
REPORT ON

Limited FCC CFR 47: Parts 2 and 80
and Industry Canada RSS-GEN, RSS-182 Testing
of a Raymarine plc RAY218 Fixed Mount VHF (with Class D DSC)

COMMERCIAL-IN-CONFIDENCE

Report No RM615608/01 Issue 4

March 2007



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REPORT ON

Limited FCC CFR 47: Parts 2 and 80 and Industry Canada
RSS-GEN, RSS-182 Testing of a Raymarine plc RAY218 Fixed
Mount VHF (with Class D DSC)

FCC ID: PJ5VHFGEN1
Industry Canada ID: 4069A-VHFGEN1

Report No RM615608/01 Issue 4

March 2007

PREPARED FOR

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DATED

22nd March 2007

This report has been up-issued to Issue 4 to included omitted test results for FCC Part 80

ENGINEERING STATEMENT

The measurements shown in this report were made in accordance with the procedures described on test pages. All reported testing was carried out on a sample equipment to demonstrate limited compliance with FCC CFR 47: Parts 2 and 80 and RSS-GEN, RSS-182 . The sample tested was found to comply with the requirements defined in the applied rules.

Test Engineers;

R A Blagg

S Bennett



0141
Group

S Hartley



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SECTION 1

REPORT SUMMARY

Limited FCC CFR 47: Parts 2 and 80
and Industry Canada RSS-GEN, RSS-182 Testing
of a Raymarine plc RAY218 Fixed Mount VHF (with Class D DSC)



Product Service

1.1 STATUS

Equipment Under Test	RAY218 Fixed Mount VHF (with Class D DSC)
Objective	To undertake measurements to determine the Equipment Under Test's (EUT's) compliance with the specification.
Name and Address of Client	Raymarine Anchorage Park Portsmouth Hampshire PO3 5TD United Kingdom
Type	RAY218
Product Code	E43032
Serial Number(s)	03
Hardware Version	1.00
Firmware Issue	1.00
Declared Variants	None
Test Specification/Issue/Date	FCC CFR 47: Part 2: 2001 FCC CFR 47: Part 80: 2005 RSS-Gen: 2005 RSS-182: 2003
Number of Items Tested	One
Security Classification of EUT	Commercial-in-Confidence
Incoming Release Date	Declaration of Build Status 8 th November 2006
Disposal Reference Number Date	Held pending disposal Not Applicable Not Applicable
Order Number Date	FTL1888 17 th October 2006
Start of Test Finish of Test	13 th December 2006 21 st March 2007
Related Documents	ANSI C63.4: 2001 RSS-212, Issue 1: 1999 SRSP-503, Issue 6: 2003 SRSP-510, Issue 3: 2003



Product Service

1.2 INTRODUCTION

The information contained within this report is intended to show limited verification of compliance of the Raymarine plc RAY218 Fixed Mount VHF (with Class D DSC) to the requirements of FCC Specification Parts 2 and 80 and Industry Canada Radio Specifications RSS-132 and RSS-133.

Testing has been performed under the following site accreditations

FCC Accreditation

90987 Octagon House, Fareham Test Laboratory and Maplewood, Basingstoke Test Laboratory

Industry Canada Accreditation

IC5208 Octagon House, Fareham Test Laboratory

IC5208 Maplewood, Basingstoke Test Laboratory



1.3 BRIEF SUMMARY OF RESULTS

A brief summary of the tests carried out is shown below.

FCC CFR 47: Part 15, Subparts B and C, RSS-Gen, RSS-132 and RSS-133

Section	Spec Clause		Test Description	Result	Comments
	FCC	Industry Canada			
2.1	2.1049 / 80.205	RSS-Gen 4.4.1	Bandwidths	Pass	
2.2	2.1049 / 80.207	RSS-Gen 4.4.1	DSC Bandwidths	Pass	
2.3	2.1055 / 80.209	RSS-182 4.2	Transmitter Frequency Tolerances - Voltage	Pass	
2.4	2.1055 / 80.209	RSS-182 6.1	Transmitter Frequency Tolerances - Temperature	Pass	
2.5	2.1051 / 80.211	-	Emissions Limitations (Emission Mask)	Pass	
2.6	2.1053 / 80.211(f)(1)(2)	-	Emissions Limitations (Emission Mask) DSC	Pass	
2.7	2.10551 / 80.211(c)	-	Emissions Limitations (Conducted Transmitter Spurious)	Pass	
2.8	2.1053 / 80.211(c)	-	Emissions Limitations (Radiated Transmitter Spurious)	Pass	
2.9	2.1047 / 2.1047(a) / 80.213	RSS-182 6.4	Modulation Requirements	Pass	
2.10	1.1046 / 80.215	RSS-182 4.3 & 6.2	Transmitter Power	Pass	
2.11	80.217	-	Suppression of Interference aboard ships	Pass	

* No test required.



1.4 APPLICATION FORM

APPLICANT'S DETAILS	
CATEGORY OF APPLICANT (please tick relevant box opposite)	(a) <input checked="" type="checkbox"/> MANUFACTURER
	(b) <input type="checkbox"/> IMPORTER
If box (b), (c) or (d) is ticked complete details in box below with respect to the manufacturer	(c) <input type="checkbox"/> DISTRIBUTOR
	(d) <input type="checkbox"/> AGENT
COMPANY NAME :	Raymarine plc.
ADDRESS :	Quay Point Northarbour Road Portsmouth, Hampshire PO6 3TD United Kingdom
NAME FOR CONTACT PURPOSES :	J.D.Walsh
TELEPHONE NO :01234 22600	FAX NO :
	TELEX NO :

MANUFACTURER'S DETAILS	
COMPANY NAME :	As above
ADDRESS :	
NAME FOR CONTACT PURPOSES :	
TELEPHONE NO :	FAX NO :
	TELEX NO :



1.4 APPLICATION FORM

TYPE OF EQUIPMENT	
<input type="checkbox"/>	Transmitter
<input checked="" type="checkbox"/>	Transmitter/Receiver
<input type="checkbox"/>	Receiver
<input checked="" type="checkbox"/>	Simplex on single-frequency channels
<input checked="" type="checkbox"/>	Simplex on two-frequency channels
<input type="checkbox"/>	Duplex
<input type="checkbox"/>	Separate DSC unit
<input checked="" type="checkbox"/>	Integrated DSC units
<input type="checkbox"/>	Integrated analogue selective calling decoder
Interfaces	
<input type="checkbox"/>	DSC at audio level
<input type="checkbox"/>	DSC at DC level
<input type="checkbox"/>	Printer
<input checked="" type="checkbox"/>	External loudspeaker
<input type="checkbox"/>	DSC watchkeeping receiver antenna output
<input type="checkbox"/>	DSC watchkeeping receiver control



Product Service

1.4 APPLICATION FORM

DUPLEX OPERATION		
Is the equipment intended for		
Duplex operation	[]	Yes
	[✓]	No
Is the equipment fitted with separate transmitter and receiver antenna sockets		
	[]	Yes
	[✓]	No
Is the equipment fitted with a duplex filter as an integral part of the equipment with a single antenna connection socket		
	[]	Yes
	[✓]	No
Is the duplex filter externally fitted and connected to the main equipment by co-axial cable(s)		
	[]	Yes
	[✓]	No
Type and make of duplex filter		
.....		



1.4 APPLICATION FORM

TRANSMITTER AND RECEIVER CHARACTERISTICS	
NUMBER OF CHANNELS:	
<input type="checkbox"/> [all]	ITU channels
<input type="checkbox"/> [all]	USA channels
<input type="checkbox"/> [8]	PRIVATE channels
<input type="checkbox"/> [6]	WEATHER channels (Rx Only)
<input type="checkbox"/> []	MEMORY channels
DSC CHANNEL(S) (if provided)	
<input type="checkbox"/> []	
<input type="checkbox"/> []	Other :
CHANNEL SEPARATION :	25 kHz
ITU designation of class of emission(s) : G3E for speech, G2B for DSC	
ANTENNA IMPEDANCE : 50 ohm	



1.4 APPLICATION FORM

TRANSMITTER TECHNICAL CHARACTERISTICS	
TRANSMITTER FREQUENCY	
Method of frequency generation	
<input type="checkbox"/>	CRYSTAL
<input checked="" type="checkbox"/>	SYNTHESIZER
<input type="checkbox"/>	OTHER
Transmitter frequency bands : 156.025MHz to 157.425MHz	
TRANSMITTER MODULATION	
Modulation method : FM	
Occupied bandwidth :16KHz	
Maximum frequency deviations : 5Hz	
TRANSMITTER MODULATION INPUT CHARACTERISTICS	
Impedance :2k ohm	
<input type="checkbox"/>	balanced
<input checked="" type="checkbox"/>	unbalanced



Product Service

1.4 APPLICATION FORM

TRANSMITTER RF POWER CHARACTERISTICS	
RATED TRANSMITTER OUTPUT POWER (as stated by the manufacturer)	
Maximum output power :	25W
Reduced output power :	1W
Output power switch :	<input checked="" type="checkbox"/> Yes
	<input type="checkbox"/> No



1.4 APPLICATION FORM

RECEIVER TECHNICAL CHARACTERISTICS	
RECEIVER FREQUENCY	
Method of frequency generation :	
<input type="checkbox"/>	CRYSTAL
<input checked="" type="checkbox"/>	SYNTHESISER
<input type="checkbox"/>	OTHER :
Intermediate frequencies :	
[21.6]	MHz
[455]	kHz
[]	3rd
Receiver frequency channels : 156.025MHz to 163.275MHz	
Is local oscillator injection frequency higher or lower than the receiver nominal frequency?	
<input type="checkbox"/>	Higher
<input checked="" type="checkbox"/>	Lower



1.4 APPLICATION FORM

RECEIVER MODULATION OUTPUT CHARACTERISTICS	
RATED AUDIO OUTPUT POWER (as stated by the manufacturer)	
Loudspeaker :	2 W
Earphone :	W
RECEIVER MULTIPLE WATCH FACILITIES	
Dual watch facilities :	
	<input checked="" type="checkbox"/> Yes
	<input type="checkbox"/> No
If Yes, then :	
Selection of priority channel possible ? :	
	<input type="checkbox"/> Yes
	<input checked="" type="checkbox"/> No (= 16Ch)
Multiple watch facilities :	
	<input checked="" type="checkbox"/> Yes
	<input type="checkbox"/> No
If Yes, then :	
Selection of priority channel possible ? :	
	<input type="checkbox"/> Yes
	<input checked="" type="checkbox"/> No (= 16Ch)
Number of additional channels selectable : 56	
Scan time programmable ? :	
	<input type="checkbox"/> Yes
	<input checked="" type="checkbox"/> No



1.4 APPLICATION FORM

RECEIVER POWER SOURCE (1)	
<input type="checkbox"/> AC MAINS	State voltage: _____ V <input type="checkbox"/> Single phase
AC MAINS FREQUENCY	<input type="checkbox"/> Three phase
DC Voltage (V) : 12V	
DC Maximum Current : 2A	
<input type="checkbox"/> Other	
BATTERY	
<input type="checkbox"/> Nickel Cadmium	
<input type="checkbox"/> Mercury	
<input type="checkbox"/> Alkaline	
<input type="checkbox"/> Lead acid (Vehicle regulated)	
<input type="checkbox"/> Leclanche	
<input type="checkbox"/> Lithium	
<input type="checkbox"/> Other	
Volts nominal: . End point voltage as quoted by equipment manufacturer 10.6V. (Refer to Clause 4.9.2 and 4.10.3 of the Standard when completing the above)	

(1) If a transmitter and receiver use the same power source, this should be declared. In such cases only the box for the transmitter power source should be filled in.



Product Service

1.4 APPLICATION FORM

CONSTRUCTION OF THE EQUIPMENT	
<input checked="" type="checkbox"/> []	Single unit (1)
[]	Multiple units
If multiple units, describe each one clearly :	
TEMPERATURE RANGES over which the equipment is to be tested	
[]	+15°C to +35°C
<input checked="" type="checkbox"/> []	-15°C to +55°C
[]	Other

(1) Unit means a physically separate item of the equipment.



Product Service

1.4 APPLICATION FORM

OTHER ITEMS SUPPLIED		
Spare batteries	[]	Yes
	[]	No
Battery charging device	[]	Yes
	[]	No
Special tools for dismantling equipment	[]	Yes
	[]	No
Test interface box (if applicable)	[]	Yes
	[]	No
Full documentation on equipment (Handbook and circuit diagrams)	[]	Yes
	[]	No
Others	[]	Yes
	[]	No
If Yes, please specify :		



1.4 APPLICATION FORM

DECLARATION		
Are the equipments submitted representative production models ?	[]	Yes
	[✓]	No
If not are the equipments pre-production models ?	[✓]	Yes
	[]	No
If pre-production equipments are submitted will the final production equipments be identical in all respects with the equipment tested.	[]	Yes
	[]	No
If no supply full details		
Is the Test Report to be used as part of a Type Approval Application ?	[]	Yes
	[✓]	No
If yes, has the product, any direct engineering predecessor, or variant ever been granted Type Approval in any EEC member country ?	[]	Yes
	[✓]	No
If yes supply full details :		
Will labelling of the equipment comply with the requirements of ETS 300 338 ?	[]	Yes
	[]	No
If no supply full details		

I hereby declare that I am entitled to sign on behalf of the applicant and that the information supplied is correct and complete.

Signature : 

Name : J.D Walsh

Position held : Consultant

Date : 6th November 2006

TUV Product Service formally certifies that the manufacturer's declaration as typed out in this report, is a true and accurate record of the original received from the applicant.



Product Service

1.5 PRODUCT INFORMATION

1.5.1 Technical Description

The Equipment Under Test (EUT) was a Raymarine plc RAY218 Fixed Mount VHF (with Class D DSC) Marine Radio.

