EMI TEST REPORT

Test Report No.:15008849S

Customer	**TDK Corporation**
Description of EUT	**Sensor Module**
Model Number of EUT	**i3 Micro Module**
FCC ID	**2ADLX-MM0110113M**
Test Regulation	**FCC Part 15 Subpart B, Class A**
Test Result	**Complied (Refer to SECTION 3)**
Issue Date	**October 17, 2023**
Remarks	**-**

Representative test engineer	**Approved by**
Yasumasa Owaki	Kazutaka Takeyama
Engineer	Leader

CERTIFICATE 1266.03

☐ The testing in which "Non-accreditation" is displayed is outside the accreditation scopes in UL Japan, Inc.
☒ There is no testing item of "Non-accreditation".

Report Cover Page - Form-ULID-003532 (DCS:13-EM-F0429) Issue# 21.0

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- The information provided from the customer for this report is identified in Section 1.
- For test report(s) referred in this report, the latest version (including any revisions) is always referred.

REVISION HISTORY

Original Test Report No.: 15008849S

Revision	Test report No.	Date	Revised Contents
- (Original)	15008849S	October 17, 2023	-

Reference: Abbreviations (Including words undescribed in this report)

A2LA	The American Association for Laboratory Accreditation	IEEE	Institute of Electrical and Electronics Engineers
AAN	Asymmetric Artificial Network	IF	Intermediate Frequency
AC	Alternating Current	ILAC	International Laboratory Accreditation Conference
AM	Amplitude Modulation	ISED	Innovation, Science and Economic Development Canada
AMN	Artificial Mains Network	ISN	Impedance Stabilization Network
Amp, AMP	Amplifier	ISO	International Organization for Standardization
ANSI	American National Standards Institute	JAB	Japan Accreditation Board
Ant, ANT	Antenna	LAN	Local Area Network
AP	Access Point	LCL	Longitudinal Conversion Loss
ASK	Amplitude Shift Keying	LIMS	Laboratory Information Management System
Atten., ATT	Attenuator	LISN	Line Impedance Stabilization Network
AV	Average	MRA	Mutual Recognition Arrangement
BPSK	Binary Phase-Shift Keying	N/A	Not Applicable
BR	Bluetooth Basic Rate	NIST	National Institute of Standards and Technology
BT	Bluetooth	NS	No signal detect.
BT LE	Bluetooth Low Energy	NSA	Normalized Site Attenuation
BW	BandWidth	OBW	Occupied BandWidth
C.F	Correction Factor	OFDM	Orthogonal Frequency Division Multiplexing
Cal Int	Calibration Interval	PER	Packet Error Rate
CAV	CISPR AV	PK	Peak
CCK	Complementary Code Keying	P_{LT}	long-term flicker severity
CDN	Coupling Decoupling Network	POHC(A)	Partial Odd Harmonic Current
Ch., CH	Channel	Pol., Pola.	Polarization
CISPR	Comite International Special des Perturbations Radioelectriques	PR-ASK	Phase Reversal ASK
Corr.	Correction	P_{ST}	short-term flicker severity
CPE	Customer premise equipment	QAM	Quadrature Amplitude Modulation
CW	Continuous Wave	QP	Quasi-Peak
DBPSK	Differential BPSK	QPSK	Quadrature Phase Shift Keying
DC	Direct Current	r.m.s., RMS	Root Mean Square
DET	Detector	RBW	Resolution BandWidth
D-factor	Distance factor	RE	Radio Equipment
Dmax	maximum absolute voltage change during an observation period	REV	Reverse
DQPSK	Differential QPSK	RF	Radio Frequency
DSSS	Direct Sequence Spread Spectrum	RFID	Radio Frequency Identifier
DUT	Device Under Test	RNSS	Radio Navigation Satellite Service
EDR	Enhanced Data Rate	RSS	Radio Standards Specifications
e.i.r.p., EIRP	Equivalent Isotropically Radiated Power	Rx	Receiving
EM clamp	Electromagnetic clamp	SINAD	Ratio of (Signal + Noise + Distortion) to (Noise + Distortion)
EMC	ElectroMagnetic Compatibility	S/N	Signal to Noise ratio
EMI	ElectroMagnetic Interference	SA, S/A	Spectrum Analyzer
EMS	ElectroMagnetic Susceptibility	SABS	South African Bureau of Standards
EN	European Norm	SANS	South African National Standards
e.r.p., ERP	Effective Radiated Power	SG	Signal Generator
ETSI	European Telecommunications Standards Institute	SVSWR	Site-Voltage Standing Wave Ratio
EU	European Union	THC(A)	Total Harmonic Current
EUT	Equipment Under Test	THD(%)	Total Harmonic Distortion
Fac.	Factor	TR, T/R	Test Receiver
FCC	Federal Communications Commission	Tx	Transmitting
FHSS	Frequency Hopping Spread Spectrum	VBW	Video BandWidth
FM	Frequency Modulation	Vert.	Vertical
Freq.	Frequency	WLAN	Wireless LAN
FSK	Frequency Shift Keying	xDSL	Generic term for all types of DSL technology (DSL: Digital Subscriber Line)
Fund	Fundamental		
FWD	Forward		
GFSK	Gaussian Frequency-Shift Keying		
GNSS	Global Navigation Satellite System		
GPS	Global Positioning System		
Hori.	Horizontal		
ICES	Interference-Causing Equipment Standard		
I/O	Input/Output		
IEC	International Electrotechnical Commission		

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Section 1: Customer information

Company Name	TDK Corporation
Address	2-15-7 Higashiohwada Ichikawa-shi Chiba, Japan
Telephone Number	+81-70-2260-5879
Contact Person	Michihiro Muramoto

The information provided from the customer is as follows:
- Customer, Description of EUT, Model Number of EUT, FCC ID on the cover and other relevant pages
- Operating/Test Mode(s) (Mode(s)) on all the relevant pages
- Section 1: Customer information
- Section 2: Equipment under test (EUT) other than the Receipt Date and Test Date
- Section 4: Operation of EUT during testing

* The laboratory is exempted from liability of any test results affected from the above information in Section 2 and 4.

Section 2 : Equipment under test (EUT)

2 . 1 Identification of EUT

Description	Sensor Module
Model Number	i3 Micro Module
Serial Number	Refer to 4.2.
Condition	Engineering prototype (Not for Sale: This sample is equivalent to mass-produced items.)
Modification	No Modification by the test lab.
Receipt Date	December 23, 2022
Test Date	December 23, 2022 to February 15, 2023

2 . 2 Product description

General Specification

Rating	DC 2.2 V to 3.2 V (Battery), DC 4.75 V to 5.25 V (USB Bus Power)
Clock frequency (ies) in the system	48 MHz

Radio Specification

IEEE 802.15.4

Equipment Type	Transceiver
Frequency of Operation	2405 MHz to 2480 MHz
Type of Modulation	O-QPSK
Antenna Gain	-4.1 dBi

Bluetooth (Low Energy)

Equipment Type	Transceiver
Frequency of Operation	2402 MHz to 2480 MHz
Type of Modulation	GFSK
Antenna Gain	-4.1 dBi

* IEEE 802.15.4 and Bluetooth do not transmit simultaneously.

Section 3 : Test specification, procedures and results

3 . 1 Test specification

Test Specification	FCC Part 15 Subpart B The latest version on the first day of the testing period
Title	FCC 47CFR Part15 Radio Frequency Device Subpart B Unintentional Radiators

3 . 2 Procedures & results

Item	Test procedure	Limits	Worst margin	Result	Remarks
Conducted emission	ANSI C 63.4:2014 /C 63.4a:2017 7. AC powerline conducted emission measurements	Class A	29.8 dB Freq.: 0.15000 MHz Detector: Quasi-Peak Phase: L1 Mode: BLE Communication Freq.: 0.15000 MHz Detector: Quasi-Peak Phase: L1 Mode: IEEE 802.15.4 Communication	Complied a)	-
Radiated emission	ANSI C 63.4:2014 /C 63.4a:2017 8. Radiated emission measurements	Class A	6.3 dB Freq.: 250.000 MHz Detector: Quasi-Peak Polarization: Horizontal Mode: BLE Communication	Complied b)	*1)
Note: UL Japan's EMI work procedure: Work Instructions-ULID-003591 a) Refer to Appendix 1 (data of Conducted emission) b) Refer to Appendix 1 (data of Radiated emission)					

*1) Measurements have been performed up to 13 GHz since the highest frequency of internal source of the EUT is 2480 MHz.

