RF Test Reports

Report No.: SL18041906-MED-029-FCC-IC-175K Rev 1.0
Supersede Report No.: SL18041906-MED-029-FCC-IC-175K

Applicant	Medtronic, Inc.
Product Name	Indra
Model No.	TM91
Product Description	Restorative Therapy Ultra Low Power Active Medical Implant Peripheral (UP-AMI-P)
Test Standard	47 CFR 15.209 RSS-Gen, RSS-310 Issue 4
Test Method	ANSI C63.10: 2013 RSS-Gen, RSS-310 Issue 4
FCC ID	LF5TM91
IC ID	3408D-TM91
Date of test	05/14/2018 to 05/18/2018
Issue Date	03/21/2019
Test Result	☒ Pass ☐ Fail
Equipment complied with the test standard equipment	**[x]**
Equipment did not comply with the test standard equipment	**[ ]**
This Test Report is Issued Under the Authority of:	
	
Cipher	**Chen Ge**
Test Engineer	**Engineer Reviewer**
This test report may be reproduced in full only **Test result presented in this test report is applicable to the tested sample only**	

Issued By:
SIEMIC Laboratories
775 Montague Expressway, Milpitas, CA 95035

Laboratory Introduction

SIEMIC, headquartered in the heart of Silicon Valley, with superior facilities in US and Asia, is one of the leading independent testing and certification facilities providing customers with one-stop shop services for Compliance Testing and Global Certifications.

In addition to testing and certification, SIEMIC provides initial design reviews and compliance management throughout a project. Our extensive experience with China, Asia Pacific, North America, European, and International compliance requirements, assures the fastest, most cost effective way to attain regulatory compliance for the global markets.

Accreditations for Conformity Assessment

Country/Region	Accreditation Body	Scope
USA	FCC, A2LA	EMC, RF/Wireless, Telecom
Canada	IC, A2LA, NIST	EMC, RF/Wireless, Telecom
Taiwan	BSMI, NCC, NIST	EMC, RF, Telecom, Safety
Hong Kong	OFTA, NIST	RF/Wireless, Telecom
Australia	NATA, NIST	EMC, RF, Telecom, Safety
Korea	KCC/RRA, NIST	EMI, EMS, RF, Telecom, Safety
Japan	VCCI, JATE, TELEC, RFT	EMI, RF/Wireless, Telecom
Mexico	NOM, COFETEL, Caniety	EMC, RF/Wireless, Telecom, Safety
Europe	A2LA, NIST	EMC, RF, Telecom, Safety
Israel	MOC, NIST	EMC, RF, Telecom, Safety

Accreditations for Product Certifications

Country	Accreditation Body	Scope
USA	FCC TCB, NIST	EMC, RF, Telecom
Canada	IC FCB, NIST	EMC, RF, Telecom
Singapore	iDA, NIST	EMC, RF, Telecom
EU	NB	EMC & R&TTE Directive
Japan	MIC (RCB 208)	RF, Telecom
Hong Kong	OFTA (US002)	RF, Telecom

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1 Report Revision History

Report No.	Report Version	Description	Issue Date
SL18041906-MED-029-FCC-IC-175K	None	Original Report	05/29/2018
SL18041906-MED-029-FCC-IC-175K Rev 1.0	1.0	Update	3/21/2019

2 Executive Summary

The purpose of this test program was to demonstrate compliance of following product

Company: Medtronic, Inc.
Product: Indra
Model: TM91

against the current Stipulated Standards. The specified model product stated above has demonstrated compliance with the Stipulated Standard listed on 1st page.

