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# Report On

FCC and Industry Canada Testing of the  
SRT Marine Technology Ltd Apollo  
In accordance with FCC CFR 47 Part 80, Industry Canada RSS-182  
and Industry Canada RSS-GEN

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FCC ID: UYW-425-0002  
IC: 7075A-4250002A

Document 75929063 Report 03 Issue 1

May 2015



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TÜV SÜD Product Service, Octagon House, Concorde Way, Segensworth North,  
Fareham, Hampshire, United Kingdom, PO15 5RL  
Tel: +44 (0) 1489 558100. Website: [www.tuv-sud.co.uk](http://www.tuv-sud.co.uk)

COMMERCIAL-IN-CONFIDENCE

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FCC and Industry Canada Testing of the  
SRT Marine Technology Ltd Apollo  
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Document 75929063 Report 03 Issue 1

May 2015

**PREPARED FOR**

SRT Marine Technology Ltd  
Wireless House  
Wireless Industrial Estate  
Midsomer Norton  
Bath  
BA3 4BS

**PREPARED BY**

**Natalie Bennett**  
Senior Administrator, Project Support

**APPROVED BY**

**Simon Bennett**  
Authorised Signatory

**DATED**

01 May 2015

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**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 Part 80 and Industry Canada RSS-182. The sample tested was found to comply with the requirements defined in the applied rules.

Test Engineer(s);

M Russell





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## **SECTION 1**

### **REPORT SUMMARY**

FCC and Industry Canada Testing of the  
SRT Marine Technology Ltd Apollo  
In accordance with FCC CFR 47 Part 80, Industry Canada RSS-182 and  
Industry Canada RSS-GEN



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## 1.1 INTRODUCTION

The information contained in this report is intended to show the verification of FCC and Industry Canada Testing of the SRT Marine Technology Ltd Apollo to the requirements of FCC CFR 47 Part 80 and Industry Canada RSS-182.

Objective	To perform Industry Canada Testing to determine the Equipment Under Test's (EUT's) compliance with the Test Specification, for the series of tests carried out.
Manufacturer	SRT Marine Technology Ltd
Model Number(s)	Apollo
Serial Number(s)	T1-01-07
Number of Samples Tested	1
Test Specification/Issue/Date	FCC CFR 47 Part 80 (2013) Industry Canada RSS-182 (Issue 5, 2012) Industry Canada RSS-GEN (Issue 4, 2014)
Incoming Release Date	Application Form 09 February 2015
Disposal Reference Number Date	Held Pending Disposal Not Applicable Not Applicable
Order Number Date	POR005047 16 January 2015
Start of Test	30 March 2015
Finish of Test	7 April 2015
Name of Engineer(s)	M Russell



**1.2 BRIEF SUMMARY OF RESULTS**

A brief summary of the tests carried out in accordance with FCC CFR 47 Part 80, Industry Canada RSS-182 and Industry Canada RSS-GEN is shown below.

Section	Spec Clause			Test Description	Result	Comments/Base Standard
	Pt 80	RSS-182	RSS-GEN			
AIS Transmit						
2.1	80.205	7.3	6.6	Bandwidths	Pass	
2.2	80.209	5.1 and 7.4	-	Transmitter Frequency Tolerances	Pass	
2.3	80.211	7.9	-	Emission Limitations	Pass	
2.4	80.213	7.3	-	Modulation Requirements	Pass	
2.5	80.213 (a)(2)	7.3	-	Transmitter Frequency Deviation	Pass	
2.6	80.215	5.2 and 7.5	-	Transmitter Power	Pass	
2.7	80.215 (e)(g)(1)(2)(3)	7.5	-	Transmitter Carrier Power Reduction	Pass	
2.8	80.217 (b)	-	-	Suppression of Interference Aboard Ships	Pass	



1.3 DECLARATION OF BUILD STATUS

MAIN EUT	
MANUFACTURING DESCRIPTION	AIS Class A Transceiver
MANUFACTURER	SRT-Marine Technology Ltd
TYPE	Apollo
PART NUMBER	425-0001- Packaged. 425-0002 -Unit
SERIAL NUMBER	N/A
HARDWARE VERSION	V1
SOFTWARE VERSION	MKD 110400.01.02.00 Modem 110200.00.11.00
TRANSMITTER FREQUENCY OPERATING RANGE (MHz)	156.025 MHz, - 162.025MHz
RECEIVER FREQUENCY OPERATING RANGE (MHz)	156.025 MHz, - 162.025MHz
COUNTRY OF ORIGIN	Hungary
INTERMEDIATE FREQUENCIES	19.655MHz / 26.055 MHz / 51.655 MHz / 0.455 MHz / TX-36.5MHz
EMISSION DESIGNATOR(S): (i.e. G1D, GXW)	16K0G1D
MODULATION TYPES: (i.e. GMSK, QPSK)	GMSK
HIGHEST INTERNALLY GENERATED FREQUENCY	214MHz
OUTPUT POWER (W or dBm)	12.5W
FCC ID	UYW-425-0002
INDUSTRY CANADA ID	7075A-4250002A
TECHNICAL DESCRIPTION (a brief description of the intended use and operation)	AIS Class A Transceiver for use on SOLAS and non SOLAS vessels
BATTERY/POWER SUPPLY	
MANUFACTURING DESCRIPTION	
MANUFACTURER	
TYPE	
PART NUMBER	
VOLTAGE	12-24V
COUNTRY OF ORIGIN	
MODULES (if applicable)	
MANUFACTURING DESCRIPTION	Wi Fi
MANUFACTURER	Blue Giga
TYPE	WF111-
POWER	0.082W
FCC ID	QQQWF111
COUNTRY OF ORIGIN	Finland
INDUSTRY CANADA ID	5123A-BGTWF111
EMISSION DESIGNATOR	16M9F7X
DHSS/FHSS/COMBINED OR OTHER	
ANCILLARIES (if applicable)	
MANUFACTURING DESCRIPTION	GPS Antenna
MANUFACTURER	2J
TYPE	
PART NUMBER	2J9001GF
SERIAL NUMBER	
COUNTRY OF ORIGIN	

Signature

Date 09.02.2015

Declaration of Build Status Serial Number 240-1



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## **1.4 PRODUCT INFORMATION**

### **1.4.1 Technical Description**

The Equipment Under Test (EUT) was a SRT Marine Technology Ltd Apollo. A full technical description can be found in the manufacturer's documentation.

## **1.5 TEST CONDITIONS**

For all tests the EUT was set up in accordance with the relevant test standard and to represent typical operating conditions. Tests were applied with the EUT situated in a shielded enclosure.

The EUT was powered from a 12.0 V DC supply.

FCC Measurement Facility Registration Number  
90987 Octagon House, Fareham Test Laboratory

Industry Canada Company Address Code  
IC2932B-1 Octagon House, Fareham Test Laboratory

## **1.6 DEVIATIONS FROM THE STANDARD**

No deviations from the applicable test standard were made during testing.

## **1.7 MODIFICATION RECORD**

Modification 0 - No modifications were made to the test sample during testing.





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## **SECTION 2**

### **TEST DETAILS**

FCC and Industry Canada Testing of the  
SRT Marine Technology Ltd Apollo  
In accordance with FCC CFR 47 Part 80, Industry Canada RSS-182  
and Industry Canada RSS-GEN



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## 2.1 BANDWIDTHS

### 2.1.1 Specification Reference

FCC CFR 47 Part 80, Clause 80.205  
Industry Canada RSS-182, Clause 7.3  
Industry Canada RSS-GEN, Clause 6.6

### 2.1.2 Equipment Under Test and Modification State

Apollo S/N: T1-01-07 - Modification State 0

### 2.1.3 Date of Test

31 March 2015

### 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 was transmitting at maximum power, modulated by the standard AIS test signals as defined in IEC 61993-2. The EUT was connected to a spectrum analyser via a cable and attenuator, the RBW of the spectrum analyser was set to at least 1% of the emission bandwidth and a video bandwidth of 3 times RBW, the occupied bandwidth measurement function of the analyser was used and the 99% bandwidth recorded.

The plots on the following pages show the resultant display from the Spectrum Analyser.

### 2.1.6 Environmental Conditions

Ambient Temperature	24.8°C
Relative Humidity	20.9%



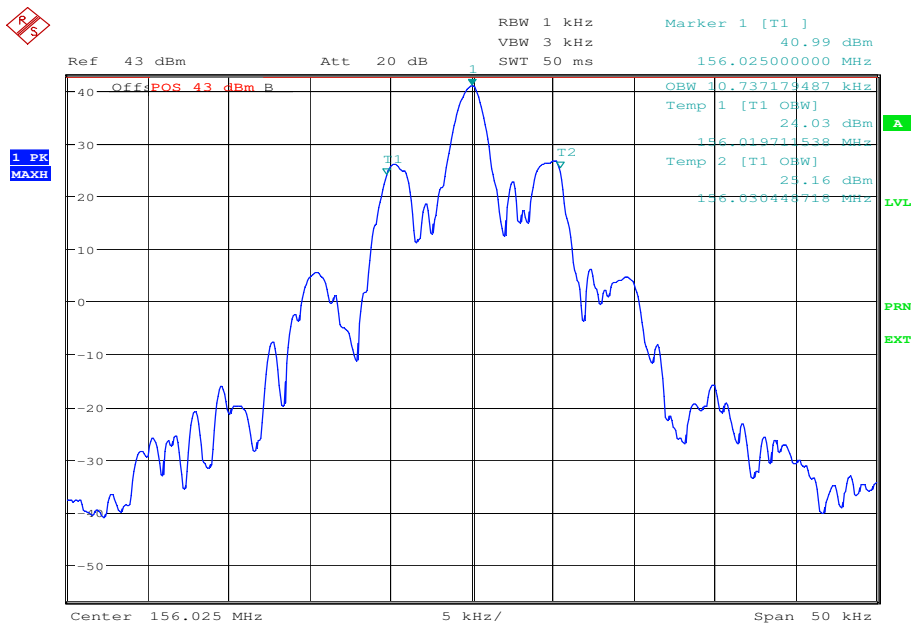
2.1.7 Test Results

AIS

Frequency	Test Signal	Authorised Bandwidth	Result (kHz)
156.025 MHz	01010101	20 kHz	10.74
	00001111	20 kHz	8.73
	PRBS	20 kHz	9.78
162.025 MHz	01010101	20 kHz	10.82
	00001111	20 kHz	8.81
	PRBS	20 kHz	9.62

