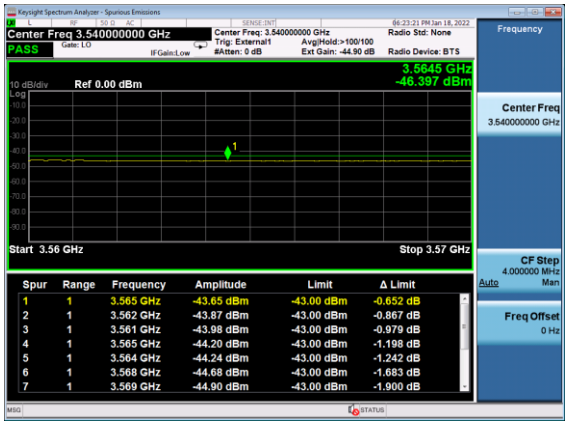
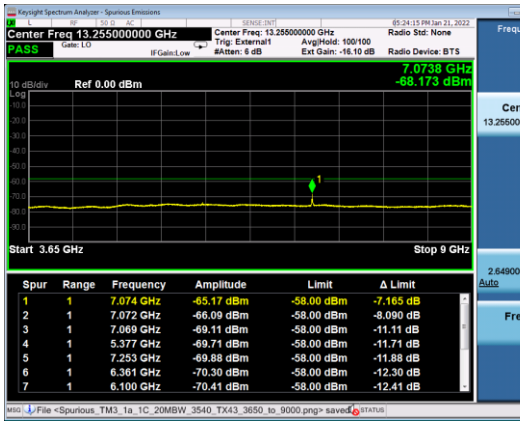
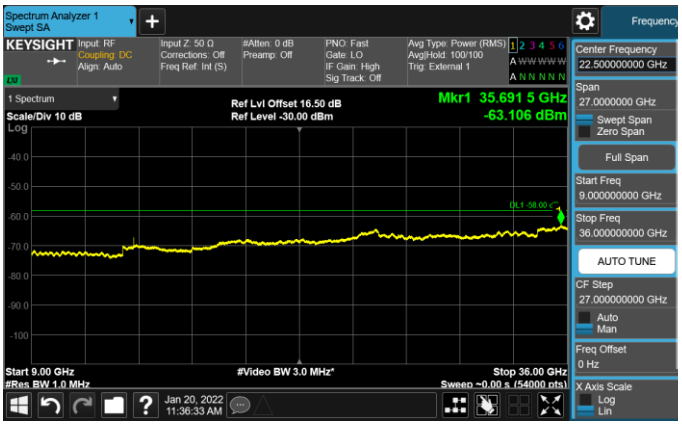
3.56G-3.57GHz



