



Nemko Test Report: 11786RUS1Rev1

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

Equipment Under Test: CRU-2
(E.U.T.)

In Accordance With: **CFR 47 Part 90, Subpart I**
Base Station Transmitter

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: 13 May, 2008

APPROVED BY:

A handwritten signature in black ink, appearing to read 'Tom Tidwell'.

Tom Tidwell, Frontline Manager

DATE: 28 August, 2008

Number of Pages: 35

Table of Contents

SECTION 1.	SUMMARY OF TEST RESULTS	3
SECTION 2.	GENERAL EQUIPMENT SPECIFICATION	5
SECTION 3.	RF POWER OUTPUT	6
SECTION 4.	OCCUPIED BANDWIDTH	7
SECTION 5.	SPURIOUS EMISSIONS AT ANTENNA TERMINALS	11
SECTION 6.	FIELD STRENGTH OF SPURIOUS EMISSIONS	18
SECTION 7.	FREQUENCY STABILITY	20
SECTION 9.	TRANSIENT FREQUENCY BEHAVIOR	22
SECTION 8.	TEST EQUIPMENT LIST	25
ANNEX A - TEST METHODOLOGIES		26
ANNEX B - TEST DIAGRAMS		32

EQUIPMENT: CRU-2

Section 1. Summary of Test Results

Manufacturer: ION Geophysical Corporation

Model No.: CRU-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 CFR 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".



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Summary Of Test Data

NAME OF TEST	PARA. NO.	SPEC.	RESULT
RF Power Output	90.205	500 W	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	2.55 ppm	Complies
Transient Frequency Behavior	90.214	90.214 Table	Complies

Footnotes For N/A's:

- (1) Since the E.U.T. is digitally modulated, modulation characteristics were not measured.

Section 2. General Equipment Specification**Transmitter**

Supply Voltage Input:	13.6 Vdc Battery
Frequency Range:	150 to 174 MHz
Type(s) of Modulation:	GMSK
Emission Designator:	10K0GXW
Output Impedance:	
RF Power Output (rated):	28 44.5 W dBm
Channel Spacing(s):	12.5 kHz

Description of EUT

The CRU is the command and control base station that communicates with multiple remote field station units via a proprietary protocol.

Section 3. RF Power Output

NAME OF TEST: RF Power Output	PARA. NO.: 2.985
TESTED BY: David Light	DATE: 09 May 2008

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

Frequency (MHz)	Peak Output Power (Watts)	Peak Output Power (dBm)
153.1	30.9	44.9
163.1	26.9	44.3
172.7	24.0	43.8

Spectrum Analyzer Setting: RBW/VBW = 1 MHz
Peak Detector**Equipment Used:** 1036-1082-1054-1064-1065**Measurement Uncertainty:** +/- 1.7 dB**Temperature:** 22 °C**Relative Humidity:** 35 %

EQUIPMENT: CRU-2

Section 4. Occupied Bandwidth

NAME OF TEST: Occupied Bandwidth	PARA. NO.: 2.989
TESTED BY: David Light	DATE: 09 May 2008

Test Results: Complies.

Test Data: See attached plot(s).

