TEST REPORT
FROM
RFI GLOBAL SERVICES LTD.

Test Of: Draeger Safety UK
460MHz Portable Radio Unit

To: FCC Part 90: 2004

Test Report Serial No:
RFI\MPTE1\RP47086JD01A
Supersedes Test Report Serial No:
RFI\MPTE1\RP46068JD09A

This Test Report Is Issued Under The Authority Of Andrew Brown, Operations Manager: 	
Tested By: Steven Wong 	**Checked By: Tony Henriques** 
Report Copy No: **PDF01**	
Issue Date: 15 March 2005	**Test Dates: 25 August to 08 September 2004 and 07 March 2005**

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Test Of: Draeger Safety UK
460MHz Portable Radio Unit
To: FCC Part 90: 2004

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1. Client Information

Company Name:	Draeger Safety UK
Address:	Kitty Brewster Estate Blyth Northumberland NE24 4RG United Kingdom
Contact Name:	Mr M Berney-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:	DrägerMan PSS Merlin
Model Name or Number:	460 MHz Portable Radio Unit
Serial Number:	BRSE-72
Country of Manufacture:	UK
FCC ID Number:	SIZ002
Date of Receipt:	25 August 2004

Brand Name:	DrägerMan PSS Merlin
Model Name or Number:	460 MHz Portable Radio Unit
Serial Number:	None stated
Country of Manufacture:	UK
FCC ID Number:	SIZ002
Date of Receipt:	07 March 2005

2.2. Accessories

The following accessories were supplied with the EUT:

Description:	Digital pressure gauge
Brand Name:	Dräger
Model Name or Number:	33 50821
Serial Number:	EX01E2009
Country of Manufacture:	UK

Description:	6.5V NiMH Battery Pack
Brand Name:	Dräger
Model Name or Number:	33 50752
Serial Number:	BRSF-0104
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 EUT

The originally submitted test sample was fully tested to the relevant requirements of Part 90. The client then decided to slightly modify the equipment by moving the position of the antenna on the external casework and changing the format of the antenna connector. Refer to Section 7.1 *General Comments* of this report for details of the testing performed on the modified sample.

2.5. Support Equipment

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

Description:	Test Box*
Brand Name:	None Stated
Model Name or Number:	None Stated
Serial Number:	None Stated
Cable Length And Type:	1.5m, 4 Core
Connected to Port:	Data

Description:	Laptop PC**
Brand Name:	IBM
Model Name or Number:	ThinkPad 600E
Serial Number:	55184D8 02/99
Cable Length And Type:	1.5m, 4 Core
Connected to Port:	Data

**The test box was used to allow the changing of channels and entering the receive or transmit condition on the original, unmodified, sample.*

***The lap top PC was used to allow the changing of channels and entering the receive or transmit condition on the modified sample and was not connected during testing.*

2.6. Additional Information Related To Testing

Power Supply Requirement:	Nominal 6V NiMH Battery Supply		
Intended Operating Environment:	Public Emergency Services (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	Not stated	450
	Middle	Not stated	460
	Top	Not stated	470
Receive Frequency Range	450 MHz to 470 MHz		
Receive Channels Tested	**Channel ID**	**Channel Number**	**Channel Frequency (MHz)**
	Bottom	Not stated	450
	Middle	Not stated	460
	Top	Not stated	470
Occupied Bandwidth	11.25 kHz		
Highest Unintentionally Generated Frequency	470 MHz		

3. Test Specification, Methods And Procedures

3.1. Test Specifications

Reference:	FCC Part 90: 2004 (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-2003
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 (2003)
Title: American National Standard for Methods of Measurement of Radio-Noise 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 Conditions

During testing, the EUT was powered by it's integral nominal 6 V battery supply

5.2. 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 if 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.

5.3. Configuration And Peripherals

The EUT was tested in the following configuration:

Configured with the test box for all tests except for the transmitter ERP and radiated emissions tests where the EUT was fitted with the digital pressure gauge.

6. Test Results

6.1. Summary Of Part 90 Tests

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: 2004 Section 15.109	Enclosure	Complied
Transmitter Carrier Output Power (ERP)	C.F.R. 47 FCC Part 90: 2004 Sections 90.205/90.267 TIA-603-B Section 2.2.17	Antenna	Complied
Transmitter Occupied Bandwidth (Bandwidth Limitations)	C.F.R. 47 FCC Part 90: 2004 Sections 90.209/90.267/2.1049	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)	C.F.R. 47 FCC Part 90: 2004 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: 2004 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: 2004 Sections 90.214 TIA-603-B Section 2.2.19	Antenna	Complied

6.2. 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.

7.1.3. Full testing was performed on the original test sample during the period 25 August to 8 September 2004. The client then decided to slightly modify the equipment by moving the position of the antenna on the external casework and changing the format of the antenna connector, everything else remaining the same. It was decided that only the re-measurement of transmitter ERP and radiated spurious emissions was necessary and therefore these tests were performed on the revised sample on 7 March 2005. The results given in this test report for transmitter ERP and radiated spurious emissions are those for the revised sample whilst all the other tests (including emission masks) were performed on the original unit.

