Test report

460990-11TRFEMC

Date of issue: September 28, 2022

Applicant:

Cubic Transportation Systems

Product:

Bus Validator

Model:

Validator 3.0

Variant(s):

See Section 11

Specifications:

- RSS-210 — Licence-Exempt Radio Apparatus: Category I Equipment, Issue 10 (December 2019), Annex B.6

Lab and test locations

Company name	Nemko USA Inc.
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State	California
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Country	USA
Telephone	+1 760 444 3500
Website	www.nemko.com
FCC Site Number	Test Firm Registration Number: 392943; Designation Number: US5058
ISED Test Site	2040B-3

Tested by	Lan Sayasane, EMC Test Engineer
Reviewed by	James Cunningham, EMC/MIL/WL Supervisor
Review date	September 28, 2022
Reviewer signature	

Limits of responsibility

Note that the results contained in this report relate only to the items tested and were obtained in the period between the date of initial receipt of samples and the date of issue of the report.
This test report has been completed in accordance with the requirements of ISO/IEC 17025. All results contain in this report are within Nemko USA's ISO/IEC 17025 accreditation.
This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the U.S. Government.

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Section 1 Report summary

1.1 Test specifications

RSS-210 Issue 10 (December 2019)	Licence-Exempt Radio Apparatus: Category I Equipment, Annex B.6

1.2 Test methods

ANSI C63.10: 2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

1.3 Exclusions

None.

1.4 Statement of compliance

Testing was performed against all relevant requirements of the test standard(s).

Results obtained indicate that the product under test complies in full with the tested requirements.

The test results relate only to the item(s) tested.

See “Section 2 Summary of test results” for full details.

1.5 Test report revision history

Table 1.5-1: *Test report revision history*

Revision #	Issue Date	Details of changes made to test report
460990-11TRFEMC	28 September 2022	Original report issued

Section 2 Summary of test results

2.1 Sample information

Receipt date	14-Mar-2022
Nemko sample ID number	460990

2.2 Testing period

Test start date	14-Mar-2022
Test end date	31-May-2022

2.3 Test results

Table 2.3-1: *Summary of results*

IC Clause	Test description	Verdict
RSS-Gen 8.8	Conducted limits	Pass [1]
RSS-Gen 6.6	Occupied bandwidth	Pass
RSS-Gen 7.3	Receiver radiated emission limits	Not applicable [3]
RSS-Gen 7.4	Receiver conducted emission limits	Not applicable [3]
B.6(a)(i)	Field strength within 13.553–13.567 MHz band	Pass
B.6(a) (ii)	The field strength within the bands 13.410–13.553 MHz and 13.567–13.710 MHz	Pass
B.6(a) (iii)	The field strength within the bands 13.110–13.410 MHz and 13.710–14.010 MHz.	Pass
B.6(a) (iv)	The field strength outside the band 13.110–14.010 MHz.	Pass
B6(b)	Frequency tolerance of carrier signals	Pass

Note 1: The EUT is AC powered via AC/DC power adaptor

Note 2: According to sections 5.2 and 5.3 of RSS-Gen, the EUT does not have a stand-alone receiver nor is it a scanning receiver and is therefore exempt from receiver requirements.

Section 3 Equipment under test (EUT) details

3.1 Disclaimer

This section contains information provided by the applicant and has been utilized to support the test plan. Inaccurate information provided by the applicant can affect the validity of the results within this test report. Nemko accepts no responsibility for the information contained within this section and the impact it may have on the test plan and resulting measurements.

3.2 Applicant

Company name	Cubic Transportation Systems
Address	9233 Balboa Ave.
City	San Diego
State	CA
Postal/Zip code	92123
Country	United States

3.3 Manufacturer

Company name	Cubic Transportation Systems
Address	1308 S. Washington St.
City	Tullahoma
State	TN
Postal/Zip code	37388
Country	United States

3.4 EUT information

Product name	Bus Validator
Model	Validator 3.0
Variant(s)	See Section 11
Serial number	n/a
Part number	10055645 (FCC Validator 3, Ethernet Only) & 10055834 (FCC Validator 3, Cellular/Ethernet)

Frequency band(s)	
Fundamental frequency	
Type of modulation	
Power requirements	24 VDC nominal (accepts 8-36VDC) / POE IEEE 802.3af and IEEE 802.3at
Description/theory of operation	The device is to be used by public transit operators to collect fares for journeys through contactless media i.e. contactless bankcard (EMV), contactless token card (e.g. ISO14443 type A and B) and barcode (QR code on printed media or phone).
Antenna information	
Software details	Validator 3 Qualification Software

3.5 EUT exercise and monitoring details

EUT description of the methods used to exercise the EUT and all relevant ports:

- Please provide details

EUT setup/configuration rationale:

- The EUT setup in a configuration that was expected to produce the highest amplitude emissions relative to the limit and that satisfy normal operation/installation practice by the end user.
- The type and construction of cables used in the measurement set-up were consistent with normal or typical use. Cables with mitigation features (for example, screening, tighter/more twists per length, ferrite beads) have been noted below:
  - The following deviations were made:
  - None
- The EUT was setup in a manner that was consistent with its typical arrangement and use. The measurement arrangement of the EUT, local ancillary equipment and associated cabling was representative of normal practice. Any deviations from typical arrangements have been noted below:
  - The following deviations were:
  - None

3.6 EUT setup details

Table 3.6-1: *EUT sub assemblies*

Description	Brand name	Model/Part number	Serial number	Rev.
Bus Validator	Cubic Transportation Systems	Validator 3	n/a	n/a

Table 3.6-2: *EUT interface ports*

Description	Qty.
Serial cable	1
Ethernet cable	1
DC input	1

Table 3.6-3: *Support equipment*

Description	Brand name	Model/Part number	Serial number	Rev.
Wideband Radio Communication Tester	Rohde & Schwarz	CMW500	143306	n/a
AC/DC adaptor	XP Power	VER36US240-JA	n/a	n/a
PC	Dell	Latitude 7480	ID IT2381	n/a

Table 3.6-4: *Inter-connection cables*

Cable description	From	To	Length (m)
DC power	EUT (Equipment Under Test)	Power source	2.0 m
Serial cable	EUT (Equipment Under Test)	PC	1.5 m

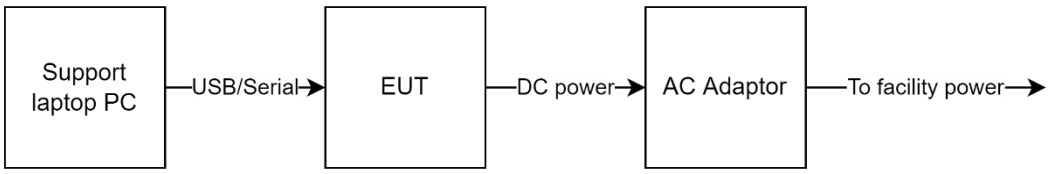


Figure 3.6-1: Test setup diagram

Section 4 Engineering considerations

4.1 Modifications incorporated in the EUT

None.

