RF TEST REPORT



Report No.: FCC IC_RF_SL1802601-CAL-013-colocation

Supersede Report No.: N/A

Applicant	:	CalAmp
Host Model No.	• •	LMU-3035
Test Standard	:-	FCC 15.247 RSS-247 Issue 2, February 2017
Test Method		ANSI C63.10: 2013 RSS Gen Iss 4: Nov 2014 558074 D01 DTS Meas Guidance v04 971168 D01 Power Meas License Digital Systems v03
BT module FCC ID	:	APV-BLD01
BT module IC ID	:	5843C-BLD01
Dates of test	:	02/27/2018 – 03/10/2018
Issue Date		04/20/2018
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:	
AR	\mathcal{C}
Cipher	Chen Ge
Test Engineer	Engineer Reviewer

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





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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

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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

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Report Revision History

Report No.	Report Version	Description	Issue Date
FCC IC_RF_SL1802601-CAL-013-colocation	None	Original	04/20/2018





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2 Executive Summary

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

<u>Company:</u> CalAmp <u>Host Model:</u> LMU-3035

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	:	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.	881796
IC Test Site No.	4842D-2
VCCI Test Site No.	A0133

5 Modification

Index	Item	Description	Note
-	-	-	-

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EUT Information

EUT Description 6.1

Product Name	:	Vehicle tracking device
Model No.	:	LMU-3035
Trade Name	:	CalAmp
Serial No.	:	N/A
Input Power	:	3.3VDC
Date of EUT received	:	02/28/2018
Equipment Class/ Category	:	DTS
Port/Connectors	:	None

<u>6.2</u> Spec for BT Radio

Radio Type	Bluetooth
Operating Frequency	2402MHz-2480MHz
Modulation	GFSK (LE)
Channel Spacing	2MHz (LE)
Antenna Type	Integrated
Antenna Gain	2.5 dBi
Antenna Connector Type	N/A

Туре	Channel No.	Frequency (MHz)	Power Setting
Dluotooth(DLC)	0	2402	Default
Bluetooth(BLE) 2402-2480MHz	19	2440	Default
2402-2400IVITZ	39	2480	Default

Radio Type	GSM
Operating Frequency	GSM850, GSM1900
Modulation	GMSK
Channel Spacing	200kHz
Antenna Type	Fixed internal
Antenna Gain (Peak)	-2 dBi
Antenna Connector Type	Integrated

6.3 EUT test modes/configuration Description

Mode	Note
Bluetooth	BLE (GFSK)
GSM	GSM

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Supporting Equipment/Software and cabling Description

Supporting Equipment <u>7.1</u>

Item	Supporting Equipment Description	Model	Serial Number	Manufacturer	Note
1	Laptop	N/A	3YZQ162	Dell	-

7.2 **Cabling Description**

Name	Connection Start		Connection Stop		Length / shielding Info		Noto
Name	From	I/O Port	To	I/O Port	Length (m)	Shielding	Note
USB	USB	EUT	USB	Laptop	USB	1	Unshielded

Test Software Description 7.3

Test Item	Software	Description
RF Testing	Command Line	Set the EUT to transmit continuously in different test mode

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Test Summary

Test Item	-	Test standard		Test Method/Procedure		
Restricted Band of	FCC	15.205	FCC	ANSI C63.10:2013	⊠ Pass*	
Operation	IC	RSS Gen 8.10	IC	558074 D01 DTS Meas Guidance v03r05	□ N/A	
AC Canduated Emissions	FCC	15.207(a)	FCC	ANSI C63.10:2013	☐ Pass	
AC Conducted Emissions	IC	RSS Gen 8.8	IC	RSS Gen Issue 4: 2014	⊠ N/A	
Antenna Requirement	FCC	15.203	FCC	-	□ Pass* □ N/A	

DTS Band Requirement

Te	st Item		Test standard		Test Method/Procedure	Pass / Fail
00% Occur	pied Bandwidth	-	-	-	-	☐ Pass*
77 /0 Occu	pied Dandwidth	IC	RSS Gen 6.6	IC	RSS Gen Issue 4: 2014 -	□ N/A
AdR I	Bandwidth	FCC	15.247(a)(2)	FCC	558074 D01 DTS Meas Guidance v03r05	⊠ Pass*
OUD I	Dandwidth	IC	RSS247 (5.2.1)	IC	330074 DOT DTS INTERS GUIDANCE VOSIOS	□ N/A
	e and Radiated	FCC	15.247(d)	FCC	ANSI C63.10:2013	⊠ Pass*
Spuriou	s Emissions	IC	RSS247 (5.5)	IC	558074 D01 DTS Meas Guidance v03r05	□ N/A
Outn	Output Power		15.247(b)	FCC	558074 D01 DTS Meas Guidance v03r05	⊠ Pass*
Outp			RSS247 (5.4.4)	IC	550074 DOT DTS ivieas Guidance vosios	□ N/A
Antonna	Gain > 6 dBi	FCC	15.247(e)	FCC	-	☐ Pass
Antenna	Galii > 0 UDi	IC	-	IC	-	⊠ N/A
Dowor Sn	ectral Density	FCC	15.247(e)	FCC	558074 D01 DTS Meas Guidance v03r05	⊠ Pass*
r ower Sp	ectial Delisity	IC	RSS247 (5.2.2)	IC	330074 DOT DTS INTERS Guidance vosios	□ N/A
DE Evnosi	ura raquirament	FCC	15.247(i)	FCC	-	□ Pass
KF EXPOSE	ire requirement	IC	RSS Gen(5.5)	IC	RSS Gen Issue 4: 2014	□ N/A
 All measurement uncertainties do not take into consideration for all presented test results. 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. There is simultaneous operation with Bluetooth and GSM. GSM module FCC ID: QIPEHS5-US, IC: 7830A-EHS5US. All other test items can be found in test report no. 6-147-12-9-3. 						

