
REPORT ON

Limited FCC CFR 47: Parts 15 and 80
of a Raymarine RAY49 Fixed Mount VHF (with Class D DSC)

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FCC ID: PJ5RAY49

Doc Number 75900802 Report 06 Issue 3

September 2007



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REPORT ON

Limited FCC CFR 47: Parts 15 and 80 Testing of a Raymarine RAY49
Fixed Mount VHF (with Class D DSC)

FCC ID: PJ5RAY49

Doc Number 75900802 Report 06 Issue 3

September 2007

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DATED

5th September 2007

This report is up-issued to issue 3 to correct typographical errors in the summary table.

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, 15 and 80. The sample tested was found to comply with the requirements defined in the applied rules.

Test Engineers;

R Blagg
M Hardy
P Harrison



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SECTION 1

REPORT SUMMARY

Limited FCC CFR 47: Parts 15 and 80
Testing of a Raymarine RAY49 Fixed Mount VHF (with Class D DSC)



Product Service

1.1 STATUS

Manufacturer	Raymarine
Type Designation	RAY49 Fixed Mount VHF
Serial No	Sample No. 2 Sample ATIS (Blue)
Number of Samples Tested	Two
Test Specification/Issue/Date	FCC CFR 47: Part 15: 2006 FCC CFR 47: Part 80: 2006
Date of Receipt of Test Sample	18 th April 2007 Sample No. 2 28 th June 2007 Sample ATIS (Blue)
Start of Test	2 nd July 2007
Finish of Test	11 th July 2007
Test Engineer(s)	R Blagg M Hardy P Harrison



Product Service

1.2 INTRODUCTION

The information contained within this report is intended to show limited verification of compliance of the Raymarine RAY49 Fixed Mount VHF (with Class D DSC) to the requirements of FCC Specification Parts 15 and 80.

Testing has been performed under the following site accreditations

FCC Accreditation
90987 Octagon House, Fareham Test Laboratory.



Product Service

1.3 BRIEF SUMMARY OF RESULTS

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

FCC CFR 47: Part 15, Subpart B

Section	Spec Clause	Test Description	Result	Comments
2.1	15.109	Spurious Radiated Emissions	Pass	

FCC CFR 47: Part 80, Subparts B and C

Section	Spec Clause	Test Description	Result	Comments
2.2	2.1049 / 80.205	Bandwidths	Pass	
2.3	2.1049 / 80.207	DSC Bandwidths	Pass	
2.4	2.1055 / 80.209	Transmitter Frequency Tolerances - Voltage	Pass	
2.5	2.1055 / 80.209	Transmitter Frequency Tolerances - Temperature	Pass	
2.6	2.1055 / 80.209	Frequency Stability DSC Emissions	Pass	
2.7	2.1051 / 80.211	Emissions Limitations (Emission Mask)	Pass	
2.8	2.1053 / 80.211(f)(1)(2)	Emissions Limitations (Emission Mask) DSC	Pass	
2.9	2.1051 / 80.211(c)	Emissions Limitations (Conducted Transmitter Spurious)	Pass	
2.10	2.1051 / 80.211(c)	Emissions Limitations DSC (Conducted Transmitter Spurious)	Pass	
2.11	2.1053 / 80.211(c)	Emissions Limitations (Radiated Transmitter Spurious)	Pass	
2.12	2.1047 / 2.1047(a) / 80.213	Modulation Requirements	Pass	
2.13	1.1046 / 80.215	Transmitter Power	Pass	
2.14	1.1046 / 80.215	Transmitter Power DSC	Pass	
2.15	80.217(b)	Suppression of Interference aboard ships	Pass	
	80.225	Requirements for selective calling equipment	Customer declaration	
	80.227	Special requirements for protection from RF Radiation	Covered under 75900802 Report 08	



Product Service

1.4 APPLICATION FORM

APPLICANT'S DETAILS	
CATEGORY OF APPLICANT (please tick relevant box opposite)	(a) [] MANUFACTURER
	(b) [] IMPORTER
If box (b), (c) or (d) is ticked complete details in box below with respect to the manufacturer	(c) [] DISTRIBUTOR
	(d) [X] AGENT
COMPANY NAME	Marine Electronics Marketing
ADDRESS :	Hollycroft Holybred Lane Little Baddow Chelmsford
NAME FOR CONTACT PURPOSES :	J. D. Walsh
TELEPHONE NO :01245 226000	FAX NO :
	TELEX NO :

MANUFACTURER'S DETAILS	
COMPANY NAME :	Raymarine Limited
ADDRESS :	Anchorage Park Robinson Way Portsmouth Hampshire PO3 5TD
NAME FOR CONTACT PURPOSES :	Al Sundoro
TELEPHONE NO : 001 954 267 8057	FAX NO :
	TELEX NO :



Product Service

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 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

DUPLEX OPERATION		
Is the equipment intended for		
Duplex operation	<input type="checkbox"/>	Yes
	<input checked="" type="checkbox"/>	No
Is the equipment fitted with separate transmitter and receiver antenna sockets		
	<input type="checkbox"/>	Yes
	<input checked="" type="checkbox"/>	No
Is the equipment fitted with a duplex filter as an integral part of the equipment with a single antenna connection socket		
	<input type="checkbox"/>	Yes
	<input checked="" type="checkbox"/>	No
Is the duplex filter externally fitted and connected to the main equipment by co-axial cable(s)		
	<input type="checkbox"/>	Yes
	<input checked="" type="checkbox"/>	No
Type and make of duplex filter		
.....		



Product Service

TRANSMITTER AND RECEIVER CHARACTERISTICS	
NUMBER OF CHANNELS:	
<input checked="" type="checkbox"/>	ITU channels
<input checked="" type="checkbox"/>	USA channels
<input checked="" type="checkbox"/>	PRIVATE channels
<input checked="" type="checkbox"/>	WEATHER channels (Rx Only)
<input type="checkbox"/>	MEMORY channels
DSC CHANNEL(S) (if provided)	
<input checked="" type="checkbox"/>	
<input type="checkbox"/>	Other :
CHANNEL SEPARATION : 25 kHz	
ITU designation of class of emission(s) : 16K0G3EJN, 16K0G2BJN	
ANTENNA IMPEDANCE : 50 Ohms	



Product Service

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 : 156.000–161.450MHz	
TRANSMITTER MODULATION	
Modulation method :PHASE	
Occupied bandwidth : 16KHz	
Maximum frequency deviations : 5KHz	
TRANSMITTER MODULATION INPUT CHARACTERISTICS	
Impedance : 2.2kohm	
<input type="checkbox"/>	balanced
<input checked="" type="checkbox"/>	unbalanced



Product Service

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



Product Service

TRANSMITTER AND 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
<input checked="" type="checkbox"/>	DC Voltage : 12V nominal			
	DC Maximum Current (A) : 6A			
<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:12. End point voltage as quoted by equipment manufacturer: V. (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

RECEIVER TECHNICAL CHARACTERISTICS	
RECEIVER FREQUENCY	
Method of frequency generation :	
<input type="checkbox"/>	CRYSTAL
<input checked="" type="checkbox"/>	SYNTHESISER
<input type="checkbox"/>	OTHER :
Intermediate frequencies :	
<input type="checkbox"/>	[21.6] MHz
<input type="checkbox"/>	[450] kHz
<input type="checkbox"/>	[N/A] 3rd
Receiver frequency channels : 156.000–163.275MHz	
Is local oscillator injection frequency higher or lower than the receiver nominal frequency?	
<input type="checkbox"/>	Higher
<input checked="" type="checkbox"/>	Lower



RECEIVER MODULATION OUTPUT CHARACTERISTICS	
RATED AUDIO OUTPUT POWER (as stated by the manufacturer)	
Loudspeaker :	2W for External
Earphone :	N/A 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 (= Ch16)
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 (= Ch16)
Number of additional channels selectable : 56	
Scan time programmable ? :	
	<input type="checkbox"/> Yes
	<input checked="" type="checkbox"/> No



Product Service

RECEIVER POWER SOURCE (1) transmitter and receiver use the same power source			
<input type="checkbox"/>	AC MAINS	State voltage: V	<input type="checkbox"/> Single phase
	AC MAINS FREQUENCY		<input type="checkbox"/> Three phase
<input checked="" type="checkbox"/>	DC Voltage : 12V nominal		
	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:12. End point voltage as quoted by equipment manufacturer			V.
(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

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.



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OTHER ITEMS SUPPLIED		
Spare batteries	<input type="checkbox"/>]	Yes
	<input checked="" type="checkbox"/>]	No
Battery charging device	<input type="checkbox"/>]	Yes
	<input checked="" type="checkbox"/>]	No
Special tools for dismantling equipment	<input type="checkbox"/>]	Yes
	<input checked="" type="checkbox"/>]	No
Test interface box (if applicable)	<input checked="" type="checkbox"/>]	Yes
	<input type="checkbox"/>]	No
Full documentation on equipment (Handbook and circuit diagrams)	<input type="checkbox"/>]	Yes
	<input type="checkbox"/>]	No
Others	<input type="checkbox"/>]	Yes
	<input type="checkbox"/>]	No
If Yes, please specify :		



Product Service

DECLARATION		
Are the equipments submitted representative production models ?	<input type="checkbox"/>	Yes
	<input type="checkbox"/>	No
If not are the equipments pre-production models ?	<input checked="" type="checkbox"/>	Yes
	<input type="checkbox"/>	No
If pre-production equipments are submitted will the final production equipments be identical in all respects with the equipment tested	<input checked="" type="checkbox"/>	Yes
	<input type="checkbox"/>	No
If no supply full details		
Is the Test Report to be used as part of a Type Approval Application ?	<input type="checkbox"/>	Yes
	<input checked="" type="checkbox"/>	No
If yes, has the product, any direct engineering predecessor, or variant ever been granted Type Approval in any EEC member country ?	<input type="checkbox"/>	Yes
	<input checked="" type="checkbox"/>	No
If yes supply full details :		
Will labelling of the equipment comply with the requirements of ETS 300 338 ?	<input type="checkbox"/>	Yes
	<input checked="" type="checkbox"/>	No
If no supply full details-equipment to IEC 62238		

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 :29 March 2007.

TÜV 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 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 EUT was powered by a 12V dc power supply.

1.6 DEVIATIONS FROM THE STANDARD

No deviations from the applicable test standards were made to the EUT during testing.

1.7 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 by the customer	N/A	N/A
1	Upgrade firmware to V0625 to enable ATIS function. Upgrade 'Dealer Programmed' software to set correct parameters for ATIS. The firmware upgrade necessitated opening the radio.	Richard Andrews of Raymarine	26 th June 2007



Product Service

SECTION 2

TEST RESULTS

Limited FCC CFR 47: Parts 15 and 80
Testing of a Raymarine RAY49 Fixed Mount VHF (with Class D DSC)



Product Service

2.1 SPURIOUS RADIATED EMISSIONS

2.1.1 Specification Reference

FCC CFR 47: Part 15 Subpart B, Section 15.109

2.1.2 Equipment Under Test

RAY49 Fixed Mount VHF (with Class D DSC)

Sample: No. 2

2.1.3 Date of Test

17th May 2007 – Modification State 0

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

Test Performed in accordance with ANSI C63.4.

A preliminary profile of the Spurious Radiated Emissions was obtained by operating the EUT on a remotely controlled turntable within a semi-anechoic chamber. Measurements of emissions from the EUT were obtained with the Measurement Antenna in both Horizontal and Vertical Polarisations. The profiling produced a list of the worst-case emissions together with the EUT azimuth and antenna polarisation.

Using the information from the preliminary profiling of the EUT. The list of emissions was then confirmed or updated under Alternative Open Site conditions. Emission levels were maximised by adjusting the antenna height, antenna polarisation and turntable azimuth.

Emissions identified within the range 30MHz – 1GHz were then formally measured using a CISPR Quasi-Peak detector.

Emissions identified within the range 1GHz – 2GHz were then formally measured using Peak and Average Detectors, as appropriate.

The measurements were performed at a 3m distance unless otherwise stated.



Product Service

2.1 SPURIOUS RADIATED EMISSIONS

2.1.6 Test Results

Equipment Designation: Unintentional Radiator.

The EUT met the requirements of FCC CFR 47: Part 15 Subpart B, Section 15.109 for Spurious Radiated Emissions (30MHz – 1GHz).

EUT Receiving on Middle Channel 16(156.8MHz)

Frequency MHz	Polarisation	Height cm	Azimuth degree	Field Strength		Limit	
				dBµV/m	µV/m	dBµV/m	µV/m
135.2	Vertical	100	058	21.0	11.2	43.5	150.0
225.0	Vertical	100	052	16.2	6.5	46.0	200.0

No other emissions were detected within 20dB of the specification limit.

The EUT met the requirements of FCC CFR 47: Part 15 Subpart B, Section 15.109 for Spurious Radiated Emissions (1GHz – 2GHz).

No emissions were detected within 20dB of the specification limit therefore no table of results is presented



Product Service

2.2 OCCUPIED BANDWIDTH

2.2.1 Specification Reference

FCC CFR 47: Part 80.205, Part 2.1049(c)

2.2.2 Equipment Under Test

RAY49 Fixed Mount VHF (with Class D DSC)

Sample ATIS (Blue)

2.2.3 Date of Test

11th July 2007– Modification State 0

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

The EUT is declared as having a class of emission designator of : 16K0G3E which equates to an Authorised Bandwidth of: 16kHz.

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 2.7kHz. 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.

2.2.6 Test Results

Channel Number/Frequency	Power Level (W)	Result (kHz)	Authorised Bandwidth (kHz)
60 / 156.025MHz	25	14.96	16
16 / 156.800MHz	25	14.97	16
88 / 157.425MHz	25	14.98	16

The test result plots are presented on the following pages.



