TCC
Copenhagen

DANAK
Reg. Nr. 416

SAR Compliance Test Report

Test Report no.:	DTX04243-EN	**Date of Report:**	25th of March 2002
Number of pages:	18	**Contact person:**	Darin Yeoman
		Responsible Test engineer:	Ruben Chr. Hansen

Testing laboratory:	TCC Copenhagen Nokia Danmark A/S Frederikskaj DK-1790 Copenhagen V Denmark Tel. +45 33 29 29 29 Fax. +45 33 29 20 01	**Client:**	Nokia USA 12278 Scripps Summit Dr. San Diego CA 92131, USA Tel. +1.858.831.5000 Fax.+1.858.831.6500

Tested device: FCC ID: GMLNHP-2AX, Model 6385, ESN: 235/14004990, HW: B4.0, SW: cb320b07, DUT#: 231388

Supplement reports:

Testing has been Carried out in Accordance with: IEEE Std 1528-200X Draft 6.4
Recommended Practice for Determining the Spatial-Peak Specific Absorbtion Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques.

Documentation: The documentation of the testing performed on the tested devices is archived for 15 years at Test & Certification Center, Copenhagen

Test Results: The tested device complies with the requirements in respect of all parameters subject to the test.
The test results and statements relate only to the items tested.
The test report shall not be reproduced except in full, without written approval of the laboratory.

Date and signatures: 2002-03-25

For the contents:

Svend Bøgsted
TCC Manager

Ruben Chr. Hansen
SAR Test Engineer

CONTENTS

1. SUMMARY FOR SAR TEST REPORT

The tests described in this report have been performed in order to demonstrate that the equipment under test complies with the requirements in IEEE Std 1528-200X Draft 6.4 Recommended Practice for Determining the Spatial-Peak Specific Absorbtion Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques.

Date of receipt	2001.12.03
Date of test	2001.12.03 - 2001.12.14
Deadline for test report	2002.03.25
Contact person	Robert Taylor, TCC San Diego, Nokia Mobile Phones, CA, USA
Testplan referred to	-
Phone with FCC ID, ESN, HW, SW and DUT numbers	GMLNHP-2AX, ESN: 235/14004990, HW: B4.0, SW: cb320b07 DUT #: 231388
Accessories	Battery, Type: BLB-3; Headset, Type: HDE-1; Headset, Type: HDC-5; Carrying Case, Type CSL-21.
Document code	V:\TCC\EMC\Reports\Columbia\DTX04243-EN.doc
Responsible SAR Test Engineer	Ruben Chr. Hansen
Measurements performed by	Leif Funch Klysner

1.1 Maximum Results Found during SAR Evaluation

The equipment is deemed to fulfil the requirements if the measured values are less than or equal to the limit.

1.1.1 Head Configuration

Ch / *f* (MHz)	Power	Position	Limit	Measured	Result
991 / 824.60	dBm 25.8	Touch, Right Hand, Antenna Retracted	mW/g 1.6	mW/g 1.20	**PASSED**

1.1.2 Body Worn Configuration

Ch / *f* (MHz)	Power	Position	Limit	Measured	Result
1013 / 824.70	dBm 25.4	Flat Section, Carrying Case, Headset HDE-1	mW/g 1.6	mW/g 0.36	**PASSED**

Ch / *f* (MHz)	Power	Position	Limit	Measured	Result
991 / 824.60	dBm 25.8	Flat Section, Carrying Case, Headset HDC-5	mW/g 1.6	mW/g 0.33	**PASSED**

1.1.3 Measurement Uncertainty

Combined Uncertainty	± **12.11%**
Expanded Uncertainty (k=2) 95.5%	± **24.23%**

2. DESCRIPTION OF THE DEVICE

2.1 Picture of GMLNHP-2AX (NOKIA 6385)

Figure 1 GMLNHP-2AX (NOKIA 6385)

2.2 Description of the antenna

The GMLNHP-2AX (NOKIA 6385) cellular phone has an integral patch antenna and a retractable antenna.

Figure 2 GMLNHP-2AX with antenna extended

2.3 Battery

A Li-Ion battery, BLB-3 was used during the measurement.

2.4 Body Worn Accessory

The following body worn accessory is available for the GMLNHP-2AX (NOKIA 6385) cellular phone.

