



**Test report no. : 89325 - 10**

**Item tested : TR-810**

**Type of equipment : VHF Transceiver**

**FCC ID : RA9TR-810**

**Client : Jotron AS**

**FCC Part 87 Subpart D**

Aviation Services

**RSS-141**

Aeronautical radiocommunication equipment in the  
Frequency Range 117.975 – 137 MHz

**15 April 2008**

**Authorized by :** 

Frode Sveinsen  
Technical Verificator



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## 1 GENERAL INFORMATION

### 1.1 Testhouse Info

Name : Nemko Comlab  
Address : Gåsevikeien 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: 34

### 1.2 Client Information

Name : Jotron AS  
Address : P.O.Box 54, Østbyveien 1, 3280 Tjodalyng  
Telephone : +47 33 13 97 14

**Contact:**

Name : Eirik Storjordet  
Telephone : +47 33 13 97 14  
E-mail : eirik.storjordet@jotron.com

### 1.3 Manufacturer ( if other than client)

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## 2 Test Information

### 2.1 Test Item

Name :	Jotron
Model/version :	TR-810
Serial number :	Not stated
Hardware identity and/or version:	Main unit: 0.21, Front unit: 0.2.08
Software identity and/or version :	Not stated
Frequency Range :	118.000 – 136.975 MHz
Tunable Bands :	None
Emission designator:	6K00A3E
Number of Channels :	720 in 25 kHz mode
Operating Modes :	TX & RX (Simplex)
Channel separation:	25 kHz
Type of Modulation :	AM
User Frequency Adjustment :	Yes
Rated Output Power (TX) :	High power: 10 W, Low power: 1W
Rated maximum audio output:	200mW @ 8ohm
Rated maximum audio input:	-18 dBm
Type of Power Supply :	10 - 30.8VDC
Antenna Connector :	50 Ohm N-connector

#### Description of Test Item

The Jotron 810 VHF mobile radio is an AM transceiver is designed for ground to air communications 118 – 137 MHz aeronautical band. The front module can be disconnected from the radio module, and mounted separately in a position close to the operator. The two modules are connected with a CAT6 cable.

The TR-810 has three RJ-45 ports, one input for microphone, two rear ports, one port (Mic) for microphone and one (I/O) for external loudspeaker.

#### Theory of Operation

The EUT is a simple AM modulated ground to air VHF aeronautical radio transceiver.

## 2.2 Test Environment

### 2.2.1 Normal test condition

Temperature:	20 - 24 °C
Relative humidity:	20 - 50 %
Normal test voltage:	12 V DC

The values are the limit registered during the test period.

## 2.3 Test Period

Item received date: 2008-01-06

Test period : from 2008-01-28 to 2008-02-06

### 3 TEST REPORT SUMMARY

#### 3.1 General

Manufacturer: Jotron AS  
Model No.: TR-810  
Serial No.: Not stated

All measurements are traceable to national standards.

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

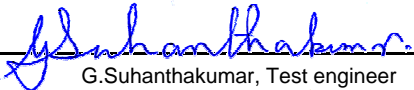
Radiated tests were conducted in accordance with ANSI C63.4-2003. The radiated tests were made in a semi-anechoic chamber at measuring distances of 3 and 10metres.

- |   |   |
|---|---|
| <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        |
| <b>FVH</b> 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 #: 89325-10**

**TESTED BY:**   
G.Suhanthakumar, Test engineer

**DATE: 19.02.2008**

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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 <sup>1</sup>
Audio Frequency Response	2.1047	-	Complies
Audio Low-Pass Filter Response	2.1047	-	Complies
Modulation Limiting	87.141b / 2.1047	-	Complies
Occupied Bandwidth	87.139a / 2.1049	-	Complies
Spurious Emissions at Antenna Terminals (conducted)	87.139(a)(3) / 2.1051 / 2.1057	4.4 / 6.2	Complies
Spurious Emissions radiated, Transmitter & receiver	87.139(a)(3) / 2.1053 / 2.1057	4.5	Complies
Frequency Stability	87.133 / 2.1055	4.2	Complies <sup>2</sup>

<sup>1</sup> The output power from 1 to 10 W is selected in software.

<sup>2</sup> The manufacturer specified voltage range is 10 - 30.8 V DC

### 3.3 Description of modification for Modification Filing

Not applicable.

### 3.4 Comments

The measurements were done with the EUT powered by 12Vdc. It was checked that power variations between 10 V DC and 30.8 V DC 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: 29.01.2008
------------------------------------	--------------------------

**Test Results:** Complies.

The maximum RF output power is 13.3W (41.24dBm) with 90% AM modulation.

The carrier power is within 1.3 dB of the manufacturer's rating of RF power output.

**Measurement Data:**

TX: 118 MHz, ref 50% AM, 1000Hz – Modulated 2.5KHz with 16dB overdrive

Carrier power			Mean Power		
Rated (W)	Measured (W)	(Measured/rated) dB	Rated (W)	Measured (W)	(Measured/rated) dB
10	10.07	0.03	14.4	13.3	-0.34
1	1.35	1.3	1.4	1.75	0.96

TX: 128 MHz, ref 50% AM, 1000Hz – Modulated 2.5KHz with 16dB overdrive

Carrier power			Mean Power		
Rated (W)	Measured (W)	(Measured/rated) dB	Rated (W)	Measured (W)	(Measured/rated) dB
10	9.97	-0.1	14.4	13	-0.44
1	1.33	1.24	1.4	1.64	0.69

TX: 136.975 MHz, ref 50% AM, 1000Hz – Modulated 2.5KHz with 16dB overdrive

Carrier power			Mean Power		
Rated (W)	Measured (W)	(Measured/rated) dB	Rated (W)	Measured (W)	(Measured/rated) dB
10	9.79	-0.09	14.4	13.06	-0.43
1	1.28	1.07	1.4	1.58	0.53

**Note:**

Mean power rating is based on the limit of 90% AM. This is equivalent to 1.44 x 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

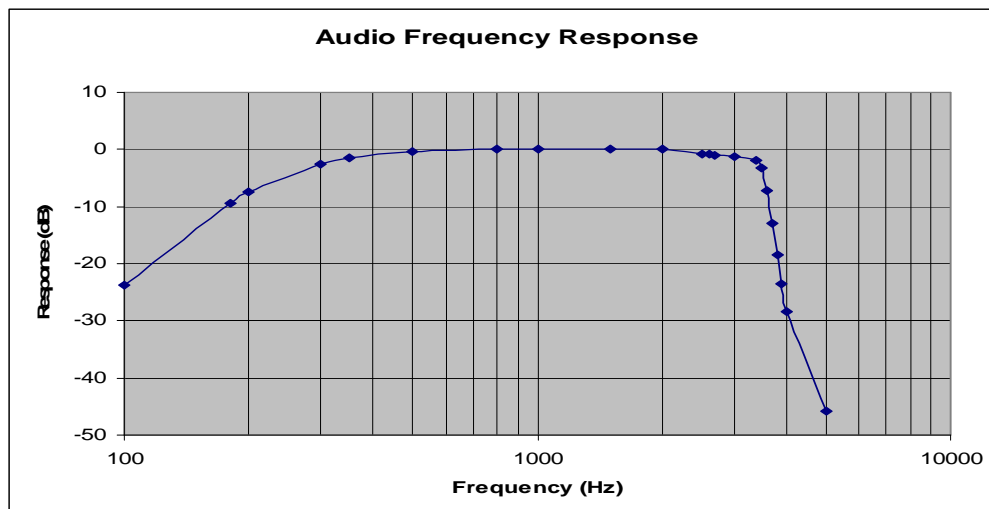
Test Performed By: G.Suhandhakumar

Date of Test: 31.01.2008

Test Results: See attached graph.

### Measurement Data:

Frequency(Hz)	Response (dB)
100	-23.7
180	--9.5
200	-7.5
300	-2.5
350	-1.5
500	-0,3
800	0
1000	0
1500	0
2000	0
2500	-0,9
2600	-0,9
2700	-1.0
3000	-1.3
3400	-1.9
3500	-3.2
3600	-7.3
3700	-12.9
3800	-18,4
3900	-23.6
4000	-28.4
5000	-45.7



## 7 Audio Low-Pass Filter Response

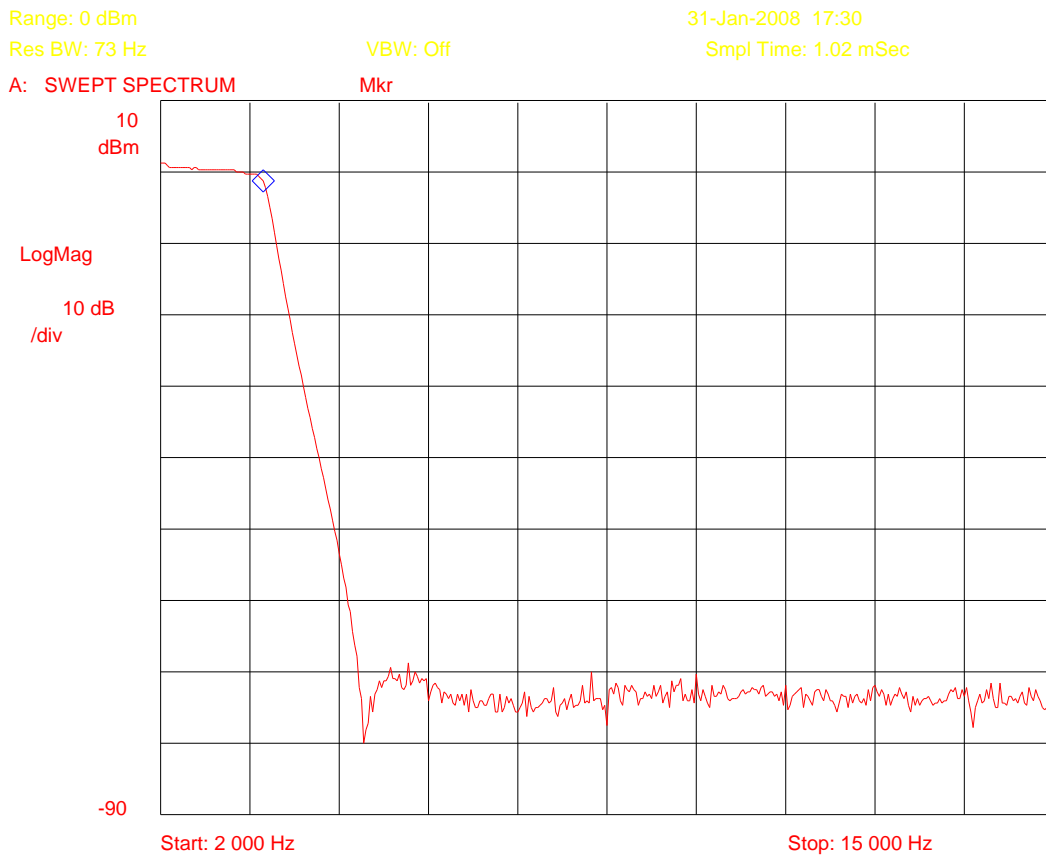
Para. No.: 2.1047

Test Performed By: G.Suhandhakumar	Date of Test: 31.01.2008
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Test Results: see attached graph

