

EMC TEST REPORT – 407245-4TRFEMC

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

Specification:

ETSI EN 301 489-17 V3.2.3 (2020-07)

Date of issue: December 11, 2020

Alvin Liu, EMC/RF Specialist

Tested by



Signature

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Reviewed by



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

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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.

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Section 1 Report summary

1.1 Test specifications

ETSI EN 301 489-17 V3.2.3 (2020-07)	ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 17: Specific conditions for Broadband Data Transmission Systems; Harmonised Standard for ElectroMagnetic Compatibility
ETSI EN 301 489-1 V2.2.3 (2019-11)	ElectroMagnetic Compatibility (EMC) standard for radio equipment and services; Part 1: Common technical requirements; Harmonised Standard for ElectroMagnetic Compatibility

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 11, 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 purpose of the present document, the nominal voltage shall be the declared voltage, or any of the declared 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	(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
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

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 contained within this section and the impact it may have 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
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

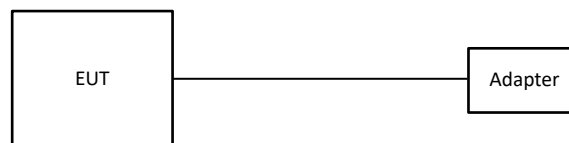


Figure 5.4-1: Block diagram

Section 6 Summary of test results

6.1 Testing location

Test location (s)	Cambridge
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6.2 Testing period

Test start date	December 1, 2020	Test end date	December 2, 2020
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6.3 Sample information

Receipt date	October 1, 2020	Nemko sample ID number	17
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6.4 Transmitter/Receiver info

Wireless classification	☒ Data transmission systems operating in the 2.4 GHz ISM band and using wide band modulation techniques ☐ 5 GHz high performance RLAN systems ☐ Broadband data transmitting systems operating in the band 5725 MHz to 5875 MHz ☐ Broadband data transmitting/BWA Terminal Stations ☐ Multi-Gigabit Wireless Systems (MGWS) ☐ Other
Wireless technology	Wi-Fi
Frequency band	2402-2480 MHz

6.5 Equipment classification

Equipment classification	Radio and ancillary equipment for fixed use (e.g. base stations equipment) Radio and ancillary equipment for vehicle use (e.g. mobile equipment) Radio and ancillary equipment for portable use (portable equipment) This classification determines the extent of applicable EMC tests. However, the following instructions shall also apply to multiple use radio and/or ancillary equipment: – Radio and/or ancillary equipment for portable use or combinations thereof declared as capable of being powered for intended use by the main battery of a vehicle shall additionally be considered as equipment for vehicular use; – Radio and/or ancillary equipment for portable or vehicular use or combinations thereof declared as capable of being powered for intended use by an AC mains or DC network shall additionally be considered as equipment for fixed use.
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6.6 Results

Table 6.6-1: Clause 8 of ETSI EN 301 489-1 – Methods of measurement and limits for EMC emissions results

Environmental phenomenon	Test port	Basic standard	Verdict
Radio and ancillary equipment for portable use			
Radiated emissions (Ancillary equipment) – Clause 8.2	Enclosure Enclosure ¹ – Equipment intended to be used in telecommunication centers and industrial environments	EN 55032	Pass Not applicable

Notes: ¹ Equipment is not intended to be used in telecommunication centres and industrial environments

Table 6.6-2: Clause 9 of ETSI EN 301 489-1 Test methods and levels for immunity tests results

Environmental phenomenon	Test port	Basic standard	Verdict
Radio and ancillary equipment for portable use			
Radio frequency electromagnetic field – Clause 9.2	Enclosure	EN 61000-4-3	Pass
Electrostatic discharge – Clause 9.3	Enclosure	EN 61000-4-2	Not applicable ¹

Notes: ¹ These devices are designed to be integrate into system that implement proper static protection mechanisms.

