Radio Test Report

Saab AB
R60 AIS AtoN Station

In accordance with IEC 62320-2

Prepared for: Saab AB
Lasblecksgatan 3
Linkoping
SE-589 41
SWEDEN

COMMERCIAL-IN-CONFIDENCE

Document 75959974-01 Issue 01

SIGNATURE			
			
NAME	**JOB TITLE**	**RESPONSIBLE FOR**	**ISSUE DATE**
Matthew Russell	Chief Engineer	Authorised Signatory	09 January 2024

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 62320-2: 2016 for the tests detailed in section 1.3.

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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	09-Jan-2024

Table 1

1.2 Introduction

Applicant	Saab AB
Manufacturer	Saab AB Transponder Tech
Model Number(s)	R60 AIS AtoN Station
Serial Number(s)	100098
Hardware Version(s)	B
Software Version(s)	1.0.12
Number of Samples Tested	1
Test Specification/Issue/Date	IEC 62320-2: 2016
Order Number	4777274 - QAF
Date	30-November-2023
Date of Receipt of EUT	05-December-2023
Start of Test	13-December-2023
Finish of Test	20-December-2023
Name of Engineer(s)	Thomas Biddlecombe

1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with IEC 62320-2 is shown below.

Section	Specification Clause	Test Description	Result	Comments/Base Standard
Configuration and Mode: AIS Transceiver				
2.1	7.1.4	Modulation Spectrum Slotted Transmission	Pass	
2.2	7.1.5	Transmitter Test Sequence and Modulation Accuracy	Pass	
2.3	7.1.6	Transmitter Output Power Versus Time Function (FATDMA and RATDMA)	Pass	
2.4	7.2.7	Blocking or Desensitisation	Pass	

Table 2

1.4 Application Form

Equipment Description

Technical Description: *(Please provide a brief description of the intended use of the equipment)*	Type 3 Aids-to-Navigation (AtoN) AIS designed for marking of offshore maritime installations, such as wind energy farms, navigational aids and hazards.
Manufacturer:	Saab AB (publ.) Transponder Tech
Model:	R60 AIS AtoN Station
Part Number:	7000 120-204
Hardware Version:	B
Software Version:	1.0.12

Table 3

Transmitter Technical Characteristics – Frequency Characteristics

Transmitter frequency alignment range:	156 - 162 MHz
Transmitter channel switching frequency range:	25 kHz

Table 4

Transmitter RF Power Characteristics

Maximum effective rated power (rated as stated by the manufacturer):		12.5 W
Average effected radiated power (rated as stated by the manufacturer):		N/A
Is transmitter intended for:	Continuous duty: Yes ☐ No ☒ Intermittent duty: Yes ☒ No ☐	
If intermittent state DUTY CYCLE:	Transmitter ON:	0.053 seconds
	Transmitter OFF:	10 seconds
Is transmitter output power variable?	Continuous duty: Yes ☒ No ☐	
Maximum power:		W
	Continuously variable	☐
	Stepped	☒
		11 dB per step
Maximum RF output power:		12.5 W
Minimum RF output power:		1 W

Table 5

Transmitter Modulation Input Character Characteristics (FM)

Modulation input signal level for 60% of maximum deviation at:				
Microphone socket:		mV		Impedance (Ohms)
Accessory socket:		mV		Impedance (Ohms)
Other (4):		mV		Impedance (Ohms)
Lowest audio modulation frequency transmitted by the equipment				Hz

Table 6

Transmitter Modulation

Frequency ☐ Phase ☒ Other ☐	
If Other, Please Detail:	
Channel spacing	25 kHz
State the maximum number of channels over which the equipment can operate: 240	

Table 7

Receiver Technical Characteristics – Frequency Characteristics

Receiver frequency alignment range:	156 - 162 MHz
Receiver channel switching frequency:	25 kHz
Method of Frequency Generation	Crystal ☐ Synthesizer ☐ Other ☒ Please Detail: Subsampling
Intermediate Frequencies:	1st ☐ 2nd ☐ 3rd ☐
Is local oscillator injection frequency higher or lower than the receiver nominal frequency?	Higher ☐ Lower ☐

Table 8

Receiver Audio (AF) Characteristics – Maximum Rated Audio (AF) Frequency Output Power

Into Loudspeaker:		W
Into Line:		W
Into Earpiece:		W
Balanced:	Yes ☐ No ☐	
Unbalanced:	Yes ☐ No ☐	
Does connection carry DC voltage?	Yes ☐ No ☐ if Yes, please state voltage	
Normal Audio load impedance:	At Loudspeaker:	Ohms
	At Line:	Ohms
	At Earpiece:	Ohms
At audio accessory connection or facility socket (if fitted):	Output:	W
	Impedance:	W
Max input level at audio accessory socket:	Output:	W
	Impedance:	W

Table 9

AC Power Source

AC supply frequency:		47 – 63 Hz	
100 V	240 V	Max current:	3 A
Single phase ☒ Three phase ☐			

Table 10

DC Power Source

Nominal voltage:	12 – 24 V
Extreme upper voltage:	28.8 V
Extreme lower voltage:	10.8 V
Max current:	20 A

Table 11

Battery Power Source

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

Table 12

Temperature *(over which equipment is to be type tested)*

Minimum Temperature:	-15 °C
Maximum Temperature:	+55 °C
Other, please specify:	

Table 13

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 ☐	Cut off voltage	V
Does not apply ☐		

Table 14

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.			
Channel Position	Channel Number	Transmit Nominal Frequency (MHz)	Receive Nominal Frequency (MHz)

Table 15

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

Name: Christian Andersson
Position held: Product Manager
Date: 06-Decmeber-2023

1.5 Product Information

1.5.1 Technical Description

The EUT is a Type 3 AtoN AIS according to IEC 62320-2 and ITU-R M.1371-5, that supports the following:
• Reporting of virtual or synthetic AtoNs with AIS message 21 with individual reporting rates
• FATDMA and RATDMA access schemes
• Reception of all applicable AIS messages

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: R60 AIS AtoN Station, Serial Number: 100098			
0	As supplied by the customer	Not Applicable	Not Applicable

Table 16

1.8 Test Location

TÜV SÜD conducted the following tests at our Octagon House Test Laboratory.

Test Name	Name of Engineer(s)	Accreditation
Configuration and Mode: AIS Transceiver		
Modulation Spectrum Slotted Transmission	Thomas Biddlecombe	UKAS
Transmitter Test Sequence and Modulation Accuracy	Thomas Biddlecombe	UKAS
Transmitter Output Power Versus Time Function (FATDMA and RATDMA)	Thomas Biddlecombe	UKAS
Blocking or Desensitisation	Thomas Biddlecombe	UKAS

Table 17

Office Address:

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

2 Test Details

2.1 Modulation Spectrum Slotted Transmission

2.1.1 Specification Reference

IEC 62320-2, Clause 7.1.4

2.1.2 Equipment Under Test and Modification State

R60 AIS AtoN Station, S/N: 100098 - Modification State 0

2.1.3 Date of Test

13-December-2023

2.1.4 Test Method

This test was performed in accordance with IEC 62320-2, clause 7.1.4.2.