### Measurement Data:

LP filter is at 3495 Hz



## 8 Modulation Limiting

Para. No.: 87.141(b)/ 2.1047

Test Performed By: G.Suhandhakumar	Date of Test: 31.01.2008
------------------------------------	--------------------------

**Test Results:** Complies.

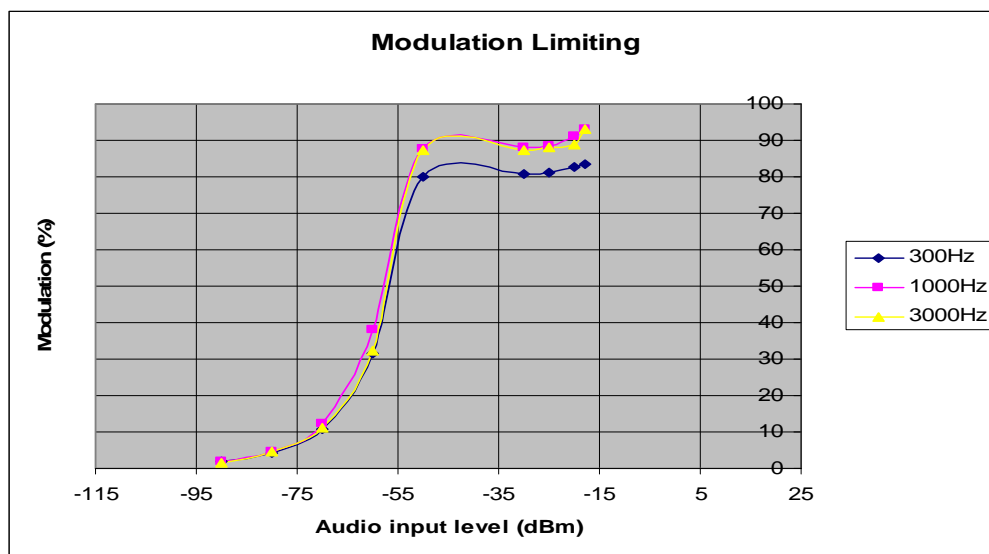
The maximum AM modulation level is 93 % @ 1000 Hz.

**Measurement Data:** See attached graph.

### 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.

Audio input level dBm	300HZ	1000Hz	3000Hz
	%	%	%
-90	1,8	1,8	1,6
-80	4,1	4,5	4,6
-70	10,9	12,5	11,1
-60	31,6	37,9	32,2
-50	80,0	87,6	87,4
-30	80,6	88,1	87,5
-25	81,1	88,6	88,0
-20	82,6	91,1	89
-18	83,4	93	93



## 9 Occupied Bandwidth

Para. No.: 87.139(a)/ 2.1049

Test Performed By: G.Suwanthakumar

Date of Test: 31.01.2008

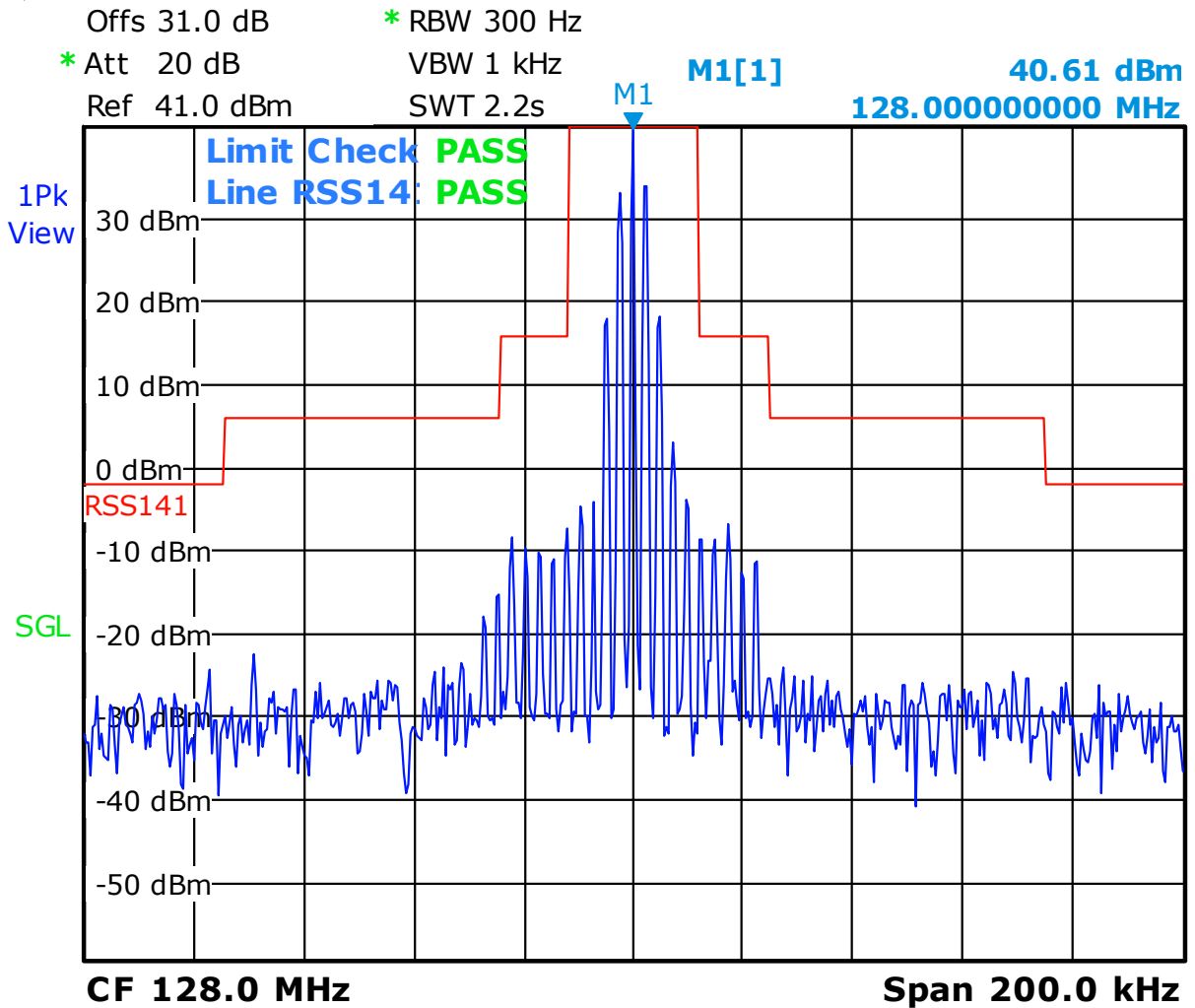
**Test Results:** Complies.

