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Test report

396135-2TRFEMC

Date of issue: April 29, 2020

Applicant:

TEXAS INSTRUMENTS INCORPORATED

Product:

Intelligent mmWave sensor antenna-on-package (AoP) Evaluation Board

Model

IWR6843AOPEVM

Specifications:

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

Lab and test locations

Company name	Nemko USA Inc.
Address	2210 Faraday Ave, Suite 150
City	Carlsbad
State	California
Postal code	92008
Country	USA
Telephone	+1 760 444 3500
Website	www.nemko.com

Tested by	Marco Velderrain, EMC Engineer.
Reviewed by	Mark Phillips, Sr. EMC Test Engineer
Review date	April 29, 2020
Reviewer signature	

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 USA's ISO/IEC 17025 accreditation. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, or any agency of the U.S. Government.

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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: 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. 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 #	Details of changes made to test report
396135-2TRFEMC	Original report issued

Notes: None

Section 2 Summary of test results

2.1 Emissions Test results

Table 2.1-1: *FCC 47 CFR Part 15, Subpart B and ICES-003 Issue 6 results*

Test description	Verdict
Radiated disturbance [1]	Pass
Conducted disturbance at mains port [1]	Pass

Notes: [1] Product classification B

Section 3 Equipment under test (EUT) details

3.1 Applicant

Company name	Texas Instruments Incorporated
Address	12500 TI Boulevard MS K1-20
City	Dallas
State	Texas
Postal/Zip code	75243
Country	United States

3.2 Manufacturer

Company name	Texas Instruments Incorporated
Address	12500 TI Boulevard MS K1-20
City	Dallas
State	Texas
Postal/Zip code	75243
Country	United States

3.3 Sample information

Receipt date	February 13, 2020
Nemko sample ID number	NEx: 396135

3.4 EUT information

Product name	Intelligent mmWave sensor antenna-on-package (AoP) Evaluation Board
Model	IWR6843AOPEVM
Serial number	5119910017
Part number	IWR6843
Power requirements	5VDC
Description/theory of operation	mmWave sensor EVM with integrated, short-range, wide field-of-view AoP technology and allows for stand-alone use
Operational frequencies	60-GHz to 64-GHz mmWave sensor
Software details	N/A

3.5 EUT exercise and monitoring details

The device was tested on “Stand-by” mode.

3.6 EUT setup details

Table 3.6-1: *EUT sub assemblies*

Description	Brand name	Model/Part number	Serial number	Rev.
N/A				

Table 3.6-2: *EUT interface ports*

Description	Qty.
Micro USB port	2
60 Pin HD Male	1

Table 3.6-3: *Support equipment*

Description	Brand name	Model/Part number	Serial number	Rev.
mmWave sensors carrier card platform	Texas Instruments	MMWAVEICBOOST	6047900083	
AC/DC Adapter	CUI INC	AC adapter	N/A	

Table 3.6-4: *Inter-connection cables*

Cable description	From	To	Length (m)
N/A			

Figure 3.6-1: *Setup diagram*

Section 4 Engineering considerations

4.1 Modifications incorporated in the EUT

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 USA 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.

Test name	Measurement uncertainty, dB
Radiated spurious emissions	3.78
AC power line conducted emissions	1.38

Section 7 Terms and definitions

7.1 Product classifications definitions

7.1.1 Title 47: Telecommunication – Part 15-Radio Frequency devices, Subpart B – General

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

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 B – General

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

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 disturbance

8.1.1 References

ANSI C63.4-2014

8.1.2 Test summary

Verdict	Pass		
Test date	March 25, 2020	Temperature	20 °C
Test engineer	Marco Velderrain	Air pressure	1000 mbar
Test location	3m semi anechoic chamber	Relative humidity	25 %

8.1.3 Notes

None

8.1.4 Setup details

EUT setup configuration	Table top
Test facility	3 m 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 6 dB or above 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) – 5000 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) – 5000 ms (Peak and CAverage final measurement)

