

Test Report



Emission tests to FCC requirements of Laerdal Control unit VitalSim and Power adapter for VitalSim

Performed for Laerdal Medical

DANAK-196771

Project no.: E500676-4

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5 annexes

2003-02-25

DELTA

*Danish Electronics,
Light & Acoustics*

*Venlighedsvej 4
2970 Hørsholm
Denmark*

*Tel. (+45) 72 19 40 00
Fax (+45) 72 19 40 01
www.delta.dk*



Title Emission tests to FCC requirements of Laerdal Control unit VitalSim and Power adapter for VitalSim

Test object Laerdal Control unit VitalSim and Power adapter for VitalSim

FCC ID QHQ-FST1908

Report no. DANAK-196771

Project no. E500676-4

Test period 2003-01-27 to 2003-01-29, and 2003-02-26

Client Laerdal Medical
Tanke Svilandsgt. 30, P.O. Box 377
4001 Stavanger
Norway

Telephone: 47 5151 1700
Fax: 47 5151 1788

Contact person Mr. Håkon Hodne


Manufacturer Laerdal Medical
Friwo

Specifications 47 CFR Part 15, Subpart C - Intentional Radiators

Results The equipment under test was in compliance with the requirements.

Test personnel Henrik Nielsen
Jesper Nielsen

Date 2003-02-25

Responsible 

Vagn Sylvest
Project Manager - EMC
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 points to the following procedure, used during the measurements in this report:

ANSI C63.4:1992 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 specimen**

The EUT is part of the Laerdal VitalSim system. It consists of a Control Unit connected to a manikin. The operation of the Control Unit can be controlled by the Laerdal Operating Device. The system is used to train health care professionals and will be used only in professional training facilities.

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 or Rx, as appropriate.

2.1 **Test object - Control unit VitalSim (Tx & Rx)**

Category	SRD
Manufacturer	Laerdal Medical
Model / type	FST1908
Part no.	-
Serial no.	Unit-1
FCC ID	QHQ-FST1908
Supply voltage	9 VDC via 230 VAC adapter
Operational mode	TX

2.2 **Test object - Control unit VitalSim (Rx)**

Category	SRD
Manufacturer	Laerdal Medical
Model / type	FST1908
Part no.	-
Serial no.	Unit-2
FCC ID	QHQ-FST1908
Supply voltage	9 VDC via 230 VAC adapter
Operational mode	Rx

2.3 **Test object - Power adapter for VitalSim (for Unit-1)**

Category	IT
Manufacturer	Friwo
Model / type	FW75550/09
Part no.	-
Serial no.	-
FCC ID	-
Supply voltage	100-240 VAC 9VDC 1.5A
Operational mode	Normal operation

2.4 Test object - Power adapter for VitalSim (for Unit-2)

Category	IT
Manufacturer	Mascot
Model / type	9525
Part no.	-
Serial no.	-
FCC ID	-
Supply voltage	100-240 VAC 12VDC 0,8A
Operational mode	Normal operation

2.5 AUX equipment – Megacode Manikin

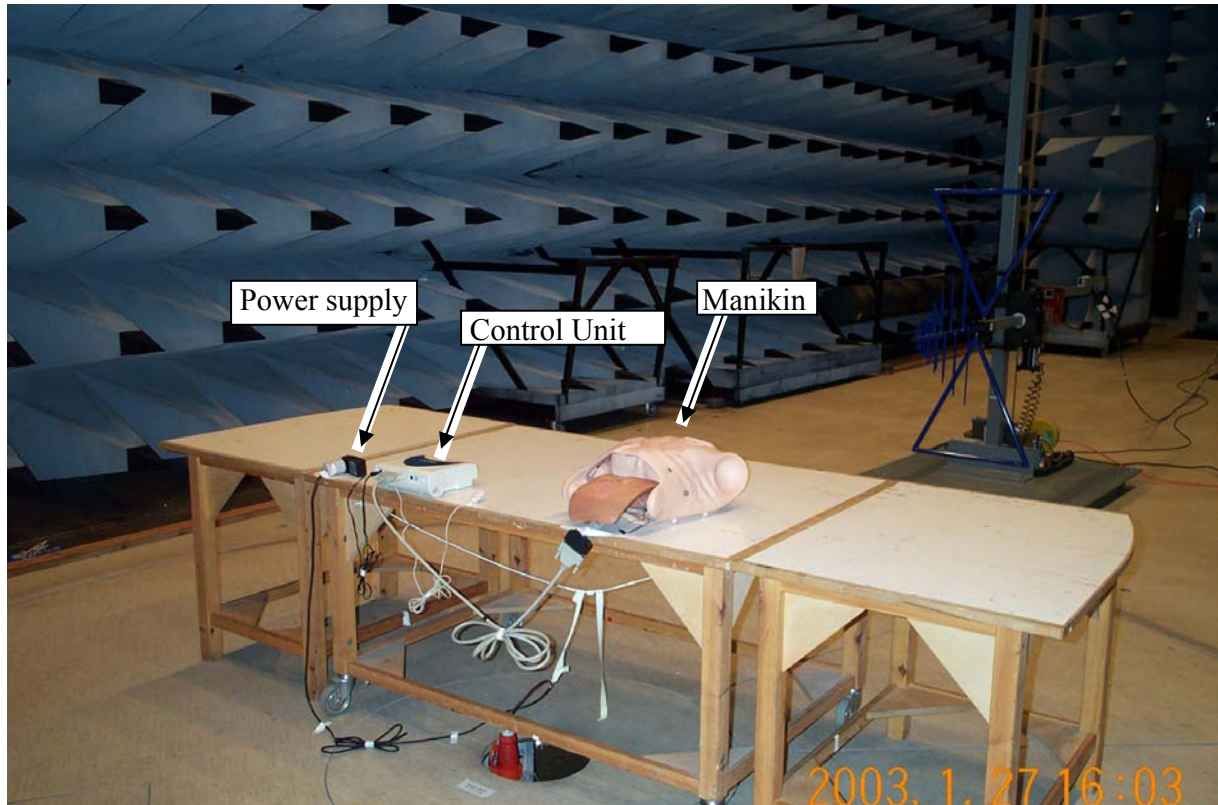
Manufacturer	Laerdal Medical
Model / type	Megacode Mankin
Part no.	-
Serial no.	-
FCC ID	-

Photo of CU:



3. General test conditions

3.1 Test set-up



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 C63.4:1992	
Frequency range	0.45-30 MHz	
Limit: (quasi-peak)	0.45-30 MHz:	48 dB μ V
Test set-up	<i>Annex 2</i>	
Test record sheets	<i>Annex 3</i>	

Results

The module in Rx mode and in Tx mode 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 C63.4:1992	
Measuring distance	3 m	
Frequency range	30-10.000 MHz	
Limits: As specified in 15.209(a)	30-88 MHz: 88-216 MHz: 216-960 MHz: Above 960 MHz:	40 dB μ V/m 43.5 dB μ V/m 46 dB μ V/m 54 dB μ V/m
Measurement uncertainty (2 σ) <1 GHz	2.6 dB	
Measurement uncertainty (2 σ) >1 GHz	4.9 dB	
Below 1 GHz the limits apply to measurements performed using a quasi-peak detector. Above 1 GHz the limits apply to measurements of spurious emission performed with an average detector. Furthermore, the peak level must be no higher than 20 dB above the average limit.		
Test set-up	<i>Annex 2</i>	
Test record sheets	<i>Annex 4</i>	

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.

