



Test report no. : 89270-5

Item tested : VHF Warning Board (VWB)

Type of equipment : VHF Transmitter
(Part of Obstacle Collision Avoidance System)

FCC ID : VE8142005

Client : OCAS AS

FCC Part 87 Subpart D
Aviation Services

RSS-141

Aeronautical radiocommunication equipment in the
Frequency Range 117.975 – 137 MHz

28 January 2008

Authorized by :

Frode Sveinsen
Technical Verificator

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1 GENERAL INFORMATION

1.1 Testhouse Info

Name : Nemko Comlab
Address : Gåsevikveien 8, Box 96
N-2027 Kjeller, NORWAY
Telephone : +47 64 84 57 00
Fax : +47 64 84 57 05
E-mail: post@comlab.no
FCC test firm registration # : 994405
IC OATS registration # : 4443
Total Number of Pages: 43

1.2 Client Information

Name : OCAS AS
Address : Post box 434 Økern, N-0513 Oslo, Norway
Telephone : +47 22 071 000
Fax : +47 22 071 009

Contact:

Name : Jostein Sund Jensen
e-mail: jostein.sund.jensen@ocas-as.no

1.2.1 Manufacturer

Name : Kitron
Address : Tangen alle 39, 4817 His, Norway
Postal Address : Serviceboks 500, 4809 Arendal, Norway
Telephone : +47 37071300
Fax : -

2 Test Information

2.1 Test Item

Name :	OCAS VHF
Model/version :	142005 VWB (Part of 141001 CM)
Serial number :	VWB: W00719165005, (CM: W007310040002 Rev. 11)
Hardware identity and/or version:	142005 Rev 2.5
Software identity and/or version :	AVRSW142005 VWB_0_0_3, AVRBL142005 VWB_0_0_6, FPGAW142005 VWB_0_0_5 and FPGALASH142005 VWB_3_3
Frequency Range :	118 – 136 MHz
Tunable Bands :	None
Emission designator:	6K00A3E
Number of Channels :	Multi Channel System
Operating Modes :	TX only
Channel separation:	25kHz
Type of Modulation :	AM
User Frequency Adjustment :	NO
Rated Output Power (TX) :	The maximum out-put power on each channel is 1 mW
Rated maximum audio output:	NA
Rated maximum audio input:	NA
Type of Power Supply :	13 V DC
Antenna Connector :	50 Ohm QMA - connector

Description of Test Item

This VHF unit is a part of a system called Obstacle Collision Avoiding System (OCAS). The OCAS is a warning system for traffic obstacles for aircrafts. The radar placed near the obstacle detects aircrafts with course towards the obstacle. A configurable set of rules is applied to define whether the aircraft must be alarmed or not, select warning signals, light and audio, depending on time-to-impact with obstacle(s) speed, course, and altitude. This unit consists of three major units: VHF aeronautical warning unit, radar unit for detecting aircrafts and UHF internal link to communicate between nearby OCAS systems. The power is supplied by a separate power unit.

Theory of Operation

The VHF Warning Board is a multi carrier VHF transmitter for transmitting Warning Messages in the Aeronautical VHF band from 118MHz to 136MHz. The transmitter can transmit on any combination of carriers in this frequency band.

The warning Board is configured from the Control Module (CM) and is turned on by the CM when the Radar system indicates flying objects.

2.2 Test Environment

2.2.1 Normal test condition

Temperature: 20 - 24 °C

Relative humidity: 20 - 50 %

Normal test voltage: 13 V DC

The values are the limit registered during the test period.

2.3 Test Period

Item received date: 2007-08-30

Test period : from 2007-08-30 to 2008-01-28

3 TEST REPORT SUMMARY

3.1 General

Manufacturer: OCAS AS
Model No.: 142005 VWB (Part of 141 001 CM)
Serial No.: VWB: W00719165005, (CM: W007310040002 Rev. 11)

All measurements are traceable to national standards.

The tests were conducted for the purpose of demonstrating compliance with FCC Part 87 subpart D.

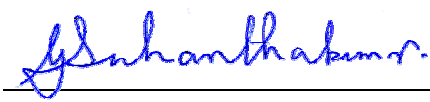
Radiated tests were conducted in accordance with ANSI C63.4-2003. The radiated tests were made in a semi-anechoic chamber at measuring distances of 3 and 10metres.

<input checked="" type="checkbox"/> New Submission	<input checked="" type="checkbox"/> Production Unit
<input type="checkbox"/> Class II Permissive Change	<input type="checkbox"/> Pre-production Unit
FVH Equipment Code	<input type="checkbox"/> Family Listing

THIS TEST REPORT RELATES ONLY TO THE ITEMS AND CONFIGURATIONS TESTED.
Deviations from, additions to, or exclusions from the test specifications are described in
“Summary of Test Data”.



TEST REPORT #: 89270/5

TESTED BY: 
G.Suwanthakumar, Test engineer

DATE: 28.01.2008

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3.2 Test Summary

Name of test	FCC part 87 paragraph	IC RSS-141 paragraph	Result
RF Power Output	87.131 / 2.1046	4.3	Complies ¹
Audio Frequency Response	2.1047	-	Complies
Audio Low-Pass Filter Response	2.1047	-	Complies
Modulation Limiting	87.141b / 2.1047	-	*
Occupied Bandwidth	87.139a / 2.1049	-	Complies
Spurious Emissions at Antenna Terminals (conducted)	87.139a3 / 2.1051/2.1057	4.4/6.2	Complies
Spurious Emissions radiated, Transmitter only	87.139(a)(3) / 2.1053/2.1057	4.5	Complies
Frequency Stability	87.133 / 2.1055	4.2	Complies ²

¹ The output power 0.001 to 1 W is selected in software.

² The manufacturer specified voltage range is 13V DC

* Please see page 12 of this report.

3.3 Description of modification for Modification Filing

Not applicable.

3.4 Comments

The measurements were done with the EUT powered by 13V DC. It was checked that power variations between 85% and 115% did not have any influence on the measurements.

All ports were populated during spurious emission measurements.

3.5 Family List Rational

Not Applicable.

4 TEST RESULTS

5 RF Power Output

Para. No.: 87.131/ 2.1046

Test Performed By: G.Suhandhakumar

Date of Test: 30.08.2007

Test Results: Complies.

The maximum RF output power is 1.3W (45.46dBm) with 90% AM modulation.

The carrier power is within 0.79 dB of the manufacturer's rating of RF power output.

Measurement Data:

TX: 118 MHz – Modulated with 2.5KHz

Carrier power			Mean Power		
Rated (W)	Measured (W)	(Measured/rated) dB	Rated (W)	Measured (W)	(Measured/rated) dB
1	0.91	-0.4	1.44	1.1	-1.34
0.001	0.002	3.5	0.001	0.003	3.0

TX: 127.5 MHz – Modulated with 2.5KHz

Carrier power			Mean Power		
Rated (W)	Measured (W)	(Measured/rated) dB	Rated (W)	Measured (W)	(Measured/rated) dB
1	1.3	1.1	1.44	1.3	-0.42
0.001	0.002	3.5	0.001	0.003	3.0

TX: 136 MHz – Modulated with 2.5KHz

Carrier power			Mean Power		
Rated (W)	Measured (W)	(Measured/rated) dB	Rated (W)	Measured (W)	(Measured/rated) dB
1	0.81	-0.92	1.44	1.2	-0.79
0.001	0.002	3.5	0.001	0.003	3.0

The EUT does not have any input port to audio. It only transmits a digitally stored voice message "Wire Wire Wire.....". And it also transmits on many channels simultaneously. Therefore it is not possible to follow the test method described in the standard. In order to follow the method as close as possible, the manufacturer has made some test files, such as 2.5kHz modulating frequency.

The composite output power for Frequency Plan 4 to 7– Modulated with "Power Line" digitally stored Voice signal is: 32dBm

The out-put power of the each frequency in this plan is 0 dBm (1mW)

Note:

Mean power rating is based on the limit of 90% AM.

This is equivalent to $1.44 \times$ carrier power.

Carrier power is the average power supplied to the antenna transmission line by a transmitter during one radio frequency cycle taken under the condition of no modulation.

Mean power is the average power supplied to the antenna transmission line by a transmitter during an interval of time sufficiently long compared with the lowest frequency encountered in the modulation taken under normal operating conditions.

Requirement (87.131):

For Airport control tower equipment (A3E, GiD, G7D) VHF: $\leq 50W$

6 Audio Frequency Response

Para. No.: 2.1047

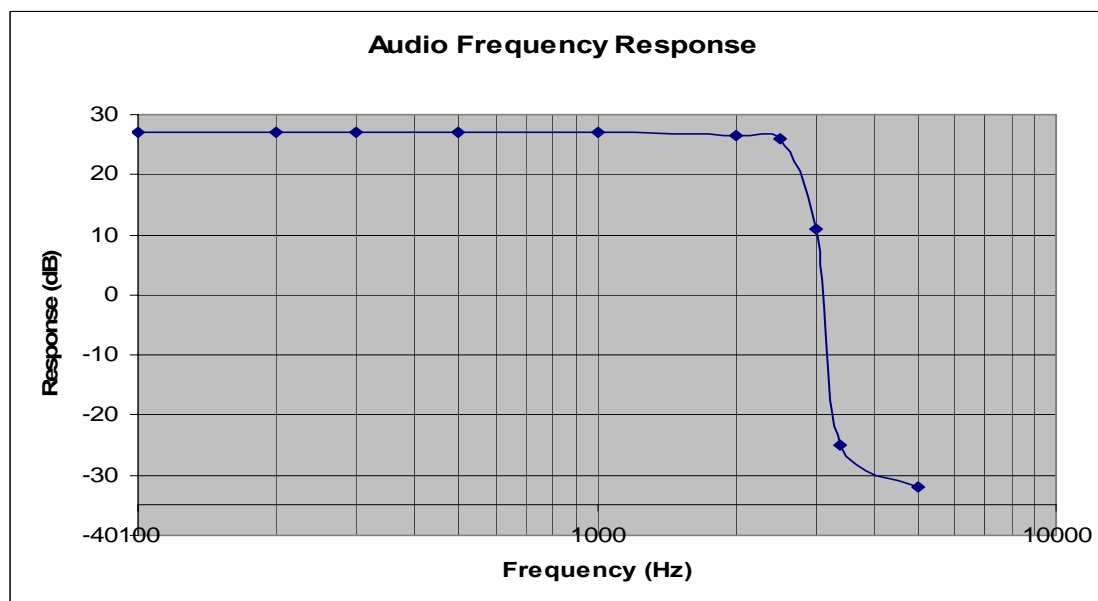
Test Performed By: G.Suwanthakumar

Date of Test: 07.09.2007

Test Results: See attached graph.

Measurement Data:

Frequency(Hz)	Response (dB)
100	27
180	27
200	27
300	27
350	27
500	27
800	27
1000	27
1500	27
2000	26
2500	26
2600	26
2700	26
3000	11
3400	-25
3500	-25
3600	-25
5000	-33



7 Audio Low-Pass Filter Response

Para. No.: 2.1047

Test Performed By: G.Suwanthakumar

Date of Test: 07.09.2007

Test Results: see attached graph above

Measurement Data:

LP filter is at 3200 Hz

8 Modulation Limiting

Para. No.: 87.141(b)/ 2.1047

Test Performed By: G.Suwanthakumar

Date of Test: 11.01.2007

Test Results: Complies.

The maximum AM modulation level is 100 % @ 1000 Hz.

Measurement Data:

The measurement can not be performed since the EUT has no audio input.

The default AM maximum modulation is 100%. The EUT can only transmit the pre-programmed digitally stored voice message.

Requirement (87.141(b):

A double sideband full carrier amplitude modulated radiotelephone transmitter with rated carrier power output exceeding 10 watts must be capable of automatically preventing modulation in excess of 100 percent.

9 Occupied Bandwidth

Para. No.: 87.139(a)/ 2.1049

Test Performed By: G.Suwanthakumar	Date of Test: 18.09.2007
------------------------------------	--------------------------

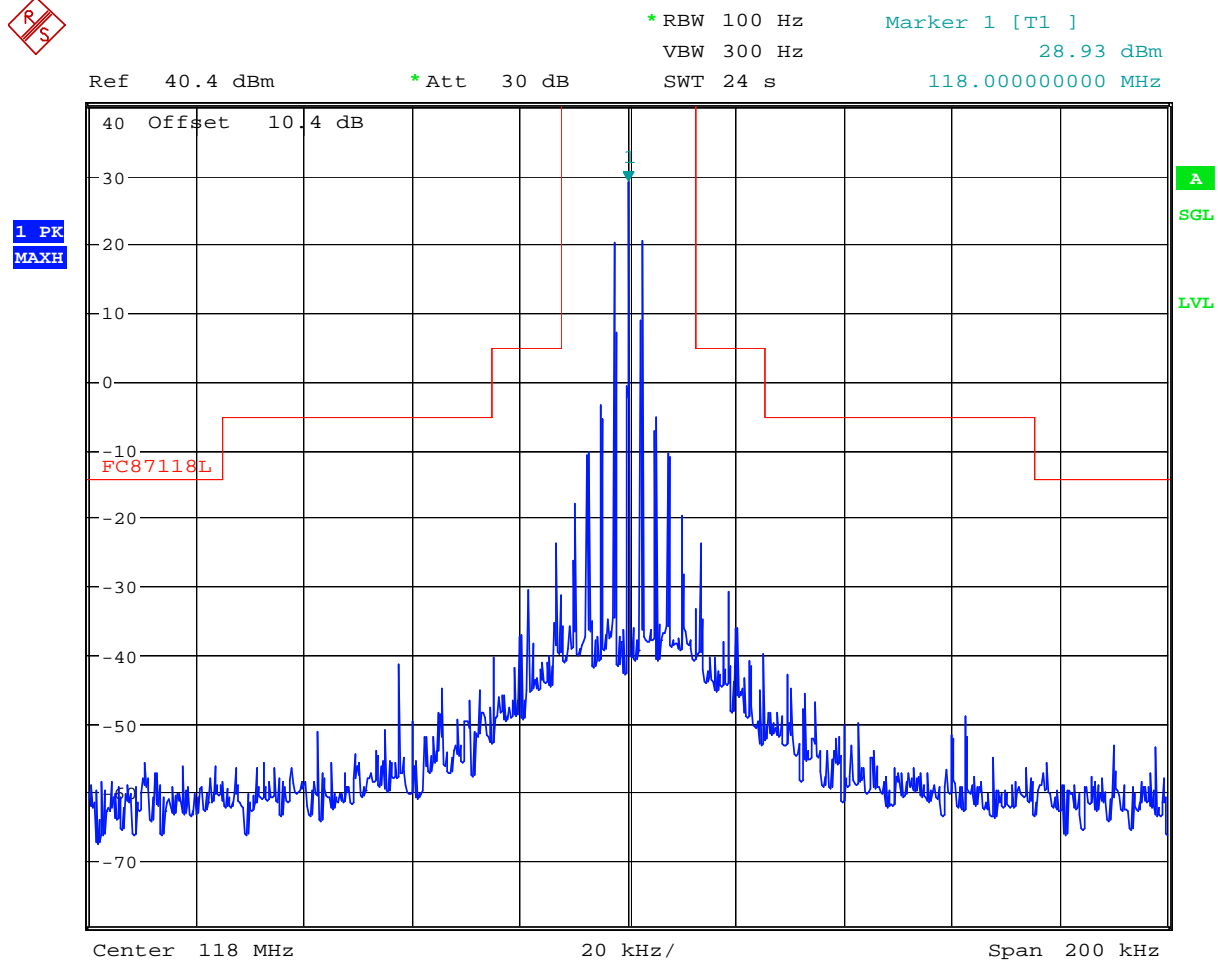
Test Results: Complies.

