Compliance Testing, LLC
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http://www.ComplianceTesting.com
info@ComplianceTesting.com

Test Report

Prepared for: EMS technologies Canada Lts.

Model: IPLD

Description: Aircraft earth station

Serial Number: N/A

FCC ID: K6KIPLD

To

FCC Part 87

Date of Issue: April 12, 2020

On the behalf of the applicant:	**EMS Technologies Canada Ltd.** **400 Maple Grove Road** **Ottawa, ON K2V 1B8** **Canada**
Attention of:	**Hicham El-Zibawi** **Phone: (613)595-7631** **Email: Hicham.Zibawi@Honeywell.com**

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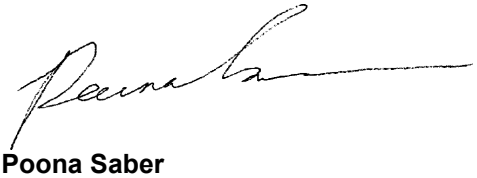
Project No: p16c0010



Poona Saber
Project Test Engineer

Test Report Revision History

Revision	Date	Revised By	Reason for Revision
1.0	April 12th,2020	Poona Saber	Original Document

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ILAC / A2LA

Compliance Testing, LLC, has been accredited in accordance with the recognized International Standard ISO/IEC 17025:2005. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (refer 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 in the table below

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

Testing Certificate Number: **2152.01**

ACCREDITED
TESTING CERT
#2152.01

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: IPLD
Description: aircraft earth station
Part number: 1524-A-2000
Additional Information:

The aircraft user terminal functions also known as the SATCOM Avionics is an integral part of the complete L-band Inmarsat Satellite communications system and comprises of the following components:

- SDU or HDU-200 Transceiver
- SDU Configuration Module (SCM)
- The IPLD integrates the HPA function, the RF diplexer and a Low Noise Rx Amplifier (.i.e. a DLNA)
- Antenna - Intermediate Gain (IGA) or High Gain (HGA)
- Satellite network Services

The IPLD works in conjunction with a Satcom Transceiver unit. An HDU-200 (FCC ID K6K HSDXi) is used as a source generator.

DC Power and Control signaling is used to connect the HDU-200 Transceiver to the IPLD. The High Power Amplifier (HPA), Diplexer and Low-Noise Amplifier functions are integrated into the IPLD.

The testing included in this report exclusively exercizes the compliance of the IPLD.

Software Configuration
Software configuration is defined by the software LI document as follows:

- Platform 1541-A-3000-01 is LI-90406994 (HDU-200)
- Platform 1542-A-2000 is LI-1541-10000 (IPLD).

Hardware Configuration
Hardware configuration is defined by the respective platforms as follows:

- 1541-A-3000-01 – HDU-200 Transceiver
- 1542-A-2000 – IPLD DC Powered

EUT Operation during Tests
EUT is supplied with 28.2 VDC power supply. The device was configured and controlled by a serial communication application through a PC.

List Of the modulations available for IPLD

Modulation Identifier	Mod	Sym Rate ksym/s	Data Rate kb/s	NBW kHz	FCC Emission Desig.	ABW kHz	TEST mode
R20T05QD	π/4 QPSK	16.8	33.6	25	25K0G7W	25	RT05Q
R20T1QD	π/4 QPSK	33.6	67.2	50	50K0G7W	225	RT1Q
R5T1XD	16QAM	33.6	134.4	50	50K0D7W	225	RT1X
R5T2QD	π/4 QPSK	67.2	134.4	100	100KG7W	225	RT2Q
R5T2XD	16QAM	67.2	268.8	100	100KD7W	225	RT2X
FR80T25X16	16QAM	84	336	110	110KD7W	225	RT25X16
FR80T25X32	32QAM	84	420	110	110KD7W	225	RT25X32
FR80T25X64	64QAM	84	504	110	110KD7W	225	RT25X64
R5T45QD	π/4 QPSK	151.2	302.4	200	200KG7W	225	RT45Q
R5T45XD	16QAM	151.2	604.8	200	200KD7W	225	RT45X
FR80T5X32	32QAM	168	420	200	200KD7W	225	RT5X32
FR80T5X64	64QAM	168	504	200	200KD7W	225	RT5X64
FR80T5X16	16QAM	168	672	200	200KD7W	225	RT5X16

Note:
Based on the highest power measured per each modulation the testing of spurious emissions has been reduced to the worst case result.

