TEST REPORT
FROM
RFI GLOBAL SERVICES LTD.

Test Of: Plextek Ltd
LoJack VLU5 Transceiver

To: FCC Part 90: 2003

Test Report Serial No:
RFI\MPTE2\RP46683JD01A

Supersedes Test Report Serial No:
RFI/MPTE1/RP46683JD01A

This Test Report Is Issued Under The Authority Of Andrew Brown, Operations Manager:  pp	
Tested By: Tony Henriques 	**Checked By: Nigel Davison** 
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LoJack VLU5 Transceiver
To: FCC Part 90: 2003

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1. Client Information

Company Name:	Plextek Ltd
Address:	London Road Great Chesterford CB10 1NY
Contact Name:	Mr Gerard Smith

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:	LoJack
Model Name or Number:	IDIVLU5
Serial Number:	40125
Country of Manufacture:	Malaysia
FCC ID Number:	IDIVLU5
Date of Receipt:	06 December 2004

Brand Name:	LoJack
Model Name or Number:	IDIVLU5
Serial Number:	40126
Country of Manufacture:	Malaysia
FCC ID Number:	IDIVLU5
Date of Receipt:	06 December 2004

2.2. Description of EUT

The LoJack system is implemented on a single VHF Radio channel using propriety hardware and software operating a LoJack defined protocol.

When a VLU5 equipped vehicle is reported stolen by the owner, the stolen car tracking authority enters the thief information into a central computer system. The central computer system then arranges the activation of the Vehicles Locating Unit (VLU5) by dispatching messages to a network of base stations called Remote Transceiver Unit (RTU).

Once a VLU5 has been activated, it transmits a Reply (Tracking) message repeatedly unit deactivated by the RTU. The VLU5 will transmit the reply at a rapid rate (“Tracing Mode”). The VLU5 may also report activation automatically via an uplink message.

The vehicle tracking receiver (VTU) locks on to the VLU5 signal when it is within range and gives directional information as well as an indication of distance using a signal strength.

The vehicle tracking receiver is typically used in a police mobile vehicle to track and locate the stolen vehicle.

The VLU5 is a module that monitors the RF channel for commands addressed to it. When a valid command addressed to the VLU5 is received, the unit will perform the action associated with the command.

2.3. Modifications Incorporated in EUT

During the course of testing the EUT was not modified.

2.4. Support Equipment

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

Description:	AC Coupled Nominal Modulation Bleep Box (not directly connected to EUT)
Brand Name:	Plextek
Model Name or Number:	Not Applicable
Serial Number:	Not Applicable
Cable Length And Type:	1m Coax, 1m serial communications 12 V power and ground
Connected to Port:	Support Laptop / Sig

Description:	Signal Generator (not directly connected to EUT)
Brand Name:	Marconi Instruments
Model Name or Number:	MI 2022E
Serial Number:	P285
Cable Length And Type:	Not Applicable
Connected to Port:	Not Applicable

Description:	Windows 98 Laptop (not directly connected to EUT)
Brand Name:	Toshiba Thandar Instruments
Model Name or Number:	PL32QMD
Serial Number:	P128
Cable Length And Type:	Not Applicable
Connected to Port:	Not Applicable

Description:	Bench Power Supply
Brand Name:	Thurlby Thander Instruments
Model Name or Number:	PL32QMD
Serial Number:	P128
Cable Length And Type:	Not Applicable
Connected to Port:	Not Applicable

2.5. Additional Information Related to Testing

Power Supply Requirement:	External battery supply of 12 V		
Intended Operating Environment:	Vehicular		
Equipment Category:	Transceiver		
Type of Unit:	Mobile (Vehicular Use, powered via vehicle regulated supply)		
Interface Ports:	RS232 (Not used)		
Channel Spacing	25.0 kHz		
Transmit Frequency Range	173.075 MHz, Single frequency		
Transmit Channels Tested	**Channel ID**	**Channel Number**	**Channel Frequency (MHz)**
	Not Applicable	Not Applicable	173.075
Receive Frequency Range	173.075 MHz, Single frequency		
Receive Channels Tested	**Channel ID**	**Channel Number**	**Channel Frequency (MHz)**
	Not Applicable	Not Applicable	173.075

3. Test Specification, Methods and Procedures

3.1. Test Specifications

Reference:	FCC Part 15 Subpart B: 2003 (Sections 15.109)
Title:	Code of Federal Regulations, Part 15 (47CFR215) Radio Frequency Devices
Purpose of Test:	To determine whether the equipment complied with the requirements of the specification for the purposes of verification.

Reference:	FCC Part 90: 2003 (Private Land Mobile Radio Services)
Title:	Code of Federal Regulations, Part 90 (47CFR90) Private Land Mobile Radio Services
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/TIA-603-B-2002
Title: Land Mobile FM or PM Communications Equipment. Measurement and Performance Standard.

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.

4. Deviations from the Test Specification

None.

5. Operation of the EUT During Testing

5.1. Operating Modes

The EUT was tested in the following operating modes:

Tracking (Transmit) Mode
Constant Receive Mode.

5.2. Configuration And Peripherals

The EUT was tested in the following configuration:

Standalone connected to a 12 V Car Battery.

6. Test Results

Range Of Measurements	Specification Reference	Port Type	Compliancy Status
Receiver Radiated Spurious Emissions (30 MHz to 2 GHz)	C.F.R. 47 FCC Part 15: 2003 Section 15.109	Enclosure	Complied
Transmitter Carrier Output Power (ERP)	C.F.R. 47 FCC Part 90: 2003 Sections 90.20(e)(6) TIA-603-B Section 2.2.11	Antenna	Complied
Transmitter Occupied Bandwidth (Bandwidth Limitations)	C.F.R. 47 FCC Part 90: 2003 Sections 90.209/90.20(e)(6)//2.1049	Antenna	Complied
Emissions Masks	C.F.R. 47 FCC Part 90: 2003 Sections 90.210 / 2.1047 TIA-603-B Section 2.2.12	Antenna	Complied
Transmitter Radiated Emissions (Out of Band) (30 MHz to 2 GHz)	C.F.R. 47 FCC Part 90: 2003 Sections 90.210 TIA-603-B Section 2.2.12	Antenna	Complied
Transmitter Frequency Stability (Temperature & Voltage Variation)	C.F.R. 47 FCC Part 90: 2003 Sections 90.213/2.1055 TIA-603-B Section 2.2.2	Antenna*	Complied
Transmitter Transient Frequency Behaviour	C.F.R. 47 FCC Part 90: 2003 Sections 90.214 TIA-603-B Section 2.2.19	Antenna*	Complied
Transmitter Duty Cycle	C.F.R. 47 FCC Part 90: 2003 Section 90.20(e)(6)	Antenna*	Complied

** The test was performed via a temporary 50Ω antenna connector fitted to the EUT to facilitate the measurement.*

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.

