

Test Report No. 7191155156-EEC17/03
dated 07 Feb 2017



PSB Singapore

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FORMAL REPORT ON TESTING IN ACCORDANCE WITH
47 CFR FCC Parts 15B & C
OF AN
E-Log And Fleet Management Device
[Model : DC200]
[Contains FCC ID : A4C01005A & QIPXS8]

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FCC REG. NO. 160581 (3m and 10m Semi-Anechoic Chamber, International Business Park)

IND. CANADA REG. NO. 2932N-1 (10m Semi-Anechoic Chamber, International Business Park)

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QUOTATION NUMBER 2191055485

JOB NUMBER 7191155156

TEST PERIOD 24 Jan 2017 – 25 Jan 2017

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LA-2007-0380-A LA-2007-0384-G
LA-2007-0381-F LA-2007-0385-E
LA-2007-0382-B LA-2007-0386-C
LA-2007-0383-G LA-2010-0464-D

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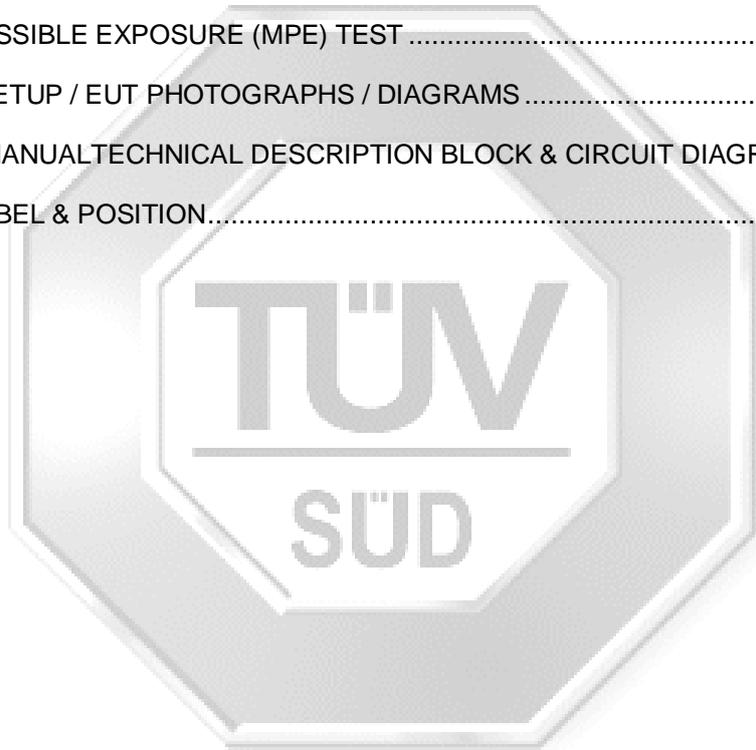
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TEST SUMMARY

The product was tested in accordance with the customer's specifications.

Test Results Summary

Test Standard	Description	Pass / Fail
47 CFR FCC Part 15		
15.107(a), 15.207	Conducted Emissions	Not Applicable *See Note 6
15.109(a), 15.205, 15.209	Radiated Emissions (Spurious Emissions inclusive Restricted Bands Requirement)	Pass
15.247(a)(2)	Spectrum Bandwidth (6dB Bandwidth Measurement)	Not Tested *See Note 8
15.247(b)(3)	Maximum Peak Power	Not Tested *See Note 8
15.247(d)	RF Conducted Spurious Emissions (Non-Restricted Bands)	Not Tested *See Note 8
15.247(d)	RF Conducted Spurious Emissions (Restricted Bands)	Not Tested *See Note 8
15.247(d)	Band Edge Compliance (Conducted)	Not Tested *See Note 8
15.247(d)	Band Edge Compliance (Radiated)	Pass
15.247(e)	Peak Power Spectral Density	Not Tested *See Note 8
1.1310	Maximum Permissible Exposure	Pass

TEST SUMMARY

Notes

1. The channels as listed below, under the different configurations were tested for 802.11b WLAN.

<u>Transmit Channel</u>	<u>Frequency (GHz)</u>	<u>Modulation</u>	<u>Data Rate</u>
Channel 1 (Lower Channel)	2.412	DBPSK	1Mbps
Channel 7 (Middle Channel)	2.437	DBPSK	1Mbps
Channel 11 (Upper Channel)	2.462	DBPSK	1Mbps
Channel 1 (Lower Channel)	2.412	DQPSK	2Mbps
Channel 7 (Middle Channel)	2.437	DQPSK	2Mbps
Channel 11 (Upper Channel)	2.462	DQPSK	2Mbps
Channel 1 (Lower Channel)	2.412	CCK	11Mbps
Channel 7 (Middle Channel)	2.437	CCK	11Mbps
Channel 11 (Upper Channel)	2.462	CCK	11Mbps

2. The channels as listed below, under the different configurations were tested for 802.11g WLAN.

<u>Transmit Channel</u>	<u>Frequency (GHz)</u>	<u>Modulation</u>	<u>Data Rate</u>
Channel 1 (Lower Channel)	2.412	BPSK	9Mbps
Channel 7 (Middle Channel)	2.437	BPSK	9Mbps
Channel 11 (Upper Channel)	2.462	BPSK	9Mbps
Channel 1 (Lower Channel)	2.412	QPSK	18Mbps
Channel 7 (Middle Channel)	2.437	QPSK	18Mbps
Channel 11 (Upper Channel)	2.462	QPSK	18Mbps
Channel 1 (Lower Channel)	2.412	16QAM	36Mbps
Channel 7 (Middle Channel)	2.437	16QAM	36Mbps
Channel 11 (Upper Channel)	2.462	16QAM	36Mbps
Channel 1 (Lower Channel)	2.412	64QAM	54Mbps
Channel 7 (Middle Channel)	2.437	64QAM	54Mbps
Channel 11 (Upper Channel)	2.462	64QAM	54Mbps