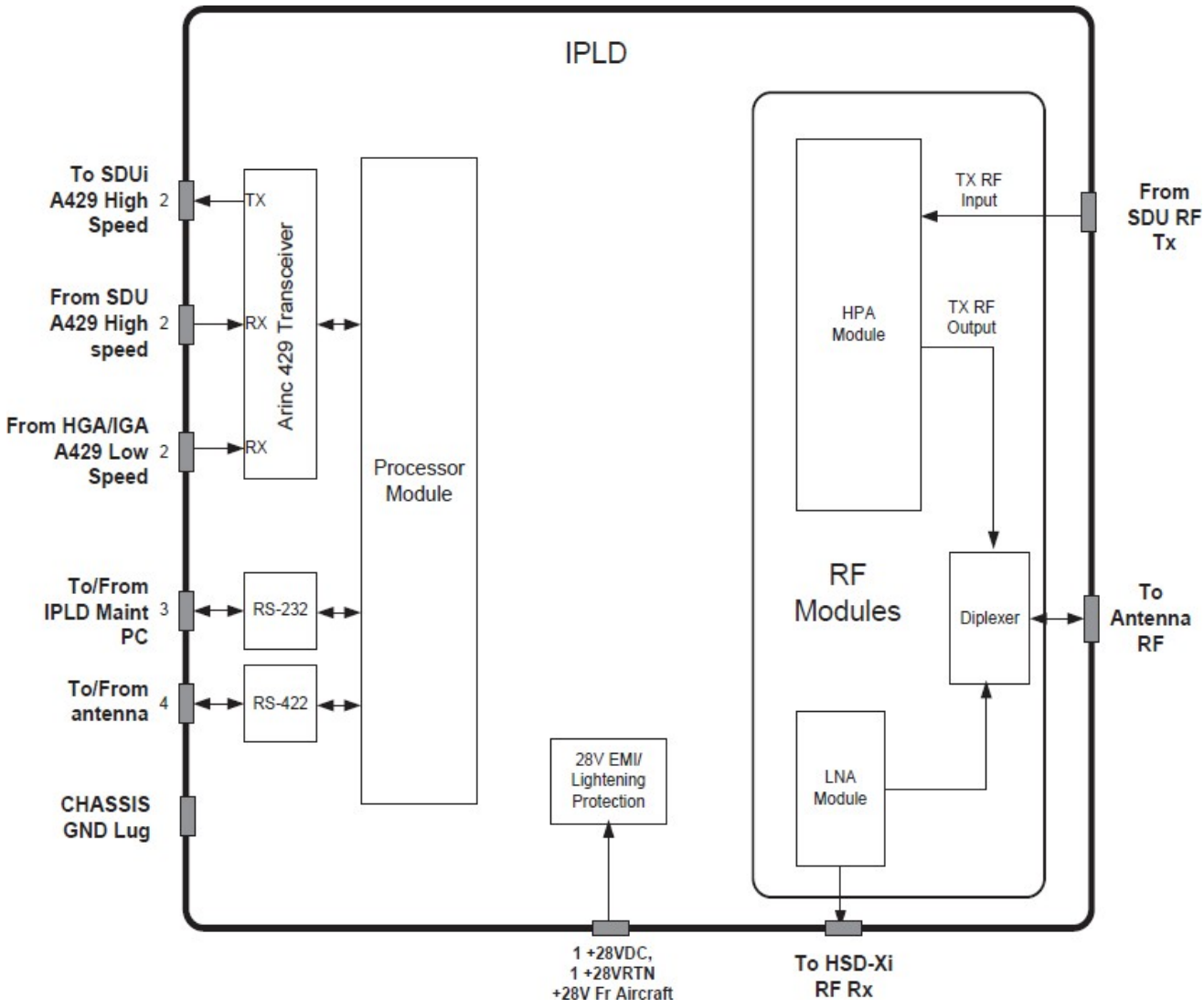
Antennas:
The IPLD as part a SATCOM systems has been configured and tested with the following antenna Types:

- HGA (AMT-3800, AMT-700)
- IGA (AMT-1800)
- LGA (Omnidirectional Blade antenna)

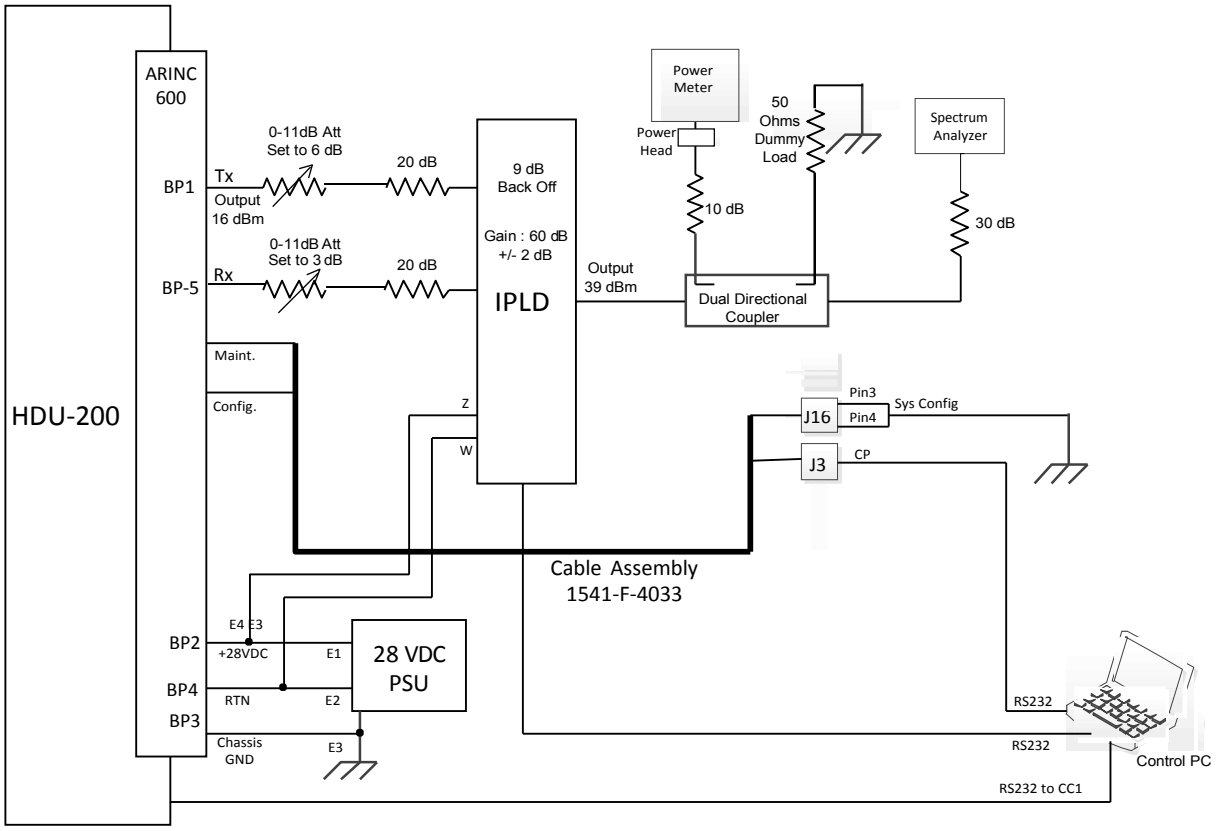
Below are some details on the antennas.

