EMC TEST REPORT

RADIO PERFORMANCE MEASUREMENTS ON THE SAITEK PP09W1 WIRELESS TRANSCEIVER

K Newman

Test Report 04015117 (a) Issue 5

Report approved by:

R Orchard
Principal EMC Engineer

September, 2005

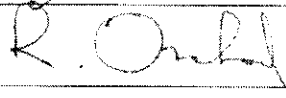
REPORT SUMMARY

Customer:	Saitek Plc Units 3 & 4 West Point Row Great park Road Almondsbury Bristol BS32 4QG United Kingdom
Customer's Representative:	Martin Mannix
Customer's Purchase Order:	Proforma Invoice
Description of Equipment Under Test:	Wireless Transceiver
Type Number(s):	PP09W1
Serial Number(s):	None
Test Specification(s):	CFR47 Part 15
Test Site:	ANSI C63.4 compliant
Equipment Received:	7 January 2005
Test Date(s):	10th January to 4th February and 22nd August 2005 17th to 19th September 2005

The results of the tests are summarised as follows:

Transmitter Parameters	CFR47-15 Clause Number	Compliance
Power Output (Radiated)	15.247 (b) (3)	Pass
Occupied Bandwidth (Radiated)	15.247 (a) (2)	Pass
Spurious Emissions (Radiated)	15.247 (d)	Pass
Spectral Power Density (Radiated)	15.247 (e)	Pass

Receiver Parameters	CFR47-15 Clause Number	Compliance
Conducted Emissions	15.207	Pass
Spurious Emissions (Radiated)	15.247 (d)	Pass

Test Engineer(s):	K Newman	
Report Written by:	K Newman	
Checked by:	R Orchard	

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RADIO PERFORMANCE MEASUREMENTS ON THE SAITEK PP09W1 DONGLE AND GAMEPAD WIRELESS TRANSCEIVER

1 INTRODUCTION

Intertek Testing & Certification Ltd on behalf of Saitek Plc tested the Saitek PP09W1 Dongle and Gamepad with a standard laptop PC as the host computer. The samples used operated in the frequency sub-band of 2400 - 2483.5 which contains 78 channels. The lower channel frequency centre point is 2402.0 MHz and the upper channel frequency centre point is 2478.0 MHz. The samples were set to a discrete frequency of lower, middle and upper frequency limits, and were tested to the relevant performance specifications published by the Federal Communications Commission. This report contains the results of these tests and is submitted to Saitek Plc as the final test results.

2 TEST PROCEDURE

2.1 Relevant Performance Specification

The relevant performance specification for the Saitek Plc PP09W1 is FCC CFR47 Part 15. The tests performed are those required to demonstrate compliance with the essential requirements of CFR47 Part 15 for regulatory purposes.

2.2 Test Environment

The tests were performed in the EMC Test Department Test Facility at Intertek Testing & Certification Ltd laboratories in Leatherhead. The samples were subjected to the ambient conditions in the laboratory. The temperature and relative humidity recorded during the period of each test are given in the results.

2.3 Configuration of Test Sample

The test samples consisted of three PP09W1 Dongles and Game pads. Unless otherwise stated, the dongle and game pad were tested together as a pair.

The Dongle was connected to the PC via a USB cable. The only other cable from the PC was the PC's power cable.

The software used to demonstrate the pad functions was built in to the PC operating system (windows). In the control panel, activate the game controllers feature. The pad will be recognised, click on properties and the pad's buttons and axis will be displayed and can be seen on screen when they are activated on the device.

2.4 Test Frequency

The samples supplied operated at the discrete frequencies of 2402.0, 2442.0and 2478.0

2.5 Test Power Sources

The Dongle is intended to operate from an internal battery using 1.2 Vdc, whilst the Dongle derives 5.0 Vdc from the host PC. A new and fully charged battery was used for the testing.

2.6 Measurement Uncertainty

All measurement uncertainties stated in this report are estimated to a 95% confidence level.

3 RESULTS OF TRANSMITTER TESTS

3.1 Power Output

The clause used for this test was CFR47 Part 15.247 (b) (3).

The tests were carried out under normal test conditions in a fully lined anechoic chamber using a test range of 3.0 m.

The EUTs were set to transmit and rotated through 360° in a vertical axis to find the maximum radiated power. The lower, middle and upper channels were tested.

Laboratory Conditions: Temperature 22.0 °C Humidity 58 %

Fundamental (MHz)	Electric Field (mV/m)	Power (µW)	Limit (W)	Comment
2402.3	19.3	111.7	1	Pass
Measurement uncertainty ±3.3 dB				

Fundamental (MHz)	Electric Field (mV/m)	Power (µW)	Limit (W)	Comment
2441.7	23.5	166.7	1	Pass
Measurement uncertainty ±3.3 dB				

Fundamental (MHz)	Electric Field (mV/m)	Power (µW)	Limit (W)	Comment
2478.3	14.6	64.6	1	Pass
Measurement uncertainty ±3.3 dB				

Example calculation for 2402.3 MHz result:

E (dBµV/m) = Analyser Reading + Cable Loss + Antenna Factor – Pre Amplifier Gain
= 81.01 dBµV + 3.4 dB + 28.3 dB/m – 27 dB
= 85.71 dBµV/m

E (V/m) = (10^ (dBµV/m / 20)) / 1e6
= 19.3 mV/m

P (W) = $(E * d)^2 / (30 * G)$ E = V/m; d = 3m; G = 1
= $(19.3*10^{-3} * 3)^2 / (30 * 1)$
= 111.7 µW

3.2 Occupied Bandwidth

The clause used for this test was CFR47 Part 15.247 (a) (2).

