TEST REPORT
FROM
RFI GLOBAL SERVICES LTD

Test of: Draeger Safety UK Ltd
PSS Merlin

To: FCC Part 90: 2006
(Requested Parts Only)

Test Report Serial No:
RFI/RPTE2/RP49177JD01A

Supersedes Test Report Serial No:
RFI/RPTE1/RP49177JD01A

This Test Report Is Issued Under The Authority Of Michael Derby, Radio Performance Service Leader: 	
Tested By: Petr Hajek **pp** 	**Checked By: Nigel Davison** **pp.** 
Report Copy No: PDF01	
Issue Date: 23 July 2007	**Test Dates: 11 April 2007 to 21 June 2007**

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Test of: **Draeger Safety UK Ltd**
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1. Client Information

Company Name:	Draeger Safety UK Ltd
Address:	Ullswater Close Blyth Riverside Business Park Blyth Northumberland NE24 4RG UK
Contact Name:	Mr M Berney

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:	DrägerMan PSS Merlin
Model Name or Number:	460 MHz Portable Radio Unit
Serial Number:	BRSJ-0114
FCC ID Number:	SIZ002
Country of Manufacture:	UK
Date of Receipt:	11 April 2007

2.2. Accessories

The following accessories were supplied with the EUT:

Description:	Digital Pressure Gauge
Brand Name:	Dräger
Model Name or Number:	Bodyguard II
Serial Number:	BRRM-0752
Country of Manufacture:	UK

Description:	6.5 V NiMH Battery Pack
Brand Name:	Dräger
Model Name or Number:	33 50752
Serial Number:	BRSF-0111
Country of Manufacture:	UK

2.3. Description of EUT

The equipment under test is a data only telemetry radio, body worn by fire-fighters. It connects via a wired interface to a digital pressure gauge that gives a compressed air cylinder pressure reading to fire-fighters.

2.4. Modifications Incorporated in the EUT

During the course of testing the EUT was not modified.

2.5. Additional Information Related to Testing

Power Supply Requirement:	Nominal 6 V NiMH Battery Supply		
Intended Operating Environment:	Public Emergency Service (Fire)		
Equipment Category:	Portable		
Type of Unit:	Transceiver		
Interface Ports:	Data Connection Port		
Transmit Frequency Range:	450 MHz to 470 MHz		
Transmit Channels Tested:	**Channel ID**	**Channel Number**	**Channel Frequency (MHz)**
	Bottom	-	450
	Middle	-	460
	Top	-	470
Highest Unintentionally Generated Frequency:	470 MHz		
Receive Frequency Range:	450 MHz to 470 MHz		
Receive Channels Tested:	**Channel ID**	**Channel Number**	**Channel Frequency (MHz)**
	Bottom	-	450
	Middle	-	460
	Top	-	470
Highest Unintentionally Generated Frequency:	470 MHz		

2.6. Support Equipment

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

Description:	Laptop PC
Brand Name:	Dell
Model Name or Number:	Latitude
Serial Number:	CN-035010-12961-29B 4261
Cable Length and Type:	1.5m, Multicore
Connected to Port:	Serial Port

3. Test Specification, Methods and Procedures

3.1. Test Specifications

Reference:	FCC Part 90: 2006
Title:	Code of Federal Regulations, Part 15 (47CFR290) Radio Frequency Devices.

3.2. Methods and Procedures

The methods and procedures used were as detailed in:

ANSI/TIA-603-B-2003
Land Mobile Communications Equipment, Measurements and performance Standards

ANSI C63.2 (1987)
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 (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.

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

There were no deviations from the test specification, other than the request to perform only partial testing.

5. Operation of the EUT During Testing

5.1. Operating Modes

The EUT was tested in the following operating modes, unless otherwise stated.

Preliminary radiated spurious emissions pre-scan tests were performed in transmit and receive mode on the highest operating frequency of the EUT (top channel) with the accessories stated in section 2.2 of this report connected. Final measurements were performed on the top, middle and bottom channels, where an emission was identified.

For all other transmit mode measurements, the EUT was set to transmit on the top, middle and bottom channels as necessary.

5.2. Configuration and Peripherals

The EUT was tested in the following configuration:

Through serial interface cables and custom software.

6. Summary of Test Results

Range of Measurements	Section Reference	Port Type	Compliancy Status
Receiver Radiated Spurious Emissions (30 MHz to 2.5 GHz)	Section 15.109	Enclosure	Complied
Transmitter Carrier Output Power (ERP)	Sections 90.205/90.267 TIA-603-B Section 2.2.1	Antenna	Complied
Transmitter Radiated Emissions Masks	C.F.R. 47 FCC Part 90: 2004 Sections 90.210 TIA-603-B Section 2.2.12	Antenna	Complied
Transmitter Radiated Emissions (Out of Band) (30 MHz to 5 GHz)	Sections 90.210 TIA-603-B Section 2.2.12	Antenna	Complied

6.1. Location of Tests

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

7. Measurements, Examinations and Derived Results

7.1. General Comments

This section contains test results only.

