

EMC TEST REPORT – 407245-1TRFEMC

Applicant:

GHI Electronics, LLC

Product:

SITCore

Model:

SITCore SCM20xxx

Model variant(s):

FEZ Portal, SCM20260D, SC20100S,
SCM20100E, SCM20260N, FEZ Bit,
FEZ Stick, FEZ Duino, FEZ Feather

Specifications:

- ◆ FCC 47 CFR Part 15, Subpart B – Verification
- ◆ ICES-003 Issue 7 October 2020

Date of issue: December 10, 2020

Alvin Liu, EMC/RF Specialist

Tested by

Fahar A Sukkoor, EMC/RF Specialist

Reviewed by



Signature



Signature

Nemko Canada Inc., a testing laboratory, is accredited by the Standards Council of Canada.
The tests included in this report are within the scope of this accreditation

Lab locations

Company name	Nemko Canada Inc.			
Facilities	Ottawa site:	Montréal site:	Cambridge site:	Almonte site:
	303 River Road	292 Labrosse Avenue	1-130 Saltsman Drive	1500 Peter Robinson Road
	Ottawa, Ontario	Pointe-Claire, Québec	Cambridge, Ontario	West Carleton, Ontario
	Canada	Canada	Canada	Canada
	K1V 1H2	H9R 5L8	N3E 0B2	K0A 1L0
	Tel: +1 613 737 9680	Tel: +1 514 694 2684	Tel: +1 519 650 4811	Tel: +1 613 256-9117
	Fax: +1 613 737 9691	Fax: +1 514 694 3528		
Test site registration	Organization	Recognition numbers and location		
	FCC/ISED	FCC: CA2040; IC: 2040A-4 (Ottawa/Almonte); FCC: CA2041; IC: 2040G-5 (Montreal); CA0101 (Cambridge)		
Website	www.nemko.com			

Limits of responsibility

Note that this report's results 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 this report.

This test report has been completed following the requirements of ISO/IEC 17025. All results contained in this report are within Nemko Canada's ISO/IEC 17025 accreditation.

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Section 1 Report summary

1.1 Test specifications

FCC 47 CFR Part 15, Subpart B – Verification	Title 47: Telecommunication; Part 15—Radio Frequency Devices
996369 D04 Module Integration Guide v01	MODULAR TRANSMITTER INTEGRATION GUIDE—GUIDANCE FOR HOST PRODUCT MANUFACTURERS
ICES-003 Issue 7 October 2020	Information Technology Equipment (including Digital Apparatus)

1.2 Exclusions

None

1.3 Statement of compliance

In the configuration tested, the EUT was found compliant.

Unless noted in section 1.2, all testing was performed against all relevant requirements of the test standard. Results obtained indicate that the product under test complies in full with the requirements tested. The test results relate only to the items tested.

See "Summary of test results" for full details.

1.4 Test report revision history

Table 1.4-1: Test report revision history

Revision #	Date of issue	Details of changes made to test report
TRF	December 10, 2020	Original report issued

Section 2 Engineering considerations

2.1 Modifications incorporated in the EUT for compliance

There were no modifications performed to the EUT during this assessment.

2.2 Technical judgment

EUT model SCM20xxx, and variants: FEZ Portal, SCM20260D, SC20100S, SCM20100E, SCM20260N, FEZ Bit, FEZ Stick, FEZ Duino, FEZ Feather.

FEZ Portal, FEZ Bit, FEZ Duino, and FEZ Feather, have same WiFi module on board. Other models have no WiFi module used.

Applicant claims all models are variants of one another.

All models were prescanned on radiated emission test, worst case emissions model FEZ Portal was identified and went through full test program.

2.3 Deviations from laboratory tests procedures

No deviations were made from laboratory procedures.

Section 3 Test conditions

3.1 Atmospheric conditions

Temperature	15 °C – 35 °C
Relative humidity	30 % – 60 %
Air pressure	86 kPa (860 mbar) – 106 kPa (1060 mbar)

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.

3.2 Power supply range

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

Section 4 Measurement uncertainty

4.1 Uncertainty of measurement

Nemko Canada 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 4.1-1: Measurement uncertainty calculations

Measurement		U_{CISPR} dB	U_{lab} dB			
			Ottawa	Montreal	Cambridge	Almonte
Conducted disturbance at AC mains and other port power using a V-AMN	(9 kHz to 150 kHz)	3.8	2.9	2.8	2.8	N/A
	(150 kHz to 30 MHz)	3.4	2.3	2.2	2.2	N/A
Conducted disturbance at telecommunication port using AAN	(150 kHz to 30 MHz)	5.0	4.3	4.3	4.3	N/A
Conducted disturbance at telecommunication port using CVP	(150 kHz to 30 MHz)	3.9	2.9	2.8	2.8	N/A
Conducted disturbance at telecommunication port using CP	(150 kHz to 30 MHz)	2.9	1.4	1.1	1.1	N/A
Conducted disturbance at telecommunication port using CP and CVP	(150 kHz to 30 MHz)	4.0	3.1	3.0	3.0	N/A
Disturbance power	(30 MHz to 300 MHz)	4.0	3.7	3.7	3.7	N/A
Radiated disturbance (electric field strength at an OATS or in a SAC)	(30 MHz to 1 GHz)	6.3	5.7	5.5	5.5	5.5
Radiated disturbance (electric field strength in a FAR)	(1 GHz to 6 GHz)	5.2	4.8	5.1	4.8	N/A
Radiated disturbance (electric field strength in a FAR)	(6 GHz to 18 GHz)	5.5	5.1	5.0	4.7	N/A

