



**Nemko Test Report:** 10240230RUS1

**Applicant:** Electronic Systems Technology, Inc  
415 N. Quay Street Building B-1  
Kennewick, WA 99336

**Equipment Under Test:  
(E.U.T.)** 210M

**FCC ID:** ENPESTEEM210M

**IC ID:** 2163A-ESTEEM210M

**In Accordance With:** **FCC Part 90, Subpart I and  
Industry Canada RSS-119, Issue 11**  
Private Land Mobile Transmitter

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

**TESTED BY:**   
\_\_\_\_\_  
David Light, Senior Wireless Engineer **DATE:** 05-Apr-13

**APPROVED BY:**   
\_\_\_\_\_  
Michael Cantwell, Reviewer **DATE:** 19-Apr-13

**Total Number of Pages:** 45

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## Section 1.0 Summary of Test Results

Manufacturer: Electronic Systems Technology

Model No.: 210M

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 and Industry Canada RSS-119, Issue 11



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

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**Summary of Test Data**

NAME OF TEST	PARA. NO.	RESULT
RF Power Output	90.205	Complies
Audio Frequency Response	TIA EIA-603.3.2.6	N/A <sup>1</sup>
Audio Low-Pass Filter Response	TIA EIA-603.3.2.6	N/A <sup>1</sup>
Modulation Limiting	TIA EIA-603.3.2.6	Complies
Occupied Bandwidth	90.210	Complies
Spurious Emissions at Antenna Terminals	90.210	Complies
Field Strength of Spurious Emissions	90.210	Complies
Frequency Stability	90.213	Complies
Transient Frequency Behavior	90.214	Complies
Receiver Spurious Emissions	RSS-GEN	Complies

## Footnotes:

1. The radio is data only. There are no voice or audio circuits.

**Section 2.0**

**General Equipment Specification**

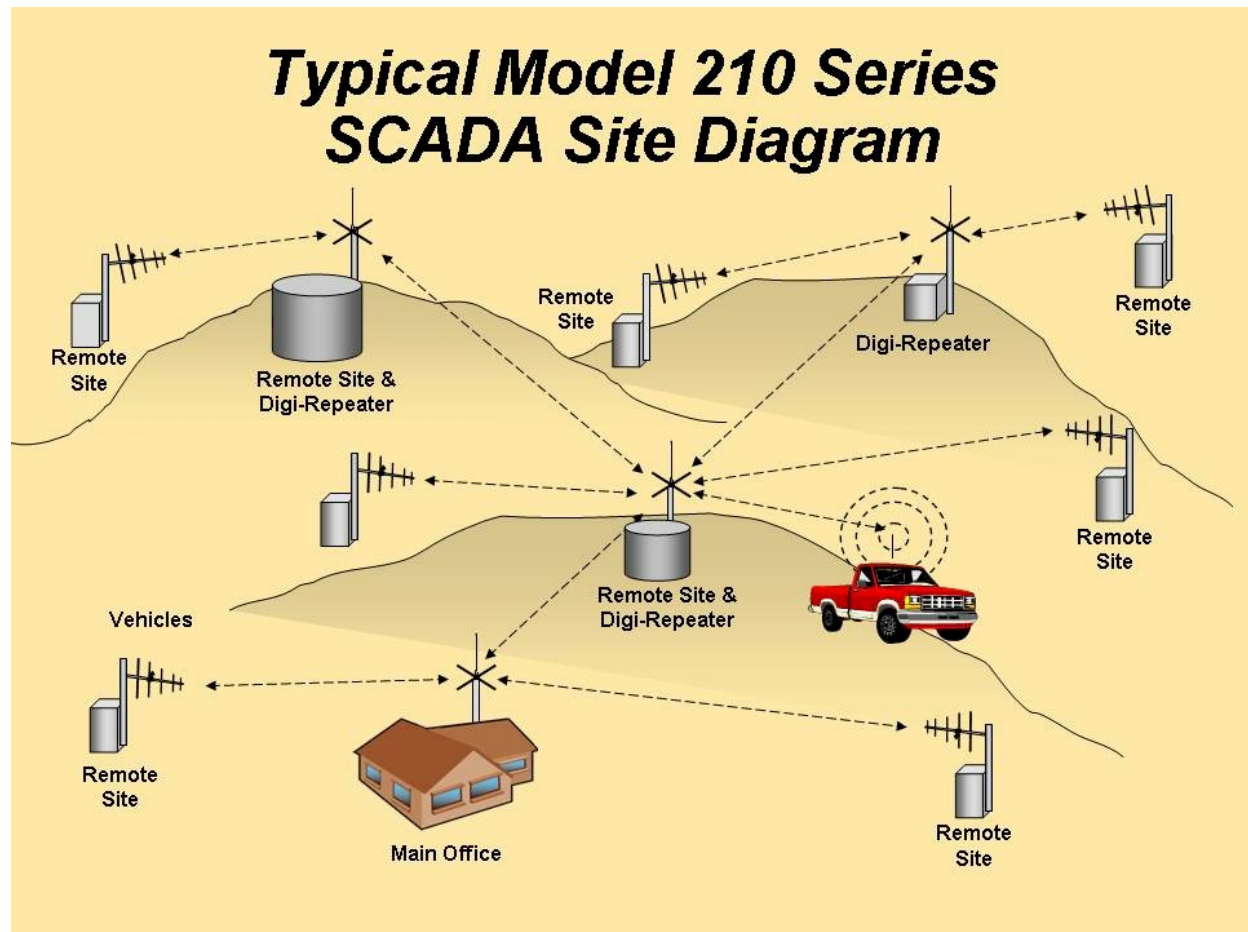
**Transmitter**

<b>Supply Voltage Input:</b>	12Vdc										
<b>Frequency Range:</b>	150 to 174 MHz										
<b>Tunable Bands:</b>	150 to 174 MHz										
<b>Necessary Bandwidth:</b>	11.25 kHz (12.5 kHz channel spacing), 6 kHz (6.25 kHz channel spacing)										
<b>Type(s) of Modulation:</b>	<table border="0"> <tr> <td><b>F3E (Voice)</b></td> <td><b>F1D</b></td> <td><b>F2D</b></td> <td><b>D7W</b></td> <td><b>Other</b></td> </tr> <tr> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input checked="" type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> </table>	<b>F3E (Voice)</b>	<b>F1D</b>	<b>F2D</b>	<b>D7W</b>	<b>Other</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<b>F3E (Voice)</b>	<b>F1D</b>	<b>F2D</b>	<b>D7W</b>	<b>Other</b>							
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>							
<b>Internal/External Data Source:</b>	Internal data modulation circuits										
<b>Emission Designator:</b>	6K00D7W, 11K3D7W										
<b>Output Impedance:</b>	50 ohms										
<b>RF Power Output (rated):</b>	4 watts pk.										
<b>Channel Spacing(s):</b>	6.25kHz and 12.5kHz										
<b>Operator Selection of Operating Frequency:</b>	Software Controlled										
<b>Power Output Adjustment Capability:</b>	Software Controlled										

### System Description

The ESTeem Model 210m with *one Ethernet port (10/100/1G) and one independent Serial RS-232C data port* is the perfect radio solution designed for the rigors of the Industrial, Public Safety, and Federal markets when the low VHF band is needed for terrain coverage.

### System Diagram



**Section 3.0 RF Power Output**

NAME OF TEST: RF Power Output	PARA. NO.: 2.985
TESTED BY: David Light	DATE: 02 April 2013

**Measurement Results:** Complies.

**Measurement Data:**

Frequency (MHz)	Measured Power (dBm)	Rated Power (dBm)	Measured/Rated (dB)
150.0	36.0	36.0	0.0
160.0	36.1	36.0	+0.1
174.0	35.6	36.0	-0.4

Spectrum analyzer settings:

RBW: 1 MHz

VBW: 3 MHz

Detector: Max Peak

**Measurement Conditions:**

Temperature: 24 °C

Humidity: 52 %

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

## Section 4.0 Modulation Characteristics

NAME OF TEST: Modulation Characteristics	PARA. NO.: 2.987
TESTED BY: David Light	DATE: 02 April 2013

**Measurement Results:** Complies.

**Measurement Data:** See following pages

**Measurement Conditions:** Temperature: 24 °C  
Humidity: 52 %

**Measurement Uncertainty:** +/-0.05 kHz

**Description of modulation:** Modulation is Quadrature Amplitude Modulation

**Description of baseband filtering:** In-phase and Quadrature-phase channels are digitally filtered. Since the baseband signal is digital only, modulation levels are limited.



**Section 4.1                      Modulation Limiting**

NAME OF TEST: Modulation Limiting	PARA. NO.: 2.987(b)
TESTED BY: David Light	DATE: 02 April 2013

The baseband modulation signal digitally modulates the rf carrier. The modulation input is buffered and cannot exceed the nominal modulation level.

