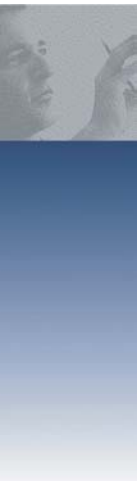

Test Report

DANAK
Reg. no. 19

Emission tests to FCC requirements of Laerdal Operating Device

Performed for Laerdal Medical

DANAK-196770
Project no.: E500676-5
Page 1 of 10
4 annexes

2003-02-25

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Danish Electronics,
Light & Acoustics

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Denmark

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Title	Emission tests to FCC requirements of Laerdal Operating Device
Test object	Laerdal Operating Device (LOD)
FCC ID	QHQ-FST1909
Report no.	DANAK-196770
Project no.	E500676-5
Test period	2002-10-30 - 2002-11-19
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
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

Table of contents *Page*

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	N/A
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.

The Laerdal Operating Device is a portable device. The distance between the hand of a person carrying the transmitter and the antenna will always be larger than 2.5 cm. See also photo in *Annex 2*.

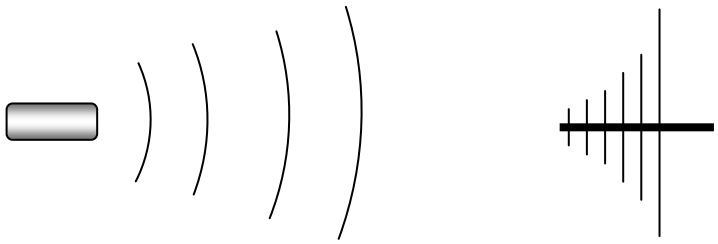
2.1 Test object - Laerdal operating device

Category	SRD
Manufacturer	Laerdal Medical
Model / type	Laerdal.PCB FST1899
Part no.	-
Serial no.	A01
FCC ID	QHQ-FST1909
Supply voltage	4 AA Alkaline cells
Operational mode	TX/RX

Photo of LOD:

3. General test conditions

3.1 Test set-up



The antenna of the EUT module in an internal wire antenna, mounted on the main circuit board.

The EUT is configured to transmit un-modulated carrier.

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.

4. Test and results

4.1 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 dBµV/m 43.5 dBµV/m 46 dBµV/m 54 dBµV/m
Measurement uncertainty (2 σ) <1 GHz Measurement uncertainty (2 σ) >1 GHz		2.6 dB 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 Test record sheets		*Annex 2* *Annex 3*

During exploratory radiated emission measurements all three orthogonal planes, X, Y and Z are investigated. The final measurements are performed in worst-case position.

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.

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.

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 3*)

Spurious freq. MHz	Polarisation	QPeak dBµV/m	dB below QP limit	Note
400.14 (R)	V	29.4	16.5	-
424.14	V	29.4	16.6	-
432.15	V	28.7	17.3	-
665.41	V	33.2	12.8	-
694.91	V	32.9	13.1	-

(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 3*).

Spurious freq. MHz	Polarisation	Peak dBµV/m	Average dBµV/m	dB below peak limit	dB below average limit	Note
1832.21	H	49.4	49.4	24.5	4.5	2nd harm.
2748.32 (R)	H	53.3	53.9	20.6	0.6	3rd harm.
3662.7 (R)	H/V	49.0	49.0	24.9	4.9	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.

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 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).

4.2 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 4* 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 38.1 dB above spurious limit. Subtracting 38.1 dB from the maximum value of the relative plots, the following occupied bandwidths are measured:

Occupied bandwidth: Un-modulated: 0.215 MHz measured in 10 kHz bandwidth.
Modulated: 0.273 MHz measured in 10 kHz bandwidth.

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

4.3 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: 84.1 dBµV/m at the frequency 914.465 MHz.

See plot Sheet 1 in *Annex 4*.

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
29861	EMI-SOFTWARE Ver. 1.60	ROHDE & SCHWARZ	ES-K1, PART: 1026.6790.02	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)

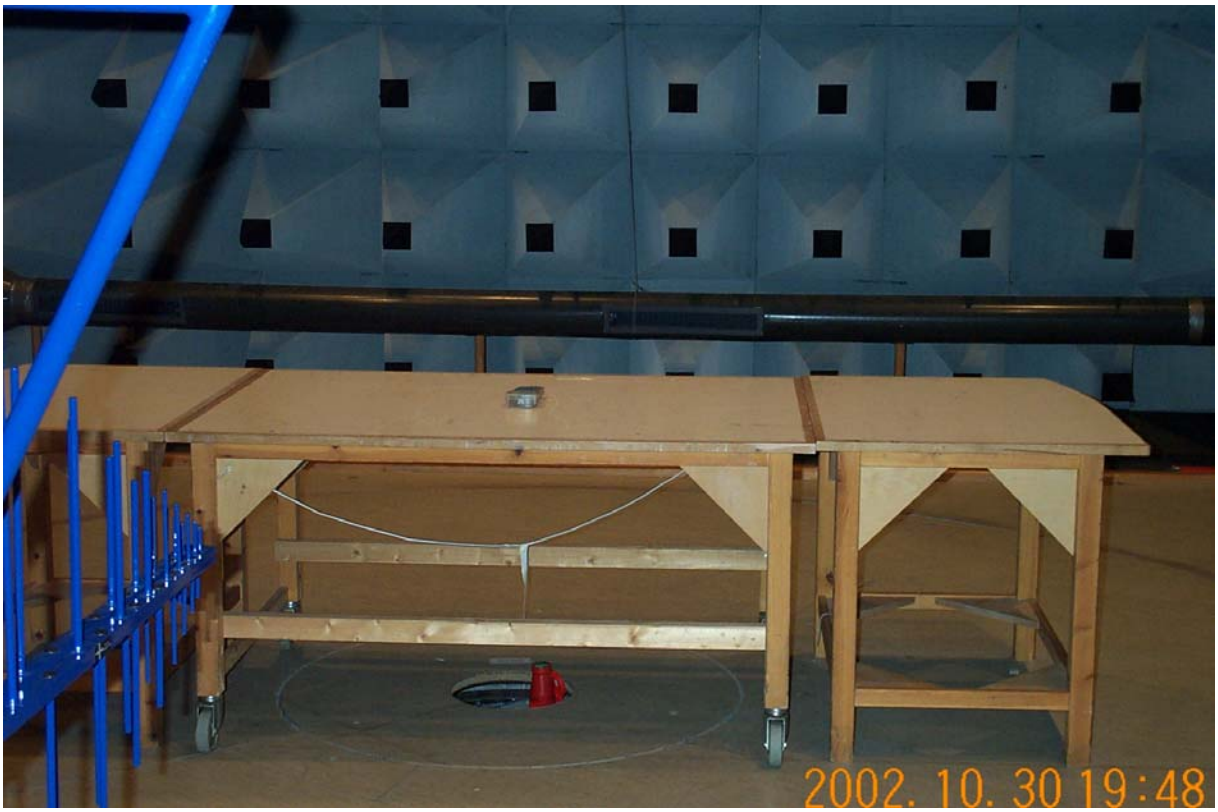


Photo 1 Set-up for measurements 30 - 1000 MHz.

