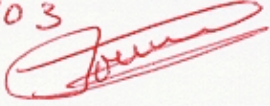
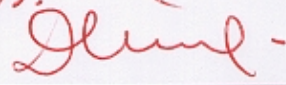


ENHANCED VHF RADIO

FCC RULES COMPLIANCE REPORT

(Part 15 Subpart B, Part 87 Subpart D & Part 2 Subpart J)

for EVR750-04-xxxxx

Etabli / Prepared Service / Department Date 13/03/03 Signature 	B. Bourcier UAN/DCA/SIP/LRB	Approuvé / Approved Service / Department Date 13.03.03 Signature 	D. Bourdarias UAN/DCA/SIP/LRB
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1 DOCUMENT OVERVIEW

This document provides the data showing that the EVR750-04-xxxxx VHF communications transceiver complies with the FCC Rules and Regulations.

The EVR750-04-xxxxx equipment is to be operated under FCC Rules Part 15 Subpart B, Part 87 Subpart D & Part 2 Subpart J.

2 REFERENCES

2.1 APPLICABLE STANDARDS

[1]	Minimum Operational Performance Specification for Airborne VHF	EUROCAE/ED-23B
[2]	Minimum Operational Performance Standards Airborne VHF	RTCA/DO-186A
[3]	Environmental Conditions and Test Procedures for Airborne Equipment	EUROCAE/ED14-D RTCA/DO-160D
[4]	Minimum Operational Performance Specification for Airborne VDL Mode 2	EUROCAE/ED-92
[5]	ARINC "Airborne VHF Communication Transceiver"	ARINC 716-10
[6]	ARINC "VHF Data Radio"	ARINC 750-3
[7]	FCC "Rules and Regulations"	FCC - Part 87, Subpart D
[8]	FCC "Rules and Regulations"	FCC - Part 15, Subpart C

2.2 EQUIPMENT DOCUMENTATION

[9]	System Requirements Document (SSS/SSDD)	4689708A305 (AE)
[10]	Qualification & Certification Plan	4689708A440 (AE)
[11]	Qualification Test Procedure - Functional Part	4689708A206 (AF)
[12]	Qualification Test Procedure - Environmental Part	56152562AA206 (AH)
[13]	QTR for EVR750-04-0100A/0200A - Functional Part	61224830-279 (--)
[14]	QTR for EVR750-04-0100A/0200A - Environmental Part	61224831-279 (--)
[15]	QTR for EVR750-04-0100B - Functional Part	61224846-279 (--)
[16]	QTR for EVR750-04-0100b - Environmental Part	61224847-279 (--)

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3 FUNCTION OF EQUIPMENT

3.1 GENERAL

The EVR750-04-xxxxx is an Air Transport VHF communications transceiver operating in the VHF aeronautical band 118-137 MHz and providing voice and data communications.

3.2 LIST OF OPERATING MODES

Mode 0A (Voice/25kHz)

Analogue voice with 25 kHz channeling (ED-23B / D0-186A) : receiver class C, transmitter class 3; ARINC 716)
Modulation : Amplitude Modulation with Double-SideBand.

Mode 0B (Voice/8.33kHz)

Analogue voice with 8.33 kHz channeling (MOPS ED-23B/D0-186A) : receiver class E, transmitter class 5; ARINC 716)
Modulation : Amplitude Modulation with Double-SideBand.

Mode 1A (ACARS)

Datalink at 2.4kb/s with 25 kHz channeling (ARINC 716, ARINC 618)
RF Modulation : Minimum Shift Keying - Amplitude Modulated
(The MSK modulation is performed outside the VHF transceiver)

Mode 1C (Mode A)

Datalink with 25 kHz channeling (ARINC 750)
RF Modulation : Minimum Shift Keying - Amplitude Modulated
(Digital interface: The MSK modulation is performed inside the VHF transceiver)

VDL Mode 2

Datalink at 31.5kb/s with 25kHz channeling (MOPS ED-92 & ARINC 750)
RF Modulation : Phase modulation D8PSK (Differential Eight Phases Shift Keying)

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3.3 MODES ACRONYMS AND ASSOCIATED BANDWIDTH/POWER

Mode	Output Power		Required Bandwidth	Mode Acronym see [7]-§.87.137	
	Carrier power	Average power		Class of emission	Emission designator
Mode 0A	> 25W	> 33W	6000Hz	A3E	6K00A3E
Mode 0B	> 25W	> 33W	6000Hz	A3E	6K00A3E
Mode 1A	> 25W	> 34W	13.2kHz	A2D	13K0A2D
Mode 1C	> 25W	> 34W	13.2kHz	A2D	13K0A2D
VDL Mode 2	> 15W	> 15W	16kHz	G1D	16K0G1D

3.4 PART-NUMBER COMPOSITION

1 _____
EVR XXX-XX-XX XX X
 2 **3** **4** **5** **6**

1 : Complete P/N

2 : Version

716: according to ARINC 716 (Voice + ACARS)

750: according to ARINC 750 (Voice + ACARS + Mode A and/or VDL)

3 : Type

Examples

01: voice 25kHz/8.33kHz + ACARS

03: idem 01 + Mode A

04: idem 03 + VDL Mode 2

4 : Optional Maintenance SW addressing

Examples

01: Airbus maintenance by default

(Airbus and Boeing maintenance by pin programming)

02: Boeing maintenance by default

(Airbus and Boeing maintenance by pin programming)

5 : Software Evolution

6 : Hardware Evolution

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3.5 DESCRIPTION

The EVR750-04-xxxxx equipment is composed of seven Serviceable Replace Units (SRU).

- Transmitter Unit (Tx)

This SRU provides all the functionalities required for transmission.

- modulation,
- power amplification stages,
- regulation loop,
- transmission synthesizer,
- ...,
- except audio processing, filters, compressor performed by the DPU module.

- Receiver Unit (Rx)

This SRU provides all the functionalities required for reception.

- front end,
- first intermediate frequency (21.4MHz),
- second intermediate frequency (455kHz),
- Demodulation,
- Rx/Tx switch,
- reception synthesizer,
- ...,
- except audio processing, filters, squelch, limiter performed by the DPU module.

- Data Processing Unit (DPU)

This SRU provides both signal and data digital processing. Three software modules are resident on this unit:

- the MAIN software that manages the equipment including the BITE functions,
- the maintenance (MNT) software that ensures interfacing for Airbus or Boeing maintenance,
- the Data Processing Software (DPS) that ensure the VDL data transmission and reception functions.

- Power Supply Unit (PSU)

This SRU provides secondary power supplies from 28VDC primary power supply.

- High Intensity Radio Frequency Unit (HIRF)

This SRU provides all the high intensity radio frequency protection and lightnings protections.

- Power Storage Unit (PST)

This unit protects the transceiver against power supply drop-out (>200ms reception).

- Chassis (CHA)

This SRU provides all the mechanicals and interconnections.

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4 PURPOSE OF THE TESTS

The EVR750-04-xxxxx equipment shall comply with FCC Rules Part 15 Subpart B, Part 87 Subpart D, and Part 2 Subpart J. The following sections provide measurements or calculations proving the compliance with these FCC rules.

4.1 FCC PART 15 SUBPART B COMPLIANCE.

In reception mode, the equipment shall comply with FCC Rules Part 15 Subpart B (Unintentional Radiators).

Technical requirements are listed below:

- Radiated emission limits (§15.109)
- Antenna power conduction limits for receivers (§15.111).

4.2 FCC PART 87 SUBPART D COMPLIANCE

In transmission mode, the equipment shall comply with FCC Rules Part 87 Subpart D.

Technical requirements are listed below:

- Power and emissions (§87.131)
- Frequency stability (§87.133)
- Bandwidth of emission (§87.135)
- Types of emission (§87.137)
- Emissions limitations (§87.139)
- Modulation requirements (§87.141).

4.3 FCC PART 2 SUBPART J COMPLIANCE

Technical requirements are listed below:

- Frequency stability for variation of ambient temperature [§ 2.995 (a) (2)]
- Frequency stability for voltage variation [§ 2.995 (d)]
- Occupied bandwidth [§ 2.989 (c) (1)]
- Field strength measurements of spurious emissions in transmission mode
 - Field strength of spurious radiation [§ 2.993]
 - Spurious emissions at antenna terminals [§ 2.991]

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5 MEASUREMENTS RESULTS

Tests have been conducted with EVR750-04-0100A S/N= 01791.

5.1 FCC PART 15 SUBPART B.

5.1.1 Radiated emissions limits

(According to §.15.109)

The equipment powered and operated in its reception mode must not emit RF radiated field levels in excess of the specified limits.

The specified frequency range applied to the measurement of radiated emissions in reception mode is from 30MHz to 2000MHz. (See §15.33(b)).