**Section 5.0                      Occupied Bandwidth**

NAME OF TEST: Occupied Bandwidth	PARA. NO.: 2.989
TESTED BY: David Light	DATE: 02 April 2013

**Measurement Results:**    Complies.

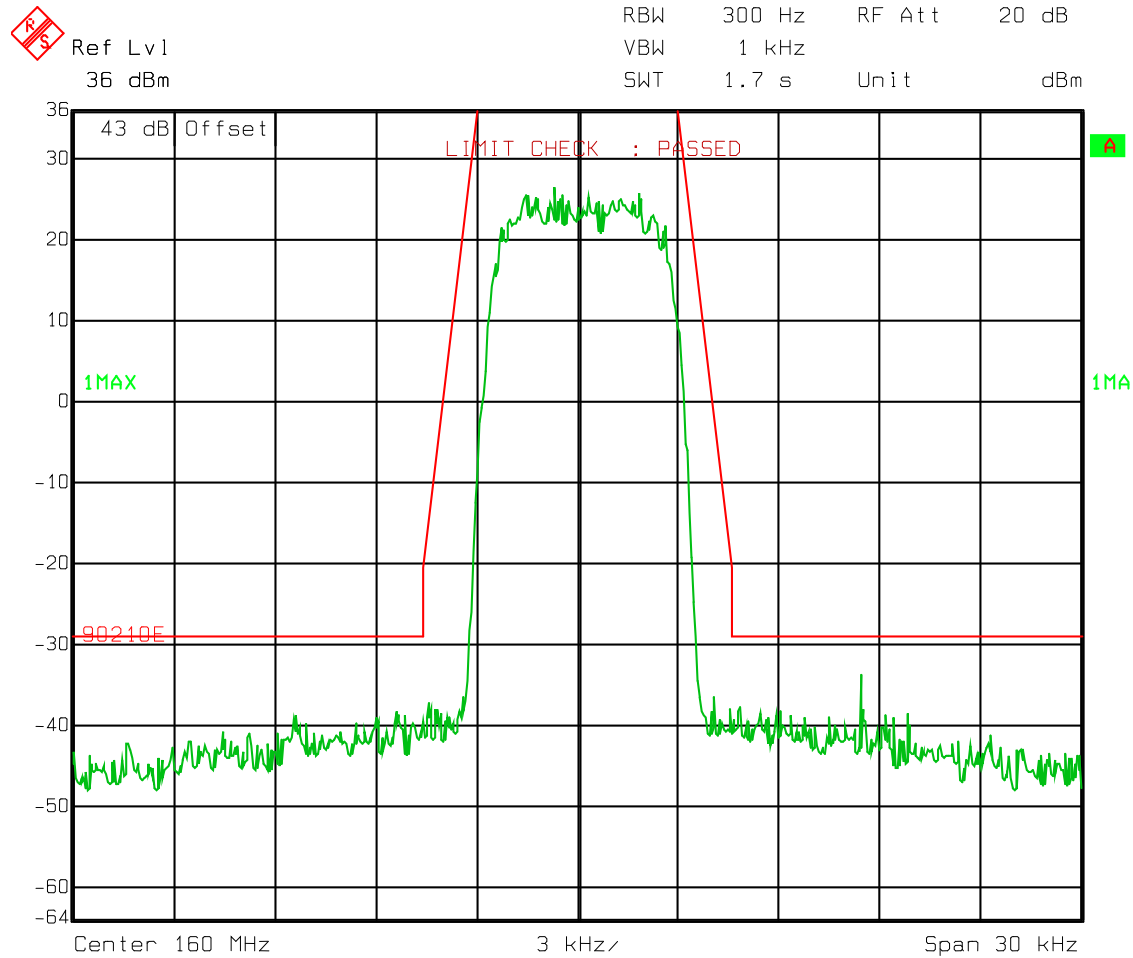
**Measurement Data:**                      See attached data

**Measurement Conditions:**              Temperature:    24 °C  
   Humidity:        52 %

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

EQUIPMENT: 210M

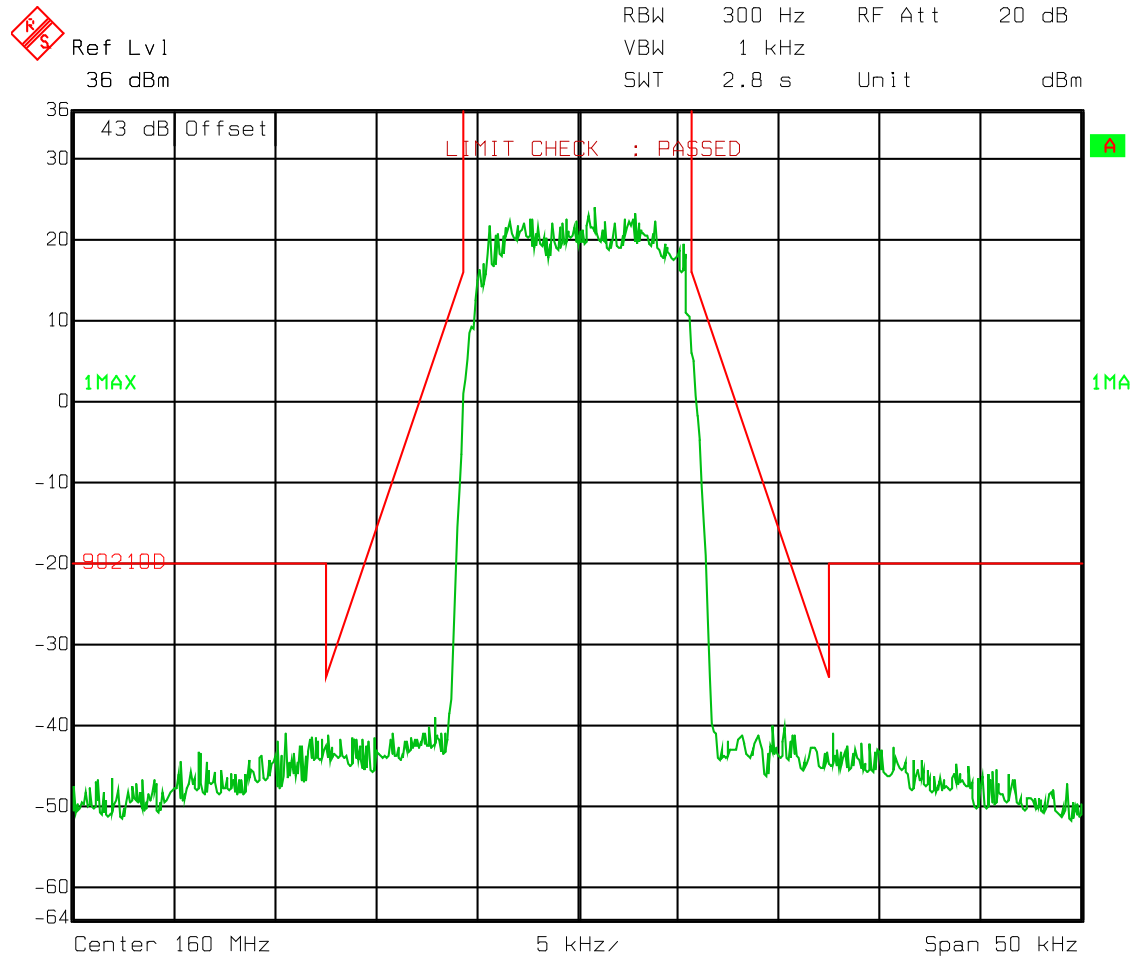
Mask E  
4800 bps



Date: 02.APR.2013 09:55:34

EQUIPMENT: 210M

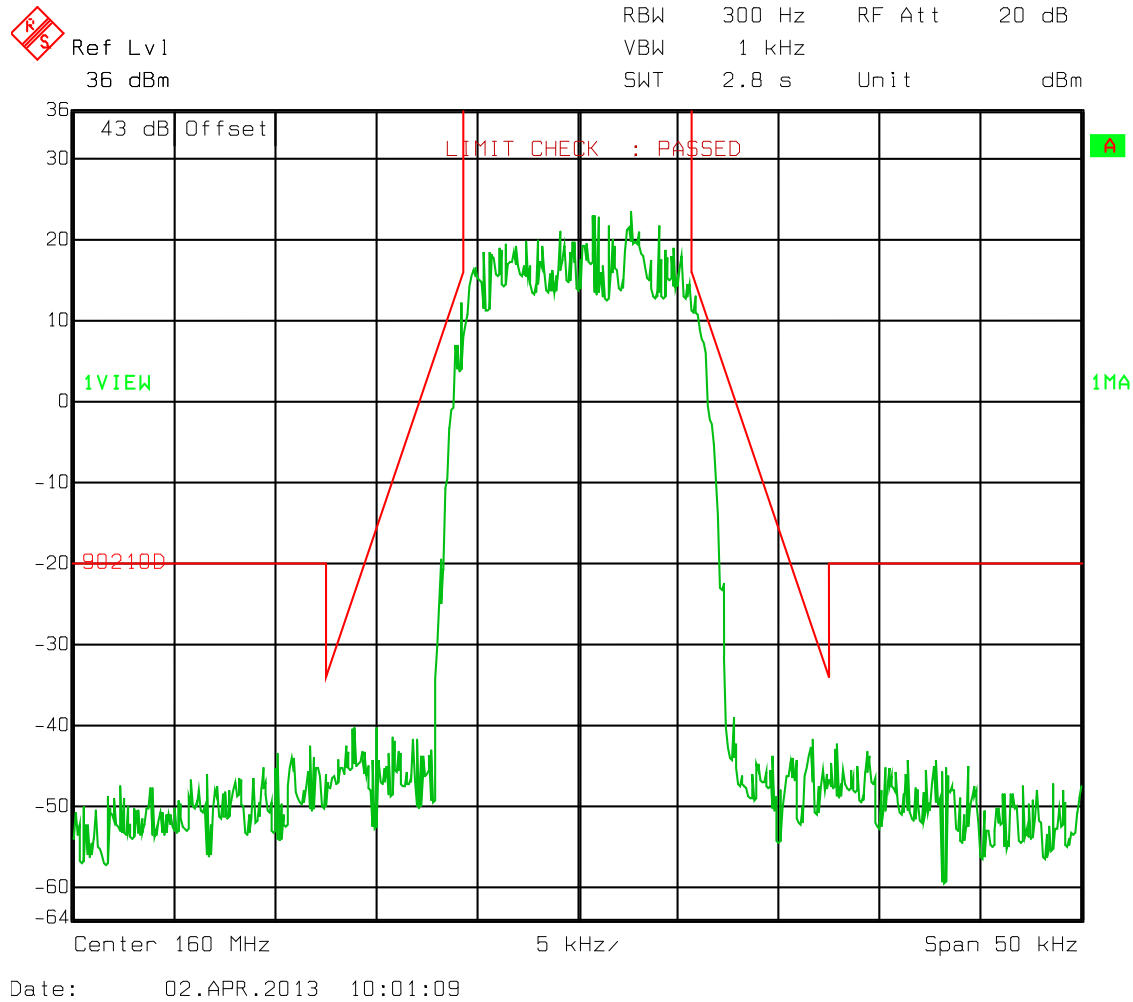
Mask D  
9600 bps



Date: 02.APR.2013 09:59:26

EQUIPMENT: 210M

Mask D  
10800 bps



**Section 6.0 Spurious Emissions at Antenna Terminals**

NAME OF TEST: Spurious Emissions @ Antenna Terminals	PARA. NO.: 2.991
TESTED BY: David Light	DATE: 05 April 2013

