Nemko Test Report: 10225611RUS1

Applicant: EF Johnson Company
1440 Corporate Drive
Irving, TX 75308
USA

Equipment Under Test: (E.U.T.) Viking VP 600
Model: 242-5720

FCC ID. ATH2425720
IC: 933B-2425720

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

TESTED BY: _____ **DATE:** 03 July 2012
David Light, Wireless Engineer

APPROVED BY: _____ **DATE:** 11-Jul-2012
Michael Cantwell

Total Number of Pages: 39

Table of Contents

Section 1. Summary of Test Results

Manufacturer: EF Johnson Company

Model Number: Model: 242-5720

Serial No.: 517001208720083

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. EIA/TIA 603 was used as a test method for these measurements.

☒	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

Summary Of Test Data

NAME OF TEST	PARA. NO.	RESULT
RF Power Output	90.205 / 5.4.1	Complies
Audio Frequency Response	TIA EIA-603.3.2.6	Complies
Audio Low-Pass Filter Response	TIA EIA-603.3.2.6	Complies
Modulation Limiting	TIA EIA-603.3.2.6	Complies
Occupied Bandwidth	90.210 / / 5.5.8 Table 3	Complies
Spurious Emissions at Antenna Terminals	90.210 / 5.5.8 Table 3	Complies
Field Strength of Spurious Emissions	90.210 / 5.5.8 Table 3	Complies
Frequency Stability	90.213 / 5.3	Complies
Transient Frequency Behavior	90.214 / 5.9	Complies

Footnotes:

.

Section 2. General Equipment Specification

Transmitter

Supply Voltage Input:	7.4 Vdc Lithium Ion Battery
Frequency Range:	380 to 470 MHz
Tunable Bands:	1

Type(s) of Modulation:

F3E (Voice)	F1D	F1E	D7W (QAM)	Other
☒	☒	☒	☐	☐

Internal/External Data Source:	Internal (Vocoded voice)
Emission Designator:	11K0F3E, 8K10F1E, 8K10F1D
Output Impedance:	50 ohms
RF Power Output (rated):	5 watts
Channel Spacing(s):	12.5 kHz
Operator Selection of Operating Frequency:	Pre-programmed channel selection

System Description

The VP 600 is a 4.5 watt UHF radio for mobile radio services. The radio functions as a normal Push-to-Talk type radio.

Section 3. RF Power Output

NAME OF TEST: RF Power Output	PARA. NO.: 2.985
TESTED BY: David LightTom Tidwell & Debbie Jensen	DATE: 27 June 2012

Measurement Results: Complies.

Measurement Data:

Frequency (MHz)	Modulation	Peak Output Power (dBm)	Peak Output Power (Watts)
425.0	Analog	36.5	4.46
425.0	Digital	36.5	4.46

Rated Output Power: 4.5 watts

Spectrum Analyzer Setting: RBW/VBW = 300 kHz
Peak Detector

Equipment Used: 1036-1082-1064-1065

Measurement Uncertainty: +/- 1.7 dB

Temperature: 20 °C

Relative Humidity: 45 %

Section 4. Modulation Characteristics

NAME OF TEST: Modulation Characteristics	PARA. NO.: 2.987
TESTED BY: David LightTom Tidwell & Debbie Jensen	DATE: 27 June 2012

Measurement Results: Complies.

Measurement Data: See following pages

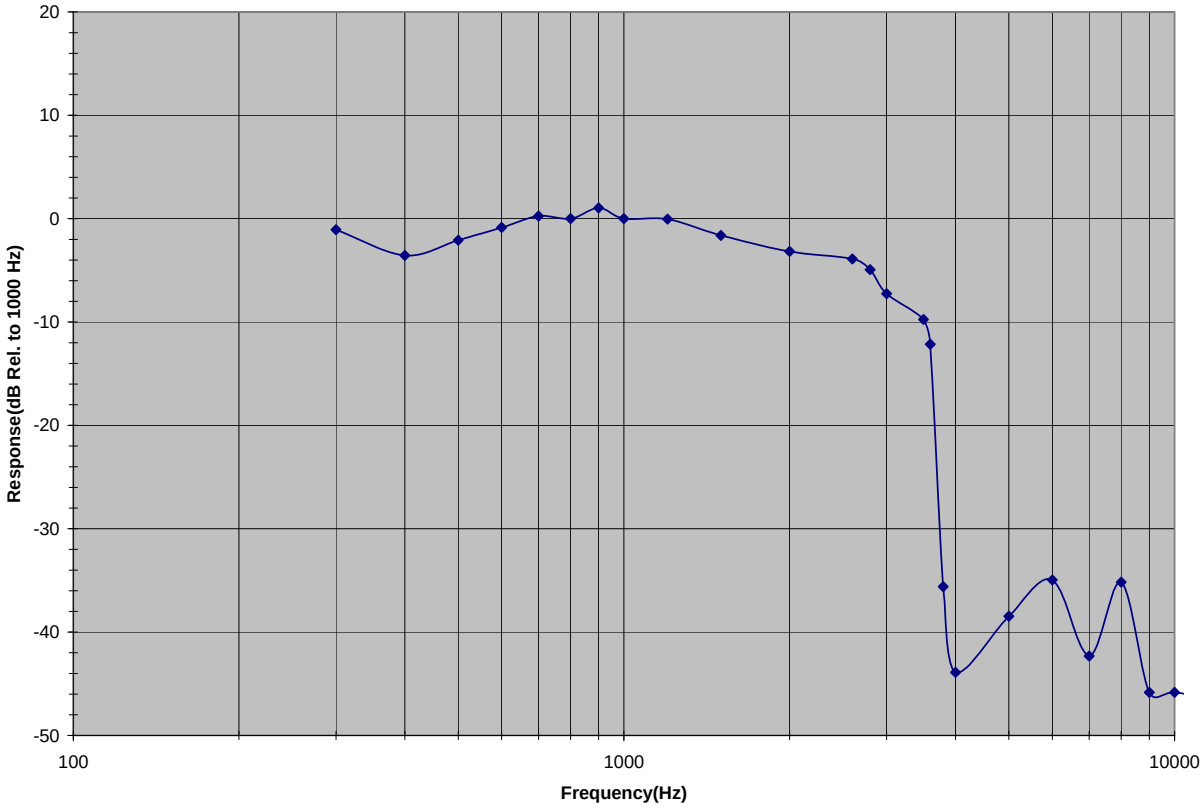
Description of modulation: Modulation input to the radio is voice via a microphone. The radio has two modes of operation:

1) Narrow band voice for 12.5 kHz channels
2) Data modulation. In this mode the voice input signal goes through a Vocoder to translate the audio to data.

Description of baseband filtering: The radio has a low-pass audio filter.

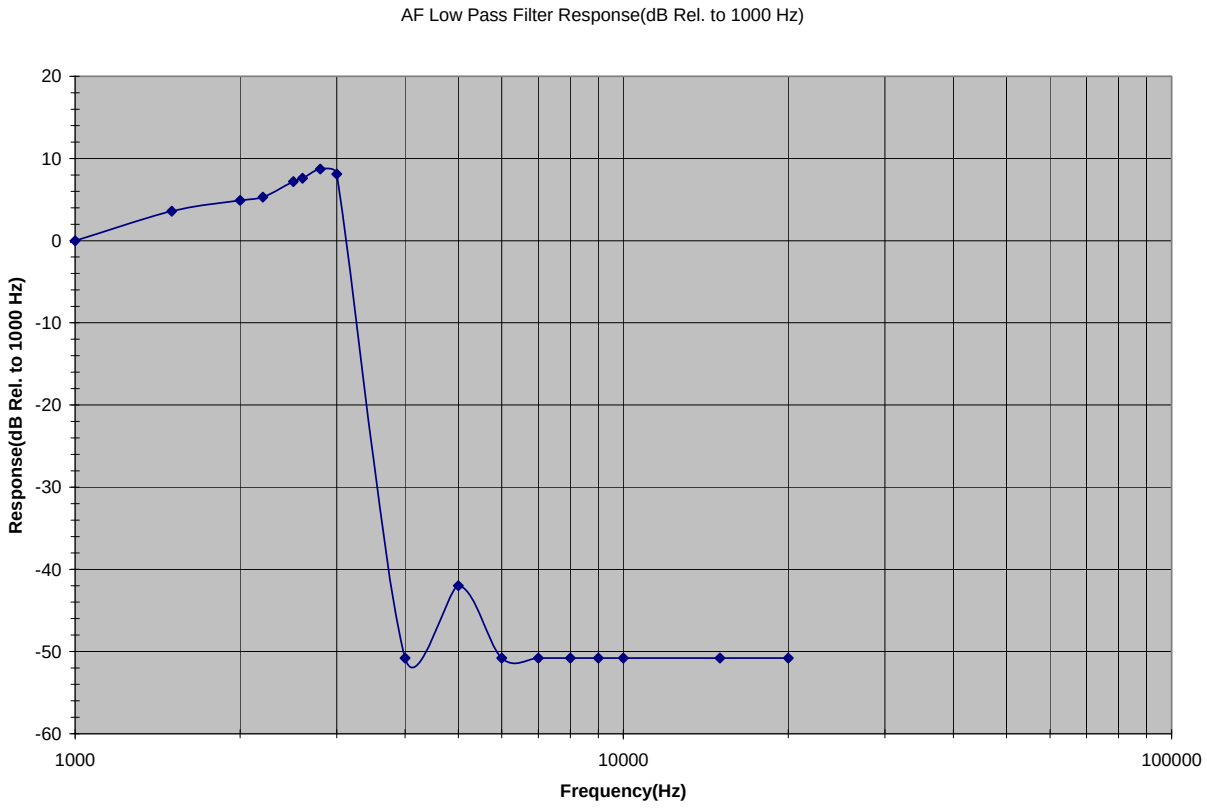
Section 4.1 Audio Frequency Response

NAME OF TEST: Audio Frequency Response	PARA. NO.: 2.987(a)
TESTED BY: David LightTom Tidwell & Debbie Jensen	DATE: 27 June 2012



