# Test Report

DANAK
Reg. no. 19

## Emission tests to FCC requirements of Laerdal Resusci Anne Simulator

## Performed for Laerdal Medical AS

DANAK-197698
Project no.: E501991-1
Page 1 of 14
5 annexes

22 November 2004

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| | |
|---|---|
| **Title** | Emission tests to FCC requirements of<br>Laerdal Resusci Anne Simulator |
| **Test object** | Laerdal Resusci Anne Simulator |
| **FCC ID** | QHQ-150-00001 |
| **Report no.** | DANAK-197698 |
| **Project no.** | E501991-1 |
| **Test period** | 18 August to 22 September 2004 |
| **Client** | Laerdal Medical AS<br>Tanke Svilandsgt. 30, P.O. Box 377<br>4001 Stavanger<br>Norway<br><br>Telephone: +47 5151 1700<br>Fax: +47 5151 1788 |
| **Contact person** | Mr. Håkon Hodne |
| **Manufacturer** | Laerdal Medical AS |
| **Specifications** | 47 CFR Part 15, Subpart C - Intentional Radiators |
| **Results** | The equipment under test was in compliance with the requirements. |
| **Test personnel** | Henrik Nielsen |
| **Date** | 22 November 2004 |
| **Responsible** | Vagn Sylvest<br>Project Manager - EMC<br>DELTA |

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# 1. Summaries

## 1.1 Technical report summary

The tests reported in this document have been performed to demonstrate compliance with the requirements of FCC Part 15, Section 15.249 "Rules for transmitters in band 902 - 928 MHz".

Furthermore, during the tests it was verified that the receiver was in compliance with the requirements of FCC Part 15.

This report contains measurement data from tests performed at DELTA, Hørsholm, Denmark, an FCC listed and DANAK accredited test laboratory.

### 1.1.1 Applicable FCC rules for test

47 CFR Part 15, Subpart C - Intentional Radiators

§15.207 Conducted limits
§15.209 Radiated emission limits, general requirements
§15.215 Additional provisions to the general radiated emission limitations
§15.249 Operation within the bands 902 - 928 MHz, 2400 - 2583.5 MHz.

The methods and procedures have been applied as specified in:

§15.31 Measurements standards.

This point to the following procedure used during the measurements in this report:

ANSI C63.4:2003 Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz.

Furthermore, the requirements of the following have been applied:

§ 15.33 Frequency range of radiated measurements
§ 15.35 Measurement detector functions and bandwidths.

## 1.2 Summary of tests

The results of the emission tests can be summarised as follows:

| Tests of Intentional Radiator | Key references to requirement | FCC Part 15 Subpart C |
|---|---|---|
| Conducted emission, AC mains | § 15.207 | Passed |
| Radiated electromagnetic field emission | §15.209 | Passed |
| Radiated emission limits, additional provisions | §15.215 and §15.249 | Passed |
| Emission in restricted bands | §15.205 | Passed |

Abbreviations

| | | |
|---|---|---|
| Passed | : | The requirements are met. |
| Failed | : | The requirements are not met. |
| Not done | : | No test was performed. |
| N/A | : | Not applicable. |
| Not relevant | : | The test was not relevant for the test object. |

The test results relate only to the objects tested.

# 2. Test objects

The Resusci Anne Simulator is used for basic and intermediate life support training for healthcare providers and is intended for use in professional training facilities.

This manikin can be programmed to perform a variety of capabilities using either a PC via an USB interface or a Laerdal Operating Device using RF link on 916 MHz carrier.

On the main board of the manikin is mounted a radio transceiver for communication with the operating device.

The test object can on the air interface receive and transmit data on one of five customer selected frequencies between 915.606 MHz and 916.484 MHz. The carrier is FSK modulated with 64 kHz swing at a bit rate of 9600 bps.

During test two modules were used, one programmed to Rx-only (Unit-2) and the other to constant Tx.

## 2.1 Test object - Resusci Anne Simulator (Tx & Rx)

| | |
|---|---|
| Category | Short Range Device |
| Manufacturer | Laerdal Medical AS |
| Model / type | RA BLS Simulator |
| Part no. | 150-00001 |
| Serial no. | Unit-1 |
| FCC ID | QHQ-150-00001 |
| Supply voltage | 9 VDC via 230 VAC adapter |
| Operational mode | TX-only |

## 2.2 Test object - Resusci Anne Simulator - Control board only (Rx)

| | |
|---|---|
| Category | Short Range Device |
| Manufacturer | Laerdal Medical AS |
| Model / type | RA BLS Simulator |
| Part no. | FST1959 |
| Serial no. | Unit-2 |
| FCC ID | QHQ-150-00001 |
| Supply voltage | 9 VDC via 230 VAC adapter |
| Operational mode | Rx-only |
| Note | This unit consist of a bare PCB with the RF circuit and digital control electronics. Main purpose is to verify that LO leakage is within specifications. |

## 2.3 Test object - Power adapter for Resusci Anne Simulator (for Unit-1)

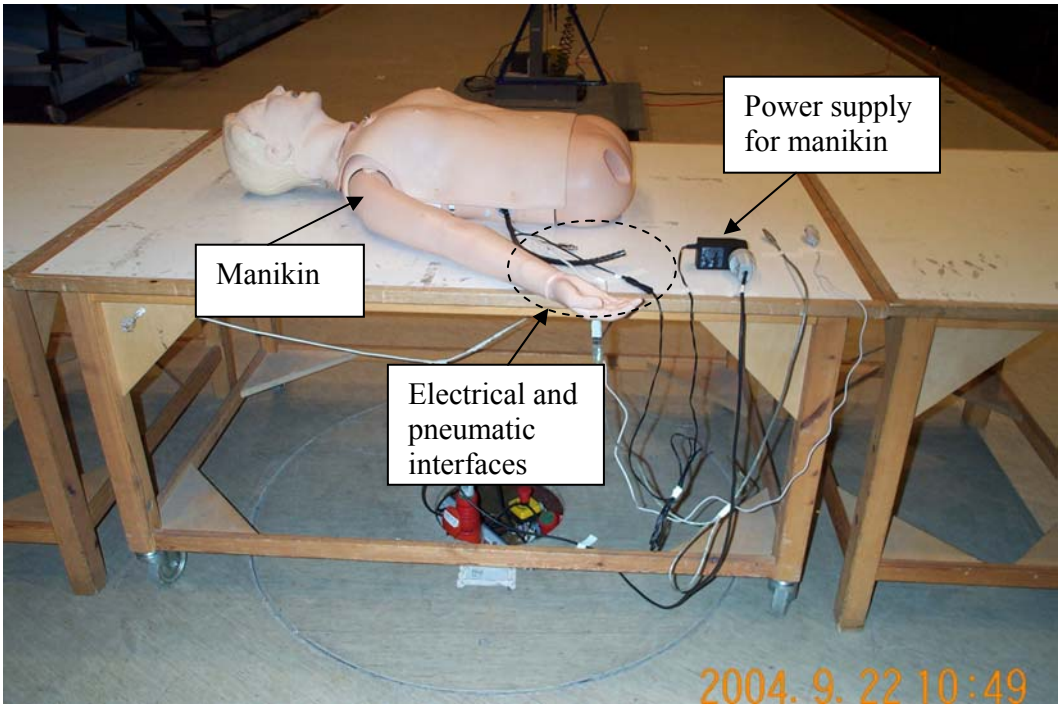
| | |
|---|---|
| Category | IT |
| Manufacturer | Friwo |
| Model / type | FW75550/09 |
| Part no. | KID3129 |
| Serial no. | Test Unit 101 |
| Supply voltage | 100-240 VAC 9VDC 1.5A |
| Operational mode | Normal operation |

## 2.4 Test object - Power adapter for Resusci Anne Simulator (for Unit-2)

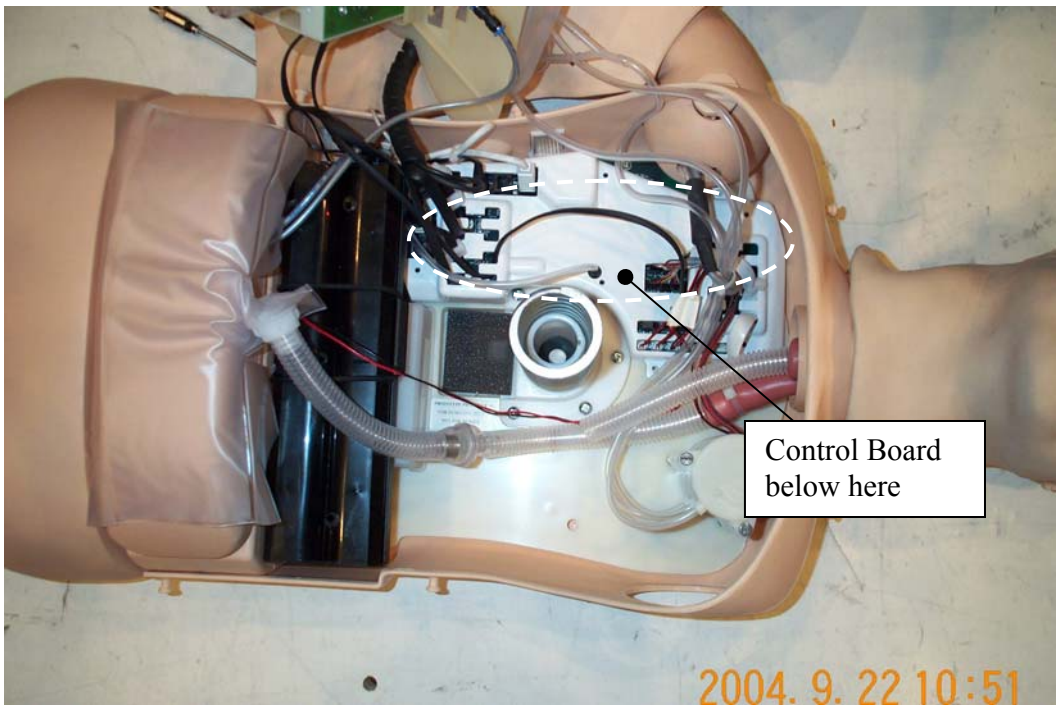
| | |
|---|---|
| Category | IT |
| Manufacturer | Friwo |
| Model / type | FW75550/09 |
| Part no. | KID3129 |
| Serial no. | Test Unit 102 |
| Supply voltage | 100-240 VAC 9VDC 1.5A |
| Operational mode | Normal operation |

