FCC and ISED Test Report

Jotron AS
EPIRB Model: Tron 60AIS

In accordance with FCC 47 CFR Part 80, FCC 47 CFR Part 2, ISED RSS-182 and ISED RSS-GEN (AIS)

Add value.
Inspire trust.

Prepared for: Jotron AS
Ringdalskogen 8,
3270 Larvik,
Norway

FCC ID: VRV60AIS IC: 2131A-60AIS

COMMERCIAL-IN-CONFIDENCE

Document 75950996-04 Issue 02

SIGNATURE			
NAME	**JOB TITLE**	**RESPONSIBLE FOR**	**ISSUE DATE**
Simon Bennett	Director of Test Operations	Authorised Signatory	21 January 2022

Signatures in this approval box have checked this document in line with the requirements of TÜV SÜD 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, ISED RSS-182 and ISED RSS-GEN. The sample tested was found to comply with the requirements defined in the applied rules.

RESPONSIBLE FOR	NAME	DATE	SIGNATURE
Testing	Neil Rousell	21 January 2022	
Testing	Graeme Lawler	21 January 2022	

FCC Accreditation
90987 Octagon House, Fareham Test Laboratory

ISED Accreditation
12669A Octagon House, Fareham Test Laboratory

EXECUTIVE SUMMARY

A sample of this product was tested and found to be compliant with FCC 47 CFR Part 80: 2019, FCC 47 CFR Part 2: 2019, ISED RSS-182: Issue 5 (2012-01) and ISED RSS-GEN: Issue 5 (2018-04) for the tests detailed in section 1.3.

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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	12 January 2022
2	Second Issue to amend note in the test results for Section 2.1 Bandwidths	21 January 2022

Table 1

1.2 Introduction

Applicant	Jotron AS
Manufacturer	Jotron AS
Model Number(s)	Tron 60AIS
Serial Number(s)	00016 and 00008
Hardware Version(s)	Rev: 2021
Software Version(s)	Rev 1.2
Number of Samples Tested	2
Test Specification/Issue/Date	FCC 47 CFR Part 80: 2019 FCC 47 CFR Part 2: 2019 ISED RSS-182: Issue 5 (2012-01) ISED RSS-GEN: Issue 5 (2018-04)
Order Number Date	P42647 15-January-2021
Date of Receipt of EUT	23-February-2021
Start of Test	13-May-2021
Finish of Test	1-July-2021
Name of Engineer(s)	Neil Rousell and Graeme Lawler
Related Documents	ANSI C63.26: 2015 FCC KDB 971168 D01 v03r01

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, ISED RSS-182 and ISED RSS-GEN is shown below.

Section	Specification Clause				Test Description	Result	Comments/Base Standard
	Part 80	Part 2	RSS-182	RSS-GEN			
Configuration and Mode: AIS Transceiver							
2.1	80.205	2.1049	7.7 and 7.9.1	6.7	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	Pass	
2.4	80.211	2.1053	7.9	6.13	Radiated Spurious Emissions	Pass	
2.5	80.213	2.1047	7.7	-	Modulation Requirements	Pass	
2.6	80.215	2.1046	7.5	6.12	Transmitter Power	Pass	

Table 2

1.4 Application Form

Equipment Description

Technical Description: *(Please provide a brief description of the intended use of the equipment including the technologies the product supports)*	COSPAS-SARSAT 406 MHz Satellite Emergency Position-Indication Radio Beacon
Manufacturer:	Jotron AS
Model:	Tron 60AIS
Part Number:	103161
Hardware Version:	Rev: 2021
Software Version:	Rev 1.2
FCC ID of the product under test – see guidance here	VRV60AIS
IC ID of the product under test – see guidance here	2131A-60AIS

Intentional Radiators

Technology	EPIRB					
Frequency Range (MHz to MHz)	406.031 MHz, 161.975 - 162.025 MHz, 121.5 MHz					
Conducted Declared Output Power (dBm)	35.5 dBm (406 MHz) 31.4 dBm (162 MHz) 19.2 dBm (121.5 MHz)					
Antenna Gain (dBi)	-					
Supported Bandwidth(s) (MHz) (e.g 1 MHz, 20 MHz, 40 MHz)	25 KHz (406 MHz) 25 KHz (162 MHz) 25 KHz (121.5 MHz)					
Modulation Scheme(s) (e.g GFSK, QPSK etc)	Phase modulation 1.1 rad (406 MHz) GMSK/FM (162 MHz) AM Homing (121.5 MHz)					
ITU Emission Designator (see guidance here) (not mandatory for Part 15 devices)	16K0G1D (406.031 MHz) 16K0GXW (162 MHz) 3K20A3X (121.5 MHz)					
Bottom Frequency (MHz)	121.5 MHz					
Middle Frequency (MHz)	-					
Top Frequency (MHz)	406.031 MHz					

Un-intentional Radiators

Highest frequency generated or used in the device or on which the device operates or tunes	406.031 MHz
Lowest frequency generated or used in the device or on which the device operates or tunes	121.5 MHz
Class A Digital Device (Use in commercial, industrial or business environment) ☒ Class B Digital Device (Use in residential environment only) ☐	

AC Power Source

AC supply frequency:	-	Hz

Voltage	-	V
Max current:	-	A
Single Phase ☐ Three Phase ☐		

DC Power Source

Nominal voltage:	-	V
Extreme upper voltage:	-	V
Extreme lower voltage:	-	V
Max current:	-	A

Battery Power Source

Voltage:	12	V
End-point voltage:	10	V *(Point at which the battery will terminate)*
Alkaline ☐ Leclanche ☐ Lithium ☒ Nickel Cadmium ☐ Lead Acid* ☐ **(Vehicle regulated)*		
Other ☐ Please detail:		

Charging

Can the EUT transmit whilst being charged	Yes ☐ No ☒

Temperature

Minimum temperature:	-20	°C
Maximum temperature:	+55	°C

Cable Loss

Adapter Cable Loss (Conducted sample)	-	dB

Antenna Characteristics

Antenna connector ☐			State impedance		Ohm
Temporary antenna connector ☐			State impedance		Ohm
Integral antenna ☒	Type:		Gain		dBi
External antenna ☐	Type:		Gain		dBi

For external antenna only:
Standard Antenna Jack ☐ If yes, describe how user is prohibited from changing antenna (if not professional installed):
Equipment is only ever professionally installed ☐
Non-standard Antenna Jack ☐

Ancillaries (if applicable)

Manufacturer:		Part Number:	

Model:		Country of Origin:	

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

Name: Frank Løke
Position held: Certification Manager Jotron AS
Date: 2021-11-18

1.5 Product Information

1.5.1 Technical Description

The Equipment under test (EUT) was a Jotron AS Tron 60AIS EPIRB with Float Free capsule

The primary function of the EUT is a Emergency Position Indication Radio Beacon (EPIRB) within capsule.

Additionally, the EUT has functionality for Automatic Identification System (AIS), GNSS Rx (GPS/Galileo/Glonass), Transmitting 406 MHz, 121.5 MHz Homer and RLS.

