

5. FCC Section 2.1051 - Spurious Emissions at Transmit Antenna Port

5.1 Measurement of Spurious Emissions at Transmit Antenna Port

Spurious Emissions at the transmit-antenna terminals were investigated over the frequency range of 10 MHz to beyond the 10th harmonic of the specific transmit band. Carrier Bandwidth is exempt. For this band of operation, the measurements were performed up to 37 GHz. Measurements were made using a Keysight MXA Signal Analyzer. The RF output from the transmitter was reduced (to an amplitude usable by the receivers) using calibrated attenuators. The RF power level was continuously monitored via a coupled RF Power Meter.

The required emission limitation is specified as appropriate in 27.53. The measured spurious emission levels were plotted for the frequency range as specified in 2.1057. For 64 ports where $10\log(64) = 18\text{dBm}$, the limit is 31dBm/MHz.. Data below documents performance up to 37 GHz.

NOTE: Only a sample of the plots are used in this report. The full suite of raw data resides at the MH, New Jersey location.

20MHz BW

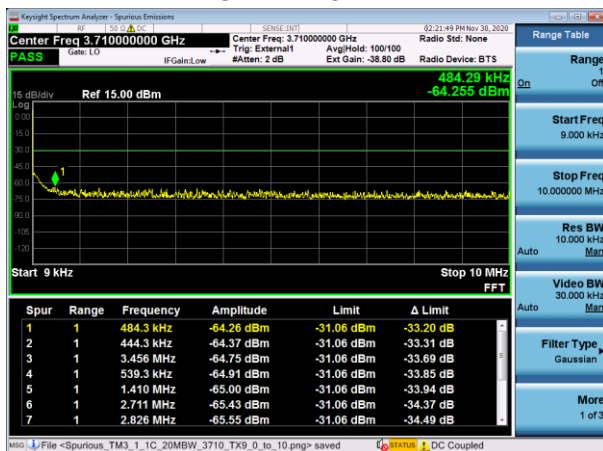
Test Model 3.1

Modulation 64QAM

Channel Frequency 3710MHz

TX9

9KHz – 10MHz

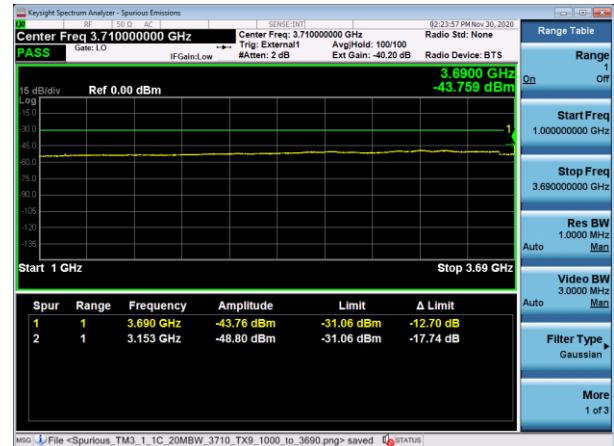
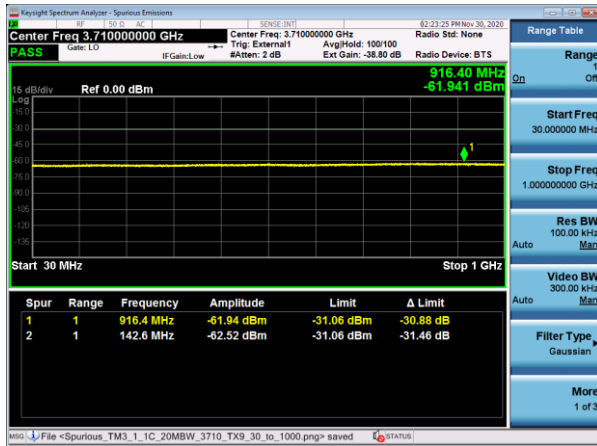