The tests were carried out under normal test conditions in a fully lined anechoic chamber using a test range of 3.0 m.

The measurements were carried out using a spectrum analyser with the RBW set to 100 kHz and the VBW set to 1 MHz.

Only the lower and upper channels were tested.

Laboratory Conditions: Temperature 21.0 °C Humidity 45 %

Fundamental	Result (6dB BW)	Limit	Comment
2401.9 MHz	721.4 kHz	> 500 kHz	Pass
2477.8 MHz	602.1 kHz	> 500 kHz	Pass
Measurement uncertainty ± 1 kHz			

Plots of these results are shown in Annex 1.

3.3 Spurious Emissions

The clause used for this test was CFR47 Part 15.247 (d).

The tests were carried out under normal test conditions in a fully lined anechoic chamber using a test range of 3.0 m.

The measurements were carried out using a spectrum analyser with the RBW set to 1 MHz, the VBW set to 1 MHz and the analyser attenuation set to 30dB.

The lower (2402 MHz), middle (2442 MHz) and upper (2478 MHz) channels were tested.

The spurious emissions were tested up to 25 GHz (just beyond the 10th harmonic). Only the significant emissions are specifically reported. Plots are shown in Annex 2.

Laboratory Conditions: Temperature 22.0 °C Humidity 43 %

3.3.1 Radiated - Transmitter and Receiver Operating – 2402.0MHz

Dongle and Gamepad - Vertical Polarisation

Laboratory Conditions: Temperature 21.0℃; Humidity 32%

Frequency (MHz)	Emission (µV/m)	Limits (µV/m)	Comment
195.48	20.3	150	Pass
521.22	64.0	200	Pass
586.38	45.0	200	Pass
651.54	91.3	200	Pass
1114.0	81.0	500	Pass
1890.0	241.2	500	Pass
2390.0	116.1	500	Pass
4803.97	150	500	Pass
All other emissions were at least 10 dB within specification up to 18 GHz All other emissions were at least 8 dB within specification from 18 GHz to 25 GHz			
Measurement uncertainty ±3.3 dB			

3.3.2 Radiated - Transmitter Standby

There were no emissions found above system measuring level (at least 10 dB below limit).

3.3.3 Radiated - Transmitter and Receiver Operating – 2442.0

Dongle and Gamepad - Vertical Polarisation

Laboratory Conditions: Temperature 21.0℃; Humidity 32%

Frequency (MHz)	Emission (µV/m)	Limits (µV/m)	Comment
989.52	51.2	500	Pass
1114.0	61.4	500	Pass
2116.0	180.3	500	Pass
3000.0	< 58.0	500	Pass
4884.3	150	500	Pass
All other emissions were at least 10 dB within specification up to 18 GHz All other emissions were at least 8 dB within specification from 18 GHz to 25 GHz			
Measurement uncertainty ±3.3 dB			

3.3.4 Radiated - Transmitter Standby

There were no emissions found above system measuring level (at least 10 dB below limit).

3.3.5 Radiated - Transmitter and Receiver Operating – 2478.0MHz

Dongle and Gamepad - Vertical Polarisation

Laboratory Conditions: Temperature 21.0℃; Humidity 32%

Frequency (MHz)	Emission (µV/m)	Limits (µV/m)	Comment
1181.0	150.0	500	Pass
1860.0	210.0	500	Pass
1890.0	180.0	500	Pass
3000.0	< 58.0	500	Pass
4956.0	100	500	Pass
All other emissions were at least 10 dB within specification up to 18 GHz All other emissions were at least 8 dB within specification from 18 GHz to 25 GHz			
Measurement uncertainty ±3.3 dB			

3.3.6 Radiated - Transmitter Standby

There were no emissions found above system measuring level (at least 10 dB below limit).

3.3.7 Conducted – Line/Neutral/Ground – Transmit Mode

The clause used for this test was CFR47 Part 15.207.

Laboratory Conditions: Temperature 19.5℃; Humidity 24%

Operating Frequency (MHz)	Measured Frequency (MHz)	Emission (dBµV)	Limits (dBµV)	Comment
2402.0	0.15 to 30	See Annex 3	56 / 46*	Pass
2442.0	0.15 to 30	Note 1	56 / 46*	Pass
2478.0	0.15 to 30	Note 1	56 / 46*	Pass
Note 1: All emissions were at least 15 dB within specification				
Measurement uncertainty : ± 2.2 dB				

*The lowest limits are 56 dBµV (Quasi-peak) between 0.5 MHz and 5 MHz and 46 dBµV (Average) between 0.5 MHz and 5 MHz

A plot showing the results for the lower channel (2402 MHz) is shown in Annex 3.

3.4 Spectral Power Density

The clause used for this test was CFR47 Part 15.247 (e).

The tests were carried out under normal test conditions in a fully lined anechoic chamber using a test range of 3.0 m.

The measurements were carried out using a spectrum analyser with the RBW set to 3 kHz, the VBW set to 5 kHz.

Only the lower channel was tested.

Laboratory Conditions: Temperature 21.0 °C Humidity 45 %

Frequency (MHz)	Field (mV/m)	Power (dBm)	Limit (dBm)	Comment
2401.9	2.08	-28.86	8	Pass
Measurement uncertainty ±3.3 dB				

The plot showing the results is shown in Annex 4.