3 . 3 Deviation from standard

Item	Normative references of FCC Subpart A Section 15.31	Actually applied
Conducted emission Radiated emission	ANSI C 63.4:2014	ANSI C 63.4:2014/C 63.4a:2017

Other than above, no addition, exclusion nor deviation has been made from the standard.

3 . 4 Uncertainty

Measurement uncertainty is not taken into account when stating conformity with a specified requirement.
Note: When margins obtained from test results are less than the measurement uncertainty, the test results may exceed the limit.

The following uncertainties have been calculated to provide a confidence level of 95 % using a coverage factor $k = 2$.

Item	Frequency range	Calculated Uncertainty (±)
Conducted emission (AC Mains) AMN/LISN	9 kHz to 150 kHz	3.1 dB
	150 kHz to 30 MHz	3.1 dB
Radiated emission (Measurement distance: 10 m)	30 MHz to 200 MHz	4.7 dB
	200 MHz to 1 GHz	4.9 dB
Radiated emission (Measurement distance: 3 m)	30 MHz to 200 MHz	4.8 dB
	200 MHz to 1 GHz	6.1 dB
	1 GHz to 6 GHz	4.7 dB
	6 GHz to 18 GHz	5.3 dB

3 . 5 Test location

UL Japan, Inc. Shonan EMC Lab.
1-22-3 Megumigaoka, Hiratsuka-shi, Kanagawa-ken 259-1220 Japan
Telephone number : +81-463-50-6400
A2LA Certificate Number : 1266.03
(FCC Test firm registration number: 626366, ISED lab company number: 2973D / CAB identifier: JP0001)

Test room	Width x Depth x Height (m)	Test room	Width x Depth x Height (m)
No.1 Semi-anechoic chamber	20.6 x 11.3 x 7.65 Maximum measurement distance: 10 m	No.1 Shielded room	6.8 x 4.1 x 2.7
No.2 Semi-anechoic chamber	20.6 x 11.3 x 7.65 Maximum measurement distance: 10 m	No.2 Shielded room	6.8 x 4.1 x 2.7
No.3 Semi-anechoic chamber	12.7 x 7.7 x 5.35 Maximum measurement distance: 5 m	No.3 Shielded room	6.3 x 4.7 x 2.7
No.4 Semi-anechoic chamber	8.1 x 5.1 x 3.55	No.4 Shielded room	4.4 x 4.7 x 2.7
		No.5 Shielded room	7.8 x 6.4 x 2.7
		No.6 Shielded room	7.8 x 6.4 x 2.7
		No.7 Shielded room	2.76 x 3.76 x 2.4
		No.8 Shielded room	3.45 x 5.5 x 2.4
		No.1 Measurement room	2.55 x 4.1 x 2.5

3 . 6 Test setup, test data & test instruments

Refer to Appendix 1 to 3.

Section 4 : Operation of EUT during testing

4 . 1 Operating modes

The EUT exercise program used during testing was designed to exercise the various system components in a manner similar to typical use.

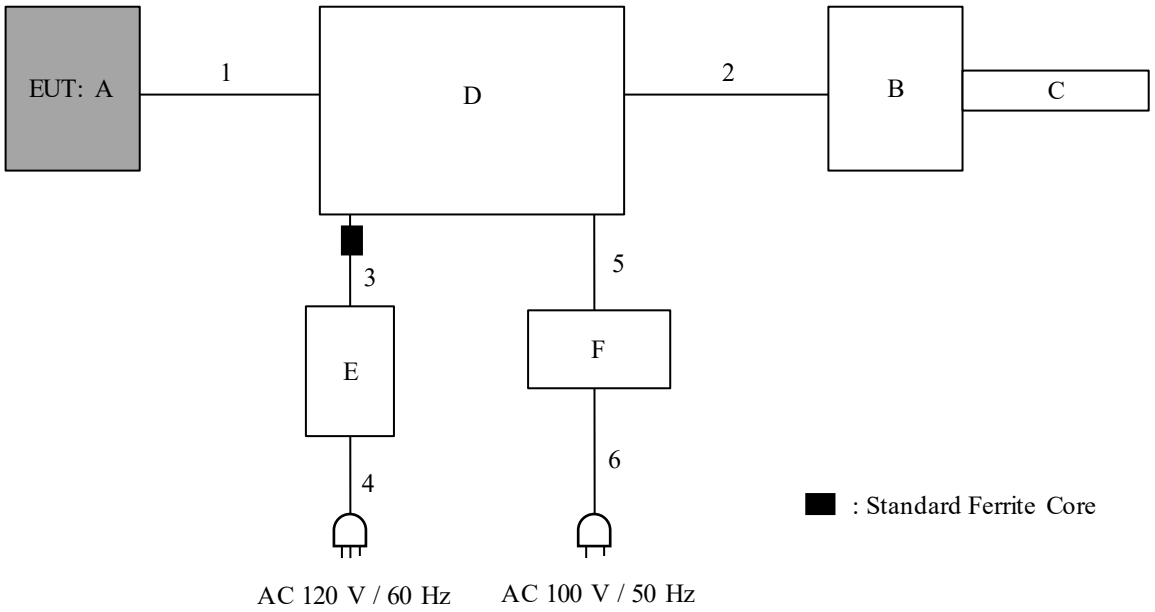
Operation mode(s)	BLE Communication
	IEEE 802.15.4 Communication

Software	CbM Studio Version: 0.19.3

Justification	The system was configured in typical fashion (as a customer would normally use it) for testing.

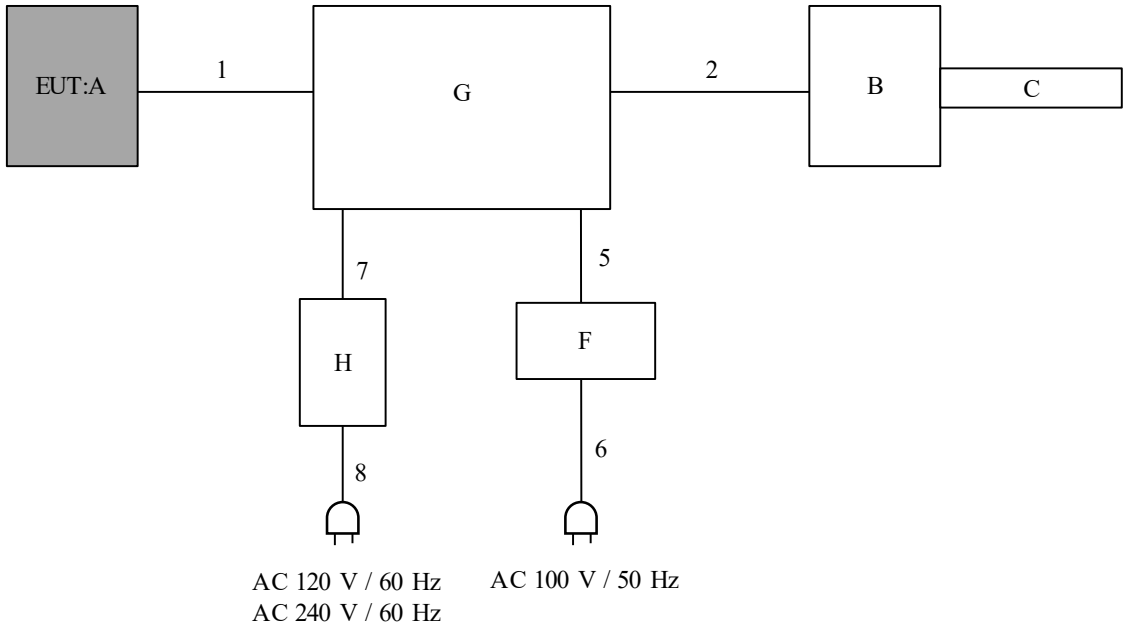
4 . 2 Configuration and peripherals

Radiated emission



* Cabling and setup(s) were taken into consideration and test data was taken under worse case conditions.