2.1.5 Environmental Conditions

Ambient Temperature	22.2 °C
Relative Humidity	33.7 %

2.1.6 Test Results

AIS Transceiver

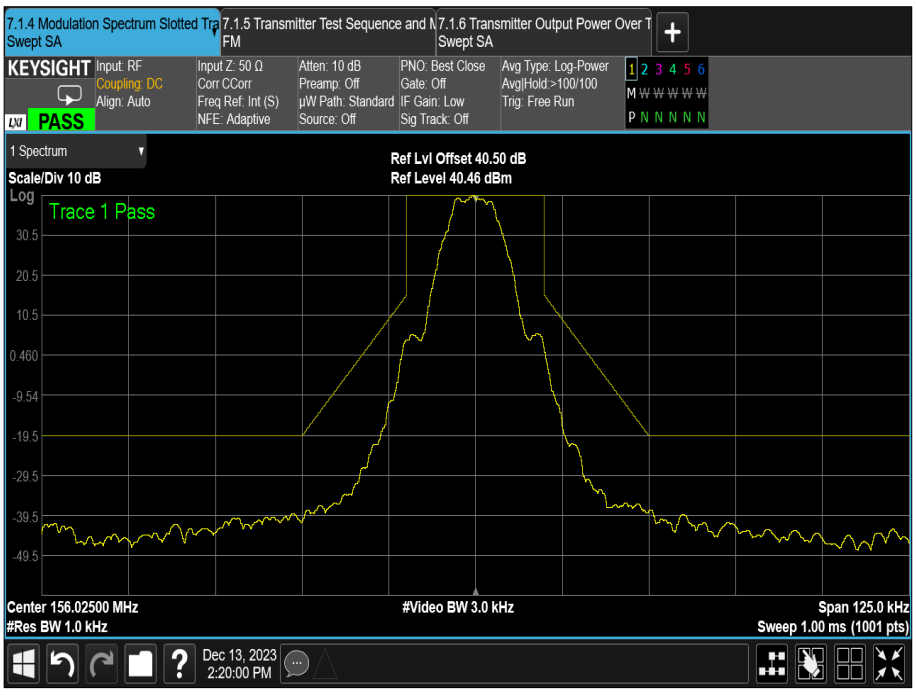

Figure 1 - 156.025 MHz

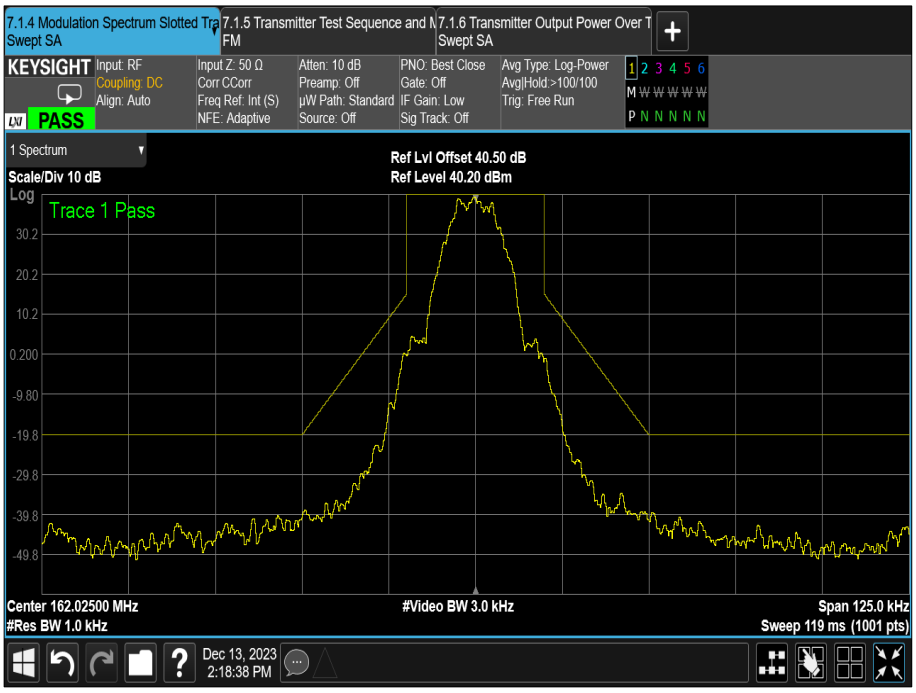

Figure 2 - 162.025 MHz

IEC 62320-2, Limit Clause 7.1.4.3

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 −60 dBc or −30 dBm;
• 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 7.1.1.2.

For information the emission mask specified above is shown below.

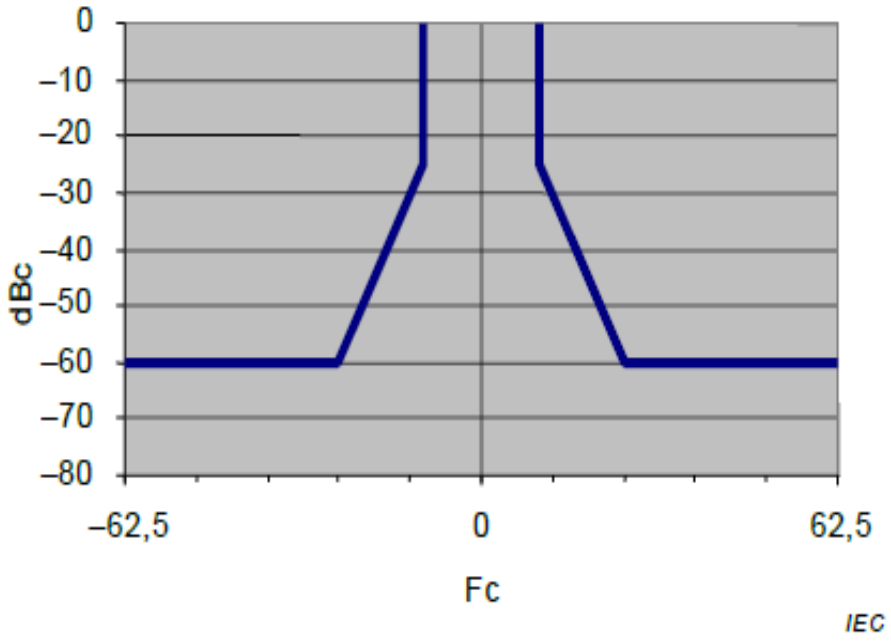

Figure 3 - Transmission Spectrum Mask Limit

2.1.7 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 Expires
Attenuator (20dB, 10W)	Aeroflex / Weinschel	23-20-34	3159	12	21-May-2024
Hygrometer	Rotronic	I-1000	3220	12	28-Nov-2024
Attenuator (20 dB, 150 W)	Narda	769-20	3367	12	02-Aug-2024
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	06-Mar-2024
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	06-Mar-2024
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	08-Feb-2024
Signal Analyzer	Keysight Technologies	PXA N9030B	5432	12	08-Jun-2024
Cable (K-Type to K-Type, 1 m)	Junkosha	MWX241-01000KMSKMS/A	5511	12	21-May-2024
Cable (SMA to SMA 1m)	Junkosha	MWX221-01000AMSAMS/A	5514	12	21-May-2024

Table 18

2.2 Transmitter Test Sequence and Modulation Accuracy

2.2.1 Specification Reference

IEC 62320-2, Clause 7.1.5

2.2.2 Equipment Under Test and Modification State

R60 AIS AtoN Station, S/N: 100098 - Modification State 0

2.2.3 Date of Test

13-December-2023 to 19-December-2023

2.2.4 Test Method

This test was performed in accordance with IEC 62320-2, clause 7.1.5.2.