3. The channels as listed below, under the different configurations were tested for 802.11n WLAN.

<u>Transmit Channel</u>	<u>Frequency (GHz)</u>	<u>Modulation</u>	<u>Data Rate</u>
Channel 1 (Lower Channel)	2.412	BPSK	6.5Mbps
Channel 7 (Middle Channel)	2.437	BPSK	6.5Mbps
Channel 11 (Upper Channel)	2.462	BPSK	6.5Mbps
Channel 1 (Lower Channel)	2.412	QPSK	19.5Mbps
Channel 7 (Middle Channel)	2.437	QPSK	19.5Mbps
Channel 11 (Upper Channel)	2.462	QPSK	19.5Mbps
Channel 1 (Lower Channel)	2.412	16QAM	39Mbps
Channel 7 (Middle Channel)	2.437	16QAM	39Mbps
Channel 11 (Upper Channel)	2.462	16QAM	39Mbps
Channel 1 (Lower Channel)	2.412	64QAM	65Mbps
Channel 7 (Middle Channel)	2.437	64QAM	65Mbps
Channel 11 (Upper Channel)	2.462	64QAM	65Mbps

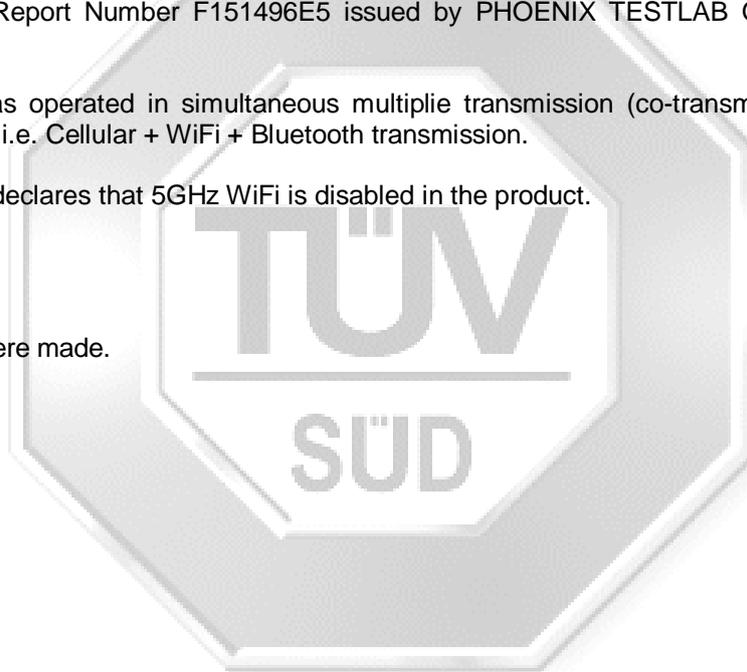


TEST SUMMARY

4. The EUT is a Class B device when in non-transmitting state and meets the 47 CFR FCC Part15B Class B requirements.
5. All test measurement procedures are according to ANSI C63.4: 2014, ANSI C63.10: 2013 and KDB 558074 D01 DTS Measurement Guidance V03R05.
6. The Equipment Under Test (EUT) is a battery operated device / DC operated device and contains no provision for public utility connections.
7. The EUT was tested using fully charged batteries with DC voltage of 12.2V.
8. PCI Limited declares that the WiFi Module (Model: ODIN-W2) used in the product is a FCC & IC certified module (FCC ID: PVH0965, IC: 5325A-0965). The module was integrated into the main board without modifications in hardware nor firmware and this WiFi Module used was tested and reported in Report Number F151496E5 issued by PHOENIX TESTLAB GmbH dated 16 October 2015.
9. The EUT was operated in simultaneous multiple transmission (co-transmission) mode during the assessment. i.e. Cellular + WiFi + Bluetooth transmission.
10. PCI Limited declares that 5GHz WiFi is disabled in the product.

Modifications

No modifications were made.



PRODUCT DESCRIPTION

Description	: The Equipment Under Test (EUT) is an E-Log And Fleet Management Device .
Applicant	: A4C-RM Acquisition LLC 855 Woods Drive Skokies IL 60077 USA
Manufacturer	: PCI Limited 35 Pioneer Road North Singapore 628475
Factory (ies)	: Pt PCI Elektronik Internasional Panbil Industrial Estate Factory C Lot 2-3 Jalan Ahmad Yani Muka Kuning, Batam 29433 Indonesia
Model Number	: DC200
Contains FCC ID	: A4C01005A & QIPPS8
Serial Number	: Nil
Microprocessor	: STMicroelectronics STM32F746ZGT6 & IC ARM CORTEX M7 STM32 32-Bit LQFP144
Operating / Transmitting Frequency	: <u>Bluetooth</u> 2402MHz (lower channel) to 2480MHz (upper channel) 79 channels <u>Bluetooth LE</u> 2402MHz (lower channel) to 2480MHz (upper channel) 40 channels <u>WiFi 802.11b/g/n</u> 2412MHz (lower channel) to 2462MHz (upper channel) 11 channels
Clock / Oscillator Frequency	: 16MHz
Modulation	: 802.11b: CCK, DQPSK, DBPSK 802.11g: OFDM 802.11n: OFDM
Antenna Gain	: 3.0 dBi (Max)
Port / Connectors	: Refer to manufacturer's user manual / operating manual
Rated Input Power	: 12Vdc / 24Vdc
Accessories	: Nil