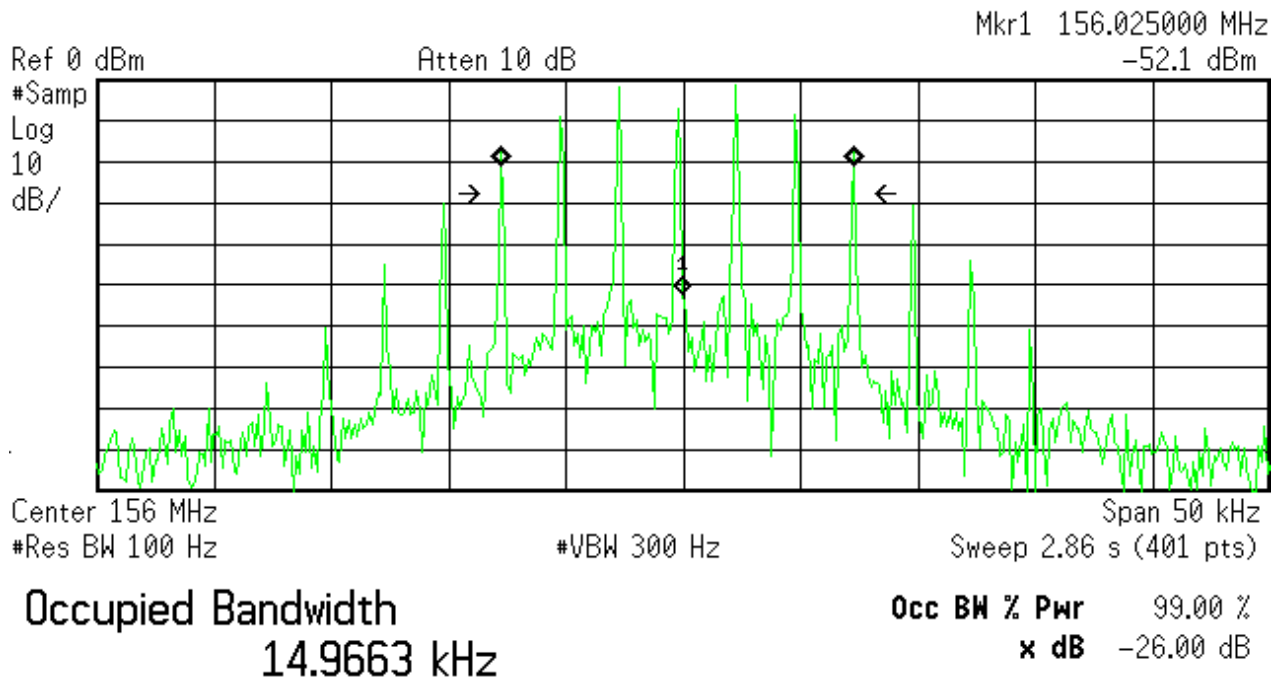
Product Service

2.2 OCCUPIED BANDWIDTH

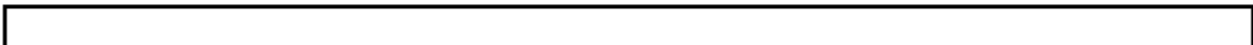
2.2.6 Test Results

Occupied Bandwidth As Defined By The -26dBc Points

* Agilent 10:36:16 Jul 11, 2007



Transmit Freq Error -247.538 Hz
x dB Bandwidth 15.226 kHz*



Maximum Power – Channel 60 Bottom



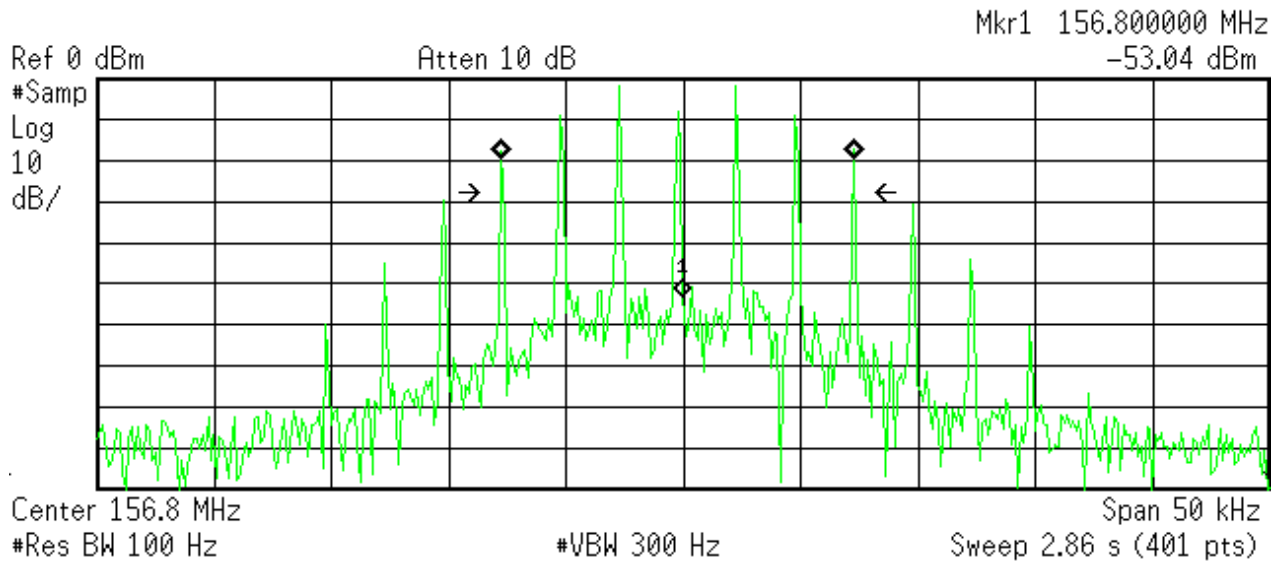
Product Service

2.2 OCCUPIED BANDWIDTH

2.2.6 Test Results

Occupied Bandwidth As Defined By The -26dBc Points

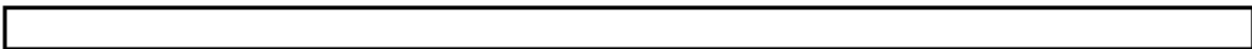
Agilent 10:32:05 Jul 11, 2007



Occupied Bandwidth
14.9776 kHz

Occ BW % Pwr 99.00 %
x dB -26.00 dB

Transmit Freq Error -248.106 Hz
x dB Bandwidth 15.227 kHz*



Maximum Power – Channel 16 Middle



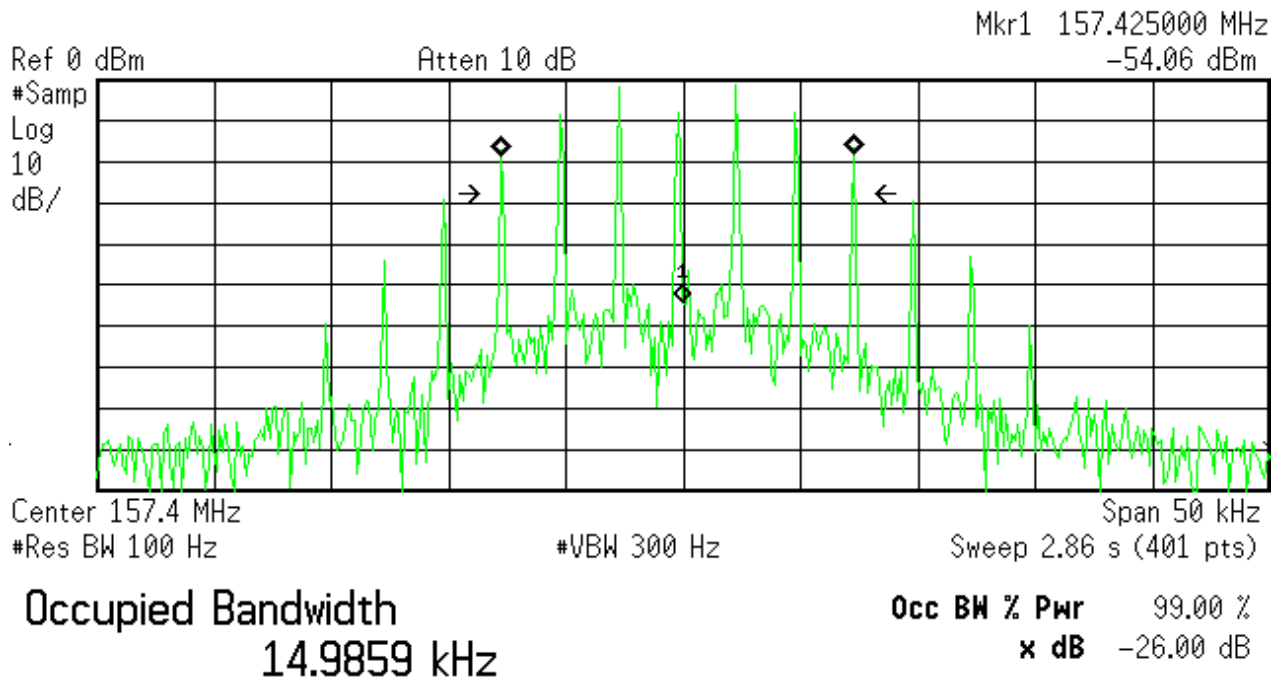
Product Service

2.2 OCCUPIED BANDWIDTH

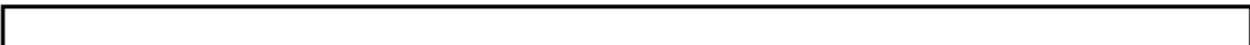
2.2.6 Test Results

Occupied Bandwidth As Defined By The -26dBc Points

Agilent 10:35:13 Jul 11, 2007



Transmit Freq Error -247.980 Hz
x dB Bandwidth 15.229 kHz*



Maximum Power – Channel 88 Top



Product Service

2.3 OCCUPIED BANDWIDTH DSC

2.3.1 Specification Reference

FCC CFR 47: Part 80.205, Part 2.1049(c)

2.3.2 Equipment Under Test

RAY49 Fixed Mount VHF (with Class D DSC)

Sample ATIS (Blue)

2.3.3 Date of Test

11th July 2007– Modification State 0

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

DSC devices are classed as 16K0G2B emissions designator. This 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 was set to 156 which is a default value set by the EUT. 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.

2.3.6 Test Results

Test Mode	Occupied Bandwidth (kHz)	Authorised Bandwidth (kHz)
1300Hz	7.81	20
2100Hz	12.60	20
Dotting Pattern	11.32	20

The test result plots are presented on the following pages.



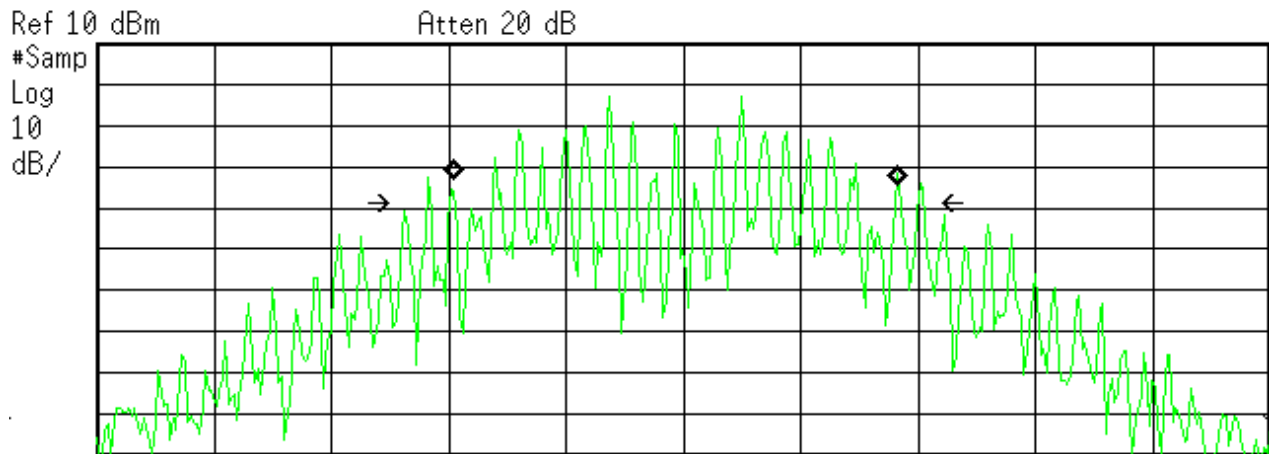
Product Service

2.3 OCCUPIED BANDWIDTH DSC

2.3.6 Test Results

Occupied Bandwidth As Defined By The -26dBc Points

* Agilent 11:44:37 Jul 11, 2007

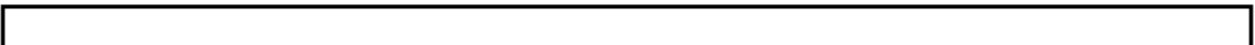


Ref 10 dBm Atten 20 dB
#Samp
Log
10
dB/
Center 156.5 MHz Span 30 kHz
#Res BW 100 Hz #VBW 300 Hz Sweep 1.705 s (401 pts)

Occupied Bandwidth
11.3244 kHz

Occ BW % Pwr 99.00 %
x dB -26.00 dB

Transmit Freq Error -208.079 Hz
x dB Bandwidth 13.247 kHz*



Dotting Pattern Test Mode



Product Service

2.4 FREQUENCY STABILITY UNDER VOLTAGE VARIATIONS

2.4.1 Specification Reference

FCC CFR 47: Part 80.209, Part 2.1055

2.4.2 Equipment Under Test

RAY49 Fixed Mount VHF (with Class D DSC)

Sample: No. 2

2.4.3 Date of Test

3rd July 2007– Modification State 1

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 at maximum power. Using a frequency counter, the frequency error was measured on channels 60 and 88 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

2.4 FREQUENCY STABILITY UNDER VOLTAGE VARIATIONS

2.4.6 Results

Ambient conditions: 20.0°C 53.6% RH

Channel 60 – 156.025MHz

DC Voltage (V)	Test Frequency (MHz)	Error (kHz)	Limit (kHz)
11.56	156.025	-0.185	± 1.56025
13.60	156.025	-0.214	± 1.56025
15.64	156.025	-0.266	± 1.56025

Channel 88 – 157.425MHz

DC Voltage (V)	Test Frequency (MHz)	Error (kHz)	Limit (kHz)
11.56	157.425	-0.192	± 1.57425
13.60	157.425	-0.231	± 1.57425
15.64	157.425	-0.288	± 1.57425

LIMITS:

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

Remarks

EUT complies with CFR 47 Part 2.1055, 80.209



Product Service

2.5 FREQUENCY STABILITY UNDER TEMPERATURE VARIATIONS

2.5.1 Specification Reference

FCC CFR 47: Part 80.209, Part 2.1055

2.5.2 Equipment Under Test

RAY49 Fixed Mount VHF (with Class D DSC)

Sample: No. 2

2.5.3 Date of Test

3rd July 2007– Modification State 1

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 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 and the temperature was adjusted between -20°C and +50°C in 10° steps as per 2.1055. Measurements were repeated on channels 60 and 88.



Product Service

2.5 FREQUENCY STABILITY UNDER TEMPERATURE VARIATIONS

2.5.6 Test Results

Channel 60

Temperature Interval °C	Voltage (V)	Test Frequency MHz	Deviation Hz	Ch60 error (ppm)	Limit (ppm)
-20	11.56	156.025135	135	0.865	+/- 10
	13.6	156.025103	103	0.660	+/- 10
	15.64	156.025113	113	0.724	+/- 10
-10	11.56	156.025184	184	1.179	+/- 10
	13.6	156.025179	179	1.147	+/- 10
	15.64	156.025166	166	1.064	+/- 10
0	11.56	156.025211	211	1.352	+/- 10
	13.6	156.025197	197	1.263	+/- 10
	15.64	156.025171	171	1.096	+/- 10
+10	11.56	156.025055	55	0.353	+/- 10
	13.6	156.025041	41	0.263	+/- 10
	15.64	156.025019	19	0.122	+/- 10
+20	11.56	156.024815	-185	-1.186	+/- 10
	13.6	156.024786	-214	-1.372	+/- 10
	15.64	156.024734	-266	-1.705	+/- 10
+30	11.56	156.024595	-405	-2.596	+/- 10
	13.6	156.024578	-422	-2.705	+/- 10
	15.64	156.024546	-454	-2.910	+/- 10
+40	11.56	156.024466	-534	-3.423	+/- 10
	13.6	156.024448	-552	-3.538	+/- 10
	15.64	156.024429	-571	-3.660	+/- 10
+50	11.56	156.024481	-519	-3.326	+/- 10
	13.6	156.024482	-518	-3.320	+/- 10
	15.64	156.024489	-511	-3.275	+/- 10



Product Service

2.5 FREQUENCY STABILITY UNDER TEMPERATURE VARIATIONS

2.5.6 Test Results

Channel 16

Temperature Interval °C	Voltage (V)	Test Frequency MHz	Deviation Hz	Ch16 error (ppm)	Limit (ppm)
-20	11.56	156.800115	115	0.733	+/- 10
	13.6	156.800105	105	0.670	+/- 10
	15.64	156.800108	108	0.689	+/- 10
-10	11.56	156.800181	181	1.154	+/- 10
	13.6	156.800176	176	1.122	+/- 10
	15.64	156.800173	173	1.103	+/- 10
0	11.56	156.800206	206	1.314	+/- 10
	13.6	156.800204	204	1.301	+/- 10
	15.64	156.800187	187	1.193	+/- 10
+10	11.56	156.800060	60	0.383	+/- 10
	13.6	156.800051	51	0.325	+/- 10
	15.64	156.800028	28	0.179	+/- 10
+20	11.56	156.799819	-181	-1.154	+/- 10
	13.6	156.799799	-201	-1.282	+/- 10
	15.64	156.799754	-246	-1.569	+/- 10
+30	11.56	156.799598	-402	-2.564	+/- 10
	13.6	156.799587	-413	-2.634	+/- 10
	15.64	156.799557	-443	-2.825	+/- 10
+40	11.56	156.799471	-529	-3.374	+/- 10
	13.6	156.799455	-545	-3.476	+/- 10
	15.64	156.799434	-566	-3.610	+/- 10
+50	11.56	156.799478	-522	-3.329	+/- 10
	13.6	156.799480	-520	-3.316	+/- 10
	15.64	156.799486	-514	-3.278	+/- 10

Remarks

EUT complies with CFR 47 Parts 2.1055, 80.209.



