

TEST REPORT FROM RFI GLOBAL SERVICES LTD

Test of: e2v Technologies Ltd
DA5819 2.4 GHz Mass Movement Sensor

To: FCC Part 15.245

Test Report Serial No:
RFI/MPTE2/RP46778JD01A

Supersedes Test Report Serial No:
RFI/MPTE1/RP46778JD01A

**This Test Report Is Issued Under The Authority
Of Richard Jacklin, Operations Director:**

pp

Tested By: Steven Wong



Checked By: Nigel Davison



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1. Customer Information

Company Name:	e2v technologies Ltd
Address:	106 Waterhouse Lane Chelmsford Essex CM1 2QU
Contact Name:	Ms Samantha Ridler

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2. Equipment Under Test (EUT)

The following information (with the exception of the Date of Receipt) has been supplied by the customer:

2.1. Identification of Equipment Under Test (EUT)

Brand Name:	e2v Technologies
Model Name or Number:	DA5819
Unique Type Identification:	011
Serial Number:	DA5819-011-041903-00006
FCC ID Number:	PW9DA5815
Country of Manufacture:	UK
Date of Receipt:	09 November 2004

2.2. Description of EUT

The equipment under test is an e2V Technologies volumetric microwave Doppler radar sensor (movement sensor) that operates at 2.45 GHz in the ISM band. The unit is intended for security/alarm applications such as the protection of the interior of a vehicle against any unauthorised entry or other domestic security alarm systems.

2.3. Modifications Incorporated In EUT

During the course of testing the EUT was not modified.

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2.4. Additional Information Related to Testing

Power Supply Requirement:	Nominal 12VDC external supply		
Intended Operating Environment:	In Vehicle		
Equipment Category:	Mobile		
Type of Unit:	Transceiver		
Interface Ports:	DC Supply/Alarm Output/Program Input interface (4 Pin)		
Transmit Frequency Range:	n/a Single Channel		
Transmit Channels Tested:	Channel ID	Channel Number	Channel Frequency (MHz)
	Single Channel	N/A	2450
Receive Frequency Range:	n/a Single Channel		
Receive Channels Tested:	Channel ID	Channel Number	Channel Frequency (MHz)
	Single Channel	N/A	2450
Occupied Bandwidth:	0.5 MHz		
Highest Unintentionally Generated Frequency:	2450 MHz		

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2.5. Support Equipment

The following support equipment was used to exercise the EUT during testing:

Description:	Programming Box
Brand Name:	None Stated
Model Name or Number:	None Stated
Serial Number:	None Stated
Cable Length and Type:	165 cm, 5 pin female
Connected to Port:	Program Input interface via the Interface box

Description:	Interface Box
Brand Name:	None Stated
Model Name or Number:	None Stated
Serial Number:	None Stated
Cable Length and Type:	24 cm, 4 pin female
Connected to Port:	DC Supply/Alarm Output/Program Input interface (4 Pin)

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3. Test Specification, Methods and Procedures

3.1. Test Specification

Reference:	FCC Part 15 Subpart C: 2003 (Section 15.245)
Title:	Code of Federal Regulations, Part 15 (47CFR15) Radio Frequency Devices
Comments:	A description of the test facility used for this test is on file with, and has been accepted by, the Federal Communications Commission as required by Section 2.948 of Federal Rules.
Purpose of Test:	To determine whether the equipment complied with the requirements of the specification for the purposes of certification.

3.2. Methods and Procedures

The methods and procedures used were as detailed in:

ANSI C63.2 (1987)

Title: American National Standard for Instrumentation - Electromagnetic noise and field strength.

ANSI C63.4 (2003)

Title: American National Standard Methods of Measurement of Electromagnetic Emissions from Low Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz.

ANSI C63.5 (1988)

Title: American National Standard for the Calibration of antennas used for Radiated Emission measurements in Electromagnetic Interference (EMI) control.

ANSI C63.7 (1988)

Title: American National Standard Guide for Construction of Open Area Test Sites for performing Radiated Emission Measurements.

CISPR 16-1: (1999)

Title: Specification For Radio Disturbance and Immunity Measuring Apparatus and Methods. Part 1: Radio Disturbance and Immunity Measuring Apparatus.

DA00-705 (2000)

Title: Filing and Frequency Measurement Guidelines for Frequency Hopping Spread Spectrum Systems.

3.3. Definition of Measurement Equipment

The measurement equipment used complied with the requirements of the standards referenced in the Methods & Procedures section above. Appendix 1 contains a list of the test equipment used.

