Radio Test Report

Icom Inc F.L.O
AIS Class B, Model: MA-510TR

In accordance with IEC 62287-1

Prepared for: Icom Inc F.L.O
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ZI Champs Pinsons
Sain Orens de Gameville
31650
France

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Document 75947192-03 Issue 01

SIGNATURE			
NAME	**JOB TITLE**	**RESPONSIBLE FOR**	**ISSUE DATE**
Martin Hardy	Engineer	Authorised Signatory	02 April 2020

EXECUTIVE SUMMARY
A sample of this product was tested and found to be compliant with IEC 62287-1: Edition 3 (2017) 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	02 April 2020

Table 1

1.2 Introduction

Applicant	Icom Inc F.L.O
Manufacturer	Icom Inc F.L.O
Model Number(s)	MA-510TR
Serial Number(s)	00000034
Hardware Version(s)	1.000
Software Version(s)	1.000, 1.002, 1.003
Number of Samples Tested	1
Test Specification/Issue/Date	IEC 62287-1: Edition 3 (2017)
Order Number Date	Signed QAF 03-October-2019
Date of Receipt of EUT	26-November-2019
Start of Test	08-January-2020
Finish of Test	20-February-2020
Name of Engineer(s)	George Porter
Related Document(s)	IEC 60945: 2002

1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with IEC 62287-1 is shown below.

Section	Specification Clause	Test Description	Result	Comments/Base Standard
Configuration and Mode: DC Powered - AIS Transceiver				
2.1	11.1.1	Frequency Error	Pass	
2.2	11.1.2	Carrier Power	Pass	
2.3	11.1.3	Transmission Spectrum	Pass	
2.4	11.1.4	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	Spurious Emissions from the Receiver	Pass	
2.14	11.3.2	Spurious Emissions from the Transmitter	Pass	

Table 2

1.4 Application Form

EQUIPMENT DESCRIPTION	
Model Name/Number	MA-510TR
Part Number	
Hardware Version	1.000
Software Version	1.000, 1.002, 1.003
Technical Description (Please provide a brief description of the intended use of the equipment)	Class B AIS Transponder CSTDMA

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	to	MHz

TRANSMITTER RF POWER CHARACTERISTICS		
Maximum rated transmitter output power as stated by manufacturer (if applicable)		
2	W	At transmitter permanent external 50 Ω RF output connector
and/or		
	W	Effective radiated power (for equipment with integral antenna)
Minimum rated transmitter output power as stated by manufacturer (if applicable)		
2	W	At transmitter permanent external 50 Ω RF output connector
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	0.1	Seconds	Transmitter OFF	30	Seconds

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

RECEIVER TECHNICAL CHARACTERISTICS	
FREQUENCY CHARACTERISTICS	
Receiver frequency alignment range	161.500 MHz to 162.025 MHz
Receiver channel switching frequency range	161.500 MHz to 162.025 MHz
Channel Separation (if applicable)	25 kHz
State the maximum number of channels over which the equipment can operate:	22

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	12/24 V	Max Current 1.5 A
	Extreme upper voltage	31.2 V	
	Extreme lower voltage	9.6 V	
Battery			
☐	Nickel Cadmium		☐ Lead acid (Vehicle regulated)
☐	Alkaline		☐ Leclanche
☐	Lithium		☐ Other Details :
	Volts nominal.		
End point voltage as quoted by equipment manufacturer			V

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

CHANNEL IDENTIFICATION

Each equipment, whether one or more submitted for tests shall carry clear identification (such as a serial number), together with the frequencies associated with the channel identification displayed on the equipment.

Equipment Identification eg Serial Number	Channel No.	Transmit Nominal Freq MHz	Receive Nominal Freq MHz
DSC	70	N/A	156.525 MHz

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

Name: Akira Yamashita Position held: General Manager
Date: 09 October 2019

1.5 Product Information

1.5.1 Technical Description

Class B AIS Transponder. CSTDMA.

1.6 Deviations from the Standard

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

1.7 EUT Modification Record

The table below details modifications made to the EUT during the test programme.

The modifications incorporated during each test are recorded on the appropriate test pages.

Modification State	Description of Modification still fitted to EUT	Modification Fitted By	Date Modification Fitted
Model: MA-510TR, Serial Number: 00000034			
0	As supplied by the customer	Not Applicable	Not Applicable
1	Updated to Ver 1.002. Corrections to messages 22, 23 and 24B. New method for SART, MOB and EPIRB identification. Additional language options.	George Porter	10-January-2020
2	Updated to Ver 1.003. Fixed to reduce time between resetting the internal GPS engine and sending an initialisation command. Fixed the NMEA 2000 PGN 129029 output to consider leap years.	George Porter	04-February-2020

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 Transceiver		
Frequency Error	George Porter	UKAS
Carrier Power	George Porter	UKAS
Transmission Spectrum	George Porter	UKAS
Modulation Accuracy	George Porter	UKAS
Transmitter Output Power Versus Time Function	George Porter	UKAS
Sensitivity	George Porter	UKAS
Error Behaviour at High Input Levels	George Porter	UKAS
Co-channel Rejection	George Porter	UKAS
Adjacent Channel Selectivity	George Porter	UKAS
Spurious Response Rejection	George Porter	UKAS
Intermodulation Response Rejection	George Porter	UKAS
Blocking or Desensitisation	George Porter	UKAS
Spurious Emissions from the Receiver	George Porter	UKAS
Spurious Emissions from the Transmitter	George Porter	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 62287-1, Clause 11.1.1

2.1.2 Equipment Under Test and Modification State

MA-510TR, S/N: 00000034 - Modification State 0 (ambient conditions)
MA-510TR, S/N: 00000034 - Modification State 2 (extreme conditions)

2.1.3 Date of Test

08-January-2020 to 19-February-2020

2.1.4 Test Method

This test was performed in accordance with IEC 62287-1, clause 11.1.1.2.

2.1.5 Environmental Conditions

Ambient Temperature	23.2 - 25.7 °C
Relative Humidity	25.4 - 50.4 %

2.1.6 Test Results

DC Powered - AIS Transceiver

Temperature	Voltage	Error (Hz) - 161.500 MHz		Error (Hz) - 162.025 MHz	
		Tx1	Tx2	Tx1	Tx2
+23.2 °C	12.0 V DC	103.098	102.481	10.015	-17.840
-15.0 °C	9.6 V DC	111.600	124.000	-74.400	-62.000
+55.0 °C	31.2 V DC	37.200	-74.400	-124.000	-161.200

Table 5 - Frequency Error Results

IEC 62287-1, Limit Clause 11.1.1.3

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

2.1.7 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 Due
Dual Power Supply Unit	Hewlett Packard	6253A	271	-	O/P Mon
50ohm Load (50W)	Weinschel	M1426	361	12	15-Nov-2020
Attenuator (10dB/100W)	Bird	8343-100	495	12	18-Nov-2020
Power Divider	Weinschel	1506A	604	12	23-Apr-2020
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	16-Apr-2020
Hygromer	Rotronic	Hygropalm	2404	12	02-May-2020
Multimeter	Iso-tech	IDM101	2419	12	28-Nov-2020
Thermocouple Thermometer	Fluke	51	3172	12	02-Jan-2021
Hygrometer	Rotronic	I-1000	3220	12	25-Sep-2020
Attenuator (30dB, 150W)	Narda	769-30	3369	12	17-Jul-2020
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	16-Apr-2020
Digital Multi-meter	Iso-tech	IDM93N	4435	12	07-Oct-2020
2 metre N-Type Cable	Florida Labs	NMS-235SP-78.8-NMS	4622	12	12-Jul-2020
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	06-Feb-2020*
Vector Signal Generator	Keysight Technologies	ESG E4438C	4731	12	19-Sep-2020
EXA	Keysight Technologies	N9010B	4968	24	23-Dec-2021
Cable (40 GHz)	Rosenberger	LU1-001-500	5021	12	11-Jun-2020
Cable (18 GHz)	Rosenberger	LU7-036-1000	5032	-	O/P Mon

Table 6

O/P Mon – Output Monitored using calibrated equipment

*Note: Testing was performed over multiple test dates therefore it may appear that this item was out of calibration at the time of use however, TUV SUD can confirm that when this item was used it had a valid calibration and holds records of this.

2.2 Carrier Power

2.2.1 Specification Reference

IEC 62287-1, Clause 11.1.2

2.2.2 Equipment Under Test and Modification State

MA-510TR, S/N: 00000034 - Modification State 0 (ambient conditions)
MA-510TR, S/N: 00000034 - Modification State 2 (extreme conditions)

2.2.3 Date of Test

09-January-2020 to 19-February-2020

2.2.4 Test Method

This test was performed in accordance with IEC 62287-1, clause 11.1.2.2.

2.2.5 Environmental Conditions

Ambient Temperature 22.6 - 26.3 °C
Relative Humidity 25.8 - 46.0 %

2.2.6 Test Results

DC Powered - AIS Transceiver

Temperature	Voltage	Power (dBm) - 161.500 MHz		Power (dBm) - 162.025 MHz	
		Tx1	Tx2	Tx1	Tx2
+22.6 °C	12.0 V DC	33.191	33.163	33.100	33.039
-15.0 °C	9.6 V DC	33.494	33.462	33.452	33.407
+55.0 °C	31.2 V DC	32.918	32.901	32.919	32.823

Table 7 - Carrier Power Results

IEC 62287-1, Limit Clause 11.1.2.3

At all test frequencies, the carrier power shall be 33 dBm ± 1.5 dBm under normal test conditions.
At all test frequencies, the carrier power shall be 33 dBm ± 3.0 dBm under extreme test conditions.

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 Due
Dual Power Supply Unit	Hewlett Packard	6253A	271	-	O/P Mon
50ohm Load (50W)	Weinschel	M1426	361	12	15-Nov-2020
Attenuator (10dB/100W)	Bird	8343-100	495	12	18-Nov-2020
Power Divider	Weinschel	1506A	604	12	23-Apr-2020
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	16-Apr-2020
Hygromer	Rotronic	Hygropalm	2404	12	02-May-2020
Multimeter	Iso-tech	IDM101	2419	12	28-Nov-2020
Thermocouple Thermometer	Fluke	51	3172	12	02-Jan-2021
Hygrometer	Rotronic	I-1000	3220	12	25-Sep-2020
Attenuator (30dB, 150W)	Narda	769-30	3369	12	17-Jul-2020
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	16-Apr-2020
Digital Multi-meter	Iso-tech	IDM93N	4435	12	07-Oct-2020
2 metre N-Type Cable	Florida Labs	NMS-235SP-78.8-NMS	4622	12	12-Jul-2020
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	06-Feb-2020*
EXA	Keysight Technologies	N9010B	4968	24	23-Dec-2021
Cable (40 GHz)	Rosenberger	LU1-001-500	5021	12	11-Jun-2020
Cable (18 GHz)	Rosenberger	LU7-036-1000	5032	-	O/P Mon

Table 8

O/P Mon – Output Monitored using calibrated equipment

*Note: Testing was performed over multiple test dates therefore it may appear that this item was out of calibration at the time of use however, TUV SUD can confirm that when this item was used it had a valid calibration and holds records of this.

2.3 Transmission Spectrum

2.3.1 Specification Reference

IEC 62287-1, Clause 11.1.3

2.3.2 Equipment Under Test and Modification State

MA-510TR, S/N: 00000034 - Modification State 0

2.3.3 Date of Test

09-January-2020

2.3.4 Test Method

This test was performed in accordance with IEC 62287-1, clause 11.1.3.2.

2.3.5 Environmental Conditions

Ambient Temperature	22.9 °C
Relative Humidity	50.9 %

2.3.6 Test Results

<u>DC Powered - AIS Transceiver</u>

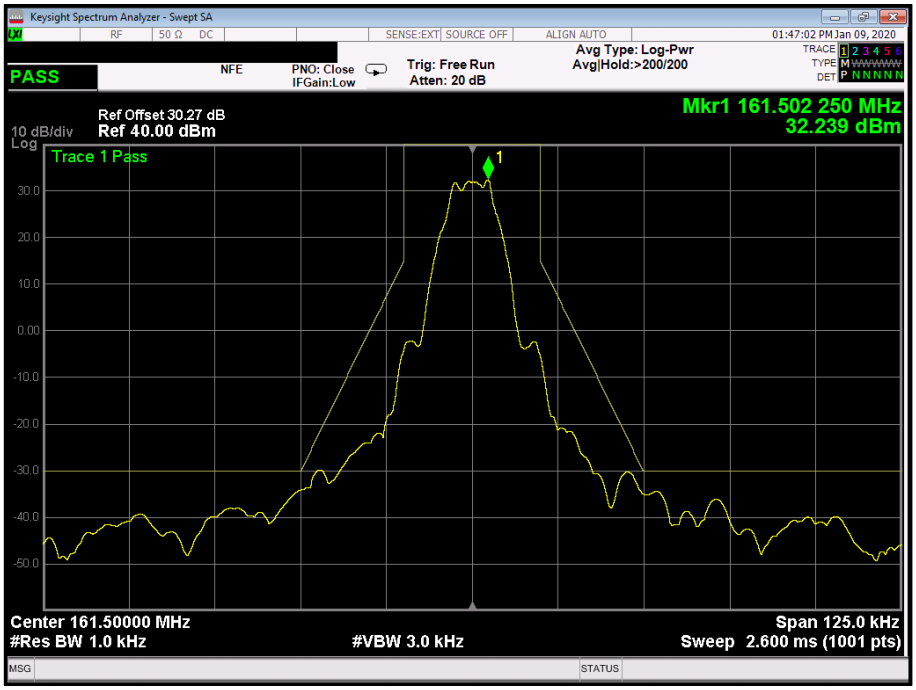

Figure 1 - 161.500 MHz - Tx1

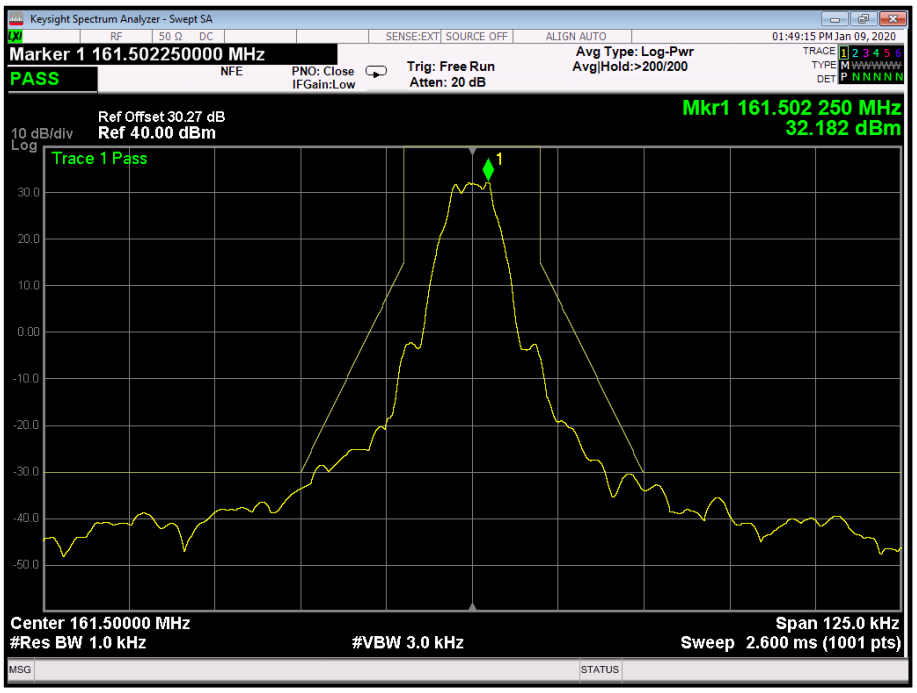

Figure 2 - 161.500 MHz – Tx2

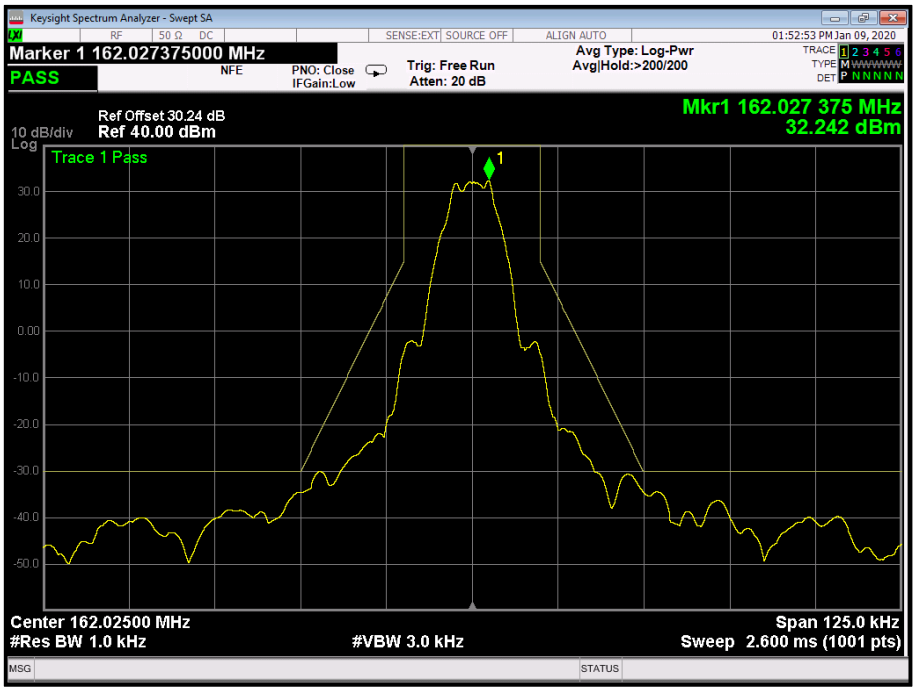

Figure 3 - 162.025 MHz - Tx1

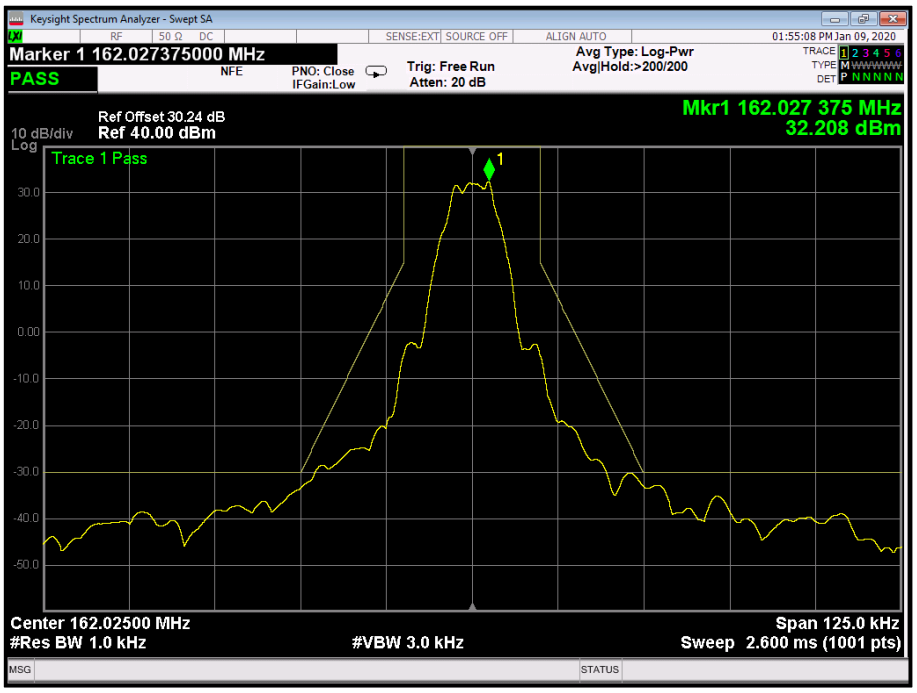

Figure 4 - 162.025 MHz – Tx2

<u>IEC 62287-1, Limit Clause 11.1.3.3</u>

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 dBW;

• at ± 25 kHz to ± 62.5 kHz removed from the carrier, the modulation and transient sidebands shall be below the lower value of -60 dBW;

• 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.

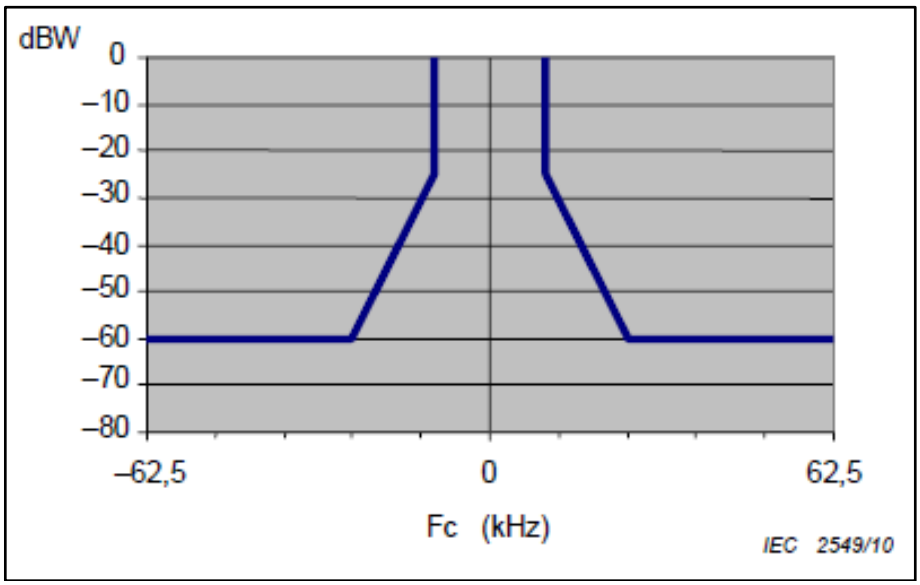

Figure 5 - Transmission Spectrum Mask Limit

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 Due
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	16-Apr-2020
Hygromer	Rotronic	Hygropalm	2404	12	02-May-2020
Attenuator (30dB, 150W)	Narda	769-30	3369	12	17-Jul-2020
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	16-Apr-2020
Digital Multi-meter	Iso-tech	IDM93N	4435	12	07-Oct-2020
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	06-Feb-2020
Cable (18 GHz)	Rosenberger	LU7-036-1000	5032	-	O/P Mon

Table 9

O/P Mon – Output Monitored using calibrated equipment

2.4 Modulation Accuracy

2.4.1 Specification Reference

IEC 62287-1, Clause 11.1.4

2.4.2 Equipment Under Test and Modification State

MA-510TR, S/N: 00000034 - Modification State 0 (ambient conditions)
MA-510TR, S/N: 00000034 - Modification State 2 (extreme conditions)

2.4.3 Date of Test

10-January-2020 to 19-February-2020

2.4.4 Test Method

This test was performed in accordance with IEC 62287-1, clause 11.1.4.2.

