

Test Report



DANAK
Reg. no. 19

**Emission tests to FCC requirements
of Precise BioAccess(tm) Mifare DC/W Reader**

Performed for Precise Biometrics AB

DANAK-196060

Project no.: K222371-7

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5 annexes

2002-03-04

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Title Emission tests to FCC requirements of Precise BioAccess(tm) Mifare DC/W Reader

Test object Precise BioAccess(tm) with Mifare contactless card

Report no. DANAK-196060

Project no. K222371-7

Test period November 2001 -February 2002

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Specifications 47 CFR Part 15, Subpart B - Unintentional Radiators
47 CFR Part 15, Subpart C - Intentional Radiators

Results The equipment under test was in compliance with the requirements

Test personnel Jesper Nielsen
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Date 2002-03-04

Project manager



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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 for Information Technology Digital Equipment and for intentional radiators, operating within the band 13.553 - 13.567 MHz.

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

1.1.1 Applicable FCC Rules for test

47 CFR Part 15, Subpart B - Unintentional Radiators

§15.107 Conducted limits

§15.109 Radiated emission limits, general requirements

47 CFR Part 15, Subpart C - Intentional Radiators

§15.207 Conducted limits

§15.209 Radiated emission limits, general requirements

§15.225 Operation within the band 13.553 - 13.567 MHz

The methods and procedures have been applied as specified in:

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.

1.2 Summary of tests

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

Tests of Unintentional Radiator	Key references to requirement	FCC Part 15 Subpart B Class B
Conducted emission, AC mains	§ 15.107	Passed
Radiated electromagnetic field emission	§ 15.109	Passed

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
Peak field strength	§ 15.225(a)	Passed
Occupied bandwidth	§ 15.225(b)	Passed
Frequency tolerance over temperature	§ 15.225(c)	Passed
Frequency tolerance over supply voltage range	§ 15.225(c)	Passed

Abbreviations

Passed	:	The requirements are 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(s)

The test object consists of the following items:

2.1 Test object - Precise BioAccess(tm) Mifare DC/W Reader

Category	Information Technology Equipment with intentional transmitter
Manufacturer	Precise Biometrics AB
Model / type	Precise BioAccess(tm) Mifare DC/W Reader
Part no.	MS 010 039
Serial no.	001
FCC ID	-
Supply voltage	12 - 24 VDC
Operational mode	Reading card and fingerprint (black level)

2.2 Test object - AC Adapter

Category	AC/DC Converter
Manufacturer	Nordic Power AB
Model / type	SA30-15U
Supply voltage	100-240 VAC / 16 VDC
Operational mode	Normal, 115-120 VAC

2.3 Test object - AC Adapter

Category	AC/DC Converter
Manufacturer	IBM
Model / type	O2K6543
Supply voltage	100-240 VAC / 16 VDC
Operational mode	Normal, 115-120 VAC

2.4 AUX equipment - PreciseWiegand monitor

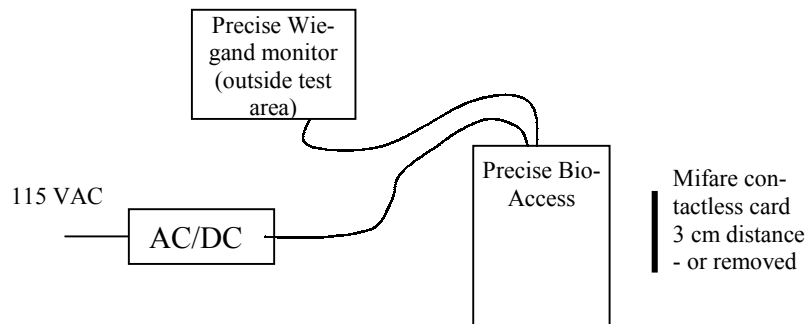
Manufacturer	Precise Biometrics AB
Model / type	(internal test equipment)

2.5 AUX equipment - AC Adapter

Manufacturer	Nordic Power AB
Model / type	A20930GL 9 VAC

3. General test conditions

3.1 Test set-up



Precise BioAccess(tm) Mifare DC/W Reader is an access reader that reads a standard Mifare contactless card and reads fingerprints. The Precise BioAccess unit is normally connected to an access control system in a building.

If the card is correct read a green led bar in the unit will indicate this and the acceptance of a fingerprint is indicated with another green led bar. If the card/fingerprint is not accepted, the led bar will be red instead.

During tests the Precise Wiegand monitor decodes the Wiegand signals and flashes the "OK" LED if a valid sequence is received. The "Error" LED will flash for a non-valid sequence.

Furthermore, a Mifare contactless card with a "black" finger template is used; i.e. the unit will accept the card without a finger present at the sensor. When the "black" card is placed at normal distance (approx. 25 mm), the unit will do an infinite loop through all functions of normal use.

When the card is removed a carrier modulated five times a second by a request command (duration below 100 μ s) is transmitted continuously. This mode was used for most tests.

The power adapter / EUT was powered from 115 VAC 50 Hz during the tests.

In the user's installation the power cable connections will be made using a screened cable, not terminated in the EUT-end but terminated in the far end.

During radiated emission tests un-screened cable was used.

During test of conducted emission a screened power cable was used. In this way conducted emission on the carrier frequency could be separated from signals pick-up from the transmitted field by the power wire. Furthermore, during conducted emission test the Mifare contactless card was replaced by a shorted loop placed close to the EUT in order to reduce radiated fields reaching the power wire and LISN.