**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.JAN.2008 16:27:31

6K00A3E

TX 128 MHz , High power: 10Watts

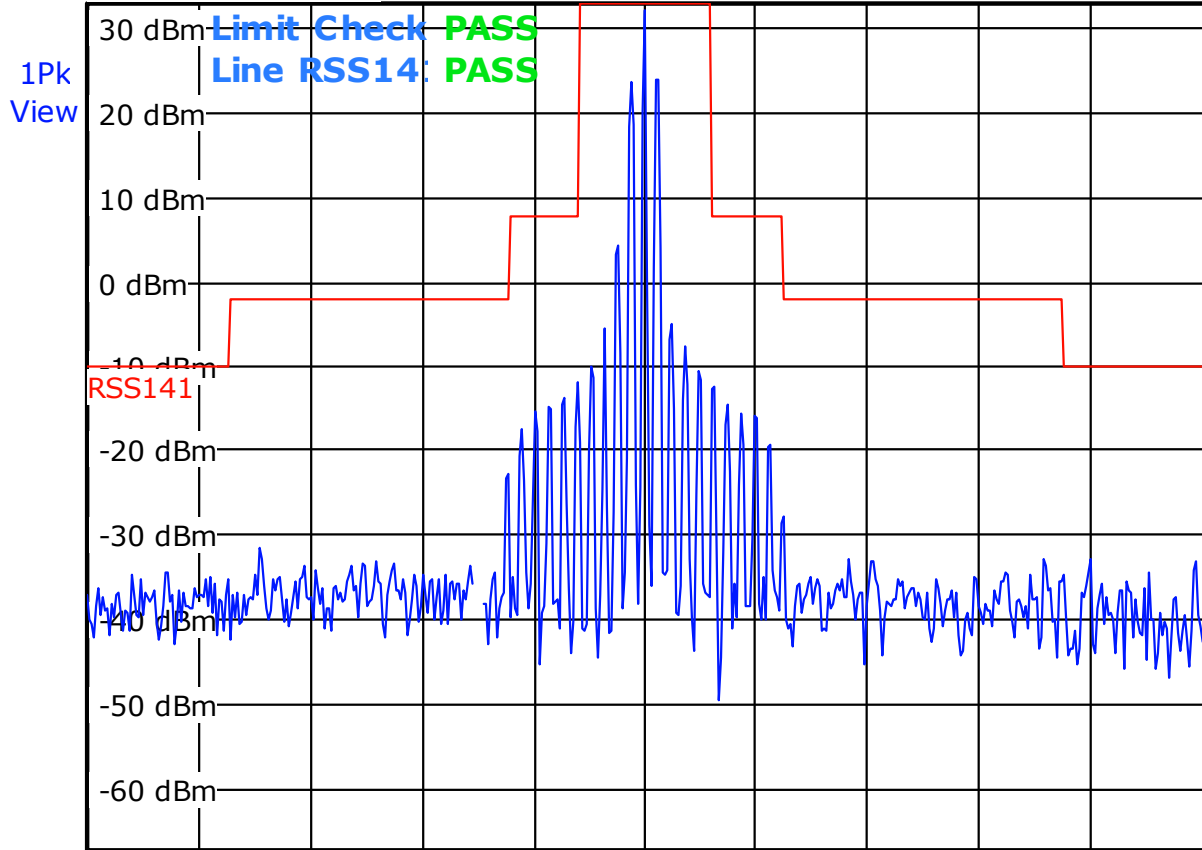
Modulated 2500 Hz, 16 dB overdrive (ref: 50% modulation, 1000 Hz)

Authorized Bandwidth: 25 kHz, 87.137(a)

$43+10\log(10)= 53\text{dB}$



Offs 31.0 dB      \* RBW 300 Hz  
Att 25 dB        VBW 1 kHz  
Ref 33.0 dBm     SWT 2.2s



**CF 128.0 MHz**

**Span 200.0 kHz**

Date: 31.JAN.2008 16:18:28

6K00A3E

TX 128 MHz, Low Power: 1Watt

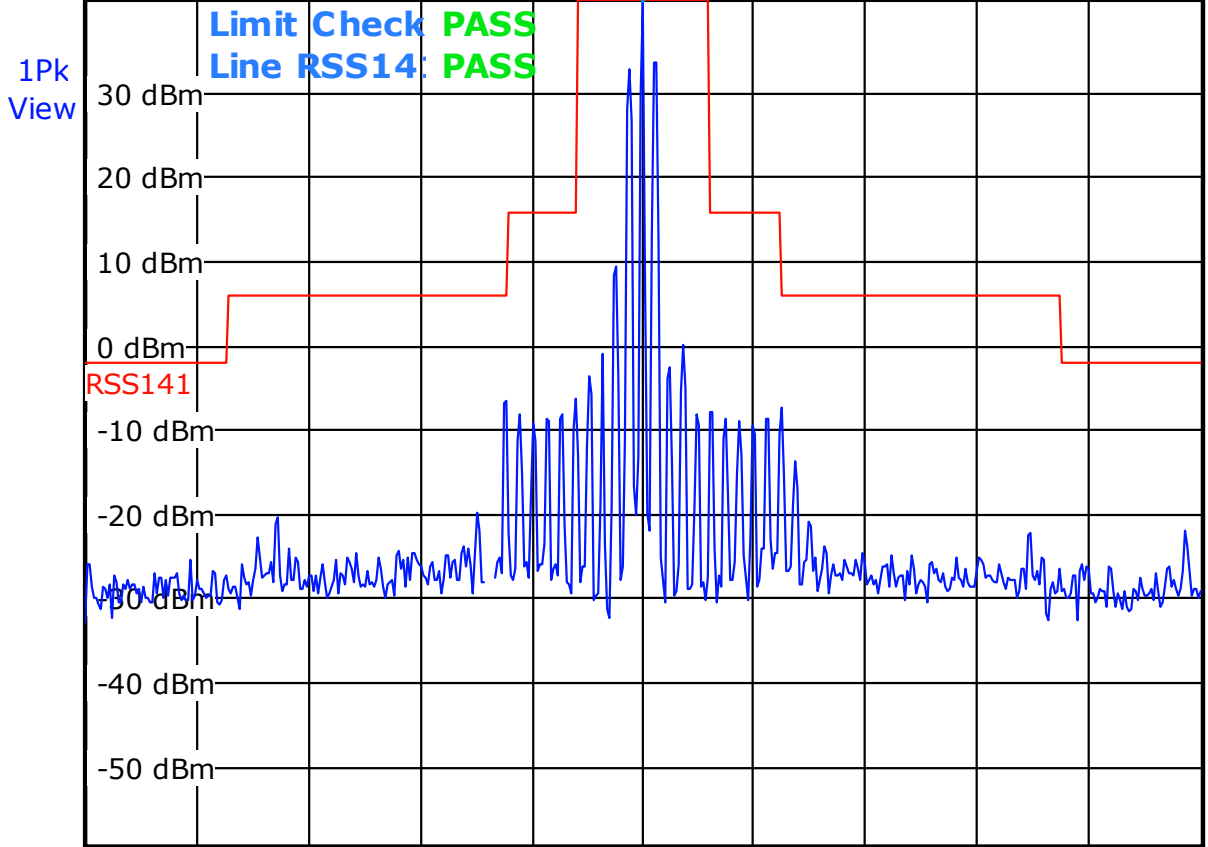
Modulated 2500 Hz, 16 dB overdrive (ref: 50% modulation, 1000 Hz)

Authorized Bandwidth: 25 kHz, 87.137(a)

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



Offs 31.0 dB      \* RBW 300 Hz  
 \* Att 20 dB      VBW 1 kHz  
 Ref 41.0 dBm      SWT 2.2s



**CF 118.0 MHz**

**Span 200.0 kHz**

Date: 31.JAN.2008 16:25:35

6K00A3E

TX 118 MHz , High power: 10Watts

Modulated 2500 Hz, 16 dB overdrive (ref: 50% modulation, 1000 Hz)

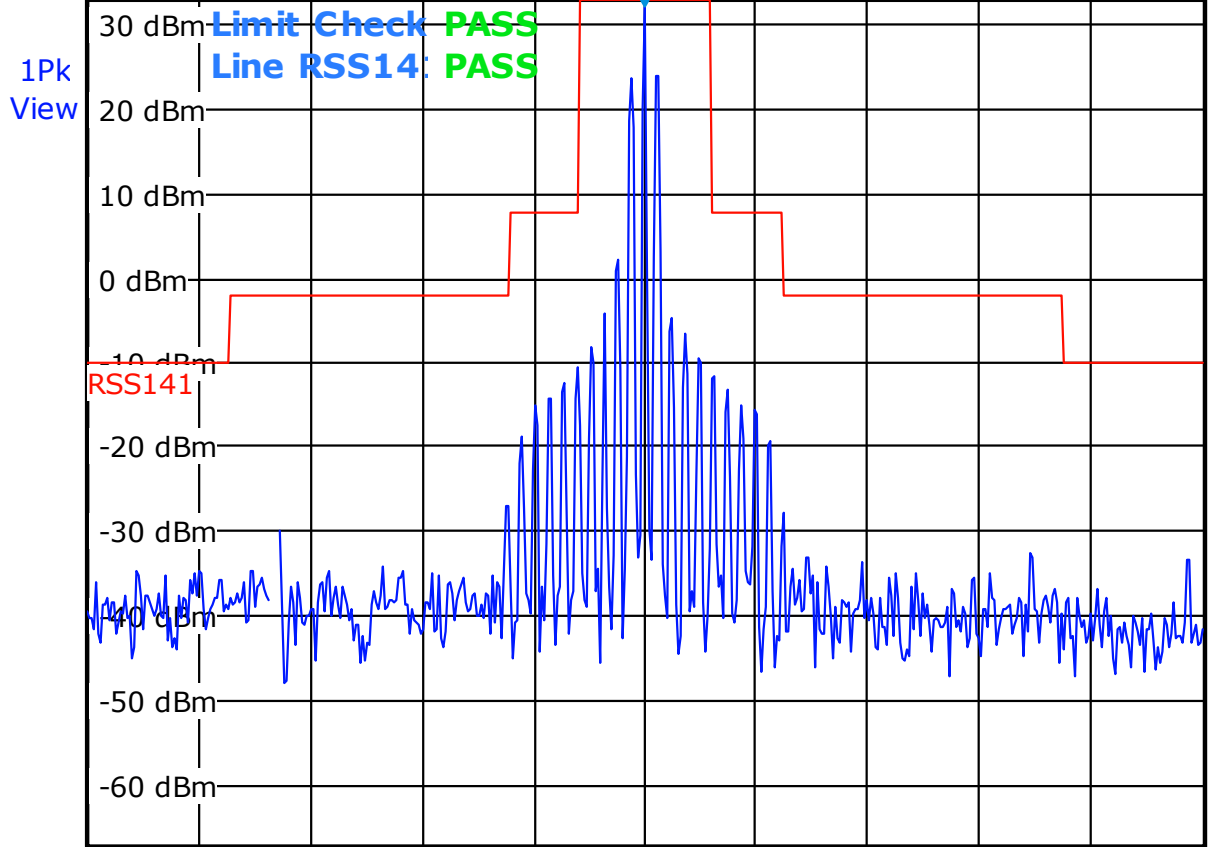
Authorized Bandwidth: 25 kHz, 87.137(a)

$43+10 \log(10)= 53\text{dB}$





Offs 31.0 dB      \* RBW 300 Hz  
 Att 25 dB      VBW 1 kHz  
 Ref 33.0 dBm      SWT 2.2s