3.65G-9GHz



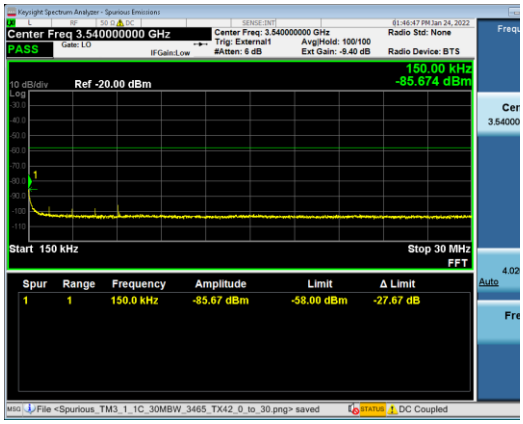
9G-36GHz



5.1.1.4 30 MHz BW, TM3.1, 64QAM, 3465 MHz, TX42

9k-150kHz

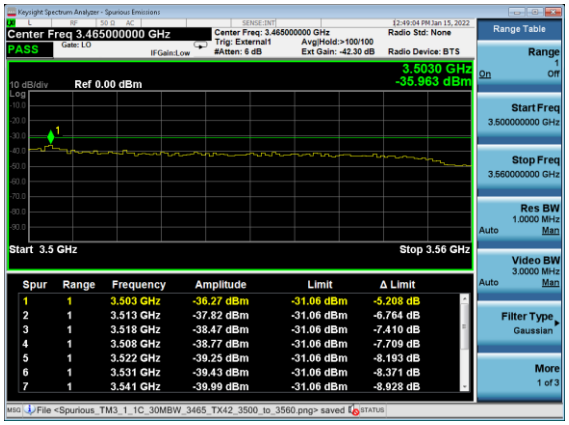
150k-30MHz



30M-1GHz

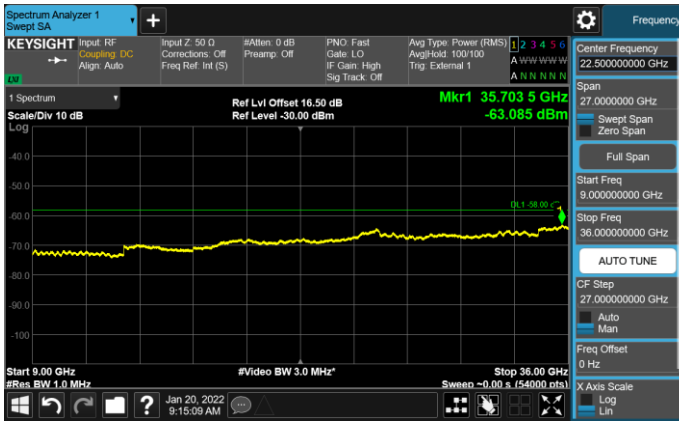
1G-3.35GHz

3.5G-3.56GHz



3.65G-9GHz

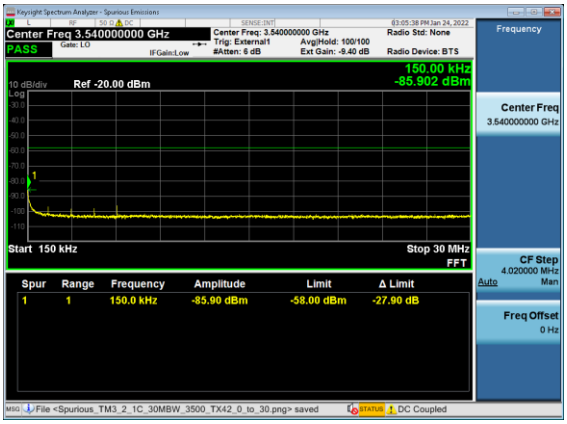
9G-36GHz


Spectrum Analyzer 1
Swept SA
KEYSIGHT
Input: RF
Coupling: DC
Align: Auto
Input Z: 50 Ω
Corrections: Off
Freq Ref: Int (S)
#Atten: 0 dB
Preamp: Off
PNO: Fast
Gate: LO
IF Gain: High
Sig Track: Off
Avg Type: Power (RMS)
Avg|Hold: 100/100
Trig: External 1
1 Spectrum
Scale/Div 10 dB
Ref Lvl Offset 16.50 dB
Ref Level -30.00 dBm
Mkr1 35.703 5 GHz
-63.085 dBm
Log
-40.0
-50.0
-60.0
-70.0
-80.0
-90.0
-100
Start 9.00 GHz
#Res BW 1.0 MHz
#Video BW 3.0 MHz*
Stop 36.00 GHz
Sweep ~0.00 s (54000 pts)
Jan 20, 2022
9:15:09 AM
Frequency
Center Frequency
22.500000000 GHz
Span
27.0000000 GHz
Swept Span
Zero Span
Full Span
Start Freq
9.000000000 GHz
Stop Freq
36.000000000 GHz
AUTO TUNE
CF Step
27.000000000 GHz
Auto
Man
Freq Offset
0 Hz
X Axis Scale
Log
Lin

5.1.1.5 30 MHz BW, TM3.2, QPSK/16QAM, 3500 MHz, 3500 MHz, TX42

9k-150kHz

150k-30MHz

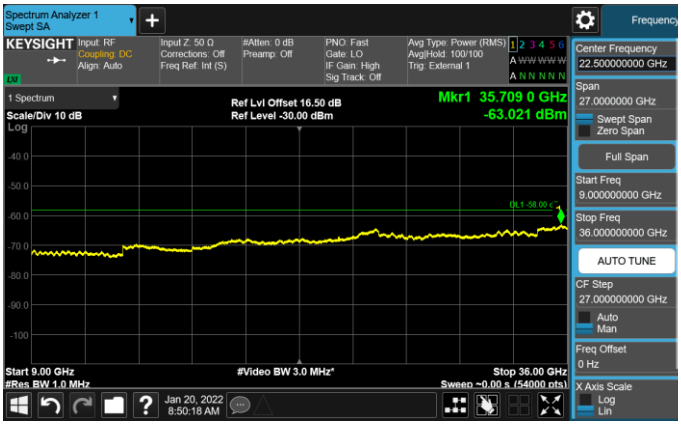


30M-1GHz

1G-3.35GHz

3.65G-9GHz

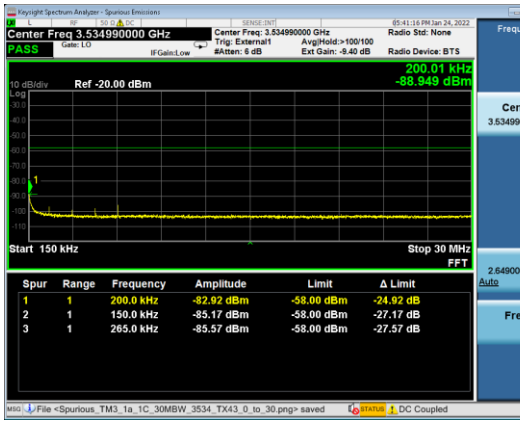
9G-36GHz



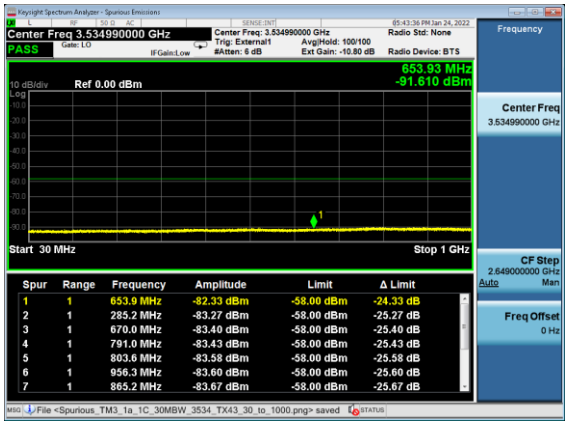
5.1.1.6 30 MHz BW, TM3.1a, 256QAM, 3535 MHz, TX43

