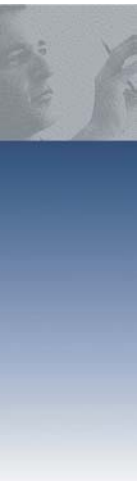

Test Report

DANAK
Reg. no. 19

Emission tests to FCC requirements of EXCOUNT- II Transceiver

Performed for ABB Power Technology Products AB

DANAK-196230
Project no.: E500087-1
Page 1 of 11
4 annexes

2002-05-28

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Title	Emission tests to FCC requirements of EXCOUNT- II Transceiver
Test object	EXCOUNT- II Transceiver
Report no.	DANAK-196230
Project no.	E500087-1
Test period	2002-03-14 - 2002-05-22
Client	ABB Power Technology Products AB Dept. HVP/AKB SE-771 80 Ludvika Sweden Telephone: +46 240 782000 Fax: +46 240 782780
Contact person	Mr. Michael Gudmundsson
Manufacturer	ABB Power Technology Products AB
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	2002-05-28
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.

This report contains measurement data from tests performed at DELTA in Denmark, a 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 specimen tested.

2. Test specimen

The test object EXCOUNT-II is one part of a two part system, consisting of a "Sensor" and a "Transceiver". The sensor is installed on a surge arrester, used to protect high voltage power system utilized by a public utility.

The sensor captures data, like lighting intensity. The sensor is powered by solar cells, backed by electrical field sensors and backed by an internal battery. The sensor will listen for a few seconds every approximately 10 seconds if a transceiver is polling it for data. The sensor has a fixed internal antenna.

The transceiver is hand held battery powered device. It is carried to the vicinity of a surge arrester by an operator. He will activate it to start polling the sensor. The sensor will then transfer captured data to the transceiver. The transceiver has a fixed internal antenna. Captured data can be transferred to a PC, which is installed in the power plant management office of a public utility.

The transceiver is never transmitting at the time it is connected to a PC.

The transceiver will never be connected to a cable when transmitting.

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

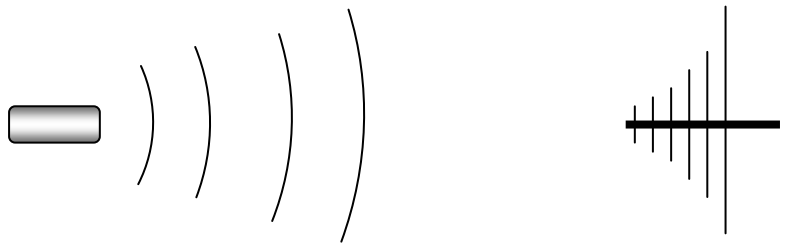
This report covers the Transceiver FCC Identifier: P7Z440914A.

2.1 Test object - TRANSCEIVER

Category	Intentional radiator in 902 to 928 MHz band
Manufacturer	ABB Power Technology Products AB
Model/type	EXCOUNT-II Transceiver
Serial no.	F5
FCC ID	P7Z440914A
Antenna type	Internal, fixed. Part of printed circuit board
Supply voltage	Nominal 9 VDC
Operational mode	Transmitting constantly 10000 blocks/second. Duty cycle approximately 40 %. This also represents the maximum duty cycle during normal operation.

3. General test conditions

3.1 Test set-up



Transceiver at 3 m test distance

The EUT is configured to transmit blocks continuously at a rate of 10000 blocks/second and with a duty cycle of approximately 40%.

The EUT is internally battery powered.

When the unit is used as a transmitter it is portable hand held, not connected to any external cables.

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 dBµV
Test record sheets	

Results

The test is not applicable to equipment using internal battery power.

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	To 18 GHz: 3 m. Above 18 GHz: 0.2 m	
Frequency range	30-25.000 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 record sheets		*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.

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 GHz to 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.

Peak-to-Average Factor is established by to be 8 dB, based on a 40% duty cycle.

The measurements in the frequency band 6 GHz to 10 GHz have been measured using a resolution bandwidth of 30 kHz in order to lower the noise floor. This change was judged not to violate the test requirements, because tests on the carrier had shown that the amplitude difference between measuring with a resolution bandwidth of 1 MHz and width a resolution bandwidth of 30 kHz was less than 1 dB.

Results

The emission was within the specified limits.

Spurious emission 30 MHz to 1000 MHz in tabular form:
(For spectral plots see *Annex 3*)

Spurious freq. MHz	Polarisation	QPeak dBµV/m	dB below QP limit	Note
960	V	34.0	12	Noise floor

(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	Polarisa-tion	Peak dBµV/m	Average dBµV/m	dB below peak limit	dB below average limit	Note
1833.04	H	44.7	36.7	29.3	17.2	2nd harm.
2749.56(R)	V	49.6	41.6	24.4	12.3	3rd harm.
2800(R)	-	-	45	-	9	Noise floor
5350(R)	-	-	51.8	-	2.2	Noise floor
10000	-	-	52.8	-	1.2	Noise floor

(R) means 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 30 MHz to 1000 MHz are performed using a test receiver with quasi peak detector.