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. Receiver Radiated Spurious Emissions: Section 15.109

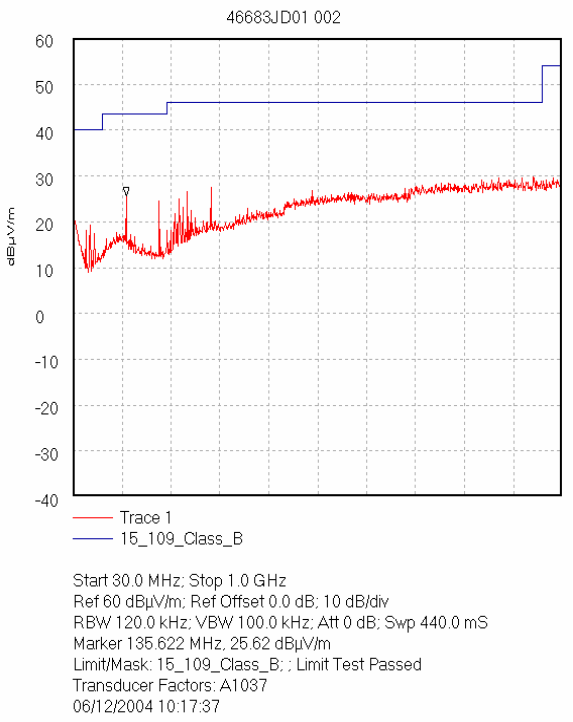
7.2.1. Electric Field Strength Measurements (Frequency Range: 30 to 1000 MHz)

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

7.2.1.2. Tests were performed to identify the maximum receiver or standby radiated emissions levels.

Results:

Frequency (MHz)	Antenna Polarity	Q-P Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
136.002	Horiz.	13.4	43.5	30.1	Complied
256.005	Horiz	15.0	46.0	31.0	Complied
303.355	Vert.	16.9	46.0	29.1	Complied



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

Receiver Radiated Emissions: Section 15.109 (Continued)

7.2.2. Electric Field Strength Measurements (Frequency Range: 1 to 2 GHz)

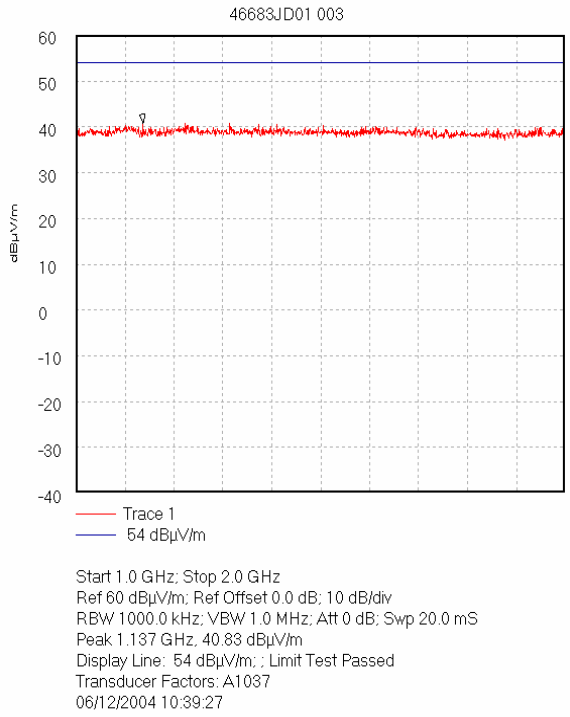
Results:

Highest Peak Level:

Frequency (GHz)	Antenna Polarity (H/V)	Peak Detector level (dBµV)	Antenna factor (dB)	Cable loss (dB)	Actual Peak Level (dBµV/m)	Average Limit (dBµV/m)	Margin (dB)	Result
1.137	Vert.	18.4	21.5	0.9	40.8	54.0	13.2	Complied

Note(s):

1. *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.*
2. *Note: The peak level was compared to the average limit as opposed to being compared to the peak limit because this is the more onerous limit.*



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

7.3. Transmitter Carrier Output Power (ERP): Sections 90.20(e)(6)

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

7.3.2. Tests were performed to identify the EUT's maximum radiated transmit power.

Results:

Frequency (MHz)	ERP (dBm)	ERP Limit (dBm)	Margin (dB)	Result
173.075	30.0	34.0	4.0	Complied

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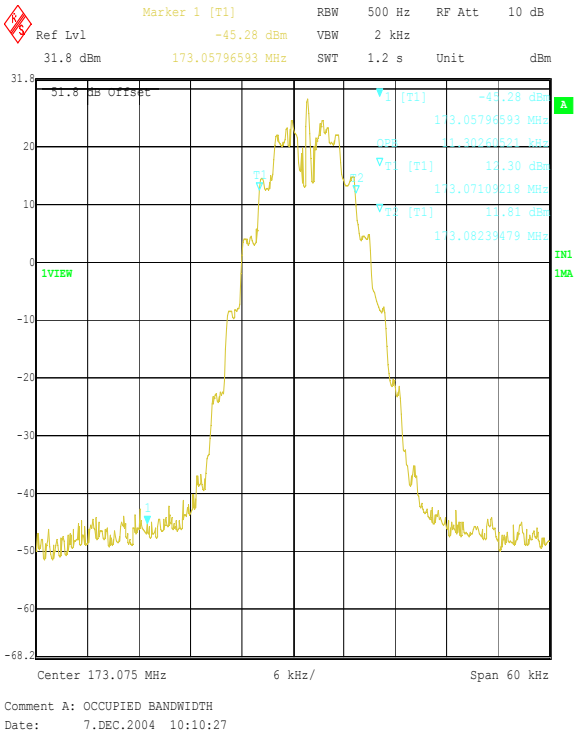
7.4. Transmitter Occupied Bandwidth (Bandwidth Limitations): Sections 90.209/90.20(e)(6)/2.1049