**Measurement Results:** Complies.

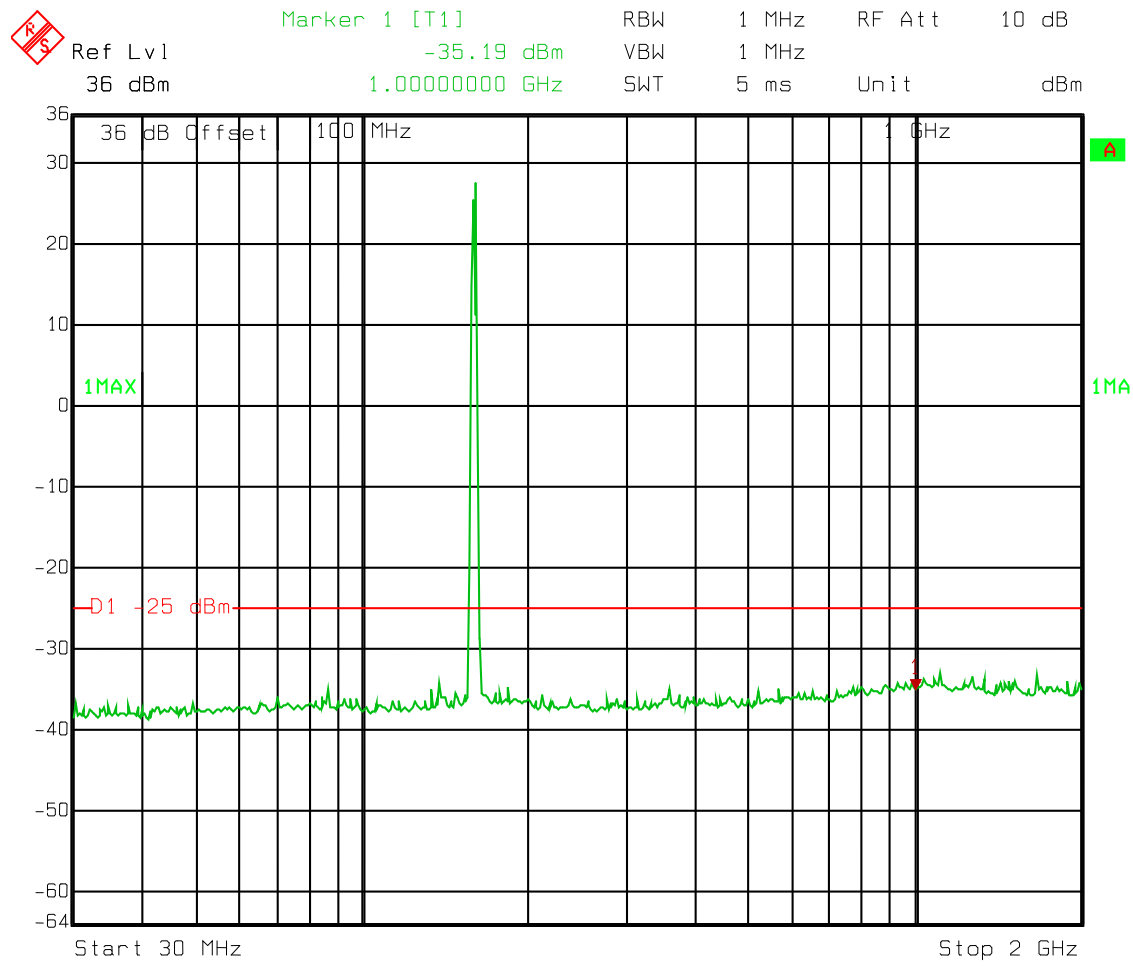
**Measurement Data:** See attached data

**Measurement Conditions:** Temperature: 22 °C  
Humidity: 40 %

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

EQUIPMENT: 210M

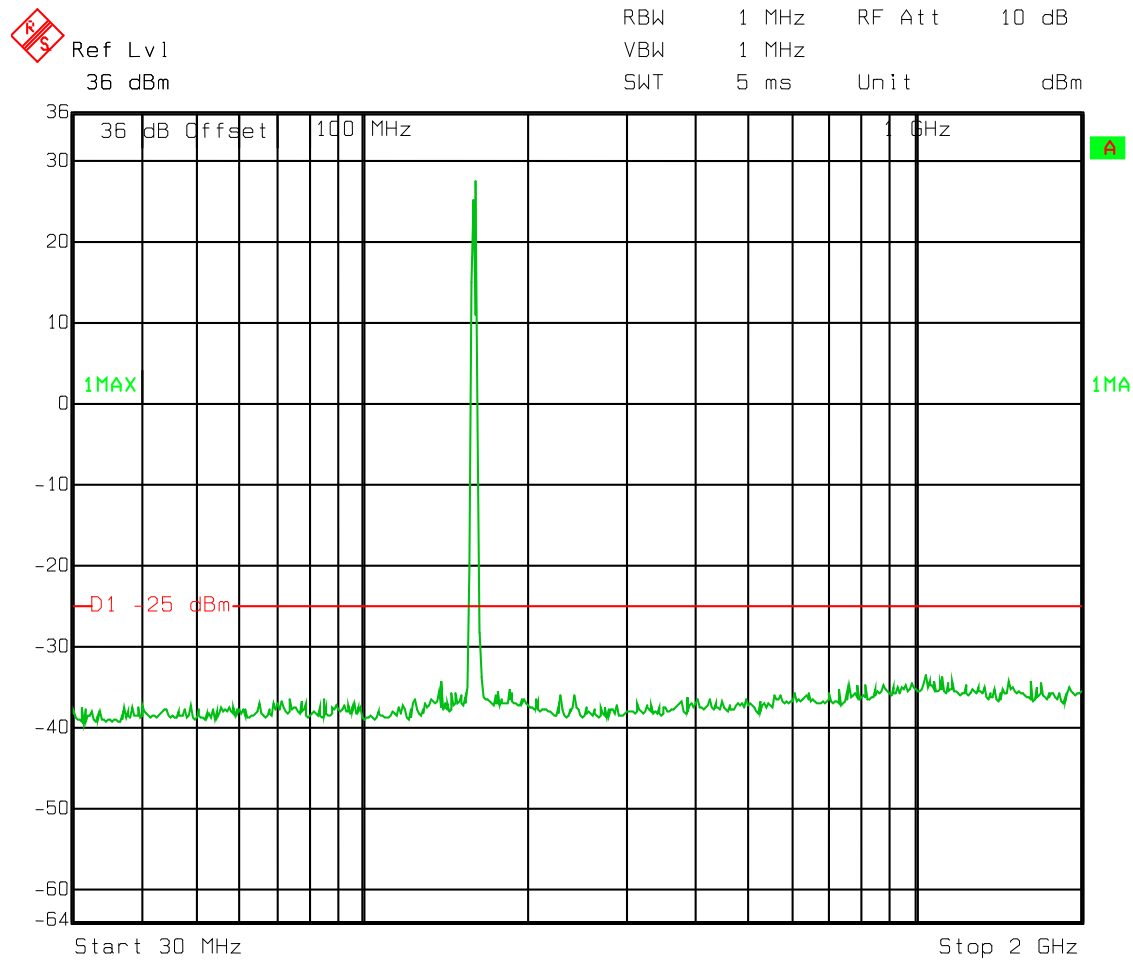
4800 bps



Date: 05.APR.2013 10:45:25

EQUIPMENT: 210M

9600 bps

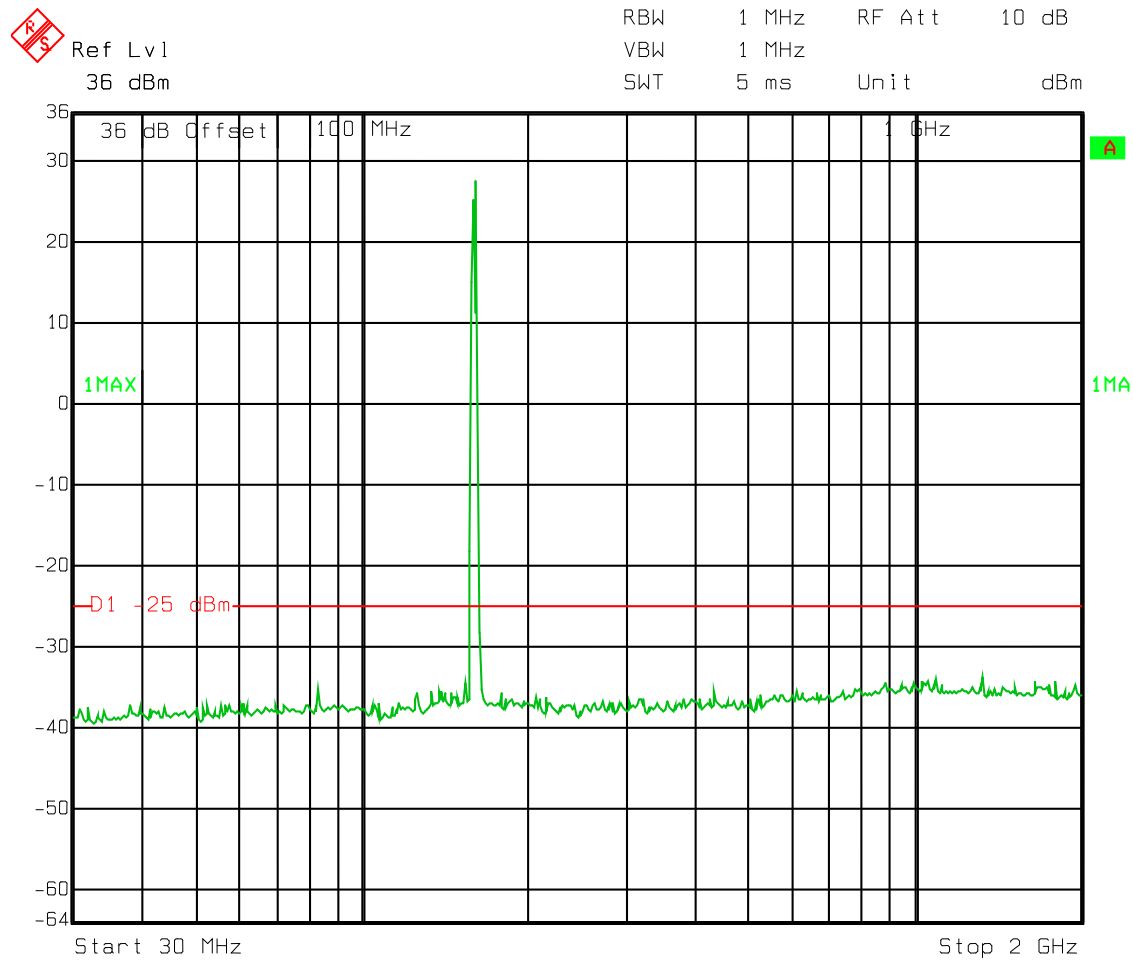


Date: 05.APR.2013 10:46:23



EQUIPMENT: 210M

10800 bps



Date: 05.APR.2013 10:47:10

**Section 7.0                      Field Strength of Spurious Emissions**

NAME OF TEST: Field Strength of Spurious Emissions	PARA. NO.: 2.993
TESTED BY: David Light	DATE: 02 April 2013