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 dB μ V/m	dB below QP limit	Note
132.000 (R)	V	36,6	6.9	
144.000	V	31,6	11.9	
198.700	H	34,2	9.3	
462.000	H	33,8	12.2	
694.910	H	38,8	7.2	
724.400	H	33,3	12.7	

(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 dB μ V/m	Average dB μ V/m	dB below peak limit	dB below average limit	Note
1832.21	V	53.1	53.1	20.8	0.8	2 nd harm.
2748.32 (R)	V	52.1	52.1	21.8	1.8	3 rd harm.
3641 (R)	V/H	43.4	43.4	30.5	10.5	4 th harm.

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

Average limit is 500 μ V/m or 54 dB μ V/m.

Peak limit is 20 dB above average limit or 74 dB μ V/m.

Comments

Measurements of spurious emission 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 $20 \cdot \log \langle \text{duty cycle} \rangle$ 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, using 10 kHz resolution bandwidth. The measurement is relative, based on absolute carrier measurement in peak-mode, where the level of the carrier 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 measured:

Occupied bandwidth: 680 kHz measured in 10 kHz bandwidth

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 dB μ V/m, following §15.249(a). Measurements show:

Peak output field strength: 91.6 dB μ V/m at the frequency 916.105 MHz.

See plot in *Annex 5*.

The EUT is in compliance with the requirement.

Annex 1

List of instruments

(1 page)

LIST OF INSTRUMENTS

NO.	DESCRIPTION	MANUFACTURER	TYPE NO.	CALIBR. EXPIRES
29494,3	MICROWAVE CABLE, 1 m	SUHNER	SUCOFLEX 104	2003-05-10
29660	PRE SELECTOR, 0 – 22 GHz.	HEWLETT-PACKARD	70600A	AS 29665
29661	RF SECTION. 50kHz - 26.5 GHz.	HEWLETT-PACKARD	70906A	AS 29665
29662	LOCAL OSCILLATOR	HEWLETT-PACKARD	70900A	AS 29665
29663	IF SECTION, 10 Hz – 300 kHz BW	HEWLETT-PACKARD	70902A	AS 29665
29664	MAINFRAME	HEWLETT-PACKARD	70001A	AS 29665
29665	SYSTEM DISPLAY (FOR SPECTRUM ANALYZER 71200C)	HEWLETT-PACKARD	71200A (70206A MAIN FRAME)	2003-12-12
29300	MEASURING RECEIVER	ROHDE & SCHWARZ	ESH3, 335.8017.52	2003-12-13
29461	ARTIFICIAL MAINS NETWORK	ROHDE & SCHWARZ	ESH2/Z5	2004-12-23
29861	EMI-SOFTWARE Ver. 1.60	ROHDE & SCHWARZ	ES-K1, PART: 1026.6790.02	ONLY CAL. IF REQ.
49071	STANDARD OFFICE PC, WITH MONITOR AND MEMORY CARD	BOSTON	350 MHz	ONLY CAL. IF REQ.
29916	AUTOMATIC TEST RECEIVER, 9 kHz - 2.75 GHz	ROHDE & SCHWARZ	ESCS 30 1102.4500.30	2003-01-02
29942	"CABLE #26", LOW-LOSS uWAVE CABLE, SMA-SMA, 1 m	SUHNER	SUCOFLEX 104A	2003-05-08
29985	BILOG ANTENNA 26-2000 MHz	SCHAFFNER/CHASE	6140A	2003-07-05
29876	RIDGED GUIDE HORN ANTENNA, 1-12.75 (18) GHz	EMCO	3115	2005-02-11
49037	BROADBAND MICROWAVE PREAMPLIFIER, 1-12.8 GHz	MITEQ / DELTA	AMF-5D-001128-35-11P	2003-10-11
49097	MICROWAVE HP FILTER 2.75-12.75 GHz, MAX. 2 W	MICRO-TRONICS	HPM13106	2003-11-25

Annex 2
Photos
(2 pages)



Photo 1 Set-up for measurements of conducted emission.

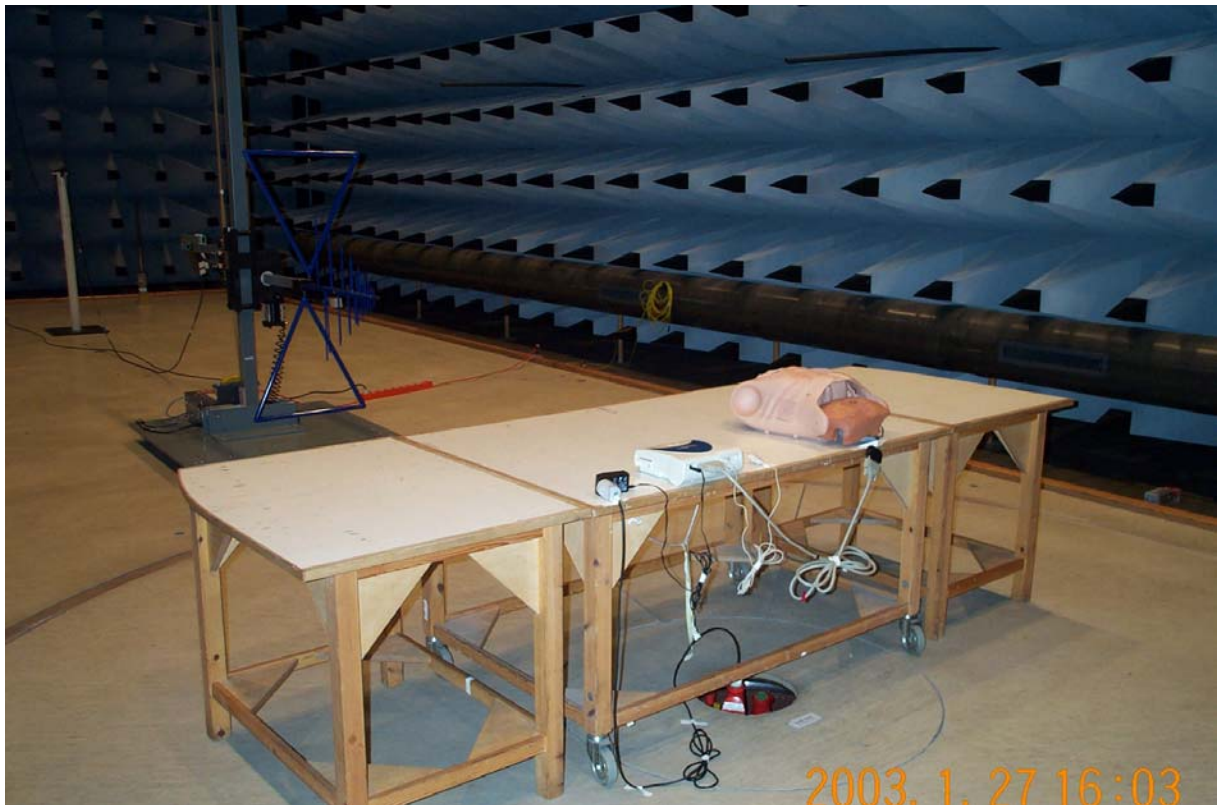


Photo 2 Set-up for measurements 30 - 1000 MHz.



