

RF TEST REPORT



Report No.: FCC_IC_RF_SL18070503-DIG-006
Supersede Report No.: NONE

Applicant	Digital Security Controls, A Div. of TYCO Safety Products Canada Ltd.
Product Name	LTE Cellular Alarm Communicator
Model No.	LE4020/LE4020CF
Test Standard	47CFR Part22, 47CFR Part24, 47CFR Part27 RSS-130, Issue 1 RSS-132, Issue 3 RSS133, Issue 6
Test Method	TIA-603-D: 2010 RSS Gen Issue 4, Nov 2014
FCC ID	F5318LE4020
IC ID	160A-LE4020
Date of test	07/20/2018 - 07/27/2018
Issue Date	07/27/2018
Test Result	<u>Pass</u> Fail
Equipment complied with the specification	☒ [x]
Equipment did not comply with the specification	☐ []
	
George Hsu	Rachana Khanduri
Lead EMC Test Engineer	Engineering 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:
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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/RRR, 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 & Radio Equipment Directive (RED)
Japan	MIC (RCB 208)	RF, Telecom
HongKong	OFTA (US002)	RF, Telecom

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1 Report Revision History

Report No.	Report Version	Description	Issue Date
FCC_IC_RF_SL18070503-DIG-006	None	Original	07/27/2018

2 Executive Summary

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

Company: Digital Security Controls, A Div. of TYCO Safety Products Canada Ltd.
Product: LTE Cellular Alarm Communicator
Model: LE4020/LE4020CF

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	Digital Security Controls, A Div. of TYCO Safety Products Canada Ltd.
Applicant Address	3301 Langstaff Rd., Concord, ON L4k4L2 Canada
Manufacturer Name	Digital Security Controls, A Div. of TYCO Safety Products Canada Ltd.
Manufacturer Address	3301 Langstaff Rd., Concord, ON L4k4L2 Canada

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
-	-	-	-

6 EUT Information

6.1 EUT Description

Product Name	LTE Cellular Alarm Communicator
Model No.	LE4020/LE4020CF
Trade Name	Tyco - Digital Security Controls
Serial No.	N/A
Host Input Power	100-240VAC,50/60Hz
EUT Input Power	13.8VDC
Power Adapter Manu/Model	SOY-1380100US
Date of EUT received	7/20/2018
Hardware Version	UA716 Rev.03
Software Version	ver. 1.0
Equipment Class/ Category	PCB, TNB
Operating Frequencies	LTE 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 TX: 699 MHz to 716 MHz, RX: 729 MHz to 746 MHz TX: 777 MHz to 787 MHz, RX: 746 MHz to 756 MHz UMTS TX: 1850 MHz to 1910 MHz, RX: 1930 MHz to 1990 MHz TX: 824 MHz to 849 MHz, RX: 869 MHz to 894 MHz
Port/Connectors	N/A
Remark	NONE

6.2 Radio Description

Item	LTE	LTE	LTE
Operating Band /Radio Type	LTE Band 2	LTE Band 4	LTE Band 5
Bandwidth	5MHz, 10MHz, 15MHz, 20MHz	5MHz, 10MHz, 15MHz, 20MHz	5MHz, 10MHz
Modulation	QPSK/16QAM/64QAM	QPSK/16QAM/64QAM	QPSK/16QAM/64QAM
Antenna Type	PCB Dipole Antenna	PCB Dipole Antenna	PCB Dipole Antenna
Antenna Gain	6.8 dBi	4.6 dBi	1.3 dBi
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

Item	LTE	LTE
Operating Band /Radio Type	LTE Band 12	LTE Band 13
Bandwidth	5MHz, 10MHz	5MHz, 10MHz
Modulation	QPSK/16QAM/64QAM	QPSK/16QAM/64QAM
Antenna Type	PCB Dipole Antenna	PCB Dipole Antenna
Antenna Gain	1.2 dBi	2.2 dBi
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

Item	UMTS	UMTS
Operating Band /Radio Type	UMTS Band 2	UMTS Band 5
Bandwidth	3.84MHz	3.84MHz
Modulation	QPSK	QPSK
Antenna Type	PCB Dipole Antenna	PCB Dipole Antenna
Antenna Gain	6.8 dBi	1.3 dBi
Frequency TX(MHz)	TX: 1850 MHz to 1910 MHz RX: 1930 MHz to 1990 MHz	TX: 824 MHz to 849 MHz RX: 869 MHz to 894 MHz

6.3 EUT test modes/configuration Description

Test mode

Final Test Mode		Note
Final test mode 1	Continuous transmission, single channel	LTE
Final test mode 2	Continuous transmission, single channel	UMTS
Remark: LTE band 2,4,5,12,13 and UMTS band 2, 5 are evaluated.		