10MHz – 30MHz

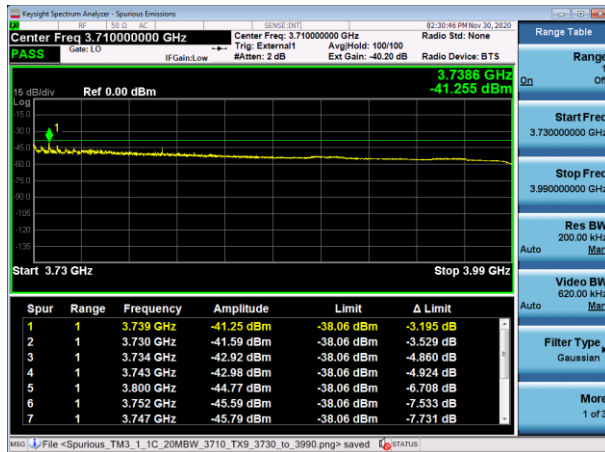


30MHz – 1GHz

1GHz – 3.69GHz



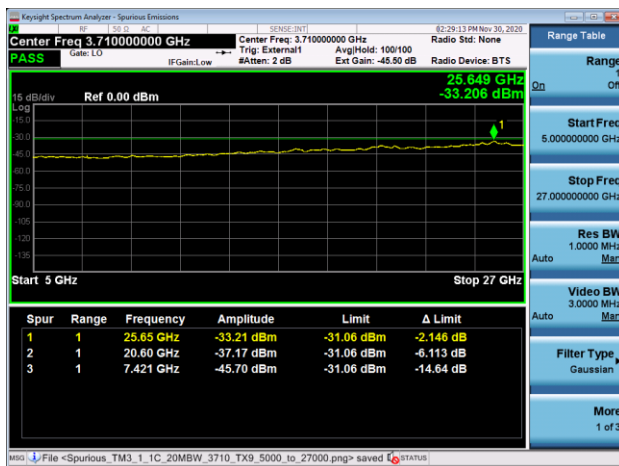
3.73GHz – 3.9GHz



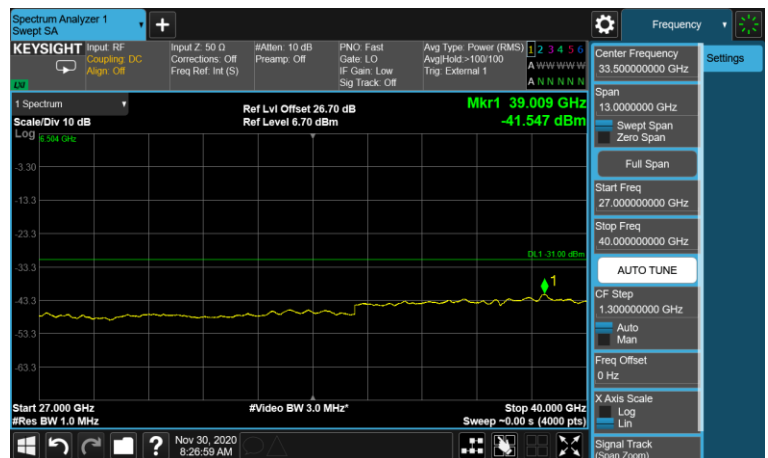
3.9GHz – 5GHz



5GHz – 27GHz



27 GHz – 40 GHz



40MHz BW

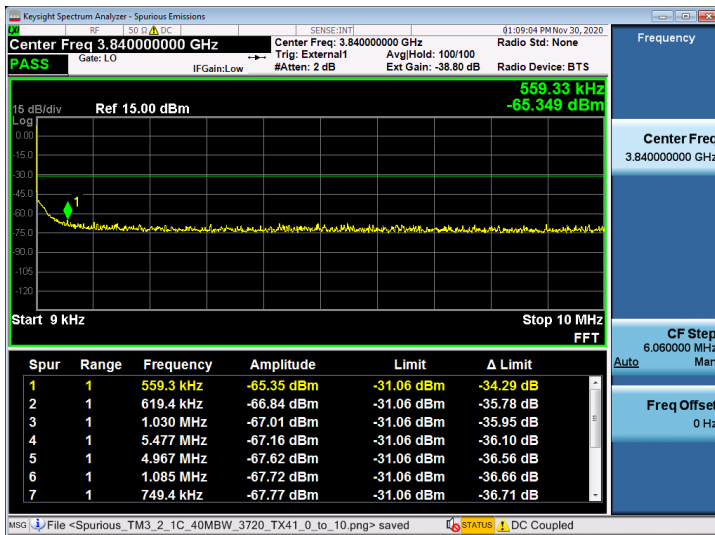
Test Model 3.2

Modulation QPSK/16QAM

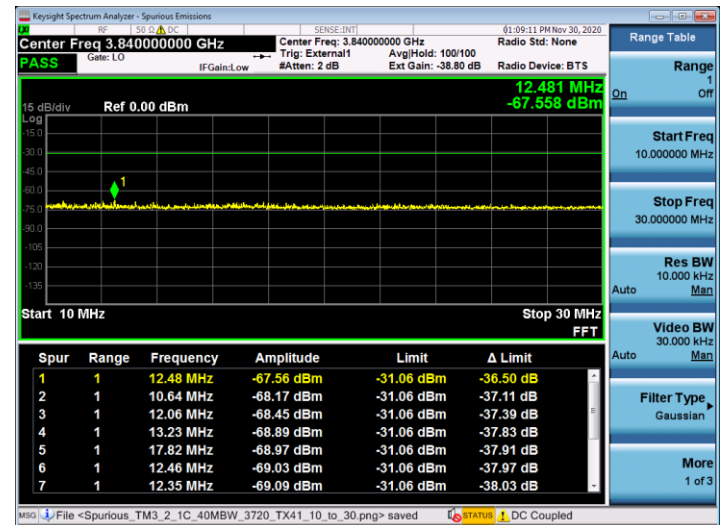
Channel Frequency 3840MHz

TX41

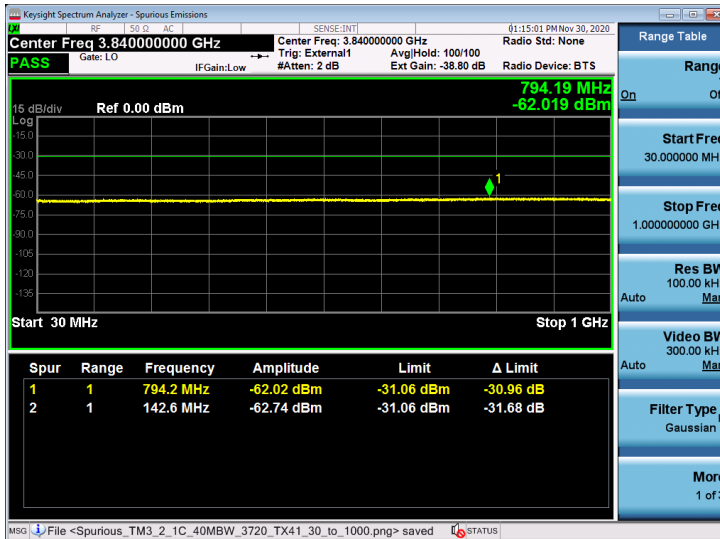
9KHz – 10MHz



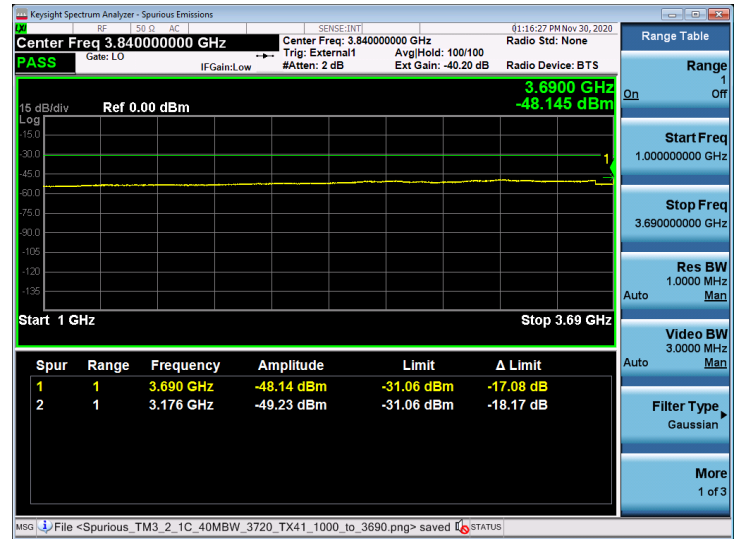
10MHz – 30MHz



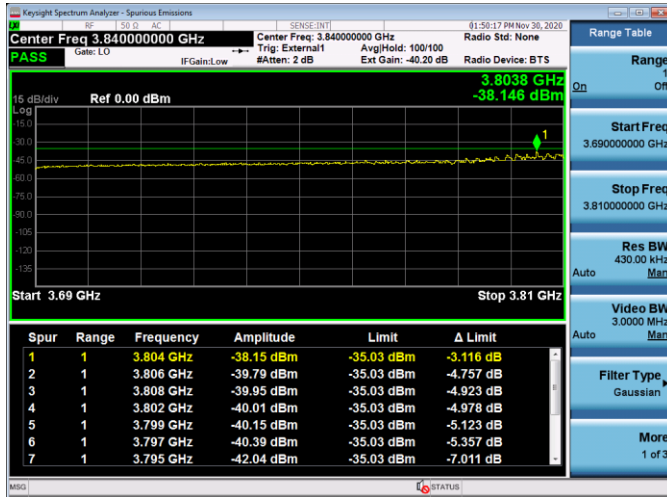
30MHz – 1GHz



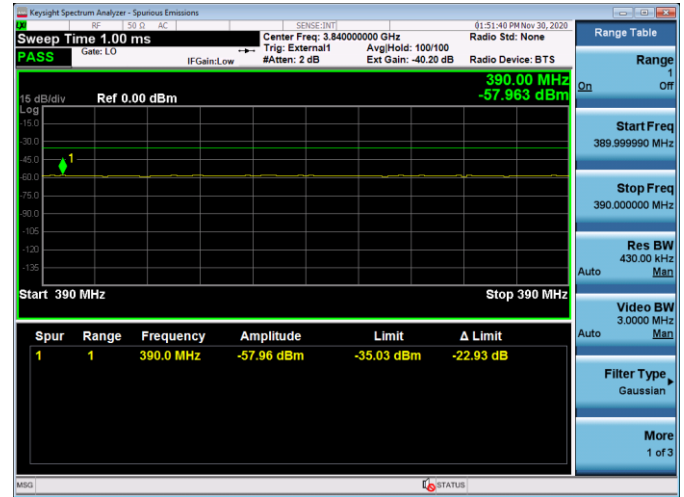
1GHz – 3.7GHz



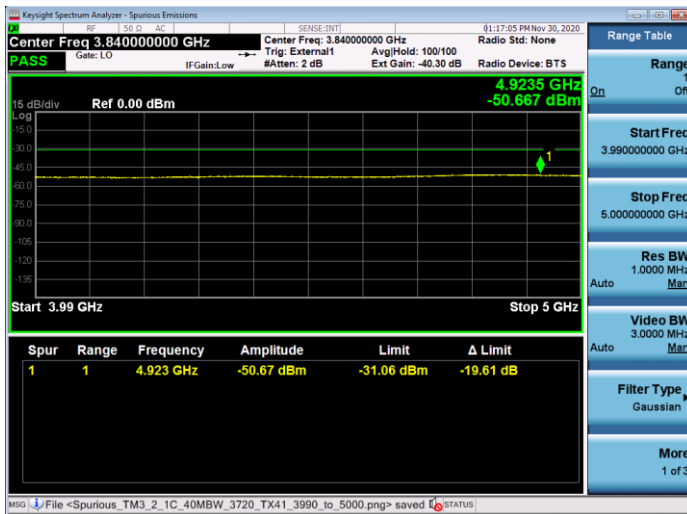
3.7GHz – 3.81GHz



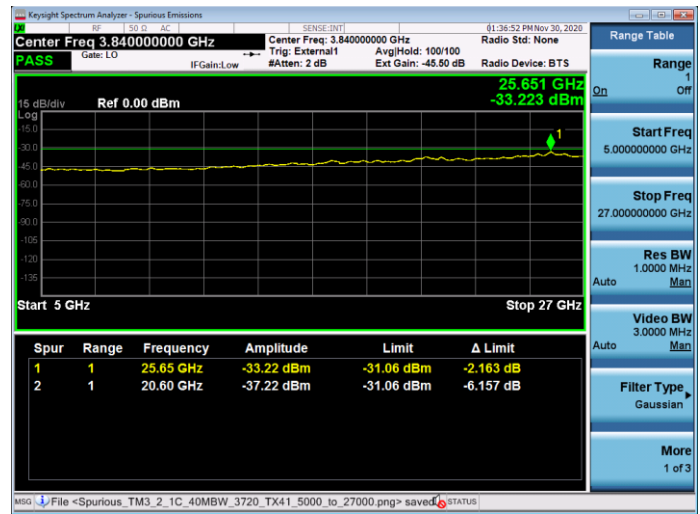
3.87GHz – 3.99GHz



3.99GHz – 5GHz



5GHz – 27GHz



27 GHz – 40 GHz

