

# TEST REPORT



Your Ref:

Date: 24 Sept 2003

Our Ref: 56S030690/01

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FORMAL REPORT ON TESTING IN ACCORDANCE WITH  
FCC Parts 15B & C : 2002  
OF A  
**PORTABLE PC WITH BUILT IN 2.4GHz WIRELESS LAN**  
[ MODEL : W988A ]  
[ FCC ID : RGV0309W988A ]

**TEST FACILITY** Telecoms & EMC, Testing Group, PSB Corporation Pte Ltd  
1 Science Park Drive, Singapore 118221

**FCC REG. NO.** 90937 (3m & 10m OATS)  
99142 (10m Anechoic Chamber)  
871638 (5m Anechoic Chamber)

**IND. CANADA REG. NO.** IC 4257 (10m Anechoic Chamber)

**PREPARED FOR** Mr Yang Hong  
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**JOB NUMBER** 56S030690

**TEST PERIOD** 30 Aug 2003 - 8 Sept 2003

PREPARED BY

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APPROVED BY

Colin Gan  
Vice President



LA-2001-0212-A  
LA-2001-0213-F  
LA-2001-0214-E  
LA-2001-0215-B  
LA-2001-0216-G  
LA-2001-0217-G

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

TEST SUMMARY

PRODUCT DESCRIPTION

SUPPORTING  
EQUIPMENT LIST

EUT OPERATING  
CONDITION

TEST RESULTS

- |         |  |
|---------|--|
| ANNEX A | - TEST INSTRUMENTATION & GENERAL PROCEDURES                    |
| ANNEX B | - EUT PHOTOGRAPHS / DIAGRAMS                                   |
| ANNEX C | - USER MANUAL, TECHNICAL DESCRIPTION, BLOCK & CIRCUIT DIAGRAMS |
| ANNEX D | - FCC LABEL & POSITION   |

## TEST SUMMARY

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

### Test Results Summary

Test Standard	Description	Pass / Fail
FCC Part 15: 2002		
15.107, 15.207	Conducted Emissions	Pass
15.205	Radiated Emissions (Restricted Band Requirements)	Pass
15.109, 15.209	Radiated Emissions (Spurious Emissions)	Pass
15.247 (a)(2)	Spectrum Bandwidth (6dB Bandwidth Measurement)	Pass
15.247 (b)(3)	Maximum Peak Power	Pass
15.247 (c)	RF Conducted Spurious Emissions & Band Edge Compliance at the Transmitter Antenna Terminal	Pass
15.247 (d)	Peak Power Spectral Density	Pass

### Notes

- Three channels as listed below, which respectively represents 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 different modulation as detailed below:

Transmit Channel	Frequency (GHz)	Modulation
Channel 1	2.412	DBPSK (1Mbps) DQPSK (2Mbps) CCK (11Mbps)
Channel 7	2.442	DBPSK (1Mbps) DQPSK (2Mbps) CCK (11Mbps)
Channel 13	2.472	DBPSK (1Mbps) DQPSK (2Mbps) CCK (11Mbps)

- All the measurements in section 15.247 were done based on conducted measurements.
- The EUT is a Class B device when in non-transmitting state and meets the FCC Part15B Class B requirements.

### Modifications

No modifications were done.

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**PRODUCT DESCRIPTION**

Description	: The Equipment Under Test (EUT) is a <b>Portable PC with Built In 2.4GHz Wireless LAN.</b>
Manufacturer	: InfoWave Pte Ltd
Model Number	: W988A
FCC ID	: RGV0309W988A
Serial Number	: Nil
Operating / Transmitting Frequency	: 2.412GHz to 2.472GHz with 13 channels. Starting at 2.412MHz with subsequent channel at 5MHz interval from the preceding channel.
Modulation	: DBPSK (1Mbps) DQPSK (2Mbps) CCK (5.5Mbps) CCK (11Mbps)
Port / Connectors	: 1 x Ethernet port (RJ45 port) 2 x RS232 port 1 x parallel port 2 x USB ports 1 x PS2 port 2 x IR ports 2 x PC card slots (Type II, PCMCIA 2.1) 1 x IEEE 1394 port 1 x docking connector 1 x earphone out jack 1 x microphone in jack 1 x DC in jack
Rated Input Power	: 19VDC, 60W via 100 - 240VAC Power Adapter

## SUPPORTING EQUIPMENT DESCRIPTION

Equipment Description (Including Brand Name)	Model, Serial & FCC ID Number	Cable Description (List Length, Type & Purpose)
Epson Printer Stylus Photo 700	M/N P952B S/N: AWSK007034 FCC ID : DoC	2.0m unshielded power cable. 2.0m standard parallel cable.
Mitsumi Floppy Disk Drive	M/N D353GUE S/N: Nil FCC ID : DoC	Nil
DynaLink Modem	M/N: V1416VQER1 S/N: Nil FCC ID: DoC	2.0m unshielded power cable. 1.5m standard RS232 cable.
Dell Keyboard	M/N: SK-8000 S/N: MY035KKW3884313H2725 FCC ID: DoC	1.80m unshielded keyboard cable.
Altec Headphone	M/N: Lansing S/N: Nil FCC ID: Nil	1.5m standard audio cable
Touch AC/DC Adapter (EUT AC/DC Power Adapter)	M/N: EA10603B S/N: R0003220041 FCC ID: Nil	1.00m standard DC power adapter cable

## EUT OPERATING CONDITIONS

Tests	Description Of Operation
<ol style="list-style-type: none"> <li>1. Conducted Emissions</li> <li>2. Radiated Emissions</li> <li>3. Spectrum Bandwidth (6dB Bandwidth Measurement)</li> <li>4. Maximum Peak Power</li> <li>5. RF Conducted Spurious Emissions at the Transmitter Antenna Terminal</li> <li>6. Band Edge Compliance at the Transmitter Antenna Terminal</li> <li>7. Peak Power Spectral Density</li> </ol>	<p>The EUT was exercised by activating the following operations continuously:</p> <ol style="list-style-type: none"> <li>1. R/W operation to harddisk and floppy disk drive</li> <li>2. Print characters 'H' to LCD panel and printer</li> <li>3. Send and receive data via modem</li> <li>4. Send audio signal to earphone</li> <li>5. Continuous transmitting in Channel 1 (2.412GHz), Channel 7 (2.442GHz) and Channel 13 (2.472GHz) respectively with maximum transmitting power. For each channel, the EUT was configured to modulate in the following modulation: <ul style="list-style-type: none"> <li>- DBPSK (1Mbps)</li> <li>- DQPSK (2Mbps)</li> <li>- CCK (11Mbps)</li> </ul> </li> </ol>

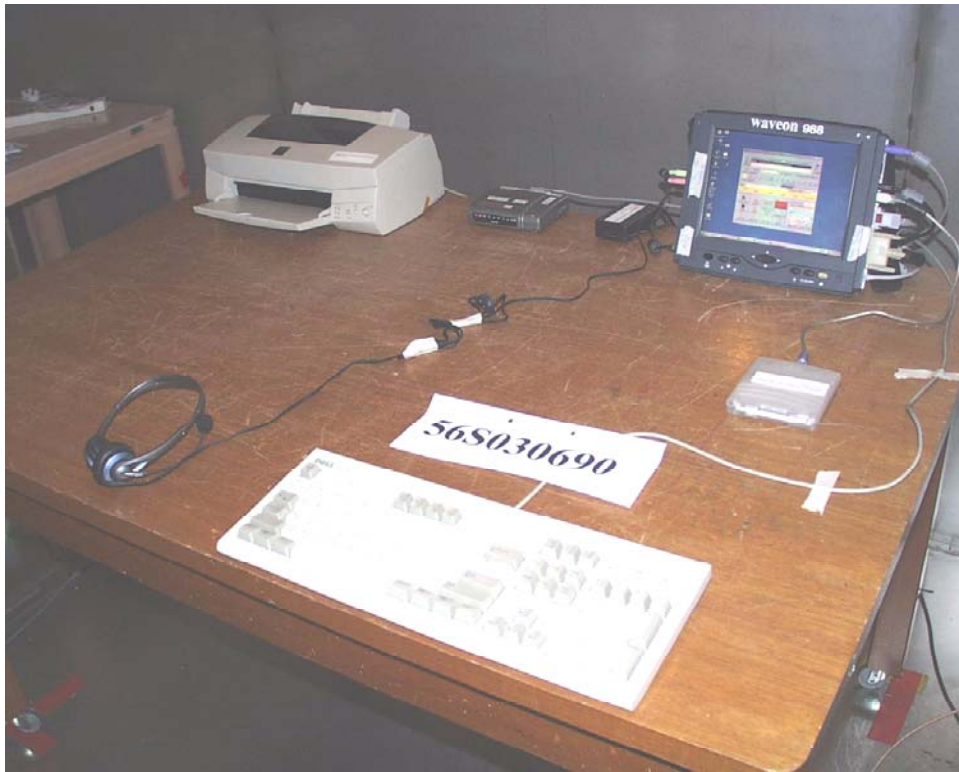
**FCC Parts 15B & C (15.107 & 15.207) Conducted Emission Results**

Frequency (MHz)	AV Value (dB $\mu$ V)	AV Margin (dB)	Q-P Value (dB $\mu$ V)	Q-P Margin (dB)	Line	Channel
16.4683	44.1	-5.9	53.7	-6.3	Live	13
17.2261	46.5	-3.5	55.0	-5.0	Live	1
20.1396	42.2	-7.8	50.0	-10.0	Live	13
20.8377	39.7	-10.3	47.9	-12.1	Neutral	1
22.1541	39.2	-10.8	46.7	-13.3	Live	13
22.8518	40.2	-9.8	46.6	-13.4	Neutral	7

Tested by: CMH

**Notes**

1. All possible modes of operation were investigated from 150kHz to 30MHz. Only the 6 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: 10kHz 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 (Average & Quasi-peak) is  $\pm 2.4$ dB.



Conducted Emission Setup (Front View)



Conducted Emission Setup (Rear View)



**FCC Parts 15B & C (15.109 & 15.209) Radiated Emissions Results**

Test Distance : 3m

Frequency (MHz)	Q-P Value (dB $\mu$ V/m)	Q-P Margin (dB)	Channel	Azimuth (Degrees)	Height (cm)	Polarisation (H/V)
368.4000	41.2	-4.8	1	128	127	V
536.2047	38.1	-7.9	7	82	100	V
593.6000	42.9	-3.1	13	156	113	V
620.8788	41.5	-4.5	7	82	100	V
620.8830	43.6	-2.4	1	87	100	V
909.1380	42.6	-3.4	1	179	120	V

Tested by: WR/ATH

**Notes**

- All possible modes of operation were investigated. Only the 6 worst case emissions measured, using the correct CISPR detectors, are reported. All other emissions were relatively insignificant.
- The transmitting antenna was found to be in the worst case condition when it was orientated in a vertical position.
- Spurious emissions were investigated from 30MHz – 25GHz.
- 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.
- A "-ve" margin indicates a PASS as it refers to the margin present below the limit line at the particular frequency.
- EMI receiver Resolution Bandwidth (RBW) and Video Bandwidth (VBW) settings:  
30MHz - 1GHz  
 RBW: 120kHz      VBW: 1MHz  
>1GHz  
 RBW: 1MHz      VBW: 3MHz
- The peak emissions above 1GHz show compliance to the requirement stated in Section 15.35 (b).
- 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 (QP only @ 3m & 10m) is  $\pm 4.3$ dB (for EUTs < 0.5m X 0.5m X 0.5m).

**FCC Part 15C (15.205) Radiated Emissions (Restricted Band Requirements) Results**

Test Distance : 3m

Frequency (MHz)	Q-P Value (dB $\mu$ V/m)	Q-P Margin (dB)	Channel	Azimuth (Degrees)	Height (cm)	Polarisation (H/V)
112.9000	36.7	-6.8	7	272	100	V
117.6986	40.2	-2.8	1	303	100	V
269.2103	41.0	-5.0	7	75	100	V
400.7000	42.1	-3.9	7	185	115	V
402.9011	41.7	-4.3	13	22	156	H
537.6124	43.0	-3.0	7	112	103	H

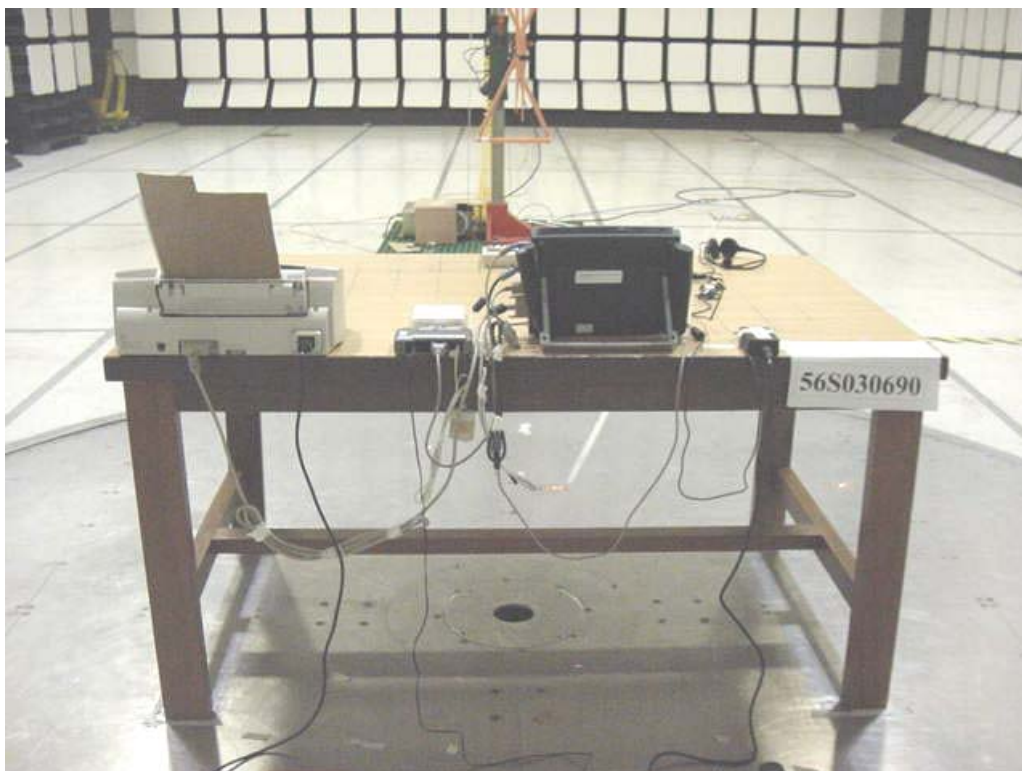
Tested by: WR/ATH

**Notes**

- All possible modes of operation were investigated. Only the 6 worst case emissions measured, using the correct CISPR detectors, are reported. All other emissions were relatively insignificant.
- The transmitting antenna was found to be in the worst case condition when it was orientated in a vertical position.
- Spurious emissions on restricted bands were investigated from 30MHz – 25GHz.
- 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.
- A "-ve" margin indicates a PASS as it refers to the margin present below the limit line at the particular frequency.
- EMI receiver Resolution Bandwidth (RBW) and Video Bandwidth (VBW) settings:  
30MHz - 1GHz  
 RBW: 120kHz      VBW: 1MHz  
>1GHz  
 RBW: 1MHz      VBW: 3MHz
- The peak emissions above 1GHz show compliance to the requirement stated in Section 15.35 (b).
- 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 (QP only @ 3m & 10m) is  $\pm 4.3$ dB (for EUTs < 0.5m X 0.5m X 0.5m).



**Radiated Emissions Setup (Front View)**



**Radiated Emissions Setup (Rear View)**

**FCC Part 15C (15.247(a)(2)) Spectrum Bandwidth (6dB Bandwidth Measurement) Results**

The EUT shows compliance to the requirements of this section, which states that for system using digital modulation techniques, the minimum 6dB bandwidth shall be at least 500kHz.

Channel	Channel Frequency (GHz)	6dB Bandwidth (Min.) (MHz)	Limit (Min. Bandwidth) (MHz)
1	2.412	10.33	$\geq 0.5$
7	2.442	10.50	$\geq 0.5$
13	2.472	10.58	$\geq 0.5$

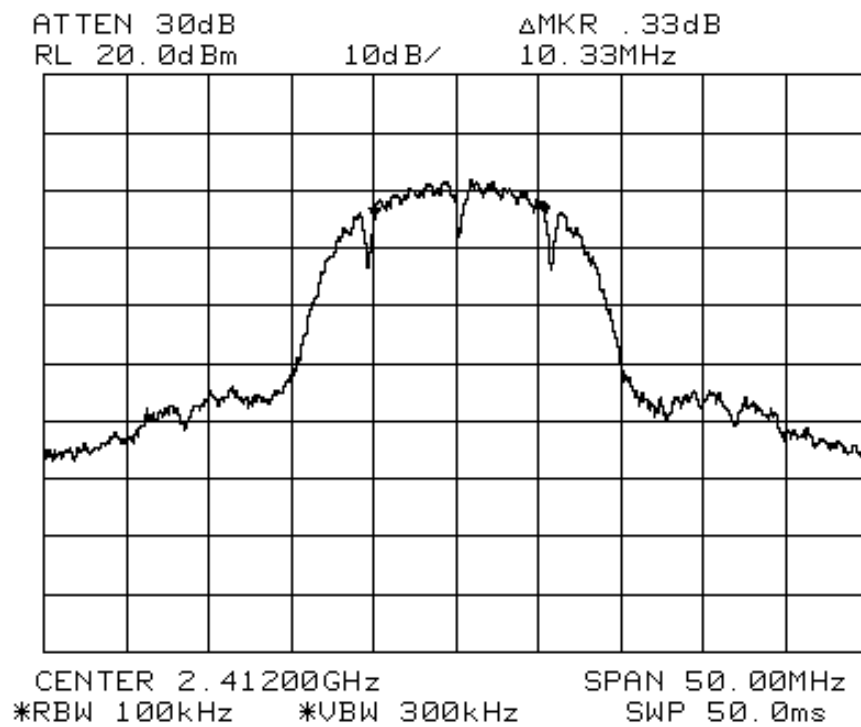
Please refer to the attached Plots 1 - 9 for details.