Equipment Used: 1036-1082-1054-1064-1065

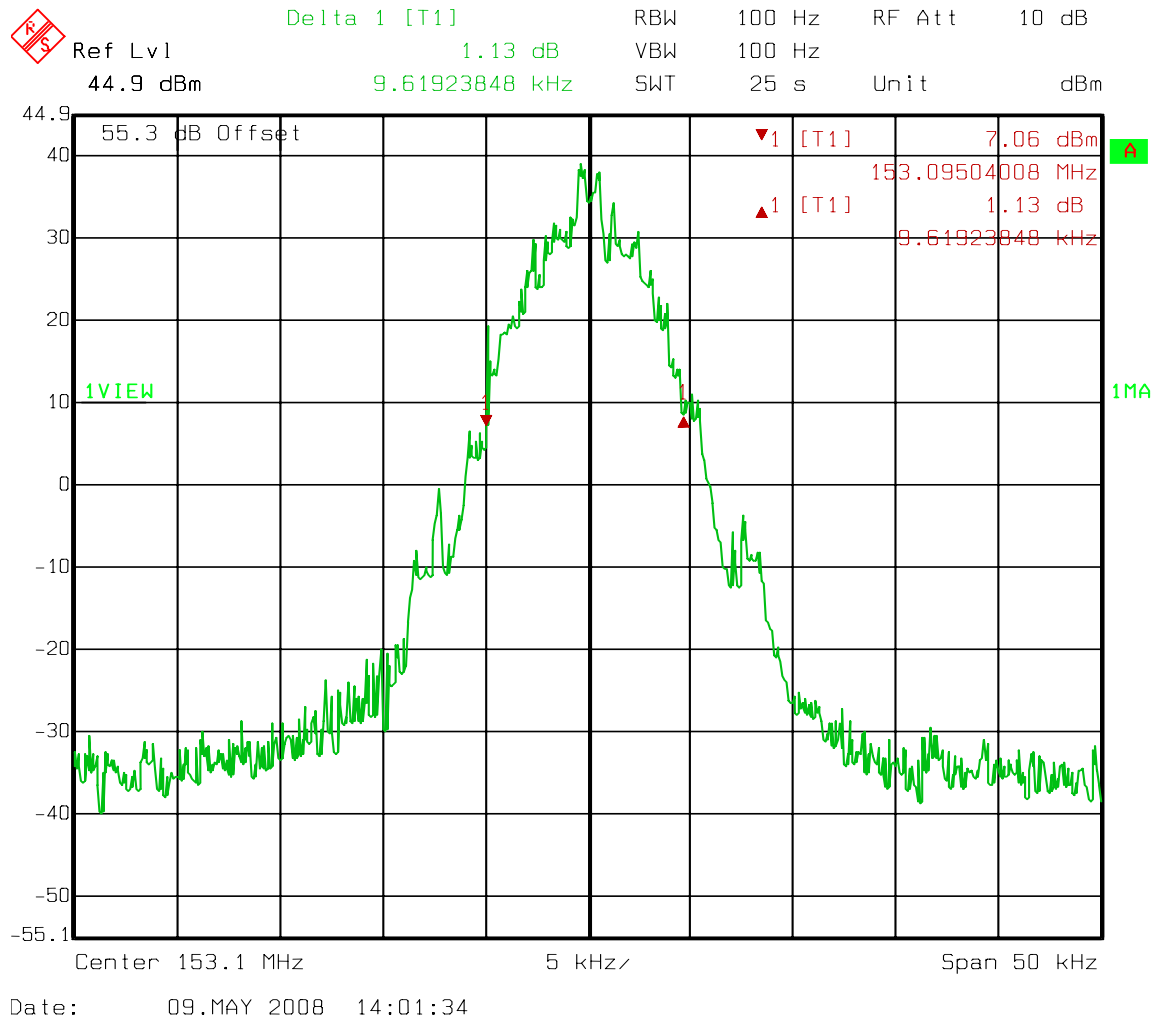
Measurement Uncertainty: 1X10⁻⁷ ppm

Temperature: 22 °C

Relative Humidity: 35 %

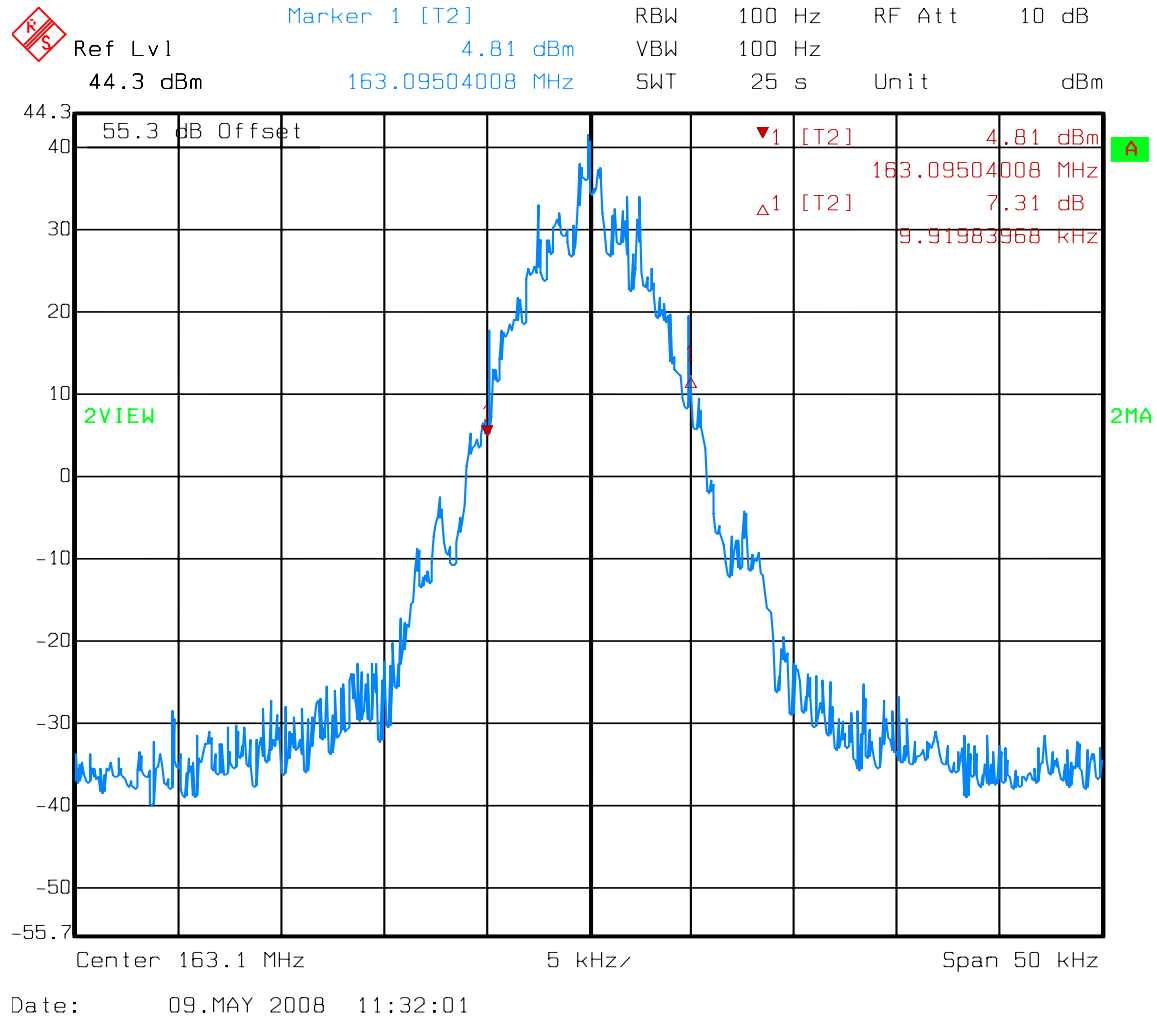
EQUIPMENT: CRU-2

Test Data – Occupied Bandwidth



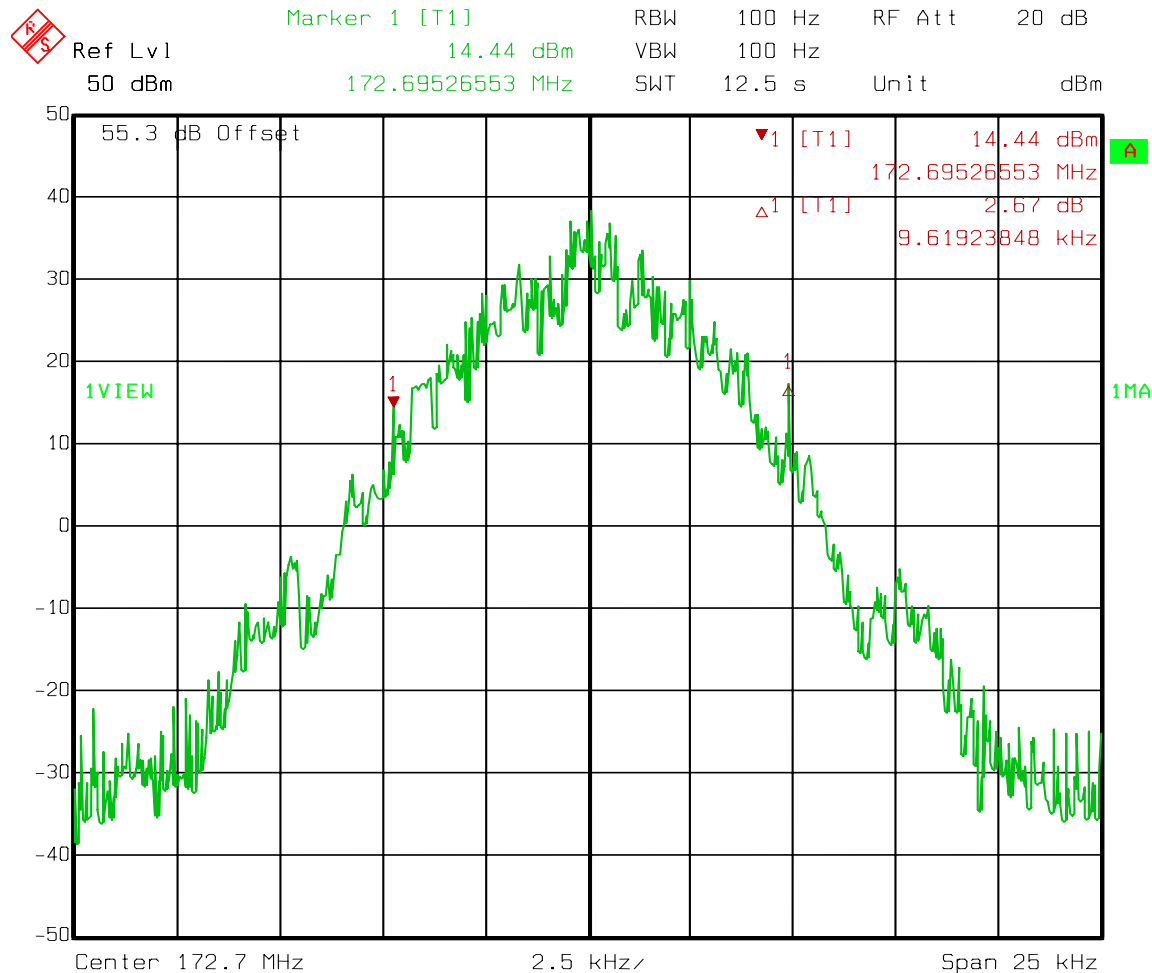
EQUIPMENT: CRU-2

Test Data – Occupied Bandwidth



EQUIPMENT: CRU-2

Test Data – Occupied Bandwidth



Date: 09.MAY 2008 10:29:40

Section 5. Spurious Emissions at Antenna Terminals

NAME OF TEST: Spurious Emissions @ Antenna Terminals	PARA. NO.: 2.991
TESTED BY: David Light	DATE: 09 May 2008

Test Results: Complies.

Test Data: See attached plot(s).

