

FCC and Industry Canada Testing of the
SRT Marine Technology Limited
AIS Class B CSTDMA and SOTDMA Transceiver,
Model: COBALT II
In accordance with FCC 47 CFR Part 80,
FCC 47 CFR Part 2, Industry Canada RSS-182
and Industry Canada RSS-GEN



Product Service

Choose certainty.
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Prepared for: SRT Marine Technology Limited
Wireless House, Westfield Ind Est.
Midsomer Norton, Bath, BA3 4BS
United Kingdom

FCC ID: (CSTDMA): YYG-411-0010, (SOTDMA): YYG-411-0012
IC: (CSTDMA): 9384A-4110010B, (SOTDMA): 9384A-4110012B

COMMERCIAL-IN-CONFIDENCE

Date: September 2017

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RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Project Management	Sarah Jones	29 September 2017	
Authorised Signatory	Matthew Russell	29 September 2017	

Signatures in this approval box have checked this document in line with the requirements of TÜV SÜD Product Service document control rules.

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 47 CFR Part 80, FCC 47 CFR Part 2, Industry Canada RSS-182 and Industry Canada RSS-GEN. The sample tested was found to comply with the requirements defined in the applied rules.

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Testing	Dan Ralley	29 September 2017	
Testing	Graeme Lawler	29 September 2017	

FCC Accreditation
90987 Octagon House, Fareham Test Laboratory

Industry Canada Accreditation
IC2932B-1 Octagon House, Fareham Test Laboratory

EXECUTIVE SUMMARY

A sample of this product was tested and found to be in compliance with FCC 47 CFR Part 80: 2016, FCC 47 CFR Part 2: 2016, Industry Canada RSS-182: Issue 5 (2012-01) and Industry Canada RSS-GEN: Issue 4 (2014).



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1 Report Summary

1.1 Report Modification Record

Alterations and additions to this report will be issued to the holders of each copy in the form of a complete document.

Issue	Description of Change	Date of Issue
1	First Issue	29 September 2017

Table 1

1.2 Introduction

Applicant	SRT Marine Technology Limited
Manufacturer	SRT Marine Technology Limited
Model Number(s)	COBALT II
Serial Number(s)	#18, #05 and #03
Hardware Version(s)	B100 CSTDMA AIS Class B Transceiver: EP2 B100 SOTDMA AIS Class B Transceiver: EP2
Software Version(s)	B100 CSTDMA AIS Class B Transceiver: 140200.01.00.03 B100 SOTDMA AIS Class B Transceiver: 150200.01.00.05
Number of Samples Tested	3
Test Specification/Issue/Date	FCC 47 CFR Part 80: 2016 FCC 47 CFR Part 2: 2016 Industry Canada RSS-182: Issue 5 (2012) Industry Canada RSS-GEN: Issue 4 (2014)
Order Number	POR006376
Date	19-May-2017
Date of Receipt of EUT	06-June-2017 and 28-June-2017
Start of Test	11-June-2017
Finish of Test	21-August-2017
Name of Engineer(s)	Dan Ralley and Graeme Lawler
Related Document(s)	ANSI C63.4

1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with FCC 47 CFR Part 80, FCC 47 CFR Part 2, Industry Canada RSS-182 and Industry Canada RSS-GEN and Industry Canada RSS-GEN is shown below.

Section	Specification Clause				Test Description	Result	Comments/Base Standard
	FCC Part 80	FCC Part 2	RSS-182	RSS-GEN			
Configuration and Mode: Idle							
2.8	-	-	-	5 and 7.1	Receiver Emissions	Pass	
Configuration and Mode: AIS - SOTDMA							
2.1	80.205	2.1049	-	6.6	Bandwidths	Pass	
2.2	80.209	2.1055	7.4	6.11	Transmitter Frequency Tolerances	Pass	
2.3	80.211	2.1051	7.9	6.13	Spurious Emissions at Antenna Terminals		
2.4	80.211	2.1051	7.9	6.13	Radiated Spurious Emissions	Pass	
2.5	80.213	2.1047	7.7	N/A	Modulation Requirements	Pass	
2.6	80.215	2.1046	7.5	6.12	Transmitter Power	Pass	
2.7	80.217(b)	-	-	-	Suppression of Interference Aboard Ships	Pass	
Configuration and Mode: AIS - CSTDMA							
2.6	80.215	2.1046	7.5	6.12	Transmitter Power	Pass	

Table 2

Full testing was performed on the SOTDMA variant as this was determined worst case based on power measurements.



1.4 Application Form

Cobalt II AIS Class B SOTDMA

EQUIPMENT DESCRIPTION			
Model Name/Number	em-trak B100		
Part Number	411-0012		
Hardware Version	1		
Software Version	150200.01.00.05		
Technical Description (Please provide a brief description of the intended use of the equipment)	AIS Class B SO TDMA		

EXTREME TEMPERATURE RANGE (over which equipment is to be type tested)	
☐	Not Applicable (no extreme temperature testing required)
☒	Category I (General)
☐	Category II (Portable equipments)
☐	Other (please specify):

TYPE OF EQUIPMENT			
☐ Fixed Station	☐ Transmitter	☐ Simplex	☐ Integral Antenna
	☐ Receiver	☒ Duplex	☐ Single Antenna
	Connector		
☒ Mobile Station	☒ Transceiver	☒ Two Antenna Connector	
		☐ Multiple Antenna Connectors No.	
☐ Portable Station	☐		
☐ Transponder (Tag)	☐ Active	☐ Passive	

TRANSMITTER TECHNICAL CHARACTERISTICS		
FREQUENCY CHARACTERISTICS		
Transmitter frequency alignment range	156.025 to 162.025	MHz
Transmitter channel switching frequency range	156.025 to 162.025	MHz



TRANSMITTER RF POWER CHARACTERISTICS			
Maximum rated transmitter output power as stated by manufacturer (if applicable)			
5	W	At transmitter permanent external 50 Ω RF output connector	
and/or			
	W	Effective radiated power (for equipment with integral antenna)	
Minimum rated transmitter output power as stated by manufacturer (if applicable)			
1	W	At transmitter permanent external 50 Ω RF output connector	
and/or			
	W	Effective radiated power (for equipment with integral antenna)	
Is transmitter intended for :			
Continuous duty		☐ Yes	☒ No
Intermittent duty only		☒ Yes	☐ No
If intermittent duty state DUTY CYCLE			
Transmitter ON	0.025	Seconds	Transmitter OFF 5 Seconds

TRANSMITTER - MODULATION			
Amplitude	☐	Other	☐
Frequency	☒	Details :	
Phase	☒	Channel Spacing	25kHz
Can the transmitter be operated without modulation? * See definition below			☐ Yes ☐ No

RECEIVER TECHNICAL CHARACTERISTICS	
FREQUENCY CHARACTERISTICS	
Receiver frequency alignment range	156.025 to 162.025MHz
Receiver channel switching frequency range	156.025 to 162.025MHz
Channel Separation (if applicable)	
State the maximum number of channels over which the equipment can operate:	240



POWER SOURCE			
☐ AC mains AC supply frequency (Hz) VAC Max Current Hz State voltage			
☐ Single phase ☐ Three phase			
And / Or			
☒ External DC supply			
Nominal voltage 12 V		Max Current 3 A	
Extreme upper voltage 31.2 V			
Extreme lower voltage 9.6 V			
Battery			
☐ Nickel Cadmium		☐ Lead acid (Vehicle regulated)	
☐ Alkaline		☐ Leclanche	
☐ Lithium		☐ Other Details :	
Volts nominal.			
End point voltage as quoted by equipment manufacturer V			

AUTOMATIC EQUIPMENT SWITCH OFF	
If the equipment is designed to automatically switch off at a predetermined voltage level which is higher or lower in value than the battery minimum and minimum calculated values this shall be clearly stated.	
☐ Applies V cut-off voltage	
☒ Does not apply	

CHANNEL IDENTIFICATION			
Each equipment, whether one or more submitted for tests shall carry clear identification (such as a serial number), together with the frequencies associated with the channel identification displayed on the equipment.			
Equipment Identification eg Serial Number	Channel No.	Transmit Nominal Freq MHz	Receive Nominal Freq MHz

I hereby declare that that the information supplied is correct and complete.

Name: Phil Pittaway
Date: 18/08/17

Position held: Quality Manager



Cobalt II AIS Class B CSTDMA

EQUIPMENT DESCRIPTION			
Model Name/Number	em-trak B100		
Part Number	411-0010		
Hardware Version	1		
Software Version	140200.01.00.03		
Technical Description (Please provide a brief description of the intended use of the equipment)	AIS Class B CS TDMA		

EXTREME TEMPERATURE RANGE (over which equipment is to be type tested)	
☐ Not Applicable (no extreme temperature testing required)	
☐ Category I (General)	
☐ Category II (Portable equipments)	
☐ Other (please specify):	

TYPE OF EQUIPMENT			
☐ Fixed Station	☐ Transmitter ☐ Receiver	☐ Simplex ☒ Duplex	☐ Integral Antenna ☐ Single Antenna
☒ Mobile Station	☒ Transceiver		
☐ Portable Station	☐		
☐ Transponder (Tag)	☐ Active ☐ Passive		
Connector			
☒ Two Antenna Connector			
☐ Multiple Antenna Connectors No.			

TRANSMITTER TECHNICAL CHARACTERISTICS			
FREQUENCY CHARACTERISTICS			
Transmitter frequency alignment range	156.025 to 162.025		MHz
Transmitter channel switching frequency range	156.025 to 162.025		MHz



TRANSMITTER RF POWER CHARACTERISTICS			
Maximum rated transmitter output power as stated by manufacturer (if applicable)			
2	W	At transmitter permanent external 50 Ω RF output connector	
	W	Effective radiated power (for equipment with integral antenna)	
Minimum rated transmitter output power as stated by manufacturer (if applicable)			
2	W	At transmitter permanent external 50 Ω RF output connector	
	W	Effective radiated power (for equipment with integral antenna)	
Is transmitter intended for :			
Continuous duty		☐ Yes	☒ No
Intermittent duty only		☒ Yes	☐ No
If intermittent duty state DUTY CYCLE			
Transmitter ON	0.025	Seconds	Transmitter OFF 5 Seconds

TRANSMITTER - MODULATION			
Amplitude	☐	Other	☐
Frequency	☒	Details :	
Phase	☒	Channel Spacing	25kHz
Can the transmitter be operated without modulation? * See definition below			☐ Yes ☐ No

RECEIVER TECHNICAL CHARACTERISTICS	
FREQUENCY CHARACTERISTICS	
Receiver frequency alignment range	156.025 to 162.025MHz
Receiver channel switching frequency range	156.025 to 162.025MHz
Channel Separation (if applicable)	
State the maximum number of channels over which the equipment can operate:	240



POWER SOURCE			
☐ AC mains AC supply frequency (Hz) VAC Max Current Hz State voltage			
☐ Single phase ☐ Three phase			
And / Or			
☒ External DC supply			
Nominal voltage 12 V		Max Current 2 A	
Extreme upper voltage 31.2 V			
Extreme lower voltage 9.6 V			
Battery			
☐ Nickel Cadmium		☐ Lead acid (Vehicle regulated)	
☐ Alkaline		☐ Leclanche	
☐ Lithium		☐ Other Details :	
Volts nominal.			
End point voltage as quoted by equipment manufacturer V			

AUTOMATIC EQUIPMENT SWITCH OFF	
If the equipment is designed to automatically switch off at a predetermined voltage level which is higher or lower in value than the battery minimum and minimum calculated values this shall be clearly stated.	
☐ Applies V cut-off voltage	
☒ Does not apply	

CHANNEL IDENTIFICATION			
Each equipment, whether one or more submitted for tests shall carry clear identification (such as a serial number), together with the frequencies associated with the channel identification displayed on the equipment.			
Equipment Identification eg Serial Number	Channel No.	Transmit Nominal Freq MHz	Receive Nominal Freq MHz

I hereby declare that that the information supplied is correct and complete.

Name: Phil Pittaway
Date: 18/08/17

Position held:

Quality Manager

1.5 Product Information

1.5.1 Technical Description

Cobalt II AIS Class B SOTDMA.
Cobalt II AIS Class B CSTDMA.

