EMC & RF Test Report

as per

FCC Part 15 Subpart C 15.249
RSS-210 Issue 2:2017

on the

Swidget PNS50E0452

Issued by: **TÜV SÜD Canada Inc.**
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Testing produced for
Swidget
See Appendix A for
full client & EUT details.

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(See Calibrations and Accreditations)

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Report Scope

This report addresses the RF verification testing and test results of the **Swidget PNS50E0452**, emissions and immunity compliance against the following standards:

- FCC Part 15 Subpart C
- RSS-210

Emissions and Immunity requirements were evaluated on the EUT. Test procedures, results, justifications, and engineering considerations, if any, follow later in this report.

For a more detailed list of the standards and the revision used, see the section Applicable Standards, Specifications, and Methods of this report.

This report does not imply product endorsement by any government, accreditation agency, or TÜV SÜD Canada Inc.

Opinions or interpretations expressed in this report, if any, are outside the scope of TÜV SÜD Canada Inc accreditations. Any opinions expressed do not necessarily reflect the opinions of TÜV SÜD Canada Inc, unless otherwise stated.

Summary

The results contained in this report relate only to the EUT.

Table 1: Test results summary overview

Equipment Under Test (EUT)	**Swidget PNS50E0452**
EUT passed all tests performed?	Yes
Testing was performed by	Steve McFarlane

For testing dates, see the section Testing Environmental Conditions and Dates.

Test Results Summary

The test results in this report apply only to the tested components that are identified in the section.

The following tables summarize the EMC test results for the test cases performed on the EUT.

Table 2: Summary of test results for the USA; FCC Part 15 subpart B

FCC Section	Description	Specification / Method	Class / Level	Pass or Fail
15.109	Radiated Emissions (RE)	FCC Part 15 Subpart B / ANSI C63.10	Class B	PASS
15.107	Conducted Emissions (CE) for AC Power	FCC Part 15 Subpart B / ANSI C63.10	Class B	PASS
Overall results				**PASS**
Table notes				
1.				

Table 3: Summary of test results for Canada; ICES-003

FCC Section	Description	Specification / Method	Class / Level	Pass or Fail
6.2	Radiated Emissions (RE)	ICES 003 / ANSI C63.10	Class B	PASS
6.1	Conducted Emissions (CE) for AC Power	ICES 003 / ANSI C63.10	Class B	PASS
Overall results				**PASS**
Table notes				
1.				

If the product as tested complies with the specification or requirement, the EUT is issued a PASS. If not, FAIL is issued.

Notes, Justifications, or Deviations

The following justifications for tests not performed or deviations from the above listed specifications apply.

The following deviations from the Radiated Emissions requirement were applied to the EUT:

The following deviations from the Conducted Emissions requirement were applied to the EUT:

The following deviations from the band edge requirement were applied to the EUT: The EUT transmits on 2 channels in the band 902 – 928 MHz. These channels are 908.4 MHz and 916.0 MHz. Since these are more than 2 MHz from the band edges no band edge measurements were required.

The EUT was mounted in three orthogonal axis for spurious radiated emissions. Worst case or representative results are presented.

A later revision of the standard may have been substituted in place of the previous dated referenced revision. The year of the specification used is listed under applicable standards. Using the later revision accomplishes the goal of ensuring compliance to the intent of the previous specification, while allowing the laboratory to incorporate the extensions and clarifications made available by a later revision.

Sample Calculations

Radiated Emission Test

The following example shows the way in which the compliance margin is calculated in the "RE Test Results" tables.

The rows in these tables are defined as follows.

Meter Reading (dBµV) =	Voltage measured using the spectrum analyzer with the proper detector
Correction (dB) =	Cumulative gain or loss of pre-amplifier and cables used in the measurement path (dB) + Antenna Factor (dB)
Level (dBµV/m) =	Corrected value or field strength, that is, the parameter of interest that is compared to the limit
Margin (dB) =	Level with respect to the appropriate limit (a negative Margin indicates that the Level is below the limit and that the measurement is a Pass)

The values in the Level row are calculated as follows: Level = Meter Reading + Correction (dB)

The values in the Margin row are calculated as follows: Margin = Level - Limit

Power Line Conducted Emission Test

See the section above for radiated Emissions.

Applicable Standards, Specifications, and Methods

ANSI C63.4:2014	Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
FCC Part 2	FCC Rules for Radio Frequency Devices, Title 47 of the Code of Federal Regulations, Part 2, U.S. Federal Communications Commission.
FCC Part 15 Subpart C	FCC Rules for Radio Frequency Devices, Title 47 of the Code of Federal Regulations, Part 15 Radio Frequency Devices, U.S. Federal Communications Commission.
ICES-003, Issue 6 (2016)	Spectrum Management and Telecommunications, Interference-Causing Equipment Standard: Information Technology Equipment (ITE) – Limits and methods of measurement.
IEC/EN17025:2017	General Requirements for the Competence of Testing and Calibration Laboratories

Document Revision Status

Revision 000 10/19/2023
Initial Release

Revision 001 02/02/2024

Definitions and Acronyms

The following definitions and acronyms apply to this report.

AE – Associated Equipment. Equipment needed to exercise and/or monitor the operation of the EUT.

AAN – Asymmetric Artificial Network (ISN)

AE – auxiliary equipment

AFC – Ambient Free Chamber

ANSI – American National Standards Institute

Antenna Port – Port, other than a broadcast receiver tuner port, for connection of an antenna used for intentional transmission and/or reception of radiated RF energy.

AVG – Average detector

BiLog® – Biconical Log-Periodic Hybrid antenna (a registered trademark of Schaffner-Chase EMC Limited, 1993)

Broadcast Receiver Tuner Port – Port intended for the reception of a modulated RF signal carrying terrestrial, satellite and/or cable transmissions of audio and/or video broadcast and similar services.

CC – RF current clamp

CE – Conducted Emissions

Class A Device – A device that is marketed for use in a commercial, industrial or business environment. A “Class A” device should not be marketed for use by the general public. A Class A device should contain a warning notice in the user manual stating that it could cause radio interference. For example: "**Warning**: Operation of this equipment in a residential environment could cause radio interference."

Class B Device – A device that is marketed for use in a residential environment and may also be used in a commercial, business or industrial environments. Note: A residential environment is an environment where the use of broadcast radio and television receivers may be expected within a distance of 10 m of the device concerned.

CP – RF current probe

EMC – Electro-Magnetic Compatibility. The ability of an equipment or system to function satisfactorily in its electromagnetic environment without introducing intolerable electromagnetic disturbances to anything in that environment.

EMC Test Plan – An EMC test plan established prior to testing. See Appendix A – The EUT and Client-Provided .

EUT – Equipment Under Test. A device or system being evaluated for compliance that is representative of a product to be marketed.

FCC – Federal Communications Commission

GND – Ground

h/w – hardware

HCP – Horizontal Coupling Plane

IC – Industry Canada

ICES – Canadian Specification: ICES-003, Issue 3, "Spectrum Management: Interference-causing equipment standard (Digital Apparatus)

ISN – Impedance Stabilization Network

ITE – Information Technology Equipment. Has a primary function of entry, storage, display, retrieval, transmission, processing, switching, or control of data and/or telecommunication messages and which may be equipped with one or more ports typically for information transfer.

LISN – Line Impedance Stabilization Network

NCR – No Calibration Required

NSA – Normalized Site Attenuation

NA – not applicable

Optical Fiber Port – Port at which an optical fiber is connected to an equipment.

PA – broadband power amplifier

PK – peak detector

PPS – programmable power supply

PS – power supply

QP – quasi-peak detector

R – 100-ohm injection resistor

RBW – resolution bandwidth

RE – Radiated Emissions

RF – Radio Frequency

Signal/Control Port – Port intended for the interconnection of components of a EUT, or between a EUT and local AE and used in accordance with relevant functional specifications (for example for the maximum length of cable connected to it).
(Examples include RS-232, USB, HDMI, and Fire Wire.

s/w – software

SA – Spectrum Analyzer, the CISPR 16, ANSI C63.2 Compliant EMI meter

STP – Shielded Twisted Pair

T – 50-ohm coaxial termination (Conducted Emissions)

TL – transient limiter

VBW – Video Bandwidth Video Bandwidth

VCP – Vertical Coupling Plane

Wired Network Port – Point of connection for voice, data and signaling transfers intended to interconnect widely dispersed systems by direct connection to a single-user or multi-user communication network.
(Examples include CATV, PSTN, ISDN, xDSL, LAN, and similar networks.)

Testing Facility

Testing for EMC on the EUT was performed at TÜV SÜD Canada testing lab in Ottawa, Ontario. The testing lab has a calibrated 3m semi-anechoic chamber, which is a calibrated 10-meter semi-anechoic chamber which allows measurements on a EUT that has a maximum width or length of up to 3 m and a height of up to 3 m. The chamber is equipped with a turntable that is capable of testing devices in excess to 3300 lbs in weight. This facility is capable of testing products that are rated for 120 V AC and 240 V AC single phase, or devices that are rated for a 208 V AC 3-phase input. DC capability is also available for testing. The chamber is equipped with a mast that controls the polarization and height of the antenna. Control of the mast occurs in the control room adjoining the shielded chamber. Radiated emission measurements are performed using a BiLog® antenna and a Horn antenna where applicable. Conducted Emissions, unless otherwise stated, are performed using a LISN and using the Vertical Ground plane if applicable.

Calibrations and Accreditations

The 10-meter chamber is registered with Federal Communications Commission ISED Canada and Voluntary Control Council for Interference. This chamber was calibrated for Normalized Site Attenuation (NSA) using test procedures outlined in ANSI C63.4 "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz". The chamber is lined with ferrite tiles and absorption cones to minimize any undesired reflections. The NSA data is kept on file at TÜV SÜD Canada. For radiated susceptibility testing, a 16-point field calibration has been performed on the chamber. The field uniformity data is kept on file at TÜV SÜD Canada. TÜV SÜD Canada Inc is accredited to ISO/IEC 17025 by A2LA certificate 2955.19. The laboratory's current scope of accreditation listing can be found as listed on the A2LA website. All measuring equipment is calibrated on an annual or bi-annual basis as listed for each respective test.

Testing Environmental Conditions and Dates

The temperature and humidity in the test facilities are controlled. The temperature is maintained between 20 ºC and 25 ºC, with a relative humidity between 30 % and 60 %. Levels are recorded and any exceptions are included in the detailed test results sections of this report.

The following environmental conditions were recorded in the test facility during the time of testing.

Table 4: Environmental conditions and dates

Test	Tester	Temperature (ºC)	Humidity (%)	Pressure (kPa)	Date
Radiated Emissions, E-field	Steve McFarlane	21.1 – 25	36.0 – 51	98.0 – 102.0	2023-08-01 to 2023-08-30
Conducted Emissions on AC power leads	Steve McFarlane	21.1 – 25	36.0 – 51	98.0 – 102.0	2023-08-01 to 2023-08-30
Conducted Spurious Emissions	Steve McFarlane	21.1 – 25	36.0 – 51	98.0 – 102.0	2023-08-01 to 2023-08-30
Occupied Bandwidth	Steve McFarlane	21.1 – 25	36.0 – 51	98.0 – 102.0	2023-08-01 to 2023-08-30

Detailed Test Results

Radiated Emissions, E-field

Purpose

This test verifies that the EUT does not produce excess amounts of E-field Radiated Emissions (RE) that could interfere with licensed radiators.

Limits and Method

The limits and method are as defined in:

- FCC Part 15 Subpart B
- ICES-003

Table 5: RE test requirements

Requirement	Method	Country of application
FCC Part 15, Subpart B	ANSI C63.4 & ANSI C63.10	USA
ICES 003	ANSI C63.4 & ANSI C63.10	Canada

The limits of the RE tests are as follows.

Table 6: RE limits at 10 m for Class A of FCC and ICES 003

Frequency range (MHz)	**FCC Part 15 & ICES 003** (dBμV/m)	**Detector**
30 to 88	39.1	Quasi-Peak
88 to 216	43.5	Quasi-Peak
216 to 960	46.4	Quasi-Peak
960 to 1000	49.5	Quasi-Peak
1000 to 40000	49.5[1]	Average
Table notes		
1. The peak level cannot exceed the limit by more than 20 dB.		

Table 7: RE limits at 10 m for Class B of FCC and ICES 003

Frequency range (MHz)	**FCC Part 15 & ICES 003** (dBµV/m)	**Detector**
30 to 88	29.5	Quasi-Peak
88 to 216	33.0	Quasi-Peak
216 to 960	35.5	Quasi-Peak
960 to 1000	43.5	Quasi-Peak
1000 to 40000	43.5[1]	Average
Table notes		
1. The peak level cannot exceed the limit by more than 20 dB.		