Section 7 Terms and definitions

7.1 Performance criterion

General performance criteria

The performance criteria are:

- performance criterion A for immunity tests with phenomena of a continuous nature;
- performance criterion B for immunity tests with phenomena of a transient nature;
- performance criterion C for immunity tests with power interruptions exceeding a certain time.

The equipment shall meet the minimum performance criteria as specified in the following clauses.

Criterion	During test	After test
A	Shall operate as intended. (see note 1).	Shall operate as intended.
	Shall be no loss of function.	Shall be no degradation of performance (see note 3).
	Shall be no unintentional transmissions.	Shall be no loss of function.
B	May show loss of function (one or more).	Shall be no loss of stored data or user programmable functions.
	May show degradation of performance (see note 2).	Functions shall be self-recoverable.
	Shall be no unintentional transmissions.	Shall operate as intended after recovering.
C	May be loss of function (one or more).	Shall be no degradation of performance (see note 3).
		Shall be no loss of stored data or user programmable functions.
		Functions shall be recoverable by the operator.

NOTE 1: Operate as intended during the test allows a level of degradation not below a minimum performance level specified by the manufacturer for the use of the apparatus as intended. In some cases the specified minimum performance level may be replaced by a permissible degradation of performance. If the minimum performance level or the permissible performance degradation is not specified by the manufacturer then either of these may be derived from the product description and documentation (including leaflets and advertising) and what the user may reasonably expect from the apparatus if used as intended.

NOTE 2: Degradation of performance during the test is understood as a degradation to a level not below a minimum performance level specified by the manufacturer for the use of the apparatus as intended. In some cases the specified minimum performance level may be replaced by a permissible degradation of performance.

If the minimum performance level or the permissible performance degradation is not specified by the manufacturer then either of these may be derived from the product description and documentation (including leaflets and advertising) and what the user may reasonably expect from the apparatus if used as intended.

NOTE 3: No degradation of performance after the test is understood as no degradation below a minimum performance level specified by the manufacturer for the use of the apparatus as intended. In some cases the specified minimum performance level may be replaced by a permissible degradation of performance. After the test no change of actual operating data or user retrievable data is allowed.

If the minimum performance level or the permissible performance degradation is not specified by the manufacturer then either of these may be derived from the product description and documentation (including leaflets and advertising) and what the user may reasonably expect from the apparatus if used as intended.

7.1 Performance criterion, continued

Performance criteria for Continuous phenomena applied to Transmitters (CT)

The performance criterion A shall apply.

Tests shall be repeated with the EUT in standby mode (if applicable) to ensure that unintentional transmission does not occur. In systems using acknowledgement signals, it is recognized that an ACKnowledgement (ACK) or Not ACKnowledgement (NACK) transmission may occur, and steps should be taken to ensure that any transmission resulting from the application of the test is correctly interpreted.

Performance criteria for Transient phenomena applied to Transmitters (TT)

The performance criterion B shall apply, except for voltage dips of 100 ms and voltage interruptions of 5 000 ms duration, for which performance criterion C shall apply.

Tests shall be repeated with the EUT in standby mode (if applicable) to ensure that unintentional transmission does not occur. In systems using acknowledgement signals, it is recognized that an acknowledgement (ACK) or not-acknowledgement (NACK) transmission may occur, and steps should be taken to ensure that any transmission resulting from the application of the test is correctly interpreted.

Performance criteria for Continuous phenomena applied to Receivers (CR)

The performance criterion A shall apply.

Where the EUT is a transceiver, under no circumstances, shall the transmitter operate unintentionally during the test. In systems using acknowledgement signals, it is recognized that an ACK or NACK transmission may occur, and steps should be taken to ensure that any transmission resulting from the application of the test is correctly interpreted.

Performance criteria for Transient phenomena applied to Receivers (TR)

The performance criterion B shall apply, except for voltage dips of 100 ms and voltage interruptions of 5 000 ms duration for which performance criterion C shall apply.