Calculation for 2401.9 MHz result:

E (dBµV/m) = Analyser Reading + Cable Loss + Antenna Factor – Pre Amplifier Gain
= 61.48 dBµV + 3.4 dB + 28.5 dB/m – 27 dB
= 66.38 dBµV/m

E (V/m) = (10^ (dBµV/m / 20)) / 1e6
= 2.08 mV/m

P (W) = $(E * d)^2 / (30 * G)$ E = V/m; d = 3m; G = 1
= $(2.08*10^{-3} * 3)^2 / (30 * 1)$
= 1.3 µW

P (dBm) = 10 $\log_{10}$ P (mW)
= 10 $\log_{10}$ 1.3 * 10^{-3} mW
= -28.86 dBm

4 RESULTS OF RECEIVER TESTS

4.1 Spurious Emissions

4.1.1 Conducted – Line/Neutral/Ground

The clause used for this test was CFR47 Part 15.207.

Laboratory Conditions: Temperature 19.5℃; Humidity 24%

Operating Frequency (MHz)	Measured Frequency (MHz)	Emission (dBµV)	Limits (dBµV)	Comment
2402.0	0.15 to 30	Note 1	56 / 46*	Pass
2442.0	0.15 to 30	Note 1	56 / 46*	Pass
2478.0	0.15 to 30	Note 1	56 / 46*	Pass
Note 1: All emissions were at least 15 dB within specification				
Measurement uncertainty : ± 4.4dB				

*The lowest limits are 56 dBµV (Quasi-peak) between 0.5 MHz and 5 MHz and 46 dBµV (Average) between 0.5 MHz and 5 MHz

4.1.2 Radiated Emissions – Receive mode

The clause used for this test was CFR47 Part 15.247 (d).

The tests were carried out under normal test conditions in a fully lined anechoic chamber using a test range of 3.0 m.

The measurements were carried out using a spectrum analyser with the RBW set to 1 MHz, the VBW set to 1 MHz and the analyser attenuation set to 30dB.

The lower, middle and upper channels were tested.

The spurious emissions were tested up to 25 GHz (just beyond the 10^{th} harmonic).

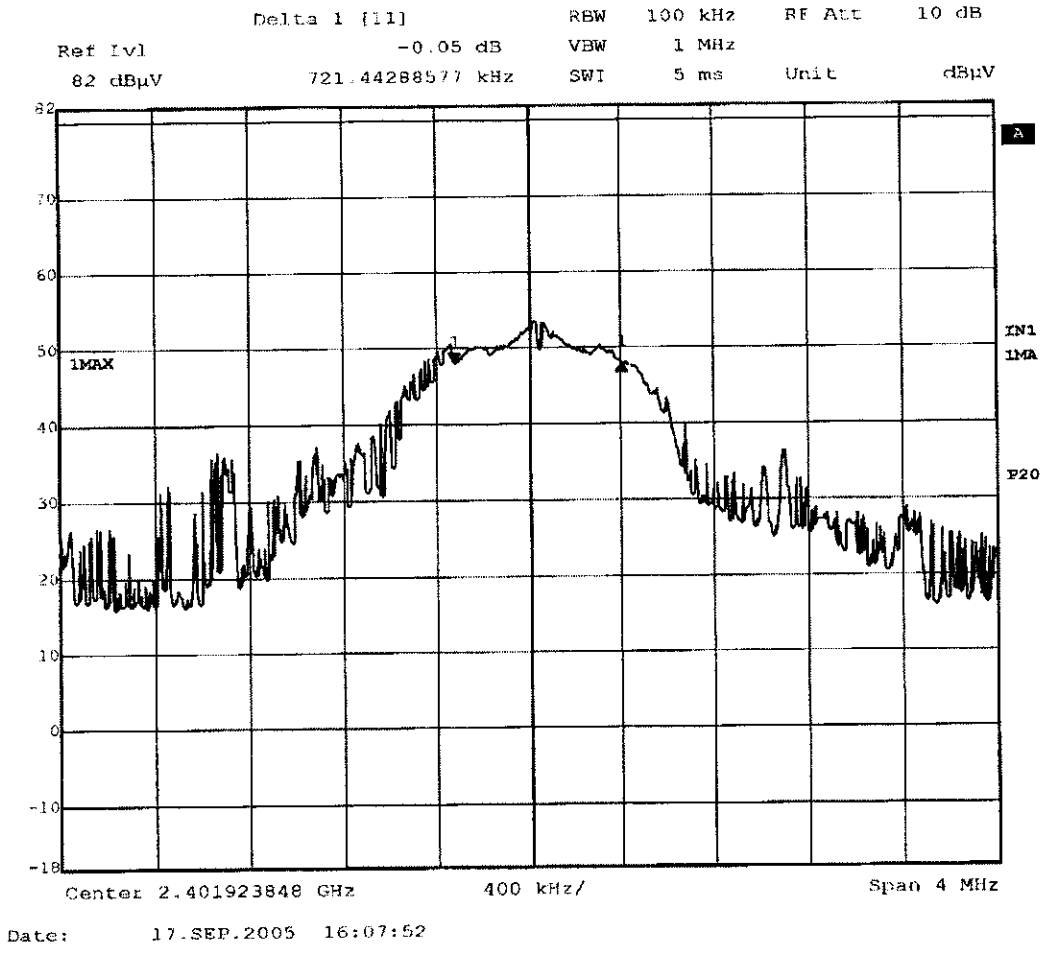
Laboratory Conditions: Temperature 22.0 °C Humidity 43 %

There were no emissions above measuring system noise.

