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EMC TEST REPORT 367906-1R1TRFEMC

Applicant:

ROTRONIC AG

Product:

Rotronic Monitoring System (RMS)

Models:

RMS-GW-915, RMS-MLOG-BT-915, RMS-Dongle-915, RMS-MLOG-LGT-915, RMS-MADC-915-V, RMS-MDI-915 and RMS-LOG-T30-915

Specifications:

- FCC 47 CFR Part 15, Subpart B – Verification
- ICES-003 Issue 6 January 2016

Date of issue: February 12, 2019

Test engineer(s):	Mark Libbrecht , Wireless/EMC Specialist	Signature:	Mark Libbrecht
Reviewed by:	David Duchesne, Senior EMC/Wireless Specialist	Signature:	

Lab and test locations

Company name	Nemko Canada Inc.	
Facility	GTA site: 130 Saltsmans Drive #1, Cambridge, ON, Canada, N3E 0B2 Tel: +1 519 680 4811	
Test site registration	**Organization**	**Recognition numbers and location**
	FCC	CA0101
	ISED	CA0101
Website	www.nemko.com	

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 Canada's ISO/IEC 17025 accreditation.

Copyright notification

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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
ICES-003 Issue 6 January 2016	Information Technology Equipment (ITE) – Limits and methods of measurement

1.2 Exclusions

None

1.3 Statement of compliance

In the configuration tested, the EUT was found compliant.

Testing was performed against all relevant requirements of the test standard except as noted in section 1.2 above. 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	February 5, 2019	Original report issued
R1	February 12, 2019	Correction of Figure 3.4 1: block diagram, and Table 3.4 1: EUT sub assemblies.

Section 2 Summary of test results

2.1 Testing period

Test start date	January 17, 2019
Test end date	January 18, 2019

2.2 North America test results

Table 2.2-1: *Result summary for emissions*

Standard	Clause	Test description	Verdict
FCC 47 CFR Part 15, Subpart B	§15.109	Radiated emissions limits[1]	Pass
FCC 47 CFR Part 15, Subpart B	§15.107	Conducted emissions limits (AC mains) [1]	Pass
ICES-003 Issue 6	6.1	AC Power Line Conducted Emissions Limits[1]	Pass
ICES-003 Issue 6	6.2	Radiated Emissions Limits[1]	Pass

Notes: [1] Product classification A

[2] The EUT can be powered by 24 V_{DC} adapter or PoE; both configurations were tested.

Section 3 Equipment under test (EUT) details

3.1 Applicant/Manufacturer

Company name	ROTRONIC AG
Address	Grindelstrasse 6, CH-8303 Bassersdorf, Switzerland

3.2 Sample information

Receipt date	January 17, 2019
Nemko sample ID number	Item 1, 2, 3, 4, 5, 6 and 7

3.3 EUT information

Product name	Rotronic Monitoring System (RMS)
Models/ Part numbers	– RMS-GW-915 – RMS-MLOG-BT-915 – RMS-Dongle-915 – RMS-MLOG-LGT-915 – RMS-MADC-915-V – RMS-MDI-915 – RMS-LOG-T30-915
Serial numbers	– RMS-GW-915, SN:61842907 – RMS-MLOG-BT-915, SN:117000165 – RMS-Dongle-915, SN: None – RMS-MLOG-LGT-915, SN:117000111 – RMS-MADC-915-V, SN:117000119 – RMS-MDI-915, SN:117000146 – RMS-LOG-T30-915, SN:4121801
Power requirements	– 24 V_{DC} via AC/DC adapter or 48 V_{DC} PoE (Gateway RMS-GW-915) – 24 V_{DC} via AC/DC adapter (RMS-LOG-T30-915) – 3.6V AA-batteries (RMS-MLOG-LGT-915, RMS-MADC-915-V, RMS-MDI-915, RMS-LOG-T30-915)
Description/theory of operation	The Rotronic Monitoring System is a wireless data logging system for real-time monitoring of critical environments. The wireless data loggers communicate to the monitoring system via the gateway. Transmission of the data loggers to the gateway are as frequent as 10 seconds up to 15 minutes.
Operational frequencies	– Radio frequencies: 912.5, 913, 913.5, 914, 914.5, 915, 915.5, 916, 916.5, 917, 917.5 MHz – 16 MHz internal clock: RMS-MLOG-LGT-915, RMS-MADC-915-V, RMS-MDI-915, RMS-LOG-T30-915 – 32 MHz internal clock: RMS-LOG-T30-915 – 32 MHz, 125 MHz internal clock: RMS-GW-915
Software details	– RMS-GW-915, N/A – RMS-MLOG-BT-915, V1.2 – RMS-Dongle-915, N/A – RMS-MLOG-LGT-915, V1.3 – RMS-MADC-915-V, V1.3 – RMS-MDI-915, V1.3 – RMS-LOG-T30-915, V1.0

3.4 EUT setup details

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

- All the EUTs being exercised were powered either by battery, 24 V_{DC} adapter or POE injector.
- Communication between the EUTs and the RMS software/database was prohibited.
- The EUTs functioned as expected under these conditions.

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:
- None
- The EUT was setup 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:
- The following deviations were:
- None

EUT monitoring method:

- The devices were first paired to the software system to ensure they were online and communication.
- The device reset buttons were each applied one at a time to stop RF transmitting and communication.
- Loss of communication to the software cloud confirmed that RF communication had stopped.

3.4 EUT setup details, continued

Table 3.4-1: *EUT sub assemblies*

Description	Brand name	Model, Part number, Serial number, Revision level
Gateway	Rotronic	RMS-GW-915 (SN:61842907)
Internal Temperature Logger	Rotronic	RMS-MLOG-BT-915 (SN:117000165)
External Temperature Logger	Rotronic	RMS-Dongle-915 (SN: none)
Internal Temperature and Humidity Logger	Rotronic	RMS-MLOG-LGT-915 (SN:117000111)
Temperature and Humidity Data Logger, External Probe	Rotronic	RMS-MADC-915-V (SN:117000119)
Analog Input Module	Rotronic	RMS-MDI-915 (SN:117000146)
Temperature and Humidity Data Logger, External Probe	Rotronic	RMS-LOG-T30-915 (SN:4121801)
AC/DC Adapter for Gateway and RMS-LOG-T30-915	None	SKTC24001000
AC/USB Adapter for Dongle	SCOSCHE	USBH102
PoE Adapter for Gateway	TP-LINK	TL-POE150S

Table 3.4-2: *EUT interface ports*

Description	Qty.
Gateway – Ethernet	1
Gateway – DC input	1
Temperature and Humidity Data Logger, External Probe – Antenna port	1
Temperature and Humidity Data Logger, External Probe – DC input	1

Table 3.4-3: *Support equipment*

Description	Brand name	Model, Part number, Serial number, Revision level
PoE Injector	TP-LINK	MN: TL-POE150S, SN: 2173728013622
AC Adapter	TP-LINK	MN: T480050-2B1

Table 3.4-4: *Inter-connection cables*

Cable description	From	To	Length (m)
Ethernet	Gateway	PoE injector	1

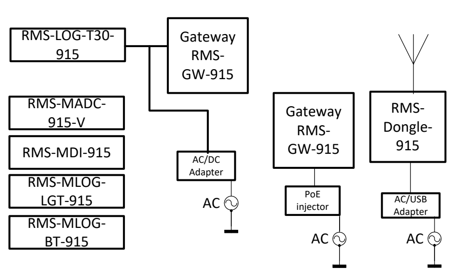


Figure 3.4-1: *block diagram*

Section 4 Engineering considerations

4.1 Modifications incorporated in the EUT for compliance

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

4.2 Technical judgment

None

4.3 Deviations from laboratory tests procedures

No deviations were made from laboratory procedures.

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 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 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	(150 kHz to 30 MHz)	3.4	2.2
Radiated disturbance (electric field strength at an OATS or 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	4.8
Radiated disturbance (electric field strength in a FAR)	(6 GHz to 18 GHz)	5.5	4.7

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

Section 7 Terms and definitions

7.1 Product classifications 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-003 – Equipment classification

Class B ITE	limits of radio noise for ITE for residential operation
Class A ITE	limits of radio noise for ITE for non-residential operation
Conditions	Only ITE intended strictly for non-residential use in commercial, industrial or business environments, and whose design or other characteristics strongly preclude the possibility of its use in a residential environment, shall be permitted to comply with the less stringent Class A limits. All ITE that cannot meet the conditions for Class A operation shall comply with the Class B limits. The ITE shall comply with both the power line – conducted and the radiated emissions limits within the same Class, with no intermixing.

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

Information technology equipment (ITE)	Information Technology Equipment (ITE) is defined as devices or systems that use digital techniques for purposes such as data processing and computation. ITE is any unintentional radiator (device or system) that generates and/or uses timing signals or pulses having a rate of at least 9 kHz and employs digital techniques for purposes such as computation, display, data processing and storage, and control.

Section 8 Testing data

8.1 Conducted emissions – from AC mains power ports

8.1.1 References and limits

- FCC 47 CFR Part 15, Subpart B: Clause §15.107 (Test method ANSI C63.4:2014)
- ICES-003: Section 6.1

Table 8.1-1: *Requirements for conducted emissions from the AC mains power ports for Class A*

Frequency range [MHz]	Measurement		Limits
	Coupling device	Detector type/ bandwidth	[dBµV]
0.15–0.5	AMN	Quasi Peak/9 kHz	79
0.5–30			73
0.15–0.5	AMN	CAverage/9 kHz	66
0.5–30			60

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

8.1.2 Test summary

Gateway and RMS-LOG-T30-915 with AC/DC Adapter

Verdict	Pass		
Test date	January 18, 2019	Temperature	23 °C
Test engineer	Mark Libbrecht	Air pressure	980 mbar
Test location	GTA	Relative humidity	33 %

Gateway with POE Injector

Verdict	Pass		
Test date	January 18, 2019	Temperature	23 °C
Test engineer	Mark Libbrecht	Air pressure	980 mbar
Test location	GTA	Relative humidity	33 %

Dongle AC/USB adapter

Verdict	Pass		
Test date	January 21, 2019	Temperature	23 °C
Test engineer	Mark Libbrecht	Air pressure	980 mbar
Test location	GTA	Relative humidity	33 %

8.1.3 Notes

- The spectral plots have been corrected with transducer factors. (i.e. cable loss, LISN factors, and attenuators).
- Where tabular data has not been provided, no emissions were observed within 10 dB of the specified limit when measured with the appropriate detector.
- 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.
- Conducted Emissions Set-ups
    1. Gateway and RMS-LOG-T30-915 with AC/DC adapter (system)
    2. Gateway with PoE Injector (system)
    3. Dongle with AC/USB Adapter (Dongle and adapter only)

8.1.4 Setup details

Port under test – Coupling device	AC Mains – Artificial Mains Network (AMN)
EUT power input during test	– 120 V_{AC}, 60 Hz (via PoE Injector or AC/DC adapter) – 120 V_{AC}, 60 Hz (via AC/USB 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 measurement), Quasi-peak and CAverage (Final measurement)
Trace mode	Max Hold
Measurement time	– 100 ms (Peak and Average preview measurement) – 100 ms (Quasi-peak final measurement) – 160 ms (CAverage final measurement)