**CF 118.0 MHz**

**Span 200.0 kHz**

Date: 31.JAN.2008 16:19:34

6K00A3E

TX 118 MHz, Low Power: 1Watt

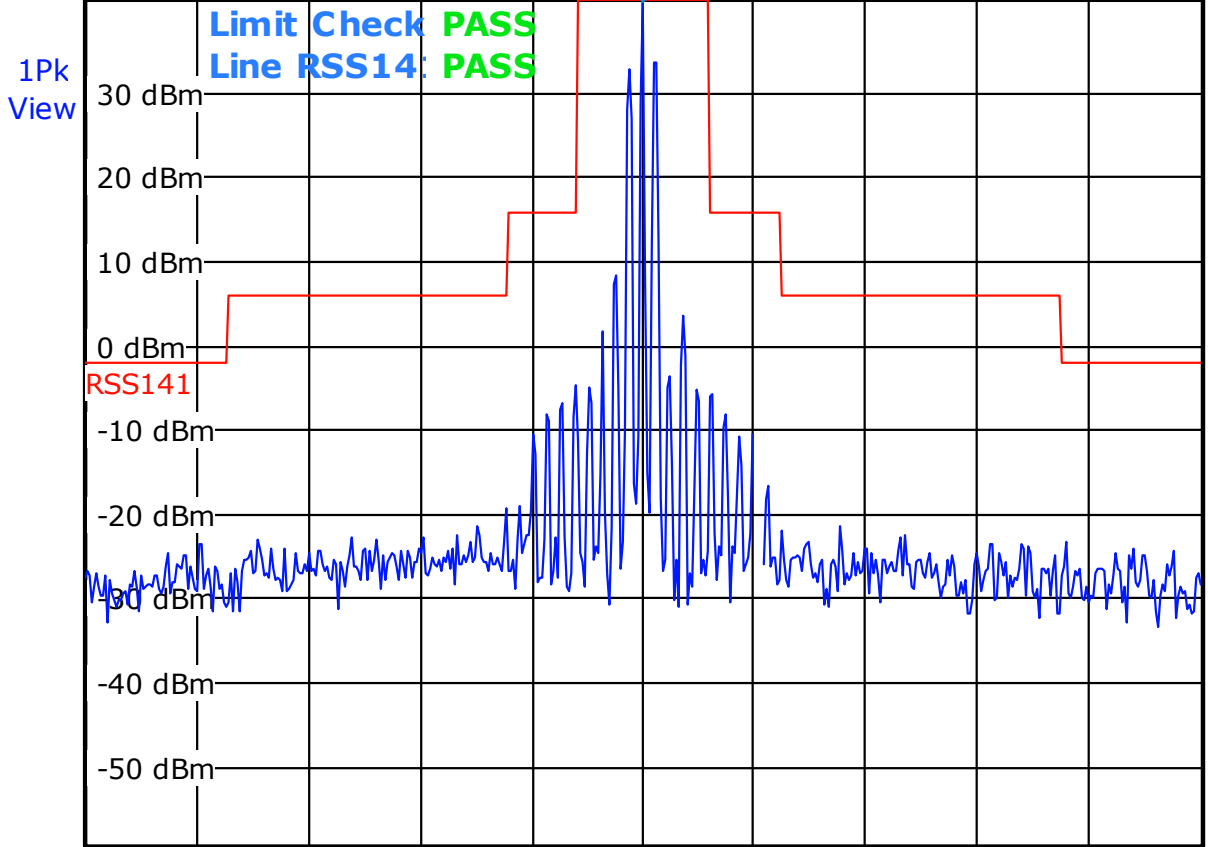
Modulated 2500 Hz, 16 dB overdrive (ref: 50% modulation, 1000 Hz)

Authorized Bandwidth: 25 kHz, 87.137(a)

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



Offs 31.0 dB      \* RBW 300 Hz  
 \* Att 20 dB      VBW 1 kHz  
 Ref 41.0 dBm      SWT 2.2s



**CF 136.975 MHz**

**Span 200.0 kHz**

Date: 31.JAN.2008 16:24:11

6K00A3E

TX 136.975 MHz , High power: 10Watts

Modulated 2500 Hz, 16 dB overdrive (ref: 50% modulation, 1000 Hz)

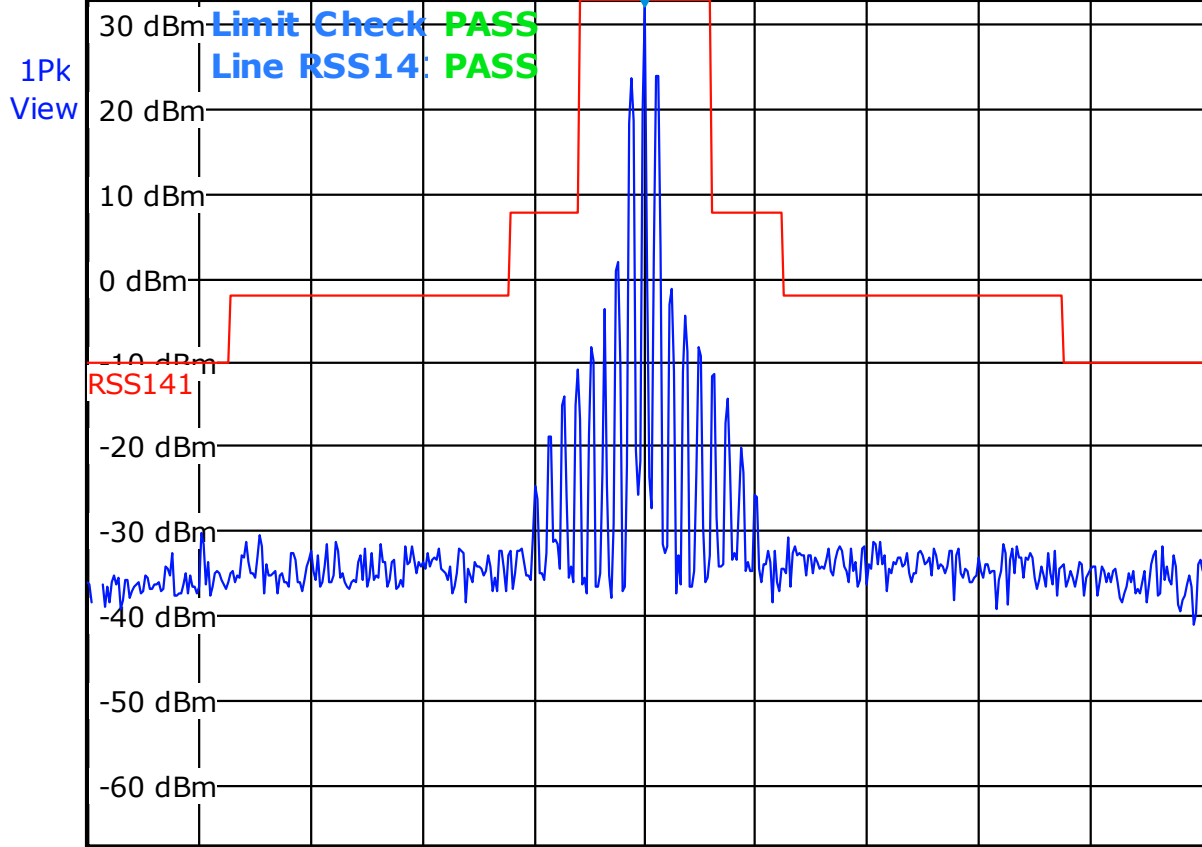
Authorized Bandwidth: 25 kHz, 87.137(a)

$43+10 \log(10)= 53\text{dB}$



Offs 31.0 dB      \* RBW 300 Hz  
 Att 25 dB      VBW 1 kHz  
 Ref 33.0 dBm      SWT 2.2s

**M1[1]**      **32.20 dBm**  
**136.97500000 MHz**



**CF 136.975 MHz**

**Span 200.0 kHz**

Date: 31.JAN.2008 16:22:16

6K00A3E

TX 136.975 MHz, Low Power: 1Watt

Modulated 2500 Hz, 16 dB overdrive (ref: 50% modulation, 1000 Hz)

Authorized Bandwidth: 25 kHz, 87.137(a)

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

## 10 Spurious Emissions at Antenna Terminals

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

Test Performed By: G.Suhandhakumar	Date of Test: 31.01.08
------------------------------------	------------------------

**Test Results:** Complies.

The maximum emission is -50 dBm at 255 MHz. This is 37 dB below the specification limit. The spectrum was searched from 30 to 1400 MHz using a spectrum analyzer set to positive peak detector, 100kHz 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 1118MHz, 128MHz & 136.975MHz and in High and low power. The measured spurious emissions are well below 20 dB from the limit.

**Test Data:** See the table below.

TX 128 MHz, 10 Watts

Frequency of Emission (MHz)	Measured Emission Level (dBm)	Limit (dBm)	Margin (dB)
255	-50	-13	38
382.5	-60	-13	47
510	-65	-13	52
637.5	-55	-13	42
765	-62	-13	49
892.5	-53	-13	40
1020	-51	-13	38
1147,5	-52	-13	39
1275	-64	-13	51
1402	-65	-13	52

**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  $43 + 10 \log_{10} P_Y$  dB,  $< (-13 \text{ dBm})$

## 11 Field Strength of Spurious Emissions

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

Test Performed By: G.Suhandhakumar	Date of Test: 18.01.07
------------------------------------	------------------------

**Test Results:** Complies.

The spectrum was searched from 30 to 1400 MHz.