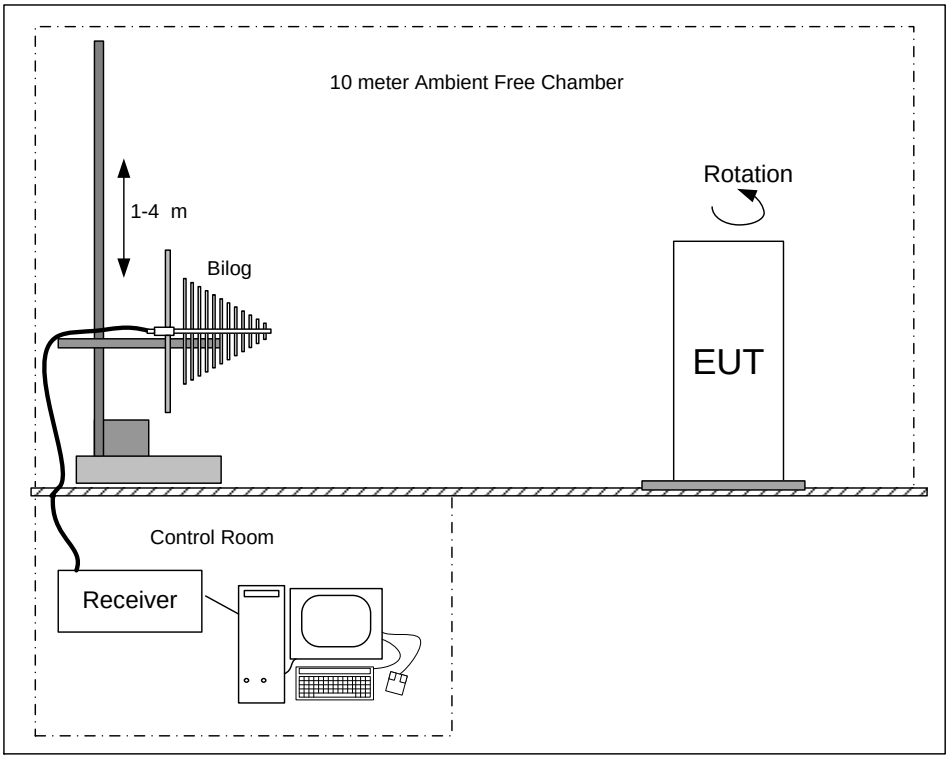
Test procedure

Verifications of the test equipment and AFC were performed before the installation of the EUT in accordance with the quality assurance procedures documented in the TÜV SÜD EMC test procedures document. The test was performed according to the relevant procedures listed in Table 5.

- The EUT was placed on the turntable inside the AFC (configured for normal operation). The system and its cables were separated from the ground plane by an insulating support 10 mm in height.
- For tests between 30 MHz and 1 GHz the receive antenna (BiLog®) was placed 10 m away from the EUT. An initial scan was performed to find emissions/frequencies requiring detailed measurement. The pre-scan was performed by rotating the system 360 degrees while recording all emissions (frequency and amplitude). This procedure was repeated for antenna heights of 1 to 4 m, as well as both polarizations of the receiving antenna.
- For tests above 1 GHz the receive antenna (horn) was placed 3 m away from the EUT. Absorbing cones were placed on the floor between the antenna and the EUT. An initial scan was performed to find emissions/frequencies requiring detailed measurement. The pre-scan was performed by rotating the system 360 degrees while recording all emissions (frequency and amplitude). This procedure was repeated for antenna heights of 1 to 4 m, as well as both polarizations of the receiving antenna.
- For FCC Part 15 or ICES tests between 18 and 40 GHz the receive horn antenna was placed at a 1 m distance from the EUT with the absorbing cones placed on the floor. An initial scan was performed to find emissions/frequencies requiring detail measurement. The pre-scan was performed on all sides of the EUT, using both polarization of the receive antenna to find any system emissions.

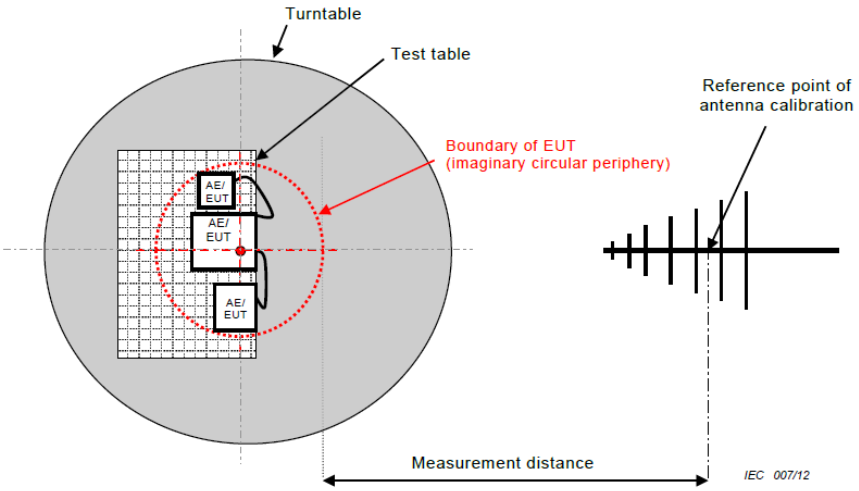
- For all above frequency ranges, the pre-scan peak data was compared to the limits. Peaks with less than 6 dB of margin were maximized using the proper detector: the EUT was rotated in azimuth over 360 degrees to identify the direction of maximum emission, antenna height was then varied from 1 to 4 m to obtain maximum emission level.

Figure 1: Setup of Radiated Emissions



If the Peak detector or Quasi-Peak measurements do not exceed the RMS limits, where defined, then the EUT is deemed to have passed the requirements.

Figure 2: Typical setup of RE tests



Note: Testing was performed at 3 meters test distance below 1 GHz and 3 meters above 1 GHz.

Measurement Uncertainty

The expanded measurement instrumentation uncertainty with a 95 % level of confidence, calculated according to the method described in CISPR 16 is:

- ± 3.8 dB between 30 MHz and 1 GHz
- ± 4.7 dB between 1 GHz and 10 GHz
- ± 4.8 dB between 10 GHz and 18 GHz
- ± 4.6 dB between 18 GHz and 26.5 GHz
- ± 4.8 dB between 26.5 GHz and 40 GHz

Preliminary Graphs

The graphs shown below are maximized peak measurement graphs measured with a resolution bandwidth greater than or equal to the final required detector over a full 0 to 360°. This peaking process is done as a worst-case measurement and enables the detection of frequencies of concern for final measurement. For final measurements with the appropriate detector, where applicable, refer to the tables under Final Measurements. The ERP limits have been added to the graphs in green.

For the following test results that have supporting data tables, negative margin values indicate a pass.

Figure 3: Graph of RE at 3 m for FCC Part 15 from 30 to 1000 MHz

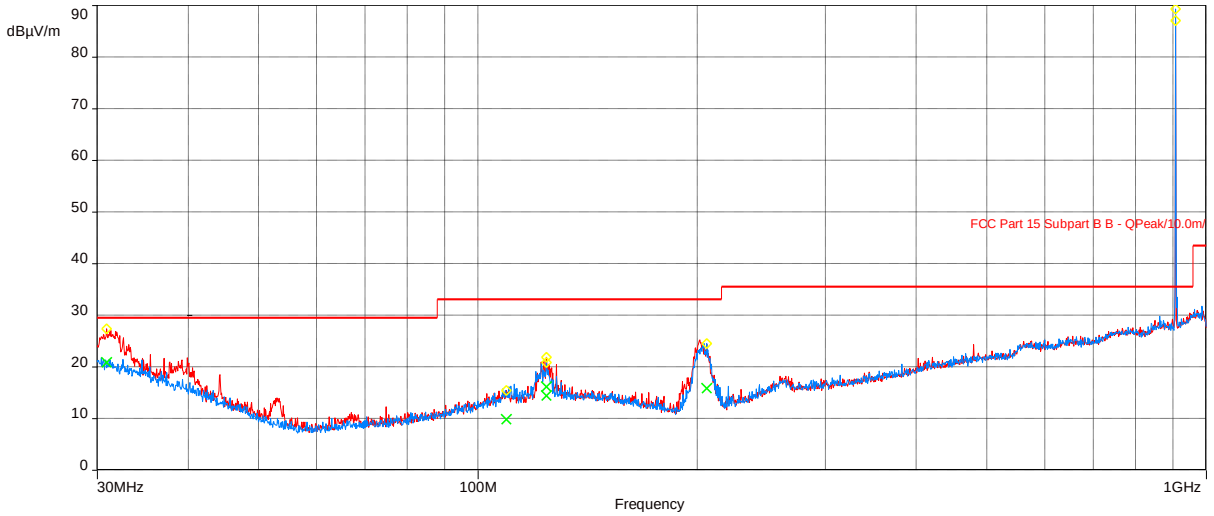


Table 8: RE test results for FCC Part 15 from 30 to 1000 MHz

Suspects

Manual suspects (7)

Frequency (MHz)	SR	Level (dBµV/m)	Height (m)	Angle (°)	Position
30.90533333	2	27.31	3.98	184.00	Vertical
109.346	2	15.46	3.98	258.50	Vertical
124.1546667	2	21.82	1.01	0.50	Vertical
124.284	1	20.87	1.98	250.00	Horizontal
206.055	1	24.52	1.98	277.75	Horizontal
908.3996667	2	87.09	1.01	167.25	Vertical
908.432	1	89.30	1.01	109.25	Horizontal

Finals

QuasiPeak (5)

Frequency (MHz)	SR	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (m) (dB)	Azimuth (°) (dB)	Polarization (dB)	Correction (dB)
124.2979423	1	14.37	33.06	-18.69	2.44	88.25	Horizontal	-10.26
206.0333654	1	15.78	33.06	-17.28	1.20	254.50	Horizontal	-11.82

30.90196762	2	20.84	29.54	-8.70	3.08	226.25	Vertical	-4.45
109.3583397	2	9.79	33.06	-23.27	4.00	233.50	Vertical	-10.41
124.2032277	2	16.10	33.06	-16.96	1.14	329.75	Vertical	-10.26

Figure 4: Graph of RE at 3 m for ICES 003 from 30 to 1000 MHz

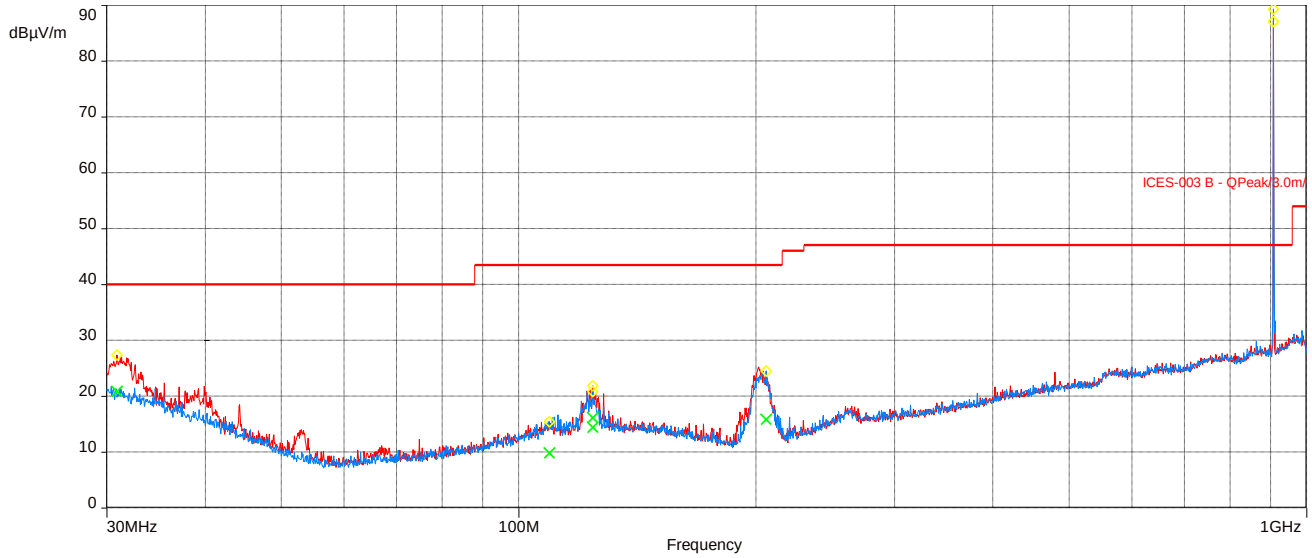


Table 9: RE test results for ICES-003 from 30 to 1000 MHz

Suspects

Manual suspects (7)

Frequency (MHz)	SR	Level (dBµV/m)	Height (m)	Angle (°)	Position
30.90533333	2	27.31	3.98	184.00	Vertical
109.346	2	15.46	3.98	258.50	Vertical
124.1546667	2	21.82	1.01	0.50	Vertical
124.284	1	20.87	1.98	250.00	Horizontal
206.055	1	24.52	1.98	277.75	Horizontal
908.3996667	2	87.09	1.01	167.25	Vertical
908.432	1	89.30	1.01	109.25	Horizontal