4. Test and results

4.1 Conducted emission, AC mains (FCC Part 15, Subpart B, Class B and FCC Part 15, Subpart C)

	Requirements
Specification 1	FCC Rules and Regulations Part 15, Subpart B, class B
Specification 2	FCC Rules and Regulations Part 15, Subpart C
Test set-up	ANSI C63.4:1992
Frequency range	0.45-30 MHz
Limit: (quasi-peak) As specified in 15.107(a) 15.207(a)	0.45-30 MHz: 48 dB μ V
Test record sheets	<i>Annex 3</i>

Results

The emission was within the specified limits.

The plots on the test record sheet show peak measurements.

Comments

The EUT is DC supplied from the system in which it is installed. During conducted emission the EUT was powered from an AC/DC converter supplied from 115 VAC 50 Hz.

In the user's installation the power cable connections will be made using a screened cable not terminated in the EUT-end, but terminated in the far end.

During test of conducted emission a screened power cable was used. In this way conducted emission on the carrier frequency could be separated from signals pick-up from the transmitted field by the power wire. Furthermore, during conducted emission test the Mifare contactless card was replaced by a shorted loop placed close to the EUT in order to reduce radiated fields reaching the power wire and LISN. The AC/DC converter has its cables low-inductively wrapped. The screened cable is terminated to the LISN.

4.2 Radiated electromagnetic field (FCC Part 15, Subpart B, Class B and FCC Part 15, Subpart C)

	Requirements
Specification 1	FCC Rules and Regulations Part 15, Subpart B, class B
Specification 2	FCC Rules and Regulations Part 15, Subpart C
Test set-up	ANSI C63.4:1992
Measuring distance	3 m, except 13 to 30 MHz band which is measured at 30 m
Frequency range	13-30 and 30-1.000 MHz
Limits: As specified in 15.109(a) 15.209(a) and 15.225(a)	13-30 MHz 29,5 dB μ V/m 13.553-13.567 MHz 80 dB μ V/m 30-88 MHz: 40 dB μ V/m 88-216 MHz: 43.5 dB μ V/m 216-960 MHz: 46 dB μ V/m Above 960 MHz: 54 dB μ V/m
Measurement uncertainty (2 σ) <1 GHz	2.6 dB
Measurement uncertainty (2 σ) >1 GHz	4.9 dB
Test record sheets	<i>Annex 4</i>
<i>Note:</i> The transducer values have been calculated/corrected for in the level shown in the 2nd column of the test record sheet.	

Measurement results in tabular form

Frequency MHz	Polarity	Measured dB μ V/m	dB to limit	Notes
13.56	Magnetic loop	37.7	42.3	No harmonics or other spurious emissions were detected in the band 13 MHz to 30 MHz
197.92	Vertical	37.4	6.1	
202.64	Vertical	34.0	9.5	
495.5	Vertical	37.9	8.1	
557.7	Vertical	36.5	9.5	

Results

The emission was within the specified limits.

Comments

Because the transmitter is operating on 13.56 MHz, radiated emission measurements have been performed from 13 MHz and up.

Measurements were performed with the card removed enabling the transmitter to send constant carrier. Measurements were performed also when the system was communicating with card enabling observation of modulation products. The survey of the content of modulation products was performed using relative measurements on a distance of 9 m using a rod antenna. For plot of this survey measurement, see *annex 4*.

Measurements using a magnetic loop antenna from 13 to 30 MHz were performed on a 30 m OATS.

4.3 **Peak field strength**

§ 15.225(a) specifies the peak field strength within the band 13.553 - 13.567 MHz to be maximum 10.000 microvolts/meter at 30 meters, or 80 dB μ V/m.

The maximum field strength measured at a distance of 30 m was 37.7 dB μ V/m - 42.3 dB below the limit.

The carrier is 8.2 dB above the spurious limit.

Result

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

4.4 **Occupied bandwidth**

§ 15.225(b) specifies that emission outside the band 13.553 - 13.567 MHz shall be in compliance with the requirements of 15.209.

Using a spectrum analyser with RBW = VBW = 100 Hz, the 20 dB bandwidth was measured to 347 Hz with the transmitter constantly transmitting (no card detected). The 20 dB level is lower than the spurious limit. The carrier bandwidth is expected to be less, if measured using narrow bandwidths.

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

Based on the frequency measurements to be presented in *section 4.5 and 4.6* it can be calculated that the carrier will come no closer to the lower frequency limit than $13560537 - (347/2 + 13553000) = 7363.5$ Hz and no closer to the upper frequency limit than $13567000 - (347/2 + 13560758) = 6068.5$ Hz.

Result

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

4.5 Frequency tolerance over temperature

§ 15.225(c) specifies that the frequency tolerance of the carrier signal shall be maintained within $\pm 0.01\%$ of the operating frequency over a temperature variation of -20°C to $+50^{\circ}\text{C}$ at normal supply voltage.