Figure 3 Carrying case CSL-21.

3. TEST CONDITIONS

3.1 Temperature and Humidity

Ambient temperature: 23° C

Tissue simulating liquid temperature: 23° C

Ambient humidity: 38% r.h.

3.2 Test signal, frequencies, and output power

The GMLNHP-2AX (NOKIA 6385) was put in operation using an Agilent E8285A Mobile Station Test Set. Communication between the phone and the tester was established by air link using a Schwarzbech BBHA 9120 rigid horn antenna.

The battery is a Li-Ion rechargeable type. The battery holds enough energy for at least 2 hours of continous transmission.

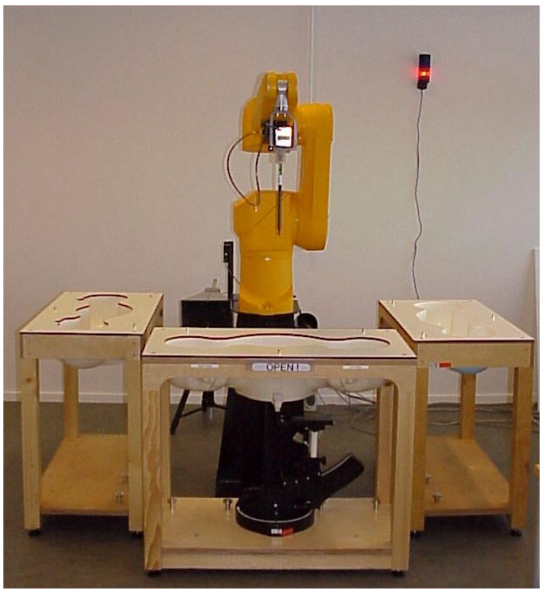
The Phone was set to maximum power level during all the tests.

4. DESCRIPTION OF THE TEST EQUIPMENT

The measurements were performed with a automated near-field scanning system, **DASY3**.

4.1 Manufacturer of DASY3

Schmid & Partner Engineering AG (SPEAG)
Zeughausstrasse 43
8004 Zurich, Switzerland
Phone 41 1 245 97 00, Fax 41 1 245 97 79
www.speag.com



4.2 Robot

The robot is a RX90L manufactured by Stäubli France, www.staubli.com

Number of axis	6
Payload	3..5 kg
Reach	1185 mm
Repeatability	± 0.025 mm
Control unit	CS7/CS7M

4.3 Isotrophic E-field probe ET3DV6R

Frequency	10 MHz to 3 GHz
Linearity	± 0.2 dB (30 MHz to 3 GHz)
Directivity	± 0.2 dB in HSL (rotation around probe axis) ± 0.4 dB in HSL (rotation normal to probe axis)
Dynamic range	5 μW/g to > 100 mW/g; Linearity: ± 0.2 dB
Dimensions	Overall length: 330 mm
	Tip length: 16 mm
	Body diameter: 12 mm
	Tip diameter: 6.8 mm
	Distance from probe tip to dipole centers: 2.7 mm

4.4 Device holder

The holder was provided by SPEAG as a part of the DASY3 system.

4.5 Dipole antennas for validation

The dipole antennas are matched for use near flat phantoms filled with head/body simulation solutions. The dipoles are equipped with 10 or 15 mm distance holders.

4.6 Phantom

The pantoms enables dosimetric evaluation of left and right hand phone usage, as well as body mounted usage at the flat phantom region.

Shell thickness: 2 ± 0.2 mm, except at Ear Reference Point, where an integrated spacer provides a 6 mm spacing from the tissue simulating liquid.

4.7 Liquid depth

The liquid depth was during measurment at least 15 cm.

4.8 Calibration and validation procedures

The probes are calibrated annually by the manufacturer. The tissue simulating liquids are measured using an HP 85070A dielectric probe kit. The SAR measurements were validated using a dipole antenna placed under the flat section of the generic twin phantom. A power level of 250 mW supplied to the dipole antenna was used for the validation. The results are normalized to 1 W input power. The power level was controlled during validation, using directional coupler and power meter.

