

ELECTROMAGNETIC EMISSIONS COMPLIANCE REPORT

INTENTIONAL RADIATOR CERTIFICATION TO FCC PART 15 SUBPART C REQUIREMENT

OF

Product Name:	SmartSense Staff Tag
Brand Name:	SmartSense Staff Tag
Model No.:	STG-821(919), STG-821(925)
Model Difference:	Different in frequency (919.8MHz & 925MHz)
FCC ID:	VPE-STG-821
Report No.:	E2/2016/90061
Issue Date:	Nov. 15, 2016
FCC Rule Part:	§15.209
Prepared for	CADI SCIENTIC PTE LTD 31, Ubi Road 1, Aztech Building, #07-01A, 408694, Singapore SGS Taiwan Ltd.
Prepared by	Electronics & Communication Laboratory No.2, Keji 1st Rd., Guishan District, Taoyuan City, Taiwan 333



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VERIFICATION OF COMPLIANCE

Applicant:	CADI SCIENTIC PTE LTD 31, Ubi Road 1, Aztech Building, #07-01A, 408694, Singapore
Product Description:	SmartSense Staff Tag
Brand Name:	SmartSense Staff Tag
FCC ID:	VPE-STG-821
Model No.:	STG-821(919), STG-821(925)
Model Difference:	Different in frequency (919.8MHz & 925MHz)
File Number:	E2/2016/90061
Date of test:	Sep. 23, 2016 ~ Nov. 9, 2016
Date of EUT Received:	Sep. 23, 2016

We hereby certify that:

The above equipment was tested by SGS Taiwan Ltd., Electronics & Communication Laboratory. The test data, data evaluation, test procedures, and equipment configurations shown in this report were made in accordance with the procedures given in ANSI C63.10 2013 and the energy emitted by the sample EUT tested as described in this report is in compliance with conducted and radiated emission limits.

The test results of this report relate only to the tested sample identified in this report.

Test By:	Jerry Lu	Date:	Nov. 15, 2016
Prepared By:	Jerry Lu/Asst. Supervisor Uroletta Tang	Date:	Nov. 15, 2016
Approved By	Violetta Tang / Clerk Jim Chang / Asst. Manager	Date:	Nov. 15, 2016

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Revision History

Report Number	Revision	Revision Description Issu	
E2/2016/90061	Rev.00	Initial creation of document	Nov. 15, 2016

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1. GENERAL INFORMATION

1.1. Product Description

Product Name:	SmartSense Staff Tag		
Brand Name:	SmartSense Staff Tag		
Model No.:	STG-821(919), STG-821(925)		
Model Difference:	Different in frequency (919.8MHz & 925MHz)		
Hardware Version:	V3.1		
Software Version	V6		
Power Supply:	3.7Vdc from Rechargeable Lithium Ion Polymer Battery or 5Vdc from USB Port		
	Battery: Model No.: N/A; Supplier: N/A		

Transmitter:

Operating Frequency	125kHz
Transmit Power	< 105dBuV/m at 3m.
Number of Channels	1
Operating Mode	Point-to-Point

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1.2. Test Methodology of Applied Standards

FCC Part 15, Subpart C §15.225 ANSI C63.10:2013

Note:

- 1. All test items have been performed and record as per the above standards.
- 2. The composite system is compliance with FCC Subpart B is authorized under the certification procedure.
- 3. The EUT was placed 1.5m height for frequency above 1GHz in accordance with ANSI C63 10[.]2013

1.3. Test Facility

SGS Taiwan Ltd. Electronics & Communication Laboratory No.2, Keji 1st Rd., Guishan District, Taoyuan City, Taiwan 333. (TAF code 0513)

FCC Registration Numbers are: 735305 Canada Registration Number: 4620A-5

1.4. Special Accessories

There are no special accessories used while test was conducted.

1.5. Equipment Modifications

There was no modification incorporated into the EUT.

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2. System Test Configuration

2.1. EUT Configuration

The EUT configuration for testing is installed on RF field strength measurement to meet the Commissions requirement and operating in a manner which intends to maximize its emission characteristics in a continuous normal application.

2.2. EUT Exercise

An engineering test mode (software/firmware) that applicant provided was utilized to manipulate the EUT into transmit, selection of the test channel, and modulation scheme.