Tested by: CMH

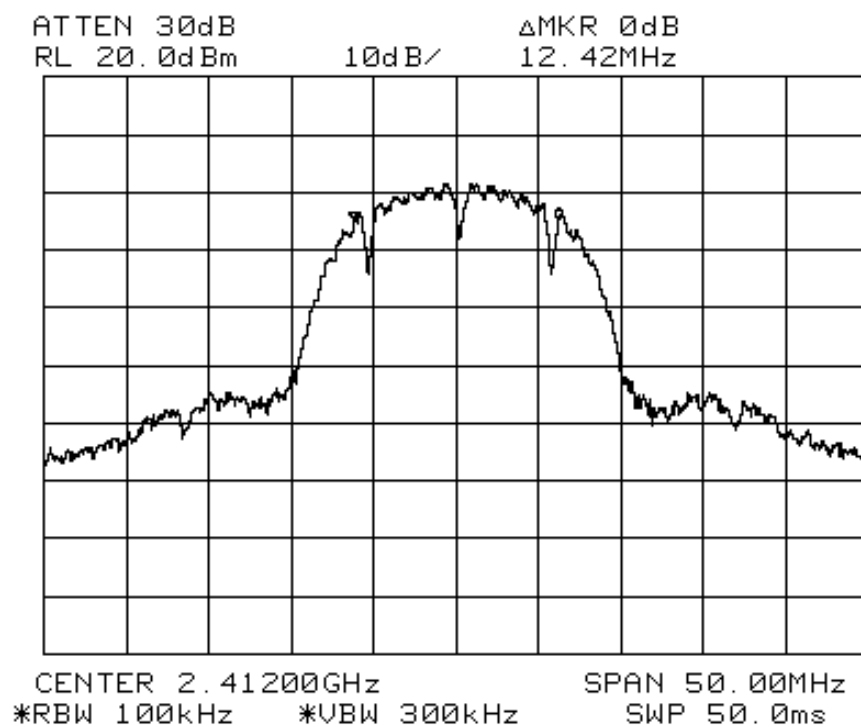


**Spectrum Bandwidth Measurement Test Setup**

**SPECTRUM BANDWIDTH (6dB BANDWIDTH MEASUREMENT) PLOTS**

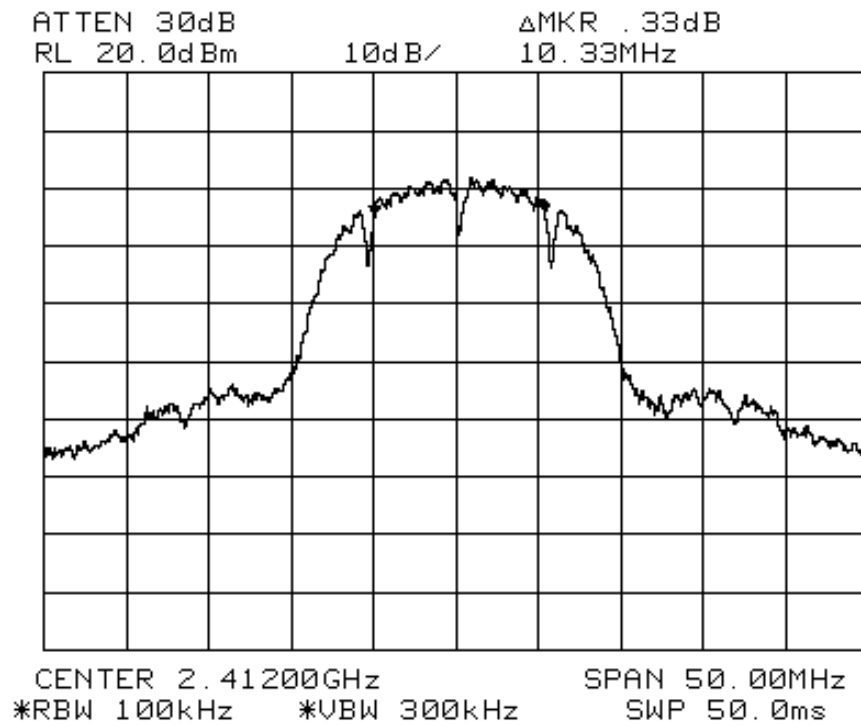


**Plot 1 - Channel 1 @ 1Mbps**

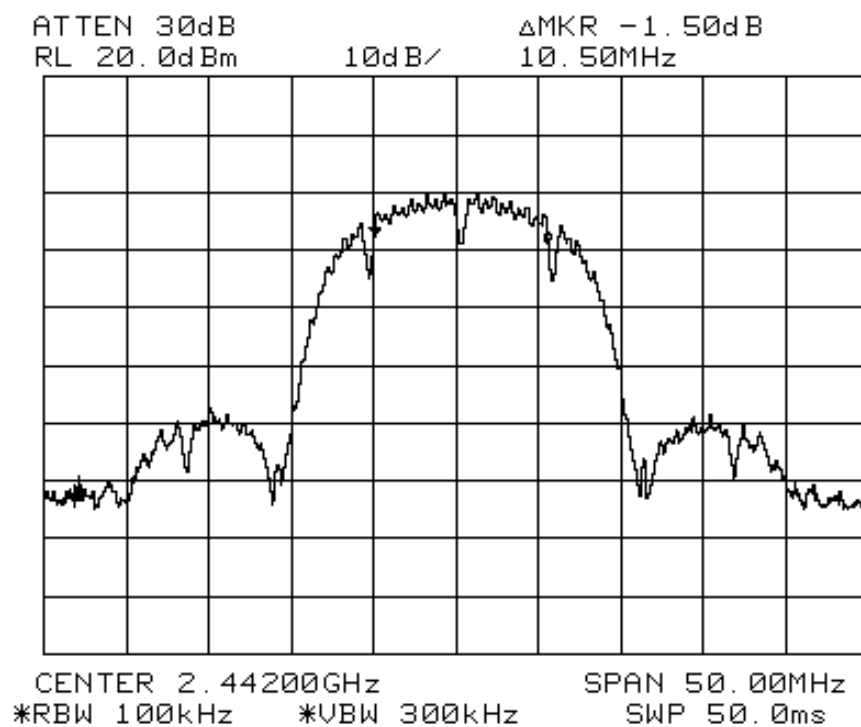


**Plot 2 - Channel 1 @ 2Mbps**

**SPECTRUM BANDWIDTH (6dB BANDWIDTH MEASUREMENT) PLOTS**

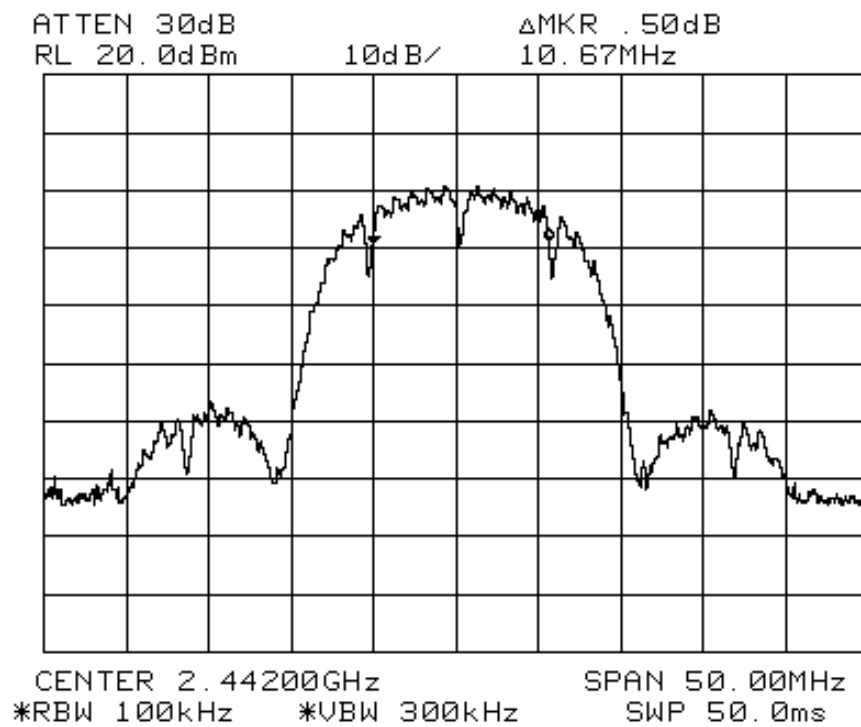


**Plot 3 - Channel 1 @ 11Mbps**

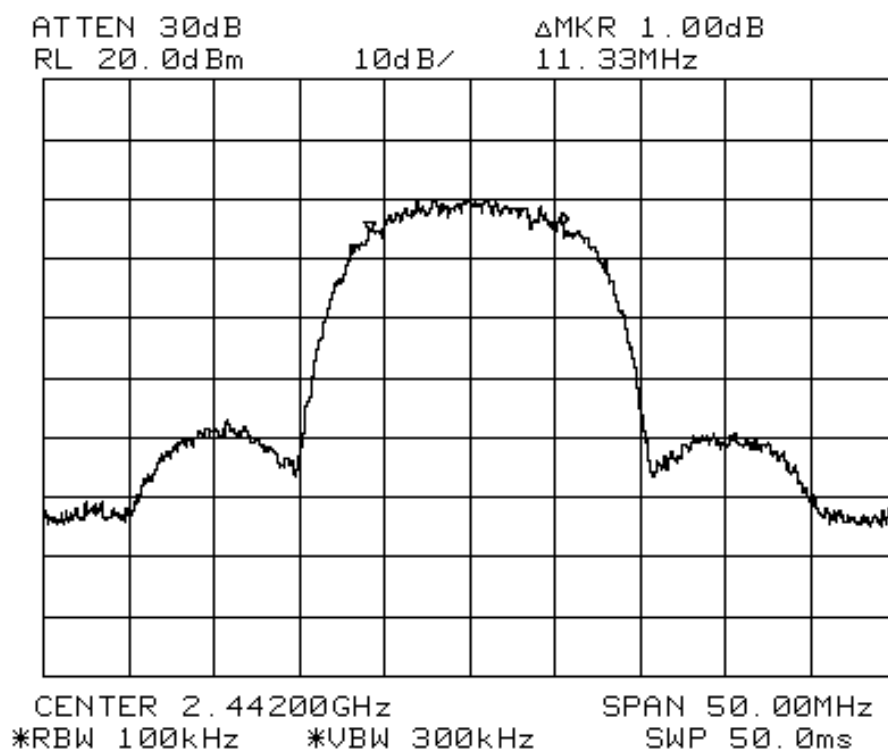


**Plot 4 - Channel 7 @ 1Mbps**

**SPECTRUM BANDWIDTH (6dB BANDWIDTH MEASUREMENT) PLOTS**

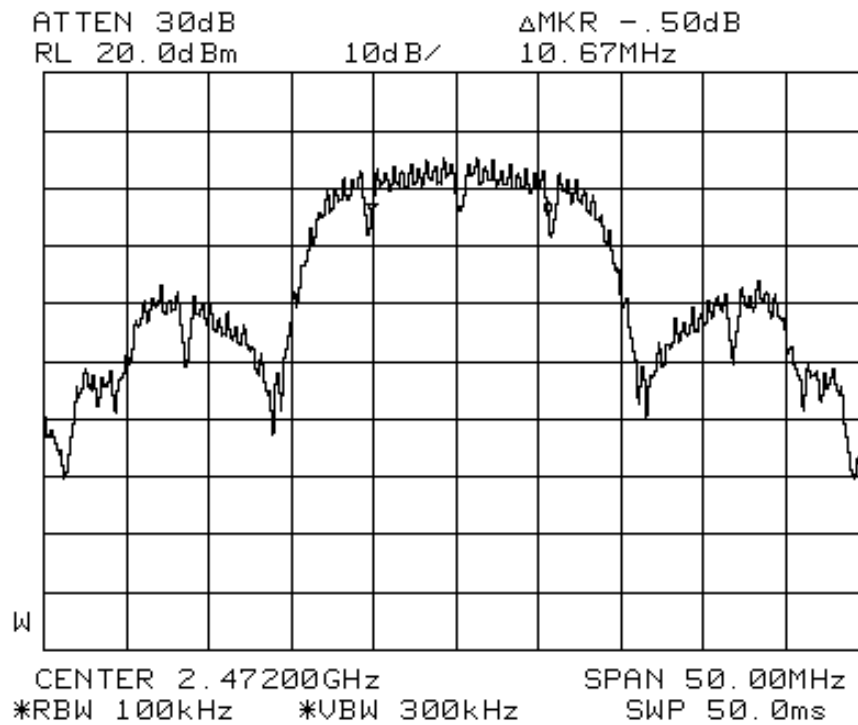


**Plot 5 - Channel 7 @ 2Mbps**

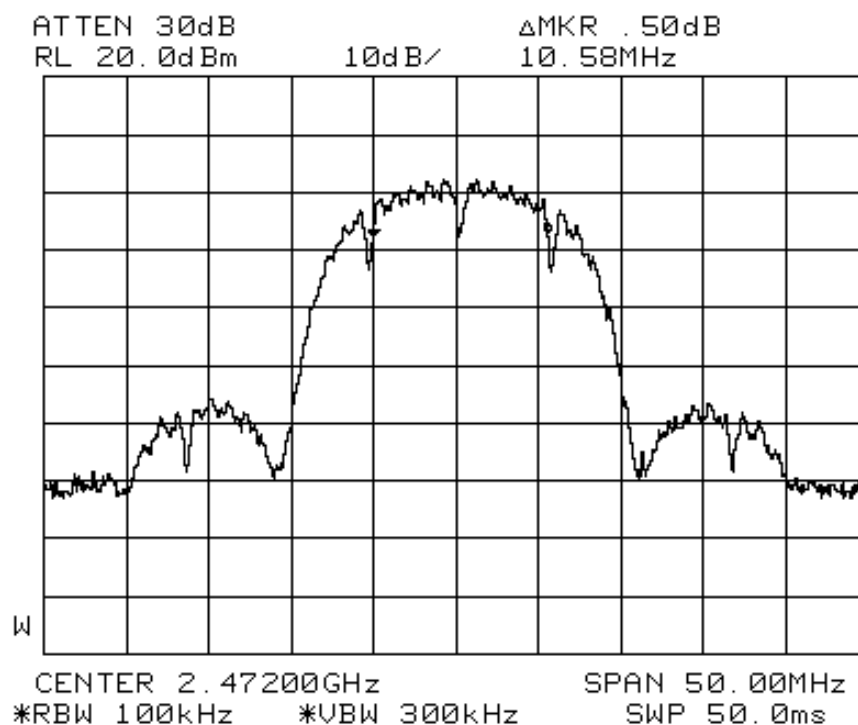


**Plot 6 - Channel 7 @ 11Mbps**

**SPECTRUM BANDWIDTH (6dB BANDWIDTH MEASUREMENT) PLOTS**



**Plot 7 - Channel 13 @ 1Mbps**



**Plot 8 - Channel 13 @ 2Mbps**



ATTEN 30dB                      ΔMKR .50dB  
RL 20.0dBm                  10dB/  
                                      12.33MHz



**FCC Part 15C (15.247(b)(3)) Maximum Peak Power Results**

The EUT shows compliance to the requirements of this section, which states the peak power of an intentional radiator (EUT) shall not exceed 30dBm (1 Watt).

The maximum peak power for Channels 1, 7 and 13 at 2.412GHz, 2.442GHz and 2.472GHz respectively were investigated and found below 30dBm (1Watt).

Channel	Channel Frequency (GHz)	Maximum Peak Power (W)	Limit (W)
1	2.412	0.079	1
7	2.442	0.081	1
13	2.472	0.076	1

Tested by: CMH

**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.



**Maximum Peak Power Measurement Test Setup**

**FCC Part 15C (15.247(c)) RF Conducted Spurious Emissions & Band Edge Compliance at the Transmitter Antenna Results**

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 RF power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of desired power.