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4. Deviations from the Test Specification

None.

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5. Operation of the EUT During Testing

5.1. Operating Conditions

The EUT was tested in a normal laboratory environment.

During testing, the EUT was powered by an external 12VDC supply.

5.2. Operating Modes

Preliminary radiated scans were performed on the EUT operating as intended. Final measurements were performed if an emission was identified.

5.3. Configuration and Peripherals

The EUT was tested in the following configuration:

Configured with Interface box, the external 12VDC supply via the Interface box and the Programming box connected via the interface box.

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6. Summary of Test Results

Range of Measurements	Specification Reference	Port Type	Compliancy Status
Transmitter Fundamental Field strength	C.F.R. 47 FCC Part 15: 2003 Section 15.245(b)	Antenna	Complied
Transmitter 20dB Bandwidth	C.F.R. 47 FCC Part 2: 2003 Section 2.1049	Antenna	Complied
Transmitter Radiated Spurious Emissions	C.F.R. 47 FCC Part 15: 2003 Section 15.245(b) & 15.209	Antenna	Complied
Transmitter Band Edge Radiated Emissions	C.F.R. 47 FCC Part 15: 2003 Section 15.245(b) & 15.209	Antenna	Complied

6.1. Location of Tests

All the measurements described in this report were performed at the premises of RFI Global Services Ltd, Ewhurst Park, Ramsdell, Basingstoke, Hampshire, RG26 5RQ, England.

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7. Measurements, Examinations and Derived Results

7.1. General Comments

7.1.1. This section contains test results only.

7.1.2. Measurement uncertainties are evaluated in accordance with current best practice. Our reported expanded uncertainties are based on standard uncertainties, which are multiplied by an appropriate coverage factor to provide a statistical confidence level of approximately 95%. Please refer to Section 8 for details of measurement uncertainties.

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7.2. Transmitter Fundamental Field-Strength: Section 15.245(b)

7.2.1. The EUT was configured as for radiated emissions testing as described in section 9 of this report.

7.2.2. Tests were performed to identify the maximum field strength of the fundamental frequency.

Peak Level Result:

Frequency (MHz)	Antenna Polarity	Detector Level (dB μ V/m)	Antenna Factor (dB)	Cable Loss (dB)	Actual Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
2451.555	Horiz.	65.3	21.3	0.9	87.5	134.0	46.5	Complied

Average Level Result:

Frequency (MHz)	Antenna Polarity	Detector Level (dB μ V/m)	Antenna Factor (dB)	Cable Loss (dB)	Actual Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
2451.555	Horiz.	65.0	21.3	0.9	87.2	114.0	26.8	Complied

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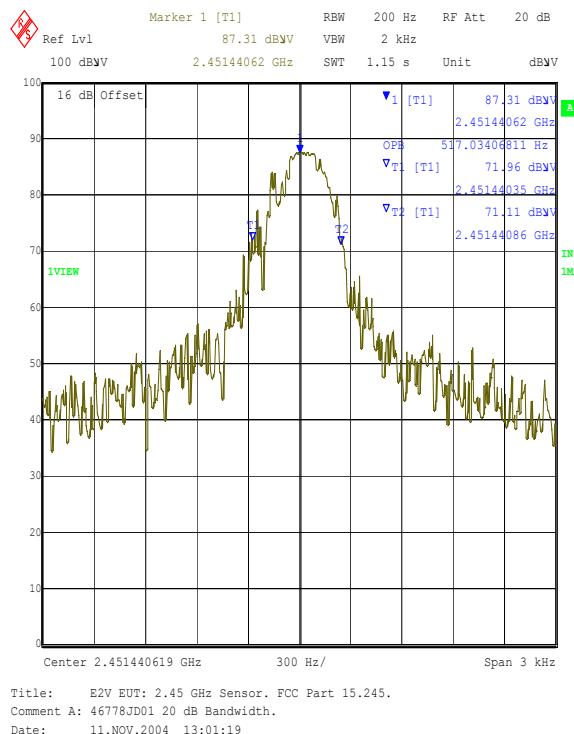
7.3. Transmitter 20 dB Bandwidth: Section 2.1049

7.3.1. The EUT was configured as for 20 dB bandwidth measurements as described in Section 9 of this report.

7.3.2. Tests were performed to identify the 20 dB bandwidth.

Results:

Transmitter 20 dB Bandwidth (kHz)	
0.517	



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7.4. Transmitter Radiated Emissions: Section 15.245(b) and 15.209

7.4.1. Electric Field Strength Measurements: 30 to 1000 MHz.

7.4.1.1. The EUT was configured as for radiated emissions testing as described in Section 9 of this report.

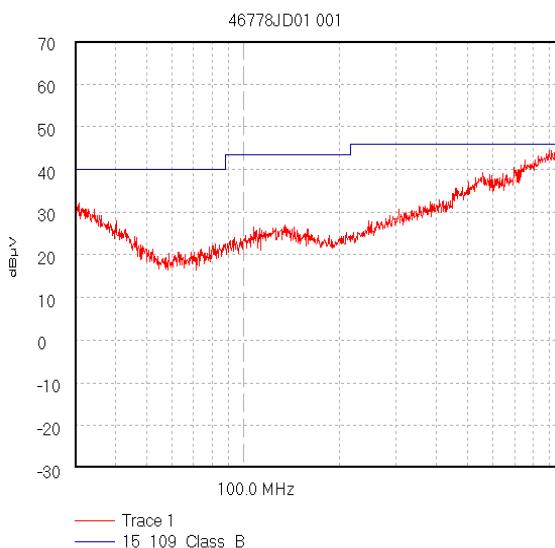
7.4.1.2. Tests were performed to identify the maximum radiated spurious emission levels.

Results:

Frequency (MHz)	Antenna Polarity	Peak Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
965.542*	Vert.	45.0**	54.0	9.0	Complied

*Note: No spurious emissions were detected above the noise floor of the measuring receiver; therefore the highest peak noise floor reading of the measuring receiver was recorded as shown in the table above.

**Note: The pre-scans were performed using a peak detector, the peak noise figure was then compared to the quasi-peak limit. This peak level will always be greater than or equal to the quasi-peak level.



Start 30.0 MHz; Stop 1.0 GHz - Log Scale
Ref 70 dB μ V; Ref Offset 0.0 dB; 10 dB/div
RBW 120.0 kHz; VBW 100.0 kHz; Att 10 dB; Swp 80.0 mS
Peak 965.542 MHz, 45.04 dB μ V
Limit/Mask: 15_109_Class_B; Limit Test Passed
Transducer Factors: A490
11/9/2004 10:23:15 AM

Note: This plot is a pre-scan and is for indication purposes only. For final measurements, see accompanying tables.

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Transmitter Radiated Emissions (Continued)

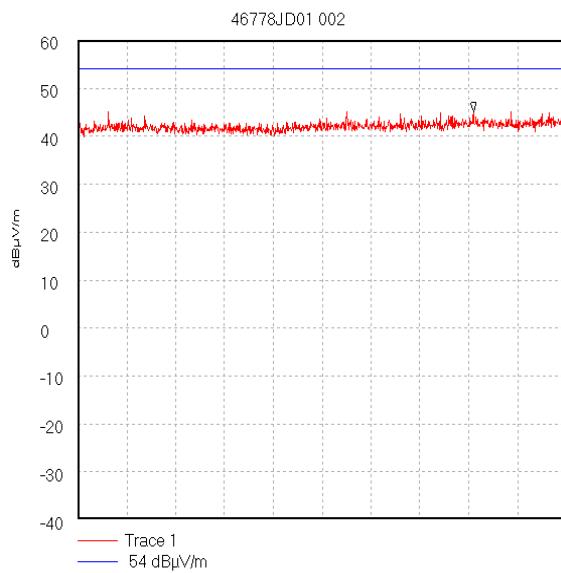
7.4.2. Electric Field Strength Measurements: 1.0 to 25.0 GHz

Highest Peak Level:

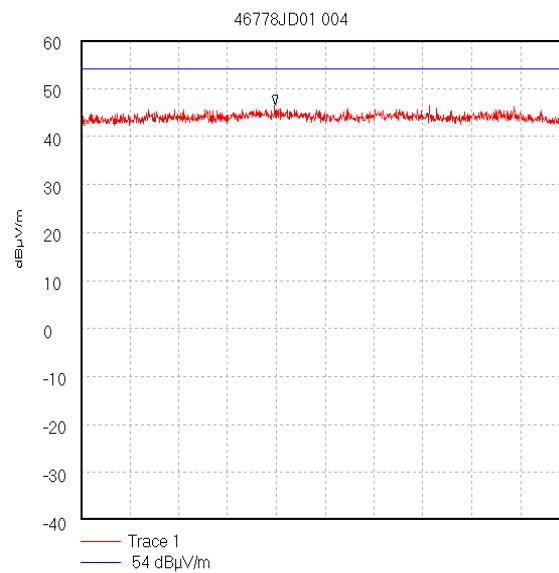
Frequency (MHz)	Antenna Polarity	Detector Level (dB μ V/m)	Antenna Factor (dB)	Cable Loss (dB)	Actual Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
4903.288	Vert.	28.3	24.2	1.3	53.8	74.0	20.2	Complied
7354.911	Vert.	25.8	26.9	1.6	54.3	74.0	19.7	Complied
9806.433	Vert.	18.7	30.5	1.9	51.1	84.1	33.0	Complied

