NOKIA

Bell Labs

Global Product Compliance Laboratory
600-700 Mountain Avenue
Room 5B-108
Murray Hill, New Jersey 07974-0636 USA

TESTING
NVLAP LAB CODE: 100275-0

FCC Certification Part 2/30 Test Report

2.1047 Modulation
2.1053 Frequency Stability

Product Evaluated

5G AirScale 28 GHz 2T2R n261 mmWave Radio
FCC ID: 2AD8UASMR28FA3UA

Customer

Nokia Solutions and Networks US LLC
6000 Connection Drive
Irving, Texas 75039 USA

Test Laboratory

Nokia Bell Labs
Nokia, Global Product Compliance Laboratory
600-700 Mountain Avenue, Rm 5B-108
Murray Hill, New Jersey 07974-0636 USA

Date: February 5, 2021

Revisions

Date	Revision	Section	Change
11/13/2020	0		Initial Release
02/05/2021	1		Modified product name. Modified KDB 842590 D01 test standard reference to latest version.

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02/05/2021

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02/05/2021

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02/05/2021

Compliance Engineer
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1. ATTESTATION OF TEST RESULTS

Company Name	Nokia Solutions and Networks, OY 2000 Lucent Lane Naperville, Illinois 60563
FCC ID	2AD8UASMR28FA3UA
Product Name	5G AirScale 28 GHz 2T2R n261 mmWave Radio
Model Name	ASMR AWEUA/B
Part No	ASMR (AC) - 475166A.102 FA3UA - 475001A.X22 FA3UA - 475001A.X22
Serial Number(s)	ASMR (AC) - AH203301168 FA3UA - YK201300064 FA3UA - YK201300062
Test Requirement	47 CFR FCC Part 2 and Part 30 (Part 2.1047, 2.1055)
Test Standard(s)	• ANSI C63.26 (2015) • KDB 842590 D01 Upper Microwave Flexible Use Service v01r01 – April 3, 2020
Measurement Procedure	• FCC-IC-OB - GPCL Power Measurement, Occupied Bandwidth & Modulation Test Procedure 6-20-2019 • FCC-IC-FS – GPCL Frequency Stability Measurement Process 6-20-2019
Test Date(s):	10/21/2020 – 10/22/2020 11/02/2020 – 11/05/2020
Test Performed By:	Nokia Global Product Compliance Laboratory 600-700 Mountain Avenue P.O. Box 636 Murray Hill, NJ 07974-0636
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Product Engineer(s):	Ron Remy
Lead Engineer:	W. Steve Majkowski
Test Engineer(s):	Joe Bordonaro, W. Steve Majkowski
Test Results: The product, as tested met the above listed Test Requirements. The decision rule employed is binary (Pass/Fail) based on the calculated values without accounting for Measurement Uncertainty or any Guard Band. The calculated values obtained during evaluation were compared to a value given in the referenced regulation or normative standard. Report copies and other information not contained in this report are held by either the product engineer or in an identified file at the Global Product Compliance Laboratory in New Providence, NJ.	

2. SUMMARY OF THE TEST RESULTS

47 CFR FCC Sections	Description of Tests	Compliance Results
2.1046, 30.202 (a)	RF Power Output	Not Required
2.1047,	Modulation Characteristics	Pass
2.1049, 30.203	(a) Occupied Bandwidth (b) Edge-of-Band Emissions	Not Required
2.1051, 30.203	Spurious Emissions at Antenna Terminals - Radiated	Not Required
2.1053, 30.203	Field Strength of Spurious Radiation	Not Required
2.1055,	Measurement of Frequency Stability	Pass

2.1 Measurement Uncertainty

The results of the calculations to estimate uncertainties for the several test methods and standards are shown in the Tables below. These are the worst-case values.

Worst-Case Estimated Measurement Uncertainties

Standard, Method or Procedure	Condition	Frequency MHz	Expanded Uncertainty (k=2)
a. Classical Emissions, (*e.g.*, ANSI C63.4, CISPR 11, 14, 22, *etc.*, using ESHS 30,	Conducted Emissions	0.009 - 30	±3.5 dB
	Radiated Emissions (AR-8 Semi-Anechoic Chamber)	30 MHz – 200MHz H 30 MHz – 200 MHz V 200 MHz – 1000 MHz H 200 MHz – 1000 MHz V 1 GHz- 18 GHz	±5.4 dB ±5.4 dB ±4.7 dB ±4.7 dB ±3.3 dB

Antenna Port Test	Signal Bandwidth	Frequency Range	Expanded Uncertainty (k=2), Amplitude
Occupied Bandwidth, Edge of Band,	10 Hz 100 Hz 10 kHz to 1 MHz 1MHz to 100 MHz	9 kHz to 20 MHz 20 MHz to 1 GHz 1 GHz to 10 GHz 10 GHz to 40 GHz:	±2.2 dB
Conducted Spurious Emissions	30 kHz to 100 MHz	10 MHz to 40 GHz:	±2.8 dB
RF Power, Channel Power	10 Hz to 100 MHz	10 MHz to 40 GHz	±1.4 dB

3. GENERAL INFORMATION

3.1 Product Descriptions

The equipment under test (EUT) has the following specifications.

Table 3.1.1 Product Specifications

Specification Items	Description
Product	5G AirScale 28 GHz 2T2R n261 mmWave Radio
AC Variant	AWEUA (475166A.X22)
DC Variant	AWEUB (475167A.X22)
Equipment Type	Radio Transmitter Device
Equipment Option	Equipped with Solar Shield
Operating Temperature	-40 °C – 55 °C
Environment	Outdoor Unit
Power	-48 Vdc to -57 Vdc (Nominal); 90VAC – 265 VAC (Nominal)
RF Frequency and Type	27.5-28.35 GHz mmWave
Radio Access Technology	5G NR
Band Class	n261
RF Port Power/ Number of Ports	None Integrated Antenna, 180 deg coverage with Ext unit. Power per Port:158.5W / Polarization, 52 dBm / polarization, 55 dBm (316 W) for 2 Arrays (per antenna)
MIMO	2X
Modulation	QPSK, 16QAM, 64QAM, 256QAM
Carrier Configuration	Single Carrier Only, Multi Carrier, Multi (three or more), Contiguous & Non- Contiguous (NC)
New Bandwidths	100MHz @316W
Maximum Rated Conducted RF Power	100 MHz @316W
Hardware Version (Master)	475166A.102
Software Version (Master)	5G19B
Serial No.	AH203301168
Power Type	90-265 VAC 50/60Hz or -40.5 to -57 VDC

4. REQUIRED MEASUREMENTS AND RESULTS

Per 47CFR FCC Section 2.1033(c)(14), the following certification tests are required by Section 2.1046 through Section 2.1057. These tests are identified in Table 4.0a below.

Table 4.0a Required Certification Measurements

47 CFR FCC Sections	Description of Tests	Test Required
2.1046, 30.202 (a)	**RF Power Output** **(a) Power Limits, EIRP, PSD**	**No**
2.1047,	**Modulation Characteristics**	**Yes**
2.1049, 30.203	**(a) Occupied Bandwidth** **(b) Out-of-Band Emissions**	**No**
2.1051, 30.203	**Spurious Emissions at Antenna Terminals**	**No**
2.1053, 30.203, **30.204, 15.109(a) Class B**	**Field Strength of Spurious Radiation**	**No**
2.1055,	**Measurement of Frequency Stability**	**Yes**

The measurements were conducted in accordance with the procedures set out in Section 2.1041 and as appropriate per the test Standards listed in Table 4.0b below. These tests are presented to demonstrate compliance with FCC requirements.

Table 4.0b Test Standards Used for Radiated Measurements of Radio Performance

Test Standard(s)	• ANSI C63.26 (2015) • KDB 842590 D01 Upper Microwave Flexible Use Service v01r01 – April 3, 2020
Measurement Procedure(s)	• FCC-IC-OB - GPCL Power Measurement, Occupied Bandwidth & Modulation Test Procedure 6-20-2019 • FCC-IC-FS – GPCL Frequency Stability Measurement Process 6-20-2019

4.1 Section 2.1046 MEASUREMENT NOT REQUIRED: RF POWER OUTPUT

RF Power Output testing was not required.

4.2 Section 2.1047 MEASUREMENT REQUIRED: MODULATION CHARACTERISTICS

This measurement evaluates the frequency difference between the actual transmit carrier frequency and the specified transmit frequency assignment. Only the portion of the transmitter system containing the frequency determining and stabilizing circuitry need be put in an environmental chamber and subjected to the temperature variation test per FCC Section 2.1055. The unit which provides baseband signals, such as BBU (baseband unit), can be located outside the chamber if it is a separated unit.

4.2.1 Modulation Measurements Results:

Modulation Characteristics measurements were performed by Steve Majkowski from 10/21/2020 – 10/22/2020 in Murray Hill, NJ.

The typical measured modulation characteristics of the EUT are shown below:

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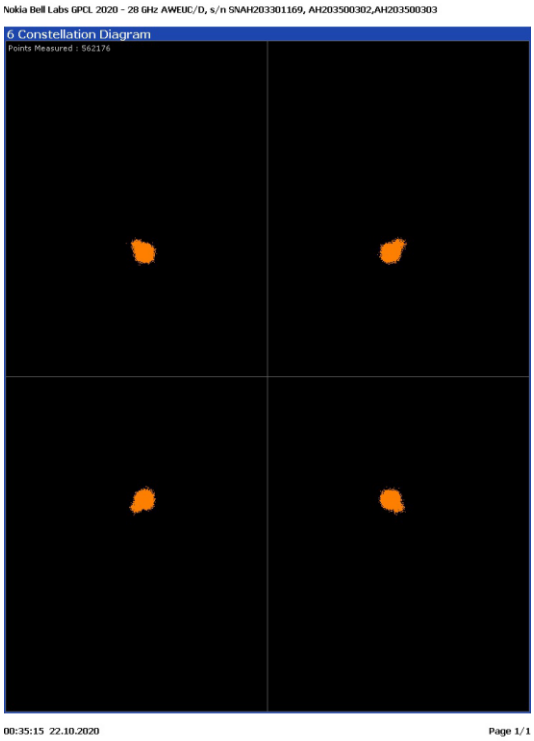

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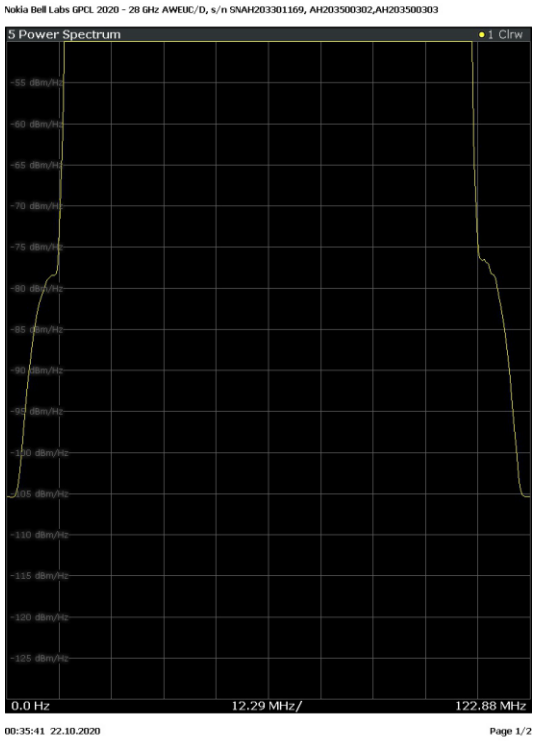

