Test Report No. 7191035552-EEC12/03
dated 18 Jun 2012

PSB Singapore

Choose certainty.
Add value.

Note: This report is issued subject to the Testing and Certification Regulations of the TÜV SÜD Group and the General Terms and Conditions of Business of TÜV SÜD PSB Pte Ltd. In addition, this report is governed by the terms set out within this report.

FORMAL REPORT ON TESTING IN ACCORDANCE WITH
47 CFR FCC Parts 15B & C : 2011
OF A
VEHICLE MOUNT TERMINAL (BLUETOOTH TRANSMITTER)
[Models : VM1 C & VM1 W]
[FCC ID : KDZLXE-VM1]

TEST FACILITIES	TÜV SÜD PSB Pte Ltd, Electrical & Electronics Centre (EEC), Product Services, No. 1 Science Park Drive, Singapore 118221 TÜV SÜD PSB Pte Ltd, Electrical & Electronics Centre (EEC), Product Services, 13 Internatonal Business Park #01-01, Singapore 609932
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)
PREPARED FOR	Honeywell International Inc 9680 Old Bailes Road, Fort Mill, SC 29707 USA Tel : 803-835-8220 Fax : 803-835-8097
QUOTATION NUMBER	219124671 & 219152743
JOB NUMBER	7191006338 & 7191035552
TEST PERIOD	30 May 2011 – 13 Jun 2011

PREPARED BY

Quek Keng Huat
Higher Associate Engineer

APPROVED BY

Lim Cher Hwee
Assistance Vice President

TÜV SÜD PSB

ilac-MRA ACCREDITED LABORATORY SAC-SINGLAS

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

The results reported herein have been performed in accordance with the laboratory's terms of accreditation under the Singapore Accreditation Council - Singapore Laboratory Accreditation Scheme. Tests/Calibrations marked "Not SAC-SINGLAS Accredited" in this Report are not included in the SAC-SINGLAS Accreditation Schedule for our laboratory.

Laboratory:
TÜV SÜD PSB Pte. Ltd.
No.1 Science Park Drive
Singapore 118221

Phone : +65-6885 1333
Fax : +65-6776 8670
E-mail: testing@tuv-sud-psb.sg
www.tuv-sud-psb.sg
Co. Reg : 199002667R

Regional Head Office:
TÜV SÜD Asia Pacific Pte. Ltd.
3 Science Park Drive, #04-01/05
The Franklin, Singapore 118223

TABLE OF CONTENTS

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: 2011		
15.107(a), 15.207	Conducted Emissions	Pass
15.109(a), 15.205, 15.209	Radiated Emissions (Spurious Emissions inclusive Restricted Bands Requirement)	Pass
15.247(a)(1)	Carrier Frequency Separation	Pass
	Spectrum Bandwidth (20dB Bandwidth Measurement)	Pass
15.247(a)(1)(iii)	Number of Hopping Frequencies	Pass
	Average Frequency Dwell Time	Pass
15.247(b)(1)	Maximum Peak Power	Pass
15.247(d)	RF Conducted Spurious Emissions	Pass
15.247(d)	Band Edge Compliance (Conducted)	Pass
15.247(d)	Band Edge Compliance (Radiated)	Pass
15.247(e)	Peak Power Spectral Density	Pass
1.1310	Maximum Permissible Exposure	Pass
15.35(c)	Duty Cycle Factor Computation	See Note 7

Notes

1. Three channels as listed below, which respectively represent the lower, middle and upper channels of the Equipment Under Test (EUT) were chosen and tested. For each channel, the EUT was configured to operate in the test mode.

Transmit Channel	Frequency (GHz)
Channel 0	2.402
Channel 39	2.441
Channel 78	2.480

2. All the measurements in section 15.247 were done based on conducted measurements.

3. The EUT is a Class B device when in non-transmitting state and meets the 47 CFR FCC Part15B Class B requirements.

4. All test measurement procedures are according to ANSI C63.4: 2003.

5. The maximum measured RF power of the Equipment Under Test is 4.77dBm.

6. Vehicle Mount Terminal (EUT) come with 2 types of keypad as shown:

7. The Equipment Under Test (EUT) was exercised in continuous transmission mode, ie 0 duty cycle.

8. The models VM1 C and VM1 W are under the VM1 family series. Both models contains the same circuitries, PCB layouts, PCB routing and components used. The difference between the models are:
   - VMI C uses the certified WLAN module (FCC ID: TWG-SDCMSD30AG)
   - VM1 W uses the certified WLAN module (FCC ID: TWG-SDCPE15N)

9. This report 7191035552-EEC12/03 was reproduced from the test report 7191006338-EEC11/03 to change applicant name from LXE Inc. to Honeywell International Inc. In addition, antenna information was added to ANNEX D.

10. The FCC Part 15, subpart E for SDC-MSD30AG was tested by Elliott Laboratories and was documented in report files R78443 and R78277.

Modifications

No modifications were made.

PRODUCT DESCRIPTION

Description	:	The Equipment Under Test (EUT) is a **VEHICLE MOUNT TERMINAL WITH QUICK MOUNT CRADLE.** It is designated for industrial environment and vehicle use. The terminal integrated with the following wireless modules: - Bluetooth module - certified WLAN module (FCC ID: TWG-SDCMSD30AG) (for VM1 C) - certified WLAN module (FCC ID: TWG-SDCPE15N) (for VM1 D) and - mobile telecom module (WWAN) (FCC ID: N7NGOBI2) It also integrated with audio function and basic I/O ports as follows: - serial-RS232 - USB and - CANBUS Input and output ports are available for peripheral support like power input, RS232, USB and CANBUS/Audio. The terminal can be powered by vehicle battery from 10V to 60V or an AC-DC adapter or UPS battery. The UPS battery provides an alternate power when the terminal is removed from the cradle mount or when the vehicle is powered off. The front panel of the display designated with 64-Key QWERTY keyboard and/or 13 functional keys. Four SMA antennas connectors are mounted at the top-rear for the housing panel for external connection.
Applicant	:	Honeywell International Inc 9680 Old Bailes Road, Fort Mill, SC 29707 USA
Manufacturer	:	GES Singapore Pte Ltd 28 Marsiling Lane, Singapore 739152
Factor (ies)	:	GES Manufacturing Services (M) Sdn Bhd PLO 34 Fasa 2, Kawasan Perindustrian Senai, 81400 Senai, Johor, Malaysia
Model Number	:	VM1 C & VM1 W
FCC ID		KDZLXE-VM1
Serial Number	:	VM1110300173 (Config#1: 64-Key) VM1110400348 (Config#2: 13-Key)
Microprocessor	:	Intel Atom, Z530

Continued

Operating Frequency	:	Bluetooth (FCC ID: KDZLXE-VM1) 2.412GHz - 2.480GHz WLAN 802.11a/b/g (FCC ID: TWG-SDCMSD30AG) 2.412GHz - 2.462GHz 5.180GHz to 5.240GHz 5.260GHz to 5.320GHz 5.500GHz to 5.700GHz WLAN 802.11a/b/g/n (FCC ID: TWG-SDCPE15N) 2.412GHz – 2.462GHz 2.422GHz – 2.452GHz 5.180GHz to 5.240GHz 5.260GHz to 5.320GHz 5.500GHz to 5.700GHz WWAN (FCC ID: N7NGOBI2) 824.2MHz – 848.8MHz 1850.2MHz – 1909.8MHz
Clock / Oscillator Frequency	:	Z530 CPU speed: 1.6GHz FSB, front-side bus: 400MHz, 533MHz Clock generator: 14.31818MHz, 100MHz, 133.33MHz, 200MHz, 1666.67MHz, Crystal clock (USB CAD BUS): 24MHz Crystal clock: 32.768kHz
Port / Connectors	:	Refer to manufacturer's user manual / operating manual
Rated Input Power	:	7-12Vdc, 7.5A (Terminal) 10Vdc to 60Vdc, 6.4A (Terminal and Quick Mount Cradle)
Accessories	:	Refer to manufacturer's user manual / operating manual

SUPPORTING EQUIPMENT DESCRIPTION

Equipment Description (Including Brand Name)	Model, Serial & FCC ID Number	Cable Description (List Length, Type & Purpose)
DMC Monitor	M/N: AM1564 S/N: MT71C3014046 FCC ID: I84AM1564	3.00m unshielded power cable
HP PC	M/N: HPDX2300 S/N: SGH73006RP FCC ID: DoC	1.80m unshielded power cable
Datamini Mouse	M/N: 80XX S/N: SG74800268 FCC ID: DoC	1.80m PS/2 cable
Symbol Scanner	M/N: SBRE S/N: M1J37F764 FCC ID: Nil	1.50m USB cable
HP Keyboard	M/N: SK-2501K S/N: M970936881 FCC ID: GYVR385K	1.80m PS/2 cable
CanBus Cable Power Adapter	M/N: GT81081-6015-T3 S/N: RCHS10082139/09 FCC ID: DoC	1.80m unshielded power cable
Microsoft Mouse	M/N: Nil S/N: Nil FCC ID: DoC	1.50m USB cable

47 CFR FCC Part 15
1. Conducted Emissions **2. Radiated Emissions (Spurious Emissions inclusive Restricted Bands Requirement)** **3. Spectrum Bandwidth (20dB Bandwidth Measurement)** **4. Maximum Peak Power** **5. RF Conducted Spurious Emissions** **6. Peak Power Spectral Density** **7. Maximum Permissible Exposure** **8. Duty Cycle Factor Computation**
The EUT was exercised by operating in maximum continuous transmission with frequency hopping off, i.e transmitting at lower, middle and upper channels respectively at one time.
47 CFR FCC Part 15
1. Carrier Frequency Separation **2. Number of Hopping Frequencies** **3. Average Frequency Dwell Time** **4. Band Edge Compliance (Conducted)** **5. Band Edge Compliance (Radiated)**
The EUT was exercised by operating in maximum continuous transmission with frequency hopping on.

47 CFR FCC Parts 15.107(a) and 15.207 Conducted Emission Limits

Frequency Range (MHz)	Limit Values (dBµV)	
	Quasi-peak (QP)	Average (AV)
0.15 - 0.5	66 – 56 *	56 – 46 *
0.5 - 5.0	56	46
5.0 - 30.0	60	50
* Decreasing linearly with the logarithm of the frequency		

47 CFR FCC Parts 15.107(a) and 15.207 Conducted Emission Test Instrumentation

Instrument	Model	S/No	Cal Due Date
Rohde & Schwarz EMI Test Receiver (9kHz-3GHz)	ESCI	100477	24 Sep 2011
Schaffner LISN 2-Line V-Network (EUT) (9kHz-30MHz)	NNB41	04/10152	14 Sep 2011
Schaffner LISN 2-Line V-Network (9kHz-30MHz)	NNB41	04/10151	14 Sep 2011

47 CFR FCC Parts 15.107(a) and 15.207 Conducted 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 1m x 0.8m high, non-metallic table.
2. The power supply for the EUT was fed through a 50Ω/50μH EUT LISN, connected to filtered mains.
3. The RF OUT of the EUT LISN was connected to the EMI test receiver via a low-loss coaxial cable.
4. All other supporting equipment were powered separately from another LISN.

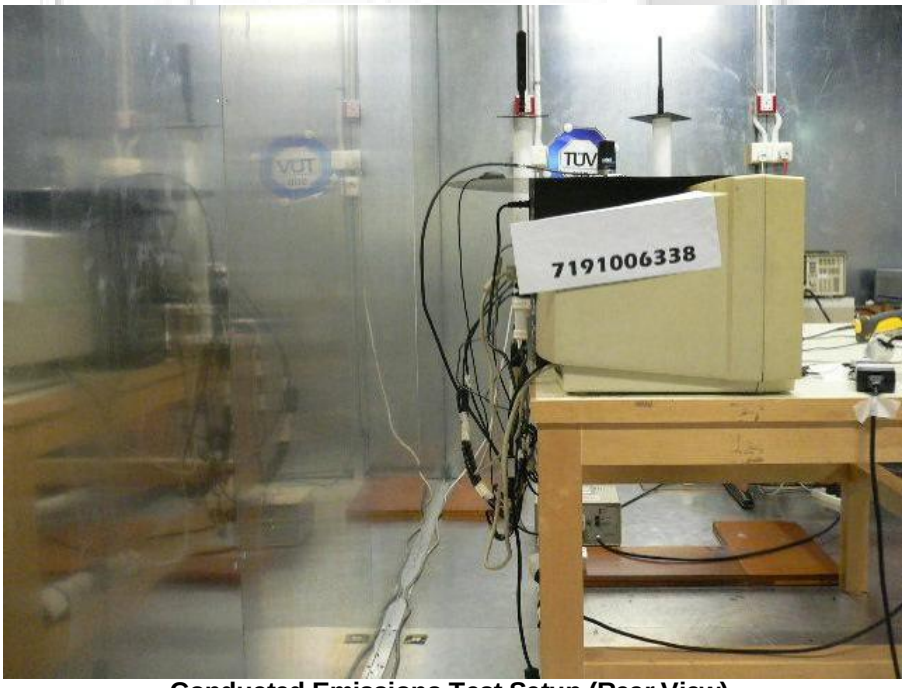
47 CFR FCC Parts 15.107(a) and 15.207 Conducted Emission Test Method

1. The EUT was switched on and allowed to warm up to its normal operating condition.
2. A scan was made on the NEUTRAL line over the required frequency range using an EMI test receiver.
3. High peaks, relative to the limit line, were then selected.
4. The EMI test receiver was then tuned to the selected frequencies and the necessary measurements made with a receiver bandwidth setting of 9kHz. Both Quasi-peak and Average measurements were made.
5. Steps 2 to 4 were then repeated for the LIVE line.

Sample Calculation Example

At 20 MHz	Q-P limit (Class B) = 1000 μV = 60.0 dBμV
Transducer factor of LISN, pulse limiter & cable loss at 20 MHz = 11.2 dB	
Q-P reading obtained directly from EMI Receiver = 40.0 dBμV (Calibrated for system losses)	
Therefore, Q-P margin = 40.0 - 60.0 = -20.0	i.e. 20.0 dB below Q-P limit

Conducted Emissions Test Setup (Front View)



Conducted Emissions Test Setup (Rear View)

47 CFR FCC Parts 15.107(a) and 15.207 Conducted Emission Results

Operating Mode	Internal Antenna + 802.11b/g + ITE + BT + Active Sync + WWAN mode (Worst mode)	Temperature	23°C
Test Input Power	110V 60Hz	Relative Humidity	58%
Line Under Test	AC Mains	Atmospheric Pressure	1030mbar
Class	B	Tested By	Kelvin Cheng

Frequency (MHz)	Q-P Value (dBµV)	Q-P Margin (dB)	AV Value (dBµV)	AV Margin (dB)	Line
0.1745	37.5	-27.2	17.7	-37.0	Neutral
0.7455	38.7	-17.3	33.5	-12.5	Live
2.6893	44.3	-11.7	41.4	-4.6	Live
7.6901	44.6	-15.4	43.9	-6.1	Live
9.8206	41.2	-18.8	40.4	-9.6	Neutral
15.3805	33.6	-26.4	31.8	-18.2	Live

Operating Mode	Internal Antenna + 802.11a + ITE + BT + Active Sync + WWAN mode (Worst mode)	Temperature	23°C
Test Input Power	110V 60Hz	Relative Humidity	58%
Line Under Test	AC Mains	Atmospheric Pressure	1030mbar
Class	B	Tested By	Kelvin Cheng

Frequency (MHz)	Q-P Value (dBµV)	Q-P Margin (dB)	AV Value (dBµV)	AV Margin (dB)	Line
0.7286	40.7	-15.3	35.9	-10.1	Live
6.2785	42.0	-18.0	35.1	-14.9	Live
6.8219	46.7	-13.3	39.1	-10.9	Live
7.7301	51.8	-8.2	43.6	-6.4	Live
9.8239	42.2	-17.8	34.2	-15.8	Live
11.8208	39.4	-20.6	31.5	-18.5	Live

Notes

1. All possible modes of operation were investigated from 150kHz to 30MHz. Only the worst case emissions measured, using the correct CISPR detectors, are reported. All other emissions were relatively insignificant.
2. A "-ve" margin indicates a PASS as it refers to the margin present below the limit line at the particular frequency.
3. EMI receiver Resolution Bandwidth (RBW) and Video Bandwidth (VBW) settings:
   9kHz - 30MHz
   RBW: 9kHz VBW: 30kHz
4. Conducted 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 9kHz – 30MHz is ±3.0dB.

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) @ 3m
30 - 88	40.0
88 - 216	43.5
216 - 960	46.0
Above 960	54.0*
* 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	829179/002 829179/005	28 Jul 2011
Sonoma Preamplifier (9kHz – 1GHz)	310N	270640	13 Sep 2012
Toyo MicroWave Preamplifier (1GHz - 8GHz)	TPA0108-40	0443	02 Feb 2012
EMCO Horn Antenna – H14	3115	0003-6087	19 May 2012
TDK RF Solutions Hybrid Log Periodic Antenna (30MHz-3GHz)	HLP-3003C	130237	30 May 2012
Micro-Tronics Bluetooth Notch Filter (Stopband 2.4 - 2.5GHz)	BRM50701-02	007	13 Aug 2012

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

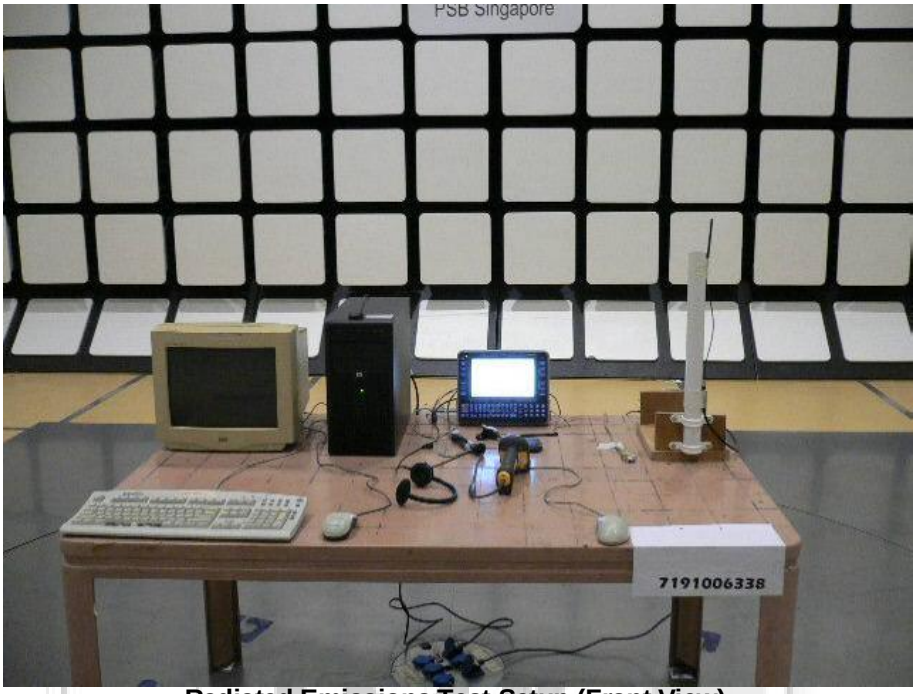
1. The EUT and supporting equipment were set up in accordance with the requirements of the standard on top of a 1.5m X 1.0m X 0.8m high, non-metallic table.
2. The filtered power supply for the EUT and supporting equipment were tapped from the appropriate power sockets located on the turntable.
3. The 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

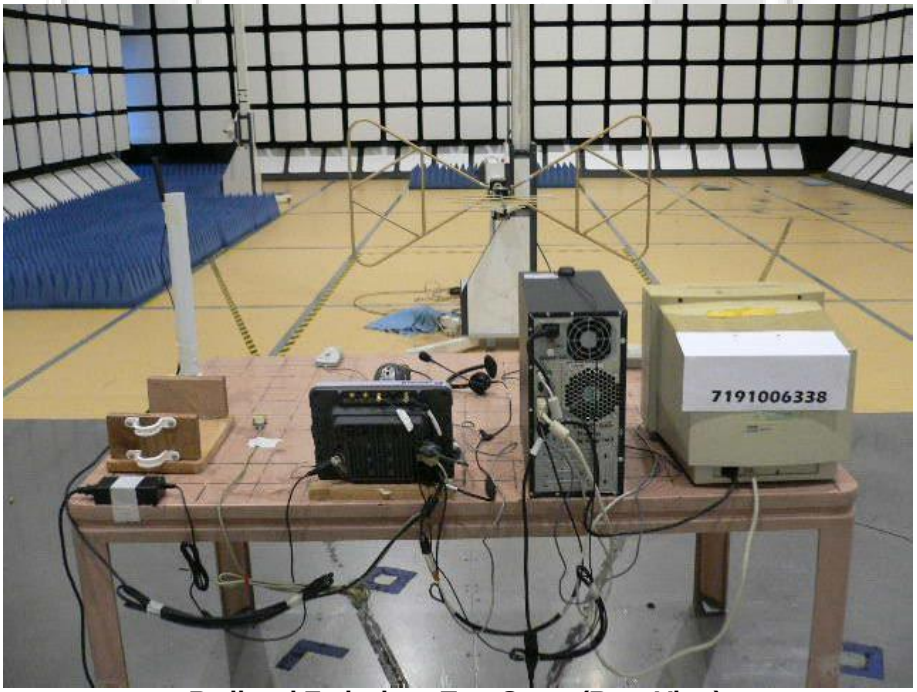
1. The EUT was switched on and allowed to warm up to its normal operating condition.
2. A prescan was carried out to pick the worst emission frequencies from the EUT. For EUT which is a portable device, the prescan was carried out by rotating the EUT through three orthogonal axes to determine which altitude 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 that 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 30MHz to 10th harmonics of the EUT fundamental frequency, using the 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) = 200 μV/m = 46.0 dBμV/m
Log-periodic antenna factor & cable loss at 300 MHz = 18.5 dB	
Q-P reading obtained directly from EMI Receiver = 40.0 dBμV/m (Calibrated level including antenna factors & cable losses)	
Therefore, Q-P margin = 40.0 - 46.0 = -6.0	i.e. 6 dB below Q-P limit



Radiated Emissions Test Setup (Front View)



Radiated Emissions Test Setup (Rear View)

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

Test Input Power	110V 60Hz	Temperature	23°C
Test Distance	3m	Relative Humidity	60%
		Atmospheric Pressure	1030mbar
		Tested By	Derrick Ng

Spurious Emissions ranging from 30MHz – 1GHz

Frequency (MHz)	Q-P Value (dBµV/m)	Q-P Margin (dB)	Azimuth (Degrees)	Height (cm)	Polarisation (H/V)	Channel
53.2920	39.3	-0.7	75	109	V	39
66.6550	38.5	-1.5	320	106	V	39
85.6390	28.7	-11.3	90	118	V	39
126.6480	32.0	-11.5	318	111	V	0
300.3500	42.2	-3.8	5	102	H	0
333.6840	45.2	-0.8	6	105	H	0

Spurious Emissions above 1GHz

Frequency (MHz)	Peak Value (dBµV/m)	Peak Margin (dB)	Average Value (dBµV/m)	Average Margin (dB)	Azimuth (Degrees)	Height (cm)	Pol (H/V)	Channel
1347.8900	53.3	-20.7	26.7	-27.3	353	288	V	0
3081.7200	42.1	-31.9	32.9	-21.1	353	101	V	0
4434.0000	44.5	-29.5	35.5	-18.5	353	101	H	0
5000.7200	49.4	-24.6	42.9	-11.1	7	188	H	0
13702.9300	37.1	-36.9	27.1	-26.9	9	101	V	0
17931.4700	42.9	-31.1	33.4	-20.6	8	101	V	0

Spurious Emissions above 1GHz

Frequency (MHz)	Peak Value (dBµV/m)	Peak Margin (dB)	Average Value (dBµV/m)	Average Margin (dB)	Azimuth (Degrees)	Height (cm)	Pol (H/V)	Channel
1336.6700	47.8	-26.2	29.9	-24.1	8	189	V	39
2290.5600	40.6	-33.4	29.4	-24.6	146	188	H	39
3121.0000	42.0	-32.0	32.0	-22.0	7	188	H	39
4832.3900	47.0	-27.0	40.4	-13.6	10	399	V	39
5314.9500	48.6	-25.4	39.6	-14.4	10	399	V	39
17864.1300	42.0	-32.0	33.3	-20.7	350	192	V	39

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

Spurious Emissions above 1GHz

Frequency (MHz)	Peak Value (dBµV/m)	Peak Margin (dB)	Average Value (dBµV/m)	Average Margin (dB)	Azimuth (Degrees)	Height (cm)	Pol (H/V)	Channel
1342.2800	45.1	-28.9	27.9	-26.1	7	187	H	78
1656.5000	41.7	-32.3	30.8	-23.2	8.8	101	V	78
1875.3300	43.4	-30.6	26.6	-27.4	9.6	399	H	78
4983.8900	50.9	-23.1	41.3	-12.7	7	187	H	78
13649.0700	37.6	-36.4	29.1	-24.9	352	189	V	78
17877.6000	42.5	-31.5	32.7	-21.3	352	189	V	78

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. 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
3. A "-ve" margin indicates a PASS as it refers to the margin present below the limit line at the particular frequency.
4. EMI receiver Resolution Bandwidth (RBW) and Video Bandwidth (VBW) settings:
   30MHz - 1GHz
   RBW: 120kHz VBW: 1MHz
   >1GHz
   RBW: 1MHz VBW: 1MHz
5. 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.
6. The channel in the table refers to the transmit channel of the EUT.
7. 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 ±4.6dB.

47 CFR FCC Part 15.247(a)(1) Carrier Frequency Separation Limits

The EUT shows compliance to the requirements of this section, which states the adjacent carrier frequencies must be separated by a minimum of 25kHz or the 20dB bandwidth of the hopping channel, whichever is greater. Alternatively, the EUT may have hopping channel carrier frequencies that are separated by 25kHz or two-thirds of the 20dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125mW (21dBm).

47 CFR FCC Part 15.247(a)(1) Carrier Frequency Separation Test Instrumentation

Instrument	Model	S/No	Cal Due Date
Agilent EMC Analyzer (9kHz-26.5GHz)	E7405A	US40240195	26 Mar 2012
GW Laboratory DC Power Supply	GPR-3030	1720403	Output Monitor

47 CFR FCC Part 15.247(a)(1) Carrier Frequency Separation 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 RF antenna connector was connected to the spectrum analyser via a low-loss coaxial cable.
4. The resolution bandwidth (RBW) and the video bandwidth (VBW) of the spectrum analyser were respectively set to 100kHz and 100kHz.
5. All other supporting equipment were powered separately from another filtered mains.