156.025 MHz

01010101

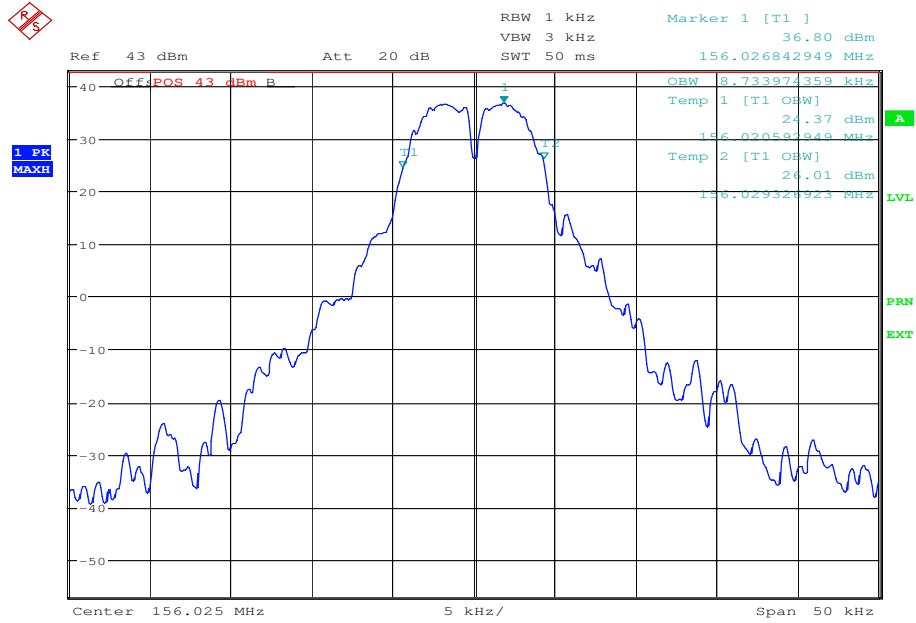


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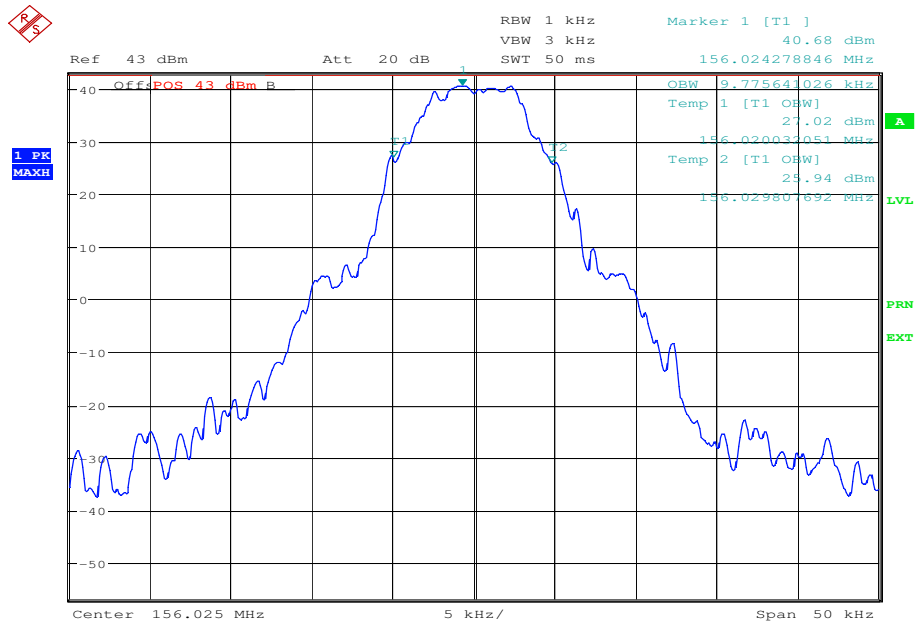
Product Service

00001111



Date: 31.MAR.2015 16:27:09

PRBS



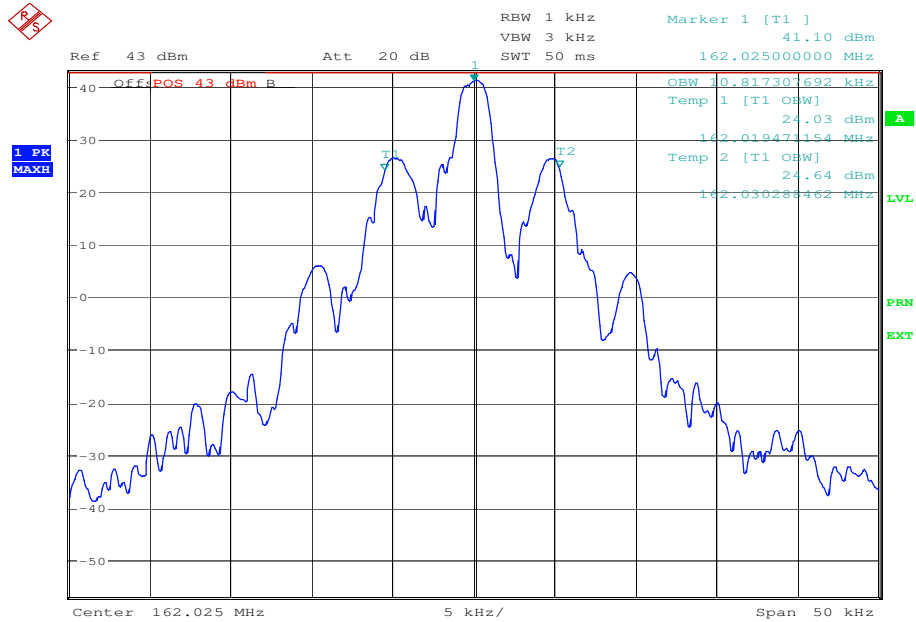
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Product Service

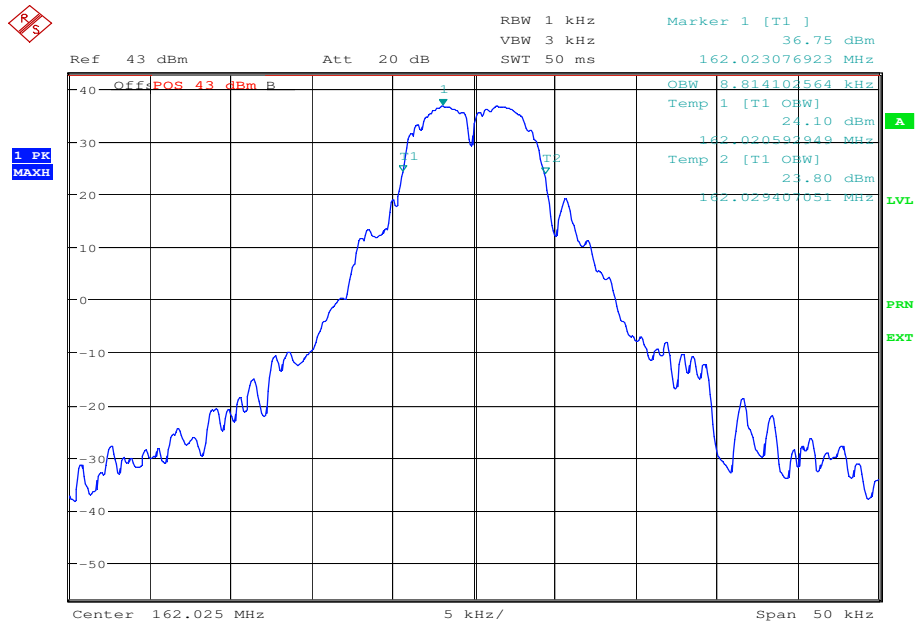
162.025 MHz

01010101



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00001111

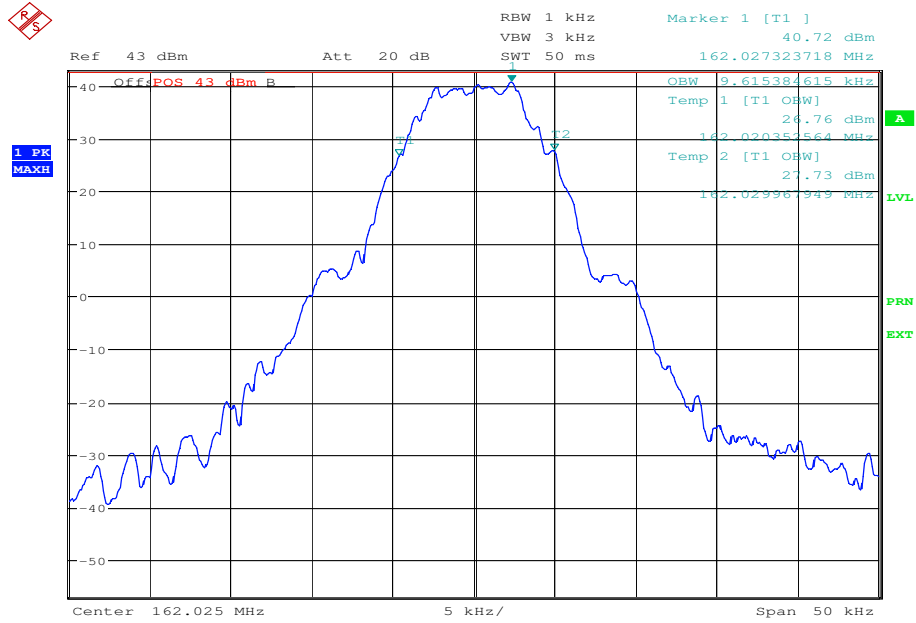


Date: 31.MAR.2015 16:38:39



Product Service

PRBS



Date: 31.MAR.2015 16:56:14

Limit Clause

20 kHz



## 2.2 TRANSMITTER FREQUENCY TOLERANCES

### 2.2.1 Specification Reference

FCC CFR 47 Part 80, Clause 80.209,  
Industry Canada RSS-182, Clause 5.1 and 7.4

### 2.2.2 Equipment Under Test and Modification State

Apollo S/N: T1-01-07 - Modification State 0

### 2.2.3 Date of Test

1 April 2015 & 2 April 2015 & 9 April 2015

### 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 test was applied in accordance with the test method requirements of FCC CFR 47 Part 2.1055 (a) (2), (d) (1).