# 3. General test conditions

## 3.1 Test setup




Resusci Anne Simulator. External view.




Resusci Anne Simulator. Breast plate removed.

The antenna of the EUT module is an internal PCB antenna on the Control board.

The module was also tested in receive-only mode to verify compliance with CFR47 Part 15. The test record sheets are contained in *Annex 4*, sheets 11 and 20, at which time the LO leakage has been adjusted. Plots of measurements above 1 GHz is found on sheets 21and 23.

The EUT can be configured and monitored by a Laerdal Operating Device, FCC ID QHQ-FST1909. If radio communication is unreliable it is possible to interconnect the Operating Device with the Control Unit using a cable.

The EUT is configured to transmit un-modulated carrier. The EUT can be powered by batteries or by AC/DC converter supplied from mains power. During tests the units were supplied from 115 VAC.

A Control Board in receive-only was used to verify receiver spurious requirements.

# 4. Test and results

## 4.1 Conducted emission, AC mains (FCC Part 15, Subpart C)

| | Requirements | |
|---|---|---|
| Specification | FCC Rules and Regulations Part 15, Subpart C | |
| Test set-up | ANSI C63.4:2003 | |
| Frequency range | 0.15-30 MHz | |
| Limit using quasi-peak detector | 0.15-0.50 MHz *)<br>0.50-5.0 MHz<br>5.0-30 MHz | 66-56 dBµV<br>56 dBµV<br>60 dBµV |
| Limit using average detector | 0.15-0.50 MHz *)<br>0.50-5.0 MHz<br>5.0-30 MHz | 56-46 dBµV<br>46 dBµV<br>50 dBµV |
| *) decreasing linear with the logarithm of frequency | | |
| Test set-up<br>Test record sheets | | *Annex 2*<br>*Annex 3* |

**Results**

The module is in compliance with the requirements.

**Comments**

None.

## 4.2 Radiated electromagnetic field (FCC Part 15, Subpart C)

| | **Requirements** | |
|---|---|---|
| Specification | FCC Rules and Regulations Part 15, Subpart C | |
| Test set-up | ANSI C63.4:2003 | |
| Measuring distance | 3 m | |
| Frequency range | 30-10.000 MHz | |
| Limits:<br>As specified in<br>15.209(a) | 30-88 MHz:<br>88-216 MHz:<br>216-960 MHz:<br>Above 960 MHz: | 40 dBµV/m<br>43.5 dBµV/m<br>46 dBµV/m<br>54 dBµV/m |
| Measurement uncertainty (2 σ) <1 GHz<br>Measurement uncertainty (2 σ) >1 GHz | | 2.6 dB<br>4.9 dB |
| Below 1 GHz the limits apply to measurements performed using a quasi-peak detector.<br>Above 1 GHz the limits apply to measurements of spurious emission performed with an average detector.<br>Furthermore, the peak level must be no higher than 20 dB above the average limit. | | |
| Test set-up<br>Test record sheets | | *Annex 2*<br>*Annex 4* |

Two modules were measured, sometimes simultaneously, one in Rx mode and one in Tx mode.

If for a frequency band only plots from one polarisation have been included, this will be the worst case plot.

On plots from the R&S receiver, found as A4-portrait plots, statements like "Ant 1 m vertical" and "4 m horizontal" are the antenna positions used during exploratory measurements.

The module was also tested in receive-only mode to verify compliance with CFR47 Part 15. The test record sheets are included in this report. The test record sheets with results from the receiver are contained in *Annex 4*, sheets 11 and 20, at which time the LO leakage has been adjusted. Plots of measurements of the receiver above 1 GHz is found on sheets 21and 23.

Measurements 1 - 2.75 GHz were performed using an R&S test receiver. The tabulated values on the plot are the measured average values using a resolution bandwidth of 1 MHz.

Plots from 2.75 - 10 GHz are spectrum analyser plots in peak-hold mode. Peak-to-Average Factor is established to be 0 dB, because un-modulated carrier is transmitted.

Therefore, AVG emission values are 0 dB lower than the values indicated on the spectrum analyser plots.

**Results**

The emission was within the specified limits.

Spurious emission 30 - 1000 MHz in tabular form:
(For spectral plots see *Annex 4*)

| Spurious freq. MHz | Polarisation | QPeak dBµV/m | dB below QP limit | Note |
|---|---|---|---|---|
| 143.200 | H | 27,3 | 16.2 | |
| 159.000 | H | 32,7 | 10,8 | |
| 264.000 (R) | H | 40.4 | 5.6 | |
| 436.300 | V | 32.5 | 13.5 | |
| 576.000 | H | 31,8 | 14.2 | |
| 592.800 | V | 31.7 | 14.3 | |
| 915.49 | V | 38.8 | 7.2 | LO Leakage |

(R) means frequency in restricted band as defined in §15.205.

Spurious emission 1000 MHz to 10 GHz in tabular form:
(For spectral plots see *Annex 4*)

| Spurious freq. MHz | Polarisation | Peak dBµV/m | Average dBµV/m | dB below peak limit | dB below average limit | Note |
|---|---|---|---|---|---|---|
| 1832.17 | H | 53.7 | 53.7 | 20.2 | 0.2 | 2nd harm. |
| 2748.25 (R) | H | 47.2 | 47.2 | 26.7 | 6.7 | 3rd harm. |
| 3656.3 (R) | V/H | 52.3 | 52.3 | 21.7 | 1.7 | 4th harm. |

(R) Indicates frequency in restricted band as defined in §15.205.
Average limit is 500 µV/m or 54 dBµV/m.
Peak limit is 20 dB above average limit or 74 dBµV/m.

**General comments**

Measurements of spurious emission are performed with CW carrier.

Measurements 30 - 1000 MHz are performed using a test receiver with quasi-peak detector.

Measurements 1 GHz to 2.7 GHz are performed using a test receiver with average detector and 1 MHz bandwidth.

Measurements above 2.7 GHz are performed using a spectrum analyser in peak-hold mode. Average measurements are performed on spurious peak emission exceeding the average limit, when measured in peak-hold mode.

The average level is determined using one of the following procedures:

a) Measuring the signal using RBW 1 MHz and VBW 10 Hz, and using linear level axis, will give an output showing average value.

b) Measuring the peak value of the signal and reducing it by the peak-to-average factor ratio (in dB), which is calculated as 20*log<duty cycle> or established by measurement using a test receiver.

   The duty cycle is determined as described in C63.4, I4 j).

## 4.3 Occupied bandwidth

The limits of the transmission band are reached when only spurious emission can be measured.

The lower band limit is 902 MHz and the upper band limit is 928 MHz.

In *Annex 5* the occupied bandwidth is obtained from a radio module, using 10 kHz resolution bandwidth. The measurement is relative, based on absolute carrier measurement in peak-mode, where the level of the carrier of the module used for this test is (91.6-46) 45.6 dB above spurious limit. Subtracting 45.6 dB from the maximum value of the relative plots, the following occupied bandwidths are obtained:

**Occupied bandwidth:** 680 kHz measured in 10 kHz bandwidth.

The carrier of the module can be set on frequencies between 915.606 MHz and 916.484 MHz. Taking this into consideration together with the bandwidth, the result is:

The EUT is in compliance with the requirement(s).

Note: In its test configuration the unit is not able to transmit continuous modulated carrier. Only when the unit is switched on an enquiry is transmitted. The plot in *Annex 5* is the sum of some captured transmissions. The spikes are generated when switching. However, the stated occupied bandwidth is worst case because it includes the spikes.

## 4.4 Peak output field strength

The peak output field strength of the unit is limited to 50 mV/m, or 94 dBµV/m, following §15.249(a). Measurements show:

**Peak output field strength**: 84.2 dBµV/m at the frequency 915.67 MHz.

See plot in *Annex 5*.

The EUT is in compliance with the requirement.