Product Service

2.5 FREQUENCY STABILITY UNDER TEMPERATURE VARIATIONS

2.5.6 Test Results

Channel 88

Temperature Interval °C	Voltage (V)	Test Frequency MHz	Deviation Hz	Ch88 error (ppm)	Limit (ppm)
-20	11.56	157.425154	154	0.978	+/- 10
	13.6	157.425106	106	0.673	+/- 10
	15.64	157.425106	106	0.673	+/- 10
-10	11.56	157.425189	189	1.201	+/- 10
	13.6	157.425187	187	1.188	+/- 10
	15.64	157.425171	171	1.086	+/- 10
0	11.56	157.425209	209	1.328	+/- 10
	13.6	157.425190	190	1.207	+/- 10
	15.64	157.425182	182	1.156	+/- 10
+10	11.56	157.425066	66	0.419	+/- 10
	13.6	157.425036	36	0.229	+/- 10
	15.64	157.425005	5	0.032	+/- 10
+20	11.56	157.424808	-192	-1.220	+/- 10
	13.6	157.424769	-231	-1.467	+/- 10
	15.64	157.424712	-288	-1.829	+/- 10
+30	11.56	157.424589	-411	-2.611	+/- 10
	13.6	157.424565	-435	-2.763	+/- 10
	15.64	157.424528	-472	-2.998	+/- 10
+40	11.56	157.424458	-542	-3.443	+/- 10
	13.6	157.424436	-564	-3.583	+/- 10
	15.64	157.424419	-581	-3.691	+/- 10
+50	11.56	157.424477	-523	-3.322	+/- 10
	13.6	157.424480	-520	-3.303	+/- 10
	15.64	157.424493	-507	-3.220	+/- 10

Remarks

EUT complies with CFR 47 Parts 2.1055, 80.209.



Product Service

2.6 FREQUENCY STABILITY DSC EMISSIONS

2.6.1 Specification Reference

FCC CFR 47: Part 80.209, Part 2.1055

2.6.2 Equipment Under Test

RAY49 Fixed Mount VHF (with Class D DSC)

Sample ATIS (Blue)

2.6.3 Date of Test

6th July 2007 – Modification State 0

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 configured in a test mode supplied by the manufacturer to enable testing of the DSC modulation frequencies. The EUT was set to transmit in a B and Y state, 2100Hz and 1300HZ respectively. Using a modulation analyser and a frequency counter, the modulation frequencies were measured and recorded in the table below:

2.6.6 Test Results

Channel Frequency – 156.525MHz, (Channel 70)

Test Conditions		Transmitter Frequency (Hz)	
		fB-state	fY-state
T _{nom} (26°C)	V _{nom} (12Vdc)	2099.533	1299.520
Measurement Uncertainty (Hz)		±0.15	

Limit	2100 Hz ± 10Hz 1300Hz ± 10Hz
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Product Service

2.7 EMISSION LIMITATIONS (EMISSION MASK)

2.7.1 Specification Reference

FCC CFR 47: Part 80, 80.211 Part 2, 2.10551

2.7.2 Equipment Under Test

RAY49 Fixed Mount VHF (with Class D DSC)

Sample ATIS (Blue)

2.7.3 Date of Test

6th July 2007 – Modification State 0

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

The EUT was connected to a Spectrum Analyser via attenuators. The path loss was measured for each channel frequency and 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 4.30mV 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 = 41.56dB

2.7.6 Test Results

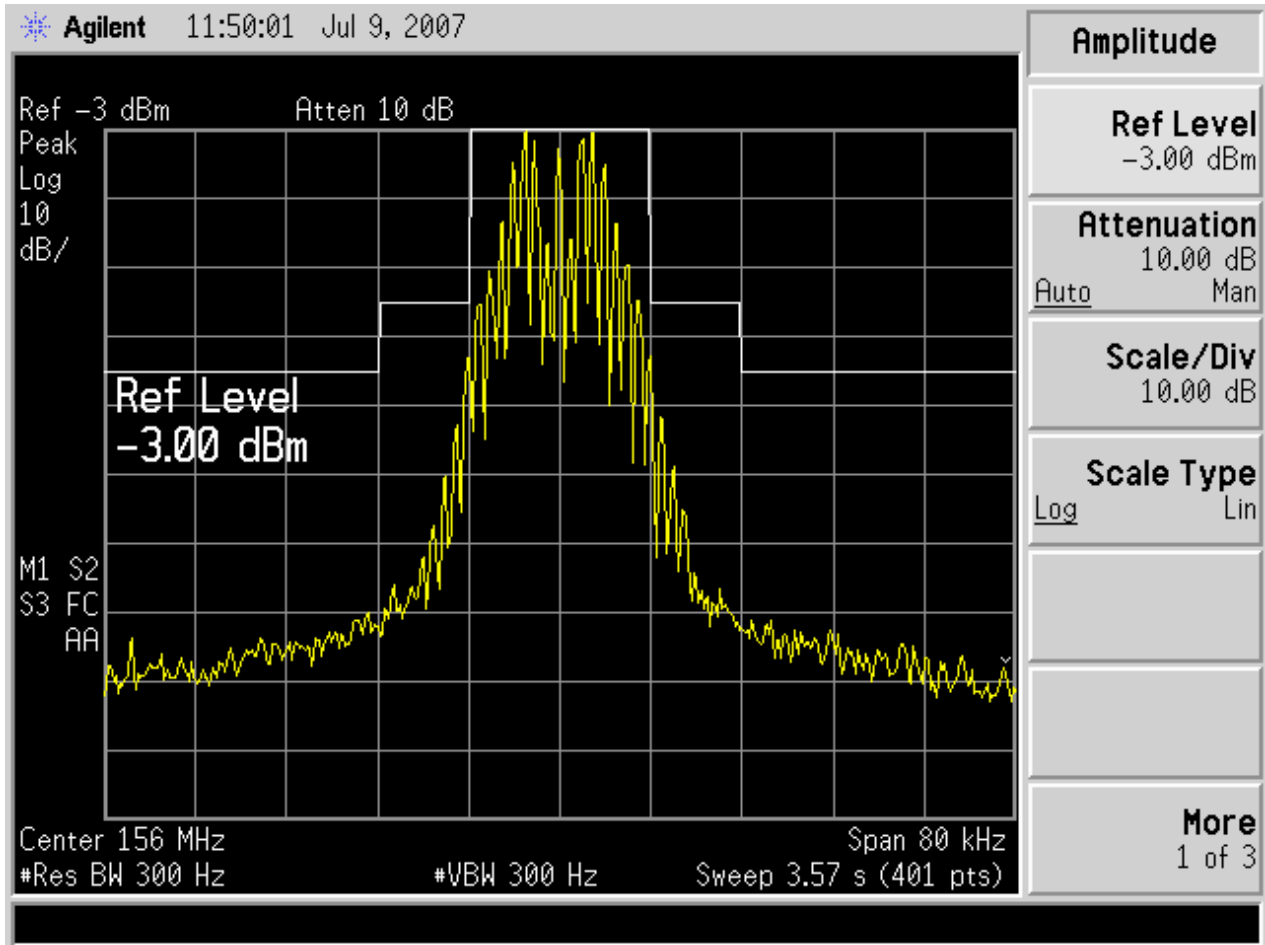
The EUT meets the requirements of Part 80.211(c)
The test result plots are presented on the following pages.



Product Service

2.7 EMISSION LIMITATIONS (EMISSION MASK)

2.7.6 Test Results



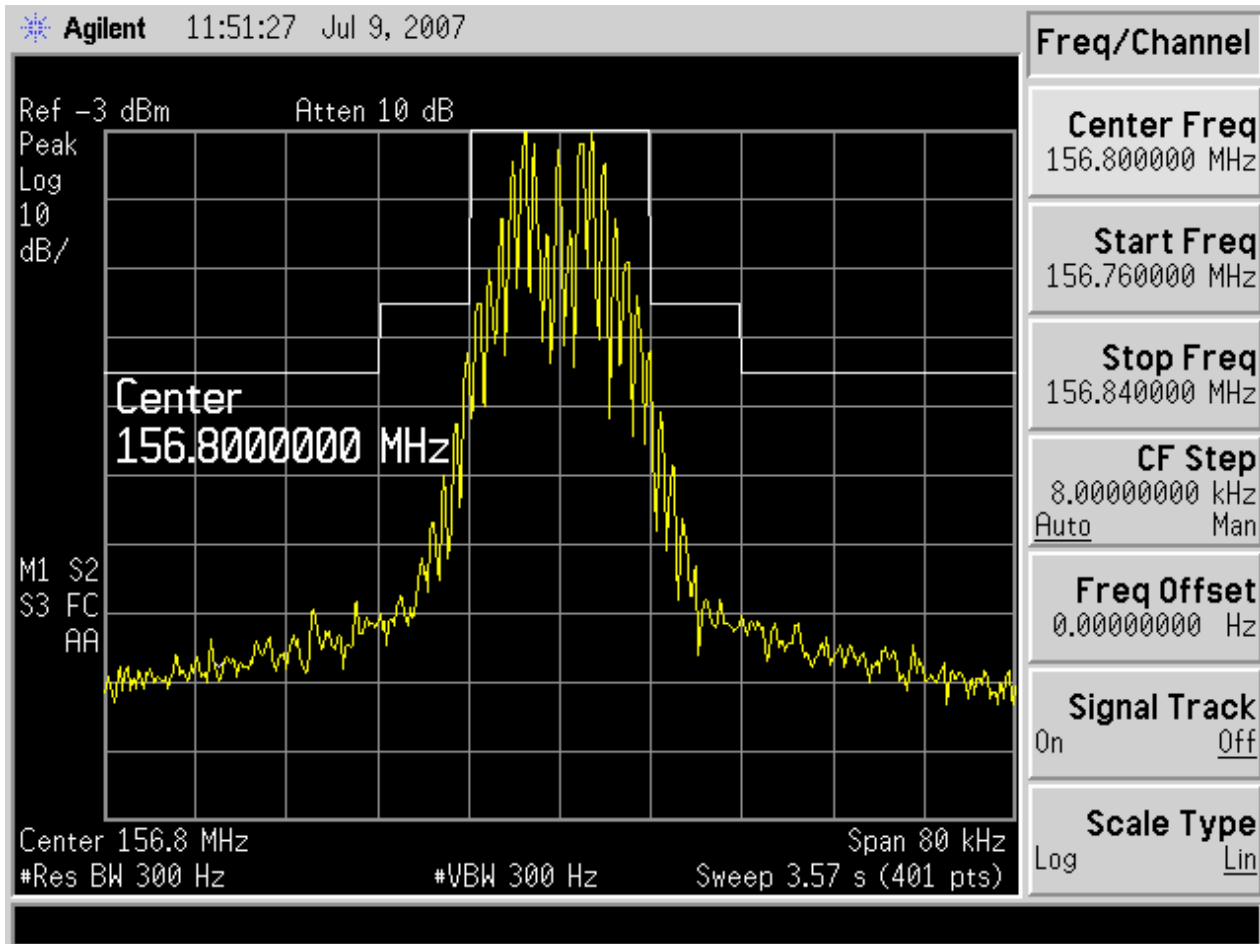
Emission Mask Channel 60 - Bottom



Product Service

2.7 EMISSION LIMITATIONS (EMISSION MASK)

2.7.6 Test Results



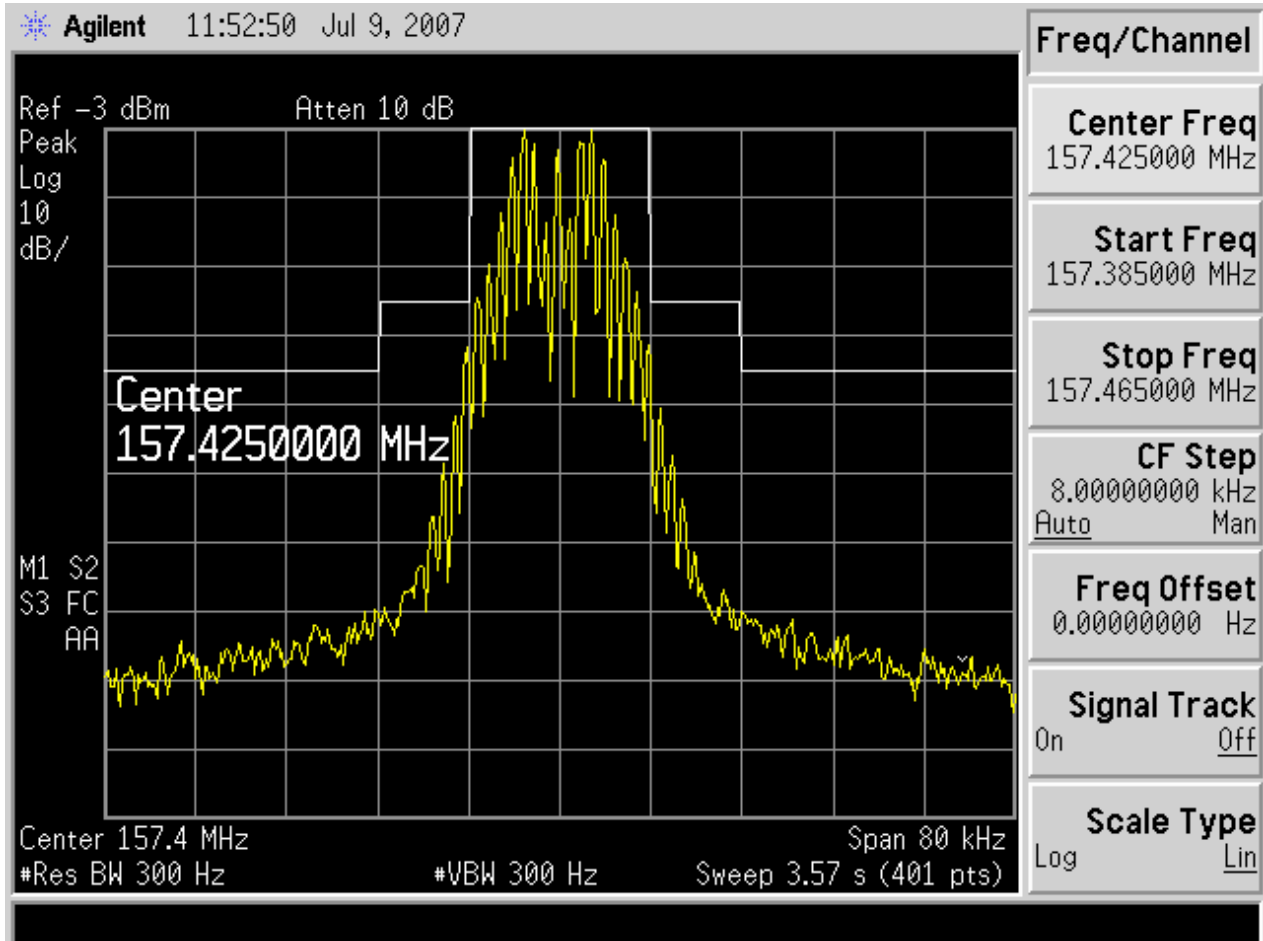
Emission Mask Channel 16 - Middle



Product Service

2.7 EMISSION LIMITATIONS (EMISSION MASK)

2.7.6 Test Results



Emission Mask Channel 88 - Top



Product Service

2.8 EMISSION LIMITATIONS DSC (EMISSION MASK)

2.8.1 Specification Reference

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

2.8.2 Equipment Under Test

RAY49 Fixed Mount VHF (with Class D DSC)

Sample ATIS (Blue)

2.8.3 Date of Test

9th July 2007 – Modification State 0

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 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.

