RF TEST REPORT

SIEMIC
A Bureau Veritas Group Company

Report No.: FCC_IC_RF_SL19012101-MET-002_Co-location
Supersede Report No.:

Applicant	:	CalAmp
IC Applicant Name	:	CALAMP WIRELESS NETWORKS CORPORATION
Host Product Name	:	Tracking Device
Host Model No.	:	SC1204
Test Standard	:	47 CFR 15.247, Part 22, Part 24, Part 27 RSS 247, RSS 133, RSS 132, RSS 130, RSS 139
Test Method	:	ANSI C63.10: 2013 RSS Gen Issue 5, April 2018
BT module FCC ID WIFI module FCC ID Cellular module FCC ID	:	APV-SC1204 2AC7Z-ESPWROOM02 XMR201707BG96
BT module IC WIFI module IC Celluar module IC	:	5843C-SC1204 21098-ESPWROOM02 10224A-201709BG96
Dates of test	:	03/29/2019-04/06/2019
Issue Date	:	04/08/2019
Test Result	:	☒ Pass ☐ Fail
Equipment complied with the specification [X] Equipment did not comply with the specification [ ]		

This Test Report is Issued Under the Authority of:	
	
Deon Dai	**Chen Ge**
Test Engineer	Engineer Reviewer

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

ilac-MRA
A2LA ACCREDITED
TESTING CERT # 2742-01

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	Safety, EMC, RF/Wireless, Telecom
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

CONTENTS

1 Report Revision History

Report No.	Report Version	Description	Issue Date
FCC_IC_RF_SL19012101-MET-002_Co-location	None	Original	04/08/2019

2 Executive Summary

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

Company:	CalAmp
Host Product:	Tracking Device
Host Model:	SC1204

against the current Stipulated Standards. The specified model product stated above has demonstrated compliance with the Stipulated Standard listed on 1st page. This test report covers the radiated emissions requirements for simultaneous transmission of the standards referenced in the report to allow system level approval of the modules in Host device.

Simultaneous Transmission Conditions:
BLE and Cellular (LTE/GSM) transmit simultaneously.
BLE and WIFI transmit simultaneously.
WIFI & Celllular will not be on at the same time.

When the SC1204 is turned ON or when the unit wakes from sleep, the Wi-Fi module is on for less than 3 seconds. In these 3 seconds the Wi-Fi modules scans for access points and then turns off. After Wi-Fi module turns OFF, the cellular module is turned on.

RSE testing was confucted for Bluetooth and Wifi simultaneous transmission.
RSE testing was conducted for the worst case cellular/bluetooth configuration: BLE & LTE.

3 Customer information

Applicant Name	:	CalAmp
Applicant Address	:	2177 Salk Ave, Suite 200, Carlasbad, CA 90228, USA
Manufacturer Name	:	CalAmp
Manufacturer Address	:	2177 Salk Ave, Suite 200, Carlasbad, CA 90228, USA

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 Modification

Index	Item	Description	Note
-	-	-	-

6 EUT Information

6.1 EUT Description

Product Name	Tracking Device
Model No.	SC1204
Trade Name	CalAmp Corp.
Serial No.	N/A
Input Power	3.7 VDC Battery
Power Adapter Manu/Model	N/A
Power Adapter SN	N/A
Date of EUT received	03/28/2019
Equipment Class/ Category	DTS
Port/Connectors	N/A

6.2 Radio Description

Spec for BLE:

Radio Type	BLE
Operating Frequency	2402MHz-2480MHz
Modulation	GFSK
Channel Spacing	2 MHz
Antenna Type	PCB Trace Antenna
Antenna Gain	2 dBi
Antenna Connector Type	N/A

Spec for WIFI:

Radio Type	802.11b	802.11g	802.11n-20M
Operating Frequency	2412-2462MHz	2412-2462MHz	2412-2462MHz
Modulation	DSSS (CCK, DQPSK, DBPSK)	OFDM-CCK (BPSK, QPSK, 16QAM, 64QAM)	OFDM (BPSK, QPSK, 16QAM, 64QAM)
Channel Spacing	5MHz	5MHz	5MHz
Number of Channels	11	11	11
Antenna Type	PCB Trace Antenna		
Antenna Gain (Peak)	2.4G: 2 dBi		
Antenna Connector Type	N/A		