Measurements above 1 GHz are performed using a spectrum analyzer 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>.

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

c) For measurements performed using the R&S receiver in the band 1 GHz to 2.75 GHz the build-in average detector is used.

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.

On the plot in *Annex 4* the occupied bandwidth is measured at the level of the spurious limit using 120 kHz resolution bandwidth.

Occupied bandwidth: 2.066 MHz.

Measurements showed that there were no difference on the levels measured with a QP detector and a peak detector. Therefore, the same measurements have been used for occupied bandwidth (peak requirement) and for peak output field strength (QP requirement).

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

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: 93.8 dBµV/m.

See plot in *Annex 4*.

The EUT is in compliance with the requirement.

Annex 1

List of instruments

(1 page)

NO.	DESCRIPTION	MANUFACTURER	TYPE NO.	CAL. EX-PIRES
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 ANA-LYZER 71200C)	HEWLETT-PACKARD	71200A (70206A MAIN FRAME)	2002-11-26
29746	SHIELD-LINE CDN NETWORK, IEC 61000-4-6	DELTA EMC DEPT.	SHIELD-LINE CDN	2003-04-23
29797	BILOG ANTENNA, 30-1000 MHz	CHASE ELECTRICS LTD	CBL 6111A	2003-07-27
29805	BROADBAND u-WAVE AMPLIFIER, 100 MHz-10 GHz (red)	MITEQ	AFS5-00101000-30-10P-5	2002-10-18
29861	EMI-SOFTWARE Ver. 1.60	ROHDE & SCHWARZ	ES-K1, PART: 1026.6790.02	ONLY CAL. IF REQUIRED
29873	TERMINATION/INTEGRATOR FOREC 29192	DELTA EMC	RE 101	ONLY CAL. IF REQUIRED
29876	RIDGED GUIDE HORN ANTENNA, 1-18 GHz	EMCO	3115	2005-03-07
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
29945	"CABLE #29", LOW-LOSS uWAVE CABLE, N-SMA, 6.1 m "EMI"	SUHNER	SUCOFLEX 104A	2002-06-01
29946	"CABLE #30", LOW-LOSS uWAVE CABLE, N-SMA, 6.9 m "EMI"	SUHNER	SUCOFLEX 104A	2002-06-01
29985	BILOG ANTENNA 26-2000 MHz	SCHAFFNER/CHASE	6140A	2003-07-05
49041	6 dB ATTENUATOR, DC-18 GHz, SMA CONN.	SUHNER	6806.19.A	2002-11-27
49042	6 dB ATTENUATOR, DC-18 GHz, SMA CONN.	SUHNER	6806.19.A	2002-11-27

Annex 2

Photos

(3 pages)