5. Pass*: BLE module: Please refer to report FCC IC_RF_SL1802601-CAL-013-BLE





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9 Measurement Uncertainty

9.1 Conducted Emissions

The test is to measure the conducted emissions to the mains port of the EUT.

Some error sources that can contribute to the total uncertainty:

- Uncertainty of the receiver
- Uncertainty of the LISN
- Uncertainty of cables
- Uncertainty due to the mismatches
- Etc, see the below table for details

Source of Uncertainty	Value	Probability	Division	Sensitivity	Expanded
	(dB)	Distribution		Coefficient	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
LISN Insertion Loss	0.40	Normal	2	1	0.20
Receiver CW accuracy	0.5	Rectangular	1.732	1	0.2886836
Pulse Amplitude	1.5	Rectangular	1.732	1	0.86605081
Response					
PRF Response	1.5	Rectangular	1.732	1	0.86605081
Mismatch LISN -	0.25	U-Shape	1.414	1	0.1768033
Receiver					
LISN Impedance	2.5	Triangular	2.449	1	1.0208248
Combined Standard Unce	1.928133				
Expanded Uncertainty (F	(=2)	_		•	3.856266

The total derived measurement uncertainty is +/- 3.86 dB.

9.2 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.

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9.3 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 Uncertain	4.2363				
Expanded Uncertainty (K=2)	·		•	8.4726

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

9.4 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 Unce	0.476087				
Expanded Uncertainty (<=2)	·			0.952174

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

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10 Measurements, Examination and Derived Results

10.1 Radiated Spurious Emissions below 1GHz

Requirement(s):

Spec	Item	Requirement	Applicable
47CFR§15.247(d) RSS247 (5.5)	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)	
47CFR§22.917	b)	Out of band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB.	
Test Setup		Radio Absorbing Material O.8m Antenna Ground Plane	um Analyzer
Procedure	1. 2. 3. 4.	The EUT was switched on and allowed to warm up to its normal operating condition. The test was carried out at the selected frequency points obtained from the EUT che Maximization of the emissions, was carried out by rotating the EUT, changing the applarization, and adjusting the antenna height in the following manner: a. Vertical or horizontal polarisation (whichever gave the higher emission le rotation of the EUT) was chosen. b. The EUT was then rotated to the direction that gave the maximum emiss c. Finally, the antenna height was adjusted to the height that gave the maximum A Quasi-peak measurement was then made for that frequency point. Steps 2 and 3 were repeated for the next frequency point, until all selected frequence measured.	naracterisation. Intenna vel over a full ion. mum emission.
Remark		JT was scanned up to 1GHz. Both horizontal and vertical polarities were investigate only the worst case.	d. The results
Result	⊠ Pa	ss 🗆 Fail	

Test Data \boxtimes Yes (See below) \square N/A Test Plot \boxtimes Yes (See below) \square N/A Test was done by Cipher at 10m chamber.

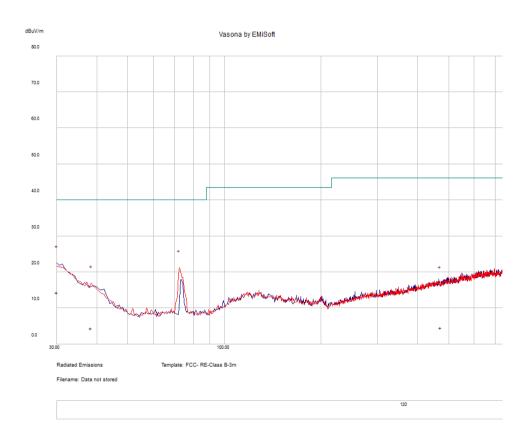
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Radiated Emission Test Results (Below 1GHz)

Test specification	below 1GHz			
	Temp (°C):	22		
Environmental Conditions:	Humidity (%) 47			
	Atmospheric (mbar): 1020			
Mains Power:	3.3VDC		Result	Pass
Tested by:	Cipher		Rosun	1 433
Test Date:	02/28/2018			
Remarks:	Bluetooth LE 2440 MHz + GSM			
Remarks.	Worst case limit was used for testing.			