7.4.1. The EUT was configured as for Occupied Bandwidth measurements as described in Section 9 of this report.

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

Results:

Frequency (MHz)	RBW (Hz)	VBW (kHz)	Occupied Bandwidth (kHz)	Limit (kHz)	Margin (kHz)	Result
173.075	500	2	11.303	20.0	8.697	Complied



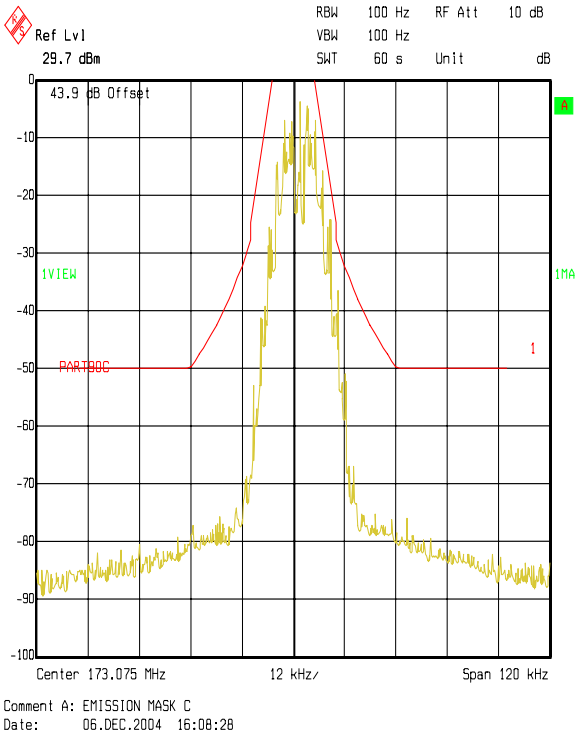
7.5. Emissions Masks: Section 90.210/2.1047

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

7.5.2. Tests were performed to determine compliance with the out of band power requirements at frequencies adjacent to the channel occupied by the fundamental frequency of the EUT.

Results:

Results are presented graphically in the following graphs. As can be seen from the plots the EUT complies with the requirements of relevant part of the regulations.



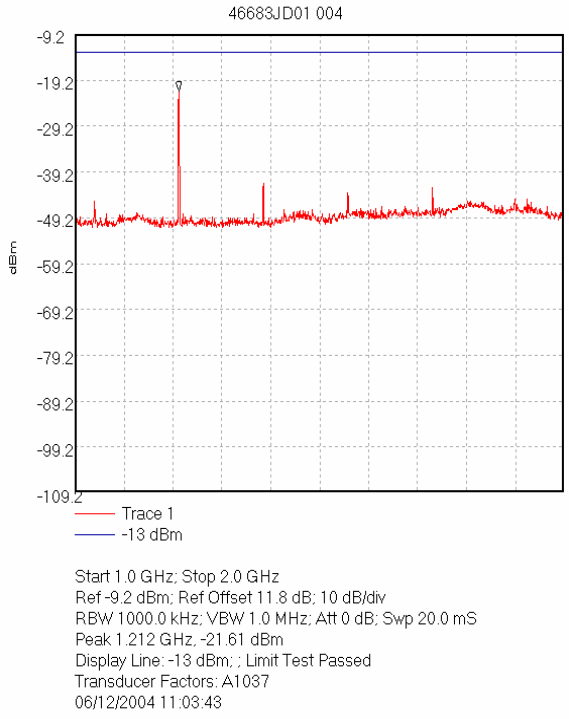
7.6. Transmitter Radiated Emissions (Out of Band): Section 90.210

7.6.1. The EUT was configured as for transmitter radiated emissions measurements as described in Section 9 of this report.

7.6.2. Tests were performed to identify the maximum transmitter radiated emissions levels.

Results:

Frequency (MHz)	Peak Emission Level (dBm)	Peak Emission Level (dBc)	Limit (dBc)	Margin (dB)	Result
346.150	-45.4	-75.4	-43.0	32.4	Complied
519.225	-61.0	-91.0	-43.0	48.0	Complied
1211.525	-42.7	-72.7	-43.0	29.7	Complied



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

7.7. Transmitter Frequency Stability (Temperature Variation): Sections 90.213/2.1055

7.7.1. The EUT was configured as for frequency stability measurements as described in Section 9 of this report.

7.7.2. Tests were performed to identify the maximum frequency error of the EUT with variations in ambient temperature.

Results: (Nominal 173.075 MHz)

Temp (°C)	Measured Frequency (MHz)	Frequency Error (Hz)	Frequency Error (ppm)	Limit (ppm)	Margin (ppm)	Result
-30	173.075844	844	4.9	50.0	45.1	Complied
-20	173.075803	803	4.6	50.0	45.4	Complied
-10	173.075515	515	3.0	50.0	47.0	Complied
0	173.075259	259	1.5	50.0	48.5	Complied
10	173.075214	214	1.2	50.0	48.8	Complied
20	173.075001	1	<0.1	50.0	>49.9	Complied
30	173.074974	-26	0.2	50.0	49.8	Complied
40	173.074962	-38	0.2	50.0	49.8	Complied
50	173.075064	64	0.4	50.0	49.6	Complied

Results: (Nominal 173.075 MHz)

Temp (°C)	Measured Frequency (MHz)	Frequency Error (Hz)	Frequency Error (ppm)	Limit (ppm)	Margin (ppm)	Result
10.2	173.074995	-5	<0.1	50.0	>49.9	Complied
12.0	173.075001	1	<0.1	50.0	>49.9	Complied
13.8	173.075001	1	<0.1	50.0	>49.9	Complied

7.8. Transmitter Transient Frequency Behaviour: Sections 90.214

7.8.1. The EUT was configured as for transient frequency behaviour measurements as described in Section 9 of this report.