Where the EUT is a transceiver, under no circumstances, shall the transmitter operate unintentionally during the test. In systems using acknowledgement signals, it is recognized that an ACK or NACK transmission may occur, and steps should be taken to ensure that any transmission resulting from the application of the test is correctly interpreted.

7.2 General definitions

7.2.1 EN 61000-4-3: (Radiated, radio-frequency, electromagnetic field)

Continuous waves (CW)	Electromagnetic waves, the successive oscillations of which are identical under steady-state conditions, which can be interrupted or modulated to convey information.
Electromagnetic (EM) wave	Radiant energy produced by the oscillation of an electric charge characterized by oscillation of the electric and magnetic fields.
Field strength	The term "field strength" is applied only to measurements made in the far field. The measurement may be of either the electric or the magnetic component of the field and may be expressed as V/m, A/m or W/m ² ; any one of these may be converted into the others.
Sweep	Continuous or incremental traverse over a range of frequencies.

Section 8 Testing data

8.1 Clause 8.2 – Enclosure port of ancillary equipment measured on a stand alone basis

8.1.1 References and limits

EN 55032:2015

Table 8.1-1: Requirements as per EN 55032 for radiated emissions

Facility	Frequency range [MHz]	Measurement		limits [dBμV/m]
		Distance [m]	Detector type/ bandwidth	
Equipment not intended to be used in telecommunication centers and industrial environments				
OATS/SAC	30–230	3	Quasi Peak/120 kHz	40.0
	230–1000			47.0
FSOATS	1000–3000	3	CAverage/1 MHz	50.0
	3000–6000			54.0
FSOATS	1000–3000	3	Peak/1 MHz	70.0
	3000–6000			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 relevant 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 a vertical and horizontal scans. The spectral scans have been corrected with the associated applicable 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 has 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 6 GHz

Table 8.1-2: Frequency range

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

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 Powered
EUT setup configuration	Table top
Test facility	Semi anechoic chamber
Measuring distance	3 m
Antenna height variation	1–4 m
Turn table position	0–360°
Measurement details	A preview measurement was generated with receiver in continuous scan or sweep mode while the EUT was rotated and 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: *Clause 8.2 – Enclosure port of ancillary equipment measured on a stand alone basis 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: *Clause 8.2 – Enclosure port of ancillary equipment measured on a stand alone basis test software details*