- HGA = AMT-3800 (P/N = 1242-A-0010) [Manufacturer = EMS Aviation] – Maximum Antenna Gain = 17 dBi
- HGA = AMT-700 (P/N = 1428-A-0010) [Manufacturer = EMS Aviation] – Maximum Antenna Gain = 17 dBi
- IGA = AMT-1800 (P/N: 1242-A-7010) [Manufacturer = EMS Aviation] – Maximum Antenna Gain = 12 dBi
- LGA = SATCOM Antenna (Omni-directional Blade Antenna, P/N = S65-8282-101) [Manufacturer = Sensor Systems, Inc.]

IPLD Block Diagram:



Representative Test Set up



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) 87.139(a)	Unwanted Emissions (Transmitter Conducted)	Pass	
2.1053	Field Strength of Spurious Radiation	Pass	
2.1049, 87.139(i)(3)	(Occupied Bandwidth)	Pass	
2.1051, 87.139(i)(3) 87.139(a)	Emission Masks	Pass	
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	

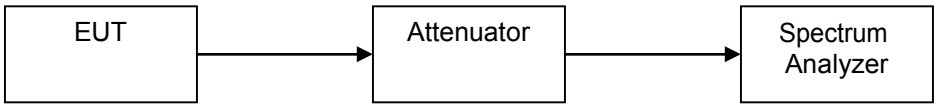
Occupied Bandwidth

Engineer: Poona Saber
Test Date: 7/24/2018

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



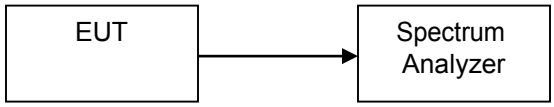
Refer to Annex A for Occupied bandwidth data.

Carrier Output Power (Conducted)
Engineer: Poona Saber
Test Date: 7/23/2018

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



R20T05QD Transmitter Peak Output Power

Tuned Frequency (MHz)	Measured Power (dBm)	Measured Power (W)	Limit (W)
1626.5	36.72	4.69	60
1643.5	37.03	5.04	60
1660.5	37.51	5.63	60

R20T1QD Transmitter Peak Output Power

Tuned Frequency (MHz)	Measured Power (dBm)	Measured Power (W)	Limit (W)
1626.5	36.71	4.68	60
1643.5	38.42	6.95	60
1660.5	37.54	5.67	60

R5T1XD Transmitter Peak Output Power

Tuned Frequency (MHz)	Measured Power (dBm)	Measured Power (W)	Limit (W)
1626.5	39.17	8.26	60
1643.5	40.70	11.74	60
1660.5	39.84	9.41	60

R5T2QD Transmitter Peak Output Power

Tuned Frequency (MHz)	Measured Power (dBm)	Measured Power (W)	Limit (W)
1626.5	36.87	4.86	60
1643.5	38.60	7.24	60
1660.5	37.76	5.97	60

R5T2XD Transmitter Peak Output Power

Tuned Frequency MHz	Measured Power dBm	Measured Power W	Limit W
1626.5	39.01	7.96	60
1643.5	40.65	11.61	60
1660.5	40.06	10.13	60

FR80T25X16 Transmitter Peak Output Power

Tuned Frequency MHz	Measured Power dBm	Measured Power W	Limit W
1626.5	39.51	8.93	60
1643.5	41.59	14.42	60
1660.5	40.51	11.24	60

FR80T25X32 Transmitter Peak Output Power

Tuned Frequency MHz	Measured Power dBm	Measured Power W	Limit W
1626.5	39.32	8.55	60
1643.5	41.38	13.74	60
1660.5	40.05	10.11	60

FR80T25X64 Transmitter Peak Output Power

Tuned Frequency MHz	Measured Power dBm	Measured Power W	Limit W
1626.5	39.96	9.90	60
1643.5	41.31	13.52	60
1660.5	40.83	12.10	60

R5T45QD Transmitter Peak Output Power

Tuned Frequency MHz	Measured Power dBm	Measured Power W	Limit W
1626.5	36.81	4.79	60
1643.5	38.52	7.11	60
1660.5	37.65	5.821	60

R5T45XD Transmitter Peak Output Power

Tuned Frequency MHz	Measured Power dBm	Measured Power W	Limit W
1626.5	39.27	8.45	60
1643.5	40.88	12.24	60
1660.5	39.91	9.79	60

FR80T5X32 Transmitter Peak Output Power

Tuned Frequency MHz	Measured Power dBm	Measured Power W	Limit W
1626.5	39.80	9.54	60
1643.5	41.04	12.70	60
1660.5	39.97	9.93	60

FR80T5X64 Transmitter Peak Output Power

Tuned Frequency MHz	Measured Power dBm	Measured Power W	Limit W
1626.5	39.90	9.77	60
1643.5	41.71	14.82	60
1660.5	40.56	11.37	60

FR80T5X16 Transmitter Peak Output Power

Tuned Frequency MHz	Measured Power dBm	Measured Power W	Limit W
1626.5	39.41	8.72	60
1643.5	41.17	13.09	60
1660.5	40.29	10.69	60

Conducted Spurious Emissions
Engineer: Poona Saber
Test Date: 2/26/2020

Test Procedure

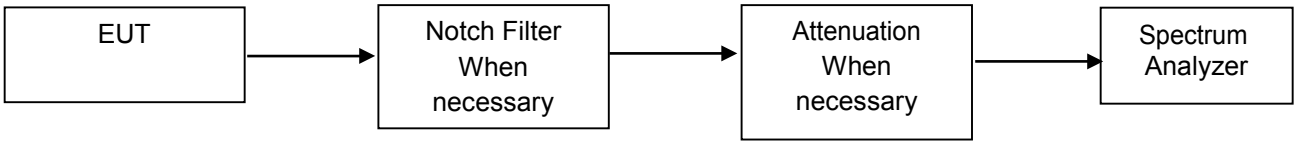
The EUT was connected directly to a spectrum analyzer to verify that the UUT met the requirements for spurious emissions.