2.2.5 Environmental Conditions

Ambient Temperature	21.8 - 22.2 °C
Relative Humidity	33.7 - 52.1 %

2.2.6 Test Results

AIS Transceiver

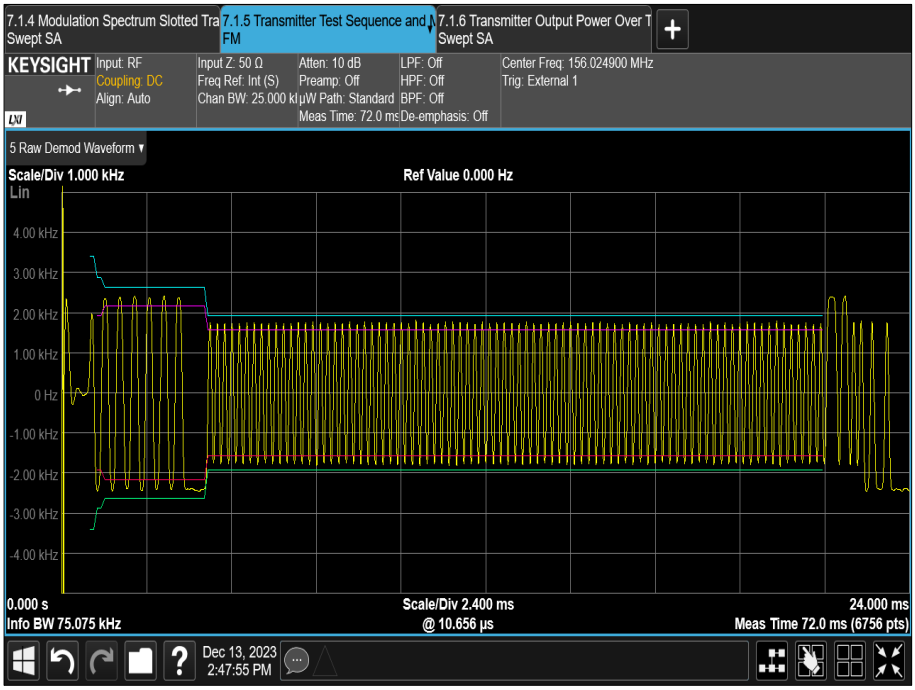

Figure 4 - 156.025 MHz, Test Signal #1, +22.2 °C, 24 V DC

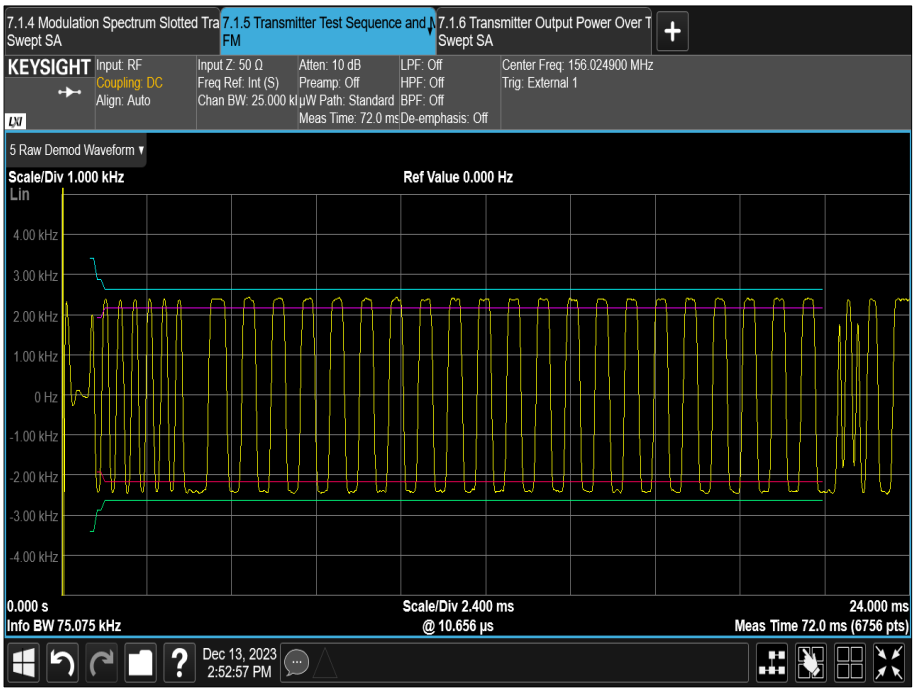

Figure 5 - 156.025 MHz, Test Signal #2, +22.2 °C, 24 V DC

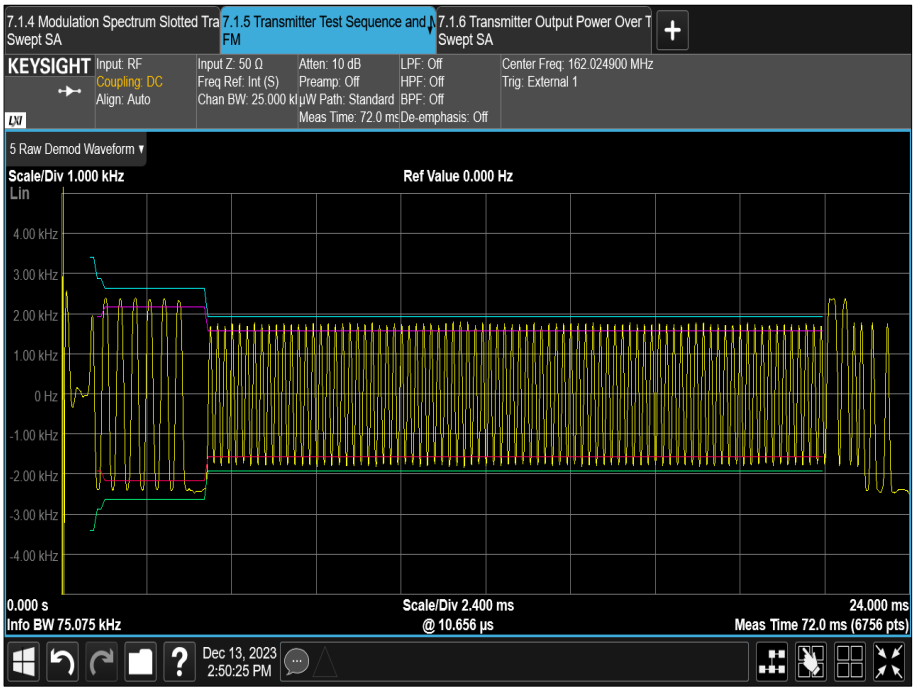

Figure 6 - 162.025 MHz, Test Signal #1, +22.2 °C, 24 V DC

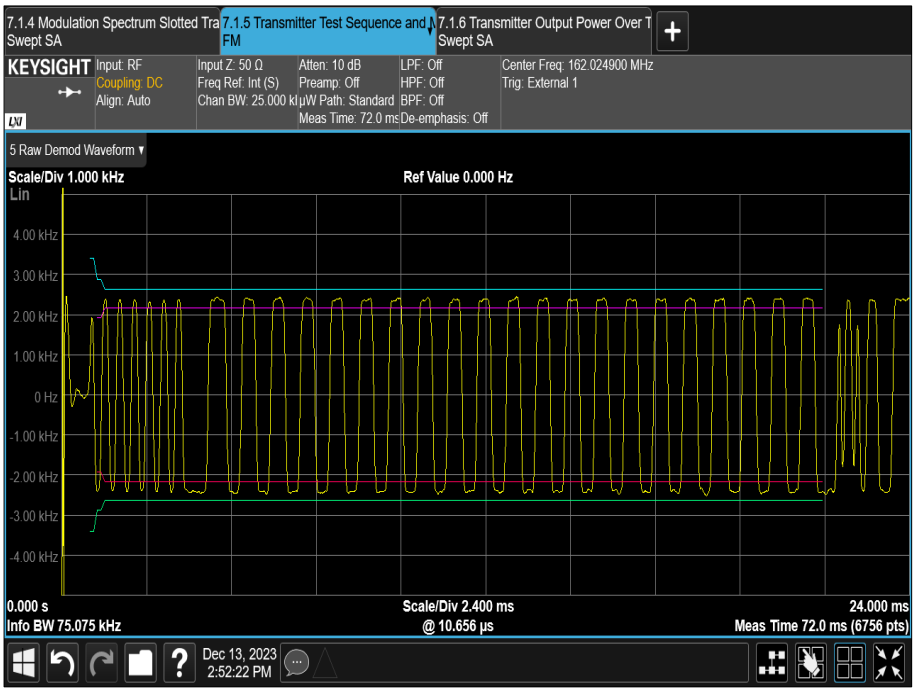

Figure 7 - 162.025 MHz, Test Signal #2, +22.2 °C, 24 V DC

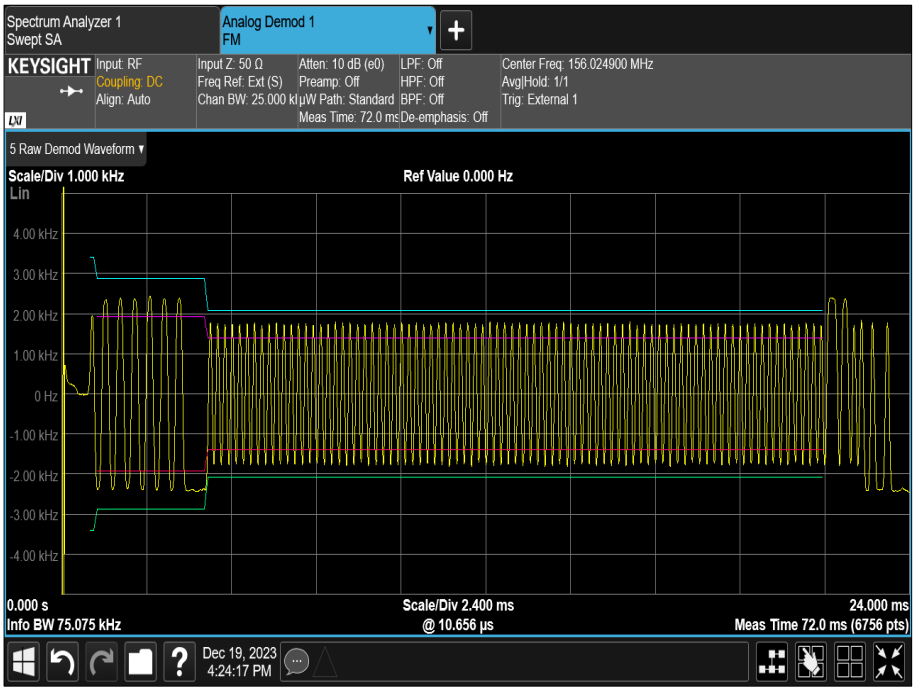

Figure 8 - 156.025 MHz, Test Signal #1, -15 °C, 10.8 V DC

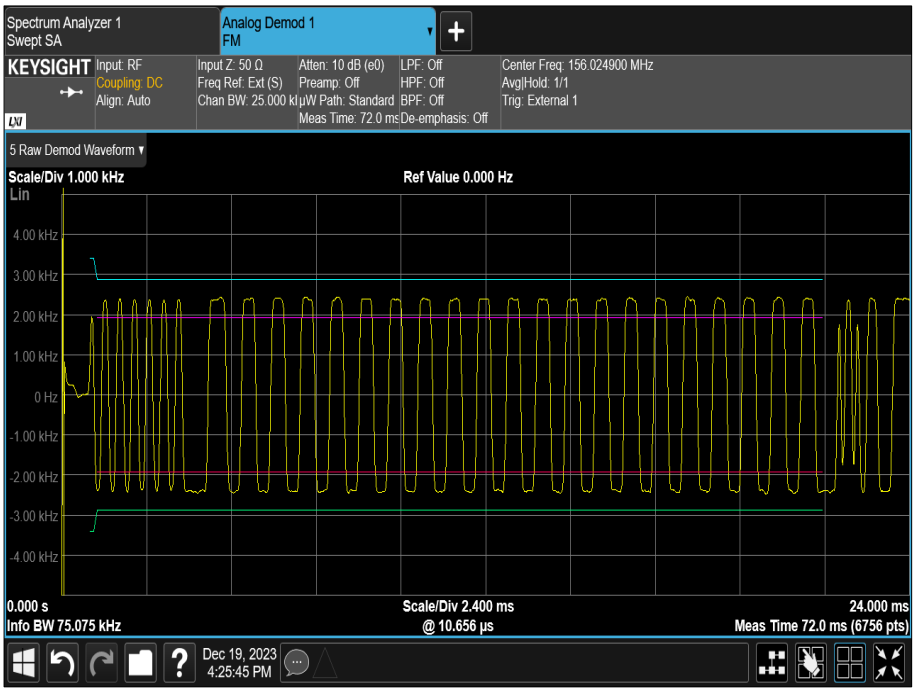

Figure 9 - 156.025 MHz, Test Signal #2, -15 °C, 10.8 V DC

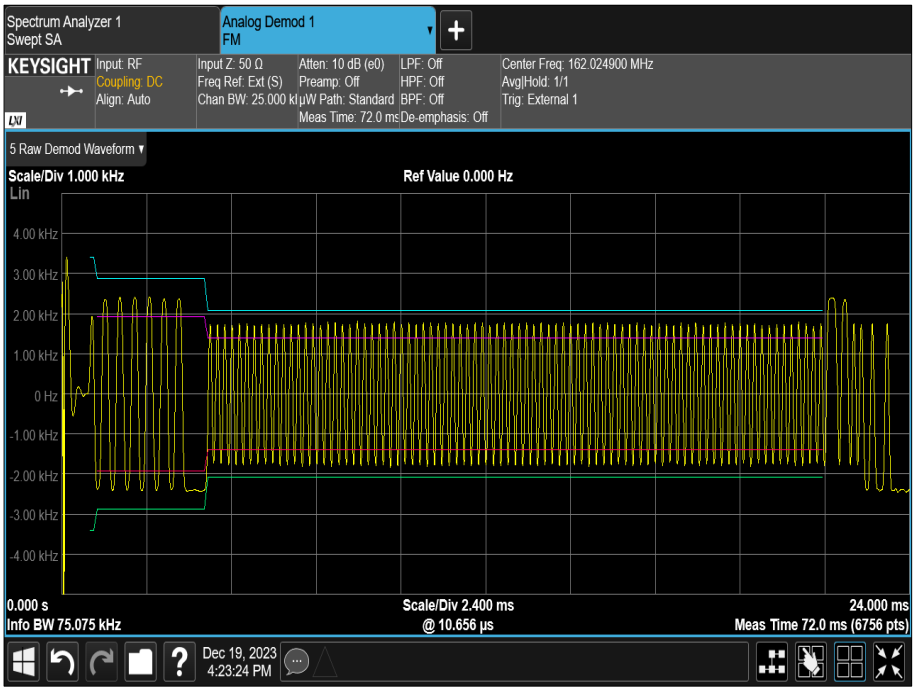

Figure 10 - 162.025 MHz, Test Signal #1, -15 °C, 10.8 V DC

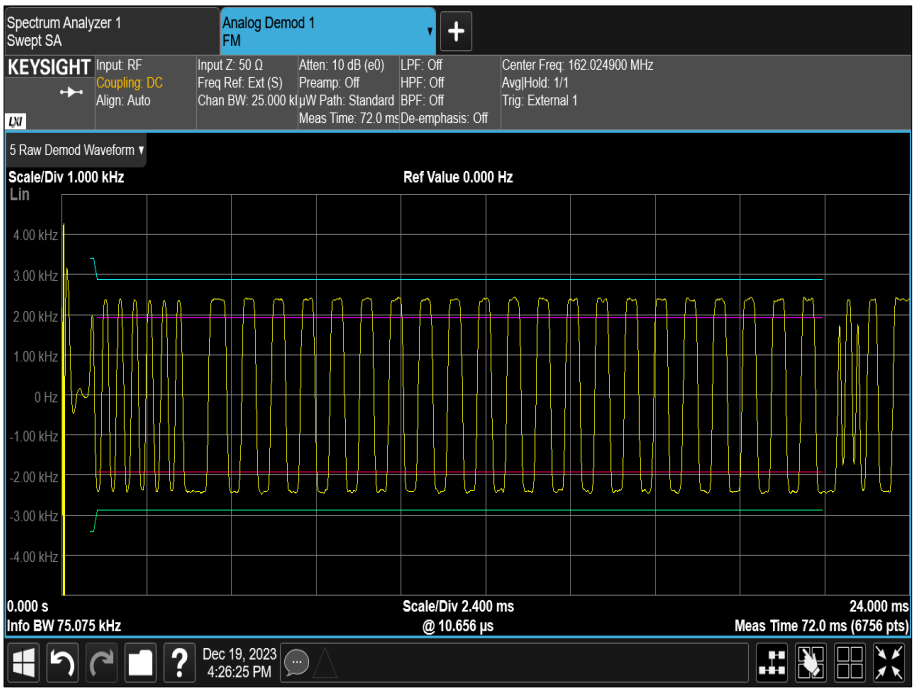

Figure 11 - 162.025 MHz, Test Signal #2, Tx1, -15 °C, 10.8 V DC

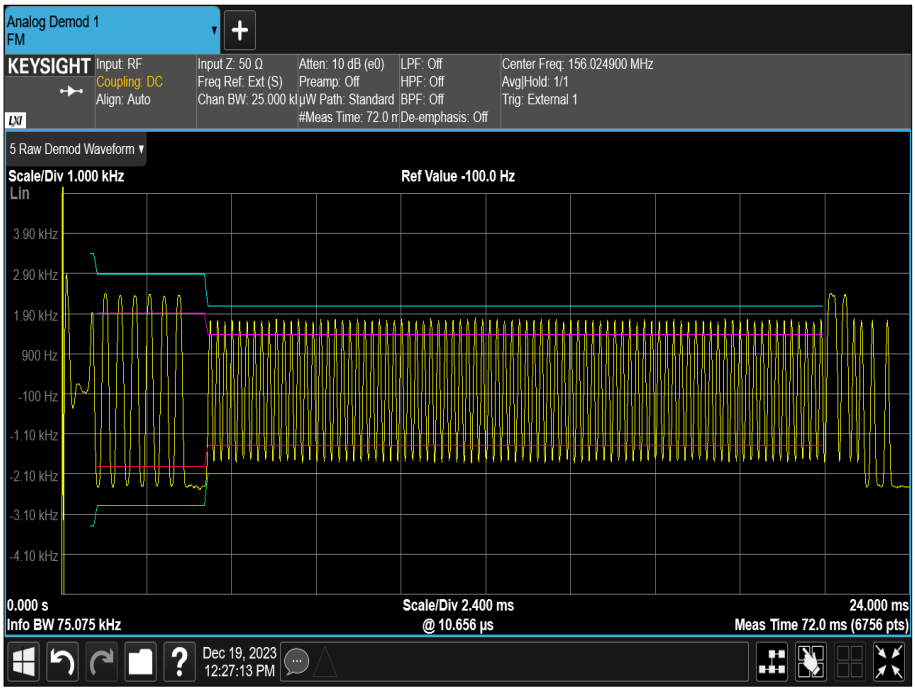