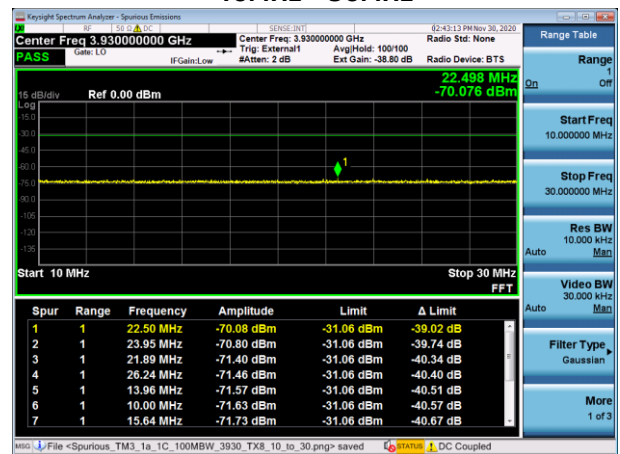


100MHz BW
Test Model 3.1a
Modulation 256QAM
Channel Frequency 3930MHz
TX8

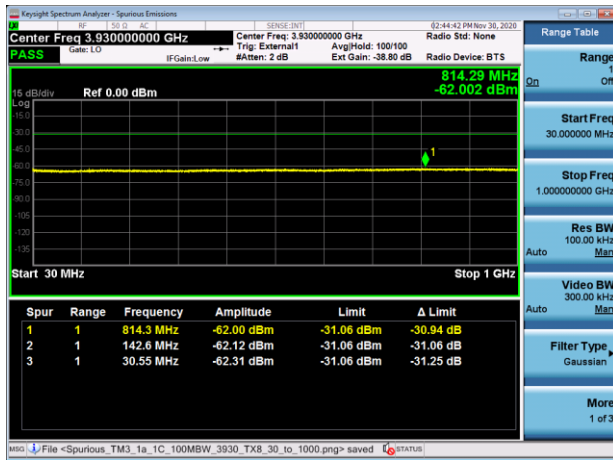
9KHz – 10MHz



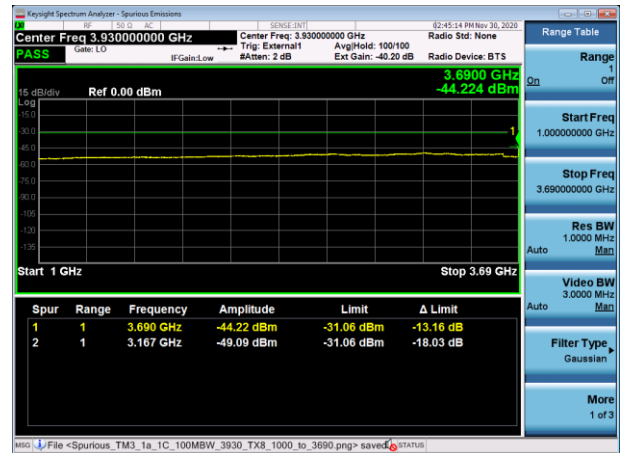
10MHz – 30MHz



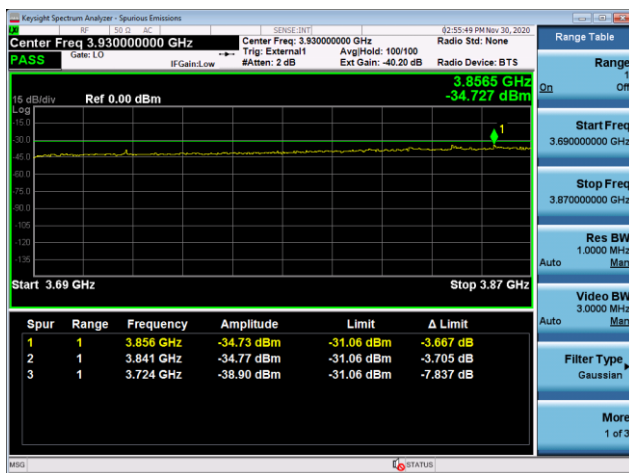
30MHz – 1GHz



1GHz – 3.69GHz



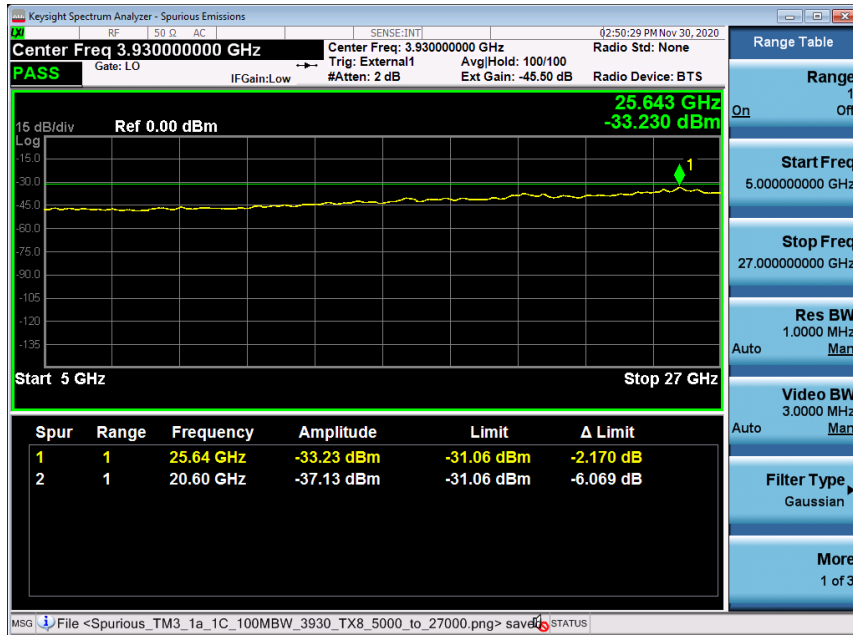
3.69GHz – 3.87GHz



4.0 GHz – 5.0 GHz



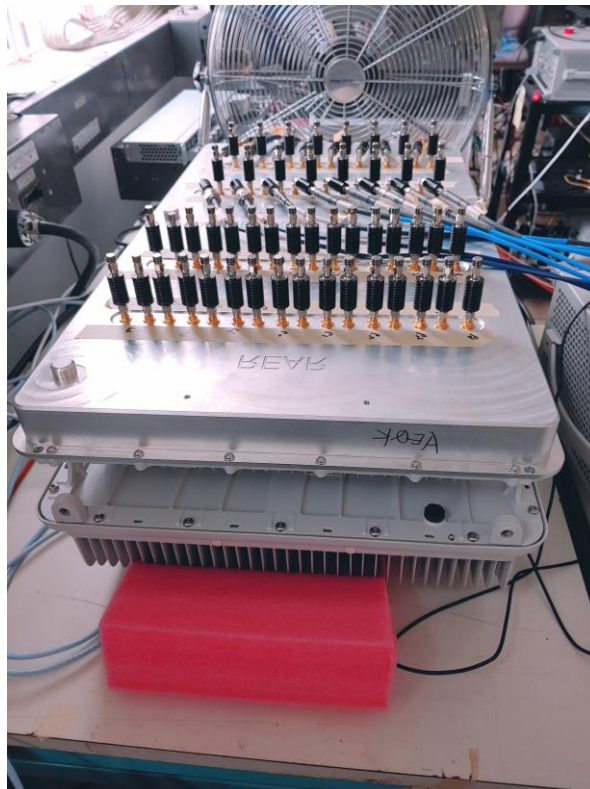
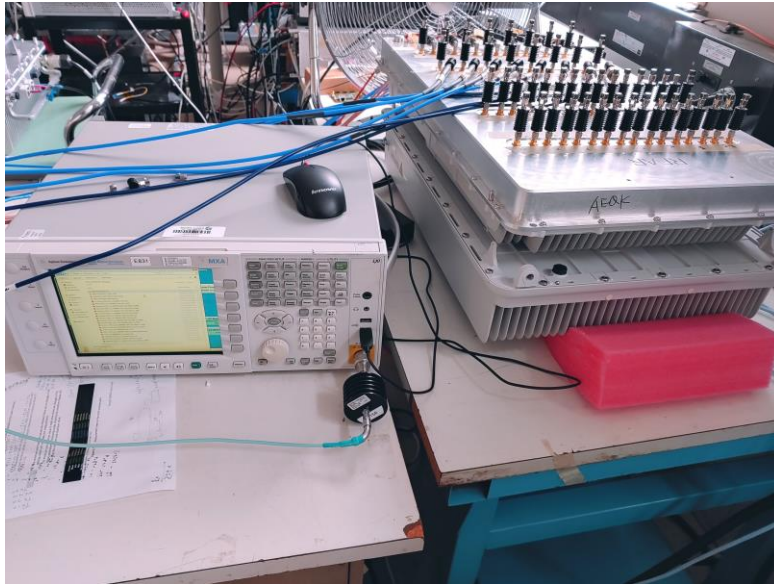
5 GHz – 27 GHz



27 GHz – 40 GHz



Photographs



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	2019-01-31	2021-01-31
E1263	Hewlett Packard	Filter, High Pass	8.2 - 18 GHz	84300-80039	001	CNR-V	CNR-V
E954	Rohde & Schwarz	Test Receiver	EMI 20Hz - 40GHz -155 dBm +30 dBm	ESU40	100246	2020-08-03	2022-08-03
E1156	Weinschel	Attenuator	10dB 0.05GHz-26GHz 25W	74-10-12	1069	CNR-V	CNR-V