Test Data: See attached graphs.

Requirement (87.139(a)):

(a) Except for ELTs and when using single sideband (R3E, H3E, J3E), or frequency modulation (F9) or digital modulation (F9Y) for telemetry or telecommand in the frequency bands 1435-1535 MHz and 2310-2390 MHz or digital modulation (G7D) for differential GPS, the mean power of any emission must be attenuated below the mean power of the transmitter (pY) as follows:

- (1) When the frequency is removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth the attenuation must be at least 25 dB;
- (2) When the frequency is removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth the attenuation must be at least 35 dB.
- (3) When the frequency is removed from the assigned frequency by more than 250 percent of the authorized bandwidth the attenuation for aircraft station transmitters must be at least 40 dB; and the attenuation for aeronautical station transmitters must be at least $43 + 10 \log_{10} pY$ dB



Date: 31.AUG.2007 12:21:54

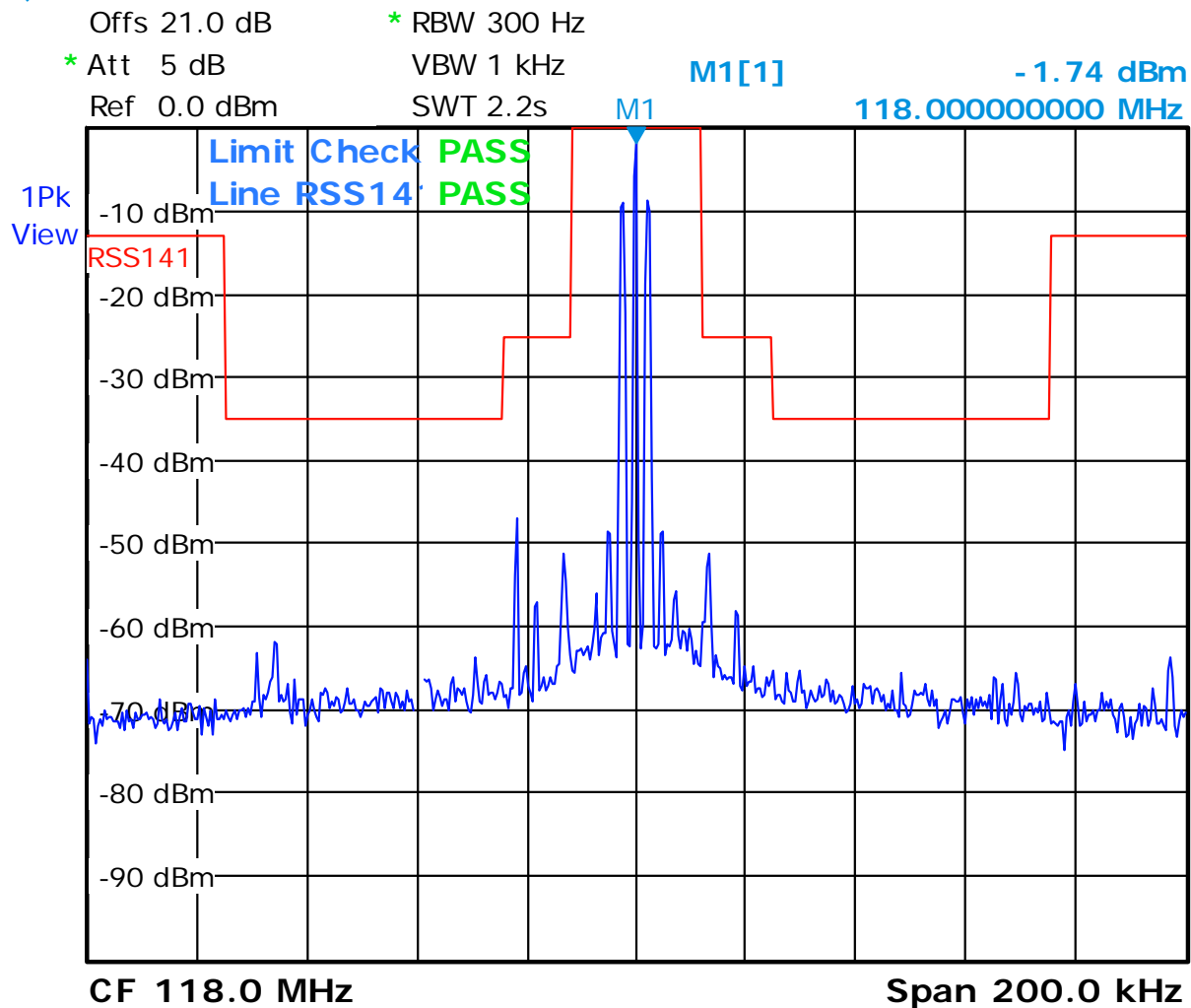
6K00A3E

TX 118 MHz, high Power: 1Watt

Modulated 2500 Hz, 100% modulation,

Authorized Bandwidth: 25 kHz, 87.137(a)

$43+10\log(1)=43\text{dB}$



Date: 23.JAN.2008 14:31:07

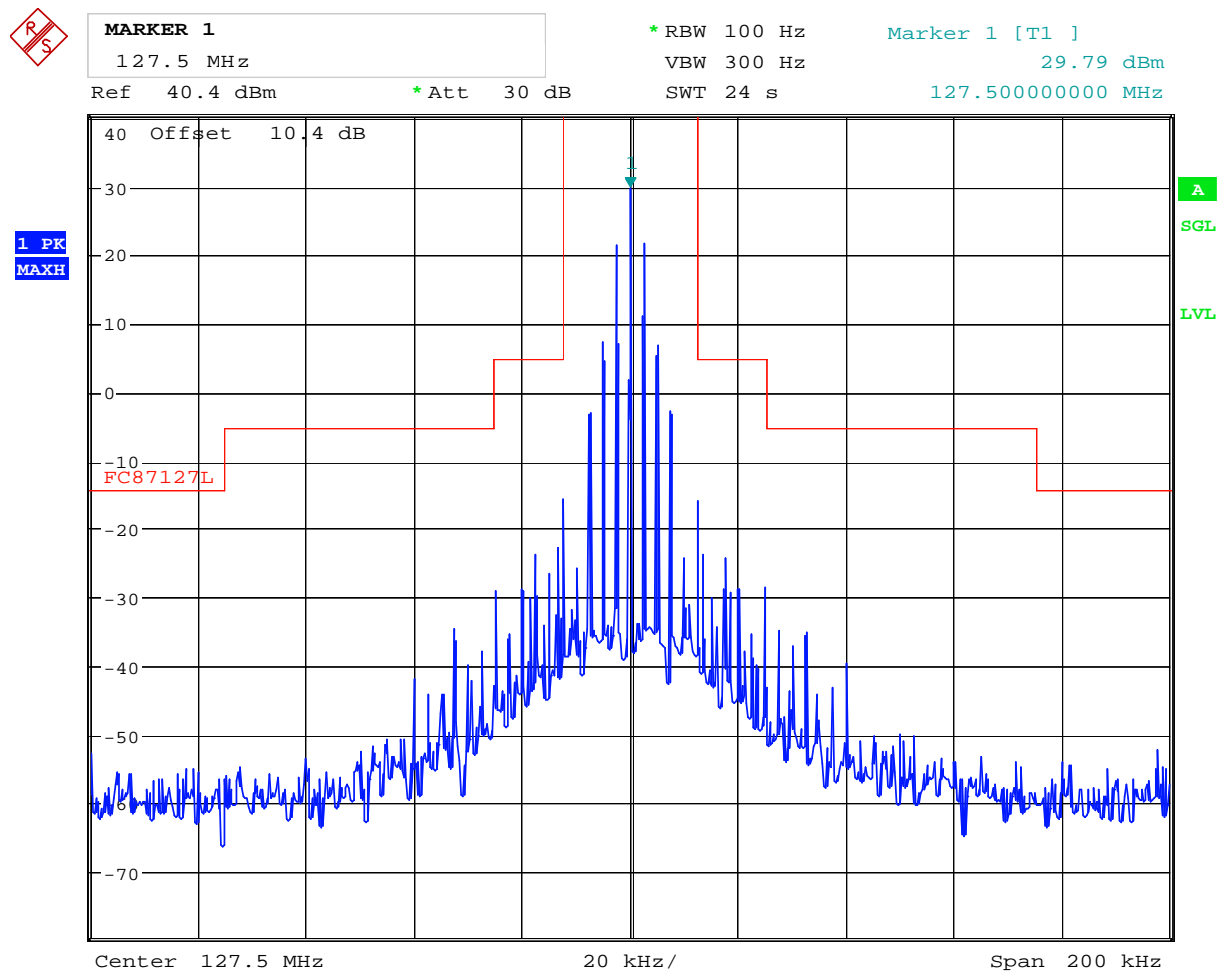
6K00A3E

TX 118 MHz, high Power: 1mWatt

Modulated 2500 Hz, 100% modulation,

Authorized Bandwidth: 25 kHz, 87.137(a)

$43+10\log(0.001)=13\text{dB}$



Date: 31.AUG.2007 13:07:42

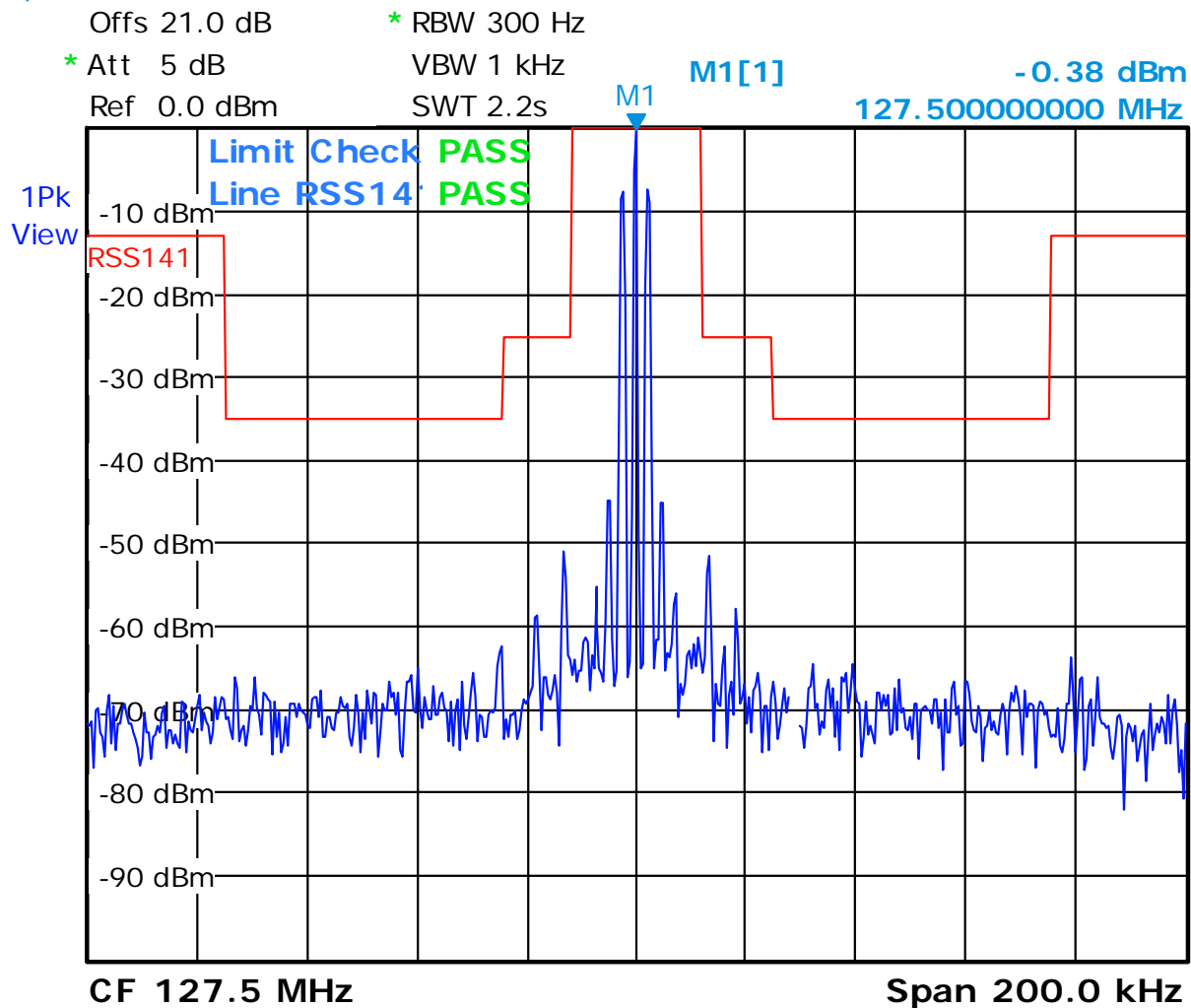
6K00A3E

TX 127.5 MHz, high Power: 1Watt

Modulated 2500 Hz, 100% modulation

Authorized Bandwidth: 25 kHz, 87.137(a)