1.6 Deviations from the Standard

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

1.7 EUT 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
Serial Number: #18			
0	As supplied by the customer	Not Applicable	Not Applicable
Serial Number: #05			
0	As supplied by the customer	Not Applicable	Not Applicable
Serial Number: #03			
0	As supplied by the customer	Not Applicable	Not Applicable

Table 3

1.8 Test Location

TÜV SÜD Product Service conducted the following tests at our Fareham Test Laboratory.

Test Name	Name of Engineer(s)	Accreditation
Configuration and Mode: Idle		
Receiver Emissions	Graeme Lawler	UKAS
Configuration and Mode: AIS - SOTDMA		
Bandwidths	Dan Ralley	UKAS
Transmitter Frequency Tolerances	Dan Ralley	UKAS
Spurious Emissions at Antenna Terminals	Dan Ralley	UKAS
Radiated Spurious Emissions	Graeme Lawler	UKAS
Modulation Requirements	Dan Ralley	UKAS
Transmitter Power	Dan Ralley	UKAS
Suppression of Interference Aboard Ships	Dan Ralley	UKAS
Configuration and Mode: AIS - CSTDMA		
Transmitter Power	Dan Ralley	UKAS

Table 4

Office Address:

Octagon House
Concorde Way
Segensworth North
Fareham
Hampshire
PO15 5RL
United Kingdom

2 Test Details

2.1 Bandwidths

2.1.1 Specification Reference

FCC 47 CFR Part 80, Clause 80.205
FCC 47 CFR Part 2, Clause 2.1049
Industry Canada RSS-GEN, Clause 6.6.

2.1.2 Equipment Under Test and Modification State

COBALT II EP2, S/N: #18 - Modification State 0

2.1.3 Date of Test

16-June-2017

2.1.4 Test Method

The test was applied in accordance with the test method requirements of FCC CFR 47 Part 80.205, Part 2.1049, Industry Canada RSS-GEN Clause 6.6 and KDB 971168.

The EUT was transmitting at maximum power, modulated by the standard AIS test signals using either PRBS, 01010101 or 00001111 packet payloads. 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.

2.1.5 Environmental Conditions

Ambient Temperature 23.4 °C
Relative Humidity 46.6 %

2.1.6 Test Results

AIS - SOTDMA

156.025 MHz	162.025 MHz
9.572	9.568

Table 5 - Occupied Bandwidth Results



Product Service

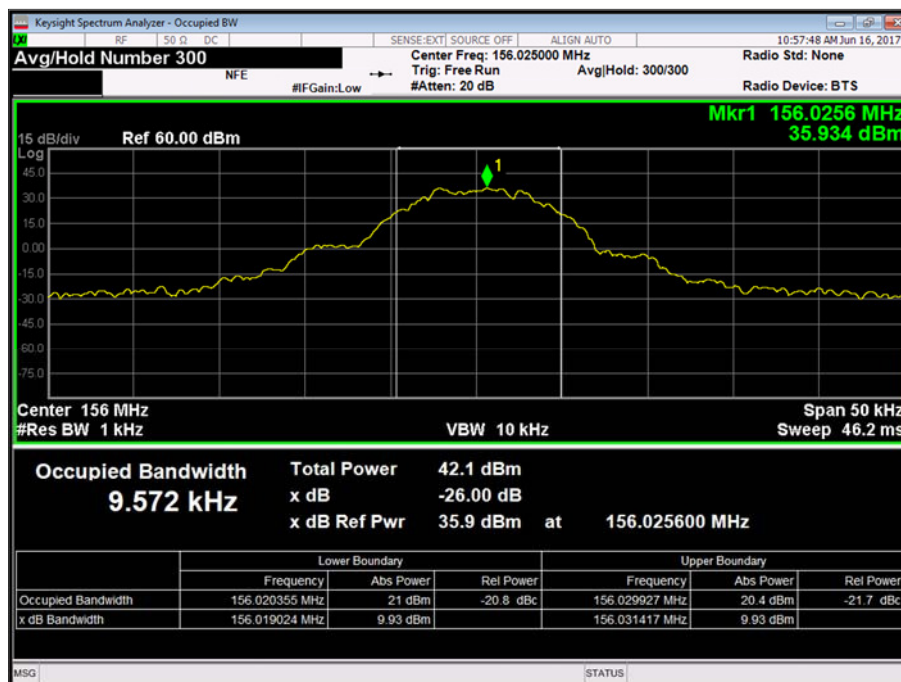


Figure 1 - 156.025 MHz Occupied Bandwidth

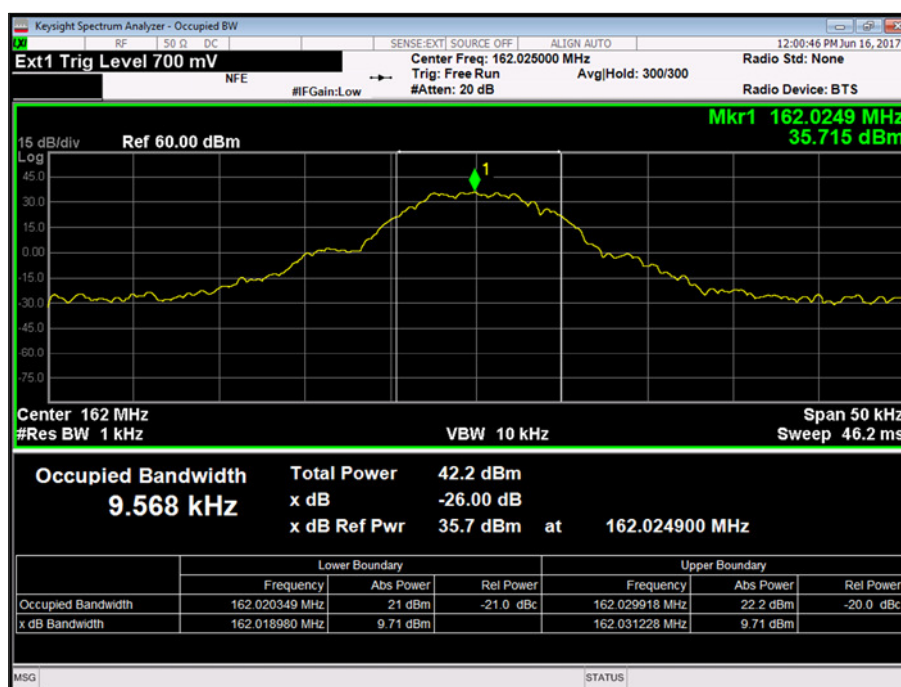


Figure 2 - 162.025 MHz Occupied Bandwidth

FCC 47 CFR Part 80, Limit Clause 80.205

< 20 kHz

Industry Canada RSS-GEN, Limit Clause

None Specified.

2.1.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1 and RF Laboratory 3.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	09-Sep-2017
High Pass Filter	Lorch	4HP2-0-3-5	2166	-	TU
Hygrometer	Rotronic	I-1000	2891	12	23-Aug-2017
Attenuator (20dB, 2W)	Pasternack	PE7004-20	2943	12	04-Apr-2018
Attenuator (10dB, 50W)	Aeroflex / Weinschel	47-10-34	3166	12	20-Sep-2017
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	15-Sep-2017
'N' - 'N' RF Cable (2m)	Rhophase	NPS-1803-2000-NPS	3698	12	12-Oct-2017
TRUE RMS MULTIMETER	Fluke	179	4006	12	13-Dec-2017
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	08-Sep-2017
Frequency Standard	Spectracom	Secure Sync 1200-0408-0601	4393	6	09-Sep-2017
PXA Signal Analyser	Keysight Technologies	N9030A	4654	12	06-Oct-2017
2 Channel PSU	Rohde & Schwarz	HMP2020	4735	-	O/P Mon

Table 6

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment

2.2 Transmitter Frequency Tolerances

2.2.1 Specification Reference

FCC 47 CFR Part 80, Clause 80.209
FCC 47 CFR Part 2, Clause 2.1055
Industry Canada RSS-182, Clause 7.4
Industry Canada RSS-GEN, Clause 6.11.

2.2.2 Equipment Under Test and Modification State

COBALT II EP2, S/N: #18 - Modification State 0
COBALT II EP2, S/N: #03 - Modification State 0

2.2.3 Date of Test

21-June-2017 to 21-August-2017

2.2.4 Test Method

AIS (FM DEMOD)

The test was applied in accordance with the test method requirements of FCC CFR 47 Part 80.209 (a), FCC CFR 47 Part 2.1055 (a) (2), (d) (1) and Industry Canada RSS-GEN Clause 6.11.

The EUT was transmitting at maximum power in turn on either AIS channel. The EUT was modulated using the standard AIS test signal with PRBS packet payload. 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 +50°C in 10° steps at both minimum and maximum voltage extremes.

2.2.5 Environmental Conditions

Ambient Temperature 23.4 - 25.0 °C
Relative Humidity 46.6 - 68.8 %

2.2.6 Test Results

AIS - SOTDMA

Voltage	Frequency Error (ppm)
10.2 V DC	0.92403
27.6 V DC	0.89844

Table 7 - Frequency Stability Under Voltage Variations

Temperature	Frequency Error (ppm)
50 °C	-1.53420
40 °C	-0.53823
30 °C	-0.42370
20 °C	0.95800
10 °C	2.55345
0 °C	2.36373
-10 °C	3.83189
-20 °C	4.08971

Table 8 - Frequency Stability Under Voltage Variations

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

± 10 ppm.

2.2.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1 and RF Laboratory 3.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Attenuator (Software Driver)	Hewlett Packard	11713A	116	-	TU
Climatic Chamber	Votsch	VT4002	161	-	O/P Mon
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	09-Sep-2017
Digital Temperature Indicator	Fluke	51	2267	12	05-Jul-2018
Attenuator (30dB/50W)	Aeroflex / Weinschel	47-30-34	3164	12	11-Jul-2018
Hygrometer	Rotronic	I-1000	3220	12	23-Aug-2017
'N' - 'N' RF Cable (1m)	Rhophase	NPS-1803-1000-NPS	3700	12	26-Jan-2018
TRUE RMS MULTIMETER	Fluke	179	4006	12	13-Dec-2017
Frequency Standard	Spectracom	Secure Sync 1200-0408-0601	4393	6	09-Sep-2017
PXA Signal Analyser	Agilent Technologies	N9030A PXA	4409	12	09-Aug-2018
2 metre N-Type Cable	IW Microwave	NPS-1806LC-788-NPS	4503	12	14-Jun-2018
2 Channel PSU	Rohde & Schwarz	HMP2020	4735	-	O/P Mon

Table 9

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment



2.3 Spurious Emissions at Antenna Terminals

2.3.1 Specification Reference

FCC 47 CFR Part 80, Clause 80.211
FCC 47 CFR Part 2, Clause 2.1051
Industry Canada RSS-182, Clause 7.9
Industry Canada RSS-GEN, Clause 6.13.

2.3.2 Equipment Under Test and Modification State

COBALT II EP2, S/N: #18 - Modification State 0

2.3.3 Date of Test

19-June-2017 to 20-June-2017

2.3.4 Test Method

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 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 established with an RBW approximately 2 or 3 times the emission bandwidth. The RBW was then reduced to at least 1% of the emission bandwidth, with a VBW of 3 times RBW. 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, filter and cable. Between 300 MHz and 2 GHz a 300 MHz high pass filter was used. The spectrum analyser was configured with an RBW of 100 kHz below 1 GHz and 1 MHz for frequencies greater than 1 GHz with the trace set to max hold using a peak detector.