Table 8.1-2: *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	Jan. 30/19
LISN	Rohde & Schwarz	ENV216	FA002964	1 year	Mar. 27/19

Notes: None

Table 8.1-3: *Conducted emissions – from AC mains power ports test software details*

Manufacturer of Software	Details
Rohde & Schwarz	EMC32, Software for EMC Measurements, Version 10.40.10

8.1.5 Test data

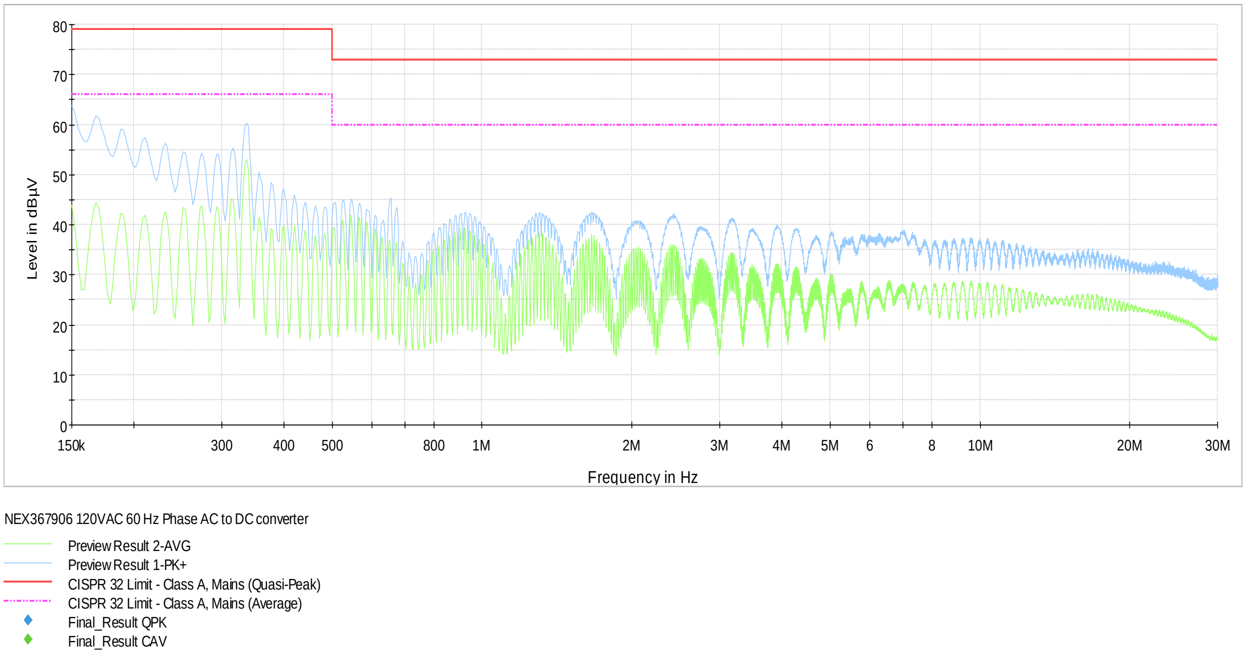


Figure 8.1-1: *Conducted emissions – from AC mains power ports spectral plot on phase line,* Gateway and RMS-LOG-T30-915 with AC/DC adapter

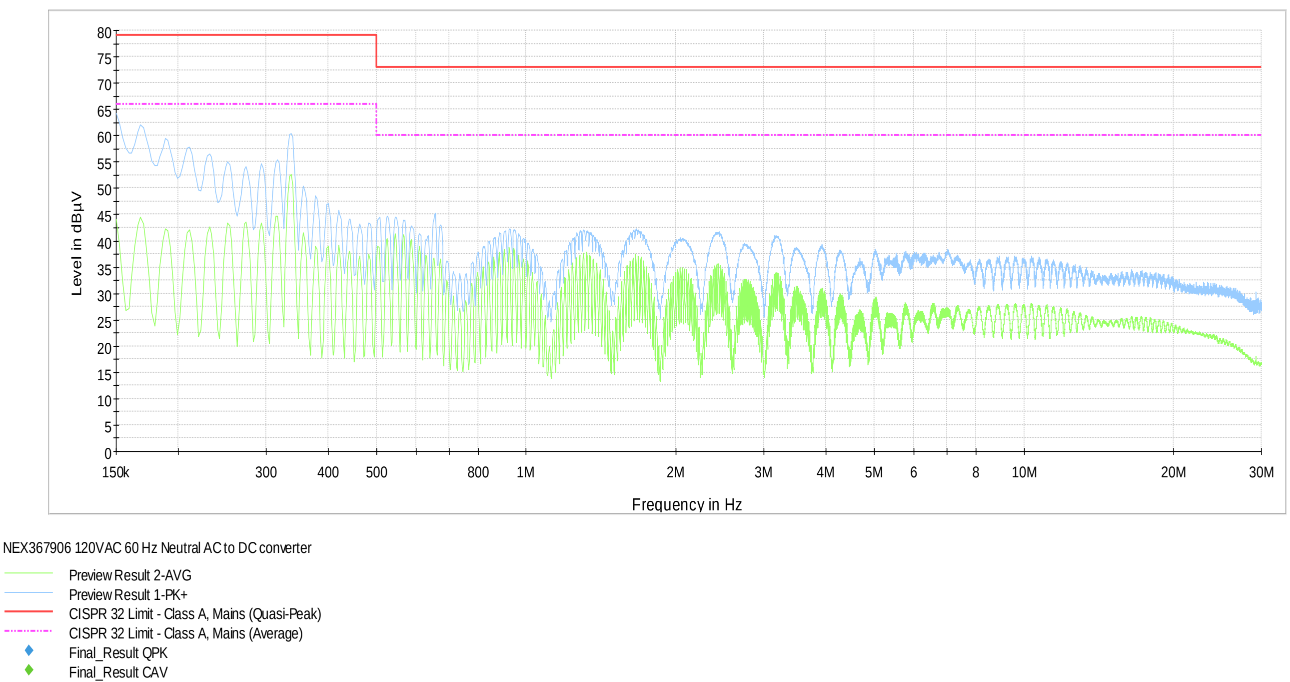
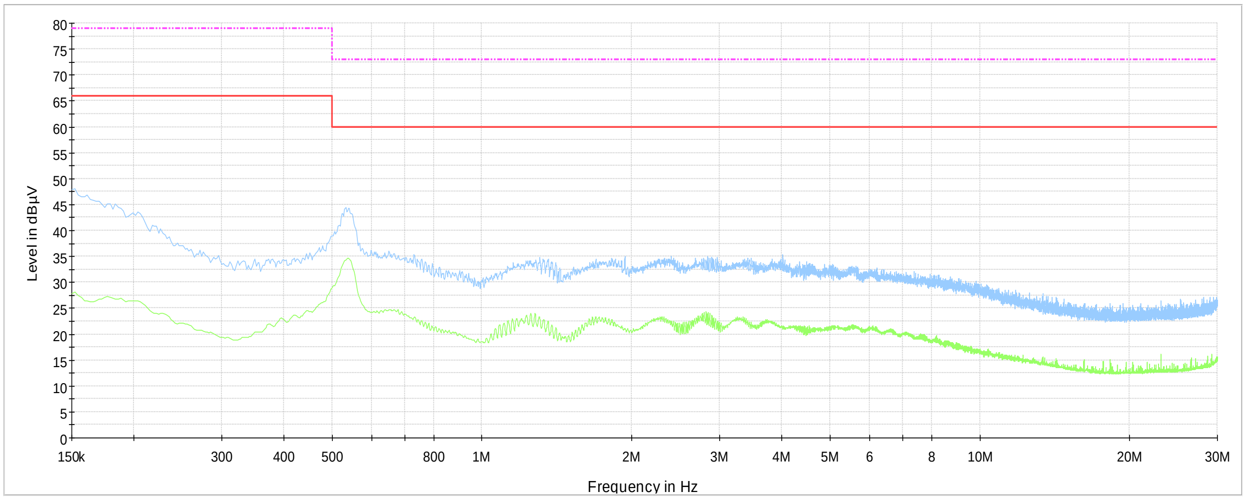


Figure 8.1-2: *Conducted emissions – from AC mains power ports spectral plot on neutral line,* Gateway and RMS-LOG-T30-915 with AC/DC adapter

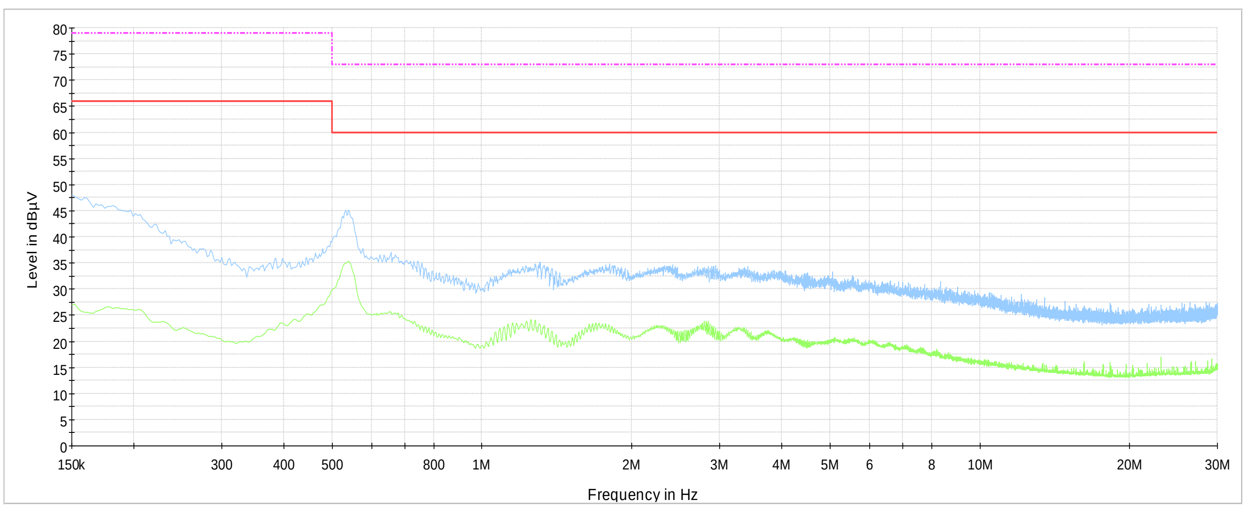
8.1.5 Test data, continued



367906 120VAC 60Hz Phase POE converter

- Preview Result 2-AVG
- Preview Result 1-PK+
- CISPR 32 Limit - Class A, Mains (Average)
- CISPR 32 Limit - Class A, Mains (Quasi-Peak)
- Final_Result QPK
- Final_Result CAV

Figure 8.1-3: *Conducted emissions – from AC mains power ports spectral plot on phase line, Gateway with PoE Injector*

