TEST REPORT

Of

Industry Canada Interference-Causing Equipment Standard ICES-003 Class B

Product :	**Lora transceiver module**
Model(s):	**LR62XE**
Brand:	**Fanstel**
Applicant:	**Fanstel Corporation, Taipei**
Address:	**10F-10, No. 79, Sec. 1, Hsin Tai Wu Rd., Hsi-Chih, New Taipei City 221 Taiwan**

Test Performed by:

International Standards Laboratory Corp. LT Lab.
TEL: +886-3-263-8888 FAX: +886-3-263-8899
No. 120, Lane 180, Hsin Ho Rd., Lung-Tan Dist., Tao Yuan City 325, Taiwan

Report No.: **ISL-21LR042IC**
Issue Date : **February 4, 2021**

Testing Laboratory
0997

Contents of Report

1. General

1.1 Certification of Accuracy of Test Data

Standards:	Industry Canada Interference-Causing Equipment Standard ICES-003 Issue 7: 2020 Class B
Equipment Tested:	Lora transceiver module
Model:	LR62XE
Brand:	Fanstel
Applicant:	Fanstel Corporation, Taipei
Sample received Date:	January 28, 2021
Final test Date:	refer to the date of test data
Test Site:	Conduction 03; Chamber 19
Test Distance:	3m; 3m (above1GHz-18GHz)
Temperature:	refer to each site test data
Humidity:	refer to each site test data
Input power:	Conduction input power: AC 120 V / 60 Hz Radiation input power: AC 120 V / 60 Hz
Test Result:	**PASS**
Report Engineer:	Elisa Chen
Test Engineer:	 Jason Chao
Approved By:	 Jerry Liu / Assistant Manager

1.2 Description of EUT

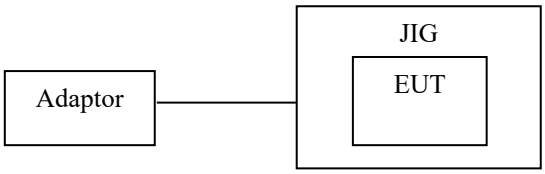
General:

Product Name:	Lora transceiver module
Brand Name:	Fanstel
Model Name:	LR62XE
Model Difference:	N/A
Power Supply:	5Vdc from USB (JIG)

1.3 Configuration of Tested System

Fig. 1-1 Configuration

Config 1



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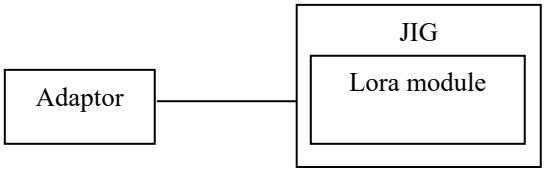


Table 1-1 Support Equipment Used in Tested System

Item	Equipment	Mrf/Brand	Model name	Series No	Data Cable	Power Cable
1	adaptor	Apple	A1385	N/A	N/A	Shielded /1m

I/O Cable Condition of EUT and Support Units

Description	Path	Cable Length	Cable Type	Connector Type
USB power cable	Adaptor USB port to JIG micro USB port	0.6m	Non-Shielded	Metal Head

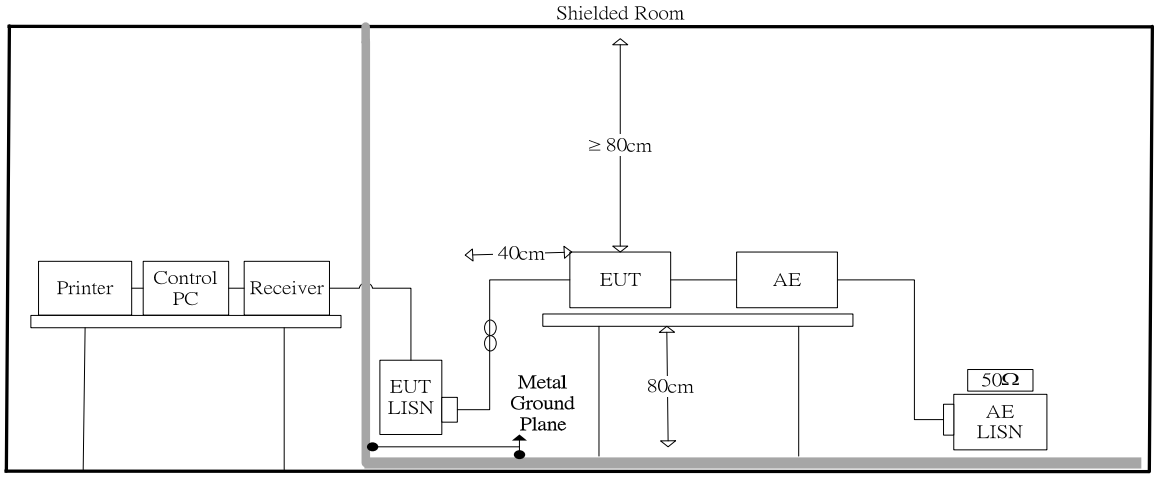
Note: All the above equipment/cables were placed in worse case positions to maximize emission signals during emission test.

Grounding: Grounding was in accordance with the manufacturer's requirements and conditions for the intended use.

2. Power Line Conducted Emissions

2.1 Test Setup and Procedure

2.1.1 Test Setup



2.1.2 Test Procedure

The measurements are performed in a shielded room test site. The EUT was placed on non-conduction 1.0m x 1.5m table, which is 0.8 meters above an earth-grounded.

Power to the EUT was provided through the LISN which has the Impedance (50ohm/50uH) vs. Frequency Characteristic in accordance with the standard. Power to the LISNs were filtered to eliminate ambient signal interference and these filters were bonded to the ground plane. Peripheral equipment required to provide a functional system (support equipment) for EUT testing was powered from the second LISN through a ganged, metal power outlet box which is bonded to the ground plane at the LISN.

The interconnecting cables were arranged and moved to get the maximum measurement. Both the line of power cord, hot and neutral, were measured. All of the interface cables were manipulated according to ANSI C63.4 requirements.

The highest emissions were analyzed in details by operating the spectrum analyzer in fixed tuned mode to determine the nature of the emissions and to provide information which could be useful in reducing their amplitude.

