EMC TEST REPORT – 353421-1TRFEMC

Applicant:

Thalmic Labs, Inc.

Product name:

Focals

Model:

Kona; Loop; Case

Specifications:

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

Date of issue: August 9, 2018

Test engineer(s):	Kevin Rose, Wireless/EMC Specialist	Signature:
Reviewed by:	Andrey Adelberg, Senior Wireless/EMC Specialist	Signature:

Lab and test locations

Company name	Nemko Canada Inc.		
Facilities	Ottawa site: 303 River Road, Ottawa, ON, Canada, K1V 1H2 Tel: +1 613 737 9680 Fax: +1 613 737 9691	Montreal site: 292 Labrosse Avenue, Pointe-Claire, QC, Canada, H9R 5L8 Tel: +1 514 694 2684 Fax: +1 514 694 3528	Almonte site: 1500 Peter Robinson Road, West Carleton, ON, Canada, K0A 1L0 Tel: +1 613 256-9117 Fax: +1 613 256-8848

Test site registration	**Organization**	**Recognition numbers and location**
	FCC	CA2040 (Ottawa); CA2041 (Montreal)
	ISED	CA2040A-4 (Ottawa); CA2040G-5 (Montreal); CA2040A-3 (Almonte)
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 contained in this report are within Nemko Canada's ISO/IEC 17025 accreditation.

Copyright notification

Table of Contents

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	August 9, 2018	Original report issued

Section 2 Summary of test results

2.1 Testing period

Test start date	July 9, 2018
Test end date	July 16, 2018

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 [2]
ICES-003 Issue 6	6.1	AC Power Line Conducted Emissions Limits[1]	Pass [2]
ICES-003 Issue 6	6.2	Radiated Emissions Limits[1]	Pass

Notes: [1] Product classification B

[2] The EUT is Battery powered Charge VIA USB

Section 3 Equipment under test (EUT) details

3.1 Applicant/Manufacturer

Company name	Thalmic Labs Inc
Address	24 Charles St West
City	Kitchener
Province/State	Ontario
Postal/Zip code	N2G 1H2
Country	Canada

3.2 Sample information

Receipt date	July 17, 2018
Nemko sample ID number	1 and 2

3.3 EUT information

Product name	Focals
Model	Kona; Loop; Case
Serial number	None
Part number	None
Power requirements	3.85 VDC; 1.4 VDC; 5 VDC
Description/theory of operation	Wearable device that projects information to an embedded screen, transmitting data over wireless links with accompanying wearable device which acts as an accessory input, transmitting navigational information
Operational frequencies	10.5 kHz, 32 kHz, 2 MHz, 16 MHz, 19.2 MHz, 30 MHz, 2400–2483.5 MHz
Software details	SDK 5.0.4

3.4 EUT setup details

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

- The EUT was controlled via command line scripts

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 EUT was monitored via LEDs present on the EUT as well as continued function of the command line scripts

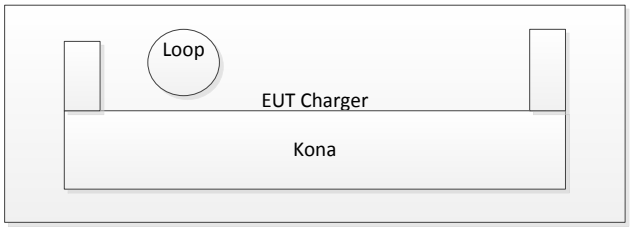


Figure 3.4-1: *block diagram*

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 Specification for radio disturbance and immunity measuring apparatus and methods – Part 4: Uncertainty in EMC measurements; as well as described in UKAS LAB34: The expression of Uncertainty in EMC Testing. Measurement uncertainty calculations assume a coverage factor of K=2 with 95% certainty.