Figure 12 - 156.025 MHz, Test Signal #1, 55 °C, 31.2 V DC

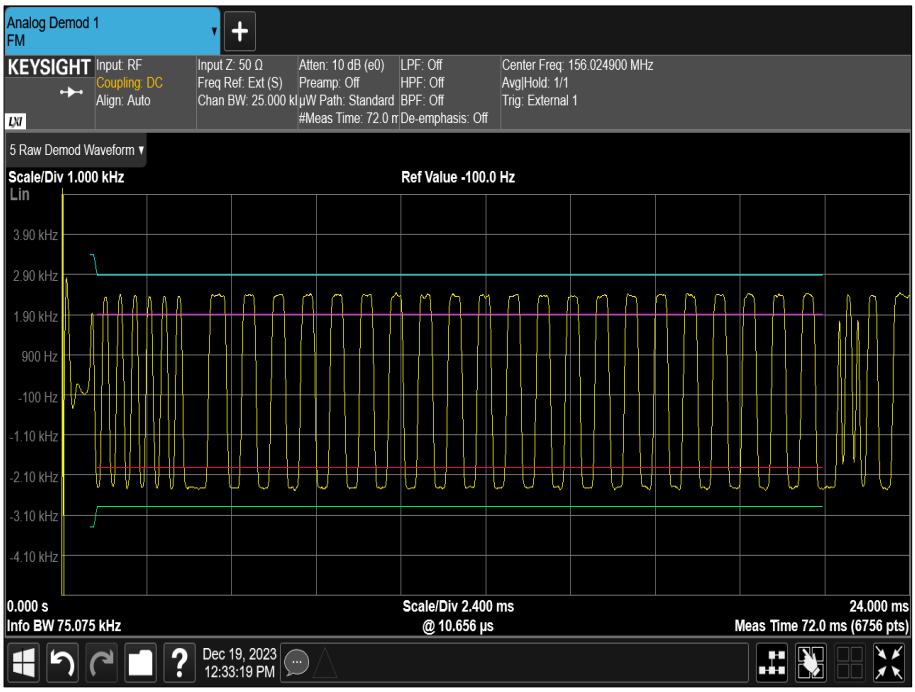

Figure 13 - 156.025 MHz, Test Signal #2, 55 °C, 31.2 V DC

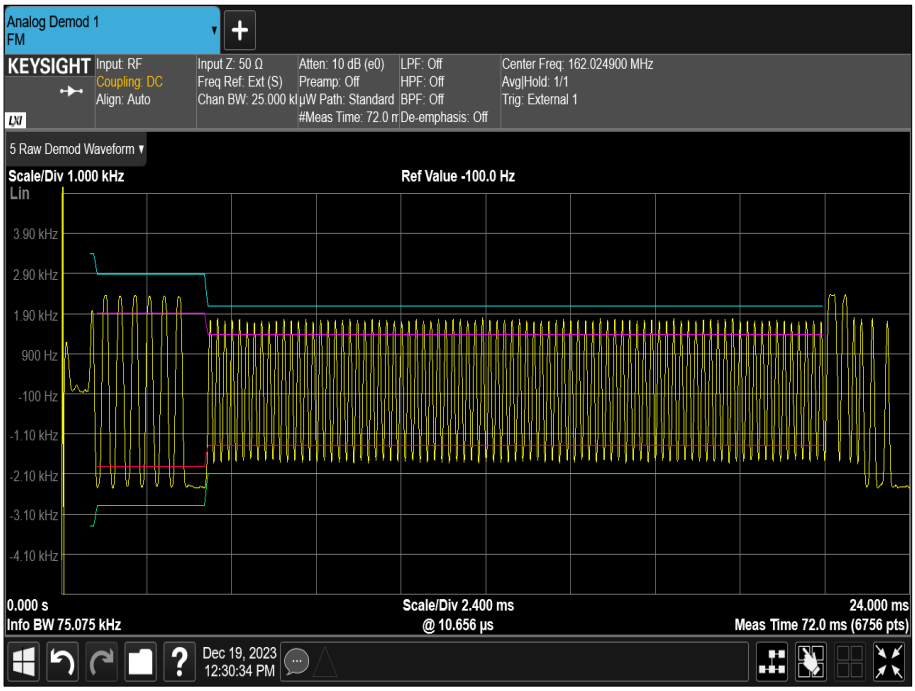

Figure 14 - 162.025 MHz, Test Signal #1, 55 °C, 31.2 V DC

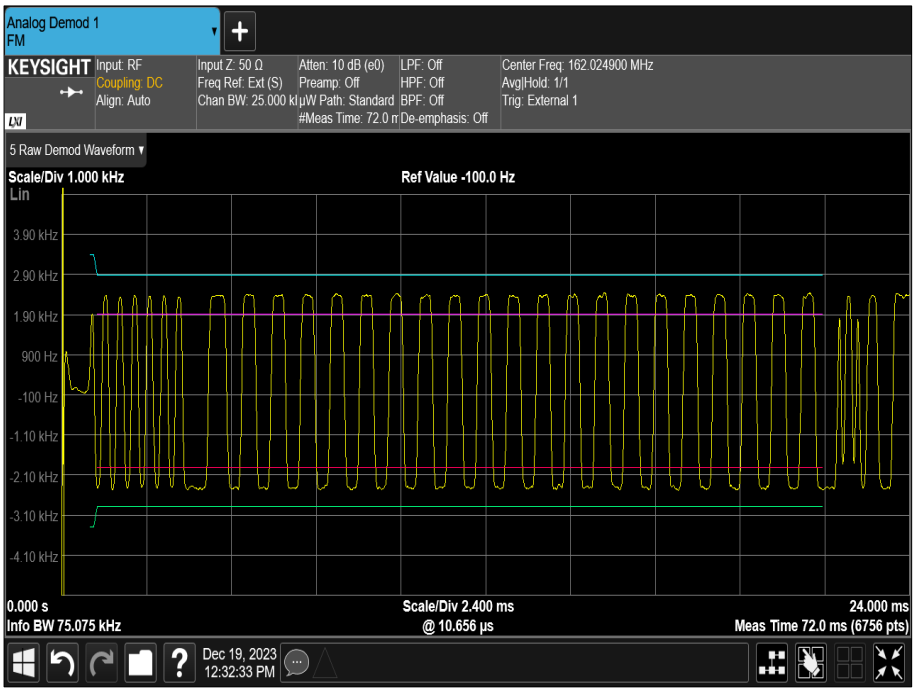

Figure 15 - 162.025 MHz, Test Signal #2, 55 °C, 31.2 V DC

IEC 62320-2, Limit Clause 7.1.5.3

Measurement Period from Centre to Centre of each Bit	Test Signal 1		Test Signal 2	
	Normal	Extreme	Normal	Extreme
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 19 - Peak Frequency Deviation versus Time Limit

2.2.7 Test Location and Test Equipment Used

This test was carried out in RF Laboratory 1 and RF Laboratory 2.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Expires
Power Supply Unit	Farnell	H60-25	1092		O/P Mon
Multimeter	Iso-tech	IDM101	2421	12	08-Nov-2024
Attenuator (20dB, 10W)	Aeroflex / Weinschel	23-20-34	3159	12	21-May-2024
Hygrometer	Rotronic	I-1000	3220	12	28-Nov-2024
Attenuator (20 dB, 150 W)	Narda	769-20	3367	12	02-Aug-2024
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	06-Mar-2024
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	06-Mar-2024
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	08-Feb-2024
Signal Analyzer	Keysight Technologies	PXA N9030B	5432	12	08-Jun-2024
Cable (K-Type to K-Type, 1 m)	Junkosha	MWX241-01000KMSKMS/A	5511	12	21-May-2024
Cable (SMA to SMA 1m)	Junkosha	MWX221-01000AMSAMS/A	5514	12	21-May-2024
Thermo-Hygro-Barometer	PCE Instruments	PCE-THB 40	5605	12	07-Nov-2024
Climatic Chamber	Weiss Technik	TempEvent T/180/40/3	5894	12	07-Jul-2024

Table 20

O/P Mon – Output Monitored using calibrated equipment

2.3 Transmitter Output Power Versus Time Function (FATDMA and RATDMA)

2.3.1 Specification Reference

IEC 62320-2, Clause 7.1.6

2.3.2 Equipment Under Test and Modification State

R60 AIS AtoN Station, S/N: 100098 - Modification State 0

2.3.3 Date of Test

13-December-2023

2.3.4 Test Method

This test was performed in accordance with IEC 62320-2, clause 7.1.6.2.