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460MHz Portable Radio Unit
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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)

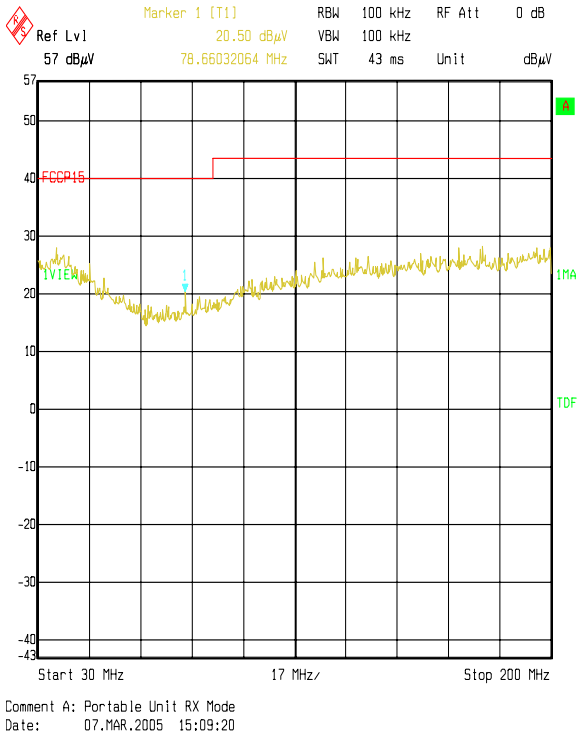
7.2.1.1. The EUT was configured as for receiver radiated emissions testing as described in Section 9 of this report.

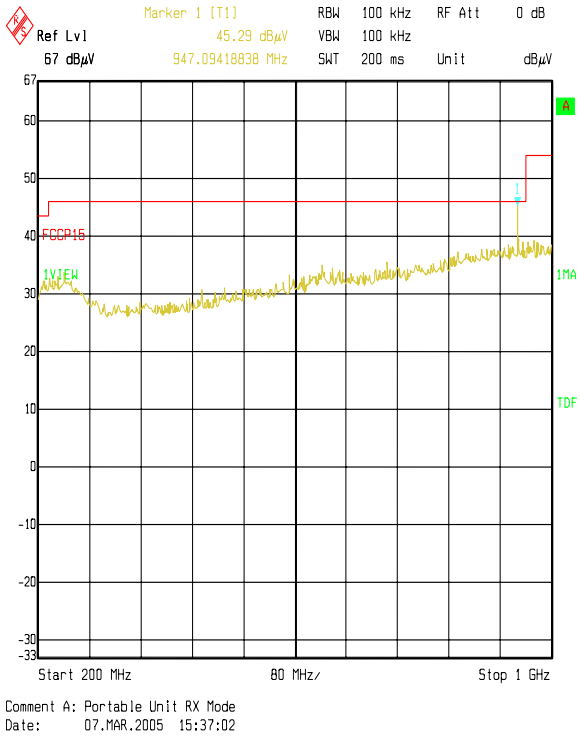
7.2.1.2. Tests were performed to identify the maximum receiver or standby radiated emissions levels.

Results: Top Channel

Frequency (MHz)	Ant. Pol.	Q-P Level (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Result
78.456	Vert.	19.7	40.0	20.3	Complied
78.660	Horiz	20.5	40.0	19.5	Complied

Note: The preliminary scans showed similar emission levels for each channel below 1 GHz, therefore final radiated emissions measurements were performed with the EUT set to the top channel only.





Note: the emission shown in the 200 MHz to 1 GHz plot at 947.094 MHz is an ambient and does not emanate from the EUT. Because the emission is not from the EUT no level has been recorded in the preceding result table.

Note: these plots are pre-scans and for indication purposes only. For final measurements, see accompanying tables. It is confirmed that although the scans indicate a RBW of 100 kHz final measurements were performed using the appropriate CISPR bandwidth i.e. 120 kHz

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Receiver Radiated Emissions: Section 15.109 (Continued)

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

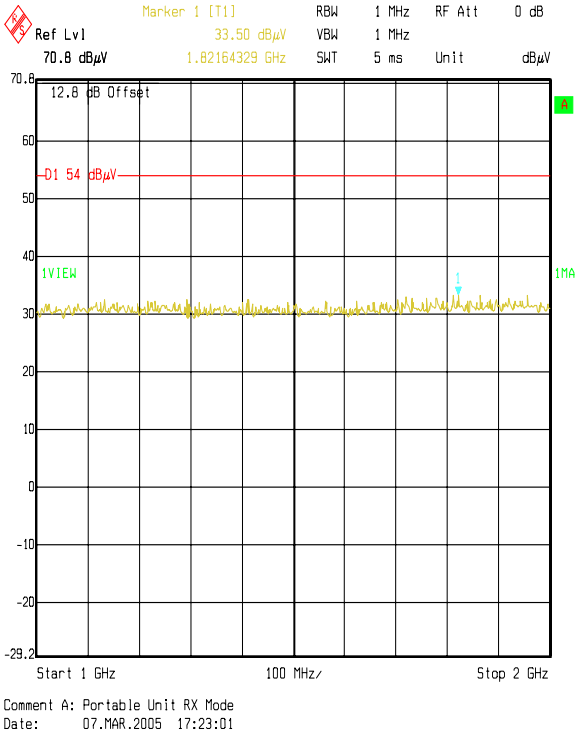
Results: Top Channel

Highest Peak Level

Frequency (GHz)	Antenna. Polarity	Peak Detector Level (dBµV)	Antenna Factor	Cable Loss	Actual Peak Level (dBµV/m)	**Average Limit (dBµV/m)	Margin (dB)	Result
1.821*	Vert.	10.8	21.6	1.1	33.5	54.0	20.5	Complied

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

***Note: The 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 90.205/90.267

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:

Channel	Frequency (MHz)	ERP (dBm)	ERP Limit (dBm)	Margin (dB)	Result
Bottom	450	20.5	33.0	12.5	Complied
Middle	460	20.0	33.0	13.0	Complied
Top	470	20.7	33.0	12.3	Complied

7.4. Transmitter Occupied Bandwidth (Bandwidth Limitations): Sections 90.209/90.267/2.1049

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.