2.3. Test Procedure

2.3.1 Conducted Emissions (Not apply in the report)

The EUT is a placed on as turn table which is 0.8 m above ground plane. Conducted emissions from the EUT measured in the frequency range between 0.15 MHz and 30MHz, The CISPR Quasi-Peak and Average detector mode is employed according to §15.107. The two LISNs provide 50 ohm/ 50uH of coupling impedance for the measuring instrument. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.

2.3.2 Radiated Emissions

The EUT is a placed on as turn table which is 0.8 m above ground plane. The turn table shall rotate 360 degrees to determine the position of maximum emission level. EUT is set 3m away from the receiving antenna which varied from 1m to 4m to find out the highest emission. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical. In order to find out the max. emission, the relative positions of this hand-held transmitter (EUT) was rotated through three orthogonal axes and measurement procedures for electric field radiated emissions above 1 GHz the EUT measurement is to be made "while keeping the antenna in the 'cone of radiation' from that area and pointed at the area both in azimuth and elevation, with polarization oriented for maximum response." is still within the 3dB illumination BW of the measurement antenna.

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2.4. Limitation

(1) Conducted Emission

According to section 15.207(a) Conducted Emission Limits is as following.

	Limits			
Frequency range	d	B (uV)		
MHz	Quasi-peak	Average		
0.15 to 0.50	66 to 56	56 to 46		
0.50 to 5	56	46		
5 to 30	60 50			
Note				
1. The lower limit shall apply at the transition frequencies				
2.The limit decreases	The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50			
MHz.				

(2) Radiated Emission

- (a) Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:
- (b) In the emission table above, the tighter limit applies at the band edges.
- (c) The level of any unwanted emissions from an intentional radiator operating under these general provisions shall not exceed the level of the fundamental emission. For intentional radiators which operate under the provisions of other Sections within this Part and which are required to reduce their nwanted emissions to the limits specified in this table, the limits in this table are based on the frequency of the unwanted emission and not the fundamental frequency. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.
- The emission limits shown in the above table are based on measurements employing a CISPR quasi-peak detector except for the frequency bands 9-90 kHz, 110-490 kHz and above 1000 MHz. Radiated emission limits in these three bands are based on measurements employing an average detector.

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 Frequency (MHz)	Field strength μV/m	Distance (m)	Field strength at 3m dBµV/m
0.009-0.490	2400/F(KHz)	300	
0.490-1.705	24000/F(KHz)	30	
1.705-30	30	30	69.54
30-88	100	3	40
88-216	150	3	43.5
216-960	200	3	46
Above 960	500	3	54

Limit Table:

Frequency	Distance	Limit at 300m	Limit at 30m	Distance Factor	Limit
kHz	m	dBµV/m	dBµV/m	dB	dBµV/m at
125	300	25.67		80	105.67
250	300	19.65		80	99.65
375	300	16.12		80	96.12
500	30		33.62	40	73.62
625	30		31.69	40	71.69
750	30		30.10	40	70.10
875	30		28.76	40	68.76
1000	30		27.60	40	67.60
1125	30		26.58	40	66.58
1250	30		25.67	40	65.67

Limit Calculation and transfer to 1m test distance:

If the frequency between 9 – 490kHz, Limit = 20log(2400/f(KHz) + 40log(300/1))

If the frequency between 490kHz – 1.705MHz Limit = 20log(24000/f(KHz) + 40log(30/1))

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2.5. Configuration of Tested System

Fig. 2-1 Configuration of Tested System



Table 2-1 Equipment Used in Tested System

Item	Equipment	Mfr/Brand	Model/ Type No.	Series No.	Data Cable	Power Cord
1	Test Software	N/A	N/A	N/A	N/A	N/A

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3. Summary of Test Results

FCC Rules	Description of Test	Result
§15.207 (a)	AC Power Line Conducted Emission	Compliant
§15.209	Radiated Emission	Compliant

4. Description of test modes

The EUT has been tested under continuous operating condition. The Frequency 125kHz was chosen for testing.

5. MEASUREMENT UNCERTAINTY

Test Items	Uncertainty
AC Power Line Conducted Emission	+/- 2.586 dB
Temperature	+/- 0.65 °C
Humidity	+/- 4.6 %
DC / AC Power Source	DC= +/- 0.13%, AC= +/- 0.2%

Radiated Spurious Emission:

	9kHz - 30MHz: +/- 2.3dB
	30MHz - 180MHz: +/- 3.37dB
Measurement uncertainty (Polarization : Vertical)	180MHz -417MHz: +/- 3.19dB
	0.417GHz-1GHz: +/- 3.19dB
	1GHz - 18GHz: +/- 4.04dB
	18GHz - 40GHz: +/- 4.04dB

	9kHz - 30MHz: +/- 2.3dB
Maggurament uncertainty	30MHz - 167MHz: +/- 4.22dB
Measurement uncertainty (Polarization : Horizontal)	167MHz -500MHz: +/- 3.44dB
	0.5GHz-1GHz: +/- 3.39dB
	1GHz - 18GHz: +/- 4.08dB
	18GHz - 40GHz: +/- 4.08dB

This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

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6. Conducted Emissions Test

6.1. Standard Applicable:

Frequency range within 150kHz to 30MHz shall not exceed the Limit table as below.

