Test Report

Prepared for: EMC Technologies Canada, Ltd.

Model: Aspire 400 AES6 – SDU 400

Description: Aircraft earth station

Serial Number: 062

FCC ID: K6K-MK5

To

FCC Part 87

Date of Issue: September 14, 2020

On the behalf of the applicant:	**EMS Technologies Canda LTD** **FRN:0019381896** **400 Maple Groove** **Ottawa Ontario K2V1B8** **Canada**
Attention of:	**Dennis Teske** **613-595-7935** **Dennis.teske@honeywell.com**

Prepared by
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Project No: p2020007

Poona Saber
Project Test Engineer

Test Report Revision History

Revision	Date	Revised By	Reason for Revision
1.0	Ootober 13, 2020	Poona Saber	Original Document
2.0	October 20, 2020	Poona Saber	Revised power table for R20T2QD on page 15

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ANAB

Compliance Testing, LLC, has been accredited in accordance with the recognized International Standard ISO/IEC 17025:2017. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer to the joint ISO-ILAC-IAF Communiqué dated January 2009).

The tests results contained within this test report all fall within our scope of accreditation, unless noted below.

Please refer to http://www.compliancetesting.com/labscope.html for current scope of accreditation.

FCC Site Reg. #349717

IC Site Reg. #2044A-2

Non-accredited tests contained in this report:

N/A

Standard Test Conditions Engineering Practices

Except as noted herein, the following conditions and procedures were observed during the testing:

All tests and measurement data shown were performed in accordance with FCC Rules and Regulations, Volume II; Part 2, Sub-part J, Sections 2.947, 2.1033(c), 2.1041, 2.1046, 2.1047, 2.1051, 2.1053, 2.1055, 2.1057 and the following individual Parts: FCC Part 87.

Measurement results, unless otherwise noted, are worst-case measurements.

Environmental Conditions		
Temperature (ºC)	**Humidity (%)**	**Pressure (mbar)**
24-25.3	24.1-32.2	956-962

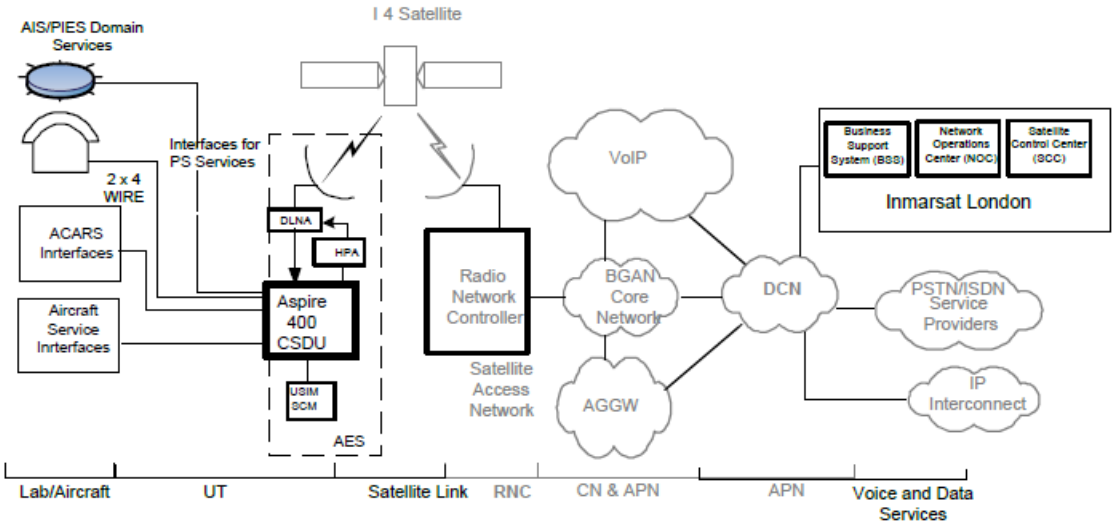
EUT Description

Model: Aspire 400 AES6 – SDU 400
Description: aircraft earth station
Firmware: NA
Software: EMG49-L011-010K, VDD-90406277-REV-R00
Part Number: 90402651

Additional Information:

The Aspire 400 AES6, AES7 SATCOM Avionics is an integral part of the complete L-band Inmarsat Satellite communications system, as shown in Figure 1 and is composed of the following components:

- • Compact Satellite Data Unit (CSDU)
- • CSDU Configuration Module (SCM)
- • High Power Amplifier (HPA)
- • RF Diplexer and LNA (DLNA)
- • High Gain Antenna (HGA) for AES6
- • Intermediate Gain Antenna (IGA) for AES7
- • Associated wiring



The CSDU is the central communications processing and control unit, largely determining the functionality of the complete SATCOM system. The signal-in-space parameters are determined by the CSDU in relation to modulation/demodulation, error correction, coding, interleaving and data rates associated with the communication channel(s). The CSDU contains circuits for conversion of digital and/or analog inputs/outputs to/from radio frequency (RF). The CSDU requires external Amplifier and Antenna functions in order to complete the SATCOM Avionics Suite. The CSDU is capable of sending and receiving various data rates. The rate is dynamically selected by the individual applications and by the network assessment of current operating conditions.

The external SCM contains the Secure Owner Requirements Table (ORT), the User Owner Requirements Table (ORT), and the 2 SwiftBroadband Universal Subscriber Identity Module (USIM). The SCM also contains the AES PKI information (Public/Private Keys and certificate information stored in a UICC smart card).
The High Power Amplifier (HPA) provides signal amplification to attain the required EIRP level for the given services and class definition.

Diplexer and Low-Noise Amplifier functions are combined into the DLNA (Type F) standalone LRU. The Low-Noise Amplifier (LNA) provides the signal amplification for the receive RF signal, and the diplexer provides signal filtering to separate the TX and RX signals. The DLNA provides the interfaces between the CSDU and the Antenna on the receive path, and between the HPA and the Antenna on the transmit path.

The CSDU has the following physical characteristics. Some key elements are listed below:

• Unit Assembly: Aspire 400 CSDU, AC Powered

• Part Number: 90402651

The HPA has the following physical characteristics. Some key elements are listed below:

• Unit Assembly: HPA–115 Vac Powered

• Part Number: 90404514

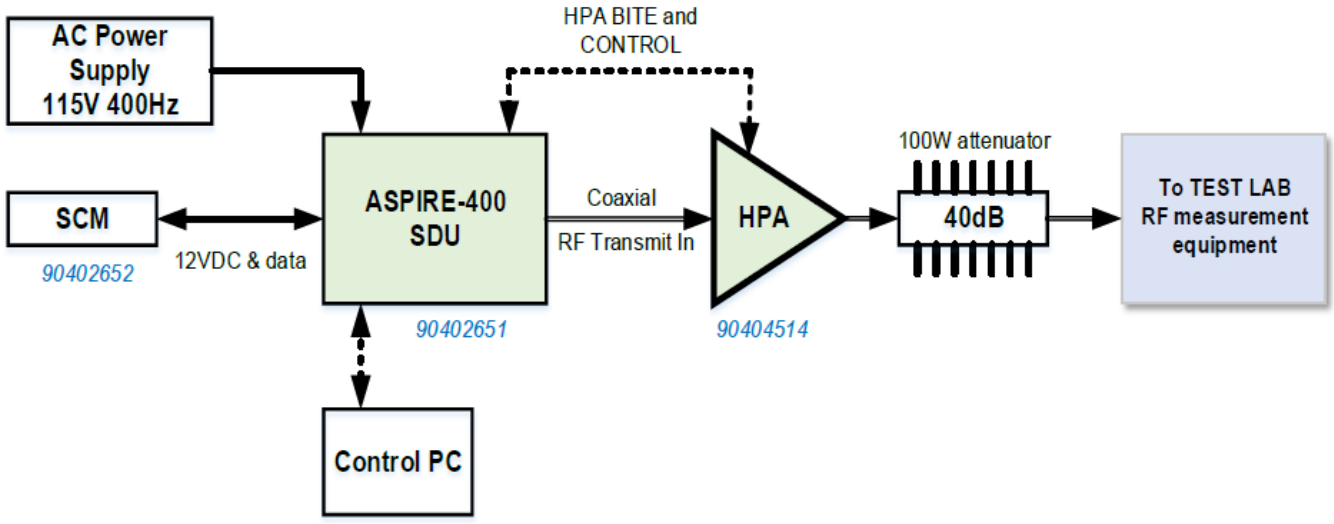
The SCM has the following physical characteristics. Some key elements are listed below