4.2 Technical judgement

None.

4.3 Deviations from laboratory test procedures

None.

Section 5 Test conditions

5.1 Atmospheric conditions

Temperature	15–30 °C
Relative humidity	20–75 %
Air pressure	86–106 kPa

When it is impracticable to carry out tests under these conditions, a note to this effect stating the ambient temperature and relative humidity during the tests shall be recorded and stated.

5.2 Power supply range

The normal test voltage for equipment to be connected to the mains shall be the nominal mains voltage. For the purpose of the present document, the nominal voltage shall be the declared voltage, or any of the declared voltages ±5 %, for which the equipment was designed.

Section 6 Measurement uncertainty

6.1 Uncertainty of measurement

Nemko USA Inc. has calculated measurement uncertainty and is documented in EMC/MUC/001 "Uncertainty in EMC measurements." Measurement uncertainty was calculated using the methods described in CISPR 16-4-2 Specification for radio disturbance and immunity measuring apparatus and methods – Part 4-2: Uncertainties, statistics, and limit modelling – Measurement instrumentation uncertainty. The expression of Uncertainty in EMC testing. Measurement uncertainty calculations assume a coverage factor of K=2 with 95% certainty.

Table 6.1-1: *Measurement uncertainty calculations*

Measurement		**U_{cispr} dB**	**U_{lab} dB**
Conducted disturbance at AC mains and other port power using a V-AMN	9 kHz to 150 kHz	3.8	2.9
	150 kHz to 30 MHz	3.4	2.3
Conducted disturbance at telecommunication port using AAN	150 kHz to 30 MHz	5.0	4.3
Conducted disturbance at telecommunication port using CVP	150 kHz to 30 MHz	3.9	2.9
Conducted disturbance at telecommunication port using CP	150 kHz to 30 MHz	2.9	1.4
Conducted disturbance at telecommunication port using CP and CVP	150 kHz to 30 MHz	4.0	3.1
Radiated disturbance (electric field strength in a SAC)	30 MHz to 1 GHz	6.3	5.5
Radiated disturbance (electric field strength in a FAR)	1 GHz to 6 GHz	5.2	4.7
Radiated disturbance (electric field strength in a FAR)	6 GHz to 18 GHz	5.5	5.0

Notes: Compliance assessment:

If U_{lab} is less than or equal to U_{cispr} then:

- compliance is deemed to occur is no measured disturbance level exceeds the disturbance limit;
- non-compliance is deemed to occur if any measured disturbance level exceeds the disturbance limit

If U_{lab} is greater than U_{cispr} then:

- compliance is deemed to occur is no measured disturbance level, increased by (U_{lab} - U_{cispr}), exceeds the disturbance limit;
- non-compliance is deemed to occur if any measured disturbance level, increased by (U_{lab} - U_{cispr}), exceeds the disturbance limit

V-AMN: V type artificial mains network
AAN: Asymmetric artificial network
CP: Current probe
CVP: Capacitive voltage probe
SAC: Semi-anechoic chamber
FAR: Fully anechoic room

Section 7 Test equipment

7.1 Test equipment list

Table 7.1-1: *Test equipment list*

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
EMI Test Receiver	Rohde & Schwarz	ESU40	E1131	1 yr	02-Mar-2023
System Controller	Sunol Sciences	SC104V	E1129	NCR	NCR
Bilog Antenna	Schaffner	CBL 6111C	1480	2 yr	28-Oct-2022
DRG Horn	ETS-Lindgren	3117-PA	E1160	1 yr	26-Jan-2023
Pre Amp	ETS-Lindgren	3117-PA	Part of E1139	1 yr	26-Jan-2023
Active Loop H Field Antenna	Hewlett Packard	6502	E1267	2 yr	04-Dec-2022
FSW – Signal & Spectrum Analyzer	Rohde & Schwarz	FSW43	E1302	1 yr	08-Nov-2022
Temperature Chamber	Test Equity	115A	E1162	1 yr	29-Aug-2022

Notes: N/A – not applicable
NCR – no calibration required
VOU – verify on use

Table 7.1-2: T*est software details*

Manufacturer of Software	Details
Rohde & Schwarz	EMC 32 V10.60.15

Notes: None

Section 8 Testing data

8.1 AC power line conducted emissions

8.1.1 References and limits

- FCC 47 CFR Part 15, Subpart C: §15.207
- RSS-Gen: 8.8
- Test method: ANSI C63.10-2014 §6.2

Table 8.1-1: *AC power line conducted emissions limit*

Frequency of emission, MHz	Conducted limit, dBµV	
	Quasi-peak	Average
0.15 – 0.5	66 to 56*	56 to 46*
0.5 – 5	56	46
5 – 30	60	50

Note: * - Decreases with the logarithm of the frequency.

8.1.2 Test summary

Verdict	Pass		
Test date	March 14, 2022	Temperature	21 °C
Test engineer	Lan Sayasane, EMC Test Engineer	Air pressure	1005 mbar
Test location	☒ Ground plane ☐ Other:	Relative humidity	45 %

8.1.3 Notes

Testing was performed with the transmitter operating on a fixed channel at full power. Low, middle, and high channels were tested if supported by the EUT.

8.1.4 Setup details

Port under test	AC power input
EUT power input during test	120 VAC / 60 Hz
EUT setup configuration	☒ Table-top ☐ Floor standing ☐ Other:
Measurement details	A preview measurement was generated with the receiver in continuous scan mode. Emissions detected within 6 dB or above limit were re-measured with the appropriate detector against the correlating limit and recorded as the final measurement.