Spec for Cellular:

Item	LTE		
Operating Band /Radio Type	Band 2	Band 4	Band 5
Frequency TX(MHz)	TX: 1850 MHz to 1910 MHz RX: 1930 MHz to 1990 MHz	TX: 1710 MHz to 1755 MHz RX: 2110 MHz to 2155 MHz	TX: 824 MHz to 849 MHz RX: 869 MHz to 894 MHz
Bandwidth	1.4MHz, 3MHz, 5MHz, 10MHz, 15MHz, 20MHz	1.4MHz, 3MHz, 5MHz, 10MHz, 15MHz, 20MHz	1.4MHz, 3MHz, 5MHz, 10MHz
Modulation	QPSK/16QAM/64QAM	QPSK/16QAM/64QAM	QPSK/16QAM/64QAM
Antenna Type	SMD	SMD	SMD
Antenna Gain(Peak)	1.6 dBi	1.6 dBi	1.0 dBi
Antenna Connect Type	N/A	N/A	N/A

Item	LTE		
Operating Band /Radio Type	Band 12	Band 13	Band 26
Frequency TX(MHz)	TX: 699 MHz to 716 MHz RX: 729 MHz to 746 MHz	TX: 777 MHz to 787 MHz RX: 746 MHz to 756 MHz	TX: 814 MHz to 849 MHz RX: 859 MHz to 894 MHz
Bandwidth	1.4MHz, 3MHz, 5MHz, 10MHz	5MHz, 10MHz	1.4MHz, 3MHz, 5MHz, 10MHz, 15MHz
Modulation	QPSK/16QAM/64QAM	QPSK/16QAM/64QAM	QPSK/16QAM/64QAM
Antenna Type	SMD	SMD	SMD
Antenna Gain(Peak)	0.5 dBi	0.5 dBi	1.0 dBi
Antenna Connect Type	N/A	N/A	N/A

Item	GSM	
Operating Band /Radio Type	GSM 850	GSM 1900
Frequency TX(MHz)	TX: 824 MHz to 849 MHz RX: 869 MHz to 894 MHz	TX: 1850 MHz to 1910 MHz RX: 1930 MHz to 1990 MHz
Modulation	GMSK,8PSK	GMSK,8PSK
Antenna Type	SMD	SMD
Antenna Gain(Peak)	1.0 dBi	1.6 dBi
Antenna Connect Type	N/A	N/A

7 Supporting Equipment/Software and cabling Description

7.1 Supporting Equipment

Item	Supporting Equipment Description	Model	Serial Number	Manufacturer	Note
1	Laptop	Satellite C55-A5322	3E198990U	TOSHIBA	-
2	USB to UART Bridge	CP210x	-	Silicon	-
3	USB to UART Bridge	CP210x	-	Silicon	-
4	Wideband Radio Communicator	CMW500	163332	Rohde & Schwarz	-

7.2 Cabling Description

Name	Connection Start		Connection Stop		Length / shielding Info		Note
	From	I/O Port	To	I/O Port	Length (m)	Shielding	
-	Laptop	USB	UART Bridge	USB	-	-	-
							-

7.3 Test Software Description

Test Item	Software	Description
RF Testing	Putty	Set the EUT to transmit continuously in diferent test modes and channels

8 Test Summary

Test Item	Test standard		Test Method/Procedure		Pass / Fail
Radiated Spurious Emissions	FCC	15.247(d)	FCC	ANSI C63.10:2013 558074 D01 DTS Meas Guidance v05r01	☒ Pass ☐ N/A
	IC	RSS247 (5.5)	IC		
Remark	1. All measurement uncertainties do not take into consideration for all presented test results. 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. 3. Only Radiated Spurious Emission was tested in simultaneous transmission Host configuration. 4. All other test details can be found in the original modules filing test report.				