• Unit Assembly: Aspire 400 SCM

• Part Number: 90402652

Article	FCC ID
Aspire 400 SDU	K6K-MK5
AC Aspire 400 HPA	K6K-HP

Typical test set up Block Diagram



Note: To test the SDU RF power a directional coupler was used between the SDU and HPA and the 20 dB coupling port was used to measure the power and mask requirements. All other measurements were taken from the HPA output.

DLNA: Type-F Characteristics

Frequency (MHz)			Rejection
0.0	to	1525.0	>80 dB
1525.0	to	1559.0	> 120 dB
1559.0	to	1585.0	> 111 dB
1585.0	to	1605.0	> 95 dB
1605.0	to	1610.0	> 62 dB
1610.0	to	1614.0	> 40 dB
1614.0	to	1620.0	> 30 dB
1620.0	to	1624.5	> 20 dB
1624.5	to	1625.5	> 10 dB
1625.5	to	1626.5	Decreases
1626.5	to	1633.0	Insertion loss < 1.3 dB
1633.0	to	1660.5	Insertion loss < 0.8 dB
1660.5	to	1735.0	Increases
1735.0	to	1865.0	> 50 dB
1865.0	to	3250.0	> 20 dB
3250.0	to	3330.0	> 50 dB
3330.0	to	4000.0	> 40 dB
4000.0	to	12000.0	> 50 dB
12000.0	to	18000.0	> 15 dB

Note:
Based on manufacturer's recent testing on 140 DLNA samples the rejection limit in the band of 3250-3330 MHz is updated from 50 dB to 65 dB.

Hardware List :

1. **Test Rack Components**

   Below is the list of rack equipment required to run the UUT system to produce signals

Item	PN	SN	HON Asset
Rack	88000259	204	6504
PC			7684
UPS			7630
PDU 1			
PDU 2			
ACPS	751ix		7536
DCPS	DLM 60-10		7633
Breakout box	88000196		
Relay box			
Switch			

2. **Units under test**

UUT	PN
CSDU	90402651-000R
HPA	90404514-000R
SCM	90402652-000R

List of modulations used for testing:

Modulation Identifier	Mod	Sym Rate ksym/s	Data Rate kb/s	NBW kHz	FCC Emission Desig.	ABW kHz
R5T1XD	16 QAM	33.6	134.4	50	50K0D7W	225
R5T2XD	16 QAM	67.2	268.8	100	100KD7W	225
R5T4.5XD	16 QAM	151.2	604.8	200	200KD7W	225
R20T0.5QD	4 QPSK	16.8	33.6	25	25K0G7W	25
R20T1QD	4 QPSK	33.6	67.2	50	50K0G7W	225
R20T2QD	4 QPSK	67.2	134.4	100	100KG7W	225
R20T4.5QD	4 QPSK	151.2	302.4	200	200KG7W	225
FR80T2.5X16	16 QAM	84	336	110	110KD7W	225
FR80T2.5X32	32 QAM	84	420	110	110KD7W	225
FR80T2.5X64	64 QAM	84	504	110	110KD7W	225
FR80T5X16	16 QAM	168	672	200	200KD7W	225
FR80T5X32	32 QAM	168	840	200	200KD7W	225
FR80T5X64	64 QAM	168	1008	200	200KD7W	225

NBW= Necessary Bandwidth
ABW= Authorized Bandwidth

List of frequencies tested:

Frequency (MHz)
1626.5
1643.5
1660.5

List of Antennas:

Manufacturer	Model number	AES Class	Max Gain
Honeywell	AMT-3800 HGA	6	17 dBiC
Chelton	HGA-2100 HGA	6	12 dBiC
Honeywell	AMT-1800 IGA	7	12 dBiC
CMC Electronics	CMA-2200SB IGA	7	8.5 dBiC

Test Rack


Honeywell
Aspire 400
Power
Fault
Honeywell | Aspire 400
PNO 90404514-000R HPA 400
CAG 22373
SEQ 1928-11496
Honeywell Int. Inc.
21111 N 19 Ave
PHX, AZ USA
MADE IN CANADA
TCCA MFG 8-94
PNR 90404514-000R
p2020007 A1/3


Honeywell
Aspire 400
Power
Fault
S.I.S
Honeywell | Aspire 400
Description SDU 400
CAG 22373
PNO 90402651-000R
SEQ 062
Honeywell Int. Inc. MADE IN CANADA
21111 N 19 Ave, PHX, AZ, USA
Modifications:
1 2 3 4 5 6 7 8 9 10 11 12

Test Results Summary

Specification	Test Name	Pass, Fail, N/A	Comments
2.1046, 87.131	Carrier Output Power (Conducted)	Pass	
2.1051, 87.139(i)(1)	Unwanted Emissions (Transmitter Conducted)	Pass	
2.1053	Field Strength of Spurious Radiation	Pass	
2.1049, 87.139(i)(3)	Emission Masks (Occupied Bandwidth)	Pass	
2.1051, 87.139(i)(3) 87.139(a)	Emission Masks	Pass	See FCC waiver for allowable variance
2.1047	Audio Low Pass Filter (Voice Input)	N/A	The EUT does not contain an audio input
2.1047	Audio Frequency Response	N/A	The EUT does not contain an audio input
2.1047	Modulation Limiting	N/A	The EUT does not contain an audio input
2.1055, 87.133(a)	Frequency Stability (Temperature Variation)	Pass	
2.1055, 87.133(a)	Frequency Stability (Voltage Variation)	Pass	

Statements of conformity

Statements of conformity are reported as:

- Pass - the measured value is below the acceptance limit, acceptance limit = test limit.
- Fail - the measured value is above the acceptance limit, acceptance limit = test limit.

Occupied Bandwidth

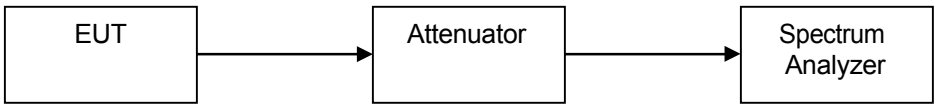
Engineer: Poona Saber

Test Date: 8/25/2020

Test Procedure

The EUT was connected to a spectrum analyzer through enough attenuation to measure the Occupied Bandwidth. To Measure the 99% occupied bandwidth The RBW was set to 1-5% of the anticipated OBW and VBW 3 times higher than that. The span of the instrument is set wide enough to capture all modulation products including the emission skirt. Peak detection mode with trace set to max hold is used.

Test Setup



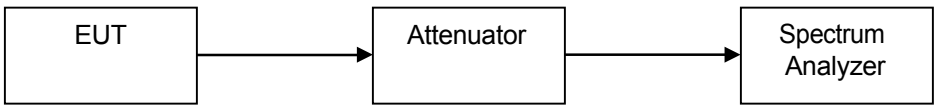
Refer to Annex A for Occupied bandwidth data.