Highest Average Level:

Frequency (MHz)	Antenna Polarity	Detector Level (dB μ V/m)	Antenna Factor (dB)	Cable Loss (dB)	Actual Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
4903.288	Vert.	26.9	24.2	1.3	52.4	54.0	1.6	Complied
7354.911	Vert.	25.4	26.9	1.6	53.9	54.0	0.1	Complied
9806.433	Vert.	17.5	30.5	1.9	49.9	64.1	14.2	Complied



Start 1.0 GHz; Stop 2.0 GHz
 Ref 60 dB μ V/m; Ref Offset 21.5 dB; 10 dB/div
 RBW 1.0 MHz; VBW 1.0 MHz; Att 0 dB; Swp 20.0 mS
 Peak 1.811 GHz, 45.18 dB μ V/m
 Display Line: 54 dB μ V/m;
 11/9/2004 11:09:57 AM

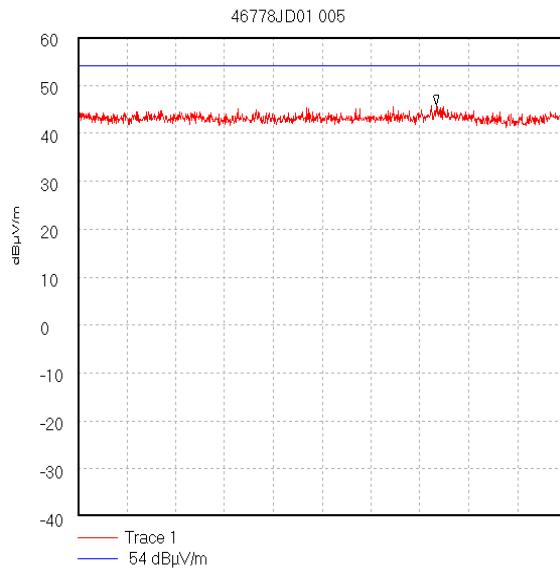


Start 2.0 GHz; Stop 2.435 GHz
 Ref 60 dB μ V/m; Ref Offset 21.8 dB; 10 dB/div
 RBW 1.0 MHz; VBW 1.0 MHz; Att 0 dB; Swp 20.0 mS
 Peak 2.173 GHz, 46.52 dB μ V/m
 Display Line: 54 dB μ V/m;
 11/9/2004 11:37:22 AM

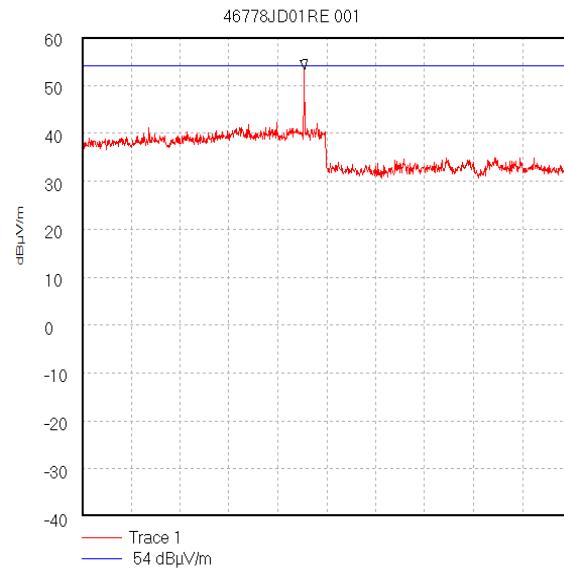
Note: This plot is a pre-scan and is for indication purposes only. For final measurements, see accompanying tables.