8.1.4 Setup details, continued

Table 8.1-1: *Radiated disturbance equipment list*

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
EMC Test Receiver	Rohde & Schwarz	ESU 40	E1131	1 Year	11-19-2020
Antenna, Bilog	Schaffner-Chase	CBL6111C	1480	1 Year	04-18-2020
Antenna, Horn	ETS-Lindgren	3117	E1139	2 Year	03-21-2021
Pre-Amplifier	ETS-Lindgren	3117-PA	E1139	2 Year	03-21-2021
EMC Test Receiver	Rohde & Schwarz	ESU 40	E1131	1 Year	11-19-2020
Antenna, Bilog	Schaffner-Chase	CBL6111C	1480	1 Year	04-18-2020

Notes: None

Table 8.1-2: *Radiated disturbance test software details*

Manufacturer of Software	Details
Rohde & Schwarz	EMC 32 V10.00.00

Notes: None

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).

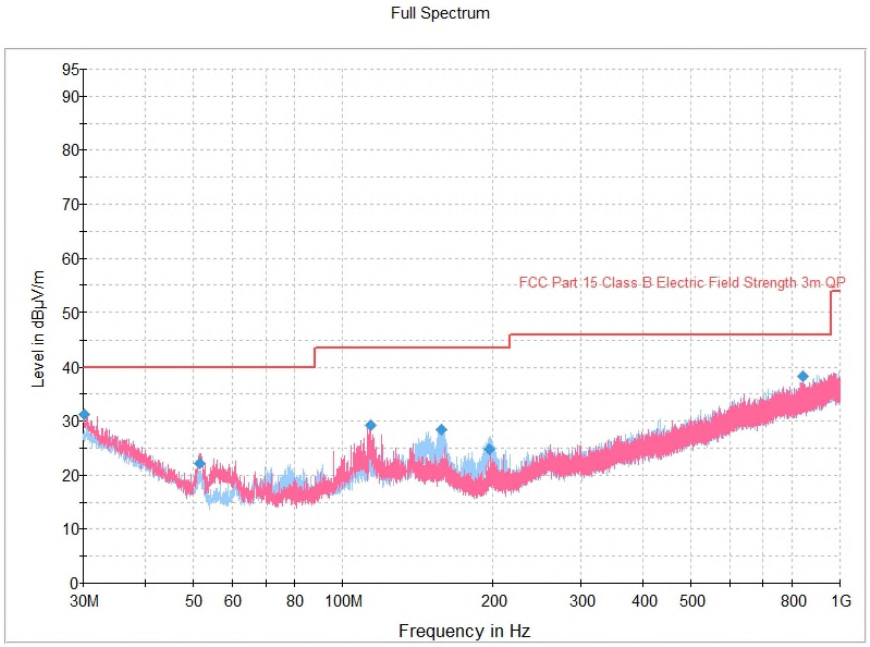

Figure 8.1-1: Radiated disturbance spectral plot (30 to 1000 MHz)

Table 8.1-3: *Radiated disturbance (Quasi-Peak) results*

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
30.200000	31.35	40.00	8.65	1000.0	120.000	142.0	V	129.0	26.4
51.552667	22.15	40.00	17.85	1000.0	120.000	124.0	V	10.0	15.1
113.654000	29.34	43.50	14.16	1000.0	120.000	393.0	V	114.0	18.8
157.538000	28.41	43.50	15.09	1000.0	120.000	109.0	H	93.0	18.6
196.953000	24.82	43.50	18.68	1000.0	120.000	112.0	H	201.0	17.3
841.140333	38.27	46.00	7.73	1000.0	120.000	159.0	V	341.0	32.1

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] The maximum measured value observed over a period of 1 second was recorded.
[4] An inverse proportionality factor of 20 dB per decade (20 log (10/3) = 10.5 dB) has been used to normalize the specification limit to a measurement distance of 3 meters to determine compliance.

