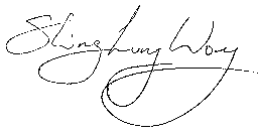
TEST REPORT
FROM
RADIO FREQUENCY
INVESTIGATION LTD.

Test Of: PipeHawk plc.
Ground Probing Radar

To: FCC Part 15: 2002,
Section 15.509

Test Report Serial No:
RFI/MPTB3/RP45398JD01A

Supersedes Test Report Serial No:
RFI/MPTB1/RP44292JD04A,
RFI/MPTB2/RP44292JD04A and
RFI/MPTB1/RP45398JD01A

This Test Report Is Issued Under The Authority Of Richard Jacklin, Operations Director: 	**Checked By: Alan McHale** 
Tested By: 	**Release Version No: PDF01**
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Test Of: PipeHawk plc.
Ground Probing Radar
To: FCC Part 15: 2002, Section 15.509

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1. Client Information

Company Name:	PipeHawk plc
Address:	Systems House Mill Lane Alton Hampshire GU34 2QG United Kingdom
Contact Name:	Dr. R Chignell

2. Equipment Under Test (EUT)

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

2.1. Identification Of Equipment Under Test (EUT)

Brand Name:	PipeHawk
Model Name or Number:	PipeHawk
Unique Type Identification:	None stated
Serial Number:	101023039
FCC ID Number:	RBT99061003
Country of Manufacture:	UK
Date of Receipt:	10 April 2003 and 17 September 2003

Brand Name:	PipeHawk
Model Name or Number:	Co-Polar Antenna
Unique Type Identification:	None stated
Serial Number:	101023186
Country of Manufacture:	UK
Date of Receipt:	10 April 2003 and 17 September 2003

Brand Name:	PipeHawk
Model Name or Number:	Cross-Polar Antenna
Unique Type Identification:	None stated
Serial Number:	101023123
Country of Manufacture:	UK
Date of Receipt:	10 April 2003 and 17 September 2003

2.2. Description Of EUT

The equipment under test is a ground probing radar that radiates downwards to detect and map the position of buried pipes and cables. It radiates a pulse, which is only normally triggered by the forward motion of the devices; the operator pushes it forwards or backwards. The device is offered with two antennas. Both types have a dedicated pulse generator acting as the transmitter. The Co-Polar Antenna provides greater depth penetration into the ground. The Cross-Polar design provides greater resolution at shallower depths.

2.3. Modifications Incorporated In EUT

The EUT has not been modified.

2.4. Additional Information Related To Testing

Power Supply Requirement:	Internal battery supply of 24 V	
Intended Operating Environment:	Residential, Commercial	
Equipment Category:	Mobile	
Type of Unit:	Ground Probing Radar	
Weight:	Approx 15 kg	
Dimensions:	1014 x 1796 x 575 mm Handle Extended	
Interface Ports:	None	
Transmit Frequency Range	120 MHz to 960 MHz (Broadband)	
Occupied Bandwidth	**Co-Polar:**	579.8 MHz
	Cross-Polar:	578.8 MHz

2.5. Support Equipment

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

Description:	Battery Charger (used to charge batteries between tests)
Brand Name:	PipeHawk
Model Name or Number:	97091000
Serial Number:	101023492
Cable Length And Type:	Twin core, approx. 1.5 m
Connected to Port:	Input terminal of battery when not in use

3. Test Specification, Methods And Procedures

3.1. Test Specification

Reference:	FCC Part 15: 2002 (Section 15.509)
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 verification.

3.2. Methods And Procedures

The methods and procedures used were as detailed in:

ANSI/TIA-603-B-2002
Land Mobile Communications Equipment, Measurements and performance Standards.

ANSI C63.2 (1996)
Title: American National Standard for Instrumentation - Electromagnetic noise and field strength.

ANSI C63.4 (2001)
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 (1998)
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.

Appendix F of the UWB First Report and Order (FCC 02-48 February 2002).

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.

4. Deviations From The Test Specification

None

5. Operation Of The EUT During Testing

5.1. Operating Conditions

The EUT was tested in a normal laboratory environment.

5.2. Operating Modes

The EUT was tested in Transceive and Standby modes.