9k-150kHz

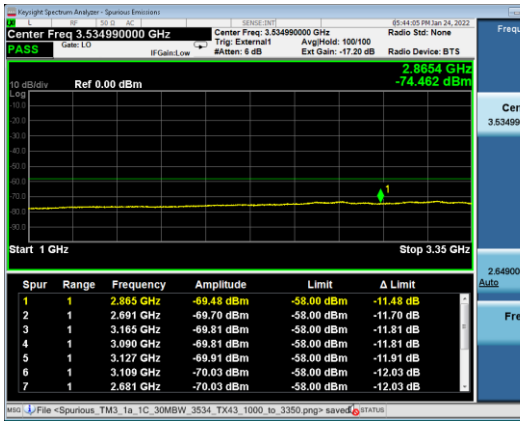
150k-30MHz



30M-1GHz

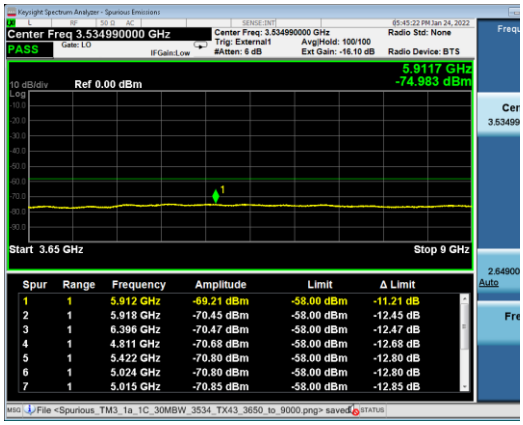


1G-3.35GHz

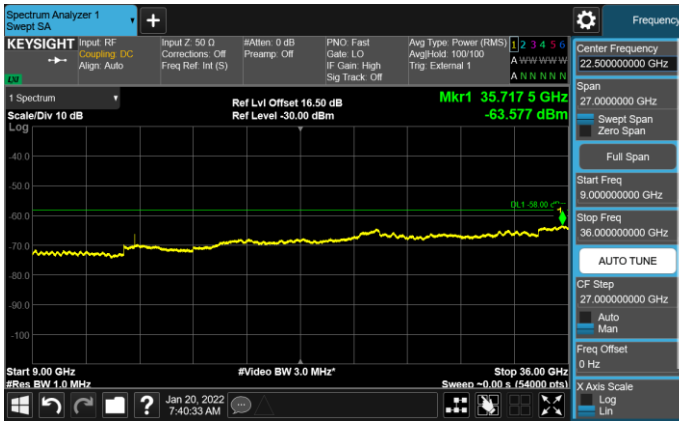


3.44G-3.5GHz

3.65G-9GHz



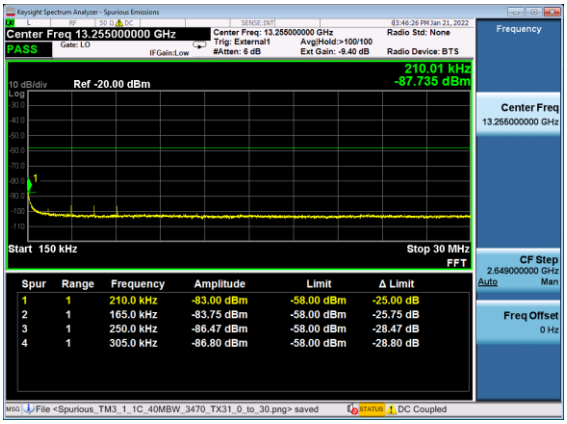
9G-36GHz


Spectrum Analyzer 1
Swept SA
KEYSIGHT
Input: RF
Coupling: DC
Align: Auto
Input Z: 50 Ω
Corrections: Off
Freq Ref: Int (S)
#Atten: 0 dB
Preamp: Off
PNO: Fast
Gate: LO
IF Gain: High
Sig Track: Off
Avg Type: Power (RMS)
Avg|Hold: 100/100
Trig: External 1
1 Spectrum
Ref Lvl Offset 16.50 dB
Ref Level -30.00 dBm
Mkr1 35.717 5 GHz
-63.577 dBm
Scale/Div 10 dB
Log
-40.0
-50.0
-60.0
-70.0
-80.0
-90.0
-100
D1 -58.00 dBm
Start 9.00 GHz
#Res BW 1.0 MHz
#Video BW 3.0 MHz*
Stop 36.00 GHz
Sweep ~0.00 s (54000 pts)
Jan 20, 2022
7:40:33 AM
Frequency
Center Frequency
22.500000000 GHz
Span
27.0000000 GHz
Swept Span
Zero Span
Full Span
Start Freq
9.000000000 GHz
Stop Freq
36.000000000 GHz
AUTO TUNE
CF Step
27.000000000 GHz
Auto
Man
Freq Offset
0 Hz
X Axis Scale
Log
Lin

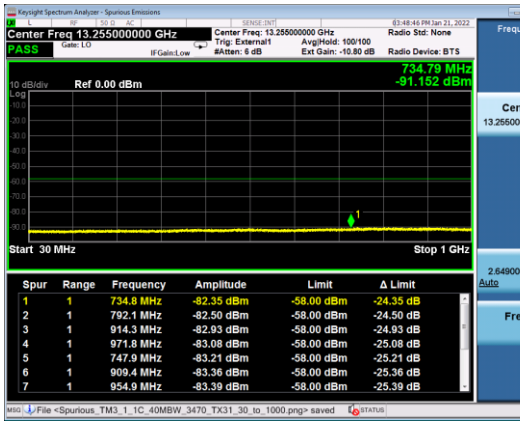
5.1.1.7 40 MHz BW, TM3.1, 64QAM, 3470 MHz, TX31

