



TEST REPORT FROM RFI GLOBAL SERVICES LTD

Test of: Blighter B422-SP Main Unit

To: FCC Part 90: 2009, Subpart F in accordance with
RFI Test Plan RFI/REGE1/TP75565JD03

Test Report Serial No:
RFI-RPT-RP76954JD03A_V2.0

Versions 2.0 supersedes all previous versions

This Test Report Is Issued Under The Authority pp  Of Brian Watson, COO Payments and Consultancy:	
Checked By:	R. Graham
Signature:	
Date of Issue:	30 April 2010

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1. Customer Information

Company Name:	Plextek Ltd
Address:	London Road Great Chesterford Essex CB10 1NY United Kingdom









2. Summary of Testing

2.1. General Information

Specification Reference:	47CFR90
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications) 2009: Part 90: Public Safety Radio Pool
Specification Reference:	47CFR2
Specification Title:	Code of Federal Regulations Volume 47 (Telecommunications) 2009: Part 2: Frequency Allocations and Radio Treaty Matters; General Rules and Regulations
Site Registration:	FCC: 209735
Location of Testing:	RFI Global Services Ltd, Wade Road, Basingstoke, Hampshire, RG24 8AH, England
Test Dates:	01 March 2010 to 26 March 2010

RFI Test Plan Reference:	RFI/REGE1/TP75565JD03 Date: 11 th January 2010
Description:	Test Plan from RFI Global Services Ltd for Blighter B400 Series Radar

2.2. Summary of Test Results

FCC Reference (47CFR)	Measurement	Result
Part 2.1046	Transmitter RF Conducted Output Power	
Part 2.1049	Transmitter Occupied Bandwidth (Bandwidth Limitations)	
Part 2.1051 / Part 2.1057	Spurious Emissions at Antenna Terminals	
Part 2.1053 / Part 2.1057	Field Strength of Spurious Radiation	
Part 2.1053	Transmitter Band Edge Radiated Emissions	
Part 2.1055	Transmitter Frequency Stability (Temperature & Voltage Variation)	
Key to Results		
 = Complied  = Did not comply		

2.3. Methods and Procedures

Reference:	ANSI/TIA-603-C-2004
Title:	Land Mobile Communications Equipment, Measurements and performance Standards
Reference:	ANSI C63.10 (2009)
Title:	American National Standard for Testing Unlicensed Wireless Devices

2.4. Deviations from the Test Specification

For the measurements contained within this test report, there were no deviations from, additions to, or exclusions from the test specification identified above.

3. Equipment Under Test (EUT)

3.1. Identification of Equipment Under Test (EUT)

Description:	FMCW Radar – Main Unit
Brand Name:	Blighter
Model Name or Number:	B422-NBSP
Serial Number:	6B501
Hardware Version Number:	BoM / Rev – Main 6BA39B/01
Software Version Number:	Build 81
FCC ID Number:	UFQB400SPNBMAIN

3.2. Description of EUT

The equipment under test was the Main Unit of a multi-frequency ground surveillance radar system that can scan and detect moving vehicles and persons over a 180° area and can operate up to a range of 16 km.

The main radar unit contains a GPS receiver and Wireless LAN transceiver (WLAN).

The EUT assembly was mounted onto a tripod for test purposes. A personal computer (PC) is normally connected to the main radar unit by Ethernet or WLAN. The radar system can be configured and monitored from the PC.

The Client stated that power to the EUT is provided from a DC supply only.

The Client stated that an electronic test target was not required.

3.3. Modifications Incorporated in the EUT

No modifications were applied to the EUT during testing.

3.4. Additional Information Related to Testing

Category of Equipment:	Radar		
Type of Radio Device:	Transceiver		
Intended Operating Environment:	Outdoor		
Power Supply Requirement(s):	Nominal	16.0 V	
	Minimum	13.6 V	
	Maximum	18.4 V	
Antenna Type:	Sectoral Horn		
Antenna Gain:	26 (dBi) On Boresight		
Modulation Type:	FM-CW		
Channel Bandwidth When Operating On A Single Frequency:	25.538MHz		
Transmit Frequency Range:	16.2 GHz – 17.2 GHz		
Transmit Channels Tested:	Channel ID	Test Frequency (MHz)	Azimuth Angle (°)
	Main Unit Bottom	16276.375	-92.3
	Main Unit Middle	16698.250	-43.3
	Main Unit Top	17101.375	0.4
Receive Channels Tested:	Channel ID	Test Frequency (MHz)	Azimuth Angle (°)
	Main Unit Bottom	16276.375	-92.3
	Main Unit Middle	16698.250	-43.3
	Main Unit Top	17101.375	0.4

3.5. Support Equipment

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

Description:	Bench Power Supply
Brand Name:	Thurlby-Thandar Instruments Ltd.
Model Name or Number:	CPX400
Serial Number:	220643

Description:	Laptop PC running Windows XP and Plextek Blighter HMI Software V1.39
Brand Name:	Hewlett Packard
Model Name or Number:	KU357ET#ABU
Serial Number:	CNU9118PRK

4. Operation and Monitoring of the EUT during Testing

4.1. Operating Modes

The EUT was tested in the following operating mode(s):

- Transmitting at maximum power on the bottom, centre or top channels as required.

4.2. Configuration and Peripherals

The EUT was tested in the following configuration(s):

- Radiated tests were performed with the horn antennas removed, two blanking plates fitted over the receiver ports and waveguide to coaxial adaptor plates fitted to the transmitter ports. Waveguides were fitted to each adaptor plate and the antenna ports were terminated into suitable loads. The EUT was mounted onto a tripod located in the centre of the anechoic chamber turntable. All earthing points on the EUT were bonded to the structure of the anechoic chamber. The centre of the radar units were positioned at 1.5 metres above the anechoic chamber floor in line with height of the test antennas.
- Conducted tests were performed with the horn antennas removed, a blanking plate containing radar absorbent material was fitted over the receiver port and waveguide to coaxial adaptor plate fitted to the transmitter port. Waveguides were fitted to each adaptor plate and the test system was connected to the waveguides by coaxial cables.
- Power was provided by a bench power supply. The power supply was located outside the anechoic chamber during radiated tests. Power cables were routed through an access point in the anechoic chamber wall.
- LAN connection was through Ethernet cable to a laptop PC. A bespoke application on the laptop PC was used to configure the EUT during tests. The laptop PC was located outside the anechoic chamber during radiated tests. Ethernet cables were routed through an access point in the anechoic chamber wall.
- EUT range was set to Normal 8 km for all tests.
- 'Underlay' was set to Total Power for all tests.
- The compass was enabled for all tests apart from frequency stability tests.
- GPS receiver was enabled during all tests.
- Radar scan mode was disabled.
- The WLAN was enabled during all tests. The supplied antenna was fitted to the WLAN RF port on the EUT during tests.