2.4.5 Environmental Conditions

Ambient Temperature	22.5 - 26.5 °C
Relative Humidity	24.5 - 58.7 %

2.4.6 Test Results

<u>DC Powered - AIS Transceiver</u>

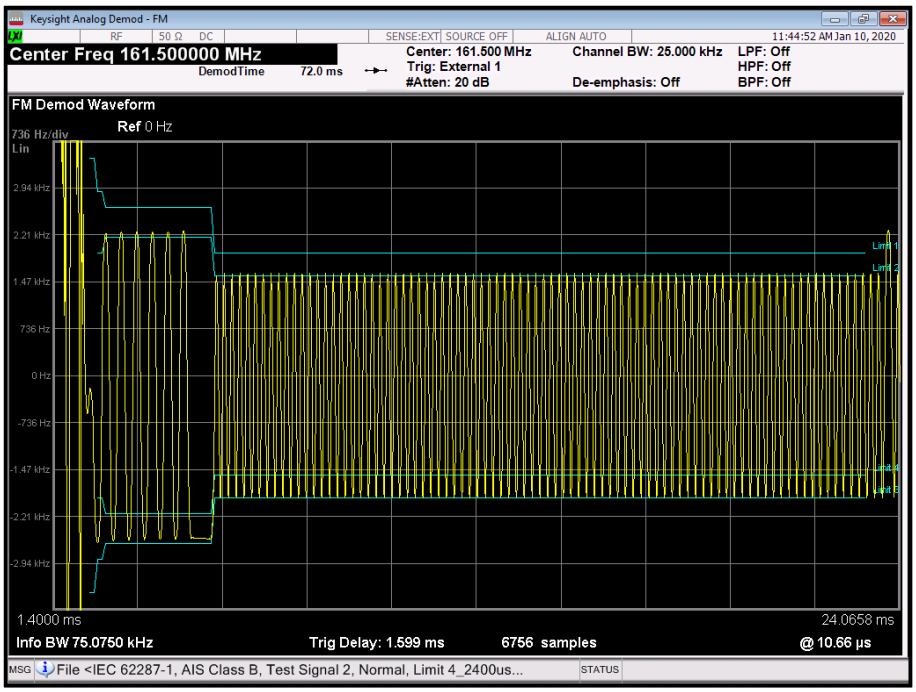

Figure 6 - 161.500 MHz, Test Signal #2, Tx1, +22.9 °C, 12.0 V DC

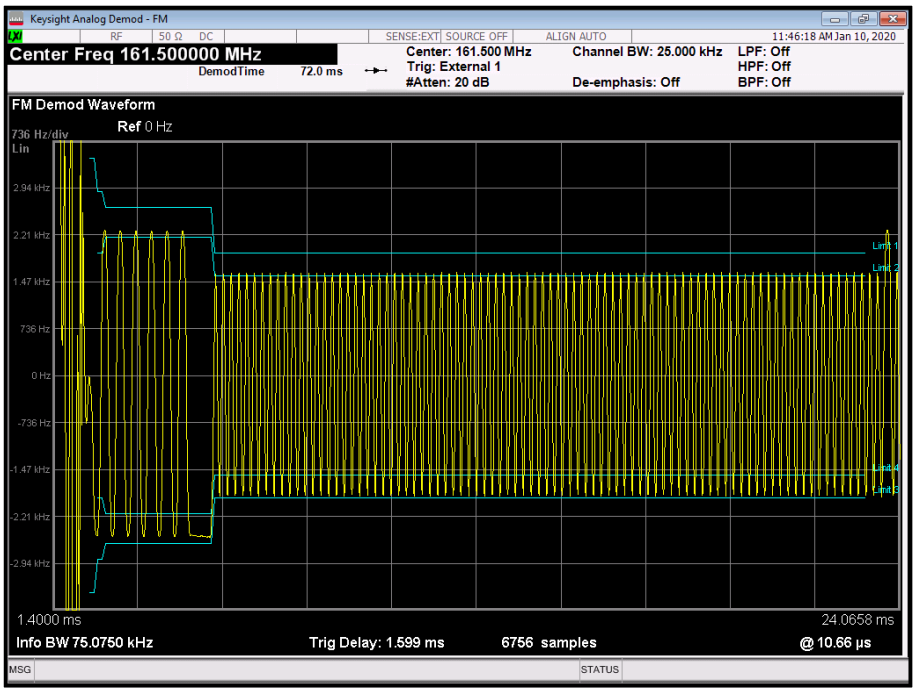

Figure 7 - 161.500 MHz, Test Signal #2, Tx2, +22.9 °C, 12.0 V DC

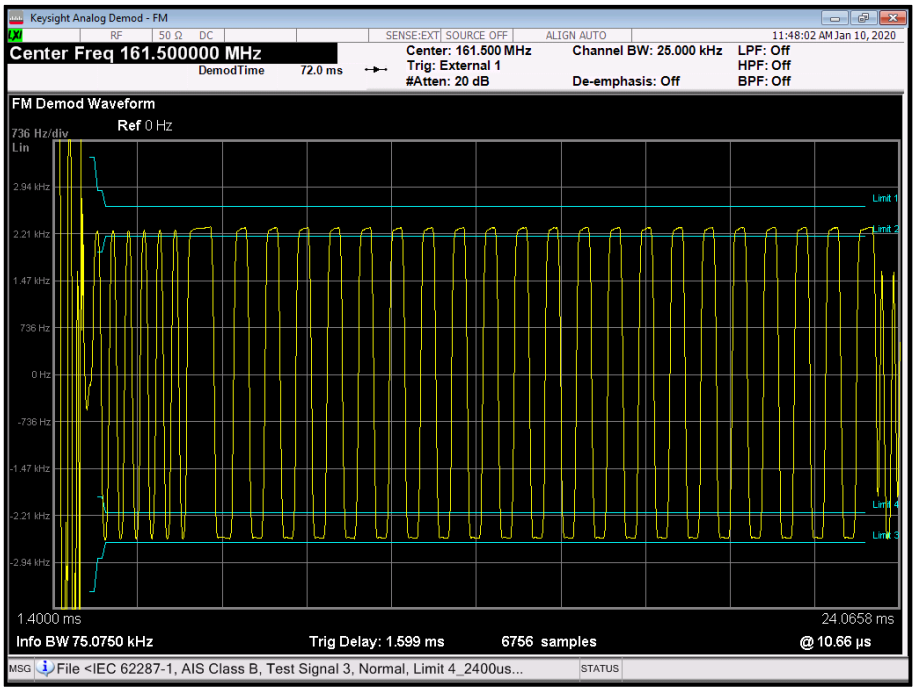

Figure 8 - 161.500 MHz, Test Signal #3, Tx1, +22.9 °C, 12.0 V DC

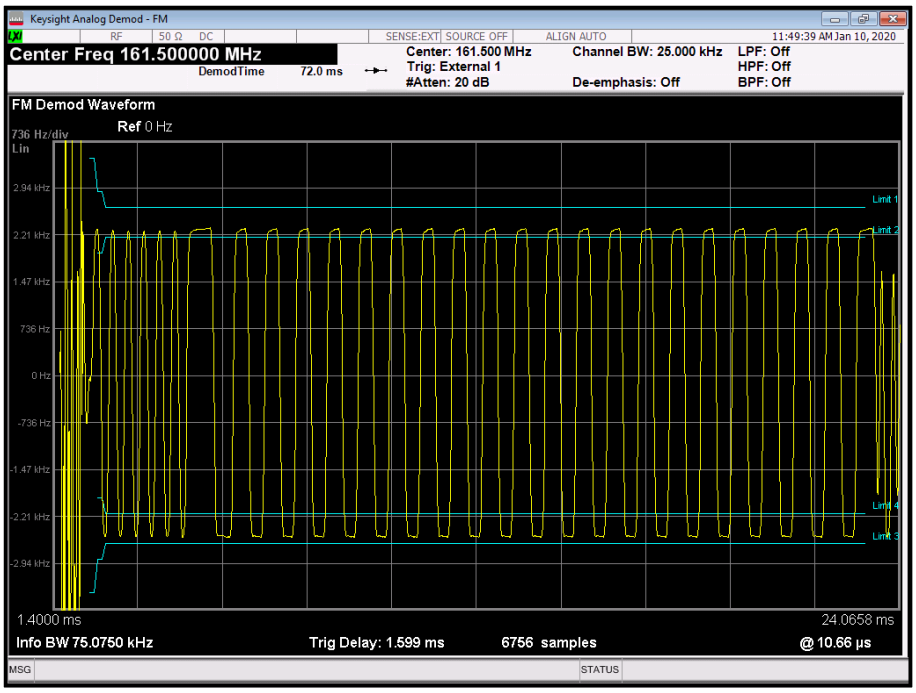

Figure 9 - 161.500 MHz, Test Signal #3, Tx2, +22.9 °C, 12.0 V DC

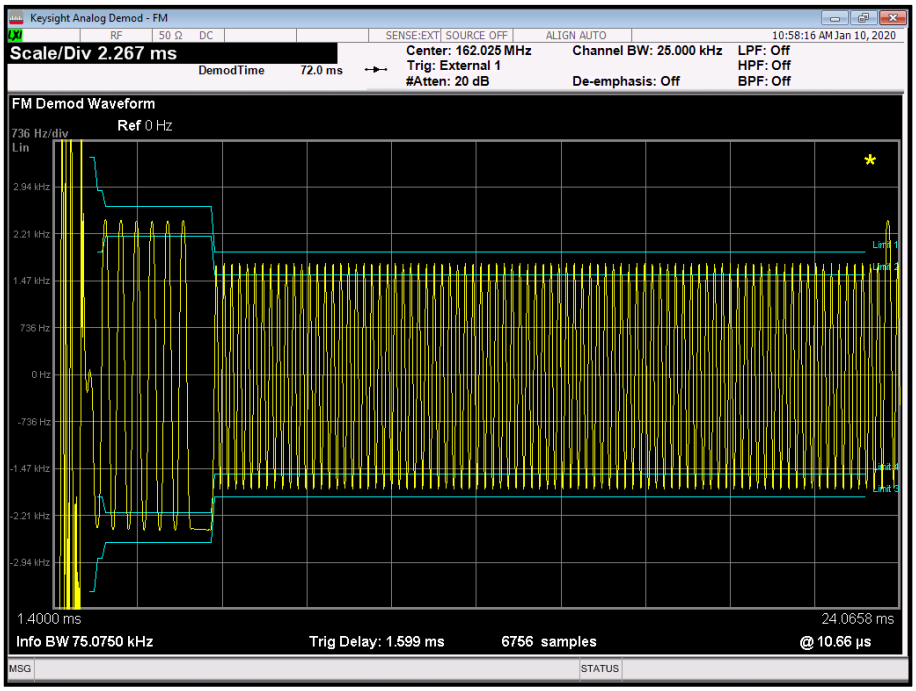

Figure 10 - 162.025 MHz, Test Signal #2, Tx1, +22.9 °C, 12.0 V DC

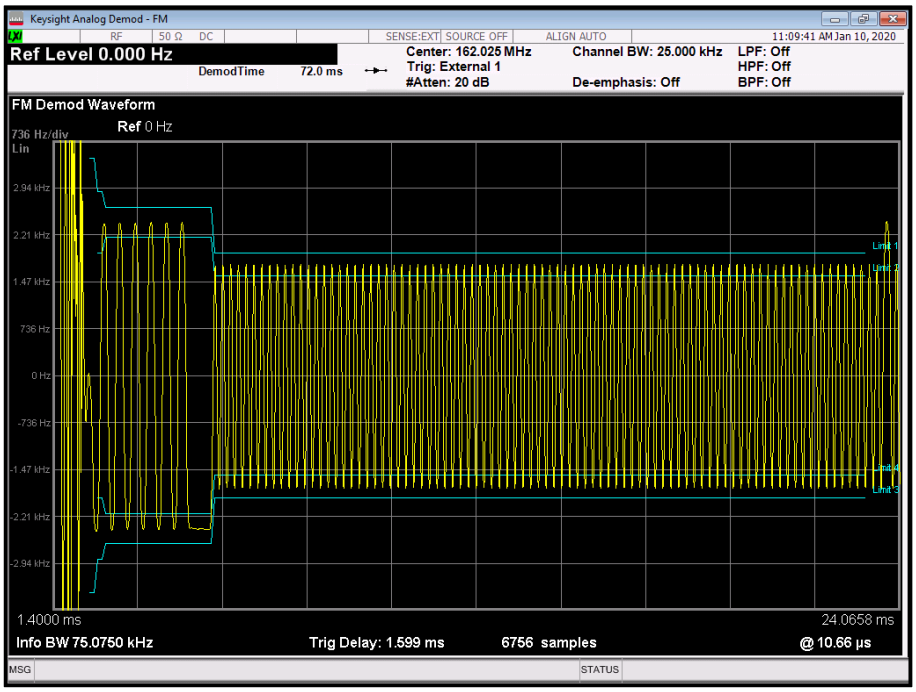

Figure 11 - 162.025 MHz, Test Signal #2, Tx2, +22.9 °C, 12.0 V DC

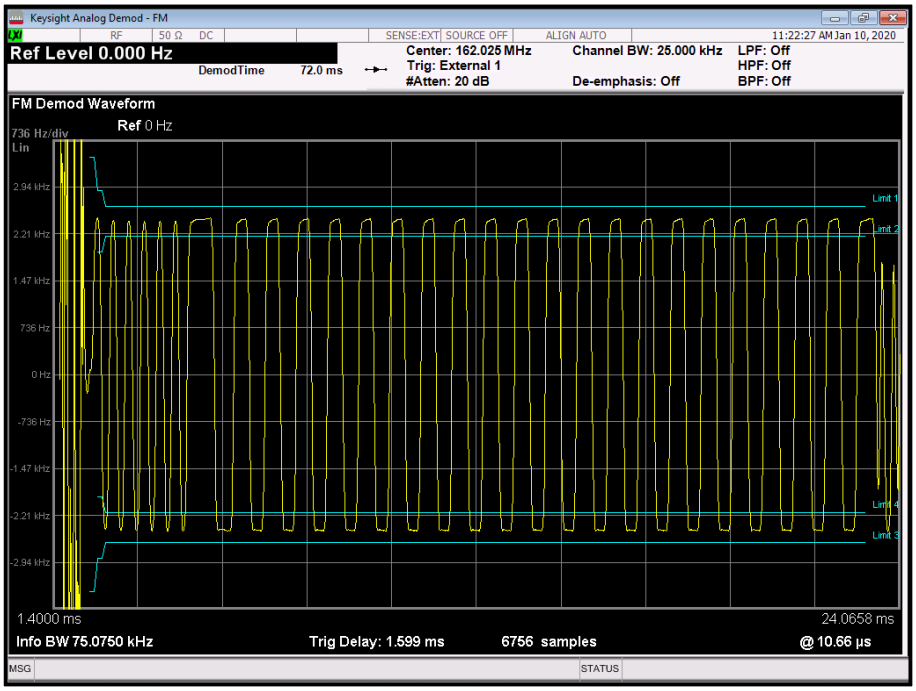

Figure 12 - 162.025 MHz, Test Signal #3, Tx1, +22.9 °C, 12.0 V DC

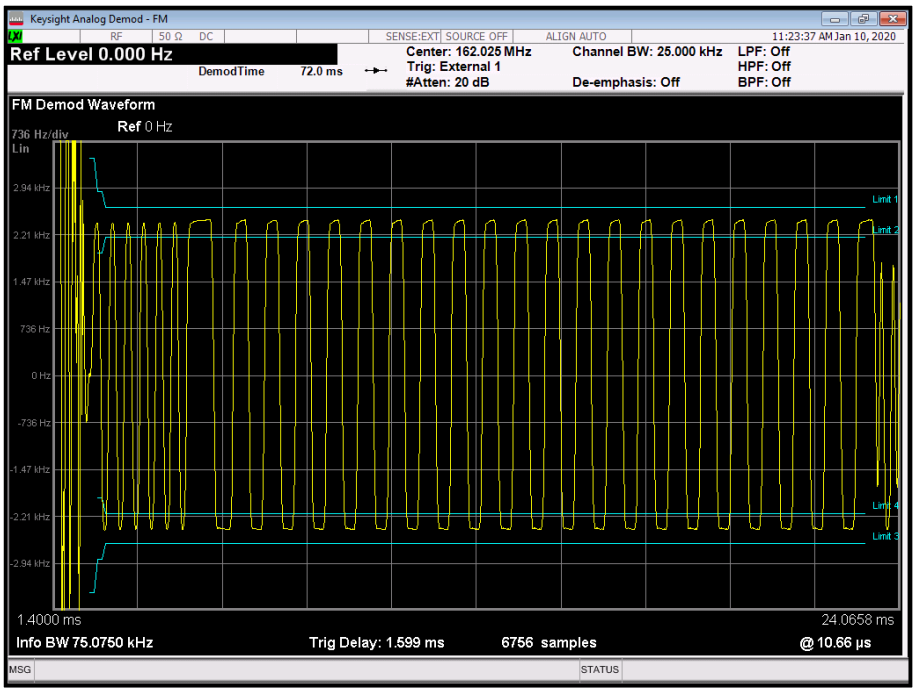

Figure 13 - 162.025 MHz, Test Signal #3, Tx2, +22.9 °C, 12.0 V DC

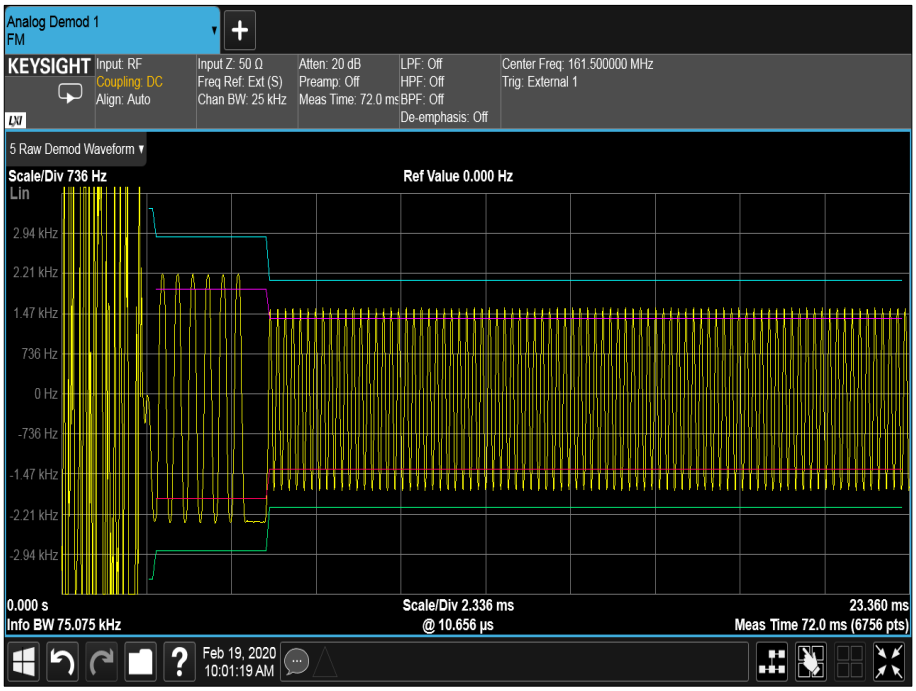

Figure 14 - 161.500 MHz, Test Signal #2, Tx1, -15.0 °C, 9.6 V DC

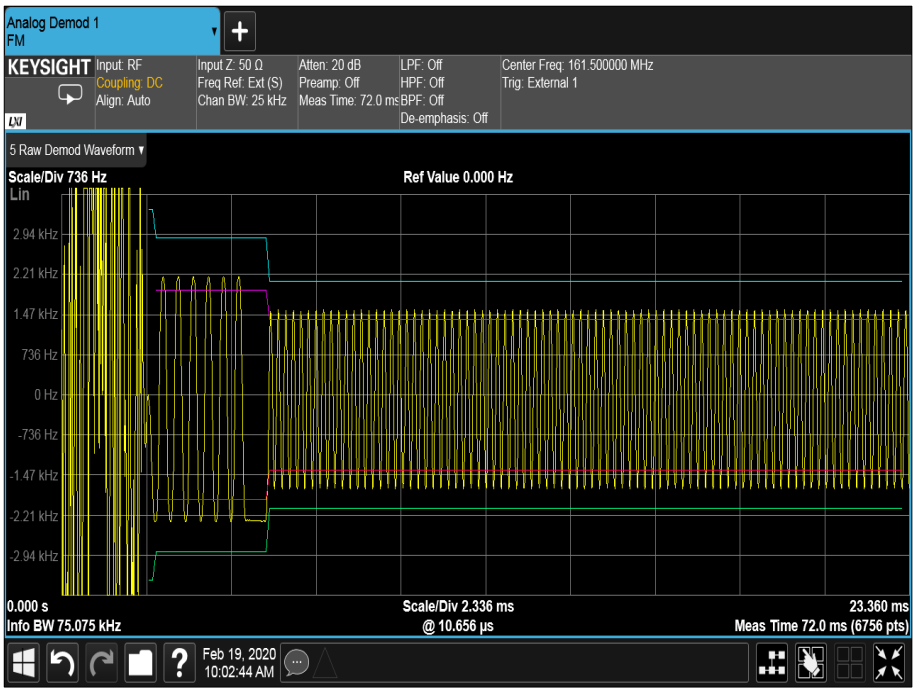

Figure 15 - 161.500 MHz, Test Signal #2, Tx2, -15.0 °C, 9.6 V DC

Figure 16 - 161.500 MHz, Test Signal #3, Tx1, -15.0 °C, 9.6 V DC

Figure 17 - 161.500 MHz, Test Signal #3, Tx2, -15.0 °C, 9.6 V DC

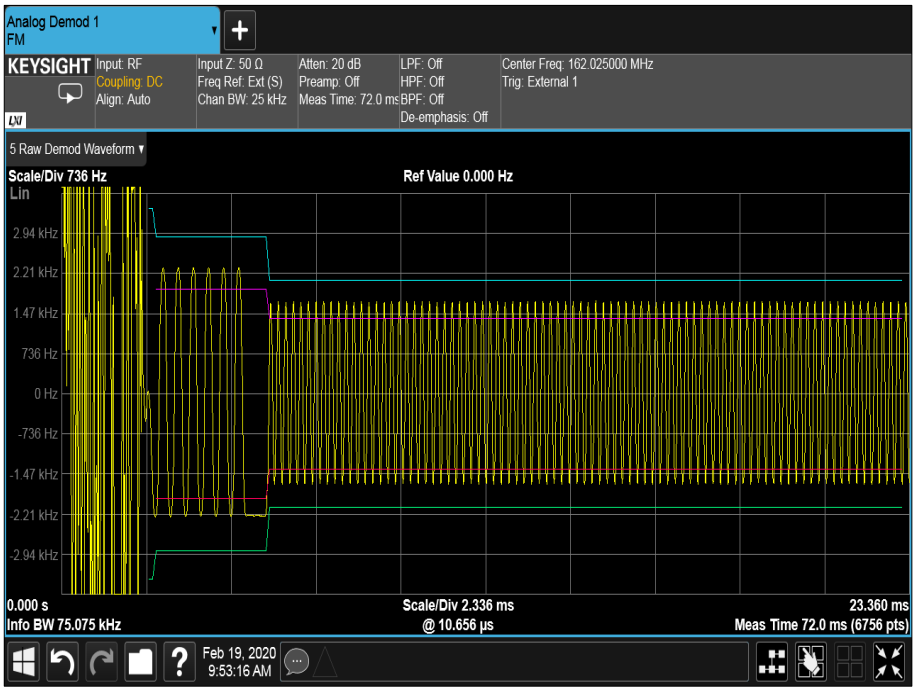