7.8.2. Tests were performed to identify the EUT's transient frequency behaviour.

Results:

Time Intervals	FREQUENCY DIFFERENCE (kHz)
	Single Channel 173.075 MHz
t1	15.3
t2	< 1.0
t3	19.9

LIMITS		
Time Intervals	**Maximum frequency difference**	**Frequency Range**
		150 to 174 MHz
t1	+/-25.0 kHz	≤5.0 mS
t2	+/-12.50 kHz	≤20.0 mS
t3	+/-25.0 kHz	≤5.0 mS

Confirm that during the period from the end of t2 to the beginning of t3 the frequency difference does not exceed 5 ppm (865 Hz) of the bottom channel carrier frequency — YES

Note(s):

1. If the transmitter carrier output power rating is 6 Watts or less the frequency difference during time periods t1 and t3 may exceed the maximum frequency difference for these time periods.

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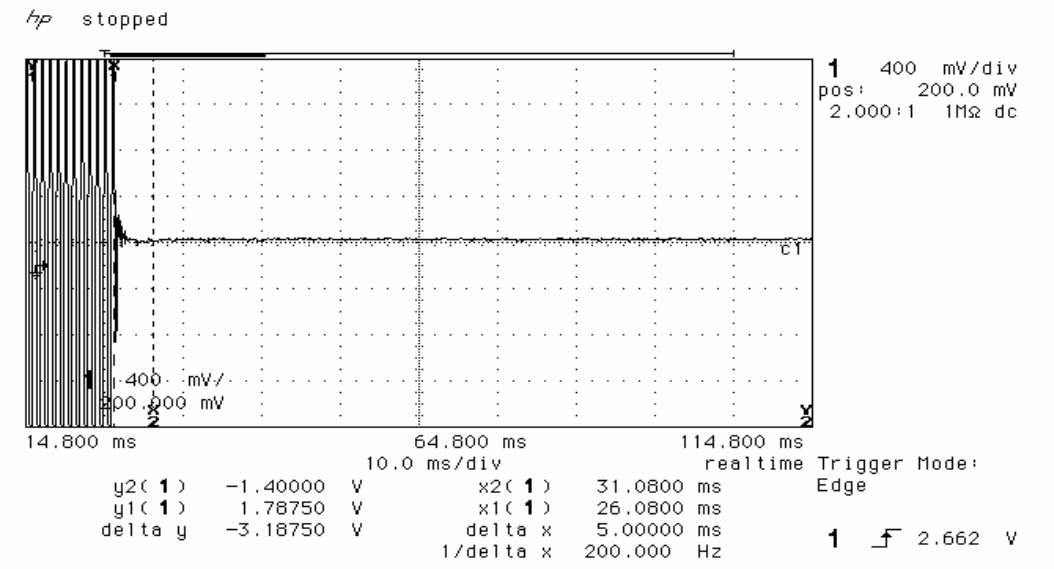
Transmitter Transient Frequency Behaviour: Sections 90.214 (Continued)



Test Of: **Plextek Ltd**
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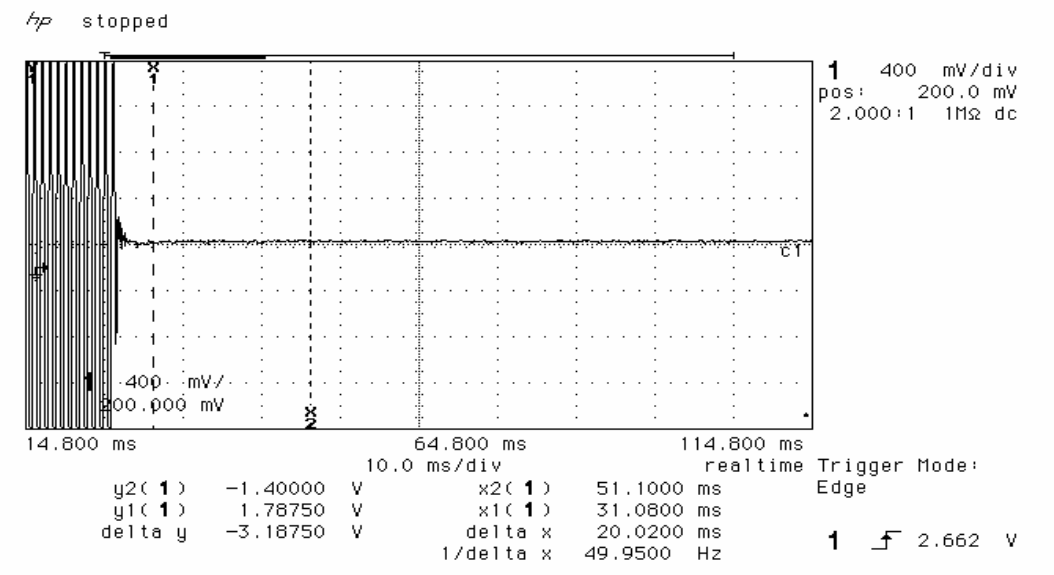
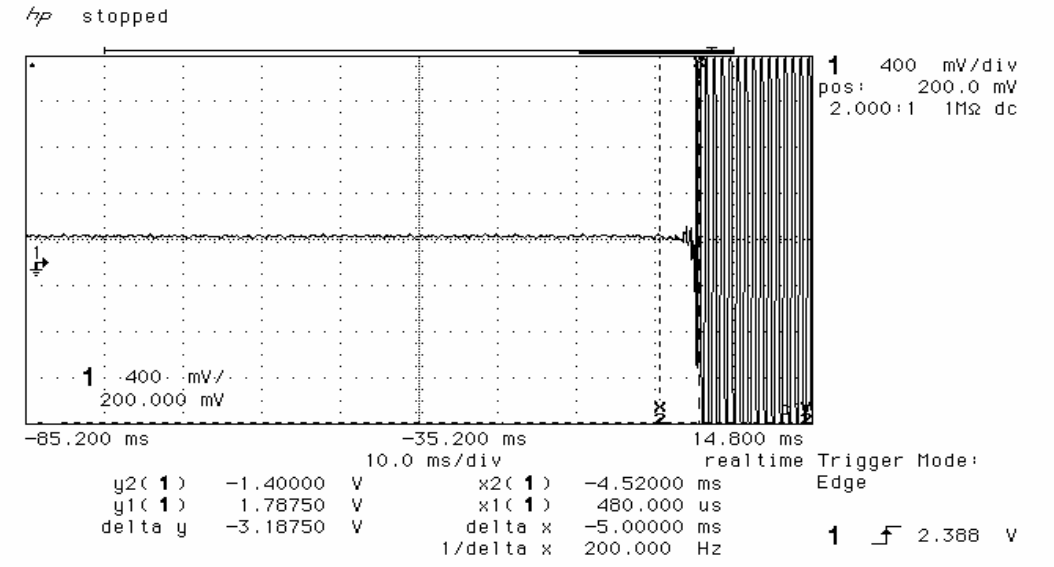
Transmitter Transient Frequency Behaviour: Sections 90.214 (Continued)