5. Measurements, Examinations and Derived Results

5.1. General Comments

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 6* Measurement Uncertainties for details.

5.2. Test Results

5.2.1. Transmitter Conducted RF Power Output

Test Summary:

FCC Part:	47CFR2.1046
Test Method:	ANSI/TIA-603-C-2004 Section 2.2.1

Environmental Conditions:

Temperature (°C):	20
Relative Humidity (%):	25

Results:

Channel	Frequency (MHz)	Conducted RF Output Power (dBm)	Waveguide to coaxial adaptor plate loss (dB)	Total Conducted RF Power Output (dBm)
Bottom	16276.375	14.2	16.0	30.2
Centre	16698.250	13.9	16.0	29.9
Top	17101.375	13.6	16.0	29.6

Note(s):

1. Conducted output power was measured using a calibrated RF power meter with thermal power sensor. The stated loss of 16 dB for the waveguide to coaxial adaptor plate and waveguide was added to the conducted power measurement and the result recorded in the above tables.
2. The transmitter was enabled until the power measurement stabilised. The power was recorded at this point.

5.2.2. Transmitter Occupied Bandwidth**Test Summary:**

FCC Part:	47CFR2.1049
Test Method:	Occupied bandwidth was measured using the occupied bandwidth function of a Rohde & Schwarz ESIB Test Receiver.

Environmental Conditions:

Temperature (°C):	20
Relative Humidity (%):	24

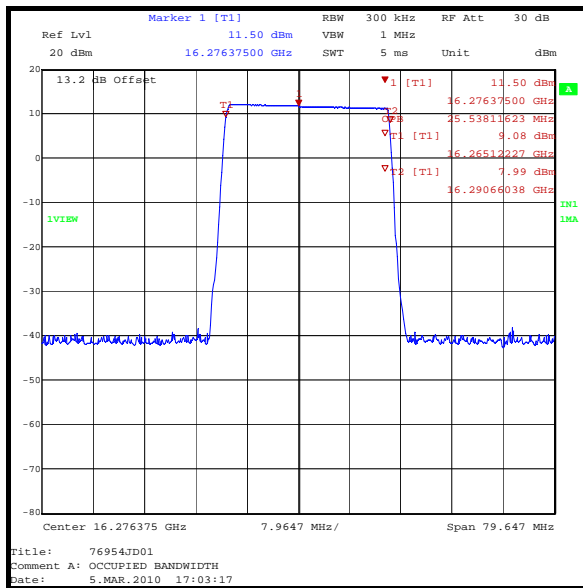
Results:

Channel	Frequency (GHz)	RBW (kHz)	VBW (kHz)	Occupied Bandwidth (MHz)
Bottom	16276.375	300	1000	25.538
Centre	16698.250	300	1000	25.379
Top	17101.375	300	1000	25.538

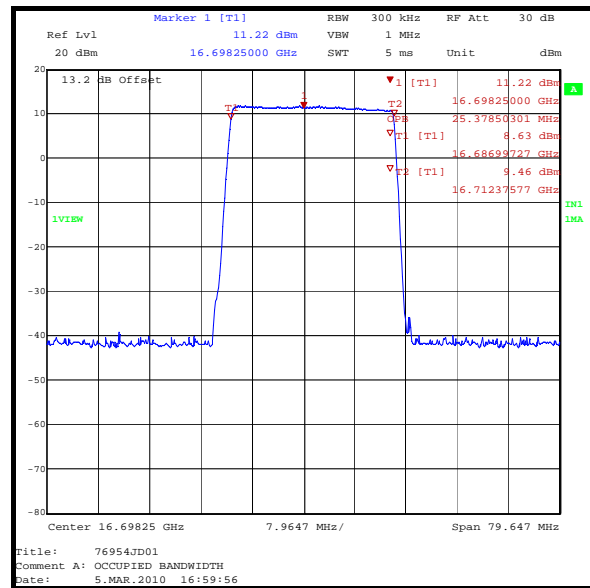
Note(s):

1. The test was performed as a conducted measurement at the antenna port.
2. The measurement equipment was configured to measure 99% of the power bandwidth.
3. Measurement bandwidths were set automatically by the test receiver.

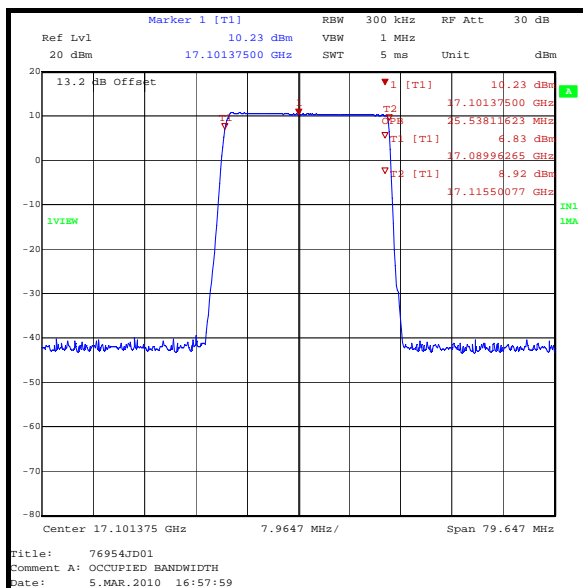
Transmitter Occupied Bandwidth (continued)



Bottom channel



Centre channel



Top channel

5.2.3. Transmitter Spurious Emissions at Antenna Terminals**Test Summary:**

FCC Part:	47CFR2.1053 and 47CFR2.1057
Test Method:	ANSI/TIA-603-C-2004 Section 2.2.13

Environmental Conditions:

Temperature Variation (°C):	19 to 22
Relative Humidity Variation (%):	26 to 30

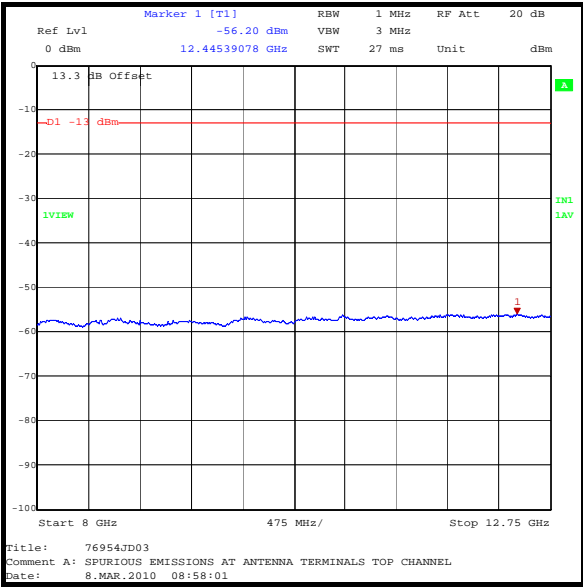
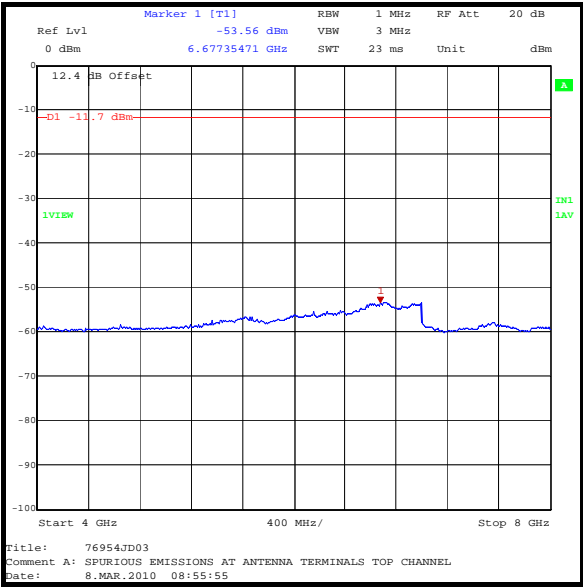
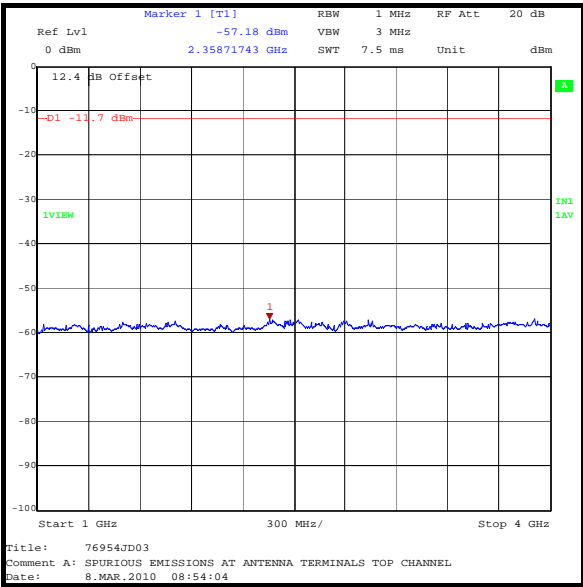
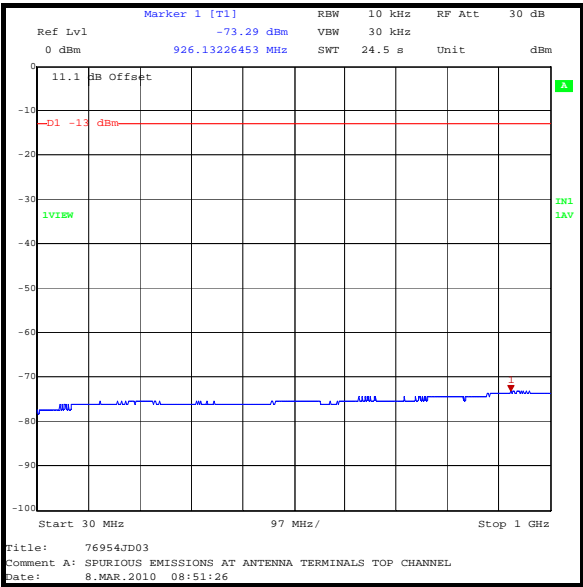
Results:

Frequency (MHz)	Peak Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
83920.000	-43.5	-13.0	30.5	Complied

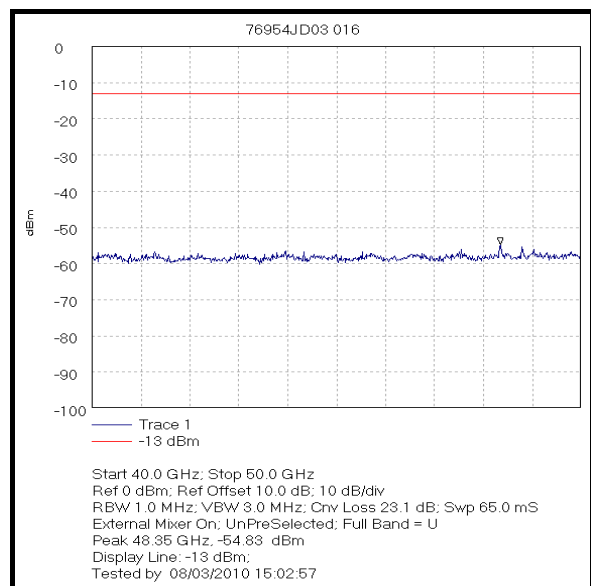
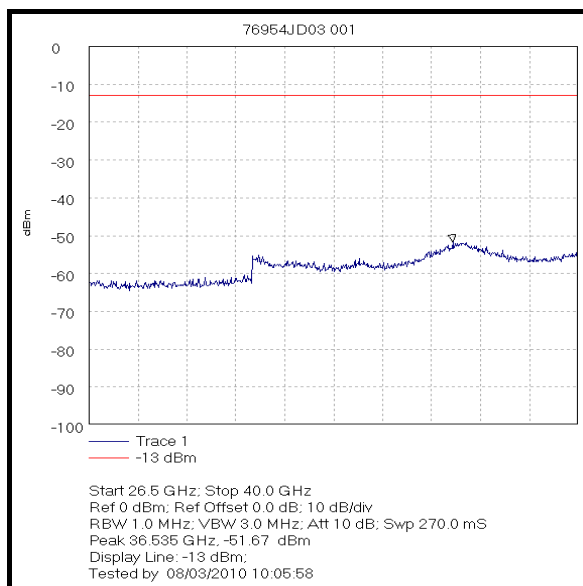
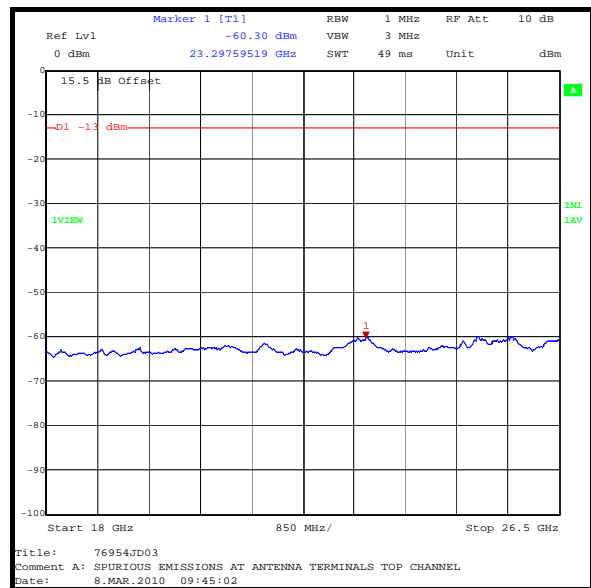
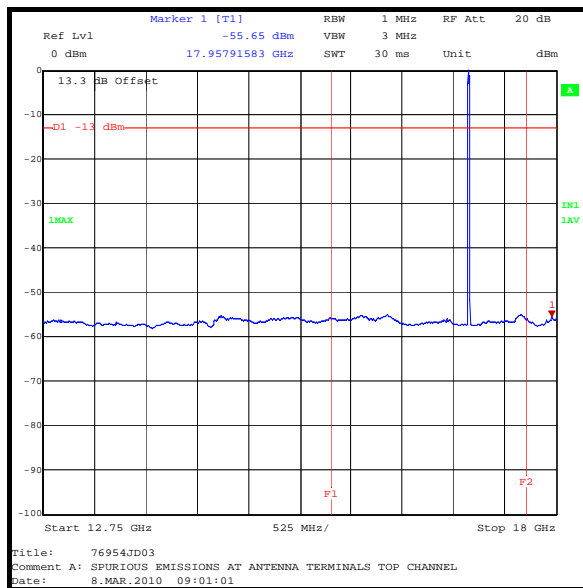
Note(s):