Finals

QuasiPeak (5)

Frequency (MHz)	SR	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (m) (dB)	Azimuth (°) (dB)	Polarization (dB)	Correction (dB)
124.2979423	1	14.37	33.04	-18.67	2.44	88.25	Horizontal	-10.26
206.0333654	1	15.78	33.04	-17.26	1.20	254.50	Horizontal	-11.82
30.9019676 2	2	20.84	29.54	-8.70	3.08	226.25	Vertical	-4.45
109.3583397	2	9.79	33.04	-23.25	4.00	233.50	Vertical	-10.41
124.203227	2	16.10	33.04	-16.94	1.14	329.75	Vertical	-10.26

Figure 5: Graph of RE at 3 m for FCC from 1 to 10 GHz

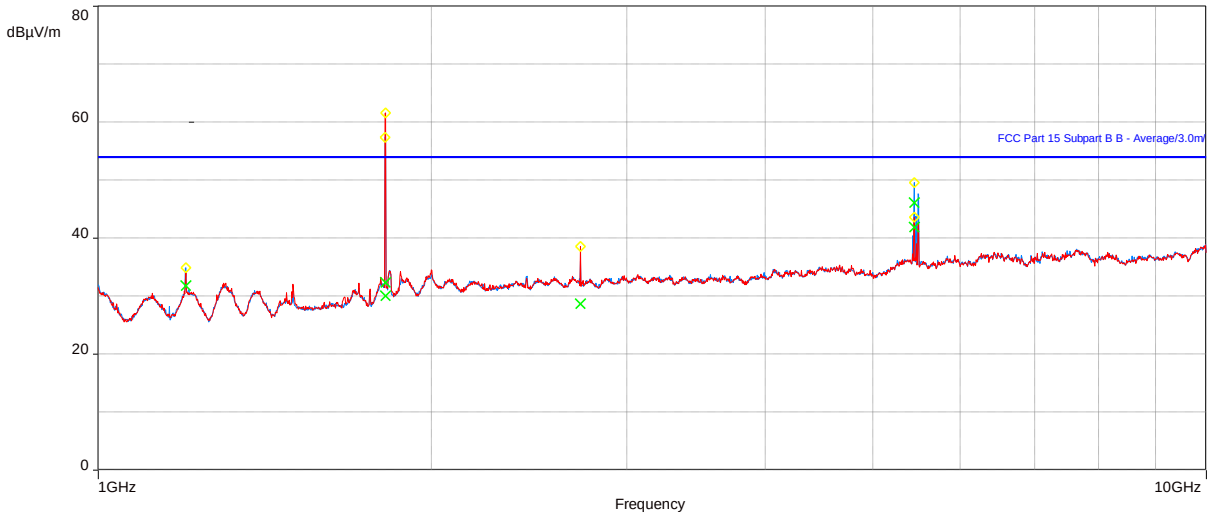


Table 10: RE test results for FCC Part 15 from 1 to 10 GHz

Suspects

Manual suspects (6)

Frequency (MHz)	SR	Level (dBµV/m)	Height (m)	Angle (°)	Position
1816.9	1	61.54	1.50	245.50	Vertical
2725.3	1	38.52	2.99	246.50	Vertical
5454.7	1	43.59	1.00	318.50	Vertical
1199.8	2	34.87	2.00	251.00	Horizontal
1816.6	2	57.31	3.00	31.75	Horizontal
5454.7	2	49.54	2.00	0.00	Horizontal

Finals

AVG (6)

Frequency (MHz)	SR	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (m) (dB)	Azimuth (°) (dB)	Polarization (dB)	Correction (dB)
1817.244551	1	30.04	53.96	-23.92	2.91	291.50	Vertical	-7.47
2725.205449	1	28.65	53.96	-25.31	1.45	139.75	Vertical	-5.17
5454.680769	1	41.88	53.96	-12.08	1.08	320.00	Vertical	-0.93
1199.912179	2	31.79	53.96	-22.17	2.07	24.50	Horizontal	-10.73

1816.798718	2	32.34	53.96	-21.62	2.96	362.00	Horizontal	-7.48
5454.679167	2	46.10	53.96	-7.86	2.02	0.00	Horizontal	-0.93

Figure 6: Graph of RE at 3 m for ICES-003 from 1 to 10 GHz

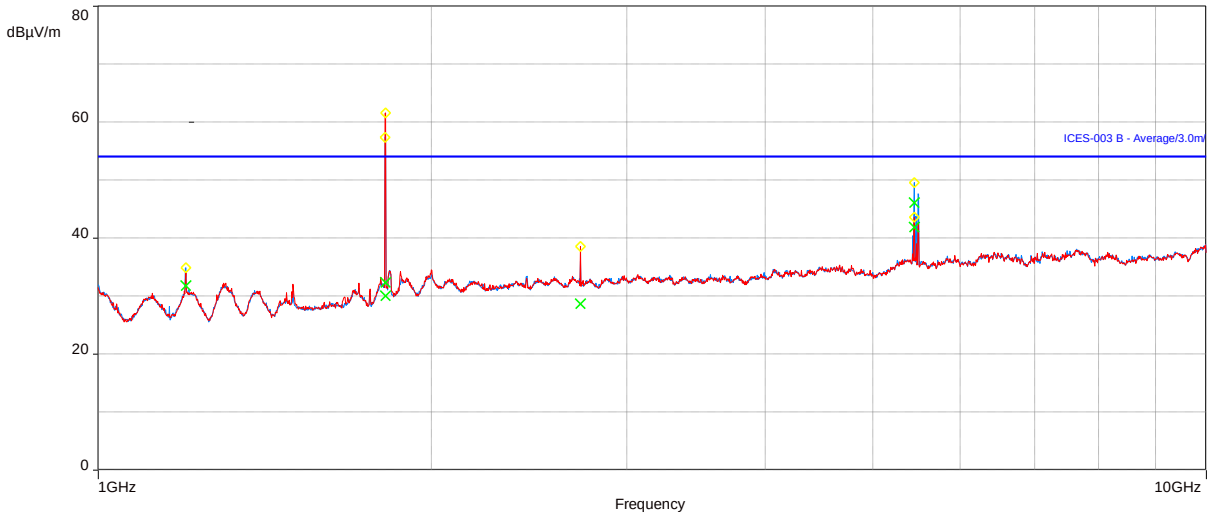


Table 11: RE test results for ICES-003 from 1 to 10 GHz

Suspects

Manual suspects (6)

Frequency (MHz)	SR	Level (dBµV/m)	Height (m)	Angle (°)	Position
1816.9	1	61.54	1.50	245.50	Vertical
2725.3	1	38.52	2.99	246.50	Vertical
5454.7	1	43.59	1.00	318.50	Vertical
1199.8	2	34.87	2.00	251.00	Horizontal
1816.6	2	57.31	3.00	31.75	Horizontal
5454.7	2	49.54	2.00	0.00	Horizontal

Finals

AVG (6)

Frequency (MHz)	SR	Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Height (m) (dB)	Azimuth (°) (dB)	Polarization (dB)	Correction (dB)
1817.244551	1	30.04	54.00	-23.96	2.91	291.50	Vertical	-7.47
2725.205449	1	28.65	54.00	-25.35	1.45	139.75	Vertical	-5.17
5454.680769	1	41.88	54.00	-12.12	1.08	320.00	Vertical	-0.93
1199.912179	2	31.79	54.00	-22.21	2.07	24.50	Horizontal	-10.73
1816.798718	2	32.34	54.00	-21.66	2.96	362.00	Horizontal	-7.48

5454.679167	2	46.10	54.00	-7.90	2.02	0.00	Horizontal	-0.93

Test Equipment List

Table 12: Test equipment used for RE

Description	Make	Model number	Asset ID	Calibr. due
EMC Automation Software	Nexio V3.18	BAT-EMC	F0163649	Not required
EMI Receiver	Rohde & Schwarz	ESU26	SSG013729	2024-05-02
EMI Receiver	Rohde & Schwarz	ESU40	SSG013672	2024-01-14
Coaxial Cable	Huber & Suhner	104PEA	SSG012041	2024-01-24
Coaxial Cable (18-40 GHz)	Huber & Suhner	101 PEA, Sucoflex	SSG012290	2024-01-27
Coaxial Cable (1-18 GHz)	Micro-Coax	UFA 210B-1-1500-504504	SSG012376	2024-01-27
Coaxial Cable (1-18 GHz)	Huber & Suhner In.c	ST18/Nm/Nm/36	SSG012786	2024-01-27
Bilog Antenna	Teseq	59119	SSG013965	2024-01-24
Horn Antenna 3MCH 00003	ETS-Lindgren	3117	LAVE04211	2024-05-11
Pre-amp (18-40GHz)	microComp Nordie	MCN-40-18004000-3.3-10P	SSG014000	2023-11-04
Pre-Amplifier (1-18GHz) (A5)	BNR	LNA	SSG012360	2024-10-31
RF Amplifier (30-1000MHz)	Hewlett Packard	8447D	SSG013045	2025-04-26
Horn Antenna 3MCH 00004	ETS-Lindgren	3116	LAVE04210	2023-11-05

See the section Appendix B – EUT, Peripherals, and Test Set-up Photos for photos showing the test setup for the highest Radiated Emission.

Conducted Emissions on AC power leads

Purpose

This test verifies the EUT does not produce excessive Conducted Emissions (CE) on the AC main power leads.

Limits and Method

The limits and method are as defined in:

- FCC Part 15 Subpart B
- ICES-003

Table 13: CE test requirements on AC power leads

Requirement	Method	Country of application
FCC Part 15, Subpart B	ANSI C63.4	USA
ICES 003	ANSI C63.4	Canada

The limits of the CE tests on AC power leads are as follows.

Table 14: CE test limits on AC power leads for Class A

Frequency range (MHz)	**FCC Part 15 & ICES 003 Average** (dBμV)	**FCC Part 15 & ICES 003 Quasi-peak** (dBμV)
0.15 to 0.5	66	79
0.5 to 30	60	73

Table 15: CE test limits on AC power leads for Class B

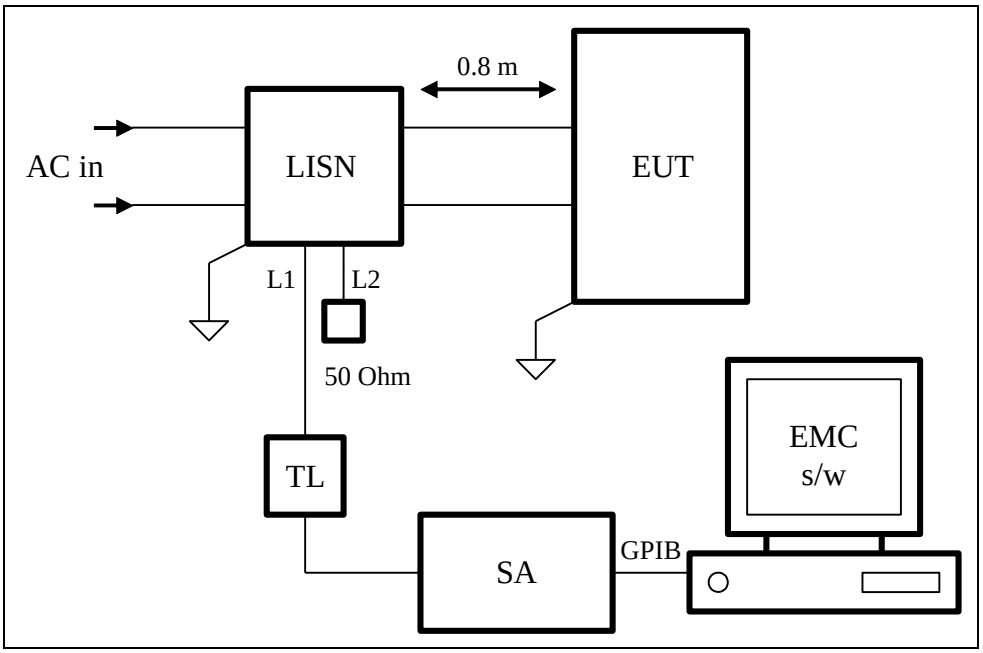
Frequency range (MHz)	**FCC Part 15 & ICES 003 Average** (dBμV)	**FCC Part 15 & ICES 003 Quasi-peak** (dBμV)
0.15 to 0.5	56 to 46	66 to 56
0.5 to 5	46	56
5 to 30	50	60

Test procedure

Verifications of the test equipment were performed before the installation of the EUT in accordance with the quality assurance procedures documented in the TÜV SÜD EMC test procedures document. The test was performed by the relevant procedures listed in Table 13.

Figure shows the test method for regulatory CE measurements on AC Leads.