Frequency range	Lin dB(
MHz	Quasi-peak	Average
0.15 to 0.50	66 to 56	56 to 46
0.50 to 5	56	46
5 to 30	60	50
Note		

1. The lower limit shall apply at the transition frequencies

2. The limit decreases linearly with the logarithm of the frequency in the range 0.15 MHz to 0.50 MHz.

6.2. Measurement Equipment Used:

Conducted Emission Test Site								
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Date	Calibration Due			
EMI Test Receiver	R&S	ESCI 7	100950	12/12/2015	12/11/2016			
Coaxial Cables	N/A	N30N30-1042-150cm	N/A	02/07/2016	02/06/2017			
LISN	Schwarzbeck	NSLK 8127	8127-648	03/11/2016	03/10/2017			
Test Software	Farad	EZ-EMC	Ver. SGS-03A2	N.C.R.	N.C.R.			

6.3. EUT Setup:

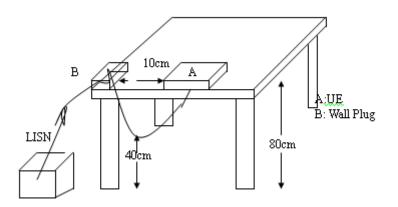
- 1. The conducted emission tests were performed in the test site, using the setup in accordance with the ANSI C63.10:2013.
- 2. The AC/DC Power adaptor of EUT was plug-in LISN. The EUT was placed flushed with the rear of the table.
- 3. The LISN was connected with 120Vac/60Hz power source.

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6.4. Test SET-UP (Block Diagram of Configuration)



6.5. Measurement Procedure:

1. The EUT was placed on a table which is 0.8m above ground plane.

Maximum procedure was performed on the six highest emissions to ensure EUT compliance.

3. Repeat above procedures until all phases of power being supplied by given UE are completed.

6.6. Measurement Result:

Note: Refer to next page for measurement data and plots.

Note2: The * reveals the worst-case results that closet to the limit.

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AC POWER LINE CONDUCTED EMISSION TEST DATA

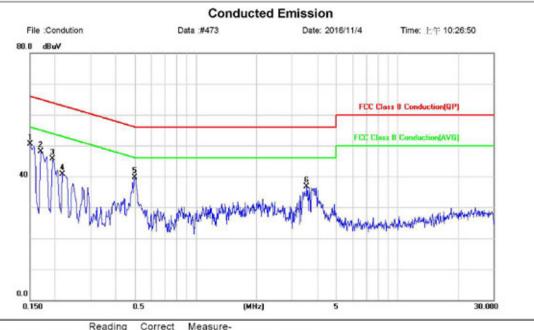
Operation Mode:	Operation Mode	Test Date:	Nov. 04, 2016
Temperature:	23		

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Temperature: 23 °C Site : Conduction Room Phase: N Power: AC 120V/60Hz Humidity: 60 % Limit: FCC Class B Conduction(QP) Mode: CADI

Note:



No.	Mk.	Freq.	Level	Factor	ment	Limit	Over			
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector	Comment	
1	•	0.1500	30.83	19.73	50.56	66.00	-15.44	peak		
2		0.1700	28.47	19.73	48.20	64.96	-16.76	peak		
3		0.1940	26.05	19.72	45.77	63.86	-18.09	peak		
4		0.2180	20.95	19.73	40.68	62.89	-22.21	peak		
5		0.4980	19.82	19.91	39.73	56.03	-16.30	peak		
6		3.5620	16.71	19.96	36.67	56.00	-19.33	peak		

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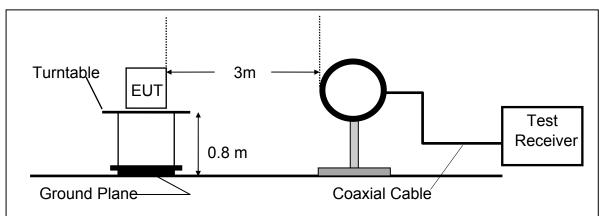
7. Radiated Emission Test