3 Customer information

Applicant Name	:	Medtronic, Inc.
Applicant Address 1	:	8200 Coral Sea St. NE, Mounds View, MN 55112
Applicant Address 2	:	7000 Central Ave. NE, Minneapolis, MN 55432
Manufacturer Name	:	Medtronic, Inc.
Manufacturer Address 1	:	8200 Coral Sea St. NE, Mounds View, MN 55112
Manufacturer Address 2	:	7000 Central Ave. NE, Minneapolis, MN 55432

4 Test site information

Lab performing tests	SIEMIC Laboratories
Lab Address	775 Montague Expressway, Milpitas, CA 95035
FCC Test Site No.	540430
IC Test Site No.	4842D-2
VCCI Test Site No.	A0133

5 Equipment Under Test (EUT) Information

5.1 EUT Description

Product Name	Indra
Model No.	TM91
Trade Name	Medtronic
Serial No.	NPE000046N
Input Power	3.7 Vdc from Battery, and 5.0Vdc USB charge
Date of EUT received	04/28/2018
Equipment Class/ Category	DCD, Class 3

5.2 Radio Description

Radio Parameters

Operating Frequency	175 KHz
Modulation	OOK burst
Channel Spacing	Single Channel Operation
Antenna Type	Integral loop antenna
Antenna Gain	None

Channel List

Type	Channel No.	Frequency (KHz)
175kHz	1	175

6 Supporting Equipment/Software and cabling Description

6.1 Supporting Equipment

Item	Supporting Equipment Description	Model	Serial Number	Manufacturer	Note
1	LAPTOP	LATITUDE E6220	N/A	DELL	N/A

6.2 I/O Ports

Item	Connection Start		Connection Stop		Length / shielding Info		Note
	From	I/O Port	To	I/O Port	Length (m)	Shielding	
N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

6.3 Test Software Description

Test Item	Software	Description
RF Testing	BLUE MAGIC 1.95	Provided by manufacturer to set EUT in continuous mode

7 Test Summary

Test Item	Test standard		Test Method/Procedure		Pass / Fail
Antenna Requirement	FCC	47 CFR 15.203	FCC	ANSI C63.10 – 2013	☒ Pass ☐ N/A
	IC	RSS-Gen	IC	RSS-Gen	
Radiated Spurious Emissions	FCC	47 CFR 15.209	FCC	ANSI C63.10: 2013	☒ Pass ☐ N/A
	IC	RSS-310	IC	RSS-310	
Remark	1. All measurement uncertainties are not taken into consideration for all presented test result. 2. The applicant shall ensure frequency stability by showing that an emission is maintained within the band of operation under all normal operating conditions as specified in the user's manual.				

8 Measurement Uncertainty

8.1 Radiated Emissions (9kHz to 30MHz)

The test is to measure the radiated emissions of the EUT.

Some error sources that can contribute to the total uncertainty:
- Uncertainty of the receiver
- Uncertainty of the antenna
- Uncertainty of cables
- Uncertainty due to the mismatches

Source of Uncertainty	Value (dB)	Probability Distribution	Division	Sensitivity Coefficient	Expanded Uncertainty
Receiver Reading	0.10	Rectangular	1.732	1	0.069284
Cable Insertion Loss	0.21	Normal	2	1	0.105
Antenna Factor	0.65	Normal	2	1	0.325
Receiver CW accuracy	0.45	Rectangular	1.732	1	0.2598152
Mismatch	0.25	U-Shape	1.414	1	0.1768033
Combined Standard Uncertainty					0.935
Expanded Uncertainty (K=2)					**1.87**

The total derived measurement uncertainty is +/- 1.87 dB.

8.2 Radiated Emissions (30MHz to 1GHz)

The test is to measure the radiated emissions of the EUT.

Some error sources that can contribute to the total uncertainty:
- Uncertainty of the receiver
- Uncertainty of the antenna
- Uncertainty of cables
- Uncertainty due to the mismatches
- NSA Calibration
- Etc., details see the below table

Source of Uncertainty	Value (dB)	Probability Distribution	Division	Sensitivity Coefficient	Expanded Uncertainty
Receiver Reading	0.12	Rectangular	1.732	1	0.069284
Cable Insertion Loss	0.21	Normal	2	1	0.105
Filter Insertion Loss	0.25	Normal	2	1	0.125
Antenna Factor	0.65	Normal	2	1	0.325
Receiver CW accuracy	0.5	Rectangular	1.732	1	0.2886836
Pulse Amplitude Response	1.5	Rectangular	1.732	1	0.86605081
PRF Response	1.5	Rectangular	1.732	1	0.86605081
Mismatch Filter - Receiver	0.25	U-Shape	1.414	1	0.1768033
NSA Calibration	4.0	U-Shape	1.414	1	2.8288543
Combined Standard Uncertainty					3.0059131
Expanded Uncertainty (K=2)					**6.0118262**

The total derived measurement uncertainty is +/- 6.00 dB.