# Annex 1

# List of instruments

# (1 page)

| NO. | DESCRIPTION | MANUFACTURER | TYPE NO. | CAL. EXPIRES |
|---|---|---|---|---|
| 29433 | SPECTRUM ANALYZER | HEWLETT-PACKARD | 8566 B | 2004-12-16 |
| 29499 | BROADBAND RF PREAMPLIFIER | EC/MTS TELEMETER | TVV 711 | 2004-11-25 |
| 29680 | IMPULSE VOLTAGE LIMITER | ROHDE & SCHWARZ | ESH3/Z2 | 2004-12-30 |
| 29797 | BILOG ANTENNA, 30-1000 MHz | CHASE ELECTRICS LTD | CBL 6111A | 2005-11-20 |
| 29861 | EMI-SOFTWARE Ver. 1.60 | ROHDE & SCHWARZ | ES-K1, PART: 1026.6790.02 | ONLY CAL. IF REQUIRED |
| 29876 | RIDGED GUIDE HORN ANTENNA, 1-12.75 (18) GHz | EMCO | 3115 | 2005-02-11 |
| 29916 | AUTOMATIC TEST RECEIVER, 9 kHz-2.75 GHz | ROHDE & SCHWARZ | ESCS 30 1102.4500.30 | 2005-01-02 |
| 49037 | BROADBAND MICROWAVE PREAMPLIFIER, 1-12.8 GHz | MITEQ / DELTA | AMF-5D-001128-35-11P | 2005-11-16 |
| 49097 | MICROWAVE HP FILTER 2.75-12.75 GHz, MAX. 2 W | MICRO-TRONICS | HPM13106 | 2005-11-09 |
| 49306 | "CABLE#52", LOW-LOSS uWAVE CABLE, N-N, 8.0 m "EMI" | SUHNER | SUCOFLEX 104 PB | 2005-10-07 |
| 49307 | "CABLE#53", LOW-LOSS uWAVE CABLE, N-N, 7.0 m "EMI" | SUHNER | SUCOFLEX 104 PB | 2005-10-07 |

# Annex 2

# Photos

# (2 pages)

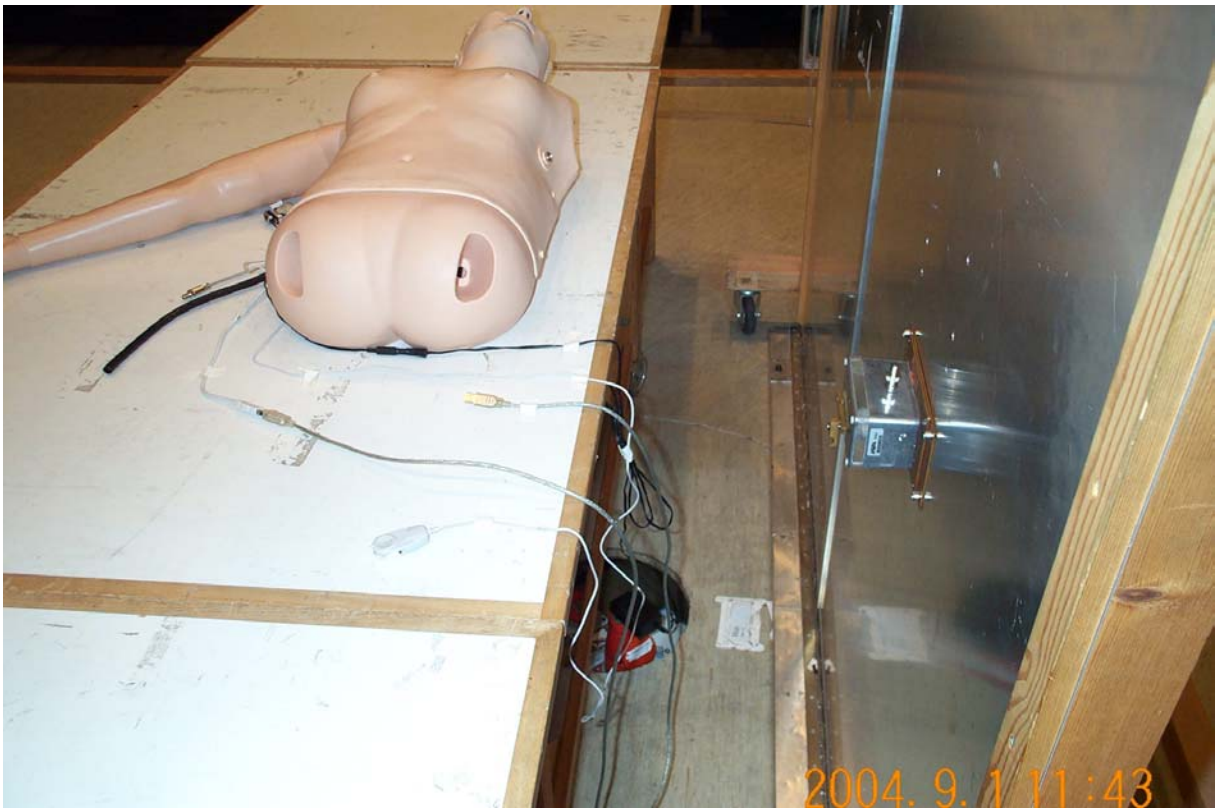



Photo A2.1 Test setup for conducted emission measurements.

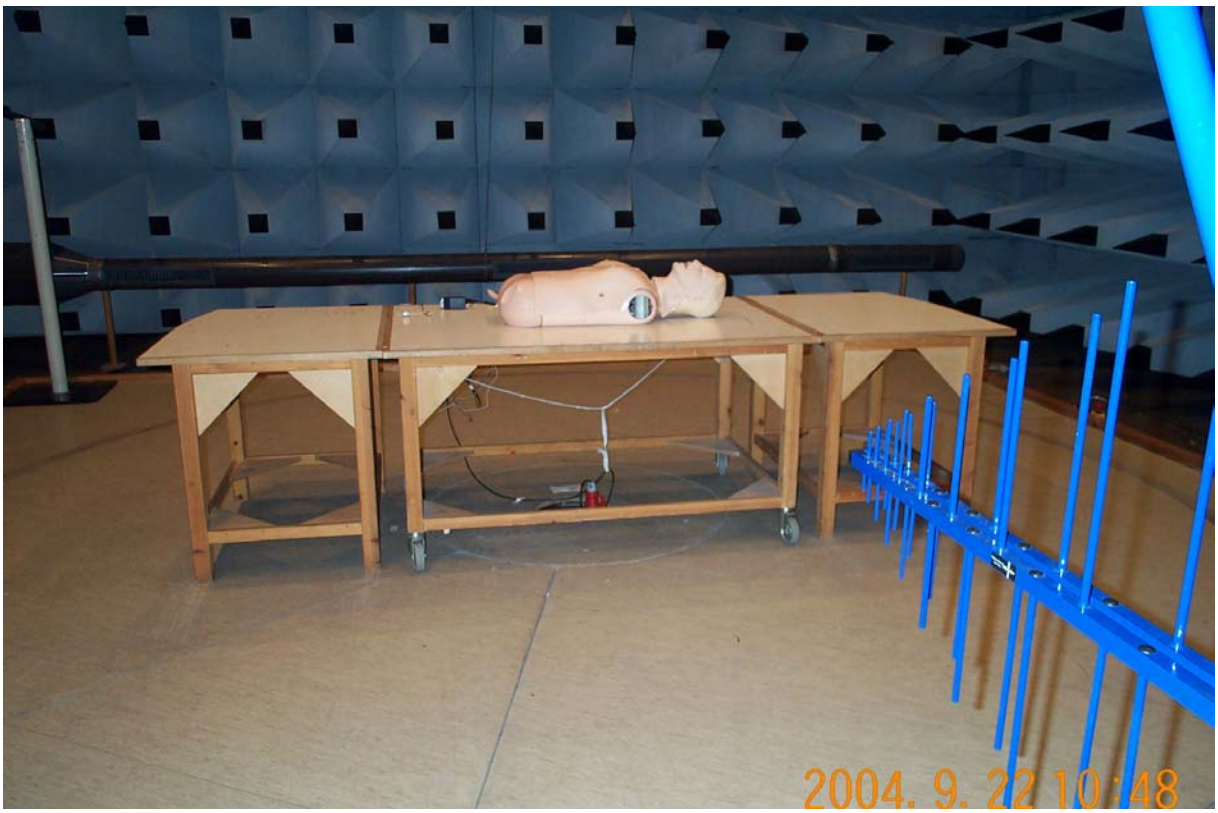



Photo A2.2 Test setup for radiated emission measurements 30-1000 MHz.