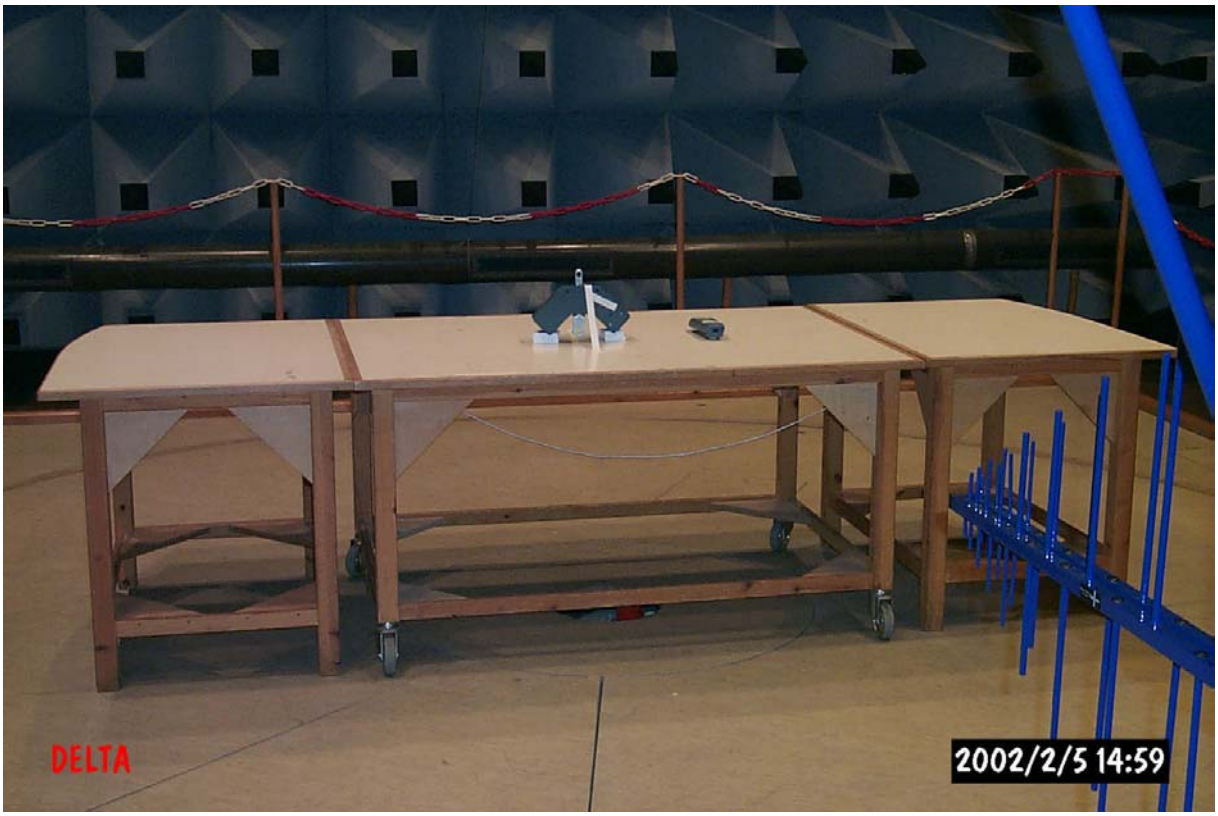


Photo 1 Set-up for measurements 30 MHz to 1000 MHz.
EUT to the right. A sensor from the same product family is monitored in receive-only mode.

