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Test report no. : 4-1905-01-03/05
Type identification: SPECTRAN HF-2025E
Test specification : comparative measurements

Table of Contents

1 General Information

1.1 Notes

The test results of this test report relate exclusively to the test item specified in 1.5. The CETECOM ICT Services GmbH does not assume responsibility for any conclusions and generalisations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item. The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of the CETECOM ICT Services GmbH.

1.1.1 Assessment of Compliance

The Aaronia SPECTRAN portable field meter has been tested for compliance of measurement values in comparison with industrial broadband field probes and spectrum analyzers. Especially the correct display of RMS-field strength (in connection with a logarithmic-periodic test antenna) and of artificial signal sources was checked in comparison with industrial reference devices. Special attention was directed to the following signal shapes : CW, GSM, UMTS, WLAN and DECT. The measurements were exclusively performed by skilled personnel under objective and representative conditions, yet device under test and reference device were not always operated under comparative conditions and device settings. The Spectrum Analyzer HF-2025E showed a sufficient measurement accuracy during the measurements of RMS-signal strength of pulsed and unpulsed signals as required by EMF-test specifications (see chapter 2.5 for details). It can therefore be applied for EMCE measurements of all tested signal types.

1.1.2 Bewertung (deutsch)

Das tragbare Feldstärke-Messgerät Aaronia SPECTRAN wurde auf Übereinstimmung der Messwerte im Vergleich zu industriellen Breitband-Feldsonden und Spektrum-Analysatoren überprüft. Zielsetzung war die Überprüfung der korrekten Anzeige von gemessenen RMS-Feldstärkewerten (in Verbindung mit einer logarithmisch-periodischen Messantenne) und von künstlichen Signalquellen im Vergleich zu industriellen Referenzgeräten. Dabei wurde auf folgende Signalformen besonderes Augenmerk gelegt : CW, GSM, UMTS, WLAN und DECT.
Die Messungen wurden ausschließlich von sachkundigen Mitarbeitern unter objektiven und repräsentativen Bedingungen durchgeführt. Gemessenes Gerät und Referenzgerät wurden nicht immer unter vergleichbaren Bedingungen und Einstellungen betrieben.
Der Spectrum Analyzer HF-2025E lieferte bei den in Kapitel 2.5 (test results) beschriebenen Messungen im Rahmen der eigenen Messunsicherheit genaue Ergebnisse bei der Messungen der gemittelten Signalstärke von gepulsten und ungepulsten Signalen, wie sie in diversen EMF-Messrichtlinien gefordert sind. Er ist daher zur EMVU-Messung bei allen getesteten Signalarten einsetzbar.

Test engineer:

2006-08-03	**Thomas Vogler**	Thomas Vogler
Date	Name	Signature

Test engineer:

2006-08-03	**Christophe Weiden**	
Date	Name	Signature

Technical responsibility for area of testing:

2006-08-03	**Ralf Hoehn**	R. Höhn
Date	Name	Signature

1.2 Testing laboratory

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Test location, if different from CETECOM ICT Services GmbH

Name: ---
Street: ---
Town: ---
Country: ---
Phone: ---
Fax: ---

1.3 Details of applicant

Name: Aaronia AG

Street: Gewerbegebiet Aaronia AG
Town: 54597 Strickscheid
Country: Germany
email: info@aaronia.de
Internet http://www.aaronia.de

Contact: Mr. Thorsten Chmielus
Telephone: 06556-93033

1.4 Application details

Date of receipt of application: 2006-04-20
Date of receipt of test item: 2006-04-21
Start/Date of test: 2006-04-21
End of test: 2006-04-28

1.5 Test item

Description of the test item:	portable field meter and spectrum analyzer
Type identification:	SPECTRAN HF-2025E
Serial number:	05317
Manufacturer:	
Name:	Aaronia AG
Street:	Gewerbegebiet Aaronia AG
Town:	54597 Strickscheid
Country:	Germany

additional information on test item :
(acc. to applicant's information)

frequency range :	700 – 2500 MHz
level range :	- 80 – 0 dBm
measurement level uncertainty :	+/- 4 dB typical

additional equipment :

Logarithmic-Periodic directional antenna	HyperLog 60xxx (S/N 60-25007)

1.6 Test specification(s)

The device under test has not been tested according to a special test specification.

2 Technical test

2.1 Summary of test results

No deviations from the technical specification(s) for the applied test cases were ascertained in the course of the tests performed.	☒
The deviations as specified in 2.5 were ascertained in the course of the tests performed.	☐

2.2 Test environment

General Environment conditions in the test area are as follows:

Ambient temperature:	20°C – 24°C
Tissue simulating liquid:	20°C – 24°C
Humidity:	40% – 50%

2.3 Measurement and test set-up

The measurement system is described in chapter 2.4.

A description of positioning and test signal control can be found in chapter 2.5 together with the test results.

2.4 Measurement system

2.4.1 Broadband Electromagnetic Field Test system

A state of the art Broadband Electromagnetic Field Test system was used. The probes of the system are fitted with three sensors which measure the field strength of the X, Y and Z plane directions separately. The field strength is calculated by the instrument's processor by summing the squares of the three measured values.

The frequency range 5 Hz to 40 GHz is covered.
Depending from the used probe type
E and H or E-field only is detectable.

EHP50B	5 Hz to 100 kHz	E and H-Field
EP 330	100 kHz to 3 GHz	E-Field
EP 408	1 GHz to 40 GHz	E-Field

H-Field measurements from 100 kHz to 40 GHz have not been performed due to limitations of the measurement equipment.

2.4.2 Test equipment list

No	Manufacturer	Device	Type	Serial number
1	PMM	Electric and Magnetic Field Meter	PMM 8053	0220J10945
2	**PMM**	**Electric Field Probe 100 kHz - 3 GHz**	**EP330**	**1010J10627**
3	PMM	Electric Field Probe 1 MHz - 40 GHz	EP408	0000J10902
4	PMM	Optical Repeater	OR 02	0100J10812
5	PMM	Electric and Magnetic Field Analyser 5 Hz – 100 kHz	EHP-50B	241WM30404
6	Frankonia	10 m EMC-Chamber	Chamber F	n.a.

Last calibration date of PMM equipment : May 24, 2004

2.4.3 Averaging

For time efficient testing the average function “last 32 samples” was used. With some spot checks was shown, that caused by the time structure of the measured responses, the results did not change with 6-minutes averaging.

2.4.4 Uncertainties

The probe uncertainties stated by the manufacturer are considered to be the main relevant and dominant issues.

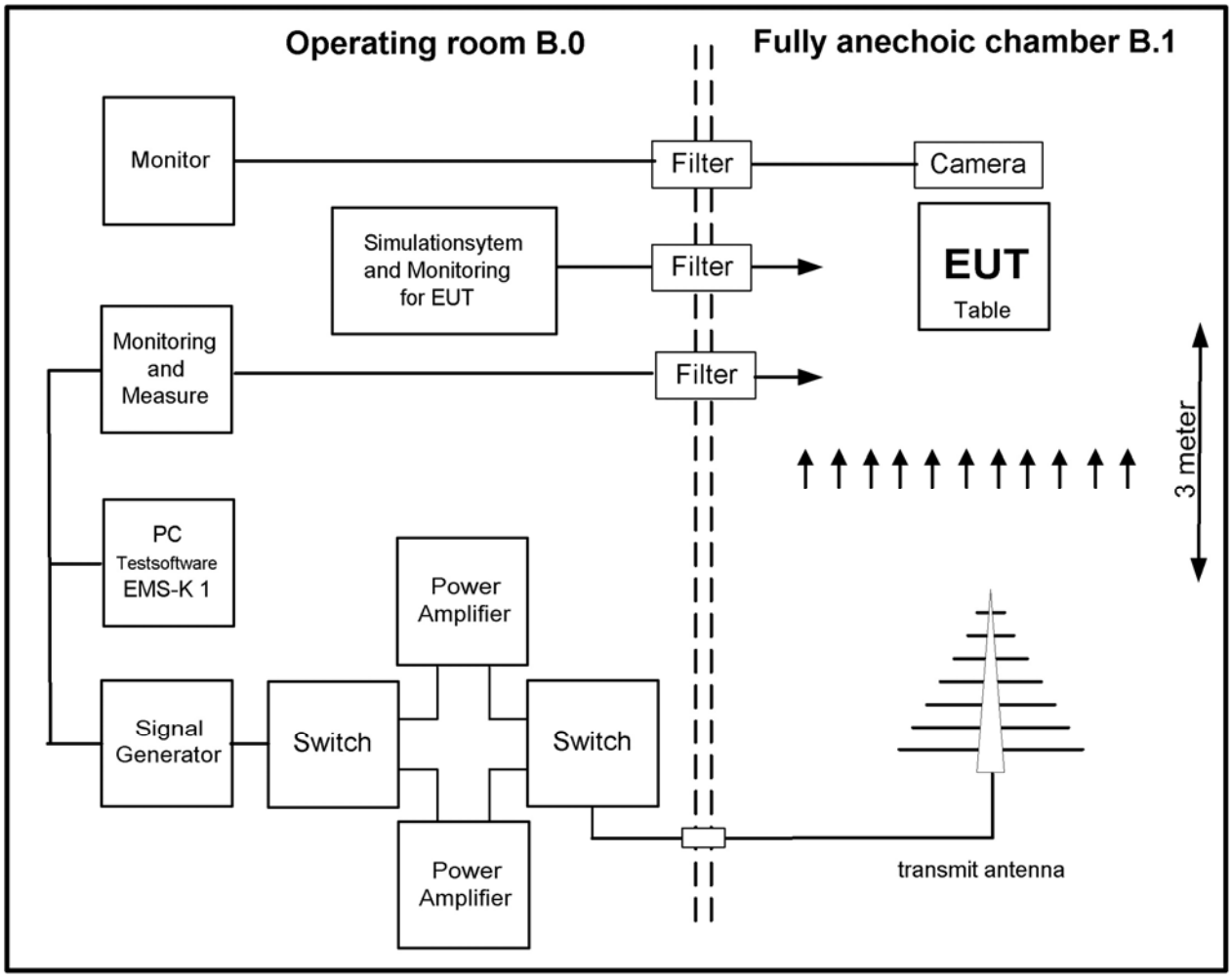
	Expanded Uncertainties k=2 in %		
Probe type	Magn. Flux Density (B) in µT	Electrical Field Strength in V/m	Frequency Range
EHP 50B	4	3	5 Hz – 100 kHz
	10	10	50 Hz
EP 330	-	15	100 kHz – 3 GHz
	-	10	300 MHz
EP 408	-	10	1 MHz – 300 MHz
	-	15	300 MHz – 18 GHz
	-	20	18 GHz – 40 GHz

2.4.5 Definition of test distances

Due to the mechanical concept of the used probe a distance between DUT surface and electrical centre of the probe antennas remains.
This distance needs to be taken into account when measuring EMF at small spatial resolution.

Probe type	Magn. Field Distance in mm	Electrical Field distance in mm
EHP 50B	max. 4 cm	max. 4cm
EP 330	-	max. 2 cm
	-	
EP 408	-	max. 1.5 cm
	-	

2.4.6 Anechoic chamber B



No.	Instrument/Ancillary	Manufacturer	Type	Serial-No.	Internal identification
	Radiated immunity in chamber B				
1.	Fully anechoic chamber B	Frankonia			
2.	Controll computer	Tecline	DT6/400H1300P II	FW09910190	300002591
3.	Software	R&S	EMS-K1		300002591a
4.	Position control unit	Deisel	HD 100	100/322/93	300002187
5.	Antenna positioner (Horn)	Deisel	MA 240	240/308 Bj.93	300002187a
6.	Antenna positioner (Log. Per.)	Deisel	MA 240	240/309 Bj.93	300002187b
7.	Stacked double Log.-Per Antenna (65-3000MHz)	Schwarzbeck	STLP9128E	9128E-013	300003408
8.	Horn antenna 1-4.2 GHz	Amplifire research	AT4002 ar	19739	300000633
9.	Isotropic Field Probe	HI-6005	Holaday	107894	300003042
10.	Directional coupler unit	R&S	DCU	316790/005	300002242
11.	Amplifier 0.01-220 MHz	Amplifire research	250L	13163	300002180
12.	Amplifier 25MHz-1GHz	Ampl. Res.	100W1000M7	12930	300002183
13.	Amplifier 1- 2.5 GHz	Bonn.	BLMA 0825-60		300001631
14.	Data Processing / Interface Unit	EMCO	7110	9303-1225	300002194
15.	Signal generator 0.1-2000 MHz	R&S	SMH	864219/033	300001410
16.	Signal generator0.1-4320 MHz	R&S	SMHU	860292/019	300002232
17.	Relay matrix	R&S	PSN	892176/0002	300001149
18.	Power meter	R&S	URV 5	833658/005	300002238
19.	power sensor, insertion unit A	R&S	URV5-Z2	832874/021	300002239
20.	power sensor, insertion unit B	R&S	URV5-Z2	832874/022	300002240
21.	power sensor, insertion unit A	R&S	URV5-Z2		300002234
22.	power sensor, insertion unit B	R&S	URV5-Z2		300002235
23.	Bus extender	National Instruments	GPIB-110	10688	300002205
	Observation equipment, audio rack 1 in chamber B				
24.	Connection field	R&S	1039.8944.91	316790/001	300002244
25.	Relay matrix	Electronics Corporation	4874B	ohne	300002189
26.	Bus Extender	National Instruments	GPIB-110	10700	300002206
27.	Control computer				300002694
28.	Software	ICT			
29.	band pass	B&K	1618	1125088	
30.	Measurement amplifier	B&K	2636	1537486	
31.	Optical fibre microphone system	Sennheiser		keine	
32.	Artificial mouth with AF transformer	B&K	4227	1536875	300002314
33.	sound calibrator	CR511F	CYRRUS	34688	
34.	empty				
35.	empty				

2.4.7 Additional equipment utilized

Device	Type	Serial number	last calibration
Signal Analyzer	Rhode & Schwarz FSIQ26	835111/004	2004-04-07
Vector Signal Generator	SMJ100A	100300	n/a
ESG Vector Signal Generator	Agilent E4438C	MY45092266	n/a
Base station simulator	CMU200	106826	n/a
Wideband horn	EMCO 3115	3088	n/a

n/a : calibration not necessary for test cases in chapter 2.5.
A regular in-house verification of test equipment is performed annually.

For all relevant calibration information see annex 2.

2.5 Test results

The following test cases were applied during the comparative measurements of the Aaronia HF-2025E.

1. Comparative measurement of an electromagnetic field generated inside an anechoic chamber with broadband field probe (CW signal) at 800, 1000 and 2000 MHz.
2. Measurement of the same field at different frequencies.
3. Comparative measurement of an artificially generated GSM and UMTS signal with broadband field probe.
4. Comparative measurement of an artificially generated DECT signal with broadband field probe.
5. Comparative outdoor measurement of a GSM base station with broadband field probe.
6. Comparative outdoor measurement of external Log-Per antenna with FSIQ26 spectrum analyzer using the signal of a GSM base station.
7. Comparative conducted measurement of different modulated signals with FSIQ26 spectrum analyzer.

The target of the above described tests were :

- proving the ability to measure electromagnetic fields in RMS mode of pulsed and unpulsed signals
- showing usability of external logarithmic-periodic antenna
- checking level accuracy (conducted)

2.5.1 Comparative measurement of an electromagnetic field generated inside an anechoic chamber with broadband field probe (CW signal) at 800, 1000 and 2000 MHz.

The test was performed with the following settings :

Aaronia SPECTRAN HF-2025E	PMM 8053
Center frequency : transmit frequency	wide band probe EP330 0.1 – 3000 MHz
Span : 20 MHz	RMS : last 32 samples
Filter : 3 MHz	
Sample time : 50 ms	
Max hold mode : on	

Test results :

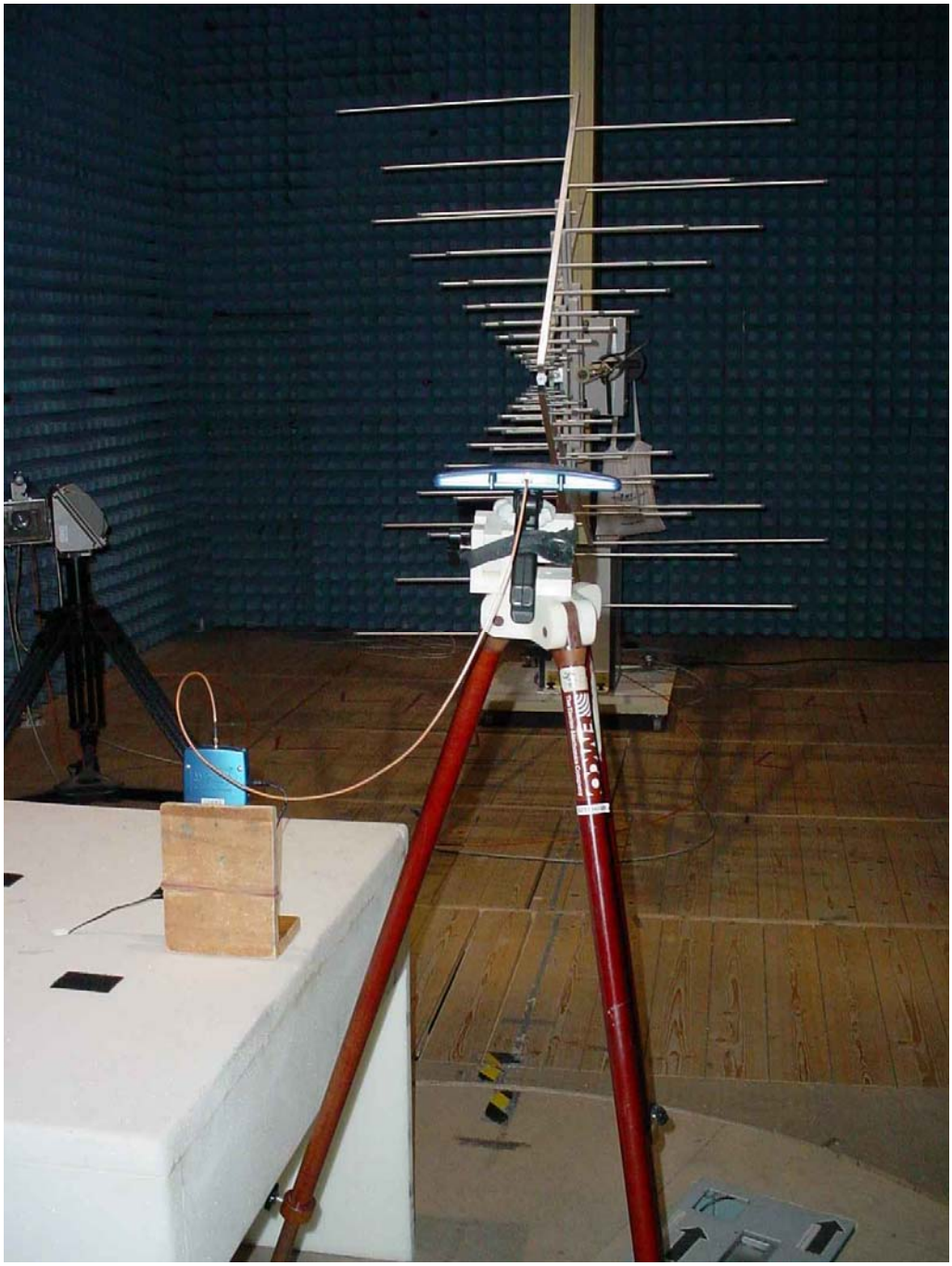
generated E-field / V/m	frequency / MHz	level PMM / V/m	level SPECTRAN / V/m
1	800	1.06	1.100
3	800	3.09	3.151
6	800	6.15	6.063
1	1000	1.22	1.124
3	1000	3.10	3.024
6	1000	6.29	6.122
1	2000	1.98	1.679
3	2000	3.74	3.673
6	2000	7.18	6.866

Test signal : CW within a frequency range of 800 – 2000 MHz.
Field strength deviations of up to 1.5 V/m to target values are within tolerances of generated field.
For good comparability of test results during these parallel measurements it was necessary to position the PMM probe close to the logarithmic-periodic antenna.