1.5.2 Modes of Operation

The EUT was operated as described under the specific test Sections.



Product Service

1.5 PRODUCT INFORMATION

1.5.1 Declaration of Build Status

Manufacturer	Raymarine
Country of origin	Japan Raymarine PLC
UK Agent	Marine VHF with Class D DSC & ATIS
Technical Description	
Model No	Ray218 E43032 Ray218 VHF Radio with removable microphone
Product Code	E43032
Serial No	03
Drawing Number	
Build Status	Pre production
Firmware Issue	10/23
FCC ID	PJ5VHFGEN1
IC ID	4069A-VHFGEN1

Signature

A handwritten signature in blue ink, appearing to be 'D. ...' followed by a stylized flourish.

Date

8 Nov 2006

D of B S Serial No

Note: This document has been prepared to enable manufacturers with no mechanism for producing their own Declaration of Build Status, to declare the build state of the equipment submitted for test.

No responsibility will be accepted by BABT/TÜV Product Service as to the accuracy of the information declared in this document by the manufacturer.



Product Service

1.6 TEST CONDITIONS

The EUT was set-up simulating a typical user installation at the Test Laboratory, as listed in Section 1.2 and tested in accordance with the applicable specification.

For all tests, the Raymarine plc RAY218 Fixed Mount VHF (with Class D DSC) was powered by a 12V dc power supply.

1.7 DEVIATIONS FROM THE STANDARD

Not Applicable

1.8 MODIFICATION RECORD

The table below details modifications made to the EUT during the test programme. The Modifications incorporated during each test are recorded on the appropriate test pages.

Modification State	Description of Modification still fitted to EUT	Modification Fitted By	Date Modification Fitted
0	As supplied	N/A	
1	Software update and instructions provided as to how to access the ATIS Transmission test Firmware update - duration improved to 187ms . 125ms. Stand-by terminal (pin #8) of audio amp IC, IC306 TDA1519 was damaged. IC306 was replaced. Replaced the XTL001. (Confirmed the issue was resolved) After the replacement, we did the aging test for 12 hours at +70 C degrees. Also, temperature cycle test was done from -20 to 70 C degrees, no problem found.	Raymarine plc	Prior to testing

All testing was conducted at Modification State 1



Product Service

SECTION 2

TEST RESULTS

Limited FCC CFR 47: Parts 2 and 80
and Industry Canada RSS-GEN, RSS-182 Testing
of a Raymarine plc RAY218 Fixed Mount VHF (with Class D DSC)



Product Service

2.1 OCCUPIED BANDWIDTH

2.1.1 Specification Reference

FCC CFR 47: Part 80 Section 2.1049(c), 80.205 and Industry Canada RSS-Gen 4.4.1

2.1.2 Equipment Under Test

RAY218 Fixed Mount VHF (with Class D DSC)

2.1.3 Date of Test

12th February 2007

2.1.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.1.5 Test Procedure

The EUT is declared as having a class of emission: G3E which dictates an emission designator of: 16K0G3E which from 80.205(a) equates to an Authorised Bandwidth of: 20kHz.

Initially, the EUT was connected via a 40dB Attenuator to a Modulation Analyser, which was set to measure the Deviation. From the results in 80.213, the audio frequency for a set input level which produces the highest level of deviation was 2.8kHz. Thus, the Audio Analyser was set to supply the EUT with an audio tone of 2.5kHz at an amplitude which produced a deviation corresponding to 50% of the maximum permissible frequency deviation, (± 2.5 kHz). The level was then increased on the audio analyser by 16dB.

The Modulation Analyser was then replaced with a Spectrum Analyser and the 99% Bandwidth was measured. The measurements were performed on Channel 16, bottom and top channels on maximum power levels.

2.1.6 Test Results

Channel Number/Frequency	Power Level (W)	Result (kHz)	Authorised Bandwidth (kHz)
60 / 156.025MHz	25	14.93	20
16 / 156.800MHz	25	15.03	20
88 / 157.425MHz	25	15.13	20

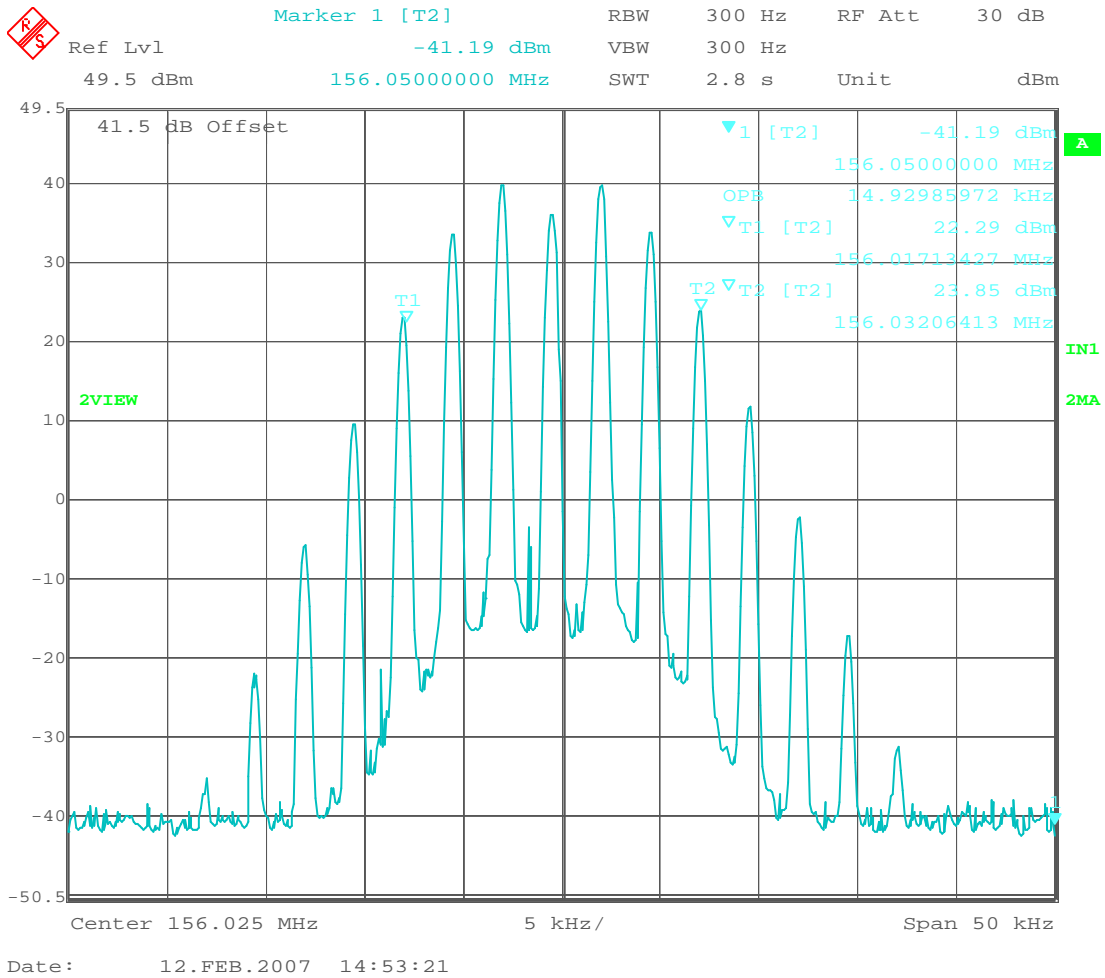
The test result plots are presented on the following pages.



2.1 OCCUPIED BANDWIDTH

2.1.6 Test Results

Occupied Bandwidth As Defined By The -26dBc Points



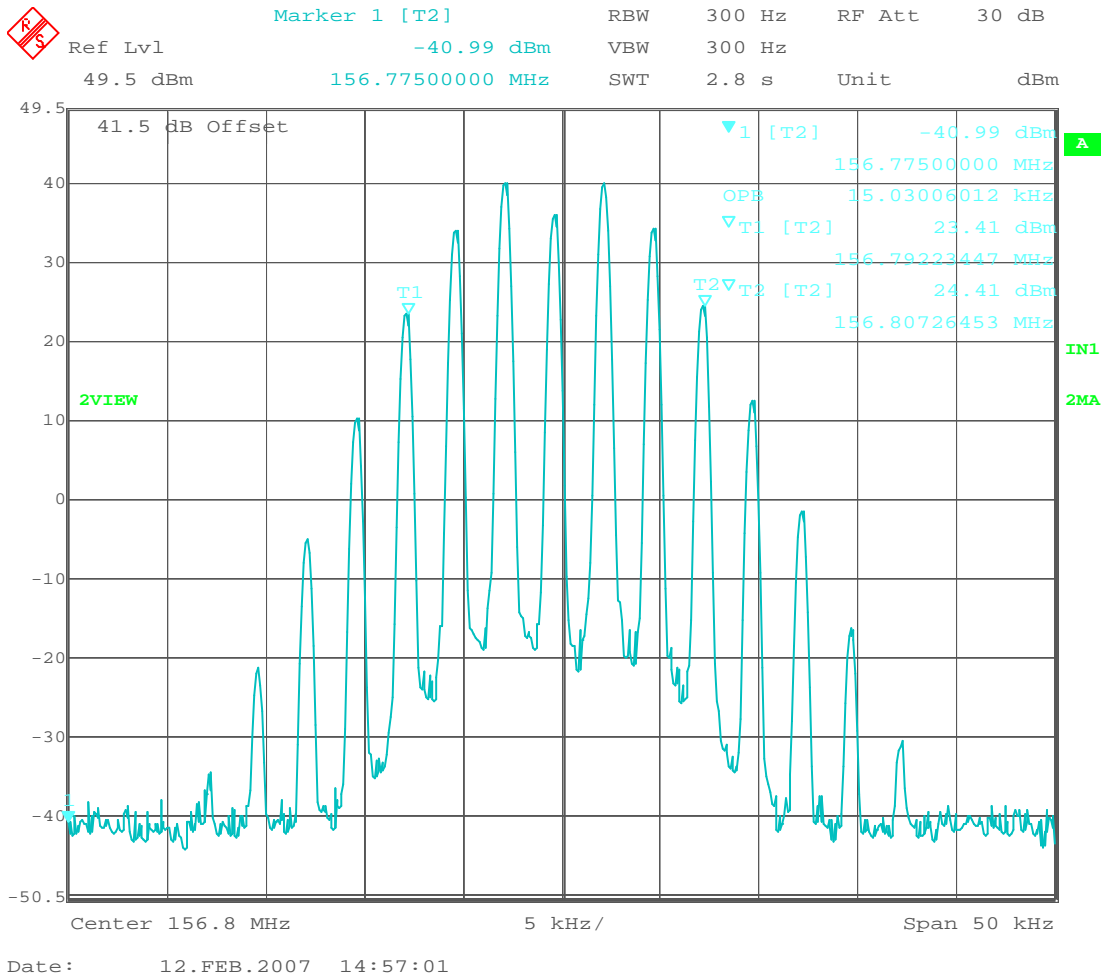
Maximum Power – Channel 60 Bottom



2.1 OCCUPIED BANDWIDTH

2.1.6 Test Results

Occupied Bandwidth As Defined By The -26dBc Points



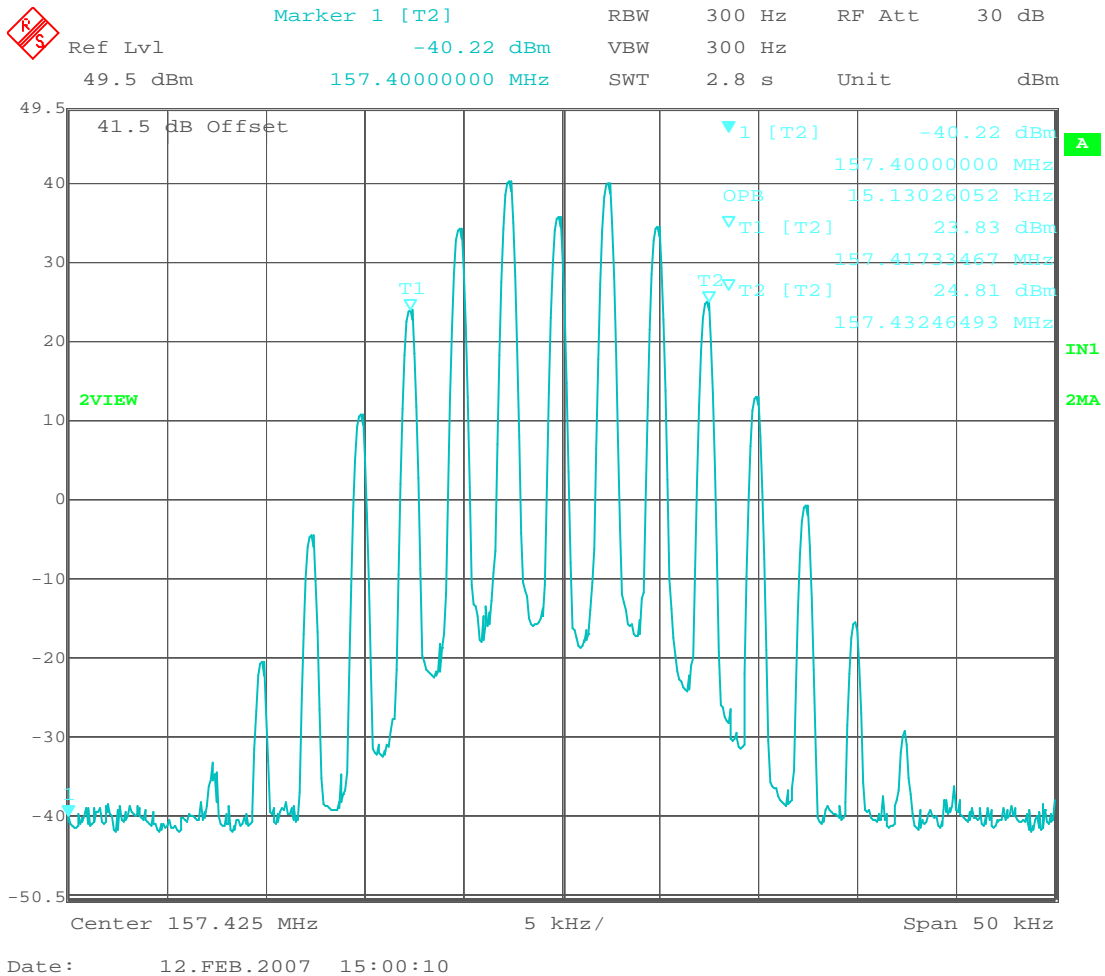
Maximum Power – Channel 16 Middle



2.1 OCCUPIED BANDWIDTH

2.1.6 Test Results

Occupied Bandwidth As Defined By The -26dBc Points



Maximum Power – Channel 88 Top



Product Service

2.2 OCCUPIED BANDWIDTH DSC

2.2.1 Specification Reference

FCC CFR 47: Part 80 Section 2.1049(c), 80.207 and Industry Canada RSS-Gen 4.4.1

2.2.2 Equipment Under Test

RAY218 Fixed Mount VHF (with Class D DSC)

2.2.3 Date of Test

12th February 2007

2.2.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.2.5 Test Procedure

DSC devices are classed as G2B emissions designator. Which equates to an authorised bandwidth of 20kHz from 80.225(C)(3)(ii), where it states that the radiotelephone emissions bandwidth shall not be exceeded.