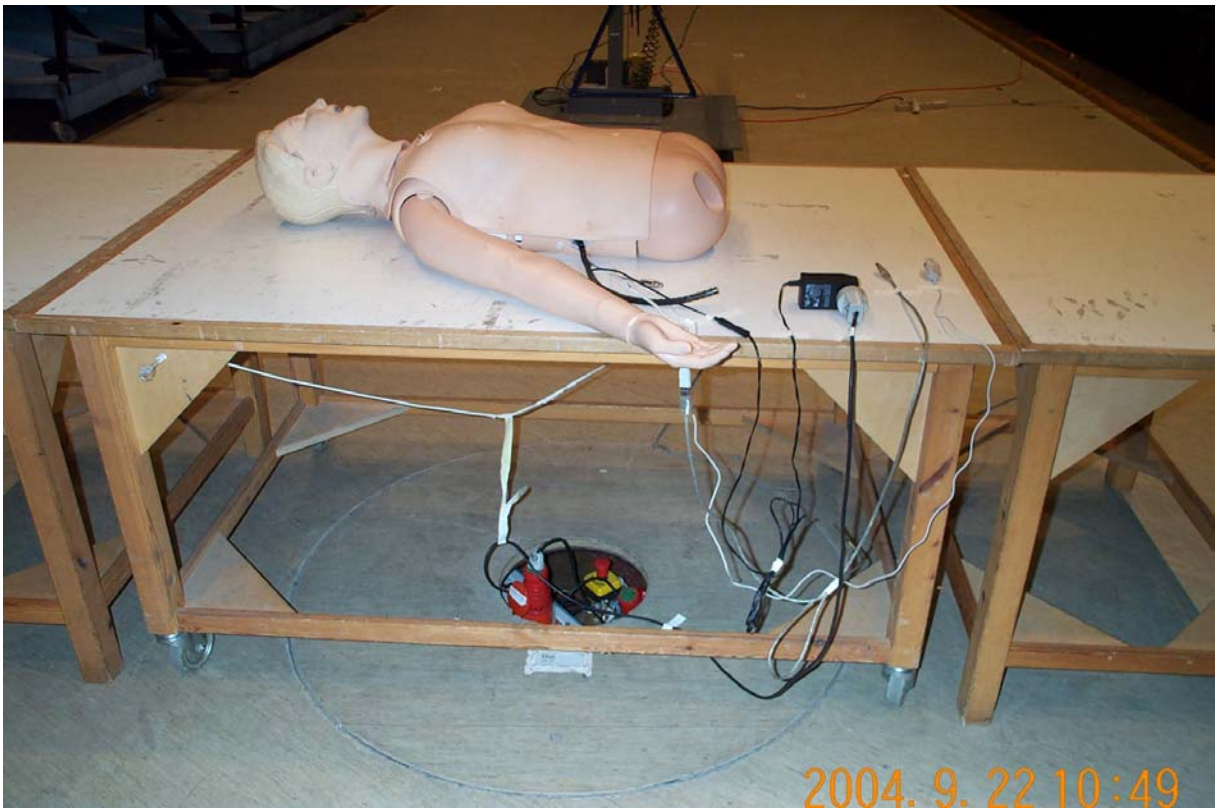



Photo A2.3 Test setup for radiated emission measurements 30-1000 MHz.

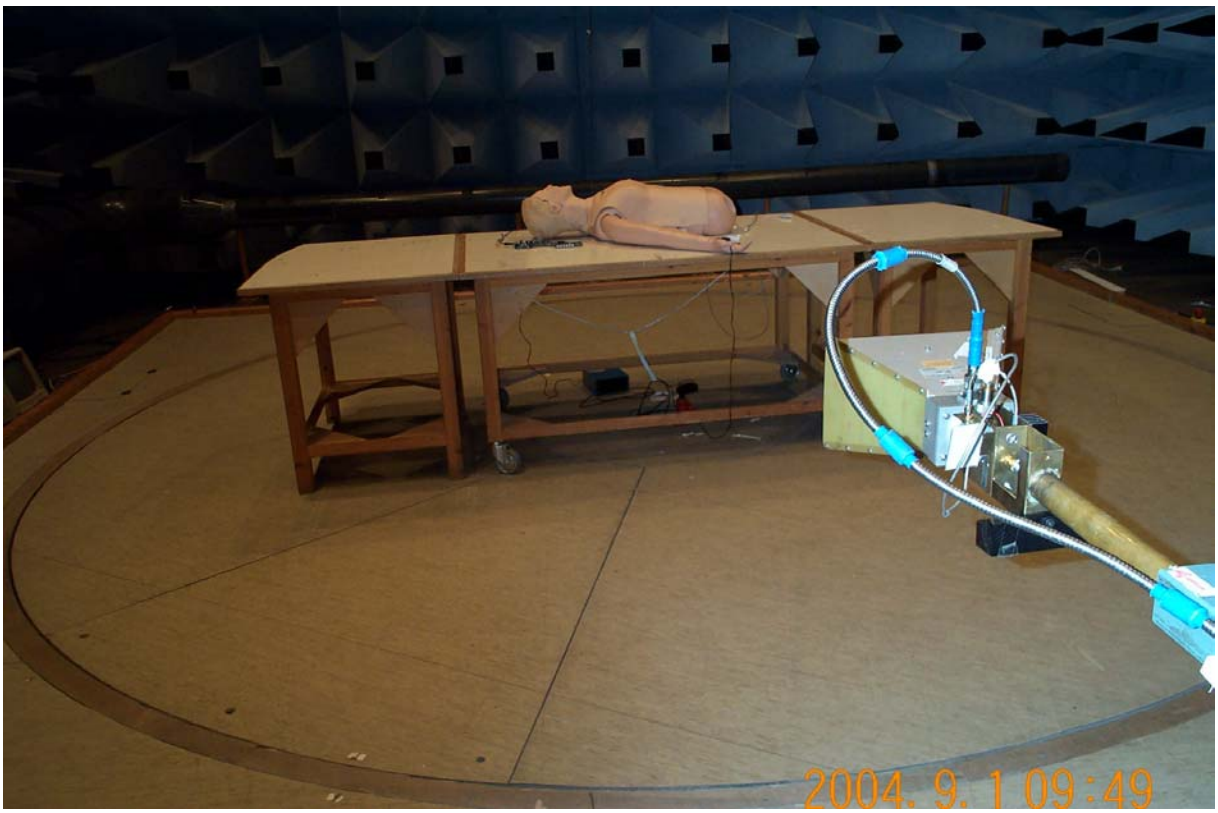


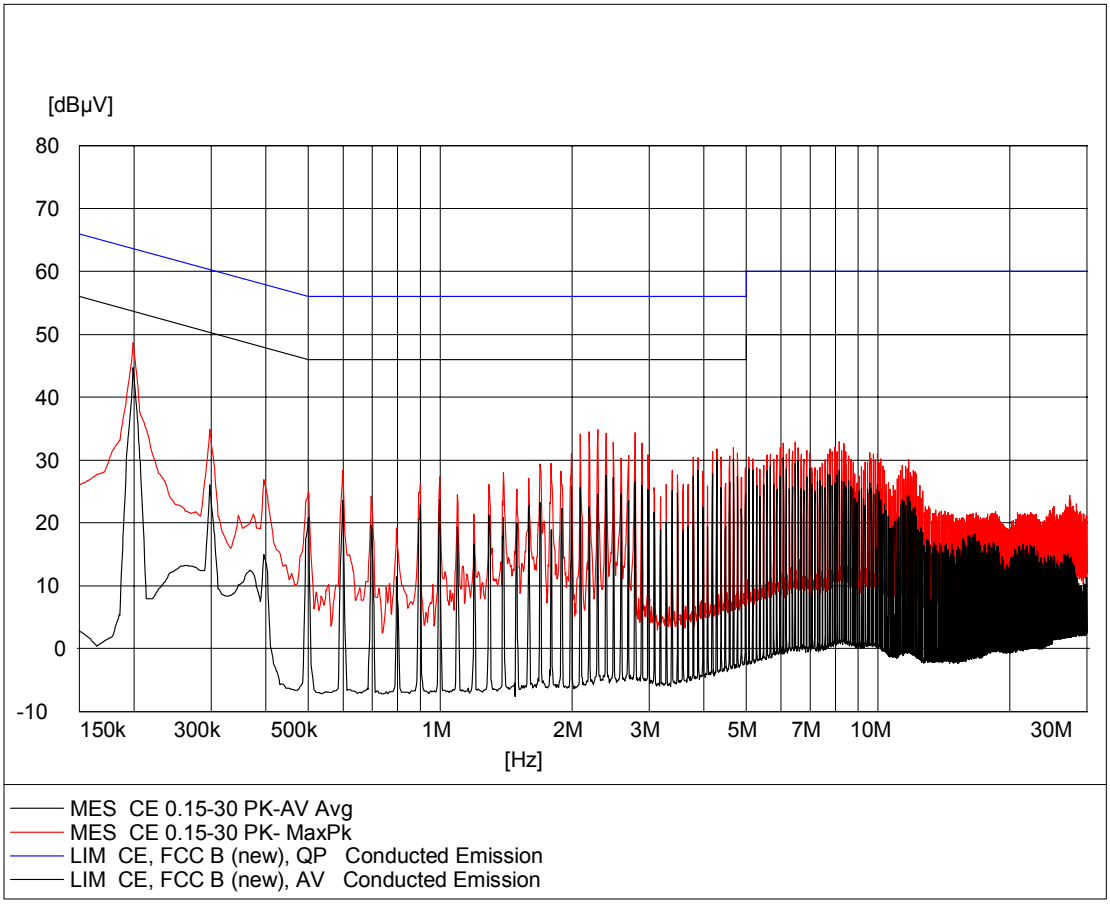

Photo A2.4 Test setup for radiated emission measurements 1-10 GHz.