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, and corrected power were summed together to determine the necessary 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.
In order to make these measurements and meet the limitations of the table under part i) with specified Bandwidths the spurious emissions were measured from input to the Amplifier to its output right before the diplexer. The rejection characteristic of the diplexer filter was measured separately and further added to the former spurious emissions measurement. The result is shown in the tables below for four different modulations.

The tables below depict the measurement results.
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)

FR80T25X32

Freq. (MHz)	RBW	RBW Used Spurious	RBW Used Carrier	RBW Correction	RBW Correction Carrier	Limit (dBc)	Filter Rejection	Measured carrier Power	Corrected Power	Absolute Measured Spurious (dBm)	Corrected spur. (dBc)	Limit (dBc)	Margin
.010 - 1525	0.004	0.0039	0.11	-0.11	14.39	-135	76.5	41.38	26.99	-54.49	-157.87	-135	-22.87
1525 - 1559	0.004	0.003	0.11	-1.25	14.39	-203	88.44	41.38	26.99	-91.86	-206.04	-203	-3.04
1559 - 1585	1	0.003	0.11	-25.23	-9.59	-155	85.37	41.38	50.97	-92	-203.11	-155	-48.11
1585 - 1605	1	0.003	0.11	-25.23	-9.59	-143	69.94	41.38	50.97	-87.12	-182.80	-143	-39.80
1605 - 1610	1	0.003	0.11	-25.23	-9.59	-117	64.41	41.38	50.97	-77.6	-167.75	-117	-50.75
1610 - 1610.6	1	0.003	0.11	-25.23	-9.59	-95	62.25	41.38	50.97	-77.92	-165.91	-95	-70.91
1610.6 - 1613.8	1	0.003	0.11	-25.23	-9.59	-50	50.94	41.38	XX	-68.97	-94.68	-50	-44.68
1613.8 - 1614	1	0.003	0.11	-25.23	-9.59	-95	50.21	41.38	50.97	-72.39	-148.34	-95	-53.34
1614 - 1620	0.004	0.0039	0.11	-0.11	14.39	-70	14.48	41.38	26.99	-51.73	-93.09	-70	-23.09
1620 - 1624.5	0.004	0.0039	0.11	-0.11	14.39	-70	1.28	41.38	26.99	-51.73	-79.89	-70	-9.89
1624.5 - 1625.5	0.004	0.0039	0.11	-0.11	14.39	-70	1.08	41.38	26.99	-51.73	-79.69	-70	-9.69
1625.5 - 1626.5	0.004	0.0039	0.11	-0.11	14.39	-70	1.09	41.38	26.99	-51.73	-79.70	-70	-9.70
1626.5 - 1660	0.004	0.0039	0.11	-0.11	14.39	-70	0.73	41.38	26.99	-51.73	-79.34	-70	-9.34
1660 - 1670	0.02	0.03	0.11	1.76	7.40	-19.5	1.07	41.38	XX		-2.83	-19.5	16.67
1670 - 1735	0.004	0.0039	0.11	-0.11	14.39	-60	17.02	41.38	26.99	-52.71	-96.61	-60	-36.61
1735 - 1865	0.004	0.02	0.11	6.99	14.39	-105	75.2	41.38	26.99	-77	-186.18	-105	-81.18
1865 - 2260.5	0.004	0.02	0.11	6.99	14.39	-105	84.38	41.38	26.99	-77	-195.36	-105	-90.36
2260.5 - 3250	0.004	0.02	0.11	6.99	14.39	-105	52.97	41.38	26.99	-77	-163.95	-105	-58.95
3250 - 3330	0.004	0.02	0.11	6.99	14.39	-105	40	41.38	26.99	-34	-107.98	-105	-2.98
3330 - 4000	0.004	0.02	0.11	6.99	14.39	-105	50.99	41.38	26.99	-34	-118.97	-105	-13.97
4000 - 12000	0.004	0.02	0.11	6.99	14.39	-105	64.01	41.38	26.99	-7.82	-105.81	-105	-0.81
12000 - 18000	0.004	0.03	0.11	8.75	14.39	-70	35.7	41.38	26.99	-33.5	-104.9373	-70	-34.94