Figure 6: CE test method on AC leads for regulatory test cases



- The EUT was arranged and connected according to its normal mode of operation on a metallic ground plane. The EUT and all cables were insulated from the ground plane which extended by at least 0.5 m beyond the boundaries of the EUT.
- The LISNs were bonded to the ground plane; the distance between the boundary of the EUT and the closest surface of the LISN was 0.8 m. The mains cable between the EUT and the LISNs was 1 m long, or if more than 1 m, the excess cable was folded to form a non-inductive bundle, not exceeding 0.4 m in length. The safety ground connection of the EUT, if present, was connected to the reference ground plane.
- Conducted Emissions were measured by connecting the spectrum analyzer input, through the transient limiter, to the LISN outputs, L1 and L2 (the unused LISN output was terminated with a coaxial 50-ohm termination).
- For each lead, a pre-scan was taken over the frequency range of the requirement, using peak detection on the spectrum analyzer. The pre-scan data was then compared to the

specification limits. Frequencies close to the limit lines were measured using a QP and/or an AVG detector as required.

If the Peak detector or Quasi-Peak measurements do not exceed the RMS limits, where defined, then the EUT is deemed to have passed the requirements.

Measurement Uncertainty

The expanded measurement instrumentation uncertainty, with a 95 % level of confidence, calculated according to the method described in CISPR 16 is: ± 2.8 dB on CISPR 22 Conducted Emissions on AC power leads.

Preliminary Graphs

For the following test results that have supporting data tables, negative margin values indicate a pass.

Figure 8: Graph of CE on port A line L1 for FCC Part 15 on Configuration x

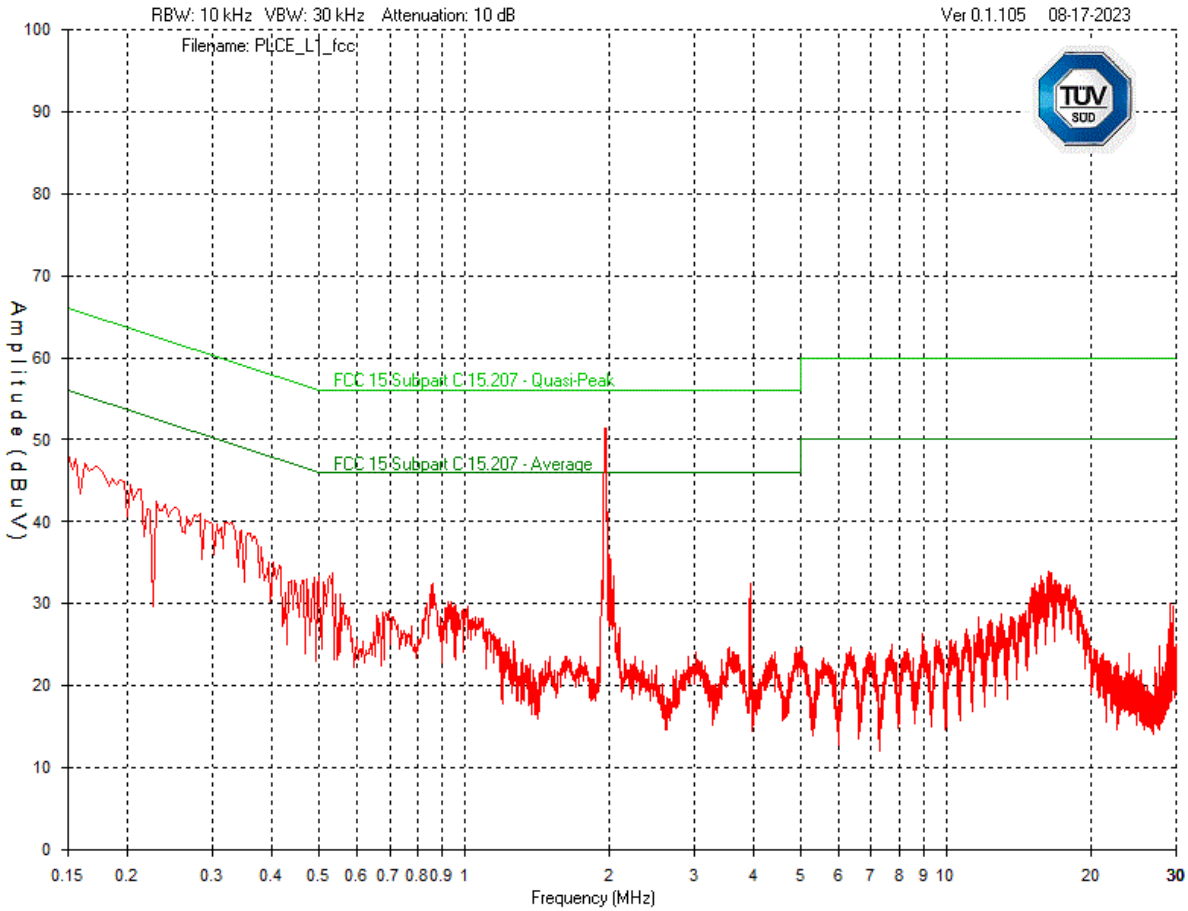


Table 16: CE test results on port A line L1 for FCC Part 15 on Configuration x

Frequency	Detector	Raw Reading	Cable 27 - 10m LMR400 Factor	LISN 65 - FCC Factor	Level	FCC 15 Subpart C 15.207 - Quasi-Peak Limit	FCC 15 Subpart C 15.207 - Average Limit	FCC 15 Subpart C 15.207 - Quasi-Peak Margin	FCC 15 Subpart C 15.207 - Average Margin
1.9609	PEAK	51.4	0.1	0.1	51.6	56		4.4	
1.9609	avg	43.7	0.1	0.1	43.9		46		2.1
0.1566	SCAN	47.5	0	0.1	47.6		55.6		8
0.2296	SCAN	42.4	0	0.1	42.5		52.5		10
1.9974	SCAN	35.9	0.1	0.1	36.1		46		9.9

0.3556	SCAN	38.5	0	0.1	38.6		48.8		10.2

Figure 9: Graph of CE on port A line L2 for FCC Part 15 on Configuration x

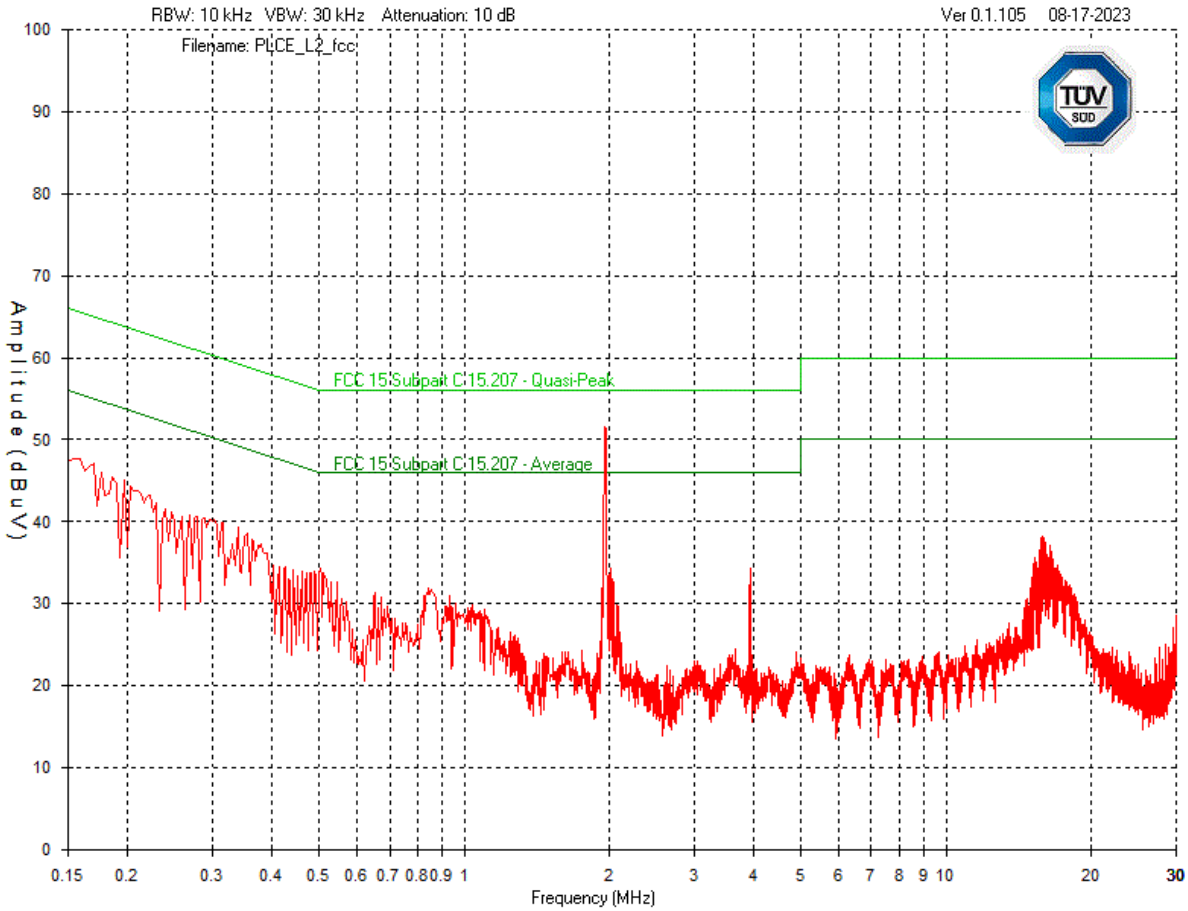


Table 17: CE test results on port A line L2 for FCC Part 15 on Configuration x

Frequency	Detector	Raw Reading	Cable 27 - 10m LMR400 Factor	LISN 65 - FCC Factor	Level	FCC 15 Subpart C 15.207 - Quasi-Peak Limit	FCC 15 Subpart C 15.207 - Average Limit	FCC 15 Subpart C 15.207 - Quasi-Peak Margin	FCC 15 Subpart C 15.207 - Average Margin
1.9609	SCAN	51.5	0.1	0.1	51.7	56		4.3	
1.9609	avg	40.76	0.1	0.1	40.96		46		5.04
0.1533	SCAN	47.7	0	0.1	47.8		55.8		8
0.1964	SCAN	45.1	0	0.1	45.2		53.8		8.6
0.2031	SCAN	44.3	0	0.1	44.4		53.5		9.1
0.3391	SCAN	39.3	0	0.1	39.4		49.2		9.8

Test Equipment List

Table 18: Test equipment used for CE on AC power leads

Description	Make	Model number	Asset ID	Calibr. due
EMC Automation Software	Nexio V3.18	BAT-EMC	F0163649	Not required
EMI Test Receiver	Rohde & Schwarz	ESU40	LAVE04092	2 May 2024

See the section Appendix B – EUT, Peripherals, and Test Set-up Photos for photos showing the test setup for the highest Radiated Emission.

Power Level

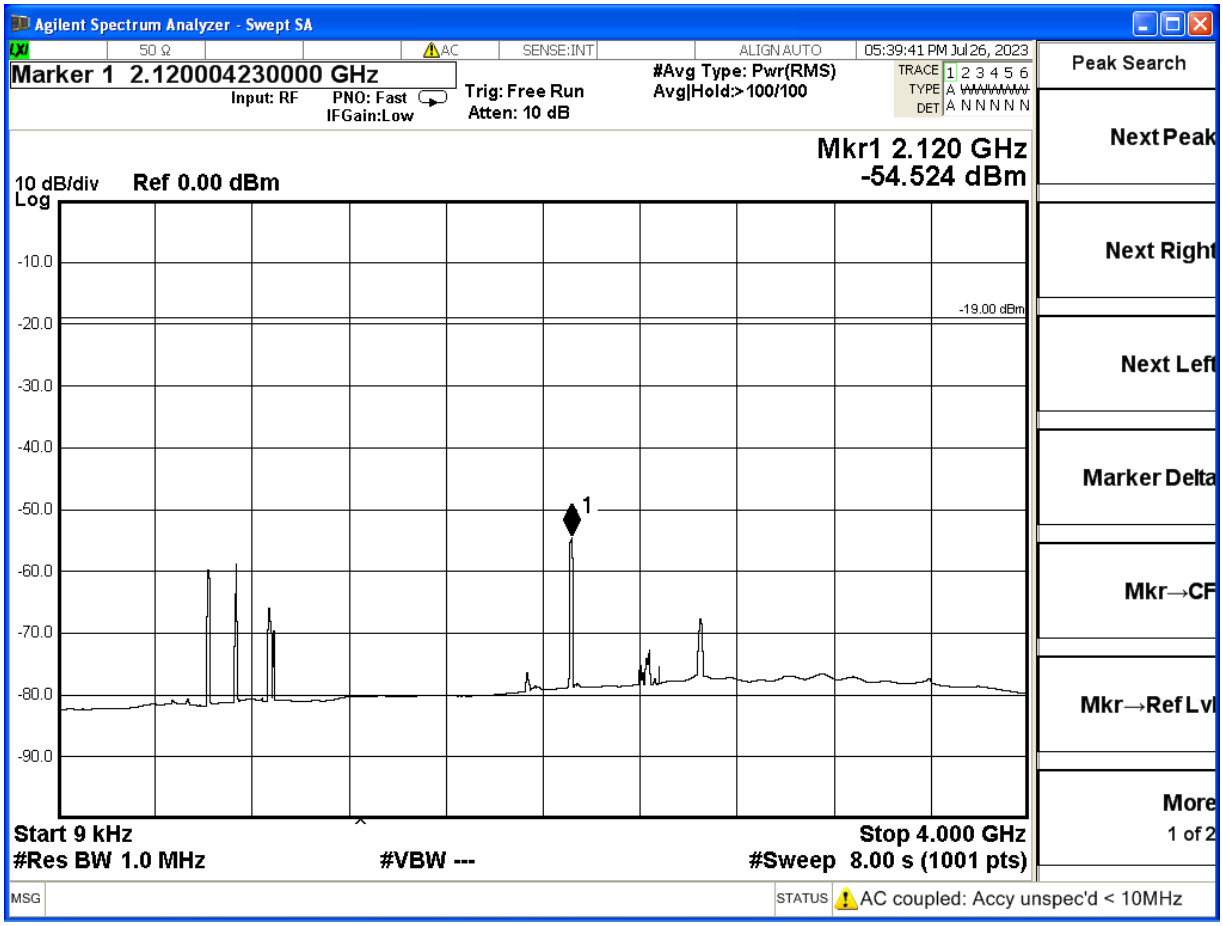
Frequency (MHz)	SR	Level (dBµV/m)	Height (m)	Angle (°)	Position
908.3996667	2	87.09	1.01	167.25	Vertical
908.400	1	89.30	1.01	109.25	Horizontal
916.000	1	83.30	1.01	110.15	Horizontal
915.99999	2	84.40	1.01	110.20	Vertical