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 $(U_{\text{lab}} - U_{\text{CISPR}})$, exceeds the disturbance limit;
– non-compliance is deemed to occur if any measured disturbance level, increased by $(U_{\text{lab}} - U_{\text{CISPR}})$, exceeds the disturbance limit

Section 5 Information provided by the applicant

5.1 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 contained within this test report. Nemko accepts no responsibility for the information within this section and its impact on the test plan and resulting measurements.

5.2 Applicant/Manufacturer

Applicant name	GHI Electronics, LLC
Applicant address	501 E. Whitcomb Ave, Madison Heights MI, USA48701
Manufacturer name	Same as applicant
Manufacturer address	Same as applicant

5.3 EUT information

Product	SITCore
Model	FEZ Portal
Serial number	None
Part number	SCC-FPRTL-C
Power requirements	5 V _{DC} USB-C Powered (via external 100–240 V _{AC} , 50/60 Hz power adapter)
Description/theory of operation	Development boards, SoMs, and single board computers.
Operational frequencies	8 MHz Crystal, processor running at 240 MHz
Software details	Firmware version 2.0.0.8, TinyCLR OS 2.0

5.4 EUT setup details

5.4.1 EUT Exercise and monitoring

Methods used to exercise the EUT and all relevant ports:

- EUT powered and had the complete software stack running behind it.
- Wi-Fi module was active by default.
- The display on board turned on and showed white screen.

Configuration details:

- The EUT was set up 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 setup 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:
 - None
- The EUT was set up in a manner that was consistent with its typical arrangement and use. The measurement arrangement of the EUT, local AE and associated cabling was representative of normal practice. Any deviations from typical arrangements have been noted below:
 - None

Monitoring details:

- Monitor the display and blinking led on board.

5.4.2 EUT test configuration

Table 5.4-1: EUT interface ports

Description	Qty.
DC power input (USB-C)	1
USB	1

Table 5.4-2: Support equipment

Description	Brand name	Serial number, Part number, Model, Revision level
Adapter	Samsung	SN: SE1F122AS/B-E, MN: EP-TA10JWE

Table 5.4-3: Inter-connection cables

Cable description	From	To	Length (m)
DC power input (USB-C)	Adapter	EUT	2.8

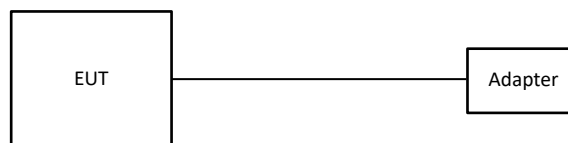


Figure 5.4-1: Block diagram

Section 6 Summary of test results

6.1 Testing location

Test location (s) Cambridge

6.2 Testing period

Test start date December 1, 2020 Test end date December 1, 2020

6.3 Sample information

Receipt date October 1, 2020 Nemko sample ID number 17

6.4 Test results

Table 6.4-1: Result summary for emissions

Standard	Clause	Test description	Verdict
FCC 47 CFR Part 15, Subpart B	§15.107	Conducted emissions limits (AC mains) ¹	Pass ²
FCC 47 CFR Part 15, Subpart B	§15.109	Radiated emissions limits ¹	Pass
ICES-003 Issue 7	3.2.1	AC Power Line Conducted Emissions Limits ¹	Pass ²
ICES-003 Issue 7	3.2.2	Radiated Emissions Limits ¹	Pass

Notes: ¹ Product classification B

² The EUT is DC powered via AC/DC adapter

Section 7 Terms and definitions

7.1 Product classifications and definitions

7.1.1 Title 47: Telecommunication – Part 15-Radio Frequency devices, Subpart A – General – Equipment classification

Class A digital device	A digital device that is marketed for use in a commercial, industrial or business environment, exclusive of a device which is marketed for use by the general public or is intended to be used in the home.
Class B digital device	A digital device that is marketed for use in a residential environment notwithstanding use in commercial, business and industrial environments. Examples of such devices include, but are not limited to, personal computers, calculators, and similar electronic devices that are marketed for use by the general public. Note: The responsible party may also qualify a device intended to be marketed in a commercial, business or industrial environment as a Class B device, and in fact is encouraged to do so, provided the device complies with the technical specifications for a Class B digital device. In the event that a particular type of device has been found to repeatedly cause harmful interference to radio communications, the Commission may classify such a digital device as a Class B digital device, regardless of its intended use.

7.1.2 ICES-GEN – Equipment classification

Class A	Equipment that is, by virtue of its characteristics, highly unlikely to be used in a residential environment, including a home business shall be classified as Class A and shall comply with the Class A limits specified in the applicable ICES standard. Characteristics considered in this assessment include price, marketing and advertising methodology, the degree to which the functional design inhibits applications suitable to residential environments, or any combination of features that would effectively preclude the use of such equipment in a residential environment.
Class B	Equipment that cannot be classified as Class A shall comply with the Class B limits specified in the applicable ICES standard.