E1154	Weinschel	Attenuator	30dB 25W 0.05GHz-26GHz	74-30-12	1065	CNR-V	CNR-V
E1250	Weinschel	Attenuator	3dB Attenuator 100W	24-3-43	BB9072	CNR-V	CNR-V

Customer Provided Equipment

Manufacturer	Type	Description	Model	Serial	Calibration Date	Calibration Due
	Attenuator	30dB 10W dc-6ghz	P/NZSJ30-10RS-6TA		CNR-V	CNR-V
Micro-Coax	Cable	Utiflex	UFB142A-0-0720-2G0200/A	MFR 64639 227883-001	CNR-V	CNR-V

CNR-V: Calibration Not Required, Must Be Verified

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.

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

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

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 dB μ V/m at 3m and 91.77 dB μ V/m at 1m

The Part 27 non-report level is 62.23 dB μ V/m at 3m.

The calculated emission levels were found by:

$$\text{Measured level (dB}\mu\text{V)} + \text{Cable Loss(dB)} + \text{Antenna Factor(dB)} = \text{Field Strength (dB}\mu\text{V/m)}$$

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 dB μ V/meter (82.23 @ 3m). Emissions equal to or less than 62.23 dB μ V/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 AEQK Unit with Center Frequency 3840 MHz. Testing was performed from 11/17/2020 through 11/18/2020 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 EUT 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 10C increments

Frequency Stability performance was verified by measuring Frequency Tolerance using an MXA Signal Analyzer. Frequency Tolerance is a measurement of the difference between the actual transmit frequency and the assigned frequency (3840.0 MHz).