5.3. Configuration And Peripherals

The EUT was configured with two different antennas, Co-Polar and Cross-Polar in Transceive mode.

6. Summary Of Test Results

6.1. Conducted Emissions

Range Of Measurements	Specification Reference	Port Type	Compliancy Status
Transmitter Radiated Emissions	C.F.R. 47 FCC Part 15: 2002 Section 15.209(a), 15.509(d)	Enclosure	Complied
Receiver Radiated Emissions	C.F.R. 47 FCC Part 15: 2002 Section 15.109	Enclosure	Complied
Transmitter Ultra Wide Bandwidth (UWB)	C.F.R. 47 FCC Part 15: 2002 Section 15.509(a)	Enclosure	Complied
Transmitter Radiated Emissions (EIRP)	C.F.R. 47 FCC Part 15: 2002 Section 15.509(d)	Enclosure	Complied
Transmitter Radiated Emissions (EIRP)	C.F.R. 47 FCC Part 15: 2002 Section 15.509(e)	Enclosure	Complied
Transmitter Maximum Peak Output Power	C.F.R. 47 FCC Part 15: 2002 Section 15.509(f)	Enclosure	For Information Only

6.2. Location Of Tests

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

7. Measurements, Examinations And Derived Results

7.1. General Comments

7.1.1. This section contains test results only. Details of the test methods and procedures can be found in Appendix 2 of this report.

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.

7.2. Radiated Emissions: Co-Polar Antenna – FCC Part 15: Section 15.209, Section 15.509(d) Transceive Mode

7.2.1.Electric Field Strength Measurements (Frequency Range: 30 to 960 MHz)

7.2.1.1. Plots of the initial scans can be found in Appendix 4.

7.2.1.2. The EUT was configured as for radiated field strength emissions testing as described in Section 2 of this report.

7.2.1.3. The following table lists frequencies at which emissions were measured using a Quasi-Peak detector, at a test measurement distance of 3 meters:

Frequency (MHz)	Ant. Pol.	Q-P Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
48.415	Vert.	34.81	40.00	5.19	Complied
69.976	Vert.	38.33	40.00	1.67	Complied
93.904	Vert.	29.50	43.50	14.00	Complied
109.977	Vert.	39.15	43.50	4.35	Complied
149.977	Vert.	39.59	43.50	3.91	Complied
163.419	Vert.	38.68	43.50	4.82	Complied
208.404	Vert.	37.02	43.50	6.48	Complied
288.107	Vert.	36.03	46.00	9.97	Complied
331.852	Vert.	35.54	46.00	10.46	Complied
379.974	Vert.	34.61	46.00	11.39	Complied
585.599	Vert.	43.46	46.00	2.54	Complied
767.792	Vert.	36.37	46.00	9.63	Complied

Note: The wrong dates were shown some of the plots due to the analyser being preset to default. These dates have been corrected manually to indicate the correct date.

7.3. Radiated Emissions: Cross-Polar Antenna – FCC Part 15: 2002 Section 15.209, Section 15.509(d) Transceive Mode

7.3.1.Electric Field Strength Measurements (Frequency Range: 30 to 960 MHz)

7.3.1.1. Plots of the initial scans can be found in Appendix 4.

7.3.1.2. The EUT was configured as for radiated field strength emissions testing as described in Section 2 of this report.

7.3.1.3. The following table lists frequencies at which emissions were measured using a Quasi-Peak detector, at a test measurement distance of 3 meters:

Frequency (MHz)	Ant. Pol.	Q-P Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
47.490	Vert.	32.54	40.000	7.46	Complied
85.892	Vert.	38.40	40.000	1.60	Complied
94.275	Vert.	37.47	43.500	6.03	Complied
99.999	Vert.	39.05	43.500	4.45	Complied
109.987	Vert.	41.92	43.500	1.58	Complied
114.524	Vert.	42.08	43.500	1.42	Complied
128.877	Vert.	41.36	43.500	2.14	Complied
140.385	Vert.	33.82	43.500	9.68	Complied
186.538	Horiz.	36.53	43.500	6.97	Complied
199.977	Horiz.	35.15	43.500	8.35	Complied
209.196	Horiz.	41.95	43.500	1.55	Complied
237.339	Horiz.	43.10	46.000	2.90	Complied
320.758	Horiz.	39.11	46.000	6.89	Complied
357.946	Vert.	36.51	46.000	9.49	Complied
399.976	Horiz.	36.27	46.000	9.73	Complied
563.103	Horiz.	36.64	46.000	9.36	Complied

Note: The wrong dates were shown some of the plots due to the analyser being preset to default. These dates have been corrected manually to indicate the correct date.