2.8.6 Test Results

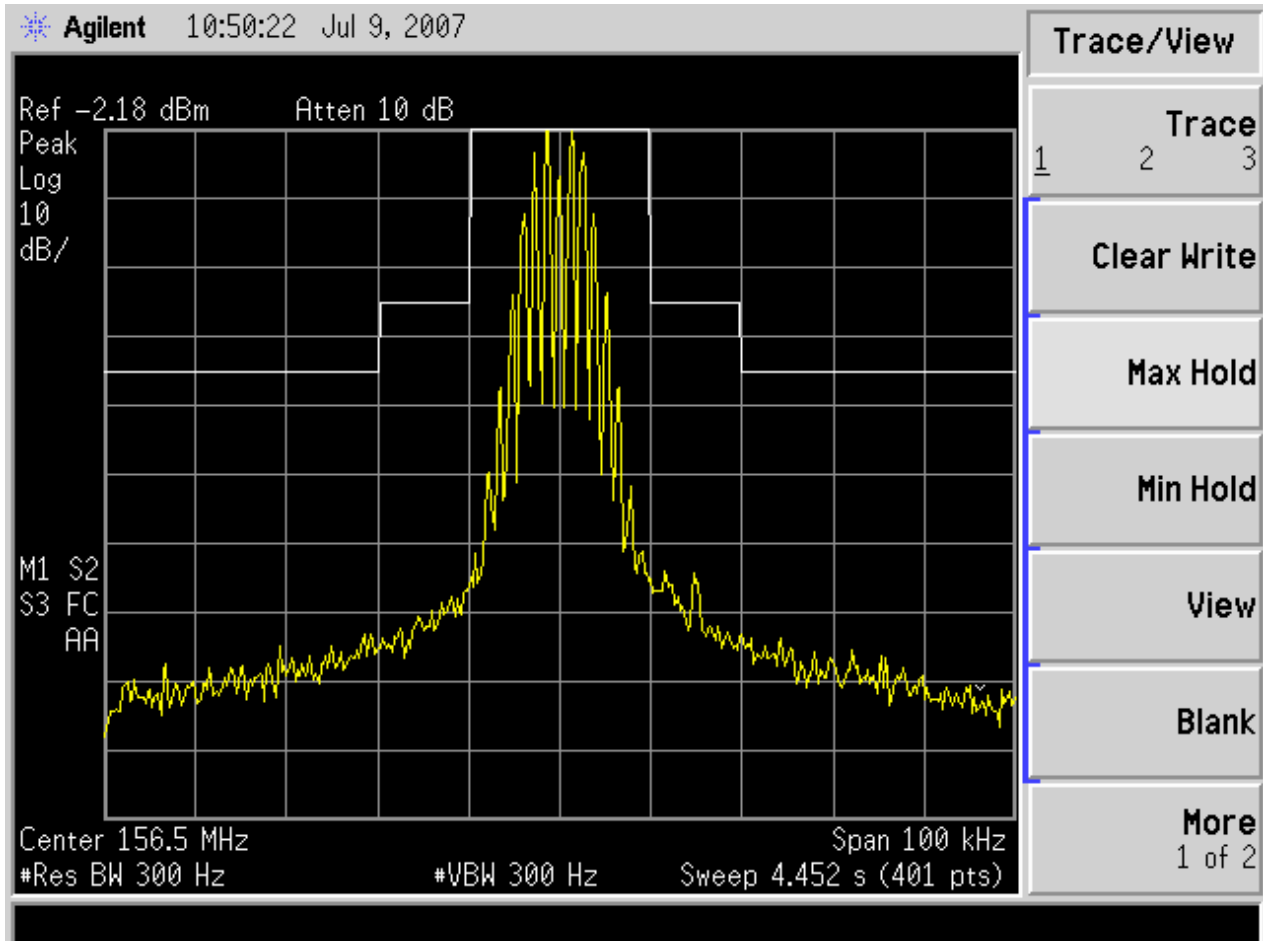
The EUT meets the requirements of Sections 2.1053, 80.211(f)(1)(2)
The test result plots are presented on the following pages.



Product Service

2.8 EMISSION LIMITATIONS (EMISSION MASK) DSC

2.8.6 Test Results



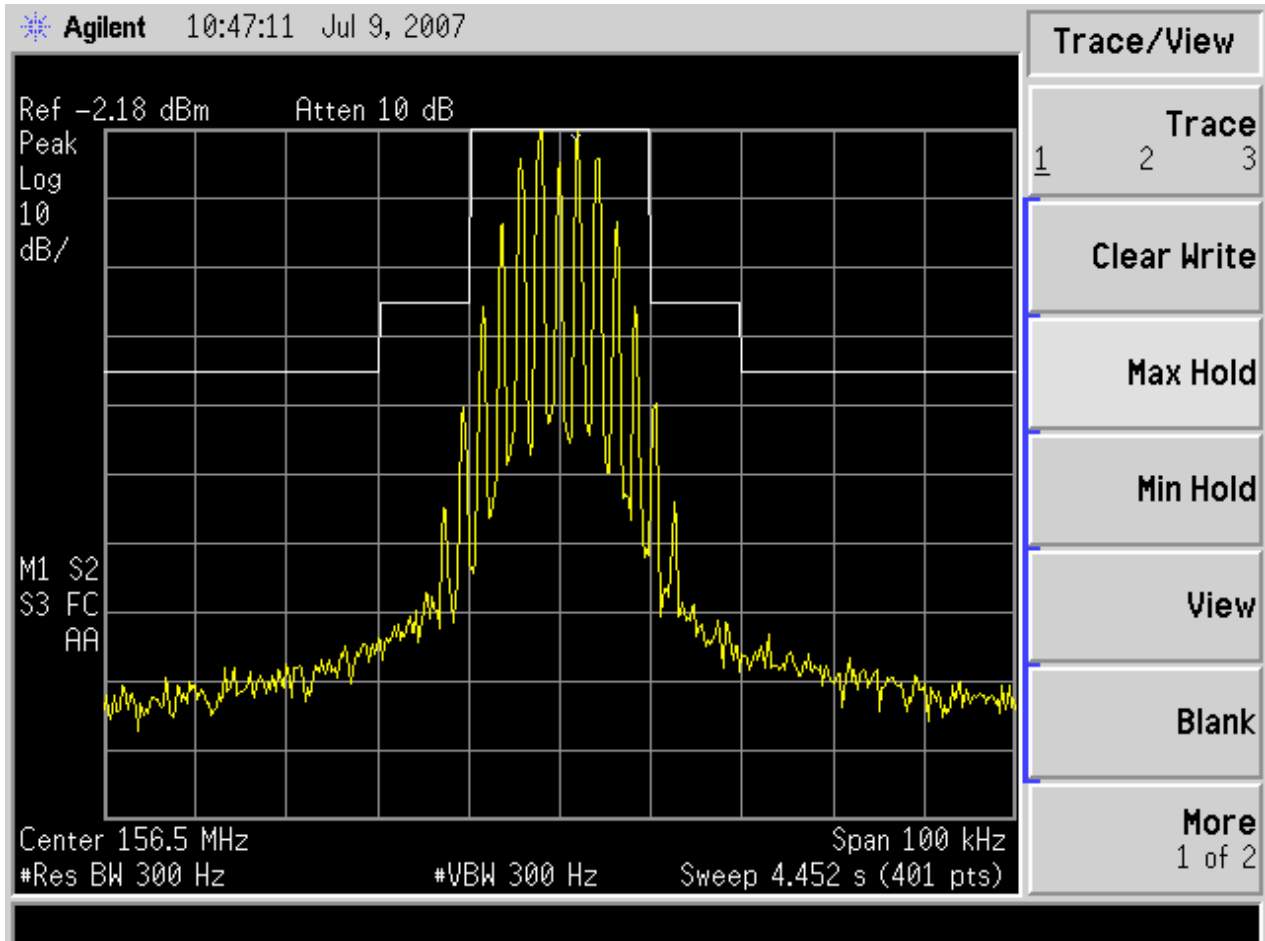
1300kHz Test Mode



Product Service

2.8 EMISSION LIMITATIONS (EMISSION MASK) DSC

2.8.6 Test Results



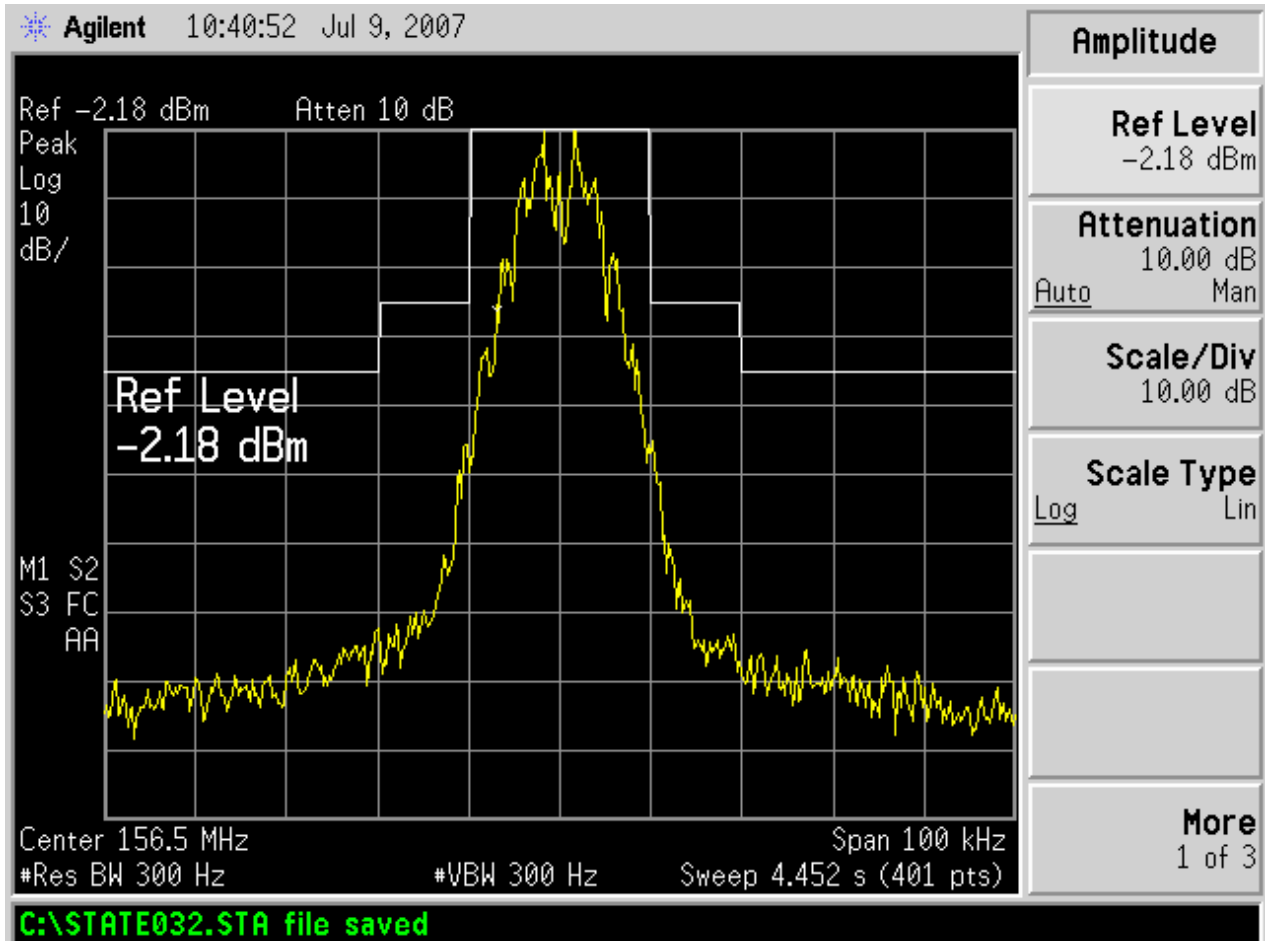
2100kHz Test Mode



Product Service

2.8 EMISSION LIMITATIONS (EMISSION MASK) DSC

2.8.6 Test Results



Dotting Pattern Mode



Product Service

2.9 EMISSION LIMITATIONS (CONDUCTED TRANSMITTER SPURIOUS)

2.9.1 Specification Reference

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

2.9.2 Equipment Under Test

RAY49 Fixed Mount VHF (with Class D DSC)

Sample ATIS (Blue)

2.9.3 Date of Test

6th July 2007 – Modification State 0

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

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 4.30mV 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) = 41.56dB

Total Path loss (600MHz - 1.6GHz) = 41.68dB

2.9.6 Test Results

The EUT meets the requirements of Part 80.211(c)

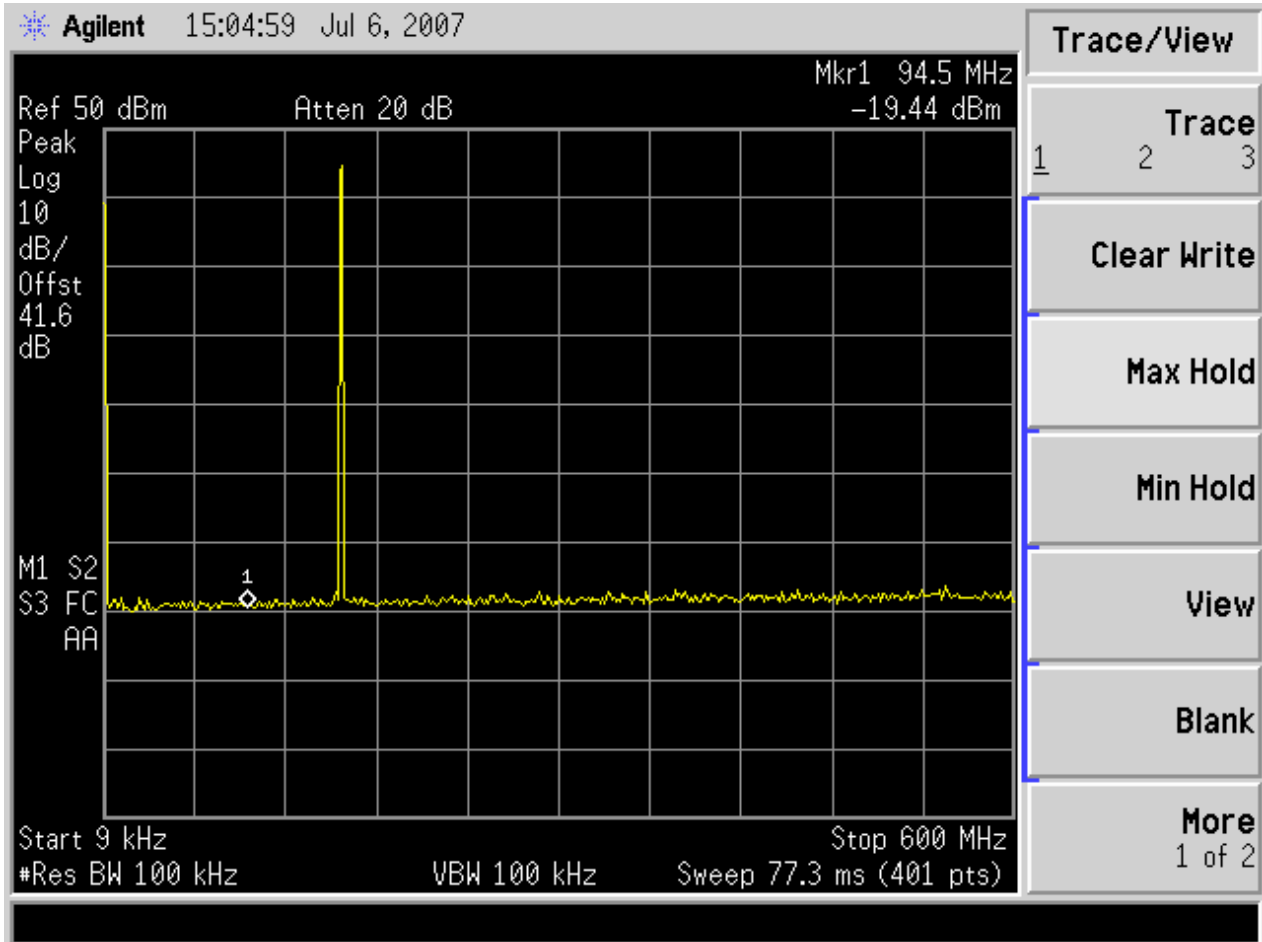
The test result plots are presented on the following pages.