With the receiver antenna terminal connected to a resistive termination (50 ohms) equal to the impedance specified for the antenna, the radiated emissions measurements are noted in the following table:

TABLE 1 - SPURIOUS EMISSION IN RECEPTION MODE					
Frequency of emissions (MHz)	Field strength tolerance specified at 3m (d ₁)		Field strength tolerance extrapolation at 1m (d ₂) 10log(d ₁ ² /d ₂ ²)=9.5dB (dBµV/m)	Field strength * measured at 1m in dBµV/m	
	(µV/m)	(dBµV/m)		in Voice mode (dBµV/m)	in VDL2 mode (dBµV/m)
30 – 88	< 100	< 40.0	< 49.5	< 40	< 40
88 – 216	< 150	< 43.5	< 53.0	< 35	< 32
216 – 960	< 200	< 46.0	< 55.5	< 32	< 32
960 – 2000	< 500	< 54.0	< 63.5	< 40	< 40

(*): These results are extracted from the Qualification Test Reports [14]-§.12 and [16]-§.12.

CONCLUSION :

Equipment EVR750-04-0100A is compliant with the requirement.

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5.1.2 Antenna power conduction limits for receivers

(According to §.15.111)

With the receiver antenna terminal connected to a resistive termination (50 ohms) equal to the impedance specified for the antenna, the power at the antenna terminal at any frequency specified below shall not exceed 2.0 nW (-57dBm).

The specified frequency range applied to the measurement of antenna power conduction limits in reception mode is from 30MHz to 2000MHz. (See §15.33(c)).

Results are given below:

TABLE 2 - SPURIOUS EMISSIONS IN RECEPTION ACCORDING TO FCC PART15 Subpart B		
Spectrum analyzer is connected to the receiver input in order to measure the emitted power level. The tuning frequency of the spectrum is scanned from 30MHz to 2000MHz. Floor noise of spectrum analyzer is at -93dBm. F0=128.5MHz		
TEMPERATURE : +25°C		
SPURIOUS FREQUENCY (MHz)		EMITTED POWER LEVEL (dBm)
Voice	-	From 30MHz to 1215MHz : no spurious emissions at more than -90dBm*.
	-	From 1215MHz to 2000MHz : no spurious emissions at more than -90dBm.
VDL Mode 2	-	From 30MHz to 1215MHz : no spurious emissions at more than -90dBm*.
	-	From 1215MHz to 2000MHz : no spurious emissions at more than -90dBm.
TOLERANCE		< 2nW (i.e.< -57dBm)

(*): These results are extracted from the Qualification Test Report [13]-§.8.12

CONCLUSION :

The power level delivered by the receiver to the antenna is less than -90dBm from 30MHz to 2000MHz, which is compliant with the requirement (<-57dBm).

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5.2 FCC PART 87 SUBPART D

5.2.1 Power and emissions

(According to §.87.131)

The power (Carrier Wave) is measured at the transmitter output terminals connected to a resistive termination (50 ohms) equal to the impedance specified for the antenna.

The tolerance for aircraft communications in VHF range (118-137MHz) is $pY < 55 \text{ Watts}$.

RESULTS:

The results, given in tables 3 to 6, are extracted from [13]-§.9.1.

Voice/25kHz (mode 0A)

Maximum power is measured at 128.500 MHz: $P_{CW} = 27.6 \text{ W}$ (with a modulation ratio $m = 88.4\%$)

$$\begin{aligned} \text{Mean Power (pY)} &= P_{CW} \times (1 + (m^2/2)) \\ pY &= 38.4 \text{ W} \end{aligned}$$

Voice/8.33kHz (mode 0B)

Maximum power is measured at 128.433 MHz: $P_{CW} = 27.0 \text{ W}$ (with a modulation ratio $m = 87.9\%$)

$$\begin{aligned} \text{Mean Power (pY)} &= P_{CW} \times (1 + (m^2/2)) \\ pY &= 37.4 \text{ W} \end{aligned}$$

ACARS/25kHz (mode 1A/1C)

Maximum power is measured at 121.500 MHz: $P_{CW} = 28.4 \text{ W}$ (with a modulation ratio $m = 88.4\%$)

$$\begin{aligned} \text{Mean Power (pY)} &= P_{CW} \times (1 + (m^2/2)) \\ pY &= 41.0 \text{ W} \end{aligned}$$

VDL MODE 2

Maximum power is measured at 118.000 MHz: $P_{CW} = 18.7 \text{ W}$

$$\begin{aligned} \text{Mean Power (pY)} &= P_{CW} \\ pY &= 18.7 \text{ W} \end{aligned}$$

CONCLUSION :

Equipment is compliant with the requirement.

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TABLE 3 - OUTPUT POWER IN MODE 0A					
Frequency (MHz)	Output Power (Watt)	Modulation Ratio (%)	(S+N)/N Ratio (dB)	Distortion (%)	Residual FM Deviation (kHz)
118.000	27.1	88.1	46.5	23.1	±0.5
128.500	27.6	88.4	46.4	2.2	±0.7
136.975	27.4	88.2	46.7	2.1	±0.6
Tolerance	>25W	>85%	>35 dB	< 10%	< ±3kHz

TABLE 4 - OUTPUT POWER IN MODE 0B					
Frequency (MHz)	Output Power (Watt)	Modulation Ratio (%)	(S+N)/N Ratio (dB)	Distortion (%)	Residual FM Deviation (kHz)
118.008	27.0	87.7	48.3	3.2	±0.6
128.433	27.0	87.9	47.9	2.3	±0.7
136.992	26.8	87.9	48.2	2.2	±0.6
Tolerance	>25W	>85%	>35 dB	< 10%	< ±3kHz

TABLE 5 - OUTPUT POWER IN MODE 1A/1C				
Frequency (MHz)	Output Power (Watt)	Modulation Ratio (%)	(S+N)/N Ratio (dB)	Distortion (%)
121.500	28.4	88.4	44.4	3.2
128.500	27.2	88.6	44.3	2.4
135.00	27.4	88.7	44.2	2.2
Tolerance	>25W	>85%	>35 dB	< 10%

TABLE 6 - OUTPUT POWER IN VDL MODE 2	
Frequency (MHz)	Output Power (W)
118.000	18.7
127.500	18.2
136.975	18.0
Tolerance	> 15W

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5.2.2 Frequency stability

(According to §.87.133)

The tolerance is: $< \pm 30$ ppm ("Band-100 to 137MHz: Aircraft and other mobile stations in the Aviation Services").

Table 7 gives the results extracted from [13]-§.9.7.

TABLE 7 - FREQUENCY ACCURACY		
Frequency (MHz)	Variation ($\pm$ kHz)	Accuracy (ppm)
128.500	-0.12	-0.9 ppm
FCC Tolerance	NA	$< \pm 30$ ppm
Equip.Spec. Tolerance	NA	$< \pm 5$ ppm

CONCLUSION :

Equipment is compliant with the requirement.

5.2.3 Bandwidth of emission

(According to §.87.135)

Authorized bandwidth

In the band 117.975-136MHz, the authorized bandwidth is 25kHz (± 12.5 kHz) for transmitters type accepted after January 1, 1974. Emission designator: 6K00A3E (according to §.87.137).

In Voice/8.33kHz (mode 0B), the authorized bandwidth shall be ± 4.166 kHz.

In ACARS mode (modes 1A/1C), emission designator 13K0A2D, the authorized bandwidth is 50kHz (± 25 kHz) (according to §.87.137).

Occupied bandwidth

Occupied bandwidth is the width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to 0.5% of the total mean power of a given emission.

Test procedure

In modes 0A & 0B (according to EUROCAE ED-23B):

The level of the audio signal is adjusted to produce 70% modulation at 1000Hz (compressor OFF). Then the frequency of the audio signal is varied in the range 300Hz - 10kHz, at the constant above mentioned level between 300Hz and 800Hz, and following a slope of -10dB/octave, between 800Hz and 10kHz.

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In mode 1A/1C:

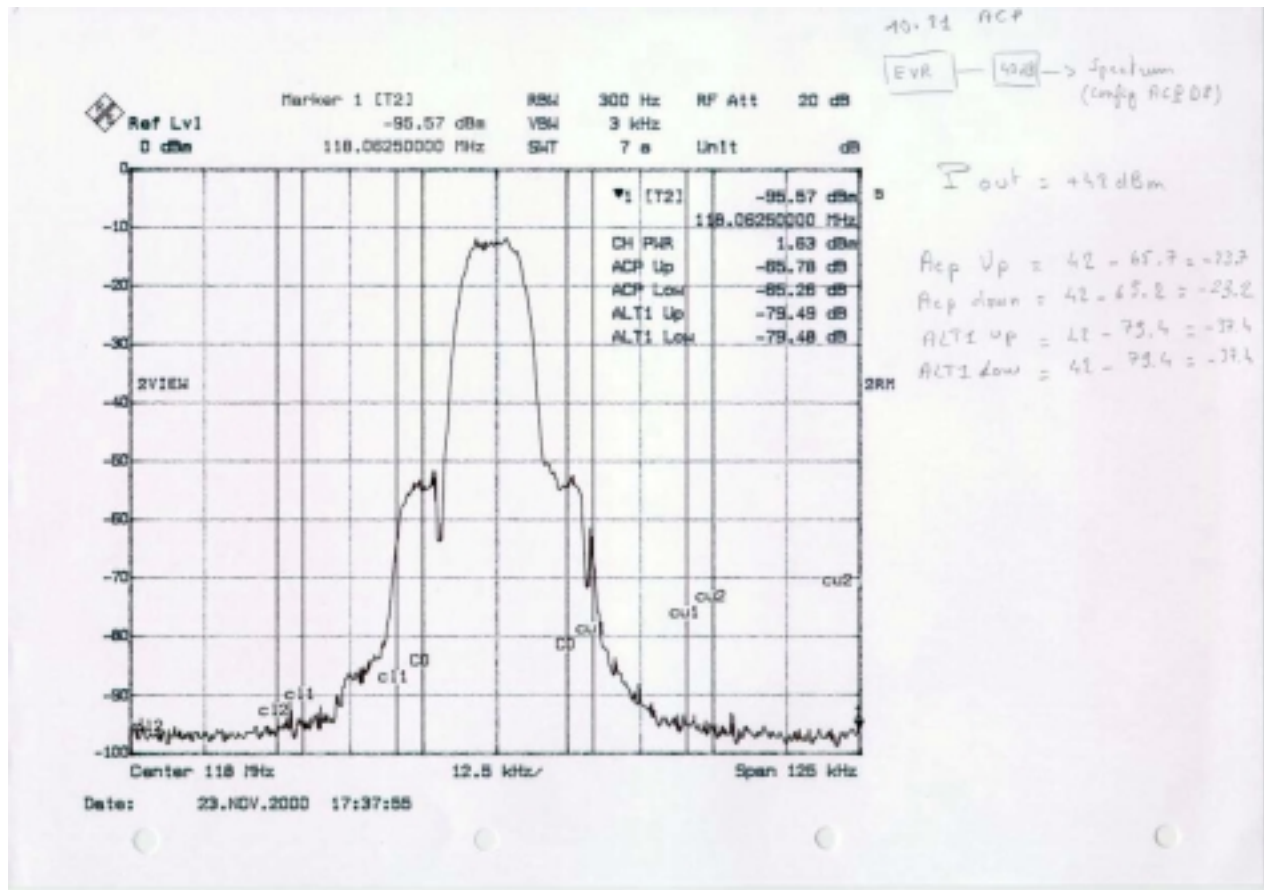
Binary "ones" and binary "zeros" (sequence 2^7-1) are modulated by using 1200Hz and 2400Hz tones, producing data transmission at a bit rate of 2400 bits/s.
The level of the signal is adjusted to produce 70% modulation (compressor OFF).

RESULTS

TABLE 8 - OCCUPIED BANDWIDTH (see §.3.3)		
Mode	Measured (for 99% of the transmitted power)	FCC Tolerance
0A	3.7 kHz	< 25 kHz (± 12.5 kHz)
0B	3.4 kHz	< 8.4 kHz (± 4.2 kHz)
1A	5.9 kHz	< 25 kHz (± 12.5 kHz)
VDL Mode 2	See Figure 1 16kHz	< 25 kHz (± 12.5 kHz)

CONCLUSION : Equipment is compliant with the requirement.

FIGURE 1 - VDL Mode 2 Spectrum



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5.2.4 Types of emissions

(According to §.87.137)

(See §.5.2.3 of this document "Authorized bandwidth")

5.2.5 Emissions limitations

(According to §.87.139)

Voice/25kHz (mode 0A)

TABLE 9 - FCC SPECTRUM (MODE 0A)
(Edition 10/01/95 – Part 87 – Subpart D-§.87.139)

The mean power of any emissions must be attenuated below the mean power of the transmitter (pY) when the frequency is removed from the assigned frequency by more than (see tolerance below).

F0= 128.500MHz

Frequency	Attenuation (dB)	Tolerance (dB)
From 12.5kHz to 25kHz	> 70 dB	> 25 dB
From 25kHz to 62.5kHz	> 80 dB	> 35 dB
> 62.5 kHz	> 80 dB	> 40 dB

Voice/8.33kHz (mode 0B)

According §87.139(a) of FCC requirements, the mean power of any emissions is attenuated below the mean power (pY), when the frequency is removed from the assigned frequency, by more than:

- >25dBc from 4.165kHz to 8.33 kHz,
- >35dBc from 8.33kHz to 20.825kHz,
- >43+10log (pY) from frequencies upper than 20.825kHz. (that is >57dBc)

These tolerances are included into transmitter spectrum mask specified in ED-23B requirements and ARINC716 characteristics. This diagram is given on Figure 2.

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VDL Mode 2

VDL Mode 2 spectrum is specified through [4] (MOPS for Airborne VDL Mode 2) : the following table (Table 10) gives the tolerances and results (extracted from [13]-§.12.20).

TABLE 10 - VDL MODE 2 ADJACENT CHANNEL POWER AND WIDE-BAND NOISE					
Frequency (MHz)	1st ACP in 16kHz (at ± 25 kHz)	1st ACP in 25kHz (at ± 25 kHz)	2nd ACP in 25kHz (at ± 50 kHz)	4th ACP in 25kHz (at ± 100 kHz)	WB-Noise in 25kHz at ± 0.8 MHz
128.000	-23.0 dBm	-2.0 dBm	-34.4 dBm	-48.5 dBm	-58.6 dBm
Tolerance	< -18 dBm	< +2 dBm	< -28 dBm	< -38 dBm	< -53 dBm

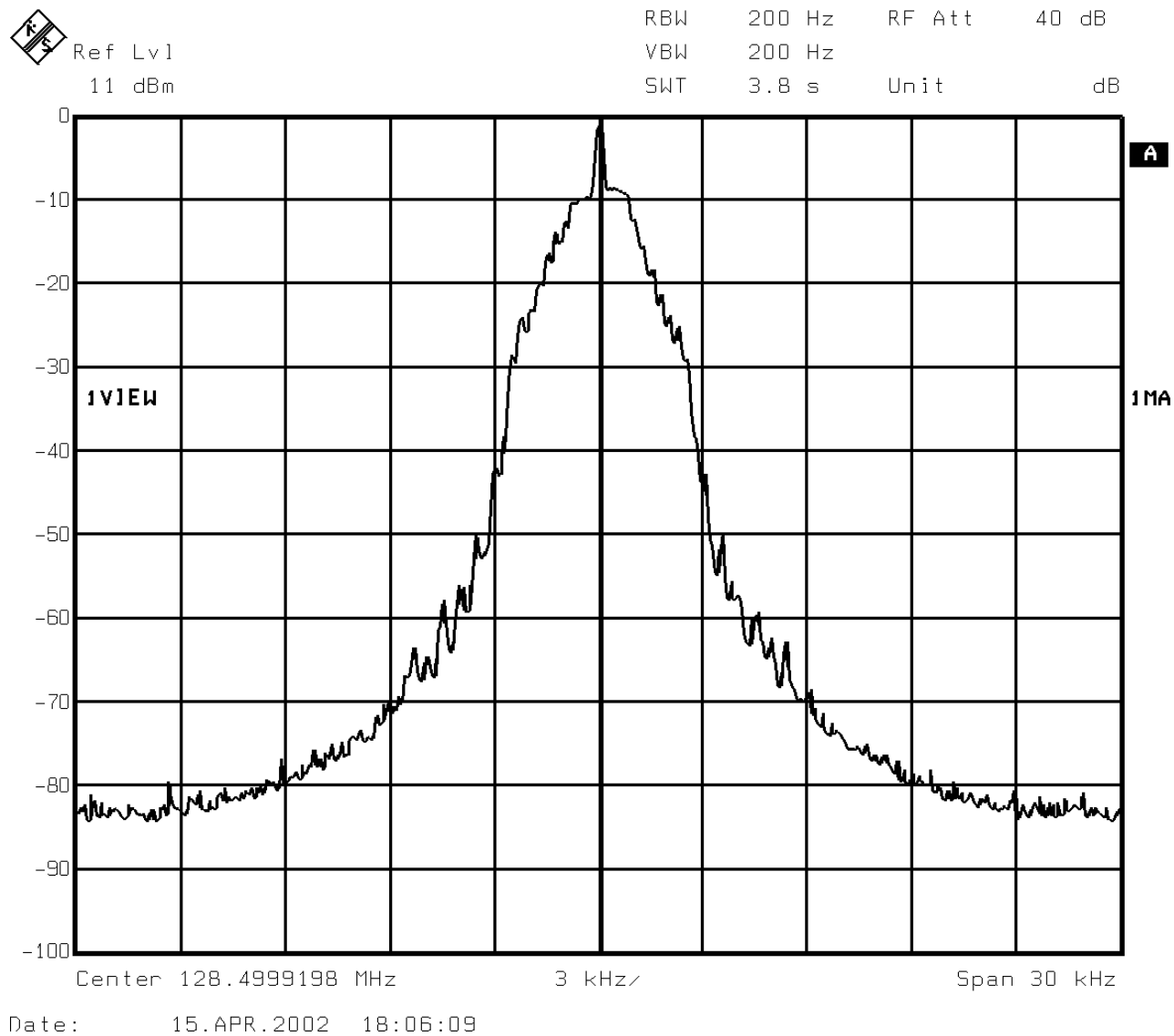
Results given in Figure 1 and Table 10 lead to the following synthesis (Table 11).