Liquid	Frequency [MHz]	Description	SAR averaged over 1g [mW/g]	Dielectric Parameters	
				ε_r	σ [S/m]
Head	900	Measured	11.48	40.9	0.95
		Reference	11.44	41.5	0.97
	1800	Measured	38.08	39.8	1.38
		Reference	37.4	40.7	1.35
Body	900	Measured	11.08	57.0	0.96
		Reference	11.84	55.4	1.04
	1800	Measured	39.08	52.5	1.45
		Reference	40.8	53.5	1.45

4.9 Synthetic brain tissue simulating liquid parameters, measured values:

Target Frequency [MHz]	Description	ε_r Relative permittivity	σ [S/m] Conductivity
835	Measured	40.9	0.95
	Recommended	41.5	0.90
1880	Measured	39.8	1.38
	Recommended	40.0	1.40

4.10 Synthetic body tissue simulating liquid parameters, measured values:

Frequency band [MHz]	Description	ε_r Relative permittivity	σ [S/m] Conductivity
835	Measured	57.0	0.96
	Recommended	55.2	0.97
1880	Measured	52.5	1.45
	Recommended	53.3	1.52

Recommended values are adopted from OET Bulletin 65 (97-01) Supplement C (01-01).

4.11 Synthetic tissue simulating liquid recipes

4.11.1 835 MHz

Ingredients	Head (% by weight)	Body (% by weight)
De-ionized Water	39.74	55.97
Hydroxyethyl Cellulose	0.25	1.21
Sugar	58.31	41.76
Preservative	0.15	0.27
Salt	1.55	0.79

4.11.2 1880 MHz

Ingredients	Head (% by weight)	Body (% by weight)
De-ionized Water	54.88	69.02
Di(ethylene glycol) butyl ether	44.91	30.76
Salt	0.21	0.22

5. DESCRIPTION OF THE TEST PROCEDURE

5.1 Test positions

The cellular phone was measured in 2 positions on both the "left hand" and "right hand" side of the phantom with the antenna in both extended and retracted positions. Furthermore the cellular phone was measured in the carrying case under the flat section of the phantom.

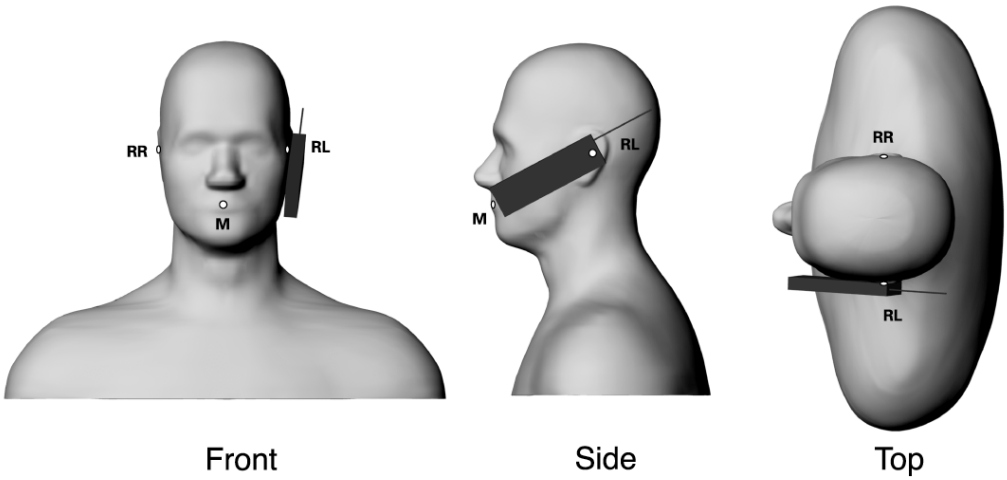


Figure 4. "Cheek/Touch" Position. The reference points for the right ear (RE), left ear (LE) and mouth (M), which define the plane for phone positioning, are indicated.

5.1.1 Cheek/Touch Position

1) The phone was positioned with the vertical center line of the body of the phone and the horizontal line crossing the center of the ear piece in a plane parallel to the sagittal plane of the phantom ("initial position"). While maintaining the phone in this plane, the vertical center line was aligned with the reference plane containing the three ear and mouth reference points (RE, LE and M) and the center of the ear piece was aligned with the line RE-LE
2) The mobile phone was moved towards the phantom with the earpiece aligned with the line LE-RE until the phone touched the ear. While maintaining the phone contact with the ear, the bottom of the phone was moved until a point on the front side was in contact with the cheek of the phantom or until contact with the ear was lost.