Figure 18 - 162.025 MHz, Test Signal #2, Tx1, -15.0 °C, 9.6 V DC

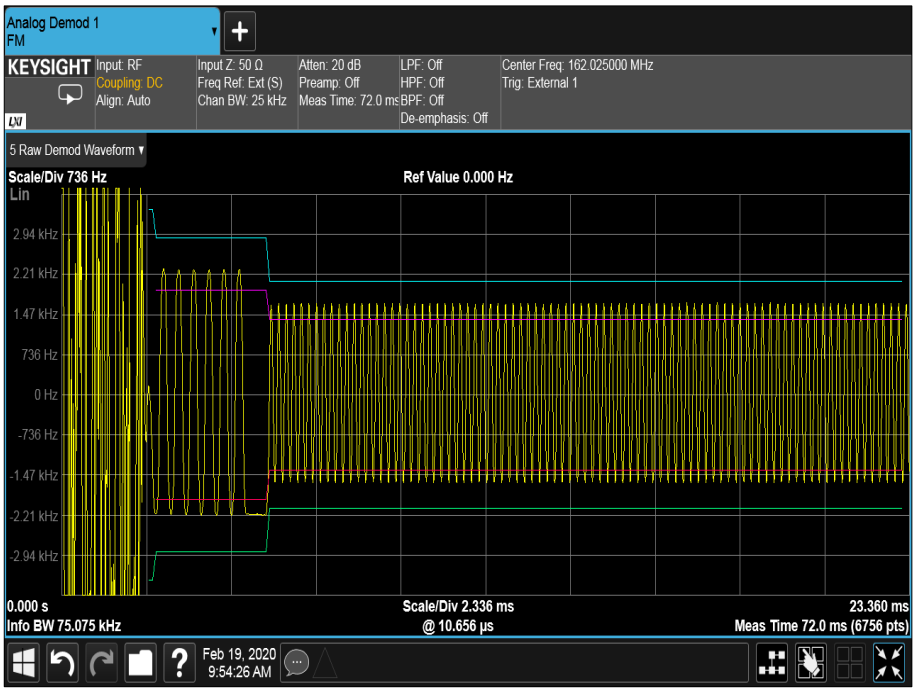

Figure 19 - 162.025 MHz, Test Signal #2, Tx2, -15.0 °C, 9.6 V DC

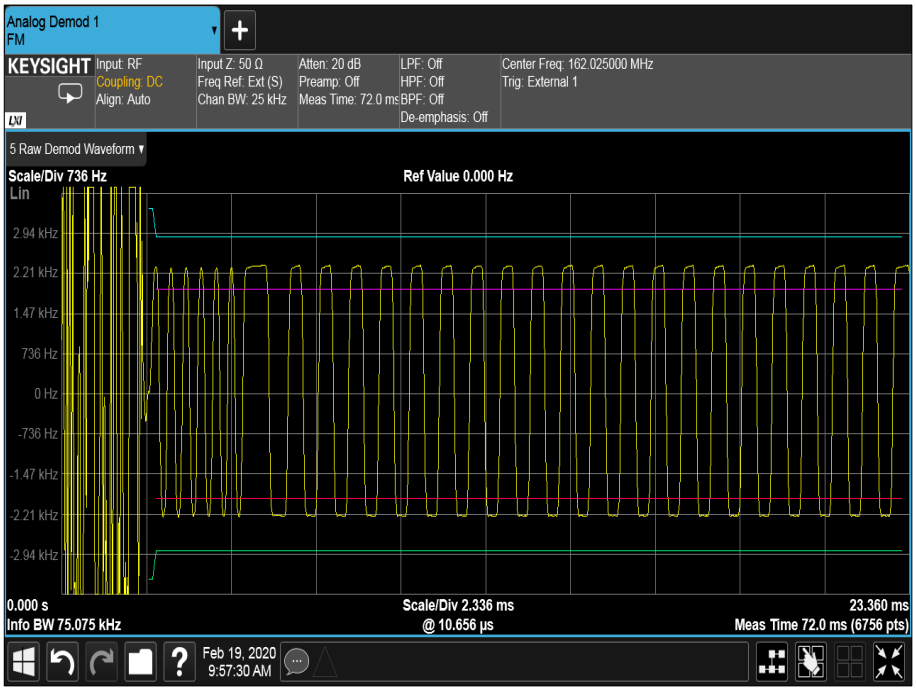

Figure 20 - 162.025 MHz, Test Signal #3, Tx1, -15.0 °C, 9.6 V DC

Figure 21 - 162.025 MHz, Test Signal #3, Tx2, -15.0 °C, 9.6 V DC

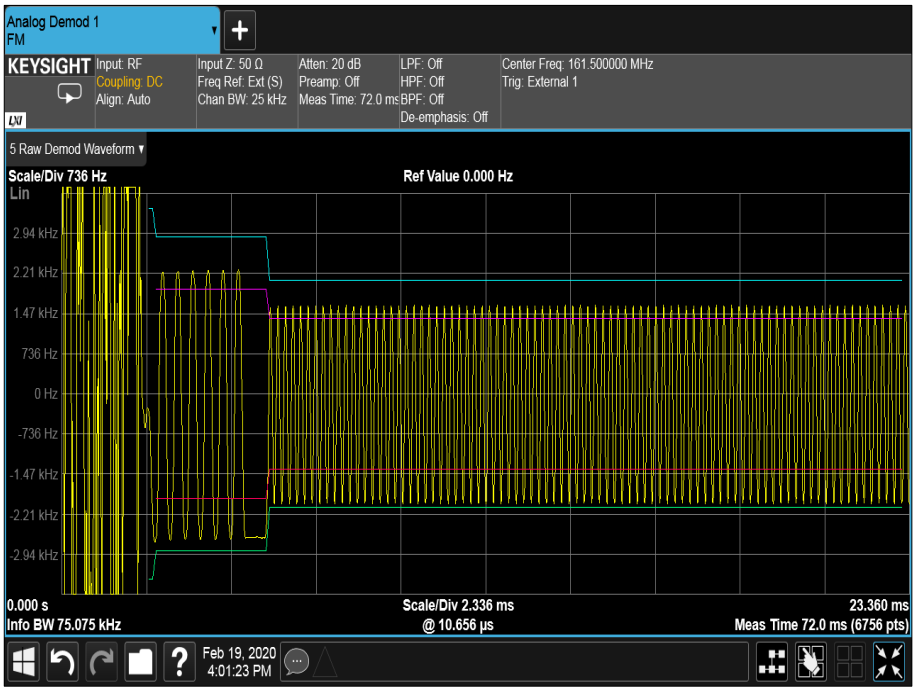

Figure 22 - 161.500 MHz, Test Signal #2, Tx1, +55.0 °C, 31.2 V DC

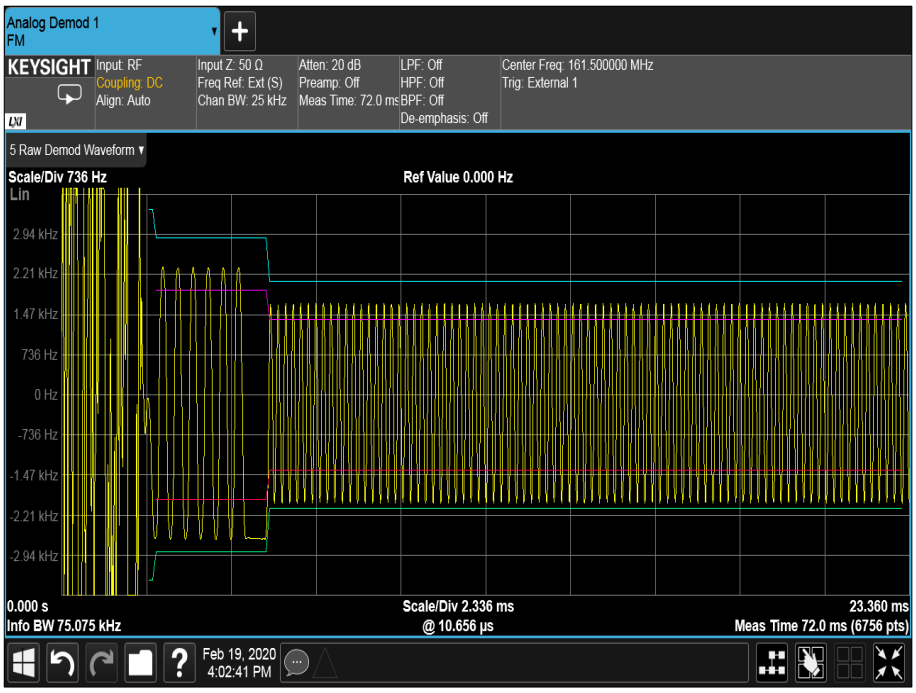

Figure 23 - 161.500 MHz, Test Signal #2, Tx2, +55.0 °C, 31.2 V DC

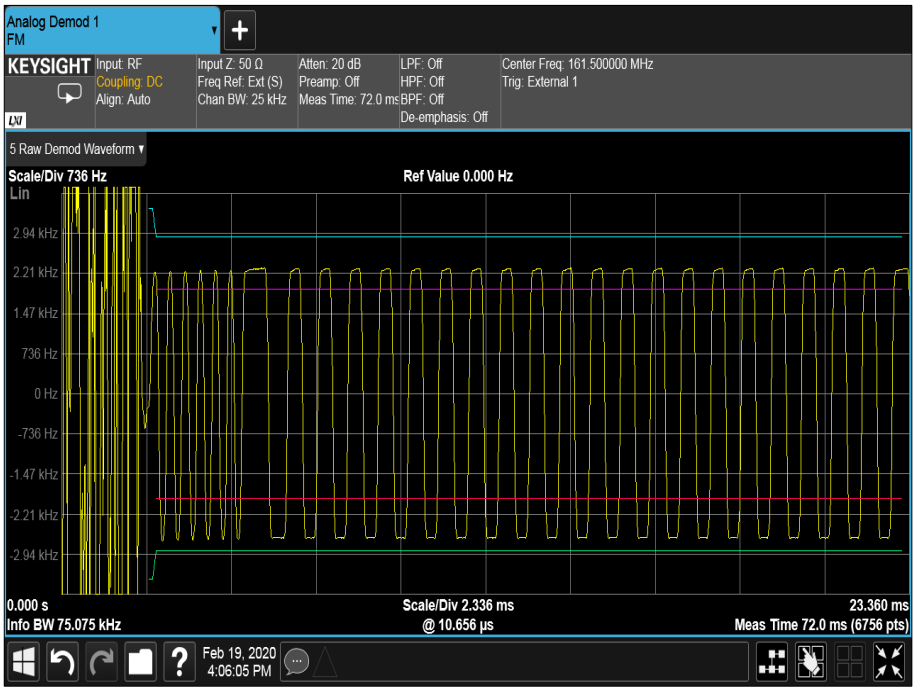

Figure 24 - 161.500 MHz, Test Signal #3, Tx1, +55.0 °C, 31.2 V DC

Figure 25 - 161.500 MHz, Test Signal #3, Tx2, +55.0 °C, 31.2 V DC

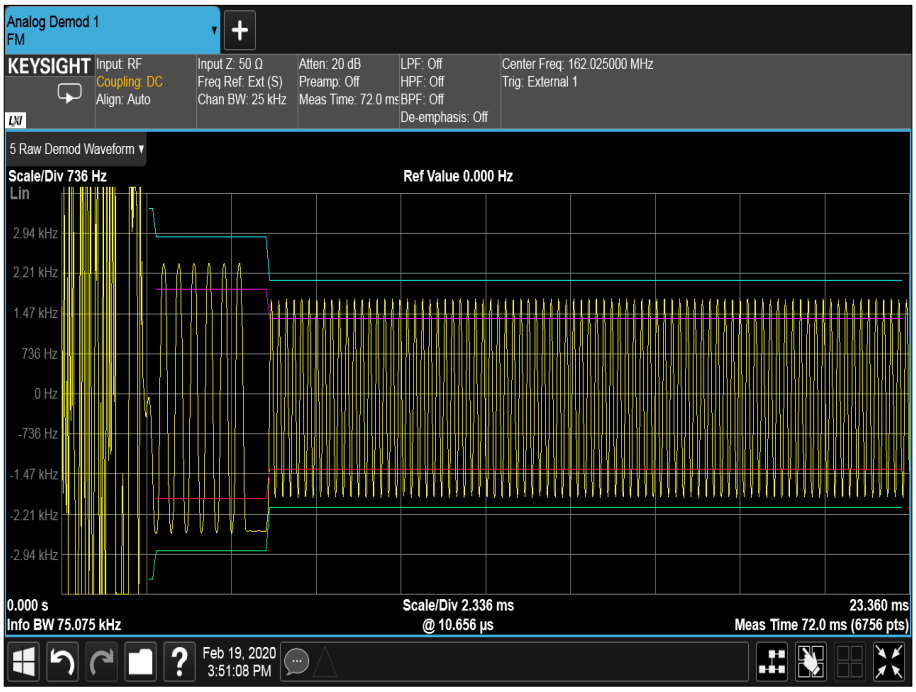

Figure 26 - 162.025 MHz, Test Signal #2, Tx1, +55.0 °C, 31.2 V DC

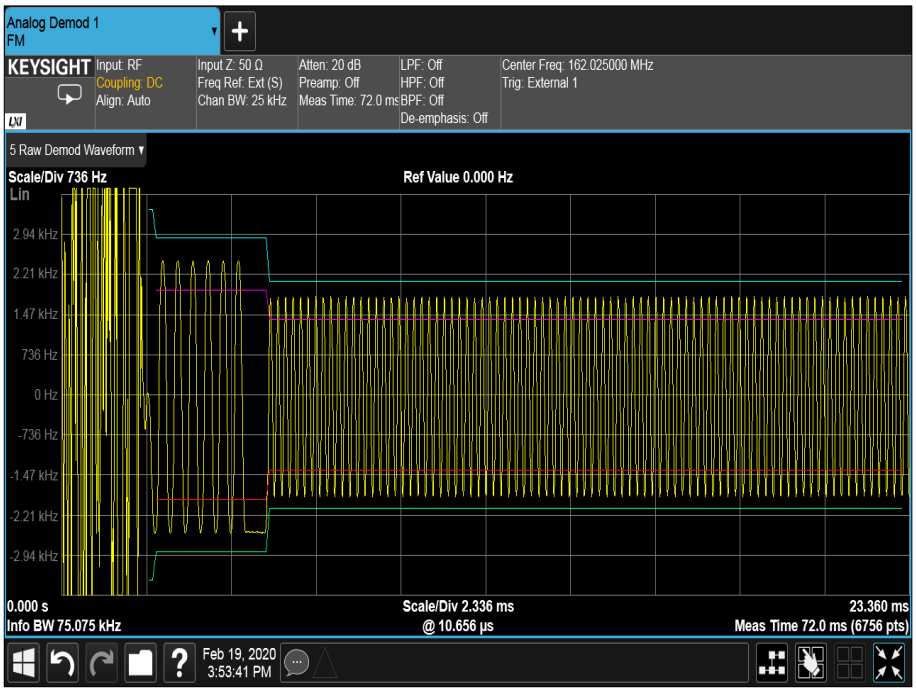

Figure 27 - 162.025 MHz, Test Signal #2, Tx2, +55.0 °C, 31.2 V DC

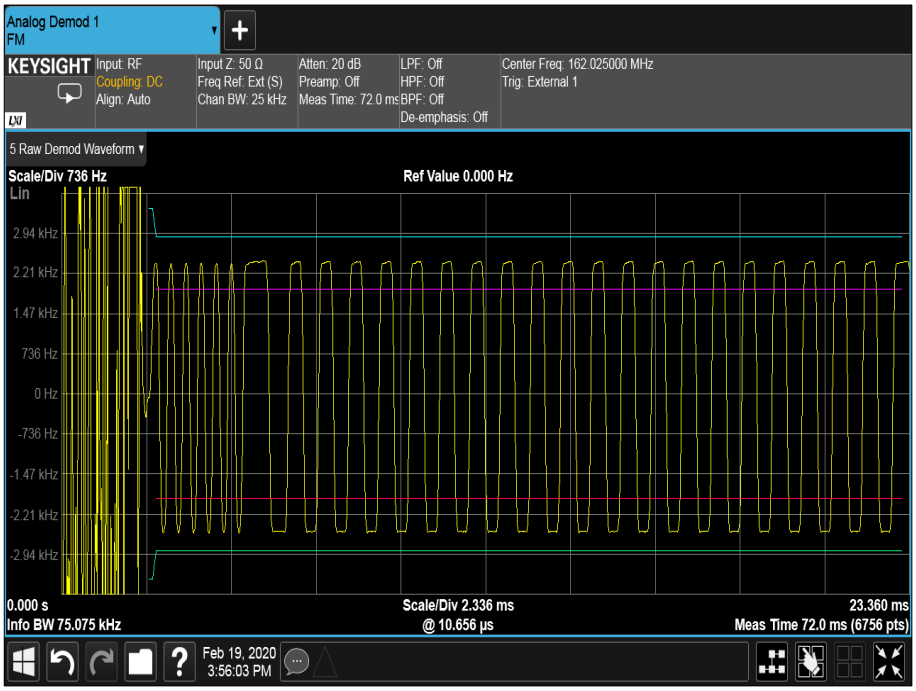

Figure 28 - 162.025 MHz, Test Signal #3, Tx1, +55.0 °C, 31.2 V DC

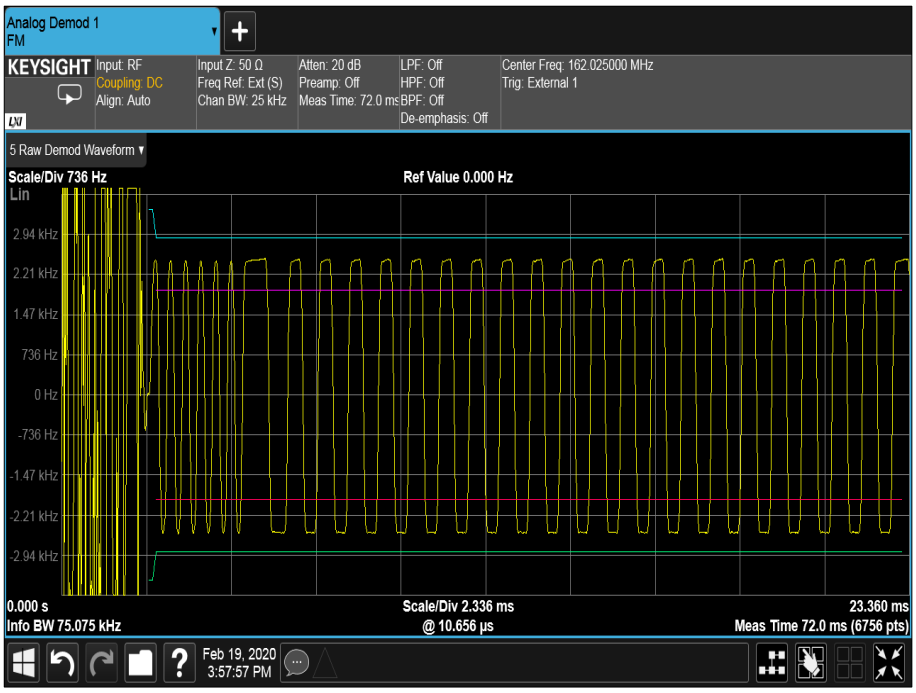

Figure 29 - 162.025 MHz, Test Signal #3, Tx2, +55.0 °C, 31.2 V DC

IEC 62287-1, Limit Clause 11.1.4.3

Measurement Period from Centre to Centre of each Bit	Test Signal 2		Test Signal 3	
	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 10 - Peak Frequency Deviation versus Time Limit