47 CFR FCC Part 15.247(a)(1) Carrier Frequency Separation 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 frequency hopping sequence on.
2. The start and stop frequencies of the spectrum analyser were set to 2.401GHz and 2.405GHz.
3. The spectrum analyser was set to max hold to capture the two adjacent transmitting frequencies within the span. The signal capturing was continuous until no further signals were detected.
4. The carrier frequency separation of the two adjacent transmitting / operating frequency was measured by finding the carrier frequency difference between the two adjacent channels.
5. The steps 2 to 4 were repeated with the following start and stop frequencies settings:
   a. 2.4835GHz to 2.4435GHz
   b. 2.475GHz to 2.483GHz

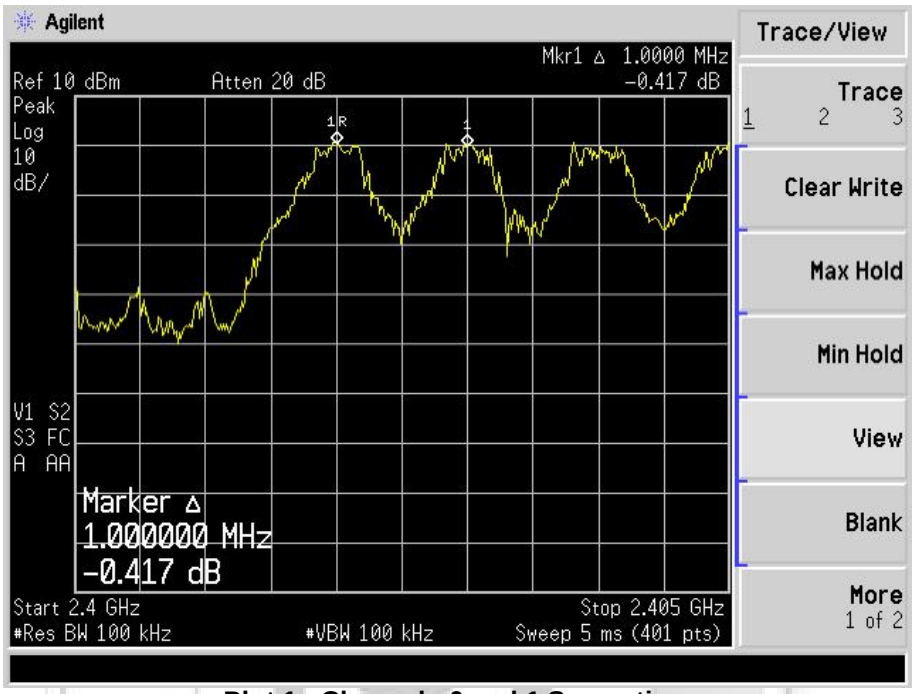
Carrier Frequency Separation Test Setup

47 CFR FCC Part 15.247(a)(1) Carrier Frequency Separation Results

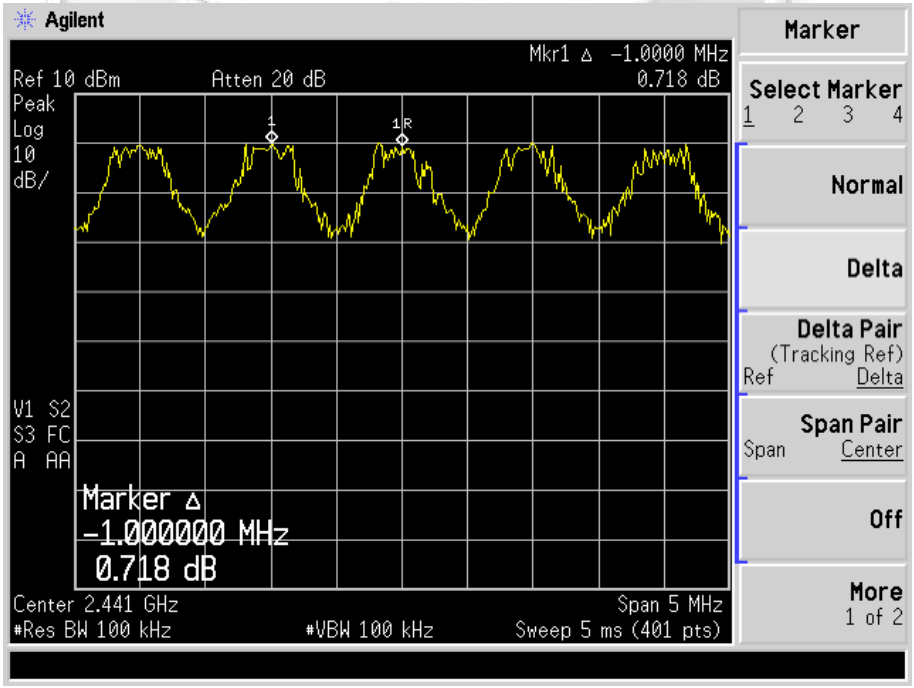
Test Input Power	36Vdc	Temperature	24°C
Attached Plots	1 - 4	Relative Humidity	60%
Data Type	DH5	Atmospheric Pressure	1030mbar
		Tested By	Zechs Ng Chee Siong

Adjacent Channels	Channel Separation (MHz)
0 and 1 (2.402GHz and 2.403GHz)	1.000
38 and 39 (2.440GHz and 2.441GHz)	1.000
39 and 40 (2.441GHz and 2.442GHz)	1.000
77 and 78 (2.479GHz and 2.480GHz)	1.000

Carrier Frequency Separation Plots

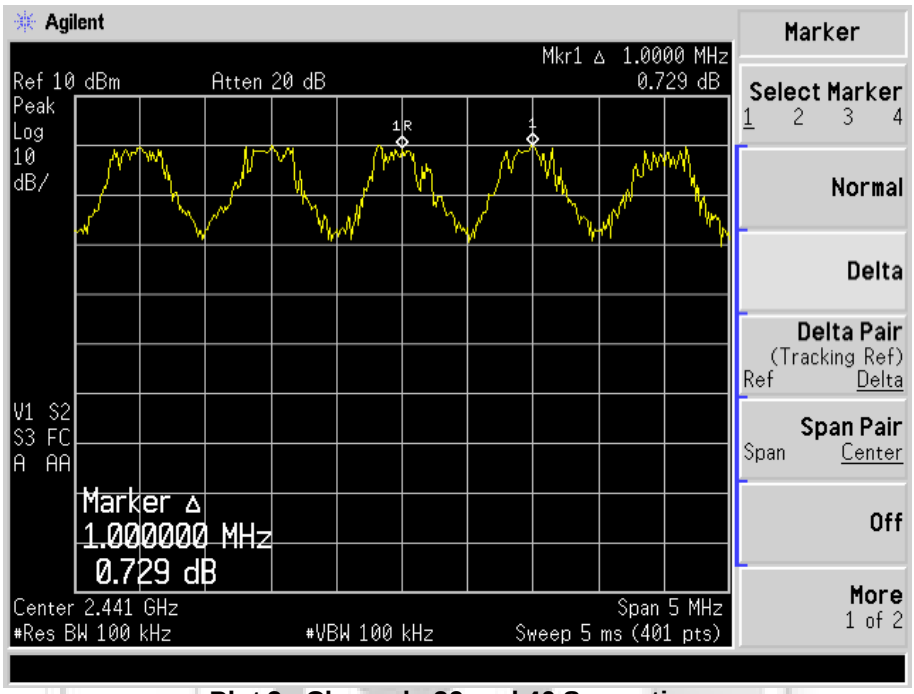


Plot 1 - Channels 0 and 1 Separation

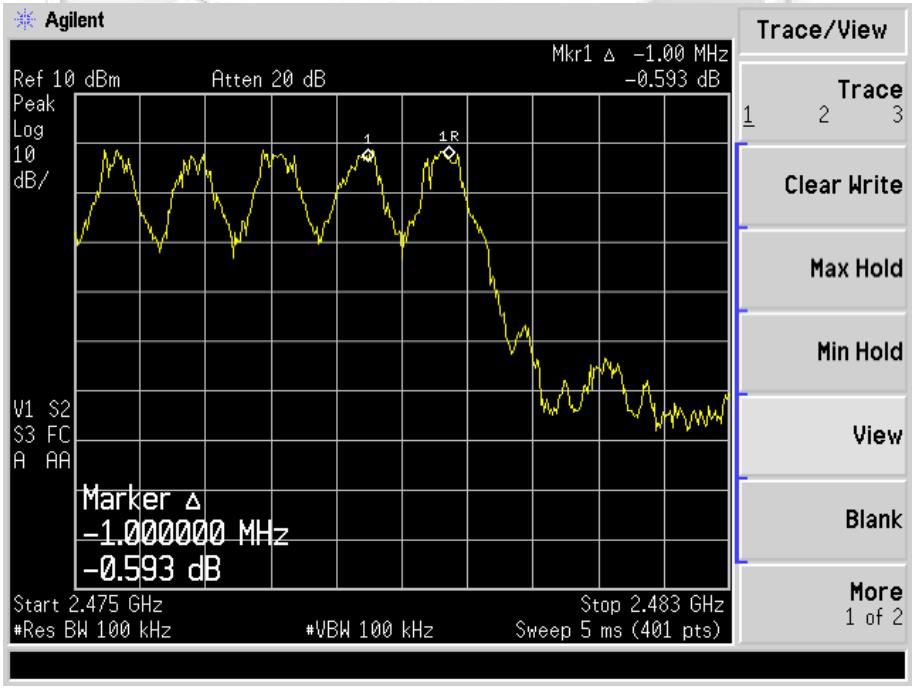


Plot 2 – Channels 38 and 39 Separation

Carrier Frequency Separation Plots



Plot 3 - Channels 39 and 40 Separation



Plot 4 - Channels 77 and 78 Separation

SPECTRUM BANDWIDTH (20dB BANDWIDTH MEASUREMENT) TEST

47 CFR FCC Part 15.247(a)(1) Spectrum Bandwidth (20dB Bandwidth Measurement) Limits

The EUT shows compliance to the requirements of this section, which states that the 20dB bandwidth of the hopping channel shall be the channel frequency separation by a minimum of 25kHz or the 20dB bandwidth of the hopping channel, whichever is greater.

47 CFR FCC Part 15.247(a)(1) Spectrum Bandwidth (20dB Bandwidth Measurement) Test Instrumentation

Instrument	Model	S/No	Cal Due Date
Agilent EMC Analyzer (9kHz-26.5GHz)	E7405A	US40240195	26 Mar 2012
GW Laboratory DC Power Supply	GPR-3030	1720403	Output Monitor

47 CFR FCC Part 15.247(a)(1) Spectrum Bandwidth (20dB Bandwidth Measurement) 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 RF antenna connector was connected to the spectrum analyser via a low-loss coaxial cable.
4. The resolution bandwidth (RBW) and the video bandwidth (VBW) of the spectrum analyser were respectively set to 10kHz and 30kHz.
5. All other supporting equipment were powered separately from another filtered mains.

47 CFR FCC Part 15.247(a)(1) Spectrum Bandwidth (20dB Bandwidth Measurement) 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, non-hopping with transmitting frequency at Channel 0 (2.402GHz).
2. The center frequency of the spectrum analyser was set to the transmitting frequency with the frequency span wide enough to capture the 20dB bandwidth of the transmitting frequency.
3. The spectrum analyser was set to max hold to capture the transmitting frequency. The signal capturing was continuous until no further changes were observed.
4. The peak of the transmitting frequency was detected with the marker peak function of the spectrum analyser. The frequencies below the 20dB peak frequency at lower (f_L) and upper (f_H) sides of the transmitting frequency were marked and measured by using the marker-delta function of the spectrum analyser.
5. The 20dB bandwidth of the transmitting frequency is the frequency difference between the marked lower and upper frequencies, $| f_H - f_L |$.
6. The steps 2 to 5 were repeated with the transmitting frequency was set to Channel 39 (2.441GHz) and Channel 78 (2.480GHz) respectively.

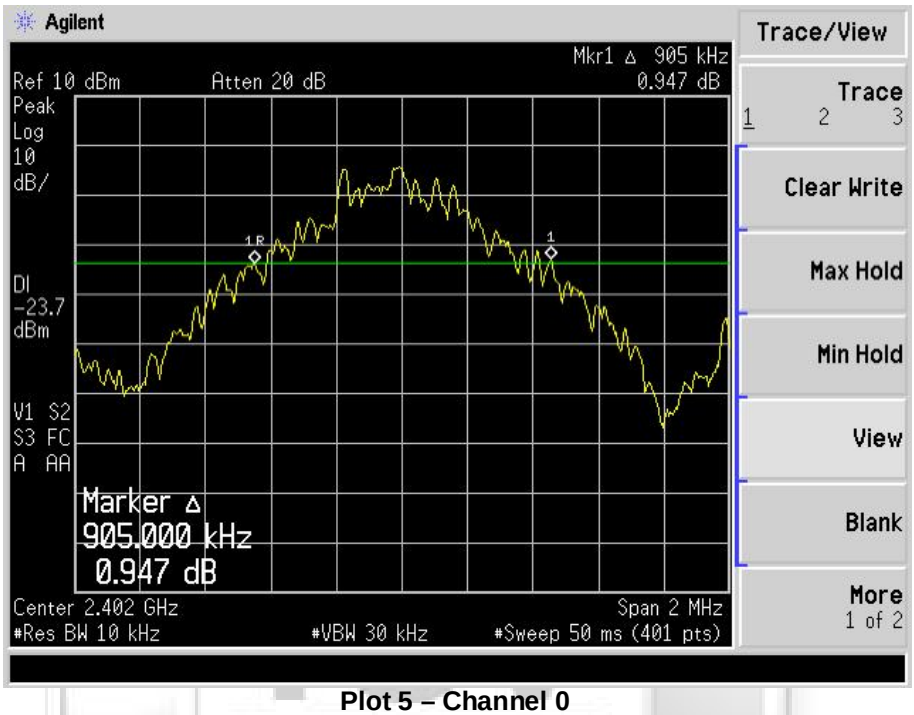
Spectrum Bandwidth (20dB Bandwidth Measurement) Test Setup

47 CFR FCC Part 15.247(a)(1) Spectrum Bandwidth (20dB Bandwidth Measurement) Results

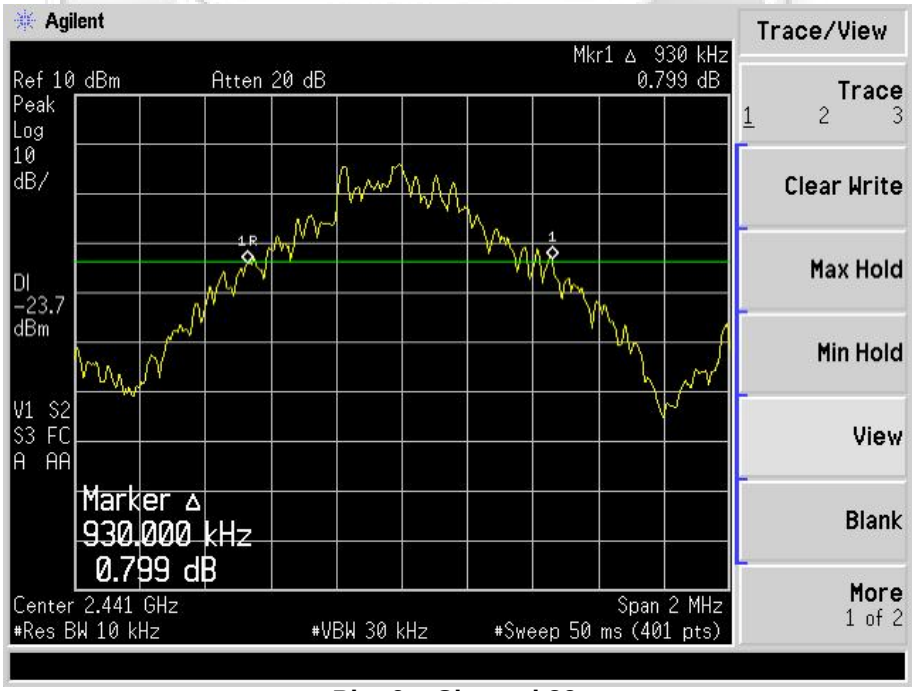
Test Input Power	36Vdc	Temperature	23°C
Attached Plots	5 - 7	Relative Humidity	60%
		Atmospheric Pressure	1030mbar
		Tested By	Zechs Ng Chee Siong

Channel	Channel Frequency (GHz)	20dB Bandwidth (MHz)
0	2.402	0.905
39	2.441	0.930
78	2.480	0.945

Spectrum Bandwidth (20dB Bandwidth Measurement) Plots

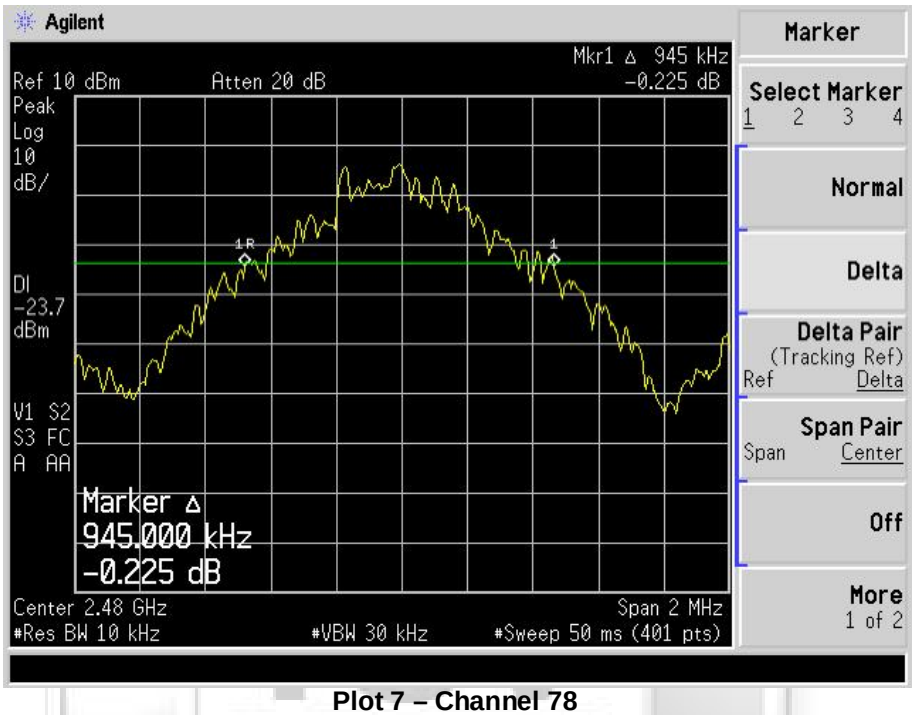


Plot 5 – Channel 0



Plot 6 – Channel 39

Spectrum Bandwidth (20dB Bandwidth Measurement) Plots



Plot 7 – Channel 78

47 CFR FCC Part 15.247(a)(1)(iii) Number of Hopping Frequencies Limits

The EUT shows compliance to the requirements of this section, which states the EUT shall use at least 15 channels.

47 CFR FCC Part 15.247(a)(1)(iii) Number of Hopping Frequencies Test Instrumentation

Instrument	Model	S/No	Cal Due Date
Agilent EMC Analyzer (9kHz-26.5GHz)	E7405A	US40240195	26 Mar 2012
GW Laboratory DC Power Supply	GPR-3030	1720403	Output Monitor

47 CFR FCC Part 15.247(a)(1)(iii) Number of Hopping Frequencies 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 RF antenna connector was connected to the spectrum analyser via a low-loss coaxial cable.
4. The resolution bandwidth (RBW) and the video bandwidth (VBW) of the spectrum analyser were respectively set to 100kHz and 100kHz.
5. All other supporting equipment were powered separately from another filtered mains.

47 CFR FCC Part 15.247(a)(1)(iii) Number of Hopping Frequencies 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 frequency hopping sequence on.
2. The start and stop frequencies of the spectrum analyser were set to 2.40GHz and 2.42GHz.
3. The spectrum analyser was set to max hold to capture all the transmitting frequencies within the span. The signal capturing was continuous until all the transmitting frequencies were captured and no further signals were detected.
4. The numbers of transmitting frequencies were counted and recorded.
5. The steps 2 to 4 were repeated with the following start and stop frequencies settings:
   a. 2.390GHz to 2.420GHz
   b. 2.420GHz to 2.441GHz
   c. 2.441GHz to 2.461GHz
   d. 2.461GHz to 2.483GHz
6. The total number of hopping frequencies is the sum of the number of the hopping frequencies found for each span.

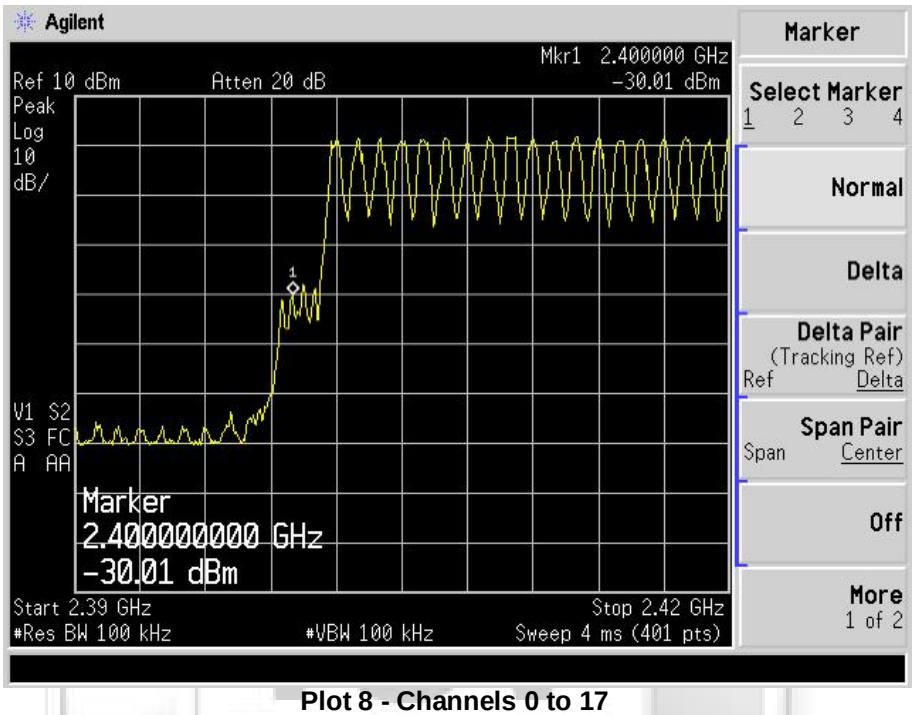
Number of Hopping Frequencies Test Setup

47 CFR FCC Part 15.247(a)(1)(iii) Number of Hopping Frequencies Results

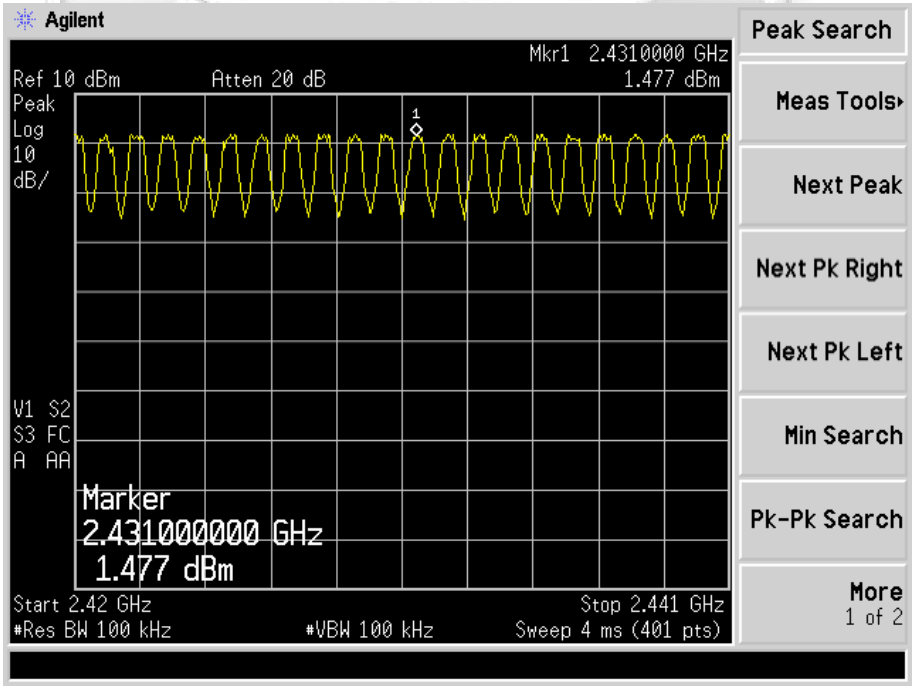
Test Input Power	36Vdc	Temperature	23°C
Attached Plots	8 - 11	Relative Humidity	60%
		Atmospheric Pressure	1030mbar
		Tested By	Zechs Ng Chee Siong

The EUT was found to have 79 hopping frequencies. Please refer to the attached plots.

Number Of Hopping Frequencies Plots

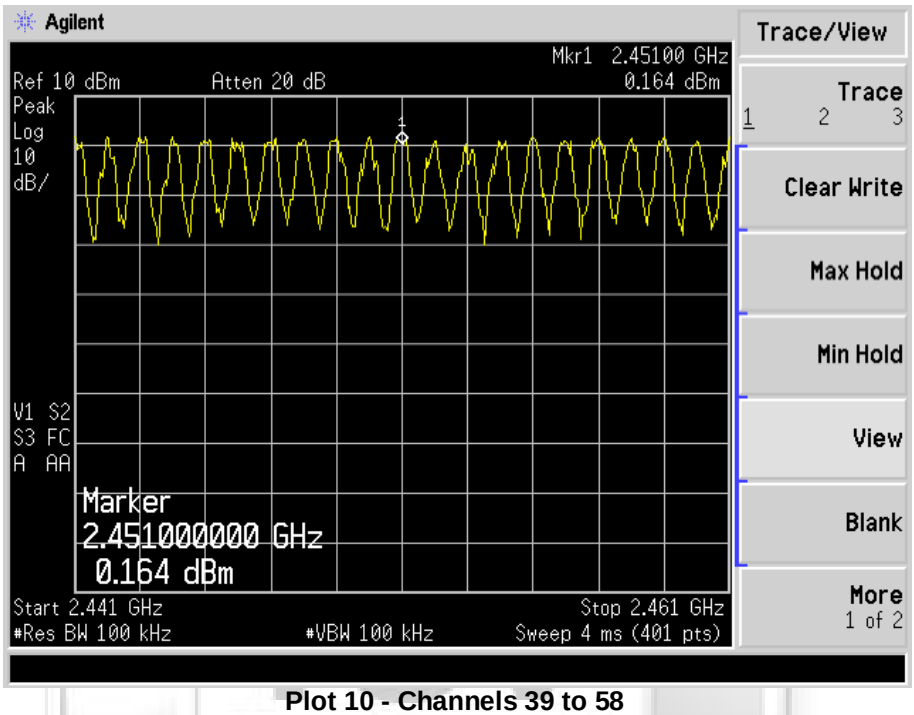


Plot 8 - Channels 0 to 17

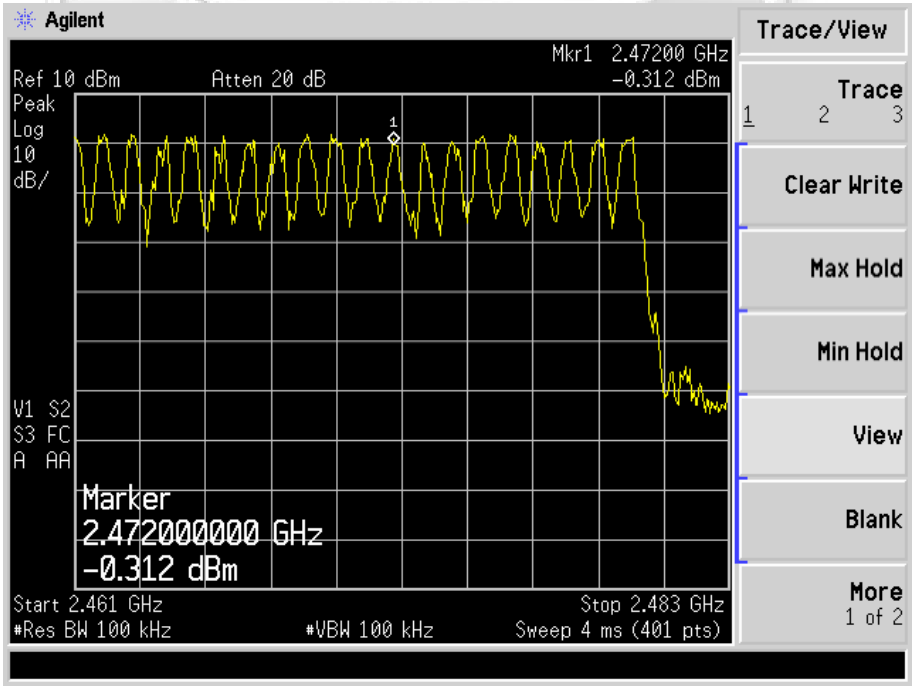


Plot 9 - Channels 18 to 38

Number Of Hopping Frequencies Plots



Plot 10 - Channels 39 to 58



Plot 11 - Channels 59 to 78

47 CFR FCC Part 15.247(a)(1)(iii) Average Frequency Dwell Time Limits

The EUT shows compliance to the requirements of this section, which states the average time of occupancy on any frequency shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed.