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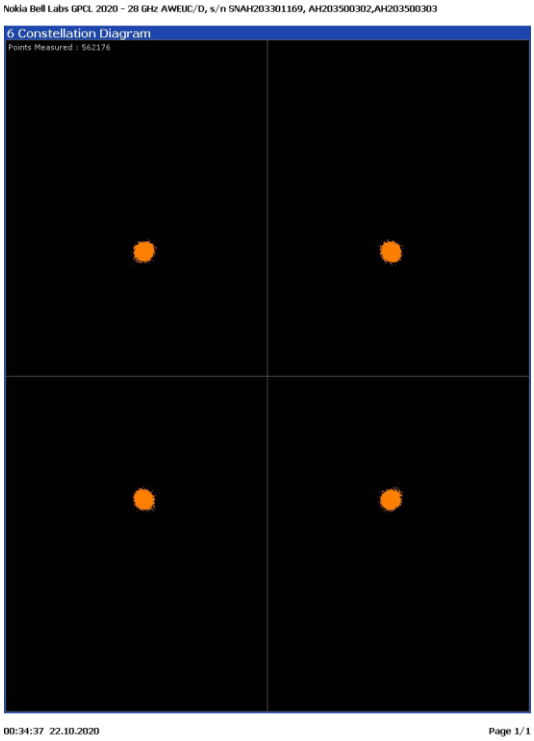

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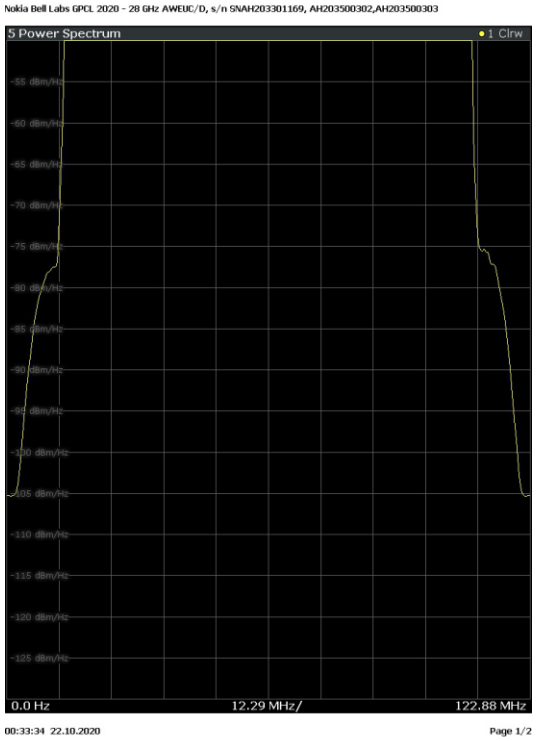

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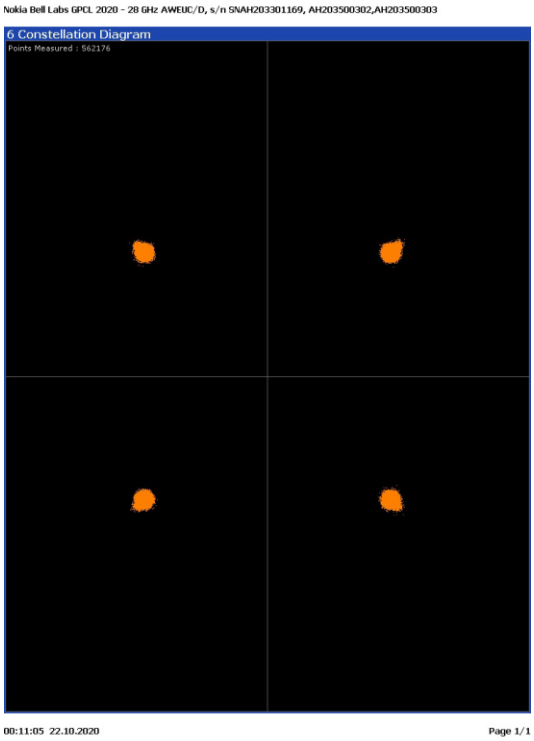

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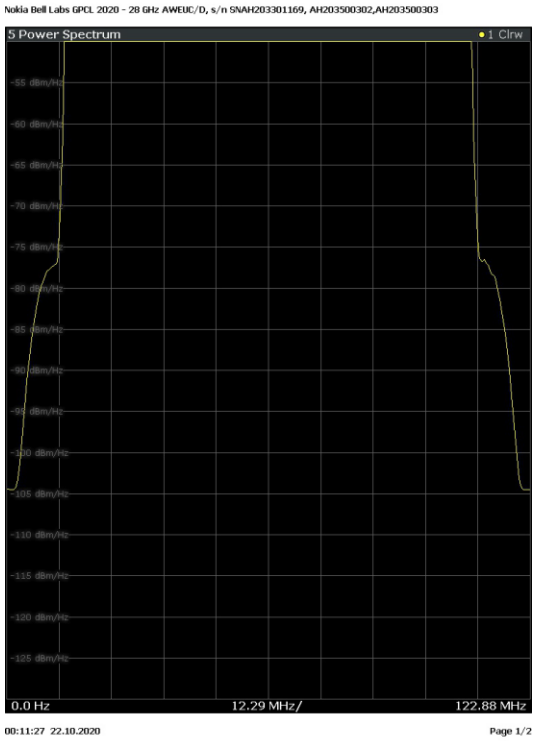

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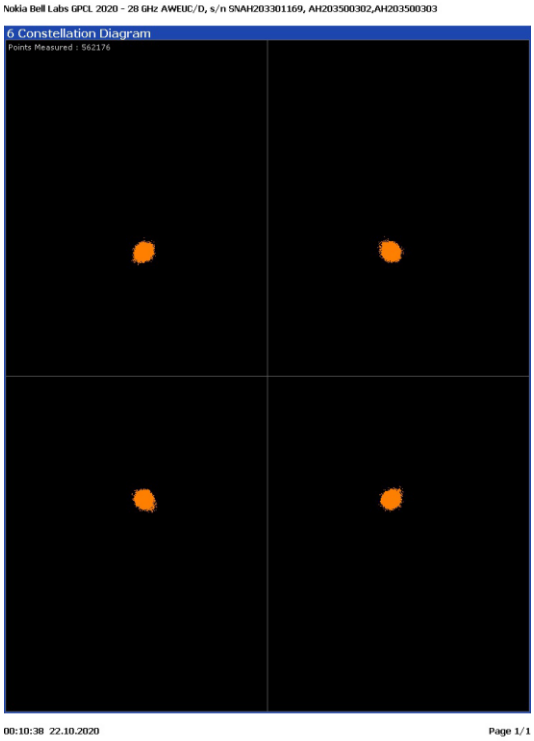

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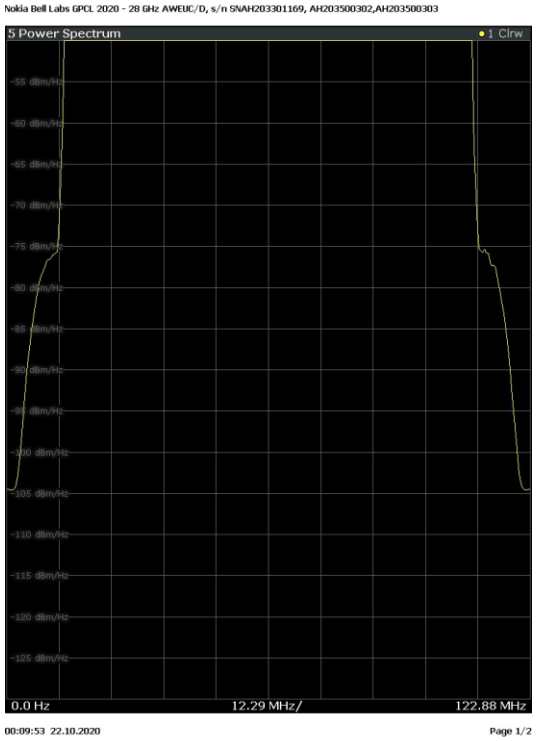

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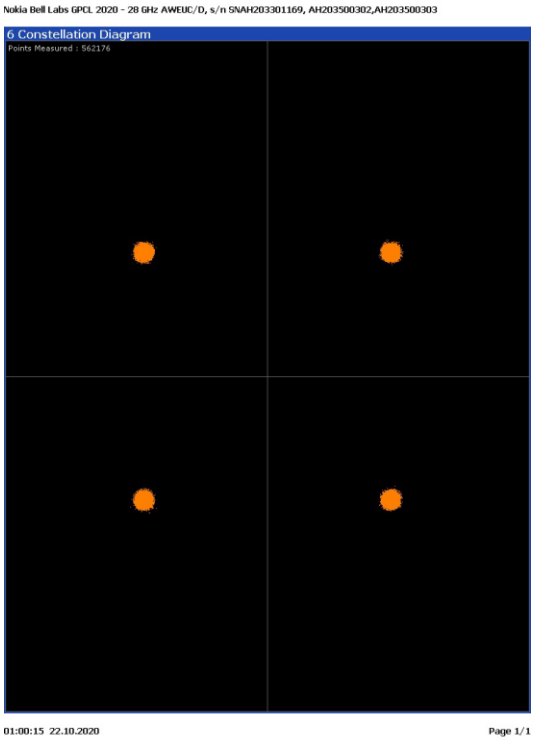

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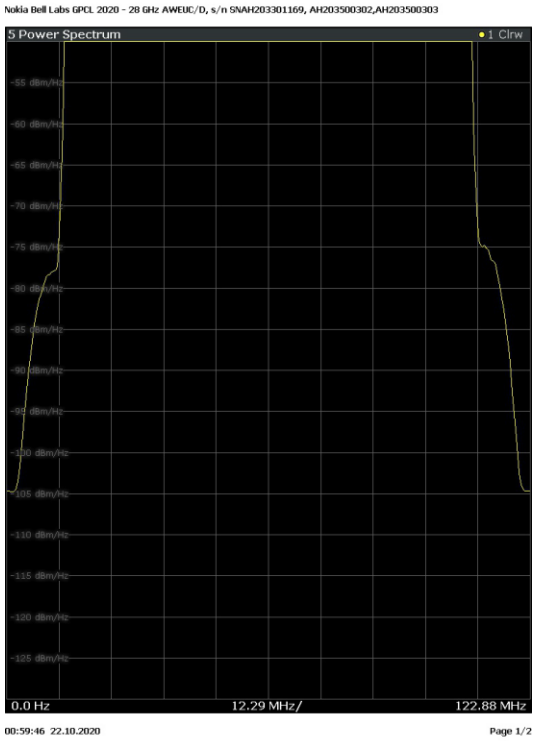