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

Photo 3 Set-up for measurements 1 - 10 GHz.

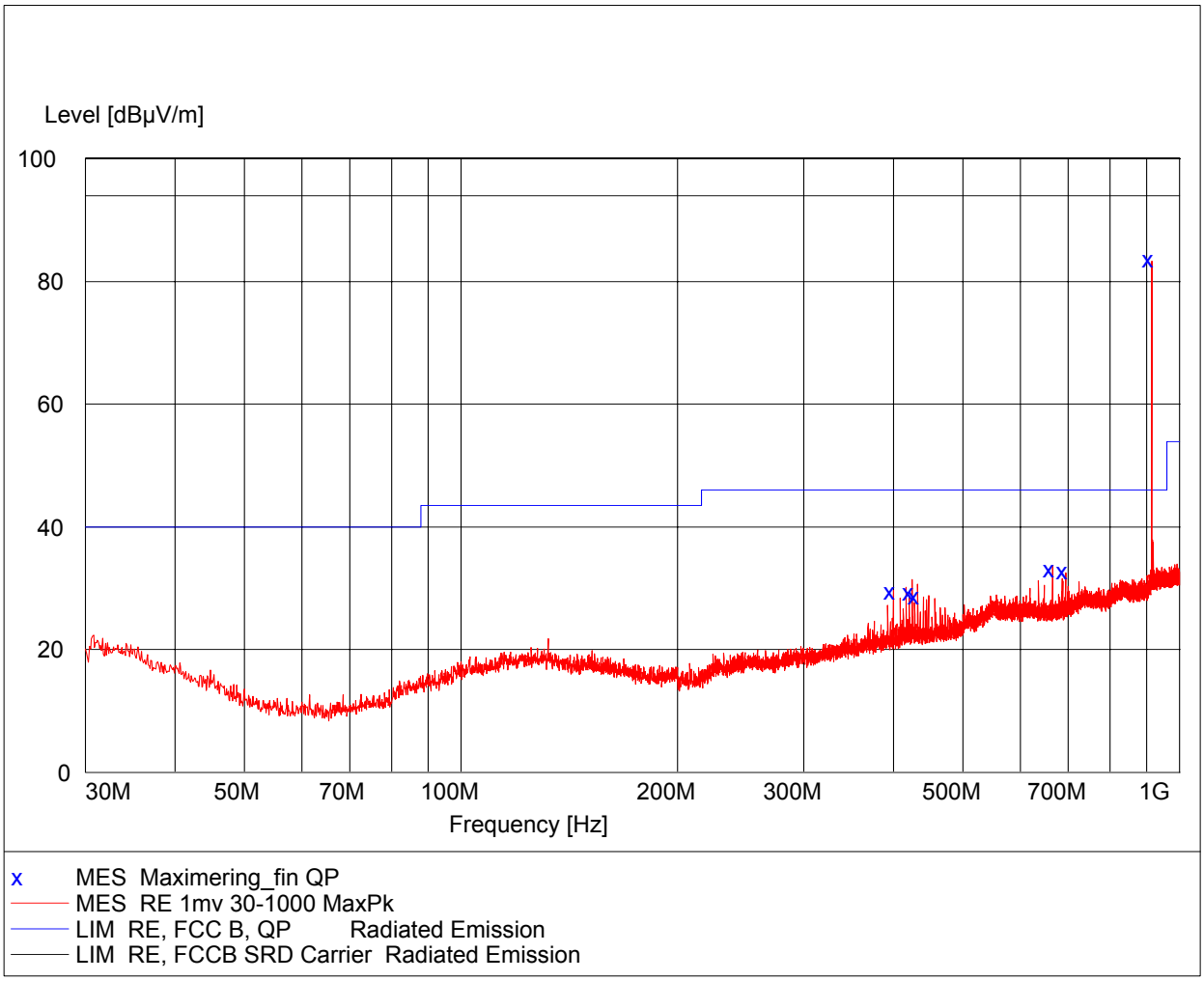
Photo 4 Distance between antenna and hand will be larger than 2.5 cm.

Annex 3

Test record sheets regarding radiated emission

(10 pages)

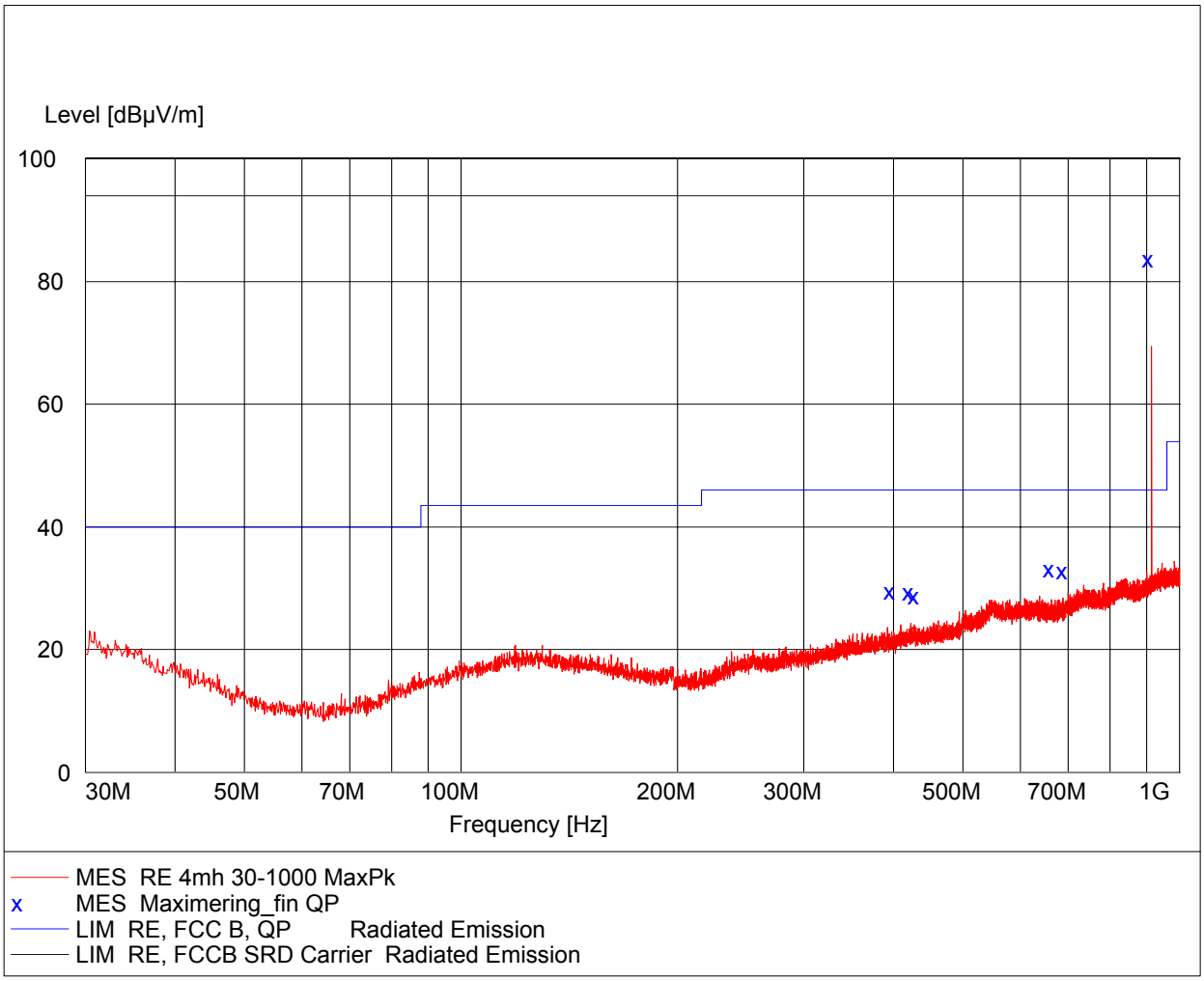
EUT:	Atlantic 2 LOD A01
Manufacturer:	Laerdal
Operating Condition:	Ant 1 meter vertical. Internal battery. Tx mode.
Test Site:	EMC-5
Operator:	JN - E500676
Test Specification:	FCC class B
Comment:	Sheet 18