**Measurement Results:**    Complies.

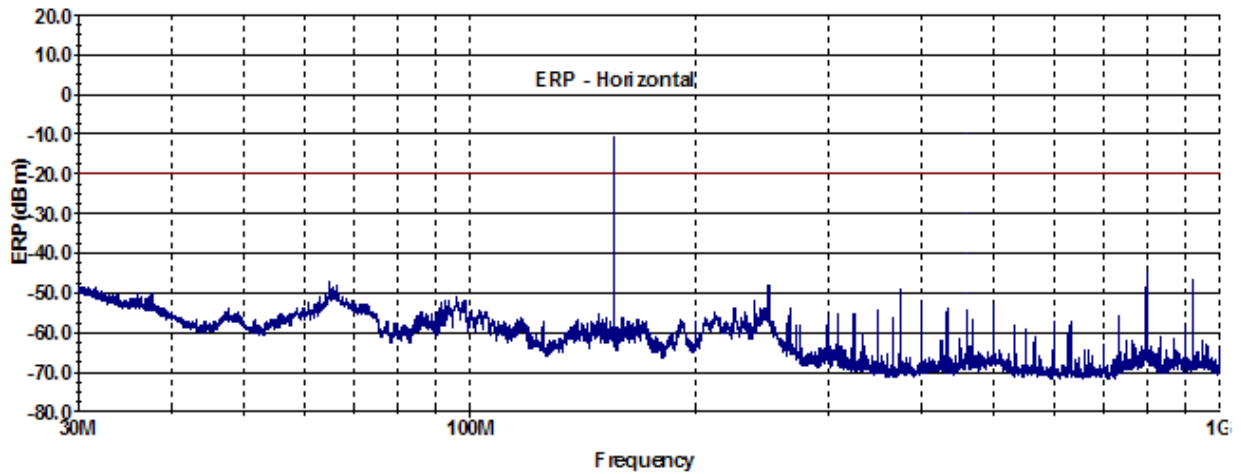
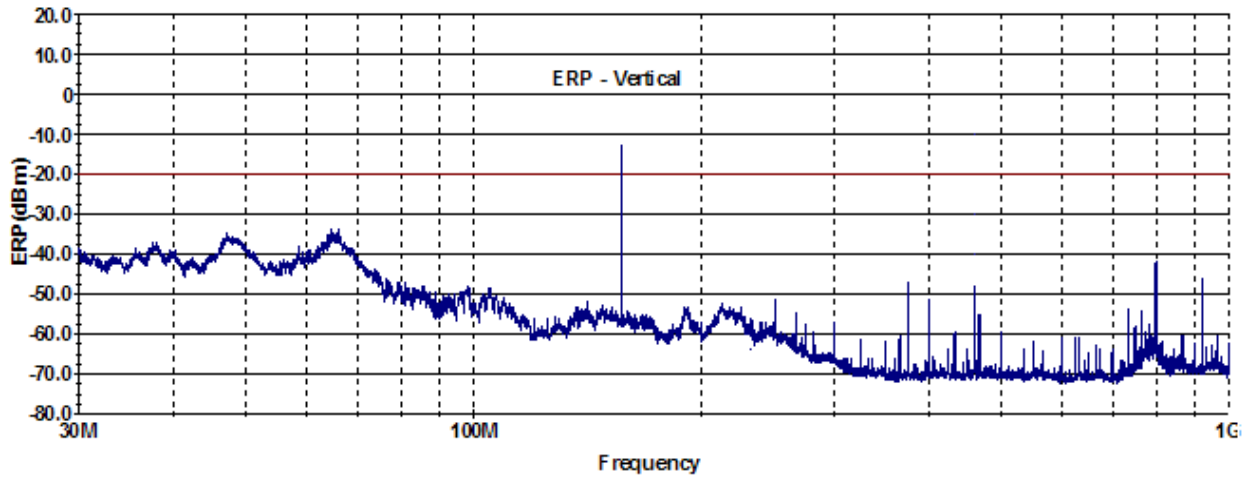
**Measurement Data:**                      See attached data

**Measurement Conditions:**            Temperature:    22 °C  
   Humidity:        54 %

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

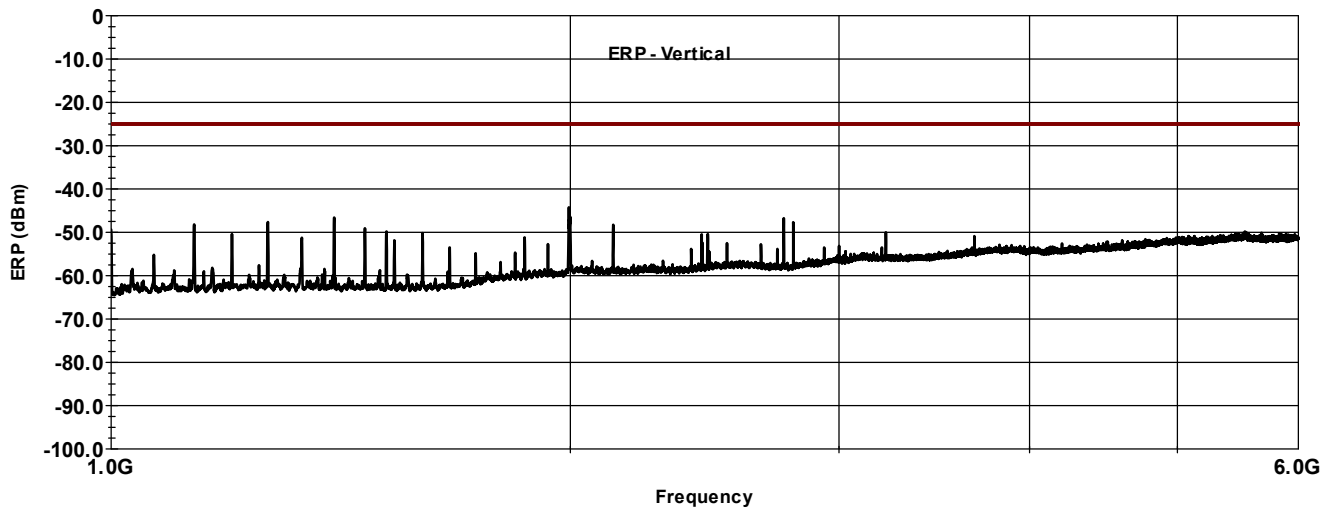
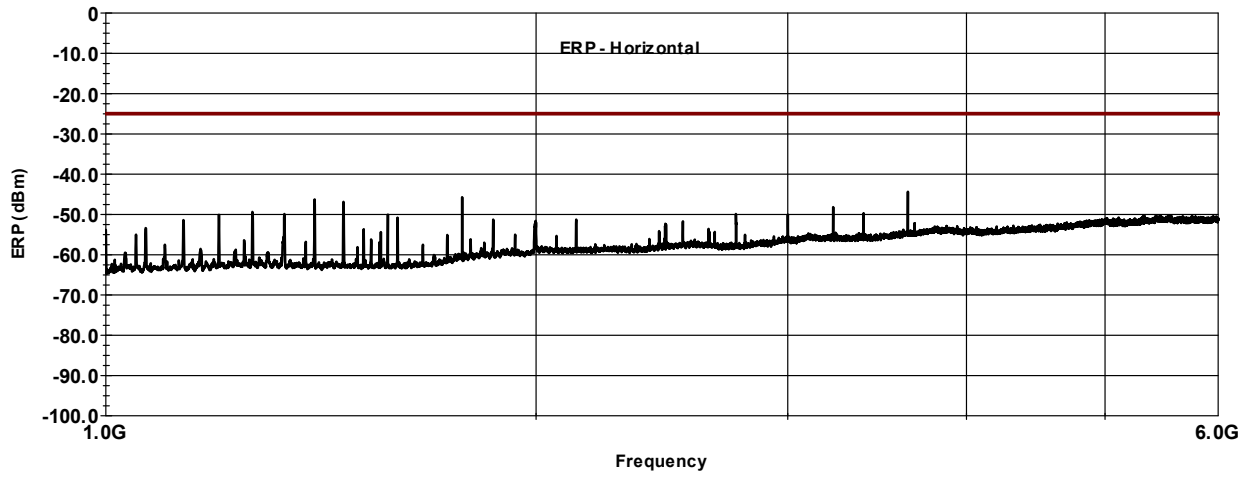
EQUIPMENT: 210M

Test Data



EQUIPMENT: 210M

Test Data



**Section 8.0                      Frequency Stability**

NAME OF TEST: Frequency Stability	PARA. NO.: 2.995
TESTED BY: David Light	DATE: 03 April 2013