Frequency Block Tested: AEQK 3.840GHz RRH (CF = 3840MHz)

Baseline Measurement at +25°C

Transmit Frequency Deviation at +25°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	89.703
0.5	100.56
1.0	84.931
1.5	71.240
2.0	92.454
2.5	69.059
3.0	97.997
FCC SPECIFICATION	3840 MHz ($\pm 0.05\text{ppm}$) $\pm 0.05\text{ppm} = \pm 192.0\text{Hz}$
FCC RESULT	PASS

Transmit Frequency Deviation at +50°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	105.02
0.5	82.692
1.0	33.201
1.5	69.279
2.0	85.429
2.5	73.246
3.0	95.571
FCC SPECIFICATION	3840 MHz ($\pm 0.05\text{ppm}$) $\pm 0.05\text{ppm} = \pm 192.0\text{Hz}$
FCC RESULT	PASS

Transmit Frequency Deviation at +40°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	92.575
0.5	111.49
1.0	92.643
1.5	74.558
2.0	101.41
2.5	64.737
3.0	110.76
FCC SPECIFICATION	3840 MHz ($\pm 0.05\text{ppm}$) $\pm 0.05\text{ppm} = \pm 192.0\text{Hz}$
FCC RESULT	PASS

Transmit Frequency Deviation at +30°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	89.260
0.5	108.21
1.0	61.204
1.5	111.57
2.0	71.201
2.5	96.440
3.0	102.26
FCC SPECIFICATION	3840 MHz ($\pm 0.05\text{ppm}$) $\pm 0.05\text{ppm} = \pm 192.0\text{Hz}$
FCC RESULT	PASS

Transmit Frequency Deviation at +20°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	66.349
0.5	101.43
1.0	99.318
1.5	126.97
2.0	91.311
2.5	114.70
3.0	94.090
FCC SPECIFICATION	3840 MHz ($\pm 0.05\text{ppm}$) $\pm 0.05\text{ppm} = \pm 192.0\text{Hz}$
FCC RESULT	PASS

Transmit Frequency Deviation at +10°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	62.636
0.5	101.26
1.0	72.076
1.5	99.218
2.0	87.444
2.5	91.633
3.0	65.979
FCC SPECIFICATION	3840 MHz (±0.05ppm) ±0.05ppm = ±192.0Hz
FCC RESULT	PASS

Transmit Frequency Deviation at 0°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	92.711
0.5	67.464
1.0	73.030
1.5	60.622
2.0	32.721
2.5	113.66
3.0	96.928
FCC SPECIFICATION	3840 MHz (±0.05ppm) ±0.05ppm = ±192.0Hz
FCC RESULT	PASS

Transmit Frequency Deviation at -10°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	53.396
0.5	78.469
1.0	96.868
1.5	104.74
2.0	88.326
2.5	71.457
3.0	111.61
FCC SPECIFICATION	3840 MHz (±0.05ppm) ±0.05ppm = ±192.0Hz
FCC RESULT	PASS

Transmit Frequency Deviation at -20°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	95.469
0.5	80.104
1.0	60.109
1.5	78.724
2.0	111.54
2.5	90.380
3.0	89.464
FCC SPECIFICATION	3840 MHz ($\pm 0.05\text{ppm}$) $\pm 0.05\text{ppm} = \pm 192.0\text{Hz}$
FCC RESULT	PASS

Transmit Frequency Deviation at -30°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	36.343
0.5	89.690
1.0	106.76
1.5	82.738
2.0	107.66
2.5	81.469
3.0	102.50
FCC SPECIFICATION	3840 MHz ($\pm 0.05\text{ppm}$) $\pm 0.05\text{ppm} = \pm 192.0\text{Hz}$
FCC RESULT	PASS

Return to +25°C

Transmit Frequency Deviation at +25°C at 100% of Nominal Voltage, -48VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	103.91
0.5	49.003
1.0	96.227
1.5	110.38
2.0	100.61
2.5	85.485
3.0	92.857
FCC SPECIFICATION	3840 MHz ($\pm 0.05\text{ppm}$) $\pm 0.05\text{ppm} = \pm 192.0\text{Hz}$
FCC RESULT	PASS

Transmit Frequency Deviation at +25°C at 103% of Nominal Voltage, -49.44VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	101.43
0.5	77.184
1.0	89.438
1.5	82.626
2.0	110.58
2.5	59.384
3.0	38.407
FCC SPECIFICATION	3840 MHz ($\pm 0.05\text{ppm}$) $\pm 0.05\text{ppm} = \pm 192.0\text{Hz}$
FCC RESULT	PASS

Transmit Frequency Deviation at +25°C at 106% of Nominal Voltage, -50.88VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	97.111
0.5	127.29
1.0	84.057
1.5	133.08
2.0	104.67
2.5	83.032
3.0	111.16
FCC SPECIFICATION	3840 MHz ($\pm 0.05\text{ppm}$) $\pm 0.05\text{ppm} = \pm 192.0\text{Hz}$
FCC RESULT	PASS

Transmit Frequency Deviation at +25°C at 109% of Nominal Voltage, -52.32VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	83.090
0.5	105.96
1.0	91.086
1.5	70.932
2.0	126.49
2.5	105.07
3.0	116.60
FCC SPECIFICATION	3840 MHz ($\pm 0.05\text{ppm}$) $\pm 0.05\text{ppm} = \pm 192.0\text{Hz}$
FCC RESULT	PASS

Transmit Frequency Deviation at +25°C at 112% of Nominal Voltage, -53.76VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	116.69
0.5	97.472
1.0	28.502
1.5	84.944
2.0	113.80
2.5	106.03
3.0	94.721
FCC SPECIFICATION	3840 MHz (± 0.05 ppm) ± 0.05 ppm = ± 192.0 Hz
FCC RESULT	PASS