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
Model: Tron 60AIS, Serial Number:00008 and 00016			
0	As supplied by the customer	Not Applicable	Not Applicable
1	GNSS LED changed to blink before or after 406MHz to reduce noise on modulation	Manufacturer at TUV SUD site	31-March 2021
2	Addition of a LDO (Low Dropout Regulator) to the TCXO, to reduce the noise coming from the power supply. A resistor of 0 ohm (added to the design for current measurement) was replaced by the three-legged regulator.	Manufacturer	27-April 2021
3	SW update to reduce image AIS frequencies. Parameter in the synthesizer was adjusted to reduce the signal level from the clock.	Manufacturer	21-May 2021

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: AIS Transceiver		
Bandwidths	Neil Rousell	UKAS
Transmitter Frequency Tolerances	Neil Rousell	UKAS
Spurious Emissions at Antenna Terminals	Neil Rousell	UKAS
Radiated Spurious Emissions	Graeme Lawler	UKAS
Modulation Requirements	Neil Rousell	UKAS
Transmitter Power	Neil Rousell	UKAS

Table 4

Office Address:

TÜV SÜD
Octagon House
Concorde Way
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
ISED RSS-182, Clause 7.7 and 7.9.1
ISED RSS-GEN, Clause 6.7

2.1.2 Equipment Under Test and Modification State

Tron 60AIS, S/N: 00016 - Modification State 2

2.1.3 Date of Test

13-May-2021

2.1.4 Test Method

The test was applied in accordance with the test method requirements of FCC CFR 47 Part 80, clause 80.205, FCC CFR 47 Part 2, clause 2.1049, ISED RSS-GEN, clause 6.7 and KDB 971168. The EUT was transmitting at maximum power, modulated by the standard AIS test signals using PRBS 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, the occupied bandwidth measurement function of the analyser was used and the 99 % bandwidth recorded.

2.1.5 Environmental Conditions

Ambient Temperature	23.3 °C
Relative Humidity	44.8 %

2.1.6 Test Results

AIS Transceiver

161.975 MHz	162.025 MHz
9.36 kHz	9.52 kHz

Table 5 - Occupied Bandwidth Results

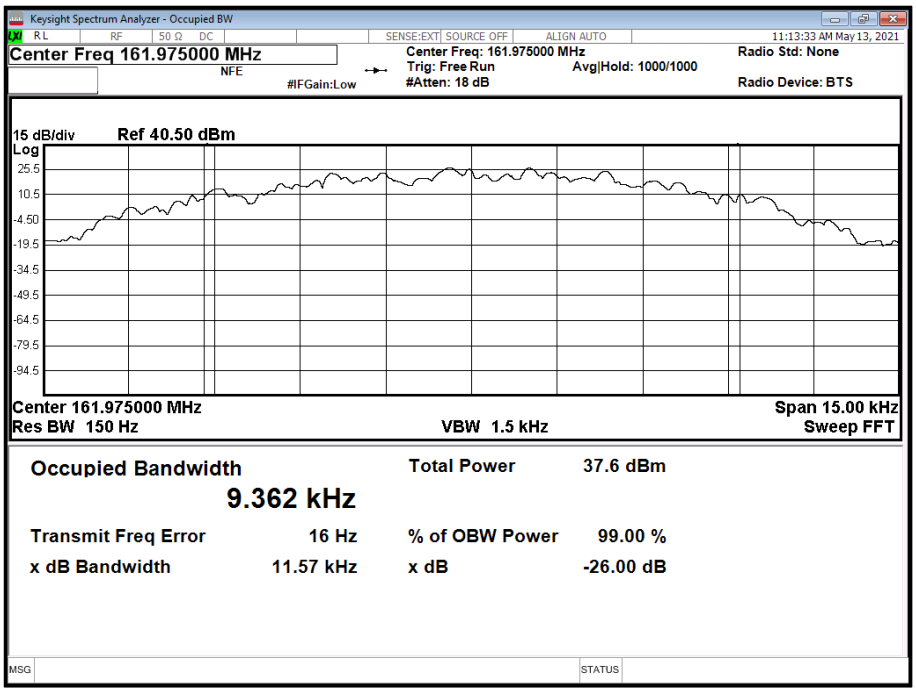

Figure 1 - 161.975 MHz Occupied Bandwidth

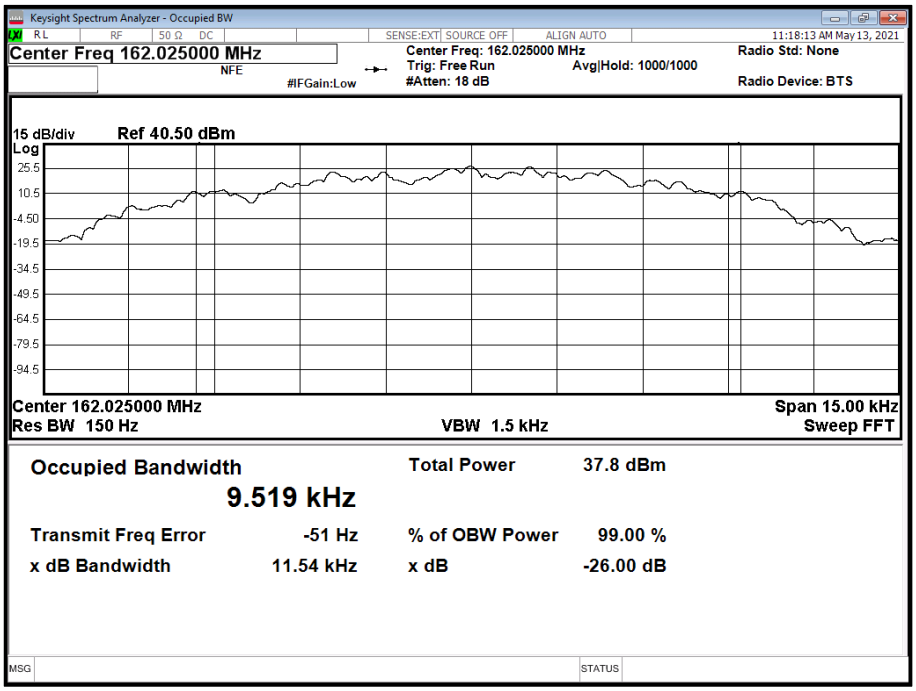

Figure 2 - 162.025 MHz Occupied Bandwidth

<u>FCC 47 CFR Part 80, Limit Clause 80.205</u>

Emission Designator: 16K0GXW (Note: Emission Designator for AIS not specified in Part 80.205)
Authorised Bandwidth: < 20 kHz

<u>ISED RSS-182, Limit Clause 7.9.1</u>

Equipment with a 25 kHz channel spacing, an authorised bandwidth of 16 kHz for voice and 20 kHz for data.

2.1.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 2.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Expires
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	17-May-2021
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	29-Jan-2022
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	30-Dec-2021
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	17-May-2021
1 metre K-Type Cable	Florida Labs	KMS-180SP-39.4-KMS	4520	12	16-Nov-2021
PXA Signal Analyser	Keysight Technologies	N9030A	4654	12	06-Nov-2021
Thermo-Hygro-Barometer	PCE Instruments	PCE-THB-40	5475	12	06-Apr-2022
Attenuator 5W 30dB DC-18GHz	Aaren	AT40A-4041-D18-30	5504	12	14-Apr-2022
Attenuator 2W 10dB DC-10GHz	Telegartner	J01156A0031	5577	-	O/P Mon

Table 6

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
ISED RSS-182, Clause 7.4
ISED RSS-GEN, Clause 6.11

2.2.2 Equipment Under Test and Modification State

Tron 60AIS, S/N: 00016 - Modification State 3

2.2.3 Date of Test

15-June-2021 to 16-June-2021

2.2.4 Test Method

The EUT was modulated using the standard AIS test signal with PRBS packet payload and was transmitting in turn on either AIS channel. The EUT was connected to a spectrum analyser via a cable and attenuator. The external frequency reference of the spectrum analyser was locked to a 10 MHz rubidium frequency standard reference. The 99% OBW function of the spectrum analyser was used to record the carrier frequency error. The temperature was varied from -30.0 °C to +55.0 °C in 10 ° steps. At 20.0 °C the voltage was also reduced to the manufacturer declared battery endpoint voltage and the carrier frequency measured

2.2.5 Environmental Conditions

Ambient Temperature	24.7 - 24.9 °C
Relative Humidity	48.7 - 50.9 %

2.2.6 Test Results

<u>AIS Transceiver</u>

Voltage	Frequency Error (ppm)	
	161.975 MHz	162.025 MHz
12 V DC	-0.25	-0.24
10 V DC	-0.25	-0.19

Table 7 - Frequency Stability Under Voltage Variations

Temperature	Frequency Error (ppm)	
	161.975 MHz	162.025 MHz
+55.0 °C	-0.18	-0.20
50.0 °C	-0.19	-0.20
40.0 °C	-0.23	-0.43
30.0 °C	-0.33	-0.15
20.0 °C	-0.25	-0.24
10.0 °C	-0.20	-0.10
0 °C	-0.20	-0.21
-10.0 °C	-0.12	-0.28
-20.0 °C	0.01	-0.04
-30.0 °C	-0.06	-0.04

Table 8 - Frequency Stability Under Temperature Variations

FCC 47 CFR Part 80, Limit Clause 80.209

± 10 ppm.