Result:

Channel	Frequency (MHz)	RBW (kHz)	VBW kHz)	Occupied Bandwidth (kHz)	Limit (kHz)	Margin (kHz)	Result
Bottom	450	0.3	1	3.758	11.25	7.492	Complied
Middle	460	0.3	1	3.833	11.25	7.417	Complied
Top	470	0.3	1	3.983	11.25	7.267	Complied

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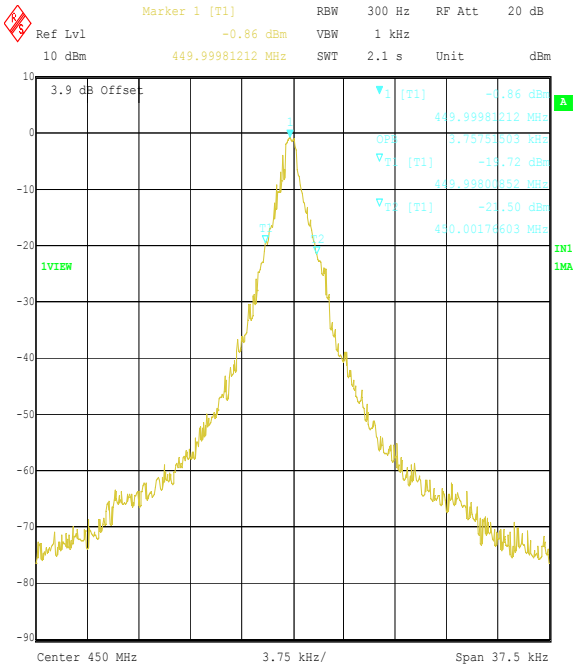
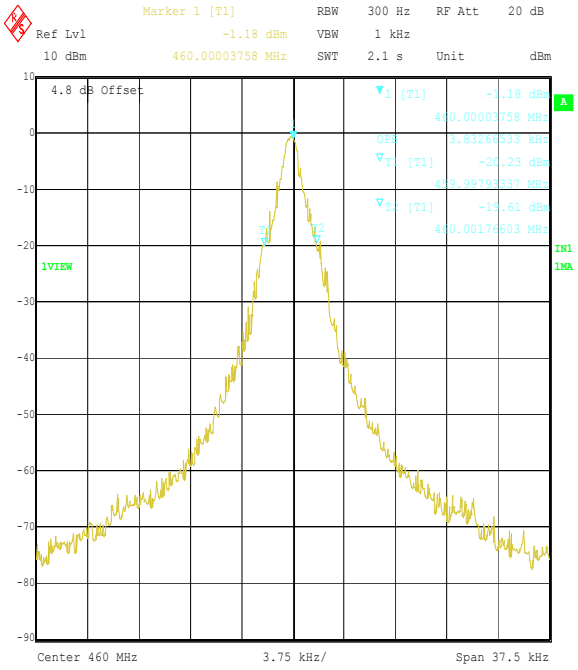
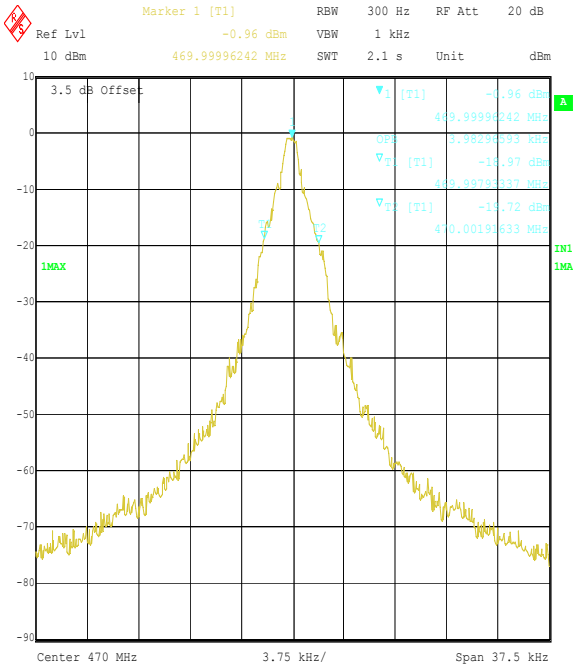
Transmitter Occupied Bandwidth (Bandwidth Limitations): Sections 90.209/90.267/2.1049 (Continued)



Title: Draeger EUT: Portable Radio Unit. FCC P90 Emission Bandwidth
Comment A: 46068JD10 Bottom Channel.
Date: 1.SEP.2004 17:02:10



Title: Draeger EUT: Portable Radio Unit. FCC P90 Emission Bandwidth
Comment A: 46068JD10 Middle Channel.
Date: 1.SEP.2004 16:47:52



Title: Draeger EUT: Portable Radio Unit. FCC P90 Emission Bandwidth
Comment A: 46068JD10 Top Channel.
Date: 1.SEP.2004 16:41:32

7.5. Transmitter Radiated Emissions Masks: Section 90.210

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.