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

### Test Data:

TX 128 MHz, 10 Watts - Modulated 2500 Hz, 16 dB overdrive (ref: 50% modulation, 1000 Hz)

Frequency of Emission (MHz)	Measured Emission Level (dBm)	Limit (dBm)	Margin (dB)
255	-44	-13	31
382,5	-38	-13	25
510	-60,5	-13	47,5
637,5	-42	-13	29
756	-44	-13	31
892,5	-34	-13	21
1019	-50	-13	37

Worst case emissions are obtained at vertical polarization

Peak Detector

RBW is 100 kHz below 1 GHz and 1 MHz above 1 GHz

### 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,  $< (-13 \text{ dBm})$

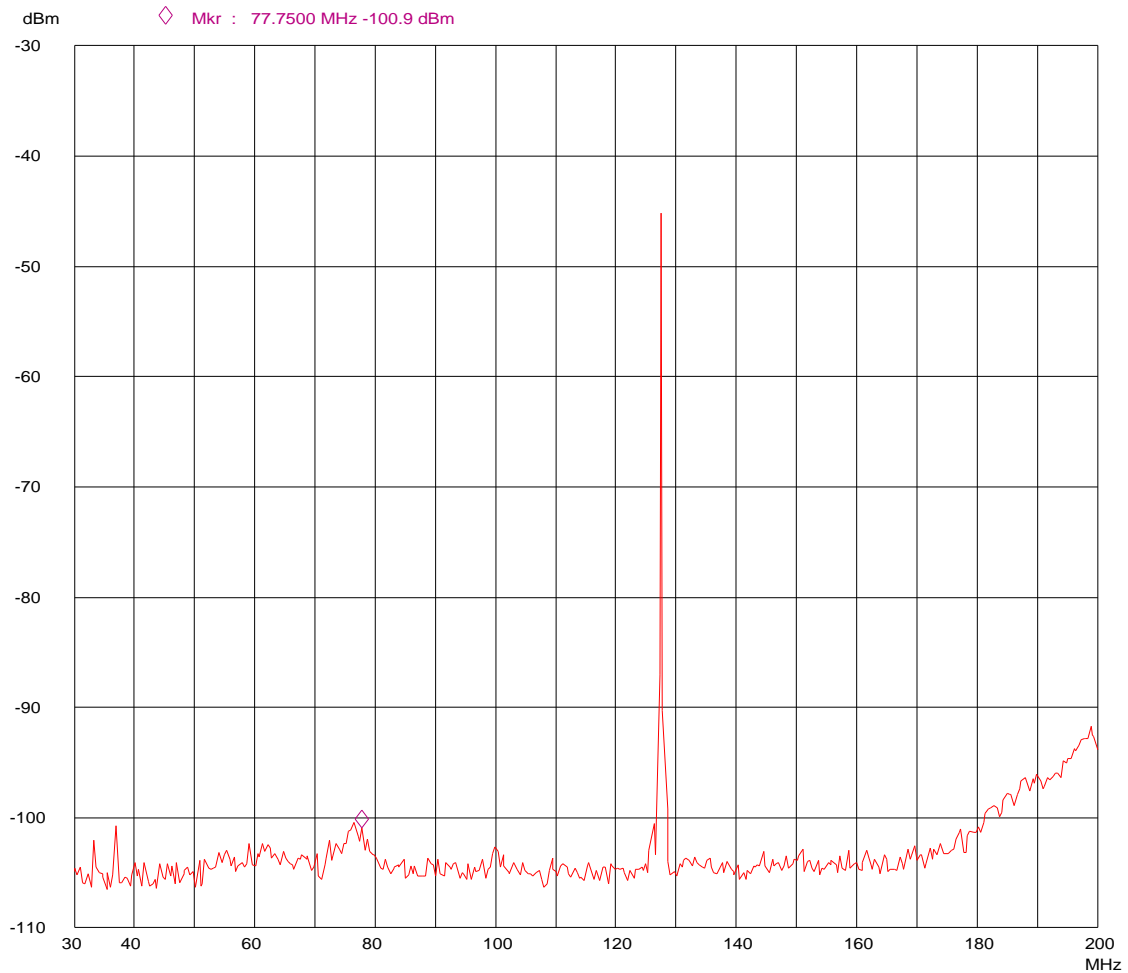
Nemko Comlab  
 Peak

04. Feb 08 14:17

EUT: Jotron 810  
 Manuf: Jotron  
 Op Cond: 1m Vp 10m distance  
 Operator: gns  
 Test Spec: Part 87D  
 Comment: TX mode

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, VP, 30- 200 MHz

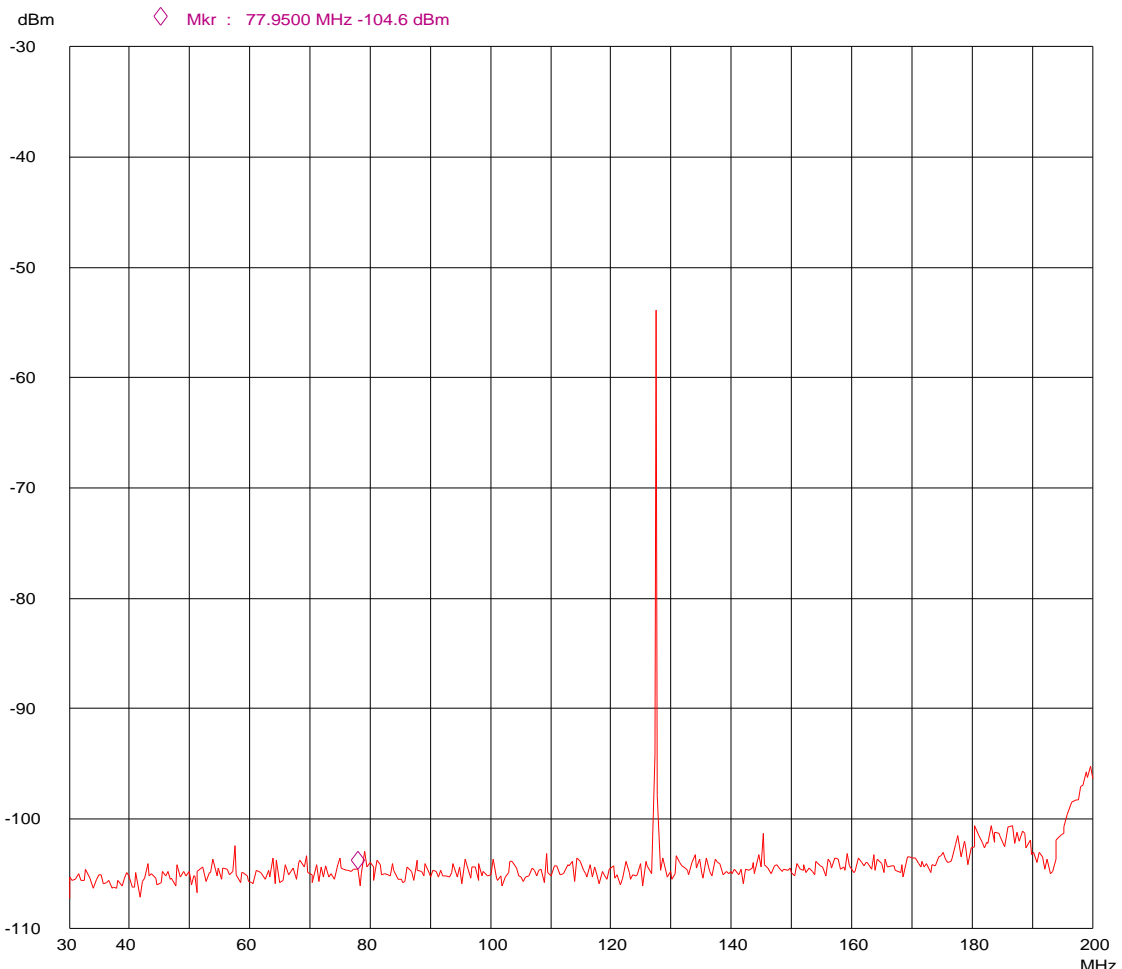
Nemko Comlab  
 Peak

04. Feb 08 14:21

EUT: Jotron 810  
 Manuf: Jotron  
 Op Cond: 4n Hp 10m distance  
 Operator: gns  
 Test Spec: Part 87D  
 Comment: TX mode