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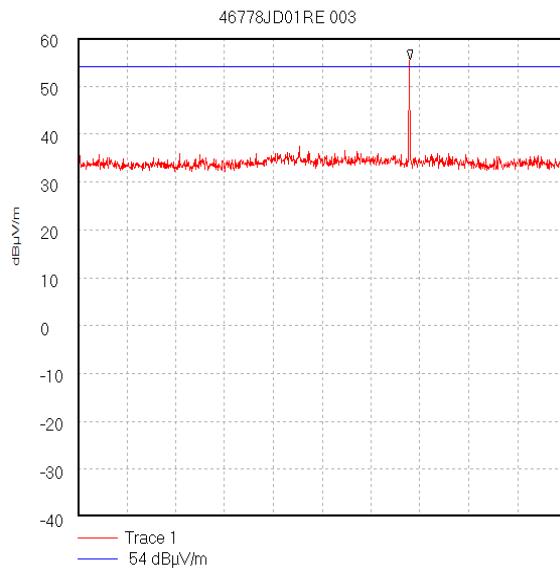
Transmitter Radiated Emissions (Continued)



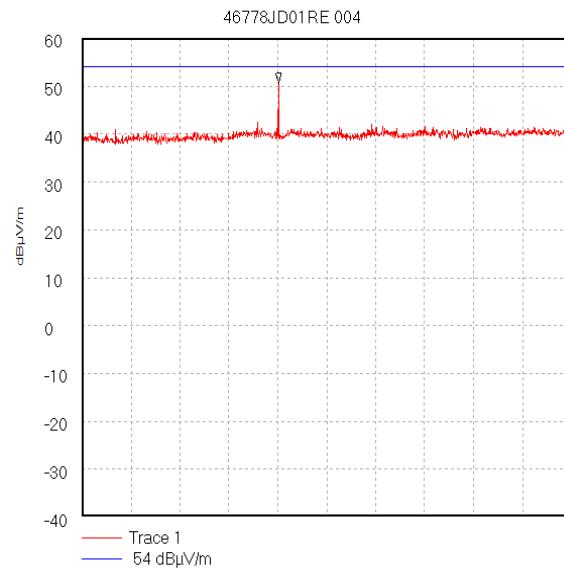
Start 2.465 GHz; Stop 4.0 GHz
Ref 60 dB μ V/m; Ref Offset 21.8 dB; 10 dB/div
RBW 1.0 MHz; VBW 1.0 MHz; Att 0 dB; Swp 20.0 mS
Peak 3.592 GHz, 45.89 dB μ V/m
Display Line: 54 dB μ V/m;
11/9/2004 11:39:13 AM



Start 4.0 GHz; Stop 6.0 GHz
Ref 60 dB μ V/m; Ref Offset 1.5 dB; 10 dB/div
RBW 1.0 MHz; VBW 3.0 MHz; Att 5 dB; Swp 20.0 mS
Peak 4.908889 GHz, 53.3 dB μ V/m
Display Line: 54 dB μ V/m; ; Limit Test Passed
11/11/2004 10:18:01



Start 6.0 GHz; Stop 8.0 GHz
Ref 60 dB μ V/m; Ref Offset 1.7 dB; 10 dB/div
RBW 1.0 MHz; VBW 3.0 MHz; Att 5 dB; Swp 20.0 mS
Peak 7.36 GHz, 55.51 dB μ V/m
Display Line: 54 dB μ V/m; ; Limit Test Failed
11/11/2004 10:34:08

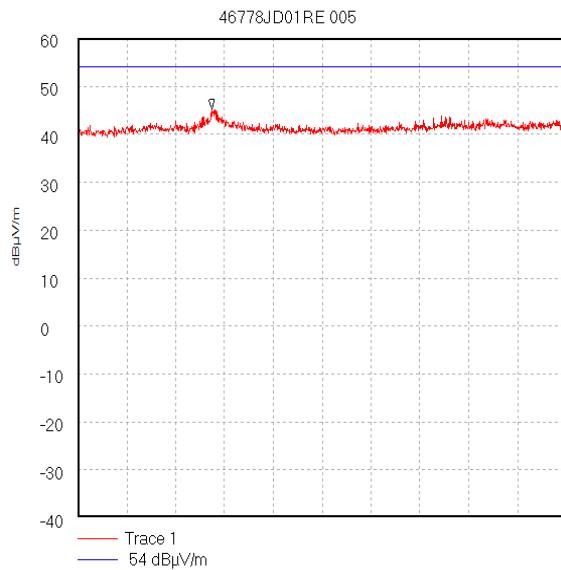


Start 8.0 GHz; Stop 12.5 GHz
Ref 60 dB μ V/m; Ref Offset 2.1 dB; 10 dB/div
RBW 1.0 MHz; VBW 3.0 MHz; Att 5 dB; Swp 40.0 mS
Peak 9.81 GHz, 50.86 dB μ V/m
Display Line: 54 dB μ V/m; ; Limit Test Passed
11/11/2004 10:36:56