2.4.7 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 Due
Dual Power Supply Unit	Hewlett Packard	6253A	271	-	O/P Mon
50ohm Load (50W)	Weinschel	M1426	361	12	15-Nov-2020
Attenuator (10dB/100W)	Bird	8343-100	495	12	18-Nov-2020
Power Divider	Weinschel	1506A	604	12	23-Apr-2020
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	16-Apr-2020
Hygromer	Rotronic	Hygropalm	2404	12	02-May-2020
Multimeter	Iso-tech	IDM101	2419	12	28-Nov-2020
Thermocouple Thermometer	Fluke	51	3172	12	02-Jan-2021
Hygrometer	Rotronic	I-1000	3220	12	25-Sep-2020
Attenuator (30dB, 150W)	Narda	769-30	3369	12	17-Jul-2020
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	16-Apr-2020
Digital Multi-meter	Iso-tech	IDM93N	4435	12	07-Oct-2020
2 metre N-Type Cable	Florida Labs	NMS-235SP-78.8-NMS	4622	12	12-Jul-2020
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	06-Feb-2020*
EXA	Keysight Technologies	N9010B	4968	24	23-Dec-2021
Cable (40 GHz)	Rosenberger	LU1-001-500	5021	12	11-Jun-2020
Cable (18 GHz)	Rosenberger	LU7-036-1000	5032	-	O/P Mon

Table 11

O/P Mon – Output Monitored using calibrated equipment

*Note: Testing was performed over multiple test dates therefore it may appear that this item was out of calibration at the time of use however, TUV SUD can confirm that when this item was used it had a valid calibration and holds records of this.

2.5 Transmitter Output Power Versus Time Function

2.5.1 Specification Reference

IEC 62287-1, Clause 11.1.5

2.5.2 Equipment Under Test and Modification State

MA-510TR, S/N: 00000034 - Modification State 1

2.5.3 Date of Test

10-January-2020 to 15-January-2020

2.5.4 Test Method

This test was performed in accordance with IEC 62287-1, clause 11.1.5.2.