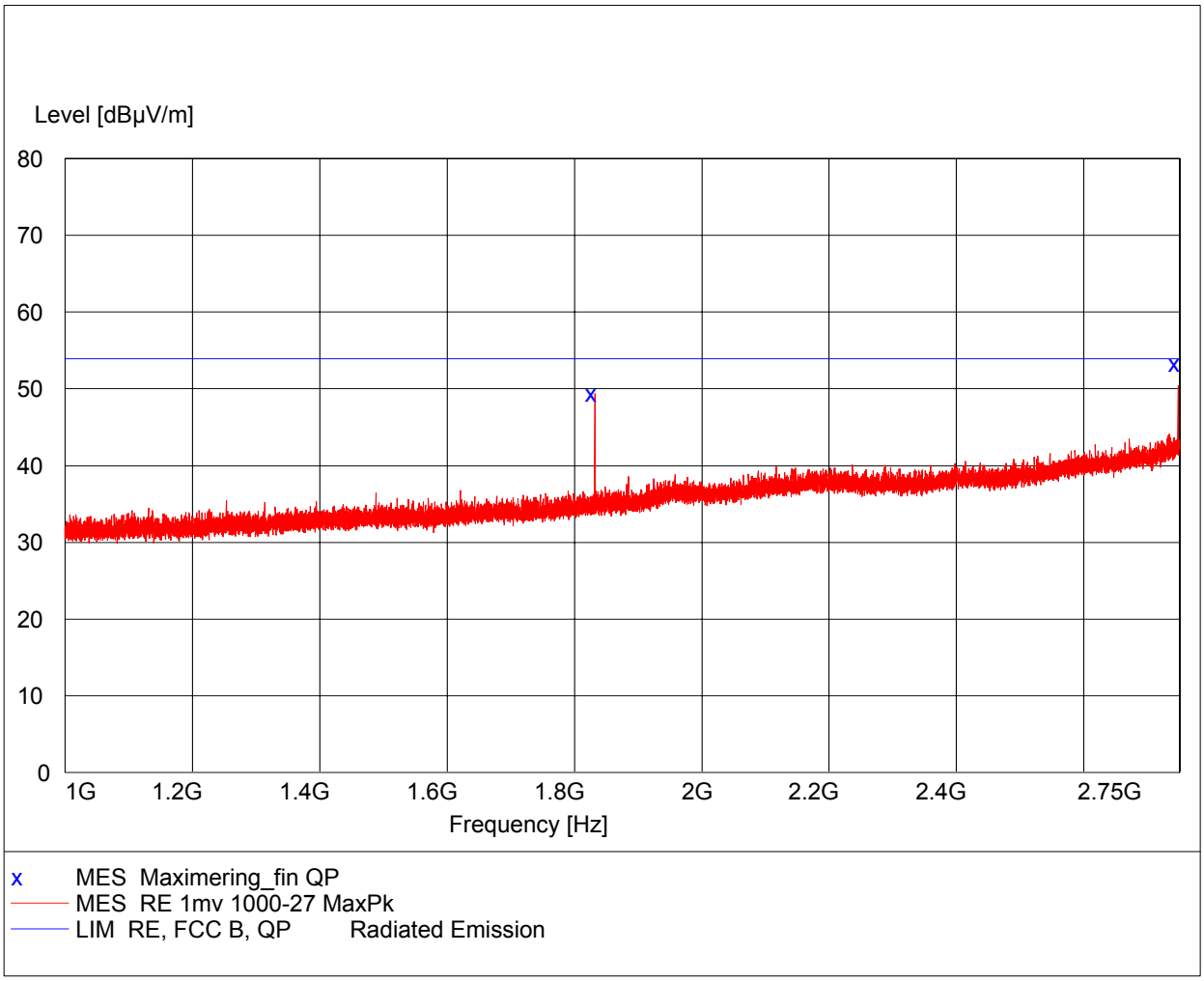
MEASUREMENT RESULT: "Maximering_fin QP"
2003-10-30 18:49

Frequency MHz	Level dBµV/m	Transd. dB	Limit dBµV/m	Margin dB	Height cm	Azimuth deg.	Polarisation
400.140	29.50	19.0	46.0	16.5	113.0	0.00	Vertical
424.140	29.40	19.8	46.0	16.6	113.0	3.00	Vertical
432.150	28.70	19.9	46.0	17.3	112.0	0.00	Vertical
665.410	33.20	24.4	46.0	12.8	124.0	181.00	Vertical
694.910	32.90	25.0	46.0	13.1	192.0	0.00	Vertical
916.100	83.60	28.9	94.0	-10.4	101.0	19.00	Vertical

EUT:	Atlantic 2 LOD A01
Manufacturer:	Laerdal
Operating Condition:	Ant 4 meter horizontal. Internal battery. Tx mode.
Test Site:	EMC-5
Operator:	JN - E500676
Test Specification:	FCC class B
Comment:	Sheet 19