7 Supporting Equipment/Software and cabling Description

7.1 Supporting Equipment

Item	Supporting Equipment Description	Model	Serial Number	Manufacturer	Note
-	-	-	-	-	-

7.1 Cabling Description

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

7.2 Test Software Description

Test Item	Software	Description
N/A	N/A	N/A

8 Test Summary

Test Item	Test standard		Test Method/Procedure		Pass / Fail
E.R.P/ E.I.R.P.	FCC	47CFR24.232, 47CFR27.50	FCC	TIA-603-D: 2010	☒ Pass *
	IC	RSS-130, RSS-132, RSS-133	IC	RSS Gen Issue 4: 2014	☐ N/A
Occupied Bandwidth	FCC	47CFR24.238(a), 47CFR27.53	FCC	TIA-603-D: 2010	☒ Pass *
	IC	RSS-130, RSS-132, RSS-133	IC	RSS Gen Issue 4: 2014	☐ N/A
Peak-Average Ratio	FCC	47CFR24.232, 47CFR27.50	FCC	TIA-603-D: 2010	☒ Pass *
	IC	RSS-130, RSS-132, RSS-133	IC	RSS Gen Issue 4: 2014	☐ N/A
Spurious and harmonic Emission at antenna port	FCC	47CFR2.1051, 47CFR24.238, 47CFR27.53	FCC	TIA-603-D: 2010	☒ Pass
	IC	RSS-130, RSS-132, RSS-133	IC	RSS Gen Issue 4: 2014	☐ N/A
Band Edge	FCC	47CFR2.1053, 47CFR24.238, 47CFR27.53	FCC	TIA-603-D: 2010	☒ Pass *
	IC	RSS-130, RSS-132, RSS-133	IC	RSS Gen Issue 4: 2014	☐ N/A
Radiated spurious and harmonic emission	FCC	47CFR2.1053, 47CFR24.238, 47CFR27.53	FCC	TIA-603-D: 2010	☒ Pass
	IC	RSS-130, RSS-132, RSS-133	IC	RSS Gen Issue 4: 2014	☐ N/A
Frequency stability	FCC	47CFR2.1055, 47CFR24.135, 47CFR27.54	FCC	TIA-603-D: 2010	☒ Pass *
	IC	RSS-130, RSS-132, RSS-133	IC	RSS Gen Issue 4: 2014	☐ N/A
Remark	- 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. - Pass* Please refer to RI7LE910NAV2 RF test report for test items.				

9 Measurement Uncertainty

9.1 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.

9.2 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.

9.3 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

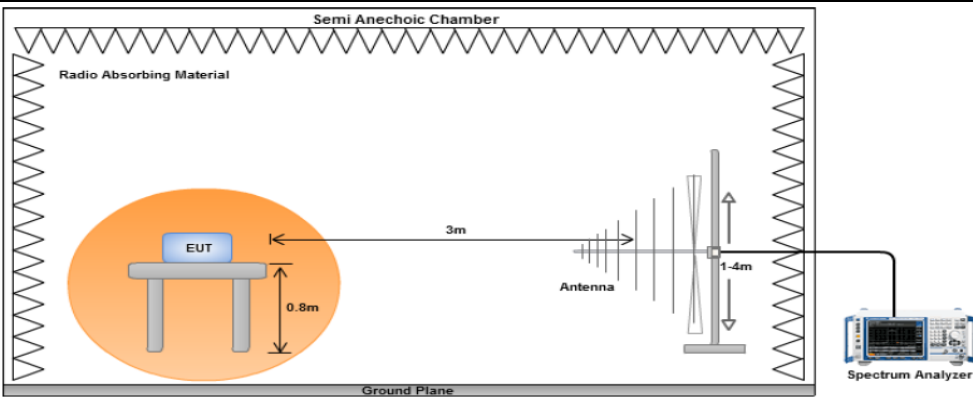
Source of Uncertainty	Value (dB)	Probability Distribution	Division	Sensitivity Coefficient	Expanded Uncertainty
Reference Level	0.12	Rectangular	1.732	1	0.069284
Cable Insertion Loss	0.21	Normal	2	1	0.105
Attenuator	0.25	Normal	2	1	0.125
Mismatch	0.25	U-Shape	1.414	1	0.1768033
Combined Standard Uncertainty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

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

10 Measurements, Examination and Derived Results

10.1 Radiated Spurious Emission below 1GHz

Requirement(s):