2.5.5 Environmental Conditions

Ambient Temperature	22.5 - 23.9 °C
Relative Humidity	44.0 - 48.2 %

2.5.6 Test Results

<u>DC Powered - AIS Transceiver</u>

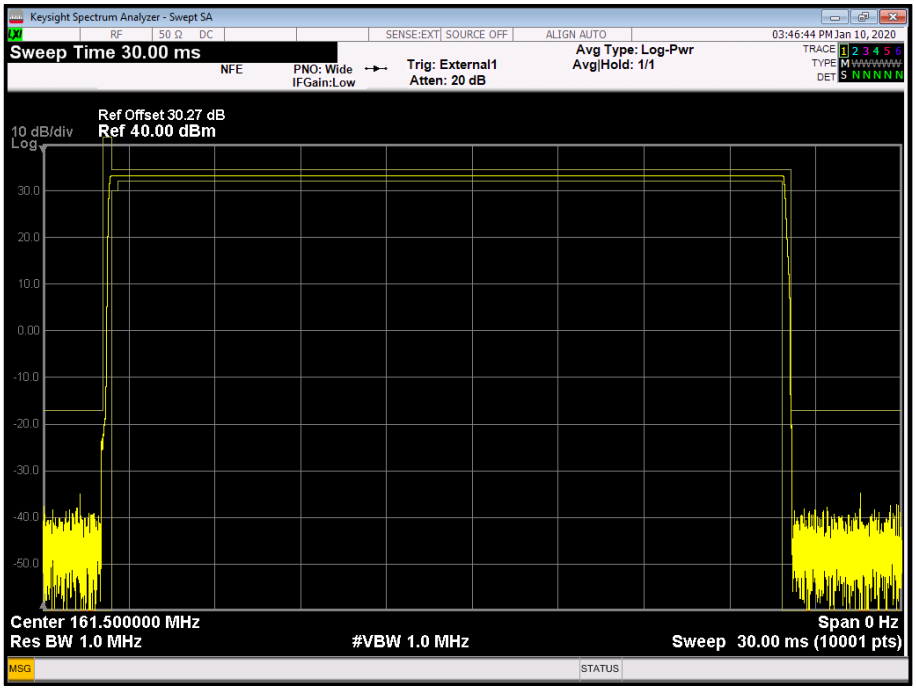

Figure 30 - 161.500 MHz - Tx1 - Complete Burst

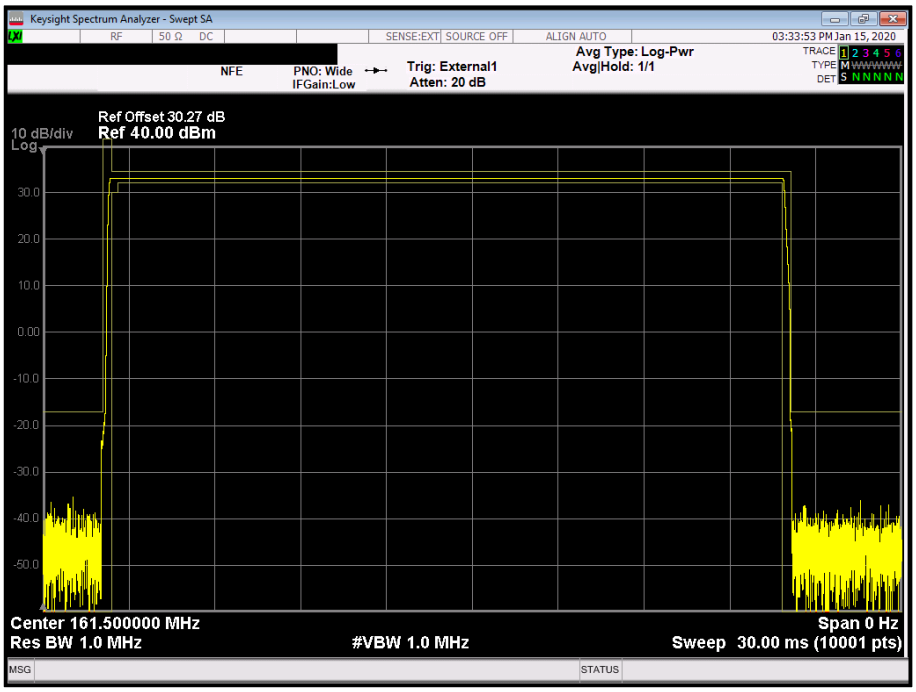

Figure 31 - 161.500 MHz – Tx2 - Complete Burst

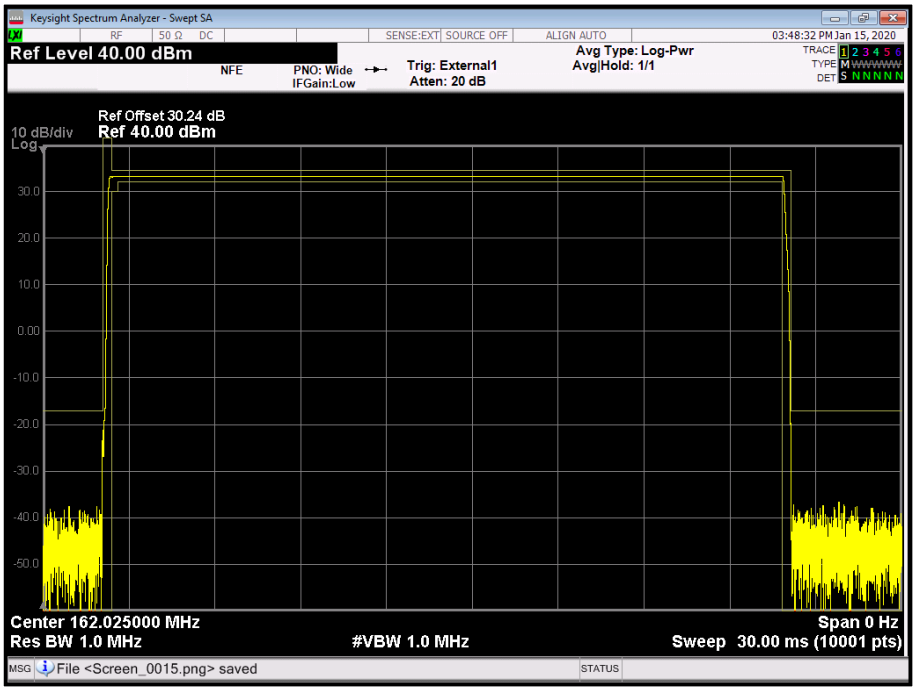

Figure 32 - 162.025 MHz - Tx1 - Complete Burst

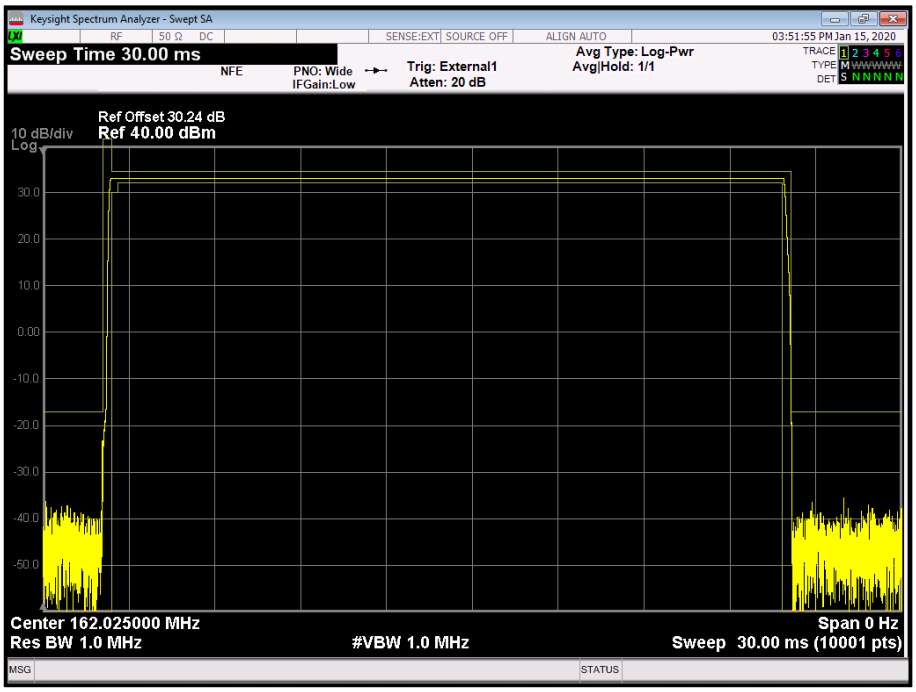

Figure 33 - 162.025 MHz – Tx2 - Complete Burst

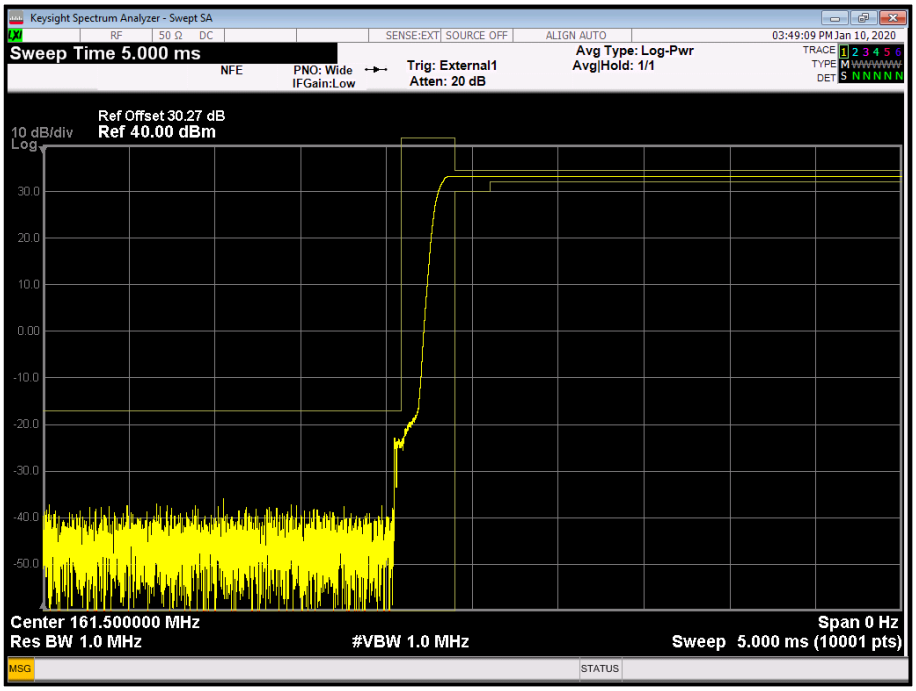

Figure 34 - 161.500 MHz - Tx1 - Ramp Up Zoomed

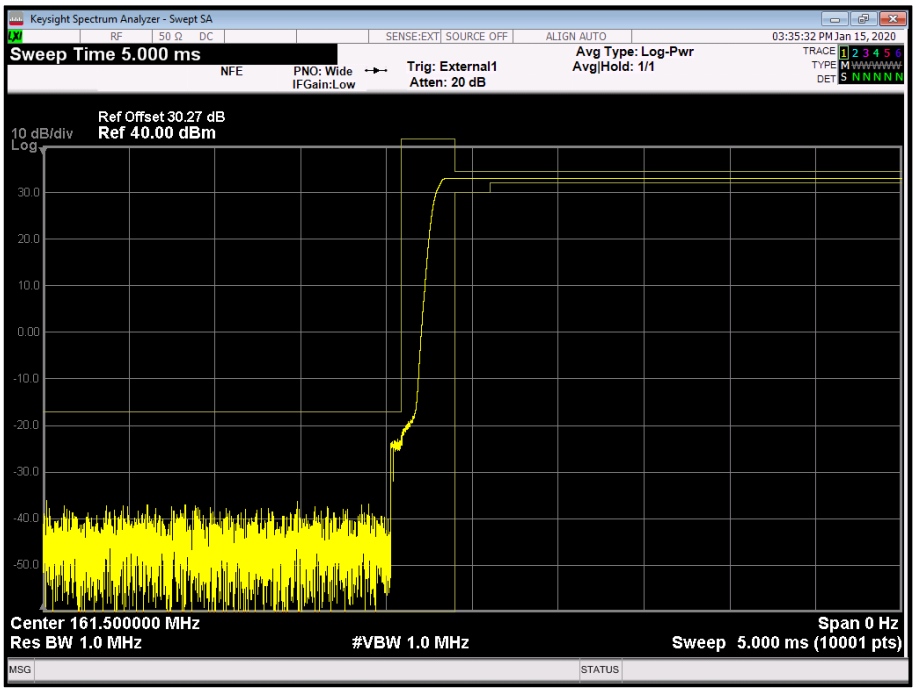

Figure 35 - 161.500 MHz – Tx2 - Ramp Up Zoomed

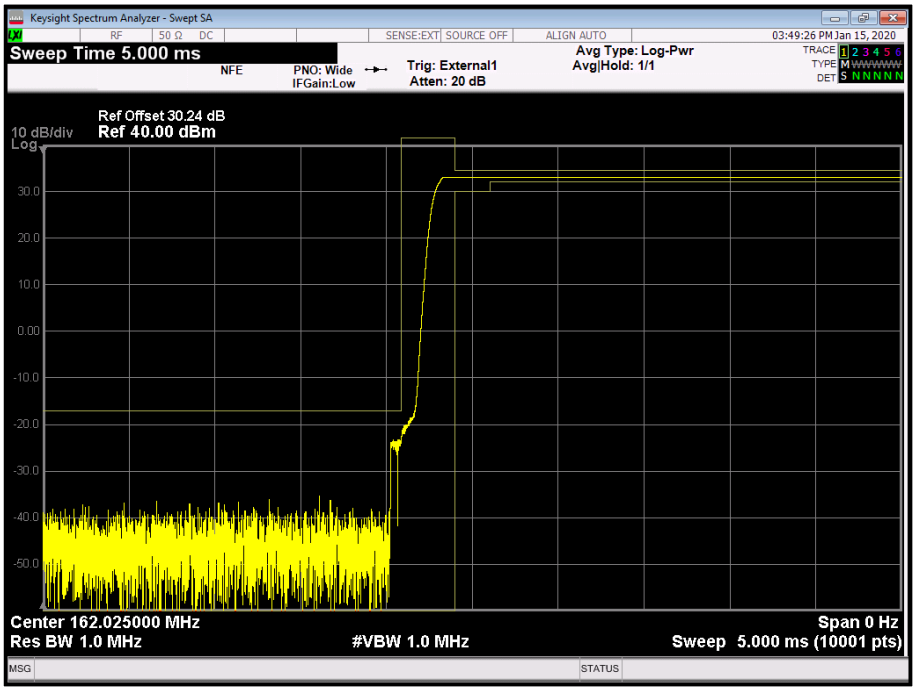

Figure 36 - 162.025 MHz - Tx1 - Ramp Up Zoomed

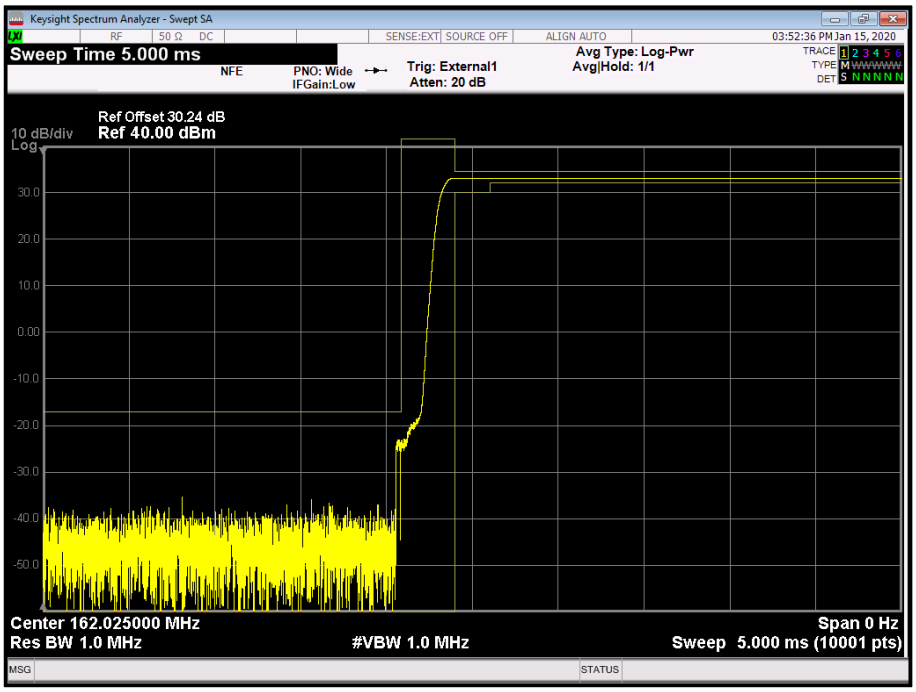

Figure 37 - 162.025 MHz – Tx2 - Ramp Up Zoomed

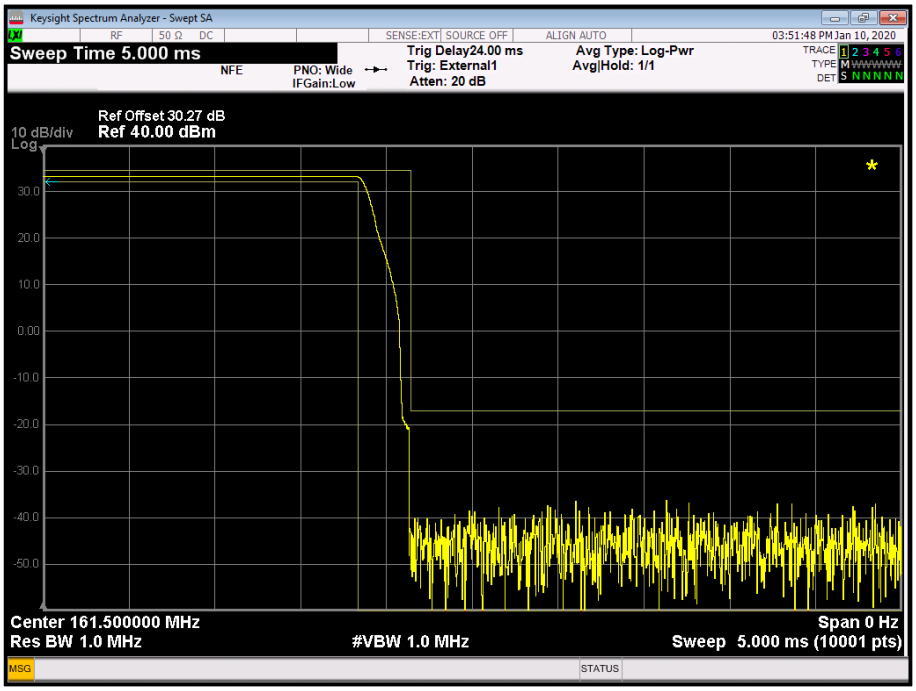

Figure 38 - 161.500 MHz - Tx1 - Ramp Down Zoomed

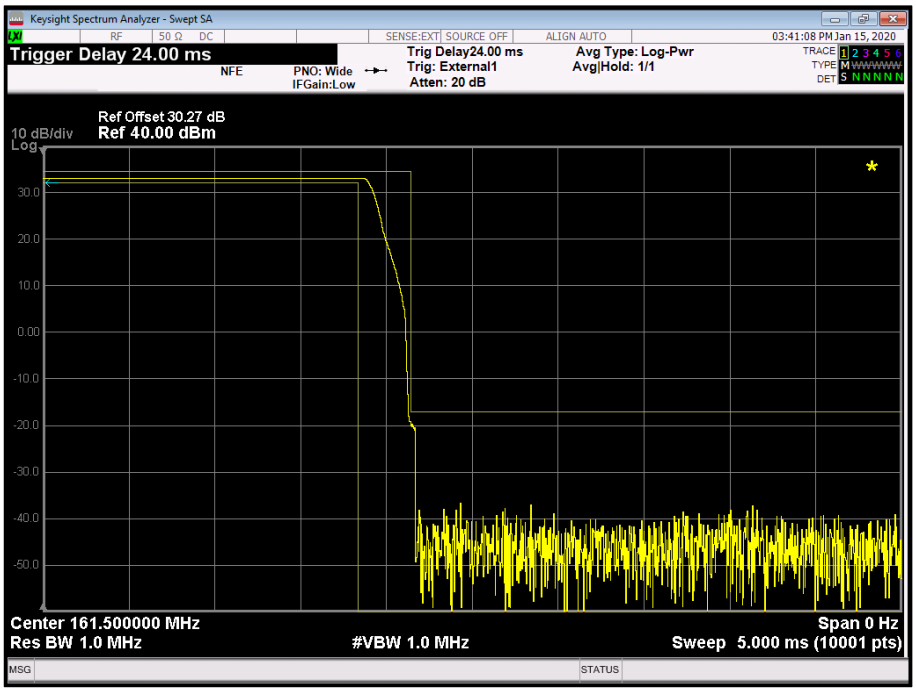

Figure 39 - 161.500 MHz – Tx2 - Ramp Down Zoomed

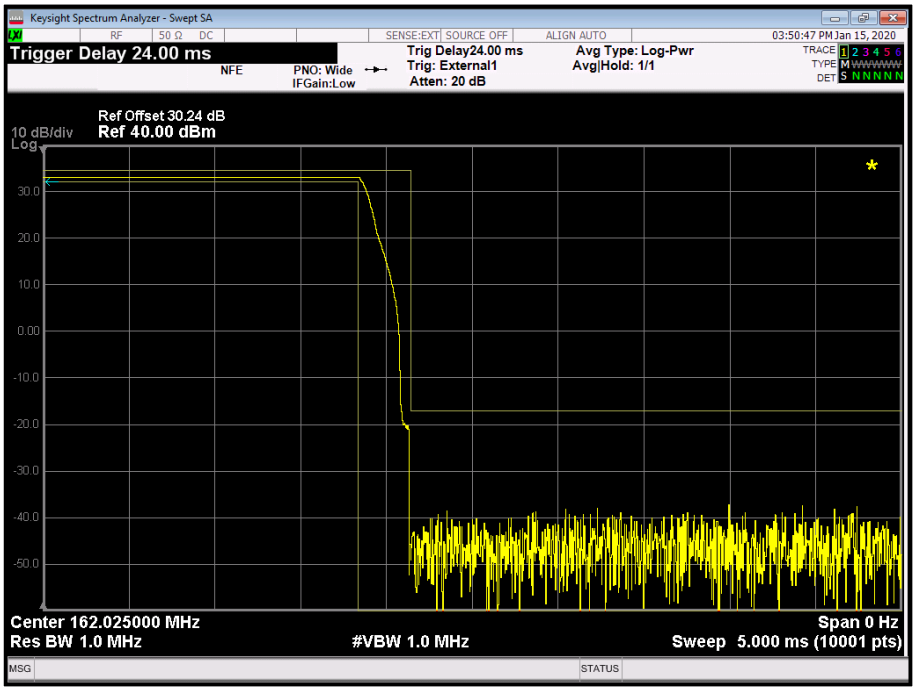

Figure 40 - 162.025 MHz - Tx1 - Ramp Down Zoomed

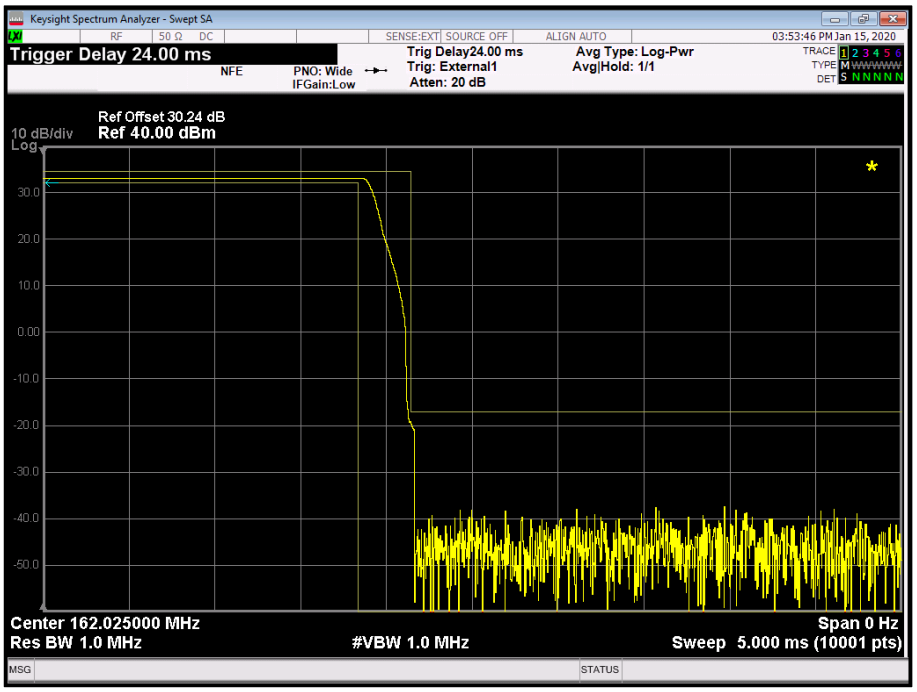

Figure 41 - 162.025 MHz – Tx2 - Ramp Down Zoomed

<u>IEC 62287-1, Limit Clause 11.1.5.3</u>

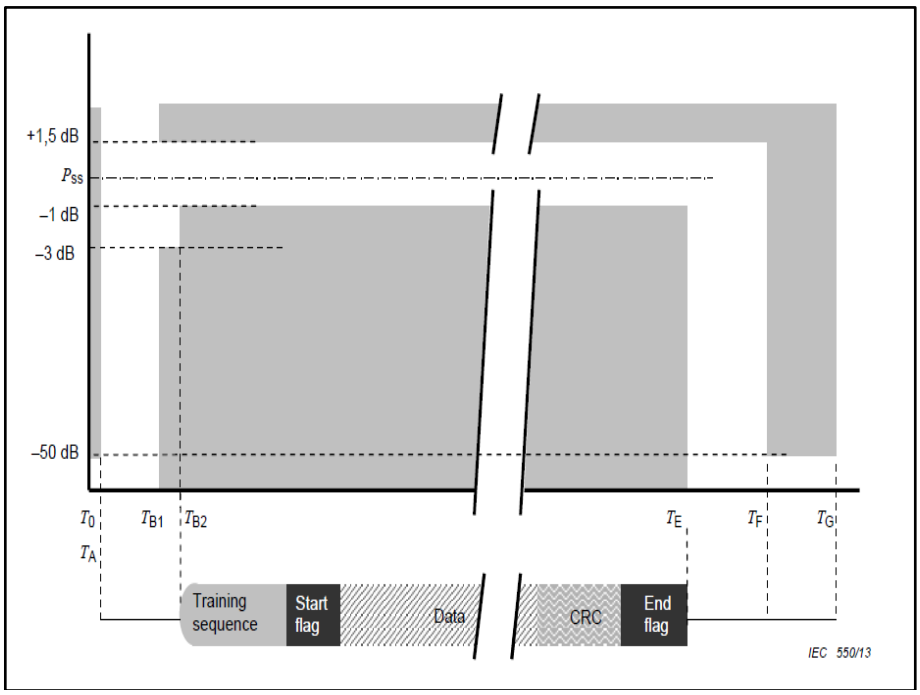

Figure 42 - Power Versus Time Mask

Reference		Bits	Time (ms)	Definitions
T_0		0	0	Start of candidate transmission time period.
T_A		20	2.083	Power shall not exceed -50 dB of P_{SS}
T_B	T_{B1}	23	2.396	Power shall reach within ±1.5 dB or -3 dB of P_{SS}
	T_{B2}	25	2.604	Power shall reach within +1.5 dB or -1 dB of P_{SS}
T_E (includes 1 stuffing bit)		248	25.833	Power shall still remain within +1.5 dB or -1 dB of P_{SS}
T_F (includes 1 stuffing bit)		251	26.146	Power shall reach -50 dB of P_{SS} and stay below this

Table 12 - 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 and RF Laboratory 2.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	16-Apr-2020
Hygromer	Rotronic	Hygropalm	2404	12	02-May-2020
Attenuator (30dB, 150W)	Narda	769-30	3369	12	17-Jul-2020
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	16-Apr-2020
Digital Multi-meter	Iso-tech	IDM93N	4435	12	07-Oct-2020
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	06-Feb-2020
Cable (18 GHz)	Rosenberger	LU7-036-1000	5032	-	O/P Mon

Table 13

O/P Mon – Output Monitored using calibrated equipment

2.6 Sensitivity

2.6.1 Specification Reference

IEC 62287-1, Clause 11.2.1

2.6.2 Equipment Under Test and Modification State

MA-510TR, S/N: 00000034 - Modification State 1 (ambient conditions)
MA-510TR, S/N: 00000034 - Modification State 2 (extreme conditions)

2.6.3 Date of Test

16-January-2020 to 20-February-2020

2.6.4 Test Method

This test was performed in accordance with IEC 62287-1, clause 11.2.1.2.

2.6.5 Environmental Conditions

Ambient Temperature	22.1 - 26.2 °C
Relative Humidity	27.6 - 47.0 %

2.6.6 Test Results

DC Powered - AIS Transceiver

Frequency Offset (Hz)	161.500 MHz		162.025 MHz	
	PER (%) - Rx1	PER (%) - Rx2	PER (%) - Rx1	PER (%) - Rx2
-500	0.000	0.000	0.000	0.000
0	0.000	0.000	0.000	0.000
500	0.000	0.503	0.000	0.000

Table 14 - +22.1 °C, 12.0 V DC

Test Conditions		161.500 MHz		162.025 MHz	
Temperature	Voltage	PER (%) - Rx1	PER (%) - Rx2	PER (%) - Rx1	PER (%) - Rx2
-15.0 °C	9.6 V DC	0.503	0.000	0.000	0.503
+55.0 °C	31.2 V DC	0.000	0.000	0.503	0.000

Table 15 - Extreme Test Conditions

IEC 62287-1, 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 2.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Dual Power Supply Unit	Hewlett Packard	6253A	271	-	O/P Mon
50ohm Load (50W)	Weinschel	M1426	361	12	15-Nov-2020
Attenuator (10dB, 10W)	Bird	8343-100	478	-	O/P Mon
Attenuator (10dB/100W)	Bird	8343-100	495	12	18-Nov-2020
Power Divider	Weinschel	1506A	604	12	23-Apr-2020
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	16-Apr-2020
Hygromer	Rotronic	Hygropalm	2404	12	02-May-2020
Multimeter	Iso-tech	IDM101	2419	12	28-Nov-2020
Signal Generator (250kHz to 4GHz)	Agilent Technologies	E4433B	2893	12	09-Sep-2020
Thermocouple Thermometer	Fluke	51	3172	12	02-Jan-2021
Hygrometer	Rotronic	I-1000	3220	12	25-Sep-2020
Programmable Modulation Waveform Generator	Sine Qua Non	PMG1	3291	-	O/P Mon
DC to TTL Converter	TUV SUD	-	3599	-	TU
Combiner/Splitter	Weinschel	1506A	3878	12	23-Apr-2020
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	16-Apr-2020
Digital Multi-meter	Iso-tech	IDM93N	4435	12	07-Oct-2020
2 metre N-Type Cable	Florida Labs	NMS-235SP-78.8-NMS	4622	12	12-Jul-2020
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	06-Feb-2020
Vector Signal Generator	Keysight Technologies	ESG E4438C	4731	12	19-Sep-2020
Cable (40 GHz)	Rosenberger	LU1-001-500	5021	12	11-Jun-2020
Cable (18 GHz)	Rosenberger	LU7-036-1000	5032	-	O/P Mon
Cable (18 GHz)	Rosenberger	LU7-036-2000	5035	-	O/P Mon
3.5 mm 2m Cable	Junkosha	MWX221-02000DMS	5428	6	13-Jun-2020

Table 16

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

*Note: Testing was performed over multiple test dates therefore it may appear that this item was out of calibration at the time of use however, TUV SUD can confirm that when this item was used it had a valid calibration and holds records of this.

2.7 Error Behaviour at High Input Levels

2.7.1 Specification Reference

IEC 62287-1, Clause 11.2.2

2.7.2 Equipment Under Test and Modification State

MA-510TR, S/N: 00000034 - Modification State 1

2.7.3 Date of Test

17-January-2020

2.7.4 Test Method

This test was performed in accordance with IEC 62287-1, clause 11.2.2.2.

2.7.5 Environmental Conditions

Ambient Temperature 22.9 °C
Relative Humidity 42.8 %

2.7.6 Test Results

DC Powered - AIS Transceiver

Input Signal Level (dBm)	161.500 MHz		162.025 MHz	
	PER (%) - Rx1	PER (%) - Rx2	PER (%) - Rx1	PER (%) - Rx2
-77	0	0	0	0
-7	0	0	0	0

Table 17 - Error Behaviour at High Input Level Results

IEC 62287-1, 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 2.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Attenuator (10dB, 10W)	Bird	8343-100	478	-	O/P Mon
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	16-Apr-2020
Hygromer	Rotronic	Hygropalm	2404	12	02-May-2020
Signal Generator (250kHz to 4GHz)	Agilent Technologies	E4433B	2893	12	09-Sep-2020
Programmable Modulation Waveform Generator	Sine Qua Non	PMG1	3291	-	O/P Mon
DC to TTL Converter	TUV SUD	-	3599	-	TU
Combiner/Splitter	Weinschel	1506A	3878	12	23-Apr-2020
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	16-Apr-2020
Digital Multi-meter	Iso-tech	IDM93N	4435	12	07-Oct-2020
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	06-Feb-2020
Cable (18 GHz)	Rosenberger	LU7-036-1000	5032	-	O/P Mon
Cable (18 GHz)	Rosenberger	LU7-036-2000	5035	-	O/P Mon
3.5 mm 2m Cable	Junkosha	MWX221-02000DMS	5428	6	13-Jun-2020

Table 18

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

2.8 Co-channel Rejection

2.8.1 Specification Reference

IEC 62287-1, Clause 11.2.3

2.8.2 Equipment Under Test and Modification State

MA-510TR, S/N: 00000034 - Modification State 1

2.8.3 Date of Test

20-January-2020

2.8.4 Test Method

This test was performed in accordance with IEC 62287-1, clause 11.2.3.2.

2.8.5 Environmental Conditions

Ambient Temperature 23.4 °C
Relative Humidity 33.8 %

2.8.6 Test Results

DC Powered - AIS Transceiver

Unwanted Signal Frequency Offset (Hz)	161.500 MHz		162.025 MHz	
	PER (%) - Rx1	PER (%) - Rx2	PER (%) - Rx1	PER (%) - Rx2
-1000	8.543	1.508	6.533	1.508
0	3.518	2.010	5.025	2.010
+1000	6.030	3.518	4.020	5.025

Table 19

IEC 62287-1, 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 2.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Attenuator (10 dB, 75 W)	Bird	8308-100	386	12	23-Jul-2020
Attenuator (10dB, 10W)	Bird	8343-100	478	-	O/P Mon
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	16-Apr-2020
Hygromer	Rotronic	Hygropalm	2404	12	02-May-2020
Signal Generator (250kHz to 4GHz)	Agilent Technologies	E4433B	2893	12	09-Sep-2020
Programmable Modulation Waveform Generator	Sine Qua Non	PMG1	3291	-	O/P Mon
Signal Generator, 9kHz - 3GHz	Rohde & Schwarz	SMA 100A	3504	12	02-Sep-2020
DC to TTL Converter	TUV SUD	-	3599	-	TU
Combiner/Splitter	Weinschel	1506A	3878	12	23-Apr-2020
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	16-Apr-2020
Digital Multi-meter	Iso-tech	IDM93N	4435	12	07-Oct-2020
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	06-Feb-2020
Cable (18 GHz)	Rosenberger	LU7-036-1000	5032	-	O/P Mon
Cable (18 GHz)	Rosenberger	LU7-036-2000	5035	-	O/P Mon
3.5 mm 2m Cable	Junkosha	MWX221-02000DMS	5428	6	13-Jun-2020

Table 20

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

2.9 Adjacent Channel Selectivity

2.9.1 Specification Reference

IEC 62287-1, Clause 11.2.4

2.9.2 Equipment Under Test and Modification State

MA-510TR, S/N: 00000034 - Modification State 1

2.9.3 Date of Test

03-February-2020

2.9.4 Test Method

This test was performed in accordance with IEC 62287-1, clause 11.2.4.2.

2.9.5 Environmental Conditions

Ambient Temperature 21.8 °C
Relative Humidity 47.2 %

2.9.6 Test Results

DC Powered - AIS Transceiver

Unwanted Signal Frequency Offset (kHz)	161.500 MHz		162.025 MHz	
	PER (%) - Rx1	PER (%) - Rx2	PER (%) - Rx1	PER (%) - Rx2
-25	0.503	0.000	0.000	0.000
25	0.000	0.503	0.000	0.000

Table 21 - Adjacent Channel Selectivity Results

IEC 62287-1, 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 and RF Laboratory 2.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Attenuator (10 dB, 75 W)	Bird	8308-100	386	12	23-Jul-2020
Attenuator (10dB, 10W)	Bird	8343-100	478	-	O/P Mon
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	16-Apr-2020
Hygromer	Rotronic	Hygropalm	2404	12	02-May-2020
Signal Generator (250kHz to 4GHz)	Agilent Technologies	E4433B	2893	12	09-Sep-2020
Programmable Modulation Waveform Generator	Sine Qua Non	PMG1	3291	-	O/P Mon
Signal Generator, 9kHz - 3GHz	Rohde & Schwarz	SMA 100A	3504	12	02-Sep-2020
DC to TTL Converter	TUV SUD	-	3599	-	TU
Multimeter	Fluke	177	3813	12	09-Oct-2020
Combiner/Splitter	Weinschel	1506A	3878	12	23-Apr-2020
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	16-Apr-2020
Digital Multi-meter	Iso-tech	IDM93N	4435	12	07-Oct-2020
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	06-Feb-2020
Cable (18 GHz)	Rosenberger	LU7-036-1000	5032	-	O/P Mon
Cable (18 GHz)	Rosenberger	LU7-036-2000	5035	-	O/P Mon
3.5 mm 2m Cable	Junkosha	MWX221-02000DMS	5428	6	13-Jun-2020

Table 22

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

2.10 Spurious Response Rejection

2.10.1 Specification Reference

IEC 62287-1, Clause 11.2.5

2.10.2 Equipment Under Test and Modification State

MA-510TR, S/N: 00000034 - Modification State 1 (For tests as SFIs)
MA-510TR, S/N: 00000034 - Modification State 2 (Limited frequency search)

2.10.3 Date of Test

23-January-2020 to 17-February-2020

2.10.4 Test Method

This test was performed in accordance with IEC 62287-1, clause 11.2.5.4 and 11.2.5.5.