9k-150kHz

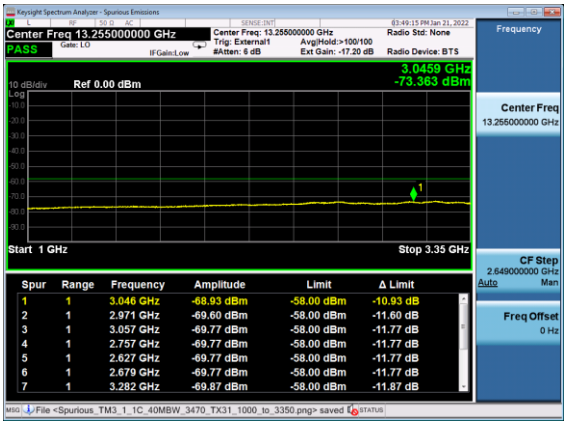
150k-30MHz



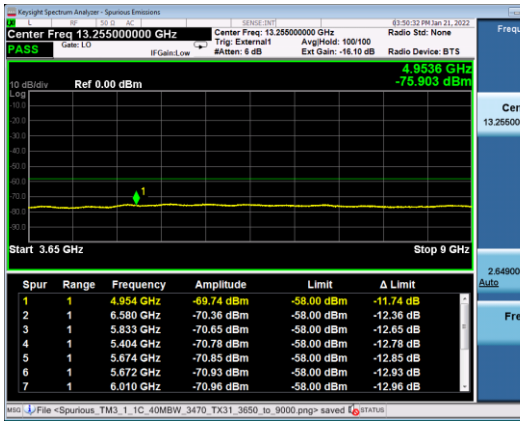
30M-1GHz



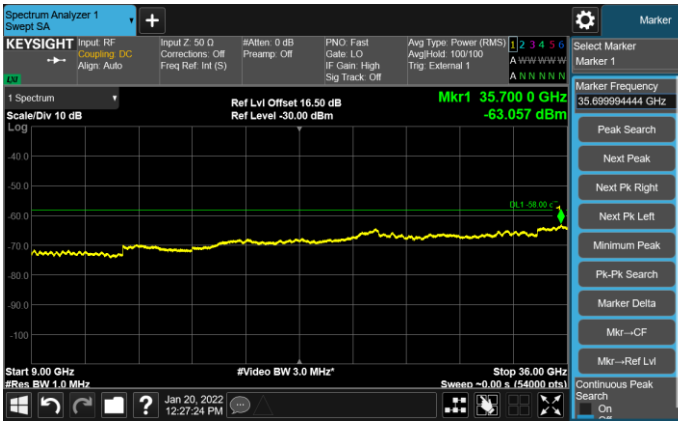
1G-3.35GHz



3.65G-9GHz



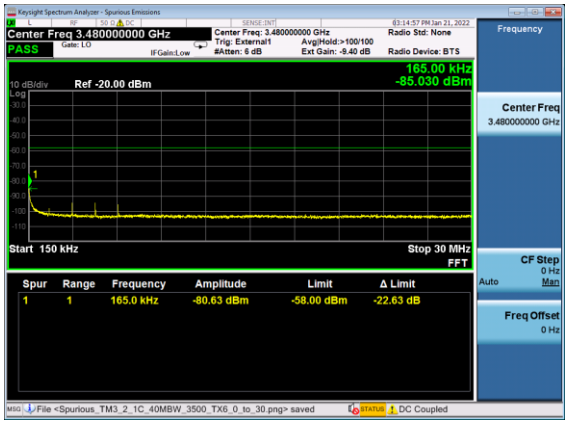
9G-36GHz



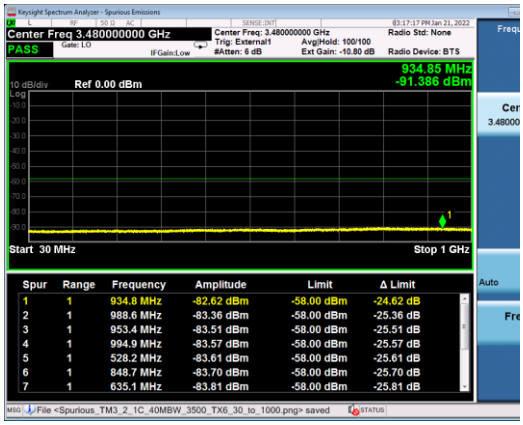
5.1.1.8 40 MHz BW, TM3.2, QPSK/16QAM, 3500 MHz, TX6