The input level is not adjustable in DSC mode. The 1300Hz and 2100Hz tones are generated from within the EUT, Using the test modes supplied, three plots have been taken showing the carrier modulated with B and Y states and dotting pattern.

2.2.6 Test Results

Test Mode	Occupied Bandwidth (kHz)	Authorised Bandwidth (kHz)
1300Hz	8.116	20
2100Hz	12.725	20
Dotting Pattern	11.422	20

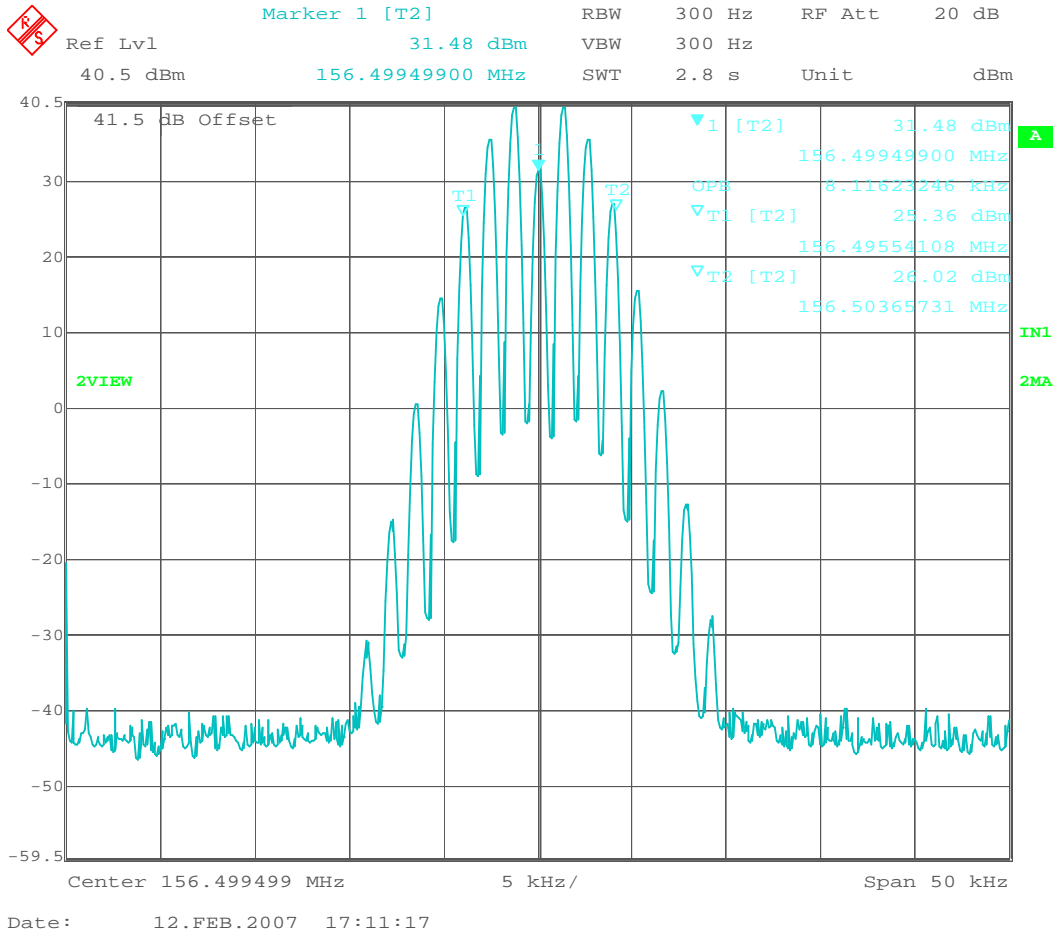
The test result plots are presented on the following pages.



2.2 OCCUPIED BANDWIDTH DSC

2.2.6 Test Results

Occupied Bandwidth As Defined By The -26dBc Points



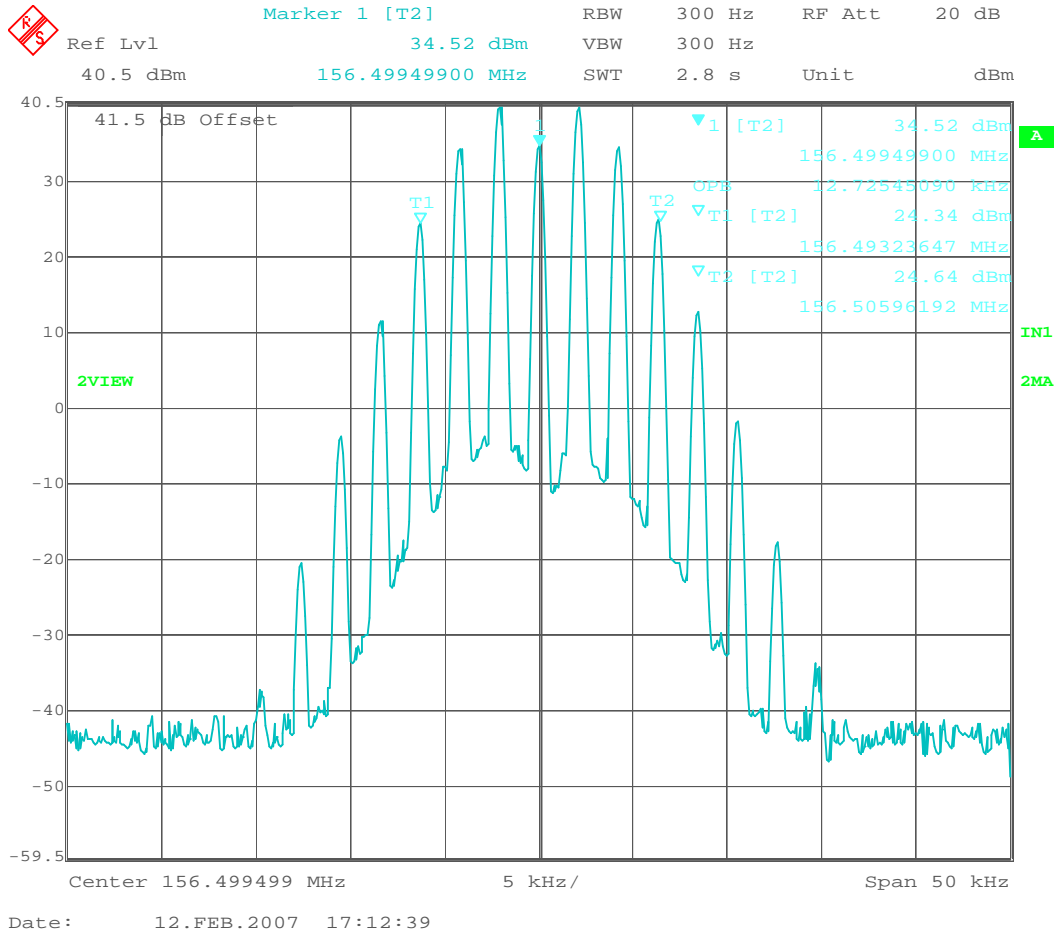
1300Hz Test Mode



2.2 OCCUPIED BANDWIDTH DSC

2.2.6 Test Results

Occupied Bandwidth As Defined By The -26dBc Points



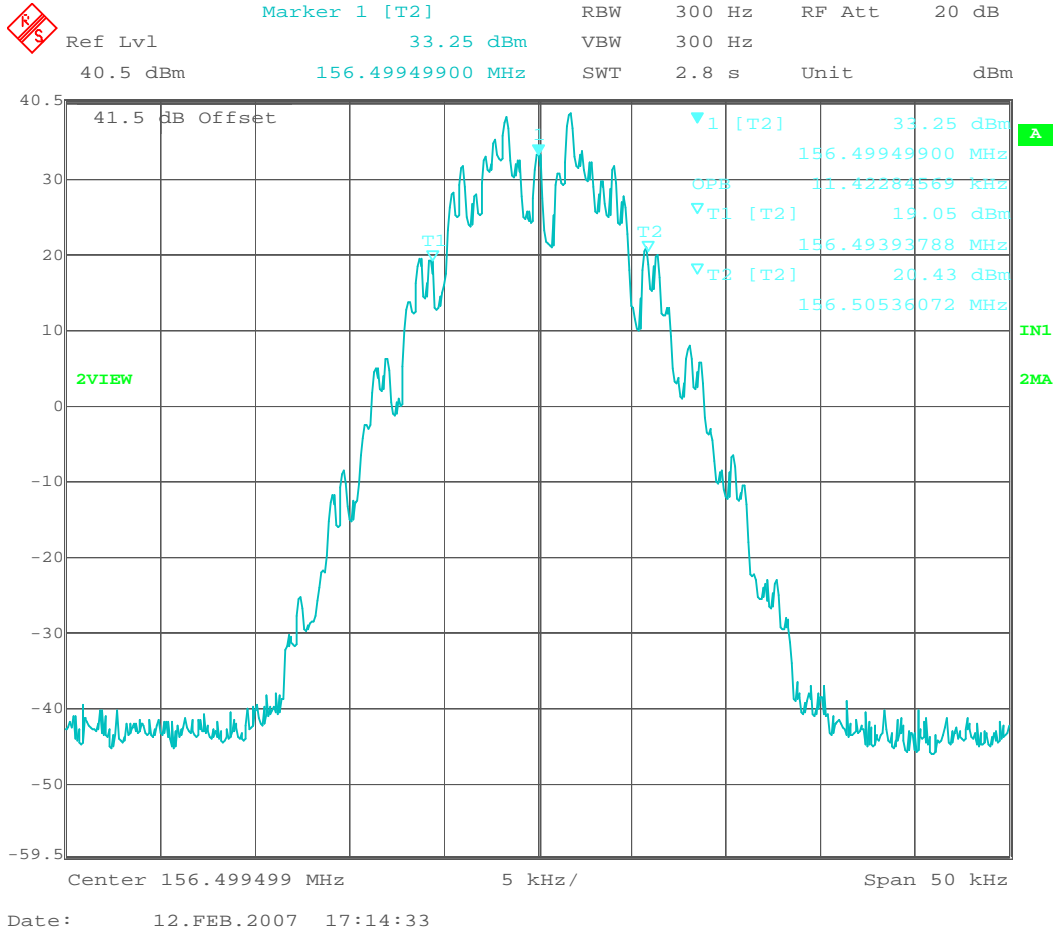
2100Hz Test Mode



2.2 OCCUPIED BANDWIDTH DSC

2.2.6 Test Results

Occupied Bandwidth As Defined By The -26dBc Points



Dotting Pattern Test Mode



Product Service

2.3 FREQUENCY STABILITY UNDER VOLTAGE VARIATIONS

2.3.1 Specification Reference

FCC CFR 47: Part 80, Sections 2.1055, 80.209 and Industry Canada RSS-182, 4.2

2.3.2 Equipment Under Test

RAY218 Fixed Mount VHF (with Class D DSC)

2.3.3 Date of Test

12th January 2007

2.3.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.3.5 Test Procedure

The EUT was set to transmit an unmodulated carrier on channel 16 at maximum power. Using a frequency counter, the frequency error was measured and the result recorded.

The voltage to the EUT was varied as shown in the table of results at a temperature of 20°C.



Product Service

2.3 FREQUENCY STABILITY UNDER VOLTAGE VARIATIONS

2.3.6 Results

Ambient conditions: 24.0°C 37.1% RH

Channel 60 – 156.025MHz

DC Voltage (V)	Test Frequency (MHz)	Error (kHz)	Limit (kHz)
11.56	156.025	-0.114	± 1.56025
13.60	156.025	-0.120	± 1.56025
15.64	156.025	-0.135	± 1.56025

Channel 88 – 157.425MHz

DC Voltage (V)	Test Frequency (MHz)	Error (kHz)	Limit (kHz)
11.56	157.425	-0.255	± 1.57425
13.60	157.425	-0.218	± 1.57425
15.64	157.425	-0.189	± 1.57425

LIMITS:

Limit	±1.56025kHz / ±1.57425kHz or 10ppm
-------	------------------------------------

Remarks

EUT complies with CFR 47 Part 2.1055, 80.209 and Industry Canada RSS-182, 4.2.