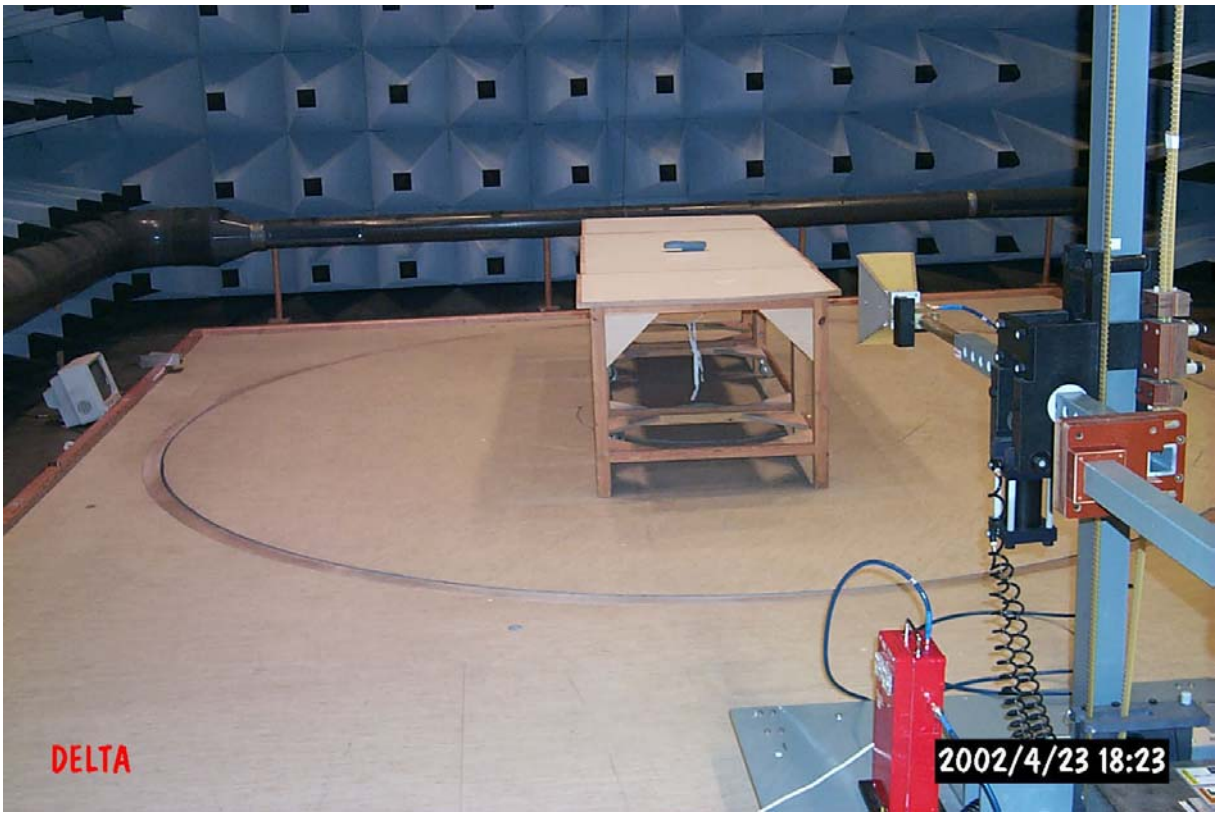


Photo 2 Set-up for measurements 1 GHz to 10 GHz

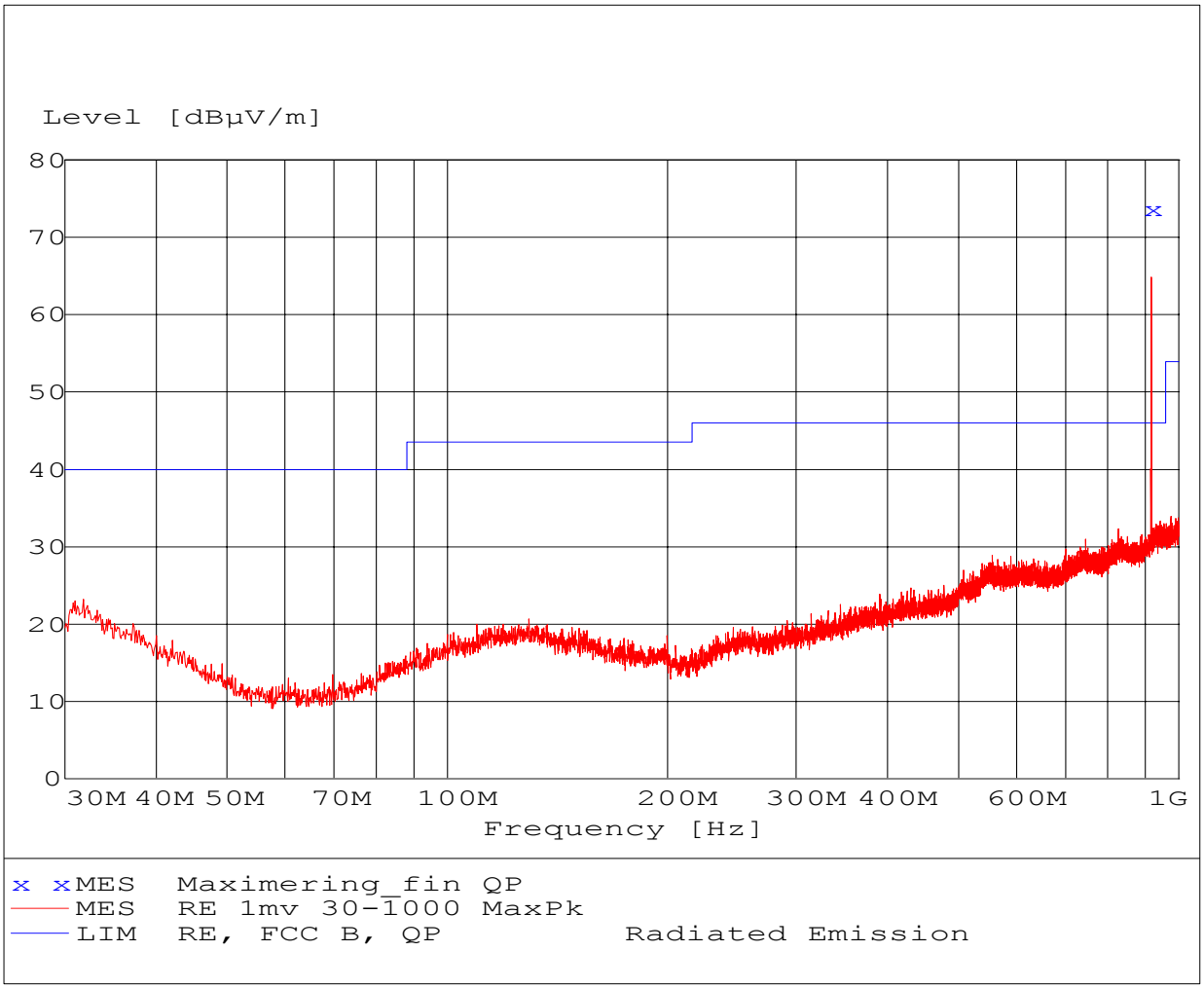
Photo 3 Internal photo showing distance to antenna from about where the closest part of the hand would be during transmission.

Annex 3

Test record sheets regarding radiated emission

(5 pages)