Equipment Used: 1036-1082-1054-1064-1065

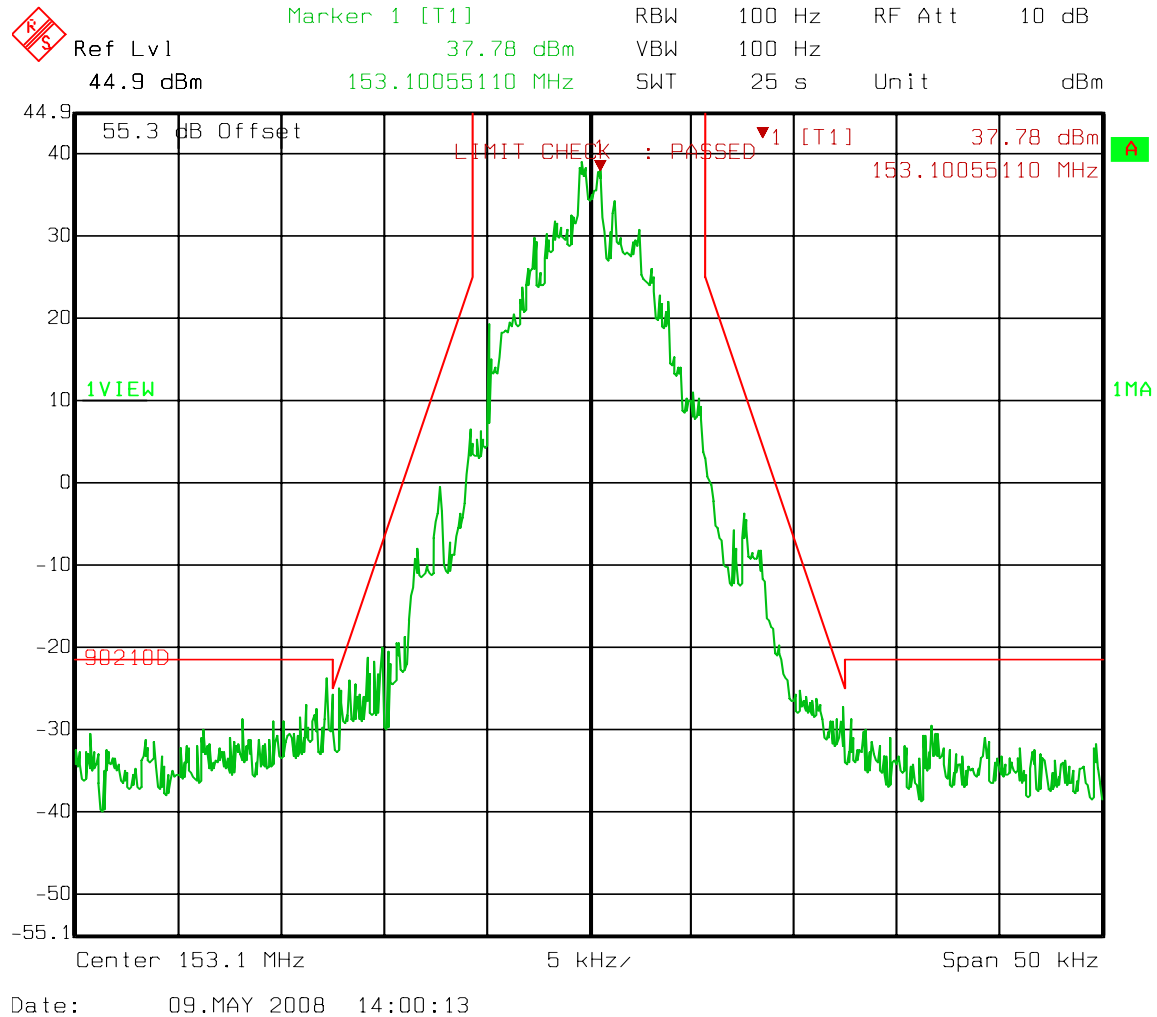
Measurement Uncertainty: +/- 1.7 dB

Temperature: 22 °C

Relative Humidity: 35 %

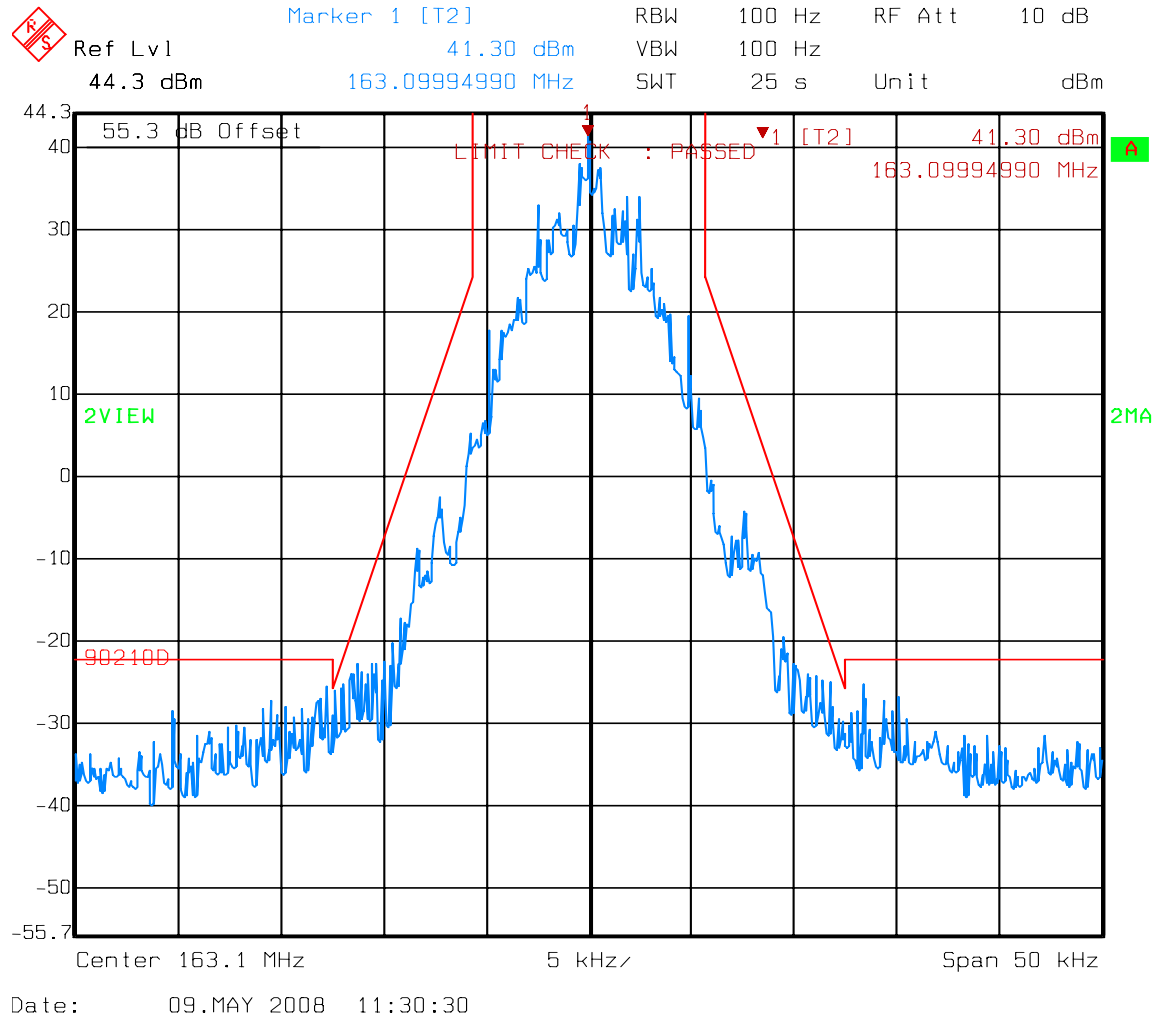
EQUIPMENT: CRU-2

Test Data – Spurious Emissions at Antenna Terminals