The EUT was transmitting at maximum power using test signal 4 as defined in IEC 61993-2. The EUT was connected to the spectrum analyser via a cable and attenuator. The external frequency reference of the spectrum analyser was locked to a 10 MHz rubidium frequency reference. The FM DEMOD function of the spectrum analyser was used which records the carrier frequency error. In accordance with 2.1055, the temperature was varied from -20°C to +55°C in no more than 10°C steps at both minimum and maximum voltage extremes.

Testing was performed at 10.8 V DC, as opposed to -15% of 12 V DC as required by FCC Part 2.1055 (d)(1) as the equipment would cease to transmit and reboot below this cut off voltage. The upper voltage extreme was 31.2 V DC which is the upper voltage extreme required as per IEC 61993-2. This is considered 'worst case' compared to the +15% of 24 V DC and therefore the EUT can be considered compliant.

The RSS-182 minimum temperature requirement of -15°C was considered 'compliant' as the EUT was within the requirements of RSS-182 at -20°C and this is also considered 'worst case' conditions.

### 2.2.6 Environmental Conditions

Ambient Temperature	23.9 - 24.3°C
Relative Humidity	22.1 - 30.6%



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**2.2.7 Test Results**

156.025 MHz

Temperature	Frequency Error (ppm)	
	10.8 V DC	31.2 V DC
-20°C	-5.43	-5.46
-10°C	-5.27	-5.28
0°C	-4.27	-4.23
+10°C	-3.50	-3.47
+20°C	-2.29	-2.30
+30°C	-1.83	-1.76
+40°C	-0.49	-0.50
+50°C	0.27	0.29
+55°C	0.49	0.52

161.975 MHz

Temperature	Frequency Error (ppm)	
	10.8 V DC	31.2 V DC
-20°C	-5.10	-5.06
-10°C	-4.95	-4.94
0°C	-3.90	-3.92
+10°C	-3.08	-3.10
+20°C	-2.04	-2.01
+30°C	-1.36	-1.42
+40°C	-0.23	-0.26
+50°C	0.53	0.55
+55°C	0.74	0.77





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162.025 MHz

Temperature	Frequency Error (ppm)	
	10.8 V DC	31.2 V DC
-20°C	-4.98	-5.02
-10°C	-4.94	-4.94
0°C	-3.92	-3.97
+10°C	-3.03	-3.03
+20°C	-2.05	-2.09
+30°C	-1.37	-1.32
+40°C	-0.27	-0.36
+50°C	0.53	0.58
+55°C	0.77	0.78

Frequency	Maximum Frequency Error (Hz)
156.025 MHz	-5.46
161.975 MHz	-5.10
162.025 MHz	-5.02

Limit Clause

±10 ppm.



## 2.3 EMISSION LIMITATIONS

### 2.3.1 Specification Reference

FCC CFR 47 Part 80, Clause 80.211  
Industry Canada RSS-182, Clause 7.9

### 2.3.2 Equipment Under Test and Modification State

Apollo S/N: T1-01-07 - Modification State 0

### 2.3.3 Date of Test

30 March 2015, 1 April 2015 & 7 April 2015

### 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

For emissions where the frequency is removed less than 250% of the authorized bandwidth measurements were performed conducted as follows:

The EUT was connected to a spectrum analyser via a cable and attenuator. The EUT was set to transmit on maximum power modulated using the standard AIS test signal number 4 as defined in IEC 61993-2 via test mode. The path loss between the EUT and analyser was calibrated using a network analyser and entered in to the spectrum analyser as a reference level offset. The reference level for the mask was set to the values recorded for transmitter power as defined in FCC CFR 47 Part 80.215. The RBW and VBW were then reduced to 1 kHz and 3 kHz respectively and the mask as per FCC CFR 47 Part 80.211 (f) was applied.

For emissions where the frequency is removed more than 250% of the authorized bandwidth measurements were performed both conducted and radiated as follows:

Conducted: A network analyser was used to measure the path loss and the worst case was entered as a reference level offset in to the spectrum analyser. The EUT was connected to a spectrum analyser via an attenuator and cable for frequencies below 300 MHz and via a cable, attenuator and 300 MHz high pass filter for frequencies greater than 300 MHz. The spectrum analyser was configured with an RBW of 100 kHz below 1 GHz other than below 100 kHz where a an RBW of 1 kHz was used to reduce the DC leakage from the spectrum analyser For frequencies greater than 1 GHz an RBW of 1 MHz was used. The trace set to max hold using a peak detector.

Radiated; A preliminary profile of the Spurious Radiated Emissions was obtained up to the 10th harmonic 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.



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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.

The EUT was set to transmit on maximum power with both channels operating simultaneously which was achieved by programming a valid MMSI in the 'real-life' mode of operation.

For any emissions found the EUT was then removed from the chamber and replaced with a substitution antenna. Using a signal generator the level was adjusted to achieve the same value on the measuring instrument as previously recorded with the EUT. The final result was determined by a calculation using the signal generator level, antenna gain and cable loss.

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

**2.3.6 Environmental Conditions**

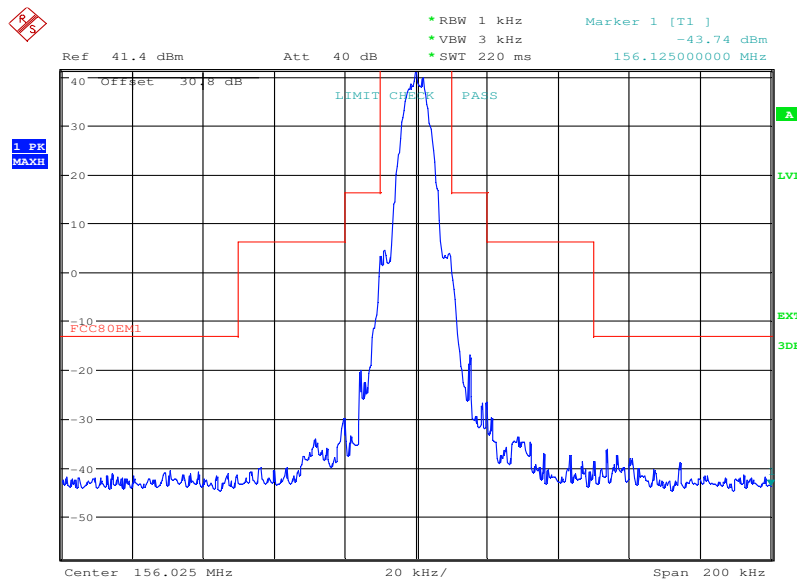
Ambient Temperature 23.8°C  
 Relative Humidity 31.5%

**2.3.7 Test Results**

12.0 V DC Supply

Conducted

156.025 MHz

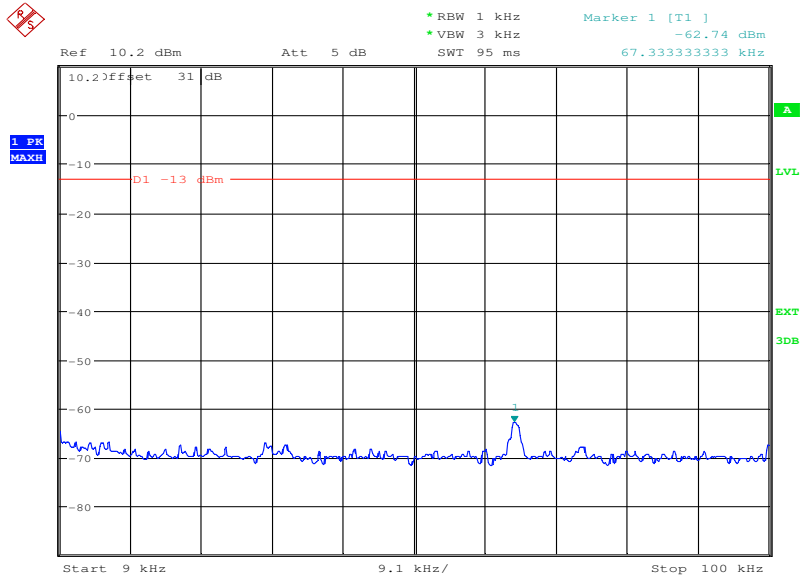


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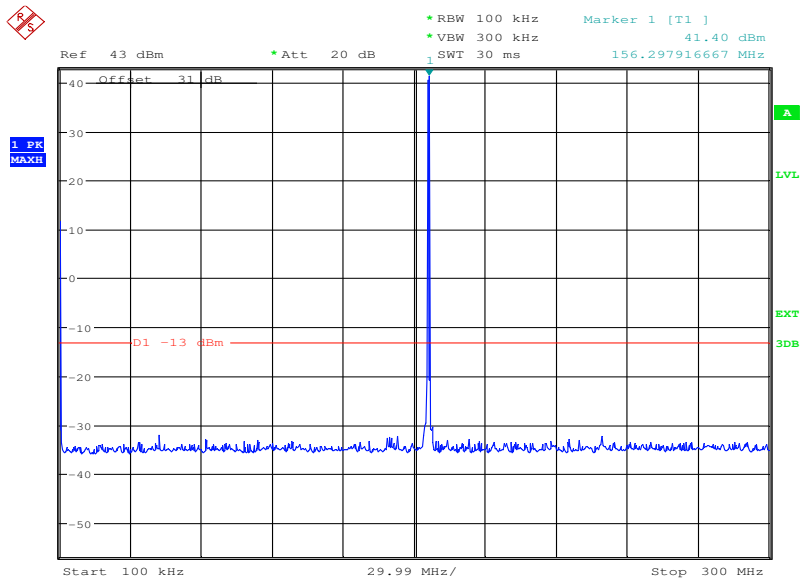
Product Service