The RF conducted spurious emissions were scanned from 10MHz to 25GHz for Channels 1, 7, and 13 with channel frequency at 2.412GHz, 2.442GHz and 2.472GHz respectively. No significant signal was found and they were below the specified limit. Please refer to the attached Plots 10 - 27 for details.

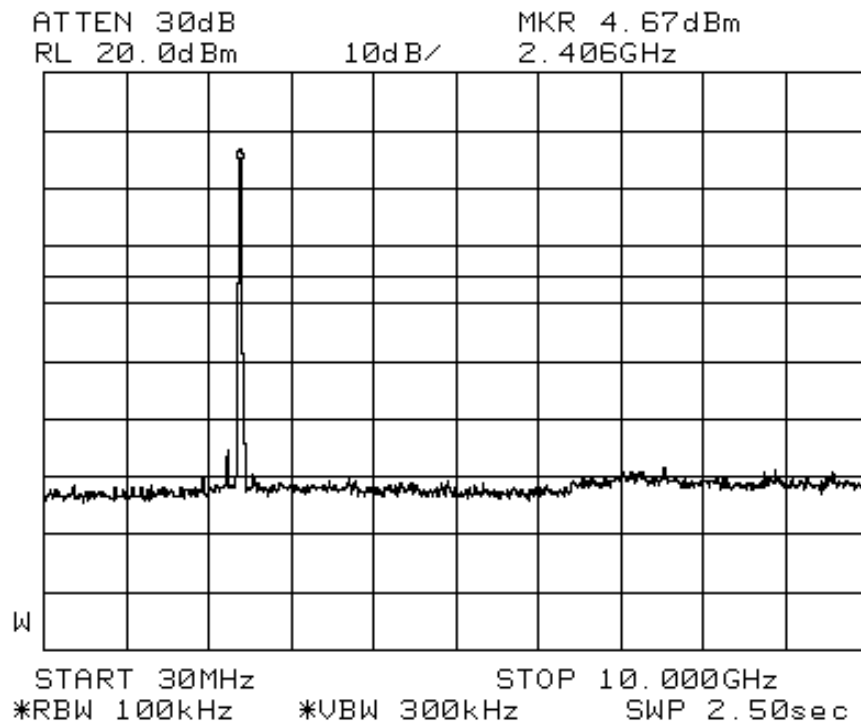
The conducted spurious at lower and upper band-edges (2.4000GHz and 2.4835GHz) were scanned. The spurious emissions at band-edges were found below the specified limit. Please refer to the attached Plots 28 - 33 for details.