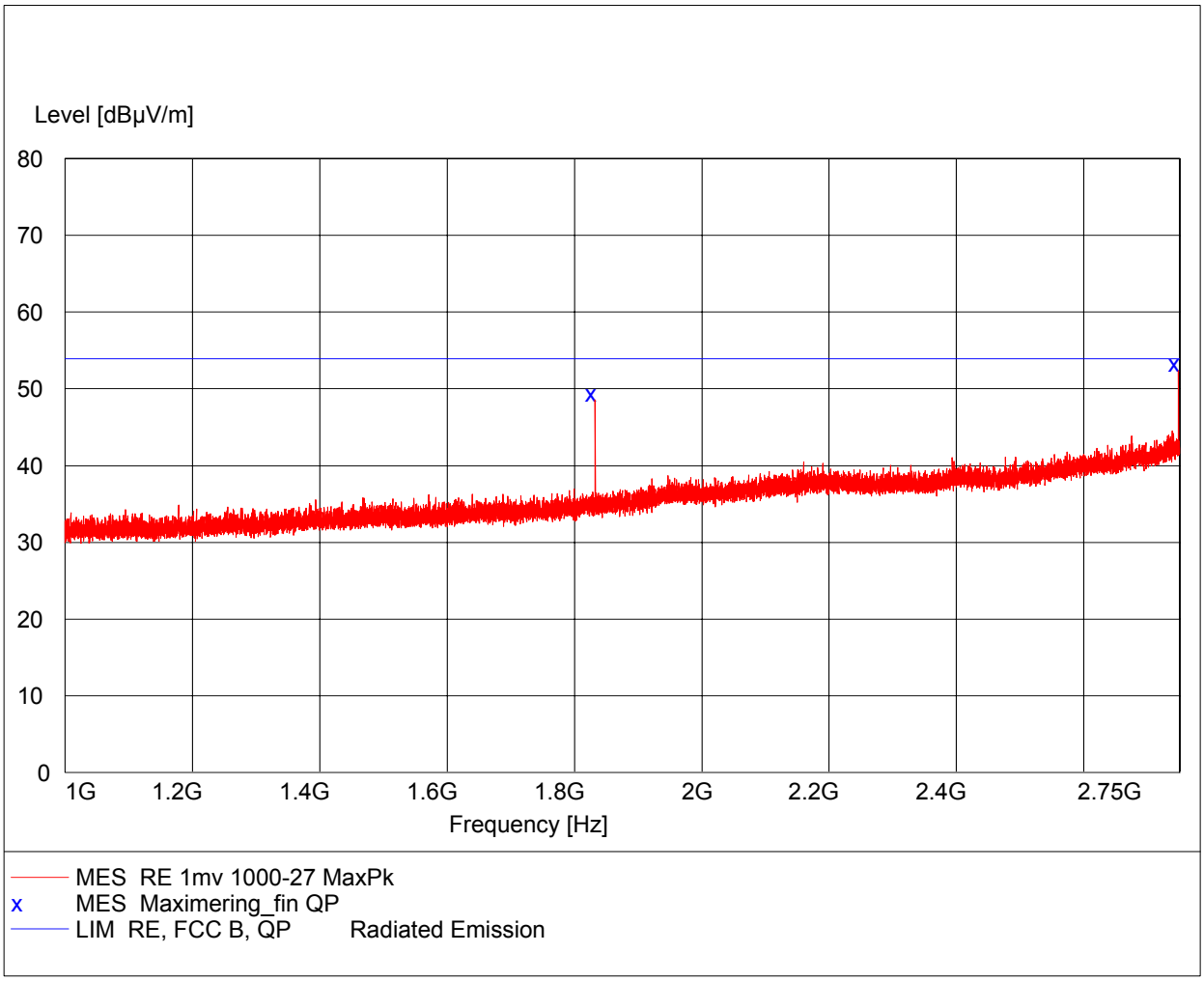
EUT:	Atlantic 2 LOD A01
Manufacturer:	Laerdal
Operating Condition:	Ant 1 meter vertical. Internal battery. Tx mode.
Test Site:	EMC-5
Operator:	JN - E500676
Test Specification:	FCC class B
Comment:	Sheet 22

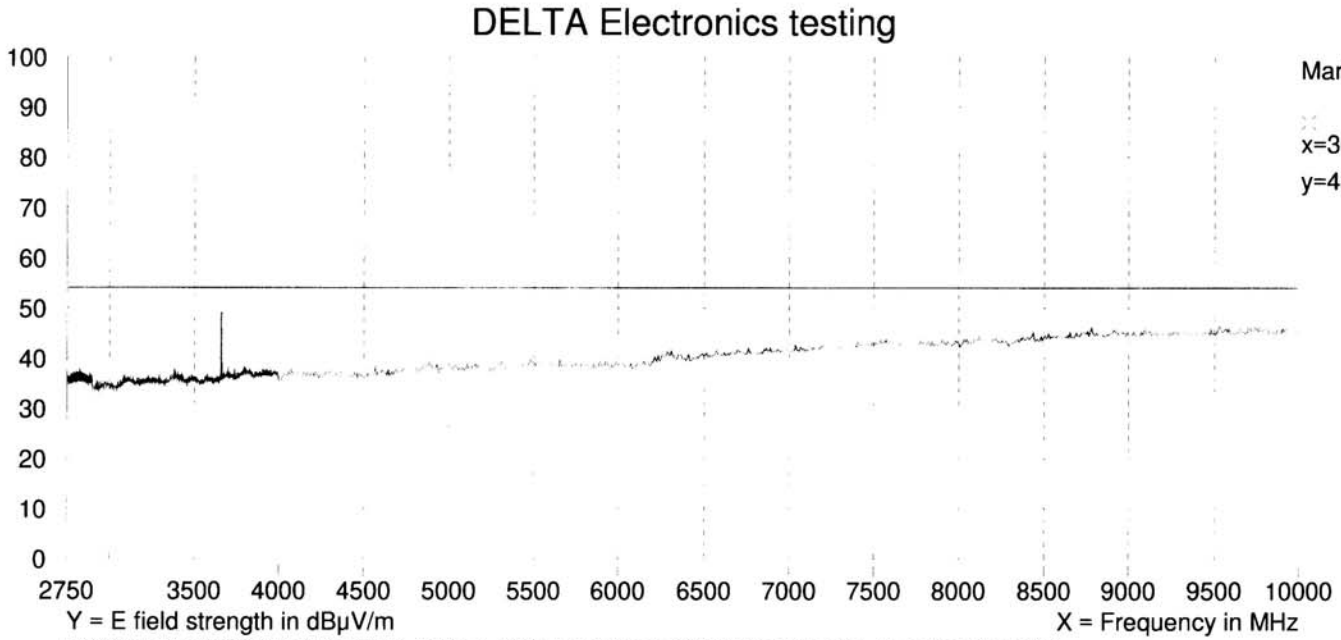


MEASUREMENT RESULT: "Maximering_fin AVG"
2003-10-30 20:54

Frequency MHz	Level dBµV/m	Transd. dB	Limit dBµV/m	Margin dB	Height cm	Azimuth deg.	Polarisation
1832.210	49.40	31.4	53.9	4.5	275.0	357.00	Horizontal
2748.320	53.30	35.2	53.9	0.6	204.0	358.00	Horizontal