7.1. Measurement Procedure

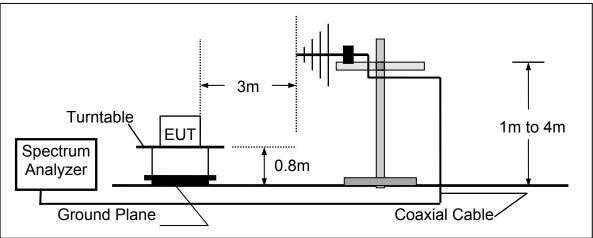
- 1. The EUT was placed on a turn table which is 0.8m above ground plane.
- 2. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
- 3. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
- 4. Repeat above procedures until all frequency measured were complete.

7.2. Test SET-UP (Block Diagram of Configuration)

(A) Radiated Emission Test Set-Up, Frequency Below 30MHz



(B) Radiated Emission Test Set-Up, Frequency Below 1000MHz



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7.3. Measurement Equipment Used:

966 Chamber								
EQUIPMENT	MFR	MODEL	SERIAL	LAST	CAL DUE.			
TYPE		NUMBER	NUMBER	CAL.				
EMI Test Receiver	R&S	ESU 40	100363	04/12/2016	04/11/2017			
Loop Antenna	ETS-Lindgren	6502	00143303	12/23/2015	12/22/2016			
Broadband Antenna	TESEQ	CBL 6112D	35240	10/28/2015	10/27/2016			
Horn Antenna	ETS-Lindgren	3117	00143272	12/16/2015	12/15/2016			
Horn Antenna	Schwarzbeck	BBHA9170	185	07/18/2016	07/17/2017			
Pre Amplifier	EMC Instruments	EMC330	980096	12/12/2015	12/11/2016			
Pre Amplifier	EMC Instruments	EMC0011830	980199	12/12/2015	12/11/2016			
Pre Amplifier	R&S	SCU-18	10204	12/12/2015	12/11/2016			
Pre Amplifier	R&S	SCU-26	100780	12/12/2015	12/11/2016			
Coaxial Cable	Huber+Suhner	RG 214/U	966Rx 9K-30M	12/12/2015	12/11/2016			
Coaxial Cable	Huber+Suhner	RG 214/U SUCOFLEX 104	966Rx 30M-3G	12/12/2015	12/11/2016			
Coaxial Cable	Huber+Suhner	SUCOFLEX 104	966Rx 1G-18G	12/12/2015	12/11/2016			
Coaxial Cable	Huber+Suhner	mini 141-12 SUCOFLEX 104	966Rx 18G-40G	12/12/2015	12/11/2016			
Coaxial Cable	Huber+Suhner	SUCOFLEX 104	966Tx 30M-18G	12/12/2015	12/11/2016			
Coaxial Cable	Huber+Suhner	SUCOFLEX 102	966Tx 18G-40G	12/12/2015	12/11/2016			
Attenuator	WOKEN	218FS-10	RF27	12/12/2015	12/11/2016			
Site NSA	SGS	966 Chamber C	SAC-C	03/04/2016	03/03/2017			
Site VSWR	SGS	966 Chamber C	SAC-C	03/04/2016	03/03/2017			
DC Power Supply	HOLA	DP-3003	D7070035	05/04/2016	05/03/2017			
Controller	MF	MF-7802	N/A	N.C.R.	N.C.R.			
Antenna Master	MF	N/A	N/A	N.C.R.	N.C.R.			
Turn Table	MF	N/A	N/A	N.C.R.	N.C.R.			
Test Software	World-Pallas	Dr. E	V 3.0 Lite	N.C.R.	N.C.R.			

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7.4. Field Strength Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor and subtracting the Amplifier Gain and Duty Cycle Correction Factor (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CL - AG

Where	0	CL = Cable Attenuation Factor (Cable Loss)
	RA = Reading Amplitude	AG = Amplifier Gain
	AF = Antenna Factor	

Actual FS(dB μ V/m) = SPA. Reading level(dB μ V) + Factor(dB)

Factor(dB) = Antenna Factor(dB μ V/m) + Cable Loss(dB) – Pre Amplifier Gain(dB)

"F" : denotes Fundamental Frequency. ; "H" : denotes Harmonic Frequency. Note :

"E" : denotes Band Edge Frequency. ; "S" : denotes Spurious Frequency.