$43 + 10 \log(25) = 43\text{dB}$



Date: 23.JAN.2008 14:30:11

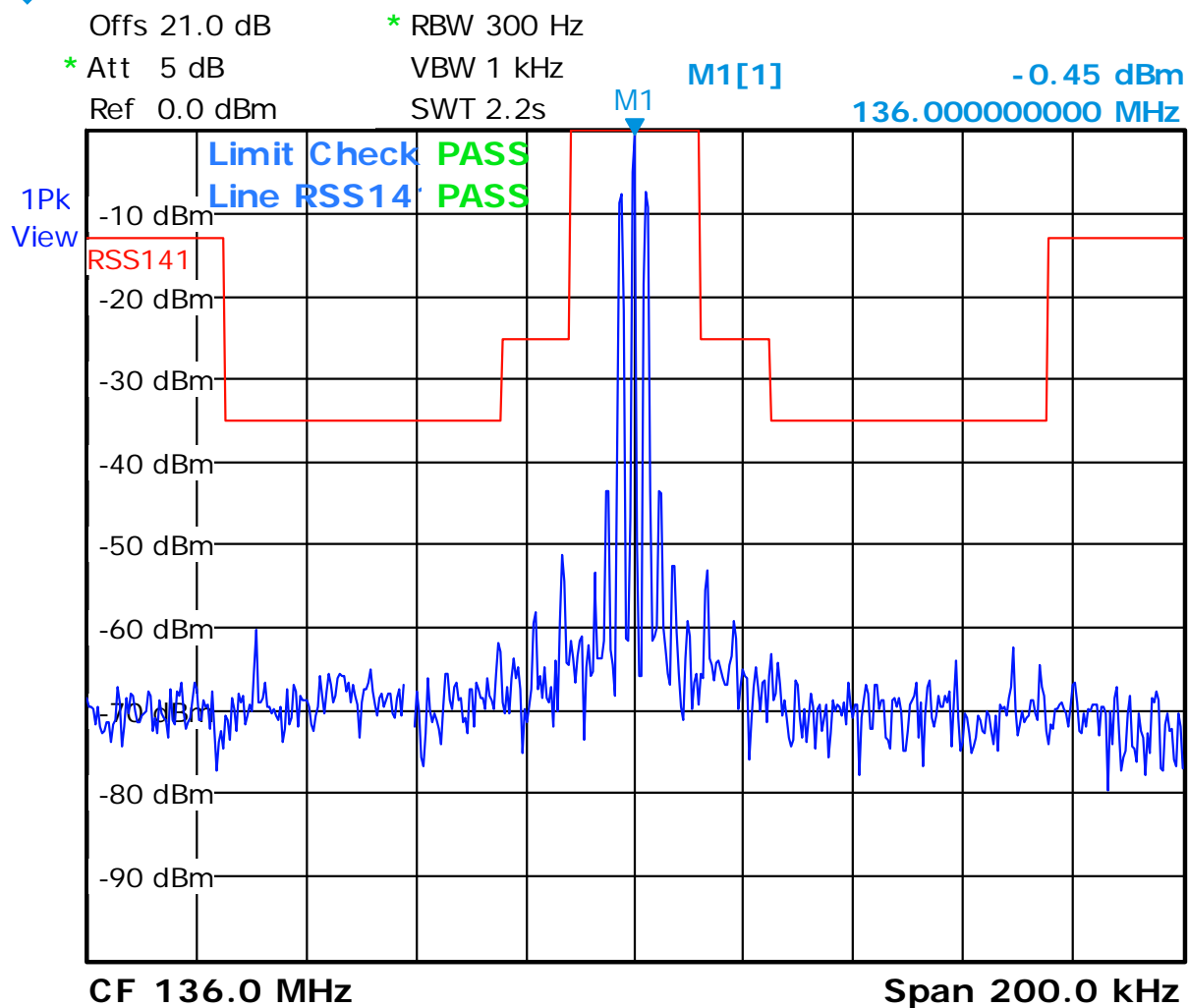
6K00A3E

TX 127.5 MHz, high Power: 1mWatt

Modulated 2500 Hz, 100% modulation,

Authorized Bandwidth: 25 kHz, 87.137(a)

$43+10\log(1)=13\text{dB}$



Date: 23.JAN.2008 14:29:21

6K00A3E

TX 136 MHz, high Power: 1mWatt

Modulated 2500 Hz, 100% modulation,

Authorized Bandwidth: 25 kHz, 87.137(a)

$43+10\log(1)=13\text{dB}$



SELECT TRACE

1

* RBW 100 Hz

Marker 1 [T1]

VBW 300 Hz

30.12 dBm

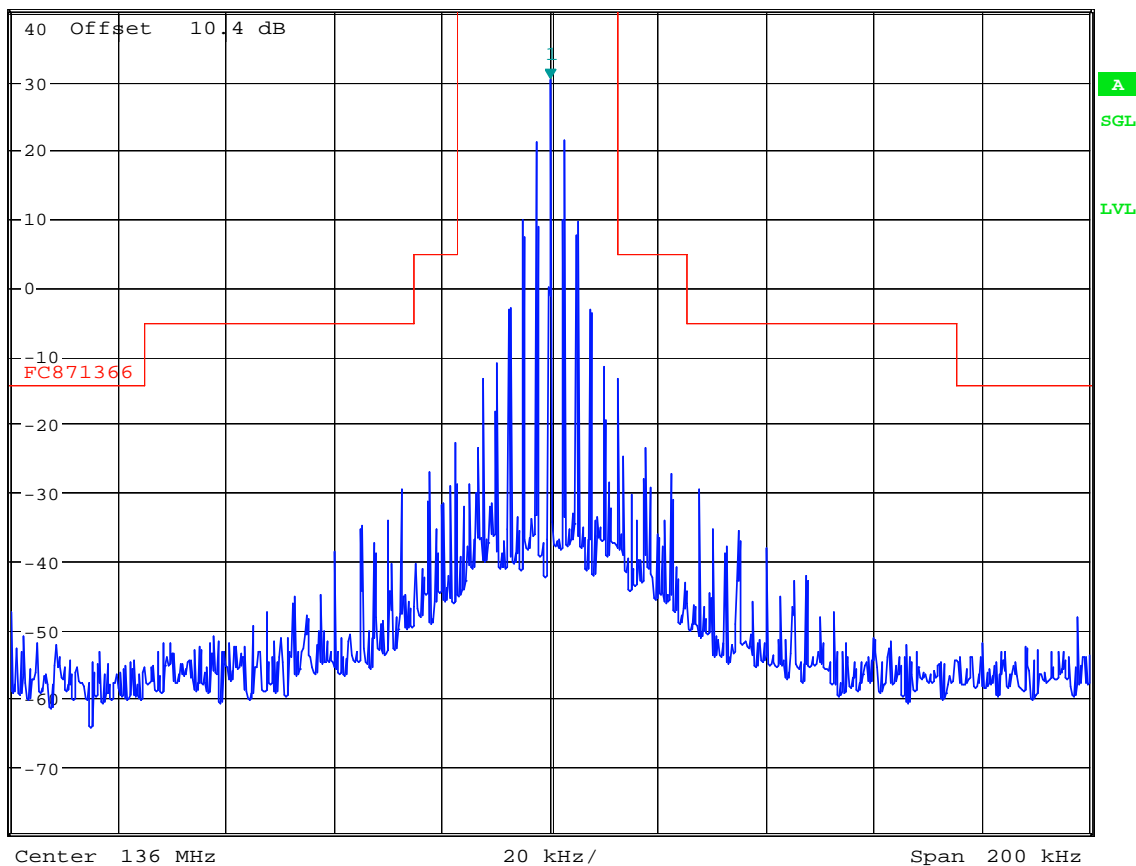
Ref 40.4 dBm

* Att 30 dB

SWT 24 s

136.00000000 MHz

1 PK
MAXH



Date: 31.AUG.2007 13:05:23

6K00A3E

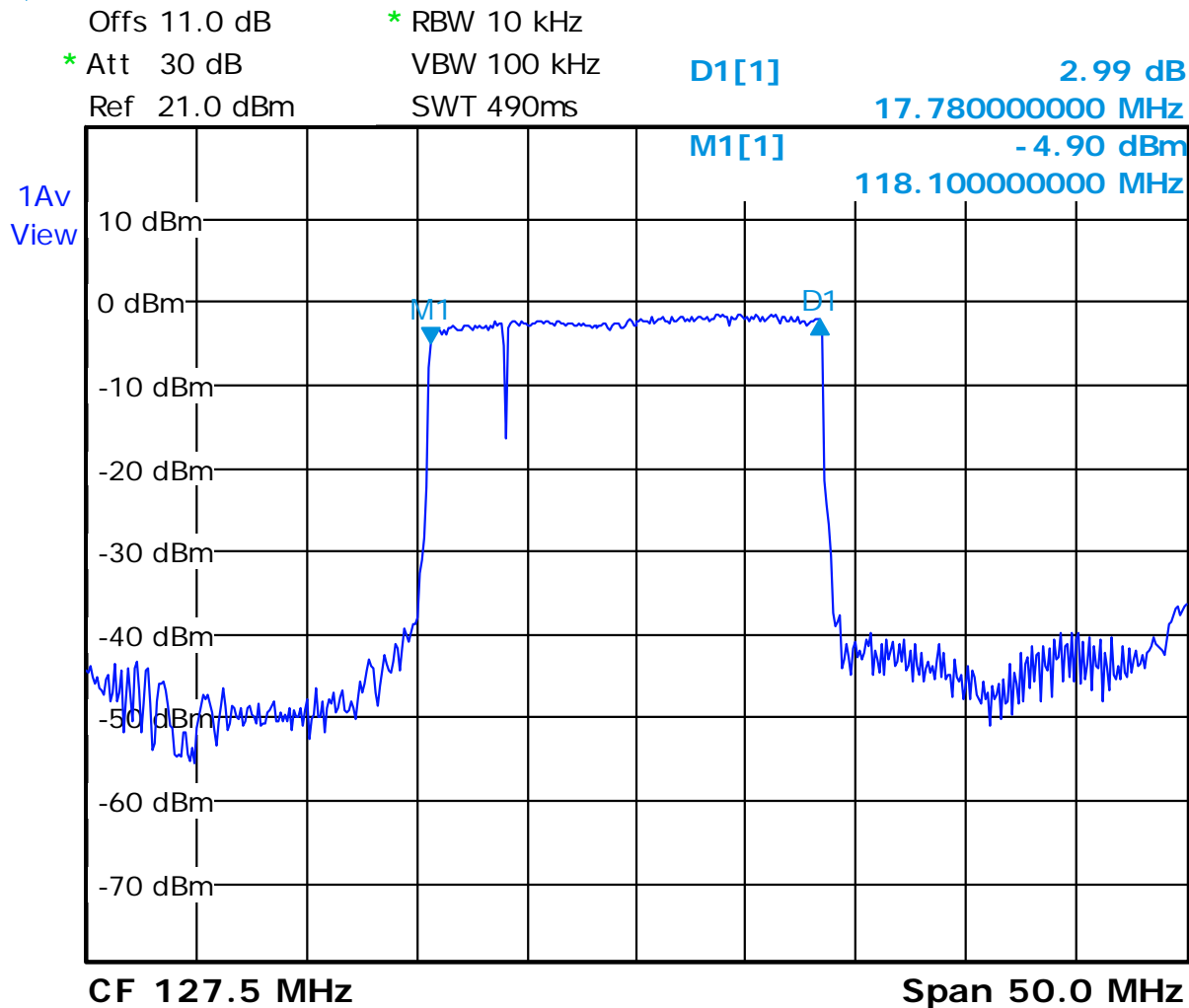
TX 136 MHz, High Power: 1Watt

Modulated 2500 Hz, 100% modulation

Authorized Bandwidth: 25 kHz, 87.137(a)

$43 + 10 \log(25) = 43\text{dB}$

Frequency plan 6: The EUT transmits on all channels simultaneously in the frequency band 118 – 136 MHz. The maximum peak power level at each channel is 0 dBm (1mW).