SUPPORTING EQUIPMENT DESCRIPTION

Equipment Description (Including Brand Name)	Model, Serial & FCC ID Number	Cable Description (List Length, Type & Purpose)
Rohde & Schwarz Universal Radio Communication Tester	M/N: CMU200 S/N: 112123 FCC ID: Nil	2.00m unshielded power cable





EUT OPERATING CONDITIONS

47 CFR FCC Part 15

- 1. Radiated Emissions (Spurious Emissions inclusive Restricted Bands Requirement)**
- 2. Band Edge Compliance (Radiated)**
- 3. Maximum Permissible Exposure**

The EUT was exercised by operating in maximum continuous transmission in test mode, i.e transmitting at lower, middle and upper channels respectively at one time.



RADIATED EMISSION TEST

47 CFR FCC Part 15.205 Restricted Bands

MHz		MHz		MHz		GHz	
0.090	- 0.110	16.42	- 16.423	399.9	- 410	4.5	- 5.15
0.495	- 0.505	16.69475	- 16.69525	608	- 614	5.35	- 5.46
2.1735	- 2.1905	16.80425	- 16.80475	960	- 1240	7.25	- 7.75
4.125	- 4.128	25.5	- 25.67	1300	- 1427	8.025	- 8.5
4.17725	- 4.17775	37.5	- 38.25	1435	- 1626.5	9.0	- 9.2
4.20725	- 4.20775	73	- 74.6	1645.5	- 1646.5	9.3	- 9.5
6.215	- 6.218	74.8	- 75.2	1660	- 1710	10.6	- 12.7
6.26775	- 6.26825	108	- 121.94	1718.8	- 1722.2	13.25	- 13.4
6.31175	- 6.31225	123	- 138	2200	- 2300	14.47	- 14.5
8.291	- 8.294	149.9	- 150.05	2310	- 2390	15.35	- 16.2
8.362	- 8.366	156.52475	- 156.52525	2483.5	- 2500	17.7	- 21.4
8.37625	- 8.38675	156.7	- 156.9	2690	- 2900	22.01	- 23.12
8.41425	- 8.41475	162.0125	- 167.17	3260	- 3267	23.6	- 24.0
12.29	- 12.293	167.72	- 173.2	3332	- 3339	31.2	- 31.8
12.51975	- 12.52025	240	- 285	3345.8	- 3358	36.43	- 36.5
12.57675	- 12.57725	322	- 335.4	3600	- 4400	Above 38.6	
13.36	- 13.41						

47 CFR FCC Parts 15.109(a) and 15.209 Radiated Emission Limits

Frequency Range (MHz)	Quasi-Peak Limit Values (dBµV/m)
0.009 - 0.490	20 log [2400 / F (kHz)] @ 300m
0.490 - 1.705	20 log [24000 / F (kHz)] @ 30m
1.705 - 30.0	30.0 @ 30m
30 - 88	40.0 @ 3m
88 - 216	43.5 @ 3m
216 - 960	46.0 @ 3m
Above 960	54.0* @ 3m

* For frequency bands 9kHz – 90kHz, 110kHz – 490kHz and above 1GHz, average detector was used. A peak limit of 20dB above the average limit does apply.

47 CFR FCC Parts 15.109(a) and 15.209 Radiated Emission Test Instrumentation

Instrument	Model	S/No	Cal Due Date
Rohde & Schwarz EMI Test Receiver (20Hz – 26.5GHz)	ESMI	849182/003 848926/007	22 Apr 2017
TDK RF Solutions Hybrid Log Periodic Antenna (30MHz-3GHz)	HLP-3003C	130238	22 Feb 2017
Sonoma Preamplifier (9kHz – 1GHz)	310N	270640	27 Dec 2017
Eletro-Metrics Double Ridged Antenna (Horn) Antenna (1-18GHz)	EM-6961	6525	24 Jan 2018
R&S Preamplifier (1GHz -18GHz)	SCU18	102191	11 Mar 2017
ETS Horn Antenna(18GHz-40GHz)(Ref)	3116	0004-2474	18 Oct 2017
Agilent Preamplifier(1GHz-26.5GHz) (PA18)	8449D	3008A02305	12 Oct 2017
Micro-tronics Bandstop Filter (2.4GHz)	BRM50701-02	007	13 Aug 2017
Micro-tronics Bandstop Filter (900MHz)	BRM14753	002	13 Aug 2017

RADIATED EMISSION TEST

47 CFR FCC Parts 15.109(a) and 15.209 Radiated Emission Test Setup

1. The EUT and supporting equipment were set up in accordance with the requirements of the standard on top of a 1.5m X 1.0m X 0.8m high, non-metallic table for measurement up to 1GHz. For measurement above 1GHz, 1.5m height table was used.
2. The filtered power supply for the EUT and supporting equipment were tapped from the appropriate power sockets located on the turntable.
3. The relevant broadband antenna was set at the required test distance away from the EUT and supporting equipment boundary.