ISED 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 3.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Expires
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	03-Dec-2021
Hygrometer	Rotronic	I-1000	2891	12	16-Oct-2021
Multimeter	Fluke	79 Series II	3057	12	21-Aug-2021
Thermocouple Data Logger	Pico Technology Ltd	TC-08	3783	12	22-Jun-2021
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	03-Dec-2021
1 metre K-Type Cable	Florida Labs	KMS-180SP-39.4-KMS	4520	12	16-Nov-2021
PXA Signal Analyser	Keysight Technologies	N9030A	4654	12	06-Nov-2021
Quad Power Supply	Rohde & Schwarz	HMP4040	4954	-	O/P Mon
Thermo-Hygro-Barometer	PCE Instruments	OCE-THB-40	5470	12	31-Mar-2022
Attenuator 5W 30dB DC-18GHz	Aaren	AT40A-4041-D18-30	5504	12	14-Apr-2022
Attenuator 2W 10dB DC-10GHz	Telegartner	J01156A0031	5577	-	O/P Mon
Environmental Chamber	ACS	DY110TC	5589	-	O/P Mon

Table 9

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
ISED RSS-182, Clause 7.9
ISED RSS-GEN, Clause 6.13

2.3.2 Equipment Under Test and Modification State

Tron 60AIS, S/N: 00016 - Modification State 3

2.3.3 Date of Test

11-June-2021 to 01-July-2021

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 into the spectrum analyser as a reference level offset. The spectrum analyser was configured with an RBW of 300 Hz with the trace set to max hold using a peak detector. The mask as per FCC CFR 47 Part 80, clause 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. Conducted measurements were performed as follows:

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 30 kHz with the trace set to max hold using a peak detector