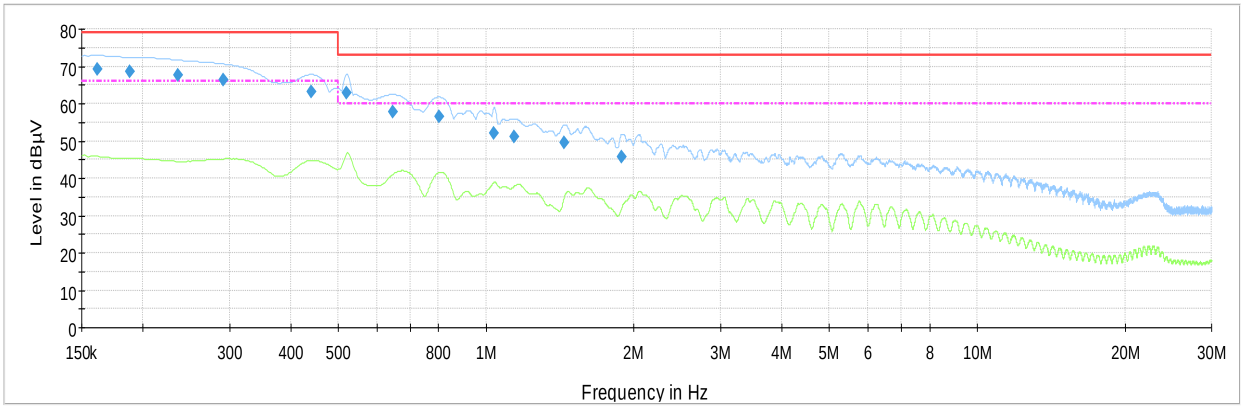


367906 120VAC 60 Hz Neutral POE converter

- Preview Result 2-AVG
- Preview Result 1-PK+
- CISPR 32 Limit - Class A, Mains (Average)
- CISPR 32 Limit - Class A, Mains (Quasi-Peak)
- Final_Result QPK
- Final_Result CAV

Figure 8.1-4: *Conducted emissions – from AC mains power ports spectral plot on neutral line, Gateway with PoE Injector*

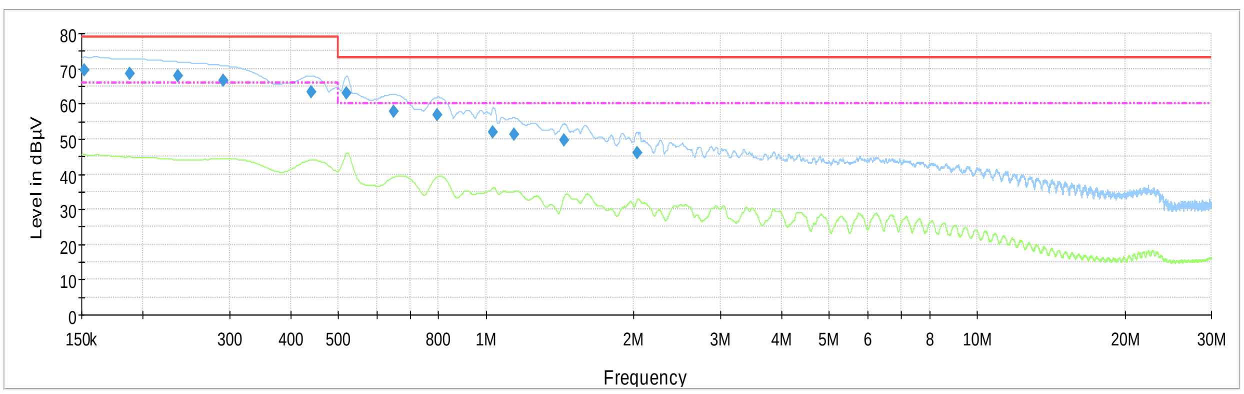
8.1.5 Test data, continued



NEX367906 150kHz - 30 MHz 120VAC 60 Hz Phase Dongle

- Preview Result 2-AVG
- Preview Result 1-PK+
- CISPR 32 Limit - Class A, Mains (Quasi-Peak)
- CISPR 32 Limit - Class A, Mains (Average)
- Final_Result QPK
- Final_Result CAV

Figure 8.1-5: *Conducted emissions – from AC mains power ports spectral plot on phase line, Dongle AC/USB adapter*



NEX367906 150kHz - 30 MHz 120VAC 60 Hz Neutral Dongle

- Preview Result 2-AVG
- Preview Result 1-PK+
- CISPR 32 Limit - Class A, Mains (Quasi-Peak)
- CISPR 32 Limit - Class A, Mains (Average)
- Final_Result QPK
- Final_Result CAV

Figure 8.1-6: *Conducted emissions – from AC mains power ports spectral plot on neutral line, Dongle AC/USB adapter*

8.1.5 Test data, continued

Table 8.1-4: *Conducted emissions – from AC mains power ports (Quasi-Peak) results – Dongle AC/USB adapter*

Frequency (MHz)	Quasi-Peak result[1 and 3] (dBµV)	Quasi-Peak limit (dBµV)	Margin (dB)	Measurement time (ms)	Bandwidth (kHz)	Conductor	Filter	Correction factor[2] (dB)
0.161	69.1	79.0	9.9	100	9	L1	ON	15.6
0.188	68.5	79.0	10.5	100	9	L1	ON	15.6
0.236	67.7	79.0	11.3	100	9	L1	ON	15.6
0.292	66.4	79.0	12.6	100	9	L1	ON	15.6
0.440	63.1	79.0	15.9	100	9	L1	ON	15.7
0.519	62.9	73.0	10.1	100	9	L1	ON	15.8
0.645	57.7	73.0	15.3	100	9	L1	ON	15.8
0.803	56.6	73.0	16.4	100	9	L1	ON	15.8
1.037	52.0	73.0	21.0	100	9	L1	ON	15.7
1.138	51.1	73.0	21.9	100	9	L1	ON	15.7
1.442	49.5	73.0	23.5	100	9	L1	ON	15.7
1.889	45.8	73.0	27.2	100	9	L1	ON	15.7
0.152	69.6	79.0	9.4	100	9	N	ON	15.6
0.188	68.6	79.0	10.4	100	9	N	ON	15.6
0.236	67.9	79.0	11.1	100	9	N	ON	15.6
0.292	66.6	79.0	12.4	100	9	N	ON	15.7
0.440	63.2	79.0	15.8	100	9	N	ON	15.7
0.519	63.0	73.0	10.0	100	9	N	ON	15.8
0.650	57.7	73.0	15.3	100	9	N	ON	15.8
0.796	56.7	73.0	16.3	100	9	N	ON	15.8
1.032	52.1	73.0	20.9	100	9	N	ON	15.7
1.138	51.2	73.0	21.8	100	9	N	ON	15.7
1.444	49.5	73.0	23.5	100	9	N	ON	15.7
2.033	46.0	73.0	27.0	100	9	N	ON	15.7

Notes:
[1] Result (dBµV) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factor (dB) = LISN factor IL (dB) + cable loss (dB) + attenuator (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 have been recorded.

Sample calculation: 69.1 dBµV (result) = 53.5 dBµV (receiver reading) + 15.6 dB (Correction factor)

8.1.6 Setup photos

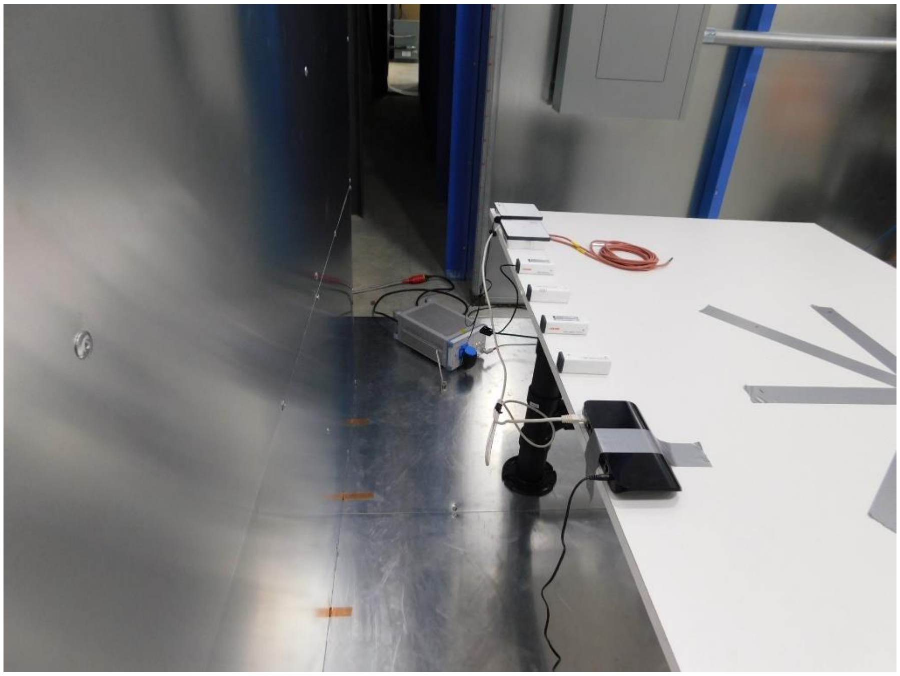


Figure 8.1-7: *Conducted emissions – from AC mains power ports setup* - Gateway and RMS-LOG-T30-915 with AC/DC adapter

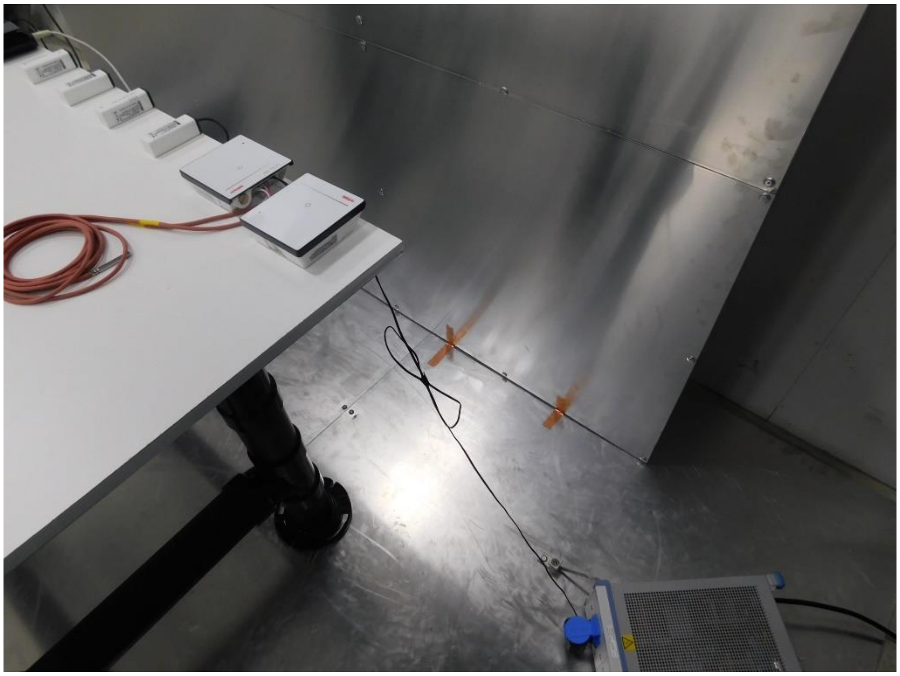


Figure 8.1-8: *Conducted emissions – from AC mains power ports setup* - Gateway and RMS-LOG-T30-915 with AC/DC adapter