Temperature	Minutes after switch ON	Frequency Hz	% from frequency measured at 20°C	Result
$+20^{\circ}\text{C}$	10	13560622	0	Reference
$+50^{\circ}\text{C}$	0	13560758	0.001%	Passed
$+50^{\circ}\text{C}$	2	13560758	0.001%	Passed
$+50^{\circ}\text{C}$	5	13560537	-0.0006%	Passed
$+50^{\circ}\text{C}$	10	13560537	-0.0006%	Passed
-20°C	0	13560703	0.0006%	Passed
-20°C	2	13560703	0.0006%	Passed
-20°C	5	13560703	0.0006%	Passed
-20°C	10	13560703	0.0006%	Passed

Result

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

Comments/procedure

During temperature transitions the carrier was left on and the spectrum analyser set in max-hold showing the carrier. In this way it can be observed that the carrier frequency stays within limits on all temperatures between extreme temperature limits.

The EUT was switched off for 10 min before measurements on the carrier frequency at the temperatures -20°C , $+20^{\circ}\text{C}$ and $+50^{\circ}\text{C}$ using a spectrum analyser and a marker generator. Therefore, double traces can be observed on the test record sheets. This method enables frequency measurements with the accuracy of the marker generator.

4.6 **Frequency tolerance over supply voltage range**

§ 15.225(c) specifies that the frequency tolerance of the carrier signal shall be maintained within $\pm 0.01\%$ of the operating frequency for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20°C.

Supply voltage (actual)	% from nominal (target voltage)	Frequency Hz	% from frequency measured at 18 VDC	Temperature °C
10.08	85% of 12 V	13560622	0	20
18	0	13560622	0	20
27.64	115% of 24 V	13560622	0	20

Result

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

Comments

Voltages between 12 and 24 VD are considered nominal. 18 V was used a reference voltage during this test.

The carrier frequency was measured during the tests using a spectrum analyser and a marker generator. Therefore, double traces can be observed on the test record sheets. Using this method it is possible to measure the frequency with the accuracy of the marker generator, which is very high.

Annex 1

List of instruments

(1 page)

LIST OF INSTRUMENTS

NO.	DESCRIPTION	MANUFACTURER	TYPE NO.	CAL. EXPIRES
29224	BROADBAND ROD ANTENNA	SINGER	95010-1	2003-01-08
29300	MEASURING RECEIVER	ROHDE & SCHWARZ	ESH3, 335.8017.52	2003-01-03
29332	ACTIVE LOOP ANTENNA	ROHDE & SCHWARZ	HFH-Z2	2002-04-20
29433	SPECTRUM ANALYZER	HEWLETT-PACKARD	8566 B	2002-05-06
29439	ARTIFICIAL MAINS NETWORK	EMCO	3825/2	2002-07-17
29680	IMPULSE VOLTAGE LIMITER	ROHDE & SCHWARZ	ESH3/Z2	2003-01-02
29797	BILOG ANTENNA, 30-1000 MHz	CHASE ELECTRICS LTD	CBL 6111A	2003-07-27
29861	EMI-SOFTWARE Ver. 1.60	ROHDE & SCHWARZ	ES-K1, PART: 1026.6790.02	ONLY CAL. IF REQUIRED
29916	AUTOMATIC TEST RECEIVER, 9 kHz-2.75 GHz	ROHDE & SCHWARZ	ESCS 30 1102.4500.30	2003-01-02

Annex 2

Photos

(3 pages)



Photo 1 FCC Conducted emission on AC mains port.

