	Rated Power (Watts)
151.25	33.18	2.08	2.0
160.5	33.21	2.09	2.0
173.5	32.97	1.98	2.0

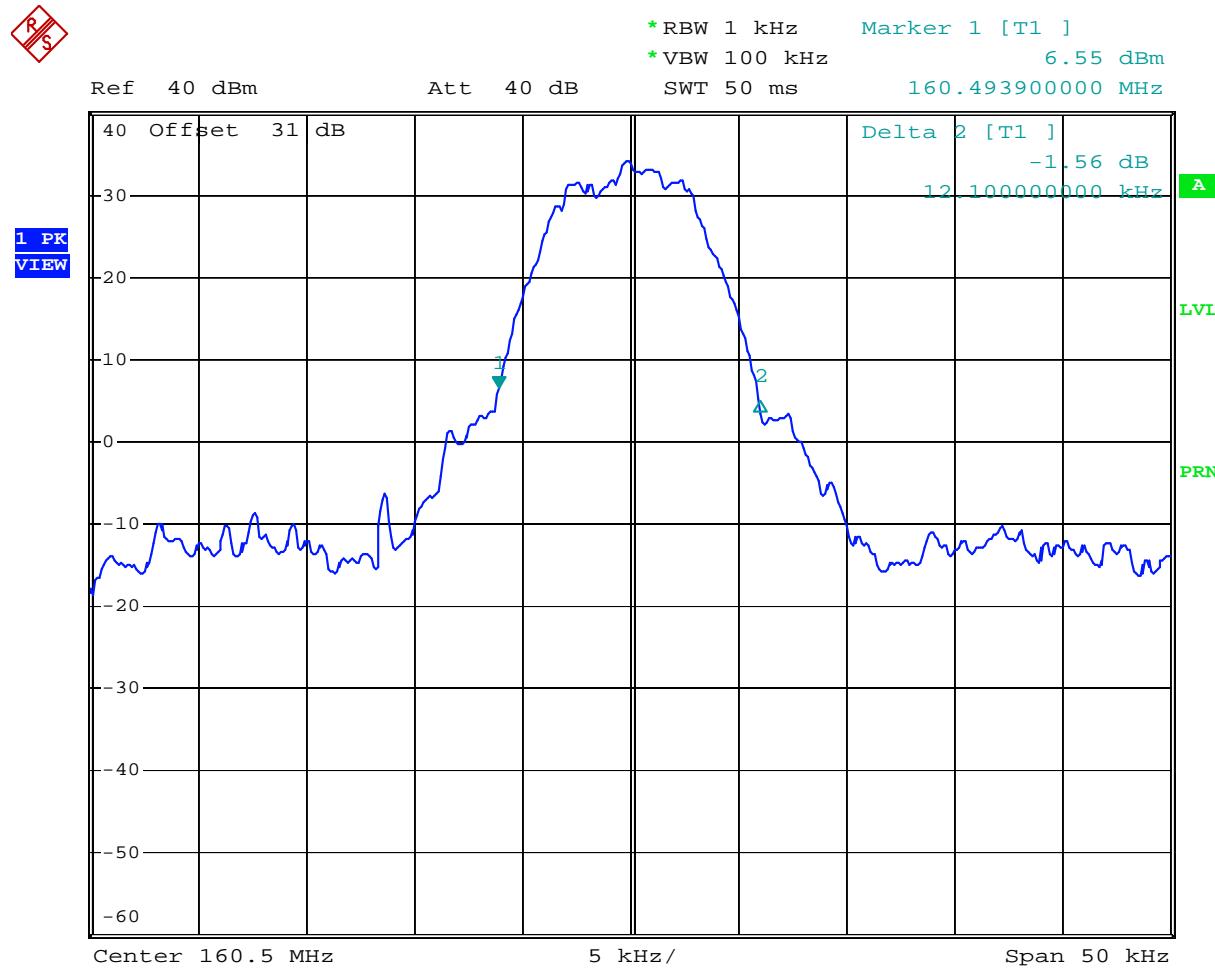
Measurement Conditions:Temperature: 20 °C
Humidity: 30 %**Measurement Uncertainty:** +/- 1.7 dB**Test Equipment:** 1036-1082-1472-1469

Section 4. Occupied Bandwidth

NAME OF TEST: Occupied Bandwidth	PARA. NO.: 2.989
TESTED BY: David Light	DATE: 28 March 2008

Measurement Results: Complies.**Measurement Data:** See attached data**Measurement Conditions:** Temperature: **20** °C
Humidity: **30** %**Measurement Uncertainty:** +/- **1 X 10⁻⁷** ppm**Test Equipment:** 1036-1082-1472-1469