47 CFR FCC Part 15.247(a)(1)(iii) Average Frequency Dwell Time Test Instrumentation

Instrument	Model	S/No	Cal Due Date
Agilent EMC Analyzer (9kHz-26.5GHz)	E7405A	US40240195	26 Mar 2012
GW Laboratory DC Power Supply	GPR-3030	1720403	Output Monitor

47 CFR FCC Part 15.247(a)(1)(iii) Average Frequency Dwell 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 RF antenna connector was connected to the spectrum analyser via a low-loss coaxial cable.
4. The resolution bandwidth (RBW) and the video bandwidth (VBW) of the spectrum analyser were respectively set to 1MHz and 3MHz.
5. All other supporting equipment were powered separately from another filtered mains.

47 CFR FCC Part 15.247(a)(1)(iii) Average Frequency Dwell 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 frequency hopping sequence on.
2. The center frequency of the spectrum analyser was set to 2.402GHz with zero frequency span (spectrum analyser acts as an oscilloscope).
3. The sweep time of the spectrum analyser was adjusted until a stable signal can be seen on the spectrum analyser.
4. The duration (dwell time) of a packet was measured using the marker-delta function of the spectrum analyser. The average dwell time of the transmitting frequency was computed based on general expression as shown below:

   Average Frequency Dwell Time = [measured time slot length x hopping rate / number of hopping channels] x [0.4 x number of hopping channels]
5. The steps 2 to 4 were repeated with the center frequency of the spectrum analyser were set to 2.441GHz and 2.480GHz respectively.

Average Frequency Dwell Time Test Setup

47 CFR FCC Part 15.247(a)(1)(iii) Average Frequency Dwell Time Results

Test Input Power	36Vdc	Temperature	23°C
Attached Plots	12 – 14 (non-EDR) 15 – 17 (EDR)	Relative Humidity	60%
Hopping Rate	1600 hops / s	Atmospheric Pressure	1030mbar
Number of Hopping Channels	79 channels	Tested By	Zechs Ng Chee Siong

Non-EDR

Channel	Channel Frequency (GHz)	Average Frequency Dwell Time (s)	Average Occupancy Limit (s)
0	2.402	0.2016	0.4
39	2.441	0.1984	0.4
78	2.480	0.2000	0.4

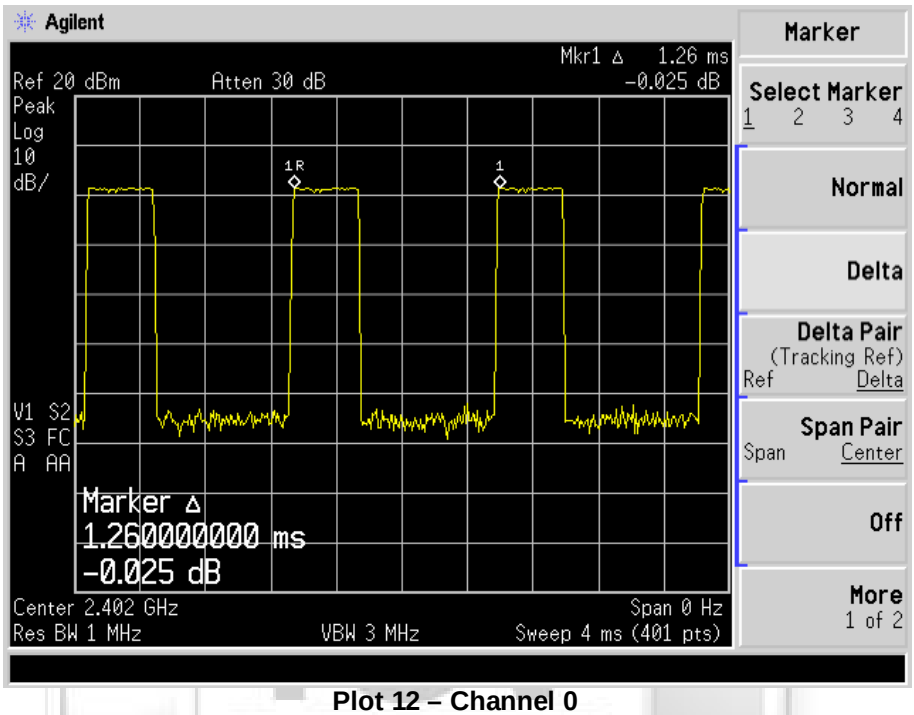
EDR

Channel	Channel Frequency (GHz)	Average Frequency Dwell Time (s)	Average Occupancy Limit (s)
0	2.402	0.2000	0.4
39	2.441	0.2020	0.4
78	2.480	0.2000	0.4

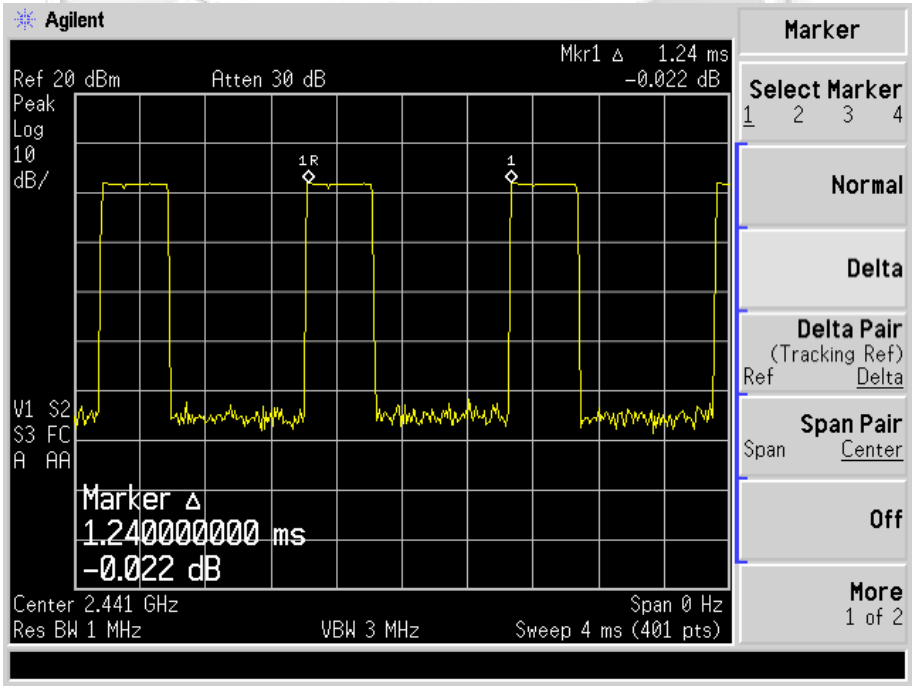
Notes

1. The EUT operates based on 1-slot transmission and 1-slot reception basis. As such, there are [1600 hops/s / (1 + 1)] transmissions per second and the time occupancy per channel is [measured time slot length / 2].
2. Average Frequency Dwell Time = [measured time slot length / 2 x hopping rate / 2 / number of hopping channels] x [0.4 x number of hopping channels]

Average Frequency Dwell Time Plots

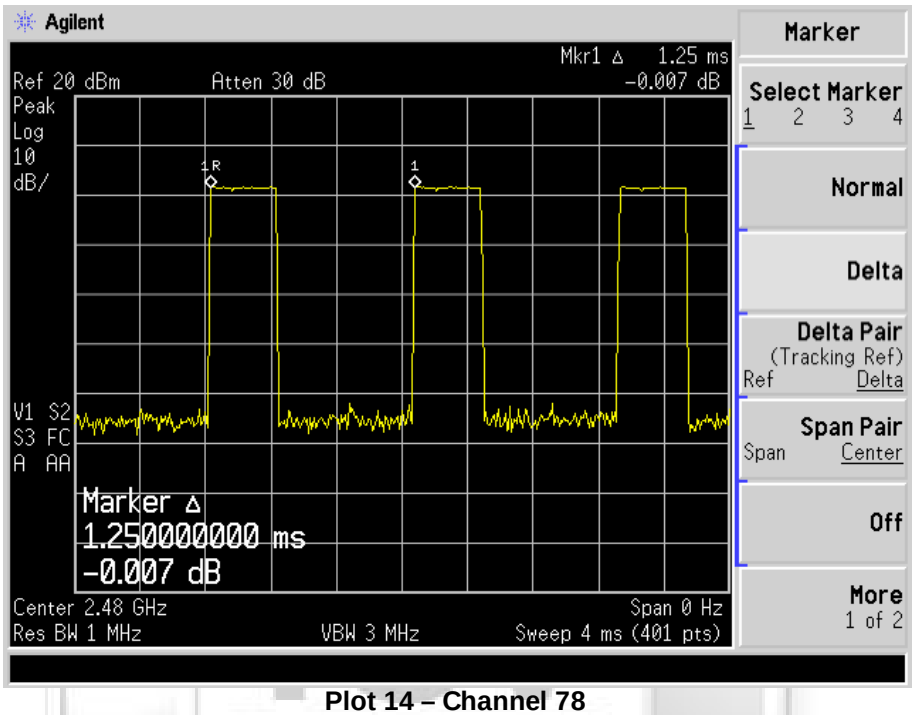


Plot 12 – Channel 0



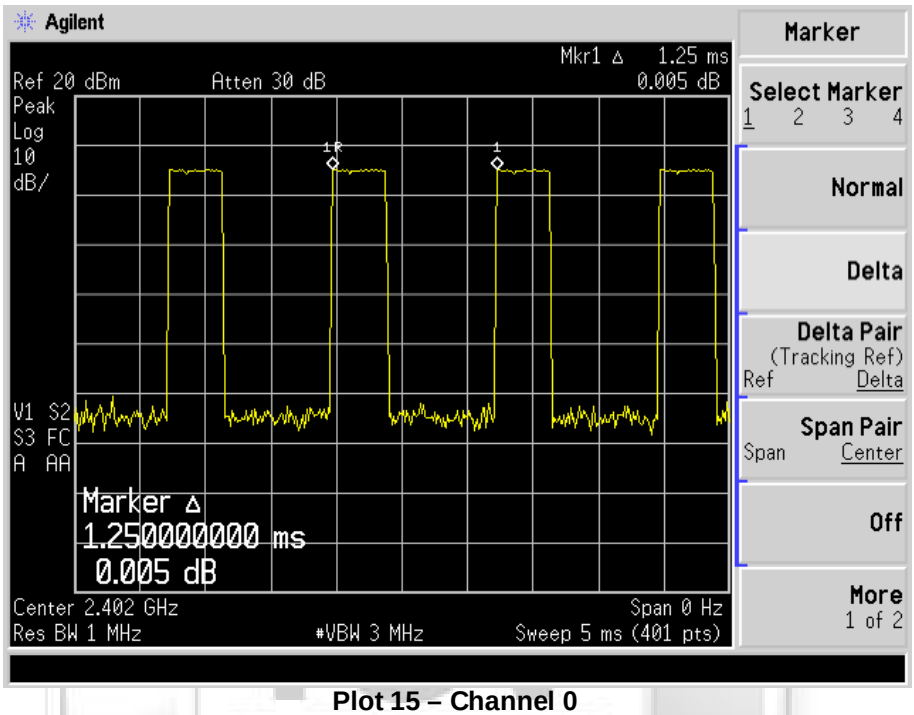
Plot 13 – Channel 39

Average Frequency Dwell Time Plots

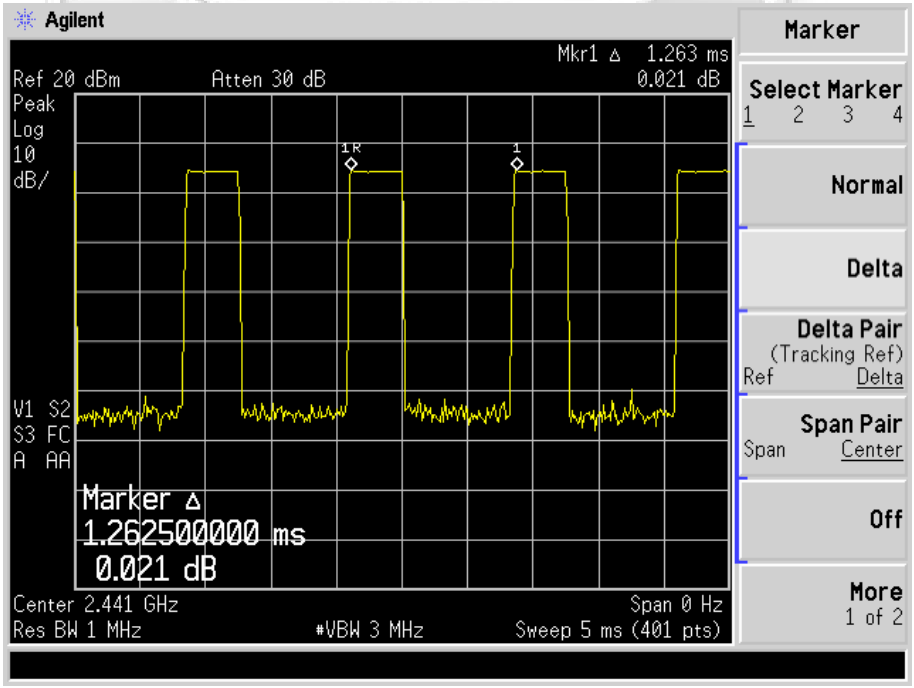


Plot 14 – Channel 78

Average Frequency Dwell Time Plots

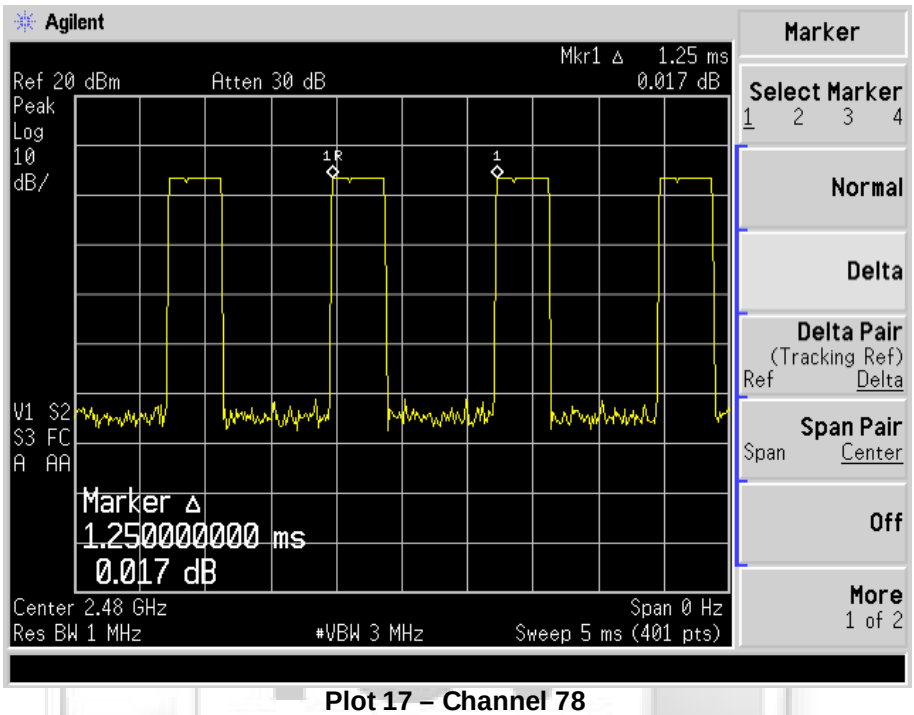


Plot 15 – Channel 0



Plot 16 – Channel 39

Average Frequency Dwell Time Plots



Plot 17 – Channel 78

47 CFR FCC Part 15.247(b)(1) Maximum Peak Power Limits

The EUT shows compliance to the requirements of this section, which states the EUT employing at least 75 non-overlapping hopping channels shall not exceed 1W (30dBm). For the EUT employs other frequency hopping systems, the peak power shall not greater than 0.125W (21dBm).

47 CFR FCC Part 15.247(b)(1) Maximum Peak Power Test Instrumentation

Instrument	Model	S/No	Cal Due Date
Boonton RF Power Meter	4532	72901	26 Mar 2012
Boonton Power Sensor	56218-S/1	1417	26 Mar 2012
GW Laboratory DC Power Supply	GPR-3030	1720403	Output Monitor

47 CFR FCC Part 15.247(b)(1) Maximum Peak Power 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 RF antenna connector was connected to the Universal Radio Communication Tester, which set into power analyser mode via a low-loss coaxial cable.
4. All other supporting equipment were powered separately from another filtered mains.

47 CFR FCC Part 15.247(b)(1) Maximum Peak Power 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, non-hopping with transmitting frequency at Channel 0 (2.402GHz).
2. The maximum peak power of the transmitting frequency was detected and recorded.
3. The Equivalent Isotropic Radiated Power (EIRP) of the EUT was computed by adding its antenna gain to the measured maximum peak power.
4. The steps 2 to 3 were repeated with the transmitting frequency was set to Channel 39 (2.441GHz) and Channel 78 (2.480GHz) respectively.

Maximum Peak Power Test Setup

47 CFR FCC Part 15.247(b)(1) Maximum Peak Power Results

Test Input Power	36Vdc	Temperature	23°C
Antenna Gain	-1.5 dBi	Relative Humidity	60%
		Atmospheric Pressure	1030mbar
		Tested By	Zechs Ng Chee Siong

Channel	Channel Frequency (GHz)	Maximum Peak Power (W)	Maximum EIRP (W)	Limit (W)
0	2.402	0.003	0.002	1.0
39	2.441	0.003	0.002	1.0
78	2.480	0.003	0.002	1.0

Notes

1. Power analyser of Universal Radio Communication Tester was used for power measurement with peak detection as mode of measurement. The power analyser mode supports a wideband power measurement ranging from 100kHz to 2700MHz.

47 CFR FCC Part 15.247(d) RF Conducted Spurious Emissions 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 desired power.

47 CFR FCC Part 15.247(d) RF Conducted Spurious Test Instrumentation

Instrument	Model	S/No	Cal Due Date
Agilent EMC Analyzer (9kHz-26.5GHz)	E7405A	US40240195	26 Mar 2012
GW Laboratory DC Power Supply	GPR-3030	1720403	Output Monitor

47 CFR FCC Part 15.247(d) RF Conducted Spurious Emissions 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 RF antenna connector was connected to the spectrum analyser via a low-loss coaxial cable.
4. The resolution bandwidth (RBW) and the video bandwidth (VBW) of the spectrum analyser were respectively set to 100kHz and 300kHz.
5. All other supporting equipment were powered separately from another filtered mains.

47 CFR FCC Part 15.247(d) RF Conducted Spurious Emissions 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, non-hopping with transmitting frequency at Channel 0 (2.402GHz).
2. The start and stop frequencies of the spectrum analyser were set to 30MHz and 10GHz.
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. The steps 2 to 3 were repeated with frequency span was set from 10GHz to 25GHz.
5. The steps 2 to 4 were repeated with the transmitting frequency was set to Channel 39 (2.441GHz) and Channel 78 (2.480GHz) respectively.

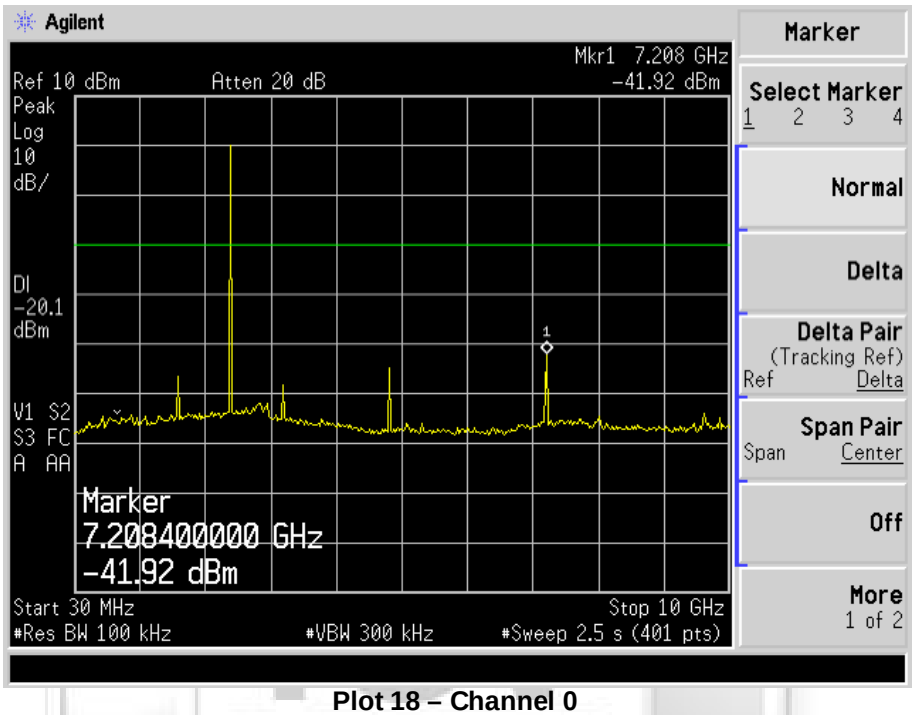
RF Conducted Spurious Emissions Test Setup

47 CFR FCC Part 15.247(d) RF Conducted Spurious Emissions Results

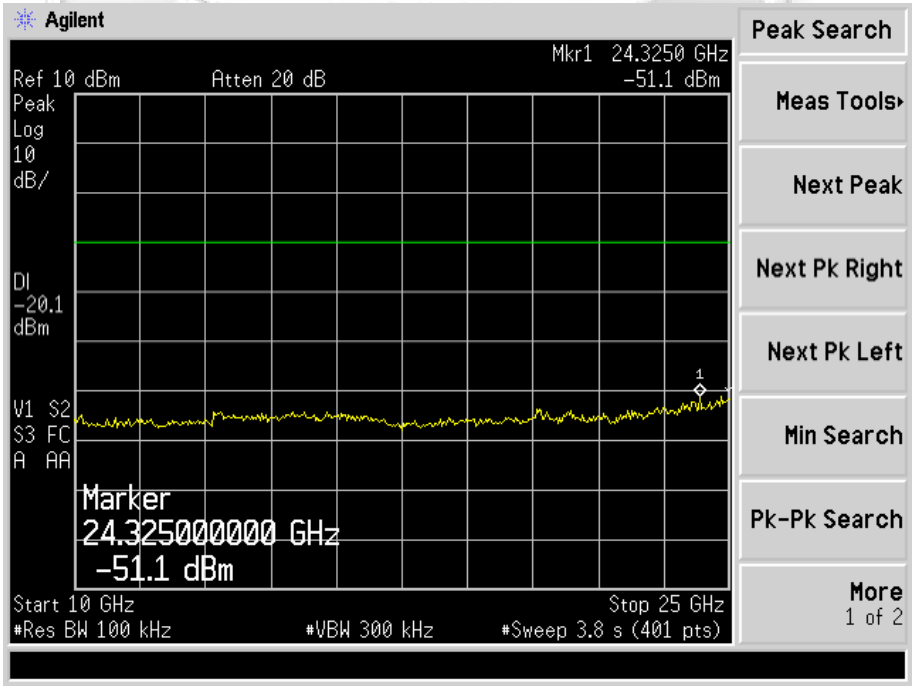
Test Input Power	36Vdc	Temperature	23°C
Attached Plots	18 - 23	Relative Humidity	60%
		Atmospheric Pressure	1030mbar
		Tested By	Zechs Ng Chee Siong

All spurious signals found were below the specified limit. Please refer to the attached plots.