Product Service

2.4 FREQUENCY STABILITY UNDER TEMPERATURE VARIATIONS

2.4.1 Specification Reference

FCC CFR 47: Part 80, Sections 2.1055, 80.209 and Industry Canada RSS-182, 6.1

2.4.2 Equipment Under Test

RAY218 Fixed Mount VHF (with Class D DSC)

2.4.3 Date of Test

14th December 2006

2.4.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.4.5 Test Procedure

The EUT was set to transmit an unmodulated carrier on channel 16 at maximum power. Using a frequency counter, the frequency error was measured and the result recorded. The temperature was adjusted between -20°C and +50°C in 10° steps as per 2.1055.



2.4 FREQUENCY STABILITY UNDER TEMPERATURE VARIATIONS

2.4.6 Test Results

12V SUPPLY – Channel 60

Temperature Interval °C	Voltage (V)	Test Frequency MHz	Deviation Hz	Ch60 error (ppm)	Limit (ppm)
-20	11.56	156.025562	0.562	3.602	+/- 10
	13.6	156.025523	0.523	3.352	+/- 10
	15.64	156.025490	0.49	3.141	+/- 10
-10	11.56	156.025501	0.501	3.211	+/- 10
	13.6	156.025515	0.515	3.301	+/- 10
	15.64	156.025541	0.541	3.467	+/- 10
0	11.56	156.025496	0.496	3.179	+/- 10
	13.6	156.025519	0.519	3.326	+/- 10
	15.64	156.025532	0.532	3.410	+/- 10
+10	11.56	156.025255	0.255	1.634	+/- 10
	13.6	156.025254	0.254	1.628	+/- 10
	15.64	156.025253	0.253	1.622	+/- 10
+20	11.56	156.024906	-0.094	-0.602	+/- 10
	13.6	156.024936	-0.064	-0.410	+/- 10
	15.64	156.024983	-0.017	-0.109	+/- 10
+30	11.56	156.024594	-0.406	-2.602	+/- 10
	13.6	156.024593	-0.407	-2.609	+/- 10
	15.64	156.024590	-0.41	-2.628	+/- 10
+40	11.56	156.024403	-0.597	-3.826	+/- 10
	13.6	156.024421	-0.579	-3.711	+/- 10
	15.64	156.024447	-0.553	-3.544	+/- 10
+50	11.56	156.024361	-0.639	-4.095	+/- 10
	13.6	156.024364	-0.636	-4.076	+/- 10
	15.64	156.024363	-0.637	-4.083	+/- 10



2.4 FREQUENCY STABILITY UNDER TEMPERATURE VARIATIONS

2.4.6 Test Results

12V SUPPLY – Channel 88

Temperature Interval °C	Voltage (V)	Test Frequency MHz	Deviation Hz	Ch60 error (ppm)	Limit (ppm)
-20	11.56	157.425057	0.057	0.362	+/- 10
	13.6	157.425120	0.12	0.762	+/- 10
	15.64	157.425218	0.218	1.385	+/- 10
-10	11.56	157.425621	0.621	3.945	+/- 10
	13.6	157.425607	0.607	3.856	+/- 10
	15.64	157.425591	0.591	3.754	+/- 10
0	11.56	157.425564	0.564	3.583	+/- 10
	13.6	157.425560	0.56	3.557	+/- 10
	15.64	157.425560	0.56	3.557	+/- 10
+10	11.56	157.425159	0.159	1.010	+/- 10
	13.6	157.425187	0.187	1.188	+/- 10
	15.64	157.425219	0.219	1.391	+/- 10
+20	11.56	157.425020	0.02	0.127	+/- 10
	13.6	157.425020	0.02	0.127	+/- 10
	15.64	157.425013	0.013	0.083	+/- 10
+30	11.56	157.424428	-0.572	-3.633	+/- 10
	13.6	157.424444	-0.556	-3.532	+/- 10
	15.64	157.424455	-0.545	-3.462	+/- 10
+40	11.56	157.424485	-0.515	-3.271	+/- 10
	13.6	157.424482	-0.518	-3.290	+/- 10
	15.64	157.424474	-0.526	-3.341	+/- 10
+50	11.56	157.424384	-0.616	-3.913	+/- 10
	13.6	157.424365	-0.635	-4.034	+/- 10
	15.64	157.424357	-0.643	-4.084	+/- 10

Remarks

EUT complies with CFR 47 Parts 2.1055, 80.209 and Industry Canada RSS-182, 6.1.



2.5 EMISSION LIMITATIONS (EMISSION MASK)

2.5.1 Specification Reference

FCC CFR 47: Part 80, Sections 2.10551 80.211

2.5.2 Equipment Under Test

RAY218 Fixed Mount VHF (with Class D DSC)

2.5.3 Date of Test

12th February 2007

2.5.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.5.5 Test Procedure

The EUT was connected to a Spectrum Analyser via attenuators with this configuration; emissions were measured from 9kHz to 600MHz and the emission mask. From 600MHz to 1600MHz, attenuators and a high pass filter was used. The emissions were measured on Bottom, Middle and Top channels up to the 10th harmonic. The path loss was measured for both the above configurations and the worst case loss was entered as a reference level offset.

All Measurements were performed with the EUT modulated in accordance with Part 2.1051. The EUT was initially connected to a Modulation Analyser and the EUT set to transmit. Using an Audio Analyser, an audio frequency was swept between 300Hz to 5kHz to find the frequency which produced the highest deviation.

The amplitude at this frequency was then increased to give a deviation of 2.5kHz.

The amplitude and frequency levels were 6.06mV at 2.8kHz

Then at a frequency of 2.5kHz the amplitude recorded above was increased by 16dB to provide the Final Modulated level.

The EUT transmitting on full power was then connected to a Spectrum Analyser via a 40dB Attenuator. The modulated carrier was checked (for the bottom, middle and top channels of the EUT) against the emission mask.

The Path Loss was recorded and the worst case loss was entered as a Reference Level Offset

Total Path loss = 41.5dB

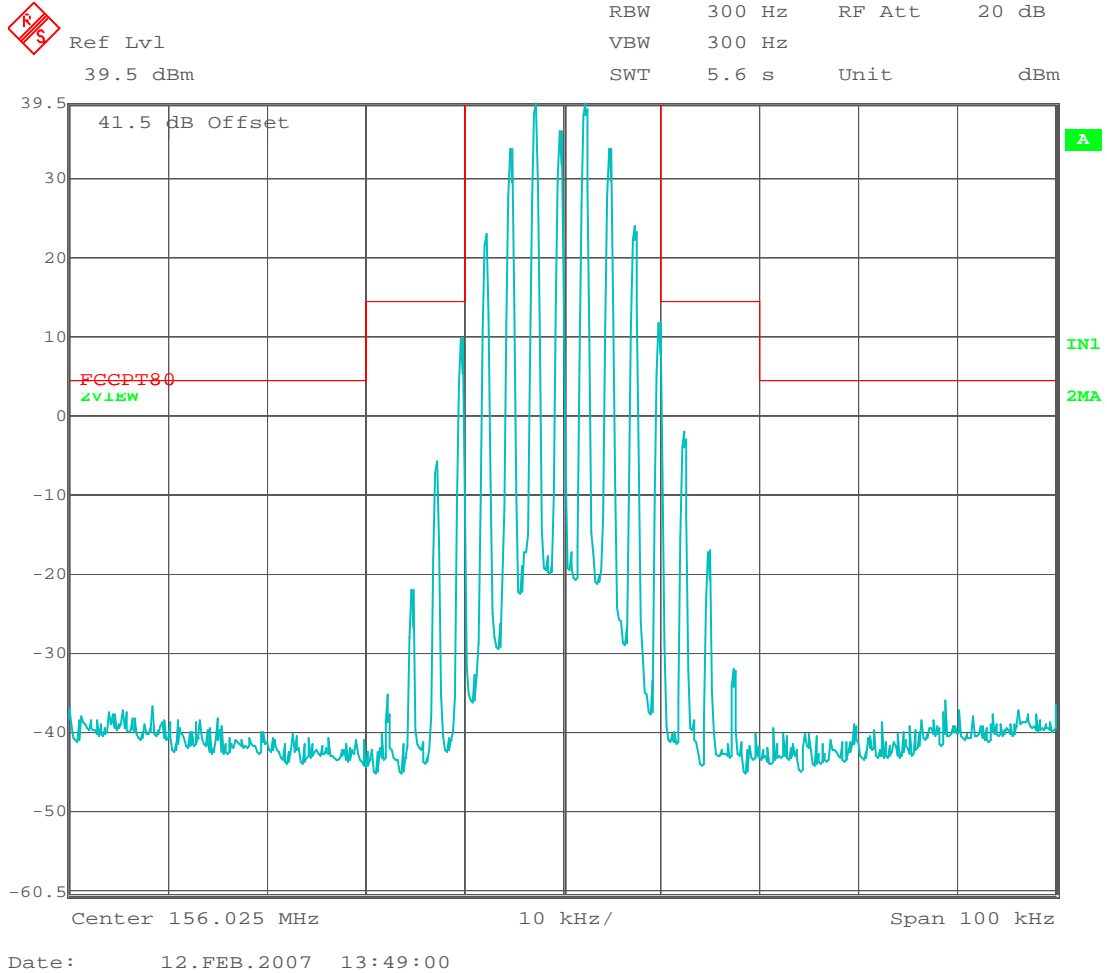
2.5.6 Test Results

The EUT meets the requirements of Part 80.211(c)
The test result plots are presented on the following pages.