Test Data – 99% Occupied Bandwidth

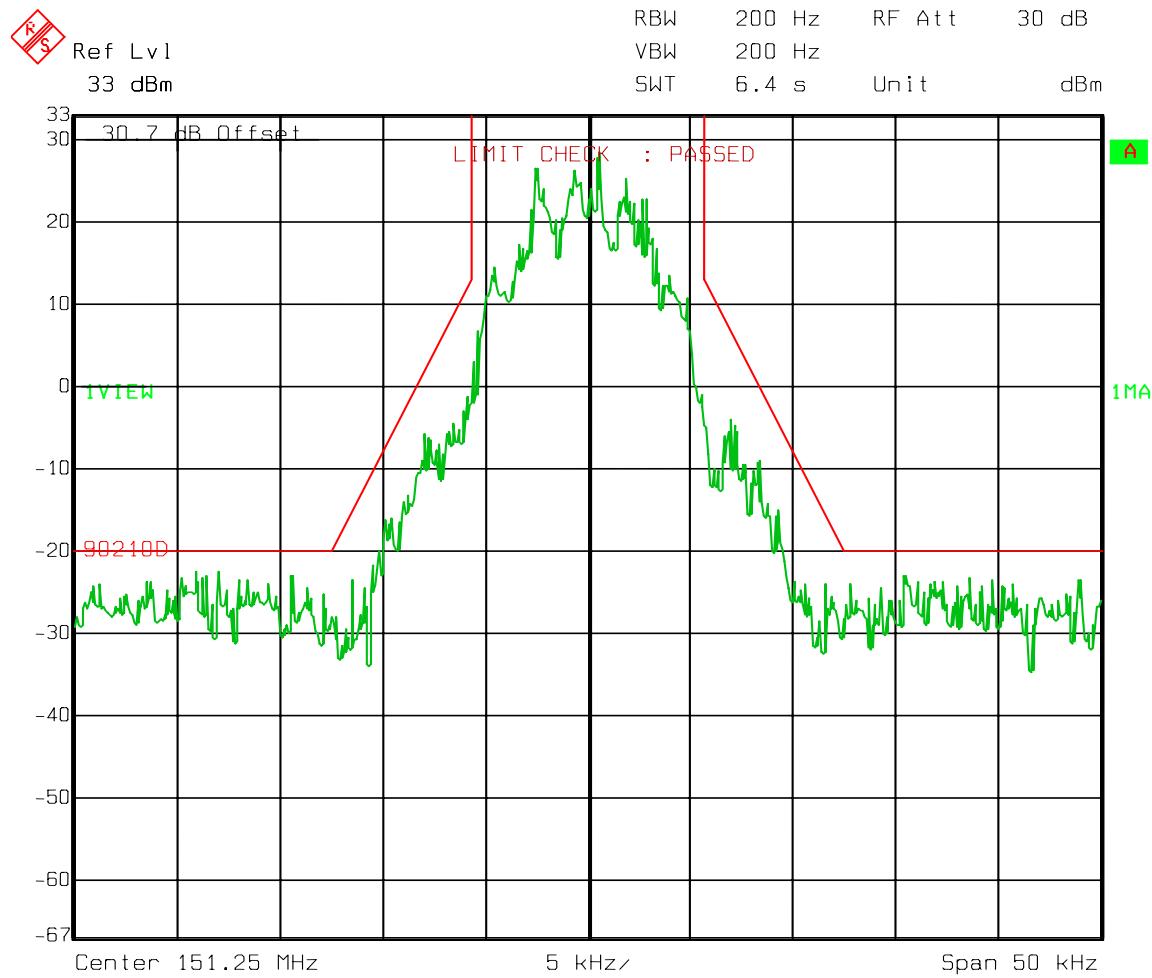


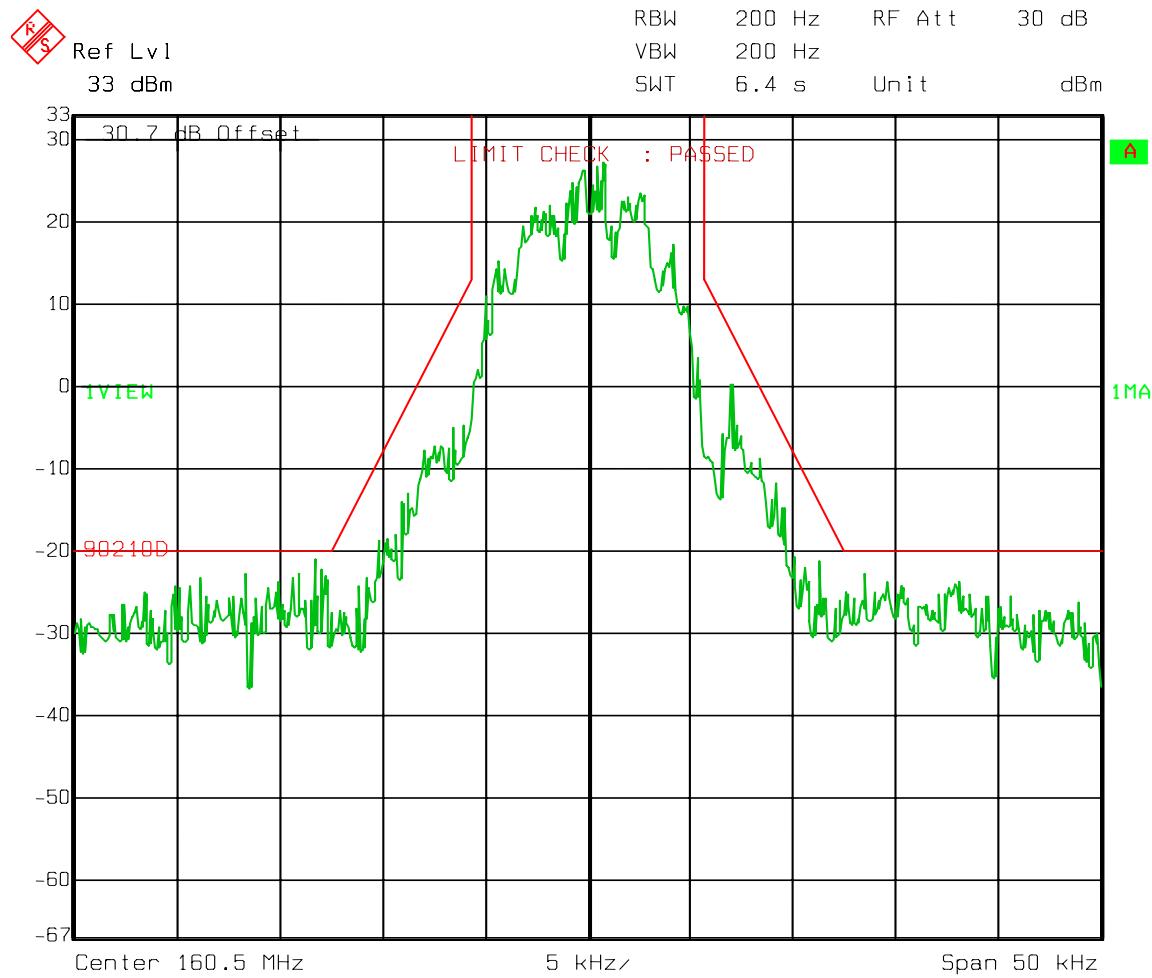
Date: 28.MAR.2008 14:38:50

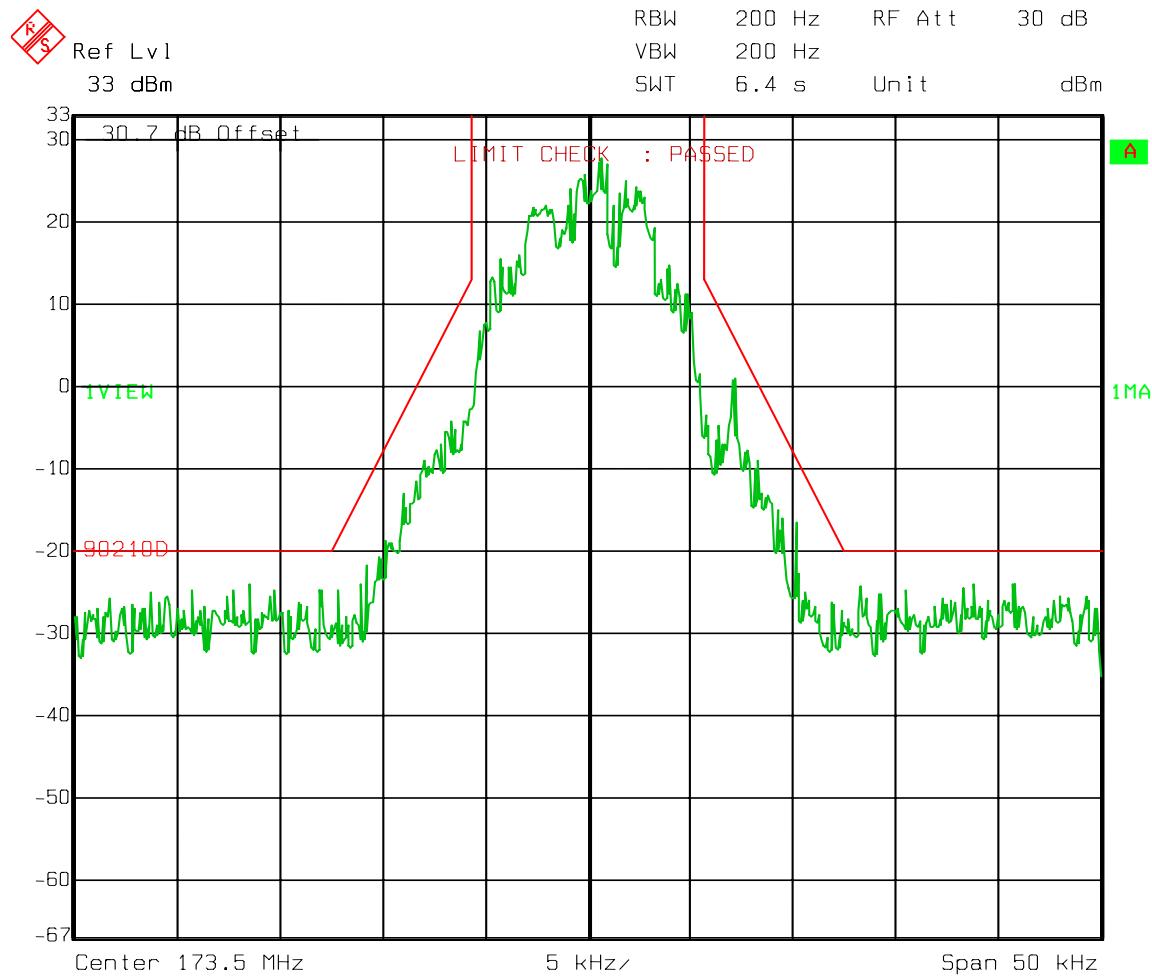
Section 5. Spurious Emissions at Antenna Terminals

NAME OF TEST: Spurious Emissions @ Antenna Terminals	PARA. NO.: 2.991
TESTED BY: David Light	DATE: 26 March 2008