8.3 Radiated Emissions (1GHz to 40GHz)

The test is to measure the radiated emissions of the EUT.

Some error sources that can contribute to the total uncertainty:
- Uncertainty of the receiver
- Uncertainty of the antenna
- Uncertainty of cables
- Uncertainty due to the mismatches
- VSWR Calibration
- Etc., details see the below table

Source of Uncertainty	Value (dB)	Probability Distribution	Division	Sensitivity Coefficient	Expanded Uncertainty
Receiver Reading	0.12	Rectangular	1.732	1	0.0692840
Cable Insertion Loss	0.21	Normal	2	1	0.1050000
Filter Insertion Loss	0.25	Normal	2	1	0.1250000
Antenna Factor	0.65	Normal	2	1	0.3250000
Receiver CW accuracy	0.5	Rectangular	1.732	1	0.2886836
Pulse Amplitude Response	1.5	Rectangular	1.732	1	0.8660508
PRF Response	1.5	Rectangular	1.732	1	0.8660508
Mismatch Filter - Receiver	0.25	U-Shape	1.414	1	0.1768033
VSWR Calibration	2.0	U-Shape	1.414	1	1.4144272
Combined Standard Uncertainty					4.2363
Expanded Uncertainty (K=2)					**8.4726**

The total derived measurement uncertainty is +/- 8.47 dB.

8.4 RF conducted measurement

The test is to measure the RF output power from the EUT.

Some error sources that can contribute to the total uncertainty:

- Uncertainty of the Reference Level Uncertainty
- Uncertainty of variable attenuators
- Uncertainty of cables
- Uncertainty due to the mismatches

Source of Uncertainty	Value (dB)	Probability Distribution	Division	Sensitivity Coefficient	Expanded Uncertainty
Reference Level	0.12	Rectangular	1.732	1	0.069284
Cable Insertion Loss	0.21	Normal	2	1	0.105
Attenuator	0.25	Normal	2	1	0.125
Mismatch	0.25	U-Shape	1.414	1	0.1768033
Combined Standard Uncertainty					0.476087
Expanded Uncertainty (K=2)					**0.952174**

The total derived measurement uncertainty is +/- 0.95 dB.

9 Measurements, Examination and Derived Results

9.1 Antenna Requirement

Spec	Requirement	Applicable
§15.203 RSS-Gen	An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. Antenna requirement must meet at least one of the following: a) Antenna must be permanently attached to the device. b) The antenna must use a unique type of connector to attach to the device. c) Device must be professionally installed. The installer shall be responsible for ensuring that the correct antenna is employed by the device.	☒
Remark	The EUT has an integrated antenna which meets the requirement.	
Result	☒ PASS ☐ FAIL	

9.2 Radiated Spurious Emissions below 30MHz

Requirement(s):