2.1.3 EMI Receiver/Spectrum Analyzer Configuration (for the frequencies tested)

Frequency Range:	150kHz~30MHz
Detector Function:	Quasi-Peak / Average Mode
Resolution Bandwidth:	9kHz

2.1.4 Limit

Conducted emissions limits of Class_A equipment. (AC mains power terminals):

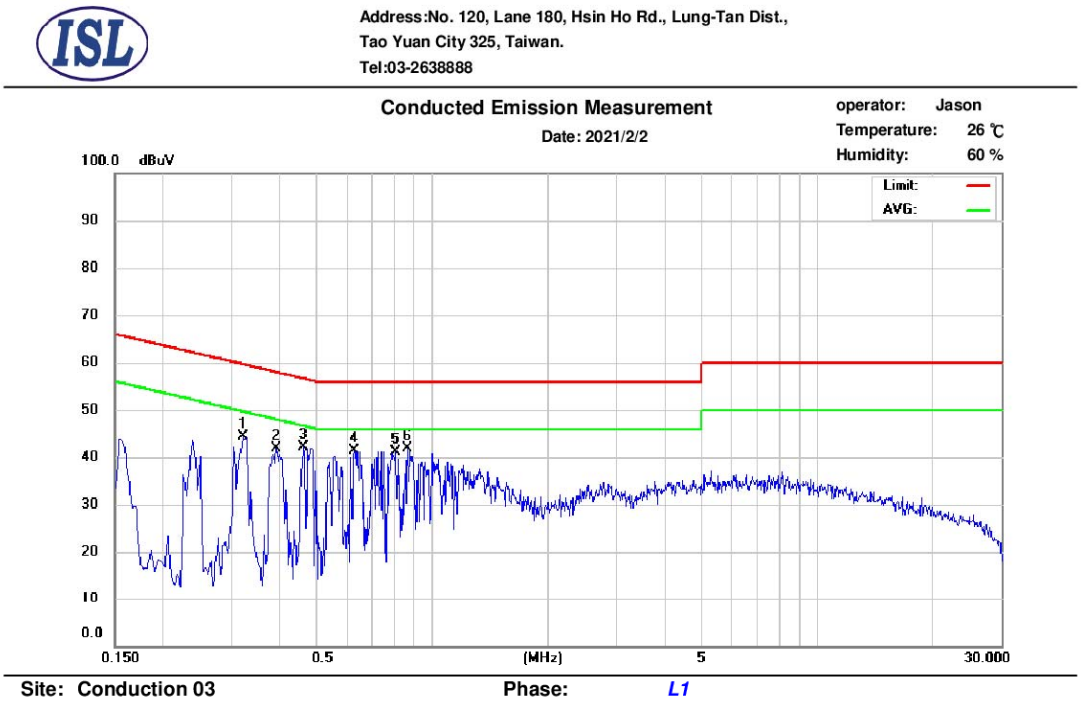
Frequency range (MHz)	Quasi-peak (dBμV)	Average (dBμV)
0.15-0.50	79	66
0.50-5.0	73	60
5.0-30	73	60
Note: The more stringent limit applies at transition frequencies.		

Conducted emissions limits of Class_B equipment. (AC mains power terminals):

Frequency range (MHz)	Quasi-peak (dBμV)	Average (dBμV)
0.15-0.50	66 to 56*	56-46*
0.50-5.0	56	46
5.0-30	60	50
*The limit level in dBμV decreases linearly with the logarithm of frequency. Note: The more stringent limit applies at transition frequencies.		

2.2 *Conduction Test Data: Configuration 1*

- Line



No.	Frequency (MHz)	QP_R (dBuV)	AVG_R (dBuV)	Correct Factor (dB)	QP Emission (dBuV)	QP Limit (dBuV)	QP Margin (dB)	AVG Emission (dBuV)	AVG Limit (dBuV)	AVG Margin (dB)
1	0.322	32.18	16.30	9.71	41.89	59.66	-17.77	26.01	49.66	-23.65
2	0.394	30.08	15.59	9.72	39.80	57.98	-18.18	25.31	47.98	-22.67
3	0.462	29.83	10.22	9.72	39.55	56.66	-17.11	19.94	46.66	-26.72
4	0.630	29.36	14.28	9.73	39.09	56.00	-16.91	24.01	46.00	-21.99
5	0.806	26.99	11.52	9.74	36.73	56.00	-19.27	21.26	46.00	-24.74
6	0.866	27.83	14.98	9.74	37.57	56.00	-18.43	24.72	46.00	-21.28

Note:
Margin = QP/AVG Emission - Limit
QP/AVG Emission = QP_R/AVG_R + Correct Factor
Correct Factor = LISN Loss + Cable Loss
A margin of -8dB means that the emission is 8dB below the limit
The frequency spectrum graph is for final peak graph, and the attached table is for QP/AVG test result.
If peak data can pass, it will be shown in “QP/AVG Correct” column, if not, QP/AVG data will instead.

- Neutral

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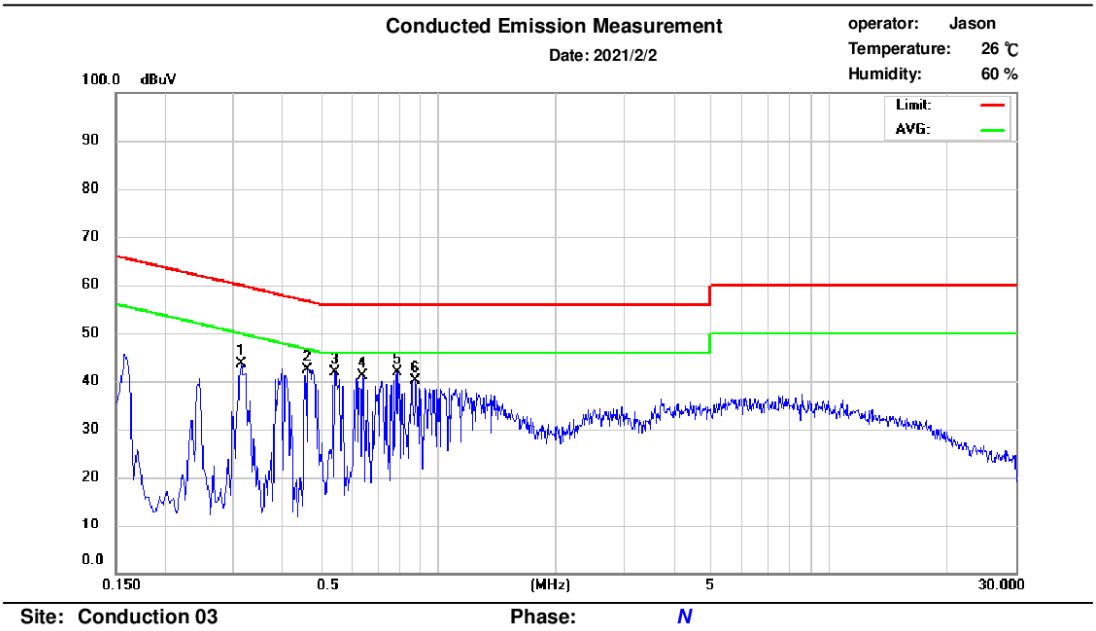
Tao Yuan City 325, Taiwan.
Tel:03-2638888

