KTL Test Report:	98529930
Applicant:	Motorola GmbH Zitadellenweg 34 D-13599 Berlin Germany
Equipment Under Test: (E.U.T.)	Radiotelephone MR1145
FCC ID:	OSAMR1145
In Accordance With:	**FCC Part 90, Subpart I** Private Land Mobile Transmitter
Tested By:	KTL Arnhem Postbus 6004 6800 JA Arnhem The Netherlands
Authorized By:	
	Ing. Patric Wender, Test Engineer
Date:	August 1, 1999
Total Number of Pages:	50

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Section 1. Summary of Test Results

Manufacturer: Motorola GmbH

Model No.: MR1145 SD-R-A-12-25

Serial No.: 965 9325

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

T	N	B

Equipment Code

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: 100351-0

TESTED BY: _____ DATE: _____
Ing. Patric Wender, Test Engineer

Summary Of Test Data

NAME OF TEST	PARA. NO.	SPEC.	MEAS.	RESULT
RF Power Output	90.205			C
Audio Frequency Response	TIA EIA-603.3.2.6			C
Audio Low-Pass Filter Response	TIA EIA-603.3.2.6			C
Modulation Limiting	TIA EIA-603.3.2.6			C
Occupied Bandwidth	90.210			C
Spurious Emissions at Antenna Terminals	90.210			C
Field Strength of Spurious Emissions	90.210			C
Frequency Stability	90.213			C
Transient Frequency Behavior	90.214			C

Footnotes For N/A's:

Test conditions Temperature: 22°C
Humidity: 55%

Section 2. General Equipment Specification

Transmitter

Supply Voltage Input:	13.2 Vdc
Frequency Range:	440 – 470 MHz
Tunable Bands:	1
Necessary Bandwidth:	11 kHz

Type(s) of Modulation:

F3E (Voice)	F1D	F2D	D7W (QAM)	Other
☒	☐	☐	☐	☒

Data Rate(s)	Not Applicable
Internal/External Data Source:	Not Applicable
Emission Designator:	11K0F3E, 11K0G3E
Output Impedance:	50 Ω
RF Power Output (rated):	10 – 25 Watt
Duty Cycle:	Continuous
Channel Spacing(s):	12.5 kHz
Operator Selection of Operating Frequency:	The user can only select pre-programmed frequencies.
Power Output Adjustment Capability:	2 Power levels

Receiver

Frequency Range:	440 – 470 MHz
Tunable Bands:	1
Local Oscillator:	395 – 425 MHz
1st IF:	45 MHz
2nd IF:	455 kHz
Operator Selection of Operating Frequency:	The user can only select pre-programmed frequencies.

Section 3. RF Power Output

NAME OF TEST: RF Power Output	PARA. NO.: 2.985
TESTED BY: ing. P.H.J. Wender	DATE: 01 August 1999

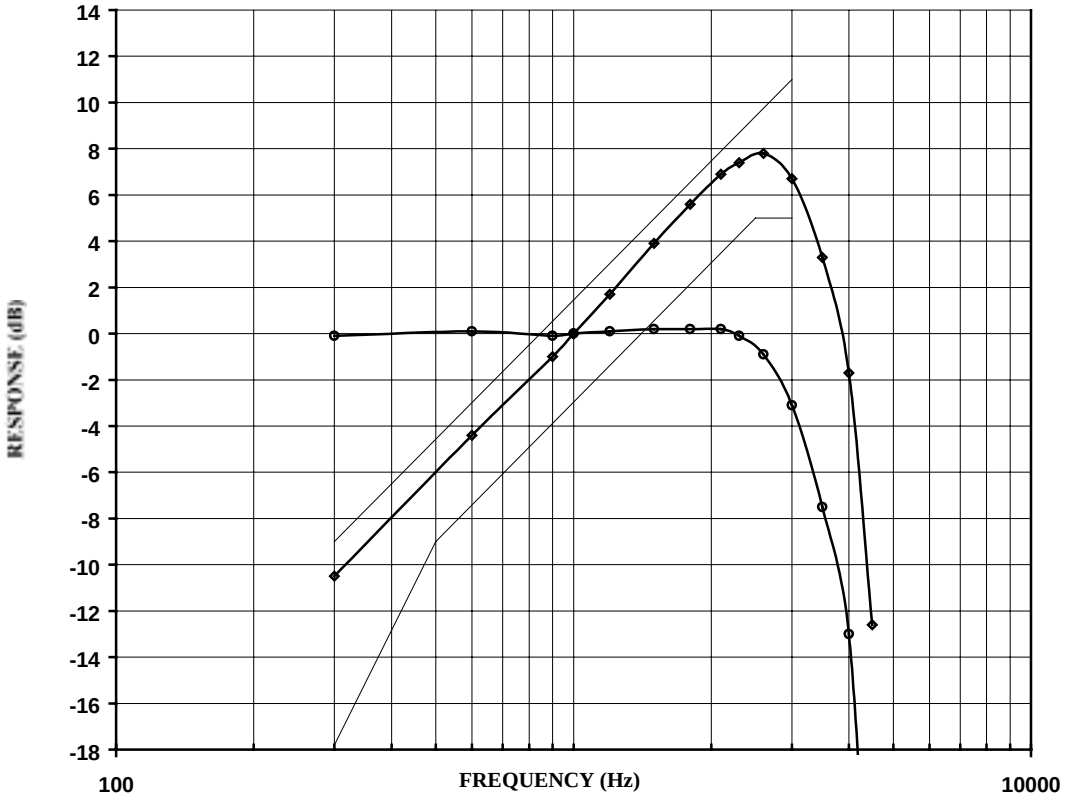
Test Results: Complies

Measurement Data:

Frequency (MHz)	Measured Power (dBm)	Rated Power (dBm)	Measured/Rated (dB)
455.025	43.8	44	-0.2
455.025	40.9	40	0.9

Section 4. Audio Frequency Response

NAME OF TEST: Audio Frequency Response	PARA. NO.: 2.987(a)
TESTED BY: ing. P.H.J. Wender	DATE: 01 August 1999



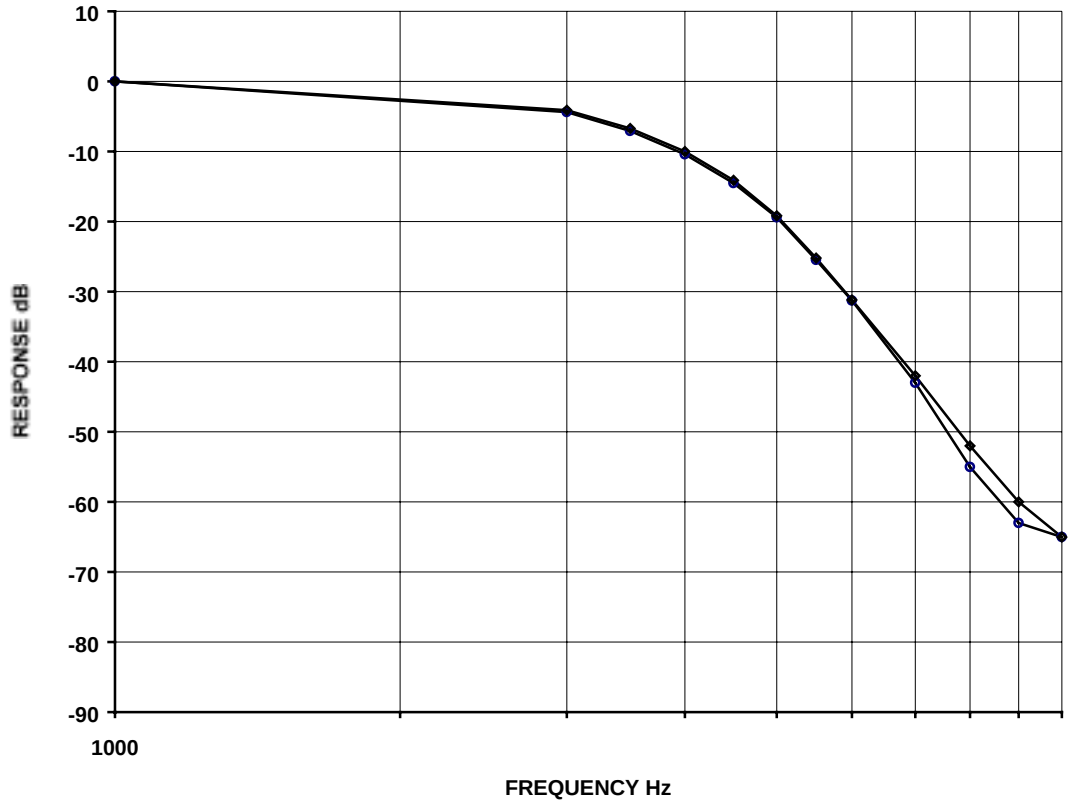
Audio Frequency Response

Frequency	300	600	900	1.2 k	1.5 k	1.8 k	2.1k	2.3 k	2.6 k	3.0 k	3.5 k	4 k
FM	-0.1	0.1	-0.1	0.1	0.2	0.2	0.2	-0.1	-0.9	-3.1	-7.5	-13
PM	-10.5	-4.4	-1	1.7	3.9	5.6	6.9	7.4	7.8	6.7	3.3	-1.7

Frequency	4.5 k	5 k	5.5 k	6 k	6.5 k	7 k	7.5 k	8 k	8.5 k	9 k	9.5 k	10 k
FM	-29	--	--	--	--	--	--	--	--	--	--	--
PM	-12.6	--	--	--	--	--	--	--	--	--	--	--

Section 5. Audio Low-Pass Filter Response

NAME OF TEST: Audio Low-Pass Filter Response	PARA. NO.: 2.987(a)
TESTED BY: ing. P.H.J. Wender	DATE: 01 August 1999



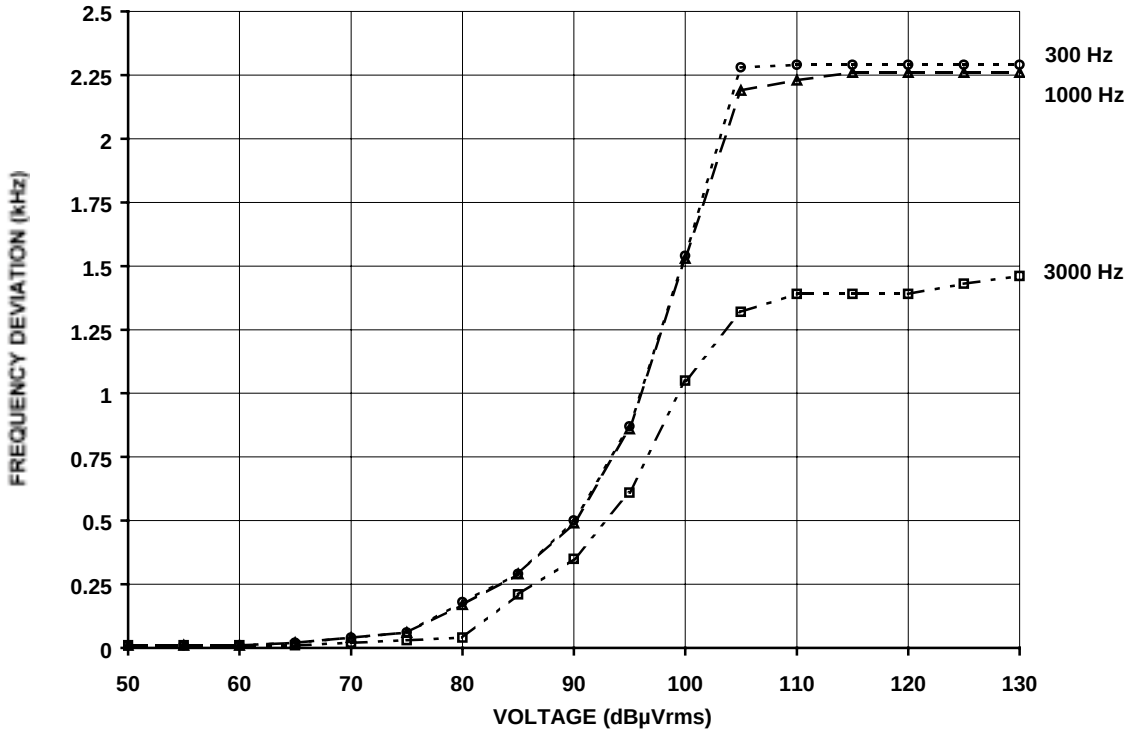
Audio Low-Pass Filter Response

Frequency	1k	3 k	3.5 k	4 k	4.5 k	5 k	5.5 k	6 k	7 k	8 k	9 k	10 k
FM	0	-4.4	-7.1	-10.4	-14.5	-19.4	-25.5	-31.4	-43	-55	-63	-65
PM	0	-4.1	-6.7	-10.0	-14.1	-19.2	-25.2	-31.2	-42	-52	-60	-65