EUT:	Atlantic 2 LOD A01
Manufacturer:	Laerdal
Operating Condition:	Ant 4 meter horizontal. Internal battery. Tx mode.
Test Site:	EMC-5
Operator:	JN - E500676
Test Specification:	FCC class B
Comment:	Sheet 23



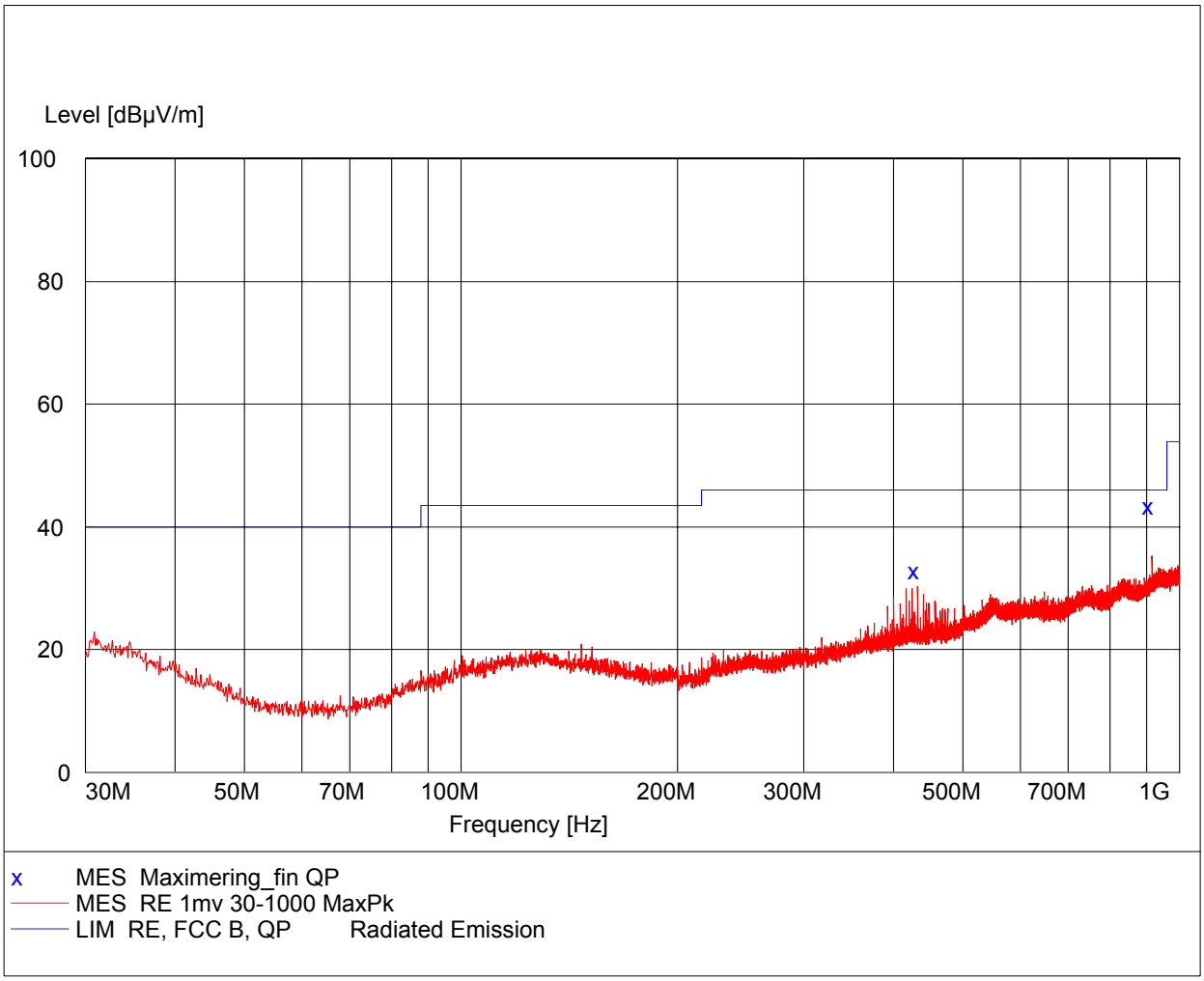


to 2900MHz: Step: Y=0.1 dB lin, X=0.1 MHz lin, t=100 ms, , 1000 kHz, Level range 100 dBM, Attenuation 0 dB, Preamplifier off, HP 7000
to 4000MHz: Step: Y=0.1 dB lin, X=0.1 MHz lin, t=100 ms, , 1000 kHz, Level range 100 dBM, Attenuation 0 dB, Preamplifier off, HP 7000
to 10000MHz: Step: Y=0.1 dB lin, X=0.1 MHz lin, t=100 ms, , 1000 kHz, Level range 100 dBM, Attenuation 0 dB, Preamplifier off, HP 7000

10/31/2002 18:31:37 File: 29-1275V.TO1, EUT 1
10/31/2002 18:27:43 File: FCC.LM2, Limit 1, FCC15.109(part B) unintentional rad. and FCC 15.209(Part C) intentional rad. Both Rx

Laerdal.
Atlantic 2, LOD A01 in Tx mode
Ant. height : 1-4 meter.
Ant. pol : hor & vert.
TT azimuth: 0-360 deg.
FCC class B