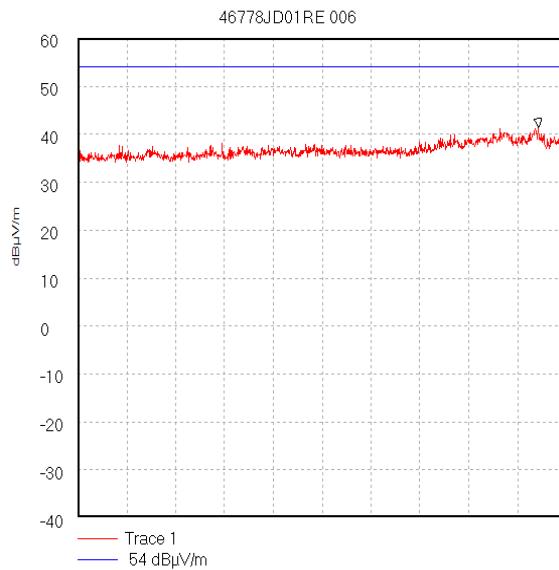
Note: the following plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

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Transmitter Radiated Emissions (Continued)



Start 12.5 GHz; Stop 18.0 GHz
Ref 60 dB μ V/m; Ref Offset 2.4 dB; 10 dB/div
RBW 1.0 MHz; VBW 3.0 MHz; Att 0 dB; Swp 40.0 mS
Peak 14.00944 GHz, 45.4 dB μ V/m
Display Line: 54 dB μ V/m; Limit Test Passed
11/11/2004 10:41:21



Start 18.0 GHz; Stop 25.0 GHz
Ref 60 dB μ V/m; Ref Offset 2.9 dB; 10 dB/div
RBW 1.0 MHz; VBW 3.0 MHz; Att 0 dB; Swp 60.0 mS
Peak 24.603333 GHz, 41.47 dB μ V/m
Display Line: 54 dB μ V/m; Limit Test Passed
11/11/2004 10:47:02

Note: the following plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables.

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7.5. Transmitter Radiated Emissions at Band Edges: Section 15.245(b) and 15.209

7.5.1. The EUT was configured as for radiated emissions testing as described in Section 9 of this report.

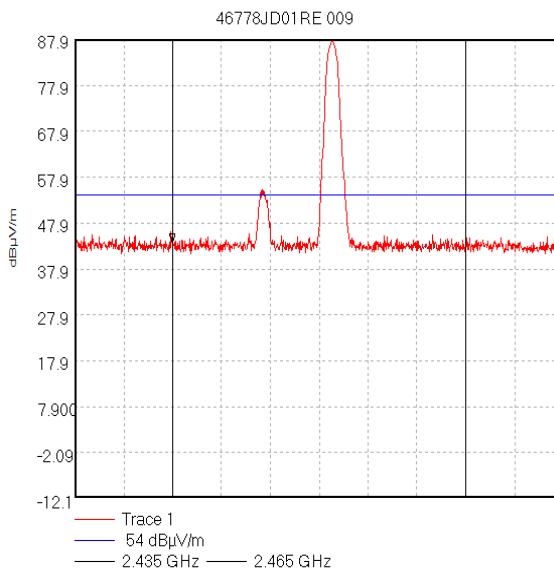
7.5.2. Tests were performed to identify the maximum radiated band edge emission levels.