47 CFR FCC Parts 15.109(a) and 15.209 Radiated Emission Test Method

1. The EUT was switched on and allowed to warm up to its normal operating condition.
2. A prescan was carried out to pick the worst emission frequencies from the EUT. For EUT which is a portable device, the prescan was carried out by rotating the EUT through three orthogonal axes to determine which altitude and equipment arrangement produces such emissions.
3. The test was carried out at the selected frequency points obtained from the prescan in step 2. 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.
4. A Quasi-peak measurement was made for that frequency point if it was less than or equal to 1GHz. For frequency point in the range of 9kHz – 90kHz, 110kHz – 490kHz and above 1GHz, both Peak and Average measurements were carried out.
5. Steps 3 and 4 were repeated for the next frequency point, until all selected frequency points were measured.
6. The frequency range covered was from the lowest radio frequency signal generated from the EUT, without going below 9kHz to 10th harmonics of the EUT fundamental frequency, using the loop antenna for frequency below 30MHz, Bi-log antenna for frequencies from 30MHz up to 1GHz, and the Horn antenna above 1GHz.

Sample Calculation Example

At 300 MHz	Q-P limit (Class B) = 46.0 dB μ V/m
Log-periodic antenna factor & cable loss at 300 MHz = 18.5 dB	
Q-P reading obtained directly from EMI Receiver = 40.0 dB μ V/m (Calibrated level including antenna factors & cable losses)	
Therefore, Q-P margin = 46.0 - 40.0 = 6.0	i.e. 6.0 dB below Q-P limit



RADIATED EMISSION TEST

47 CFR FCC Parts 15.109(a), 15.205 and 15.209 Radiated Emission Results

Test Input Power	12Vdc	Temperature	24°C
Test Distance	3m (<30MHz) 3m (≥30MHz – 25GHz)	Relative Humidity	60%
Worst Modulation	IEEE 802.11b @ 1Mbps	Atmospheric Pressure	1030mbar
		Tested By	Dylan Lin / Derrick Ng

Spurious Emissions ranging from 9kHz – 30MHz (for 9kHz – 90kHz, 110kHz – 490kHz) *See Note 5

Freq (GHz)	Peak Value (dBμV/m)	Peak Limit (dBμV/m)	Peak Margin (dB)	AV Value (dBμV/m)	AV Limit (dBμV/m)	AV Margin (dB)	Height (cm)	Azimuth (Degrees)	Pol (H/V)	Ch
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Spurious Emissions ranging from 9kHz – 30MHz *See Note 5

Frequency (MHz)	Q-P Value (dBμV/m)	Q-P Limit (dBμV/m)	Q-P Margin (dB)	Height (cm)	Azimuth (Degrees)	Pol (H/V)	Channel
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Spurious Emissions ranging from 30MHz – 1GHz

Frequency (MHz)	Q-P Value (dBμV/m)	Q-P Limit (dBμV/m)	Q-P Margin (dB)	Height (cm)	Azimuth (Degrees)	Pol (H/V)	Channel (Worst)
31.0890	21.4	40.0	18.6	101	210	V	11
68.0990	27.4	40.0	12.6	201	96	V	11
72.4540	31.8	40.0	8.2	201	96	V	11
81.1620	21.5	40.0	18.5	201	100	V	11
176.9550	30.3	43.5	13.2	201	70	V	11
201.9920	39.0	43.5	4.5	101	328	V	11



RADIATED EMISSION TEST

47 CFR FCC Parts 15.109(a), 15.205 and 15.209 Radiated Emission Results

Spurious Emissions above 1GHz - 25GHz

Freq (GHz)	Peak Value (dBµV/m)	Peak Limit (dBµV/m)	Peak Margin (dB)	AV Value (dBµV/m) *See Note 2	AV Limit (dBµV/m)	AV Margin (dB) *See Note 3	Height (cm)	Azimuth (Degrees)	Pol (H/V)	Ch
1.1683	37.9	74.0	36.1	--	54.0	16.1	199	27	H	1
3.4521	46.0	74.0	28.0	--	54.0	8.0	199	343	H	1
4.3330	50.8	74.0	23.2	--	54.0	3.2	101	177	H	1
6.7945	46.6	74.0	27.4	--	54.0	7.4	100	337	V	1
7.9257	46.6	74.0	27.4	--	54.0	7.4	100	264	V	1
9.0973	48.2	74.0	25.8	--	54.0	5.8	100	148	V	1

Spurious Emissions above 1GHz - 25GHz

Freq (GHz)	Peak Value (dBµV/m)	Peak Limit (dBµV/m)	Peak Margin (dB)	AV Value (dBµV/m) *See Note 2	AV Limit (dBµV/m)	AV Margin (dB) *See Note 3	Height (cm)	Azimuth (Degrees)	Pol (H/V)	Ch
1.2581	37.8	74.0	36.2	--	54.0	16.2	100	108	H	6
3.3174	46.0	74.0	28.0	--	54.0	8.0	100	70	H	6
4.6865	51.9	74.0	22.1	--	54.0	2.1	100	289	H	6
6.8349	46.2	74.0	27.8	--	54.0	7.8	100	326	V	6
7.8719	47.8	74.0	26.2	--	54.0	6.2	100	352	V	6
8.3028	47.2	74.0	26.8	--	54.0	6.8	100	307	V	6

Spurious Emissions above 1GHz - 25GHz

Freq (GHz)	Peak Value (dBµV/m)	Peak Limit (dBµV/m)	Peak Margin (dB)	AV Value (dBµV/m) *See Note 2	AV Limit (dBµV/m)	AV Margin (dB) *See Note 3	Height (cm)	Azimuth (Degrees)	Pol (H/V)	Ch
1.6677	51.0	74.0	23.0	--	54.0	3.0	100	275	H	11
3.3174	53.2	74.0	20.8	--	54.0	0.8	100	289	H	11
7.5756	48.0	74.0	26.0	--	54.0	6.0	100	91	V	11
8.8145	48.1	74.0	25.9	--	54.0	5.9	100	330	V	11
9.5552	48.1	74.0	25.9	--	54.0	5.9	100	315	V	11
10.3901	48.5	74.0	25.5	--	54.0	5.5	100	310	V	11