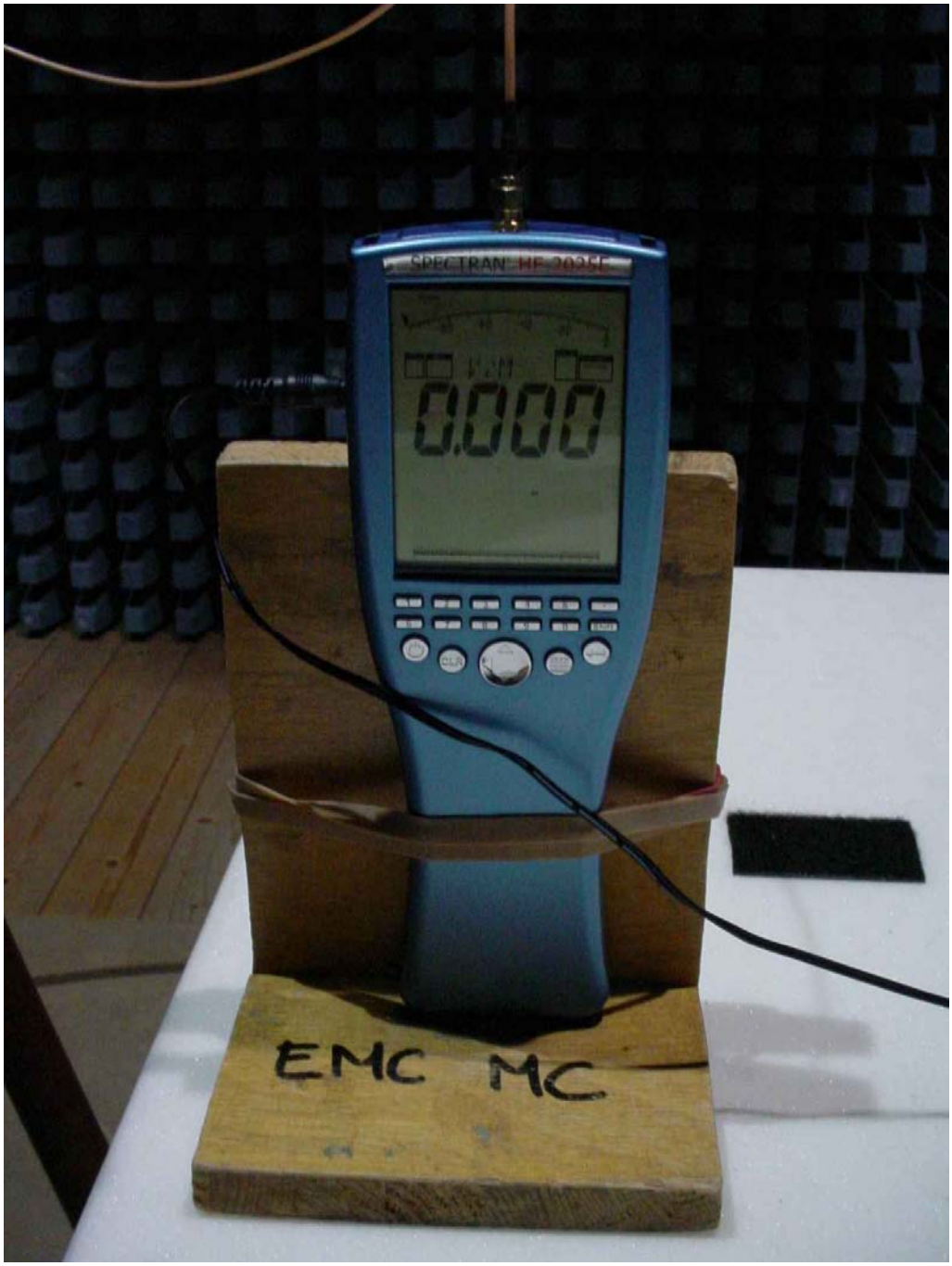
Note : 6 V/m already exceed nominal maximum measurement level of SPECTRAN without additional attenuator.

test position of log-per antenna

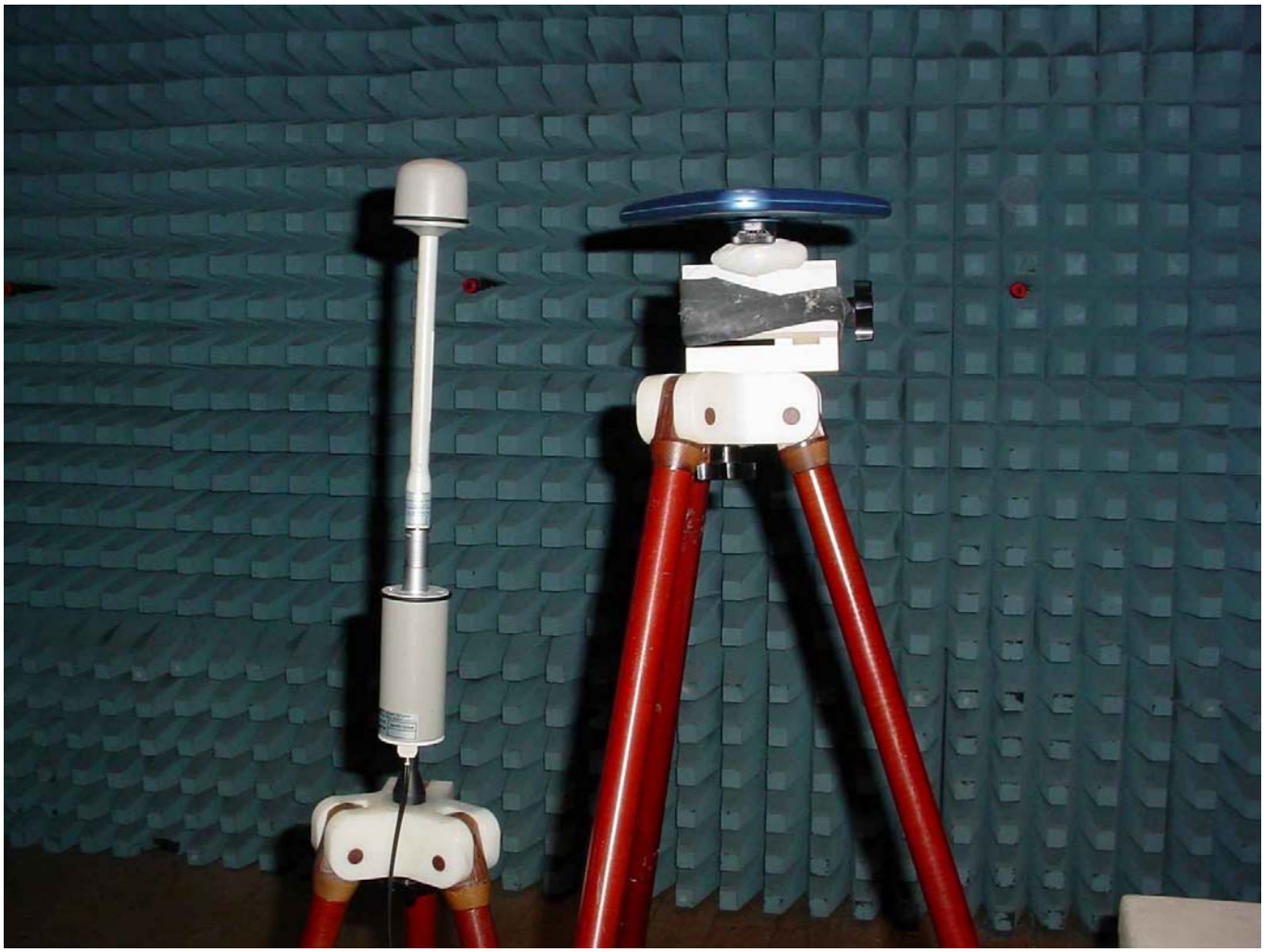
test position of log-per antenna (rear view), with observation camera at the left hand side and horizontally polarized field generating Schwarzbeck antenna in background.



SPECTRAN HF-2025E



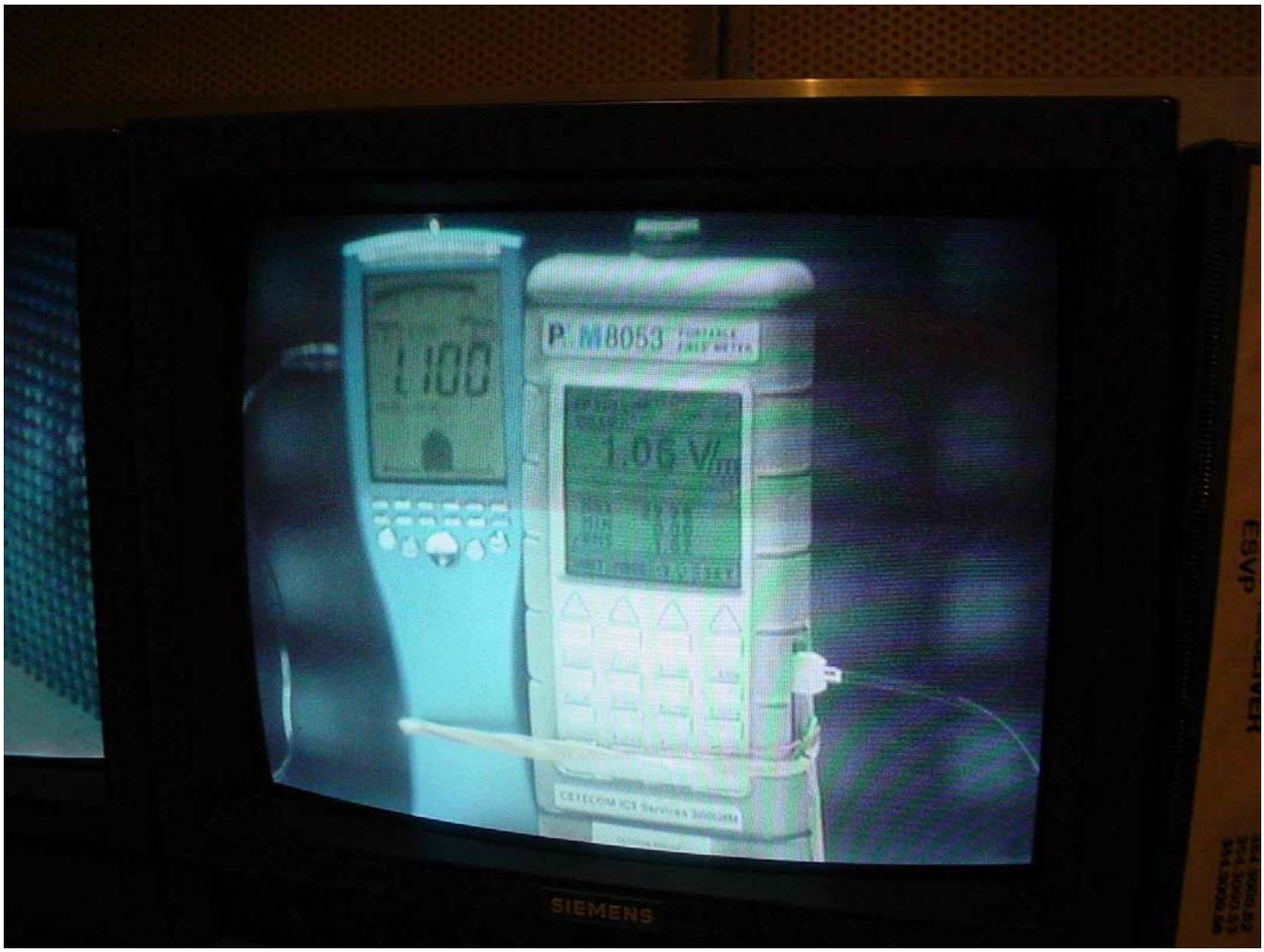
Aaronia HyperLOG log-per antenna and PMM broadband field-probe



Measurement position of wide band field probe during parallel measurements with SPECTRAN

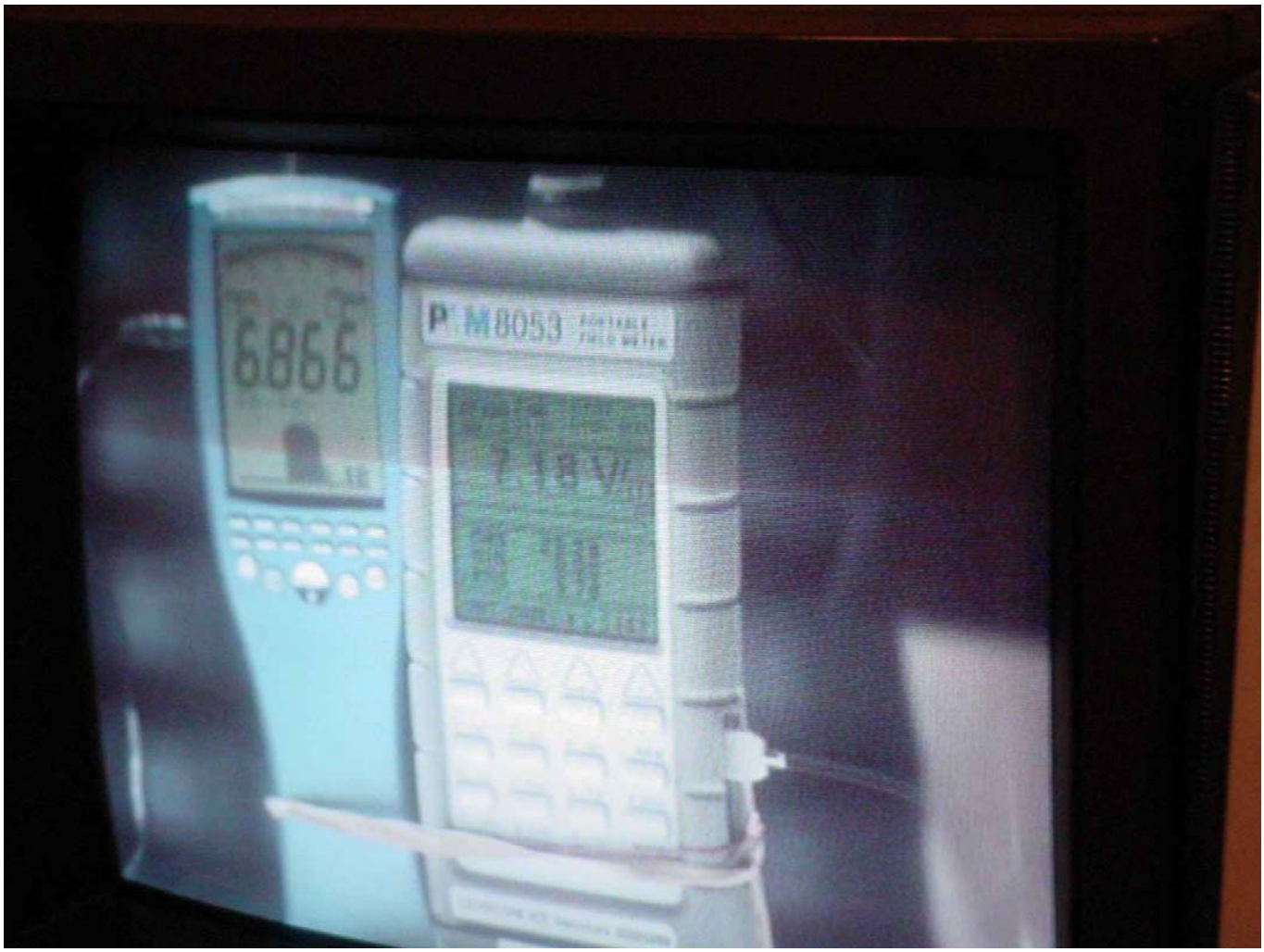
position of both handsets for monitoring

example screenshot : readout values at 1 V/m and 800 MHz (1.100 and 1.06 V/m)



example screenshot : readout values at 3 V/m and 1 GHz (3.024 and 3.10 V/m)

example screenshot : readout values at 6 V/m and 2 GHz (6.866 and 7.18 V/m)



2.5.2 Measurement of electromagnetic field at different frequencies and levels.

These measurements have been performed under the same conditions as in chapter 2.5.1. without the PMM 8053 field probe in place because measurement accuracy between PMM and SPECTRAN showed no difference.

Note : Differing measurement values are caused by a slightly different position of the Log-Per antenna. The electromagnetic field applied during this test has been calibrated for standard immunity tests and therefore spatial differences are allowed.

The following test results using levels of 1, 3 and 6 V/m, as well as some random levels has been performed to show constant measurement behaviour of the SPECTRAN used together with the Log-Per antenna.
The center frequency of SPECTRAN was adjusted before each frequency change.

Frequenz / MHz	Level V/m	Readout value SPECTRAN in Max Hold mode / V/m
800	1	0,99
800	3	2,57
800	6	5,03
1000	1	1,2
1000	3	3,18
1000	6	6,09
1200	1	1,47
1200	2,5	3,4
1200	3	3,96
1200	6	7,18
1400	1	1,61
1400	1,5	2,39
1400	3	4,49
1400	6	8,24
1600	1	1,34
1600	3	3,75
1600	5	5,84
1600	6	6,83
1800	1	1,46
1800	3	4,18
1800	4	5,4
1800	6	7,53
2000	1	1,19
2000	3	3,43
2000	4,5	4,9
2000	6	6,22

Test signal : CW within a frequency range of 800 – 2000 MHz.
Field strength deviations of up to 1.5 V/m to target values are within tolerances of generated field.

2.5.3 Comparative measurement of an artificially generated GSM and UMTS signal with broadband field probe.

test description :

An EMCO wideband horn was fed with a GSM or UMTS signal generated by a CMU base station simulator.
The electromagnetic field in front of the horn was measured simultaneously both with the PMM broadband probe and the SPECTRAN HF-2025E at a distance of 2 meters and at a small distance between each other.
This has been a check under normal user conditions (no shielded chamber, unknown field structure, possible reflections)

The test was performed with the following settings :

at 2140 MHz (WCDMA):

Aaronia SPECTRAN HF-2025E	PMM 8053
Hotkey UMTS :	
Center frequency : 2140 MHz	wide band probe EP330 0.1 – 3000 MHz
Span : 60 MHz	RMS : last 32 samples
Filter : 3 MHz	
Sample time : 50 ms	
Max hold mode : on	

at 900 MHz (GSM)

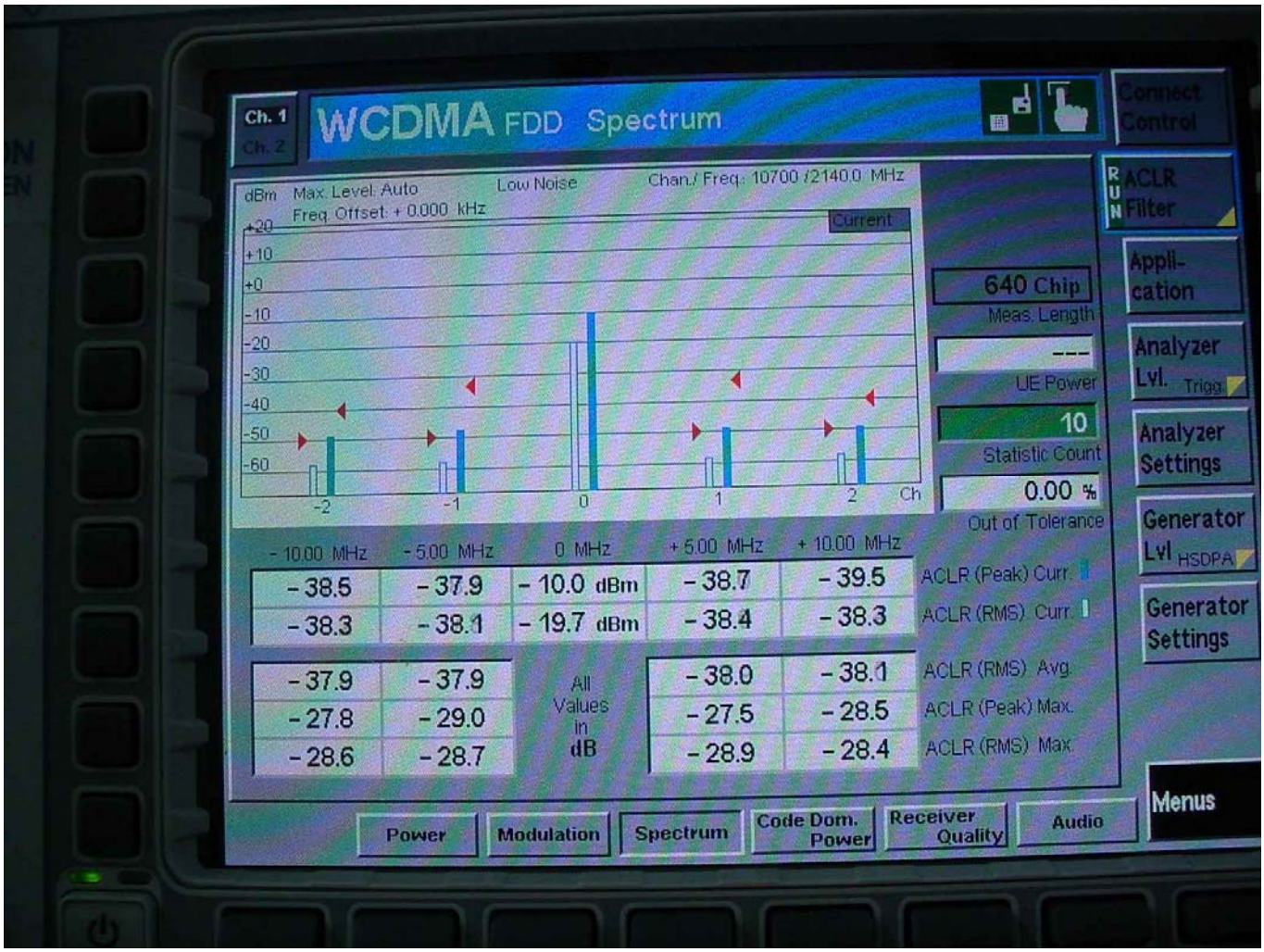
Aaronia SPECTRAN HF-2025E	PMM 8053
Hotkey GSM 900 :	
Center frequency : 940 MHz	wide band probe EP330 0.1 – 3000 MHz
Span : 40 MHz	RMS : last 32 samples
Filter : 3 MHz	
Sample time : 100 ms	
Max hold mode : on	