Section 6. Modulation Limiting

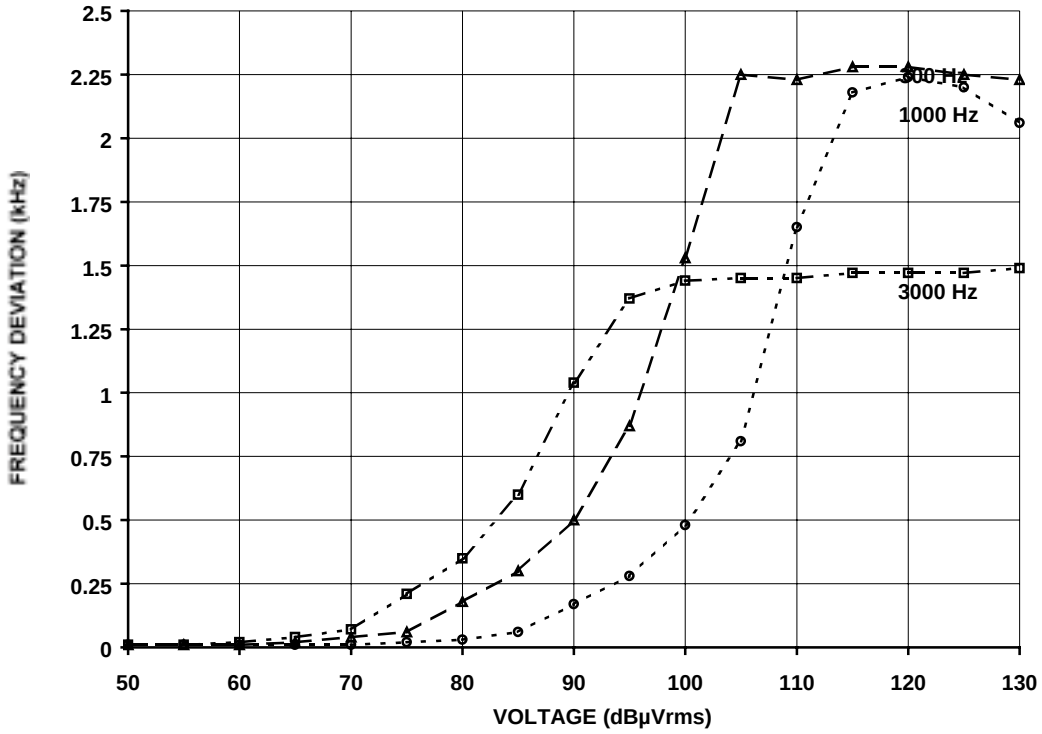
NAME OF TEST: Modulation Limiting	PARA. NO.: 2.987(b)
TESTED BY: ing. P.H.J. Wender	DATE: 01 August 1999

FM :



Input	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120	125	130
300Hz	0.01	0.01	0.01	0.02	0.04	0.06	0.18	0.29	0.50	0.87	1.54	2.28	2.29	2.29	2.29	2.29	2.29
1kHz	0.01	0.01	0.01	0.02	0.04	0.06	0.17	0.29	0.49	0.86	1.53	2.19	2.23	2.26	2.26	2.26	2.26
3kHz	0.01	0.01	0.01	0.01	0.02	0.03	0.04	0.21	0.35	0.61	1.05	1.32	1.39	1.39	1.39	1.43	1.46

PM :



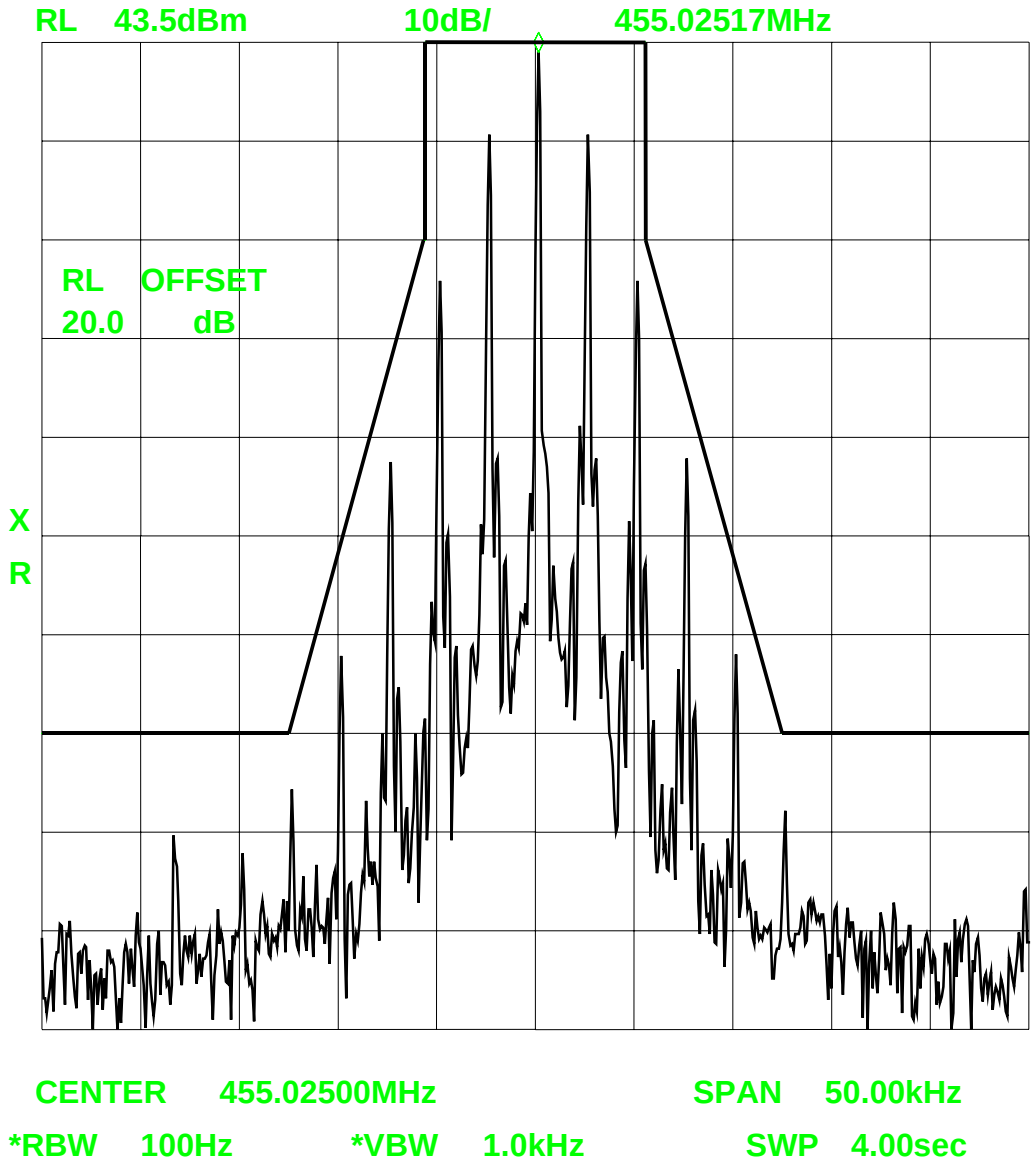
Input	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120	125	130
300Hz	0.01	0.01	0.01	0.01	0.01	0.02	0.03	0.06	0.17	0.28	0.48	0.81	1.65	2.18	2.24	2.20	2.06
1kHz	0.01	0.01	0.01	0.02	0.04	0.06	0.18	0.30	0.50	0.87	1.53	2.25	2.23	2.28	2.28	2.25	2.23
3kHz	0.01	0.01	0.02	0.04	0.07	0.21	0.35	0.60	1.04	1.37	1.44	1.45	1.45	1.47	1.47	1.47	1.49

Section 7. Occupied Bandwidth

NAME OF TEST: Occupied Bandwidth	PARA. NO.: 2.989
TESTED BY: ing. P.H.J. Wender	DATE: 01 August 1999

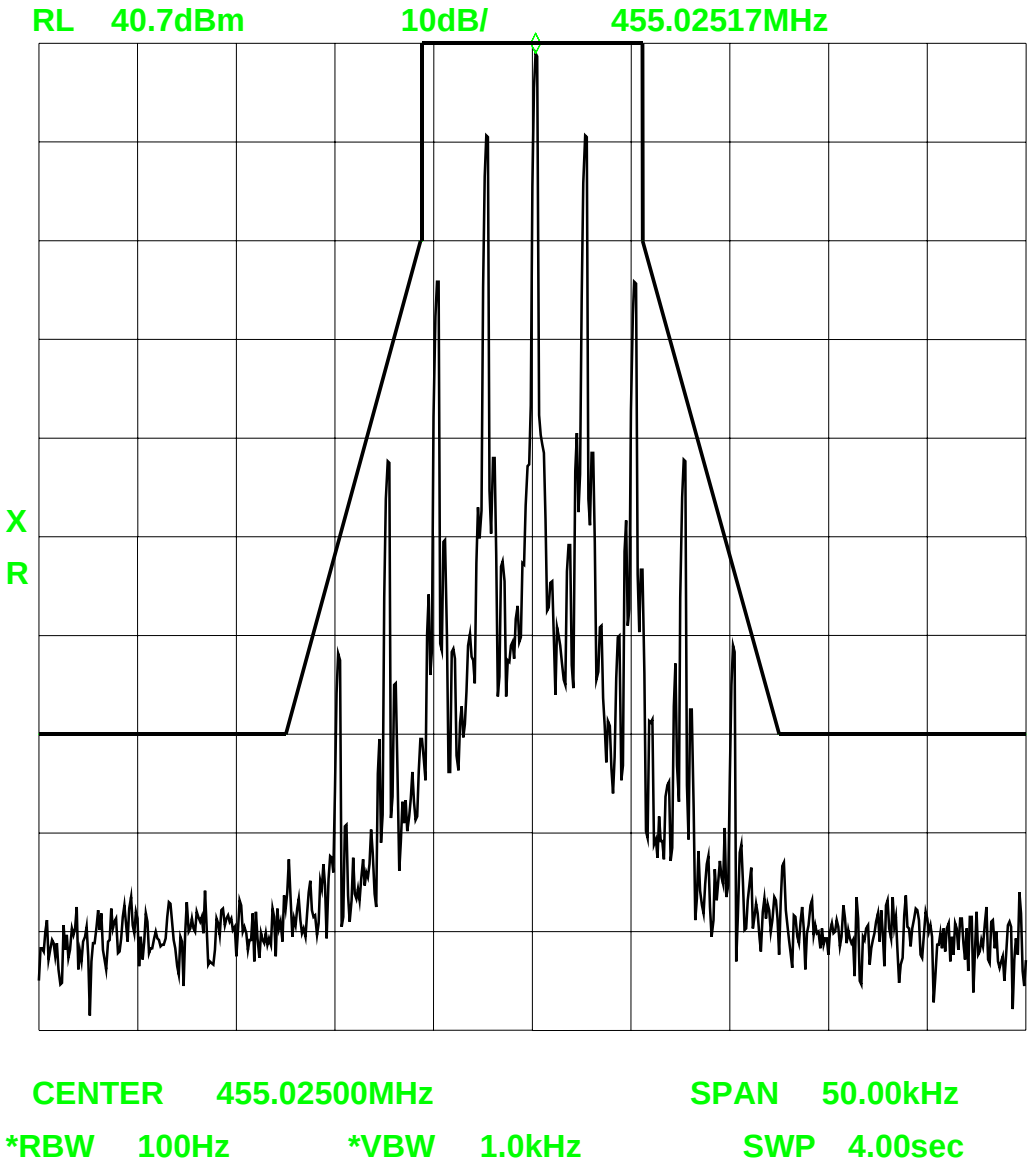
Test Results: Complies.

Test Data: See attached graph(s).