Tested by: CMH

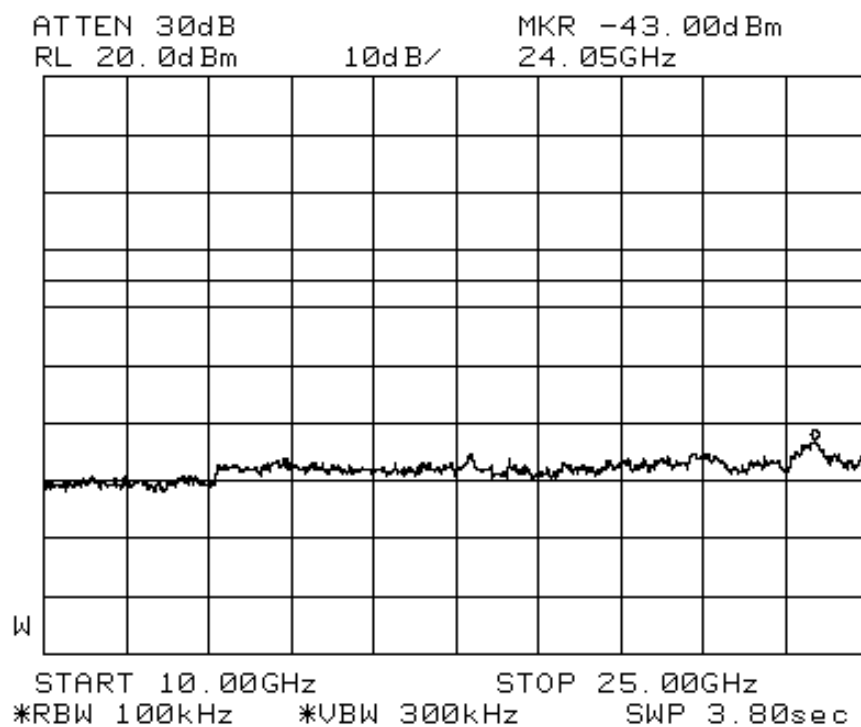


**RF Conducted Spurious & Band Edge Measurement Test Setup**

RF CONDUCTED SPURIOUS EMISSIONS PLOTS

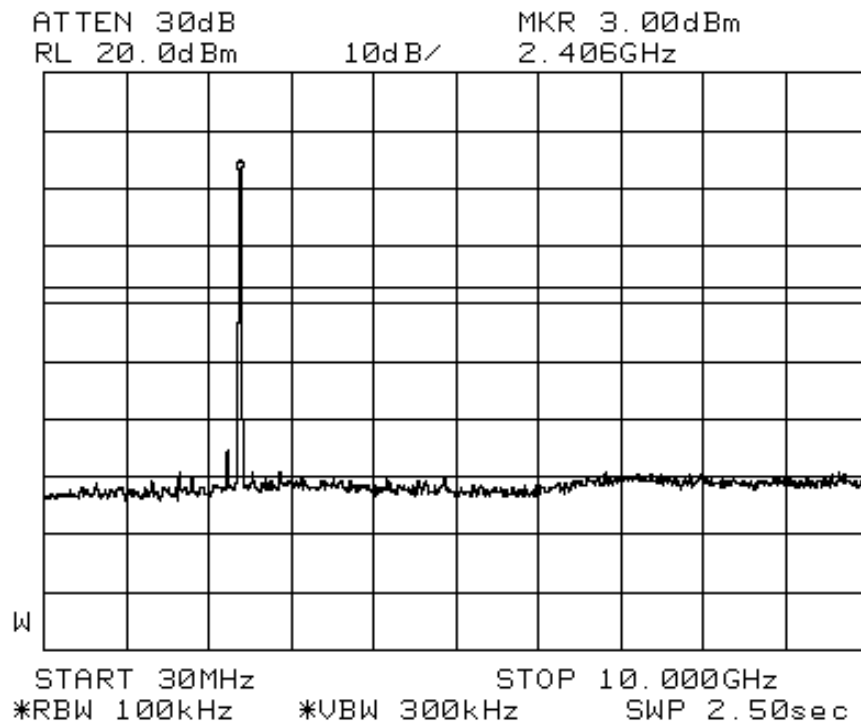


**Plot 10 - Channel 1 @ 1 Mbps (30MHz-10GHz)**

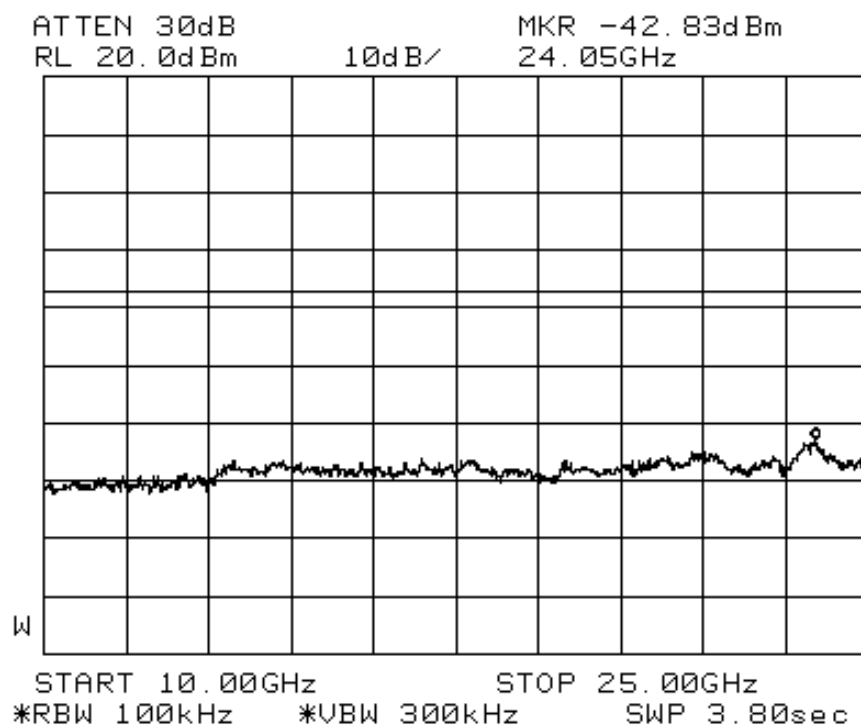


**Plot 11 - Channel 1 @ 1 Mbps (10GHz-25GHz)**

RF CONDUCTED SPURIOUS EMISSIONS PLOTS

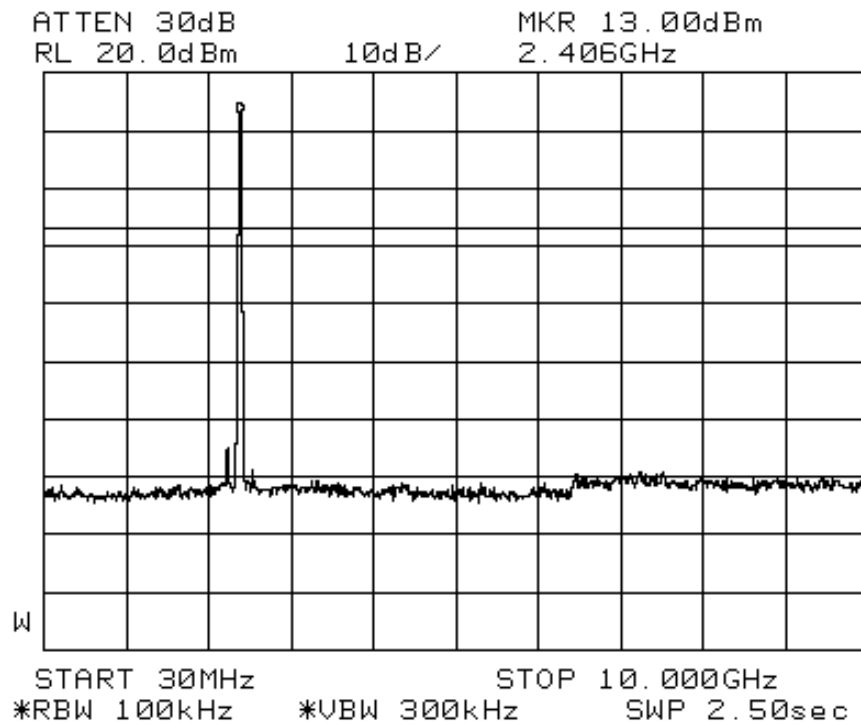


**Plot 12 - Channel 1 @ 2 Mbps (30MHz-10GHz)**

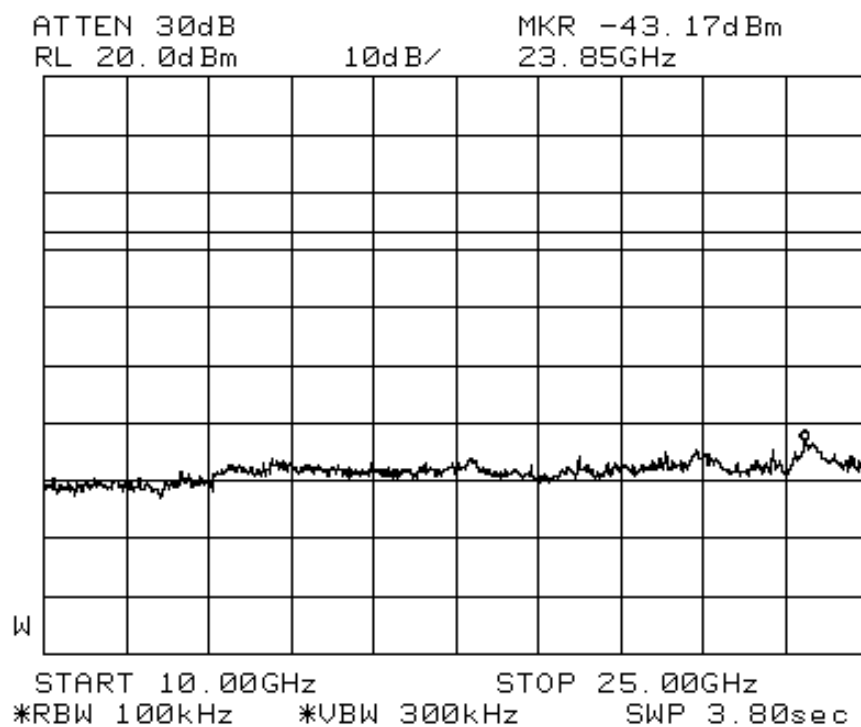


**Plot 13 - Channel 1 @ 2 Mbps (10GHz-25GHz)**

RF CONDUCTED SPURIOUS EMISSIONS PLOTS

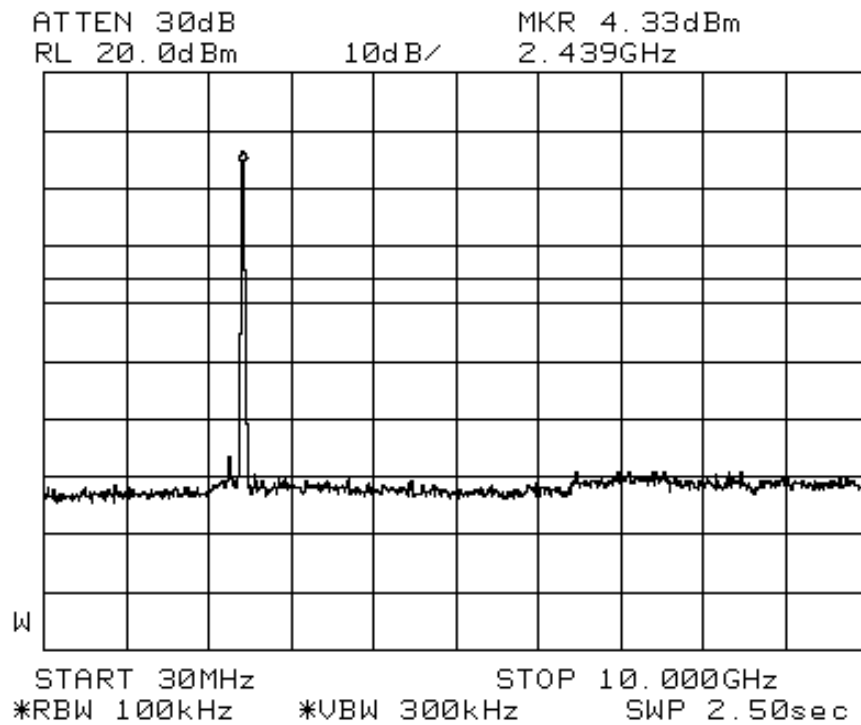


**Plot 14 - Channel 1 @ 11 Mbps (30MHz-10GHz)**

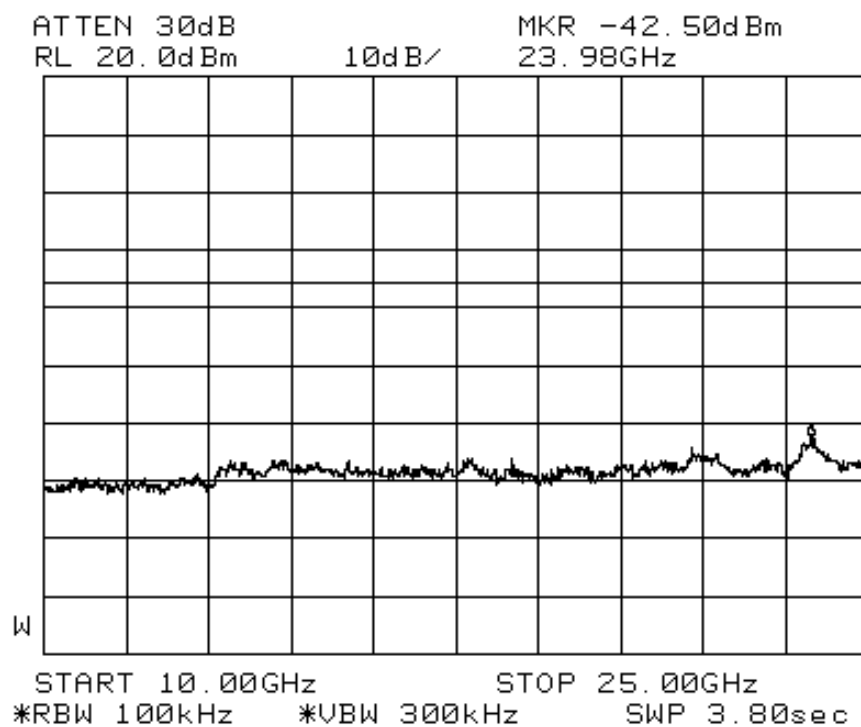


**Plot 15 - Channel 1 @ 11 Mbps (10GHz-25GHz)**

RF CONDUCTED SPURIOUS EMISSIONS PLOTS

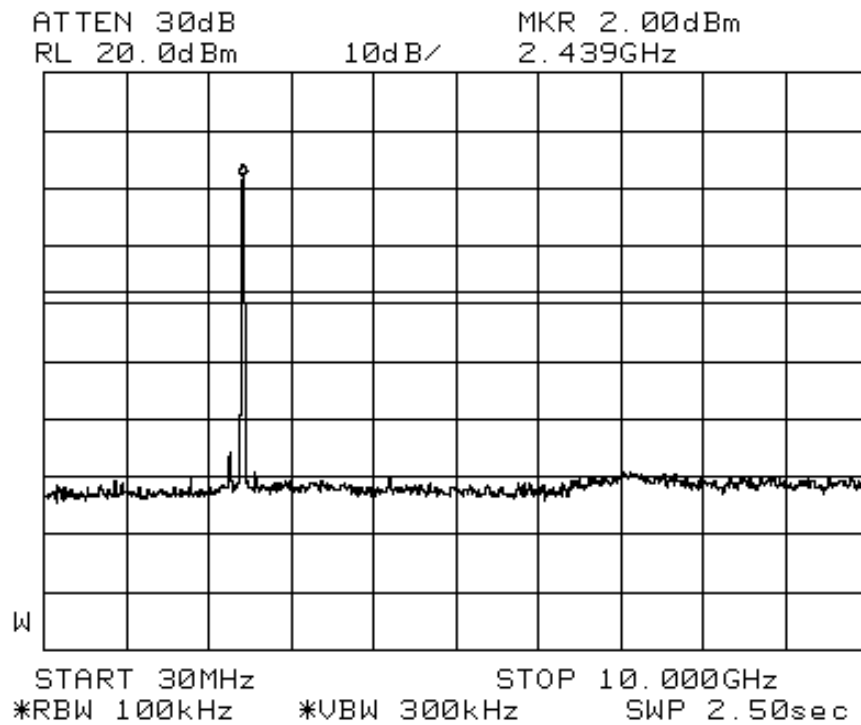


**Plot 16 - Channel 7 @ 1 Mbps (30MHz-10GHz)**

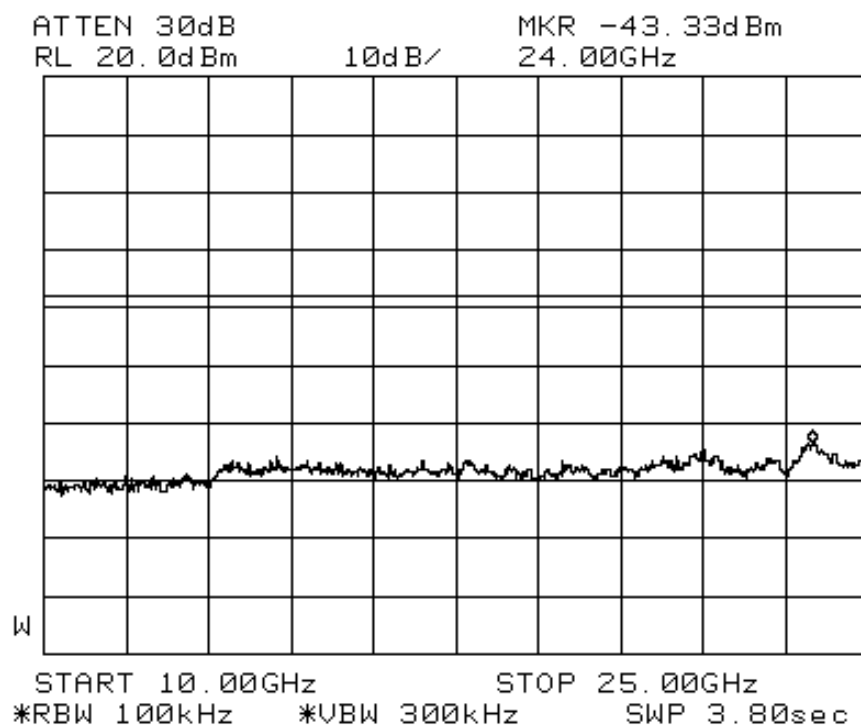


**Plot 17 - Channel 7 @ 1 Mbps (10GHz-25GHz)**

RF CONDUCTED SPURIOUS EMISSIONS PLOTS



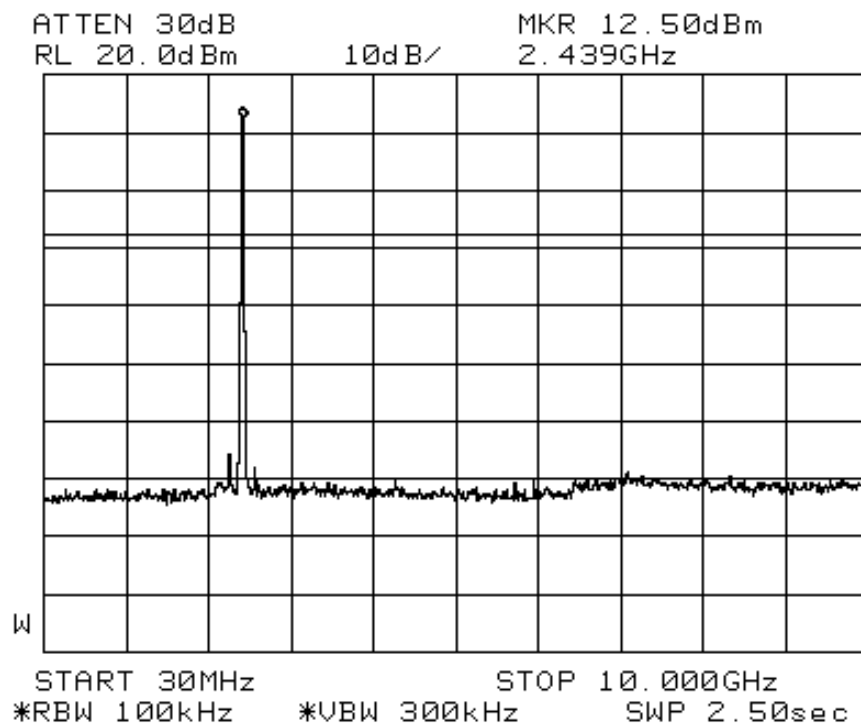
**Plot 18 - Channel 7 @ 2 Mbps (30MHz-10GHz)**



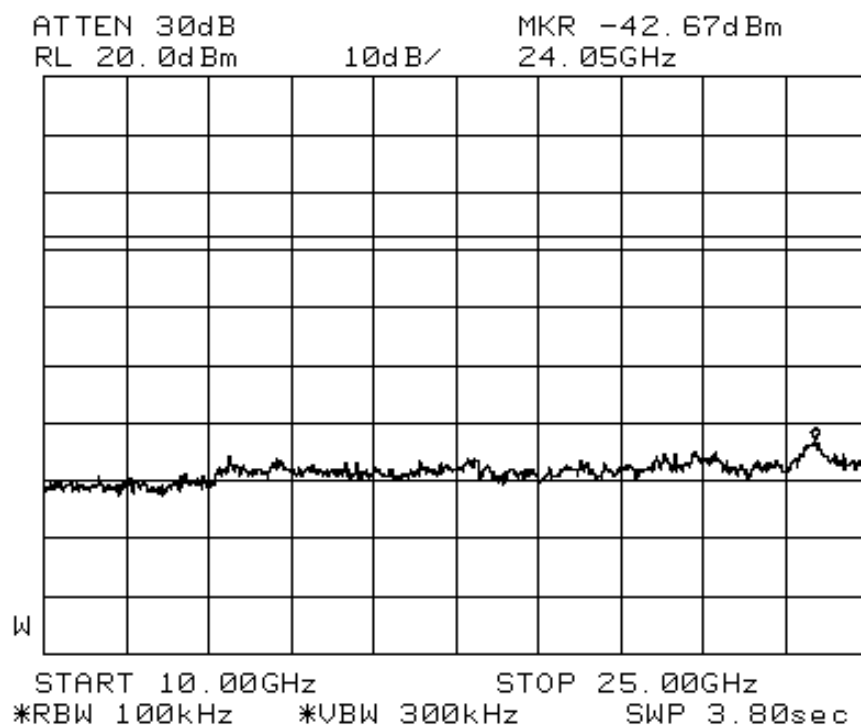
**Plot 19 - Channel 7 @ 2 Mbps (10GHz-25GHz)**