2.5 EMISSION LIMITATIONS (EMISSION MASK)

2.5.6 Test Results

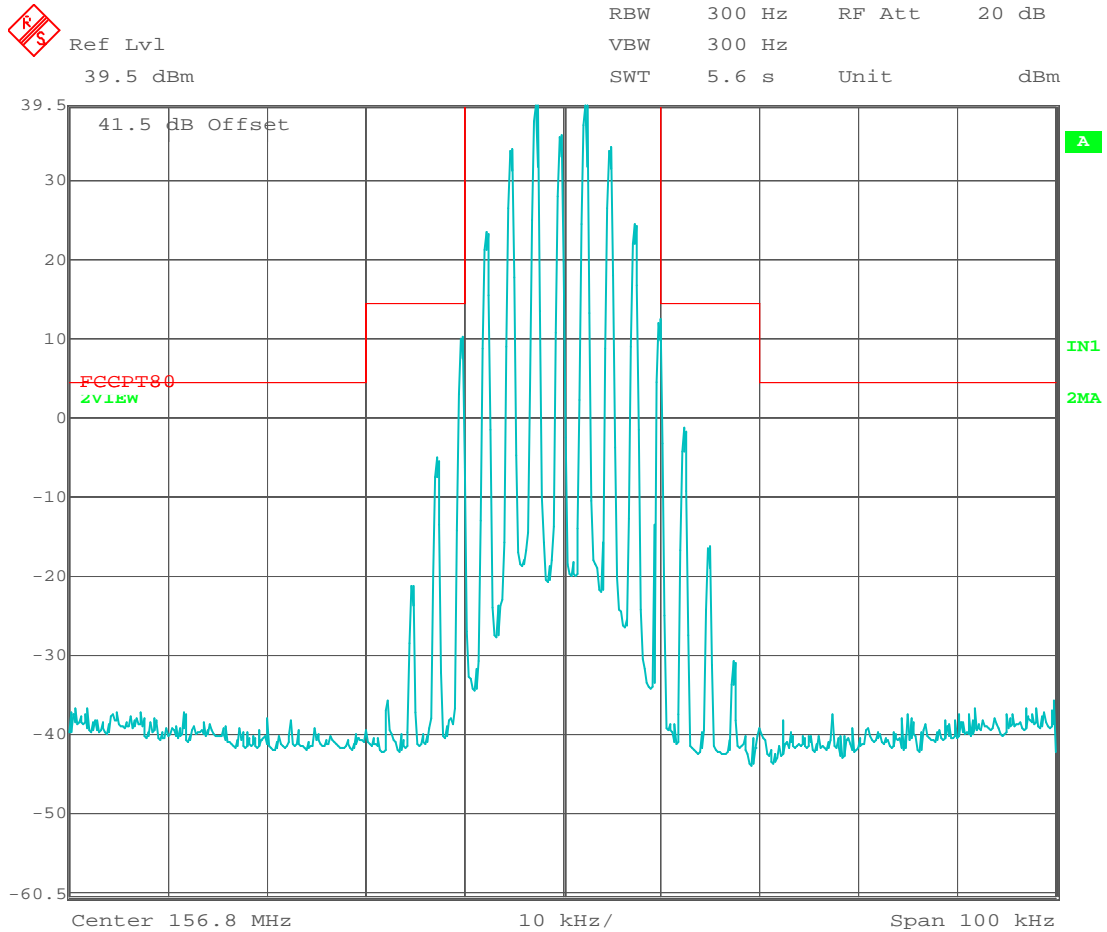


Channel 60 - Bottom



2.5 EMISSION LIMITATIONS (EMISSION MASK)

2.5.6 Test Results



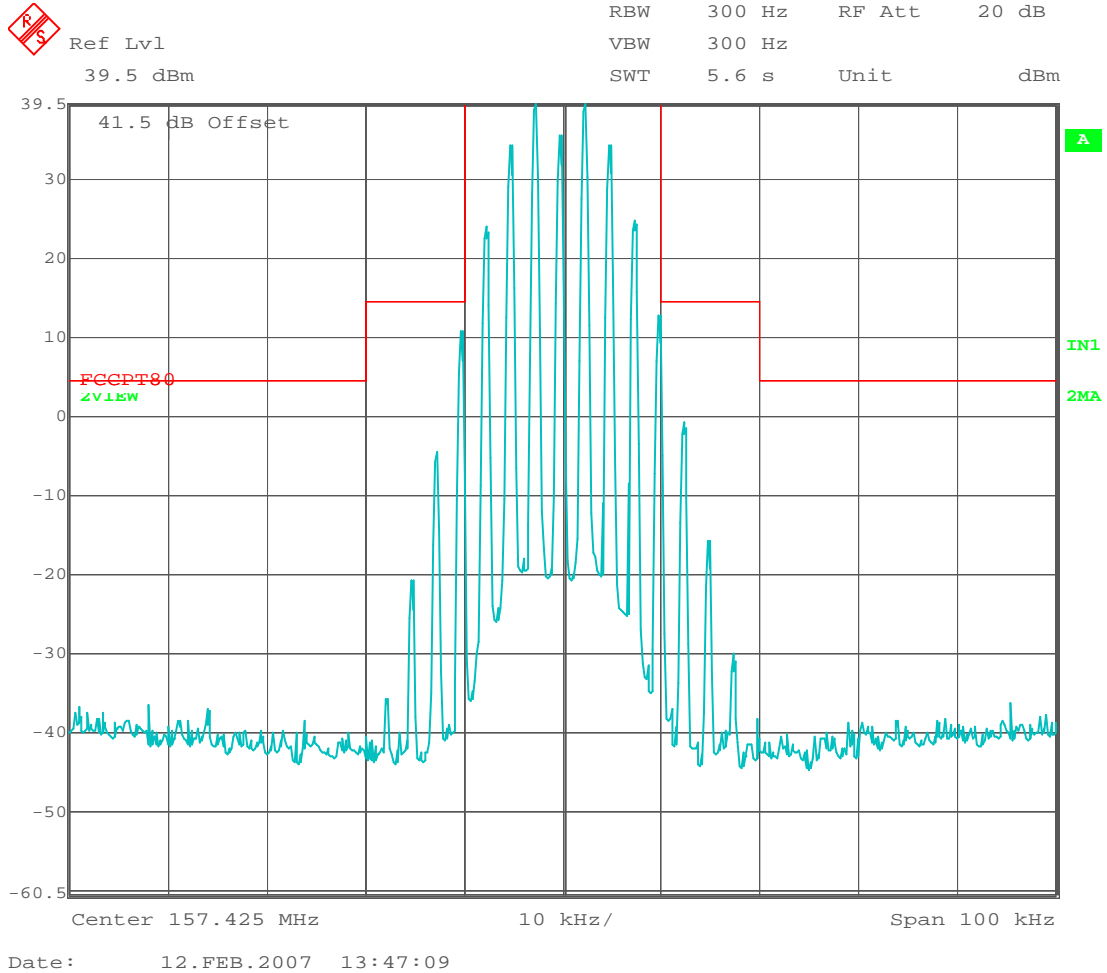
Date: 12.FEB.2007 13:51:19

Channel 16 - Middle



2.5 EMISSION LIMITATIONS (EMISSION MASK)

2.5.6 Test Results



Channel 88 - Top



Product Service

2.6 EMISSION LIMITATIONS (EMISSION MASK) DSC

2.6.1 Specification Reference

FCC CFR 47: Part 80, Sections 2.1053, 80.211(f)(1)(2)

2.6.2 Equipment Under Test

RAY218 Fixed Mount VHF (with Class D DSC)

2.6.3 Date of Test

12th February 2007: Modification State 1

2.6.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.6.5 Test Procedure

The EUT was tested in its DSC mode of operation. Using the test modes supplied by the manufacturer the FSK modulated carrier was checked for compliance against the emission mask defined in 80.211(f)(1)(2). The EUT was tested in its B and Y states and Dotting Pattern.

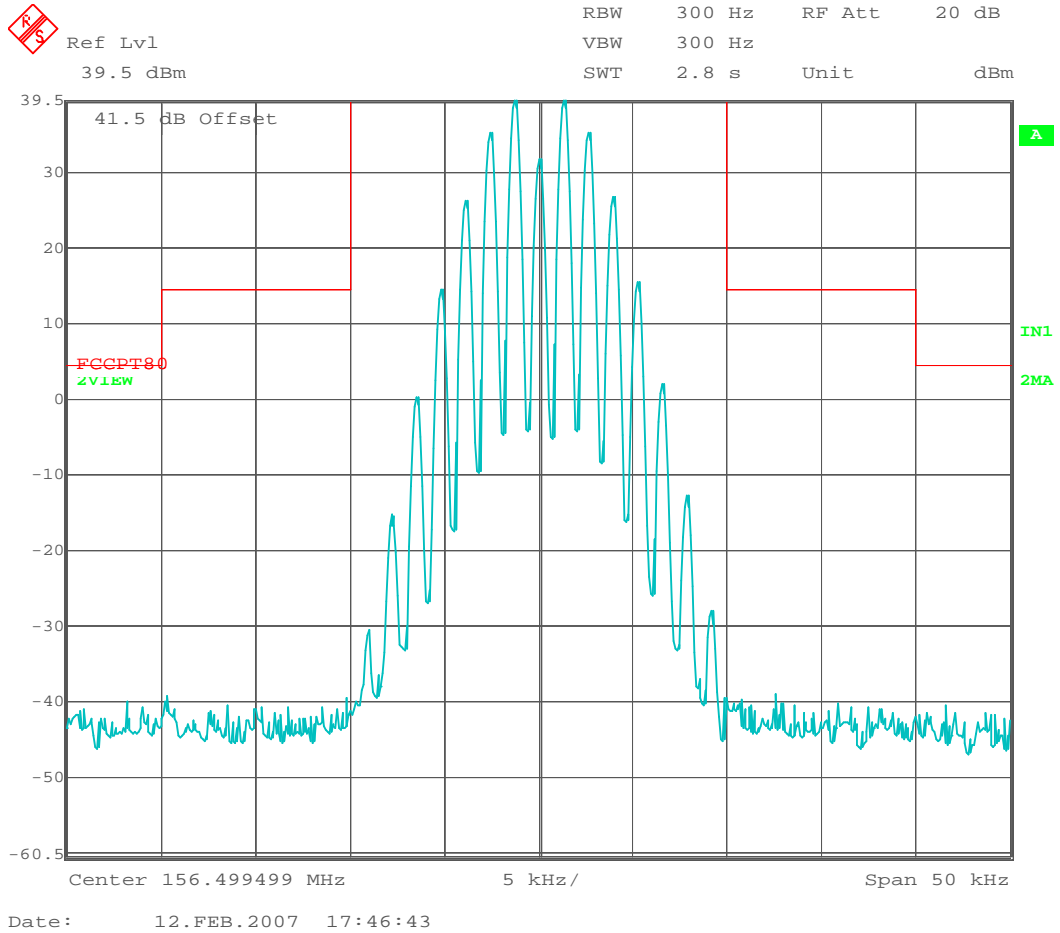
2.6.6 Test Results

The EUT meets the requirements of Sections 2.1053, 80.211(f)(1)(2)
The test result plots are presented on the following pages.



2.6 EMISSION LIMITATIONS (EMISSION MASK) DSC

2.6.6 Test Results



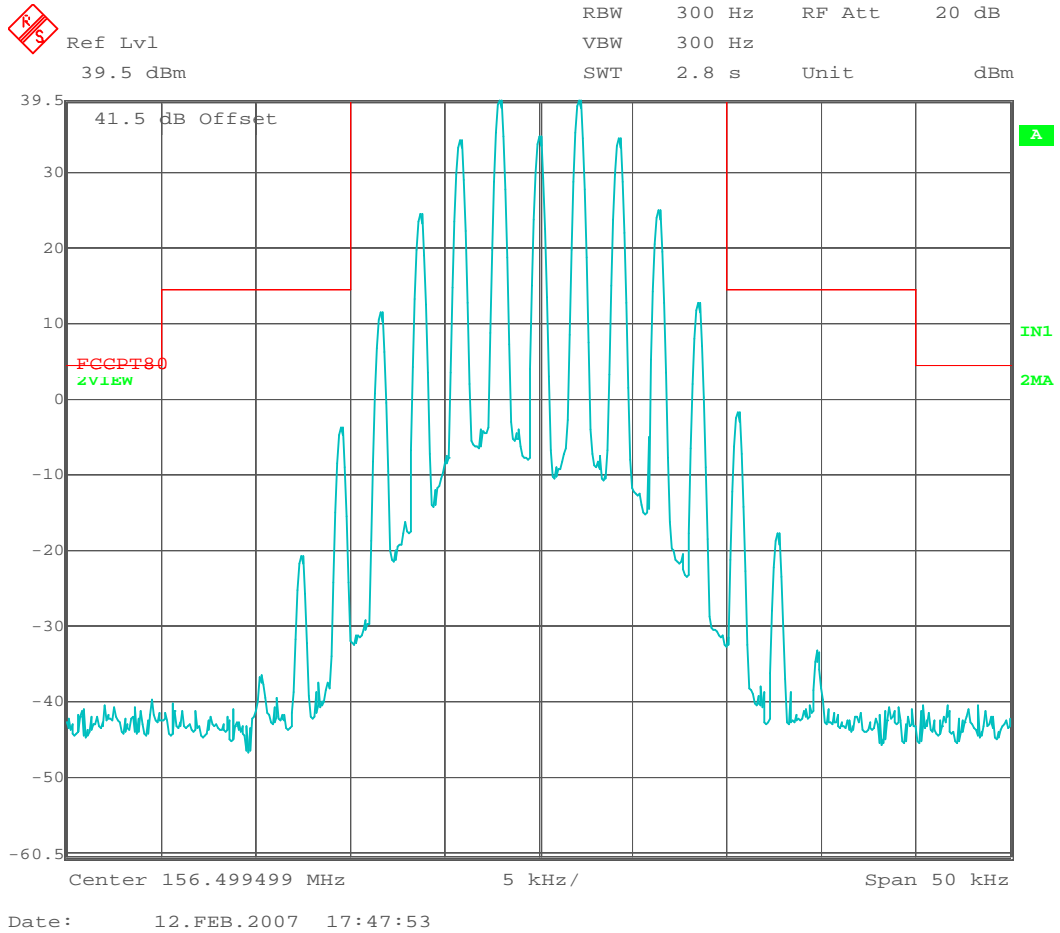
1300kHz Test Mode



Product Service

2.6 EMISSION LIMITATIONS (EMISSION MASK) DSC

2.6.6 Test Results

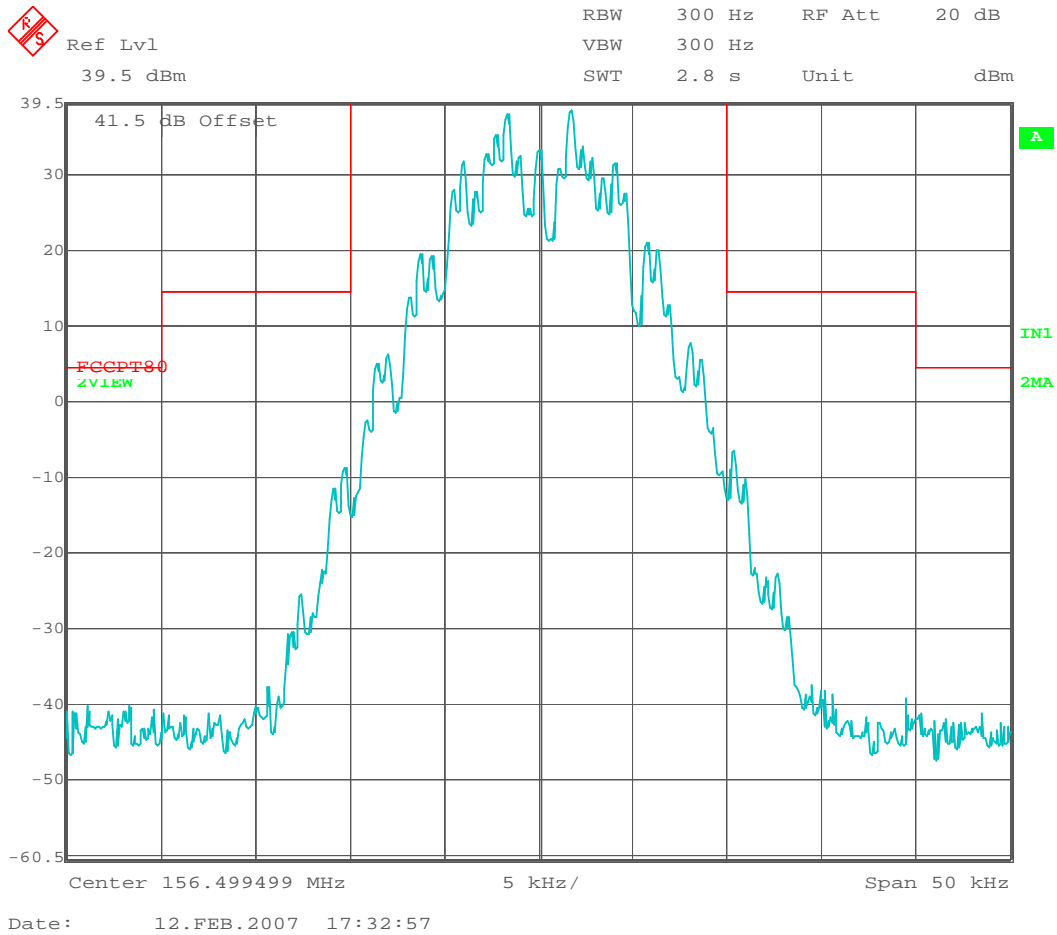


2100kHz Test Mode



2.6 EMISSION LIMITATIONS (EMISSION MASK) DSC

2.6.6 Test Results



Dotting Pattern Mode



2.7 EMISSION LIMITATIONS (CONDUCTED TRANSMITTER SPURIOUS)

2.7.1 Specification Reference

FCC CFR 47: Part 80, Sections 2.10551 80.211(c)

2.7.2 Equipment Under Test

RAY218 Fixed Mount VHF (with Class D DSC)

2.7.3 Date of Test

12th February 2006: Modification State 1

2.7.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.7.5 Test Procedure

All Measurements were performed with the EUT modulated, in accordance with Part 2.1051. Where the EUT was initially connected to a Modulation Analyser and the EUT set to transmit, using an Audio Analyser, an audio frequency was swept between 300Hz to 5kHz to find the frequency which produced the highest deviation.

