

Report on the Radio Testing of:

Ocean Signal Limited
Class A AIS. Model: ATA100

In accordance with IEC 61993-2

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



Add value.
Inspire trust.

COMMERCIAL-IN-CONFIDENCE

Document Number: 75936860-02 | Issue: 01

SIGNATURE

NAME	JOB TITLE	RESPONSIBLE FOR	ISSUE DATE
Matthew Russell	RF Team Leader	Authorised Signatory	01 October 2019

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

EXECUTIVE SUMMARY

A sample of this product was tested and found to be compliant with IEC 61993-2: 2018-07



DISCLAIMER AND COPYRIGHT

This non-binding report has been prepared by TÜV SÜD with all reasonable skill and care. The document is confidential to the potential Client and TÜV SÜD. No part of this document may be reproduced without the prior written approval of TÜV SÜD. © 2019 TÜV SÜD. This report relates only to the actual item/items tested.

ACCREDITATION

Our UKAS Accreditation does not cover opinions and interpretations and any expressed are outside the scope of our UKAS Accreditation. Results of tests not covered by our UKAS Accreditation Schedule are marked NUA (Not UKAS Accredited).

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

TÜV SÜD Ltd is a
TÜV SÜD Group Company

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

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



Contents

1	Report Summary	2
1.1	Report Modification Record.....	2
1.2	Introduction.....	2
1.3	Brief Summary of Results	3
1.4	Application Form	5
1.5	Product Information	6
1.6	Deviations from the Standard.....	6
1.7	EUT Modification Record	6
1.8	Test Location	7
2	Test Details	8
2.1	DSC Sensitivity.....	8
2.2	DSC Error Behaviour at High Input Levels.....	10
2.3	DSC Co-channel Rejection	12
2.4	DSC Adjacent Channel Selectivity.....	14
2.5	DSC Spurious Response Rejection	16
2.6	DSC Intermodulation Response Rejection.....	19
2.7	DSC Blocking or Desensitisation	21
2.8	Sensitivity	23
2.9	Error Behaviour at High Input Levels	25
2.10	Co-channel Rejection	27
2.11	Adjacent Channel Selectivity.....	29
2.12	Spurious Response Rejection	31
2.13	Intermodulation Response Rejection and Blocking	35
2.14	Spurious Emissions from the Receiver	37
2.15	Transmit to Receive Switching Time	41
2.16	Immunity to Out-of-Band Energy.....	43
2.17	Frequency Error	45
2.18	Carrier Power	47
2.19	Slotted Transmission Spectrum	49
2.20	Modulation Accuracy	53
2.21	Transmitter Output Power Characteristics	61
2.22	Spurious Emissions from the Transmitter	67
3	Photographs	80
3.1	Equipment Under Test (EUT).....	80
4	Measurement Uncertainty	81



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	01 October 2019

Table 1

1.2 Introduction

Applicant	Ocean Signal Limited
Manufacturer	Ocean Signal Limited
Model Number(s)	ATA100
Serial Number(s)	1234567Q (TA007)
Hardware Version(s)	Issue 01.00
Software Version(s)	00.1.00 (Apr 5 2019)
Number of Samples Tested	1
Test Specification/Issue/Date	IEC 61993-2: 2012
Order Number	3123-00
Date	31-October-2016
Date of Receipt of EUT	31-January-2018
Start of Test	25-April-2019
Finish of Test	03-June-2019
Name of Engineer(s)	Neil Rousell
FCC Accreditation	90987 Octagon House, Fareham Test Laboratory
Class of Emission (Manufacturer Declared)	16K0GXW



1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with IEC 61993-2 is shown below (with an FCC 47 CFR part 80 cross reference).

Section	Specification Clause		Test Description	Result	Comments/Base Standard
	IEC61993-2	FCC Part 80 Reference			
Configuration and Mode: DC Powered - TDMA Transmitter					
2.17	15.1.1	80.209	Frequency Error	Pass	
2.18	15.1.2	80.215	Carrier Power	Pass	
2.19	15.1.3	80.205 80.211	Slotted Transmission Spectrum	Pass	
2.20	15.1.4	80.213	Modulation Accuracy	Pass	
2.21	15.1.5	-	Transmitter Output Power Characteristics	Pass	
2.22	15.3.1	80.211	Spurious Emissions from the Transmitter	Pass	
Configuration and Mode: DC Powered - TDMA Receiver					
2.8	15.2.1	-	Sensitivity	Pass	
2.9	15.2.2	-	Error Behaviour at High Input Levels	Pass	
2.10	15.2.3	-	Co-channel Rejection	Pass	
2.11	15.2.4	-	Adjacent Channel Selectivity	Pass	
2.12	15.2.5	-	Spurious Response Rejection	Pass	
2.13	15.2.6	-	Intermodulation Response Rejection and Blocking	Pass	
2.14	15.3.2	80.217	Spurious Emissions from the Receiver	Pass	
2.15	15.2.7	-	Transmit to Receive Switching Time	Pass	
2.16	15.2.8	-	Immunity to Out-of-Band Energy	Pass	



Section	Specification Clause		Test Description	Result	Comments/Base Standard
	IEC61993-2	FCC Part 80 Reference			
Configuration and Mode: DC Powered - DSC Receiver					
2.1	C.2.1	-	DSC Sensitivity	Pass	
2.2	C.2.2	-	DSC Error Behaviour at High Input Levels	Pass	
2.3	C.2.3	-	DSC Co-channel Rejection	Pass	
2.4	C.2.4	-	DSC Adjacent Channel Selectivity	Pass	
2.5	C.2.5	-	DSC Spurious Response Rejection	Pass	
2.6	C.2.6	-	DSC Intermodulation Response Rejection	Pass	
2.7	C.2.7	-	DSC Blocking or Desensitisation	Pass	
-	C.2.8	-	DSC Spurious Emissions from the Receiver	N/T	EUT had no dedicated DSC receiver antenna connector.

Table 2



1.4 Application Form

MAIN EUT			
MANUFACTURING DESCRIPTION	Class A AIS transponder		
MANUFACTURER	Ocean Signal Ltd.		
MODEL NAME/NUMBER	ATA100		
PART NUMBER	760S-02697		
SERIAL NUMBER	N/A		
HARDWARE VERSION	TBD		
SOFTWARE VERSION	TBD		
PSU VOLTAGE/FREQUENCY/CURRENT	10.8-31.2Volts DSC, 6 amps		
HIGHEST INTERNALLY GENERATED / USED FREQUENCY	207.025MHz		
FCC ID (if applicable)	N/A		
INDUSTRY CANADA ID (if applicable)	N/A		
TECHNICAL DESCRIPTION (a brief description of the intended use and operation)	Class A AIS transponder		
COUNTRY OF ORIGIN	United Kingdom		
RF CHARACTERISTICS (if applicable)			
TRANSMITTER FREQUENCY OPERATING RANGE (MHz)	156.025 - 162.025 MHz		
RECEIVER FREQUENCY OPERATING RANGE (MHz)	156.025 - 162.025 MHz		
INTERMEDIATE FREQUENCIES	38.85/30.875/21.4MHz, 455kHz		
EMISSION DESIGNATOR(S): (i.e. G1D, GXW)	16K0GXW		
MODULATION TYPES: (i.e. GMSK, QPSK)	GMSK		
OUTPUT POWER (W or dBm)	12.5W		
SEPARATE BATTERY/POWER SUPPLY (if applicable)			
MANUFACTURING DESCRIPTION			
MANUFACTURER			
TYPE			
PART NUMBER			
PSU VOLTAGE/FREQUENCY/CURRENT			
COUNTRY OF ORIGIN			
MODULES (if applicable)			
MANUFACTURING DESCRIPTION			
MANUFACTURER			
TYPE			
POWER			
FCC ID			
INDUSTRY CANADA ID			
EMISSION DESIGNATOR			
DHSS/FHSS/COMBINED OR OTHER			
COUNTRY OF ORIGIN			
ANCILLARIES (if applicable)			
MANUFACTURING DESCRIPTION			
MANUFACTURER			
TYPE			
PART NUMBER			
SERIAL NUMBER			
COUNTRY OF ORIGIN			

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

Name: David Sheekey

Position held: Type Approval Manager

Date: 05/04/18



1.5 Product Information

1.5.1 Technical Description

Class A AIS transponder

1.6 Deviations from the Standard

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

1.7 EUT Modification Record

The table below details modifications made to the EUT during the test programme.
The modifications incorporated during each test are recorded on the appropriate test pages.

Modification State	Description of Modification still fitted to EUT	Modification Fitted By	Date Modification Fitted
Serial Number: TA007			
0	As supplied by the customer	Not Applicable	Not Applicable

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 - TDMA Transmitter		
Frequency Error	Neil Rousell	UKAS
Carrier Power	Neil Rousell	UKAS
Slotted Transmission Spectrum	Neil Rousell	UKAS
Modulation Accuracy	Neil Rousell	UKAS
Transmitter Output Power Characteristics	Neil Rousell	UKAS
Spurious Emissions from the Transmitter	Neil Rousell	UKAS
Configuration and Mode: DC Powered - TDMA Receiver		
Sensitivity	Neil Rousell	UKAS
Error Behaviour at High Input Levels	Neil Rousell	UKAS
Co-channel Rejection	Neil Rousell	UKAS
Adjacent Channel Selectivity	Neil Rousell	UKAS
Spurious Response Rejection	Neil Rousell	UKAS
Intermodulation Response Rejection and Blocking	Neil Rousell	UKAS
Spurious Emissions from the Receiver	Neil Rousell	UKAS
Transmit to Receive Switching Time	Neil Rousell	UKAS
Immunity to Out-of-Band Energy	Neil Rousell	UKAS
Configuration and Mode: DC Powered - DSC Receiver		
DSC Sensitivity	Neil Rousell	UKAS
DSC Error Behaviour at High Input Levels	Neil Rousell	UKAS
DSC Co-channel Rejection	Neil Rousell	UKAS
DSC Adjacent Channel Selectivity	Neil Rousell	UKAS
DSC Spurious Response Rejection	Neil Rousell	UKAS
DSC Intermodulation Response Rejection	Neil Rousell	UKAS
DSC Blocking or Desensitisation	Neil Rousell	UKAS
DSC Spurious Emissions from the Receiver	N/A	UKAS

Table 4

Office Address:

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



2 Test Details

2.1 DSC Sensitivity

2.1.1 Specification Reference

IEC 61993-2, Clause C.2.1

2.1.2 Equipment Under Test and Modification State

Class A, S/N: UNIT TA007 - Modification State 0

2.1.3 Date of Test

15-May-2019

2.1.4 Test Method

This test was performed in accordance with IEC 61993-2, clause C.2.1.2.

2.1.5 Environmental Conditions

Ambient Temperature 23.9 °C
Relative Humidity 30.1 %

2.1.6 Test Results

DC Powered - DSC Receiver

Frequency Offset (kHz)	Bit Error Rate
	156.525 MHz
-1500	0.00
0	0.00
1500	0.00

Table 5 - DSC Sensitivity Results at 23.9 °C, 12 V DC

Temperature	Voltage	Bit Error Rate
		156.525 MHz
-15.0 °C	10.8 V DC	0.00
+55.0 °C	31.2 V DC	0.00

Table 6 - DSC Sensitivity Results at Extreme Test Conditions

IEC 61993-2, Limit Clause C.2.1.3

The BER shall not exceed 10^{-2} .



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 Due
Digital Time Analyser	Marconi	2850-BS	80	-	TU
DSC Decoder/Encoder	TUV SUD	DSC TPOO1	81	-	TU
Climatic Chamber	Votsch	VT4002	161	-	O/P Mon
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	15-Oct-2019
Digital Temperature Indicator	Fluke	51	1385	12	17-Jan-2020
Signal Generator (250kHz to 4GHz)	Agilent Technologies	E4433B	2893	12	04-Sep-2019
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	17-Oct-2019
Combiner/Splitter	Weinschel	1506A	3878	12	23-Apr-2020
True RMS Multimeter	Fluke	179	4006	12	22-Jan-2020
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	22-Oct-2019
DSC Pre-emphasis Unit	TUV SUD	n/a	4369	12	10-Aug-2019
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	15-Oct-2019
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	06-Feb-2020
Hygrometer	Rotronic	HP21	4740	12	17-Jan-2020
Attenuator (10dB, 100W)	Weinschel	48-10-43	4867	12	06-Nov-2019
Quad Power Supply	Rohde & Schwarz	HMP4040	4954	-	O/P Mon

Table 7

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment



2.2 DSC Error Behaviour at High Input Levels

2.2.1 Specification Reference

IEC 61993-2, Clause C.2.2

2.2.2 Equipment Under Test and Modification State

Class A, S/N: UNIT TA007 - Modification State 0

2.2.3 Date of Test

15-May-2019

2.2.4 Test Method

This test was performed in accordance with IEC 61993-2, clause C.2.2.2.

2.2.5 Environmental Conditions

Ambient Temperature 23.9 °C

Relative Humidity 30.1 %

2.2.6 Test Results

DC Powered - DSC Receiver

Input Signal Level (dBm)	Bit Error Rate
	156.525 MHz
-7	0.00

Table 8 - DSC Error Behaviour at High Input Level Results

IEC 61993-2, Limit Clause C.2.2.3

The BER shall not exceed 10^{-2} .



2.2.7 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
Digital Time Analyser	Marconi	2850-BS	80	-	TU
DSC Decoder/Encoder	TUV SUD	DSC TPOO1	81		TU
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	15-Oct-2019
Signal Generator (250kHz to 4GHz)	Agilent Technologies	E4433B	2893	12	04-Sep-2019
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	17-Oct-2019
Combiner/Splitter	Weinschel	1506A	3878	12	23-Apr-2020
True RMS Multimeter	Fluke	179	4006	12	22-Jan-2020
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	22-Oct-2019
DSC Pre-emphasis Unit	TUV SUD	n/a	4369	12	10-Aug-2019
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	15-Oct-2019
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	06-Feb-2020
Hygrometer	Rotronic	HP21	4740	12	17-Jan-2020
Attenuator (10dB, 100W)	Weinschel	48-10-43	4867	12	06-Nov-2019
Quad Power Supply	Rohde & Schwarz	HMP4040	4954	-	O/P Mon

Table 9

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment



2.3 DSC Co-channel Rejection

2.3.1 Specification Reference

IEC 61993-2, Clause C.2.3

2.3.2 Equipment Under Test and Modification State

Class A, S/N: UNIT TA007 - Modification State 0

2.3.3 Date of Test

15-May-2019

2.3.4 Test Method

This test was performed in accordance with IEC 61993-2, clause C.2.3.2.

2.3.5 Environmental Conditions

Ambient Temperature 23.9 °C

Relative Humidity 30.1 %

2.3.6 Test Results

DC Powered - DSC Receiver

Frequency Offset (kHz)	Bit Error Rate
	156.525 MHz
-3000	0.00
0	0.00
+3000	0.00

Table 10 - DSC Co-channel Rejection Results

IEC 61993-2, Limit Clause C.2.3.3

The BER shall not exceed 10^{-2} .



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
Digital Time Analyser	Marconi	2850-BS	80	-	TU
DSC Decoder/Encoder	TUV SUD	DSC TPOO1	81	-	TU
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	15-Oct-2019
Signal Generator (250kHz to 4GHz)	Agilent Technologies	E4433B	2893	12	04-Sep-2019
Signal Generator, 9kHz - 3GHz	Rohde & Schwarz	SMA 100A	3504	12	22-Aug-2019
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	17-Oct-2019
Combiner/Splitter	Weinschel	1506A	3878	12	23-Apr-2020
True RMS Multimeter	Fluke	179	4006	12	22-Jan-2020
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	22-Oct-2019
DSC Pre-emphasis Unit	TUV SUD	n/a	4369	12	10-Aug-2019
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	15-Oct-2019
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	06-Feb-2020
Hygrometer	Rotronic	HP21	4740	12	17-Jan-2020
Attenuator (10dB, 100W)	Weinschel	48-10-43	4867	12	06-Nov-2019
Quad Power Supply	Rohde & Schwarz	HMP4040	4954	-	O/P Mon

Table 11

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment



2.4 DSC Adjacent Channel Selectivity

2.4.1 Specification Reference

IEC 61993-2, Clause C.2.4

2.4.2 Equipment Under Test and Modification State

Class A, S/N: UNIT TA007 - Modification State 0

2.4.3 Date of Test

16-May-2019

2.4.4 Test Method

This test was performed in accordance with IEC 61993-2, clause C.2.4.2.

2.4.5 Environmental Conditions

Ambient Temperature 20.7 °C

Relative Humidity 33.9 %

2.4.6 Test Results

DC Powered - DSC Receiver

Temperature	Voltage	Bit Error Rate	
		Lower Adjacent Channel	Upper Adjacent Channel
+20.7 °C	12 V DC	0.00	0.00
-15.0 °C	10.8 V DC	0.00	0.00
+55.0 °C	31.2 V DC	0.00	0.00

Table 12 - DSC Adjacent Channel Selectivity Results

IEC 61993-2, Limit Clause C.2.4.3

The BER shall not exceed 10^{-2} .



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 Due
Digital Time Analyser	Marconi	2850-BS	80	-	TU
DSC Decoder/Encoder	TUV SUD	DSC TPOO1	81	-	TU
Climatic Chamber	Votsch	VT4002	161	-	O/P Mon
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	15-Oct-2019
Digital Temperature Indicator	Fluke	51	1385	12	17-Jan-2020
Signal Generator (250kHz to 4GHz)	Agilent Technologies	E4433B	2893	12	04-Sep-2019
Signal Generator, 9kHz - 3GHz	Rohde & Schwarz	SMA 100A	3504	12	22-Aug-2019
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	17-Oct-2019
Combiner/Splitter	Weinschel	1506A	3878	12	23-Apr-2020
True RMS Multimeter	Fluke	179	4006	12	22-Jan-2020
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	22-Oct-2019
DSC Pre-empahsis Unit	TUV SUD	n/a	4369	12	10-Aug-2019
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	15-Oct-2019
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	06-Feb-2020
Hygrometer	Rotronic	HP21	4740	12	17-Jan-2020
Attenuator (10dB, 100W)	Weinschel	48-10-43	4867	12	06-Nov-2019
Quad Power Supply	Rohde & Schwarz	HMP4040	4954	-	O/P Mon

Table 13

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment



2.5 DSC Spurious Response Rejection

2.5.1 Specification Reference

IEC 61993-2, Clause C.2.5

2.5.2 Equipment Under Test and Modification State

Class A, S/N: UNIT TA007 - Modification State 0

2.5.3 Date of Test

31-May-2019 to 03-June-2019

2.5.4 Test Method

This test was performed in accordance with IEC 61993-2, clause C.2.5.4.

2.5.5 Environmental Conditions

Ambient Temperature 21.1 °C

Relative Humidity 42.9 %

2.5.6 Test Results

DC Powered - DSC Receiver

Test Parameter	Value
List of Intermediate Frequencies	IF1 = 38.85 MHz, IF2 = 0.455 MHz
Switching Range of the Receiver	N/A
Frequency of the Local Oscillator at 156.525 MHz	117.675 MHz
Calculated Limited Frequency Range	78.37 MHz to 156.98 MHz

Table 14 - Test Parameters for DSC Spurious Response Rejection

Frequency (MHz)	BER (%)
*	

Table 15 - DSC Spurious Responses

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



K	Calculated Frequency (MHz) for SF11	BER (%)
		156.525 MHz
-2	196.5	0.00
2	274.2	0.00
-3	314.175	0.00
3	391.875	0.00
-4	431.85	0.00
4	509.55	0.00

Table 16 - Identified Frequencies DSC Spurious Responses

IEC 61993-2 Limit Clause C.2.5.5

At any frequency separated from the nominal frequency of the receiver by two or more, the BER shall not exceed 10^{-2} .