FR80T25X64

Freq. (MHz)	RBW	RBW Used Spurious	RBW Used Carrier	RBW Correction	RBW Correction Carrier	Limit (dBc)	Filter Rejection	Measured carrier Power	Corrected Power	Absolute Measured Spurious (dBm)	Corrected spur. (dBc)	Limit (dBc)	Margin
.010 - 1525	0.004	0.0039	0.11	-0.11	14.39	-135	76.5	41.31	26.92	-36.84	-140.15	-135	-5.15
1026.5 - 1525	0.004	0.0039	0.11	-0.11	14.39	-135	76.5	41.31	26.92	-59.81	-163.12	-135	-28.12
1525 - 1559	0.004	0.003	0.11	-1.25	14.39	-203	88.44	41.31	26.92	-92.34	-206.45	-203	-3.45
1559 - 1585	1	0.003	0.11	-25.23	-9.59	-155	85.37	41.31	50.90	-90.89	-201.93	-155	-46.93
1585 - 1605	1	0.003	0.11	-25.23	-9.59	-143	69.94	41.31	50.90	-88.54	-184.15	-143	-41.15
1605 - 1610	1	0.003	0.11	-25.23	-9.59	-117	64.41	41.31	50.90	-77.86	-167.94	-117	-50.94
1610 - 1610.6	1	0.003	0.11	-25.23	-9.59	-95	62.25	41.31	50.90	-77.76	-165.68	-95	-70.68
1610.6 - 1613.8	1	0.003	0.11	-25.23	-9.59	-50	50.94	41.31	XX	-69.22	-94.93	-50	-44.93
1613.8 - 1614	1	0.003	0.11	-25.23	-9.59	-95	50.21	41.31	50.90	-71.3	-147.18	-95	-52.18
1614 - 1620	0.004	0.0039	0.11	-0.11	14.39	-70	14.48	41.31	26.92	-51.83	-93.12	-70	-23.12
1620 - 1624.5	0.004	0.0039	0.11	-0.11	14.39	-70	1.28	41.31	26.92	-51.83	-79.92	-70	-9.92
1624.5 - 1625.5	0.004	0.0039	0.11	-0.11	14.39	-70	1.08	41.31	26.92	-51.83	-79.72	-70	-9.72
1625.5 - 1626.5	0.004	0.0039	0.11	-0.11	14.39	-70	1.09	41.31	26.92	-51.83	-79.73	-70	-9.73
1626.5 - 1660	0.004	0.0039	0.11	-0.11	14.39	-70	0.73	41.31	26.92	-43.52	-71.06	-70	-1.06
1660 - 1670	0.02	0.03	0.11	1.76	7.40	-19.5	1.07	41.31	XX		-2.83	-19.5	16.67
1670 - 1735	0.004	0.004	0.11	0.00	14.39	-60	17.02	41.31	26.92	-52.78	-96.72	-60	-36.72
1735 - 1865	0.004	0.02	0.11	6.99	14.39	-105	75.2	41.31	26.92	-77	-186.11	-105	-81.11
1865 - 2260.5	0.004	0.02	0.11	6.99	14.39	-105	84.38	41.31	26.92	-77	-195.29	-105	-90.29
2260.5 - 3250	0.004	0.02	0.11	6.99	14.39	-105	52.97	41.31	26.92	-36	-122.88	-105	-17.88
3250 - 3330	0.004	0.02	0.11	6.99	14.39	-105	40	41.31	26.92	-36	-109.91	-105	-4.91
3330 - 4000	0.004	0.02	0.11	6.99	14.39	-105	50.99	41.31	26.92	-36	-120.90	-105	-15.90
4000 - 12000	0.004	0.02	0.11	6.99	14.39	-105	64.01	41.31	26.92	-9.61	-107.53	-105	-2.53
12000 - 18000	0.004	0.03	0.11	8.75	14.39	-70	35.7	41.31	26.92	-30.92	-102.2873	-70	-32.29

R5T1XD

Freq. (MHz)	RBW	RBW Used Spurious	RBW Used Carrier	RBW Correction	RBW Correction Carrier	Limit (dBc)	Filter Rejection	Measured carrier Power	Corrected Power	Absolute Measured Spurious (dBm)	Corrected spur. (dBc)	Limit (dBc)	Margin
.010 - 1026.5	0.004	0.0039	0.051	-0.11	11.06	-135	76.5	40.7	29.64	-54.1	-160.13	-135	-25.13
1026.5 - 1525	0.004	0.0039	0.051	-0.11	11.06	-135	76.5	40.7	29.64	-60.93	-166.96	-135	-31.96
1525 - 1559	0.004	0.003	0.051	-1.25	11.06	-203	88.44	40.7	29.64	-90.74	-207.58	-203	-4.58
1559 - 1585	1	0.003	0.051	-25.23	-12.92	-155	85.37	40.7	53.62	-91.65	-205.42	-155	-50.42
1585 - 1605	1	0.003	0.051	-25.23	-12.92	-143	69.94	40.7	53.62	-87.88	-186.22	-143	-43.22
1605 - 1610	1	0.003	0.051	-25.23	-12.92	-117	64.41	40.7	53.62	-77.28	-170.09	-117	-53.09
1610 - 1610.6	1	0.003	0.051	-25.23	-12.92	-95	62.25	40.7	53.62	-75.39	-166.04	-95	-71.04
1610.6 - 1613.8	1	0.003	0.051	-25.23	-12.92	-50	50.94	40.7	XX	-68.38	-94.09	-50	-44.09
1613.8 - 1614	1	0.003	0.051	-25.23	-12.92	-95	50.21	40.7	53.62	-71.47	-150.08	-95	-55.08
1614 - 1620	0.004	0.003	0.051	-1.25	11.06	-70	14.48	40.7	29.64	-51.06	-93.94	-70	-23.94
1620 - 1624.5	0.004	0.003	0.051	-1.25	11.06	-70	1.28	40.7	29.64	-51.06	-80.74	-70	-10.74
1624.5 - 1625.5	0.004	0.003	0.051	-1.25	11.06	-70	1.08	40.7	29.64	-51.06	-80.54	-70	-10.54
1625.5 - 1626.5	0.004	0.003	0.051	-1.25	11.06	-70	1.09	40.7	29.64	-51.06	-80.55	-70	-10.55
1626.5 - 1660	0.004	0.0039	0.051	-0.11	11.06	-70	0.73	40.7	29.64	-43.63	-73.89	-70	-3.89
1660 - 1670	0.02	0.03	0.051	1.76	4.07	-19.5	1.07	40.7	XX		-2.83	-19.5	16.67
1670 - 1735	0.004	0.0039	0.051	-0.11	11.06	-60	17.02	40.7	29.64	-51.18	-97.73	-60	-37.73
1735 - 1865	0.004	0.02	0.051	6.99	11.06	-105	75.2	40.7	29.64	-72	-183.83	-105	-78.83
1865 - 2260.5	0.004	0.02	0.051	6.99	11.06	-105	84.38	40.7	29.64	-72	-193.01	-105	-88.01
2260.5 - 3250	0.004	0.02	0.051	6.99	11.06	-105	52.97	40.7	29.64	-29.21	-118.81	-105	-13.81
3250 - 3330	0.004	0.02	0.051	6.99	11.06	-105	40	40.7	29.64	-29.21	-105.84	-105	-0.84
3330 - 4000	0.004	0.02	0.051	6.99	11.06	-105	50.99	40.7	29.64	-29.21	-116.83	-105	-11.83
4000 - 12000	0.004	0.02	0.051	6.99	11.06	-105	64.01	40.7	29.64	-5.34	-105.98	-105	-0.98
12000 - 18000	0.004	0.03	0.051	8.75	11.06	-70	35.7	40.7	29.64	-27.08	-101.1755	-70	-31.18