Test result :

frequency / MHz	level PMM / V/m	level SPECTRAN / V/m
GSM 900 MHz band	2.34 (RMS)	1.447
UMTS 2100 MHz band	4.36 (RMS)	4.446

EMCO 1 - 15 GHz wideband horn (vertically polarized)

R&S CMU 200 base station simulator for generating GSM and WCDMA signals



measured values in GSM900 MHz band
(Log-per antenna needs to have same polarization as transmitted signal to measure maximum values)

measured values in UMTS band

2.5.4 Comparative measurement of an artificially generated DECT signal with broadband field probe.

test description :

An EMCO wideband horn was fed with a DECT signal generated by the E4438C vector signal generator. The electromagnetic field in front of the horn was measured simultaneously both with the PMM broadband probe and the SPECTRAN at a distance of 2 meters and at a small distance between each other.
This has been a check under normal user conditions (no shielded chamber, unknown field structure, possible reflections)

The test was performed with the following settings :

at 1890 MHz (DECT):

Aaronia SPECTRAN HF-2025E	PMM 8053
Hotkey DECT :	
Center frequency : 1890 MHz	wide band probe EP330 0.1 – 3000 MHz
Span : 20 MHz	RMS : last 32 samples
Filter : 3 MHz	
Sample time : 50 ms	
Max hold mode : on	
Pulse mode on :	

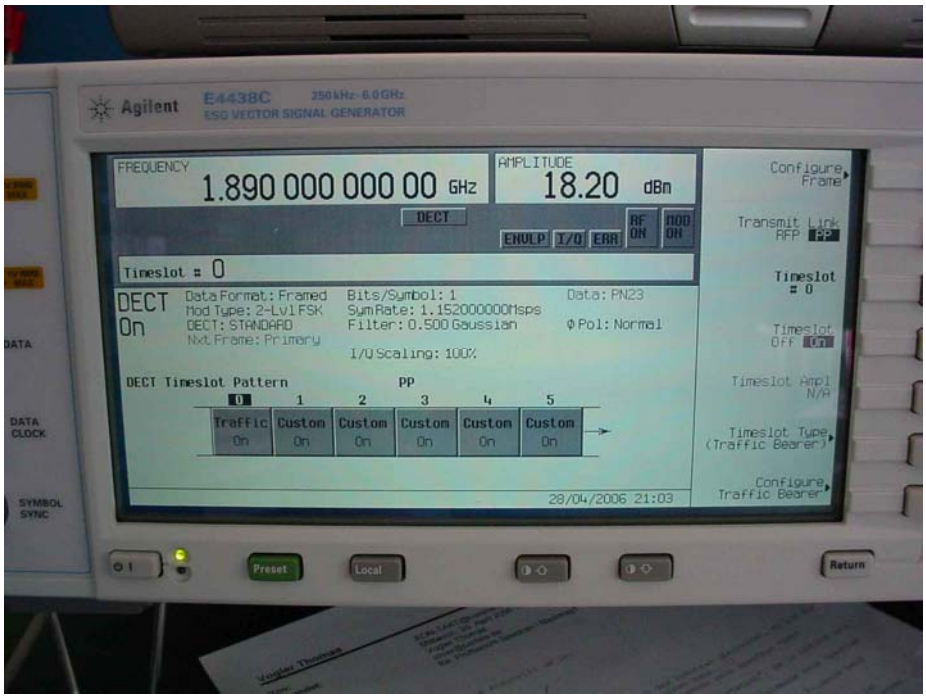
Test result :

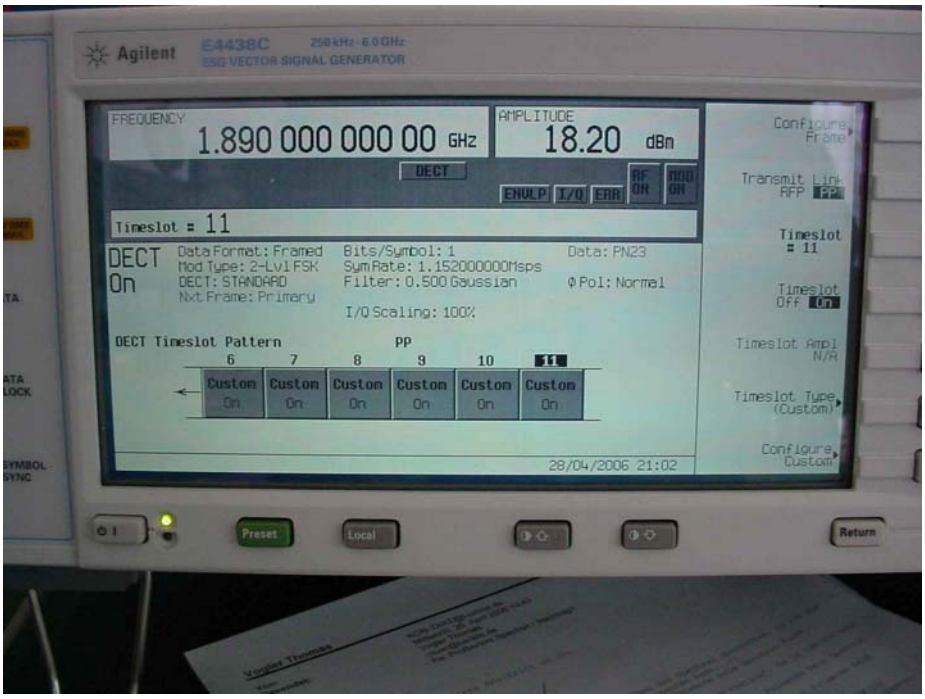
frequency / MHz	level PMM / V/m	level SPECTRAN / V/m
DECT 1900 MHz band	0.81 (RMS)	0.778

Remark : The test was performed with all 12 PP DECT channels activated to have direct comparison between PEP RMS-Value of Sprectran and averaged RMS of PMM 8053.

EMCO 1 - 15 GHz wideband horn (vertically polarized) and measured field strength

E4478C signal generator for generating DECT signal with all PP channels active





2.5.5 Comparative outdoor measurement of a GSM base station with broadband field probe.

The test was performed with the following settings :

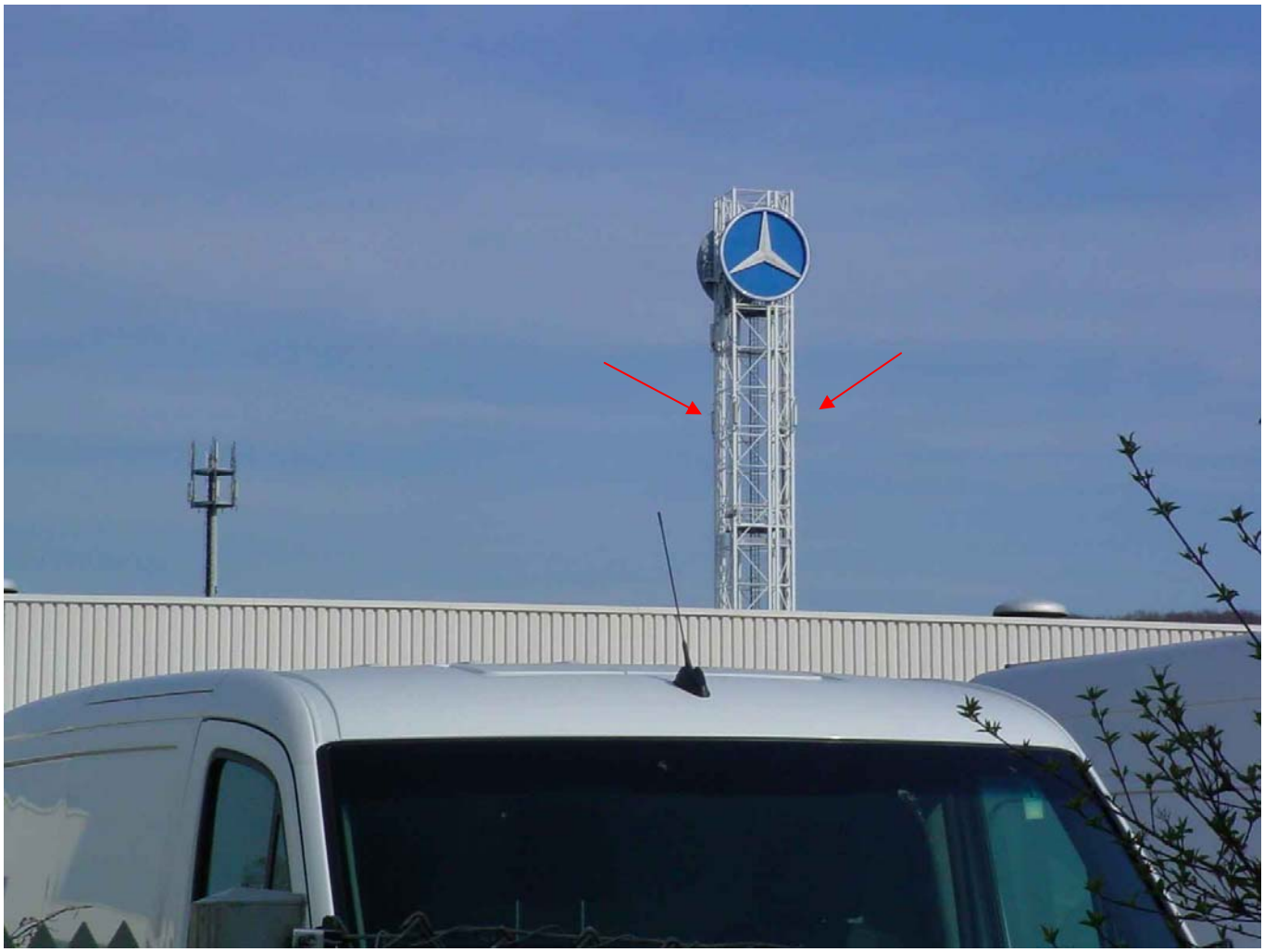
Aaronia SPECTRAN HF-2025E	PMM 8053
Hotkey GSM 900 :	
Center frequency : 940 MHz	wide band probe EP330 0.1 – 3000 MHz
Span : 40 MHz	RMS : last 32 samples
Filter : 3 MHz	
Sample time : 100 ms	
Max hold : on	

Test result :

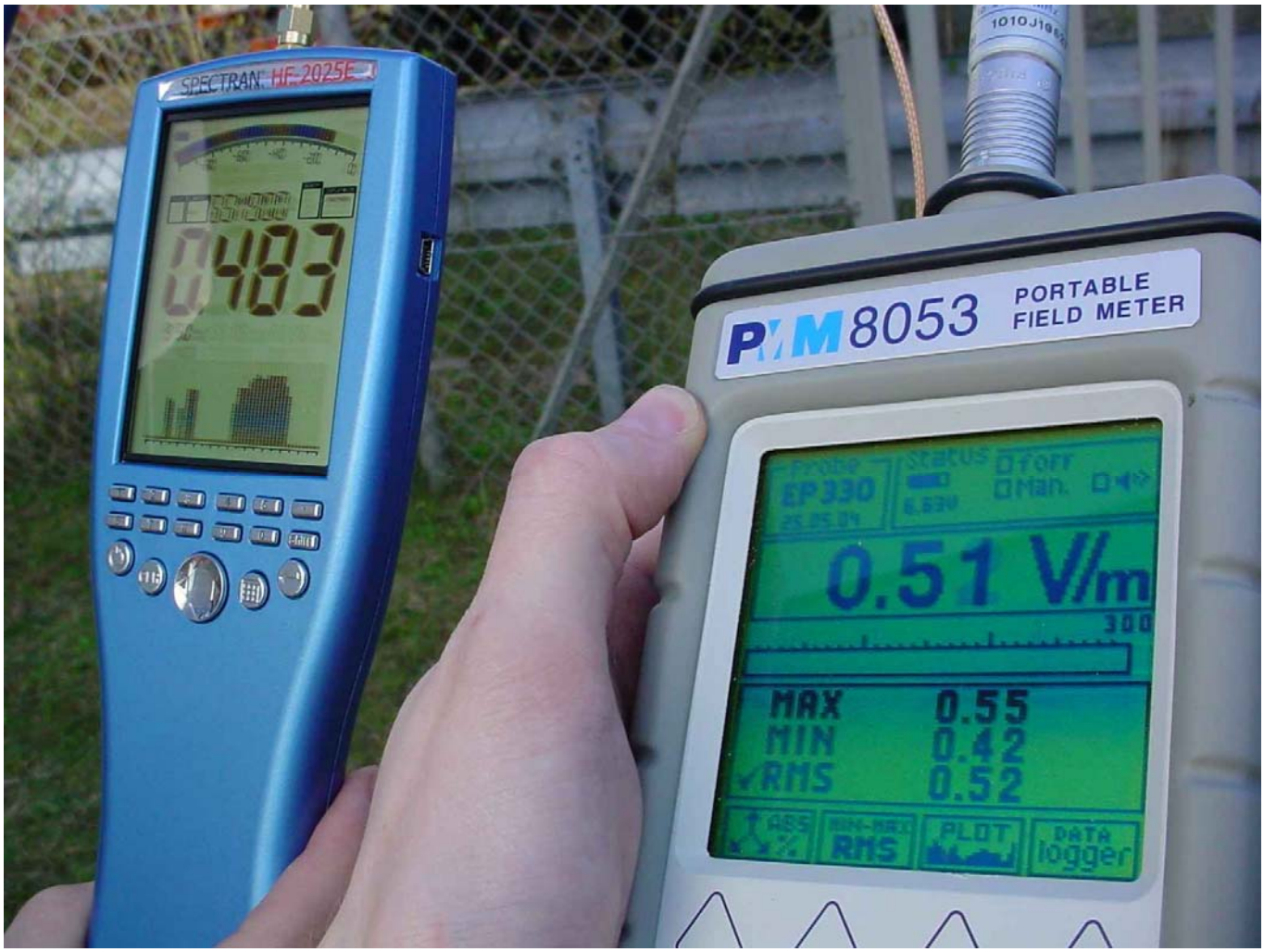
frequency / MHz	level PMM / V/m	level SPECTRAN / V/m
GSM 900 MHz band	0.52 (RMS)	0.483

The PMM 8053 measures both 900 MHz and 1800 MHz at the same time.
Chapter 2.5.5 shows that GSM 900 is the dominating signal so that influences of GSM 1800 on the measurement result of the broadband probe are small.

GSM base station 300 meters away from CETECOM ICT Services GmbH.



Displayed values of both SPECTRAN and PMM 8053 at detected position with maximum signal.



2.5.6 Comparative outdoor measurement of external Log-Per antenna with FSIQ26 spectrum analyzer using the signal of a GSM base station.

The test was performed with the following settings :

at 900 MHz :

Aaronia SPECTRAN HF-2025E	FSIQ26
Hotkey GSM 900 :	
Center frequency : 940 MHz	Center frequency : 940 MHz
Span : 40 MHz	Span : 40 MHz
Filter : 3 MHz	Filter : 3 MHz
Sample time : 100 ms	RMS detector : on
Display mode : max hold	Display mode : max hold

at 1800 MHz :

Aaronia SPECTRAN HF-2025E	FSIQ26
Hotkey GSM 1800 :	
Center frequency : 1840 MHz	Center frequency : 1840 MHz
Span : 80 MHz	Span : 80 MHz
Filter : 3 MHz	Filter : 3 MHz
Sample time : 100 ms	RMS detector : on
Display mode : max hold	Display mode : max hold

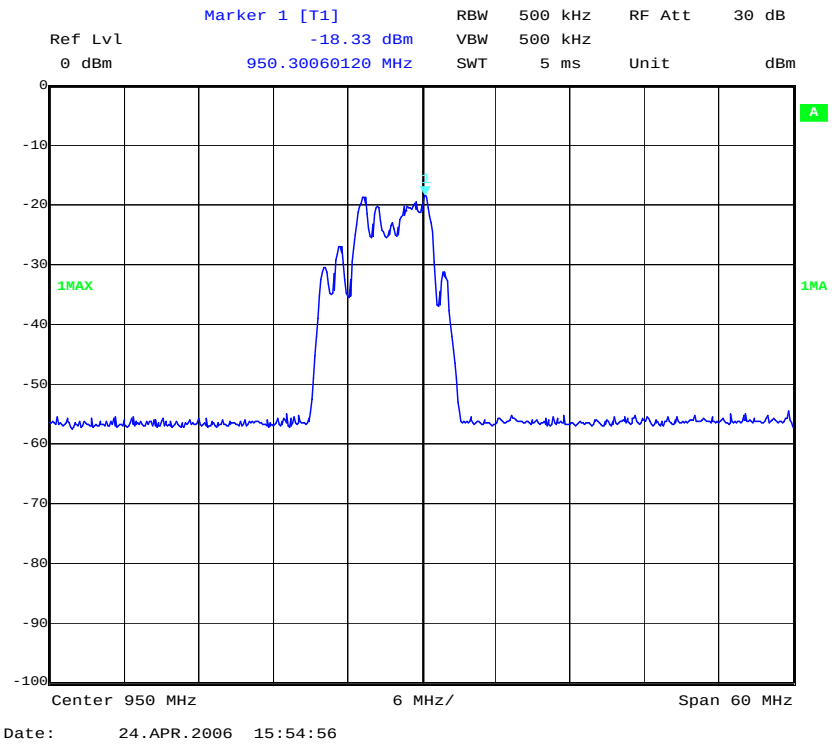
note : cable attenuation not corrected with both devices

Test result :

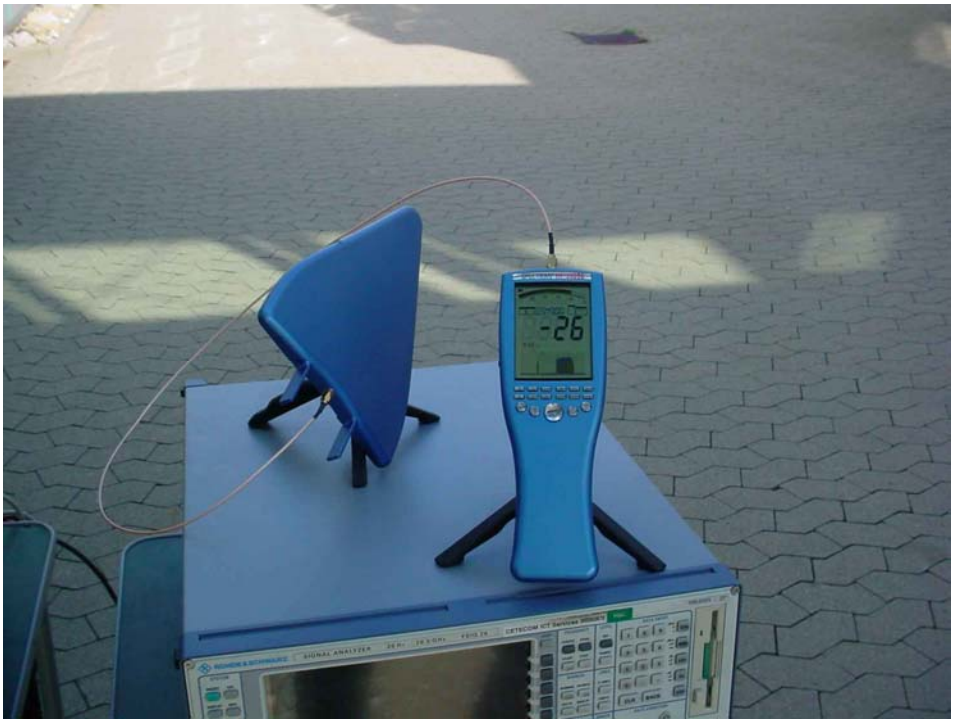
frequency / MHz	peak level FSIQ26 / dBm	peak level SPECTRAN / dBm
GSM 900 MHz band	-25.67	-26 (no decimals available)
GSM 1800 MHz band	-36.98	-38 (no decimals available)

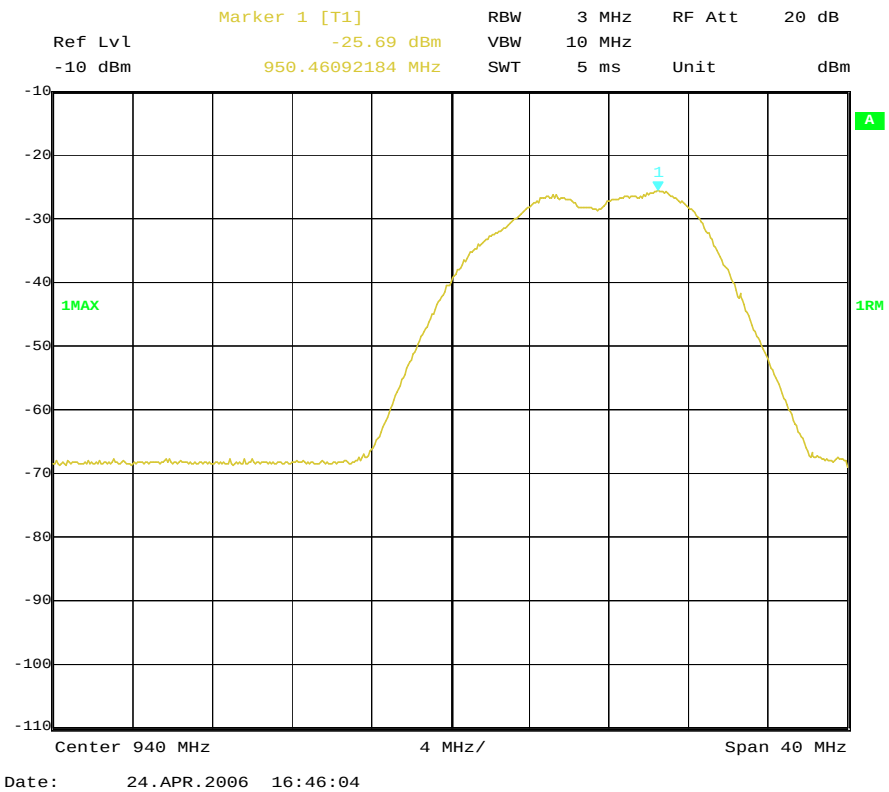
Aaronia Log-Per antenna connected to SPECTRAN with GSM base station in background

Aaronia Log-per antenna connected to FSIQ26 and detected multi-carrier GSM signal in higher resolution at highest detected level to prove existence of a real GSM signal.