Carrier Output Power (Conducted)
Engineer: Poona Saber
Test Date: 10/1/2020

Test Procedure

The Equipment Under Test (EUT) was connected directly to a spectrum analyzer with the RBW set to 1 MHz and the VBW set to 3 X RBW which set the RBW greater than the transmit signal ensuring there was no signal suppression while measuring a modulated signal. The peak readings were taken for each modulation type and the result was then compared to the limit.

Test Setup



R5T1XD Transmitter Peak Output Power

Tuned Frequency (MHz)	Measured Power (dBm)	Measured Power (W)	Limit (W)	Result
1626.5	13.33	0.021	60	Pass
1643.5	13.21	0.02	60	Pass
1660.5	13.8	0.023	60	Pass

R5T2XD Transmitter Peak Output Power

Tuned Frequency (MHz)	Measured Power (dBm)	Measured Power (W)	Limit (W)	Result
1626.5	12.97	0.019	60	Pass
1643.5	13.49	0.022	60	Pass
1660.5	13.51	0.022	60	Pass

R5T4.5XD Transmitter Peak Output Power

Tuned Frequency (MHz)	Measured Power (dBm)	Measured Power (W)	Limit (W)	Result
1626.5	13.23	0.021	60	Pass
1643.5	13.66	0.023	60	Pass
1660.5	13.8	0.023	60	Pass

R20T0.5QD Transmitter Peak Output Power

Tuned Frequency (MHz)	Measured Power (dBm)	Measured Power (W)	Limit (W)	Result
1626.5	9.82	0.009	60	Pass
1643.5	10.33	0.01	60	Pass
1660.5	10.02	0.01	60	Pass

R20T1QD Transmitter Peak Output Power

Tuned Frequency (MHz)	Measured Power (dBm)	Measured Power (W)	Limit (W)	Result
1626.5	9.45	0.008	60	Pass
1643.5	9.81	0.009	60	Pass
1660.5	10.15	0.01	60	Pass

R20T2QD Transmitter Peak Output Power

Tuned Frequency (MHz)	Measured Power (dBm)	Measured Power (W)	Limit (W)	Result
1626.5	9.04	0.008	60	Pass
1643.5	9.54	0.008	60	Pass
1660.5	9.84	0.009	60	Pass

R20T4.5QD Transmitter Peak Output Power

Tuned Frequency (MHz)	Measured Power (dBm)	Measured Power (W)	Limit (W)	Result
1626.5	9.21	0.008	60	Pass
1643.5	9.64	0.009	60	Pass
1660.5	9.91	0.009	60	Pass

FR80T2.5X16 Transmitter Peak Output Power

Tuned Frequency (MHz)	Measured Power (dBm)	Measured Power (W)	Limit (W)	Result
1626.5	12.2	0.016	60	Pass
1643.5	13.11	0.02	60	Pass
1660.5	11.84	0.015	60	Pass

FR80T2.5X32 Transmitter Peak Output Power

Tuned Frequency (MHz)	Measured Power (dBm)	Measured Power (W)	Limit (W)	Result
1626.5	12.13	0.016	60	Pass
1643.5	12.76	0.018	60	Pass
1660.5	13.09	0.02	60	Pass

FR80T2.5X64 Transmitter Peak Output Power

Tuned Frequency (MHz)	Measured Power (dBm)	Measured Power (W)	Limit (W)	Result
1626.5	12.5	0.017	60	Pass
1643.5	13.37	0.021	60	Pass
1660.5	12.85	0.019	60	Pass

FR80T5X16 Transmitter Peak Output Power

Tuned Frequency (MHz)	Measured Power (dBm)	Measured Power (W)	Limit (W)	Result
1626.5	12.29	0.016	60	Pass
1643.5	12.86	0.019	60	Pass
1660.5	13.22	0.02	60	Pass

FR80T5X32 Transmitter Peak Output Power

Tuned Frequency (MHz)	Measured Power (dBm)	Measured Power (W)	Limit (W)	Result
1626.5	12.09	0.016	60	Pass
1643.5	13.06	0.02	60	Pass
1660.5	12.98	0.019	60	Pass

FR80T5X64 Transmitter Peak Output Power

Tuned Frequency (MHz)	Measured Power (dBm)	Measured Power (W)	Limit (W)	Result
1626.5	13.23	0.021	60	Pass
1643.5	12.62	0.018	60	Pass
1660.5	13.46	0.022	60	Pass

Conducted Spurious Emissions

Engineer: Poona Saber

Test Date: 8/28-9/3/2020

Test Procedure

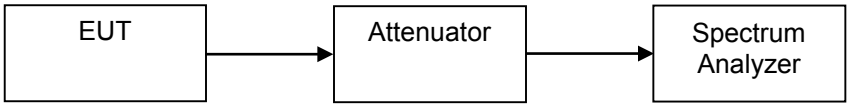
The EUT was connected directly to a spectrum analyzer to verify that the UUT met the requirements for spurious emissions.

For High Channel the RBW was set according to the requirements of 87139 (i)(1). The power was corrected for the measurement RBW bandwidth. The dBc limit, the DLNA rejection throughout the band, attenuator offset, and corrected power were summed together to determine the necessary dBc or dBm value of the EUT to provide a system rejection greater than the FCC limit.
This necessary value was compared to the measured value to ensure compliance to the specification, which is expressed as the margin. A negative value indicates a passing result. Result is shown in the tables below for different modulations.

Note: the emissions in the band 1660-1670 are not evaluated. Please refer to the manufacture's waiver document for this band.

Low and mid channel shall meet the emissions requirements of part 87.139 a)

Test Setup



See Annex B1 for Conducted Spurious Emissions test plots per part 87.139 (a)

See Annex B2 for Conducted Spurious Emissions test plots per part 87.139 (i)

Test Results for High channel per 87.139 (i)

R5T1XD

High Channel						Data Input↓		Data Input↓				
Freq. (MHz)	RBW	RBW Used	RBW Correction	Limit (dBc)	Filter Rejection	Measured carrier Power	Corrected Power	Absolute Measured Spurious (dBm)	Cable loss+Attenuator	Corrected spur. (dBc)	Limit (dBc)	Margin
.010 - 1026.5	0.004	0.03	8.75	-135	80	42.77	34.02	-56.34	21	-158.11	-135	-23.11
1026.5 - 1525	0.004	0.03	8.75	-135	80	42.77	34.02	-56.34	22	-157.11	-135	-22.11
1525 - 1559	0.004	0.03	8.75	-203	120	42.77	34.02	-76.97	22	-217.74	-203	-14.74
1559 - 1585	1	1	0.00	-155	111	42.77	42.77	-54.14	22	-185.91	-155	-30.91
1585 - 1605	1	1	0.00	-143	95	42.77	42.77	-54.14	22	-169.91	-143	-26.91
1605 - 1610	1	1	0.00	-117	62	42.77	42.77	-54.14	22	-136.91	-117	-19.91
1610 - 1610.6	1	1	0.00	-95	40	42.77	42.77	-54.14	22	-114.91	-95	-19.91
1610.6 - 1613.8	1	1	0.00	-50	40	42.77	XX	-53.77	22	-71.77	-50	-21.77
1613.8 - 1614	1	1	0.00	-95	40	42.77	42.77	-53.21	22	-113.98	-95	-18.98
1614 - 1620	0.004	0.03	8.75	-70	30	42.77	34.02	-65.38	22	-116.15	-70	-46.15
1620 - 1624.5	0.004	0.03	8.75	-70	20	42.77	34.02	-58.32	22	-99.09	-70	-29.09
1624.5 - 1625.5	0.004	0.03	8.75	-70	10	42.77	34.02	-58.32	22	-89.09	-70	-19.09
1625.5 - 1626.5	0.004	0.03	8.75	-70	1.3	42.77	34.02	-58.32	22	-80.39	-70	-10.39
1626.5 - 1660	0.004	0.03	8.75	-70	1.3	42.77	34.02	-58.32	22	-80.39	-70	-10.39
1660 - 1670	0.02	0.03	1.76	-19.5	0.8	42.77	XX	-17.3	22	2.14	-19.5	21.64
1670 - 1735	0.004	0.03	8.75	-60	0.8	42.77	34.02	-65.99	22	-87.56	-60	-27.56
1735 - 1865	0.004	0.03	8.75	-105	50	42.77	34.02	-71.13	22	-141.90	-105	-36.90
1865 - 2260.5	0.004	0.03	8.75	-105	20	42.77	34.02	-68.81	22.6	-108.98	-105	-3.98
2260.5 - 3250	0.004	0.03	8.75	-105	20	42.77	34.02	-74.83	22.8	-114.80	-105	-9.80
3250 - 3330	0.004	0.03	8.75	-105	65	42.77	34.02	-33.6	23.15	-118.22	-105	-13.22
3330 - 4000	0.004	0.03	8.75	-105	40	42.77	34.02	-76.33	23.4	-135.70	-105	-30.70
4000 - 12000	0.004	0.03	8.75	-105	50	42.77	34.02	-50.32	29	-114.09	-105	-9.09
12000 - 18000	0.004	0.03	8.75	-70	15	42.77	34.02	-76.23	36	-98.00	-70	-28.00