Receiver settings:

Resolution bandwidth	9 kHz
Detector mode	– Peak (Preview measurement) – Quasi-peak and average (Final measurement)
Trace mode	Max Hold
Measurement time	– 100 ms (Peak preview measurement) – 5000 ms (Quasi-peak and average final measurement)

8.1.5 Test data

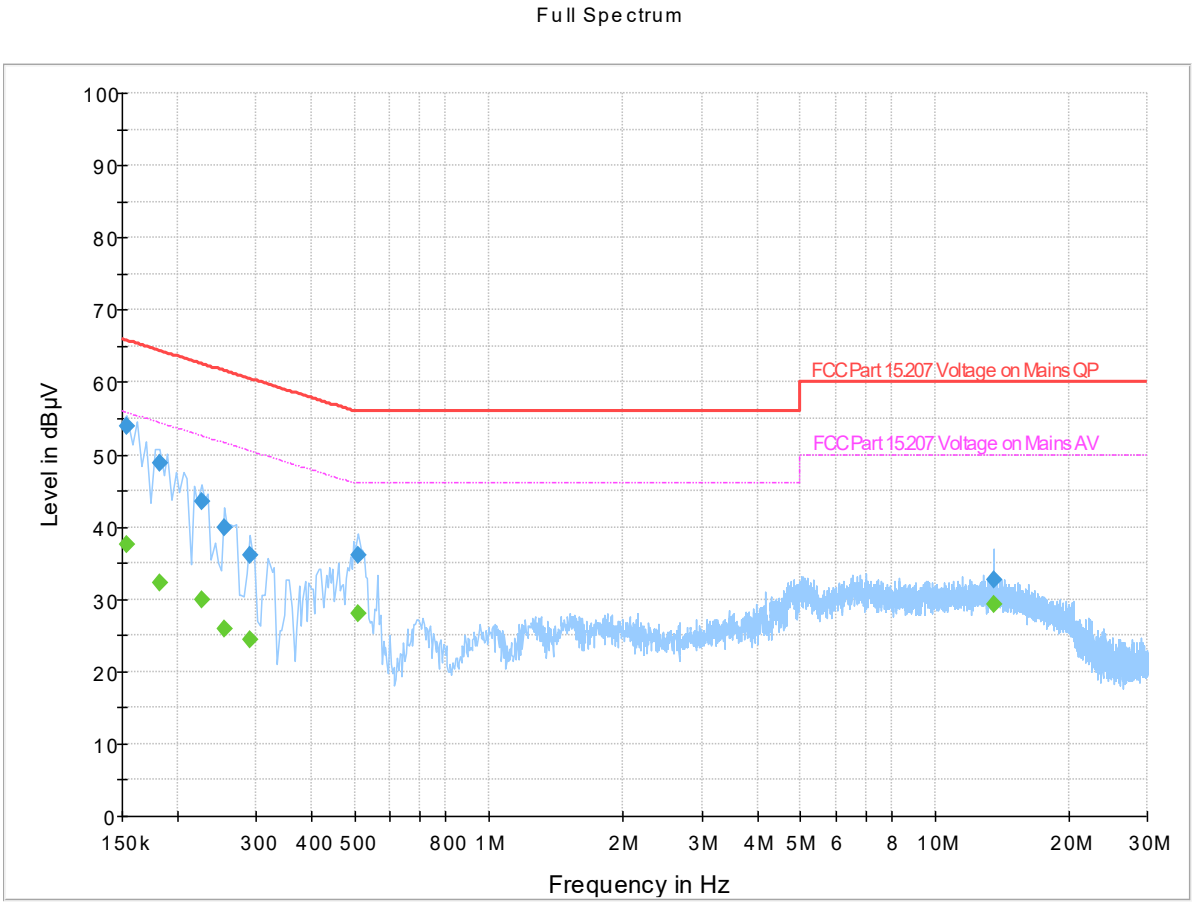


Figure 8.1-1: *Conducted emissions at mains port spectral plot (150 kHz - 30 MHz)*

Table 8.1-2*: Conducted emissions at mains port results*

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.154000	---	37.63	55.78	18.15	5000.0	9.000	N	ON	19.6
0.154000	53.93	---	65.78	11.85	5000.0	9.000	N	ON	19.6
0.182000	---	32.28	54.39	22.12	5000.0	9.000	N	ON	19.5
0.182000	48.78	---	64.39	15.61	5000.0	9.000	N	ON	19.5
0.226000	43.49	---	62.60	19.11	5000.0	9.000	L1	ON	19.5
0.226000	---	29.94	52.60	22.65	5000.0	9.000	L1	ON	19.5
0.254000	40.00	---	61.63	21.63	5000.0	9.000	L1	ON	19.5
0.254000	---	25.88	51.63	25.75	5000.0	9.000	L1	ON	19.5
0.290000	36.00	---	60.52	24.53	5000.0	9.000	L1	ON	19.5
0.290000	---	24.45	50.52	26.07	5000.0	9.000	L1	ON	19.5
0.506000	36.19	---	56.00	19.81	5000.0	9.000	L1	ON	19.4
0.506000	---	28.06	46.00	17.94	5000.0	9.000	L1	ON	19.4
13.562000	---	29.34	50.00	20.66	5000.0	9.000	N	ON	20.1
13.562000	32.78	---	60.00	27.22	5000.0	9.000	N	ON	20.1

Notes:
[1] Result (dBµV) = receiver analyzer value (dBµV) + correction factor (dB).
[2] Correction factors = LISN factor IL (dB) + cable loss (dB) + transient limiter (dB)
[3] Emissions that were continuously present for a minimum of 1 second and occurred more than once for every 15 seconds observation period were considered valid emissions. The maximum value of valid emissions has been recorded.

8.2 99 % occupied bandwidth

8.2.1 References and limits

- RSS-Gen: §6.7
- Test method: ANSI C63.4-2014: §6.9.2

RSS-GEN:

6.7 The occupied bandwidth or the "99% emission bandwidth" is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained. The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs.

8.2.2 Test summary

Verdict	Pass		
Test date	March 14, 2022	Temperature	21 °C
Test engineer	Lan Sayasane, EMC Test Engineer	Air pressure	1005 mbar
Test location	☒ Wireless bench ☐ Other:	Relative humidity	45 %

8.2.3 Notes

Testing was performed with the transmitter operating on a fixed channel at full power. Low, middle, and high channels were tested if supported by the EUT.