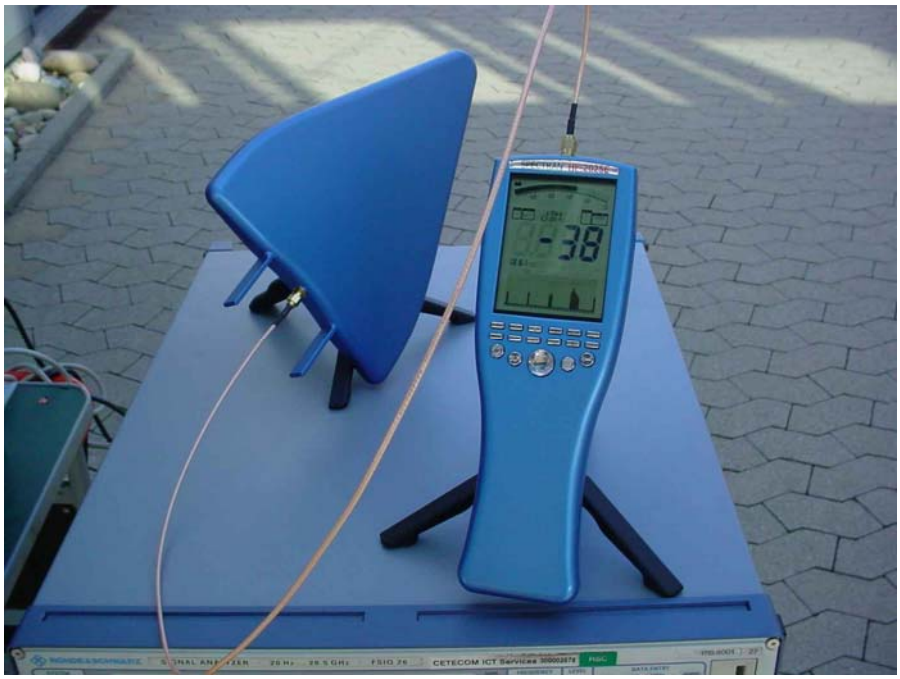


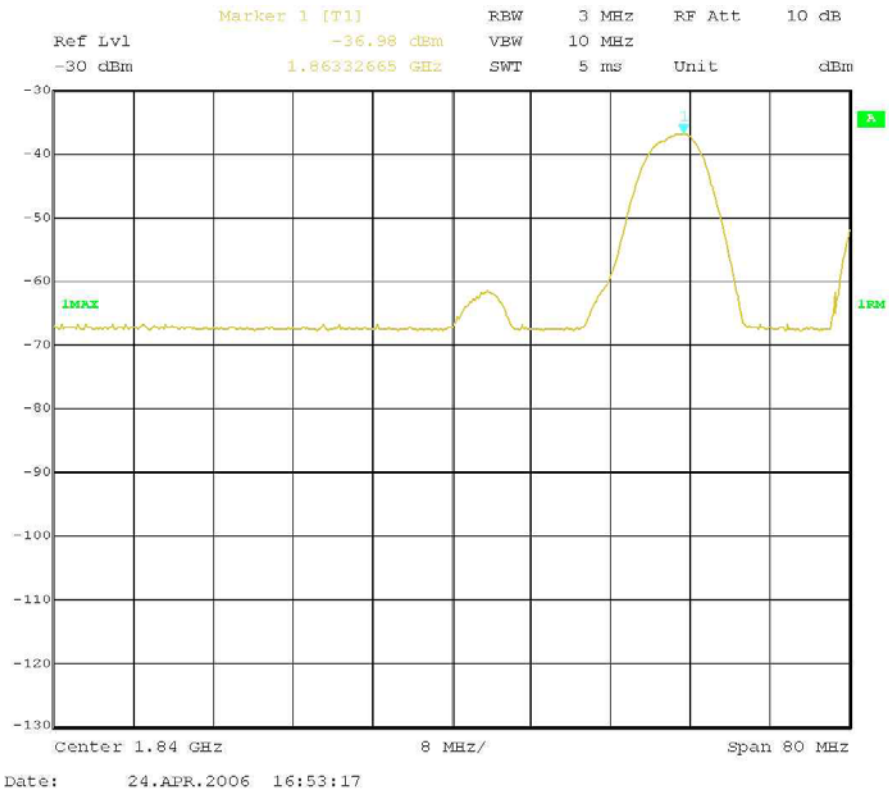
comparative test result with identical antenna position at GSM 900 (not maximum !)
(no display photo of FSIQ26 available due to poor readability in outdoor conditions.)





comparative test result with identical antenna position at GSM 1800 (not maximum)
(no display photo of FSIQ26 available due to poor readability in outdoor conditions.)





2.5.7 Comparative conducted measurement of different modulated signals with FSIQ26 spectrum analyzer.

Device settings

at 900 MHz :

Aaronia SPECTRAN HF-2025E	FSIQ26
Hotkey GSM 900 :	
Center frequency : 940 MHz	Center frequency : 940 MHz
Span : 40 MHz	Span : 40 MHz
Filter : 3 MHz	Filter : 3 MHz
Sample time : 100 ms	RMS detector : on
Display mode : max hold	Display mode : max hold

at 1800 MHz :

Aaronia SPECTRAN HF-2025E	FSIQ26
Hotkey GSM 1800 :	
Center frequency : 1840 MHz	Center frequency : 1840 MHz
Span : 80 MHz	Span : 80 MHz
Filter : 3 MHz	Filter : 2 MHz
Sample time : 100 ms	RMS detector : on
Display mode : max hold	Display mode : max hold

at 1890 MHz (DECT):

Aaronia SPECTRAN HF-2025E	FSIQ26
Hotkey DECT :	
Center frequency : 1890 MHz	Center frequency : 1890 MHz
Span : 20 MHz	Span : 20 MHz
Filter : 3 MHz	Filter : 3 MHz / 0.5 MHz
Sample time : 50 ms	RMS detector : on
Pulse mode : on	
Display mode : max hold	Display mode : max hold

at 2140 MHz (WCDMA):

Aaronia SPECTRAN HF-2025E	FSIQ26
Hotkey UMTS :	
Center frequency : 2140 MHz	Center frequency : 2140 MHz
Span : 60 MHz	Span : 60 MHz
Filter : 3 MHz	Filter : 3 MHz
Sample time : 50 ms	RMS detector : on
Display mode : max hold	Display mode : max hold

at 2450 MHz (WLAN):

Aaronia SPECTRAN HF-2025E	FSIQ26
Center frequency : 2450 MHz	Center frequency : 2450 MHz
Span : 80 MHz	Span : 80 MHz
Filter : 3 MHz	Filter : 3 MHz
Sample time : 100 ms	RMS detector : on
Display mode : max hold	Display mode : max hold

Remark :

Filter bandwidth of FSIQ26 was set to the most appropriate values during the measurements. Changes of different settings (RBW, span etc.) shown on the picture had no influence on the measurement results. FSIQ was used with 10 dB attenuation at signal input.

Summary conducted power measurements of average channel power :

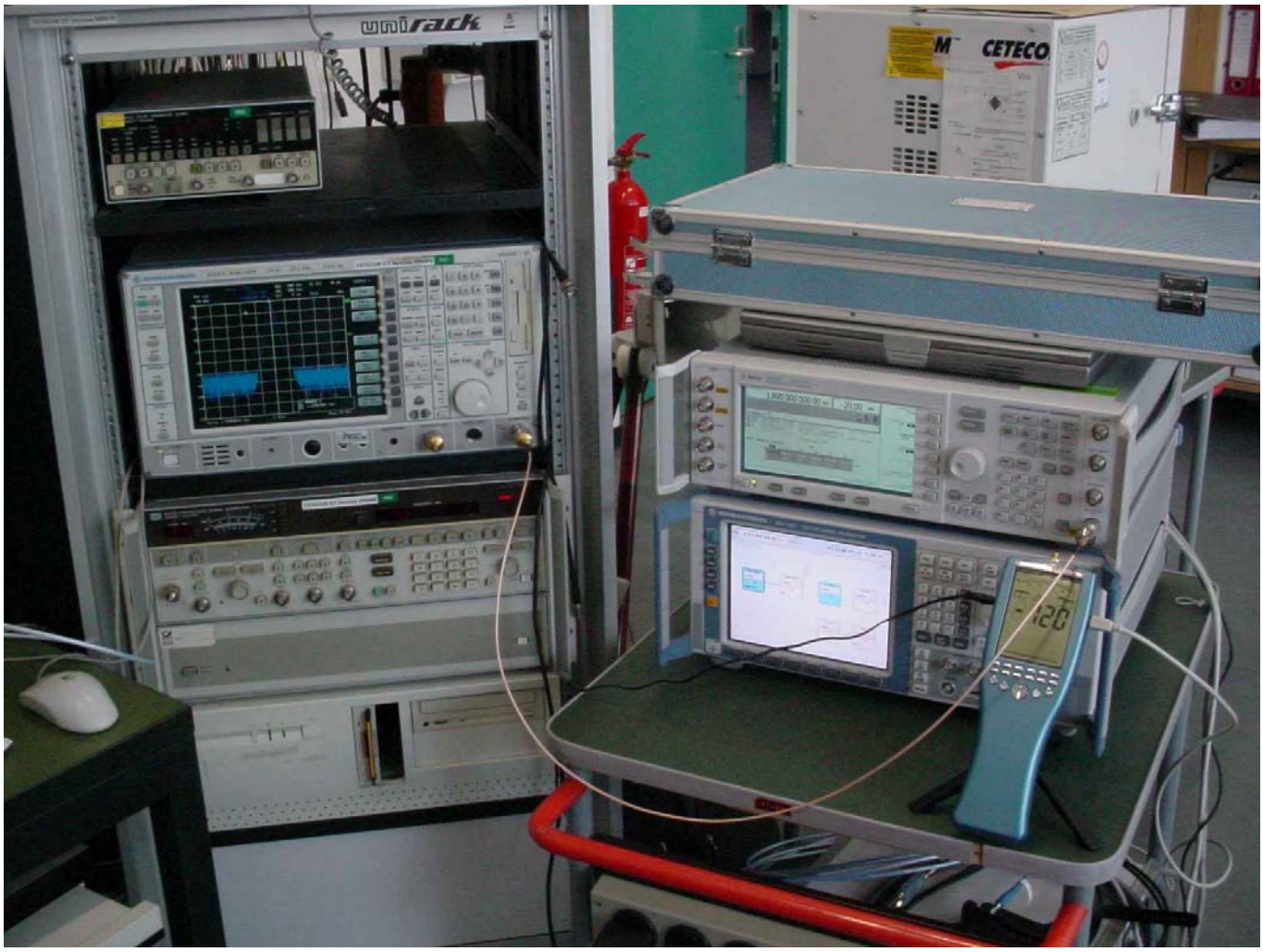
note : cable attenuation included in measurement values.

modulation	setting	output power	peak level FSIQ26 /dBm	peak level SPECTRAN /dBm
DECT	1 timeslot	-20 dBm	-21.67	-21
DECT	1 timeslot	0 dBm	-1.58	-3
GSM 900	1 timeslot, unframed	-20 dBm	-21.3	-22
GSM 1800	1 timeslot, unframed	-20 dBm	-21.64	-21
WCDMA (UMTS)	3.84 Mcps	-20 dBm	-20.98	-21
WLAN 802.11b	CCK, framed	-20 dBm	-20.56	-19

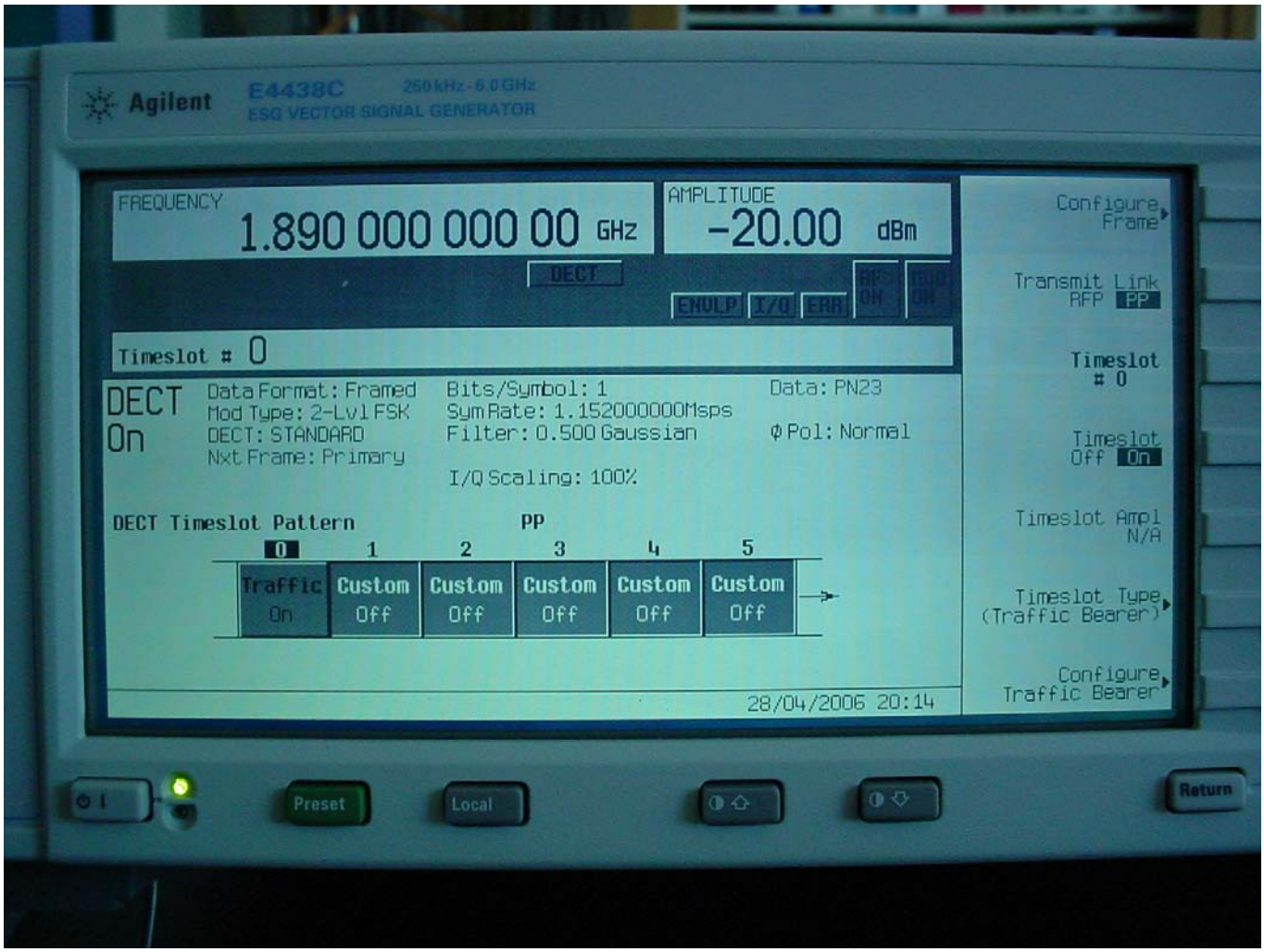
Remark :

SPECTRAN does not display decimals in dBm mode.