7.2 General definitions

7.2.1 Title 47: Telecommunication – Part 15-Radio Frequency devices, Subpart A – General – Digital device definitions

Digital device (Previously defined as a computing device)

An unintentional radiator (device or system) that generates and uses timing signals or pulses at a rate in excess of 9,000 pulses (cycles) per second and uses digital techniques; inclusive of telephone equipment that uses digital techniques or any device or system that generates and uses radio frequency energy for the purpose of performing data processing functions, such as electronic computations, operations, transformations, recording, filing, sorting, storage, retrieval, or transfer. A radio frequency device that is specifically subject to an emanation requirement in any other FCC Rule part or an intentional radiator subject to subpart C of this part that contains a digital device is not subject to the standards for digital devices, provided the digital device is used only to enable operation of the radio frequency device and the digital device does not control additional functions or capabilities.

Note: Computer terminals and peripherals that are intended to be connected to a computer are digital devices.

7.2.2 ICES-003 – Definitions

ICES

This Interference-Causing Equipment Standard (ICES) sets out limits and methods of measurement of radio frequency emissions, as well as administrative requirements for information technology equipment (ITE), including digital apparatus. This includes devices or systems that generate and/or use timing signals or pulses having a rate of at least 9 kHz and employ digital techniques for purposes such as computation, display, control, data processing and storage.

Section 8 Testing data

8.1 Radiated emissions

8.1.1 References and limits

- FCC 47 CFR Part 15, Subpart B: Clause §15.109 (Test method ANSI C63.4:2014)
- ICES-003 Issue 7, October 2020: Section 3.2.2

Table 8.1-1: Requirements as per for radiated emissions for Class B

Facility	Frequency range [MHz]	Measurement		limits [dBμV/m]
		Distance [m]	Detector type/ bandwidth	
OATS/SAC	30–88	3	Quasi Peak/120 kHz	40.0
	88–216			43.5
	216–960			46.0
	960–1000			54.0
FSOATS	>1000	3	Linear average/1 MHz	54.0
			Peak/1 MHz	74.0

- Notes:
- OATS – Open Area Test Site, SAC – Semi Anechoic Chamber, FSOATS – Free Space Open Area Test Site
 - Where there is a step in the applicable limit, the lower value was applied at the transition frequency.

8.1.2 Test summary

Verdict	Pass		
Tested by	Alvin Liu	Test date	December 1, 2020

8.1.3 Notes

- The spectral plots within this section are a summation of vertical and horizontal scans. The spectral plots within this section have been corrected with all relevant transducer factors.
- Where tabular data has not been provided, no emissions were observed within 10 dB of the specified limit when measured with the appropriate detector. Additionally, where less than 6 measurements per detector have been provided, fewer than 6 emissions were observed within 10 dB of the specified limit when measured with the appropriate detector.
- The spectrum was scanned to 18 GHz according to the EUT highest digital operating frequency and radio operational frequencies.
- The EUT was assessed as per KDB 996369 D04. All spurious emissions were below the class B digital emissions.

Table 8.1-2: Maximum frequency test range based on the highest digital operating frequency

Highest internal frequency [F _x]	Highest measured frequency
F _x ≤ 108 MHz	1 GHz
108 MHz < F _x ≤ 500 MHz	2 GHz
500 MHz < F _x ≤ 1 GHz	5 GHz
F _x > 1 GHz	5 × F _x up to a maximum of 6 GHz (CISPR 32) 5 × F _x up to a maximum of 40 GHz (ANSI C63.4)

- Notes:
- Highest internal frequency [F_x] – highest fundamental frequency generated or used within the EUT or highest frequency at which it operates. This includes frequencies which are solely used within an integrated circuit.

8.1.4 Setup details

Port under test	Enclosure Port
EUT power input during test	5 V _{DC} USB-C Powered (via external 100–240 V _{AC} , 50/60 Hz power adapter)
EUT setup configuration	Table top
Test facility	Semi anechoic chamber
Measuring distance	3 m
Antenna height variation	1–4 m
Turntable position	0–360°
Measurement details	A preview measurement was generated with the receiver in continuous scan or sweep mode while the EUT was rotated and the antenna adjusted to maximize radiated emission. Emissions detected within 10 dB or above the limit were re-measured with the appropriate detector against the correlating limit and recorded as the final measurement.

Receiver/spectrum analyzer settings.