R20T0.5QD

Freq. (MHz)	RBW	RBW Used Spurious	RBW used Carrier	RBW Correction	RBW Correction Carrier	Limit (dBc)	Filter Rejection	Measured carrier Power	Corrected Power	Absolute Measured Spurious (dBm)	Corrected spur. (dBc)	Limit (dBc)	Margin
.010 - 1026.5	0.004	0.0039	0.03	-0.11	8.75	-135	76.5	37.51	28.76	-49.98	-155.13	-135	-20.13
1026.5 - 1525	0.004	0.0039	0.03	-0.11	8.75	-135	76.5	37.51	28.76	-64.78	-169.93	-135	-34.93
1525 - 1559	0.004	0.003	0.03	-1.25	8.75	-203	88.44	37.51	28.76	-92.23	-208.18	-203	-5.18
1559 - 1585	1	0.003	0.03	-25.23	-15.23	-155	85.37	37.51	52.74	-91.46	-204.34	-155	-49.34
1585 - 1605	1	0.003	0.03	-25.23	-15.23	-143	69.94	37.51	52.74	-88.01	-185.46	-143	-42.46
1605 - 1610	1	0.003	0.03	-25.23	-15.23	-117	64.41	37.51	52.74	-78.09	-170.01	-117	-53.01
1610 - 1610.6	1	0.003	0.03	-25.23	-15.23	-95	62.25	37.51	52.74	-78.19	-167.95	-95	-72.95
1610.6 - 1613.8	1	0.003	0.03	-25.23	-15.23	-50	50.94	37.51	XX	-71.92	-97.63	-50	-47.63
1613.8 - 1614	1	0.003	0.03	-25.23	-15.23	-95	50.21	37.51	52.74	-72.29	-150.01	-95	-55.01
1614 - 1620	0.004	0.003	0.03	-1.25	8.75	-70	14.48	37.51	28.76	-49.35	-91.34	-70	-21.34
1620 - 1624.5	0.004	0.003	0.03	-1.25	8.75	-70	1.28	37.51	28.76	-49.35	-78.14	-70	-8.14
1624.5 - 1625.5	0.004	0.003	0.03	-1.25	8.75	-70	1.08	37.51	28.76	-49.35	-77.94	-70	-7.94
1625.5 - 1626.5	0.004	0.003	0.03	-1.25	8.75	-70	1.09	37.51	28.76	-49.35	-77.95	-70	-7.95
1626.5 - 1660	0.004	0.003	0.03	-1.25	8.75	-70	0.73	37.51	28.76	-42.09	-70.33	-70	-0.33
1660 - 1670	0.02	0.03	0.03	1.76	1.76	-19.5	1.07	37.51	XX		-2.83	-19.5	16.67
1670 - 1735	0.004	0.0039	0.03	-0.11	8.75	-60	17.02	37.51	28.76	-48.48	-94.15	-60	-34.15
1735 - 1865	0.004	0.02	0.03	6.99	8.75	-105	75.2	37.51	28.76	-71.28	-182.23	-105	-77.23
1865 - 2260.5	0.004	0.02	0.03	6.99	8.75	-105	84.38	37.51	28.76	-71.28	-191.41	-105	-86.41
2260.5 - 3250	0.004	0.02	0.03	6.99	8.75	-105	52.97	37.51	28.76	-30.28	-119.00	-105	-14.00
3250 - 3330	0.004	0.02	0.03	6.99	8.75	-105	40	37.51	28.76	-30.28	-106.03	-105	-1.03
3330 - 4000	0.004	0.02	0.03	6.99	8.75	-105	50.99	37.51	28.76	-30.28	-117.02	-105	-12.02
4000 - 12000	0.004	0.02	0.03	6.99	8.75	-105	64.01	37.51	28.76	-6.28	-106.04	-105	-1.04
12000 - 18000	0.004	0.03	0.03	8.75	8.75	-70	35.7	37.51	28.76	-26.27	-99.48	-70	-29.48