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.

Partial testing was performed at the client's request.

7.2. Test Results

7.2.1. Receiver Radiated Emissions: Section 15.109

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

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

Tests were performed to identify the maximum radiated emission levels.

Top Channel - Quasi Peak Level:

Frequency (MHz)	Antenna Polarity	Q-P Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Result
497.154	Vertical	32.4	46.0	13.6	Complied
566.172	Vertical	33.5	46.0	12.5	Complied

Note(s):

1. *No emissions were found, thus the highest level of noise floor was recorded.*
2. *All channels exhibited similar results as such, only data for the top channel was reported.*

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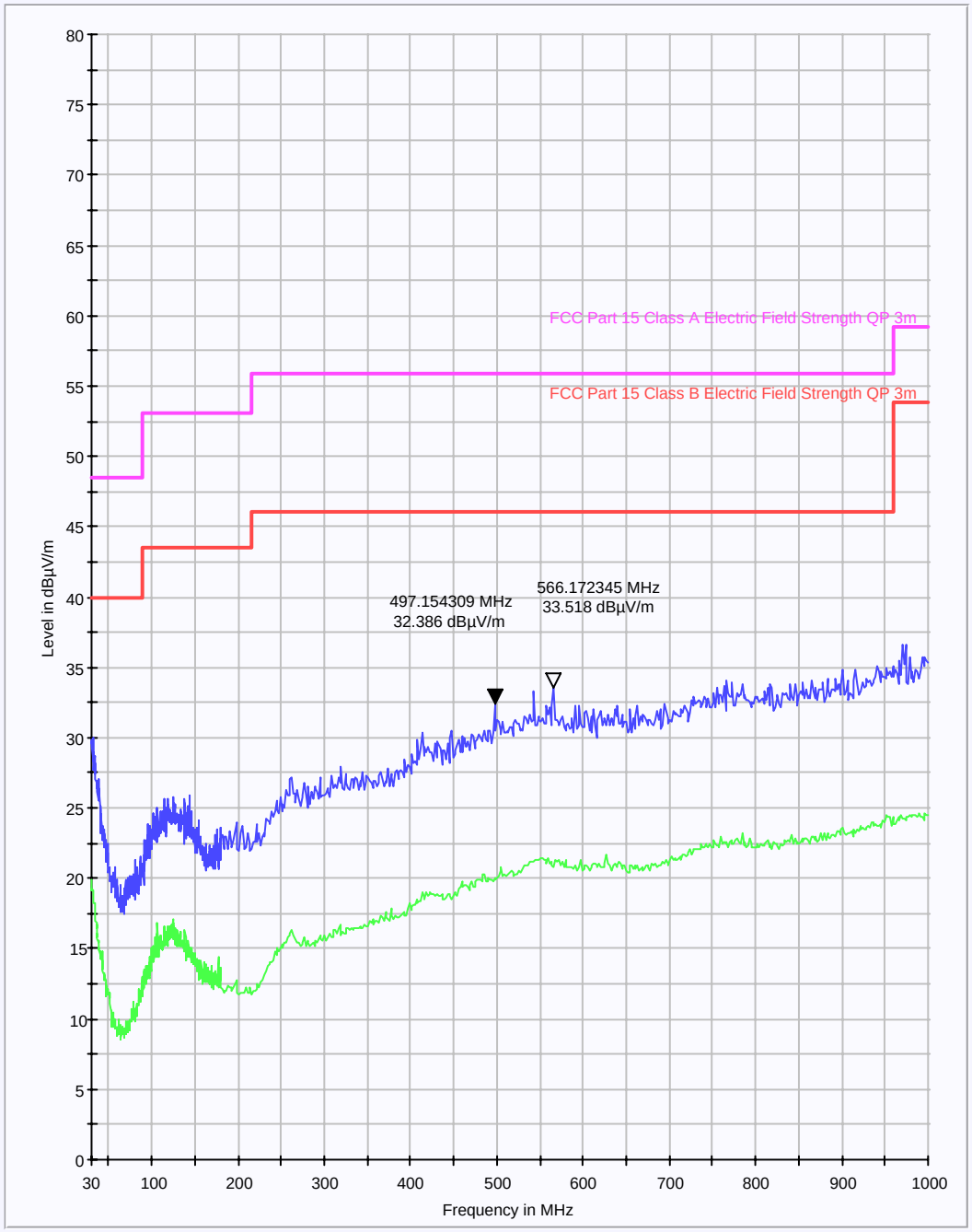
Receiver Mode Radiated Spurious Emissions: Section 15.109 (Continued)