RF Conducted Spurious Emissions Plots

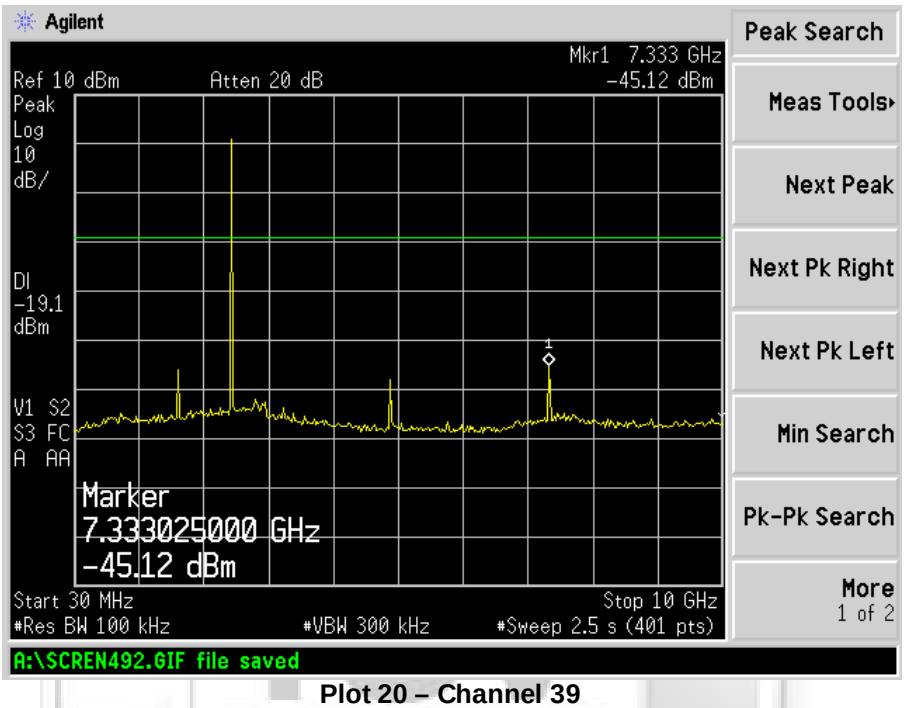


Plot 18 – Channel 0

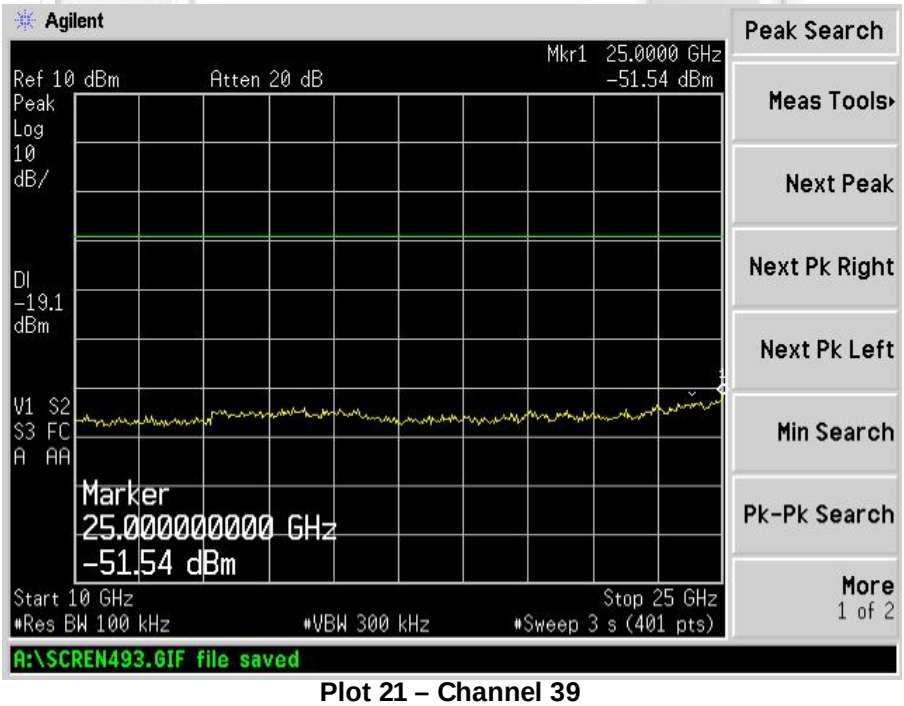


Plot 19 – Channel 0

RF Conducted Spurious Emissions Plots

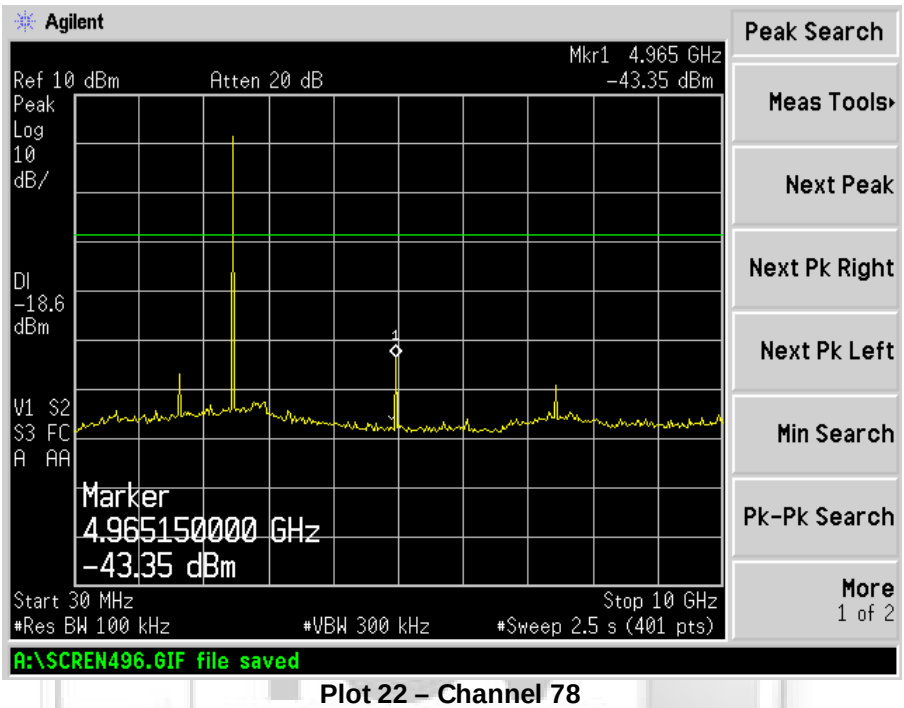


Plot 20 – Channel 39

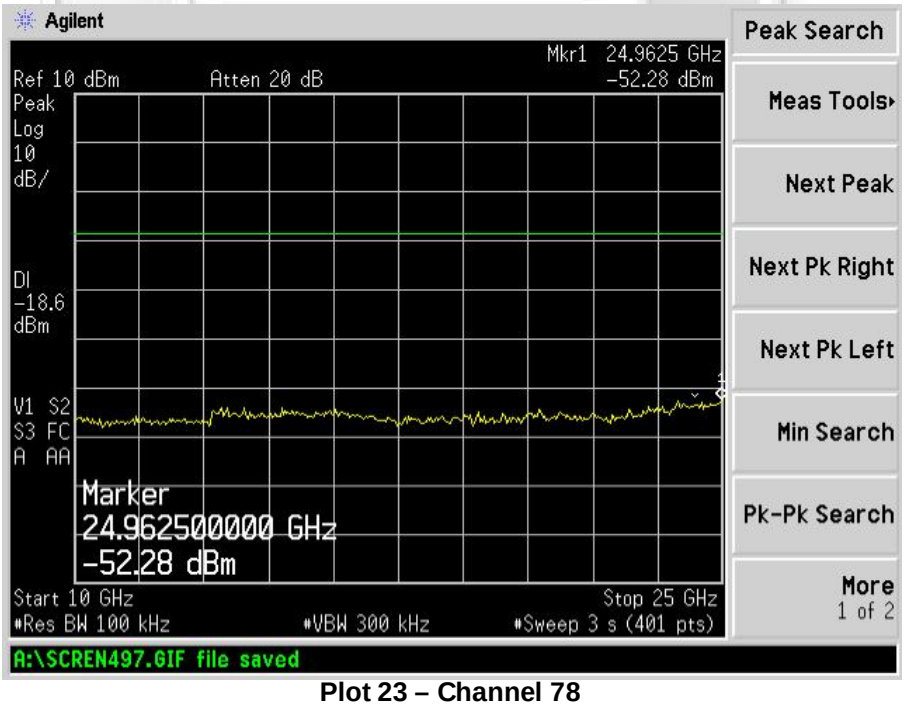


Plot 21 – Channel 39

RF Conducted Spurious Emissions Plots



Plot 22 – Channel 78



Plot 23 – Channel 78

47 CFR FCC Part 15.247(d) Band Edge Compliance (Conducted) 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 desired power.

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

Instrument	Model	S/No	Cal Due Date
Agilent EMC Analyzer (9kHz-26.5GHz)	E7405A	US40240195	26 Mar 2012
GW Laboratory DC Power Supply	GPR-3030	1720403	Output Monitor

47 CFR FCC Part 15.247(d) Band Edge Compliance (Conducted) 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 RF antenna connector was connected to the spectrum analyser via a low-loss coaxial cable.
4. The resolution bandwidth (RBW) and the video bandwidth (VBW) of the spectrum analyser were respectively set to 100kHz and 300kHz.
5. All other supporting equipment were powered separately from another filtered mains.

47 CFR FCC Part 15.247(d) Band Edge Compliance (Conducted) 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 frequency hopping sequence on.
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. The steps 2 to 3 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.

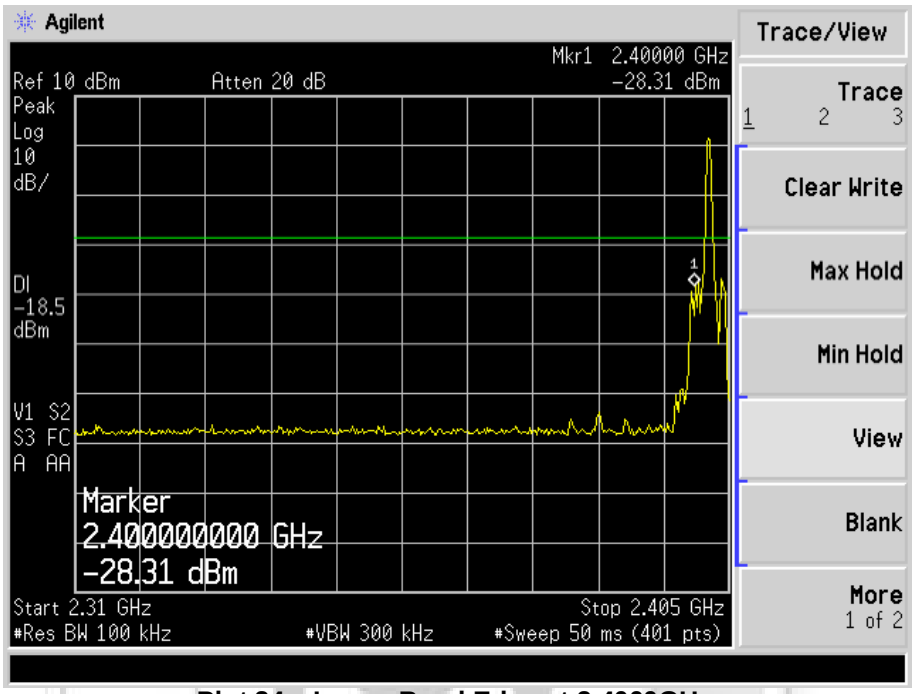
Band Edge Compliance (Conducted) Test Setup

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

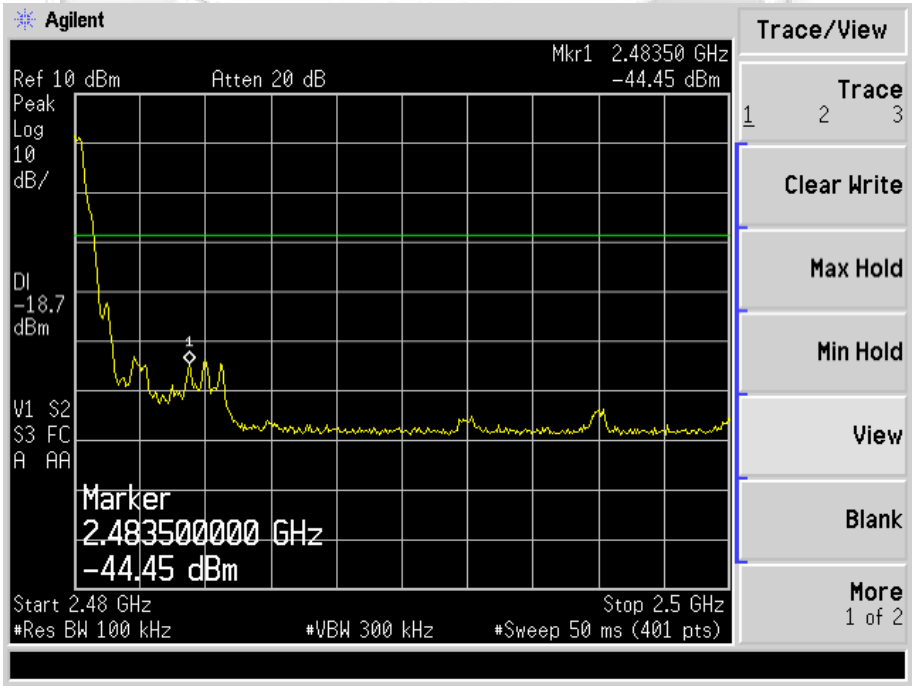
Test Input Power	36Vdc	Temperature	24°C
Attached Plots	24 - 27	Relative Humidity	60%
		Atmospheric Pressure	1030mbar
		Tested By	Zechs Ng Chee Siong

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

Band Edge Compliance (Conducted) Plots

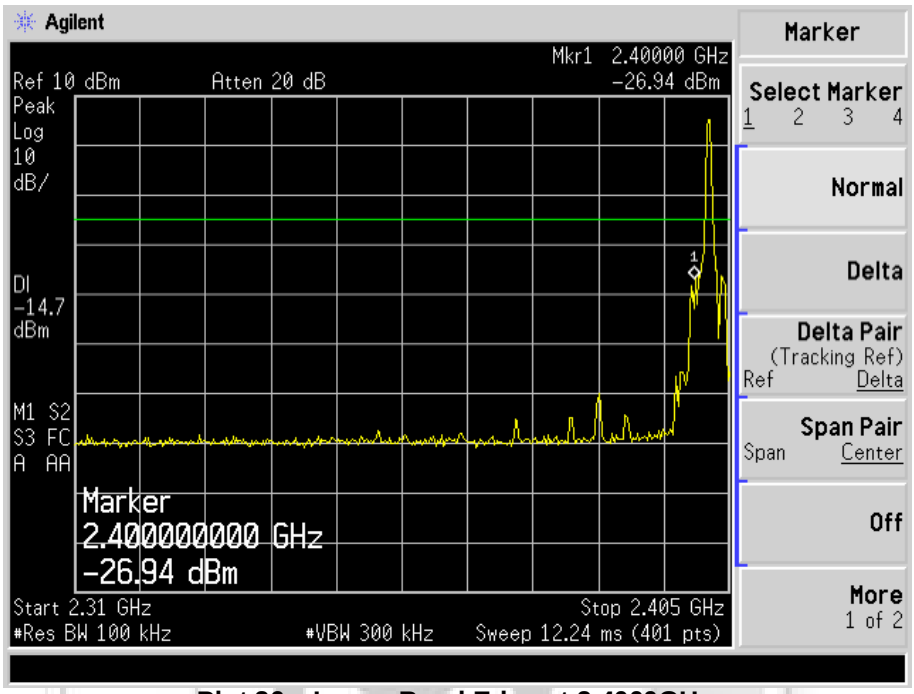


Plot 24 – Lower Band Edge at 2.4000GHz

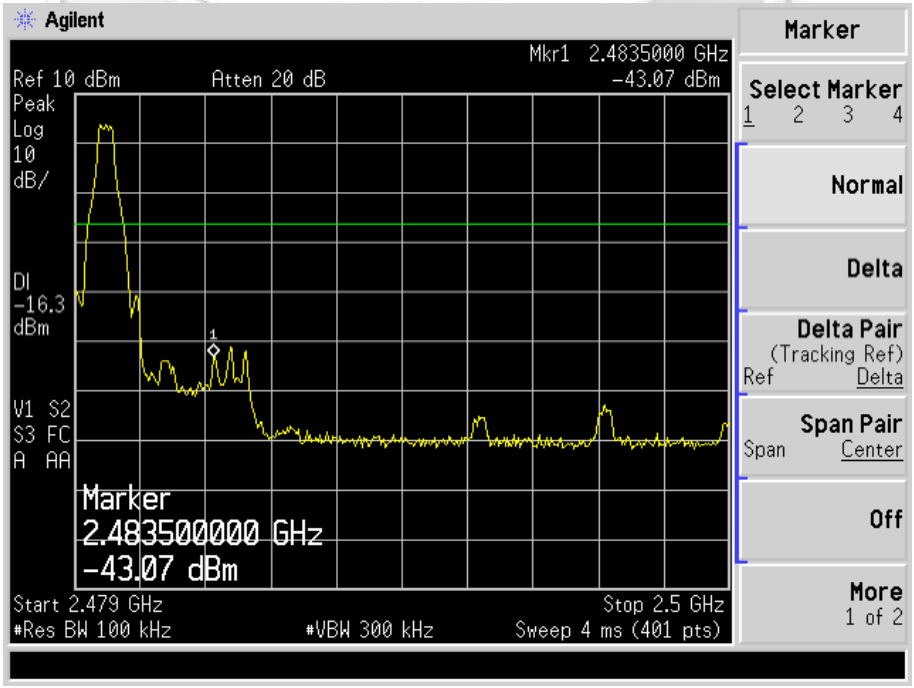


Plot 25 – Upper Band Edge at 2.4835GHz

Band Edge Compliance (Conducted) Plots



Plot 26 – Lower Band Edge at 2.4000GHz



Plot 27 – Upper Band Edge at 2.4835GHz

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 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

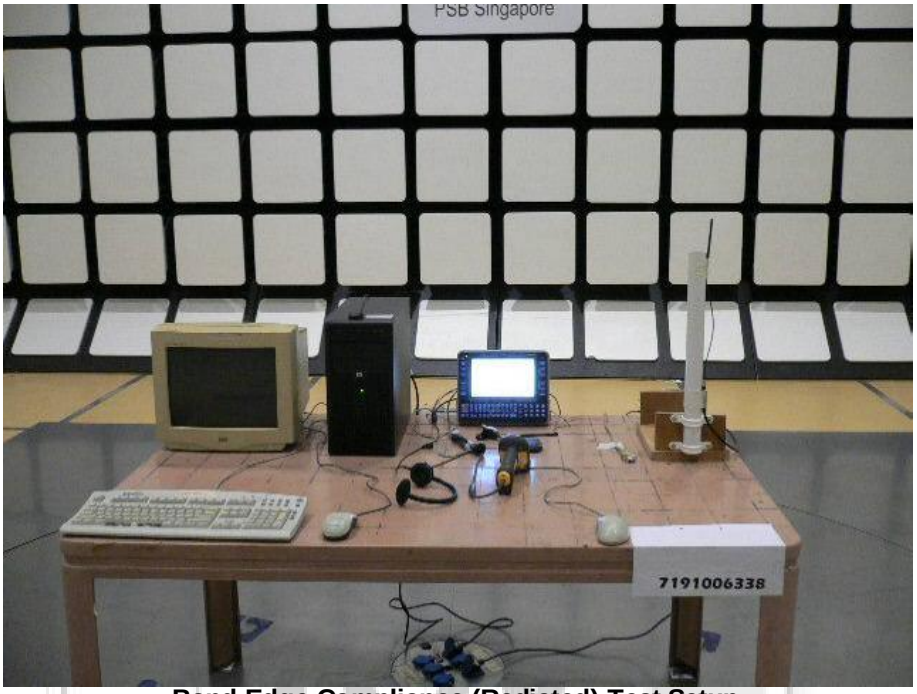
Instrument	Model	S/No	Cal Due Date
Rohde & Schwarz EMI Test Receiver (20Hz – 26.5GHz)	ESMI	829179/002 829179/005	28 Jul 2011
Sonoma Preamplifier (9kHz – 1GHz)	310N	270640	13 Sep 2012
Toyo MicroWave Preamplifier (1GHz - 8GHz)	TPA0108-40	0443	02 Feb 2012
EMCO Horn Antenna – H14	3115	0003-6087	19 May 2012
TDK RF Solutions Hybrid Log Periodic Antenna (30MHz-3GHz)	HLP-3003C	130237	30 May 2012

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 = VBW = 1MHz
   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 frequency hopping sequence on.
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. The steps 2 to 3 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.



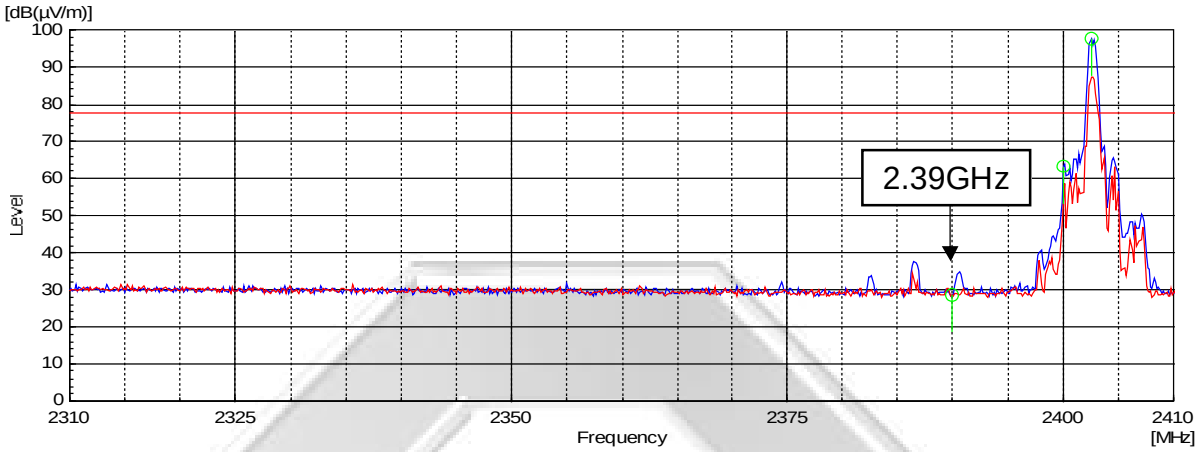
Band Edge Compliance (Radiated) Test Setup

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

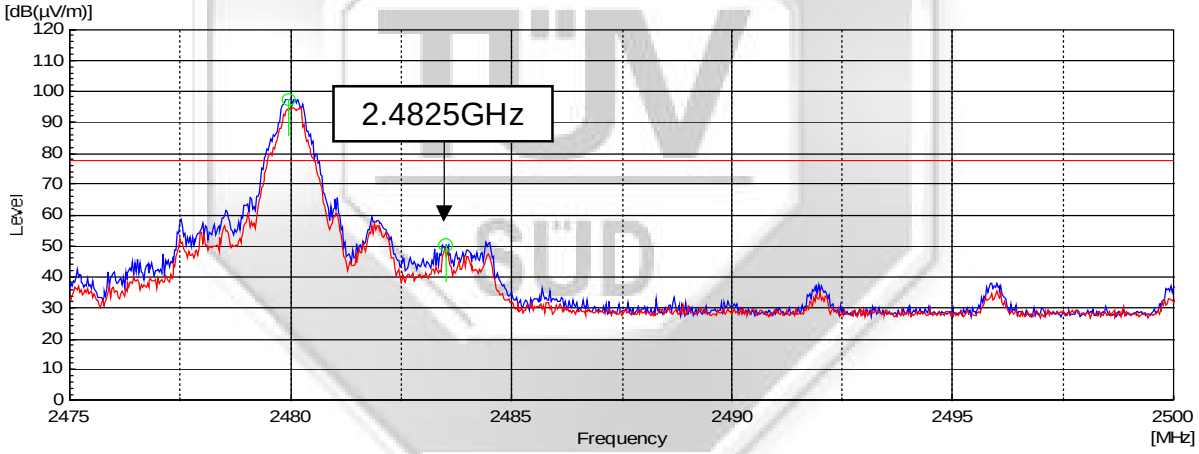
Test Input Power	36Vdc	Temperature	23°C
Attached Plots	28 - 33	Relative Humidity	60%
		Atmospheric Pressure	1030mbar
		Tested By	Zechs Ng Chee Siong

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

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

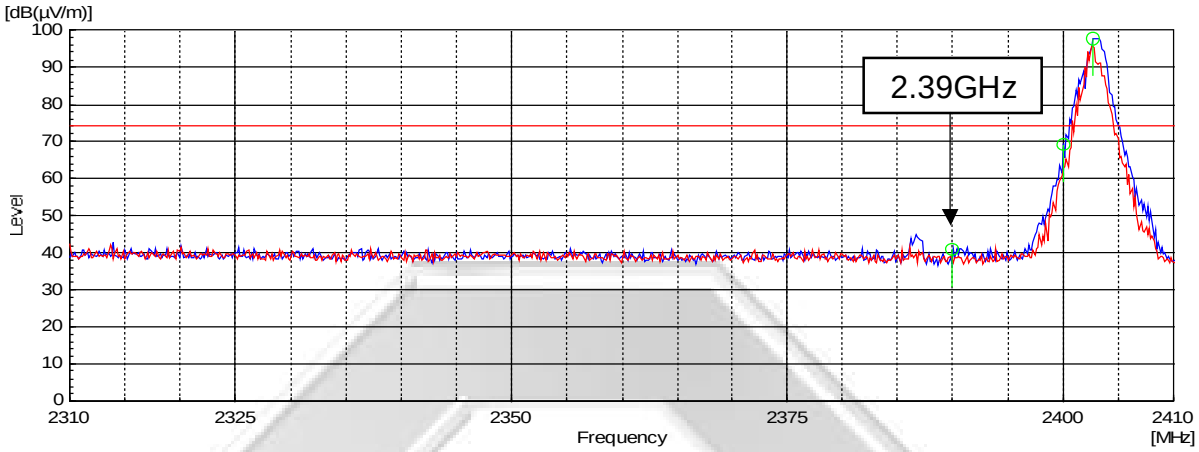


Plot 28 – Lower Band Edge at 2.4000GHz

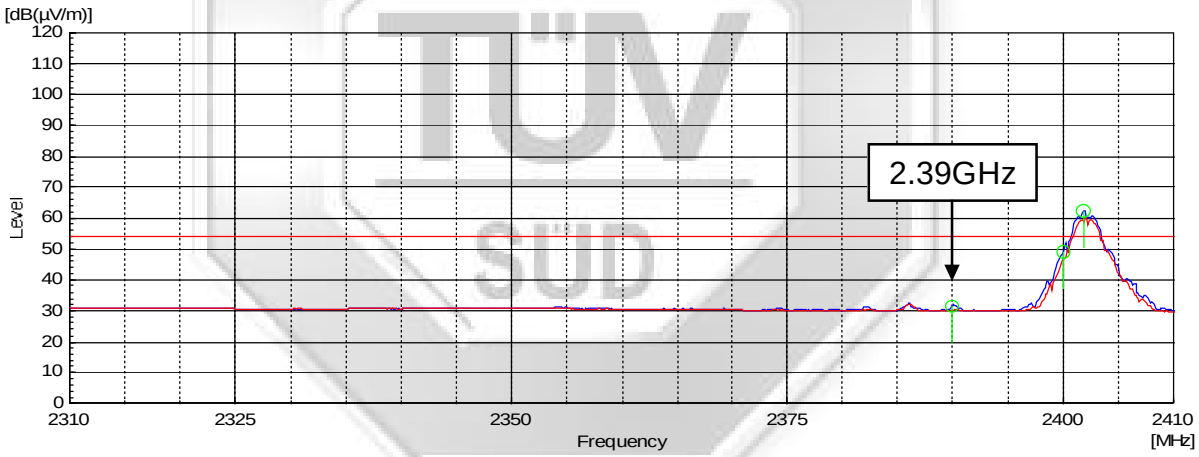


Plot 29 – Upper Band Edge at 2.4835GHz

Band Edge Compliance (Radiated) Plots (Restricted Band)

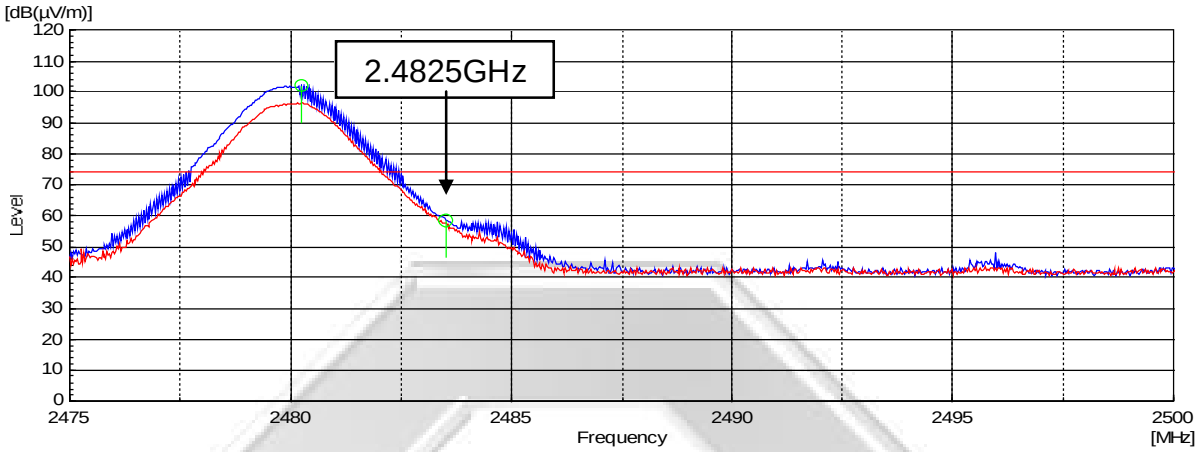


Plot 30 – Peak Plot at Lower Band Edge at 2.4000GHz

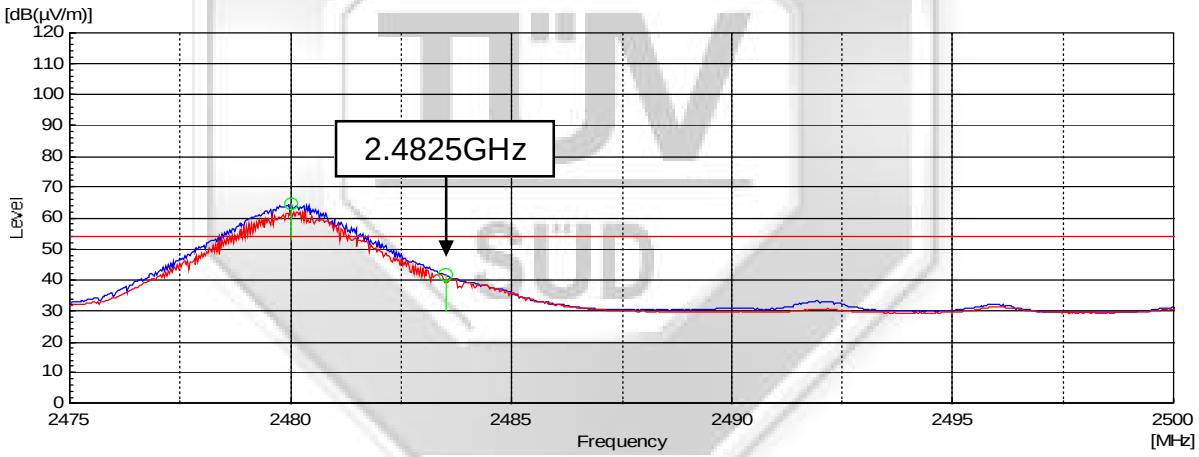


Plot 31 – Average Plot at Lower Band Edge at 2.4000GHz

Band Edge Compliance (Radiated) Plots (Restricted Band)



Plot 32 – Peak Plot at Upper Band Edge at 2.4835GHz



Plot 33 – Average Plot at Upper Band Edge at 2.4835GHz

47 CFR FCC Part 15.247(e) Peak Power Spectral Density Limits

The EUT shows compliance to the requirements of this section, which states the peak power spectral density conducted from the intentional radiator (EUT) to the antenna shall not be greater than 8dBm (6.3mW) in any 3kHz band during any time interval of continuous transmission.