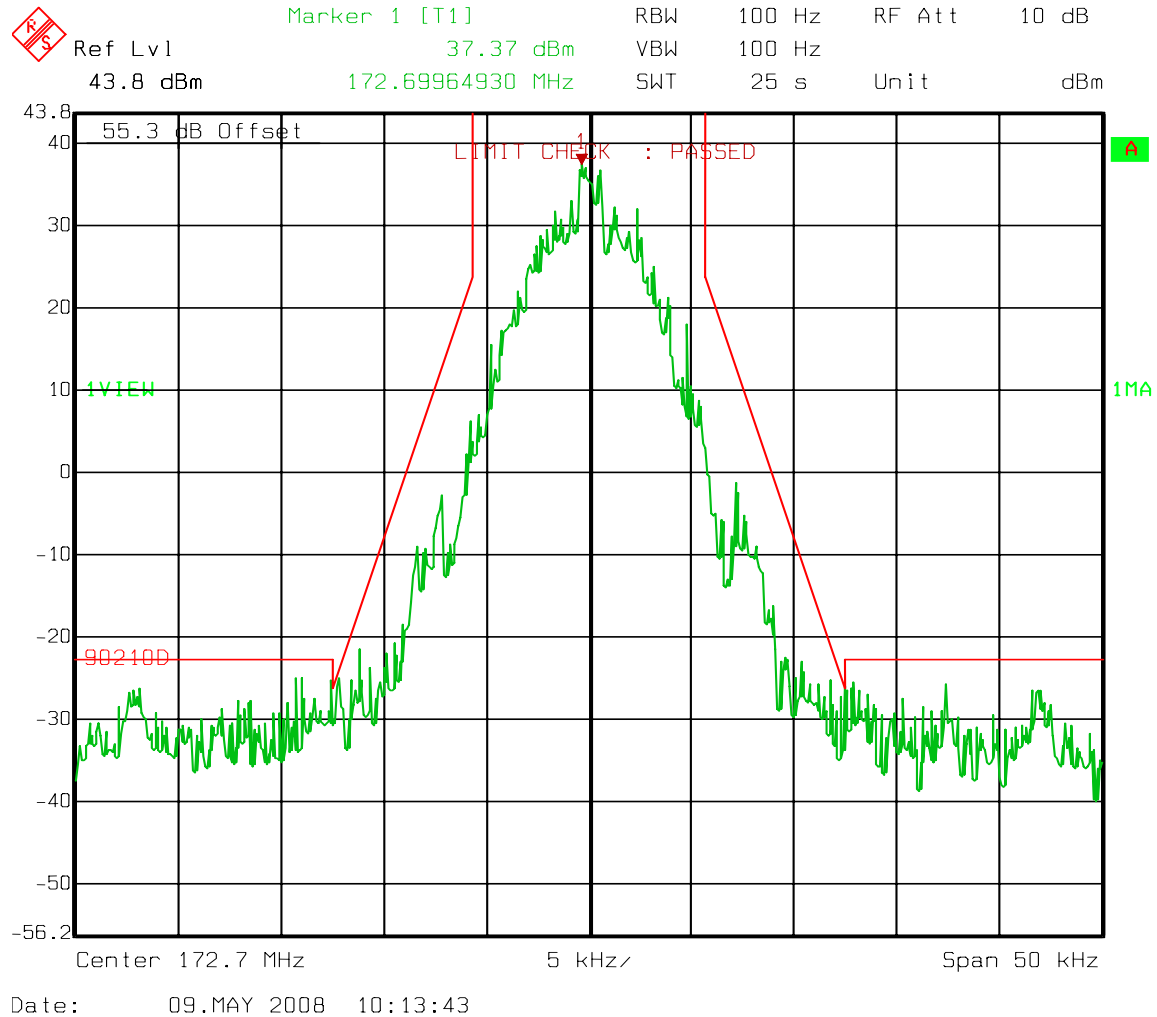
EQUIPMENT: CRU-2

Test Data – Spurious Emissions at Antenna Terminals



EQUIPMENT: CRU-2

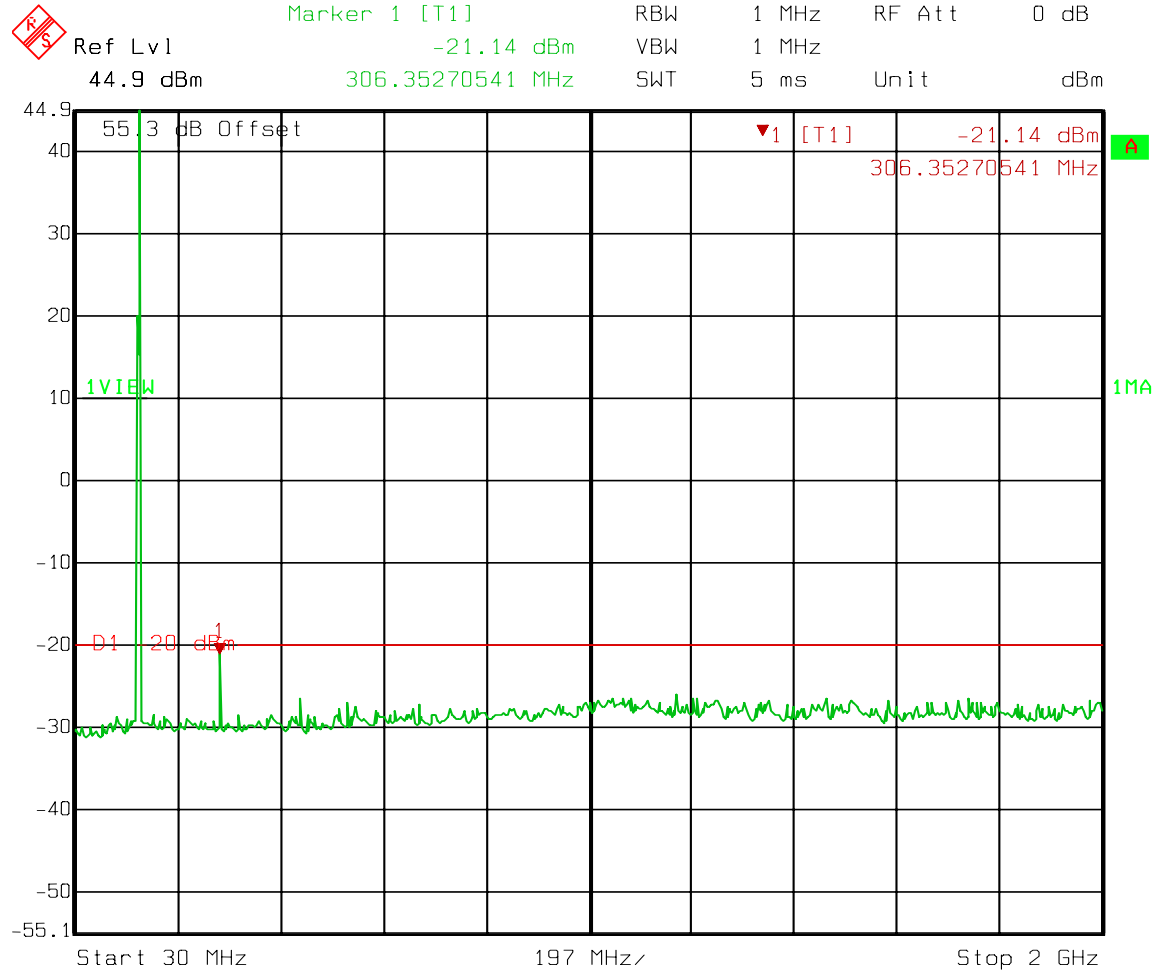
Test Data – Spurious Emissions at Antenna Terminals