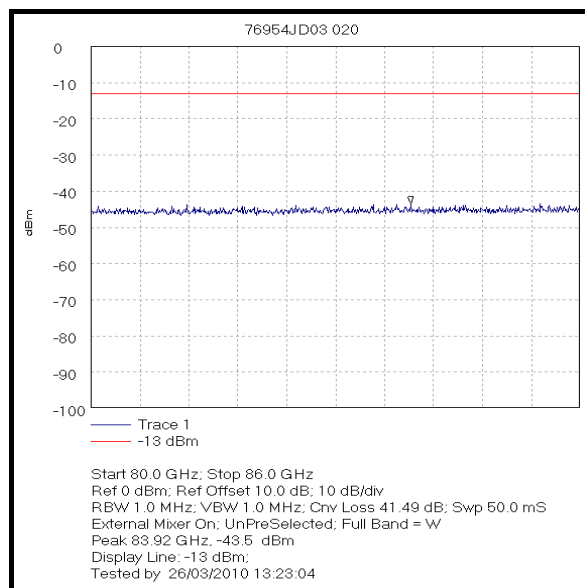
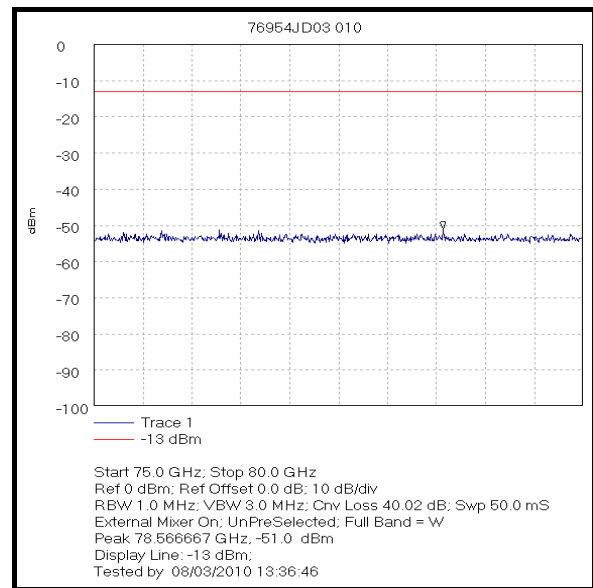
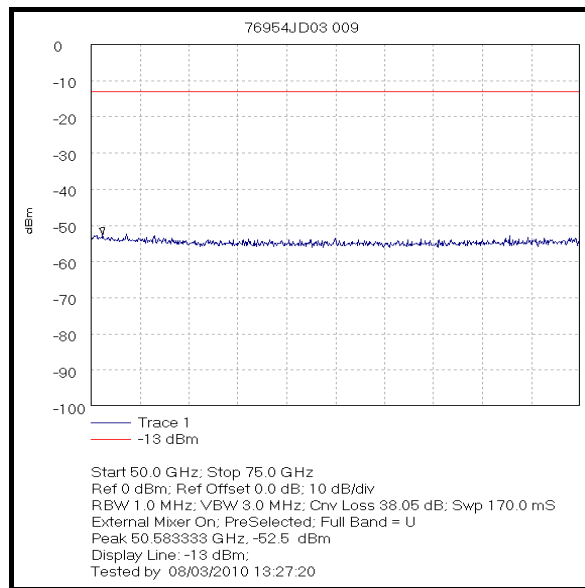
1. A waveguide to coaxial adaptor plate was fitted on transmitter antenna port. The antenna port under test was connected to the measurement equipment using suitable cables, attenuators and waveguides where required.
2. GPS, compass and WLAN were enabled during the test.
3. Pre-scans were performed with the EUT transmitting at maximum power on the highest frequency.
4. The emissions shown on the 12.75 GHz to 18 GHz pre-scan plots at approximately 17 GHz is the carrier frequency of the EUT radar transmitter. Frequency lines on the 12.75 GHz to 18 GHz plots indicate the lower and upper band edges at 15.7 GHz and 17.3 GHz.
5. Measurements were performed from 30 MHz to 86 GHz.
6. No emissions were observed above the level of the test system noise floor, therefore the highest noise floor levels were recorded in the above tables.