RF CONDUCTED SPURIOUS EMISSIONS PLOTS

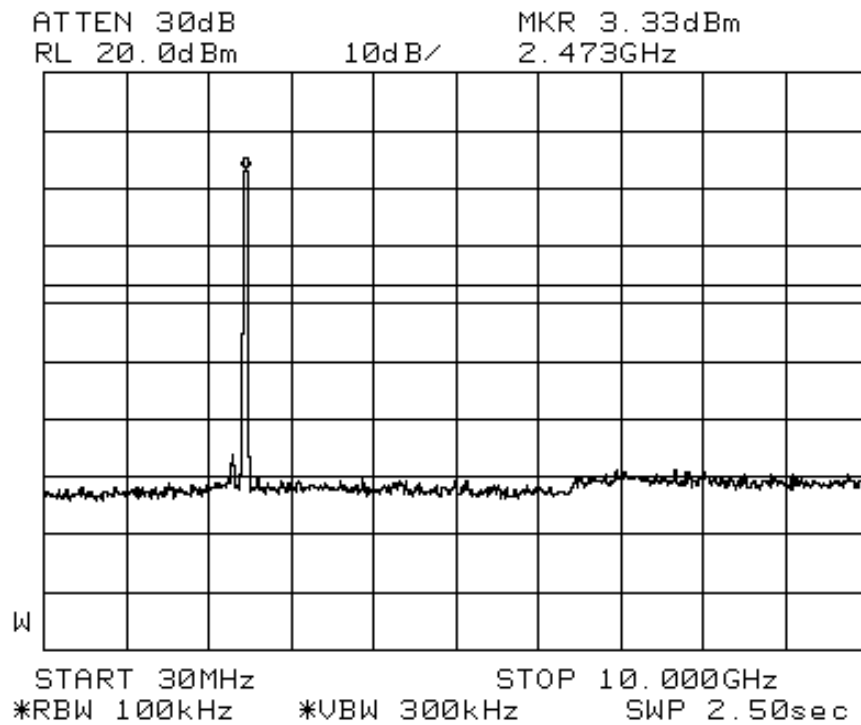


**Plot 20 - Channel 7 @ 11 Mbps (30MHz-10GHz)**

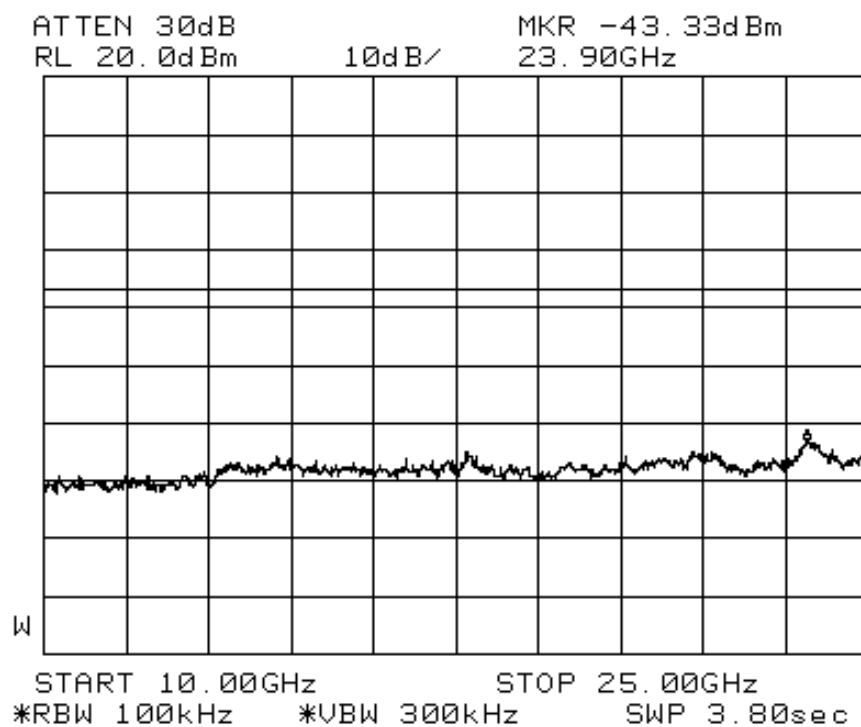


**Plot 21 - Channel 7 @ 11 Mbps (10GHz-25GHz)**

RF CONDUCTED SPURIOUS EMISSIONS PLOTS

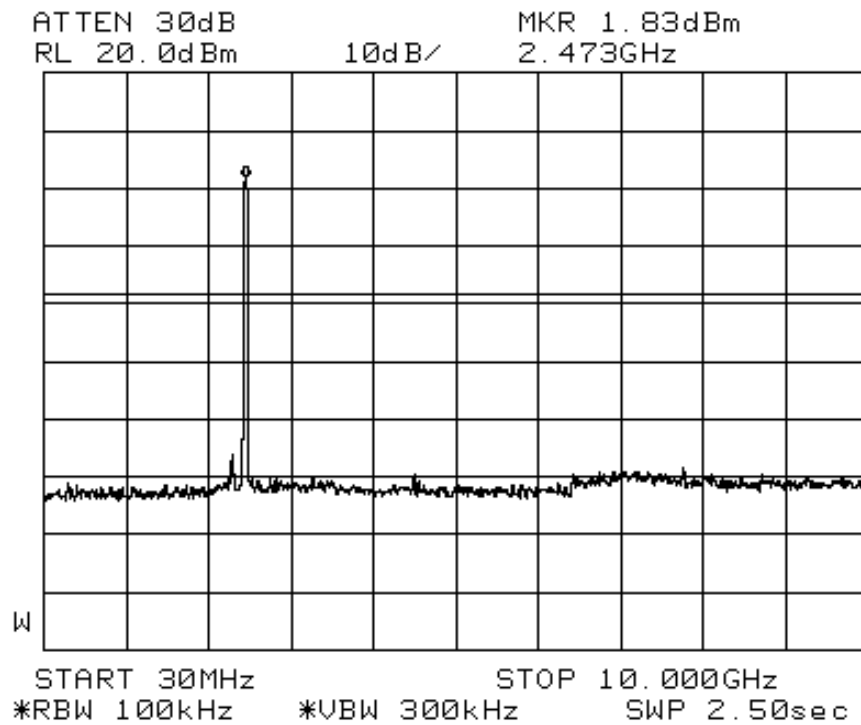


**Plot 22 - Channel 13 @ 1 Mbps (30MHz-10GHz)**

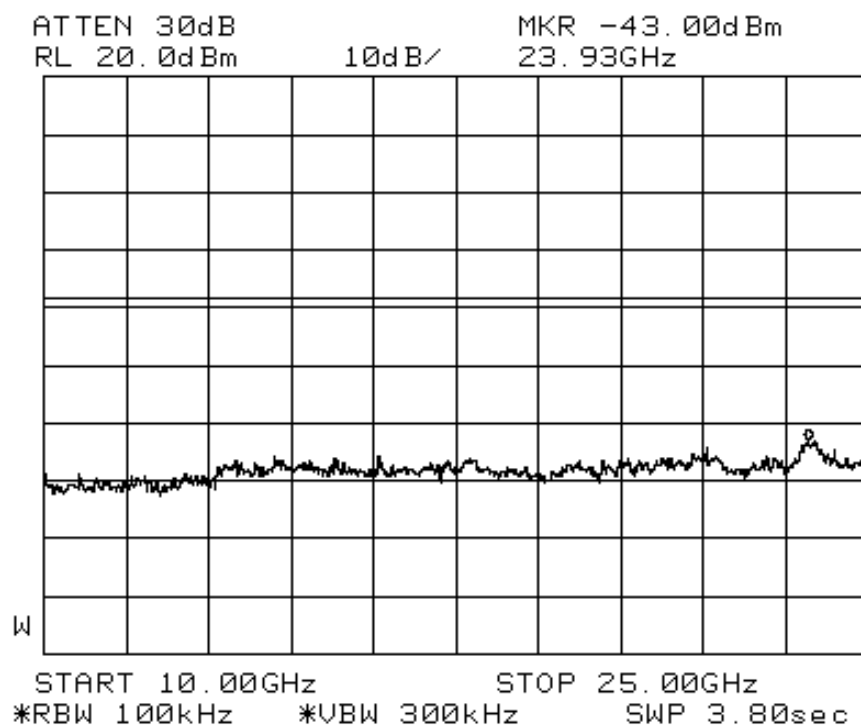


**Plot 23 - Channel 13 @ 1 Mbps (10GHz-25GHz)**

RF CONDUCTED SPURIOUS EMISSIONS PLOTS

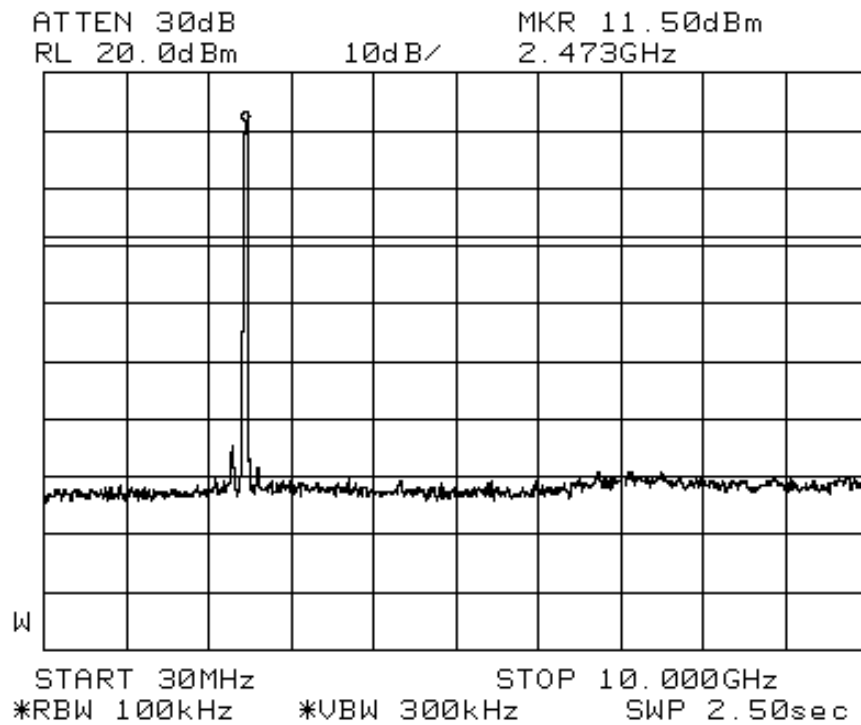


**Plot 24 - Channel 13 @ 2 Mbps (30MHz-10GHz)**

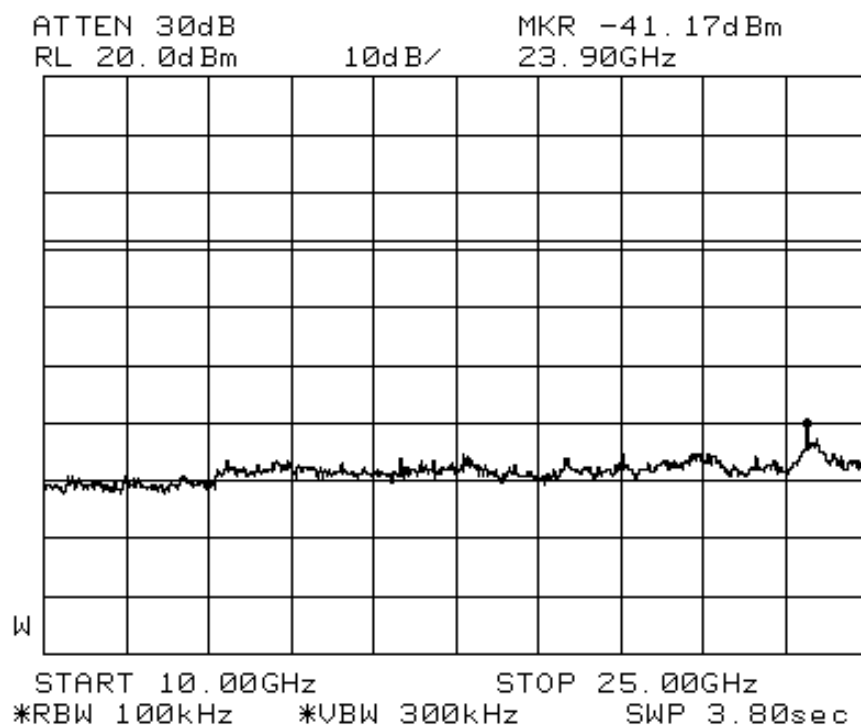


**Plot 25 - Channel 13 @ 2 Mbps (10GHz-25GHz)**

RF CONDUCTED SPURIOUS EMISSIONS PLOTS

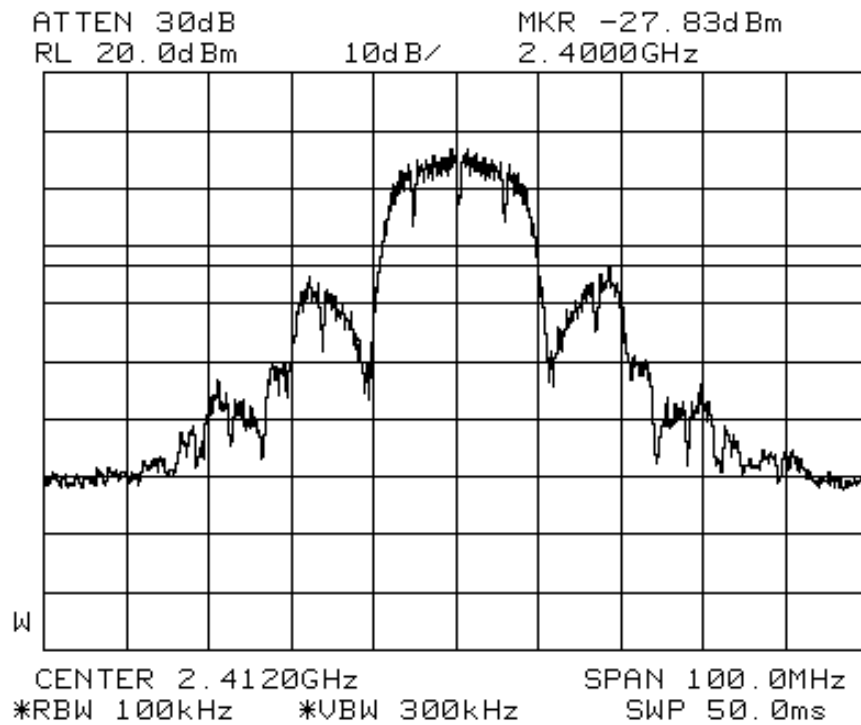


**Plot 26 - Channel 13 @ 11 Mbps (30MHz-10GHz)**

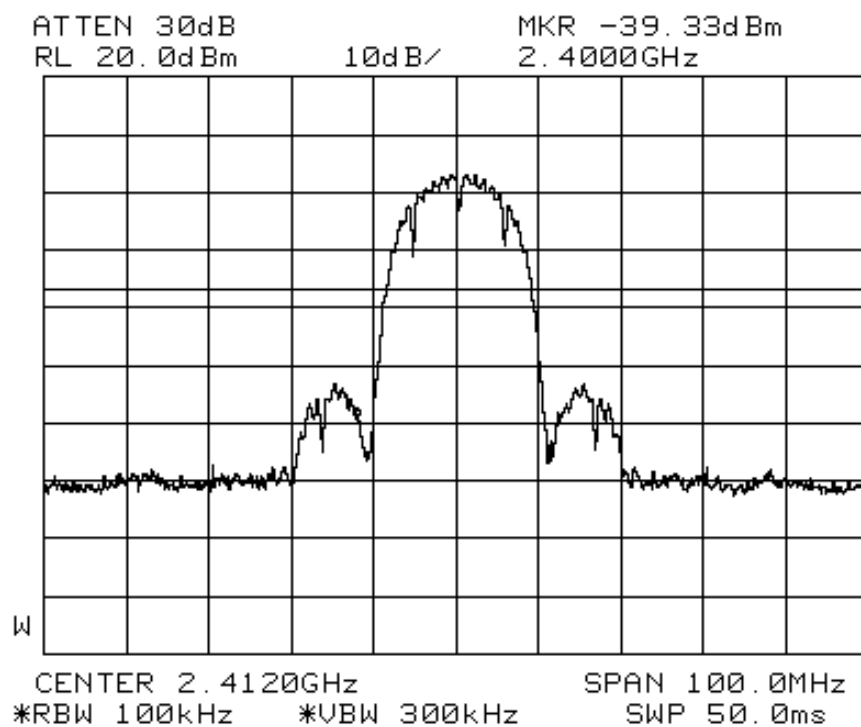


**Plot 27 - Channel 13 @ 11 Mbps (10GHz-25GHz)**

**BAND EDGE COMPLIANCE PLOTS**

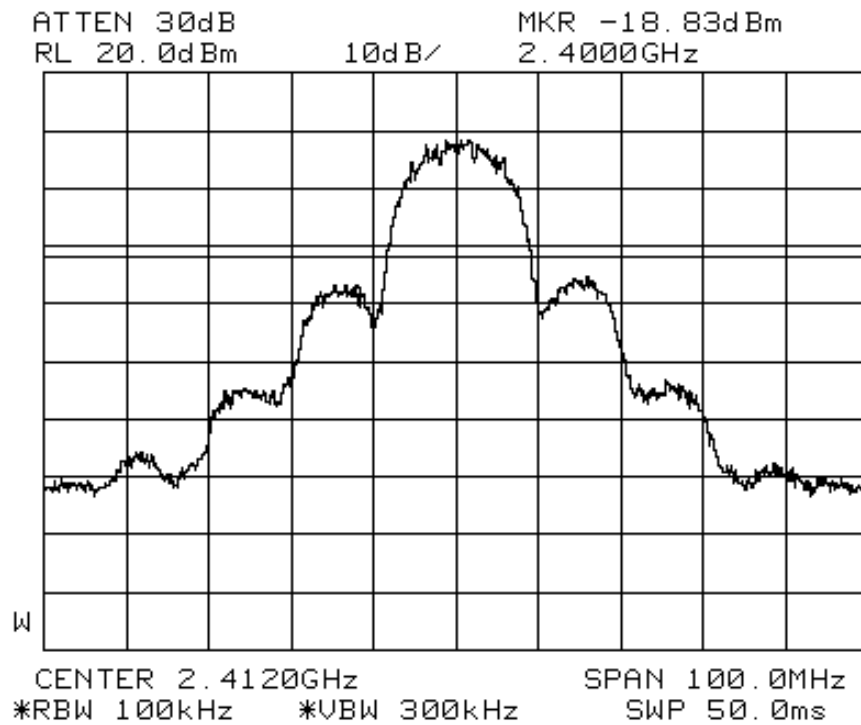


**Plot 28 - Lower Band Edge at 2.40GHz for Channel 1 @ 1Mbps**

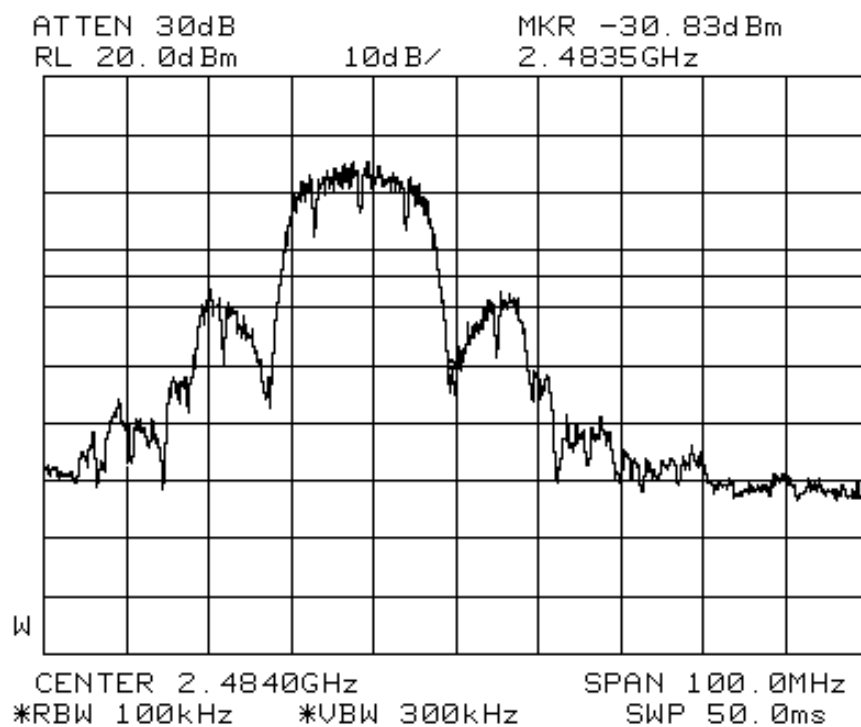


**Plot 29 - Lower Band Edge at 2.40GHz for Channel 1 @ 2Mbps**

**BAND EDGE COMPLIANCE PLOTS**

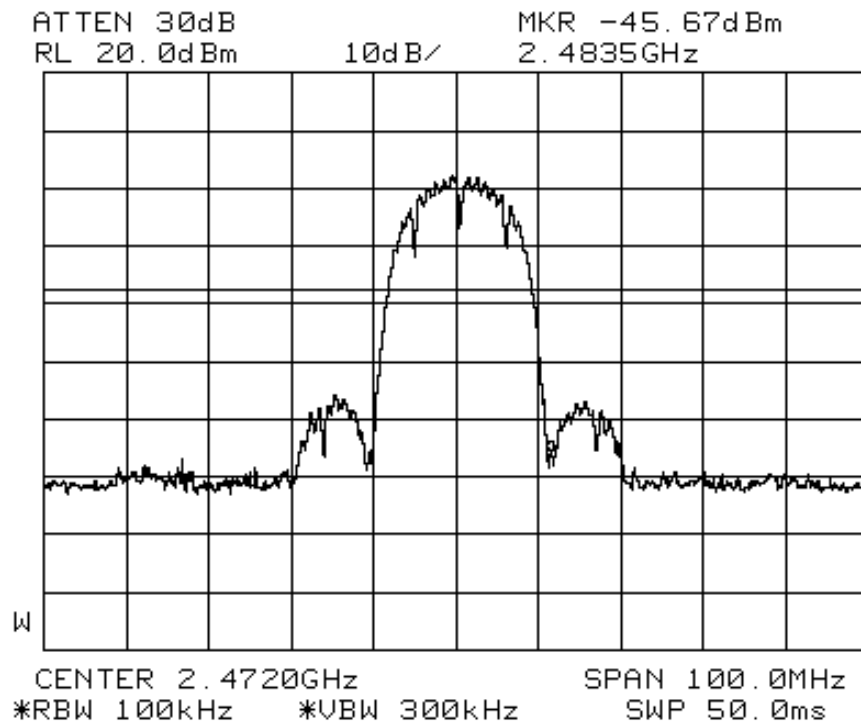


**Plot 30 - Lower Band Edge at 2.40GHz for Channel 1 @ 11Mbps**

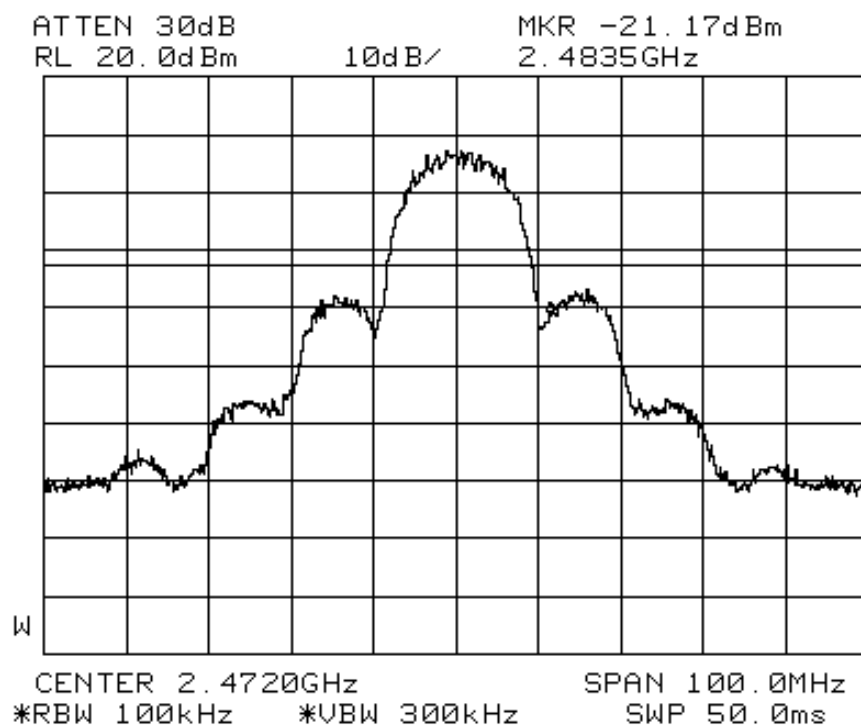


**Plot 31 - Upper Band Edge at 2.4835GHz for Channel 13 @ 1 Mbps**

**BAND EDGE COMPLIANCE PLOTS**



**Plot 32 - Upper Band Edge at 2.4835GHz for Channel 13 @ 2Mbps**



**Plot 33 - Upper Band Edge at 2.4835GHz for Channel 13 @ 11 Mbps**

**FCC Part 15C (15.247(d)) Peak Power Spectral Density Results**

The EUT shows compliance to the requirements of this section, which states the peak power spectral density of an 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.

Channel	Channel Frequency (GHz)	Peak Power Spectral Density (mW)	Limit (mW)
1	2.412	0.37	6.3
7	2.442	0.25	6.3
13	2.472	0.24	6.3

Please refer to the attached Plots 34 – 42 for details.