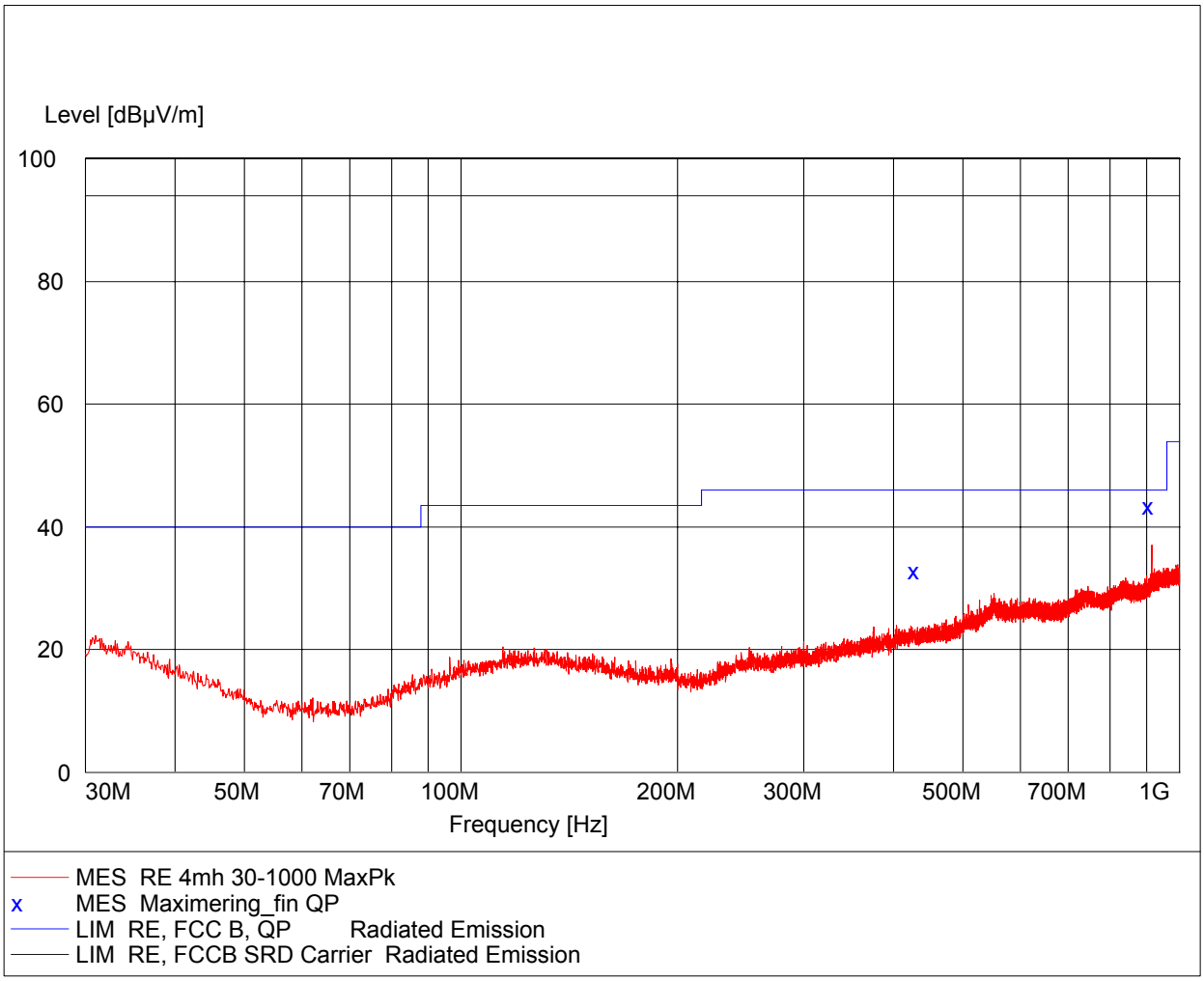
EUT:	Atlantic 2 LOD A01
Manufacturer:	Laerdal
Operating Condition:	Ant 1 meter vertical. Internal battery. Rx mode.
Test Site:	EMC-5
Operator:	JN - E500676
Test Specification:	FCC class B
Comment:	Sheet 20



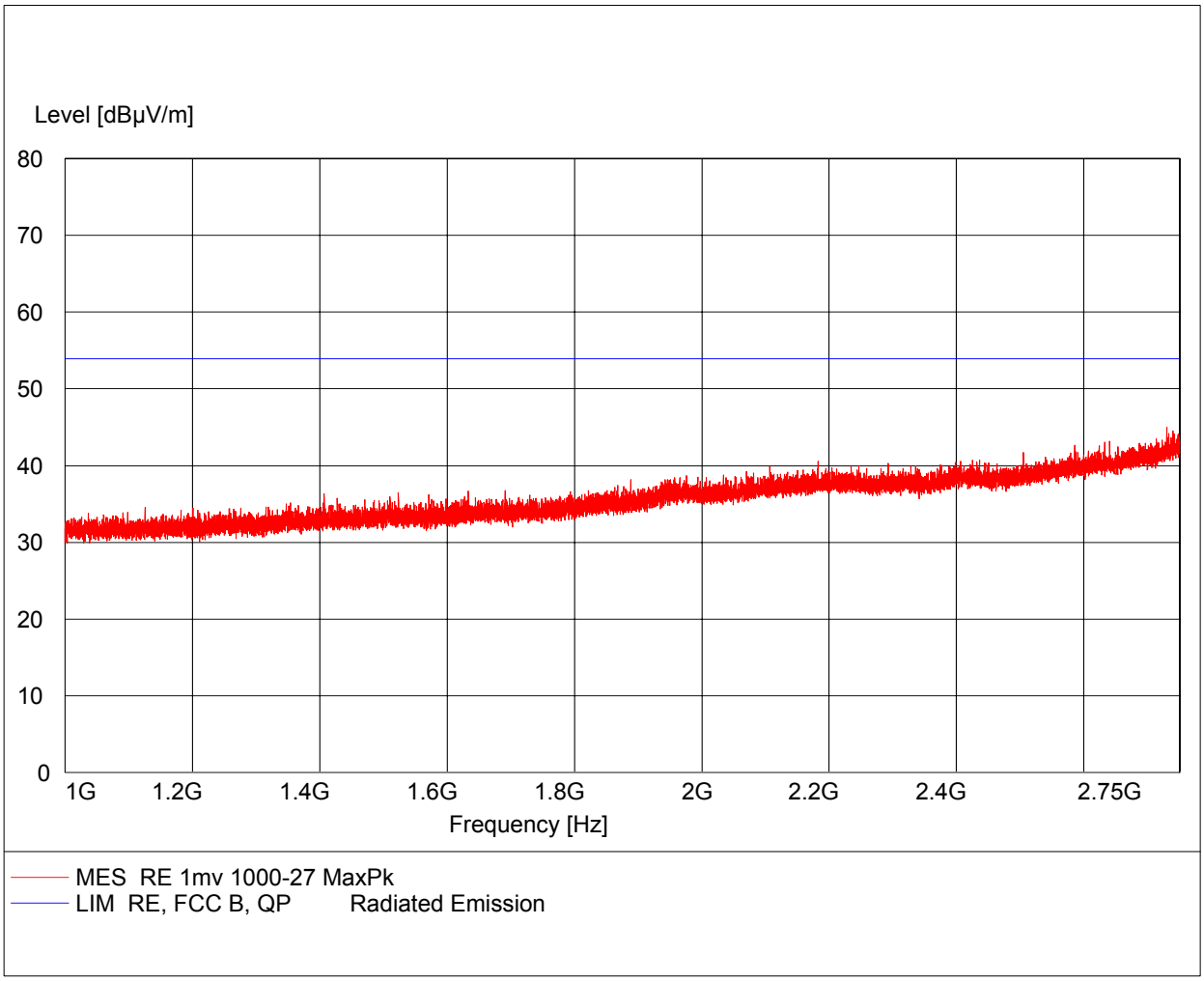
MEASUREMENT RESULT: "Maximering_fin QP"
2003-10-30 19:34