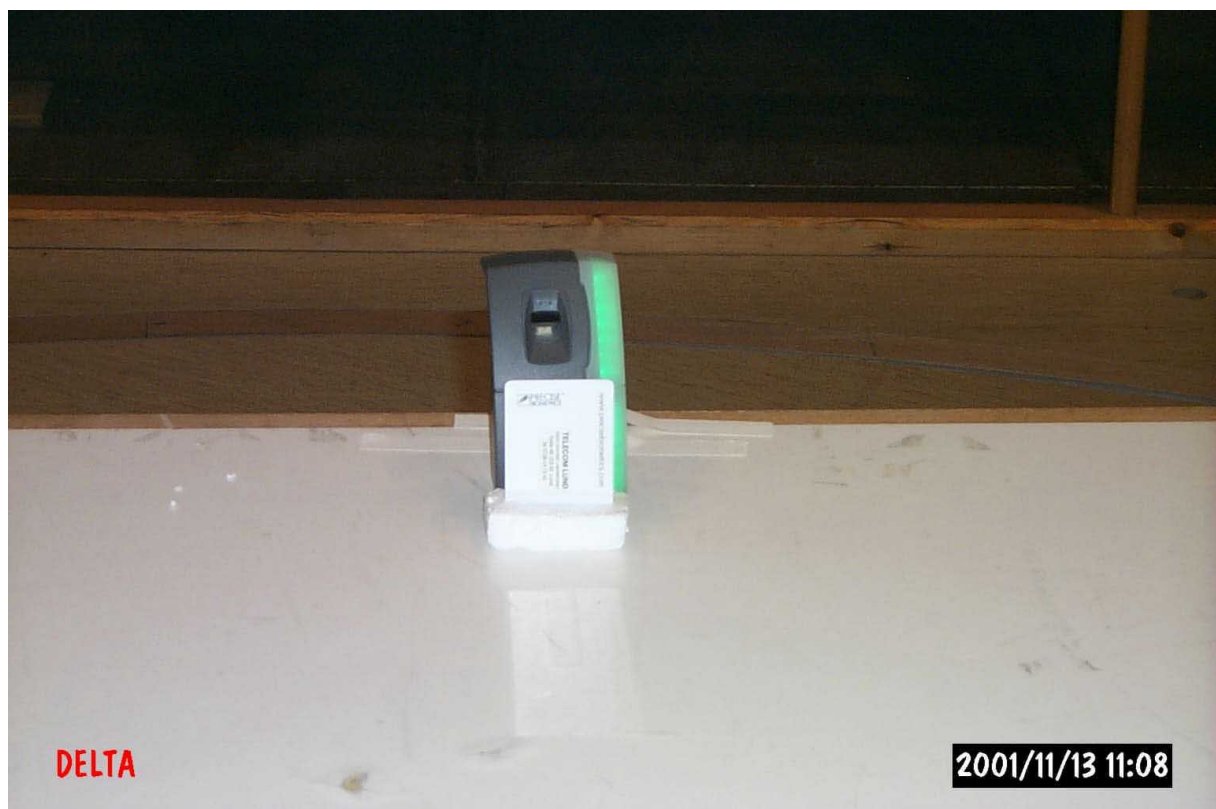


Photo 2 EUT with card.



Photo 3 FCC Radiated emission 30 - 1000 MHz.



Photo 4 Look at modulation products at a distance of 9 m. Survey only.

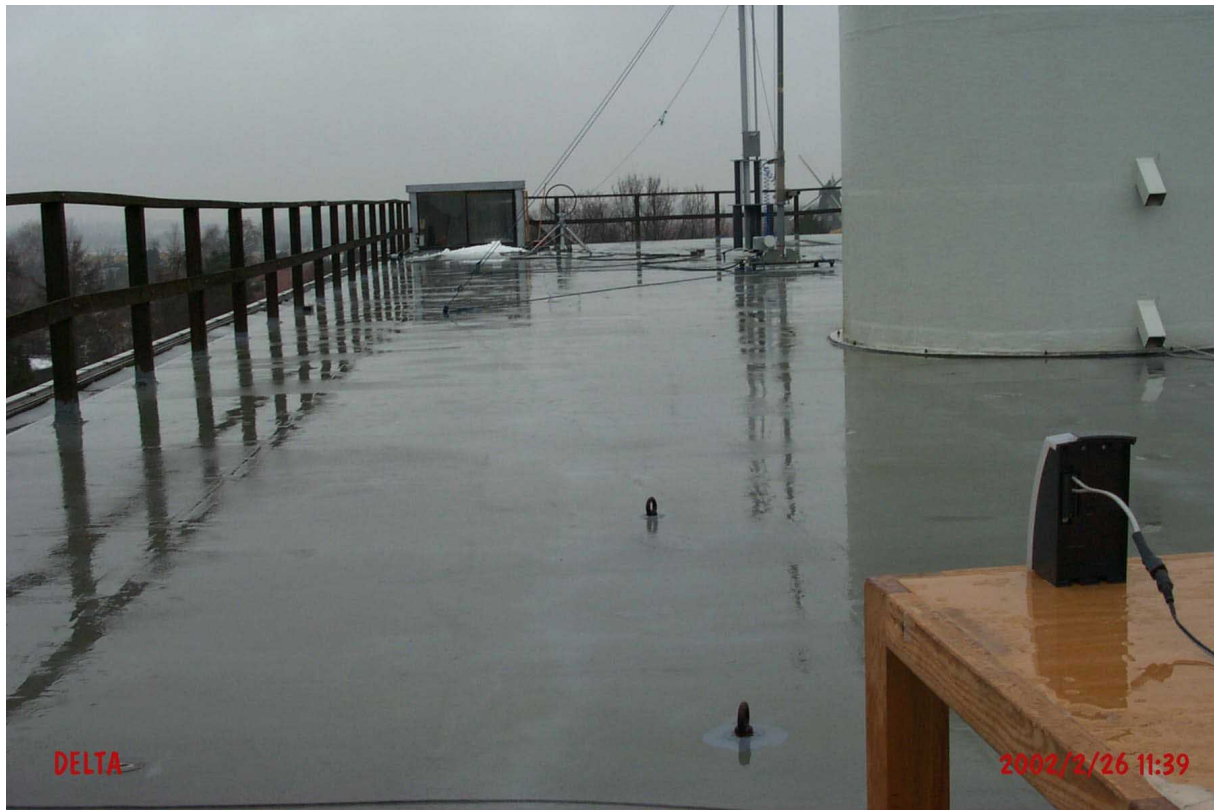


Photo 5 Radiated measurements using magnetic loop. 13 MHz to 30 MHz on 30 m OATS. EUT shown in position with maximum radiation.