R20T0.5QD

High Channel						Data Input↓		Data Input↓				
Freq. (MHz)	RBW	RBW Used	RBW Correction	Limit (dBc)	Filter Rejection	Measured carrier Power	Corrected Power	Absolute Measured Spurious (dBm)	Cable loss+Attenuator	Corrected spur. (dBc)	Limit (dBc)	Margin
.010 - 1026.5	0.004	0.03	8.75	-135	80	42.82	34.07	-39.88	21	-141.70	-135	-6.70
1026.5 - 1525	0.004	0.03	8.75	-135	80	42.82	34.07	-39.88	22	-140.70	-135	-5.70
1525 - 1559	0.004	0.03	8.75	-203	120	42.82	34.07	-71.15	22	-211.97	-203	-8.97
1559 - 1585	1	1	0.00	-155	111	42.82	42.82	-54.83	22	-186.65	-155	-31.65
1585 - 1605	1	1	0.00	-143	95	42.82	42.82	-54.83	22	-170.65	-143	-27.65
1605 - 1610	1	1	0.00	-117	62	42.82	42.82	-54.83	22	-137.65	-117	-20.65
1610 - 1610.6	1	1	0.00	-95	40	42.82	42.82	-54.83	22	-115.65	-95	-20.65
1610.6 - 1613.8	1	1	0.00	-50	40	42.82	XX	-53.47	22	-71.47	-50	-21.47
1613.8 - 1614	1	1	0.00	-95	40	42.82	42.82	-52.47	22	-113.29	-95	-18.29
1614 - 1620	0.004	0.03	8.75	-70	30	42.82	34.07	-59.62	22	-110.44	-70	-40.44
1620 - 1624.5	0.004	0.03	8.75	-70	20	42.82	34.07	-59.62	22	-100.44	-70	-30.44
1624.5 - 1625.5	0.004	0.03	8.75	-70	10	42.82	34.07	-59.62	22	-90.44	-70	-20.44
1625.5 - 1626.5	0.004	0.03	8.75	-70	1.3	42.82	34.07		22	-44.12	-70	25.88
1626.5 - 1660	0.004	0.03	8.75	-70	1.3	42.82	34.07		22	-44.12	-70	25.88
1660 - 1670	0.02	0.03	1.76	-19.5	0.8	42.82	XX	9.3	22	28.74	-19.5	48.24
1670 - 1735	0.004	0.03	8.75	-60	0.8	42.82	34.07	-62.91	22	-84.53	-60	-24.53
1735 - 1865	0.004	0.03	8.75	-105	50	42.82	34.07	-70.61	22	-141.43	-105	-36.43
1865 - 2260.5	0.004	0.03	8.75	-105	20	42.82	34.07	-69.58	22.6	-109.80	-105	-4.80
2260.5 - 3250	0.004	0.03	8.75	-105	20	42.82	34.07	-69.41	22.8	-109.43	-105	-4.43
3250 - 3330	0.004	0.03	8.75	-105	65	42.82	34.07	-28.77	23.15	-113.44	-105	-8.44
3330 - 4000	0.004	0.03	8.75	-105	40	42.82	34.07	-71.24	23.4	-130.66	-105	-25.66
4000 - 12000	0.004	0.03	8.75	-105	50	42.82	34.07	-47.24	29	-111.06	-105	-6.06
12000 - 18000	0.004	0.03	8.75	-70	15	42.82	34.07	-68.41	36	-90.23	-70	-20.23

R20T4.5QD

High Channel						Data Input↓		Data Input↓				
Freq. (MHz)	RBW	RBW Used	RBW Correction	Limit (dBc)	Filter Rejection	Measured carrier Power	Corrected Power	Absolute Measured Spurious (dBm)	Cable loss+Attenuator	Corrected spur. (dBc)	Limit (dBc)	Margin
.010 - 1026.5	0.004	0.03	8.75	-135	80	42.95	34.20	-50.54	21	-152.49	-135	-17.49
1026.5 - 1525	0.004	0.03	8.75	-135	80	42.95	34.20	-50.54	22	-151.49	-135	-16.49
1525 - 1559	0.004	0.03	8.75	-203	120	42.95	34.20	-69.2	22	-210.15	-203	-7.15
1559 - 1585	1	1	0.00	-155	111	42.95	42.95	-54.42	22	-186.37	-155	-31.37
1585 - 1605	1	1	0.00	-143	95	42.95	42.95	-54.42	22	-170.37	-143	-27.37
1605 - 1610	1	1	0.00	-117	62	42.95	42.95	-54.42	22	-137.37	-117	-20.37
1610 - 1610.6	1	1	0.00	-95	40	42.95	42.95	-54.42	22	-115.37	-95	-20.37
1610.6 - 1613.8	1	1	0.00	-50	40	42.95	XX	-52.63	22	-70.63	-50	-20.63
1613.8 - 1614	1	1	0.00	-95	40	42.95	42.95	-52.46	22	-113.41	-95	-18.41
1614 - 1620	0.004	0.03	8.75	-70	30	42.95	34.20	-59.95	22	-110.90	-70	-40.90
1620 - 1624.5	0.004	0.03	8.75	-70	20	42.95	34.20	-59.95	22	-100.90	-70	-30.90
1624.5 - 1625.5	0.004	0.03	8.75	-70	10	42.95	34.20	-61.67	22	-92.62	-70	-22.62
1625.5 - 1626.5	0.004	0.03	8.75	-70	1.3	42.95	34.20	-62.38	22	-84.63	-70	-14.63
1626.5 - 1660	0.004	0.03	8.75	-70	1.3	42.95	34.20	-66.65	22	-88.90	-70	-18.90
1660 - 1670	0.02	0.03	1.76	-19.5	0.8	42.95	XX	-6.944	22	12.50	-19.5	32.00
1670 - 1735	0.004	0.03	8.75	-60	0.8	42.95	34.20	-64.97	22	-86.72	-60	-26.72
1735 - 1865	0.004	0.03	8.75	-105	50	42.95	34.20	-73	22	-143.95	-105	-38.95
1865 - 2260.5	0.004	0.03	8.75	-105	20	42.95	34.20	-71.18	22.6	-111.53	-105	-6.53
2260.5 - 3250	0.004	0.03	8.75	-105	20	42.95	34.20	-74.84	22.8	-114.99	-105	-9.99
3250 - 3330	0.004	0.03	8.75	-105	65	42.95	34.20	-34.66	23.15	-119.46	-105	-14.46
3330 - 4000	0.004	0.03	8.75	-105	40	42.95	34.20	-76.34	23.4	-135.89	-105	-30.89
4000 - 12000	0.004	0.03	8.75	-105	50	42.95	34.20	-50.09	29	-114.04	-105	-9.04
12000 - 18000	0.004	0.03	8.75	-70	15	42.95	34.20	-76.16	36	-98.11	-70	-28.11