Date: 28.JAN.2008 08:21:55

Measured with average detector

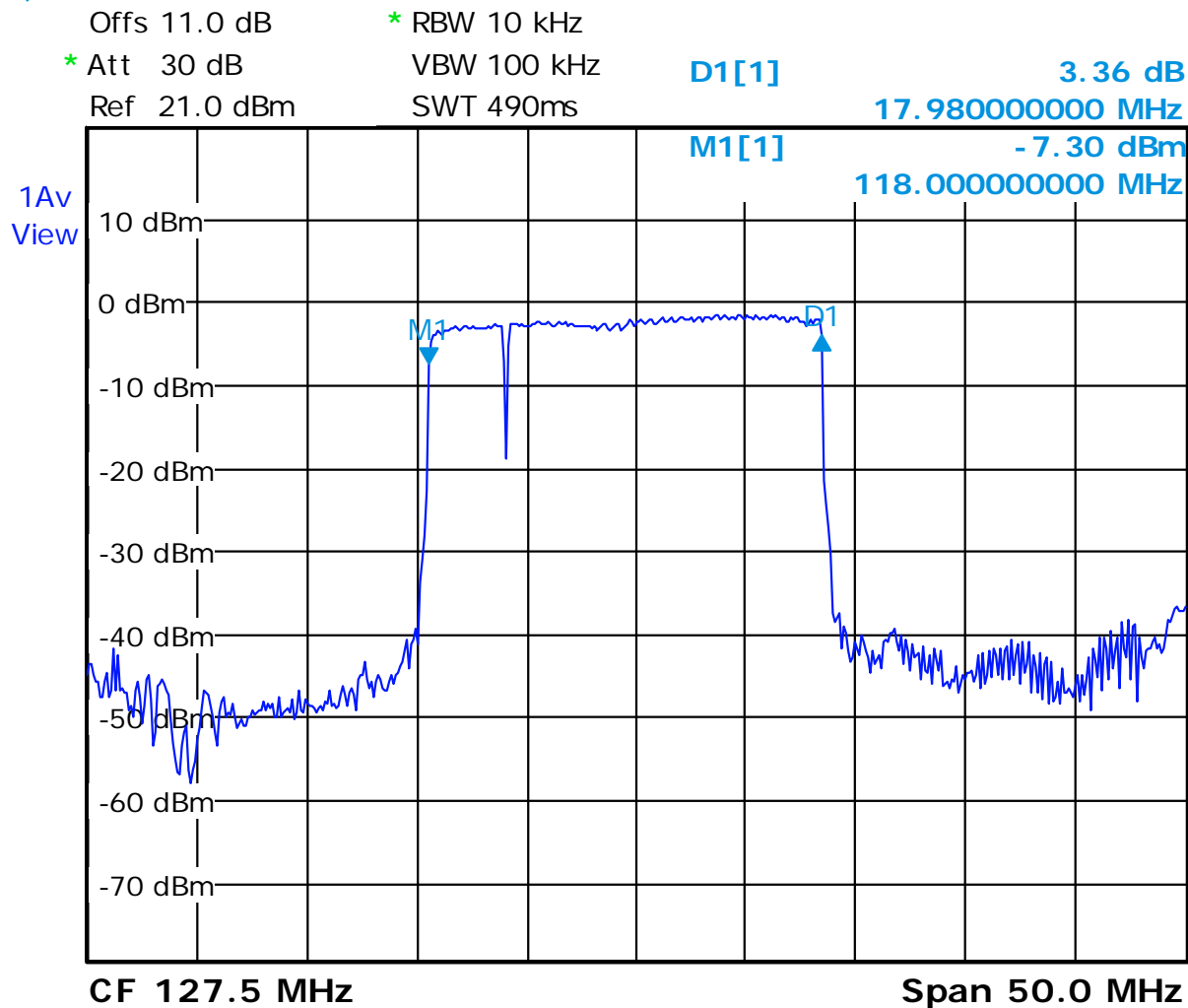
6K00A3E

TX Frequency plan 6,: Composite power

Modulated 2500 Hz, 100% modulation,

Authorized Bandwidth: 25 kHz, 87.137(a)

$43 + 10 \log(1) = 43 \text{ dB}$



Date: 28.JAN.2008 08:19:32

Measured with average detector

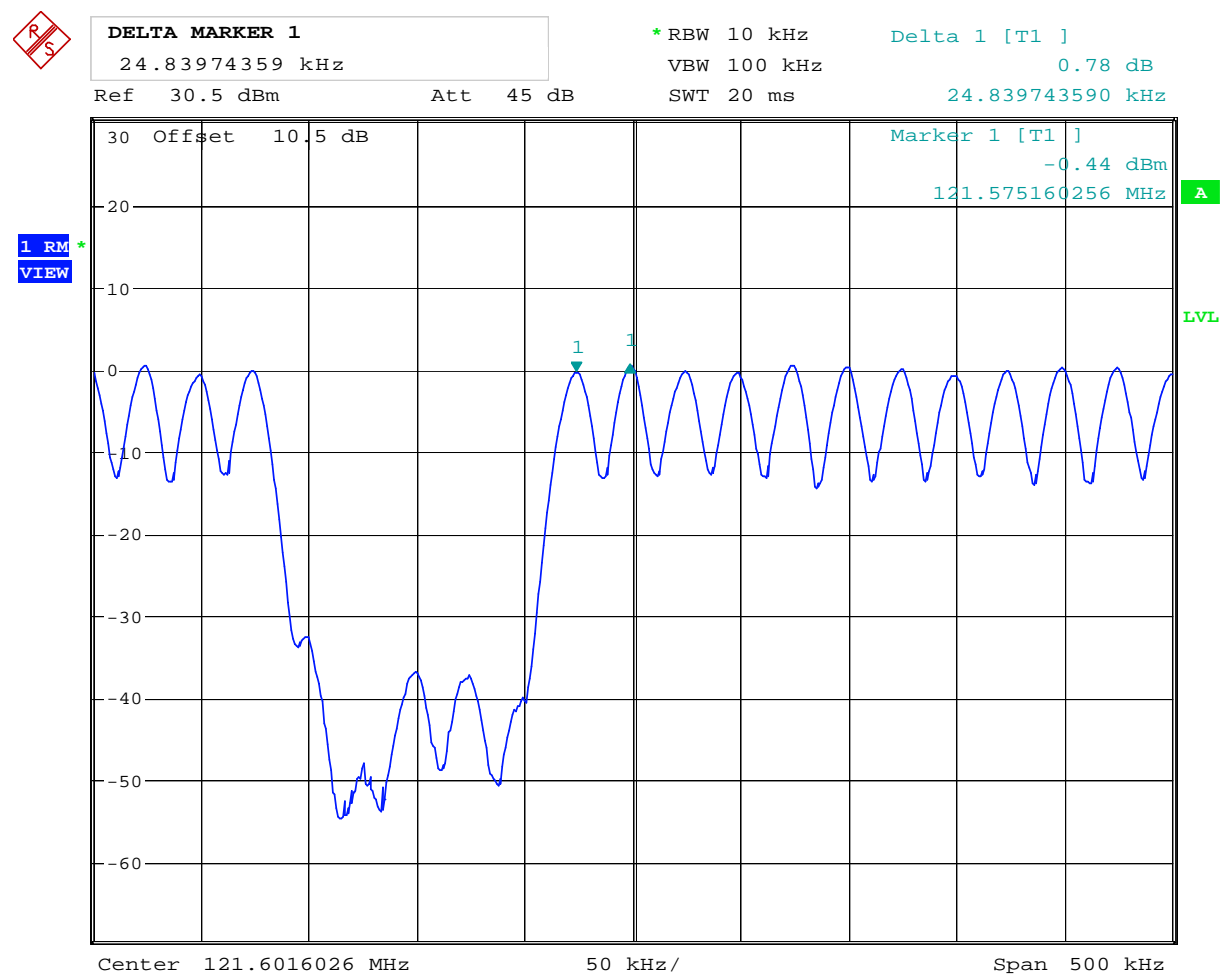
6K00A3E

TX Frequency plan 7,: Composite power

Modulated 2500 Hz, 100% modulation,

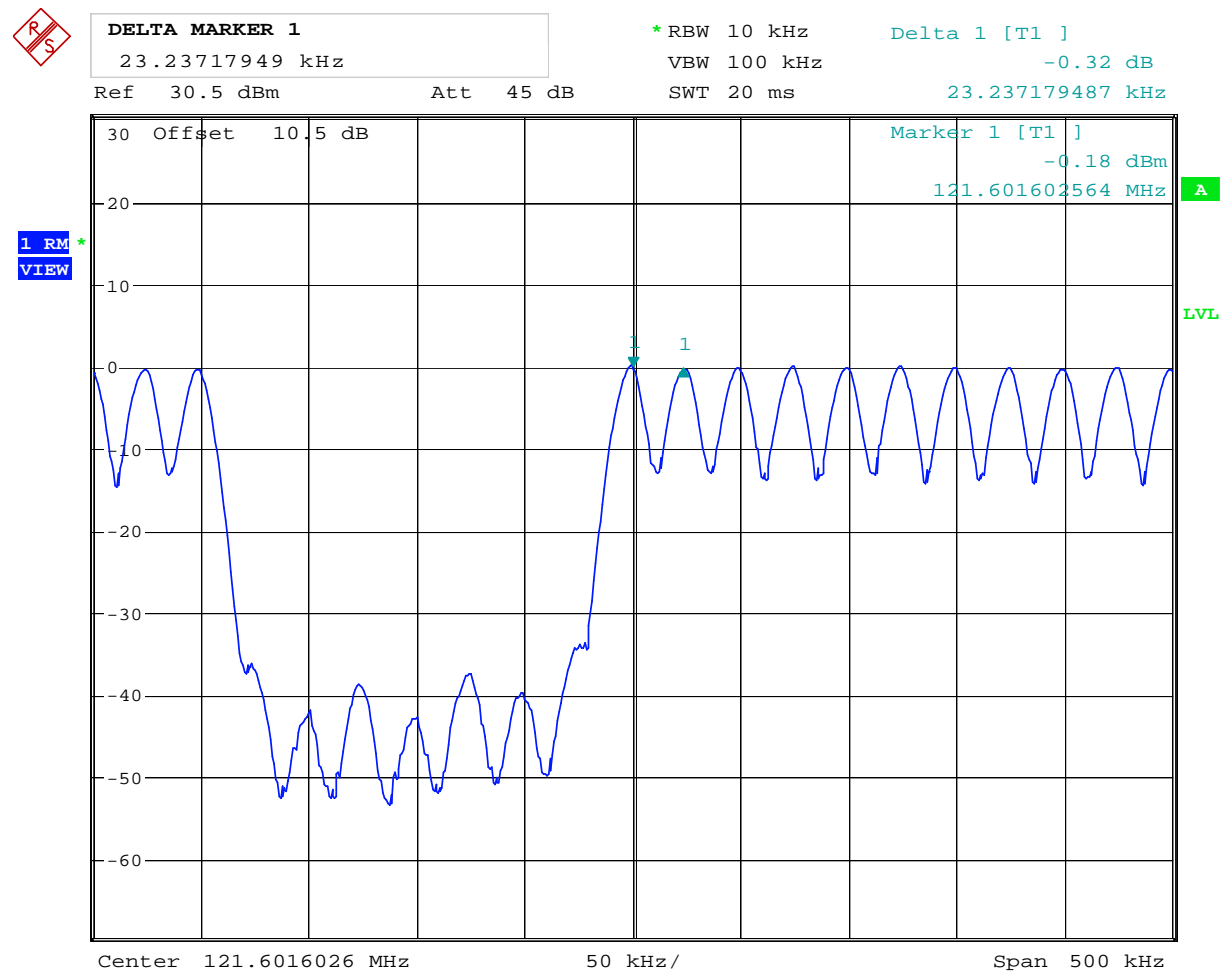
Authorized Bandwidth: 25 kHz, 87.137(a)

$43 + 10 \log(1) = 43 \text{ dB}$



Date: 4.SEP.2007 10:53:14

The measured power for each channels in the frequency plan 6.



Date: 4.SEP.2007 10:51:34

The measured power for each channels in the frequency plan 7.

10 Spurious Emissions at Antenna Terminals

Para. No.: 87.139(a)(3)/2.1051

Test Performed By: G.Suwanthakumar

Date of Test: 10.09.07

Test Results: Complies.

The maximum emission is -20 dBm at 235 MHz. This is 7 dB below the specified limit. The spectrum was searched from 30 to 1700 MHz using a spectrum analyzer set to Quasi peak detector below 1000MHz and above 1000MHz 1 MHz RBW/VBW. A band pass filter was used for each detected spurious to suppress the fundamental emission. Measurements were made using signal substitution method.

The measurements are done on 118MHz, 127.5MHz, 136MHz & frequency plan 6 .

Test Data: See attached graphs.

TX 127.5 MHz, 1 Watt

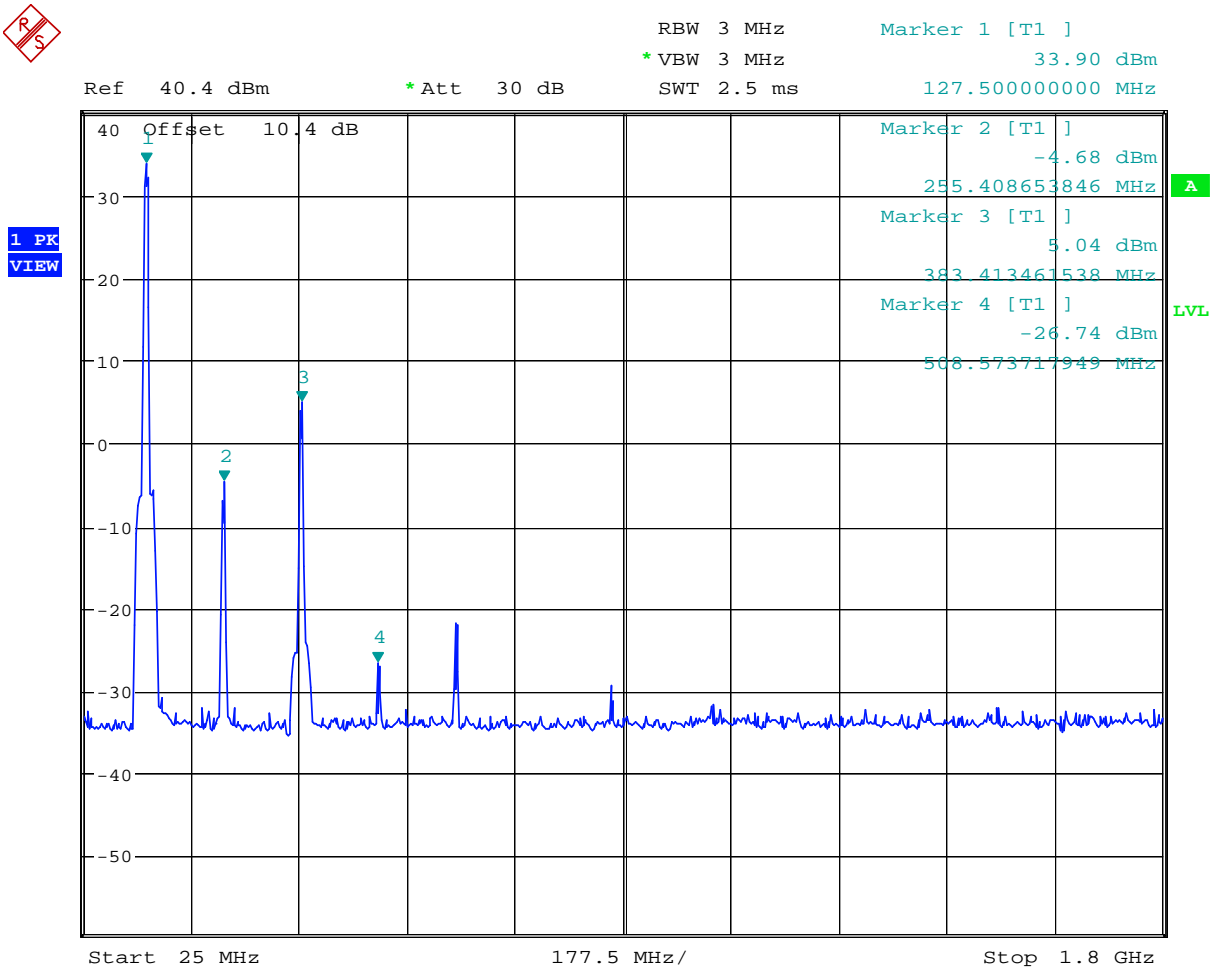
Frequency of Emission (MHz)	Measured Emission Level (dBm)	Limit (dBm)	Margin (dB)
255	-28	-13	15
332.34	-64	-13	51
510	-35	-13	22
892.55	-42	-13	29