2.3.5 Environmental Conditions

Ambient Temperature	23.4 - 26.3 °C
Relative Humidity	46.6 - 53.2 %

2.3.6 Test Results

AIS - SOTDMA

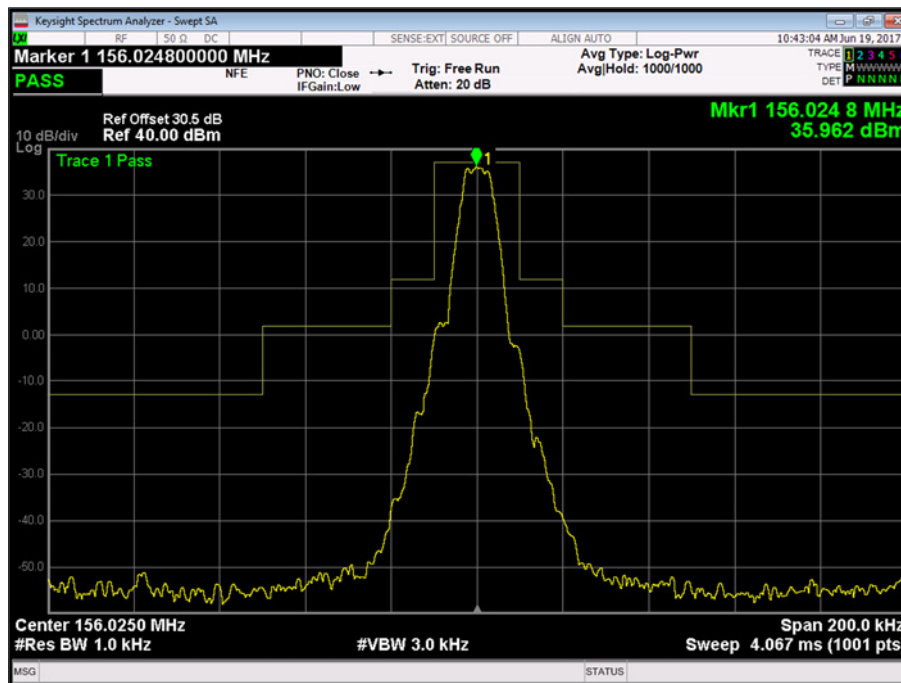


Figure 3 - 156.025 MHz - Transmitter Spectrum Mask

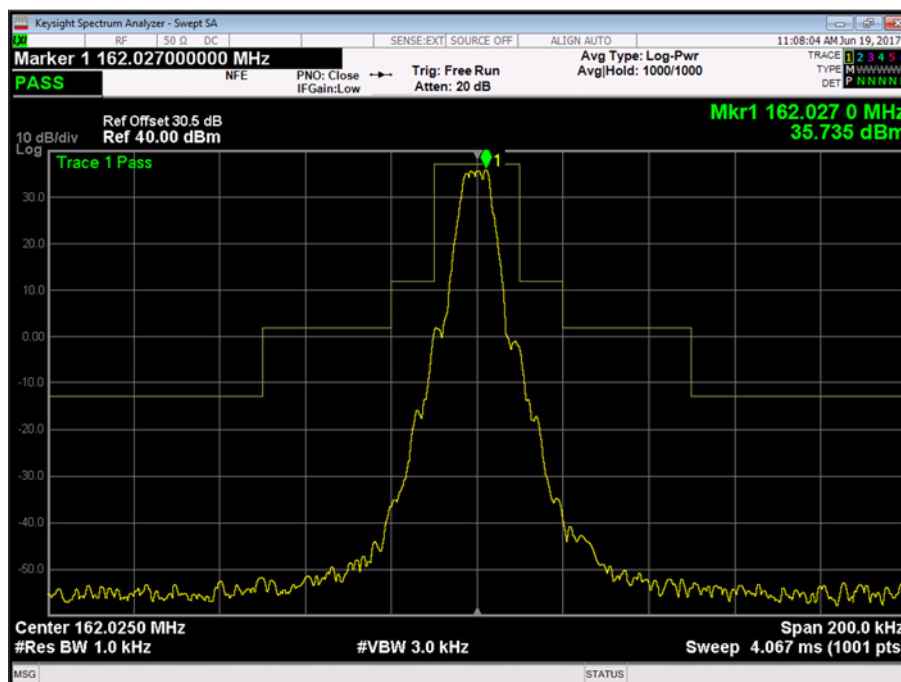


Figure 4 - 162.025 MHz - Transmitter Spectrum Mask

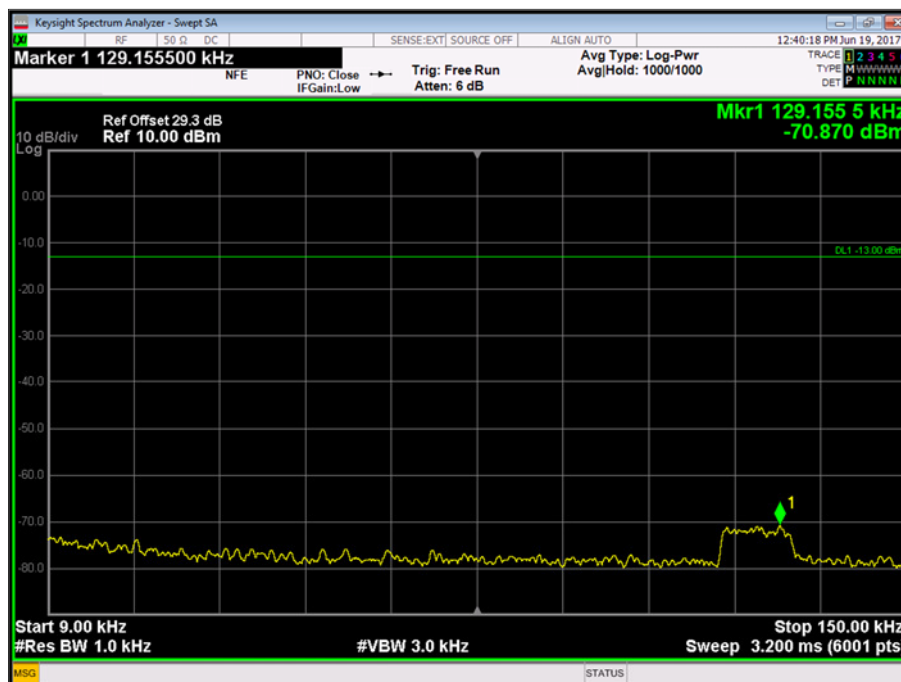


Figure 5 - 156.025 MHz - 9 kHz to 150 kHz

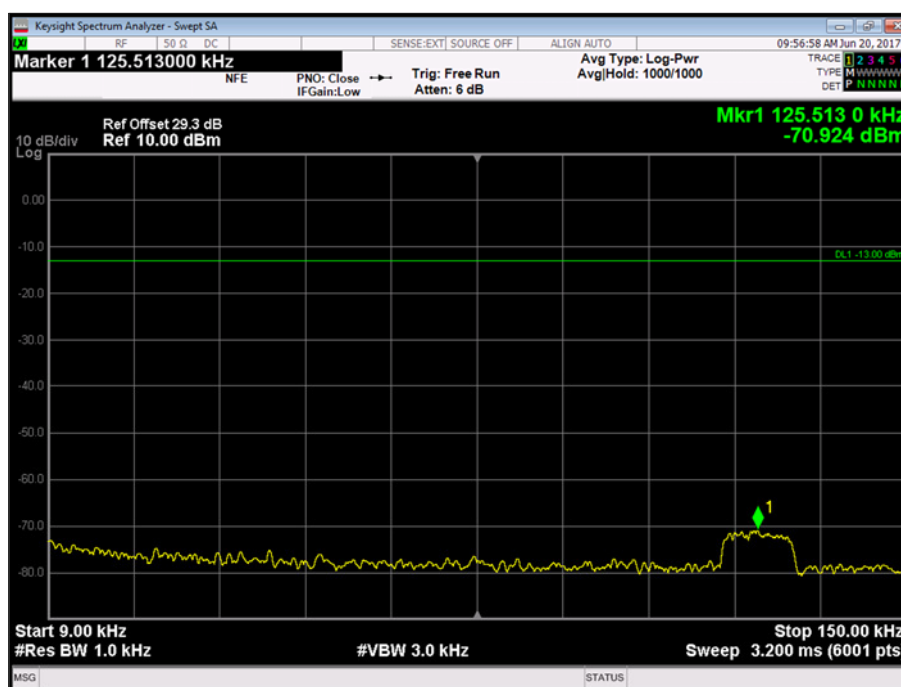


Figure 6 - 162.025 MHz - 9 kHz to 150 kHz

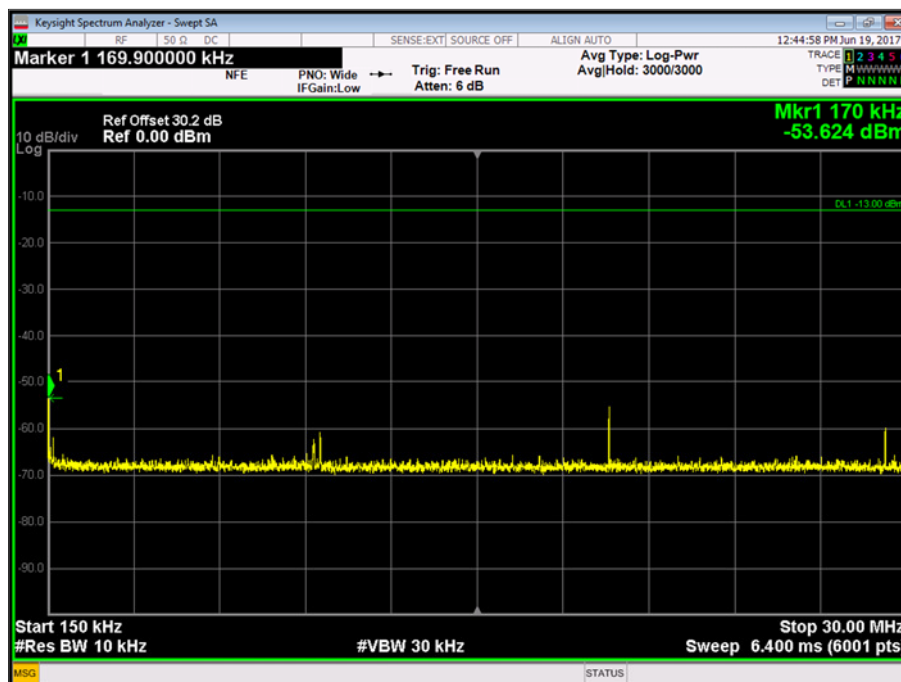


Figure 7 - 156.025 MHz - 150 kHz to 30 MHz

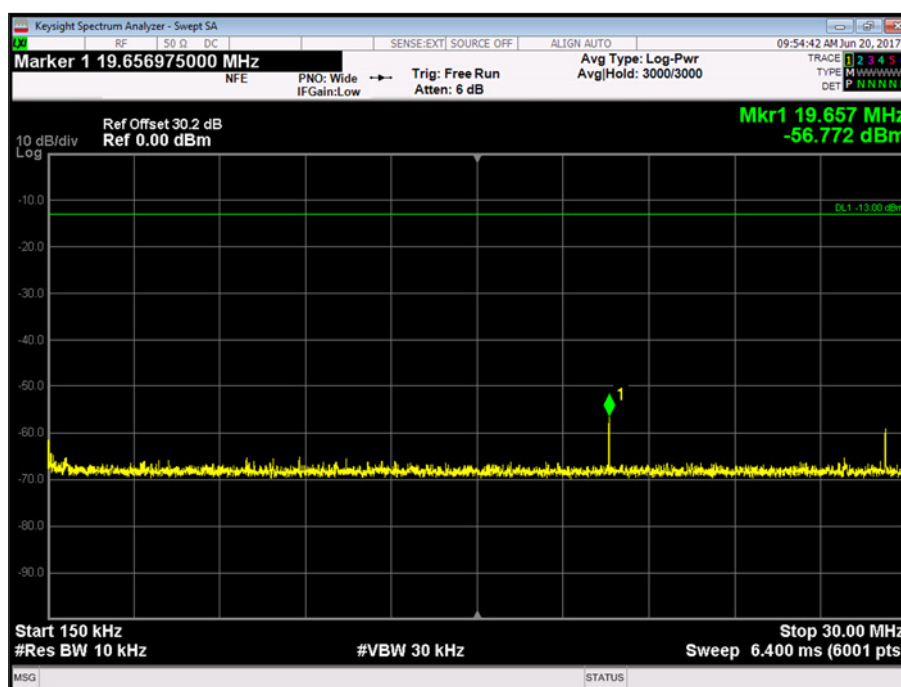


Figure 8 - 162.025 MHz - 150 kHz to 30 MHz

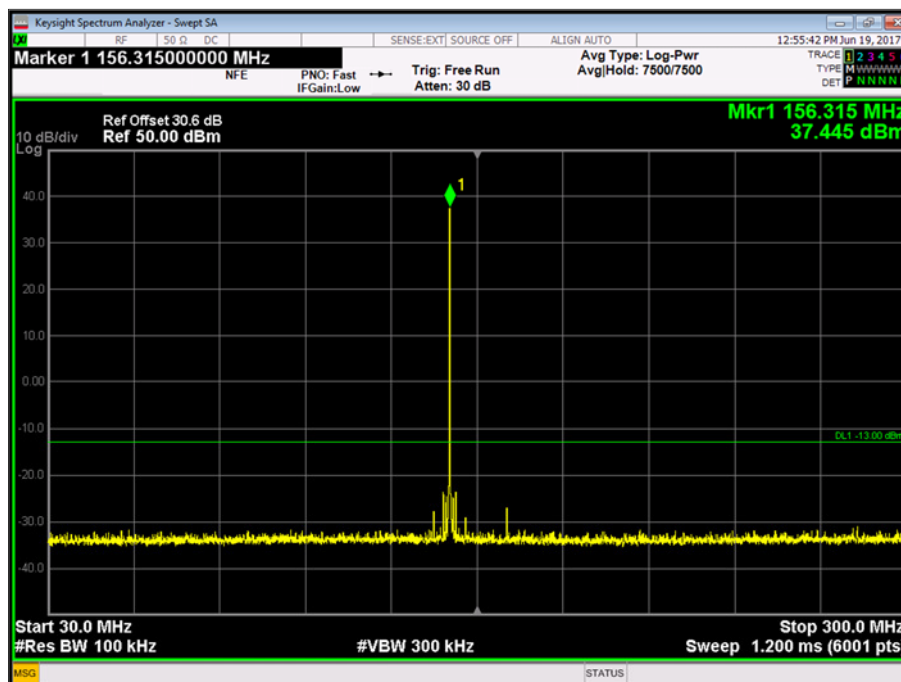


Figure 9 - 156.025 MHz - 30 MHz to 300 MHz

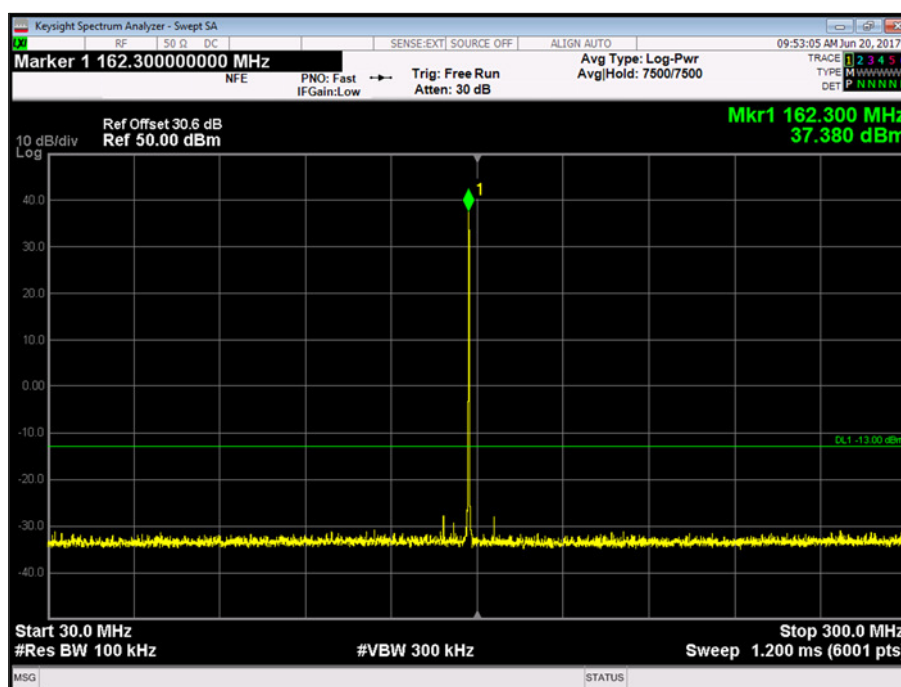