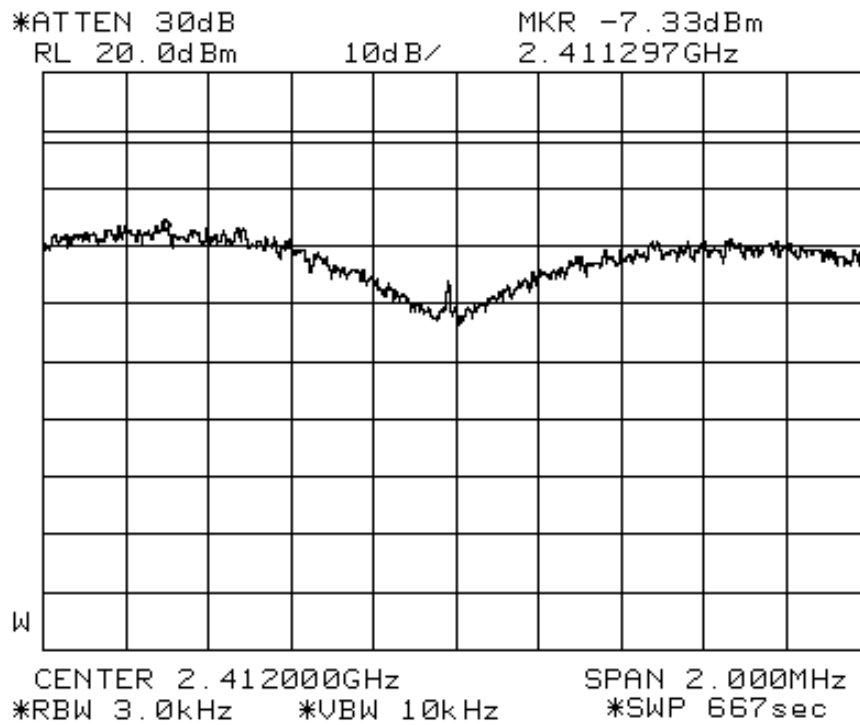
Tested by: CMH



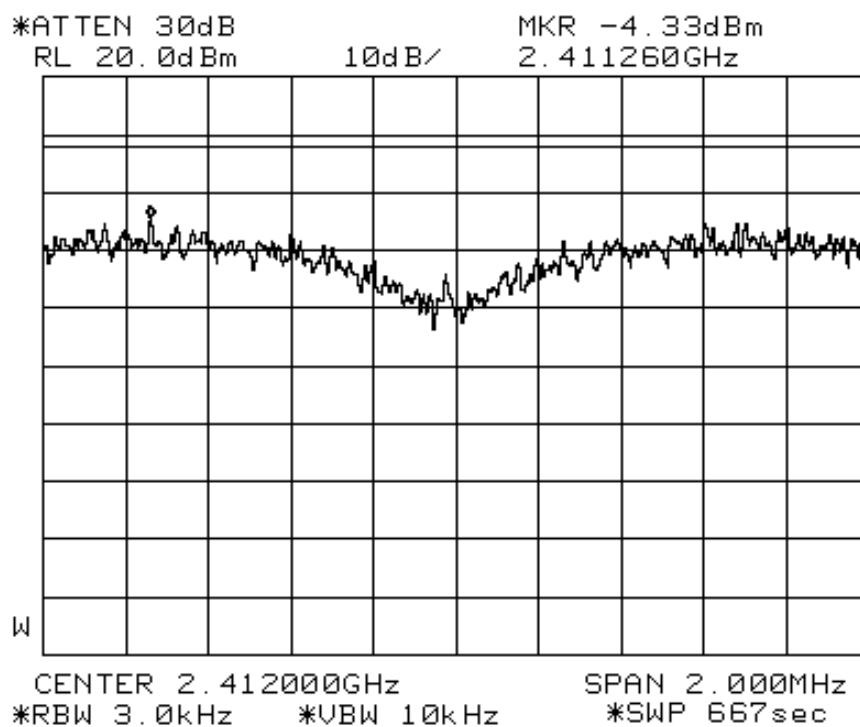
**Peak Power Spectral Density Measurement Test Setup**



PEAK POWER SPECTRAL DENSITY PLOTS

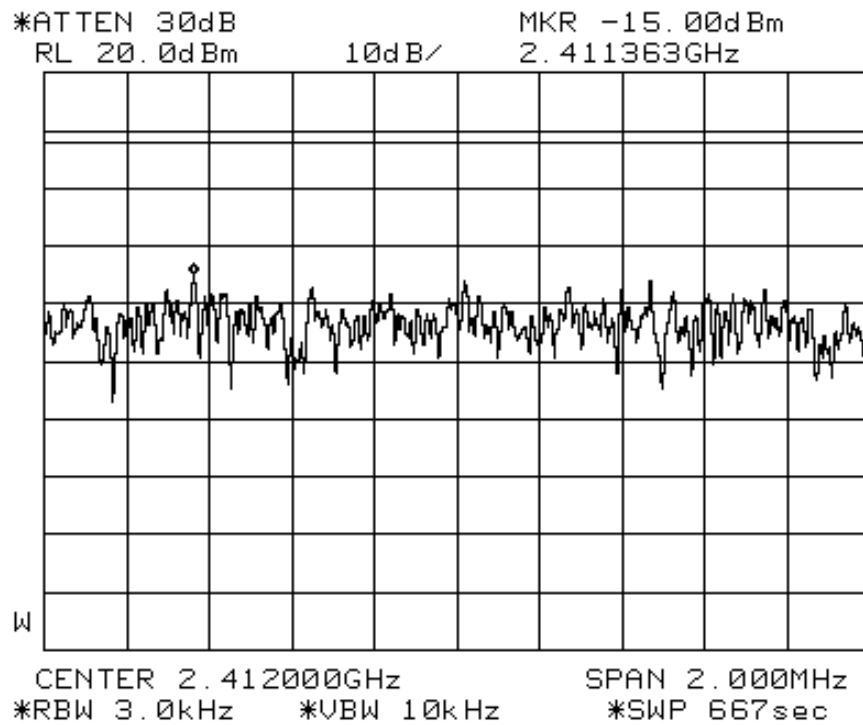


**Plot 34 - Channel 1 @ 1Mbps**

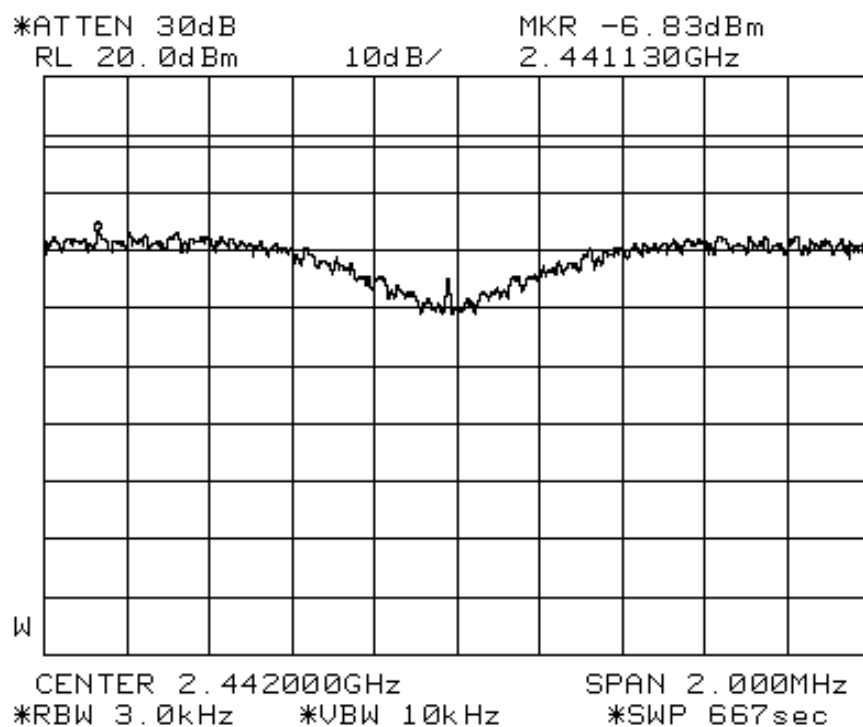


**Plot 35 - Channel 1 @ 2Mbps**

PEAK POWER SPECTRAL DENSITY PLOTS

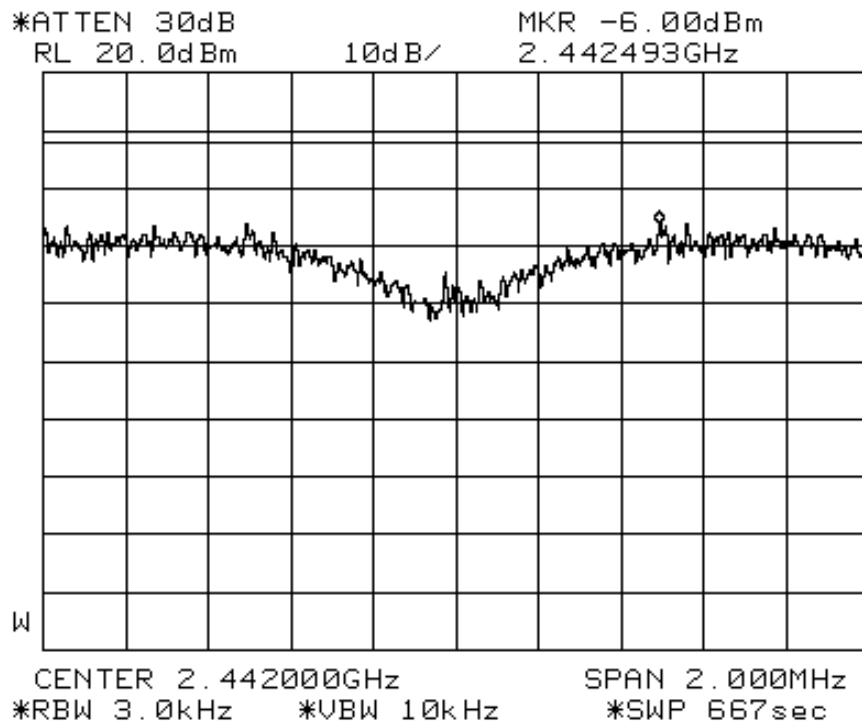


**Plot 36 - Channel 1 @ 11Mbps**

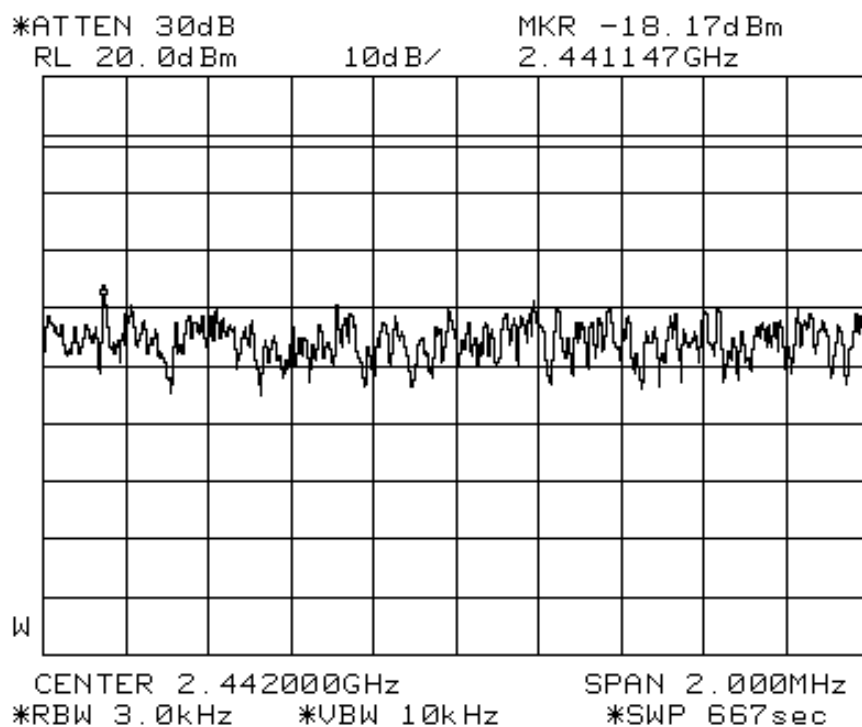


**Plot 37 - Channel 7 @ 1Mbps**

PEAK POWER SPECTRAL DENSITY PLOTS

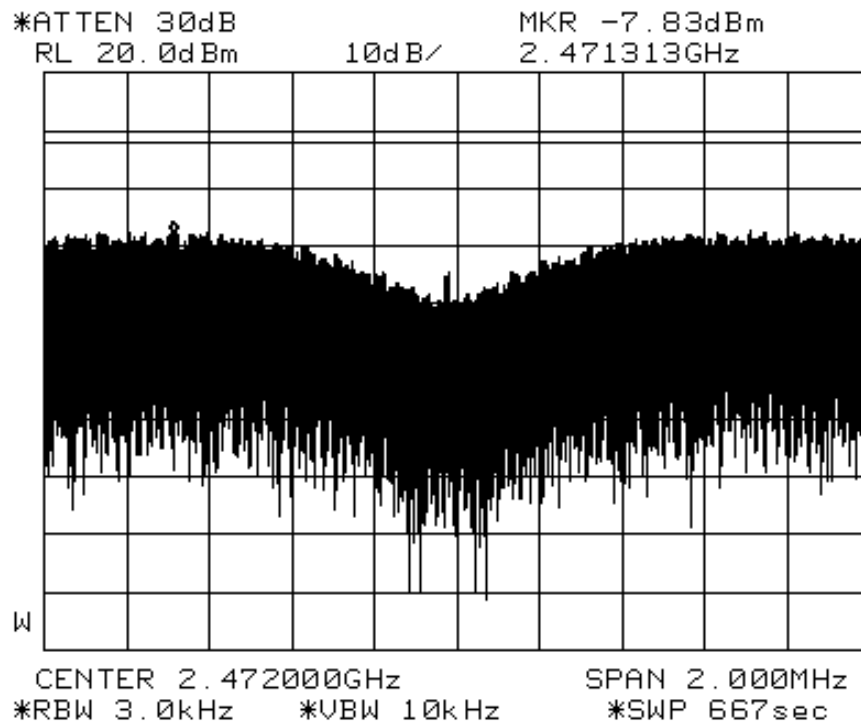


**Plot 38 - Channel 7 @ 2Mbps**

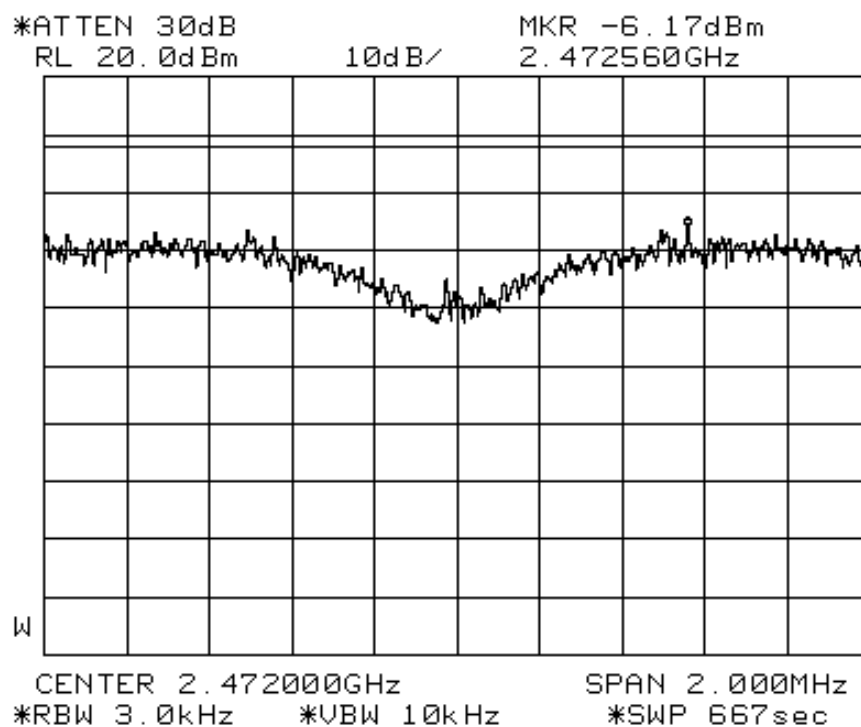


**Plot 39 - Channel 7 @ 11Mbps**

PEAK POWER SPECTRAL DENSITY PLOTS



**Plot 40 - Channel 13 @ 1Mbps**



**Plot 41 - Channel 13 @ 2Mbps**

\*ATTEN 30dB  
RL 20.0dBm  
10dB/  
MKR -18.67dBm  
2.471147GHz

W

CENTER 2.472000GHz  
SPAN 2.000MHz  
\*RBW 3.0kHz \*VBW 10kHz \*SWP 667sec

Page 37 of 38

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2. Unless otherwise requested, a report shall contain only technical results. Analysis and interpretation of the results and professional opinion and recommendations expressed thereupon, if required, shall be clearly indicated and additional fee paid for, by the Client.
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August 2003