9k-150kHz

150k-30MHz

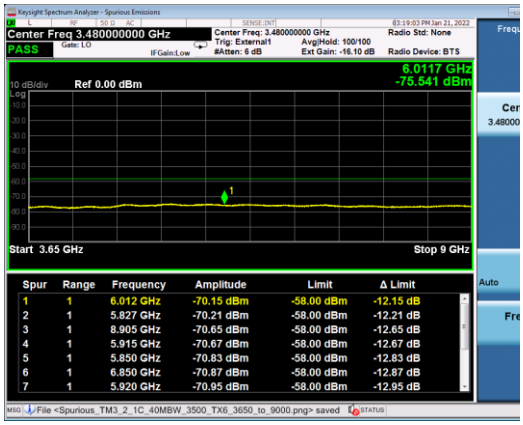


30M-1GHz

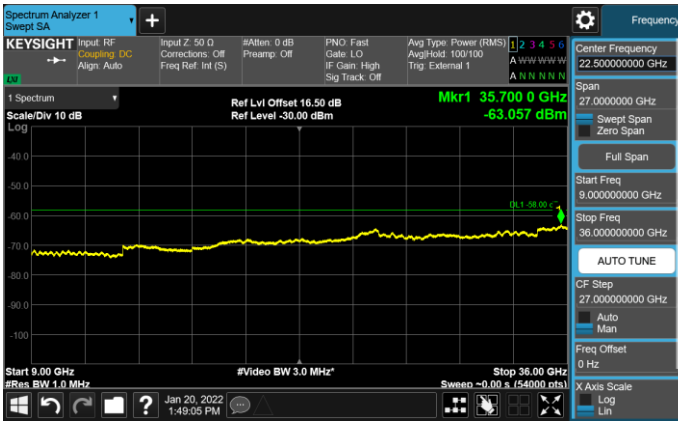


1G-3.35GHz

3.65G-9GHz



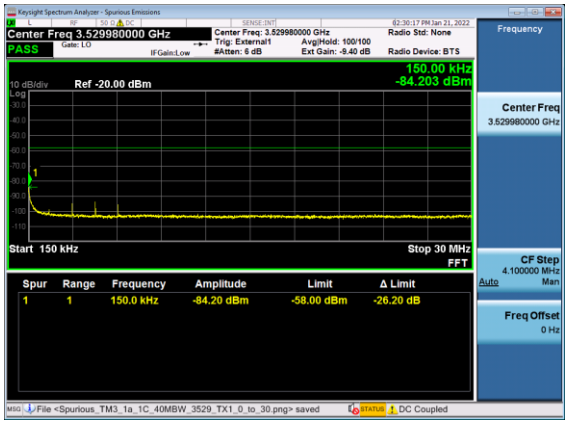
9G-36GHz



5.1.1.9 40 MHz BW, TM3.1a, 256QAM, 3530 MHz, TX1

9k-150kHz

150k-30MHz



30M-1GHz

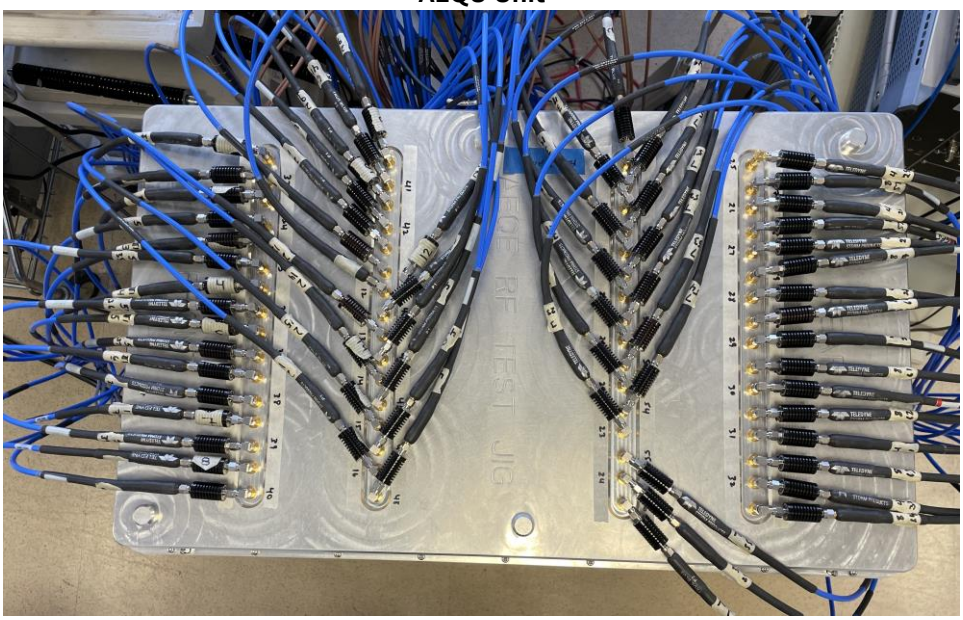
1G-3.35GHz

3.65G-9GHz

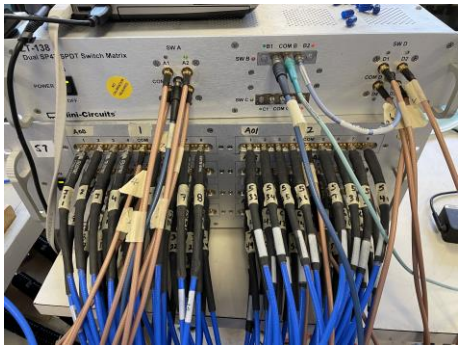
9G-36GHz

Photographs

AEQU Unit



Radio Testing Setup



Test Equipment

Asset ID	Manufacturer	Type	Description	Model	Serial	Calibration Date	Calibration Due
E831	Agilent Technologies	MXA Signal Analyzer	20Hz-26.5GHz	N9020A	MY48011791	2020-06-16	2022-06-16
E896	Agilent Technologies	Network Analyzer	10 MHz - 40 GHz	N5230C	MY49000897	2021-03-03	2023-03-03
E1338	KeySight Technologies	MXA Signal Analyzer		N9020B	MY57430927	2021-01-07	2023-01-07
E1579	KeySight Technologies	MXA Signal Analyzer	10 Hz - 50 GHz	N9021B	MY60080199	2021-11-30	2023-11-30
E1212	RLC Electronics Inc	Filter, High Pass	10 - 30 GHz, 2W, 5dB	F-19414	1444002	CNR-V	CNR-V
E1156	Weinschel	Attenuator	10dB 0.05GHz-26GHz 25W	74-10-12	1069	CNR-V	CNR-V
	CF	Notch Filter	03380/3620-5000MHz		2018260005	NA	NA
	Mini Circuit		8 port RF Switch	C/B11311100013	S E480101350	NA	NA
	Mini Circuit		64 port RF Switch	S E210301724	11702280003	NA	NA
	Microcoax Utiflex		RF Cable	UFB142A-) 0720_2G0200 A	MFR 64639 227883-001	NA	NA
	Microcoax Utiflex		RF Cable	UFB142A-) 0720_2G0200 A	MFR 64639 227883-002	NA	NA

CNR-V: Calibration Not Required, Must Be Verified

Tests Dates: 1/13/2022 – 1/28/2022.

6. FCC Section 2.1053 - Field strength of spurious radiation

6.1 Section 2.1053 Field Strength of Spurious Emissions

Field strength measurements of radiated spurious emissions were made in an FCC registered 3m Semi-Anechoic Chamber which is maintained by Nokia Bell Labs in Murray Hill, New Jersey. A complete description and full measurement data for the site is on file with the Commission (Site Registration Number: 515091).

The spectrum from 30 MHz to beyond the tenth harmonic of the carrier, 37 GHz, was searched for spurious radiation. Measurements were made using both horizontally and vertically polarized broadband antennas. Per FCC regulations, the comparison of out of band spurious emissions directly to the limit is appropriately made using the substitution method. However, when the emissions are more than 20 dB below the specification limit, the use of field strength measurements for compliance determination is acceptable and those emissions are considered not reportable (Section 2.1053 and the FCC Interpretive database for 2.1053). For this case the evaluation of acceptable radiated field strength is as follows.

6.2 Field Strength of Spurious Emissions - Limits

Sections 2.1053 and 27.53 contain the requirements for the levels of spurious radiation as a function of the level of the unmodulated carrier. The reference level for the unmodulated carrier is calculated as the field produced by an ideal dipole excited by the transmitter output power according to the following relation taken from Reference Data for Radio Engineers, page 676, 4th edition, IT&T Corp.

$$E = [(30*P)^{1/2}]/R$$

$$20 \log (E*10^{6}) - (43 + 10 \log P) = 82.23 \text{ dB}\mu\text{V/meter}$$

Where:
E = Field Intensity in Volts/meter P = Transmitted Power in Watts
R = Measurement distance in meters = 3 m

The Part 27 Limit is 82.23 dBµV/m at 3m and 91.77 dBuV/m at 1m
The Part 27 non-report level is 62.23 dBµV/m at 3m.

The calculated emission levels were found by:

Measured level (dBµV) + Cable Loss(dB)+Antenna Factor(dB) = Field Strength (dBµV/m)

RESULTS:

For compliance with 47CFR Parts 2 and 27, the field strength of any spurious radiation, measured at 3m, is required to be less than 82.23 dBµV/meter (82.23 @ 3m). Emissions equal to or less than 62.23 dBµV/meter at 3m are not reportable and may be verified using field strength measurements and broadband antennas. Over the out of band spectrum investigated from 30 MHz to beyond the tenth harmonic of the carrier (up to 37 GHz), no reportable spurious emissions were detected.

7. FCC Section 2.1055 - Measurement of Frequency Stability

Frequency Stability testing was completed on the AEQU Unit with Center Frequency 3500.01 MHz. Testing was performed from 12/6/2021 through 12/8/2021 on the radio, which was located in the T-15 Thermal chamber of the Global Product Compliance Laboratory (GPCL) test facility located in Building 4, Room 4-280, Murray Hill, NJ, by Joe Bordonaro from GPCL.

The temperatures to which the UUT were subjected ranged from a high temperature of +50°C system ambient to a low temperature of -30°C system ambient with measurements recorded at 10°C increments

Frequency Stability performance was verified by measuring Frequency Tolerance using an MXE Signal Analyzer. Frequency Tolerance is a measurement of the difference between the actual transmit frequency and the assigned frequency (3500.01 MHz).

Frequency Block Tested: *AEQU (CF =3500.01 MHz)*

1. (a) Set the power supply to nominal Voltage. (b) Record the frequency at ~25°C. (c) Raise EUT operating temperature to 50°C. (d) Record the frequency difference. (e) Repeat step (d) at each 10°C step down to -30°C. Result will be 10 readings and take temperature readings to establish thermal stability at each point.