7.9. Transmitter Duty Cycle: Section 90.20(e)(6)

7.9.1. The EUT was configured as for duty cycle measurements as described in Section 9 of this report.

7.9.2. Tests were performed to determine the transmission duration and silent period time of the transmitter.

Operating Mode	Duration Time (milliseconds)	Limit (milliseconds)
Normal	199.9**	≤200
Active Tracking	199.9**	≤200

Operating Mode	Silent Period (seconds)	Limit (seconds)
Normal	11.603	≥9.8*
Active Tracking	0.981	≥0.8*

Note(s):

*.0.8 seconds when the vehicle is being tracked actively

**Transmission release time was taken to be the paint where the transmitter output power reduced to a level 50 dB below the steady state power and remained at that level thereafter.

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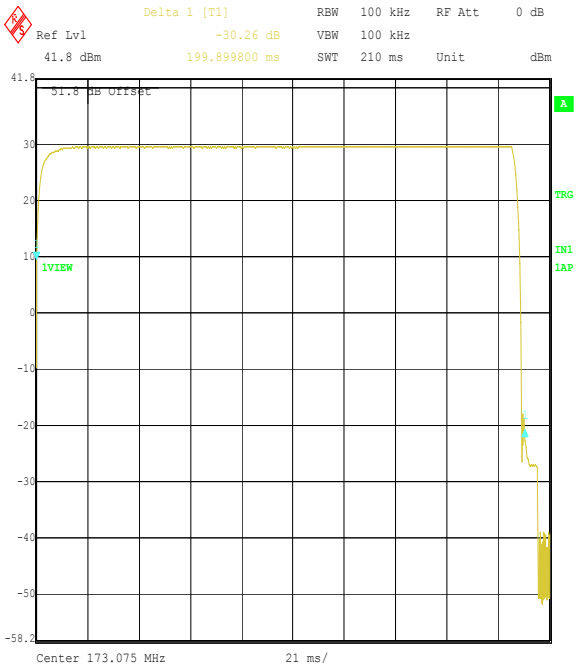
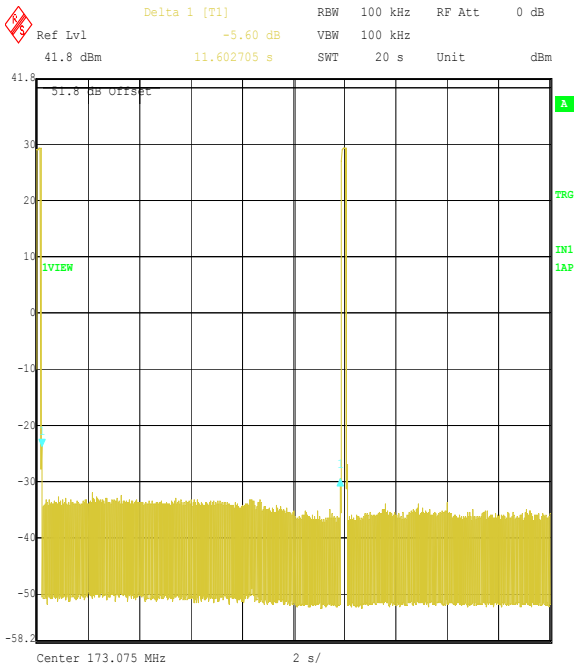
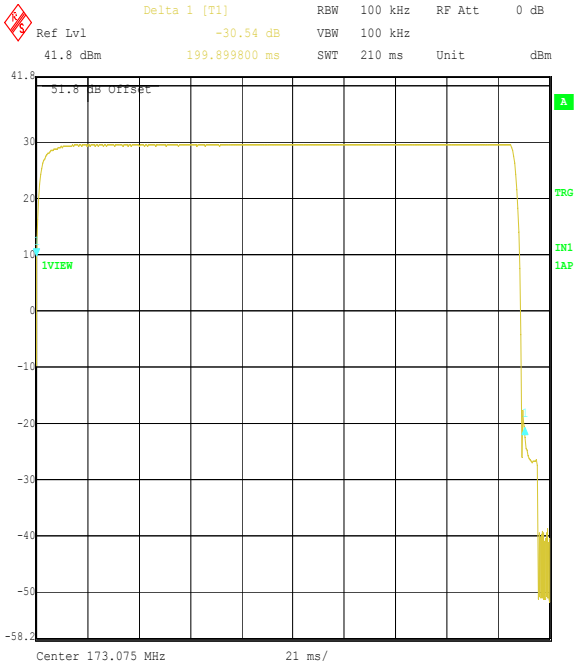
Transmitter Duty Cycle: Section 90.20(e)(6) (Continued)



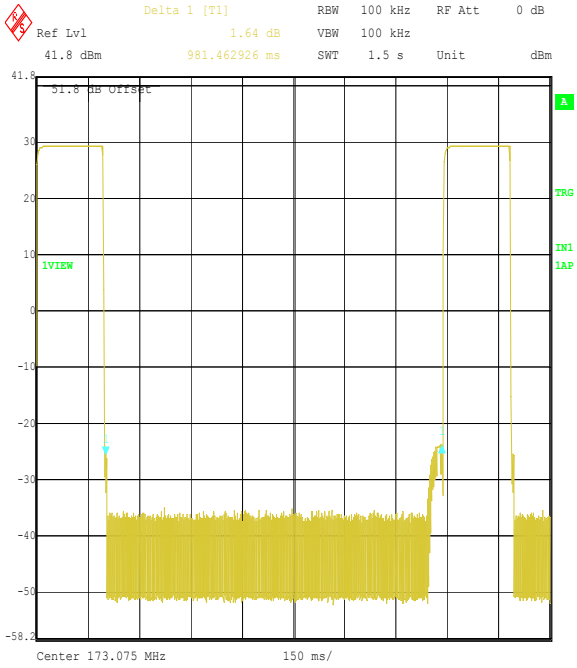
Comment A: DUTY CYCLE TRANSMISSION ON TIME
NORMAL MODE
Date: 7.DEC.2004 12:11:42