Product Service

2.9 EMISSION LIMITATIONS (CONDUCTED TRANSMITTER SPURIOUS)

2.9.6 Test Results



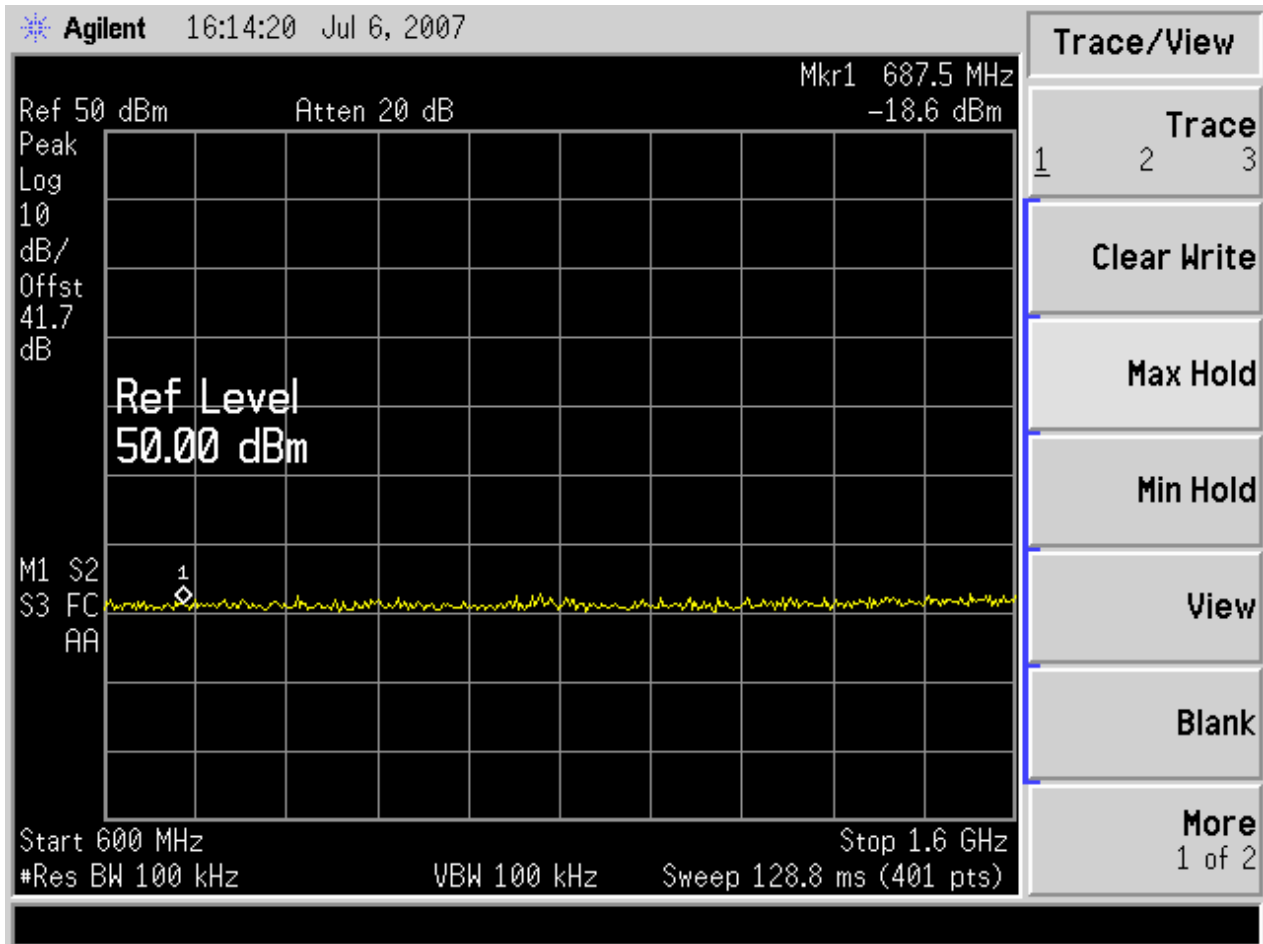
(Channel 60 - Bottom) 9kHz – 600MHz



Product Service

2.9 EMISSION LIMITATIONS (CONDUCTED TRANSMITTER SPURIOUS)

2.9.6 Test Results



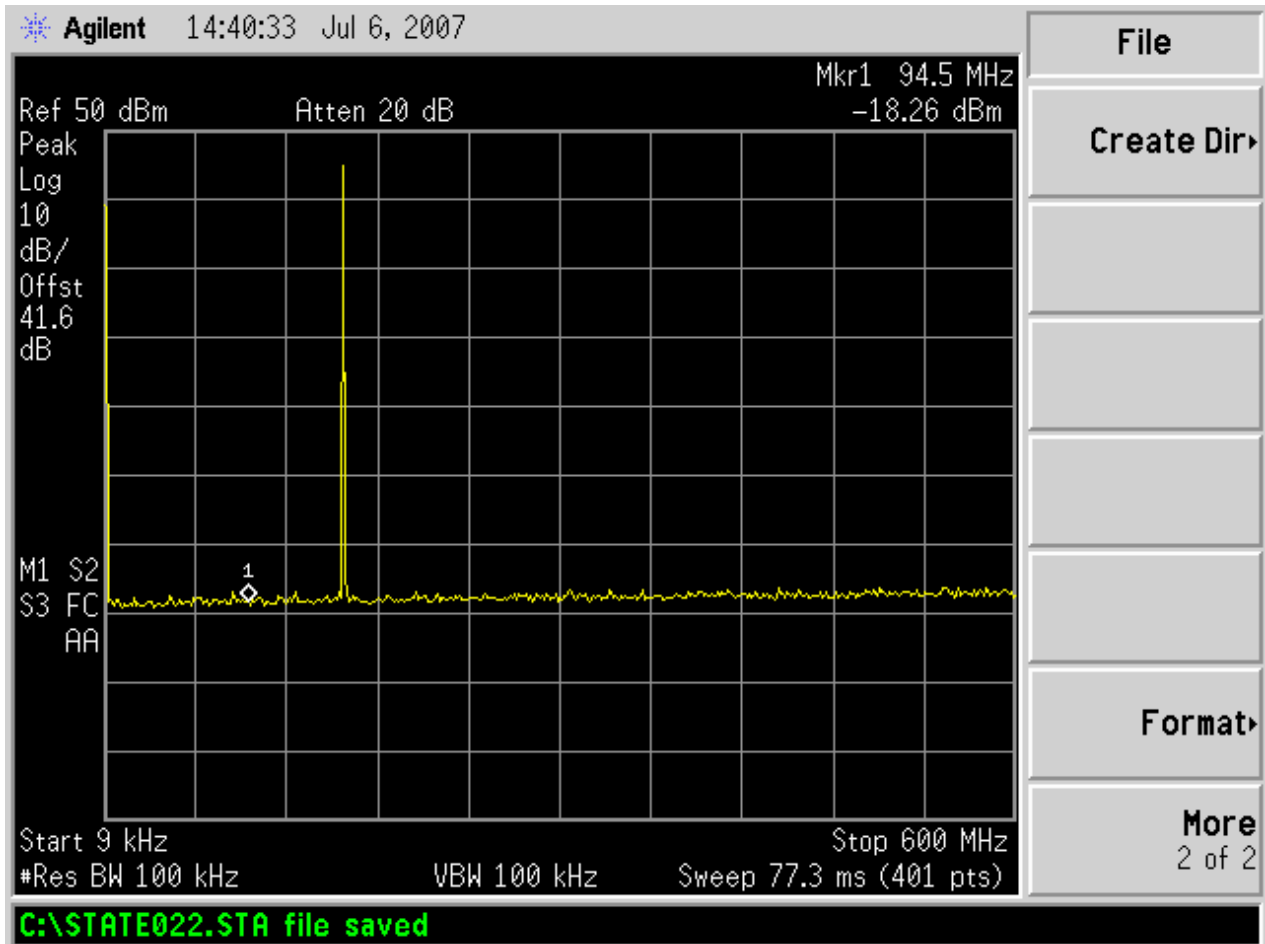
(Channel 60 - Bottom) 600MHz – 1.6GHz



Product Service

2.9 EMISSION LIMITATIONS (CONDUCTED TRANSMITTER SPURIOUS)

2.9.6 Test Results



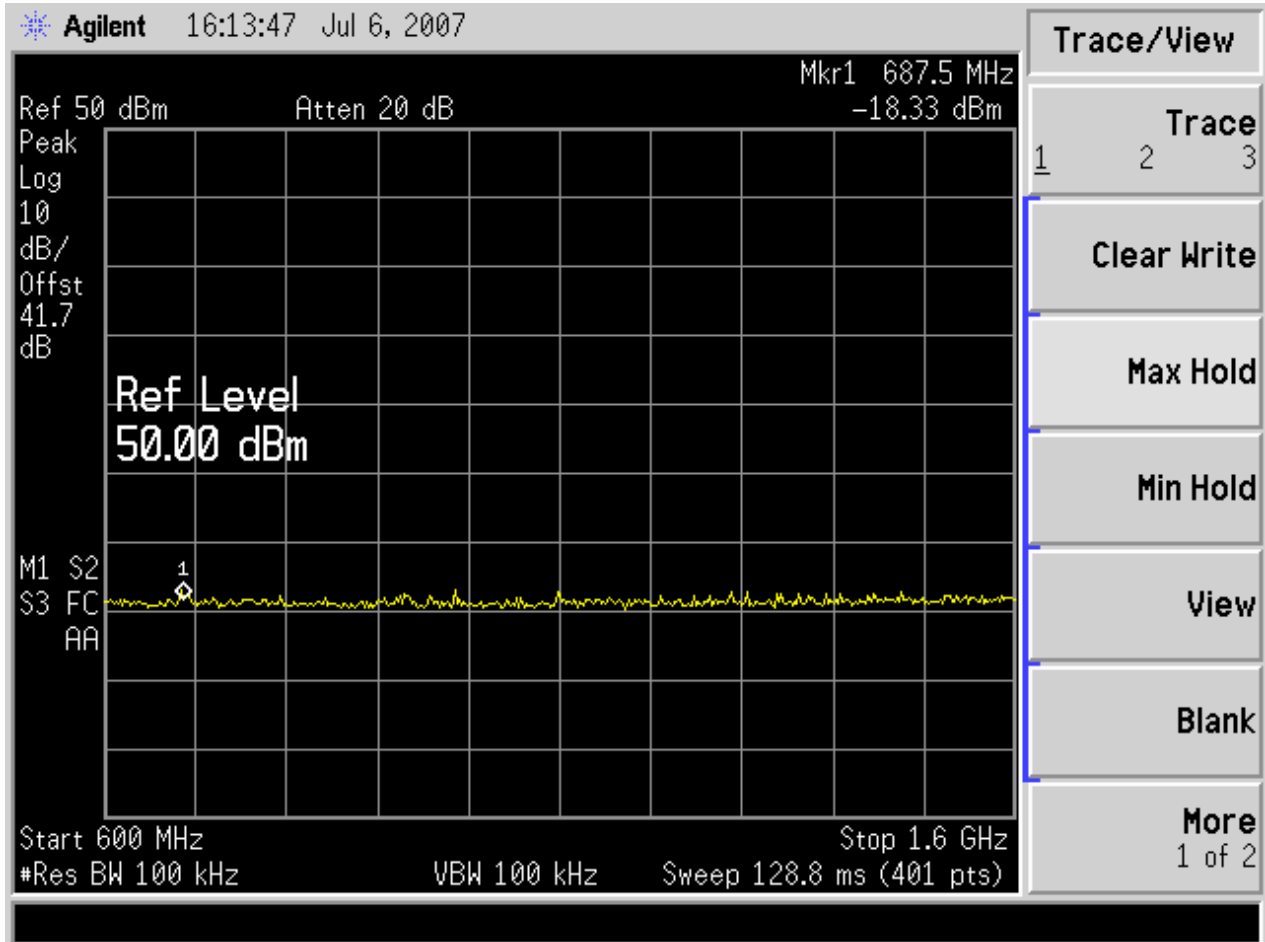
(Channel 16 - Middle) 9kHz – 600MHz



Product Service

2.9 EMISSION LIMITATIONS (CONDUCTED TRANSMITTER SPURIOUS)

2.9.6 Test Results



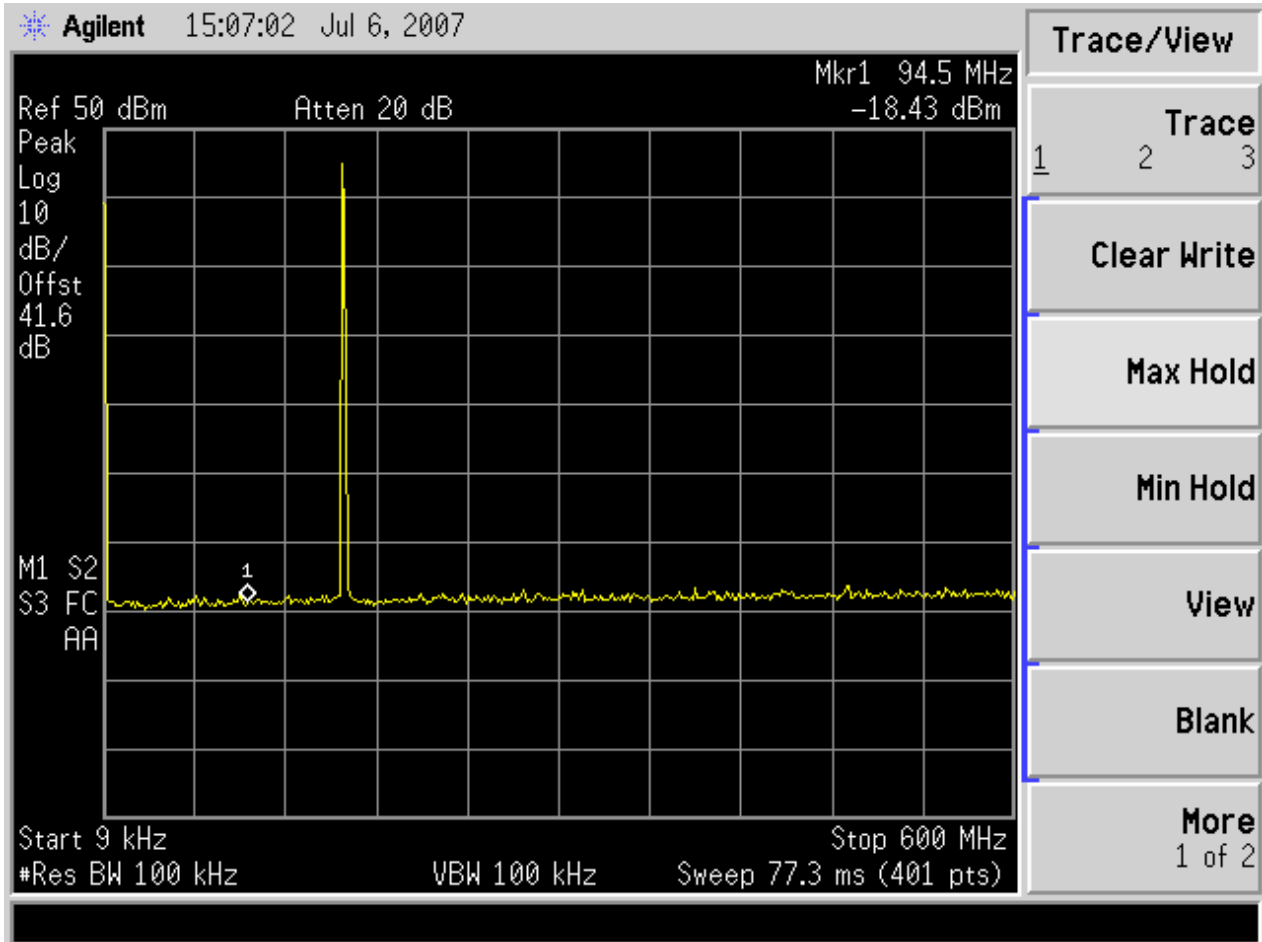
(Channel 16 - Middle) 600MHz – 1.6GHz



Product Service

2.9 EMISSION LIMITATIONS (CONDUCTED TRANSMITTER SPURIOUS)

2.9.6 Test Results



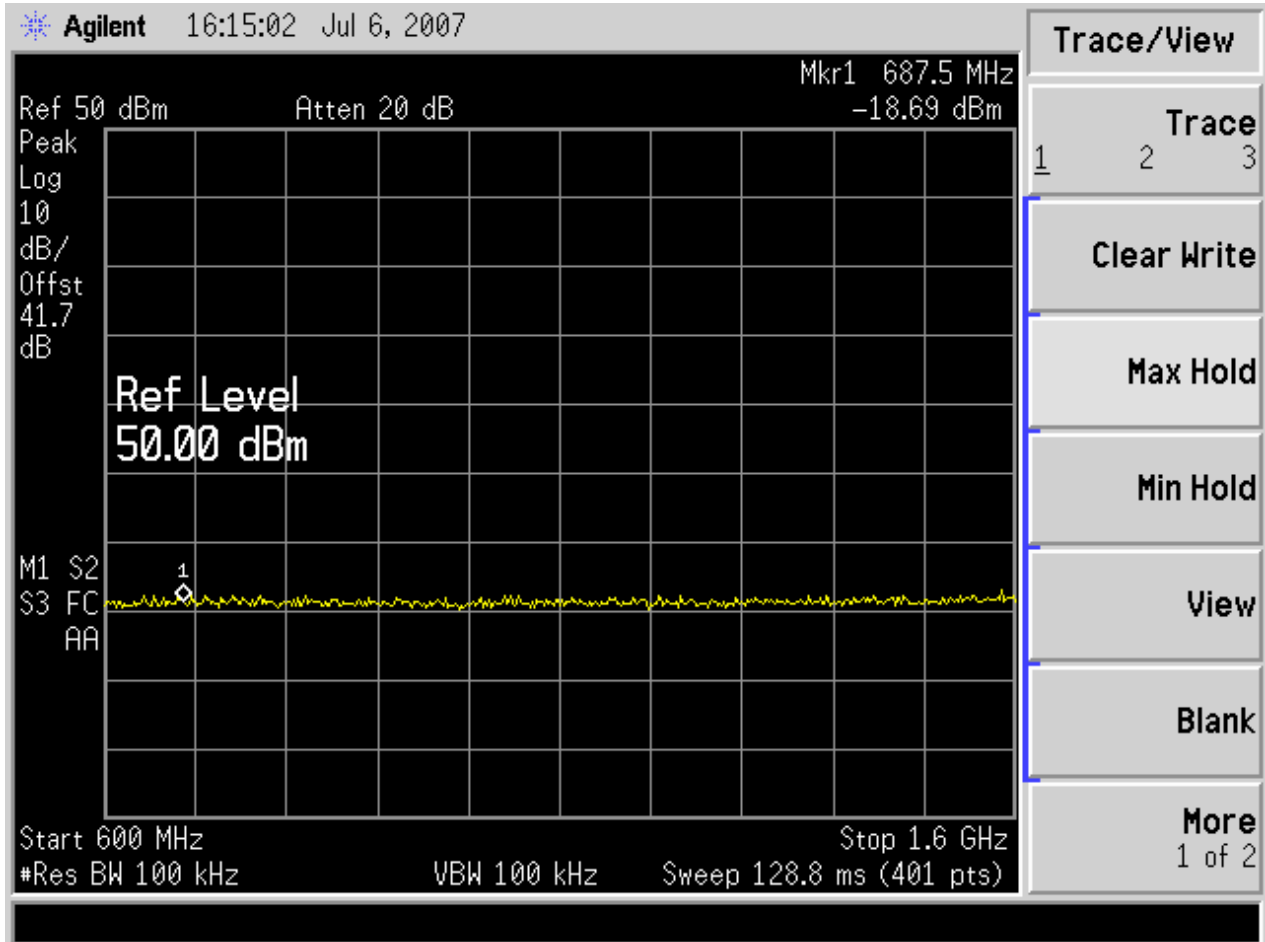
(Channel 88 - Bottom) 9kHz – 600MHz



Product Service

2.9 EMISSION LIMITATIONS (CONDUCTED TRANSMITTER SPURIOUS)

2.9.6 Test Results



(Channel 88 - Bottom) 600MHz – 1.6GHz



Product Service

2.10 EMISSION LIMITATIONS DSC (CONDUCTED TRANSMITTER SPURIOUS)

2.10.1 Specification Reference

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

2.10.2 Equipment Under Test

RAY49 Fixed Mount VHF (with Class D DSC)

Sample ATIS (Blue)

2.10.3 Date of Test

9th July 2007 – Modification State 0

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