EQUIPMENT: CRU-2

Test Data – Spurious Emissions at Antenna Terminals

Low Channel

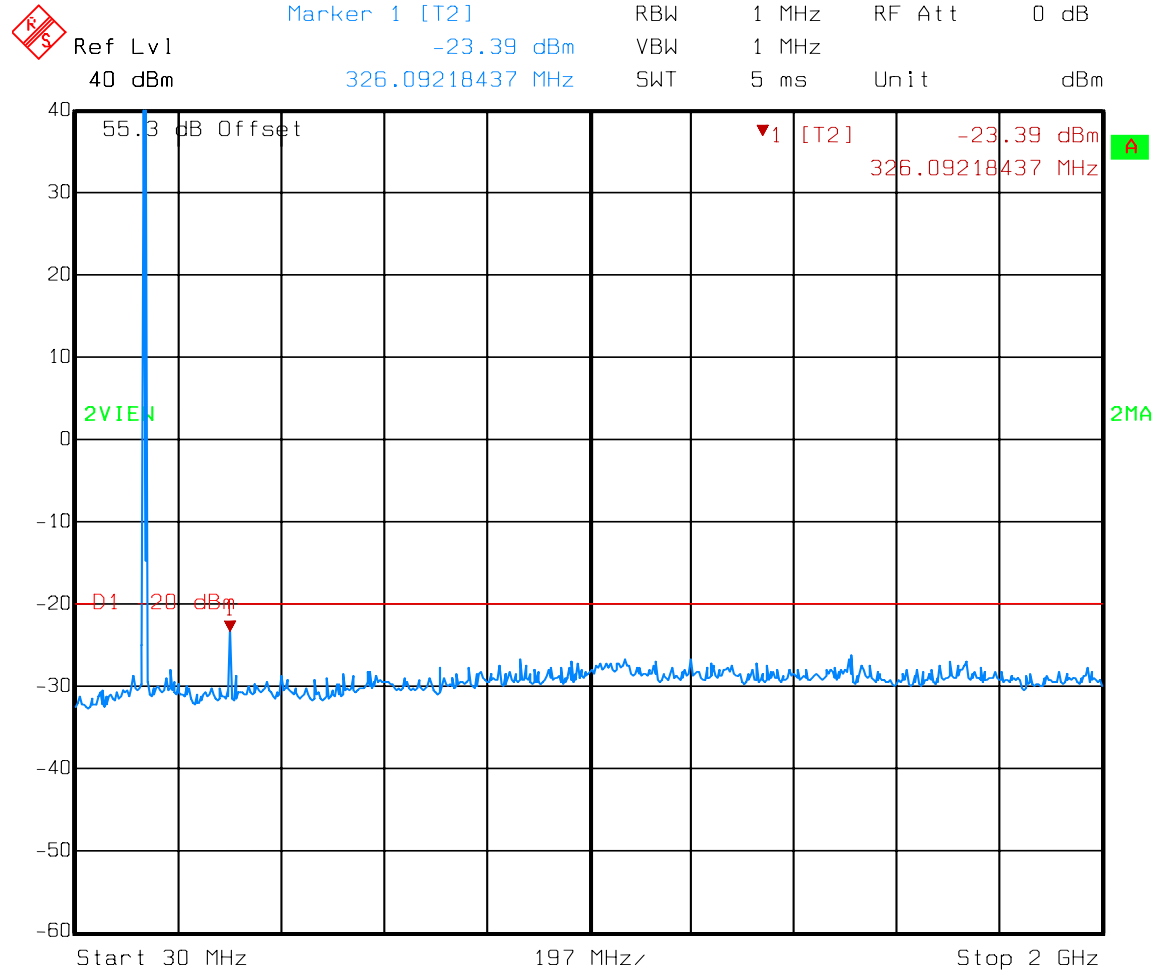


Date: 09.MAY 2008 14:02:44

EQUIPMENT: CRU-2

Test Data – Spurious Emissions at Antenna Terminals

Mid Channel

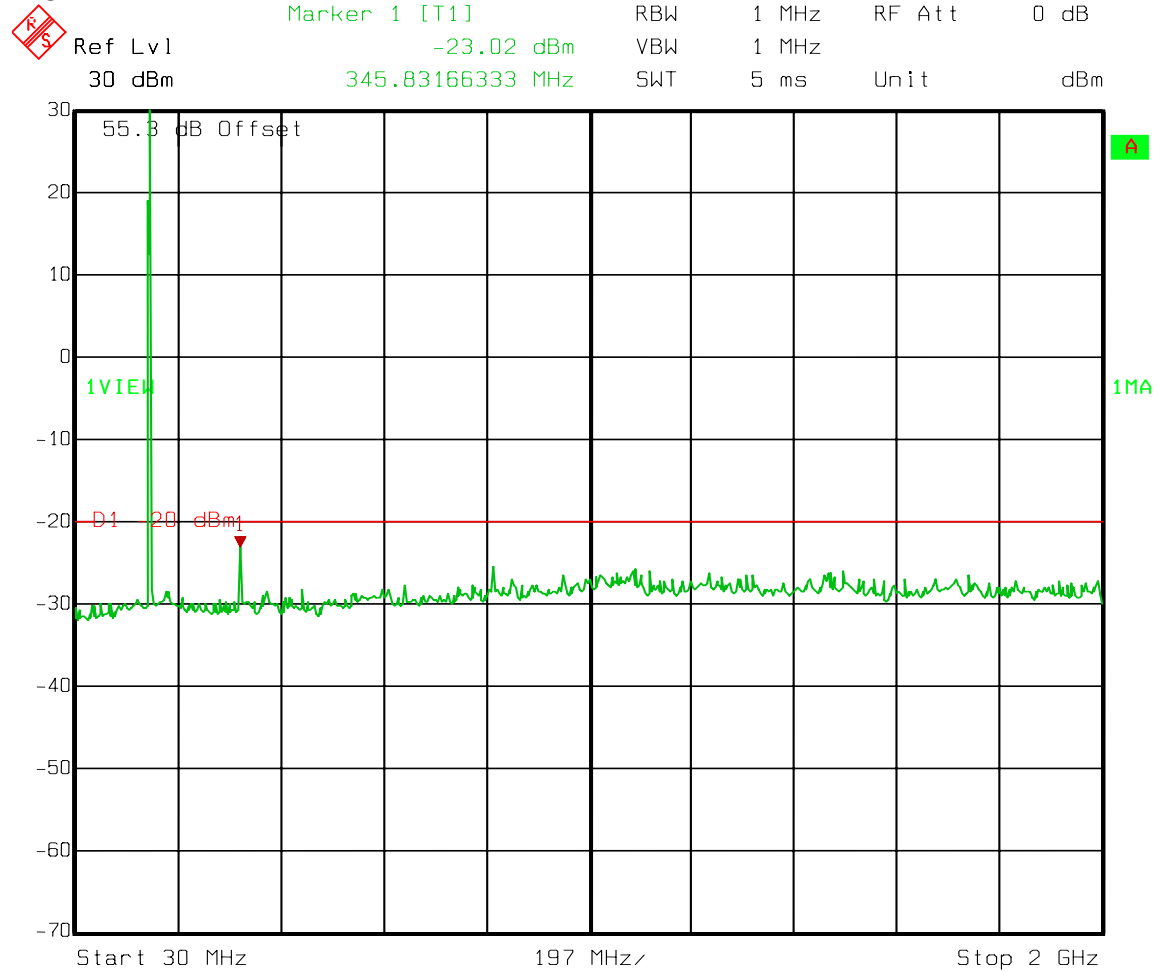


Date: 09.MAY 2008 11:36:13

EQUIPMENT: CRU-2

Test Data – Spurious Emissions at Antenna Terminals

High Channel



Date: 09.MAY 2008 10:19:42

Section 6. Field Strength of Spurious Emissions

NAME OF TEST: Field Strength of Spurious Emissions	PARA. NO.: 2.993
TESTED BY: David Light	DATE: 09 May 2008

Test Results: Complies.

Test Data: See attached table.

Equipment Used: 1464-1484-1485-1016-993-791-1763

Measurement Uncertainty: +/-1.7 dB

Temperature: 22 °C

Relative Humidity: 35 %

[illegible]

The EUT was tested on three channels. Worst case emissions for the low channel are presented.