Conducted emission



* Cabling and setup(s) were taken into consideration and test data was taken under worse case conditions.
As a result of comparing AC 120 V and AC 240 V at pre-check, conducted emission test was performed with AC 240 V of the worst voltage as representative.

Description of EUT and Support equipment

No.	Item	Model number	Serial number	Manufacturer	Remarks
A	Sensor Module	i3 Micro Module	i3 MM 002	TDK	EUT
B	Network Controller	Network Controller	NC 002	TDK	-
C	Antenna	W1010	WK282022	Pulse Electronics	*1)
D	Laptop PC	DX-C3	723450-31162	THIRDWAVE	-
E	AC Adapter	A18-045N2A	CNYAAG19023C 169014T00131	Chiconya POWER TECHNOLOGY	-
F	HUB	EHC-G05MN-HJW	6AL829502975A	ELECOM	-
G	Laptop PC	ThinkPad E14 Gen2	PF397TQG	LENOVO	-
H	AC Adapter	ADLX65YCC2D	8SSA10R16922C2TJ19M1368	LENOVO	-

*1) W1010 used in the tests is the same as W1030 except for the antenna connector part.

List of cables used

No.	Name	Length (m)	Shield		Remarks
			Cable	Connector	
1	USB	1.0	Shielded	Shielded	USB2.0
2	USB	2.5	Shielded	Shielded	USB2.0
3	DC	1.5	Unshielded	Unshielded	-
4	AC	0.9	Unshielded	Unshielded	-
5	LAN	3.0	Unshielded	Unshielded	Cat.5e
6	AC	1.0	Unshielded	Unshielded	-
7	DC	1.8	Unshielded	Unshielded	-
8	AC	2.0	Unshielded	Unshielded	-

Section 5 : Conducted emission

5 . 1 Test conditions

Frequency range	0.15 MHz to 30 MHz
EUT position	Table top

5 . 2 Test configuration

The EUT was placed on a platform of nominal size, 1.0 m by 1.5 m, raised 0.8 m above the conducting ground plane. The rear of tabletop was located 40 cm to the vertical conducting plane. The rear of EUT, including peripherals was aligned and was flushed with rear of tabletop. All other surfaces of tabletop were at least 80 cm from any other grounded conducting surface. The EUT was located 0.8 m from Line Impedance Stabilization Network (LISN) and excess AC Cable was bundled in center. I/O cables that were connected to the peripherals were bundled in center. They were folded back and forth forming a bundle 30 cm to 40 cm long and were hanged at a 40 cm height to the ground plane.
Each EUT current-carrying power lead, except the ground (safety) lead, was individually connected through a LISN to the input power source. All unused 50 ohm connectors of the LISN were resistively terminated in 50 ohm when not connected to the measuring equipment.
Photographs of the set up are shown in Appendix 3.

5 . 3 Test procedure

The emission had been measured with the EUT in the shielded room. An overview sweep with peak detection has been performed. The measurements had been performed with a quasi-peak detector and if required, with a CISPR average detector (CAV).

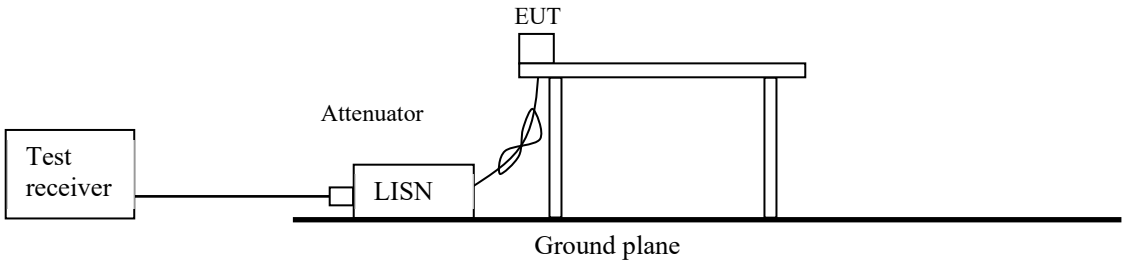
The conducted emission measurements were made with the following detector function.

Detector Type	QP / CAV
IF Bandwidth	9 kHz / 9 kHz

5 . 4 Results

Summary of the test results : Pass

Figure 1. Test Setup



Section 6 : Radiated emission

6 . 1 Test conditions

Frequency range	30 MHz to 13 GHz
EUT position	Table top

6 . 2 Test configuration

The EUT was placed on a platform of nominal size, 1.0 m by 1.5 m, raised 0.8 m above the conducting ground plane. The table is made of expanded polystyrol and expanded polypropylene and the table top is covered with polycarbonate. That has very low permittivity. The rear of EUT, including its peripherals was aligned and flushed with rear of tabletop. I/O cables that were connected to the peripherals were bundled in center. They were folded back and forth forming a bundle 30 cm to 40 cm long and were hanged at a 40 cm height to the ground plane. Photographs of the set up are shown in Appendix 3.

6 . 3 Test procedure

The Radiated Electric Field Strength intensity has been measured in a Semi-Anechoic Chamber with a ground plane at a distance of 10 m* or 3 m.
* Measuring distance (below 1 GHz)
The boundary of the EUT is defined by an imaginary circular periphery.

The measuring antenna height was varied between 1 m and 4 m and EUT was rotated a full revolution in order to obtain the maximum value of the electric field intensity.
The measurements were performed for both vertical and horizontal antenna polarization.
Test antenna was aimed at the emission source for receiving the maximum signal and always kept. (above 1 GHz)

The radiated emission measurements were made with the following detector function.

	30 MHz to 1000 MHz (Test receiver)	1 GHz to 13 GHz (Spectrum analyzer)	
Detector Type	QP	AV *1)	PK
IF Bandwidth	120 kHz	RBW 1 MHz/ VBW 10 Hz	RBW 1 MHz/ VBW 3 MHz

*1) When using Spectrum analyzer, the test was made with adjusting span to zero by using peak hold.

The noise levels were confirmed at each position of X, Y and Z axes of EUT to see the position of maximum noise, and the test was made at the position that has the maximum noise.

6 . 4 Results

Summary of the test results : Pass

Figure 2. Antenna angle

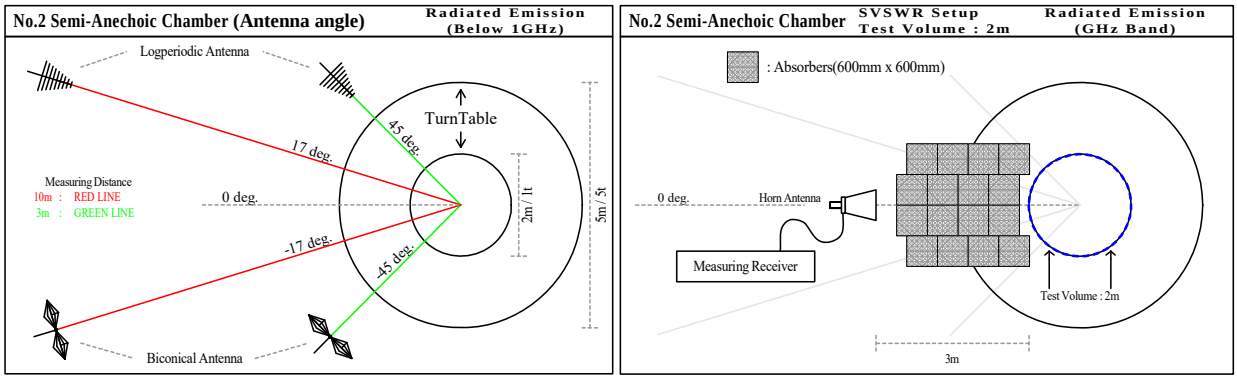
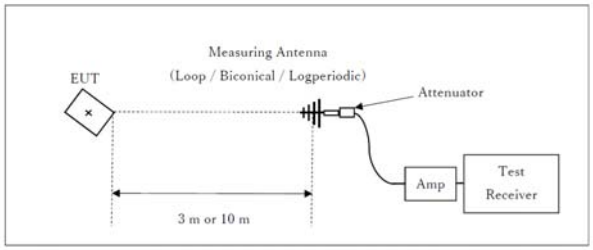


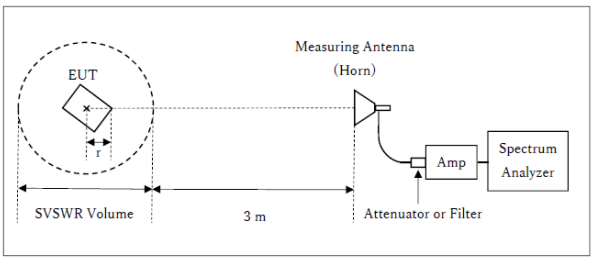
Figure 3. Test Setup

Below 1 GHz



Test Distance: 10 m

1 GHz to 13 GHz



Distance Factor: 20 x log (3.53 m*/10 m) = -9.04 dB
* Test Distance: (3 + SVSWR Volume /2) - r = 3.53 m

SVSWR Volume: 2 m
(SVSWR Volume has been calibrated based on CISPR 16-1-4.)
r = 0.47 m

Distance Factor is based on FCC Subpart A Section 15.31 (f).