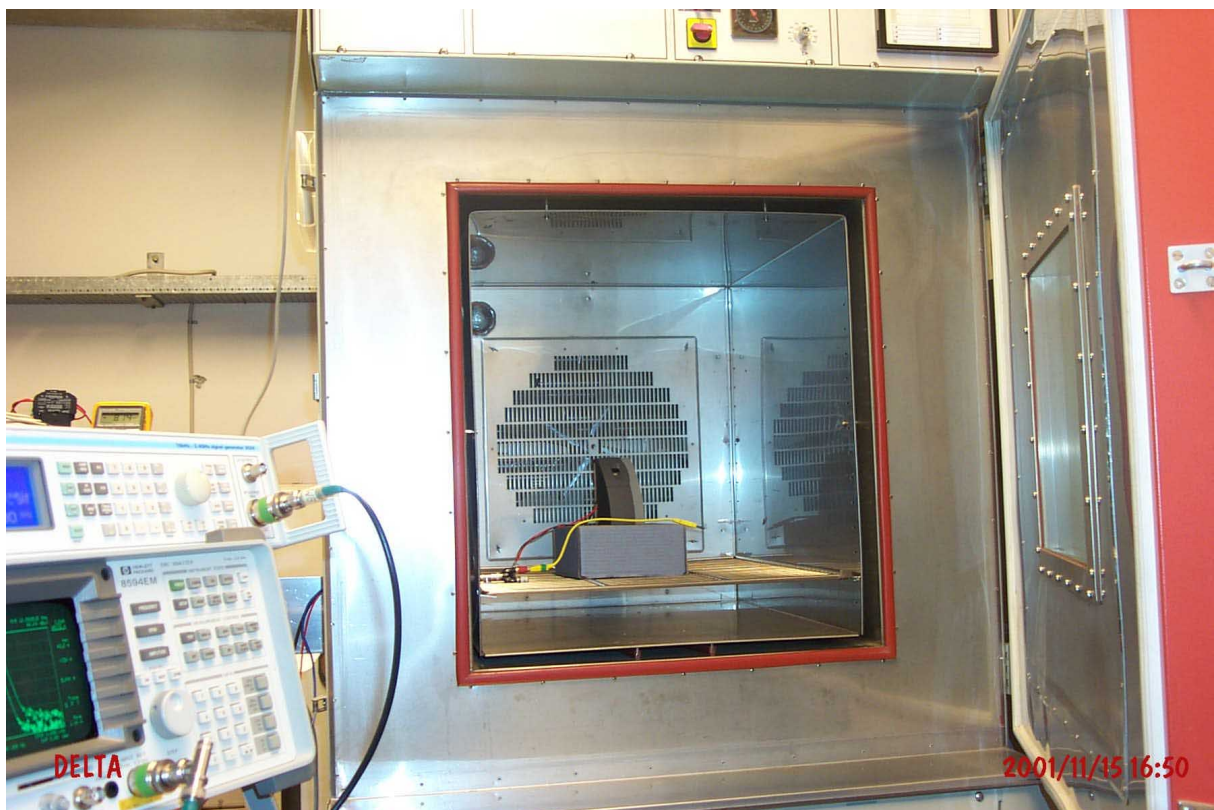
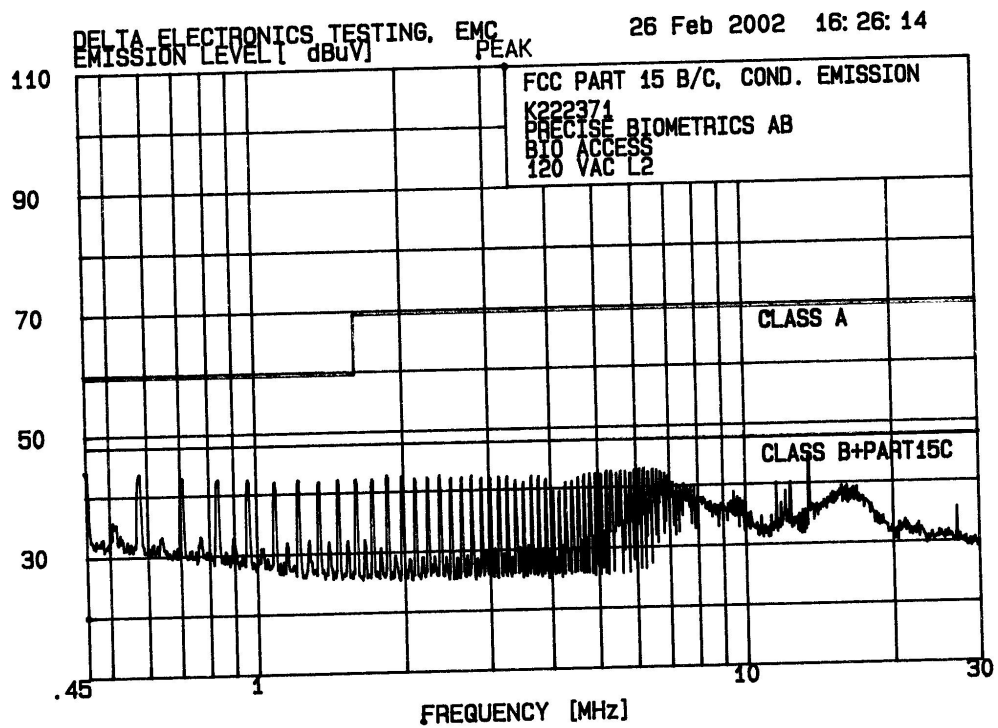
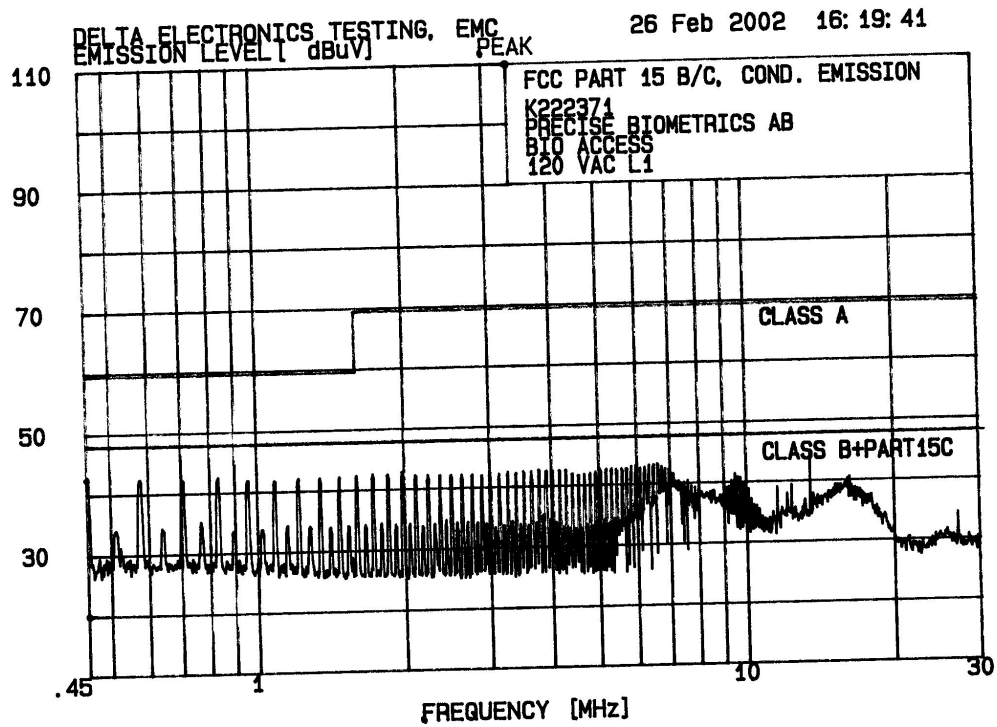