# Annex 3

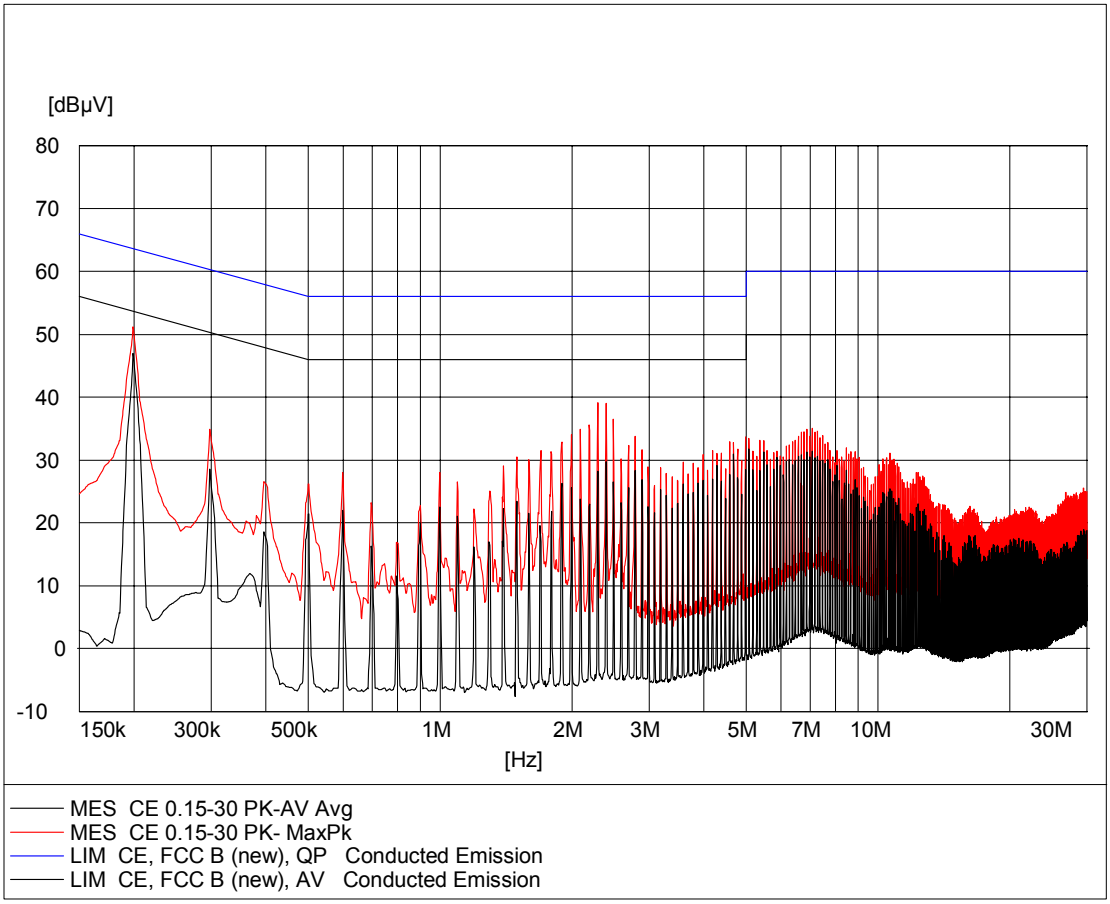
# Test record sheets regarding conducted emission

# (2 pages)

EUT: RA BLS Simulator
Manufacturer: Laerdal Medical AS
Operating Condition: Line no.: Neutral. 120 VAC
Test Site: EMC-5
Operator: HEN - E501991
Test Specification: FCC Part 15 Subpart C
Comment: Sheet 24



```
EUT:                    RA BLS Simulator
Manufacturer:           Laerdal Medical AS
Operating Condition:    Line no.: Line 1. 120 VAC
Test Site:              EMC-5
Operator:               HEN - E501991
Test Specification:     FCC Part 15 Subpart C
Comment:                Sheet 25
```