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

8.1.5 Test data

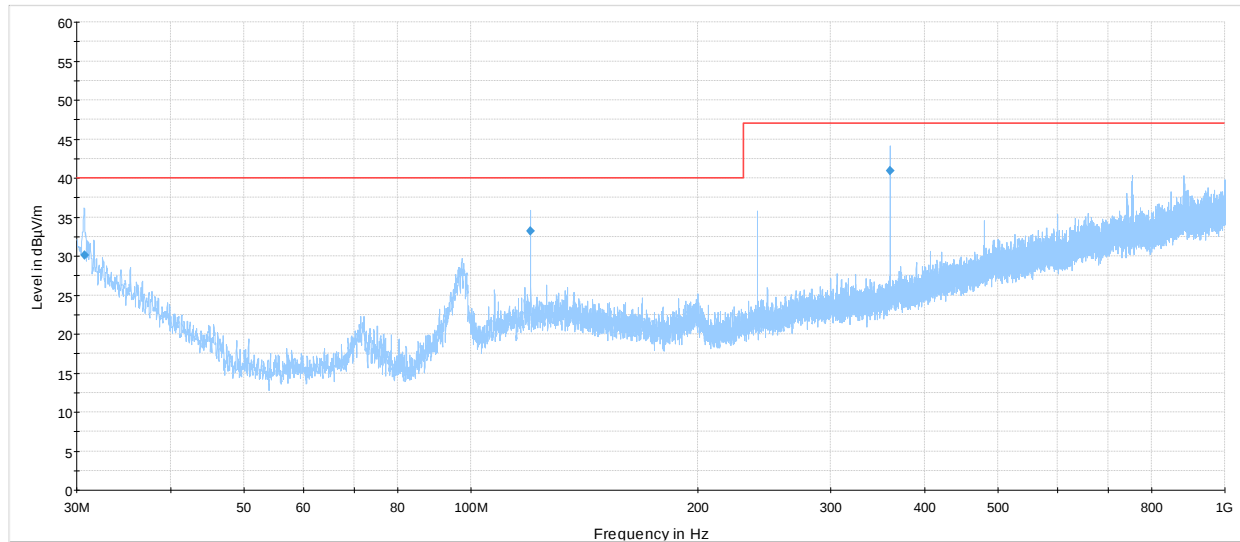


Figure 8.1-1: Clause 8.2 – Enclosure port of ancillary equipment measured on a stand alone basis spectral plot (30 to 1000 MHz)

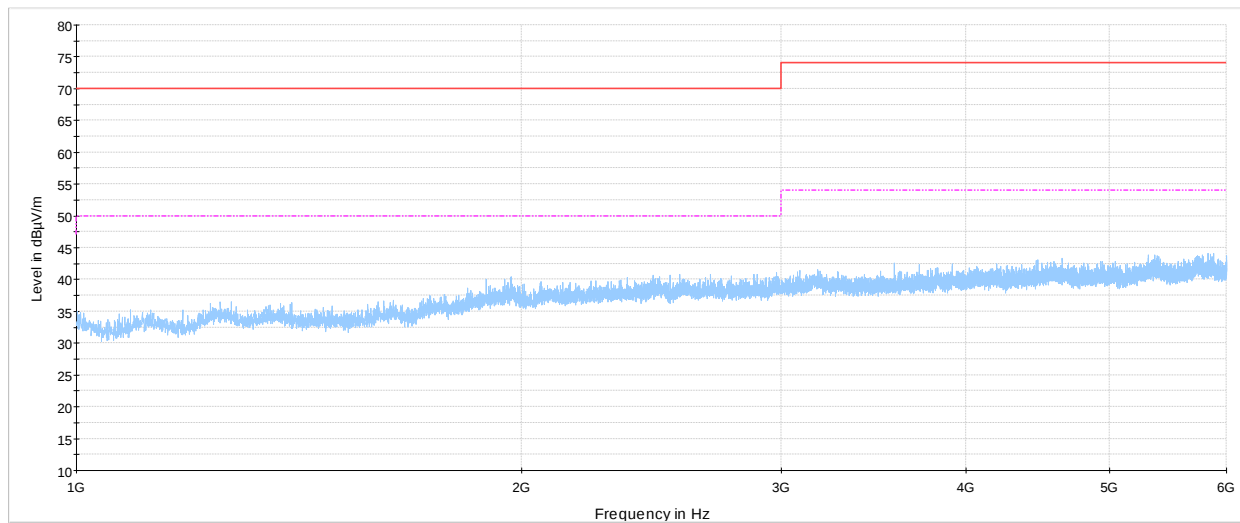


Figure 8.1-2: Clause 8.2 – Enclosure port of ancillary equipment measured on a stand alone basis spectral plot (1 to 6 GHz)

Test data, continued

Table 8.1-5: *Clause 8.2 – Enclosure port of ancillary equipment measured on a stand alone basis (Quasi-Peak) results*

Frequency (MHz)	Quasi-Peak field strength ¹ (dBμV/m)	Quasi-Peak limit ³ (dBμV/m)	Quasi-Peak margin (dB)	Correction factor ² (dB)
30.729	30.1	40.0	9.9	24.6
119.995	33.2	40.0	6.8	18.7
359.997	40.9	47.0	6.1	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 photo



Figure 8.1-3: Clause 8.2 – Enclosure port of ancillary equipment measured on a stand alone basis setup photo (30 to 1000 MHz)