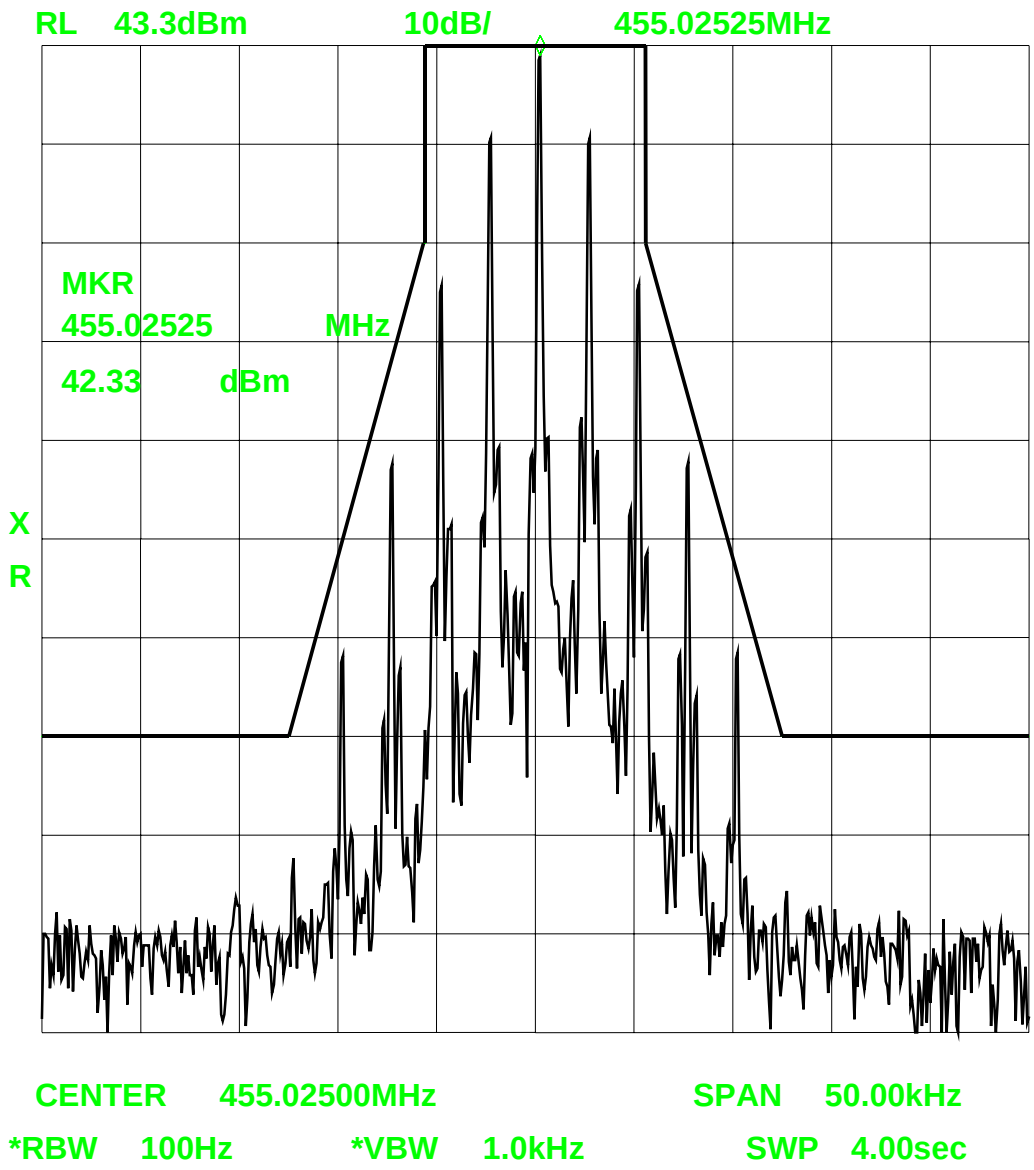
FM, High power

Modulation frequency	:	2500 Hz
Modulation level	:	125 dBµV



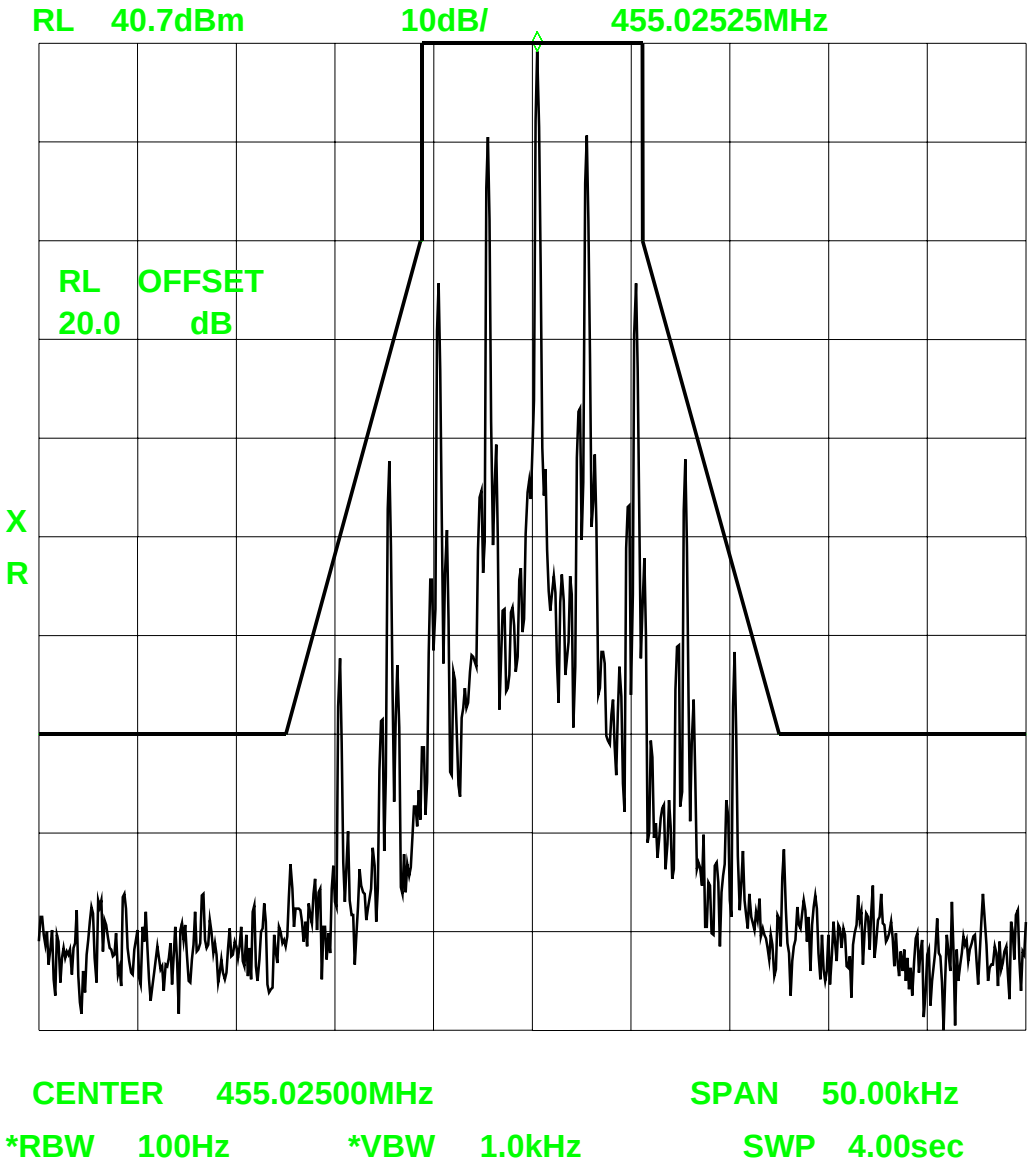
FM, Low power

Modulation frequency	:	2500 Hz
Modulation level	:	125 dBµV



PM, High Power

Modulation frequency	:	2500 Hz
Modulation level	:	125 dBµV



PM, Low power

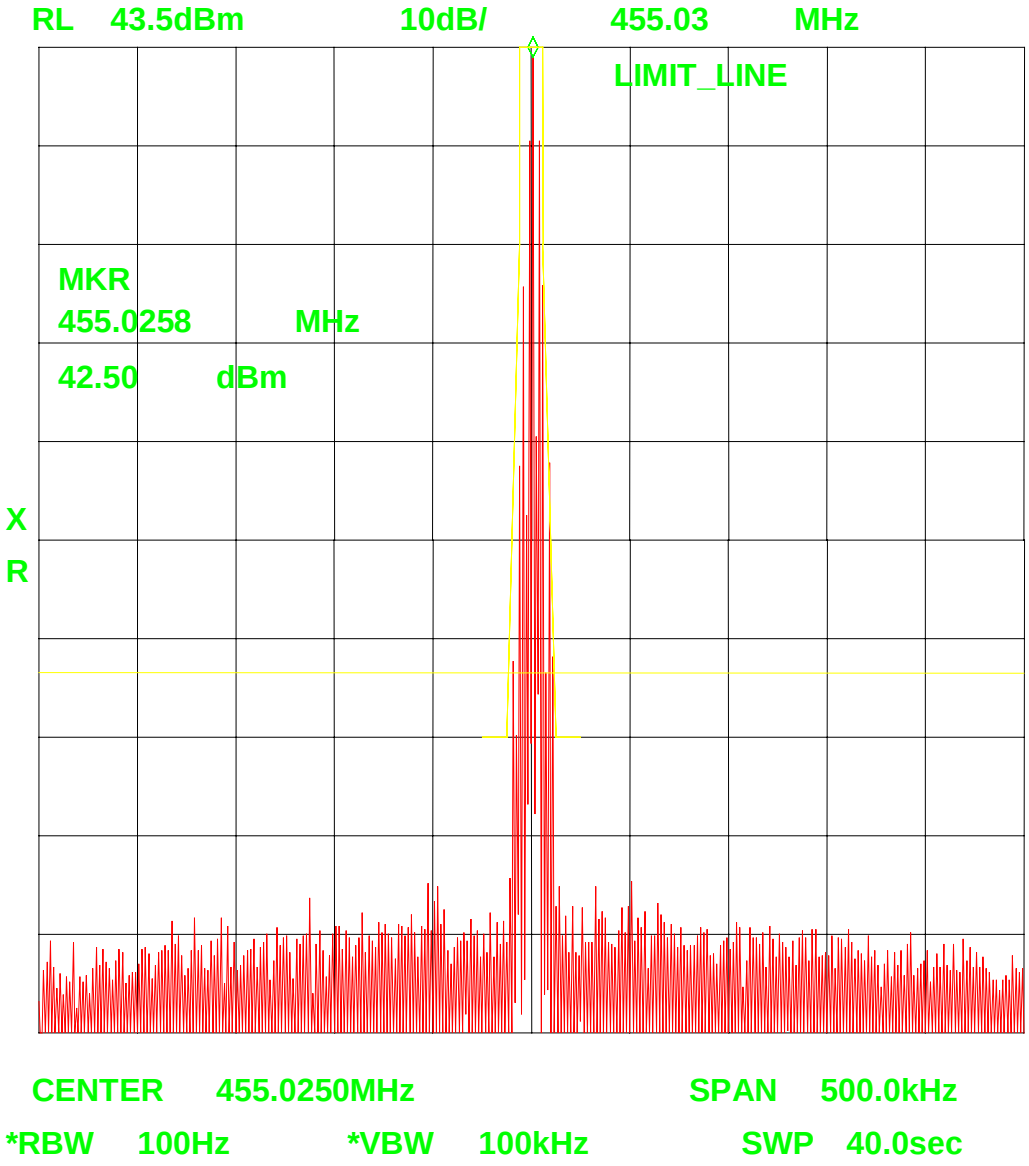
Modulation frequency	:	2500 Hz
Modulation level	:	125 dBµV

Section 8. Spurious Emissions at Antenna Terminals

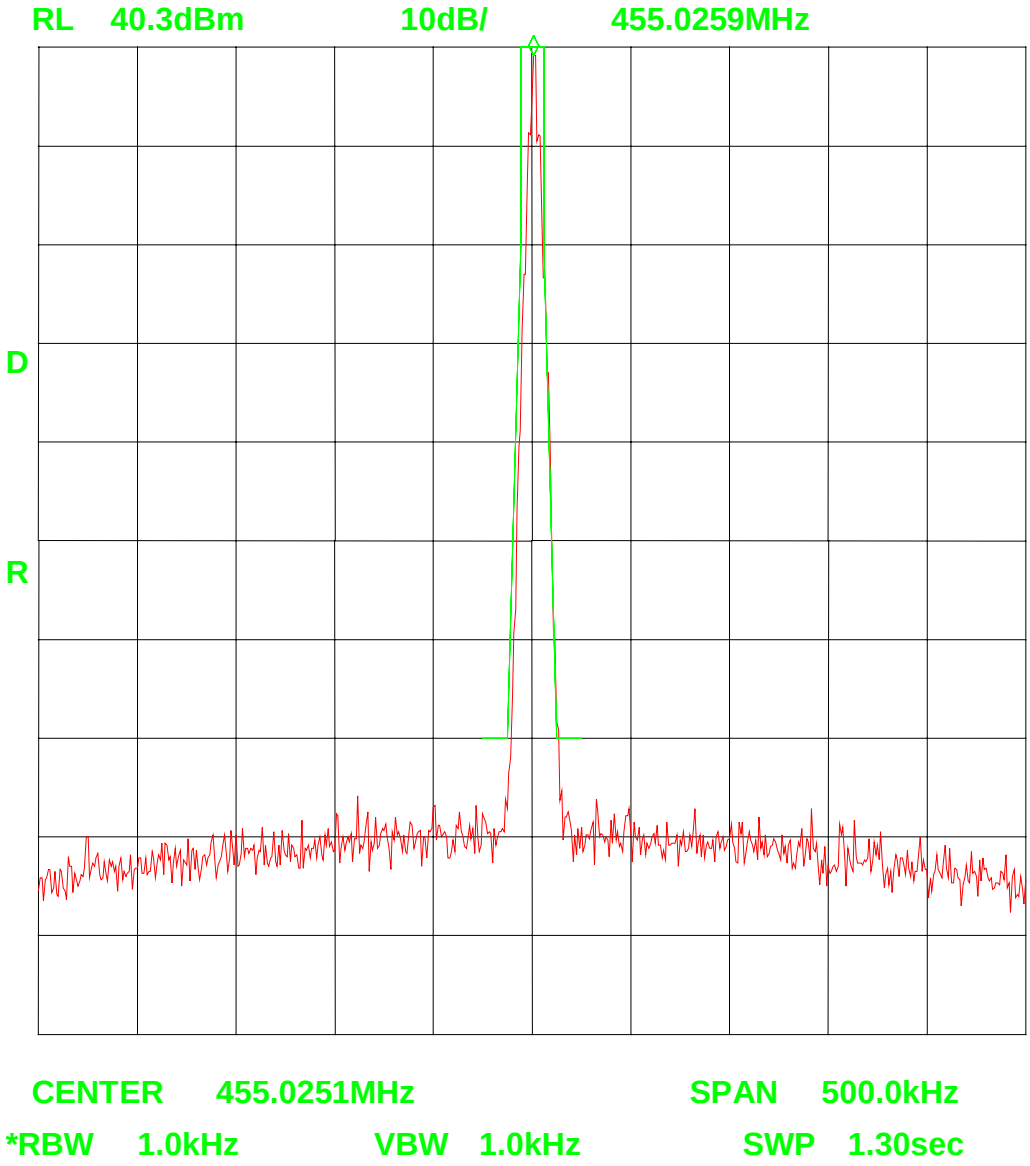
NAME OF TEST: Spurious Emissions @ Antenna Terminals	PARA. NO.: 2.991
TESTED BY: ing. P.H.J. Wender	DATE: 01 August 1999

Test Results: Complies.