Max. power level per FCC Part 15 Subpart C 15.249 is 50 mV/m

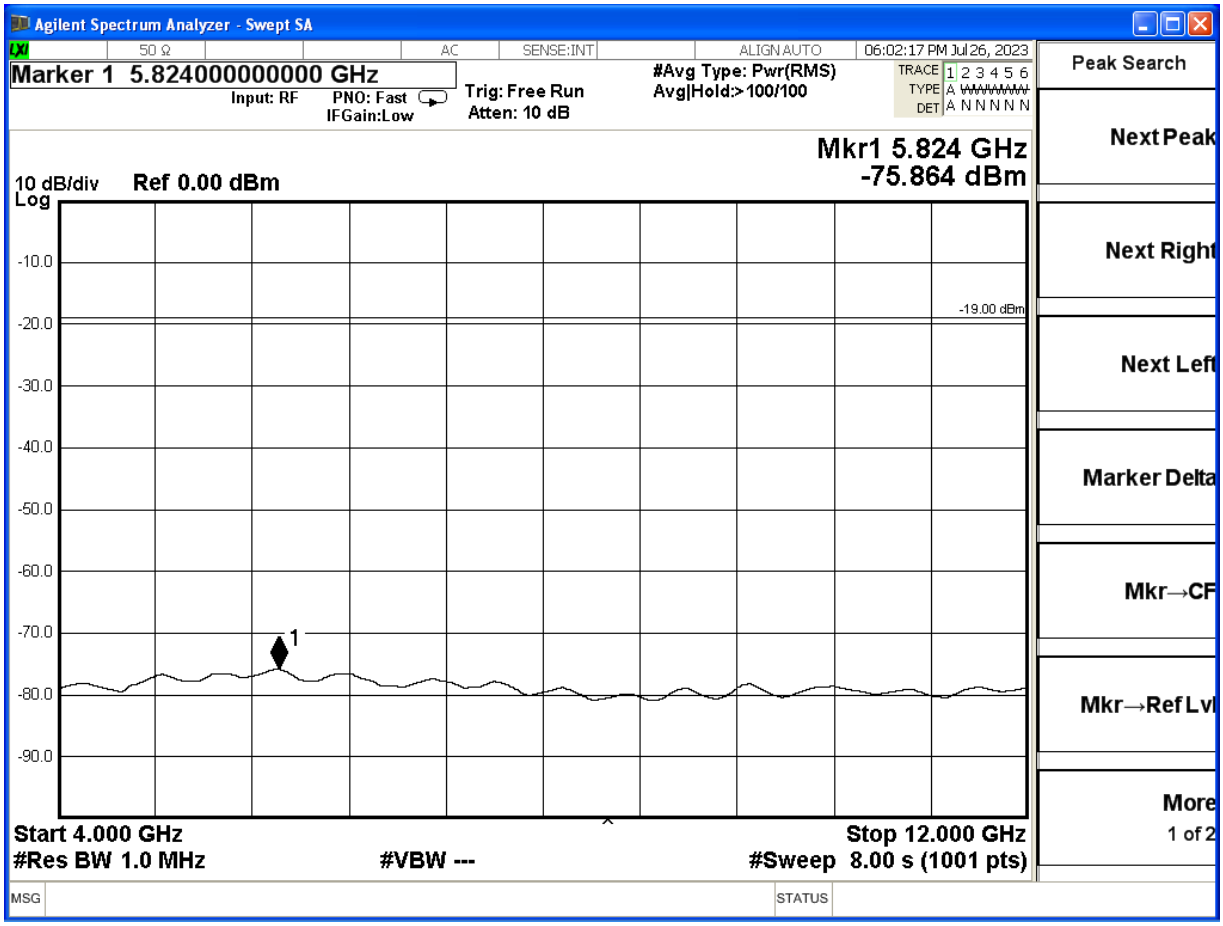
50mV/m = 50,000 uV/m = 93.98dBuV/m

Maximum measured value = 89.30 dBuV/m Verdict PASS

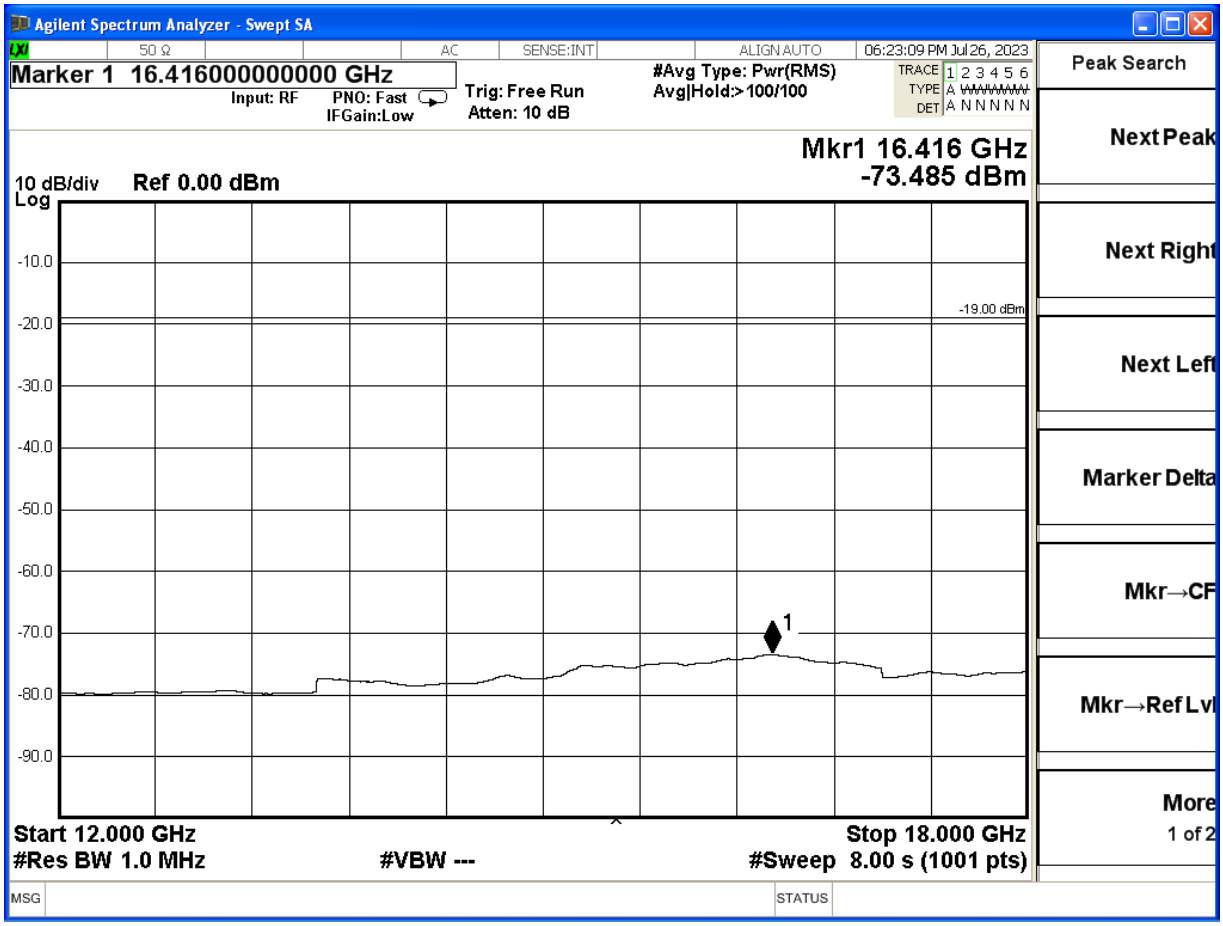
Conducted Spurious Emissions



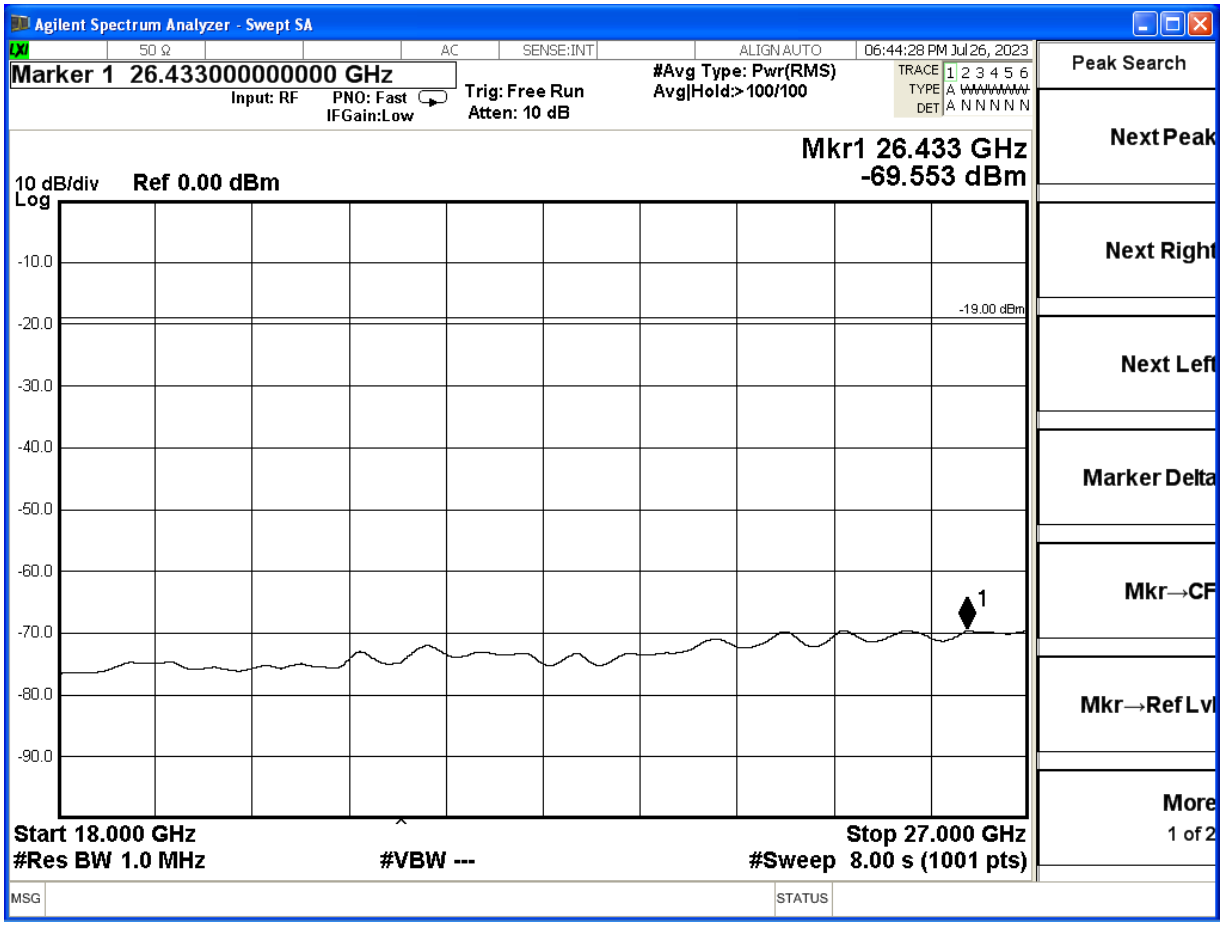
Spurious Emissions 9 KHz to 4 GHz



Spurious Emissions 4 GHz to 12 GHz