TABLE 11 - FCC SPECTRUM (VDL MODE 2) (Edition 10/01/95 – Part 87 – Subpart D-§.87.139)		
The mean power of any emissions must be attenuated below the mean power of the transmitter (pY) when the frequency is removed from the assigned frequency by more than (see tolerance below).		
Output mean power at 128MHz is 18.2W (+42.6dBm).		
Frequency	Attenuation (see Figure 1 & Table 8) (dB)	Tolerance (dB)
From 12.5kHz to 25kHz	> 40 dB	> 25 dB
From 25kHz to 62.5kHz	> 65 dB	> 35 dB
> 62.5 kHz	> 77 dB	> 40 dB

CONCLUSION : Equipment is compliant with the requirement.

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FIGURE 2 – Transmitter spectrum in mode 8.33kHz



4.2.6. Modulation requirements
(According to §.87.141(a))

An audio compressor is included in the equipment, which maintains the modulation ratio between 85% and 100%.

Results, extracted from [13]-§.9.4, are given hereafter.

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TABLE 12 - COMPRESSOR			
F0= 128.433 MHz			
AF input level (mVrms)	Output level Vrms	Modulation ratio %	(S+N)/N (dB)
250	2.6	88.0	47.8
2500	2.6	87.9	47.9
FCC Tolerance	-	85% < m < 100%	-
Equipment Tolerance	2.5V (±0.6V) from 250 to 2500 mV	80% < m < 100% from 250 to 2500 mV	> 35dB from 250 to 2500mV

CONCLUSION : Equipment is compliant with the requirement.

4.2.7. Audio frequency response

Results, extracted from [13]-§.9.8 & §.8.1, are given here below (Table 13 to 18).

TABLE 13 - TRANSMITTER AUDIO FREQUENCY RESPONSE IN MODE 0A	
F0= 128.5 MHz Reference is done for 1000Hz.	
Audio Frequency (Hz)	Attenuation (dB)
300	-0.7
1000	0
2500	0.0
5000	16.0
Equipment Tolerance	< 6 dB from 300 Hz to 2500 Hz >10 dB at 5000 Hz

TABLE 14 - RECEIVER AUDIO FREQUENCY RESPONSE IN MODE 0A	
F0= 128.5 MHz RF Level = -53dBm Reference is done for 1000Hz.	
Audio Frequency (Hz)	Attenuation (dB)
300	0.7
1000	0
2500	0.5
3750	41.2
Equipment Tolerance	From 300 to 2500 Hz, att. < 6 dB At 3750 Hz, att.>20 dB

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**TABLE 15 - TRANSMITTER AUDIO FREQUENCY RESPONSE
IN MODE 0B**

F0= 128.5 MHz

Reference is done for 1000Hz.

Audio Frequency (Hz)	Attenuation (dB)
300	-0.1
1000	0
2500	+2.9
3200	+23.5
Equipment Tolerance	< 6 dB from 300 Hz to 2500 Hz >22 dB at 3200 Hz

**TABLE 16 - RECEIVER AUDIO FREQUENCY RESPONSE
IN MODE 0A**

F0= 128.5 MHz RF Level = -53dBm

Reference is done for 1000Hz.

Audio Frequency (Hz)	Attenuation (dB)
300	0.7
1000	0
2500	1.0
3750	41.8
Equipment Tolerance	From 300 to 2500 Hz, att. < 6 dB At 3750 Hz, att.>20 dB

**TABLE 17 - TRANSMITTER AUDIO FREQUENCY RESPONSE
IN MODE 1A**

F0= 128.5MHz

Frequency (Hz)	Attenuation (dB)
600	-0.3
1000	0
6600	1.5
12500	44.3
Equipment Tolerance	< 6 dB from 600 Hz to 6600 Hz >30 dB at 12.5 kHz

**TABLE 18 - RECEIVER AUDIO FREQUENCY RESPONSE
IN MODE 1A**

F0= 128.5 MHz RF Level = -53dBm

Reference is done for 1000Hz.

Frequency (Hz)	Attenuation (dB)
300	1.0
312	0.8
1000	0
1200	0.5
3750	1.9
Equipment Tolerance	From 312 to 1200 Hz, att. < 3 dB From 300 to 6600 Hz, att. < ±6 dB

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5.3 FCC PART 2 SUBPART J

5.3.1 Frequency stability for variation of ambient temperature [§ 2.995 (a) (2)]

Results, extracted from [14]-Section 1, are given hereafter (Tables 19 to 22).

MEASUREMENTS AT +25°C

TABLE 19 - FREQUENCY ACCURACY		
Frequency (MHz)	Variation (±kHz)	Accuracy (ppm)
128.500	-0.12	-0.9 ppm
FCC Tolerance	NA	< ± 30 ppm
Equip.Spec. Tolerance	NA	< ± 5 ppm

MEASUREMENTS AT -25°C

TABLE 20 - FREQUENCY ACCURACY		
Frequency (MHz)	Variation (±kHz)	Accuracy (ppm)
128.500	-0.13	-1.01 ppm
FCC Tolerance	NA	< ± 30 ppm
Equip.Spec. Tolerance	NA	< ± 5 ppm

MEASUREMENTS AT +70°C

TABLE 21 - FREQUENCY ACCURACY		
Frequency (MHz)	Variation (±kHz)	Accuracy (ppm)
128.500	+0.17	+1.32 ppm
FCC Tolerance	NA	< ± 30 ppm
Equip.Spec. Tolerance	NA	< ± 5 ppm

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MEASUREMENTS OF FREQUENCY ACCURACY FOR TEMPERATURE INTERVALS OF 10 °C
(FROM -25°C TO +70°C).

TABLE 22 - FREQUENCY ACCURACY		
F0= 128.5MHz		
TEMPERATURE	Variation (±kHz)	Accuracy (ppm)
- 20 °C	-0.14	-1.1
-10°C	-0.10	-0.8
0	-0.20	-1.6
+10°C	-0.16	-1.2
+20°C	-0.12	-0.9
+30°C	-0.09	-0.7
+40°C	-0.06	-0.5
+50°C	+0.02	+0.2
+60°C	+0.10	+0.8
+70°C	+0.17	+1.3
FCC Tolerance	NA	< ± 30 ppm
Equipment Tolerance	NA	< ± 5 ppm

CONCLUSION : Equipment is compliant with the requirement.

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5.3.2 Frequency stability for voltage variation [§ 2.995 (d)]

TABLE 23 - FREQUENCY STABILITY FOR VOLTAGE VARIATION		
POWER SUPPLY (V)	VARIATION (kHz)	ACCURACY (ppm)
17	-0.12	-0.9
23	-0.12	-0.9
28	-0.12	-0.9
32.2	-0.12	-0.9
FCC Tolerance	NA	< ± 30 ppm

CONCLUSION : Equipment is compliant with the requirement.

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5.3.3 Occupied bandwidth [§ 2.989 (c) (1)]

5.3.3.1 Test procedure

In mode 0A & 0B

The level N1 of the audio signal is adjusted to produce 50% modulation at 2500 Hz;
Then, an audio signal level $N2=N1+16$ dB is applied on the transceiver.

In mode VDL Mode 2

The transmitted energy is directly extracted from the spectrum measured at the transmitter output (see Figure 1).

5.3.3.2 Results

In modes 0A & 0B

$N1 = 50$ mVrms;

For $N2 = 315$ mVrms,

In mode 0A, the occupied bandwidth including 99% of transmitted power is:

"OPB"=5.4 kHz.

In mode 0B, the occupied bandwidth including 99% of transmitted power is:

"OPB"=5.4 kHz.

In VDL Mode 2

The transmitted energy is more than 99% in the band of 16kHz.

"OPB"=16kHz

CONCLUSION : Taking into account the tolerances given in §.5.2.3, the equipment is compliant.

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5.3.4 Field strength measurement of spurious emission in transmission mode

5.3.4.1 Field strength of spurious radiation [§ 2.993]

The following results are extracted from [14-§.12.

(According to section 21 "Emission of Radio Frequency Energy"- Category Z - of RTCA DO-160D).

The equipment powered and operated in its transmission mode must not emit RF radiated field levels in excess of the specified limits. This does not include any radiation on the selected frequency.

With the transmitter antenna terminal connected to a resistive termination (50 ohms) equal to the impedance specified for the antenna, the radiated emissions measurements are noted in the following table:

TABLE 24 - SPURIOUS EMISSION IN TRANSMISSION MODE				
F0=128.5MHz				
Frequency of emissions (MHz)	Field strength Tolerance specified at d ₁ m (μV/m)	Field strength Tolerance specified at d ₁ m 20log(level/1μV) (dBμV/m)	Field strength Tolerance extrapolation at 1m (d ₂) 10log(d ₁ ² /d ₂ ²) (dBμV/m)	Field strength Measurement at 1m (dBμV/m)
0.150 - 0.490	<2400/F(kHz) (d ₁ =300m) giving: <16 at 150kHz (d ₁ =300m) < 5 at 490kHz (d ₁ =300m)	<24 at 150kHz (d ₁ =300m) <14 at 490kHz (d ₁ =300m)	<73.5 at 150kHz (d ₂ =1m) <63.5 at 490kHz (d ₂ =1m)	<25 at 150kHz < 10 at 490kHz *
0.490 - 1.705	<24000/F(kHz) (d ₁ =30m) giving: <49 at 490kHz (d ₁ =30m) <14 at 1705kHz (d ₁ =30m)	<34 at 490kHz (d ₁ =30m) <23 at 1705kHz (d ₁ =30m)	<63.5 at 490kHz (d ₂ =1m) <52.5 at 1705kHz (d ₂ =1m)	< 8 at 490kHz * < 8 at 1705kHz *
1.705 - 30.0	<30 (d ₁ =30m)	<29.5 (d ₁ =30m)	<59 (d ₂ =1m)	<10 *
30 - 88	<100 (d ₁ =3m)	<40 (d ₁ =3m)	<49.5 (d ₂ =1m)	<40
88 - 216	<150 (d ₁ =3m)	<43.5 (d ₁ =3m)	<53 (d ₂ =1m)	<32 (except F0 : 52)
216 - 960	<200 (d ₁ =3m)	<46 (d ₁ =3m)	<55.5 (d ₂ =1m)	<28
960 - 1370	<500 (d ₁ =3m)	<54 (d ₁ =3m)	<63.5 (d ₂ =1m)	<38 *

(*): The radiated levels noted are due to the floor noise of the measurement set-up.