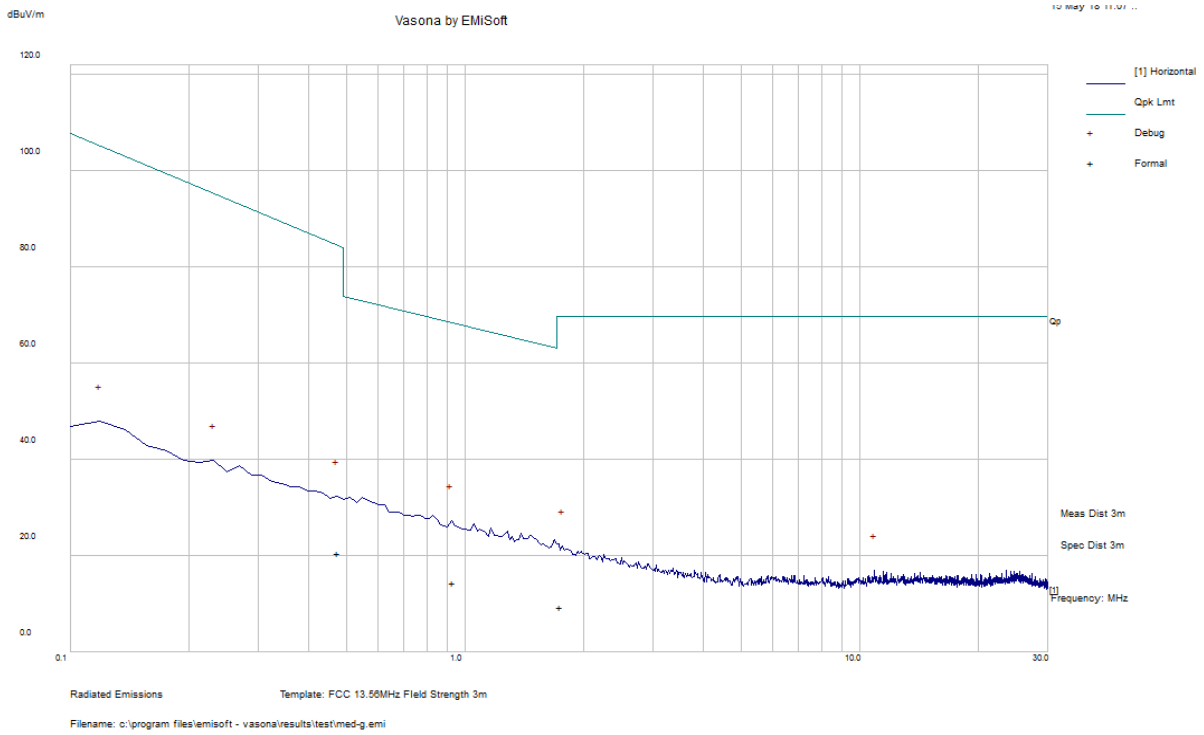
<table>
<tr><td></td><td>Item</td><td>Requirement</td><td>Applicable</td></tr>
<tr><td>FCC 15.209</td><td>1</td><td>Except higher limit as specified elsewhere in other section, the emissions from the low-power radio-frequency devices shall not exceed the field strength levels specified in the following table and the level of any unwanted emissions shall not exceed the level of the fundamental emission. The tighter limit applies at the band edges
<table>
<tr><th>Frequency range (MHz)</th><th>Field Strength (uV/m)</th><th>Measurement distance (meters)</th></tr>
<tr><td>0.009-0.490</td><td>2400/F(kHz)</td><td>300</td></tr>
<tr><td>0.490-1.705</td><td>24000/F(kHz)</td><td>30</td></tr>
<tr><td>1.705-30.0</td><td>30</td><td>30</td></tr>
</table></td><td>☒</td></tr>
<tr><td>RSS-310</td><td>3.7</td><td>Transmitters whose fundamental emission lies below 490 kHz and for which it is shown that all emissions are at least 40 dB below the general field strength limits listed in RSS-Gen, shall comply with the general provisions of RSS-310 and the applicable provisions of RSS-Gen.
<table>
<tr><th>Frequency range (MHz)</th><th>Field Strength (uA/m)</th><th>Measurement distance (meters)</th></tr>
<tr><td>0.009-0.490</td><td>6.37/F(kHz)</td><td>300</td></tr>
<tr><td>0.490-1.705</td><td>63.7/F(kHz)</td><td>30</td></tr>
<tr><td>1.705-30.0</td><td>0.08</td><td>30</td></tr>
</table></td><td>☒</td></tr>
<tr><td>Procedure</td><td colspan="3">1. The EUT was switched on and allowed to warm up to its normal operating condition.
2. The test was carried out at the selected frequency points obtained from the EUT characterisation. Maximization of the emissions, was carried out by rotating the EUT, changing the antenna polarization, and adjusting the antenna height in the following manner:
a. Vertical or horizontal polarisation (whichever gave the higher emission level over a full rotation of the EUT) was chosen.
b. The EUT was then rotated to the direction that gave the maximum emission.
c. Finally, the antenna height was adjusted to the height that gave the maximum emission.
3. A Quasi-peak measurement was then made for that frequency point.
4. Steps 2 and 3 were repeated for the next frequency point, until all selected frequency points were measured.</td></tr>
<tr><td>Test Date</td><td>05/14/2018 to 05/18/2018</td><td>Environmental condition</td><td>Temperature 21°C
Relative Humidity 42%
Atmospheric Pressure 1015mbar</td></tr>
<tr><td>Remark</td><td colspan="3">N/A</td></tr>
<tr><td>Result</td><td colspan="3">☒ Pass ☐ Fail</td></tr>
</table>