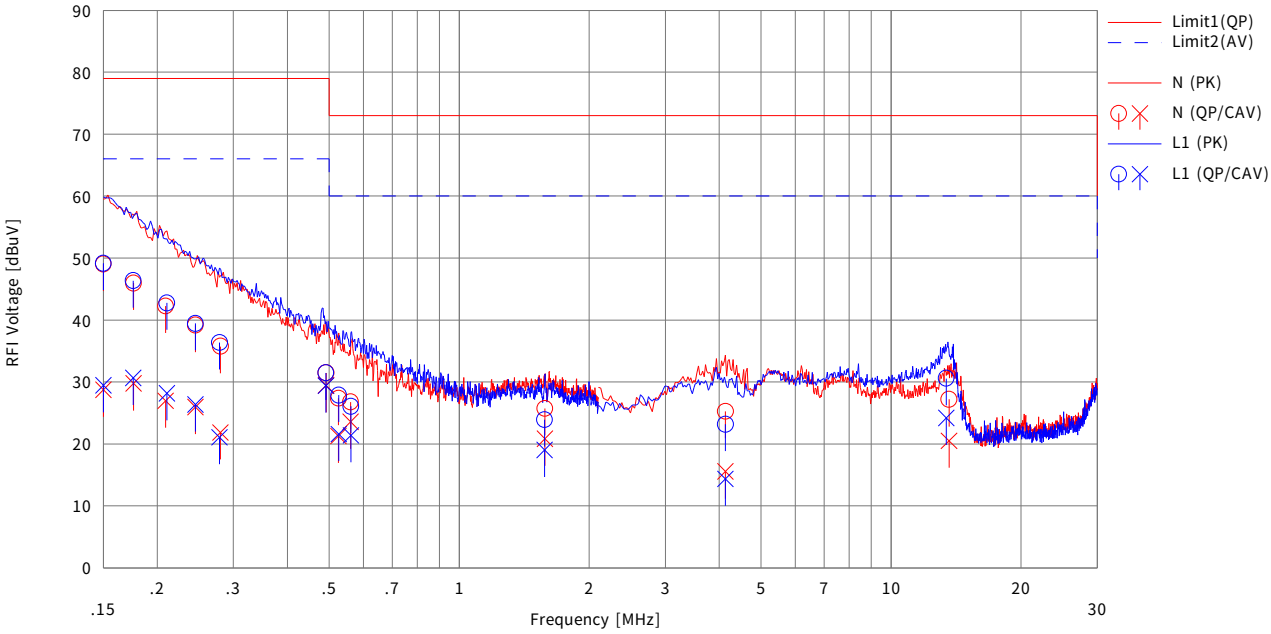
DATA OF CONDUCTED EMISSION TEST

UL Japan,Inc. Shonan EMC Lab. No.2 Shielded Room
Date : 2023/02/15

Company	: TDK Corporation	Mode	: BLE Communication
Kind of EUT	: Refer to Section 4, Clause 4.2	Order No.	: 14568536
Model No.	: Refer to Section 4, Clause 4.2	Power	: AC 240 V / 60 Hz (AC Adapter)
Serial No.	: Refer to Section 4, Clause 4.2	Temp./Humi.	: 23 deg.C / 25 %RH
Remarks	: -		

Limit : FCC_Part 15 Subpart B(15.107)_Class A

Engineer : Yusuke Tanikawara



No.	Freq.	Reading		C.Fac	Results		Limit		Margin		Phase	Comment
		<QP>	<CAV>		<QP>	<CAV>	<QP>	<AV>	<QP>	<AV>		
	[MHz]	[dBuV]	[dBuV]	[dB]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dB]	[dB]		
1	0.15000	36.70	16.40	12.35	49.05	28.75	79.00	66.00	29.9	37.2	N	
2	0.17617	33.60	17.40	12.36	45.96	29.76	79.00	66.00	33.0	36.2	N	
3	0.20918	29.90	14.60	12.35	42.25	26.95	79.00	66.00	36.7	39.0	N	
4	0.24508	26.80	13.60	12.36	39.16	25.96	79.00	66.00	39.8	40.0	N	
5	0.28017	23.40	9.50	12.35	35.75	21.85	79.00	66.00	43.2	44.1	N	
6	0.49197	19.10	17.10	12.37	31.47	29.47	79.00	66.00	47.5	36.5	N	
7	0.52550	15.00	8.90	12.37	27.37	21.27	73.00	60.00	45.6	38.7	N	
8	0.56092	14.40	11.20	12.37	26.77	23.57	73.00	60.00	46.2	36.4	N	
9	1.58005	13.30	8.40	12.41	25.71	20.81	73.00	60.00	47.2	39.1	N	
10	4.13700	12.80	3.10	12.46	25.26	15.56	73.00	60.00	47.7	44.4	N	
11	13.61959	14.50	7.80	12.69	27.19	20.49	73.00	60.00	45.8	39.5	N	
12	0.15000	36.80	17.10	12.35	49.15	29.45	79.00	66.00	29.8	36.5	L1	
13	0.17596	34.00	18.30	12.36	46.36	30.66	79.00	66.00	32.6	35.3	L1	
14	0.21034	30.40	15.80	12.35	42.75	28.15	79.00	66.00	36.2	37.8	L1	
15	0.24504	27.10	14.00	12.36	39.46	26.36	79.00	66.00	39.5	39.6	L1	
16	0.27889	24.00	8.70	12.35	36.35	21.05	79.00	66.00	42.6	44.9	L1	
17	0.49158	19.10	17.00	12.37	31.47	29.37	79.00	66.00	47.5	36.6	L1	
18	0.52603	15.50	9.20	12.37	27.87	21.57	73.00	60.00	45.1	38.4	L1	
19	0.56158	13.70	9.00	12.37	26.07	21.37	73.00	60.00	46.9	38.6	L1	
20	1.57780	11.50	6.60	12.41	23.91	19.01	73.00	60.00	49.0	40.9	L1	
21	4.13664	10.70	1.90	12.46	23.16	14.36	73.00	60.00	49.8	45.6	L1	
22	13.41831	17.90	11.50	12.69	30.59	24.19	73.00	60.00	42.4	35.8	L1	

Calculation:Result[dBuV]=Reading[dBuV]+C.Fac(LISN(AMN)+Cable+ATT)[dB]
LISN(AMN)=SLS-03