The amplitude at this frequency was then increased to give a deviation of 2.5kHz.

The amplitude and frequency levels were 6.06mV at 2.8kHz

Then at a frequency of 2.5kHz the amplitude recorded above was increased by 16dB to provide the Final Modulated level.

The EUT transmitting on full power, was then connected to a Spectrum Analyser via a 40dB Attenuator in the 9kHz - 600MHz frequency range and via a 30dB Attenuator with 600MHz High Pass Filter in the 600MHz - 1.6GHz frequency range.

The EUT was checked (for the bottom, middle and top channels of the EUT) against the specification limit for all emissions >250% removed from the assigned Frequency, between 9kHz - 1.6GHz.

The Path Loss for each frequency range was recorded and the worst case loss was entered as a Reference Level Offset.

Total Path loss (9kHz - 600MHz) = 41.5dB
Total Path loss (600MHz - 1.6GHz) = 32.6dB

2.7.6 Test Results

The EUT meets the requirements of Part 80.211(c)
The test result plots are presented on the following pages.

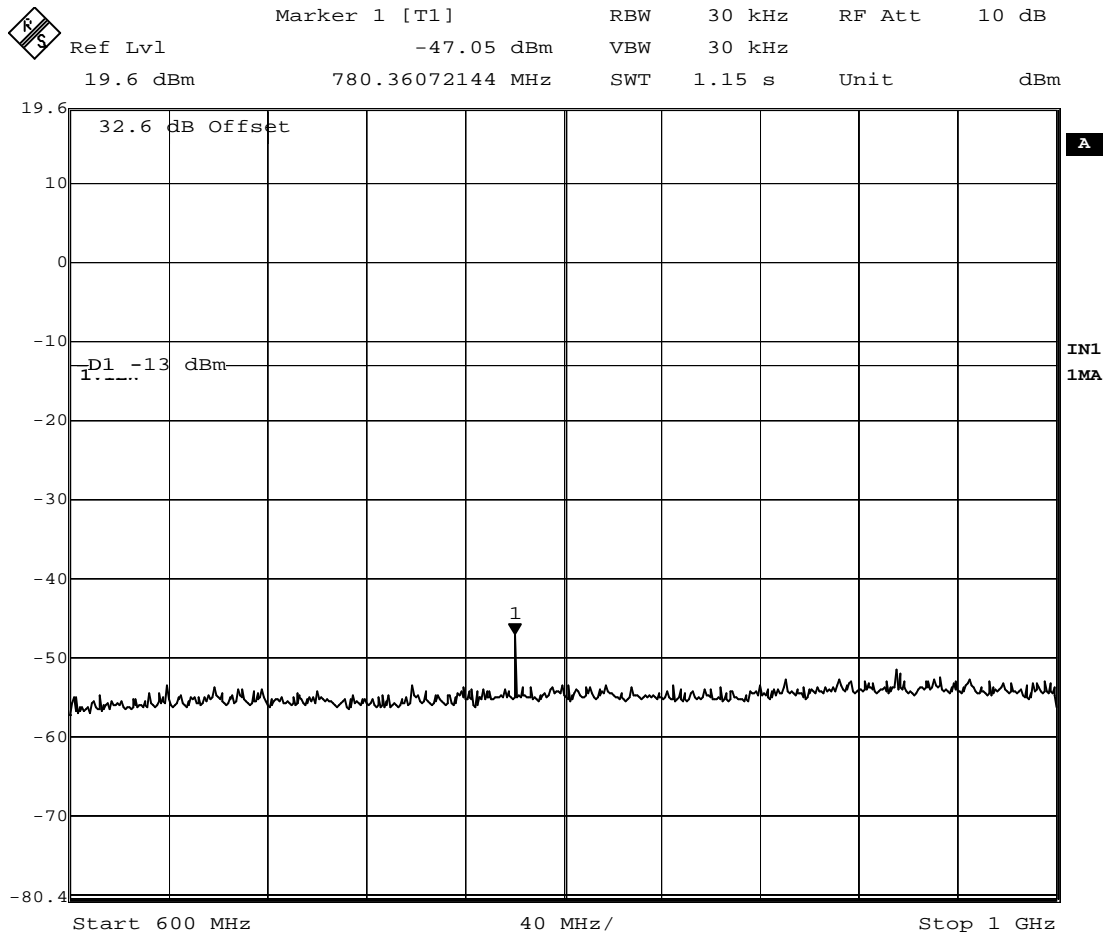


Product Service

2.7 EMISSION LIMITATIONS (CONDUCTED TRANSMITTER SPURIOUS)

2.7.6 Test Results

(Channel 60 - Bottom) 600MHz – 1.0GHz



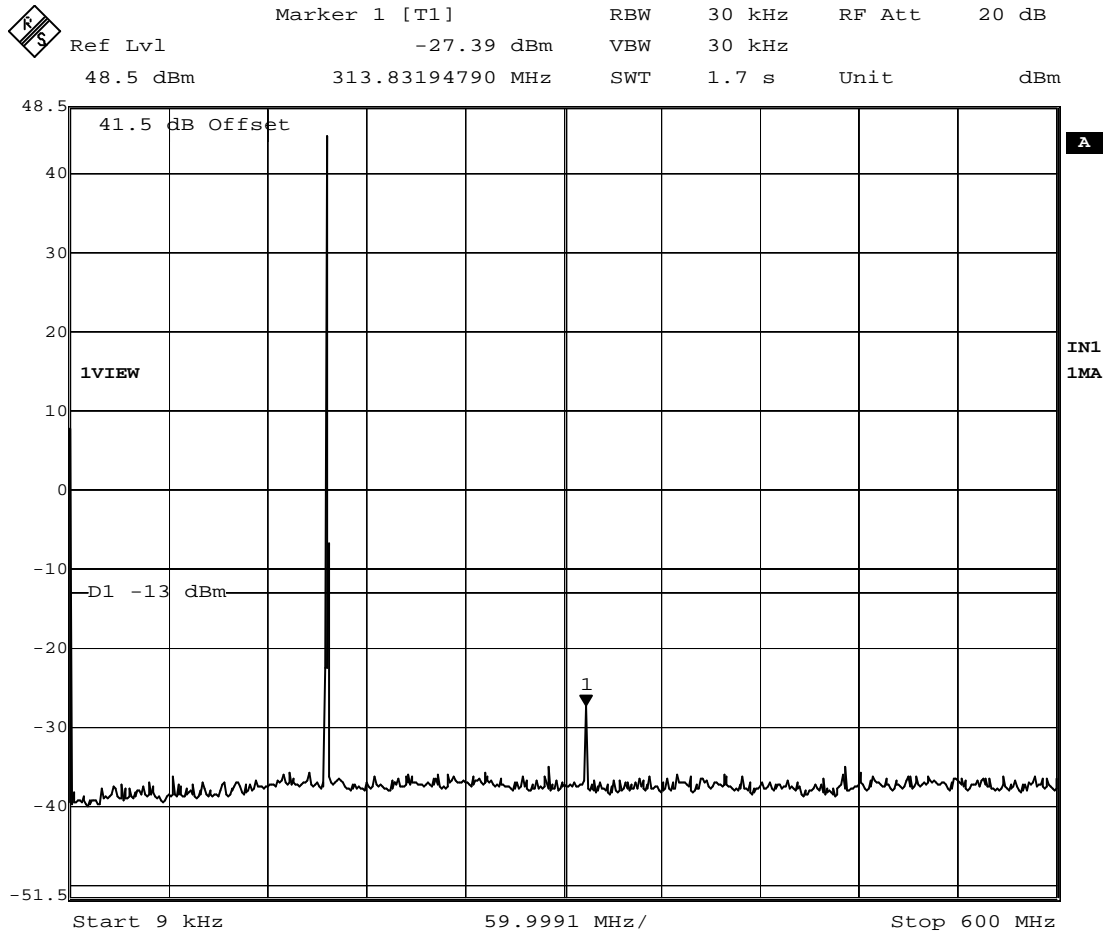
Date: 12.FEB.2007 11:55:11



2.7 EMISSION LIMITATIONS (CONDUCTED TRANSMITTER SPURIOUS)

2.7.6 Test Results

(Channel 16 - Middle) 9kHz – 600MHz



Date: 12.FEB.2007 11:45:22

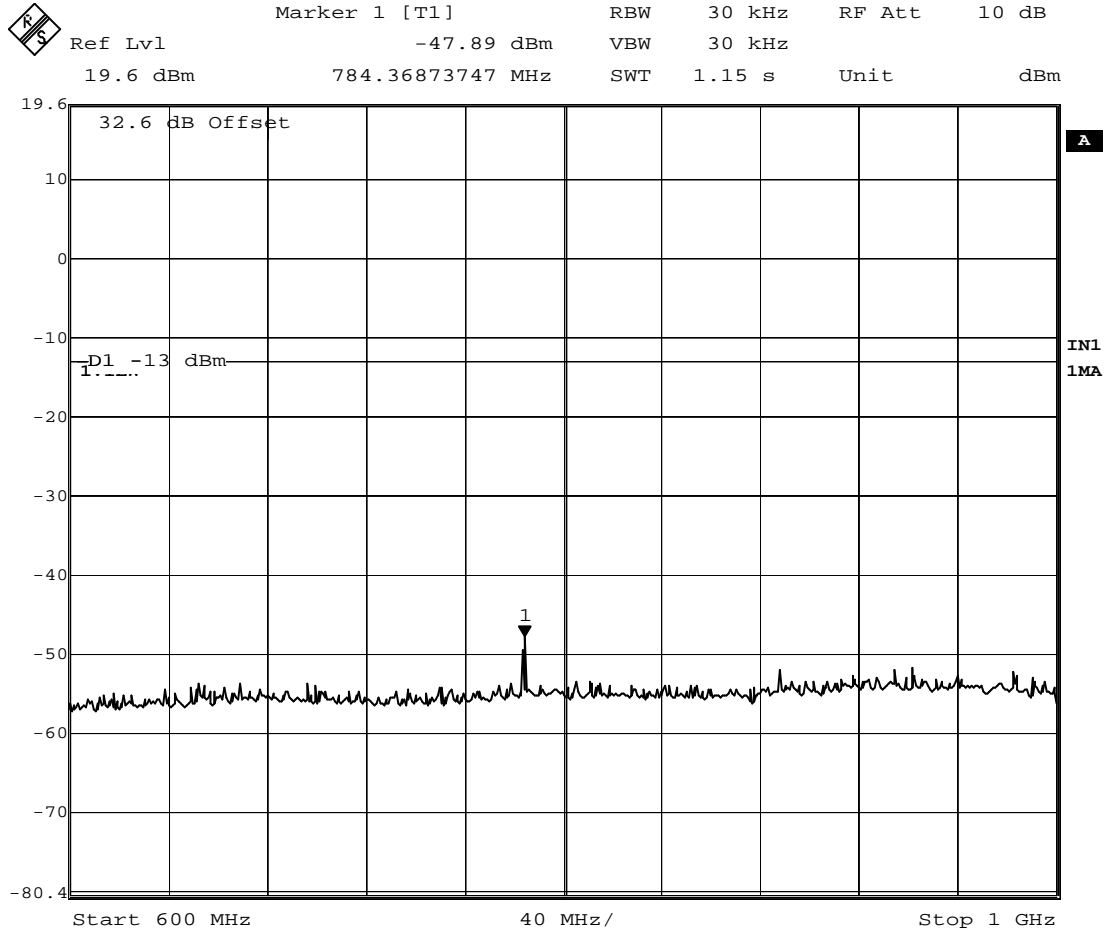


Product Service

2.7 EMISSION LIMITATIONS (CONDUCTED TRANSMITTER SPURIOUS)

2.7.6 Test Results

(Channel 16 - Middle) 600MHz – 1GHz



Date: 12.FEB.2007 11:52:31

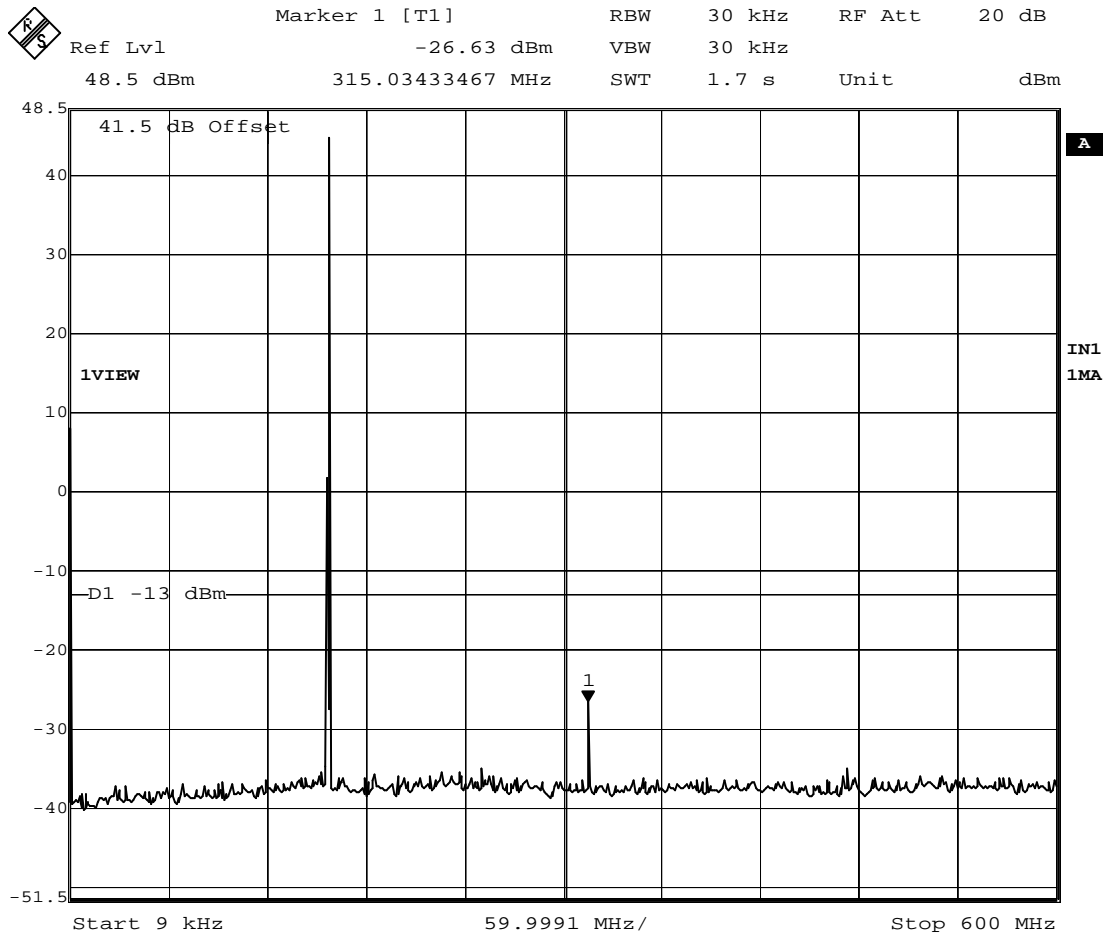


Product Service

2.7 EMISSION LIMITATIONS (CONDUCTED TRANSMITTER SPURIOUS)

2.7.6 Test Results

(Channel 88 - Bottom) 9kHz – 600MHz



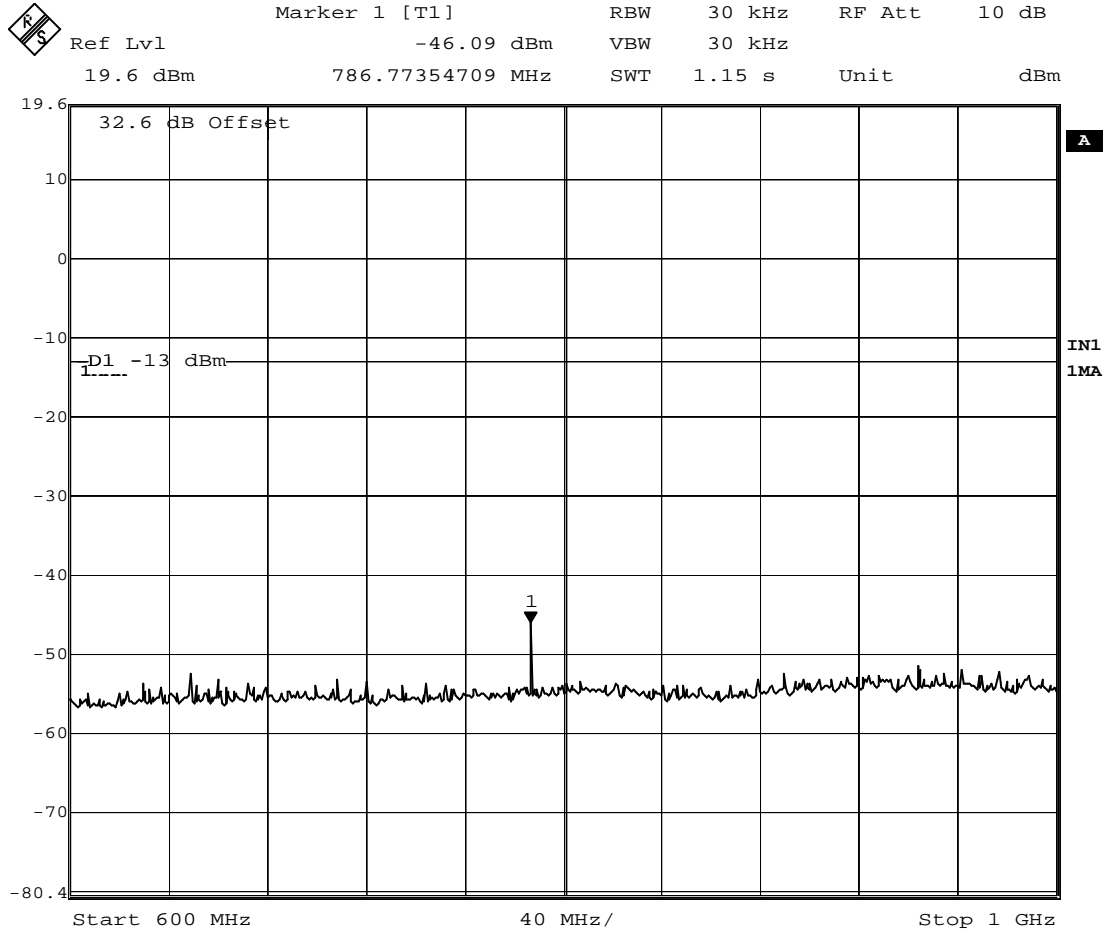
Date: 12.FEB.2007 11:46:43



2.7 EMISSION LIMITATIONS (CONDUCTED TRANSMITTER SPURIOUS)

2.7.6 Test Results

(Channel 88 - Bottom) 600MHz – 1GHz



Date: 12.FEB.2007 11:50:29

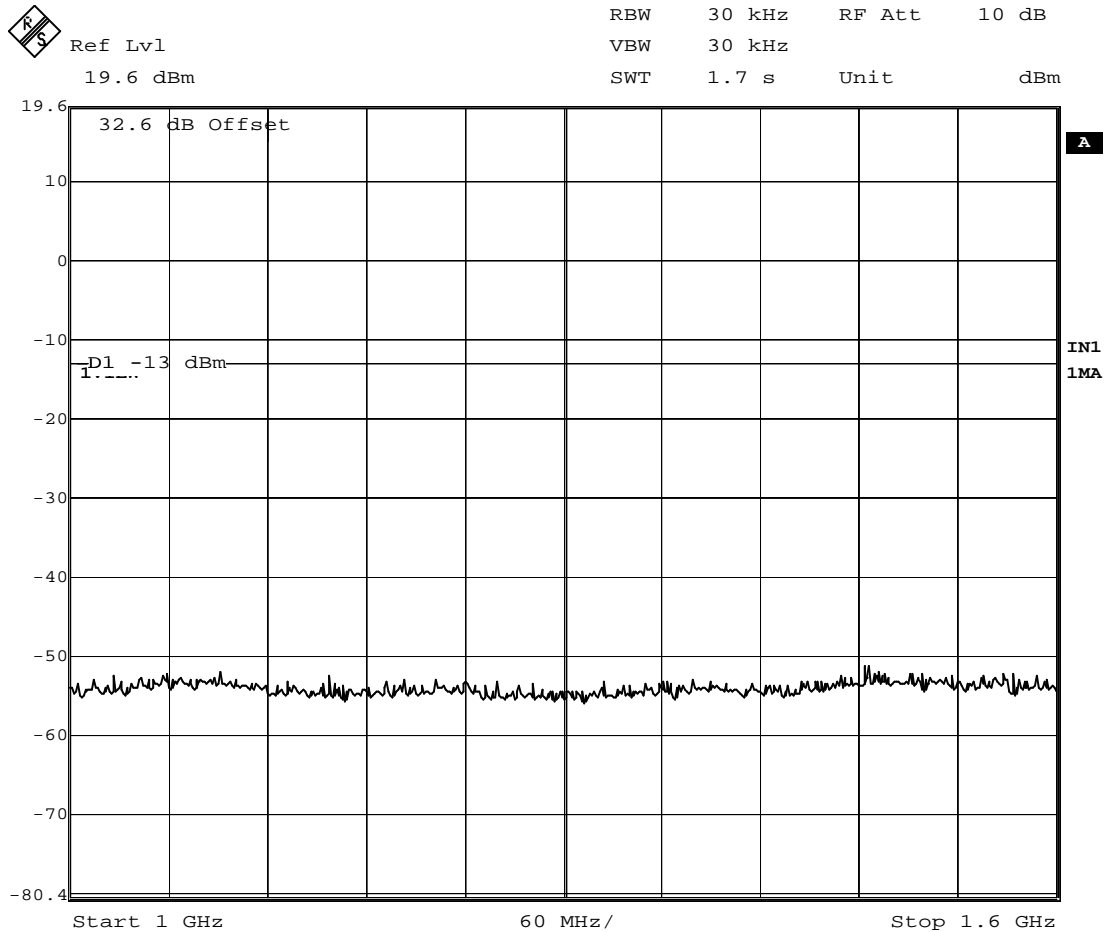


Product Service

2.7 EMISSION LIMITATIONS (CONDUCTED TRANSMITTER SPURIOUS)

2.7.6 Test Results

(Channel 88 - Bottom) 1GHz – 1.6GHz



Date: 12.FEB.2007 12:00:58



2.8 EMISSION LIMITATIONS (RADIATED TRANSMITTER SPURIOUS)

2.8.1 Specification Reference

FCC CFR 47: Part 80, Sections 2.1053 80.211(c)

2.8.2 Equipment Under Test

RAY218 Fixed Mount VHF (with Class D DSC)

2.8.3 Date of Test

21st March 2007: Modification State 1

2.8.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.8.5 Test Procedure