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High Channel						Data Input↓		Data Input↓				
Freq. (MHz)	RBW	RBW Used	RBW Correction	Limit (dBc)	Filter Rejection	Measured carrier Power	Corrected Power	Absolute Measured Spurious (dBm)	Cable loss+Attenuator	Corrected spur. (dBc)	Limit (dBc)	Margin
.010 - 1026.5	0.004	0.03	8.75	-135	80	43.23	34.48	-48.32	21	-150.55	-135	-15.55
1026.5 - 1525	0.004	0.03	8.75	-135	80	43.23	34.48	-48.32	22	-149.55	-135	-14.55
1525 - 1559	0.004	0.03	8.75	-203	120	43.23	34.48	-67.89	22	-209.12	-203	-6.12
1559 - 1585	1	1	0.00	-155	111	43.23	43.23	-54.32	22	-186.55	-155	-31.55
1585 - 1605	1	1	0.00	-143	95	43.23	43.23	-54.32	22	-170.55	-143	-27.55
1605 - 1610	1	1	0.00	-117	62	43.23	43.23	-54.32	22	-137.55	-117	-20.55
1610 - 1610.6	1	1	0.00	-95	40	43.23	43.23	-54.32	22	-115.55	-95	-20.55
1610.6 - 1613.8	1	1	0.00	-50	40	43.23	XX	-53.9	22	-71.90	-50	-21.90
1613.8 - 1614	1	1	0.00	-95	40	43.23	43.23	-52.75	22	-113.98	-95	-18.98
1614 - 1620	0.004	0.03	8.75	-70	30	43.23	34.48	-60.92	22	-112.15	-70	-42.15
1620 - 1624.5	0.004	0.03	8.75	-70	20	43.23	34.48	-60.92	22	-102.15	-70	-32.15
1624.5 - 1625.5	0.004	0.03	8.75	-70	10	43.23	34.48	-60.92	22	-92.15	-70	-22.15
1625.5 - 1626.5	0.004	0.03	8.75	-70	1.3	43.23	34.48	-60.92	22	-83.45	-70	-13.45
1626.5 - 1660	0.004	0.03	8.75	-70	1.3	43.23	34.48	-51.7	22	-74.23	-70	-4.23
1660 - 1670	0.02	0.03	1.76	-19.5	0.8	43.23	XX	-2.088	22	17.35	-19.5	36.85
1670 - 1735	0.004	0.03	8.75	-60	0.8	43.23	34.48	-65.94	22	-87.97	-60	-27.97
1735 - 1865	0.004	0.03	8.75	-105	50	43.23	34.48	-60.13	22	-131.36	-105	-26.36
1865 - 2260.5	0.004	0.03	8.75	-105	20	43.23	34.48	-67.12	22.6	-107.75	-105	-2.75
2260.5 - 3250	0.004	0.03	8.75	-105	20	43.23	34.48	-67.12	22.8	-107.55	-105	-2.55
3250 - 3330	0.004	0.03	8.75	-105	65	43.23	34.48	-35.08	23.15	-120.16	-105	-15.16
3330 - 4000	0.004	0.03	8.75	-105	40	43.23	34.48	-74.78	23.4	-134.61	-105	-29.61
4000 - 12000	0.004	0.03	8.75	-105	50	43.23	34.48	-52.82	29	-117.05	-105	-12.05
12000 - 18000	0.004	0.03	8.75	-70	15	43.23	34.48	-66.81	36	-89.04	-70	-19.04

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High Channel						Data Input↓		Data Input↓				
Freq. (MHz)	RBW	RBW Used	RBW Correction	Limit (dBc)	Filter Rejection	Measured carrier Power	Corrected Power	Absolute Measured Spurious (dBm)	Cable loss+Attenuator	Corrected spur. (dBc)	Limit (dBc)	Margin
.010 - 1026.5	0.004	0.03	8.75	-135	80	43.02	34.27	-57.34	21	-159.36	-135	-24.36
1026.5 - 1525	0.004	0.03	8.75	-135	80	43.02	34.27	-57.34	22	-158.36	-135	-23.36
1525 - 1559	0.004	0.03	8.75	-203	120	43.02	34.27	-67.37	22	-208.39	-203	-5.39
1559 - 1585	1	1	0.00	-155	111	43.02	43.02	-54.57	22	-186.59	-155	-31.59
1585 - 1605	1	1	0.00	-143	95	43.02	43.02	-54.57	22	-170.59	-143	-27.59
1605 - 1610	1	1	0.00	-117	62	43.02	43.02	-54.57	22	-137.59	-117	-20.59
1610 - 1610.6	1	1	0.00	-95	40	43.02	43.02	-54.57	22	-115.59	-95	-20.59
1610.6 - 1613.8	1	1	0.00	-50	40	43.02	XX	-53.27	22	-71.27	-50	-21.27
1613.8 - 1614	1	1	0.00	-95	40	43.02	43.02	-53.13	22	-114.15	-95	-19.15
1614 - 1620	0.004	0.03	8.75	-70	30	43.02	34.27	-60.33	22	-111.35	-70	-41.35
1620 - 1624.5	0.004	0.03	8.75	-70	20	43.02	34.27	-60.33	22	-101.35	-70	-31.35
1625.5 - 1626.5	0.004	0.03	8.75	-70	1.3	43.02	34.27	-60.33	22	-82.65	-70	-12.65
1626.5 - 1660	0.004	0.03	8.75	-70	1.3	43.02	34.27	-51.2	22	-73.52	-70	-3.52
1660 - 1670	0.02	0.03	1.76	-19.5	0.8	43.02	XX	-6.764	22	12.68	-19.5	32.18
1670 - 1735	0.004	0.03	8.75	-60	0.8	43.02	34.27	-65.92	22	-87.74	-60	-27.74
1735 - 1865	0.004	0.03	8.75	-105	50	43.02	34.27	-68.82	22	-139.84	-105	-34.84
1865 - 2260.5	0.004	0.03	8.75	-105	20	43.02	34.27	-68.82	22.6	-109.24	-105	-4.24
2260.5 - 3250	0.004	0.03	8.75	-105	20	43.02	34.27	-68.82	22.8	-109.04	-105	-4.04
3250 - 3330	0.004	0.03	8.75	-105	65	43.02	34.27	-34.49	23.15	-119.36	-105	-14.36
3330 - 4000	0.004	0.03	8.75	-105	40	43.02	34.27	-70.32	23.4	-129.94	-105	-24.94
4000 - 12000	0.004	0.03	8.75	-105	50	43.02	34.27	-49.79	29	-113.81	-105	-8.81
12000 - 18000	0.004	0.03	8.75	-70	15	43.02	34.27	-69.3	36	-91.32	-70	-21.32