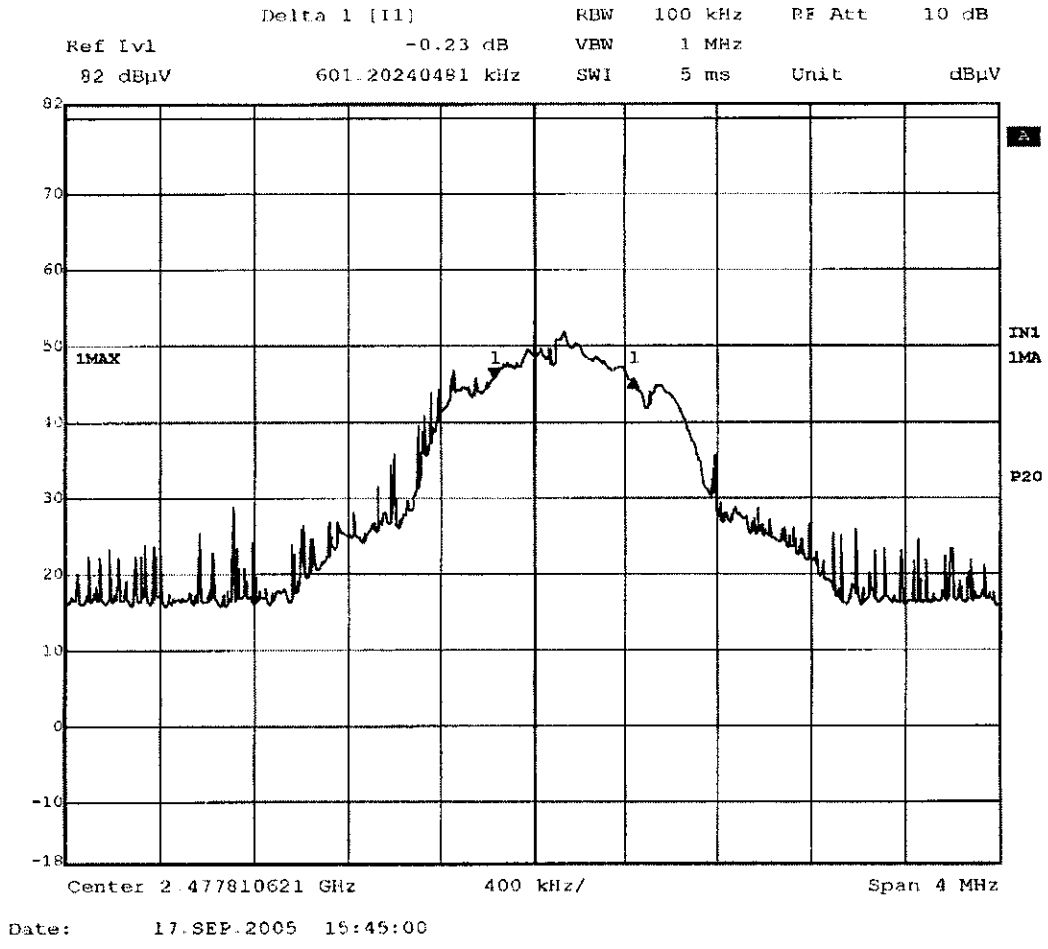
All emissions were at least 10 dB within specification up to 18 GHz and at least 8 dB within specification from 18 GHz to 25 GHz.