7.4. Radiated Emissions: – FCC Part 15: 2002 Section 15.109 Standby Mode

7.4.1. Electric Field Strength Measurements (Frequency Range: 30 to 1000 MHz)

7.4.1.1. Plots of the initial preliminary exploratory scans can be found in Appendix 4.

7.4.1.2. The EUT was configured as for radiated field strength emissions testing as described in Section 2 of this report.

7.4.1.3. The following table lists frequencies at which emissions were measured using a Quasi-Peak detector:

Frequency (MHz)	Ant. Pol.	Q-P Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
48.092	Vert.	19.300	39.000	19.700	Complied
55.304	Vert.	24.500	39.000	14.500	Complied
62.814	Vert.	18.500	39.000	20.500	Complied
70.000	Vert.	27.400	39.000	11.600	Complied
84.220	Vert.	22.400	39.000	16.600	Complied
100.231	Vert.	24.200	39.000	14.800	Complied
108.908	Vert.	27.300	43.500	16.200	Complied
114.063	Vert.	25.500	43.500	18.000	Complied
126.876	Vert.	25.300	43.500	18.200	Complied
142.345	Vert.	26.400	43.500	17.100	Complied
150.470	Vert.	28.200	43.500	15.300	Complied
161.720	Vert.	30.400	43.500	13.100	Complied
175.312	Vert.	32.400	43.500	11.100	Complied
212.344	Vert.	27.100	43.500	16.400	Complied
283.126	Vert.	35.900	46.400	10.500	Complied
288.437	Vert.	40.700	46.400	5.700	Complied
522.499	Vert.	38.700	46.400	7.700	Complied
547.812	Vert.	39.300	46.400	7.100	Complied
788.748	Vert.	31.600	46.400	14.800	Complied
949.529	Vert.	34.100	46.400	12.300	Complied
971.873	Vert.	29.300	49.600	20.300	Complied

7.5.Transmitter Ultra Wide Bandwidth (UWB): Section 15.509(a)

7.5.1. The EUT was configured as for Ultra Wide Bandwidth measurements as described in Appendix 2 of this report.

7.5.2. Tests were performed to identify the maximum bandwidth occupied by the fundamental frequency of the EUT.

The maximum level f(m) were offset to 0dBm (therefore the maximum level does not indicated the true value of the radiated emission) in this case with both f(l) and f(h) taken when their level reaches -10dB.

For Cross-Polar:

f(m) = 508.57 MHz; f(l) = 128.83MHz; f(h) = 707.63MHz.

For Co-Polar:

f(m) = 348.47 MHz; f(l) = 184.24MHz; f(h) = 764.04MHz.

Those emissions that are within 10dB of the peak but not taken into account were spurious emissions and not intended emission of the EUT.

Results:

Antenna	Resolution Bandwidth (kHz)	Video Bandwidth (kHz)	Occupied Bandwidth (MHz)	Occupied Bandwidth Limit (MHz)	Result
Co-Polar	118.8	300	579.8	10600	Complied
Cross-Polar	118.8	300	578.8	10600	Complied

7.6. Transmitter Radiated Emissions: Co-Polar Antenna Section 15.509(d)

7.6.1. EIRP Measurements (above 1 GHz)

7.6.1.1. Plots of the initial scans can be found in Appendix 4.

7.6.1.2. The EUT was configured as for radiated emissions testing as described in Section 2 of this report.

7.6.1.3. The following tables list frequencies at which emissions were measured using average detector functions:

7.6.1.4. All measurements were performed at 3 metres distance from the EUT.

Average Level:

Frequency (MHz)	Antenna Polarity (H/V)	Average Detector Level (dBuV/m)	Antenna Factor (dB)	Cable Loss (dB)	Actual Average level (dBm)	Average Limit (dBm)	Average Margin (dB)	Result
1090.30	Horiz.	-1.1	21.8	6.5	-68.0	-65.3	2.7	Complied
1630.00	Horiz.	2.7	20.9	7.8	-63.8	-53.3	10.5	Complied
1995.00	Horiz.	0.0	21.6	8.7	-64.9	-51.3	13.6	Complied

Notes:

A conversion factor of 95.2 dB was applied to derive the actual average power level in EIRP.