"---": denotes Noise Floor.

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7.5. Measurement Result

Fundam	Operation Mode :125kHzTest Date :Fundamental Frequency :125kHzTemp. / Humi. :Operation Band :Main CH MidTest Engineer :					2016/10/14 22.7deg_C/57RH Ashton		
EUT Pol	.:	E	2	Measure	Vertical			
Freq.	Note	Detector Mode		ctum Ig Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/A	5		dB	dBµV/m	dBµV/m	dB
0.12	F	Peak	55	6.67	11.61	67.28	105.7086	-38.43

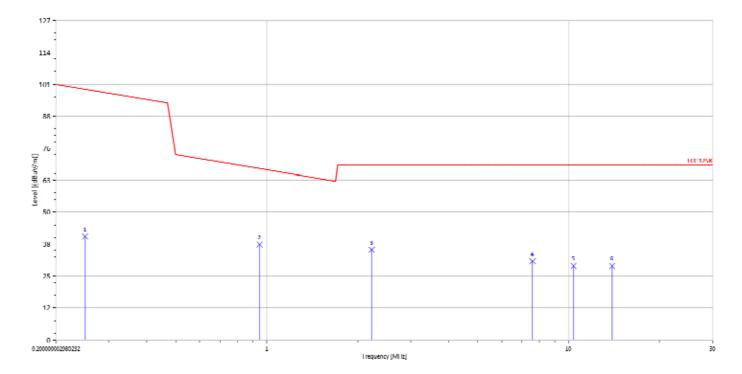
Operatio	Operation Mode: 125kHz Test Date:					2016/10/14	1		
Fundamental Frequency : 125kHz Temp. / Humi. :					22.7deg_0)/57 RH			
Operatio	n Band :		Main CH Mid	Test Eng	ineer:		Ashton		
EUT Pol	.:		E2	Measure	ment Ante	enna Pol. :	Horizontal		
Freq.	Note	Detect	or Spe	ctum	Factor	Actual	Limit	Margin	
		Mode	e Readir	Reading Level		FS	@3m	-	
MHz	F/H/E/S	PK/QP/	AV dE	μV	dB	dBµV/m	dBµV/m	dB	
0.13	F	Peak	55	.20	11.61	66.82	105.6573	-38.84	

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(10MHz~30MHz)

Operation Mode :	125kHz	Test Date :	2016/10/14
Fundamental Frequency :	125kHz	Temp. / Humi. :	22.7deg_C/57RH
Operation Band :	Tx CH Mid	Test Engineer:	Ashton
EUT Pol. :	E2	Measurement Antenna Pol. :	Vertical

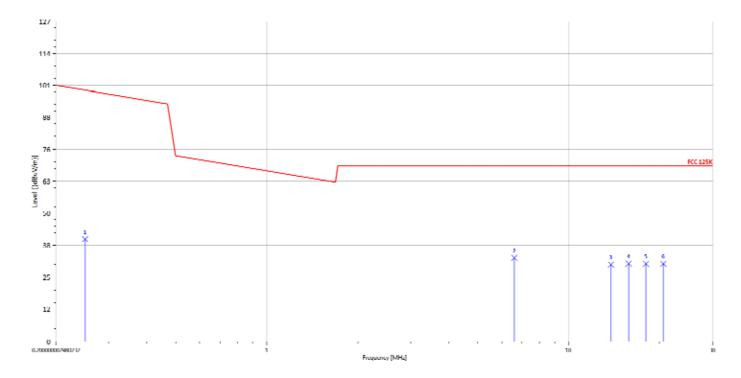


Freq.	Note	Detector Mode	Spectum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
0.25	Н	Peak	29.58	11.55	41.14	99.65	-58.51
0.95	S	Peak	26.30	11.64	37.93	68.096	-30.16
2.23	S	Peak	24.43	11.39	35.82	69.54	-33.72
7.59	S	Peak	19.52	11.67	31.19	69.54	-38.35
10.39	S	Peak	17.73	11.69	29.42	69.54	-40.12
13.94	S	Peak	17.78	11.58	29.36	69.54	-40.18

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Operation Mode :	125kHz	Test Date :	2016/10/14
Fundamental Frequency :	125kHz	Temp. / Humi. :	22.7deg_C/57RH
Operation Band :	Tx CH Mid	Test Engineer :	Ashton
EUT Pol. :	E2	Measurement Antenna Pol. :	Horizontal