8.2.4 Setup details

EUT power input during test	120 VAC / 60 Hz
EUT setup configuration	☒ Table-top ☐ Floor standing ☐ Other:

Receiver settings:

Resolution bandwidth	10 Hz
Video bandwidth	30 Hz
Detector mode	Peak
Trace mode	Max Hold
Measurement time	Long enough for trace to stabilize

8.2.5 Test data

Table 8.2-1: *99 % occupied bandwidth test data*

Test frequency (MHz)	Bandwidth	Measured f_c (MHz)	Measured f_L (MHz)	Measured f_H (MHz)	Limit
13.56	22.28 Hz	13.559833333	13.559822436	13.559844712	f_H and f_L within 13.110 – 14.010MHz

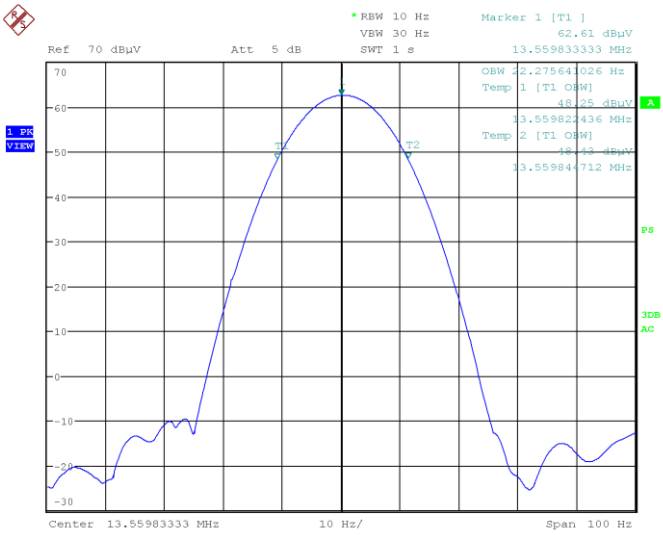


Figure 8.2-1: *99 % occupied bandwidth, 13.56 MHz*

8.3 Radiated emissions

8.3.1 References and limits

- RSS-210 §B.6(a)
- Test method: ANSI C63.10 §6.4, 6.5

RSS-210 §B.6(a):

The field strength of any emission shall not exceed the following limits:

a. 15.848 mV/m (84 dBµV/m) at 30m, within the band 13.553-13.567 MHz;
b. 334 µV/m (50.5 dBµV/m) at 30m, within the bands 13.410-13.553 MHz and 13.567-13.710 MHz;
c. 106 µV/m (40.5 dBµV/m) at 30m, within the bands 13.110-13.410 MHz and 13.710-14.010 MHz; and
d. RSS-Gen general field strength limits for frequencies outside the band 13.110-14.010 MHz.

Table 8.3-1: *RSS-Gen – Radiated emission limits*

Frequency, MHz	Field strength of emissions		Measurement distance, m
	µV/m	dBµV/m	
0.009–0.490	2400/F	$67.6 - 20 \times \log_{10}(F)$	300
0.490–1.705	24000/F	$87.6 - 20 \times \log_{10}(F)$	30
1.705–30.0	30	29.5	30
30–88	100	40.0	3
88–216	150	43.5	3
216–960	200	46.0	3
above 960	500	54.0	3

Notes: In the emission table above, the tighter limit applies at the band edges.
For frequencies above 1 GHz the limit on peak RF emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test.

Table 8.3-2: *IC restricted frequency bands*

MHz	MHz	MHz	GHz
0.090–0.110	12.51975–12.52025	399.9–410	5.35–5.46
2.1735–2.1905	12.57675–12.57725	608–614	7.25–7.75
3.020–3.026	13.36–13.41	960–1427	8.025–8.5
4.125–4.128	16.42–16.423	1435–1626.5	9.0–9.2
4.17725–4.17775	16.69475–16.69525	1645.5–1646.5	9.3–9.5
4.20725–4.20775	16.80425–16.80475	1660–1710	10.6–12.7
5.677-5.683	25.5–25.67	1718.8–1722.2	13.25–13.4
6.215–6.218	37.5–38.25	2200–2300	14.47–14.5
6.26775–6.26825	73–74.6	2310–2390	15.35–16.2
6.31175–6.31225	74.8–75.2	2655–2900	17.7–21.4
8.291–8.294	108–138	3260–3267	22.01–23.12
8.362–8.366	156.52475–156.52525	3332–3339	23.6–24.0
8.37625–8.38675	156.7–156.9	3345.8–3358	31.2–31.8
8.41425–8.41475	240–285	3500–4400	36.43–36.5
12.29–12.293	322–335.4	4500–5150	Above 38.6

8.3.2 Test summary

Verdict	Pass		
Test date	March 14, 2022	Temperature	21 °C
Test engineer	Lan Sayasane, EMC Test Engineer	Air pressure	1005 mbar
Test location	☐ 10m semi anechoic chamber ☒ 3m semi anechoic chamber ☐ Wireless bench ☐ Other:	Relative humidity	45 %

8.3.3 Notes

None

8.3.4 Setup details

EUT power input during test	120 VAC / 60 Hz
EUT setup configuration	☒ Table-top ☐ Floor standing ☐ Other:
Measurement details	A preview measurement was generated with the receiver in continuous scan mode. Selected emissions were re-measured with the appropriate detector(s) against the correlating limit(s) and recorded as the final measurement.

Receiver settings; 9 kHz to 30 MHz:

Resolution bandwidth	200 Hz from 9 – 150 kHz 9 kHz from 150 kHz – 30 MHz
Detector mode	– Peak (Preview measurement) – Quasi-peak (Final measurement)
Measurement time	– 100 ms (Peak preview measurement) – 15000 ms (Quasi-peak final measurement)

Receiver settings; 30 – 1000 MHz:

Resolution bandwidth	120 kHz
Detector mode	– Peak (Preview measurement) – Quasi-peak (Final measurement)
Measurement time	– 100 ms (Peak preview measurement) – 5000 ms (Quasi-peak final measurement)

8.3.5 Test data

Test 1: Fundamental emission:

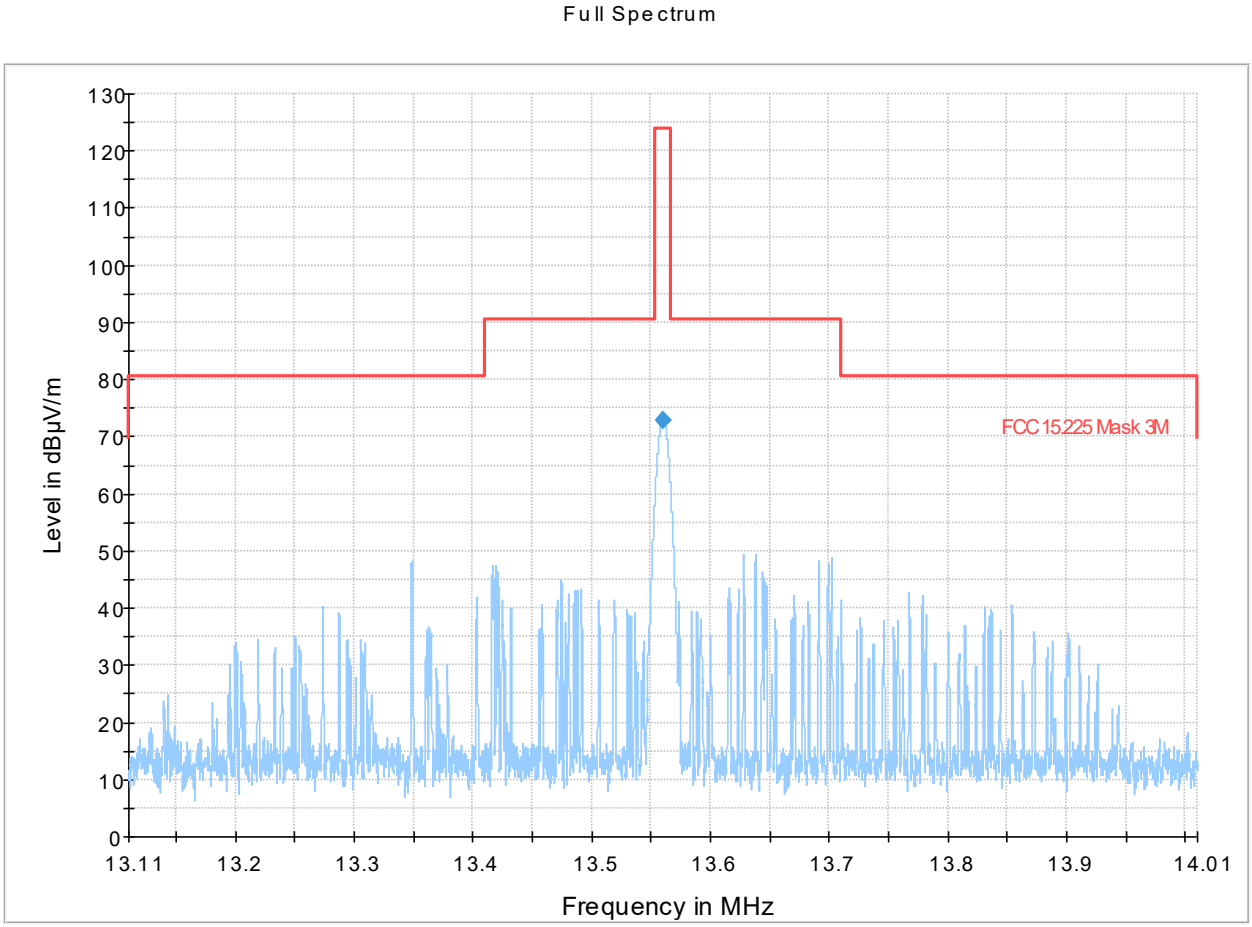


Figure 8.3-1: *Radiated emissions spectral plot (13.11 MHz - 14.01 MHz), 0° orientation*

Table 8.3-3*: Radiated emissions results*

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB/m)
13.559922	72.89	124.00	51.11	15000.0	9.000	H	173.0	11.1

Notes:
[1] Field strength (dB V/m) = receiver/spectrum analyzer value (dB V) + correction factor (dB)
[2] Correction factors = antenna factor ACF (dB) + cable loss (dB)
[3] Emissions that were continuously present for a minimum of 1 second and occurred more than once for every 15 seconds observation period were considered valid emissions. The maximum value of valid emissions has been recorded.

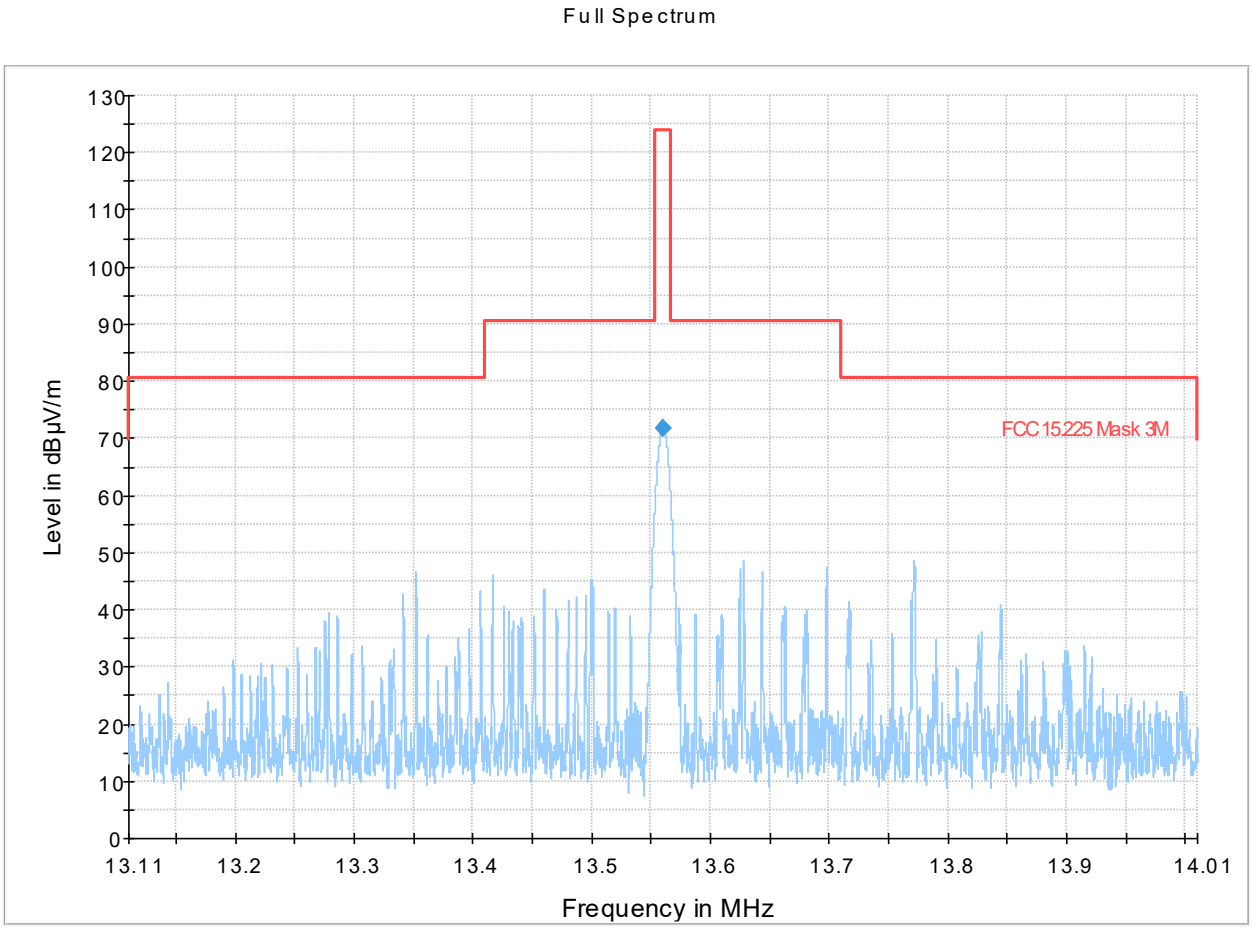


Figure 8.3-2: *Radiated emissions spectral plot (13.11 MHz - 14.01 MHz)*

Table 8.3-4*: Radiated emissions results*

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB/m)
13.559835	71.82	124.00	52.18	15000.0	9.000	H	266.0	11.1