5 ANNEX 1 – OCCUPIED BANDWIDTH

5.1 Lower Channel (2402 MHz)

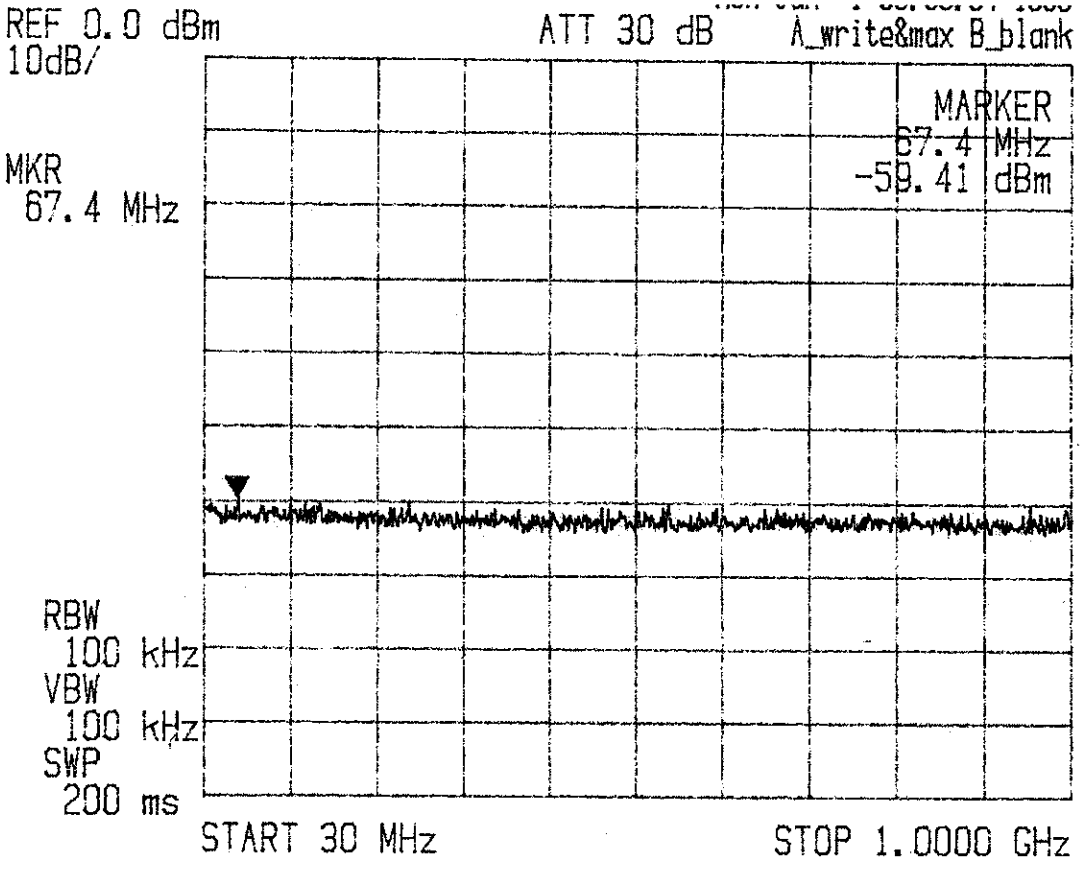


5.2 Upper Channel (2478 MHz)

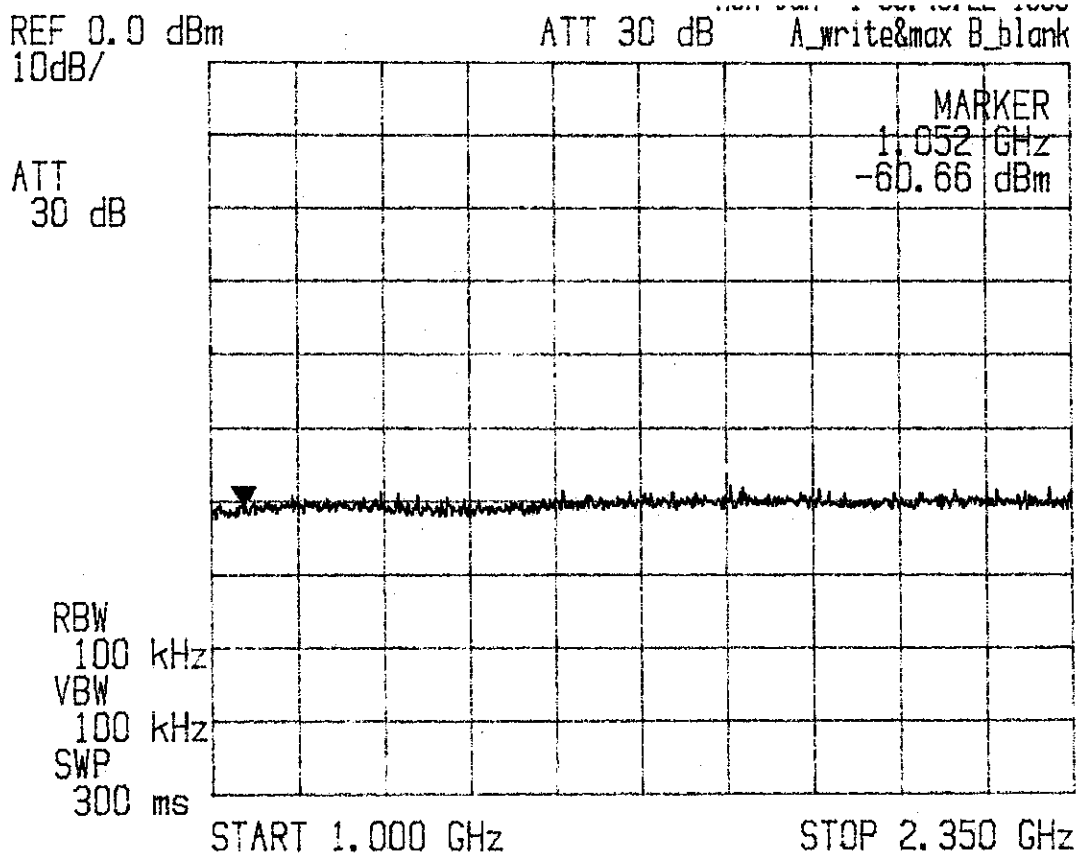


6 ANNEX 2 - RADIATED SPURIOUS EMISSIONS

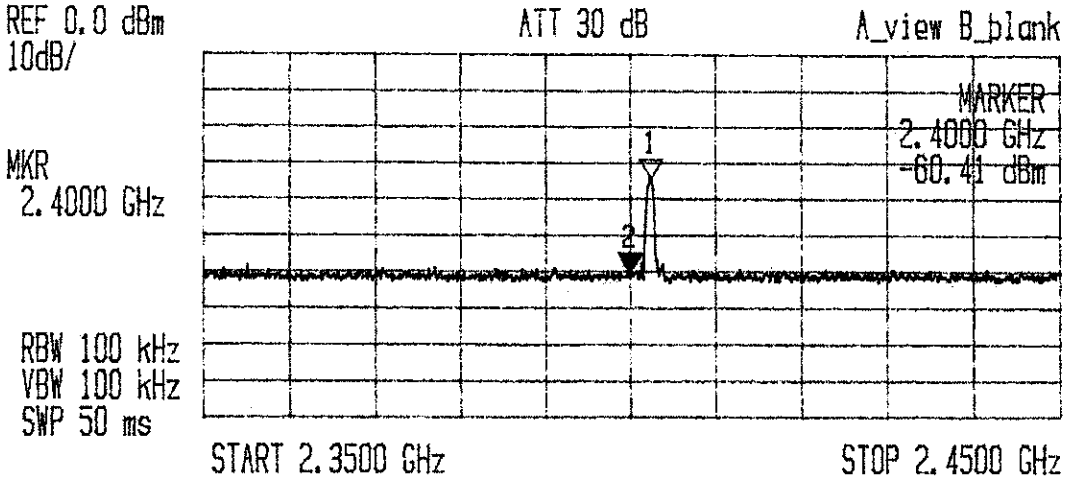
6.1 30 MHz to 1GHz



6.2 1GHz to 2.35 GHz



