Report on the Radio Testing of:

Ocean Signal Limited
AIS Class B transponder. Model: ATB1

In accordance with IEC 62287-2

Prepared for: Ocean Signal Limited
Ocivan Way
Margate
CT9 4NN
United Kingdom

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RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Project Management	Sarah Jones	15 July 2019	
Authorised Signatory	Simon Bennett	15 July 2019	

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

EXECUTIVE SUMMARY
A sample of this product was tested and found to be compliant with IEC 62287-2: Edition 2 (2017).

TÜV SÜD
is a trading name of TUV SUD Ltd
Registered in Scotland at East Kilbride,
Glasgow G75 0QF, United Kingdom
Registered number: SC215164

TUV SUD Ltd is a
TÜV SÜD Group Company

Phone: +44 (0) 1489 558100
Fax: +44 (0) 1489 558101
www.tuv-sud.co.uk

TÜV SÜD
Octagon House
Concorde Way
Fareham
Hampshire PO15 5RL
United Kingdom

Contents

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	19 October 2018
2	FCC 47 CFR Part 80 cross reference added to section 1.3	15 July 2019

Table 1

1.2 Introduction

Applicant	Ocean Signal Limited
Manufacturer	Ocean Signal Limited
Model Number(s)	ATB1
Serial Number(s)	TA 005 (TUV Ref TSR0004)
Hardware Version(s)	Mod State 0: 0B.00 Mod State 1: 0B.01 Mod State 2: 0B.02 Mod State 3: 0B.03 Final Build Version: 01.00 (same as 0B.03)
Firmware Version(s)	0.1.03 0.1.14 01.00.00 (Final Version)
Number of Samples Tested	1
Test Specification/Issue/Date	IEC 62287-2: Edition 2 (2017)
Order Number Date	3122-00 reprint 03/1 03-November-2016
Date of Receipt of EUT	13-February-2018
Start of Test	19-March-2018
Finish of Test	29-August-2018
Name of Engineer(s)	Neil Rousell and Matthew Russell
Related Document(s)	IEC 60945 (2002)
FCC Accreditation	90987 Octagon House, Fareham Test Laboratory
Class of Emission (Manufacturer Declared)	16K0GXW

1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with IEC 62287-2 is shown below (with an FCC 47 CFR Part 80 cross reference).

Section	Specification Clause		Test Description	Result	Comments/Base Standard
	IEC 62287-2	FCC Part 80 Reference			
Configuration and Mode: DC Powered - AIS - SOTDMA					
2.1	11.1.1	80.209	Frequency Error	Pass	
2.2	11.1.2	80.215	Carrier Power	Pass	
2.3	11.1.3	80.205 80.211	Transmission Spectrum	Pass	
2.4	11.1.4	80.213	Modulation Accuracy	Pass	
2.5	11.1.5	-	Transmitter Output Power Versus Time Function	Pass	
2.6	11.2.1	-	Sensitivity	Pass	
2.7	11.2.2	-	Error Behaviour at High Input Levels	Pass	
2.8	11.2.3	-	Co-channel Rejection	Pass	
2.9	11.2.4	-	Adjacent Channel Selectivity	Pass	
2.10	11.2.5	-	Spurious Response Rejection	Pass	
2.11	11.2.6	-	Intermodulation Response Rejection	Pass	
2.12	11.2.7	-	Blocking or Desensitisation	Pass	
2.13	11.3.1	80.217	Spurious Emissions from the Receiver	Pass	
2.14	11.3.2	80.211	Spurious Emissions from the Transmitter	Pass	
Configuration and Mode: DC Powered - DSC Receiver					
2.15	A.5	-	DSC Receiver Tests	Declaration	
2.16	A.5.8	-	DSC Blocking or Desensitisation	Pass	

Table 2

1.4 Application Form

EQUIPMENT DESCRIPTION	
Model Name/Number	ATB1
Part Number	760S-02700
Hardware Version	01.00
Software Version	01.00.00
Technical Description (Please provide a brief description of the intended use of the equipment)	Class B AIS transponder

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
☒	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	to	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)						
	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	0.026	Seconds	Transmitter OFF	Seconds		

TRANSMITTER - MODULATION			
Amplitude	☐	Other	☒
Frequency	☐	Details :	GMSK
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	to
Receiver channel switching frequency range	156.025 to 162.025
Channel Separation (if applicable)	25kHz
State the maximum number of channels over which the equipment can operate:	

POWER SOURCE			
☐	AC mains		State voltage
	AC supply frequency	(Hz)	
	VAC		
	Max Current		
	Hz		
☐	Single phase		☐ Three phase
And / Or			
☒	External DC supply		
	Nominal voltage	V	Max Current 6 A
	Extreme upper voltage	31.2 V	
	Extreme lower voltage	10.8 V	
Battery			
☐	Nickel Cadmium		☐ Lead acid (Vehicle regulated)
☐	Alkaline		☐ Leclanche
☐	Lithium		☐ Other Details :
	Volts nominal.		
End point voltage as quoted by equipment manufacturer		10.8	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: David Sheekey Position held: Type Approval Manager
Date: 28/3/2018

1.5 Product Information

1.5.1 Technical Description

Class B AIS Transponder

1.5.2 Test Power Source

The equipment is designed to operate from a 12 V or 24 V DC supply. Unless otherwise stated, all tests made under nominal voltage conditions were performed at 12 V DC.

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: 005			
Hardware:			
0	As supplied	-	-
1	Add 22pf decoupling capacitor from IC 42 Pin 42 to 0V - SPI data line (Signal RF_MOSI) Add 22pf decoupling capacitor from IC 42 Pin 43 to 0V - SPI data line (Signal RF_MISO) Change C299 from 1nF to 4n7 – TX Power control loop BW reduction	Manufacturer	15-May-2018
2	Add M95512 non -volatile memory IC to SPI Bus (IC50).	Manufacturer	12 June 2018
3	Add 4A SM Fuse “F2” to Supply +V between J1 and D2 (TA001 only). Not applicable to this document.	Manufacturer	17 September 2018
Firmware: all testing was carried out with firmware 0.1.00 unless indicated otherwise.			
0.1.00	As supplied by the Manufacturer	Manufacturer	As supplied
0.1.14	Fixed issue with channel management in message 22. Fixed problem with SOG error in message 27. Fixed problem with TX malfunction alarm not clearing.	TUV	21 August 2018
Further firmware revisions were applied to the EUT within the test dates. This was to maintain all of the supplied test samples at the same firmware revision. The revisions made were to resolve non-compliances identified during network testing and had no effect on the EUT transceiver performance or the operation of the serial data ports.			

Table 3

1.8 Test Location

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

Test Name	Name of Engineer(s)	Accreditation
Configuration and Mode: DC Powered - AIS - SOTDMA		
Frequency Error	Neil Rousell and Matthew Russell	UKAS
Carrier Power	Neil Rousell and Matthew Russell	UKAS
Transmission Spectrum	Matthew Russell	UKAS
Modulation Accuracy	Neil Rousell and Matthew Russell	UKAS
Transmitter Output Power Versus Time Function	Neil Rousell	UKAS
Sensitivity	Neil Rousell and Matthew Russell	UKAS
Error Behaviour at High Input Levels	Neil Rousell	UKAS
Co-channel Rejection	Neil Rousell	UKAS
Adjacent Channel Selectivity	Neil Rousell	UKAS
Spurious Response Rejection	Neil Rousell	UKAS
Intermodulation Response Rejection	Neil Rousell	UKAS
Blocking or Desensitisation	Neil Rousell	UKAS
Spurious Emissions from the Receiver	Neil Rousell	UKAS
Spurious Emissions from the Transmitter	Neil Rousell	UKAS
Configuration and Mode: DC Powered - DSC Receiver		
DSC Blocking or Desensitisation	Matthew Russell	UKAS

Table 4

Office Address:

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

2 Test Details

2.1 Frequency Error

2.1.1 Specification Reference

IEC 62287-2, Clause 11.1.1

2.1.2 Equipment Under Test and Modification State

ATB 1, S/N: 005 - Modification State 0
ATB 1, S/N: 005 - Modification State 2 (test at extreme lower voltage)
ATB 1, S/N: 005 - Modification State 2 and firmware 0.1.14 (test at extreme upper voltage)

2.1.3 Date of Test

28-March-2018 to 29-August-2018

2.1.4 Test Method

This test was performed in accordance with IEC 62287-2, clause 11.1.1.2.

2.1.5 Environmental Conditions

Ambient Temperature	21.7 - 24.4 °C
Relative Humidity	45.7 - 54.1 %

2.1.6 Test Results

DC Powered - AIS - SOTDMA

Test Conditions		156.025 MHz		162.025 MHz	
Temperature	Voltage	Error (Hz)	Error (ppm)	Error (Hz)	Error (ppm)
+ 24.3°C	12.0 V DC	57	0.37	38	0.23
-20.0 °C	10.8 V DC	-35	-0.22	-35	-0.22
+55.0 °C	31.2 V DC	-77	0.49	-77	-0.48

Table 5 - Frequency Error Results

IEC 62287-2, Limit Clause 11.1.1.3

The frequency error shall not exceed ±0.5 kHz under normal and ± 1 kHz under extreme test conditions.

FCC 47 CFR Part 80, Limit Clause 80.209

± 10 ppm.

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
Power Supply Unit	Hewlett Packard	6267B	21	-	O/P Mon
Climatic Chamber	Votsch	VT4002	161	-	O/P Mon
Attenuator (20dB/ 2W)	Pasternack	PE7004-20	489	12	12-Feb-2018
Multimeter	Fluke	79 Series III	498	12	09-Aug-2018
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	20-Oct-2018
Digital Temperature Indicator	Fluke	51	1385	12	02-Jan-2019
Digital Temperature Indicator	Fluke	51	2267	12	05-Jul-2018
Hygrometer	Rotronic	I-1000	2891	12	30-Aug-2018
Multimeter	Fluke	79 Series II	3057	12	20-Jul-2019
Attenuator (10dB, 50W)	Aeroflex / Weinschel	47-10-34	3166	12	20-Oct-2018
Hygrometer	Rotronic	I-1000	3220	12	30-Aug-2018
Attenuator (20dB, 150W)	Narda	769-20	3367	12	31-May-2018
Attenuator (30dB, 150W)	Narda	769-30	3369	12	17-Jul-2019
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	02-Oct-2018
'N' - 'N' RF Cable (1m)	Rhophase	NPS-1803-1000-NPS	3700	12	31-Jan-2019
TRUE RMS MULTIMETER	Fluke	179	4006	12	13-Dec-2018
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	06-Mar-2019
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	11-Apr-2018
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	20-Oct-2018
PXA Signal Analyser	Keysight Technologies	N9030A	4654	12	06-Oct-2018
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	TU
Climatic Chamber	Aralab	FitoTerm 300E45	4823	12	O/P Mon
Attenuator (10dB, 100W)	Weinschel	48-10-43	4868	12	01-Nov-2018
Quad Power Supply	Rohde & Schwarz	HMP4040	4954	-	O/P Mon
EXA	Keysight Technologies	N9010B	4969	12	21-Dec-2018

Table 6

TU - Traceability Unscheduled
O/P Mon – Output Monitored using calibrated equipment

NOTE: As testing was performed over multiple days, the calibration of some items may have expired before the test was complete. It was confirmed by the test lab that all items were in calibration at the time of use.

2.2 Carrier Power

2.2.1 Specification Reference

IEC 62287-2, Clause 11.1.2

2.2.2 Equipment Under Test and Modification State

ATB 1, S/N: 005 - Modification State 0
ATB 1, S/N: 005 - Modification State 2 (test at extreme lower voltage)
ATB 1, S/N: 005 - Modification State 2 and firmware 0.1.14 (test at extreme upper voltage)

2.2.3 Date of Test

28-March-2018 to 29-August-2018

2.2.4 Test Method

This test was performed in accordance with IEC 62287-2, clause 11.1.2.2.

2.2.5 Environmental Conditions

Ambient Temperature	21.7 - 25.0 °C
Relative Humidity	44.1 - 54.1 %

2.2.6 Test Results

DC Powered - AIS - SOTDMA

Test Conditions		156.025 MHz		162.025 MHz	
Temperature	Voltage	Power (dBm)	Power (W)	Power (dBm)	Power (W)
21.7°C	12.0 V DC	37.44	5.55	37.48	5.60
-20.0 °C	10.8 V DC	37.90	6.17	37.96	6.25
+55.0 °C	31.2 V DC	37.76	5.97	37.48	5.60

Table 7 - Carrier Power Results - High Power

Test Conditions		156.025 MHz		162.025 MHz	
Temperature	Voltage	Power (dBm)	Power (W)	Power (dBm)	Power (W)
21.7	12.0 V DC	30.46	1.11	30.43	1.10
-20.0 °C	10.8 V DC	30.94	1.24	31.26	1.34
+55.0 °C	31.2 V DC	31.18	1.31	30.37	1.09

Table 8 - Carrier Power Results – Low Power

IEC 62287-2, Limit Clause 11.1.2.3

At all test frequencies, the carrier power shall be for high power 37 dBm ± 1,5 dBm and 30 dBm ± 1,5 dBm for low power under normal test conditions.

At all test frequencies, the carrier power shall be for high power 37 dBm ± 3,0 dBm and 30 dBm ± 3,0 dBm for low power under extreme test conditions.

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

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

- Ships Stations: 156 to 162 MHz - 25 W

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
Climatic Chamber	Votsch	VT4002	161	-	O/P Mon
Attenuator (20dB/ 2W)	Pasternack	PE7004-20	489	12	12-Feb-2018
Multimeter	Fluke	79 Series III	498	12	09-Aug-2018
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	11-Apr-2018
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	20-Oct-2018
Digital Temperature Indicator	Fluke	51	1385	12	02-Jan-2019
Digital Temperature Indicator	Fluke	51	2267	12	05-Jul-2018
Hygrometer	Rotronic	I-1000	2891	12	30-Aug-2018
Multimeter	Fluke	79 Series II	3057	12	20-Jul-2019
Attenuator (10dB, 50W)	Aeroflex / Weinschel	47-10-34	3166	12	20-Oct-2018
Hygrometer	Rotronic	I-1000	3220	12	30-Aug-2018
Attenuator (20dB, 150W)	Narda	769-20	3367	12	31-May-2018
Attenuator (30dB, 150W)	Narda	769-30	3369	12	17-Jul-2019
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	02-Oct-2018
'N' - 'N' RF Cable (1m)	Rhophase	NPS-1803-1000-NPS	3700	12	31-Jan-2019
TRUE RMS MULTIMETER	Fluke	179	4006	12	13-Dec-2018
1m N-Type Cable	Rhophase		4233	12	14-Jun-2018
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	06-Mar-2019
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	11-Apr-2018
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	20-Oct-2018
PXA Signal Analyser	Keysight Technologies	N9030A	4654	12	06-Oct-2018
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	TU
Climatic Chamber	Aralab	FitoTerm 300E45	4823	-	O/P Mon
Attenuator (10dB, 100W)	Weinschel	48-10-43	4868	12	01-Nov-2018
Quad Power Supply	Rohde & Schwarz	HMP4040	4954	-	O/P Mon
EXA	Keysight Technologies	N9010B	4969	12	21-Dec-2018

Table 9

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment

NOTE: As testing was performed over multiple days, the calibration of some items may have expired before the test was complete. It was confirmed by the test lab that all items were in calibration at the time of use.

2.3 Transmission Spectrum

2.3.1 Specification Reference

IEC 62287-2, Clause 11.1.3

2.3.2 Equipment Under Test and Modification State

ATB 1, S/N: 005 - Modification State 2

2.3.3 Date of Test

13-June-2018

2.3.4 Test Method

This test was performed in accordance with IEC 62287-2, clause 11.1.3.2.

2.3.5 Environmental Conditions

Ambient Temperature	24.1 °C
Relative Humidity	42.7 %

2.3.6 Test Results

DC Powered - AIS - SOTDMA

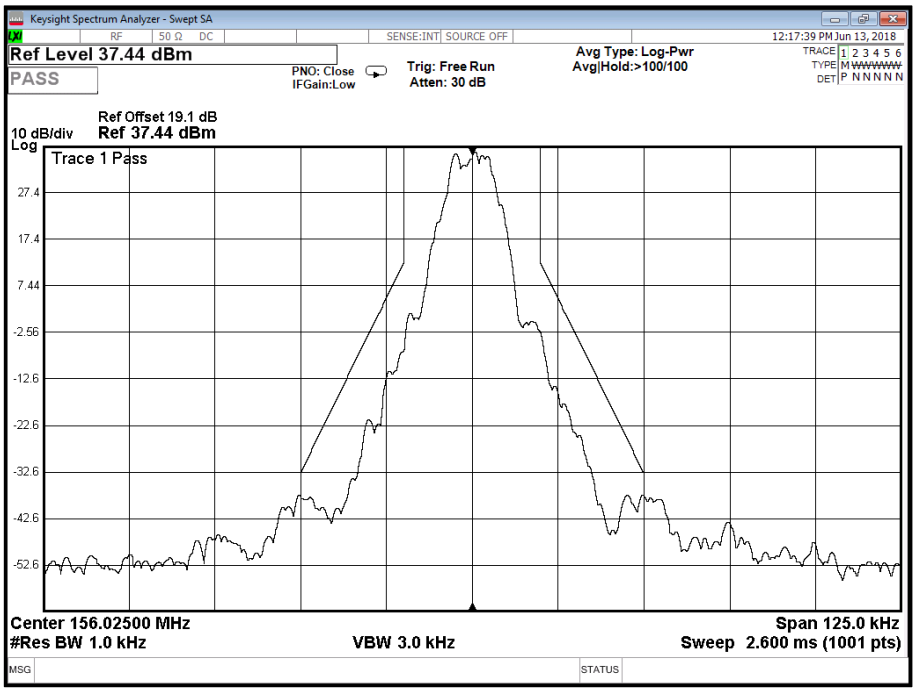

Figure 1 - 156.025 MHz

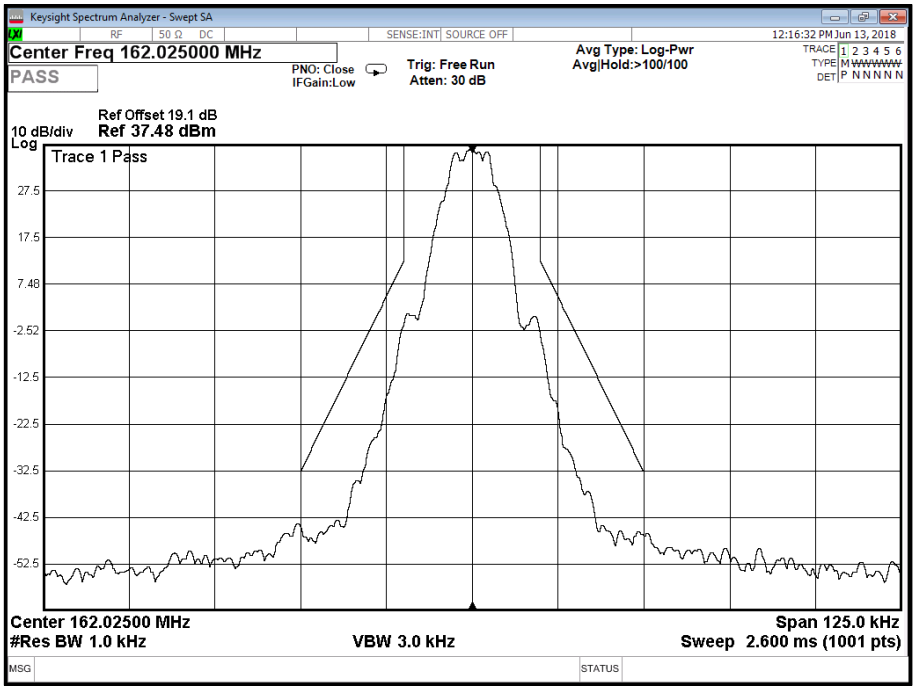

Figure 2 - 162.025 MHz

IEC 62287-2, Limit Clause 11.1.3.3

The spectrum for slotted transmission shall be within the emission mask as follows:

• in the region between the carrier and ±10 kHz removed from the carrier, the modulation and transient sidebands shall be below 0 dBc;
• at ±10 kHz removed from the carrier, the modulation and transient sidebands shall be below –25 dBc;
• at ±25 kHz to ±62,5 kHz removed from the carrier, the modulation and transient sidebands shall be below the lower value of –70 dBc;
• in the region between ±10 kHz and ±25 kHz removed from the carrier, the modulation and transient sidebands shall be below a line specified between these two points.