8.1.5 Test data, continued

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).

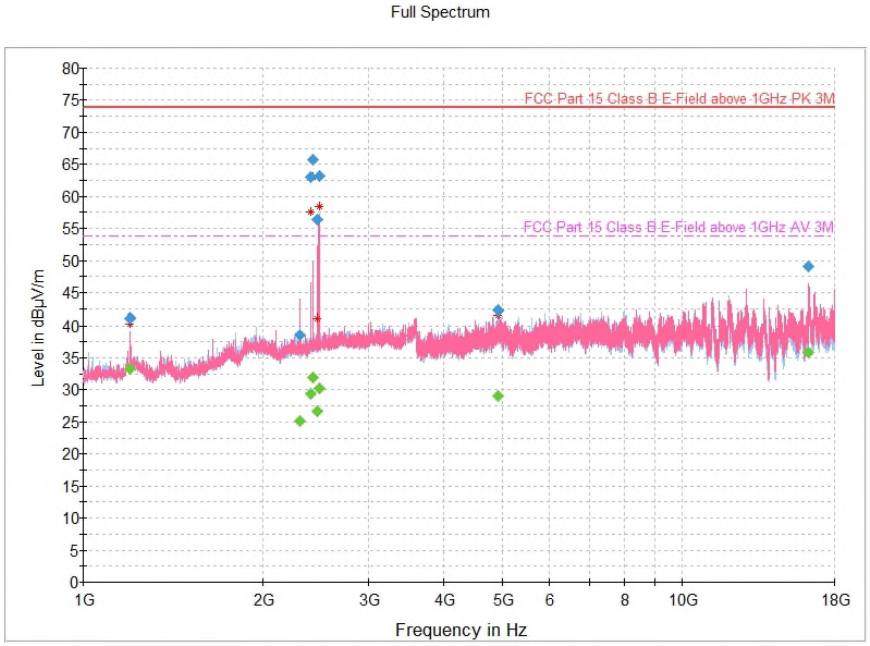

Figure 8.1-2: *Radiated disturbance spectral plot (1 to 18GHz)*

Table 8.1-4: *Radiated disturbance (Peak and CAverage) results*

Frequency (MHz)	MaxPeak (dBµV/m)	CAverage (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
1199.866667	41.04	---	73.90	32.86	5000.0	1000.000	272.0	V	0.0	-14.5
1199.866667	---	33.27	53.90	20.63	5000.0	1000.000	272.0	V	0.0	-14.5
2305.600000	38.59	---	73.90	35.31	5000.0	1000.000	370.0	V	0.0	-11.5
2305.600000	---	25.21	53.90	28.69	5000.0	1000.000	370.0	V	0.0	-11.5
2401.600000	63.04	---	73.90	10.86	5000.0	1000.000	100.0	V	53.0	-11.0
2401.600000	---	29.44	53.90	24.46	5000.0	1000.000	100.0	V	53.0	-11.0
2426.066667	65.80	---	73.90	8.10	5000.0	1000.000	116.0	V	54.0	-10.8
2426.066667	---	31.88	53.90	22.02	5000.0	1000.000	116.0	V	54.0	-10.8
2468.166667	56.31	---	73.90	17.59	5000.0	1000.000	126.0	V	186.0	-10.5
2468.166667	---	26.62	53.90	27.28	5000.0	1000.000	126.0	V	186.0	-10.5
2480.133333	63.25	---	73.90	10.65	5000.0	1000.000	109.0	V	62.0	-10.5
2480.133333	---	30.18	53.90	23.72	5000.0	1000.000	109.0	V	62.0	-10.5
4915.700000	---	29.04	53.90	24.86	5000.0	1000.000	383.0	H	160.0	-3.4
4915.700000	42.30	---	73.90	31.60	5000.0	1000.000	383.0	H	160.0	-3.4
16298.966667	---	35.76	53.90	18.14	5000.0	1000.000	402.0	V	144.0	10.3
16298.966667	49.11	---	73.90	24.79	5000.0	1000.000	402.0	V	144.0	10.3

Notes: [1] Field strength (dBµV/m) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factor = antenna factor ACF (dB) + cable loss (dB) − amplifier gain (dB)
[3] The maximum measured value observed over a period of 5 seconds was recorded.