Test Data ☒ Yes ☐N/A

Test Plot ☒ Yes (See below) ☐ N/A

Test was done by Cipher at 10m chamber.

Test specification:	Radiated Spurious Emissions			
Mains Power:	3VDC		Result:	☒ Pass ☐ Fail
Tested by:	Cipher			
Test Date:	05/14/2018 to 05/18/2018			
Remarks:	**f= 100kHz – 30MHz plot, and loop antenna at 0 degree**			



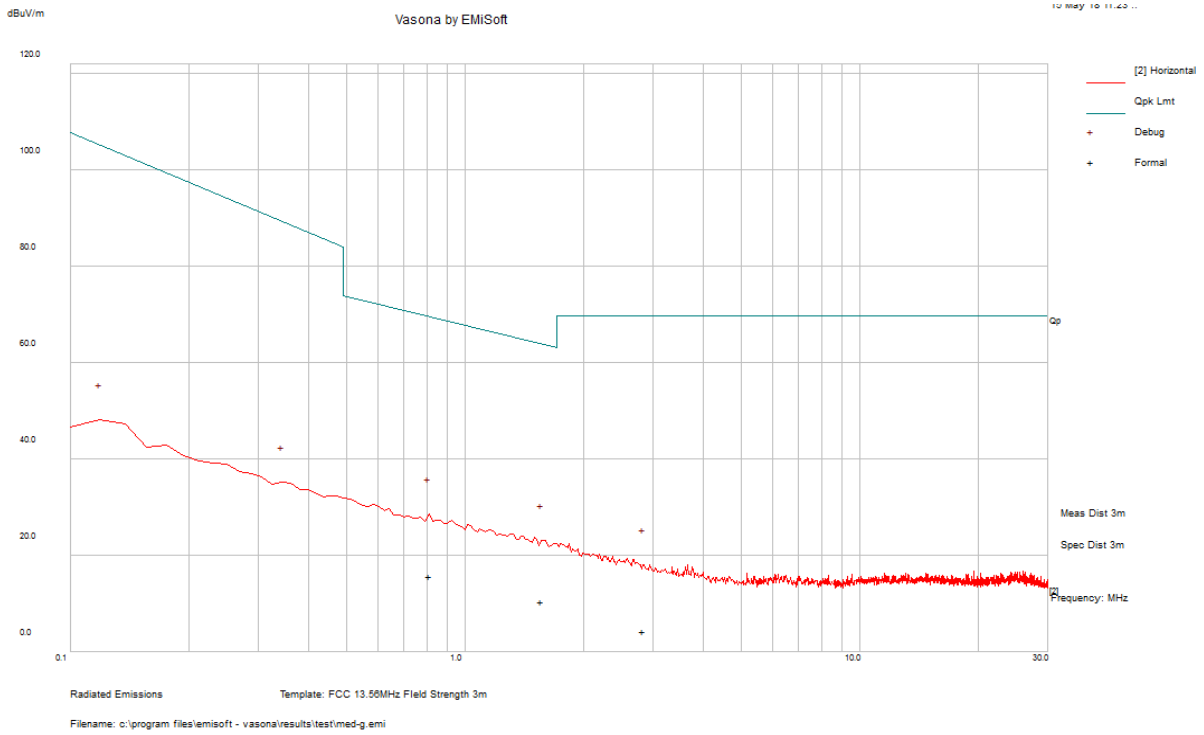
Quasi Max Measurement

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol (0/90)	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail
1.74	0.86	0.48	13.08	14.41	Quasi Max	H	99	15	69.54	-55.13	Pass
0.58	0.65	0.4	8.36	9.41	Quasi Max	H	99	299	72.34	-62.93	Pass
0.48	1.61	0.4	18.62	20.63	Quasi Max	H	99	228	93.98	-73.35	Pass

IC:

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol (0/90)	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail
1.74	0.86	0.48	13.08	14.41	Quasi Max	H	99	15	52.00	-37.59	Pass
0.58	0.65	0.4	8.36	9.41	Quasi Max	H	99	299	54.81	-45.40	Pass
0.48	1.61	0.4	18.62	20.63	Quasi Max	H	99	228	76.46	-55.83	Pass

Test specification:	Radiated Spurious Emissions			
Mains Power:	3VDC		Result:	☒ Pass ☐ Fail
Tested by:	Cipher			
Test Date:	05/14/2018 to 05/18/2018			
Remarks:	***f*= 100kHz – 30MHz plot, and loop antenna at 90 degree**			



Quasi Max Measurement

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol (0/90)	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail
1.58	0.8	0.48	9.11	10.39	Quasi Max	H	99	160	63.63	-53.24	Pass