Baseline Measurement at +25°C **mhz =milli-hertz**

Transmit Frequency Deviation at +25°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	-103.0mHz
0.5	538.55 mHz
1.0	-163.6 mHz
1.5	487.38 mHz
2.0	281.89 mHz
2.5	1.2287
3.0	873.55 mHz
SPECIFICATION	3500.01 MHz (±0.05ppm) ±0.05ppm = ± 175Hz
RESULT	PASS

Transmit Frequency Deviation at +50°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	413.61 mHz
0.5	169.59 mHz
1.0	445.51 mHz

1.5	1.3912
2.0	1.4279
2.5	448.40 mHz
3.0	51.765 mHz
SPECIFICATION	3500.01 MHz (±0.05ppm) ±0.05ppm = ± 175Hz
RESULT	PASS

Transmit Frequency Deviation at +40°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	738.16 mHz
0.5	1.3413
1.0	263.62 mHz
1.5	495.22 mHz
2.0	-480.6 mHz
2.5	125.20 mHz
3.0	1.2433
SPECIFICATION	3500.01 MHz (±0.05ppm) ±0.05ppm = ± 175Hz
RESULT	PASS

Transmit Frequency Deviation at +30°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	-445.4 mHz
0.5	2.2132 mHz
1.0	-540.9 mHz
1.5	1.5443
2.0	1.0018
2.5	841.16 mHz
3.0	-537.8 mHz
SPECIFICATION	3500.01 MHz (±0.05ppm) ±0.05ppm = ± 175Hz
RESULT	PASS

Transmit Frequency Deviation at +20°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	2.4307

0.5	-369.0 mHz
1.0	2.0542
1.5	-207.8 mHz
2.0	458.51 mHz
2.5	1.6510
3.0	556.53 mHz
SPECIFICATION	3500.01 MHz (±0.05ppm) ±0.05ppm = ± 175Hz
RESULT	PASS

Transmit Frequency Deviation at +10°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	632.15 mHz
0.5	-326.0 mHz
1.0	-2.7555
1.5	-1.4039
2.0	12.111
2.5	261.32 mHz
3.0	1.9263
SPECIFICATION	3500.01 MHz (±0.05ppm) ±0.05ppm = ± 175Hz
RESULT	PASS

Transmit Frequency Deviation at 0°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	1.9831
0.5	301.93 mHz
1.0	-1.3306
1.5	2.2250
2.0	-268.9 mHz
2.5	-1.1102
3.0	1.4095
SPECIFICATION	3500.01 MHz (±0.05ppm) ±0.05ppm = ± 175Hz
RESULT	PASS

Transmit Frequency Deviation at -10°C at 100% of Nominal Voltage, -48VDC	
Time	**Transmit Carrier Deviation**

(minutes)	(Hz)
0	1.1038
0.5	700.39 mHz
1.0	-1.3479
1.5	212.64 mHz
2.0	-454.3 mHz
2.5	2.1493
3.0	1.0615
SPECIFICATION	3500.01 MHz (±0.05ppm) ±0.05ppm = ± 175Hz
RESULT	PASS

Transmit Frequency Deviation at -20°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	-1.0511
0.5	707.47 mHz
1.0	-1.4491
1.5	432.66 mHz
2.0	994.12 mHz
2.5	1.1916
3.0	128.84 mHz
SPECIFICATION	3500.01 MHz (±0.05ppm) ±0.05ppm = ± 175Hz
RESULT	PASS

Transmit Frequency Deviation at -30°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	1.3313
0.5	-79.48 mHz
1.0	2.0110
1.5	1.9011
2.0	946.11 mHz
2.5	1.0722
3.0	2.0827
SPECIFICATION	3500.01 MHz (±0.05ppm) ±0.05ppm = ± 175Hz
RESULT	PASS

Upon return to +25°C.

1. At ambient, vary voltage to +15% and -15% of nominal VAC and record frequency difference. Result will be 12 readings for each voltage (nominal, ~+ 3%, ~+6%, ~+9%, ~+12%, +15%, and nominal, ~- 3%, ~-6%, ~-9%, ~-12%, -15%).

Transmit Frequency Deviation at +25°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	676.90 mHz
0.5	-149.3 mHz
1.0	1.1526
1.5	277.40 mHz
2.0	1.4864
2.5	9.1178
3.0	-606.5 mHz
SPECIFICATION	3500.01 MHz (±0.05ppm) ±0.05ppm = ± 175Hz
RESULT	PASS

Transmit Frequency Deviation at +25°C at 103% of Nominal Voltage, -49.44VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	595.30 mHz
0.5	-1.3347
1.0	-365.1 mHz
1.5	1.3395
2.0	-2.5593
2.5	-183.3 mHz
3.0	1.7113
SPECIFICATION	3500.01 MHz (±0.05ppm) ±0.05ppm = ± 175Hz
RESULT	PASS

Transmit Frequency Deviation at +25°C at 106% of Nominal Voltage, -50.88VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	1.3063
0.5	-2.5164
1.0	928.37 mHz
1.5	144.67 mHz
2.0	2.1063

2.5	-428.1 mHz
3.0	1.6926
SPECIFICATION	3500.01 MHz (±0.05ppm) ±0.05ppm = ± 175Hz
RESULT	PASS

Transmit Frequency Deviation at +25°C at 109% of Nominal Voltage, -52.32VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	1.4042
0.5	198.71 mHz
1.0	2.5559
1.5	478.22 mHz
2.0	-1.0730
2.5	943.70 mHz
3.0	721.85 mHz
SPECIFICATION	3500.01 MHz (±0.05ppm) ±0.05ppm = ± 175Hz
RESULT	PASS

Transmit Frequency Deviation at +25°C at 112% of Nominal Voltage, -53.76VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	1.2244
0.5	6.1111
1.0	-117.4 mHz
1.5	199.05 mHz
2.0	1.2447
2.5	6.0850
3.0	712.05 mHz
SPECIFICATION	3500.01 MHz (±0.05ppm) ±0.05ppm = ± 175Hz
RESULT	PASS

Transmit Frequency Deviation at +25°C at 115% of Nominal Voltage, -55.20VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	2.0657
0.5	-645.9 mHz
1.0	1.1556

1.5	-9.7775
2.0	517.22 mHz
2.5	2.4489
3.0	8.2997
SPECIFICATION	3500.01 MHz (±0.05ppm) ±0.05ppm = ± 175Hz
RESULT	PASS

Transmit Frequency Deviation at +25°C at 100% of Nominal Voltage, -48.0VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	1.1053
0.5	509.22 mHz
1.0	1.0217
1.5	1.2277
2.0	347.12 mHz
2.5	158.87 mHz
3.0	1.5507
SPECIFICATION	3500.01 MHz (±0.05ppm) ±0.05ppm = ± 175Hz
RESULT	PASS

Transmit Frequency Deviation at +25°C at -3% of Nominal Voltage, -46.56VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	3.2517
0.5	714.69 mHz
1.0	20.716
1.5	1.1770
2.0	268.7 mHz
2.5	-601.8 mHz
3.0	14.475
SPECIFICATION	3500.01 MHz (±0.05ppm) ±0.05ppm = ± 175Hz
RESULT	PASS