Photo 3 Set-up for measurements 1 - 10 GHz. One unit in Tx-mode and one in Rx-mode.

Annex 3

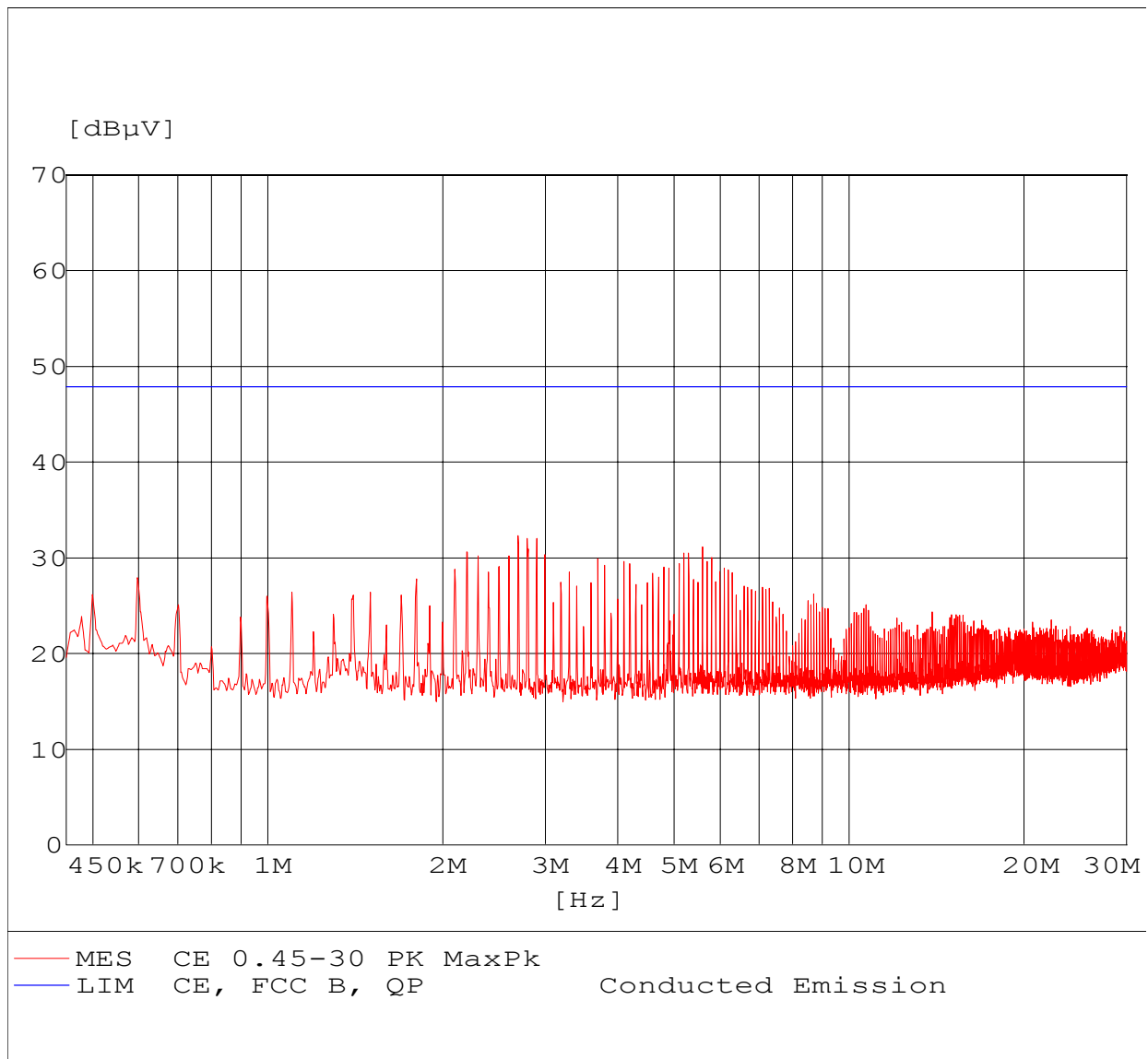
Test record sheets regarding conducted emission

(2 pages)

EUT: VitalSim
Manufacturer: Laerdal
Operating Condition: Transmit mode - Line: Line 1
Test Site: Room 2
Operator: BLa
Test Specification: FCC Class B - 120 VAC
Comment: Sheet 4
Start of Test: 2003-02-26

SCAN TABLE: "CE 0.45-30 PK"

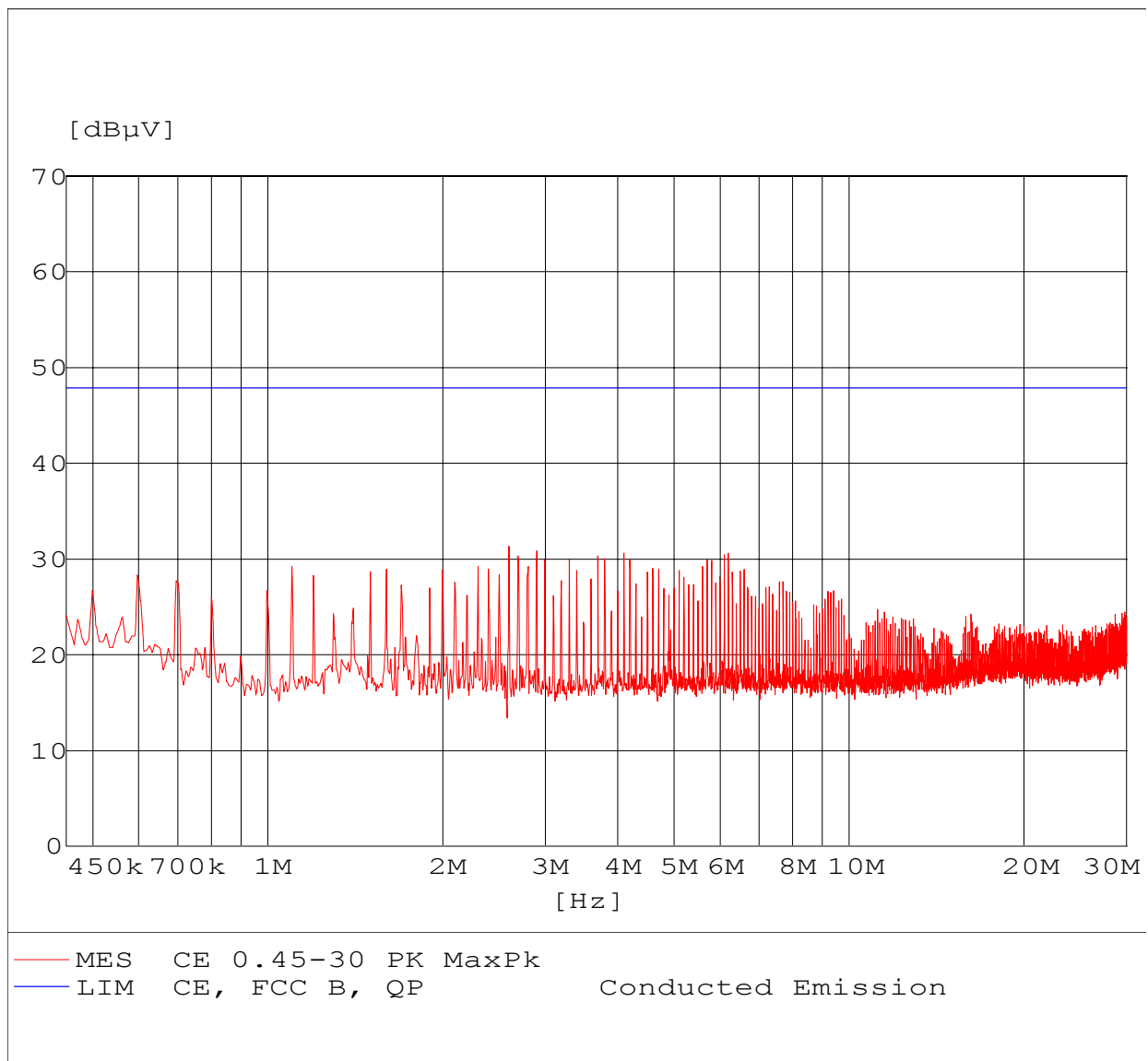
Start Frequency	Stop Frequency	Step width	Detector	Meas. time	IF Bandwidth	Transducer
450.0 kHz	30.0 MHz	7.0 KHz	MaxPeak	20.0 ms	10 kHz	LISN (29461)