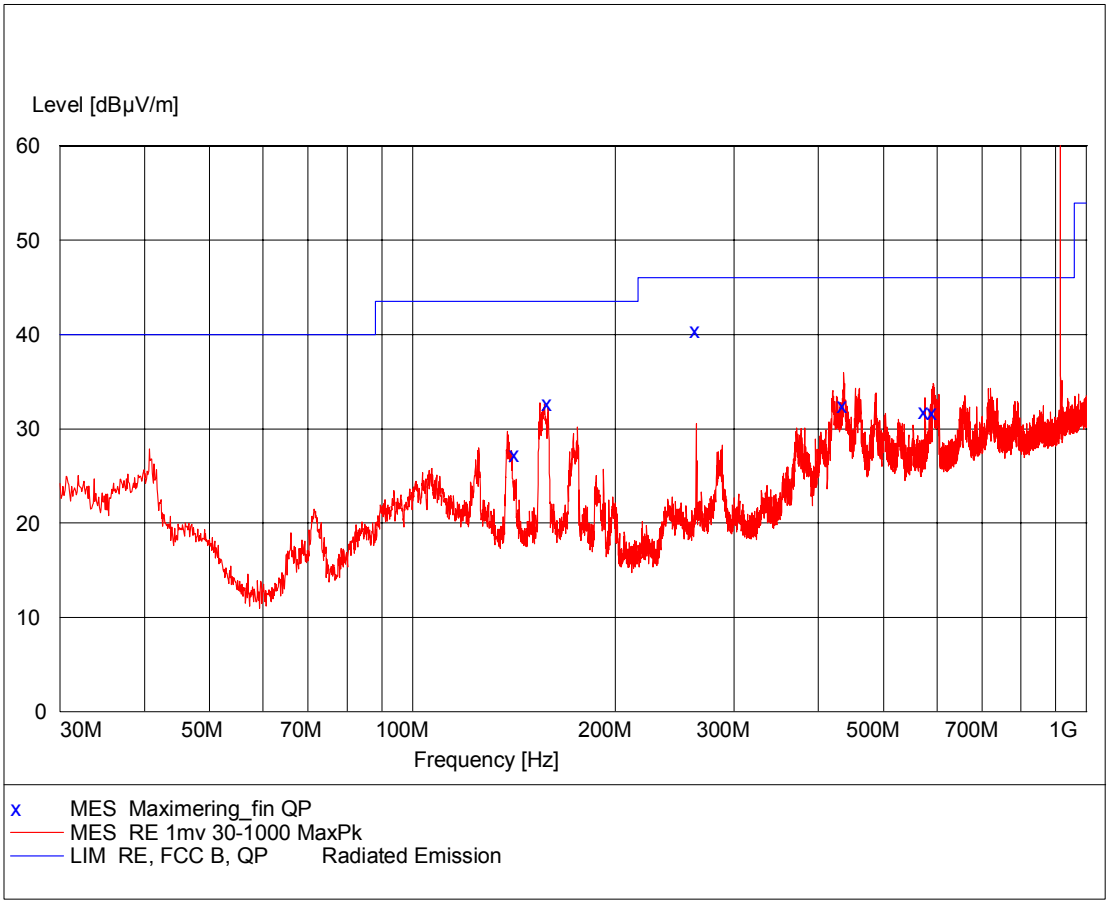


# Annex 4

# Test record sheets regarding radiated emission

# (6 pages)

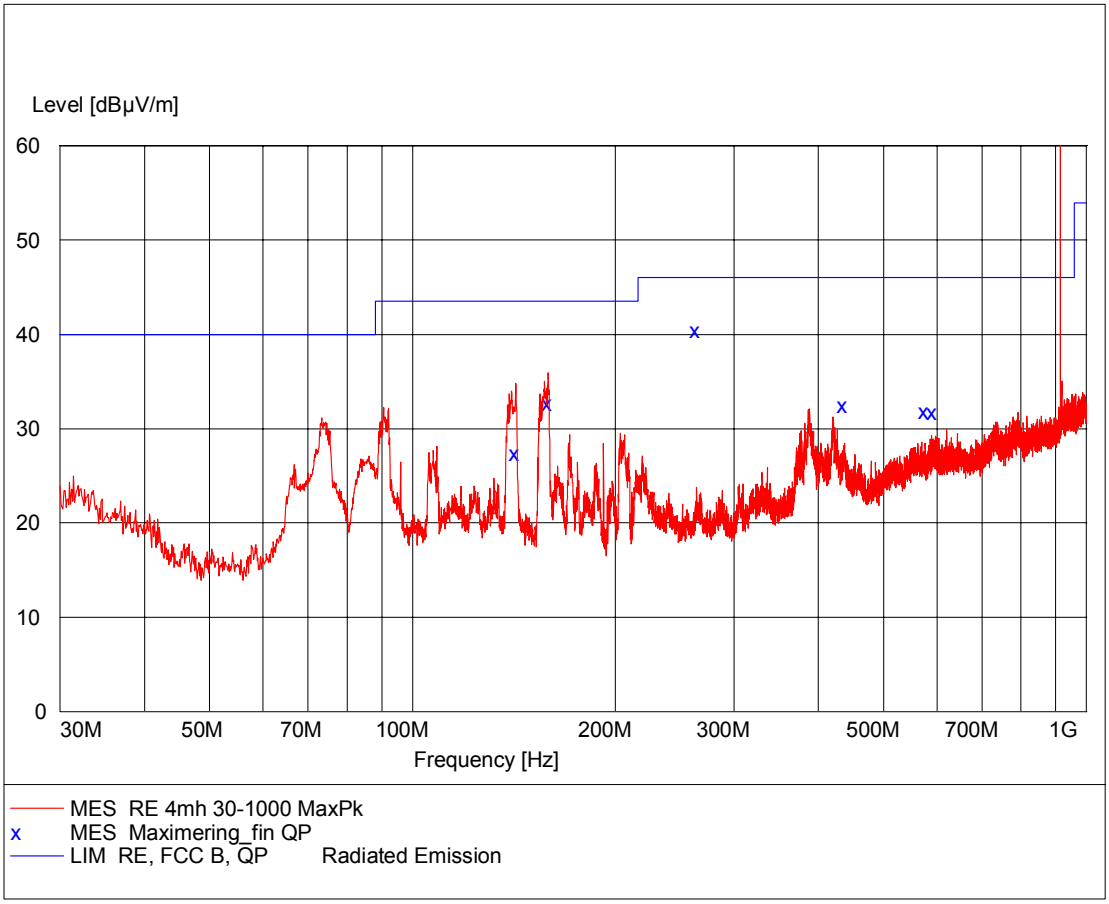
EUT: RA BLS Simulator Tx mode
Manufacturer: Laerdal Medical AS
Operating Condition: Ant. 1 m vertical. 115 VAC
Test Site: EMC-5
Operator: HEN - E501991
Test Specification: FCC Class B
Comment: Sheet 1



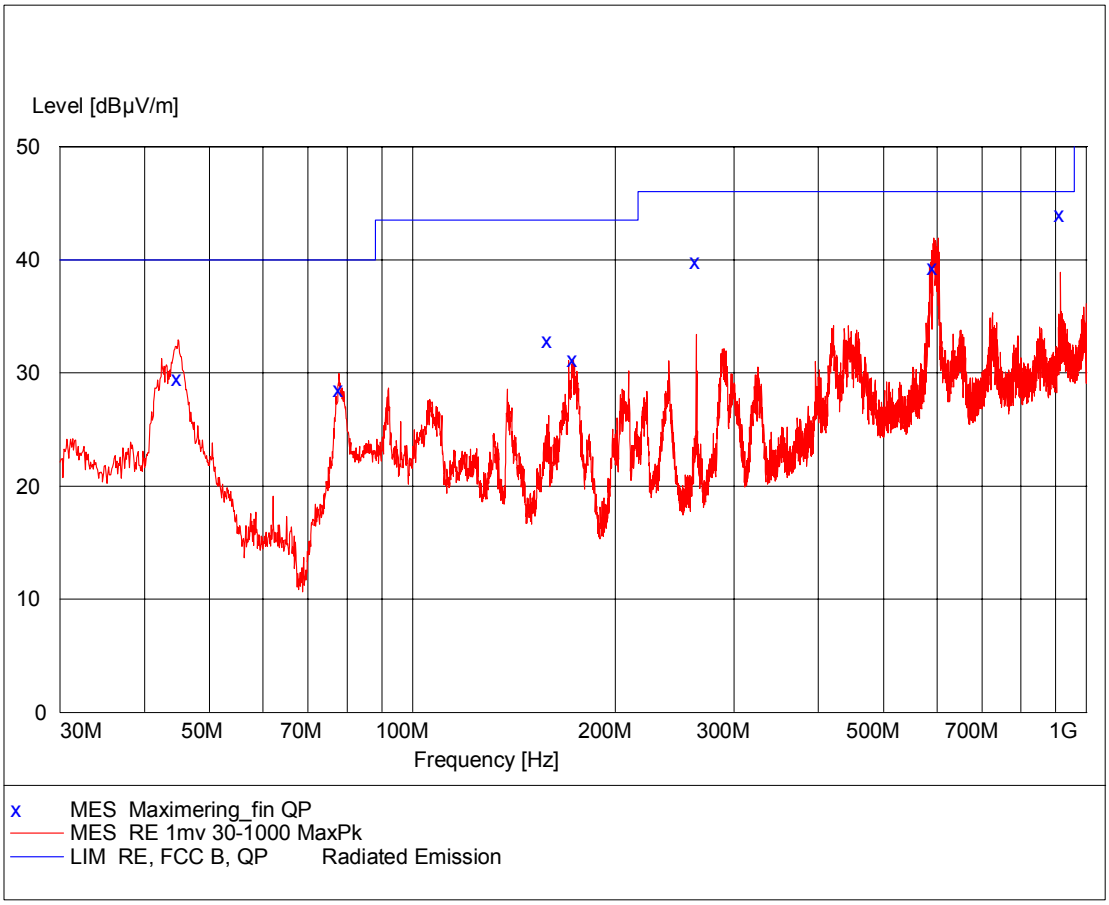

**MEASUREMENT RESULT: "Maximering_fin QP"**
2004-09-22 10:21

| Frequency MHz | Level dBµV/m | Transd dB | Limit dBµV/m | Margin dB | Height cm | Azimuth deg | Polarisation |
|---|---|---|---|---|---|---|---|
| 142.300000 | 27.30 | 14.0 | 43.5 | 16.2 | 208.0 | 358.00 | HORIZONTAL |
| 159.000000 | 32.70 | 13.1 | 43.5 | 10.8 | 200.0 | 8.00 | HORIZONTAL |
| 264.000000 | 40.40 | 15.7 | 46.0 | 5.6 | 101.0 | 266.00 | HORIZONTAL |
| 436.300000 | 32.50 | 20.4 | 46.0 | 13.5 | 112.0 | 168.00 | VERTICAL |
| 576.000000 | 31.80 | 23.5 | 46.0 | 14.2 | 155.0 | 331.00 | HORIZONTAL |
| 592.800000 | 31.70 | 23.5 | 46.0 | 14.3 | 111.0 | 261.00 | VERTICAL |

EUT: RA BLS Simulator Tx mode
Manufacturer: Laerdal Medical AS
Operating Condition: Ant. 3 m horizontal. 115 VAC
Test Site: EMC-5
Operator: HEN - E501991
Test Specification: FCC Class B
Comment: Sheet 2



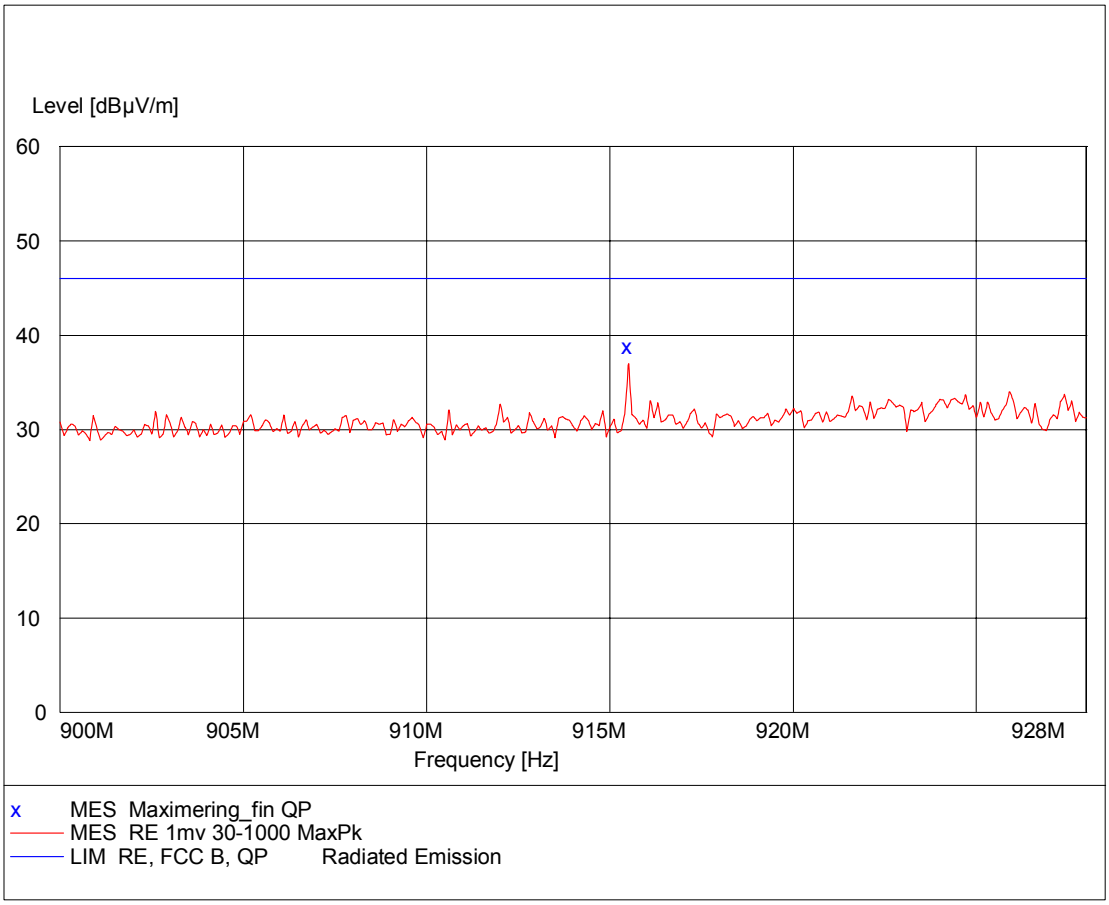
EUT: RA BLS Simulator Rx mode
Manufacturer: Laerdal Medical AS
Operating Condition: Ant. 1 m vertical. 120 VAC
Test Site: EMC-5
Operator: HEN - E501991
Test Specification: FCC Part 15 Subpart C
Comment: Sheet 11