Comment A: DUTY CYCLE SILENT PERIOD
NORMAL MODE
Date: 7.DEC.2004 12:25:32



Comment A: DUTY CYCLE TRANSMISSION ON TIME
ACTIVE TRACKING MODE
Date: 7.DEC.2004 12:15:32



Comment A: DUTY CYCLE SILENT PERIOD
ACTIVE TRACKING MODE
Date: 7.DEC.2004 12:19:40

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**
Radiated Spurious Emissions	30 MHz to 1000 MHz	95%	+/- 5.26 dB
Radiated Spurious Emissions	1 GHz to 18 GHz	95%	+/- 4.18 dB
Carrier Output Power (ERP)	30 MHz to 1000 MHz	95%	+/- 1.78 dB
Occupied Bandwidth	N/A	95%	+/- 0.12%
Frequency Stability	Not applicable	95%	+/- 20 Hz
Duty Cycle	Not applicable	95%	+/- 10%

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.

9. Measurement Methods – Part 90

9.1. Receiver Radiated Emissions

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

9.1.2. Initial pre-scans covering the entire measurement band from the lowest generated frequency declared up to the upper frequency detailed in Section 15.33(b) were performed within a screened chamber in order to identify frequencies on which the EUT was generating interference. This determined the frequencies from the EUT that required further examination. In order to minimise the time taken for the swept measurements, a peak detector was used in conjunction with the appropriate detector measuring bandwidth (see table below). Repetitive scans were performed to allow for emissions with low repetition rates, and for the duty cycle of the EUT.

9.1.3. 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. 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.

9.1.4. An open area test site using the appropriate test distance and measuring receiver with a Quasi-Peak detector was used for measurements below 1000 MHz, for measurements above 1000 MHz average and peak detectors were used.

9.1.5. For the final measurements the EUT was arranged on a non-conducting turn table on a standard test site compliant with ANSI C63.4 - 2001 Clause 5.4.

9.1.6. On the open area test site, at each frequency where a signal was found, the levels were maximised by initially rotating the turntable through 360° and then varying the antenna height between 1 m and 4 m in the horizontal 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 vertical polarisation.

9.1.7. The final field strength was determined as the indicated level in dBμV plus cable loss and antenna factor.

Radiated Emissions (Continued)

9.1.8. 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	Not applicable
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

9.2. Occupied (20 dB) Bandwidth

9.2.1. The EUT was connected to a spectrum analyser enabled with an occupied bandwidth function via a direct connection (via suitable attenuation).

9.2.2. Measurements were performed to determine the Occupied Bandwidth in accordance with FCC Part 2.1049. The Occupied Bandwidth was measured from the fundamental emission at the bottom and top channels. The Occupied Bandwidth was measured in line with the requirements of 2.1049 i.e. with the EUT modulated with a signal representing the maximum rated conditions under which it will operate (worst case)

9.2.3. 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 automatically configures the measurement bandwidths to make an accurate measurement based on the channel bandwidth and channel spacing of the EUT.

9.3. Transmitter Radiated Emissions

9.3.1. The EUT and spectrum analyser were configured as per ANSI TIA-603-B, Land Mobile FM or PM Communications Equipment; Measurement and Performance Standards.

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

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

9.3.4. The initial scans were performed using an antenna height of 1.5 m and a measurement distance of 3 m, below 4 GHz; above 4 GHz a 1 m measurement distance was used. A limit line was set to the specification limit. 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.

9.3.5. For the final measurements the EUT was arranged on a non-conducting turn table on a standard test site compliant with ANSI C63.4 – 2001 Clause 5.4.

9.3.6. An open area test site using the appropriate test distance and spectrum analyser with an peak detector was used for final measurements. All measurements on the open area test site were performed using broadband antennas.

9.3.7. On the open area test site, at each frequency where a signal was found, the levels were maximised by initially rotating the turntable through 360° and then varying the antenna height between 1 m and 4 m in the horizontal 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 vertical polarisation.

9.3.8. Once the final amplitude (maximised) had been obtained and noted, the EUT was replaced by a substitution antenna, and a substitution method applied. The substitution antennas used were a horn antenna for measurements greater then or equal to 1 GHz and a dipole for measurements below 1 GHz. The centre of the substitution antenna was set to approximately the same centre location as the EUT. The substitution antenna was set to the horizontal polarity. The substitution antenna was matched into a signal generator using a 6 dB or greater attenuator. The signal generator was tuned to the EUT's frequency under test.

9.3.9. The test antenna was then raised and lowered to obtain a maximum reading on the spectrum analyser. The level of the signal generator output was then adjusted until the maximum recorded EUT level was observed. The signal generator level was noted. This procedure was repeated with both test antenna and substitution antenna vertically polarised. The EIRP was calculated as:-

ERP = Signal Generator Level - Cable Loss + Antenna Gain

9.3.10. Once the ERP was obtained, the difference between it and the level of the fundamental emission for the ERP of the channel under test was noted at the spurious attenuation level in dBc. The following formula was used as described in TIA-603-B.

$$\text{dB} = 10 \log_{10} \left(\frac{\textit{TX power in watts}}{0.001} \right) \text{- spurious level (dBm)}$$

9.3.11. For frequencies further than 12.5 kHz from the centre of the authorised bandwidth (fc) the emissions shall be attenuated by at least 50 + 10 log (P *in Watts*) dB or 70 dB (whichever is the lesser attenuation) relative to the transmitter output power level measured for the channel under test. The tabulated results in the results section of this report show the spurious emission in dBm and as attenuation relative to the carrier in dBc.