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

7.2.3. Receiver Radiated Emissions: Section 15.109 (Continued)

7.2.4. Electric Field Strength Measurements (Frequency Range: 1 GHz to 2.5 GHz)

Results:

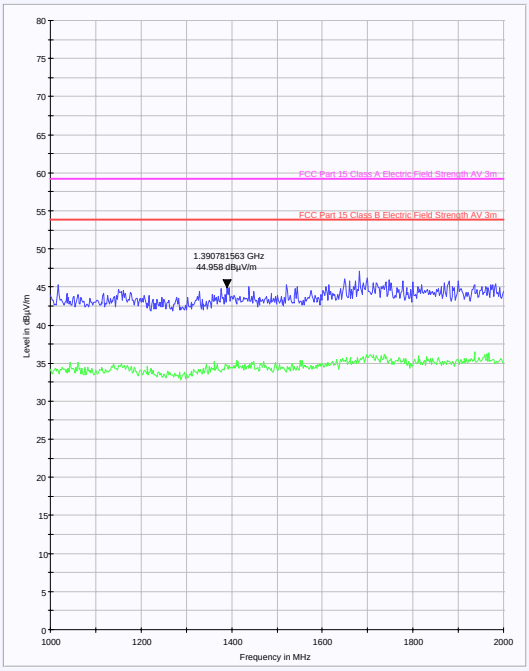
Top Channel - Highest Peak Level:

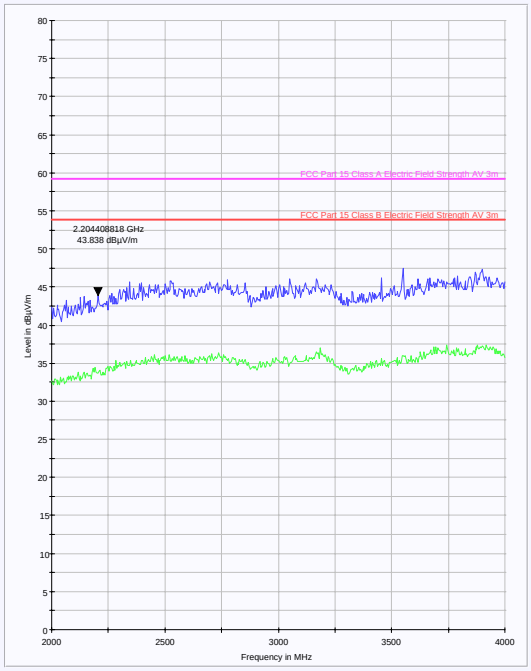
Frequency (MHz)	Antenna Polarity	Detector Level (dBμV)	Transducer Factor (dB)	Actual Level (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Result
1390.781	Vertical	54.4	-9.4	45.0	74.0	29.0	Complied
2204.408	Vertical	50.4	-6.6	43.8	74.0	30.2	Complied

Note(s):

1. *No emissions were found, thus the highest level of noise floor was recorded.*
2. *All channels exhibited similar results as such, only data for the top channel was reported.*

Receiver Radiated Emissions: Section 15.109 (Continued)





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

7.2.5. Transmitter Carrier Output Power (ERP): Sections 90.205/90.267

The EUT was configured as for conducted RF output power as described in Section 9 of this report.

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

Results:

Channel	Frequency (MHz)	Level (dBm)	Limit (dBm)	Margin (dB)	Result
Bottom	450	19.6	33.0	13.4	Complied
Middle	460	21.2	33.0	11.8	Complied
Top	470	23.8	33.0	9.2	Complied

7.3. Transmitter Radiated Emissions Masks: Section 90.210

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

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.