**Measurement Results:**    Complies.

**Measurement Data:**                      See attached data

**Measurement Conditions:**            Temperature:    24 °C  
   Humidity:        52 %

**Measurement Uncertainty:**     $1 \times 10^{-7}$

EQUIPMENT: 210M

Test Data

		<b>Standard Test Frequency</b>		<b>160.000000</b>		<b>MHz</b>	
<b>Temp (°C)</b>	<b>Measured Frequency (MHz)</b>	<b>Test Voltage</b>	<b>Frequency Error (Hz)</b>	<b>Limit (+/-Hz)</b>	<b>Error (ppm)</b>	<b>Comment</b>	
20	160.000044	12 Vdc	44	160.0	0.3		
20	160.000044	13.8 Vdc	44	160.0	0.3		
20	160.000044	10.2 Vdc	44	160.0	0.3		
50	160.000069	12 Vdc	69	160.0	0.4		
40	160.000030	12 Vdc	30	160.0	0.2		
30	160.000022	12 Vdc	22	160.0	0.1		
10	160.000087	12 Vdc	87	160.0	0.5		
0	160.000095	12 Vdc	95	160.0	0.6		
-10	160.000144	12 Vdc	144	160.0	0.9		
-20	160.000150	12 Vdc	150	160.0	0.9		
-30	160.000162	12 Vdc	162	160.0	1.0		
Notes:							

## Section 9.0                      Transient Frequency Behavior

NAME OF TEST: Transient Frequency Behaviour	PARA. NO.: 90.214
TESTED BY: David Light	DATE: 02 April 2013

**Measurement Results:**                      Complies.

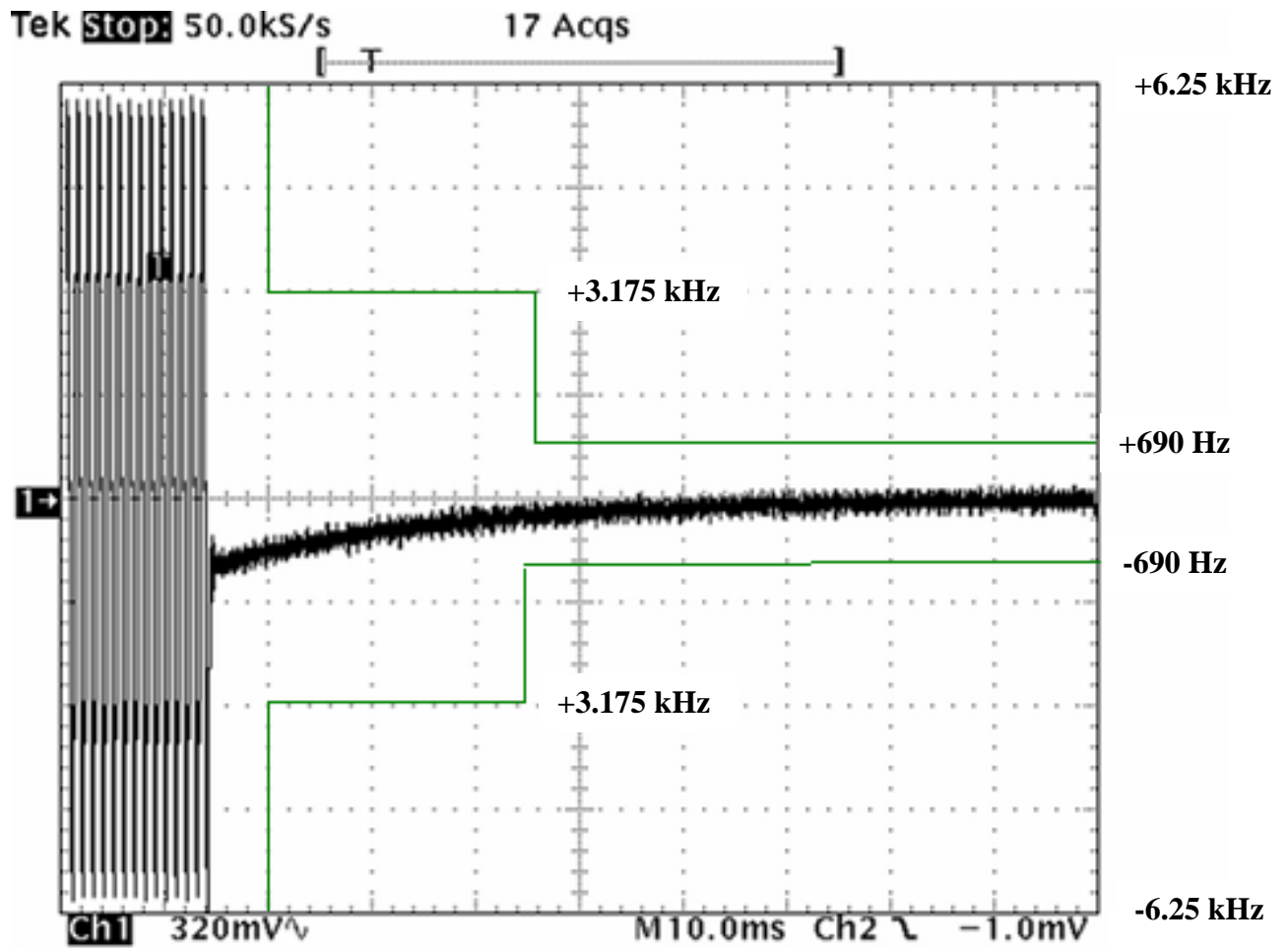
**Measurement Data:**                        See attached data