8.1.6 Setup photos, continued

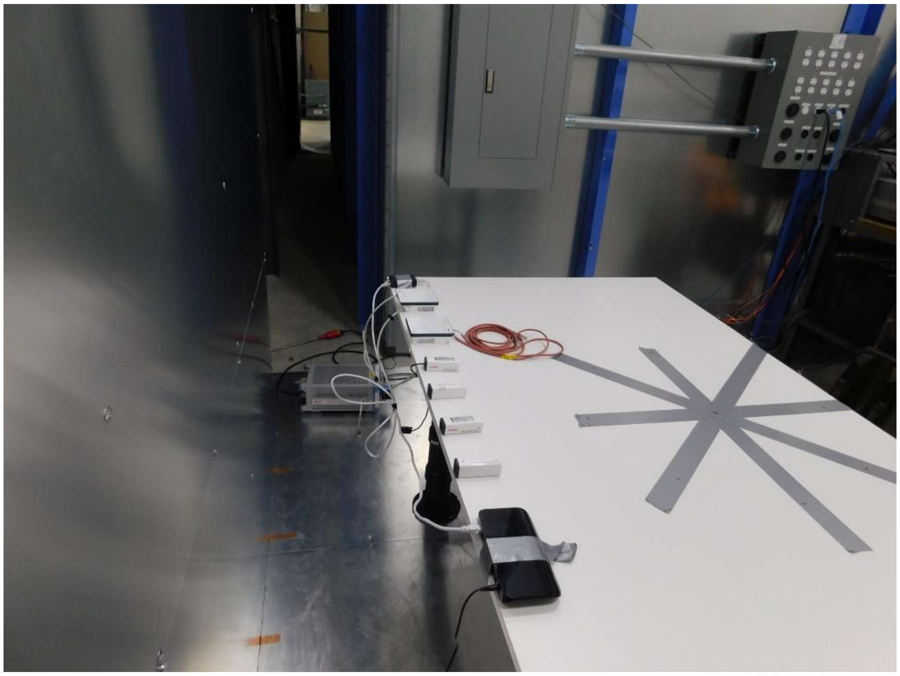


Figure 8.1-9: *Conducted emissions – from AC mains power ports setup - Gateway with PoE Injector*

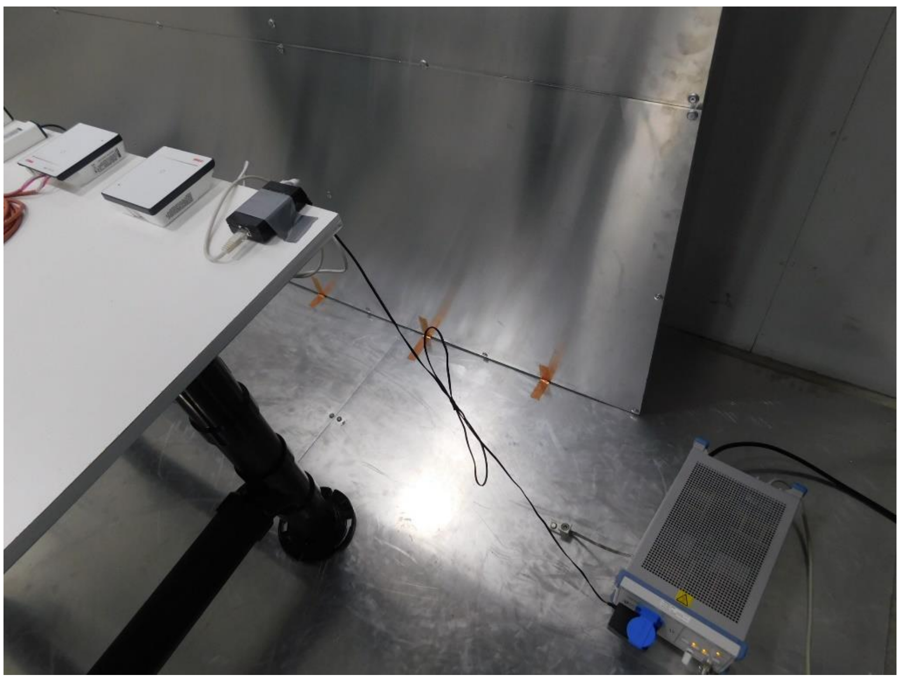


Figure 8.1-10: *Conducted emissions – from AC mains power ports setup – Gateway with PoE Injector*

8.1.6 Setup photos, continued

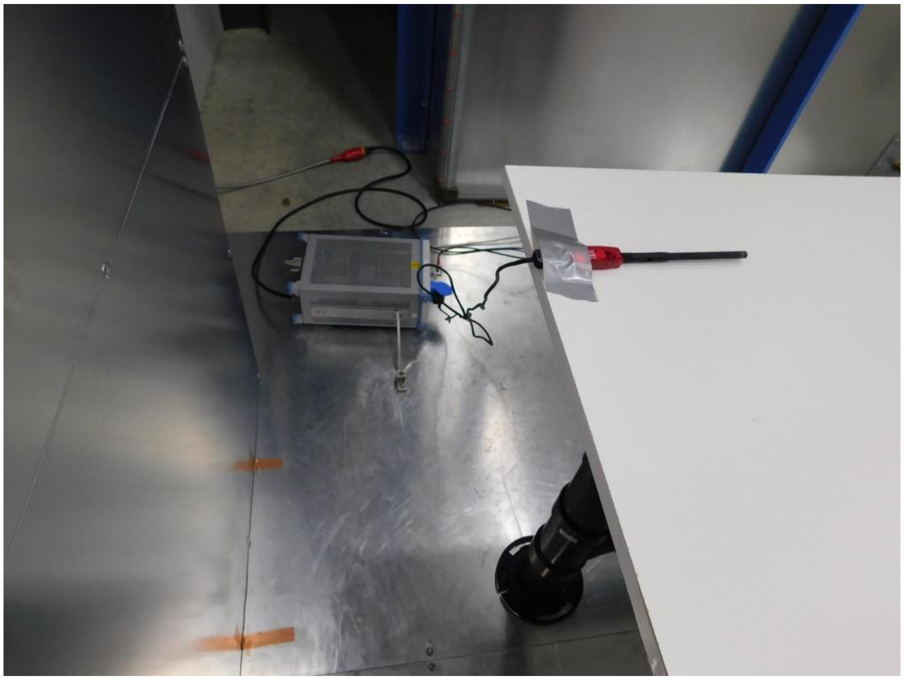


Figure 8.1-11: *Conducted emissions – from AC mains power ports setup Dongle with AC/USB Adapter*

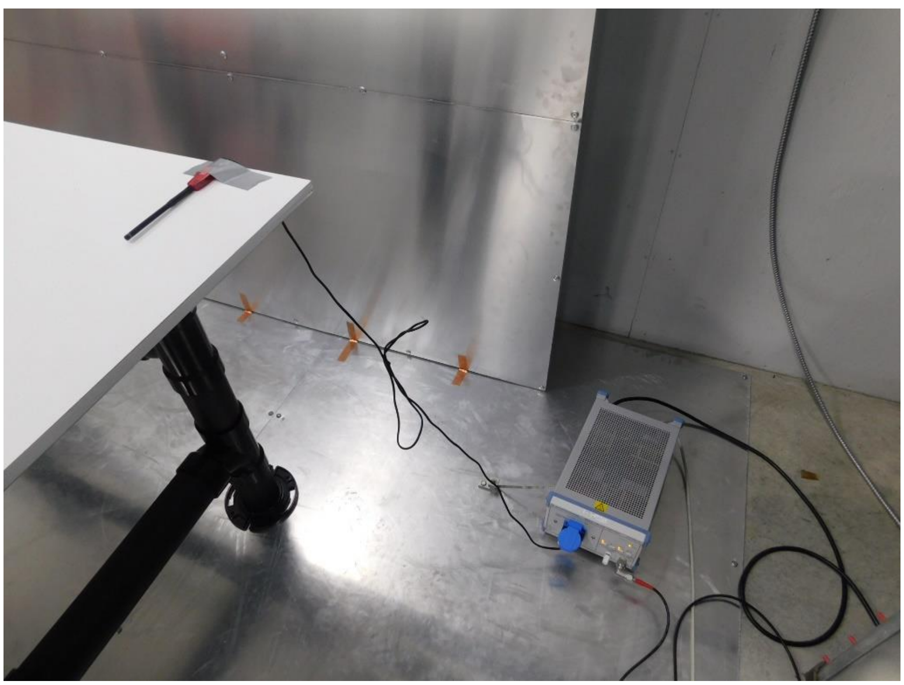


Figure 8.1-12: *Conducted emissions – from AC mains power ports setup – Dongle with AC/USB Adapter*

8.2 Radiated emissions

8.2.1 References and limits

- FCC 47 CFR Part 15, Subpart B: Clause §15.109 (Test method ANSI C63.4:2014)
- ICES-003: Section 6.2

Table 8.2-1: *Requirements as per FCC Part 15 Subpart B and ICES-003 for radiated emissions for Class A*

Frequency range [MHz]	Measurement		limits
	Distance [m]	Detector type/ bandwidth	[dBµV/m]
30–88	3	Quasi Peak/120 kHz	49.5
88–216			54.0
216–960			56.9
960–1000			60.0
>1000	3	Linear average/1 MHz	60.0
		Peak/1 MHz	80.0

Notes: Where there is a step in the relevant limit, the lower value was applied at the transition frequency.

8.2.2 Test summary

System with AC/DC adapter

Verdict	Pass		
Test date	January 21, 2019	Temperature	24 °C
Test engineer	Mark Libbrecht	Air pressure	975 mbar
Test location	GTA	Relative humidity	33 %

System with POE Injector

Verdict	Pass		
Test date	January 21, 2019	Temperature	24 °C
Test engineer	Mark Libbrecht	Air pressure	975 mbar
Test location	GTA	Relative humidity	33 %

8.2.3 Notes

- The spectral scans have been corrected with the associated transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators.
- Where tabular data has not been provided, no emissions were observed within 10 dB of the specified limit when measured with the appropriate detector.
- 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 highest operating digital frequency of the EUT as provided by the client was 125 MHz. The spectrum was scanned to 6 GHz for information purpose.