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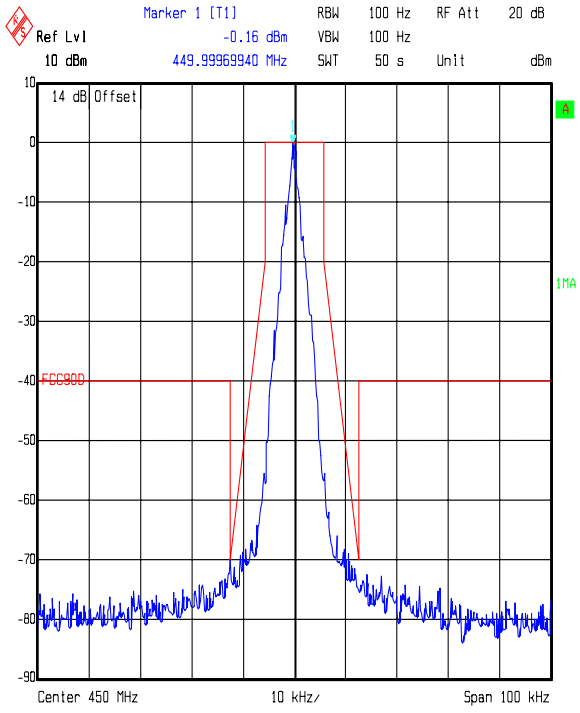
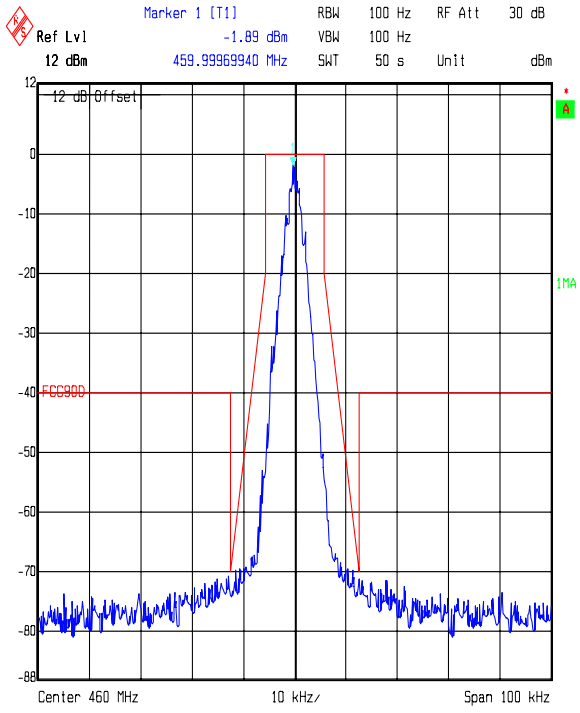
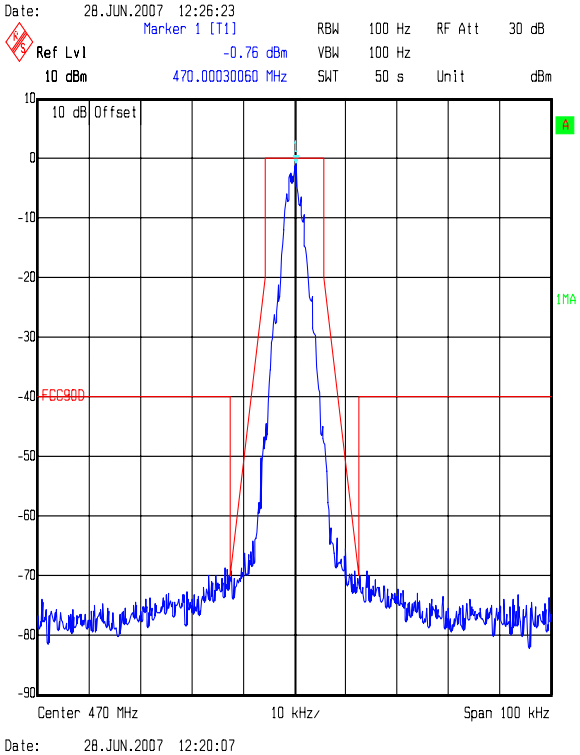
Transmitter Radiated Emissions Masks: Section 90.210 (Continued)







7.3.1. Transmitter Out of Band Radiated Emissions: Section 90.210

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

Tests were performed to identify the maximum transmitter radiated emission levels.

Result:

Bottom Channel

Frequency (MHz)	Peak Emission Level (dBm)	Peak Emission Level (dBc)	Limit (dBc)	Margin (dB)	Result
See Note Below					

Note(s):