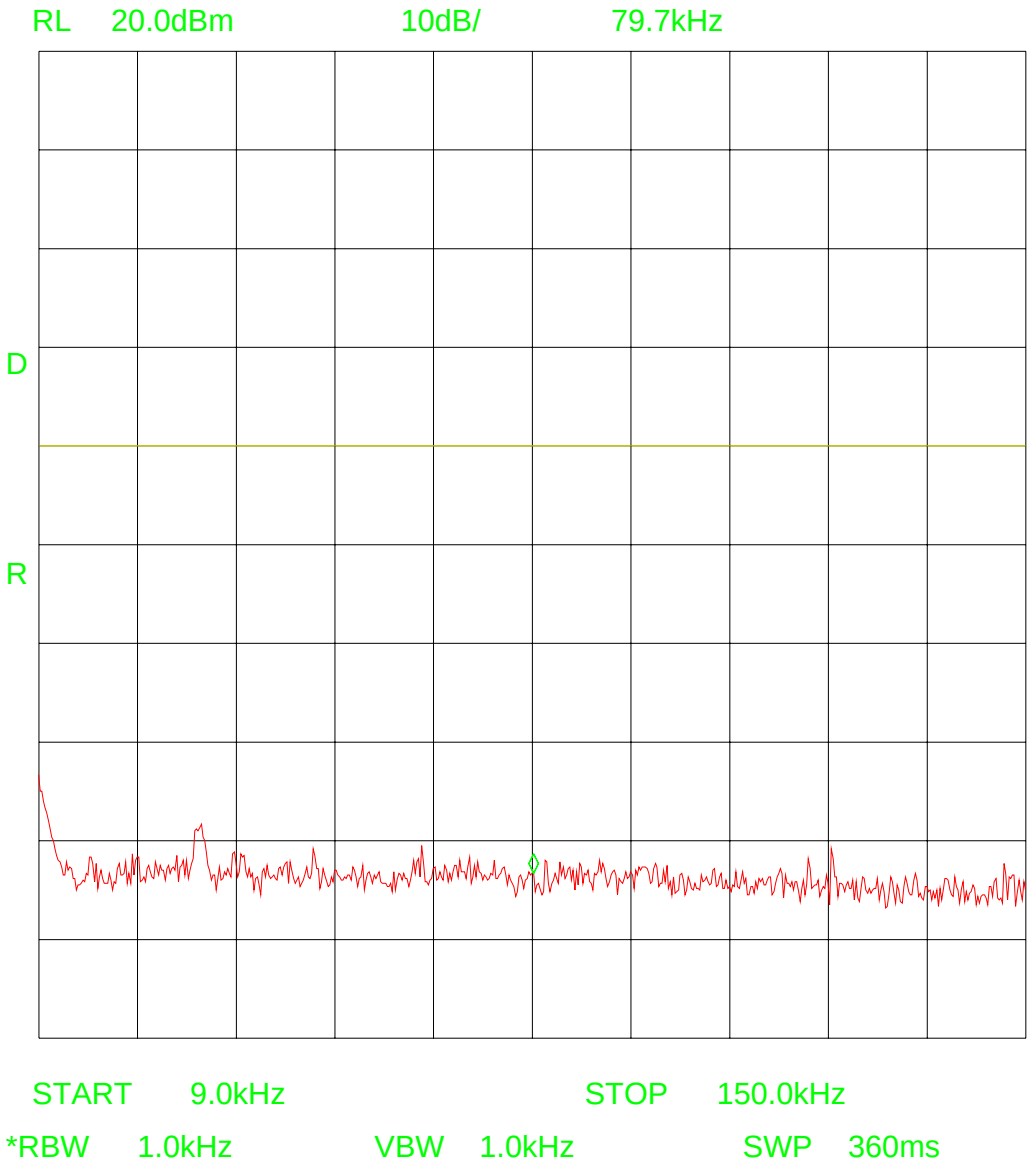
Test Data: See attached graph(s).



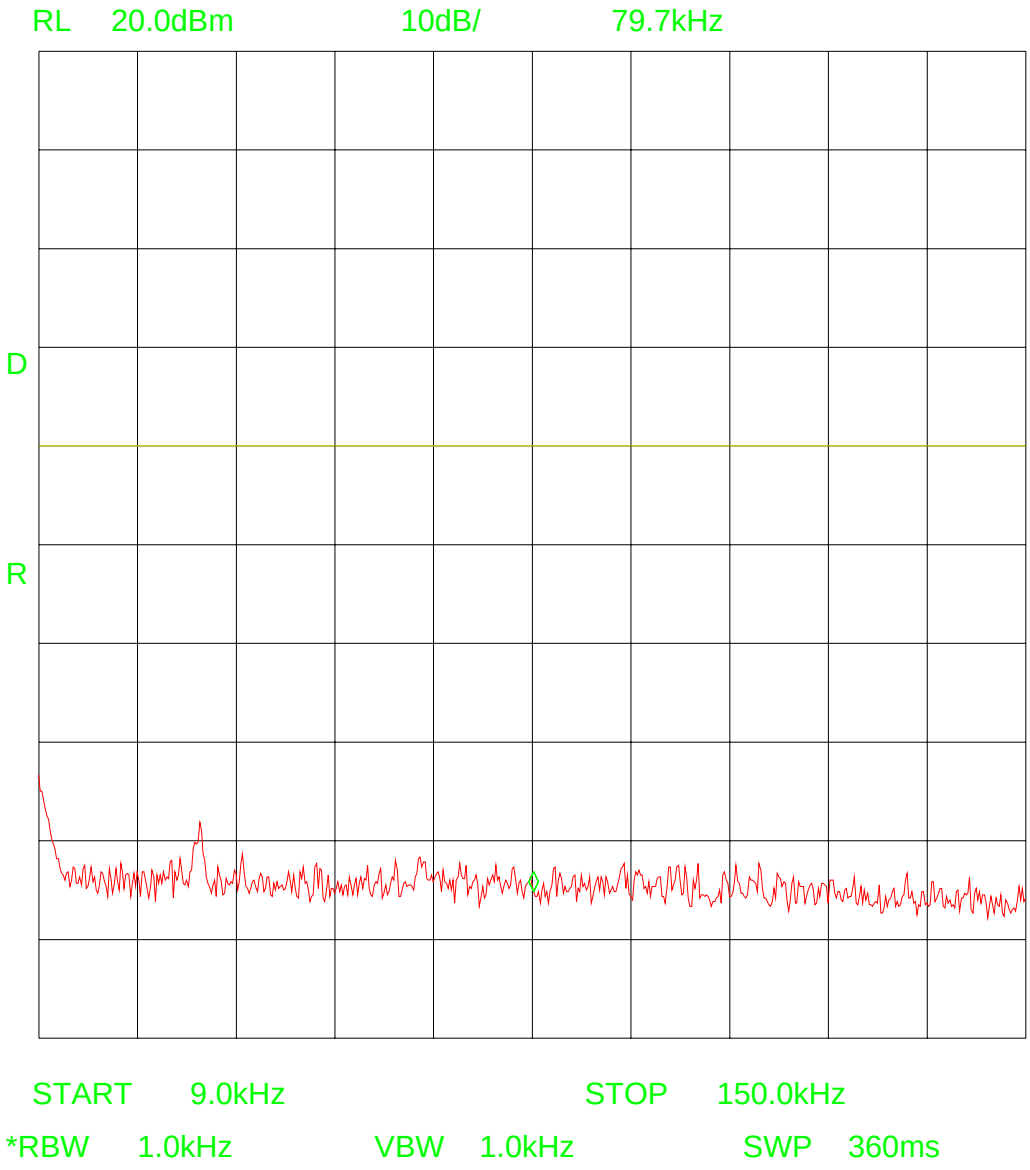
FM high power,plus mask D and limit line –20 dBm
Modulation 2500 Hz, 125 dBµV



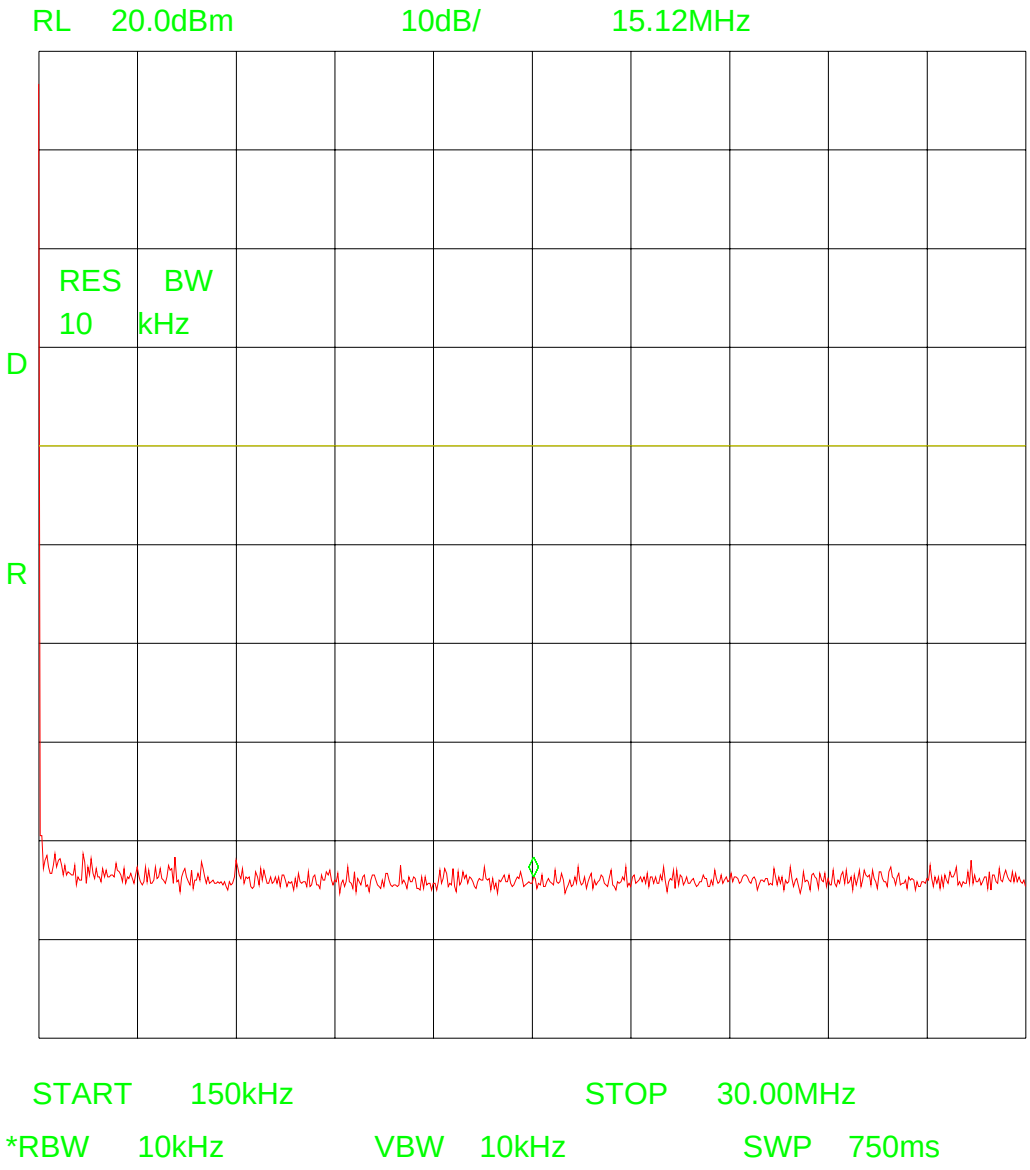
FM low power,plus mask D
Modulation 2500 Hz, 125 dBµV