9 Measurement Uncertainty

Emissions			
Test Item	**Frequency Range**	**Description**	**Uncertainty**
RF conducted measurement	150KHz – 40GHz	Confidence level of approximately 95% (in the case where distributions are normal), with a coverage factor of 2	±0.95dB
Radiated Spurious Emissions	30MHz – 1GHz	Confidence level of approximately 95% (in the case where distributions are normal), with a coverage factor of 2 (for EUTs < 0.5m X 0.5m X 0.5m)	±6dB
Radiated Spurious Emissions	1GHz – 40GHz	Confidence level of approximately 95% (in the case where distributions are normal), with a coverage factor of 2 (for EUTs < 0.5m X 0.5m X 0.5m)	±6dB

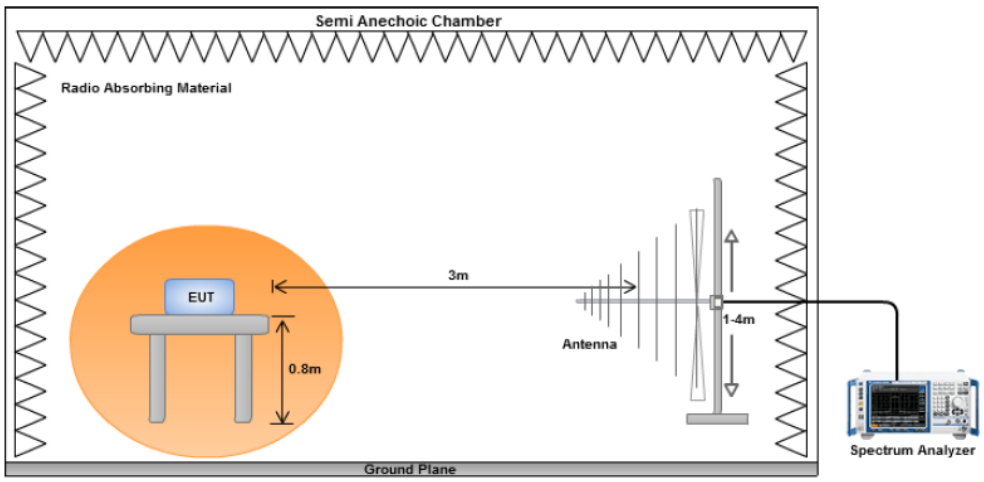
10 Measurements, Examination and Derived Results

10.1 Radiated Spurious Emissions below 1GHz

Requirement(s):

Spec	Item	Requirement	Applicable
47CFR§15.247(d) RSS247 (A8.5)	a)	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	☒

Frequency range (MHz)	Field Strength (uV/m)
30 – 88	100
88 – 216	150
216 960	200
Above 960	500

Test Setup	
Procedure	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.
Remark	The EUT was scanned up to 1GHz. Both horizontal and vertical polarities were investigated. The results show only the worst case. The EUT was evaluated in each of three orthogonal axis positions, the orientation is the worst case, please refer to setup photos.
Result	☒ Pass ☐ Fail