The reference level for the measurement shall be the carrier power (conducted) recorded for the appropriate test frequency in clause 11.1.2 of the test specification.

For information the emission mask specified above is shown below.

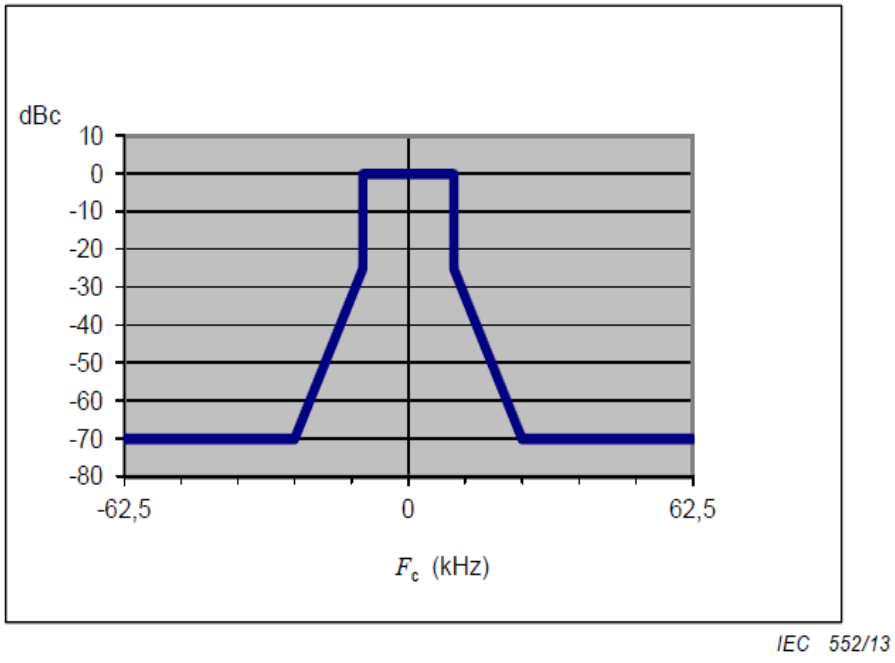

Figure 3 - Transmission Spectrum Mask Limit

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

Note: The results above show that at ±10kHz to ±20kHz the level is below -25dBc, and from ±20kHz to ±62.5kHz the level is below 70dBc.

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
Power Supply Unit	Hewlett Packard	6267B	21	-	TU
Multimeter	Fluke	79 Series III	498	12	09-Aug-2018
Hygrometer	Rotronic	I-1000	2891	12	30-Aug-2018
Attenuator (10dB, 50W)	Aeroflex / Weinschel	47-10-34	3166	12	20-Oct-2018
Signal Generator, 9kHz - 3GHz	Rohde & Schwarz	SMA 100A	3504	12	17-Oct-2018
PXA Signal Analyser	Keysight Technologies	N9030A	4654	12	06-Oct-2018
Attenuator (30dB, 250W)	Weinschel	45-30-43	4866	12	02-May-2019

Table 10

TU - Traceability Unscheduled

2.4 Modulation Accuracy

2.4.1 Specification Reference

IEC 62287-2, Clause 11.1.4

2.4.2 Equipment Under Test and Modification State

ATB 1, S/N: 005 - Modification State 0
ATB 1, S/N: 005 - Modification State 2 (test at extreme lower voltage)
ATB 1, S/N: 005 - Modification State 2 and firmware 0.1.14 (test at extreme upper voltage)

2.4.3 Date of Test

28-March-2018 to 29-August-2018

2.4.4 Test Method

This test was performed in accordance with IEC 62287-2, clause 11.1.4.2.