8.1.6 Setup photos

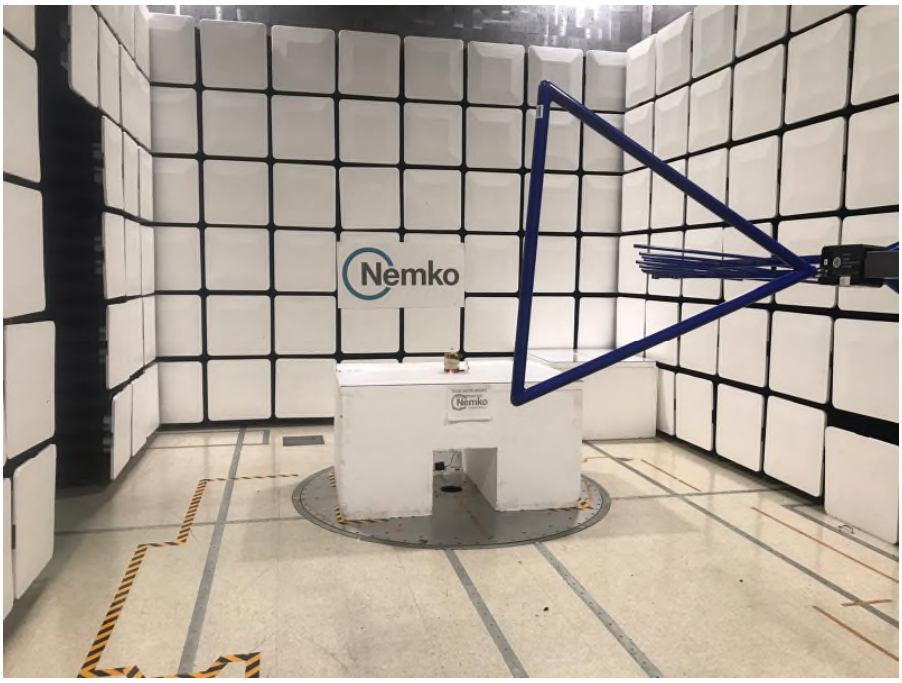

Figure 8.1-3: *Radiated disturbance setup photo below 1GHz*

Figure 8.1-4: *Radiated disturbance setup photo below 1GHz*

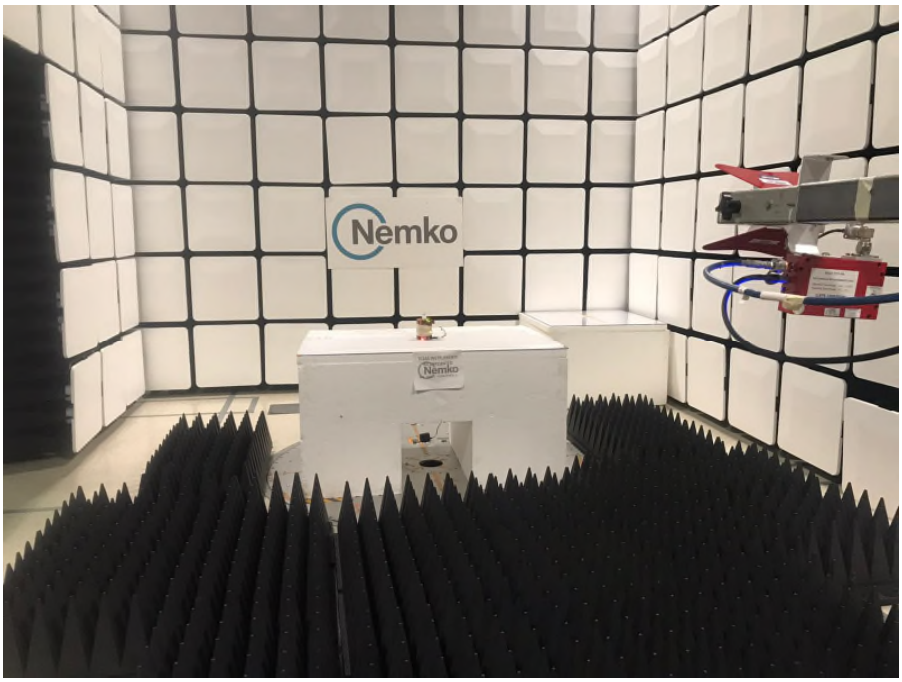

Figure 8.1-5: *Radiated disturbance setup photo above 1GHz*

Figure 8.1-6: *Radiated disturbance setup photo above 1GHz*

8.2 Conducted disturbance at mains port

8.2.1 References

ANSI C63.4-2014

8.2.2 Test summary

Verdict	Pass		
Test date	February 21, 2020	Temperature	22 °C
Test engineer	Martha Espinoza, Wireless Test Engineer	Air pressure	1001 mbar
Test location	Ground Plane	Relative humidity	25 %

8.2.3 Notes

None

8.2.4 Setup details

Port under test	AC main port*
EUT setup configuration	Table top
Measurement details	A preview measurement was generated with the receiver in continuous scan mode. Emissions detected within 6 dB or above limit were re-measured with the appropriate detector against the correlating limit and recorded as the final measurement.

*AC/DC converter.

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) – 5000 ms (Quasi-peak final measurement) – 5000 ms (CAverage final measurement)

Table 8.2-1: *Conducted disturbance at mains port equipment list*

Equipment	Manufacturer	Model no.	Asset no.	Cal cycle	Next cal.
Two Line V-Network	Rohde & Schwartz	ENV216	E1019	1 Year	12-Jul-2020
Transient Limiter	HP	11947A	684	1 Year	20-Jan-2021
EMC Test Receiver	Rohde & Schwarz	ESCI 7	E1026	2 Year	29-May-2021