RADIATED EMISSION TEST

Notes

1. All possible modes of operation were investigated. Only the worst case emissions measured, using the correct CISPR detectors, are reported. All other emissions were relatively insignificant.
2. As the measured peak shows compliance to the average limit, as such no average measurement was required.
3. The average margin indicates the margin of the measured peak value below the average limit.
4. "--" indicates no emissions were found and shows compliance to the limits.
5. The measurement was done at 3m. The measured results were extrapolated to the specified test limits as specified in § 15.209 (a) based on 40dB/decade.
6. Quasi-peak measurement was used for frequency measurement up to 1GHz. Average and peak measurements were used for emissions above 1GHz. The average measurement was done by averaging over a complete cycle of the pulse train, including the blanking interval as the pulse train duration does not exceed 0.1 second.
7. A "positive" margin indicates a PASS as it refers to the margin present below the limit line at the particular frequency. Conversely, a "negative" margin indicates a FAIL.
8. EMI receiver Resolution Bandwidth (RBW) and Video Bandwidth (VBW) settings:
30MHz - 1GHz
RBW: 120kHz VBW: 1MHz
>1GHz
RBW: 1MHz VBW: 3MHz
9. The upper frequency of radiated emission investigations was according to requirements stated in Section 15.33(a) for intentional radiators & Section 15.33(b) for unintentional radiators.
10. The channel in the table refers to the transmit channel of the EUT.
11. Radiated Emissions Measurement Uncertainty
All test measurements carried out are traceable to national standards. The uncertainty of the measurement at a confidence level of approximately 95%, with a coverage factor of 2, in the range 30MHz – 25GHz is ± 4.0 dB.

BAND EDGE COMPLIANCE (RADIATED) TEST

47 CFR FCC Part 15.247(d) Band Edge Compliance (Radiated) Limits

The EUT shows compliance to the requirements of this section, which states in any 100kHz bandwidth outside the frequency band in which the spread spectrum intentional radiator (EUT) is operating, the radio frequency power that is produced by the EUT shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power. In addition, radiated emissions which fall in the restricted bands shall comply to the radiated emission limits specified in 15.209.

47 CFR FCC Part 15.247(d) Band Edge Compliance (Radiated) Test Instrumentation

Instrument	Model	S/No	Cal Due Date
Rohde & Schwarz EMI Test Receiver (20Hz – 26.5GHz)	ESMI	849182/003 848926/007	22 Apr 2017
Eletro-Metrics Double Ridged Antenna (Horn) Antenna (1-18GHz)	EM-6961	6525	24 Jan 2018
R&S Preamplifier (1GHz -18GHz)	SCU18	102191	11 Mar 2017
Micro-tronics Bandstop Filter (900MHz)	BRM14753	002	13 Aug 2017

47 CFR FCC Part 15.247(d) Band Edge Compliance (Radiated) Test Setup

1. The EUT and supporting equipment were set up as shown in the setup photo.
2. The power supply for the EUT was connected to a filtered mains.
3. The resolution bandwidth (RBW) and the video bandwidth (VBW) of the spectrum analyser were respectively set to 100kHz and 300kHz to show compliance of spurious at band edges are at least 20dB below the carriers. For restricted band spurious at band edges, peak and average measurement plots were taken using the following setting:
 - a. Peak Plot:
RBW = 1MHz, VBW = 3RBW
 - b. Average Plot
RBW = 1MHz, VBW = 10Hz
4. All other supporting equipment were powered separately from another filtered mains.

47 CFR FCC Part 15.247(d) Band Edge Compliance (Radiated) Test Method

1. The EUT was switched on and allowed to warm up to its normal operating condition. The EUT was then configured to operate in the test mode with specified modulation and data rate.
2. The frequency span of the spectrum analyser was set to wide enough to capture the lower band edge of the transmission band, 2.400GHz and any spurious emissions at the band edge.
3. The spectrum analyser was set to max hold to capture any spurious emissions within the span. The signal capturing was continuous until no further spurious emissions were detected.
4. Repeat steps 1 to 3 with all possible modulations and data rates.
5. The steps 2 to 4 were repeated with the frequency span of the spectrum analyser was set to wide enough to capture the upper band edge frequency of the transmission band, 2.4835GHz and the any spurious emissions at the band-edge.