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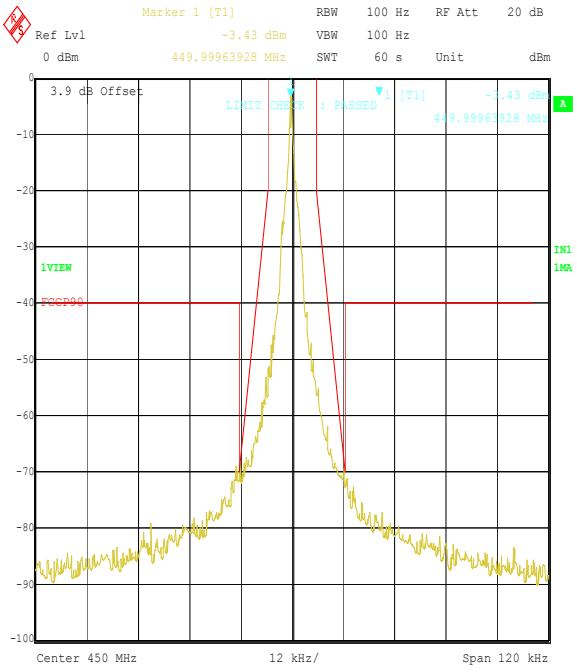
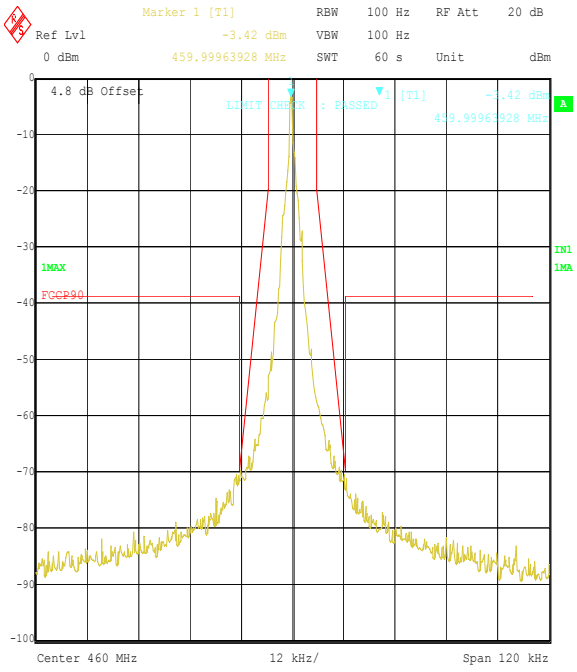
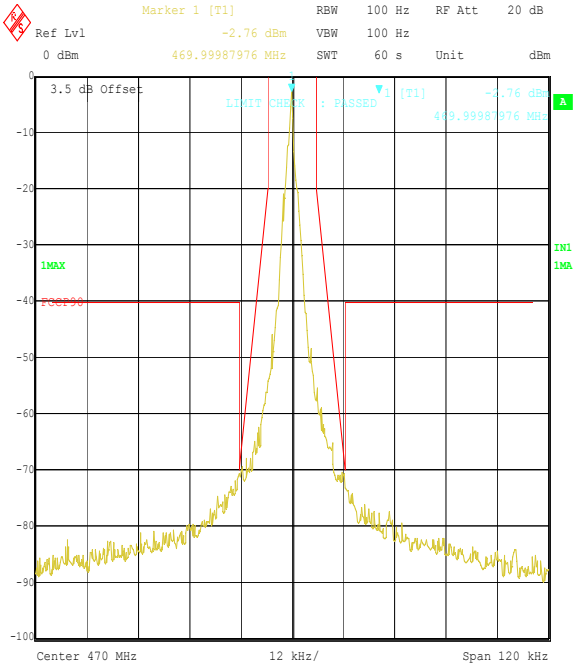
Transmitter Radiated Emissions Masks: Section 90.210 (Continued)



Title: Draeger EUT: Portable Radio Unit. FCC P90.210 Emission Mask
Comment A: 46068JD10 Bottom Channel.
Date: 1.SEP.2004 17:01:22



Title: Draeger EUT: Portable Radio Unit. FCC P90.210 Emission Mask
Comment A: 46068JD10 Middle Channel.
Date: 1.SEP.2004 16:46:56



Title: Draeger EUT: Portable Radio Unit. FCC P90.210 Emission Mask
Comment A: 46068JD10 Top Channel.
Date: 1.SEP.2004 16:40:38

Test Of: **Draeger Safety UK**
460MHz Portable Radio Unit
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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 emission levels.

Result: Bottom Channel

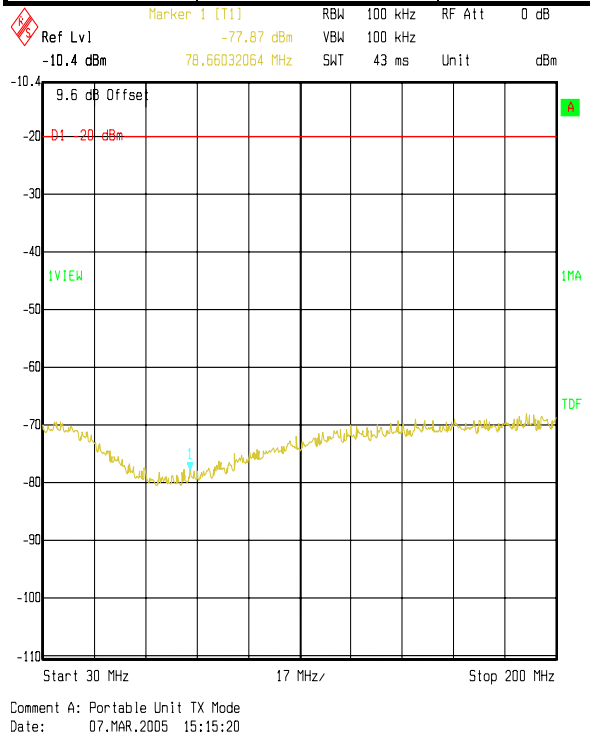
Frequency (MHz)	Peak Emission Level (dBm)	Peak Emission Level (dBc)	Limit (dBc)	Margin (dB)	Result
899.991	-36.7	-57.2	-40.5	16.7	Complied
1349.984	-49.8	-70.3	-40.5	29.8	Complied