Figure 10 - 162.025 MHz - 30 MHz to 300 MHz



Product Service

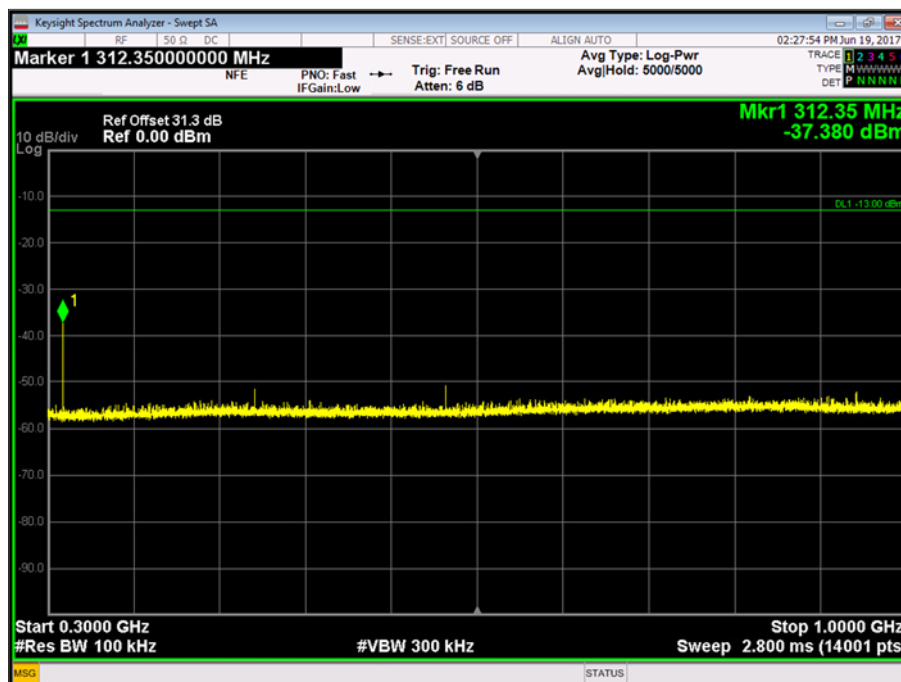


Figure 11 - 156.025 MHz - 300 MHz to 1 GHz

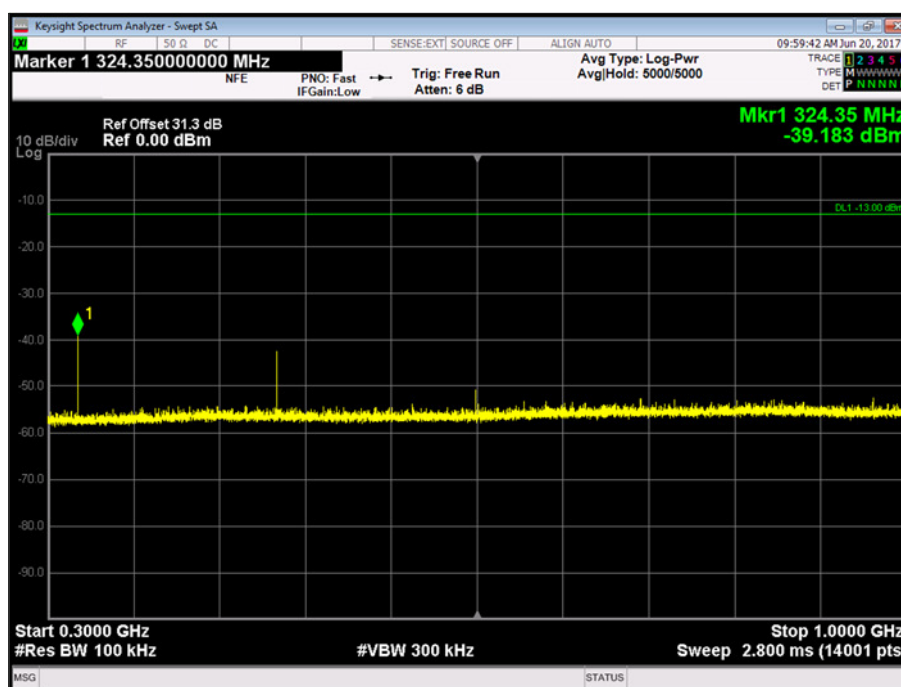


Figure 12 - 162.025 MHz - 300 MHz to 1 GHz



Product Service

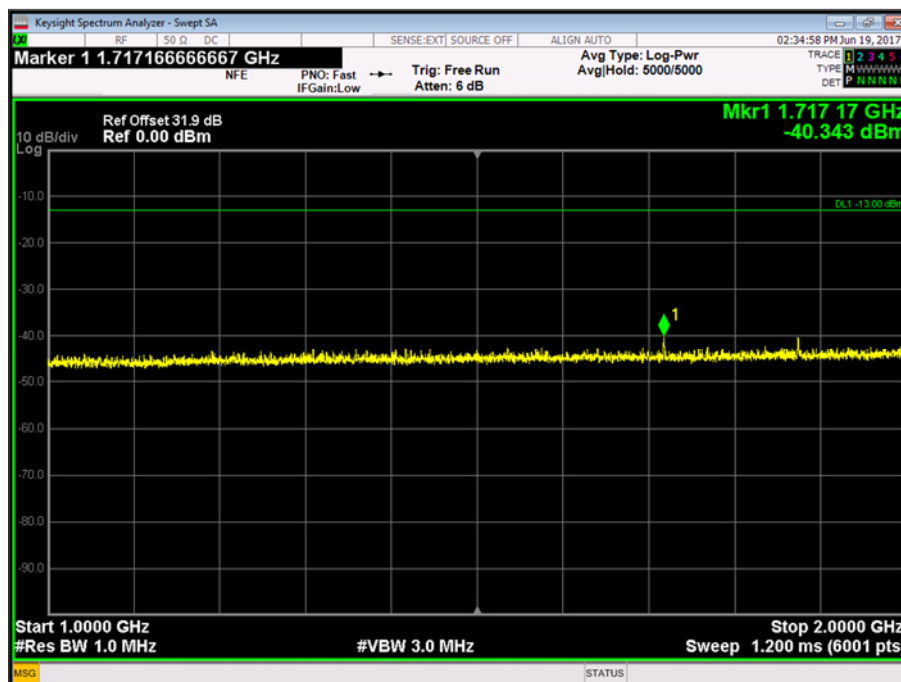


Figure 13 - 156.025 MHz - 1 GHz to 2 GHz

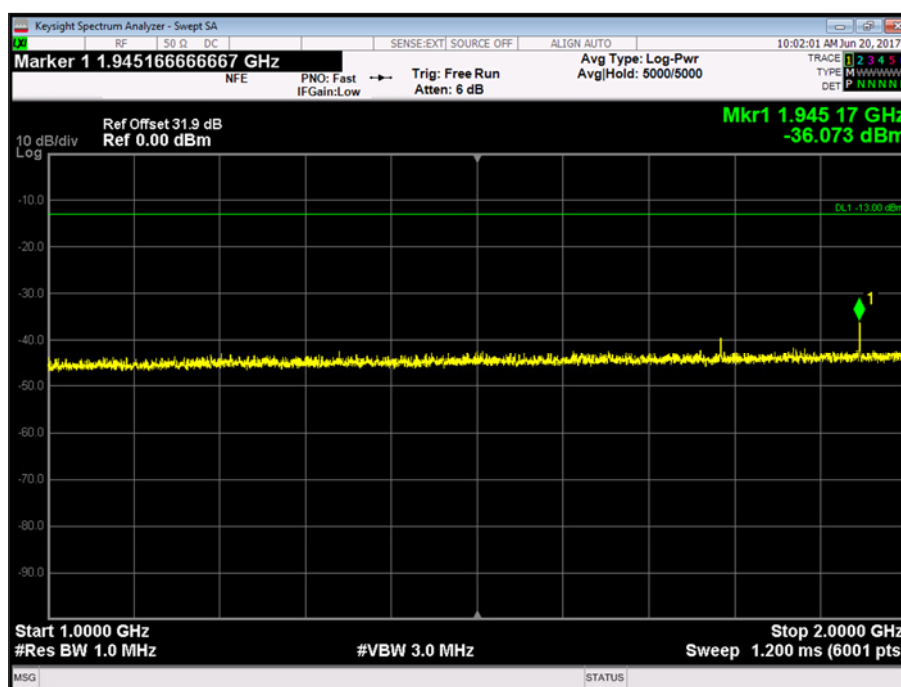


Figure 14 - 162.025 MHz - 1 GHz to 2 GHz

FCC 47 CFR Part 80, Limit Clause 80.211

Within 250% of the Authorised Bandwidth:

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

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

More than 250% of the Authorised Bandwidth:

On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 plus $10\log_{10}$ (mean power in watts) dB.