1. All emissions were at least more than 20dB below the specified limit of 43+10Log(P) dB.

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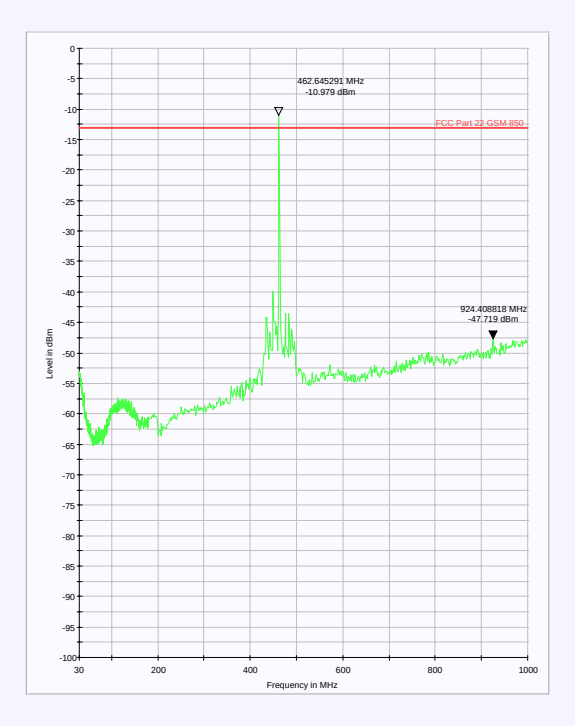
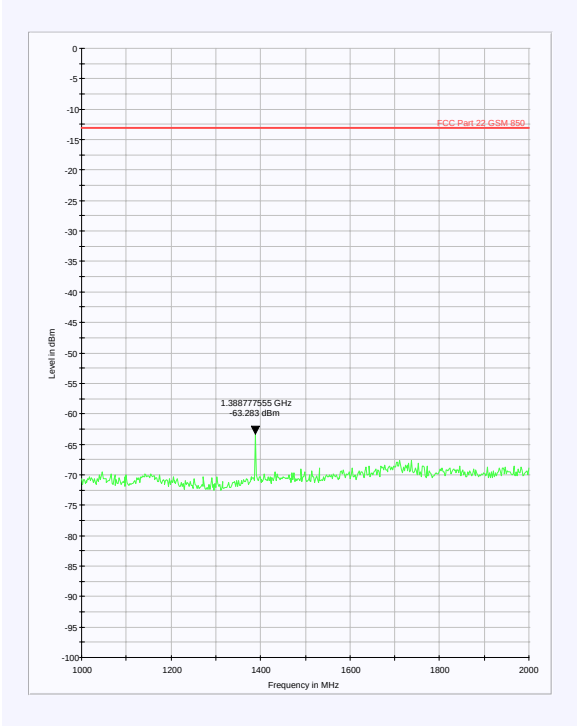
Transmitter Out of Band Radiated Emissions: Section 90.210 (Continued)





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

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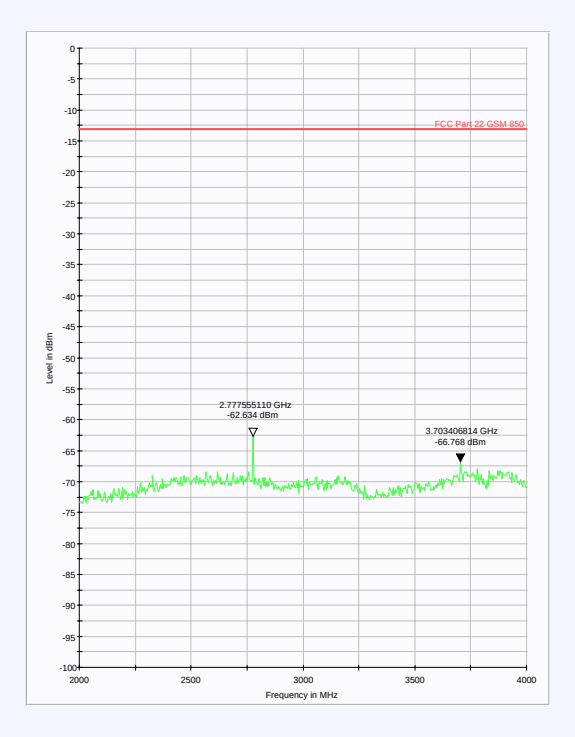
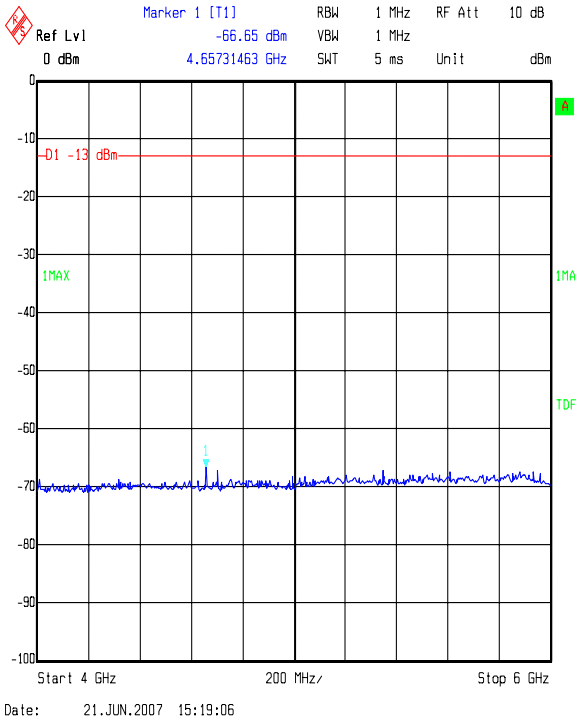
Transmitter Out of Band Radiated Emissions: Section 2.1053 & 22.917 (Continued)





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

8. Measurement Uncertainty

Measurement Type	Range	Confidence Level (%)	Calculated Uncertainty
Radiated Spurious Emissions	9 kHz to 30 MHz	95%	+/- 3.53 dB
Radiated Spurious Emissions	30 MHz to 1000 MHz	95%	+/- 5.26 dB
Radiated Spurious Emissions	1 GHz to 18 GHz	95%	+/- 4.18 dB

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

9.1. Effective Radiated Power (ERP)

ERP measurements were performed in accordance with the standard, against appropriate limits.