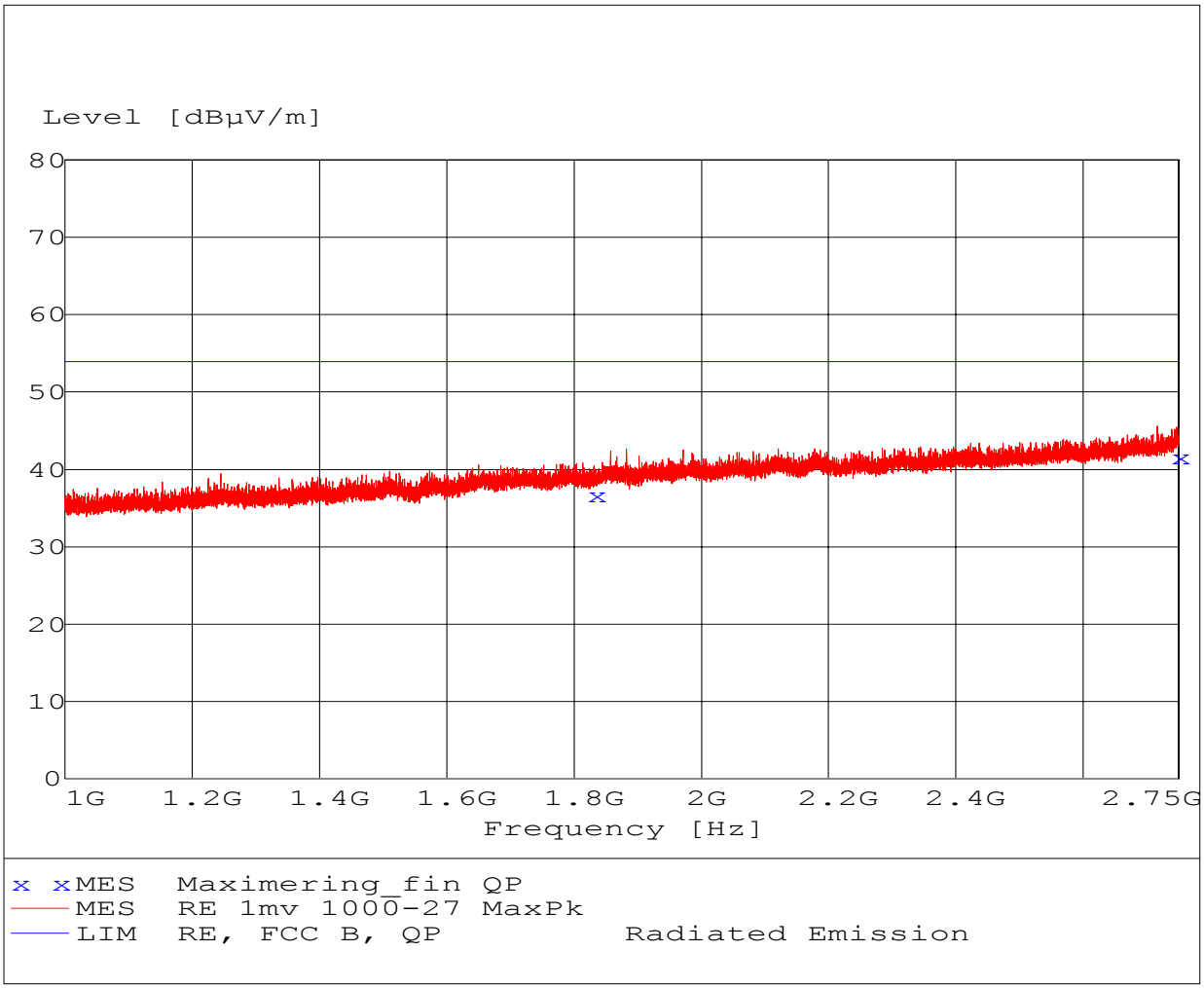
EUT:	Excount-II transceiver F5 (Tx) Sensor F3 (Rx)
Manufacturer:	ABB Power Technology Products AB
Operating Condition:	Ant 1 m vertical
Test Site:	EMC-5
Operator:	HEN - E500087
Test Specification:	FCC B
Comment:	Sheet 8
Start of Test:	2002-03-14



MEASUREMENT RESULT: "Maximering_fin QP"
2002-03-14 14:56

Frequency MHz	Level dBµV/m	Transd. dB	Limit dBµV/m	Margin dB	Height cm	Azimuth deg.	Polarisation
916.52	73.70	28.70	46.00	-27.70	101.00	344.00	Horizontal

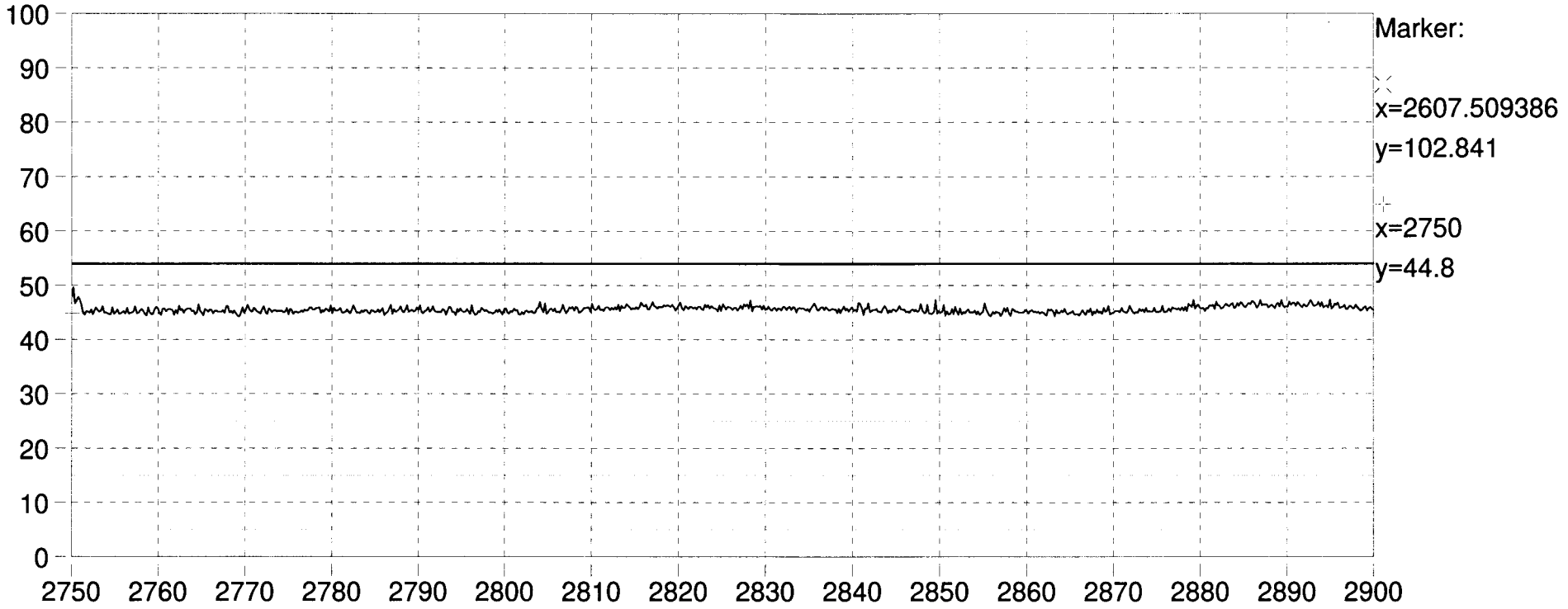
EUT:	Excount II. Transceiver F5
Manufacturer:	ABB Power Technology Products AB
Operating Condition:	Ant 1 m vertical - Internal battery
Test Site:	EMC-5
Operator:	JN - E500087
Test Specification:	FCC class B
Comment:	Sheet 3
Start of Test:	2002-05-02