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 Due
Digital Time Analyser	Marconi	2850-BS	80	-	TU
DSC Decoder/Encoder	TUV SUD	DSC TPOO1	81	-	TU
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	15-Oct-2019
Signal Generator (250kHz to 4GHz)	Agilent Technologies	E4433B	2893	12	04-Sep-2019
Tunable Notch Filter	Wainwright	WRCD 130.0/170.0-0.05/50-5EEK	3412	-	TU
Signal Generator, 9kHz - 3GHz	Rohde & Schwarz	SMA 100A	3504	12	22-Aug-2019
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	17-Oct-2019
Combiner/Splitter	Weinschel	1506A	3878	12	23-Apr-2020
True RMS Multimeter	Fluke	179	4006	12	22-Jan-2020
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	22-Oct-2019
DSC Pre-emphasis Unit	TUV SUD	n/a	4369	12	10-Aug-2019
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	15-Oct-2019
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	06-Feb-2020
Hygrometer	Rotronic	HP21	4740	12	17-Jan-2020
Attenuator (10dB, 100W)	Weinschel	48-10-43	4867	12	06-Nov-2019
Quad Power Supply	Rohde & Schwarz	HMP4040	4954	-	O/P Mon

Table 17

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment



2.6 DSC Intermodulation Response Rejection

2.6.1 Specification Reference

IEC 61993-2, Clause C.2.6

2.6.2 Equipment Under Test and Modification State

Class A, S/N: UNIT TA007 - Modification State 0

2.6.3 Date of Test

16-May-2019

2.6.4 Test Method

This test was performed in accordance with IEC 61993-2, clause C.2.6.2.

2.6.5 Environmental Conditions

Ambient Temperature 20.7 °C

Relative Humidity 33.9 %

2.6.6 Test Results

DC Powered - DSC Receiver

Test Number	Generator A (Test Signal #1)	Generator B (Unmodulated ± 50 kHz)	Generator C (Modulated ± 100 kHz)	Bit Error Rate
				156.525 MHz
1	156.525	156.475	156.425	0
2	156.525	156.575	156.625	0

Table 18 - DSC Intermodulation Results

IEC 61993-2 Limit clause C.2.6.3

The BER shall not exceed 10^{-2} .



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 Due
Signal Generator	Rohde & Schwarz	SMY 01	49	12	01-Nov-2019
Digital Time Analyser	Marconi	2850-BS	80	-	TU
DSC Decoder/Encoder	TUV SUD	DSC TPOO1	81	-	TU
Attenuator (10dB)	Weinschel	47-10-34	481	12	18-Jul-2019
Power Splitter	Weinschel	1506A	607	12	23-Apr-2020
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	15-Oct-2019
Signal Generator (250kHz to 4GHz)	Agilent Technologies	E4433B	2893	12	04-Sep-2019
Signal Generator, 9kHz - 3GHz	Rohde & Schwarz	SMA 100A	3504	12	22-Aug-2019
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	17-Oct-2019
Combiner/Splitter	Weinschel	1506A	3878	12	23-Apr-2020
True RMS Multimeter	Fluke	179	4006	12	22-Jan-2020
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	22-Oct-2019
DSC Pre-empahsis Unit	TUV SUD	n/a	4369	12	10-Aug-2019
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	15-Oct-2019
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	06-Feb-2020
Hygrometer	Rotronic	HP21	4740	12	17-Jan-2020
Attenuator (10dB, 100W)	Weinschel	48-10-43	4867	12	06-Nov-2019
Quad Power Supply	Rohde & Schwarz	HMP4040	4954	-	O/P Mon

Table 19

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment



2.7 DSC Blocking or Desensitisation

2.7.1 Specification Reference

IEC 61993-2, Clause C.2.7

2.7.2 Equipment Under Test and Modification State

Class A, S/N: UNIT TA007 - Modification State 0

2.7.3 Date of Test

16-May-2019

2.7.4 Test Method

This test was performed in accordance with IEC 61993-2, clause C.2.7.2.

2.7.5 Environmental Conditions

Ambient Temperature 20.7 °C

Relative Humidity 33.9 %

2.7.6 Test Results

DC Powered - DSC Receiver

Unwanted Signal Frequency Offset (MHz)	Bit Error Rate
	156.525 MHz
-10	0.00
-1	0.00
+1	0.00
+10	0.00

Table 20 - DSC Blocking Results

IEC 61993-2, Limit Clause C.2.7.3

The BER shall not exceed 10^{-2} .



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
Digital Time Analyser	Marconi	2850-BS	80	-	TU
DSC Decoder/Encoder	TUV SUD	DSC TPOO1	81	-	TU
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	15-Oct-2019
Signal Generator (250kHz to 4GHz)	Agilent Technologies	E4433B	2893	12	04-Sep-2019
Signal Generator, 9kHz - 3GHz	Rohde & Schwarz	SMA 100A	3504	12	22-Aug-2019
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	17-Oct-2019
Combiner/Splitter	Weinschel	1506A	3878	12	23-Apr-2020
True RMS Multimeter	Fluke	179	4006	12	22-Jan-2020
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	22-Oct-2019
DSC Pre-emphasis Unit	TUV SUD	n/a	4369	12	10-Aug-2019
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	15-Oct-2019
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	06-Feb-2020
Hygrometer	Rotronic	HP21	4740	12	17-Jan-2020
Attenuator (10dB, 100W)	Weinschel	48-10-43	4867	12	06-Nov-2019
Quad Power Supply	Rohde & Schwarz	HMP4040	4954	-	O/P Mon

Table 21

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment



2.8 Sensitivity

2.8.1 Specification Reference

IEC 61993-2, Clause 15.2.1

2.8.2 Equipment Under Test and Modification State

Class A, S/N: UNIT TA007 - Modification State 0

2.8.3 Date of Test

01-May-2019

2.8.4 Test Method

This test was performed in accordance with IEC 61993-2, clause 15.2.1.2.

2.8.5 Environmental Conditions

Ambient Temperature 21.1 - 21.5 °C

Relative Humidity 37.8 - 43.9 %

2.8.6 Test Results

DC Powered - TDMA Receiver

Frequency Offset (Hz)	Packet Error Rate (%)			
	156.025 MHz		162.025 MHz	
	Rx1	Rx2	Rx1	Rx2
-500	0.0	0.0	0.0	0.5
0	2.5	1.5	1.5	0.5
500	0.0	0.5	1.0	0.5

Table 22 - Sensitivity Results at 21.5 °C, 12.0 V DC

Test Conditions		Packet Error Rate (%)			
Temperature	Voltage	156.025 MHz		162.025 MHz	
		Rx1	Rx2	Rx1	Rx2
-15.0 °C	10.8 V DC	0	0.5	0	0
+55.0 °C	31.2 V DC	0	0	0	0

Table 23 - Sensitivity Results at Extreme Test Conditions



IEC 61993-2, Limit Clause 15.2.1.3

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
Climatic Chamber	Votsch	VT4002	161	-	O/P Mon
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	15-Oct-2019
Digital Temperature Indicator	Fluke	51	1385	12	17-Jan-2020
Signal Generator (250kHz to 4GHz)	Agilent Technologies	E4433B	2893	12	04-Sep-2019
Programmable Modulation Waveform Generator	Sine Qua Non	PMG1	3291	-	O/P Mon
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	17-Oct-2019
DC to TTL Converter	TUV SUD	-	3599	-	TU
Combiner/Splitter	Weinschel	1506A	3878	12	23-Apr-2020
True RMS Multimeter	Fluke	179	4006	12	22-Jan-2020
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	22-Oct-2019
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	15-Oct-2019
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	06-Feb-2020
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	O/P Mon
Hygrometer	Rotronic	HP21	4740	12	17-Jan-2020
Attenuator (10dB, 100W)	Weinschel	48-10-43	4867	12	06-Nov-2019
Quad Power Supply	Rohde & Schwarz	HMP4040	4954	-	O/P Mon

Table 24

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment



2.9 Error Behaviour at High Input Levels

2.9.1 Specification Reference

IEC 61993-2, Clause 15.2.2

2.9.2 Equipment Under Test and Modification State

Class A, S/N: UNIT TA007 - Modification State 0

2.9.3 Date of Test

01-May-2019

2.9.4 Test Method

This test was performed in accordance with IEC 61993-2, clause 15.2.2.2.

2.9.5 Environmental Conditions

Ambient Temperature 21.5 °C

Relative Humidity 43.9 %

2.9.6 Test Results

DC Powered - TDMA Receiver

Input Signal Level (dBm)	Packet Error Rate (%)			
	156.025 MHz		162.025 MHz	
	Rx1	Rx2	Rx1	Rx2
-77	0	0.5	0	0
-7	0.5	0.5	0.5	0.5

Table 25 - Error Behaviour at High Input Level Results

IEC 61993-2, Limit Clause 15.2.2.3

The PER shall not exceed 1%.



2.9.7 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
Climatic Chamber	Votsch	VT4002	161	-	O/P Mon
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	15-Oct-2019
Digital Temperature Indicator	Fluke	51	1385	12	17-Jan-2020
Signal Generator (250kHz to 4GHz)	Agilent Technologies	E4433B	2893	12	04-Sep-2019
Programmable Modulation Waveform Generator	Sine Qua Non	PMG1	3291	-	O/P Mon
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	17-Oct-2019
DC to TTL Converter	TUV SUD	-	3599	-	TU
Combiner/Splitter	Weinschel	1506A	3878	12	23-Apr-2020
True RMS Multimeter	Fluke	179	4006	12	22-Jan-2020
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	22-Oct-2019
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	15-Oct-2019
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	06-Feb-2020
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	O/P Mon
Hygrometer	Rotronic	HP21	4740	12	17-Jan-2020
Attenuator (10dB, 100W)	Weinschel	48-10-43	4867	12	06-Nov-2019
Quad Power Supply	Rohde & Schwarz	HMP4040	4954	-	O/P Mon

Table 26

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment



2.10 Co-channel Rejection

2.10.1 Specification Reference

IEC 61993-2, Clause 15.2.3

2.10.2 Equipment Under Test and Modification State

Class A, S/N: UNIT TA007 - Modification State 0

2.10.3 Date of Test

07-May-2019

2.10.4 Test Method

This test was performed in accordance with IEC 61993-2, clause 15.2.3.2.

2.10.5 Environmental Conditions

Ambient Temperature 24.5 °C

Relative Humidity 33.8 %

2.10.6 Test Results

DC Powered - TDMA Receiver

Unwanted Signal Frequency Offset (Hz)	Packet Error Rate (%)			
	156.025 MHz		162.025 MHz	
	Rx1	Rx2	Rx1	Rx2
-1000	17.6	8.5	16.6	8.5
0	9.5	13.1	12.6	13.1
+1000	9.0	18.6	8.5	19.6

Table 27 - Co-channel Rejection Results

IEC 61993-2, Limit Clause 15.2.3.3

The PER shall not exceed 20%.



2.10.7 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	15-Oct-2019
Signal Generator (250kHz to 4GHz)	Agilent Technologies	E4433B	2893	12	04-Sep-2019
Programmable Modulation Waveform Generator	Sine Qua Non	PMG1	3291	-	O/P Mon
Signal Generator, 9kHz - 3GHz	Rohde & Schwarz	SMA 100A	3504	12	22-Aug-2019
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	17-Oct-2019
DC to TTL Converter	TUV SUD	-	3599	-	TU
Combiner/Splitter	Weinschel	1506A	3878	12	23-Apr-2020
Thermocouple Data Logger	Pico Technology Ltd	USB TC-08	3911	12	26-Oct-2019
True RMS Multimeter	Fluke	179	4006	12	22-Jan-2020
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	22-Oct-2019
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	15-Oct-2019
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	06-Feb-2020
Hygrometer	Rotronic	HP21	4740	12	17-Jan-2020
Attenuator (10dB, 100W)	Weinschel	48-10-43	4867	12	06-Nov-2019
Quad Power Supply	Rohde & Schwarz	HMP4040	4954	-	O/P Mon

Table 28

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment



2.11 Adjacent Channel Selectivity

2.11.1 Specification Reference

IEC 61993-2, Clause 15.2.4

2.11.2 Equipment Under Test and Modification State

Class A, S/N: UNIT TA007 - Modification State 0

2.11.3 Date of Test

07-May-2019

2.11.4 Test Method

This test was performed in accordance with IEC 61993-2, clause 15.2.4.2.

2.11.5 Environmental Conditions

Ambient Temperature 24.5 °C

Relative Humidity 33.8 %

2.11.6 Test Results

DC Powered - TDMA Receiver

Test Conditions		Unwanted Signal Frequency Offset (kHz)	Packet Error Rate (%)			
			156.025 MHz		162.025 MHz	
Temperature	Voltage		Rx1	Rx2	Rx1	Rx2
24.5 °C	12.0 V DC	-25	2.5	0	7.5	5.0
		25	1.5	0	4.0	6.0
-15.0 °C	10.8 V DC	-25	0	0.5	0.5	0
		25	0	0	0	0
+55.0 °C	31.2 V DC	-25	0	0	0	0
		25	0	0	0	0

Table 29 - Adjacent Channel Selectivity Results

IEC 61993-2, Limit Clause 15.2.4.3

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
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	15-Oct-2019
Signal Generator (250kHz to 4GHz)	Agilent Technologies	E4433B	2893	12	04-Sep-2019
Programmable Modulation Waveform Generator	Sine Qua Non	PMG1	3291	-	O/P Mon
Signal Generator, 9kHz - 3GHz	Rohde & Schwarz	SMA 100A	3504	12	22-Aug-2019
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	17-Oct-2019
DC to TTL Converter	TUV SUD	-	3599	-	TU
Combiner/Splitter	Weinschel	1506A	3878	12	23-Apr-2020
Thermocouple Data Logger	Pico Technology Ltd	USB TC-08	3911	12	26-Oct-2019
True RMS Multimeter	Fluke	179	4006	12	22-Jan-2020
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	22-Oct-2019
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	15-Oct-2019
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	06-Feb-2020
Hygrometer	Rotronic	HP21	4740	12	17-Jan-2020
Attenuator (10dB, 100W)	Weinschel	48-10-43	4867	12	06-Nov-2019
Quad Power Supply	Rohde & Schwarz	HMP4040	4954	-	O/P Mon

Table 30

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment



2.12 Spurious Response Rejection

2.12.1 Specification Reference

IEC 61993-2, Clause 15.2.5

2.12.2 Equipment Under Test and Modification State

Class A, S/N: UNIT TA007 - Modification State 0

2.12.3 Date of Test

13-May-2019 to 14-May-2019

2.12.4 Test Method

This test was performed in accordance with IEC 61993-2, clause 15.2.5.4 and 15.2.5.5.

2.12.5 Environmental Conditions

Ambient Temperature 26.5 °C

Relative Humidity 33.4 %

2.12.6 Test Results

DC Powered - TDMA Receiver

Test Parameter	Value
List of Intermediate Frequencies	RX1 IF1 = 21.4 MHz, RX2 IF1 = 30.875 MHz, RX1 IF2 = 0.455 MHz, RX2 IF2 = 0.455 MHz
Switching Range of the Receiver	6 MHz
Frequency of the Local Oscillator at 162.025 MHz (AIS2)	RX1 140.625 MHz, RX2 125.150 MHz
Frequency of the Local Oscillator at 156.025 MHz	RX1 134.625 MHz, RX2 131.150 MHz
Calculated Limited Frequency Range	RX1 109.77 MHz to 165.48 MHz, RX2 96.82 MHz to 159.48 MHz

Table 31 - Test Parameters for Spurious Response Rejection

Frequency (MHz)	PER (%)
*	

Table 32 - Spurious Responses - 156.025 MHz

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



Frequency (MHz)	PER (%)

Table 33 - Spurious Responses - 162.025 MHz

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

K	Calculated Frequency (MHz) for SFI1	PER (%) - Rx1	
		156.025 MHz	162.025 MHz
-2	259.85		0
2	302.65		0
-3	400.475		0
3	443.275		0
-4	541.1		0
4	583.9		0

Table 34 - Identified Frequencies Spurious Responses (SFI₁) for Rx1

K	Calculated Frequency (MHz) for SFI1	PER (%) - Rx1	
		156.025 MHz	162.025 MHz
-2	247.85	0	
2	290.65	0	
-3	382.475	0	
3	425.275	0	
-4	517.1	0	
4	559.9	0	

Table 35 - Identified Frequencies Spurious Responses (SFI₂) for Rx1



K	Calculated Frequency (MHz) for SFI1	PER (%) - Rx2	
		156.025 MHz	162.025 MHz
-2	219.425		0
2	281.175		0
-3	344.575		0
3	406.325		0
-4	469.725		0
4	531.475		0

Table 36 - Identified Frequencies Spurious Responses (SFI₁) for Rx2

K	Calculated Frequency (MHz) for SFI2	PER (%) - Rx2	
		156.025 MHz	162.025 MHz
-2	231.425	0	
2	293.175	0	
-3	362.575	0	
3	424.325	0	
-4	493.725	0	
4	555.475	0	

Table 37 - - Identified Frequencies Spurious Responses (SFI₂) for Rx2

IEC 61993-2 Limit Clause 15.2.5.8

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%.



2.12.7 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
Audio Analyser	Hewlett Packard	8903B	576	12	17-Jan-2020
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	15-Oct-2019
Signal Generator (250kHz to 4GHz)	Agilent Technologies	E4433B	2893	12	04-Sep-2019
Programmable Modulation Waveform Generator	Sine Qua Non	PMG1	3291	-	O/P Mon
Tunable Notch Filter	Wainwright	WRCD 130.0/170.0-0.05/50-5EEK	3412	-	TU
Signal Generator, 9kHz - 3GHz	Rohde & Schwarz	SMA 100A	3504	12	22-Aug-2019
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	17-Oct-2019
DC to TTL Converter	TUV SUD	-	3599	-	TU
Combiner/Splitter	Weinschel	1506A	3878	12	23-Apr-2020
Thermocouple Data Logger	Pico Technology Ltd	USB TC-08	3911	12	26-Oct-2019
True RMS Multimeter	Fluke	179	4006	12	22-Jan-2020
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	22-Oct-2019
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	15-Oct-2019
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	06-Feb-2020
Hygrometer	Rotronic	HP21	4740	12	17-Jan-2020
Attenuator (10dB, 100W)	Weinschel	48-10-43	4867	12	06-Nov-2019
Quad Power Supply	Rohde & Schwarz	HMP4040	4954	-	O/P Mon

Table 38

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment



2.13 Intermodulation Response Rejection and Blocking

2.13.1 Specification Reference

IEC 61993-2, Clause 15.2.6

2.13.2 Equipment Under Test and Modification State

Class A, S/N: UNIT TA007 - Modification State 0

2.13.3 Date of Test

08-May-2019

2.13.4 Test Method

This test was performed in accordance with IEC 61993-2, clause 15.2.6.2.