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 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: Section 6.2

8.1.1 References and limits, continued

Table 8.1-1: *Requirements as per FCC Part 15 Subpart B and ICES-003 for radiated emissions for Class B*

Frequency range [MHz]	Measurement		limits
	Distance [m]	Detector type/ bandwidth	[dBµV/m]
30–88	10	Quasi Peak/120 kHz	29.6
88–216			33.1
216–960			35.6
960–1000			43.6
30–88	3	Quasi Peak/120 kHz	40.0
88–216			43.5
216–960			46.0
960–1000			54.0
>1000	10	Linear average/1 MHz	43.6
		Peak/1 MHz	63.6
>1000	3	Linear average/1 MHz	54.0
		Peak/1 MHz	74.0

Notes: 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		
Test date	July 16, 2018	Temperature	23 °C
Test engineer	Kevin Rose	Air pressure	1002 mbar
Test location	Ottawa	Relative humidity	44 %

8.1.3 Notes

- 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 digital operating frequency of the EUT as provided by the client was 25 MHz. The spectrum was scanned to 1 GHz according to the EUT highest digital operating frequency.

Table 8.1-2: *Frequency range for FCC Part 15 Subpart B and ICES-003 Issue 6*

Highest internal frequency [F_X]	Highest measured frequency
$F_X \leq 108$ MHz	1 GHz
108 MHz < $F_X \leq 500$ MHz	2 GHz
500 MHz < $F_X \leq 1$ GHz	5 GHz
$F_X > 1$ GHz	5 × F_X up to a maximum of 40 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.
For FM and TV broadcast receivers F_X is determined from the highest frequency generated or used excluding the local oscillator and tuned frequencies.

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 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 8.1-3: *Radiated emissions equipment list*

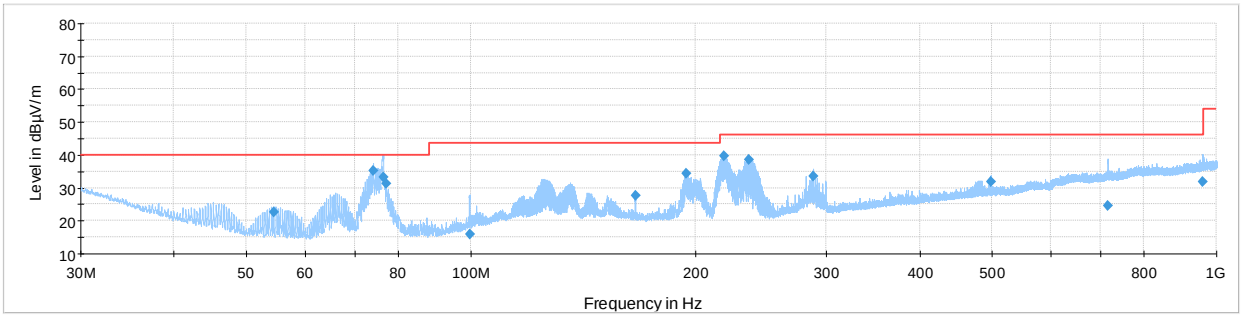
Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
3 m EMI test chamber	TDK	SAC-3	FA002047	1 year	Dec. 09/18
Flush mount turntable	Sunol	FM2022	FA002082	—	NCR
Controller	Sunol	SC104V	FA002060	—	NCR
Antenna mast	Sunol	TLT2	FA002061	—	NCR
AC Power source	Chenwa	2700M-10k	FA002716	—	VOU
Receiver/spectrum analyzer	Rohde & Schwarz	ESU 26	FA002043	1 year	March 26/19
Bilog antenna (20–3000 MHz)	Sunol	JB3	FA002108	1 year	Aug. 31/18
50 Ω coax cable	C.C.A.	None	FA002555	1 year	May 1/19
50 Ω coax cable	Huber + Suhner	None	FA002830	1 year	May 08/19

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 9.26.01

8.1.5 Test data



The spectral plot is a summation of a vertical and horizontal scan. The spectral scan has been corrected with the associated transducer factors (i.e. antenna factors, cable loss, amplifier gains, and attenuators.