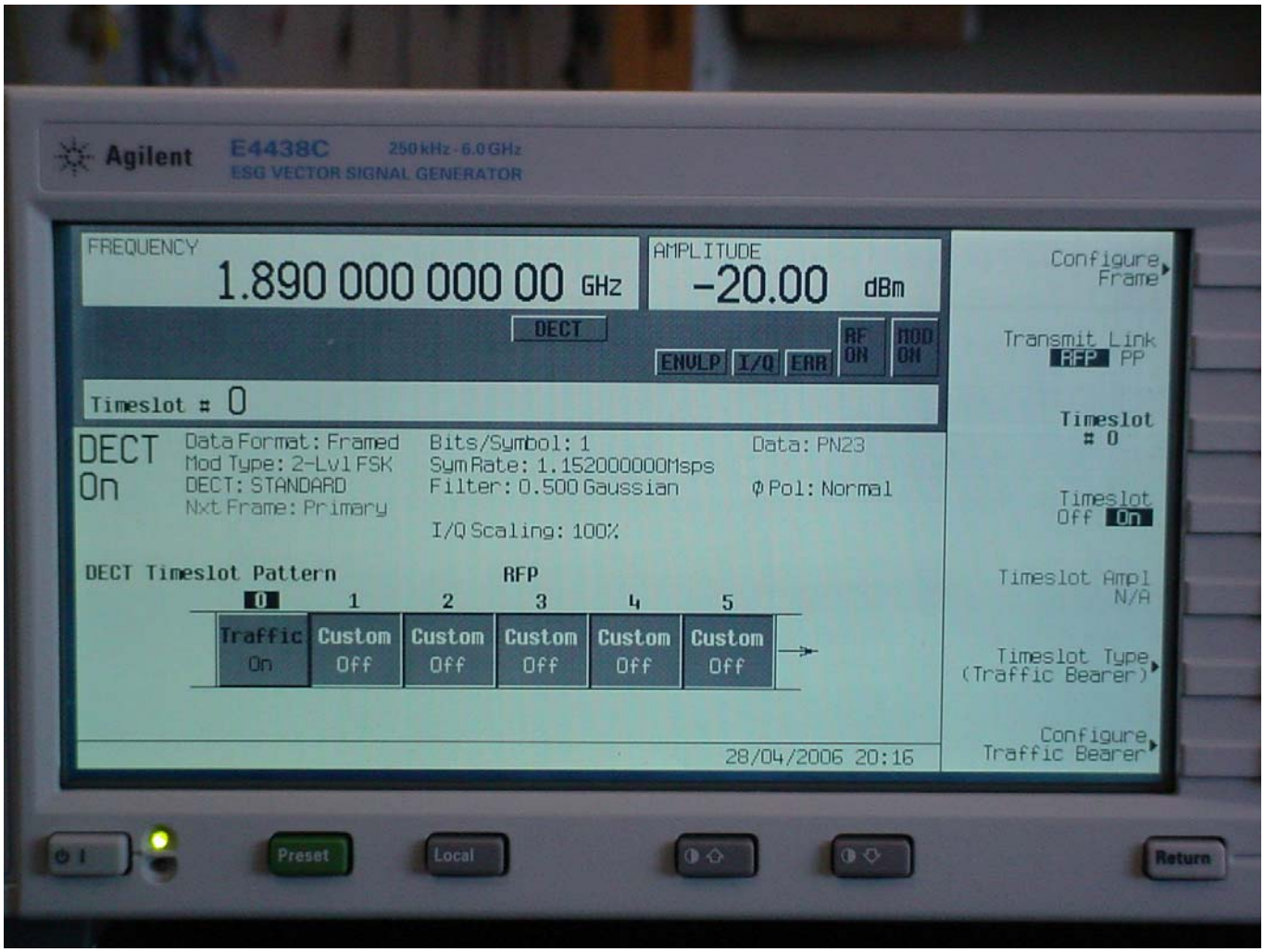
test set-up



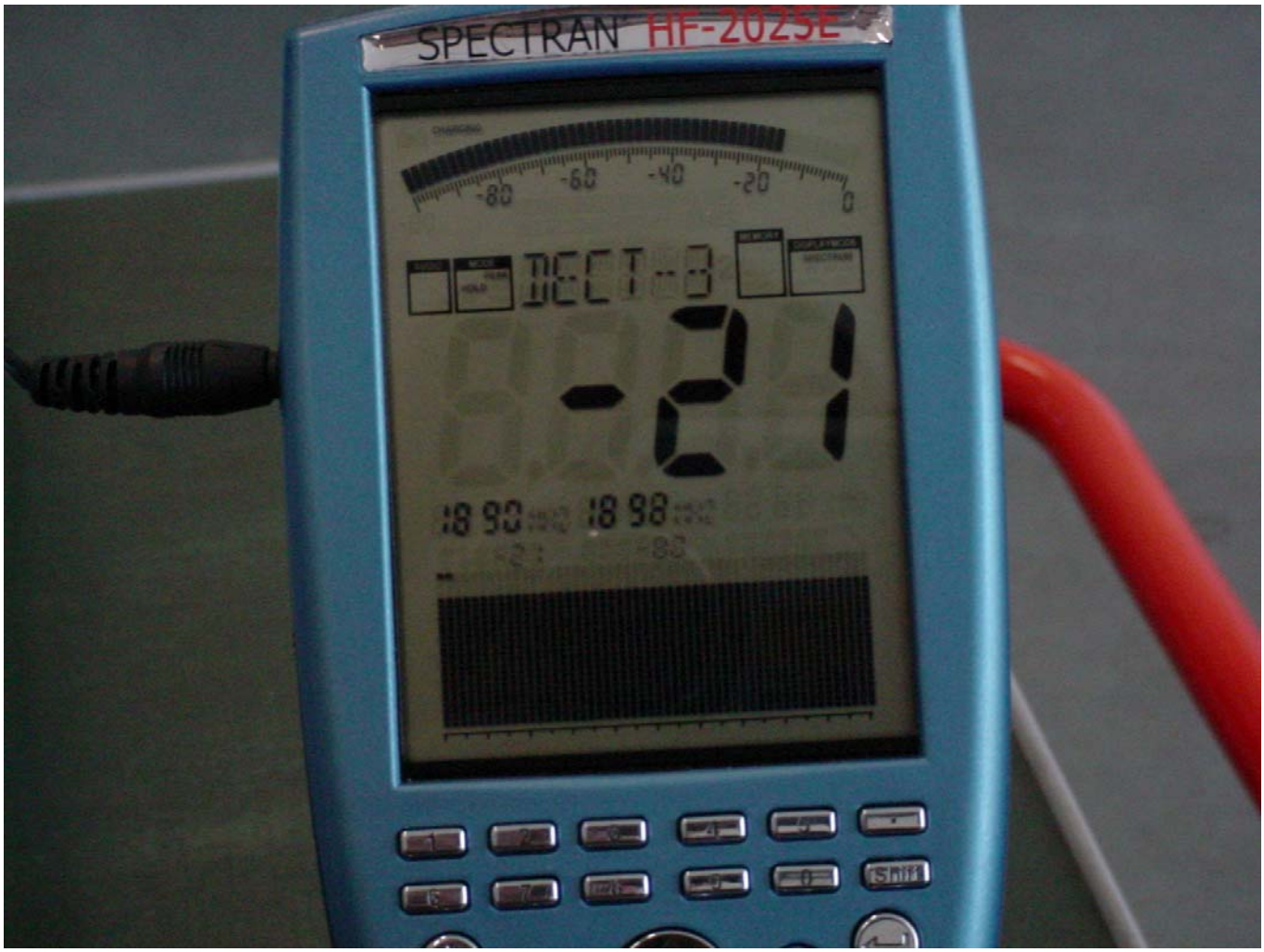
DECT setting (downlink only)



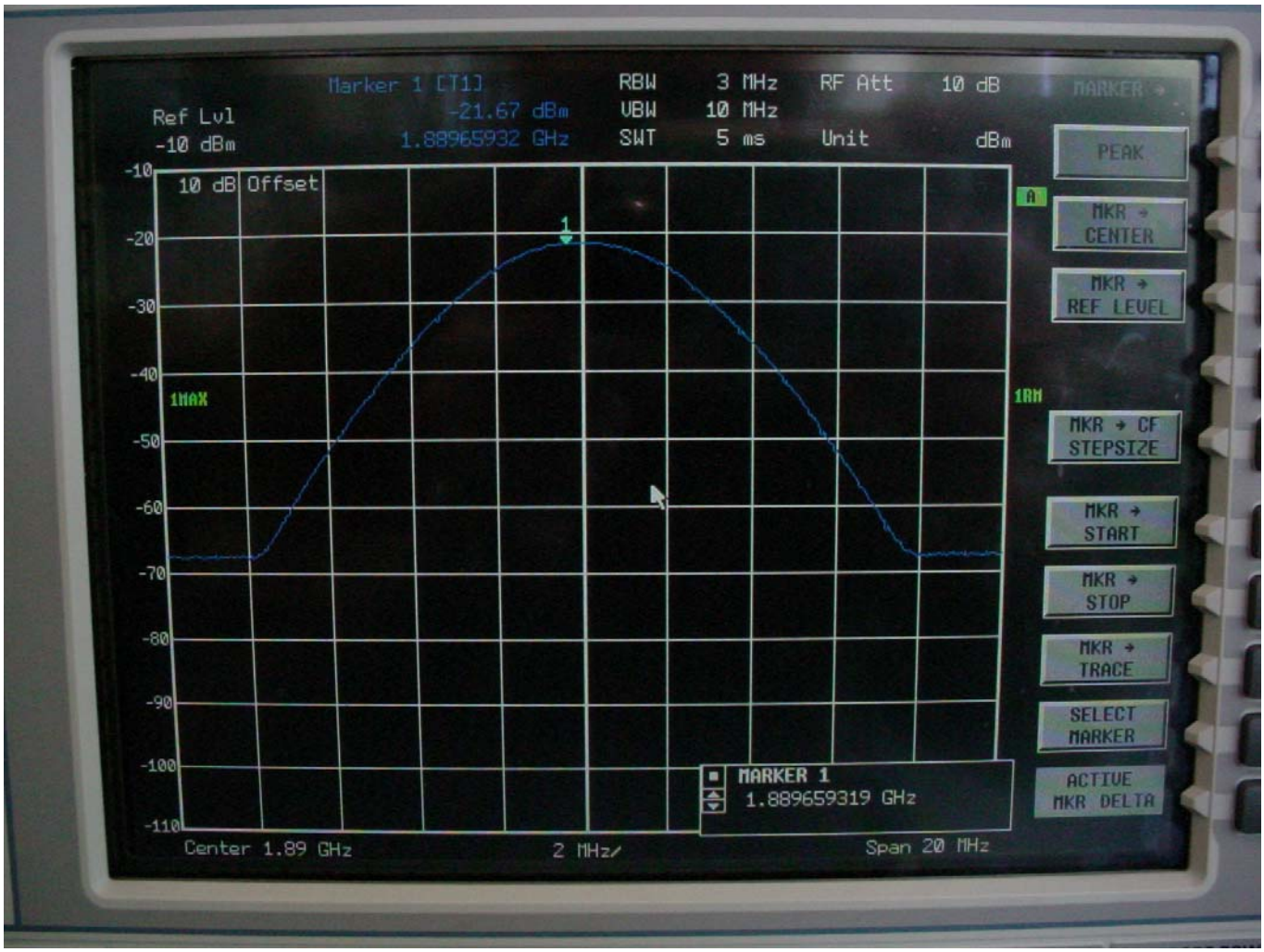
DECT setting (uplink switched on additionally)



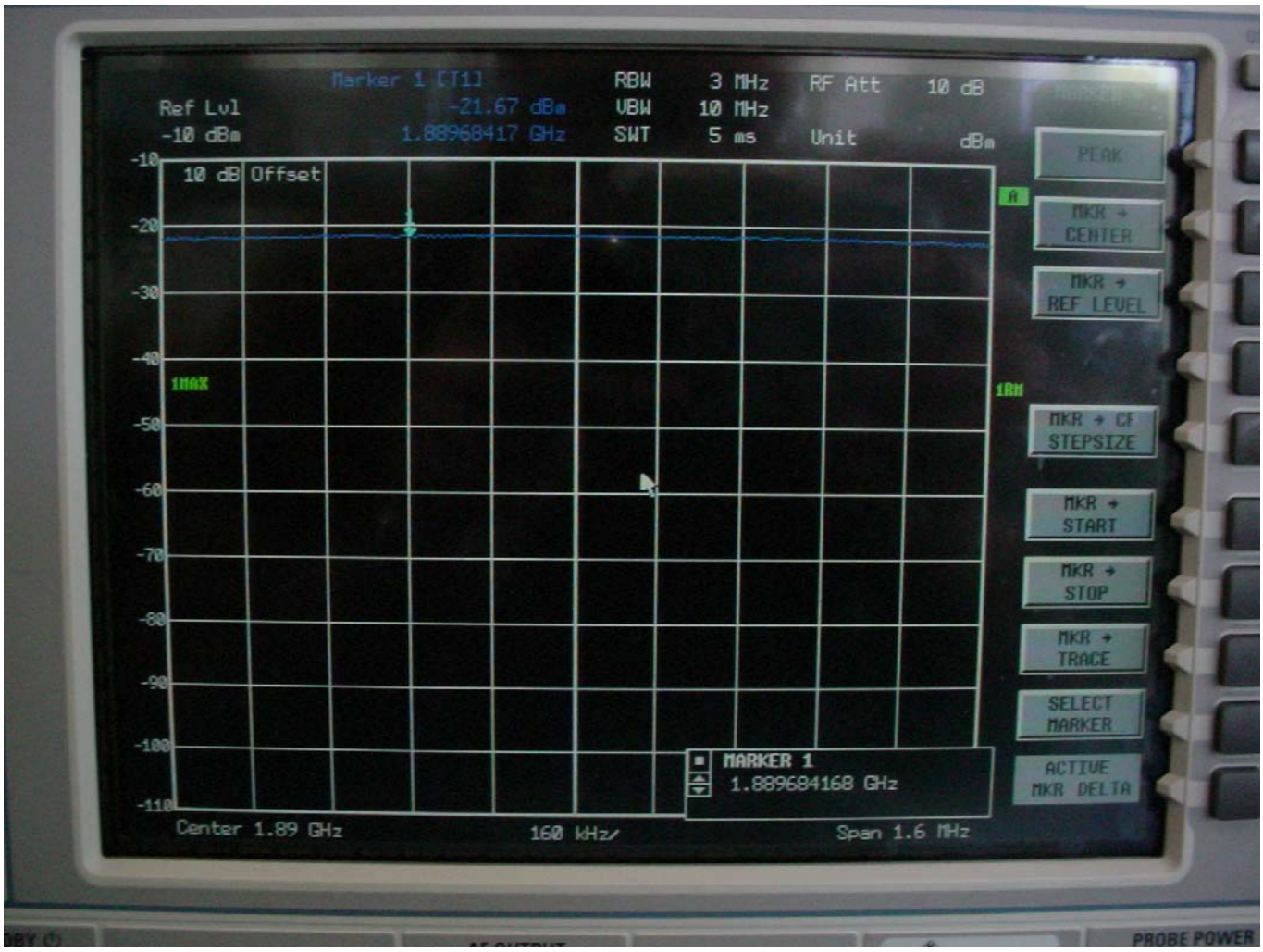
DECT peak value SPECTRAN



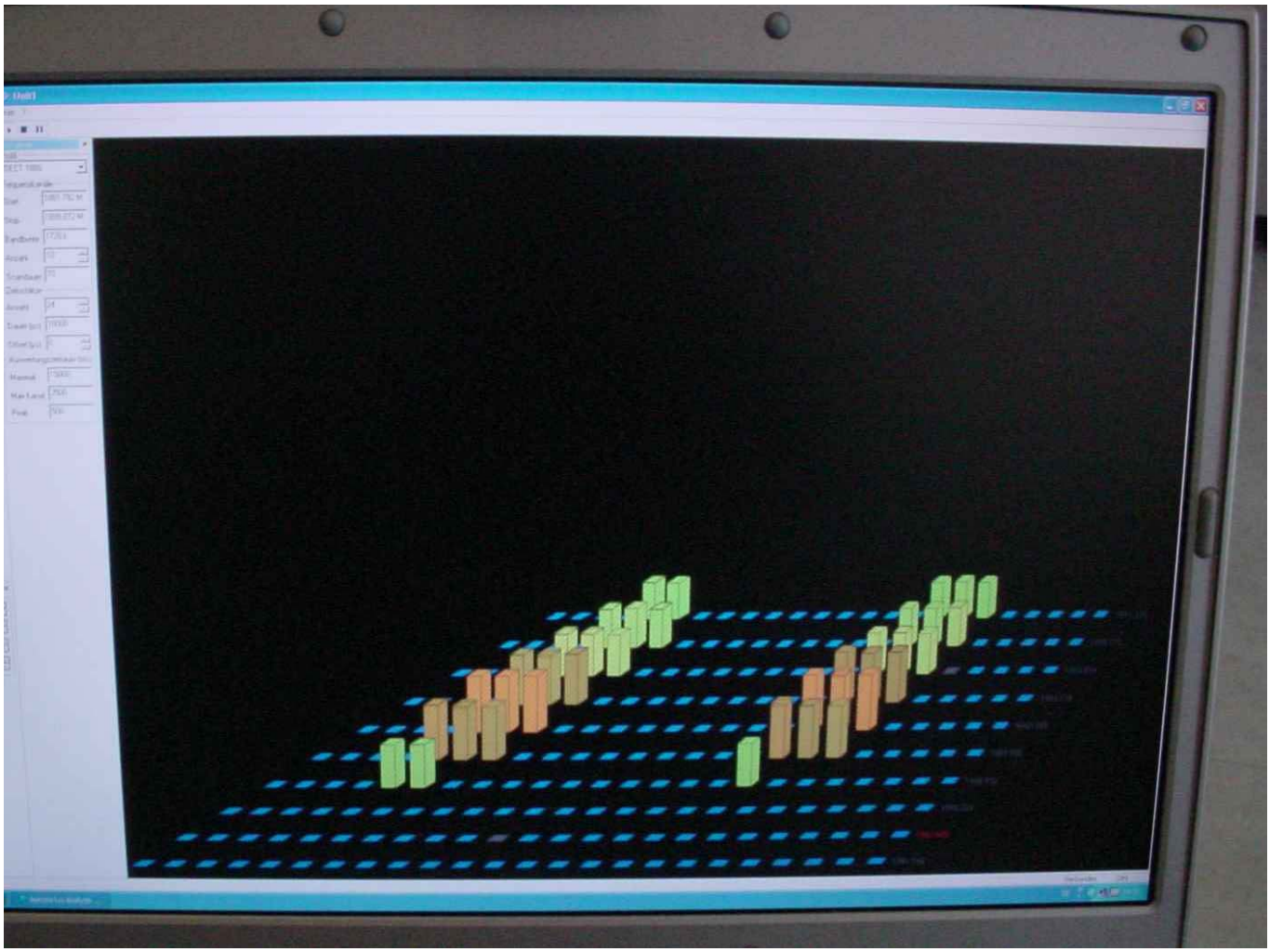
DECT peak value FSIQ 26 (with 20 MHz span)



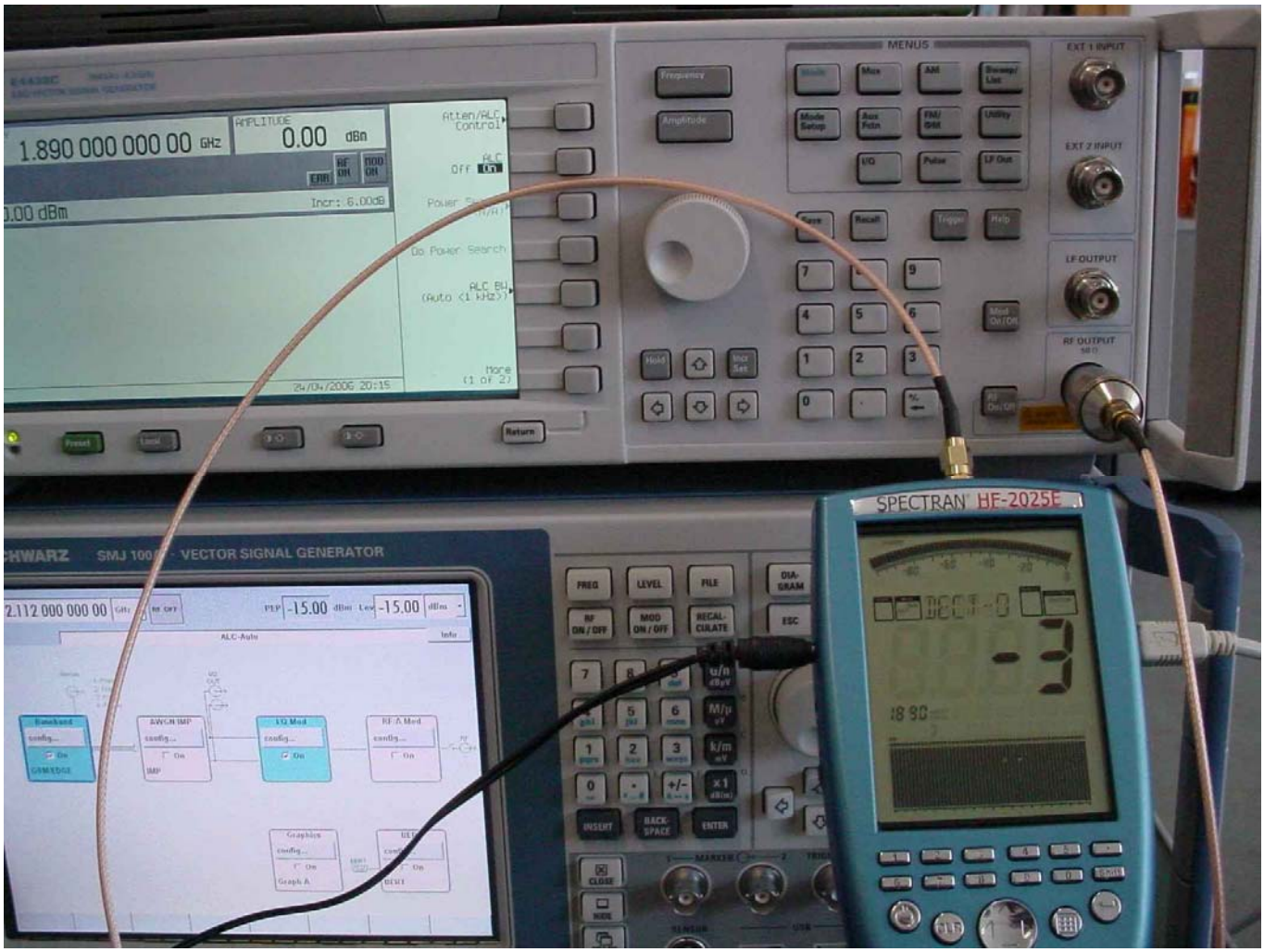
DECT peak value FSIQ 26 with 1.6 MHz span (channel bandwith) : no difference in peak dBm value