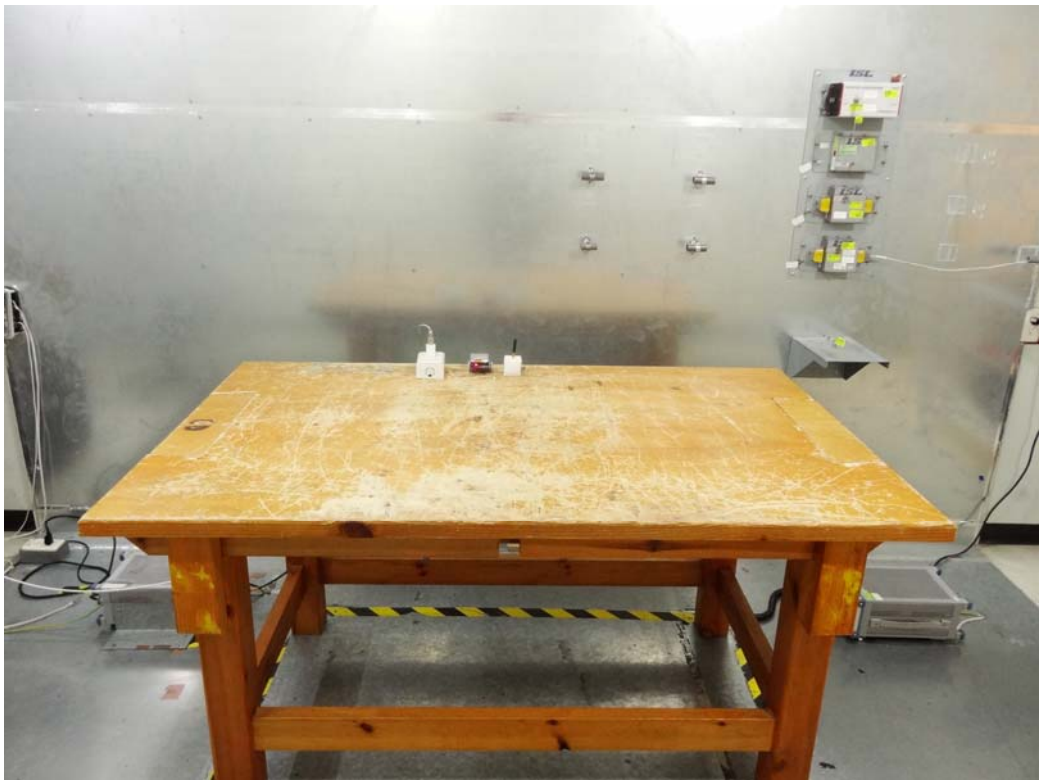


No.	Frequency (MHz)	QP_R (dBuV)	AVG_R (dBuV)	Correct Factor (dB)	QP Emission (dBuV)	QP Limit (dBuV)	QP Margin (dB)	AVG Emission (dBuV)	AVG Limit (dBuV)	AVG Margin (dB)
1	0.314	32.08	17.67	9.70	41.78	59.86	-18.08	27.37	49.86	-22.49
2	0.466	29.72	13.92	9.71	39.43	56.58	-17.15	23.63	46.58	-22.95
3	0.546	28.30	14.20	9.71	38.01	56.00	-17.99	23.91	46.00	-22.09
4	0.642	27.59	12.14	9.72	37.31	56.00	-18.69	21.86	46.00	-24.14
5	0.786	28.30	14.35	9.73	38.03	56.00	-17.97	24.08	46.00	-21.92
6	0.878	26.77	14.42	9.73	36.50	56.00	-19.50	24.15	46.00	-21.85

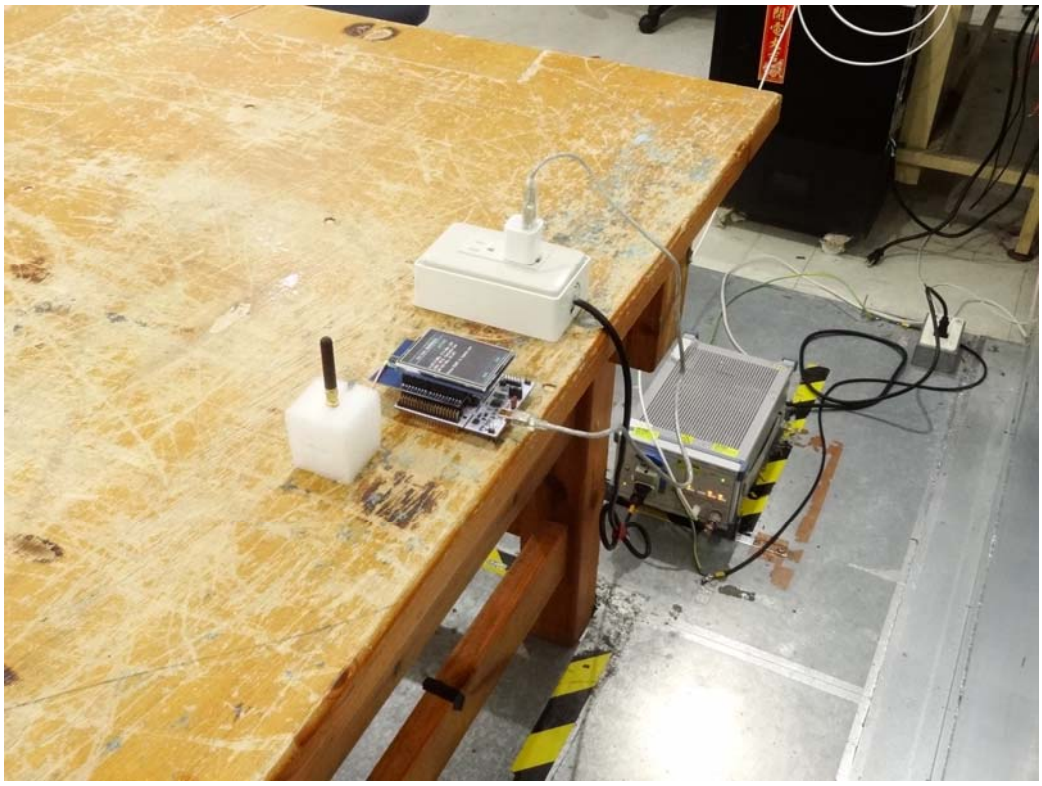
Note:
Margin = QP/AVG Emission - Limit
QP/AVG Emission = QP_R/AVG_R + Correct Factor
Correct Factor = LISN Loss + Cable Loss
A margin of -8dB means that the emission is 8dB below the limit
The frequency spectrum graph is for final peak graph, and the attached table is for QP/AVG test result.
If peak data can pass, it will be shown in “QP/AVG Correct” column, if not, QP/AVG data will instead.