EUT: VitalSim
Manufacturer: Laerdal
Operating Condition: Transmit mode - Line: Neutral
Test Site: Room 2
Operator: BLa
Test Specification: FCC Class B - 120 VAC
Comment: Sheet 5
Start of Test: 2003-02-26

SCAN TABLE: "CE 0.45-30 PK"

Start Frequency	Stop Frequency	Step width	Detector	Meas. time	IF Bandwidth	Transducer
450.0 kHz	30.0 MHz	7.0 KHz	MaxPeak	20.0 ms	10 kHz	LISN (29461)

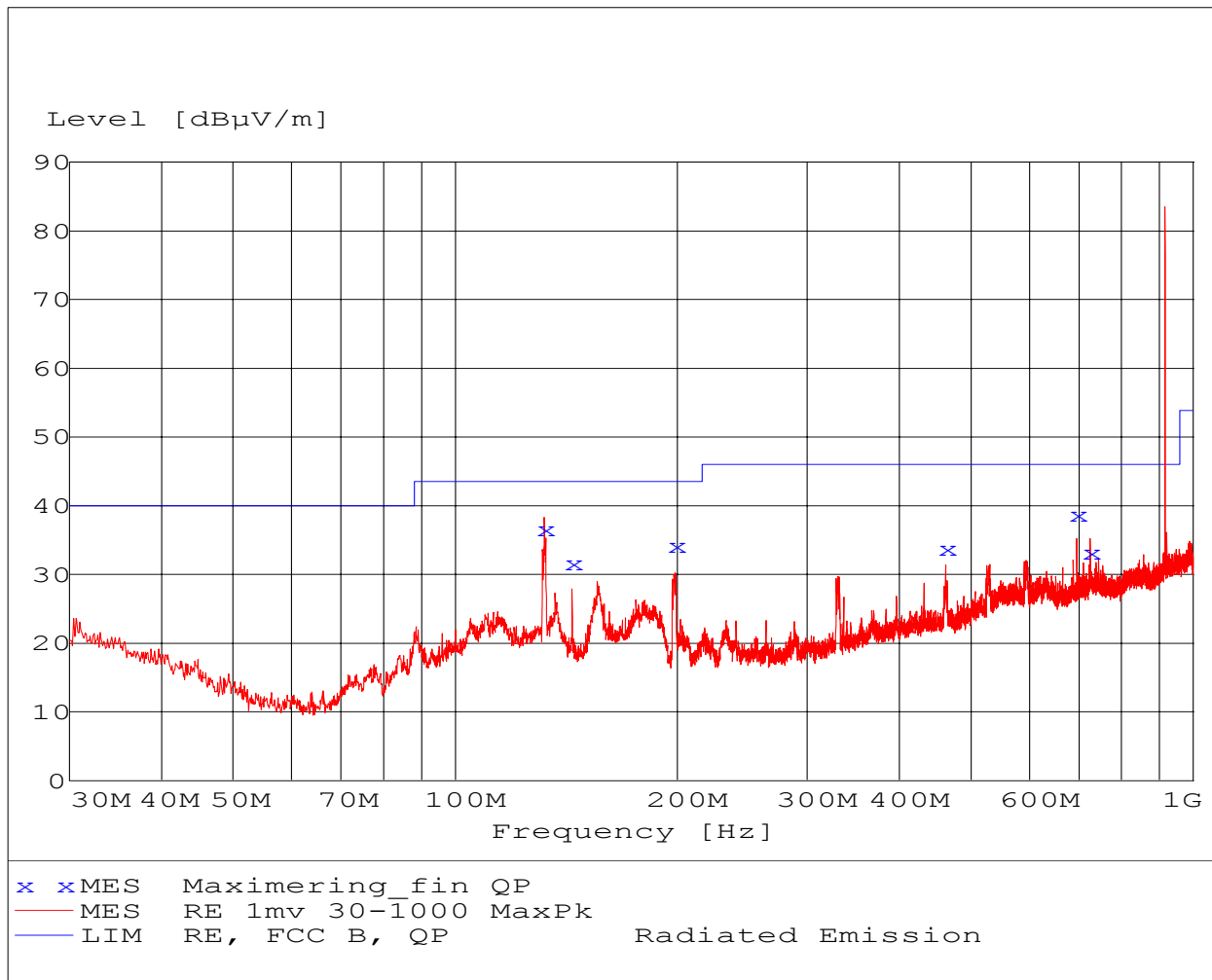


Annex 4

Test record sheets regarding radiated emission

(7 pages)

EUT: VitalSin control unit. Unit no 1 TX
Manufacturer: Laerdal
Operating Condition: Ant. 1 meter vertical. 115 VAC.
Test Site: EMC-5
Operator: HEN - E500676
Test Specification: FCC class B
Comment: Sheet 2
Start of Test: 2003-01-27