Measurement Results: Complies.**Measurement Data:** See attached data**Measurement Conditions:** Temperature: **20** °C
Humidity: **30** %**Measurement Uncertainty:** +/- 1.7 dB**Test Equipment:** 1036-1082-1472-1469

Test Data – Spurious Emissions**MASK D**
LOW CHANNEL

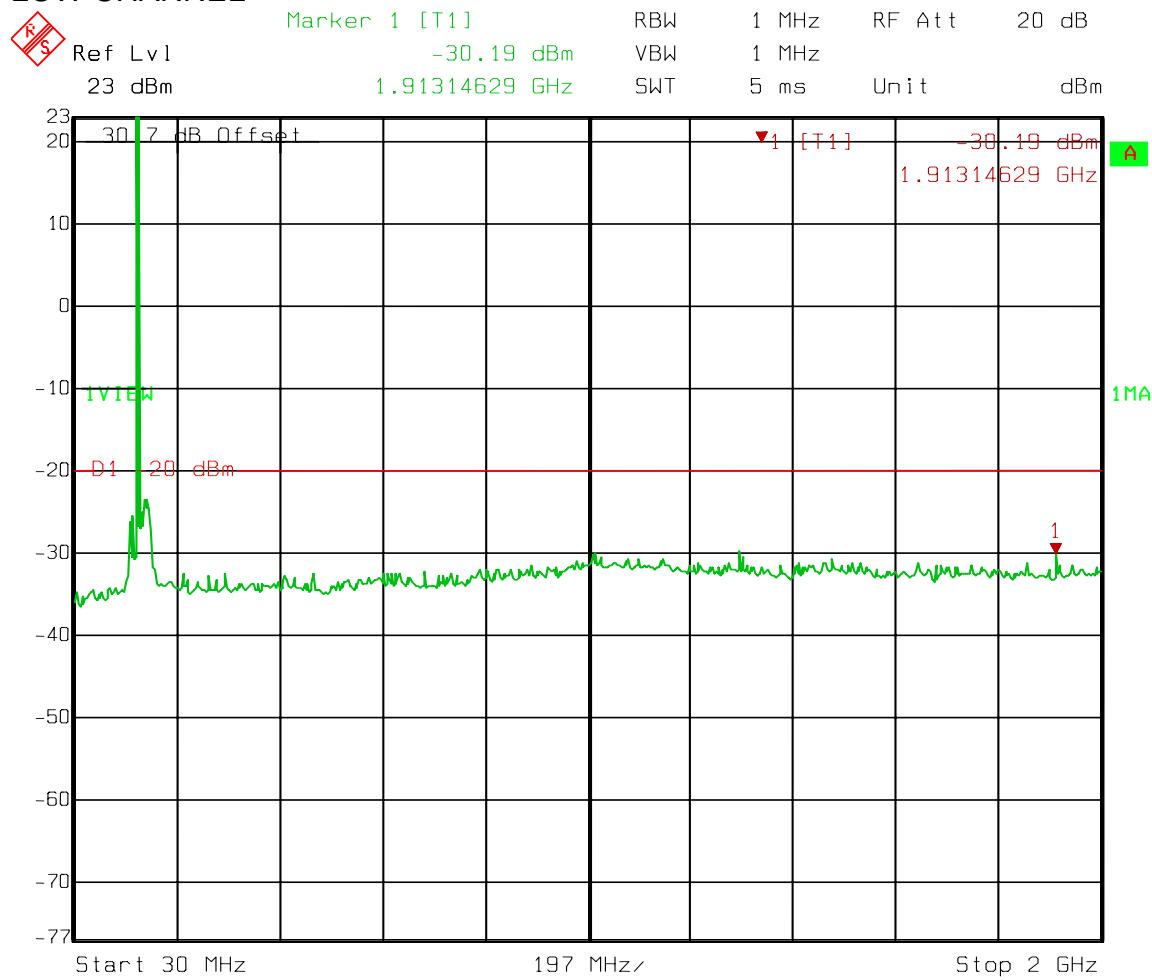
Test Data – Spurious Emissions**MASK D**
MID CHANNEL