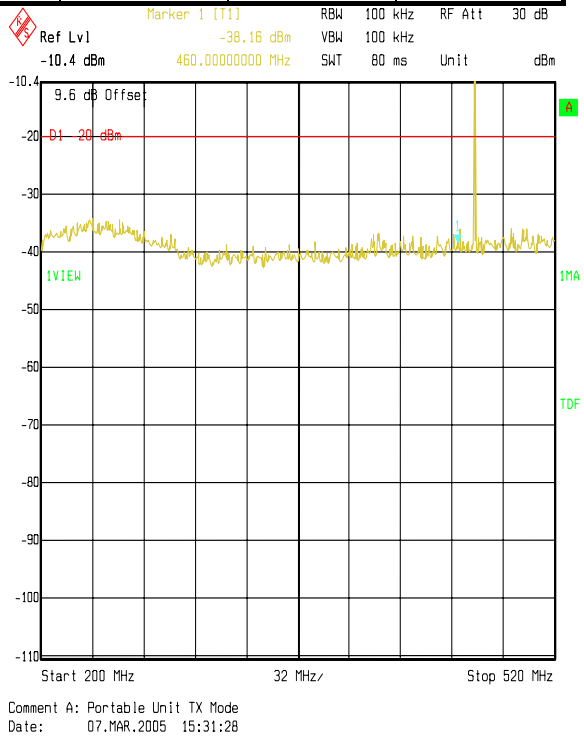
Result: Middle Channel

Frequency (MHz)	Peak Emission Level (dBm)	Peak Emission Level (dBc)	Limit (dBc)	Margin (dB)	Result
919.997	-38.2	-58.2	-40.0	18.2	Complied
1379.977	-58.6	-78.6	-40.0	38.6	Complied

Result: Top Channel

Frequency (MHz)	Peak Emission Level (dBm)	Peak Emission Level (dBc)	Limit (dBc)	Margin (dB)	Result
940.003	-32.8	-53.5	-40.7	12.8	Complied
1409.987	-58.5	-79.2	-40.7	38.5	Complied





Note: The 200 MHz to 520 MHz plot shows an emission at 470 MHz. This is the fundamental transmission frequency of the top channel i.e. it is the wanted emission and lies within the allowed operating frequency band.

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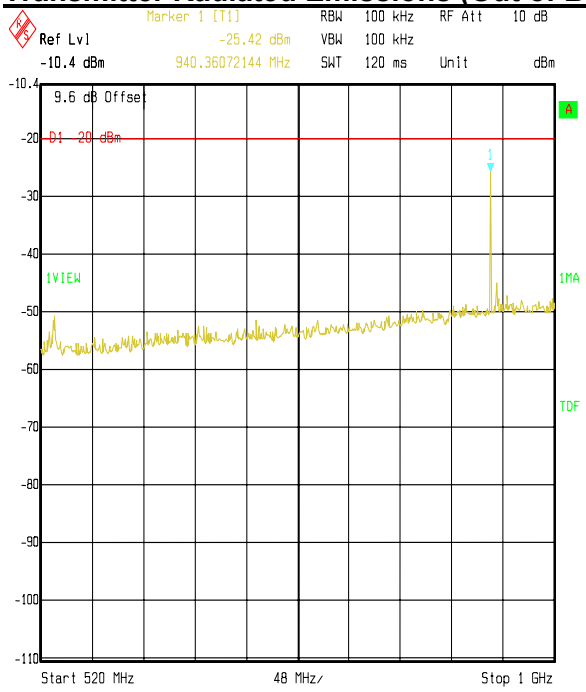
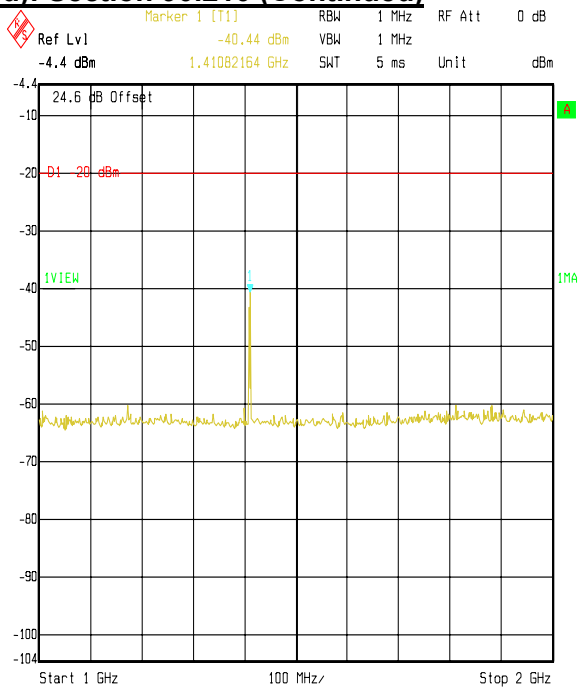
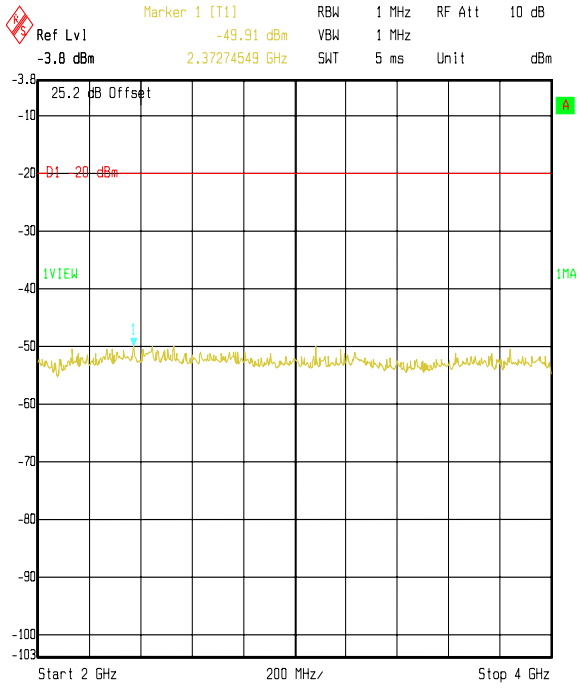
Transmitter Radiated Emissions (Out of Band): Section 90.210 (Continued)