9 kHz to 100 kHz



Date: 30.MAR.2015 14:48:53

100 kHz to 300 MHz

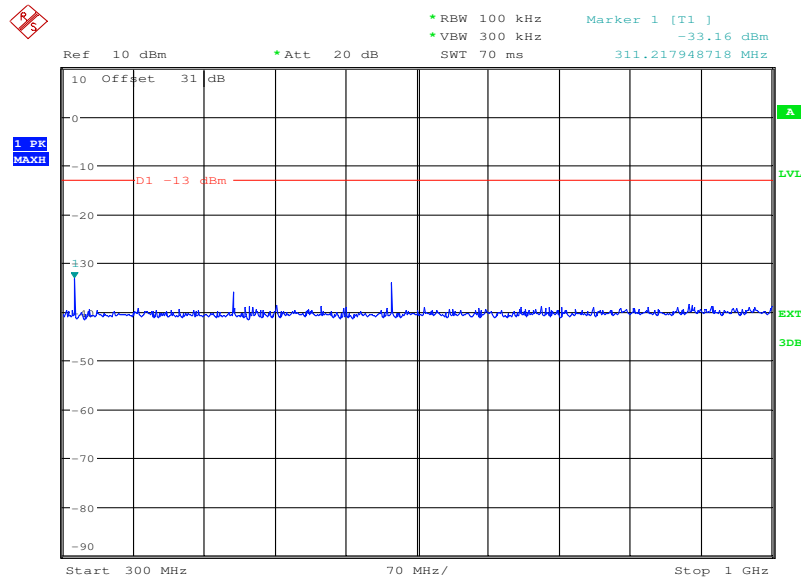


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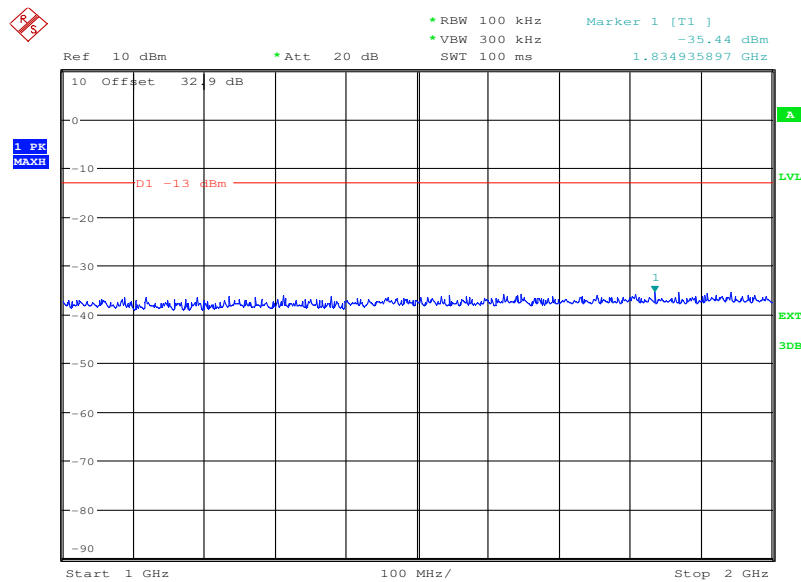
Product Service