2.4.5 Environmental Conditions

Ambient Temperature	20.9 °C
Relative Humidity	34.3 %

2.4.6 Test Results

DC Powered - AIS - SOTDMA

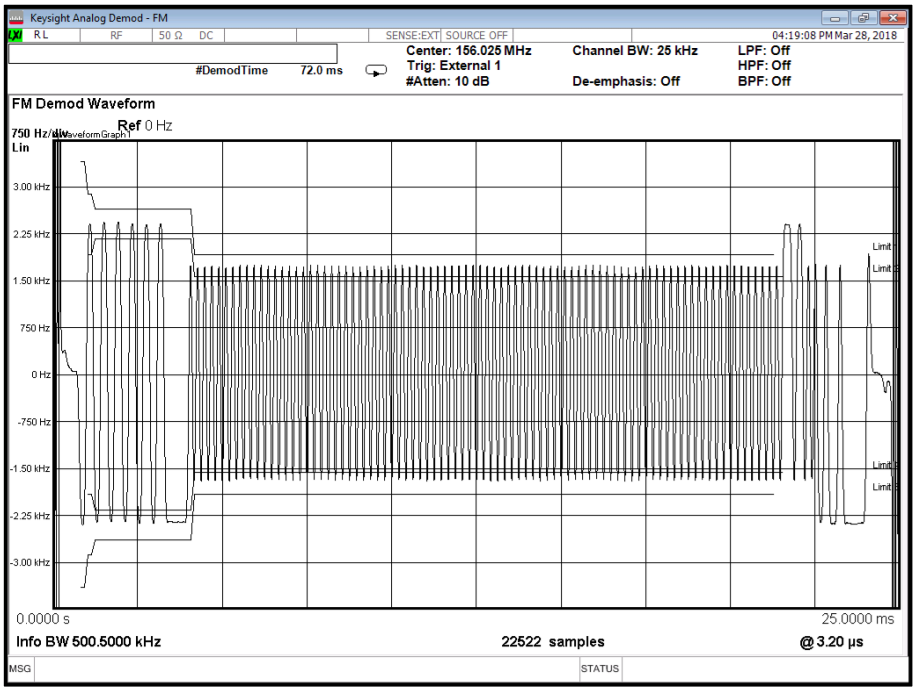

Figure 4 - 156.025 MHz, Test Signal #1, +20.9 °C, 12.0 V DC

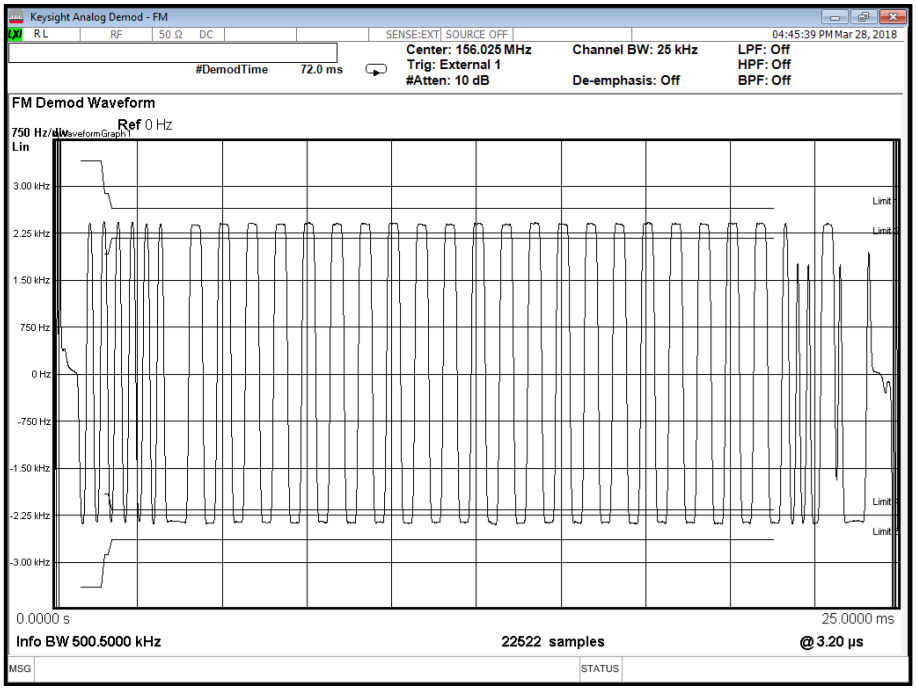

Figure 5 - 156.025 MHz, Test Signal #2, +20.9 °C, 12.0 V DC

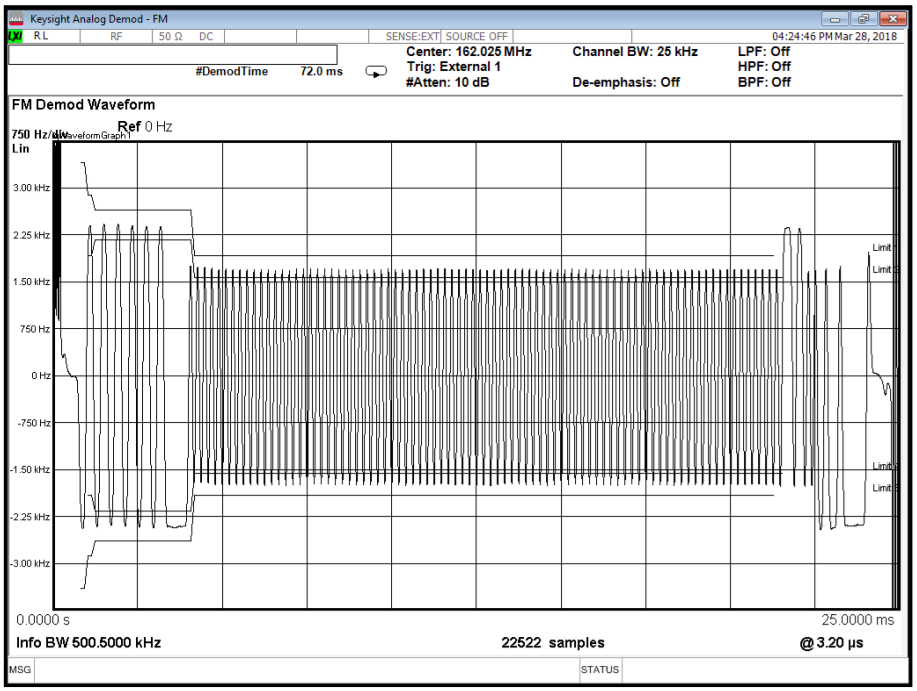

Figure 6 - 162.025 MHz, Test Signal #1, +20.9 °C, 12.0 V DC

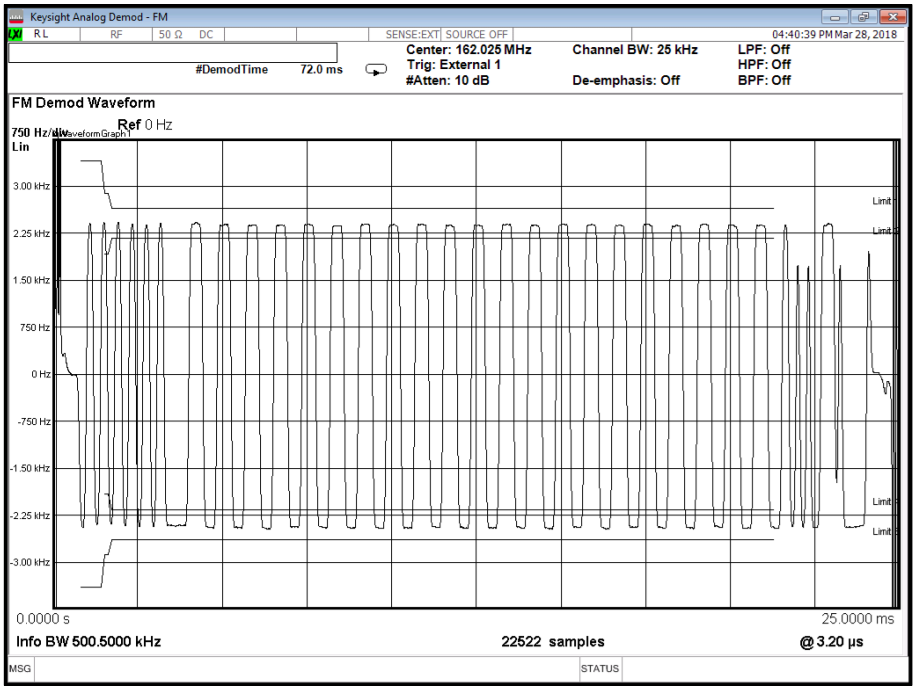

Figure 7 - 162.025 MHz, Test Signal #2, +20.9 °C, 12.0 V DC

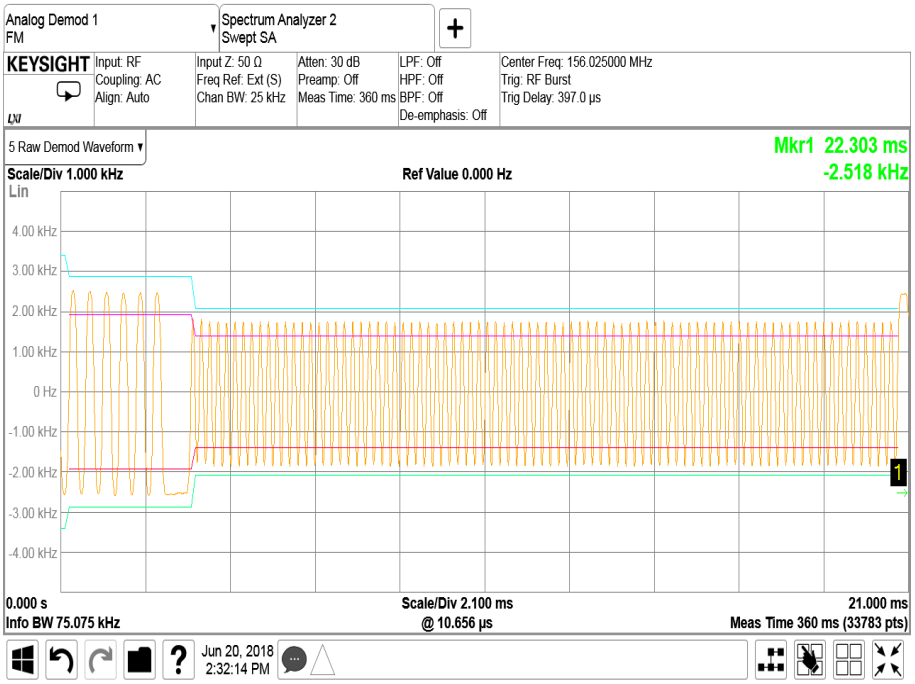

Figure 8 - 156.025 MHz, Test Signal #1, -20.0 °C, 10.8 V DC

Figure 9 - 156.025 MHz, Test Signal #2, -20.0 °C, 10.8 V DC

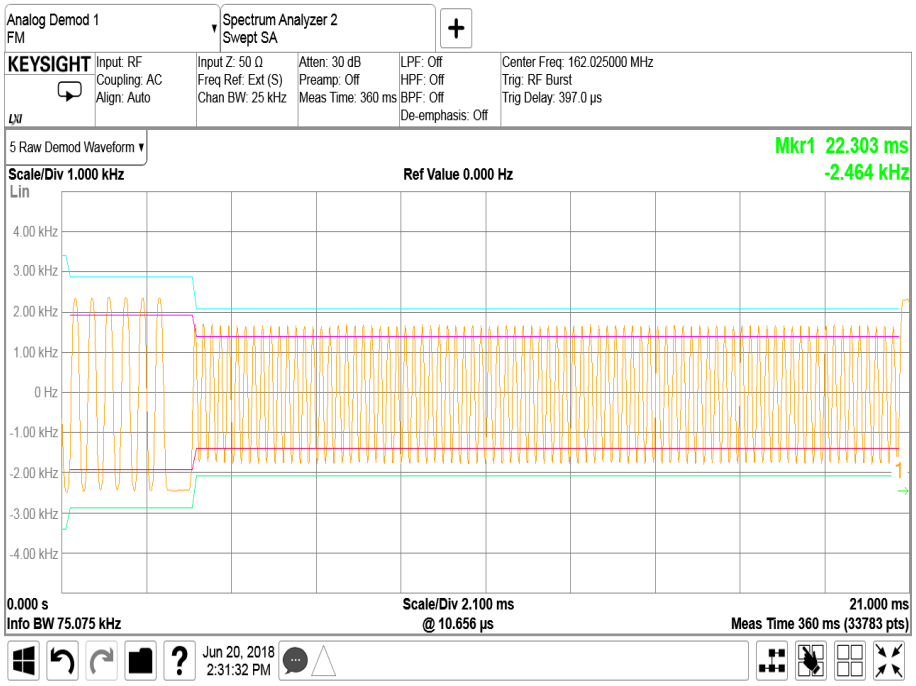

Figure 10 - 162.025 MHz, Test Signal #1, -20.0 °C, 10.8 V DC

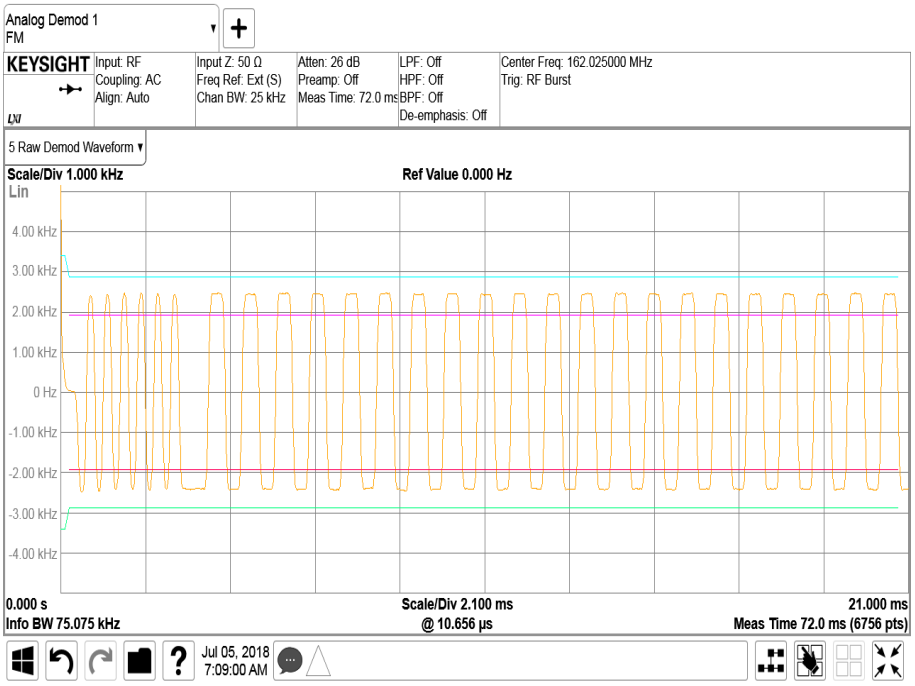

Figure 11 - 162.025 MHz, Test Signal #2, -20.0 °C, 10.8 V DC

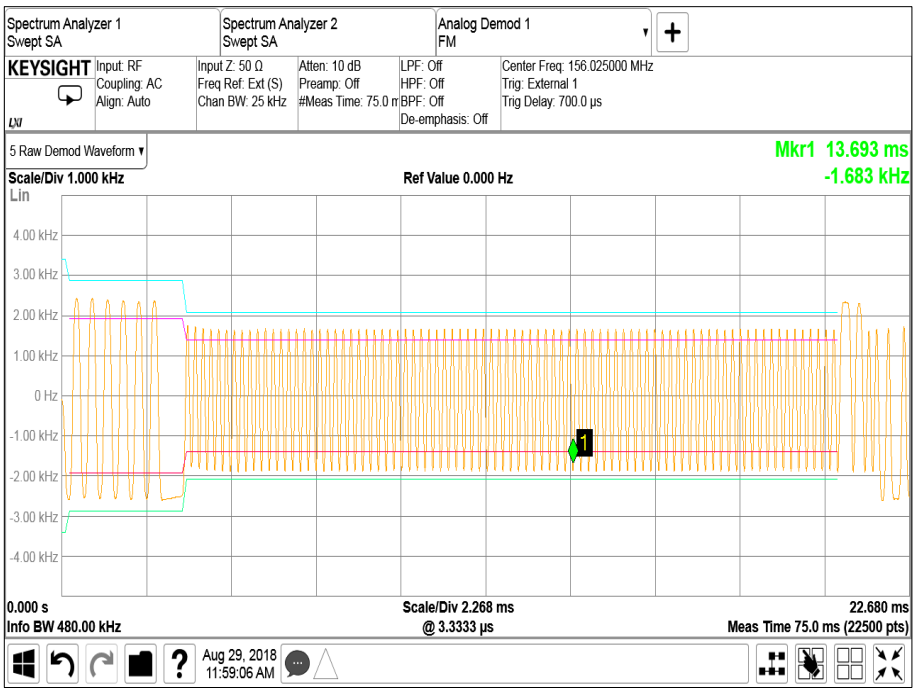

Figure 12 - 156.025 MHz, Test Signal #1, +55.0 °C, 31.2 V DC

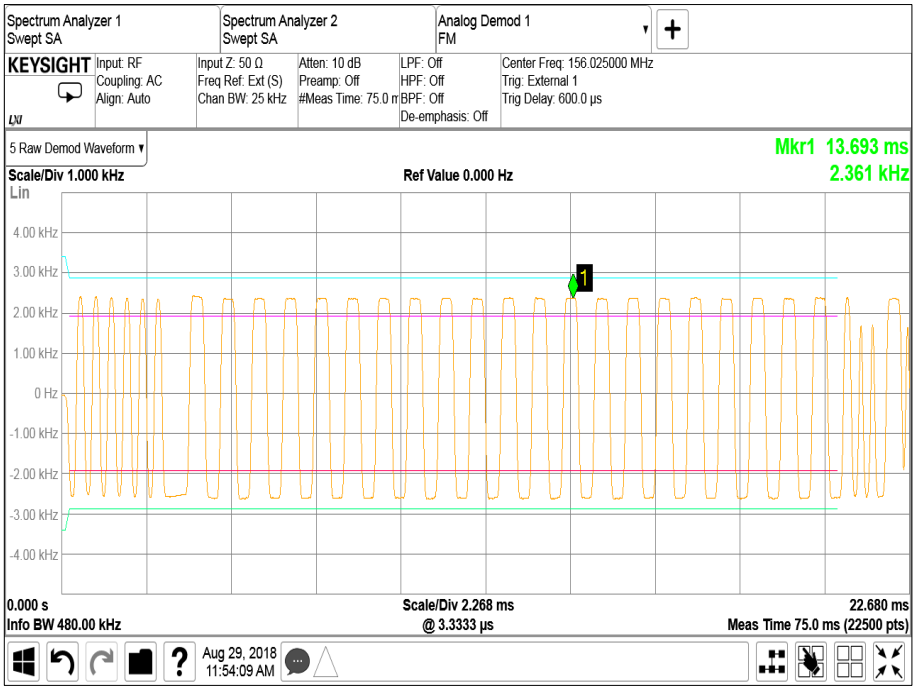

Figure 13 - 156.025 MHz, Test Signal #2, +55.0 °C, 31.2 V DC

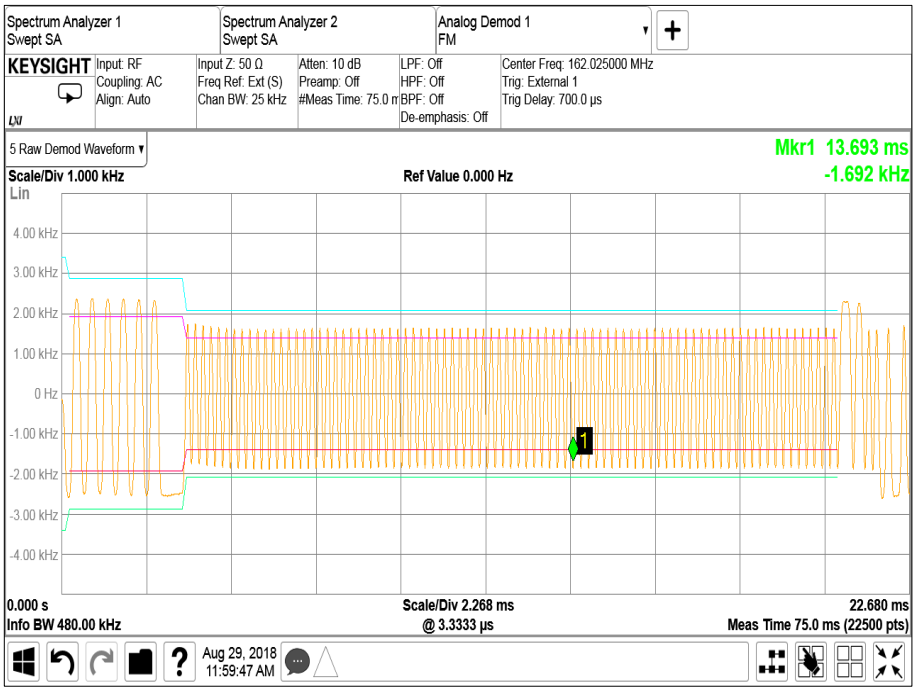

Figure 14 - 162.025 MHz, Test Signal #1, +55.0 °C, 31.2 V DC

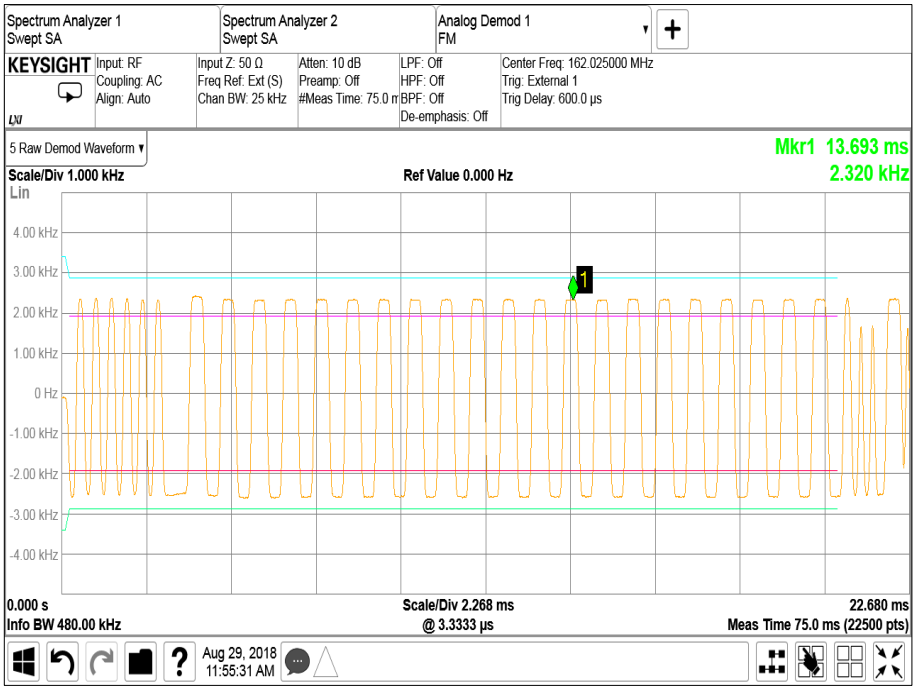

Figure 15 - 162.025 MHz, Test Signal #2, +55.0 °C, 31.2 V DC

IEC 62287-2, Limit Clause 11.1.4.3

Measurement Period from Centre to Centre of each Bit	Test Signal 1		Test Signal 2	
	Normal	Extreme	Normal	Extreme
Ramp Up	< 3400 Hz			
Bit 0 to Bit 1	< 3400 Hz			
Bit 2 to Bit 3	2400 ± 480 Hz			
Bit 4 to Bit 31	2400 ± 240 Hz	2400 ± 480 Hz	2400 ± 240 Hz	2400 ± 480 Hz
Bit 32 to Bit 199	1740 ± 175 Hz	1740 ± 350 Hz	2400 ± 240 Hz	2400 ± 480 Hz

Table 11 - Peak Frequency Deviation versus Time Limit

FCC 47 CFR Part 80, Limit Clause 80.213(d)

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

Note: There are no other specific requirements for GMSK in part 80, but modulation is within the limits specified in ITU-R M371-5 and IEC62287-2. The results above show that the signals modulation is limited within ±3400 Hz.

2.4.7 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
Power Supply Unit	Hewlett Packard	6267B	21	-	O/P Mon
Climatic Chamber	Votsch	VT4002	161	-	O/P Mon
Attenuator (20dB/ 2W)	Pasternack	PE7004-20	489	12	12-Feb-2018
Multimeter	Fluke	79 Series III	498	12	09-Aug-2018
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	20-Oct-2018
Digital Temperature Indicator	Fluke	51	1385	12	02-Jan-2019
Digital Temperature Indicator	Fluke	51	2267	12	05-Jul-2018
Hygrometer	Rotronic	I-1000	2891	12	30-Aug-2018
Multimeter	Fluke	79 Series II	3057	12	20-Jul-2019
Attenuator (10dB, 50W)	Aeroflex / Weinschel	47-10-34	3166	12	20-Oct-2018
Hygrometer	Rotronic	I-1000	3220	12	30-Aug-2018
Attenuator (20dB, 150W)	Narda	769-20	3367	12	31-May-2018
Attenuator (30dB, 150W)	Narda	769-30	3369	12	17-Jul-2019
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	02-Oct-2018
'N' - 'N' RF Cable (1m)	Rhophase	NPS-1803-1000-NPS	3700	12	31-Jan-2019
TRUE RMS MULTIMETER	Fluke	179	4006	12	13-Dec-2018
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	06-Mar-2019
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	20-Oct-2018
PXA Signal Analyser	Keysight Technologies	N9030A	4654	12	06-Oct-2018
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	TU
Climatic Chamber	Aralab	FitoTerm 300E45	4823	-	O/P Mon
Attenuator (10dB, 100W)	Weinschel	48-10-43	4868	12	01-Nov-2018
Quad Power Supply	Rohde & Schwarz	HMP4040	4954	-	O/P Mon
EXA	Keysight Technologies	N9010B	4969	12	21-Dec-2018

Table 12

TU - Traceability Unscheduled
O/P Mon – Output Monitored using calibrated equipment

NOTE: As testing was performed over multiple days, the calibration of some items may have expired before the test was complete. It was confirmed by the test lab that all items were in calibration at the time of use.

2.5 Transmitter Output Power Versus Time Function

2.5.1 Specification Reference

IEC 62287-2, Clause 11.1.5

2.5.2 Equipment Under Test and Modification State

ATB 1, S/N: 005 - Modification State 0

2.5.3 Date of Test

28-March-2018

2.5.4 Test Method

This test was performed in accordance with IEC 62287-2, clause 11.1.5.2.