2.13.5 Environmental Conditions

Ambient Temperature 25.9 °C

Relative Humidity 36.2 %

2.13.6 Test Results

DC Powered - TDMA Receiver

Test Number	Generator A (Wanted Signal)	Generator B (Unmodulated ±500 kHz)	Generator C (Modulated ±1000 kHz)	Generator D (Unmodulated ±5.725 MHz)	Packet Error Rate (%)	
					Rx1	Rx2
1	156.025	156.525	157.025	161.750	1.5	0
2	162.025	161.525	161.025	156.300	4.0	1.5

Table 39 - Intermodulation and Blocking Results

IEC 61993-2 Limit clause 15.2.6.3

The PER shall not exceed 20%.



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
Signal Generator	Rohde & Schwarz	SMY 01	49	12	01-Nov-2019
Signal Generator	Rohde & Schwarz	SMY 01	118	12	11-Dec-2019
Attenuator 10dB 75W	Bird	8308-100	386	12	17-Jul-2019
Attenuator (10dB)	Weinschel	47-10-34	481	12	18-Jul-2019
Power Divider	Weinschel	1506A	603	12	23-Apr-2020
Power Splitter	Weinschel	1506A	607	12	23-Apr-2020
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	15-Oct-2019
Signal Generator (250kHz to 4GHz)	Agilent Technologies	E4433B	2893	12	04-Sep-2019
Programmable Modulation Waveform Generator	Sine Qua Non	PMG1	3291	-	O/P Mon
Tunable Notch Filter	Wainwright	WRCD 130.0/170.0-0.05/50-5EEK	3412		TU
Signal Generator, 9kHz - 3GHz	Rohde & Schwarz	SMA 100A	3504	12	22-Aug-2019
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	17-Oct-2019
Combiner/Splitter	Weinschel	1506A	3878	12	23-Apr-2020
True RMS Multimeter	Fluke	179	4006	12	22-Jan-2020
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	22-Oct-2019
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	15-Oct-2019
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	06-Feb-2020
Hygrometer	Rotronic	HP21	4740	12	17-Jan-2020
Attenuator (10dB, 100W)	Weinschel	48-10-43	4867	12	06-Nov-2019
Quad Power Supply	Rohde & Schwarz	HMP4040	4954	-	O/P Mon

Table 40

TU - Traceability Unscheduled

O/P Mon – Output Monitored using calibrated equipment



2.14 Spurious Emissions from the Receiver

2.14.1 Specification Reference

IEC 61993-2, Clause 15.3.2

2.14.2 Equipment Under Test and Modification State

Class A, S/N: UNIT TA007 - Modification State 0

2.14.3 Date of Test

30-April-2019

2.14.4 Test Method

This test was performed in accordance with IEC 61993-2, clause 15.3.2.2.

Note that Channel A was tuned to 156.025 MHz and channel B 162.025 MHz for the duration of the test.

2.14.5 Environmental Conditions

Ambient Temperature 23.3 °C
Relative Humidity 34.9 %

2.14.6 Test Results

DC Powered - TDMA Receiver

Frequency (MHz)	Level (dBm)
*	

Table 41 - Receiver Emissions Results

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

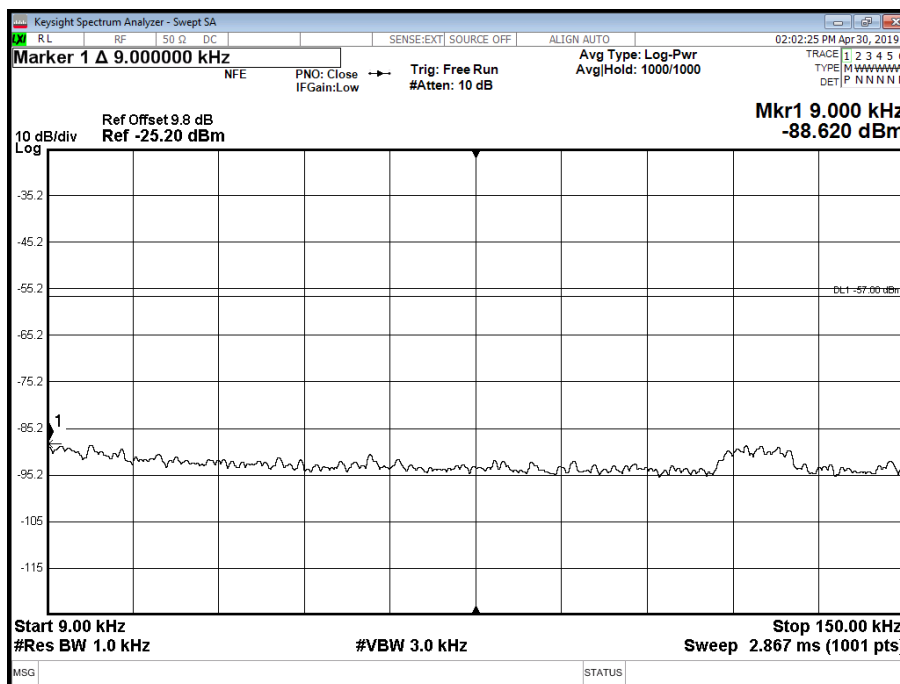


Figure 1 - 9 kHz to 150 kHz

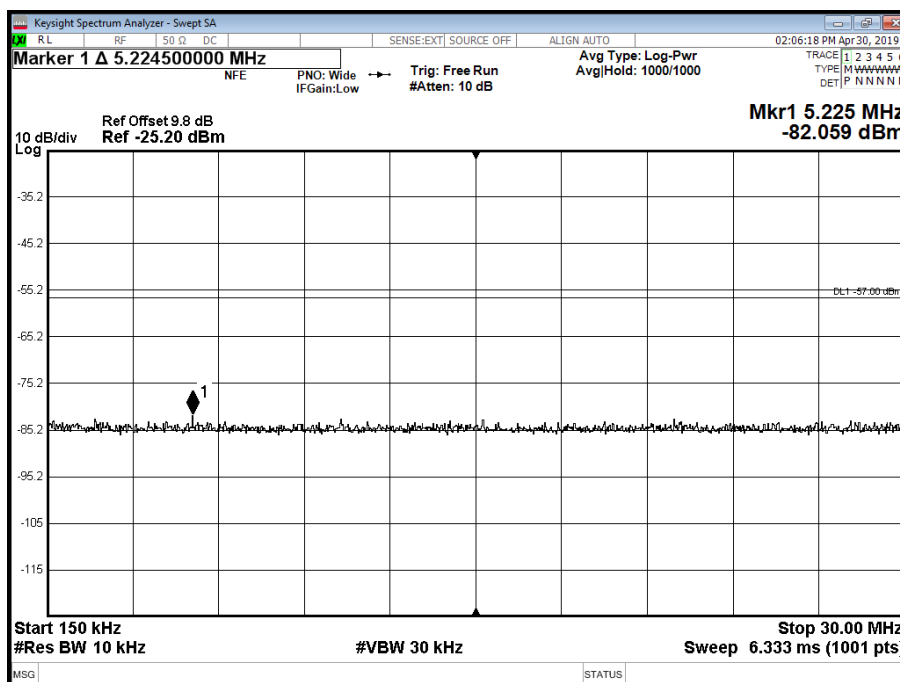


Figure 2 - 150 kHz to 30 MHz

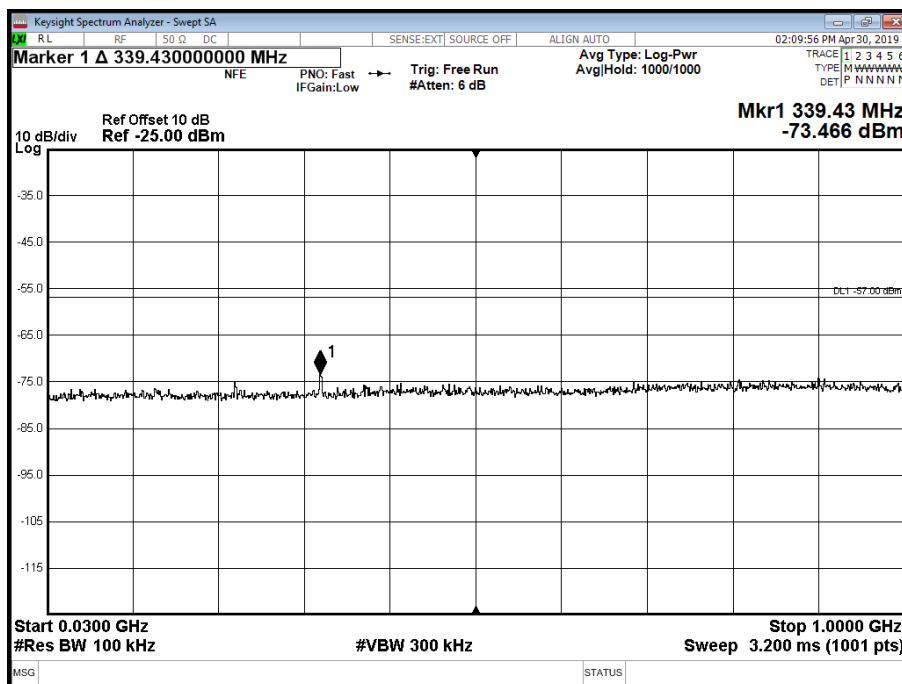


Figure 3 - 30 MHz to 1 GHz

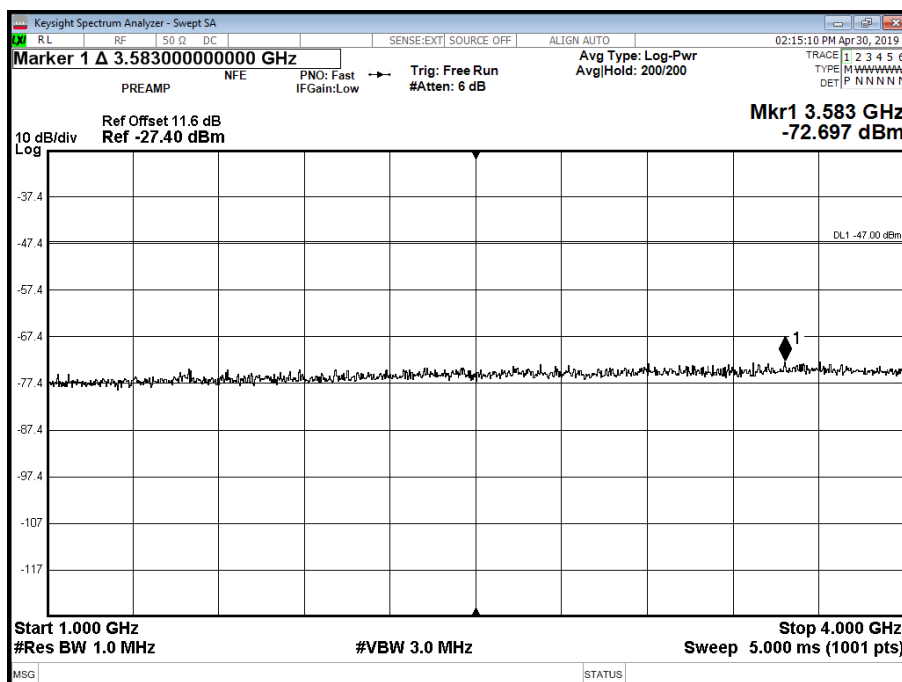


Figure 4 - 1 GHz to 4 GHz



IEC 61993-2, Limit Clause 15.3.2.3

The power of any spurious emission in the specified range at the antenna terminal shall not exceed –57 dBm (2 nW) in the frequency range 9 kHz to 1 GHz and –47 dBm (20 nW) in the frequency range 1 GHz to 4 GHz.

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

The EUT shall deliver not more than the following amounts of power, to an artificial antenna having electrical characteristics equivalent to those of the average receiving antenna(s) use on shipboard:

Frequency of interfering emissions	Power to artificial antenna in μ W	Power to artificial antenna (dBm)
Below 30 MHz	400	-4.0
30 to 100 MHz	4,000	6.0
100 to 300 MHz	40,000	16.0
Over 300 MHz	400,000	26.0

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

2.14.7 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	15-Oct-2019
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	17-Oct-2019
True RMS Multimeter	Fluke	179	4006	12	22-Jan-2020
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	22-Oct-2019
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	15-Oct-2019
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	06-Feb-2020
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	O/P Mon
Hygrometer	Rotronic	HP21	4740	12	17-Jan-2020
Attenuator (10dB, 100W)	Weinschel	48-10-43	4867	12	06-Nov-2019
Quad Power Supply	Rohde & Schwarz	HMP4040	4954	-	O/P Mon

Table 42

O/P Mon – Output Monitored using calibrated equipment



2.15 Transmit to Receive Switching Time

2.15.1 Specification Reference

IEC 61993-2, Clause 15.2.7

2.15.2 Equipment Under Test and Modification State

Class A, S/N: UNIT TA007 - Modification State 0

2.15.3 Date of Test

09-May-2019

2.15.4 Test Method

This test was performed in accordance with IEC 61993-2, clause 15.2.7.2.

The RX trigger was derived from TX transmission every 2s. PER was derived from total number of packets received after 400s (200 PKTS).

2.15.5 Environmental Conditions

Ambient Temperature 20.1 °C
Relative Humidity 53.6 %

2.15.6 Test Results

DC Powered - TDMA Receiver

156.025 MHz		162.025 MHz	
PER (%) – Rx 1	PER (%) – Rx 2	PER (%) – Rx 1	PER (%) – Rx 2
4.5	6.5	12.0	15.0

Table 43 – Transmit to Receive Switching Time



2.15.7 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	15-Oct-2019
Signal Generator (250kHz to 4GHz)	Agilent Technologies	E4433B	2893	12	04-Sep-2019
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	17-Oct-2019
Combiner/Splitter	Weinschel	1506A	3877	12	12-Apr-2019
True RMS Multimeter	Fluke	179	4006	12	22-Jan-2020
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	22-Oct-2019
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	15-Oct-2019
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	06-Feb-2020
Hygrometer	Rotronic	HP21	4740	12	17-Jan-2020
Quad Power Supply	Rohde & Schwarz	HMP4040	4954	-	O/P Mon
Attenuator 30dB 100W	Weinschel	48-30-43-LIM	5135	12	07-Nov-2019

Table 44

O/P Mon – Output Monitored using calibrated equipment



2.16 Immunity to Out-of-Band Energy

2.16.1 Specification Reference

IEC 61993-2, Clause 15.2.8

2.16.2 Equipment Under Test and Modification State

Class A, S/N: UNIT TA007 - Modification State 0

2.16.3 Date of Test

09-May-2019

2.16.4 Test Method

This test was performed in accordance with IEC 61993-2, clause 15.2.8.2.

2.16.5 Environmental Conditions

Ambient Temperature 20.1 °C

Relative Humidity 53.6 %

2.16.6 Test Results

DC Powered - TDMA Receiver

Packet Error Rate (%)			
156.025 MHz		162.025 MHz	
Rx1	Rx2	Rx1	Rx2
0	0	0	0

Table 45 - Immunity to Out-of-Band Energy

IEC 61993-2, Limit Clause 15.2.8.3

The PER shall not exceed 20%.



2.16.7 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	15-Oct-2019
Signal Generator (250kHz to 4GHz)	Agilent Technologies	E4433B	2893	12	04-Sep-2019
Programmable Modulation Waveform Generator	Sine Qua Non	PMG1	3291	-	O/P Mon
Signal Generator, 9kHz - 3GHz	Rohde & Schwarz	SMA 100A	3504	12	22-Aug-2019
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	17-Oct-2019
Combiner/Splitter	Weinschel	1506A	3878	12	23-Apr-2020
True RMS Multimeter	Fluke	179	4006	12	22-Jan-2020
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	22-Oct-2019
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	15-Oct-2019
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	06-Feb-2020
Hygrometer	Rotronic	HP21	4740	12	17-Jan-2020
Attenuator (10dB, 100W)	Weinschel	48-10-43	4867	12	06-Nov-2019
Quad Power Supply	Rohde & Schwarz	HMP4040	4954	-	O/P Mon

Table 46

O/P Mon – Output Monitored using calibrated equipment



2.17 Frequency Error

2.17.1 Specification Reference

IEC 61993-2, Clause 15.1.1

2.17.2 Equipment Under Test and Modification State

Class A, S/N: UNIT TA007 - Modification State 0

2.17.3 Date of Test

25-April-2019 to 26-April-2019

2.17.4 Test Method

This test was performed in accordance with IEC 61993-2, clause 15.1.1.2.

2.17.5 Environmental Conditions

Ambient Temperature 25.7 °C

Relative Humidity 38.3 %

2.17.6 Test Results

DC Powered - TDMA Transmitter

Test Conditions		Frequency Error (Hz)	
Temperature	Voltage	156.025 MHz	162.025 MHz
+ 25.7 °C	12 V DC	134	134
-15.0 °C	10.8 V DC	22	15
+55.0 °C	31.2 V DC	455	441

Table 47 - Frequency Error Results

IEC 61993-2, Limit Clause 15.1.1.3

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

FCC 47 CFR Part 80, Limit Clause 80.209

± 10 ppm.



2.17.7 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
Climatic Chamber	Votsch	VT4002	161	-	O/P Mon
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	15-Oct-2019
Digital Temperature Indicator	Fluke	51	1385	12	17-Jan-2020
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	17-Oct-2019
True RMS Multimeter	Fluke	179	4006	12	22-Jan-2020
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	22-Oct-2019
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	15-Oct-2019
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	06-Feb-2020
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	O/P Mon
Hygrometer	Rotronic	HP21	4740	12	17-Jan-2020
Quad Power Supply	Rohde & Schwarz	HMP4040	4954	-	O/P Mon
Attenuator 20dB 100W	Weinschel	48-20-43-LIM	5133	12	07-Nov-2019
Attenuator 30dB 100W	Weinschel	48-30-43-LIM	5135	12	07-Nov-2019

Table 48

O/P Mon – Output Monitored using calibrated equipment



2.18 Carrier Power

2.18.1 Specification Reference

IEC 61993-2, Clause 15.1.2

2.18.2 Equipment Under Test and Modification State

Class A, S/N: UNIT TA007 - Modification State 0

2.18.3 Date of Test

25-April-2019 to 26-April-2019

2.18.4 Test Method

This test was performed in accordance with IEC 61993-2, clause 15.1.2.2.

2.18.5 Environmental Conditions

Ambient Temperature 25.7 °C

Relative Humidity 38.3 %

2.18.6 Test Results

DC Powered - TDMA Transmitter

Test Conditions		Carrier Power (dBm)	
Temperature	Voltage	156.025 MHz	162.025 MHz
+25.7 °C	12 V DC	40.93	40.94
-15.0 °C	10.8 V DC	41.12	41.19
+55.0 °C	31.2 V DC	40.82	40.68

Table 49 - Carrier Power Results - High Power

Test Conditions		Carrier Power (dBm)	
Temperature	Voltage	156.025 MHz	162.025 MHz
+25.7 °C	12 V DC	29.97	29.91
-15.0 °C	10.8 V DC	30.06	30.05
+55.0 °C	31.2 V DC	29.90	29.21

Table 50 - Carrier Power Results – Low Power



IEC 61993-2, Limit Clause 15.1.2.3

At all test frequencies, the carrier power shall be within ± 1.5 dBm of its nominal power levels under normal test conditions.

At all test frequencies, the carrier power shall be within ± 3.0 dBm of its nominal power levels under extreme test conditions.