Spec	Item	Requirement	Applicable
47CFR27.53 RSS-130, RSS-132, RSS-133	-	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.	☒
47CFR24.238 RSS-130, RSS-132, RSS-133	-	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			
Test Procedure	Substitution method: - 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 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: - Vertical or horizontal polarisation (whichever gave the higher emission level over a full rotation of the EUT) was chosen. - The EUT was then rotated to the direction that gave the maximum emission. - Finally, the antenna height was adjusted to the height that gave the maximum emission. - Remove the transmitter and replace it with a substitution antenna (the antenna should be half-wavelength for each frequency involved). The center of the substitution antenna should be approximately at the same location as the center of the transmitter. - Feed the substitution antenna at the transmitter end with a signal generator connected to the antenna by means of a nonradiating cable. With the antennas at both ends horizontally polarized, and with the signal generator tuned to a particular spurious frequency, raise and lower the test antenna to obtain a maximum reading at the spectrum analyzer. Adjust the level of the signal generator output until the previously recorded maximum reading for this set of conditions is obtained. - Steps 4 were repeated for the next frequency point, until all selected frequency points were measured.		
Test Date	07/20/2018-07/27/2018	Environmental condition	Temperature 24°C Relative Humidity 42% Atmospheric Pressure 1012mbar
Remark	Limit calculation: Emission limit = $P_{dBm} - [43 + 10 \log(PW)] = 10 \log(1000 \times PW) - 43 - 10 \log(PW) = 30 \text{ dBm} - 43 = -13 \text{ dBm}$ All different modulation and bandwidth configuration has been verified and only the test data of worst case with QPSK modulation and greatest bandwidth was presented in this report.		
Result	☒ Pass ☐ Fail		

Test Data ☒ Yes (See below) ☐ N/A

Test Plot ☒ Yes (See below) ☐ N/A

Test was done by George Hsu at 10m chamber.

Radiated Emission Test Results for LTE

Test specification	Below 1GHz		Result	Pass
Environmental Conditions:	Temp (°C):	24		
	Humidity (%)	42		
	Atmospheric (mbar):	1012		
Mains Power:	120Vac, 60Hz			
Tested by:	George Hsu			
Test Date:	07/20/2018 – 07/27/2018			
Remarks:	LTE Band 2,4,5,12 and 13.			

LTE Band2-Mid CH-20MHz BW, QPSK

Indicated			Test Antenna		Substituted						
Frequency (MHz)	Raw (dBm)	Degree	Height (cm)	Polarity	Frequency (MHz)	Level (dBm)	Ant Gain (dBi)	Cable Loss (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
258.92	-58.12	0	100	V	258.92	-48.57	0	0.31	-48.88	-13	-35.88
252.25	-58.76	0	120	H	252.25	-52.50	0	0.31	-52.81	-13	-39.81
392.78	-59.36	0	100	V	392.78	-47.11	0	0.43	-47.54	-13	-34.54
391.42	-55.09	0	120	H	391.42	-41.57	0	0.43	-42.00	-13	-29.00

LTE Band4-Mid CH-20MHz BW, QPSK

Indicated			Test Antenna		Substituted						
Frequency (MHz)	Raw (dBm)	Degree	Height (cm)	Polarity	Frequency (MHz)	Level (dBm)	Ant Gain (dBi)	Cable Loss (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
259.89	-61.09	24	100	V	259.89	-51.54	0	0.31	-51.85	-13	-38.85
255.23	-53.19	279	123	H	255.23	-45.73	0	0.31	-46.04	-13	-33.04
393.75	-61.23	24	100	V	393.75	-48.98	0	0.44	-49.42	-13	-36.42
394.25	-56.33	279	123	H	394.25	-49.37	0	0.44	-49.81	-13	-36.81

LTE Band5-Mid CH-10MHz BW, QPSK

Indicated			Test Antenna		Substituted						
Frequency (MHz)	Raw (dBm)	Degree	Height (cm)	Polarity	Frequency (MHz)	Level (dBm)	Ant Gain (dBi)	Cable Loss (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
156.12	-46.68	120	135	V	156.12	-40.84	0	0.25	-41.09	-13	-28.09
152.22	-51.58	212	116	H	152.22	-44.12	0	0.24	-44.36	-13	-31.36
188.11	-49.93	120	135	V	188.11	-42.40	0	0.28	-42.68	-13	-29.68
189.23	-53.57	212	116	H	189.23	-40.05	0	0.28	-40.33	-13	-27.33

LTE Band12-Mid CH-10MHz BW, QPSK

Indicated			Test Antenna		Substituted						
Frequency (MHz)	Raw (dBm)	Degree	Height (cm)	Polarity	Frequency (MHz)	Level (dBm)	Ant Gain (dBi)	Cable Loss (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
135.73	-50.51	177	99	V	135.73	-44.67	0	0.23	-44.90	-13	-31.90
135.73	-52.62	257	115	H	135.73	-46.81	0	0.23	-47.04	-13	-34.04
229.21	-51.78	177	99	V	229.21	-43.47	0	0.31	-43.78	-13	-30.78
228.85	-58.22	257	115	H	228.85	-44.70	0	0.31	-45.01	-13	-32.01

LTE Band13-Mid CH-10MHz BW, QPSK

Indicated			Test Antenna		Substituted						
Frequency (MHz)	Raw (dBm)	Degree	Height (cm)	Polarity	Frequency (MHz)	Level (dBm)	Ant Gain (dBi)	Cable Loss (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
152.22	-50.66	0	100	V	152.22	-42.82	0	0.24	-43.06	-13	-30.06
155.23	-60.71	14	112	H	155.23	-54.90	0	0.25	-55.15	-13	-42.15
182.29	-50.98	0	100	V	182.29	-39.16	0	0.28	-39.44	-13	-26.44
189.21	-60.94	14	112	H	189.21	-47.42	0	0.29	-47.71	-13	-34.71

Note: Dipole antenna was used for substitution method.