2.3.5 Environmental Conditions

Ambient Temperature	23.5 - 23.8 °C
Relative Humidity	53.7 - 60.6 %

2.3.6 Test Results

AIS Transceiver

Figure 3 - 161.975 MHz - Transmitter Spectrum Mask

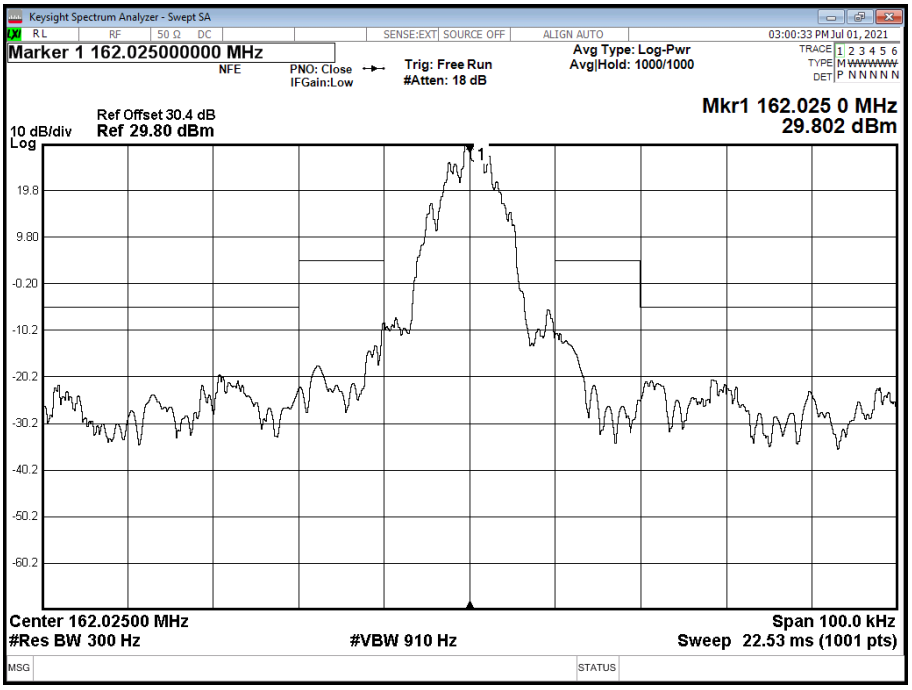

Figure 4 - 162.025 MHz - Transmitter Spectrum Mask

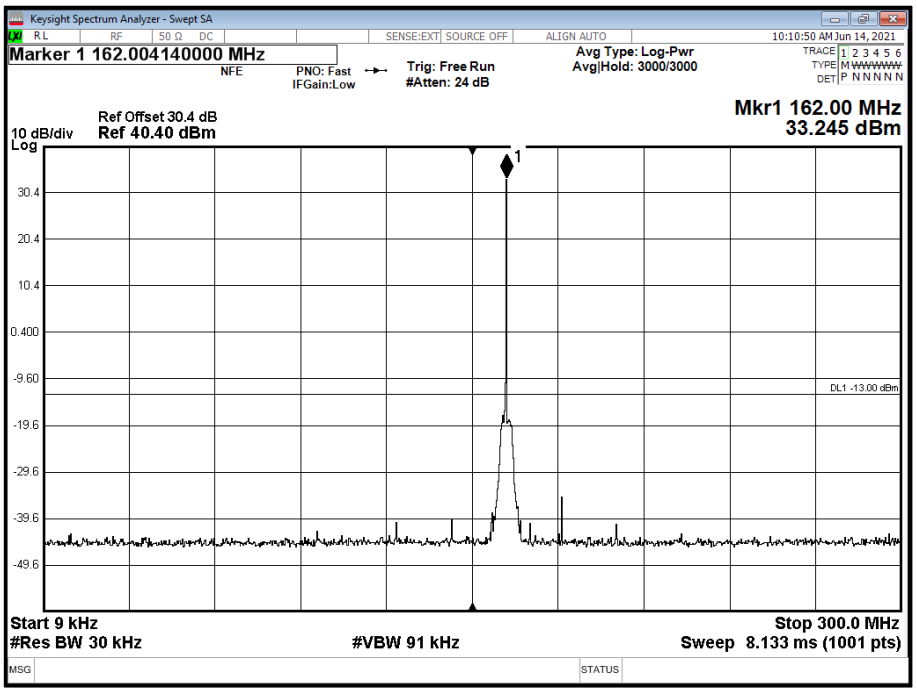

Figure 5 - 161.975 MHz - 9 kHz to 300 MHz

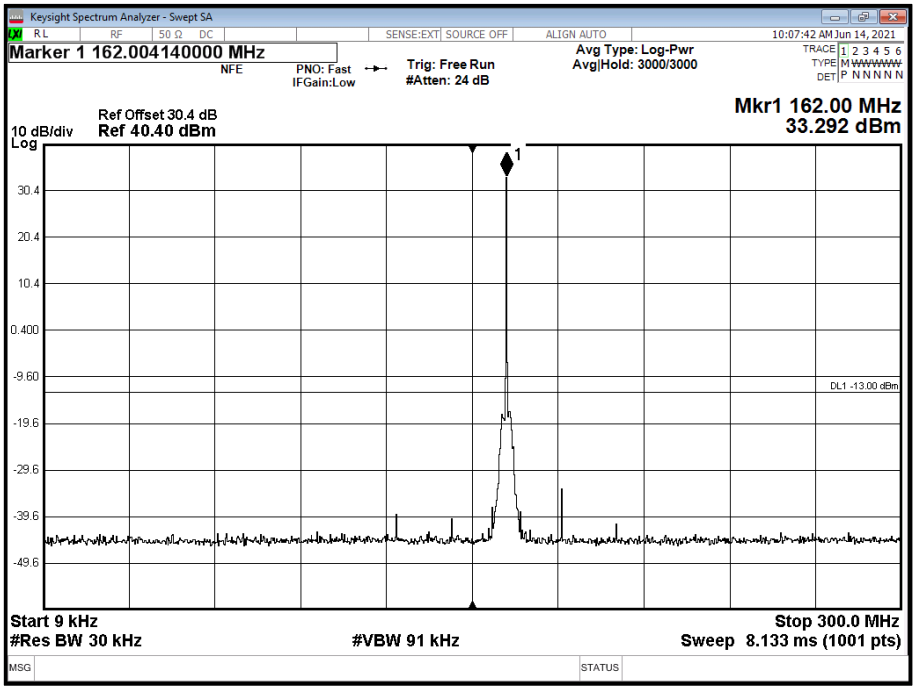

Figure 6 - 162.025 MHz - 9 kHz to 300 MHz

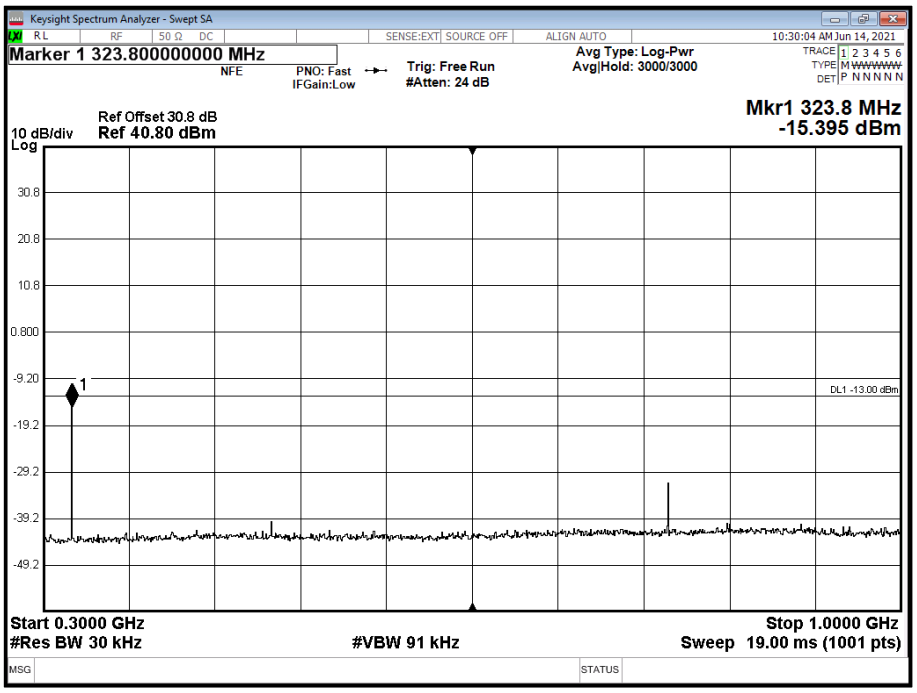

Figure 7 - 161.975 MHz - 300 MHz to 1 GHz

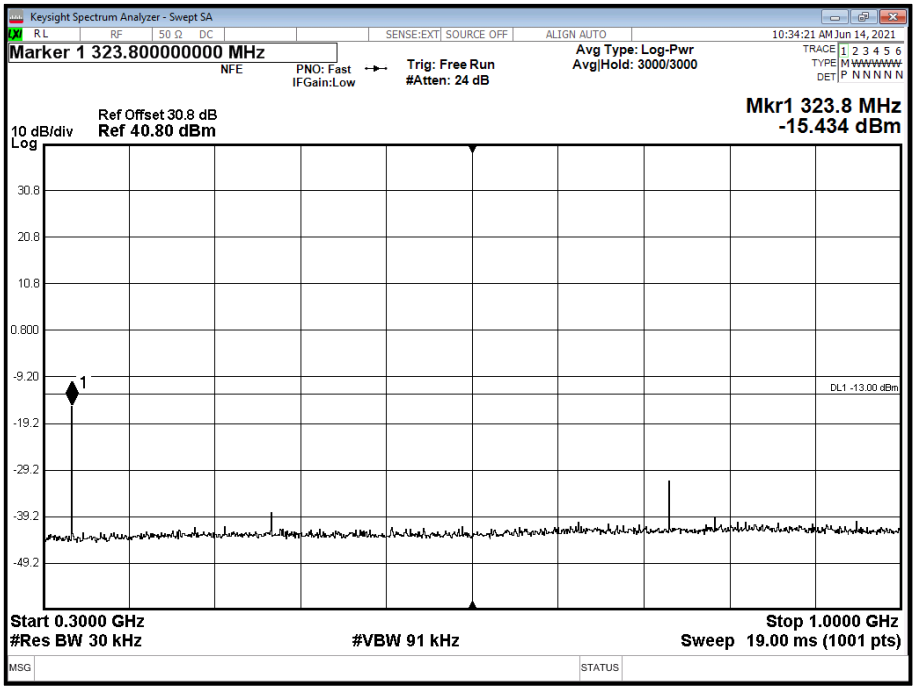

Figure 8 - 162.025 MHz - 300 MHz to 1 GHz

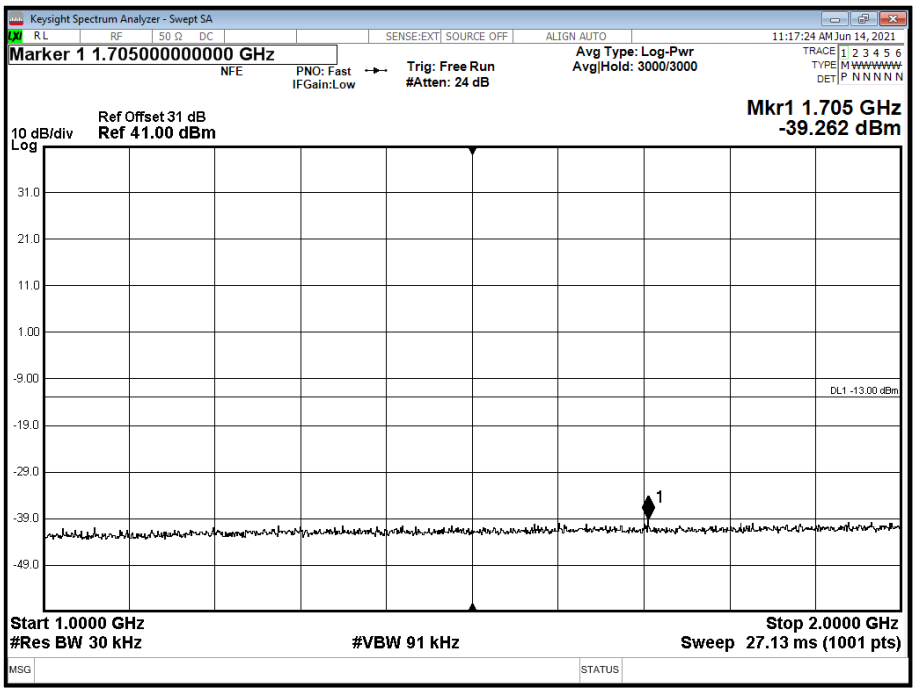

Figure 9 - 161.975 MHz - 1 GHz to 2 GHz

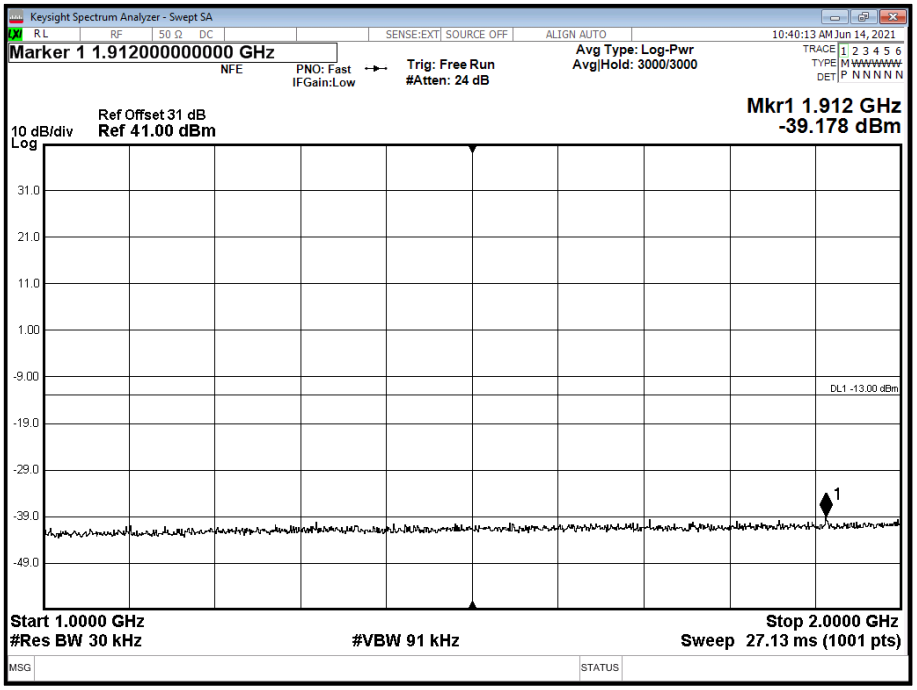

Figure 10 - 162.025 MHz - 1 GHz to 2 GHz

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 $10\log_{10}$ P(mean power in watts) dB.

ISED 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 log10 P(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 2.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Expires
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	03-Dec-2021