Transmit Frequency Deviation at +25°C at -6% of Nominal Voltage, -45.12VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	39.477 mHz

0.5	-714.7 mHz
1.0	1.9172
1.5	9.3351
2.0	1.5451
2.5	229.50 mHz
3.0	10.456
SPECIFICATION	3500.01 MHz (±0.05ppm) ±0.05ppm = ± 175Hz
RESULT	PASS

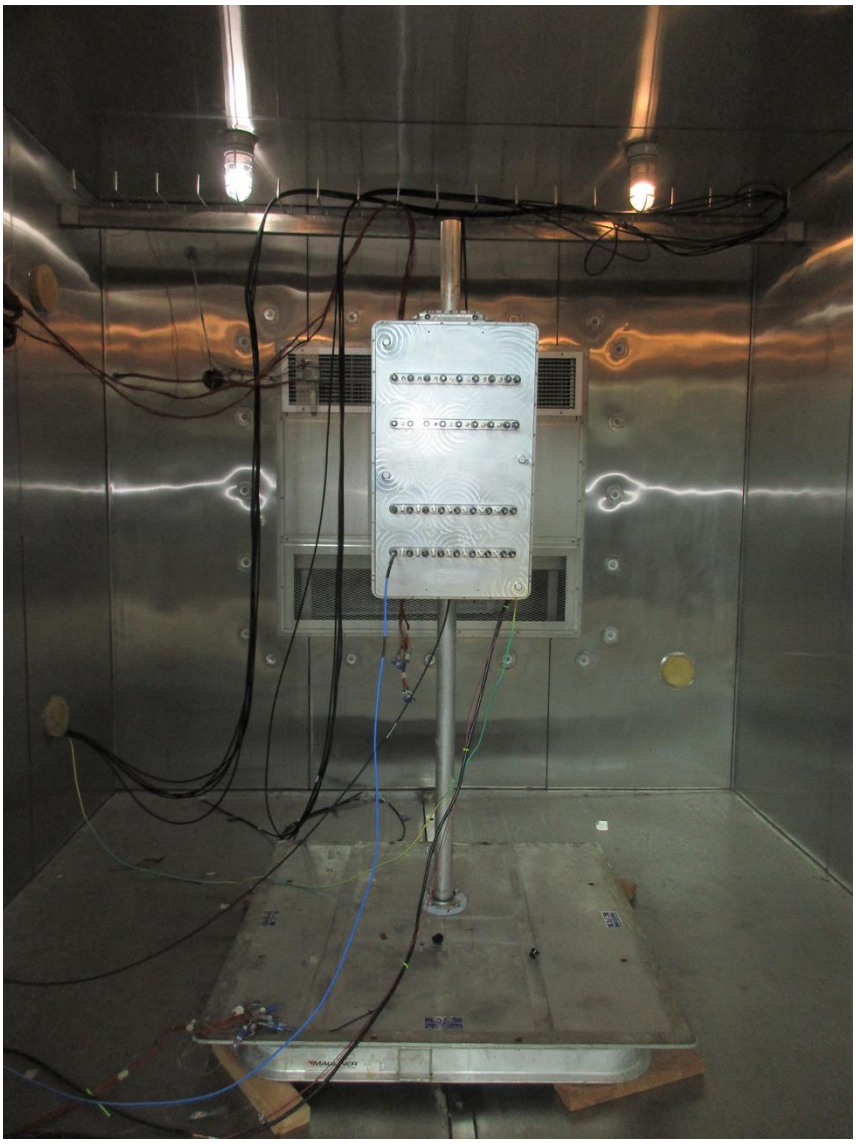
Transmit Frequency Deviation at +25°C at -9% of Nominal Voltage, -43.68VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	-556.0 mHz
0.5	1.2994
1.0	1.4559
1.5	983.97 mHz
2.0	-919.9 mHz
2.5	75.533 mHz
3.0	1.1071
SPECIFICATION	3500.01 MHz (±0.05ppm) ±0.05ppm = ± 175Hz
RESULT	PASS

Transmit Frequency Deviation at +25°C at -12% of Nominal Voltage, -42.24VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	2.0577
0.5	317.76 mHz
1.0	-12.637
1.5	798.60 mHz
2.0	2.3182
2.5	38.216 mHz
3.0	-1.1075
SPECIFICATION	3500.01 MHz (±0.05ppm) ±0.05ppm = ± 175Hz
RESULT	PASS

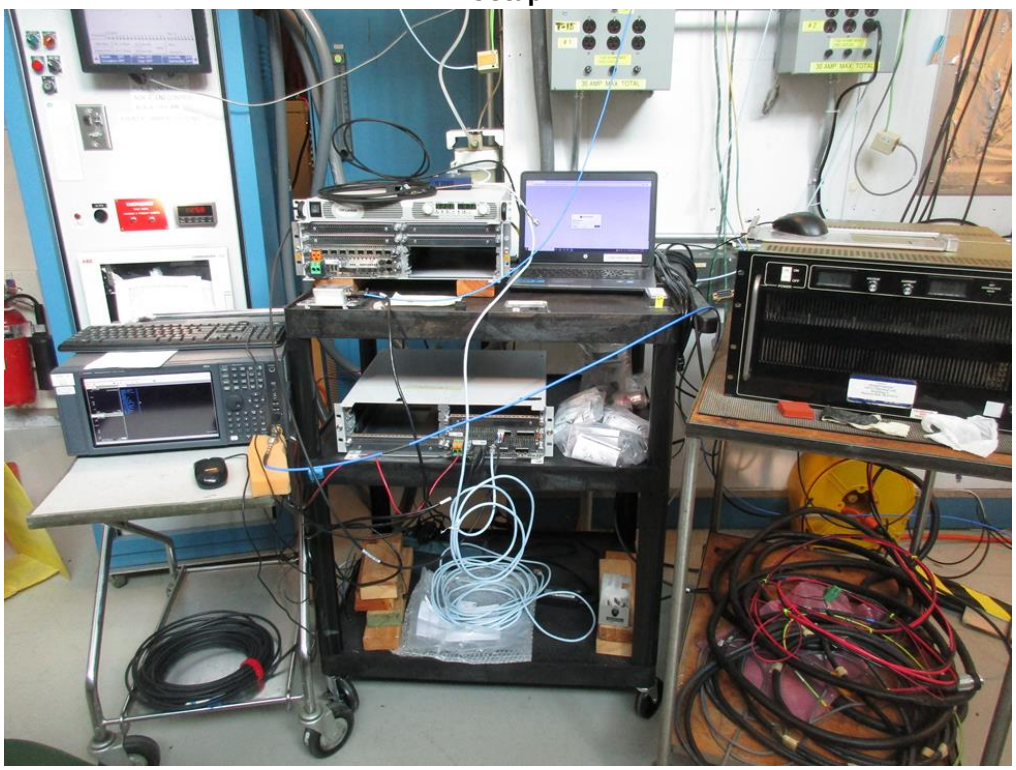
Transmit Frequency Deviation at +25°C at -15% of Nominal Voltage, -40.80VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	-162.2 mHz
0.5	22.120 mHz
1.0	-1.8047
1.5	1.1218
2.0	-7.265 mHz
2.5	601.34 mHz
3.0	-1.2780
SPECIFICATION	3500.01 MHz (±0.05ppm) ±0.05ppm = ± 175Hz
RESULT	PASS