MEASUREMENT RESULT: "Maximering_fin AVG"
05/02/2002 21:44

Frequency MHz	Level dBµV/m	Transd. dB	Limit dBµV/m	Margin dB	Height cm	Azimuth deg.	Polarisation
1833.04	36.70	7.20	53.90	17.20	162.00	0.00	Horizontal
2749.56	41.60	11.8	53.90	12.30	331.00	174.00	Vertical

DELTA Electronics Testing, EMC Section.



Y = E field strength in dBµV/m

X = Frequency in MHz

Step: Y=0.1 dB lin, X=0.1 MHz lin, t=20 ms, Positive Peak, 1000 kHz Resol, Level range 100 dBM, Attenuation 0 dB, HP 7000

2002-05-13 21:57:12 File: SHEET1.TO1, EUT 1

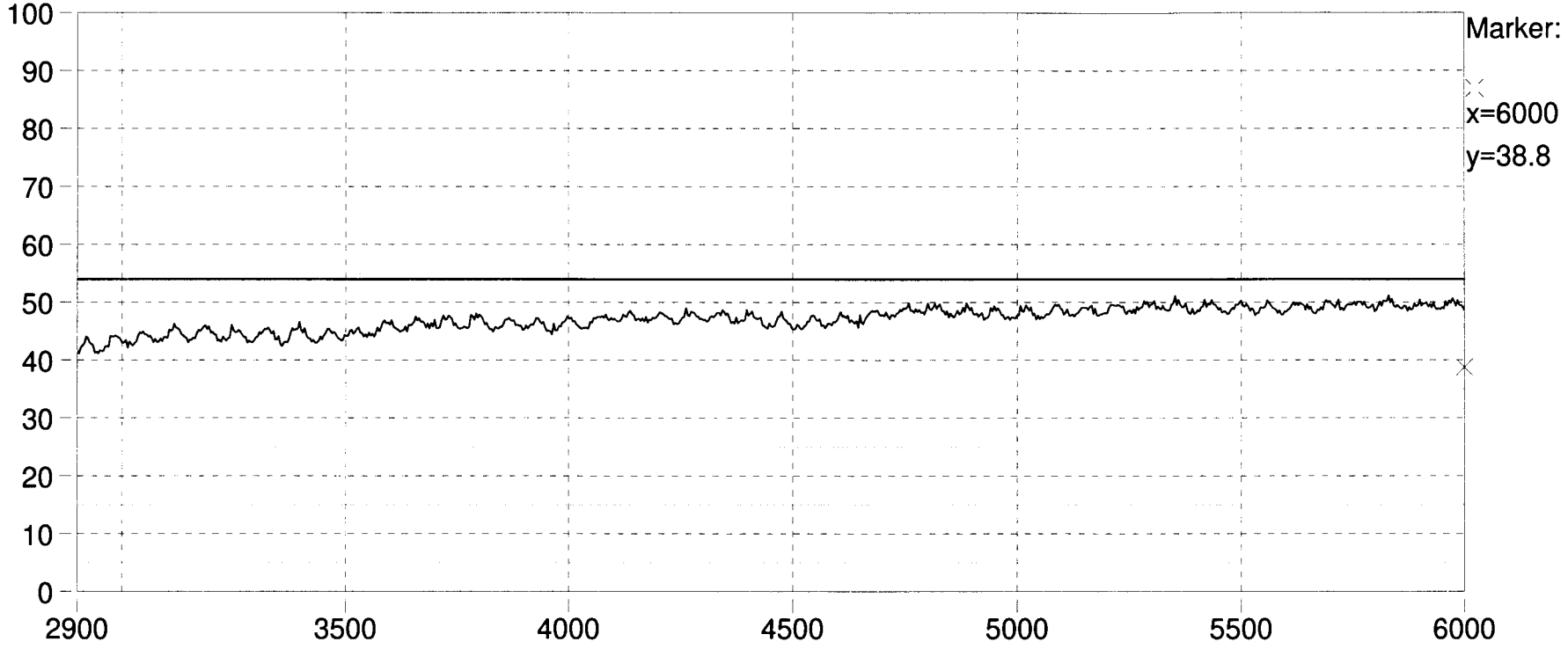
Empty File: SHEET1.LM2, Limit 2

2002-05-13 21:57:12 File: SHEET1.LM1, Limit 1, FCC15.109(part B) unintentional rad. and FCC 15.209(Part C) intentional rad. B