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

8.1.5 Test data, continued

Table 8.1-5: *Radiated emissions (Quasi-Peak) results*

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)
74.075	35.1	40.0	4.9	100	120	400.0	H	296.0	10.0
218.525	39.6	46.0	6.4	100	120	136.7	H	52.0	13.4
76.400	33.2	40.0	6.8	100	120	394.1	H	287.0	9.7
235.925	38.5	46.0	7.5	100	120	140.1	H	250.0	14.1
77.025	31.2	40.0	8.8	100	120	398.6	H	309.0	9.7
194.450	34.3	43.5	9.2	100	120	108.5	H	59.0	14.4
288.000	33.6	46.0	12.4	100	120	123.9	H	307.0	16.0
958.850	31.9	46.0	14.1	100	120	106.2	H	180.0	27.1
497.900	31.8	46.0	14.2	100	120	102.7	V	98.0	21.0
166.275	27.6	43.5	15.9	100	120	156.4	H	30.0	13.7
54.450	22.5	40.0	17.5	100	120	344.5	H	94.0	8.7
714.650	24.5	46.0	21.5	100	120	300.0	H	340.0	24.1
99.750	15.9	43.5	27.6	100	120	139.3	V	327.0	11.7

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 has been recorded.

Sample calculation: 20 dBµV/m (field strength) = 10 dBµV (receiver reading) + 10 dB (Correction factor)

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: Section 6.1

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

Frequency range [MHz]	Measurement		Limits
	Coupling device	Detector type/ bandwidth	[dBµV]
0.15–0.5	AMN	Quasi Peak/9 kHz	66–56
0.5–5			56
5–30			60
0.15–0.5	AMN	CAverage/9 kHz	56–46
0.5–5			46
5–30			50

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

8.2.2 Test summary

Verdict	Pass		
Test date	July 9, 2018	Temperature	22 °C
Test engineer	Kevin Rose	Air pressure	1004 mbar
Test location	Ottawa	Relative humidity	47 %

8.2.3 Notes

- 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.
- Equipment with a DC power port powered by a dedicated AC/DC power converter is considered to be AC mains powered equipment and was tested with a power converter. Where the power converter was provided by the manufacturer, the provided converter was used.

8.2.4 Setup details

Port under test – Coupling device	AC Mains – Artificial Mains Network (AMN)
EUT power input during test	120 V_{AC}, 60 Hz
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 8.2-2: *Conducted emissions – from AC mains power ports equipment list*

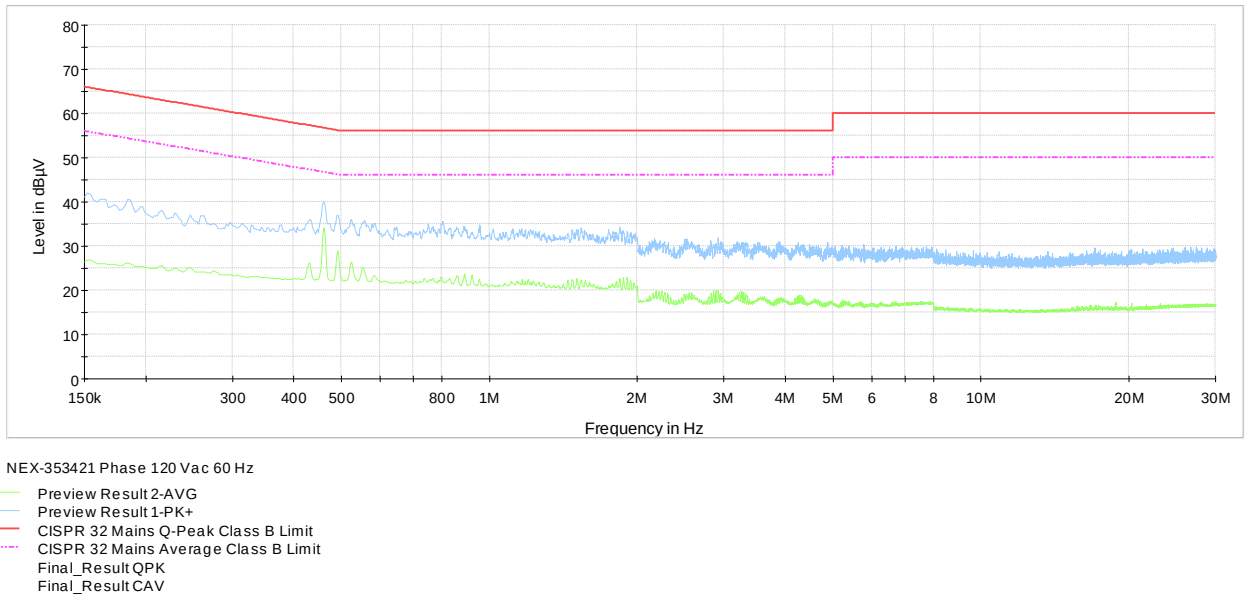
Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
Receiver/spectrum analyzer	Rohde & Schwarz	ESU 26	FA002043	1 year	March 26/19
AC Power source	Chenwa	2700M-10k	FA002716	—	VOU
LISN	Rohde & Schwarz	ENV216	FA002515	1 year	April. 30/19
50 Ω coax cable	C.C.A.	None	FA002556	1 year	May 01/19