Radiated Emission Test Results for UMTS

Test specification	Below 1GHz		Result	Pass
Environmental Conditions:	Temp (°C):	24		
	Humidity (%)	42		
	Atmospheric (mbar):	1012		
Mains Power:	120VAC, 60Hz			
Tested by:	George Hsu			
Test Date:	07/20/2018 – 07/27/2018			
Remarks:	UMTS Band 2 and 5			

UMTS band 2 Middle Channel, QPSK

Indicated			Test Antenna		Substituted						
Frequency (MHz)	Raw (dBm)	Degree	Height (cm)	Polarity	Frequency (MHz)	Level (dBm)	Ant Gain (dBi)	Cable Loss (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
138.64	-51.96	121	100	V	138.64	-46.12	0	0.23	-46.35	-13	-33.35
139.24	-53.52	265	100	H	139.24	-46.56	0	0.23	-46.79	-13	-33.79
191.02	-60.86	121	100	V	191.02	-49.04	0	0.29	-49.33	-13	-36.33
192.32	-60.68	265	100	H	192.32	-47.16	0	0.29	-47.45	-13	-34.45

UMTS band 5 Middle Channel, QPSK

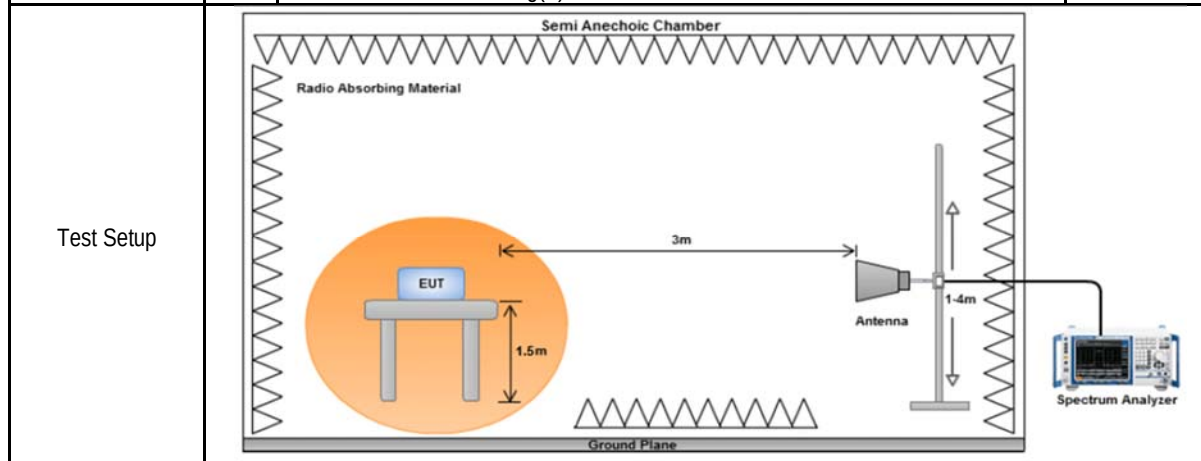
Indicated			Test Antenna		Substituted						
Frequency (MHz)	Raw (dBm)	Degree	Height (cm)	Polarity	Frequency (MHz)	Level (dBm)	Ant Gain (dBi)	Cable Loss (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
166.77	-59.77	78	100	V	166.77	-51.46	0	0.26	-51.72	-13	-38.72
164.83	-55.24	0	110	H	164.83	-48.28	0	0.26	-48.54	-13	-35.54
191.02	-59.29	78	100	V	191.02	-47.47	0	0.29	-47.76	-13	-34.76
190.12	-60.65	0	110	H	190.12	-52.34	0	0.29	-52.63	-13	-39.63

Note: Dipole antenna was used for substitution method.