Industry Canada RSS-182, Limit Clause 7.9.1

On any frequency removed from the carrier frequency by more than 50%, but not more than 100% of the authorized bandwidth: at least 25 dB, measured with a bandwidth of 300 Hz.

On any frequency removed from the carrier frequency by more than 100%, but not more than 250% of the authorized bandwidth: at least 35 dB, measured with a bandwidth of 300 Hz.

On any frequency removed from the carrier frequency by more than 250% of the authorized bandwidth: at least $43 + 10 \log_{10} p(\text{watts})$ dB, measured with a bandwidth of 30 kHz.

2.3.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 3.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	09-Sep-2017
Hygrometer	Rotronic	I-1000	2891	12	23-Aug-2017
Attenuator (20dB, 2W)	Pasternack	PE7004-20	2943	12	04-Apr-2018
Attenuator (10dB, 50W)	Aeroflex / Weinschel	47-10-34	3166	12	20-Sep-2017
'N' - 'N' RF Cable (2m)	Rhophase	NPS-1803-2000-NPS	3698	12	12-Oct-2017
TRUE RMS MULTIMETER	Fluke	179	4006	12	13-Dec-2017
Frequency Standard	Spectracom	Secure Sync 1200-0408-0601	4393	6	09-Sep-2017
PXA Signal Analyser	Keysight Technologies	N9030A	4654	12	06-Oct-2017
2 Channel PSU	Rohde & Schwarz	HMP2020	4735	-	O/P Mon

Table 10

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment



2.4 Radiated Spurious Emissions

2.4.1 Specification Reference

FCC 47 CFR Part 80, Clause 80.211
FCC 47 CFR Part 2, Clause 2.1051
Industry Canada RSS-182, Clause 7.9
Industry Canada RSS-GEN, Clause 6.13.

2.4.2 Equipment Under Test and Modification State

COBALT II EP2, S/N: #18 - Modification State 0

2.4.3 Date of Test

18-June-2017

2.4.4 Test Method

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.

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.

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 limit lines on the plots shown below are representative of -13 dBm ERP. Only final measurements within 10 dB were recorded in the tables below. Pre-scan measurements as shown in the plots below were performed in a 1 MHz RBW which is greater than 30 kHz and therefore considered worst case.

2.4.5 Environmental Conditions

Ambient Temperature	20.1 °C
Relative Humidity	58.0 %



2.4.6 Test Results

AIS - SOTDMA

Frequency (MHz)	Level (dBm)
*	

Table 11 - 156.025 MHz - Emissions Results

*No emissions were detected within 10 dB of the limit.

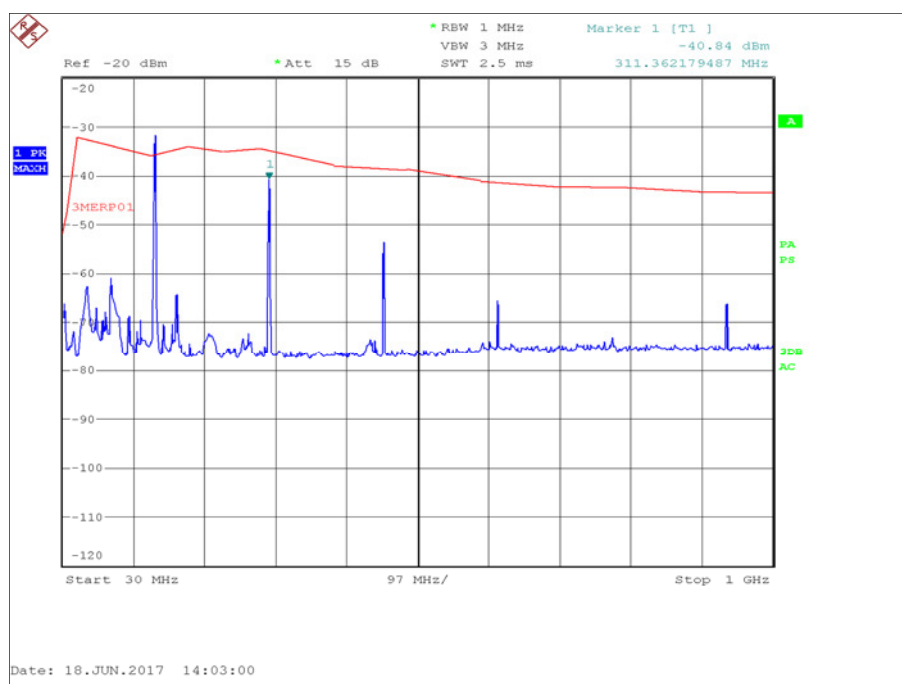


Figure 15 - 156.025 MHz - 30 MHz to 1 GHz



Product Service

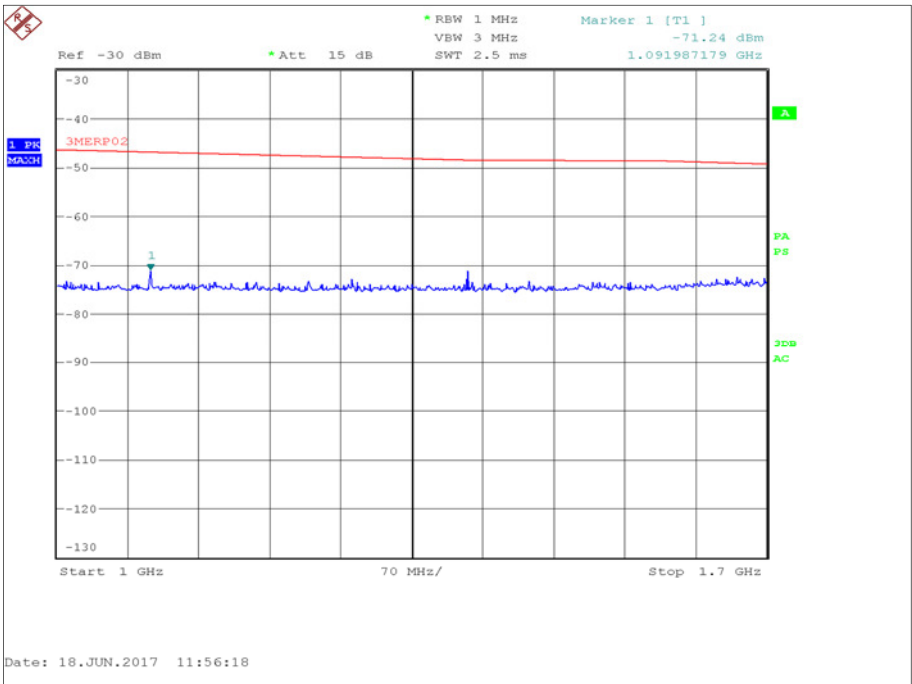


Figure 16 - 156.025 MHz - 1 GHz to 1.7 GHz

Frequency (MHz)	Level (dBm)
*	

Table 12 - 162.025 MHz - Emissions Results

*No emissions were detected within 10 dB of the limit.



Product Service

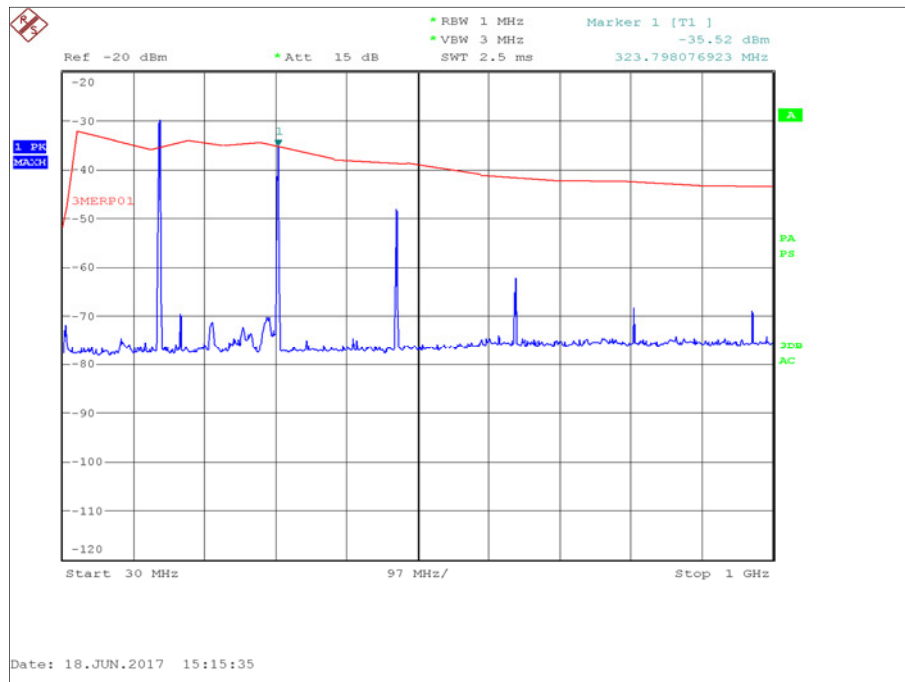


Figure 17 - 162.025 MHz - 30 MHz to 1 GHz

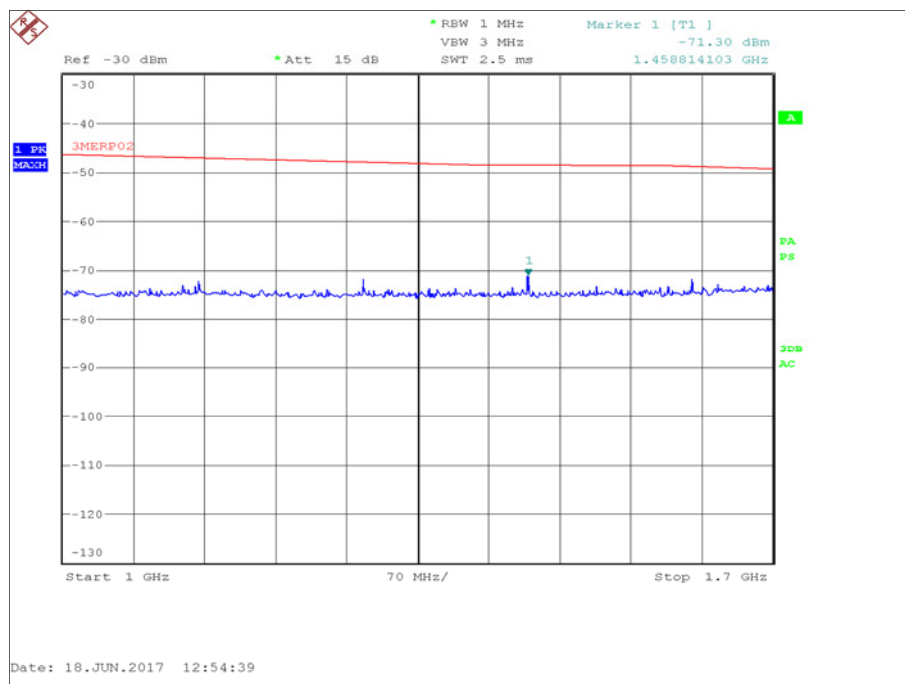


Figure 18 - 162.025 MHz - 1 GHz to 1.7 GHz

FCC 47 CFR Part 80, Limit Clause 80.211

More than 250% of the Authorised Bandwidth:

On any frequency removed from the assigned frequency by more than 250 percent of the authorized bandwidth: At least 43 plus $10\log_{10}$ (mean power in watts) dB.