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	29-Jan-2022
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	30-Dec-2021
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	03-Dec-2021
1 metre K-Type Cable	Florida Labs	KMS-180SP-39.4-KMS	4520	12	16-Nov-2021
PXA Signal Analyser	Keysight Technologies	N9030A	4654	12	06-Nov-2021
Cable (18 GHz)	Rosenberger	LU7-071-1000	5099	12	12-Oct-2021
Thermo-Hygro-Barometer	PCE Instruments	PCE-THB-40	5475	12	06-Apr-2022
Attenuator 5W 30dB DC-18GHz	Aaren	AT40A-4041-D18-30	5504	12	14-Apr-2022
300 MHz High Pass Filter	Mini-Circuits	NHP-300	5532	12	25-Mar-2022
Attenuator 2W 10dB DC-10GHz	Telegartner	J01156A0031	5577	-	O/P Mon

Table 10

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 2.1053
ISED RSS-182, Clause 7.9
ISED RSS-GEN, Clause 6.13

2.4.2 Equipment Under Test and Modification State

Tron 60AIS, S/N: 00008 - Modification State 3

2.4.3 Date of Test

08-June-2021

2.4.4 Test Method

Testing was performed in accordance with ANSI C63.26, clause 5.5.4.

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 polarization.

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 each of the AIS channels in turn.