Resolution bandwidth	Measurements below 1 GHz: 120 kHz, Measurements above 1 GHz: 1 MHz
Video bandwidth	Measurements below 1 GHz: 300 kHz, Measurements above 1 GHz: 3 MHz
Detector mode	Measurements below 1 GHz: Peak (Preview), Quasi-peak (Final) Measurements above 1GHz: Peak (Preview), Peak and CAverage (Final)
Trace mode	Max Hold
Measurement time	100 ms

Table 8.1-3: Radiated emissions equipment list

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
Receiver/spectrum analyzer	Rohde & Schwarz	ESR26	FA002969	1 year	November 12, 2021
3 m EMI test chamber	TDK	SAC-3	FA003012	1 year	April 10, 2021
Flush mount turntable	SUNAR	FM2022	FA003006	—	NCR
Controller	SUNAR	SC110V	FA002976	—	NCR
Antenna mast	SUNAR	TLT2	FA003007	—	NCR
Bilog antenna (30–2000 MHz)	SUNAR	JB1	FA003010	1 year	March 17, 2021
Horn antenna (1–18 GHz)	ETS Lindgren	3117	FA002911	1 year	March 11, 2021
Preamplifier (1–18 GHz)	ETS Lindgren	124334	FA002956	1 year	March 26, 2021

Notes: NCR - no calibration required

Table 8.1-4: Radiated emissions test software details

Manufacturer of Software	Details
Rohde & Schwarz	EMC32, Software for EMC Measurements, Version 10.60.00

8.1.5 Test data

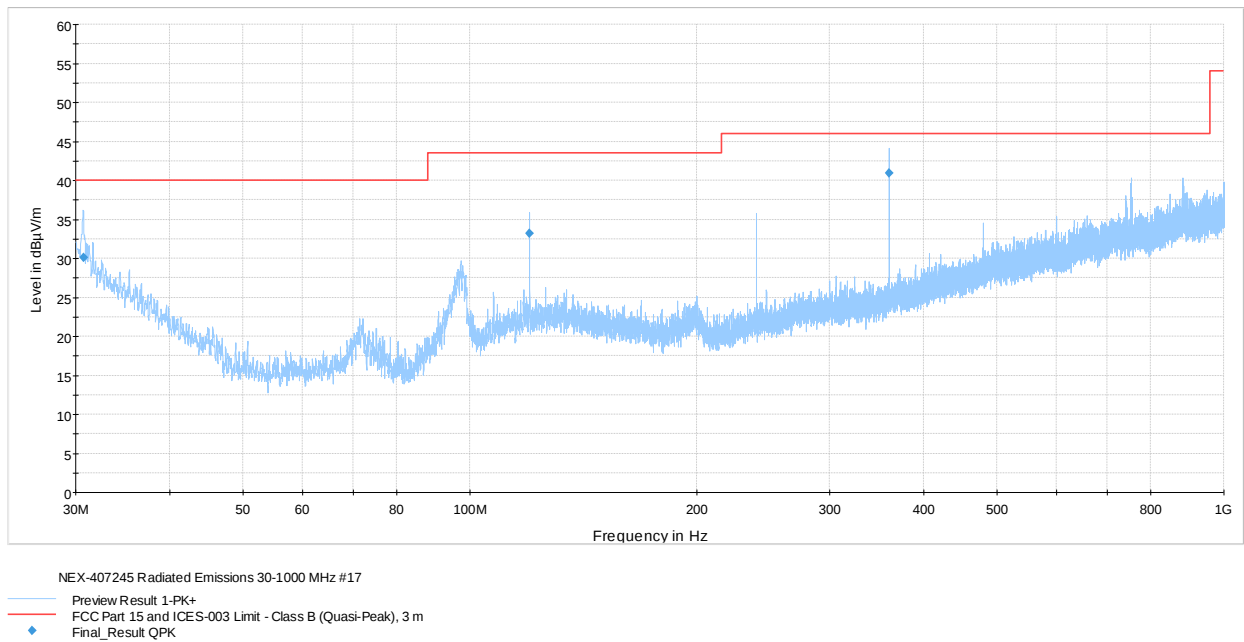


Figure 8.1-1: Radiated emissions spectral plot (30 to 1000 MHz)