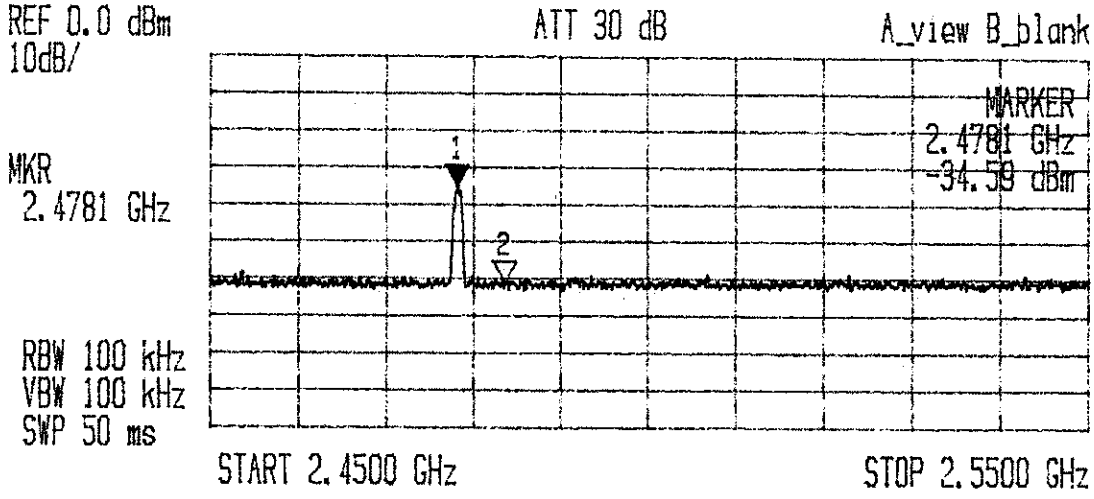
6.3 2.35 GHz to 2.45 GHz (Lower Band Edge Measurement)



*** Multi Marker List ***

No. 1:	2.4024 GHz	-34.25 dBm	A
No. 2:	2.4000 GHz	-60.41 dBm	A

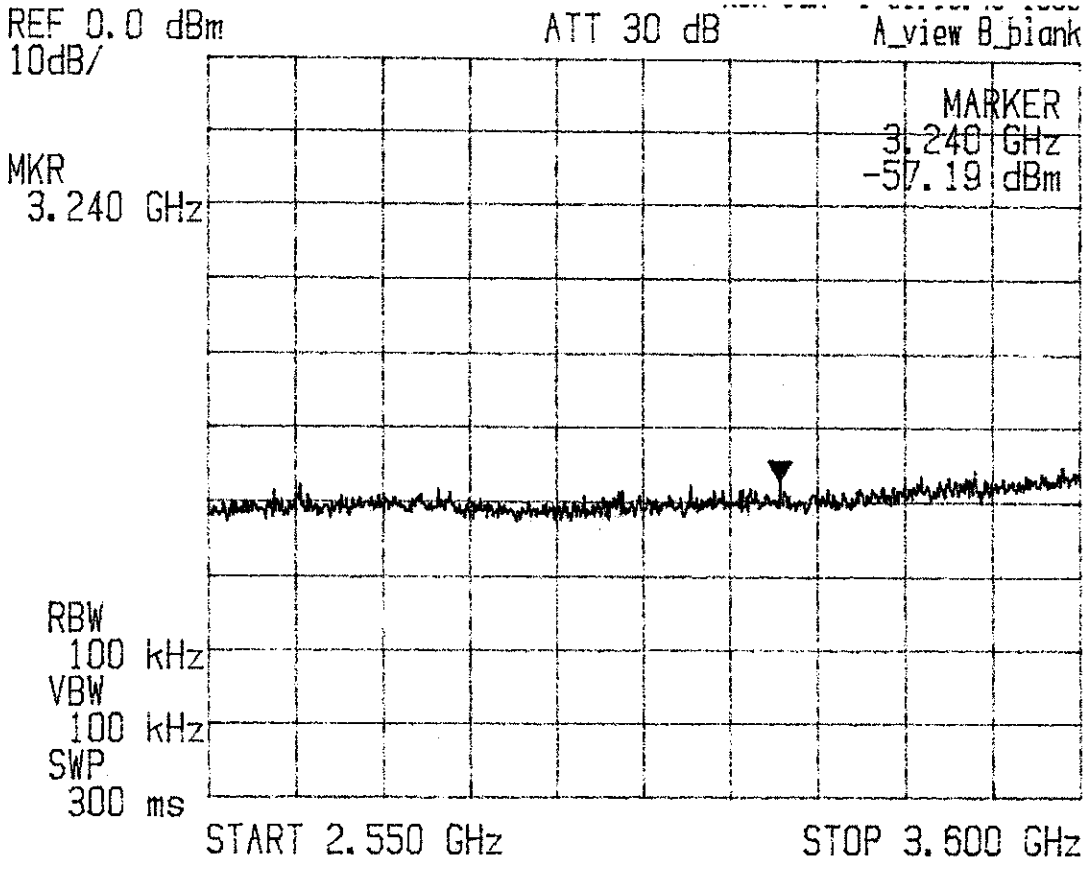
6.4 2.45 GHz to 2.55 GHz (Upper Band Edge Measurement)