2.10.5 Environmental Conditions

Ambient Temperature	20.7 - 24.2 °C
Relative Humidity	19.6 - 47.2 %

2.10.6 Test Results

DC Powered - AIS Transceiver

Test Parameter	Value
List of Intermediate Frequencies	IF_{Rx1} = 21.7 MHz, IF_{Rx1} = 0.45 MHz IF_{Rx2} = 30.15 MHz, IF_{Rx2} = 0.45 MHz
Switching Range of the Receiver	161.5 MHz to 162.025 MHz
Frequency of the Local Oscillator at 162.025 MHz (AIS2)	f_{Rx1}LOH = 183.725 MHz f_{Rx2}LOH = 131.875 MHz
Frequency of the Local Oscillator at 161.500 MHz	f_{Rx1}LOL = 183.200 MHz f_{Rx2}LOL = 131.350 MHz
Calculated Limited Frequency Range	Rx1: 160.7875 MHz to 206.1375 MHz, Rx2: 100.4875 MHz to 162.7375 MHz

Table 23 - Test Parameters

Frequency (MHz)	PER (%)
161.4775	0.335
161.8000	0.000
162.0300	0.168
162.2250	0.000

Table 24 - Spurious Responses - 161.500 MHz - Rx1

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

Frequency (MHz)	PER (%)
161.2025	0.000
161.4775	0.000
161.8000	0.000

Table 25 - Spurious Responses - 161.500 MHz – Rx2

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

Frequency (MHz)	PER (%)
161.7275	0.168
162.0025	0.335
162.3250	0.168

Table 26 - Spurious Responses - 162.025 MHz - Rx1

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

Frequency (MHz)	PER (%)
161.7275	0.000
161.9775	0.000
162.3250	0.000

Table 27 - Spurious Responses - 162.025 MHz – Rx2

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

K	Calculated Frequency (MHz)	PER (%)
-2	344.700	5.528
2	388.100	1.508
-3	527.900	0.000
3	571.300	0.167
-4	711.100	0.670
4	754.500	0.503

Table 28 - Identified Frequencies Spurious Responses for 161.500 MHz - Rx1

K	Calculated Frequency (MHz)	PER (%)
-2	344.700	5.528
2	388.100	1.508
-3	527.900	0.000
3	571.300	0.167
-4	711.100	0.670
4	754.500	0.503

Table 29 - Identified Frequencies Spurious Responses for 161.500 MHz – Rx2

Formula	Calculated Frequency (MHz)	PER (%)
-2	345.750	0.000
2	389.150	2.513
-3	529.475	0.000
3	572.875	0.000
-4	713.200	0.000
4	756.600	0.000

Table 30 - Identified Frequencies Spurious Responses for 162.025 MHz - Rx1

Formula	Calculated Frequency (MHz)	PER (%)
-2	233.600	0.000
2	293.900	0.000
-3	365.475	0.000
3	425.775	0.000
-4	497.350	0.000
4	557.650	0.000

Table 31 - Identified Frequencies Spurious Responses for 162.025 MHz – Rx2

IEC 62287-1 Limit Clause 11.2.5.6

At any frequency separated from the nominal frequency of the receiver by two channels or more, the spurious responses shall not result in a PER of greater than 20 %.

2.10.7 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 Due
Attenuator (10 dB, 75 W)	Bird	8308-100	386	12	23-Jul-2020
Attenuator (10dB, 10W)	Bird	8343-100	478	-	O/P Mon
Attenuator (10dB/100W)	Bird	8343-100	495	12	18-Nov-2020
Power Divider	Weinschel	1506A	604	12	23-Apr-2020
Microwave Source (26.5GHz-40GHz)	Hewlett Packard	83554A	792	-	TU
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	16-Apr-2020
Audio Analyser	Hewlett Packard	8903B	1350	12	26-Nov-2020
Hygromer	Rotronic	Hygropalm	2404	12	02-May-2020
Multimeter	Iso-tech	IDM101	2419	12	28-Nov-2020
Signal Generator (250kHz to 4GHz)	Agilent Technologies	E4433B	2893	12	09-Sep-2020
Hygrometer	Rotronic	I-1000	3220	12	25-Sep-2020
Programmable Modulation Waveform Generator	Sine Qua Non	PMG1	3291	-	O/P Mon
Signal Generator, 9kHz - 3GHz	Rohde & Schwarz	SMA 100A	3504	12	02-Sep-2020
DC to TTL Converter	TUV SUD	-	3599	-	TU
Multimeter	Fluke	177	3813	12	09-Oct-2020
Combiner/Splitter	Weinschel	1506A	3878	12	23-Apr-2020
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	16-Apr-2020
Digital Multi-meter	Iso-tech	IDM93N	4435	12	07-Oct-2020
2 metre N-Type Cable	Florida Labs	NMS-235SP-78.8-NMS	4622	12	12-Jul-2020
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	06-Feb-2020
Vector Signal Generator	Keysight Technologies	ESG E4438C	4731	12	19-Sep-2020
EXA	Keysight Technologies	N9010B	4968	24	23-Dec-2021
Cable (18 GHz)	Rosenberger	LU7-036-1000	5032	-	O/P Mon
Cable (18 GHz)	Rosenberger	LU7-036-2000	5035	-	O/P Mon
3.5 mm 2m Cable	Junkosha	MWX221-02000DMS	5428	6	13-Jun-2020

Table 32

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

*Note: Testing was performed over multiple test dates therefore it may appear that this item was out of calibration at the time of use however, TUV SUD can confirm that when this item was used it had a valid calibration and holds records of this.

2.11 Intermodulation Response Rejection

2.11.1 Specification Reference

IEC 62287-1, Clause 11.2.6

2.11.2 Equipment Under Test and Modification State

MA-510TR, S/N: 00000034 - Modification State 2

2.11.3 Date of Test

04-February-2020 to 05-February-2020

2.11.4 Test Method

This test was performed in accordance with IEC 62287-1, clause 11.2.6.2.

2.11.5 Environmental Conditions

Ambient Temperature 21.1 - 23.4 °C
Relative Humidity 31.2 - 32.2 %

2.11.6 Test Results

DC Powered - AIS Transceiver

Test Number	Generator A (Wanted AIS Signal)	Generator B (Unmodulated ±50 kHz)	Generator C (Modulated ±100 kHz)	PER (%)	
				Rx1	Rx2
1	162.025 MHz	162.075 MHz	162.125 MHz	1.735	0.000
2	162.025 MHz	161.975 MHz	161.925 MHz	0.400	0.000
3	161.500 MHz	161.550 MHz	161.600 MHz	0.567	0.000
4	161.500 MHz	161.450 MHz	161.400 MHz	0.934	0.000

Table 33

IEC 62287-1 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 2.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Attenuator (10 dB, 75 W)	Bird	8308-100	386	12	23-Jul-2020
Attenuator (10dB, 10W)	Bird	8343-100	478	-	O/P Mon
Attenuator (10dB/100W)	Bird	8343-100	495	12	18-Nov-2020
Power Divider	Weinschel	1506A	604	12	23-Apr-2020
Signal Generator	Marconi	2031	762	12	02-Aug-2020
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	16-Apr-2020
Hygromer	Rotronic	Hygropalm	2404	12	02-May-2020
Signal Generator (250kHz to 4GHz)	Agilent Technologies	E4433B	2893	12	09-Sep-2020
Programmable Modulation Waveform Generator	Sine Qua Non	PMG1	3291	-	O/P Mon
Signal Generator, 9kHz - 3GHz	Rohde & Schwarz	SMA 100A	3504	12	02-Sep-2020
DC to TTL Converter	TUV SUD	-	3599	-	TU
Multimeter	Fluke	177	3813	12	09-Oct-2020
Combiner/Splitter	Weinschel	1506A	3878	12	23-Apr-2020
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	16-Apr-2020
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	06-Feb-2020
Cable (18 GHz)	Rosenberger	LU7-036-1000	5030	12	06-Oct-2020
Cable (18 GHz)	Rosenberger	LU7-036-1000	5032	-	O/P Mon
Cable (18 GHz)	Rosenberger	LU7-036-2000	5035	-	O/P Mon
3.5 mm 2m Cable	Junkosha	MWX221-02000DMS	5428	6	13-Jun-2020

Table 34

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

2.12 Blocking or Desensitisation

2.12.1 Specification Reference

IEC 62287-1, Clause 11.2.7

2.12.2 Equipment Under Test and Modification State

MA-510TR, S/N: 00000034 - Modification State 1

2.12.3 Date of Test

22-January-2020

2.12.4 Test Method

This test was performed in accordance with IEC 62287-1, clause 11.2.7.2.

2.12.5 Environmental Conditions

Ambient Temperature 23.5 °C
Relative Humidity 31.9 %

2.12.6 Test Results

DC Powered - AIS Transceiver

Unwanted Signal Frequency Offset (MHz)	Packet Error Ratio (%)			
	156.025 MHz		162.025 MHz	
	Rx1	Rx2	Rx1	Rx2
-10	0	0	0	0.503
-5	0	0	0	0
-2	0	0	0	0
-1	0	0	0	0
-0.5	3.015	0	10.050	0.503
0.5	7.035	1.005	4.020	0.503
1	0	0	0	0
2	0	0.503	0	0
5	0	0	0	0
10	0	0	0	0

Table 35

IEC 62287-1, 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 2.

Instrument	Manufacturer	Type No	TE No	Calibration Period (months)	Calibration Due
Attenuator (10 dB, 75 W)	Bird	8308-100	386	12	23-Jul-2020
Attenuator (10dB, 10W)	Bird	8343-100	478	-	O/P Mon
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	16-Apr-2020
Hygromer	Rotronic	Hygropalm	2404	12	02-May-2020
Signal Generator (250kHz to 4GHz)	Agilent Technologies	E4433B	2893	12	09-Sep-2020
Programmable Modulation Waveform Generator	Sine Qua Non	PMG1	3291	-	O/P Mon
Signal Generator, 9kHz - 3GHz	Rohde & Schwarz	SMA 100A	3504	12	02-Sep-2020
DC to TTL Converter	TUV SUD	-	3599	-	TU
Combiner/Splitter	Weinschel	1506A	3878	12	23-Apr-2020
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	16-Apr-2020
Digital Multi-meter	Iso-tech	IDM93N	4435	12	07-Oct-2020
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	06-Feb-2020
Cable (18 GHz)	Rosenberger	LU7-036-1000	5032	-	O/P Mon
Cable (18 GHz)	Rosenberger	LU7-036-2000	5035	-	O/P Mon
3.5 mm 2m Cable	Junkosha	MWX221-02000DMS	5428	6	13-Jun-2020

Table 36

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

2.13 Spurious Emissions from the Receiver

2.13.1 Specification Reference

IEC 62287-1, Clause 11.3.1

2.13.2 Equipment Under Test and Modification State

MA-510TR, S/N: 00000034 - Modification State 2

2.13.3 Date of Test

07-February-2020

2.13.4 Test Method

This test was performed in accordance with IEC 62287-1, clause 11.3.1.2.