Section 7. Frequency Stability

NAME OF TEST: Frequency Stability	PARA. NO.: 2.995
TESTED BY: David Light	DATE: 12 May 2008

Test Results: Complies.

Measurement Data: See attached table.

Standard Test Frequency: 153.1 MHz
Standard Test Voltage: 12 Vdc
Limit: 5 ppm 765.5 Hz

Equipment Used: 1036-1082-1054-1064-1065-283

Measurement Uncertainty: 1 x 10⁻⁷ ppm

Lab Temperature: 24 °C

Relative Humidity: 48 %

EQUIPMENT: CRU-2**Test Data – Frequency Stability**

Temp (°C)	Measured Frequency (MHz)	Rho	Test Voltage	Frequency Error (Hz)	Limit (+/-Hz)	Error (ppm)	Comment
20	153.100016		12 Vdc	16	382.8	0.10	
20	153.100015		13.8 Vdc	15	382.8	0.10	
20	153.100012		9.8 Vdc	12	382.8	0.08	
50	153.100012		12 Vdc	12	382.8	0.08	
40	153.100012		12 Vdc	12	382.8	0.08	
30	153.100008		12 Vdc	8	382.8	0.05	
10	153.100012		12 Vdc	12	382.8	0.08	
0	153.100010		12 Vdc	10	382.8	0.07	
-10	153.100012		12 Vdc	12	382.8	0.08	
-20	153.100016		12 Vdc	16	382.8	0.10	
-30	153.100012		12 Vdc	12	382.8	0.08	
Notes:							

Section 9. Transient Frequency Behavior

NAME OF TEST: Transient Frequency Behavior	PARA. NO.: 90.214
TESTED BY: David Light	DATE: 6 May, 2008

Measurement Results: Complies.

Measurement Data: See attached data

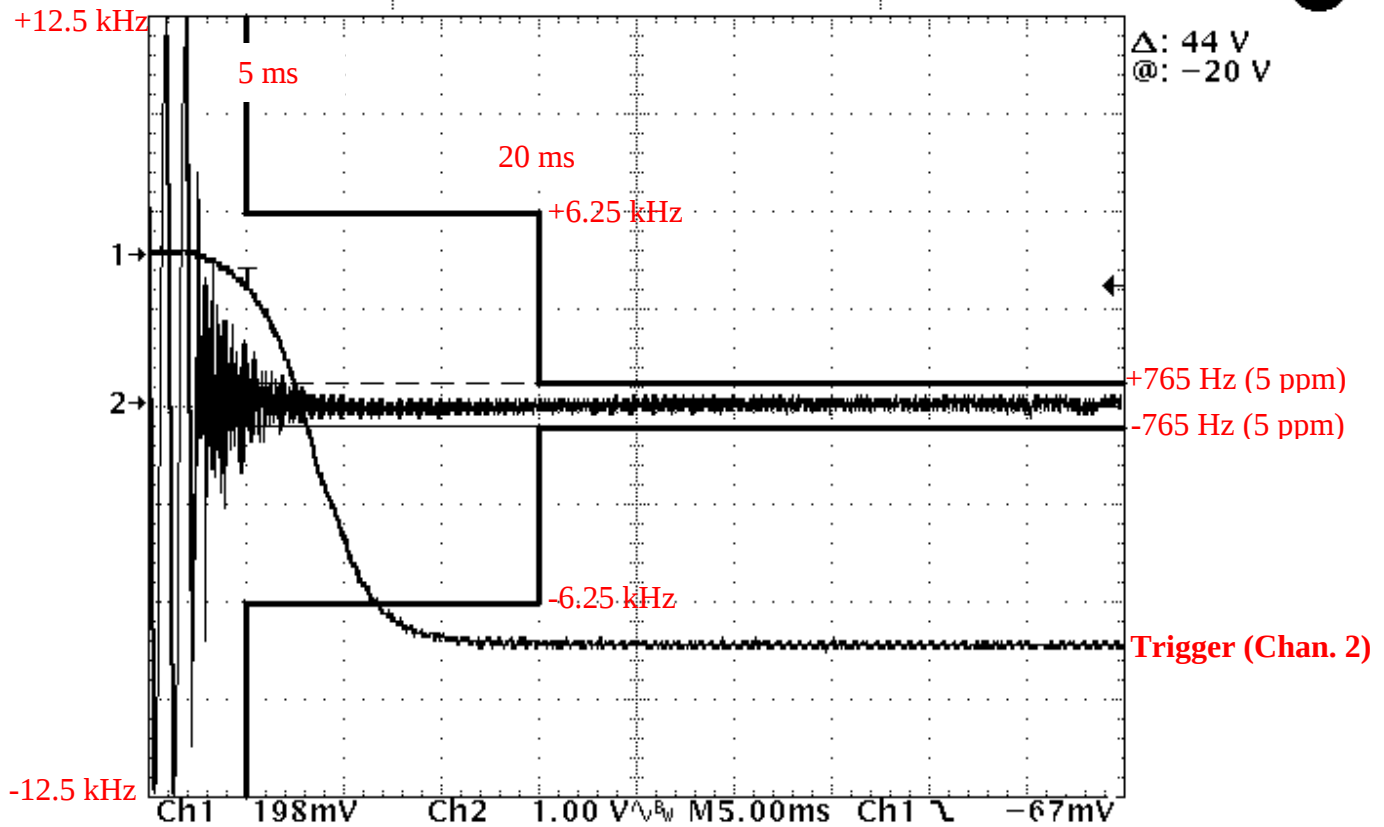
Measurement Conditions: Temperature: 22 °C
 Humidity: 35 %