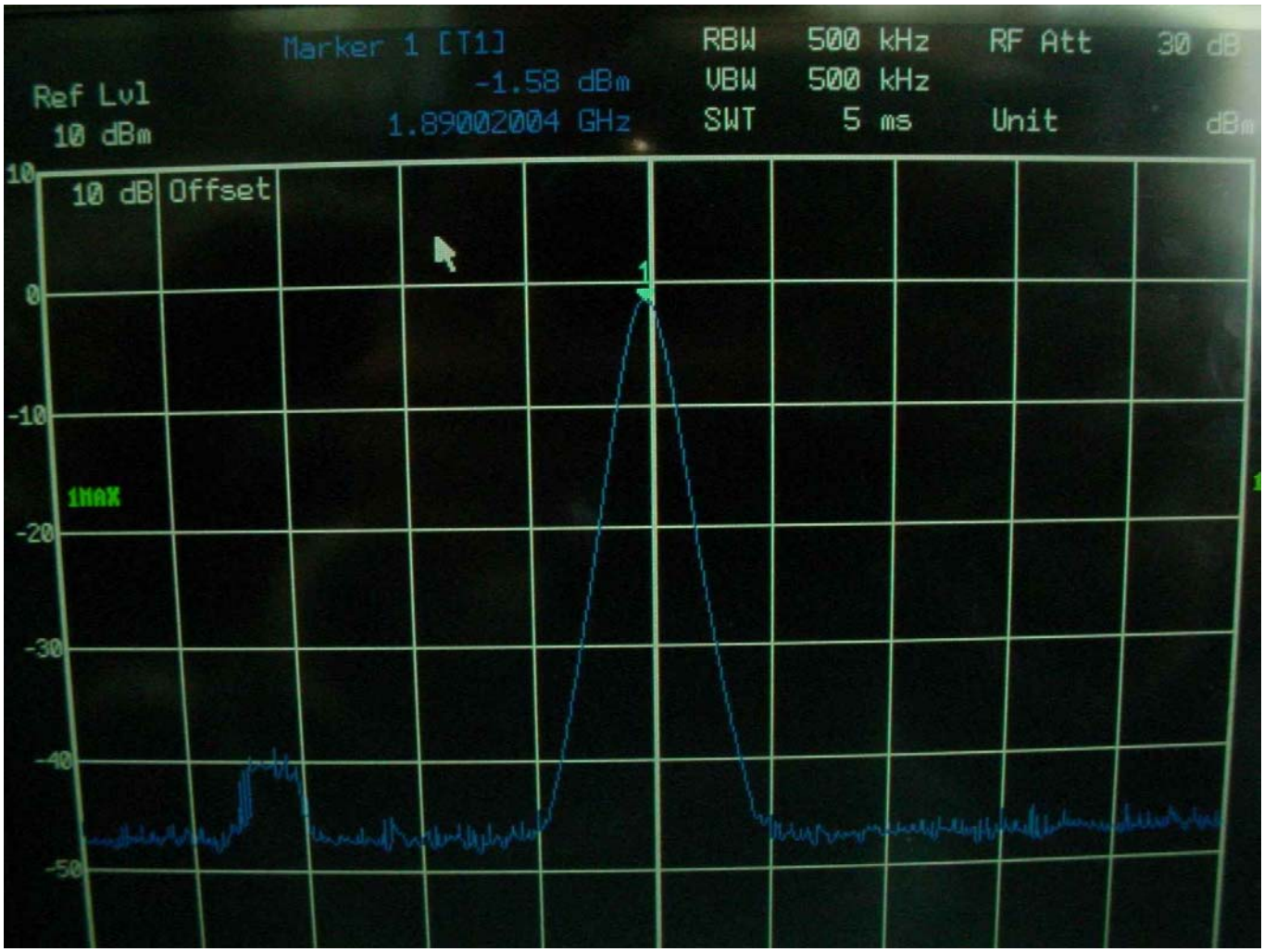
DECT timeslot overview (1 uplink and 1 downlink) shown on SPECTRAN LCS software



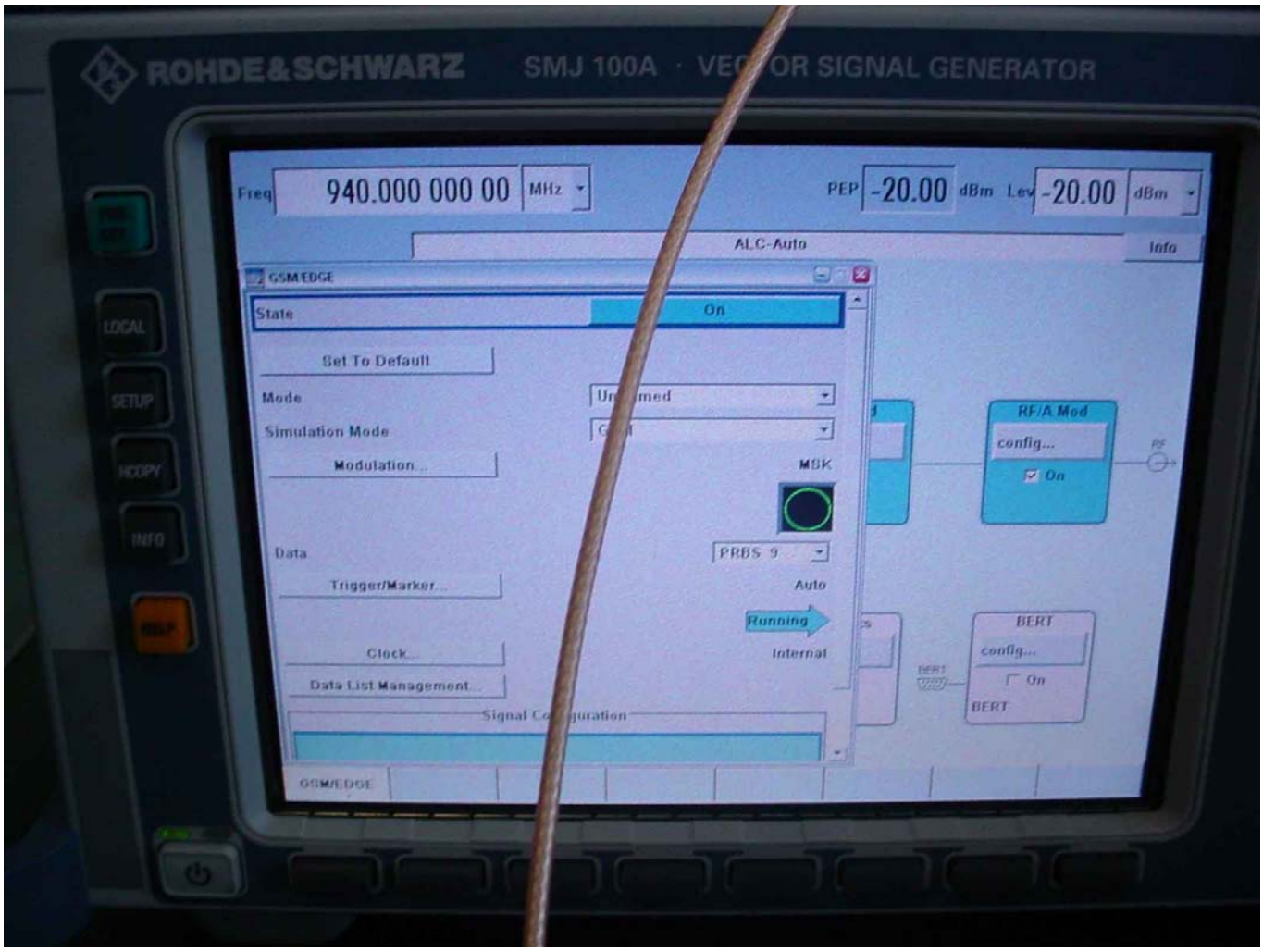
DECT setting and measured peak value of SPECTRAN (output power 0 dBm)



DECT peak value FSIQ 26 (output power 0 dBm)



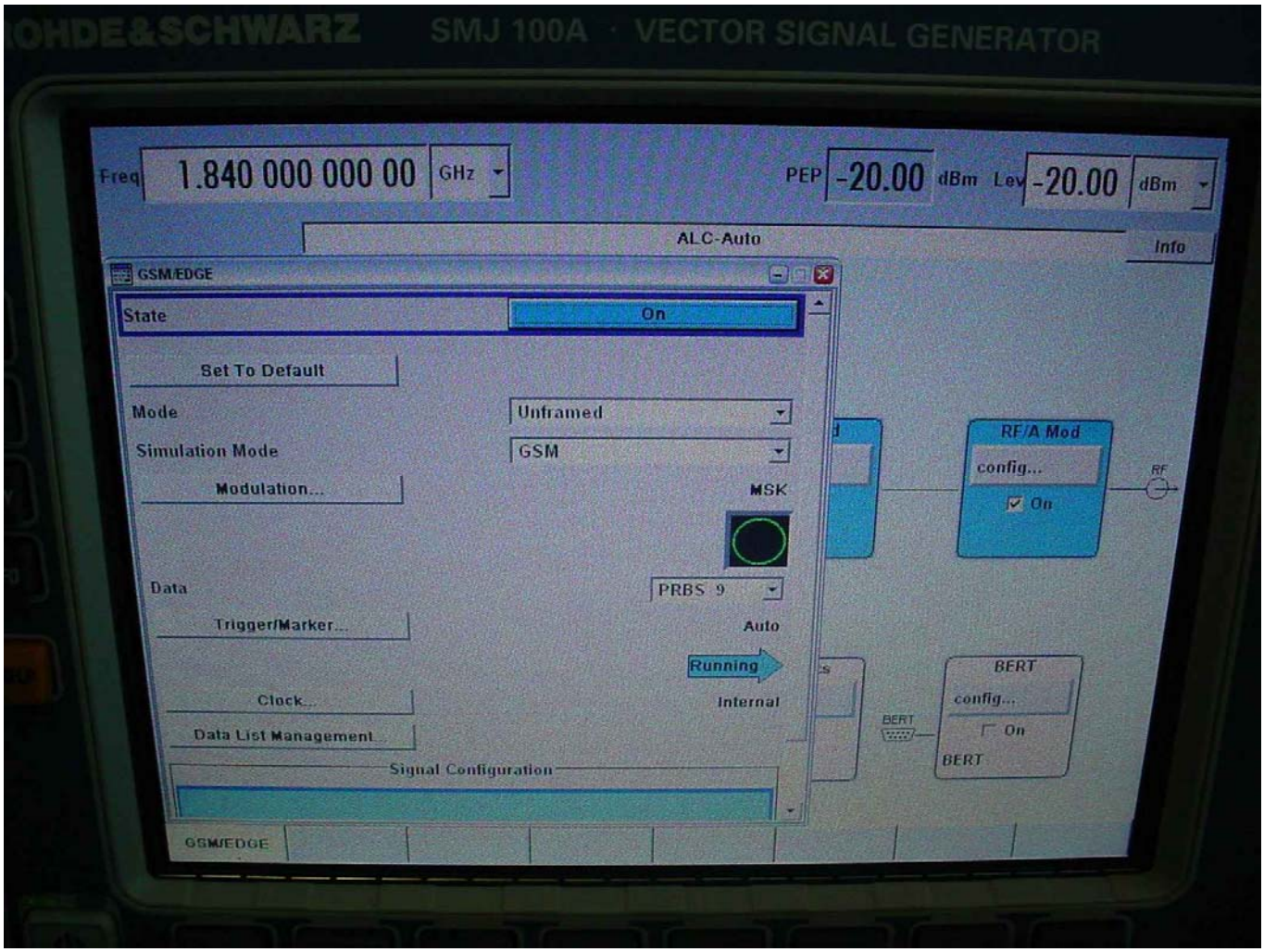
GSM 900 setting



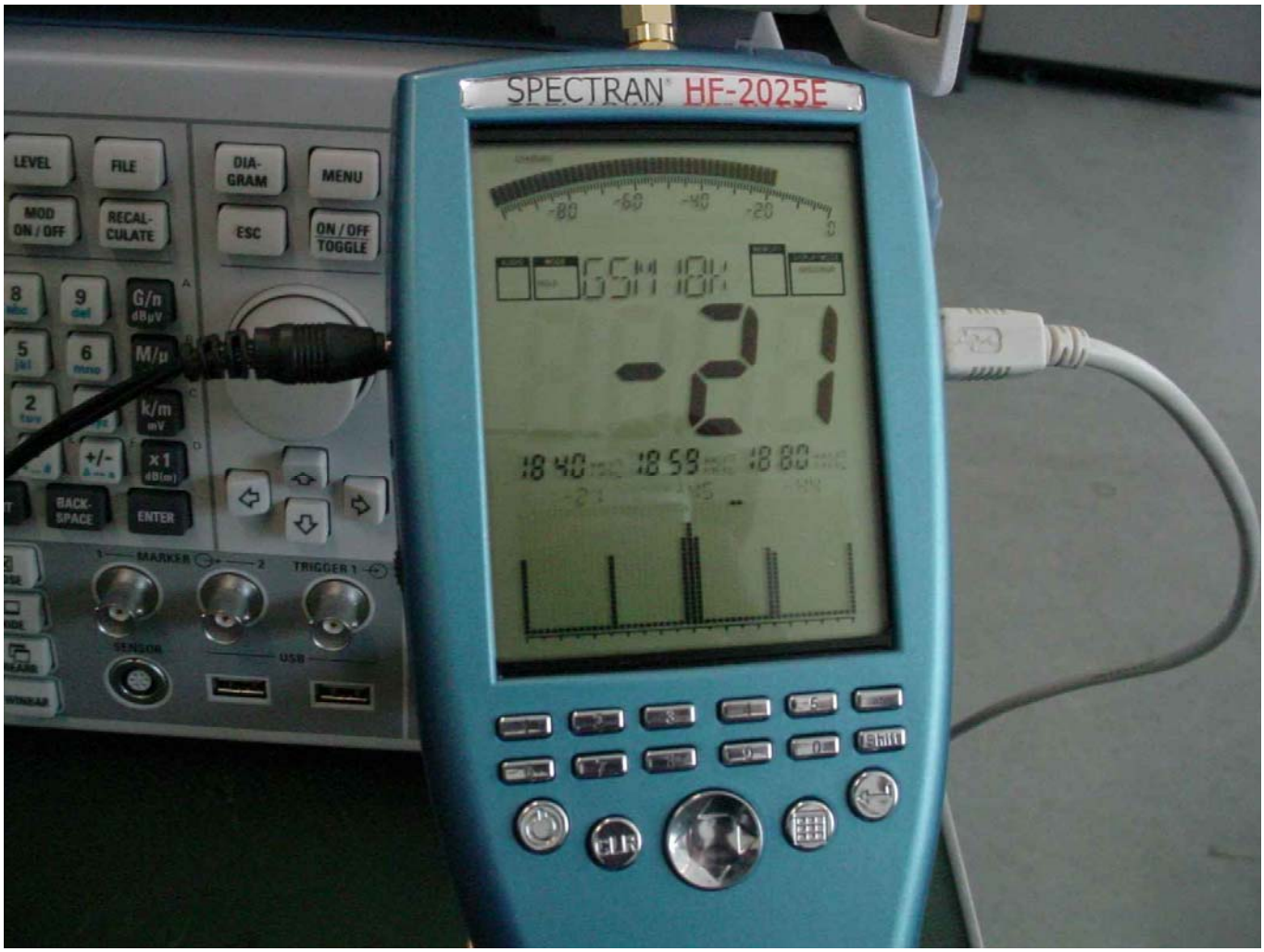
GSM peak value SPECTRAN

GSM peak value FSIQ 26

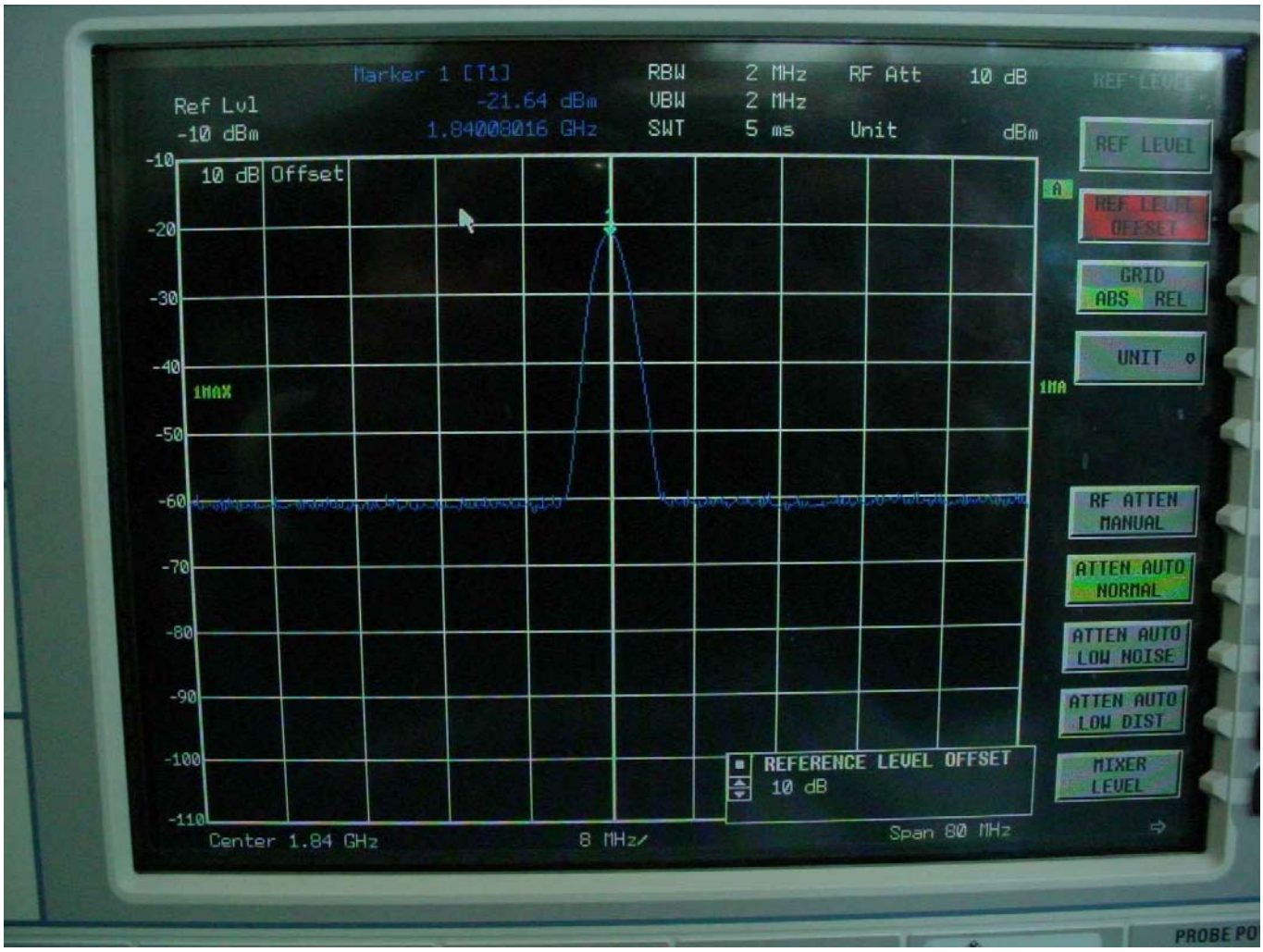
GSM1800 setting



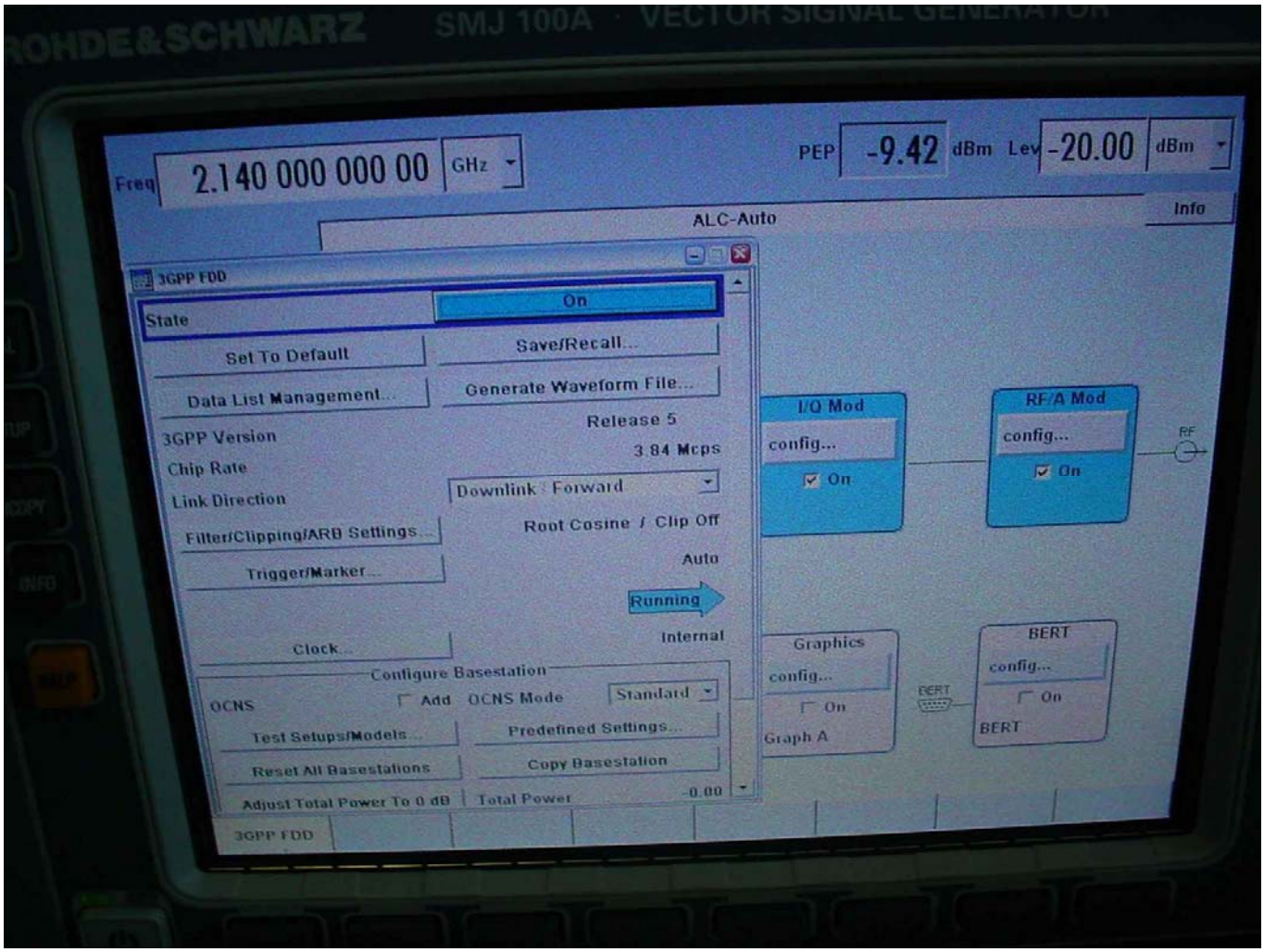
GSM1800 peak value SPECTRAN
Alias effects in spectrum display had no influence on measured peak level accuracy.