Photo 6 Measurements in climatic chamber.

Annex 3

***Test record sheet regarding
conducted emission on power port***

(1 page)



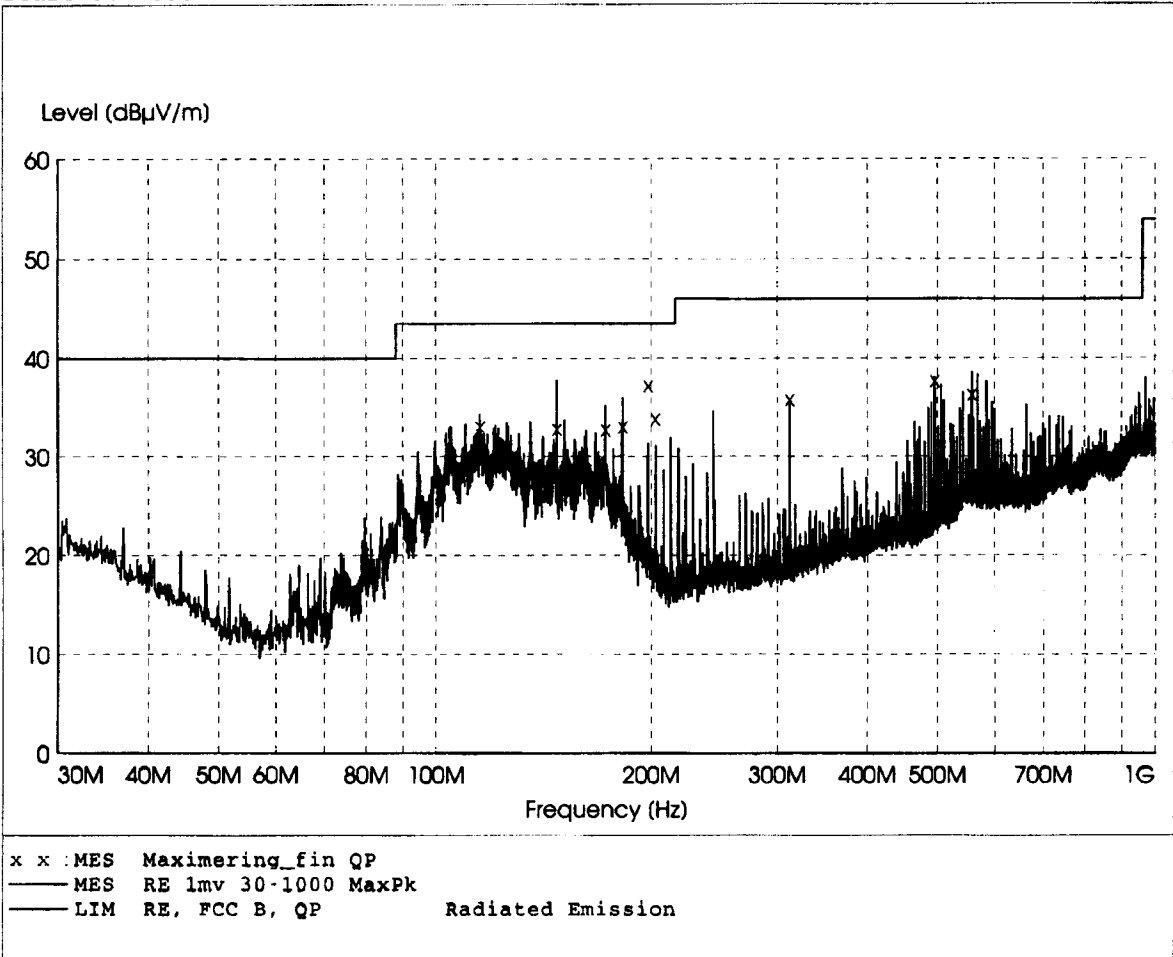
Annex 4

***Test record sheets regarding
radiated emission***

(2 pages)