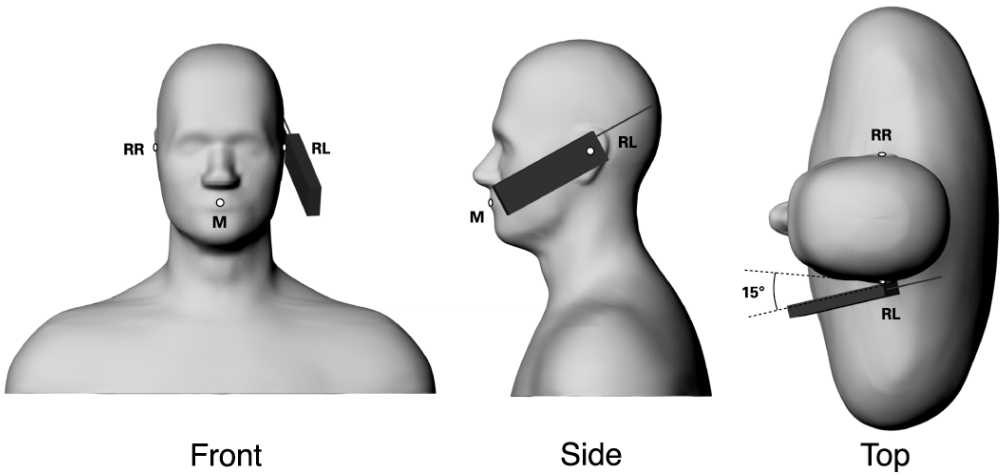


Figure 5. "Ear/Tilted Position." The reference points for the right ear (RE), left ear (LE) and mouth (M), which define the plane for phone positioning, are indicated.

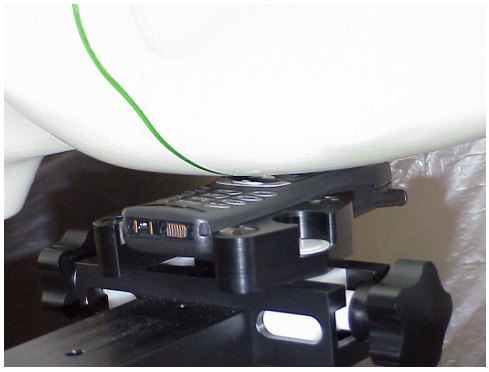
5.1.2 Ear/Tilted Position

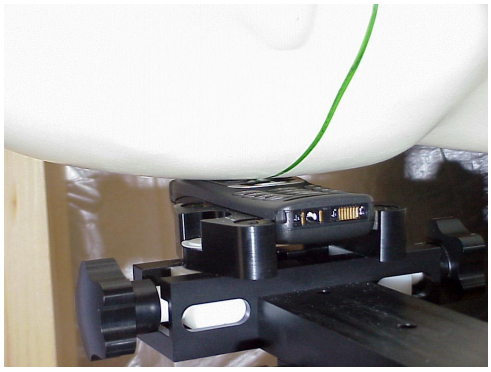
1) The phone was positioned in the "cheek/touch" position as described above;
2) While the phone was maintianed in the reference plane described above and pivoting against the ear, the phone was moved outward away from the mouth by an angle of 15 degrees or until contact with the ear was lost.

5.1.3 Photos of setup

Tilted, left hand.

Tilted, right hand


Touch, left hand


Touch, right hand.

5.1.4 Body Worn Configuration

The phone was positioned into the CSL-21 carrying case and placed below of the flat section of the phantom.
The measurment was performed in 2 positons, first with headset HDE-1 connected to the bottom connector, and second with the headset HDC-5 connected to the TTY connector on the side of the phone. The GMLNHP-2AX can be positioned into CSL-21 in one way only, with the integral antenna pointing away from users body. When the phone is placed in the carrying case, the whip antenna cannot be extended.

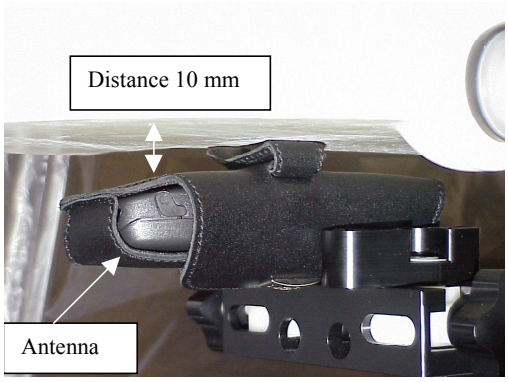


Figure 6 GMLNHP-2AX in Carrying Case CSL-21.