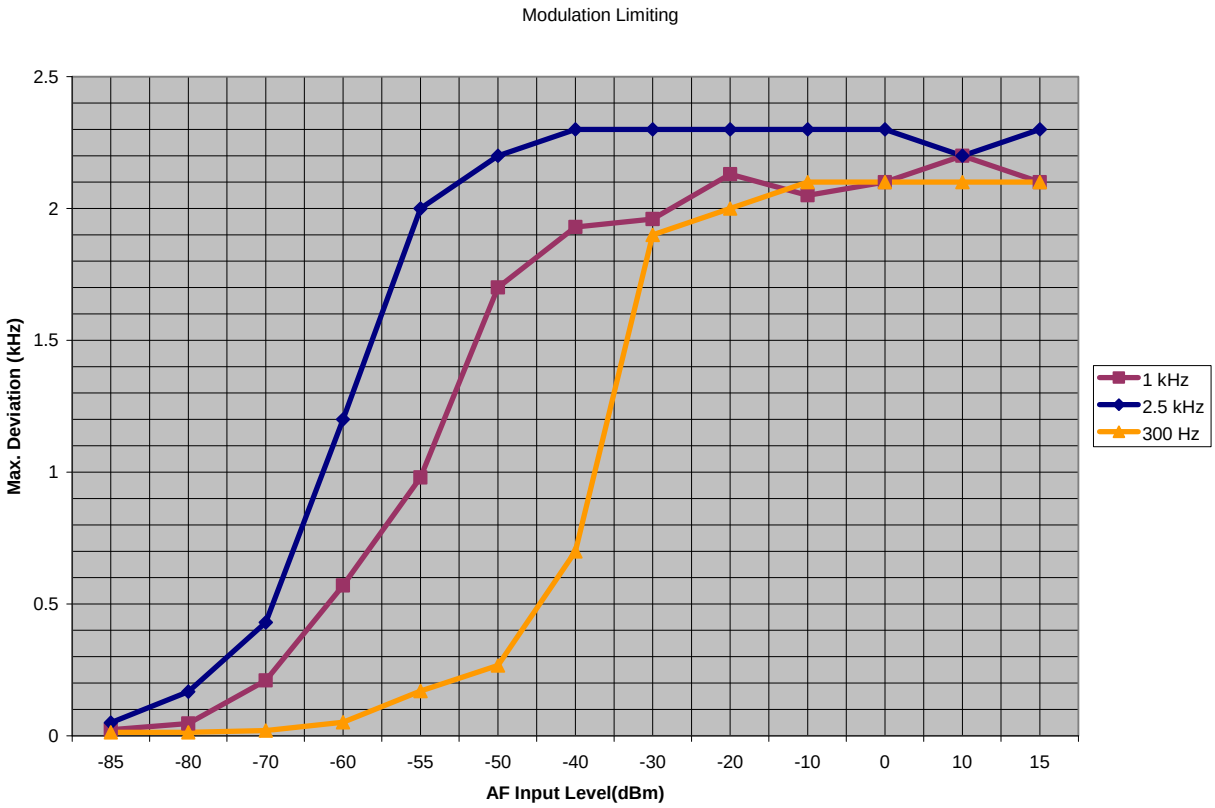
Section 4.2 Audio Low-Pass Filter Response

NAME OF TEST: Audio Low-Pass Filter Response	PARA. NO.: 2.987(a)
TESTED BY: David LightTom Tidwell & Debbie Jensen	DATE: 27 June 2012



Section 4.3 Modulation Limiting

NAME OF TEST: Modulation Limiting	PARA. NO.: 2.987(b)
TESTED BY: David LightTom Tidwell & Debbie Jensen	DATE: 27 June 2012



Maximum deviation for non-voice modulation __+/-3__ kHz.

Section 5. Occupied Bandwidth

NAME OF TEST: Occupied Bandwidth	PARA. NO.: 2.989
TESTED BY: David LightTom Tidwell & Debbie Jensen	DATE: 28 June 2012

Measurement Results: Complies.