All Measurements were performed with the EUT in the DSC mode of operation. The EUT was tested in the dotting pattern test state on DSC channel 70.

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 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) = 41.56dB

Total Path loss (600MHz - 1.6GHz) = 41.68dB

2.10.6 Test Results

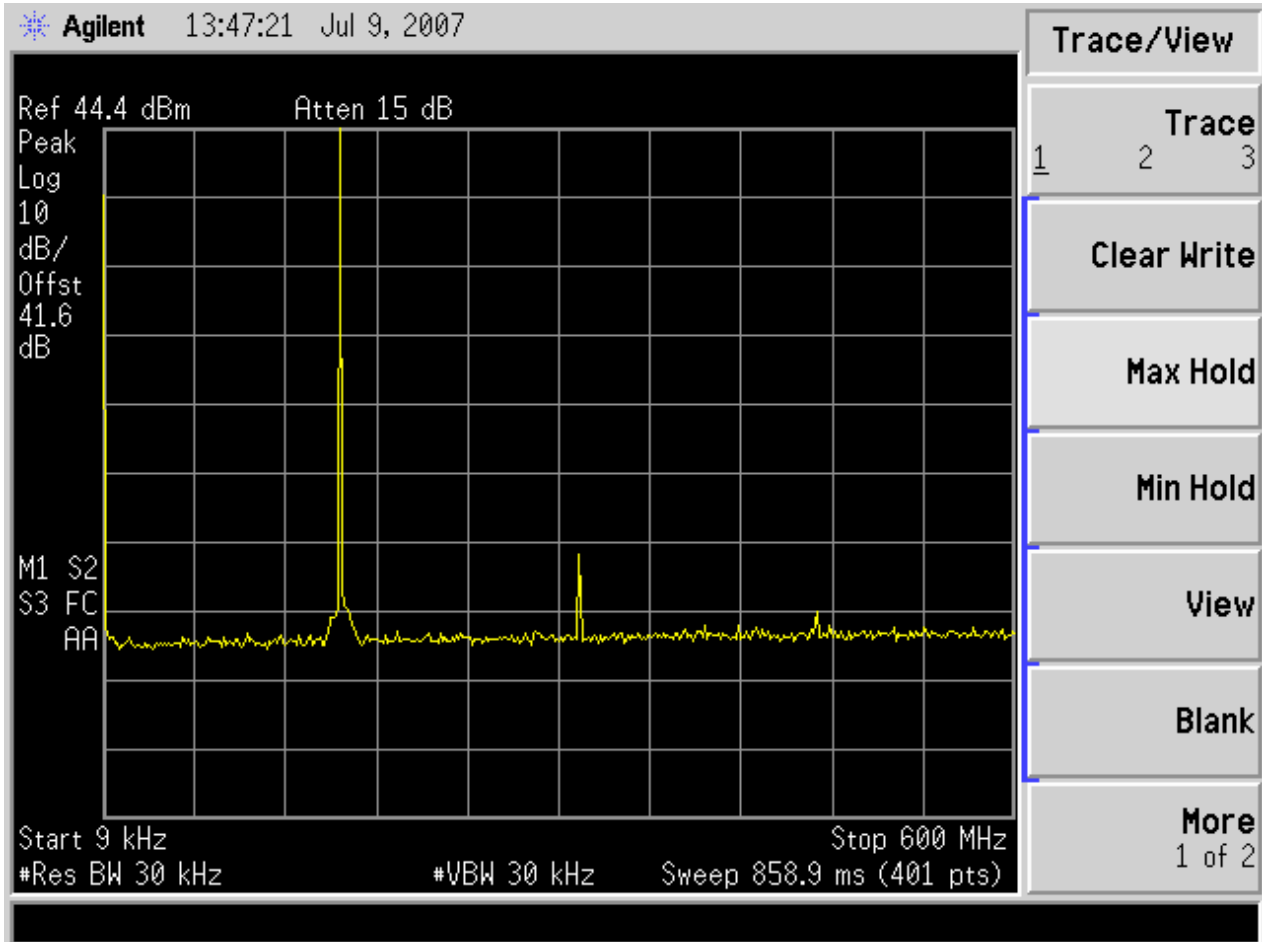
The EUT meets the requirements of Part 80.211(c)
The test result plots are presented on the following pages.



Product Service

2.10 EMISSION LIMITATIONS (CONDUCTED TRANSMITTER SPURIOUS)

2.10.6 Test Results



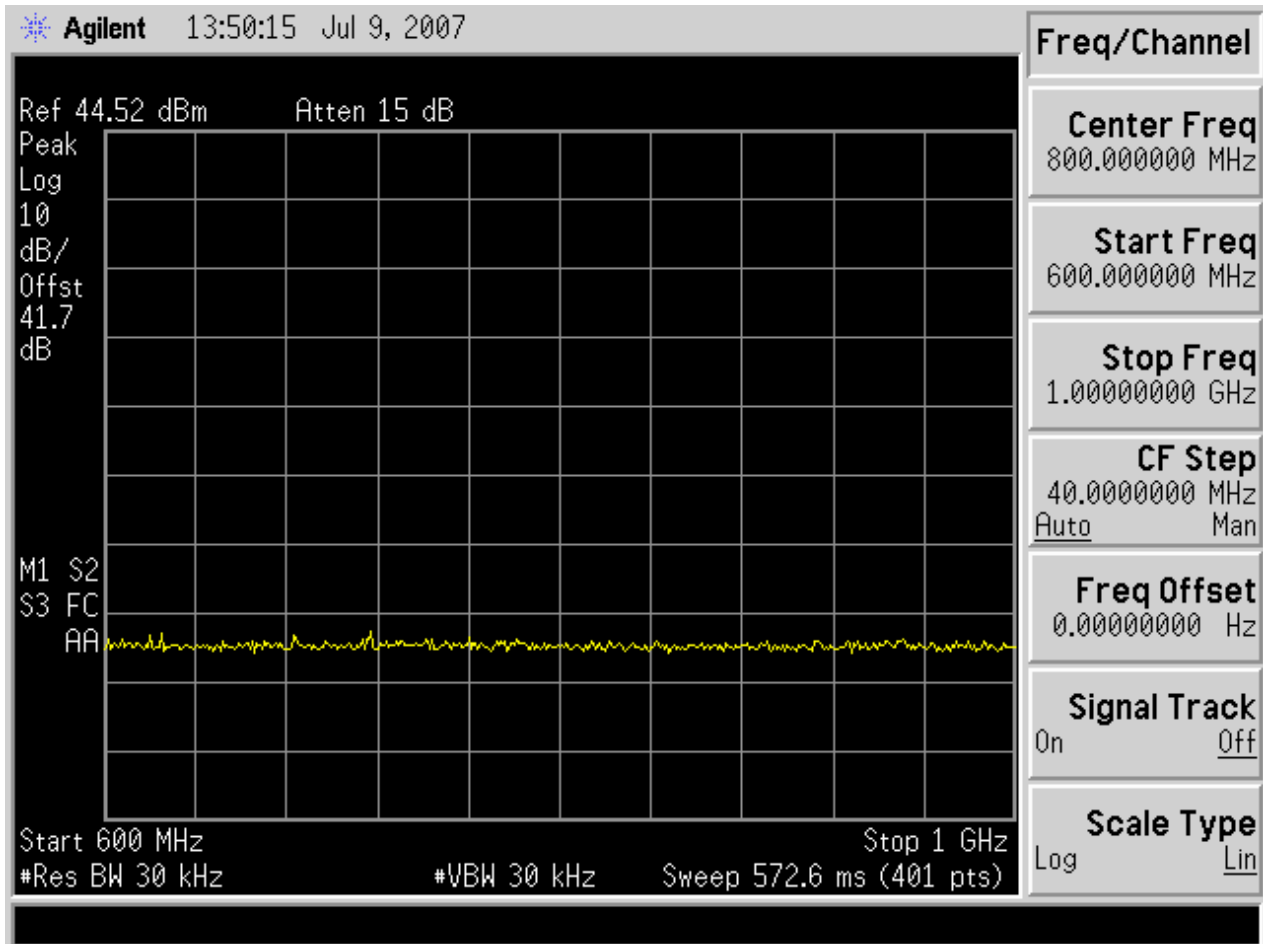
(Channel 60 - Bottom) 9kHz – 600MHz



Product Service

2.10 EMISSION LIMITATIONS (CONDUCTED TRANSMITTER SPURIOUS)

2.10.6 Test Results



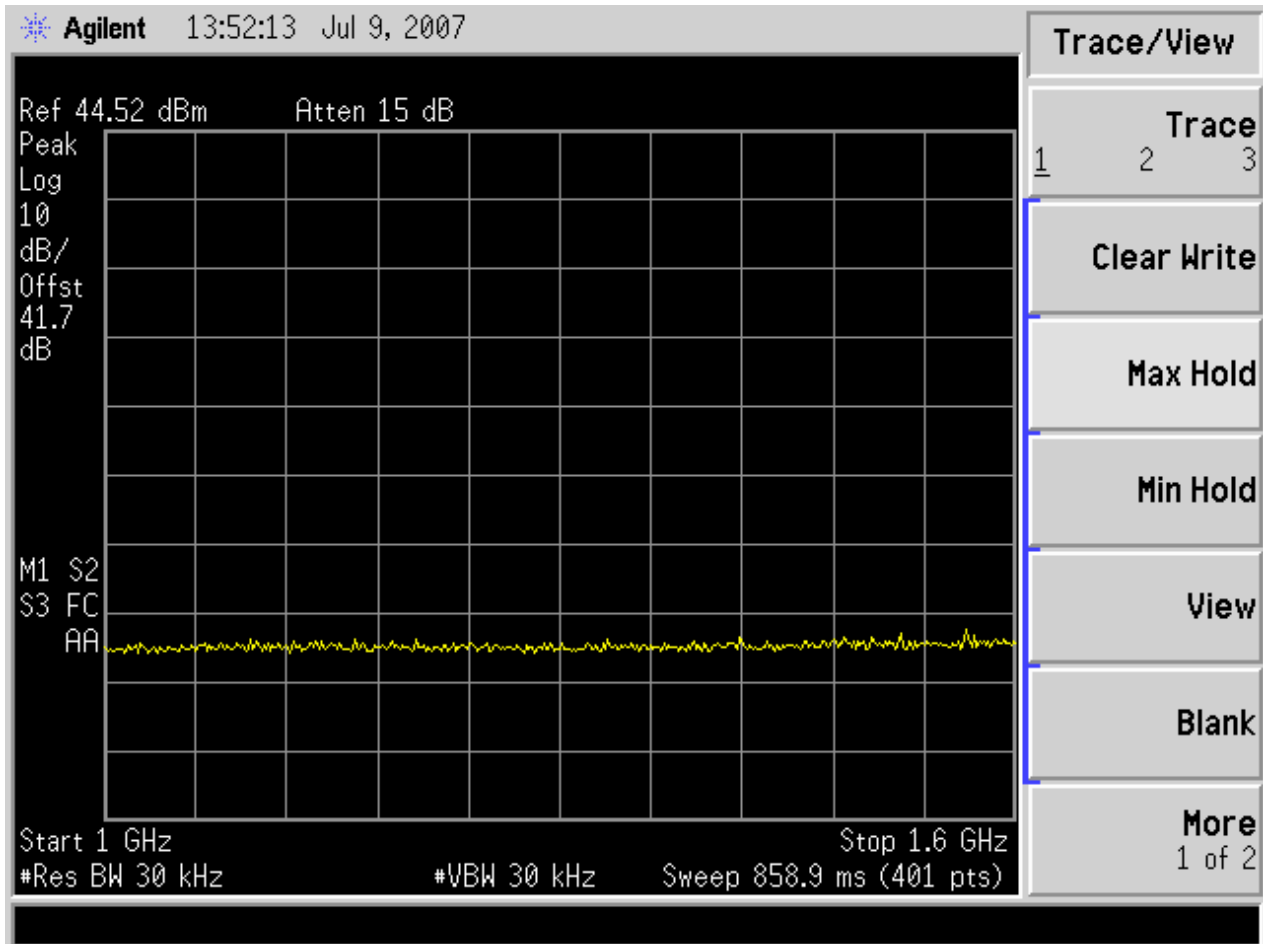
(Channel 60 - Bottom) 600MHz – 1GHz



Product Service

2.10 EMISSION LIMITATIONS (CONDUCTED TRANSMITTER SPURIOUS)

2.10.6 Test Results



(Channel 60 - Bottom) 1GHz – 1.6GHz



Product Service

2.11 EMISSION LIMITATIONS (RADIATED TRANSMITTER SPURIOUS)

2.11.1 Specification Reference

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

2.11.2 Equipment Under Test

RAY49 Fixed Mount VHF (with Class D DSC)

Sample No. 02

2.11.3 Date of Test

17th May 2007 – Modification State 0

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 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.