Results: Peak Power Level

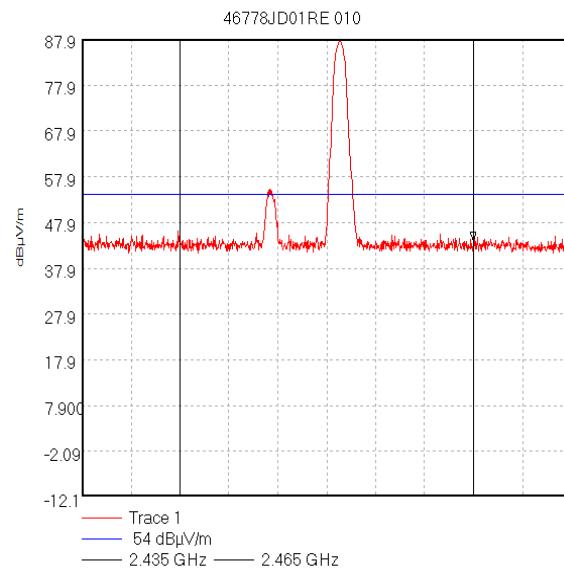
Frequency (MHz)	Antenna Polarity	Detector Level (dB μ V/m)	Antenna Factor (dB)	Cable Loss (dB)	Actual Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
2435	Horiz.	21.4	21.3	0.9	43.6	74.0	30.4	Complied
2465	Horiz.	21.6	21.3	0.9	43.8	74.0	30.2	Complied

Results: Average Power Level

Frequency (MHz)	Antenna Polarity	Detector Level (dB μ V/m)	Antenna Factor (dB)	Cable Loss (dB)	Actual Level (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)	Result
2435	Horiz.	10.8	21.3	0.9	33.0	54.0	21.0	Complied
2465	Horiz.	10.7	21.3	0.9	32.9	54.0	21.1	Complied



Start 2.425 GHz; Stop 2.475 GHz
Ref 87.9 dB μ V/m; Ref Offset 0.9 dB; 10 dB/div
RBW 1.0 MHz; VBW 1.0 MHz; Att 0 dB; Swp 20.0 mS
Marker 2.435 GHz, 43.62 dB μ V/m
Display Line: 54 dB μ V/m; Limit Test Failed
11/11/2004 11:33:40



Start 2.425 GHz; Stop 2.475 GHz
Ref 87.9 dB μ V/m; Ref Offset 0.9 dB; 10 dB/div
RBW 1.0 MHz; VBW 1.0 MHz; Att 0 dB; Swp 20.0 mS
Marker 2.465 GHz, 43.82 dB μ V/m
Display Line: 54 dB μ V/m; Limit Test Failed
11/11/2004 11:34:47

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8. Measurement Methods

8.1. Radiated Emissions

Radiated emissions measurements were performed in accordance with the standard, against appropriate limits for each detector function.

Initial measurements covering the entire measurement band from of swept scans in a shielded enclosure were preformed in order to identify frequencies on which the EUT should be re-measured in full on the open area test site. In order to minimise the time taken for the swept measurements, a peak detector was used in conjunction with the appropriate detector IF measuring bandwidth (see table below). Repetitive scans were performed to allow for emissions with low repetition rates.

The initial scans were performed using an antenna height of 1.5 m and at a measurement distance of 3 m. Following the initial scans, graphs were produced giving an overview of the emissions from the emissions from the EUT plotted against the appropriate specification limit. Any emissions within 20 dB of the limit were then measured on the open area test site, except in cases the highest point of the noise floor was measured

In either case the measurement was made at the appropriate distance using a measuring receiver with a quasi-peak detector for measurements below 1000 MHz and an average detector for measurements above 1000 MHz.

For the final measurements the EUT was arranged on a non-conducting turntable on a standard test site complaint with ANSI C63.4-2001 Clause 5.4.

All measurements on the open area test site were performed using broadband antennas.

On the open area test site, at each frequency where a signal was to be measured, the trace was maximised by rotating a turntable through 360°. The angle at which the maximum signal was observed was locked out. For frequencies below 1000 MHz the test antenna was varied in height between 1m and 4m in order to further maximise the target emission.

For frequencies above 1000 MHz where a horn antenna was used, height searching was performed to locate the optimal height of the horn with respect of the EUT. At this point the horn was locked off and the turntable was again rotated 360° to maximise the target signal. It should be noted that the receive signal from the EUT would diminish very quickly after it exits the beam width of the horn antenna, for this reason it may not be necessary to fully height search with horns.

At this point, any signal found to be between the limit and a level 6 dB below it were further maximised by changing the configuration of the EUT, e.g. re-routing cables to peripherals and moving peripherals with respect to the EUT.

Scans were performed to the under frequency limits as stated in section 15.33.

The final field strength was determined as the indicated level in dB μ V plus cable loss and antenna factor.