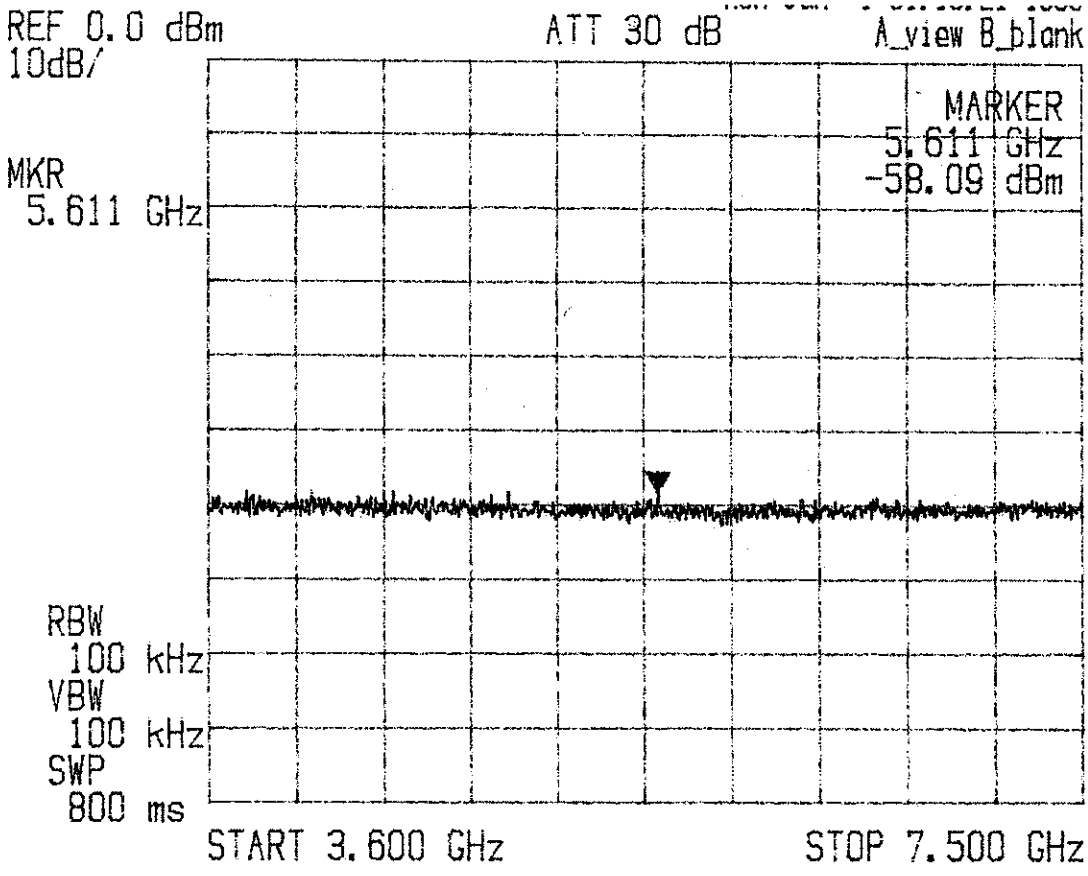
*** Multi Marker List ***

No. 1:	2.4781 GHz	-34.59 dBm	A
No. 2:	2.4836 GHz	-60.66 dBm	A

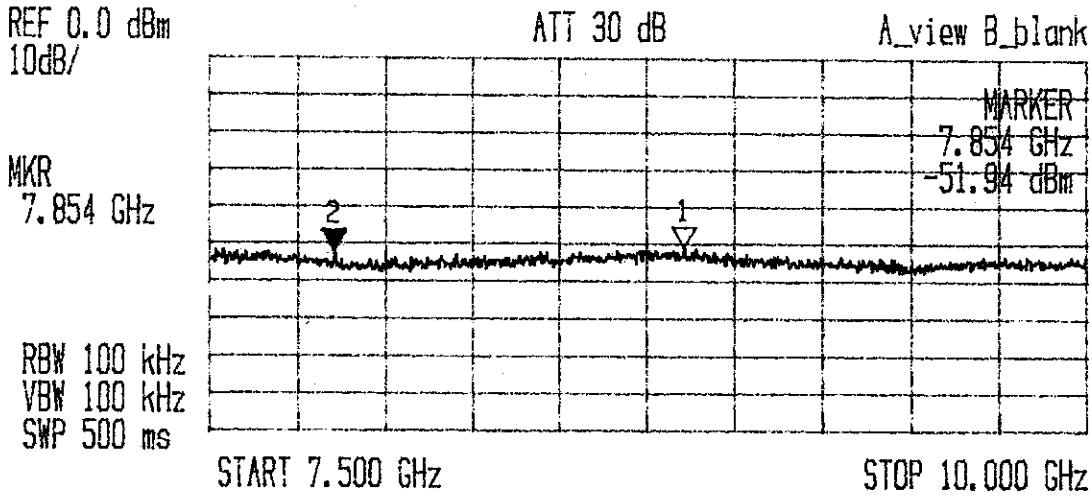
6.5 2.55 GHz to 3.6 GHz



6.6 3.6 GHz to 7.5 GHz



6.7 7.5 GHz to 10 GHz



*** Multi Marker List ***

No. 1:	8.857 GHz	-50.81 dBm	A
No. 2:	7.854 GHz	-51.94 dBm	A

7 ANNEX 3 – CONDUCTED EMISSIONS

7.1 Transmitting and Receiving

EM05015117 01 Sep 2005 10:57

Conducted Emissions

EUT:	Game Pad & Laptop
Manuf:	Saitek
Op Cond.	115V 60Hz
Operator:	D Feasey
Test Spec	FCC Part 15
Comment:	PPE&WT
	Phases: Line and Neutral
Result File:	ceconp.dat : Saitek Gamepad & laptop: Conducted Emissions FCC 15

Scan Settings (1 Range)

Frequencies			Receiver Settings					
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	CISPR
150kHz	30MHz	9kHz	10kHz	PK+AV	20msec	Auto	OFF	60dB

Transducer	No.	Start	Stop	Name
1	20	9kHz	30MHz	LISN7473
	21	9kHz	30MHz	8157

Final Measurement Detectors: X QP / + AV
Meas Time: 1sec
Subranges: 25
Acc Margin: 6 dB

Final Measurement Results

Frequency MHz	QP Level dBµV	QP Limit dBµV	QP Delta dB	Phase -	PE -
0.15	50.13	66.00	15.87	L1	8
0.255	30.38	61.59	31.21	L1	8
0.37	17.10	58.50	41.38	L1	8