8.2.4 Setup details

Port under test	Enclosure Port
EUT power input during test	24 V_{DC} via AC/DC adapter 48 V_{DC} via PoE injector
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 for frequencies below 1 GHz:

Resolution bandwidth	120 kHz
Video bandwidth	300 kHz
Detector mode	Peak (Preview measurement), Quasi-peak (Final measurement)
Trace mode	Max Hold
Measurement time	100 ms (Peak preview measurement), 100 ms (Quasi-peak final measurement)

Receiver/spectrum analyzer settings for frequencies above 1 GHz:

Resolution bandwidth	1 MHz
Video bandwidth	3 MHz
Detector mode	Peak (Preview measurement) Peak and CAverage (Final measurement)
Trace mode	Max Hold
Measurement time	100 ms (Peak preview measurement), 100 ms (Peak and CAverage final measurement)

Table 8.2-2: *Radiated emissions equipment list*

Equipment	Manufacturer	Model no.	Serial no.	Asset no.	Cal./Ver. cycle	Next cal./ver.
3 m EMI test chamber	TDK	SAC-3		FA003012	1 year	Aug. 22/19
Flush mount turntable	SUNAR	FM2022		FA003006	—	NCR
Controller	SUNAR	SC110V	050118-1	FA002976	—	NCR
Antenna mast	SUNAR	TLT2	042418-5	FA003007	—	NCR
Receiver/spectrum analyzer	Rohde & Schwarz	ESR26	101367	FA002969	1 year	Jan. 30/19
Horn antenna (1–18 GHz)	ETS-Lindgren	3117	00052793	FA002911	1 year	Aug. 16/19
Preamp (1–18 GHz)	ETS-Lindgren	124334	00224880	FA002956	1 year	Sept 18/19
Bilog antenna (30–2000 MHz)	SUNAR	JB1	A053018-1	FA003009	1 year	Sept. 6/19
50 Ω coax cable	Huber + Suhner	None	457630	FA003047	1 year	Nov 12/19
50 Ω coax cable	Huber + Suhner	None	457624	FA003044	1 year	Nov 12/19

Notes: NCR - no calibration required

Table 8.2-3: *Radiated emissions test software details*

Manufacturer of Software	Details
Rohde & Schwarz	EMC32, Software for EMC Measurements, Version 10.40.10

8.2.5 Test data

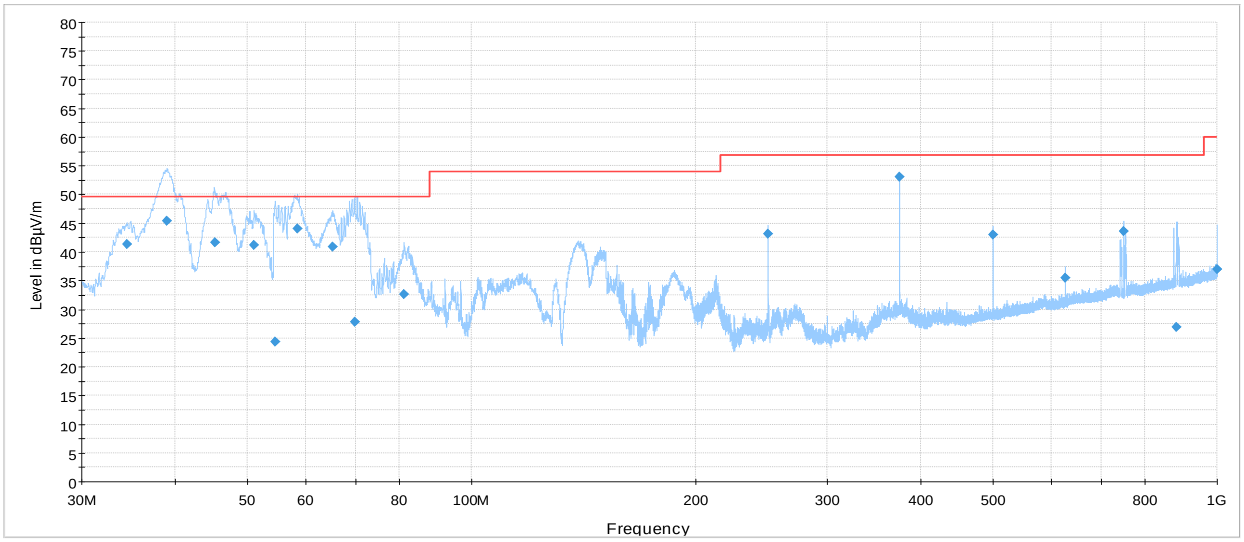


Figure 8.2-1: *Radiated emissions spectral plot (30 to 1000 MHz), System with AC/DC adapter*

Table 8.2-4: *Radiated emissions (Quasi-Peak) System with AC/DC Adapter*

Frequency (MHz)	Quasi-Peak field strength[1] (dBµV/m)	3 m Quasi-Peak limit [3] (dBµV/m)	Margin (dB)	Measurement time (ms)	Bandwidth (kHz)	Antenna height (cm)	Pol. (V/H)	Turn table position (°)	Correction factor[2] (dB)
34.500	41.4	49.6	8.2	100	120	108.0	V	279	19.1
39.000	45.4	49.6	4.2	100	120	100.0	V	71	15.6
45.240	41.7	49.6	7.9	100	120	108.0	V	55	11.3
51.030	41.2	49.6	8.4	100	120	100.0	V	273	8.9
54.570	24.3	49.6	25.3	100	120	308.0	V	268	8.5
58.380	44.0	49.6	5.6	100	120	100.0	V	307	8.5
65.070	40.9	49.6	8.7	100	120	100.0	V	100	8.9
69.750	27.8	49.6	21.8	100	120	300.0	V	274	9.1
81.060	32.6	49.6	17.0	100	120	137.0	V	272	8.7
250.020	43.2	56.9	13.7	100	120	146.0	H	202	13.7
375.000	53.1	56.9	3.8	100	120	108.0	H	198	17.5
500.010	43.0	56.9	13.9	100	120	116.0	V	65	20.2
625.020	35.5	56.9	21.4	100	120	110.0	V	326	22.1
750.000	43.6	56.9	13.3	100	120	100.0	H	267	23.9
882.810	26.9	56.9	30.0	100	120	195.0	H	76	25.3
999.970	37.0	60.0	23.0	100	120	150.0	H	58	26.9

Notes:
[1] Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factor = 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 have been recorded.

Sample calculation: 41.4 dBµV/m (field strength) = 22.3 dBµV (receiver reading) + 19.1 dB (Correction factor)

8.2.5 Test data, continued

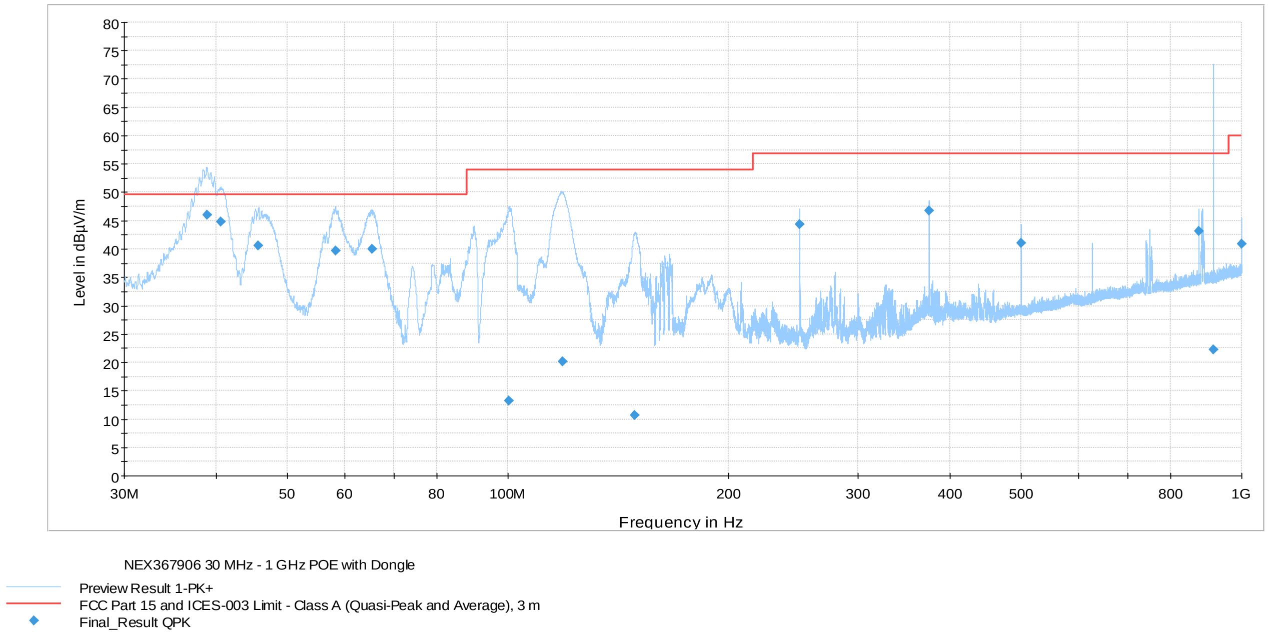


Figure 8.2-2: *Radiated emissions spectral plot (30 to 1000 MHz), System with PoE Injector*

Table 8.2-5: *Radiated emissions (Quasi-Peak) results – System with POE Injector*

Frequency (MHz)	Quasi-Peak field strength[1] (dBµV/m)	3 m Quasi-Peak limit [3] (dBµV/m)	Margin (dB)	Measurement time (ms)	Bandwidth (kHz)	Antenna height (cm)	Pol. (V/H)	Turn table position (°)	Correction factor[2] (dB)
38.880	46.0	49.6	3.6	100	120	115.0	V	86	15.7
40.650	44.8	49.6	4.8	100	120	108.0	V	114	14.4
45.690	40.7	49.6	8.9	100	120	100.0	V	80	11.1
58.200	39.7	49.6	9.9	100	120	112.0	V	313	8.5
65.340	40.0	49.6	9.6	100	120	108.0	V	66	8.9
100.260	13.2	54.0	40.8	100	120	252.0	V	0	11.5
118.740	20.2	54.0	33.8	100	120	224.0	V	0	14.9
148.830	10.6	54.0	43.4	100	120	300.0	V	0	14.0
250.020	44.4	56.9	12.5	100	120	131.0	H	189	13.7
375.000	46.7	56.9	10.2	100	120	112.0	H	11	17.5
500.010	41.1	56.9	15.8	100	120	108.0	H	178	20.2
875.010	43.2	56.9	13.7	100	120	108.0	H	272	25.2
914.910	22.3	56.9	34.6	100	120	371.0	V	206	25.6
999.970	41.0	60.0	19.0	100	120	100.0	H	339	26.9

Notes:
[1] Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factor = 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 have been recorded.