**ANNEX A**

**TEST INSTRUMENTATION & GENERAL PROCEDURES**

## TEST INSTRUMENTATION & GENERAL PROCEDURES

## ANNEX A

### 3m OATS Test Instrumentation (Conducted Emission)

<u>Instrument</u>	<u>Model</u>	<u>S/No</u>	<u>Cal Due Date</u>	
R&S Test Receiver (9kHz-30MHz)	ESH3	862301/005	25 Jul 2004	x
R&S Pulse Limiter	ESH3-Z2	357.8810.52	17 Apr 2004	x
EMCO LISN (for EUT) – LISN6	3825/2	9309-2127	2 Jun 2004	x
Solar Electronic Current Probe	6741-1	911317	11 Apr 2004	

### 10m Anechoic Chamber Test Instrumentation (Radiated Emissions)

<u>Instrument</u>	<u>Model</u>	<u>S/No</u>	<u>Cal Due Date</u>	
R&S Test Receiver (20Hz – 26.5GHz) – ESMI2	ESMI	829214/006 829550/001	25 Dec 2003	x
HP Preamplifier (for ESMI3, 0.01-3GHz) – PA6	87405A	3950M00353	29 Apr 2004	x
MITEQ Preamplifier (0.1-26.5GHz) – PA11	NSP2650-N	728231	16 Apr 2004	x
Schaffner Bilog Antenna – BL5	CBL6143	5041	21 May 2004	x
EMCO Horn Antenna – H14	3115	0003-6087	22 May 2004	x
Micro-tronics Band-Stop Filter	BRM50701	017	1 Apr 2004	x

### Room 3 Test Instrumentation

(Spectrum Bandwidth (6dB Bandwidth Measurement), Maximum Peak Power, RF Conducted Spurious Emissions at the Transmitter Antenna Terminal, Band Edge Compliance at the Transmitter Antenna Terminal, Peak Power Spectral Density)

<u>Instrument</u>	<u>Model</u>	<u>S/No</u>	<u>Cal Due Date</u>	
HP Spectrum Analyzer	8564E	3846A01433	21 Nov 2003	x
R&S Universal Radio Communication Tester	CMU 200	837587/068	03 Apr 2004	x

### Maximum Permissible Exposure

<u>Instrument</u>	<u>Model</u>	<u>S/N</u>	<u>Cal Due Date</u>	
PMM 8053 Portable Field Meter	8053	0220J10308	17 Apr 2004	x
PMM Electric and Magnetic Field Analyzer	EHP-50A	1311L10515	16 May 2004	x



**TEST INSTRUMENTATION & GENERAL PROCEDURES****ANNEX A****CONDUCTED EMISSIONS TEST DESCRIPTION****Test Set-up**

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 50 $\Omega$ /50 $\mu$ H 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.

**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 10kHz. 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	limit = 250 $\mu$ V = 47.96 dB $\mu$ V
Transducer factor of LISN, pulse limiter & cable loss at 20 MHz = 11.2 dB	
Q-P reading obtained directly from EMI Receiver = 40 dB $\mu$ V (Calibrated for system losses)	
Therefore, Q-P margin = 40 - 47.96 = -7.96	i.e. <b>7.96 dB below limit</b>

## TEST INSTRUMENTATION & GENERAL PROCEDURES

## ANNEX A

### RADIATED EMISSIONS TEST DESCRIPTION (10m ANC)

#### Test Set-up

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.

#### 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 frequencies.
3. The test was carried out at the selected frequency points obtained from the prescan. 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 25GHz, using the Bi-log antenna for frequencies from 30MHz up to 3GHz, and the Horn antenna above 3GHz.

#### Sample Calculation Example

At 300 MHz	limit = 200 $\mu$ V/m = 46 dB $\mu$ V/m
Log-periodic antenna factor & cable loss at 300 MHz = 18.511 dB	
Q-P reading obtained directly from EMI Receiver = 40 dB $\mu$ V/m (Calibrated level including antenna factors & cable losses)	
Therefore, Q-P margin = 40 - 46 = -6	i.e. <b>6 dB below limit</b>

## TEST INSTRUMENTATION & GENERAL PROCEDURES

## ANNEX A

### SPECTRUM BANDWIDTH (6dB BANDWIDTH MEASUREMENT) TEST DESCRIPTION

#### Test Set-up

1. The EUT and supporting equipment were set up in a shielded enclosure; 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 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.

#### 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 continuous transmitting at Channel 1 (2.412GHz) with DBPSK modulation (1Mbps).
2. The center frequency of the spectrum analyser was set to the transmitting frequency with the frequency span wide enough to capture the 6dB 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 6dB 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.
6. The 6dB bandwidth of the transmitting frequency is the frequency difference between the marked lower and upper frequencies,  $|f_H - f_L|$ .
7. With the same transmitting frequency, the steps 2 to 6 were repeated using DQPSK (2Mbps) and CCK (11Mbps) modulations respectively.
8. The steps 1 to 7 were repeated with the transmitting frequency was set to Channel 7 (2.442GHz) and Channel 13 (2.472GHz) respectively.

**MAXIMUM PEAK POWER TEST DESCRIPTION****Test Set-up**

1. The EUT and supporting equipment were set up in a shielded enclosure; 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 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.

**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 in continuous transmitting at Channel 1 (2.412GHz) with DBPSK modulation (1Mbps).
2. The maximum peak power of the transmitting frequency was detected and recorded.
3. With the same transmitting frequency, the step 2 was repeated using DQPSK (2Mbps) and CCK (11Mbps) modulations respectively.
4. The steps 1 to 3 were repeated with the transmitting frequency was set to Channel 7 (2.442GHz) and Channel 13 (2.472GHz) respectively.

## TEST INSTRUMENTATION & GENERAL PROCEDURES

## ANNEX A

### RF CONDUCTED SPURIOUS EMISSIONS AT THE TRANSMITTER ANTENNA TERMINAL TEST DESCRIPTION

#### Test Set-up

1. The EUT and supporting equipment were set up in a shielded enclosure; 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 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.

#### 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 continuous transmitting at Channel 1 (2.412GHz) with DBPSK modulation (1Mbps).
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. With the same transmitting frequency, the steps 2 to 4 were repeated using DQPSK (2Mbps) and CCK (11Mbps) modulations respectively.
3. The steps 1 to 5 were repeated with the transmitting frequency was set to Channel 7 (2.442GHz) and Channel 13 (2.472GHz) respectively.

## TEST INSTRUMENTATION & GENERAL PROCEDURES

## ANNEX A

### BAND EDGE COMPLIANCE AT THE TRANSMITTER ANTENNA TERMINAL TEST DESCRIPTION

#### Test Set-up

1. The EUT and supporting equipment were set up in a shielded enclosure; 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 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.

#### 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 continuous transmitting at Channel 1 (2.412GHz) with DBPSK modulation (1Mbps).
2. The frequency span of the spectrum analyser was set to wide enough to capture the lower band edge of the allowable transmission band (2.40GHz) 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. Set the EUT to continuous transmit at Channel 13 (2.472GHz) with the same modulation.
5. 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 allowable transmission band (2.4835GHz) and any spurious emissions at the band-edge.
6. The steps 1 to 5 were repeated using DQPSK (2Mbps) and CCK (11Mbps) modulations respectively.

**TEST INSTRUMENTATION & GENERAL PROCEDURES****ANNEX A****PEAK POWER SPECTRAL DENSITY TEST DESCRIPTION****Test Set-up**

1. The EUT and supporting equipment were set up in a shielded enclosure; 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 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.

**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 continuous transmitting at Channel 1 (2.412GHz) with DBPSK modulation (1Mbps)..
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. With the same transmitting frequency, the steps 2 to 3 were repeated using DQPSK (2Mbps) and CCK (11Mbps) modulations respectively.
5. The steps 1 to 4 were repeated with the transmitting frequency was set to Channel 7 (2.442GHz) and Channel 13 (2.472GHz) respectively.