47 CFR FCC Part 15.247(e) Peak Power Spectral Density Test Instrumentation

Instrument	Model	S/No	Cal Due Date
Agilent EMC Analyzer (9kHz-26.5GHz)	E7405A	US40240195	26 Mar 2012
GW Laboratory DC Power Supply	GPR-3030	1720403	Output Monitor

47 CFR FCC Part 15.247(e) Peak Power Spectral Density 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 RF antenna connector was connected to the spectrum via a low-loss coaxial cable.
4. The resolution bandwidth (RBW) and the video bandwidth (VBW) of the spectrum analyser were respectively set to 3kHz and 10kHz.
5. All other supporting equipment were powered separately from another filtered mains.

47 CFR FCC Part 15.247(e) Peak Power Spectral Density 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, non-hopping with transmitting frequency at Channel 0 (2.402GHz).
2. The sweep time of the spectrum analyser was set to the value of the ratio of the frequency span divided by the RBW.
3. The peak power density of the transmitting frequency was detected and recorded.
4. The step 3 was repeated with the transmitting frequency was set to Channel 39 (2.441GHz) and Channel 78 (2.480GHz) respectively.

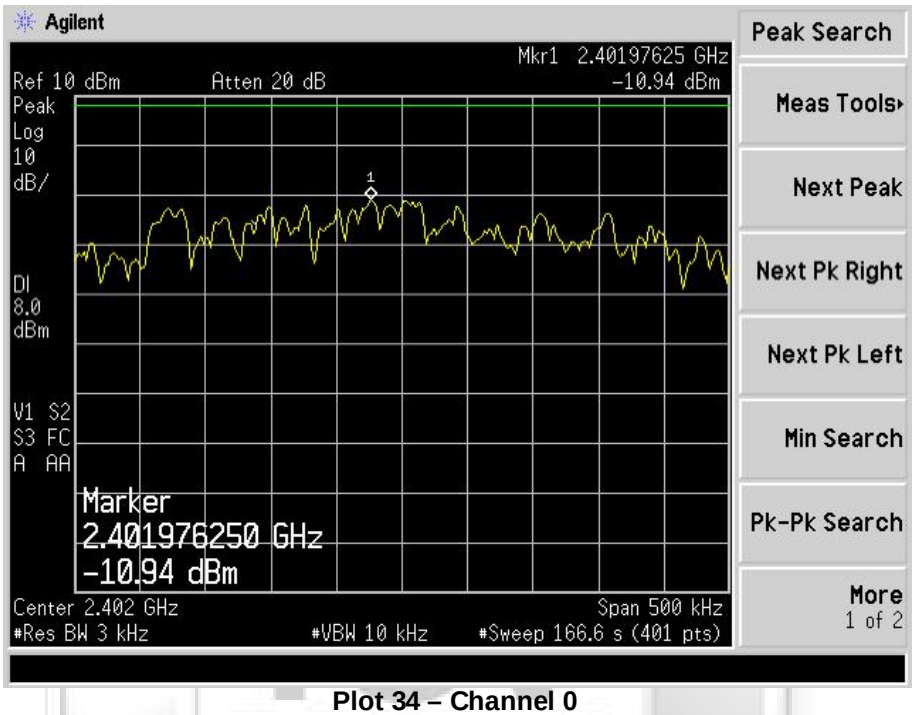
Peak Power Spectral Density Test Setup

47 CFR FCC Part 15.247(e) Peak Power Spectral Density Results

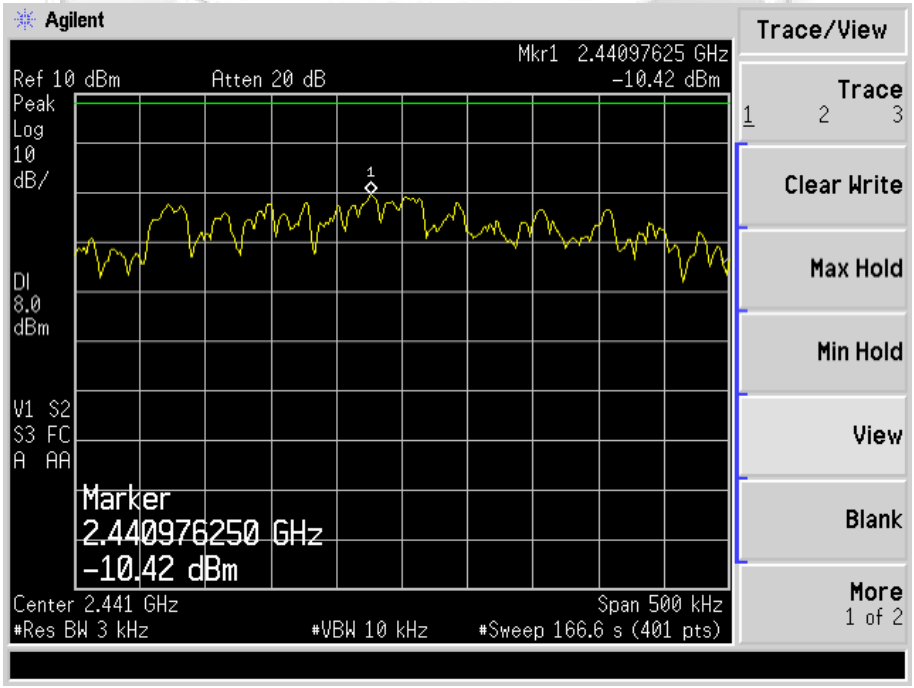
Test Input Power	36Vdc	Temperature	24°C
Attached Plots	34 - 36	Relative Humidity	60%
		Atmospheric Pressure	1030mbar
		Tested By	Zechs Ng Chee Siong

Channel	Channel Frequency (GHz)	Peak Power Spectral Density (mW)	Limit (mW)
0	2.402	-10.940	6.3
39	2.441	-10.420	6.3
78	2.480	-10.740	6.3

Peak Power Spectral Density Plots

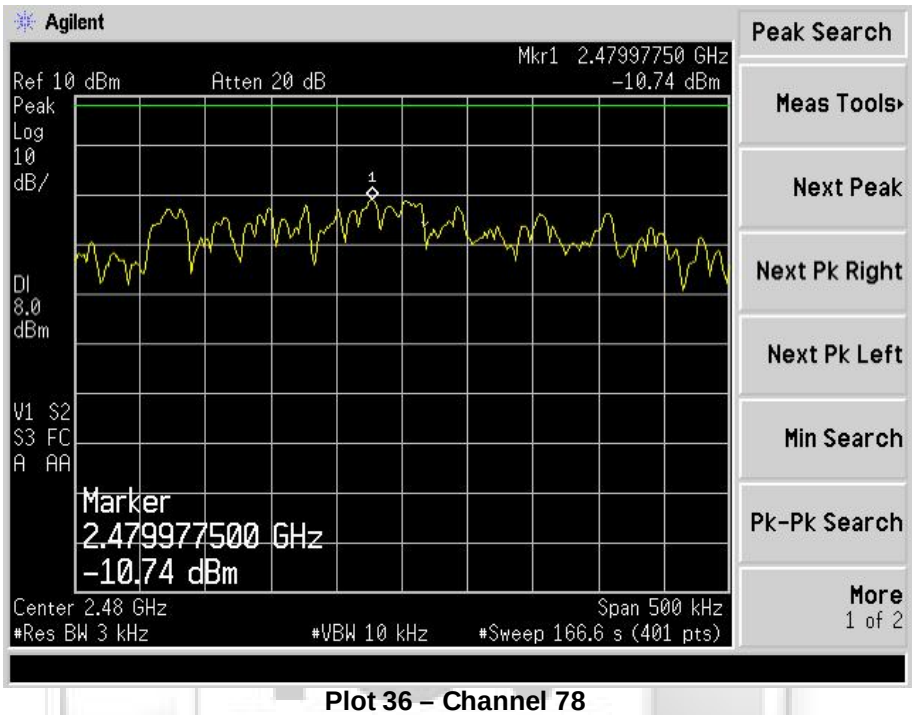


Plot 34 – Channel 0



Plot 35 – Channel 39

Peak Power Spectral Density Plots



Plot 36 – Channel 78

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 Computation

The power density at 20cm distance was computed from the following formula:

$S = (30GP) / (377d^2)$

where S = Power density in W/m^2
P = 0.003W *(maximum peak measured from Maximum Peak Power)*
d = Test distance at 0.2m
G = Numerical isotropic gain, 0.71 (-1.5dBi)

Substituting the relevant parameters into the formula:

$S = [(30GP) / 377d^2]$
$= 0.000019\ W/m^2$
$= 0.0000019\ mW/cm^2$

∴ The power density of the EUT at 20cm distance is 0.0000019 mW/cm^2 based on the above computation and found to be lower thant the power density limit of 1.0mW/cm^2.

PSB Singapore

Please note that this Report is issued under the following terms :

1. This report applies to the sample of the specific product/equipment given at the time of its testing/calibration. The results are not used to indicate or imply that they are applicable to other similar items. In addition, such results must not be used to indicate or imply that TÜV SÜD PSB approves, recommends or endorses the manufacturer, supplier or user of such product/equipment, or that TÜV SÜD PSB in any way "guarantees" the later performance of the product/equipment. Unless otherwise stated in this report, no tests were conducted to determine long term effects of using the specific product/equipment.

2. The sample/s mentioned in this report is/are submitted/supplied/manufactured by the Client. TÜV SÜD PSB therefore assumes no responsibility for the accuracy of information on the brand name, model number, origin of manufacture, consignment or any information supplied.

3. Nothing in this report shall be interpreted to mean that TÜV SÜD PSB has verified or ascertained any endorsement or marks from any other testing authority or bodies that may be found on that sample.

4. This report shall not be reproduced wholly or in parts and no reference shall be made by the Client to TÜV SÜD PSB or to the report or results furnished by TÜV SÜD PSB in any advertisements or sales promotion.