2.5.5 Environmental Conditions

Ambient Temperature	20.9 °C
Relative Humidity	34.3 %

2.5.6 Test Results

DC Powered - AIS - SOTDMA

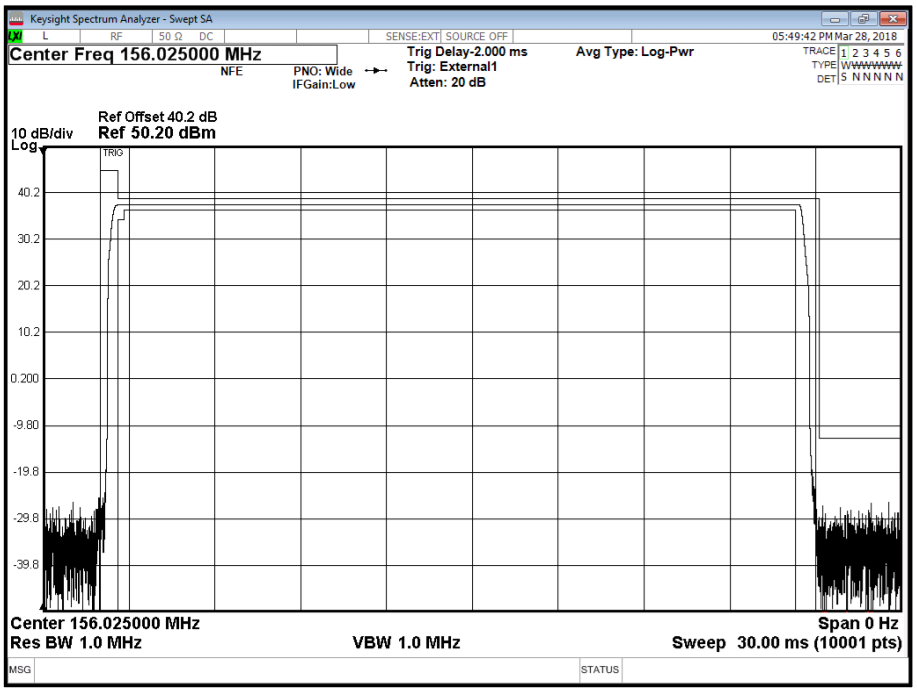

Figure 16 - 156.025 MHz - Complete Burst

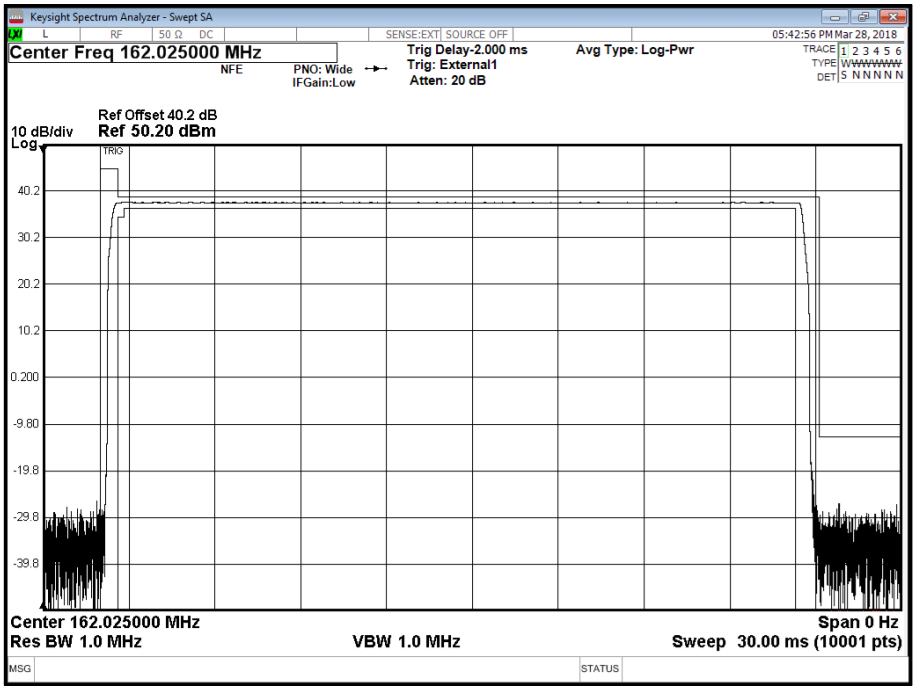

Figure 17 - 162.025 MHz - Complete Burst

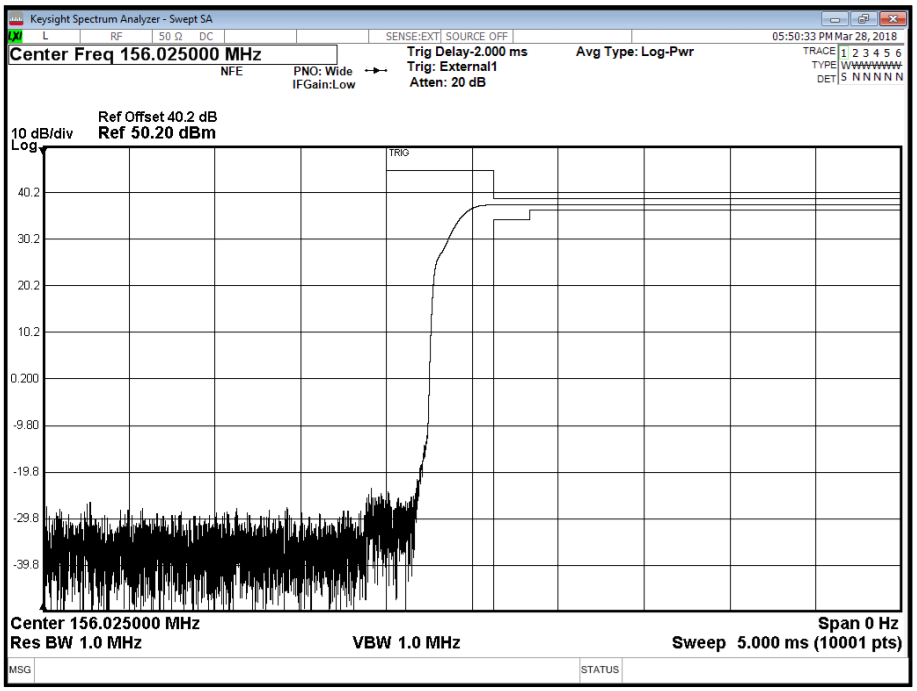

Figure 18 - 156.025 MHz - Ramp Up Zoomed

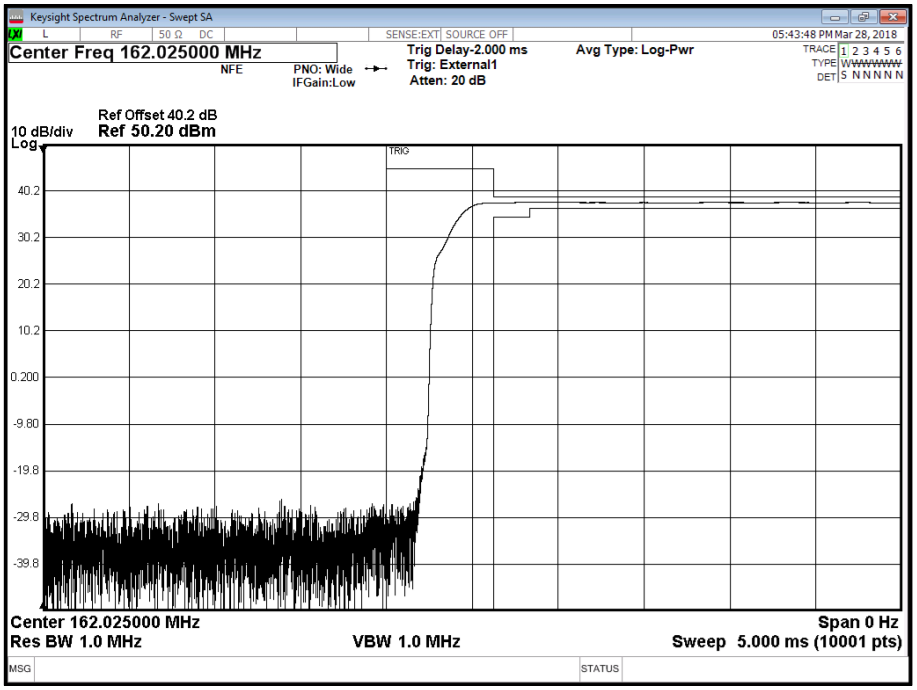

Figure 19 - 162.025 MHz - Ramp Up Zoomed

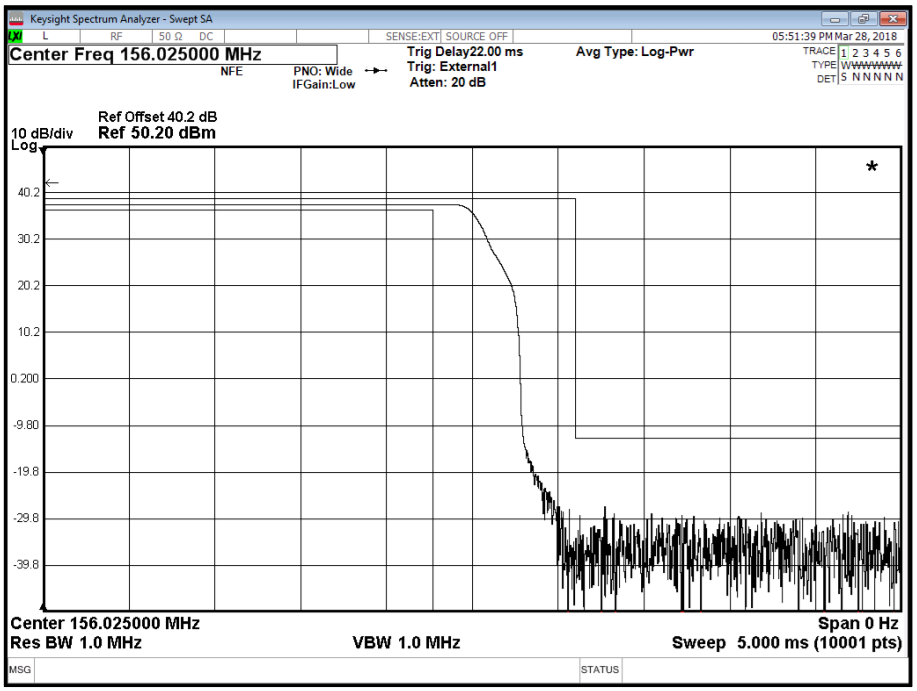

Figure 20 - 156.025 MHz - Ramp Down Zoomed

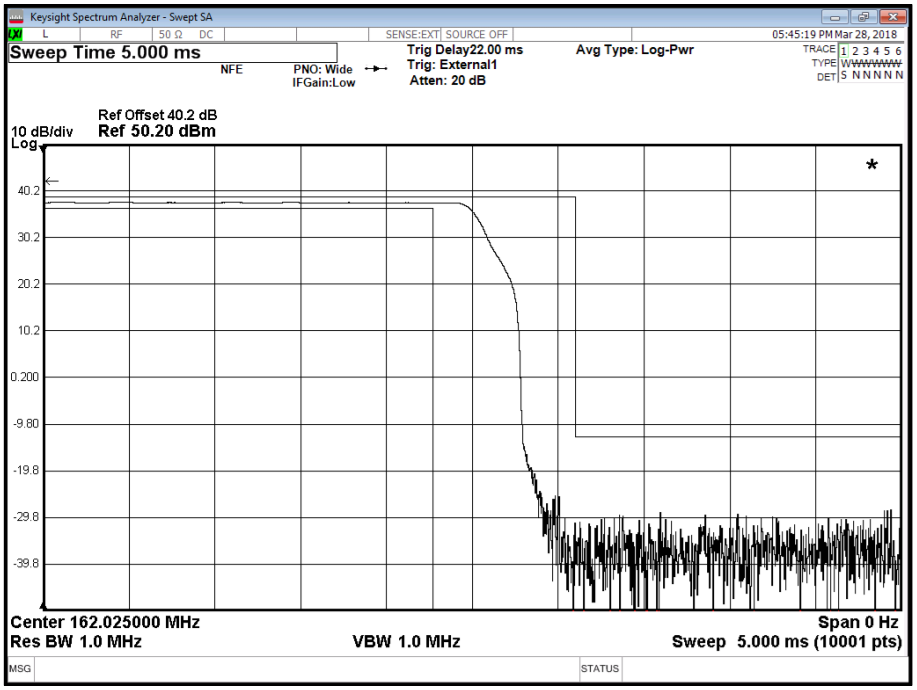

Figure 21 - 162.025 MHz - Ramp Down Zoomed

IEC 62287-2, Limit Clause 11.1.5.3

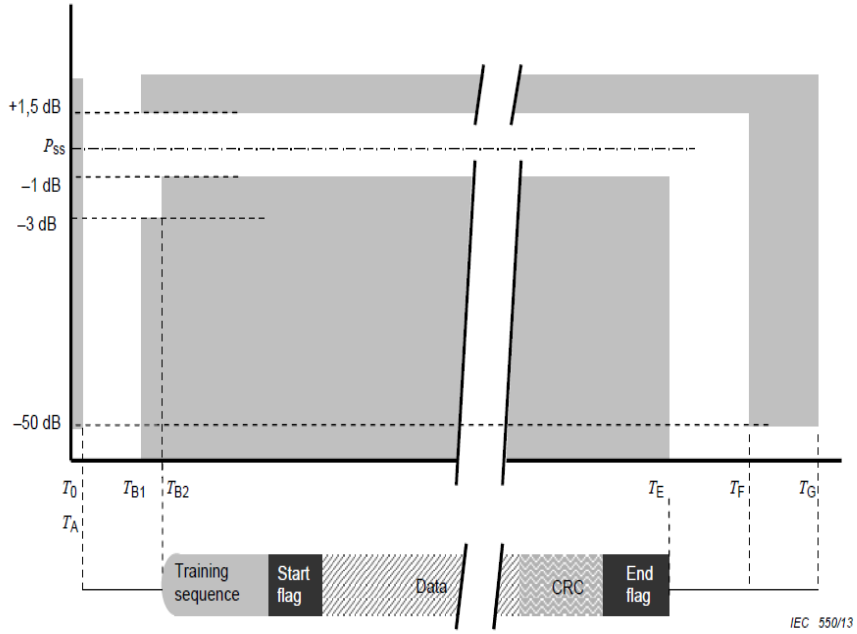

Figure 22 - Power Versus Time Mask

Reference		Bits	Time (ms)	Definitions
T_0		0	0	Start of transmission slot. Power shall NOT exceed -50 dB of P_{SS} before T_0
T_A		0 to 6	0 to 0.625	Power exceeds -50 dB of P_{SS}
T_B	T_{B1}	6	0.625	Power shall be within ±1.5 or -3 dB of P_{SS}
	T_{B2}	8	0.833	Power shall be within +1.5 or -1 dB of P_{SS} during the period T_{B2} to T_E (start of training sequence)
T_E (includes 1 stuffing bit)		233	24.271	Power shall remain within +1.5 or -1 dB of P_{SS} during the period T_{BE} to T_E
T_F (includes 1 stuffing bit)		241	25.104	Power shall be -50 dB of P_{SS} and stay below this
T_G		256	26.667	Start of next transmission time period

Table 13 - Definitions of Timing for Power Versus Time Mask

2.5.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Attenuator (20dB/ 2W)	Pasternack	PE7004-20	489	-	O/P Mon
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	11-Apr-2018
Hygrometer	Rotronic	I-1000	3220	12	30-Aug-2018
Attenuator (20dB, 150W)	Narda	769-20	3367	12	31-May-2018
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	02-Oct-2018
TRUE RMS MULTIMETER	Fluke	179	4006	12	13-Dec-2018
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	06-Mar-2019
Frequency Standard	Spectracom	Secure Sync 1200-0408-0601	4393	6	11-Apr-2018
PXA Signal Analyser	Keysight Technologies	N9030A	4654	12	06-Oct-2018
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	TU

Table 14

TU - Traceability Unscheduled
O/P Mon – Output Monitored Using Calibrated Equipment

2.6 Sensitivity

2.6.1 Specification Reference

IEC 62287-2, Clause 11.2.1

2.6.2 Equipment Under Test and Modification State

ATB 1, S/N: 005 - Modification State 0
ATB 1, S/N: 005 - Modification State 2 (test at extreme lower voltage)
ATB 1, S/N: 005 - Modification State 2 and firmware 0.1.14 (test at extreme upper voltage)

2.6.3 Date of Test

19-March-2018 to 29-August-2018

2.6.4 Test Method

This test was performed in accordance with IEC 62287-2, clause 11.2.1.2.

2.6.5 Environmental Conditions

Ambient Temperature	21.2 - 25.0 °C
Relative Humidity	19.9 - 54.1 %

2.6.6 Test Results

DC Powered - AIS - SOTDMA

Frequency Offset (Hz)	156.025 MHz		162.025 MHz	
	PER (%) - Rx1	PER (%) - Rx2	PER (%) - Rx1	PER (%) - Rx2
-500	0	1.0	0	0
0	0	0	0.5	4.0
500	0	0	0	0

Table 15 - Sensitivity Results at 21.2 °C, 12.0 V DC

Test Conditions		156.025 MHz		162.025 MHz	
Temperature	Voltage	PER (%) - Rx1	PER (%) - Rx2	PER (%) - Rx1	PER (%) - Rx2
-20.0 °C	10.8 V DC	0	0	0	0
+55.0 °C	31.2 V DC	1.5	2.0	0	1.5

Table 16 - Sensitivity Results at Extreme Test Conditions

IEC 62287-2, Limit Clause 11.2.1.3

The PER shall not exceed 20%.

2.6.7 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
Power Supply Unit	Hewlett Packard	6267B	21	-	O/P Mon
Power Supply Unit	Farnell	LB30-4	158	-	O/P Mon
Climatic Chamber	Votsch	VT4002	161	-	O/P Mon
Termination (50ohm, 50W)	Bird	8085	472	12	13-Sep-2018
Multimeter	Fluke	79 Series III	498	12	09-Aug-2018
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	11-Apr-2018
Digital Temperature Indicator	Fluke	51	2267	12	05-Jul-2018
Hygrometer	Rotronic	I-1000	2891	12	30-Aug-2018
Signal Generator (250kHz to 4GHz)	Agilent Technologies	E4433B	2893	12	24-Aug-2018
Attenuator (10dB, 50W)	Aeroflex / Weinschel	47-10-34	3166	12	20-Oct-2018
Hygrometer	Rotronic	I-1000	3220	12	30-Aug-2018
Programmable Modulation Waveform Generator	Sine Qua Non	PMG1	3291	-	O/P Mon
Signal Generator, 9kHz - 3GHz	Rohde & Schwarz	SMA 100A	3504	12	17-Oct-2018
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	02-Oct-2018
DC to TTL Converter	TUV SUD	-	3599	-	TU
'N' - 'N' RF Cable (1m)	Rhophase	NPS-1803-1000-NPS	3700	12	31-Jan-2019
Combiner/Splitter	Weinschel	1506A	3877	12	05-Apr-2018
TRUE RMS MULTIMETER	Fluke	179	4006	12	13-Dec-2018
1m N-Type Cable	Rhophase		4233	12	14-Jun-2018
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	06-Mar-2019
Frequency Standard	Spectracom	Secure Sync 1200-0408-0601	4393	6	11-Apr-2018
PXA Signal Analyser	Keysight Technologies	N9030A	4654	12	06-Oct-2018
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	O/P Mon
30dB Attenuator	Narda	766-30	4783	12	19-Dec-2018
Attenuator (10dB, 100W)	Weinschel	48-10-43	4868	12	01-Nov-2018
EXA	Keysight Technologies	N9010B	4969	12	21-Dec-2018

Table 17

TU - Traceability Unscheduled,
O/P Mon – Output Monitored using calibrated equipment

NOTE: As testing was performed over multiple days, the calibration of some items may have expired before the test was complete. It was confirmed by the test lab that all items were in calibration at the time of use.

2.7 Error Behaviour at High Input Levels

2.7.1 Specification Reference

IEC 62287-2, Clause 11.2.2

2.7.2 Equipment Under Test and Modification State

ATB 1, S/N: 005 - Modification State 0

2.7.3 Date of Test

21-March-2018

2.7.4 Test Method

This test was performed in accordance with IEC 62287-2, clause 11.2.2.2.

2.7.5 Environmental Conditions

Ambient Temperature	20.3 °C
Relative Humidity	29.1 %

2.7.6 Test Results

DC Powered - AIS - SOTDMA

Input Signal Level (dBm)	156.025 MHz		162.025 MHz	
	PER (%) - Rx1	PER (%) - Rx2	PER (%) - Rx1	PER (%) - Rx2
-77	0	0	0	0
-7	0	0	0	0

Table 18 - Error Behaviour at High Input Level Results

IEC 62287-2, Limit Clause 11.2.2.3

The PER shall not exceed 2% for an input signal level of -77 dBm and 10% for an input signal level of -7 dBm.

2.7.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Termination (50ohm, 50W)	Bird	8085	472	12	13-Sep-2018
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	11-Apr-2018
Signal Generator (250kHz to 4GHz)	Agilent Technologies	E4433B	2893	12	24-Aug-2018
Hygrometer	Rotronic	I-1000	3220	12	30-Aug-2018
Programmable Modulation Waveform Generator	Sine Qua Non	PMG1	3291	-	O/P Mon
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	02-Oct-2018
DC to TTL Converter	TUV SUD	-	3599	-	TU
Combiner/Splitter	Weinschel	1506A	3877	12	05-Apr-2018
TRUE RMS MULTIMETER	Fluke	179	4006	12	13-Dec-2018
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	06-Mar-2019
Frequency Standard	Spectracom	Secure Sync 1200-0408-0601	4393	6	11-Apr-2018
PXA Signal Analyser	Keysight Technologies	N9030A	4654	12	06-Oct-2018
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	TU
30dB Attenuator	Narda	766-30	4783	12	19-Dec-2018

Table 19

TU - Traceability Unscheduled
O/P Mon – Output Monitored Using Calibrated Equipment

2.8 Co-channel Rejection

2.8.1 Specification Reference

IEC 62287-2, Clause 11.2.3

2.8.2 Equipment Under Test and Modification State

ATB 1, S/N: 005 - Modification State 0

2.8.3 Date of Test

22-March-2018

2.8.4 Test Method

This test was performed in accordance with IEC 62287-2, clause 11.2.3.2.

2.8.5 Environmental Conditions

Ambient Temperature	19.9 °C
Relative Humidity	34.3 %

2.8.6 Test Results

DC Powered - AIS - SOTDMA

Unwanted Signal Frequency Offset (Hz)	156.025 MHz		162.025 MHz	
	PER (%) - Rx1	PER (%) - Rx2	PER (%) - Rx1	PER (%) - Rx2
-1000	7.0	10.5	7.0	12.0
0	4.0	7.5	4.0	9.5
+1000	9.5	5.5	6.5	6.5

Table 20 - Co-channel Rejection Results

IEC 62287-2, Limit Clause 11.2.3.3

The PER shall not exceed 20%.

2.8.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Attenuator 10dB/25W	Weinschel	46-10-43	400	12	21-Jun-2018
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	11-Apr-2018
Signal Generator (250kHz to 4GHz)	Agilent Technologies	E4433B	2893	12	24-Aug-2018
Hygrometer	Rotronic	I-1000	3220	12	30-Aug-2018
Programmable Modulation Waveform Generator	Sine Qua Non	PMG1	3291	-	O/P Mon
Signal Generator, 9kHz to 3GHz	Rohde & Schwarz	SMA 100A	3494	12	02-May-2018
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	02-Oct-2018
DC to TTL Converter	TUV SUD	-	3599	-	TU
Combiner/Splitter	Weinschel	1506A	3877	12	05-Apr-2018
TRUE RMS MULTIMETER	Fluke	179	4006	12	13-Dec-2018
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	06-Mar-2019
Frequency Standard	Spectracom	Secure Sync 1200-0408-0601	4393	6	11-Apr-2018
PXA Signal Analyser	Keysight Technologies	N9030A	4654	12	06-Oct-2018
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	TU
30dB Attenuator	Narda	766-30	4783	12	19-Dec-2018

Table 21

TU - Traceability Unscheduled
O/P Mon – Output Monitored Using Calibrated Equipment

2.9 Adjacent Channel Selectivity

2.9.1 Specification Reference

IEC 62287-2, Clause 11.2.4

2.9.2 Equipment Under Test and Modification State

ATB 1, S/N: 005 - Modification State 0

2.9.3 Date of Test

23-March-2018

2.9.4 Test Method

This test was performed in accordance with IEC 62287-2, clause 11.2.4.2.