TX Frequency Plan 6,

Frequency of Emission (MHz)	Measured Emission Level (dBm)	Limit (dBm)	Margin (dB)
66	-31	-13	18
83	-18	-13	5
101	-23	-13	10
153	-18	-13	5
256	-26	-13	13
406	-19	-13	6
666	-40	-13	27

Requirement (87.139(a)(3):

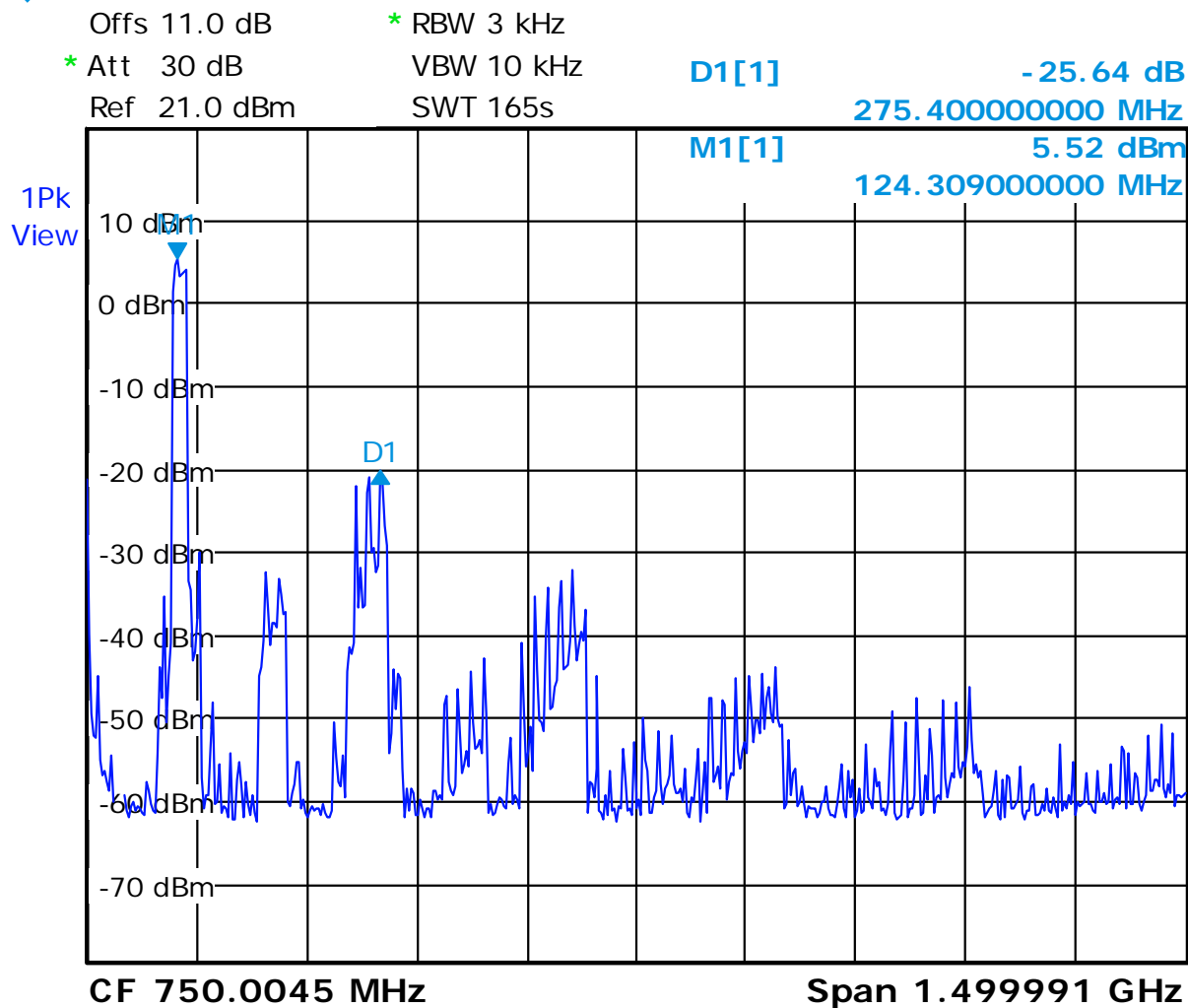
When the frequency is removed from the assigned frequency by more than 250 percent of the authorized bandwidth the attenuation for aircraft station transmitters must be at least 40 dB; and the attenuation for aeronautical station transmitters must be at least 43 + 10 log10 pY dB, < (-13 dBm)



Date: 31.AUG.2007 13:10:54

Above graph is only for frequency identification
 A notch filter was used to suppress the fundamental emission.
 See tabulated data. Measured using signal substitution method.
 6K00A3E
 TX 127.5 MHz: 1Watt
 Modulated 2500 Hz, 100% modulation
 Authorized Bandwidth: 25 kHz, 87.137(a)

Frequency Plan 6:



Date: 28.JAN.2008 09:25:31

Above graph is only for frequency identification

A notch filter was used to suppress the fundamental emission.

See tabulated data. Measured using signal substitution method.

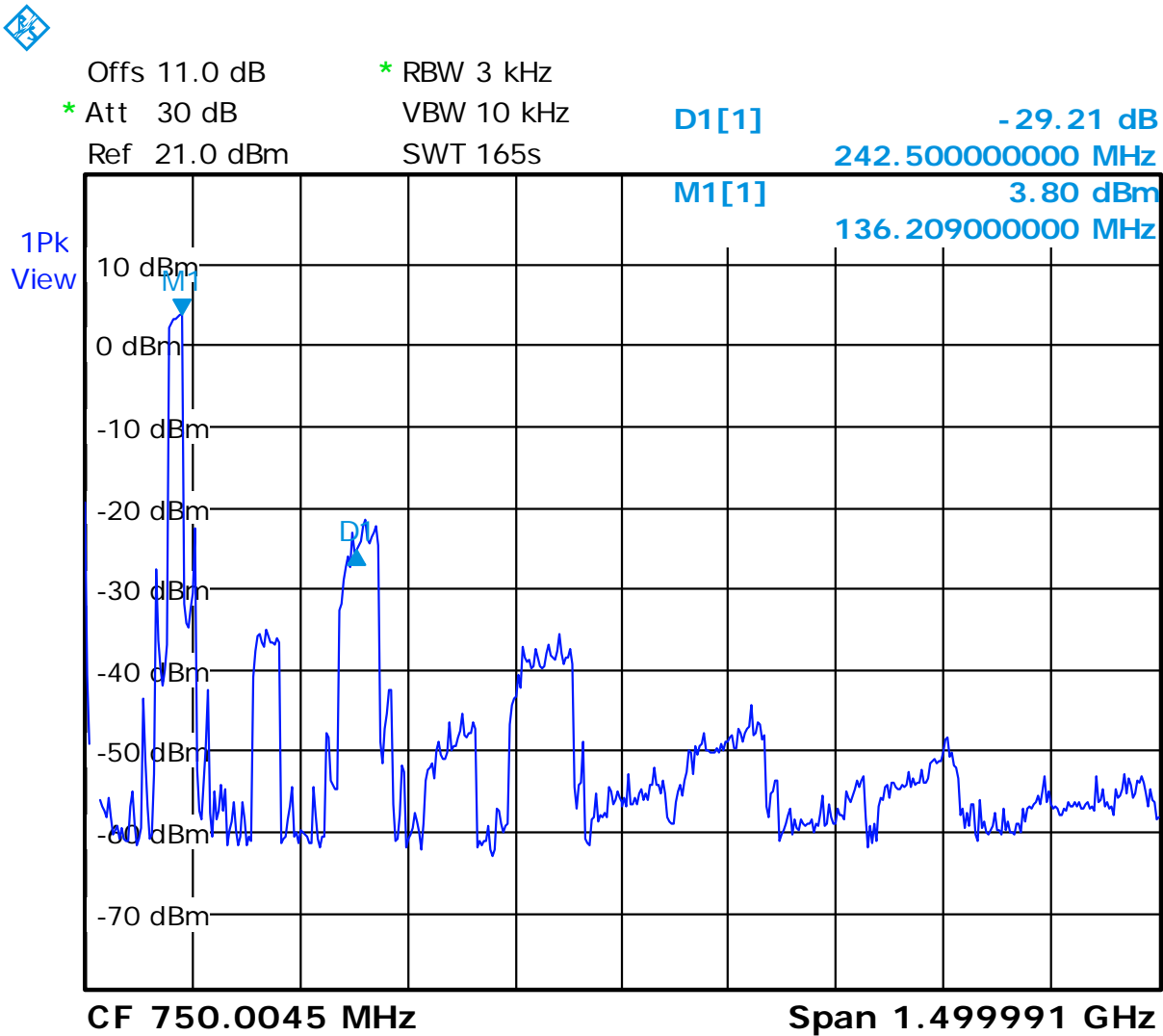
6K00A3E

TX frequency plan 6:

Modulated Stored voice signal "Power line", 100% modulation

Authorized Bandwidth: 25 kHz, 87.137(a)

Frequency plan 7:



Date: 28.JAN.2008 09:21:48

Above graph is only for frequency identification
 A notch filter was used to suppress the fundamental emission.
 See tabulated data. Measured using signal substitution method.
 6K00A3E
 TX frequency plan 7:
 Modulated Stored voice signal "Power line", 100% modulation
 Authorized Bandwidth: 25 kHz, 87.137(a)

11 Field Strength of Spurious Emissions

Para. No.: 87.139(a)(3)/2.1053

Test Performed By: G.Suwanthakumar

Date of Test: 01.10.07

Test Results: Complies.

The spectrum was searched from 30 to 1800 MHz.

The RF ports was terminated with 50 ohm load and all ports was terminated with respective loads.

Test Data:

TX 127.5 MHz, 1 Watt - Modulated 2500 Hz, 100% modulation.

The maximum emission is observed at Vertical polarization.

Frequency of Emission (MHz)	Measured Emission Level (dBm)	Limit (dBm)	Margin (dB)
39	-60	-13	47
127.5	-75	-13	62
255	-70	-13	57

TX Frequencyplan 6, Total power 1 Watt - 100% modulation

The maximum emission is observed at Vertical polarization.

Frequency of Emission (MHz)	Measured Emission Level (dBm)	Limit (dBm)	Margin (dB)
39	-64,5	-13	51,5
47,95	-59	-13	46
75	-70,6	-13	57,6
100	-66,8	-13	54
274,7	-70	-13	57

Requirement (87.139(a)(3):

When the frequency is removed from the assigned frequency by more than 250 percent of the authorized bandwidth the attenuation for aircraft station transmitters must be at least 40 dB; and the attenuation for aeronautical station transmitters must be at least $43 + 10 \log_{10} pY$ dB, $< (-13 \text{ dBm})$