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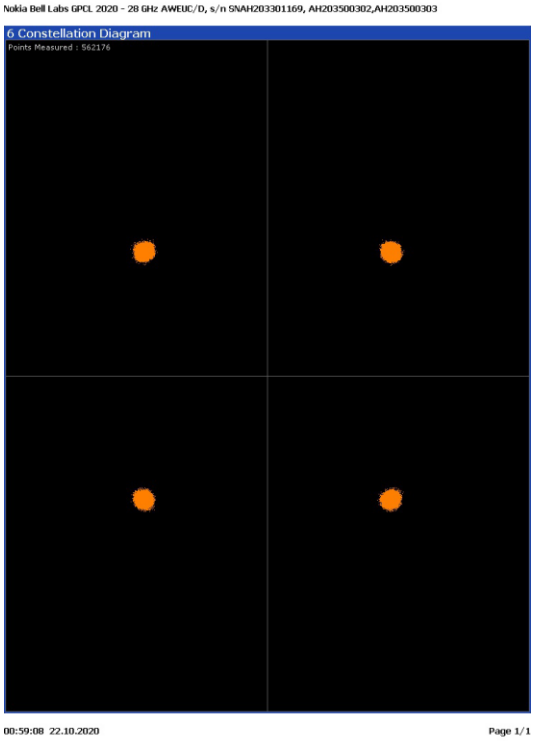

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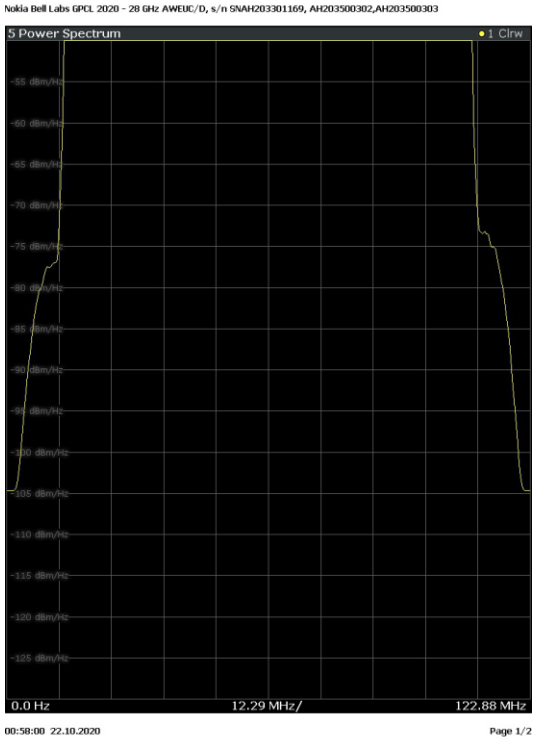

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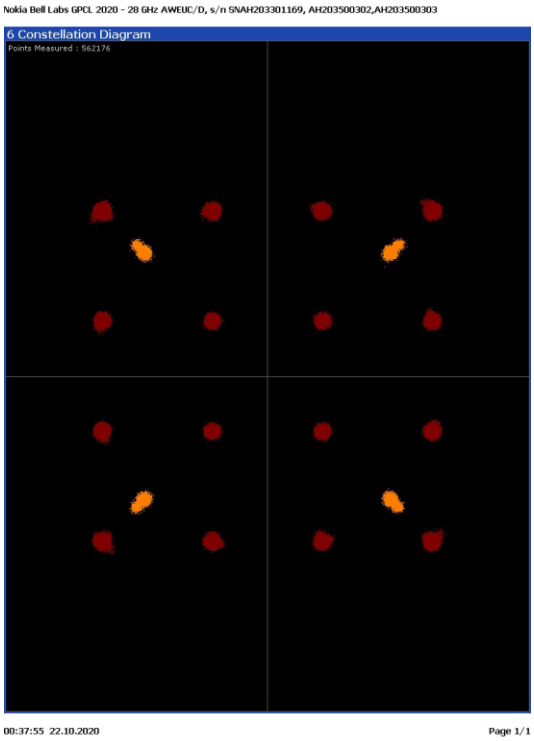

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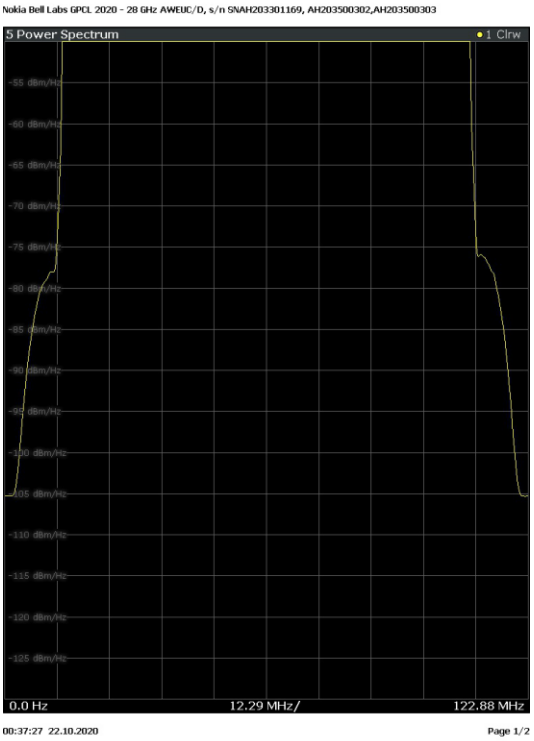

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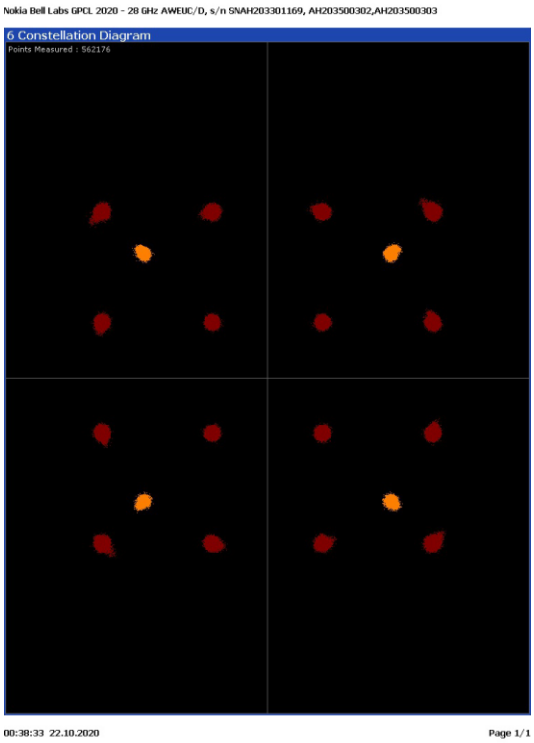

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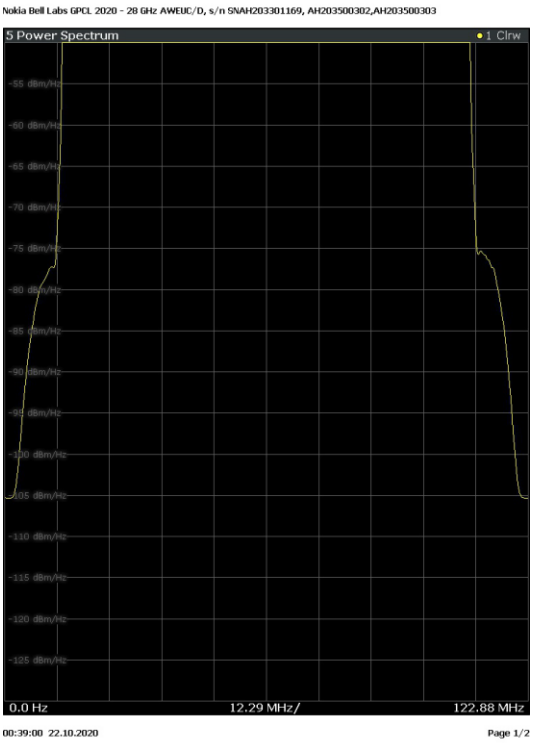

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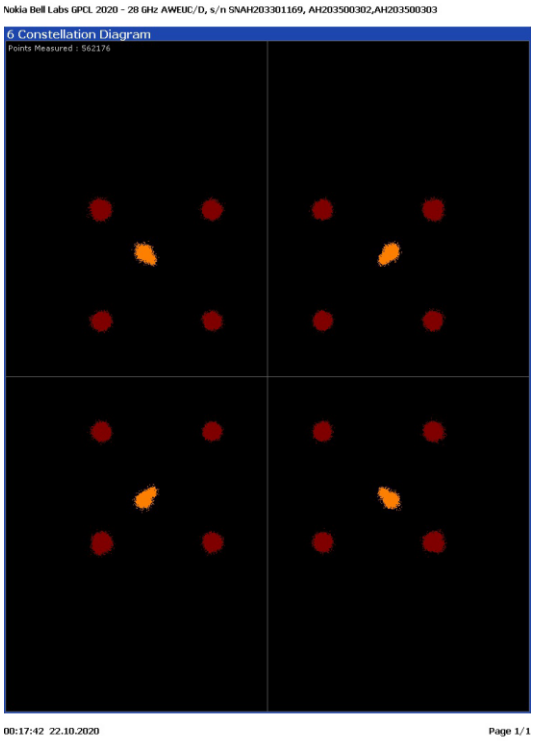

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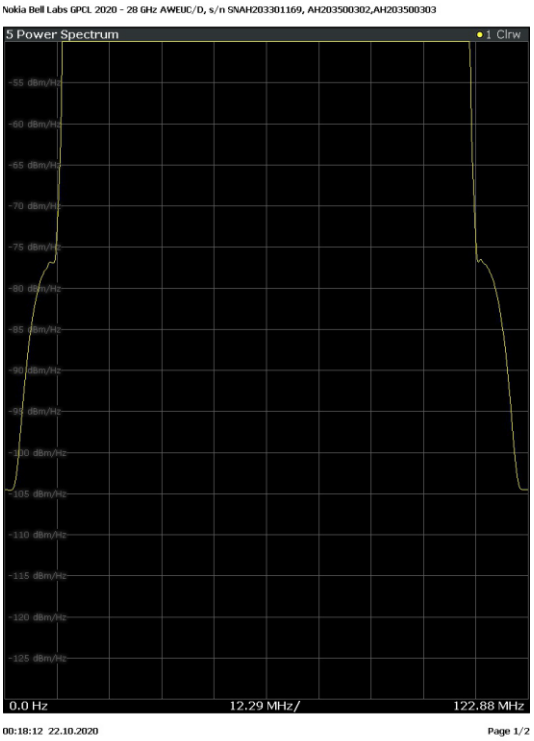

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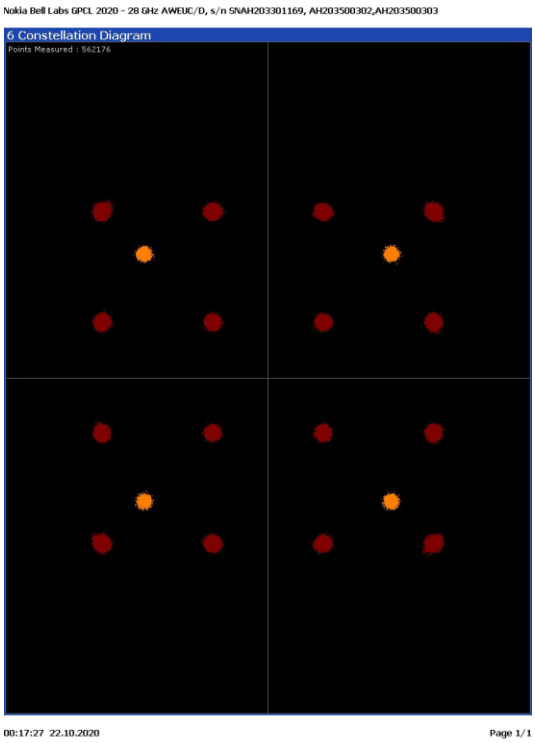