2.9.5 Environmental Conditions

Ambient Temperature	21.6 °C
Relative Humidity	36.3 %

2.9.6 Test Results

DC Powered - AIS - SOTDMA

Unwanted Signal Frequency Offset (kHz)	156.025 MHz		162.025 MHz	
	PER (%) - Rx1	PER (%) - Rx2	PER (%) - Rx1	PER (%) - Rx2
-25	6.0	8.0	0	4.1
25	7.5	3.0	0	0.5

Table 22 - Adjacent Channel Selectivity Results

IEC 62287-2, Limit Clause 11.2.4.3

The PER shall not exceed 20%.

2.9.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Attenuator 10dB/25W	Weinschel	46-10-43	400	12	21-Jun-2018
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	11-Apr-2018
Signal Generator (250kHz to 4GHz)	Agilent Technologies	E4433B	2893	12	24-Aug-2018
Hygrometer	Rotronic	I-1000	3220	12	30-Aug-2018
Programmable Modulation Waveform Generator	Sine Qua Non	PMG1	3291	-	O/P Mon
Signal Generator, 9kHz to 3GHz	Rohde & Schwarz	SMA 100A	3494	12	02-May-2018
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	02-Oct-2018
DC to TTL Converter	TUV SUD	-	3599	-	TU
Combiner/Splitter	Weinschel	1506A	3877	12	05-Apr-2018
TRUE RMS MULTIMETER	Fluke	179	4006	12	13-Dec-2018
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	06-Mar-2019
Frequency Standard	Spectracom	Secure Sync 1200-0408-0601	4393	6	11-Apr-2018
PXA Signal Analyser	Keysight Technologies	N9030A	4654	12	06-Oct-2018
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	TU
30dB Attenuator	Narda	766-30	4783	12	19-Dec-2018

Table 23

TU - Traceability Unscheduled
O/P Mon – Output Monitored Using Calibrated Equipment

2.10 Spurious Response Rejection

2.10.1 Specification Reference

IEC 62287-2, Clause 11.2.5

2.10.2 Equipment Under Test and Modification State

ATB 1, S/N: 005 - Modification State 0

2.10.3 Date of Test

26-March-2018 to 29-March-2018

2.10.4 Test Method

This test was performed in accordance with IEC 62287-2, clause 11.2.5.4 and 11.2.5.5.

2.10.5 Environmental Conditions

Ambient Temperature	19.3 °C
Relative Humidity	31.3 %

2.10.6 Test Results

DC Powered - AIS - SOTDMA

Test Parameter	Value
List of Intermediate Frequencies	RX1, IF1 = 30.875 MHz, IF2 = 0.455 MHz, RX2, IF1 = 21.400 MHz, IF2 = 0.455 MHz,
Switching Range of the Receiver	6 MHz
Frequency of the Local Oscillator at 162.025 MHz (AIS2)	RX1, 125.150 MHz, RX2, 140.625 MHz
Frequency of the Local Oscillator at 156.025 MHz	RX1, 131.150 MHz, RX2, 134.625 MHz
Calculated Limited Frequency Range	RX1, 96.82 MHz to 159.48, RX2, 109.77 MHz to 165.48

Table 24 - Test Parameters for Spurious Response Rejection

Frequency (MHz)	PER (%)
156.575	5.5
155.795	3.5
155.800	2.0
156.245	8.0
156.250	2.5

Table 25 - Spurious Responses - 156.025 MHz

No other responses were identified during the Limited Frequency Range Sweep.

Frequency (MHz)	PER (%)
*	

Table 26 - Spurious Responses - 162.025 MHz

*No responses were identified during the Limited Frequency Range Sweep.

K	Calculated Frequency (MHz) for SFI1	PER (%) - Rx1	
		156.025 MHz	162.025 MHz
-2	219.425		0
2	281.175		0
-3	344.575		0
3	406.325		0
-4	469.725		0
4	531.475		0

Table 27 - Identified Frequencies Spurious Responses (SFI_1) for Rx1

K	Calculated Frequency (MHz) for SFI1	PER (%) - Rx1	
		156.025 MHz	162.025 MHz
-2	231.425	0	
2	293.175	0	
-3	362.575	0	
3	424.325	0	
-4	493.725	0	
4	555.475	0	

Table 28 - Identified Frequencies Spurious Responses (SFI_2) for Rx1

K	Calculated Frequency (MHz) for SFI1	PER (%) - Rx2	
		156.025 MHz	162.025 MHz
-2	259.850		0.5
2	302.650		0
-3	400.475		0
3	443.275		0
-4	541.100		0
4	583.900		0

Table 29 - Identified Frequencies Spurious Responses (SFI_1) for Rx2

K	Calculated Frequency (MHz) for SFI2	PER (%) - Rx2	
		156.025 MHz	162.025 MHz
-2	247.850	0	
2	290.650	0	
-3	382.475	0	
3	425.275	0	
-4	517.100	0	
4	559.900	0	

Table 30 - Identified Frequencies Spurious Responses (SFI_2) for Rx2

IEC 62287-2 Limit Clause 11.2.6.3

The PER shall not exceed 20%.

2.10.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Attenuator 10dB/25W	Weinschel	46-10-43	400	12	21-Jun-2018
Audio Analyser	Hewlett Packard	8903B	576	12	16-Jan-2019
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	11-Apr-2018
Signal Generator (250kHz to 4GHz)	Agilent Technologies	E4433B	2893	12	24-Aug-2018
Hygrometer	Rotronic	I-1000	3220	12	30-Aug-2018
Programmable Modulation Waveform Generator	Sine Qua Non	PMG1	3291	-	O/P Mon
Signal Generator, 9kHz to 3GHz	Rohde & Schwarz	SMA 100A	3494	12	02-May-2018
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	02-Oct-2018
DC to TTL Converter	TUV SUD	-	3599	-	TU
Combiner/Splitter	Weinschel	1506A	3877	12	05-Apr-2018
TRUE RMS MULTIMETER	Fluke	179	4006	12	13-Dec-2018
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	06-Mar-2019
Frequency Standard	Spectracom	Secure Sync 1200-0408-0601	4393	6	11-Apr-2018
PXA Signal Analyser	Keysight Technologies	N9030A	4654	12	06-Oct-2018
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	TU
30dB Attenuator	Narda	766-30	4783	12	19-Dec-2018

Table 31

TU - Traceability Unscheduled
O/P Mon – Output Monitored Using Calibrated Equipment

2.11 Intermodulation Response Rejection

2.11.1 Specification Reference

IEC 62287-2, Clause 11.2.6

2.11.2 Equipment Under Test and Modification State

ATB 1, S/N: 005 - Modification State 0

2.11.3 Date of Test

23-March-2018

2.11.4 Test Method

This test was performed in accordance with IEC 62287-2, clause 11.2.6.2.

2.11.5 Environmental Conditions

Ambient Temperature	21.6 °C
Relative Humidity	36.3 %

2.11.6 Test Results

DC Powered - AIS - SOTDMA

Test Number	Generator A (Wanted AIS Signal)	Generator B (Unmodulated ±50 kHz)	Generator C (Modulated ±100 kHz)	PER (%)	
				Rx1	Rx2
1	162.025 MHz	161.075 MHz	162.125 MHz	0	0.5
2	162.025 MHz	161.975 MHz	161.925 MHz	4.0	0.5
3	156.025 MHz	156.075 MHz	156.125 MHz	0.5	0.5
4	156.025 MHz	155.975 MHz	155.925 MHz	1.0	0.5

Table 32 - Intermodulation Results

IEC 62287-2 Limit clause 11.2.6.3

The PER shall not exceed 20%.

2.11.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Signal Generator	Rohde & Schwarz	SMY 01	49	12	30-Oct-2018
Attenuator 10dB/25W	Weinschel	46-10-43	400	12	21-Jun-2018
Attenuator (10dB, 75W)	Bird	8308-100	469	12	19-Dec-2018
Power Divider	Weinschel	1506A	603	12	19-Jan-2019
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	11-Apr-2018
Signal Generator (250kHz to 4GHz)	Agilent Technologies	E4433B	2893	12	24-Aug-2018
Hygrometer	Rotronic	I-1000	3220	12	30-Aug-2018
Programmable Modulation Waveform Generator	Sine Qua Non	PMG1	3291	-	O/P Mon
Signal Generator, 9kHz to 3GHz	Rohde & Schwarz	SMA 100A	3494	12	02-May-2018
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	02-Oct-2018
DC to TTL Converter	TUV SUD	-	3599	-	TU
Combiner/Splitter	Weinschel	1506A	3877	12	05-Apr-2018
TRUE RMS MULTIMETER	Fluke	179	4006	12	13-Dec-2018
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	06-Mar-2019
Frequency Standard	Spectracom	Secure Sync 1200-0408-0601	4393	6	11-Apr-2018
PXA Signal Analyser	Keysight Technologies	N9030A	4654	12	06-Oct-2018
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	TU
30dB Attenuator	Narda	766-30	4783	12	19-Dec-2018

Table 33

TU - Traceability Unscheduled
O/P Mon – Output Monitored Using Calibrated Equipment

2.12 Blocking or Desensitisation

2.12.1 Specification Reference

IEC 62287-2, Clause 11.2.7

2.12.2 Equipment Under Test and Modification State

ATB 1, S/N: 005 - Modification State 0

2.12.3 Date of Test

23-March-2018

2.12.4 Test Method

This test was performed in accordance with IEC 62287-2, clause 11.2.7.2.

2.12.5 Environmental Conditions

Ambient Temperature	21.6 °C
Relative Humidity	36.3 %

2.12.6 Test Results

DC Powered - AIS - SOTDMA

Unwanted Signal Frequency Offset (MHz)	Packet Error Ratio (%)			
	156.025 MHz		162.025 MHz	
	Rx1	Rx2	Rx1	Rx2
-10	0	0	0	0
-5	0	0	0	0
-2	0	0	0	0
-1	0	0	0	0
-0.5	0	0	0	0
0.5	0	0	0	0
1	0	0	0	0
2	0	0	0	0
5	0	0	0	0
10	0	0	0	0

Table 34 - Blocking Results

IEC 62287-2, Limit Clause 11.2.7.3

The maximum packet error rate shall not exceed 20%.

2.12.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Attenuator 10dB/25W	Weinschel	46-10-43	400	12	21-Jun-2018
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	11-Apr-2018
Signal Generator (250kHz to 4GHz)	Agilent Technologies	E4433B	2893	12	24-Aug-2018
Hygrometer	Rotronic	I-1000	3220	12	30-Aug-2018
Programmable Modulation Waveform Generator	Sine Qua Non	PMG1	3291	-	O/P Mon
Signal Generator, 9kHz to 3GHz	Rohde & Schwarz	SMA 100A	3494	12	02-May-2018
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	02-Oct-2018
DC to TTL Converter	TUV SUD	-	3599	-	TU
Combiner/Splitter	Weinschel	1506A	3877	12	05-Apr-2018
TRUE RMS MULTIMETER	Fluke	179	4006	12	13-Dec-2018
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	06-Mar-2019
Frequency Standard	Spectracom	Secure Sync 1200-0408-0601	4393	6	11-Apr-2018
PXA Signal Analyser	Keysight Technologies	N9030A	4654	12	06-Oct-2018
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	TU
30dB Attenuator	Narda	766-30	4783	12	19-Dec-2018

Table 35

TU - Traceability Unscheduled
O/P Mon – Output Monitored Using Calibrated Equipment

2.13 Spurious Emissions from the Receiver

2.13.1 Specification Reference

IEC 62287-2, Clause 11.3.1

2.13.2 Equipment Under Test and Modification State

ATB 1, S/N: 005 - Modification State 0

2.13.3 Date of Test

26-March-2018

2.13.4 Test Method

This test was performed in accordance with IEC 62287-2, clause 11.3.1.2.

2.13.5 Environmental Conditions

Ambient Temperature	19.3 °C
Relative Humidity	31.3 %

2.13.6 Test Results

DC Powered - AIS - SOTDMA

Frequency (MHz)	Level (dBm)
*	

Table 36 - Receiver Emissions Results

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

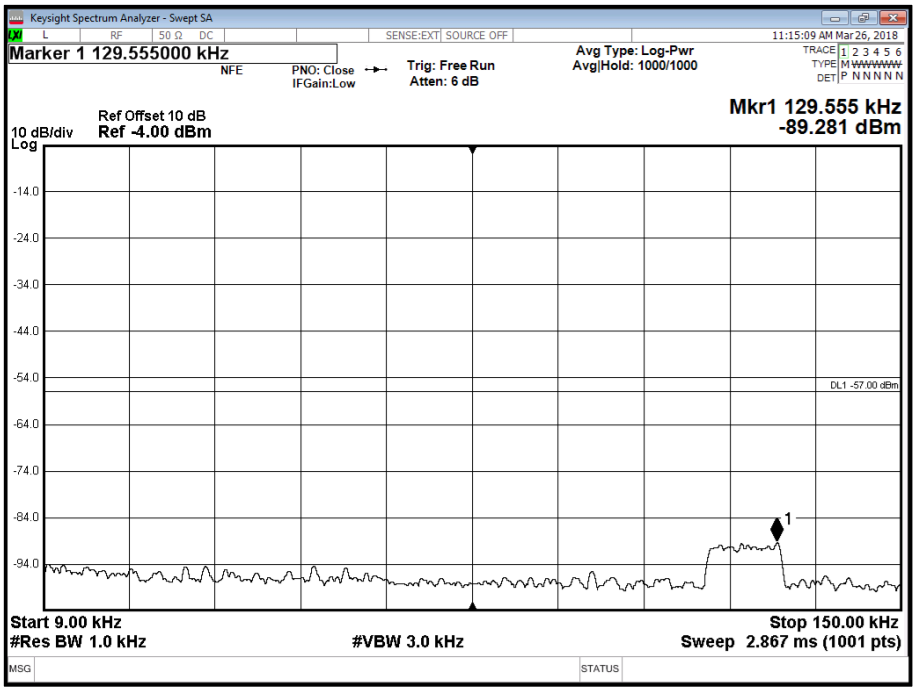

Figure 23 - 9 kHz to 150 kHz

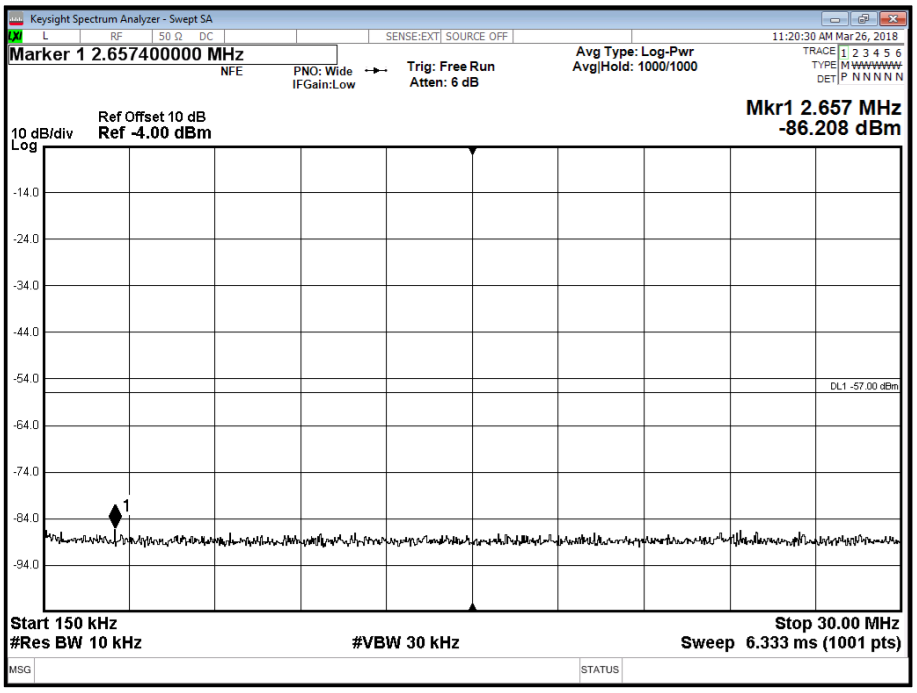

Figure 24 - 150 kHz to 30 MHz

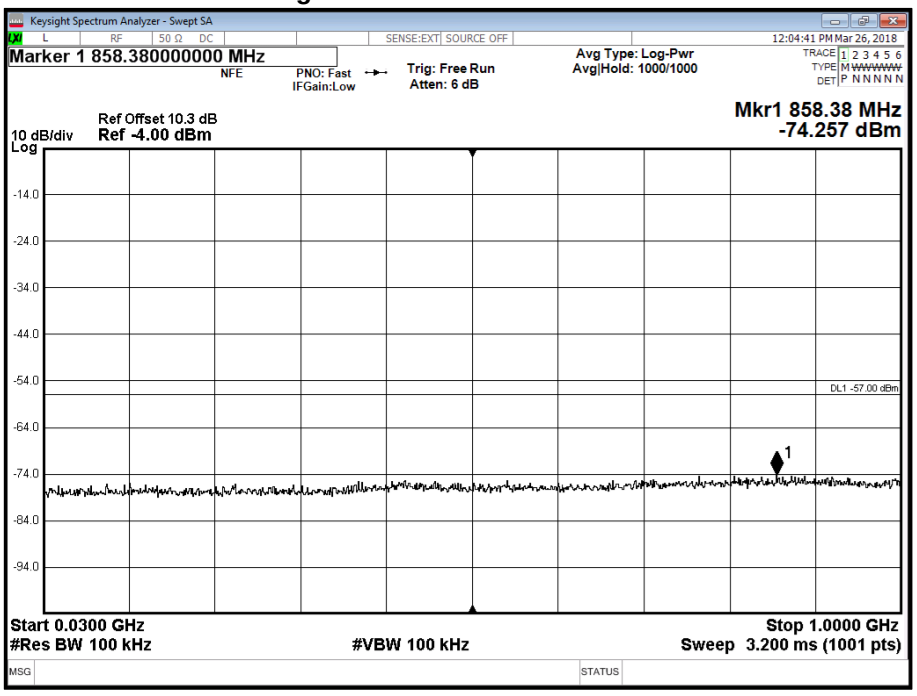

Figure 25 - 30 MHz to 1 GHz

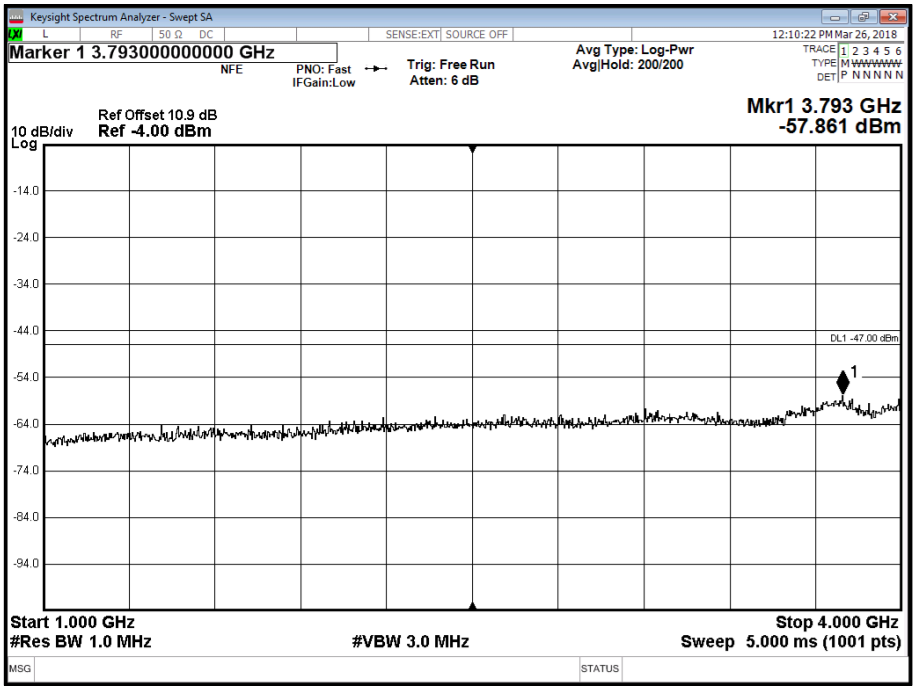

Figure 26 - 1 GHz to 4 GHz

IEC 62287-2, Limit Clause 11.3.1.3

The power of any spurious emission in the specified range at the antenna terminal shall not exceed –57 dBm (2 nW) in the frequency range 9 kHz to 1 GHz and –47 dBm (20 nW) in the frequency range 1 GHz to 4 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 µW	Power to artificial antenna (dBm)
Below 30 MHz	400	-4.0
30 to 100 MHz	4,000	6.0
100 to 300 MHz	40,000	16.0
Over 300 MHz	400,000	26.0

Note: IEC 62287-2 limits are more stringent than those specified in Part 80.217 therefore the results recorded above demonstrate compliance with the FCC Part 80 requirements.