2.3 Test Setup Photo

Front View



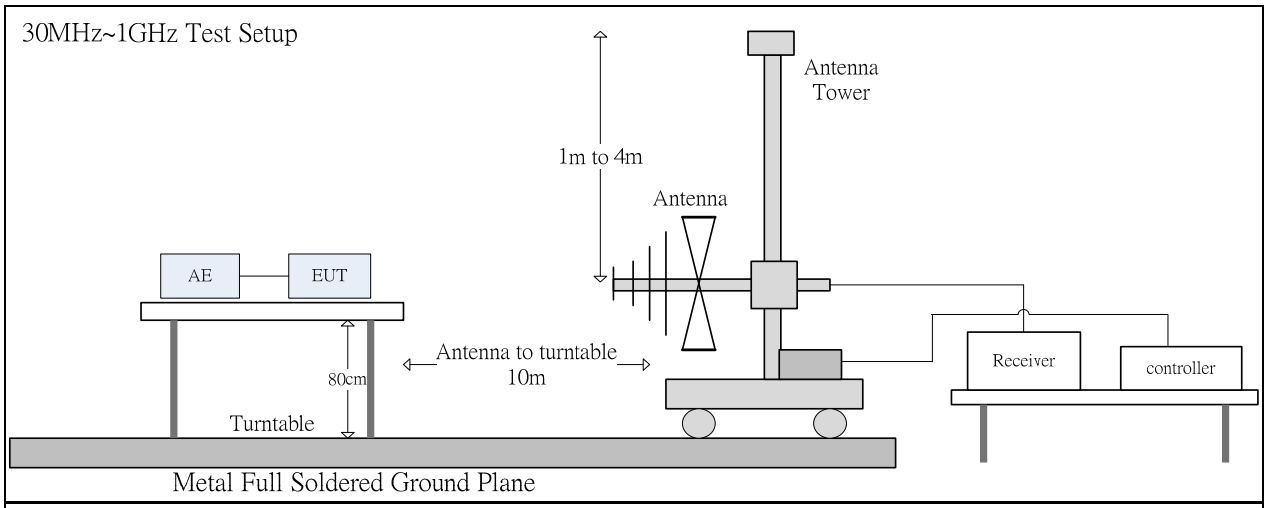
Back View

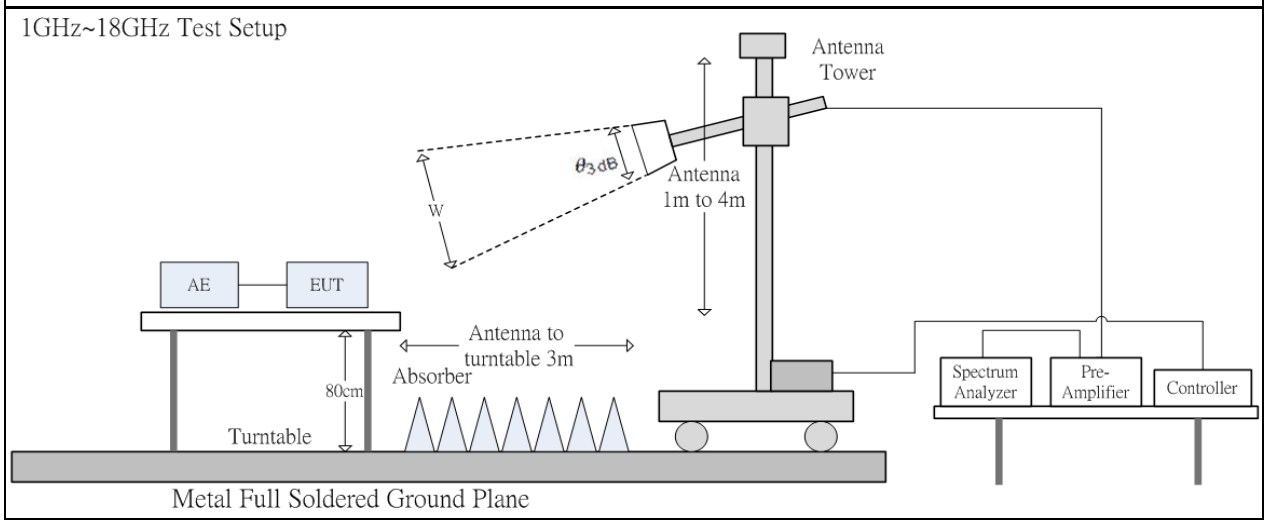


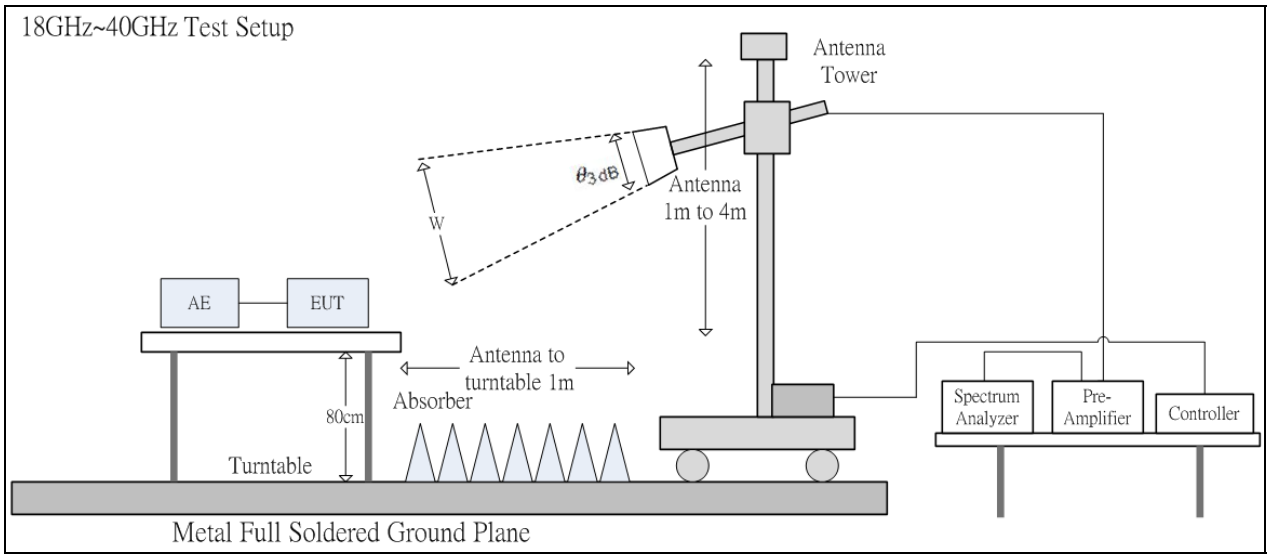
3. Radiated Emissions

3.1 Test Setup and Procedure

3.1.1 Test Setup







The 3dB beam width of the horn antenna used for the test is as shown in the table below.

1GHz~18GHz

Frequency GHz	E-plane	H-plane	$\theta_{3\,dB}$ (min)	d= 3 m
				w (m)
1	88°	147°	88°	5.79
2	68°	119°	68°	4.04
3	73°	92°	73°	4.44
4	70°	89°	70°	4.20
5	55°	60°	55°	3.12
6	63°	62°	62°	3.60
7	48°	49°	48°	2.67
8	39°	46°	39°	2.12
9	32°	42°	32°	1.72
10	30°	39°	30°	1.61
11	32°	35°	32°	1.72
12	35°	32°	35°	1.89
13	34°	31°	31°	1.66
14	32°	27°	27°	1.44
15	36°	26°	26°	1.39
16	40°	28°	28°	1.50
17	43°	26°	26°	1.39
18	41°	22°	22°	1.17

18 GHz~26.5 GHz

Frequency GHz	E-plane	H-plane	$\theta_{3\,dB}$ (min)	d= 1 m	d= 3 m
				w (m)	w (m)
18	11.4°	12.7°	11.4°	0.199	0.598
19	10.9°	12.4°	10.9°	0.190	0.572
20	10.8°	12.4°	10.8°	0.189	0.567
21	9.8°	12°	9.8°	0.171	0.514
22	9.7°	11°	9.7°	0.169	0.509
23	10°	11.8°	10°	0.174	0.524
24	9°	11°	9°	0.157	0.472
25	10°	12.3°	10°	0.174	0.524
26	9.9°	11.1°	9.9°	0.173	0.519
26.5	9.4°	11.3°	9.4°	0.164	0.493