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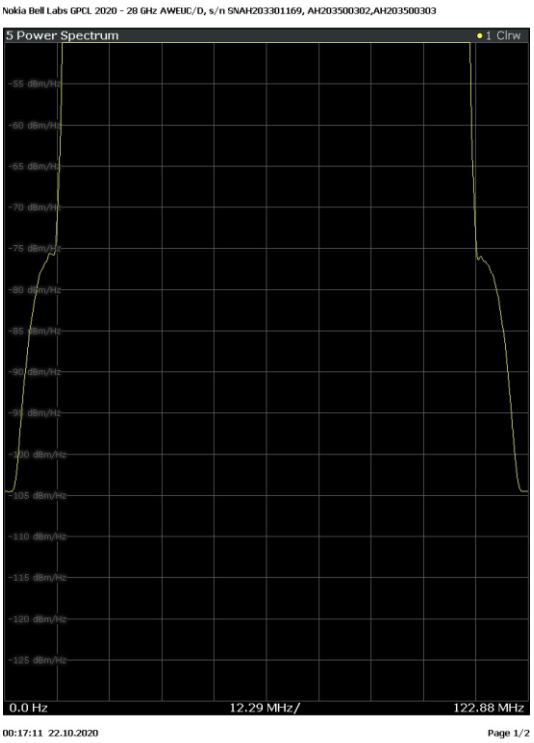

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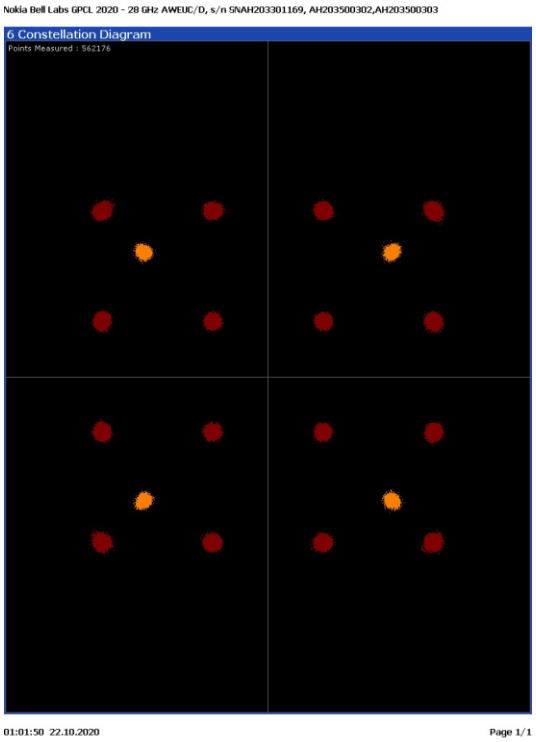

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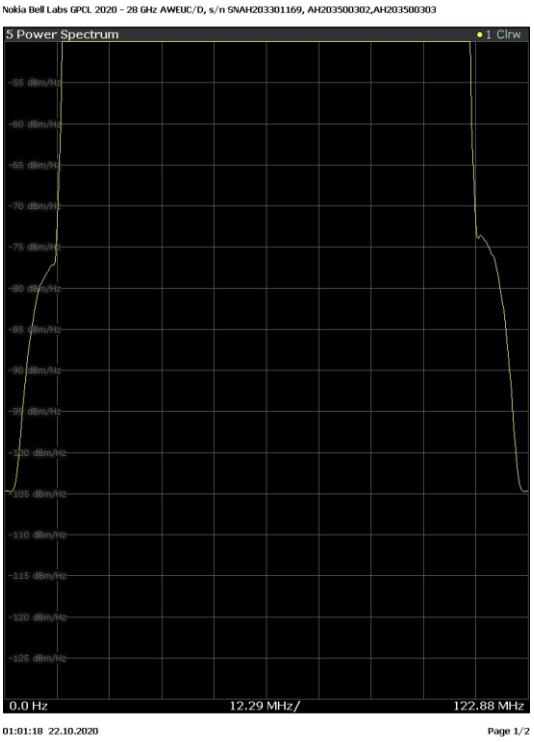

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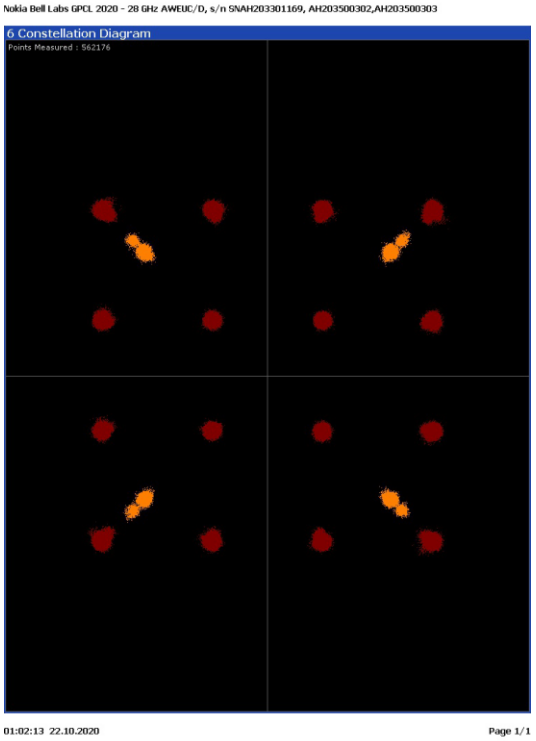

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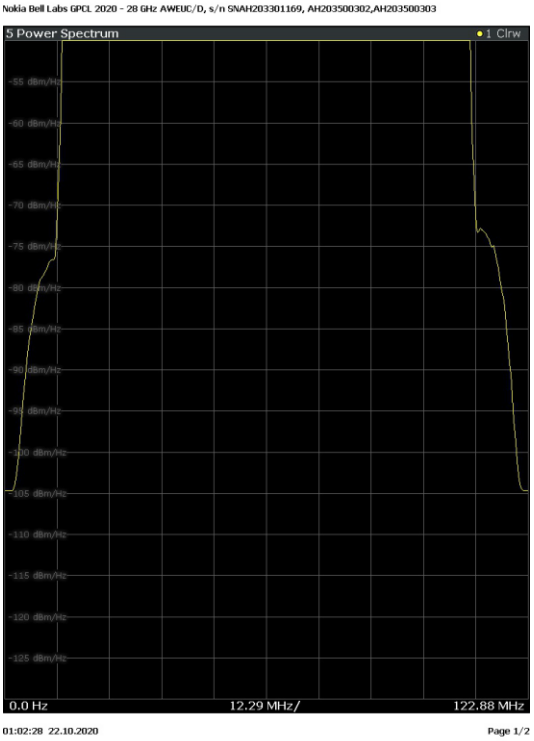

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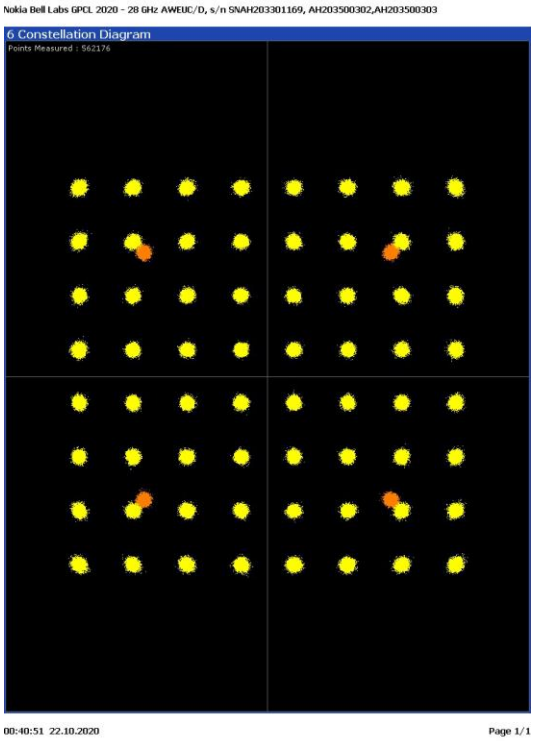

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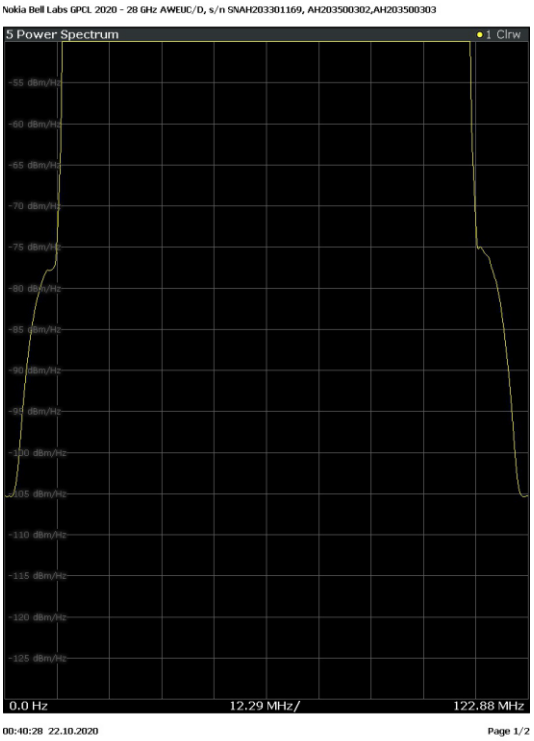

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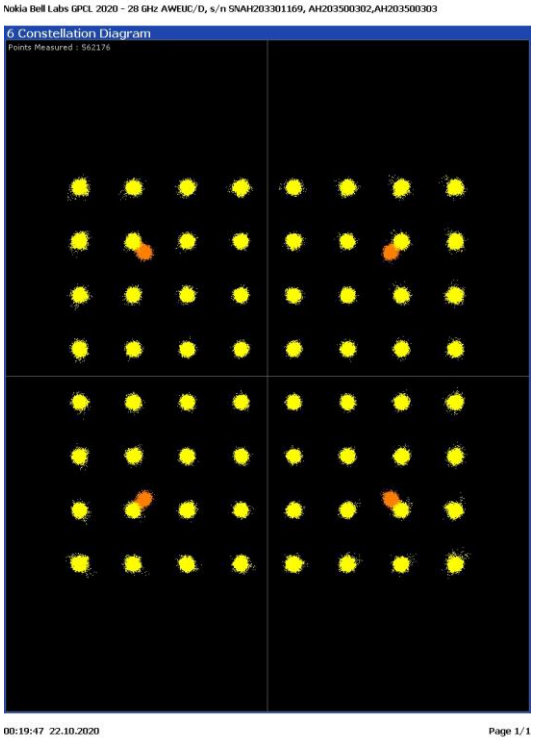