2.3.5 Environmental Conditions

Ambient Temperature	22.2 °C
Relative Humidity	33.7 %

2.3.6 Test Results

AIS Transceiver

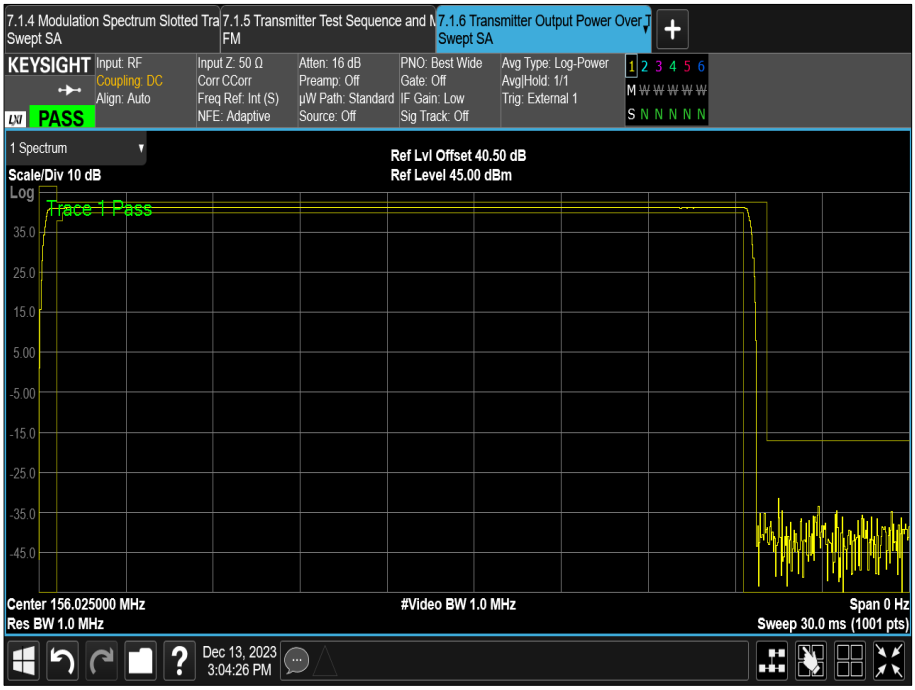

Figure 16 - 156.025 MHz - Complete Burst

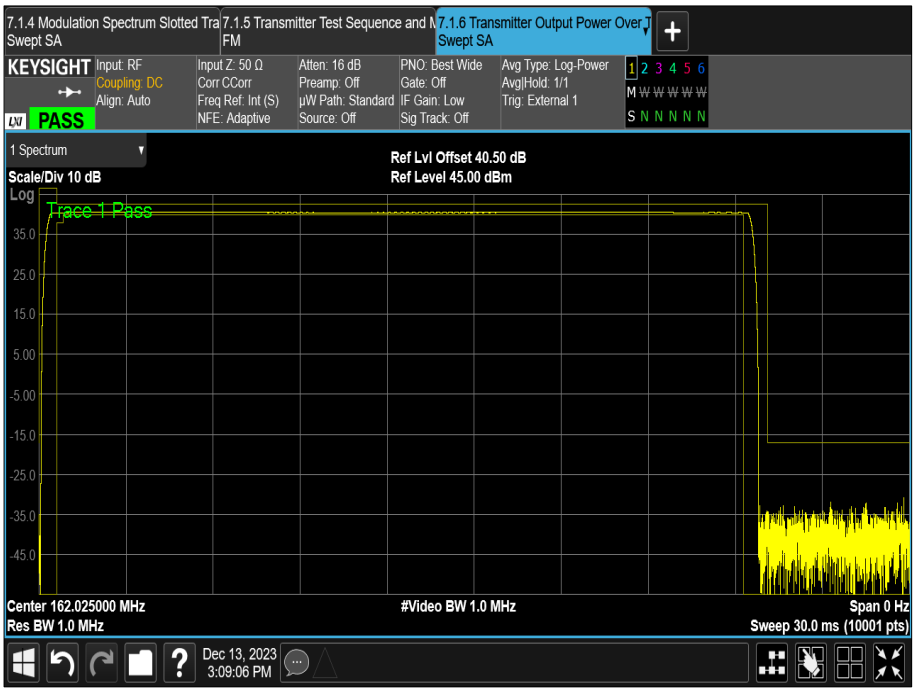

Figure 17 - 162.025 MHz - Complete Burst

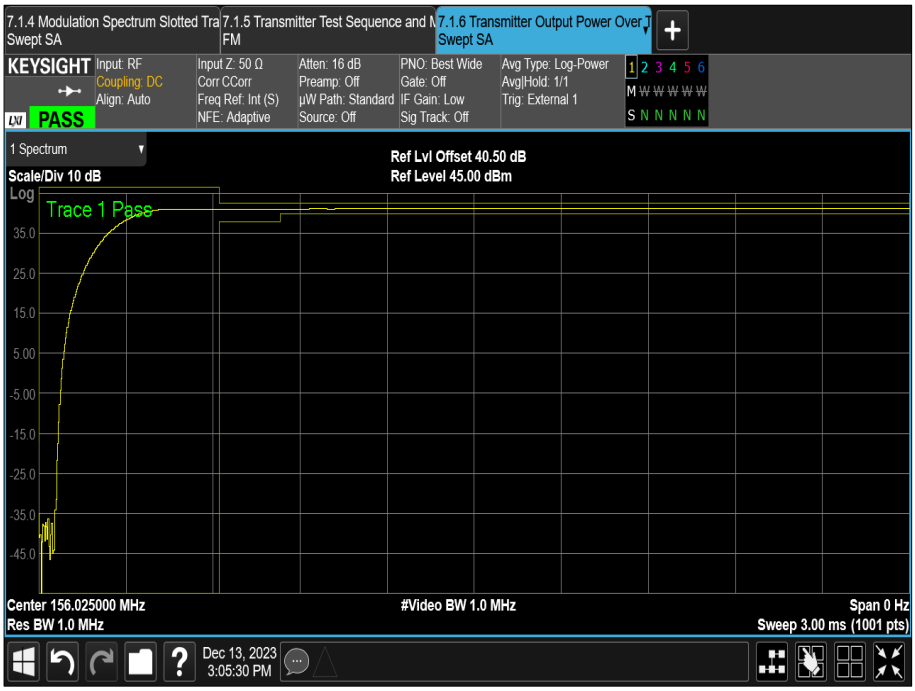

Figure 18 - 156.025 MHz - Ramp Up Zoomed

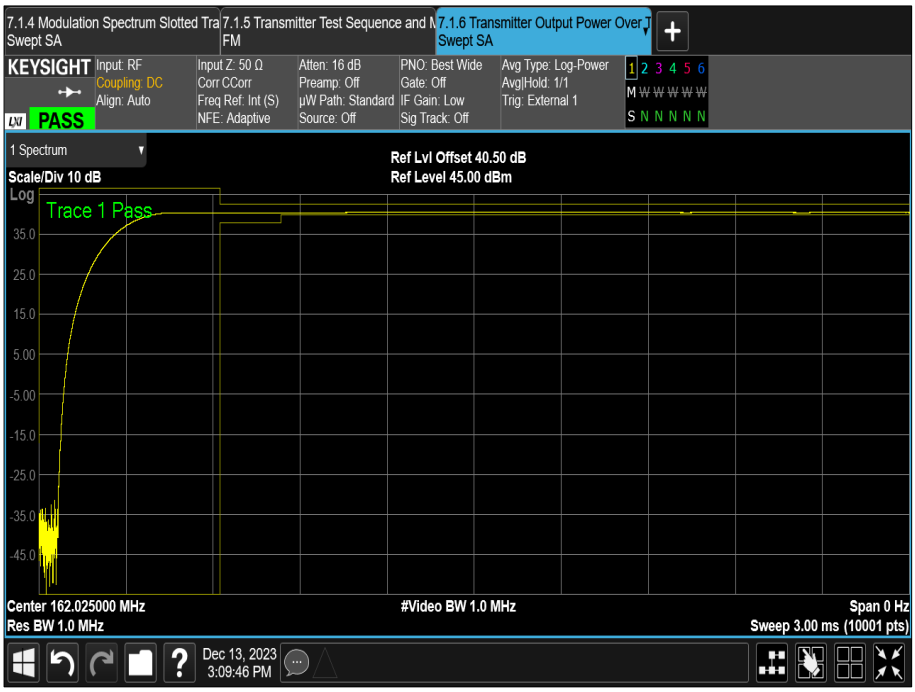

Figure 19 - 162.025 MHz - Ramp Up Zoomed

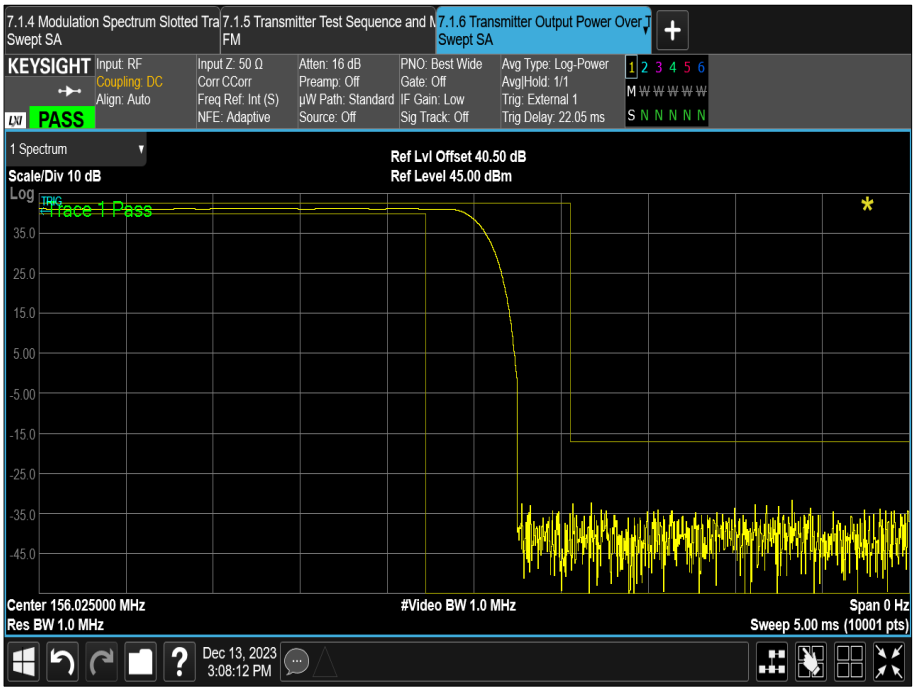

Figure 20 - 156.025 MHz - Ramp Down Zoomed

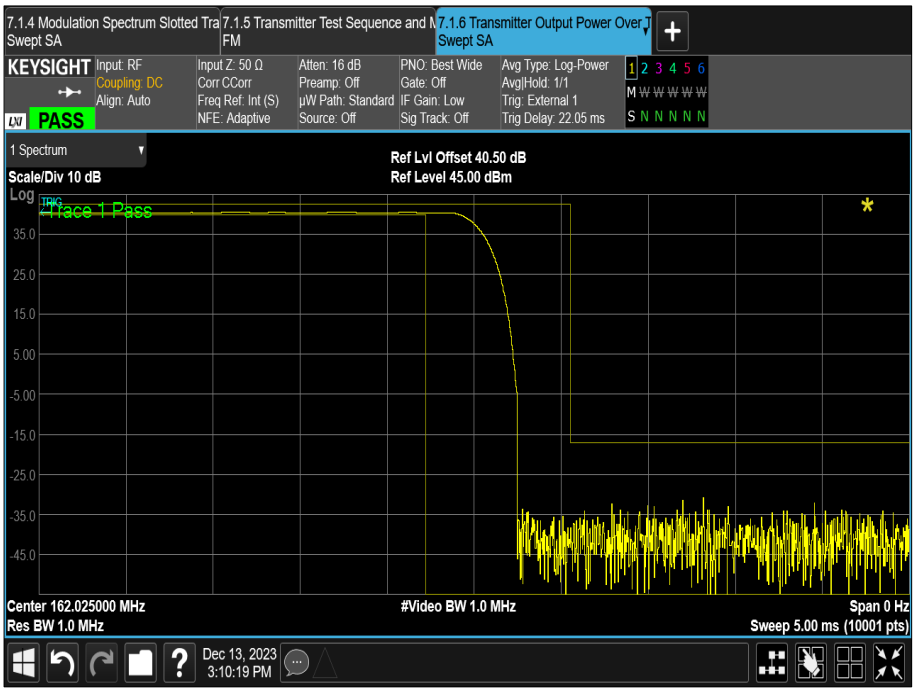

Figure 21 - 162.025 MHz - Ramp Down Zoomed

IEC 62320-2, Limit Clause 7.1.6.3

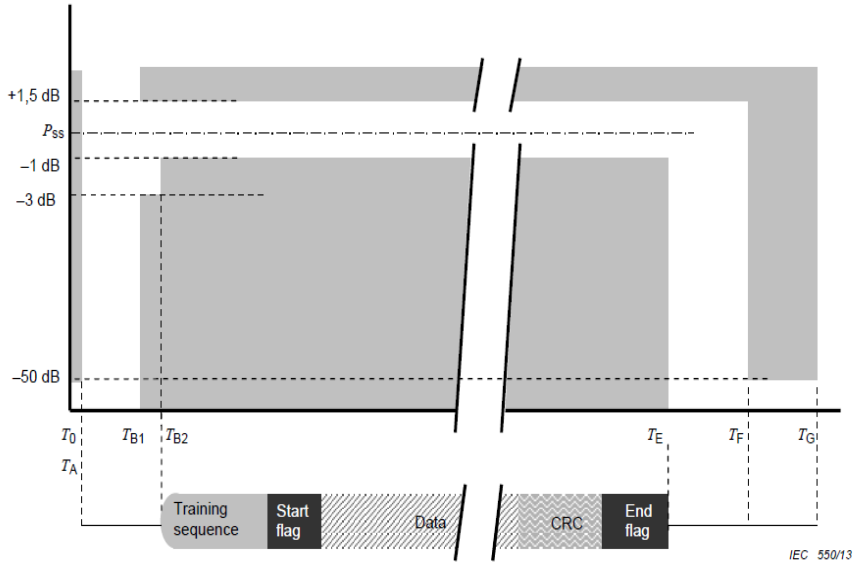

Figure 22 - Power Versus Time Mask

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 0.624	Power exceeds -50 dB of P_{SS}
T_B	T_{B1}	6	0.624	Power shall be within ±1.5 or -3 dB of P_{SS}
	T_{B2}	8	0.8324	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)		104-748	10,833 – 77,917	Power shall remain within +1.5 or -1 dB of P_{SS} during the period T_{BE} to T_E The T_E can vary depending on message type, data content and bit stuffing bits from minimum 104 bits for the shortest possible message (Message 14 and no text content) to maximum length of 740 bits for a three-slot message. T_E shall not exceed; • 236 bits for a one-slot message • 492 bits for a two-slot message • 748 bits for a three-slot message A station may occupy at maximum three consecutive slots for one continuous transmission. Only a single application of the overhead (ramp up, training sequence, flags, FCS, buffering) is required for a long transmission packet. The length of a long transmission packet should not be longer than necessary to transfer the data; i.e. the AIS should not add filler.
T_F (includes 1 stuffing bit)		112-756	11,667 – 78,787	Power shall be -50 dB of P_{SS} and stay below this
T_G		256, 512 or 768	26.667 one slot TX 53,333 two slot TX 80,000 three slot TX	Start of next transmission time period