Notes: None

Table 8.2-2: *Conducted disturbance at mains port test software details*

Manufacturer of Software	Details
Rohde & Schwarz	EMC 32 V10.20.01

Notes: None

8.2.5 Test data

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

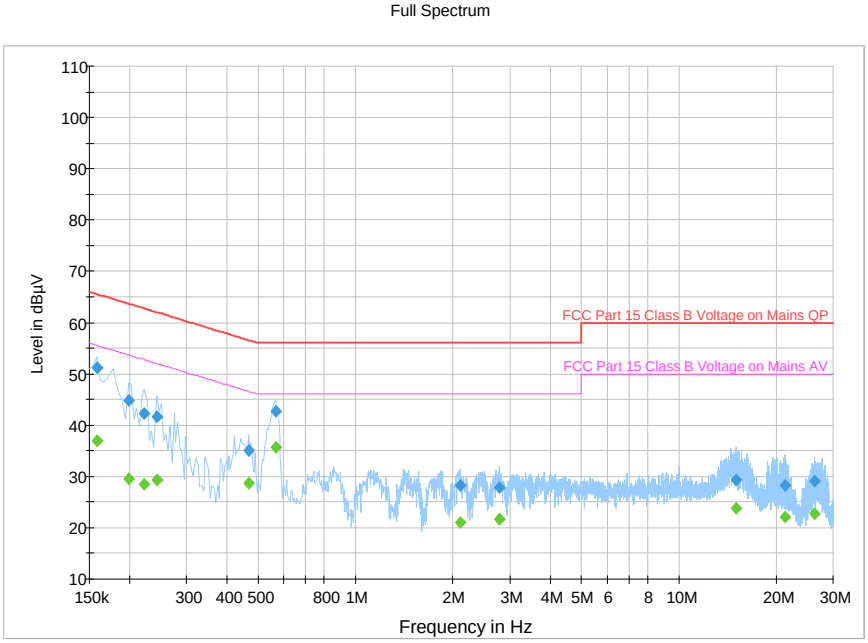

Figure 8.2-1: **Conducted disturbance at mains port spectral plot**

Table 8.2-3: *Conducted disturbance at mains port (Quasi-Peak and CAverage) results*

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Filter	Corr. (dB)
0.158000	---	36.99	55.57	18.58	5000.0	9.000	N	ON	19.6
0.158000	51.22	---	65.57	14.35	5000.0	9.000	N	ON	19.6
0.198000	44.81	---	63.69	18.88	5000.0	9.000	L1	ON	19.5
0.198000	---	29.57	53.69	24.13	5000.0	9.000	L1	ON	19.5
0.222000	42.30	---	62.74	20.45	5000.0	9.000	L1	ON	19.5
0.222000	---	28.41	52.74	24.34	5000.0	9.000	L1	ON	19.5
0.242000	41.54	---	62.03	20.49	5000.0	9.000	N	ON	19.5
0.242000	---	29.31	52.03	22.72	5000.0	9.000	N	ON	19.5
0.466000	---	28.72	46.59	17.86	5000.0	9.000	N	ON	19.4
0.466000	34.97	---	56.59	21.61	5000.0	9.000	N	ON	19.4
0.566000	42.63	---	56.00	13.37	5000.0	9.000	N	ON	19.4
0.566000	---	35.80	46.00	10.20	5000.0	9.000	N	ON	19.4
2.106000	28.19	---	56.00	27.81	5000.0	9.000	L1	ON	19.4
2.106000	---	21.02	46.00	24.98	5000.0	9.000	L1	ON	19.4
2.778000	27.90	---	56.00	28.10	5000.0	9.000	N	ON	19.4
2.778000	---	21.77	46.00	24.23	5000.0	9.000	N	ON	19.4
14.998000	---	23.70	50.00	26.30	5000.0	9.000	L1	ON	20.2
14.998000	29.30	---	60.00	30.70	5000.0	9.000	L1	ON	20.2
21.318000	28.17	---	60.00	31.83	5000.0	9.000	L1	ON	20.1
21.318000	---	22.20	50.00	27.80	5000.0	9.000	L1	ON	20.1
26.246000	29.20	---	60.00	30.80	5000.0	9.000	L1	ON	20.0
26.246000	---	22.76	50.00	27.24	5000.0	9.000	L1	ON	20.0

Notes:
[1] Result (dBµV) = receiver/spectrum analyzer value (dBµV) + correction factor (dB)
[2] Correction factor (dB) = LISN factor IL (dB) + cable loss (dB) + transient limiter (dB)
[3] The maximum measured value observed over a period of 5 seconds was recorded.