Measurement Uncertainty: +/-

EQUIPMENT: CRU-2

Turn-On Transient Frequency Behavior

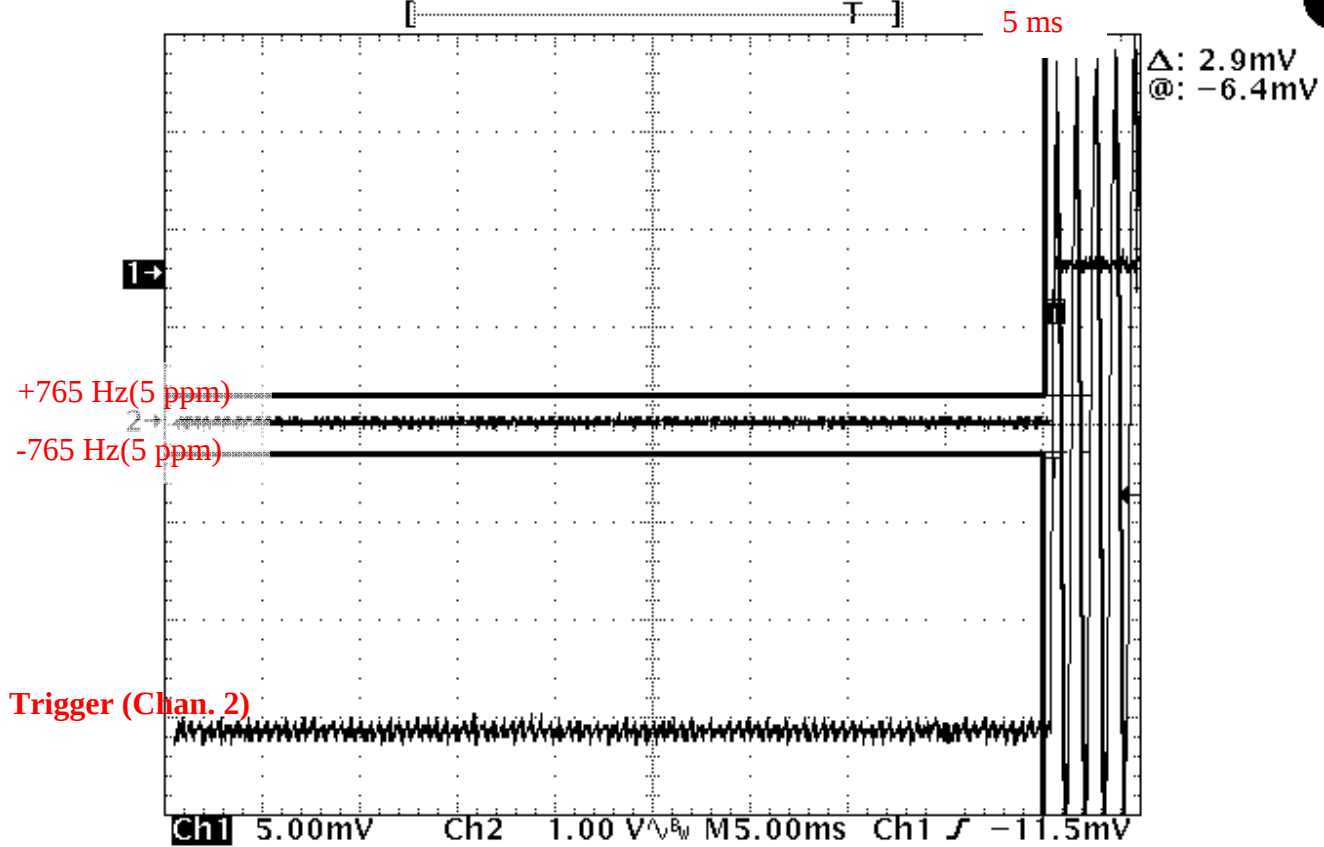
Tek Run: 50.0kS/s Sample 11192



EQUIPMENT: CRU-2

Turn-Off Transient Frequency Behavior

Tek Run: 50.0kS/s Sample 11192



EQUIPMENT: CRU-2**Section 8. Test Equipment List**

Nemko ID	Description	Manufacturer Model Number	Serial Number	Calibration Date	Calibration Due
1054	DUAL DIRECTIONAL COUPLER	NARDA 3020A	34366	Cal Not Req	N/A
1064	ATTENUATOR	NARDA 776B-20	NONE	CBU	N/A
1065	ATTENUATOR	NARDA 776B-10	NONE	CBU	N/A
1036	SPECTRUM ANALYZER	ROHDE & SCHWARZ FSEK30	830844/006	05/26/06	05/26/08
1082	CABLE 2m	Astrolab 32027-2-29094-72TC	N/A	CBU	N/A
1464	Spectrum analyzer	Hewlett Packard 8563E	3551A04428	01/24/07	01/24/09
1484	Cable	Storm PR90-010-072	N/A	05/07/08	05/07/09
1485	Cable	Storm PR90-010-216	N/A	05/07/08	05/07/09
993	Horn antenna	A.H. Systems SAS-200/571	XXX	08/31/07	08/30/08
1016	Pre-Amp	HEWLETT PACKARD 8449A	2749A00159	05/07/08	05/07/09
791	PREAMP, 25dB	Nemko USA, Inc. LNA25	398	05/07/08	05/07/09
1763	Bilog Antenna	Schaffner CBL 6111D	22926	09/21/07	09/20/08
283	Environmental Chamber with controller # 1189006	ENVIROTRONICS SH27 & 2030-22844	129010083	04/24/08	04/24/09
1051	Radio Communication Analyzer	Rhode & Schwarz CMTA-54	835875/002	N/A	N/A
396	DETECTOR	HP 11664A	741613	Cal Not Req	N/A
1763	Bilog Antenna	Schaffner CBL 6111D	22926	09/21/07	09/20/08
1463	Color 4 Ch Digitizing Oscilloscope	Tektronix TDS684A	B010460	05/27/07	05/27/08
1053	VECTOR SIGNAL GENERATOR 300 KHz	ROHDE & SCHWARZ SMIQ 03	DE22081	09/29/05	09/30/08
1091	COMBINER	MINI-CIRCUITS ZA3PD-1.5	NONE	CBU	N/A

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:

The antenna substitution method is used to determine the equivalent radiated power at spurious frequencies. The spurious emissions are measured at a distance of 3 meters. The EUT is then replaced with a reference substitution antenna with a known gain referenced to an isotropic radiator. This antenna is fed with a signal at the spurious frequency. The level of the signal is adjusted to repeat the previously measured level. The resulting eirp is the signal level fed to the reference antenna corrected for gain referenced to an isotropic radiator.

EQUIPMENT: CRU-2**NAME OF TEST: Spurious Emissions at Antenna
Terminals****PARA. NO.: 2.991****Minimum Standard:**

90.210, Table 1

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 the 0 - 1 GHz range.
1 MHz at frequencies above 1 GHz.
VBW: = RBW

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

EQUIPMENT: CRU-2

NAME OF TEST: Occupied Bandwidth	PARA. NO.: 2.989
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Minimum Standard: Not defined. Input/Output

Method Of Measurement:

Analog

Spectrum analyzer settings:

RBW=VBW=300 Hz

Span: 100 kHz

Sweep: Auto

iDEN

RBW=VBW= 300 Hz

Span: 100 kHz

Sweep: Auto

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

Method Of Measurement: TIA/EIA-603-1992

The antenna substitution method is used to determine the equivalent radiated power at spurious frequencies. The spurious emissions are measured at a distance of 3 meters. The EUT is then replaced with a reference substitution antenna with a known gain referenced to an isotropic radiator. This antenna is fed with a signal at the spurious frequency. The level of the signal is adjusted to repeat the previously measured level. The resulting eirp is the signal level fed to the reference antenna corrected for gain referenced to an isotropic radiator.

EQUIPMENT: CRU-2**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

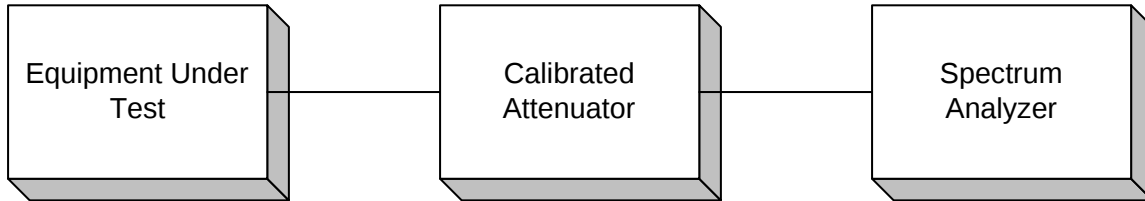
Transient Frequency Behaviour for Equipment Designed to Operate on 12.5 kHz & 6.25 kHz Channels

	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	± 12.5 / ± 6.25	5.0	10.0	20.0
t ₂	± 6.25 / ± 3.125	20.0	25.0	50.0
t ₃ ⁴	± 12.5 / ± 6.25	5.0	10.0	10.0