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

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

- Ships Stations: 156 to 162 MHz - 25 W

2.18.7 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
Climatic Chamber	Votsch	VT4002	161	-	O/P Mon
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	15-Oct-2019
Digital Temperature Indicator	Fluke	51	1385	12	17-Jan-2020
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	17-Oct-2019
True RMS Multimeter	Fluke	179	4006	12	22-Jan-2020
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	22-Oct-2019
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	15-Oct-2019
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	06-Feb-2020
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	O/P Mon
Hygrometer	Rotronic	HP21	4740	12	17-Jan-2020
Quad Power Supply	Rohde & Schwarz	HMP4040	4954	-	O/P Mon
Attenuator 20dB 100W	Weinschel	48-20-43-LIM	5133	12	07-Nov-2019
Attenuator 30dB 100W	Weinschel	48-30-43-LIM	5135	12	07-Nov-2019

Table 51

O/P Mon – Output Monitored using calibrated equipment

2.19 Slotted Transmission Spectrum

2.19.1 Specification Reference

IEC 61993-2, Clause 15.1.3

2.19.2 Equipment Under Test and Modification State

Class A, S/N: UNIT TA007 - Modification State 0

2.19.3 Date of Test

25-April-2019 to 26-April-2019

2.19.4 Test Method

This test was performed in accordance with IEC 61993-2, clause 15.1.3.2.

2.19.5 Environmental Conditions

Ambient Temperature 25.7 °C

Relative Humidity 38.3 %

2.19.6 Test Results

DC Powered - TDMA Transmitter

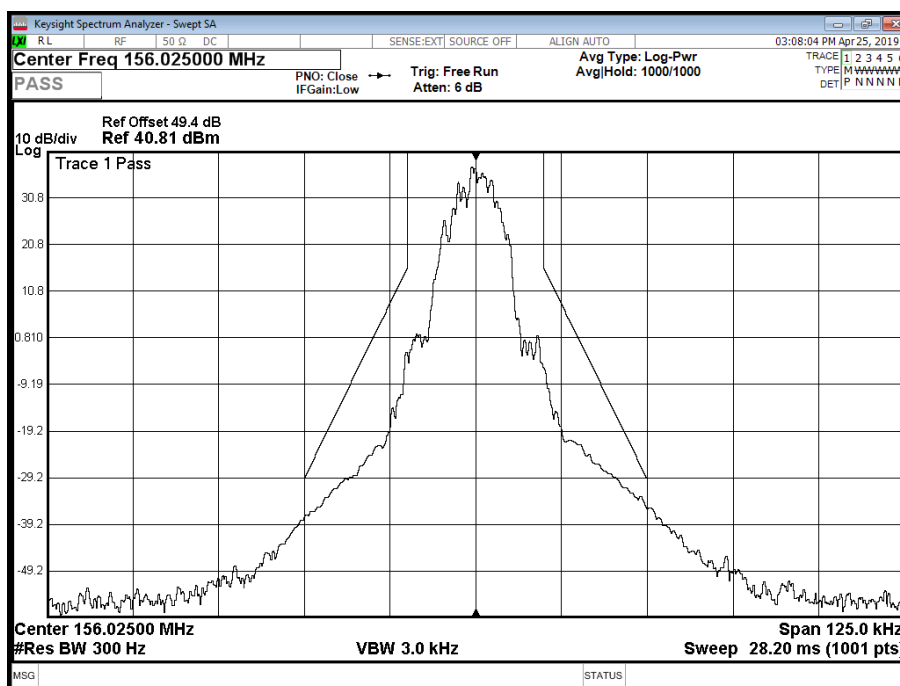


Figure 5 - 156.025 MHz

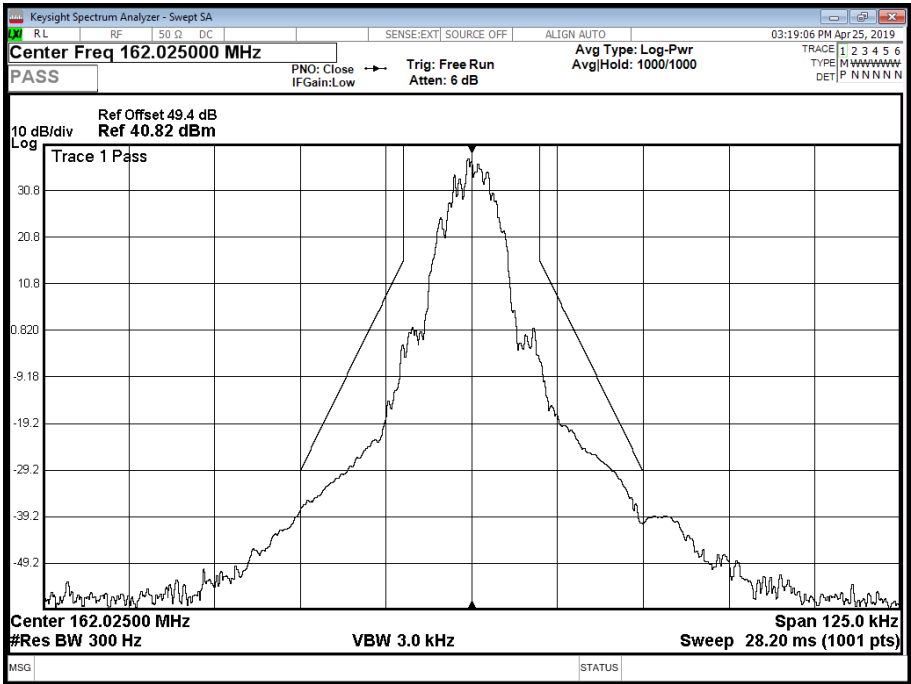


Figure 6 - 162.025 MHz

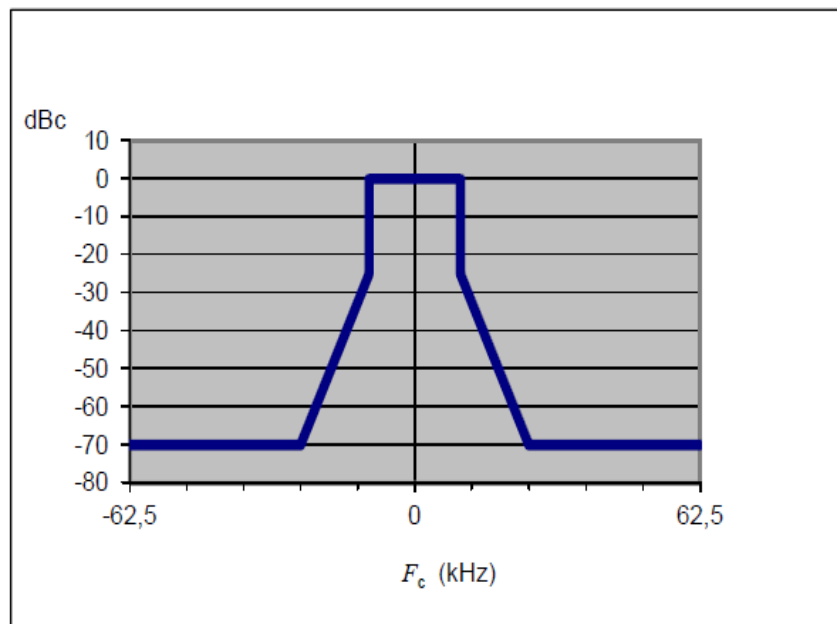
IEC 61993-2, Limit Clause 15.1.3.3

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

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

The reference level for the measurement shall be the carrier power (conducted) recorded for the appropriate test frequency in clause 15.1.2 of the test specification.

For information the emission mask specified above is shown below.



IEC 552/13

Figure 7 - Transmission Spectrum Mask Limit

FCC 47 CFR Part 80, Limit Clause 80.211

Within 250% of the Authorised Bandwidth:

- On any frequency removed from the assigned frequency by more than 50 percent up to and including 100 percent of the authorized bandwidth: At least 25 dB;
- On any frequency removed from the assigned frequency by more than 100 percent up to and including 250 percent of the authorized bandwidth: At least 35 dB

Note: The results above show that at ± 10 kHz to ± 20 kHz the level is below -25 dBc, and from ± 20 kHz to $\pm 62,5$ kHz the level is below -70 dBc.



2.19.7 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	15-Oct-2019
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	17-Oct-2019
True RMS Multimeter	Fluke	179	4006	12	22-Jan-2020
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	22-Oct-2019
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	15-Oct-2019
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	06-Feb-2020
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	O/P Mon
Hygrometer	Rotronic	HP21	4740	12	17-Jan-2020
Quad Power Supply	Rohde & Schwarz	HMP4040	4954	-	O/P Mon
Attenuator 20dB 100W	Weinschel	48-20-43-LIM	5133	12	07-Nov-2019
Attenuator 30dB 100W	Weinschel	48-30-43-LIM	5135	12	07-Nov-2019

Table 52

O/P Mon – Output Monitored using calibrated equipment



2.20 Modulation Accuracy

2.20.1 Specification Reference

IEC 61993-2, Clause 15.1.4

2.20.2 Equipment Under Test and Modification State

Class A, S/N: UNIT TA007 - Modification State 0

2.20.3 Date of Test

25-April-2019 to 26-April-2019

2.20.4 Test Method

This test was performed in accordance with IEC 61993-2, clause 15.1.4.2.