Notes:
[1] Field strength (dB V/m) = receiver/spectrum analyzer value (dB V) + correction factor (dB)
[2] Correction factors = antenna factor ACF (dB) + cable loss (dB)
[3] Emissions that were continuously present for a minimum of 1 second and occurred more than once for every 15 seconds observation period were considered valid emissions. The maximum value of valid emissions has been recorded.

Test 2: Radiated spurious emissions:

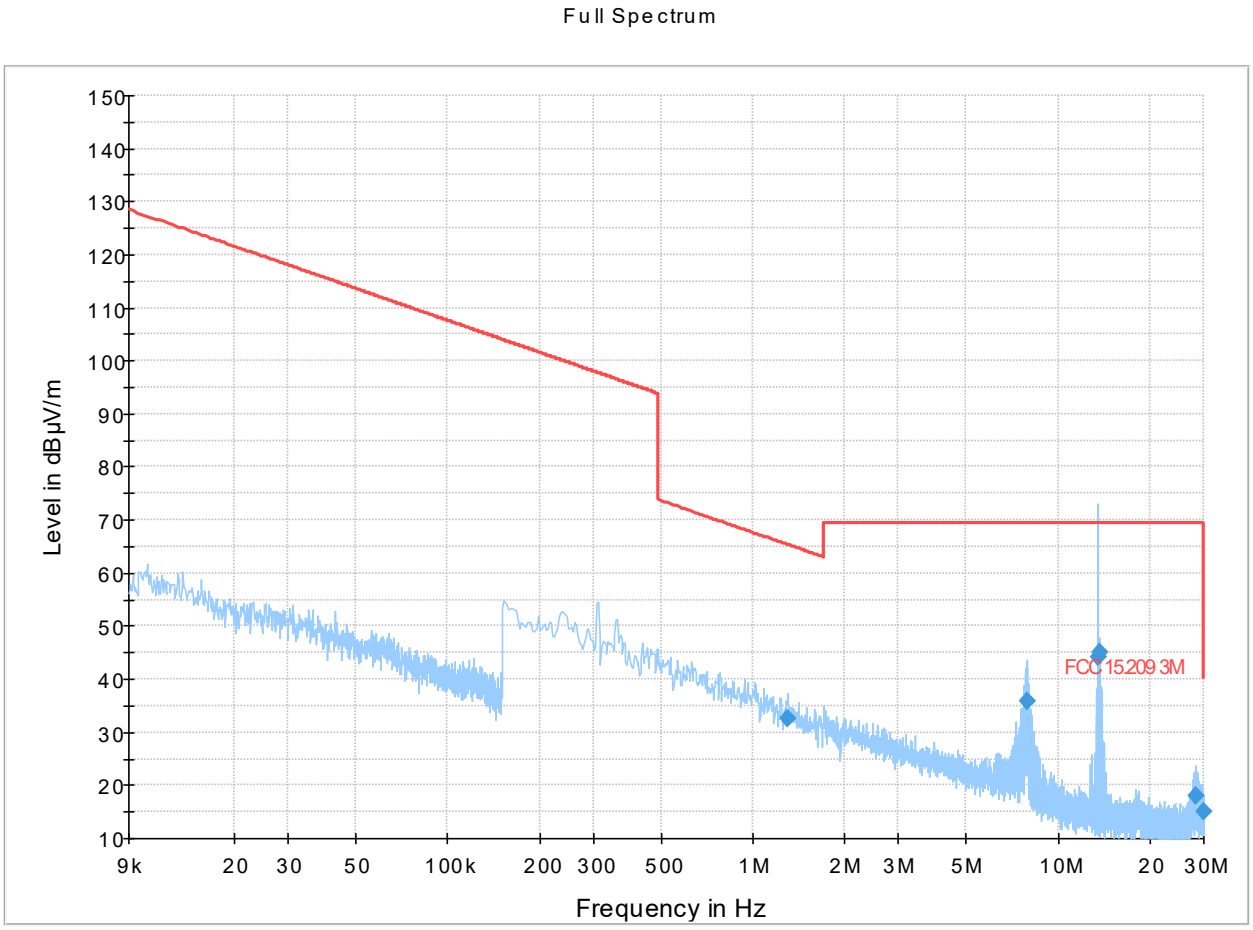


Figure 8.3-3: *Radiated emissions spectral plot (9 kHz - 30 MHz), 0° orientation*

Table 8.3-5*: Radiated emissions results*

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB/m)
1.293210	32.60	65.39	32.79	15000.0	9.000	H	0.0	10.7
7.935075	35.98	69.50	33.52	15000.0	9.000	H	283.0	10.9
13.488995	44.31	69.50	25.19	15000.0	9.000	H	178.0	11.1
13.629230	45.02	69.50	24.48	15000.0	9.000	H	181.0	11.1
28.304715	17.96	69.50	51.54	15000.0	9.000	H	312.0	9.0
29.957000	15.01	69.50	54.49	15000.0	9.000	H	295.0	8.5

Notes:
[1] Field strength (dB V/m) = receiver/spectrum analyzer value (dB V) + correction factor (dB)
[2] Correction factors = antenna factor ACF (dB) + cable loss (dB)
[3] Emissions that were continuously present for a minimum of 1 second and occurred more than once for every 15 seconds observation period were considered valid emissions. The maximum value of valid emissions has been recorded.