2.4.5 Environmental Conditions

Ambient Temperature	20.1 °C
Relative Humidity	53.2 %

2.4.6 Test Results

AIS Transceiver

Frequency (MHz)	Level (dBm)
*	

Table 11 - 161.975 MHz - Emissions Results

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

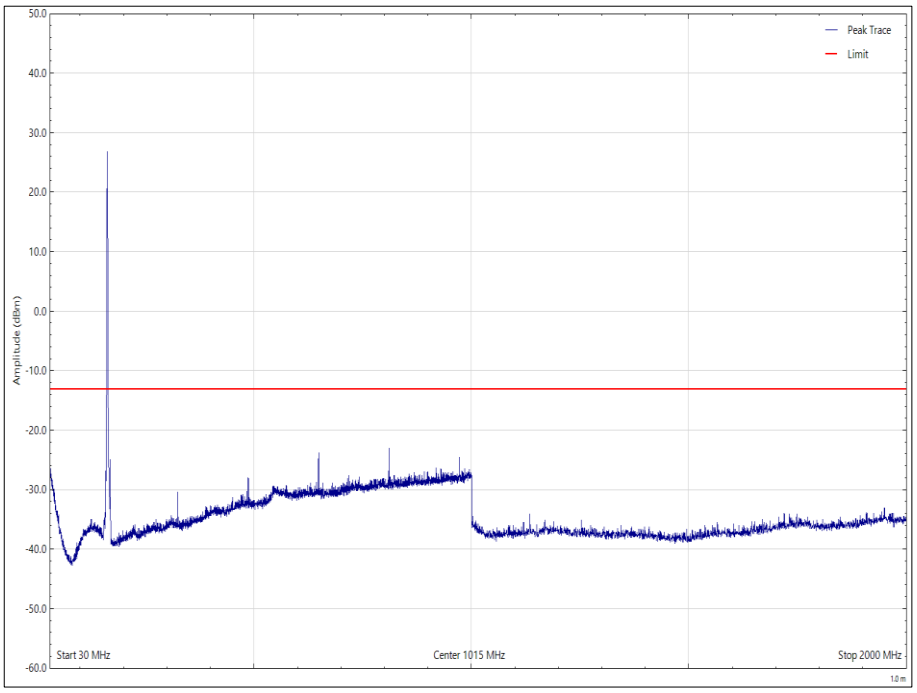

Figure 11 - 161.975 MHz - 30 MHz to 2 GHz - Vertical Polarisation

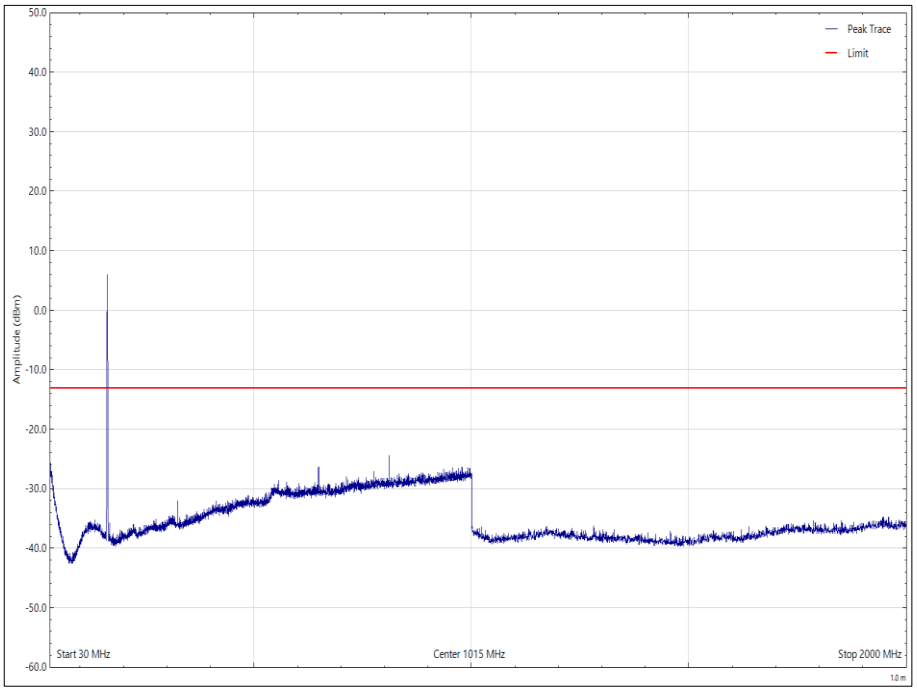

Figure 12 - 161.975 MHz - 30 MHz to 2 GHz - Horizontal Polarisation

Frequency (MHz)	Level (dBm)
*	

Table 12 - 162.025 MHz - Emissions Results

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

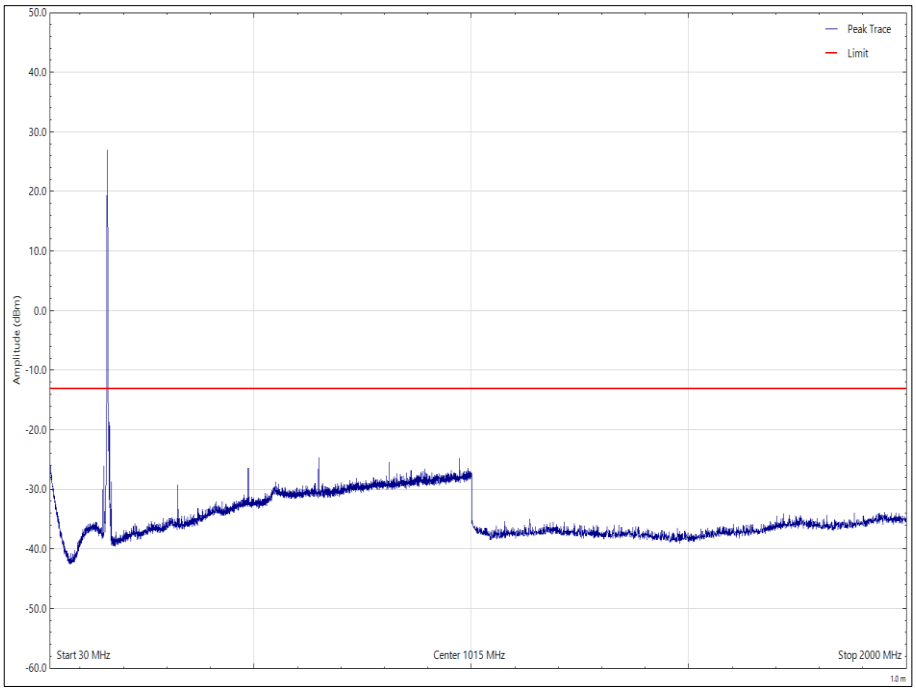

Figure 13 - 162.025 MHz - 30 MHz to 2 GHz - Vertical Polarisation

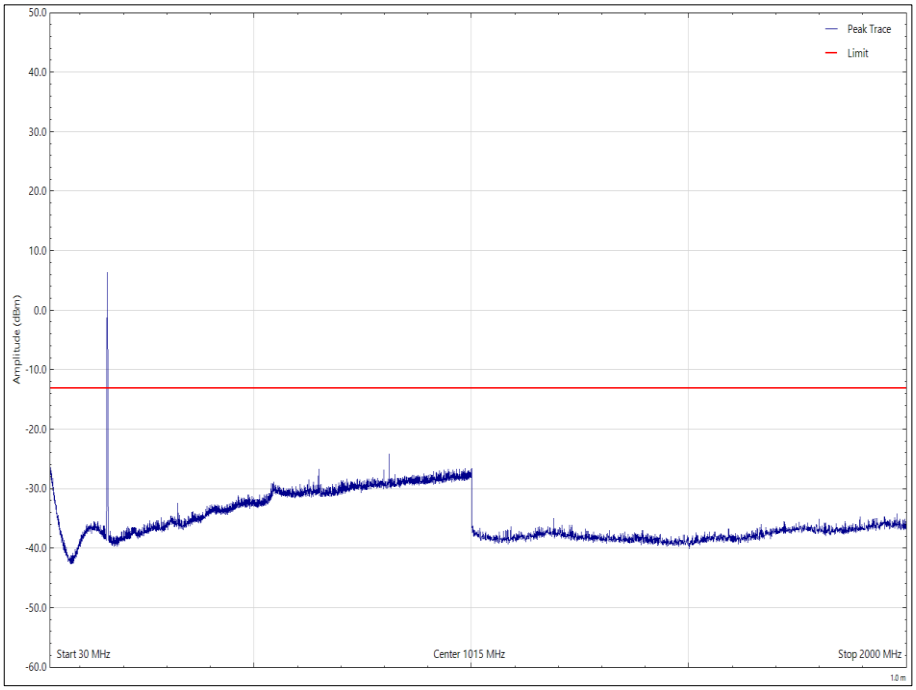

Figure 14 - 162.025 MHz - 30 MHz to 2 GHz - Horizontal Polarisation

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.

ISED 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 log10 p(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 12.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Expires
Antenna with permanent attenuator (Bilog)	Schaffner	CBL6143	287	24	14-Oct-2022
Comb Generator	Schaffner	RSG1000	3034	-	TU
EMI Test Receiver	Rohde & Schwarz	ESU40	3506	12	18-Mar-2022
EmX Emissions Software	TUV SUD	V2.1.9	5125	-	Software
3.5 mm 2m Cable	Junkosha	MWX221-02000DMS	5428	12	15-Oct-2021
Thermo-Hygro-Barometer	PCE Instruments	PCE-THB-40	5481	12	31-Mar-2022
Broadband Horn Antenna (1-10 GHz)	Schwarzbeck	BBHA 9120 B	5611	12	22-Sep-2021
Turntable & Mast Controller	Maturo Gmbh	NCD/498/2799.01	5612	-	TU
Tilt Antenna Mast TAM 4.0-P	Maturo Gmbh	TAM 4.0-P	5613	-	TU
Turntable	Maturo Gmbh	Turntable 1.5 SI-2t	5614	-	TU
3m Semi Anechoic Chamber	MVG	EMC-3	5621	36	11-Aug-2023
Cable Assembly - 18GHz 8m	Junkosha	MWX221-08000NMSNMS/B	5732	6	05-Aug-2021

Table 13

TU - Traceability Unscheduled

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
ISED RSS-182, Clause 7.7

2.5.2 Equipment Under Test and Modification State

Tron 60AIS, S/N: 00016 - Modification State 3

2.5.3 Date of Test

14-June-2021

2.5.4 Test Method

The test was applied in accordance with the test method requirements of FCC CFR 47 Part 80, clause 80.213 (d).

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.