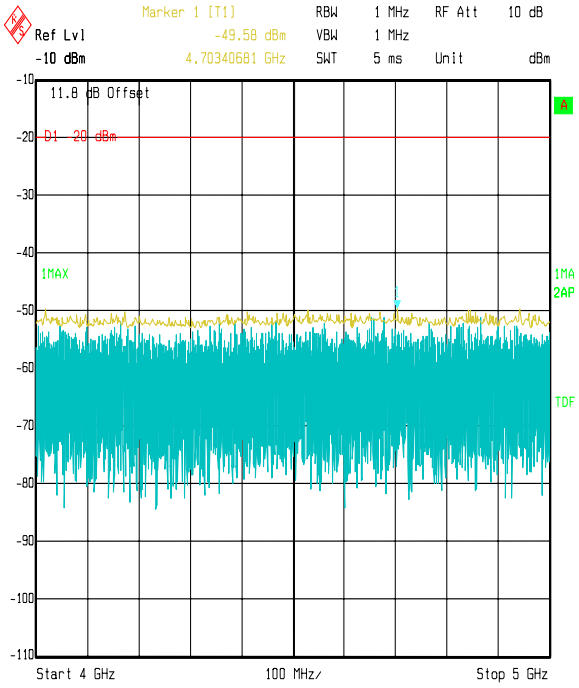
Comment A: Portable Unit TX Mode
Date: 07.MAR.2005 15:32:30



Comment A: Portable Unit TX Mode
Date: 07.MAR.2005 17:30:16



Comment A: PORTABLE UNIT TX MODE
Date: 08.MAR.2005 12:01:46



Comment A: Portable Unit TX Mode
Date: 07.MAR.2005 18:45:30

Note 1: these plots are pre-scans 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: Bottom Channel (450.0 MHz)

Temp (°C)	Measured Frequency (MHz)	Frequency Error (Hz)	Frequency Error (ppm)	Limit (ppm)	Margin (ppm)	Result
-30	450.00029	290	0.6	2.5	1.9	Complied
-20	450.00028	280	0.6	2.5	1.9	Complied
-10	450.00027	270	0.6	2.5	1.9	Complied
0	450.00023	230	0.5	2.5	2.0	Complied
10	450.00017	170	0.4	2.5	2.1	Complied
20	450.00002	20	<0.1	2.5	>2.4	Complied
30	450.00000	0	0.0	2.5	2.5	Complied
40	449.99984	-60	0.1	2.5	2.4	Complied
50	449.99977	-230	0.5	2.5	2.0	Complied

Results: Middle Channel (460.0 MHz)

Temp (°C)	Measured Frequency (MHz)	Frequency Error (Hz)	Frequency Error (ppm)	Limit (ppm)	Margin (ppm)	Result
-30	460.00030	300	0.7	2.5	1.8	Complied
-20	460.00029	290	0.6	2.5	1.9	Complied
-10	460.00028	280	0.6	2.5	1.9	Complied
0	460.00023	230	0.5	2.5	2.0	Complied
10	460.00013	130	0.3	2.5	2.2	Complied
20	459.99999	-10	<0.1	2.5	>2.4	Complied
30	459.99994	-60	0.1	2.5	2.4	Complied
40	459.99994	-60	0.1	2.5	2.4	Complied
50	459.99973	-270	0.6	2.5	1.9	Complied

Transmitter Frequency Stability (Temperature Variation) (continued)

Results: Top Channel (470.0 MHz)

Temp (°C)	Measured Frequency (MHz)	Frequency Error (Hz)	Frequency Error (ppm)	Limit (ppm)	Margin (ppm)	Result
-30	470.00031	310	0.7	2.5	1.8	Complied
-20	470.00029	290	0.6	2.5	1.9	Complied
-10	470.00027	270	0.6	2.5	1.9	Complied
0	470.00022	220	0.5	2.5	2.0	Complied
10	470.00014	140	0.3	2.5	2.2	Complied
20	469.99997	-30	0.1	2.5	2.4	Complied
30	469.99993	-70	0.1	2.5	2.4	Complied
40	469.99987	-130	0.3	2.5	2.2	Complied
50	469.99972	-280	0.6	2.5	1.9	Complied

7.8. Transmitter Frequency Stability (Voltage Variation): Sections 90.213/2.1055

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

7.8.2. Tests were performed to identify the maximum frequency error of the EUT with variations in supply voltage.

Results: Bottom Channel (450.0 MHz)

Supply Voltage (V)	Measured Frequency (MHz)	Frequency Error (Hz)	Frequency Error (ppm)	Limit (ppm)	Margin (ppm)	Result
6.0	450.00002	20	<0.1	2.5	>2.4	Complied
5.0	449.99915	-850	1.9	2.5	0.6	Complied

Results: Middle Channel (460.0 MHz)

Supply Voltage (V)	Measured Frequency (MHz)	Frequency Error (Hz)	Frequency Error (ppm)	Limit (ppm)	Margin (ppm)	Result
6.0	459.99999	10	<0.1	2.5	>2.4	Complied
5.0	459.99905	-950	2.1	2.5	0.4	Complied