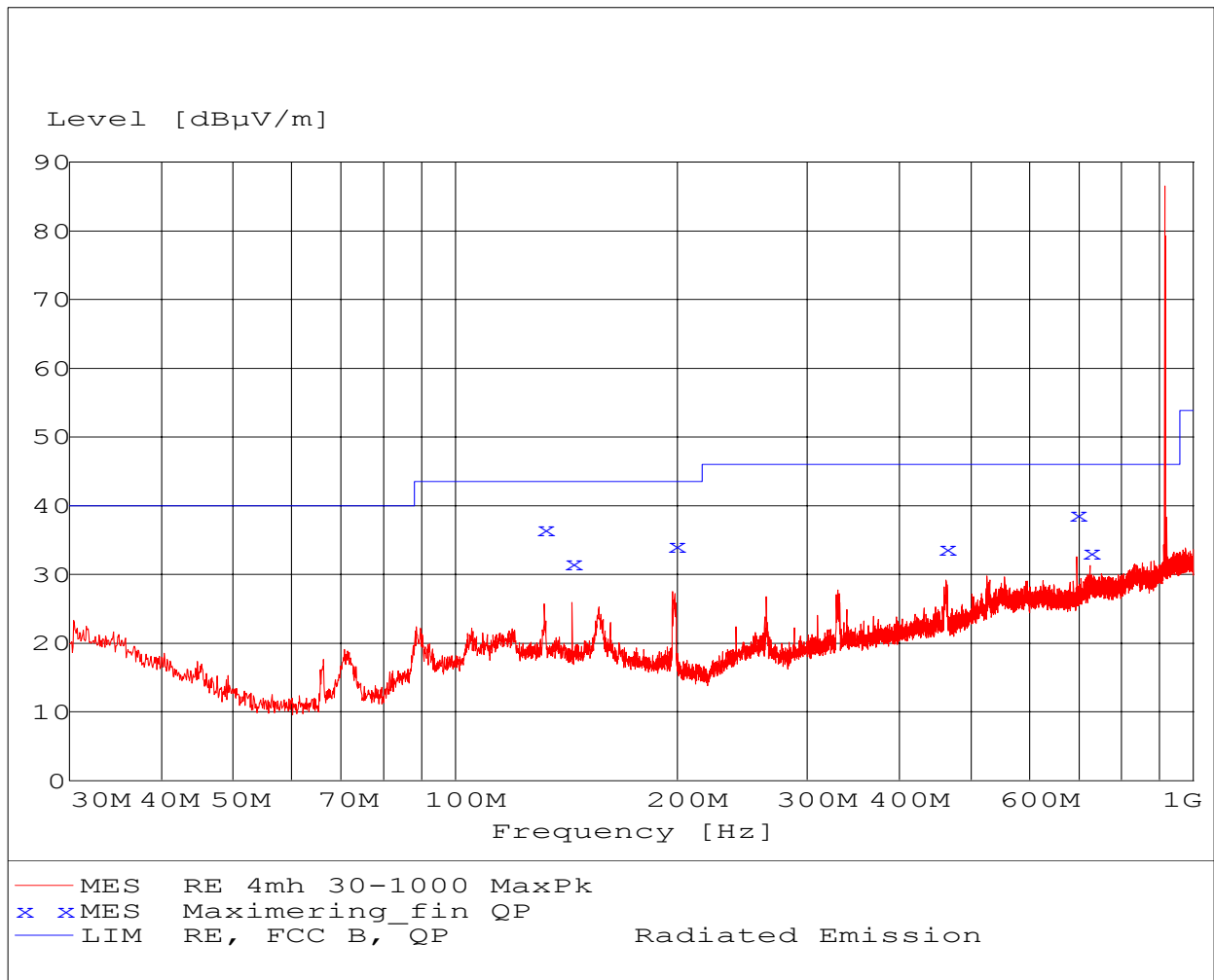


MEASUREMENT RESULT: "Maximering_fin QP"

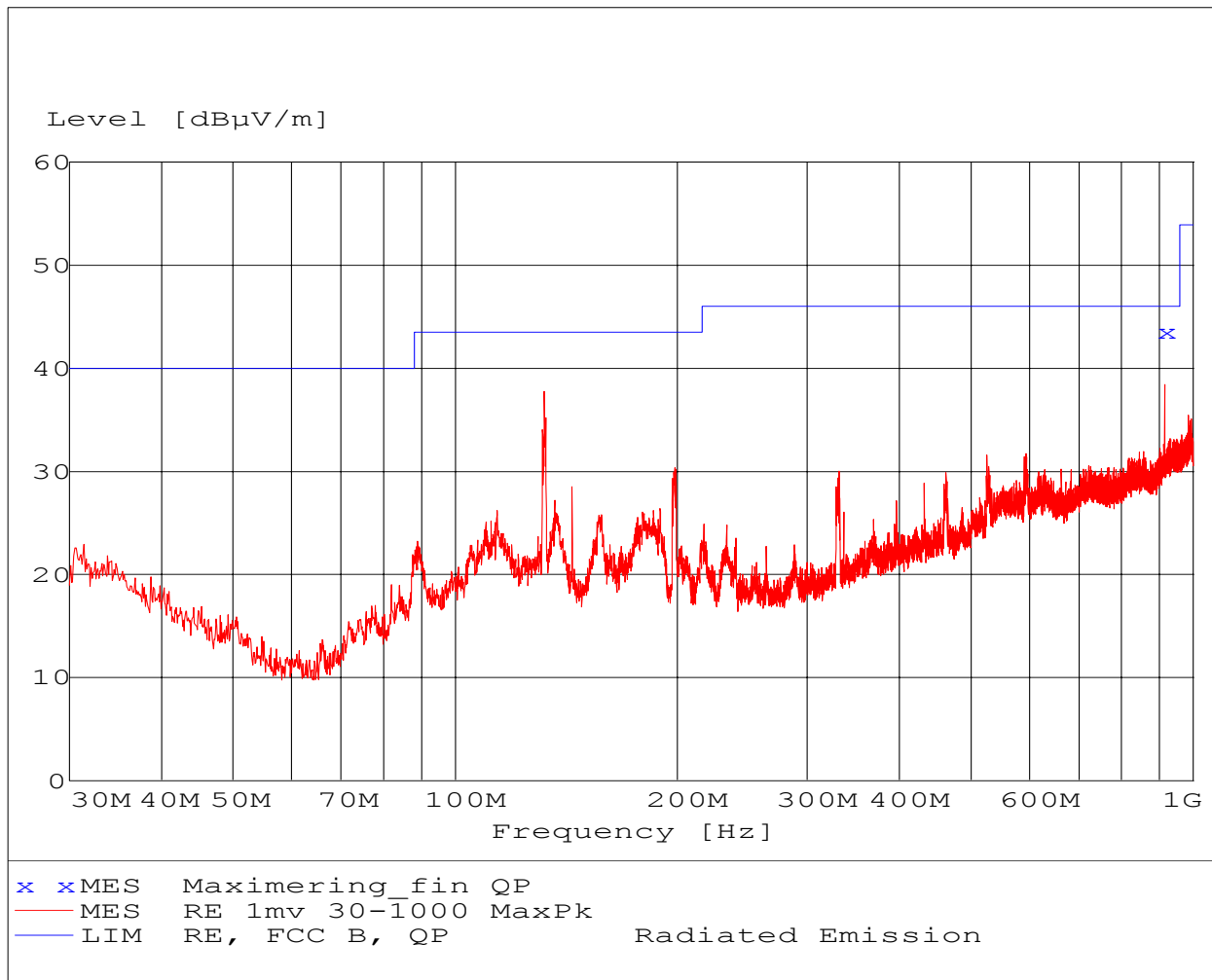
2003-01-27 11:24

Frequency MHz	Level dBμV/m	Transd. dB	Limit dBμV/m	Margin dB	Height cm	Azimuth deg.	Polarisation
132.000	36.60	14.9	43.5	6.9	110.0	2.00	Vertical
144.000	31.60	14.1	43.5	11.9	110.0	146.00	Vertical
198.700	34.20	11.9	43.5	9.3	127.0	59.00	Horizontal
462.000	33.80	20.3	46.0	12.2	168.0	121.00	Horizontal
694.910	38.80	24.9	46.0	7.2	102.0	94.00	Horizontal
724.400	33.30	26.2	46.0	12.7	101.0	339.00	Horizontal