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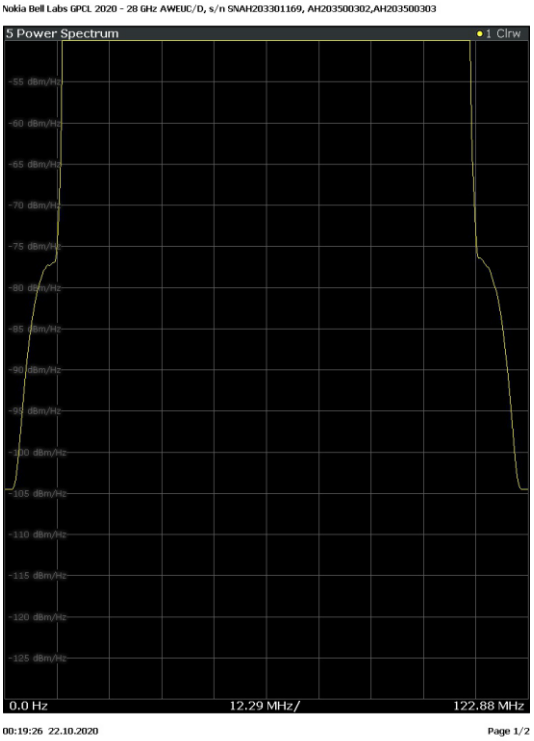

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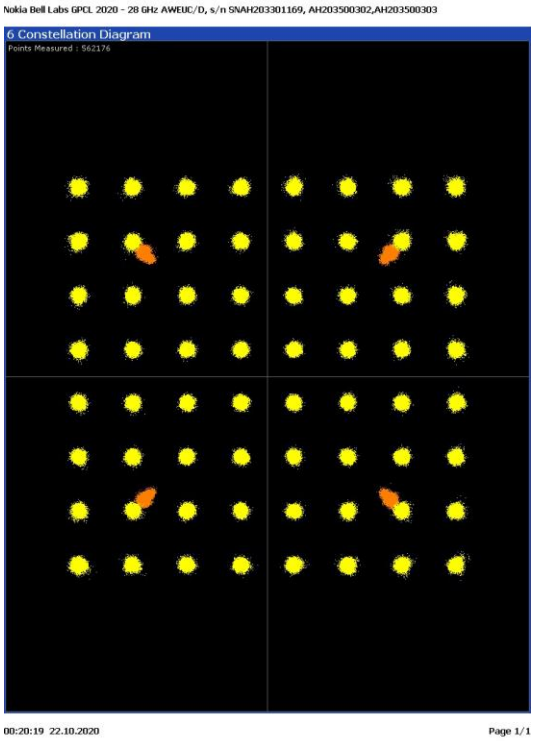

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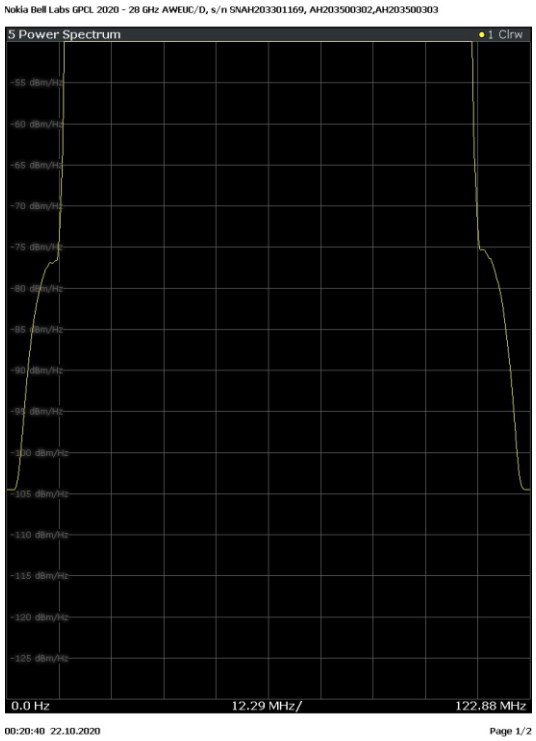

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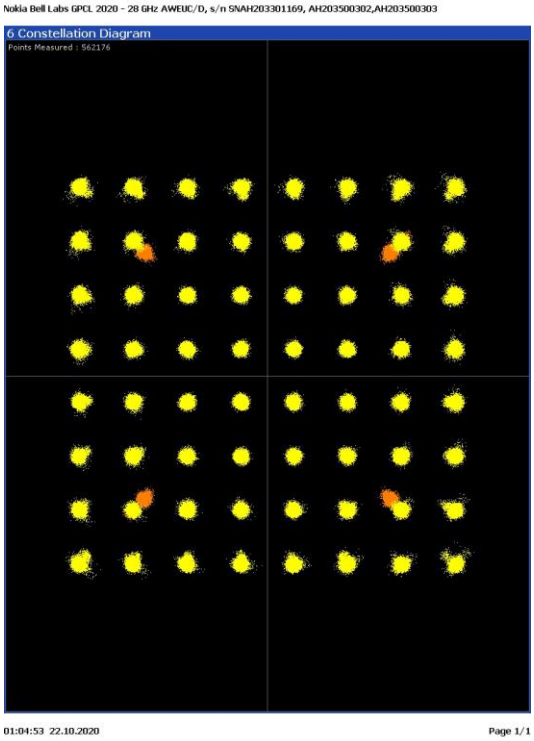

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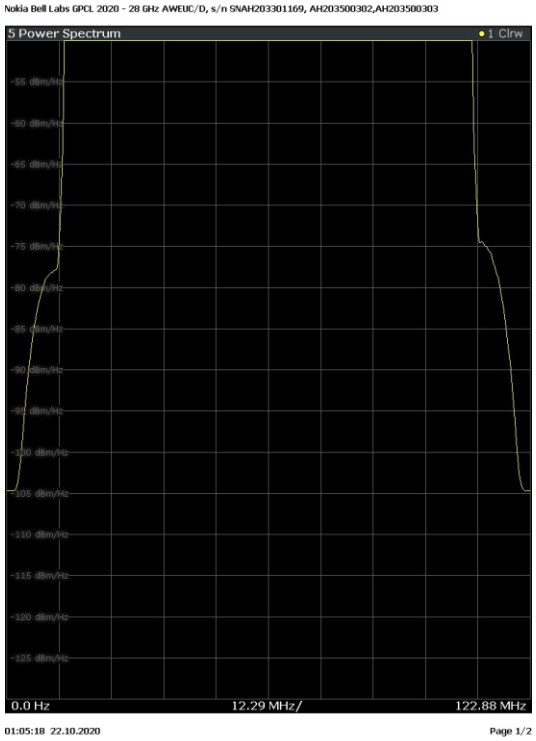

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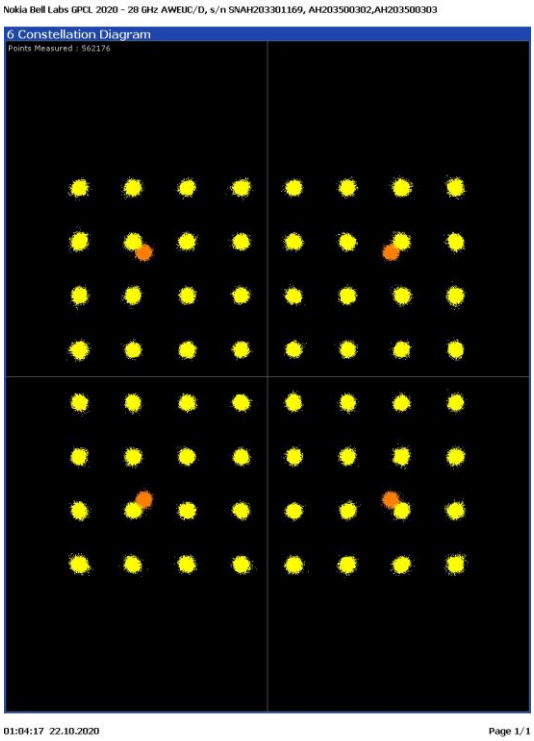

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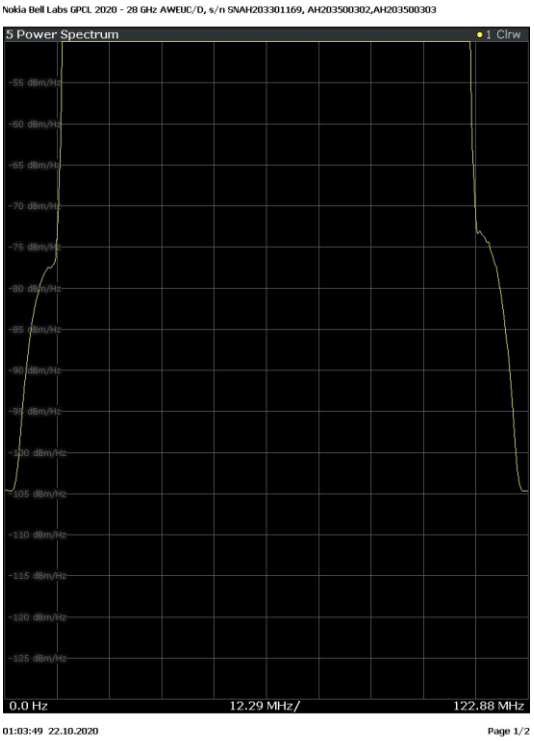


4.3 Section 2.1049 MEASUREMENT NOT REQUIRED: OCCUPIED BANDWIDTH and EDGE of BAND EMISSIONS

Occupied Bandwidth and Edge Band Emissions were not required.

4.4 Section 2.1051 MEASUREMENT NOT REQUIRED: SPURIOUS EMISSIONS AT THE ANTENNA TERMINALS

Spurious Emissions was not required.

4.5 Section 2.1053 MEASUREMENT NOT REQUIRED: FIELD STRENGTH OF SPURIOUS RADIATION

Field Strength of Spurious Radiation not required.

4.6 Section 2.1055 MEASUREMENT REQUIRED: FREQUENCY STABILITY

This measurement evaluates the frequency difference between the actual transmit carrier frequency and the specified transmit frequency assignment. Only the portion of the transmitter system containing the frequency determining and stabilizing circuitry need be put in an environmental chamber and subjected to the temperature variation test per FCC Section 2.1055 and RSS-133. The unit which provides baseband signals, such as BBU (baseband unit), can be located outside the chamber if it is a separated unit.

4.6.1 Frequency Stability Results AC Model:

Frequency Stability testing was completed on: AWEUA, 28GHz ASMR (CF 27,950.4 MHz). Two Extension Modules (FA3UA) were connected to the ASMR, but were not transmitting. Testing was performed from 11/02/2020 through 11/03/2020 on the radio, which was located in the T-14 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

Table 1: Unit Under Test

Series	Vendor	Serial Number	Model #
ASMR	Nokia	AH203301168	475166A.102
FA3UA	Nokia	YK201300064	475001A.X22
FA3UA	Nokia	YK201300062	475001A.X22

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.

Transmit frequency error measures the deviation between the actual transmit frequency and the assigned frequency. The transmit frequency error in this case was measured by capturing the transmitted signal using a receiving antenna and then cabling it to an MXA signal analyzer. The system level frequency stability testing resulted in compliance with established design criteria.

4.6.2 Frequency Stability Results DC Model:

Frequency Stability testing was completed on: AWEUB 28GHz ASMR (CF = 27,950.4 MHz). The unit tested was the AC model modified with the DC power supply module, Model 091730A.X, SN:1M201206555. Two Extension Modules (FA3UA) were connected to the ASMR, but were not transmitting. Testing was performed from 11/04/2020 through 11/05/2020 on the radio, which was located in the T-14 Thermal chamber of the Global Product Compliance Laboratory (GPCL) test facility located in Building 4, Room 4-278, Murray Hill, NJ, by Joe Bordonaro from GPCL.