Photographs

Radio in thermal chamber

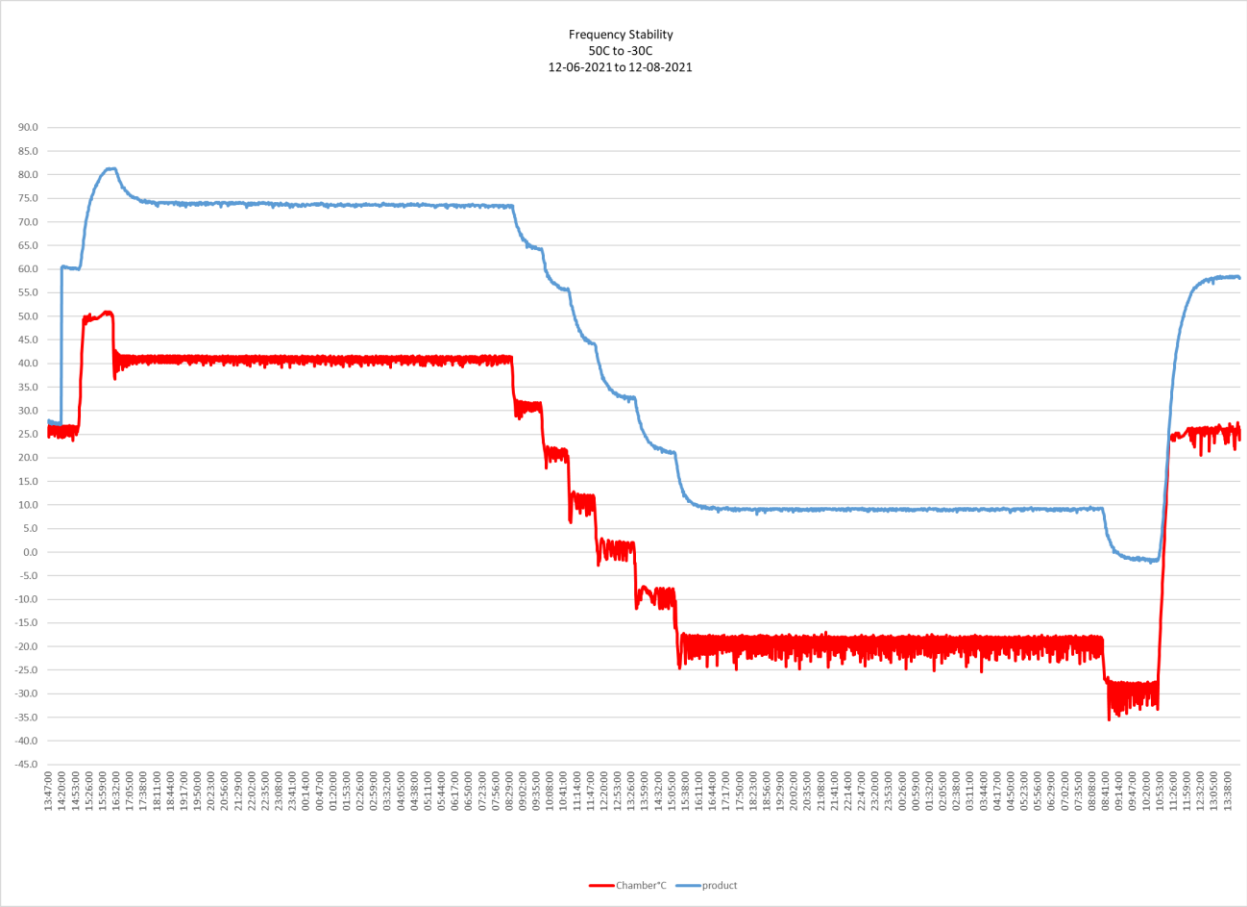


Setup



Serial Number

Chamber Temperature Plot



Test Equipment

Asset ID	Manufacturer	Type	Description	Model	Serial	Calibration Date	Calibration Due
TH513-T15	Envirotronics	Controller	Chamber Controller	Envirotronics SPPCM	SP001316	2020-02-27	2022-02-27
TH-T15	Envirotronics	Thermal Chamber	Thermal Chamber	N/A	3015242		
TH071	Extech	Data Logger	Barometric Pressure/Humidity/ Temperature	SD700	Q668911	2019-12-27	2021-12-27
TH079	Yokogawa	Recorder		GP20	S5P506676	2020-02-25	2022-02-25
TH044	Fluke	Multimeter	DMM	83III	74910377	2020-02-25	2022-02-25
MY57431033	KeySight Technologies	MXA Signal Analyzer	20 Hz-44 GHz (Analysis Bandwidth 125 MHz)	N9020B	MY5712033	2020-07-08	2022-07-08

Test Dates: 12/6/2021 - 12/8/2021.

8. NVLAP Certificate of Accreditation

United States Department of Commerce
National Institute of Standards and Technology

Certificate of Accreditation to ISO/IEC 17025:2017

NVLAP LAB CODE: 100275-0

Nokia, Global Product Compliance Lab
Murray Hill, NJ

is accredited by the National Voluntary Laboratory Accreditation Program for specific services, listed on the Scope of Accreditation, for:

Electromagnetic Compatibility & Telecommunications

This laboratory is 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 joint ISO-ILAC-IAF Communique dated January 2009).

2021-09-24 through 2022-09-30
Effective Dates

For the National Voluntary Laboratory Accreditation Program