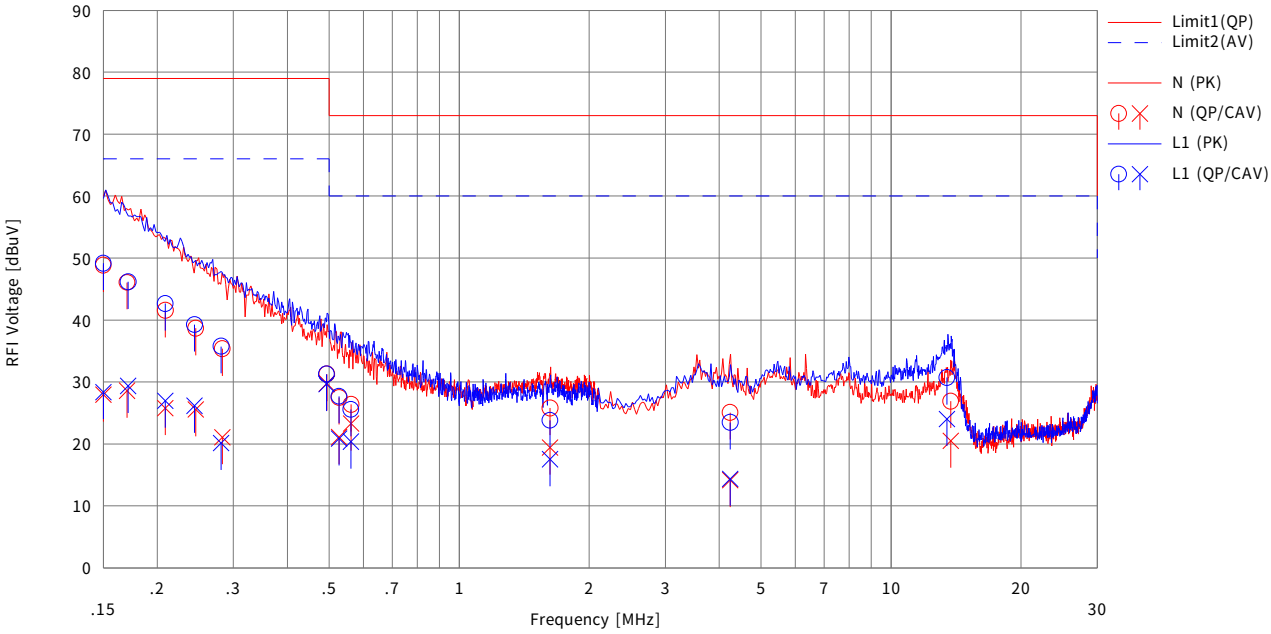
DATA OF CONDUCTED EMISSION TEST

UL Japan,Inc. Shonan EMC Lab. No.2 Shielded Room
Date : 2023/02/15

Company	: TDK Corporation	Mode	: IEEE 802.15.4 Communication
Kind of EUT	: Refer to Section 4, Clause 4.2	Order No.	: 14568536
Model No.	: Refer to Section 4, Clause 4.2	Power	: AC 240 V / 60 Hz (AC Adapter)
Serial No.	: Refer to Section 4, Clause 4.2	Temp./Humi.	: 23 deg.C / 25 %RH
Remarks	: -		

Limit : FCC_Part 15 Subpart B(15.107)_Class A

Engineer : Yusuke Tanikawara



No.	Freq.	Reading <QP>	Reading <CAV>	C.Fac	Results <QP>	Results <CAV>	Limit <QP>	Limit <AV>	Margin <QP>	Margin <AV>	Phase	Comment
	[MHz]	[dBuV]	[dBuV]	[dB]	[dBuV]	[dBuV]	[dBuV]	[dBuV]	[dB]	[dB]		
1	0.15000	36.50	15.60	12.35	48.85	27.95	79.00	66.00	30.1	38.0	N	
2	0.17026	33.70	16.20	12.36	46.06	28.56	79.00	66.00	32.9	37.4	N	
3	0.20888	29.20	13.40	12.35	41.55	25.75	79.00	66.00	37.4	40.2	N	
4	0.24558	26.30	13.20	12.36	38.66	25.56	79.00	66.00	40.3	40.4	N	
5	0.28276	23.00	8.70	12.35	35.35	21.05	79.00	66.00	43.6	44.9	N	
6	0.49368	18.90	17.40	12.37	31.27	29.77	79.00	66.00	47.7	36.2	N	
7	0.52737	15.10	8.70	12.37	27.47	21.07	73.00	60.00	45.5	38.9	N	
8	0.56198	14.00	10.90	12.37	26.37	23.27	73.00	60.00	46.6	36.7	N	
9	1.62411	13.40	7.00	12.41	25.81	19.41	73.00	60.00	47.1	40.5	N	
10	4.24187	12.60	1.70	12.46	25.06	14.16	73.00	60.00	47.9	45.8	N	
11	13.74541	14.20	7.80	12.70	26.90	20.50	73.00	60.00	46.1	39.5	N	
12	0.15000	36.80	16.00	12.35	49.15	28.35	79.00	66.00	29.8	37.6	L1	
13	0.17138	33.80	17.00	12.36	46.16	29.36	79.00	66.00	32.8	36.6	L1	
14	0.20856	30.30	14.60	12.35	42.65	26.95	79.00	66.00	36.3	39.0	L1	
15	0.24398	26.90	13.80	12.36	39.26	26.16	79.00	66.00	39.7	39.8	L1	
16	0.28116	23.40	7.80	12.35	35.75	20.15	79.00	66.00	43.2	45.8	L1	
17	0.49320	18.90	17.30	12.37	31.27	29.67	79.00	66.00	47.7	36.3	L1	
18	0.52672	15.30	8.50	12.37	27.67	20.87	73.00	60.00	45.3	39.1	L1	
19	0.56166	13.20	8.00	12.37	25.57	20.37	73.00	60.00	47.4	39.6	L1	
20	1.62287	11.40	5.10	12.41	23.81	17.51	73.00	60.00	49.1	42.4	L1	
21	4.24287	11.00	1.90	12.46	23.46	14.36	73.00	60.00	49.5	45.6	L1	
22	13.47297	18.00	11.30	12.69	30.69	23.99	73.00	60.00	42.3	36.0	L1	

Calculation:Result[dBuV]=Reading[dBuV]+C.Fac(LISN(AMN)+Cable+ATT)[dB]
LISN(AMN)=SLS-03

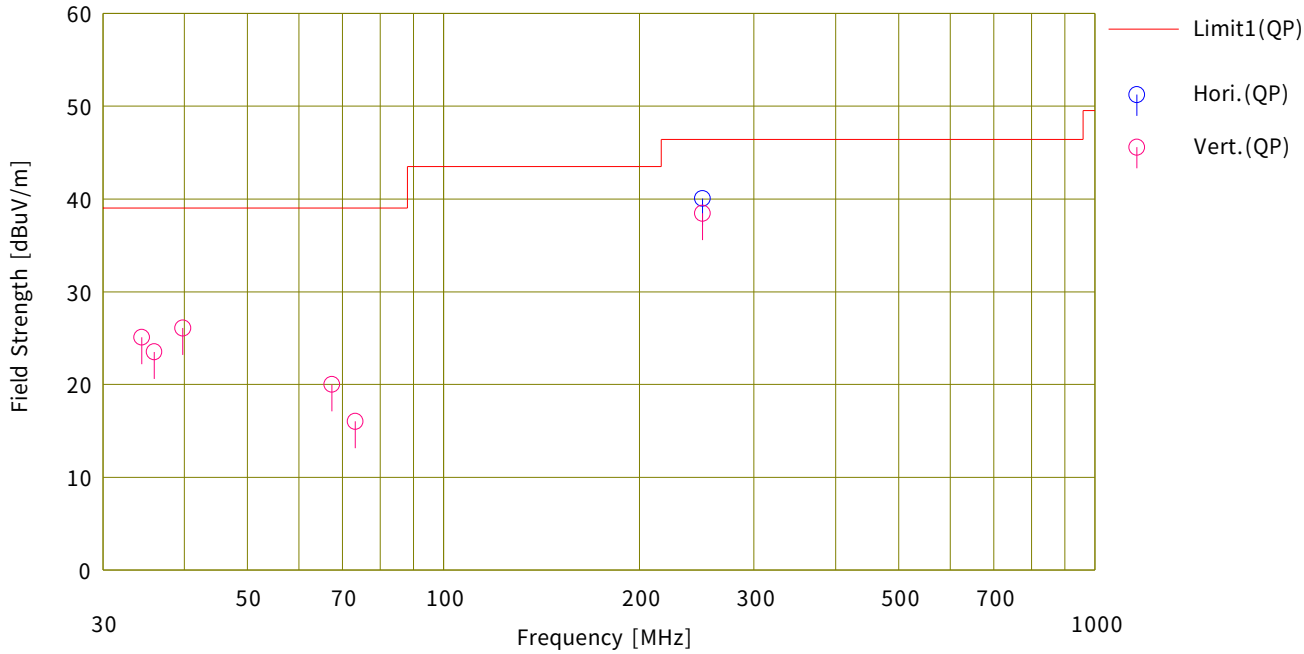
DATA OF RADIATED EMISSION TEST

UL Japan,Inc. Shonan EMC Lab. No.2 Semi-Anechoic Chamber
Date : 2022/12/23

Company	: TDK Corporation		Mode	: BLE Communication
Kind of EUT	: Refer to Section 4, Clause 4.2		Order No.	: **14568536**
Model No.	: Refer to Section 4, Clause 4.2		Power	: DC 5 V
Serial No.	: Refer to Section 4, Clause 4.2		Temp./Humi.	: 20 deg.C / 30 %RH
Remarks	: (Axis) Sensor Module: X, Network Controller: X, Antenna: X			