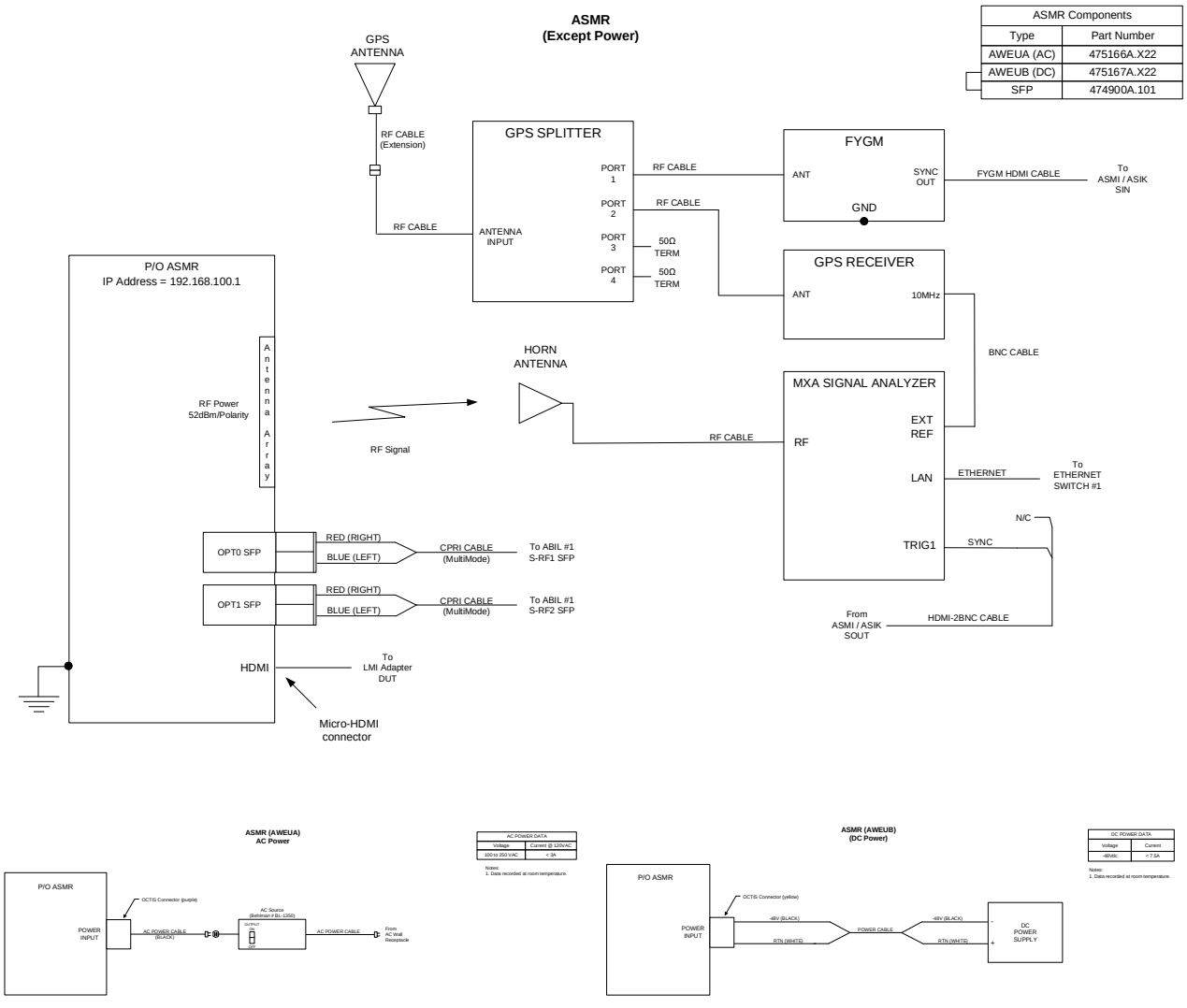
Table 2: Unit Under Test

Series	Vendor	Serial Number	Model #
ASMR	Nokia	AH203301168	475166A.102
FA3UA	Nokia	YK201300064	475001A.X22
FA3UA	Nokia	YK201300062	475001A.X22

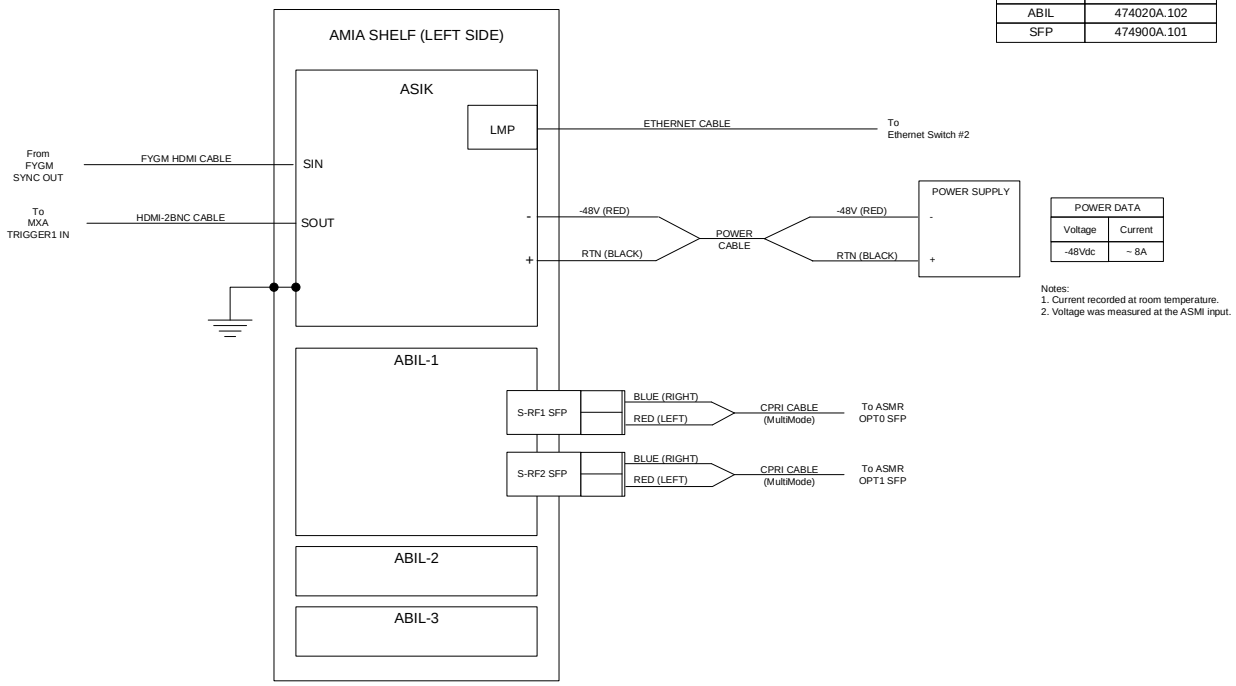
The temperatures to which the UUT's were subjected ranged from a high temperature of +50°C system ambient to a low temperature of -30°C system ambient with measurements recorded at 10°C increments.

Transmit frequency error measures the deviation between the actual transmit frequency and the assigned frequency. The transmit frequency error in this case was measured by capturing the transmitted signal using a receiving antenna and then cabling it to an MXA signal analyzer. The system level frequency stability testing resulted in compliance with established design criteria.

FIGURE 4.6.1: Frequency Stability Test Block Diagram



Airscale System Module Indoor (ASMI)



ASMI Components	
Type	Part Number
AMIA	473098A.203
ASIK	474021A.102
ABIL	474020A.102
SFP	474900A.101

POWER DATA	
Voltage	Current
-48Vdc	~ 8A

Notes:
1. Current recorded at room temperature.
2. Voltage was measured at the ASMI input.

AWEUA + FA3UA - AC Version

Frequency Block Tested: 28 GHz RADIO (CF = 27,950.4 MHz)

Baseline Measurement at +25°C

Transmit Frequency Deviation at +25°C at 100% of Nominal Voltage, 120VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	+11.072
0.5	-10.108
1.0	+2.6057
1.5	-6.5130
2.0	+10.045
2.5	-2.8575
3.0	-10.920
FCC SPECIFICATION	+/-1398Hz (±0.05ppm) ±0.05ppm = ±Hz
FCC RESULT	Pass

Transmit Frequency Deviation at +50°C at 100% of Nominal Voltage, 120VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	+9.6522
0.5	+2.5616
1.0	+3.7934
1.5	+10.078
2.0	-7.0981
2.5	+1.0042
3.0	+0.41931
FCC SPECIFICATION	+/-1398Hz (±0.05ppm) ±0.05ppm = ±Hz
FCC RESULT	Pass

Transmit Frequency Deviation at +40°C at 100% of Nominal Voltage, 120VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-9.2260**
0.5	**+0.41850**
1.0	**-6.6018**
1.5	**+0.53188**
2.0	**-11.649**
2.5	**-4.5504**
3.0	**+2.3685**
FCC SPECIFICATION	**+/-1398Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**Pass**

Transmit Frequency Deviation at +30°C at 100% of Nominal Voltage, 120VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-2.0003**
0.5	**+0.10222**
1.0	**+4.24234**
1.5	**+9.9975**
2.0	**+11.177**
2.5	**-1.4190**
3.0	**-14.126**
FCC SPECIFICATION	**+/-1398Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**Pass**

Transmit Frequency Deviation at +20°C at 100% of Nominal Voltage, 120VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**+9.5525**
0.5	**-2.16160**
1.0	**-13.072**
1.5	**+6.1249**
2.0	**+20.413**
2.5	**-0.20983**
3.0	**-9.1207**
FCC SPECIFICATION	**+/-1398Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**Pass**

Transmit Frequency Deviation at +10°C at 100% of Nominal Voltage, 120VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**+7.9192**
0.5	**-1.4481**
1.0	**-0.25610**
1.5	**+10.600**
2.0	**-9.1277**
2.5	**+8.8560**
3.0	**+2.4819**
FCC SPECIFICATION	**+/-1398Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**Pass**

Transmit Frequency Deviation at 0°C at 100% of Nominal Voltage, 120VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-10.446**
0.5	**-0.85818**
1.0	**+11.135**
1.5	**-14.702**
2.0	**+17.867**
2.5	**-20.819**
3.0	**+3.0090**
FCC SPECIFICATION	**+/-1398Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**Pass**

Transmit Frequency Deviation at -10°C at 100% of Nominal Voltage, 120VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**+6.5731**
0.5	**-11.315**
1.0	**+19.630**
1.5	**-11.309**
2.0	**+7.2138**
2.5	**-0.77128**
3.0	**-13.716**
FCC SPECIFICATION	**+/-1398Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**Pass**

Transmit Frequency Deviation at -20°C at 100% of Nominal Voltage, 120VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**+22.207**
0.5	**-15.901**
1.0	**+12.715**
1.5	**-10.676**
2.0	**+5.5340**
2.5	**-28.504**
3.0	**-8.1394**
FCC SPECIFICATION	**+/-1398Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**Pass**

Transmit Frequency Deviation at -30°C at 100% of Nominal Voltage, 120VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-6.0941**
0.5	**+12.276**
1.0	**-17.616**
1.5	**+13.886**
2.0	**-3.6242**
2.5	**+8.0970**
3.0	**+3.1688**
FCC SPECIFICATION	**+/-1398Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**Pass**