26 GHz~40 GHz

Frequency GHz	E-plane	H-plane	$\theta_{3\,dB}$ (min)	d= 1 m	d= 3 m
				w (m)	w (m)
26	12°	12.2°	12°	0.210	0.631
27	13°	10.5°	10.5°	0.184	0.551
28	13.2°	12.3°	12.3°	0.216	0.647
29	11.5°	12.8°	11.5°	0.201	0.604
30	12°	8°	8°	0.140	0.420
31	11.5°	10.1°	10.1°	0.177	0.530
32	11.8°	10°	10°	0.175	0.525
33	11.8°	9.5°	9.5°	0.166	0.499
34	11.6°	10°	10°	0.175	0.525

35	10.9°	9.8°	9.8°	0.171	0.514
36	11.8°	8.6°	8.6°	0.150	0.451
37	12.9°	10.5°	10.5°	0.184	0.551
38	12°	10.3°	10.3°	0.180	0.541
39	11.8°	9.8°	9.8°	0.171	0.514
40	12.5°	11.2°	11.2°	0.196	0.588

3.1.2 Test Procedure

The radiated emissions test will then be repeated on the chamber to measure the amplitudes accurately and without the multiple reflections existing in the shielded room. The EUT and support equipment are set up on the turntable of one of 10 meter chamber. Desktop EUT are set up on a wooden stand 0.8 meter above the ground or floor-standing arrangement shall be placed on the horizontal ground reference plane. The test volume for a height of up to 30 cm may be obstructed by absorber placed on the ground plane.

For the initial measurements, the receiving antenna is varied from 1-4 meter height and is changed in the vertical plane from vertical to horizontal polarization at each frequency. The highest emissions between 30 MHz to 1000 MHz were analyzed in details by operating the spectrum analyzer and/or EMI receiver in quasi-peak mode to determine the precise amplitude of the emissions. The highest emissions between 1 GHz to 40 GHz were analyzed in details by operating the spectrum analyzer in peak and average mode to determine the precise amplitude of the emissions.

Place the measurement antenna away from each area of the EUT determined to be a source of emissions at the specified measurement distance, while keeping the antenna in the cone of radiation from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response. At the highest amplitudes observed, the EUT is rotated in the horizontal plane while changing the antenna polarization in the vertical plane to maximize the reading. The interconnecting cables were arranged and moved to get the maximum measurement. Once the maximum reading is obtained, the antenna elevation and polarization will be varied between specified limits to maximize the readings. All of the interface cables were manipulated according to ANSI C63.4 requirements.

The highest internal source of the EUT is defined as the highest frequency generated or used within the EUT or on which the EUT operates or tunes. If the highest frequency of the internal sources of the EUT is less than 108 MHz, the measurement shall only be made up to 1 GHz. If the highest frequency of the internal sources of the EUT is between 108 MHz and 500 MHz, the measurement shall only be made up to 2 GHz. If the highest frequency of the internal sources of the EUT is between 500 MHz and 1 GHz, the measurement shall only be made up to 5 GHz. If the highest frequency of the internal sources of the EUT is above 1 GHz, the measurement shall be made up to 5 times the highest frequency or 40 GHz, whichever is less.

3.1.3 Spectrum Analyzer Configuration (for the frequencies tested)

Frequency Range: 30MHz--1000MHz
Detector Function: Quasi-Peak Mode
Resolution Bandwidth: 120kHz

Frequency Range: Above 1000MHz
Detector Function: Peak/Average Mode
Resolution Bandwidth: 1MHz

3.1.4 Limt

Radiated emissions limits of Class_A equipment. (30 MHz to 1 GHz)

Frequency range (MHz)	at 10 m distance Quasi-peak (dBμV/m)
30-88	40.0
88-216	43.5
216-230	46.4
230-960	47.0
960-1000	49.5
Note: The more stringent limit applies at transition frequencies.	

Radiated emission limits of Class_A equipment at 3 m distance (at and above 1 GHz)

Frequency range (GHz)	Average dB(μV/m)	Peak dB(μV/m)
1 – 18G	60	80

Radiated emission limits of Class_A equipment at 1 m distance (at and above 1 GHz)

Frequency range (GHz)	Average dB(μV/m)	Peak dB(μV/m)
18 – 40G	69.5	89.5

Note 1: Limit is measurement distance using an inverse linear distance extrapolation factor (20dB/decade).

Radiated emissions limits of Class_B equipment. (30 MHz to 1 GHz)

Frequency range (MHz)	at 10 m distance Quasi-peak (dBμV/m)
30-88	30.0
88-216	33.1
216-230	35.6
230-960	37.0
960-1000	43.5
Note: The more stringent limit applies at transition frequencies.	

Radiated emission limits of Class_B equipment at 3 m distance (at and above 1 GHz)

Frequency range (GHz)	Average dB(μV/m)	Peak dB(μV/m)
1 – 18G	54	74

Radiated emission limits of Class_B equipment at 1 m distance (at and above 1 GHz)

Frequency range (GHz)	Average dB(μV/m)	Peak dB(μV/m)
18 – 40G	63.5	83.5

Note 1: Limit is measurement distance using an inverse linear distance extrapolation factor (20dB/decade).

3.2 *Radiation Test Data: Configuration 1*

- Radiated Emissions (Horizontal)

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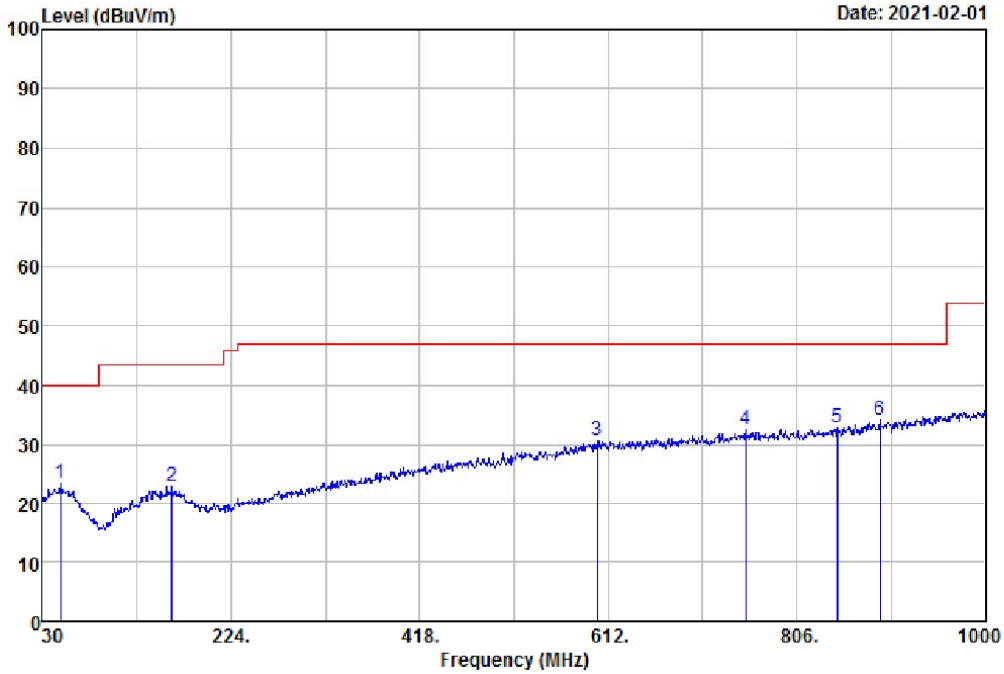
Web:www.isl.com.tw