5.2 Scan Procedure

First coarse scans are used for quick determination of the field distribution. Next a cube scan, 7x7x7 with a spacing of 5 mm between each scan point, is performed to determine the averaged SAR-distribution for 1g and 10g.

5.3 SAR averaging methods

The maximum SAR value is averaged over the volume using interpolation and extrapolation.

The interpolation of the points is done with a 3d-Spline. The 3d-Spline is composed of three one-dimensional splines with the "Not a knot" –condition [W. Gander, Computermathematik, p. 141-150] (x,y and z –directions) [Numerical Recipes in C, Second Edition, p 123ff].

The extrapolation is based on least square algoritm [W. Gander, Computermathematik, p.168-180]. Through the points in the first 3cm in all z-axis, polynomials of order four are calculated. This polynomial is then used to evaluate the points between the surface and the probe tip. The points, calculated from the surface, have a distance of 1mm from one another.

6. MEASUREMENT UNCERTAINTY

6.1 Description of individual measurement uncertainty

Uncertainty description	Error	Distrib.	Weight	Std. Dev.
- axial isotropy	± 0.2 dB	U-shape	0.5	± 2.4%
- spherical isotropy	± 0.4 dB	U-shape	0.5	± 4.8%
- Spatial resolution	± 0.5 dB	Normal	1	± 0.5%
- Linearity error	± 0.2 dB	Rectang.	1	± 2.7%
- Calibration error	± 3.3%	Normal	1	± 3.3%
Total Probe Uncertainty				± **6.87%**
- Data acquisition error	± 1%	Rectang.	1	± 0.6%
- ELF and RF disturbances	± 0.25%	Normal	1	± 0.25%
- Conductivity assessment	± 10%	Rectang.	1	± 5.8%
Total SAR Evaluation Uncertainty				± **5.84%**
- Extrapol + boundary effect	± 3%	Normal	1	± 3%
- Probe positioning error	± 0.1mm	Normal	1	± 1%
- Integrat and cube orient	± 3%	Normal	1	± 3%
- Cube shape inaccuracies	± 2%	Rectang.	1	± 1.2%
Total Spatial Peak SAR Evaluation Uncertainty				± **4.52%**
Total Measurement Uncertainty				± **10.09%**

6.2 Source Uncertainty

Uncertainty description	Error	Distrib.	Weight	Std. Dev.
- Device positioning	± 6%	Normal	1	± 6%
- Laboratory set up	± 3%	Normal	1	± 3%
Total Source Uncertainty				± **6.71%**

6.3 Estimation of the total measurement uncertainty

Uncertainty description	Uncertainty
- Total Measurement Uncertainty	± 10.09%
- Total Source Uncertainty	± 6.71%
Combined Uncertainty	**± 12.11%**
Expanded Uncertainty (k=2) 95.5%	**± 24.23%**

7. RESULTS

7.1 AMPS

Position		AMPS		
		Channel		
		991	384	799
		Power [dBm]		
		25.8	25.7	25.8
Touch, left hand	Antenna in	1.01	1.05	0.899
Touch, left hand	Antenna out	1.09	1.17	1.05
Tilted, left hand	Antenna in	0.765	0.843	0.691
Tilted, left hand	Antenna out	0.923	0.934	0.787
Touch, right hand	Antenna in	**1.20**	1.15	0.996
Touch, right hand	Antenna out	1.04	1.05	0.967
Tilted, right hand	Antenna in	0.817	0.795	0.684
Tilted, right hand	Antenna out	0.787	0.815	0.690
Body, HDE-1	Pos, 1	0.314	0.247	0.179
Body, HDC-5	Pos, 2	0.333	0.219	0.172