2.20.5 Environmental Conditions

Ambient Temperature	25.7 °C
Relative Humidity	38.3 %

2.20.6 Test Results

DC Powered - TDMA Transmitter

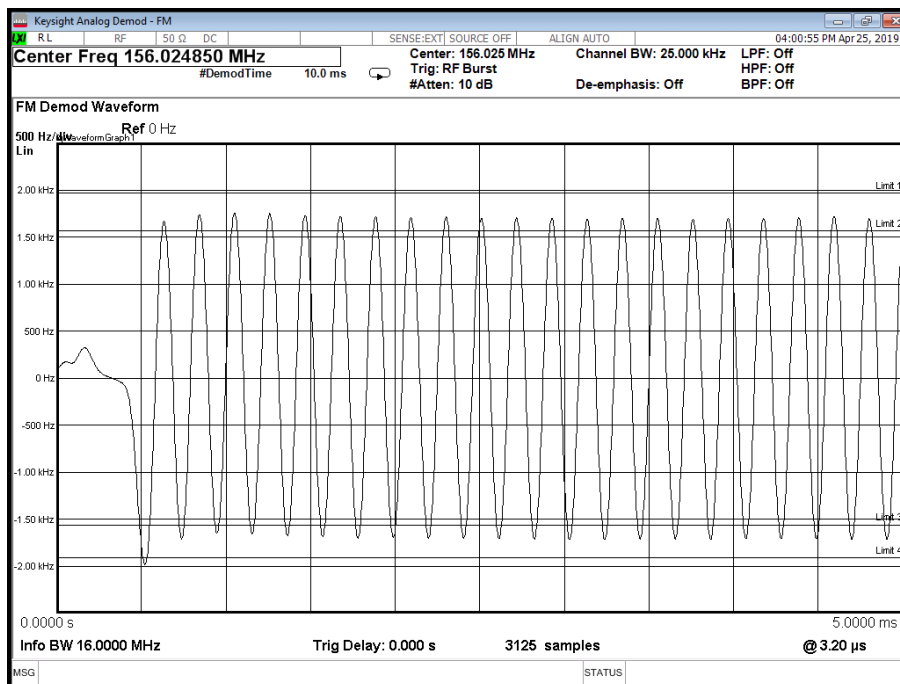


Figure 8 - 156.025 MHz, Test Signal #2, +25.7 °C, 12 V DC

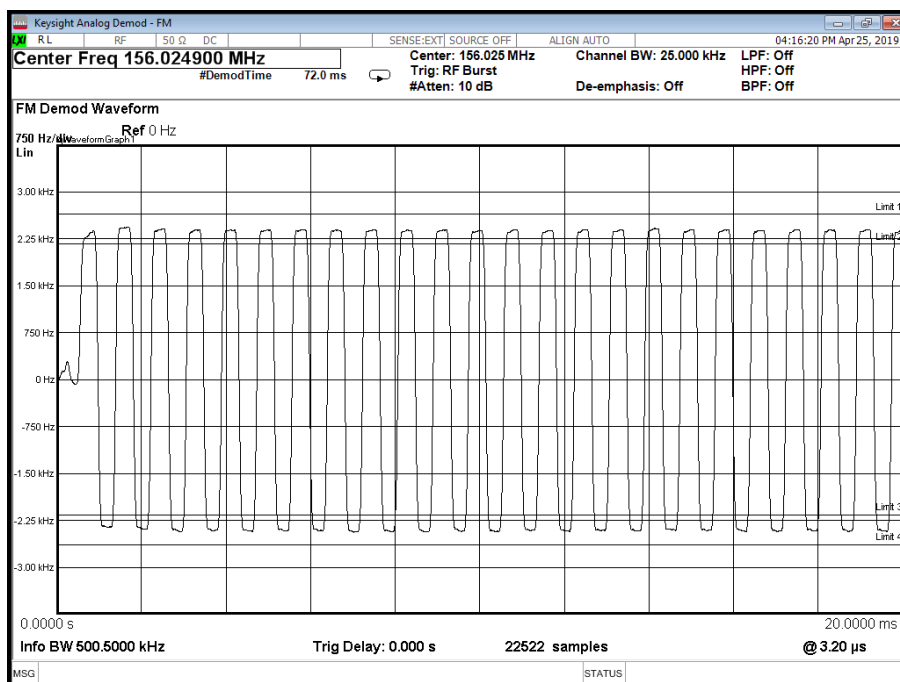


Figure 9 - 156.025 MHz, Test Signal #3, +25.7 °C, 12 V DC

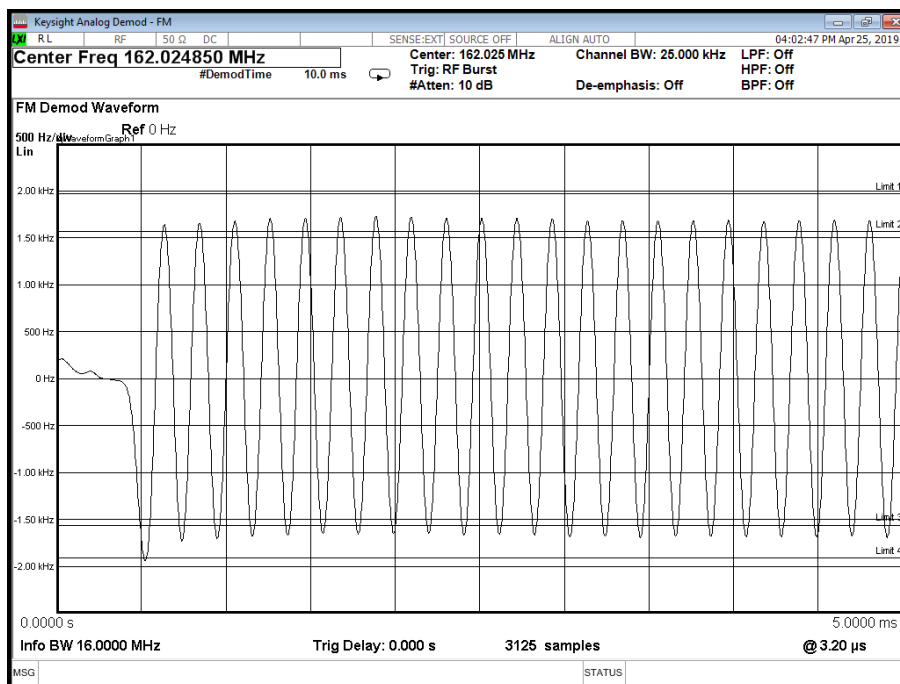


Figure 10 - 162.025 MHz, Test Signal #2, +25.7 °C, 12 V DC

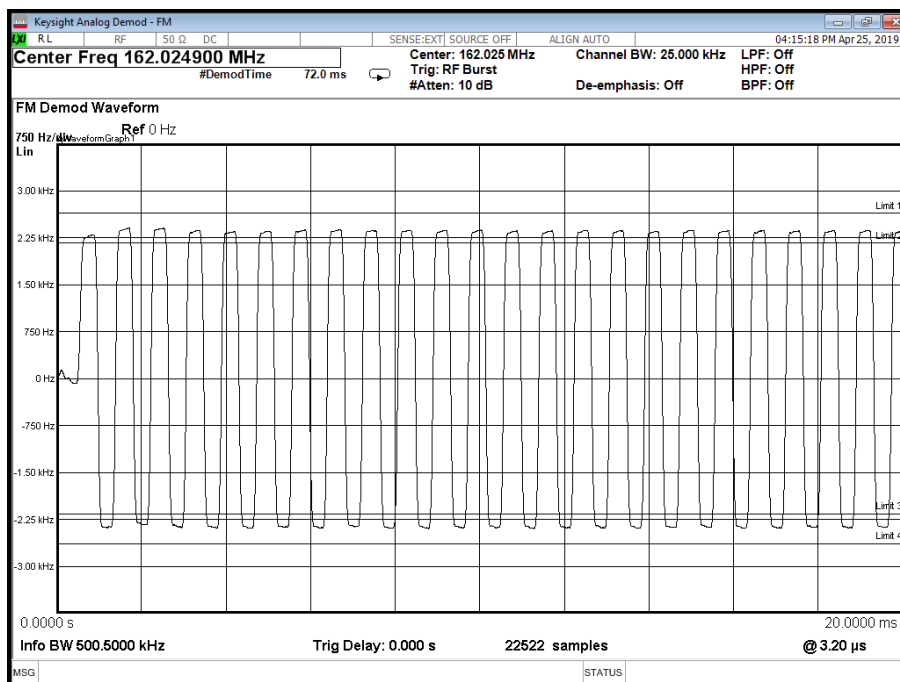


Figure 11 - 162.025 MHz, Test Signal #3, +25.7 °C, 12 V DC

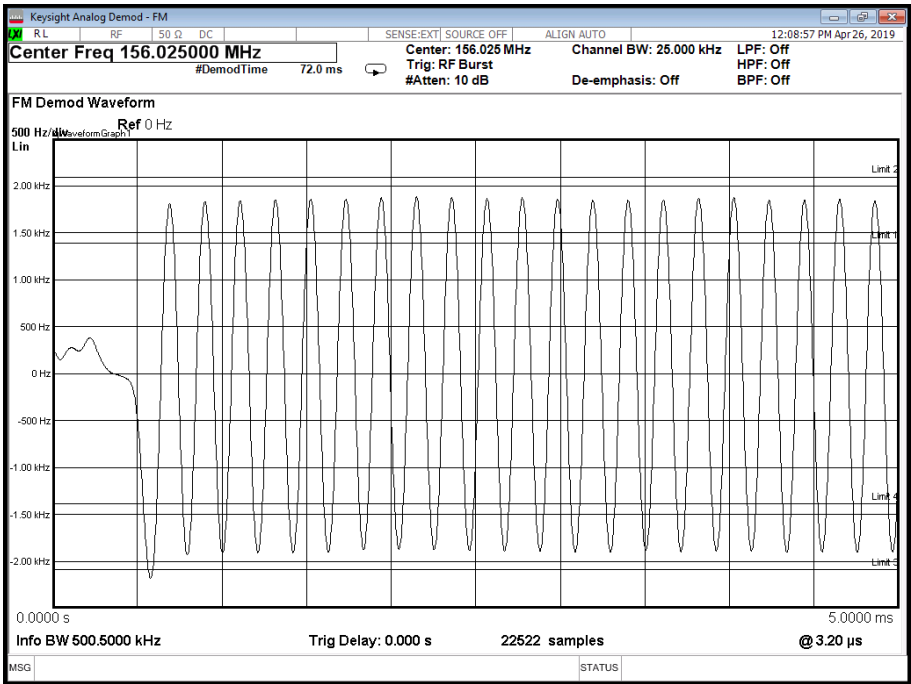


Figure 12 - 156.025 MHz, Test Signal #2, -15.0 °C, 10.8 V DC

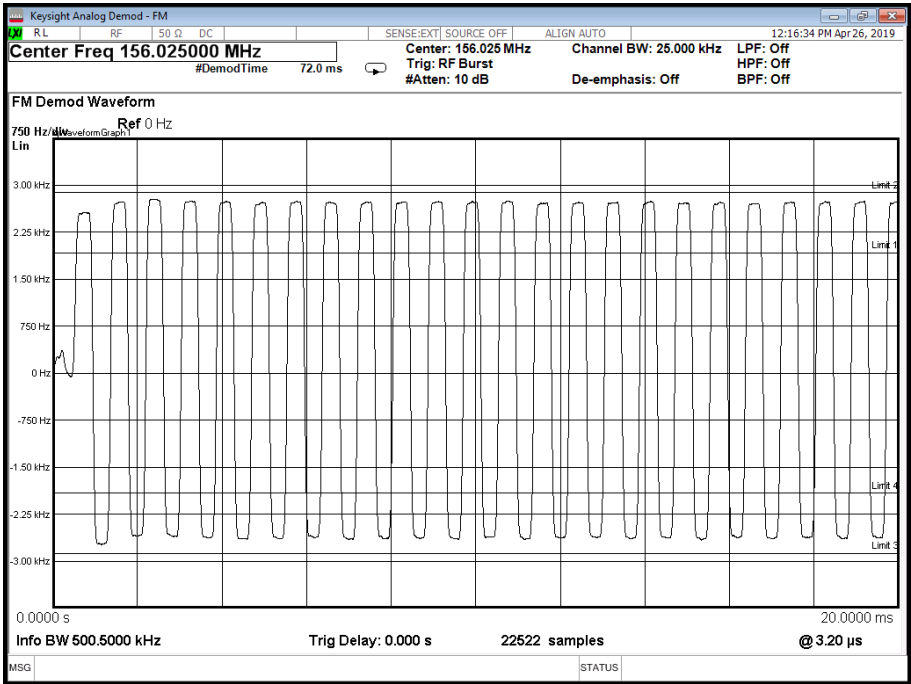


Figure 13 - 156.025 MHz, Test Signal #3, -15.0 °C, 10.8 V DC

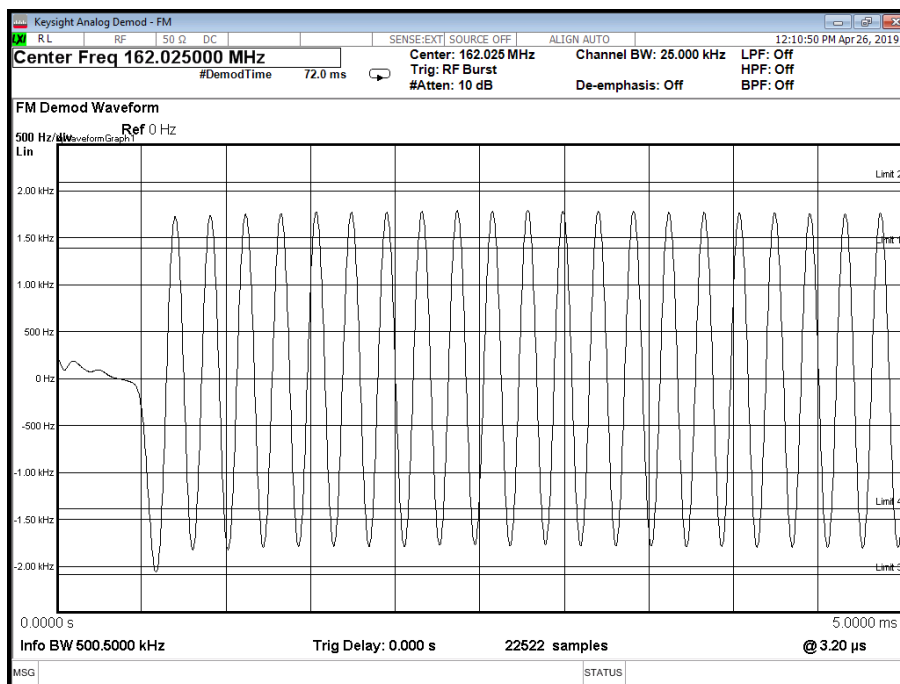


Figure 14 - 162.025 MHz, Test Signal #2, -15.0 °C, 10.8 V DC

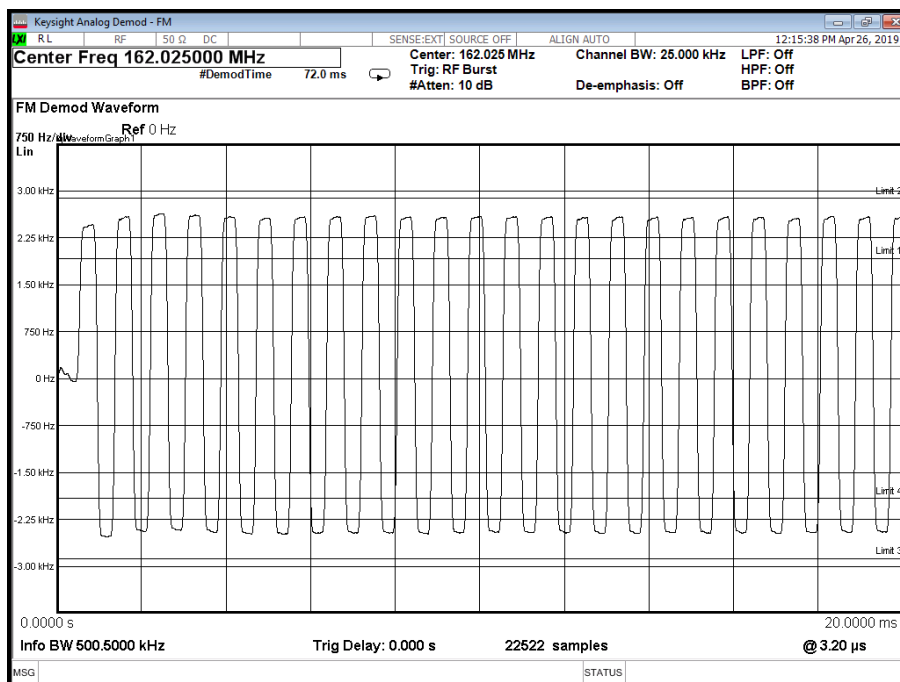


Figure 15 - 162.025 MHz, Test Signal #3, -15.0 °C, 10.8 V DC

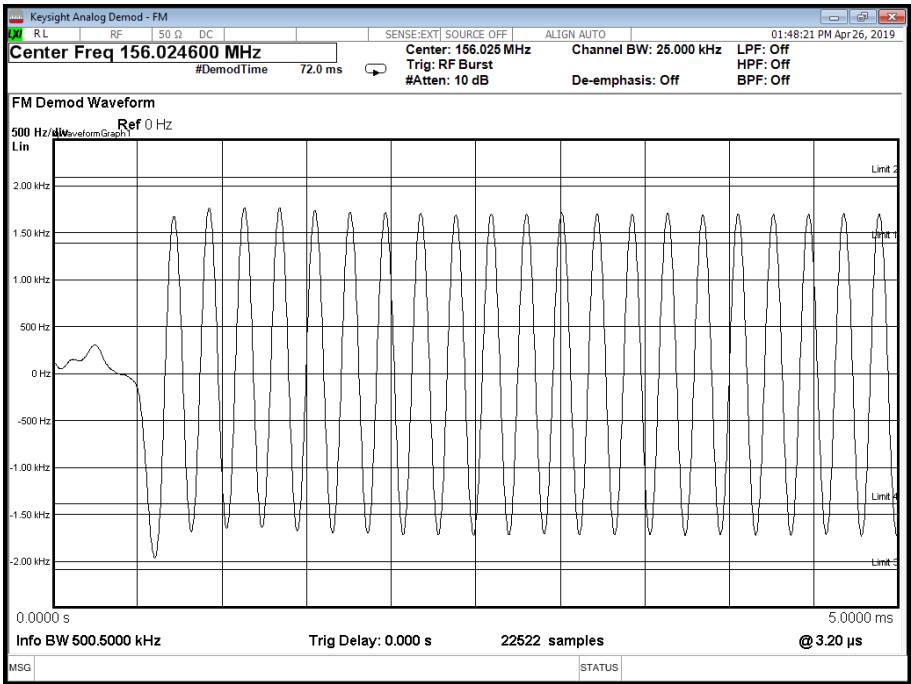


Figure 16 - 156.025 MHz, Test Signal #2, +55.0 °C, 31.2 V DC

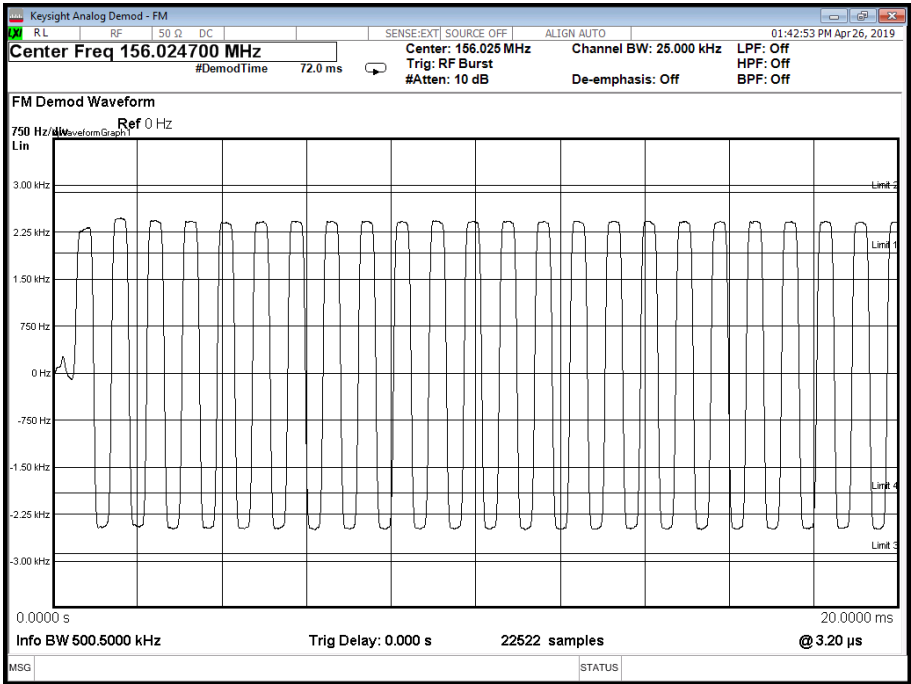


Figure 17 - 156.025 MHz, Test Signal #3, +55.0 °C, 31.2 V DC

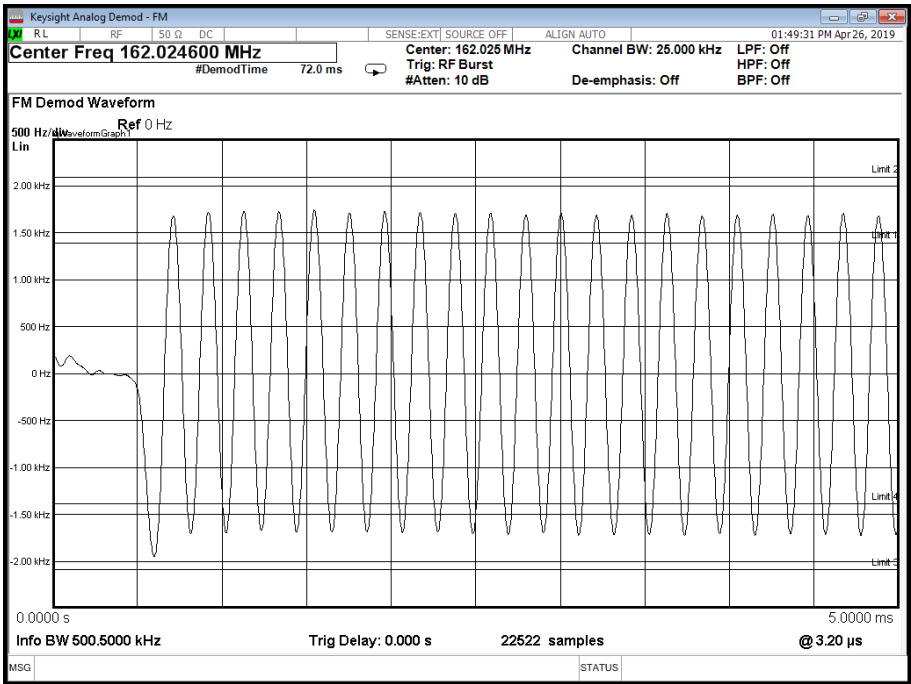


Figure 18 - 162.025 MHz, Test Signal #2, +55.0 °C, 31.2 V DC

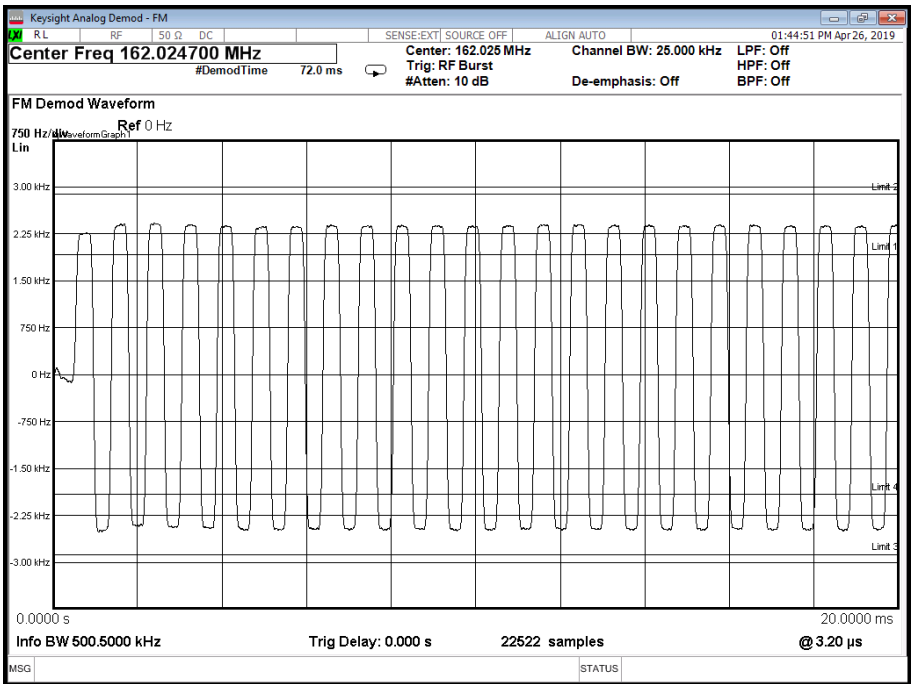


Figure 19 - 162.025 MHz, Test Signal #3, +55.0 °C, 31.2 V DC



IEC 61993-2, Limit Clause 15.1.4.3

Test Signal 2		Test Signal 3	
Normal	Extreme	Normal	Extreme
1740 ± 175 Hz	1740 ± 350 Hz	2400 ± 240 Hz	2400 ± 480 Hz

Table 53 - Peak Frequency Deviation versus Time Limit

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

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

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

2.20.7 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
Climatic Chamber	Votsch	VT4002	161	-	O/P Mon
Rubidium Standard	Rohde & Schwarz	XSRM	1316	6	15-Oct-2019
Digital Temperature Indicator	Fluke	51	1385	12	17-Jan-2020
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	17-Oct-2019
True RMS Multimeter	Fluke	179	4006	12	22-Jan-2020
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	22-Oct-2019
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	15-Oct-2019
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	06-Feb-2020
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	O/P Mon
Hygrometer	Rotronic	HP21	4740	12	17-Jan-2020
Quad Power Supply	Rohde & Schwarz	HMP4040	4954	-	O/P Mon
Attenuator 20dB 100W	Weinschel	48-20-43-LIM	5133	12	07-Nov-2019
Attenuator 30dB 100W	Weinschel	48-30-43-LIM	5135	12	07-Nov-2019