Test Data – Spurious Emissions**MASK D**
HIGH CHANNEL

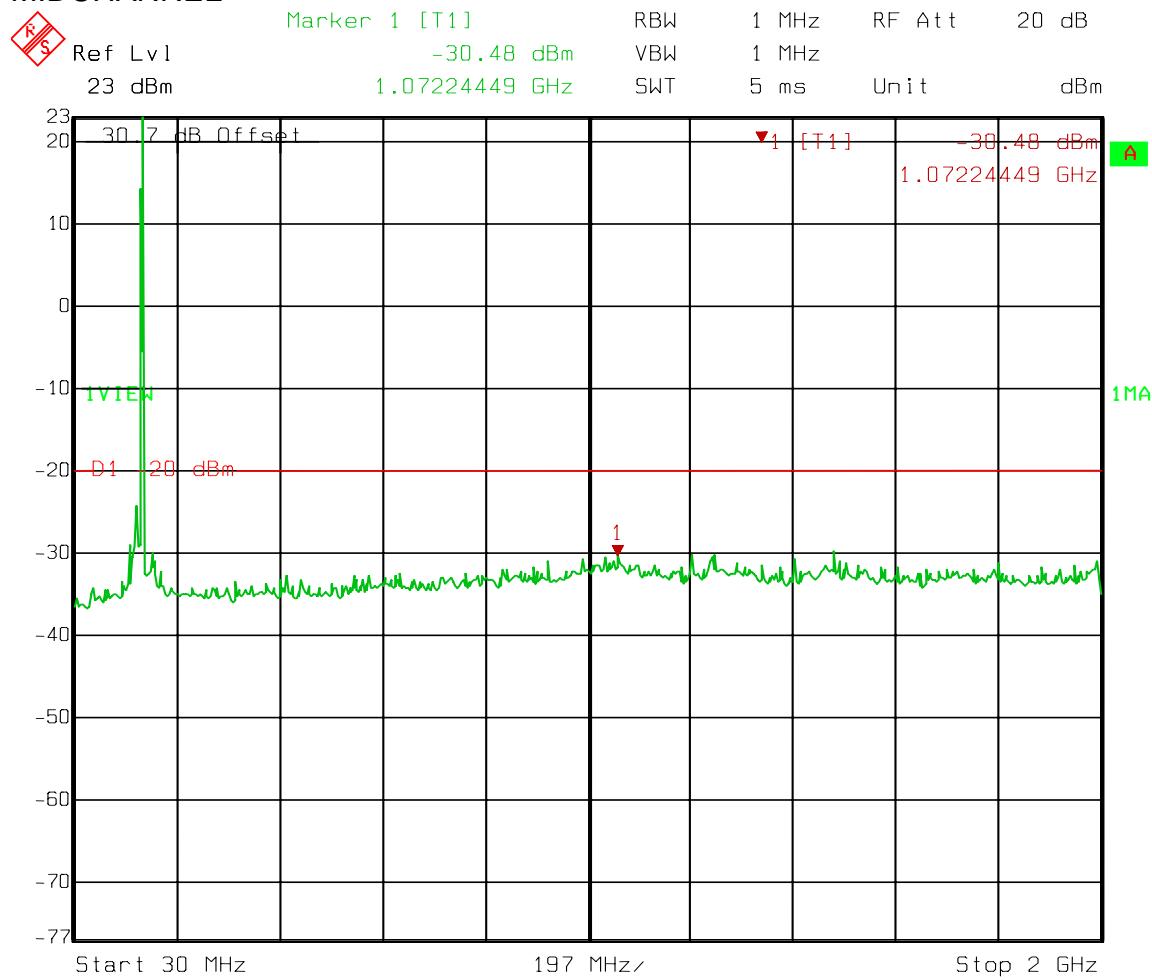
Test Data – Spurious Emissions

SPURS

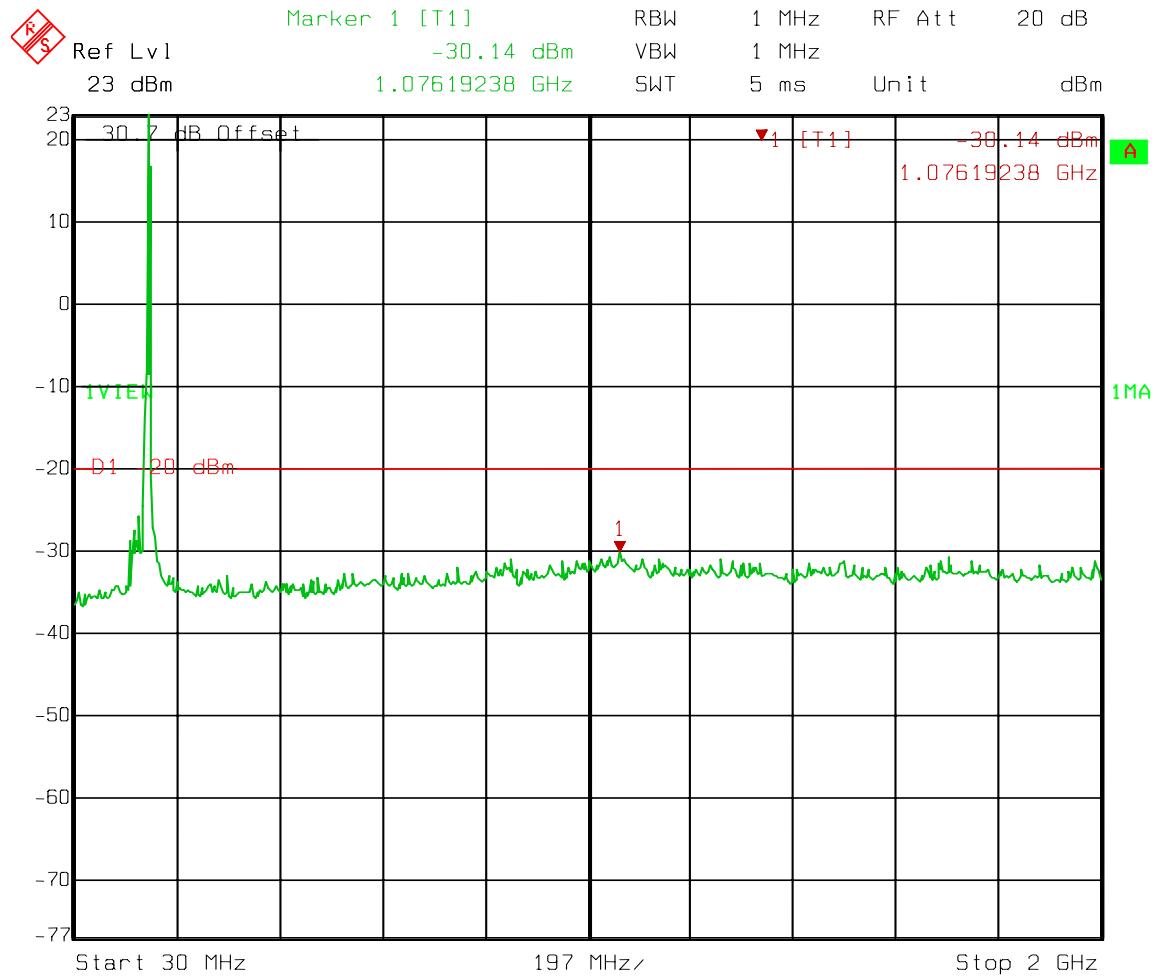
LOW CHANNEL



Date: 26.MAR.2008 15:50:56

Test Data – Spurious Emissions**SPURS
MIDCHANNEL**

Date: 26.MAR.2008 15:55:13

Test Data – Spurious Emissions**HIGH CHANNEL
SPURS**

Section 6. Field Strength of Spurious Emissions

NAME OF TEST: Field Strength of Spurious Emissions	PARA. NO.: 2.993
TESTED BY: David Light	DATE: 27 March 2008

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

Section 7. Frequency Stability

NAME OF TEST: Frequency Stability	PARA. NO.: 2.995
TESTED BY: David Light	DATE: 28 March 2008

Measurement Results: Complies.**Measurement Data:** See attached data**Measurement Conditions:** Temperature: **20** °C
Humidity: **30** %**Measurement Uncertainty:** +/- **1 X 10⁻⁷** ppm**Test Equipment:** 1659-1082-1472-1469-283-619

Test Data – Frequency Stability

<u>Frequency Stability</u>							
Page <u>1</u> of <u>1</u>							
Job No.:	11785	Date: 3/28/2008					
Specification:	90.213	Temperature(°C): 20					
Tested By:	David Light	Relative Humidity(%) 30					
E.U.T.:	150 MHz transmitter						