Spurious Emissions 12 GHz to 18 GHz



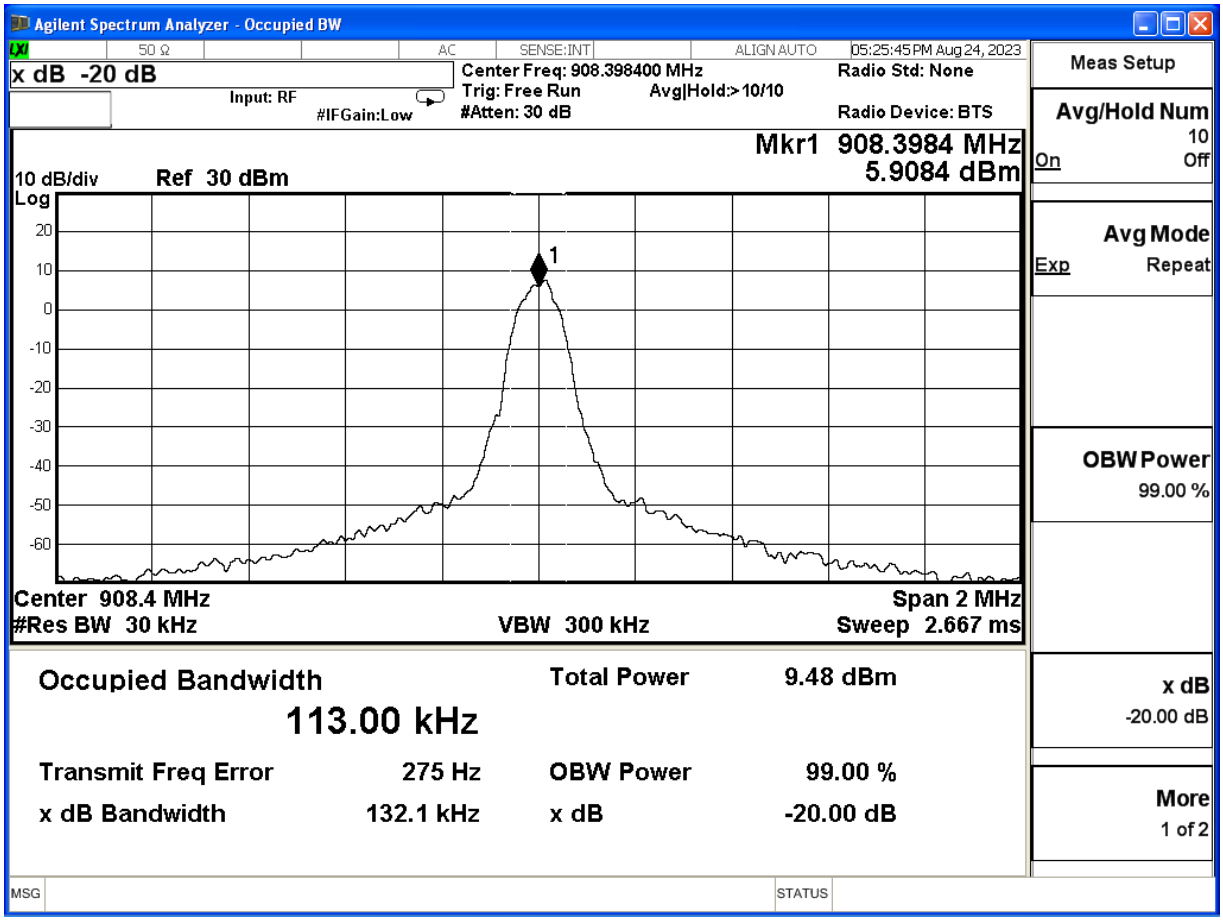
Spurious Emissions 18 GHz to 27 GHz

TABLE 20

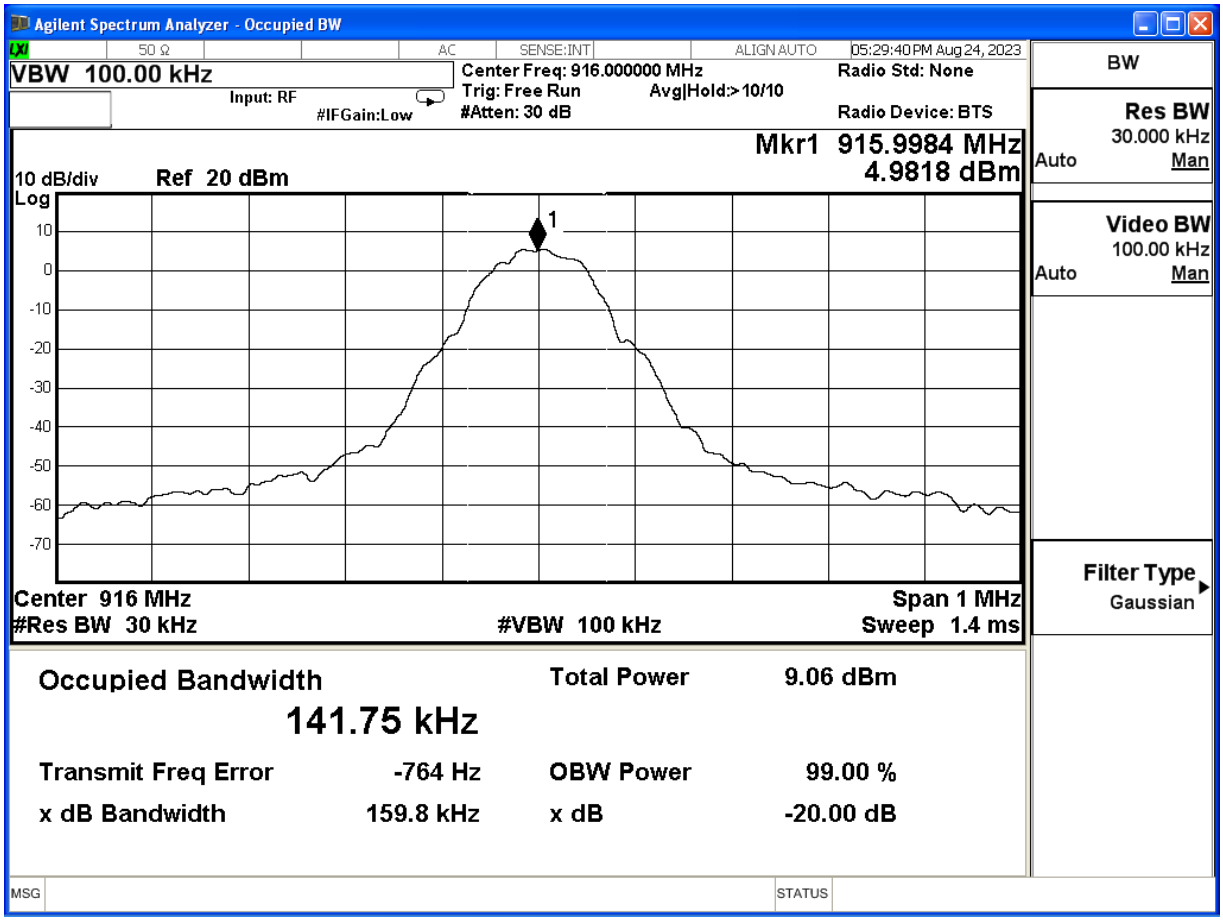
Spurious Emissions

Band	Range	Highest spurious (dBm)	PASS/FAIL
1	9 KHz – 4 GHz	-54.52	PASS
2	4 GHz – 12 GHz	-75.86	PASS
3	12 GHz – 18 GHz	-73.48	PASS
4	18 GHz – 27 GHz	-69.55	PASS