2.13.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Attenuator 10dB/25W	Weinschel	46-10-43	400	12	21-Jun-2018
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	11-Apr-2018
Hygrometer	Rotronic	I-1000	3220	12	30-Aug-2018
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	02-Oct-2018
TRUE RMS MULTIMETER	Fluke	179	4006	12	13-Dec-2018
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	06-Mar-2019
Frequency Standard	Spectracom	Secure Sync 1200-0408-0601	4393	6	11-Apr-2018
PXA Signal Analyser	Keysight Technologies	N9030A	4654	12	06-Oct-2018
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	TU

Table 37

TU - Traceability Unscheduled

2.14 Spurious Emissions from the Transmitter

2.14.1 Specification Reference

IEC 62287-2, Clause 11.3.2

2.14.2 Equipment Under Test and Modification State

ATB 1, S/N: 005 - Modification State 0

2.14.3 Date of Test

26-March-2018 to 27-March-2018

2.14.4 Test Method

This test was performed in accordance with IEC 62287-2, clause 11.3.2.2.

2.14.5 Environmental Conditions

Ambient Temperature	21.7 °C
Relative Humidity	45.7 %

2.14.6 Test Results

DC Powered - AIS - SOTDMA

Frequency (MHz)	Level (dBm)
155.169	-46.267

Table 38 - Transmitter Emissions Results - 156.025 MHz

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

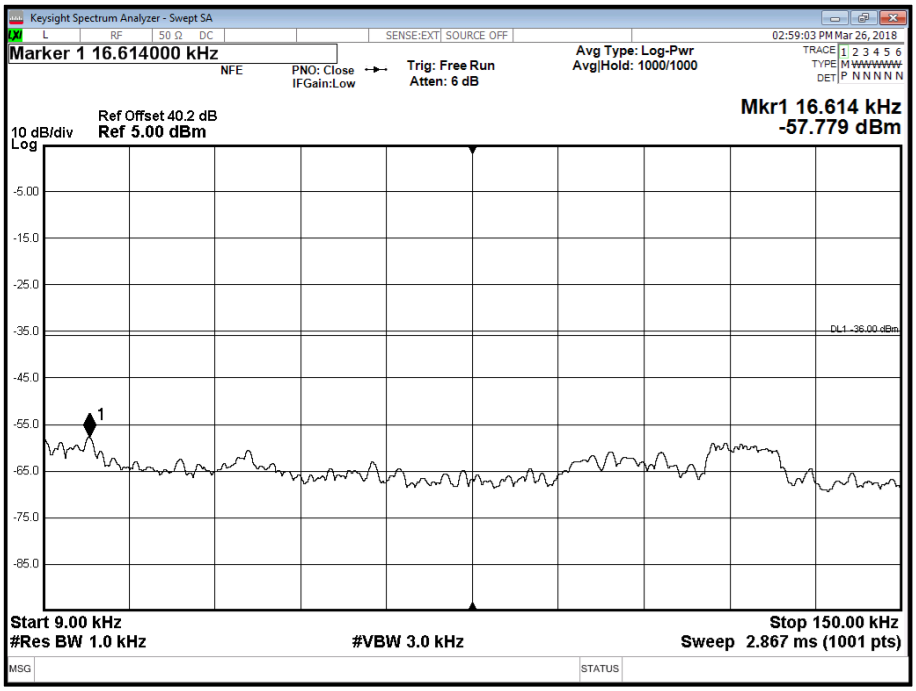

Figure 27 - 156.025 MHz - 9 kHz to 150 kHz

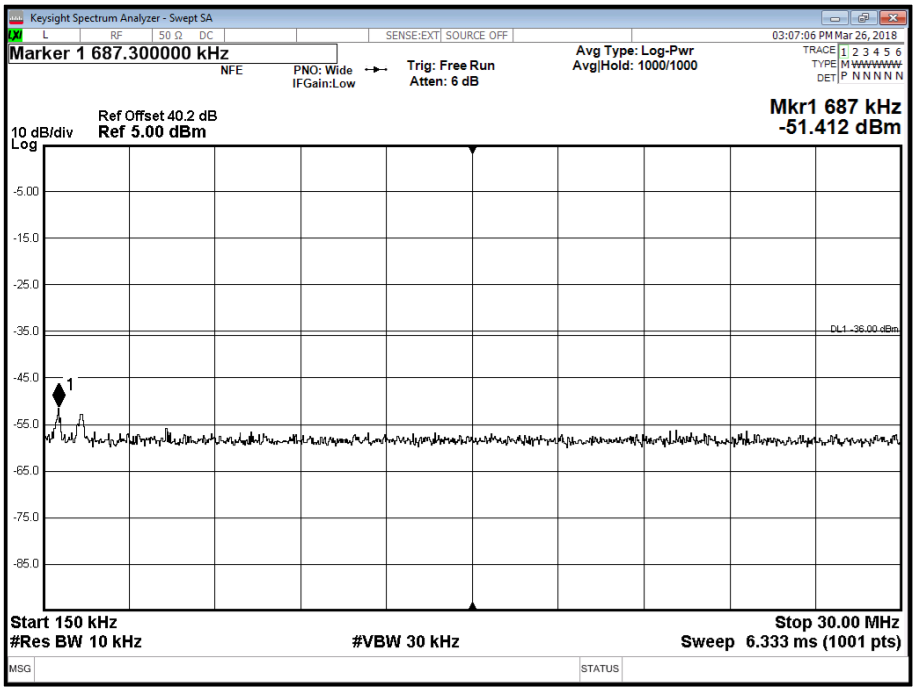

Figure 28 - 156.025 MHz - 150 kHz to 30 MHz

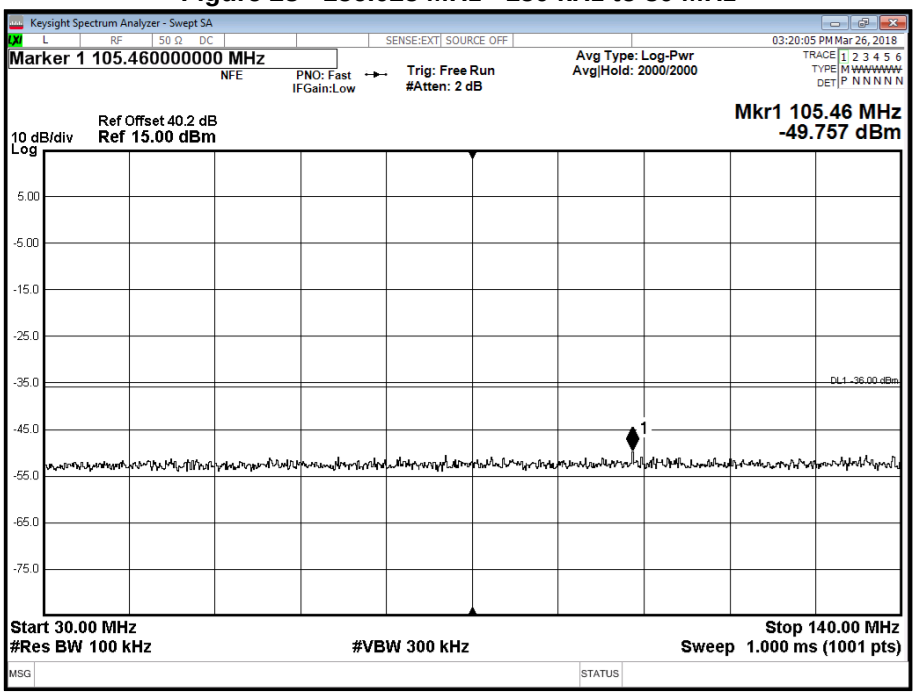

Figure 29 - 156.025 MHz - 30 MHz to 140 MHz

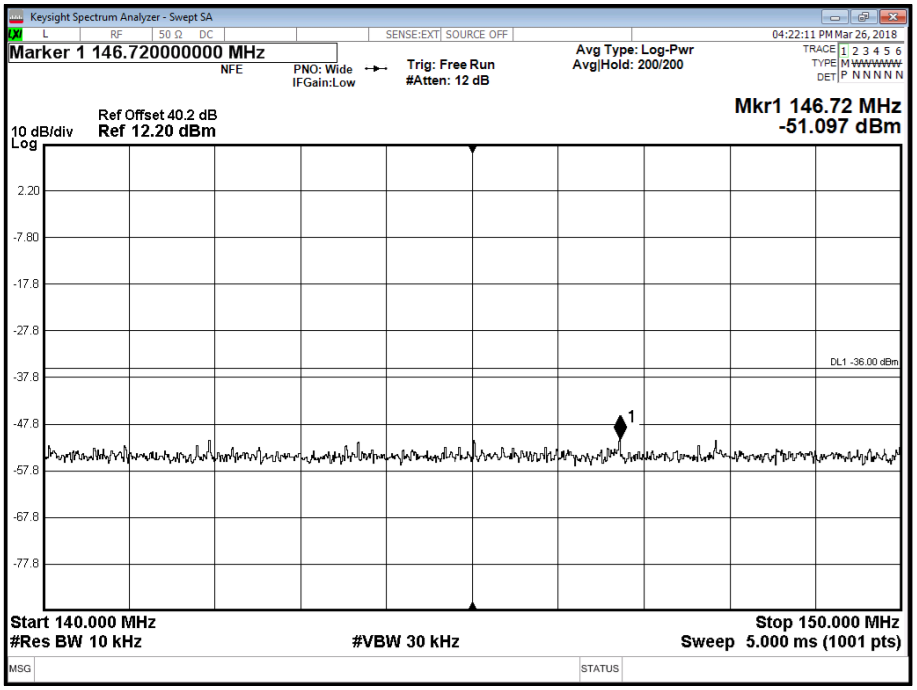

Figure 30 - 156.025 MHz - 140 MHz to 150 MHz

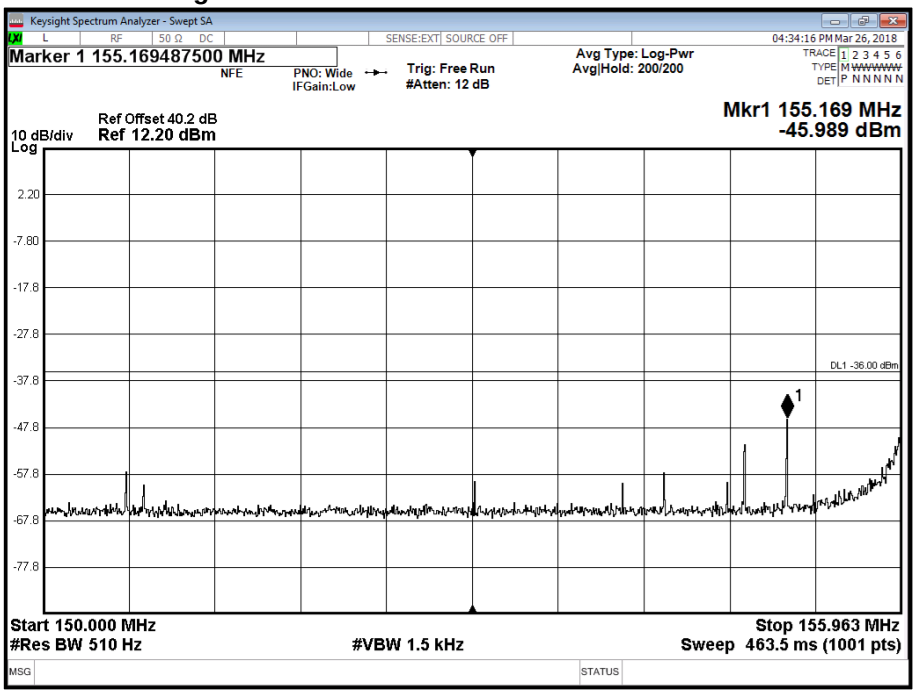

Figure 31 - 156.025 MHz - 150 MHz to 155.9625 MHz

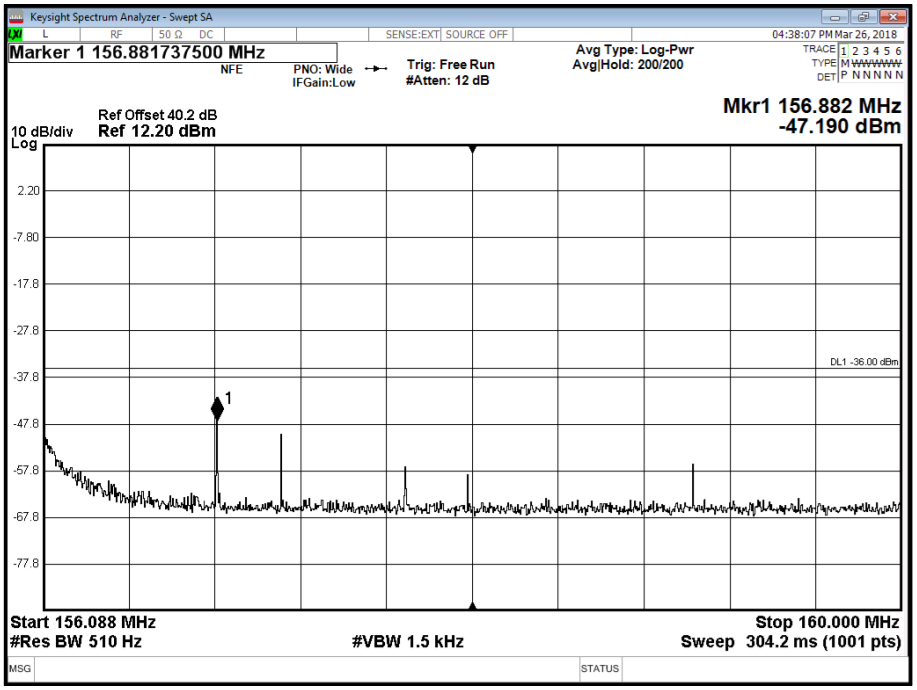

Figure 32 - 156.025 MHz - 156.0875 MHz to 160 MHz

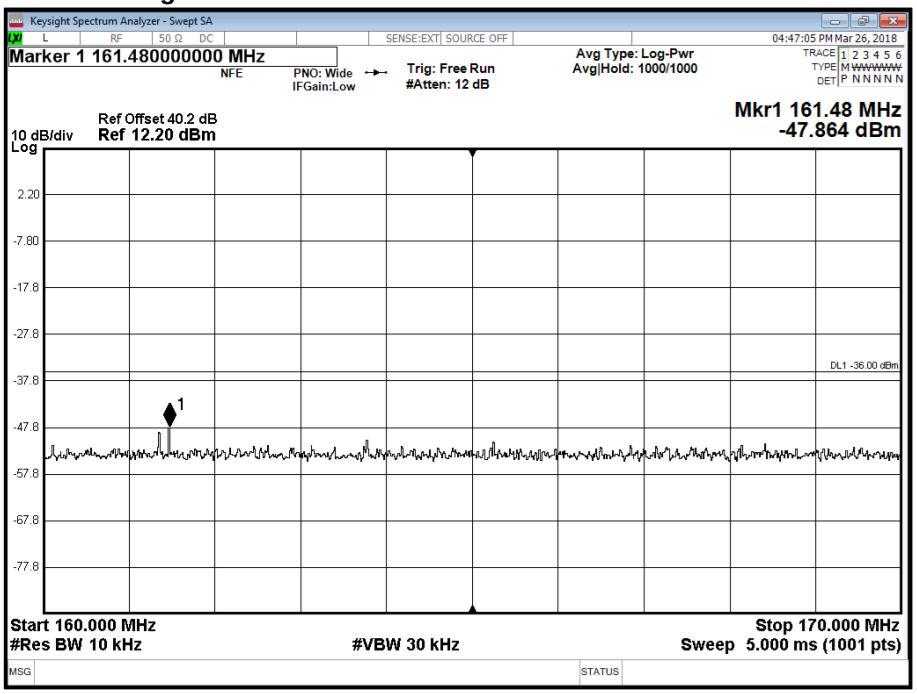

Figure 33 - 156.025 MHz - 160 MHz to 170 MHz

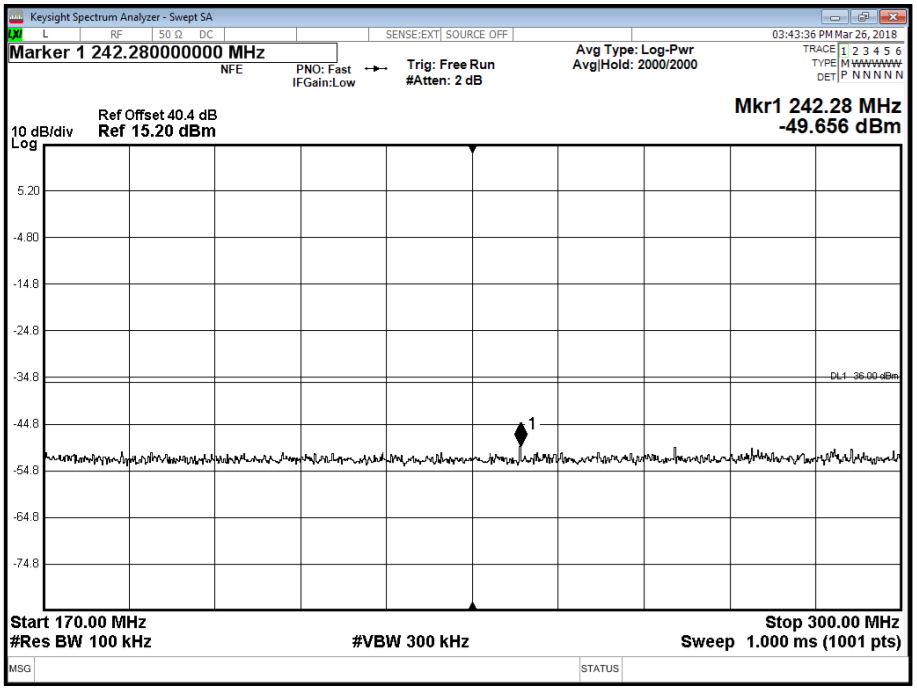

Figure 34 - 156.025 MHz - 170 MHz to 300 MHz

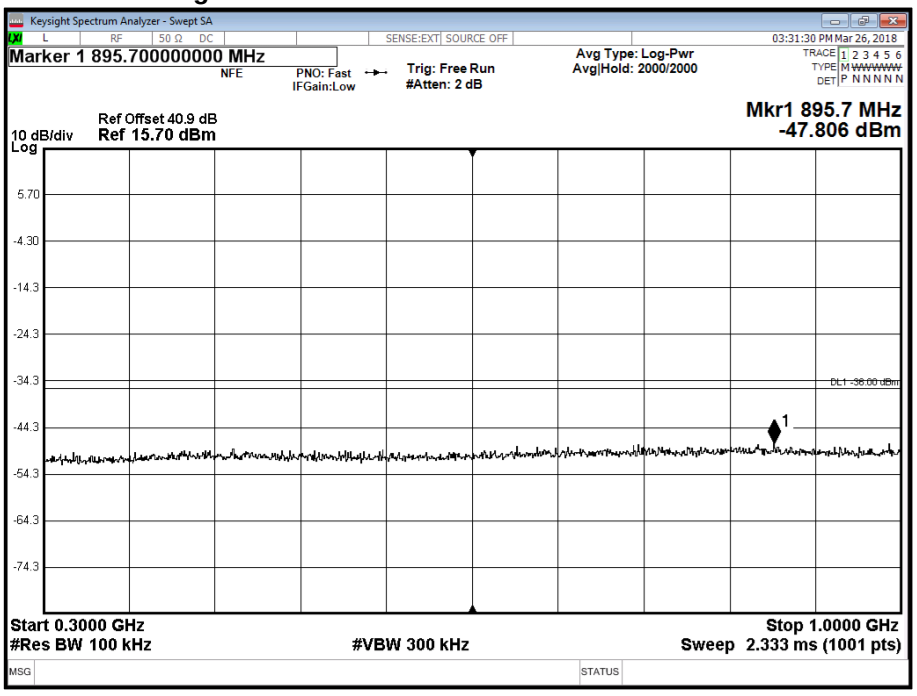

Figure 35 - 156.025 MHz - 300 MHz to 1 GHz

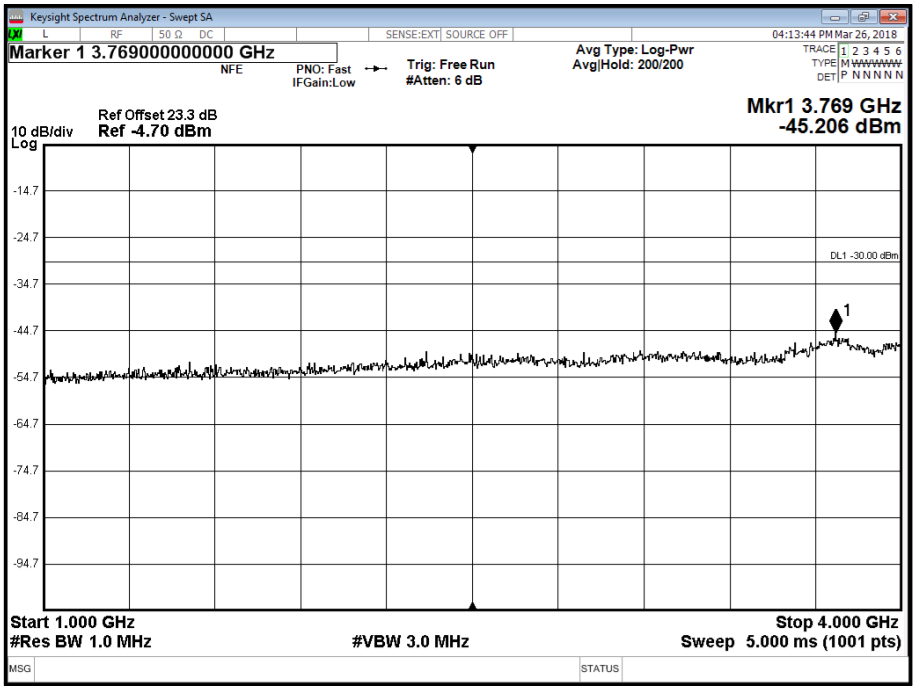

Figure 36 - 156.025 MHz - 1 GHz to 4 GHz

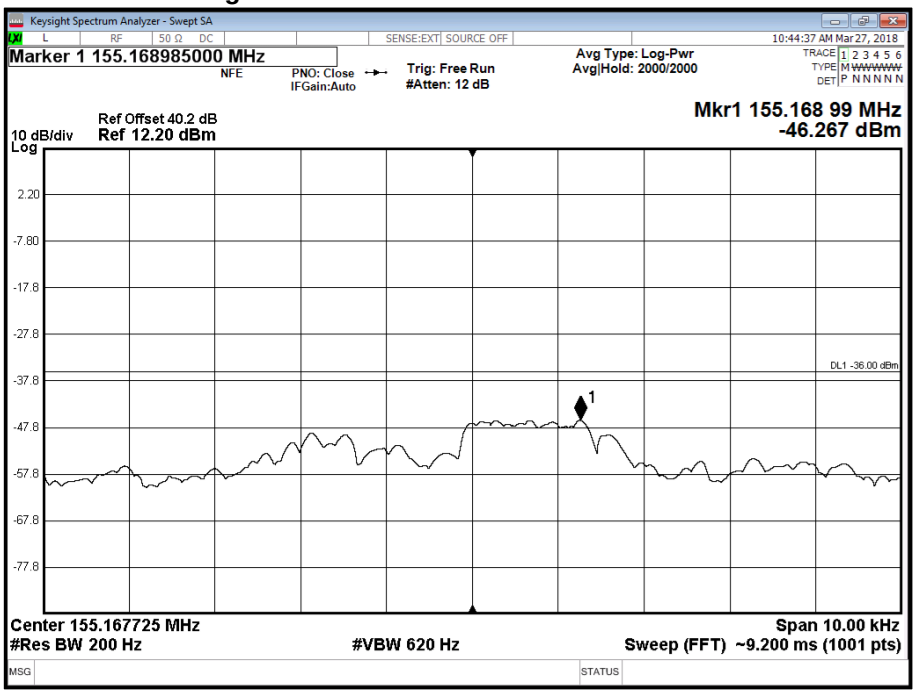

Figure 37 - 156.025 MHz - Spur at 155 MHz

Frequency (MHz)	Level (dBm)
157.774	-37.751
166.275	-43.815

Table 39 - Transmitter Emissions Results - 162.025 MHz

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

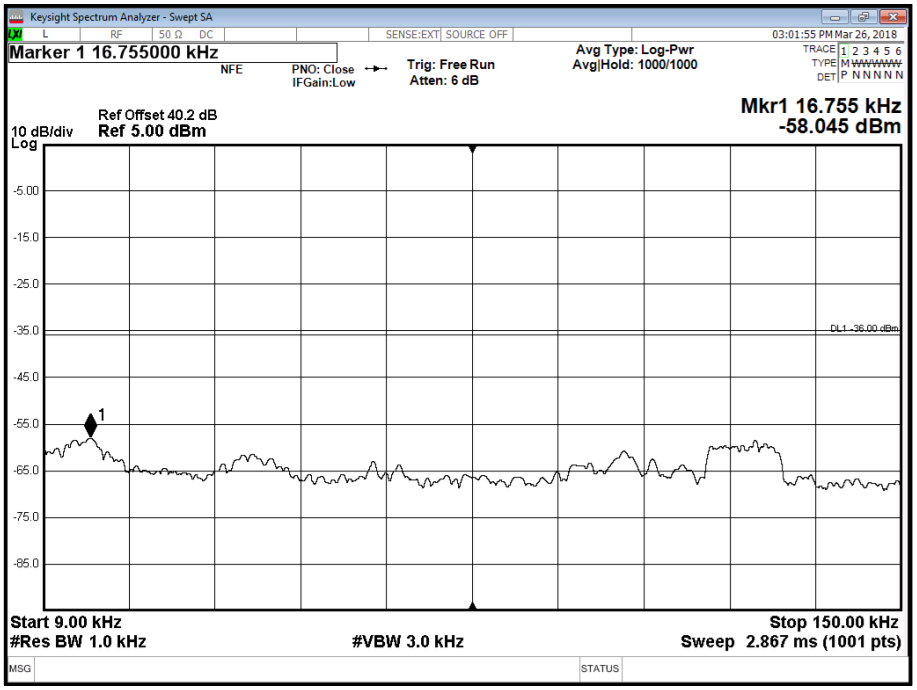

Figure 38 - 162.025 MHz - 9 kHz to 150 kHz