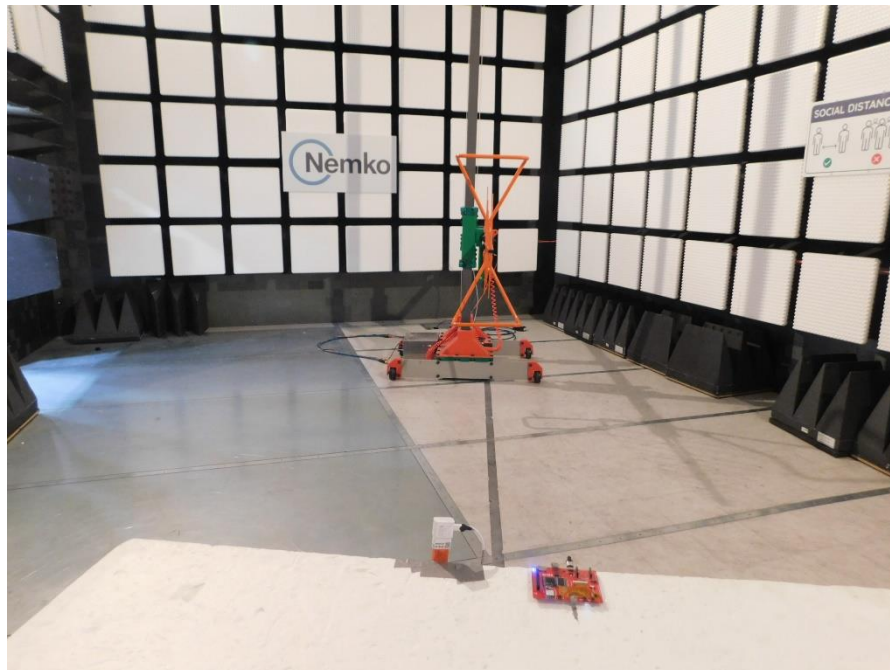


Figure 8.1-4: Clause 8.2 – Enclosure port of ancillary equipment measured on a stand alone basis setup photo (30 to 1000 MHz)

Setup photo, continued

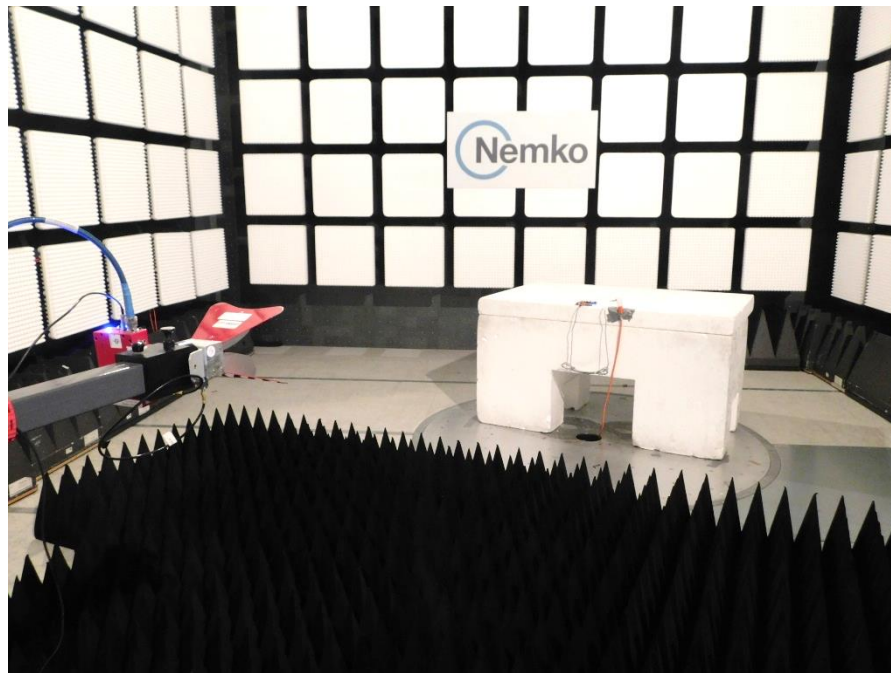


Figure 8.1-5: Clause 8.2 – Enclosure port of ancillary equipment measured on a stand alone basis setup photo (1 to 6 GHz)