Upon return to +25°C

Transmit Frequency Deviation at +25°C at 100% of Nominal Voltage, 120VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**+1.8087**
0.5	**+11.200**
1.0	**+16.168**
1.5	**+1.4285**
2.0	**-14.855**
2.5	**-5.0939**
3.0	**-6.0326**
FCC SPECIFICATION	**+/-1398Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**Pass**

Transmit Frequency Deviation at +25°C at +15% of Nominal Voltage, 138.0VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-8.0362**
0.5	**+7.6036**
1.0	**+17.556**
1.5	**-10.861**
2.0	**+8.8200**
2.5	**-9.8948**
3.0	**+3.4374**
FCC SPECIFICATION	**+/-1398Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**Pass**

Transmit Frequency Deviation at +25°C at +12% of Nominal Voltage, 134.40VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**+6.7547**
0.5	**-7.2609**
1.0	**-21.325**
1.5	**+15.315**
2.0	**+13.510**
2.5	**-16.467**
3.0	**+5.2160**
FCC SPECIFICATION	**+/-1398Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**Pass**

Transmit Frequency Deviation at +25°C at +9% of Nominal Voltage, 130.80VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**+5.2488**
0.5	**+22.911**
1.0	**-47.915**
1.5	**+13.240**
2.0	**+4.7108**
2.5	**-22.156**
3.0	**+6.3883**
FCC SPECIFICATION	**+/-1398Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**Pass**

Transmit Frequency Deviation at +25°C at +6% of Nominal Voltage, 127.20VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-12.755**
0.5	**+9.5907**
1.0	**-8.3753**
1.5	**+7.5151**
2.0	**-6.6435**
2.5	**-18.557**
3.0	**-14.272**
FCC SPECIFICATION	**+/-1398Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**Pass**

Transmit Frequency Deviation at +25°C at +3% of Nominal Voltage, 123.60VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-1.1104**
0.5	**+13.164**
1.0	**+4.0471**
1.5	**-6.3521**
2.0	**-1.3465**
2.5	**+3.4548**
3.0	**+4.2458**
FCC SPECIFICATION	**+/-1398Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**Pass**

Transmit Frequency Deviation at +25°C at -3% of Nominal Voltage, 116.40VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-7.9363**
0.5	**-3.1332**
1.0	**+10.032**
1.5	**+4.4362**
2.0	**-2.0024**
2.5	**+2.1213**
3.0	**+4.3748**
FCC SPECIFICATION	**+/-1398Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**Pass**

Transmit Frequency Deviation at +25°C at -6% of Nominal Voltage, 112.80VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-0.2998**
0.5	**+3.2838**
1.0	**-2.4257**
1.5	**+3.7357**
2.0	**-4.2755**
2.5	**+3.3764**
3.0	**+2.2788**
FCC SPECIFICATION	**+/-1398Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**Pass**

Transmit Frequency Deviation at +25°C at -9% of Nominal Voltage, 109.20VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-7.8365**
0.5	**+2.71266**
1.0	**+8.9670**
1.5	**+13.191**
2.0	**+0.4362**
2.5	**+4.6658**
3.0	**-6.0845**
FCC SPECIFICATION	**+/-1398Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**Pass**

Transmit Frequency Deviation at +25°C at -12% of Nominal Voltage, 105.60VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-18.277**
0.5	**-3.5752**
1.0	**+0.7032**
1.5	**-6.0100**
2.0	**+3.1161**
2.5	**-11.259**
3.0	**+0.36210**
FCC SPECIFICATION	**+/-1398Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**Pass**

Transmit Frequency Deviation at +25°C at -15% of Nominal Voltage, 102.0VAC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**+16.992**
0.5	**+3.7717**
1.0	**-11.326**
1.5	**+2.3722**
2.0	**+10.135**
2.5	**-9.0467**
3.0	**-18.885**
FCC SPECIFICATION	**+/-1398Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**Pass**

AWEUB + FA3UA - DC Version

Frequency Block Tested: 28 GHz RADIO (CF = 27,950.4 MHz)

Baseline Measurement at +25°C

Transmit Frequency Deviation at +25°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	+7.5789
0.5	+5.3644
1.0	-7.7168
1.5	+14.445
2.0	-0.7775
2.5	+5.8212
3.0	+17.307
FCC SPECIFICATION	+/-1398Hz (±0.05ppm) ±0.05ppm = ±Hz
FCC RESULT	PASS

Transmit Frequency Deviation at +50°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	+5.4703
0.5	+6.0704
1.0	-13.674
1.5	-6.1810
2.0	+4.3134
2.5	+1.0509
3.0	+8.3513
FCC SPECIFICATION	+/-1398Hz (±0.05ppm) ±0.05ppm = ±Hz
FCC RESULT	PASS

Transmit Frequency Deviation at +40°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	+7.0961
0.5	+12.189
1.0	-26.544
1.5	+9.7799
2.0	+0.1896
2.5	+26.441
3.0	+6.1442
FCC SPECIFICATION	+/-1398Hz (±0.05ppm) ±0.05ppm = ±Hz
FCC RESULT	PASS

Transmit Frequency Deviation at +30°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**+12.581**
0.5	**+9.9921**
1.0	**-11.396**
1.5	**+12.010**
2.0	**-5.5479**
2.5	**+9.5514**
3.0	**+0.7504**
FCC SPECIFICATION	**+/-1398Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +20°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**+10.830**
0.5	**-2.0883**
1.0	**+11.293**
1.5	**+13.775**
2.0	**+0.97807**
2.5	**+20.012**
3.0	**-9.8107**
FCC SPECIFICATION	**+/-1398Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +10°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**+29.444**
0.5	**+0.89140**
1.0	**-5.1724**
1.5	**+27.002**
2.0	**-6.4618**
2.5	**+11.439**
3.0	**+24.077**
FCC SPECIFICATION	**+/-1398Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at 0°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**+7.4997**
0.5	**-11.560**
1.0	**+4.5898**
1.5	**+13.229**
2.0	**+3.6962**
2.5	**+5.1886**
3.0	**+17.949**
FCC SPECIFICATION	**+/-1398Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at -10°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**+10.309**
0.5	**+29.452**
1.0	**-17.319**
1.5	**-13.683**
2.0	**-2.4952**
2.5	**+16.137**
3.0	**+1.4996**
FCC SPECIFICATION	**+/-1398Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at -20°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-20.872**
0.5	**+2.3315**
1.0	**+14.181**
1.5	**+4.7981**
2.0	**+6.3561**
2.5	**-4.8390**
3.0	**-5.3109**
FCC SPECIFICATION	**+/-1398Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at -30°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-2.8692**
0.5	**+1.1610**
1.0	**+6.4796**
1.5	**+12.666**
2.0	**-6.4502**
2.5	**-3.4822**
3.0	**+23989**
FCC SPECIFICATION	**+/-1398Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**PASS**

Upon return to +25°C

Transmit Frequency Deviation at +25°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**+11.511**
0.5	**-15.748**
1.0	**+12.147**
1.5	**-8.0997**
2.0	**+20.241**
2.5	**+7.1195**
3.0	**-3.8098**
FCC SPECIFICATION	**+/-1398Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +25°C at 103% of Nominal Voltage, -49.44VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-10.243**
0.5	**-22.060**
1.0	**+6.1000**
1.5	**+0.13230**
2.0	**-10.602**
2.5	**+6.9995**
3.0	**-17.134**
FCC SPECIFICATION	**+/-1398Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +25°C at 106% of Nominal Voltage, -50.88VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-17.710**
0.5	**+11.325**
1.0	**+19.984**
1.5	**-5.3197**
2.0	**-8.6910**
2.5	**+12.636**
3.0	**-48.017**
FCC SPECIFICATION	**+/-1398Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +25°C at 109% of Nominal Voltage, -52.32VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**+2.5059**
0.5	**+16.274**
1.0	**-6.0906**
1.5	**+34.212**
2.0	**+2.1934**
2.5	**-19.134**
3.0	**+21.741**
FCC SPECIFICATION	**+/-1398Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +25°C at 112% of Nominal Voltage, -53.76VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**+3.0630**
0.5	**+10.016**
1.0	**-14.444**
1.5	**-3.0886**
2.0	**8.8441**
2.5	**-7.9041**
3.0	**-3.2006**
FCC SPECIFICATION	**+/-1398Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +25°C at 115% of Nominal Voltage, -55.20VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**+52.584**
0.5	**-11.418**
1.0	**+9.6581**
1.5	**+14.717**
2.0	**-10.211**
2.5	**+15.216**
3.0	**-2.5499**
FCC SPECIFICATION	**+/-1398Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +25°C at 100% of Nominal Voltage, -48.0VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**+0.4197**
0.5	**+11.614**
1.0	**+1.2994**
1.5	**-0.6610**
2.0	**-15.090**
2.5	**+13.130**
3.0	**-27.701**
FCC SPECIFICATION	**+/-1398Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +25°C at -3% of Nominal Voltage, -46.56VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**-19.714**
0.5	**+8.9909**
1.0	**+9.9025**
1.5	**-14.164**
2.0	**-17.850**
2.5	**+13.550**
3.0	**+0.28530**
FCC SPECIFICATION	**+/-1398Hz (±0.05ppm) ±0.05ppm = ±Hz**
FCC RESULT	**PASS**

Transmit Frequency Deviation at +25°C at -6% of Nominal Voltage, -45.12VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	-7.9936
0.5	+2.8930
1.0	-1.7046
1.5	-3.8742
2.0	+9.0645
2.5	+5.8181
3.0	+1.5354
FCC SPECIFICATION	+/-1398Hz (±0.05ppm) ±0.05ppm = ±Hz
FCC RESULT	PASS

Transmit Frequency Deviation at +25°C at -9% of Nominal Voltage, -43.68VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	+11.777
0.5	-24.157
1.0	+2.0505
1.5	+19.689
2.0	+16.461
2.5	-20.020
3.0	+1.0272
FCC SPECIFICATION	+/-1398Hz (±0.05ppm) ±0.05ppm = ±Hz
FCC RESULT	PASS

Transmit Frequency Deviation at +25°C at -12% of Nominal Voltage, -42.24VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	+12.306
0.5	+24.153
1.0	+1.5802
1.5	+35.425
2.0	-11.913
2.5	+58.247
3.0	+10.502
FCC SPECIFICATION	+/-1398Hz (±0.05ppm) ±0.05ppm = ±Hz
FCC RESULT	PASS

Transmit Frequency Deviation at +25°C at -15% of Nominal Voltage, -40.80VDC	
Time (minutes)	**Transmit Carrier Deviation (Hz)**
0	**+12.237**
0.5	**-1.7437**
1.0	**+19.607**
1.5	**+3.4779**
2.0	**-2.2117**
2.5	**-10.983**
3.0	**+10.404**
FCC SPECIFICATION	**+/-1398Hz (±0.05ppm)** **±0.05ppm = ±Hz**
FCC RESULT	**PASS**

4.7 List of Test Equipment

4.7.1 List of Radio Measurement Test Equipment

The following equipment were used during Modulation Characteristics testing.

Asset ID	Manufacturer	Type	Description	Model	Serial	Calibration Date	Calibration Due
E1373	A-Info	Horn Antenna	26.5-40GHz WR28 dB	LB-28-25-C2-KF	J202062735	2018-12-05	2021-12-05
E1260	Rohde & Schwarz	Spectrum Analyzer	2 Hz to 67 GHz	FSW67	104007	2020-08-21	2022-08-21

Testing was performed between 10/21/2020 – 10/22/2020.