Results: Top Channel (470.0 MHz)

Supply Voltage (V)	Measured Frequency (MHz)	Frequency Error (Hz)	Frequency Error (ppm)	Limit (ppm)	Margin (ppm)	Result
6.0	469.99997	30	0.1	2.5	2.4	Complied
5.0	469.99896	-1040	2.2	2.5	0.3	Complied

7.9. Transmitter Transient Frequency Behaviour: Sections 90.214

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

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

Results:

Time Intervals	**FREQUENCY DIFFERENCE (kHz)**		
	Bottom Channel	Middle Channel	Top Channel
t1	6.3	2.1	2.0
t2	1.2	1.2	1.6
t3	1.1	1.2	7.5

LIMITS		
Time Intervals	**Maximum frequency difference**	**Frequency Range**
		421 to 512 MHz
t1	+/-12.5 kHz	≤10.0 mS
t2	+/-6.25 kHz	≤25.0 mS
t3	+/-12.5 kHz	≤10.0 mS

Confirm that during the period from the end of t2 to the beginning of t3 the frequency difference does not exceed 2.5 ppm (1125 Hz) of the bottom channel carrier frequency — YES

Confirm that during the period from the end of t2 to the beginning of t3 the frequency difference does not exceed 2.5 ppm (1150 Hz) of the middle channel carrier frequency — YES

Confirm that during the period from the end of t2 to the beginning of t3 the frequency difference does not exceed 2.5 ppm (1175 Hz) of the top channel carrier frequency — YES

Note: 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.

The following graphs are graphical representations of the above results but are not included in the number of pages in this report.

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
Occupied Bandwidth	N/A	95%	+/- 0.12%
Frequency Stability	N/A	95%	+/- 20 Hz
Carrier Output Power (ERP)	30 MHz to 1000 MHz	95%	+/- 1.78 dB
Frequency Stability	Not applicable	95%	+/- 20 Hz
Occupied Bandwidth	Not applicable	95%	+/- 0.12%
Transient Frequency Behaviour	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

9.1. 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 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.

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.

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 - 2003 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 1 GHz**	**Final Measurements Above 1 GHz**
Detector Type:	Peak	Quasi-Peak (CISPR)	Peak/Average
Mode:	Max Hold	Not applicable	Not applicable
Bandwidth:	(100 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

The EUT was connected to a spectrum analyser enabled with an occupied bandwidth function via an antenna test fixture.

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)

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

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

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 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.

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.

For the final measurements the EUT was arranged on a non-conducting turn table on a standard test site compliant with ANSI C63.4 – 2003 Clause 5.4.

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.

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.

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.

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

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.

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

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)

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.

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

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

The EUT was situated within an environmental test chamber and monitored on the communications analyser via an antenna test fixture.

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

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.

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

The EUT was switched off 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.

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.

The frequency error measured was converted to an error in ppm using the following formula as defined by TIA-603-B:-

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

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

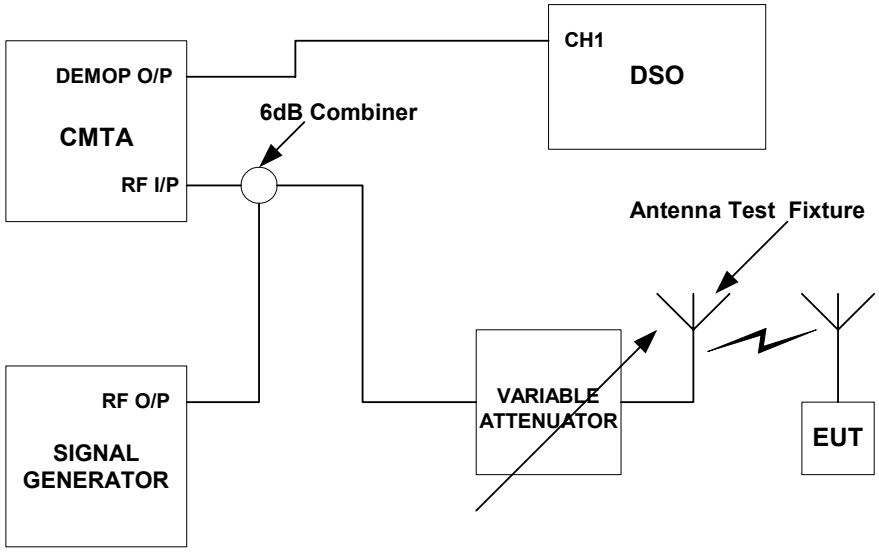
The measured ppm had to be less then the relevant limits in order to comply.

9.5. Transmitter Transient Frequency Behaviour

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

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

Figure 1



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

Appendix 1. Test Equipment Used

RFI No.	Instrument	Manufacturer	Type No.	Serial No.
A027	Horn Antenna	Eaton	9188-2	301
A030	Step Attenuator	Narda	745-69	01544
A031	Horn Antenna	Eaton	91889-2	557
A059	Log Periodic Antenna	EMCO	3146	8902-2378
A091	Biconical Antenna	EMCO	3110	9008-1182
A253	Horn Antenna	Flann Microwave	12240-20	128
A259	Bilog Antenna	Chase	CBL6111	1513
A392	Attenuator	Suhner	6803.17.B	None
A451	Log Spiral Antenna	EMCO	3101	3751
E013	Environmental Chamber	Sanyo	ATMOS chamber	None
G513	Signal Generator	Rohde & Schwarz	SMH	839858/001
M003	Spectrum Monitor	Rohde & Schwarz	EZM	883 580/008
M027	Radiocommunications Analyser	Rohde & Schwarz	CMTA	883 574/004
M028	Spectrum Analyser	Rohde & Schwarz	FSB	860 001/009 (RF); 860 161/007 (DU)
M029	Digital Storage Oscilloscope	Tektronix	2440	0120850
M044	Test Receiver	Rohde & Schwarz	ESVP	891 845/026
M069	Spectrum Analyser/ Test Receiver	Rohde & Schwarz	ESMI	829 808/007 (DU); 827 063/008 (RU)
M127	Spectrum Analyser	Rohde & Schwarz	FSEB 30	842 659/016
M128	DVM	Fluke	76	65340273
M1124	Spectrum Analyser	Rohde & Schwarz	ESIB26	100046K
S010	DC Power Supply	INSTEK	PC-3060	9401927
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.