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High Channel						Data Input↓		Data Input↓				
Freq. (MHz)	RBW	RBW Used	RBW Correction	Limit (dBc)	Filter Rejection	Measured carrier Power	Corrected Power	Absolute Measured Spurious (dBm)	Cable loss+Attenuator	Corrected spur. (dBc)	Limit (dBc)	Margin
.010 - 1026.5	0.004	0.03	8.75	-135	80	42.94	34.19	-65.84	21	-167.78	-135	-32.78
1026.5 - 1525	0.004	0.03	8.75	-135	80	42.94	34.19	-65.84	22	-166.78	-135	-31.78
1525 - 1559	0.004	0.03	8.75	-203	120	42.94	34.19	-68.19	22	-209.13	-203	-6.13
1559 - 1585	1	1	0.00	-155	111	42.94	42.94	-54.6	22	-186.54	-155	-31.54
1585 - 1605	1	1	0.00	-143	95	42.94	42.94	-54.6	22	-170.54	-143	-27.54
1605 - 1610	1	1	0.00	-117	62	42.94	42.94	-54.6	22	-137.54	-117	-20.54
1610 - 1610.6	1	1	0.00	-95	40	42.94	42.94	-54.6	22	-115.54	-95	-20.54
1610.6 - 1613.8	1	1	0.00	-50	40	42.94	XX	-53.65	22	-71.65	-50	-21.65
1613.8 - 1614	1	1	0.00	-95	40	42.94	42.94	-52.17	22	-113.11	-95	-18.11
1614 - 1620	0.004	0.03	8.75	-70	30	42.94	34.19	-61.69	22	-112.63	-70	-42.63
1620 - 1624.5	0.004	0.03	8.75	-70	20	42.94	34.19	-61.69	22	-102.63	-70	-32.63
1624.5 - 1625.5	0.004	0.03	8.75	-70	10	42.94	34.19	-61.69	22	-92.63	-70	-22.63
1625.5 - 1626.5	0.004	0.03	8.75	-70	1.3	42.94	34.19	-61.69	22	-83.93	-70	-13.93
1626.5 - 1660	0.004	0.03	8.75	-70	1.3	42.94	34.19	-53.66	22	-75.90	-70	-5.90
1660 - 1670	0.02	0.03	1.76	-19.5	0.8	42.94	XX	-1.73	22	17.71	-19.5	37.21
1670 - 1735	0.004	0.03	8.75	-60	0.8	42.94	34.19	-65.28	22	-87.02	-60	-27.02
1735 - 1865	0.004	0.03	8.75	-105	50	42.94	34.19	-69.28	22	-140.22	-105	-35.22
1865 - 2260.5	0.004	0.03	8.75	-105	20	42.94	34.19	-69.28	22.6	-109.62	-105	-4.62
2260.5 - 3250	0.004	0.03	8.75	-105	20	42.94	34.19	-69.28	22.8	-109.42	-105	-4.42
3250 - 3330	0.004	0.03	8.75	-105	65	42.94	34.19	-37.66	23.15	-122.45	-105	-17.45
3330 - 4000	0.004	0.03	8.75	-105	40	42.94	34.19	-70.59	23.4	-130.13	-105	-25.13
4000 - 12000	0.004	0.03	8.75	-105	50	42.94	34.19	-54.26	29	-118.20	-105	-13.20
12000 - 18000	0.004	0.03	8.75	-70	15	42.94	34.19	-68.37	36	-90.31	-70	-20.31

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High Channel						Data Input↓		Data Input↓				
Freq. (MHz)	RBW	RBW Used	RBW Correction	Limit (dBc)	Filter Rejection	Measured carrier Power	Corrected Power	Absolute Measured Spurious (dBm)	Cable loss+Attenuator	Corrected spur. (dBc)	Limit (dBc)	Margin
.010 - 1026.5	0.004	0.03	8.75	-135	80	43.34	34.59	-51.54	21	-153.88	-135	-18.88
1026.5 - 1525	0.004	0.03	8.75	-135	80	43.34	34.59	-51.54	22	-152.88	-135	-17.88
1525 - 1559	0.004	0.03	8.75	-203	120	43.34	34.59	-67.89	22	-209.23	-203	-6.23
1559 - 1585	1	1	0.00	-155	111	43.34	43.34	-54.65	22	-186.99	-155	-31.99
1585 - 1605	1	1	0.00	-143	95	43.34	43.34	-54.65	22	-170.99	-143	-27.99
1605 - 1610	1	1	0.00	-117	62	43.34	43.34	-54.65	22	-137.99	-117	-20.99
1610 - 1610.6	1	1	0.00	-95	40	43.34	43.34	-54.65	22	-115.99	-95	-20.99
1610.6 - 1613.8	1	1	0.00	-50	40	43.34	XX	-52.46	22	-70.46	-50	-20.46
1613.8 - 1614	1	1	0.00	-95	40	43.34	43.34	-52.1	22	-113.44	-95	-18.44
1614 - 1620	0.004	0.03	8.75	-70	30	43.34	34.59	-60.76	22	-112.10	-70	-42.10
1620 - 1624.5	0.004	0.03	8.75	-70	20	43.34	34.59	-60.76	22	-102.10	-70	-32.10
1624.5 - 1625.5	0.004	0.03	8.75	-70	10	43.34	34.59	-60.76	22	-92.10	-70	-22.10
1625.5 - 1626.5	0.004	0.03	8.75	-70	1.3	43.34	34.59	-60.76	22	-83.40	-70	-13.40
1626.5 - 1660	0.004	0.03	8.75	-70	1.3	43.34	34.59	-52.21	22	-74.85	-70	-4.85
1660 - 1670	0.02	0.03	1.76	-19.5	0.8	43.34	XX	-1.253	22	18.19	-19.5	37.69
1670 - 1735	0.004	0.03	8.75	-60	0.8	43.34	34.59	-64.55	22	-86.69	-60	-26.69
1735 - 1865	0.004	0.03	8.75	-105	50	43.34	34.59	-69.73	22	-141.07	-105	-36.07
1865 - 2260.5	0.004	0.03	8.75	-105	20	43.34	34.59	-68.38	22.6	-109.12	-105	-4.12
2260.5 - 3250	0.004	0.03	8.75	-105	20	43.34	34.59	-68.38	22.8	-108.92	-105	-3.92
3250 - 3330	0.004	0.03	8.75	-105	65	43.34	34.59	-40.62	23.15	-125.81	-105	-20.81
3330 - 4000	0.004	0.03	8.75	-105	40	43.34	34.59	-64.46	23.4	-124.40	-105	-19.40
4000 - 12000	0.004	0.03	8.75	-105	50	43.34	34.59	-56.33	29	-120.67	-105	-15.67
12000 - 18000	0.004	0.03	8.75	-70	15	43.34	34.59	-69.16	36	-91.50	-70	-21.50

Note: For the Red data in the table above refer to the waiver application for the manufacturer.

Field Strength of Spurious Radiation

Engineer: Poona Saber
Test Date: 9/16/2020

Test Procedure

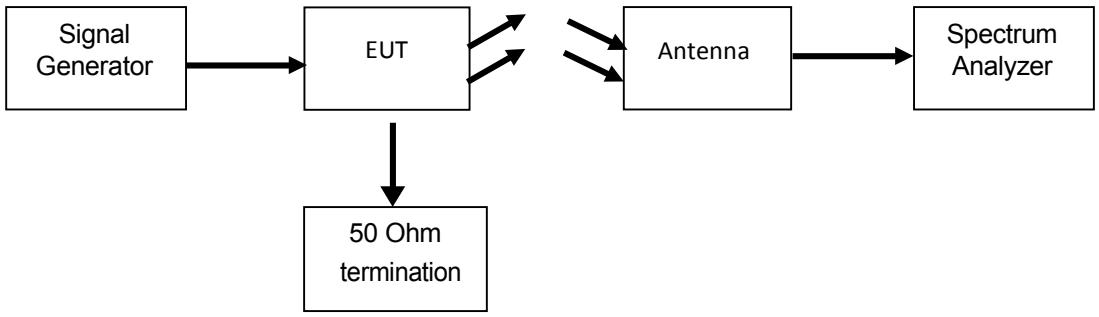
The EUT was tested in a semi-anechoic chamber with the turntable set 3m from the receiving antenna. A spectrum analyzer was used to verify that the EUT met the requirements for Radiated Emissions. The EUT was tested by rotating it 360 degrees with the antenna in both the vertical and horizontal orientation while raised from 1 to 4 meters to ensure that the signal levels were maximized. All cable and antenna correction factors were input into the spectrum analyzer ensuring an accurate measurement in ERP/EIRP with the resultant power in dBm. A signal generator was used to provide a CW signal. The EUT output was terminated into a 50 Ohm non-radiating load.