Sample calculation: 46.0 dBµV/m (field strength) = 30.3 dBµV (receiver reading) + 15.7 dB (Correction factor)

8.2.5 Test data, continued

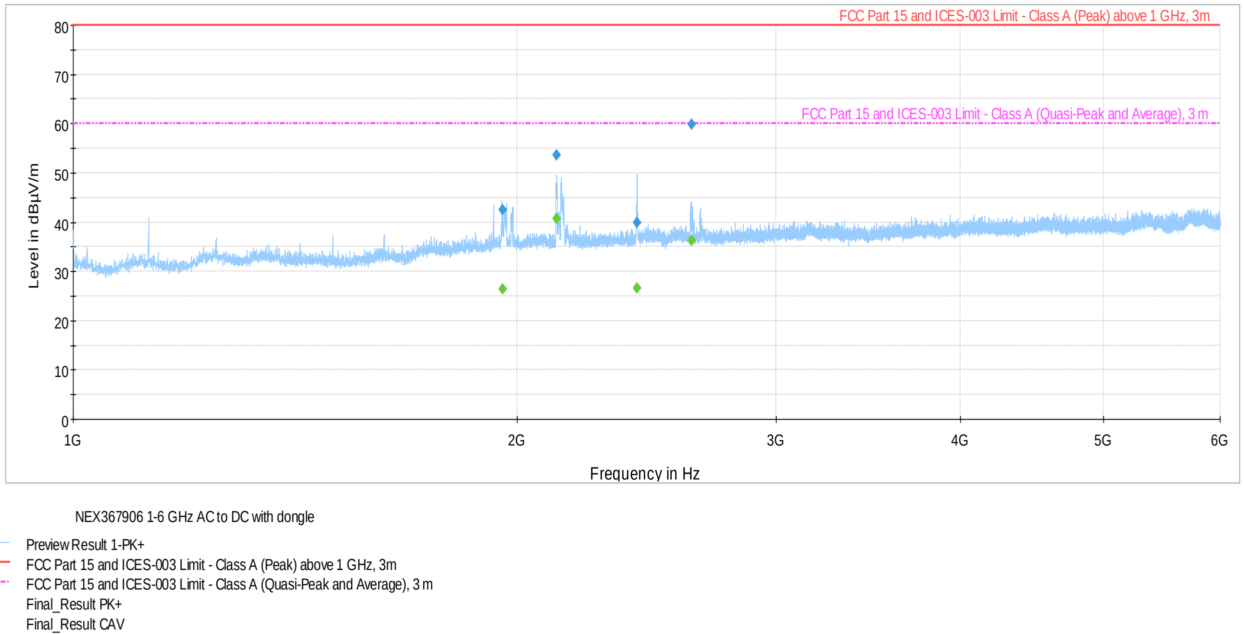


Figure 8.2-3: *Radiated emissions spectral plot (1 to 6 GHz), System with AC/DC adapter*

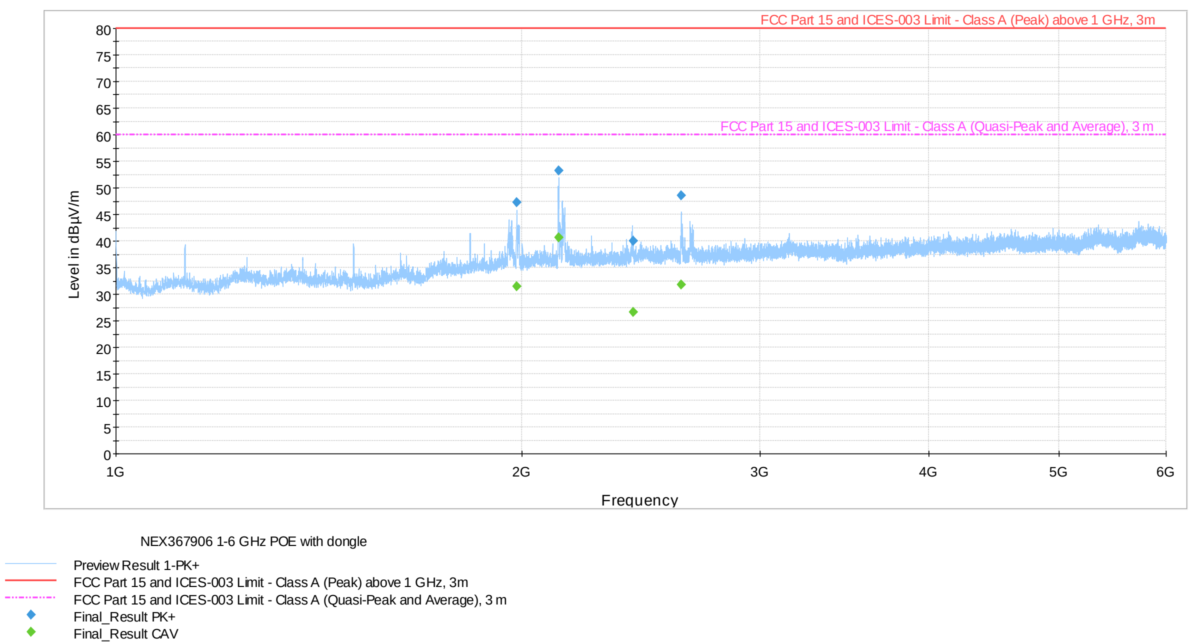


Figure 8.2-4: *Radiated emissions spectral plot (1 to 6 GHz) , System with PoE Injector*

8.2.6 Setup photos

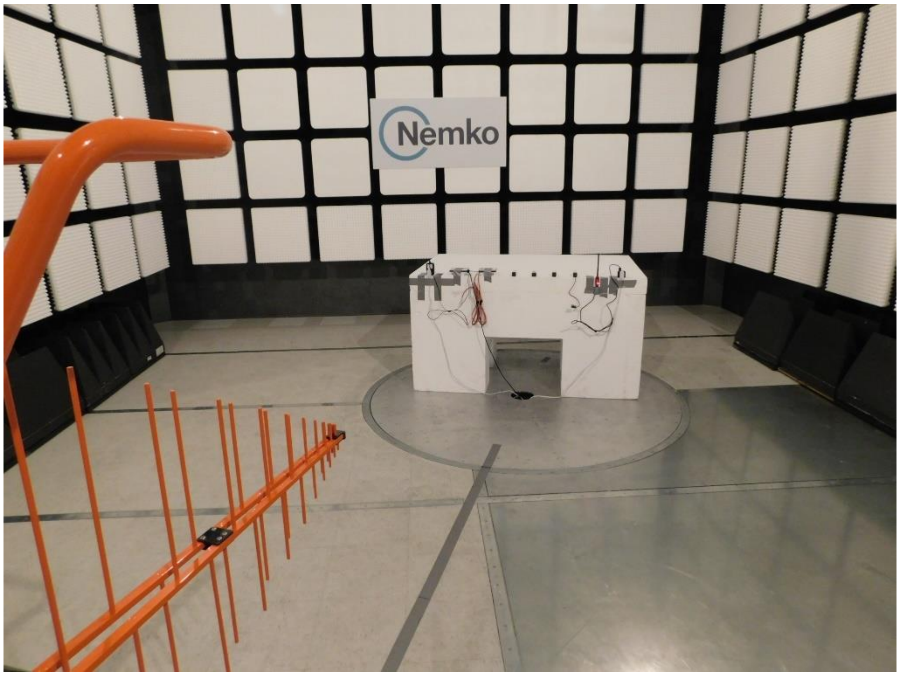


Figure 8.2-5: *Radiated emissions setup photo – below 1 GHz* - Gateway and RMS-LOG-T30-915 with AC/DC adapter

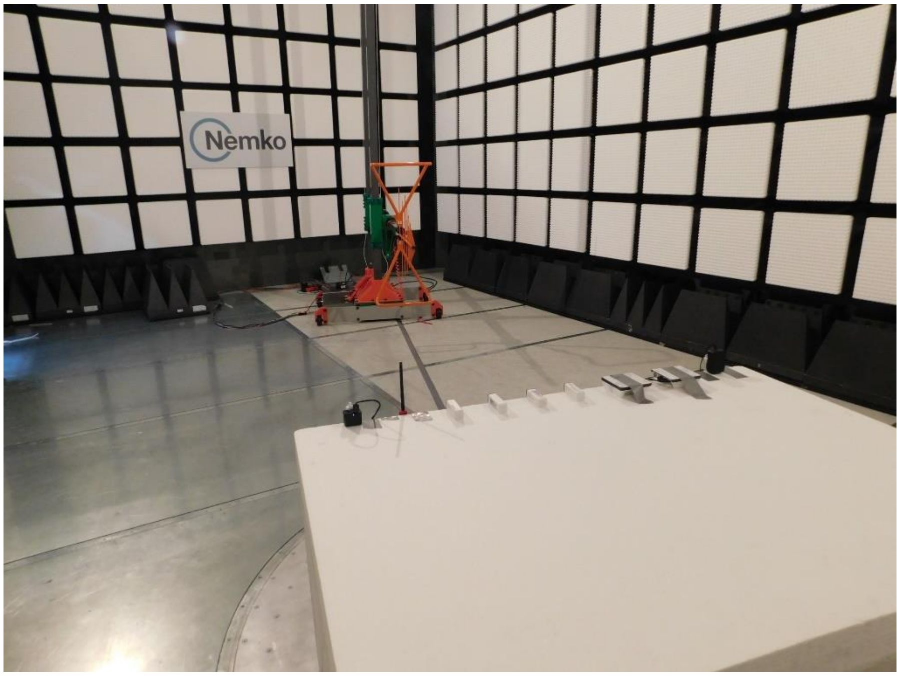


Figure 8.2-6: *Radiated emissions setup photo – below 1 GHz* - Gateway and RMS-LOG-T30-915 with AC/DC adapter

8.2.1 Setup photos, continued

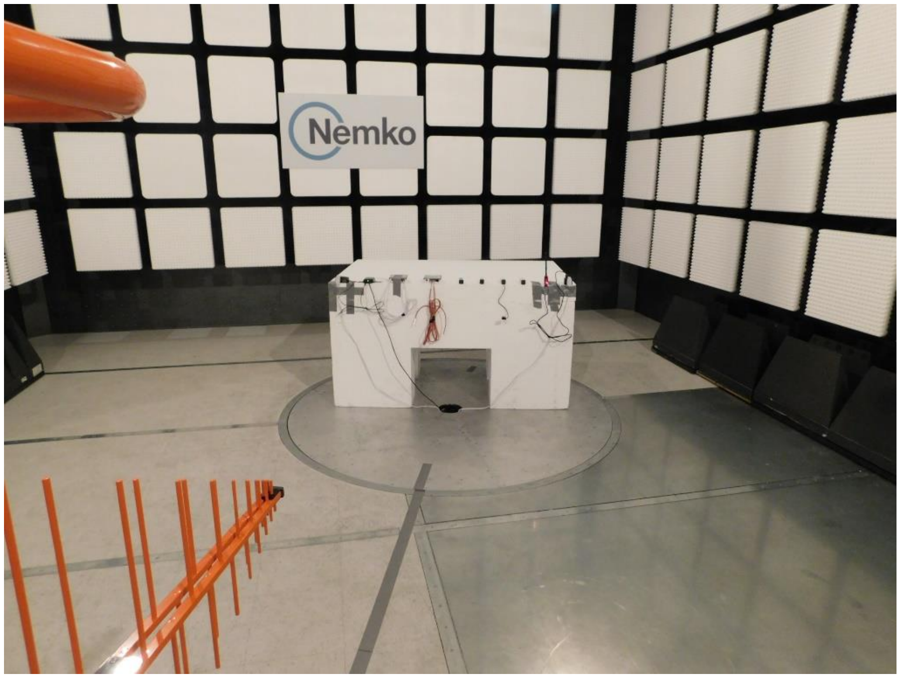


Figure 8.2-7: *Radiated emissions setup photo – below 1 GHz* - Gateway with POE Injector