Transmitter Radiated Emissions (continued)

9.3.12. For the frequency ranges close to and including the fundamental frequency, plots of the spectral distribution (emission masks) were recorded using a spectrum analyser for the EUT transmitting on bottom, middle and top channels. The method used was in accordance with the methods detailed in FCC Part 90.210.

9.3.13. FCC Part 90.210 states the appropriate emission mask that shall be used for a given channel bandwidth. Measurements were performed using the appropriate emission mask for the channel bandwidth declared i.e. Emission Mask D for a channel bandwidth of 12.5 kHz.

Receiver Function	Settings
Detector Type:	Peak
Mode:	Max Hold
Bandwidth:	As per Part 90.210 <50 kHz away from fc
Bandwidth:	1 MHz >1 GHz
Bandwidth:	10 kHz <1 GHz
Amplitude Range:	100 dB
Sweep Time:	Coupled

9.4. Transmitter Frequency Stability

9.4.1. The EUT and spectrum analyser were configured as per ANSI TIA-603-B, Land Mobile FM or PM Communications Equipment; Measurement and Performance Standards.

9.4.2. The EUT was situated within an environmental test chamber and monitored on the spectrum analyser via a direct connection.

9.4.3. Measurements were performed with the EUT operating under extremes of temperature in 10 degree increments within the range -30°C to 50°C.

9.4.4. Measurements were also performed at voltage extremes between the declared nominal supply voltage and at the declared endpoint voltage (for hand carried battery operated equipment) or by varying the primary supply voltage from 85% to 115% of the nominal value for all other equipment types.

9.4.5. The requirement was to determine the frequency stability of the device under specified environmental operating conditions.

9.4.6. The EUT was set to be in receive mode for a minimum of 30 minutes between each stage of testing while the environmental chamber stabilised at the next temperature within the stated temperature range.

9.4.7. Once the environmental chamber had reached thermal equilibrium, the nominal frequency of the EUT was measured and recorded. The recorded frequency was compared to the declared nominal operating frequency of the channel being tested.

9.4.8. The frequency error measured was converted to an error in ppm using the following formula as defined by TIA_EIA_603A :-

$$\text{ppm error} = \left(\frac{MCF_{MHz}}{ACF_{MHz}} - 1\right) * 10^6$$

where MCF_{MHz} is the measured carrier frequency in MHz
ACF_{MHz} is the assigned carrier frequency in MHz

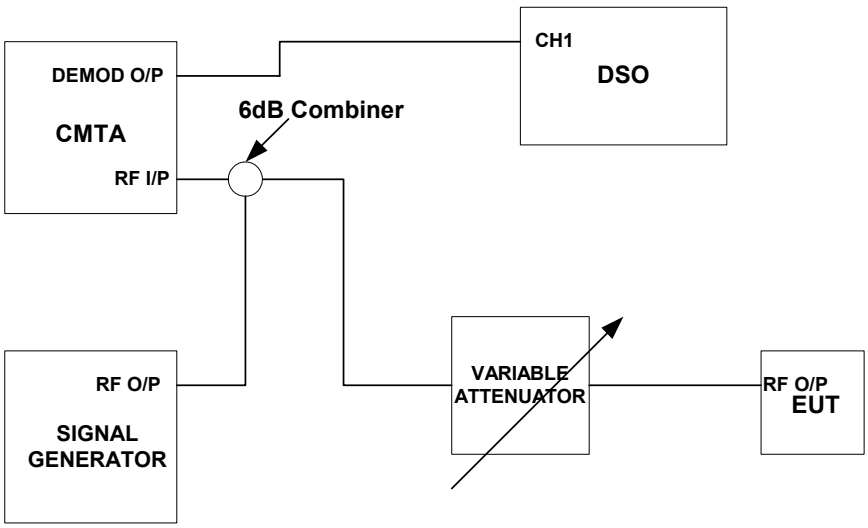
9.4.9. The measured ppm had to be less then the relevant limits in order to comply.

9.5. Transmitter Transient Frequency Behaviour

9.5.1. The EUT and test equipment were configured as per ANSI TIA-603-B, Land Mobile FM or PM Communications Equipment; Measurement and Performance Standards.

9.5.2. The EUT was connected to a communications analyser in the configuration shown in Figure 1 below.

Figure 1



9.5.3. The test equipment settings were as follows:

Oscilloscope Function	Settings
Coupling:	DC
Sweep Time:	10ms/Division
Trigger Mode:	Normal
Attack Trigger Position:	1/8th Pre-trigger
Release Trigger Position	7/8th Pre-trigger
Trigger Slope:	+ or – dependant on whether attack or release

CMTA Test Receiver Function	Settings
Centre Frequency (Set)	EUT's Nominal Frequency
Channel Spacing:	12.5 kHz
Special Function:	SPEC 72 (CMTA Squelch disable)

Signal Generator Function	Settings
Centre Frequency:	EUT's Nominal Frequency
Amplitude:	30 dB down on EUT's carrier power at the combiner
Audio Frequency:	1 kHz
FM Deviation	12.5 kHz

Transmitter Duty Cycle

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

9.5.5. To determine the transmission duration and silent period time of the transmitter, a spectrum analyser was set to the transmitter carrier frequency with its Resolution Bandwidth (RBW) set wide enough to encompass all significant spectral components, an RBW of 100 kHz was used. The Video Bandwidth was set to 100 kHz. The frequency span was set to 0 Hz.

9.5.6. The sweep time was set to a period long enough to capture the entire Transmit On Time pulse. The Transmit On Time pulse width was measured and a plot taken.

9.5.7. In order to measure the silent period, the sweep time was then extended to cover a period in excess of 10 seconds. A sweep time of 20 seconds was used for normal mode whilst a sweep time of 120 ms was used for active tracking made plot of this was taken.