### 300 MHz to 1 GHz



Date: 30.MAR.2015 15:10:53

### 1 GHz to 2 GHz

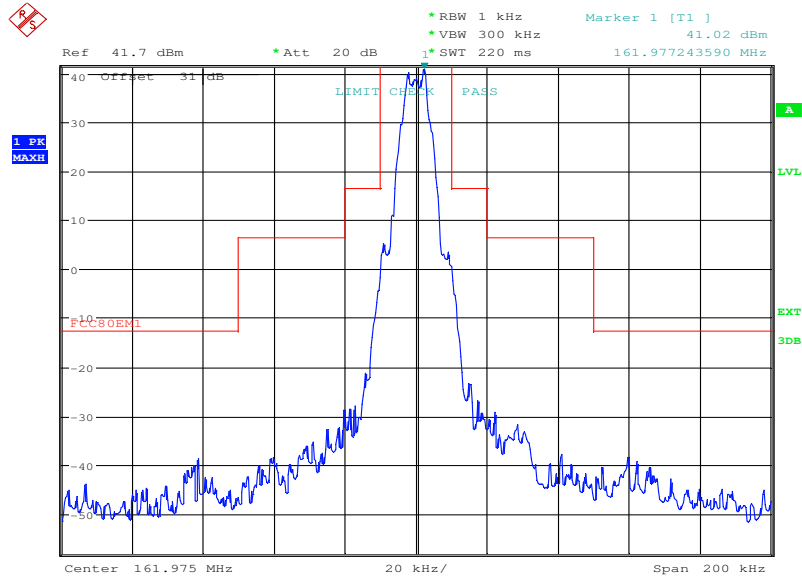


Date: 30.MAR.2015 15:08:29



Product Service

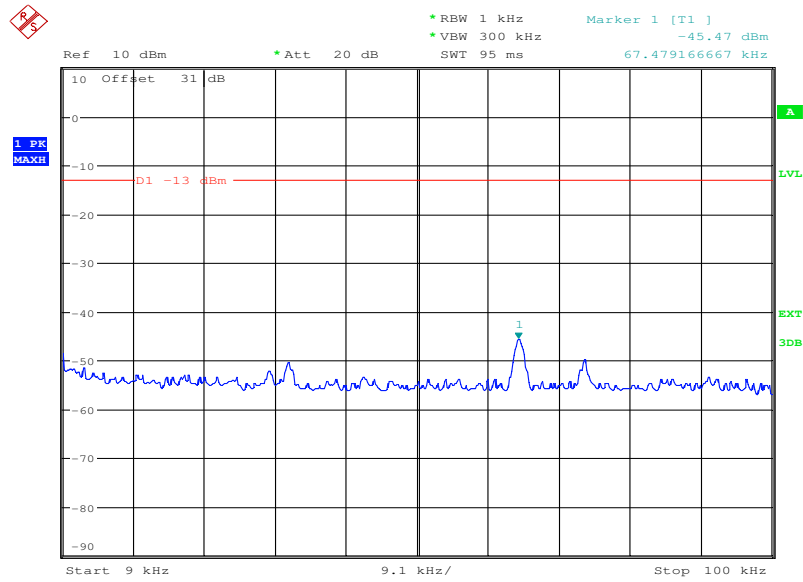
161.975 MHz



Date: 30.MAR.2015 16:41:03

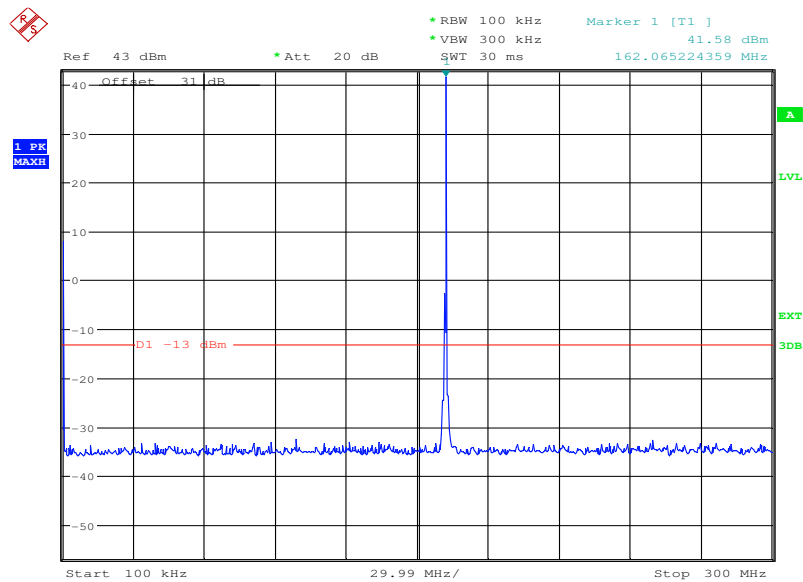


9 kHz to 100 kHz



Date: 30.MAR.2015 16:38:43

100 kHz to 300 MHz

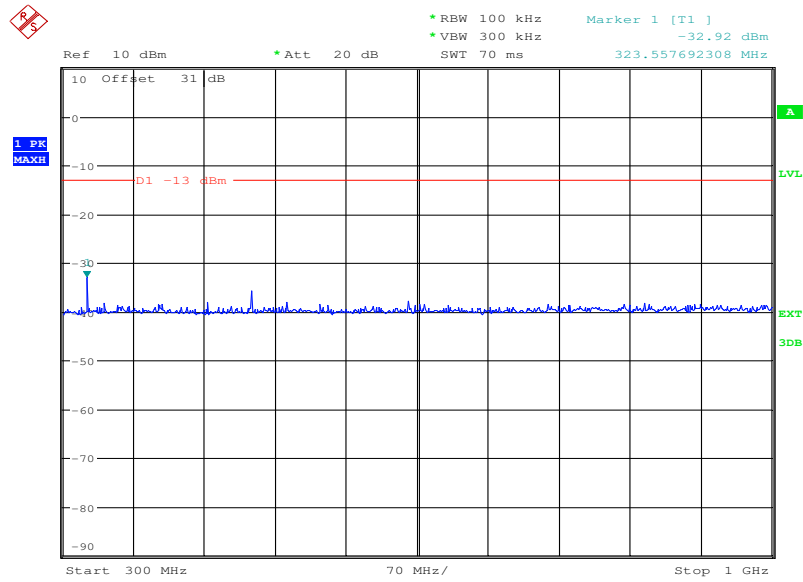


Date: 30.MAR.2015 16:37:19



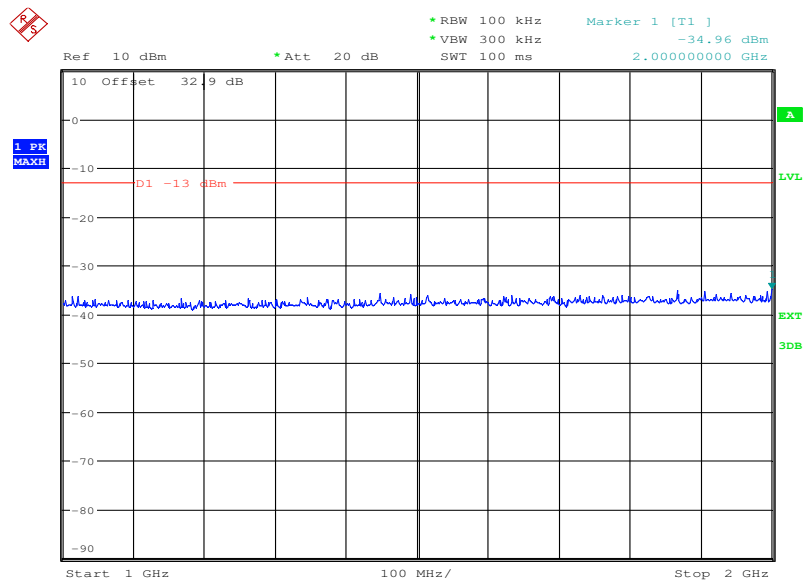
Product Service

### 300 MHz to 1 GHz



Date: 30.MAR.2015 16:33:02

### 1 GHz to 2 GHz



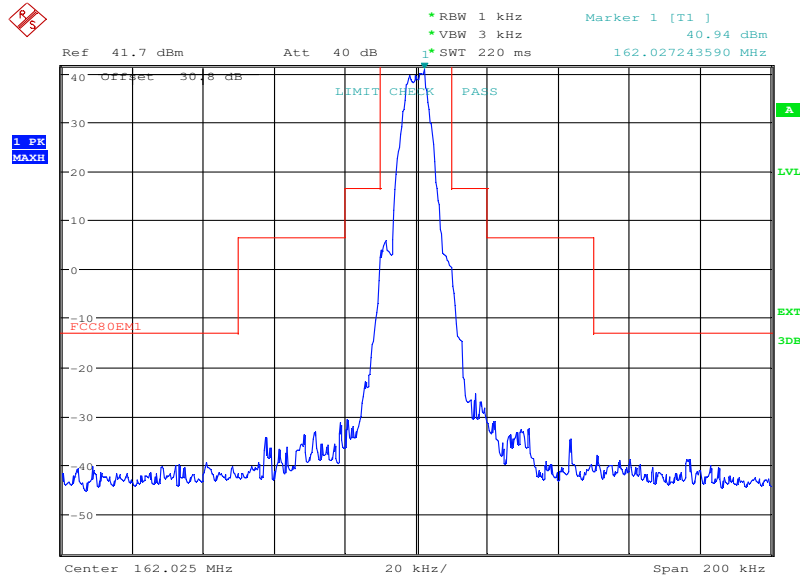
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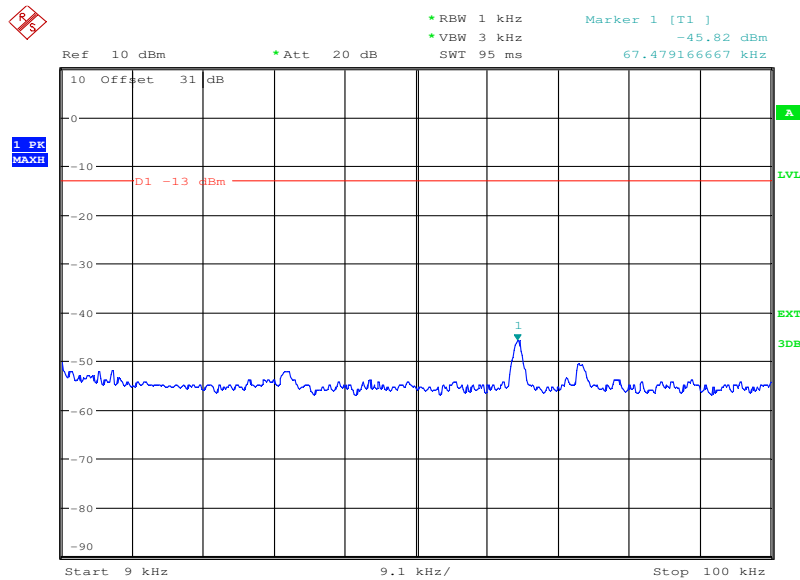
Product Service

162.025 MHz



Date: 30.MAR.2015 14:44:06

9 kHz to 100 kHz

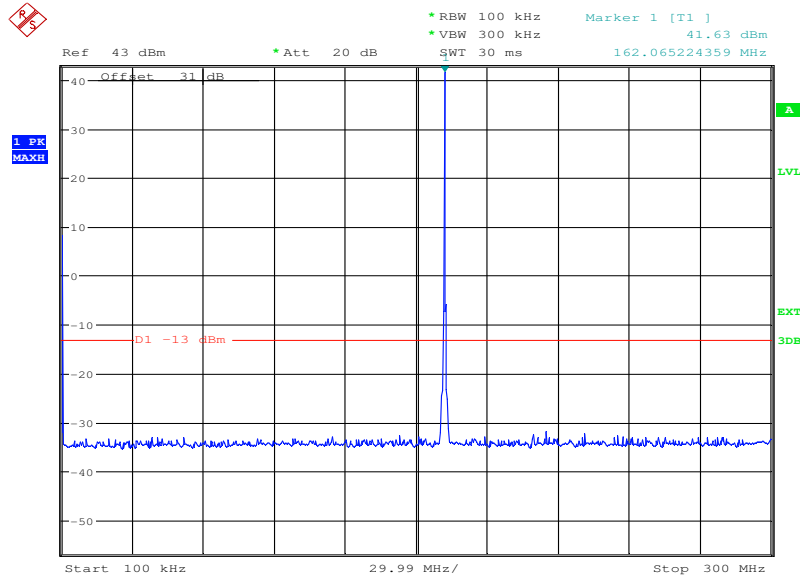


Date: 30.MAR.2015 14:58:35



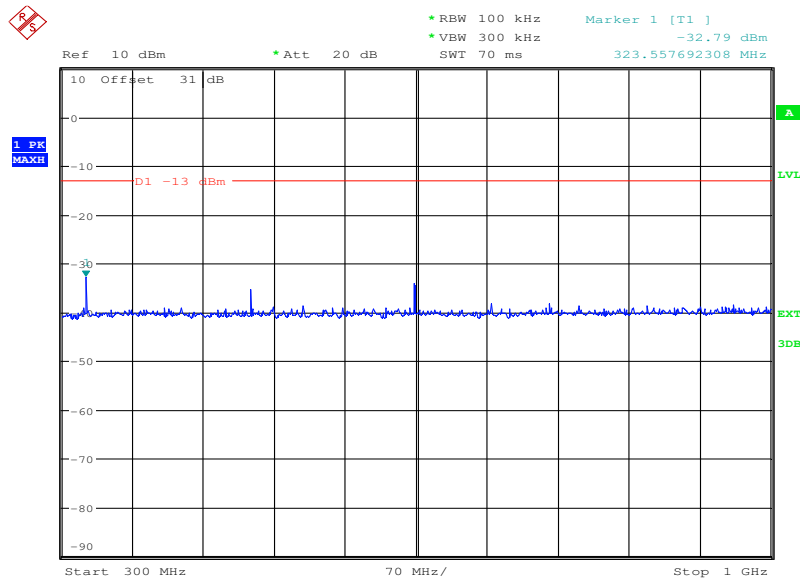
Product Service

### 100 kHz to 300 MHz



Date: 30.MAR.2015 14:56:36

### 300 MHz to 1 GHz

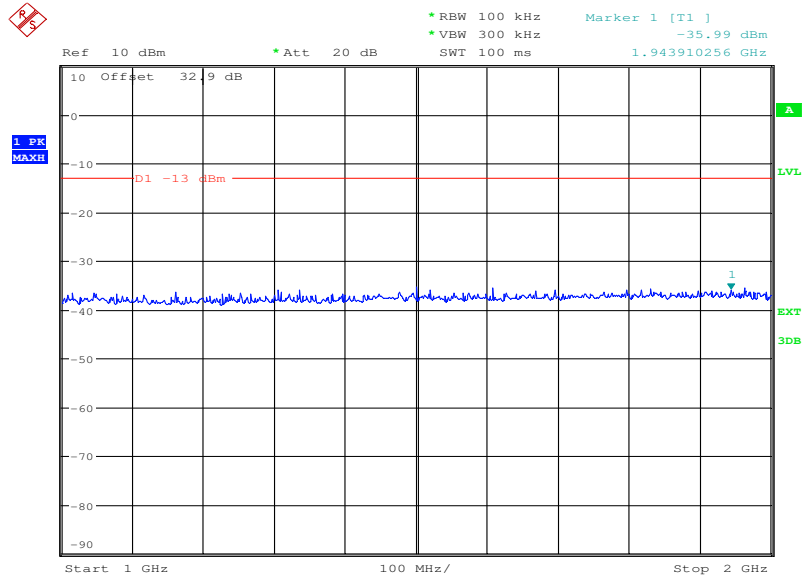


Date: 30.MAR.2015 15:02:33



Product Service

1 GHz to 2 GHz



Date: 30.MAR.2015 15:04:53



Product Service

Radiated

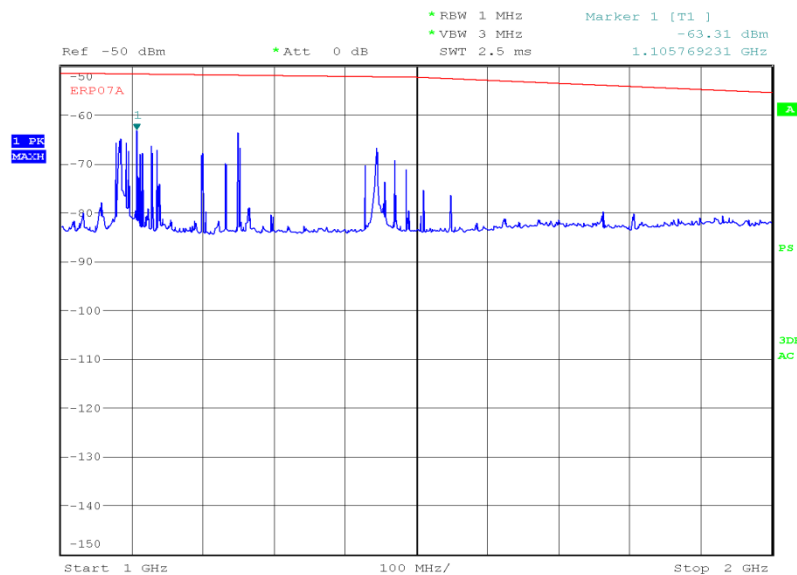
161.975 MHz

30 MHz to 1 GHz



Date: 1.APR.2015 18:42:13

1 GHz to 2 GHz



Date: 31.MAR.2015 20:58:32



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Limit Clause 80.211

Emission Mask

On any frequency removed from the assigned frequency by more than 50 % up to and including 100 % of the authorized bandwidth: At least 25 dB

On any frequency removed from the assigned frequency by more than 100 % up to and including 250 % of the authorized bandwidth: At least 35 dB

Outside the Emission Mask

>250 % of authorised bandwidth  $43+10 \log P$  or -13 dBm



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## **2.4 MODULATION REQUIREMENTS**

### **2.4.1 Specification Reference**

FCC CFR 47 Part 2, Clause 2.1047  
Industry Canada RSS-182, Clause 7.3

### **2.4.2 Equipment Under Test and Modification State**

Apollo S/N: T1-01-07 - Modification State 0

### **2.4.3 Date of Test**

30 March 2015

### **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 transmitting at maximum power, modulated by the standard AIS test signals as defined in IEC 61993-2. The EUT was connected to a spectrum analyser via a cable and attenuator, using the FM demodulation function of the spectrum analyser the following plots were taken to give a visual representation of the modulation characteristics as required by FCC CFR 47 Part 2.1047.