The wrong dates were shown some of the plots due to the analyser had been preset to default. These dates were then corrected manually by hand to indicate the correct date.

7.7. Transmitter Radiated Emissions: Cross-Polar Antenna Section 15.509(d)

7.7.1. EIRP Measurements (above 1 GHz)

7.7.1.1. Plots of the initial scans can be found in Appendix 4.

7.7.1.2. The following tables list frequencies at which emissions were measured using average detector functions:

7.7.1.3. All measurements were performed at 3 metres distance from the EUT.

Average Level:

Frequency (MHz)	Antenna Polarity (H/V)	Average Detector Level (dBuV/m)	Antenna Factor (dB)	Cable Loss (dB)	Actual Average level (dBm)	Average Limit (dBm)	Average Margin (dB)	Result
1090.30	Horiz.	-0.8	21.8	6.5	-67.7	-65.3	2.4	Complied
1630.00	Horiz.	2.9	20.9	7.8	-63.6	-53.3	10.3	Complied
1995.00	Horiz.	0.1	21.6	8.7	-64.8	-51.3	13.5	Complied

Notes:

A conversion factor of 95.2 dB was applied to derive the actual average power level in EIRP.

The wrong dates were shown some of the plots due to the analyser had been preset to default. These dates were then corrected manually by hand to indicate the correct date.

7.8. Transmitter Radiated Emissions: Co-Polar Antenna Section 15.509(e)

7.8.1. EIRP Measurements (above 1 GHz)

7.8.1.1. Plots of the initial scans can be found in Appendix 4.

7.8.1.2. The following tables list frequencies at which emissions were measured using average detector functions incorporated within the measurement receiver.

7.8.1.3. All measurements were performed at 3 metres distance from the EUT.

Average Level:

Frequency (MHz)	Antenna Polarity (H/V)	Average Detector Level (dBuV/m)	Antenna Factor (dB)	Cable Loss (dB)	Actual Average level (dBm)	Average Limit (dBm)	Average Margin (dB)	Result
1202.00	Horiz.	-20.2	20.8	6.7	-87.9	-75.3	12.6	Complied
1585.00	Horiz.	-18.1	20.9	7.8	-84.6	-75.3	9.3	Complied

Notes:

A conversion factor of 95.2 dB was applied to derive the actual average power level in EIRP.

The wrong dates were shown some of the plots due to the analyser had been preset to default. These dates were then corrected manually by hand to indicate the correct date.

7.9. Transmitter Radiated Emissions: Cross-Polar Antenna Section 15.509(e)

7.9.1. EIRP Measurements (above 1 GHz)

7.9.1.1. Plots of the initial scans can be found in Appendix 4.

7.9.1.2. The following tables list frequencies at which emissions were measured using average detector functions:

7.9.1.3. All measurements were performed at 3 metres distance from the EUT.

Average Level:

Frequency (MHz)	Antenna Polarity (H/V)	Average Detector Level (dBuV/m)	Antenna Factor (dB)	Cable Loss (dB)	Actual Average level (dBm)	Average Limit (dBm)	Average Margin (dB)	Result
1202.00	Horiz.	-20.2	20.8	6.7	-87.9	-75.3	12.6	Complied
1585.00	Horiz.	-18.1	20.9	7.8	-84.6	-75.3	9.3	Complied

Note: A conversion factor of 95.2 dB was applied to derive the actual average power level in EIRP.

7.10. Transmitter Output Power (dBμV/m): Section 15.509(f)

7.10.1. Tests were performed to identify the maximum transmit power in accordance with FCC Part 15.509(f).

7.10.2. Part 15.509(f) states a unit of measurement of dBm however, 15.521(g) indicates a field strength is acceptable if converted using a correction factor of 95.2 dB.