0.81	0.94	0.4	14.27	15.61	Quasi Max	H	99	225	69.43	-53.82	Pass
2.82	-1.06	0.51	4.85	4.2	Quasi Max	H	99	333	69.54	-65.34	Pass

IC:

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol (0/90)	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail
1.58	0.8	0.48	9.11	10.39	Quasi Max	H	99	160	46.11	-35.72	Pass
0.81	0.94	0.4	14.27	15.61	Quasi Max	H	99	225	51.91	-36.30	Pass
2.82	-1.06	0.51	4.85	4.2	Quasi Max	H	99	333	52.00	-47.80	Pass

Annex A. TEST INSTRUMENT & METHOD

Instrument	Model	Serial #	Cal Cycle	Cal Due	In use
SPURIOUS EMISSIONS					
R & S Receiver	ESL6	100178	1 Year	05/27/2019	☑
Loop Antenna	6512	49120	1 Year	08/20/2018	☑
Pre-Amplifier	8449B	3008A00715	1 Year	05/30/2019	☑
10 Meters SAC	10M	N/A	1 Year	09/05/2018	☑
TRANSMITTER CARRIER OUTPUT LEVEL					
R & S Receiver	ESL6	100178	1 Year	05/27/2019	☑
Loop Antenna	6512	49120	1 Year	08/20/2018	☑
Pre-Amplifier	8449B	3008A00715	1 Year	05/30/2019	☑
10 Meters SAC	10M	N/A	1 Year	09/05/2018	☑
TRANSMITTER CARRIER OUTPUT LEVEL (EXTREME TEST CONDITIONS)					
Spectrum Analyzer	N9010A	MY50210206	1 Year	08/13/2018	☑
Loop Antenna	6512	49120	1 Year	08/20/2018	☑
Pre-Amplifier	8449B	3008A00715	1 Year	05/30/2019	☑
10 Meters SAC	10M	N/A	1 Year	09/05/2018	☑
PERMITTED FREQUENCY RANGE OF THE MODULATION BANDWIDTH					
Spectrum Analyzer	N9010A	MY50210206	1 Year	08/13/2018	☑
Loop Antenna	6512	49120	1 Year	08/20/2018	☑
Pre-Amplifier	8449B	3008A00715	1 Year	05/30/2019	☑
10 Meters SAC	10M	N/A	1 Year	09/05/2018	☑