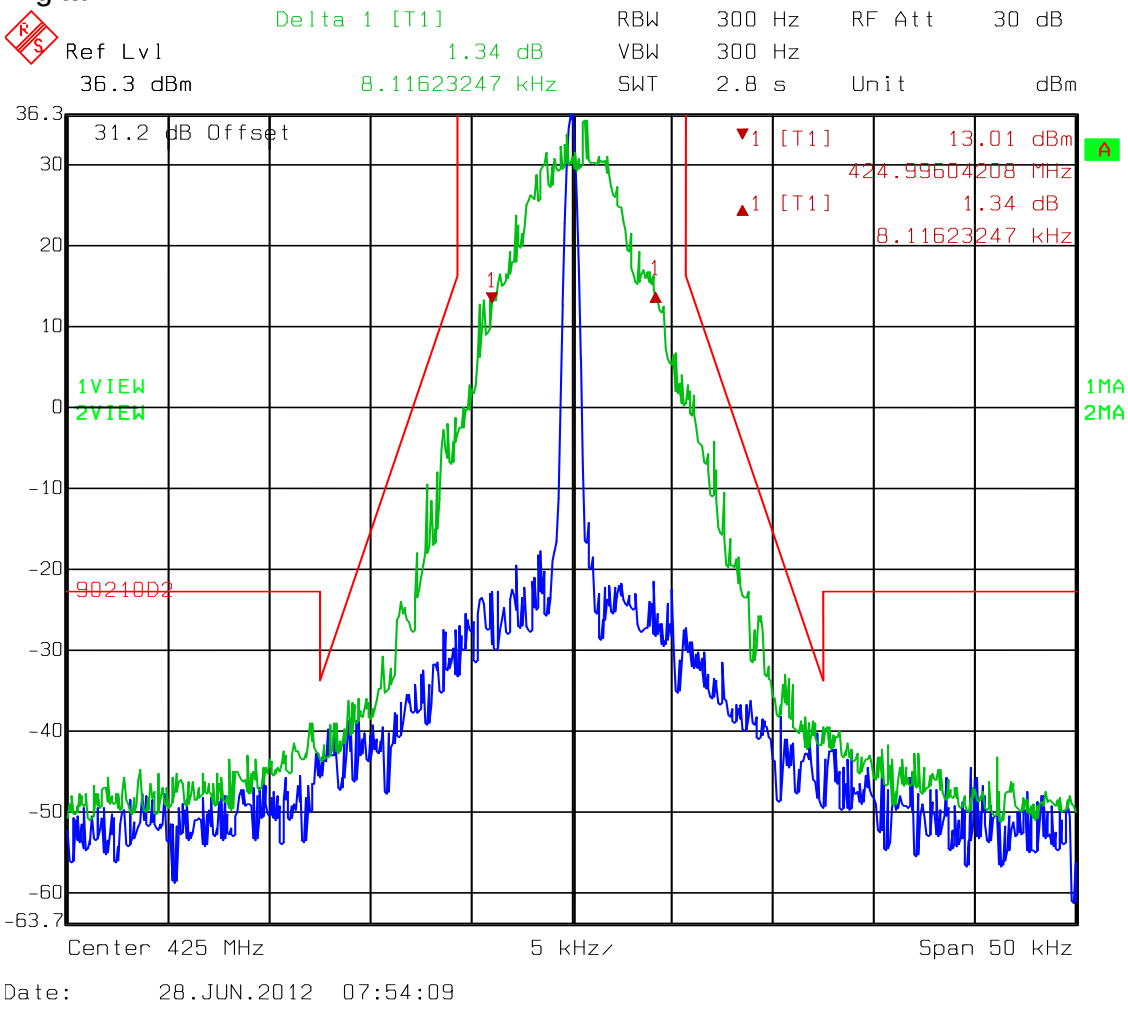
Equipment Used: 1036-1082-1064-1065

Measurement Uncertainty: $1X10^{-7}$ ppm

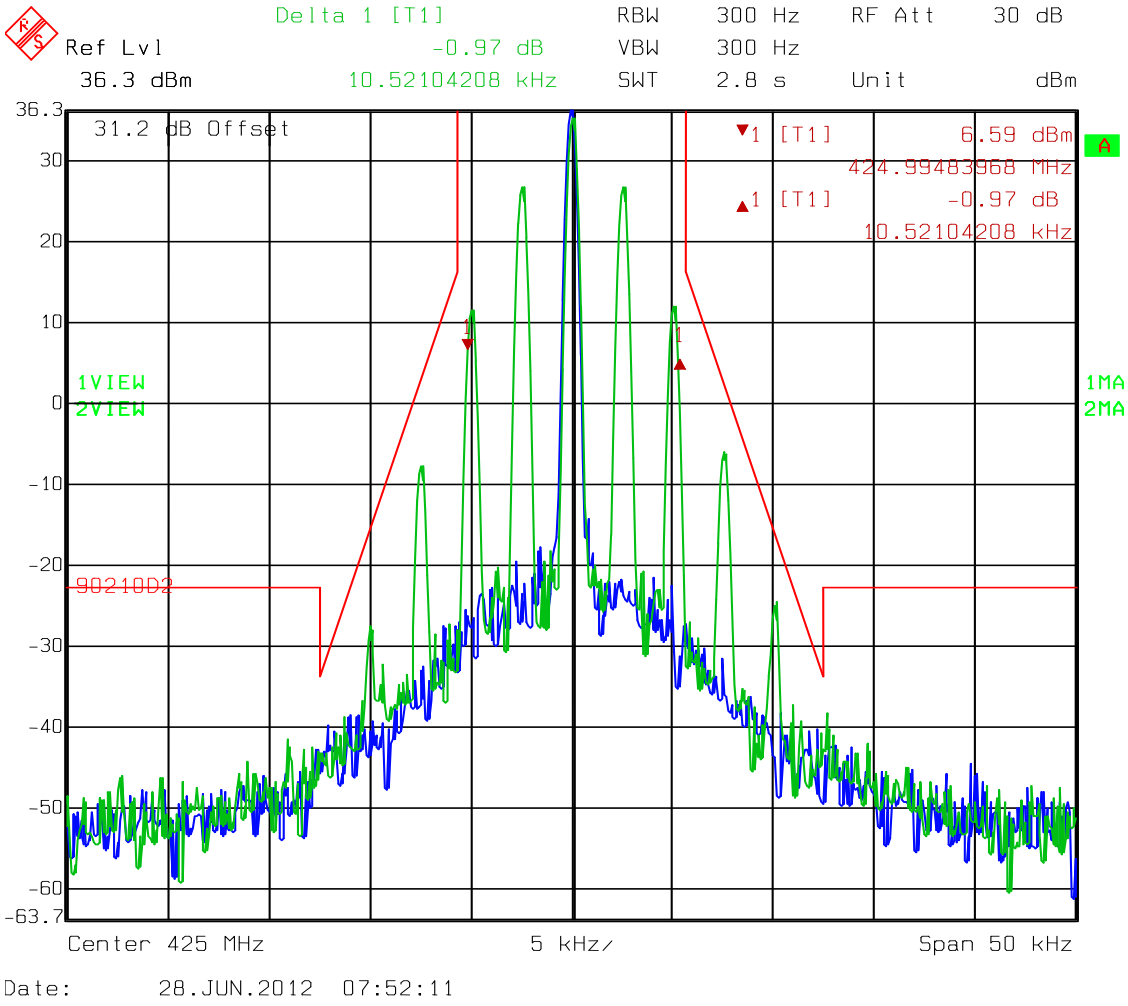
Temperature: 22 °C

Relative Humidity: 45 %

Occupied Bandwidth
Digital



Occupied Bandwidth
Narrowband FM



Section 6. Spurious Emissions at Antenna Terminals

NAME OF TEST: Spurious Emissions @ Antenna Terminals	PARA. NO.: 2.991
TESTED BY: David LightTom Tidwell & Debbie Jensen	DATE: 27 June 2012

Measurement Results: Complies.

Test Data: See attached plot(s).