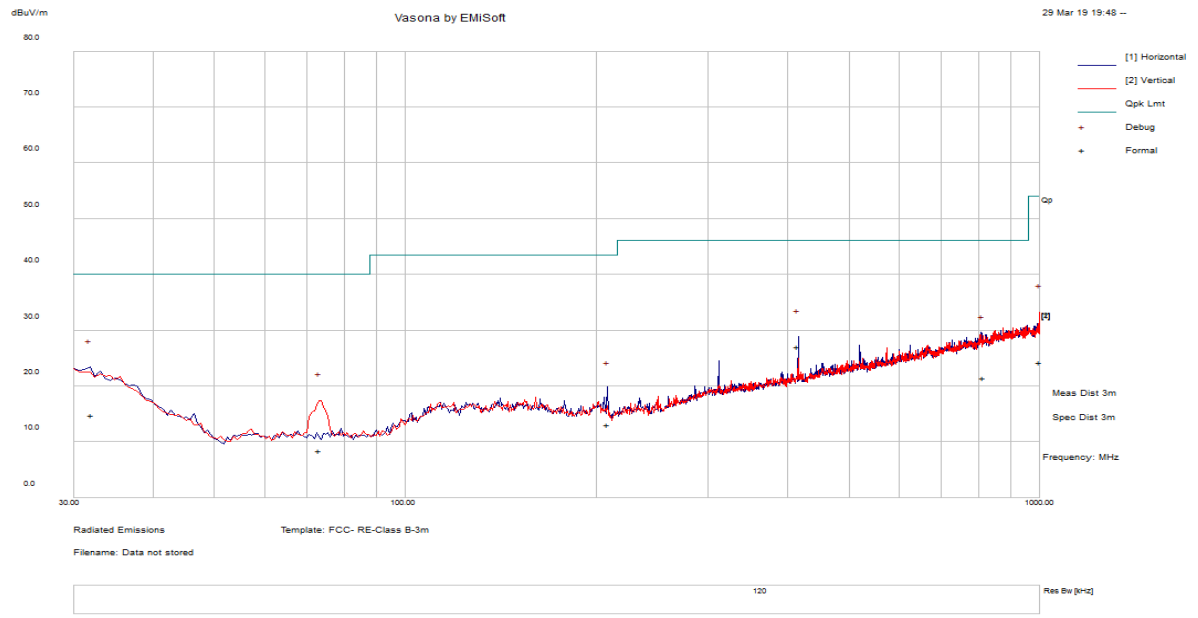
Test Data ☒ Yes (See below) ☐ N/A

Test Plot ☒ Yes (See below) ☐ N/A

Test was done by Deon Dai at 10m chamber.

Radiated Emission Test Results (Below 1GHz)

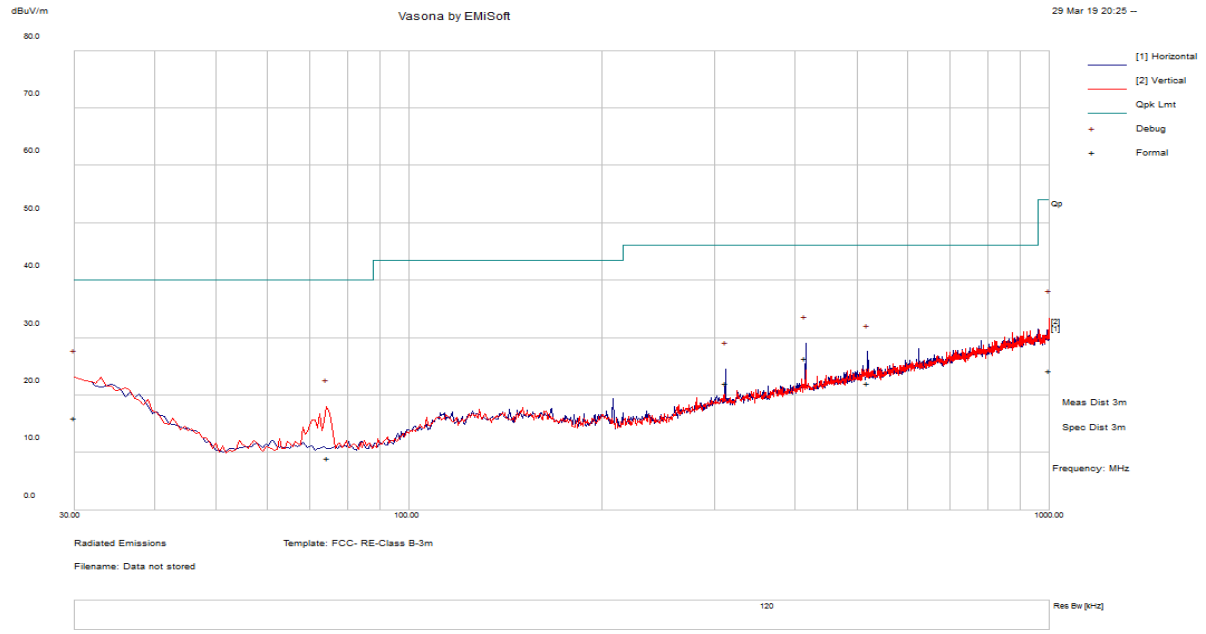
Test specification	below 1GHz			
Environmental Conditions:	Temp (°C):	26	Result	Pass
	Humidity (%)	47		
	Atmospheric (mbar):	1020		
Mains Power:	3.7VDC			
Tested by:	Deon Dai			
Test Date:	03/29/2019			
Remarks:	BLE and LTE Transmit simultaneously.			



Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail
31.99	17.64	11.15	-13.95	14.84	Quasi Max	H	171	30	40	-25.17	Pass
416.01	33.06	13.89	-19.8	27.15	Quasi Max	H	215	195	46	-18.85	Pass
813.34	20.32	15.5	-14.32	21.5	Quasi Max	H	157	142	46	-24.51	Pass
1000.00	20.02	16.28	-12	24.3	Quasi Max	V	140	105	54	-29.7	Pass
73.06	24.45	11.61	-27.39	8.67	Quasi Max	V	245	265	40	-31.33	Pass
208.03	25.31	12.7	-24.85	13.16	Quasi Max	H	197	155	43.5	-30.34	Pass

Note: Both horizontal and vertical polarities were investigated. The results above show only the worst case.

Test specification	below 1GHz			
Environmental Conditions:	Temp (°C):	26	Result	Pass
	Humidity (%)	47		
	Atmospheric (mbar):	1020		
Mains Power:	3.7VDC			
Tested by:	Deon Dai			
Test Date:	03/29/2019			
Remarks:	BLE and WIFI Transmit simultaneously.			

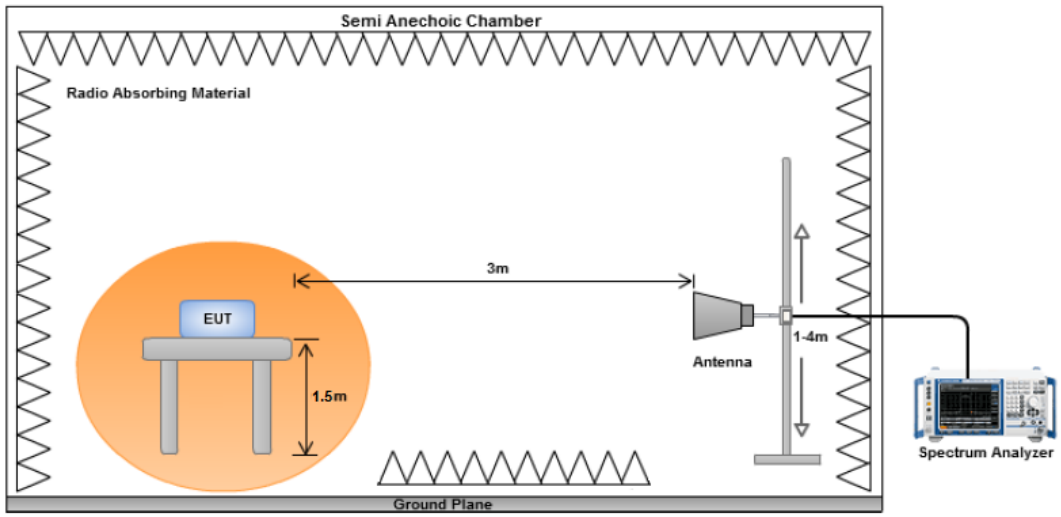


Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail
30.00	17.09	11.12	-12.08	16.12	Quasi Max	V	178	92	40	-23.88	Pass
416.00	32.41	13.89	-19.8	26.5	Quasi Max	H	257	347	46	-19.5	Pass
520.04	25.61	14.38	-17.81	22.18	Quasi Max	H	155	295	46	-23.82	Pass
1000.00	20.05	16.28	-12	24.33	Quasi Max	V	330	253	54	-29.67	Pass
312.01	30.68	13.29	-21.78	22.2	Quasi Max	H	105	162	46	-23.81	Pass
74.15	24.62	11.62	-27.45	8.79	Quasi Max	V	101	266	40	-31.21	Pass

Note: Both horizontal and vertical polarities were investigated. The results above show only the worst case.