Industry Canada RSS-182, Limit Clause 7.9.1

On any frequency removed from the carrier frequency by more than 250% of the authorized bandwidth: at least $43 + 10 \log_{10} p(\text{watts})$ dB, measured with a bandwidth of 30 kHz.

2.4.7 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 5.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Screened Room (5)	Rainford	Rainford	1545	36	20-Dec-2017
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Hygrometer	Rotronic	A1	2138	12	2-Feb-2018
Antenna (Bilog)	Chase	CBL6143	2904	24	08-Aug-2017
Comb Generator	Schaffner	RSG1000	3034	-	TU
Cable (N-N, 8m)	Rhophase	NPS-2302-8000-NPS	3248	12	2-May-2018
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	12-Nov-2017
Tilt Antenna Mast	maturo GmbH	TAM 4.0-P	3916	-	TU
Mast Controller	maturo GmbH	NCD	3917	-	TU
2 Channel PSU	Rohde & Schwarz	HMP2020	4735	-	O/P Mon

Table 13

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment



Product Service

2.5 Modulation Requirements

2.5.1 Specification Reference

FCC 47 CFR Part 80, Clause 80.213
FCC 47 CFR Part 2, Clause 2.1047
Industry Canada RSS-182, Clause 7.7

2.5.2 Equipment Under Test and Modification State

COBALT II EP2, S/N: #18 - Modification State 0

2.5.3 Date of Test

20-June-2017

2.5.4 Test Method

The test was applied in accordance with the test method requirements of FCC CFR 47 Part 80.213 (d) and Industry Canada RSS-182, Clause 7.7.

The EUT was transmitting at maximum power, modulated by the standard AIS test signals using either PRS, 01010101 or 00001111 packet payloads. 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.