Nemko Comlab

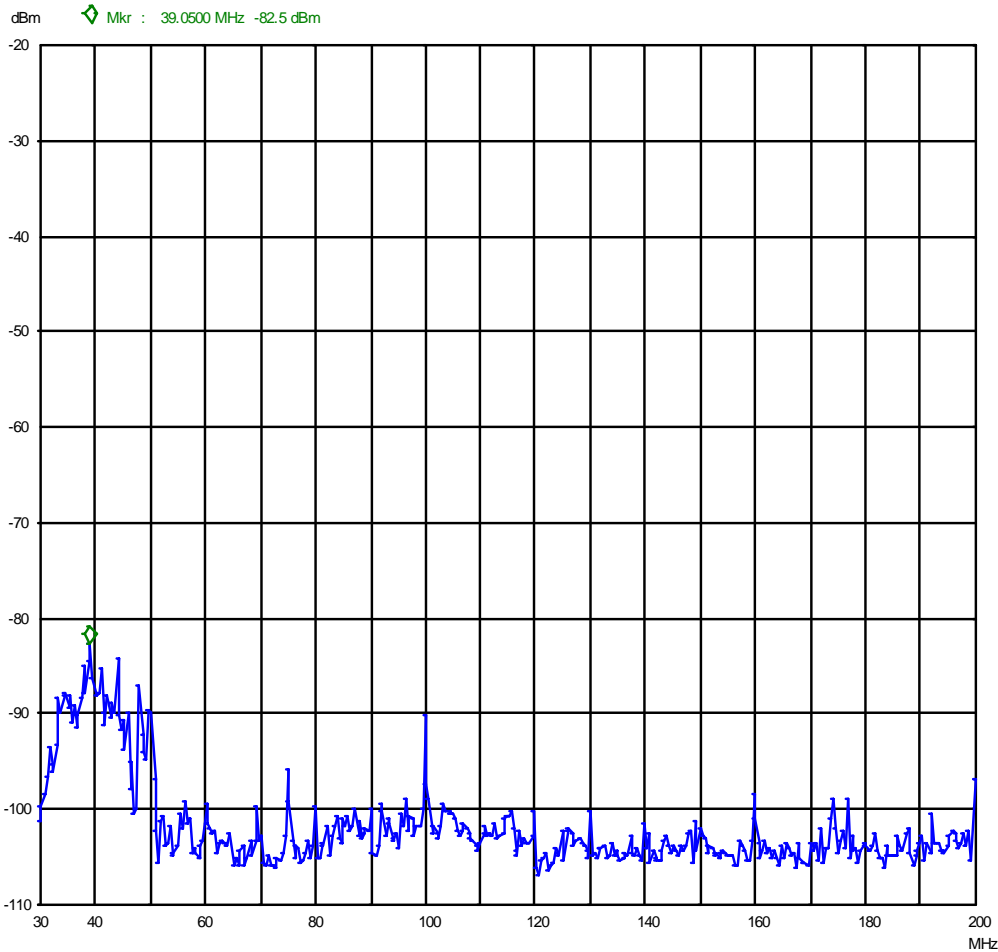
01. Oct 07 12:25

PK

EUT: vhf OCAS Bå
Manuf: OCAS AS
Op Cond: 1m vp
Operator: gns
Test Spec: FCC 90
Comment: tx active

Scan Settings (1 Range)

Frequencies			Receiver Settings					
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
30M	200M	50k	120k	PK	50ms	0dB	LN ON	60dB



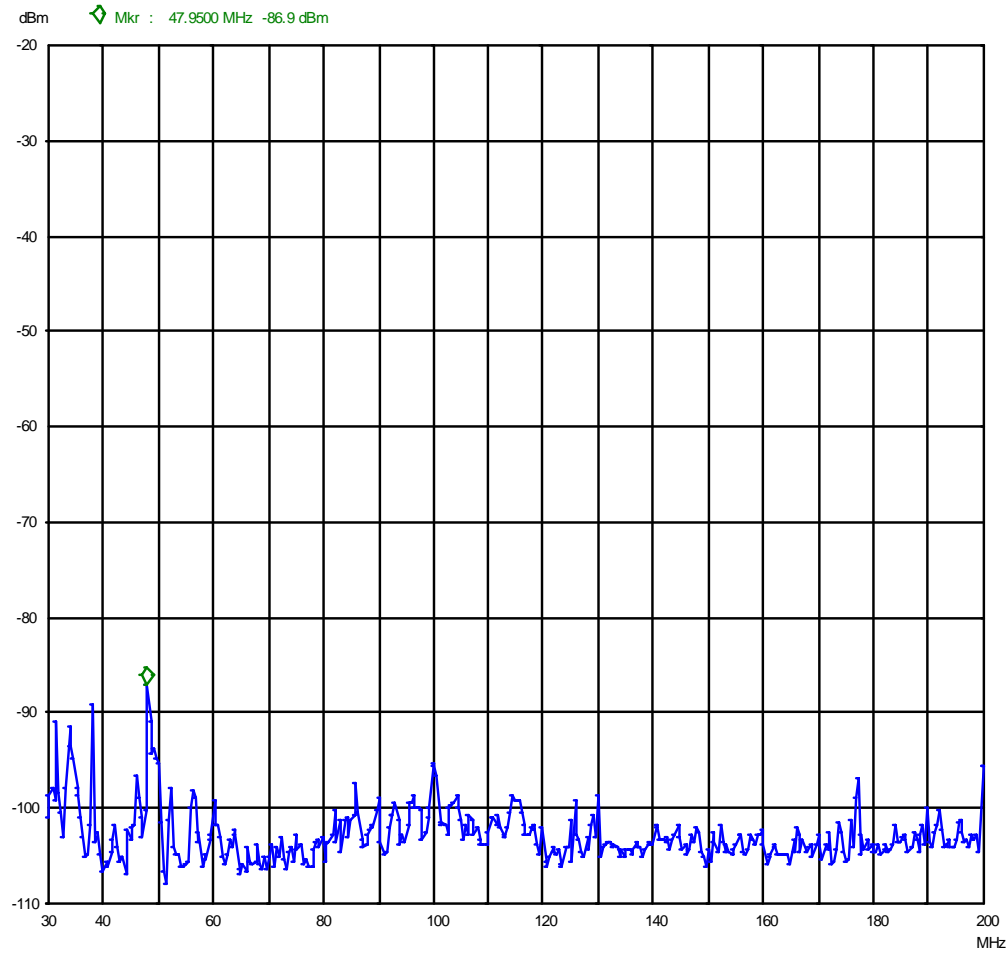
Radiated Spurious Emissions Scan, VP, 30- 200MHz

Nemko Comlab
PK

01. Oct 07 12:32

EUT: vhf OCAS Bå
Manuf: OCAS AS
Op Cond: 4m hp
Operator: gns
Test Spec: FCC 90
Comment: tx active

Scan Settings (1 Range)
|----- Frequencies -----| |----- Receiver Settings -----|
Start Stop Step IF BW Detector M-Time Atten Preamp OpRge
30M 200M 50k 120k PK 50ms 0dBLN ON 60dB



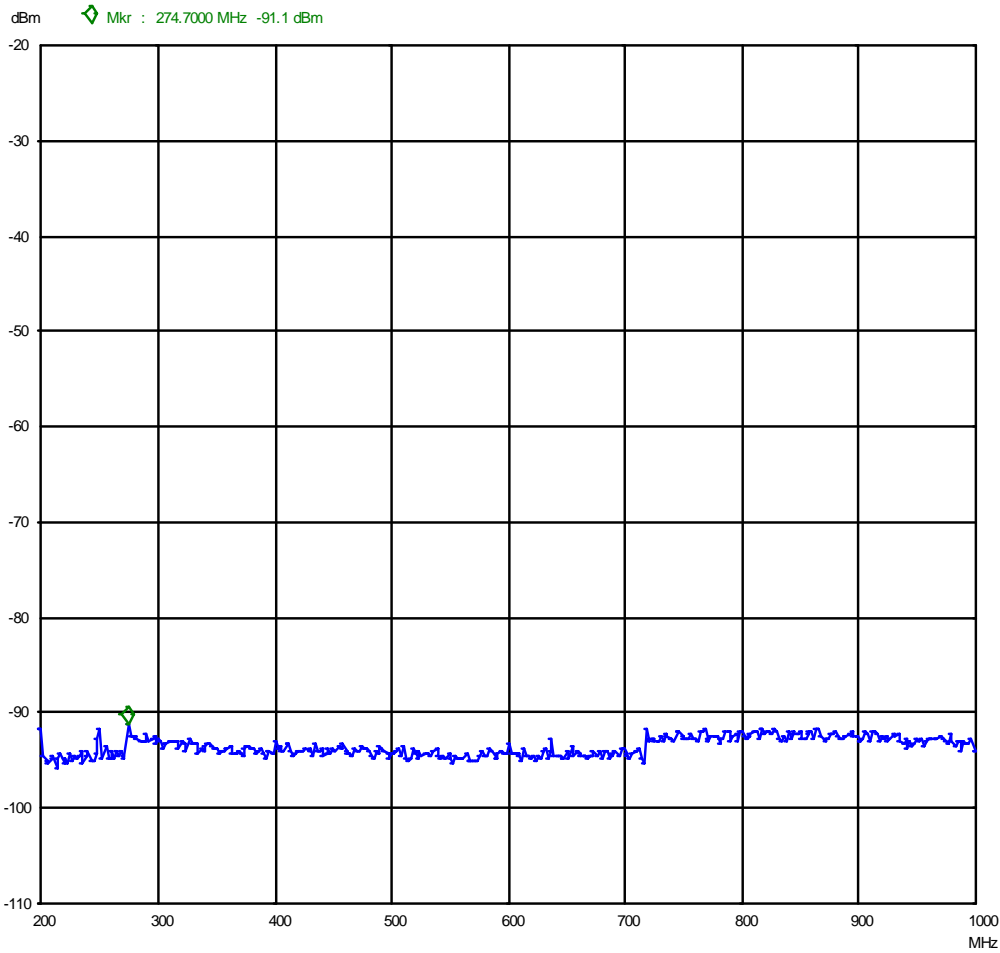
Radiated Spurious Emissions Scan, HP, 30- 200MHz

Nemko Comlab
PK

01. Oct 07 12:42

EUT: vhf OCAS Bå
Manuf: OCAS AS
Op Cond: 1m vp
Operator: gns
Test Spec: FCC 90
Comment: tx active

Scan Settings (1 Range)
|----- Frequencies -----| |----- Receiver Settings -----|
Start Stop Step IF BW Detector M-Time Atten Preamp OpRge
200M 1000M 50k 120k PK 50ms AUTO LN ON 60dB



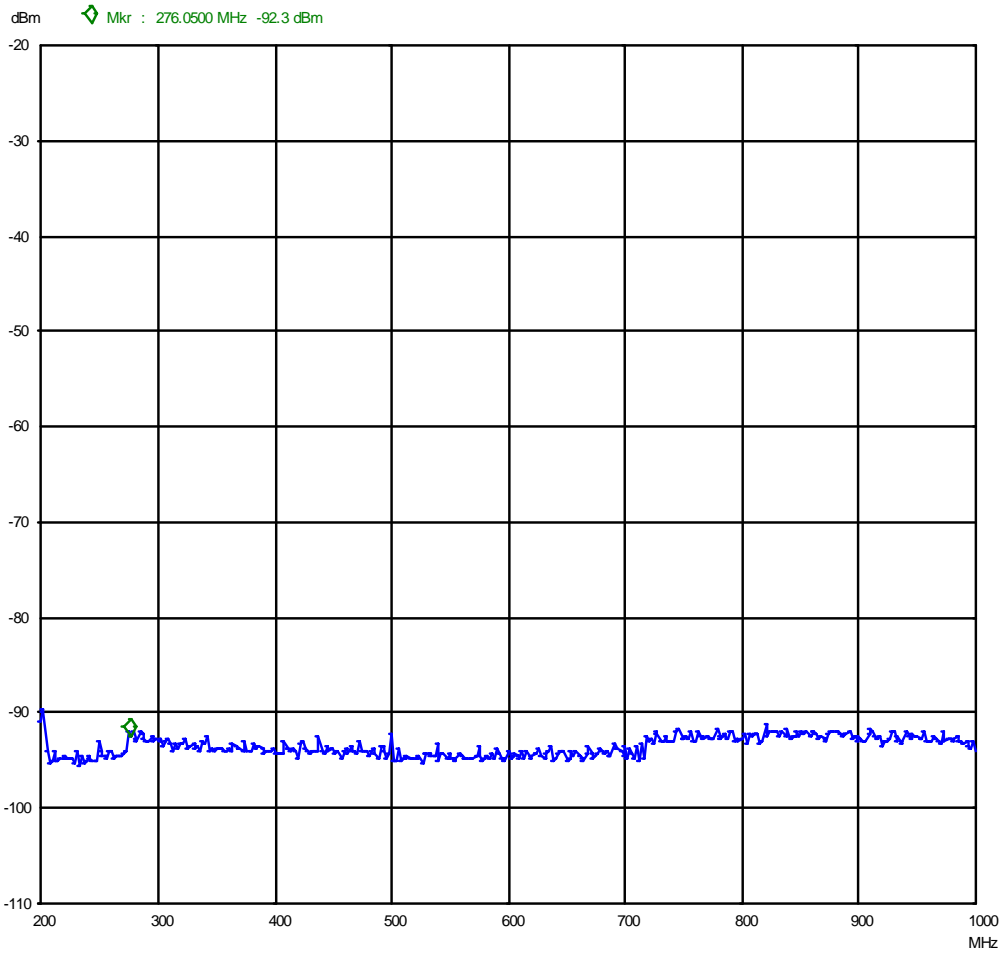
Radiated Spurious Emissions Scan, VP, 200- 1000MHz