0.55	28.31	56.00	27.69	N	8
2.955	27.91	56.00	28.09	N	8
14.375	32.58	60.00	27.42	N	8

Frequency MHz	AV Level dBµV	AV Limit dBµV	AV Delta dB	Phase -	PE -
0.15	29.01	56.00	26.99	N	8
0.255	10.52	51.59	41.07	N	8
0.37	-0.49	48.50	48.99	L1	8
0.55	16.03	46.00	29.97	N	8
2.955	14.92	46.00	31.08	L1	8
14.375	20.58	50.00	27.42	N	8

* limit exceeded

Indicated Phase/PE shows Configuration of max. Emission

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Conducted Emissions

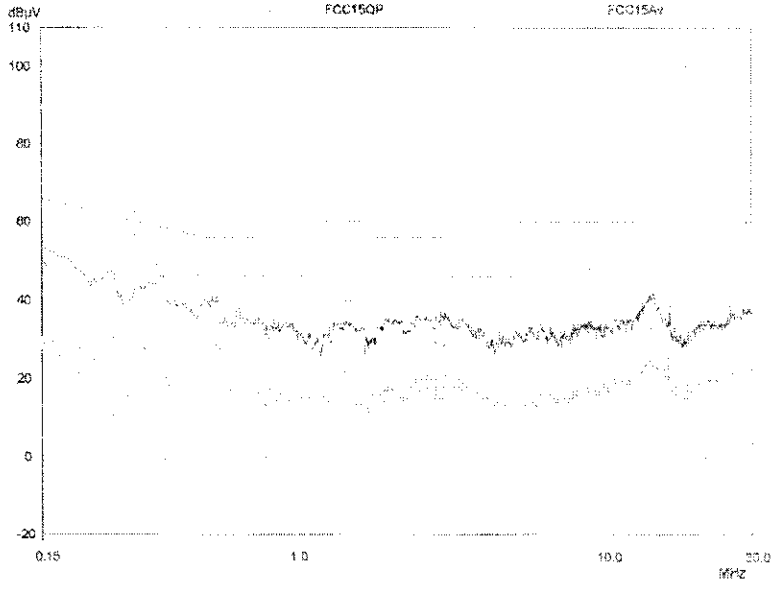
EUT:	Game Pad & Laptop
Manuf:	Saitek
Op Cond:	115V 60Hz
Operator:	D Feasey
Test Spec:	FCC Part 15
Comment:	PP05W1
	Phase: Line and Neutral
Result File:	cecomp.dat : Saitek Gamepad & laptop, Conducted Emissions FCC 15.

Scan Settings (1 Range)

Frequencies					Receiver Settings			
Start	Stop	Step	IF BW	Detector	M-Time	Atten	Preamp	OpRge
150kHz	30MHz	5kHz	10kHz	PK+AV	20msec	Auto	OFF	60dB

Transducer	No.	Start	Stop	Name
1	20	9kHz	30MHz	LISN7473
	21	9kHz	30MHz	8157

Final Measurement: Detectors: X QP / + AV
Meas Time: 1sec
Subranges: 25
Acc Margin: 6 dB



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8 ANNEX 4 – SPECTRAL POWER DENSITY

8.1 Lower Channel (2402 MHz)