5. Unless otherwise stated, the tests were carried out in TÜV SÜD PSB Pte Ltd, No.1 Science Park Drive Singapore 118221.

July 2011

ANNEX A

EUT PHOTOGRAPHS / DIAGRAMS

EUT PHOTOGRAPHS

Front View

Rear View

EUT PHOTOGRAPHS

Left View

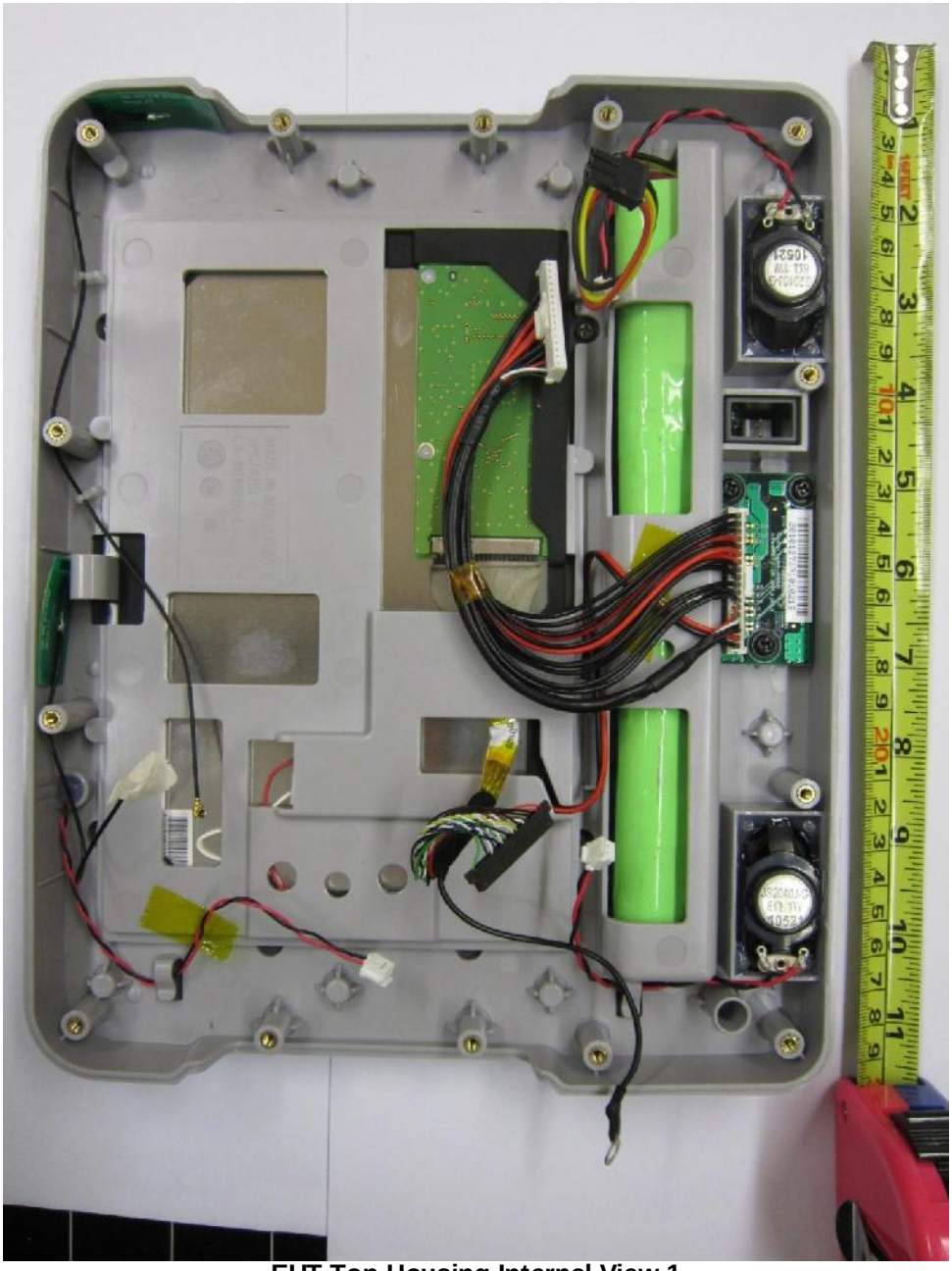
Right View

EUT PHOTOGRAPHS

Top View

Bottom View

EUT PHOTOGRAPHS



EUT Top Housing Internal View 1

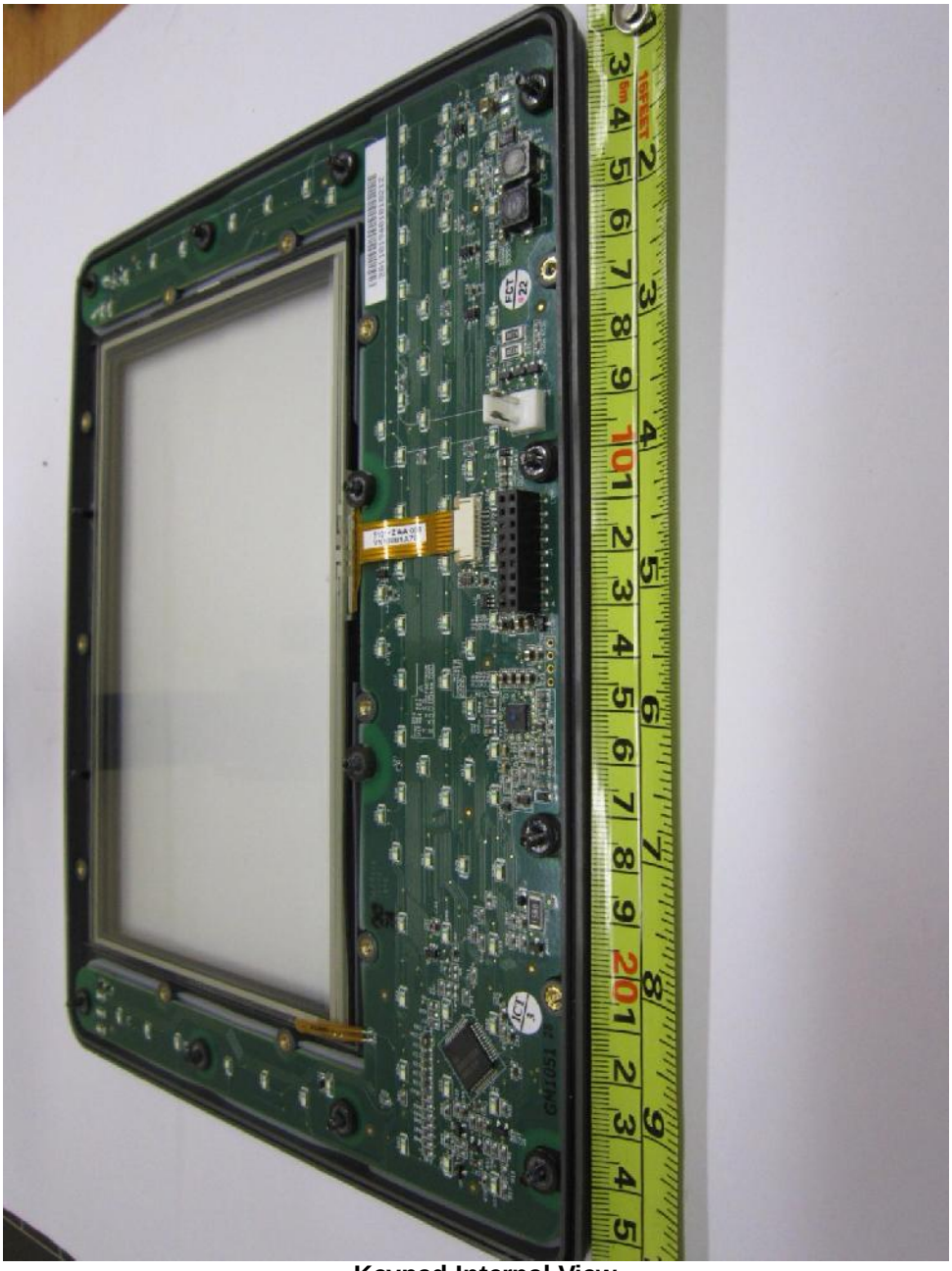
EUT PHOTOGRAPHS

EUT Top Housing Internal View 2

EUT PHOTOGRAPHS

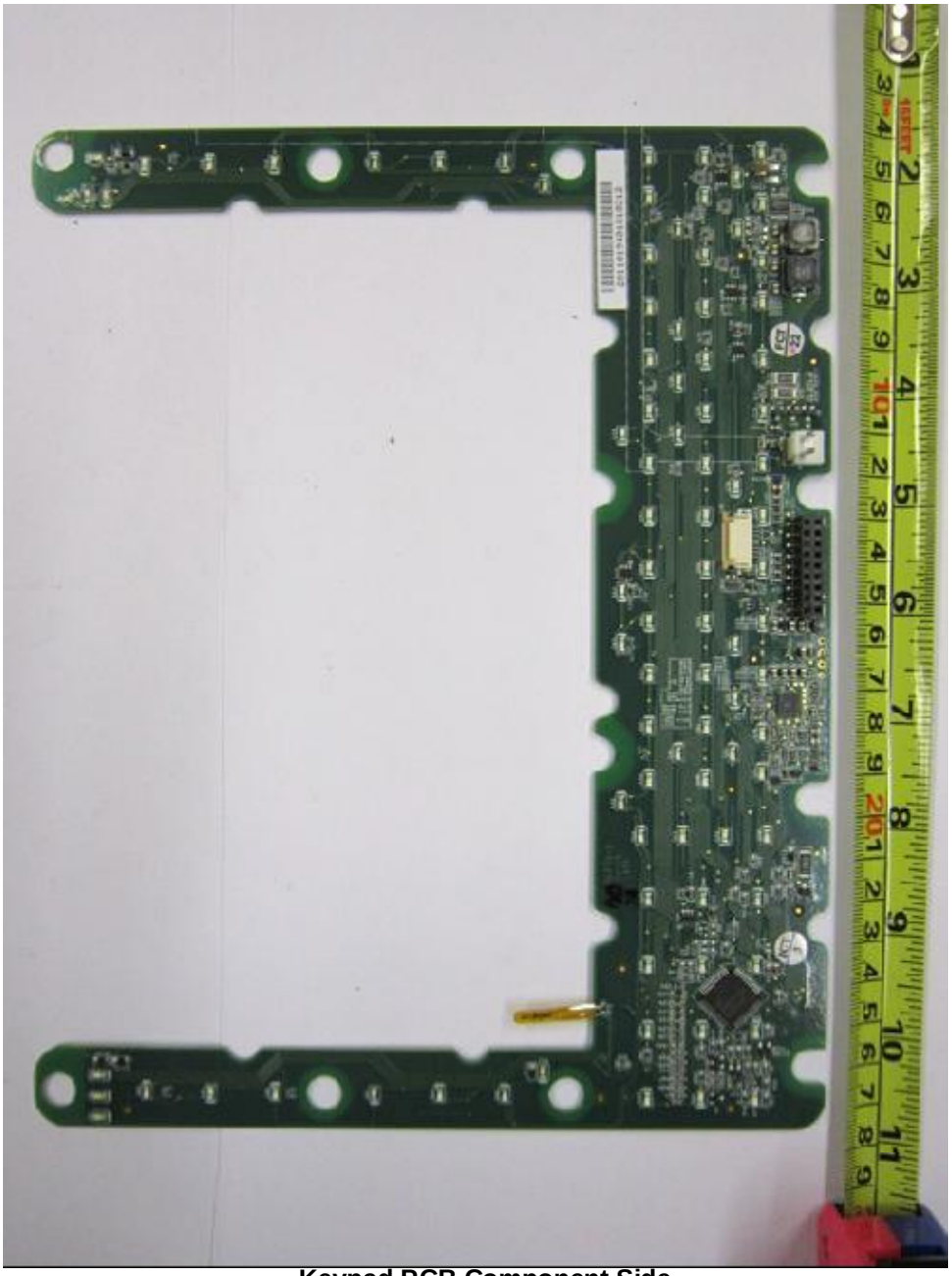
EUT Top Housing Internal View 3

EUT PHOTOGRAPHS



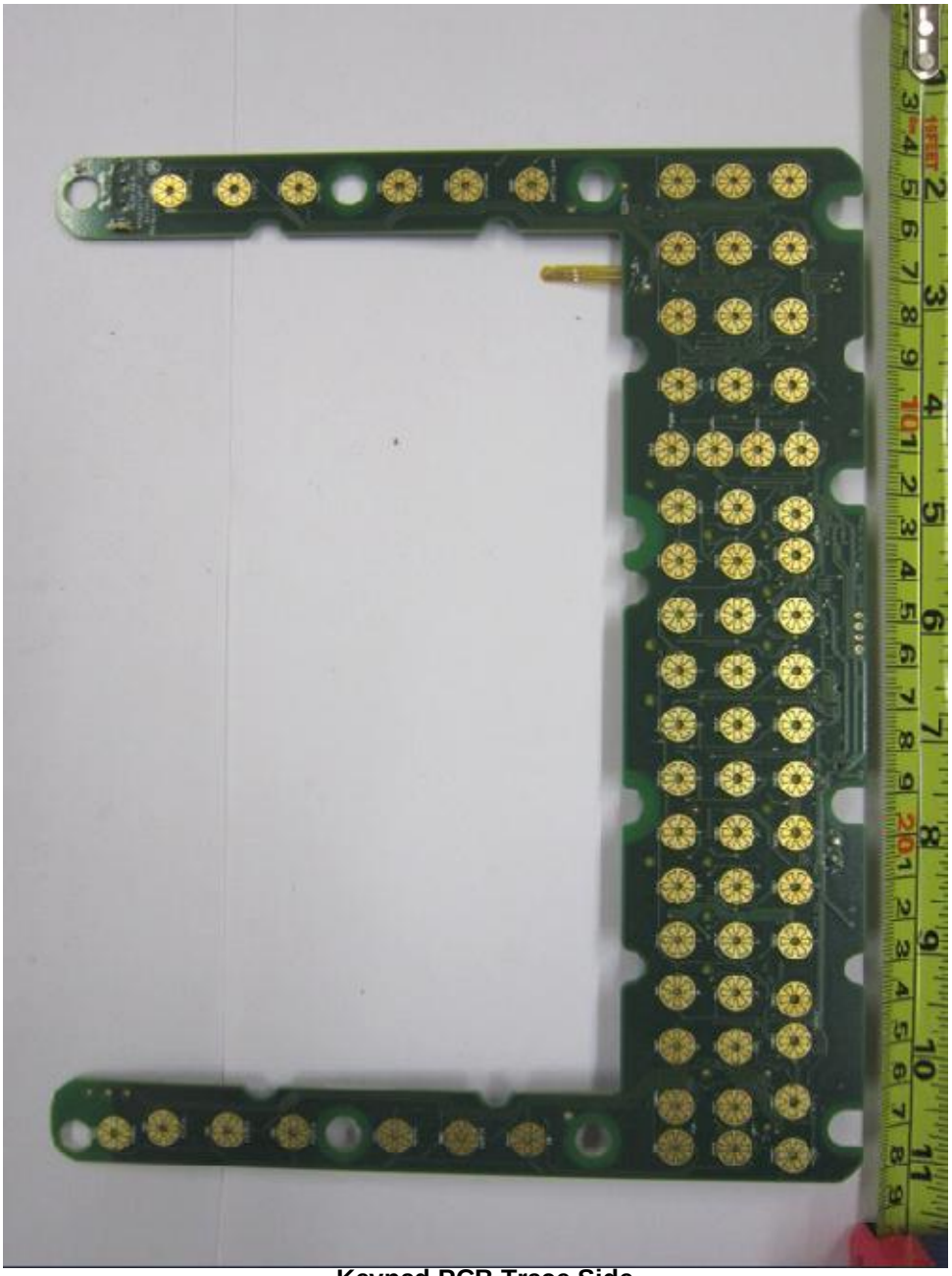
Keypad Internal View

EUT PHOTOGRAPHS



Keypad PCB Component Side

EUT PHOTOGRAPHS

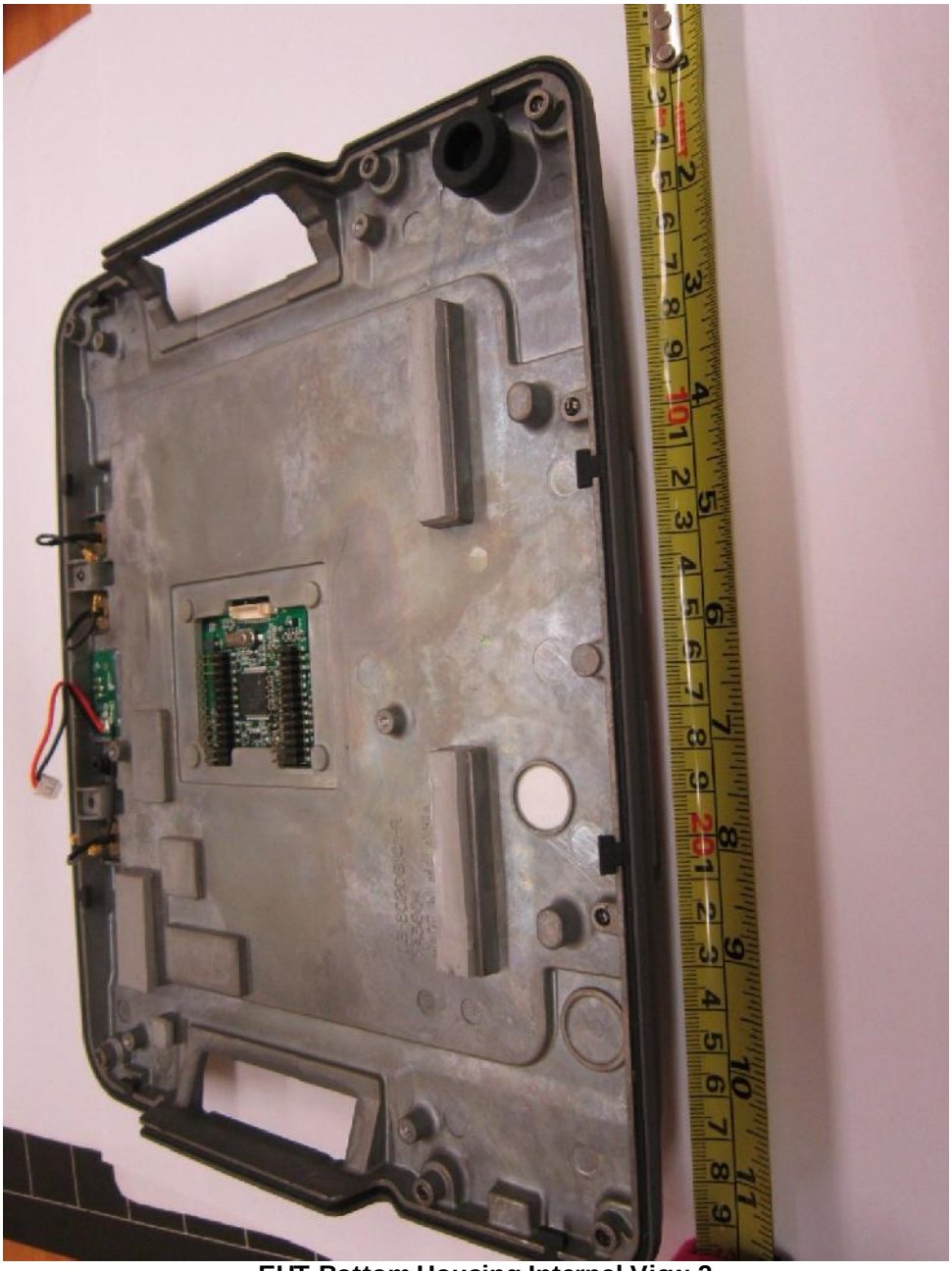


Keypad PCB Trace Side

EUT PHOTOGRAPHS

EUT Bottom Housing Internal View 1

EUT PHOTOGRAPHS

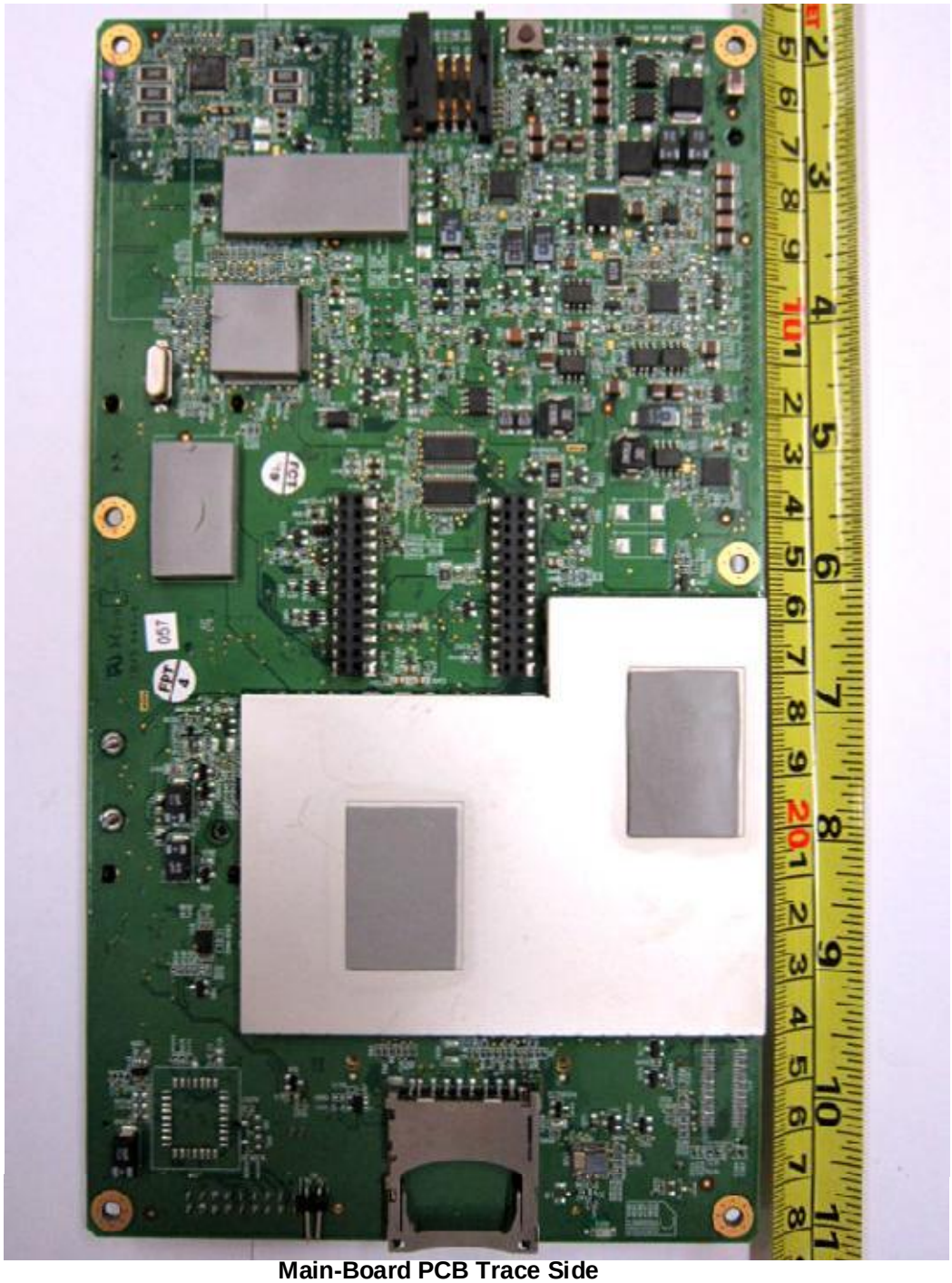


EUT Bottom Housing Internal View 2

EUT PHOTOGRAPHS

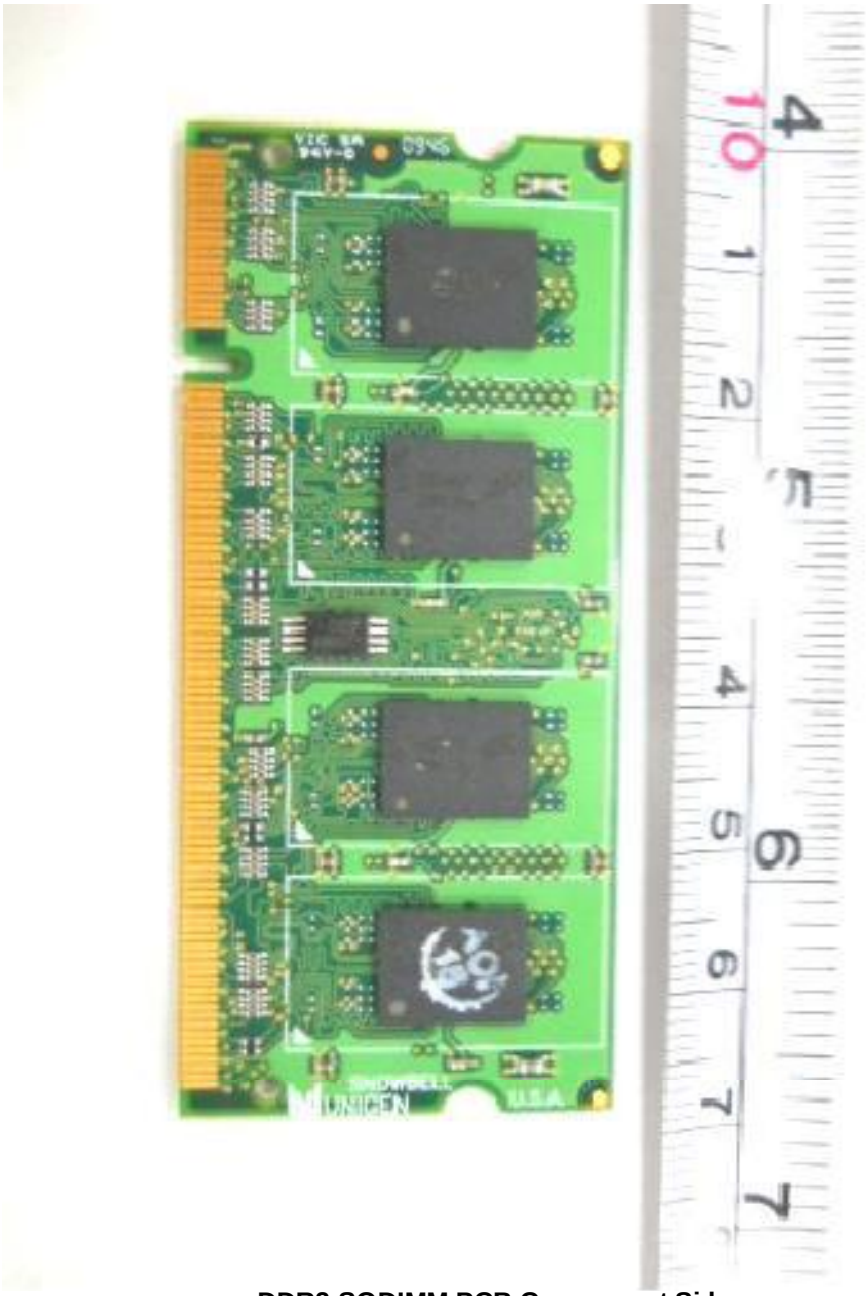
Main-Board PCB Component Side

EUT PHOTOGRAPHS



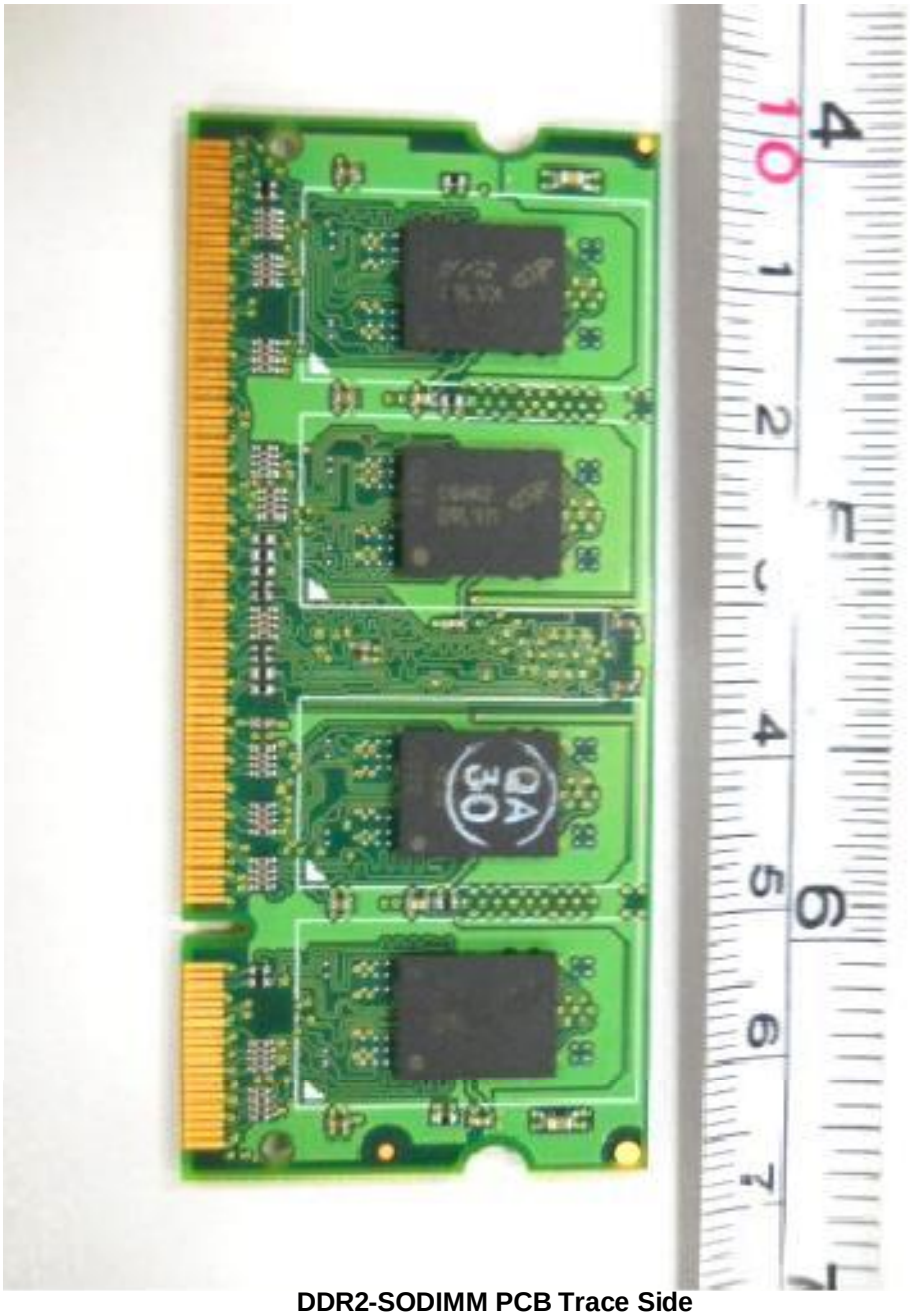
Main-Board PCB Trace Side

EUT PHOTOGRAPHS



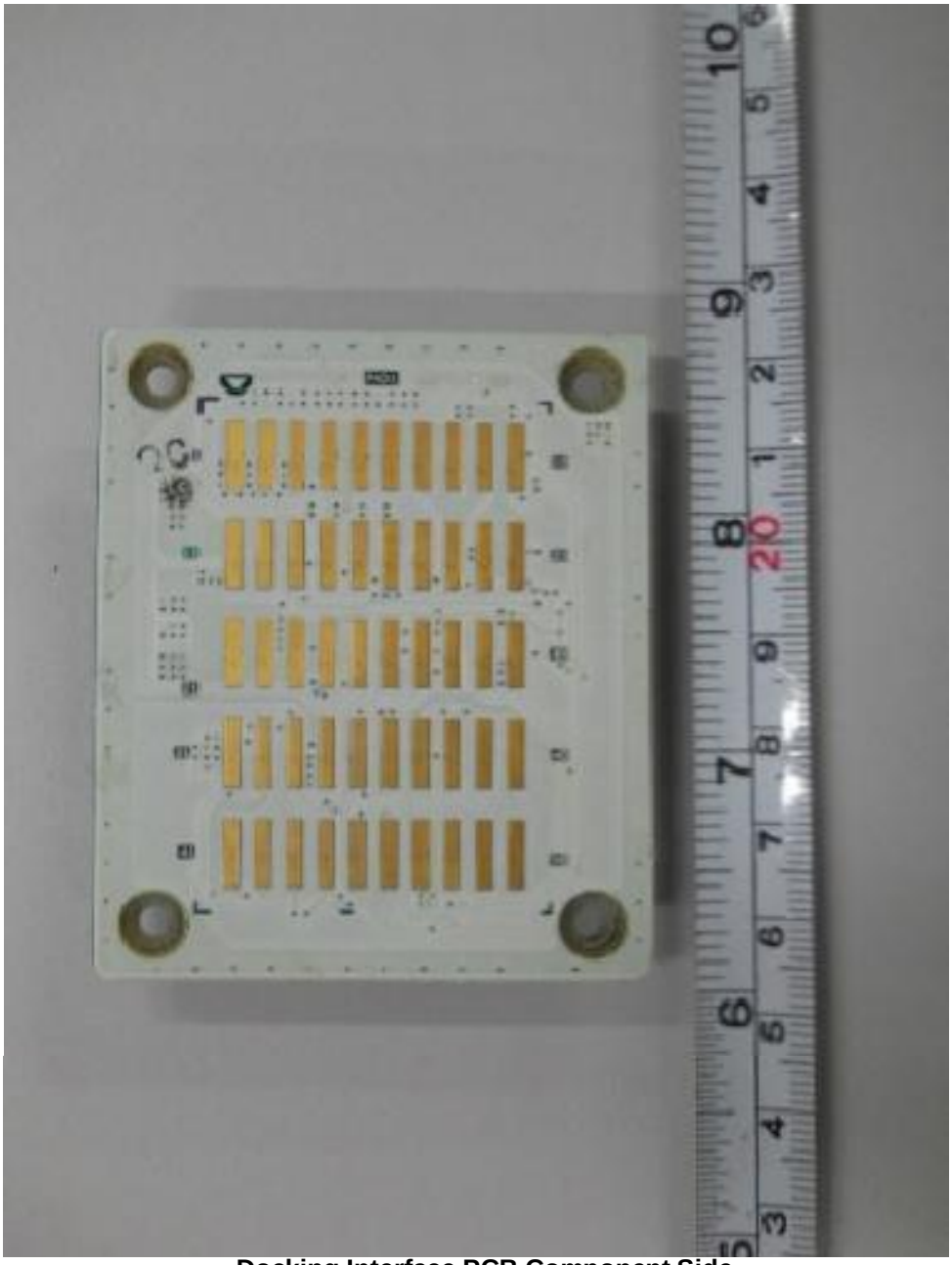