8.2.6 Setup photos

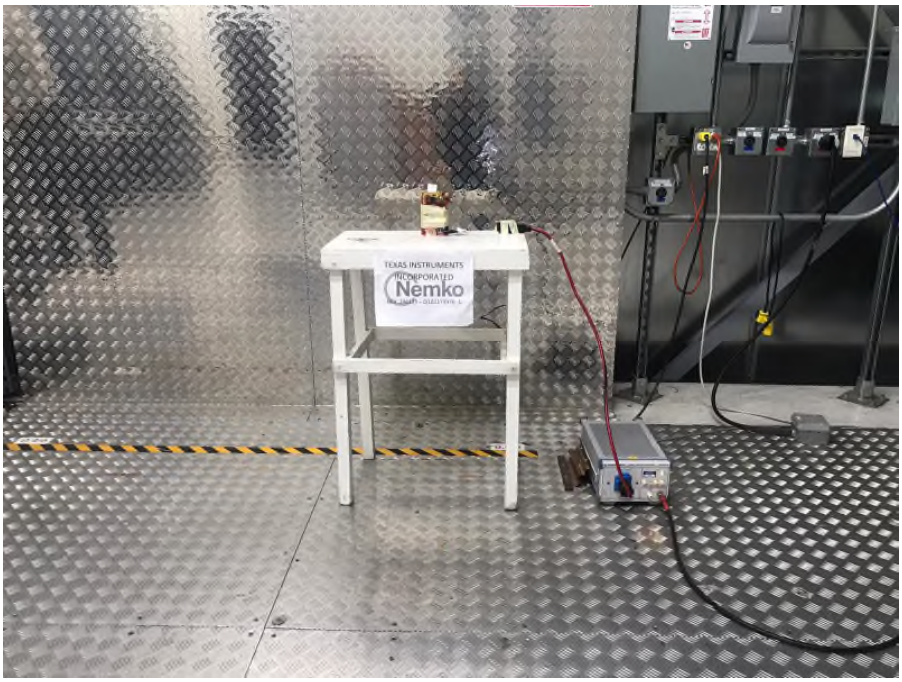

Figure 8.2-2: *Conducted disturbance at mains port setup photo*

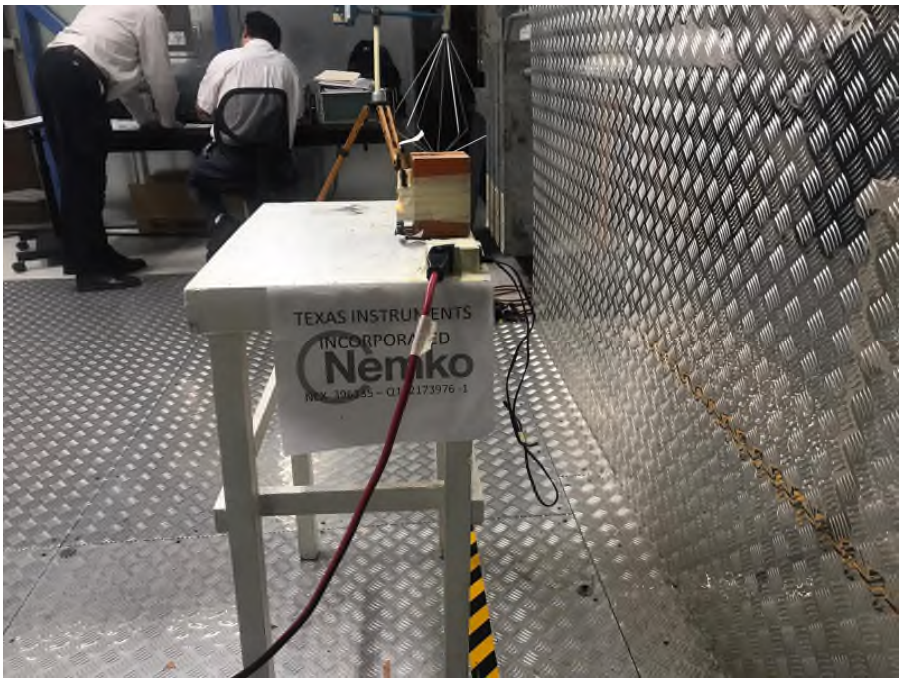

Figure 8.2-3: *Conducted disturbance at mains port setup photo*