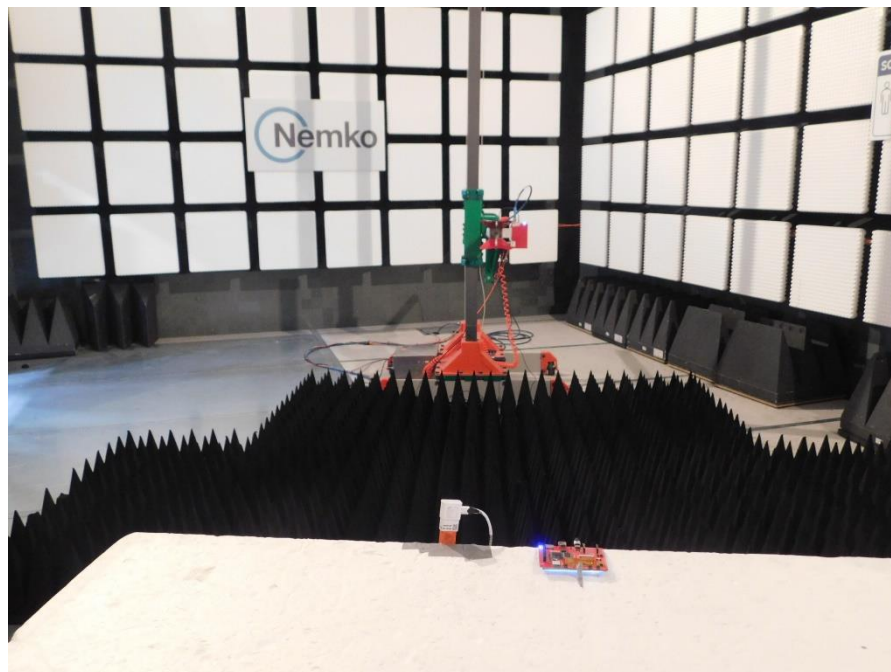


Figure 8.1-6: Clause 8.2 – Enclosure port of ancillary equipment measured on a stand alone basis setup photo (1 to 6 GHz)

8.2 Clause 9.2 – Radio frequency electromagnetic field

8.2.1 References and limits

EN 61000-4-3: 2006 + A1: 2008 + A2: 2010

Table 8.2-1: Clause 9.2 – Radio frequency electromagnetic field specification

Test specification	Performance criteria
80–6000 MHz, 3 V/m (unmodulated), 80 % AM (1 kHz)	Continuous phenomena

8.2.2 Test summary

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

8.2.3 Notes

None

8.2.4 Setup details

Table 8.2-2: Clause 9.2 – Radio frequency electromagnetic field equipment list

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
3 m EMI test chamber	TDK	SAC-3	FA003012	1 year	April 10, 2021
Signal generator	Rohde & Schwarz	SMB100A	FA002968	1 year	Nov 12, 2021
Amplifier (80–1000 MHz, 250 W)	AR	250W1000C	FA003008	—	NCR
Amplifier (1–6 GHz, 125 W)	AR	125S1G6	FA003004	—	NCR
Directional coupler (80–1000 MHz)	AR	Dc6180A	FA002973	1 year	April 08, 2021
Directional coupler (0.7–6 GHz)	AR	Dc725A	FA002994	1 year	April 08, 2021
Power sensor	Rohde & Schwarz	Nrp-6A	FA002962	1 year	Nov 13, 2021
BiConilog Antenna (26–2000 MHz)	EMCO	3141	FA003128	—	NCR
Horn antenna (1–18 GHz)	EMCO	3115	FA000649	1 year	Dec 18, 2020
Starprobe (0.1–6000 MHz)	AR	FI7006	FA002961	1 year	Dec 30, 2020