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	ON	60dB



Radiated Spurious Emissions Scan, HP, 30- 200 MHz

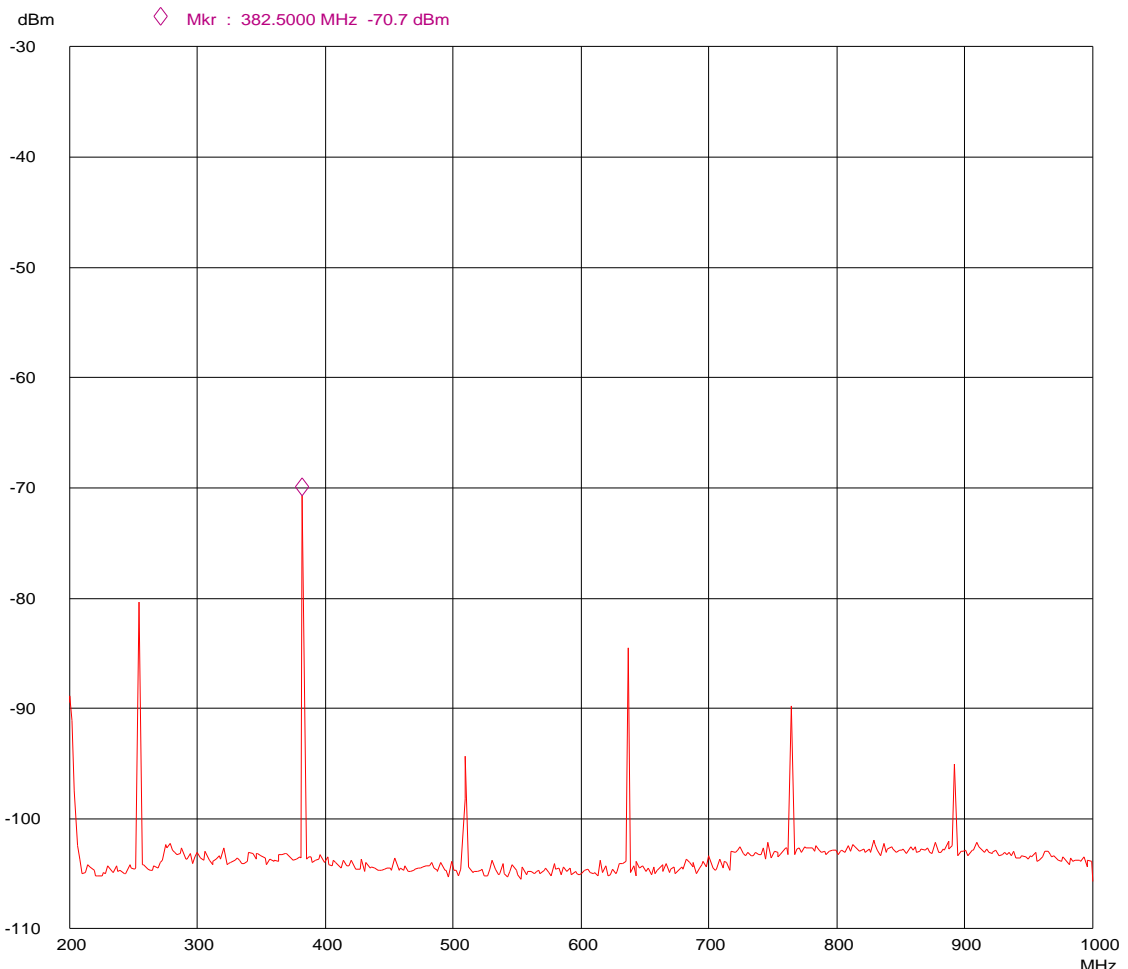
Nemko Comlab  
 Peak

04. Feb 08 13:30

EUT: Jotron 810  
 Manuf: Jotron  
 Op Cond: 1m vp 10m distance  
 Operator: gns  
 Test Spec: Part 87D  
 Comment: TX mode

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- 1000 MHz



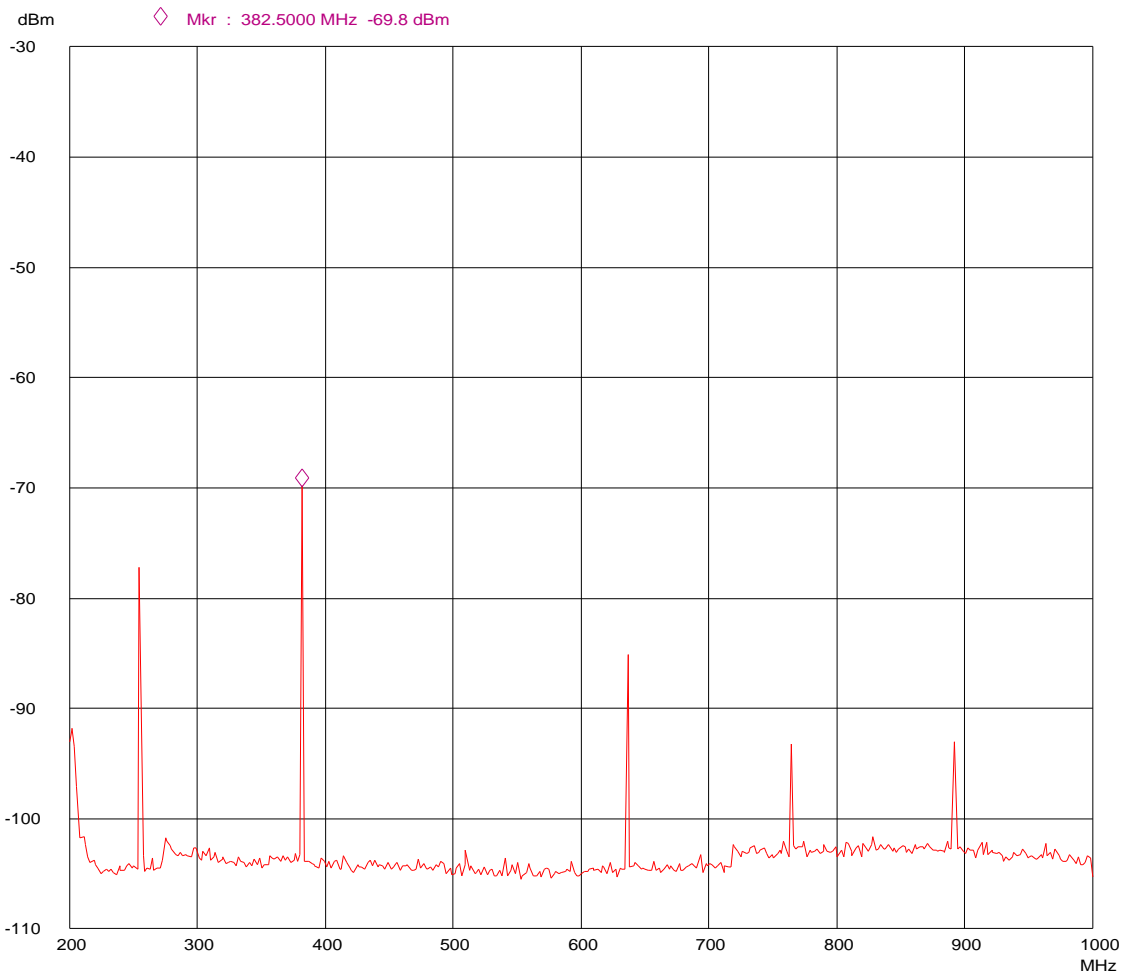
## Nemko Comlab Peak

04. Feb 08 13:09

EUT: Jotron 810  
 Manuf: Jotron  
 Op Cond: 4m hp 10m distance  
 Operator: gns  
 Test Spec: Part 87D  
 Comment: TX mode

### 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



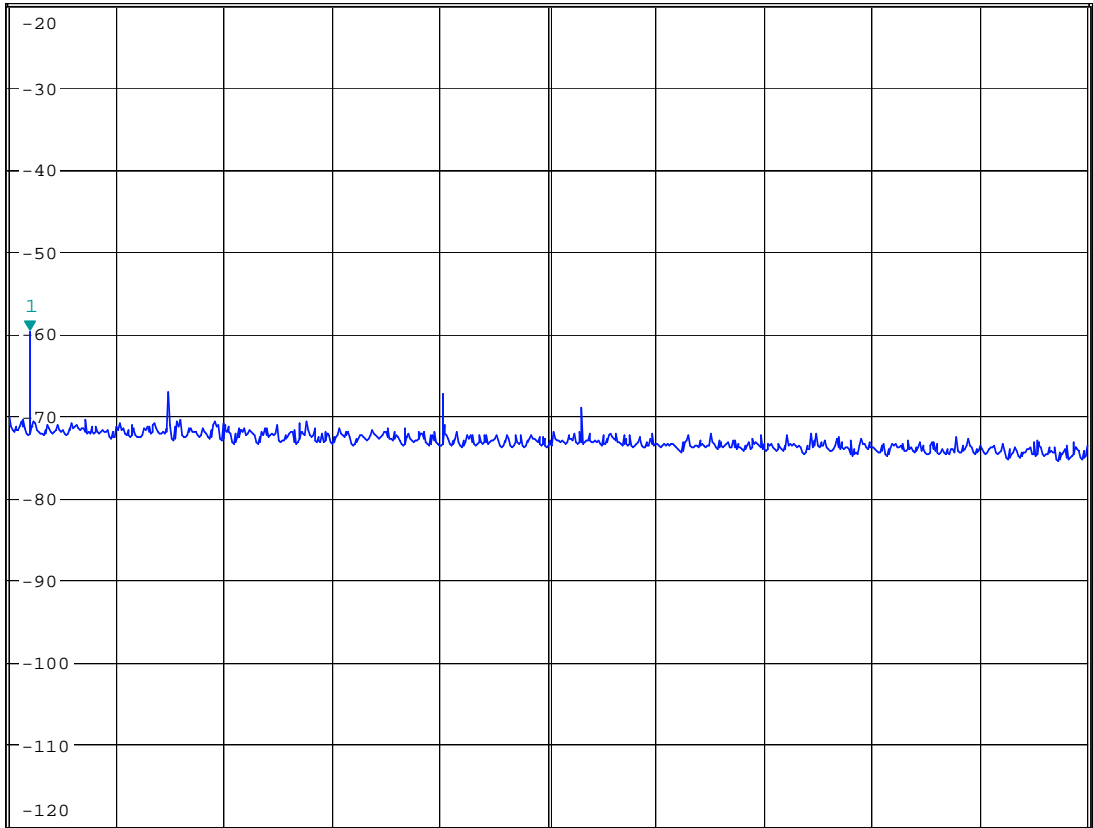
**Radiated Spurious Emissions Scan, HP, 200- 1000 MHz**



SELECT TRACE  
1  
Ref -20 dBm      \* Att 5 dB

\* RBW 100 kHz      Marker 1 [T1 ]  
VBW 300 kHz      -59.81 dBm  
SWT 100 ms      1.019230769 GHz