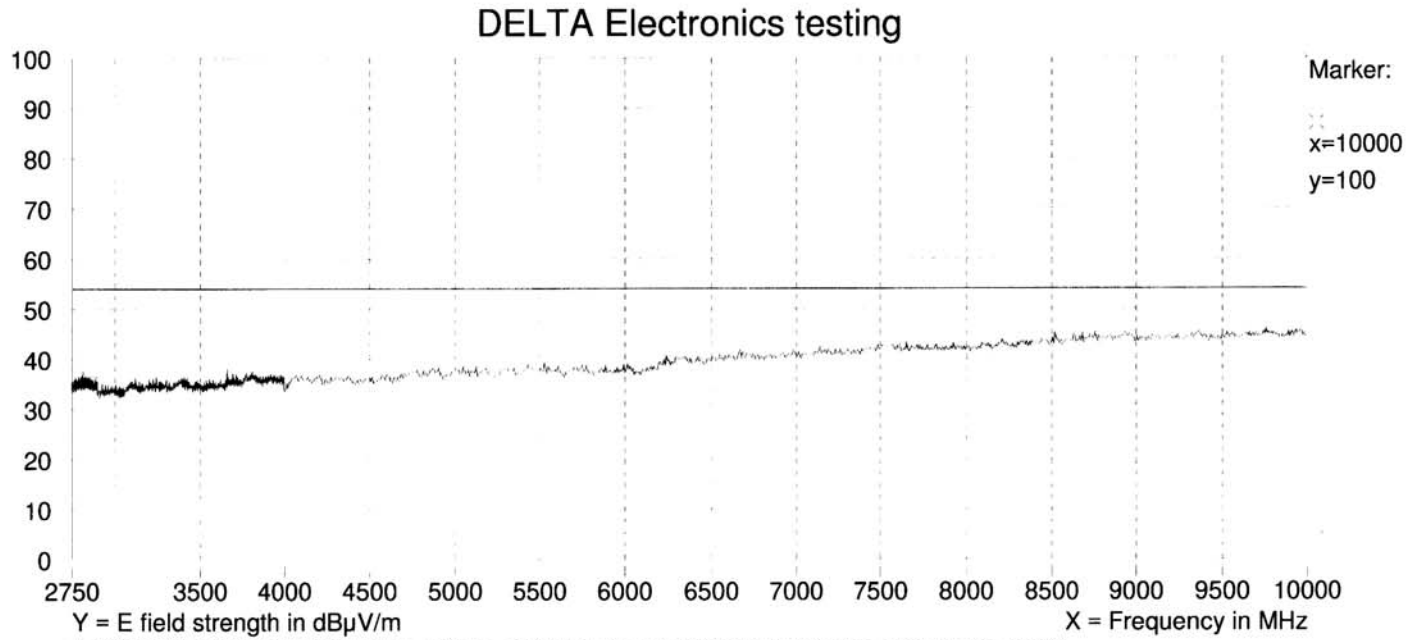
Frequency MHz	Level dBµV/m	Transd. dB	Limit dBµV/m	Margin dB	Height cm	Azimuth deg.	Polarisation
432.150	32.80	19.9	46.0	13.2	101.0	65.00	Horizontal
915.920	43.40	28.9	46.0	2.6	149.0	140.00	Horizontal

EUT:	Atlantic 2 LOD A01
Manufacturer:	Laerdal
Operating Condition:	Ant 4 meter horizontal. Internal battery. Rx mode.
Test Site:	EMC-5
Operator:	JN - E500676
Test Specification:	FCC class B
Comment:	Sheet 21



EUT:	Atlantic 2 LOD A01
Manufacturer:	Laerdal
Operating Condition:	Ant 4 meter horizontal. Internal battery. Rx mode.
Test Site:	EMC-5
Operator:	JN - E500676
Test Specification:	FCC class B
Comment:	Sheet 25





to 2900MHz: Step: Y=0.1 dB lin, X=0.1 MHz lin, t=100 ms, , 1000 kHz, Level range 100 dBM, Attenuation 0 dB, Preamplifier off, HP 7000
to 4000MHz: Step: Y=0.1 dB lin, X=0.1 MHz lin, t=100 ms, , 1000 kHz, Level range 100 dBM, Attenuation 0 dB, Preamplifier off, HP 7000
to 10000MHz: Step: Y=0.1 dB lin, X=0.1 MHz lin, t=100 ms, , 1000 kHz, Level range 100 dBM, Attenuation 0 dB, Preamplifier off, HP 7000

10/31/2002 22:11:59 File: RX.TO1, EUT 1
10/31/2002 18:27:43 File: RX.LM1, Limit 1, FCC15.109(part B) unintentional rad. and FCC 15.209(Part C) intentional rad. Both Rx a

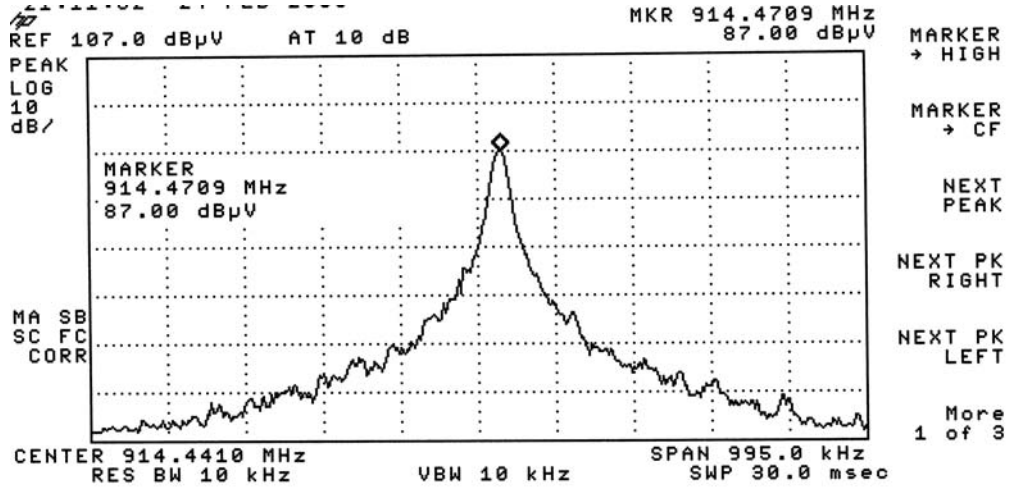
Laerdal.
Atlantic 2, LOD A01 in Rx mode
Ant. height : 1-4 meter.
Ant. pol : hor & vert.
TT azimuth: 0-360 deg.
FCC class B