CONCLUSION : The equipment is compliant with the requirement.

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5.3.4.2 Spurious emissions at antenna terminals [§ 2.991]

5.3.4.2.1 HARMONICS

The following results are extracted from [13]-§.9.9-§.12.19.

MEASUREMENTS AT +25°C

TABLE 25 - HARMONICS			
Frequency (MHz)	H2 (dBm)	H3 (dBm)	Hn (dBm)
118.000	-29.1	-53.1	< -36
128.500	-47.1	-50.0	< -36
136.975	-56.4	-55.0	< -36
Equipment Tolerance	< -16 dBm	< -26 dBm	< -26 dBm

MEASUREMENTS AT -25°C

TABLE 26 - HARMONICS			
Frequency (MHz)	H2 (dBm)	H3 (dBm)	Hn (dBm)
118.000	-26.8	-52.6	< -36
128.500	-46.2	-63.6	< -36
136.975	-66.0	-50.3	< -36
Equipment Tolerance	< -16 dBm	< -26 dBm	< -26 dBm

MEASUREMENTS AT +70°C

TABLE 27 - HARMONICS			
Frequency (MHz)	H2 (dBm)	H3 (dBm)	Hn (dBm)
118.000	-31.6	-54.4	< -36
128.500	-49.5	-54.3	< -36
136.975	-65.2	-50.0	< -36
Equipment Tolerance	< -16 dBm	< -26 dBm	< -26 dBm

CONCLUSION : Considering an output power of +44dBm,
2nd Harmonic is less than -64dBc below the carrier.
3rd and other Harmonics are less than -76dBc below the carrier.
The equipment is compliant.

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5.3.4.2.2 SPURIOUS EMISSIONS

5.3.4.2.2.1 *Test procedure*

This test requires the use of a special test bench fitted for broad-band noise measurements; the principle of this bench is to reject the transmitted carrier, using a very selective cavity filter. So the spectrum analyser can be used to measure extremely low noise levels without any risk of saturation due to the power carrier.

5.3.4.2.2.2 *Test results*

Results are given through the following curves (Figures 3 to 10).
No spurious at more than -26dBm.

CONCLUSION

Taking into account the following specifications :

- from 50kHz to 1215 MHz (except 108 to 112MHz) : < -16dBm
- from 108MHz to 112MHz : < -26dBm

The equipment is compliant.

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Tx Spurious Emissions

FIGURE 3 : Measurement from 28MHz to 228 MHz

FIGURE 4 : Measurement from 47MHz to 68MHz

FIGURE 5 : Measurement from 88MHz to 108MHz

FIGURE 6 : Measurement from 162MHz to 175MHz

FIGURE 7 : Measurement from 175MHz to 244MHz

FIGURE 8 : Measurement from 328MHz to 336MHz

FIGURE 9 : Measurement from 470MHz to 862MHz

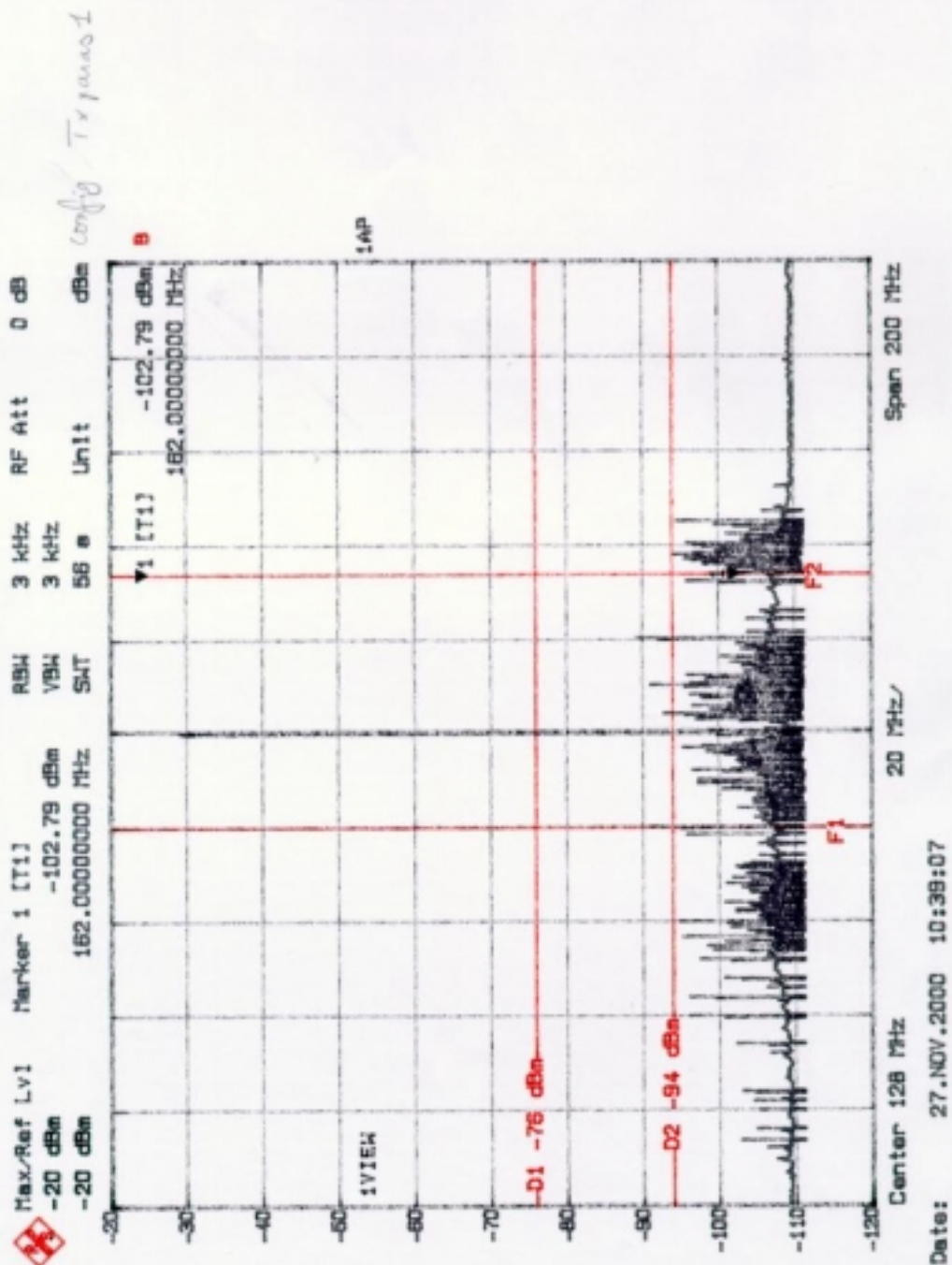
FIGURE 10 : Measurement from 118MHz to 152MHz

Note: The line D1 (-76dBm) is equivalent to a spurious level of -36dBm
The line D2 (-94dBm) is equivalent to a spurious level of -54dBm