The ERP was measured with the EUT arranged on a non-conducting turn table on a standard test site compliant with ANSI C63.4 – 2001 Clause 5.4. The transmitter was fitted with an integral antenna; as such all radiated tests were performed with the unit operating into the integral antenna.

The level of the ERP was measured using a spectrum analyser.

The test antenna was positioned in the horizontal plane. The EUT was oriented in the X plane. The test antenna was then raised and lowered until a maximum peak was observed. The turntable was then rotated through 360 degrees and the maximum peak reading obtained. The height search was then repeated to take into consideration the new angular position of the turntable. The maximum reading observed was then recorded. This procedure was then repeated with the EUT oriented in the Y and Z planes. The highest reading taken in all 3 planes was recorded. The entire procedure was then repeated with the test antenna set in the Vertical polarity.

Once the final amplitude (maximised) had been obtained, the EUT was substituted with a substitution antenna. For ERP measurements a dipole antenna was used. 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.

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 ERP was calculated as:-

ERP = Signal Generator Level - Cable Loss + Antenna Gain

9.2. Effective Radiated Power (ERP) (Continued)

Circumstances where the signal generator could not produce the desired power substitution was performed with the signal generator set to 0 dBm. The radiated signal was maximised as previously described. The level indicated on the measuring receiver was noted. The delta between this level and the maximum level for the EUT was calculated and also noted. The ERP of the signal generator was calculated using the above formulae. The recorded delta was added to the calculated ERP to obtain the substituted EUT ERP.

Delta (dB) = EUT – SG

Where :

EUT = spectrum analyser indicated EUT raw level

SG = spectrum analyser indicated signal generator raw level

The signal generator actual ERP is calculated as:

ERP SG= Signal Generator Level - Cable Loss + Antenna Gain

The EUT ERP is calculated as:

ERP EUT = ERP SG + Delta.

The test equipment settings for ERP measurements were as follows:

Receiver Function	**Setting**
Detector Type:	Peak
Mode:	Not applicable
Bandwidth:	≥ Emission Bandwidth
Amplitude Range:	100 dB
Sweep Time:	Coupled

9.3. Transmitter Radiated Emissions

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

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 20dB of this limit were measured where possible, on occasion; the receiver noise floor came within the 20dB boundary. On these occasions, the system noise floor may have been recorded.

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 levels were maximised by initially rotating the turntable through 360° 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, the EUT was substituted with a substitution antenna. For EIRP measurements a Horn antenna whose gain was based on an isotropic antenna was used, ERP measurements were done using a dipole. 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 6dB or greater attenuator. The signal generator was tuned to the EUT's frequency under test.

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 radiated power was calculated as:-

EIRP/ERP = Signal Generator Level - Cable Loss + Antenna Gain

9.4. Transmitter Radiated Emissions (Continued)

The limit in the standard states that emissions shall be attenuated by at least 43+10 log (P) dB below the transmitter power (P), where (P) is the maximum measured fundamental power for the channel under test. This limit always reduces to -13dBm therefore, the limit line presented on the accompanying plots is set to -13dBm.

Any spurious measured were then compared to the -13dBm limit. The requirement is for the emission to be less than -13dBm. The margin between emission and limit is recorded and should always be positive to indicate compliance.

It should be noted that FCC Part 22.917 states that the 1st MHz band immediately adjacent to the applicants declared frequency block may be measured using a resolution bandwidth of at least 1% of the emission bandwidth. This bandwidth was found by calculating 1% of the bandwidth measured in the transmitter occupied bandwidth section of this report. The next largest available bandwidth above this calculated figure was, therefore, used i.e. 3 kHz.

9.5. Receiver Radiated Emissions

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

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, which 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.

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 20dB of this limit were measured where possible, on occasion, the receiver noise floor came within the 20dB boundary. On these occasions, the system noise floor may have been recorded.

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.

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.

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.