Configuration:	Tx CW						
Sample Number	1						
<u>Test Equipment Used</u>							
Antenna:	_____	Directional Coupler: _____					
Pre-Amp:	_____	Cable #1: 1082					
Filter:	_____	Cable #2: _____					
Receiver:	1659						
Attenuator #1	1469						
Attenuator #2:	1472						
Limit: +/- 5 ppm							
Measurement Uncertainty:	1x10 ⁻¹⁷ ppm	Standard Test Frequency <u>160.500000</u> MHz					
Temp (°C)	Measured Frequency (MHz)		Test Voltage	Frequency Error (Hz)	Limit (+/-Hz)	Error (ppm)	Comment
20	160.499756		12.0	-244	802.5	-1.5	Nominal
20	160.499728		4.0	-272	802.5	-1.7	Battery cutoff
20	160.499756		15.0	-244	802.5	-1.5	Fully charged battery
50	160.499820		12.0	-180	802.5	-1.1	
40	160.499684		12.0	-316	802.5	-2.0	
30	160.499712		12.0	-288	802.5	-1.8	
10	160.499724		12.0	-276	802.5	-1.7	
0	160.499692		12.0	-308	802.5	-1.9	
-10	160.499660		12.0	-340	802.5	-2.1	
-20	160.499668		12.0	-332	802.5	-2.1	
-30	160.499656		12	-344	802.5	-2.1	
Notes:							

Section 8. Transient Frequency Behaviour

NAME OF TEST: Transient Frequency Behavior	PARA. NO.: 90.214
TESTED BY: David Light	DATE: 27 March 2008

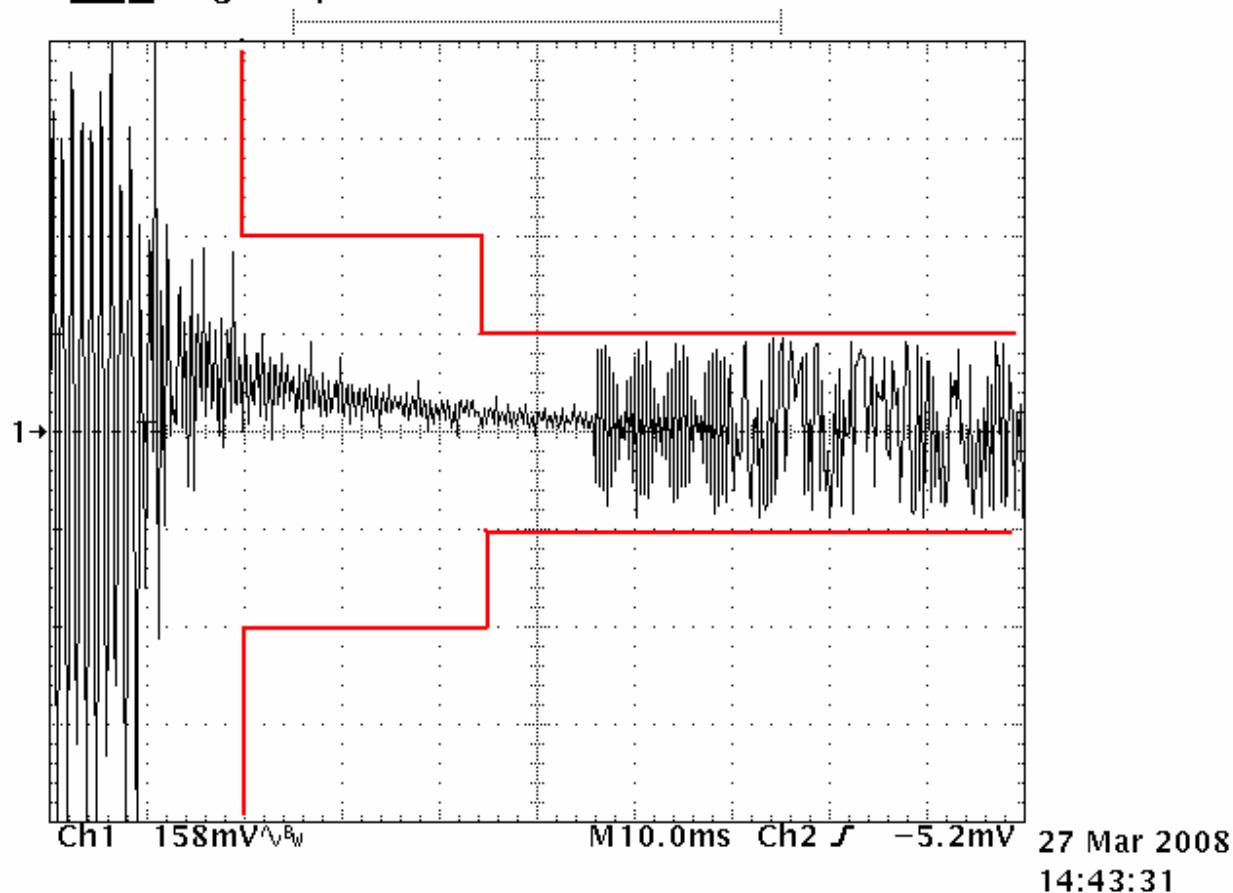
Measurement Results: Complies.