1 PK  
MAXH



Start 1 GHz      100 MHz/      Stop 2 GHz

Date: 4.FEB.2008 10:33:55

**Radiated Spurious Emissions Scan, VP, 1000 - 1400 MHz**

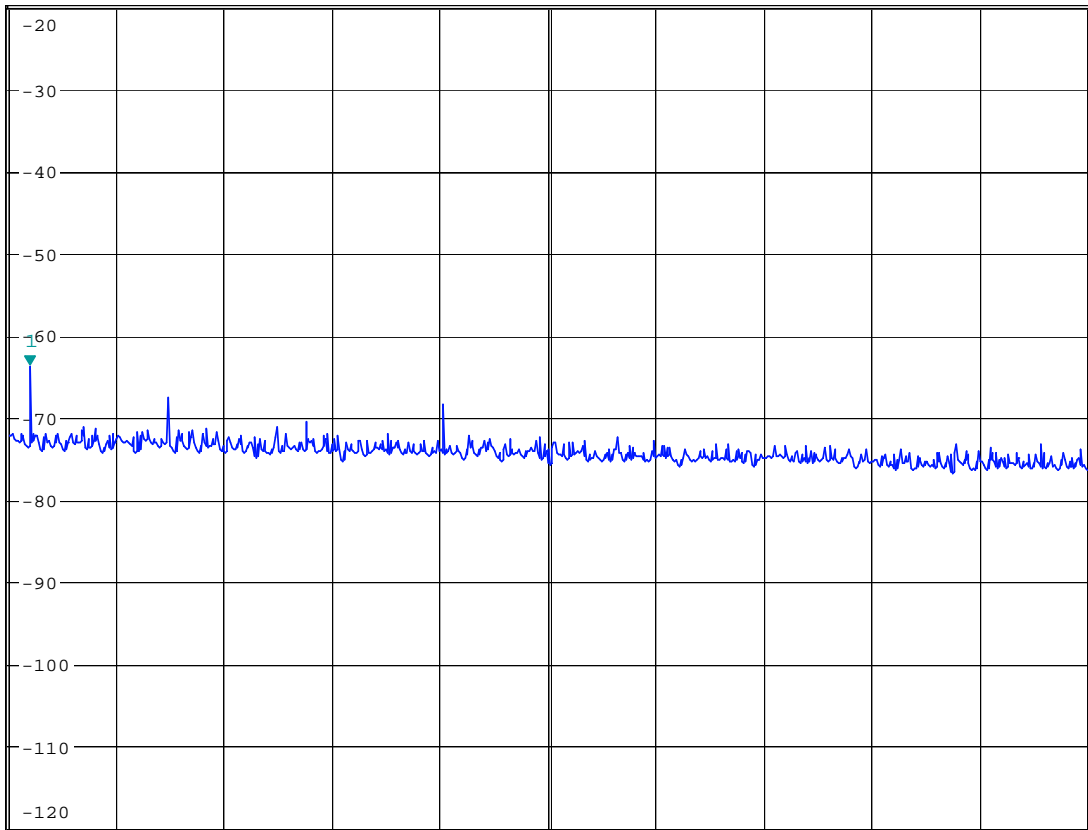


\*RBW 100 kHz      Marker 1 [T1 ]  
VBW 300 kHz      -63.70 dBm  
SWT 100 ms      1.019230769 GHz

Ref -20 dBm

\*Att 5 dB

1 PK  
MAXH



Start 1 GHz

100 MHz/

Stop 2 GHz

Date: 4.FEB.2008 10:35:25

**Radiated Spurious Emissions Scan, HP, 1000 - 1400 MHz**

## 12 Frequency Stability

Para. No.: 87.133(a)/2.1055

Test Performed By: G.Suhandhakumar	Date of Test: 05.02.08
------------------------------------	------------------------

**Test Results:** Complies.

The maximum frequency drift is 130 Hz. This is 0.949 ppm.

**Test Data:**

Test Condition	Frequency (118.000MHz)	Frequency Drift (Hz)	Frequency (128.000MHz)	Frequency Drift (Hz)	Frequency (136.975MHz)	Frequency Drift (Hz)
50 °C, 12 V DC	118.00010	100	128.00009	90	136.97513	130
40 °C, 12 V DC	118.00008	80	128.00009	90	136.97509	90
30 °C, 12 V DC	118.00008	80	128.00009	90	136.97509	90
20 °C, 30,8 V DC	118.00007	70	128.00008	80	136.97509	90
20 °C, 12 V DC	118.00007	70	128.00008	80	136.97509	90
20 °C, 10.0 V DC	118.00007	70	128.00008	80	136.97509	90
10 °C, 12 V DC	118.00009	90	128.00010	100	136.97511	110
0 °C, 12 V DC	118.00008	80	128.00008	80	136.97510	100
-10 °C, 12 V DC	118.00007	70	128.00008	80	136.97509	90
-20 °C, 12 V DC	118.00007	70	128.00007	70	136.97509	90
-30 °C, 12 V DC	118.00005	50	128.00005	50	136.97506	60
Maximum frequency drift (Hz)	100		100		130	

**Requirement 87.133(a):**

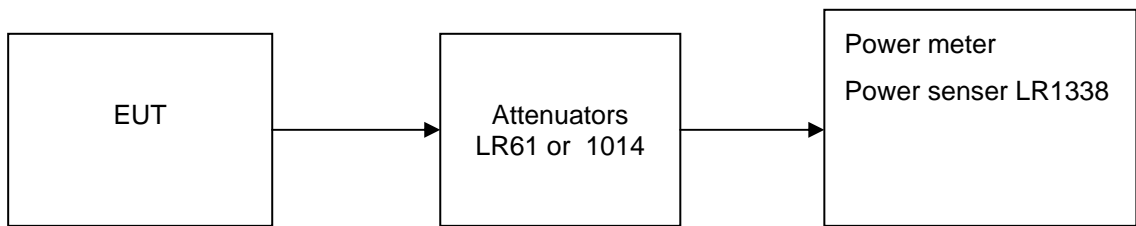
The tolerance for transmitters and stations using offset carrier techniques is less than 20 ppm.

## 13 LIST OF TEST EQUIPMENT

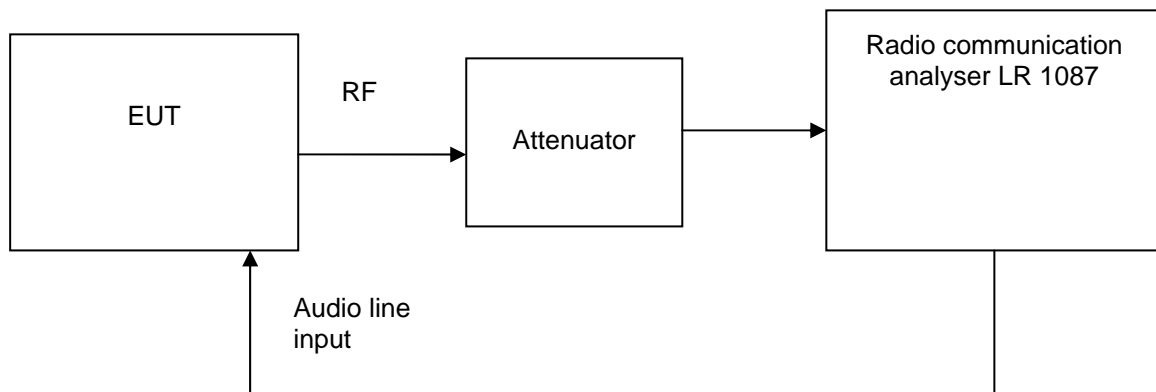
To facilitate inclusion on each page of the test equipment used for related tests, each item of test equipment and ancillaries are identified (numbered) by the Test Laboratory.

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	Radiocomm Analyzer	R&S	CMTA 54
1079	Generator, AF../UHF	R&S	SMHU56
1337	Spektrum 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	Anza	H-9
1504	EMI Receiver	R&S	FSU26
1167	Filter Band Pass	Trilithic	5VF95/190
46	Filter Band Pass	Texn	5VF190/375
1169	Filter Band Pass	Trilithic	5VF250/500
1173	Filter Band Pass	Trilithic	5VF24/48
1174	Filter Band Pass	Trilithic	5VF1000/2000
5099	Spektrum Analyzer	HP	3588A
1083	Climatic chamber	ACS	TY80