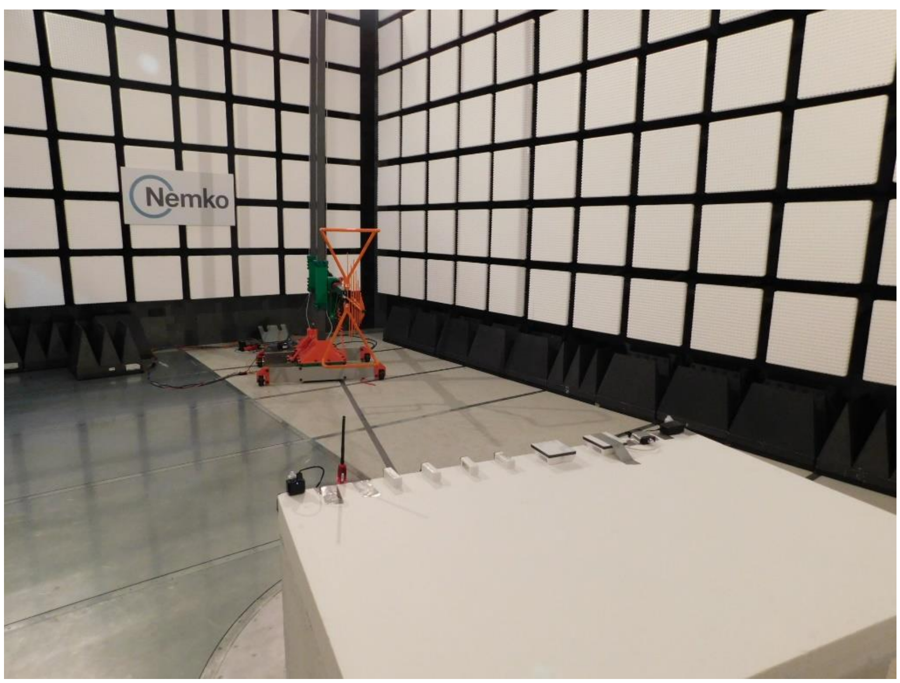


Figure 8.2-8: *Radiated emissions setup photo – below 1 GHz* - Gateway with POE Injector

8.2.6 Setup photos, continued

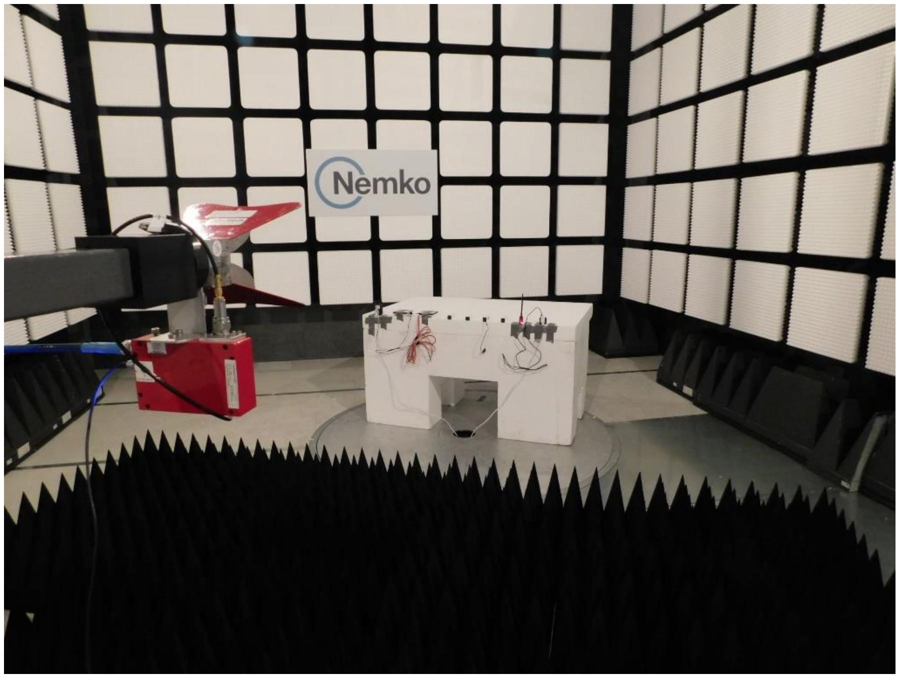


Figure 8.2-9: *Radiated emissions setup photo – above 1 GHz* - Gateway and RMS-LOG-T30-915 with AC/DC adapter

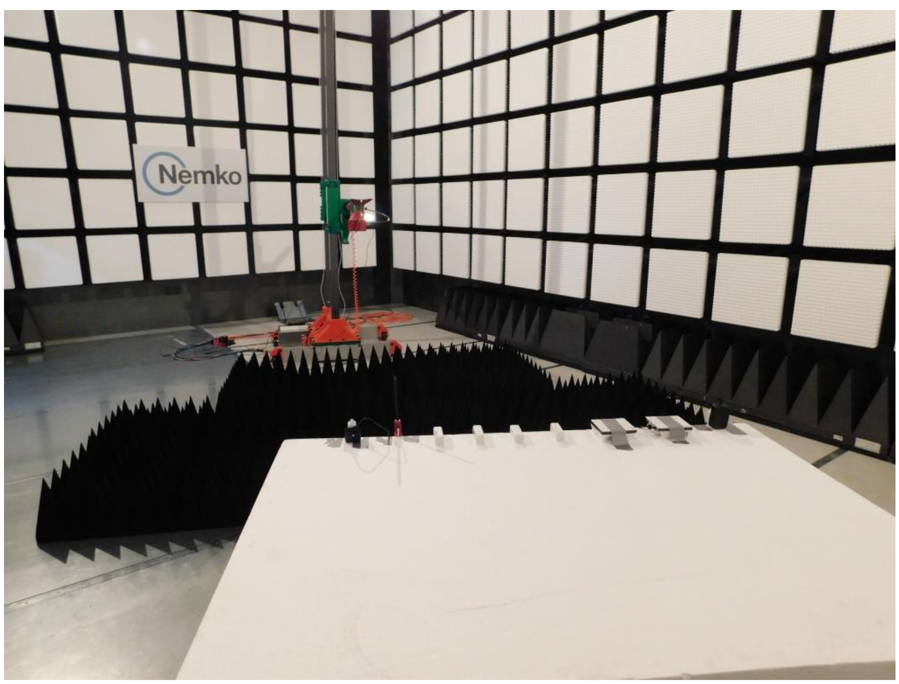


Figure 8.2-10: *Radiated emissions setup photo – above 1 GHz* - Gateway and RMS-LOG-T30-915 with AC/DC adapter

8.2.6 Setup photos, continued

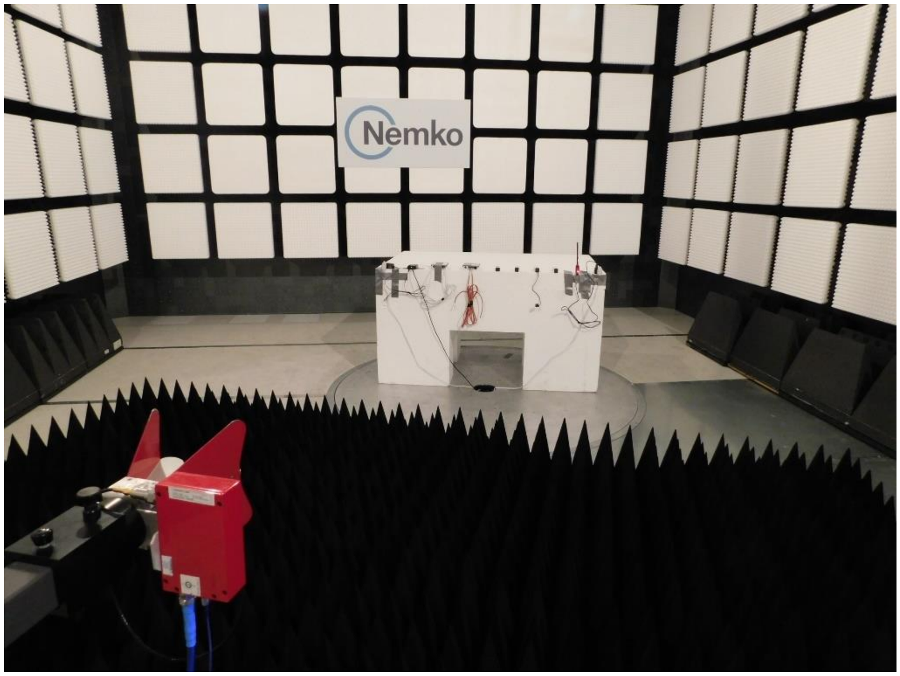


Figure 8.2-11: *Radiated emissions setup photo – above 1 GHz* - Gateway with POE Injector

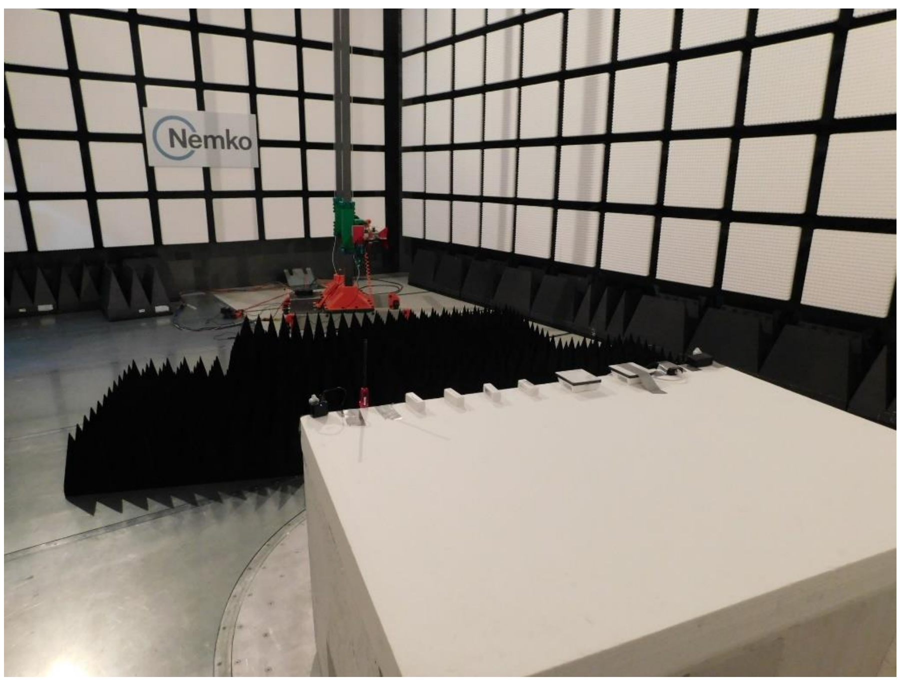


Figure 8.2-12: *Radiated emissions setup photo – above 1 GHz* - Gateway with POE Injector