2.13.5 Environmental Conditions

Ambient Temperature	22.3 - 22.9 °C
Relative Humidity	32.8 - 37.5 %

2.13.6 Test Results

DC Powered - AIS Transceiver

Frequency (MHz)	Level (dBm)
*	

Table 37 - 161.500 MHz Emission Results

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

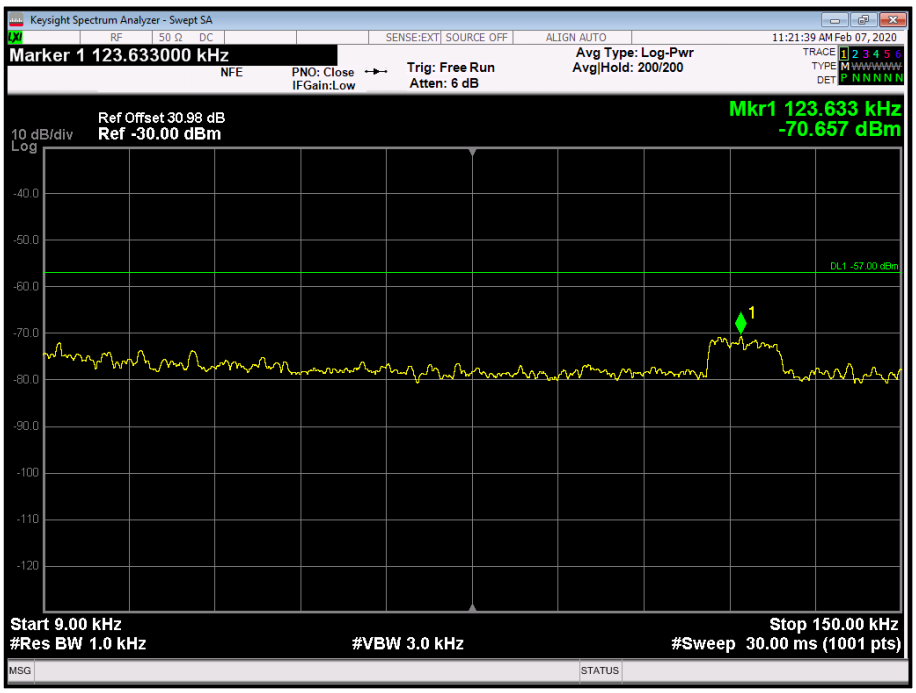

Figure 43 - 161.500 MHz - 9 kHz to 150 kHz

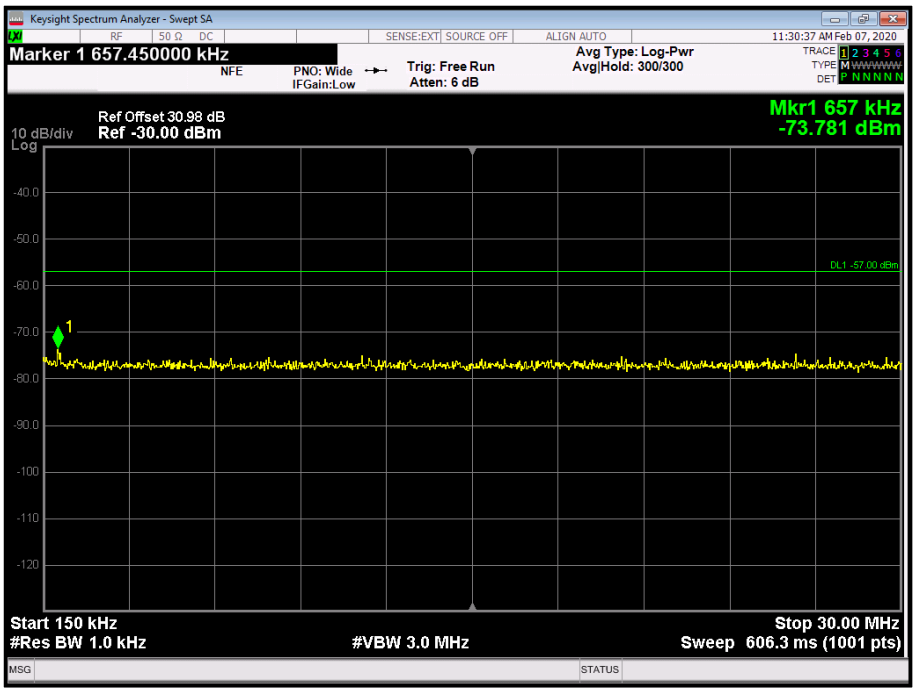

Figure 44 - 161.500 MHz - 150 kHz to 30 MHz

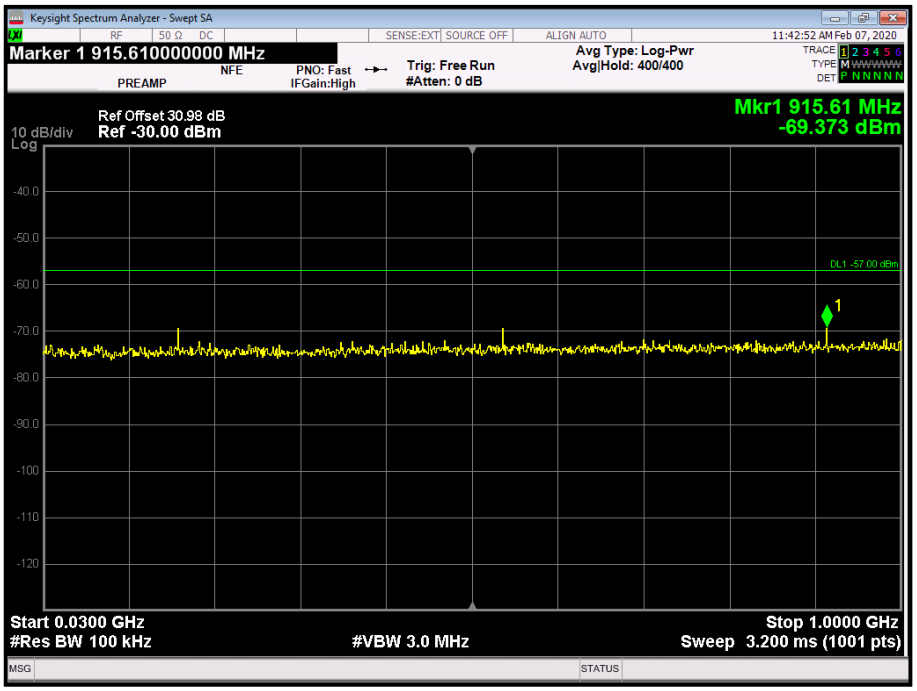

Figure 45 - 161.500 MHz - 30 MHz to 1 GHz

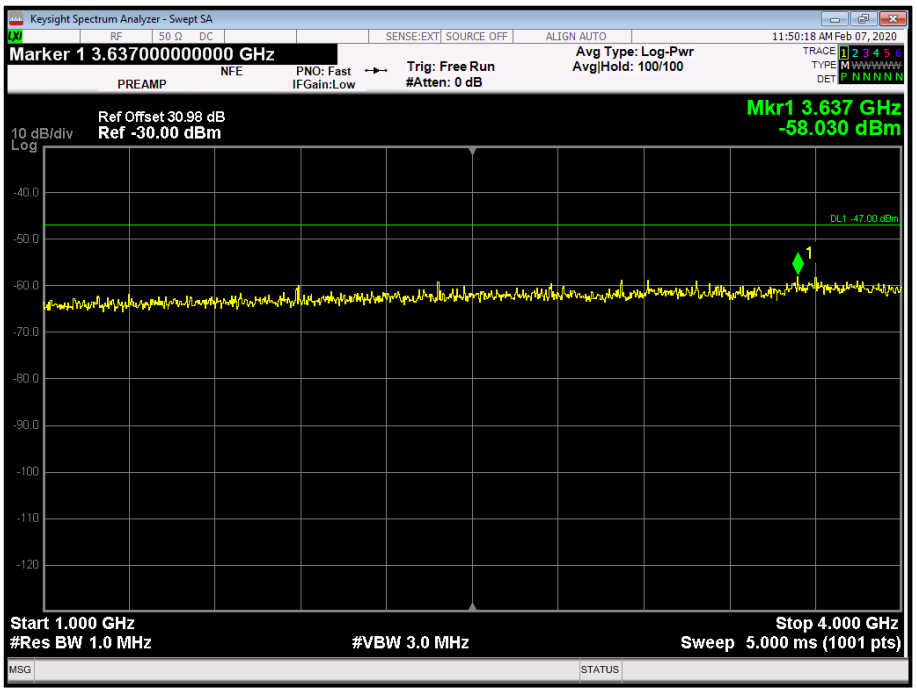

Figure 46 - 161.500 MHz - 1 GHz to 4 GHz

Frequency (MHz)	Level (dBm)
*	

Table 38 - Receiver Emissions Results - 162.025 MHz

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

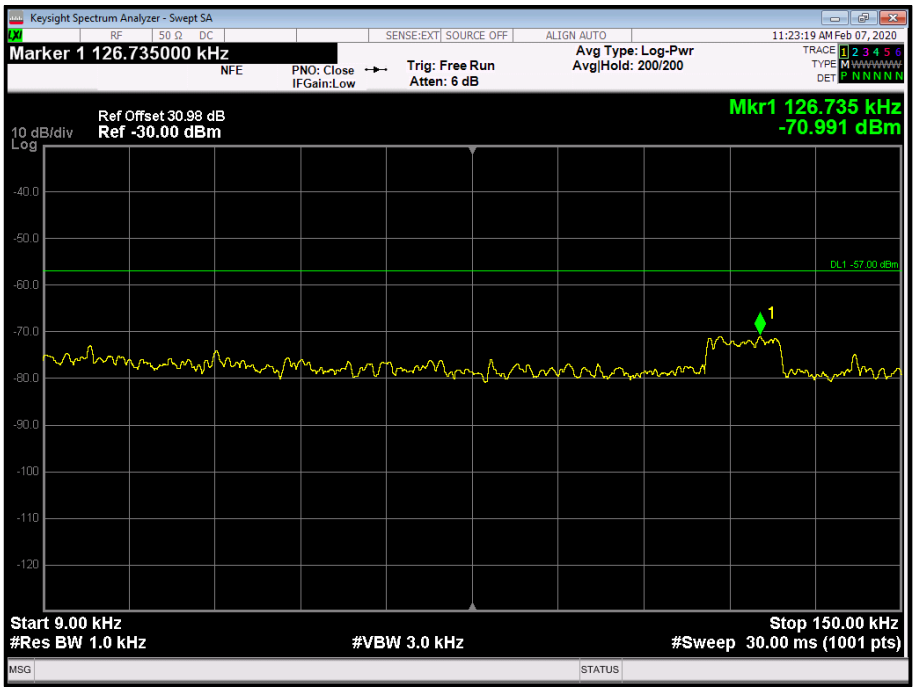

Figure 47 - 162.025 MHz - 9 kHz to 150 kHz

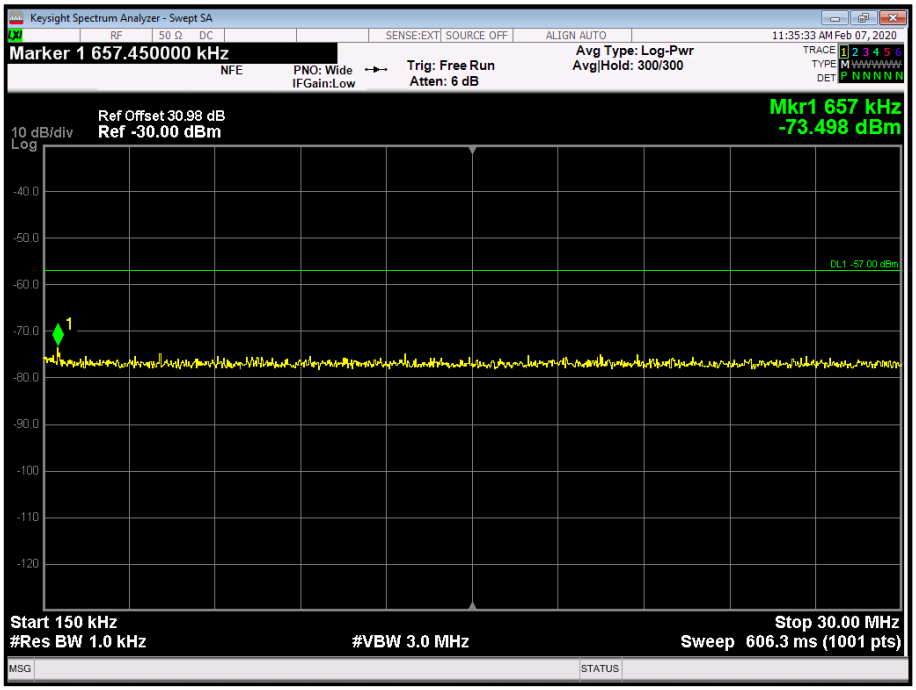

Figure 48 - 162.025 MHz - 150 kHz to 30 MHz

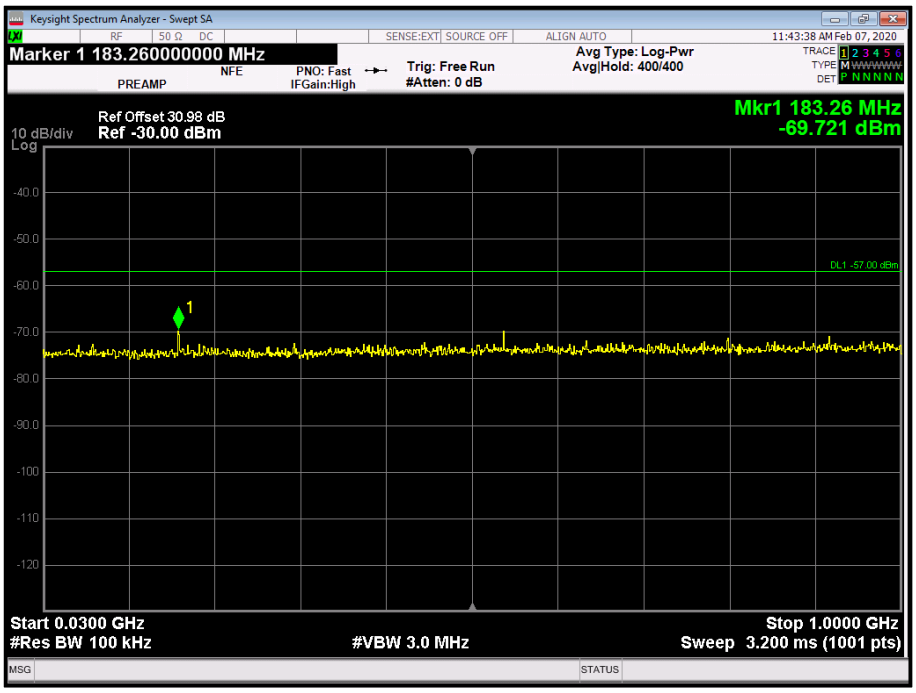

Figure 49 - 162.025 MHz - 30 MHz to 1 GHz

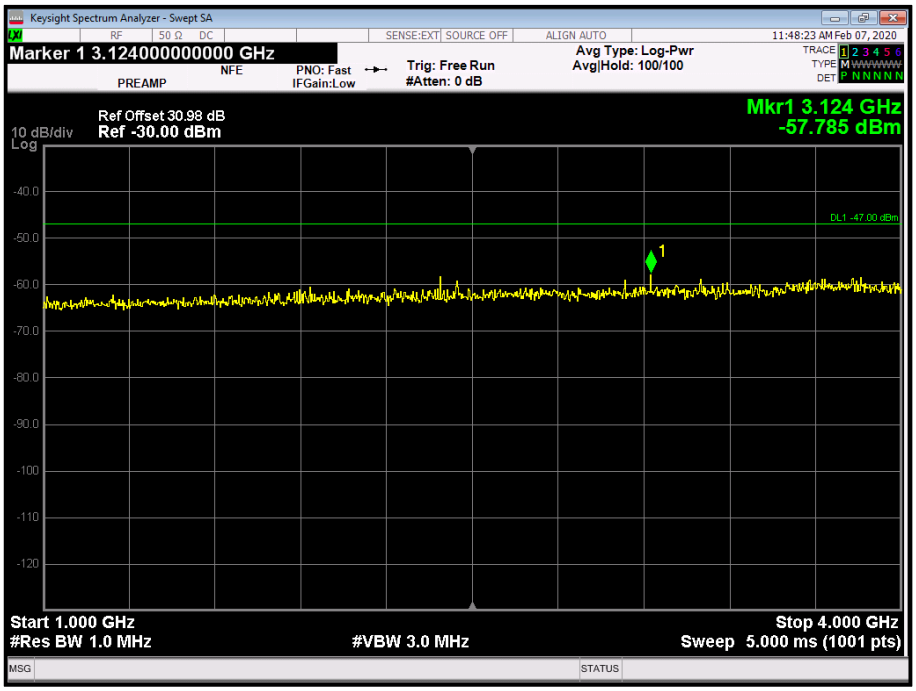

Figure 50 - 162.025 MHz - 1 GHz to 4 GHz

<u>IEC 62287-1, Limit Clause 11.3.1.3</u>

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.

2.13.7 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 Due
Attenuator (20 dB, 2 W)	Pasternack	PE7004-20	489	12	15-Jan-2021
Power Supply Unit	Farnell	H60-25	1092	-	O/P Mon
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	16-Apr-2020
High Pass Filter	Mini-Circuits	NHP-300	1640	12	15-Jan-2021
Hygromer	Rotronic	Hygropalm	2404	12	02-May-2020
Attenuator (30dB, 150W)	Narda	769-30	3369	12	17-Jul-2020
Multimeter	Fluke	177	3813	12	09-Oct-2020
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	16-Apr-2020
PXA Signal Analyser	Keysight Technologies	N9030A	4654	12	21-Oct-2020
Cable (18 GHz)	Rosenberger	LU7-036-2000	5035	-	O/P Mon

Table 39

O/P Mon – Output Monitored using calibrated equipment

2.14 Spurious Emissions from the Transmitter

2.14.1 Specification Reference

IEC 62287-1, Clause 11.3.2

2.14.2 Equipment Under Test and Modification State

MA-510TR, S/N: 00000034 - Modification State 2

2.14.3 Date of Test

07-February-2020 to 10-February-2020

2.14.4 Test Method

This test was performed in accordance with IEC 62287-1, clause 11.3.2.2.