Table 21 - Definitions of Timing for Power Versus Time Mask

2.3.7 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 Expires
Attenuator (20dB, 10W)	Aeroflex / Weinschel	23-20-34	3159	12	21-May-2024
Hygrometer	Rotronic	I-1000	3220	12	28-Nov-2024
Attenuator (20 dB, 150 W)	Narda	769-20	3367	12	02-Aug-2024
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	06-Mar-2024
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	06-Mar-2024
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	08-Feb-2024
Signal Analyzer	Keysight Technologies	PXA N9030B	5432	12	08-Jun-2024
Cable (K-Type to K-Type, 1 m)	Junkosha	MWX241-01000KMSKMS/A	5511	12	21-May-2024
Cable (SMA to SMA 1m)	Junkosha	MWX221-01000AMSAMS/A	5514	12	21-May-2024

Table 22

2.4 Blocking or Desensitisation

2.4.1 Specification Reference

IEC 62320-2, Clause 7.2.7

2.4.2 Equipment Under Test and Modification State

R60 AIS AtoN Station, S/N: 100098 - Modification State 0

2.4.3 Date of Test

20-December-2023

2.4.4 Test Method

This test was performed in accordance with IEC 62320-2, clause 7.2.7.2.

The EUT is a type 3 AtoN, therefore the level of the wanted signal at the input to the receiver was -101 dBm and the unwanted signals were set to -23 dBm when the offset was less than 5 MHz and -15 dBm when the offset was equal to or greater than 5 MHz.

2.4.5 Environmental Conditions

Ambient Temperature	19.2 °C
Relative Humidity	48.8 %

2.4.6 Test Results

AIS Transceiver

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	3	4.5
-2	0	0	0	0
-1	0	0	0	0
-0.5	0.5	0.5	0	0
0.5	0	0	0	0
1	0.5	0.5	0	0
2	0.5	0.5	0	0
5	0	0	0.5	0.5
10	0	0	0	0

Table 23 - Blocking Results

IEC 62320-2, Limit Clause 7.2.7.3

The PER shall not exceed 20%.

2.4.7 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
Power Splitter	Weinschel	1870A	3204	12	30-Nov-2024
Programmable Modulation Waveform Generator	Sine Qua Non	PMG1	3291	-	O/P Mon
Attenuator (20 dB, 150 W)	Narda	769-20	3367	12	02-Aug-2024