Table 54

O/P Mon – Output Monitored using calibrated equipment



2.21 Transmitter Output Power Characteristics

2.21.1 Specification Reference

IEC 61993-2, Clause 15.1.5

2.21.2 Equipment Under Test and Modification State

Class A, S/N: UNIT TA007 - Modification State 0

2.21.3 Date of Test

26-April-2019

2.21.4 Test Method

This test was performed in accordance with IEC 61993-2, clause 15.1.5.2

2.21.5 Environmental Conditions

Ambient Temperature	21.6 °C
Relative Humidity	38.8 %

2.21.6 Test Results

DC Powered - TDMA Transmitter

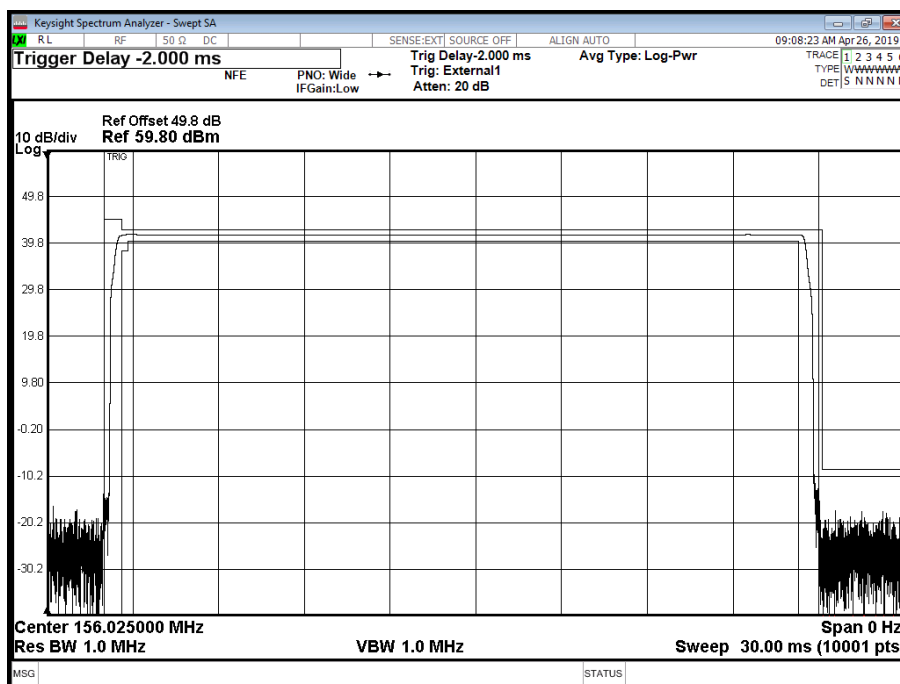


Figure 20 - 156.025 MHz - - Complete Burst

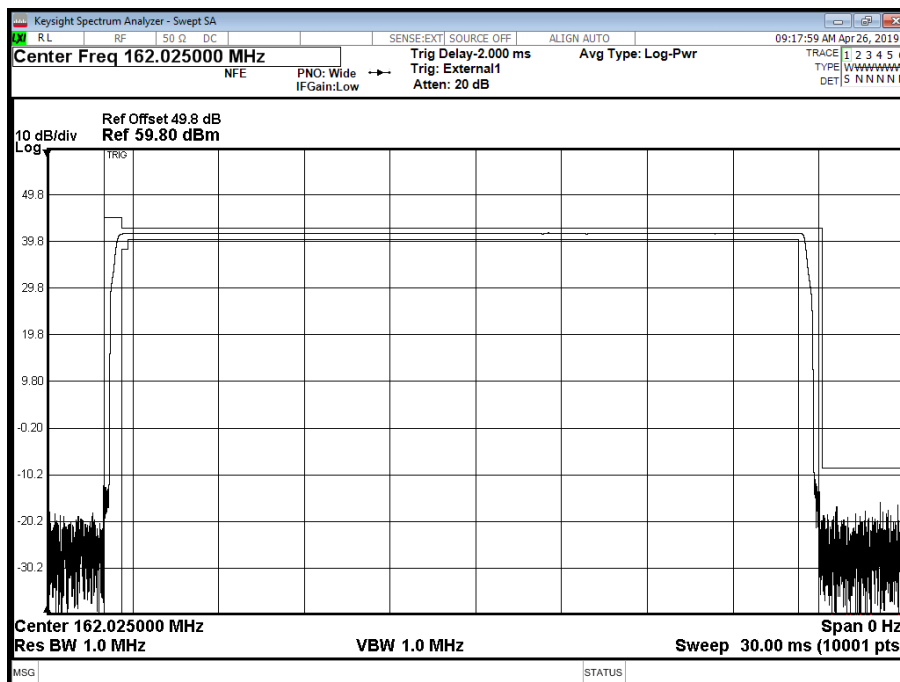


Figure 21 - 162.025 MHz - - Complete Burst

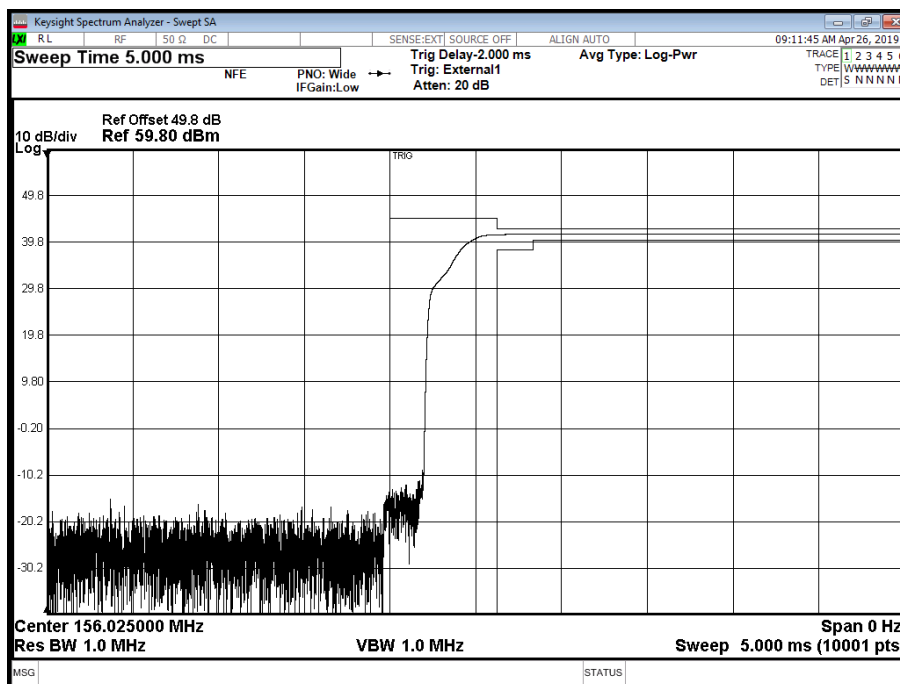


Figure 22 - 156.025 MHz - - Ramp Up Zoomed

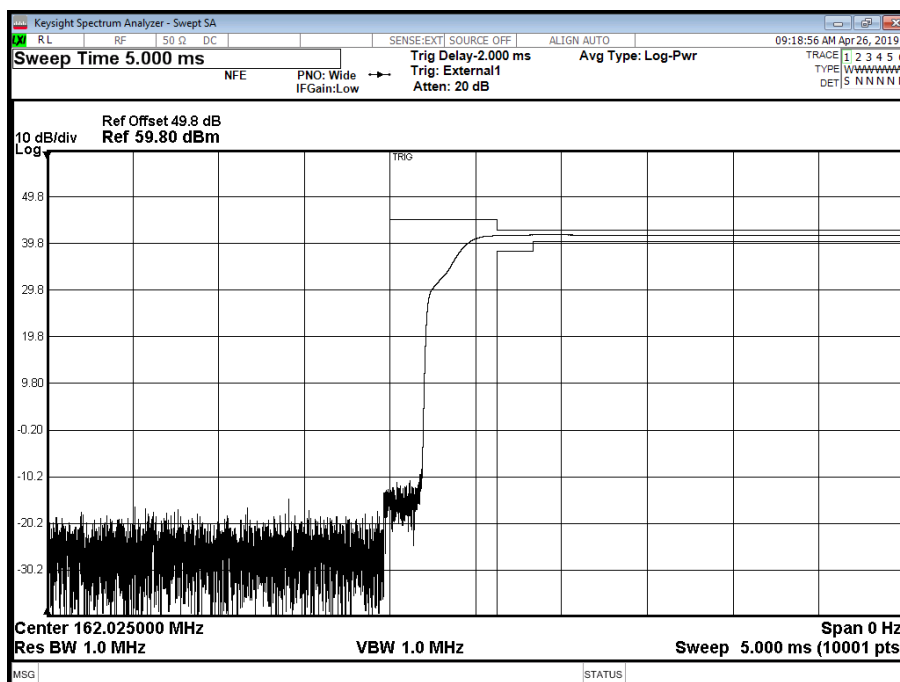


Figure 23 - 162.025 MHz - - Ramp Up Zoomed

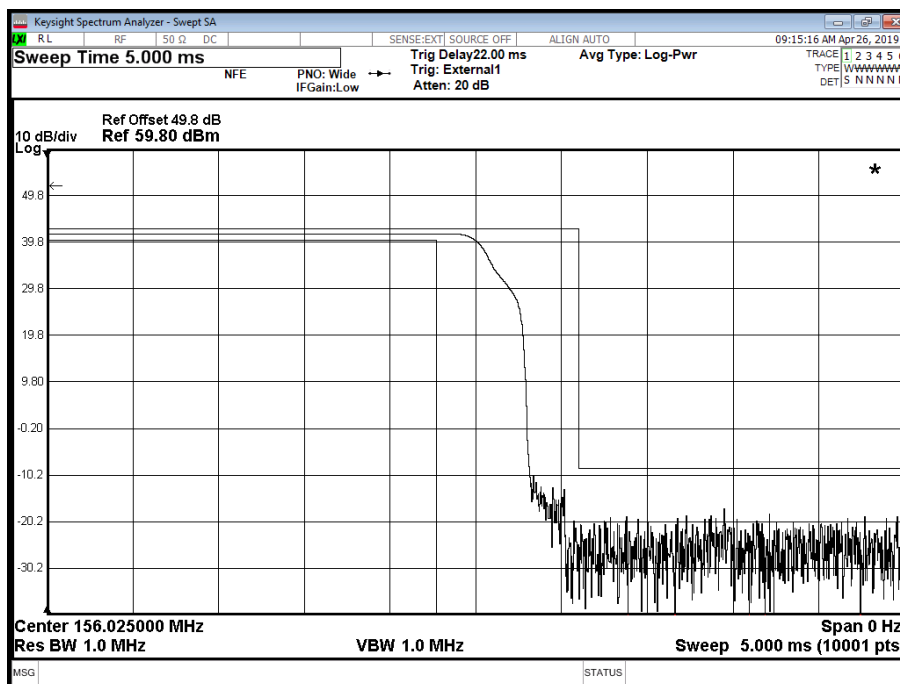


Figure 24 - 156.025 MHz - - Ramp Down Zoomed

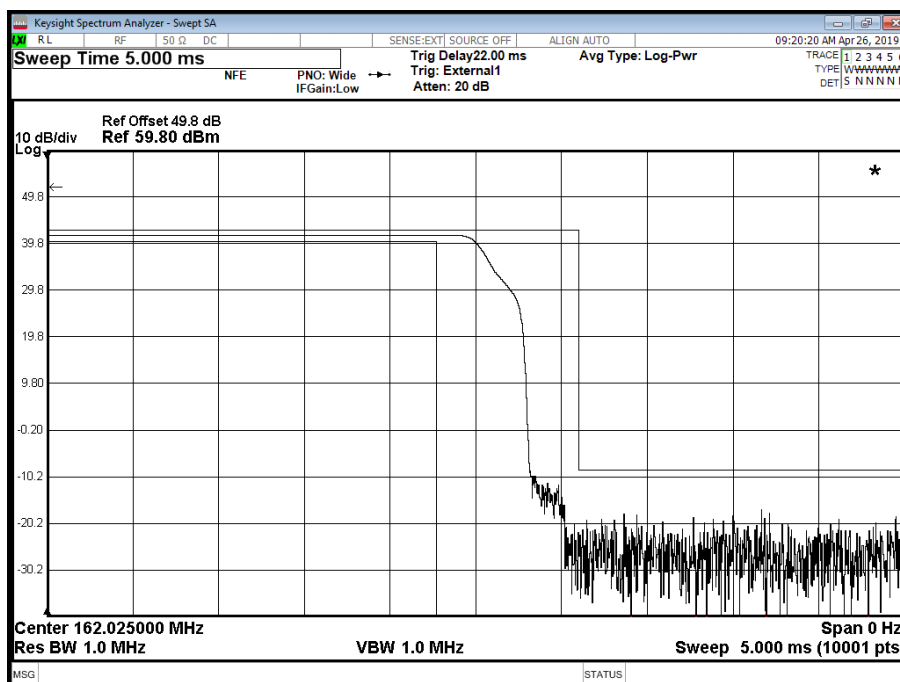


Figure 25 - 162.025 MHz - - Ramp Down Zoomed

IEC 61993-2, Limit Clause 15.1.5.3

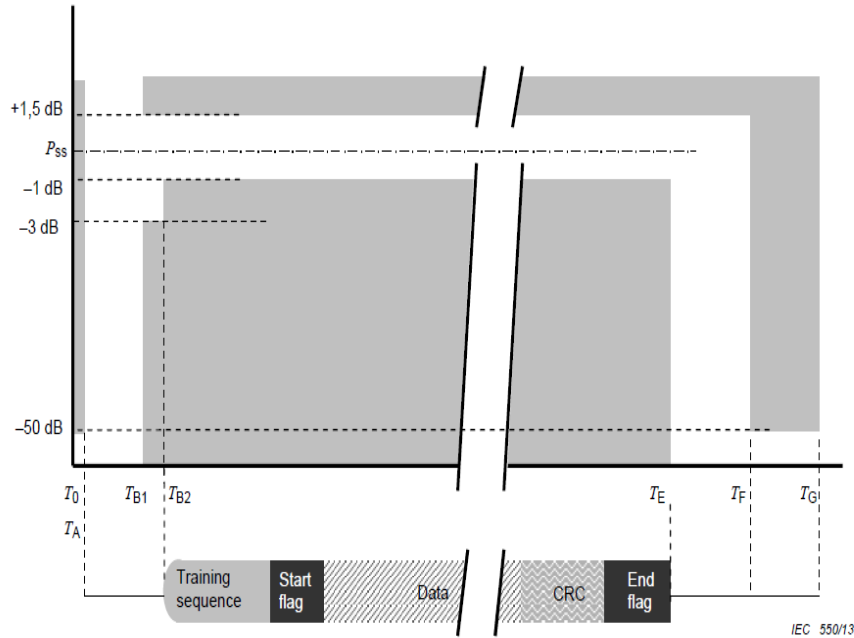


Figure 26 - Power Versus Time Mask

Reference		Bits	Time (ms)	Definitions
T ₀		0	0	Start of transmission slot. Power shall NOT exceed -50 dB of P _{SS} before T ₀
T _A		0 to 6	0 to 0.625	Power exceeds -50 dB of P _{SS}
T _B	T _{B1}	6	0.625	Power shall be within ±1.5 or -3 dB of P _{SS}
	T _{B2}	8	0.833	Power shall be within +1.5 or -1 dB of P _{SS} during the period T _{B2} to T _E (start of training sequence)
T _E (includes 1 stuffing bit)		233	24.271	Power shall remain within +1.5 or -1 dB of P _{SS} during the period T _{B2} to T _E
T _F (includes 1 stuffing bit)		241	25.104	Power shall be -50 dB of P _{SS} and stay below this
T _G		256	26.667	Start of next transmission time period

Table 55 - Definitions of Timing for Power Versus Time Mask



2.21.7 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	15-Oct-2019
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	02-Oct-2018
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	17-Oct-2019
True RMS Multimeter	Fluke	179	4006	12	22-Jan-2020
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	22-Oct-2019
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	15-Oct-2019
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	06-Feb-2020
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	O/P Mon
Hygrometer	Rotronic	HP21	4740	12	17-Jan-2020
Quad Power Supply	Rohde & Schwarz	HMP4040	4954	-	O/P Mon
Attenuator 20dB 100W	Weinschel	48-20-43-LIM	5133	12	07-Nov-2019
Attenuator 30dB 100W	Weinschel	48-30-43-LIM	5135	12	07-Nov-2019

Table 56

O/P Mon – Output Monitored using calibrated equipment



2.22 Spurious Emissions from the Transmitter

2.22.1 Specification Reference

IEC 61993-2, Clause 15.3.1

2.22.2 Equipment Under Test and Modification State

Class A, S/N: UNIT TA007 - Modification State 0

2.22.3 Date of Test

29-April-2019

2.22.4 Test Method

This test was performed in accordance with IEC 61993-2, clause 15.3.1.2.

2.22.5 Environmental Conditions

Ambient Temperature 23.8 °C

Relative Humidity 35.6 %

2.22.6 Test Results

DC Powered - TDMA Transmitter

Frequency (MHz)	Level (dBm)
*	

Table 57 - Transmitter Emissions Results - 156.025 MHz

*No emissions were detected within 6 dB of the limit.