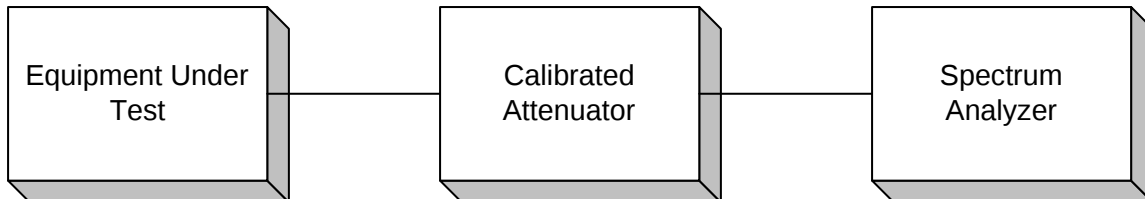
ANNEX B - TEST DIAGRAMS

EQUIPMENT: CRU-2

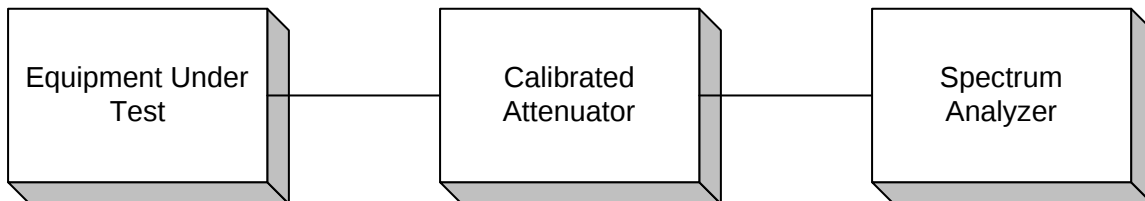
Para. No. 2.985 - R.F. Power Output



Para. No. 2.989 - Occupied Bandwidth

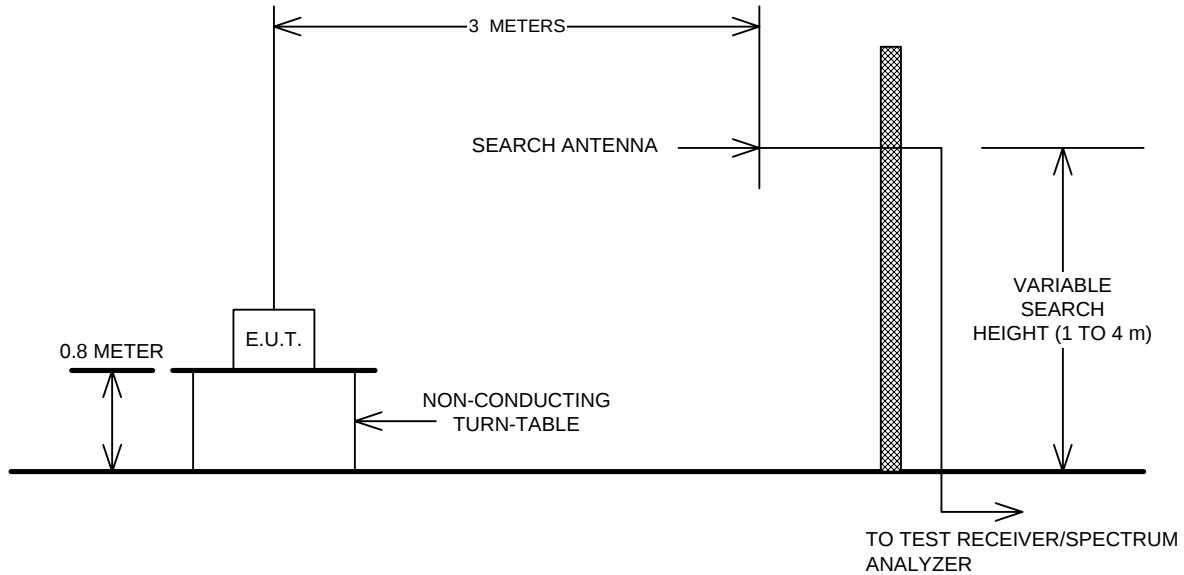


Para. No. 2.991 - Spurious Emissions at Antenna Terminals

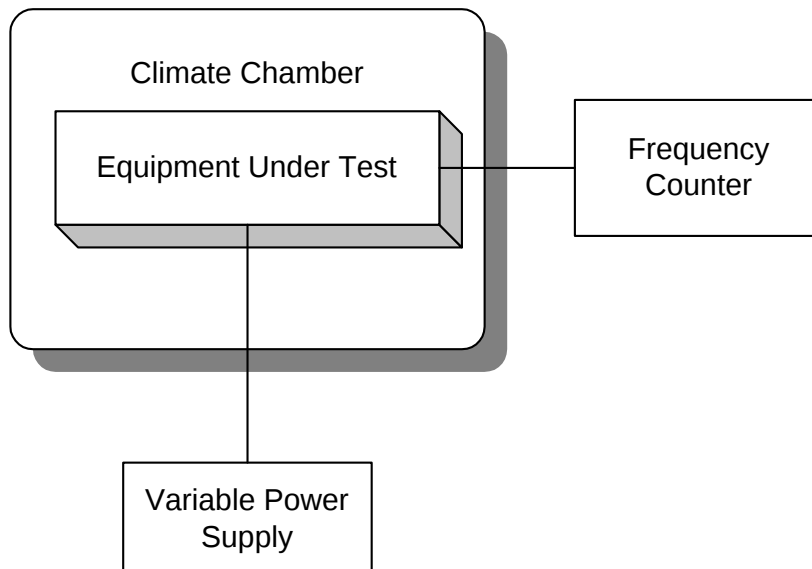


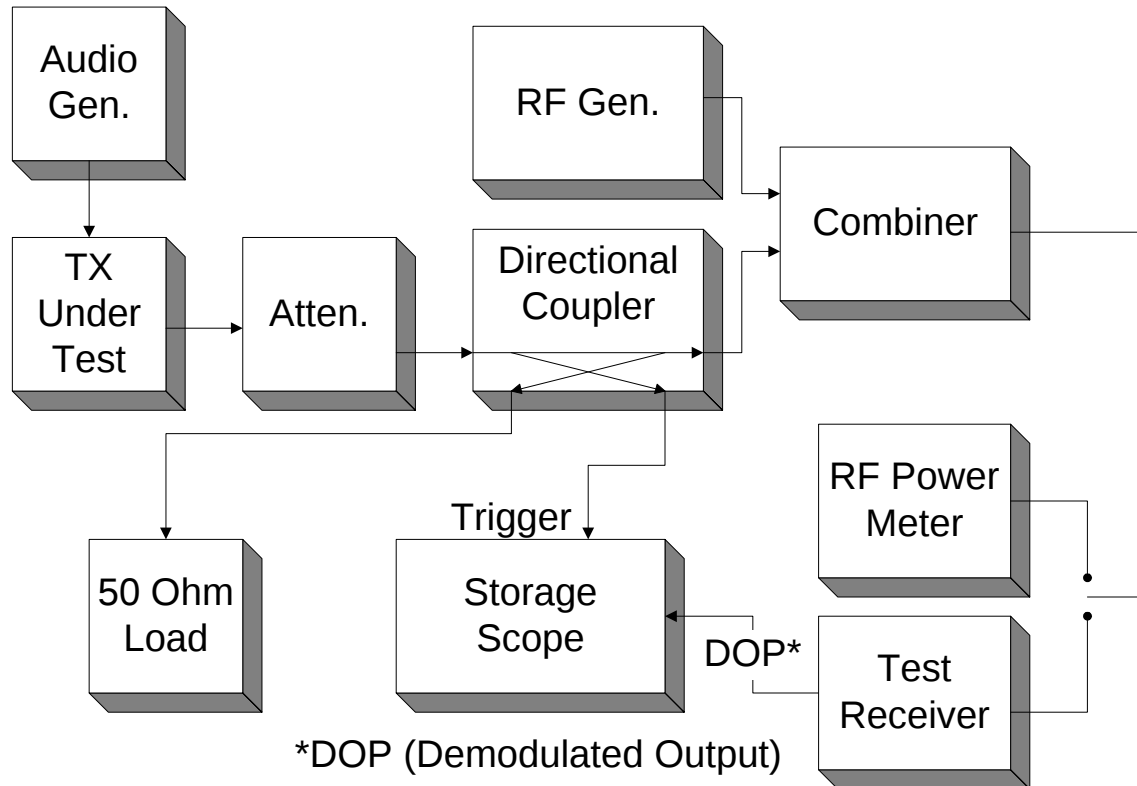
EQUIPMENT: CRU-2

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 Behavior (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 Behavior (page no. 74).