E500676 - JN

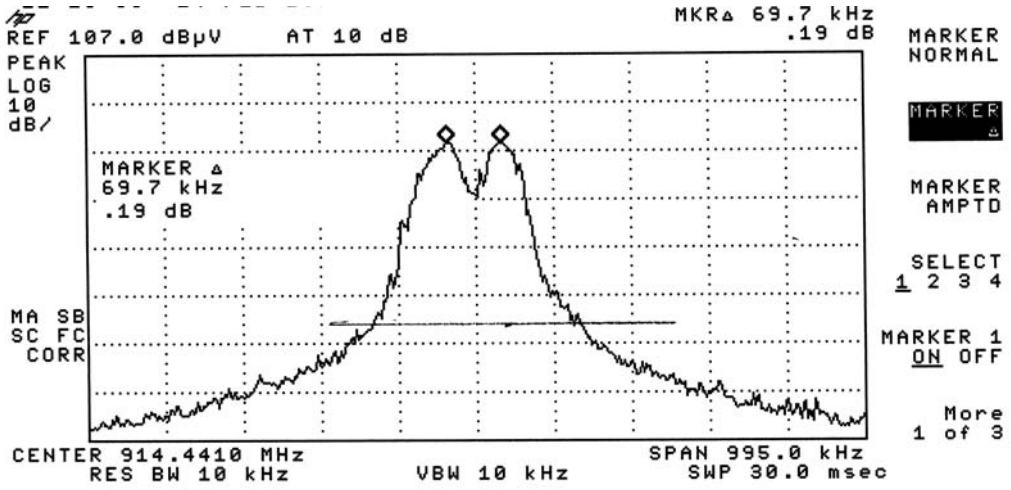
Annex 4

Occupied bandwidth / Peak output power

(2 pages)

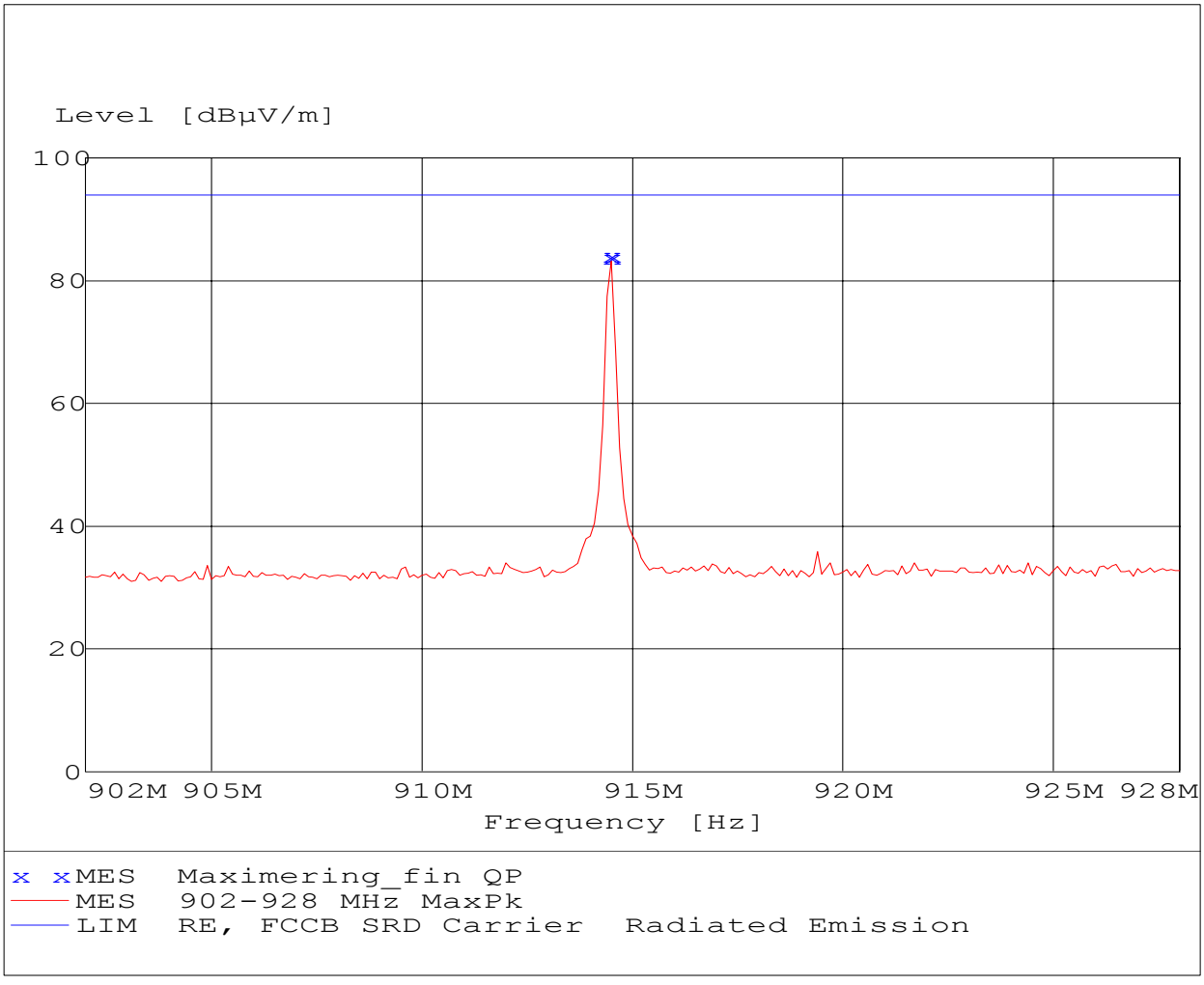


Occupied bandwidth. Relative measurement. Un-modulated carrier. 10 kHz bandwidth.



Occupied bandwidth. Relative measurement. Modulated carrier. 10 kHz bandwidth.

EUT:	LOD
Manufacturer:	Laerdal
Operating Condition:	Ant. 1 m vertical
Test Site:	EMC-5
Operator:	HEN - E500475
Test Specification:	FCC class B
Comment:	Sheet 1
Start of Test:	2002-11-19



MEASUREMENT RESULT: "Maximering_fin QP"
2002-11-19 13:24

Frequency MHz	Level dBµV/m	Transd. dB	Limit dBµV/m	Margin dB	Height cm	Azimuth deg.	Polarisation
914.465	84.10	28.6	94.0	9.9	101.0	194.00	Vertical PK
914.465	83.80	28.6	94.0	10.2	101.0	194.00	Vertical AV
914.465	83.80	28.6	94.0	10.2	101.0	194.00	Vertical QP