Transmit Frequency Deviation at +25°C at 115% of Nominal Voltage, -55.20VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	106.79
0.5	88.219
1.0	53.375
1.5	101.80
2.0	82.112
2.5	74.119
3.0	110.60
FCC SPECIFICATION	3840 MHz (± 0.05 ppm) ± 0.05 ppm = ± 192.0 Hz
FCC RESULT	PASS

Transmit Frequency Deviation at +25°C at 100% of Nominal Voltage, -48.0VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	65.963
0.5	120.35
1.0	100.08
1.5	91.976
2.0	86.877
2.5	104.02
3.0	83.396
FCC SPECIFICATION	3840 MHz (± 0.05 ppm) ± 0.05 ppm = ± 192.0 Hz
FCC RESULT	PASS

Transmit Frequency Deviation at +25°C at -3% of Nominal Voltage, -46.56VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	110.06
0.5	20.391
1.0	101.00
1.5	76.911
2.0	50.060
2.5	101.27
3.0	73.261
FCC SPECIFICATION	3840 MHz (± 0.05 ppm) ± 0.05 ppm = ± 192.0 Hz
FCC RESULT	PASS

Transmit Frequency Deviation at +25°C at -6% of Nominal Voltage, -45.12VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	53.712
0.5	36.886
1.0	105.53
1.5	87.657
2.0	81.388
2.5	108.36
3.0	63.369
FCC SPECIFICATION	3840 MHz (± 0.05 ppm) ± 0.05 ppm = ± 192.0 Hz
FCC RESULT	PASS

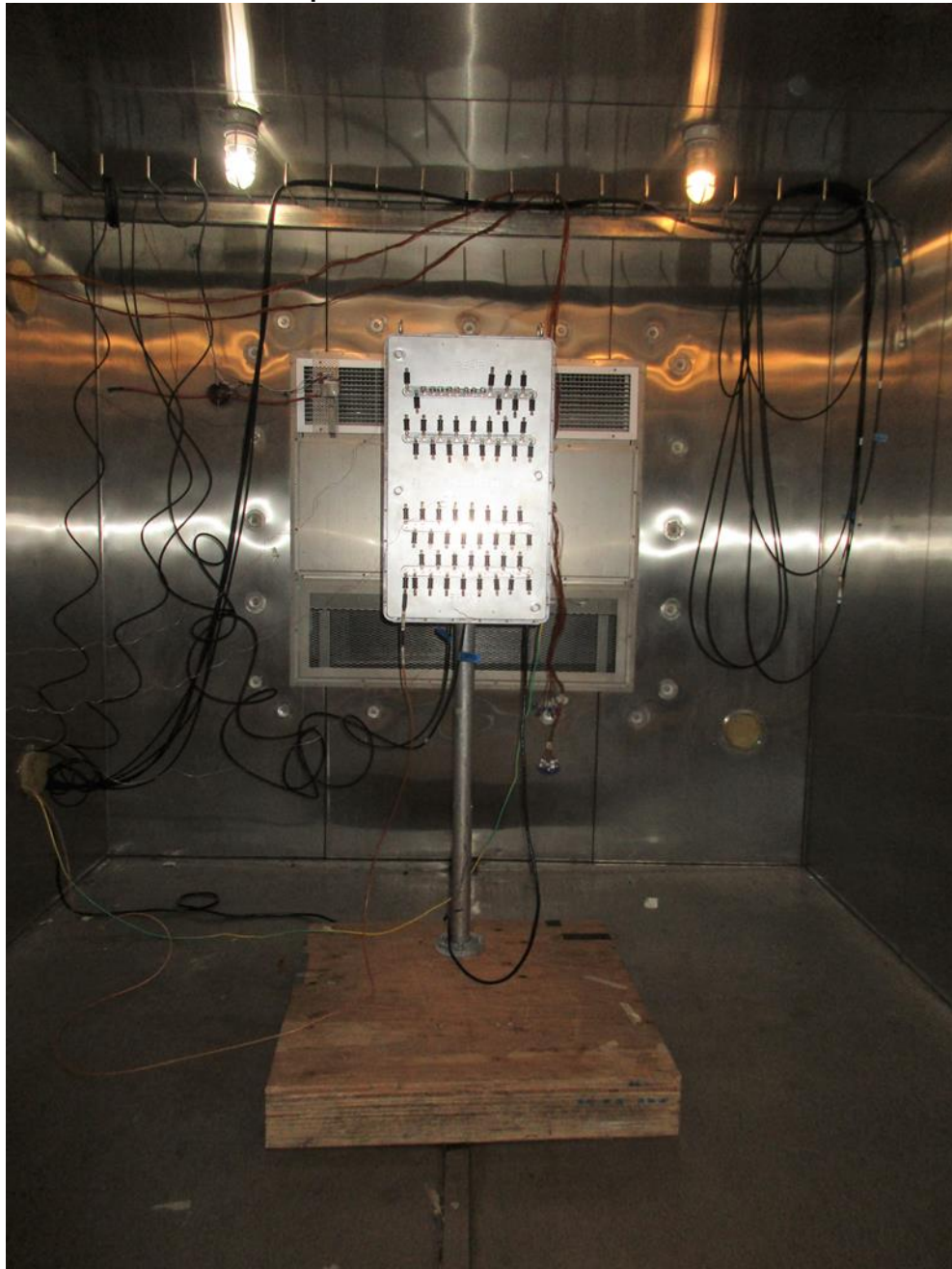
Transmit Frequency Deviation at +25°C at -9% of Nominal Voltage, -43.68VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	63.624
0.5	107.69
1.0	91.309
1.5	83.159
2.0	93.778
2.5	106.59
3.0	43.924
FCC SPECIFICATION	3840 MHz (± 0.05 ppm) ± 0.05 ppm = ± 192.0 Hz
FCC RESULT	PASS