The EUT was set up in accordance with the manufacturers instruction in a semi-anechoic chamber conforming to the requirements of ANSI-C63.4.

The frequency spectrum was investigated between 30MHz and 1700MHz. Where emissions were present, they were measured at a distance of 3m. A height search between 1 and 4m was carried out and the EUT rotated through 360° to maximise the response.

The receivers detector was set to peak and max hold function utilised. Below 1GHz an RBW of 100kHz and UBW of 300kHz was used. Above 1GHz on RBW of 1MHz and UBW of 3MHz was used.

The EUT was tested on bottom, middle and top channels on maximum power with modulation applied in accordance with FCC Part 2.1049.

2.8.6 Test Results

No emissions attributable to the EUT were detected within 20dB below the limit. Therefore no table of results is presented.



2.9 MODULATION CHARACTERISTICS

2.9.1 Specification Reference

FCC CFR 47: Part 80, Sections 2.1047 and 80.213(d) and RSS-182, 6.4

2.9.2 Equipment Under Test

RAY218 Fixed Mount VHF (with Class D DSC)

2.9.3 Date of Test

15th December 2006

2.9.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.9.5 Test Procedure

In each of the test modes listed in the table below, the maximum frequency deviation was checked to ensure that the deviation remained within $\pm 5\text{kHz}$ as defined in 80.213(d)

80.213(d)

The frequency deviation remains within $\pm 5\text{kHz}$ as the amplitude is fixed for the B and Y states, it is not possible for the deviation to exceed $\pm 5\text{kHz}$. The table shows that the EUT meets the requirements of the specification.

In accordance with 2.1047(a), a curve has been produced displaying the frequency response of the audio modulating circuit over a range of 100Hz to 5kHz. The plot shows the data for all of the circuitry installed between the microphone input and the modulated stage.

The EUT was connected to a Modulation Analyser via a 30dB Attenuator. An Audio Analyser was connected to the microphone input at a set voltage level and the frequency varied between 100Hz and 5kHz. The demodulated audio was measured and plotted as a graph, which is shown below.

2.9.6 Test Results

Frequency Deviation (kHz)	Modulation State	Limit
2.966	1300Hz	$\leq 5\text{kHz}$
3.975	2100Hz	$\leq 5\text{kHz}$
3.945	Dotting Pattern	$\leq 5\text{kHz}$

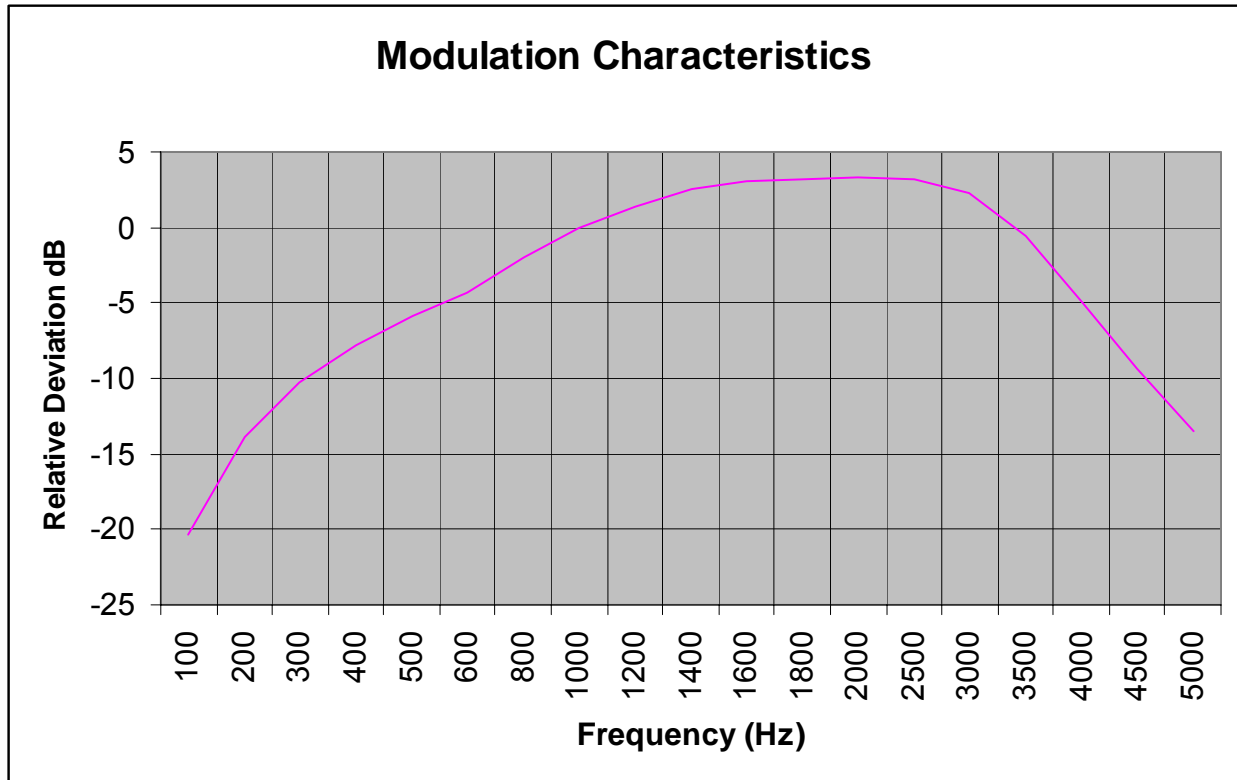
The EUT meets the requirements of Parts 2.1047, 80.213(d) and RSS-182, 6.4
The test result plot is presented on the following page.