ABB Power Technology Produtcs AB
Excount.II Transceiver no. F5
Mode: Tx.

ant 1-3 meter horizontal. T.T. 0-360 deg.

DELTA Electronics Testing, EMC Section.



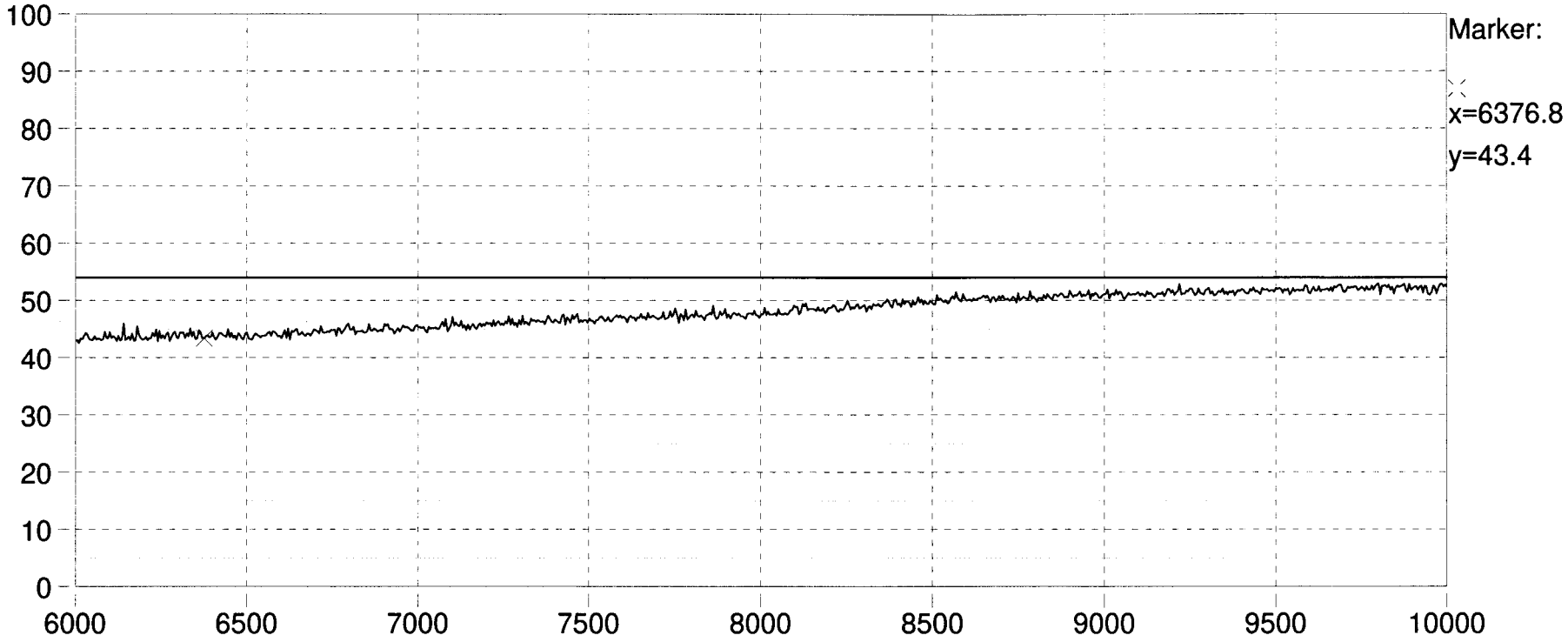
Step: Y=0.1 dB lin, X=0.1 MHz lin, t=20 ms, Positive Peak, 1000 kHz Resol, Level range 100 dBM, Attenuation 0 dB, HP 7000

2002-05-13 21:55:26 File: SHEET3.TO1, EUT 1
Empty File: SHEET3.LM2, Limit 2
2002-05-13 21:55:25 File: SHEET3.LM1, Limit 1, FCC15.109(part B) unintentional rad. and FCC 15.209(Part C) intentional rad. B

ABB Power Technology Produtcs AB
Excount.II Transceiver no. F5
Mode: Tx.

ant 1-3 meter horizontal. T.T. 0-360 deg.

DELTA Electronics Testing, EMC Section.