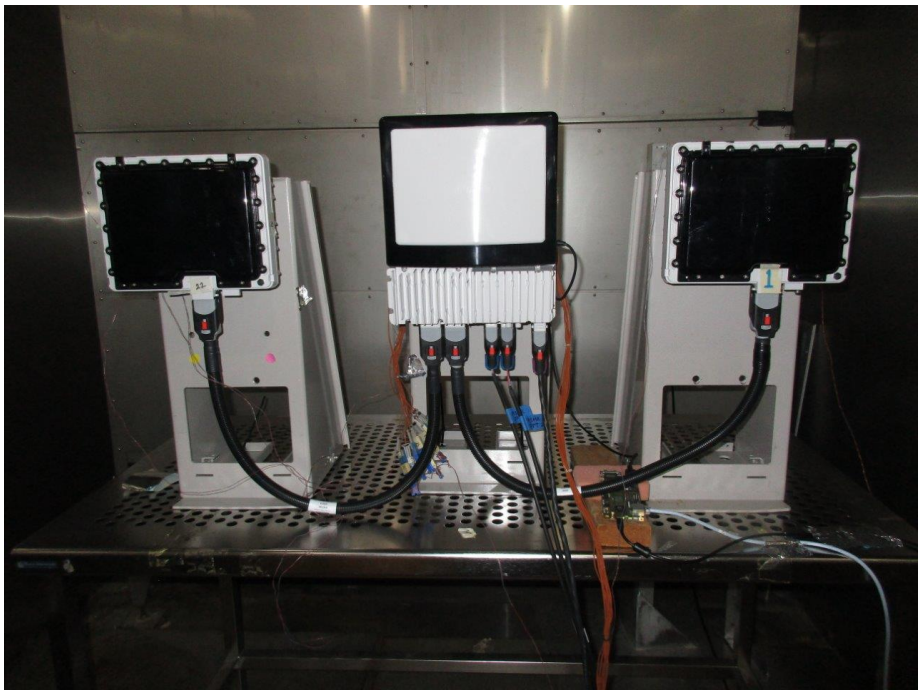
The following equipment were used during Frequency Stability testing.

Asset ID	Manufacturer	Type	Description	Model	Serial	Calibration Date	Calibration Due
TH536-T14	Envirotronics	Controller		SPPCM	SP001513	2019-03-14	2021-03-14
TH303	Yokogawa	Power Analyzer	3 Phase Power Analyzer	WT500	91L222240	2019-12-03	2021-12-03
TH-T14	Thermotron	Thermal Chamber		N/A	28431	2019-09-12	2021-09-12
MY57431033	KeySight Technologies	MXA Signal Analyzer		N9020B	MY57431033	2020-07-08	2022-07-08
TH090	Yokogawa	Data Logger	10 Channel Paperless Recorder	GP10	S5V108472	2019-05-20	2021-05-20
N/A	A-Info	Horn Antenna	26.5-40GHz WR28 25 dB	LB-28-25-C2-KF	J202023248	N/A	N/A

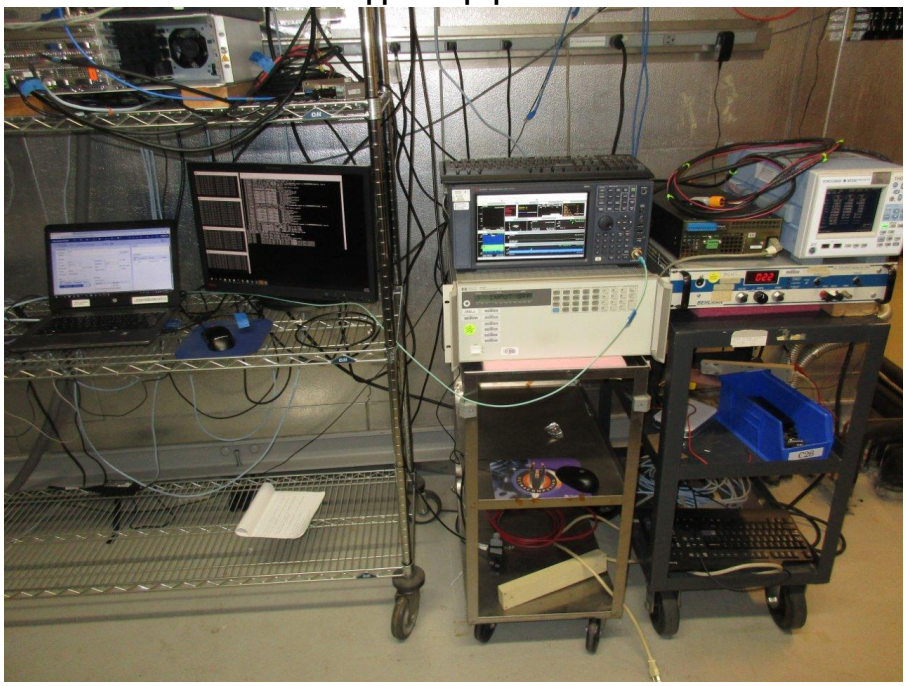
Testing was performed between 11/02/2020 – 11/05/2020.

4.8 PHOTOGRAPHS OF THE TEST SETUPS

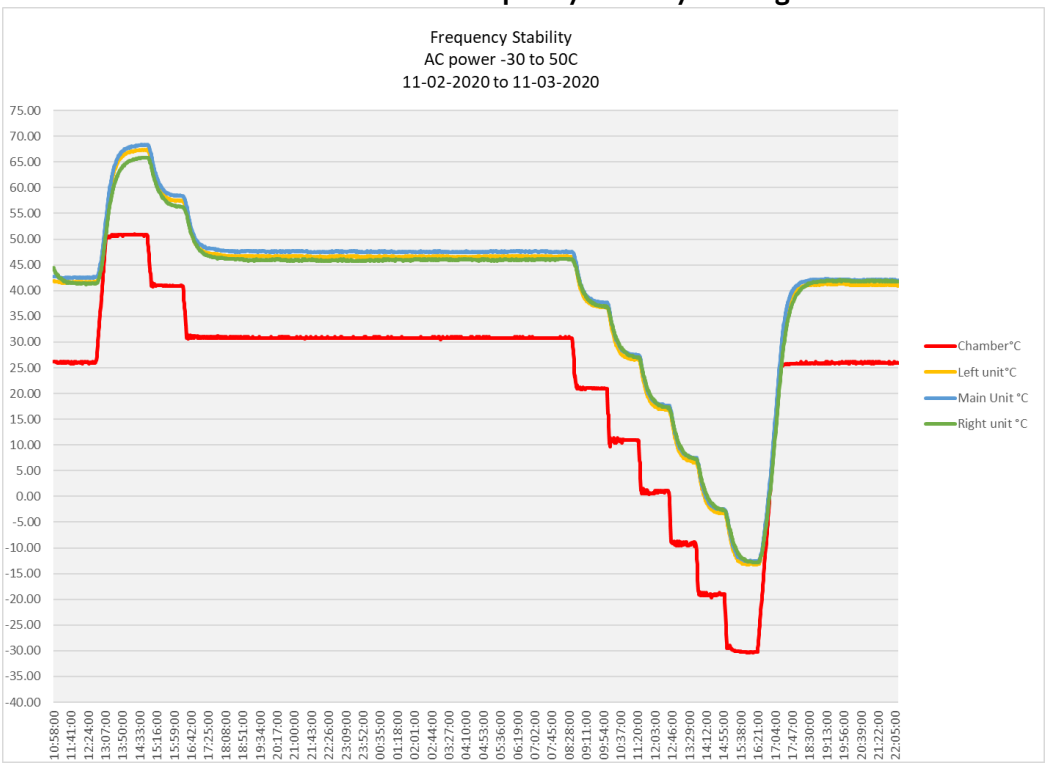
RRH in Thermal Chamber



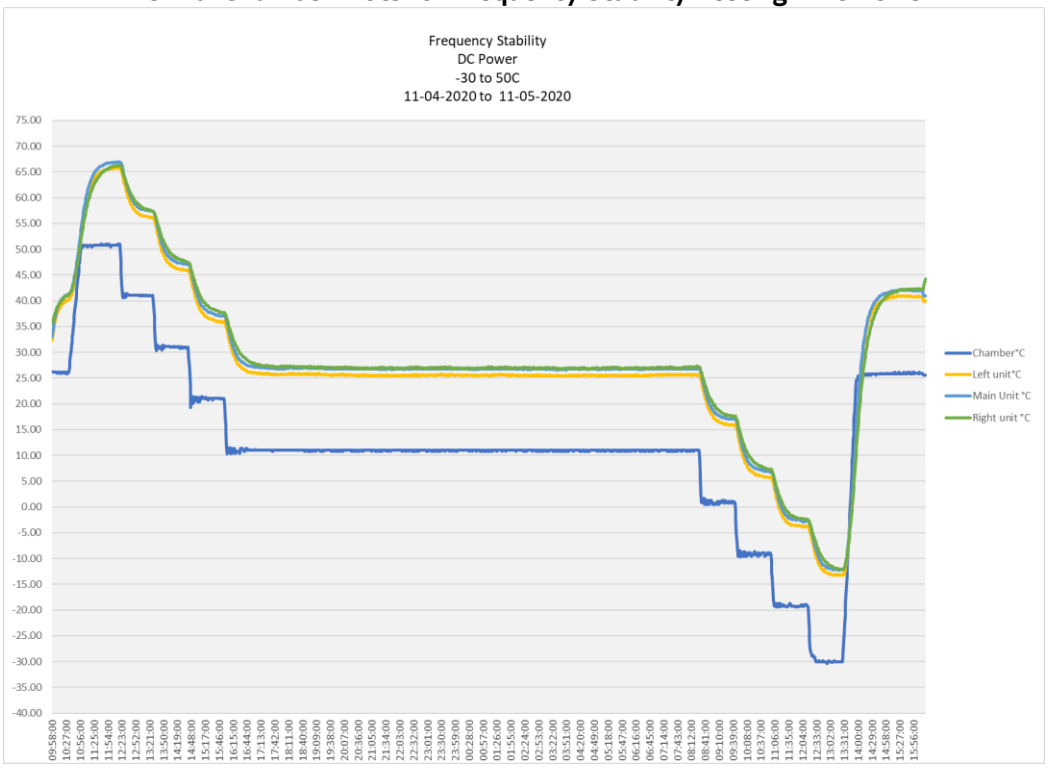
Support Equipment



Thermal Chamber Plots for Frequency Stability Testing – AC Power



Thermal Chamber Plots for Frequency Stability Testing – DC Power



4.9 FACILITIES AND ACCREDITATION

Measurement facilities at Nokia, Global Product Compliance Laboratory (GPCL) a member of the Nokia family of companies, was used to collect the measurement data in the test report. The laboratory, which is part of Nokia Bell Labs, is located at 600-700 Mountain Avenue, Murray Hill, New Jersey 07974-0636 USA.

United States Department of Commerce
National Institute of Standards and Technology

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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).

2020-09-25 through 2021-09-30
Effective Dates

DEPARTMENT OF COMMERCE · UNITED STATES OF AMERICA

For the National Voluntary Laboratory Accreditation Program