10.2 Radiated Spurious Emissions above 1GHz

Requirement(s):

Spec	Item	Requirement	Applicable
47CFR27.53 RSS-130, RSS-132, RSS-133	-	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.	☒
47CFR24.238 RSS-130, RSS-132, RSS-133	-	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 Procedure	Substitution method: - 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 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: - Vertical or horizontal polarisation (whichever gave the higher emission level over a full rotation of the EUT) was chosen. - The EUT was then rotated to the direction that gave the maximum emission. - Finally, the antenna height was adjusted to the height that gave the maximum emission. - Remove the transmitter and replace it with a substitution antenna (the antenna should be half-wavelength for each frequency involved). The centre of the substitution antenna should be approximately at the same location as the centre of the transmitter. - Feed the substitution antenna at the transmitter end with a signal generator connected to the antenna by means of a non-radiating cable. With the antennas at both ends horizontally polarized, and with the signal generator tuned to a particular spurious frequency, raise and lower the test antenna to obtain a maximum reading at the spectrum analyzer. Adjust the level of the signal generator output until the previously recorded maximum reading for this set of conditions is obtained. - Steps 4 were repeated for the next frequency point, until all selected frequency points were measured.		
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Test Date	07/20/2018-07/27/2018	Environmental condition	Temperature 23°C Relative Humidity 48% Atmospheric Pressure 1008mbar
Remark	The EUT was scanned up to 25GHz. Both horizontal and vertical polarities were investigated. The results show only the worst case. Limit calculation: Emission limit = $P \text{ dBm} - [43 + 10 \log(PW)] = 10 \log(1000 \times PW) - 43 - 10 \log(PW) = 30 \text{ dBm} - 43 = -13 \text{ dBm}$ All different modulation and bandwidth configuration has been verified and only the test data of worst case with QPSK modulation and greatest bandwidth was presented in this report.		
Result	☒ Pass ☐ Fail		

Test Data ☒ Yes (See below) ☐ N/A

Test Plot ☐ Yes (See below) ☒ N/A

Test was done by *George Hsu* at *10m chamber*.

Radiated Emission Test Results (Above 1GHz)

LTE Band 2 Low Channel, 20MHz BW, QPSK

Indicated			Test Antenna		Substituted						
Frequency (MHz)	Raw (dBm)	Degree	Height (cm)	Polarity	Frequency (MHz)	Level (dBm)	Ant Gain (dBi)	Cable Loss (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
3725.12	-34.21	12.4	110	V	3725.12	-36.76	7.95	0.76	-29.57	-13	-16.57
3726.52	-35.52	0	100	H	3726.52	-37.29	7.95	0.76	-30.10	-13	-17.10
5592.52	-30.12	12.4	110	V	5592.52	-33.00	9.78	1.22	-24.44	-13	-11.44
5591.21	-32.53	0	100	H	5591.21	-33.41	9.78	1.22	-24.85	-13	-11.85

LTE Band 2 Mid Channel, 20MHz BW, QPSK

Indicated			Test Antenna		Substituted						
Frequency (MHz)	Raw (dBm)	Degree	Height (cm)	Polarity	Frequency (MHz)	Level (dBm)	Ant Gain (dBi)	Cable Loss (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
3764.21	-32.01	25.3	100	V	3764.21	-34.56	8	0.77	-27.33	-13	-14.33
3762.13	-35.21	34	100	H	3762.13	-36.98	8	0.77	-29.75	-13	-16.75
5648.53	-33.12	25.3	100	V	5648.53	-36.00	9.8	1.23	-27.43	-13	-14.43
5642.42	-34.12	34	100	H	5642.42	-35.00	9.8	1.23	-26.43	-13	-13.43

LTE Band 2 High Channel, 20MHz BW, QPSK

Indicated			Test Antenna		Substituted						
Frequency (MHz)	Raw (dBm)	Degree	Height (cm)	Polarity	Frequency (MHz)	Level (dBm)	Ant Gain (dBi)	Cable Loss (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
3804.10	-27.80	10	100	V	3804.10	-30.35	8.00	0.78	-23.13	-13	-10.13
3804.29	-23.88	27	100	H	3804.29	-25.65	8.00	0.78	-18.43	-13	-5.43
5265.56	-31.21	10	100	V	5265.56	-34.09	8.70	-1.13	-24.26	-13	-11.26
5265.76	-27.01	27	100	H	5265.76	-27.89	8.70	-1.13	-18.10	-13	-5.06

LTE Band 4 Low Channel, 20MHz BW, QPSK

Indicated			Test Antenna		Substituted						
Frequency (MHz)	Raw (dBm)	Degree	Height (cm)	Polarity	Frequency (MHz)	Level (dBm)	Ant Gain (dBi)	Cable Loss (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
3419.86	-34.76	121	115	V	3419.86	-37.31	7.68	0.67	-30.30	-13	-17.30
3420.18	-36.44	196	210	H	3420.18	-38.21	7.68	0.67	-31.20	-13	-18.20
5131.80	-40.83	329	163	V	5131.80	-43.71	8.93	1.09	-35.87	-13	-22.87
5133.88	-36.36	60	100	H	5133.88	-37.24	8.93	1.09	-29.40	-13	-16.40