Transmit Frequency Deviation at +25°C at -12% of Nominal Voltage, -42.24VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	83.950
0.5	124.68
1.0	85.016
1.5	94.442
2.0	111.66
2.5	96.607
3.0	86.820
FCC SPECIFICATION	3840 MHz ($\pm 0.05\text{ppm}$) $\pm 0.05\text{ppm} = \pm 192.0\text{Hz}$
FCC RESULT	PASS

Transmit Frequency Deviation at +25°C at -15% of Nominal Voltage, -40.80VDC	
Time (minutes)	Transmit Carrier Deviation (Hz)
0	110.72
0.5	94.157
1.0	112.02
1.5	101.54
2.0	87.303
2.5	105.64
3.0	95.536
FCC SPECIFICATION	3840 MHz ($\pm 0.05\text{ppm}$) $\pm 0.05\text{ppm} = \pm 192.0\text{Hz}$
FCC RESULT	PASS

Photograph

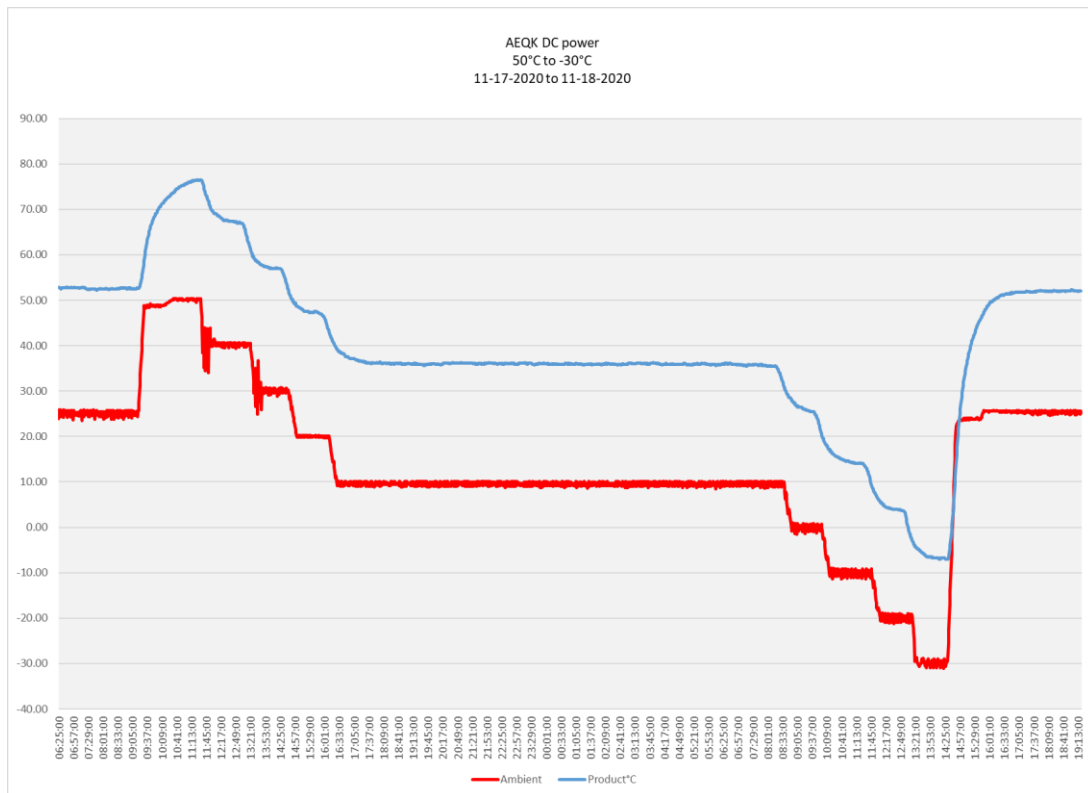
Setup Photo - EUT in thermal chamber



Test Equipment

Asset ID	Manufacturer	Type	Model	Serial	Calibration Date	Calibration Due
TH535-T15	Envirotronics	Controller	SPPCM	SP001316	2020-02-17	2022-02-17
TH069	Extech	Data Logger	SD700	Q690305	2019-06-20	2021-06-20
TH-T15	Envirotronics	Thermal Chamber	N/A	3015242	N/A	N/A
TH044	Fluke	Multimeter	83III	74910377	2020-02-25	2022-02-25
MY57431033	KeySight Technologies	MXA Signal Analyzer	N9020B	MY57431033	2020-07-08	2022-07-08
TH079	Yokogawa	Recorder	GP20	S5P506676	2020-02-25	2022-02-25
N/A	TDK Lambda	Power Supply	DC Source	00515043	13N51100J	N/A

Thermal Chamber Plot



8. NVLAP Certificate of Accreditation

<p>United States Department of Commerce National Institute of Standards and Technology</p> <p>NVLAP® </p> <hr/> <p>Certificate of Accreditation to ISO/IEC 17025:2017</p> <hr/>	
<p>NVLAP LAB CODE: 100275-0</p>	
<p>Nokia, Global Product Compliance Lab Murray Hill, NJ</p>	
<p><i>is accredited by the National Voluntary Laboratory Accreditation Program for specific services, listed on the Scope of Accreditation, for:</i></p>	
<p>Electromagnetic Compatibility & Telecommunications</p>	
<p><i>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).</i></p>	
<p>2020-09-25 through 2021-09-30 <i>Effective Dates</i></p>	<div><p>For the National Voluntary Laboratory Accreditation Program</p></div>