Nemko Comlab
PK

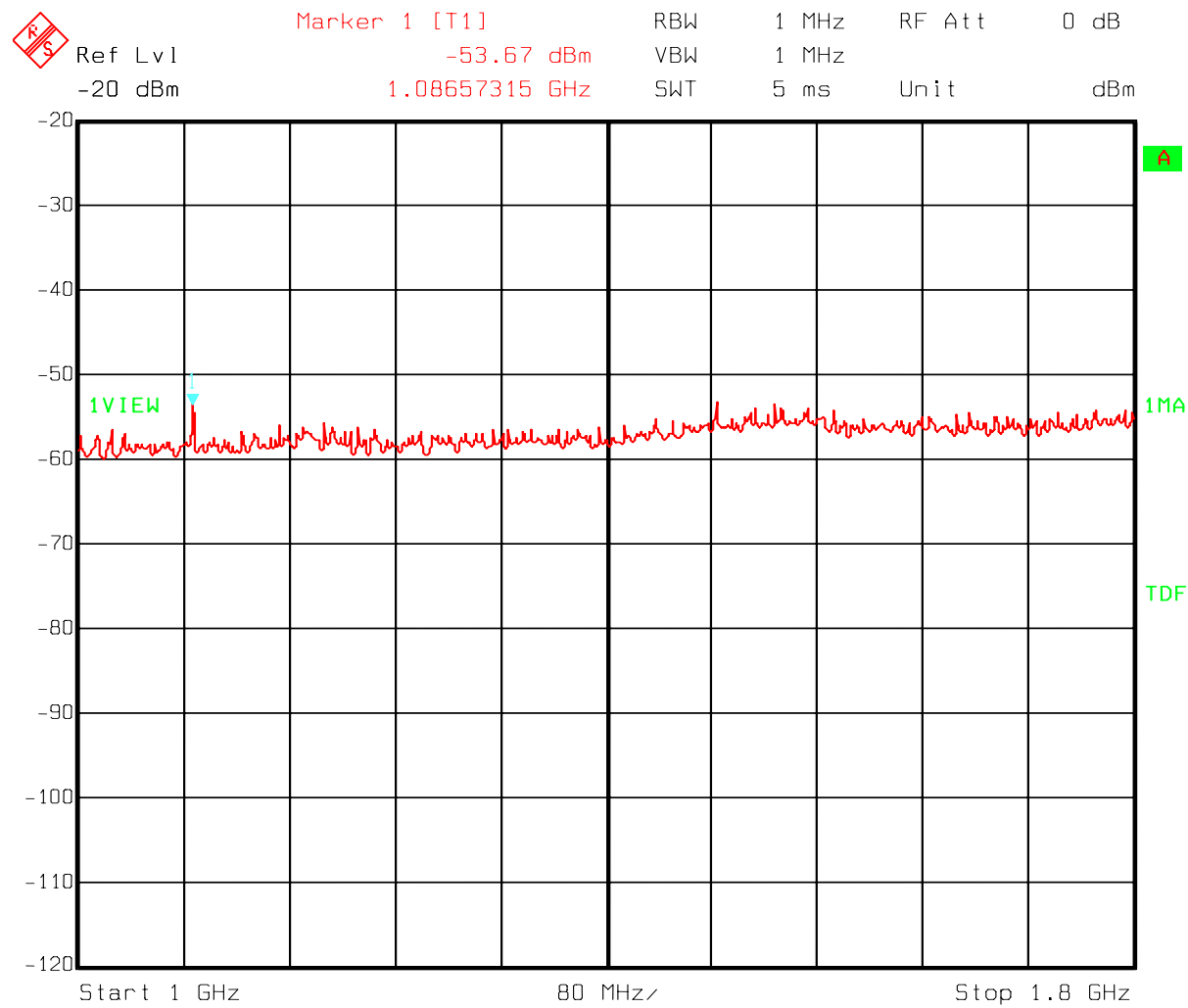
01. Oct 07 12:58

EUT: vhf OCAS Bå
Manuf: OCAS AS
Op Cond: 4m hp
Operator: gns
Test Spec: FCC 90
Comment: tx active

Scan Settings (1 Range)
|----- Frequencies -----| |----- Receiver Settings -----|
Start Stop Step IF BW Detector M-Time Atten Preamp OpRge
200M 1000M 50k 120k PK 50ms AUTO LN ON 60dB



Radiated Spurious Emissions Scan, HP, 200- 1000MHz



1VIEW

1MA

TDF

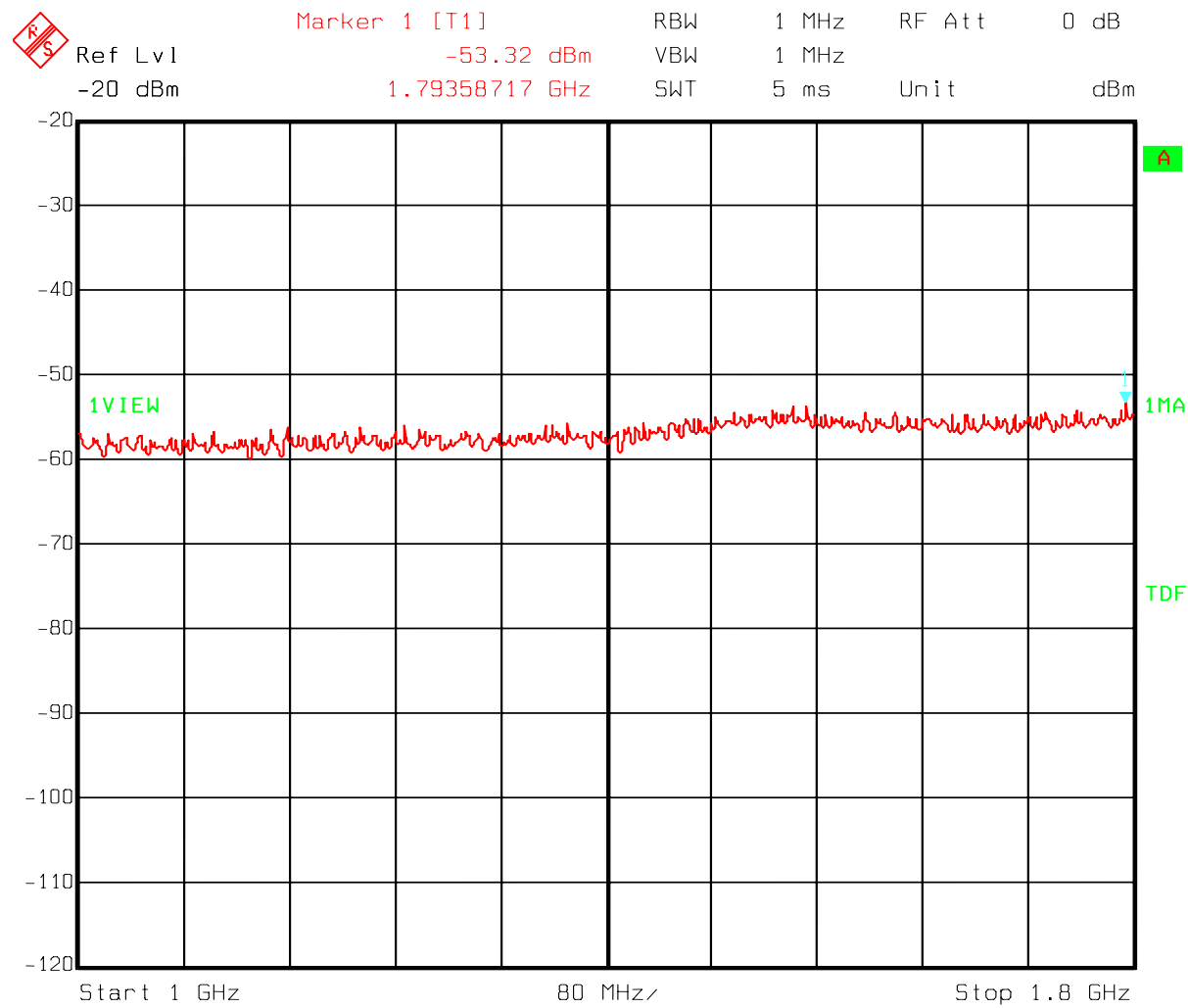
Start 1 GHz

80 MHz

Stop 1.8 GHz

Date: 1.OCT.2007 12:12:02

Radiated Spurious Emissions Scan, VP, 1000 – 1800 MHz



Start 1 GHz

80 MHz

Stop 1.8 GHz

Date: 1.OCT.2007 12:14:16

Radiated Spurious Emissions Scan, HP, 1000 – 1800 MHz

12 Frequency Stability

Para. No.: 87.133(a)/2.1055

Test Performed By: G.Suwanthakumar

Date of Test: 25.09.07

Test Results: Complies.

The maximum frequency drift is -20 Hz. This equals -0.17 ppm.

Test Data:

Test Condition	Frequency (118.000MHz)	Frequency Drift (Hz)	Frequency (127.500MHz)	Frequency Drift (Hz)	Frequency (136.000MHz)	Frequency Drift (Hz)
50°C	118.00000	0	127.50000	0	136.00000	0
40°C	118.00000	0	127.50000	0	135.99999	10
30°C	117.99998	20	127.50000	0	135.99998	-20
20°C, 11.8 Vdc	117.99998	-20	127.49998	-20	135.99998	-20
20°C, 15.3 Vdc	117.99998	-20	127.49998	-20	135.99998	-20
20°C, 13.9Vdc	117.99998	-20	127.49998	-20	135.99998	-20
10°C	118.00000	0	127.50000	0	136.00000	0
0°C	118.00000	0	127.50000	0	136.00000	0
-10°C	118.00000	0	127.50000	0	136.00000	0
-20°C	118.00000	0	127.50000	0	136.00000	0
-30°C	118.00000	0	127.50000	0	136.00000	0
Maximum frequency drift (Hz)	20		20		20	

Requirement 87.133(a):

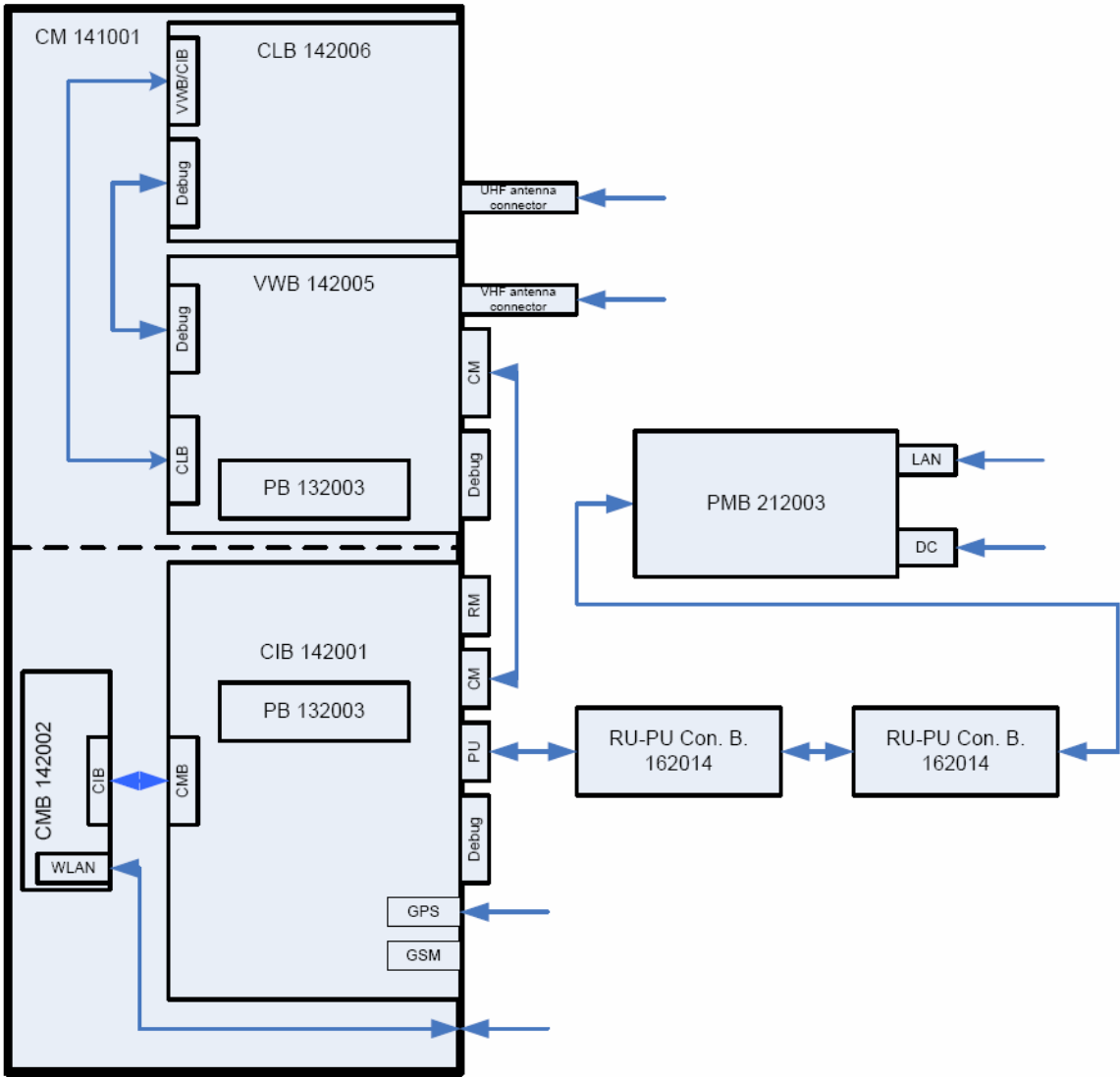
The tolerance for transmitters and stations using offset carrier techniques is less than 20 ppm.

13 LIST OF TEST EQUIPMENT

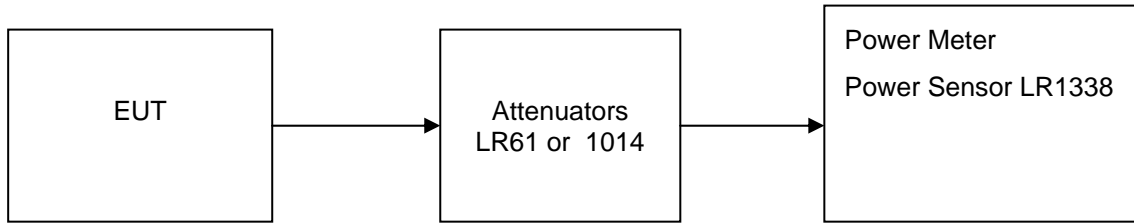
To facilitate inclusion on each page of the test equipment used for related tests, each item of test equipment and ancillaries are identified (numbered) by the Test Laboratory.