2.11.6 Test Results

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

EUT Transmitting on Bottom Channel 60 (156.025MHz)

Frequency	Antenna Polarisation	Height	Azimuth	Peak Result	Peak Limit
MHz		cm	degree	dBm	dBm
312.0	Vertical	100	000	-50.28	-13.0
936.1	Vertical	143	346	-45.86	-13.0



Product Service

Transmitting on Middle Channel 16 (156.8MHz)

Frequency	Antenna Polarisation	Height	Azimuth	Peak Result	Peak Limit
MHz		cm	degree	dBm	dBm
313.6	Horizontal	100	291	-52.48	-13.0
940.8	Vertical	100	333	-46.86	-13.0

Transmitting on Top Channel 88 (157.425MHz)

Frequency	Antenna Polarisation	Height	Azimuth	Peak Result	Peak Limit
MHz		cm	degree	dBm	dBm
314.9	Horizontal	100	300	-51.38	-13.0
944.6	Vertical	100	310	-46.46	-13.0

Transmitting on DSC Channel 70 (156.5MHz)

Frequency	Antenna Polarisation	Height	Azimuth	Peak Result	Peak Limit
MHz		cm	degree	dBm	dBm
313.00	Horizontal	100	300	-46.17	-13.0
469.50	Vertical	166	033	-54.46	-13.0
939.00	Vertical	100	330	-46.86	-13.0



Product Service

2.12 MODULATION CHARACTERISTICS

2.12.1 Specification Reference

FCC CFR 47: Part 80, 80.213(d), Part 2, 2.1047

2.12.2 Equipment Under Test

RAY49 Fixed Mount VHF (with Class D DSC)

Sample ATIS (Blue)

2.12.3 Date of Test

9th July 2007 – Modification State 0

2.12.4 Test Equipment Used

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

2.12.5 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.



Product Service

2.12 MODULATION CHARACTERISTICS

2.12.6 Test Results

Frequency Deviation (kHz)	Modulation State	Limit
2.673	1300Hz	≤ 5kHz
4.050	2100Hz	≤ 5kHz
4.080	Dotting Pattern	≤ 5kHz

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

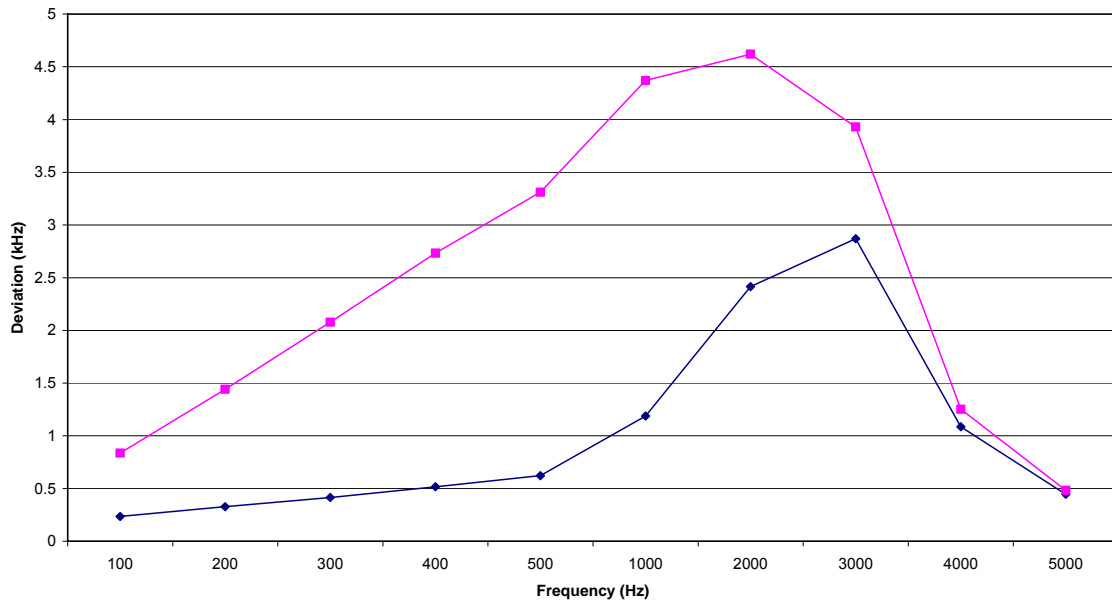


Product Service

2.12 MODULATION CHARACTERISTICS

2.12.7 Test Results

Audio Frequency Response



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

Two sets of data are plotted on the graph. One shows the audio frequency response characteristics and the other with the input level increased by 16dB to show the limiting characteristics.



Product Service

2.13 TRANSMITTER POWER

2.13.1 Specification Reference

FCC CFR 47: Part 80, 80.215(a)(2)(e)(1), Part 2, 2.1046

2.13.2 Equipment Under Test

RAY49 Fixed Mount VHF (with Class D DSC)

Sample: No. 2

2.13.3 Date of Test

2nd July 2007 – Modification State 1

2.13.4 Test Equipment Used

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

2.13.5 Test Procedure

The EUT was connected via a 30dB attenuator to a Modulation Analyser and sensor. The path loss between the EUT and the modulation analyser was measured and entered as a reference level offset.

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, middle and bottom channels of the operating frequency band and at maximum and minimum power levels.



Product Service

2.13 TRANSMITTER POWER

2.13.6 Test Results

Maximum Power – 25W

Test Conditions		Transmitter Output power (W)		
		156.025 MHz	156.800MHz	157.425MHz
Tnom (23°C)	Vnom (12Vdc)	21.232	21.429	21.928

Limit	≤25W or <+43.98dBm
-------	--------------------

Minimum Power- 1W

Test Conditions		Transmitter Output power (W)		
		156.025 MHz	156.800MHz	157.425MHz
Tnom (23°C)	Vnom (12Vdc)	0.798	0.794	0.802

Limits

Limit	≤1W or <+30dBm
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The EUT meets the requirements of Sections 2.1046, 80.215(a)(2)(e)(1) and RSS-182, 4.3 & 6.2



Product Service

2.14 TRANSMITTER POWER - DSC

2.14.1 Specification Reference

FCC CFR 47: Part 80, 80.215(a)(2)(e)(1), Part 2, 2.1046

2.14.2 Equipment Under Test

RAY49 Fixed Mount VHF (with Class D DSC)

Sample ATIS (Blue)

2.14.3 Date of Test

11th July 2007 – Modification State 0

2.14.4 Test Equipment Used

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

2.14.5 Test Procedure

The EUT was connected via a 40dB attenuator to a Modulation Analyser and sensor. The path loss between the EUT and the modulation analyser was measured and entered as a reference level offset.

The EUT was configured with a continuous dotting pattern and with a default level of 156.

The carrier power was measured on channel 70 and at maximum power.



Product Service

2.14 TRANSMITTER POWER

2.14.6 Test Results

Maximum Power – 25W

Test Conditions		Transmitter Output power (W)		
			156.800MHz	
Tnom (23°C)	Vnom (12Vdc)		24.15	
Limit		≤25W or <+43.98dBm		

The EUT meets the requirements of Sections 2.1046, 80.215(a)(2)(e)(1).



Product Service

2.15 SUPPRESSION OF INTERFERENCE ABOARD SHIPS

2.15.1 Specification Reference

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

2.15.2 Equipment Under Test

RAY49 Fixed Mount VHF (with Class D DSC)

Sample: No. 2

2.15.3 Date of Test

10th July 2007 – Modification State 1

2.15.4 Test Equipment Used

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

2.15.5 Test Procedure

The EUT was powered on with both FM and DSC receivers active, and connected to a Spectrum Analyser via an RF cable. The emissions were measured from 9kHz to 1.6GHz.

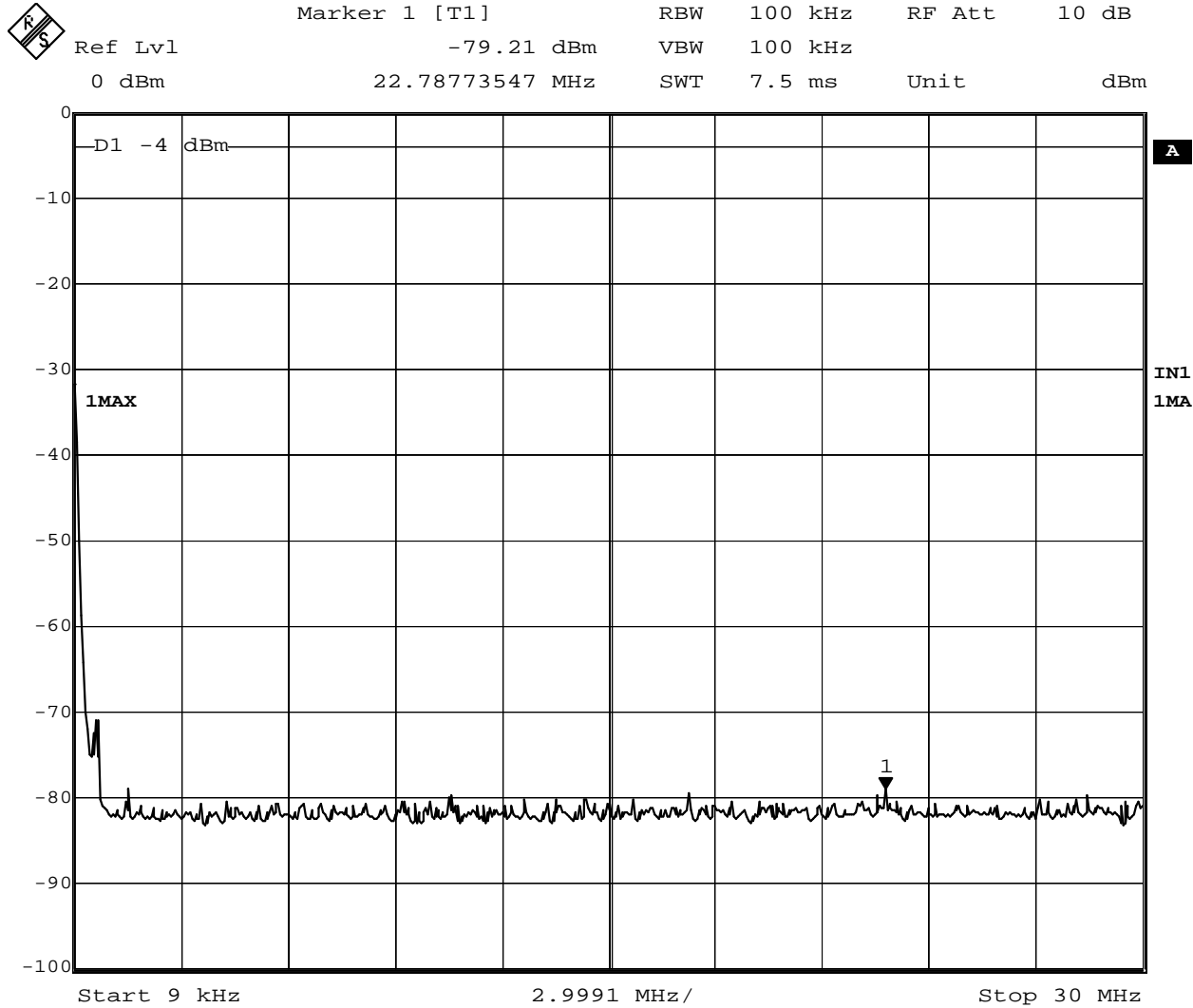
The worst case cable loss across the Measurement Frequency range was entered a reference level offset.