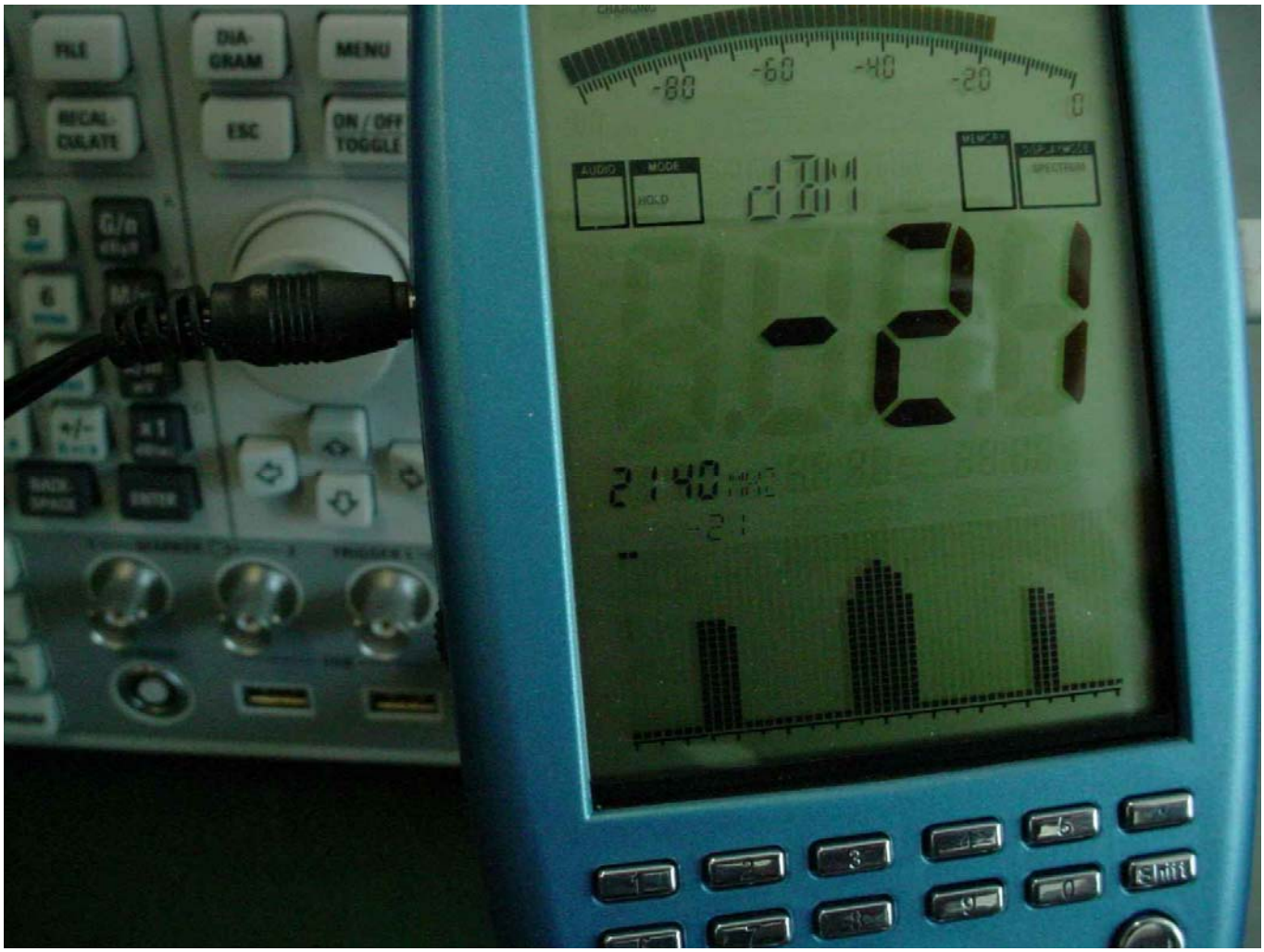
GSM1800 peak value FSIQ 26



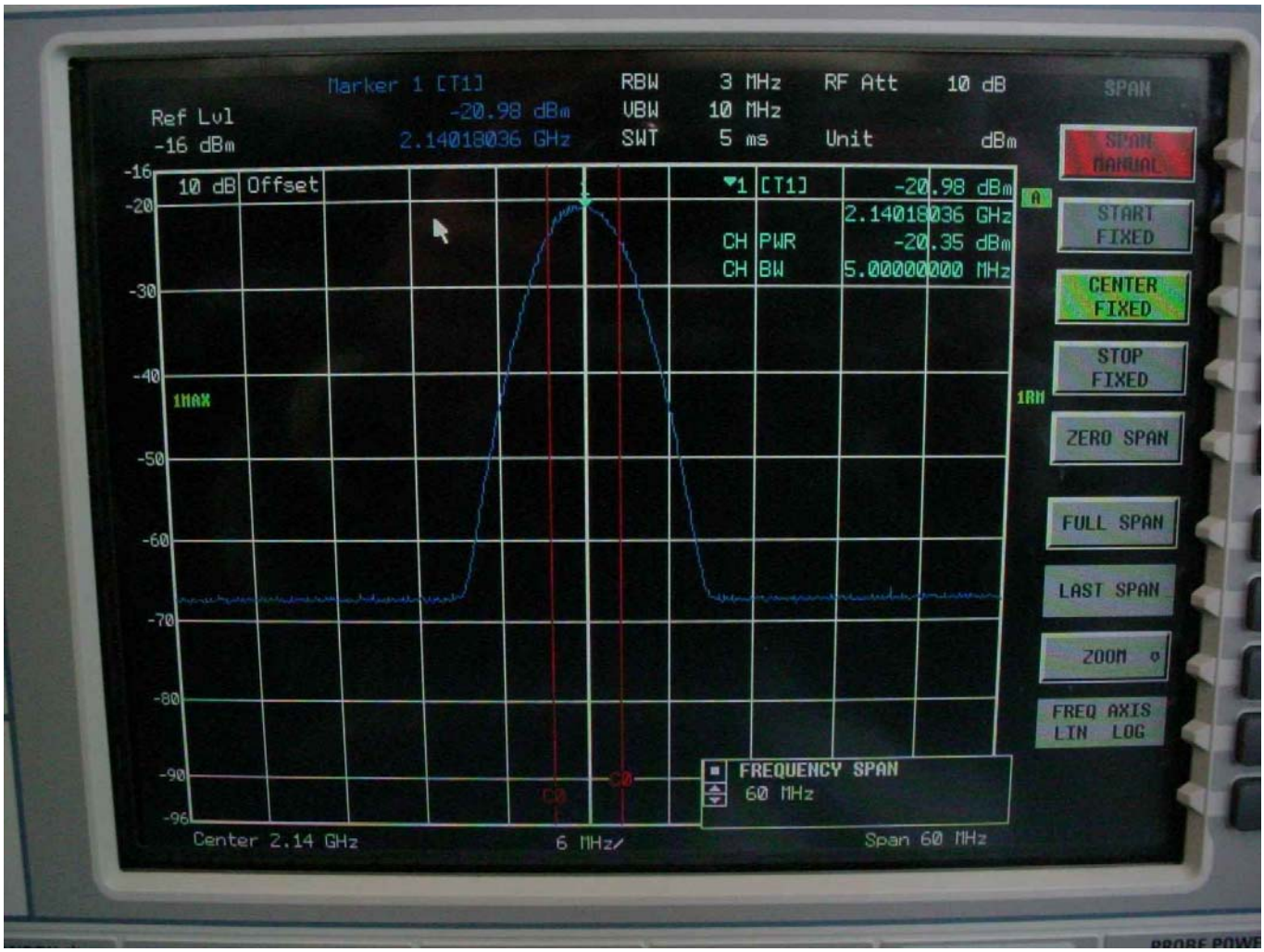
WCDMA setting



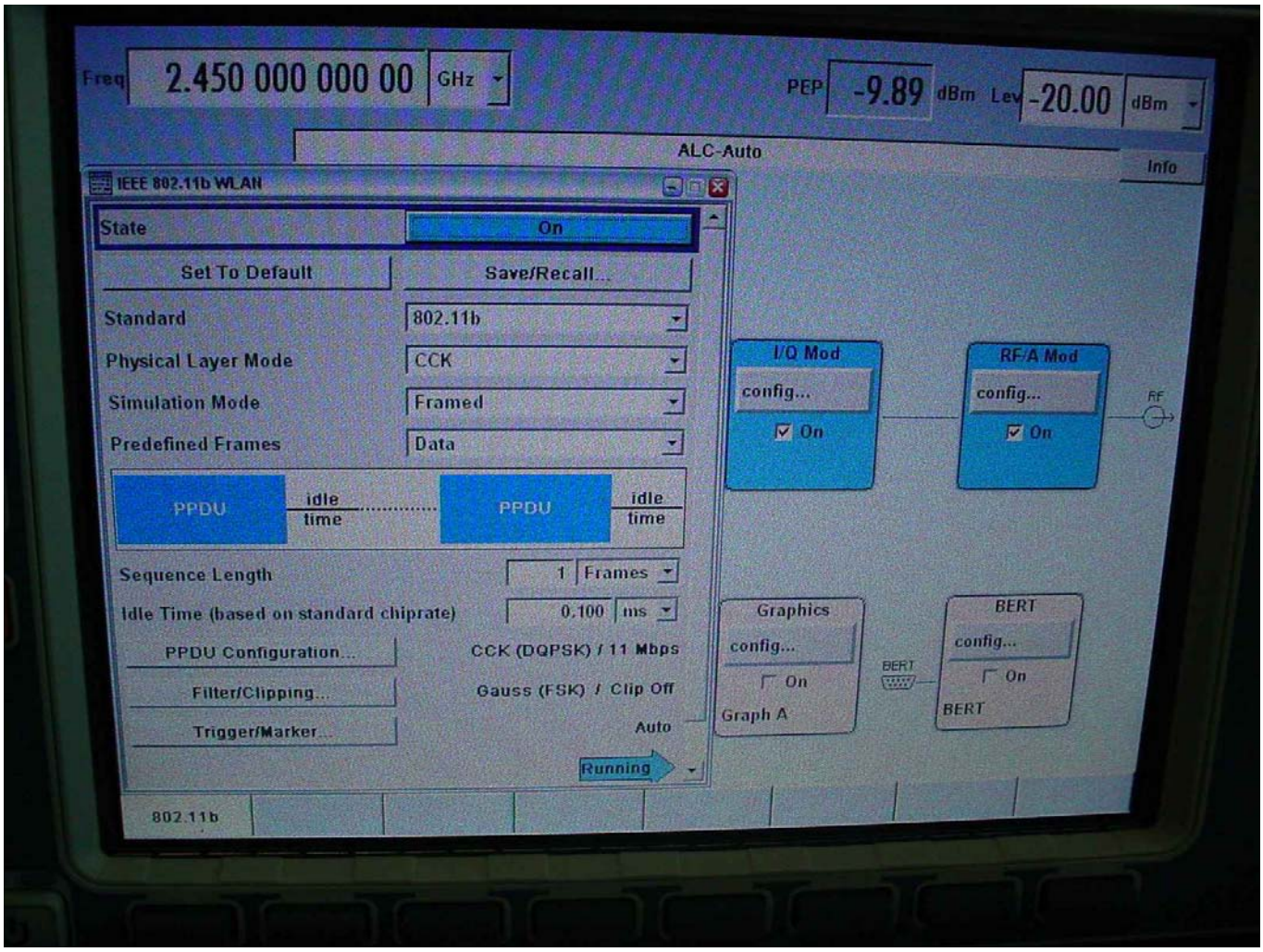
WCDMA peak value SPECTRAN
Alias effects in spectrum display had no influence on measured peak level accuracy.



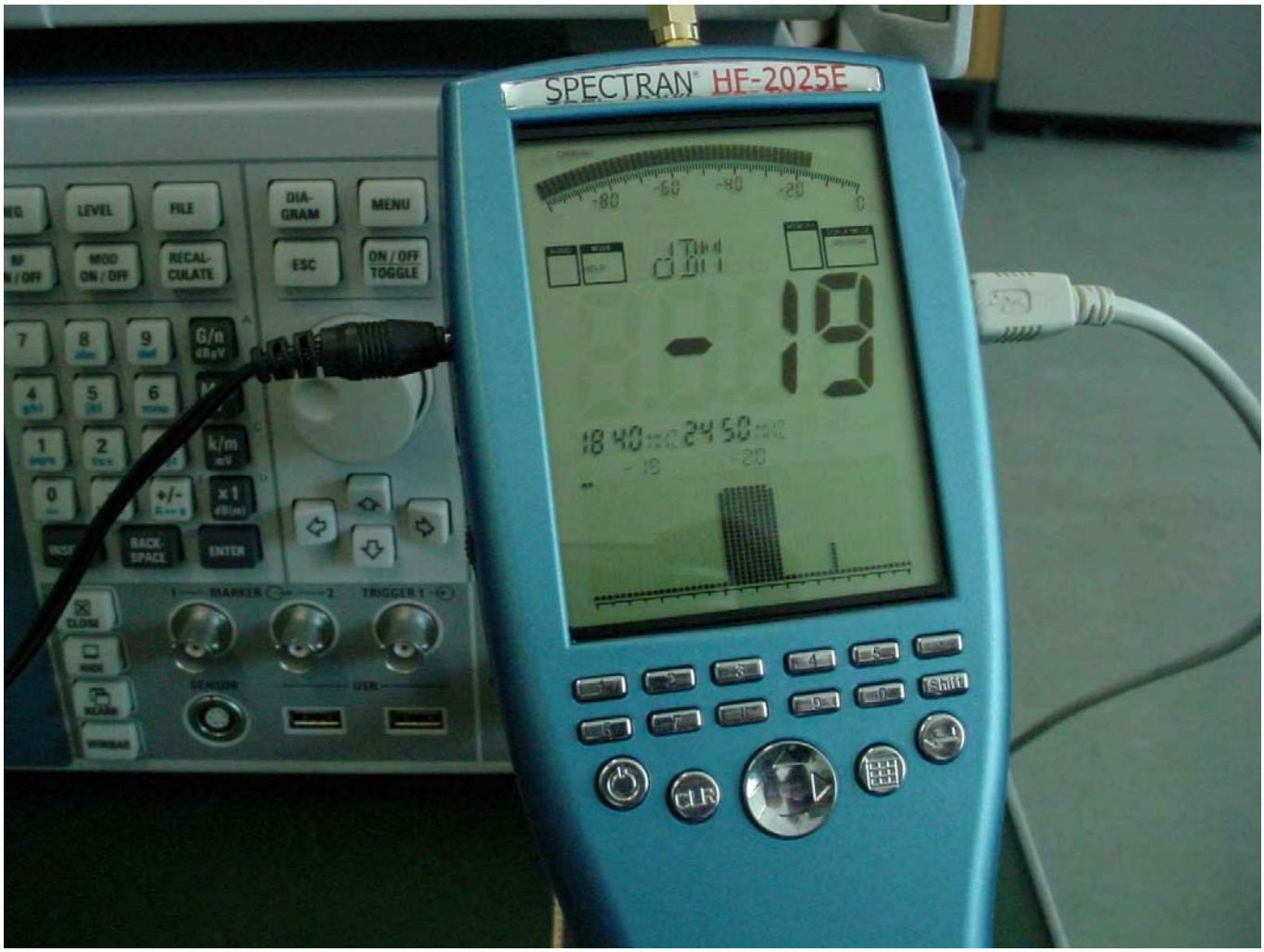
WCDMA peak value FSIQ 26



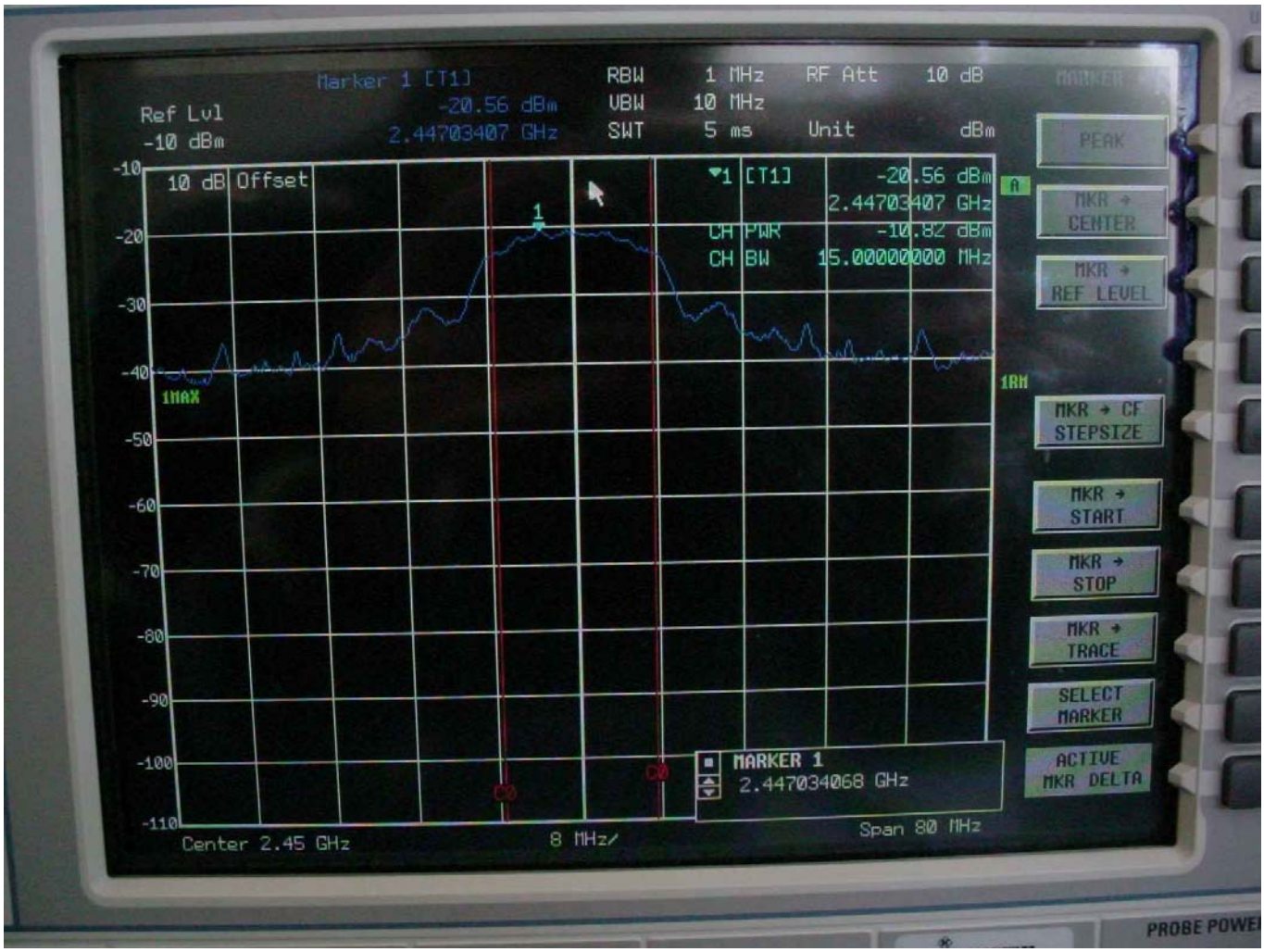
WLAN setting



WLAN peak value SPECTRAN
(the measurement has been performed in the 2.4 GHz band, the picture has been taken before a full display update so that a frequency marker of the previous measurement at 1800 MHz appears.)