### **2.4.6 Environmental Conditions**

Ambient Temperature	24.1°C
Relative Humidity	22.2%



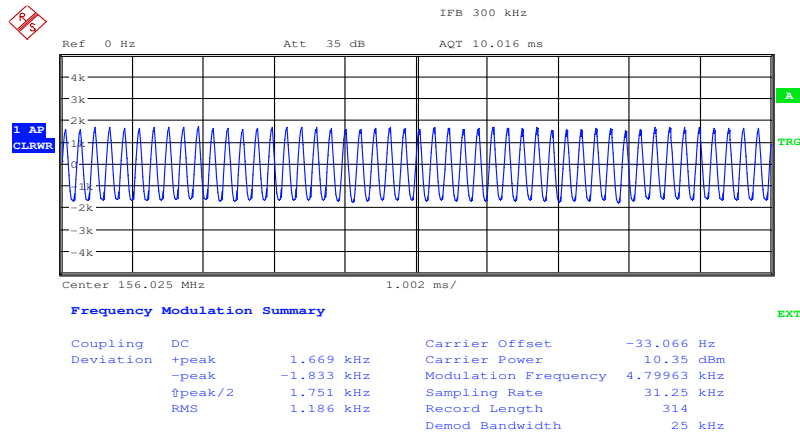
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2.4.7 Test Results

AIS

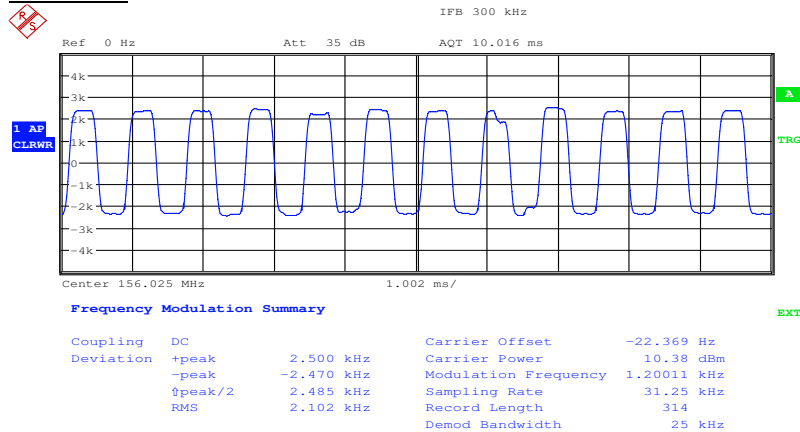
156.025 MHz

01010101



Date: 30.MAR.2015 11:52:16

00001111

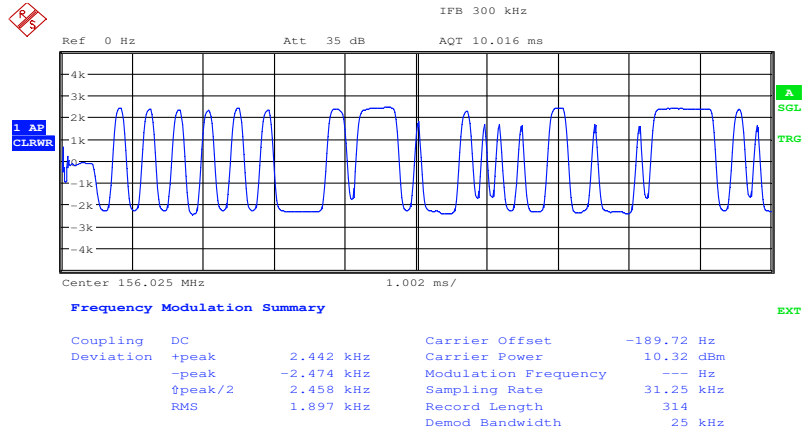


Date: 30.MAR.2015 11:52:53



Product Service

PRBS



Date: 30.MAR.2015 11:54:56

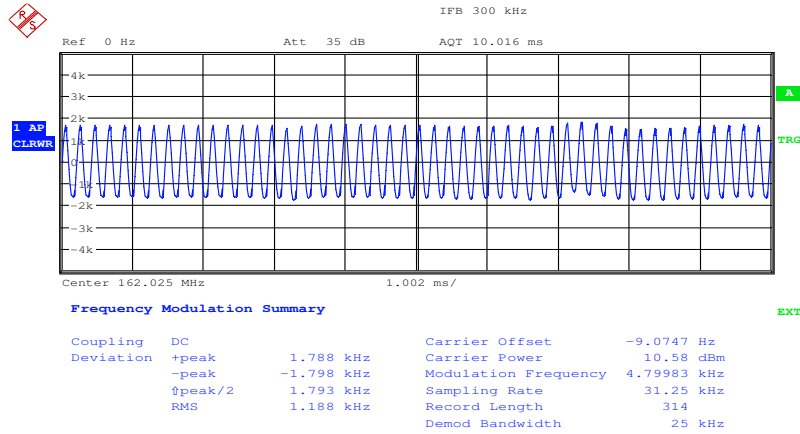




Product Service

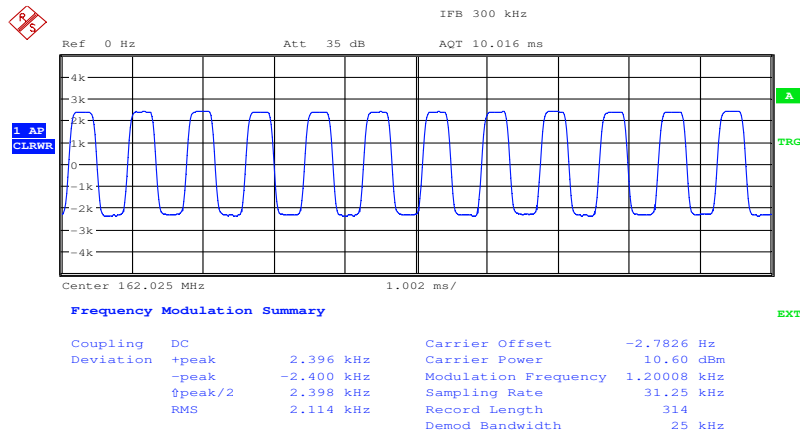
162.025 MHz

01010101



Date: 30.MAR.2015 11:42:44

00001111

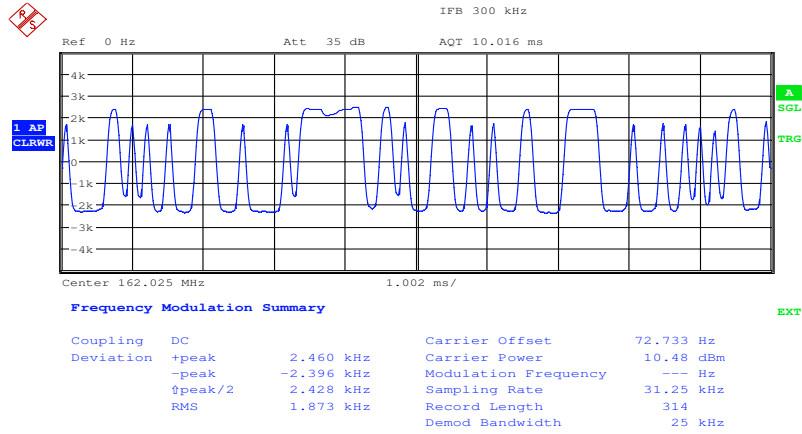


Date: 30.MAR.2015 11:41:53



Product Service

PRBS



Date: 30.MAR.2015 11:44:43



Product Service

## 2.5 TRANSMITTER FREQUENCY DEVIATION

### 2.5.1 Specification Reference

FCC CFR 47 Part 80, Clause 80.213 (a)(2)  
Industry Canada RSS-182, Clause 7.3

### 2.5.2 Equipment Under Test and Modification State

Apollo S/N: T1-01-07 - Modification State 0

### 2.5.3 Date of Test

30 March 2015

### 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 transmitting at maximum power, modulated by the standard AIS test signals as defined in IEC 61993-2. The EUT was connected to a spectrum analyser via a cable and attenuator, using the FM demodulation function of the spectrum analyser, the peak frequency deviation was observed and shown in the plots on the following pages.