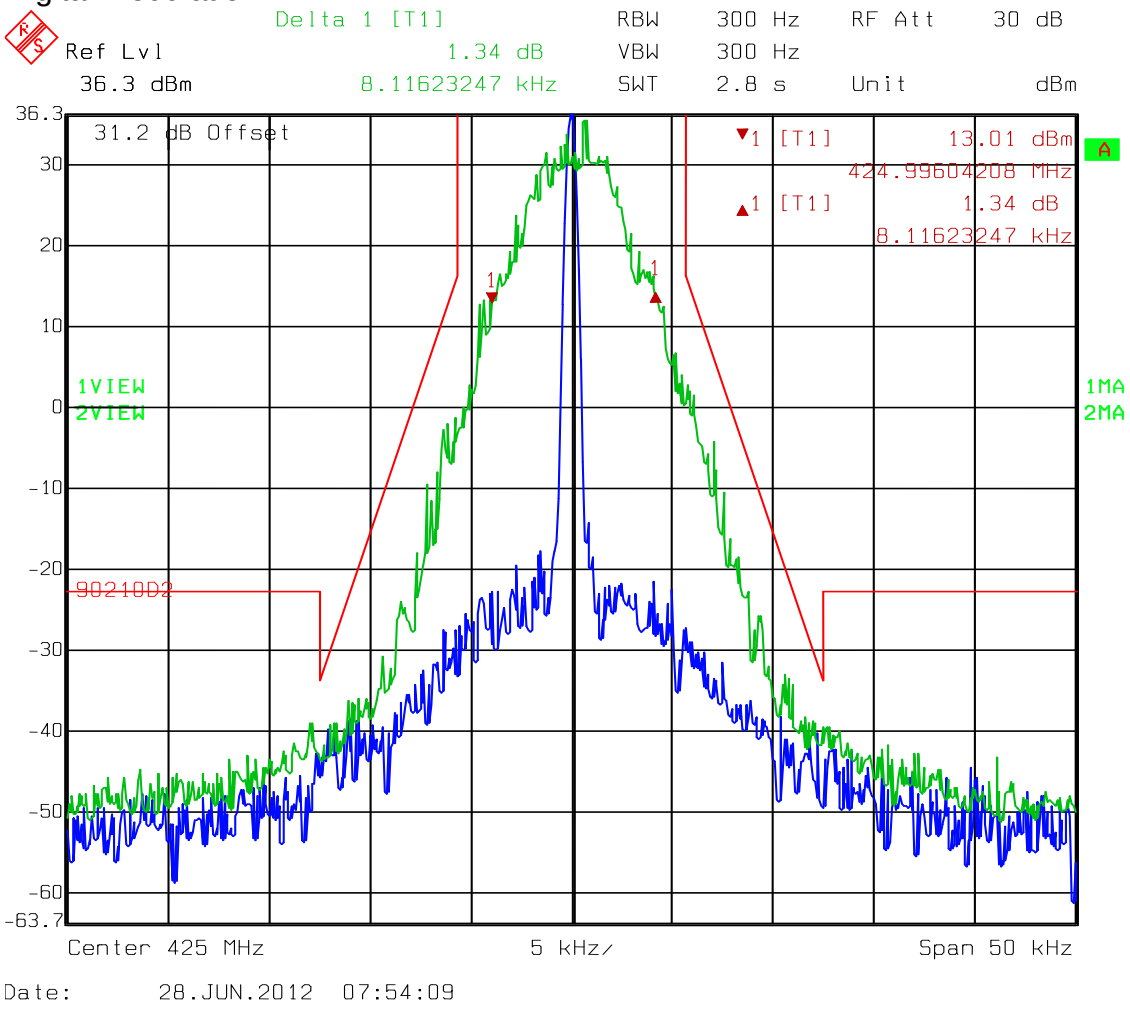
Equipment Used: 1036-1082-1064-1065

Measurement Uncertainty: +/- 1.7 dB

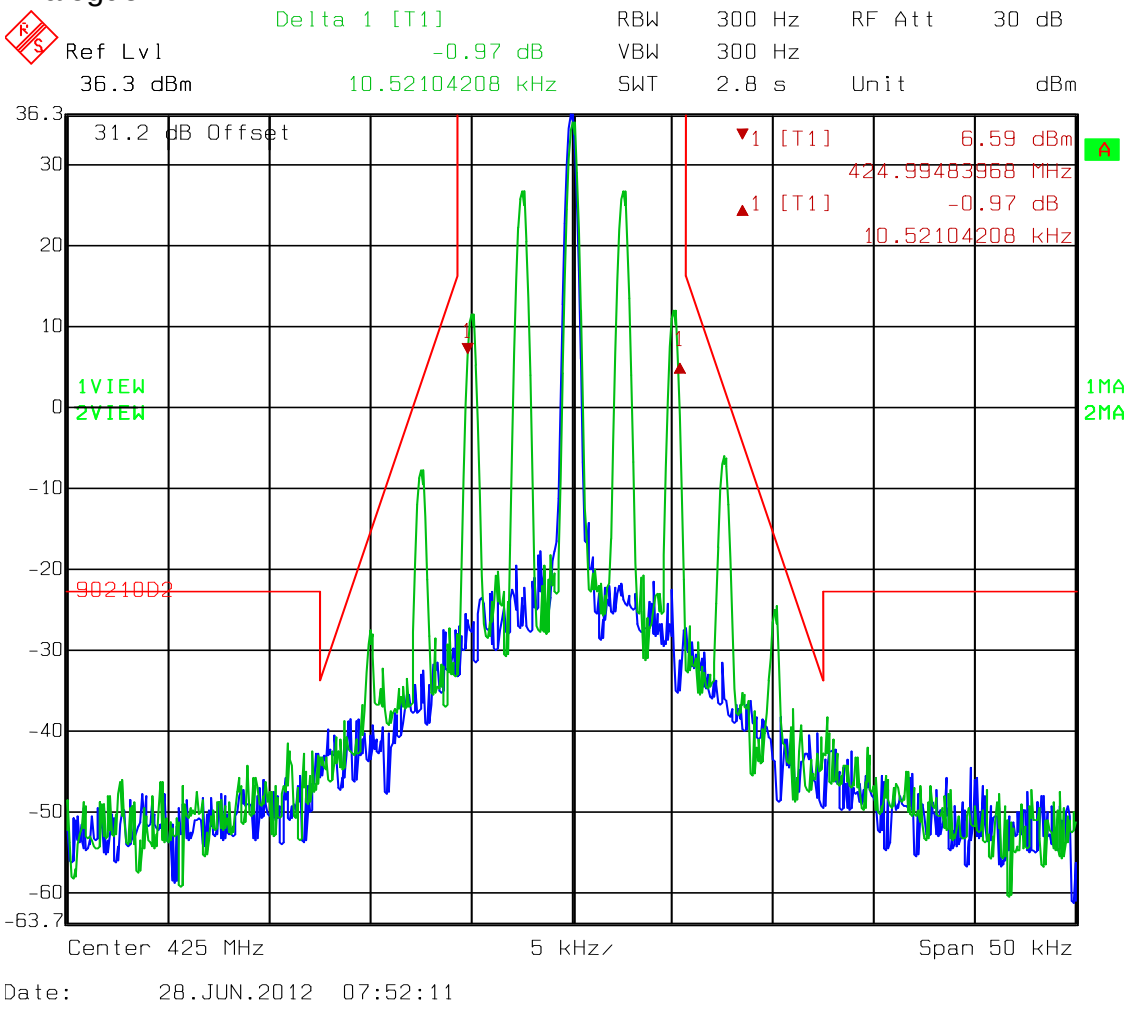
Temperature: 22 °C

Relative Humidity: 45 %

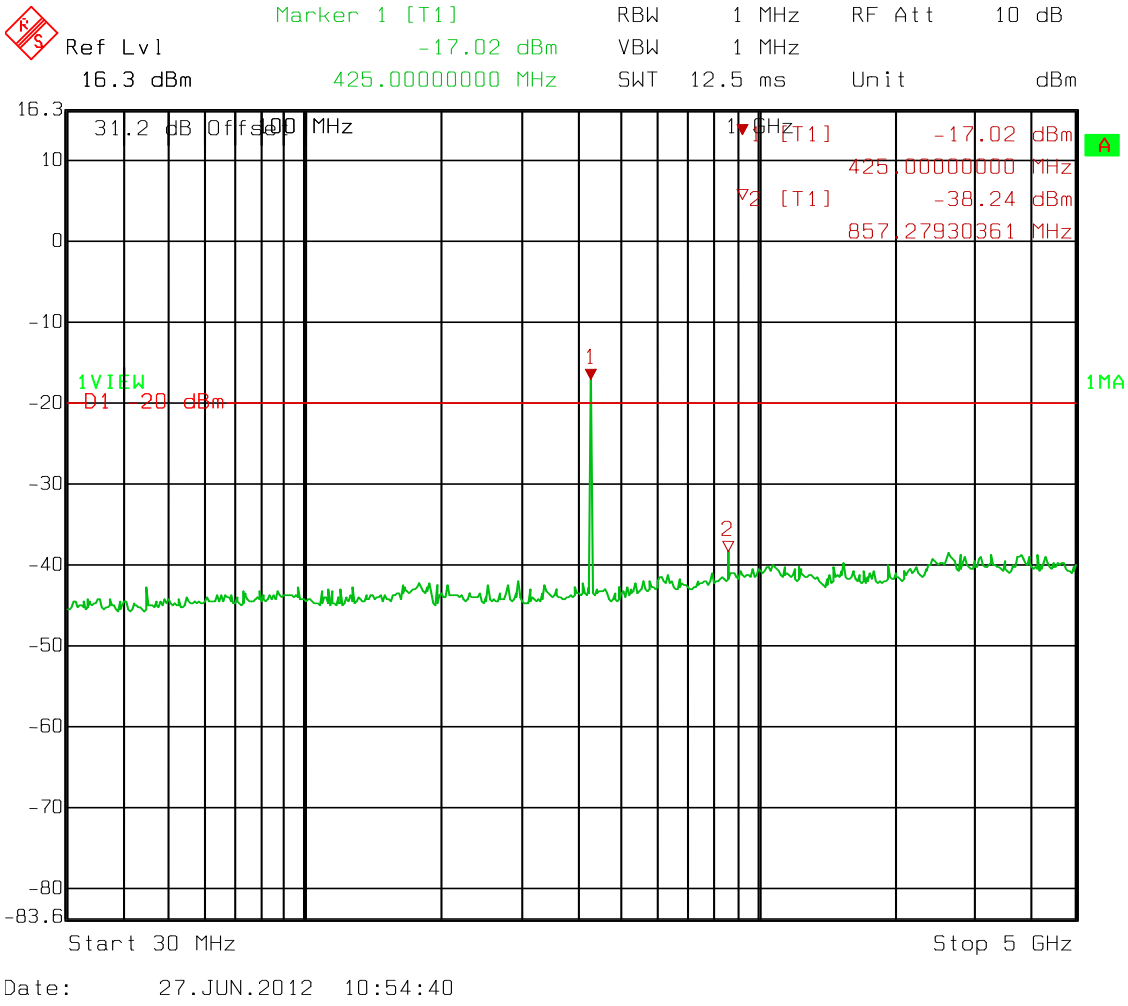
Mask 90.210(d)
Digital modulation



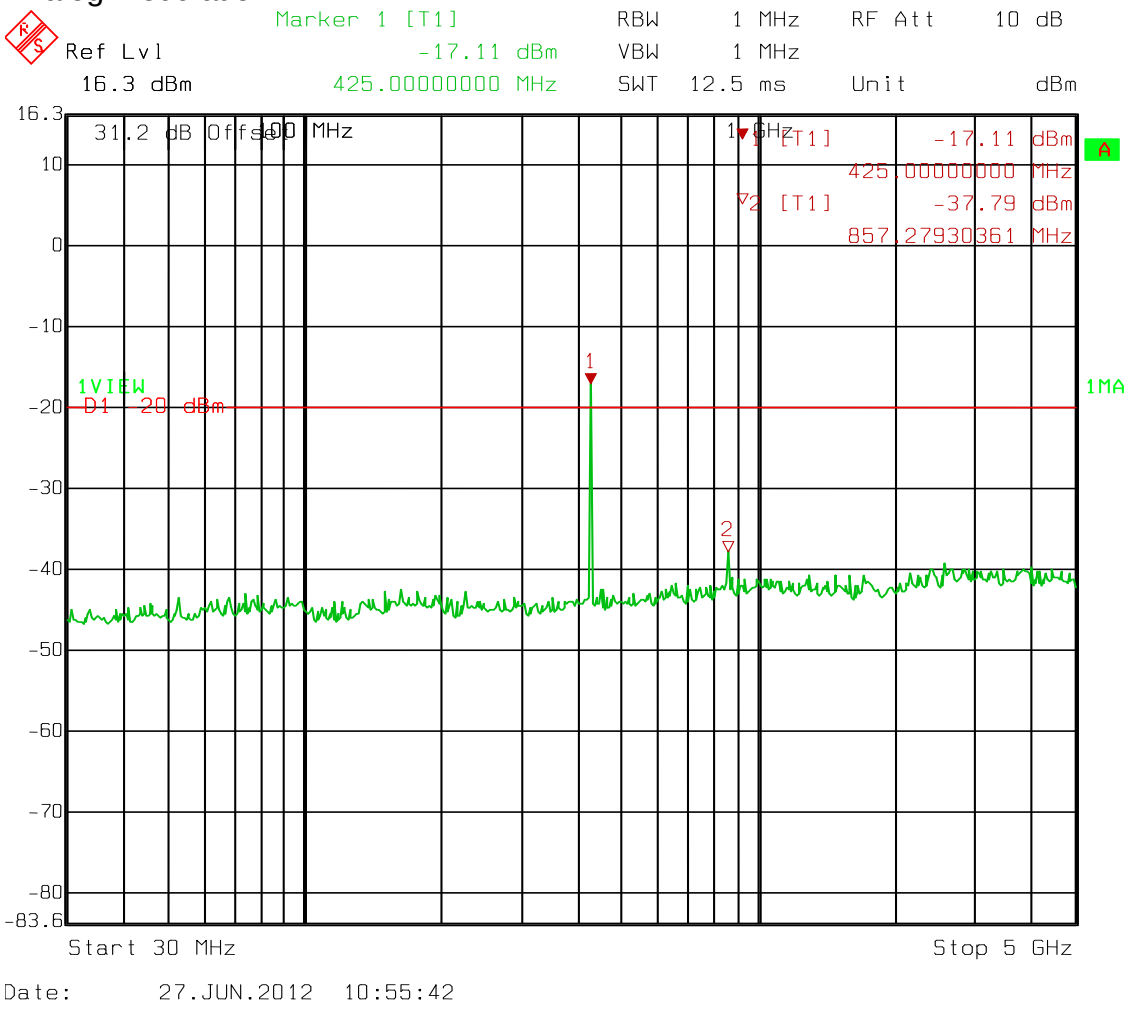
Mask 90.210(d)
Analogue



Spurs
Digital Modulation



Spurs
Analog Modulation



Section 7. Field Strength of Spurious Emissions

NAME OF TEST: Field Strength of Spurious Emissions	PARA. NO.: 2.993
TESTED BY: David LightTom Tidwell & Debbie Jensen	DATE: 13 May 2012

Measurement Results: Complies.