**ANNEX B**

**TEST PHOTOGRAPHS / DIAGRAMS**



EUT PHOTOGRAPHS



Front View

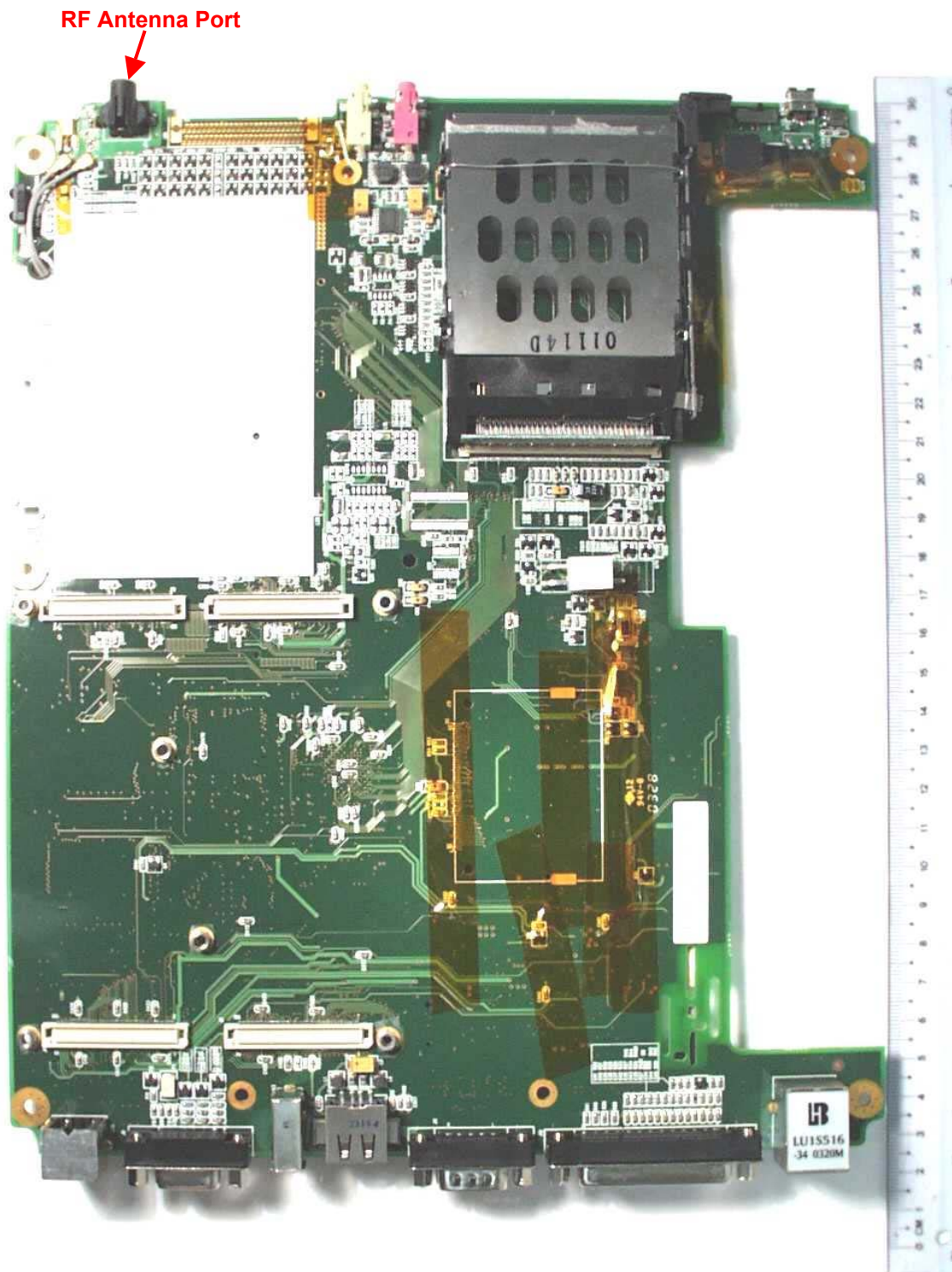


Rear View

TEST PHOTOGRAPHS / DIAGRAMS

ANNEX B

EUT PHOTOGRAPHS



EUT PCB1 – View 1



EUT PHOTOGRAPHS



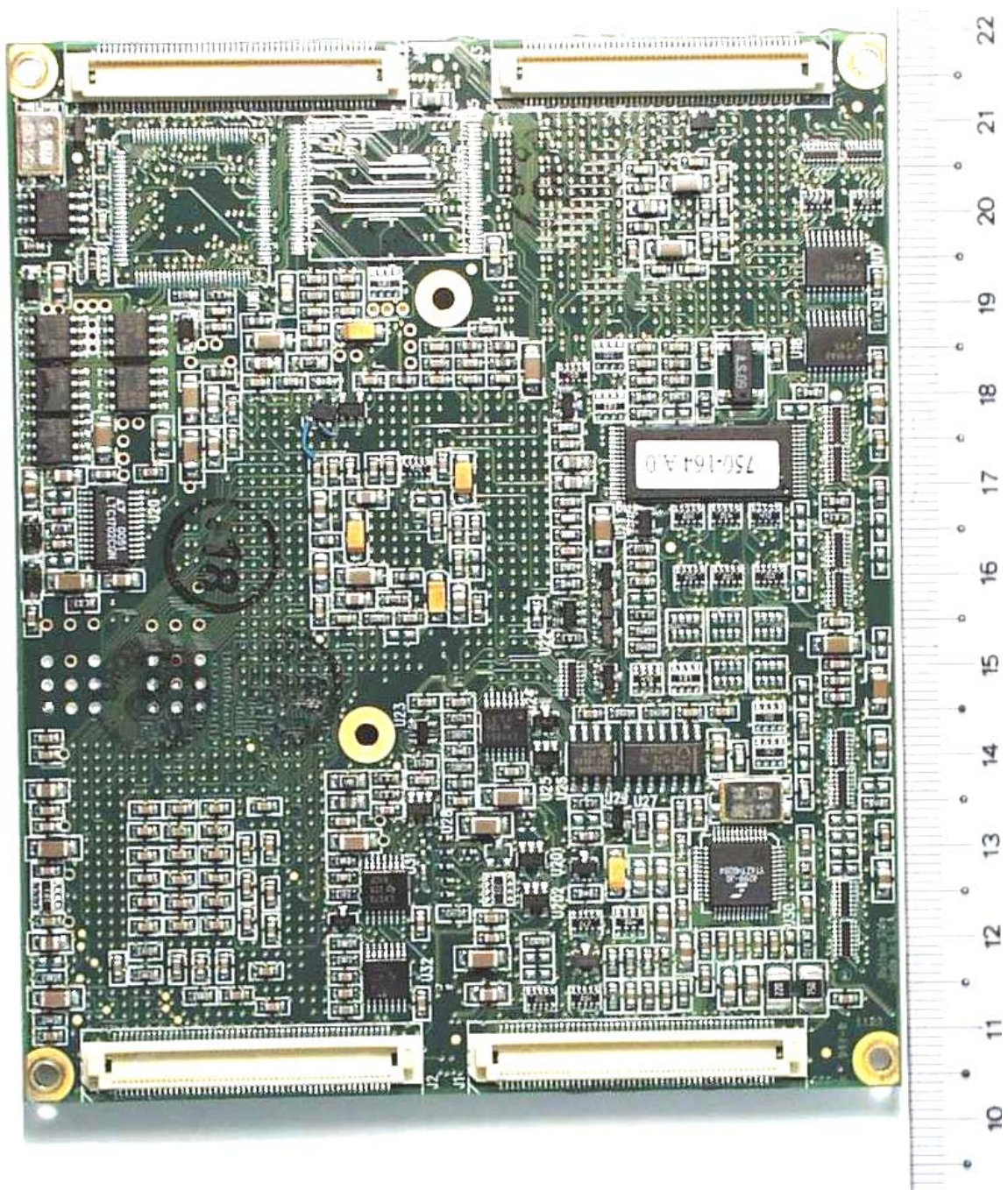
EUT PCB1 – View 2



TEST PHOTOGRAPHS / DIAGRAMS

ANNEX B

EUT PHOTOGRAPHS



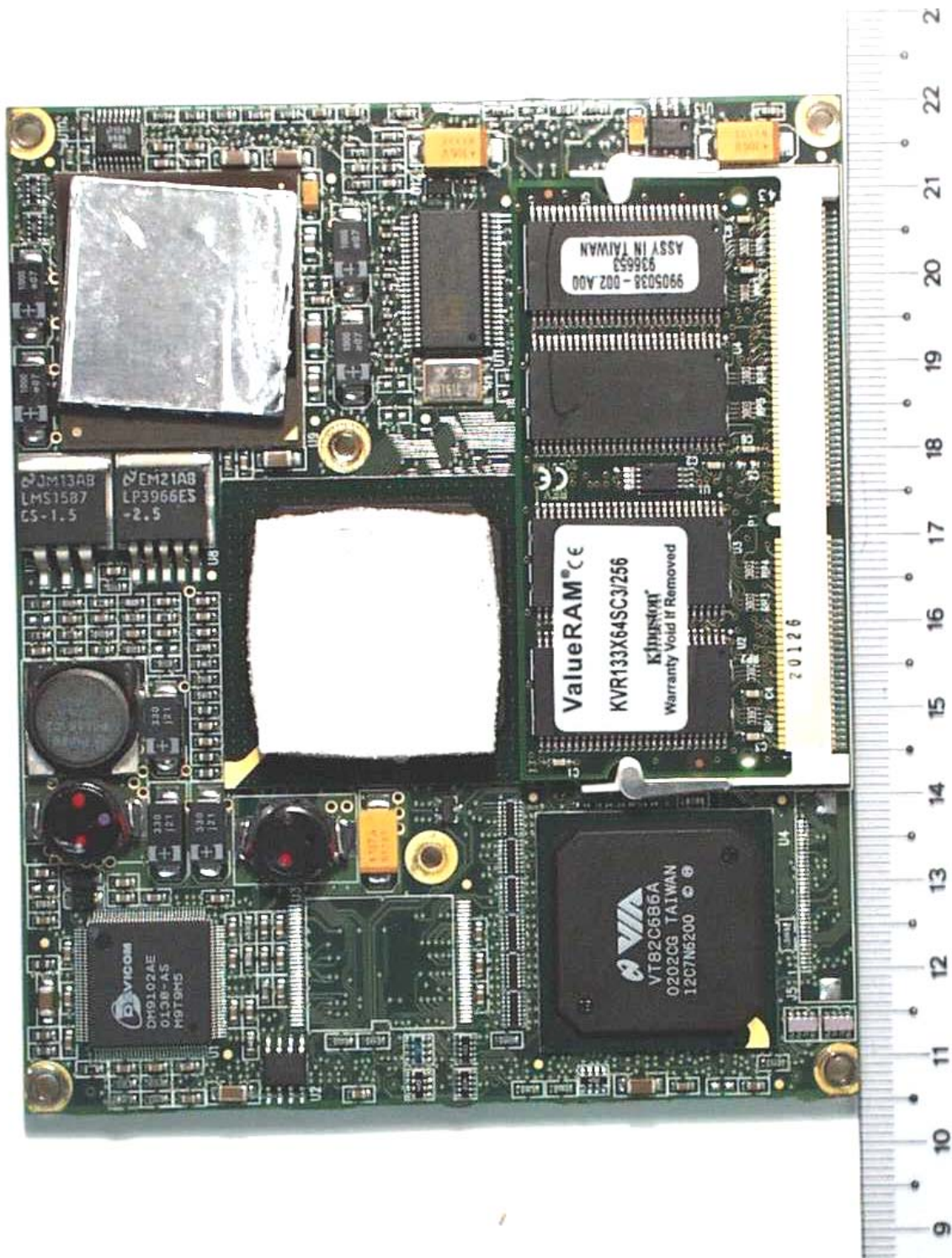
EUT PCB2 – View 1



TEST PHOTOGRAPHS / DIAGRAMS

ANNEX B

EUT PHOTOGRAPHS



EUT PCB2 – View 2

TEST PHOTOGRAPHS / DIAGRAMS

ANNEX B

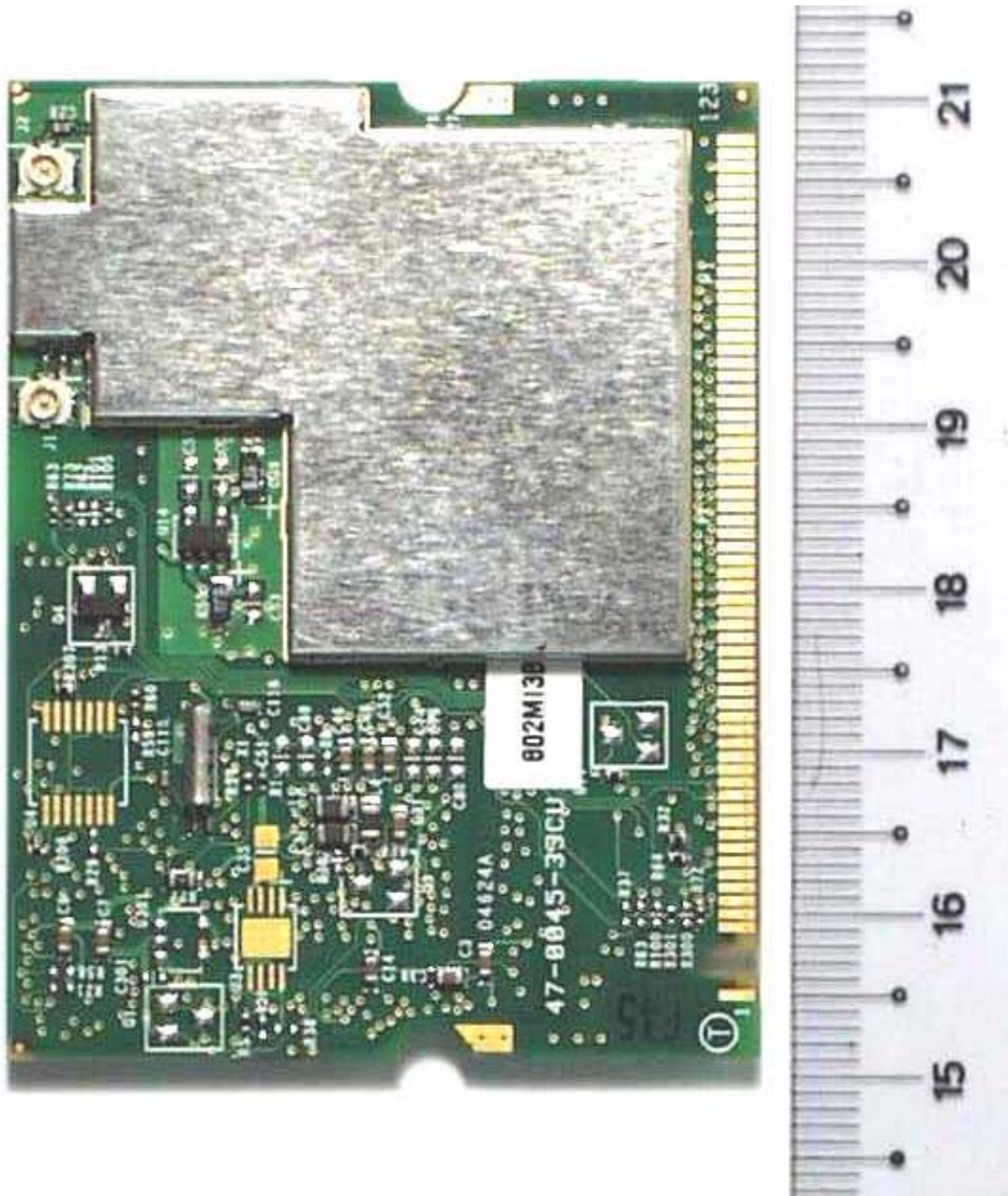
EUT PHOTOGRAPHS



EUT PCB3 - View 1



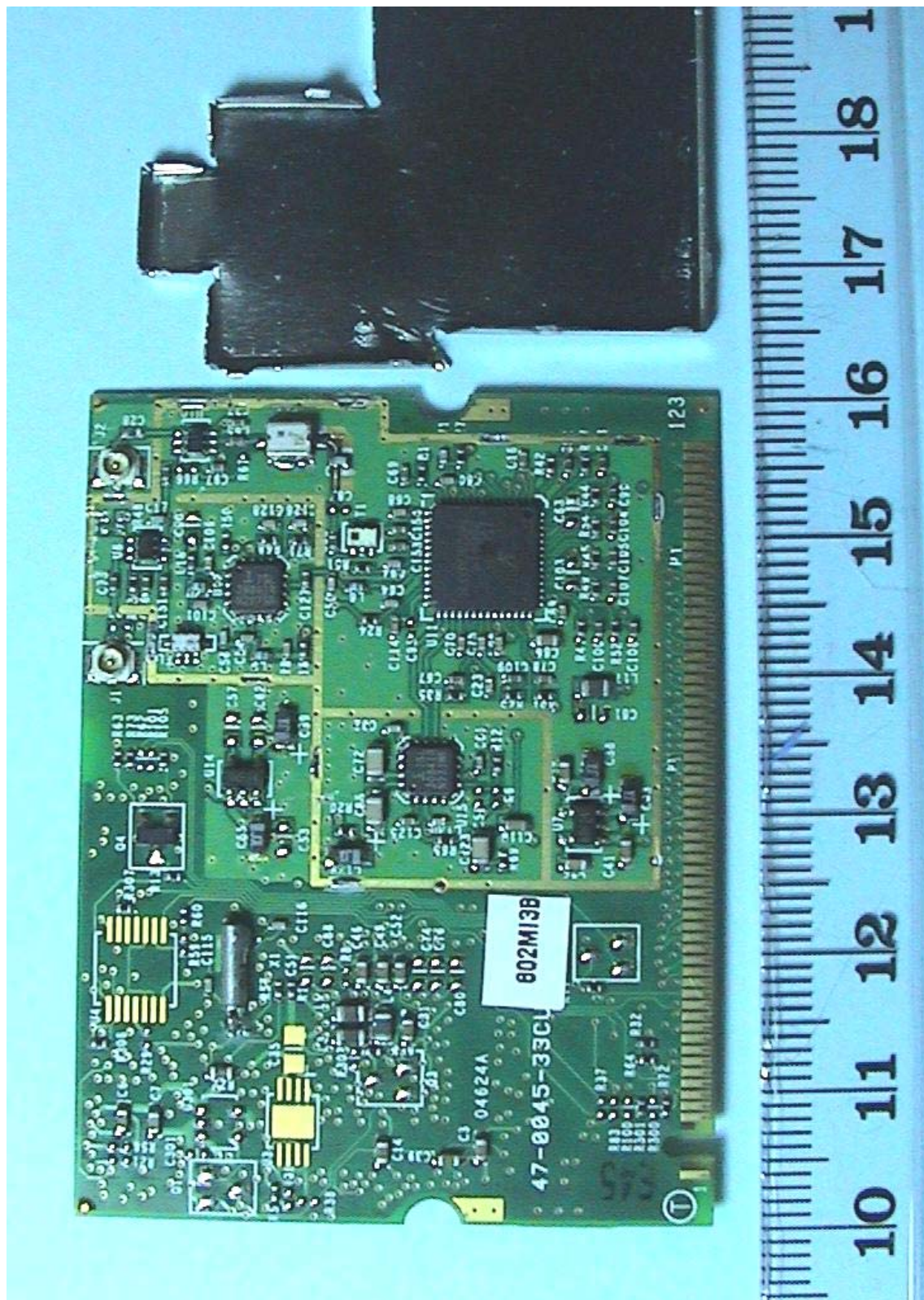
EUT PHOTOGRAPHS



EUT PCB3 – View 2



EUT PHOTOGRAPHS



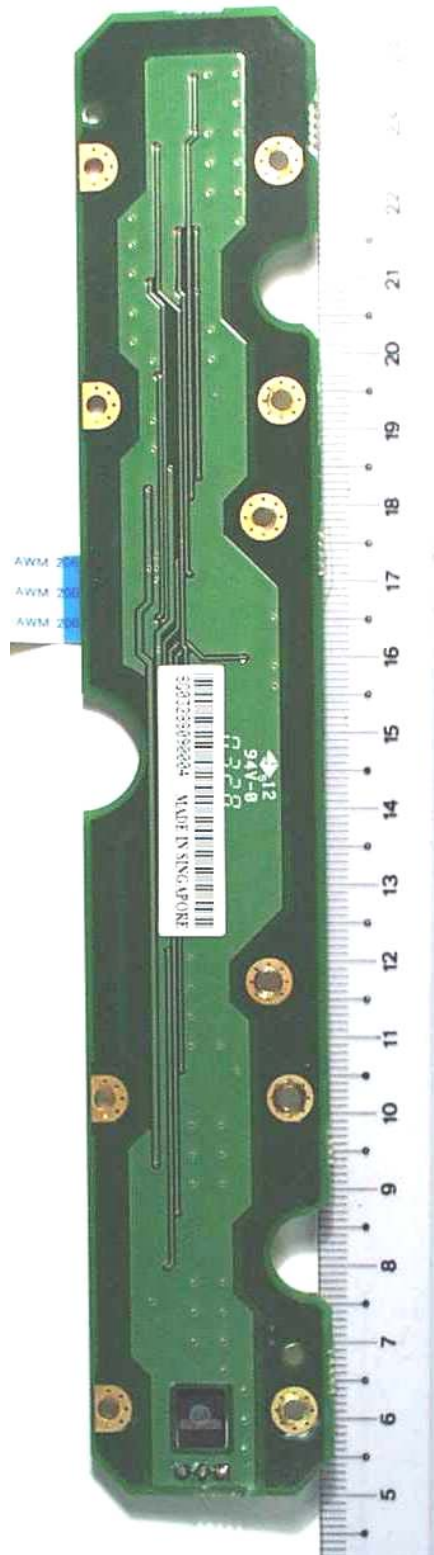
EUT PCB3 – View 3



TEST PHOTOGRAPHS / DIAGRAMS

ANNEX B

EUT PHOTOGRAPHS

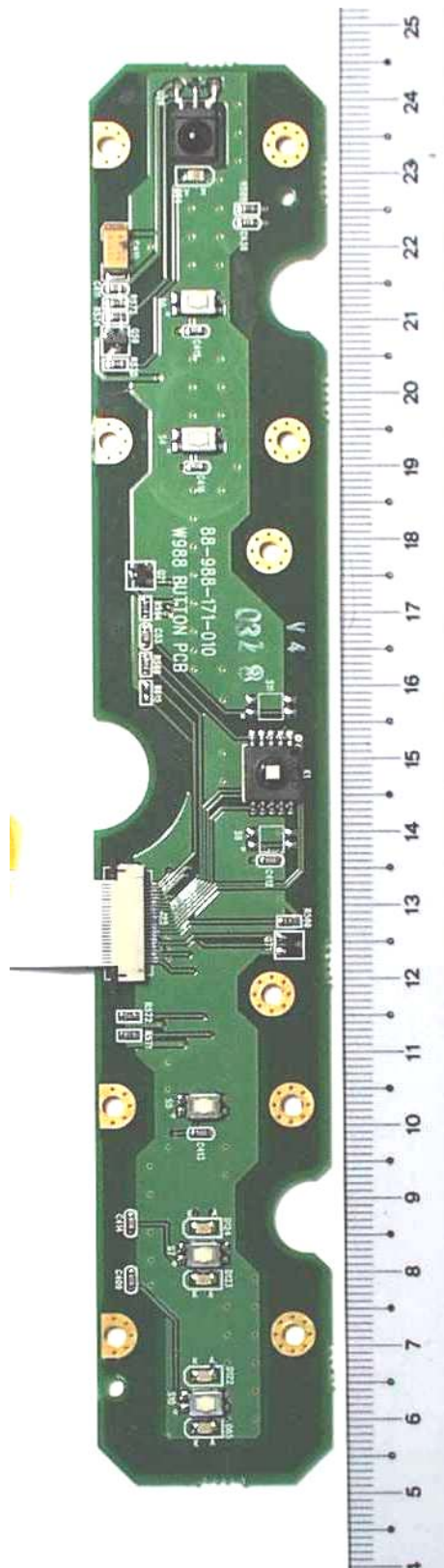


EUT PCB4 – View 1

TEST PHOTOGRAPHS / DIAGRAMS

ANNEX B

EUT PHOTOGRAPHS



EUT PCB4 – View 2

**ANNEX C**

**USER MANUAL  
TECHNICAL DESCRIPTION  
BLOCK & CIRCUIT DIAGRAMS**

(Please refer to attached copy)

**ANNEX D**

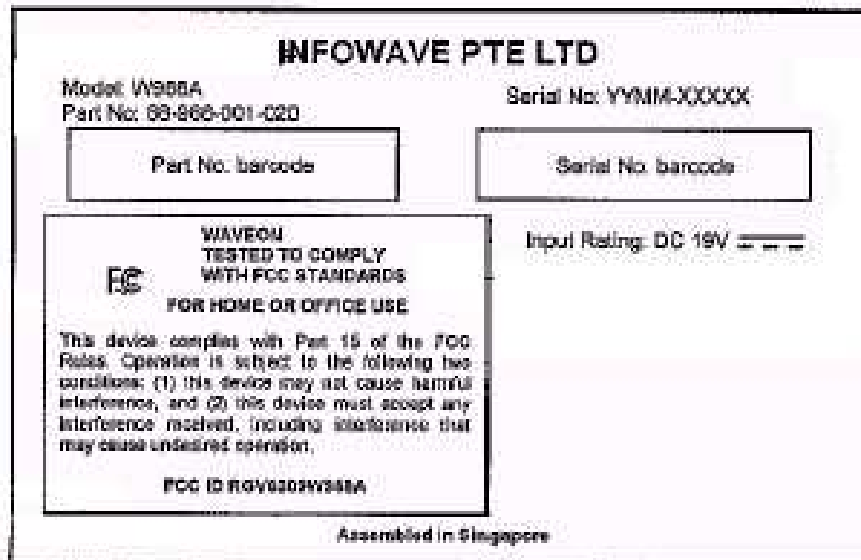
**FCC LABEL & POSITION**

## FCC LABEL & POSITION

## ANNEX D

Labeling 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.



Sample Label



Physical Location of FCC Label on EUT