Condition: ICES-003 CLASS B 3M 3m HORIZONTAL
Site : Chamber 19

Operator : Jason

	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark	Pol/Phase
	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB		
1	48.43	28.58	-5.12	23.46	40.00	-16.54	Peak	HORIZONTAL
2	162.89	27.89	-4.95	22.94	43.50	-20.56	Peak	HORIZONTAL
3	600.36	29.10	1.45	30.55	47.00	-16.45	Peak	HORIZONTAL
4	753.62	28.57	3.99	32.56	47.00	-14.44	Peak	HORIZONTAL
5	847.71	27.63	5.11	32.74	47.00	-14.26	Peak	HORIZONTAL
6	891.36	28.32	5.80	34.12	47.00	-12.88	Peak	HORIZONTAL

* Note:
Margin = Emission – Limit
Emission = Radiated Amplitude + Correct Factor
Correct Factor = Antenna Correction Factor + Cable Loss – Pre-Amplifier Gain
A margin of -8dB means that the emission is 8dB below the limit
Antenna Distance: 10 meters
Below 1GHz test, if the peak measured value meets the QP limit, it is unnecessary to perform the QP measurement.

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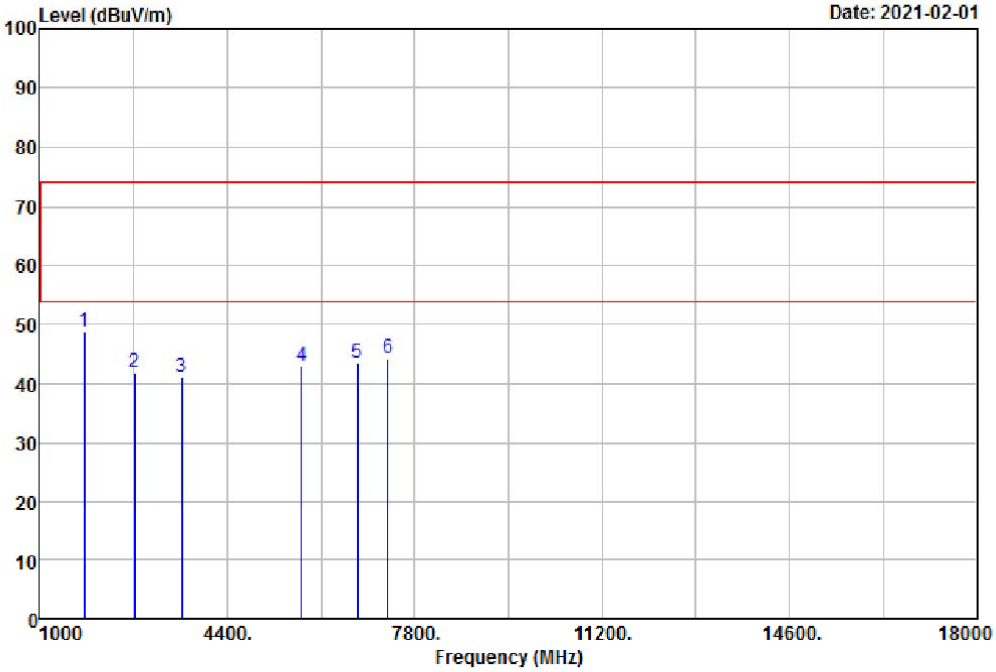

Condition: ICES-003 CLASS B 3M 3m HORIZONTAL
Site : Chamber 19

Operator : Jason

	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark	Pol/Phase
	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB		
1	1799.00	62.49	-13.76	48.73	74.00	-25.27	Peak	HORIZONTAL
2	2717.00	53.04	-11.30	41.74	74.00	-32.26	Peak	HORIZONTAL
3	3567.00	50.65	-9.58	41.07	74.00	-32.93	Peak	HORIZONTAL
4	5743.00	48.12	-5.12	43.00	74.00	-31.00	Peak	HORIZONTAL
5	6763.00	47.18	-3.73	43.45	74.00	-30.55	Peak	HORIZONTAL
6	7307.00	47.80	-3.41	44.39	74.00	-29.61	Peak	HORIZONTAL

* Note:
Margin = Emission – Limit
Emission = Radiated Amplitude + Correct Factor
Correct Factor = Antenna Correction Factor + Cable Loss – Pre-Amplifier Gain
A margin of -8dB means that the emission is 8dB below the limit
Antenna Distance: 3 meters
Above 1GHz test, if the peak measured value meets the average limit, it is unnecessary to perform the average measurement.

-Radiated Emissions (Vertical)

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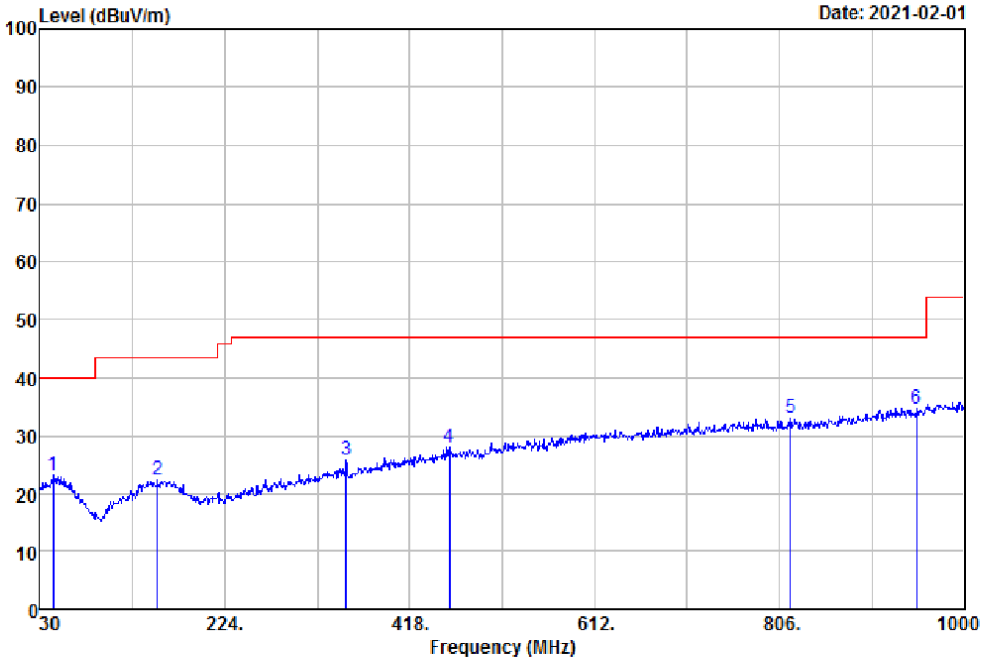

Condition: ICES-003 CLASS B 3M 3m VERTICAL
Site : Chamber 19

Operator : Jason

	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark	Pol/Phase
	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB		
1	43.58	28.44	-5.29	23.15	40.00	-16.85	Peak	VERTICAL
2	153.19	27.58	-5.12	22.46	43.50	-21.04	Peak	VERTICAL
3	351.07	28.90	-3.01	25.89	47.00	-21.11	Peak	VERTICAL
4	459.71	29.19	-1.14	28.05	47.00	-18.95	Peak	VERTICAL
5	817.64	28.40	4.72	33.12	47.00	-13.88	Peak	VERTICAL
6	950.53	27.53	7.07	34.60	47.00	-12.40	Peak	VERTICAL

* Note:
Margin = Emission – Limit
Emission = Radiated Amplitude + Correct Factor
Correct Factor = Antenna Correction Factor + Cable Loss – Pre-Amplifier Gain
A margin of -8dB means that the emission is 8dB below the limit
Antenna Distance: 10 meters
Below 1GHz test, if the peak measured value meets the QP limit, it is unnecessary to perform the QP measurement.