Measurement Data: See attached data

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

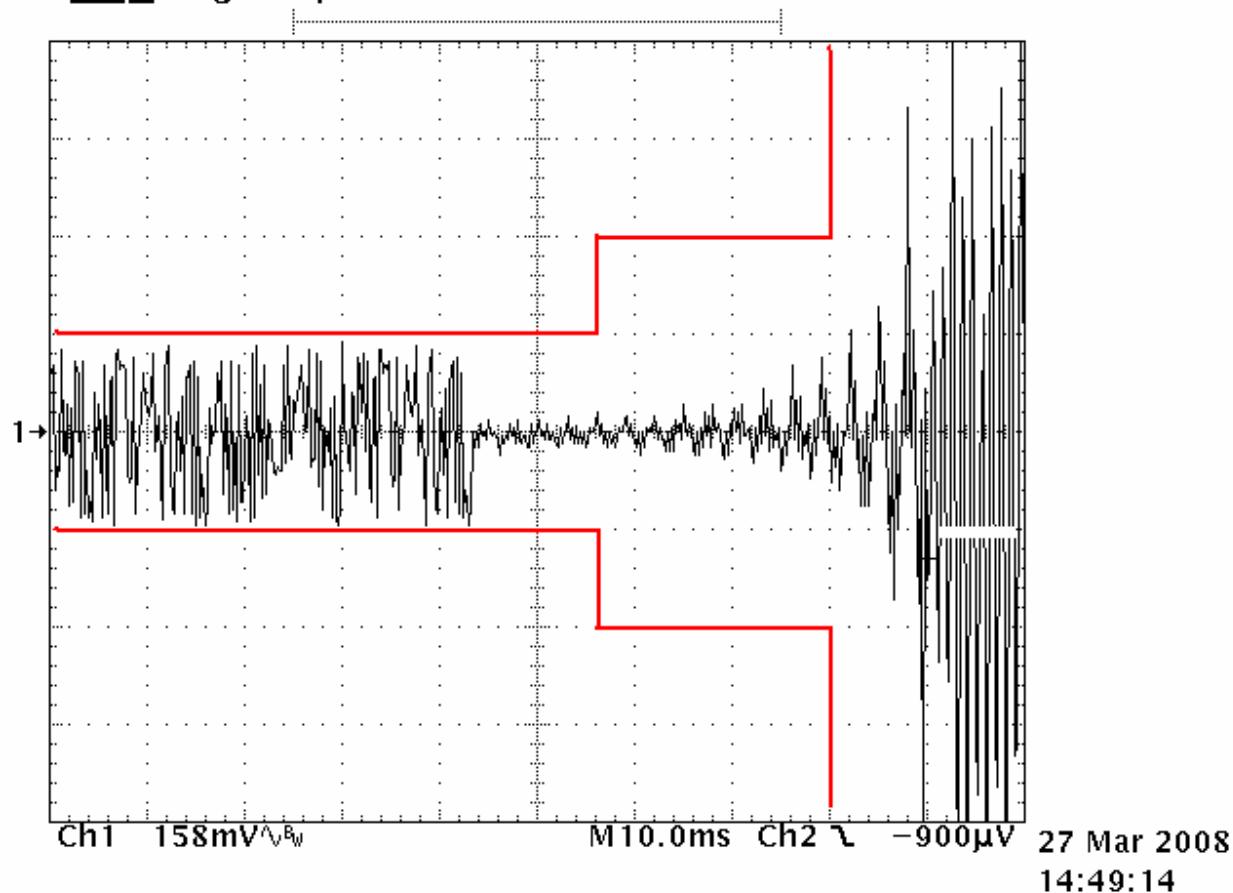
Test Data – Transient Frequency Behavior

Tek Stop: Single Seq 5.00kS/s



Test Data – Transient Frequency Behavior

Tek Stop: Single Seq 5.00kS/s



Section 9. Test Equipment List

Nemko ID	Description	Manufacturer Model Number	Serial Number	Calibration Date	Calibration Due
1659	Spectrum Analyzer	Rhode & Schwarz FSP	973353	01/24/07	01/24/09
283	Environmental Chamber with controller # 1189006	ENVIROTRONICS SH27 & 2030-22844	129010083	NA	NA
619	THERMOMETER	FLUKE 51	4520028	03/01/07	02/29/08
1082	CABLE 2m	Astrolab 32027-2-29094-72TC	N/A	CBU	N/A
1472	20db Attenuator DC 18 Ghz	Omni Spectra 20600-20db	NONE	CBU	N/A
1469	10 db Attenuator DC 18 Ghz	MCL Inc. BW-S10W2 10db-2WDC	NONE	CBU	N/A
1464	Spectrum analyzer	Hewlett Packard 8563E	3551A04428	01/24/07	01/24/09
1484	Cable	Storm PR90-010-072	N/A	05/02/07	05/01/08
1485	Cable	Storm PR90-010-216	N/A	05/02/07	05/01/08
1016	Pre-Amp	HEWLETT PACKARD 8449A	2749A00159	05/01/07	04/30/08
993	Horn antenna	A.H. Systems SAS-200/571	XXX	08/31/07	08/30/08
1036	SPECTRUM ANALYZER	ROHDE & SCHWARZ FSEK30	830844/006	05/26/06	05/26/08

Nemko USA, Inc.

FCC PART 90, SUBPART I

EQUIPMENT: FSU-2

PROJECT NO.: **11785RUS1**

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. Power output is measured with the maximum rated input level.