**MEASUREMENT RESULT: "Maximering_fin QP"**
2004-08-18 16:13

| Frequency MHz | Level dBµV/m | Transd dB | Limit dBµV/m | Margin dB | Height cm | Azimuth deg | Polarisation |
|---|---|---|---|---|---|---|---|
| 44.900000 | 29.50 | 12.9 | 40.0 | 10.5 | 101.0 | 344.00 | VERTICAL |
| 77.900000 | 28.50 | 10.2 | 40.0 | 11.5 | 400.0 | 358.00 | HORIZONTAL |
| 159.100000 | 32.90 | 13.1 | 43.5 | 10.6 | 190.0 | 27.00 | HORIZONTAL |
| 173.300000 | 31.20 | 12.4 | 43.5 | 12.3 | 128.0 | 314.00 | HORIZONTAL |
| 264.000000 | 39.90 | 15.7 | 46.0 | 6.1 | 196.0 | 349.00 | VERTICAL |
| 594.000000 | 39.30 | 23.5 | 46.0 | 6.7 | 101.0 | 1.00 | VERTICAL |
| 915.490000 | 44.00 | 28.2 | 46.0 | 2.0 | 101.0 | 96.00 | HORIZONTAL |

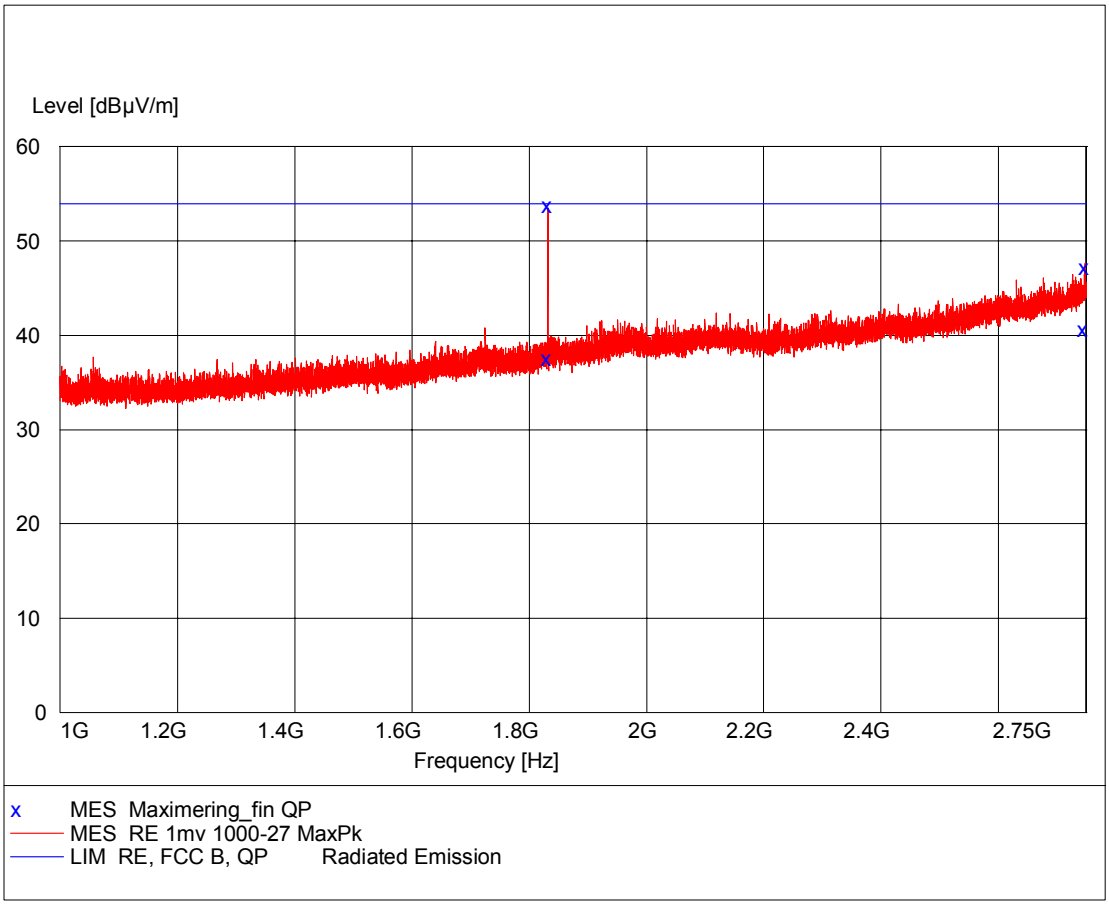
```
EUT:                  RA BLS Simulator Rx mode, LO Leakage
Manufacturer:         Laerdal Medical AS
Operating Condition:  Ant. 1 m vertical. 120 VAC
Test Site:            EMC-5
Operator:             HEN - E501991
Test Specification:   FCC Part 15 Subpart C
Comment:              Sheet 20
```




**MEASUREMENT RESULT: "Maximering_fin QP"**
2004-08-31 15:23

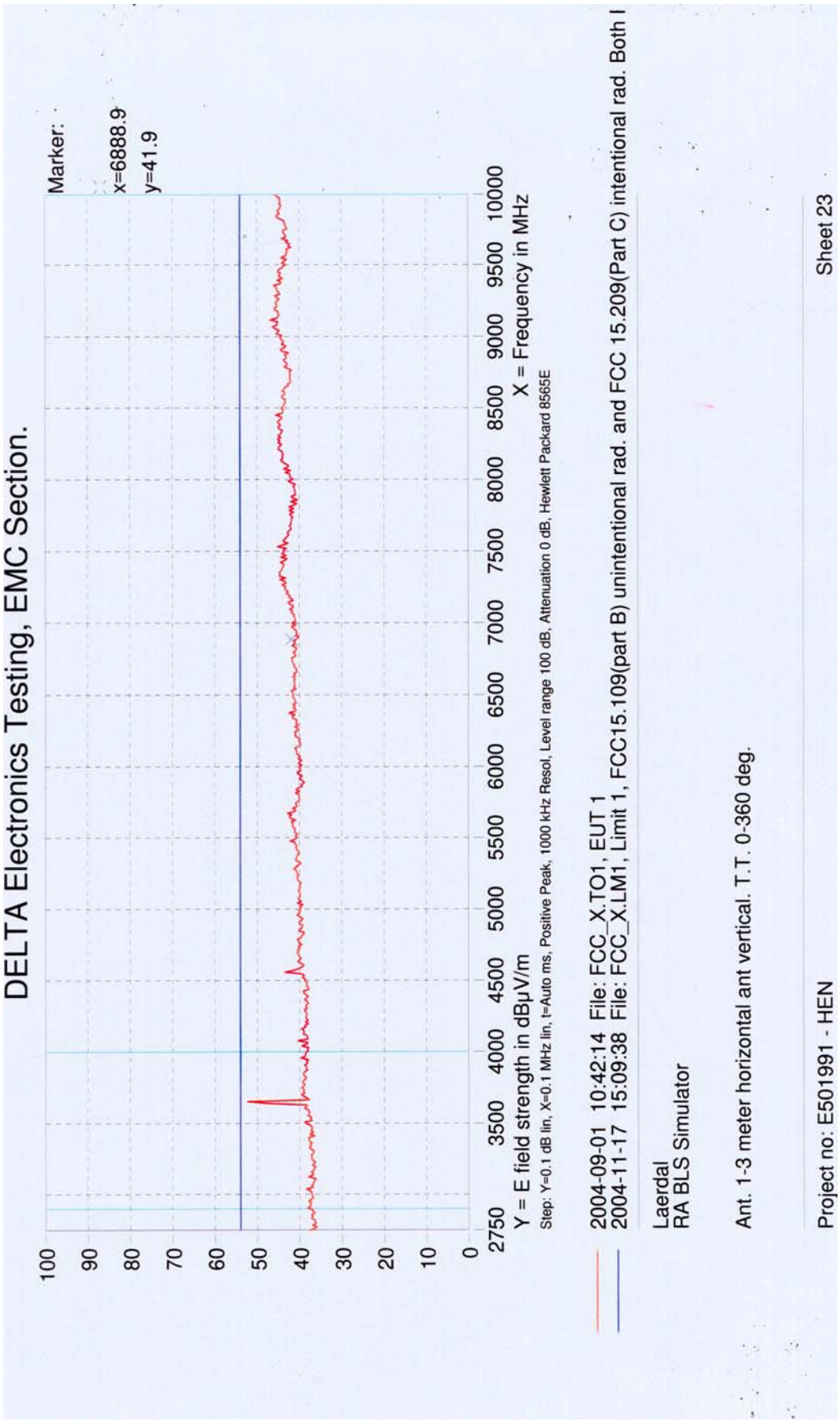
| Frequency MHz | Level dBµV/m | Transd dB | Limit dBµV/m | Margin dB | Height cm | Azimuth deg | Polarisation |
|---|---|---|---|---|---|---|---|
| 915.490000 | 38.80 | 28.2 | 46.0 | 7.2 | 147.0 | 33.00 | VERTICAL |