Occupied Bandwidth



Occupied Bandwidth LOW Channel



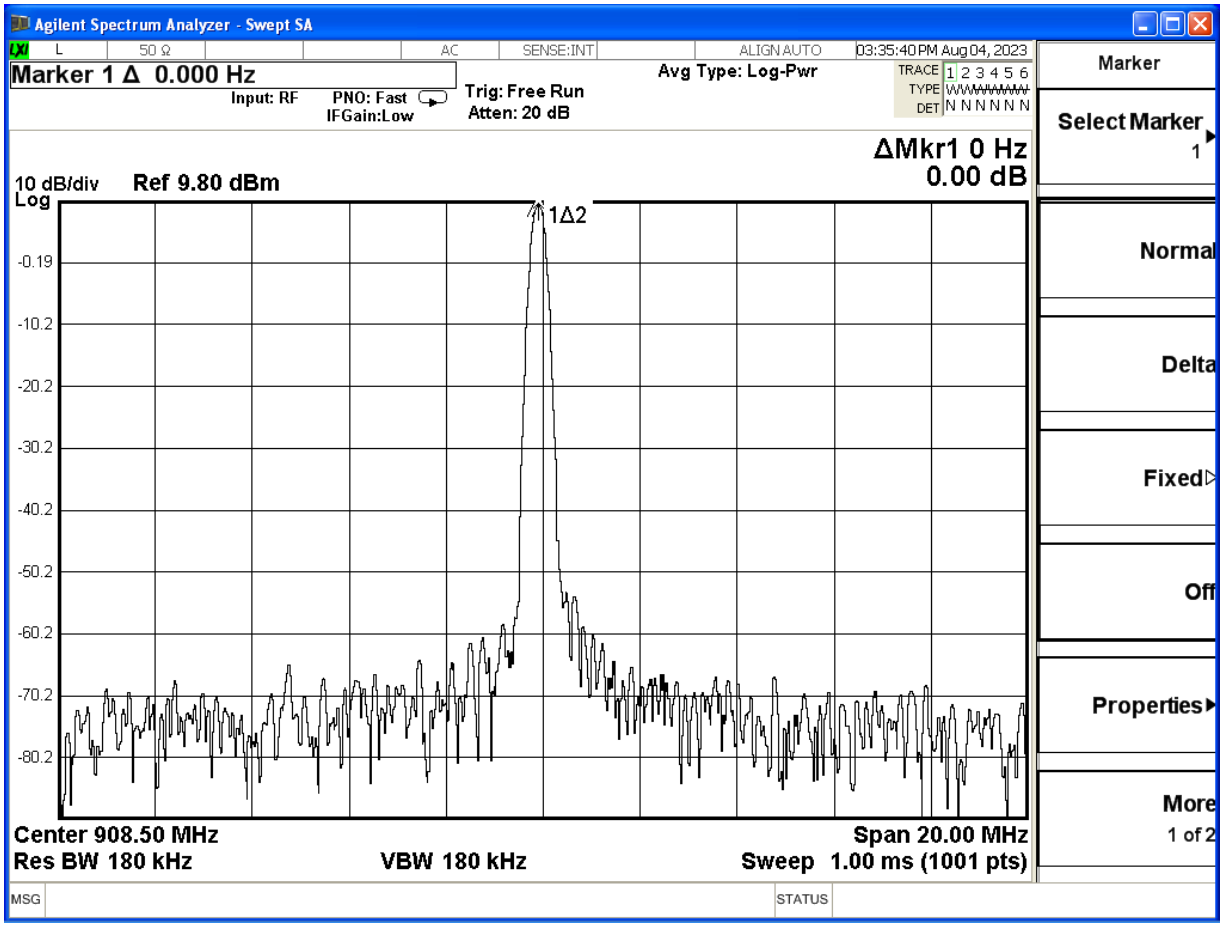
Occupied Bandwidth HIGH Channel

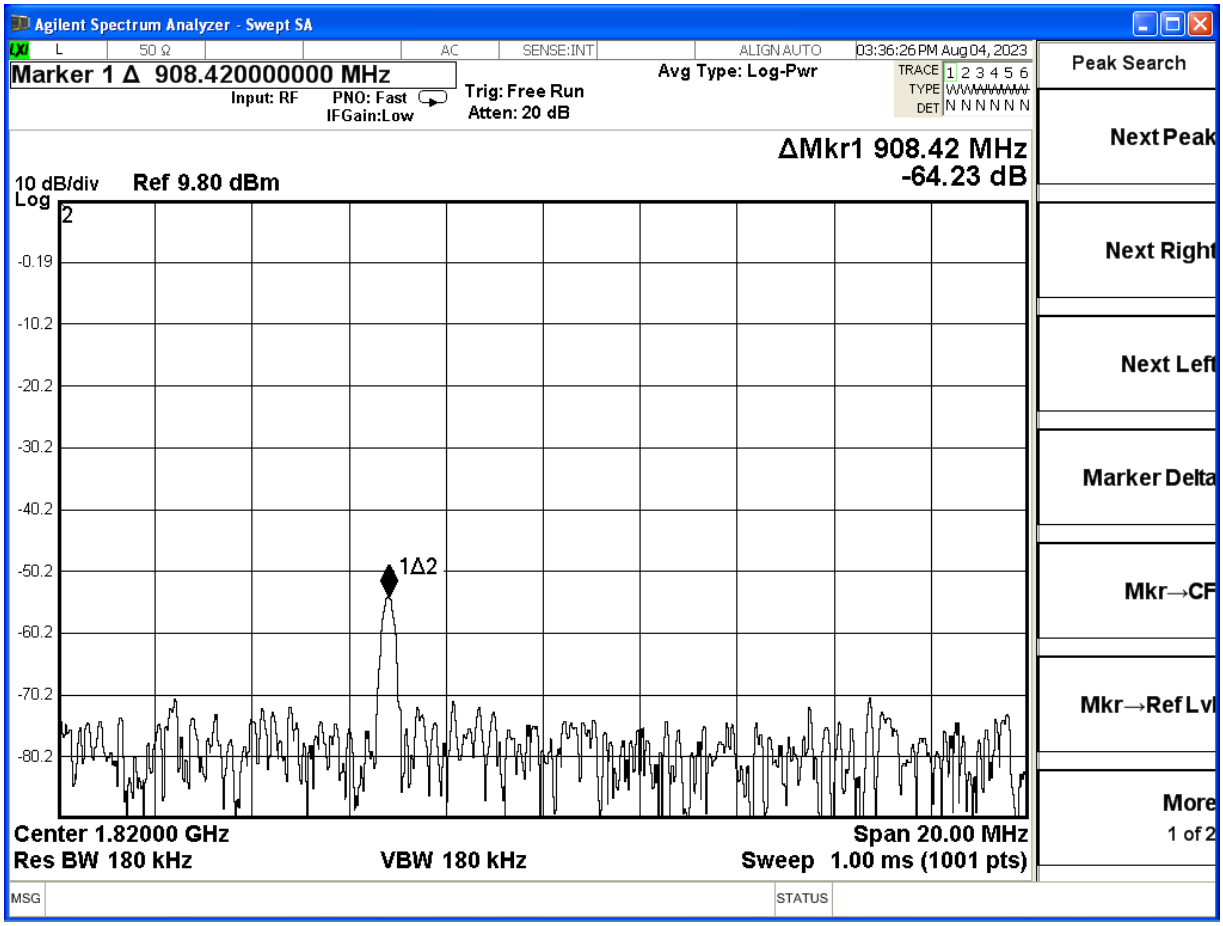
TABLE 21

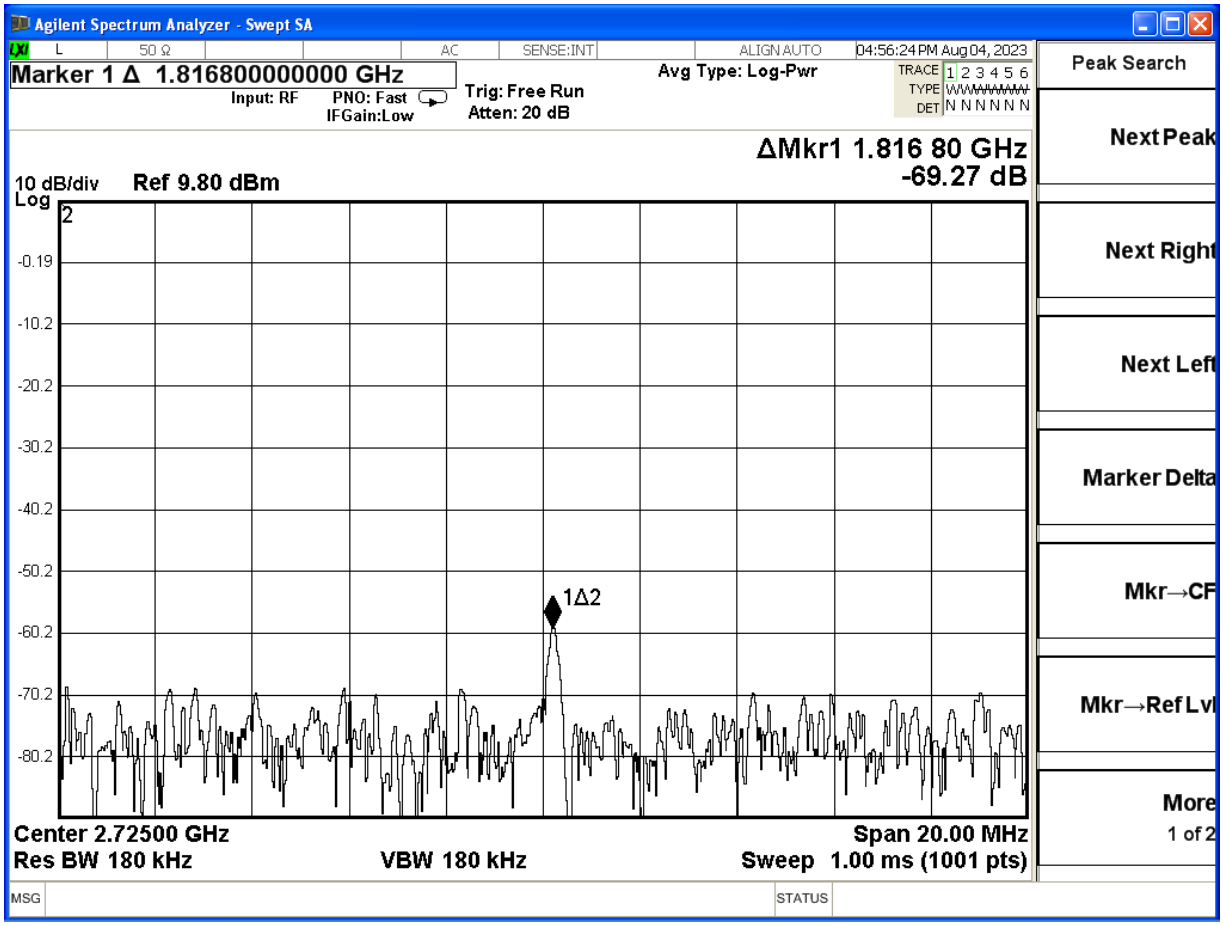
SUMMARY- Occupied Bandwidth

Channel	Frequency	Occupied Bandwidth	20 dB Bandwidth	PASS/FAIL
LOW	908.4 MHz	113.0 KHz	132.1 KHz	PASS
HIGH	916.0 MHz	141.75 KHz	159.8 KHz	PASS

Harmonics







Appendix A – The EUT and Client-Provided Details

General EUT Description

EUT information

Product name	Zwave module
Model	PNS50E0452
Part number	
Revision	REVA04

Serial number	N/A
Antenna ports	1
IBW	
Frequency:	908.4 MHz, 916.0 MHz
Nominal O/P per Antenna Port:	
Accuracy (Nominal):	
Nominal Voltage:	5 V DC
RAT:	DTM
Modulation:	FSK
Channel Bandwidth:	
Maximum Combined OBW per Port:	N/A
IF Interface:	N/A
Channel Raster:	100 kHz
Regulatory Requirements	Radio: FCC Part 15, Subpart C, 15.247,
Multi-carrier:	N/A
Operating Temperature:	5°C to 40°C
Total Power based on IBW:	N/A