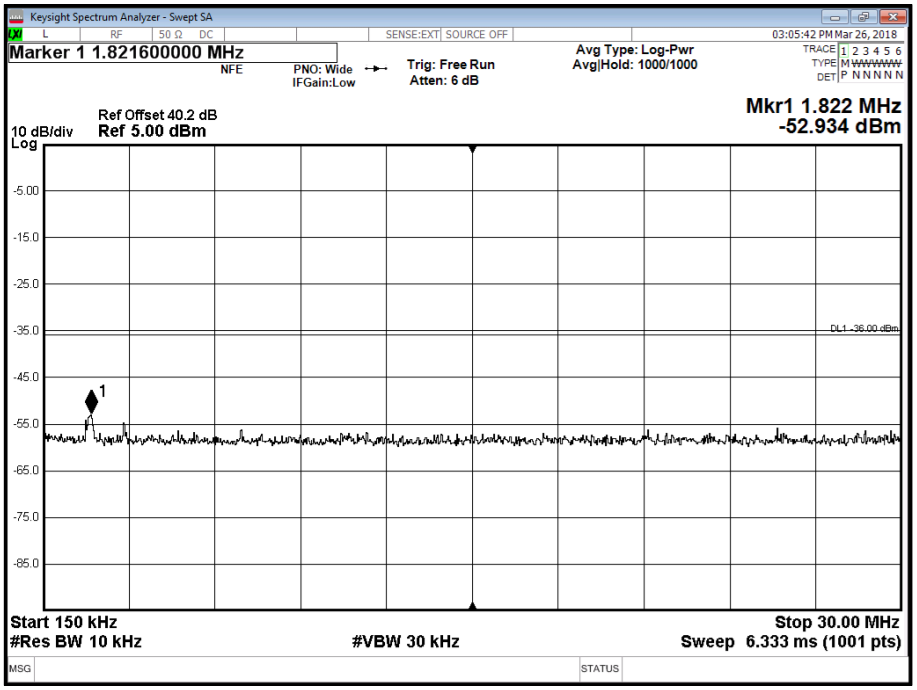

Figure 39 - 162.025 MHz - 150 kHz to 30 MHz

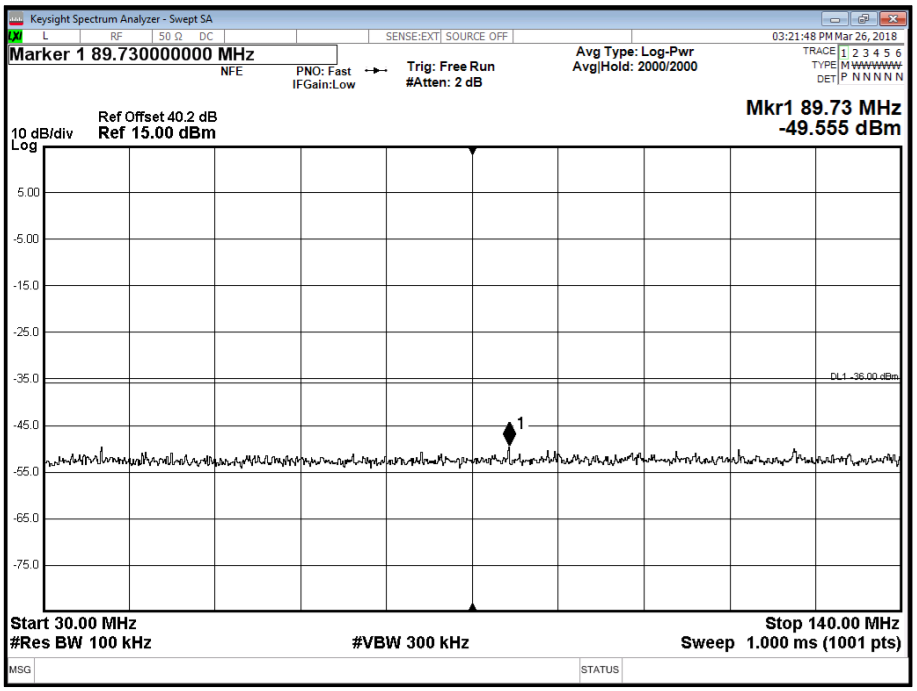

Figure 40 - 162.025 MHz - 30 MHz to 140 MHz

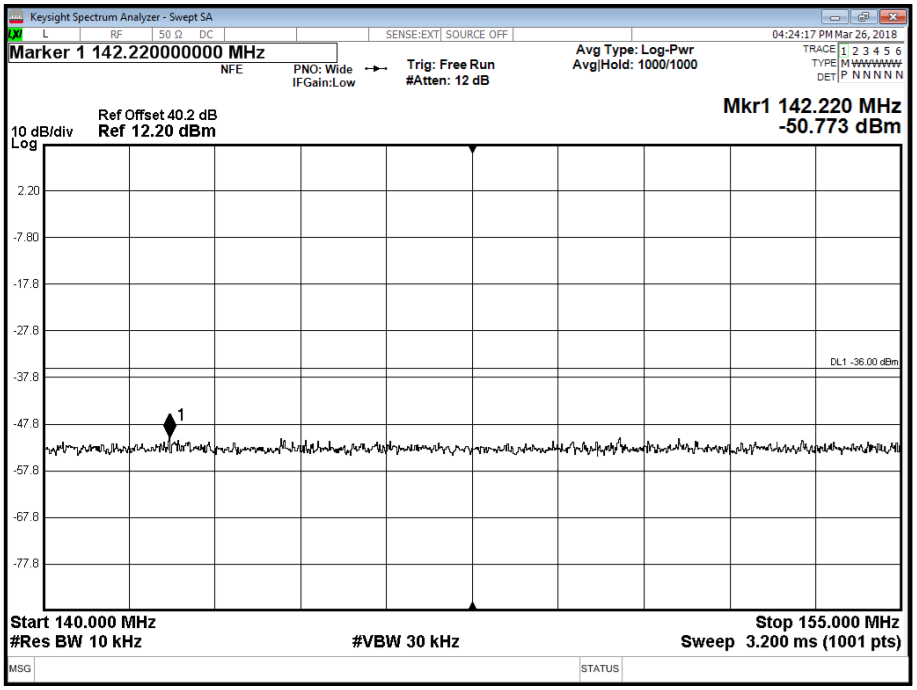

Figure 41 - 162.025 MHz - 140 MHz to 155 MHz

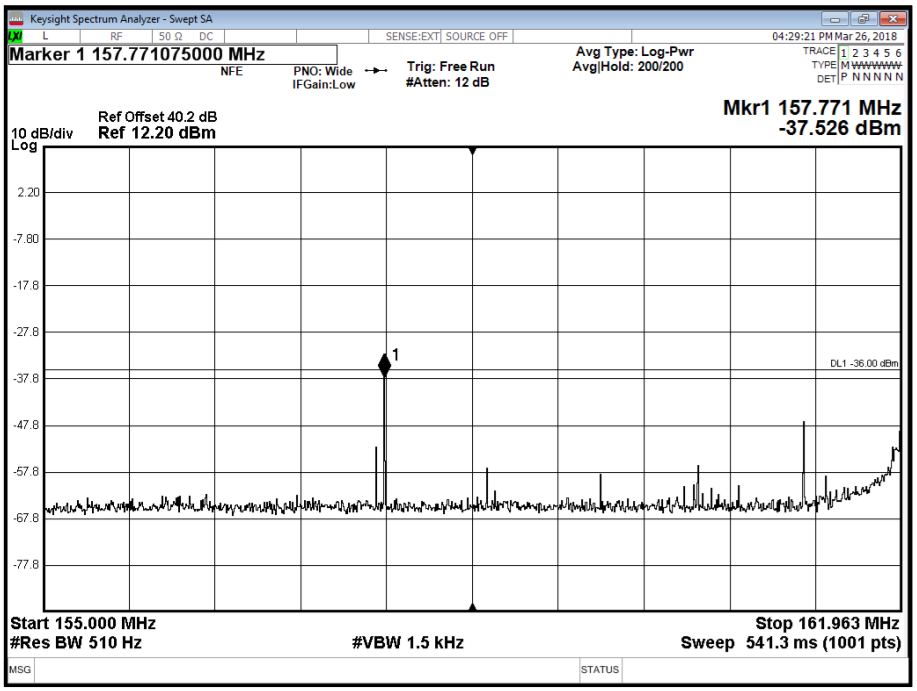

Figure 42 - 162.025 MHz - 155 MHz to 161.9625 MHz

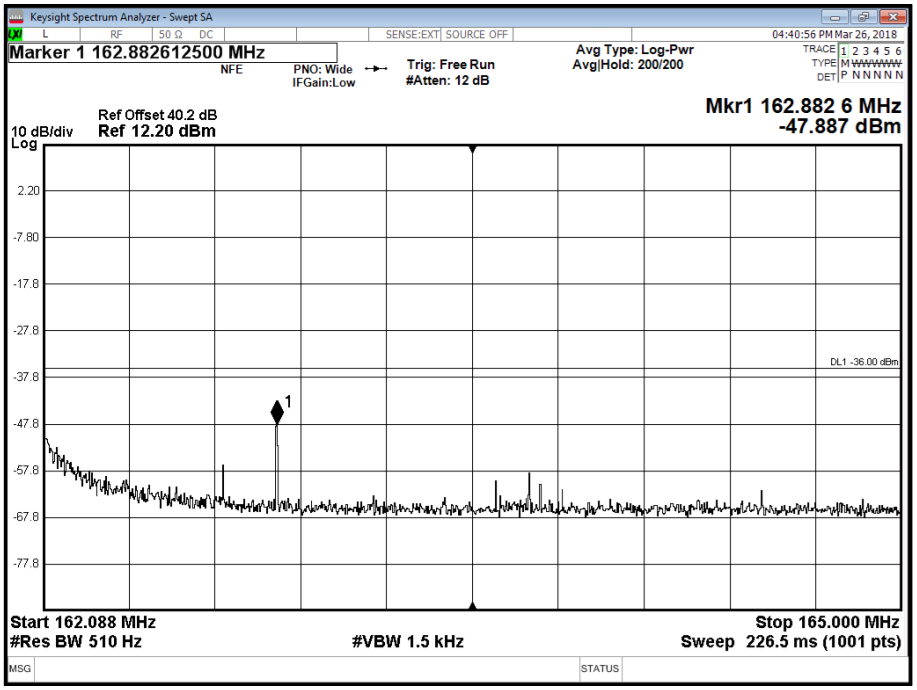

Figure 43 - 162.025 MHz - 162.0875 MHz to 165 MHz

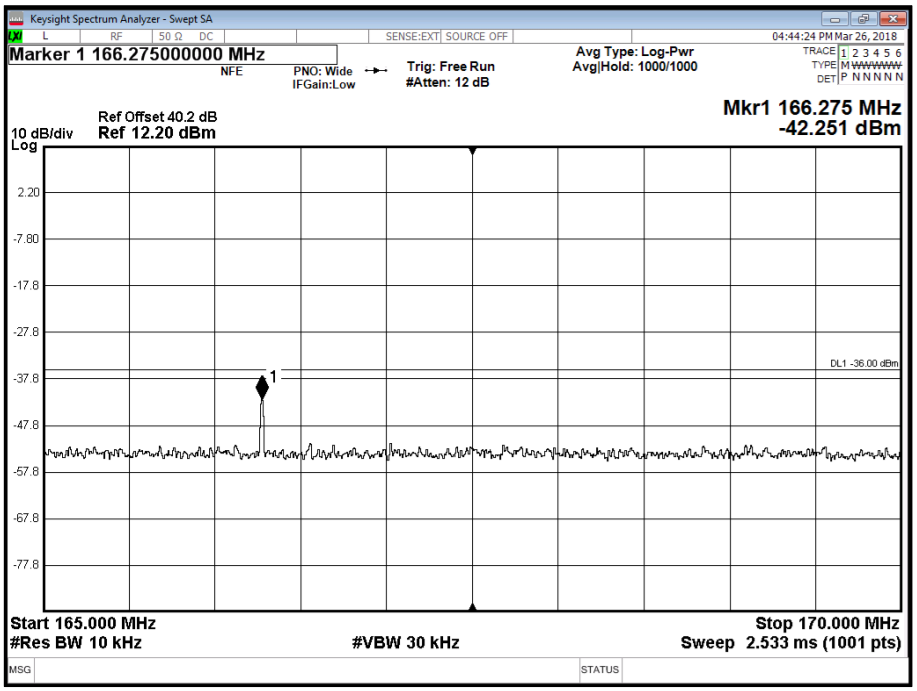

Figure 44 - 162.025 MHz - 165 MHz to 170 MHz

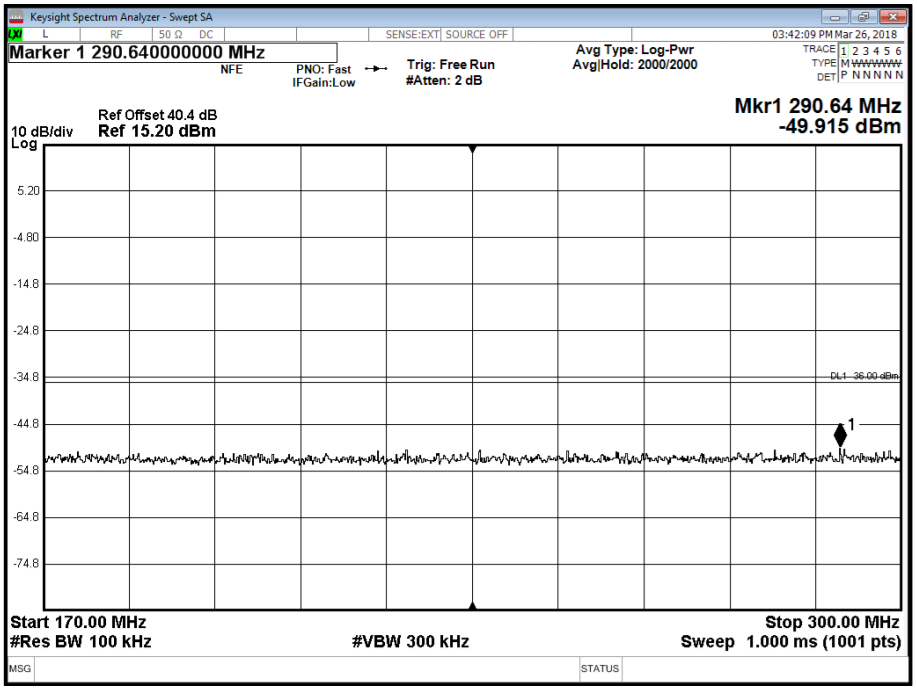

Figure 45 - 162.025 MHz - 170 MHz to 300 MHz

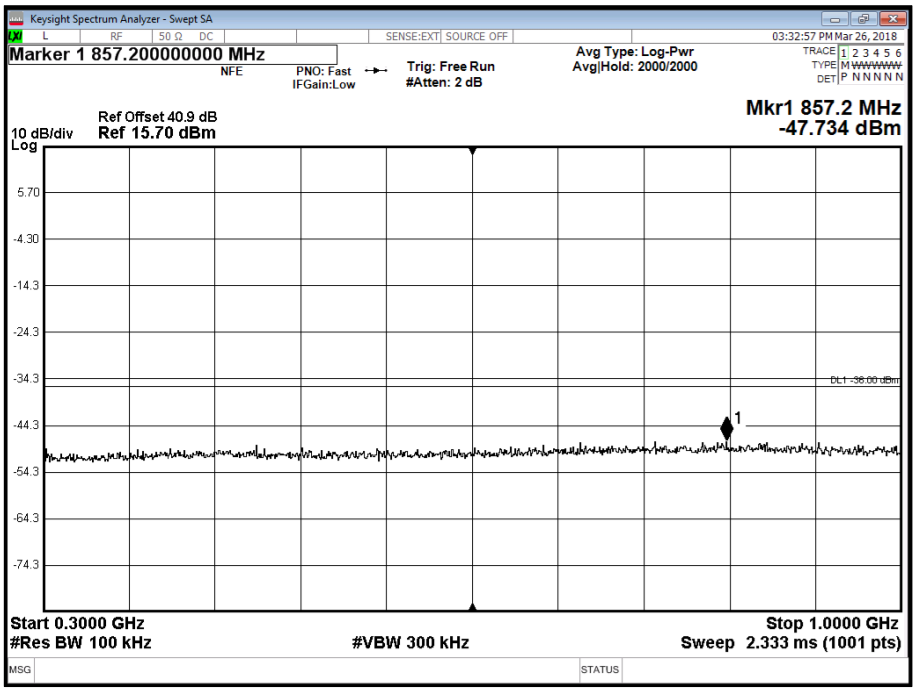

Figure 46 - 162.025 MHz - 300 MHz to 1 GHz

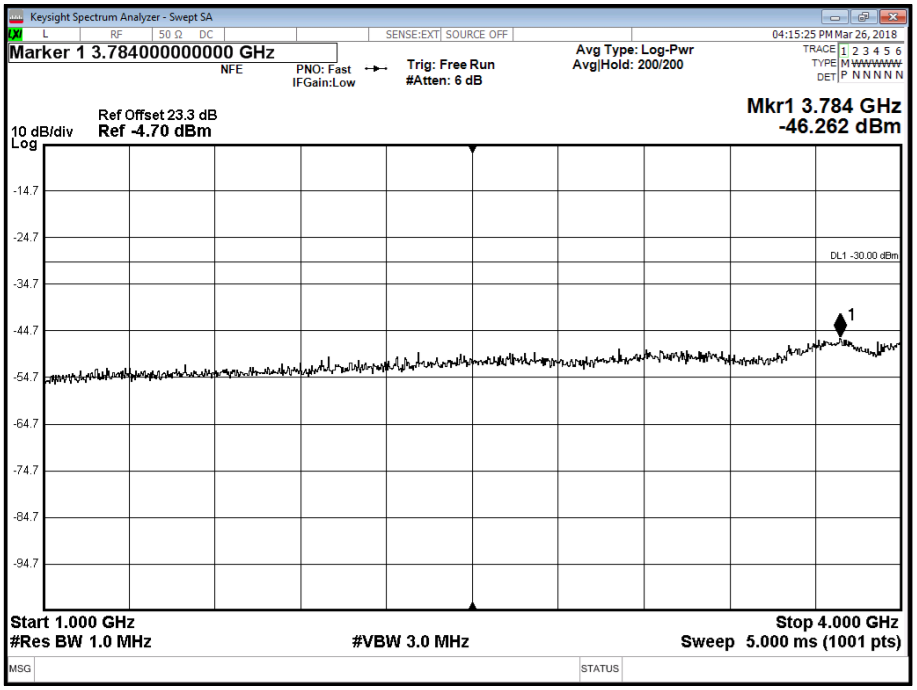

Figure 47 - 162.025 MHz - 1 GHz to 4 GHz

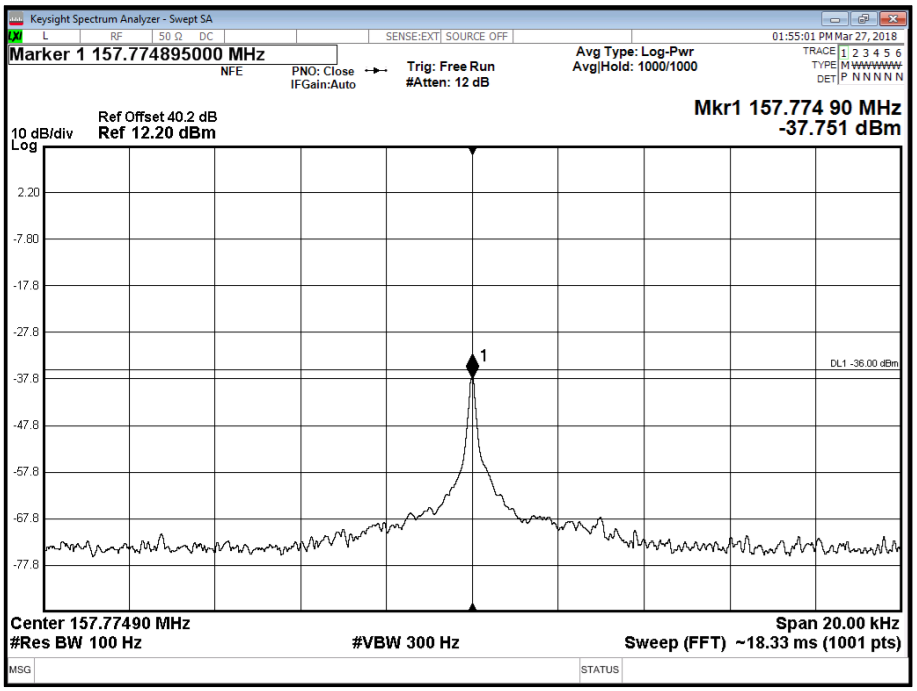

Figure 48 - 162.025 MHz - Spur at 157 MHz

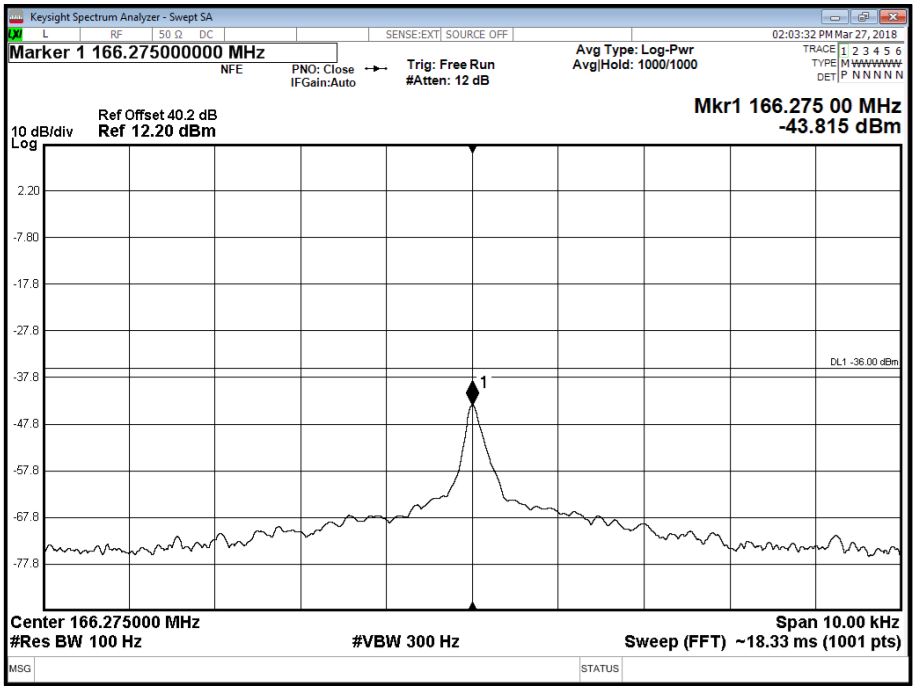

Figure 49 - 162.025 MHz - 166 MHz

IEC 62287-2, Limit Clause 11.3.2.3

The power of any spurious emission on any discrete frequency shall not exceed 0,25 µW (–36 dBm) in the frequency range 9 kHz to 1 GHz and 1 µW (–30 dBm) in the frequency range 1 GHz to 4 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.

Note: The IEC 62287-2, requirements, (≤-36 dBm < 1 GHz / ≤-30 dBm > 1 GHz), are more stringent than those in Part 80 therefore compliance with the Part 80 requirements, (≤-13 dBm), have been demonstrated from the results recorded above.

2.14.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Attenuator (20dB/ 2W)	Pasternack	PE7004-20	489	-	O/P Mon
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	11-Apr-2018
High Pass Filter	Mini-Circuits	NHP-300	1640	12	18-Sep-2018
Hygrometer	Rotronic	I-1000	3220	12	30-Aug-2018
Attenuator (20dB, 150W)	Narda	769-20	3367	12	31-May-2018
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	02-Oct-2018
TRUE RMS MULTIMETER	Fluke	179	4006	12	13-Dec-2018
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	06-Mar-2019
Frequency Standard	Spectracom	Secure Sync 1200-0408-0601	4393	6	11-Apr-2018
PXA Signal Analyser	Keysight Technologies	N9030A	4654	12	06-Oct-2018
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	TU

Table 40

TU - Traceability Unscheduled
O/P Mon – Output Monitored Using Calibrated Equipment

2.15 DSC Receiver Tests

2.15.1 Specification Reference

IEC 62287-2, Clause A.5

2.15.2 Equipment Under Test and Modification State

ATB 1

2.15.3 Test Method

A declaration was made by the provider and a test waiver was applied.