Notes: VOU - verify on use

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 9.26.01

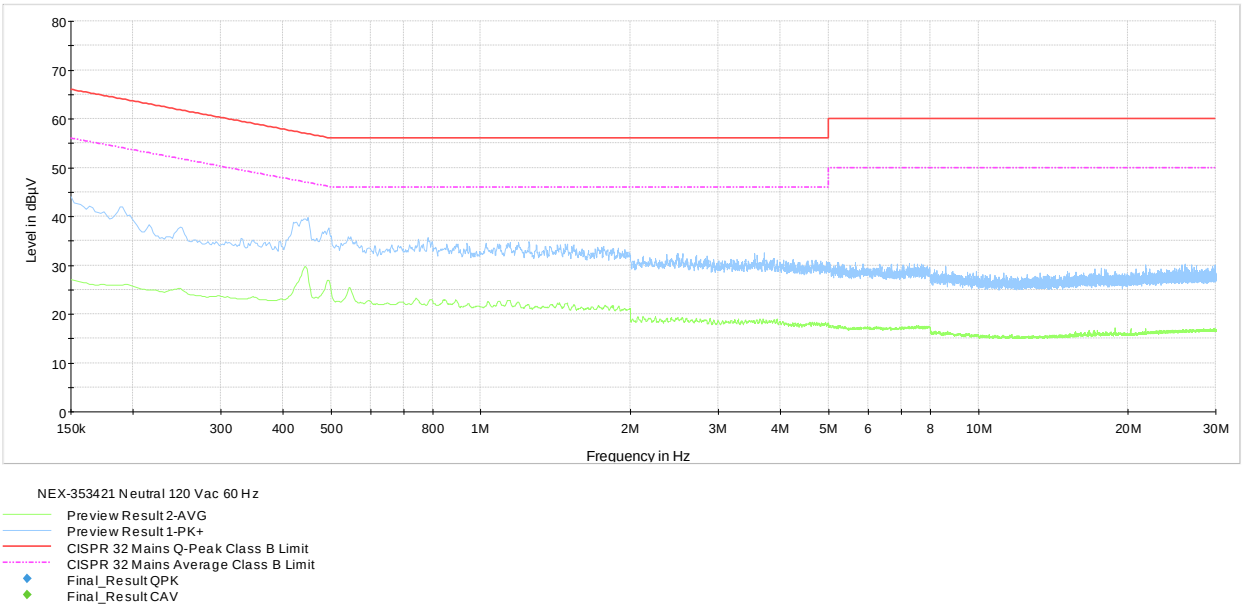
8.2.5 Test data



The spectral plot has been corrected with transducer factors. (i.e. cable loss, LISN factors, and attenuators)

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

8.2.5 Test data, continued



The spectral plot has been corrected with transducer factors. (i.e. cable loss, LISN factors, and attenuators)

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