Transmitter Spurious Emissions at Antenna Terminals (continued)



Transmitter Spurious Emissions at Antenna Terminals (continued)



Transmitter Spurious Emissions at Antenna Terminals (continued)

5.2.4. Field Strength of Spurious Radiation Out of Band**Test Summary:**

FCC Part:	47CFR2.1053 and 47CFR2.1057
Test Method:	ANSI/TIA-603-C-2004 Section 2.2.12, ANSI C63.10 Section 6.6.4

Environmental Conditions:

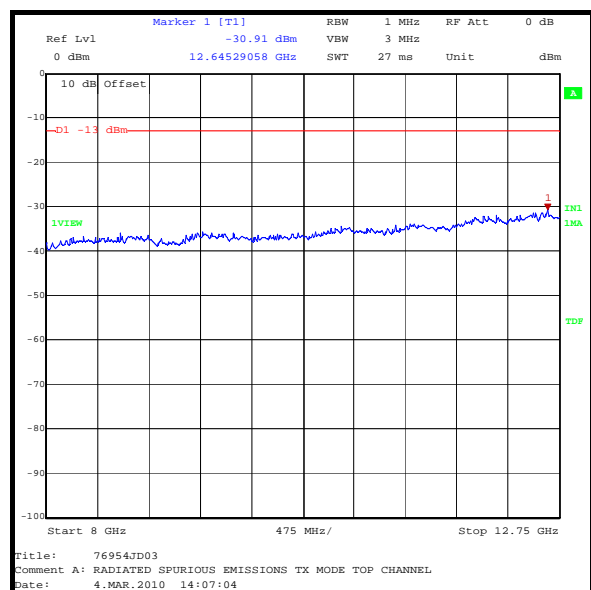
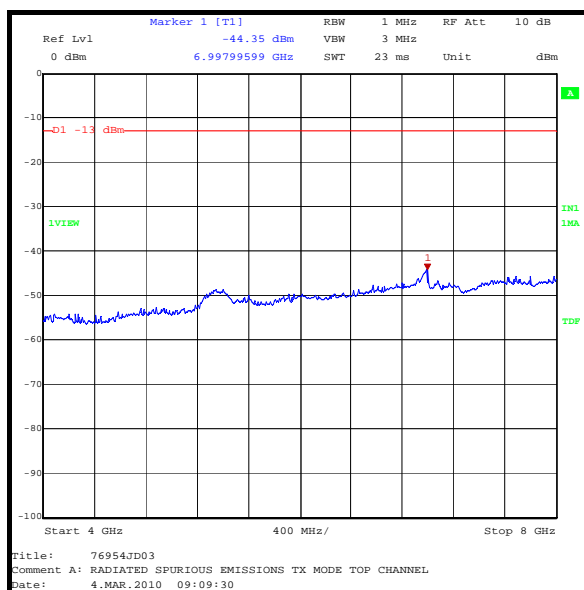
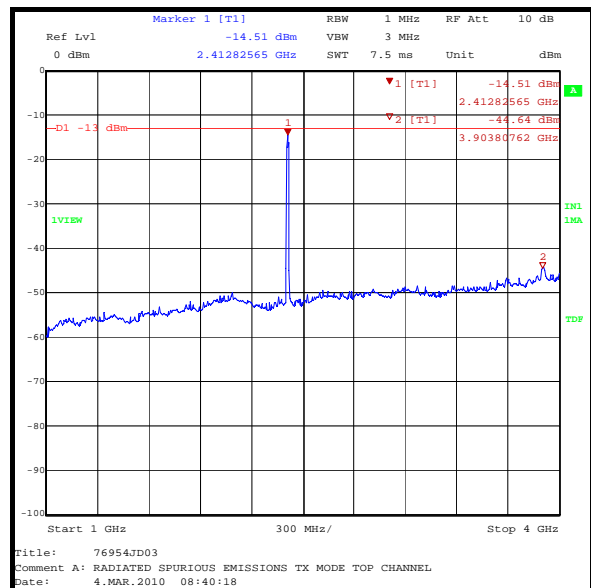
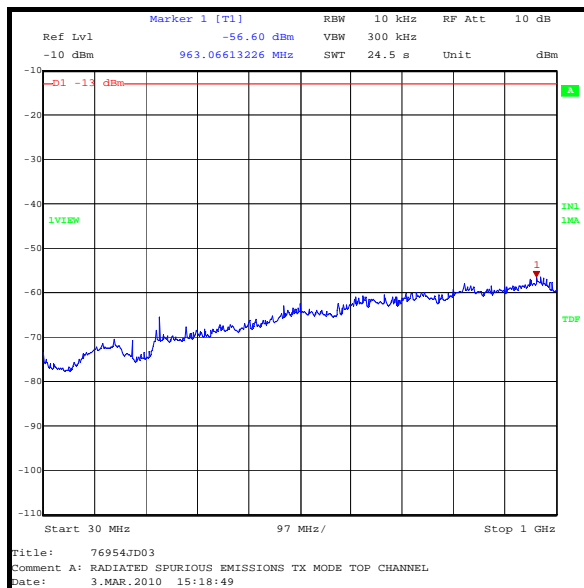
Temperature (°C):	24
Relative Humidity (%):	20

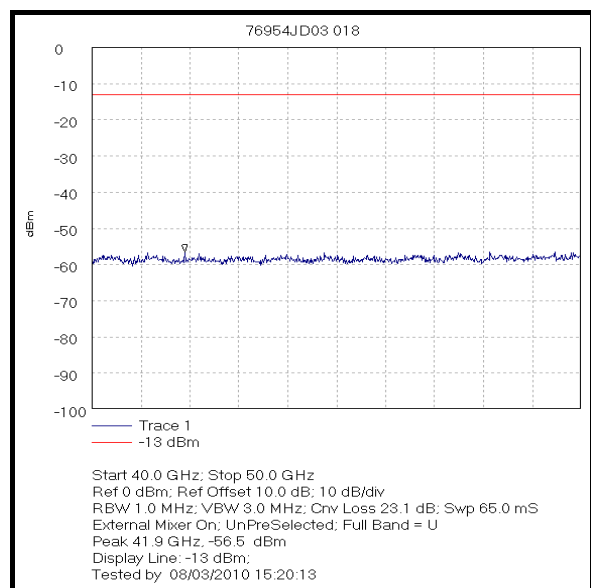
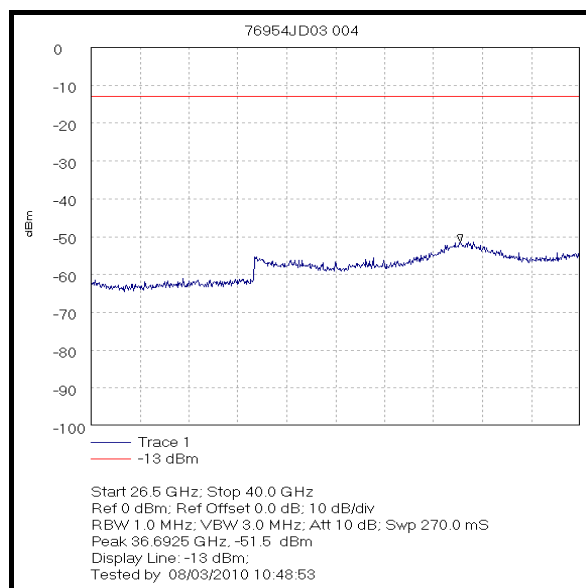
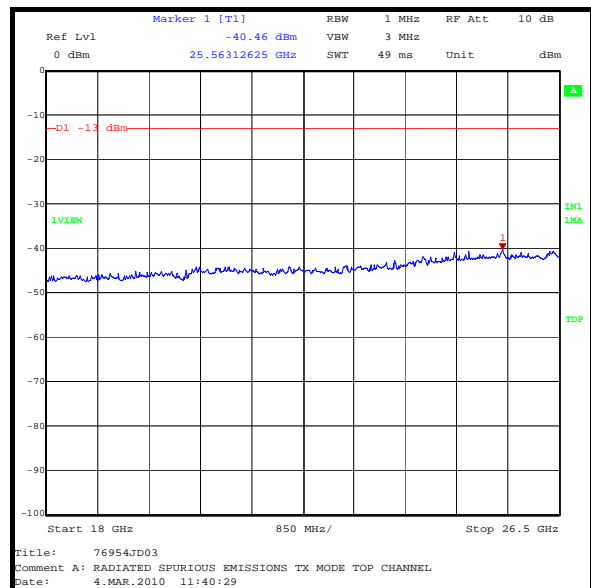
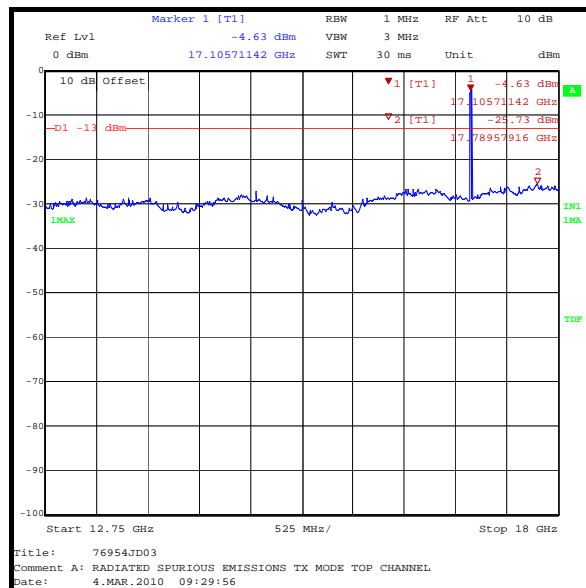
Results:

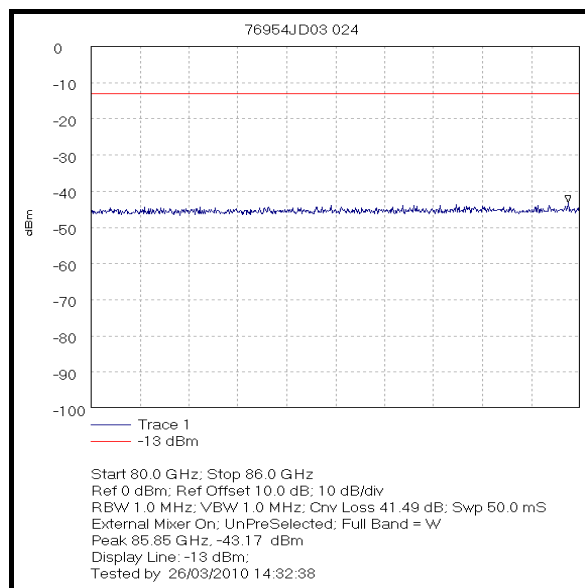
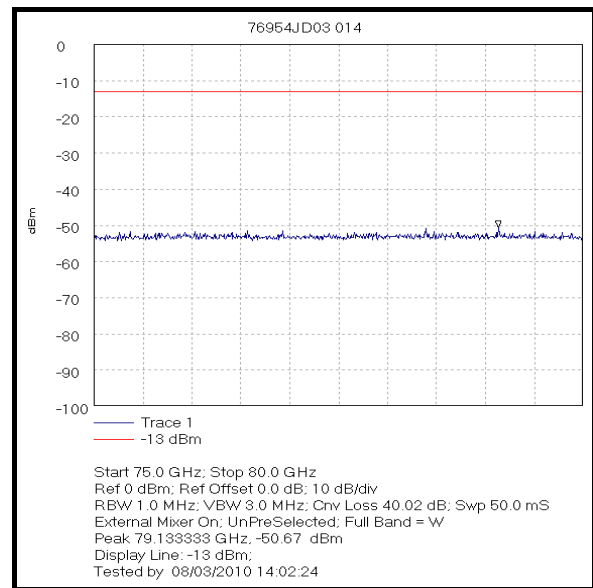
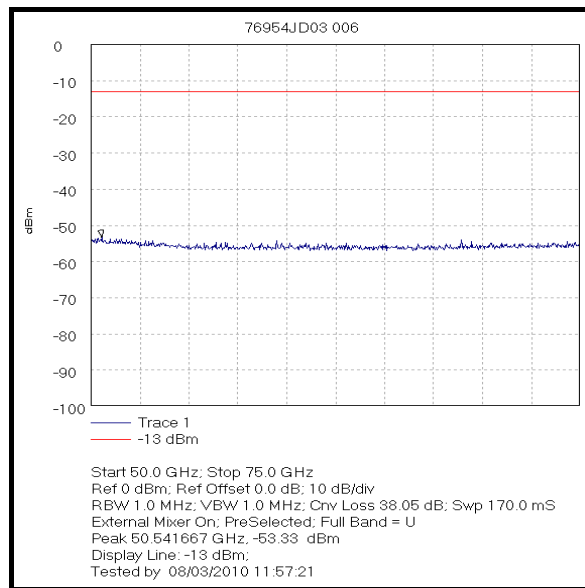
Frequency (MHz)	Peak Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
3910.972	-42.4	-13.0	29.4	Complied

Note(s):

1. A Waveguide to coaxial adaptor plate was fitted on the transmitter antenna port and the port was terminated with a suitable load in accordance with Section 4.4 of the Test Plan.
2. GPS, compass and WLAN were enabled during the test.
3. Pre-scans were performed with the EUT transmitting at maximum power on the highest frequency.
4. The emissions shown on the 1 GHz to 4 GHz pre-scan plots at approximately 2.412 GHz is the WLAN transmitter.
5. The emissions shown on the 12.75 GHz to 18 GHz pre-scan plots at approximately 17 GHz is the carrier frequency of the EUT radar transmitter.
6. All emissions were >20 dB below the limit or below the level of the measurement system noise floor. The highest level emissions noted during the pre-scans on the top channel were recorded in the above tables. Bottom and centre channels were checked and showed similar emissions and levels.