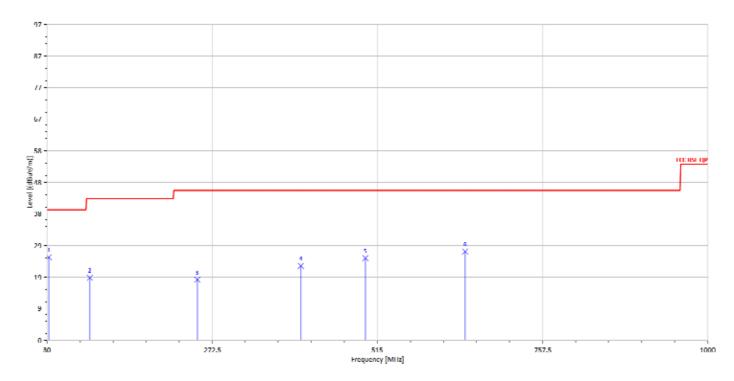
Freq.	Note	Detector Mode	Spectum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
0.25	Н	Peak	29.02	11.55	40.58	99.65	-59.07
6.61	S	Peak	21.47	11.66	33.13	69.54	-36.41
13.82	S	Peak	18.83	11.58	30.41	69.54	-39.13
15.79	S	Peak	19.29	11.52	30.80	69.54	-38.74
18.02	S	Peak	19.24	11.45	30.70	69.54	-38.84
20.61	S	Peak	19.46	11.24	30.70	69.54	-38.84

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(30MHz~1GHz)

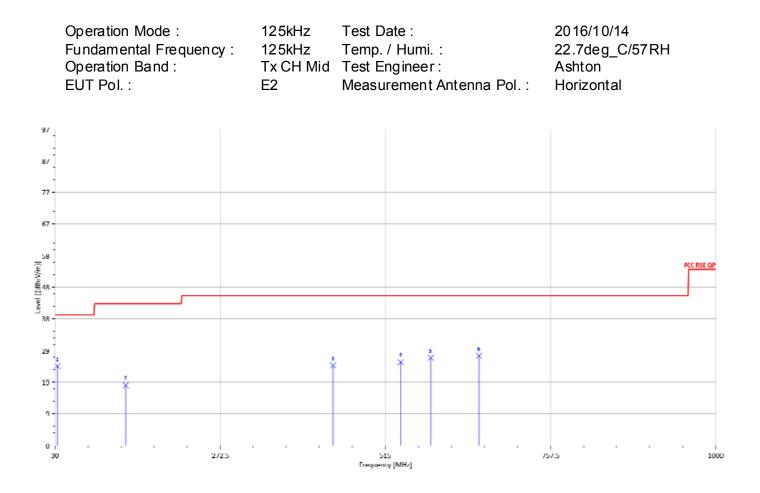
125kHz	Test Date :	2016/10/14
125kHz	Temp. / Humi. :	22.7deg_C/57RH
Tx CH Mid	Test Engineer:	Ashton
E2	Measurement Antenna Pol. :	Vertical
	125kHz Tx CH Mid	125kHz Temp. / Humi. : Tx CH Mid Test Engineer :



Freq.	Note	Detector	Spectum	Factor	Actual	Limit	Margin
		Mode	Reading Level		FS	@3m	
MHz	F/H/E/S	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
32.91	S	Peak	34.17	-8.75	25.42	40	-14.58
93.05	S	Peak	38.15	-18.95	19.20	43.5	-24.30
251.16	S	Peak	33.10	-14.49	18.61	46	-27.39
402.48	S	Peak	32.47	-9.74	22.74	46	-23.26
497.54	S	Peak	32.88	-7.72	25.16	46	-20.84
644.01	S	Peak	32.31	-5.10	27.21	46	-18.79

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Freq.	Note	Detector Mode	Spectum Reading Level	Factor	Actual FS	Limit @3m	Margin
MHz	F/H/E/S	PK/QP/AV	dBµV	dB	dBµV/m	dBµV/m	dB
33.88	S	Peak	33.55	-9.27	24.28	40	-15.72
133.79	S	Peak	34.31	-15.82	18.49	43.5	-25.01
438.37	S	Peak	33.79	-9.27	24.51	46	-21.49
537.31	S	Peak	32.76	-7.24	25.52	46	-20.48
581.93	S	Peak	33.04	-6.17	26.87	46	-19.13
652.74	S	Peak	32.78	-5.24	27.54	46	-18.46

- End of Report -

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