Limit : FCC_Part 15 Subpart B(15.109)_Class A

Engineer : Yasumasa Owaki



No.	Freq. [MHz]	Reading <QP> [dBuV]	Ant.Fac [dB/m]	Loss [dB]	Gain [dB]	S.Fac [dB]	Result <QP> [dBuV/m]	Limit <QP> [dBuV/m]	Margin <QP> [dB]	Pola. [H/V]	Height [cm]	Angle [deg]	Ant. Type	Comment
1	250.000	53.80	11.86	6.13	31.74	0.00	40.05	46.40	6.3	Hori.	360	60	LP	
2	34.420	33.00	17.09	7.03	31.93	-0.09	25.10	39.00	13.9	Vert.	100	252	BC	
3	35.961	32.00	16.47	7.06	31.93	-0.08	23.52	39.00	15.4	Vert.	100	144	BC	
4	39.804	35.90	15.04	7.13	31.93	-0.06	26.08	39.00	12.9	Vert.	100	210	BC	
5	67.420	37.80	6.93	7.56	31.91	-0.37	20.01	39.00	18.9	Vert.	100	1	BC	
6	73.212	33.90	6.40	7.64	31.91	0.00	16.03	39.00	22.9	Vert.	100	351	BC	
7	250.000	52.20	11.86	6.13	31.74	0.00	38.45	46.40	7.9	Vert.	103	72	LP	

Calculation:Result[dBuV/m]=Reading[dBuV]+Ant.Fac[dB/m]+Loss(Cable+ATT)[dB]-Gain(AMP)[dB]+S.Fac(ΔAF)[dB]
Ant.Type=BC:Biconical Antenna LP:Logperiodic Antenna **SH*: Horn Antenna

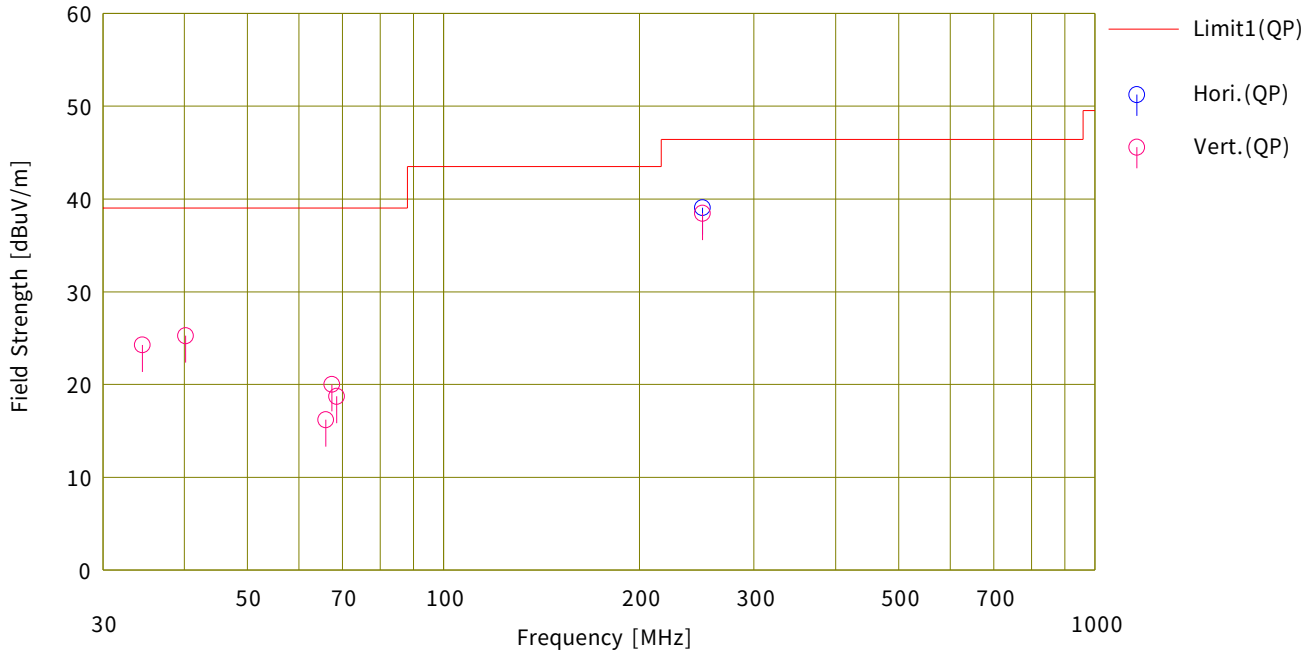
DATA OF RADIATED EMISSION TEST

UL Japan,Inc. Shonan EMC Lab. No.2 Semi-Anechoic Chamber
Date : 2022/12/23

Company	: TDK Corporation		Mode	: IEEE 802.15.4 Communication
Kind of EUT	: Refer to Section 4, Clause 4.2		Order No.	: **14568536**
Model No.	: Refer to Section 4, Clause 4.2		Power	: DC 5 V
Serial No.	: Refer to Section 4, Clause 4.2		Temp./Humi.	: 20 deg.C / 30 %RH
Remarks	: (Axis) Sensor Module: X, Network Controller: X, Antenna: X			

Limit : FCC_Part 15 Subpart B(15.109)_Class A

Engineer : Yasumasa Owaki



No.	Freq. [MHz]	Reading <QP> [dBuV]	Ant.Fac [dB/m]	Loss [dB]	Gain [dB]	S.Fac [dB]	Result <QP> [dBuV/m]	Limit <QP> [dBuV/m]	Margin <QP> [dB]	Pola. [H/V]	Height [cm]	Angle [deg]	Ant. Type	Comment
1	250.000	52.80	11.86	6.13	31.74	0.00	39.05	46.40	7.3	Hori.	362	59	LP	
2	34.512	32.20	17.06	7.03	31.93	-0.09	24.27	39.00	14.7	Vert.	100	244	BC	
3	40.196	35.20	14.91	7.13	31.92	-0.06	25.26	39.00	13.7	Vert.	100	214	BC	
4	65.970	33.90	7.11	7.54	31.91	-0.44	16.20	39.00	22.8	Vert.	100	355	BC	
5	67.419	37.80	6.93	7.56	31.91	-0.37	20.01	39.00	18.9	Vert.	100	355	BC	
6	68.552	36.60	6.78	7.57	31.91	-0.32	18.72	39.00	20.2	Vert.	100	350	BC	
7	250.000	52.20	11.86	6.13	31.74	0.00	38.45	46.40	7.9	Vert.	104	69	LP	

Calculation:Result[dBuV/m]=Reading[dBuV]+Ant.Fac[dB/m]+Loss(Cable+ATT)[dB]-Gain(AMP)[dB]+S.Fac(ΔAF)[dB]
Ant.Type=BC:Biconical Antenna LP:Logperiodic Antenna **SH*: Horn Antenna