LTE Band 4 Mid Channel, 20MHz BW, QPSK

Indicated			Test Antenna		Substituted						
Frequency (MHz)	Raw (dBm)	Degree	Height (cm)	Polarity	Frequency (MHz)	Level (dBm)	Ant Gain (dBi)	Cable Loss (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
3464.47	-25.56	12	100	V	3464.47	-28.11	7.83	0.69	-20.97	-13	-7.97
3465.27	-24.28	63	100	H	3465.27	-26.05	7.83	0.69	-18.91	-13	-5.91
5197.36	-29.73	12	100	V	5197.36	-32.61	8.81	1.11	-24.91	-13	-11.91
5193.88	-36.94	63	100	H	5193.88	-37.82	8.81	1.11	-30.12	-13	-17.12

LTE Band 4 High Channel, 20MHz BW, QPSK

Indicated			Test Antenna		Substituted						
Frequency (MHz)	Raw (dBm)	Degree	Height (cm)	Polarity	Frequency (MHz)	Level (dBm)	Ant Gain (dBi)	Cable Loss (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
3474.49	-25.21	0	100	V	3474.49	-27.76	7.85	0.69	-20.60	-13	-7.60
3474.49	-24.47	62	100	H	3474.49	-26.24	7.85	0.69	-19.08	-13	-6.08
5210.76	-29.68	0	100	V	5210.76	-32.56	8.78	1.11	-24.89	-13	-11.89
5232.14	-35.94	62	100	H	5232.14	-36.82	8.78	1.11	-29.15	-13	-16.15

LTE Band 5 Low Channel, 10MHz BW, QPSK

Indicated			Test Antenna		Substituted						
Frequency (MHz)	Raw (dBm)	Degree	Height (cm)	Polarity	Frequency (MHz)	Level (dBm)	Ant Gain (dBi)	Cable Loss (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
1664.23	-32.52	67	120	V	1664.23	-34.72	5.04	0.57	-30.25	-13	-17.25
1665.12	-36.21	110	210	H	1665.12	-37.54	5.04	0.57	-33.07	-13	-20.07
2492.00	-32.15	67	120	V	2492.00	-34.25	5.30	0.61	-29.56	-13	-16.56
2491.00	-32.76	110	210	H	2491.00	-34.00	5.30	0.61	-29.31	-13	-16.31

LTE Band 5 Mid Channel, 10MHz BW, QPSK

Indicated			Test Antenna		Substituted						
Frequency (MHz)	Raw (dBm)	Degree	Height (cm)	Polarity	Frequency (MHz)	Level (dBm)	Ant Gain (dBi)	Cable Loss (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
1682.12	-33.54	56.2	132	V	1682.12	-35.74	4.97	0.57	-31.34	-13	-18.34
1682.65	-35.32	115.6	232	H	1682.65	-36.65	4.97	0.57	-32.25	-13	-19.25
2519.21	-35.65	56.2	132	V	2519.21	-37.75	5.34	0.61	-33.02	-13	-20.02
2523.15	-37.12	115.6	232	H	2523.15	-38.36	5.34	0.61	-33.63	-13	-20.63

LTE Band 5 High Channel, 10MHz BW, QPSK

Indicated			Test Antenna		Substituted						
Frequency (MHz)	Raw (dBm)	Degree	Height (cm)	Polarity	Frequency (MHz)	Level (dBm)	Ant Gain (dBi)	Cable Loss (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
1694.23	-35.34	61	113	V	1694.23	-37.54	4.92	0.57	-33.19	-13	-20.19
1692.12	-36.98	120	212	H	1692.12	-38.31	4.92	0.57	-33.96	-13	-20.96
2543.00	-35.87	61	113	V	2543.00	-37.97	5.39	0.60	-33.19	-13	-20.19
2542.12	-34.67	120	212	H	2542.12	-35.91	5.39	0.60	-31.13	-13	-18.13

LTE Band 12 Low Channel, 10MHz BW, QPSK

Indicated			Test Antenna		Substituted						
Frequency (MHz)	Raw (dBm)	Degree	Height (cm)	Polarity	Frequency (MHz)	Level (dBm)	Ant Gain (dBi)	Cable Loss (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
1398.77	-22.52	81	118	V	1398.77	-24.72	4.78	0.49	-20.43	-13	-7.43
1392.78	-23.28	21	100	H	1392.78	-24.61	4.78	0.49	-20.32	-13	-7.32
2094.55	-25.90	81	118	V	2094.55	-28.00	4.70	0.65	-23.95	-13	-10.95
2103.32	-32.20	21	100	H	2103.32	-33.44	4.70	0.65	-29.39	-13	-16.39