2.14.5 Environmental Conditions

Ambient Temperature	22.9 - 24.5 °C
Relative Humidity	31.8 - 39.0 %

2.14.6 Test Results

DC Powered - AIS Transceiver

Frequency (MHz)	Level (dBm)
*	

Table 40 - 161.500 MHz Emissions Results

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

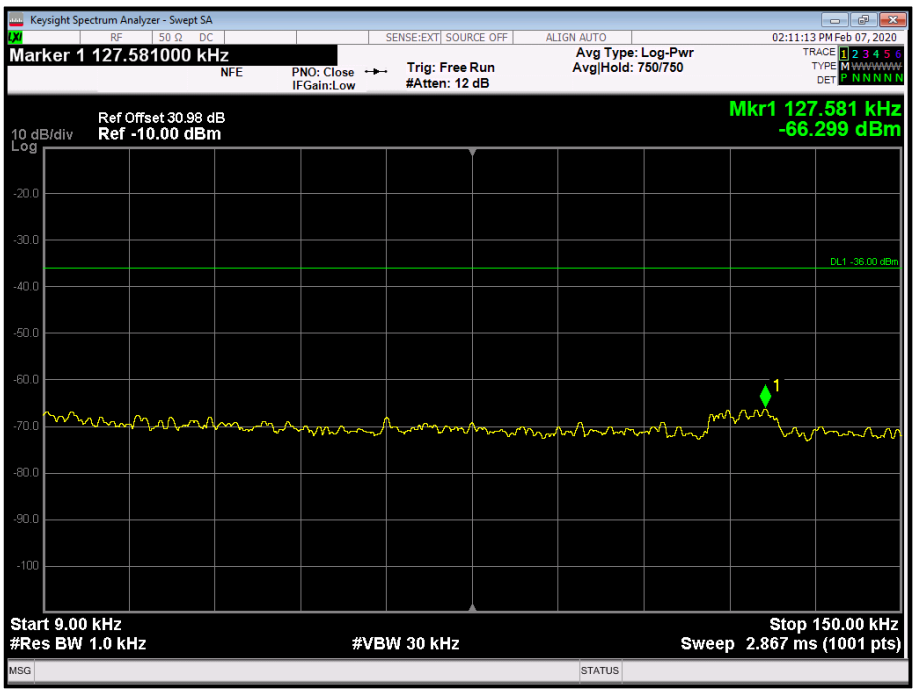

Figure 51 - 161.500 MHz - 9 kHz to 150 kHz

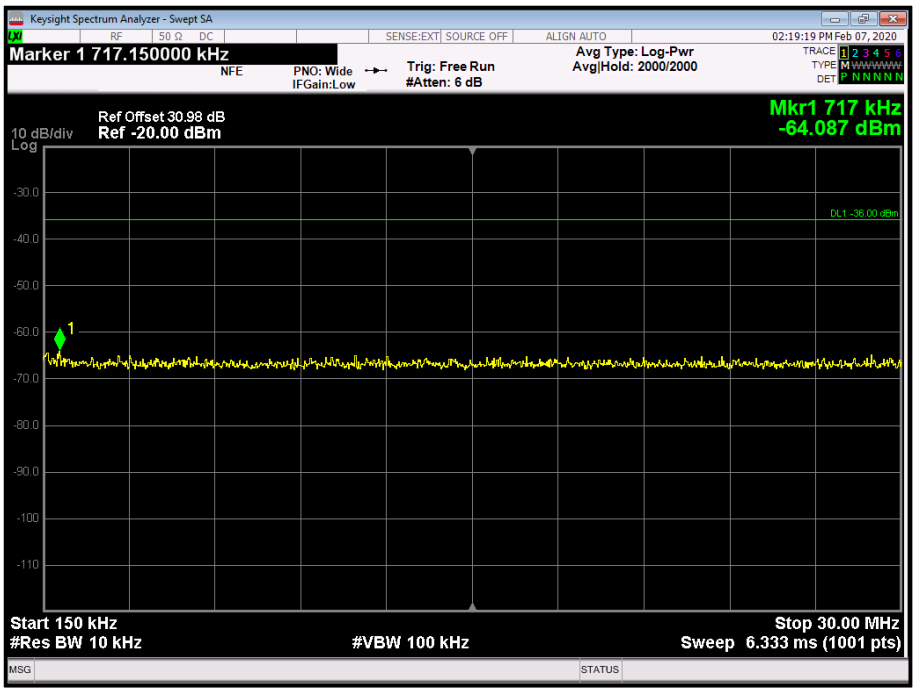

Figure 52 - 161.500 MHz - 150 kHz to 30 MHz

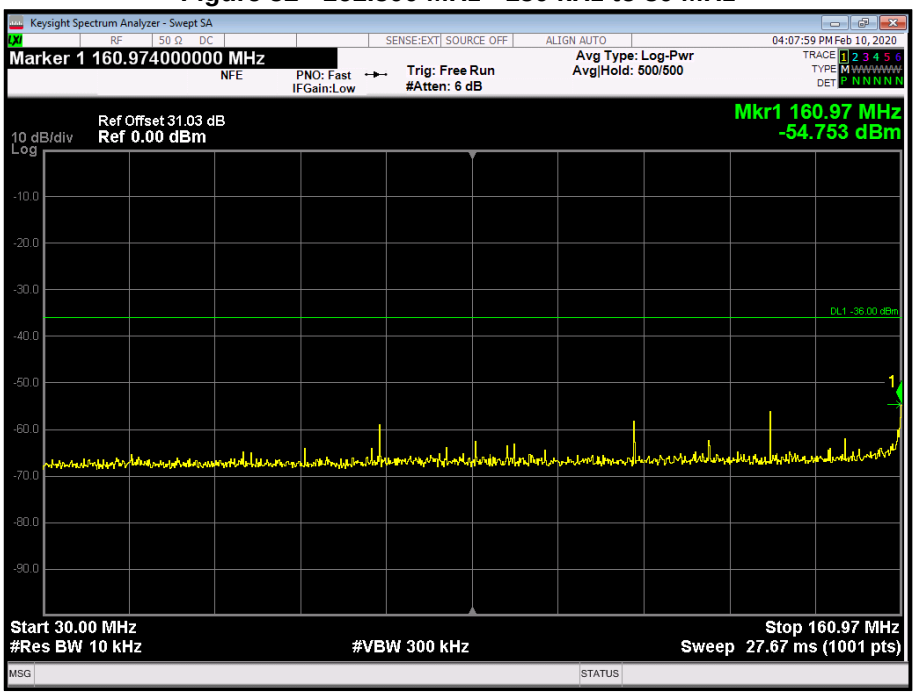

Figure 53 - 161.500 MHz - 30 MHz to 160.974 MHz

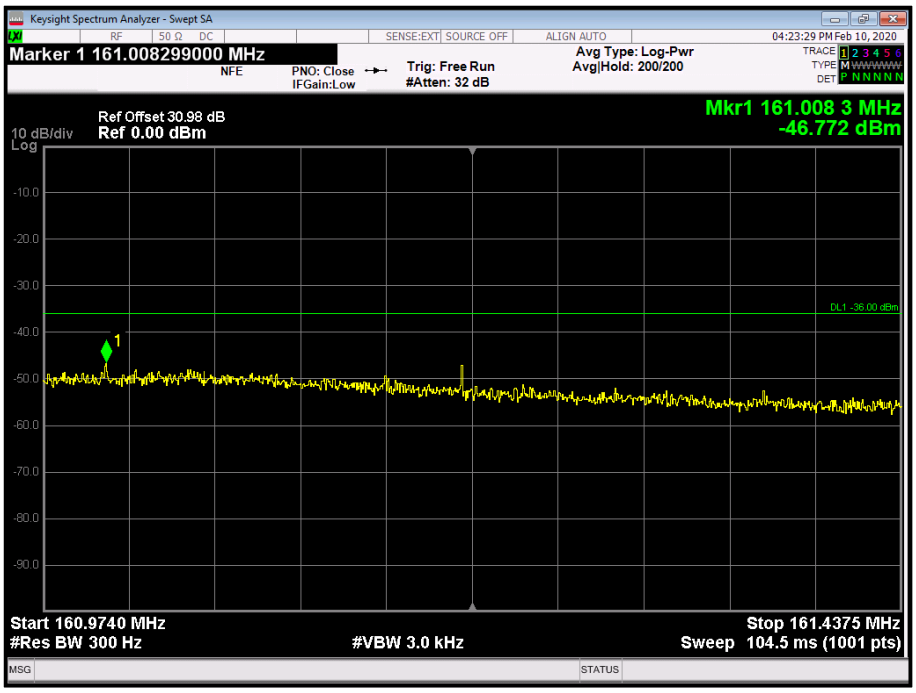

Figure 54 - 161.500 MHz - 160.974 MHz to 161.4375 MHz

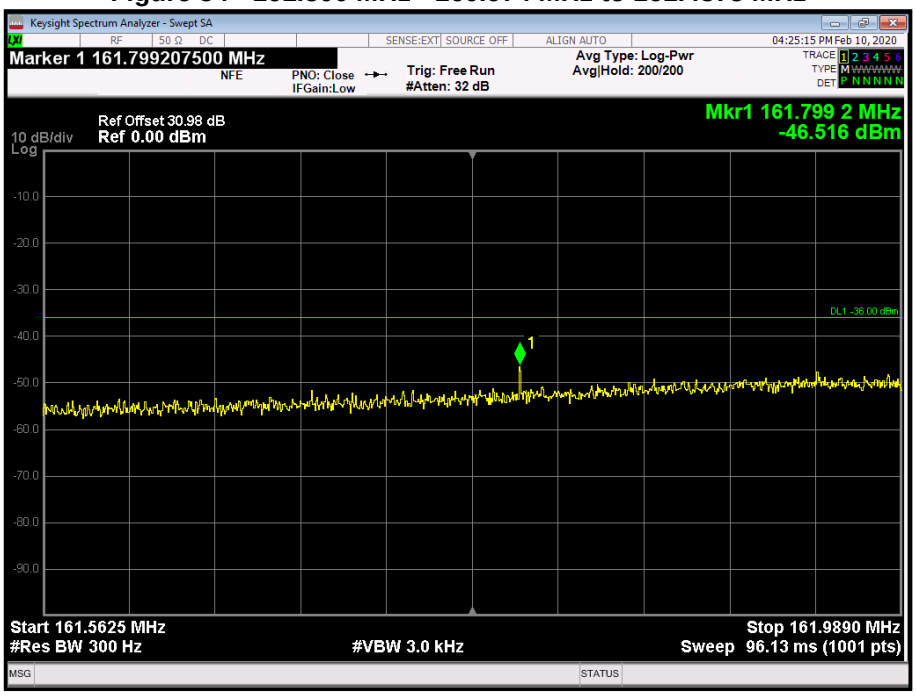

Figure 55 - 161.500 MHz - 161.5625 MHz to 161.989 MHz

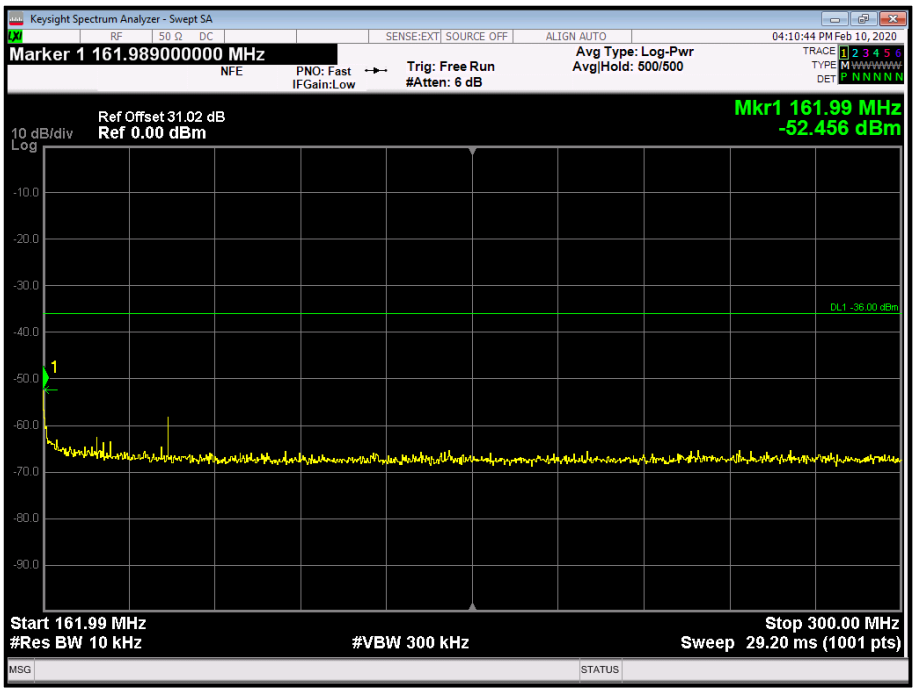

Figure 56 - 161.500 MHz - 161.989 MHz to 300 MHz

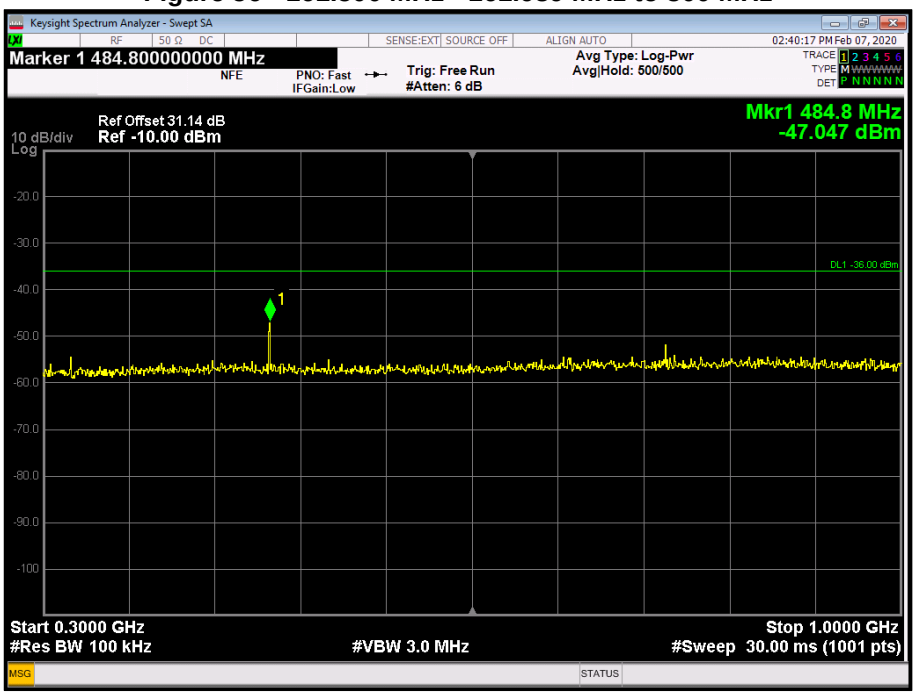

Figure 57 - 161.500 MHz - 300 MHz to 1 GHz

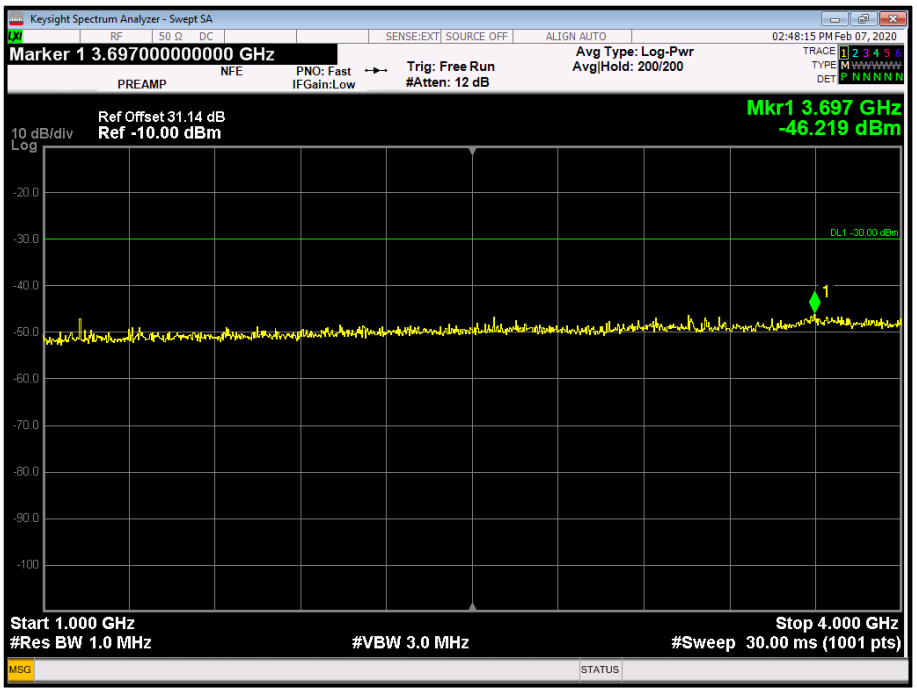

Figure 58 - 161.500 MHz - 1 GHz to 4 GHz

Frequency (MHz)	Level (dBm)
*	

Table 41 - 162.025 MHz Emissions Results

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

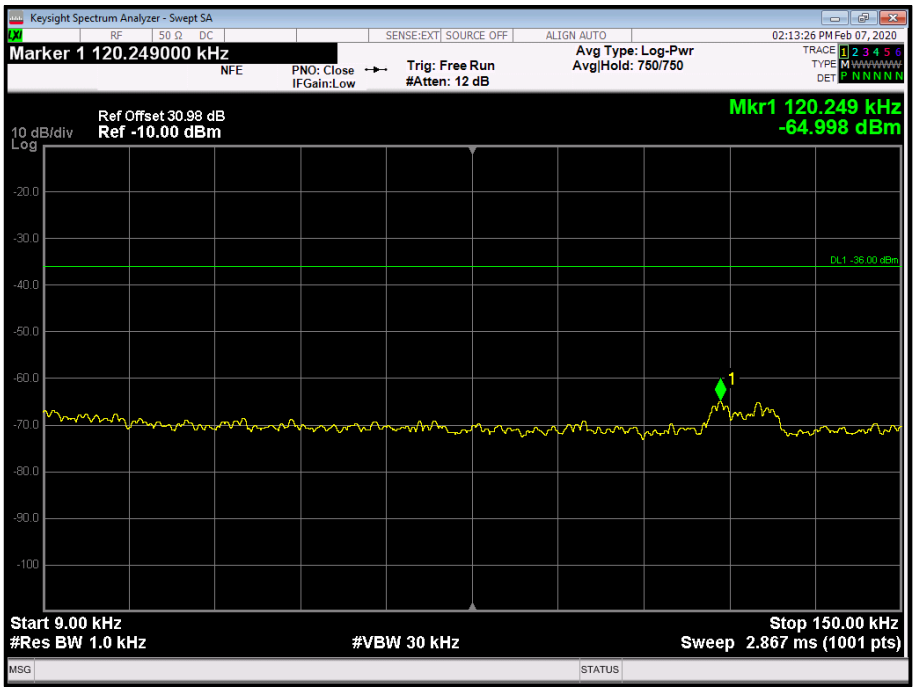

Figure 59 - 162.025 MHz - 9 kHz to 150 kHz

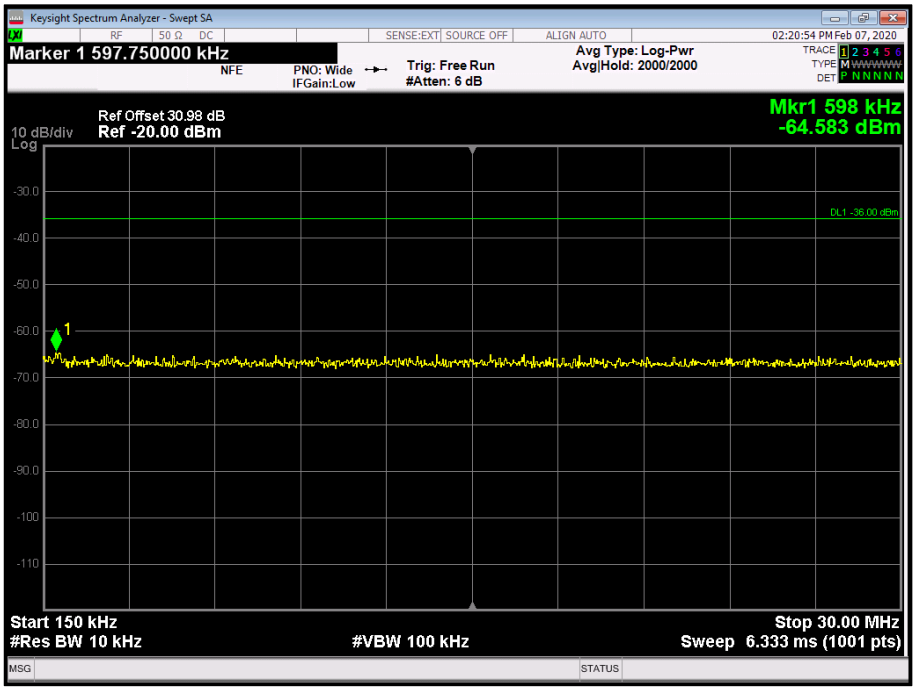

Figure 60 - 162.025 MHz - 150 kHz to 30 MHz

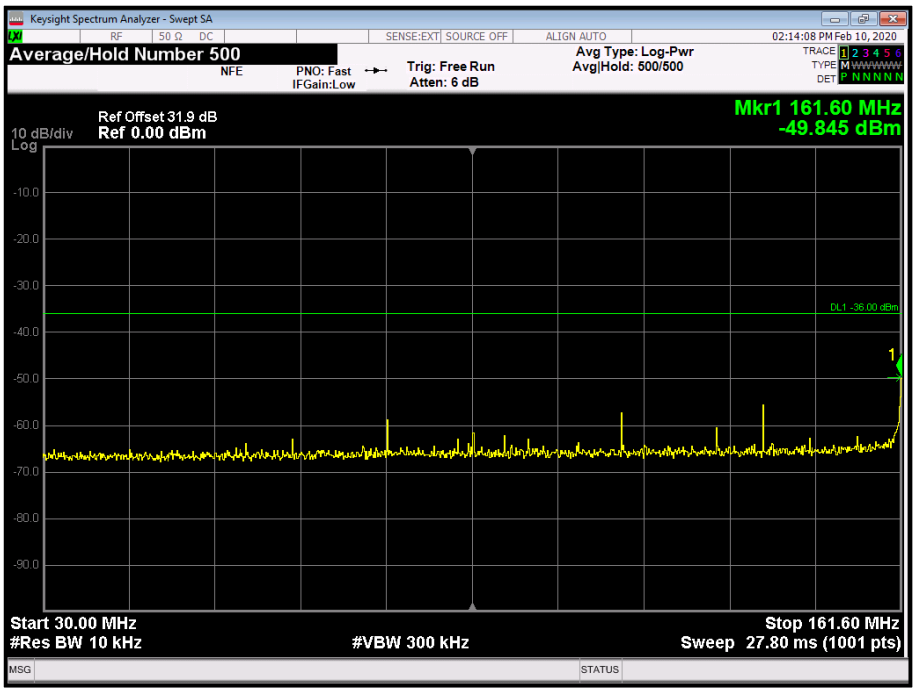

Figure 61 - 162.025 MHz - 30 MHz to 161.600 MHz

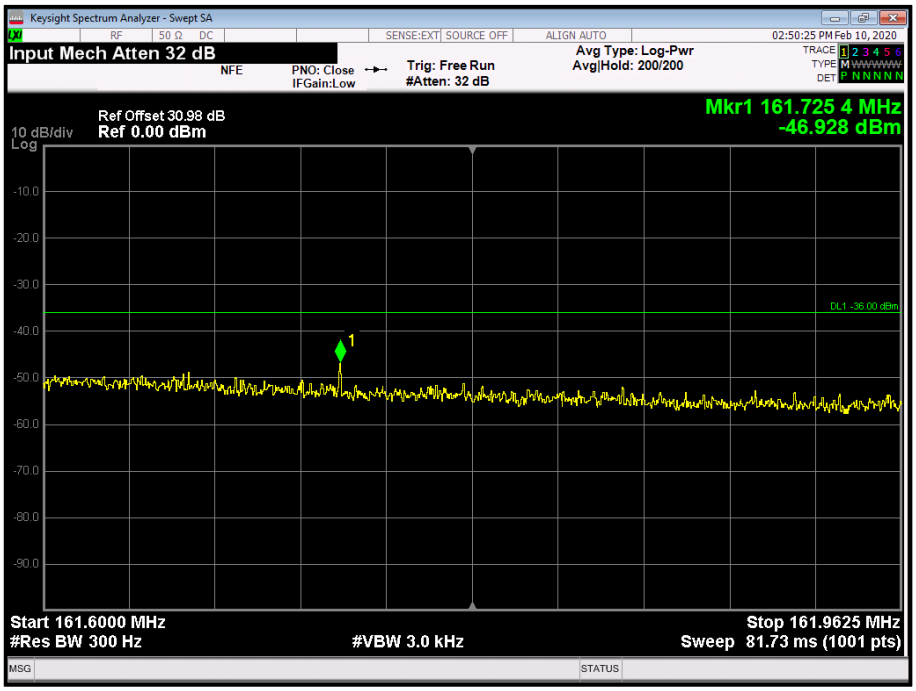

Figure 62 - 162.025 MHz - 161.600 MHz to 161.9625 MHz

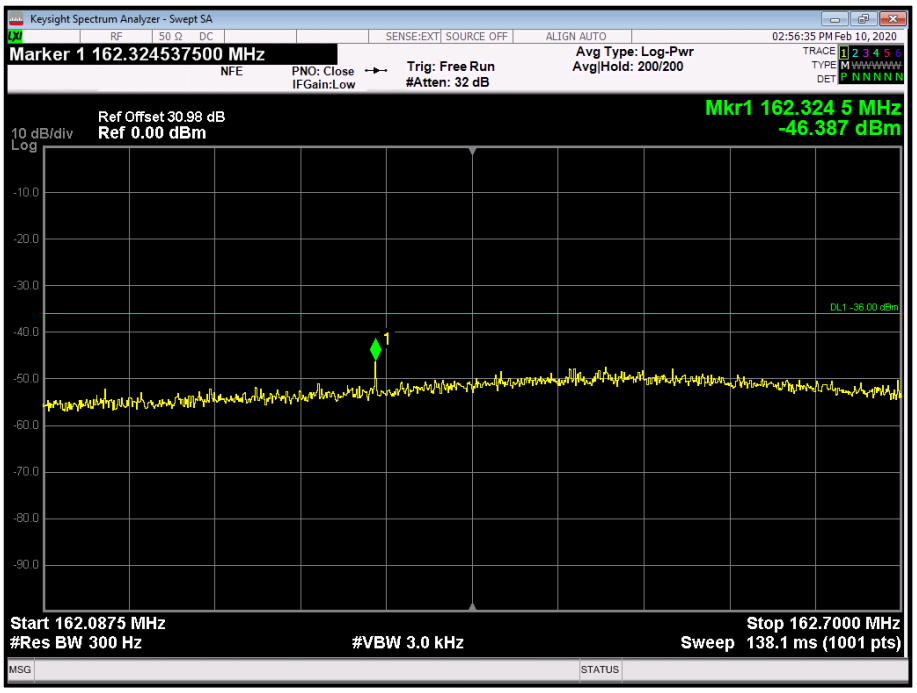

Figure 63 - 162.025 MHz - 162.0875 MHz to 162.700 MHz

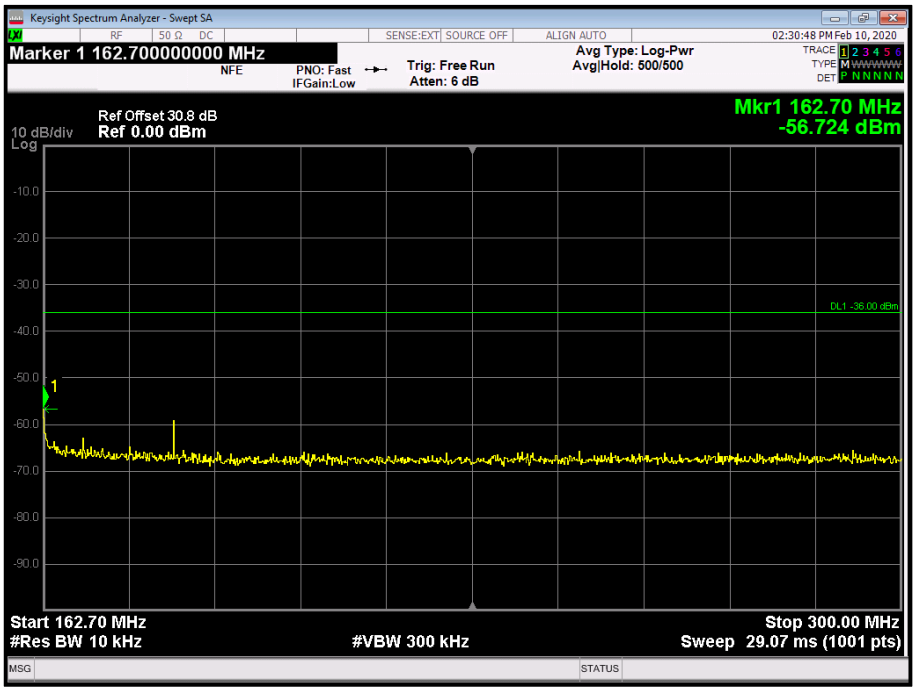

Figure 64 - 162.025 MHz - 162.700 MHz to 300 MHz

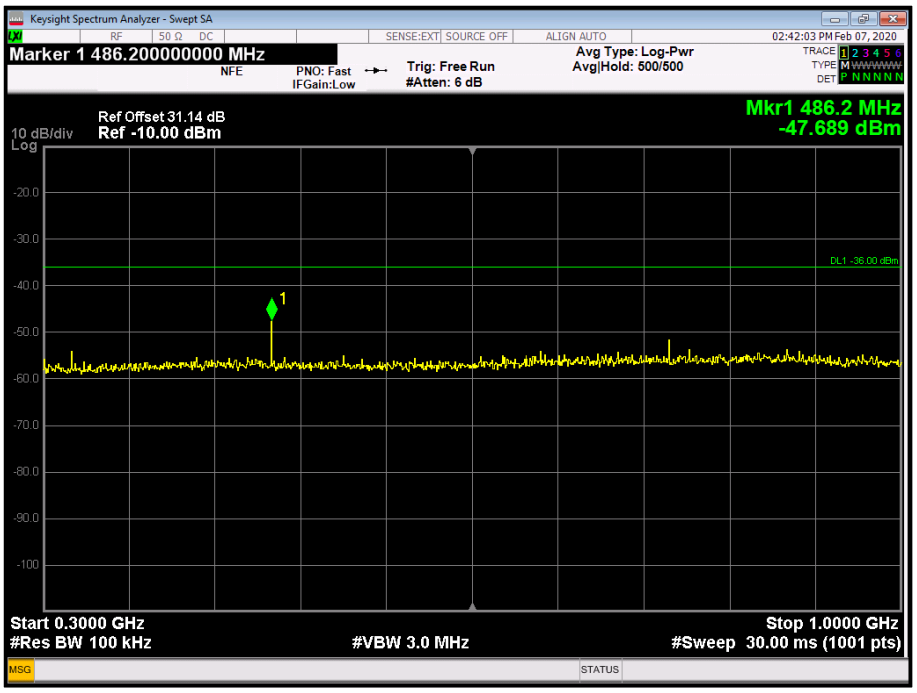

Figure 65 - 162.025 MHz - 300 MHz to 1 GHz

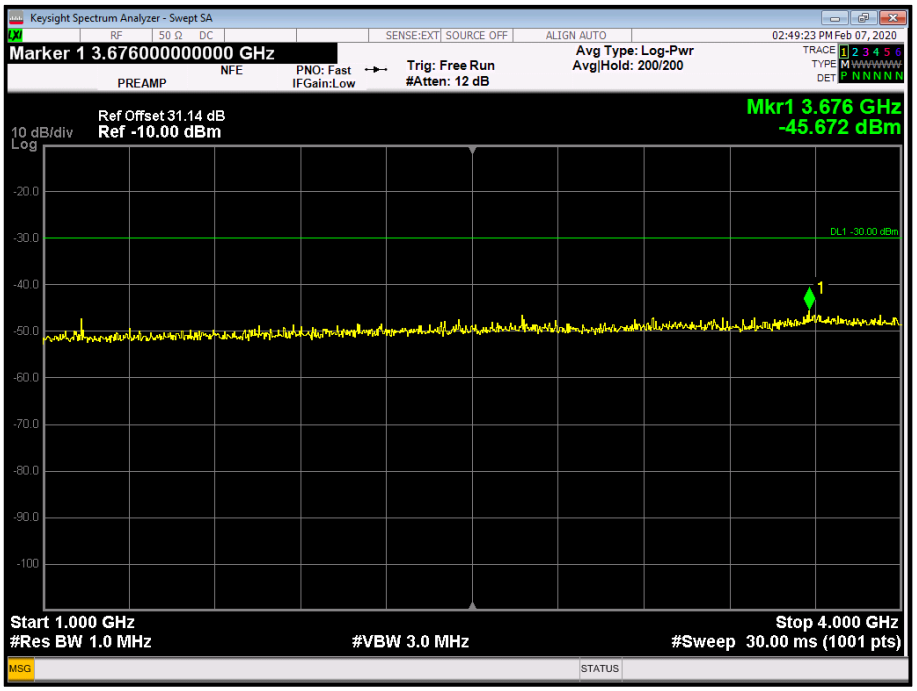

Figure 66 - 162.025 MHz - 1 GHz to 4 GHz

<u>IEC 62287-1, Limit Clause 11.3.2.3</u>

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.

2.14.7 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 Due
Dual Power Supply Unit	Hewlett Packard	6253A	271	-	O/P Mon
Power Supply Unit	Farnell	H60-25	1092	-	O/P Mon
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	16-Apr-2020
High Pass Filter	Mini-Circuits	NHP-300	1640	12	15-Jan-2021
Hygromer	Rotronic	Hygropalm	2404	12	02-May-2020
Hygrometer	Rotronic	I-1000	3220	12	25-Sep-2020
Attenuator (30dB, 150W)	Narda	769-30	3369	12	17-Jul-2020
Tunable Notch Filter	Wainwright	WRCD 130.0/170.0-0.05/50-5EEK	3412	-	TU
Multimeter	Fluke	177	3813	12	09-Oct-2020
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	16-Apr-2020
PXA Signal Analyser	Keysight Technologies	N9030A	4654	12	21-Oct-2020
Cable (40 GHz)	Rosenberger	LU1-001-500	5021	12	11-Jun-2020
Cable (18 GHz)	Rosenberger	LU7-036-2000	5035	-	O/P Mon

Table 42

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

3 Photographs

3.1 Equipment Under Test (EUT)

Figure 67 - Front View

Figure 68 - Rear View

4 Measurement Uncertainty

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

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

Table 43

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.