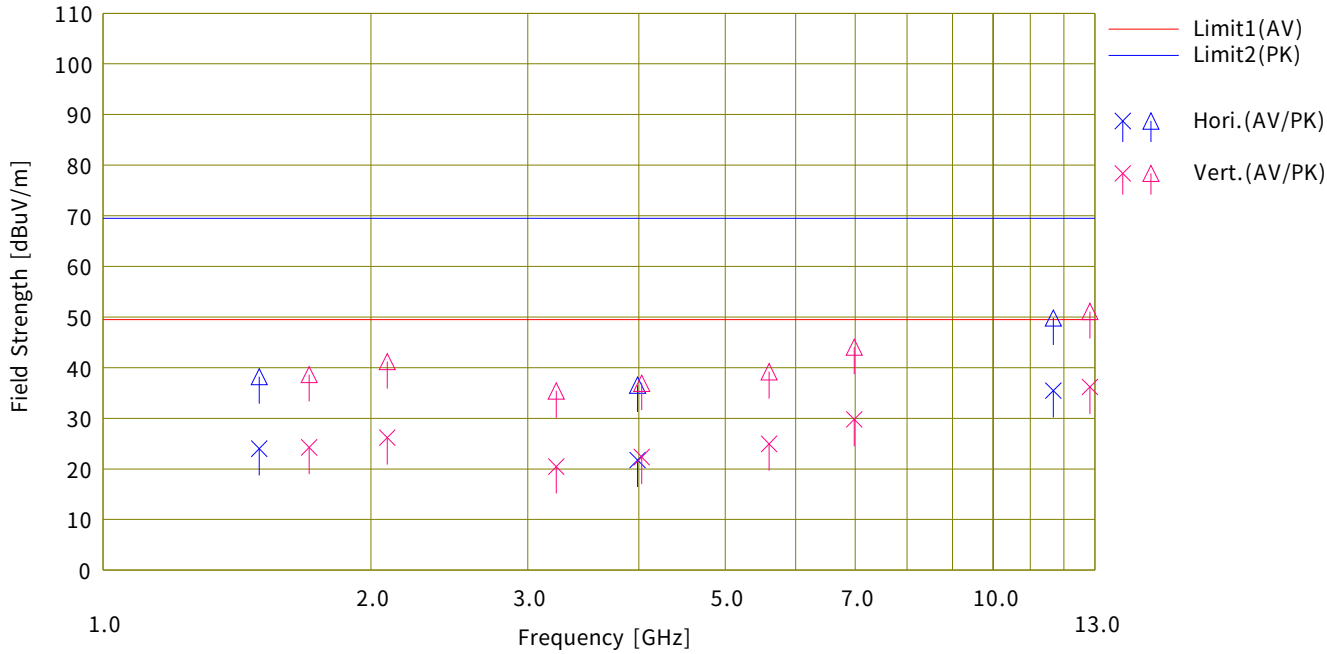
DATA OF RADIATED EMISSION TEST

UL Japan,Inc. Shonan EMC Lab. No.2 Semi-Anechoic Chamber
Date : 2022/12/24

Company	: TDK Corporation		Mode	: BLE Communication
Kind of EUT	: Refer to Section 4, Clause 4.2		Order No.	: **14568536**
Model No.	: Refer to Section 4, Clause 4.2		Power	: DC 5 V
Serial No.	: Refer to Section 4, Clause 4.2		Temp./Humi.	: 27 deg.C / 31 %RH
Remarks	: (Axis) Sensor Module: X, Network Controller: X, Antenna: X, Test Distance = 353 cm			

Limit : FCC_Part 15 Subpart B(15.109)_Class A

Engineer : Hiromasa Sato



No.	Freq.	Reading <AV>	Reading <PK>	Ant.Fac	Loss	Gain	D.Fac	Result <AV>	Result <PK>	Limit <AV>	Limit <PK>	Margin <AV>	Margin <PK>	Pola.	Height	Angle	Ant. Type	Comment
	[MHz]	[dBuV]	[dBuV]	[dB/m]	[dB]	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dBuV/m]	[dBuV/m]	[dB]	[dB]	[H/V]	[cm]	[deg]		
1	1498.163	33.19	47.44	25.55	13.26	38.99	-9.04	23.97	38.22	49.50	69.50	25.5	31.2	Hori.	100	204	31SH2	
2	3985.351	32.71	47.53	30.25	6.13	38.30	-9.04	21.75	36.57	49.50	69.50	27.7	32.9	Hori.	100	159	31SH2	
3	11681.890	34.37	48.71	40.11	10.38	40.35	-9.04	35.47	49.81	49.50	69.50	14.0	19.6	Hori.	100	63	39SH2	
4	1705.428	33.24	47.65	25.58	13.47	39.01	-9.04	24.24	38.65	49.50	69.50	25.2	30.8	Vert.	100	112	31SH2	
5	2085.976	33.05	48.05	27.27	13.86	38.98	-9.04	26.16	41.16	49.50	69.50	23.3	28.3	Vert.	105	356	31SH2	
6	3230.921	32.63	47.58	29.27	5.91	38.32	-9.04	20.45	35.40	49.50	69.50	29.0	34.1	Vert.	100	120	31SH2	
7	4027.112	33.26	47.84	30.28	6.14	38.31	-9.04	22.33	36.91	49.50	69.50	27.1	32.5	Vert.	129	352	31SH2	
8	5599.455	33.14	47.38	32.80	7.05	39.00	-9.04	24.95	39.19	49.50	69.50	24.5	30.3	Vert.	100	83	31SH2	
9	6977.368	33.49	47.77	36.57	7.91	39.16	-9.04	29.77	44.05	49.50	69.50	19.7	25.4	Vert.	116	131	31SH2	
10	12852.080	33.94	48.85	39.76	11.08	39.57	-9.04	36.17	51.08	49.50	69.50	13.3	18.4	Vert.	100	201	39SH2	

Calculation:Result[dBuV/m]=Reading[dBuV]+Ant.Fac[dB/m]+Loss(Cable+ATT or HighPassFilter)[dB]-Gain(AMP)[dB]
Ant.Type=BC:Biconical Antenna LP:Logperiodic Antenna **SH*: Horn Antenna

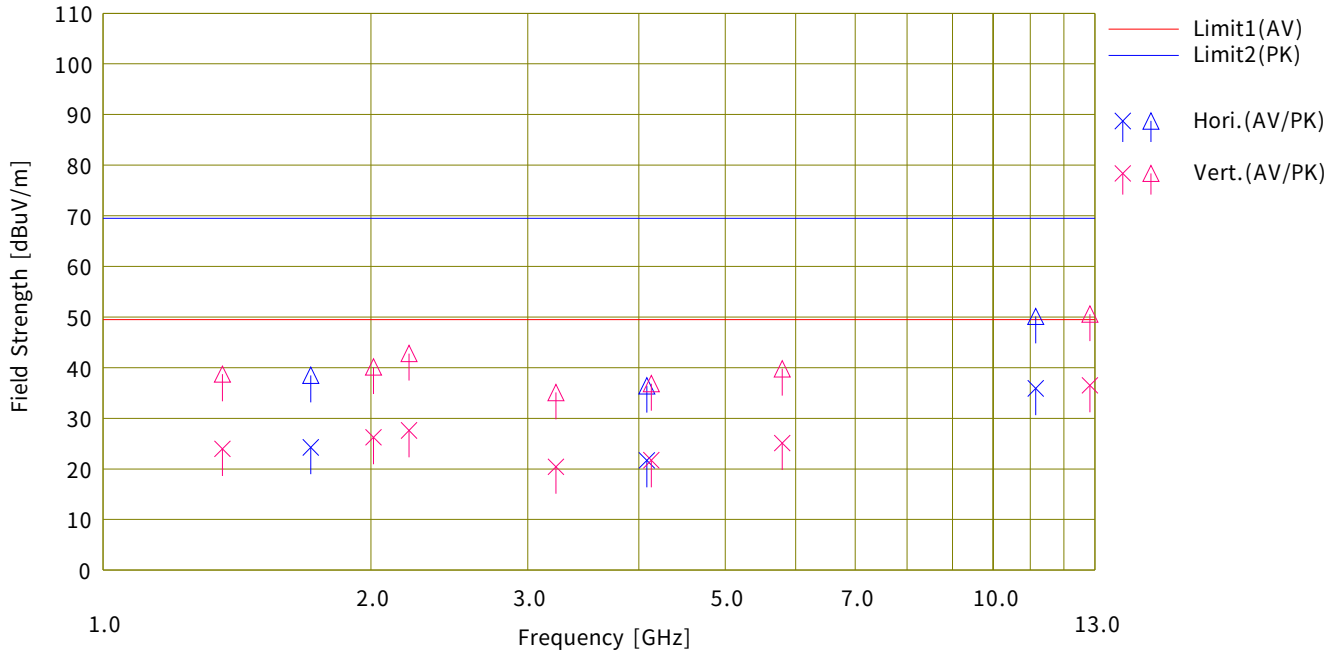
DATA OF RADIATED EMISSION TEST

UL Japan,Inc. Shonan EMC Lab. No.2 Semi-Anechoic Chamber
Date : 2022/12/24

Company	: TDK Corporation	Mode	: IEEE 802.15.4 Communication
Kind of EUT	: Refer to Section 4, Clause 4.2	Order No.	: **14568536**
Model No.	: Refer to Section 4, Clause 4.2	Power	: DC 5 V
Serial No.	: Refer to Section 4, Clause 4.2	Temp./Humi.	: 27 deg.C / 31 %RH
Remarks	: (Axis) Sensor Module: X, Network Controller: X, Antenna: X, Test Distance = 353 cm		