7.10.3. The measurement was made in a 1MHz measurement bandwidth with the limit of 0 dBm being corrected using 20log(1MHz/50MHz) as described in 15.521(g). This figure was further corrected for field strength by adding 95.2 dB.

7.10.4. All measurements were performed at 3 metres distance from the EUT.

Results

Antenna	Measured Frequency (MHz)	Peak Detector level (dBμV)	Antenna factor (dB)	Cable loss (dB)	Maximum Transmitter (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Result
Co-Polar	348.47	37.88	15.7	3.7	57.28	61.22	3.94	Complied
Cross-Polar	508.57	35.52	17.9	4.4	57.82	61.22	3.4	Complied

Notes:

These emission limits have been converted into dBμV/m in accordance with Section 15.521(d).

These results are included for information only since the limit does not apply to UWB devices where the highest radiated emissions are below 960 MHz.

8. Measurement Uncertainty

8.1. 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.

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

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

8.4. 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
Effective Isotropic Radiated Power (EIRP)	1 GHz to 15 GHz	95%	+/- 1.78 dB
Ultra Wide Bandwidth	Not applicable	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

8.5. 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.

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
A072	Adjustable Dipole Antenna Set	EMCO	3121C	9004-552
A1071	Double Ridged Guide Antenna	EMCO	3115	9811-5625
A197	Site 2 Controller SC144	Unknown	SC144	150720
A288	Bilog Antenna	Chase	CBL6111A	1589
C1080	Rosenberger Cable 3m	Rosenberger	FA210A1030M5050	28464-1
C1081	Rosenberger Cable 2m	Rosenberger	FA210A1020M5050	28463-2
C344	Cable	Rosenberger	UFA210A-1-1181-70x70	1934
G013	SMHU Signal Generator	Rohde & Schwarz	SMHU	894 055/003
M088	Receiver / Spectrum Analyser System	Rohde & Schwarz	ESBI	DU:835862/018 RU:835387/006
M1095	10V Insertion Unit 50 Ohm	Rohde & Schwarz	URY-Z2	891 493/23
M141	Power Meter	Boonton	4220	33402BE
M150	Power Sensor	Boonton	51072	28473
S202	Site 2	RFI	2	S202-15011990
S205	Site 5	RFI	5	

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

Appendix 2. Measurement Methods

Radiated Field Strength 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 in the form of swept scans were performed in a shielded enclosure in order to identify frequencies on which the EUT was generating interference. This determined the frequencies from the EUT that 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. 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 distance of 3 m or 10 m. Following the initial scans, graphs were produced giving an overview of the emissions from the EUT plotted against the appropriate specification limit. Any emission within 20 dB of the limit were then measured on the open area test site, except in cases where the noise floor was within 20 dB of the limit, in these cases the emission between the noise floor and the limit line or the highest point of the noise floor was measured. The levels on the graphs are corrected by taking into account the cable loss and antenna factors, having been programmed into the spectrum analyser.

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 and Peak detector for measurements above 1000 MHz.

On the open area test site, at each signal frequency 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. Final measurements for transmit mode were performed with the EUT situated above 20 inches of dry sand, as described in Appendix F of the UWB First Report and Order, FCC 02-48. In this case the EUT was rotated through 360° at 45° intervals.

For frequencies below 1000 MHz the test antenna was varied in height between 1 m and 4 m in order to 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 to the EUT. At this point the horn was locked off and the turntable was again rotated through 360° to maximise the target signal. It should be noted that the received 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 the horns.

At this point, any signals 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. Final measurements were performed on the worst-case configuration according to Part 15.31(i).

The procedure was repeated for both vertical and horizontal antenna polarisation.

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

Transmitter Radiated Emissions

Radiated emissions measurements were performed in accordance with the standard, against appropriate limits and measurement bandwidths for each detector function as stated in 15.509(d) and (e).

Initial pre-scans covering the entire measurement band from the lowest generated frequency declared up to 10 times the highest fundamental frequency. The scans were performed within a screened chamber in order to identify frequencies on which the EUT was generating spurious. This procedure identified the frequencies from the EUT which required further examination. Repetitive scans were performed to allow for emissions with low repetition rates, and for the duty cycle of the EUT.