BAND EDGE COMPLIANCE (RADIATED) TEST

47 CFR FCC Part 15.247(d) Band Edge Compliance (Radiated) Results

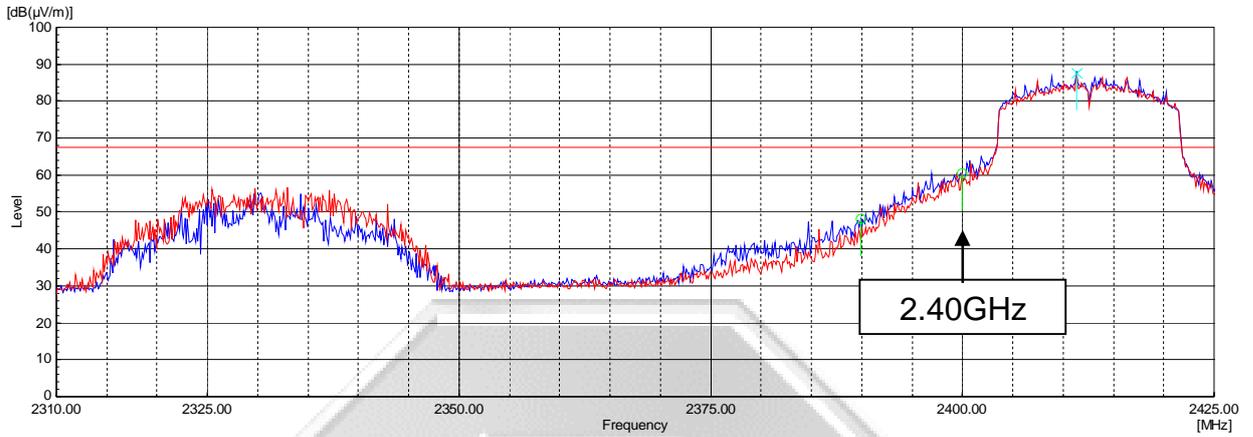
Test Input Power	12Vdc	Temperature	24°C
Attached Plots	1 – 6	Relative Humidity	60%
Worst Modulation	IEEE 802.11n @ 6.5Mbps	Atmospheric Pressure	1030mbar
		Tested By	Nazrulhizat

No significant signal was found and they were below the specified limit.

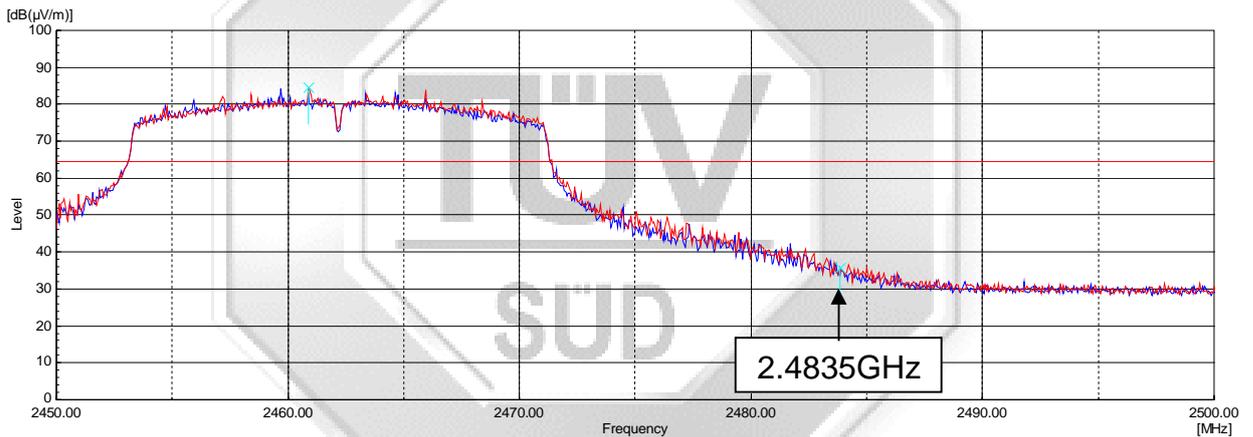


BAND EDGE COMPLIANCE (RADIATED) TEST

Band Edge Compliance (Radiated) Plots (20dB Delta from Carrier at Band Edge)