Appendix 1. Test Equipment Used

RFI No.	Instrument	Manufacturer	Type No.	Serial No.
A027	Horn Antenna	Eaton	9188-2	301
A043	HP-230-5N High Pass Filter	AERIAL FACILITIES LTD	HP-230-5N	3745B
A047	HP-470-5N High Pass Filter	AERIAL FACILITIES LTD	HP-470-5N	4015B
A059	3146 Log Periodic Antenna	EMCO	3146	8902-2378
A091	EMCO 3110 Biconical Antenna	EMCO	3110	9008-1182
A1037	Chase Bilog Antenna	Chase EMC Ltd	CBL6112B	2413
A1397	Weinschel Associates	Weinschel Associates	WA46-20	A128
A1398	Weinschel Associates	Weinschel Associates	WA46-20	A129
A227	6dB Power Divider	Suhner Electronics Ltd	4901/01/A	none
A259	Bilog Antenna	Chase	CBL6111	1513
E013	PCN Environmental Chamber	Sanyo	ATMOS chamber	None
G011	SMGU Signal Generator	Rohde & Schwarz	SMGU	894 054/004
M003	Spectrum Monitor	Rohde & Schwarz	EZM	883 580/008
M028	FSB Spectrum Analyser	Rohde & Schwarz	FSB	860 001/009 (RF), 860 161/007 (Display)
M044	ESVP Receiver	Rohde & Schwarz	ESVP	891 845/026
M093	HP Oscilloscope	Hewlett Packard	54520A	US34360744
M105	Fluke 77 DVM	Fluke	77	963580770
M1124	Rohde & Schwarz	Rohde & Schwarz	ESIB26	100046K
M127	Spectrum Analyser	Rohde & Schwarz	FSEB 30	842 659/016
M505	Analyser Display Unit	Rohde & Schwarz	ESAI-D	825316/010
M506	RF unit	Rohde & Schwarz	ESBI-RF	827060/004
S009	D.C. PSU	Farnell	PDD3502A	174
S201	Site 1	RFI	1	
S202	Site 2	RFI	2	S202-15011990

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

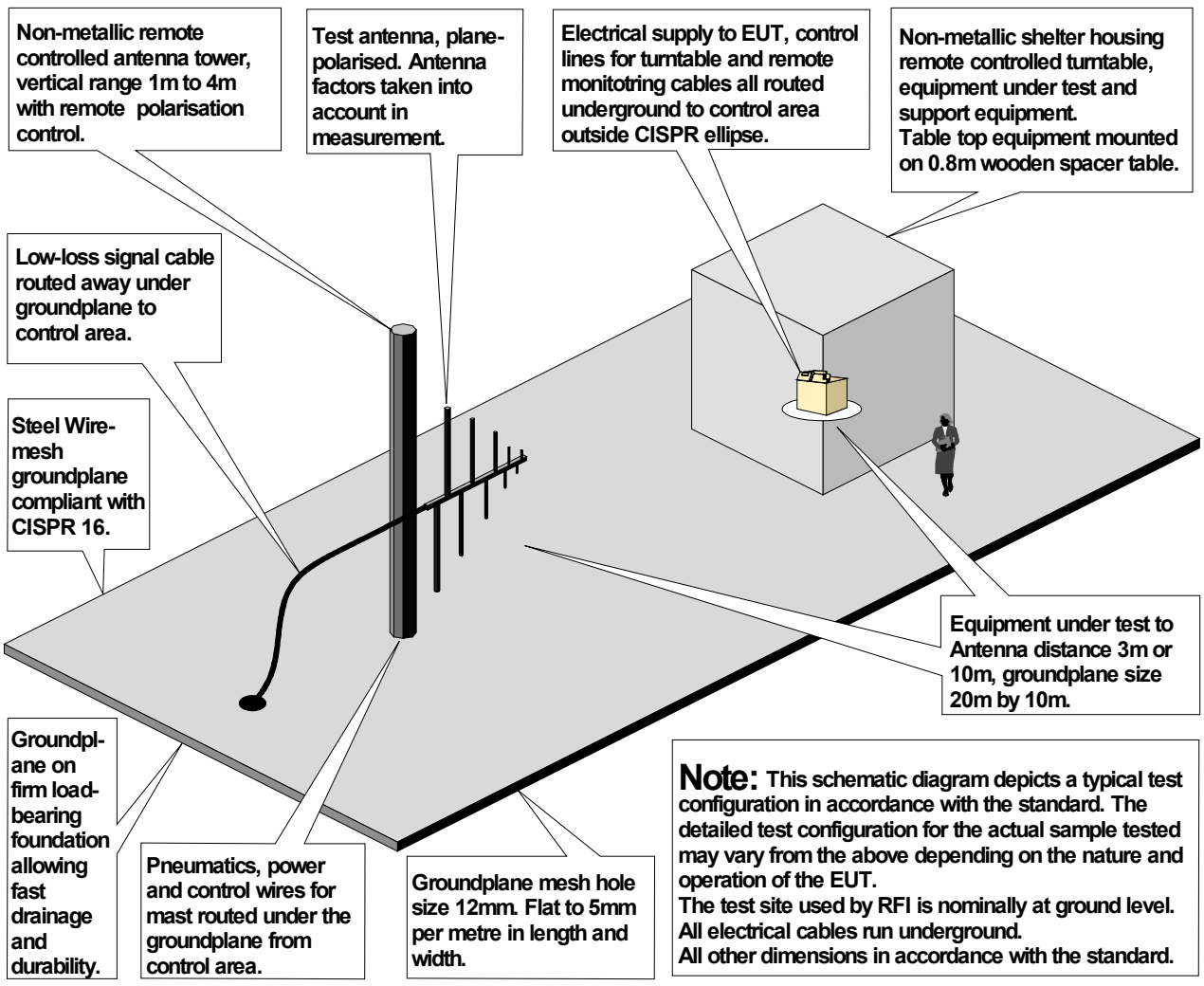
Appendix 2. Test Configuration Drawings

This appendix contains the following drawings:

Drawing Reference Number	Title
DRG\46683JD01\EMIRAD	Test configuration for measurement of radiated emissions

Test Of: Plextek Ltd
LoJack VLU5 Transceiver
To: FCC Part 90: 2003

DRG\46683JD01\EMIRAD



Note: This schematic diagram depicts a typical test configuration in accordance with the standard. The detailed test configuration for the actual sample tested may vary from the above depending on the nature and operation of the EUT.
The test site used by RFI is nominally at ground level.
All electrical cables run underground.
All other dimensions in accordance with the standard.

Test Configuration For Radiated Emissions Measurements

Reflection-free area: >60m by 52m (CISPR ellipse)
Groundplane Earthed
Control room outside CISPR ellipse