2.15.4 Test Results

DC Powered – DSC Receiver

The tests in IEC 62287-2, Clause A.5.2 to A.5.7, were waived as described in IEC 62287-2, clause A.5.1 at the discretion of the test house as the manufacturer declared the TDMA receiver is used for DSC reception on a time-shared basis

2.16 DSC Blocking or Desensitisation

2.16.1 Specification Reference

IEC 62287-2, Clause A.5.8

2.16.2 Equipment Under Test and Modification State

ATB 1, S/N: 005 - Modification State 2

2.16.3 Date of Test

13-June-2018

2.16.4 Test Method

This test was performed in accordance with IEC 62287-2, clause A.5.8.2.

2.16.5 Environmental Conditions

Ambient Temperature	23.5 °C
Relative Humidity	41.6 %

2.16.6 Test Results

DC Powered – DSC Receiver

Unwanted Signal Frequency Offset (MHz)	BER
-10	0
-5	0
-2	0
-1	0
1	0
2	0
5	0
10	0

Table 41 – DSC Blocking Results

2.16.7 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
Power Supply Unit	Hewlett Packard	6267B	21	-	TU
Modulation Analyser	Hewlett Packard	8901B	45	12	08-Sep-2018
Digital Time Analyser	Marconi	2850-BS	80	-	O/P Mon
DSC Decoder/Encoder	TUV SUD	DSC TPOO1	81	-	O/P Mon
Signal Generator	Rohde & Schwarz	SMX	115	12	12-Jul-2018
Multimeter	Fluke	79 Series III	498	12	09-Aug-2018
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	20-Oct-2018
Sensor	Hewlett Packard	11722A	2787	12	06-Sep-2018
Hygrometer	Rotronic	I-1000	2891	12	30-Aug-2018
Signal Generator, 9kHz - 3GHz	Rohde & Schwarz	SMA 100A	3504	12	17-Oct-2018
'N' - 'N' RF Cable (1m)	Rhophase	NPS-1803-1000-NPS	3700	12	31-Jan-2019
DSC Pre-empahsis Unit	TUV SUD	N/A	4369	12	03-Aug-2018
Frequency Standard	Spectracom	Secure Sync 1200-0408-0601	4393	6	20-Oct-2018

Table 42

TU - Traceability Unscheduled
O/P Mon – Output Monitored Using Calibrated Equipment

3 Photographs

3.1 Equipment Under Test (EUT)

EUT and GPS Antenna

4 Measurement Uncertainty

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

Test Name	Measurement Uncertainty
Frequency Error	± 11 Hz
Carrier Power	± 0.45 dB
Transmission Spectrum	± 2.0 dB
Modulation Accuracy	± 2.0 dB
Transmitter Output Power Versus Time Function	± 2.0 dB
Sensitivity	± 1.8 dB
Error Behaviour at High Input Levels	± 1.8 dB
Co-channel Rejection	± 2.6 dB
Adjacent Channel Selectivity	± 2.6 dB
Spurious Response Rejection	± 2.6 dB
Intermodulation Response Rejection	± 1.7 dB
Blocking or Desensitisation	± 2.6 dB
Spurious Emissions from the Receiver	± 3.45 dB
Spurious Emissions from the Transmitter	± 3.45 dB
DSC Blocking or Desensitisation	± 1.8 dB

Table 43