The initial scans were performed using an antenna height of 1.5 m and a measurement distance of 3 m. A limit line was set to the specification limit by characterising the screen room using a known signal source set at exactly the same location as the EUT. The signal source was derived from either a horn antenna or a dipole dependant on the frequency band under investigation. Any levels within 20 dB of this limit were measured where possible, on occasion; the receiver noise floor came within the 20 dB boundary. On these occasions, the system noise floor may have been recorded. The levels on the graphs are corrected by taking into account the cable loss and antenna factors, having been programmed into the spectrum analyser.

An open area test site using the appropriate test distance and measuring receiver with a Peak detector was used for final measurements at each frequency recorded in the screen room.

The final measurements were performed with EUT situated above 20 inches of dry sand, as described in Appendix F of the UWB First Report and Order, FCC 02-48.

The levels were maximised by initially rotating the EUT through 360° at 45° intervals and then varying the antenna height between 1 m and 4 m in the vertical polarisation. At this point, any signals 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. The procedure was repeated for the horizontal polarisation.

Once the final amplitude (maximised) had been obtained in dBμV/m, field strength levels was then derived by adding the appropriate antenna factor and cable loss. The EIRP in terms of dBm are then converted from field strength levels by subtracting the conversion factor of 95.2 dB.

Transmitter Radiated Emissions (Continued)

Any spurious measured were then compared to the limit to the relevant limits as stated in 15.509(d) and (e). The margin between emission and limit is recorded and should always be positive to indicate compliance.

Receiver Function	Initial Scan	Final Measurements Below or at 960 MHz	Final Measurements Above 960 MHz
Detector Type:	Peak	Quasi-Peak (CISPR)	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

Ultra Wide Bandwidth FCC 15.509(a)

The Ultra Wide Bandwidth was measured using a peak detector with the appropriate receiver bandwidth for the frequencies under investigation. As the displayed bandwidth fell below 1 GHz, a CISPR bandwidth of 120 kHz was used. A limit line was set 10 dB down on the carrier. The Ultra Wide Bandwidth was found by subtracting the lower frequency where the power envelope intersected the display line from the upper frequency from where the power envelope intersected the display line.

The measurement levels the graphs are corrected by taking into account the cable loss and antenna factors, having been programmed into the spectrum analyser.

Test Of: **PipeHawk plc.**
Ground Probing Radar
To: **FCC Part 15: 2002, Section 15.509**

Peak Output Power FCC 15.509(f)

This test was performed to identify the maximum peak output power of the EUT.

The measurement was performed as a field strength measurement, however, Part 15.509(f) states a unit of measurement of dBm, thus, the correction factor of 95.2 dB described in 15.521(g) was used.

The measurement was made using a peak detector in a 1MHz measurement bandwidth at a distance of 3 meter from the EUT with the limit of 0dBm being corrected using 20log(1 MHz/50 MHz) as described in 15.521(g). This figure was further corrected for field strength by adding 95.2 dB.

All measurements were performed with EUT situated above 20 inches of dry sand, as describe in Appendix F of the UWB First Report and Order, FCC 02-48.

The levels were maximised by initially rotating the EUT through 360° at 45° intervals and then varying the antenna height between 1 m and 4 m in the vertical polarisation. At this point, any signals 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. The procedure was repeated for the horizontal polarisation.

Once the final amplitude (maximised) had been obtained in dBμV/m, field strength levels was then derived by adding the appropriate antenna factor and cable loss.