Plot 1 – Lower Band Edge at 2.4000GHz @ CCK 1Mbps

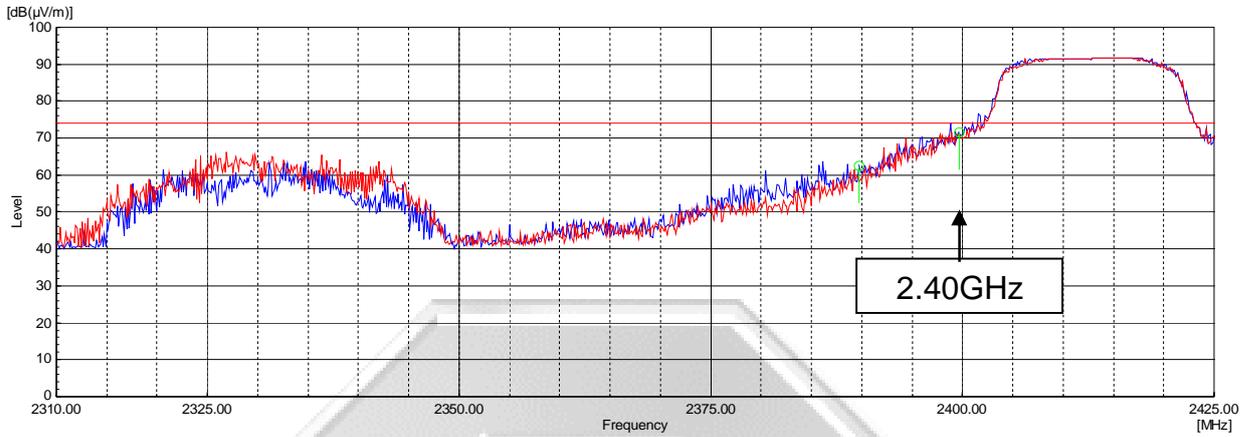


Plot 2 – Upper Band Edge at 2.4835GHz @ CCK 1Mbps

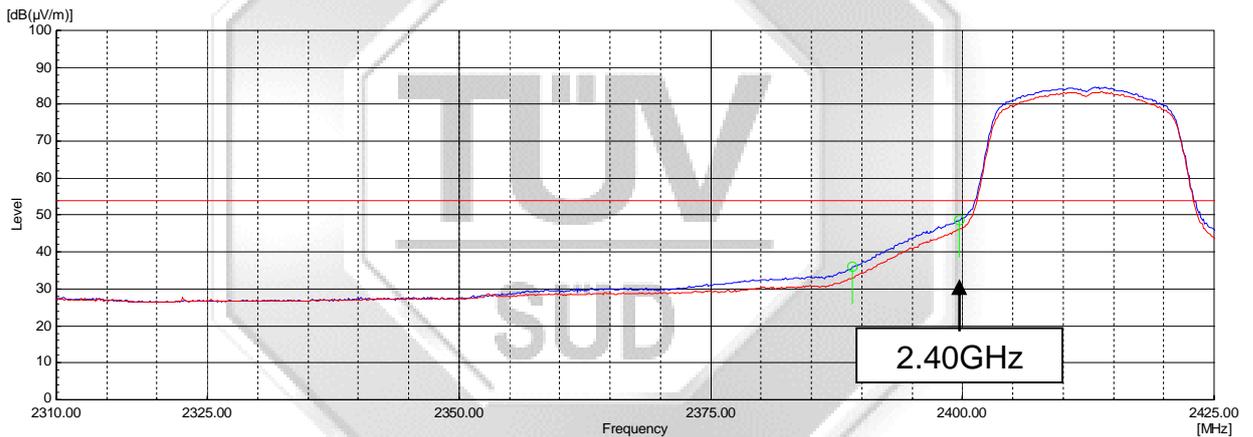


BAND EDGE COMPLIANCE (RADIATED) TEST

Band Edge Compliance (Radiated) Plots (Restricted Band)



Plot 3 – Peak Plot at Lower Band Edge at 2.4000GHz @ CCK 1Mbps

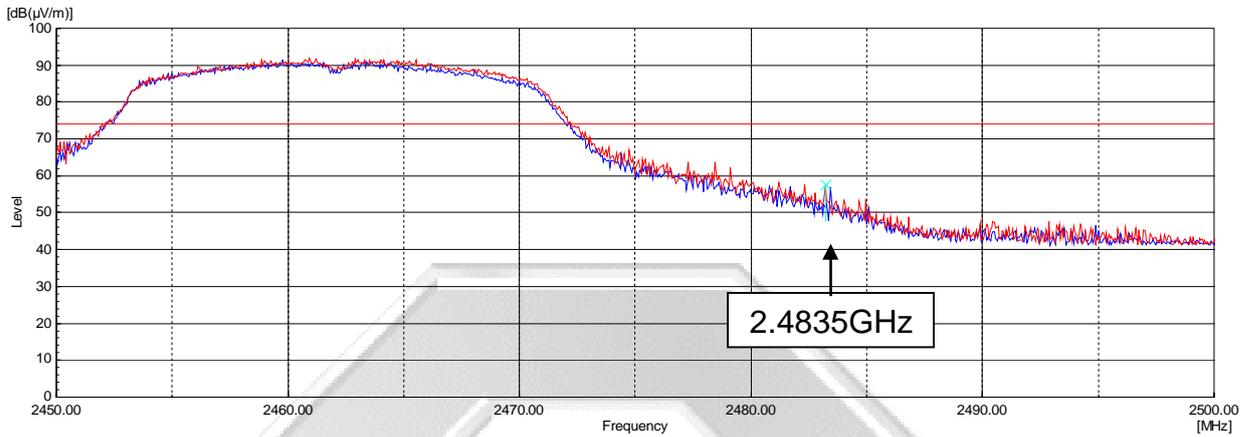


Plot 4 – Average Plot at Lower Band Edge at 2.4000GHz @ CCK 1Mbps

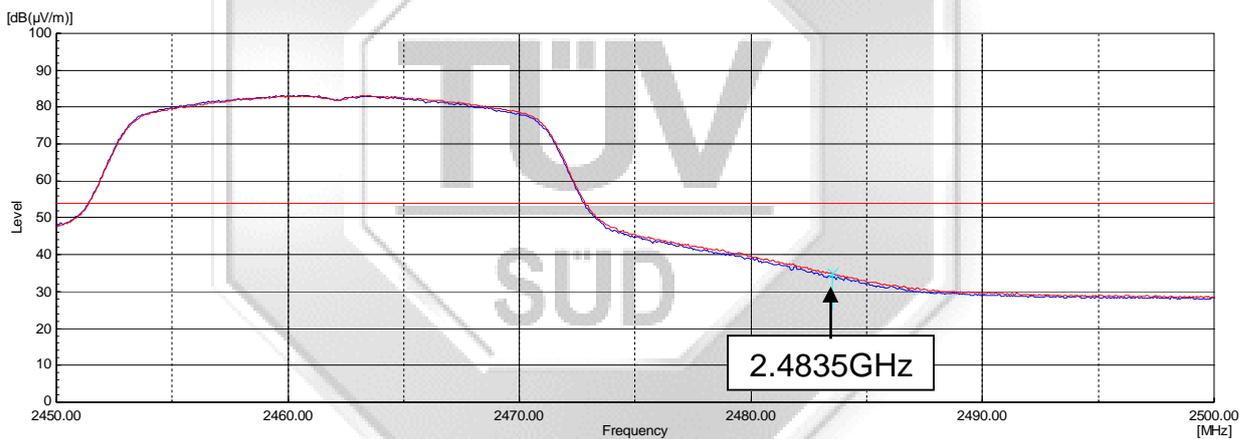


BAND EDGE COMPLIANCE (RADIATED) TEST

Band Edge Compliance (Radiated) Plots (Restricted Band)