Measurement Data: There were no emissions within 20 dB of the specification limit.

Analyzer Settings: <1 MHz RBW/VBW = 100 kHz
>1 MHz RBW/VBW = 1 MHz
Peak detector

The spectrum was searched from 30 MHz to the tenth harmonic of the carrier.

Equipment Used: 1783-1767-1763-993-1016-1025

Measurement Uncertainty: +/-1.7 dB

Temperature: 22 °C

Relative Humidity: 54 %

Section 8. Frequency Stability

NAME OF TEST: Frequency Stability	PARA. NO.: 2.995
TESTED BY: David LightTom Tidwell & Debbie Jensen	DATE: 28 June 2012

Measurement Results: Complies.

Measurement Data: See attached data

Measurement Data: See attached table.

Standard Test Frequency:	425.00	MHz
Standard Test Voltage:	7.4	Vdc

Equipment Used: 1036-1082-1064-1065

Measurement Uncertainty: 1×10^{-7} ppm

Lab Temperature: 22 °C

Relative Humidity: 45 %

Test Data – Frequency Stability

			Standard Test Frequency	425.000000			MHz
Temp (°C)	Measured Frequency (MHz)		Test Voltage	Freqeuncy Error (Hz)	Limit (+/-Hz)	Error (ppm)	Comment
20	425.000056		7.4	56	2125.0	0.13	
20	425.000036		8.5	36	2125.0	0.08	
20	425.000038		6.3	38	2125.0	0.09	
50	424.999932		7.4	-68	2125.0	-0.16	
40	424.999998		7.4	-2	2125.0	0.00	
30	425.000056		7.4	56	2125.0	0.13	
10	425.000043		7.4	43	2125.0	0.10	
0	425.000075		7.4	75	2125.0	0.18	
-10	424.999905		7.4	-95	2125.0	-0.22	
-20	424.999820		7.4	-180	2125.0	-0.42	
-30	424.999869		7.4	-131	2125.0	-0.31	
Notes:							

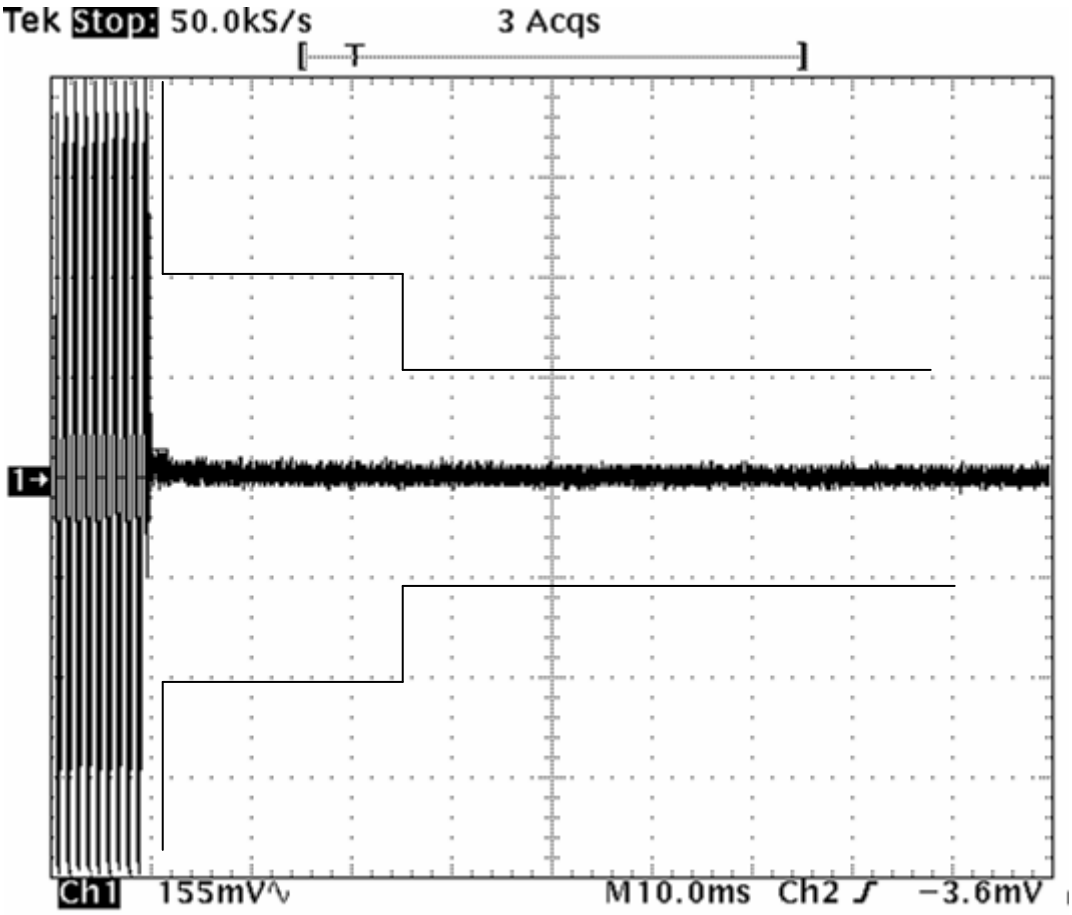
Section 9. Transient Frequency Behavior

NAME OF TEST: Transient Frequency Behavior	PARA. NO.: 90.214
TESTED BY: David LightTom Tidwell & Debbie Jensen	DATE: 28 June 2012

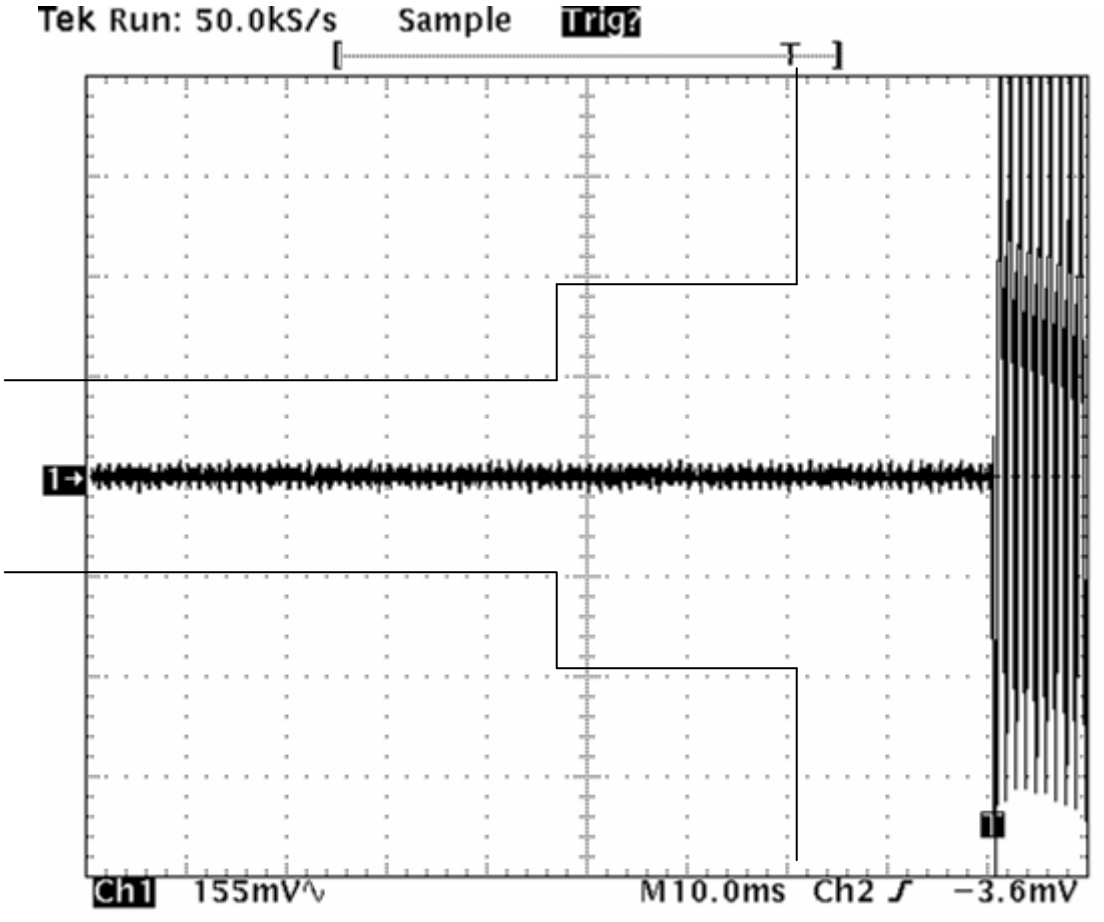
Measurement Results: Complies.