EUT: VitalSin control unit. Unit no 1 TX
Manufacturer: Laerdal
Operating Condition: Ant. 4 meter horizontal. 115 VAC.
Test Site: EMC-5
Operator: HEN - E500676
Test Specification: FCC class B
Comment: Sheet 3
Start of Test: 2003-01-27



EUT: VitalSin control unit. Unit no 1 RX
 Manufacturer: Laerdal
 Operating Condition: Ant. 1 meter vertical. 115 VAC.
 Test Site: EMC-5
 Operator: HEN - E500676
 Test Specification: FCC class B
 Comment: Sheet 5
 Start of Test: 2003-01-27

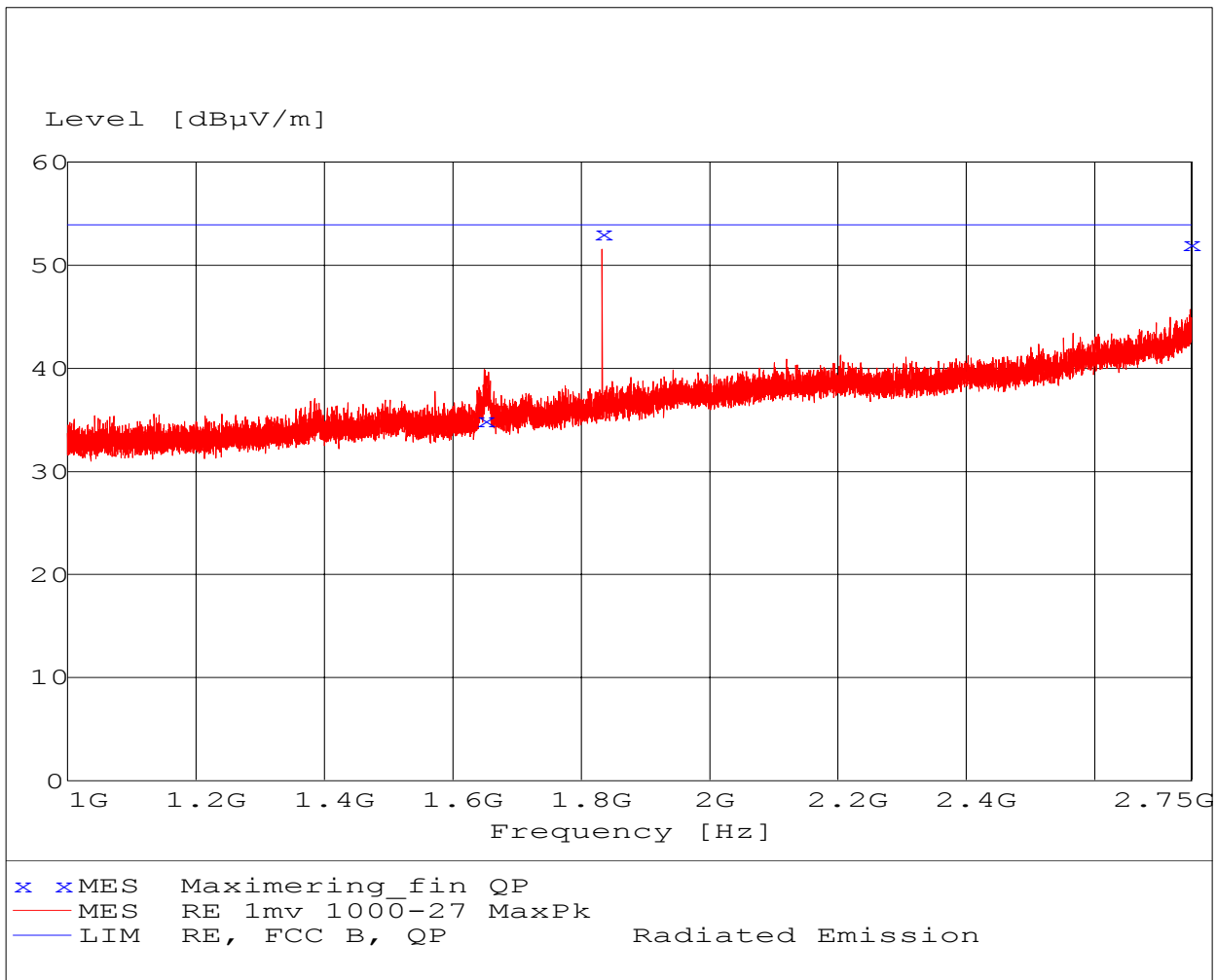


MEASUREMENT RESULT: "Maximering_fin QP"

2003-01-27 12:14

Frequency MHz	Level dBµV/m	Transd. dB	Limit dBµV/m	Margin dB	Height cm	Azimuth deg.	Polarisation
915.925	43.60	28.7	46.0	2.4	101.0	349,00	Horizontal

EUT: VitalSin control unit. Unit no 1 TX
 Manufacturer: Laerdal
 Operating Condition: Ant. 1 meter vertical. 115 VAC.
 Test Site: EMC-5
 Operator: HEN - E500676
 Test Specification: FCC class B
 Comment: Sheet 7
 Start of Test: 2003-01-27