Field Strength of Spurious Radiation
Engineer: Poona Saber
Test Date: 2/27/2020

Test Procedure

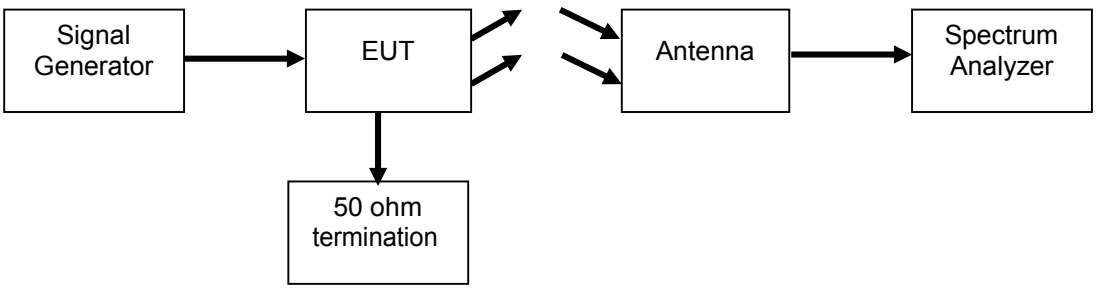
The EUT was tested in a semi-anechoic chamber with the turntable set 3m from the receiving antenna. A spectrum analyzer was used to verify that the EUT met the requirements for Radiated Emissions. The EUT was tested by rotating it 360 degrees with the antenna in both the vertical and horizontal orientation 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 test data.

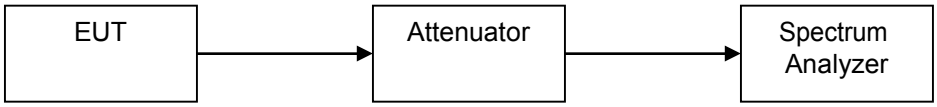
Emission Masks

Engineer: Poona Saber
Test Date: 2/25/2020

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)

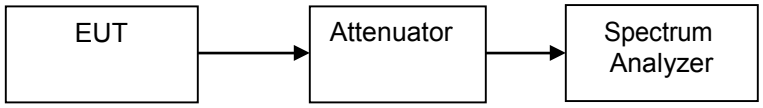
Engineer: Poona Saber

Test Date: 27/2/2020

Test Procedure

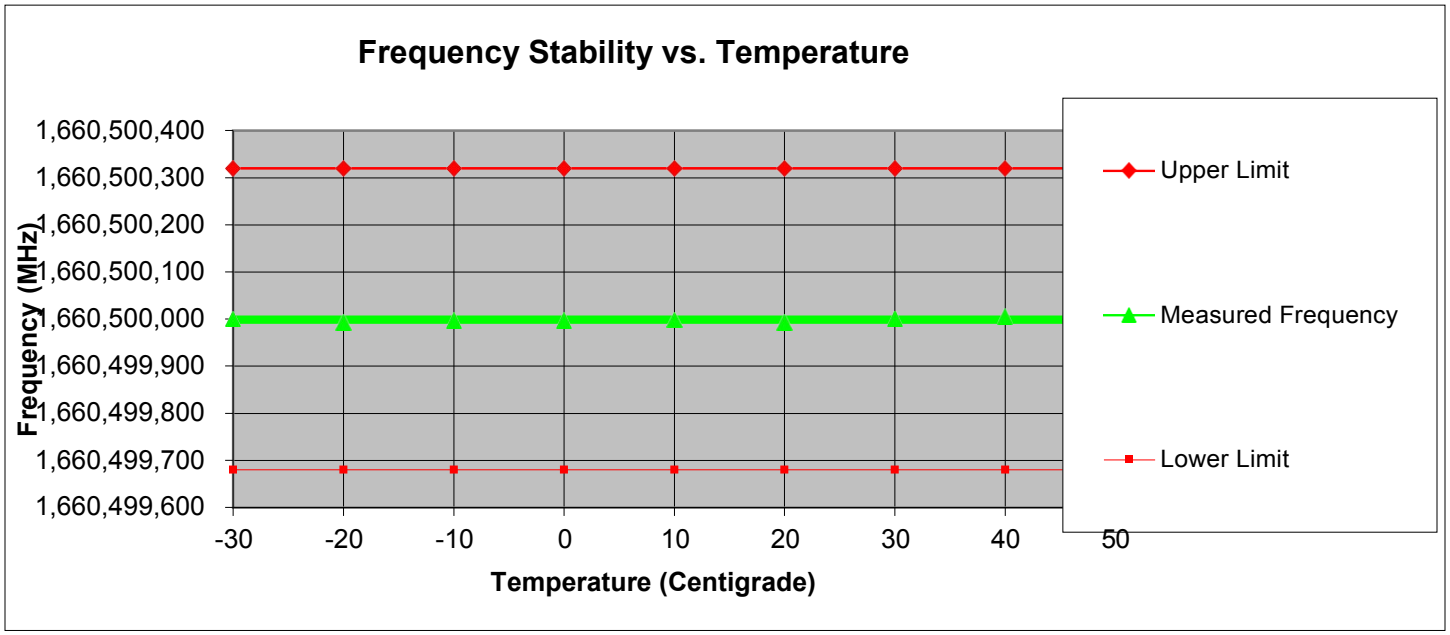
The EUT was placed in an environmental test chamber and the RF output was connected directly to a frequency counter. The temperature was varied from -30ºC to 50ºC in 10ºC increments. After a sufficient time for temperature stabilization the RF output frequency was measured.