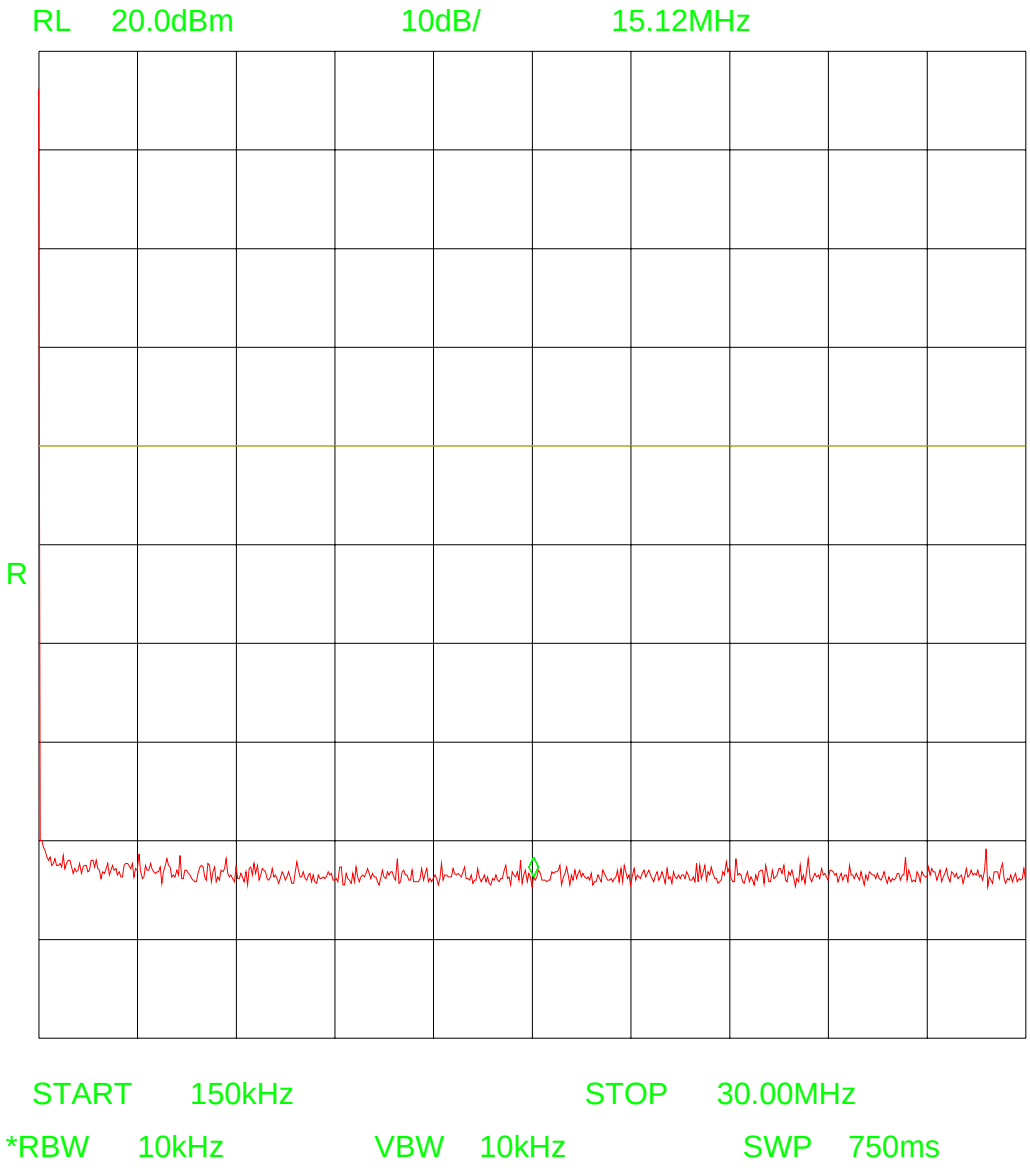
FM high power
Modulation 2500 Hz, 125 dBµV



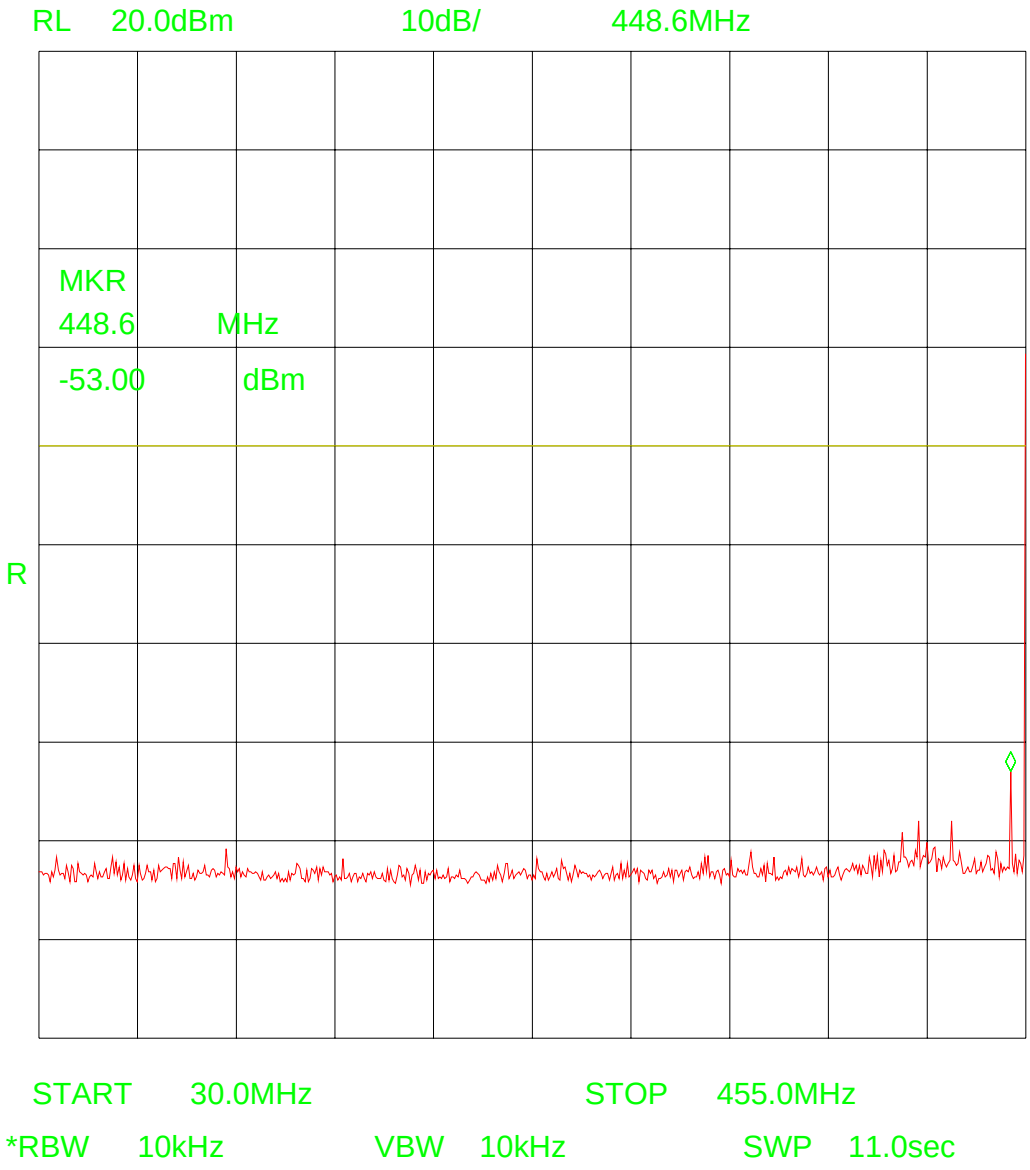
FM, low power
Modulation 2500 Hz, 125 dBµV