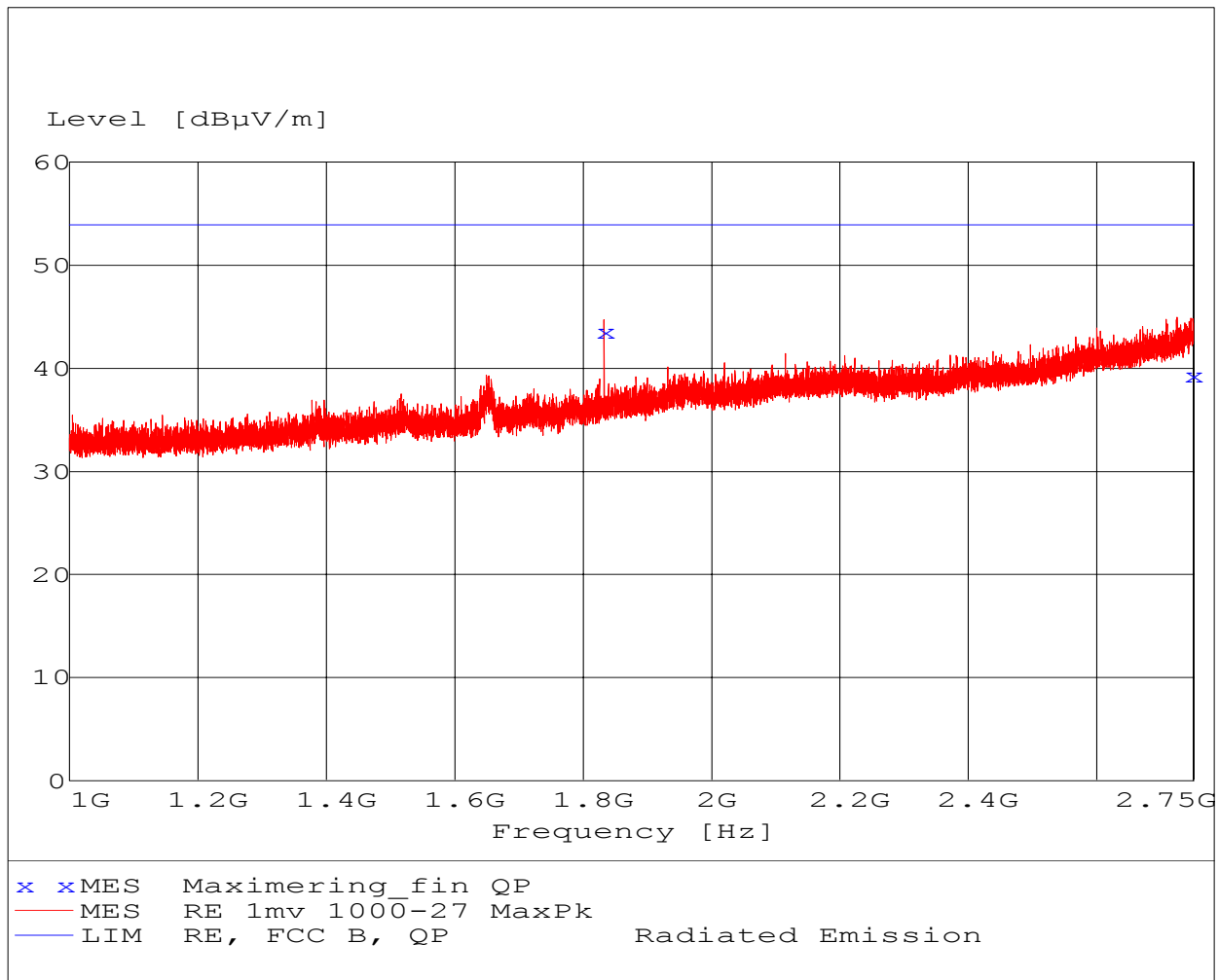


MEASUREMENT RESULT: "Maximering_fin AVG"

2003-01-27 15:24

Frequency MHz	Level dBµV/m	Transd. dB	Limit dBµV/m	Margin dB	Height cm	Azimuth deg.	Polarisation
1649.300	35.00	31.6	53.9	18.9	113.0	347.00	Vertical
1832.210	53.10	32.6	53.9	0.8	145.0	191.00	Vertical
2748.320	52.10	36.0	53.9	1.8	175.0	0,00	Vertical

EUT: VitalSin control unit. Unit no 1 RX
 Manufacturer: Laerdal
 Operating Condition: Ant. 1 meter vertical. 115 VAC.
 Test Site: EMC-5
 Operator: HEN - E500676
 Test Specification: FCC class B
 Comment: Sheet 9
 Start of Test: 2003-01-27

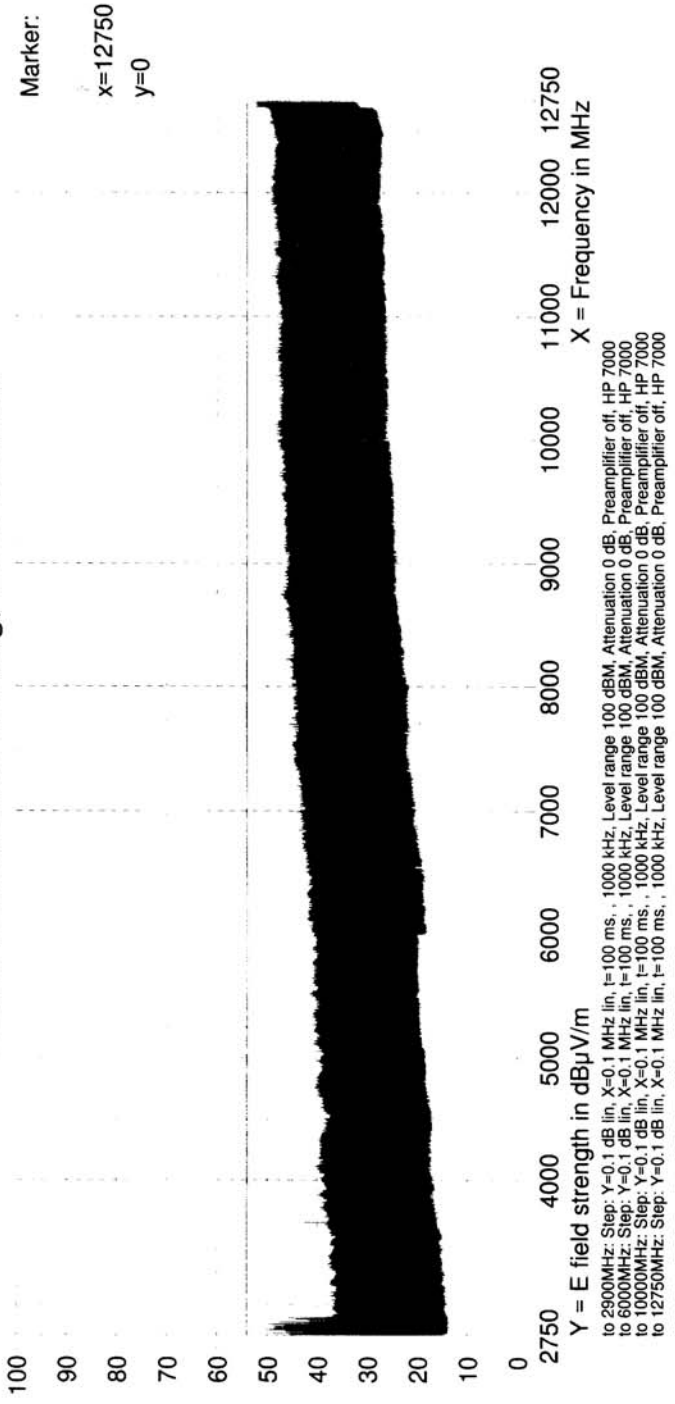


MEASUREMENT RESULT: "Maximering_fin AVG"

2003-01-27 15:55

Frequency MHz	Level dBµV/m	Transd. dB	Limit dBµV/m	Margin dB	Height cm	Azimuth deg.	Polarisation
1831.850	43.60	32.6	53.9	10.3	133.0	2.00	Vertical
2747.775	39.30	36.0	53.9	14.6	284.0	216.00	Vertical

DELTA Electronics Testing, EMC Section.