Step: Y=0.1 dB lin, X=0.1 MHz lin, t=20 ms, Positive Peak, 30 kHz Resol, Level range 100 dBM, Attenuation 0 dB, HP 7000

2002-05-13 21:50:26 File: SHEET5.TO1, EUT 1
Empty File: SHEET5.LM2, Limit 2
2002-05-13 21:50:26 File: SHEET5.LM1, Limit 1, FCC15.109(part B) unintentional rad. and FCC 15.209(Part C) intentional rad. B

ABB Power Technology Produtcs AB
Excount.II Transceiver no. F5
Mode: Tx.

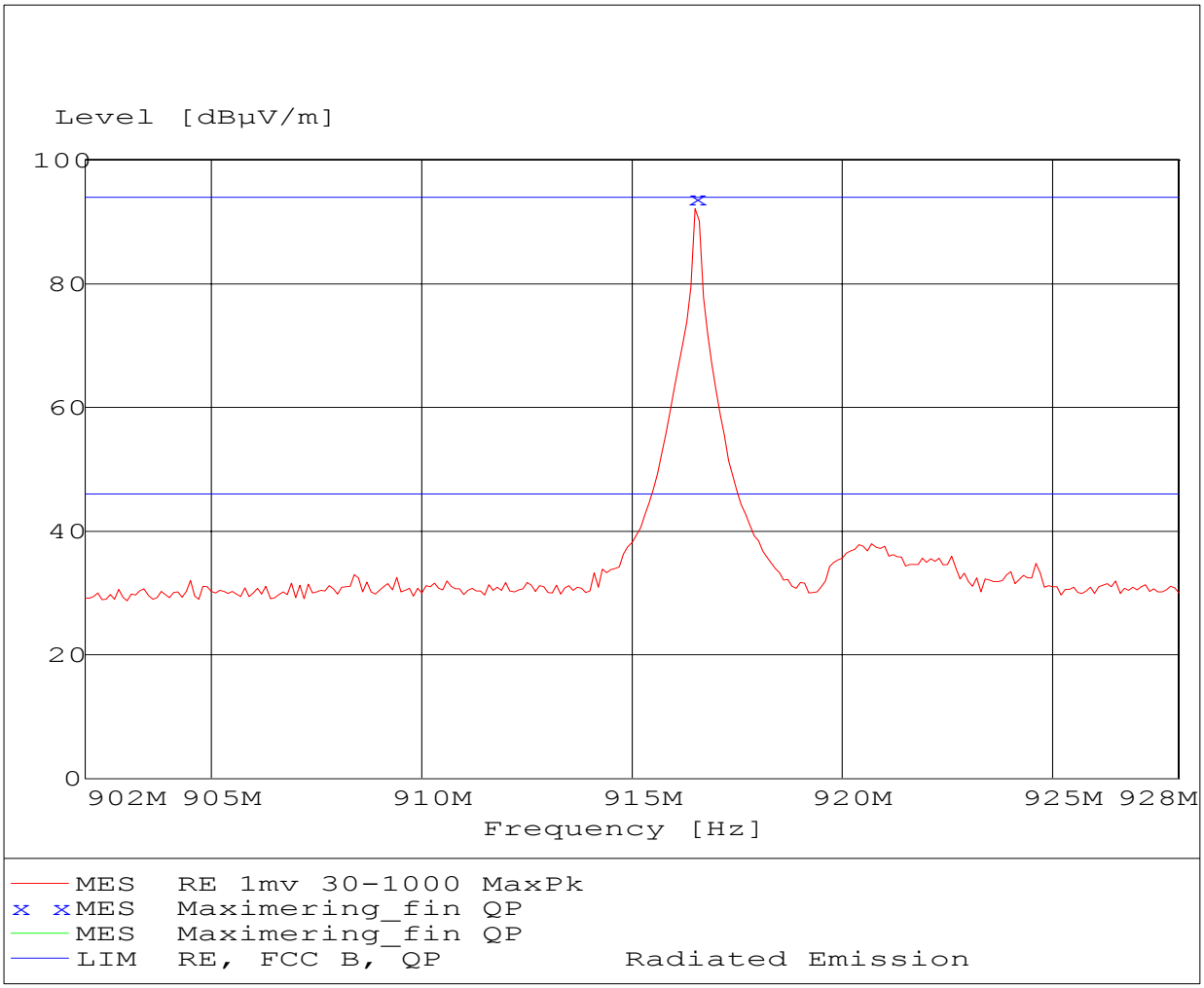
ant 1-3 meter vertical. T.T. 0-360 deg.

Annex 4

Occupied bandwidth / Peak output power

(1 page)

EUT:	Excount II Transceiver no. F5
Manufacturer:	ABB Power Technology Products AB
Operating Condition:	Ant and turn table in worst case pos.
Test Site:	EMC-5
Operator:	JN - E500087
Test Specification:	FCC B Carrier
Comment:	Sheet 41
Start of Test:	2002-05-22



MEASUREMENT RESULT: "Maximering_fin QP"
05/22/2002 19:25

Frequency MHz	Level dBµV/m	Transd. dB	Limit dBµV/m	Margin dB	Height cm	Azimuth deg.	Polarisation
916.52	93.80	28.70	94.00	0.20	137.00	183.00	Vertical