2.5.5 Environmental Conditions

Ambient Temperature	23.8 °C
Relative Humidity	52.4 %

2.5.6 Test Results

<u>AIS Transceiver</u>

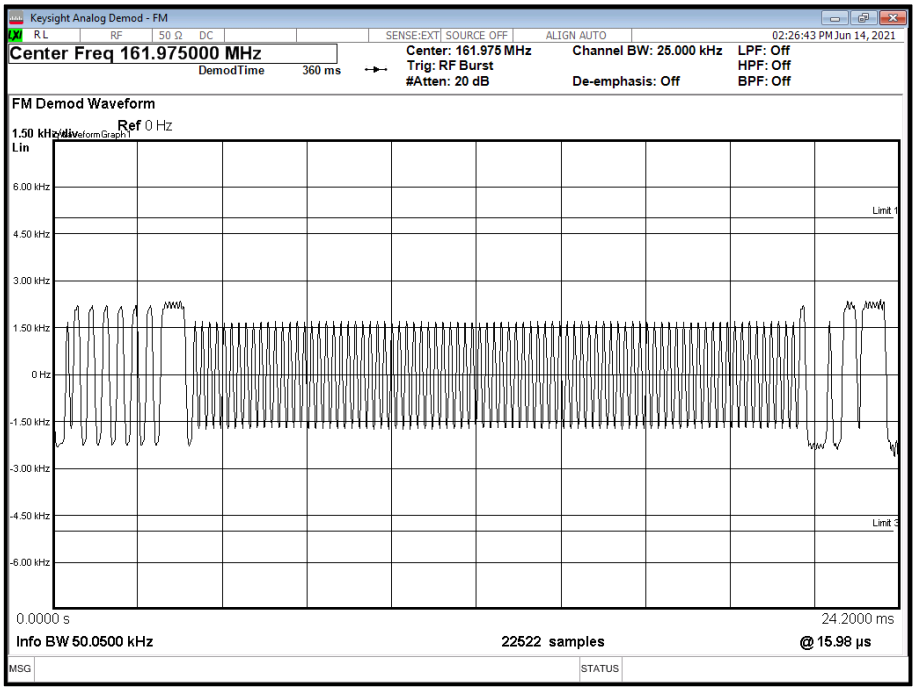

Figure 15 - 161.975 MHz - 01010101

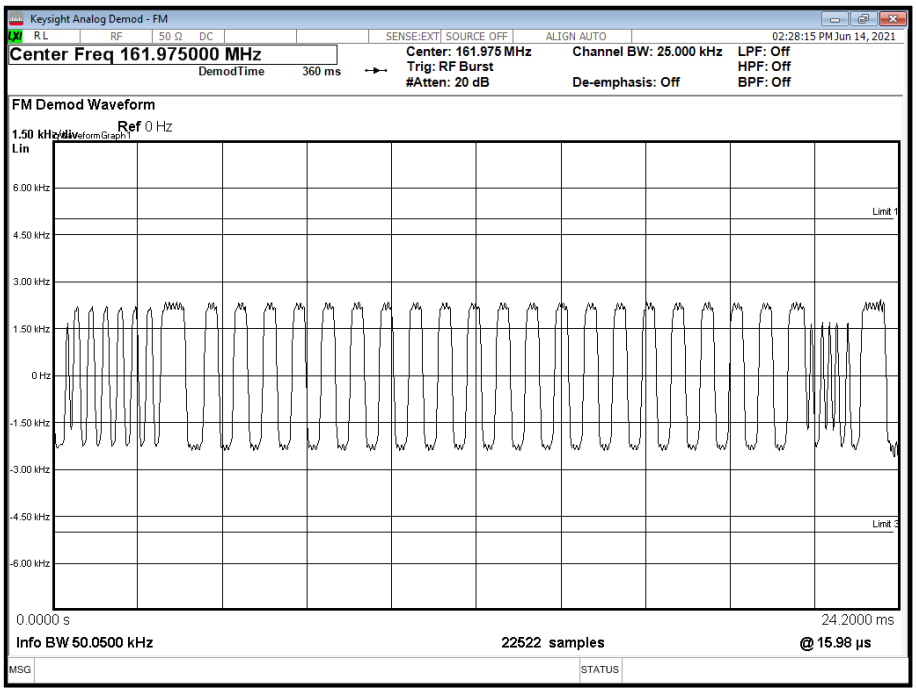

Figure 16- 161.975 MHz - 00001111

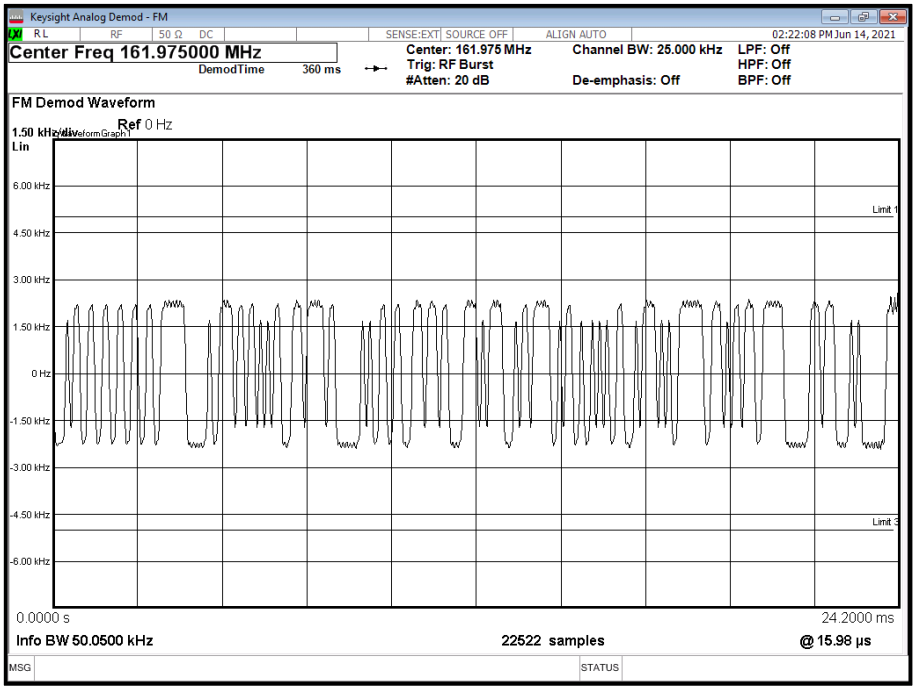

Figure 17- 161.975 MHz - PRBS

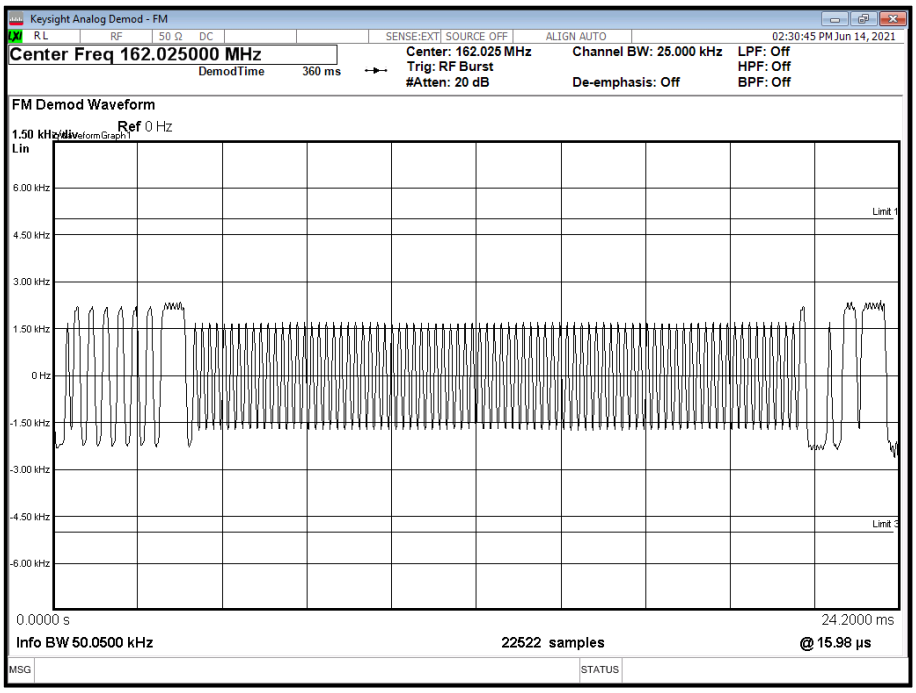

Figure 18 - 162.025 MHz - 01010101

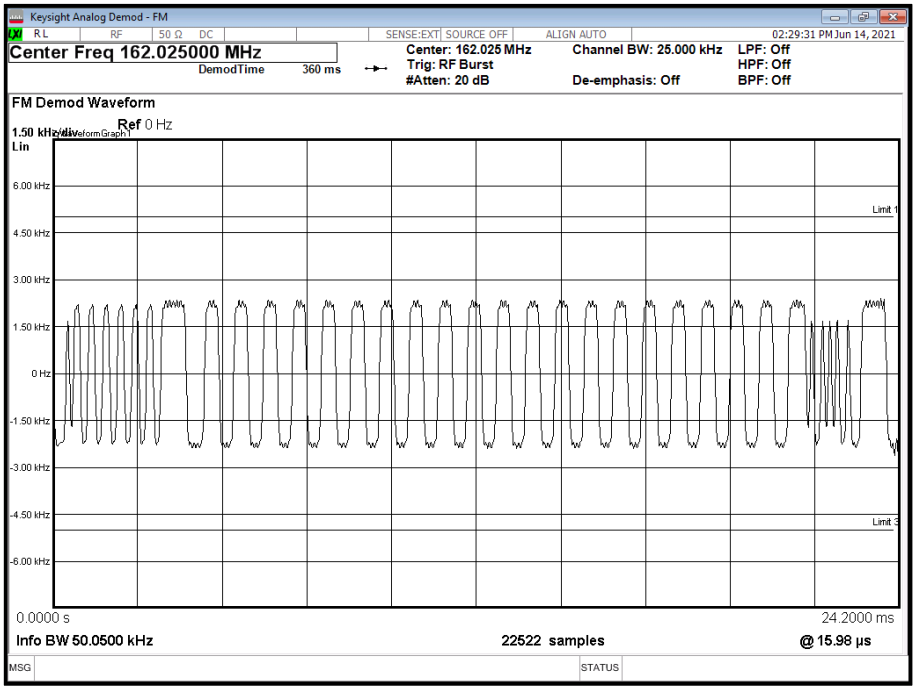

Figure 19- 162.025 MHz - 00001111

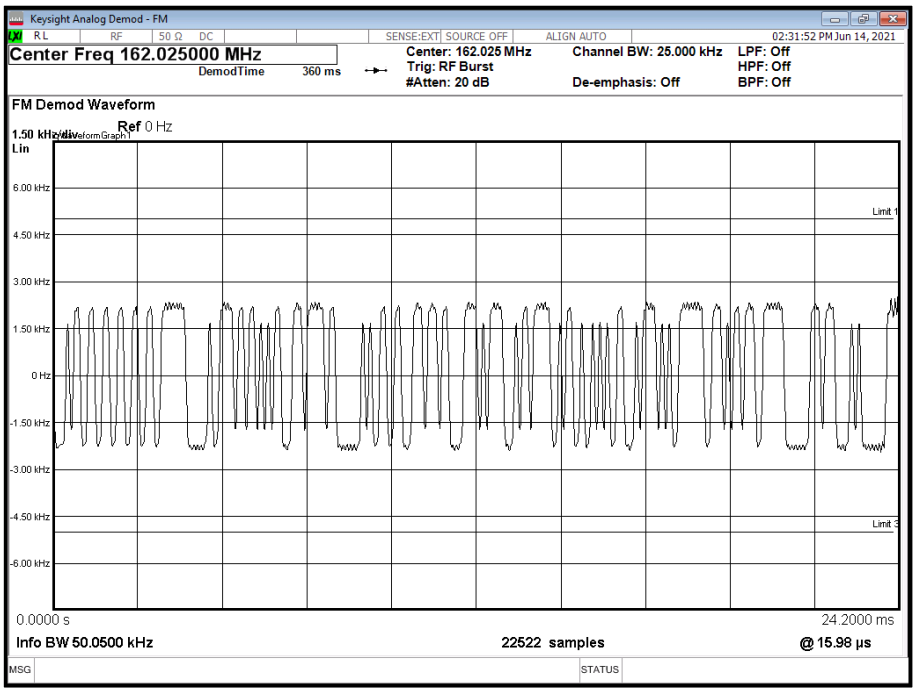

Figure 20- 162.025 MHz - PRBS

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

Ship and coast station transmitters operating in the 156-162 MHz and 216-220 bands must be capable of proper operation with a frequency deviation that does not exceed ±5 kHz when using any emission authorized by 80.207.

ISED 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 2.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Expires
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	03-Dec-2021
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	03-Dec-2021
PXA Signal Analyser	Keysight Technologies	N9030A	4654	12	06-Nov-2021
Cable (18 GHz)	Rosenberger	LU7-071-1000	5099	12	12-Oct-2021
Thermo-Hygro-Barometer	PCE Instruments	PCE-THB-40	5475	12	06-Apr-2022
Attenuator 5W 30dB DC-18GHz	Aaren	AT40A-4041-D18-30	5504	12	14-Apr-2022

Table 14

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
ISED RSS-182, Clause 7.5
ISED RSS-GEN, Clause 6.12

2.6.2 Equipment Under Test and Modification State

Tron 60AIS, S/N: 00016 - Modification State 2

2.6.3 Date of Test

13-May-2021

2.6.4 Test Method

The test was applied in accordance with the test method requirements of FCC CFR 47 Part 80, clause 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 to 100 kHz and the video bandwidth to 300 kHz with the trace set to max hold using a peak detector and the result was recorded