Integral Antenna:

If the antenna is not detachable from the circuit then the Peak Power Output is derived from the peak radiated field strength of the fundamental emission by using the plane wave relation $GP/4\pi R^2 = E^2/120\pi$ and proceeding as follows:

$$P = \frac{E^2 R^2}{30G} = \frac{E^2 3^2}{30G}$$

where,

P = the equivalent isotropic radiated power in watts

E = the maximum measured field strength in V/m

R = the measurement range (3 meters)

G = the numeric gain of the transmit antenna in relation to an isotropic radiator

NAME OF TEST: Occupied Bandwidth**PARA. NO.: 2.989**

Minimum Standard: Para. No. 90.210, see table 1 below for applicable mask.

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: \Rightarrow RBW

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

NAME OF TEST: Field Strength of Spurious**PARA. NO.: 2.993****Minimum Standard:** Para. No. 90.210, see table 1 for applicable mask.**Calculation of Field Strength Limit**

An example of attenuation requirement of $50 + 10 \log P$ is equivalent to -20 dBm (1×10^{-5} Watts) at the antenna terminal. We determine the field strength limit by using the plane wave relation.

$$GP/4\pi R^2 = E^2/120\pi$$

For emissions $\leq 1 \text{ GHz}$:

G = 1.64 (Dipole Gain)

P = 10^{-5} Watts (Maximum spurious output power)

R = 3m (Measurement Distance)

$$E = \frac{\sqrt{30GP}}{R} = E = \frac{\sqrt{30 \times 1.64 \times 10^{-5}}}{3} = 0.00739 \text{ V/m} = 77.4 \text{ dB}\mu\text{V/m}$$

For emissions $> 1 \text{ GHz}$:

G = 1 (Isotropic Gain)

P = 1×10^{-5} Watts (Maximum spurious output power)

R = 3m (Measurement Distance)

$$E = 77.4 - 20 \log \sqrt{1.64} = 75.2 \text{ dB}\mu\text{V/m} @ 3m$$

MASK	Spurious Limit	FS Limit Below 1 GHz	FS Limit Above 1 GHz
A,B,C,G,H,I	-13dBm	84.4 dB μ V/m @ 3m	82.2 dB μ V/m @ 3m
D,J	-20dBm	77.4 dB μ V/m @ 3m	75.2 dB μ V/m @ 3m
E,F,K	-25dBm	72.4 dB μ V/m @ 3m	70.2 dB μ V/m @ 3m

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

	Maximum	Frequency ranges (MHz) All equipment					
		Base station and portable radios			Mobile Radios		
Time intervals ^{1,2}	Frequency difference ³ (kHz)	150 - 174 (ms)	450 - 500 (ms)	500 - 512 (ms)	150 - 174 (ms)	450 - 500 (ms)	500 - 512 (ms)
t_1^4	± 25	5.0	10.0	20.0	5.0	10.0	5.0
t_2	± 12	20.0	25.0	50.0	20.0	25.0	20.0
t_3^4	± 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

	Maximum	Frequency ranges (MHz) All equipment		
		150 - 174 (ms)	450 - 500 (ms)	500 - 512 (ms)
Time intervals ^{1,2}	Frequency difference ³ (kHz)			
t_1^4	$\pm 12.5 / \pm 6.25$	5.0	10.0	20.0
t_2	$\pm 6.25 / \pm 3.125$	20.0	25.0	50.0
t_3^4	$\pm 12.5 / \pm 6.25$	5.0	10.0	10.0

Nemko USA, Inc.