### 2.5.6 Environmental Conditions

Ambient Temperature	24.1°C
Relative Humidity	22.2%



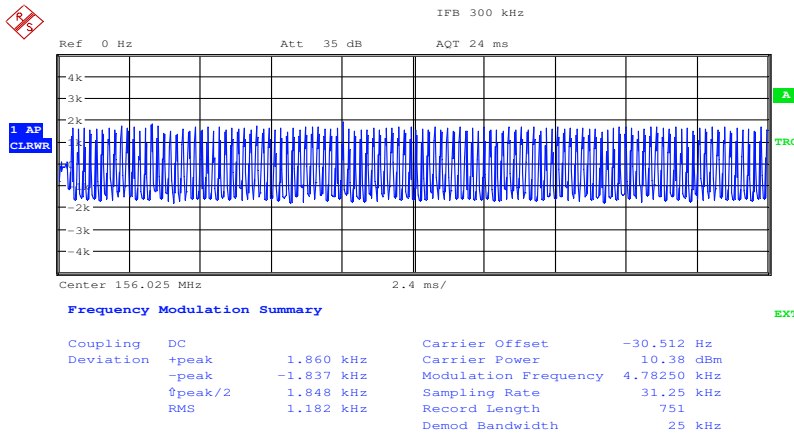
Product Service

2.5.7 Test Results

Confirm that the frequency deviation does not exceed 5 kHz	Yes
--	-----

AIS

AIS 1 – 01010101

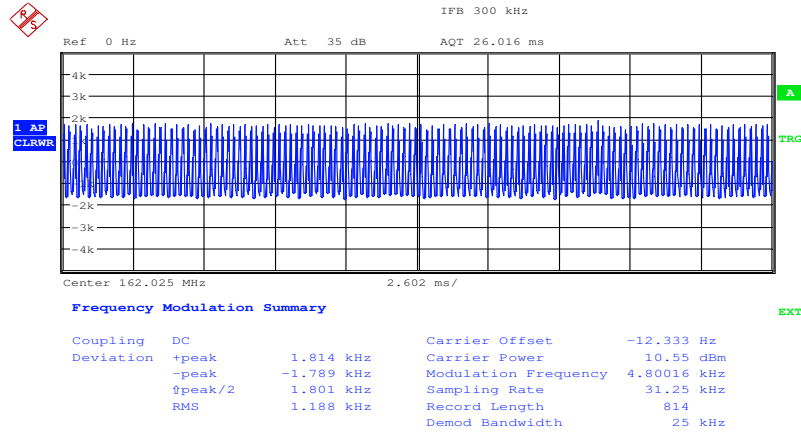


Date: 30.MAR.2015 12:00:37



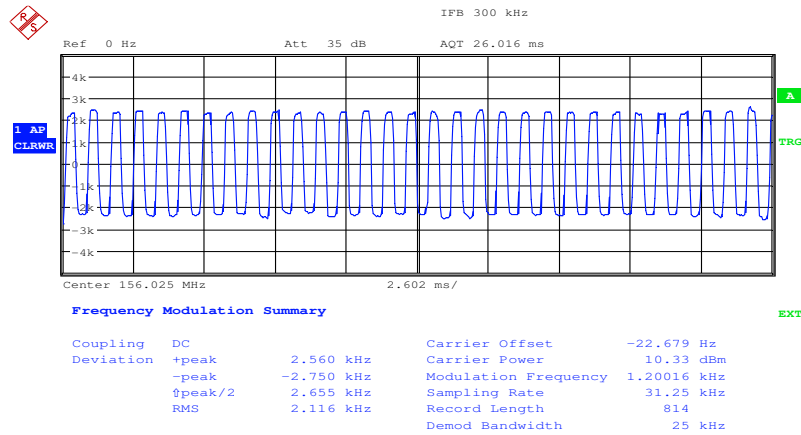
Product Service

AIS 2 – 01010101



Date: 30.MAR.2015 11:43:13

AIS 1 – 00001111

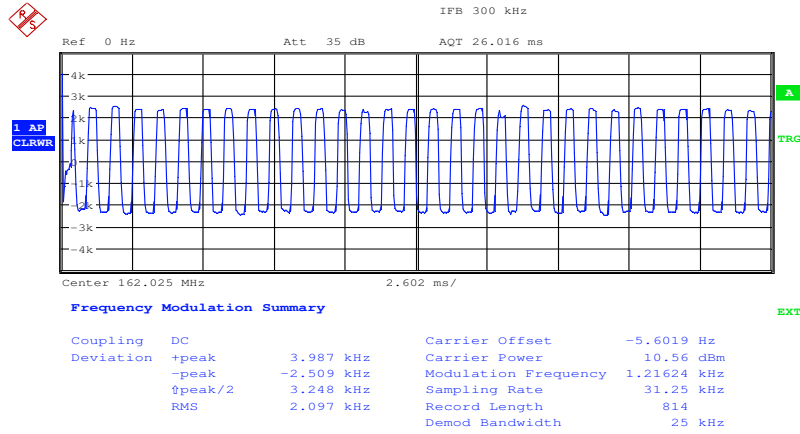


Date: 30.MAR.2015 11:53:31



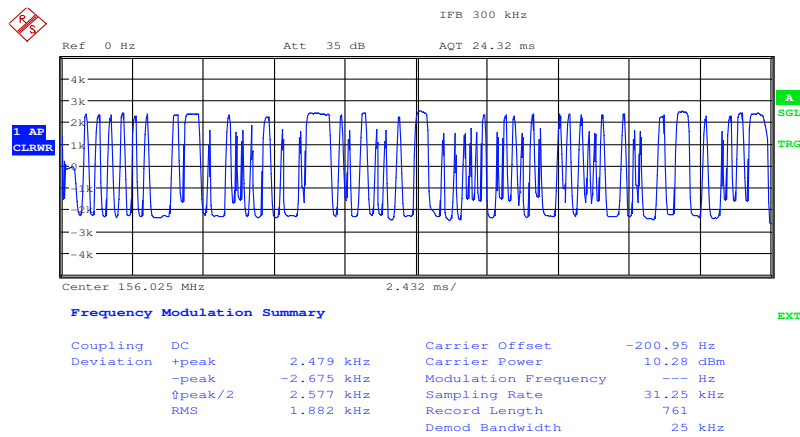
Product Service

AIS 2 – 00001111



Date: 30.MAR.2015 11:39:55

AIS 1 – PRBS

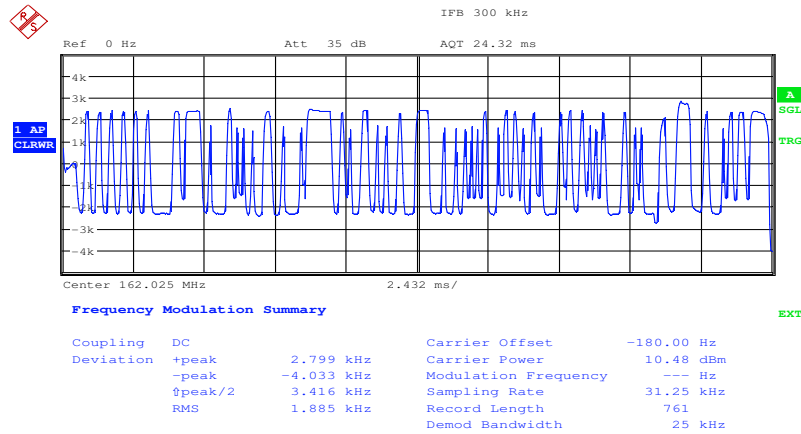


Date: 30.MAR.2015 11:54:21



Product Service

**AIS 1 – PRBS**



Date: 30.MAR.2015 11:44:02

**Limit Clause 80.213 (a)(2)**

When phase or frequency modulation is used in the 156–162 MHz band the peak modulation must be maintained between 75 and 100 percent. A frequency deviation of  $\pm 5$  kHz is defined as 100 percent peak modulation.

**Limit Clause 80.213 (d)**

Ship and coast stations transmitters operating in the 156-162 MHz and 216-220 MHz bands must be capable of proper operation with a frequency deviation that does not exceed  $\pm 5$  kHz.



Product Service

## **2.6 TRANSMITTER POWER**

### **2.6.1 Specification Reference**

FCC CFR 47 Part 80, Clause 80.215  
Industry Canada RSS-182, Clause 5.2 and 7.5

### **2.6.2 Equipment Under Test and Modification State**

Apollo S/N: T1-01-07 - Modification State 0

### **2.6.3 Date of Test**

30 March 2015

### **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 set to transmit on maximum power, the EUT was modulated using the standard AIS test signal number 4 as defined in IEC 61993-2. The EUT was connected to a spectrum analyser via a cable and attenuator. The DC input voltage was set to 12.5 V DC to satisfy the requirement of 80.215(g) as the EUT will be powered by a 12V lead acid battery. The path loss was measured using a network analyser and entered as a reference level offset in the spectrum analyser. The RBW of the spectrum analyser was set to 1 MHz and the video bandwidth to 3 MHz with the trace set to max hold and peak detector.

### **2.6.6 Environmental Conditions**

Ambient Temperature	23.7°C
Relative Humidity	21.6%





Product Service

**2.6.7 Test Results**

156.025 MHz

Result (dBm)	Result (W)
41.42	13.87

161.975 MHz

Result (dBm)	Result (W)
41.70	14.79

162.025 MHz

Result (dBm)	Result (W)
41.66	14.66

Limit Clause ITU-R M.1371-3 Clause 2.1.2

12.5 W  $\pm$ 1.5 dB

Limit Clause RSS-182 Clause 7.5

The output power shall be within  $\pm$ 1.0 dB of the manufacturer's rated power and not exceed the limits listed in Table 3, unless indicated otherwise.

Stations	Typical Power
Coast Stations	50 W
Ship Stations	Minimum 6 W, Maximum 25 W
Hand-held portable transmitters	5 W
Survival two-way radiotelephones	Should have a minimum e.i.r.p of 0.25 watt



Product Service

## 2.7 TRANSMITTER CARRIER POWER REDUCTION

### 2.7.1 Specification Reference

FCC CFR 47 Part 80, Clause 80.215 (e)(g)(1)  
Industry Canada RSS-182, Clause 7.5 and 5.2

### 2.7.2 Equipment Under Test

Apollo

### 2.7.3 Test Waiver



Software  
Radio Technology

Software Radio Technology PLC  
Tel: +44 (0)1761 409 500  
Fax: +44 (0)1410 093  
Email: [enquiries@softworerad.com](mailto:enquiries@softworerad.com)

13 April, 2015

TUV SUD BABT  
Octagon House,  
Concorde Way  
Segensworth North  
Fareham  
Hampshire  
PO15 5RL

To whom it may concern,

#### SRT-Marine Technology Apollo Class A Transceiver

#### Request for waiver against non applicable clauses Of CFR 47 and RSS-182.

CFR 47 80.215 is not applicable as the device is not capable of reducing the output power. AIS is an automated system therefore this is an exception to the FCC requirement.

RSS-182 clause 7.5 allows an exception for DSC equipment, and the same exception applies to AIS.

Yours faithfully,

A handwritten signature in blue ink, appearing to be 'Richard McMahon'.

**Richard McMahon**  
Certification Engineer  
[richard.mcmahon@srt-marine.com](mailto:richard.mcmahon@srt-marine.com)  
+44 1761 409500



Product Service

## **2.8 SUPPRESSION OF INTERFERENCE ABOARD SHIPS**

### **2.8.1 Specification Reference**

FCC CFR 47 Part 80, Clause 80.217 (b)

### **2.8.2 Equipment Under Test and Modification State**

Apollo S/N: T1-01-07 - Modification State 0

### **2.8.3 Date of Test**

31 March 2015

### **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 configured without an MMSI in order to prevent unwanted transmissions from the device. The EUT was then configured for 'normal' operation and was therefore 'scanning' across the entire frequency band.