FM, high power
Modulation 2500 Hz, 125 dBµV

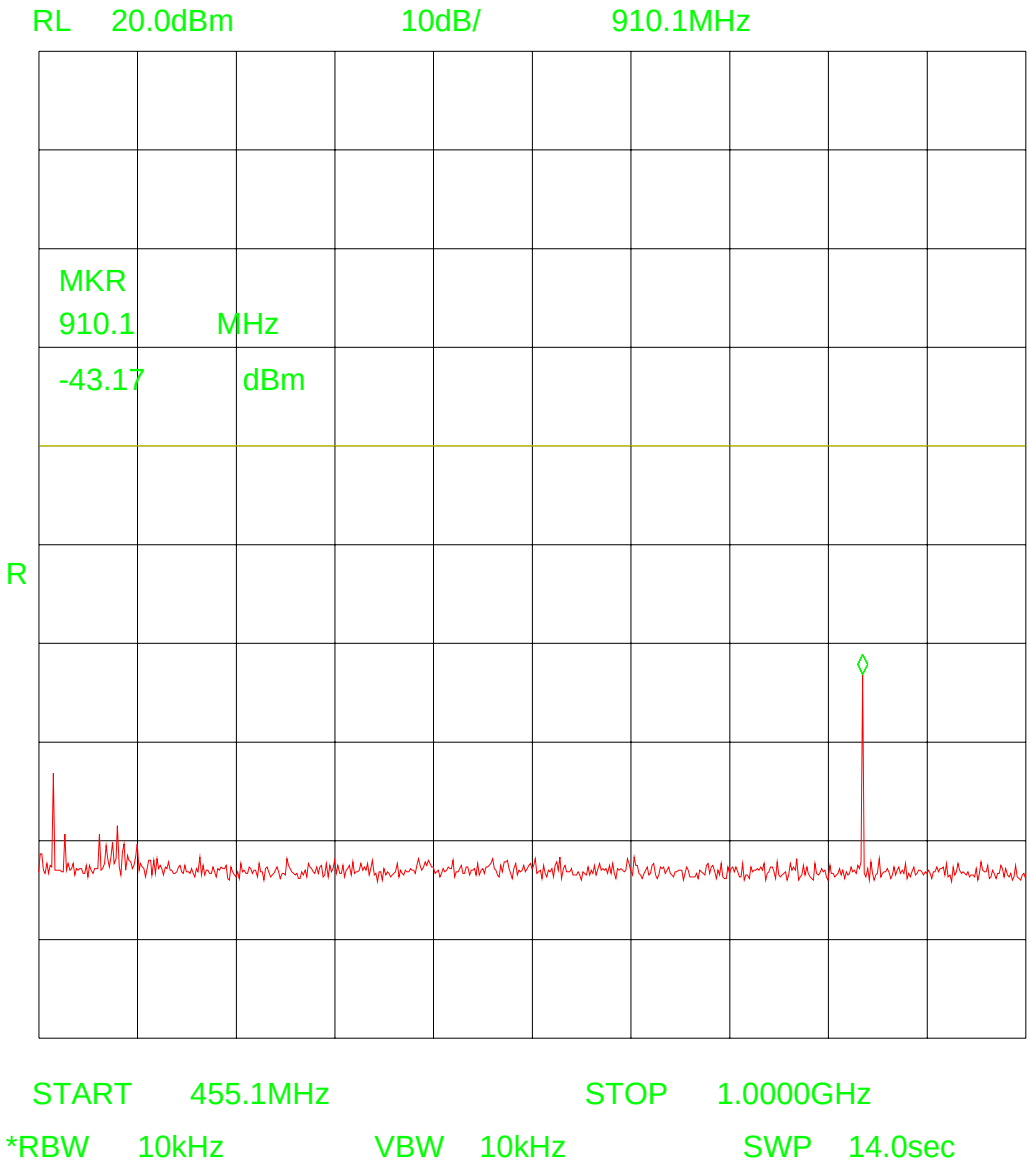


FM, low power
Modulation 2500 Hz, 125 dBµV

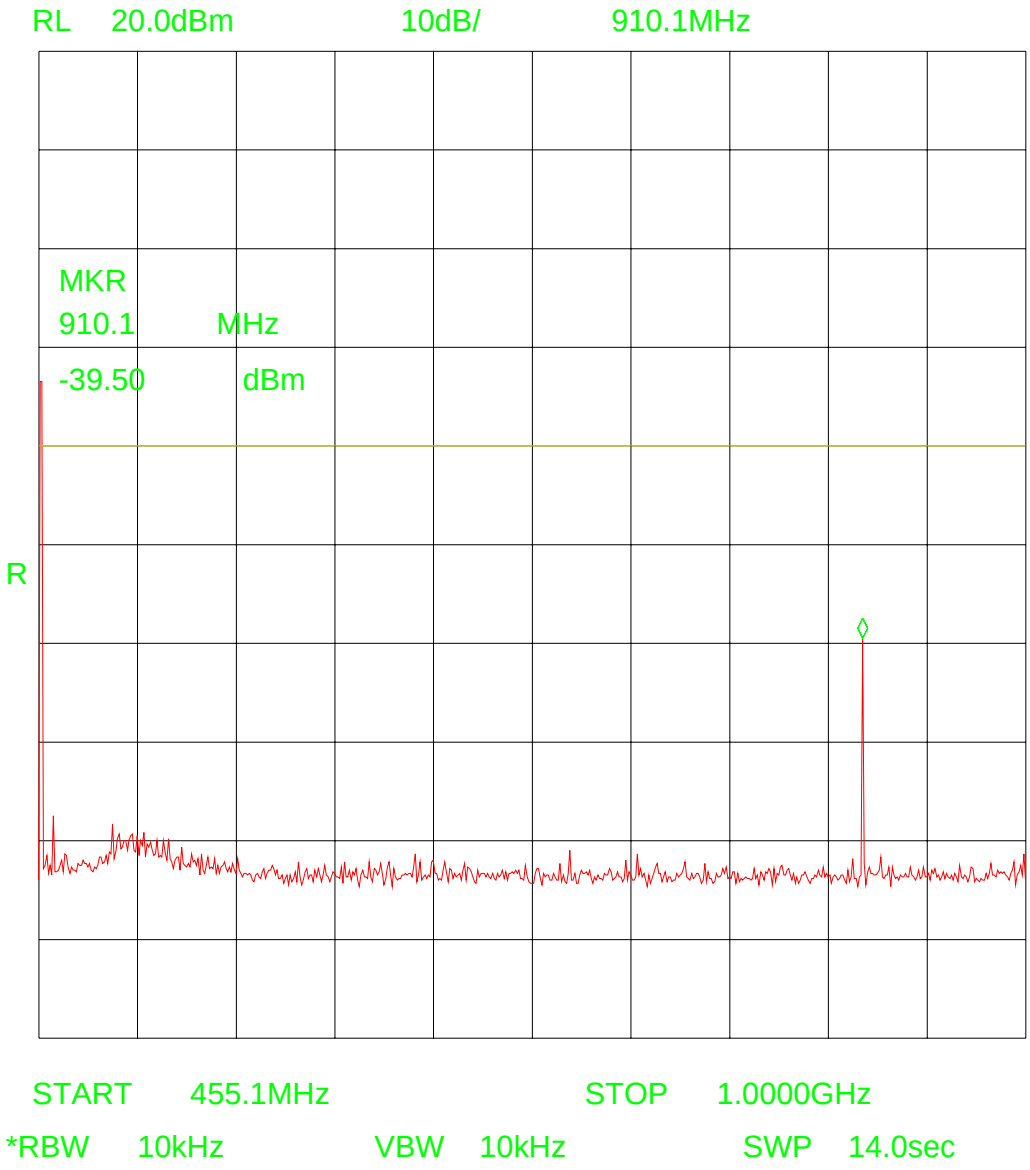


FM, high power
Modulation 2500 Hz, 125 dBµV

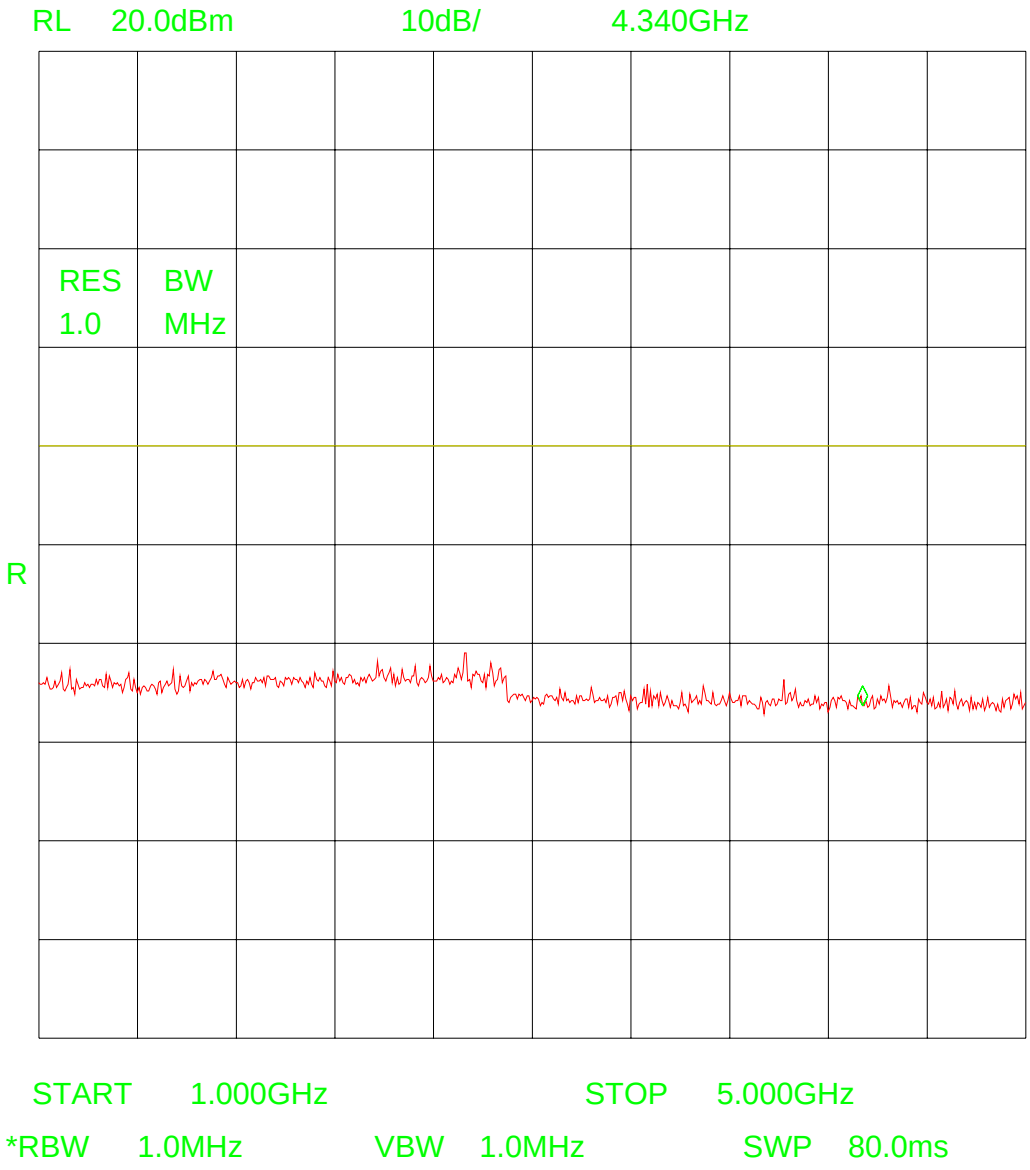
FM, low power
Modulation 2500 Hz, 125 dBµV



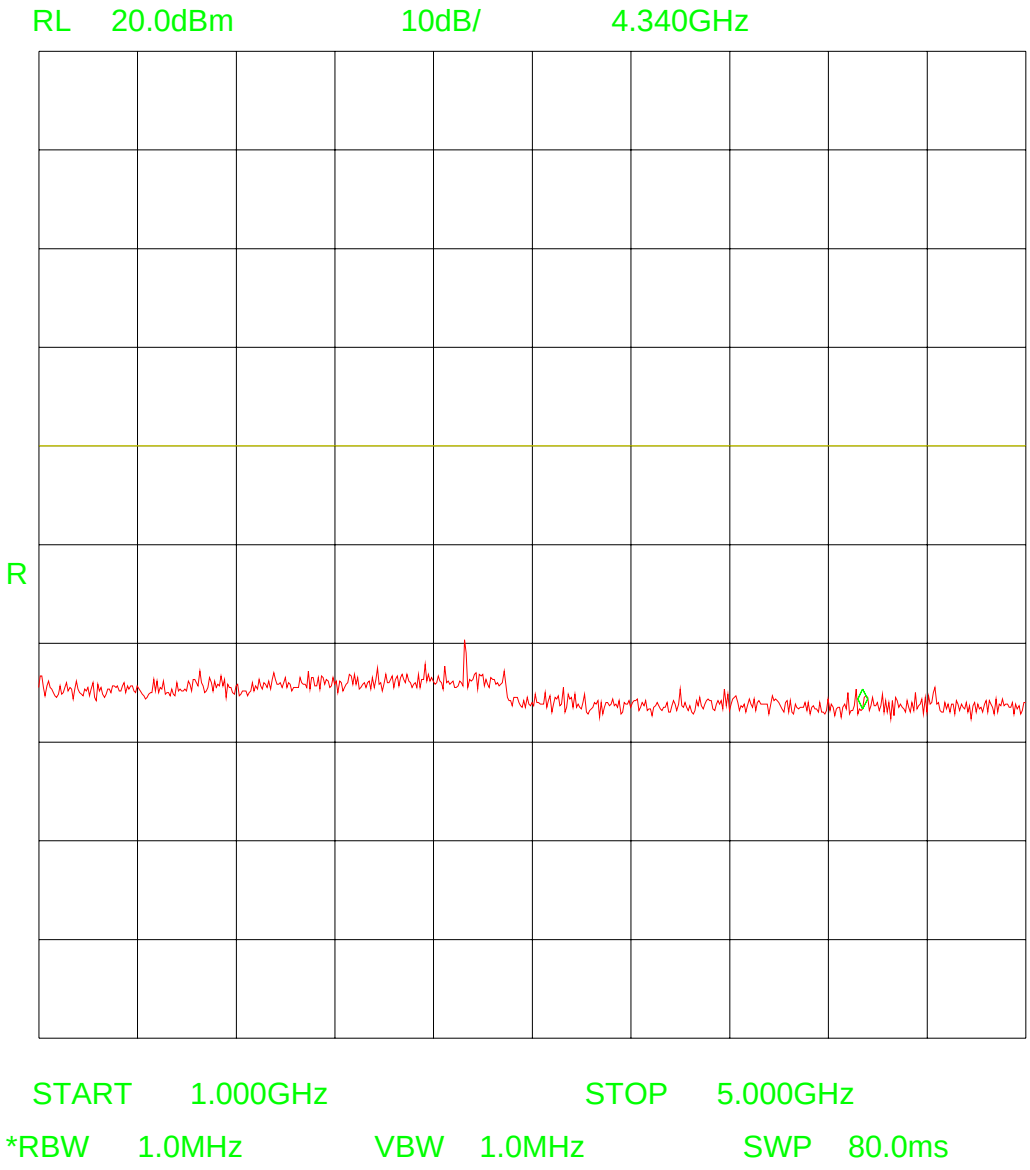
FM, high power
Modulation 2500 Hz, 125 dBµV



FM, low power
Modulation 2500 Hz, 125 dBµV



FM, high power
Modulation 2500 Hz, 125 dBµV



FM, low power
Modulation 2500 Hz, 125 dBµV

Section 9. Field Strength of Spurious Emissions

NAME OF TEST: Field Strength of Spurious Emissions	PARA. NO.: 2.993
TESTED BY: ing. P.H.J. Wender	DATE: 01 August 1999

Test Results: Complies.

Test Data: See attached table.

Test Data - Radiated Emissions

Frequency (MHz)	Polarization	Resolution bandwidth (KHz)	Fieldstrength @ 3m dBµV/m
910.05	H	100	54.9
1,367	V	1000	61.9
1,820	V	1000	66.4
2,273	V	1000	58.9
2,727	V	1000	72.7
3,187	V	1000	73.9
3,640	V	1000	52.3
4,553	V	1000	52.5

Notes:
The spectrum was search up to the 10^{th} harmonic of the fundamental frequency.
B/C = Biconical, B/L = Biconilog, L/P = Log-Periodic, H = Horn, D/P = Dipole

Section 10. Frequency Stability

NAME OF TEST: Frequency Stability	PARA. NO.: 2.995
TESTED BY: ing. P.H.J. Wender	DATE: 01 August 1999

Test Results: Complies. The maximum frequency drift is 888 Hz.
This is 1.95 ppm.

Measurement Data: See attached tables.

Standard Test Frequency: 455.025 MHz

	Frequency (MHz)		
Time (min)	85%	100%	115%
0.0	455.025302	455.025108	455.025288
0.5	455.025274	455.025113	455.025276
1.0	455.025252	455.025114	455.025248
1.5	455.025234	455.025116	455.025220
2.0	455.025222	455.025120	455.025199
2.5	455.025214	455.025126	455.025176
3.0	455.025210	455.025133	455.025159
3.5	455.025208	455.025142	455.025143
4.0	455.025208	455.025145	455.025123
4.5	455.025208	455.025148	455.025107
5.0	455.025208	455.025150	455.025085
	11.22V	13.20V	15.18V

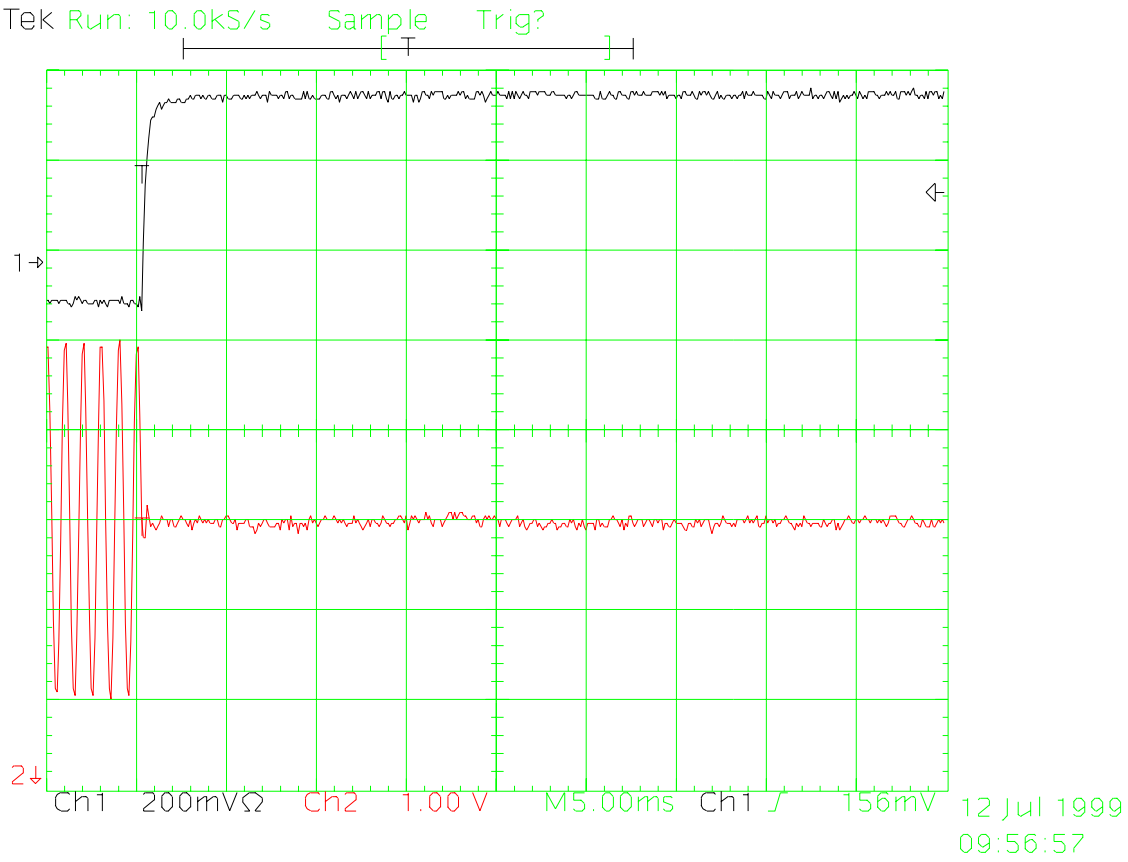
Time (min)	Frequency (MHz)				
	-30°C	-20°C	-10°C	0°C	10°C
0.0	455.025888	455.025700	455.025401	455.025174	455.025019
0.5	455.025865	455.025678	455.025381	455.025161	455.025008
1.0	455.025813	455.025627	455.025332	455.025129	455.024996
1.5	455.025762	455.025574	455.025285	455.025093	455.024976
2.0	455.025733	455.025521	455.025238	455.025052	455.024963
2.5	455.025703	455.025466	455.025193	455.025012	455.024956
3.0	455.025685	455.025419	455.025153	455.024992	455.024953
3.5	455.025664	455.025379	455.025118	455.024968	455.024955
4.0	455.025644	455.025338	455.025082	455.024949	455.024960
4.5	455.025624	455.025307	455.025056	455.024936	455.024969
5.0	455.025601	455.025278	455.025031	455.024926	455.024978