EUT: RA BLS Simulator Tx and Rx mode
Manufacturer: Laerdal Medical AS
Operating Condition: Ant. 1 m vertical. 120 VAC
Test Site: EMC-5
Operator: HEN - E501991
Test Specification: FCC Part 15 Subpart C
Comment: Sheet 21




**MEASUREMENT RESULT: "Maximering_fin QP"**
2004-09-01 09:33

| Frequency MHz | Level dBµV/m | Transd dB | Limit dBµV/m | Margin dB | Height cm | Azimuth deg | Polarisation |
|---|---|---|---|---|---|---|---|
| 1830.980000 | 37.50 | 34.0 | 53.9 | 16.4 | 112.0 | 20.00 | VERTICAL |
| 1832.170000 | 53.70 | 34.0 | 53.9 | 0.2 | 174.0 | 243.00 | HORIZONTAL |
| 2746.470000 | 40.60 | 37.6 | 53.9 | 13.3 | 254.0 | 321.00 | HORIZONTAL |
| 2748.250000 | 47.20 | 37.6 | 53.9 | 6.7 | 104.0 | 3.00 | HORIZONTAL |

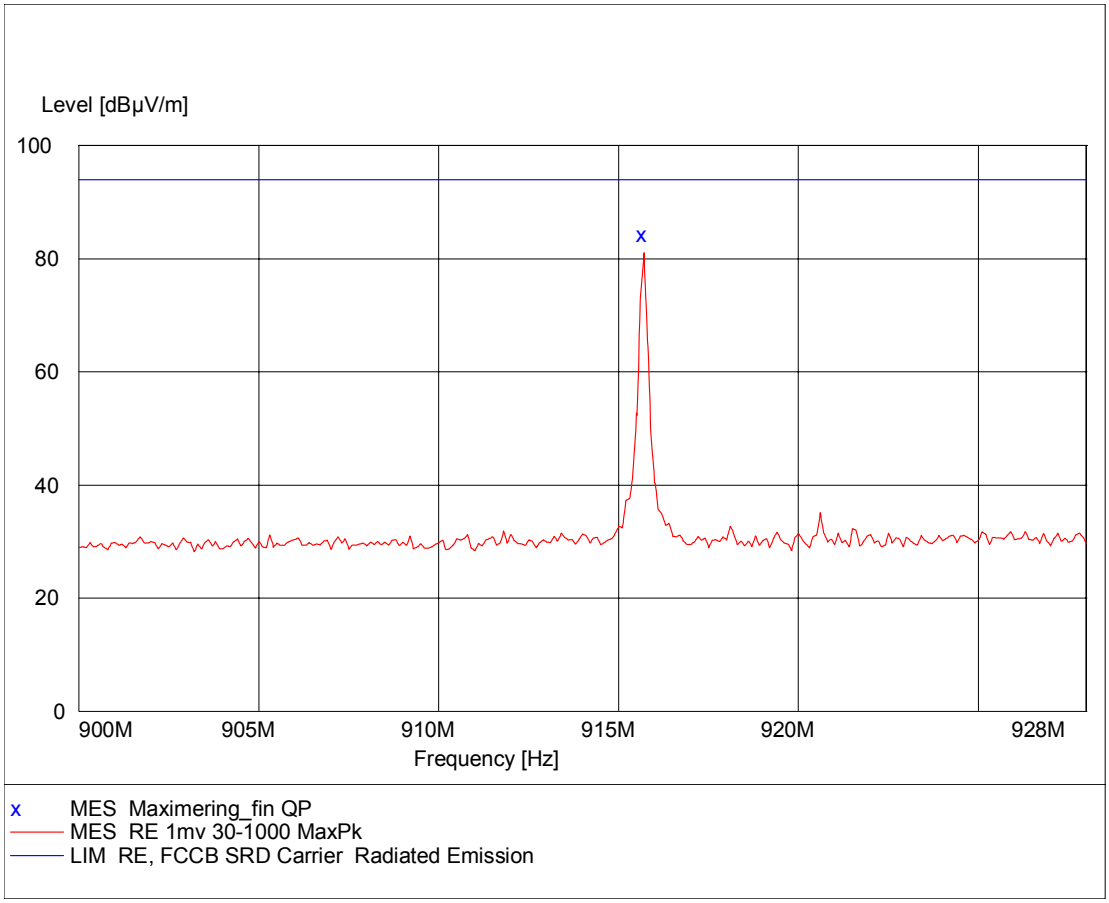

DELTA Electronics Testing, EMC Section.
Marker:
x=6888.9
y=41.9
100
90
80
70
60
50
40
30
20
10
0
2750
3500
4000
4500
5000
5500
6000
6500
7000
7500
8000
8500
9000
9500
10000
Y = E field strength in dBµV/m
X = Frequency in MHz
Step: Y=0.1 dB lin, X=0.1 MHz lin, t=Auto ms, Positive Peak, 1000 kHz Resol, Level range 100 dB, Attenuation 0 dB, Hewlett Packard 8565E
2004-09-01 10:42:14 File: FCC_X.TO1, EUT 1
2004-11-17 15:09:38 File: FCC_X.LM1, Limit 1, FCC15.109(part B) unintentional rad. and FCC 15.209(Part C) intentional rad. Both I
Laerdal
RA BLS Simulator
Ant. 1-3 meter horizontal ant vertical. T.T. 0-360 deg.
Project no: E501991 - HEN
Sheet 23

# Annex 5

# Occupied bandwidth / Peak output power

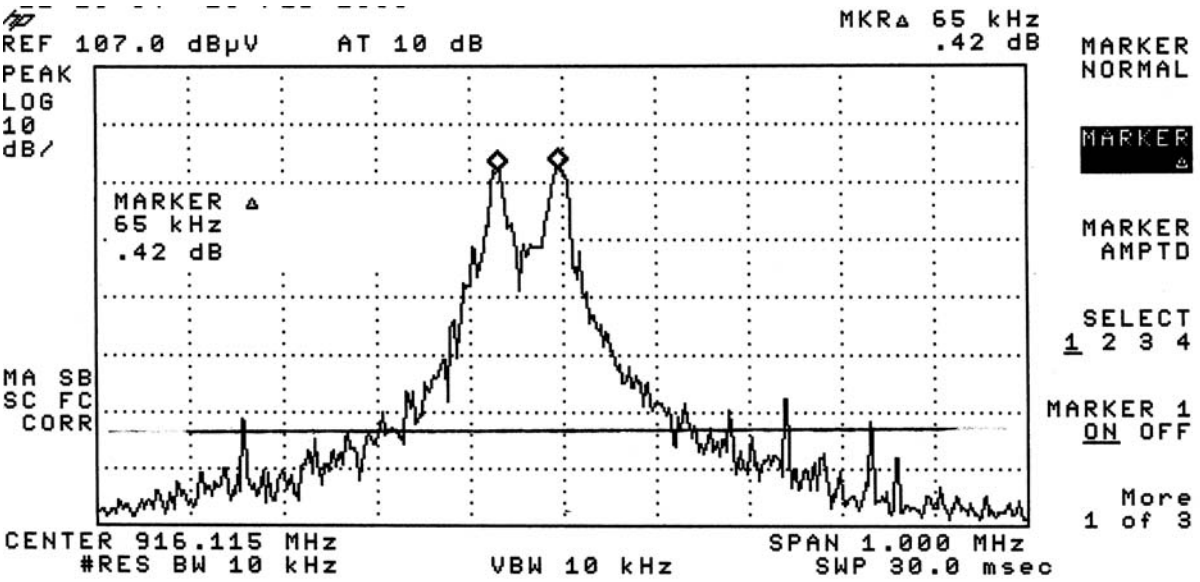
# (2 pages)

EUT: RA BLS Simulator TX carrier
Manufacturer: Laerdal Medical AS
Operating Condition: Ant. 1 m vertical. 115 VAC
Test Site: EMC-5
Operator: HEN - E501991
Test Specification: FCC Class B
Comment: Sheet 3




**MEASUREMENT RESULT: "Maximering_fin QP"**
2004-09-22 10:31

| Frequency MHz | Level dBµV/m | Transd dB | Limit dBµV/m | Margin dB | Height cm | Azimuth deg | Polarisation |
|---|---|---|---|---|---|---|---|
| 915.670000 | 84.20 | 28.2 | 94.0 | 9.8 | 171.0 | 278.00 | VERTICAL |




Occupied bandwidth. See section 4.3