**Measurement Conditions:**              Temperature:    22 °C  
   Humidity:       54 %

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

EQUIPMENT: 210M

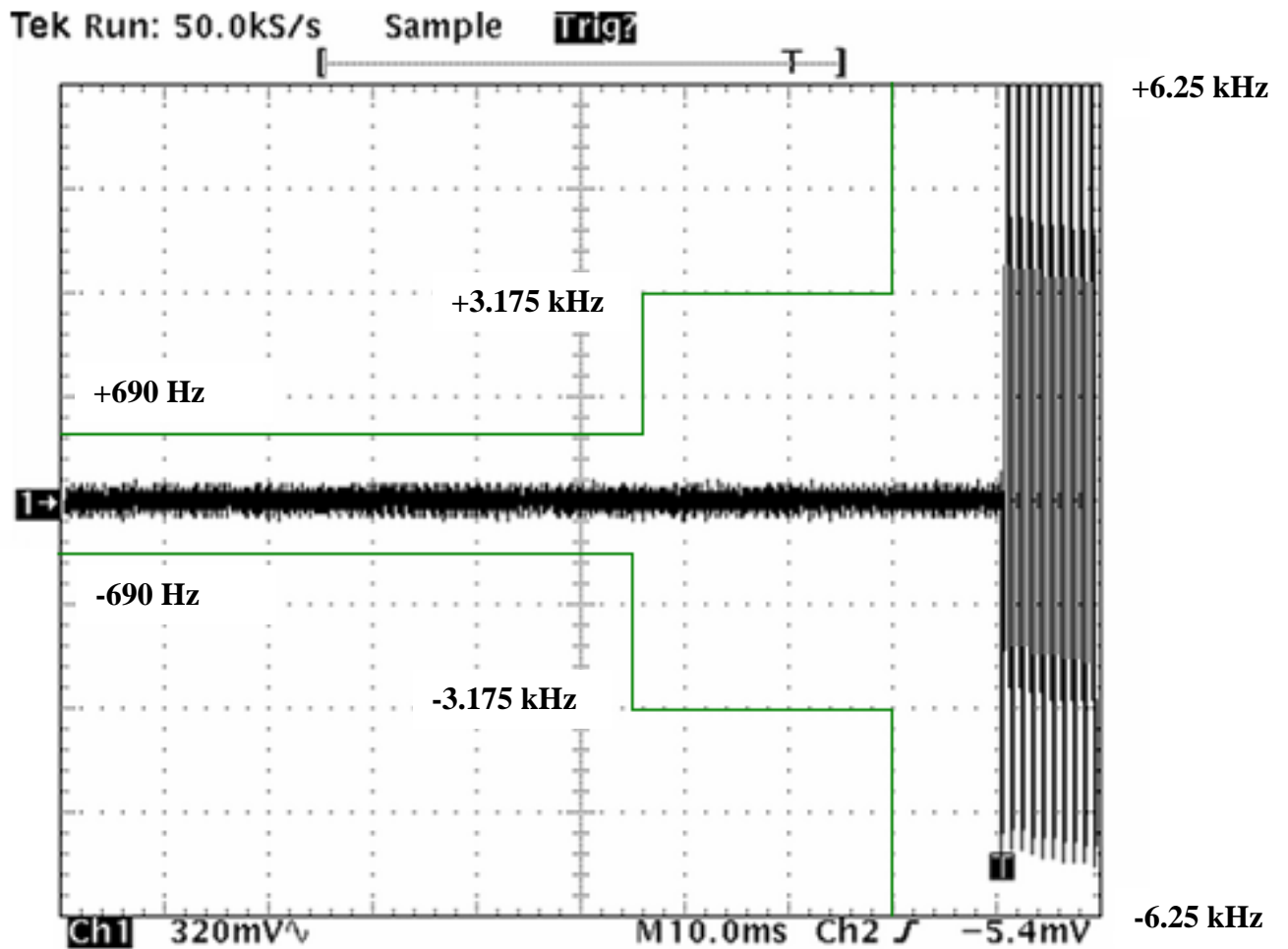
ON TRANSIENT – 6.25 kHz





EQUIPMENT: 210M

OFF TRANSIENT – 6.25 kHz channel

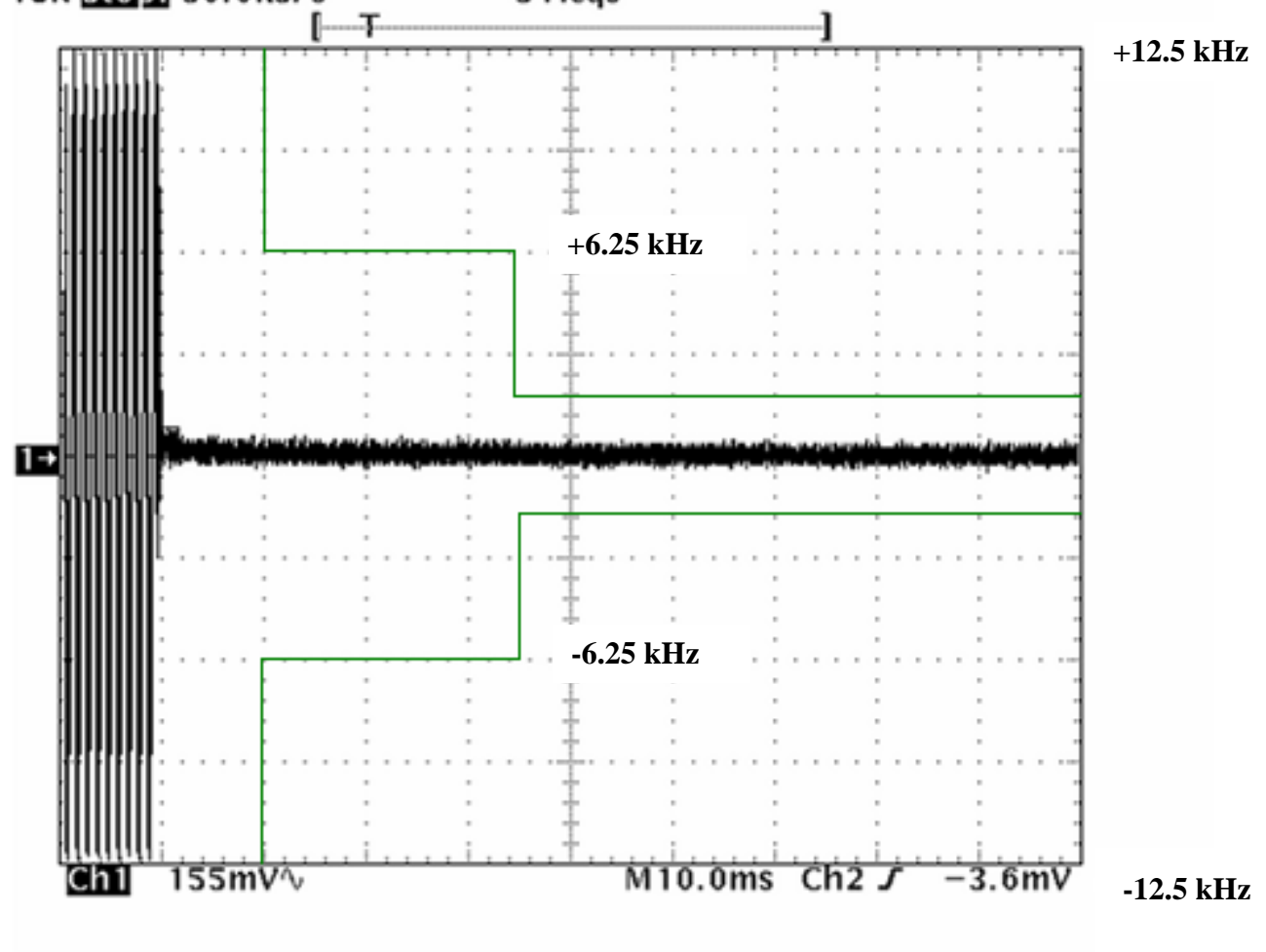


EQUIPMENT: 210M

ON TRANSIENT – 12.5 kHz channel

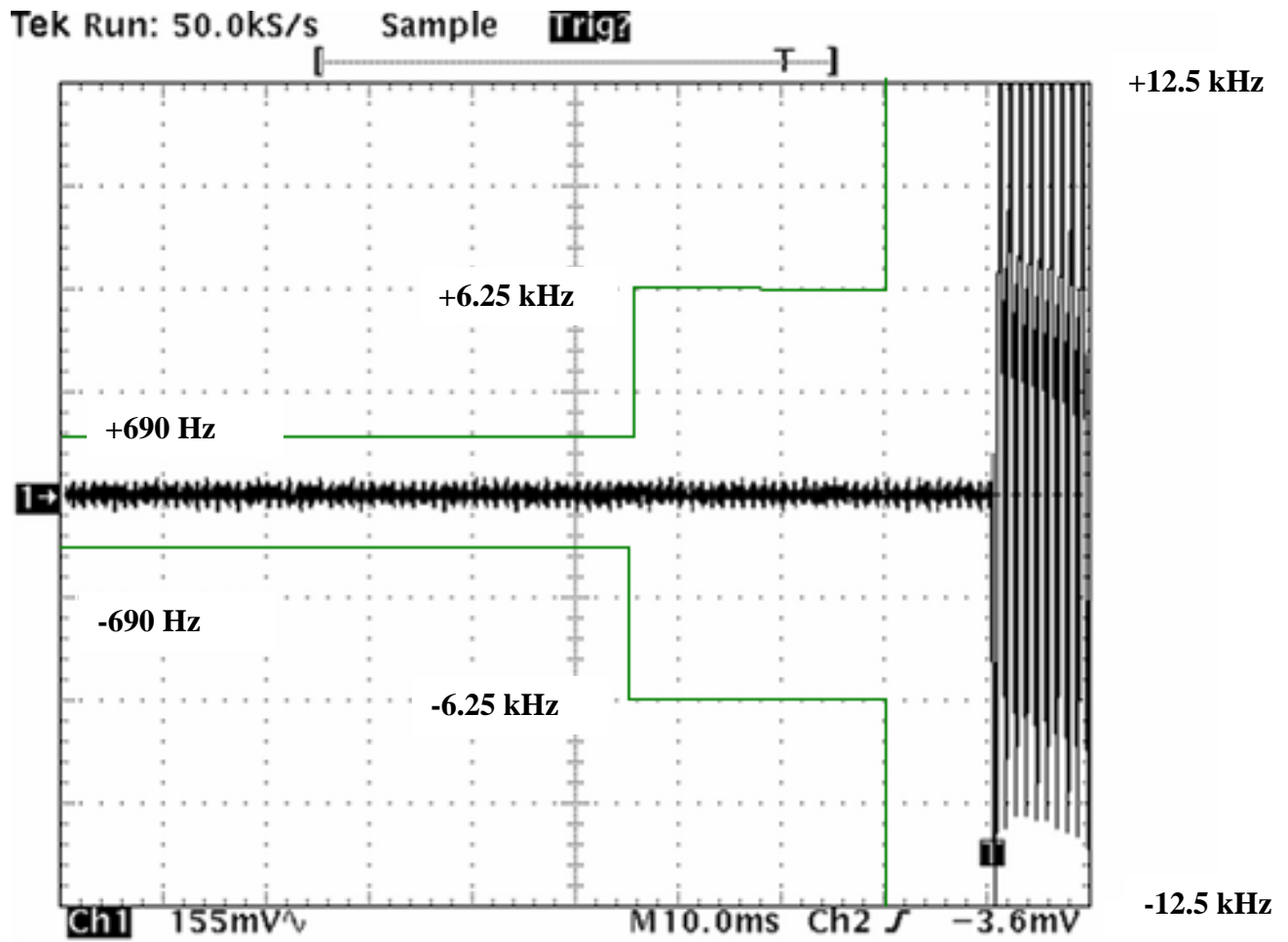
Tek **Stop:** 50.0kS/s

3 Acqs



EQUIPMENT: 210M

OFF TRANSIENT – 12.5 kHz



**Section 10.0 Receiver Spurious Emissions**

NAME OF TEST: Receiver Spurious Emissions	PARA. NO.: RSS-GEN
TESTED BY: Brian Boyea	DATE: 07 March 2013

**Measurement Results:** Complies.

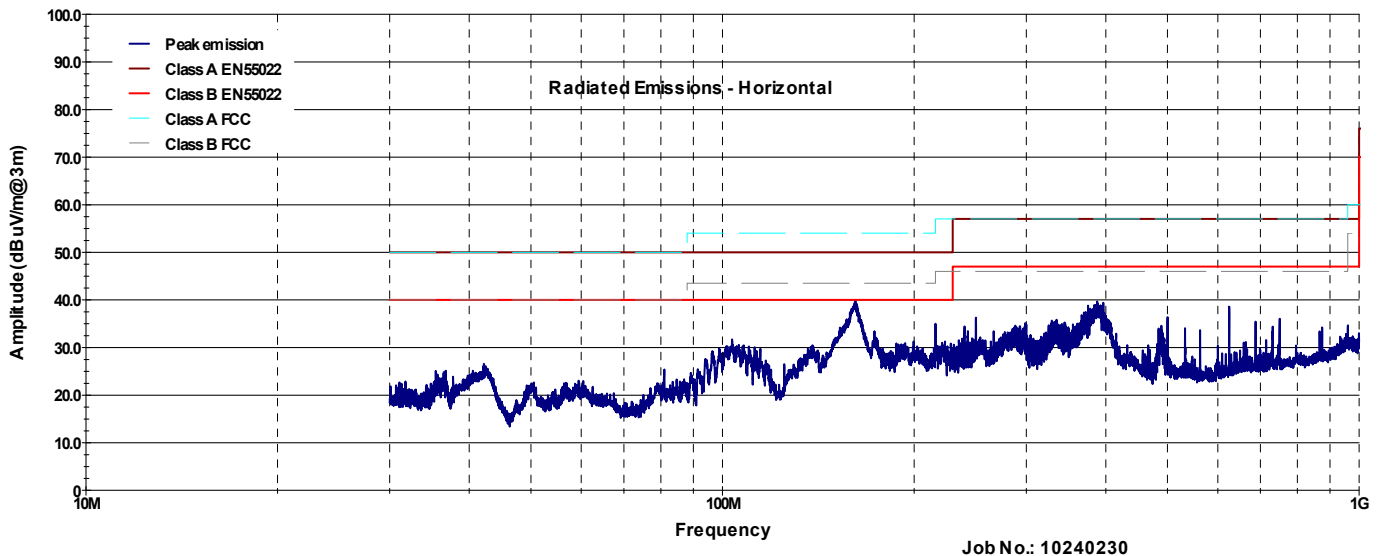
**Measurement Data:** See attached data

## **Test Results – Radiated Emissions (below 1 GHz)**

EQUIPMENT: 210M

Table No. 1	Radiated Emissions	Verdict
		P

Frequency Range ..... : 30 MHz to 1 GHz                      Test Location ..... : 3m Chamber  
 Test Method..... : 47 CFR 15.109 & ICES-003 clauses 5.4/5.5  
 Test Distance ..... : 3m  
 EUT Configuration ..... : EUT with load  
 Test Date ..... : 7-Mar-13  
 Temperature ..... : 21.2°C                      Relative Humidity .... : 22.8 %  
 Test Equipment Asset Tag List : 1,1025,1480,1783,1767