Measurement Data: See attached data

Measurement Conditions: Temperature: 21 °C
Humidity: 53 %



Switch on Condition



Switch off Condition

Section 10. Receiver Spurious Emissions

NAME OF TEST: Transient Frequency Behavior	PARA. NO.: RSS-119 5.11
TESTED BY: David LightTom Tidwell & Debbie Jensen	DATE: 29 June 2012

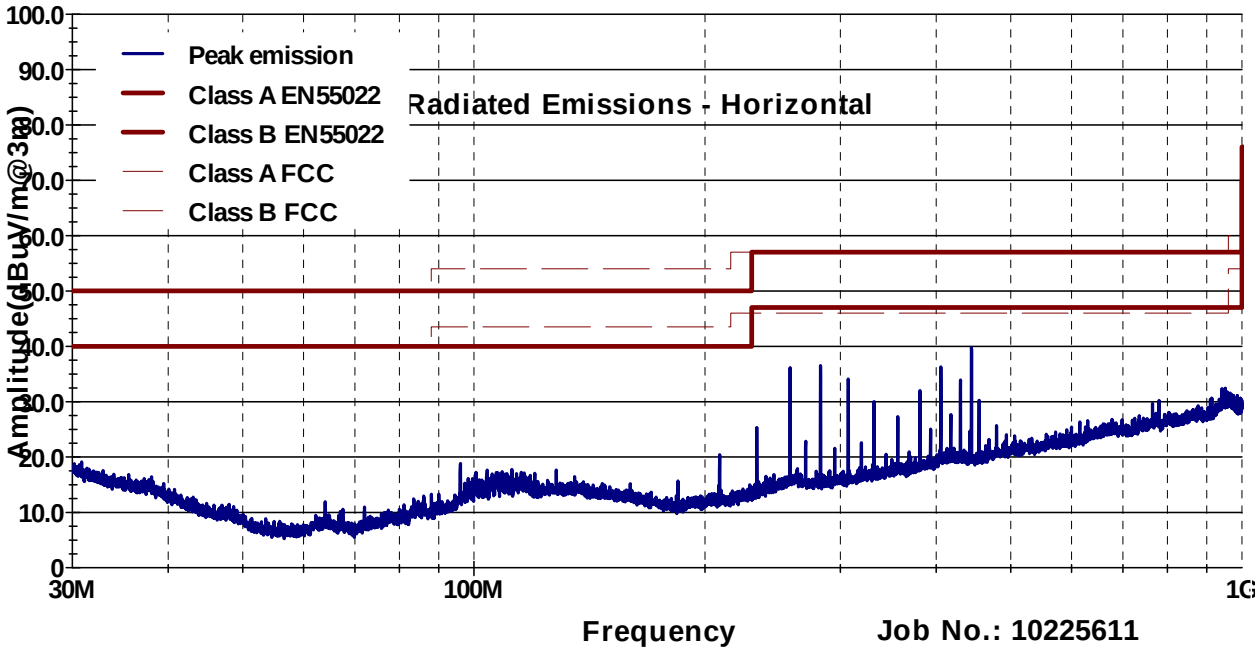
Measurement Results: Complies.

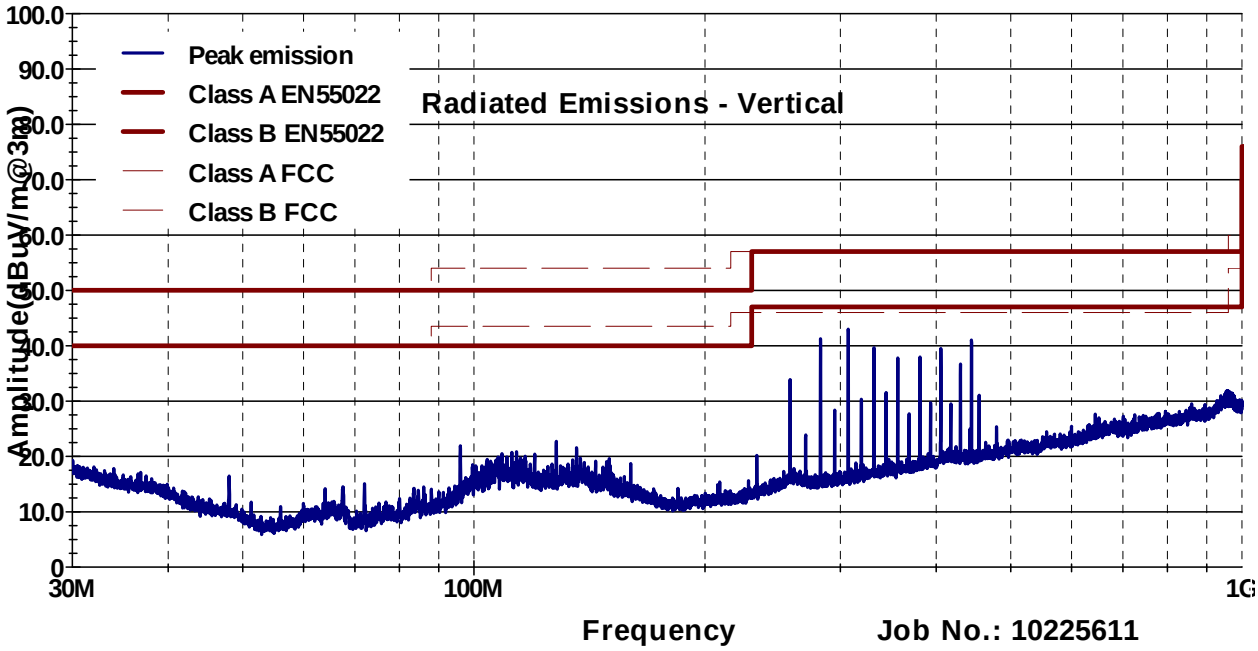
Measurement Data: See attached data

Measurement Conditions: Temperature: 21 °C
Humidity: 53 %

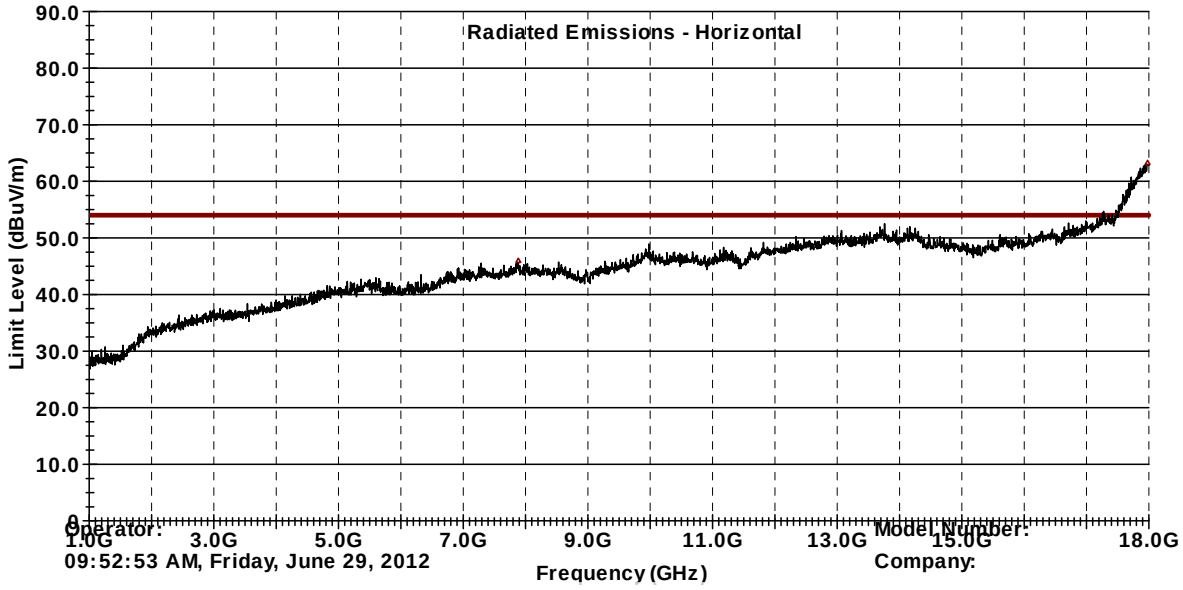
Test Equipment Used: 1783-1025-1767-1763-1304-1016