Section 9 EUT photos

9.1 External photos

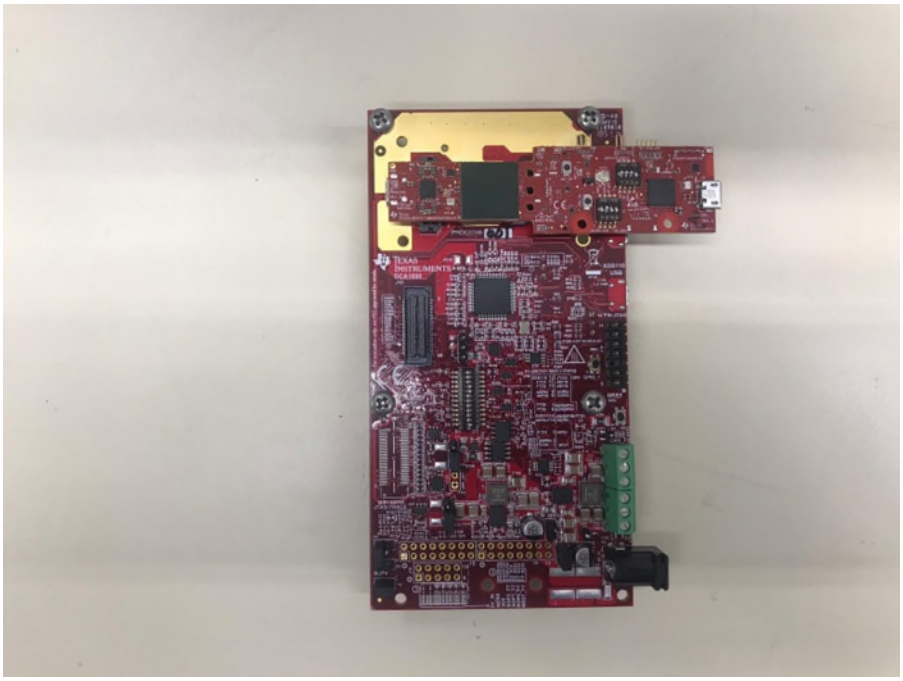

Figure 9.1-1: *Front view photo*

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

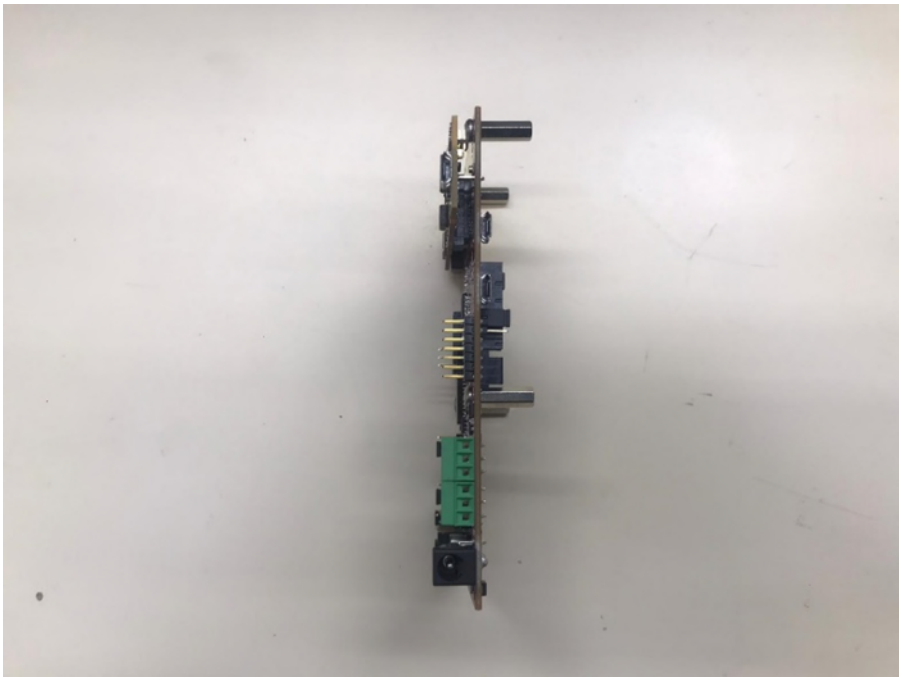

Figure 9.1-3: *Side view photo*