EUT information, continued

Appendix B – EUT, Peripherals, and Test Set-up Photos

Photo 1: The EUT

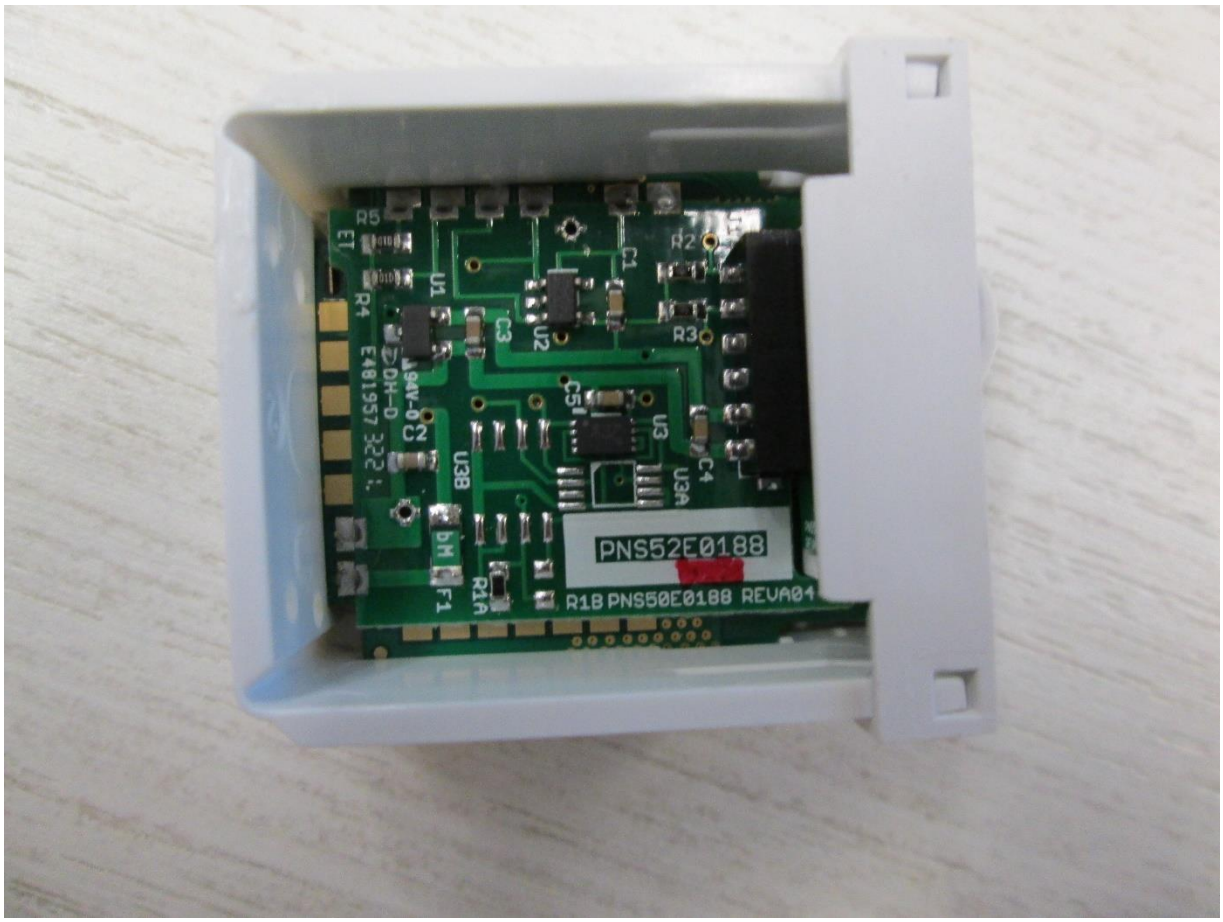


Photo 2: Test setup for RE

Photo 3: Setup of RE at 30 MHz to 1 GHz

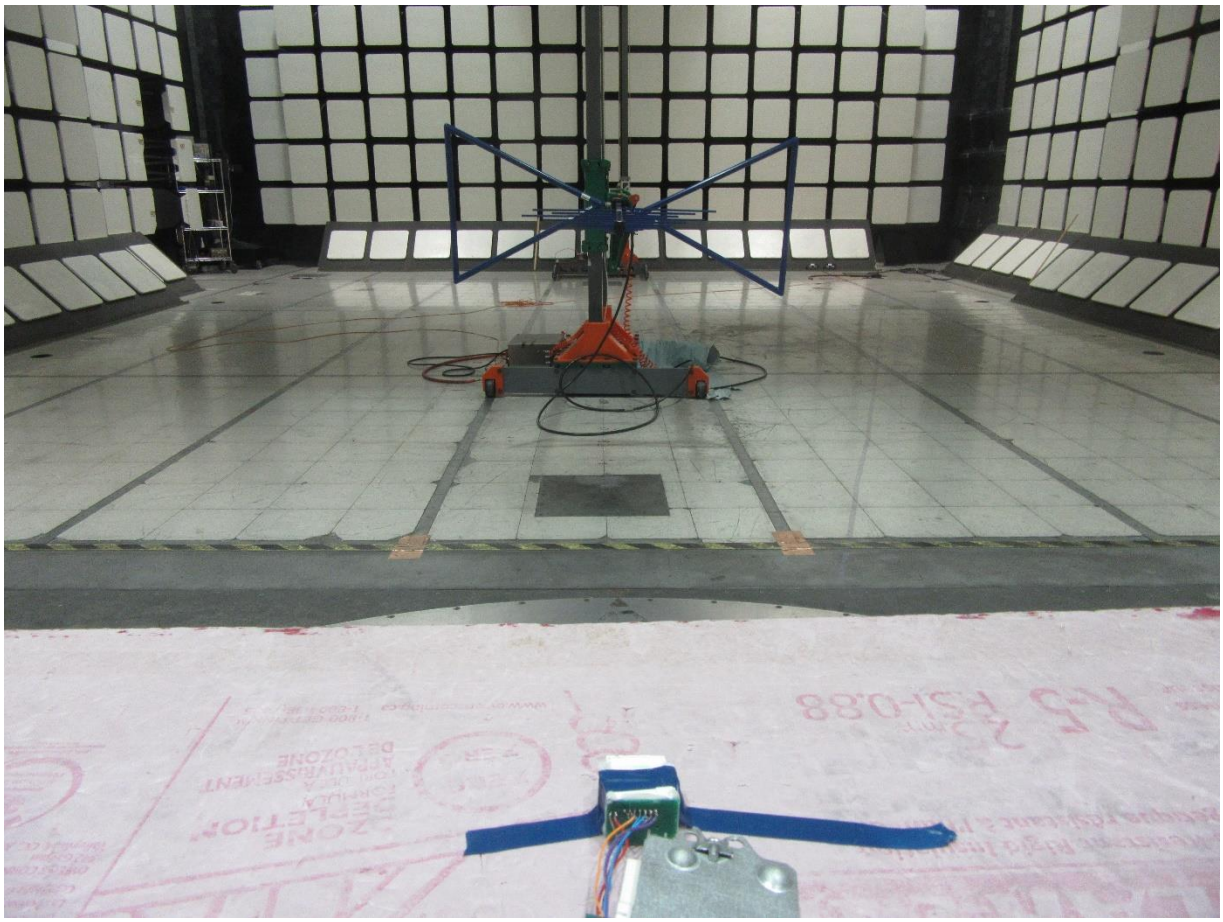


Photo 4: Setup of RE above 1 GHz

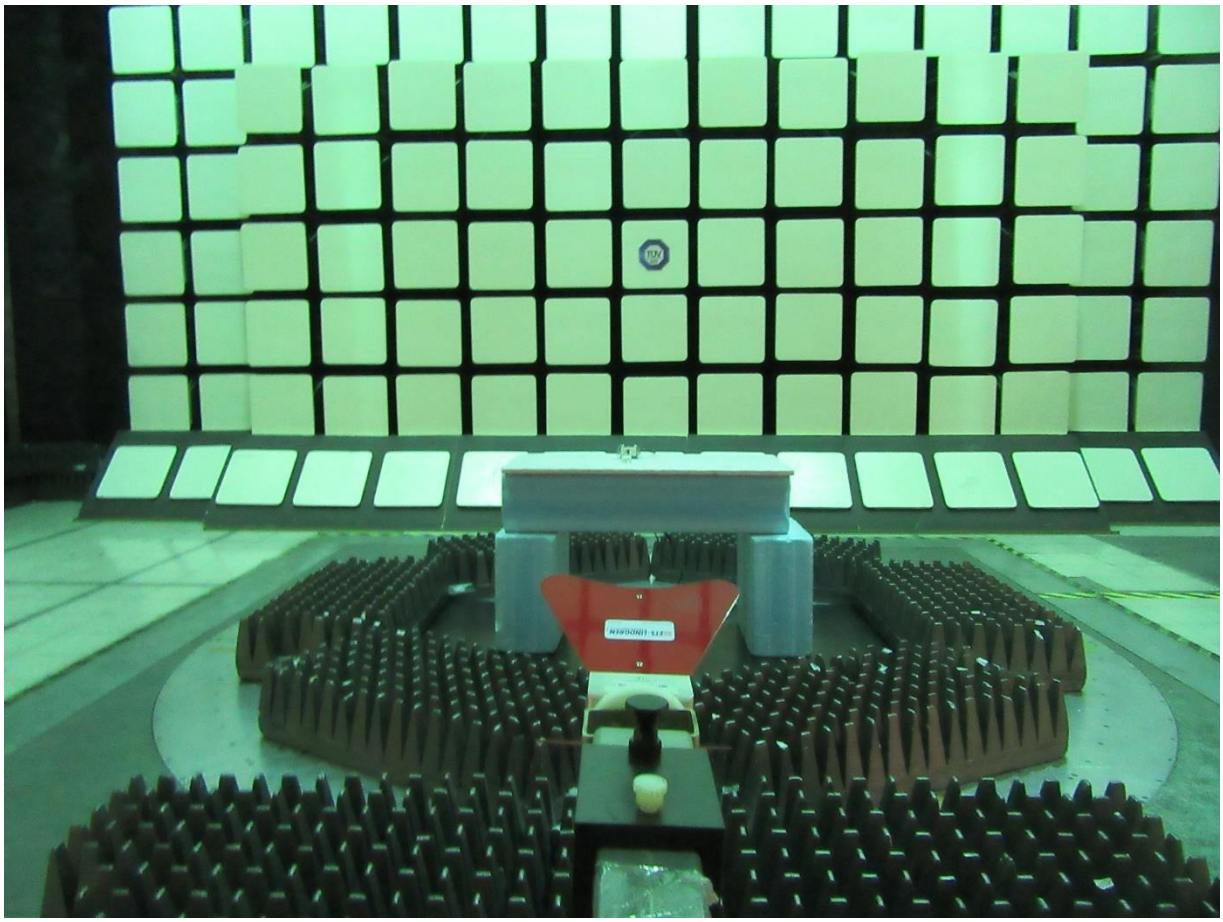


Photo 5: Close-up for RE on the table

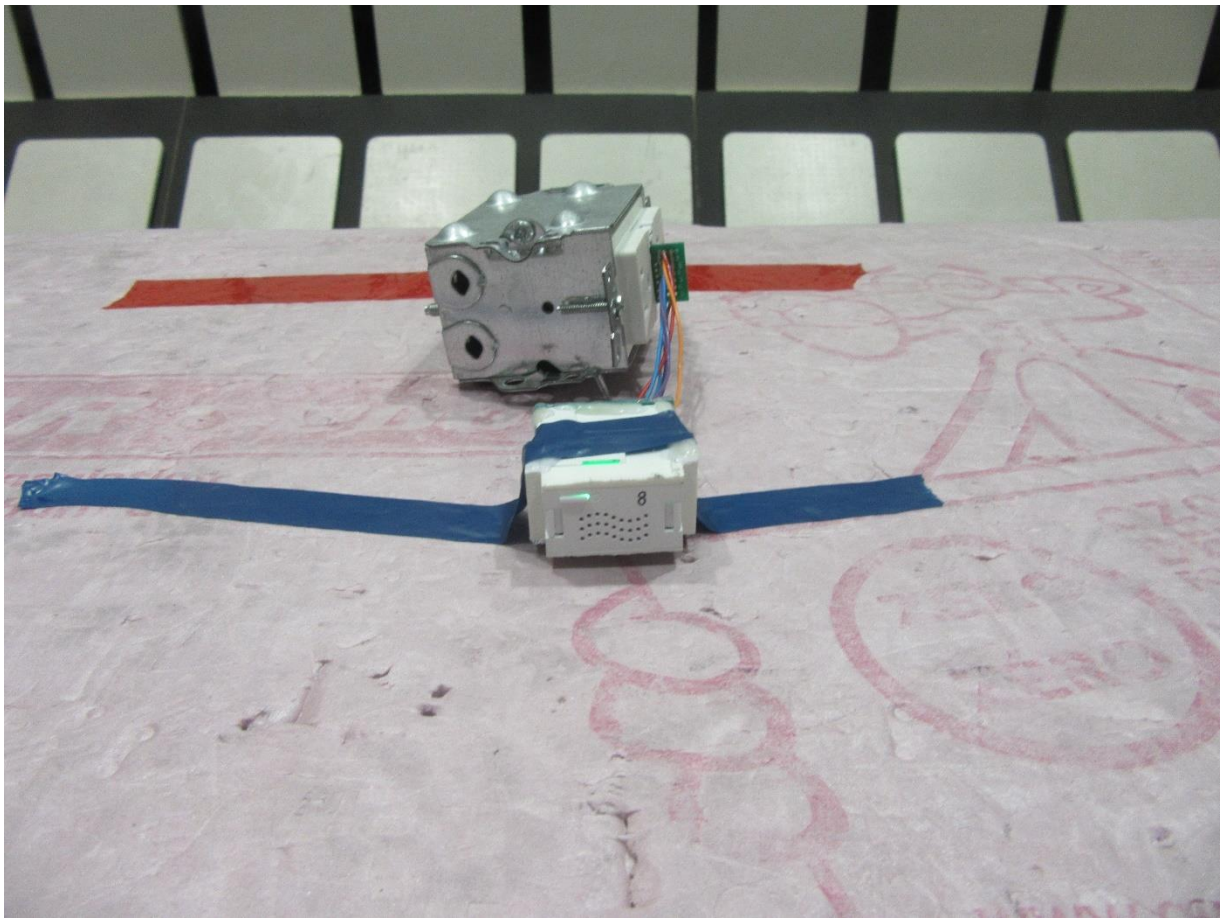


Figure 10: Setup for CE tests on AC power cables

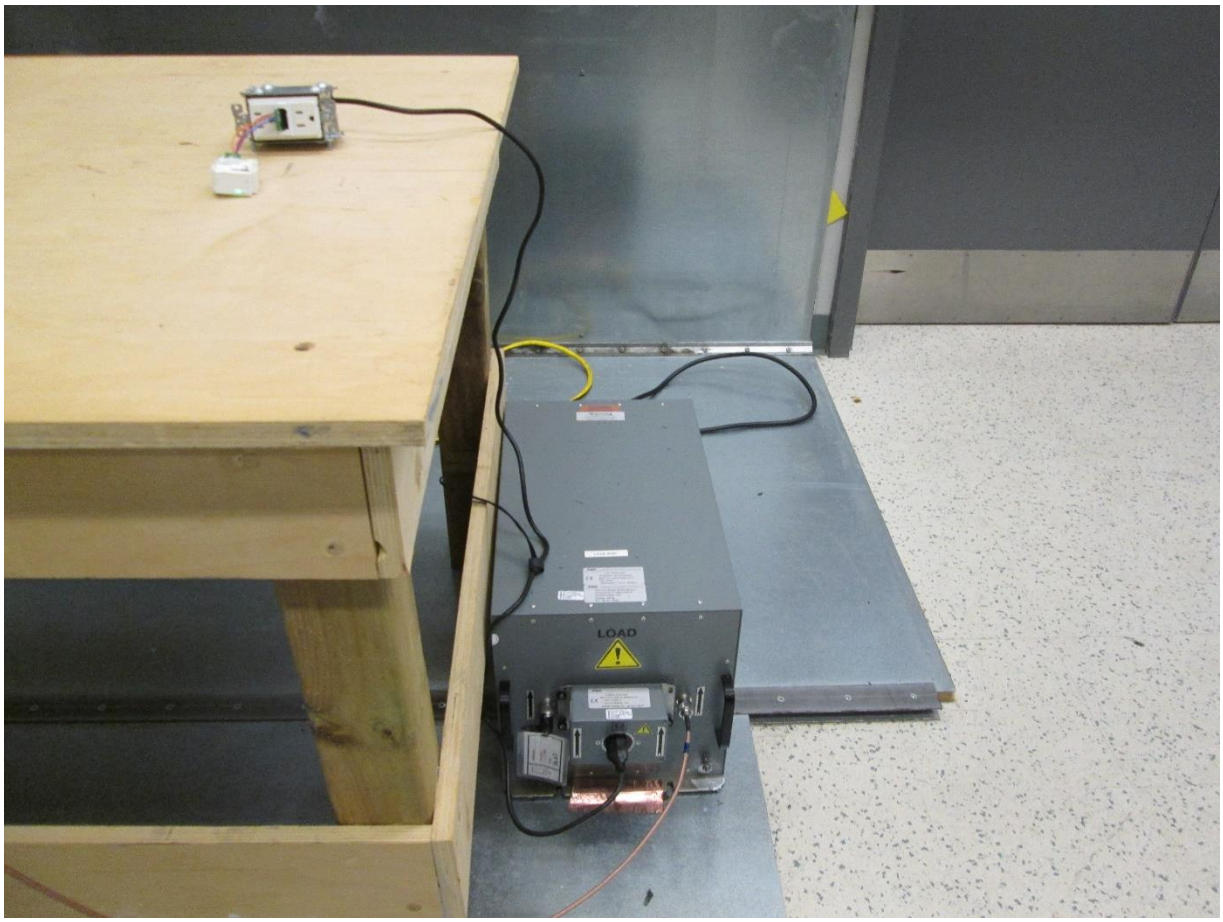


Table 19: Customer-provided peripheral test support equipment

Description	Make	Model number	Serial number
Laptop Computer	ASUS	BR1100CKA-CE1-CA	M5NXLP000850183