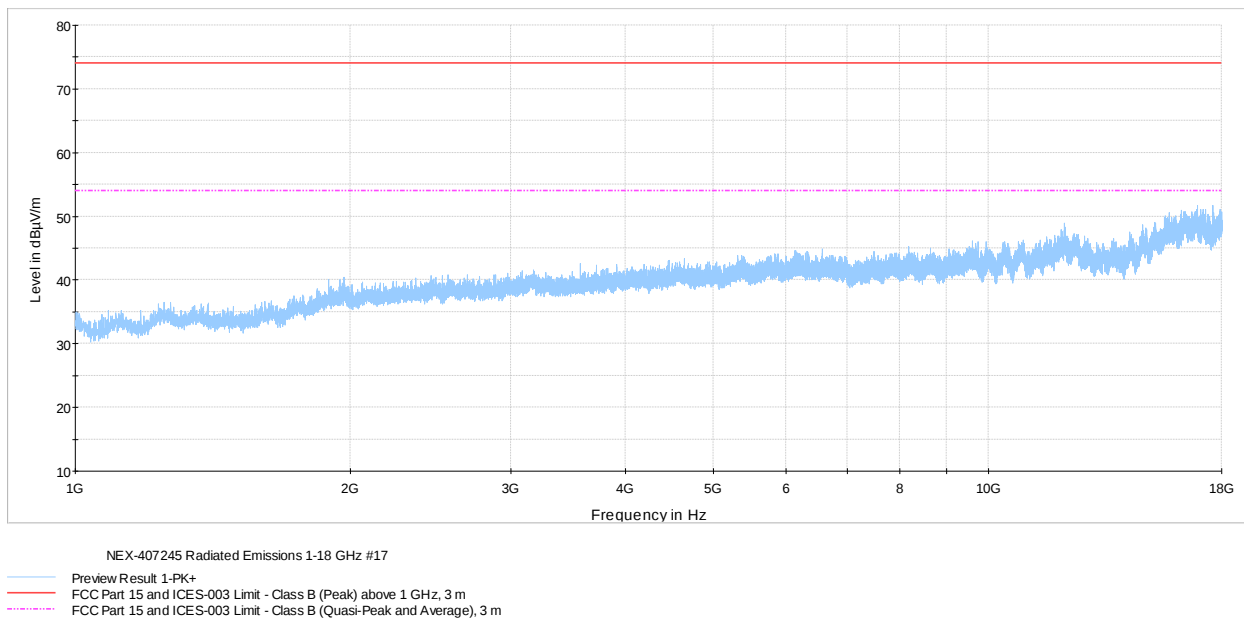


Figure 8.1-2: Radiated emissions spectral plot (1 to 18 GHz)



Test data continued

Table 8.1-5: Radiated emissions results

Frequency (MHz)	Quasi-Peak field strength ^{1 and 3} (dBμV/m)	Quasi-Peak limit (dBμV/m)	Quasi-Peak margin (dB)	Correction factor ² (dB)
30.729	30.1	40.0	9.9	24.6
119.995	33.2	43.5	10.3	18.7
359.997	40.9	46.0	5.1	20.2

Notes: ¹ Field strength (dBμV/m) = receiver/spectrum analyzer value (dBμV) + correction factor (dB)
 ² Correction factor = antenna factor ACF (dB) + cable loss (dB) – amplifier gain (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.

Sample calculation: 30.1 dBμV/m (field strength) = 5.5 dBμV (receiver reading) + 24.6 dB (Correction factor)