LTE Band 12 Mid Channel, 10MHz BW, QPSK

Indicated			Test Antenna		Substituted						
Frequency (MHz)	Raw (dBm)	Degree	Height (cm)	Polarity	Frequency (MHz)	Level (dBm)	Ant Gain (dBi)	Cable Loss (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
1413.80	-25.12	91	115	V	1413.80	-27.32	4.90	0.49	-22.91	-13	-9.91
1414.21	-26.21	11	100	H	1414.21	-27.54	4.90	0.49	-23.13	-13	-10.13
2120.70	-30.12	91	115	V	2120.70	-32.22	4.70	0.65	-28.17	-13	-15.17
2121.90	-32.12	11	100	H	2121.90	-33.36	4.70	0.65	-29.31	-13	-16.31

LTE Band 12 High Channel, 10MHz BW, QPSK

Indicated			Test Antenna		Substituted						
Frequency (MHz)	Raw (dBm)	Degree	Height (cm)	Polarity	Frequency (MHz)	Level (dBm)	Ant Gain (dBi)	Cable Loss (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
1419.23	-30.20	76	100	V	1419.23	-32.40	4.96	0.50	-27.94	-13	-14.94
1418.54	-32.10	14	100	H	1418.54	-33.43	4.96	0.50	-28.97	-13	-15.97
2128.50	-35.67	76	100	V	2128.50	-37.77	4.70	0.65	-33.72	-13	-20.72
2129.40	-35.12	14	100	H	2129.40	-36.36	4.70	0.65	-32.31	-13	-19.31

LTE Band 13 Low Channel, 10MHz BW, QPSK

Indicated			Test Antenna		Substituted						
Frequency (MHz)	Raw (dBm)	Degree	Height (cm)	Polarity	Frequency (MHz)	Level (dBm)	Ant Gain (dBi)	Cable Loss (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
1548.03	-24.20	92	100	V	1548.03	-26.40	5.36	0.53	-21.57	-13	-8.57
1559.78	-22.12	298	100	H	1559.78	-23.45	5.36	0.53	-18.62	-13	-5.62
2339.29	-32.81	92	100	V	2339.29	-34.91	5.17	0.63	-30.37	-13	-17.37
2342.82	-25.30	298	100	H	2342.82	-26.54	5.17	0.63	-22.00	-13	-9.00

LTE Band 13 Mid Channel, 10MHz BW, QPSK

Indicated			Test Antenna		Substituted						
Frequency (MHz)	Raw (dBm)	Degree	Height (cm)	Polarity	Frequency (MHz)	Level (dBm)	Ant Gain (dBi)	Cable Loss (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
1556.21	-24.60	95	100	V	1556.21	-26.80	5.33	0.54	-22.00	-13	-9.00
1557.42	-25.12	286	100	H	1557.42	-26.45	5.33	0.54	-21.65	-13	-8.65
2334.21	-32.10	95	100	V	2334.21	-34.20	5.14	0.63	-29.68	-13	-16.68
2336.42	-30.82	286	100	H	2336.42	-32.06	5.14	0.63	-27.54	-13	-14.54

LTE Band 13 High Channel, 10MHz BW, QPSK

Indicated			Test Antenna		Substituted						
Frequency (MHz)	Raw (dBm)	Degree	Height (cm)	Polarity	Frequency (MHz)	Level (dBm)	Ant Gain (dBi)	Cable Loss (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
1568.78	-27.50	297	100	V	1568.78	-29.70	5.33	0.54	-24.91	-13	-11.91
1566.03	-25.10	103	100	H	1566.03	-26.43	5.33	0.54	-21.64	-13	-8.64
2350.57	-29.58	297	100	V	2350.57	-31.68	5.20	0.63	-27.11	-13	-14.11
2352.04	-29.80	103	100	H	2352.04	-31.04	5.20	0.63	-26.47	-13	-13.47

UMTS Band 2 Low Channel, QPSK

Indicated			Test Antenna		Substituted						
Frequency (MHz)	Raw (dBm)	Degree	Height (cm)	Polarity	Frequency (MHz)	Level (dBm)	Ant Gain (dBi)	Cable Loss (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
1655.69	-47.80	187	146	V	1655.69	-50.00	5.08	0.56	-45.48	-13	-32.48
1652.89	-35.54	31	266	H	1652.89	-36.87	5.08	0.56	-32.35	-13	-19.35
2482.77	-35.75	293	163	V	2482.77	-37.85	5.30	0.61	-33.16	-13	-20.16
2480.96	-36.53	345	176	H	2480.96	-37.77	5.30	0.61	-33.08	-13	-20.08

UMTS Band 2 Middle Channel, QPSK

Indicated			Test Antenna		Substituted						
Frequency (MHz)	Raw (dBm)	Degree	Height (cm)	Polarity	Frequency (MHz)	Level (dBm)	Ant Gain (dBi)	Cable Loss (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
1677.75	-35.56	74	276	V	1677.75	-37.76	4.99	0.57	-33.34	-13	-20.34
1675.90	-35.29	158	123	H	1675.90	-36.62	4.99	0.57	-32.20	-13	-19.20
2511.07	-36.67	243	253	V	2511.07	-38.77	5.32	0.61	-34.06	-13	-21.06
2508.25	-48.82	58	339	H	2508.25	-50.06	5.32	0.61	-45.35	-13	-32.35