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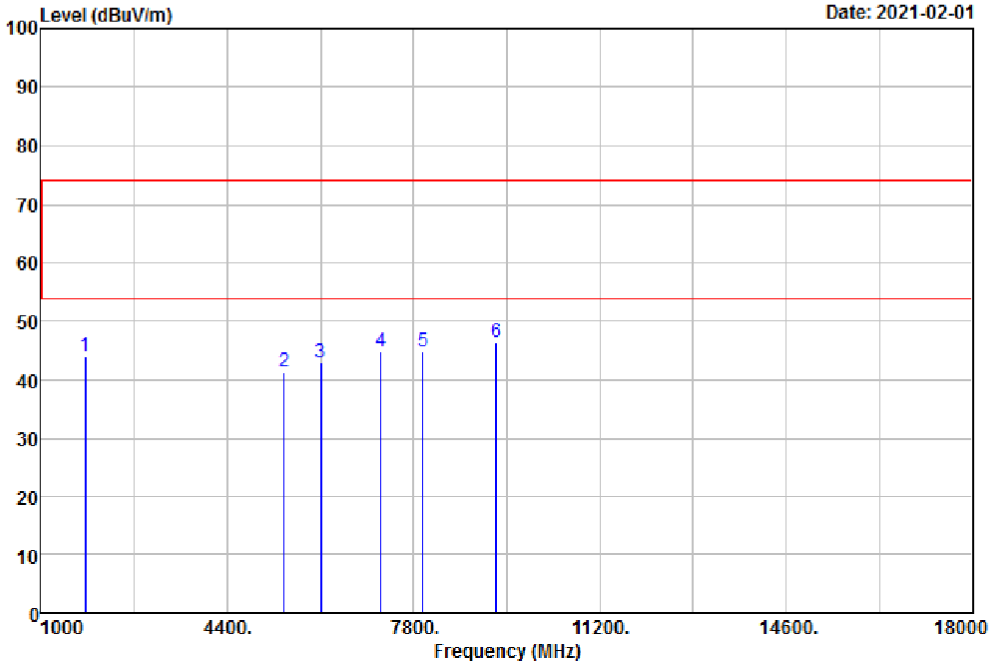


Condition: ICES-003 CLASS B 3M 3m VERTICAL
Site : Chamber 19

Operator : Jason

	Freq	Read Level	Factor	Level	Limit Line	Over Limit	Remark	Pol/Phase
	MHz	dBuV	dB/m	dBuV/m	dBuV/m	dB		
1	1799.00	57.74	-13.76	43.98	74.00	-30.02	Peak	VERTICAL
2	5437.00	47.12	-5.71	41.41	74.00	-32.59	Peak	VERTICAL
3	6100.00	46.97	-4.12	42.85	74.00	-31.15	Peak	VERTICAL
4	7205.00	48.24	-3.43	44.81	74.00	-29.19	Peak	VERTICAL
5	7970.00	47.12	-2.44	44.68	74.00	-29.32	Peak	VERTICAL
6	9313.00	46.17	0.27	46.44	74.00	-27.56	Peak	VERTICAL

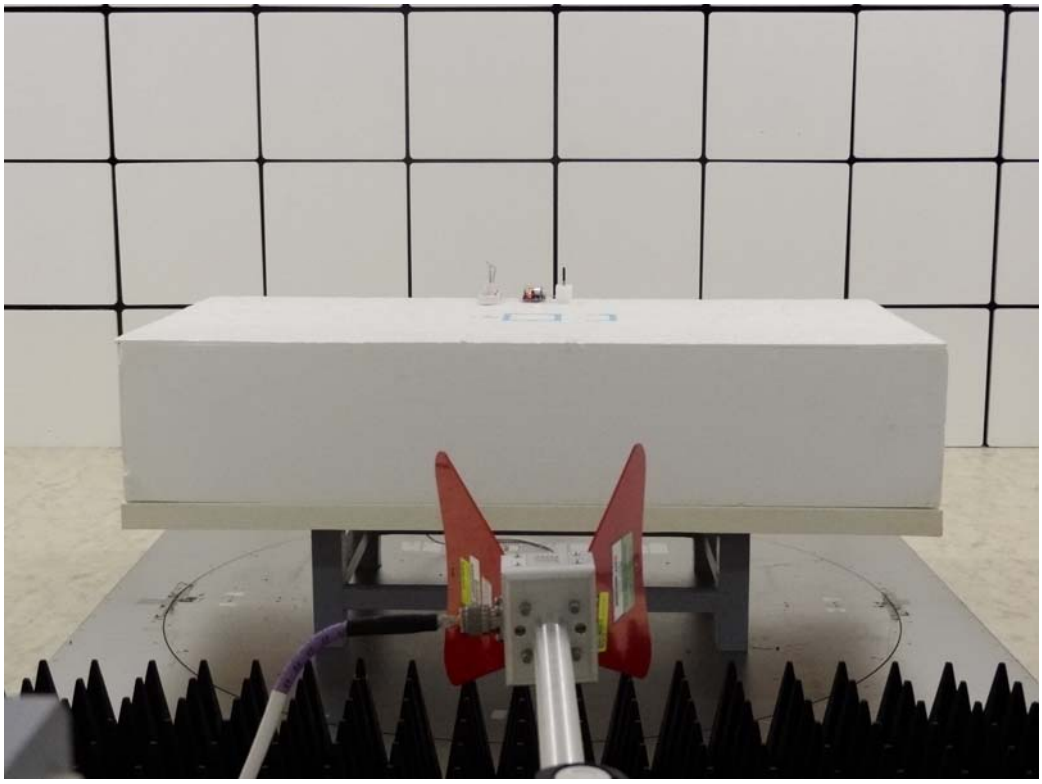
* Note:
Margin = Emission – Limit
Emission = Radiated Amplitude + Correct Factor
Correct Factor = Antenna Correction Factor + Cable Loss – Pre-Amplifier Gain
A margin of -8dB means that the emission is 8dB below the limit
Antenna Distance: 3 meters
Above 1GHz test, if the peak measured value meets the average limit, it is unnecessary to perform the average measurement.