8.1.6 Setup photos



Figure 8.1-3: Radiated emissions setup photo – below 1 GHz

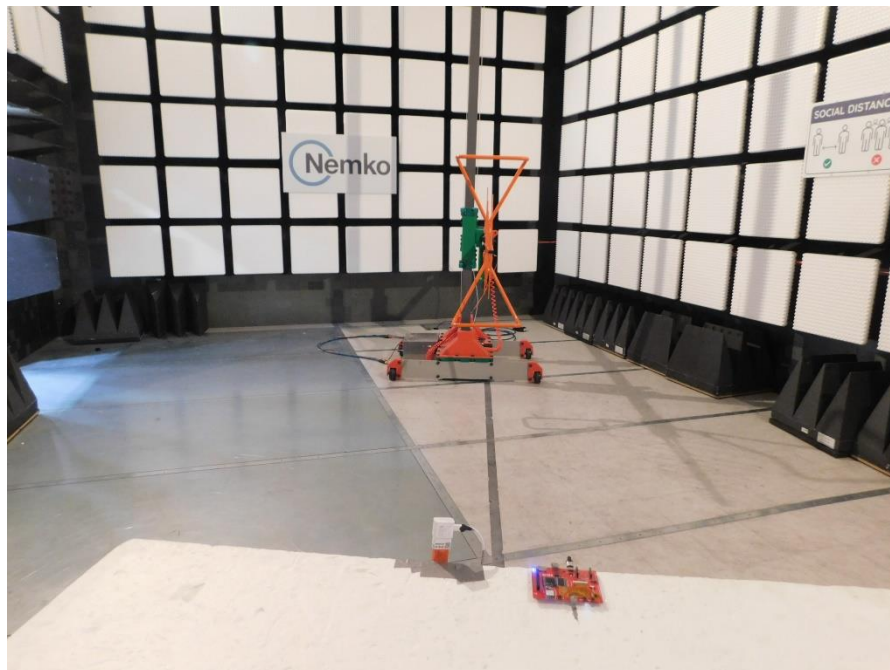


Figure 8.1-4: Radiated emissions setup photo – below 1 GHz

Setup photos continued

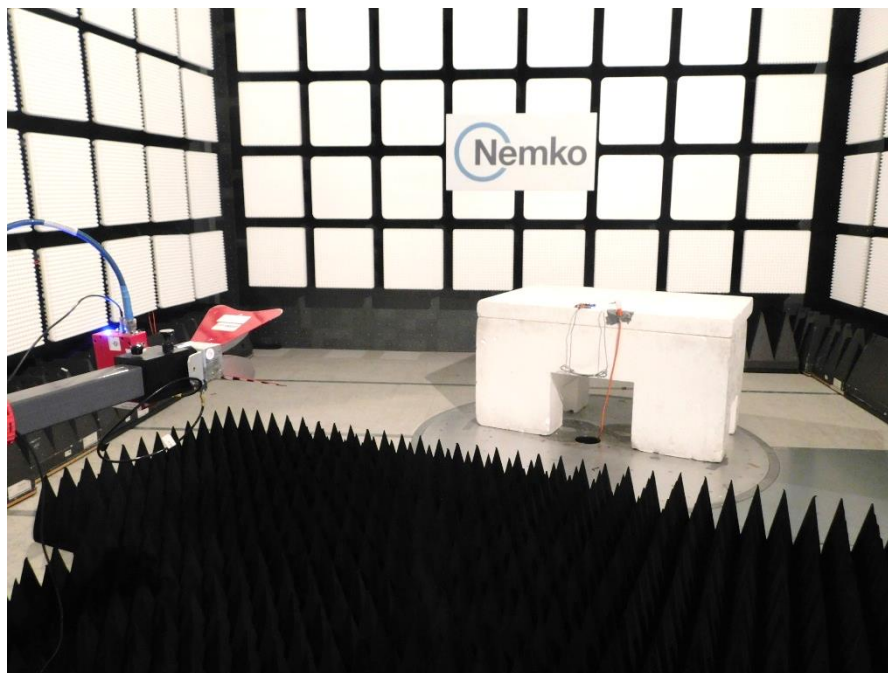


Figure 8.1-5: Radiated emissions setup photo – above 1 GHz

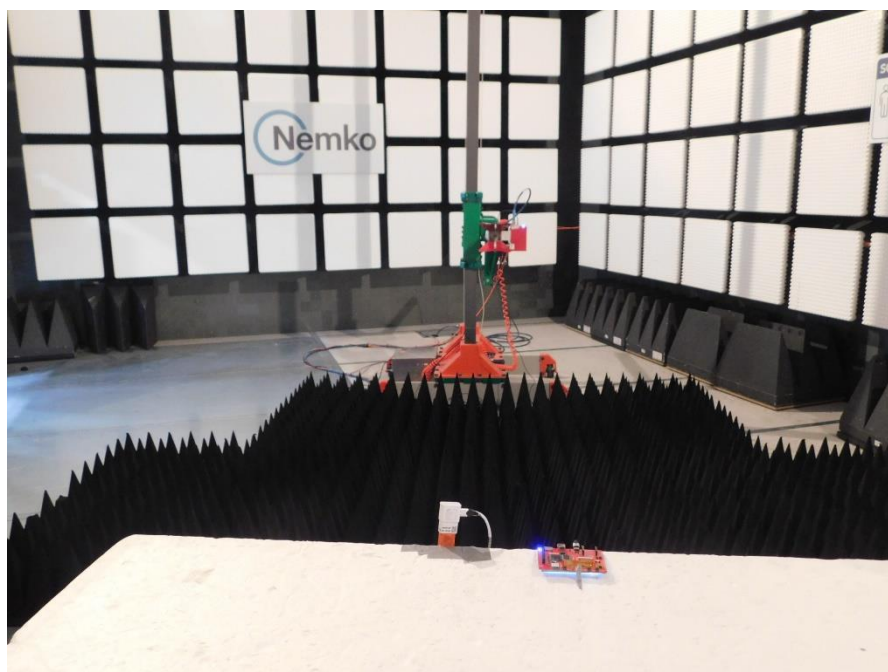


Figure 8.1-6: Radiated emissions setup photo – above 1 GHz

8.2 Conducted emissions – from AC mains power ports

8.2.1 References and limits

- FCC 47 CFR Part 15, Subpart B: Clause §15.107 (Test method ANSI C63.4:2014)
- ICES-003 Issue 7, October 2020: Section 3.2.1

Table 8.2-1: Requirements for conducted emissions from the AC mains power ports for Class B

Frequency range [MHz]	Measurement		Limits [dBμV]
	Coupling device	Detector type/ bandwidth	
0.15–0.5	AMN	Quasi Peak/9 kHz	66.0–56.0
0.5–5			56.0
5–30			60.0
0.15–0.5	AMN	CAverage/9 kHz	56.0–46.0
0.5–5			46.0
5–30			50.0

Notes: The lower limit shall apply at the transition frequency.

8.2.2 Test summary

Verdict	Pass		
Tested by	Alvin Liu	Test date	December 1, 2020

8.2.3 Notes

- The spectral plots within this section have been corrected with all relevant transducer factors.
- Where tabular data has not been provided, no emissions were observed within 10 dB of the specified limit when measured with the appropriate detector. Additionally, where less than 6 measurements per detector have been provided, fewer than 6 emissions were observed within 10 dB of the specified limit when measured with the appropriate detector.
- Equipment with a DC power port powered by AC/DC power converter is considered to be AC mains powered equipment and tested with a power converter. Where the manufacturer provided the power converter, the supplied converter was used.

8.2.4 Setup details

Port under test – Coupling device	AC power port of AC adapter – Artificial Mains Network (AMN)
EUT power input during test	5 V _{DC} USB Powered (via external 100–240 V _{AC} , 50/60 Hz power adapter)
EUT setup configuration	Table top
Measurement details	A preview measurement was generated with the receiver in continuous scan mode. Emissions detected within 10 dB or above the limit were re-measured with the appropriate detector against the correlating limit and recorded as the final measurement.