Time (min)	Frequency (MHz)				
	20°C	30°C	40°C	50°C	
0.0	455.025086	455.025206	455.025292	455.025284	
0.5	455.025080	455.025197	455.025274	455.025269	
1.0	455.025064	455.025178	455.025247	455.025223	
1.5	455.025053	455.025166	455.025224	455.025173	
2.0	455.025044	455.025159	455.025204	455.025134	
2.5	455.025040	455.025158	455.025185	455.025098	
3.0	455.025042	455.025160	455.025168	455.025069	
3.5	455.025053	455.025163	455.025153	455.025074	
4.0	455.025071	455.025163	455.025135	455.025082	
4.5	455.025091	455.025165	455.025118	455.025090	
5.0	455.025114	455.025164	455.025105	455.025101	

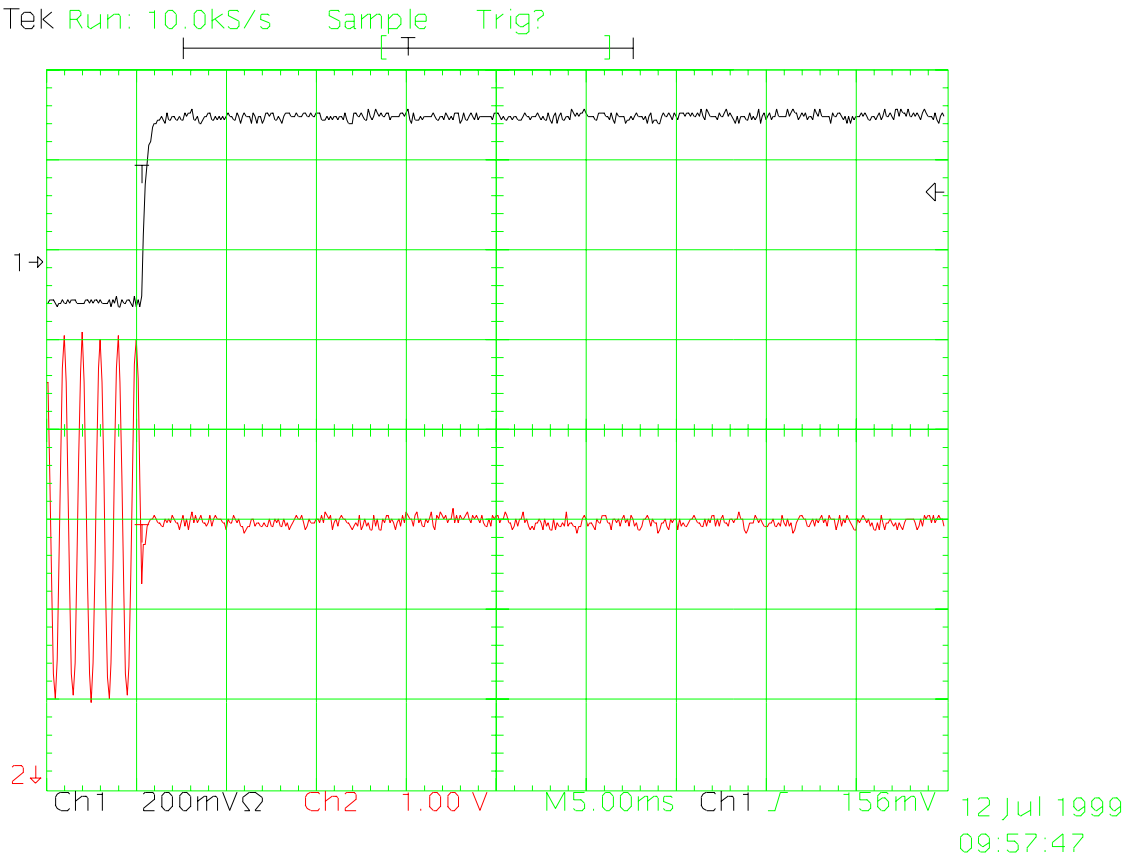
Section 11. Transient Frequency Behaviour

NAME OF TEST: Transient Frequency Behaviour	PARA. NO.: 90.214
TESTED BY: ing. P.H.J. Wender	DATE: 01 August 1999

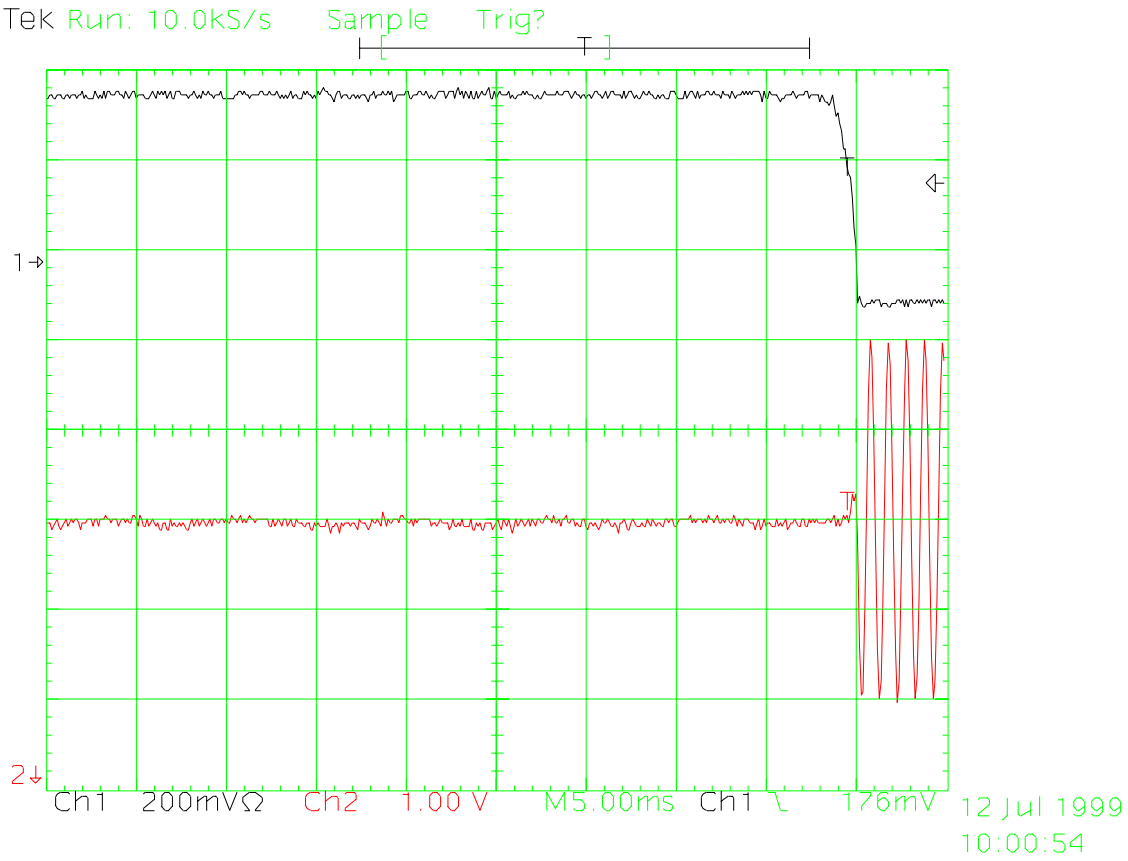
Test Results: Complies
Measurement Data: See attached graphs.



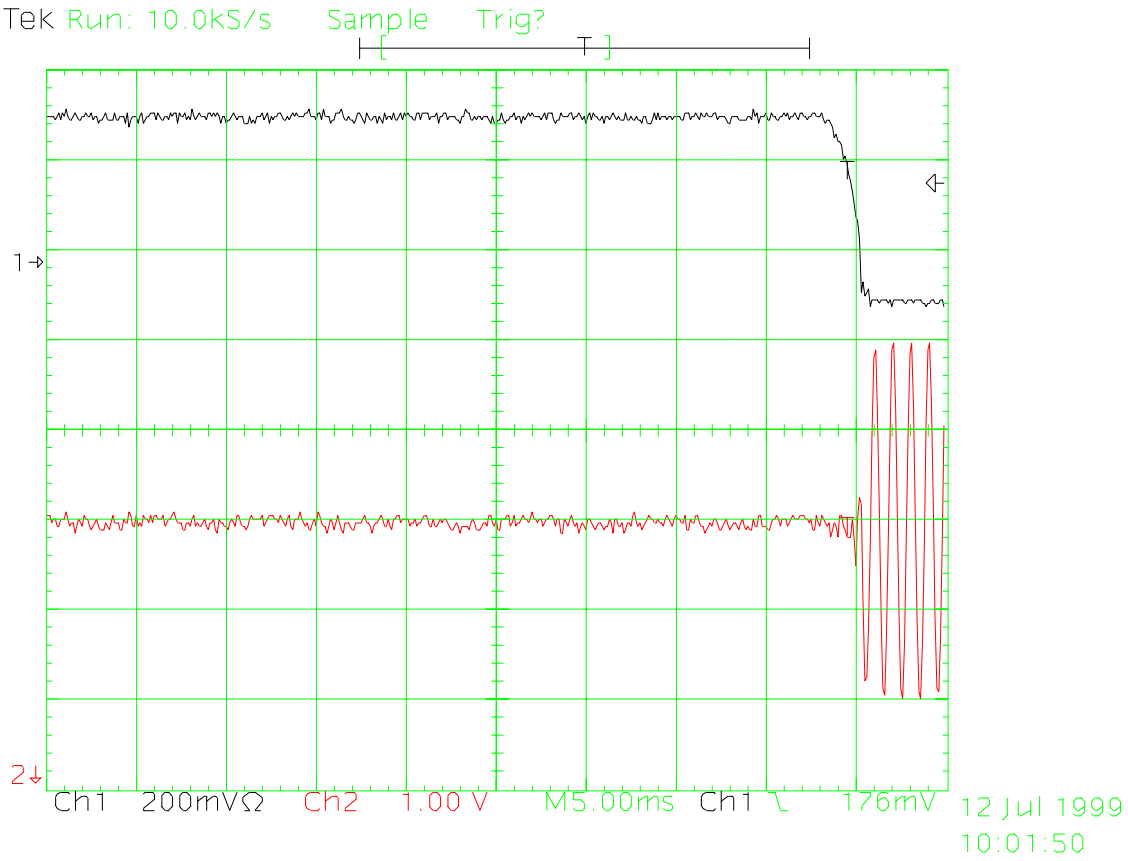
High power
4 divisions is 12.5kHz



Low power
4 divisions I 12.5 kHz



High power
4 divisions is 12.5 kHz



Low power
4 divisions is 12.5 kHz

Section 12. Test Equipment List

Radiotest set	Rohde & Schwarz	CMTA 54
Signal generator	Marconi	2042
Spectrum analyzer	Hewlwett Packard	8563 E
Selective level meter	Hewlett Packard	3586 A
Power supply	Delta	E030-10
Climate Chamber	CTS	C-40/350
Digital oscilloscoop	Tektronix	TDS 680B
Voltmeter	Fluke	Fluke 87
Thermometer	Fluke	Fluke 51
Transient detektor	KTL	1576T2

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: 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: 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 ≤ 1 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 GHz:

G = 1 (Isotropic Gain)
$P = 1 \times 10^{-5}$ Watts (Maximum spurious output power)
R = 3m (Measurement Distance)