The RBW was set to 100 kHz for measurements below 1 GHz and 1 MHz for measurements above 1 GHz. The VBW was set to 3 times the RBW.

The following formula was used for calculating the limits:

Radiated Spurious Emissions Limit = P1 – (43+ 10Log(P2)) = -13dBm
P1 = power in dBm
P2 = power in Watts

Test Setup



Test Results

Refer to Annex C for the Radiated Spurious Emissions

Emission Masks

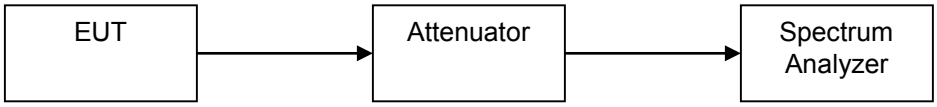
Engineer: Poona Saber

Test Date: 10/2/2020

Test Procedure

The EUT was connected directly to a spectrum analyzer to verify that the EUT meets the required emissions mask. A reference level plot is provided to verify that the peak power was established prior to testing the mask. The transmitter is digital modulation therefore no data input is required to measure the emission mask. The RBW was set as close as possible to 1% of the occupied bandwidth to ensure accurate readings.

Test Setup



Low and mid channel shall meet the emissions requirements of part 87.139 a)
High channel shall meet the emissions requirements of part 87.139 i).

Refer to Annex D for the low, mid and high channels Emission Mask test data.

Frequency Stability (Temperature Variation)

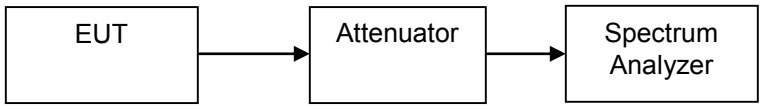
Engineer: Poona Saber

Test Date: 9/9/2020

Test Procedure

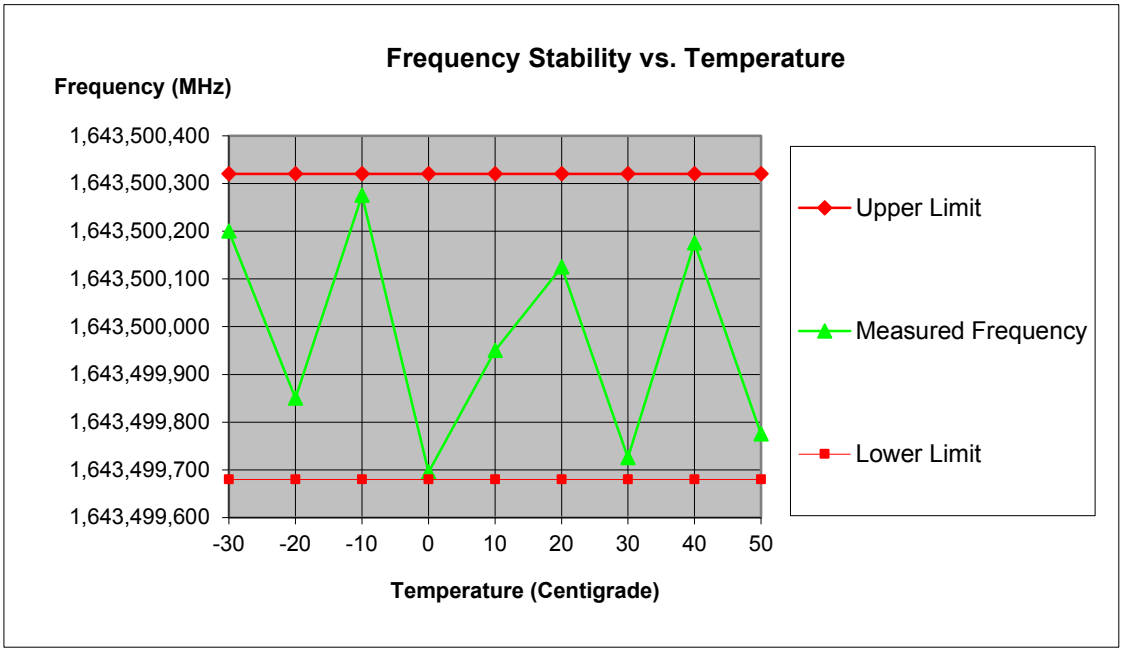
The EUT was placed in an environmental test chamber and the RF output was connected directly to a frequency counter. The temperature was varied from -30ºC to 50ºC in 10ºC increments. After a sufficient time for temperature stabilization the RF output frequency was measured.

Test Setup



Measurement Results

Tuned Frequency (Hz)	Frequency Tolerance HZ	Upper Limit (MHz)	Lower Limit (MHz)	Temperature centigrade	Measured Frequency (MHz)	Upper Margin (MHz)	Lower Margin (MHz)
1,643,500,000	320.0	1643500320	1643499680	-30	1,643,500,200	-120	520
		1643500320	1643499680	-20	1,643,499,850	-470	170
		1643500320	1643499680	-10	1,643,500,275	-45	595
		1643500320	1643499680	0	1,643,499,695	-625	15
		1643500320	1643499680	10	1,643,499,950	-370	270
		1643500320	1643499680	20	1,643,500,125	-195	445
		1643500320	1643499680	30	1,643,499,725	-595	45
		1643500320	1643499680	40	1,643,500,175	-145	495
		1643500320	1643499680	50	1,643,499,775	-545	95



Frequency Stability (Voltage Variation)

Engineer: Poona Saber

Test Date: 9/9/2020

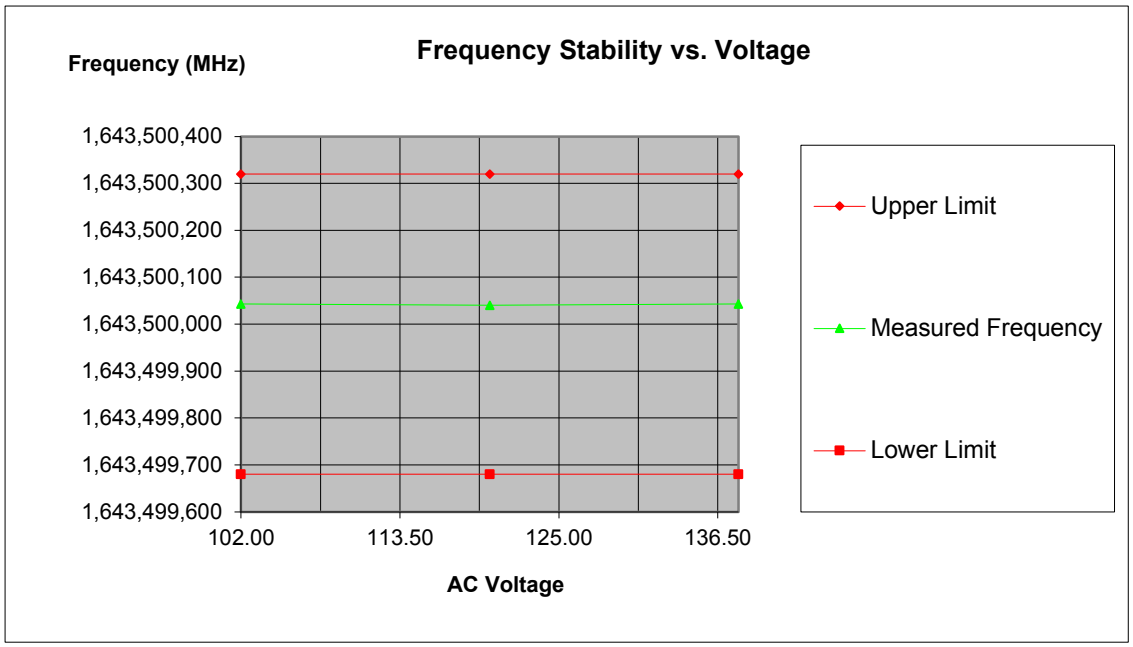
Test Procedure

The EUT was placed in a temperature chamber at 20±5°C and connected directly to a spectrum analyzer. The power supply voltage to the EUT was varied from 85% to 115% of the nominal value and the RF output was measured. This was measured with both a 400 Hz 115 VAC supply and a variable DC voltage source.