Receiver settings:

Resolution bandwidth	9 kHz
Video bandwidth	30 kHz
Detector mode	Peak and Average (Preview), Quasi-peak and CAverage (Final)
Trace mode	Max Hold
Measurement time	100 ms (Preview), 160 ms (Final)

Table 8.2-2: *Conducted emissions – from AC mains power ports equipment list*

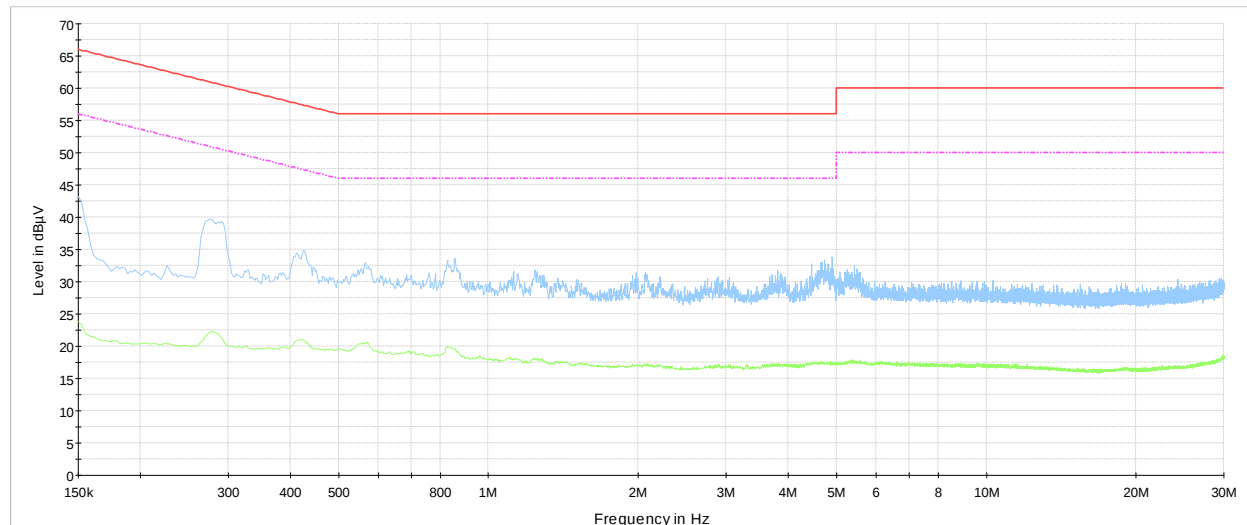
Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
Receiver/spectrum analyzer	Rohde & Schwarz	ESR26	FA002969	1 year	November 12, 2021
Two-line V-network	Rohde & Schwarz	ENV216	FA002965	1 year	November 30, 2021

Notes: None

Table 8.2-3: *Conducted emissions – from AC mains power ports test software details*

Manufacturer of Software	Details
Rohde & Schwarz	EMC32, Software for EMC Measurements, Version 10.60.00

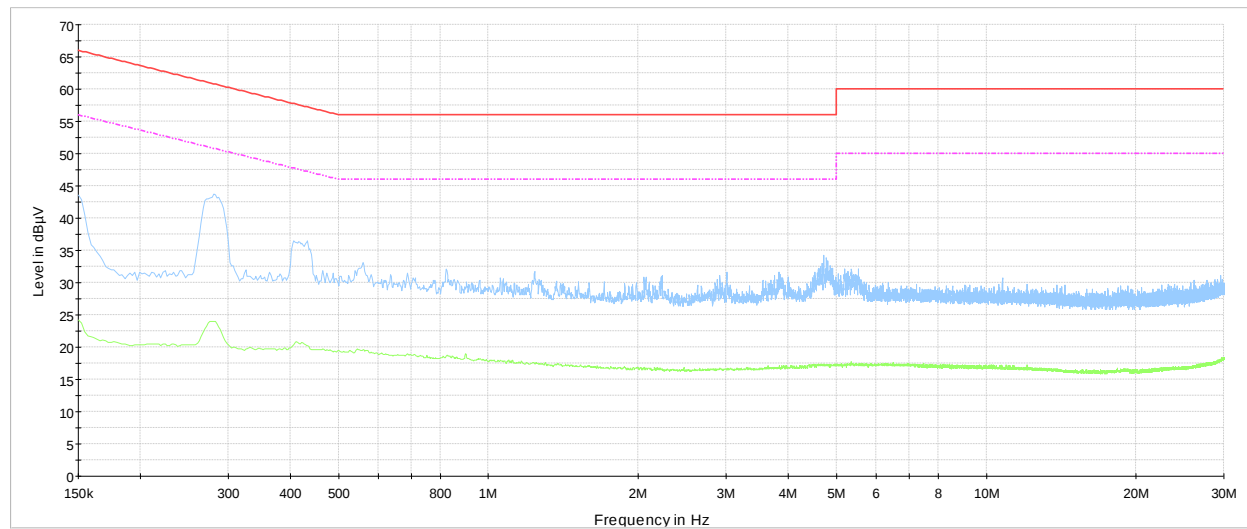
8.2.5 Test data



NEX-407245 Conducted emissions 150 kHz - 30 MHz, 120Vac 60Hz phase

Preview Result 2-AVG
 Preview Result 1-PK+
 CISPR 32 Limit - Class B, Mains (Quasi-Peak)
 CISPR 32 Limit - Class B, Mains (Average)