2.5.5 Environmental Conditions

Ambient Temperature	28.6 °C
Relative Humidity	40.7 %



Product Service

2.5.6 Test Results

AIS - SOTDMA

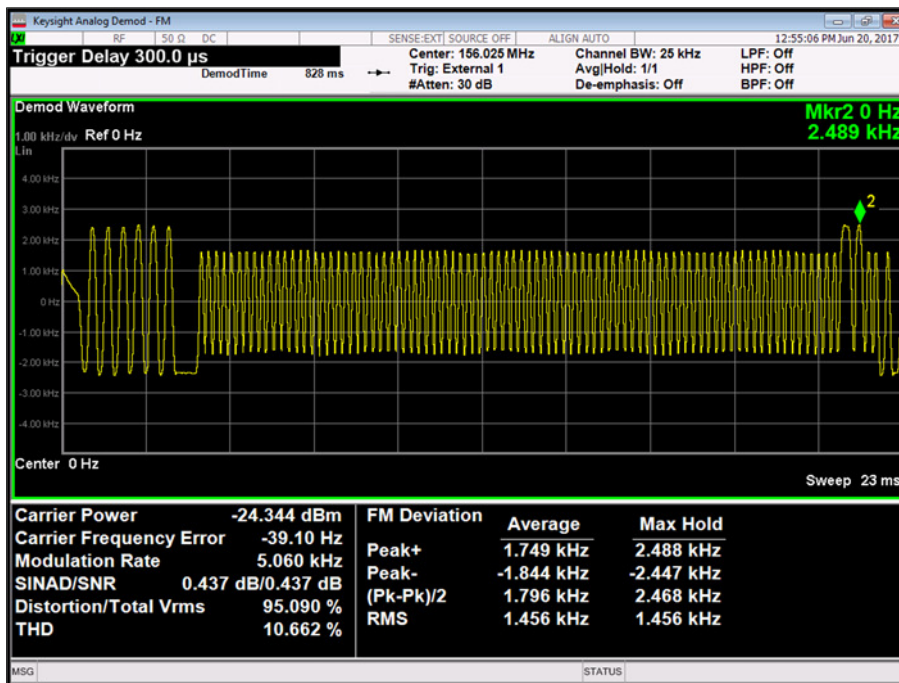


Figure 19 - 156.025 MHz - 01010101

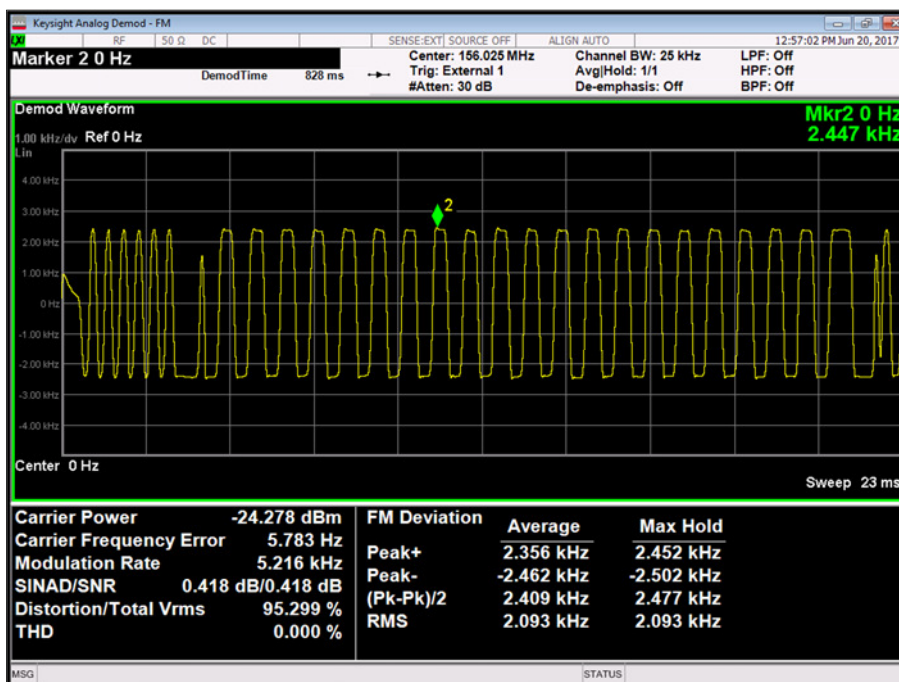


Figure 20- 156.025 MHz - 00001111

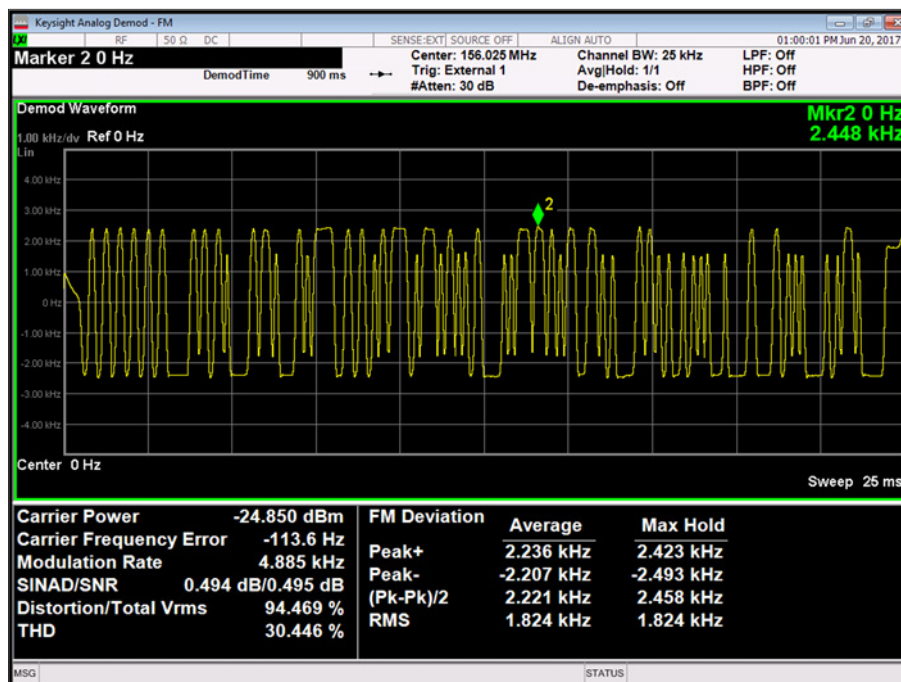


Figure 21- 156.025 MHz - PRBS

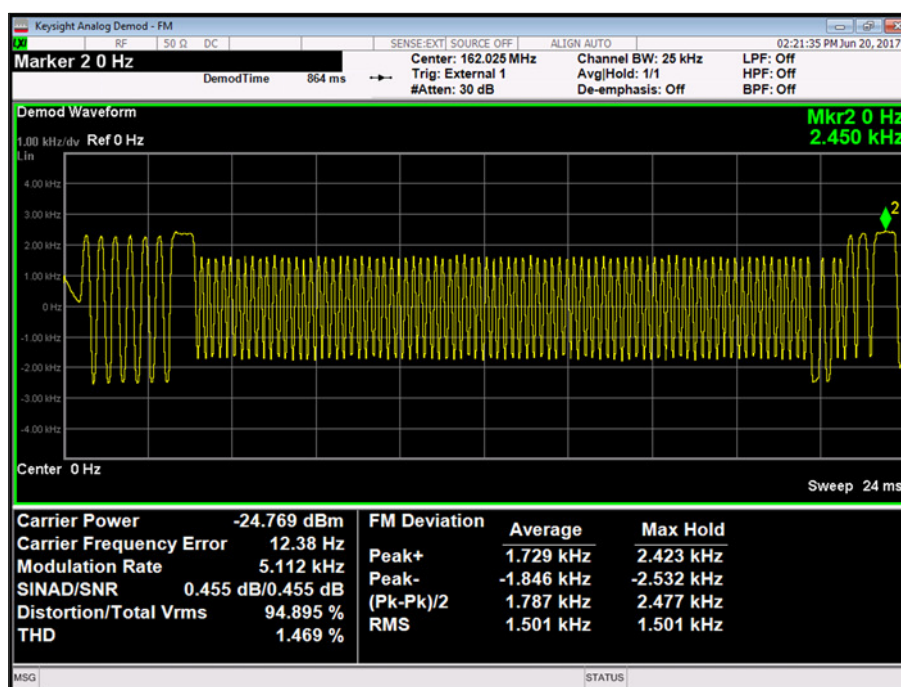


Figure 22 - 162.025 MHz - 01010101



Product Service

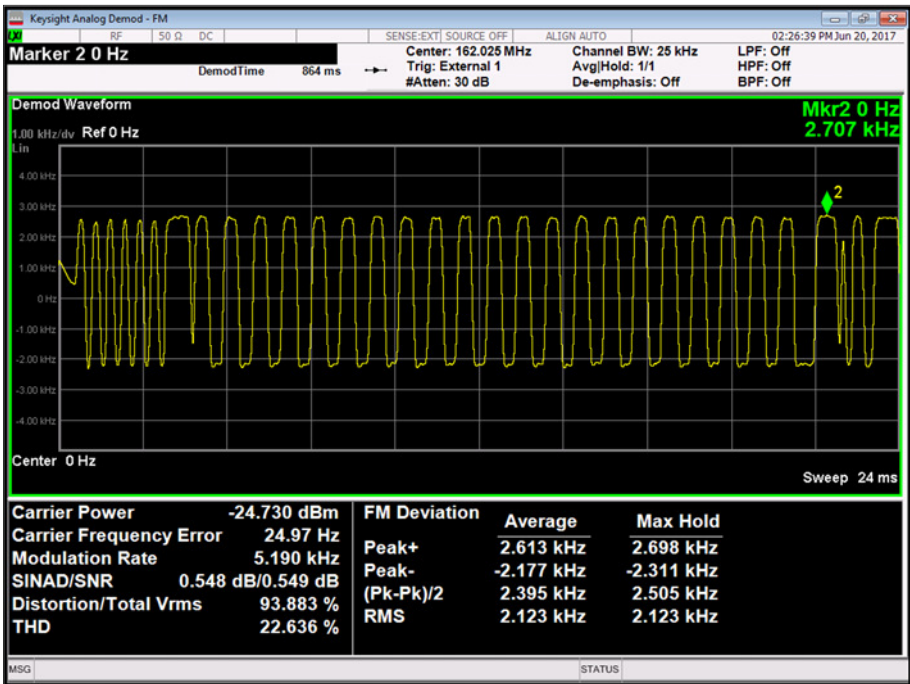


Figure 23- 162.025 MHz - 00001111

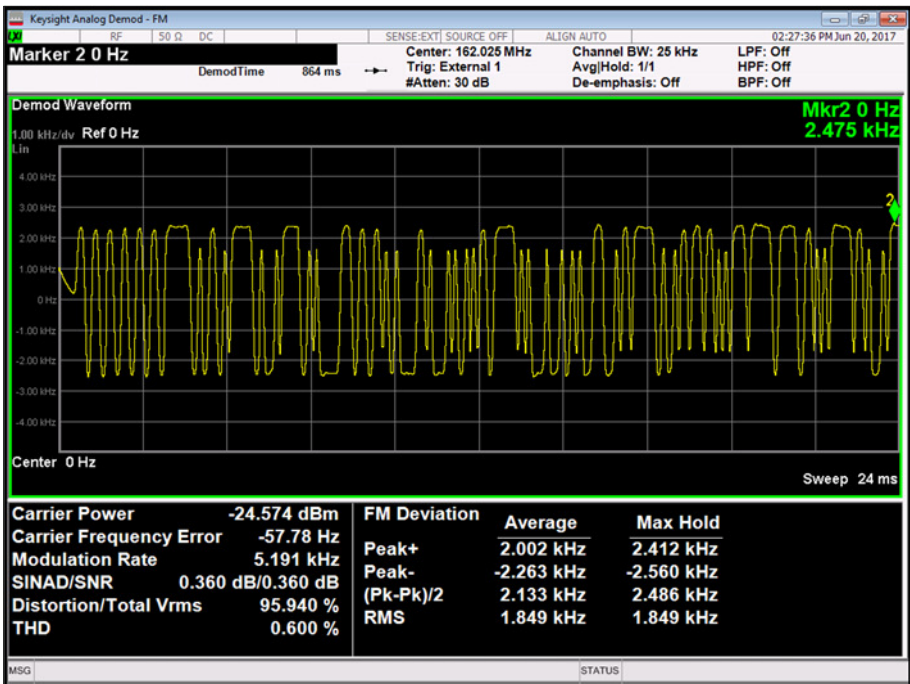


Figure 24- 162.025 MHz - PRBS

FCC 47 CFR Part 80, Limit Clause 80.213

Radiotelephone transmitters using A3E, F3E and G3E emission must have a modulation limiter to prevent any modulation over 100 percent.

Industry Canada RSS-182, Limit Clause 7.7

The VHF AIS equipment shall comply with the following characteristics.

Transmitter frequency: 161.975 MHz (channel 87B)
 162.025 MHz (channel 88B)
 Channel spacing: 25 kHz or 12.5 kHz
 Modulation scheme: GMSK/FM
 Modulation index: 0.5 max. for 25 kHz channel spacing
 0.25 max. for 12.5 kHz channel spacing
 Transmission rate: 9600 bps

2.5.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 3.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	09-Sep-2017
Hygrometer	Rotronic	I-1000	2891	12	23-Aug-2017
Attenuator (20dB, 2W)	Pasternack	PE7004-20	2943	12	04-Apr-2018
Attenuator (10dB, 50W)	Aeroflex / Weinschel	47-10-34	3166	12	20-Sep-2017
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	15-Sep-2017
'N' - 'N' RF Cable (2m)	Rhophase	NPS-1803-2000-NPS	3698	12	12-Oct-2017
TRUE RMS MULTIMETER	Fluke	179	4006	12	13-Dec-2017
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	08-Sep-2017
Frequency Standard	Spectracom	Secure Sync 1200-0408-0601	4393	6	09-Sep-2017
PXA Signal Analyser	Keysight Technologies	N9030A	4654	12	06-Oct-2017
2 Channel PSU	Rohde & Schwarz	HMP2020	4735	-	O/P Mon

Table 14

O/P Mon – Output Monitored using calibrated equipment

2.6 Transmitter Power

2.6.1 Specification Reference

FCC 47 CFR Part 80, Clause 80.215
FCC 47 CFR Part 2, Clause 2.1046
Industry Canada RSS-182, Clause 7.5
Industry Canada RSS-GEN, Clause 6.12.

2.6.2 Equipment Under Test and Modification State

COBALT II EP2, S/N: #18 - Modification State 0
COBALT II EP2, S/N: #05 - Modification State 0

2.6.3 Date of Test

16-June-2017 to 18-August-2017

2.6.4 Test Method

The test was applied in accordance with the test method requirements of FCC CFR 47 Part 80.215 (e) and KDB 971168.

The EUT was set to transmit on maximum power in turn on either AIS channel. The EUT was modulated using the standard AIS test signal with PRBS packet payload. The EUT was connected to a spectrum analyser via a cable and attenuator. 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 greater than the bandwidth of the fundamental emission and the video bandwidth to three times the RBW with the trace set to max hold using a peak detector and the result was recorded.

2.6.5 Environmental Conditions

Ambient Temperature 22.9 - 23.4 °C
Relative Humidity 46.6 - 69.6 %

2.6.6 Test Results

AIS - SOTDMA

156.025 MHz		162.025 MHz	
Result (dBm)	Result (W)	Result (dBm)	Result (W)
37.281	5.346	37.127	5.161

Table 15 - Transmitter Power Results

FCC 47 CFR Part 80, Limit Clause 80.215 (d)

Ship station frequencies above 27500 kHz. The maximum power must not exceed the values listed below:

- Ships Stations: 156 to 162 MHz - 25 W
- Marine Utility Stations and Handheld Portable Transmitters: 156 to 162 MHz - 10 W

Industry Canada RSS-182, Limit Clause 7.5

Stations	Typical Power
Coast Station	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 W

Table 16

AIS - CSTDMA

MHz		MHz	
Result (dBm)	Result (W)	Result (dBm)	Result (W)
33.248	2.113	32.31	1.702

Table 17 - Transmitter Power Results

FCC 47 CFR Part 80, Limit Clause 80.215 (d)

Ship station frequencies above 27500 kHz. The maximum power must not exceed the values listed below:

- Ships Stations: 156 to 162 MHz - 25 W
- Marine Utility Stations and Handheld Portable Transmitters: 156 to 162 MHz - 10 W

Industry Canada RSS-182, Limit Clause 7.5

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

Table 18

2.6.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 3 and RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	09-Sep-2017
Hygrometer	Rotronic	I-1000	2891	12	23-Aug-2017
Attenuator (20dB, 2W)	Pasternack	PE7004-20	2943	12	04-Apr-2018
Attenuator (10dB, 50W)	Aeroflex / Weinschel	47-10-34	3166	12	20-Sep-2017
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	15-Sep-2017
'N' - 'N' RF Cable (2m)	Rhophase	NPS-1803-2000-NPS	3698	12	12-Oct-2017
TRUE RMS MULTIMETER	Fluke	179	4006	12	13-Dec-2017
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	08-Sep-2017
Frequency Standard	Spectracom	Secure Sync 1200-0408-0601	4393	6	09-Sep-2017



Product Service

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
PXA Signal Analyser	Keysight Technologies	N9030A	4654	12	06-Oct-2017
2 Channel PSU	Rohde & Schwarz	HMP2020	4735	-	O/P Mon

Table 19

O/P Mon – Output Monitored using calibrated equipment

2.7 Suppression of Interference Aboard Ships

2.7.1 Specification Reference

FCC 47 CFR Part 80, Clause 80.217(b)

2.7.2 Equipment Under Test and Modification State

COBALT II EP2, S/N: #18 - Modification State 0

2.7.3 Date of Test

20-June-2017

2.7.4 Test Method

The test was applied in accordance with the test method requirements of FCC CFR 47 Part 80.217 (b) and KDB 971168.

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 for each frequency range of interest. The EUT was connected to a spectrum analyser via a cable and attenuator. The EUT was configured in a receive only state. 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. The trace set to max hold using a peak detector and the plots recorded as shown.

2.7.5 Environmental Conditions

Ambient Temperature 28.6 °C
Relative Humidity 40.7 %

2.7.6 Test Results

AIS - SOTDMA

Frequency of Interfering Emissions	Maximum Power delivered to Artificial Antenna (dBm)	Maximum Power delivered to Artificial Antenna (μW)
9 kHz to 30 MHz	-61.424	0.00072
30 MHz to 100 MHz	-55.370	0.0029
100 MHz to 300 MHz	-55.370	0.0029
300 MHz to 1 GHz	-48.306	0.0150