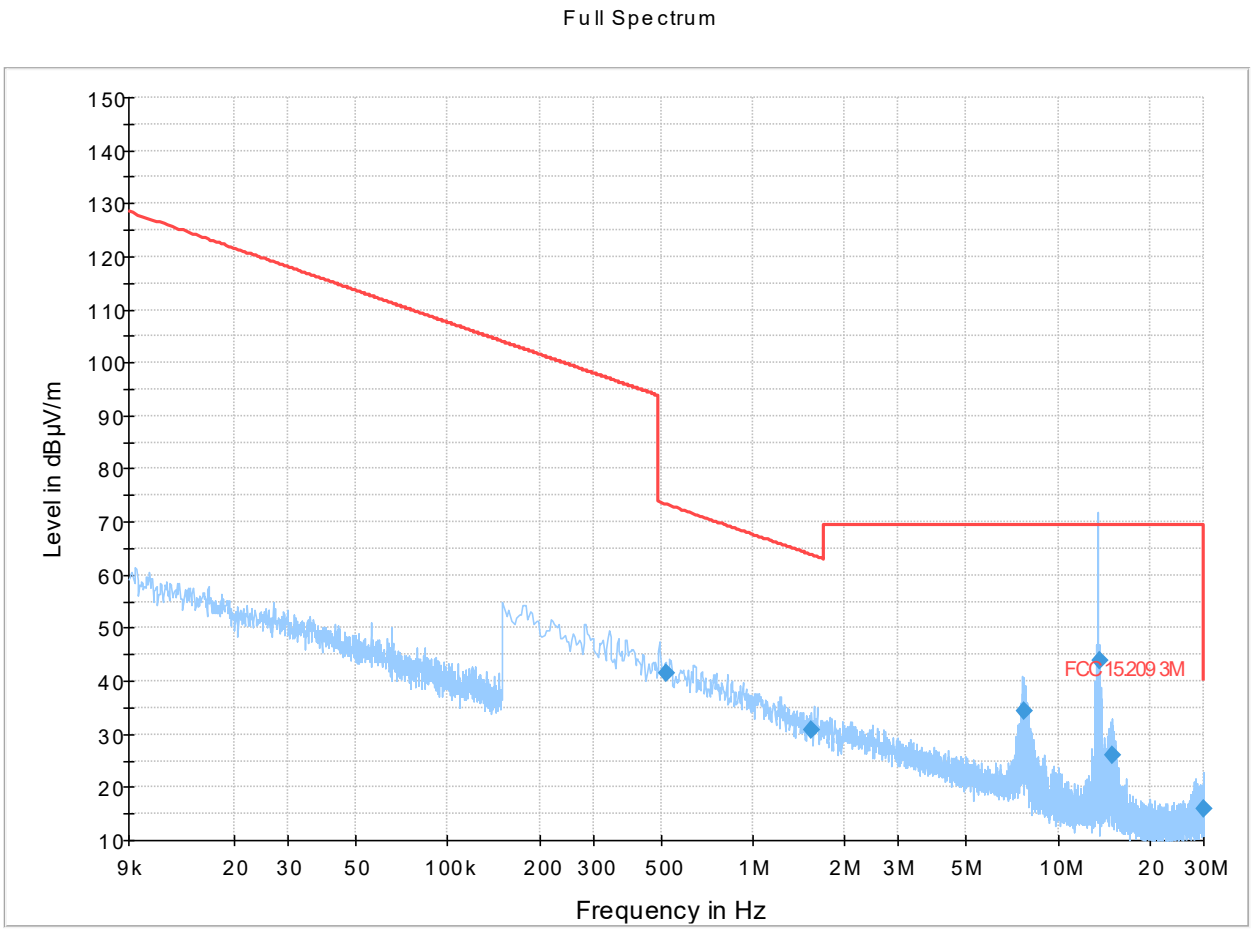


Figure 8.3-4: *Radiated emissions spectral plot (9 kHz - 30 MHz), 90° orientation*

Table 8.3-6*: Radiated emissions results*

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB/m)
0.522065	41.54	73.25	31.71	15000.0	9.000	H	266.0	10.5
1.554755	30.95	63.80	32.84	15000.0	9.000	H	288.0	10.8
7.691170	34.44	69.50	35.06	15000.0	9.000	H	119.0	10.9
13.628335	43.93	69.50	25.57	15000.0	9.000	H	270.0	11.1
15.047075	26.19	69.50	43.31	15000.0	9.000	H	318.0	11.1
30.000000	15.87	40.00	24.13	15000.0	9.000	H	213.0	8.5

Notes:
[1] Field strength (dB V/m) = receiver/spectrum analyzer value (dB V) + correction factor (dB)
[2] Correction factors = antenna factor ACF (dB) + cable loss (dB)
[3] Emissions that were continuously present for a minimum of 1 second and occurred more than once for every 15 seconds observation period were considered valid emissions. The maximum value of valid emissions has been recorded.