(1)	(2)	(3)	(6)	(7)	(8)	(9)	(10)	(11)
Antenna Polarity (H/V)	Detector	Frequency (MHz)	Receiver Reading (dBµV/m)	Site Correction Factor (dB/m)	Emission Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Pass/Fail
H	QPK	162.0870	51.2	-15.0	36.1	40.0	3.9	Pass
H	QPK	216.0210	48.0	-15.6	32.4	40.0	7.6	Pass
H	QPK	750.0800	40.9	-2.1	38.8	47.0	8.2	Pass
H	QPK	250.0250	51.0	-12.8	38.2	47.0	8.8	Pass
H	QPK	625.0790	41.0	-4.3	36.7	47.0	10.3	Pass
H	QPK	687.5200	37.4	-3.0	34.4	47.0	12.6	Pass
H	QPK	103.7520	42.4	-15.4	27.1	40.0	12.9	Pass
H	QPK	387.7280	42.8	-9.0	33.8	47.0	13.2	Pass
H	QPK	500.0590	38.4	-6.7	31.6	47.0	15.4	Pass
H	QPK	42.2967	38.3	-14.7	23.6	40.0	16.4	Pass

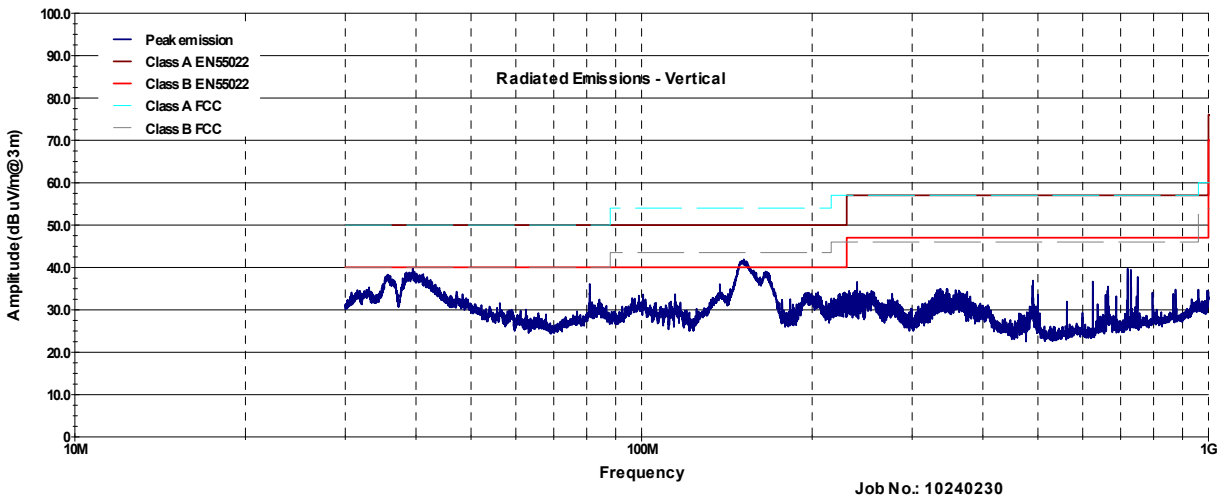
Tested by (+ signature) .....

Brian Boyea

EQUIPMENT: 210M

Table No. 2	<b>Radiated Emissions</b>	Verdict
		P

Frequency Range ..... : 30 MHz to 1 GHz                      Test Location ..... : 3m Chamber  
 Test Method..... : 47 CFR 15.109 & ICES-003 clauses 5.4/5.5  
 Test Distance ..... : 3m  
 EUT Configuration ..... : EUT with load  
 Test Date ..... : 7-Mar-13  
 Temperature ..... : 21.2°C                      Relative Humidity .... : 22.8 %  
 Test Equipment Asset Tag List : 1,1025,1480,1783,1767



(1)	(2)	(3)	(6)	(7)	(8)	(9)	(10)	(11)
Antenna Polarity (H/V)	Detector	Frequency (MHz)	Receiver Reading (dBµV/m)	Site Correction Factor (dB/m)	Emission Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Pass/Fail
V	QPK	39.7527	48.9	-13.5	35.3	40.0	4.7	Pass
V	QPK	81.0063	50.2	-18.5	31.6	40.0	8.4	Pass
V	QPK	151.0080	52.1	-14.3	37.7	40.0	2.3	Pass
V	QPK	490.1910	33.4	-6.9	26.5	47.0	20.5	Pass
V	QPK	625.0190	39.7	-4.3	35.4	47.0	11.6	Pass
V	QPK	664.7860	29.4	-3.3	26.0	47.0	21.0	Pass
V	QPK	720.1320	24.6	-2.8	21.8	47.0	25.2	Pass
V	QPK	729.5100	29.5	-2.4	27.1	47.0	19.9	Pass
V	QPK	750.0800	40.3	-2.1	38.3	47.0	8.7	Pass
V								

**Supplemental Information:**

Tested by (+ signature) .....

Brian Boyea

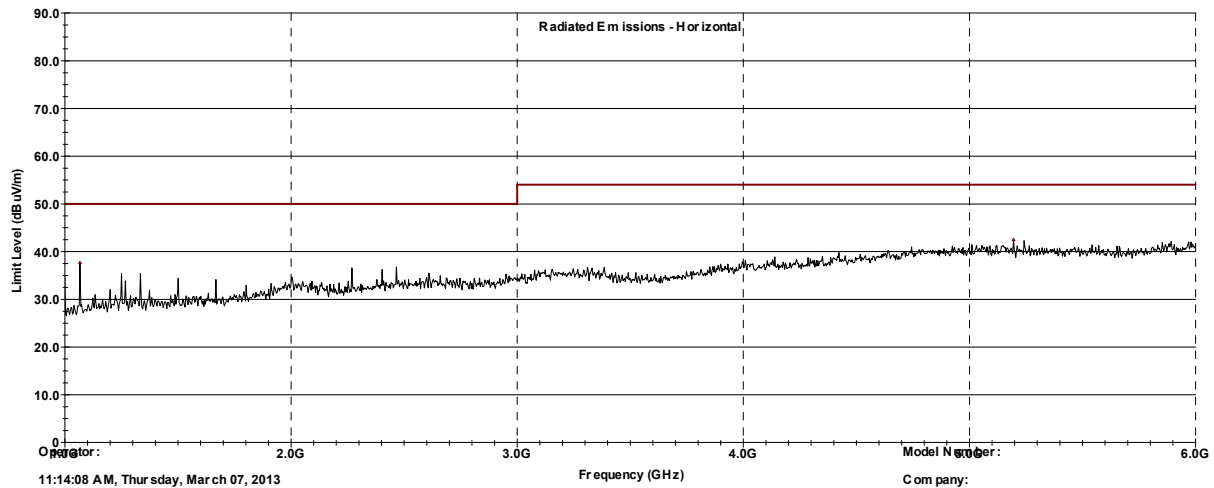
## **Test Results – Radiated Emissions (above 1 GHz)**



EQUIPMENT: 210M

Table No. 3	<b>Radiated Emissions</b>	Verdict
		P

Frequency Range ..... : 1 GHz to 6 GHz                      Test Location ..... : 3m Chamber  
 Test Method..... : 47 CFR 15.109 & ICES-003 clauses 5.4/5.5  
 Test Distance ..... : 3m  
 EUT Configuration ..... : EUT with load  
 Test Date ..... : 7-Mar-13  
 Temperature ..... : 21.2°C                      Relative Humidity .... : 22.8 %  
 Test Equipment Asset Tag List : 1,1785,1304,1783,1767



(1)	(2)	(3)	(8)	(9)	(10)	(11)
Antenna Polarity (H/V)	Detector	Frequency (GHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Pass/Fail
H	PK	1.0669	37.7	54.0	12.3	Pass
H	PK	5.1951	42.5	54.0	11.5	Pass

**Supplemental Information:**

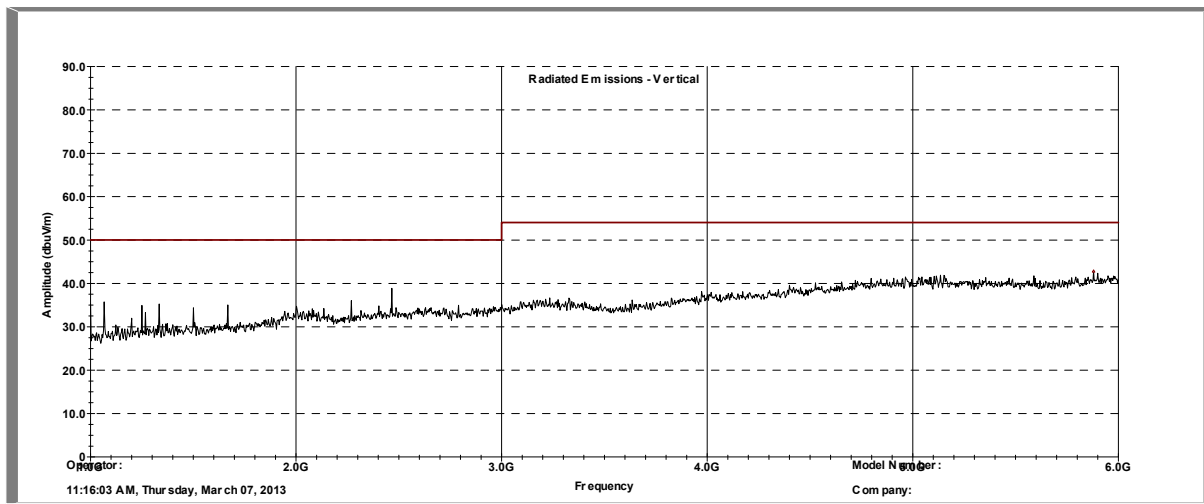
Tested by (+ signature) .....