Field Strength of Spurious Radiation Out of Band (continued)

Field Strength of Spurious Radiation Out of Band (continued)

Field Strength of Spurious Radiation Out of Band (continued)

5.2.5. Transmitter Field Strength of Spurious Radiation at Band Edges**Test Summary:**

FCC Part:	47CFR2.1053
Test Method:	ANSI/TIA-603-C-2004 Section 2.2.12 and ANSI C63.10 Section 6.6.4

Environmental Conditions:

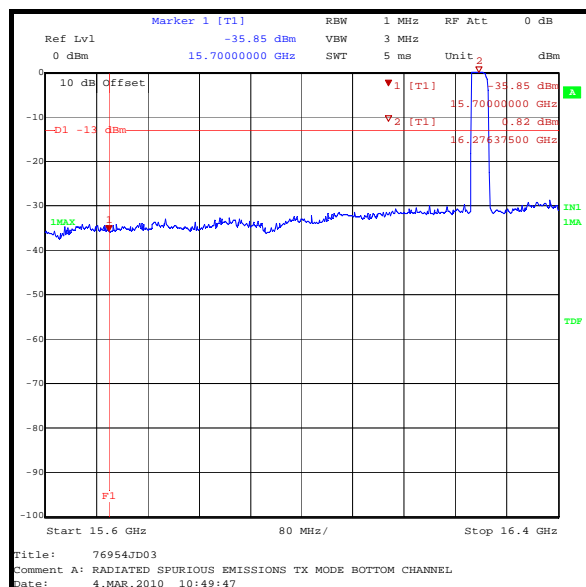
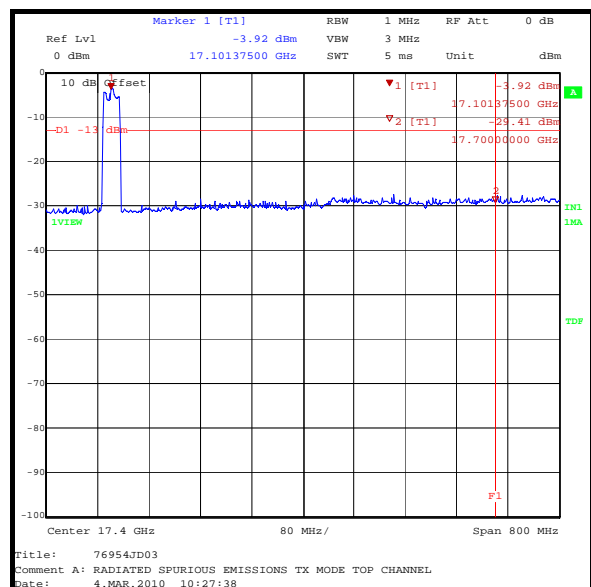
Temperature (°C):	24
Relative Humidity (%):	20

Results:

Frequency (MHz)	Peak Emission Level (dBm)	Limit (dBm)	Margin (dB)	Result
15700.0	-35.9	-13.0	22.9	Complied
17300.0	-29.4	-13.0	16.4	Complied

Note(s):

- Waveguide to coaxial adaptor plates were fitted on transmitter antenna ports. Both transmitter antenna ports were terminated with suitable loads in accordance with Section 4.4 of the Test Plan.
- GPS, compass and WLAN were enabled during the test.
- Pre-scans were performed with the EUT transmitting at maximum power on the highest frequency.
- The frequency lines and marker placed on the upper band edge plots have been incorrectly placed at 17.7 GHz. It can be seen from the plots that the noise floor level at the correct upper band edge frequency of 17.3 GHz is comparable to the noise floor level at 17.7 GHz and compliant.

**Lower band edge / Bottom operating frequency****Upper band edge / Top operating frequency**

5.2.6. Transmitter Frequency Stability (Temperature Variation)**Test Summary:**

FCC Part:	CFR47 2.1055(a)(1)
Test Method:	CFR47 Part 2.1055(b)

Environmental Conditions:

Ambient Temperature (°C):	21 to 23
Ambient Relative Humidity (%):	17 to 22

Results: Bottom Channel

Temperature (°C)	Measured Frequency F_L (MHz)	Lower Band Edge (MHz)	Margin (MHz)	Result
-30	16264.580583	15700.0	564.580583	Complied
-20	16264.579704	15700.0	564.579704	Complied
-10	16264.617841	15700.0	564.617841	Complied
0	16264.619751	15700.0	564.619751	Complied
10	16264.665172	15700.0	564.665172	Complied
20	16264.624453	15700.0	564.624453	Complied
30	16264.672115	15700.0	564.672115	Complied
40	16264.635988	15700.0	564.635988	Complied
50	16264.620695	15700.0	564.620695	Complied

Results: Top Channel

Temperature (°C)	Measured Frequency F_H (MHz)	Upper Band Edge (MHz)	Margin (MHz)	Result
-30	17115.991462	17700.0	584.008538	Complied
-20	17115.975404	17700.0	584.024506	Complied
-10	17115.974766	17700.0	584.025234	Complied
0	17115.977062	17700.0	584.022938	Complied
10	17115.977626	17700.0	584.022374	Complied
20	17115.776241	17700.0	584.223759	Complied
30	17115.825623	17700.0	584.174377	Complied
40	17115.788145	17700.0	584.211855	Complied
50	17115.695170	17700.0	584.304830	Complied

Transmitter Frequency Stability (Temperature Variation) (continued)**Results:**

Temperature (°C)	$((F_L + F_H) / 2)$ (MHz)	Frequency Delta from Frequency at 20°C (MHz)	Frequency Delta from Ambient (ppm)	Limit (ppm)	Margin (ppm)	Result
-30	16690.286023	0.085676	5.13	50.00	44.87	Complied
-20	16690.277554	0.077207	4.63	50.00	45.37	Complied
-10	16690.296304	0.095957	5.75	50.00	44.25	Complied
0	16690.298407	0.098060	5.88	50.00	44.12	Complied
10	16690.321399	0.121052	7.25	50.00	42.75	Complied
20	16690.200347	Reference	0.00	50.00	50.00	Complied
30	16690.248869	0.048522	2.91	50.00	47.09	Complied
40	16690.212067	0.011720	0.70	50.00	49.30	Complied
50	16690.157933	0.042414	2.54	50.00	47.46	Complied

Note(s):

1. The frequency was measured at the spurious emission limit (-13 dBm) closest to the respective authorised band edges while the EUT was transmitting on either the bottom or top channel. The measurement was made using a spectrum analyser with a 100 kHz measurement bandwidth. A frequency counter marker was placed on the point where the carrier intersected the -13 dBm line. These frequencies were recorded as F_L and F_H in the above tables.
2. In order to obtain an absolute frequency for comparison with the 50 parts per million (ppm) customer declared limit; the average value of $F_L + F_H$ was calculated at each temperature step. The calculated average frequency at +20°C was used as a reference point and the average frequencies at each temperature step compared to this to obtain a delta frequency and delta in ppm. The delta in ppm was compared to the 50 ppm limit to obtain the margin.
3. Measurements were performed on the bottom and top frequencies supported by the Main Unit.
4. Voltage was monitored by a calibrated voltmeter.
5. Temperature within the test chamber was monitored by a calibrated digital thermometer.
6. The EUT was switched off for a minimum period of one hour between each stage of testing after the temperature within the test chamber had stabilised at the required temperature.