2.6.5 Environmental Conditions

Ambient Temperature	23.6 °C
Relative Humidity	41.7 %

2.6.6 Test Results

AIS Transceiver

161.975 MHz		162.025 MHz	
Result (dBm)	Result (W)	Result (dBm)	Result (W)
33.3	2.1	33.3	2.1

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

ISED RSS-182, Limit Clause 7.5

The output power shall be within ±1.0 dB of the manufacturer's rated power and not exceed the limits listed in the table below, unless indicated otherwise.

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 16

2.6.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 2.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Expires
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	17-May-2021
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	29-Jan-2022
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	30-Dec-2021
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	17-May-2021
1 metre K-Type Cable	Florida Labs	KMS-180SP-39.4-KMS	4520	12	16-Nov-2021
PXA Signal Analyser	Keysight Technologies	N9030A	4654	12	06-Nov-2021
Thermo-Hygro-Barometer	PCE Instruments	PCE-THB-40	5475	12	06-Apr-2022
Attenuator 5W 30dB DC-18GHz	Aaren	AT40A-4041-D18-30	5504	12	14-Apr-2022
Attenuator 2W 10dB DC-10GHz	Telegartner	J01156A0031	5577	-	O/P Mon

Table 17

O/P Mon – Output Monitored using calibrated equipment

3 Photographs

3.1 Test Setup Photographs

Figure 21 - Test Setup - 30 MHz to 1 GHz

Figure 22 - Test Setup - 1 GHz to 2 GHz

4 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: ± 5.2 dB 1 GHz to 18 GHz: ± 6.3 dB
Modulation Requirements	-
Transmitter Power	± 3.2 dB

Table 18

Measurement Uncertainty Decision Rule

Determination of conformity with the specification limits is based on the decision rule according to IEC Guide 115: 2007, clause 4.4.3 and 4.5.1.