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

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

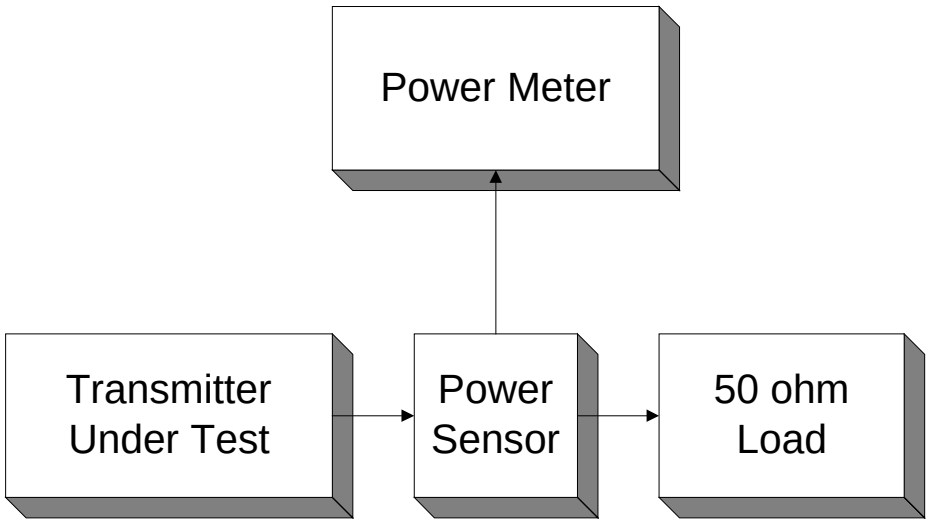
Transient Frequency Behaviour for Equipment Designed to Operate on 12.5 kHz & 6.25 kHz Channels

	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

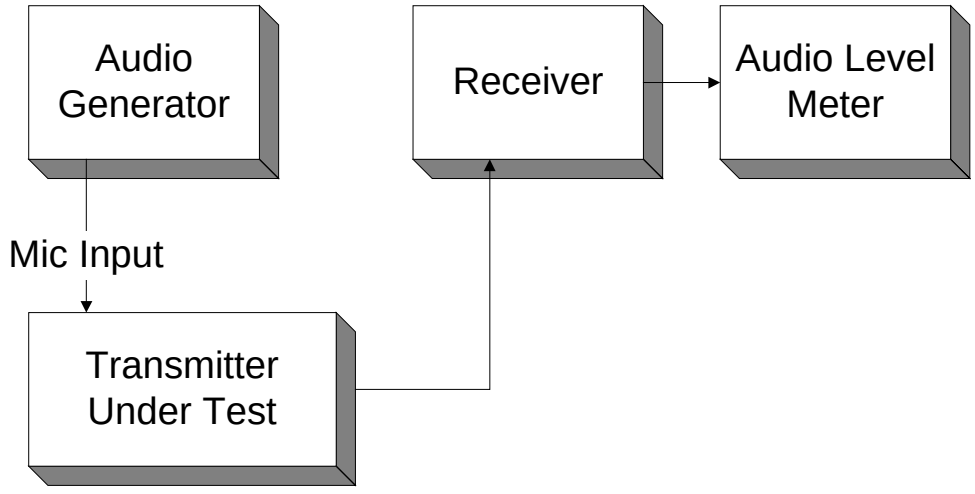
ANNEX B

TEST DIAGRAMS

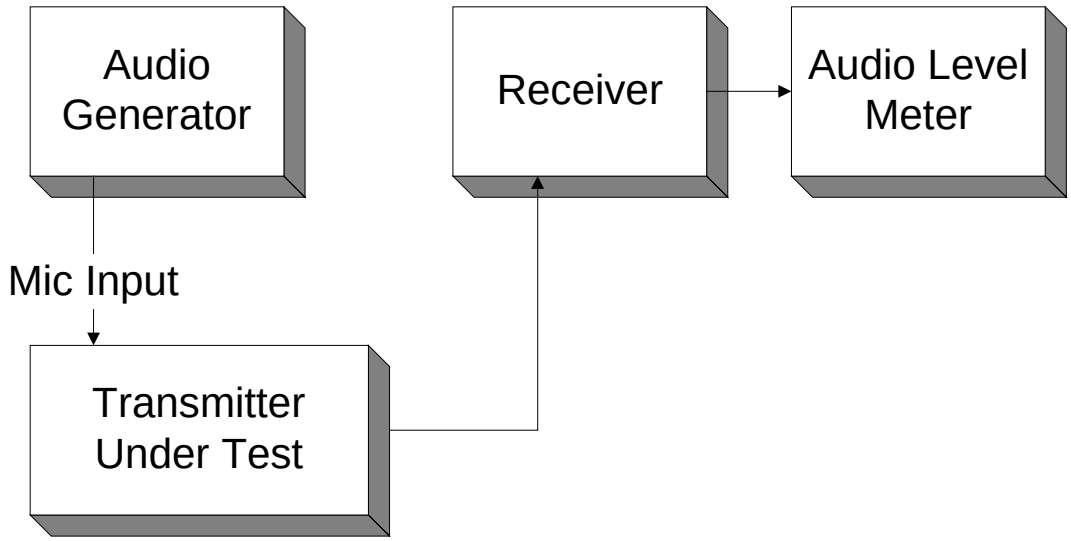
Para. No. 2.985 - R.F. Power Output



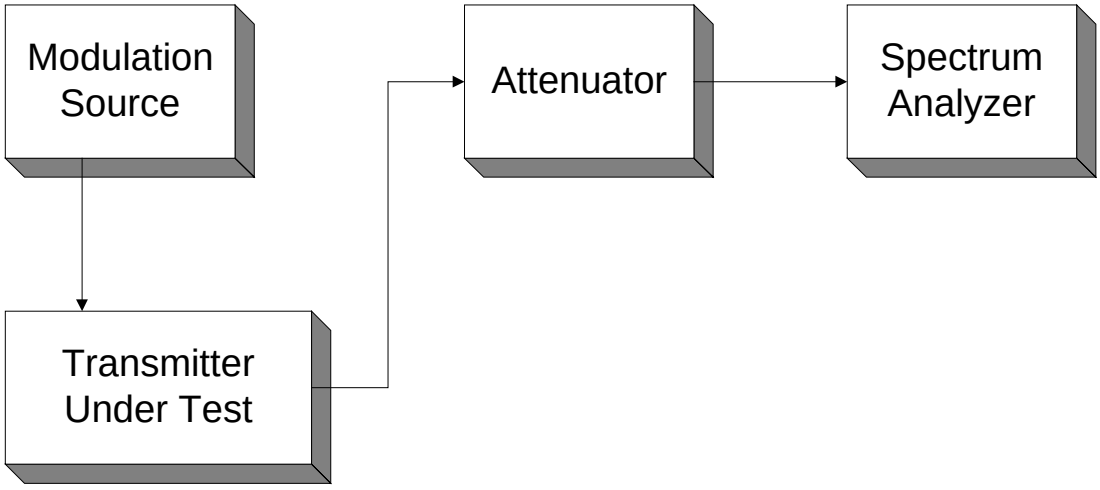
Para. No. 2.987(a) - Audio Frequency Response



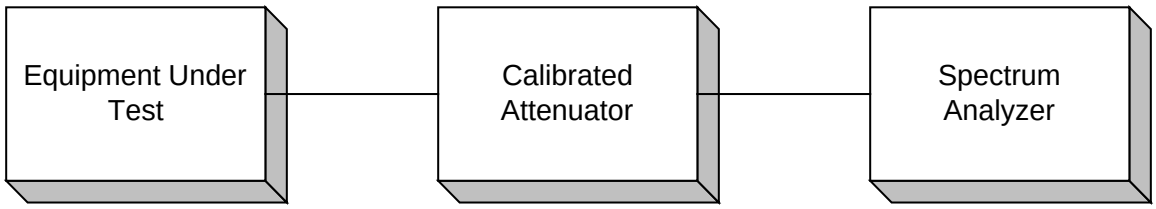
Para. No. 2.987(b) - Modulation Limiting



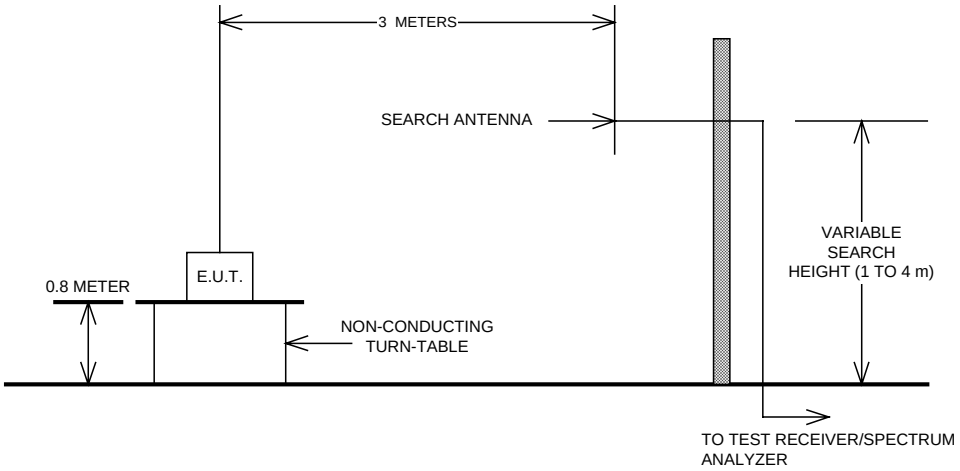
Para. No. 2.989 - Occupied Bandwidth



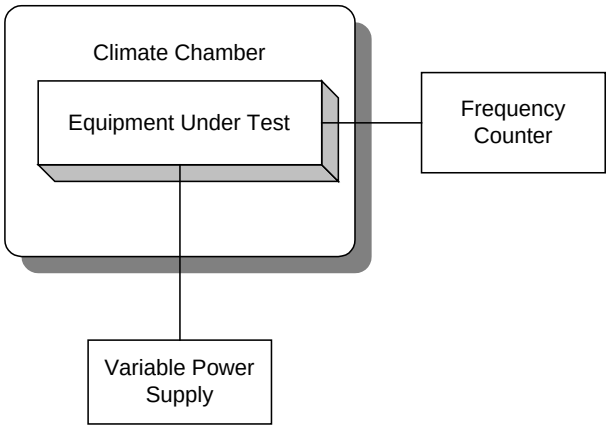
Para. No. 2.991 - Spurious Emissions at Antenna Terminals



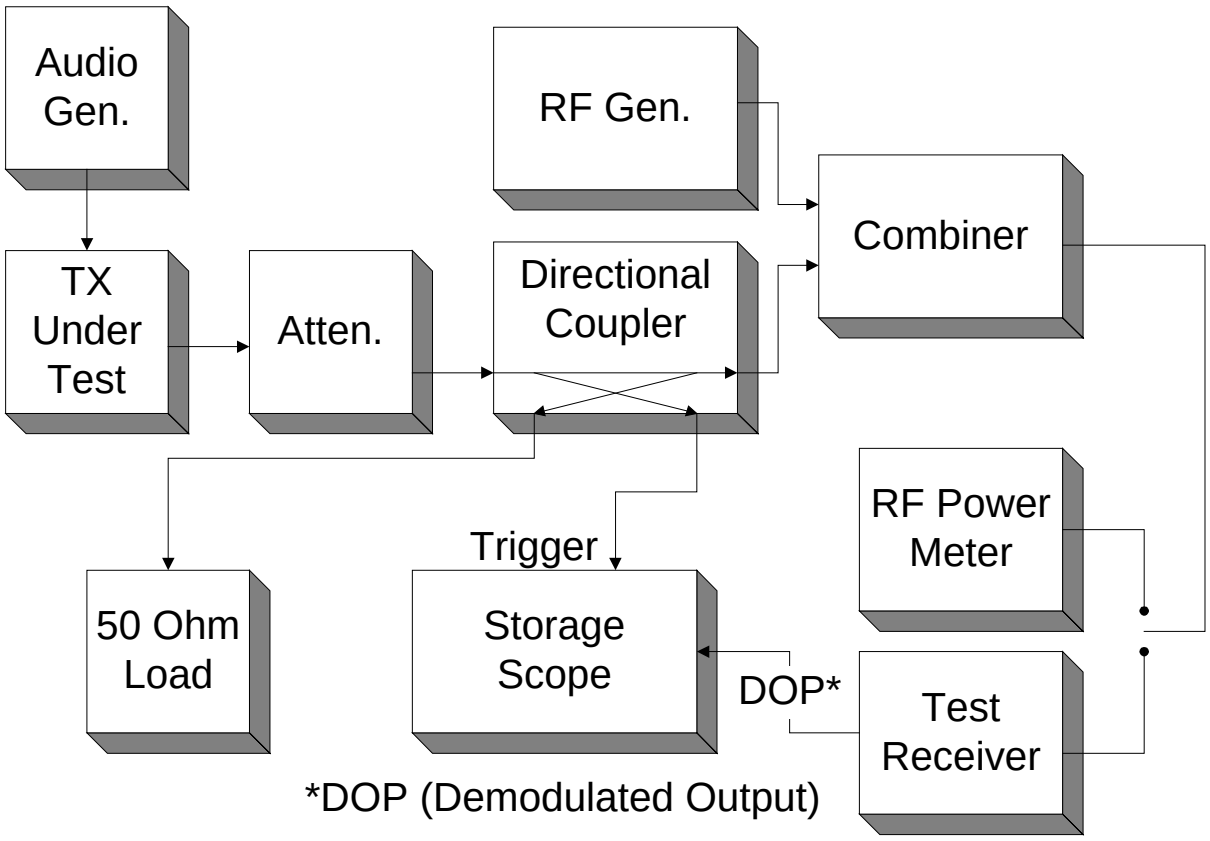
Para. No. 2.993 - Field Strength of Spurious Radiation



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).