Test Setup



Measurement Results

Tuned Frequency (Hz)	Frequency Tolerance (Hz)	Upper Limit (Hz)	Lower Limit (Hz)	Temperature centigrade	Measured Frequency (Hz)	Upper Margin (Hz)	Lower Margin (Hz)
1,660,500,000	320	1,660,500,320	1,660,499,680	-30	1,660,500,000	-320	320
		1,660,500,320	1,660,499,680	-20	1,660,499,993	-327	313
		1,660,500,320	1,660,499,680	-10	1,660,499,997	-323	317
		1,660,500,320	1,660,499,680	0	1,660,499,997	-323	317
		1,660,500,320	1,660,499,680	10	1,660,499,998	-322	318
		1,660,500,320	1,660,499,680	20	1,660,499,993	-327	313
		1,660,500,320	1,660,499,680	30	1,660,500,001	-319	321
		1,660,500,320	1,660,499,680	40	1,660,500,005	-315	325
		1,660,500,320	1,660,499,680	50	1,660,500,004	-316	324



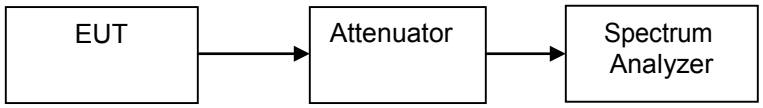
Frequency Stability (Voltage Variation)

Engineer: Poona Saber
Test Date: 02/27/2020

Test Procedure

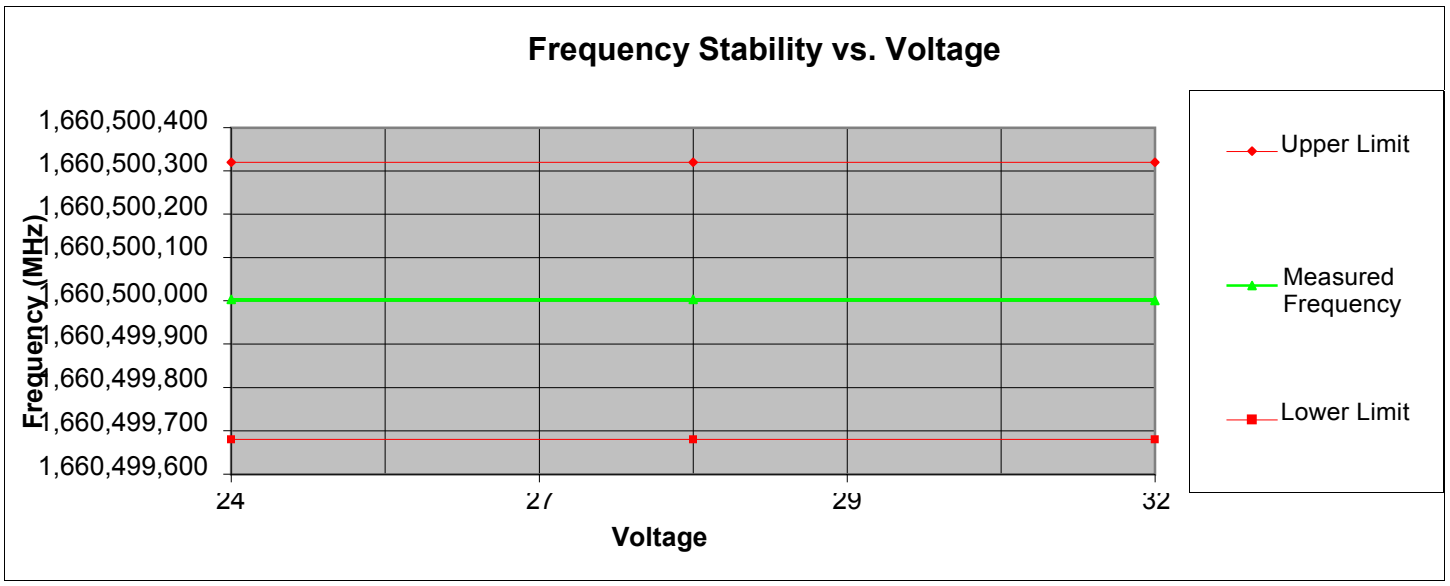
The EUT was placed in a temperature chamber at 20±5°C and connected directly to a spectrum analyzer. The power supply voltage to the EUT was varied from 85% to 115% of the nominal value and the RF output was measured. The nominal voltage is 28.2 VDC.

Test Setup



Measurement Results

Tuned Frequency (Hz)	Frequency Tolerance (Hz)	Upper Limit (Hz)	Lower Limit (Hz)	Nominal Voltatge	Voltage	Measured Frequency (Hz)	Upper Margin (Hz)	Lower Margin (Hz)
1,660,500,000	320	1,660,500,320	1,660,499,680	28	24	1,660,500,004	-316	324
		1,660,500,320	1,660,499,680		28	1,660,500,004	-316	324
		1,660,500,320	1,660,499,680		32	1,660,500,001	-319	321



Necessary Bandwidth and Emission Bandwidth

Engineer: Poona Saber

Test Date: 2/27/2020

QPSK

Modulation = 21K0G1D
Necessary Bandwidth Calculation:

Signal States (S)		=	4
Data Rate (D)	=	3.0	
Constant factor (K)		=	0.81
Necessary Bandwidth (BN), kHz		=	$2*D*K/LOG_2(S)$

Modulation = 7K20G1E
Necessary Bandwidth Calculation:

Signal States (S)		=	4
Data Rate (D)	=	5.6	
Constant factor (K)		=	0.81
Necessary Bandwidth (BN), 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 (BN), kHz		=	$2*D*K/LOG_2(S)$

Modulation = 40K0G1D
Necessary Bandwidth Calculation:

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

Modulation = 110KD7W
Necessary Bandwidth Calculation:

Signal States (S)		=	16
Data Rate (D)	=	504.4	
Constant factor (K)		=	0.70
Necessary Bandwidth (BN), 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 (BN), 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	6/16/2018	6/16/2020
Bilog Antenna	Schaffner	CBL6111C	i00267	3/8/2018	3/8/2020
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
Preamplifier for 1-18GHz horn antenna	Miteq	AFS44 00101 400 23-10P-44	i00509	N/A	N/A
Temperature Test Chamber	Tenney	Tenney Jr	i00027	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