Brian Boyea

EQUIPMENT: 210M

Table No. 4	<b>Radiated Emissions</b>	Verdict
		P

Frequency Range ..... : 1 GHz to 6 GHz                      Test Location ..... : 3m Chamber  
 Test Method..... : 47 CFR 15.109 & ICES-003 clauses 5.4/5.5  
 Test Distance ..... : 3m  
 EUT Configuration ..... : EUT with load  
 Test Date ..... : 7-Mar-13  
 Temperature ..... : 21.2°C                      Relative Humidity .... : 23.0 %  
 Test Equipment Asset Tag List : 1,1785,1304,1783,1767



(1)	(2)	(3)	(8)	(9)	(10)	(11)
Antenna Polarity (H/V)	Detector	Frequency (GHz)	Emission Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Pass/Fail
V	PK	2.4663	38.9	54.0	11.1	Pass
V	PK	5.8795	42.8	54.0	11.2	Pass

**Supplemental Information:**

Tested by (+ signature) .....

Brian Boyea

**Section 11.0 Test Equipment List**

Asset Tag	Description	Manufacturer	Model	Serial #	Last Cal	Next Cal
993	Antenna, Horn	A.H. Systems	SAS-200/571	162	22-Sep-2011	22-Sep-2013
1016	Preamplifier	Hewlett Packard	8449A	2749A00159	23-Jul-2012	23-Jul-2013
1036	Spectrum Analyzer	Rohde & Schwartz	FSEK30	830844/006	23-Dec-2011	23-Dec-2013
1054	Directional Coupler, Dual	Narda	3020A	34366	N/R	
1055	Directional Coupler, Dual	Narda	3022	73393	N/R	
1064	Attenuator	Narda	776B-20		N/R	
1082	Cable, 2m	Astrolab	32027-2- 29094-72TC		N/R	
1480	Antenna, Bilog	Schaffner- Chase	CBL6111C	2572	25-Feb-2013	25-Feb-2014
1783	Cable Assy, 3m Chamber	Nemko	Chamber		26-Sep-2012	26-Sep-2013
791	Pre Amplifier	Nemko, USA	CRA69 321003 9605	119	19-Oct-2012	19-Oct-2013

## **ANNEX A - TEST METHODOLOGIES**

<b>NAME OF TEST: RF Power Output</b>	<b>PARA. NO.: 2.985</b>
--------------------------------------	-------------------------

**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.

EQUIPMENT: 210M

<b>NAME OF TEST: Audio Frequency Response</b>	<b>PARA. NO.: 2.987(a)</b>
---	----------------------------

**Test Method:** TIA/EIA-603

**Minimum Standard:** TIA/EIA-603, Para. 3.2.6 from 300 Hz to 3000 Hz.

The

transmitter audio frequency response shall have a nominal 6 dB per octave pre-emphasis characteristic.

<b>NAME OF TEST: Audio Low-Pass Filter Frequency Response</b>	<b>PARA. NO.: 2.987(a)</b>
---	----------------------------

**Test Method:** TIA/EIA-603

**Minimum Standard:** TIA/EIA-603

<b>NAME OF TEST: Modulation Limiting</b>	<b>PARA. NO.: 2.987(a)</b>
--	----------------------------

**Test Method:** TIA/EIA-603

**Minimum Standard:** TIA/EIA-603

<b>NAME OF TEST: Occupied Bandwidth</b>	<b>PARA. NO.: 2.989</b>
---	-------------------------

**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: ≥ 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.

**Test Method:** TIA/EIA-603

An initial scan is made and any emissions within 6 dB of the specification limit are measured using the reference antenna substitution method as described in EIA 603.



**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**

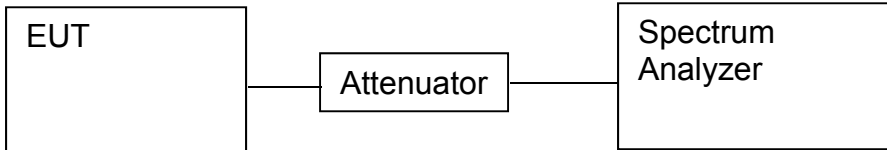
Time intervals <sup>1,2</sup>	Maximum Frequency difference <sup>3</sup> (kHz)	Frequency ranges (MHz) All equipment					
		Base station and portable radios			Mobile Radios		
		150 - 174 (ms)	450 - 500 (ms)	500 - 512 (ms)	150 - 174 (ms)	450 - 500 (ms)	500 - 512 (ms)
t <sub>1</sub> <sup>4</sup>	± 25	5.0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

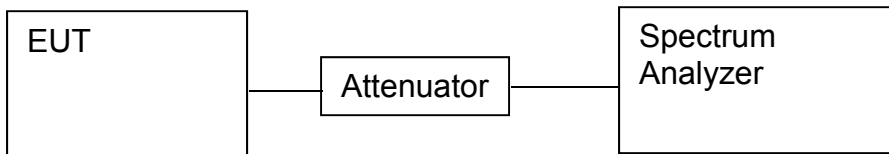
Time intervals <sup>1,2</sup>	Maximum Frequency difference <sup>3</sup> (kHz)	Frequency ranges (MHz) All equipment		
		150 - 174 (ms)	450 - 500 (ms)	500 - 512 (ms)
t <sub>1</sub> <sup>4</sup>	± 12.5 / ± 6.25	5.0	10.0	20.0
t <sub>2</sub>	± 6.25 / ± 3.125	20.0	25.0	50.0
t <sub>3</sub> <sup>4</sup>	± 12.5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

**ANNEX B - TEST DIAGRAMS**

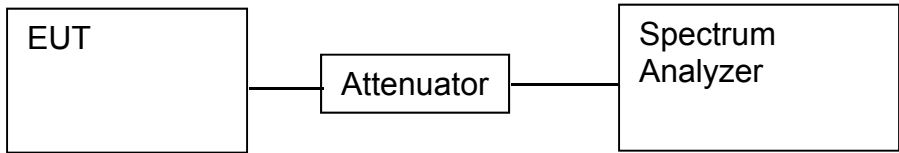
**Para. No. 2.985 - R.F. Power Output**



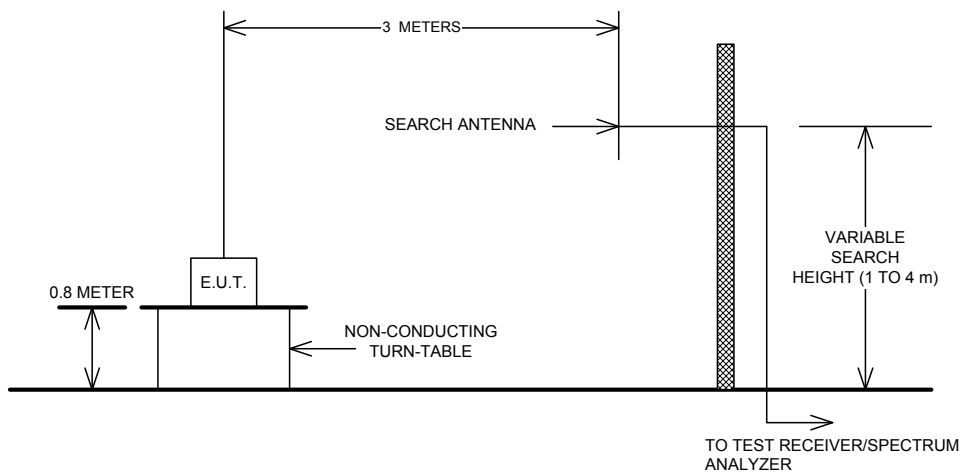
**Para. No. 2.989 - Occupied Bandwidth**



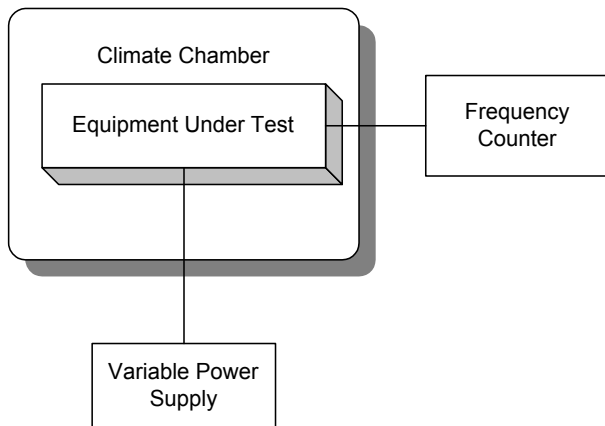
**Para. No. 2.991 - Spurious Emissions at Antenna Terminals**

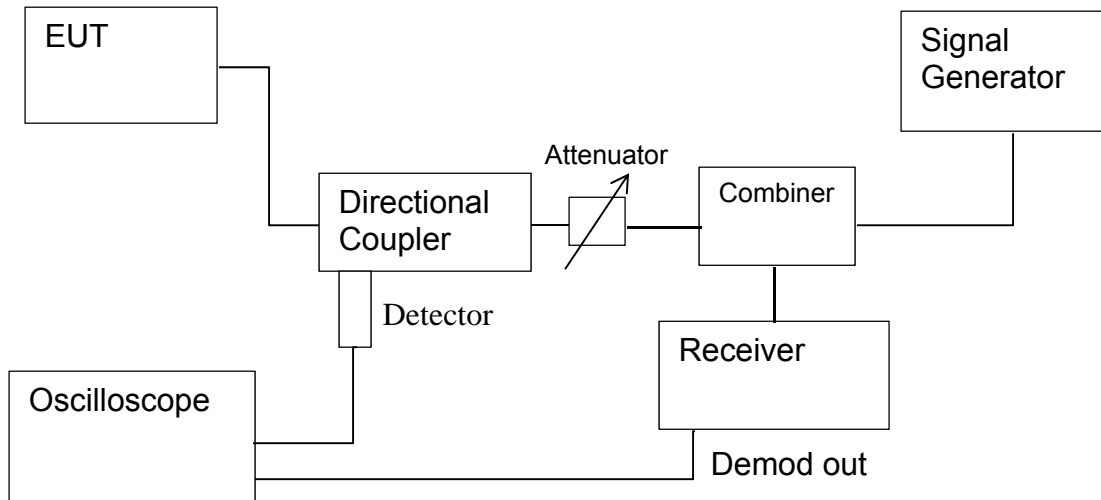


**Para. No. 2.993 - Field Strength of Spurious Radiation**



**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).