Test Setup

Test Results

Tuned Frequency (MHz)	Frequency Tolerance PPM	Upper Limit (MHz)	Lower Limit (MHz)	Nominal Voltatge	Voltage	Measured Frequency (MHz)	Upper Margin (MHz)	Lower Margin (MHz)
1,643,500,000	320.0	1643500320	1643499680	120.00	102.00	1,643,500,043	-277	363
		1643500320	1643499680		120.00	1,643,500,040	-280	360
		1643500320	1643499680		138.00	1,643,500,043	-277	363



Necessary Bandwidth and Emission Bandwidth

Engineer:

Test Date:

BPSK

Modulation = 840HG1D
Necessary Bandwidth Calculation:

Signal States (S)	=		2
Data Rate (D)		=	0.6
Constant Factor (K)	=		0.7
Necessary Bandwidth (B_N), kHz	=		$2*D*K / LOG_2(S)$

Modulation = 1K68G1D
Necessary Bandwidth Calculation:

Signal States (S)	=		2
Data Rate (D)		=	1.2
Constant Factor (K)	=		0.7
Necessary Bandwidth (B_N), kHz	=		$2*D*K / LOG_2(S)$

Modulation = 21K0G1D
Necessary Bandwidth Calculation:

Signal States (S)	=		2
Data Rate (D)		=	3
Constant Factor (K)	=		3.5
Necessary Bandwidth (B_N), kHz	=		$2*D*K / LOG_2(S)$

QPSK

Modulation = 6K80G1E
Necessary Bandwidth Calculation:

Signal States (S)	=		4
Data Rate (D)		=	8.4
Constant Factor (K)	=		0.81
Necessary Bandwidth (B_N), kHz	=		$2*D*K / LOG_2(S)$

Modulation = 7K20G1E
Necessary Bandwidth Calculation:

Signal States (S)	=		4
Data Rate (D)		=	5.6
Constant Factor (K)	=		1.29
Necessary Bandwidth (B_N), kHz	=		$2*D*K / LOG_2(S)$

Modulation = 10K5G1D
Necessary Bandwidth Calculation:

Signal States (S)	=		4
Data Rate (D)		=	10.5
Constant Factor (K)	=		1
Necessary Bandwidth (B_N), kHz	=		$2*D*K / LOG_2(S)$

Modulation = 25K0G7W
Necessary Bandwidth Calculation:

Signal States (S)	=		4
Data Rate (D)		=	33.6
Constant Factor (K)	=		0.74
Necessary Bandwidth (B_N), kHz	=		$2*D*K / LOG_2(S)$

Modulation = 40K0G1E
Necessary Bandwidth Calculation:

Signal States (S)	=		4
Data Rate (D)		=	134.4
Constant Factor (K)	=		0.74
Necessary Bandwidth (B_N), kHz	=		$2*D*K / LOG_2(S)$

Modulation = 50K0G7W
Necessary Bandwidth Calculation:

Signal States (S)	=		4
Data Rate (D)		=	67.2
Constant Factor (K)	=		0.74
Necessary Bandwidth (B_N), kHz	=		$2*D*K / LOG_2(S)$

Modulation = 100KG7W
Necessary Bandwidth Calculation:

Signal States (S)	=		4
Data Rate (D)		=	134.4
Constant Factor (K)	=		0.74
Necessary Bandwidth (B_N), kHz	=		$2*D*K / LOG_2(S)$

Modulation = 200KG7W
Necessary Bandwidth Calculation:

Signal States (S)	=		4
Data Rate (D)		=	302.4
Constant Factor (K)	=		0.66
Necessary Bandwidth (B_N), kHz	=		$2*D*K / LOG_2(S)$

QAM

Modulation = 50K0D7W
Necessary Bandwidth Calculation:

Signal States (S)	=		16
Data Rate (D)		=	134.4
Constant Factor (K)	=		0.74
Necessary Bandwidth (B_N), kHz	=		$2*D*K / LOG_2(S)$

Modulation = 40K0G1E
Necessary Bandwidth Calculation:

Signal States (S)	=		16
Data Rate (D)		=	134.4
Constant Factor (K)	=		0.6
Necessary Bandwidth (B_N), kHz	=		$2*D*K / LOG_2(S)$

Modulation = 100KD7W
Necessary Bandwidth Calculation:

Signal States (S)	=		16
Data Rate (D)		=	268.8
Constant Factor (K)	=		0.74
Necessary Bandwidth (B_N), kHz	=		$2*D*K / LOG_2(S)$

Modulation = 200KD7W
Necessary Bandwidth Calculation:

Signal States (S)	=		16
Data Rate (D)		=	604.8
Constant Factor (K)	=		0.66
Necessary Bandwidth (B_N), kHz	=		$2*D*K / LOG_2(S)$

Measurement Uncertainty

Measurement Uncertainty (U_{lab}) for Compliance Testing is listed in the table below.
The reported expanded uncertainty U_{lab}(dB) has been estimated at a 95% confidence level (k=2)

Measurement	U_{lab}
Radio Frequency	± 1.0 x10^{-12}
RF Power, conducted	± 0.43 dB
RF Power Density, conducted	± .98 dB
Spurious Emissions, Conducted	± 2.49 dB
All Emissions, radiated	± 5.7 dB
Temperature	± 1.0 deg C
Humidity	± 4.3 %
Dc voltage	± .12 %
Low Frequency voltages	± 2.3 %

The reported expanded uncertainty +/- U_{lab}(dB) has been estimated at a 95% confidence level (k=2)

U_{lab} is less than or equal to U_{CISPR} therefore

☐ Compliance is deemed to occur if no measured disturbance exceeds the disturbance limit
☐ Non-Compliance is deemed to occur if any measured disturbance exceeds the disturbance limit
☐

Test Equipment Utilized

Description	Manufacturer	Model #	CT Asset #	Last Cal Date	Cal Due Date
Horn Antenna	Antenna research Association	DRG-118/A	i00271	8/3/2020	8/3/2022
Bilog Antenna	Schaffner	CBL6111C	i00267	8/28/2020	8/28/2022
EMI Analyzer	Agilent	E7405A	i00379	1/21/2020	1/21/2021
3 Meter Semi-Anechoic Chamber	Panashield	3 Meter Semi-Anechoic Chamber	i00428	8/15/2016	8/15/2019
Spectrum Analyzer	Agilent	E4407B	i00331	12/18/2019	12/18/2020
Wideband Preamplifier for 10 MHz-40 GHz	RF Lambda USA	RLNA00M45GA	i00509	N/A	N/A
Temperature Test Chamber	Thermotron	SE-1000-3-3	i00557	N/A	N/A

In addition to the above listed equipment standard RF connectors and cables were utilized in the testing of the described equipment. Prior to testing these components were tested to verify proper operation.

END OF TEST REPORT