Full Spectrum

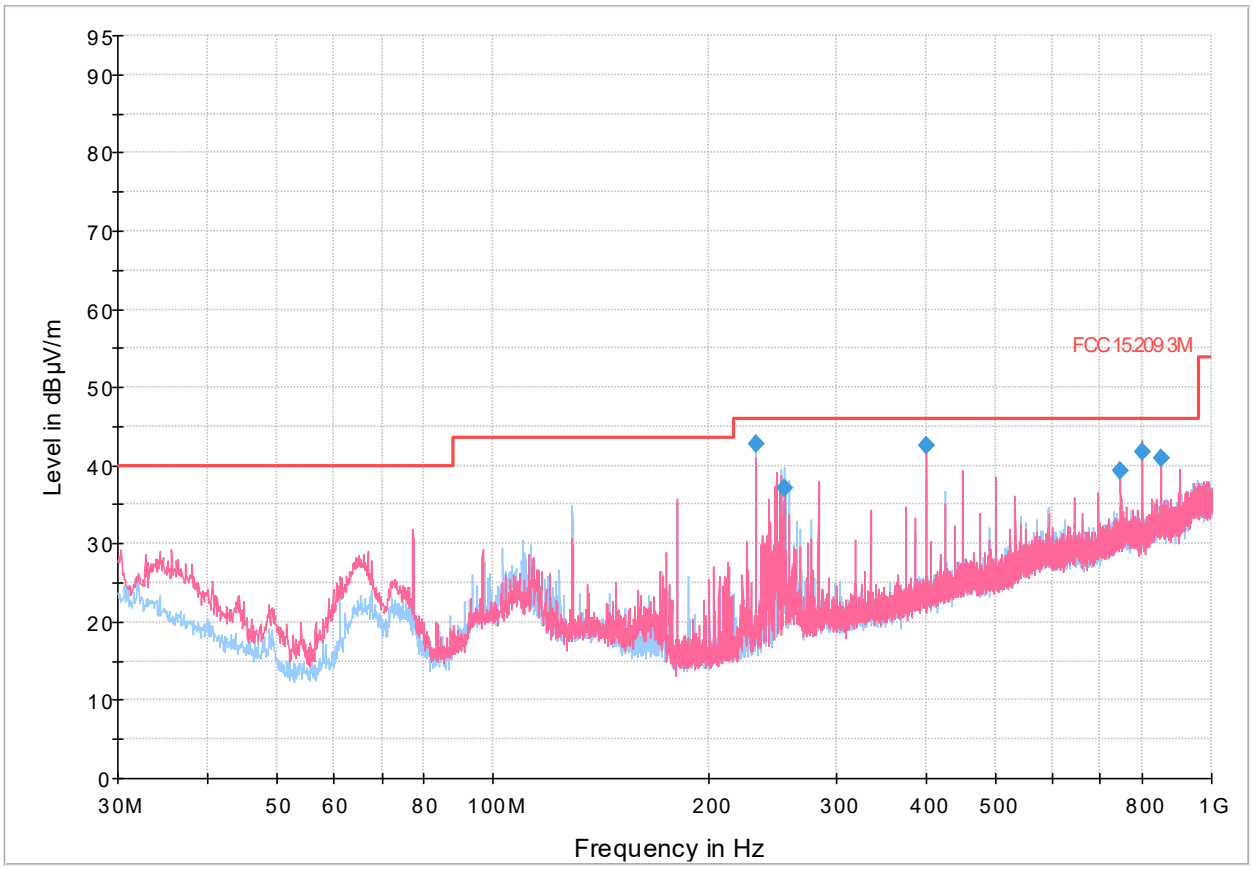


Figure 8.3-5: *Radiated emissions spectral plot (30 MHz - 1 GHz)*

Table 8.3-7*: Radiated emissions results*

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
232.042500	42.79	46.00	3.21	5000.0	120.000	100.0	H	136.0	17.9
254.554167	37.20	46.00	8.80	5000.0	120.000	117.0	H	158.0	20.9
399.974167	42.51	46.00	3.49	5000.0	120.000	100.0	V	184.0	24.4
747.679167	39.40	46.00	6.60	5000.0	120.000	109.0	V	335.0	32.1
799.170000	41.71	46.00	4.29	5000.0	120.000	100.0	V	0.0	31.8
850.783333	40.93	46.00	5.07	5000.0	120.000	100.0	V	357.0	33.4

Notes:
[1] Field strength (dB V/m) = receiver/spectrum analyzer value (dB V) + correction factor (dB)
[2] Correction factors = antenna factor ACF (dB) + cable loss (dB)
[3] Emissions that were continuously present for a minimum of 1 second and occurred more than once for every 15 seconds observation period were considered valid emissions. The maximum value of valid emissions has been recorded.

8.4 Frequency stability

8.4.1 References and limits

- RSS-210 §B.6(b)
- Test method: ANSI C63.26, §6.8

RSS-210 §B.6(b):

b) The carrier frequency stability shall not exceed ±100 ppm.

8.4.2 Test summary

Verdict	Pass		
Test date	March 31, 2022	Temperature	20 °C
Test engineer	Lan Sayasane, EMC Test Engineer	Air pressure	1006 mbar
Test location	☒ Wireless bench ☐ Other:	Relative humidity	52 %

8.4.3 Notes

The carrier frequency f_c (MHz) was measured at each temperature and supply voltage using the spectrum analyzer Signal Count marker function. The variation in ppm and % were calculated as follows:

$$Variation\ (ppm) = \left(\left(\frac{f_{expected} - f_{measured}}{f_{expected}}\right) \times 1000000\right)$$

$$Variation\ (\%) = \left(\left(\frac{f_{expected} - f_{measured}}{f_{expected}}\right) \times 100\right)$$

8.4.4 Setup details

EUT power input during test	120 VAC / 60 Hz
EUT setup configuration	☒ Table-top ☐ Floor standing ☐ Other:

8.4.5 Test data

Table 8.4-1: *Frequency stability with respect to ambient temperature results*

Temp. (°C)	0 minutes		2 minutes		5 minutes		10 minutes	
	f_c (MHz)	Drift (ppm) (RSS)	f_c (MHz)	Drift (ppm) (RSS)	f_c (MHz)	Drift (ppm) (RSS)	f_c (MHz)	Drift (ppm) (RSS)
50	13.55982207	-13.12	13.55981681	-13.51	13.55981373	-13.74	13.5598136	-13.75
40	13.55982543	-12.87	13.55982129	-13.18	13.55981862	-13.38	13.55981686	-13.51
30	13.55985163	-10.94	13.55983622	-12.08	13.55983538	-12.14	13.55983278	-12.33
20	13.55986972	-9.61	13.55986078	-10.27	13.55985636	-10.59	13.55985479	-10.71
10	13.55990147	-7.27	13.5598939	-7.82	13.55989084	-8.05	13.55988868	-8.21
0	13.55991803	-6.05	13.55991092	-6.57	13.5599104	-6.61	13.55991239	-6.46
-10	13.55995975	-2.97	13.55995568	-3.27	13.55995419	-3.38	13.55995296	-3.47
-20	13.55996058	-2.91	13.55996253	-2.76	13.55996331	-2.71	13.55996348	-2.69

Table 8.4-2: *Frequency stability with respect to supply voltage results*

Voltage (V)	f_c (MHz)	Drift (ppm) (RSS)
85%	13.55983565	-12.12
Nominal	13.55984055	-11.76
115%	13.5598355	-12.13

Nominal voltage: 120V AC
85 % voltage: 102 V AC
115 % voltage: 136 V AC

Section 9 Attestation Letter

CUBIC | Transportation Systems

Model Names Declaration

Subject: Validator 3.0 - Model Numbers
Applicant: Cubic Transportation Systems Inc

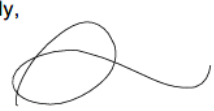
Dear Sir/Madam,

We, the undersigned, hereby confirm that all versions of device FCC ID: LVCVAL3LTE and device IC ID: 4387A-VAL3LTE are identical in electrical, mechanical, and physical design. Some versions will not include the optional LTE modem module. The detailed description is shown in the following table:

Model Name	Product Name	Description
10055834	FCC Validator 3, Cellular/Ethernet	Contains three RF Transmitter Modules: 1. TR4 NFC Reader 2. Bluetooth/Wifi Module 3. LTE Modem
10055645	FCC Validator 3, Ethernet Only	Contains Two RF Transmitter Modules: 1. TR4 NFC Reader 2. Bluetooth/Wifi Module

In addition to the above information, future devices will reference and be built upon the models listed above. They will be assigned different part numbers but will be identical in the electrical, mechanical, and physical design with only aesthetic differences.

Sincerely,



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End of test report