DELTA Electronics Testing. EMC section

EUT: BioAccess (Wiegand & Mifane)
Manufacturer: Precise Biometrics
Operating Condition: Ant 1 m vertical.
Test Site: EMC-5
Operator: JN - K222371-1
Test Specification: FCC class B
Comment: Sheet 3
Start of Test: 2001-11-13



MEASUREMENT RESULT: "Maximering_fin QP"

11/13/2001 14:19

Frequency MHz	Level dBµV/m	Transd dB	Limit dBµV/m	Margin dB	Height cm	Azimuth deg	Polarisation
115.260000	33.20	14.7	43.5	10.3	100.0	190.00	VERTICAL
147.460000	33.00	14.0	43.5	10.5	111.0	275.00	VERTICAL
172.530000	32.90	12.2	43.5	10.6	104.0	59.00	VERTICAL
182.450000	33.20	11.7	43.5	10.3	128.0	81.00	VERTICAL
197.920000	37.40	11.9	43.5	6.1	100.0	287.00	VERTICAL
202.640000	34.00	12.2	43.5	9.5	120.0	201.00	VERTICAL
311.900000	36.00	16.0	46.0	10.0	155.0	179.00	VERTICAL
495.500000	37.90	21.4	46.0	8.1	100.0	142.00	VERTICAL
557.700000	36.50	23.5	46.0	9.5	200.0	176.00	VERTICAL

Boards,
m. base

9m DISTANCE
SEMI-AUTOCOR
COMPLICATION,
WITH CARD.

MODULATION
PRODUCTS
RELATIVE
TO CARRIER
9m DISTANCE.