Product Service

2.15 SUPPRESSION OF INTERFERENCE ABOARD SHIPS

2.15.6 Test Results



Date: 10.JUL.2007 16:12:14

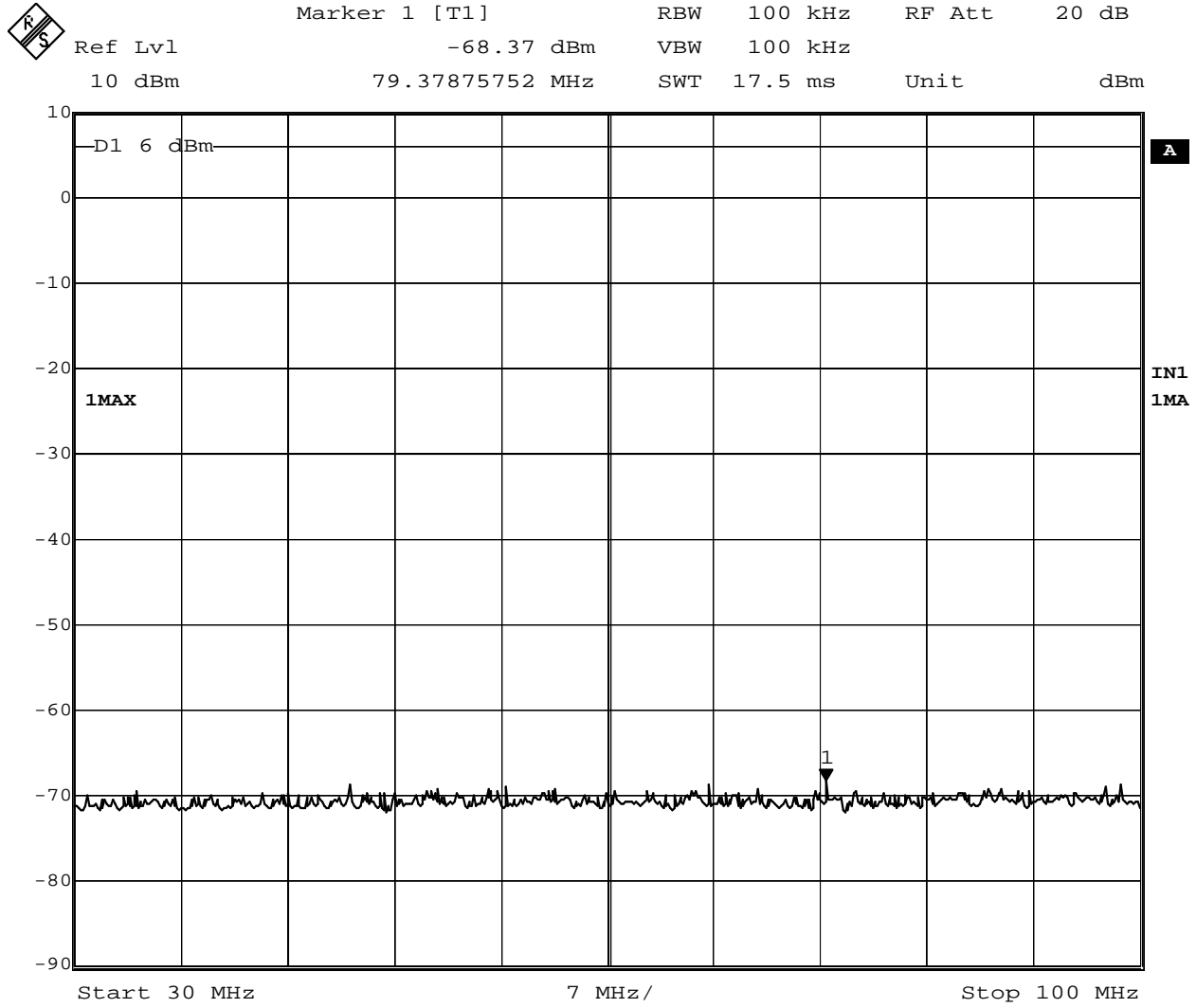
9kHz – 30MHz



Product Service

2.15 SUPPRESSION OF INTERFERENCE ABOARD SHIPS

2.15.6 Test Results



Date: 10.JUL.2007 16:13:40

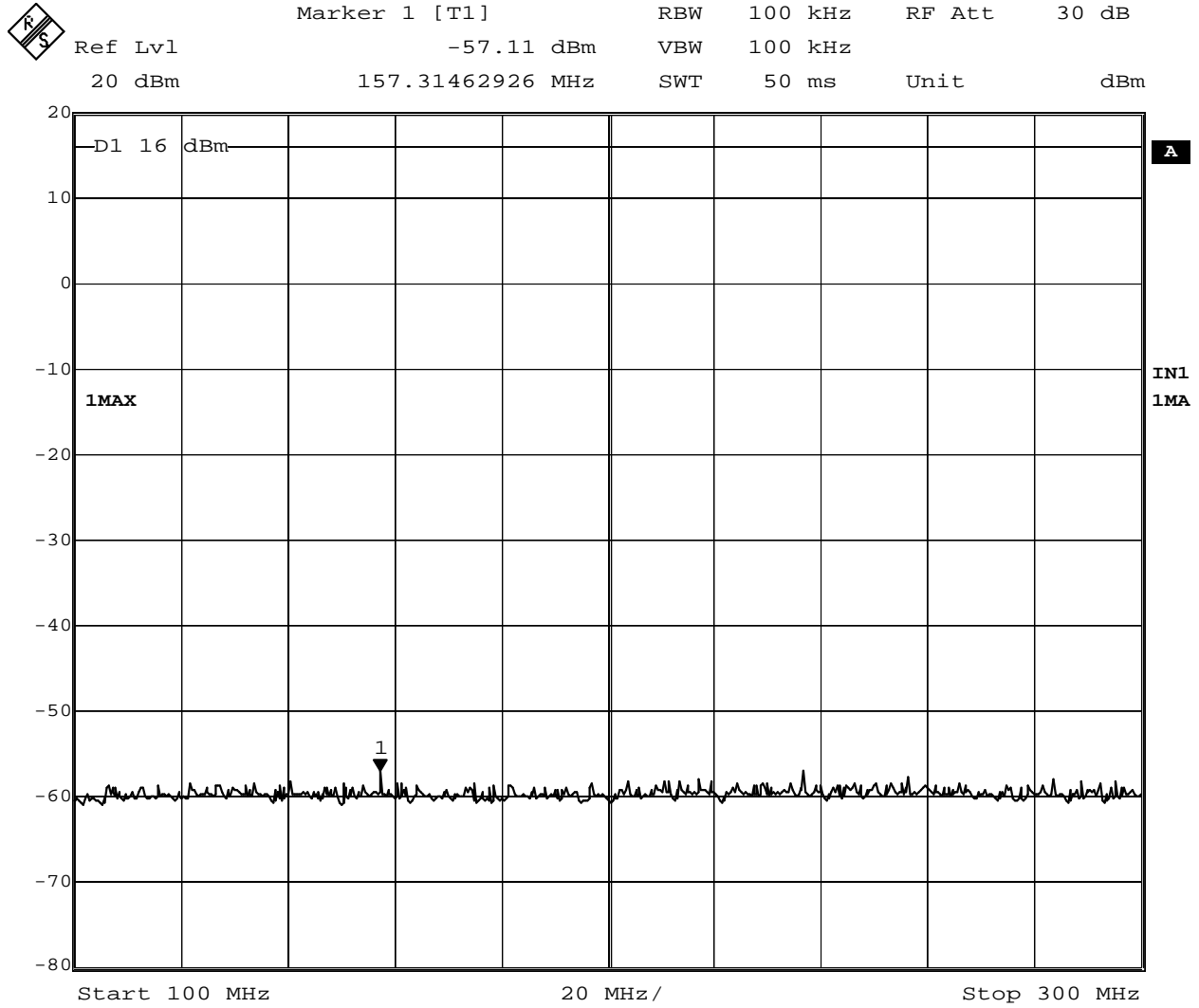
30MHz – 100MHz



Product Service

2.15 SUPPRESSION OF INTERFERENCE ABOARD SHIPS

2.15.6 Test Results



Date: 10.JUL.2007 16:15:00

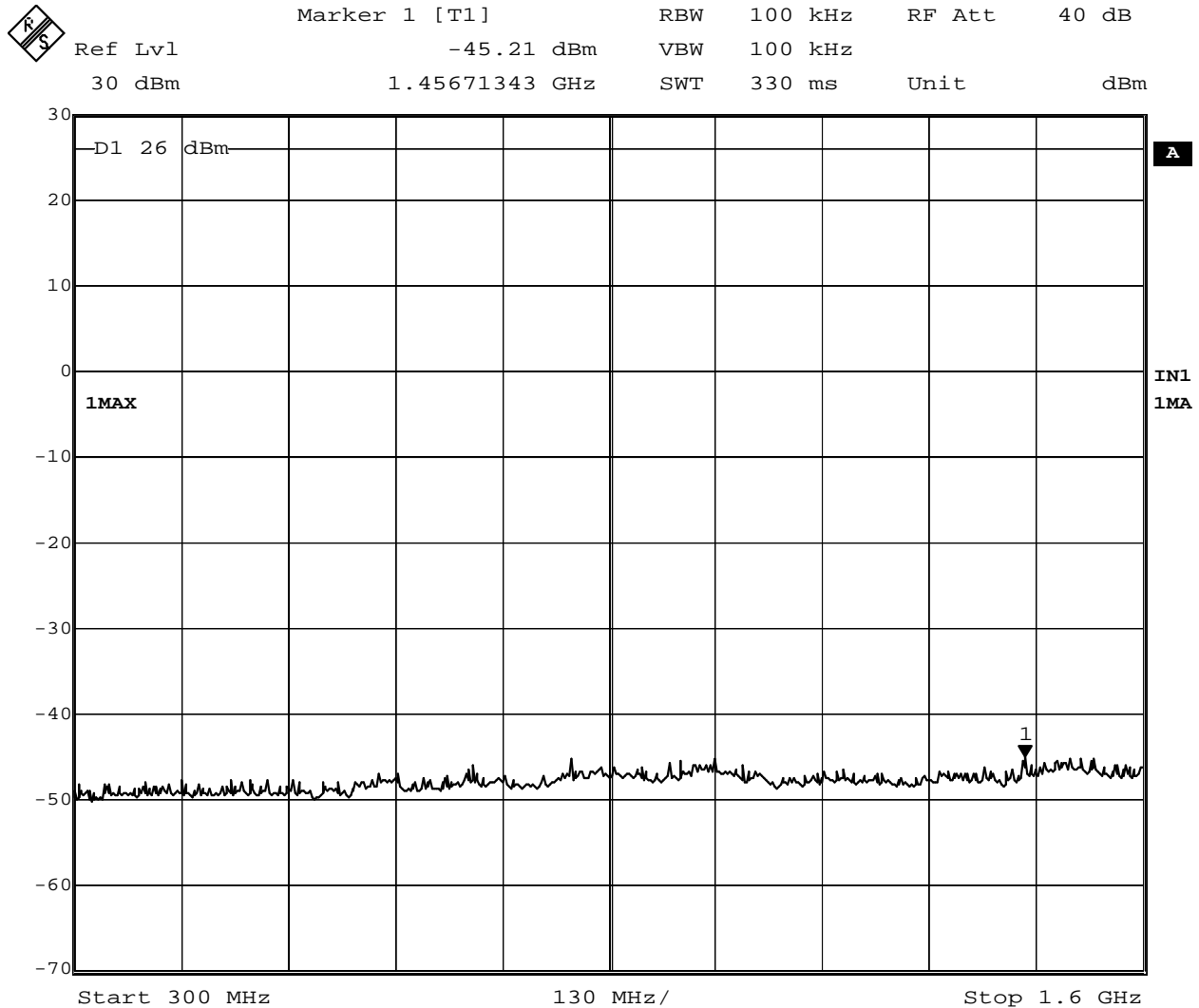
100MHz – 300MHz



Product Service

2.15 SUPPRESSION OF INTERFERENCE ABOARD SHIPS

2.15.6 Test Results



Date: 10.JUL.2007 16:16:33

300MHz – 1.6GHz



Product Service

SECTION 3

TEST EQUIPMENT



Product Service

3.1 TEST EQUIPMENT

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

Instrument	Manufacturer	Type No	TE Number	Calibration Due
Section 2.2 & 2.3 Radio (Tx) - Occupied Bandwidth				
Audio Analyser	Hewlett Packard	8903B	44	11/07/2008
Attenuator (30dB/ 50W)	Bird	8321	46	15/11/2007
Sensor Module	Hewlett Packard	11722A	1333	21/11/2007
Digital Multimeter	Iso-tech	ISO-TECH IDM63	1894	23/01/2008
Power Supply Unit	Farnell	TSV-70	2043	TU
Hygrometer	Rotronic	I-1000	2891	06/01/2008
Attenuator dc - 18GHz	Suhner	6810.17.B	2966	23/02/2008
Modulation Analyser	Hewlett Packard	8901B	3292	20/11/2007
ESA-E Series Spectrum Analyser	Agilent	E4402B	3348	16/04/2008
Section 2.4 & 2.5 Radio (Tx) - Frequency Characteristics				
Power Supply Unit	Hewlett Packard	6269B	113	TU
Counter	Hewlett Packard	53181A	159	17/08/2007
Temperature Chamber	Montford	2F3	467	OP MON
Attenuator (30dB, 50W)	Bird	8321	494	07/12/2007
Multimeter	Iso-tech	Iso Tech IDM101	2424	04/08/2007
Hygrometer	Rotronic	I-1000	2891	06/01/2008
Thermocouple Thermometer	Fluke	51	3173	18/06/2008



Product Service

3.1 TEST EQUIPMENT

Instrument	Manufacturer	Type No	TE Number	Calibration Due
Section 2.10 Emission Limitation DSC				
Attenuator (30dB/ 50W)	Bird	8321	46	15/11/2007
Digital Multimeter	Iso-tech	ISO-TECH IDM63	1894	23/01/2008
Power Supply Unit	Farnell	TSV-70	2043	TU
High Pass Filter	Mini-Circuits	NHP-600	2834	24/10/2007
Hygrometer	Rotronic	I-1000	2891	06/01/2008
Attenuator dc - 18GHz	Suhner	6810.17.B	2966	23/02/2008
ESA-E Series Spectrum Analyser	Agilent	E4402B	3348	16/04/2008
Section 2.12 Radio (Tx) - Modulation Characteristics				
Attenuator (30dB/ 50W)	Bird	8321	46	15/11/2007
Modulation Analyser	Rohde & Schwarz	FAM	119	TU
1GHz Digital Oscilloscope	Lecroy	9370M	612	21/09/2007
Sensor Module	Hewlett Packard	11722A	1333	21/11/2007
Digital Multimeter	Iso-tech	ISO-TECH IDM63	1894	23/01/2008
Power Supply Unit	Farnell	TSV-70	2043	TU
Hygrometer	Rotronic	I-1000	2891	06/01/2008
Attenuator dc - 18GHz	Suhner	6810.17.B	2966	23/02/2008
Modulation Analyser	Hewlett Packard	8901B	3292	20/11/2007



3.1 TEST EQUIPMENT

Instrument	Manufacturer	Type No	TE Number	Calibration Due
Sections 2.13 Radio (Tx) - Audio Frequency Response				
Audio Analyser	Hewlett Packard	8903B	44	11/07/2008
Attenuator (30dB/ 50W)	Bird	8321	46	15/11/2007
Spectrum Analyser (20Hz-40MHz)	Hewlett Packard	3585A	743	23/02/2008
Sensor Module	Hewlett Packard	11722A	1333	21/11/2007
Digital Multimeter	Iso-tech	ISO-TECH IDM63	1894	23/01/2008
Power Supply Unit	Farnell	TSV-70	2043	TU
Hygrometer	Rotronic	I-1000	2891	06/01/2008
Attenuator dc - 18GHz	Suhner	6810.17.B	2966	23/02/2008
Signal Generator 100kHz to 2060MHz	Hewlett Packard	8657B	2983	18/12/2007
Modulation Analyser	Hewlett Packard	8901B	3292	20/11/2007
Section 2.14 (Tx) - Power Characteristics				
Audio Analyser	Hewlett Packard	8903B	44	11/07/2008
Attenuator (30dB/ 50W)	Bird	8321	46	15/11/2007
Modulation Analyser	Hewlett Packard	8901B	773	23/01/2008
Sensor Module	Hewlett Packard	11722A	1333	21/11/2007
Digital Multimeter	Iso-tech	ISO-TECH IDM63	1894	23/01/2008
Power Supply Unit	Farnell	TSV-70	2043	TU
Multimeter	Iso-tech	Iso Tech IDM101	2424	04/08/2007
Power Attenuator 30dB	Rohde & Schwarz	RBU	2746	23/11/2007
Sensor	Hewlett Packard	11722A	2787	09/08/2007
Hygrometer	Rotronic	I-1000	2891	06/01/2008
Attenuator dc - 18GHz	Suhner	6810.17.B	2966	23/02/2008
Signal Generator 100kHz to 2060MHz	Hewlett Packard	8657B	2983	18/12/2007
Modulation Analyser	Hewlett Packard	8901B	3292	20/11/2007



Product Service

3.1 TEST EQUIPMENT

Instrument	Manufacturer	Type No	TE Number	Calibration Due
Section 2.7, 2.8 & 2.9 Radio – Emissions Limitations				
Attenuator (30dB/ 50W)	Bird	8321	46	15/11/2007
Digital Multimeter	Iso-tech	ISO-TECH IDM63	1894	23/01/2008
Power Supply Unit	Farnell	TSV-70	2043	TU
High Pass Filter	Mini-Circuits	NHP-600	2834	24/10/2007
Hygrometer	Rotronic	I-1000	2891	06/01/2008
Attenuator dc - 18GHz	Suhner	6810.17.B	2966	23/02/2008
ESA-E Series Spectrum Analyser	Agilent	E4402B	3348	16/04/2008
Section 2.1 & 2.11 EMC - Radiated Emissions				
Spectrum Analyser	Hewlett Packard	8542E	18	09/02/2008
Antenna (Dipole, 300MHz-1000MHz)	Schwarzbeck	UHAP	447	08/09/2007
Modulation Analyser	Hewlett Packard	8901B	557	31/10/2007
Test Receiver	Rohde & Schwarz	ESIB40	1006	21/04/2008
Mast Controller	Inn-Co GmbH	CO 1000	1606	TU
Turntable/Mast Controller	EMCO	2090	1607	TU
Signal Generator	Marconi	2031	2015	18/11/2007
Audio Analyser	Hewlett Packard	8903B	2212	01/12/2007
Bilog Antenna	Chase	CBL6143	2904	10/11/2007
Section 2.15 Radio - Suppression of Interference aboard ships				
Digital Multimeter	Iso-tech	ISO-TECH IDM63	1894	23/01/2008
EMI Test Receiver	Rohde & Schwarz	ESIB26	2028	25/06/2008
Power Supply Unit	Farnell	TSV-70	2043	TU
Multimeter	Iso-tech	Iso Tech	2419	04/08/2007



Product Service

3.1 TEST EQUIPMENT

Instrument	Manufacturer	Type No	TE Number	Calibration Due
Section 2.6 Radio (Tx) - Modulation Characteristics				
Attenuator (30dB/ 50W)	Bird	8321	46	15/11/2007
Modulation Analyser	Rohde & Schwarz	FAM	119	TU
1GHz Digital Oscilloscope	Lecroy	9370M	612	21/09/2007
Sensor Module	Hewlett Packard	11722A	1333	21/11/2007
Digital Multimeter	Iso-tech	ISO-TECH IDM63	1894	23/01/2008
Power Supply Unit	Farnell	TSV-70	2043	TU
Hygrometer	Rotronic	I-1000	2891	06/01/2008
Attenuator dc - 18GHz	Suhner	6810.17.B	2966	23/02/2008
Modulation Analyser	Hewlett Packard	8901B	3292	20/11/2007

* - Used to tune rejection network, calibration not required.
 TU - Traceability Unscheduled
 OP MON – Output Monitored with calibrated equipment



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

ACCREDITATION, DISCLAIMERS AND COPYRIGHT



Product Service

4.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT



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