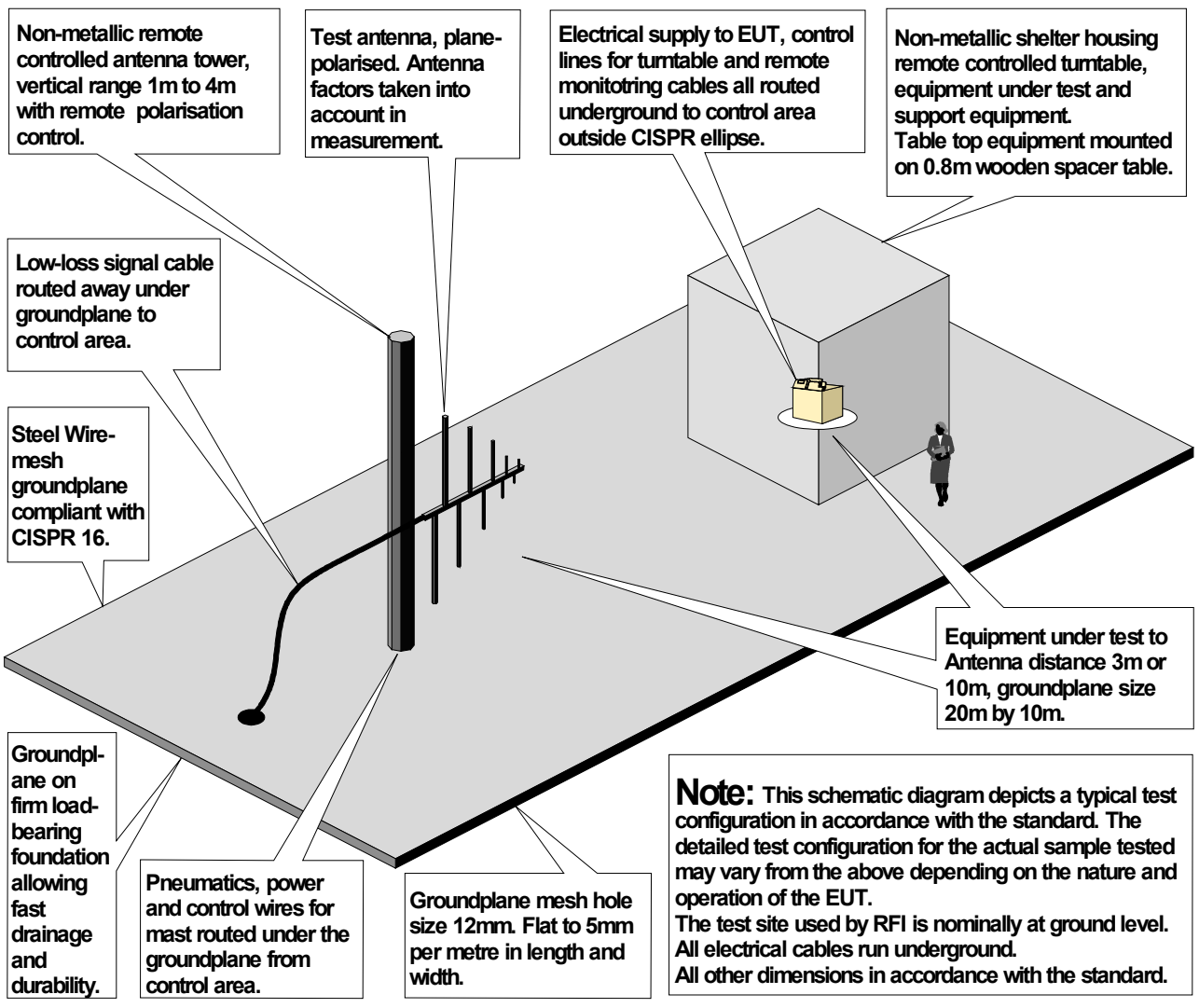
Appendix 2. Test Configuration Drawings

This appendix contains the following drawings:

Drawing Reference Number	Title
DRG\46068JD09\EMIRAD	Test configuration for measurement of radiated emissions

Test Of: Draeger Safety UK
460MHz Portable Radio Unit
To: FCC Part 90: 2004

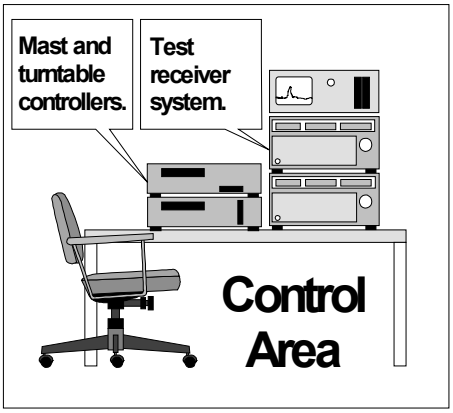
DRG\46068JD09\EMIRAD



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



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