5.2.7. Transmitter Frequency Stability (Voltage Variation)**Test Summary:**

FCC Part:	CFR47 2.1055(d)(1)
Test Method:	CFR47 Part 2.1055(b)

Environmental Conditions:

Temperature (°C):	24
Relative Humidity (%):	23

Results: Bottom Channel

Supply Voltage (VDC)	Measured Frequency F_L (MHz)	Lower Band Edge (MHz)	Margin (MHz)	Result
13.6	16264.624459	15700.0	564.624459	Complied
16.0	16264.624453	15700.0	564.624453	Complied
18.4	16264.624171	15700.0	564.624171	Complied

Results: Top Channel

Supply Voltage (VDC)	Measured Frequency F_H (MHz)	Upper Band Edge (MHz)	Margin (MHz)	Result
13.6	17115.777592	17700.0	584.222408	Complied
16.0	17115.776241	17700.0	584.223759	Complied
18.4	17115.777012	17700.0	584.222988	Complied

Transmitter Frequency Stability (Voltage Variation) (continued)**Results:**

Supply Voltage (VDC)	$((F_L + F_H) / 2)$ (MHz)	Frequency Delta from Frequency at Nominal Voltage (MHz)	Frequency Delta from Nominal (ppm)	Limit (ppm)	Margin (ppm)	Result
13.6	16690.201026	0.000679	0.04	50.00	49.96	Complied
16.0	16690.200347	Reference	0.00	50.00	50.00	Complied
18.4	16690.200592	0.000245	0.01	50.00	49.99	Complied

Note(s):

1. The frequency was measured at the spurious emission limit (-13 dBm) closest to the respective authorised band edges while the EUT was transmitting on either the bottom or top channel. The measurement was made using a spectrum analyser with a 100 kHz measurement bandwidth. A frequency counter marker was placed on the point where the carrier intersected the -13 dBm line. These frequencies were recorded as F_L and F_H the above tables.
2. In order to obtain an absolute frequency for comparison with the 50 parts per million (ppm) customer declared limit; the average value of $F_L + F_H$ was calculated at each voltage step. The calculated average frequency at nominal voltage was used as a reference point and the average frequencies at each voltage step compared to this to obtain a delta frequency and delta in ppm. The delta in ppm was compared to the 50 ppm limit to obtain the margin.
3. Measurements were performed on the bottom and top frequencies supported by the Main Unit.
4. Voltage was monitored by a calibrated voltmeter.
5. Temperature within the test chamber was monitored by a calibrated digital thermometer.

6. Measurement Uncertainty

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.

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

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

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
Radiated Spurious Emissions	30 MHz to 1000 MHz	95%	±5.26 dB
Radiated Spurious Emissions	1 GHz to 86 GHz	95%	±2.94 dB
Conducted Spurious Emissions	30 MHz to 1000 MHz	95%	±2.62 dB
Conducted Spurious Emissions	1 GHz to 86 GHz	95%	±2.62 dB
RF Power Output	16.2 GHz to 17.2 GHz	95%	±2.94 dB
Occupied Bandwidth	16.2 GHz to 17.2 GHz	95%	±0.12%
Frequency Stability	16.2 GHz to 17.2 GHz	95%	±11.37 ppm

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.

Appendix 1. Test Equipment Used

RFI No.	Instrument	Manufacturer	Type No.	Serial No.	Date Last Calibrated	Cal. Interval (Months)
A1033	Harmonic Mixer	Hewlett Packard	11970W	2521A01380	09 Jun 2009	12
A1242	Waveguide Horn Antenna	Dorado International corp.	12-GH-12-2	0002	Verified before use*	-
A1245	Waveguide Horn Antenna	Dorado International corp.	GH-10-25	200010	Verified before use*	-
A1391	Attenuator	Huber + Suhner AG	757987	6810.17.B	Calibrated before use	-
A1393	Attenuator	Huber + Suhner AG	757456	6820.17.B	Calibrated before use	-
A1534	Pre Amplifier	Hewlett Packard	8449B OPT H02	3008A00405	Calibrated before use	-
A1738	Attenuator	Atlantic Microwave	BBS40-10	R1379	Calibrated before use	-
A1818	Antenna	EMCO	3115	00075692	27 Nov 2009	12
A1916	Waveguide Horn Antenna	Flann Microwave Ltd	25240-25	166399	Verified before use*	-
A203	Waveguide Horn Antenna	Flann Microwave Ltd	22240-20	343	Verified before use*	-
A288	Antenna	Chase	CBL6111A	1589	16 Mar 2010	12
A390	Attenuator	Huber + Suhner AG	6830.17.B	None	Calibrated before use	-
A436	Waveguide Horn Antenna	Flann Microwave Ltd	20240-20	330	Verified before use*	-
E0518	Environmental Chamber	TAS	LTCL 1200	24000107	Calibration not required	-
G085	Signal Generator	Hewlett Packard	83650L	3614A00104	27 Oct 2008	24
K0002	3m RSE Chamber	Rainford EMC	N/A	N/A	01 Sep 2009	12
K005	Microwave Test Lab	RFI Global Services	N/A	N/A	26 Aug 2009	12
M1124	Spectrum Analyser	Rohde & Schwarz	ESIB26	100046K	09 Mar 2009	13
M1249	Thermometer	Fluke	52II	88800049	01 Jul 2009	12
M1253	Spectrum Analyser	Hewlett Packard	8564E	3442A00262	26 Jan 2010	12
M1267	Power Sensor	Rohde & Schwarz	NRV-Z52	100155	14 May 2009	12
M1273	Test Receiver	Rhode & Schwarz	ESIB 26	100275	01 Apr 2009	12
M1346	Digital Multimeter	Fluke	73III	90770264	19 Jun 2009	12
M194	Harmonic Mixer	Hewlett Packard	11970V	2521A01005	30 Jun 2009	12
M199	Power Meter	Rohde & Schwarz	NRVS	827023/075	14 May 2009	12

Note that assets A288 and M1124 indicate they went out of calibration during testing. It shall be noted however that these assets were in calibration for the tests for which they were used.

* The physical dimensions of the horn aperture have been verified.

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