Vector Signal Generator	Rohde & Schwarz	SMU 200A	3493	12	02-Nov-2024
DC to TTL Converter	TUV SUD	-	3599	-	TU
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	08-Feb-2024
Vector Signal Generator	Keysight Technologies	ESG E4438C	4731	12	14-Feb-2024
Quad Power Supply	Rohde & Schwarz	HMP4040	4954	-	O/P Mon
Signal Analyzer	Keysight Technologies	PXA N9030B	5432	12	08-Jun-2024
Cable (K-Type to K-Type, 1 m)	Junkosha	MWX241-01000KMSKMS/A	5511	12	21-May-2024
Thermo-Hygro-Barometer	PCE Instruments	PCE-THB 40	5605	12	07-Nov-2024
Cable (N to N 2m)	Amphenol RF	N/A	5953	12	26-Jun-2024
Cable (N to N 1m)	Junkosha	MWX221-01000NMSNMS/B	6020	12	05-Jun-2024
Cable (N to N 6m)	Junkosha	MWX221-06000NMSNMS/B	6027	12	26-Jun-2024

Table 24

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

3 Photographs

3.1 Equipment Under Test (EUT)

Figure 23 – Front of EUT

Figure 24 – Top of EUT

Figure 25 – Rear of EUT

4 Measurement Uncertainty

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

Test Name	Measurement Uncertainty
Modulation Spectrum Slotted Transmission	± 2.0 dB
Transmitter Test Sequence and Modulation Accuracy	± 2.0 dB
Transmitter Output Power Versus Time Function (FATDMA and RATDMA)	± 2.0 dB
Blocking or Desensitisation	± 2.6 dB

Table 25

Measurement Uncertainty Decision Rule – Accuracy Method

Determination of conformity with the specification limits is based on the decision rule according to IEC Guide 115:2021, Clause 4.4.3 (Procedure 2). The measurement results are directly compared with the test limit to determine conformance with the requirements of the standard.

Risk: The uncertainty of measurement about the measured result is negligible with regard to the final pass/fail decision. The measurement result can be directly compared with the test limit to determine conformance with the requirement (compare IEC Guide 115). The level of risk to falsely accept and falsely reject items is further described in ILAC-G8.