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

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

Receiver Function	**Initial Scan**	**Final Measurements Below 1GHz**	**Final Measurements Above 1 GHz**
Detector Type:	Peak	Quasi-Peak (CISPR)	Peak/Average
Mode:	Max Hold	Not applicable	Not applicable
Bandwidth:	(120 kHz < 1GHz) (1MHz > 1GHz)	120 kHz	1 MHz (If Applicable)
Amplitude Range:	60 dB	20 dB	20 dB (typical)
Step Size:	Continuous sweep	Not applicable	Not applicable
Sweep Time:	Coupled	Not applicable	Not applicable

Appendix 1. Test Equipment Used

RFI No.	Instrument	Manufacturer	Type No.	Serial No.	Date Last Calibrated	Cal. Interval (Months)
A028	Horn Antenna	Eaton	91888-2	304	08 Jun 2006	36
A031	Horn Antenna	Eaton	91889-2	557	08 Jun 2006	36
A059	Log Periodic Antenna	EMCO	3146	8902-2378	17 Nov 2006	12
A1037	Bilog Antenna	Chase EMC	CBL6112B	2413	20 Sep 2006	12
A1396	Attenuator	HUBER + SUHNER AG	757987	6810.17.B	Cal before use	-
A1534	Preamplifier	Hewlett Packard	8449B OPT H02	3008A00405	Cal before use	-
A253	Horn Antenna	Flann Microwave	12240-20	128	17 Nov 2006	36
C1165	Cable	Rosenberger Micro-Coax	FA210A1020 007070	43189-1	05 Jun 2007	12
C1167	Cable	Rosenberger Micro-Coax	FA210A1030 007070	43190-01	05 Jun 2007	12
C151	Cable	Rosenberger	UFA210A-1-1181-70x70	None	Cal before use	-
C160	Cable	Rosenberger	UFA210A-1-1181-70x70	None	Cal before use	-
C348	Cable	Rosenberger	UFA210A-1-1181-70x70	2993	Cal before use	-
M1263	Test Receiver	Rohde & Schwarz	ESIB7	100265	25 Jan 2007	12
S202	3m OATS	RFI	2	S202-15011990	17 Nov 2006	12
S212	Screened Room	RFI	12	None	Not calibrated	-

NB In accordance with UKAS requirements, all the measurement equipment is on a calibration schedule. All equipment was within calibration at the time of the test.

Appendix 2. Test Configuration Drawings

This appendix contains the following drawings:

Drawing Reference Number	Title
DRG\49177JD01A\EMICON	Test configuration for measurement of conducted emissions.
DRG\49177JD01A\EMIRAD	Test configuration for measurement of radiated emissions.

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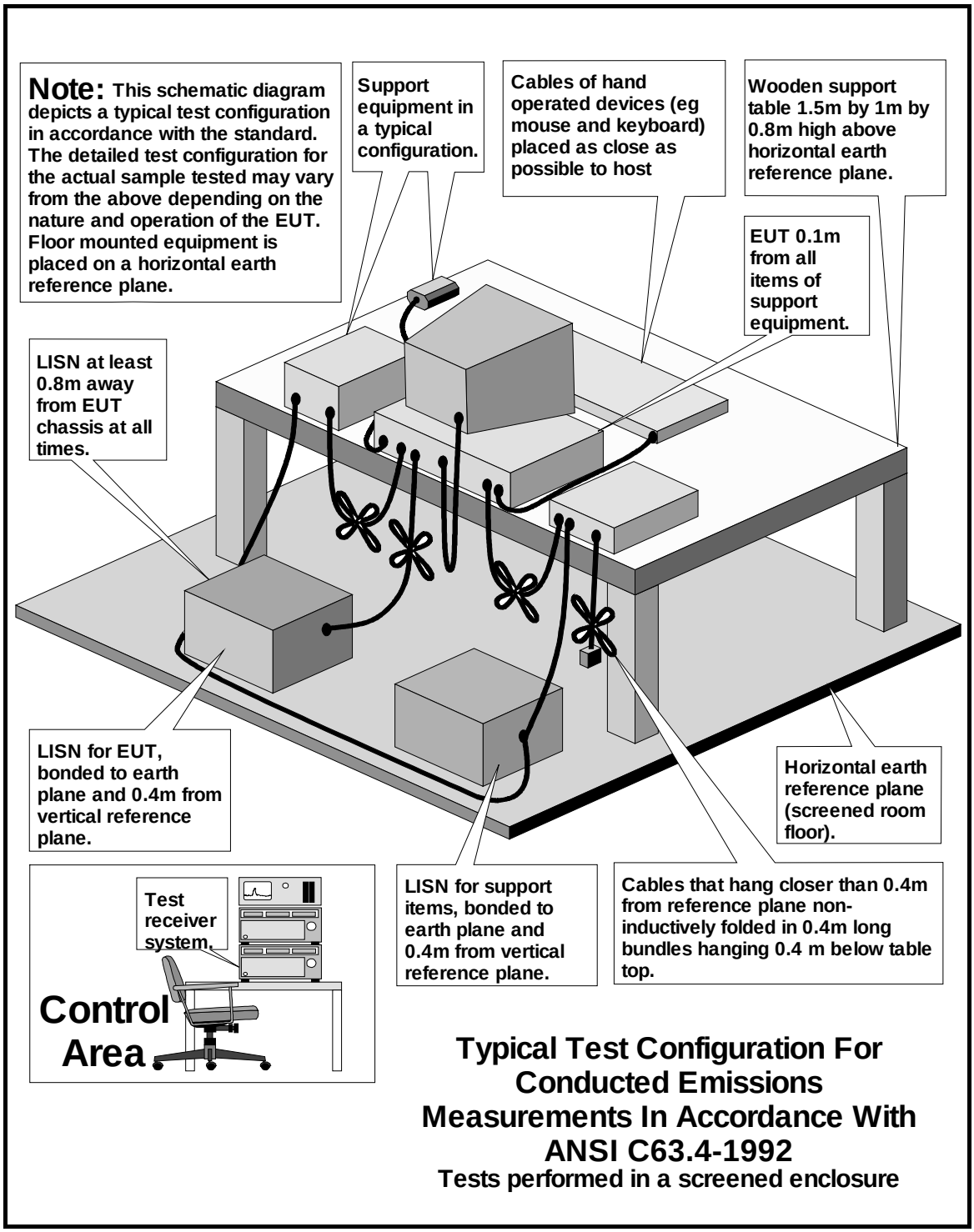
DRG\49177JD01A\EMICON