Quasi Max Measurement

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
30.01	17.26	10	-12.88	14.38	Quasi Max	Н	128	244	40	-25.62	Pass
38.33	14.48	10	-19.99	4.49	Quasi Max	V	257	48	40	-35.51	Pass
958.76	16.34	10	-13.58	12.76	Quasi Max	Н	319	154	46	-33.24	Pass
775.48	15.58	10	-14.73	10.86	Quasi Max	Н	335	357	46	-35.15	Pass
471.50	13.49	10	-18.91	4.58	Quasi Max	Н	219	137	46	-41.42	Pass
30.01	17.26	10	-12.88	14.38	Quasi Max	Н	128	244	40	-25.62	Pass

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

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10.2 Radiated Spurious Emissions between 1GHz – 25GHz

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	
	b)	or restricted band, emission must also comply with the radiated emission limits specified in 15.209	\boxtimes
47CFR§22.917	b)	Out of band emissions. The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB.	
Test Setup	\$\text{R}	Semi Anechoic Chamber adio Absorbing Material 3m Antenna Ground Plane	Spectrum Analyzer
Procedure	1. 2. 3. 4.	The EUT was switched on and allowed to warm up to its normal operating condition. The test was carried out at the selected frequency points obtained from the EUT char Maximization of the emissions, was carried out by rotating the EUT, changing the and adjusting the antenna height in the following manner: a. Vertical or horizontal polarisation (whichever gave the higher emission lever 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 An average measurement was then made for that frequency point. Steps 2 and 3 were repeated for the next frequency point, until all selected frequency measured.	enna polarization, I over a full n. um emission.
Remark		was scanned up to 26GHz. Both horizontal and vertical polarities were investigated by the worst case.	. The results
Result	□ Pass	☐ Fail	



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Test Data		□ N/A
Test Plot	☐ Yes (See below)	\boxtimes N/A

Test was done by Cipher Chu at 10m chamber.

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Radiated Emission Test Results (Above 1GHz)

BLE 2440MHz and GSM Co-Location:

Frequency (MHz)	Raw (dBuV)	Cable Loss (dB)	AF (dB)	Level (dBuV/m)	Measurement Type	Pol (V/H)	Hgt (cm)	Azt (Deg)	Limit (dBuV/m)	Margin (dB)	Pass /Fail
17385.77	38.8	8.04	10.93	57.77	Peak Max	V	216	346	74	-16.23	Pass
17385.77	26.37	8.04	10.93	45.35	Average Max	V	216	346	54	-8.66	Pass
4880.15	40.09	4.2	-2.15	42.15	Peak Max	V	160	43	74	-23.85	Pass
4880.15	27.65	4.2	-2.15	29.71	Average Max	V	160	43	54	-24.29	Pass





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Annex A. TEST INSTRUMENT

Instrument	Model	Serial #	Cal Date	Cal Cycle	Cal Due	In use
Radiated Emissions						
Keysight EXA 44GHz Spectrum Analyzer	N9010A	MY51440112	11/02/2017	1 Year	11/02/2018	>
Pre-Amplifier (1-40GHz)	SAS-474	579	05/04/2017	1 Year	05/04/2018	~
Preamplifier (100KHz-7GHz)	LPA-6-30	11170602	02/09/2018	1 Year	02/09/2019	₹
Bi-Log antenna (30MHz~2GHz)	JB1	A030702	01/13/2018	1 Year	01/13/2019	₹
Horn Antenna (1-26.5GHz)	3115	10SL0059	08/11/2017	1 Year	08/11/2018	~





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Annex B. SIEMIC Accreditation

Accreditations	Document	Scope / Remark
ISO 17025 (A2LA)	7	Please see the documents for the detailed scope
ISO Guide 65 (A2LA)	7	Please see the documents for the detailed scope
TCB Designation		A1, A2, A3, A4, B1, B2, B3, B4, C
FCC DoC Accreditation	7	FCC Declaration of Conformity Accreditation
FCC Site Registration	7	3 meter site
FCC Site Registration	7	10 meter site
IC Site Registration	7	3 meter site
IC Site Registration	7	10 meter site
		Radio & Telecommunications Terminal Equipment: EN45001 – EN ISO/IEC 17025
EU NB		Electromagnetic Compatibility: EN45001 – EN ISO/IEC 17025
Singapore iDA CB(Certification Body)	包包	Phase I, Phase II
Vietnam MIC CAB Accreditation		Please see the document for the detailed scope
		(Phase II) OFCA Foreign Certification Body for Radio and Telecom
Hong Kong OFCA	A	(Phase I) Conformity Assessment Body for Radio and Telecom
		Radio: Scope A – All Radio Standard Specification in Category I
Industry Canada CAB	A	Telecom: CS-03 Part I, II, V, VI, VII, VIII





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Japan Recognized Certification Body Designation	包包	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
		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
Korea CAB Accreditation		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	7	CNS 13438
Japan VCCI		R-3083: Radiation 3 meter site C-3421: Main Ports Conducted Interference Measurement T-1597: Telecommunication Ports Conducted Interference Measurement
		EMC: AS/NZS CISPR 11, AS/NZS CISPR 14.1, AS/NZS CISPR22, AS/NZS 61000.6.3, AS/NZS 61000.6.4
Australia CAB Recognition		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

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