Limit : FCC_Part 15 Subpart B(15.109)_Class A

Engineer : Hiromasa Sato



No.	Freq.	Reading <AV>	Reading <PK>	Ant.Fac	Loss	Gain	D.Fac	Result <AV>	Result <PK>	Limit <AV>	Limit <PK>	Margin <AV>	Margin <PK>	Pola.	Height	Angle	Ant. Type	Comment
	[MHz]	[dBuV]	[dBuV]	[dB/m]	[dB]	[dB]	[dB]	[dBuV/m]	[dBuV/m]	[dBuV/m]	[dBuV/m]	[dB]	[dB]	[H/V]	[cm]	[deg]		
1	1712.736	33.23	47.46	25.60	13.47	39.01	-9.04	24.25	38.48	49.50	69.50	25.2	31.0	Hori.	100	194	31SH2	
2	4081.529	32.54	47.27	30.34	6.17	38.33	-9.04	21.68	36.41	49.50	69.50	27.8	33.0	Hori.	100	143	31SH2	
3	11161.340	34.54	48.77	40.61	10.11	40.31	-9.04	35.91	50.14	49.50	69.50	13.5	19.3	Hori.	100	54	39SH2	
4	1362.071	33.02	47.78	25.90	13.09	39.01	-9.04	23.96	38.72	49.50	69.50	25.5	30.7	Vert.	100	99	31SH2	
5	2012.902	33.91	47.84	26.58	13.78	39.02	-9.04	26.21	40.14	49.50	69.50	23.2	29.3	Vert.	108	353	31SH2	
6	2207.201	32.98	48.17	28.60	13.97	38.91	-9.04	27.60	42.79	49.50	69.50	21.9	26.7	Vert.	131	97	31SH2	
7	3228.387	32.58	47.24	29.28	5.91	38.32	-9.04	20.41	35.07	49.50	69.50	29.0	34.4	Vert.	100	114	31SH2	
8	4129.475	32.49	47.63	30.40	6.20	38.35	-9.04	21.70	36.84	49.50	69.50	27.8	32.6	Vert.	134	359	31SH2	
9	5792.769	32.55	47.26	33.39	7.17	39.01	-9.04	25.06	39.77	49.50	69.50	24.4	29.7	Vert.	100	81	31SH2	
10	12848.320	34.29	48.36	39.76	11.08	39.57	-9.04	36.52	50.59	49.50	69.50	12.9	18.9	Vert.	100	188	39SH2	

Calculation:Result[dBuV/m]=Reading[dBuV]+Ant.Fac[dB/m]+Loss(Cable+ATT or HighPassFilter)[dB]-Gain(AMP)[dB]
Ant.Type=BC:Biconical Antenna LP:Logperiodic Antenna **SH*: Horn Antenna

APPENDIX 2

Test Instruments

EMI test equipment

Test Name	Local ID	LIMS ID	Description	Manufacturer	Model	Serial	Last Calibration Date	Calibration Interval (Month)
CE	KAT3-12	144896	Attenuator	JFW IND. INC.	50HF-003N	-	2022/07/14	12
CE	SCC-09	145035	Coaxial Cable	Suhner	RG223U	-	2022/04/20	12
CE	SLS-03	145540	LISN	Rohde & Schwarz	ENV216	100513	2022/02/23	12
CE	SLS-04	145541	LISN	Rohde & Schwarz	ENV216	100514	2022/02/23	12
CE	SOS-22	191839	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	-	2022/10/18	12
CE	STM-06	145763	Terminator	TME	CT-01 BP	-	2022/12/16	12
CE	STR-07	146209	Test Receiver	Rohde & Schwarz	ESU26	100484	2022/09/14	12
CE,RE	COTS-SEMI-5	170932	EMI Software	TSJ (Techno Science Japan)	TEPTO-DV3(RE,CE,ME,PE)	-	-	-
CE,RE	SJM-20	207277	Measuring	ASKUL	-	-	-	-
CE,RE	STS-02	145793	Digital Hitester	HIOKI E.E. CORPORATION	3805-50	80997819	2022/04/07	12
RE	KAT10-S2	144892	Attenuator	Keysight Technologies Inc	8490D 010	6036	2022/10/20	12
RE	SAEC-02(NSA)	145563	Semi-Anechoic Chamber	TDK	SAEC-02(NSA)	2	2022/03/20	12
RE	SAEC-02(SVSWR)	145598	Semi-Anechoic Chamber	TDK	SAEC-02(SVSWR)	2	2022/05/16	12
RE	SAF-02	145004	Pre Amplifier	SONOMA	310N	290212	2022/02/24	12
RE	SAF-05	145128	Pre Amplifier	Toyo Corporation	TPA0118-36	1440490	2022/05/12	12
RE	SAT3-11	150921	Attenuator	JFW	50HF-003N	-	2022/02/21	12
RE	SAT6-14	167095	Attenuator	JFW	50HF-006N	-	2022/02/21	12
RE	SBA-02	145022	Biconical Antenna	Schwarzbeck Mess-Elektronik OHG	BBA9106	91032665	2022/04/16	12
RE	SCC-B1/B3/B5/B7/B8/B13/SRSE-02	144975	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/Suhner/Suhner/TOYO	8D2W/12DSFA/141PE/141PE/141PE/141PE/NS4906	-/0901-270(RF Selector)	2022/04/20	12
RE	SCC-B2/B4/B6/B7/B8/B13/SRSE-02	144976	Coaxial Cable&RF Selector	Fujikura/Fujikura/Suhner/Suhner/Suhner/Suhner/TOYO	8D2W/12DSFA/141PE/141PE/141PE/141PE/NS4906	-/0901-270(RF Selector)	2022/04/20	12
RE	SCC-G40	166491	Coaxial Cable	Junkosha	MWX221-01000NFSNMS/B	1612S005	2022/01/06	12
RE	SCC-G50	178573	Coaxial Cable	Huber+Suhner	SUCOFLEX_104_E	MY13407/4E	2022/03/03	12
RE	SCC-G51	178572	Coaxial Cable	Huber+Suhner	SUCOFLEX 104	800288 /4A	2022/03/03	12
RE	SFL-18	145305	Highpass Filter	MICRO-TRONICS	HPM50111	119	2022/03/02	12
RE	SHA-02	145384	Horn Antenna	Schwarzbeck Mess-Elektronik OHG	BBHA9120D	9120D-726	2022/03/10	12
RE	SLA-06	145528	Logperiodic Antenna	Schwarzbeck Mess-Elektronik OHG	VUSLP9111B	195	2022/04/16	12
RE	SOS-21	191838	Thermo-Hygrometer	CUSTOM. Inc	CTH-201	-	2022/08/08	12
RE	STR-08	150463	Test Receiver	Rohde & Schwarz	ESW44	101581	2022/03/02	12

*Hyphens for Last Calibration Date and Cal Int (month) are instruments that Calibration is not required (e.g. software), or instruments checked in advance before use.

The expiration date of the calibration is the end of the expired month.
As for some calibrations performed after the tested dates , those test equipment have been controlled by means of an unbroken chains of calibrations.

All equipment is calibrated with valid calibrations . Each measurement data is traceable to the national or international standards
Test Item:
CE: Conducted emission,
RE: Radiated emission