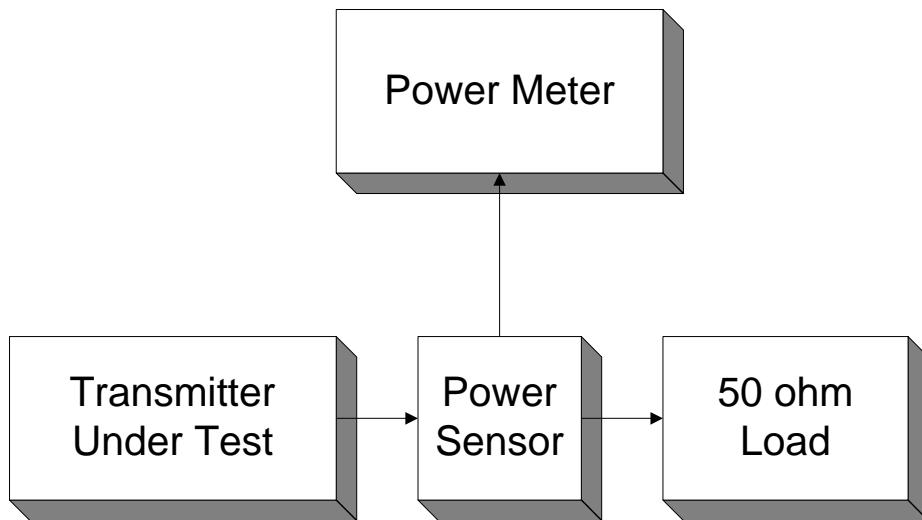
FCC PART 90, SUBPART I

EQUIPMENT: FSU-2

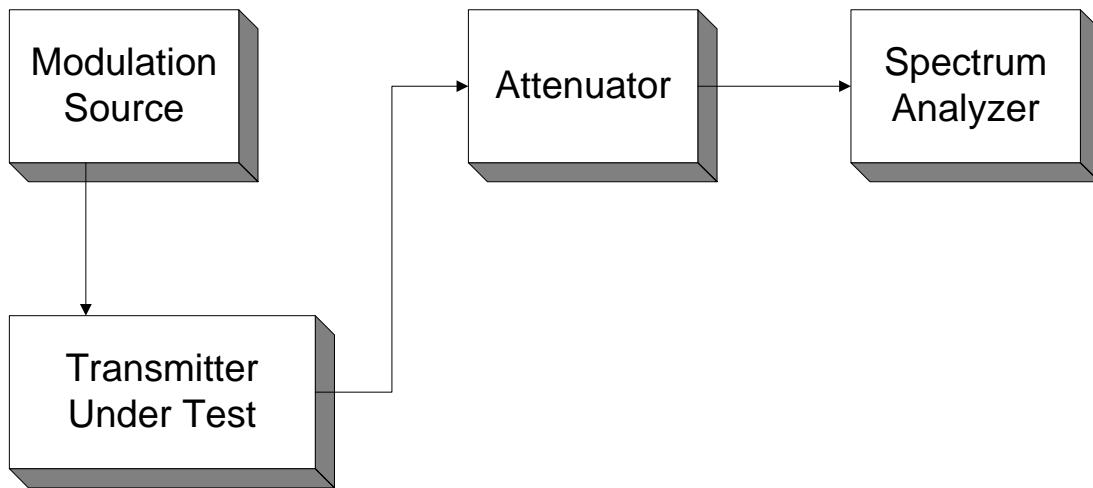
PROJECT NO.: **11785RUS1**

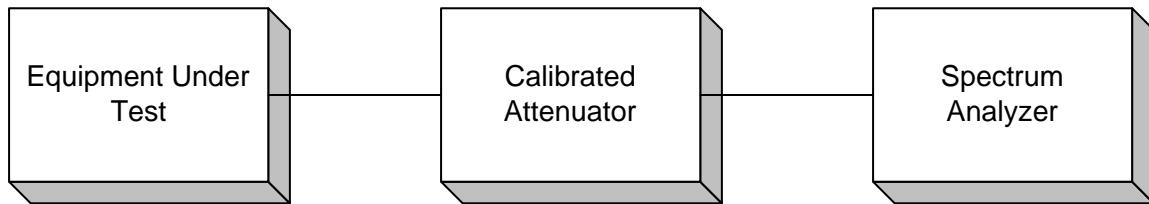
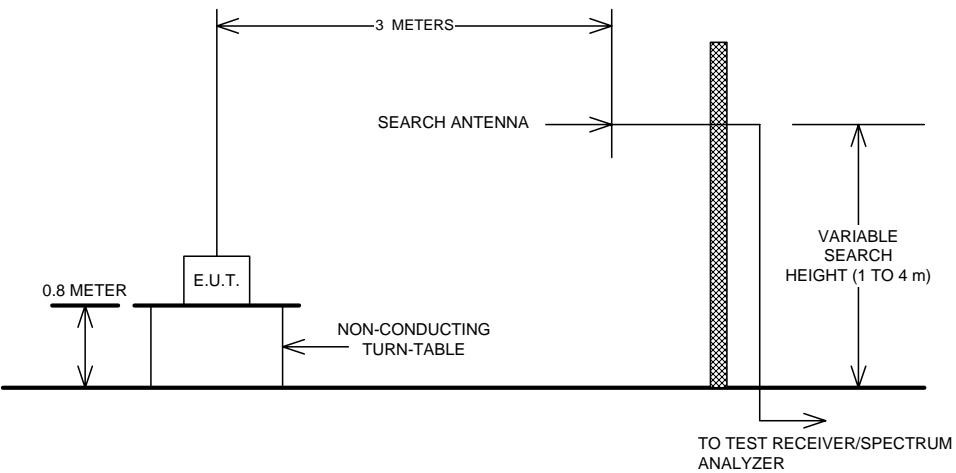
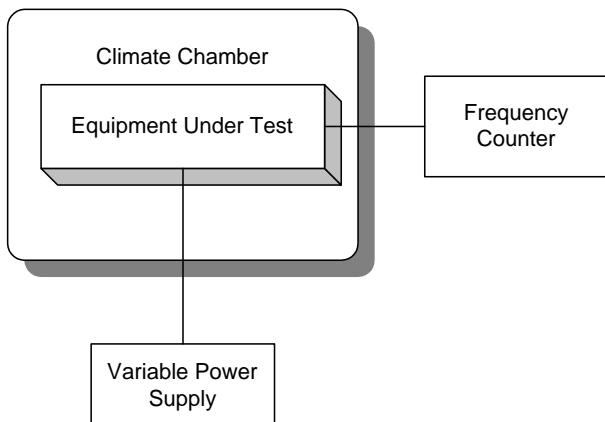
ANNEX B - TEST DIAGRAMS

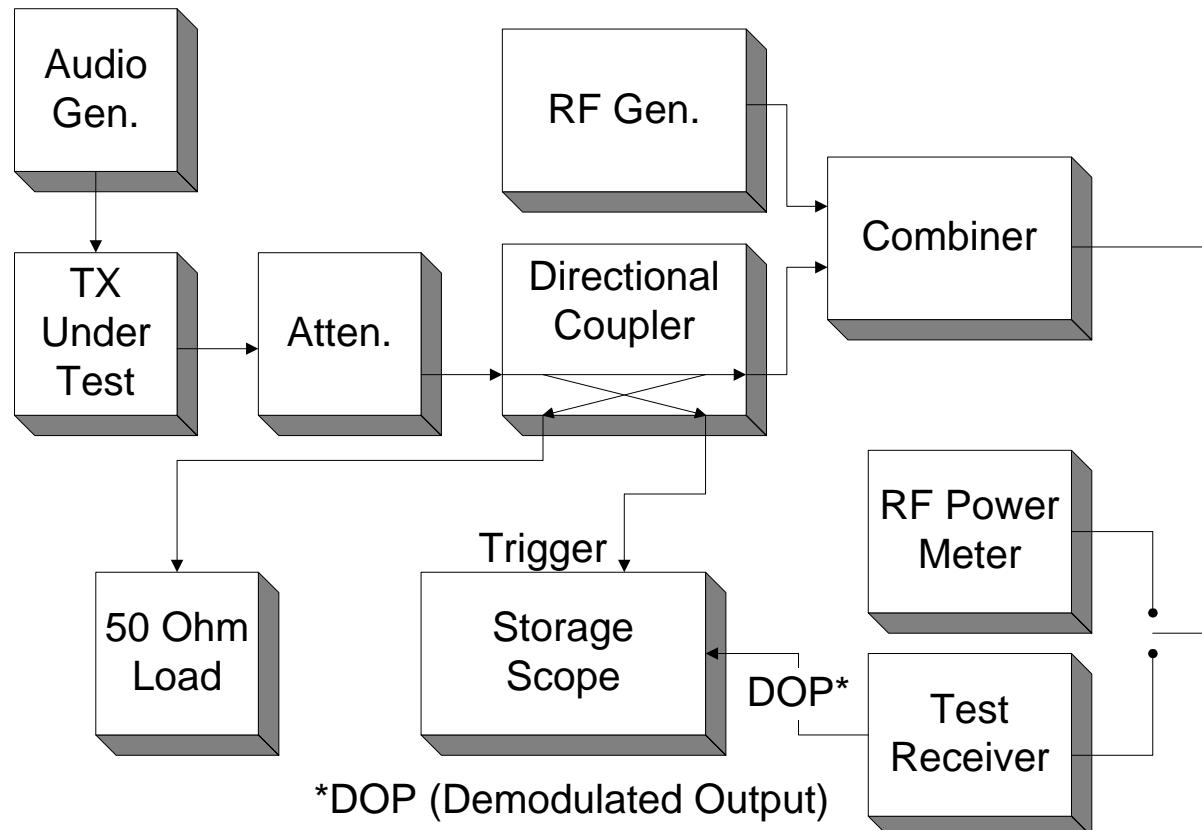
Para. No. 2.985 - R.F. Power Output



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).