WLAN peak value FSIQ 26



Annex 1 Photo documentation of test sample and PMM 8053

Picture no. 1

DUT - front view

Picture no. 2

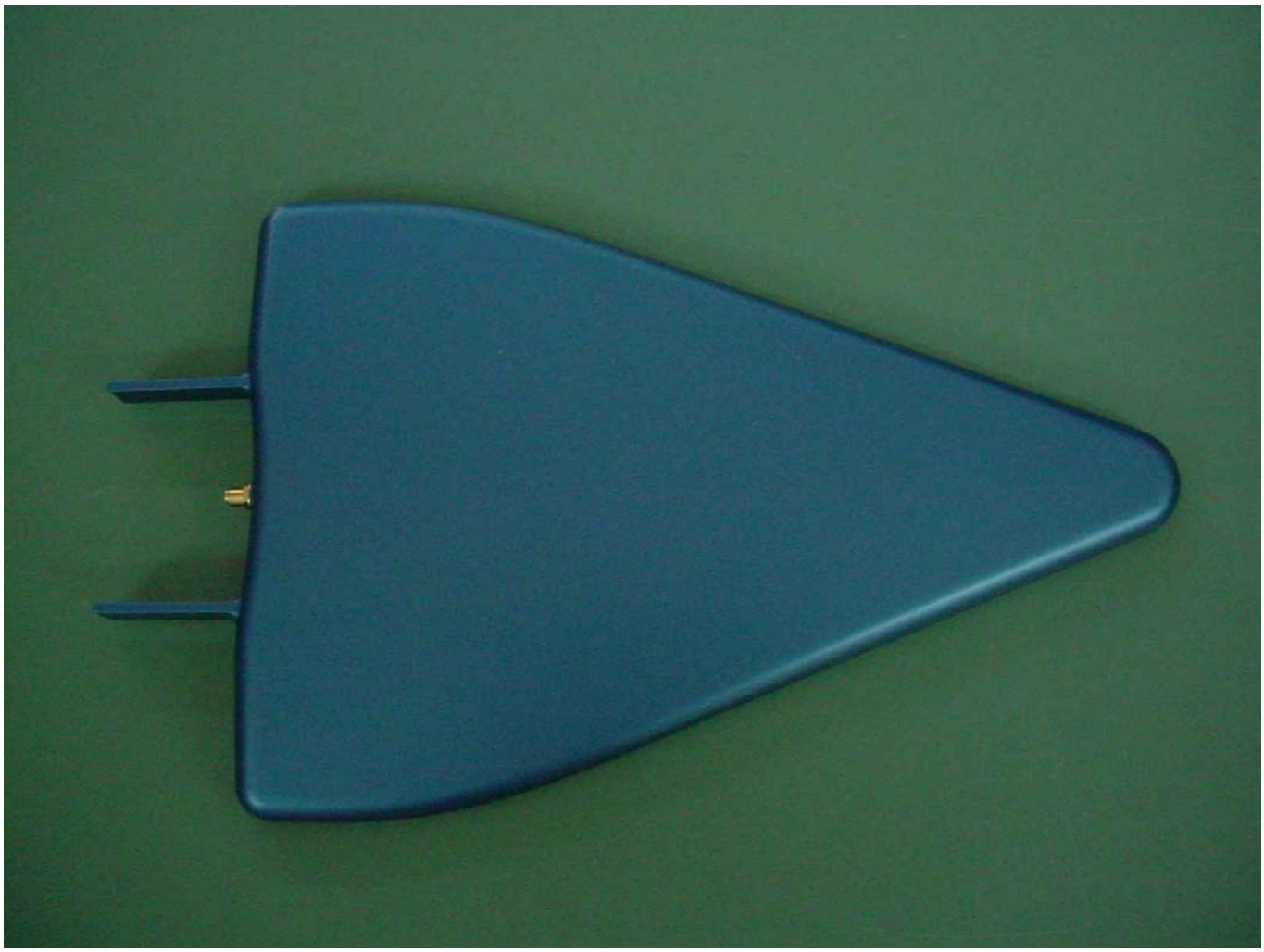
DUT - rear view

Picture no. 3

DUT - label

Picture no. 4

log-periodic antenna (top view)



Picture no. 5

log-periodic antenna (underside view)

Picture no. 6

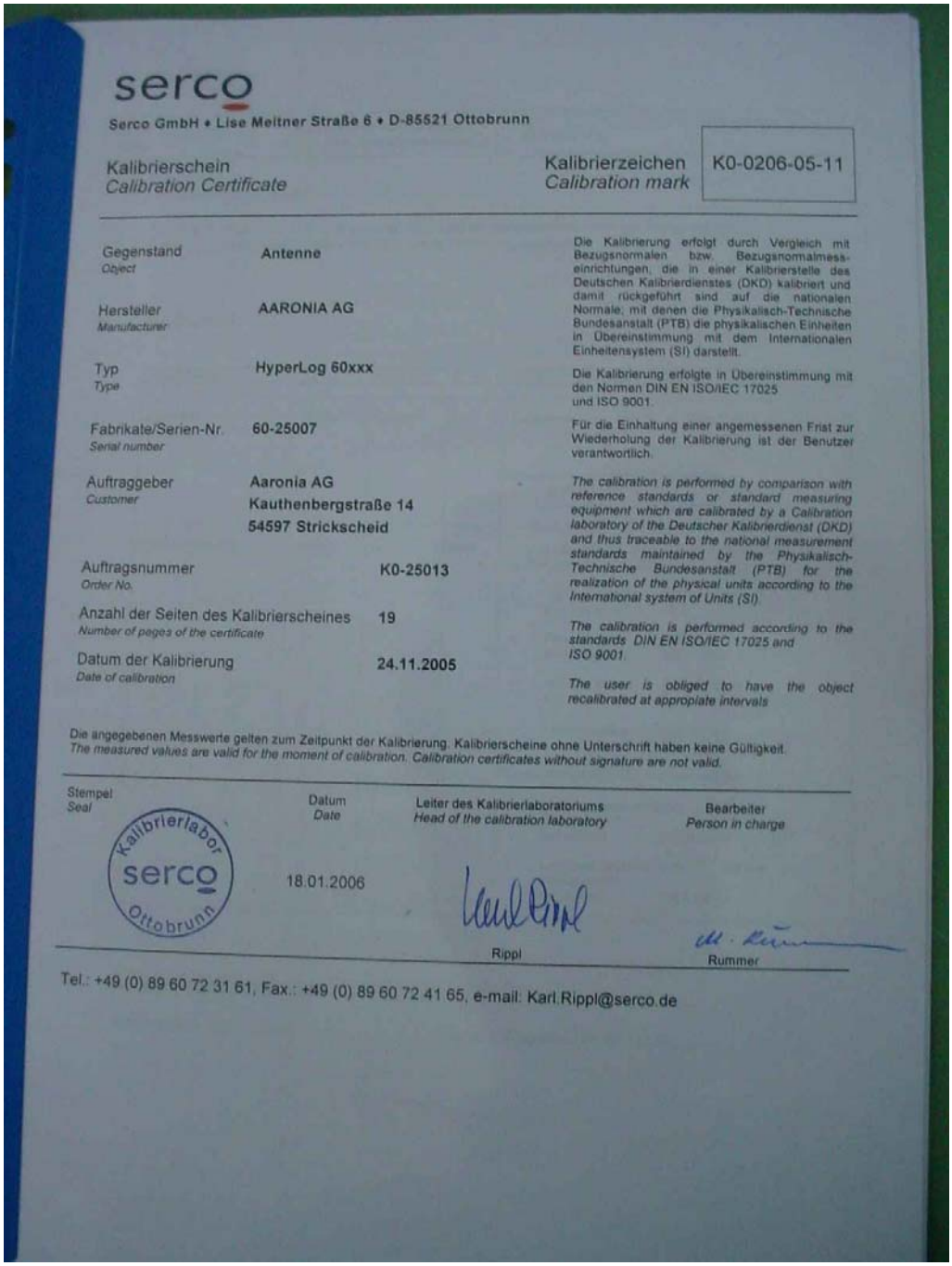
log-periodic antenna - serial number

Picture no. 7

calibration label

Picture no. 8

calibration certificate of log-periodic antenna



serco

Serco GmbH • Lise Meitner Straße 6 • D-85521 Ottobrunn

Kalibrierschein
Calibration Certificate

Kalibrierzeichen
Calibration mark
K0-0206-05-11

Gegenstand *Object*	Antenne
Hersteller *Manufacturer*	AARONIA AG
Typ *Type*	HyperLog 60xxx
Fabrikate/Serien-Nr. *Serial number*	60-25007
Auftraggeber *Customer*	Aaronia AG Kauthenbergstraße 14 54597 Strickscheid
Auftragsnummer *Order No.*	K0-25013
Anzahl der Seiten des Kalibrierscheines *Number of pages of the certificate*	19
Datum der Kalibrierung *Date of calibration*	24.11.2005

Die Kalibrierung erfolgt durch Vergleich mit Bezugsnormalen bzw. Bezugsnormalmess-einrichtungen, die in einer Kalibrierstelle des Deutschen Kalibrierdienstes (DKD) kalibriert und damit rückgeführt sind auf die nationalen Normale; mit denen die Physikalisch-Technische Bundesanstalt (PTB) die physikalischen Einheiten in Übereinstimmung mit dem Internationalen Einheitensystem (SI) darstellt.

Die Kalibrierung erfolgte in Übereinstimmung mit den Normen DIN EN ISO/IEC 17025 und ISO 9001.

Für die Einhaltung einer angemessenen Frist zur Wiederholung der Kalibrierung ist der Benutzer verantwortlich.

The calibration is performed by comparison with reference standards or standard measuring equipment which are calibrated by a Calibration laboratory of the Deutscher Kalibrierdienst (DKD) and thus traceable to the national measurement standards maintained by the Physikalisch-Technische Bundesanstalt (PTB) for the realization of the physical units according to the International system of Units (SI).

The calibration is performed according to the standards DIN EN ISO/IEC 17025 and ISO 9001.

The user is obliged to have the object recalibrated at appropiate intervals

Die angegebenen Messwerte gelten zum Zeitpunkt der Kalibrierung. Kalibrierscheine ohne Unterschrift haben keine Gültigkeit.
The measured values are valid for the moment of calibration. Calibration certificates without signature are not valid.

Stempel *Seal*	Datum *Date*	Leiter des Kalibrierlaboratoriums *Head of the calibration laboratory*	Bearbeiter *Person in charge*
Kalibrierlabor serco Ottobrunn	18.01.2006	Rippl	Rummer

Tel.: +49 (0) 89 60 72 31 61, Fax.: +49 (0) 89 60 72 41 65, e-mail: Karl.Rippl@serco.de

Picture no. 9

test equipment : field meter, E-field probes EP330 and EP408, optical repeater, probe EHP50B (only EP330 was used for the measurements described in chapter 2.5)

Annex 2 Calibration information

ROHDE & SCHWARZ

Kalibrierschein
Calibration Certificate

Nummer 11-905005/000
Number

Gegenstand *Object*	Signal Analyzer
Hersteller *Manufacturer*	ROHDE & SCHWARZ
Typ *Type*	FSIQ 26
Sach-Nr. *Ident. No.*	1119.6001.27
Serien-Nr. *Serial No.*	835111/004
Auftraggeber *Customer*	Cetecom ICT Services GmbH Untertürkheimer Str. 6-10 66117 Saarbrücken
Kunden-Referenz *Customer reference*	KIR / I
Ort u. Datum d. Kalibrierung *Place and date of calibration*	Köln, 2004-04-07
Umfang der Kalibrierung *Scope of calibration*	Standardkalibrierung *standard calibration*
Eingangsprüfung *Performance on receipt*	defekt *defective*
Kalibrierergebnis *Result of calibration*	innerhalb der Toleranz *in tolerance*
Umfang des Kalibrierscheins *Extent of the certificate*	19 Seiten *19 pages*

Dieser Kalibrierschein dokumentiert, dass der genannte Gegenstand nach festgelegten Vorgaben geprüft und gemessen wurde. Die Messwerte lagen im Regelfall mit einer Wahrscheinlichkeit von annähernd 95 % im zugeordneten Werteintervall (Erweiterte Messunsicherheit mit k = 2).
Die Kalibrierung erfolgte mit Messmitteln und Normalen, die direkt oder indirekt durch Ableitung mittels anerkannter Kalibriertechniken rückgeführt sind auf Normale der PTB/DKD oder anderer nationaler/internationaler Standards zur Darstellung der physikalischen Einheiten in Übereinstimmung mit dem Internationalen Einheitensystem (SI).
Wenn keine Normale existieren, erfolgt die Rückführung auf Bezugsnormale der R&S-Laboratorien.
Grundsätze und Verfahren der Kalibrierung entsprechen ISO/IEC 17025. Das Bestätigungssystem für die verwendeten Messmittel entspricht DIN ISO 10012-1. Das angewandte Qualitätsmanagement-System ist zertifiziert nach DIN EN ISO 9001.
Dieser Kalibrierschein darf nur vollständig und unverändert weiterverbreitet werden. Kalibrierscheine ohne Signifizierungen sind ungültig.
Für die Einhaltung einer angemessenen Frist zur Wiederholung der Kalibrierung ist der Benutzer verantwortlich.

This calibration certificate documents, that the named item is tested and measured against defined specifications. Measurement results are located usually in the corresponding interval with a probability of approx. 95 % coverage factor k = 2).
Calibration is performed with test equipment and standards directly or indirectly traceable by means of approved calibration techniques to the PTB/DKD or other national/international standards, which realize the physical units of measurement according to the International System of Units (SI). In all cases where no national standards are available, measurements are referenced to standards of the R&S laboratories.
Principles and methods of calibration correspond with ISO / IEC 17025. The metrological confirmation system for the measuring equipment used is in compliance with DIN ISO 10012-1. The applied quality system is certified to DIN EN ISO 9001.
This calibration certificate may not be reproduced other than in full. Calibration certificates without signatures are not valid.
The user is obliged to have the object recalibrated at appropriate intervals.

Ausstellungsdatum *Date of issue*	Laborleitung *Head of laboratory*	Bearbeiter *Person responsible*
2004-04-07	Wessels	Flügemann

ROHDE & SCHWARZ GmbH & Co. KG · Dienstleistungszentrum Köln · Graf-Zeppelin-Str. 18 · D - 51147 Köln
Postfach 98 02 60 · D - 51130 Köln · Telefon (02203) 49-0 · Telefax (02203) 49-51364
Geschäftsführung: Dipl.-Ing. Dipl.-Wirtsch.-Ing. Friedrich Schwarz (Vorsitzender), Dipl.-Ing. (FH) Reinhard Bruckner, Dipl.-Ing. Michael Vohrer
Sitz München · Registereintrag: HRA 16 270 · Persönlich haftender Gesellschafter: RUSEG Verwaltungs-GmbH · Sitz München · Registereintrag: AG München HRB 7 534
http://www.rohde-schwarz.com

vers9801/rsk0006

Costruzioni Elettroniche
Centro Misure Radioelettriche S.r.l.

Headquarters Via Leonardo da Vinci, 21/23
20090 Segrate (MI) - ITALY
Tel.: +39 02 26952421 Fax: +39 02 26952406
Manufacturing Plant Via Benessea, 29/B
17035 Cisano sul Neva (SV)
Tel.: +39 0182 58641 Fax: +39 0182 586400
Server http://www.pmm.it, e-mail: pmm@pmm.it

CERTIFICATE OF CALIBRATION
Certificato di taratura

Number Numero **10945-C405**

Item *Oggetto*	Electromagnetic Field Strength Meter
Manufacturer *Costruttore*	PMM
Model *Modello*	8053
Serial number *Matricola*	0220J10945
Calibration method *Metodo di taratura*	Internal procedure PTP 09-29
Date(s) of measurements *Data(e) delle misure*	28.05.2004
Result of calibration *Risultato della taratura*	Measurements results within specifications

This calibration certificate documents the traceability to national/international standards, which realise the physical units of measurements according to the International System of Units (SI).
Verification of traceability is guaranteed by mentioning used equipment included in the measurement chain. This equipment includes reference standard directly traceable to (inter)national standard (accuracy rating A) and working standard calibrated by the calibration laboratory of PMM (accuracy rating B) by means of reference standard A or by other accredited calibration laboratory.
The measurement uncertainties stated in this document are estimated at the level of twice the standard deviation (corresponding, in the case of normal distribution, to a confidence level of about 95%).
The uncertainties are calculated in conformity to the ISO Guide (Guide to the expression of uncertainty in measurement).
The metrological confirmation system for the measuring equipment used is in compliance with ISO 10012-1. The applied quality system is certified to UNI EN ISO 9001

Questo certificato di taratura documenta la tracciabilità a campioni primari nazionali o internazionali i quali realizzano la riferibilità alle unità fisiche del Sistema Internazionale delle Unità (SI).
La verifica della tracciabilità è garantita elencando gli strumenti presenti nella catena di misura.
La catena di riferibilità metrologica fa riferimento a campioni di prima linea direttamente riferiti a standard (inter)nazionali (classe A), di seconda linea, tarati nel laboratorio metrologico della PMM con riferibilità ai campioni di prima linea oppure tarati da Enti esterni accreditati (classe B).
Le incertezze di misura dichiarate in questo documento sono espresse come due volte lo scarto tipo (corrispondente, nel caso di distribuzione normale, a un livello di confidenza di circa 95%).
Le incertezze di misura sono calcolate in riferimento alla guida ISO. La conferma metrologica della strumentazione usata è conforme alla ISO 10012-1. Il sistema di qualità è certificato ISO 9001.

Date of issue *Data di emissione*	**Measure Operator** *Operatore misure*	**Person responsible** *Responsabile*
28.05.2004	Stefano Viaggio	Alessandro Rizzi

PMM Costruzioni Elettroniche
Centro Misure Radioelettriche S.r.l.

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Manufacturing Plant Via Benessea, 29/B
17035 Cisano sul Neva (SV)
Tel.: +39 0182 58641 Fax: +39 0182 586400
Server http://www.pmm.it, e-mail: pmm@pmm.it

CERTIFICATE OF CALIBRATION
Certificato di taratura

Number 10627 -C405
Numero

Item *Oggetto*	Electric field probe (100) 500 kHz - 3000 MHz
Manufacturer *Costruttore*	PMM
Model *Modello*	EP 330
Serial number *Matricola*	1010J10627
Calibration procedure *Procedura di taratura*	Internal procedure PTP 09-29
Date(s) of measurements *Data(e) delle misure*	25.05.2004
Result of calibration *Risultato della taratura*	Measurements results within specifications

This calibration certificate documents the traceability to national/international standards, which realise the physical units of measurements according to the International System of Units (SI). Verification of traceability is guaranteed by mentioning used equipment included in the measurement chain. This equipment includes reference standard directly traceable to (inter)national standard (accuracy rating A) and working standard calibrated by the calibration laboratory of PMM (accuracy rating B) by means of reference standard A or by other calibration laboratory.
The measurement uncertainties stated in this document are estimated at the level of twice the standard deviation (corresponding, in the case of normal distribution, to a confidence level of about 95%). The uncertainties are calculated in conformity to the ISO Guide (Guide to the expression of uncertainty in measurement).The metrological confirmation system for the measuring equipment used is in compliance with ISO 10012-1. The applied quality system is certified to UNI EN ISO 9001

Questo certificato di taratura documenta la tracciabilità a campioni primari nazionali o internazionali i quali realizzano la riferibilità alle unità fisiche del Sistema Internazionale delle Unità (SI). La verifica della tracciabilità è garantita elencando gli strumenti presenti nella catena di misura.La catena di riferibilità metrologica fa riferimento a campioni di prima linea direttamente riferiti a standard (inter)nazionali (classe A), di seconda linea, tarati nel laboratorio metrologico della PMM con riferibilità ai campioni di prima linea oppure tarati da Enti esterni accreditati (classe B).
Le incertezze di misura dichiarate in questo documento sono espresse come due volte lo scarto tipo (corrispondente, nel caso di distribuzione normale, a un livello di confidenza di circa 95%). Le incertezze di misura sono calcolate in riferimento alla guida ISO. La conferma metrologica della strumentazione usata è conforme alla ISO 10012-1. Il sistema di qualità è certificato ISO 9001.

Date of issue *Data di emissione*	Measure operator *Operatore misure*	Person responsible *Responsabile*
31.05.2004	A. De Lorenzo PMM-CMR OPERATORE n. 02	G. Basso

Detailed calibration information is available on request.