Section 9 EUT photos

9.1 External photos

Figure 9.1-1: *Front view photo, Gateway*

Figure 9.1-2: *Rear view photo, Gateway*

Figure 9.1-3: *Side view photo, Gateway*

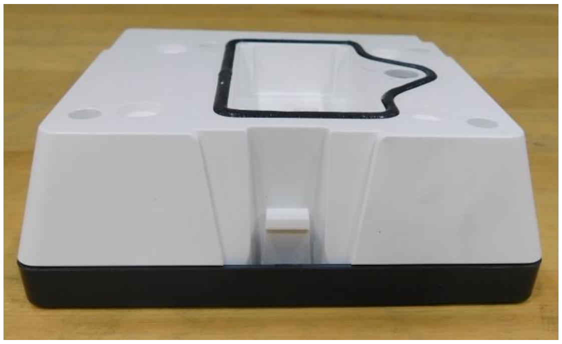


Figure 9.1-4: *Side view photo, Gateway*

Figure 9.1-5: *Side view photo, Gateway*

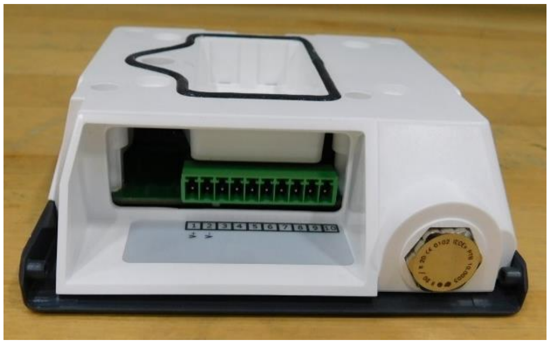


Figure 9.1-6: *Side view photo, Gateway*

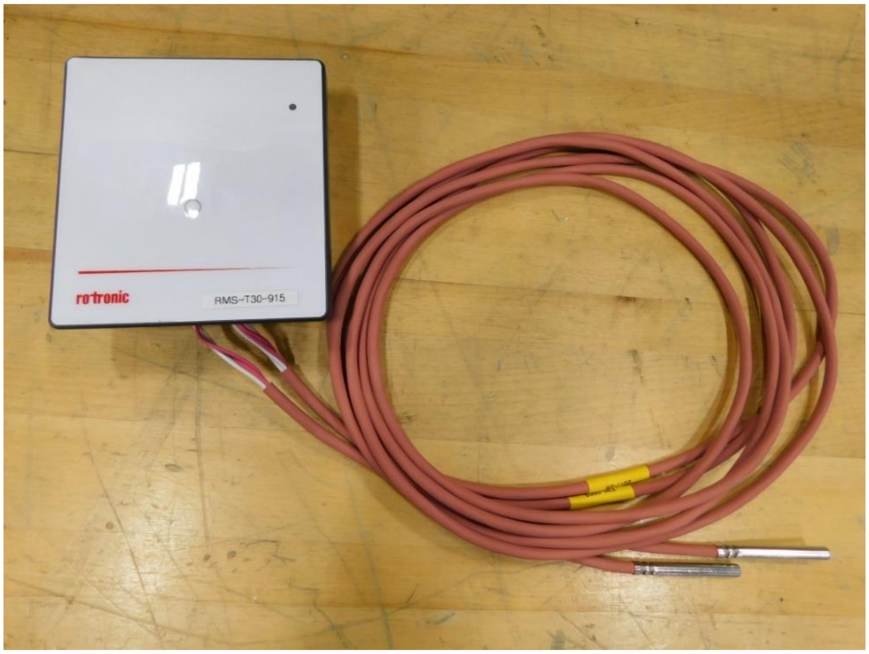


Figure 9.1-7: *Front view photo, RMS-LOG-T30-915, External Probe*

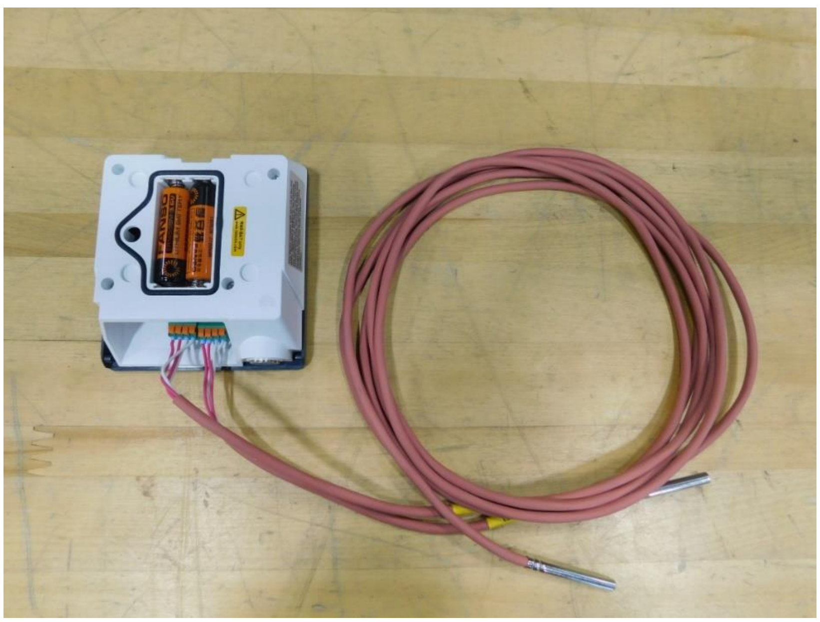


Figure 9.1-8: *Rear view photo RMS-LOG-T30-915, External Probe*

Figure 9.1-9: *Side view photo, RMS-LOG-T30-915, External Probe*

Figure 9.1-10: *Side view photo, RMS-LOG-T30-915, External Probe*

Figure 9.1-11: *Side view photo, RMS-LOG-T30-915, External Probe*

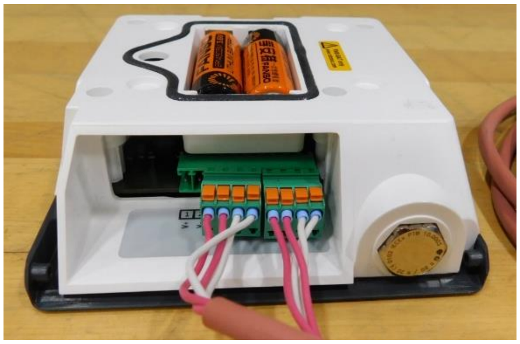


Figure 9.1-12: *Side view photo, RMS-LOG-T30-915, External Probe*

Figure 9.1-13: *Front view photo, RMS-MADC-915-V*

Figure 9.1-14: *Rear view photo, RMS-MADC-915-V*

Figure 9.1-15: *Side view photo, RMS-MADC-915-V*

Figure 9.1-16: *Side view photo, RMS-MADC-915-V*

Figure 9.1-17: *Side view photo, RMS-MADC-915-V*

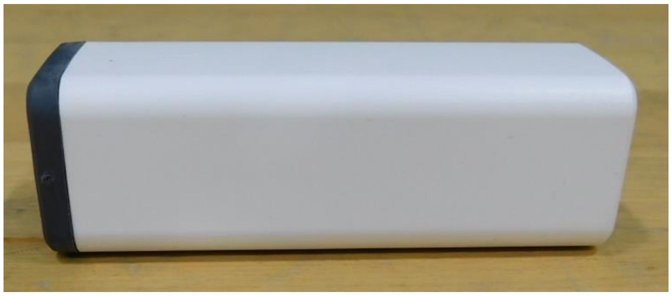


Figure 9.1-18: *Side view photo, RMS-MADC-915-V*

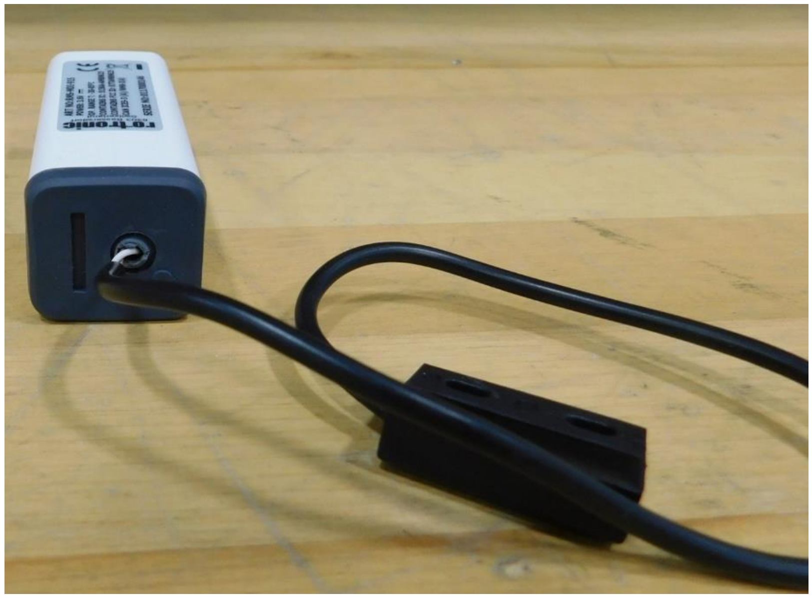


Figure 9.1-19: *Front view photo, RMS-MDI-915*

Figure 9.1-20: *Rear view photo, RMS-MDI-915*

Figure 9.1-21: *Side view photo, RMS-MDI-915*

Figure 9.1-22: *Side view photo, RMS-MDI-915*

Figure 9.1-23: *Side view photo, RMS-MDI-915*

Figure 9.1-24: *Side view photo, RMS-MDI-915*

Figure 9.1-25: *Front view photo, RMS-MLOG-BT-915*

Figure 9.1-26: *Rear view photo, RMS-MLOG-BT-915*

Figure 9.1-27: *Side view photo, RMS-MLOG-BT-915*

Figure 9.1-28: *Side view photo, RMS-MLOG-BT-915*

Figure 9.1-29: *Side view photo, RMS-MLOG-BT-915*

Figure 9.1-30: *Side view photo, RMS-MLOG-BT-915*

Figure 9.1-31: *Front view photo, RMS-MLOG-LGT-915*

Figure 9.1-32: *Rear view photo, RMS-MLOG-LGT-915*

Figure 9.1-33: *Side view photo, RMS-MLOG-LGT-915*

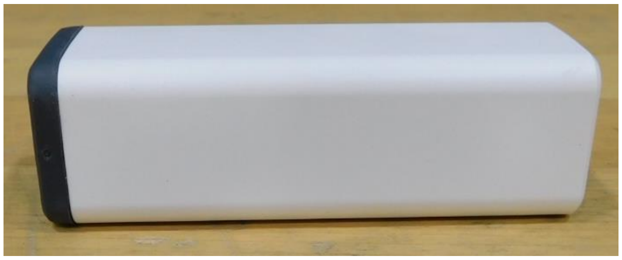


Figure 9.1-34: *Side view photo, RMS-MLOG-LGT-915*

Figure 9.1-35: *Side view photo, RMS-MLOG-LGT-915*

Figure 9.1-36: *Side view photo, RMS-MLOG-LGT-915*