DDR2-SODIMM PCB Component Side

EUT PHOTOGRAPHS



DDR2-SODIMM PCB Trace Side

EUT PHOTOGRAPHS

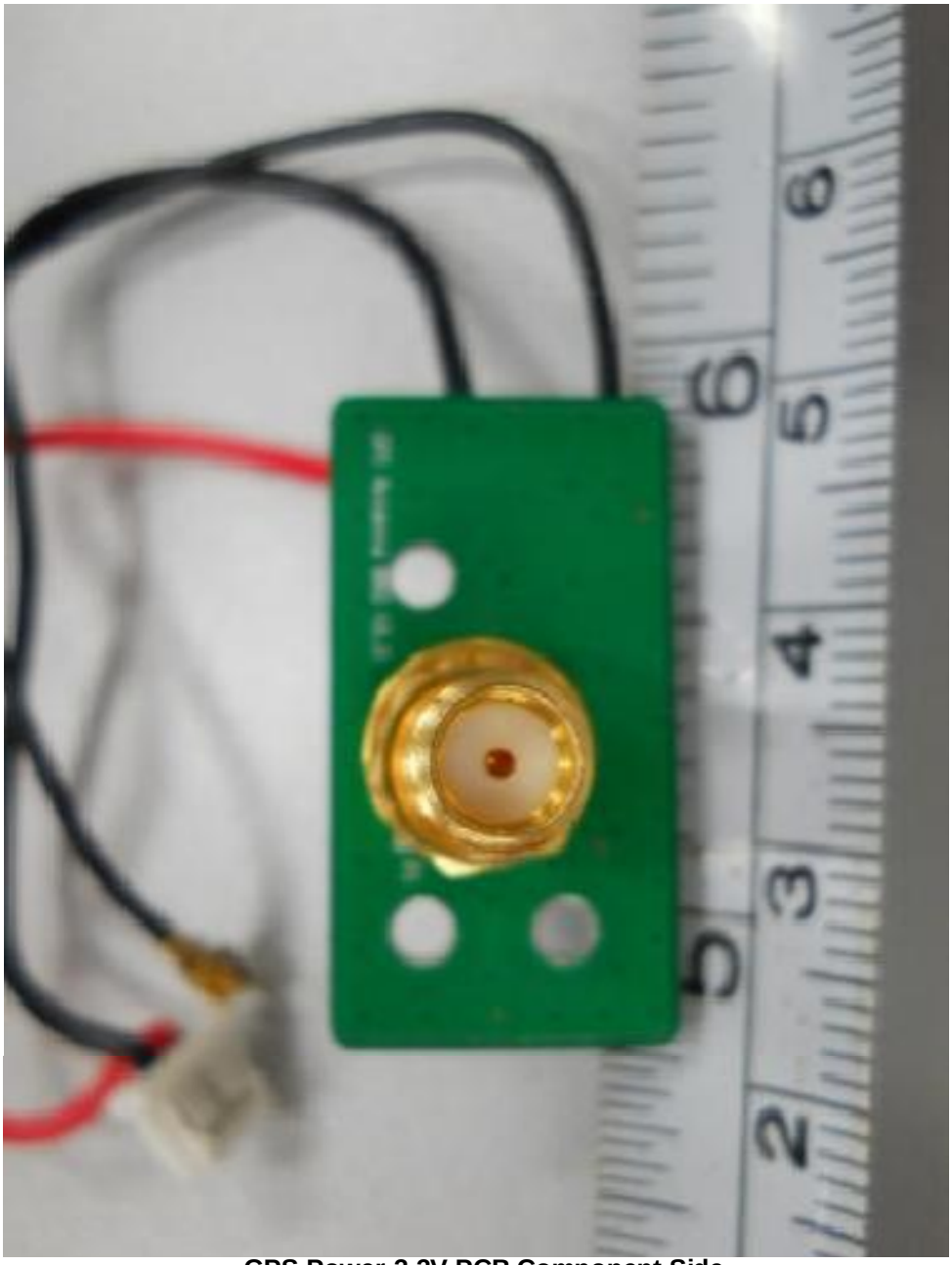


Docking Interface PCB Component Side

EUT PHOTOGRAPHS

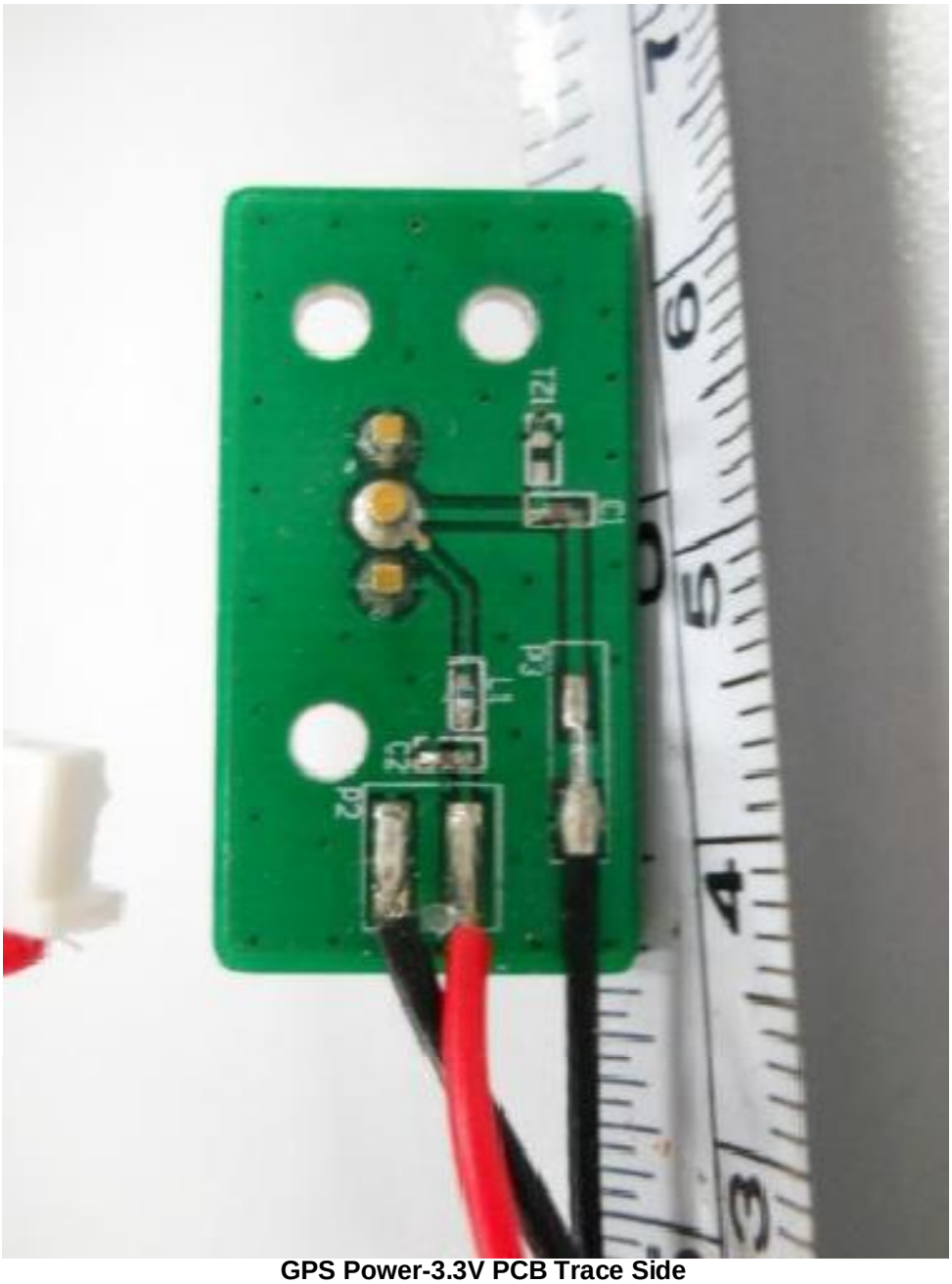
Docking Interface PCB Trace Side

EUT PHOTOGRAPHS



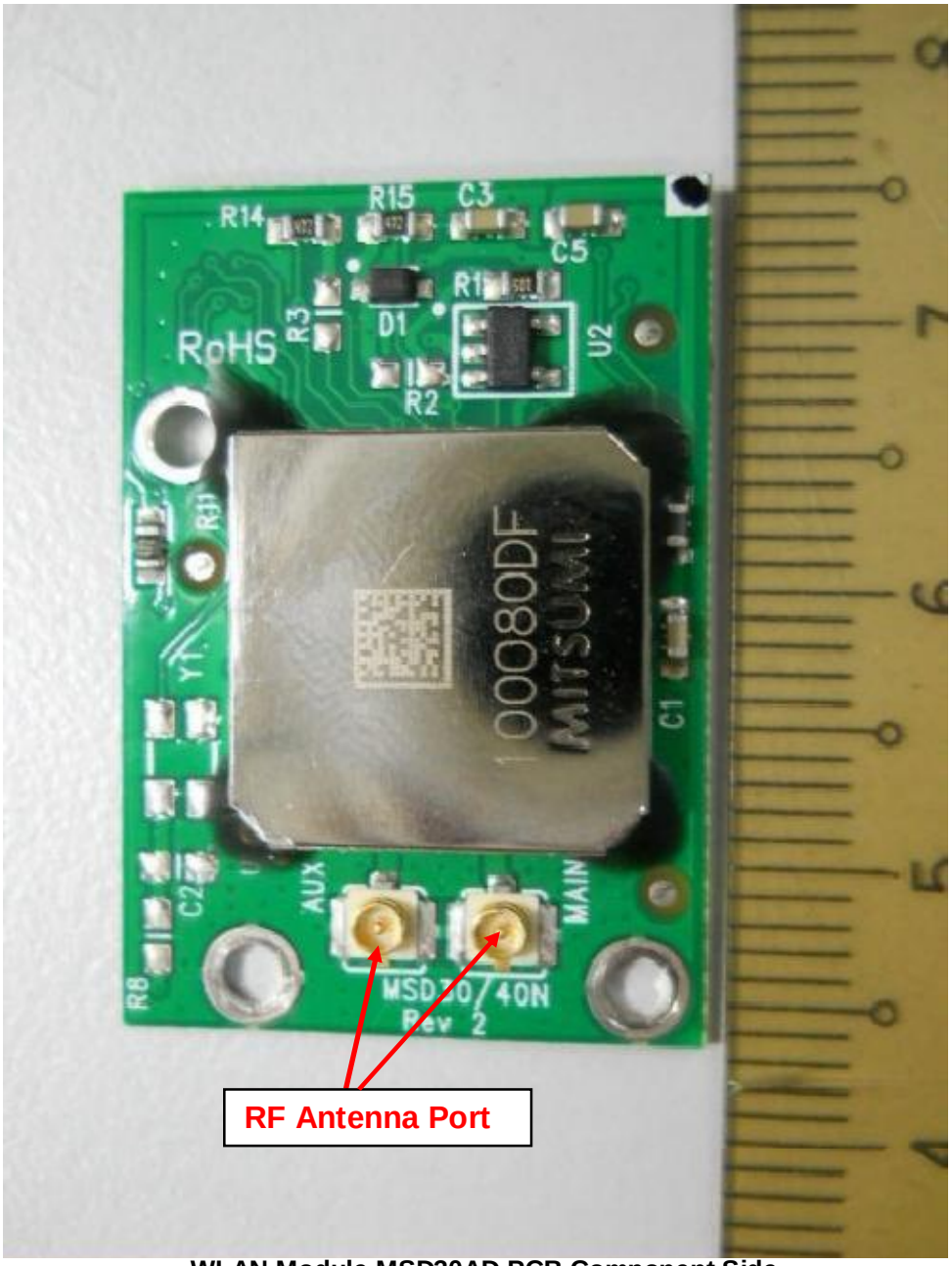
GPS Power-3.3V PCB Component Side

EUT PHOTOGRAPHS



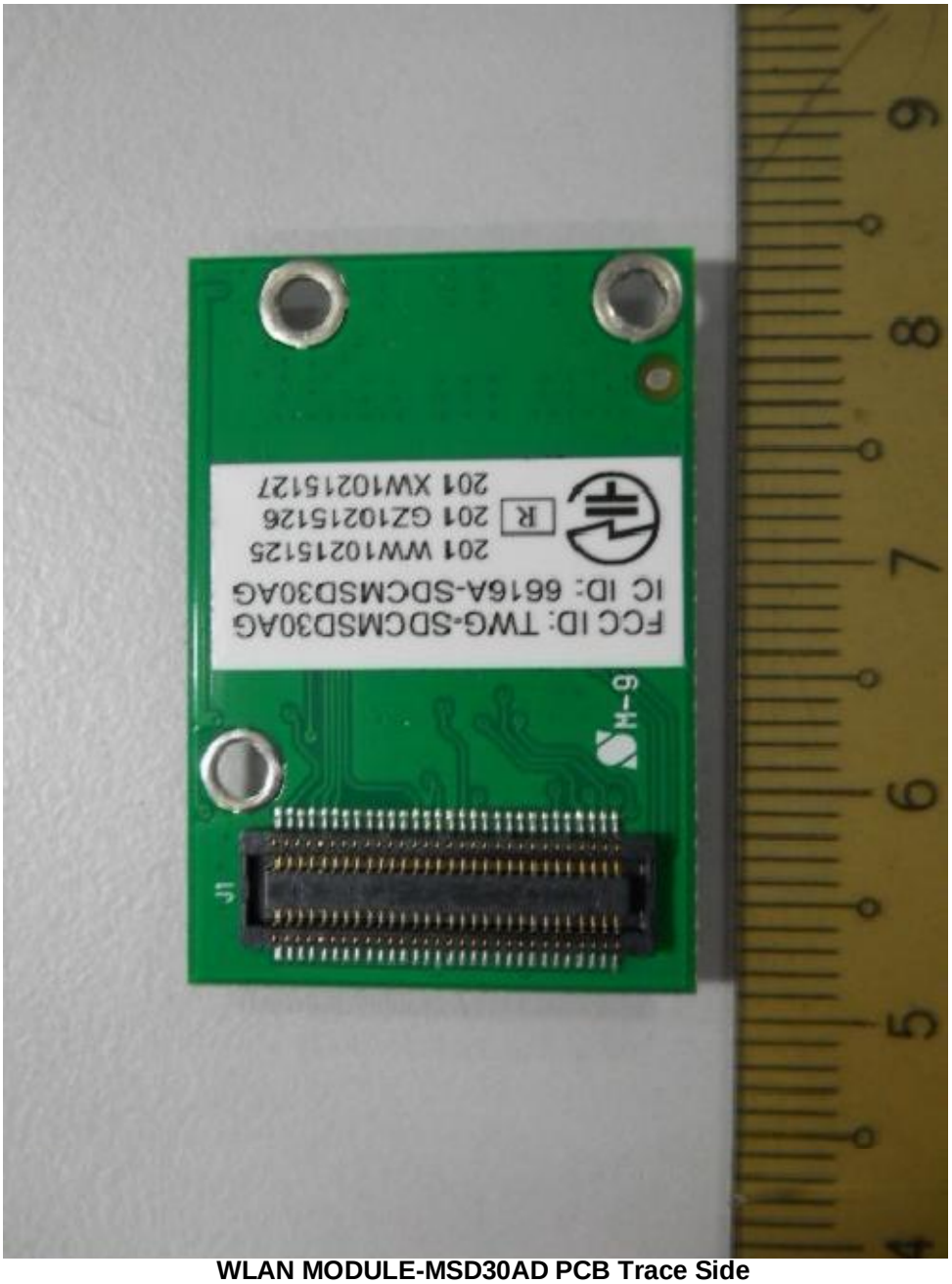
GPS Power-3.3V PCB Trace Side

EUT PHOTOGRAPHS



WLAN Module-MSD30AD PCB Component Side

EUT PHOTOGRAPHS



WLAN MODULE-MSD30AD PCB Trace Side

EUT PHOTOGRAPHS

WWAN Module PCB Component Side

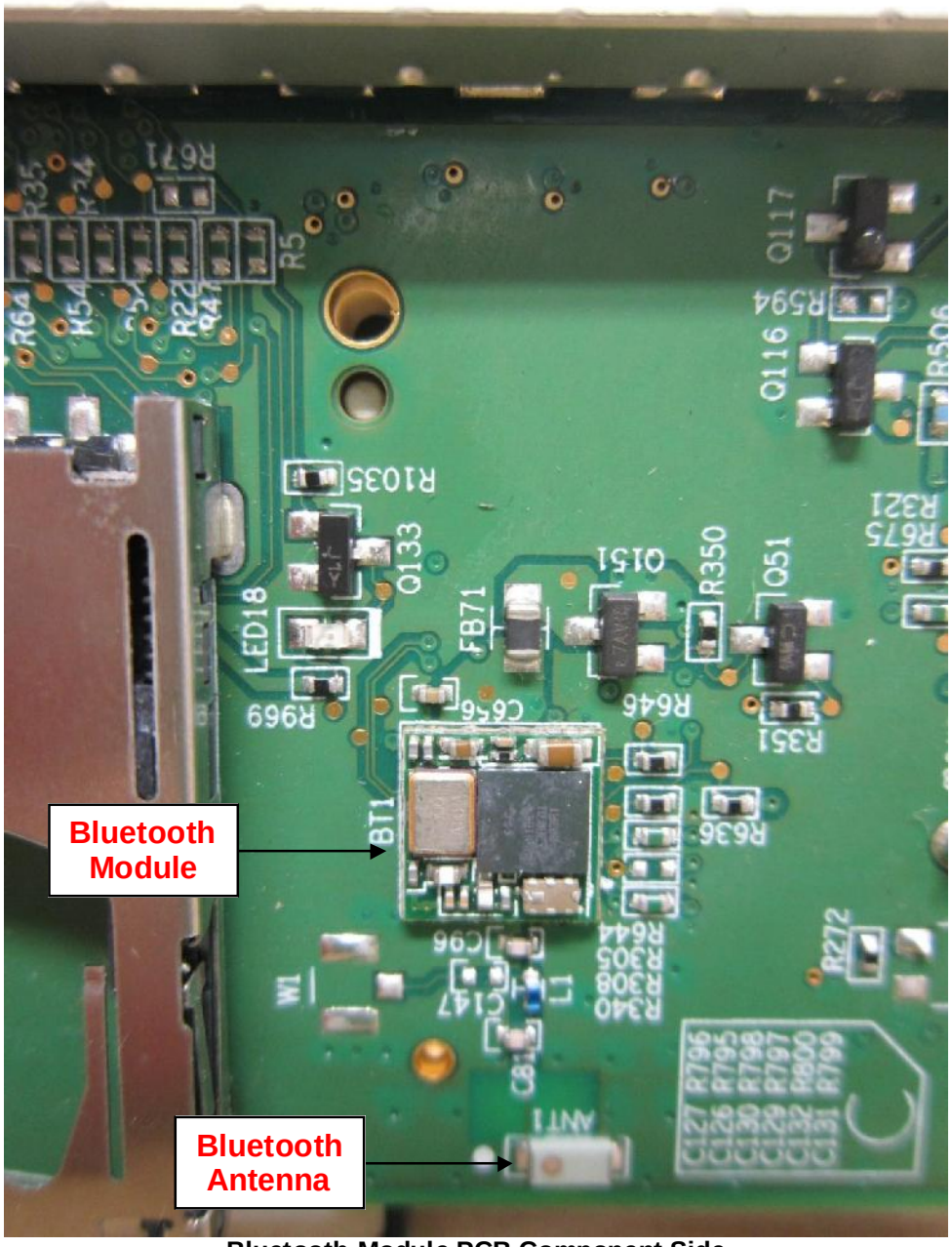
EUT PHOTOGRAPHS

WWAN Module PCB Trace Side

EUT PHOTOGRAPHS

Bluetooth-Module PCB Location

EUT PHOTOGRAPHS



Bluetooth-Module PCB Component Side

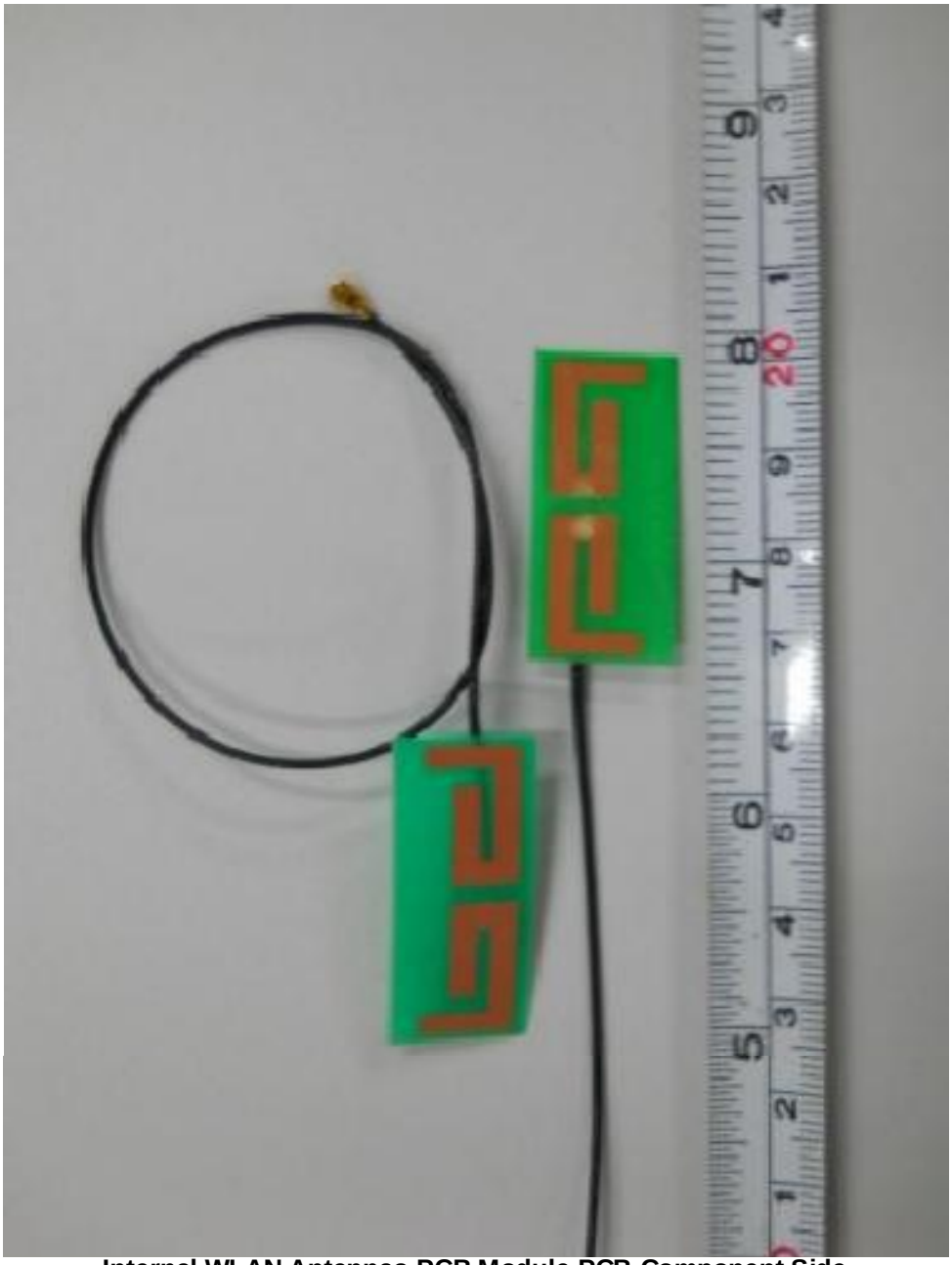
EUT PHOTOGRAPHS

CPU Circuit Shield Cover Removed PCB Component Side

EUT PHOTOGRAPHS

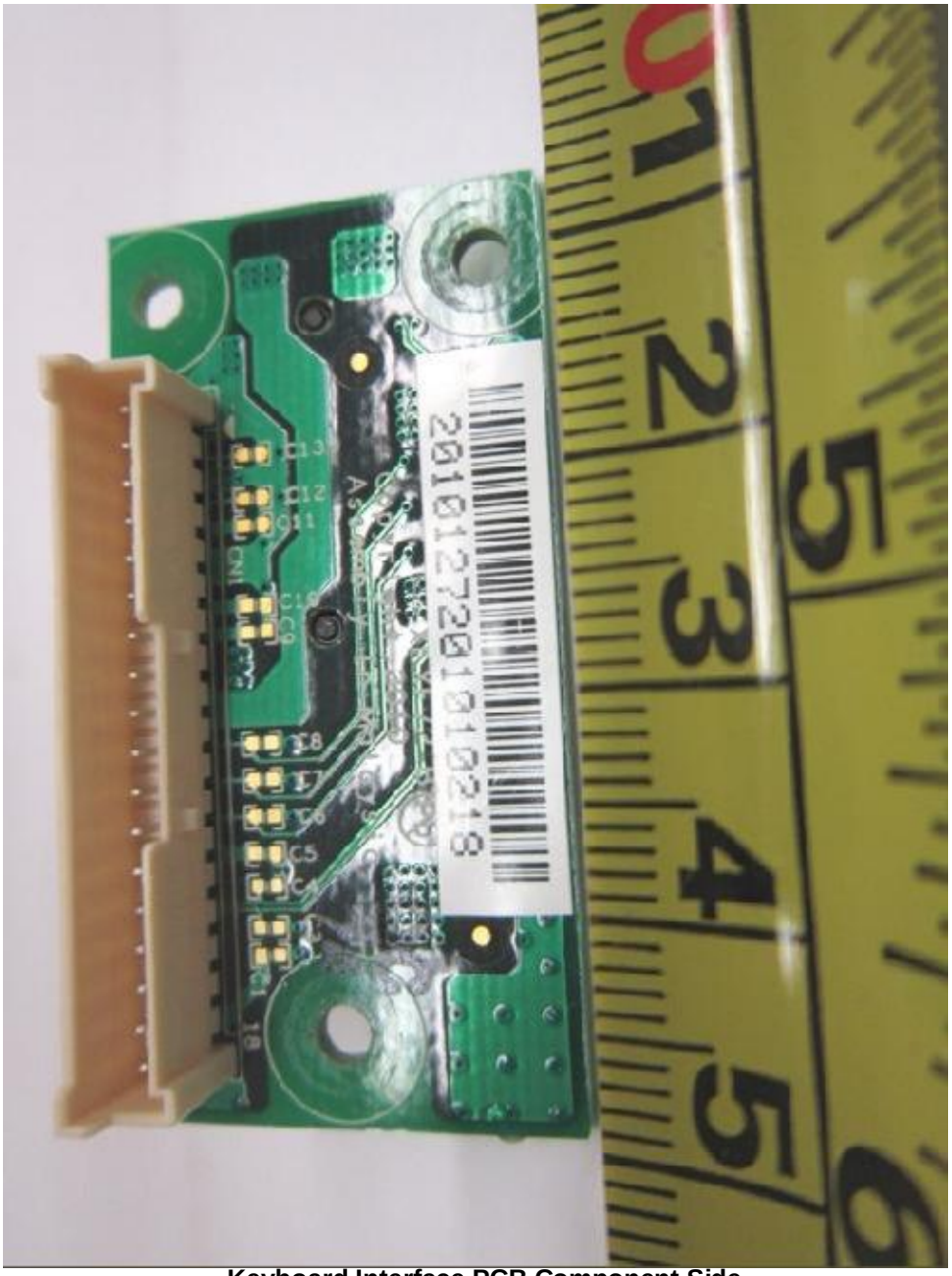
Memory DDR2-SDIO Shield Cover Removed Module PCB Component Side

EUT PHOTOGRAPHS



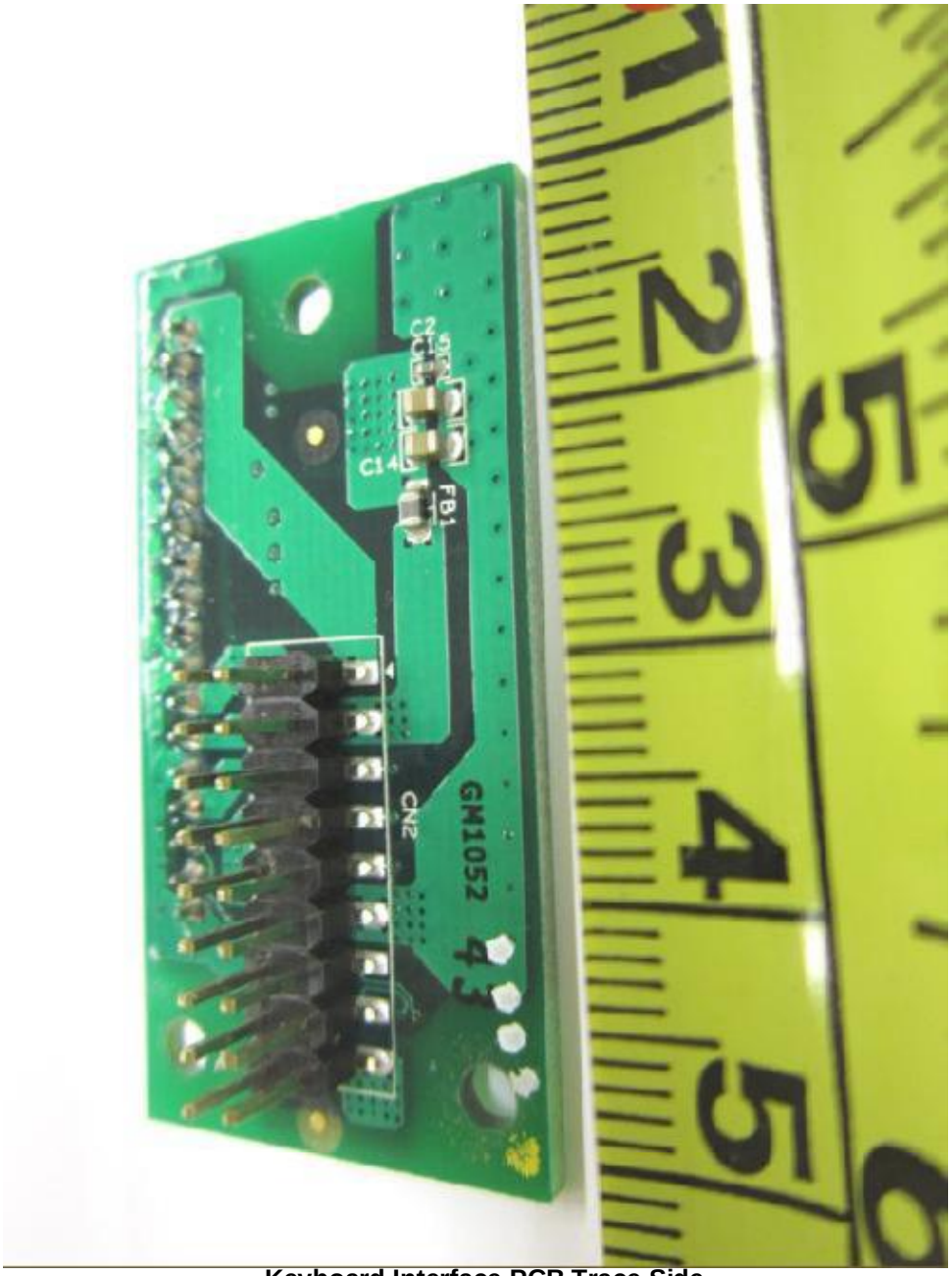
Internal WLAN Antennas-PCB Module PCB Component Side