Annex B. SIEMIC Accreditation

Accreditations	Document	Scope / Remark
ISO 17025 (A2LA)		Please see the documents for the detailed scope
ISO Guide 65 (A2LA)		Please see the documents for the detailed scope
TCB Designation		A1, A2, A3, A4, B1, B2, B3, B4, C
FCC DoC Accreditation		FCC Declaration of Conformity Accreditation
FCC Site Registration		3 meter site
FCC Site Registration		3 meter site
IC Site Registration		3 meter site
IC Site Registration		3 meter site
EU NB		**Radio & Telecommunications Terminal Equipment:** EN45001 – EN ISO/IEC 17025
		Electromagnetic Compatibility: EN45001 – EN ISO/IEC 17025
Singapore iDA CB(Certification Body)		Phase I, Phase II
Vietnam MIC CAB Accreditation		Please see the document for the detailed scope
Hong Kong OFCA		**(Phase II)** OFCA Foreign Certification Body for Radio and Telecom
		(Phase I) Conformity Assessment Body for Radio and Telecom
Industry Canada CAB		**Radio:** Scope A – All Radio Standard Specification in Category I
		Telecom: CS-03 Part I, II, V, VI, VII, VIII

Japan Recognized Certification Body Designation		**Radio**: A1. Terminal equipment for purpose of calling **Telecom**: B1. Specified radio equipment specified in Article 38-2, Paragraph 1, Item 1 of the Radio Law
Korea CAB Accreditation		**EMI:** KCC Notice 2008-39, RRL Notice 2008-3: CA Procedures for EMI KN22: Test Method for EMI **EMS:** KCC Notice 2008-38, RRL Notice 2008-4: CA Procedures for EMS KN24, KN61000-4-2, -4-3, -4-4, -4-5, -4-6, -4-8, -4-11: Test Method for EMS
		Radio: RRL Notice 2008-26, RRL Notice 2008-2, RRL Notice 2008-10, RRL Notice 2007-49, RRL Notice 2007-20, RRL Notice 2007-21, RRL Notice 2007-80, RRL Notice 2004-68
		Telecom: President Notice 20664, RRL Notice 2007-30, RRL Notice 2008-7 with attachments 1, 3, 5, 6; President Notice 20664, RRL Notice 2008-7 with attachment 4
Taiwan NCC CAB Recognition		LP0002, PSTN01, ADSL01, ID0002, IS6100, CNS14336, PLMN07, PLMN01, PLMN08
Taiwan BSMI CAB Recognition		CNS 13438
Japan VCCI		R-3083: Radiation 3 meter site C-3421: Main Ports Conducted Interference Measurement T-1597: Telecommunication Ports Conducted Interference Measurement
Australia CAB Recognition		**EMC:** AS/NZS CISPR 11, AS/NZS CISPR 14.1, AS/NZS CISPR22, AS/NZS 61000.6.3, AS/NZS 61000.6.4
		Radio communications: AS/NZS 4281, AS/NZS 4268, AS/NZS 4280.1, AS/NZS 4280.2, AS/NZS 4295, AS/NZS 4582, AS/NZS 4583, AS/NZS 4769.1, AS/NZS 4769.2, AS/NZS 4770, AS/NZS 4771
		Telecommunications: AS/ACIF S002:05, AS/ACIF S003:06, AS/ACIF S004:06 AS/ACIF S006:01, AS/ACIF S016:01, AS/ACIF S031:01, AS/ACIF S038:01, AS/ACIF S040:01, AS/ACIF S041:05, AS/ACIF S043.2:06, AS/ACIF S60950.1
Australia NATA Recognition		AS/ACIF S002, AS/ACIF S003, AS/ACIF S004, AS/ACIF S006, AS/ACIF S016,AS/ACIF S031, AS/ACIF S038, AS/ACIF S040, AS/ACIF S041, AS/ACIF S043.2