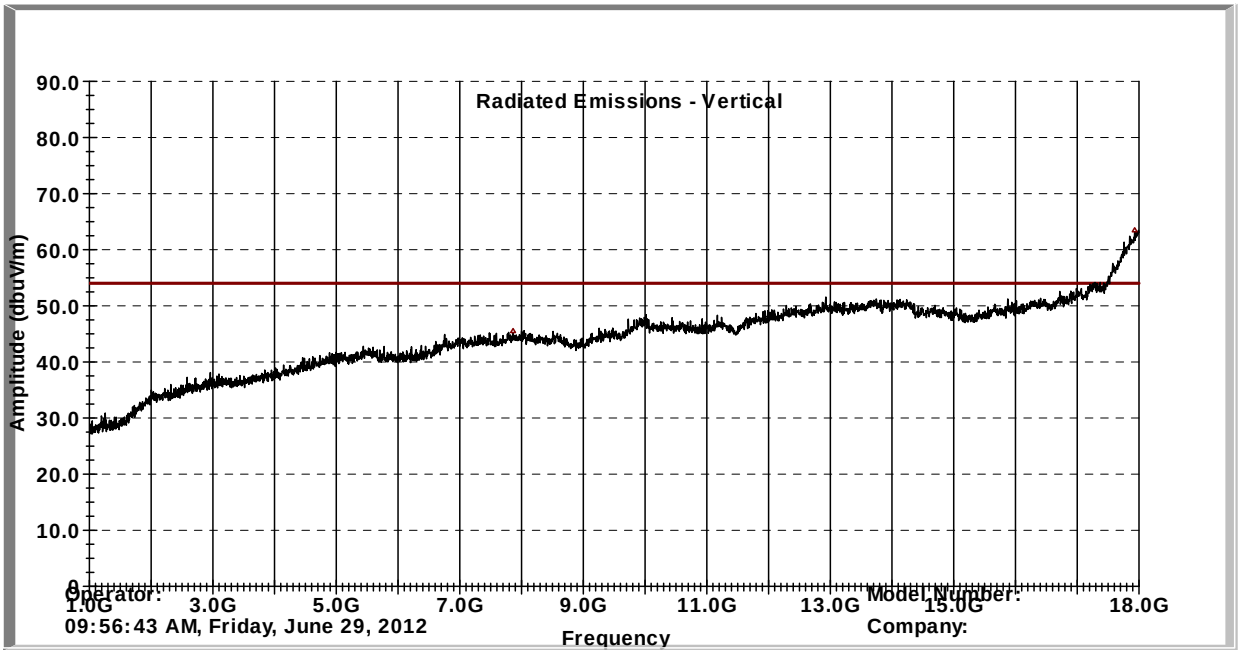
Receiver spurious Emissions





Receiver spurious Emissions





Section 11. Test Equipment List

Asset Tag	Description	Manufacturer	Model	Serial #	Last Cal	Next Cal
1016	Preamplifier	Hewlett Packard	8449A	2749A00159	20-Jul-2011	20-Jul-2012
1025	Preamplifier, 25dB	Nemko USA, Inc.	LNA25	399	27-Feb-2012	27-Feb-2013
1036	Spectrum Analyzer	Rohde & Schwartz	FSEK30	830844/006	23-Dec-2011	23-Dec-2013
1064	Attenuator	Narda	776B-20		N/R	
1065	Attenuator	Narda	776B-10		N/R	
1082	Cable, 2m	Astrolab	32027-2-29094-72TC		N/R	
1304	Antenna, Horn	Electro Metrics	RGA-60	6151	24-Nov-2010	24-Nov-2012
1763	Antenna, Bilog	Schaffner	CBL 6111D	22926	21-Feb-2012	21-Feb-2013
1767	Receiver,	Rohde & Schwartz	ESIB26	837491/0002	09-Dec-2011	09-Dec-2012
1783	Cable Assy,	Nemko	Chamber		26-Sep-2011	26-Sep-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. Power output is measured with the maximum rated input level.

NAME OF TEST: Audio Frequency Response	**PARA. NO.: 2.987(a)**

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.

NAME OF TEST: Audio Low-Pass Filter Frequency Response	**PARA. NO.: 2.987(a)**

Test Method: TIA/EIA-603

Minimum Standard: TIA/EIA-603

NAME OF TEST: Modulation Limiting	**PARA. NO.: 2.987(a)**

Test Method: TIA/EIA-603

Minimum Standard: TIA/EIA-603

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.

Test Method: The substitution antenna method was used to measure erp of spurious emissions. This method is described in EIA/TIA 603.

The field strength of the emission is measured and recorded. The EUT is then replaced with a substitution antenna of known gain against a dipole. The substitution antenna is fed with a calibrated signal which is adjusted until the previously recorded value is repeated. The erp of the spurious signal is the level required to repeat the previously measured level. If the substitution antenna gain is calibrated and expressed as dBi (referenced to an isotropic radiator instead of a dipole), the result is adjusted by 2.15 dB so that the result is erp not eirp.

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

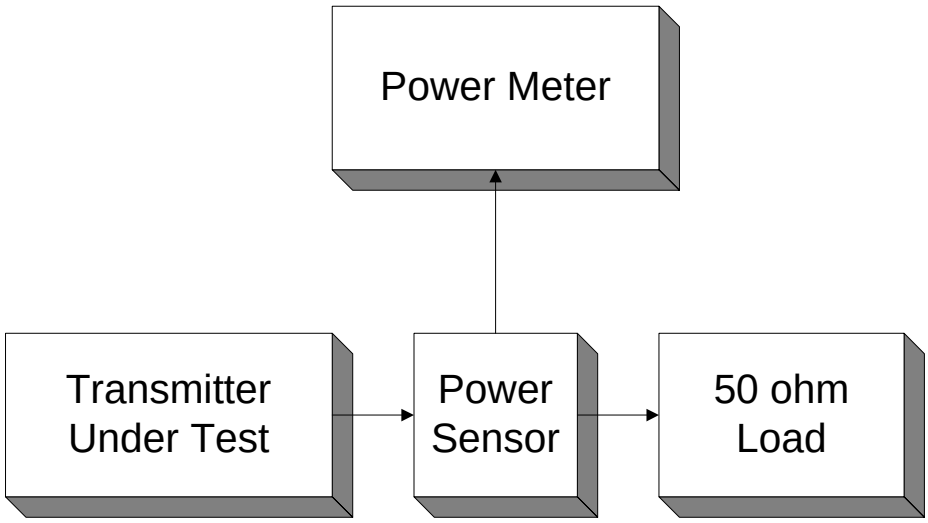
		Frequency ranges (MHz) All equipment					
	Maximum	Base station and portable radios			Mobile Radios		
Time intervals [1,2]	Frequency difference[3] (kHz)	150 - 174 (ms)	450 - 500 (ms)	500 - 512 (ms)	150 - 174 (ms)	450 - 500 (ms)	500 - 512 (ms)
t_1[4]	± 25	5.0	10.0	20.0	5.0	10.0	5.0
t_2	± 12	20.0	25.0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

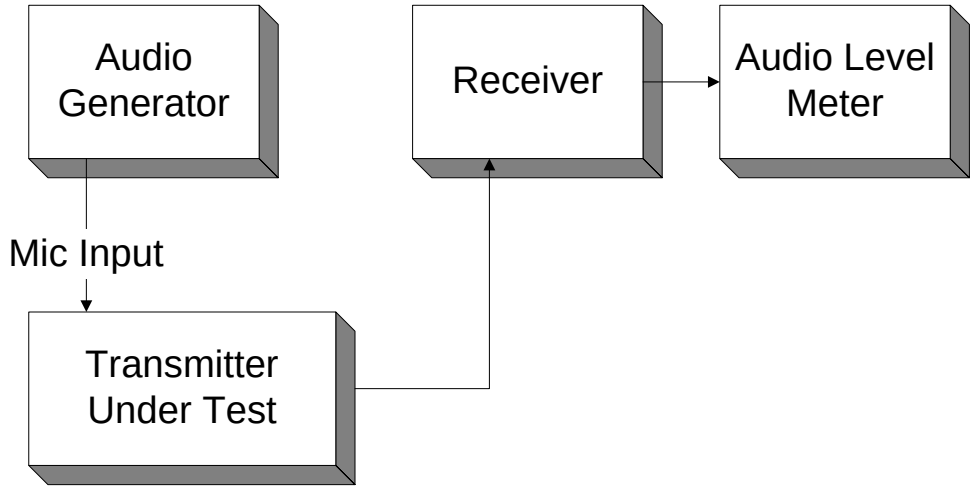
	Maximum	Frequency ranges (MHz) All equipment		
Time intervals [1,2]	Frequency difference[3] (kHz)	150 - 174 (ms)	450 - 500 (ms)	500 - 512 (ms)
t_1[4]	± 12.5 / ± 6.25	5.0	10.0	20.0
t_2	± 6.25 / ± 3.125	20.0	25.0	50.0
t_3[4]	± 12.5 / ± 6.25	5.0	10.0	10.0