The antenna port of the EUT was connected to a spectrum analyser via a cable and attenuator of 50 ohm impedance. A network analyser was used to measure the path loss and the worst case was entered as a reference level offset in to the spectrum analyser. The spectrum analyser settings were configured with an RBW of 100 kHz below 1 GHz and 1 MHz for frequencies greater than 1 GHz using a VBW of 3 times the RBW. At frequencies less than 100 kHz an RBW of 1kHz was chosen to reduce the DC component of the analyser. The trace set to max hold using a peak detector and the plots recorded as shown.

### **2.8.6 Environmental Conditions**

Ambient Temperature	24.2°C
Relative Humidity	22.3%



Product Service

**2.8.7 Test Results**

Conducted

Receive

Frequency of Interfering Emissions (MHz)	Power to Artificial Antenna ( $\mu$ W)	Power to Artificial Antenna (dBm)
9 kHz to 30 MHz	0.23	-66.42
30 MHz to 100 MHz	1.28	-58.93
100 MHz to 300 MHz	0.13	-68.71
300 MHz to 1000 MHz	1.46	-58.35
300 MHz to 2000 MHz	1.16	-59.34

Limit Clause

The EUT shall deliver not more than the following amounts of power, to an artificial antenna having electrical characteristics equivalent to those of the average receiving antenna(s) use on shipboard:

Frequency of interfering emissions	Power to artificial antenna in $\mu$ W
Below 30 MHz	400
30 to 100 MHz	4,000
100 to 300 MHz	40,000
Over 300 MHz	400,000



Product Service

### **SECTION 3**

#### **TEST EQUIPMENT USED**



### 3.1 TEST EQUIPMENT USED

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

Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Due
<b>Section 2.1- Bandwidths</b>					
Power Supply Unit	Hewlett Packard	6267B	21	-	TU
Multimeter	Fluke	79 Series III	611	12	1-Sep-2015
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	28-Jul-2015
Spectrum Analyser	Rohde & Schwarz	FSU26	2747	12	20-Jan-2016
Hygrometer	Rotronic	I-1000	3220	12	24-Jul-2015
Attenuator (30dB, 150W)	Narda	769-30	3369	12	28-May-2015
Frequency Standard	Spectracom	Secure Sync 1200-0408-0601	4393	6	28-Jul-2015
1 metre N-Type Cable	IW Microwave	NPS-1806LC-394-NPS	4504	12	26-Feb-2016
1 metre N-Type Cable	IW Microwave	NPS-1806LC-394-NPS	4506	12	26-Feb-2016
<b>Section 2.2 - Transmitter Frequency Tolerances</b>					
Power Supply Unit	Hewlett Packard	6267B	21	-	TU
Digital Temperature Indicator + T/C	Fluke	51	412	12	19-Feb-2016
Multimeter	Fluke	79 Series III	611	12	1-Sep-2015
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	28-Jul-2015
Climatic Chamber	TAS	Micro 225	2892	-	O/P Mon
Hygrometer	Rotronic	I-1000	3220	12	24-Jul-2015
Attenuator (30dB, 150W)	Narda	769-30	3369	12	28-May-2015
Signal Analyser	Rohde & Schwarz	FSQ 26	3545	12	6-Aug-2015
Frequency Standard	Spectracom	Secure Sync 1200-0408-0601	4393	6	28-Jul-2015
1 metre N-Type Cable	IW Microwave	NPS-1806LC-394-NPS	4504	12	26-Feb-2016
1 metre N-Type Cable	IW Microwave	NPS-1806LC-394-NPS	4506	12	26-Feb-2016



Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Due
<b>Section 2.3 - Emission Limitations</b>					
Power Supply Unit	Hewlett Packard	6267B	21	-	TU
Multimeter	Fluke	79 Series III	611	12	1-Sep-2015
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	28-Jul-2015
Screened Room (5)	Rainford	Rainford	1545	24	26-Jun-2015
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
High Pass Filter	Mini-Circuits	NHP-300	1640	12	17-Sep-2015
Multimeter	Iso-tech	IDM101	2417	12	26-Sep-2015
Signal Generator (250kHz to 4GHz)	Agilent Technologies	E4433B	2893	12	25-Jul-2015
Antenna (Bilog)	Chase	CBL6143	2904	24	10-Jun-2015
Antenna (Log Periodic)	Schaffner	UPA6108	3108	12	16-May-2015
Antenna (DRG Horn)	ETS-LINDGREN	3115	3125	12	16-Jul-2015
Hygrometer	Rotronic	I-1000	3220	12	24-Jul-2015
Attenuator (30dB, 150W)	Narda	769-30	3369	12	28-May-2015
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	27-Oct-2015
Signal Analyser	Rohde & Schwarz	FSQ 26	3545	12	6-Aug-2015
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	3-Sep-2015
7m Armoured RF Cable	SSI Cable Corp.	1501-13-13-7m WA(-)	3600	-	TU
9m RF Cable (N Type)	Rhophase	NPS-2303-9000-NPS	3791	-	TU
Tilt Antenna Mast	maturo GmbH	TAM 4.0-P	3916	-	TU
Mast Controller	maturo GmbH	NCD	3917	-	TU
Digital thermo Hygrometer	Radio Spares	1260	4300	12	1-May-2015
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	24-Sep-2015
Frequency Standard	Spectracom	Secure Sync 1200-0408-0601	4393	6	28-Jul-2015
1 metre N-Type Cable	IW Microwave	NPS-1806LC-394-NPS	4504	12	26-Feb-2016
1 metre N-Type Cable	IW Microwave	NPS-1806LC-394-NPS	4506	12	26-Feb-2016
2m K-Type Cable (Rx)	Scott Cables	KPS-1501-2000-KPS	4527	6	29-Jul-2015
<b>Section 2.4 - Modulation Requirements</b>					
Power Supply Unit	Hewlett Packard	6267B	21	-	TU
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	28-Jul-2015
Hygrometer	Rotronic	I-1000	3220	12	24-Jul-2015
Attenuator (30dB, 150W)	Narda	769-30	3369	12	28-May-2015
Signal Analyser	Rohde & Schwarz	FSQ 26	3545	12	6-Aug-2015
Frequency Standard	Spectracom	Secure Sync 1200-0408-0601	4393	6	28-Jul-2015
1 metre N-Type Cable	IW Microwave	NPS-1806LC-394-NPS	4504	12	26-Feb-2016
1 metre N-Type Cable	IW Microwave	NPS-1806LC-394-NPS	4506	12	26-Feb-2016
<b>Section 2.5 - Transmitter Frequency Deviation</b>					
Power Supply Unit	Hewlett Packard	6267B	21	-	TU
Multimeter	Fluke	79 Series III	611	12	1-Sep-2015
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	28-Jul-2015
Thermocouple Thermometer	Fluke	51	3172	12	24-Sep-2015
Hygrometer	Rotronic	I-1000	3220	12	24-Jul-2015
Attenuator (30dB, 150W)	Narda	769-30	3369	12	28-May-2015
Signal Analyser	Rohde & Schwarz	FSQ 26	3545	12	6-Aug-2015
Frequency Standard	Spectracom	Secure Sync 1200-0408-0601	4393	6	28-Jul-2015
1 metre N-Type Cable	IW Microwave	NPS-1806LC-394-NPS	4504	12	26-Feb-2016
1 metre N-Type Cable	IW Microwave	NPS-1806LC-394-NPS	4506	12	26-Feb-2016



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Instrument	Manufacturer	Type No.	TE No.	Calibration Period (months)	Calibration Due
<b>Section 2.6 - Transmitter Power</b>					
Power Supply Unit	Hewlett Packard	6267B	21	-	TU
Multimeter	Fluke	79 Series III	611	12	1-Sep-2015
Attenuator (30dB, 150W)	Narda	769-30	3369	12	28-May-2015
Signal Analyser	Rohde & Schwarz	FSQ 26	3545	12	6-Aug-2015
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	3-Sep-2015
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	24-Sep-2015
1 metre N-Type Cable	IW Microwave	NPS-1806LC-394-NPS	4504	12	26-Feb-2016
1 metre N-Type Cable	IW Microwave	NPS-1806LC-394-NPS	4506	12	26-Feb-2016
<b>Section 2.7 - Transmitter Carrier Power Reduction</b>					
Power Supply Unit	Hewlett Packard	6267B	21	-	TU
Multimeter	Fluke	79 Series III	611	12	1-Sep-2015
Attenuator (30dB, 150W)	Narda	769-30	3369	12	28-May-2015
Signal Analyser	Rohde & Schwarz	FSQ 26	3545	12	6-Aug-2015
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	3-Sep-2015
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	24-Sep-2015
1 metre N-Type Cable	IW Microwave	NPS-1806LC-394-NPS	4504	12	26-Feb-2016
1 metre N-Type Cable	IW Microwave	NPS-1806LC-394-NPS	4506	12	26-Feb-2016
<b>Section 2.8 - Suppression of Interface Aboard Ships</b>					
Power Supply Unit	Hewlett Packard	6267B	21	-	TU
Multimeter	Fluke	79 Series III	611	12	1-Sep-2015
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	28-Jul-2015
Spectrum Analyser	Rohde & Schwarz	FSU26	2747	12	20-Jan-2016
Hygrometer	Rotronic	I-1000	3220	12	24-Jul-2015
DC - 12.4 GHz 10 dB Attenuator 1 W	Suhner	6810.17.A	3964	12	22-Oct-2015
Frequency Standard	Spectracom	Secure Sync 1200-0408-0601	4393	6	28-Jul-2015
1 metre N-Type Cable	IW Microwave	NPS-1806LC-394-NPS	4504	12	26-Feb-2016
1 metre N-Type Cable	IW Microwave	NPS-1806LC-394-NPS	4506	12	26-Feb-2016

TU – Traceability Unscheduled





Product Service

### 3.2 MEASUREMENT UNCERTAINTY

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

Test Discipline	MU
Modulation Requirements	-
Transmitter Frequency Deviation	-
Bandwidths	$\pm 58.05$ Hz
Transmitter Power	$\pm 0.70$ dB
Transmitter Frequency Tolerances	$\pm 11$ Hz
Suppression of Interference Aboard Ships	-
Transmitter Carrier Power Reduction	-
Emission Limitations	Radiated: $\pm 3.08$ dB Conducted: $\pm 3.454$ dB



Product Service

## **SECTION 4**

### **ACCREDITATION, DISCLAIMERS AND COPYRIGHT**



Product Service

#### 4.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT



This report relates only to the actual item/items tested.

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