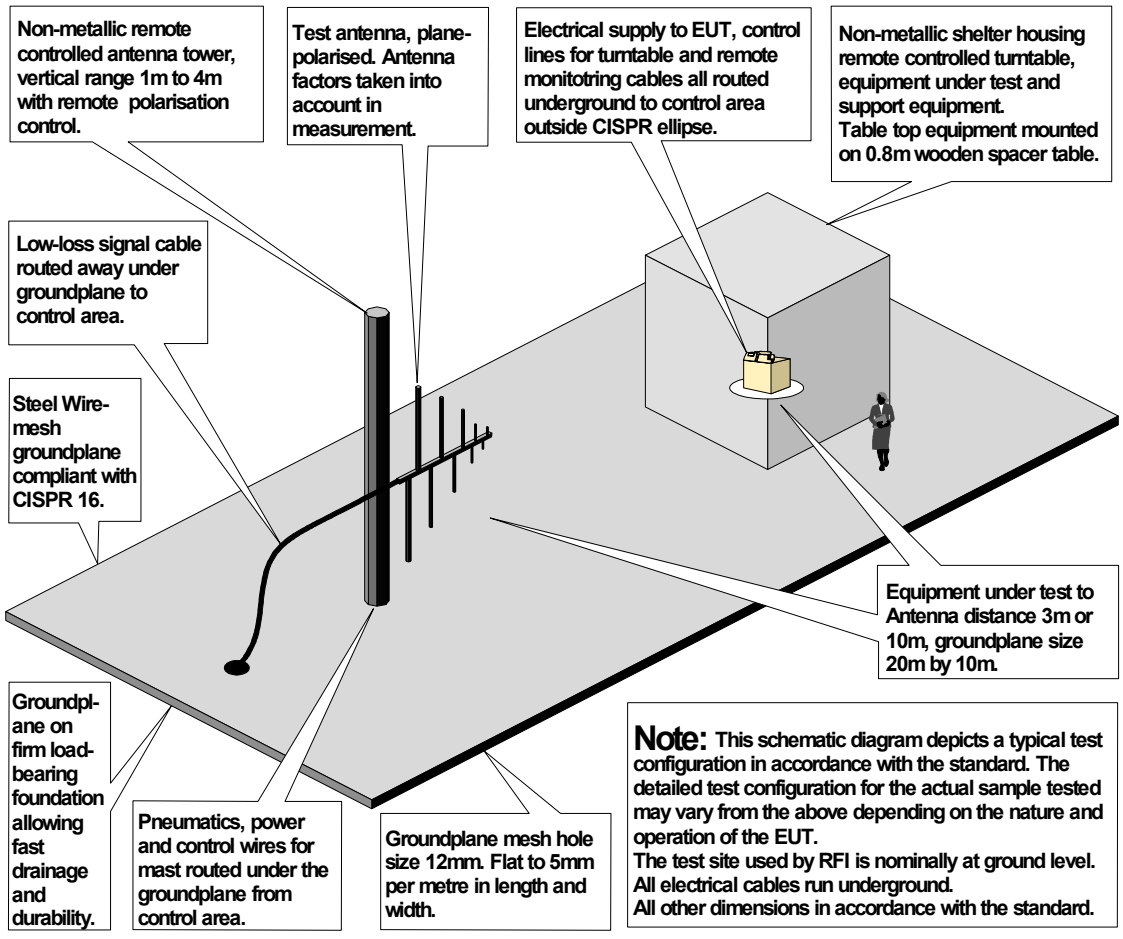
Appendix 3. Test Configuration Drawings

This appendix contains the following drawings:

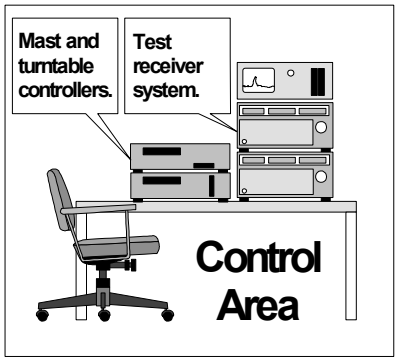
Drawing Reference Number	Title
DRG\44292JD04\EMIRAD	Test configuration for measurement of radiated emissions

Test Of: **PipeHawk plc.**
Ground Probing Radar
To: **FCC Part 15: 2002, Section 15.509**

DRG\44292JD04\EMIRAD



Test Configuration For Radiated Emissions Measurements
Reflection-free area: >60m by 52m (CISPR ellipse)
Groundplane Earthed
Control room outside CISPR ellipse



Note: All Radiated Emissions testing was performed with the EUT placed on a 20 inch thick bed of dry sand.

Appendix 4. Graphical Test Results

Please refer to Graphical Sections Part 1 and Part 2

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