Product Service

2.9 MODULATION CHARACTERISTICS

2.9.7 Test Results



A Graph To Show The Frequency Response Of The Audio Modulating Circuit



Product Service

2.10 TRANSMITTER POWER

2.10.1 Specification Reference

FCC CFR 47: Part 80, Sections 2.1046, 80.215(a)(2)(e)(1) and RSS-182, 4.3 & 6.2

2.10.2 Equipment Under Test

RAY218 Fixed Mount VHF (with Class D DSC)

2.10.3 Date of Test

15th December 2006

2.10.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.10.5 Test Procedure

The EUT was connected via a 30dB attenuator to a power meter and sensor. The path loss between the EUT and the power sensor was measured and recorded. The power meter reading and adjusted by the path loss value.

The emissions designator for the EUT is declared as G3E. In Clause 80.215(a)(2), the measurement of G3E designations is defined as being Carrier Power. In accordance with Clause 2.1, the Carrier Power was measured unmodulated.

The carrier power was measured on the top and bottom channels of the operating frequency band and at maximum and minimum power levels.



Product Service

2.10 TRANSMITTER POWER

2.10.6 Test Results

Maximum Power – 25W

Frequency (MHz)	Output Power, (Uncorrected) (dBm)	Path Loss (dB)	Result (dBm)	Result (W)
156.025 (CH60)	13.41	30.07	43.48	22.284
157.425 (CH88)	13.53	30.07	43.60	22.909

Minimum Power- 1W

Frequency (MHz)	Output Power, (Uncorrected) (dBm)	Path Loss (dB)	Result (dBm)	Result (mW)
156.025 (CH60)	-0.87	30.07	29.20	832
157.425 (CH88)	-0.84	30.07	29.23	838

Limits

Limit	$\leq 25W$ or $< +43.98dBm$
-------	-----------------------------

The EUT meets the requirements of Sections 2.1046, 80.215(a)(2)(e)(1) and RSS-182, 4.3 & 6.2



2.11 SUPPRESSION OF INTERFERENCE ABOARD SHIPS

2.11.1 Specification Reference

FCC CFR 47: Part 80, Section 80.217(b)

2.11.2 Equipment Under Test

RAY218 Fixed Mount VHF (with Class D DSC)

2.11.3 Date of Test

2nd February 2007

2.11.4 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.11.5 Test Procedure

The EUT was connected to a Spectrum Analyser via an RF cable. The emissions were measured from 9kHz to 2GHz.

The manufacturer declares a maximum antenna gain of 3dBi to be used with the EUT. Thus, in accordance with 80.217(b), the 3dBi gain has been accounted for in the limit line and the derivation of the limits are shown in the table below. The worst case cable loss across the Measurement Frequency range was entered a reference level offset.

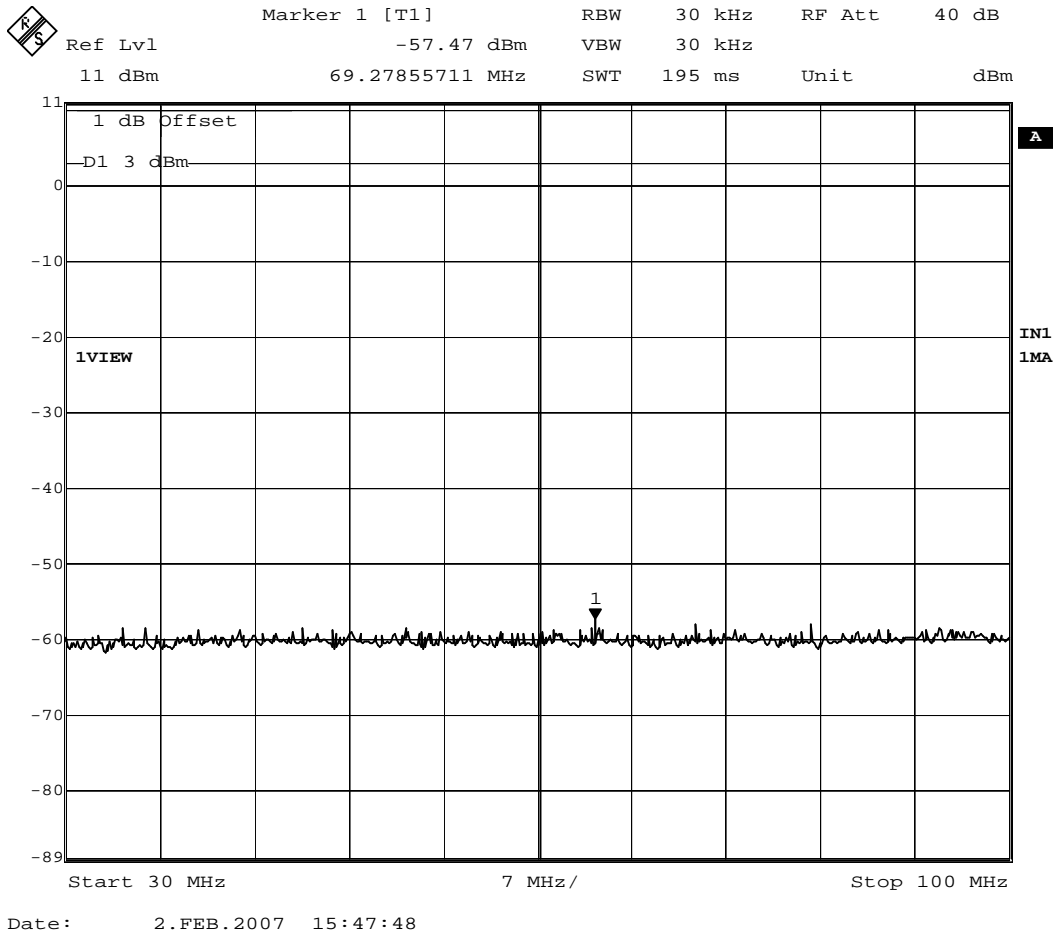
Frequency Of Interfering Emissions (MHz)	Power To Artificial Antenna (μ W)	Power To Artificial Antenna (dBm)	Power To Artificial Antenna including Maximum Declared Antenna Gain (dBm)
<30	400	-4	-7
30 – 100	4000	6	3
100 – 300	40000	16	13
300 - 2000	400000	26	23



Product Service

2.11 SUPPRESSION OF INTERFERENCE ABOARD SHIPS

2.11.6 Test Results



Channel 60 – Receive
 30MHz – 100MHz



Product Service

SECTION 3

TEST EQUIPMENT



3.1 TEST EQUIPMENT

List of absolute measuring and other principal items of test equipment.

Instrument	Manufacturer	Type No	TE Number	Calibration Due
Section 2.11 Radio (Rx) - Conducted Emissions				
Test Receiver	Rohde & Schwarz	ESIB40	1006	07/04/2007
Hygromer	Rotronic	A1	1945	07/06/2007
Power Supply Unit	Farnell	TSV-70	2043	TU
3m N(m) - N(m) RF Cable	Reynolds	269-008803000	2413	27/07/2007
Multimeter	Hewlett Packard	3478A	2742	22/07/2007
Sections 2.5, 2.6 and 2.7 Radio (Tx) - Conducted Spurious Emissions				
Audio Analyser	Hewlett Packard	8903B	44	10/07/2007
DC Power Supply Unit	Hewlett Packard	6267B	294	TU
Attenuator (10dB/ 00W)	Spinner	BN 745353	443	15/11/2007
Modulation Analyser	Hewlett Packard	8901B	773	23/01/2008
Hygromer	Rotronic	A1	1945	07/06/2007
EMI Test Receiver	Rohde & Schwarz	ESIB26	2028	13/06/2007
Multimeter	Iso-tech	Iso Tech	2419	04/08/2007
Sensor	Hewlett Packard	11722A	2787	09/08/2007
High Pass Filter	Mini-Circuits	NHP-600	2834	24/10/2007
20dB/75W Attenuator	Bird	8308-200	3076	18/02/2007
10dB/2W Attenuator	Lucas Weinschel	1	3225	15/08/2007
Sections 2.3 and 2.4 Radio (Tx) - Frequency Characteristics				
Modulation Analyser	Hewlett Packard	8901B	45	28/06/2007
RMS Voltmeter	Racal	4002A	194	21/07/2007
Sensor	Hewlett Packard	11722A	493	20/07/2007
Attenuator (30dB, 200W)	Bird	8322	562	07/12/2007
Power Supply Unit	Farnell	H60-25	1092	TU
Hygrometer	Rotronic	I-1000	2891	06/01/2008



3.1 TEST EQUIPMENT

Instrument	Manufacturer	Type No	TE Number	Calibration Due
Section 2.9 Radio (Tx) - Modulation Characteristics				
Modulation Analyser	Hewlett Packard	8901B	45	28/06/2007
Attenuator 10dB/10W)	Trilithic	HFP-50N	454	13/07/2007
Attenuator (10dB, 75W)	Bird	8308-100	469	24/10/2007
Attenuator (10dB)	Weinschel	47-10-34	481	21/12/2006
Sensor	Hewlett Packard	11722A	493	20/07/2007
Power Supply Unit	Farnell	H60-25	1092	TU
Audio Analyser	Hewlett Packard	8903B	2212	01/12/2007
Multimeter	Fluke	70 III	2277	15/11/2007
Hygrometer	Rotronic	I-1000	2891	06/01/2008
Sections 2.1 and 2.2 Radio (Tx) - Occupied Bandwidth				
Audio Analyser	Hewlett Packard	8903B	44	10/07/2007
Attenuator (10dB/ 00W)	Spinner	BN 745353	443	15/11/2007
Attenuator (30dB, 50W)	Bird	8321	494	07/12/2007
Modulation Analyser	Hewlett Packard	8901B	773	23/01/2008
HYGROMER	Rotronic	A1	1945	07/06/2007
EMI Test Receiver	Rohde & Schwarz	ESIB26	2028	13/06/2007
Multimeter	Iso-tech	Iso Tech	2419	04/08/2007
Sensor	Hewlett Packard	11722A	2787	09/08/2007
20dB/75W Attenuator	Bird	8308-200	3076	18/02/2007
10dB/2W Attenuator	Lucas Weinschel	1	3225	15/08/2007



3.1 TEST EQUIPMENT

Instrument	Manufacturer	Type No	TE Number	Calibration Due
Section 2.10 Radio (Tx) - Power Characteristics				
Modulation Analyser	Hewlett Packard	8901B	45	28/06/2007
Attenuator 10dB/10W)	Trilithic	HFP-50N	454	13/07/2007
Attenuator (10dB, 75W)	Bird	8308-100	469	24/10/2007
Attenuator (10dB)	Weinschel	47-10-34	481	21/12/2006
Sensor	Hewlett Packard	11722A	493	20/07/2007
Power Supply Unit	Farnell	H60-25	1092	TU
Signal Generator	Rohde & Schwarz	SML01	1593	17/11/2007
Multimeter	Fluke	70 III	2277	15/11/2007
Spectrum Analyser	Rohde & Schwarz	FSM	3229	20/06/2007
Section 2.8 Radio (Tx) - Radiated Spurious Emissions				
Audio Analyser	Hewlett Packard	8903B	576	13/05/2007
Antenna (Double Ridge Guide, 1GHz-18GHz)	EMCO	3115	234	29/06/2007
Load (50W)	Weinschel	M1426	361	02/08/2007
Mast Controller	Inn-Co GmbH	CO 1000	1606	TU
Turntable/Mast Controller	EMCO	2090	1607	TU
EMI Test Receiver	Rohde & Schwarz	ESIB26	2028	13/06/2007
Bilog Antenna	Chase	CBL6143	2904	10/11/2007

TU Traceability Unscheduled



Product Service

3.2 MEASUREMENT UNCERTAINTY

For a 95% confidence level, the measurement uncertainties for defined systems are:-

Test Discipline	Frequency / Parameter	MU
Radiated Emissions, Bilog Antenna, AOATS	30MHz to 1GHz Amplitude	5.1dB*
Radiated Emissions, Horn Antenna, AOATS	1GHz to 40GHz Amplitude	6.3dB*
Conducted Emissions, LISN	150kHz to 30MHz Amplitude	3.2dB*

Worst case error for both Time and Frequency measurement 12 parts in 10^6 .

* In accordance with CISPR 16-4



Product Service

SECTION 4

PHOTOGRAPHS



4.1 PHOTOGRAPHS OF EQUIPMENT UNDER TEST (EUT)



Front View of RAY218



Rear View of RAY218



Product Service

4.1 PHOTOGRAPHS OF EQUIPMENT UNDER TEST (EUT)



Label for RAY218



Product Service

SECTION 5

ACCREDITATION, DISCLAIMERS AND COPYRIGHT



Product Service

5.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT



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