Table 20 - Receive Mode Spurious Emissions Results

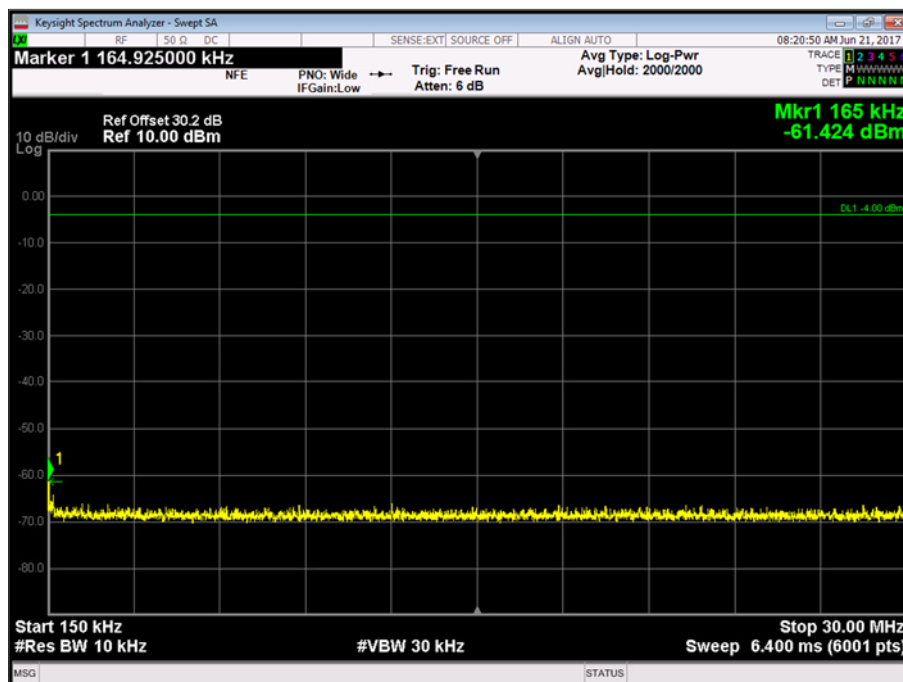


Figure 25 - 9 kHz to 30 MHz

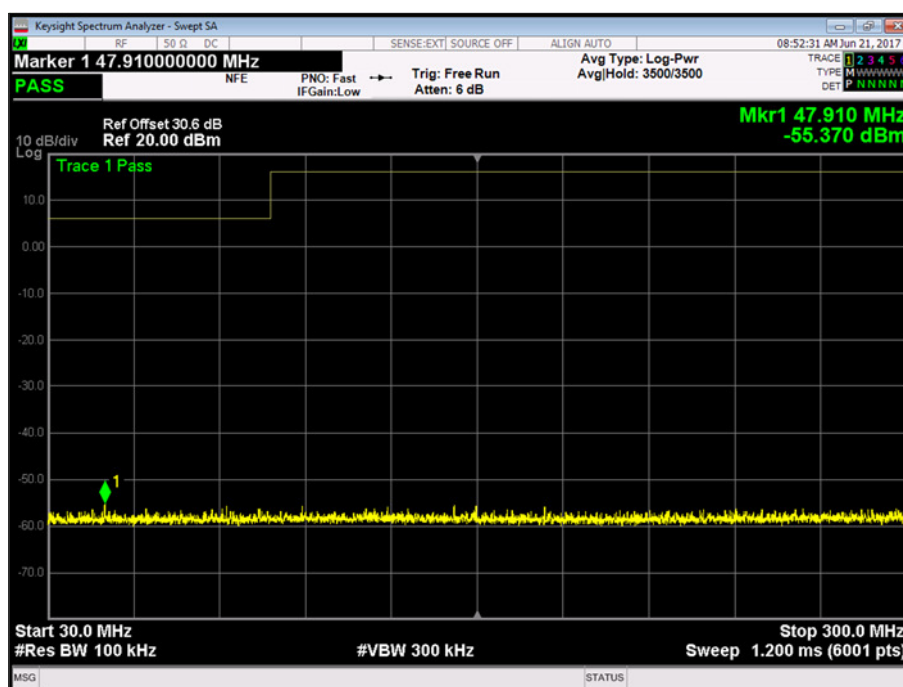


Figure 26 - 30 MHz to 100 MHz



Product Service

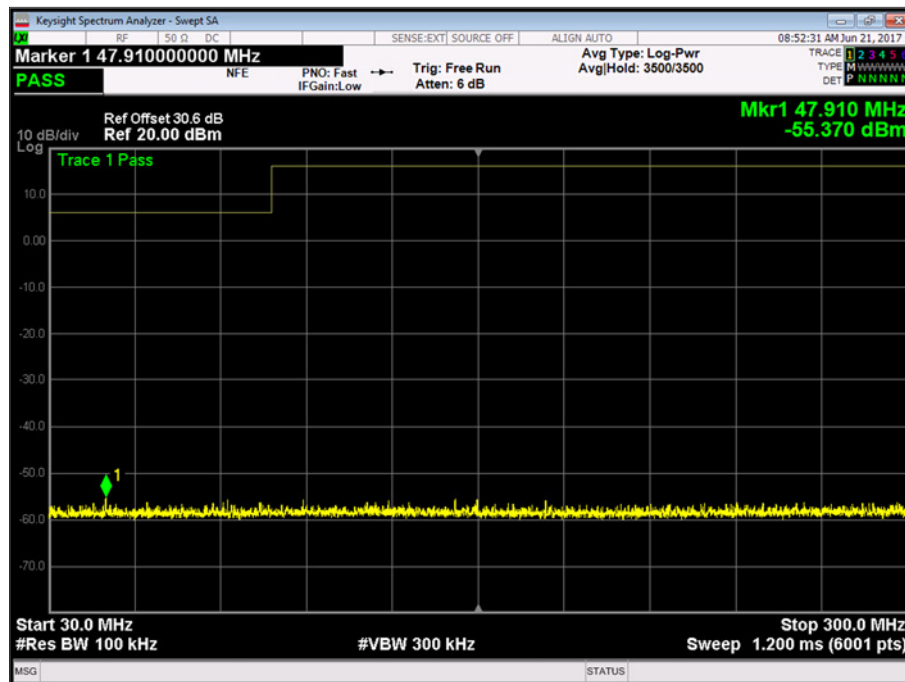


Figure 27 - 100 MHz to 300 MHz

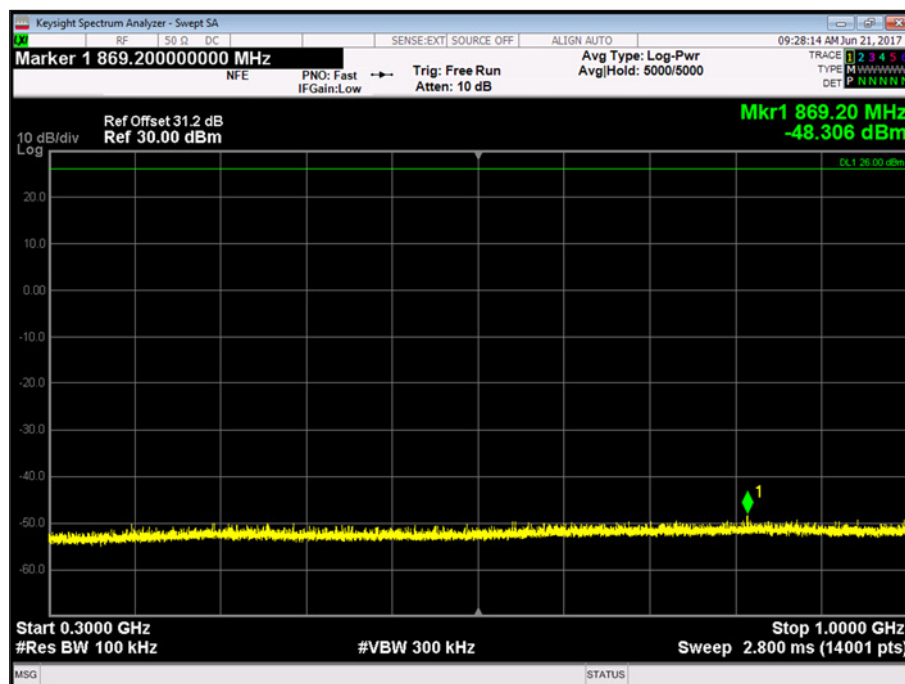


Figure 28 - 300 MHz to 1 GHz

FCC 47 CFR Part 80, Limit Clause 80.217 (b)

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 μ W
Below 30 MHz	400
30 to 100 MHz	4,000
100 to 300 MHz	40,000
Over 300 MHz	400,000

Table 21

2.7.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 3.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	09-Sep-2017
Hygrometer	Rotronic	I-1000	2891	12	23-Aug-2017
Attenuator (20dB, 2W)	Pasternack	PE7004-20	2943	12	04-Apr-2018
Attenuator (10dB, 50W)	Aeroflex / Weinschel	47-10-34	3166	12	20-Sep-2017
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	15-Sep-2017
'N' - 'N' RF Cable (2m)	Rhophase	NPS-1803-2000-NPS	3698	12	12-Oct-2017
TRUE RMS MULTIMETER	Fluke	179	4006	12	13-Dec-2017
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	08-Sep-2017
Frequency Standard	Spectracom	Secure Sync 1200-0408-0601	4393	6	09-Sep-2017
PXA Signal Analyser	Keysight Technologies	N9030A	4654	12	06-Oct-2017
2 Channel PSU	Rohde & Schwarz	HMP2020	4735	-	O/P Mon

Table 22

O/P Mon – Output Monitored using calibrated equipment



2.8 Receiver Emissions

2.8.1 Specification Reference

Industry Canada RSS-GEN, Clause 5 and 7.1

2.8.2 Equipment Under Test and Modification State

COBALT II EP2, S/N: #18 - Modification State 0

2.8.3 Date of Test

11-June-2017

2.8.4 Test Method

The test was performed in accordance with ANSI C63.4, Clause 8.

All final measurements were assessed against the emission limits in Industry Canada RSS GEN, Clause 7.1.2.

2.8.5 Environmental Conditions

Ambient Temperature 21.3 °C

Relative Humidity 51.0 %

2.8.6 Test Results

Idle

Highest frequency generated or used within the EUT: 191.28 MHz

Upper frequency test limit: 1 GHz

Frequency (MHz)	QP Level (dBuV/m)	QP Limit (dBuV/m)	QP Margin (dBuV/m)	Angle(Deg)	Height(m)	Polarity
30.939	30.3	40.0	-9.7	339	1.00	Vertical
32.382	33.3	40.0	-6.7	126	1.00	Vertical
32.714	29.7	40.0	-10.3	194	1.00	Vertical
142.315	43.2	43.5	-0.3	288	1.00	Vertical
191.281	41.2	43.5	-2.3	351	1.73	Horizontal
191.284	43.4	43.5	-0.1	166	1.00	Vertical
284.649	34.5	46.0	-11.5	172	1.17	Horizontal
382.565	37.7	46.0	-8.3	26	1.00	Horizontal
426.963	39.0	46.0	-7.0	197	1.00	Horizontal
573.835	37.1	46.0	-8.9	0	1.00	Vertical

Table 23 - 30 MHz to 1 GHz

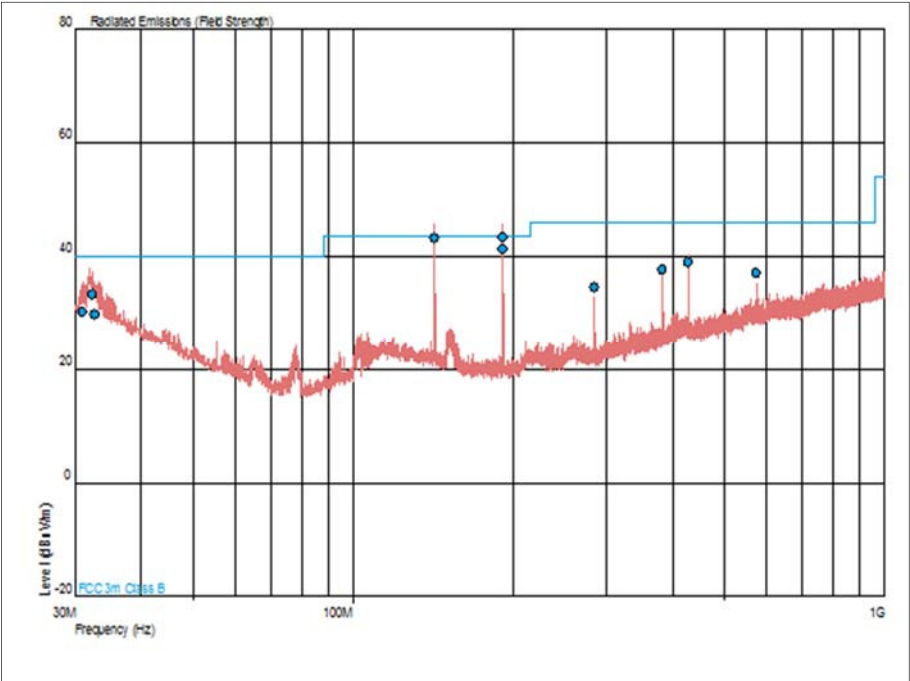


Figure 29 - 30 MHz to 1 GHz - Horizontal and Vertical

Remarks

The customer has declared that the USB port is used for service and configuration purposes only. Therefore USB port was not terminated during testing.

Industry Canada RSS-GEN, Limit Clause 7.1.2

Frequency Range (MHz)	Field Strength (µV/m at 3m)	Field Strength (dBµV/m at 3m)
30 to 88	100	40.0
88 to 216	150	43.5
216 to 960	200	46.0
> 960	500	54.0

Table 24

2.8.7 Test Location and Test Equipment Used

This test was carried out in EMC Chamber 5.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Screened Room (5)	Rainford	Rainford	1545	36	20-Dec-2017
Turntable Controller	Inn-Co GmbH	CO 1000	1606	-	TU
Hygrometer	Rotronic	A1	2138	12	02-Feb-2018
Antenna (Bilog)	Chase	CBL6143	2904	24	11-Jun-2017
Comb Generator	Schaffner	RSG1000	3034	-	TU
Cable (N-N, 8m)	Rhophase	NPS-2302-8000-NPS	3248	12	02-May-2018
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	12-Nov-2017
Tilt Antenna Mast	maturo GmbH	TAM 4.0-P	3916	-	TU
Mast Controller	maturo GmbH	NCD	3917	-	TU
2 Channel PSU	Rohde & Schwarz	HMP2020	4735	-	O/P Mon

Table 25

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment



3 Measurement Uncertainty

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

Test Name	Measurement Uncertainty
Bandwidths	± 58.05 Hz
Transmitter Frequency Tolerances	± 11 Hz
Spurious Emissions at Antenna Terminals	± 3.45 dB
Radiated Spurious Emissions	30 MHz to 1 GHz: ± 5.1 dB 1 GHz to 40 GHz: ± 6.3 dB
Modulation Requirements	-
Transmitter Power	± 0.70 dB
Suppression of Interference Aboard Ships	± 3.45 dB
Receiver Emissions	30 MHz to 1 GHz: ± 5.1 dB 1 GHz to 40 GHz: ± 6.3 dB

Table 26