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10.45 Tx Spurious Emissions

FIGURE 3: Measurement from 28MHz to 228MHz



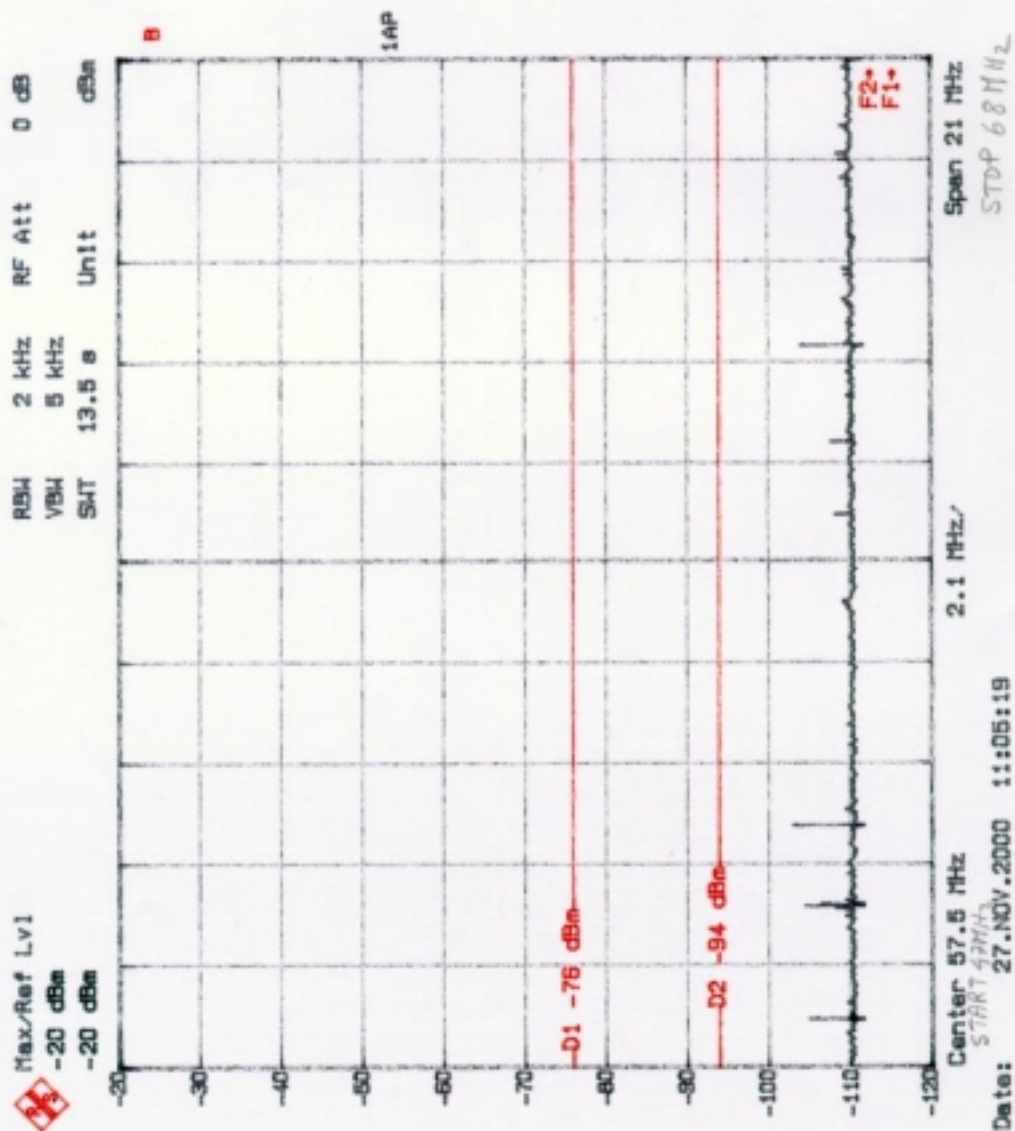
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10.18 Tx Spurious Emission

Config Tx band 2

FIGURE 4: Measurement from 47MHz to 68MHz

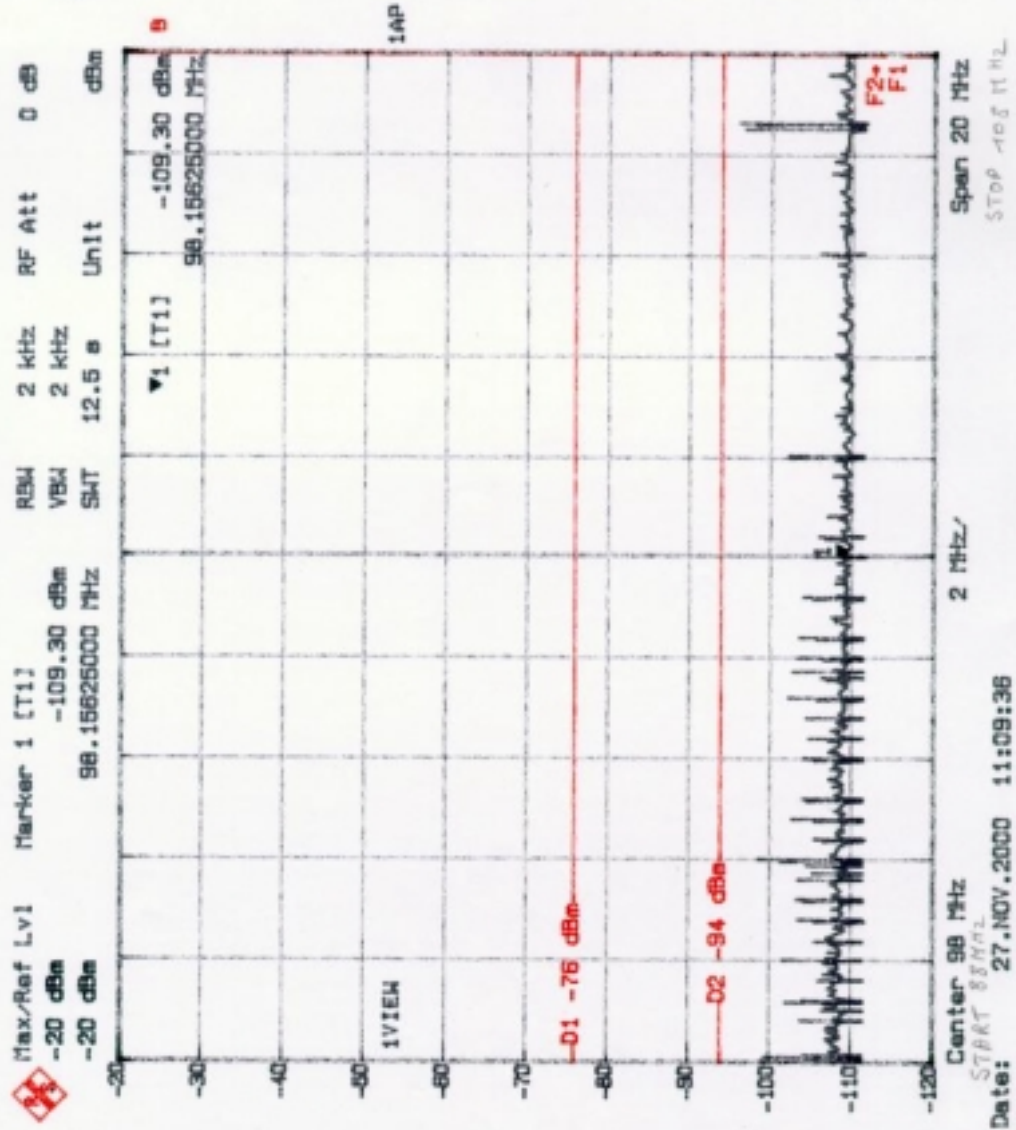


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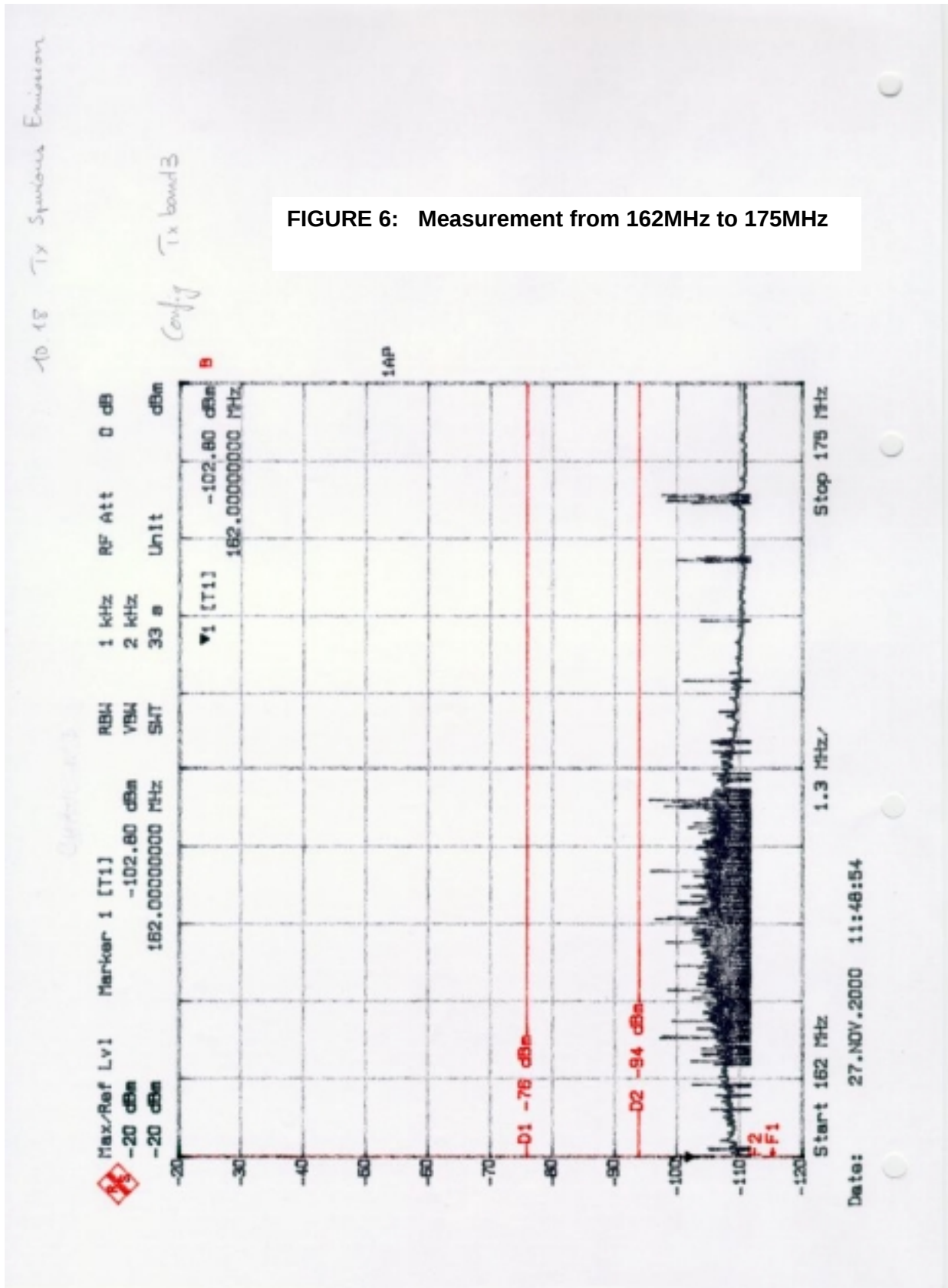
10.18 TX Spectrum Analyzer