Laerdal
VitalSim control unit. Unit no. 1 TX, unit no. 2 RX
ant 1-3 meter horizontal and vertical. T.T. 0-360 deg.

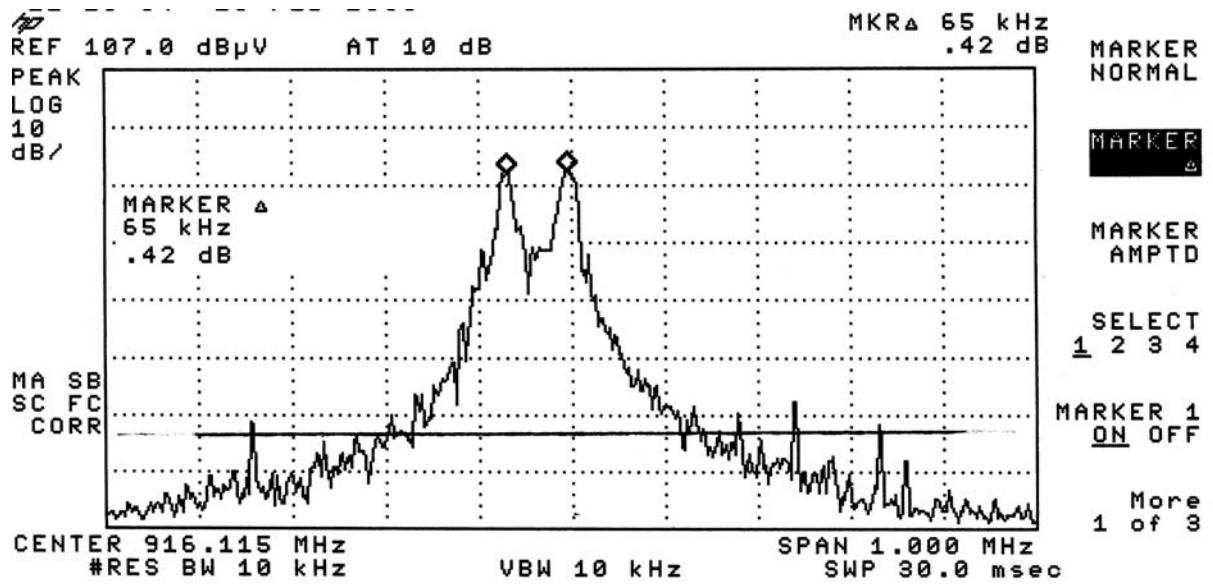
Project no: E500676 - HEN

Sheet 25

Annex 5

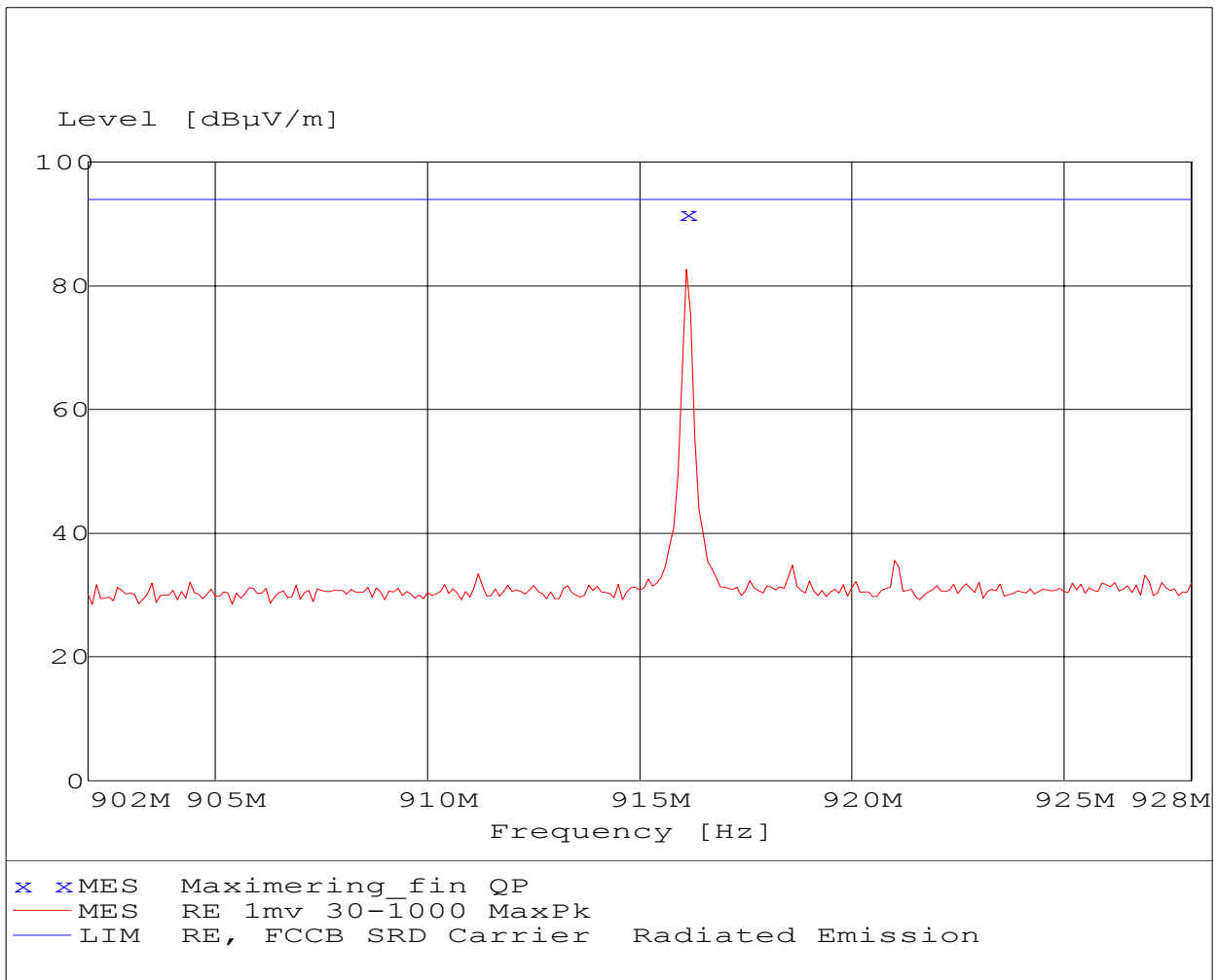
Occupied bandwidth / Peak output power

(2 pages)



Occupied bandwidth of Control Unit (see section 4.3)

EUT: VitalSin control unit. Unit no 1 TX
 Manufacturer: Laerdal
 Operating Condition: Ant. 1 meter vertical. 115 VAC.
 Test Site: EMC-5
 Operator: HEN - E500676
 Test Specification: FCC class B
 Comment: Sheet 11
 Start of Test: 2003-01-27



MEASUREMENT RESULT: "Maximering_fin QP"

2003-01-27 16:18

Frequency MHz	Level dBµV/m	Transd. dB	Limit dBµV/m	Margin dB	Height cm	Azimuth deg.	Polarisation
916.105	91.60	28.7	94.0	2.4	101.0	304.0	Horizontal