Plot 5 – Peak Plot at Upper Band Edge at 2.4835GHz @ CCK 1Mbps



Plot 6 – Average Plot at Upper Band Edge at 2.4835GHz @ CCK 1Mbps



MAXIMUM PERMISSIBLE EXPOSURE (MPE) TEST

47 CFR FCC Part 1.1310 Maximum Permissible Exposure (MPE) Limits

The EUT shows compliance to the requirements of this section, which states the MPE limits for general population / uncontrolled exposure are as shown below:

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm ²)	Average Time (min)
0.3 - 1.34	614	1.63	100 ^{Note 2}	30
1.34 - 30	824 / f	2.19 / f	180 / f ² ^{Note 2}	30
30 - 300	27.5	0.073	0.2	30
300 - 1500	-	-	f / 1500	30
1500 - 100000	-	-	1.0	30
Notes				
1. f = frequency in MHz				
2. Plane wave equivalent power density				

47 CFR FCC Part 1.1310 Maximum Permissible Exposure (MPE) Test Instrumentation

Instrument	Model	S/No	Cal Due Date
PMM 8053 Portable Field Meter	8053	0220J10308	20 Jan 2019
PMM EP330 Electric Field Probe	EP330	1010J10301	20 Jan 2019

47 CFR FCC Part 1.1310 Maximum Permissible Exposure (MPE) Test Setup

- The EUT and supporting equipment were set up as shown on the setup photo.
- The relevant field probe was positioned at least 20cm away from the EUT and supporting equipment boundary.

47 CFR FCC Part 1.1310 Maximum Permissible Exposure (MPE) Test Method

- The EUT was switched on and allowed to warm up to its normal operating condition.
- The test was first carried out at one of the positions / sides of the EUT.
- Power density measurement (mW/cm²) was made using the field meter set to the required averaging time.
- Steps 2 and 3 were repeated for the next position and its associate EUT operating mode, until all possible positions and modes were measured.

Sample Calculation Example

At 2400 MHz, limit = 1.0 mW/cm²

Power density reading obtained directly from field meter = 0.3 mW/cm² averaged over the required 30 minutes.

Therefore, margin = 0.3 – 1.0 = -0.7 mW/cm² i.e. 0.7 mW/cm² below limit



MAXIMUM PERMISSIBLE EXPOSURE (MPE) TEST

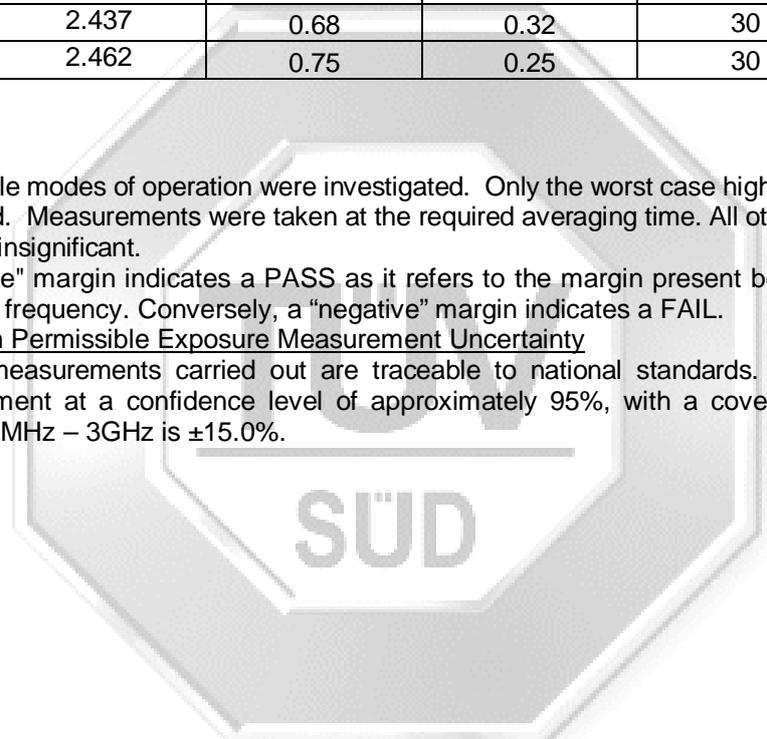
47 CFR FCC Part 1.1310 Maximum Permissible Exposure (MPE) Results

Test Input Power	12Vdc	Temperature	24°C
Test Distance	20cm	Relative Humidity	60%
		Atmospheric Pressure	1030mbar
		Tested By	Chang Wai Kit

Channel	Channel Frequency (GHz)	Power Density Value (mW/cm ²)	Margin (mW/cm ²)	Averaging Time (min)	Limit (mW/cm ²)
1 (lower ch)	2.412	0.71	0.29	30	1.0
6 (mid ch)	2.437	0.68	0.32	30	1.0
11 (upper ch)	2.462	0.75	0.25	30	1.0

Notes

1. All possible modes of operation were investigated. Only the worst case highest radiation levels were measured. Measurements were taken at the required averaging time. All other radiation levels were relatively insignificant.
2. A "positive" margin indicates a PASS as it refers to the margin present below the limit line at the particular frequency. Conversely, a "negative" margin indicates a FAIL.
3. Maximum Permissible Exposure Measurement Uncertainty
All test measurements carried out are traceable to national standards. The uncertainty of the measurement at a confidence level of approximately 95%, with a coverage factor of 2, in the range 0.1MHz – 3GHz is ±15.0%.





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July 2011