Notes: NCR - no calibration required

Table 8.2-3: Clause 9.2 – Radio frequency electromagnetic field test software details

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

8.2.5 Test data

Table 8.2-4: *Clause 9.2 – Radio frequency electromagnetic field results*

Step size increment	1 %
Dwell time	1 s
Antenna polarization	Vertical and Horizontal
Modulation	CW signal amplitude modulated (AM) with 80 % depth with a 1 kHz sine wave
EUT setup configuration	Table top
EUT power input during test	5 V _{DC} USB Powered
EUT position facing antenna	Front side, back side, top side, bottom side, left side and right side

Frequency range, MHz		Test level, V/m	Comments
80	6000	3	No degradation

Notes: The dwell time at each frequency was not less than the time necessary for the EUT to be exercised and to be able to respond. The time to exercise the EUT is not interpreted as a total time of a program or a cycle but related to the reaction time in case of failure of the EUT.

8.2.6 Setup photo

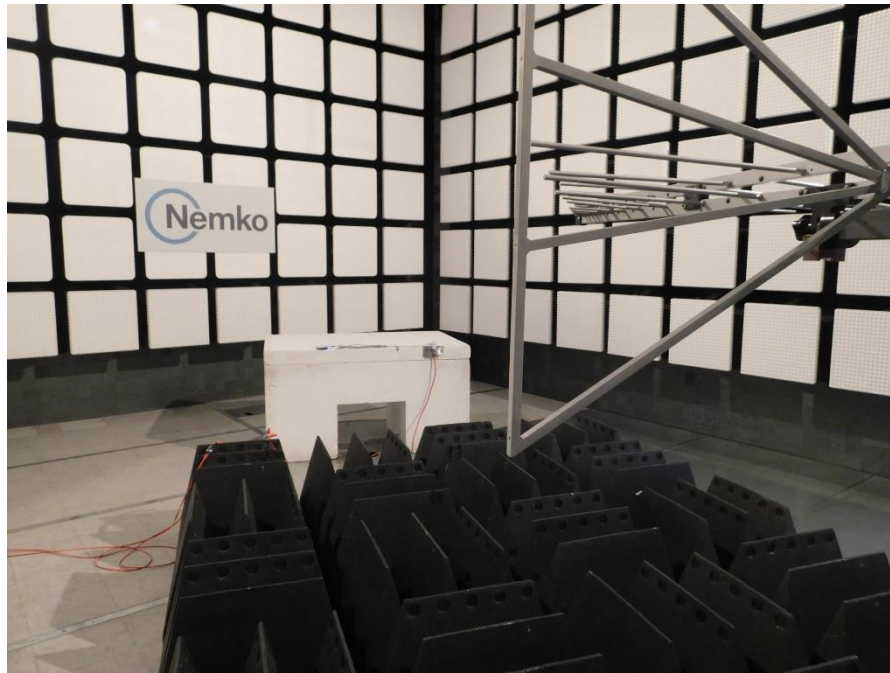


Figure 8.2-1: Clause 9.2 – Radio frequency electromagnetic field setup photo



Figure 8.2-2: Clause 9.2 – Radio frequency electromagnetic field setup photo

Section 9 EUT photos

9.1 External photos

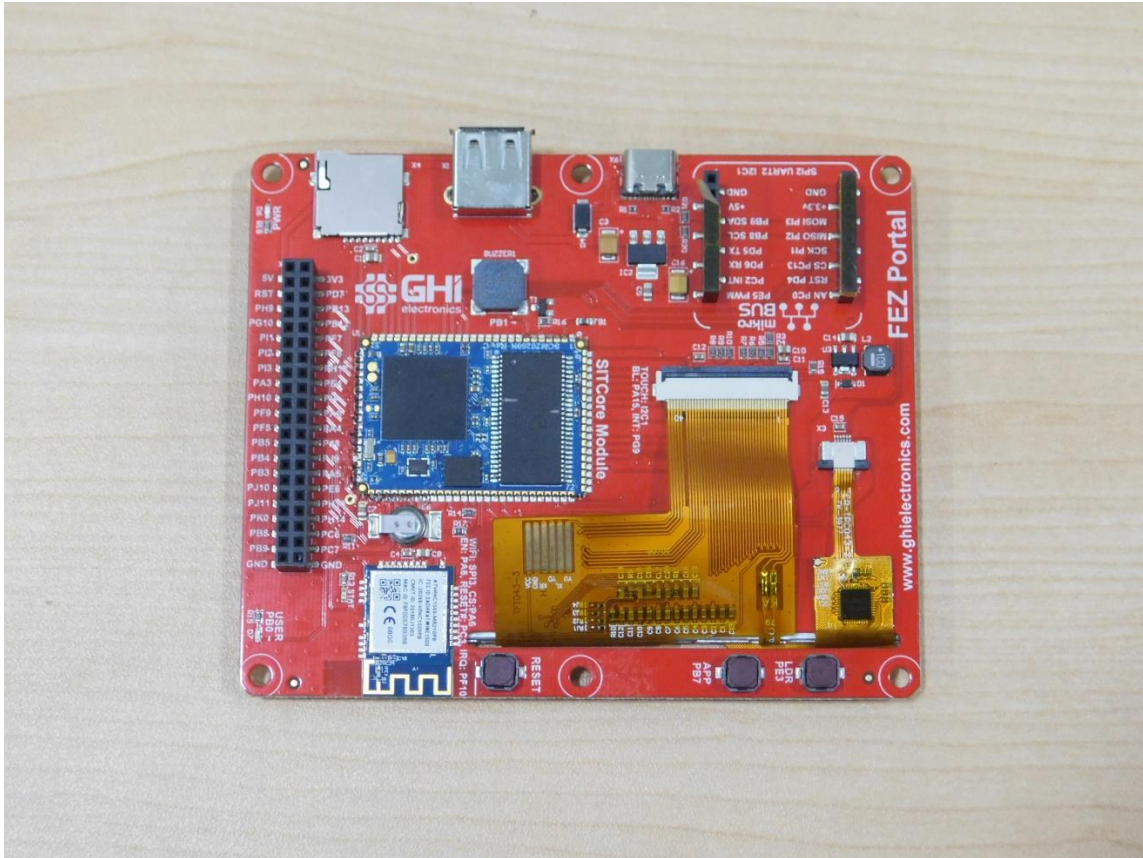


Figure 9.1-1: Top view photo

External photos continued



Figure 9.1-2: Bottom view photo

External photos continued



Figure 9.1-3: Side view photo

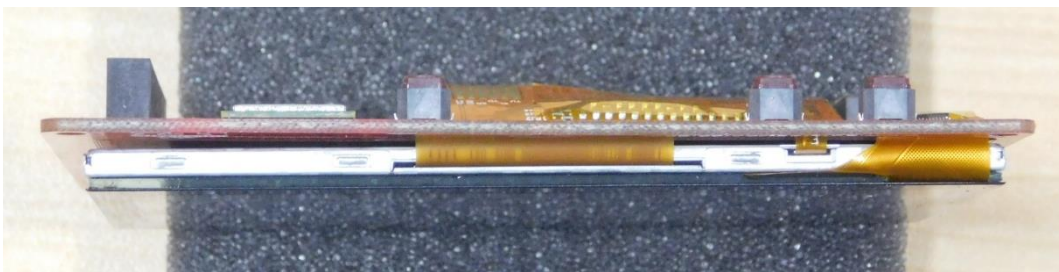


Figure 9.1-4: Side view photo



Figure 9.1-5: Side view photo



Figure 9.1-6: Side view photo

End of the test report