3.3 Test Setup Photo

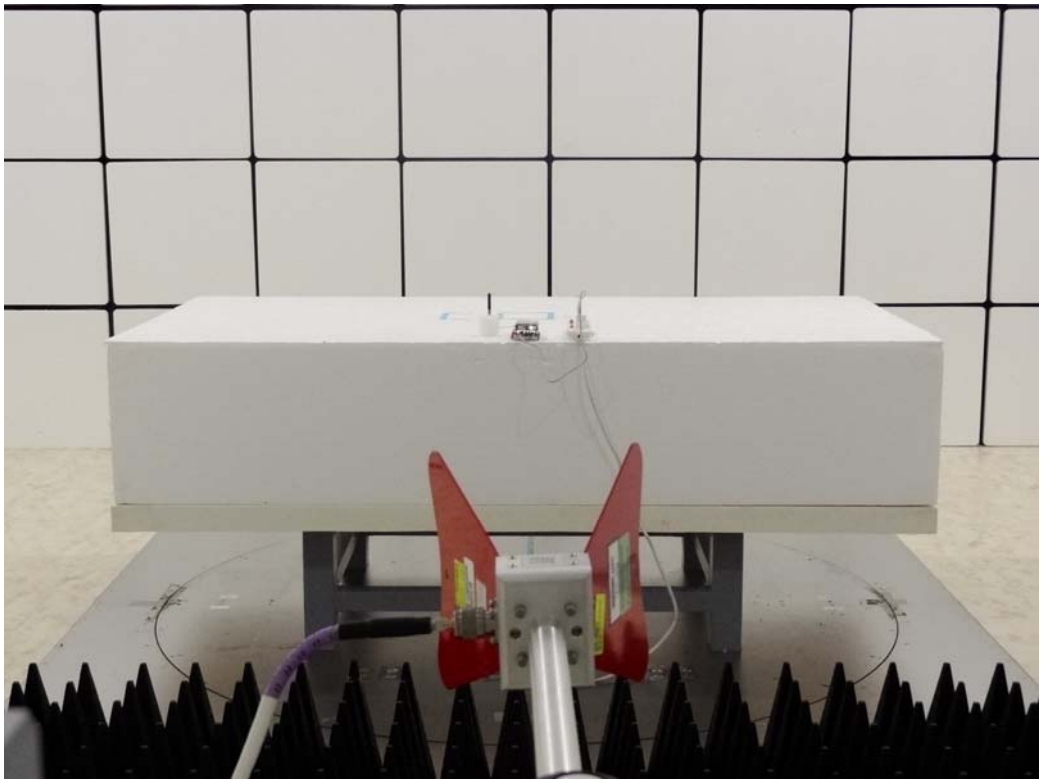
Front View (30MHz~1GHz)

Back View (30MHz~1GHz)

Front View (above 1GHz)



Back View (above 1GHz)



4. Appendix

4.1 Appendix A: Labelling and user manual requirements

The requirements specified in ICES-Gen shall apply. An example ISED compliance label, to be placed on each unit of an equipment model (or in the user manual, if allowed), is given below:

CAN ICES-003(*) / NMB-003(*)

* Insert either “A” or “B”, but not both, to identify the applicable Class of the device used for compliance verification.

The above label is only an example. The specific format is left to the manufacturer to decide, as long as the label includes the required information, in accordance with ICES-Gen.

4.2 Appendix B: Test Equipment

4.2.1 Test Equipment List

Location	Equipment Name	Brand	Model	S/N	Last Cal. Date	Next Cal. Date
Conduction 03	EMI Receiver 15	ROHDE & SCHWARZ	ESCI	101166	07/29/2020	07/29/2021
Conduction 03	ISN T4 09	Teseq GmbH	ISN T400A	49914	08/10/2020	08/10/2021
Conduction 03	ISNT8 09	Teseq GmbH	ISN T800	36190	09/16/2020	09/16/2021
Conduction 03	LISN 19	R&S	ENV216	101425	11/05/2020	11/05/2021
Conduction 03	LISN 15	R&S	ENV216	101335	11/27/2020	11/27/2021
Conduction 03	Conduction 04-3 Cable	WOKEN	CFD 300-NL	conduction 04-3	09/07/2020	09/07/2021
Conduction 03	Capacitive Voltage Probe 01	SCHAFFNER	CVP 2200A	18711	08/14/2020	08/14/2021
Conduction 03	Current Probe	SCHAFFNER	SMZ 11	18030	01/15/2021	01/15/2022

Location Conducted	Equipment Name	Brand	Model	S/N	Last Cal. Date	Next Cal. Date
Chamber 19	Spectrum analyzer	R&S	FSV40	101919	08/13/2020	08/13/2021
Chamber 19	EMI Receiver	R&S	ESR3	102461	05/05/2020	05/05/2021
Chamber 19	Loop Antenna	EM	EM-6879	271	05/21/2020	05/21/2021
Chamber 19	Bilog Antenna (30MHz-1GHz)	Schwarzbeck	VULB9168 w 5dB Att.	736	02/11/2020	02/11/2021
Chamber 19	Horn antenna (1GHz-18GHz)	ETS LINDGREN	3117	00218718	09/25/2020	09/25/2021
Chamber 19	Horn antenna (18GHz-26GHz)	Com-power	AH-826	081001	11/23/2020	11/23/2021
Chamber 19	Horn antenna (26GHz-40GHz)	Com-power	AH-640	100A	03/13/2020	03/13/2021
Chamber 19	Preamplifier (9kHz-1GHz)	HP	8447F	3113A04621	06/19/2020	06/19/2021
Chamber 19	Preamplifier (1GHz-26GHz)	EM	EM01M26G	060681	05/04/2020	05/04/2021
Chamber 19	Preamplifier (26GHz-40GHz)	MITEQ	JS4-26004000-27-5A	818471	05/04/2020	05/04/2021
Chamber 19	RF Cable (9kHz-18GHz)	HUBER SUHNER	Sucoflex 104A & 18GHz SMA(M)-SMA(M)-10M	MY817/4A & 20200525	12/25/2020	12/25/2021
Chamber 19	RF Cable (18GHz-40GHz)	HUBER SUHNER	Sucoflex 102	27963/2&37421/2	11/19/2020	11/19/2021
Chamber 19	Signal Generator	Anritsu	MG3692A	20311	01/03/2021	01/03/2022
Chamber 19	Test Software	Audix	E3 Ver:6.12023	N/A	N/A	N/A

4.2.2 Software for Controlling Spectrum/Receiver and Calculating Test Data

Site	Filename	Version	Issue Date
Conduction	EZ EMC	ISL-03A2	3/6/2013

4.3 Appendix C: Uncertainty of Measurement

The laboratory measurement uncertainty accordance with refers to CISPR 16-4-2. If Ulab is less than or equal to Ucispr in Table 1, then the test report may either state the value of Ulab or state that Ulab is less than Ucispr.
The coverage factor k = 2 yields approximately a 95 % level of confidence.

<Conduction 03>
AMN: ±2.90dB
ISN T4: ±3.05dB
ISN T8: ±3.05dB
CVP: ±3.62dB
CP: ±2.88dB

<Chamber 19>

Description Of Test	Uncertainty
Conducted Emission (AC power line)	2.586 dB
Field Strength of Spurious Radiation	<=30MHz: 2.96dB 30-1GHz: 4.22 dB 1-40 GHz: 4.08 dB
Conducted Power	2.412 GHz: 1.30 dB 5.805 GHz: 1.55 dB
Power Density	2.412 GHz:1.30 dB 5.805 GHz: 1.67 dB
Frequency	0.0032%

4.4 Appendix D: Photographs of EUT

Please refer to the File of **ISL-21LR042P**

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