Note: This diagram is also valid for the latest version of ANSI C63.4-2003

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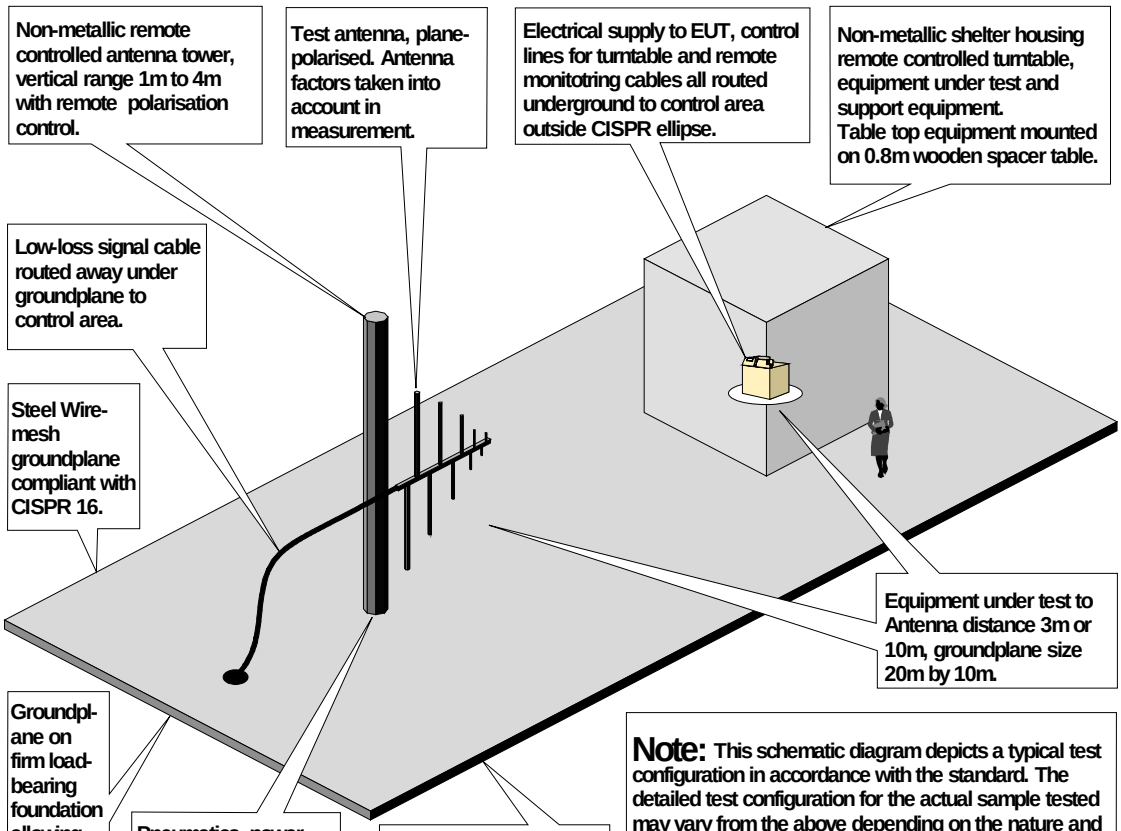
DRG\49177JD01A\EMIRAD



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