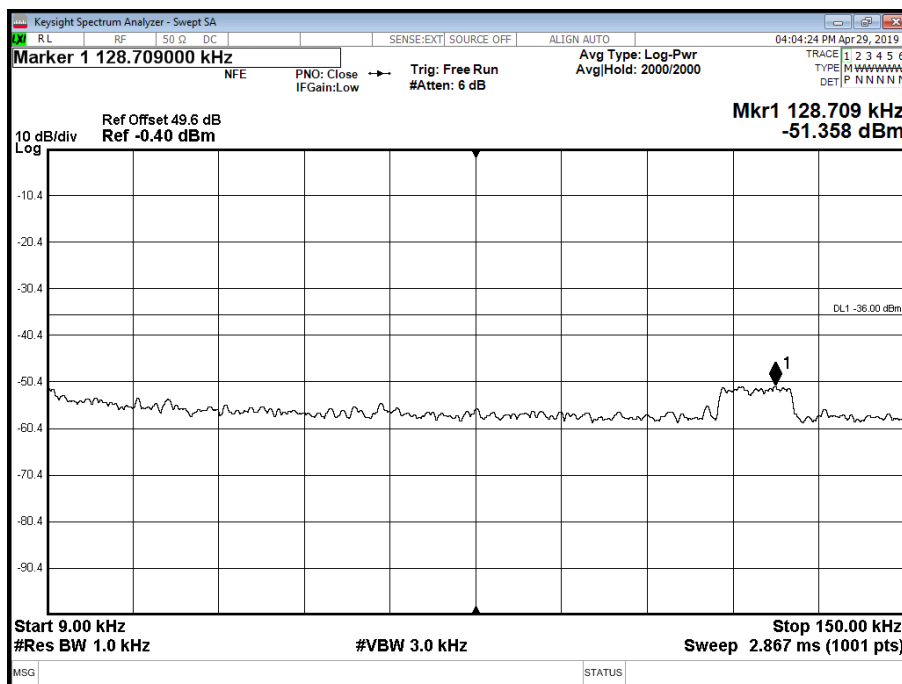


Figure 27 - 156.025 MHz - 9 kHz to 150 kHz

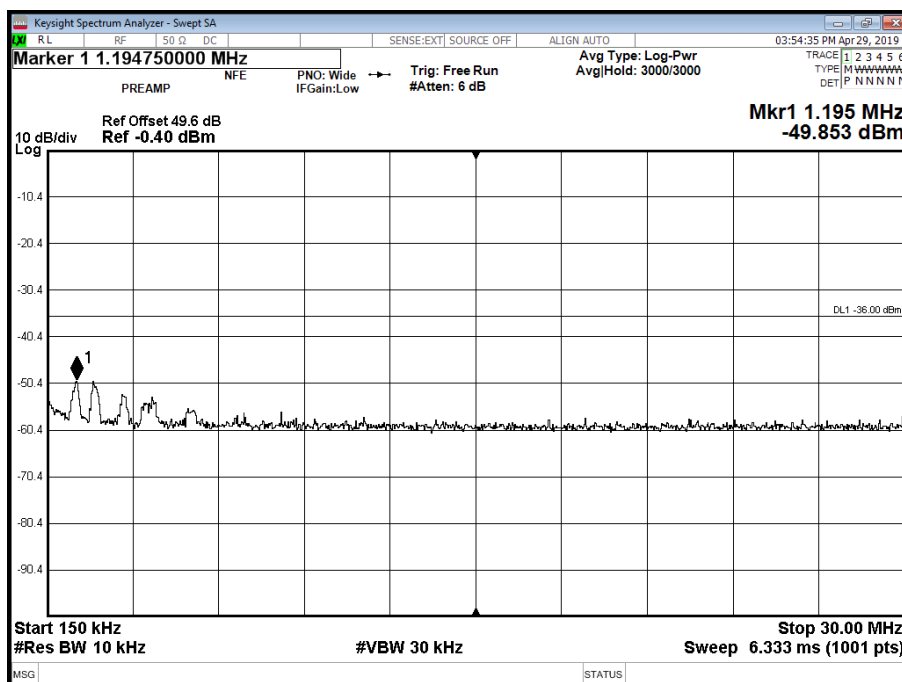


Figure 28 - 156.025 MHz - 150 kHz to 30 MHz

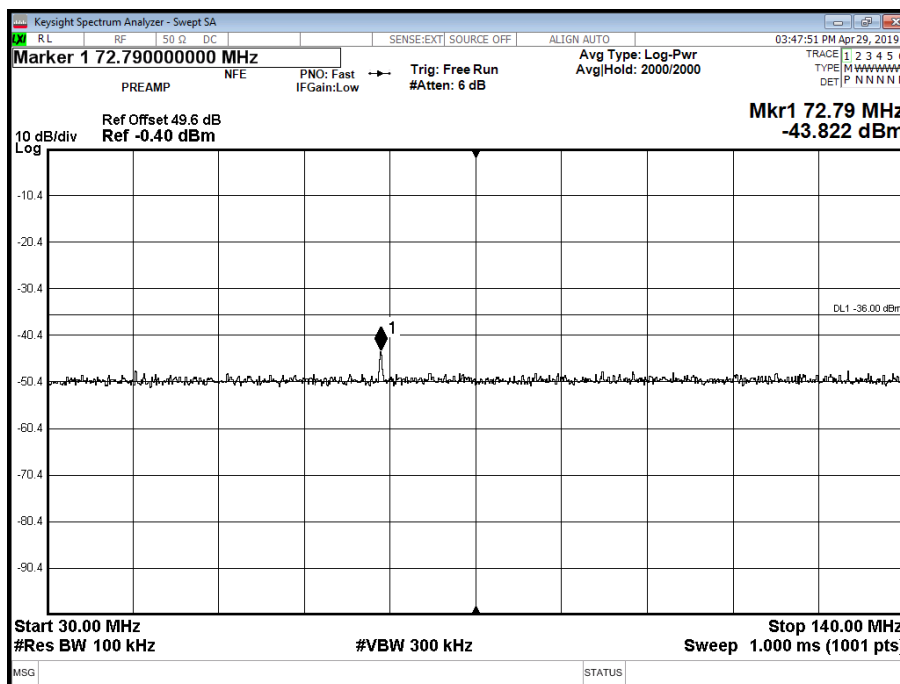


Figure 29 - 156.025 MHz - 30 MHz to 140 MHz

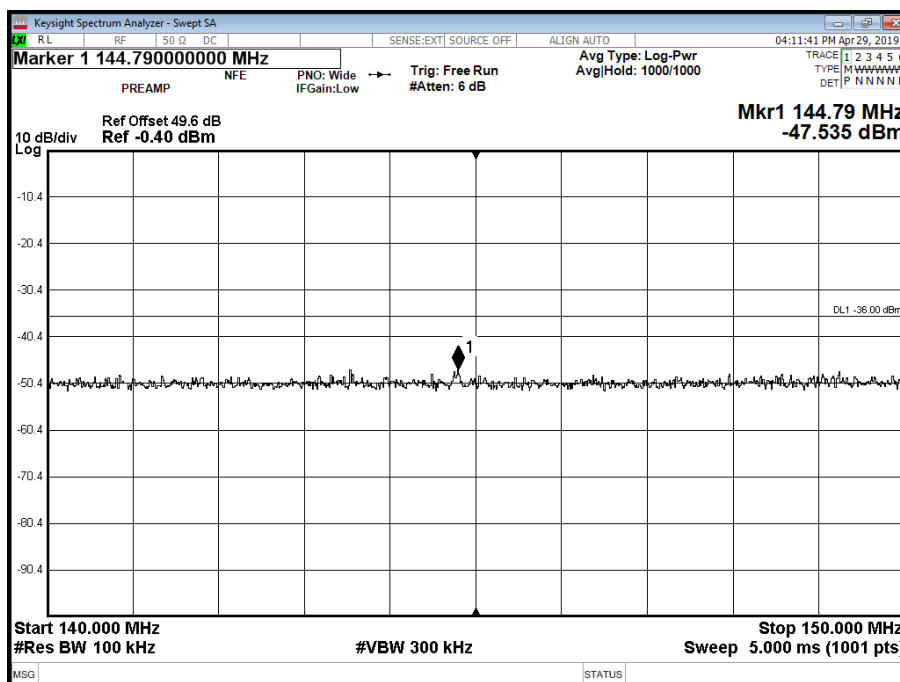


Figure 30 - 156.025 MHz - 140 MHz to 150 MHz

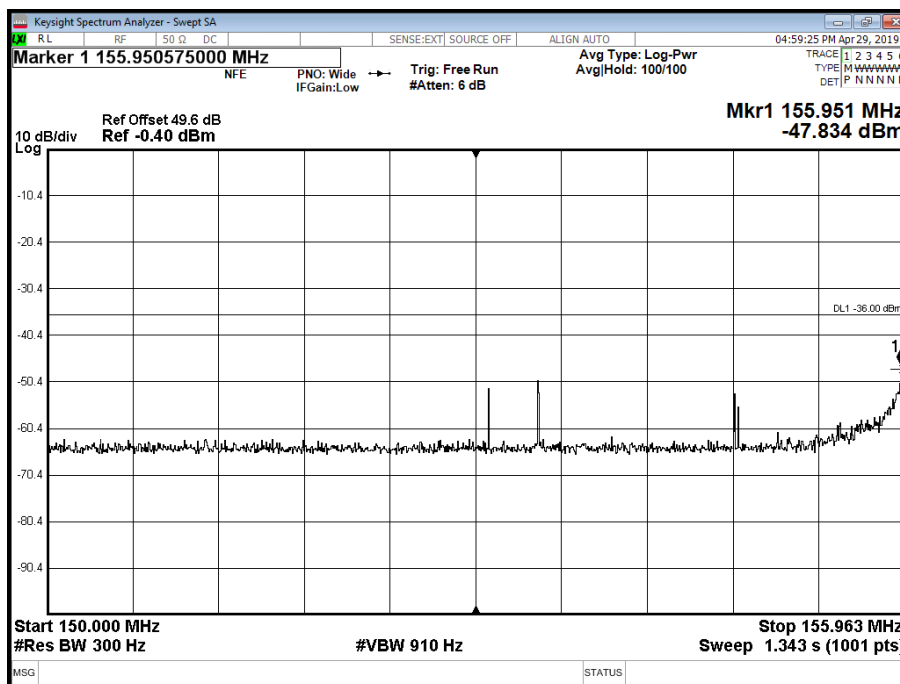


Figure 31 - 156.025 MHz - 150 MHz to 155.9625 MHz

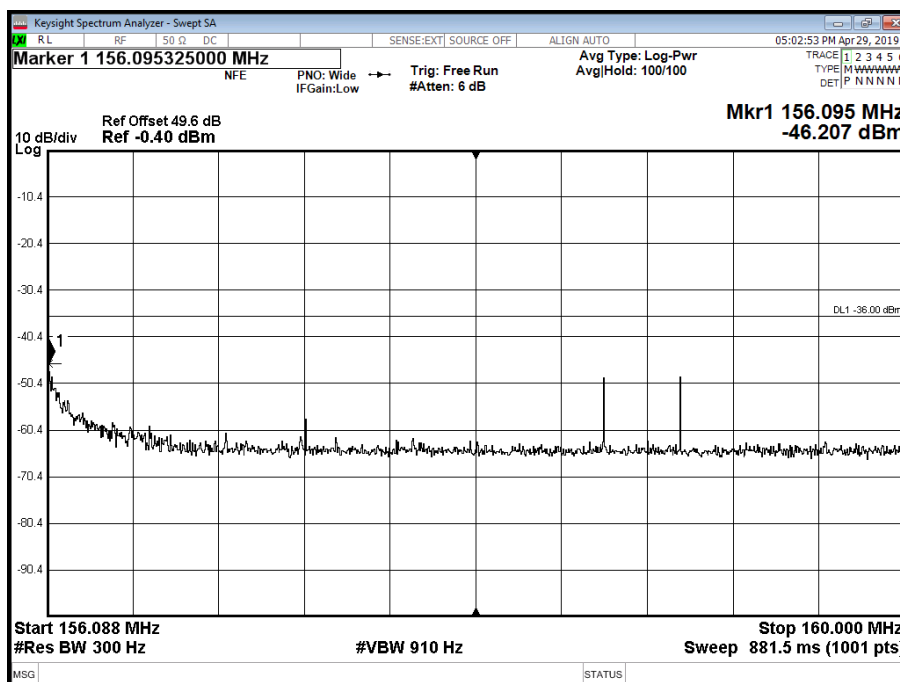


Figure 32 - 156.025 MHz - 156.0875 MHz to 160 MHz

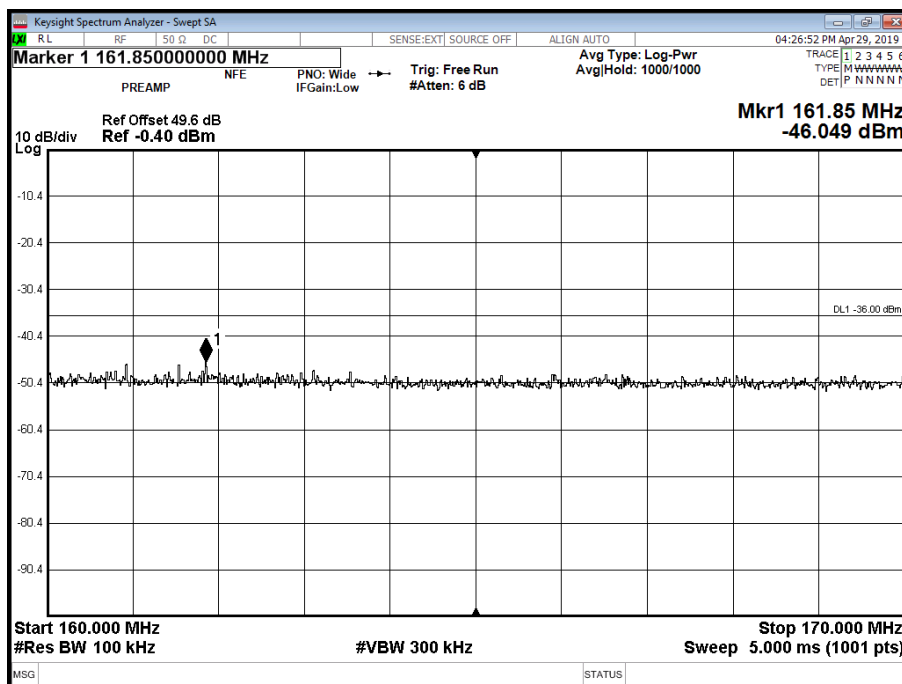


Figure 33 - 156.025 MHz - 160 MHz to 170 MHz

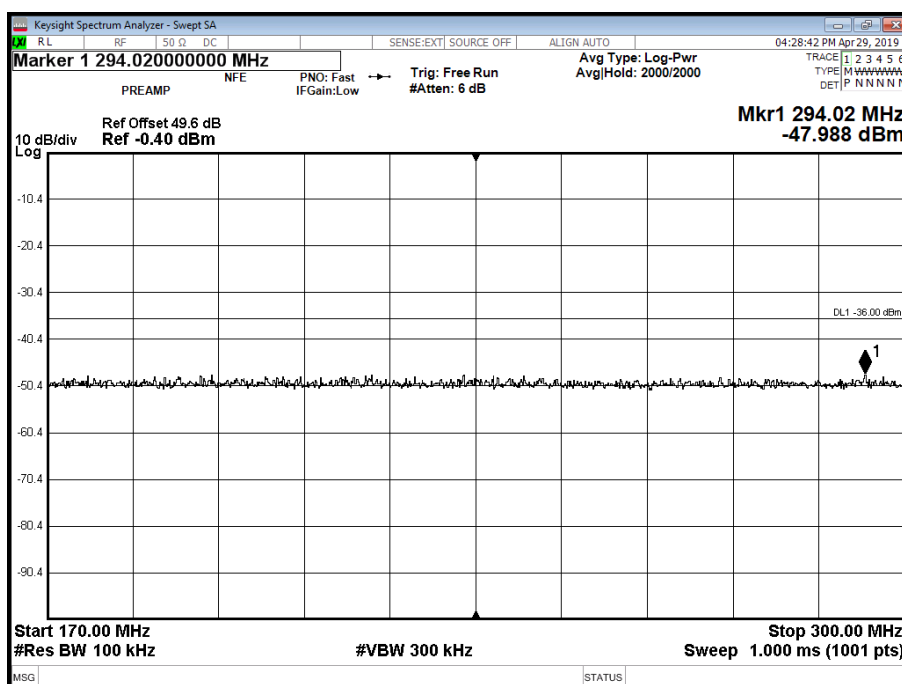


Figure 34 - 156.025 MHz - 170 MHz to 300 MHz

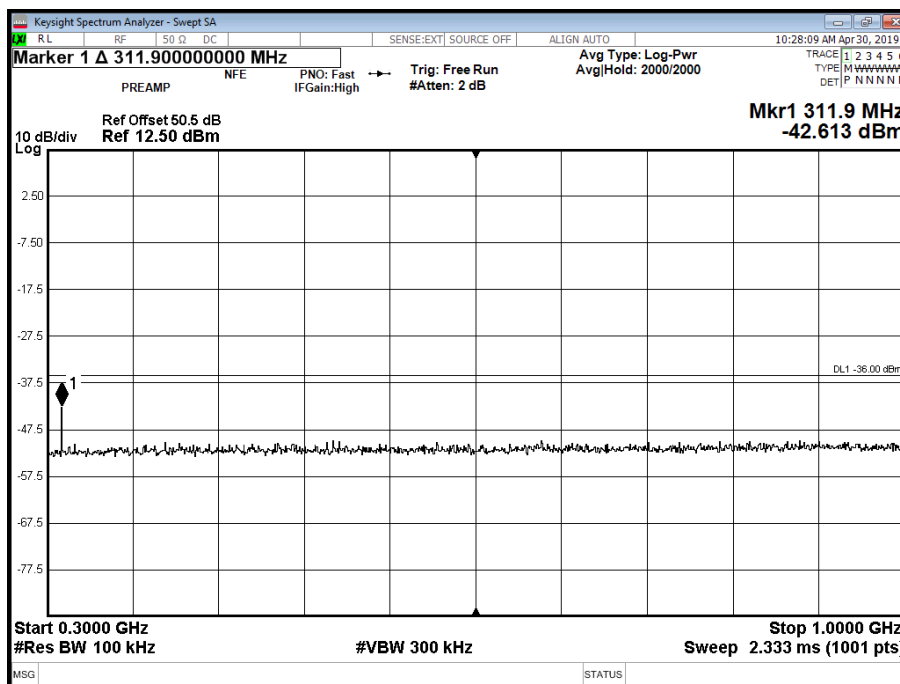


Figure 35 - 156.025 MHz - 300 MHz to 1 GHz

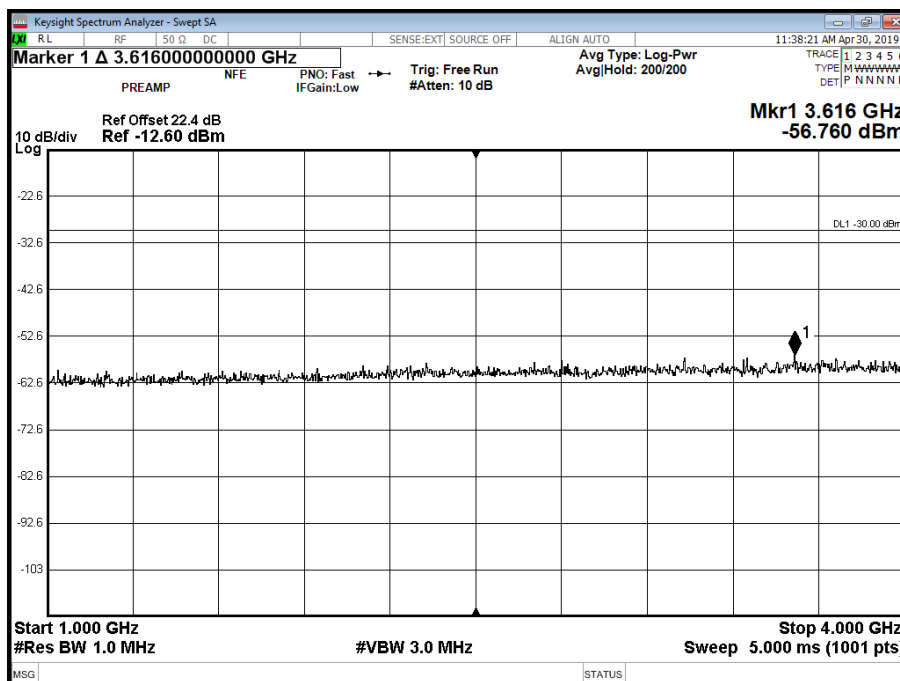


Figure 36 - 156.025 MHz - 1 GHz to 4 GHz



Frequency (MHz)	Level (dBm)
*	

Table 58 - Transmitter Emissions Results - 162.025 MHz

*No emissions were detected within 6 dB of the limit.