10.2 Radiated Spurious Emissions Above 1GHz

Requirement(s):

Spec	Item	Requirement	Applicable
47CFR§15.247(d), RSS247(A8.5)	a)	For non-restricted band, In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB or 30dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, determined by the measurement method on output power to be used. Attenuation below the general limits specified in § 15.209(a) is not required ☐ 20 dB down ☒ 30 dB down	☒
Test Setup			
Procedure	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. An average 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.		
Remark	The EUT was scanned up to 40GHz. Both horizontal and vertical polarities were investigated. The results show only the worst case. There isn't outstanding emission found at the edge of restricted frequency. The EUT was evaluated in each of three orthogonal axis positions, the orientation is the worst case, please refer to setup photos.		
Result	☒ Pass ☐ Fail		

Test Data ☒ Yes (See below) ☐ N/A

Test Plot ☐ Yes (See below) ☒ N/A

Test was done by Deon Dai at 10m chamber.

Radiated Emission Test Results (Above 1GHz)

Above 1GHz- BLE +Cellular (LTE)

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail
4803.97	56.44	4.1	-0.93	59.62	Peak Max	H	147	192	74	-14.38	Pass
7206.48	48.38	5.15	-0.45	53.08	Peak Max	V	107	15	74	-20.93	Pass
3463.18	40.78	3.56	-1.73	42.62	Peak Max	V	105	243	74	-31.38	Pass
4803.97	47.59	4.1	-0.93	50.76	Average Max	H	147	192	54	-3.24	Pass
7206.48	40.36	5.15	-0.45	45.06	Average Max	V	107	15	54	-8.94	Pass
3463.18	28.96	3.56	-1.73	30.79	Average Max	V	105	243	54	-23.21	Pass

Above 1GHz- BLE + WIFI

Frequency MHz	Raw dBuV	Cable Loss	AF dB	Level dBuV/m	Measurement Type	Pol	Hgt cm	Azt Deg	Limit dBuV/m	Margin dB	Pass /Fail
4824.02	57.98	4.12	-0.93	61.17	Peak Max	H	146	294	74	-12.83	Pass
7226.21	53.02	5.15	-0.46	57.71	Peak Max	H	114	291	74	-16.29	Pass
17936.46	39.44	7.93	8.68	56.05	Peak Max	V	116	243	74	-17.95	Pass
9647.89	46.81	5.56	0.62	52.99	Peak Max	H	131	23	74	-21.01	Pass
4824.02	47.54	4.12	-0.93	50.73	Average Max	H	146	294	54	-3.27	Pass
7226.21	45.47	5.15	-0.46	50.16	Average Max	H	114	291	54	-3.84	Pass
17936.46	27.56	7.93	8.68	44.18	Average Max	V	116	243	54	-9.83	Pass
9647.89	41.34	5.56	0.62	47.52	Average Max	H	131	23	54	-6.48	Pass

Annex A. TEST INSTRUMENT

Instrument	Model	Serial #	Cal Date	Cal Cycle	Cal Due	In use
Radiated Emissions						
50GHz Spectrum Analyzer	N9030B(PXA)	MY57140374	08/20/2018	1 Year	08/20/2019	☑
Bi-Log antenna (30MHz~6GHz)	JB6	A111717	08/12/2018	1 Year	08/12/2019	☑
Horn Antenna (1GHz~26GHz)	3115	100059	01/26/2019	1 Year	01/26/2020	☑
Horn Antenna (26GHz~40GHz)	AH-840	101013	08/28/2018	1 Year	08/28/2019	☑
Pre-Amplifier(0.3MHz-6.5GHz)	LPA-6-30	11170602	02/06/2019	1 Year	02/06/2020	☑
Pre-Amplifier (1-26.5GHz)	8449B	3008A00715	08/16/2018	1 Year	08/16/2019	☑
Pre-Amp (10MHz~50GHz)	RAMP00M50GA	17032300047	02/10/2019	1 Year	02/10/2020	☑

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		10 meter site
IC Site Registration		3 meter site
IC Site Registration		10 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