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Radiated Field Strength Emissions (Continued)

The test equipment settings for radiated emissions measurements were as follows:

Receiver Function	Initial Scan	Final Measurements Below 1 GHz	Final Measurements Above 1 GHz
Detector Type:	Peak	Quasi-Peak (CISPR)	Peak / Average
Mode:	Max Hold	Not Applicable	Max Hold
Bandwidth:	(120 KHz < 1 GHz) (1 MHz > 1 GHz)	120 KHz	1 MHz
Amplitude Range:	100 dB	100 dB	100 Db
Step Size:	Continuous Sweep	Not Applicable	Not Applicable
Sweep Time:	Coupled	Not Applicable	Not Applicable

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8.2. Transmitter 20 dB Bandwidth

The EUT and spectrum analyser was configured as for transmitter radiated emissions measured.

The Occupied Bandwidth was measured from the fundamental emission at the carrier frequency.

The Occupied Bandwidth was measured using the built in occupied bandwidth function of the Rohde and Schwarz FSEB or ESIB spectrum analyser. It was set to measure the bandwidth where 99% of the signal power was contained. The analyser settings were set as per those outlined in the spectrum analyser user manual for this measurement, i.e., $RBW \geq 1\%$ of occupied bandwidth. A value of 200 Hz was used.

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9. Measurement Uncertainty

9.1. No measurement or test can ever be perfect and the imperfections give rise to error of measurement in the results. Consequently, the result of a measurement is only an approximation to the value of the measurand (the specific quantity subject to measurement) and is only complete when accompanied by a statement of the uncertainty of the approximation.

9.2. The expression of uncertainty of a measurement result allows realistic comparison of results with reference values and limits given in specifications and standards.

9.3. The uncertainty of the result may need to be taken into account when interpreting the measurement results.

9.4. The reported expanded uncertainties below are based on a standard uncertainty multiplied by an appropriate coverage factor, such that a confidence level of approximately 95% is maintained. For the purposes of this document "approximately" is interpreted as meaning "effectively" or "for most practical purposes".

Measurement Type	Range	Confidence Level (%)	Calculated Uncertainty
20 dB Bandwidth	N/A	95%	+/- 0.12 %
Radiated Spurious Emissions	30 MHz to 1000 MHz	95%	+/- 5.26 dB
Radiated Spurious Emissions	1 GHz to 40 GHz	95%	+/- 1.78 dB

9.5. The methods used to calculate the above uncertainties are in line with those recommended within the various measurement specifications. Where measurement specifications do not include guidelines for the evaluation of measurement uncertainty, the published guidance of the appropriate accreditation body is followed.

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Appendix 1. Test Equipment Used

RFI No.	Instrument	Manufacturer	Type No.	Serial No.
A027	Horn Antenna	Eaton	9188-2	301
A031	2 to 4 GHz Eaton Horn Antenna	Eaton	91889-2	557
A1256	Power supply	Farnell	11E30/1B	000378
A253	WG 12 Microwave Horn	Flann Microwave	12240-20	128
A254	WG 14 Microwave Horn	Flann Microwave	14240-20	139
A255	WG 16 Microwave Horn	Flann Microwave	16240-20	519
A256	WG 18 Microwave Horn	Flann Microwave	18240-20	400
A259	Bilog Antenna	Chase	CBL6111	1513
A392	3 dB attenuator (9)	Suhner	6803.17.B	None
A436	WG 20 horn	Flann	20240-20	330
C573	C573-N-N-2	Rosenberger	UFA210A-1-788-50x50	97E0936
M003	Spectrum Monitor	Rohde & Schwarz	EZM	883 580/008
M044	ESVP Receiver	Rohde & Schwarz	ESVP	891 845/026
M058	Multimeter	Fluke	79	54940691
M069	ESMI Spectrum Analyser / Receiver	Rohde & Schwarz	ESMI	829 808/007 (DU) / 827 063/008 (RU)
M1124	Rohde & Schwarz	Rohde & Schwarz	ESIB26	100046K
S201	Site 1	RFI	1	None
S202	Site 2	RFI	2	S202-15011990

NB In accordance with UKAS requirements, all the measurement equipment is on a calibration schedule.

Test Of: **e2v Technologies Ltd**
DA5819 2.4 GHz Mass Movement Sensor
To: **FCC Part 15.245**

Appendix 2. Test Configuration Drawings

This appendix contains the following drawings:

Drawing Reference Number	Title
DRG\46778JD01\EMIRAD	Test configuration for measurement of radiated emissions.

Test Of: e2v Technologies Ltd
 DA5819 2.4 GHz Mass Movement Sensor
To: FCC Part 15.245

DRG\46778JD01\EMIRAD