7.2 CDMA

Position		CDMA		
		Channel		
		1013	384	777
		Power [dBm]		
		25.4	25.5	25.8
Touch, left hand	Antenna in	0.995	1.03	0.912
Touch, left hand	Antenna out	1.09	1.14	1.09
Tilted, left hand	Antenna in	0.753	0.772	0.708
Tilted, left hand	Antenna out	0.856	0.924	0.834
Touch, right hand	Antenna in	1.15	1.17	1.06
Touch, right hand	Antenna out	1.00	1.07	0.957
Tilted, right hand	Antenna in	0.789	0.787	0.669
Tilted, right hand	Antenna out	0.760	0.764	0.655
Body, HDE-1	Pos. 1	**0.363**	0.218	0.209
Body, HDC-5	Pos. 2	0.319	0.206	0.177

7.3 CDMA PCS

Position		CDMA PCS		
		Channel		
		25	600	1175
		Power [dBm]		
		24.0	24.0	24.0
Touch, left hand	Antenna in	0.735	0.633	0.526
Touch, left hand	Antenna out	0.745	0.606	0.467
Tilted, left hand	Antenna in	0.730	0.631	0.532
Tilted, left hand	Antenna out	0.672	0.578	0.472
Touch, right hand	Antenna in	0.744	0.594	0.499
Touch, right hand	Antenna out	0.688	0.557	0.448
Tilted, right hand	Antenna in	0.736	0.601	0.478
Tilted, right hand	Antenna out	0.640	0.490	0.394
Body, HDE-1	Pos. 1	0.216	0.171	0.149
Body, HDC-5	Pos. 2	0.227	0.173	0.121

8. LIST OF INSTRUMENTS

Equipment no	Equipment	Type	Serial no	Manufacturer	Last week	Last year	Next week	Next year	Calibration lab
13172	Power Supply 15V DC 4 A	PL154	043068	Thurlby&Thandar					
13393	RF Amplifier 10-2.4GHz	ZHL-42W	D091395-1	Mini-Circuits					
14509	Double Ridged Horn Antenna	BBHA9120-LF	BBHA 9120 LF-A/105	Schwarzbech Mess El.	27	98			Schwarzbech
14824	Vector Signal Generator	SMIQ03B	826046/034	Rohde&Schwarz	33	2000	33	2003	R&S
14867	Digital Weight 0-3100g 0,01g	BP3100S	81006038	Sartorius					
15001	Digital Radio Comm. Tester	CTS55	828273/014	Rohde&Schwarz					
15199	Industrial Robot f SAR	RX90L	598299-01	Stäubli					
15200	Robot Controller Unit	Dasy3	---------- -	Stäubli					
15201	Phantom	Generic Twin Phantom V3.0	---------- -	Schmid&Partner					
15202	Phantom	Generic Twin Phantom V3.0	---------- -	Schmid&Partner					
17737	SCC-34/SC-2 Phantom	Generic Twin Phantom V4.0	---------- -	Schmid&Partner					
15203	Phone Test Fixture f Test	---------- -	---------- -	Stäubli					
15204	Dipole Antenna 900MHz SMA	D900V2	033	Schmid&Partner	29	2000	29	2002	Schmid&Partner
15205	Dipole Antenna 1800MHz SMA	D1800V2	230	Schmid&Partner	29	2000	29	2002	Schmid&Partner
15206	Dummy Probe f SAR	---------- -	---------- -	Schmid&Partner					
15207	Probe f SAR Measurements	ET3DV5	1345	Schmid&Partner	34	2001	34	2002	Schmid&Partner
15208	Probe f SAR Measurements	ET3DV5	1344	Schmid&Partner	34	2001	34	2002	Schmid&Partner
15209	Dielectric Probe Kit	HP85070B	US33020403	Hewlett Packard					
15319	Closed Torso Manneguin V2.0	V2,0	---------- -	Schmid&Partner					
15859	Digital Radio Communication	4201S	0113217	Wavetek					
15883	RF Shielded Box	248390	LX658054	Wavetek					
16744	Dosimetric Assessment	DAE3V1	339	Schmid&Partner	34	2001	34	2002	Schmid&Partner
17266	RF S-Parameter Network	AT8753ES	MY40001091	Agilent Technologies	7	2001	7	2002	AT Factory
17555	Dosimetric Assessment	DAE3V1	435	Schmid&Partner	46	2001	46	2002	Scmid & Partner
17556	Dosimetric E-Field Probe f	ET3DV6R	1429	Schmid&Partner	36	2001	36	2002	Schmid&Partner