UMTS Band 2 High Channel, QPSK

Indicated			Test Antenna		Substituted						
Frequency (MHz)	Raw (dBm)	Degree	Height (cm)	Polarity	Frequency (MHz)	Level (dBm)	Ant Gain (dBi)	Cable Loss (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
1691.89	-28.48	322	168	V	1691.89	-30.68	4.93	0.58	-26.32	-13	-13.32
1692.28	-35.26	332	250	H	1692.28	-36.59	4.93	0.58	-32.23	-13	-19.23
2540.23	-37.02	121	133	V	2540.23	-39.12	5.38	0.60	-34.34	-13	-21.34
2538.19	-36.30	233	155	H	2538.19	-37.54	5.38	0.60	-32.76	-13	-19.76

UMTS Band 5 Low Channel, QPSK

Indicated			Test Antenna		Substituted						
Frequency (MHz)	Raw (dBm)	Degree	Height (cm)	Polarity	Frequency (MHz)	Level (dBm)	Ant Gain (dBi)	Cable Loss (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
3706.41	-38.20	336	127	V	3706.41	-40.75	7.91	0.76	-33.59	-13	-20.59
3706.97	-35.81	290	151	H	3706.97	-37.58	7.91	0.76	-30.42	-13	-17.42
5557.02	-41.62	221	291	V	5557.02	-44.50	9.71	1.21	-36.00	-13	-23.00
5556.13	-41.18	221	291	H	5556.13	-42.06	9.71	1.21	-33.56	-13	-20.56

UMTS Band 5 Middle Channel, QPSK

Indicated			Test Antenna		Substituted						
Frequency (MHz)	Raw (dBm)	Degree	Height (cm)	Polarity	Frequency (MHz)	Level (dBm)	Ant Gain (dBi)	Cable Loss (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
3760.00	-37.70	143	201	V	3760.00	-40.25	8.00	0.77	-33.02	-13	-20.02
3760.00	-38.50	237	139	H	3760.00	-40.27	8.00	0.77	-33.04	-13	-20.04
5639.28	-41.82	105	133	V	5639.28	-44.70	9.80	1.23	-36.13	-13	-23.13
5639.18	-41.35	146	323	H	5639.18	-42.23	9.80	1.23	-33.66	-13	-20.66

UMTS Band 5 High Channel, QPSK

Indicated			Test Antenna		Substituted						
Frequency (MHz)	Raw (dBm)	Degree	Height (cm)	Polarity	Frequency (MHz)	Level (dBm)	Ant Gain (dBi)	Cable Loss (dB)	Absolute Level (dBm)	Limit (dBm)	Margin (dB)
3813.50	-37.80	135	242	V	3813.50	-40.35	8.00	0.79	-33.11	-13	-20.11
3812.37	-38.14	224	248	H	3812.37	-39.91	8.00	0.79	-32.67	-13	-19.67
5771.98	-41.38	29	170	V	5771.98	-44.26	9.90	1.27	-35.63	-13	-22.63
5772.06	-41.38	72	140	H	5772.06	-42.26	9.90	1.27	-33.63	-13	-20.63

Annex A. TEST INSTRUMENT

Instrument	Model	Serial #	Cal Date	Cal Cycle	Cal Due	In use
Radiated Emissions						
Keysight EXA 44GHz Spectrum Analyzer	N9010A	MY51440112	11/08/2017	1 Year	11/08/2018	☒
R & S Wideband Communication Tester	CMW500	108852	08/03/2017	1 Year	08/03/2018	☒
Pre-Amplifier (1-26.5GHz)	8449B	3008A00715	08/16/2017	1 Year	08/16/2018	☒
Preamplifier (100KHz-7GHz)	LPA-6-30	11170601	10/21/2017	1 Year	10/21/2018	☒
Bi-Log antenna (30MHz~2GHz)	JB6	A111717	12/5/2017	1 Year	12/5/2018	☒
Horn Antenna (1-18GHz)	3117	214309	11/09/2017	1 Year	11/09/2018	☒
Horn Antenna (1-18GHz)	3117	218554	11/22/2018	1 Year	11/22/2019	☒
Tuned Dipole Antenna 30 - 1000 MHz (4pcs set)	AD-100	40133	01/23/2018	1 Year	01/23/2020	☒

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 Equipment: EN45011: EN ISO/IEC 17065
		Electromagnetic Compatibility: EN45011 – EN ISO/IEC 17065
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 Radiocommunications: 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