ANNEX B - TEST DIAGRAMS

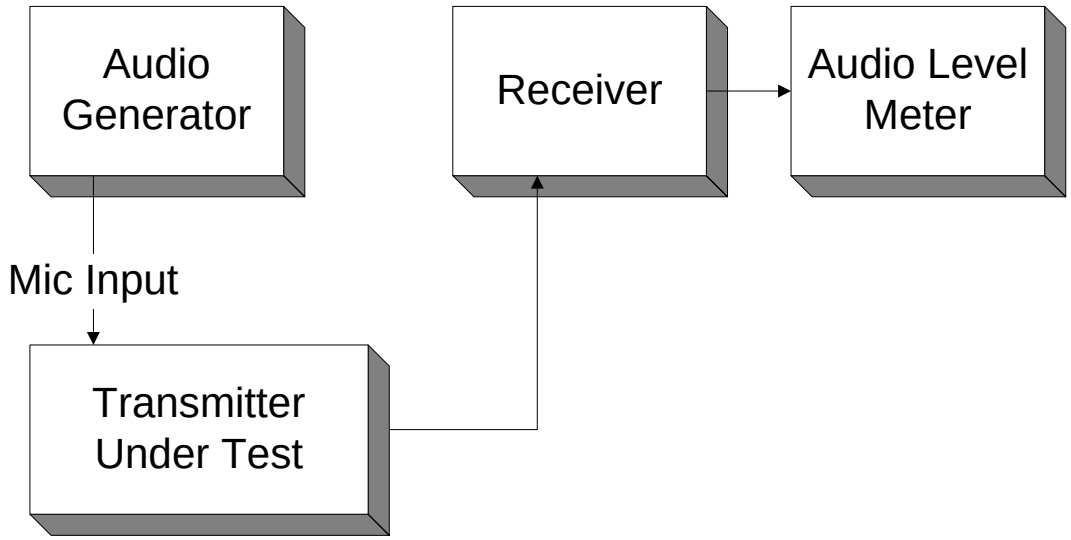
Para. No. 2.985 - R.F. Power Output



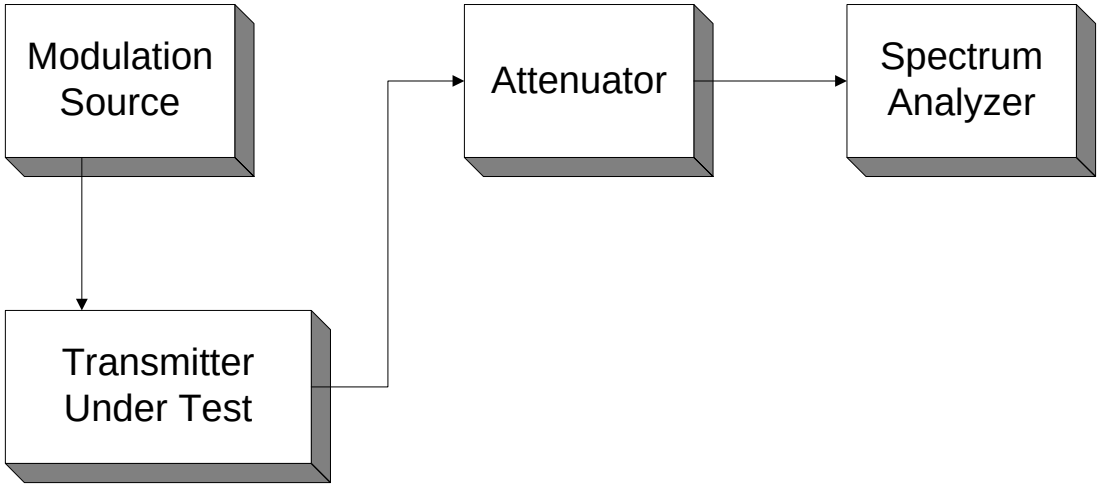
Para. No. 2.987(a) - Audio Frequency Response



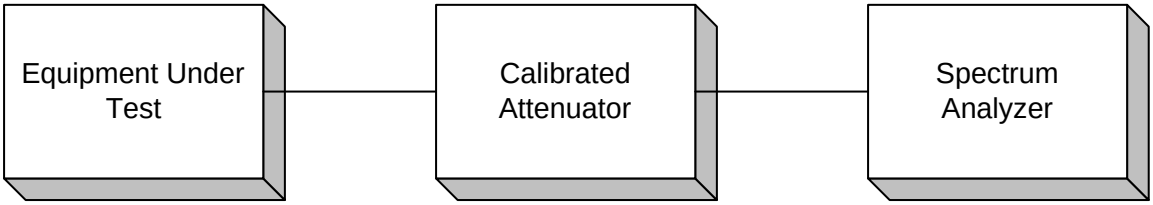
Para. No. 2.987(b) - Modulation Limiting



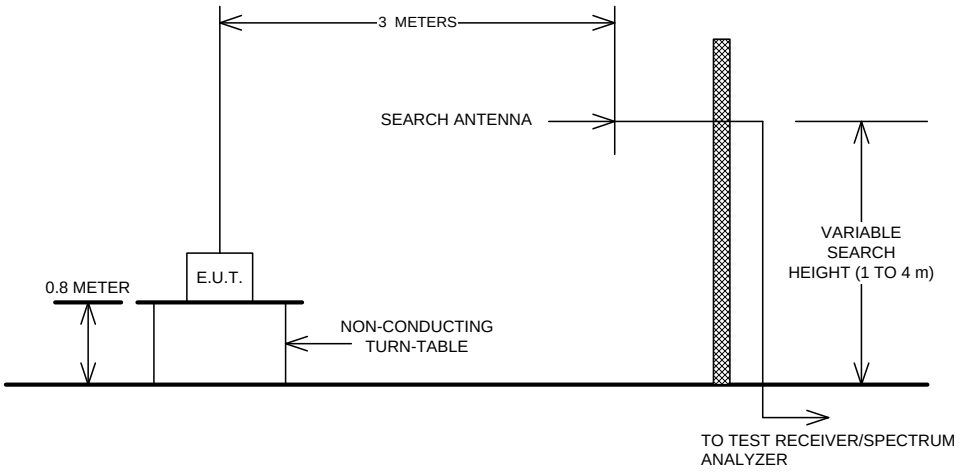
Para. No. 2.989 - Occupied Bandwidth



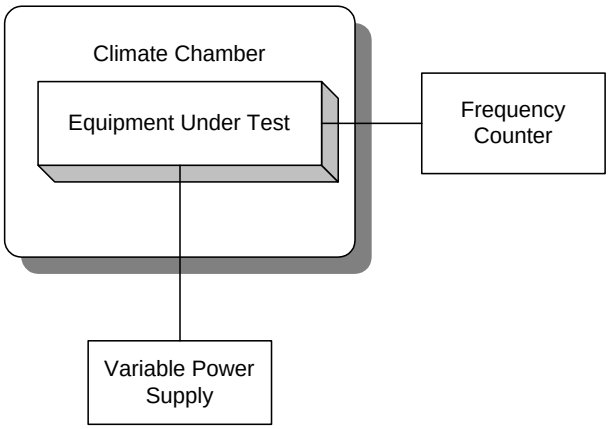
Para. No. 2.991 - Spurious Emissions at Antenna Terminals



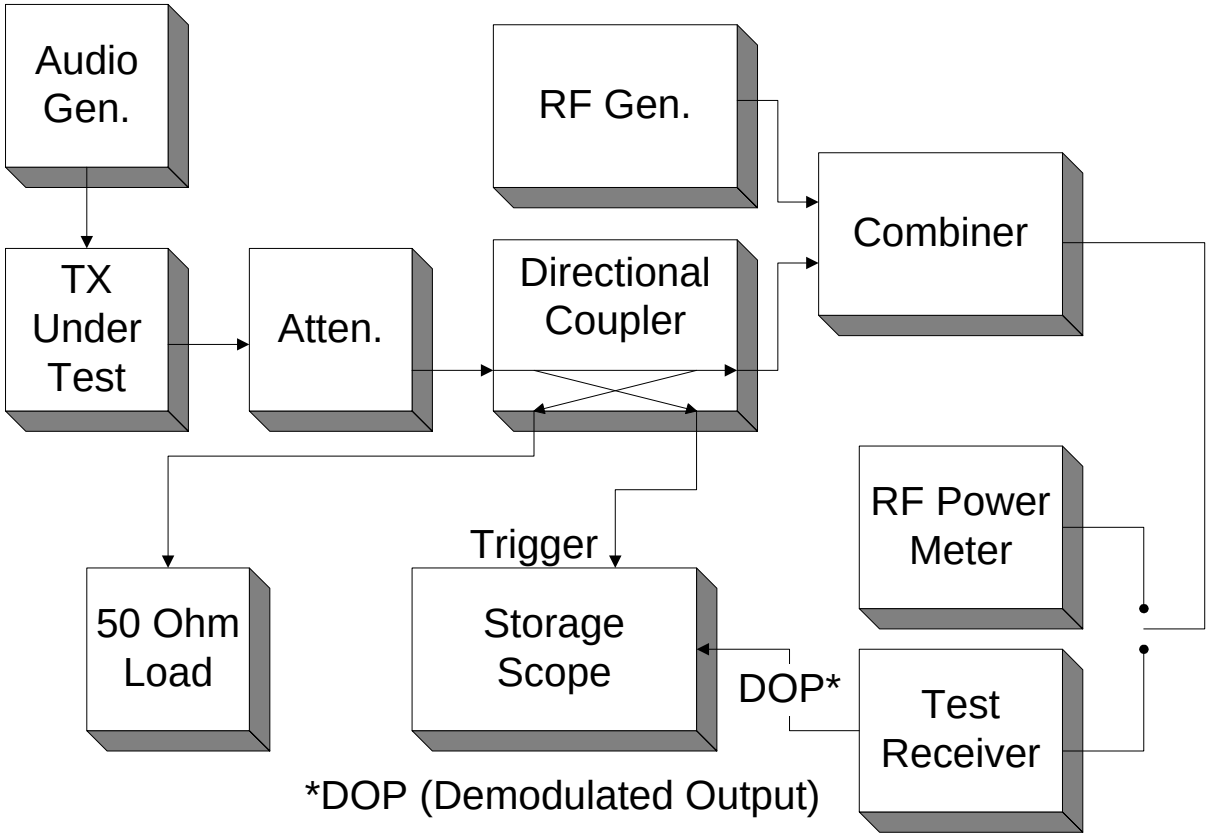
Para. No. 2.993 - Field Strength of Spurious Radiation



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).