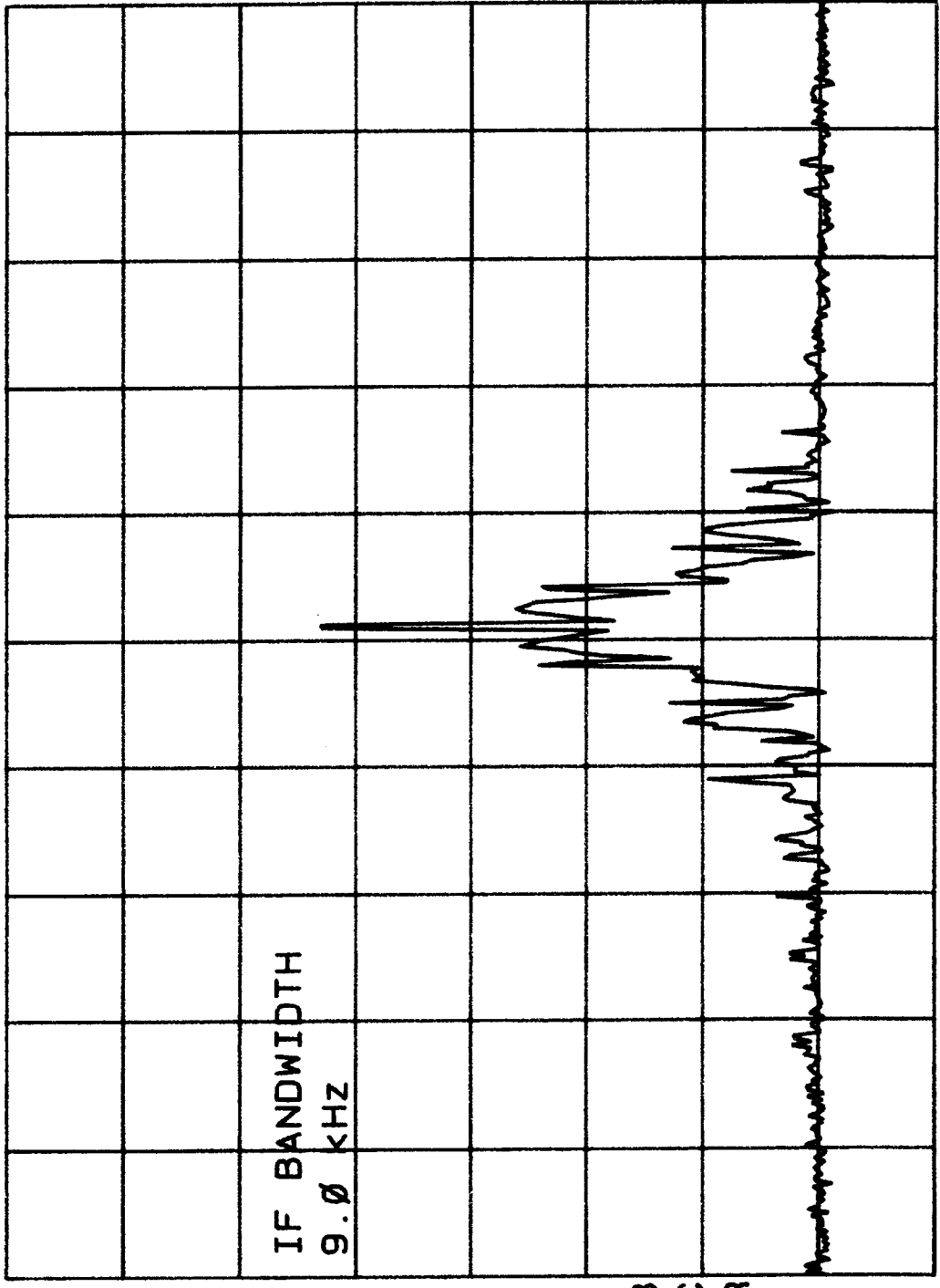
17: 20: 54 16 NOV 2001

REF 73.0 dBμV #AT 0 dB

PEAK
LOG
10
dB/

IF BANDWIDTH
9.0 KHZ

VA SB
SC FC
CORR



START 10.000 MHz STOP 17.000 MHz
#RES BW 9.0 KHZ SWP 259 msec
VBW 30 KHZ

Annex 5

Plot of relative measurement in climatic chamber

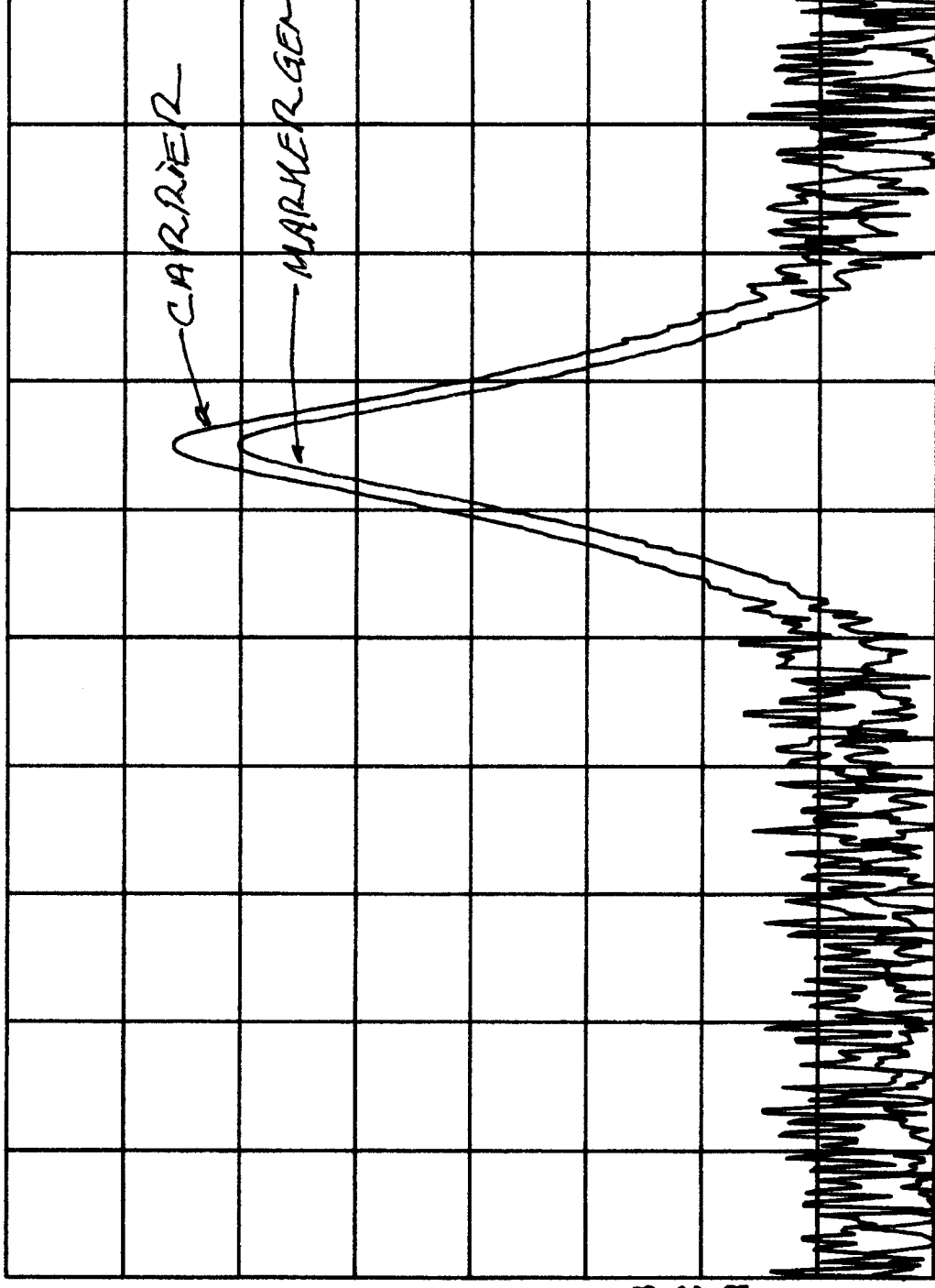
(1 page)

18:03:43 15 NOV 2001
HP

REF 90.0 dBμV AT 10 dB

PEAK
LOG
10
dB/

BioAccess
-20°C lowins



WA VB
SC FC
CORR

CENTER 13.560000 MHZ

RES BW 100 HZ

VBW 100 HZ

SPAN 4.000 KHZ
SWP 3.00 sec