EUT PHOTOGRAPHS



Keyboard Interface PCB Component Side

EUT PHOTOGRAPHS

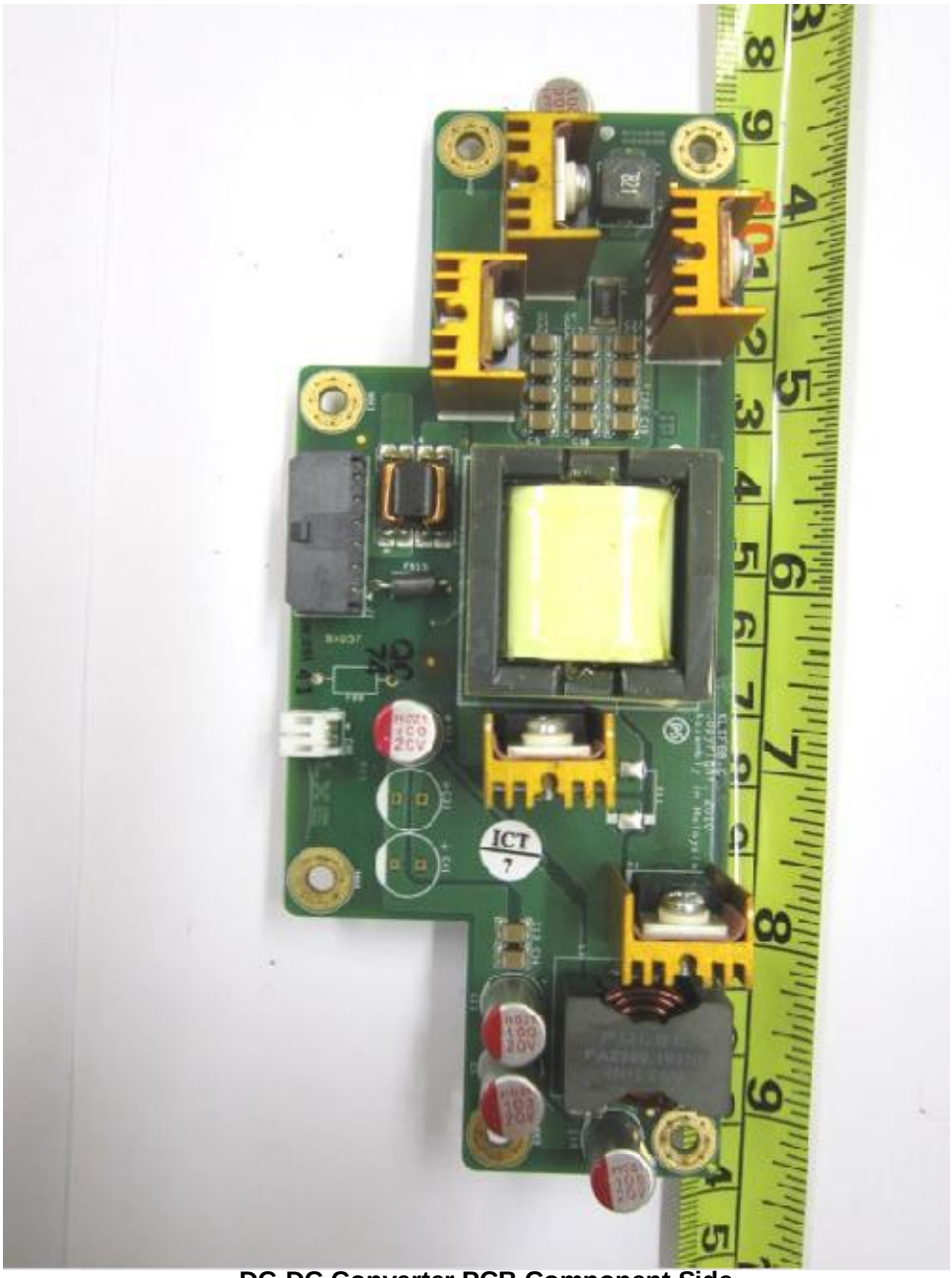


Keyboard Interface PCB Trace Side

EUT PHOTOGRAPHS

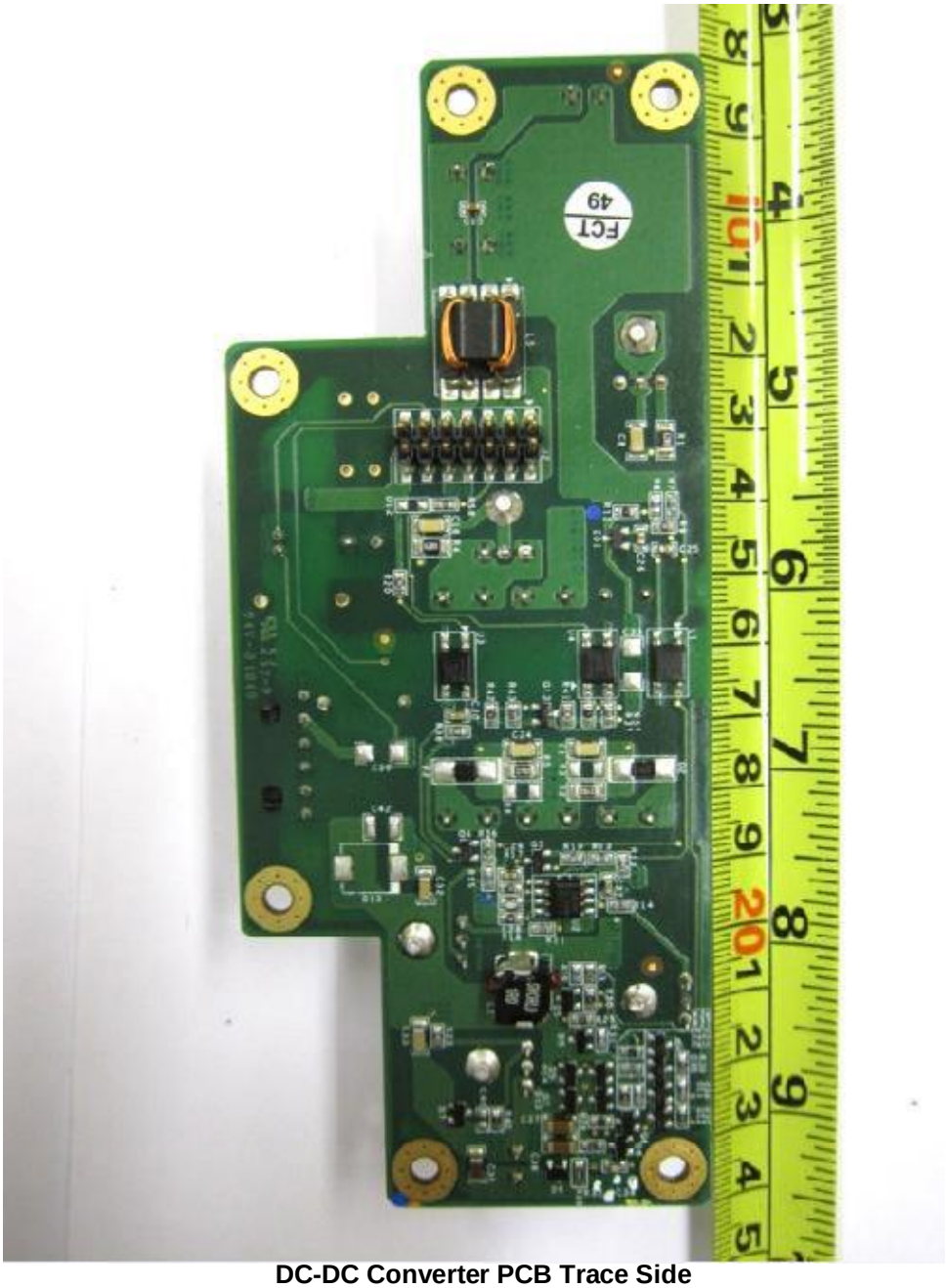
EUT Top & Bottom Housing Internal View

EUT PHOTOGRAPHS



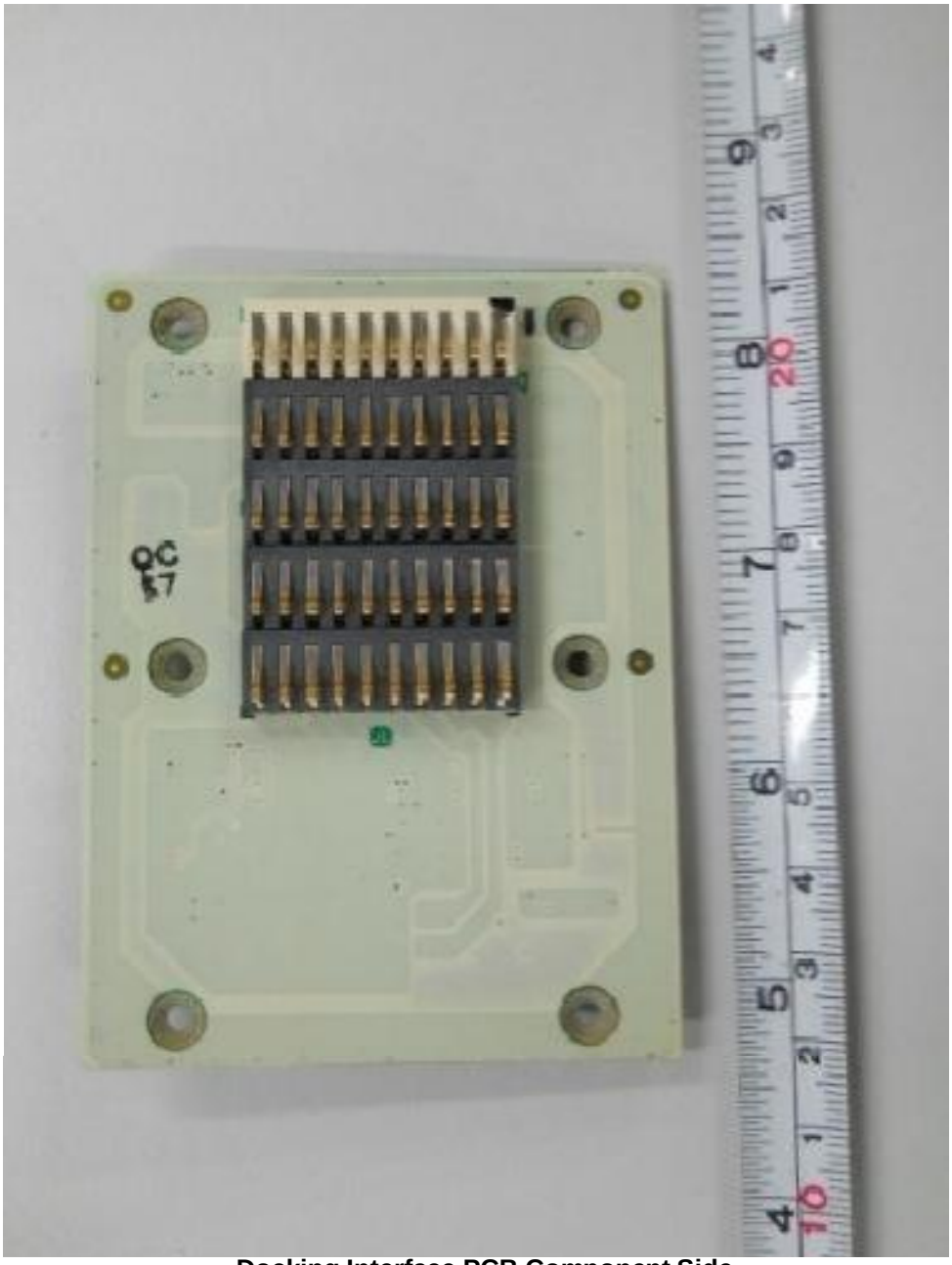
DC-DC Converter PCB Component Side

EUT PHOTOGRAPHS



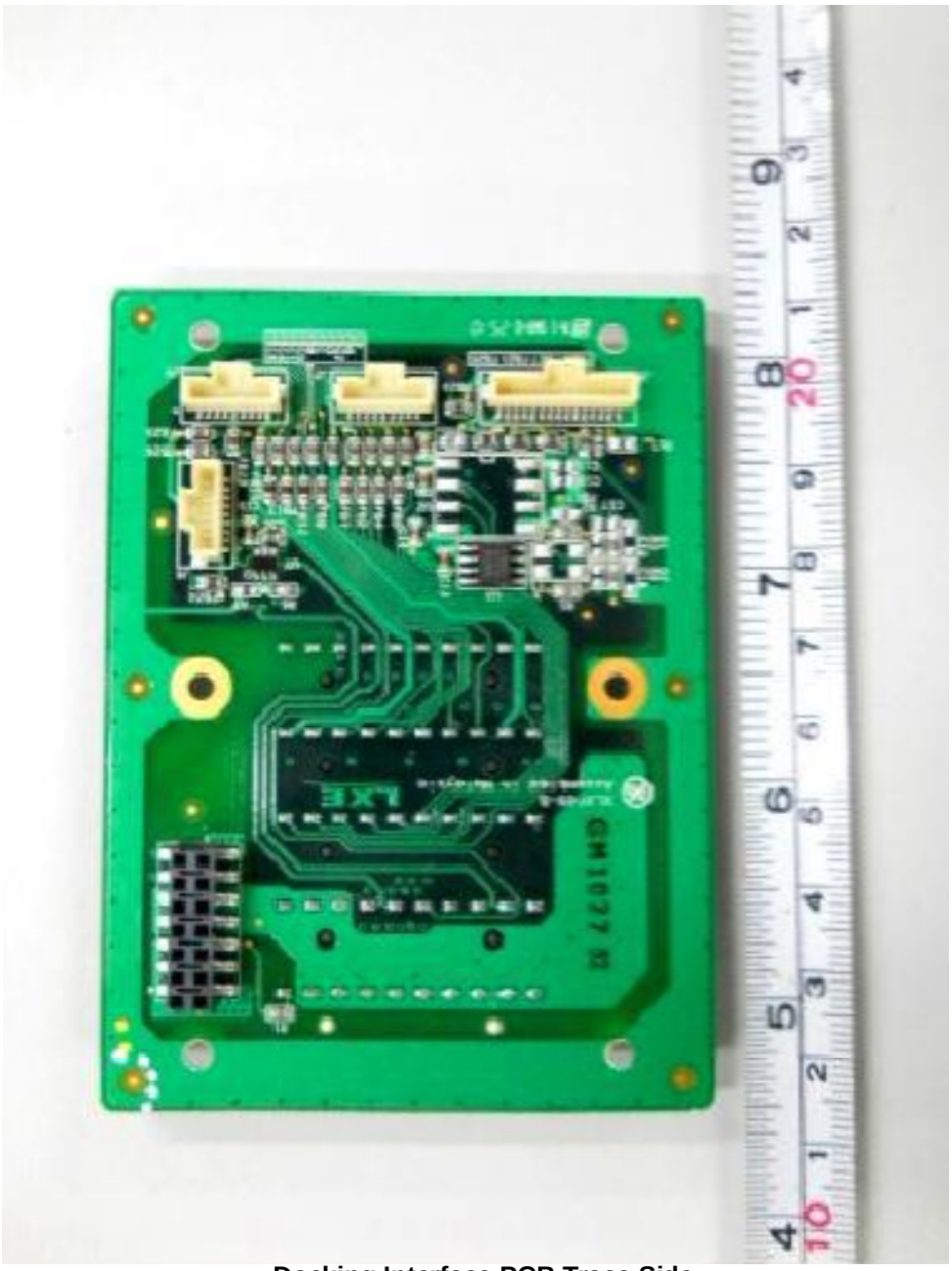
DC-DC Converter PCB Trace Side

EUT PHOTOGRAPHS



Docking Interface PCB Component Side

EUT PHOTOGRAPHS



Docking Interface PCB Trace Side

ANNEX B

USER MANUAL
TECHNICAL DESCRIPTION
BLOCK & CIRCUIT DIAGRAMS

(Please refer to manufacturer for details)

ANNEX C

FCC LABEL & POSITION

ANNEX C FCC LABEL & POSITION

Labelling requirements per Section 2.925 & 15.19

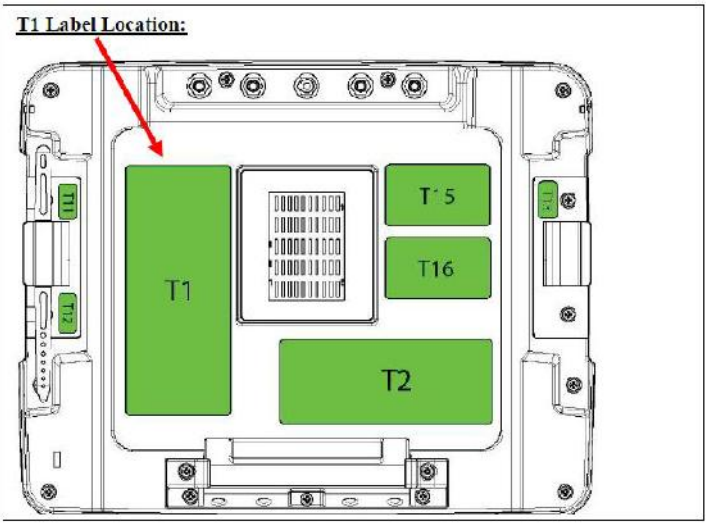
The label shown will be permanently affixed at a conspicuous location on the device and be readily visible to the user at the time of purchase.

VM1 Terminal Product Label(T1)

(1) Size; 120mm X50mm
(2) Specification: Printed Polyester, Maximum surface temperature specified, or 40 degree C if not specified.
(3) UL-CCN: PGDQ2 or PGJI2

VM1 C, Windows CE with
MSD30AG wifi module,
GOBI2000

T1 Label Location:



ANNEX C FCC LABEL & POSITION

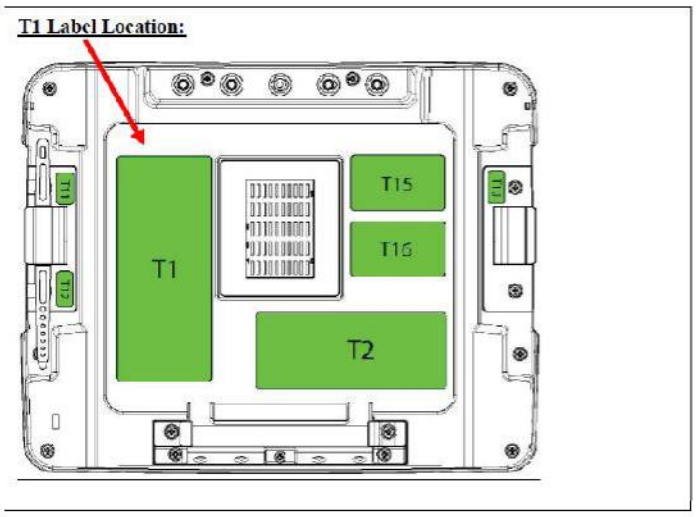
Labelling requirements per Section 2.925 & 15.19

The label shown will be permanently affixed at a conspicuous location on the device and be readily visible to the user at the time of purchase.

VM1 Terminal Product Label

(1) Size: 120mm X50mm
(2) Specification: Printed Polyester, Maximum surface temperature specified, or 40 degree C if not specified.
(3) UL-CCN: PGDQ2 or PGJI2

VM1 W: Windows OS
with PE15N wifi module,
GOBI2000



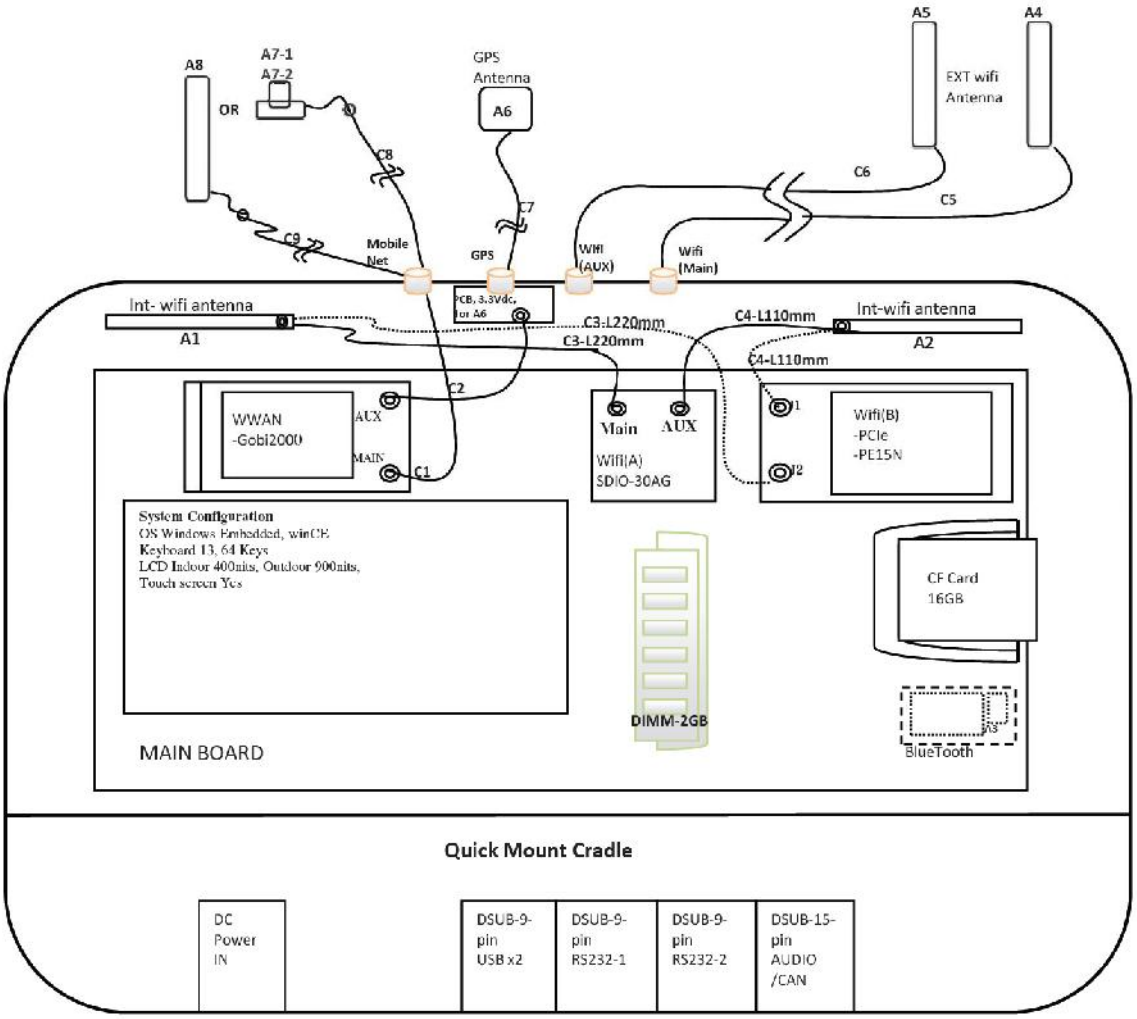
ANNEX D

ANTENNA INFORMATION

ANNEX D ANTENNA INFORMATION

TYPE OF RF CABLES AND ANTENNAS

(a) Antennas and cables connection diagram



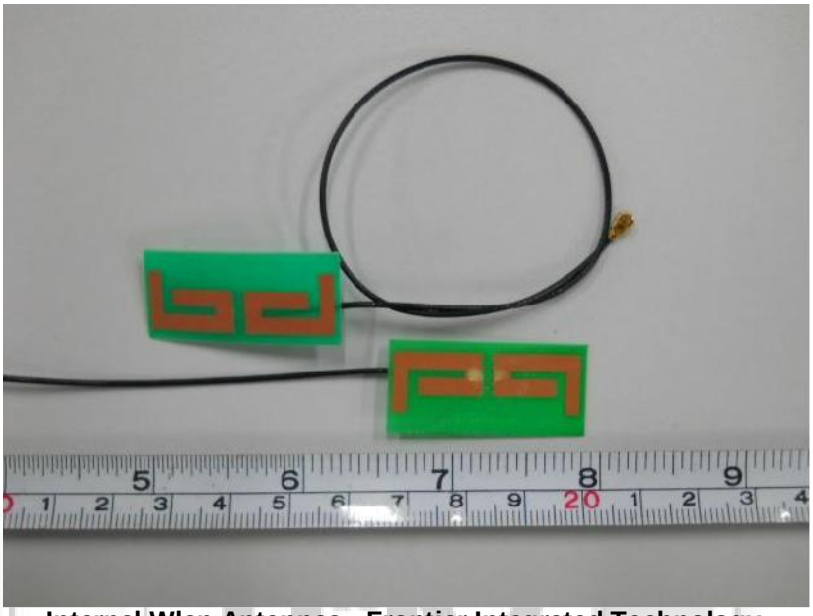
(b) TYPES OF ANTENNA

The information in below table are provides from their respective specification

Ref ID	Description	Type	Gain	Manufacturer	Connection
B1	Internal wifi antenna	FIT-ANT-VM1-10	2.4 to 2.485Ghz: 2dBi 4.9 to 5.9Ghz: 4dBi	Frontier Integrated Technology	Cable C3-L220mm, connect to SDIO-MAIN or PE15N-J2
B2		FIT-ANT-VM1-1			Cable C4 L110mm, connect to SDIO-AUX or PE15N-J1
B3	Bluetooth	AH316M245001	2.4 to 2.485Ghz: -1.5dBi	Taiyo Yuden	PCB- surface mounted device, SMD type
B4	External wifi antenna, dual band 2.40-2.50G/4.90-5.90G. Dual Band Swivel Mount. Dipole RP-TNC Blade.	R380500314	2.4 ~ 2.5Ghz: 1.0dBi 4.9 ~ 5.9Ghz: 5dBi	LARSEN	Connect to WIFI RF terminals via RF cable-C5(for A4-Main) and C6(for A5-Aux).
B5					
B6	External GPS antenna,	GPS15MGSMB	1575.42 MHz: 3dBic Cable loss 10dB	LAIRD	Antenna with attached cable connect to VM1-GPS RF terminal
B7	MobileNet antenna. There are two parts; Multi Band Phantom-A7-1 and Miniature Magnetic Mounts A7-2	A7-1: TRAB806/17103 (BLK Phantom wideband806-960, 1575, 1710 2500MHZ 3dB MEG N) A7-2: G16404 (MTMDN15SMA M-001, MOUNT, MGM, 3/4 A195,SMAM I, CMP, CH)	AMPS 806-896 MHz:5.9dBi GSM 090-960 MHz: 5.0dBi GPS 1575.42 MHz: 5.1dBi DCS 1710 1880 MHZ: 4.2dBi PCS 1850-1990 MHz: 4.2dBi UMTS 1900-2170 MHz 4.4dBi ISM (BT) 2.4 - 2.5 GHz: 3.0dBi	LAIRD	Connect to Mobile-Net RF terminal via the attached cable of magnetic mount
B8	MobileNet antenna-alternate type. Mount by double sized adhesive tape on non-metallic surface.	STEALTH BLADE ; W1923G0300-824-960/1710-2170MHZ	824-960/1710-2170 MHz: 0dBi	Pulse	As alternate for non-metallic surface connected to Mobile-Net RF terminal via RF cable C9

(C) Type of RF Cables and Interconnection

Ref ID	Part description, and Type	Connection		Specification: Length, cable loss, frequency range
Cable		From	To	
C1	RF cable-Main	Main-Gobi2000	MOBILE NET-VM1 SMA connector-Main	Type: Cable 036 RF – XXX – X "XXX": Length in mm, 50 to 400 Example:100mm=100 "X": Washer and nut options Blank-Separately packed (standard) A- Assembled with connectors
C2	RF cable-Aux	AUX-Gobi2000	MOBILE NET-VM1 SMA connector-GPS-PCBA	
C3	Internal wifi cable	Wifi(A) SDIO-Main	Internal Antenna A1-SIDE	
		Wifi(B) PCIe - J2	Internal Antenna A1-SIDE	
C4	Internal wifi cable	Wifi(A) SDIO-AUX	Internal Antenna A2-TOP	
		Wifi(B) PCIe - J1	Internal Antenna A2-TOP	
C5	Wifi cable: RDN1008006	wifi-main	Wifi antenna-A4	M/N: SMA R/A PLUG to RP TNC JACK OR LMR240 RF CABLE. RF cable, 4.573m cable.
C6		wifi-Aux	Wifi antenna-A5	
C7	GPS cable	GPS	GPS antenna - A6	Cable(4.8m) attached to GPS antenna
C8	MobileNet cable	MobileNet	Magnetic mount base(A7-2)	cable attached to magnetic mount base
C9	MobileNet cable: RDN1007129	MobileNet	Pulse antenna-A8 *alternate	M/N: SMA RA PLUG to SMA STR JACK FOR LMR240 RF CABLE. RF cable, 4.573m cable.



Internal Wlan Antennas : Frontier Integrated Technology
(Type: Fit-Ant-Vm1-1 And Fit-Ant-Vm1-10, Pcb Side)

Internal Wlan Antennas - Frontier Integrated Technology (Pcb Bottom Side)

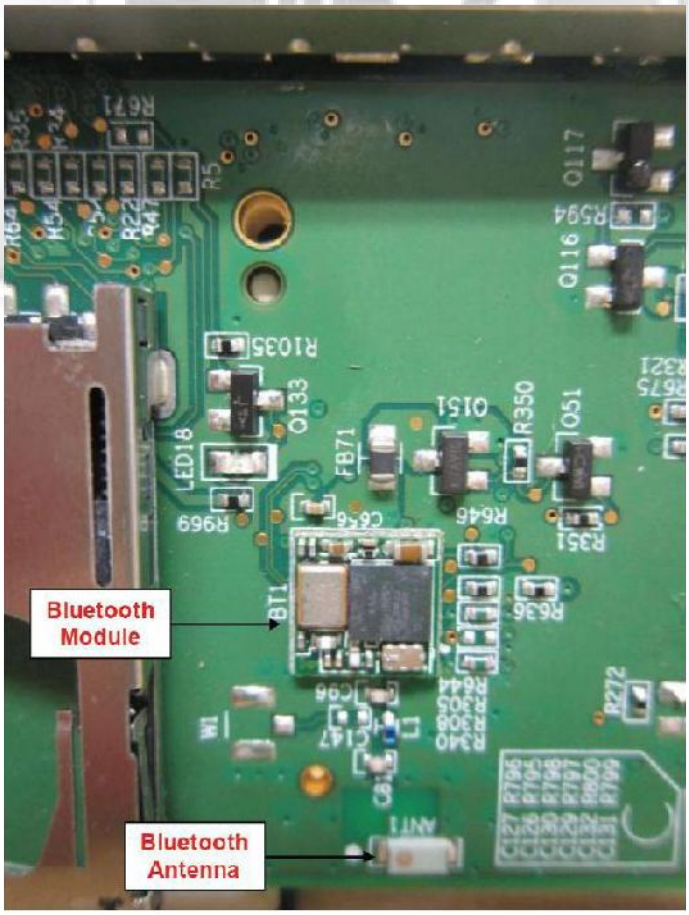
Mobile Net Antenna : Pulse (Type: W1923g0300) & Cable (Type: Rdn1007129)

Mobile Net Antenna : Laird (Type : Multi Band Phantom, Type : Trab806/17103 & Miniature Magnetic Mounts, Type : G16404 Attached With Attached 12ft Cable)

GPS Antenna : Laird (Type : GPS15MGSMB With Attached 4.8m RF Cable)

WLAN External Antennas : Larsen (Type : R380500314)

External WLAN cables : RDN1008006, 4.573m



Bluuetooth : Country Mate Technology Ltd (Type : Cm-1bc04-003)
Anetnna : Taiyo Yuden (Type : Ah316m245001)

PSB Singapore