config TX band 2

FIGURE 5: Measurement from 88MHz to 108MHz

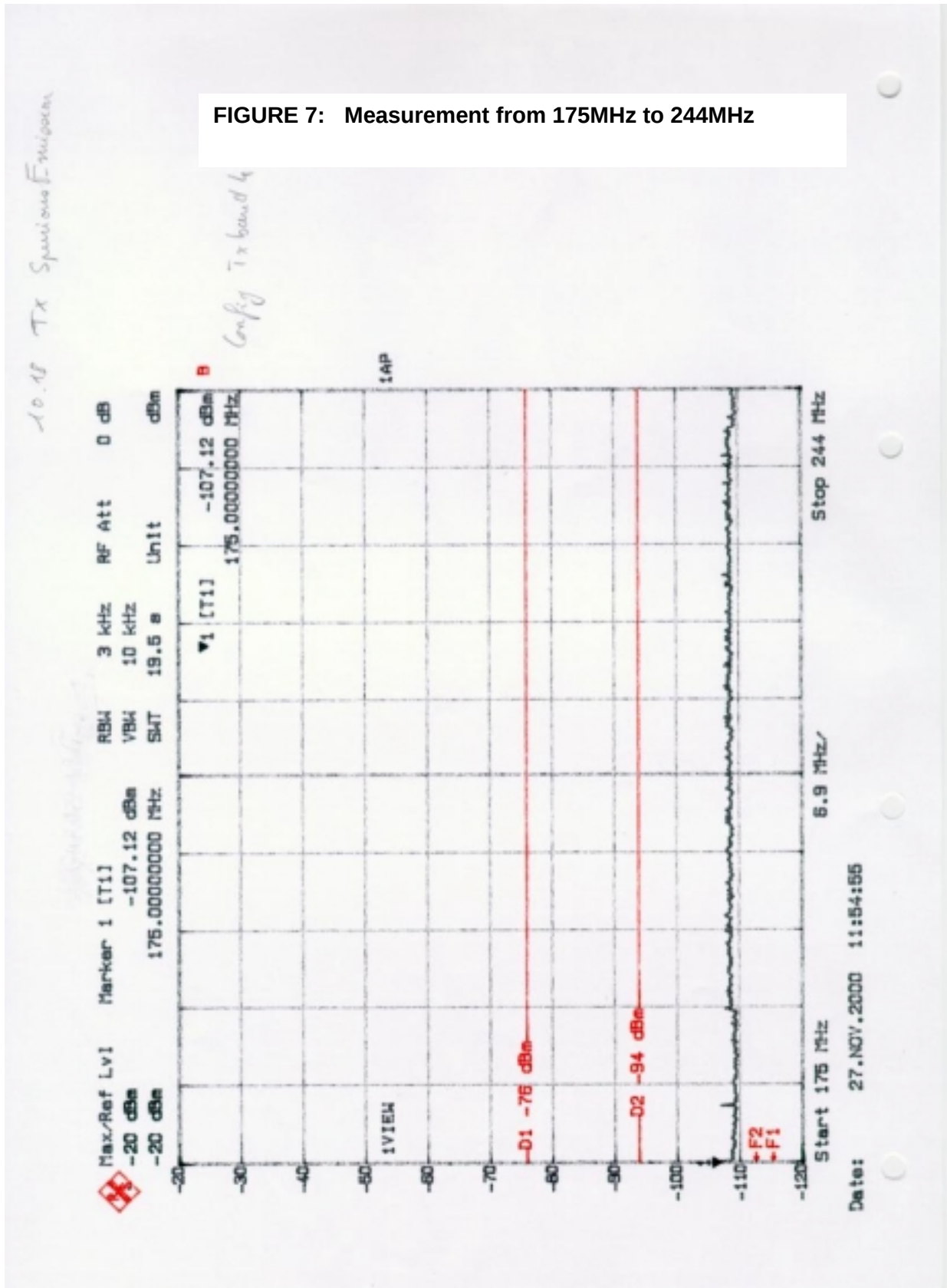


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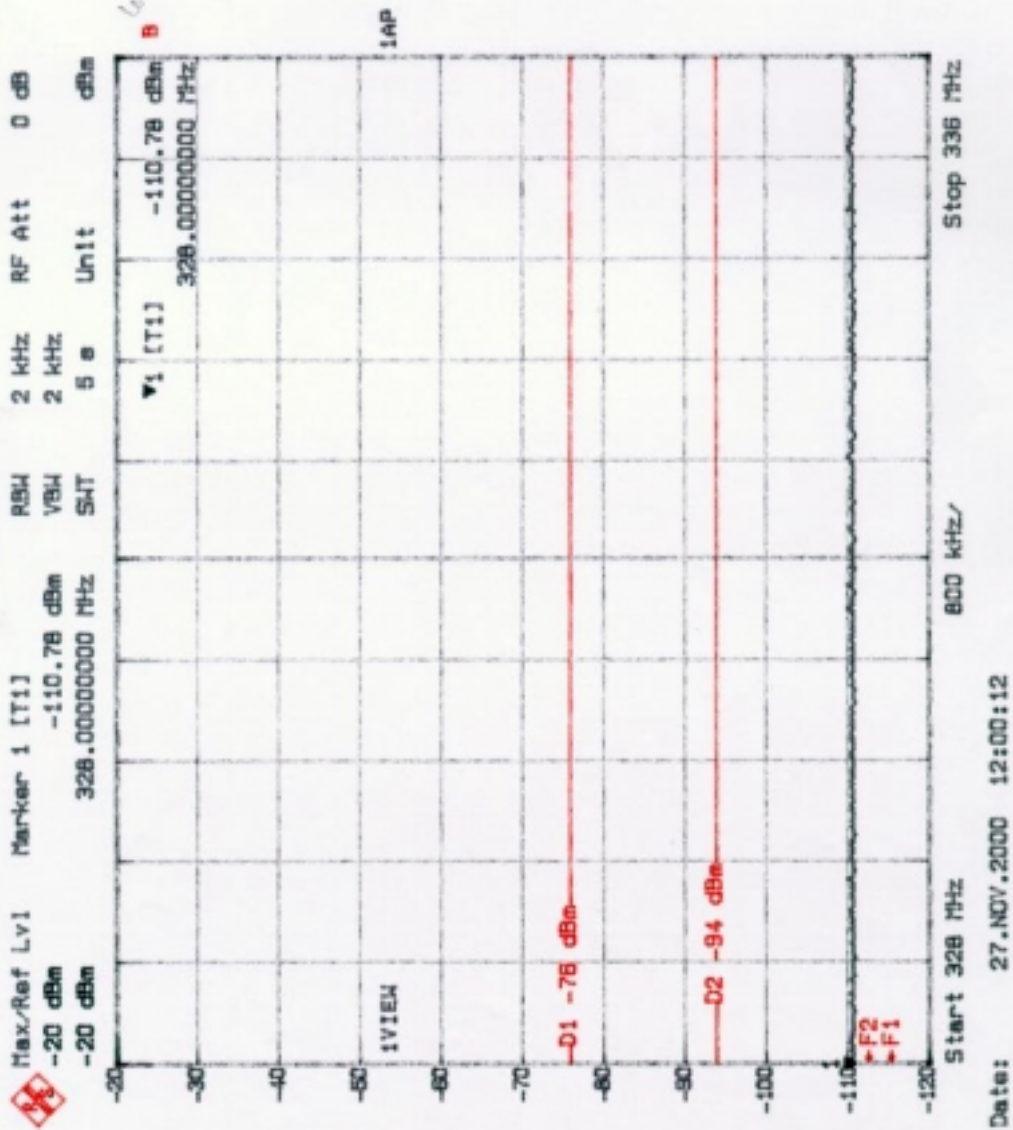
FIGURE 7: Measurement from 175MHz to 244MHz