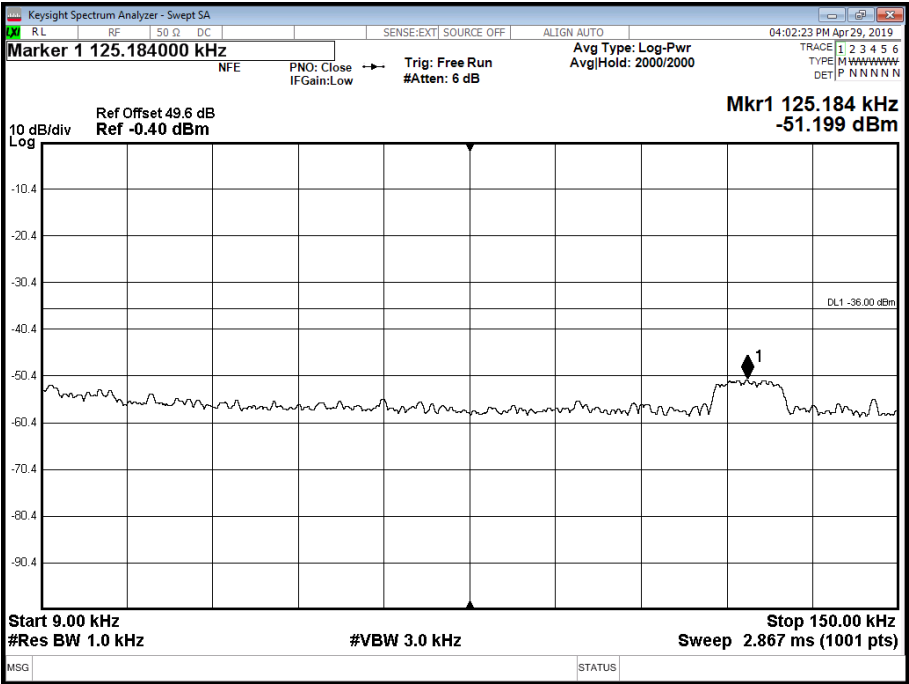


Figure 37 - 162.025 MHz - 9 kHz to 150 kHz

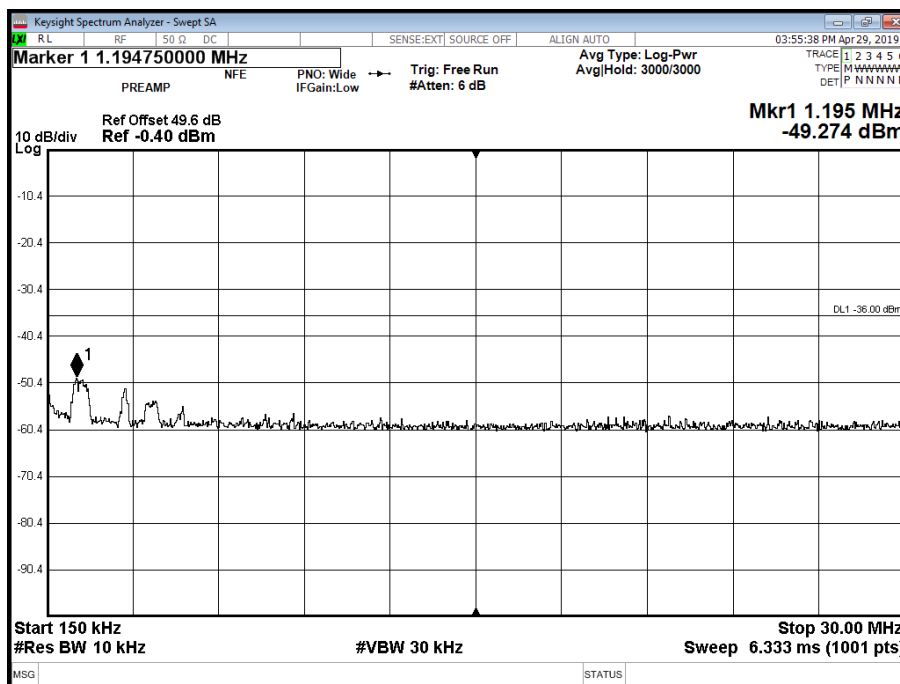


Figure 38 - 162.025 MHz - 150 kHz to 30 MHz

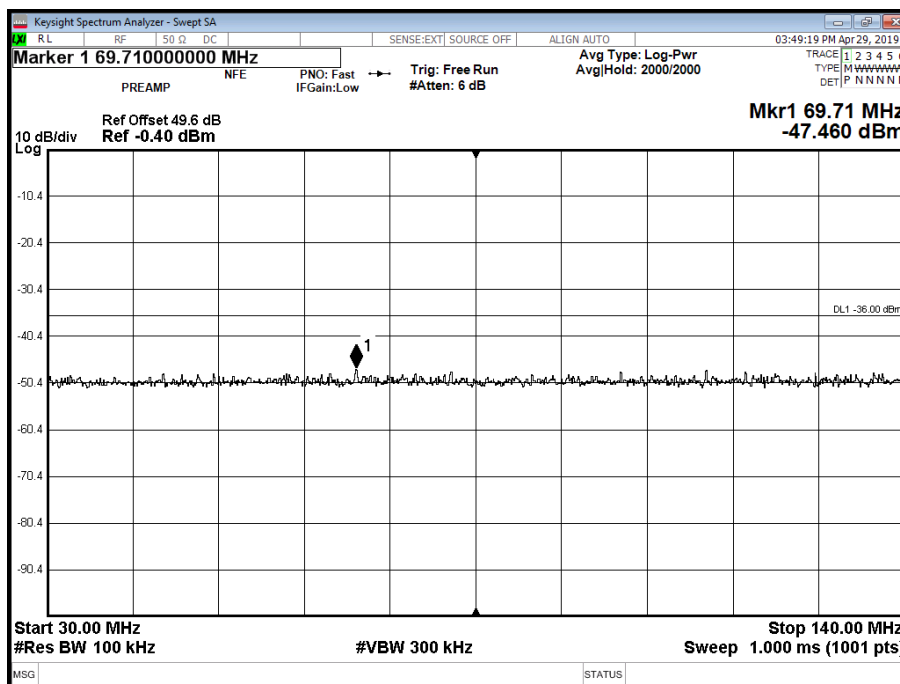


Figure 39 - 162.025 MHz - 30 MHz to 140 MHz

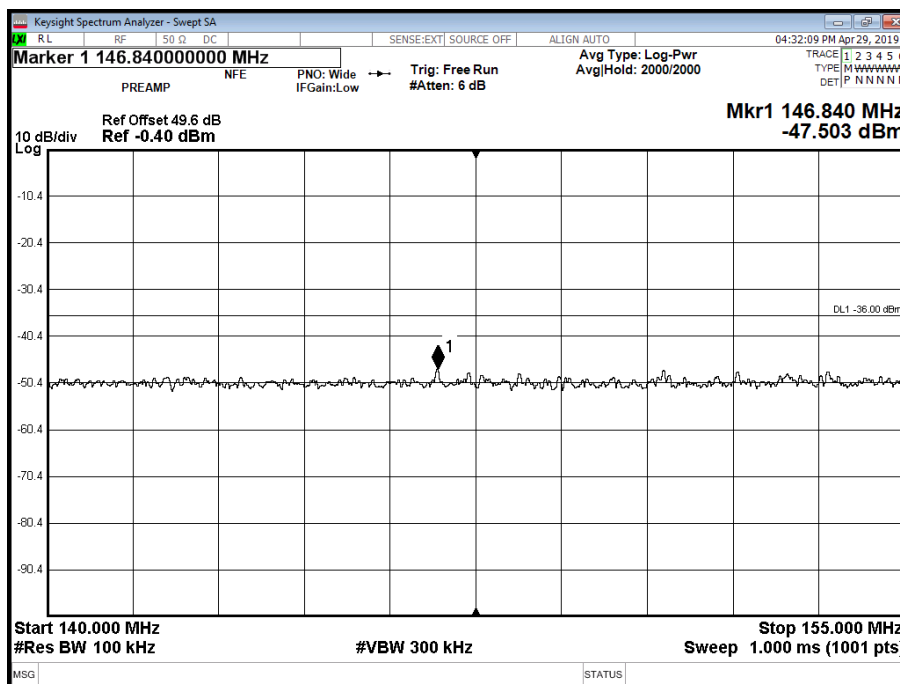


Figure 40 - 162.025 MHz - 140 MHz to 155 MHz

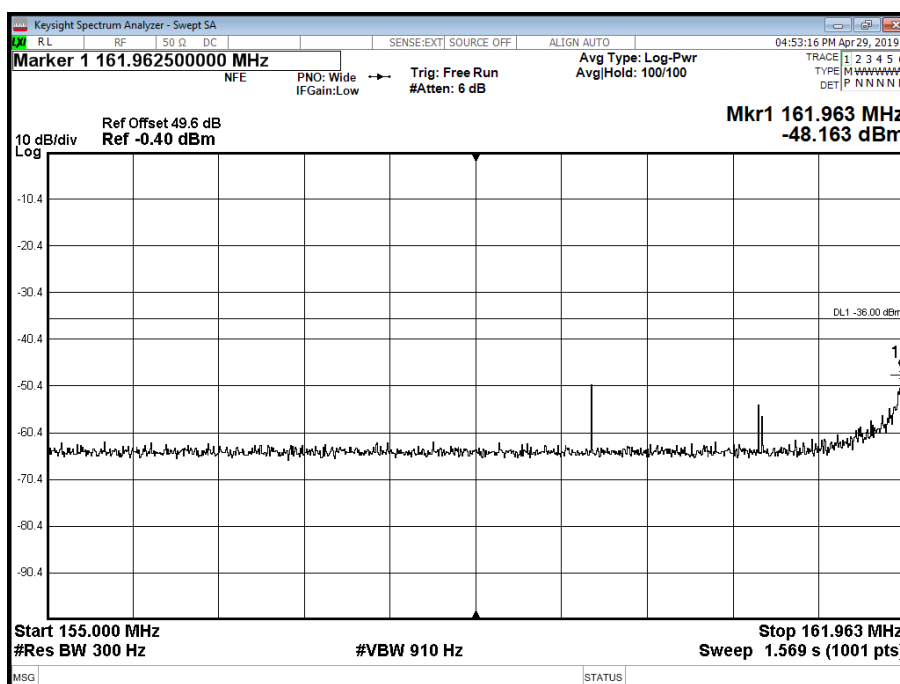


Figure 41 - 162.025 MHz - 155 MHz to 161.9625 MHz

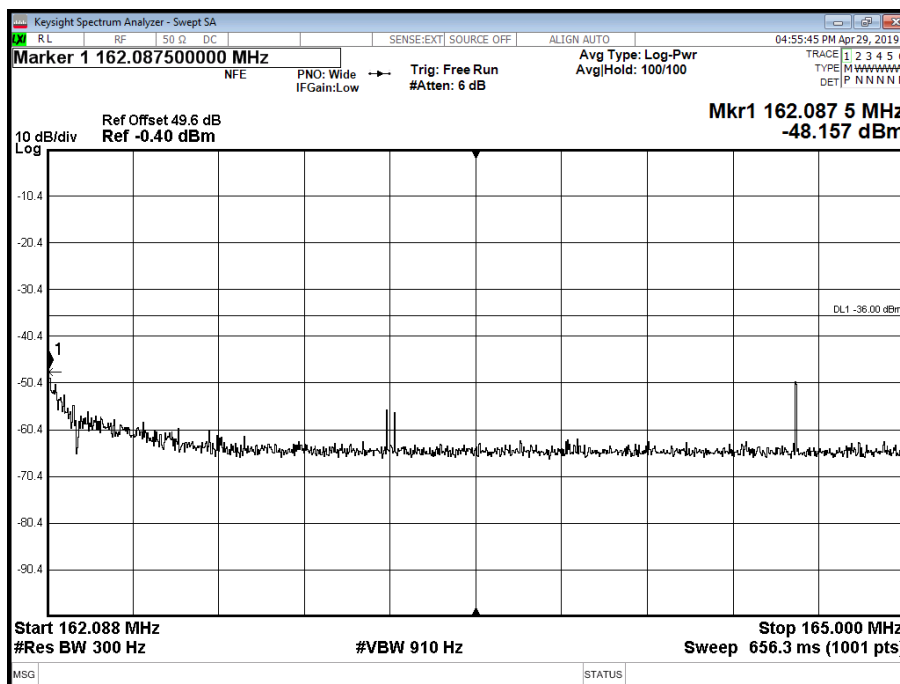


Figure 42 - 162.025 MHz - 162.0875 MHz to 165 MHz

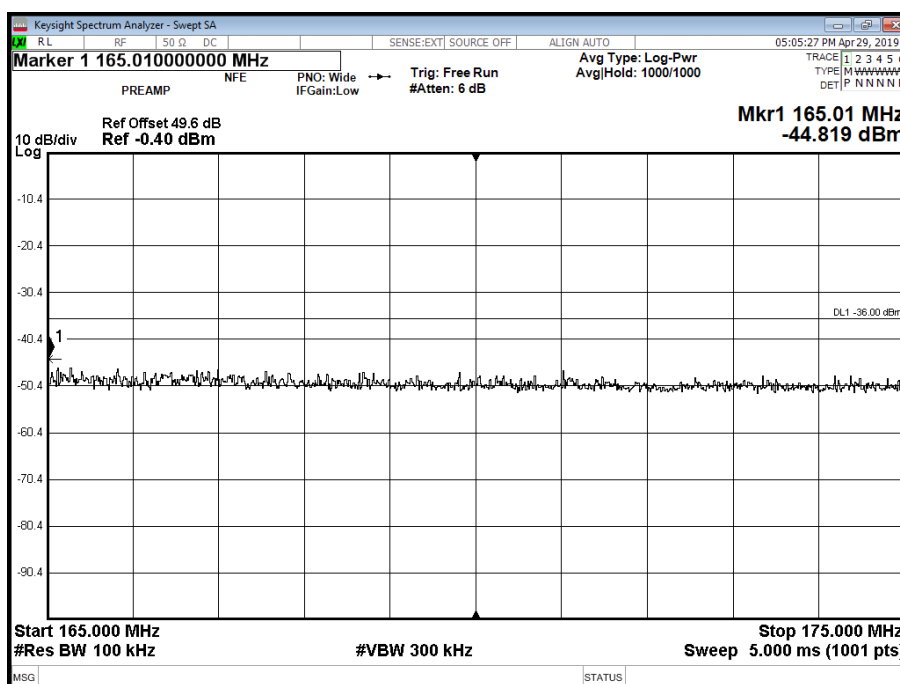


Figure 43 - 162.025 MHz - 165 MHz to 175 MHz

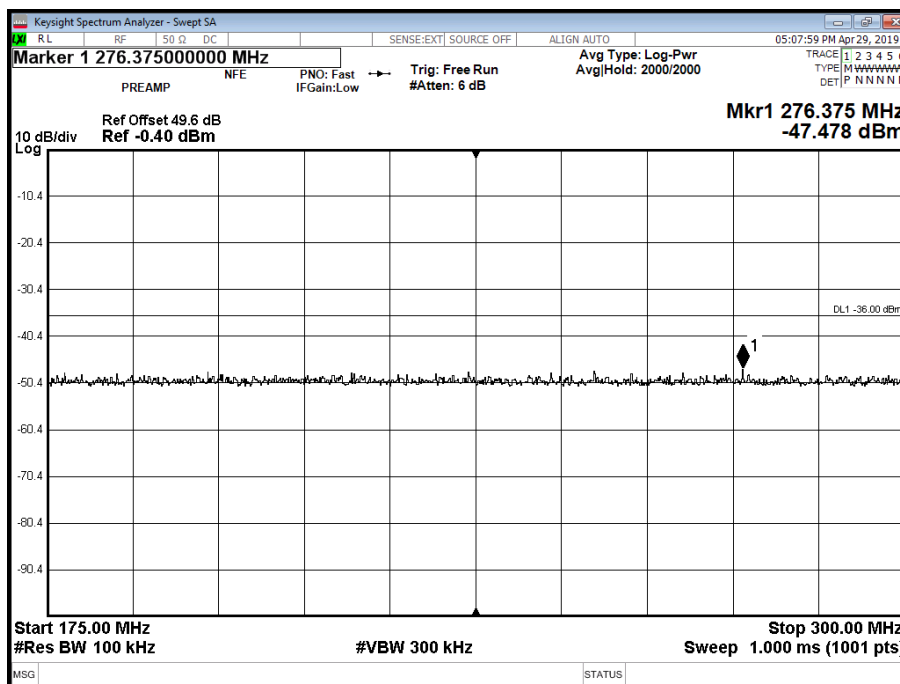


Figure 44 - 162.025 MHz - 175 MHz to 300 MHz

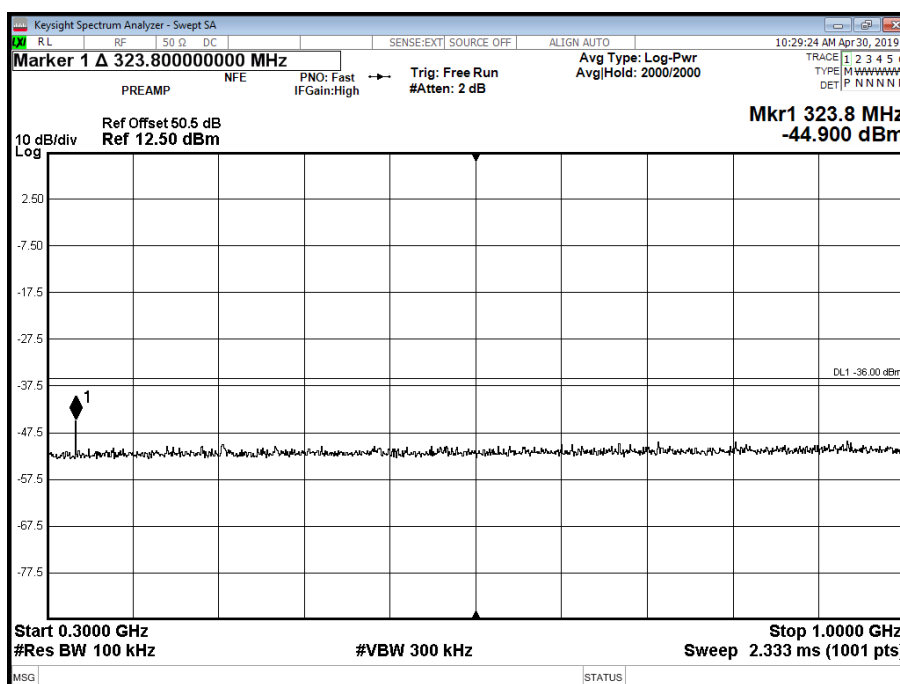


Figure 45 - 162.025 MHz - 300 MHz to 1 GHz

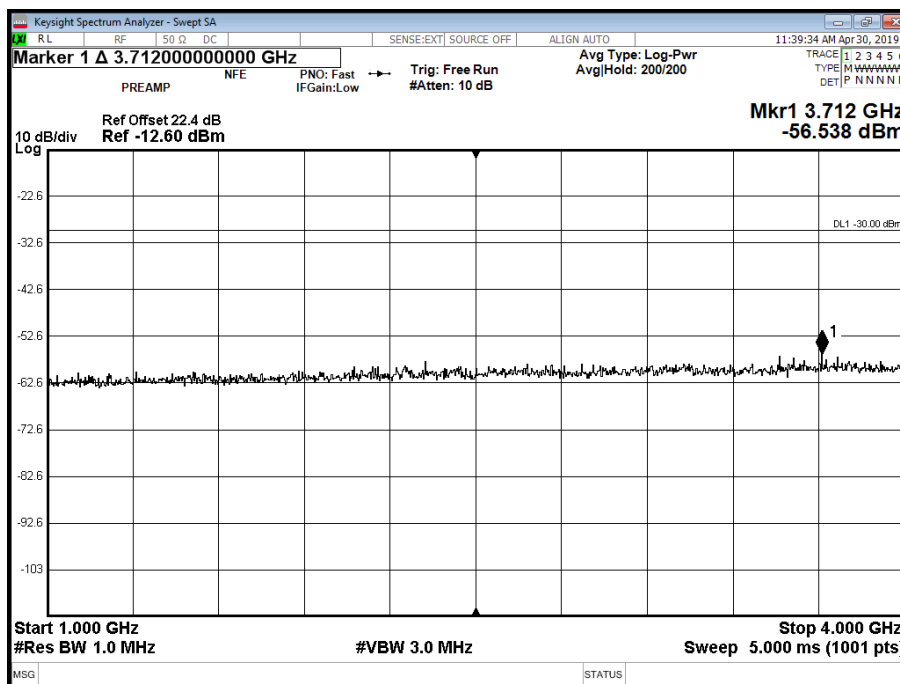


Figure 46 - 162.025 MHz - 1 GHz to 4 GHz

IEC 61993-2, Limit Clause 15.3.1.3

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

FCC 47 CFR Part 80, Limit Clause 80.211

Within 250% of the Authorised Bandwidth:

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

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

More than 250% of the Authorised Bandwidth:

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

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



2.22.7 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	15-Oct-2019
High Pass Filter	Mini-Circuits	NHP-300	1640	12	23-Oct-2019
Network Analyser	Rohde & Schwarz	ZVA 40	3548	12	17-Oct-2019
True RMS Multimeter	Fluke	179	4006	12	22-Jan-2020
Calibration Unit	Rohde & Schwarz	ZV-Z54	4368	12	22-Oct-2019
Frequency Standard	Spectracom	SecureSync 1200-0408-0601	4393	6	15-Oct-2019
PXA Signal Analyser	Keysight Technologies	N9030A	4653	12	06-Feb-2020
4 Channel PSU	Rohde & Schwarz	HMP4040	4736	-	O/P Mon
Hygrometer	Rotronic	HP21	4740	12	17-Jan-2020
Quad Power Supply	Rohde & Schwarz	HMP4040	4954	-	O/P Mon
Attenuator 20dB 100W	Weinschel	48-20-43-LIM	5133	12	07-Nov-2019
Attenuator 30dB 100W	Weinschel	48-30-43-LIM	5135	12	07-Nov-2019

Table 59

O/P Mon – Output Monitored using calibrated equipment

3 Photographs

3.1 Equipment Under Test (EUT)



Equipment Under Test – Front View



Equipment Under Test – 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
Transmitter Output Power Characteristics	± 2.0 dB
Modulation Accuracy	± 2.0 dB
Slotted Transmission Spectrum	± 2.0 dB
Carrier Power	± 0.45 dB
Frequency Error	± 11 Hz
Immunity to Out-of-Band Energy	± 2.6 dB
Transmit to Receive Switching Time	± 2.6 dB
Spurious Emissions from the Receiver	± 3.45 dB
Intermodulation Response Rejection and Blocking	± 2.6 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
DSC Spurious Emissions from the Receiver	± 3.45 dB
DSC Blocking or Desensitisation	± 2.6 dB
DSC Intermodulation Response Rejection	± 2.6 dB
DSC Spurious Response Rejection	± 2.6 dB
DSC Adjacent Channel Selectivity	± 2.6 dB
DSC Co-channel Rejection	± 2.6 dB
DSC Error Behaviour at High Input Levels	± 1.8 dB
DSC Sensitivity	± 1.8 dB

Table 60