No	Description	Manufacturer	Type
1101	EMI-Receiver	R&S	ESVS30
1261	Antenna Log-periodic	R&S	HL 223
1410	Shielded room	ETS Euroshield	Semi-anechoic
61	Attenuator	Bird	8321
1087	Radio Communications Analyzer	R&S	CMTA 54
1079	Generator, AF../UHF	R&S	SMHU56
1337	Spectrum Analyzer	R&S	FSEK 1088,3494,30
1336	Generator, RF	R&S	SMP04 1035,5005,04
1260	Antenna, Biconical	R&S	HK 116
1338	Probe, RF	HP	8481H
181	Power meter	HP	436A
1014	Counter Freq	HP	5386A
1195	Attenuator	Narda	768-30
1007	Attenuator	Narda	765-10
1020	Multimeter, Digital	Fluke	87
257	Hybrid	Anzac	H-9
1504	EMI Receiver	R&S	FSU26
1167	Filter Band Pass	Trilithic	5VF95/190
46	Filter Band Pass	Texscan	5VF190/375
1169	Filter Band Pass	Trilithic	5VF250/500
1173	Filter Band Pass	Trilithic	5VF24/48
1174	Filter Band Pass	Trilithic	5VF1000/2000
5099	Spectrum Analyzer	HP	3588A
1083	Climatic chamber	ACS	TY80

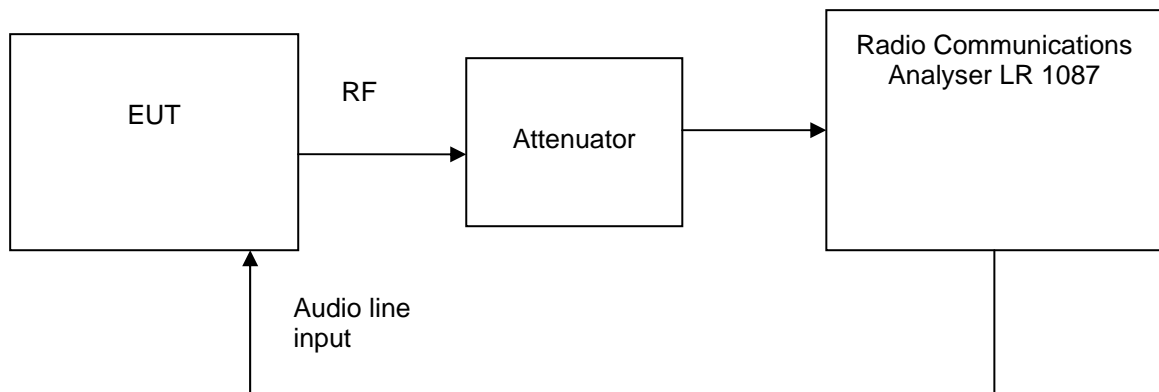
14 TEST SET-UP



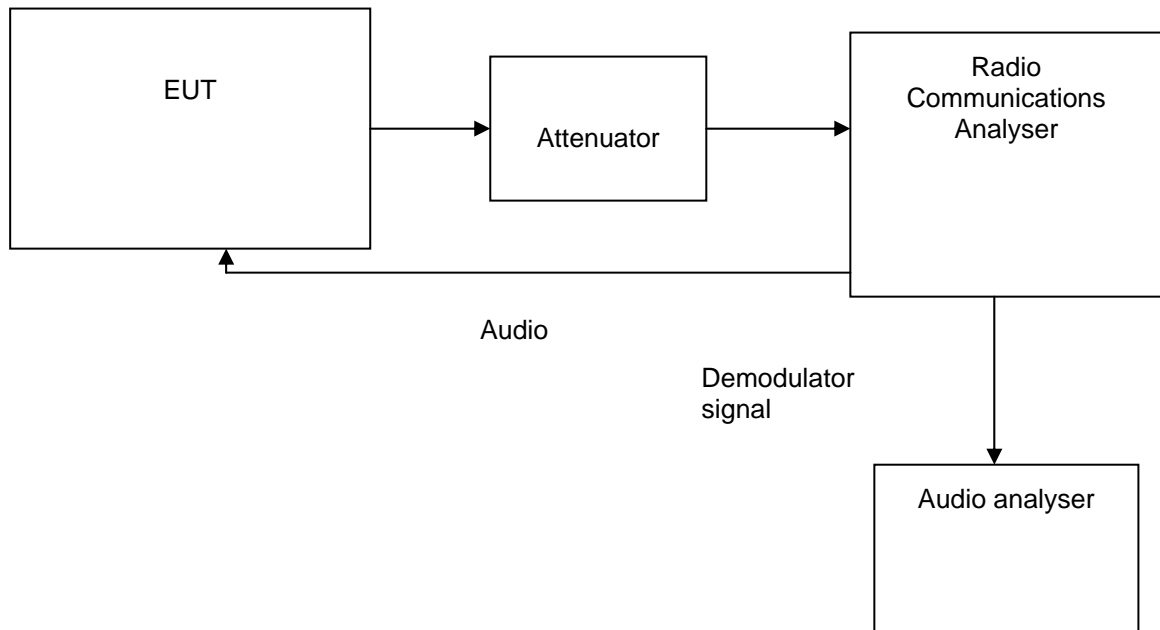
Block diagram of the System set-up



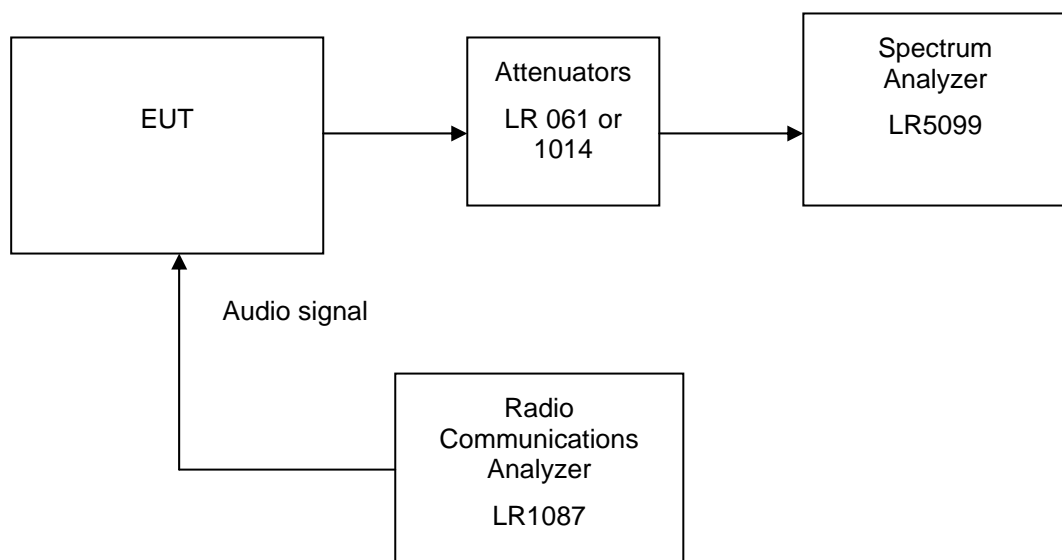
RF Output Power



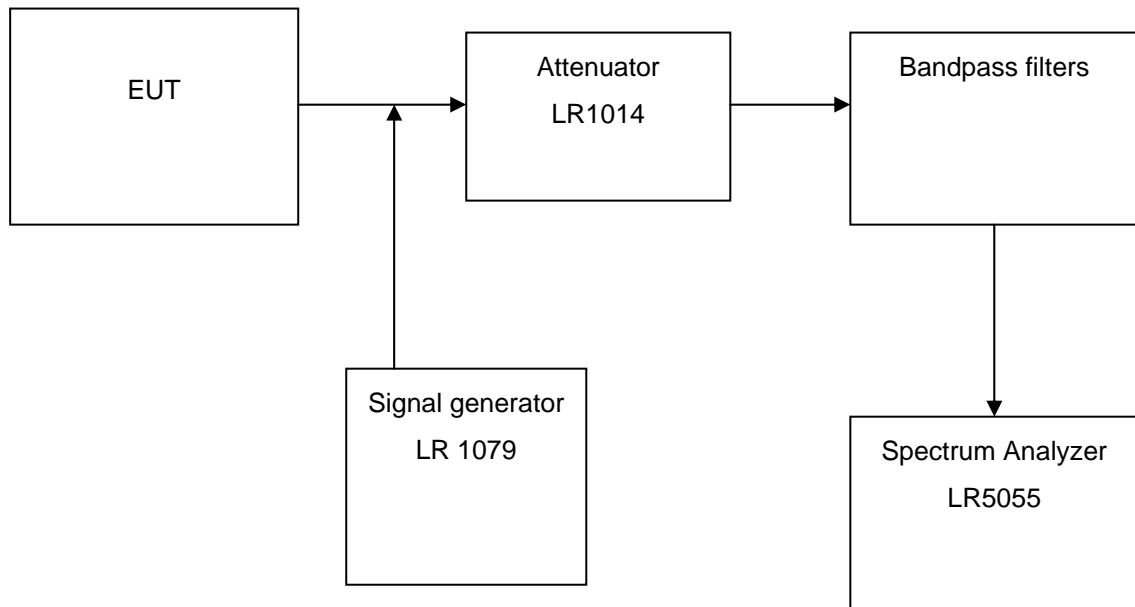
Audio Frequency Response/Modulation limiting



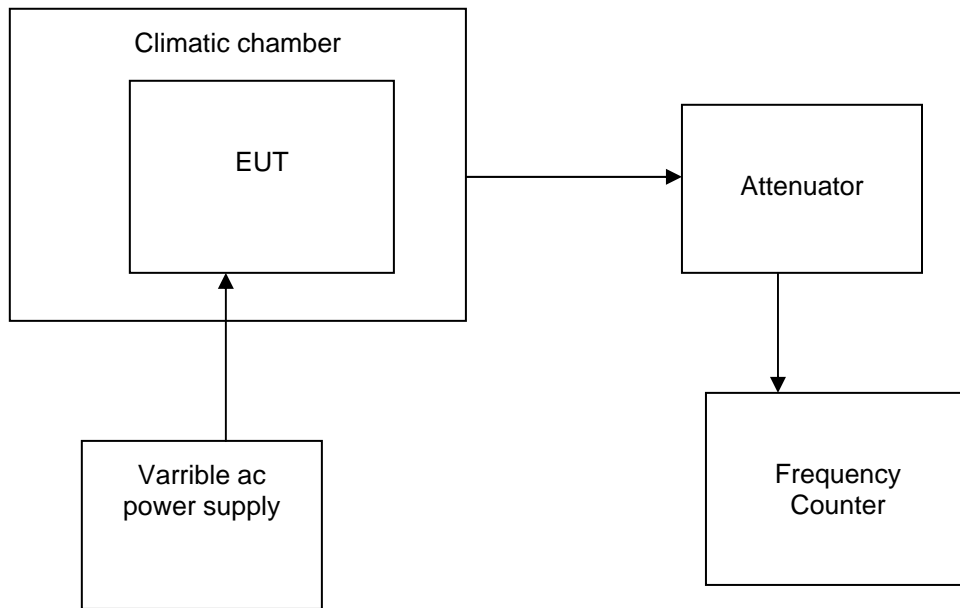
Audio low pass filter response



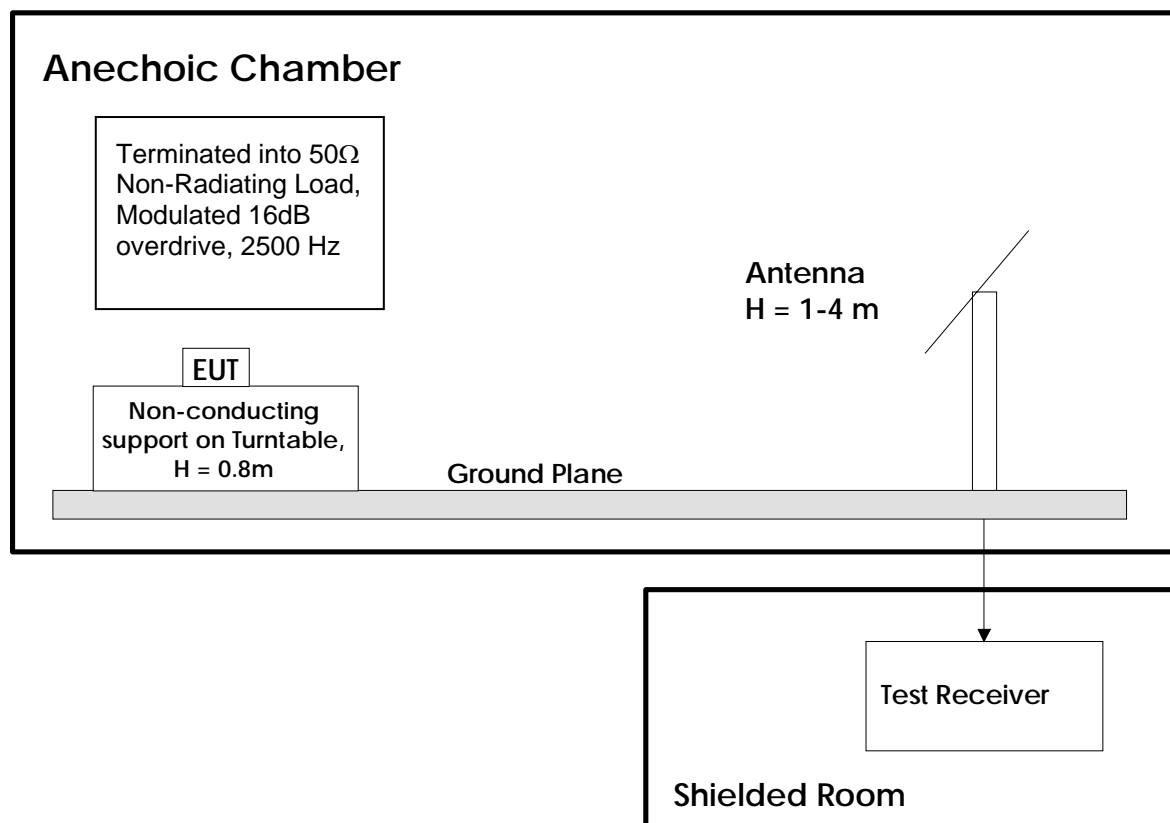
Occupied Bandwidth



Spurious Emissions at Antenna Terminals



Frequency Stability



Emission levels are measured in terms of ERP. All emissions within 20 dB of the specification limit are maximized along 360° azimuth and further maximized by raising and lowering the search antenna from 1 to 4 m. The transmitter under test is replaced with a dipole antenna and calibrated signal generator. The level and frequency of the signal generator are adjusted in order to reproduce the previously detected emission and maximized by varying the height of the search antenna. This procedure is performed both horizontal and vertical polarization of the detected signal.

Radiated spurious emissions