Figure 8.2-1: Conducted emissions – from AC mains power ports spectral plot on the phase line



NEX-407245 Conducted emissions 150 kHz - 30 MHz, 120Vac 60Hz neutral

Preview Result 2-AVG
 Preview Result 1-PK+
 CISPR 32 Limit - Class B, Mains (Quasi-Peak)
 CISPR 32 Limit - Class B, Mains (Average)

Figure 8.2-2: Conducted emissions – from AC mains power ports spectral plot on the neutral line

8.2.6 Setup photos



Figure 8.2-3: Conducted emissions – from AC mains power ports setup photo



Figure 8.2-4: Conducted emissions – from AC mains power ports setup photo

Section 9 EUT photos

9.1 External photos

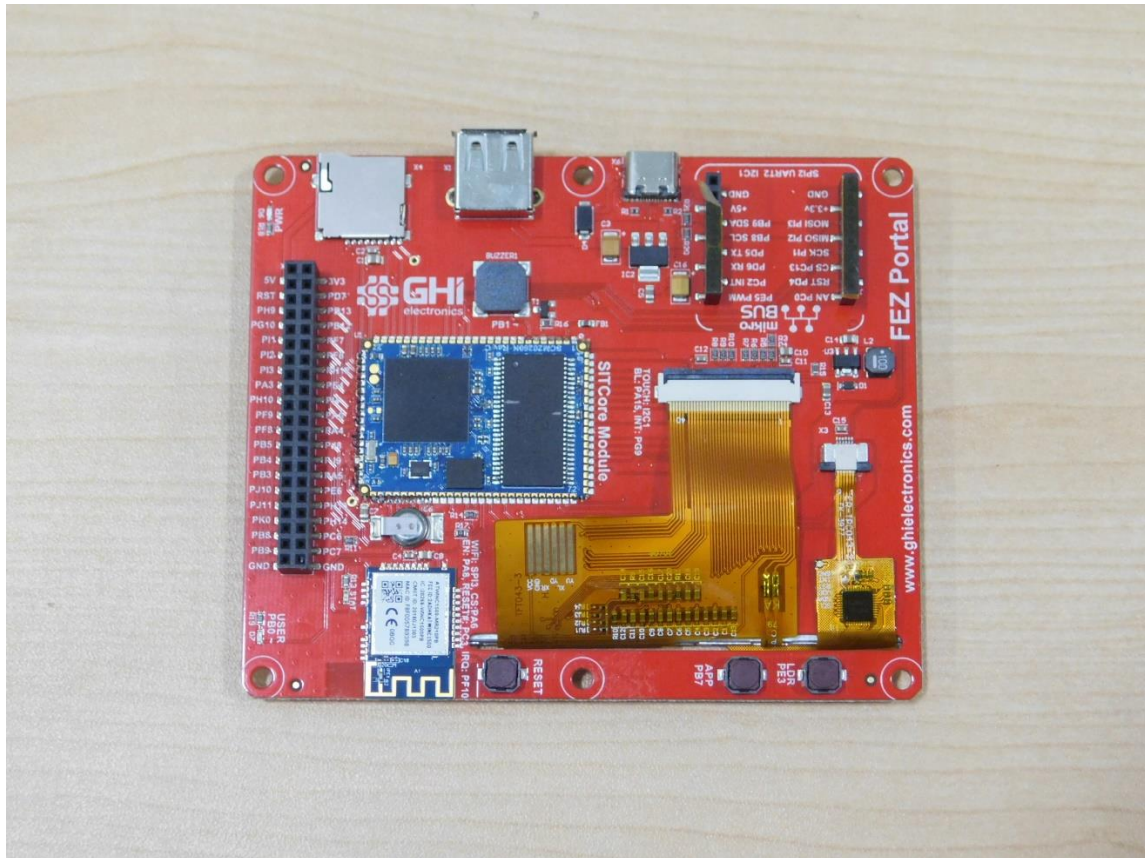


Figure 9.1-1: Top view photo

External photos continued



Figure 9.1-2: Bottom view photo

External photos continued



Figure 9.1-3: Side view photo

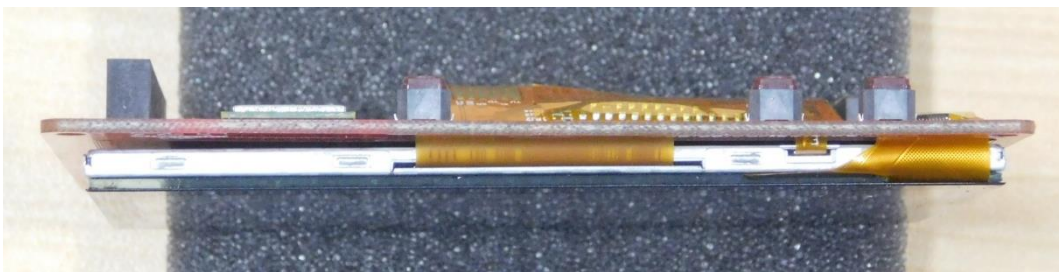


Figure 9.1-4: Side view photo



Figure 9.1-5: Side view photo



Figure 9.1-6: Side view photo

End of the test report