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10.18 Tx Spurious Emission

FIGURE 8: Measurement from 328MHz to 336MHz

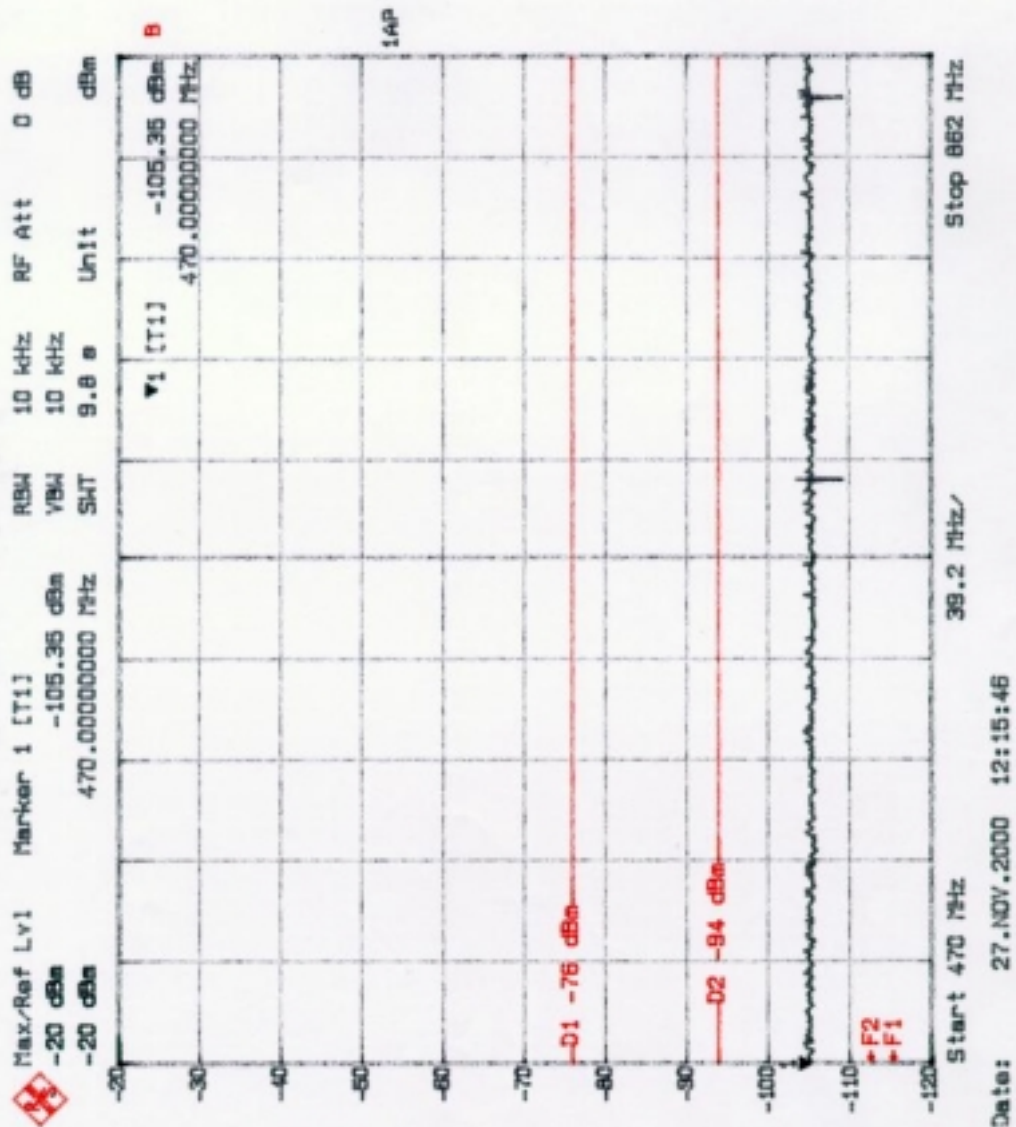


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10.15 Tx Spurious Emission

Config: Tx Band 6

FIGURE 9: Measurement from 470MHz to 862MHz

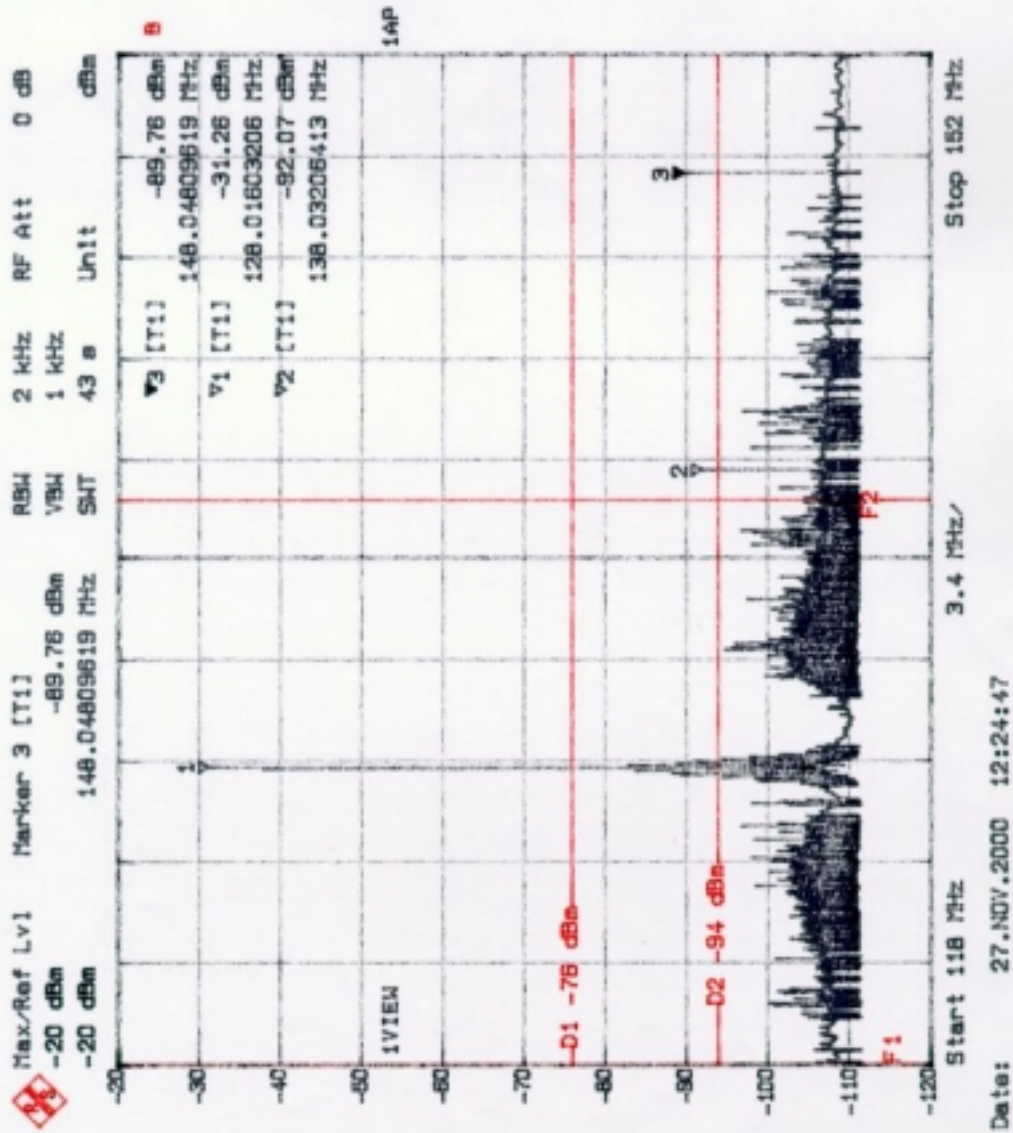


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10.18 TX Spurious Emission

conf: TXBD VHF

FIGURE 10: Measurement from 118MHz to 152MHz



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6 LIST OF COMPLIANCE

TABLE 28 - LIST OF COMPLIANCE			
FCC ref.	Characteristics	See §.	Compliance analysis
Part 15 Subpart B §.15.109	Radiated emission limits	§.5.1.1	Compliant
Part 15 Subpart B §.15.111	Antenna power conduction limits for receivers	§.5.1.2	Compliant
Part 87 Subpart D §.87.131	Power and emissions	§.5.2.1	Compliant
Part 87 Subpart D §.87.133	Frequency stability	§.5.2.2	Compliant
Part 87 Subpart D §.87.135	Bandwidth of emissions	§.5.2.3	Compliant
Part 87 Subpart D §.87.137	Types of emission	§.5.2.4	No comment.
Part 87 Subpart D §.87.139	Emissions limitations	§.5.2.5	Compliant
Part 87 Subpart D §.87.141(a)	Modulation requirements	§.5.2.6	Compliant
Part 87 Subpart D §.87.131????	Audio frequency response	§.5.2.7	Compliant
Part 2 Subpart J §.2.995(A)(2)	Frequency stability for variation of ambient temperature	§.5.3.1	Compliant
Part 2 Subpart J §.2.995(D)	Frequency stability for voltage variation	§.5.3.2	Compliant
Part 2 Subpart J §.2.989(C)(1)	Occupied bandwidth	§.5.3.3	Compliant
Part 2 Subpart J §.2.993	Field strength of spurious radiation	§.5.3.4.1	Compliant
Part 2 Subpart J §.2.991	Spurious emissions at antenna terminals	§.5.3.4.2	Compliant

All the results obtained with the VHF transceiver EVR750-04-xxxxx are compliant with the requirements.

CONCLUSION: The VHF transceiver EVR750-04-xxxxx is compliant with the FCC Rules.

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