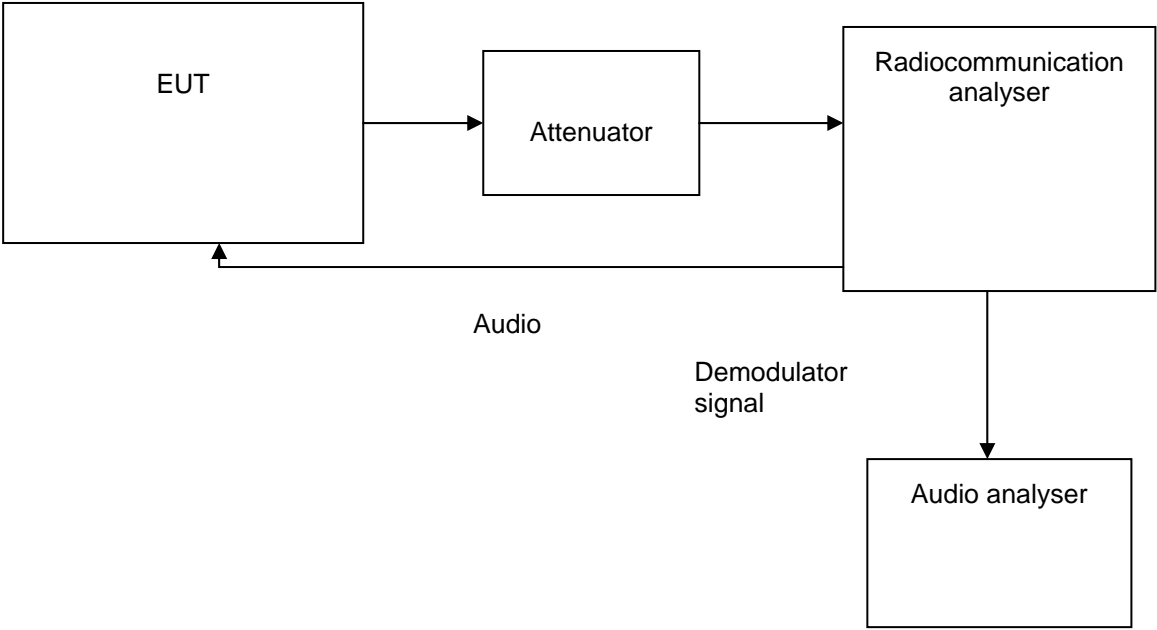
## 14 TEST SET-UP



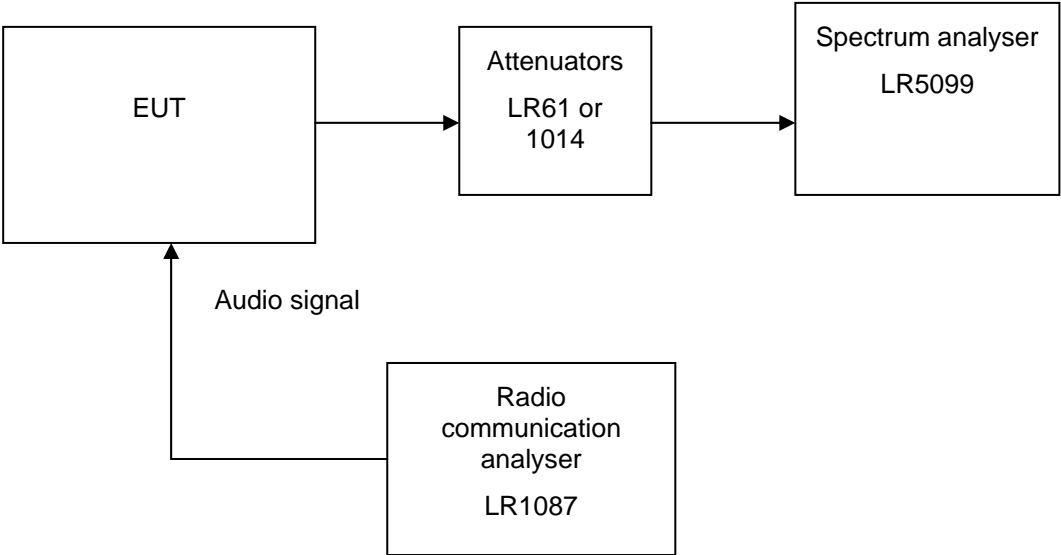
### RF Output Power



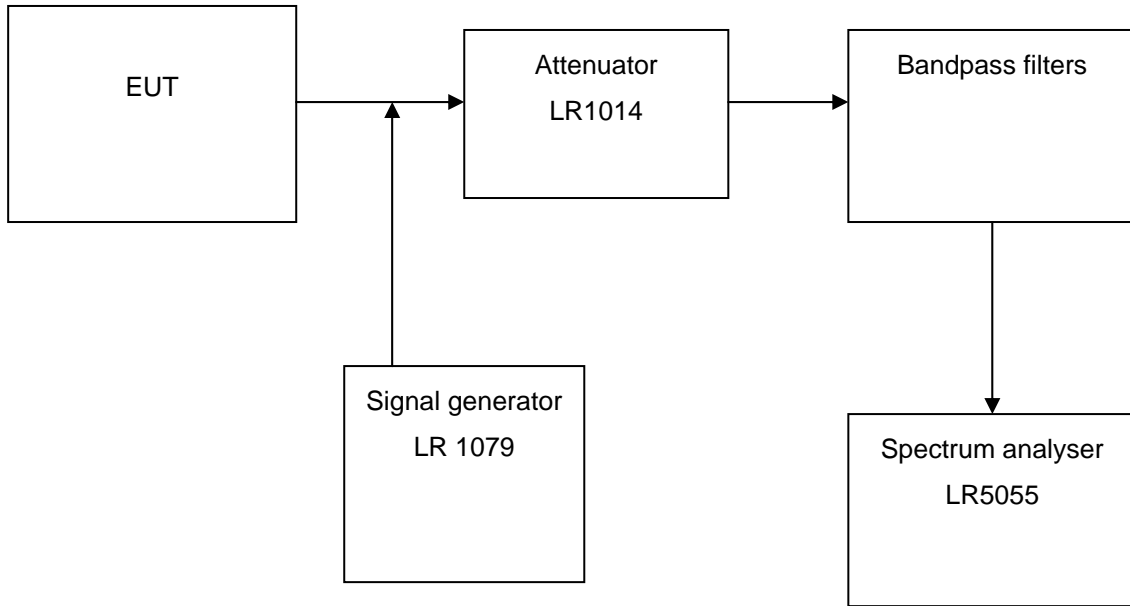
### Audio Frequency Response/Modulation limiting



**Audio low pass filter response**

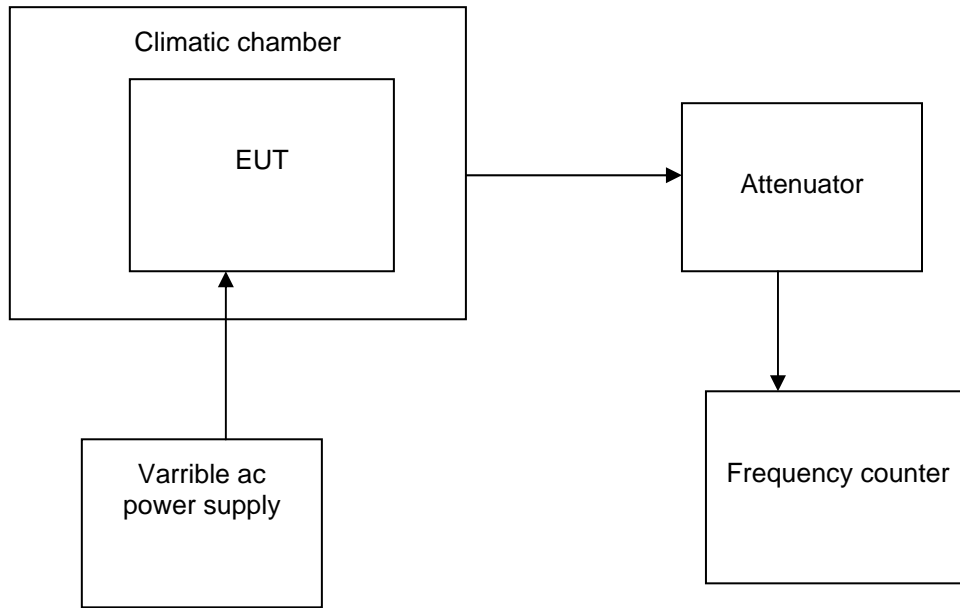


**Occupied Bandwidth**

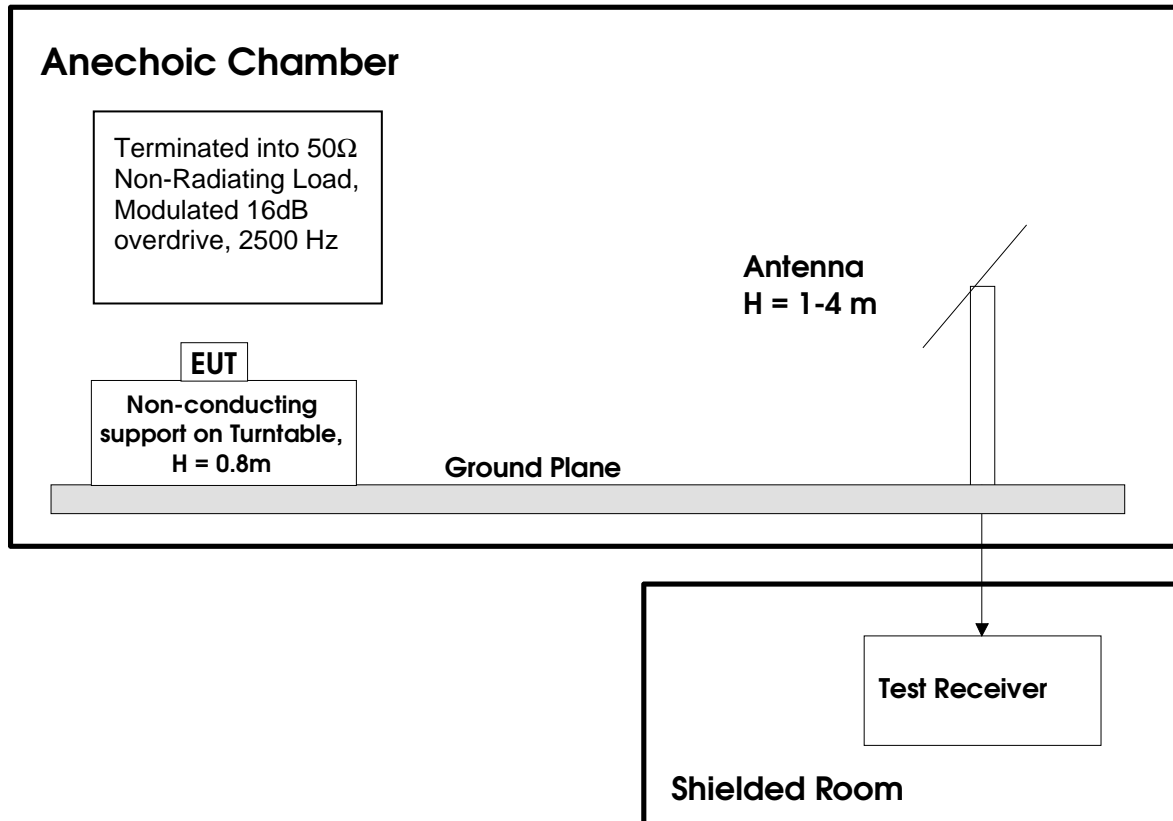


**Spurious Emissions at Antenna Terminals**





**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**