7 APPENDIX B - E-FIELD PROBE CALIBRATION DATA

[X] See Separate Attachment
[ ] See Below

Schmid & Partner
Engineering AG

Staffelstrasse 8, 8045 Zurich, Switzerland, Telefon +41 1 280 06 60, Fax +41 1 280 08 64

Probe ET3DV5

SN:1333

Manufactured:	December 1997
Calibrated:	January 1998
Recalibrated:	March 1999

Calibrated for System DASY3

Introduction

The performance of all probes is measured before delivery. This includes an assessment of the characteristic parameters, receiving patterns as a function of frequency, frequency response and relative accuracy. Furthermore, each probe is tested in use according to a dosimetric assessment protocol. The sensitivity parameters (NormX, NormY, NormZ), the diode compresion parameter (DCP) and the conversion factor (ConvF) of the probe and some of the measurement diagrams are given in the following.

The performance of the individual probes varies slightly due to tolerances arising from the manufacturing process. Since the lines are highly resistive (several MOhms), the offset and noise problem is greatly increased if signals in the low µV range are measured. Accurate measurement below 10 µW/g are possible if the following precautions are taken. 1) check the current grounding with the *multimeter*[1], i.e., low noise levels, 2) compensate the current *offset*[1], 3) use long integration time (approx 10 seconds), 4) *calibrate*[1] before each measurement, 5) persons should avoid moving around the lab while measuring.

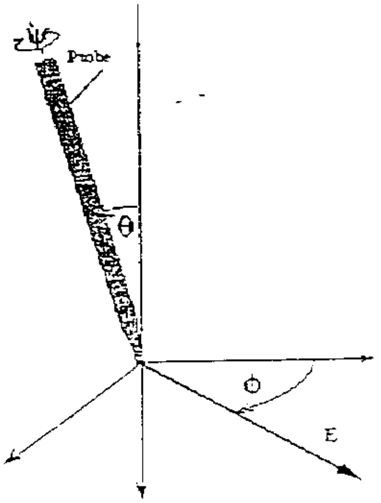


Fig 1: Due to the field distortion caused by the supporting material, the probe has two characteristic directions, referred to as angle ψ and θ.

Since the field distortion caused by the supporting material and the sheath is quite high in the θ direction, the receiving pattern is poor in air. However, the distortion in tissue equivalent material is much less because of its high dielectricity. In addition, the fields induced in the phantoms by dipole structures close to the body are dominently parallel to the surface. Thus, the error due to non-isotropy is much better than 1 dB for dosimetric assessments.

The probes are calibrated in the TEM cell ifi 110 although the field distribution in the cell is not very uniform and the frequency response is not very flat. To ensure consistency, a strict protocol is followed. The conversion factor (ConF) between this calibration and the measurement in the tissue simulation solution is performed by comparison with temperature measurements and computer simulations. This conversion factor is only valid for the specified tissue simulating liquids at the specified frequencies. If measurements have to be performed in solutions with other electrical properties or at other frequencies, the conversion factor has to be assessed by the same procedure.

As the probes have been constructed with printed resistive lines on ceramic substrates (thick film technique), the probe is very delicate with respect to mechanical shocks.

Attention:

Do not drop the probe or let the probe collide with any solid object. Never let the robot move without first activating the emergency stop feature (i.e., without first turning the data acquisition electronics on).

[1] Feature of the DASY Software Tool.

DASY3 - Parameters of Probe: ET3DV5 SN:1333

Sensitivity in Free Space

NormX	2.34	$\mu V/(V/m)^2$
NormY	2.3	$\mu V/(V/m)^2$
NormZ	2.3	$\mu V/(V/m)^2$

Diode Compression

DCP X	100	mV
DCP Y	100	mV
DCP Z	100	mV

Sensitivity in Tissue Simulating Liquid

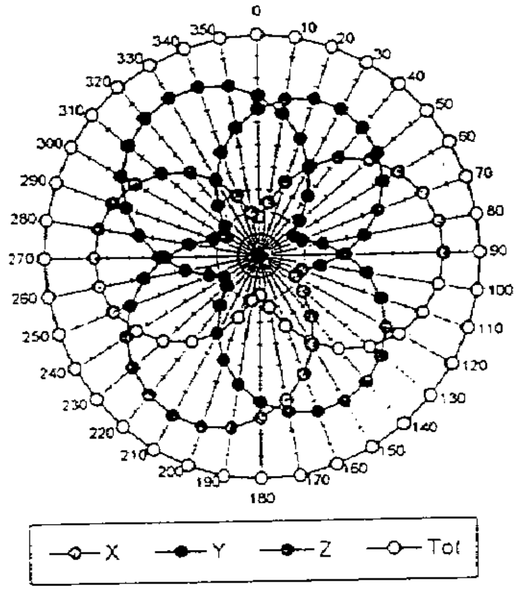
450 MHz	ConvF X	6.38	extrapolated	ε_r =	48 ± 5%
	ConvF Y	6.38	extrapolated	σ =	0.50 ± 10% mho/m
	ConvF Z	6.38	extrapolated	(brain tissue simulating liquid)	
900 MHz	ConvF X	6.03	± 10%	ε_r =	42.5 ± 5%
	ConvF Y	6.03	± 10%	σ =	0.86 ± 10% mho/m
	ConvF Z	6.03	± 10%	(brain tissue simulating liquid)	
1500 MHz	ConvF X	5.55	interpolated	ε_r =	41 ± 5%
	ConvF Y	5.55	interpolated	σ =	1.32 ± 10% mho/m
	ConvF Z	5.55	interpolated	(brain tissue simulating liquid)	
1800 MHz	ConvF X	5.31	± 10%	ε_r =	41 ± 5%
	ConvF Y	5.31	± 10%	σ =	1.69 ± 10% mho/m
	ConvF Z	5.31	± 10%	(brain tissue simulating liquid)	

Sensor Offset

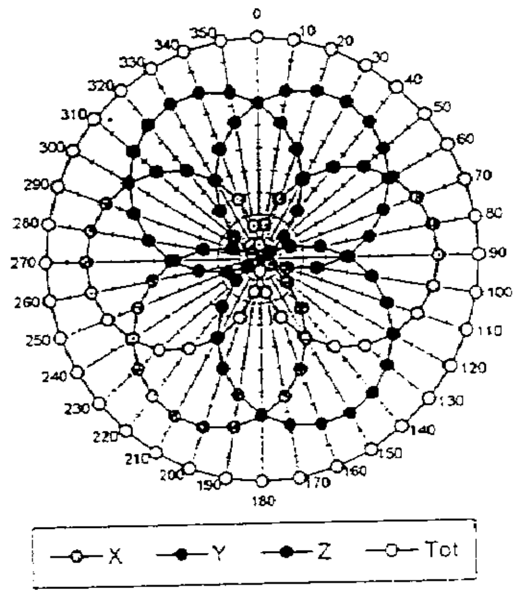
Probe Tip to Sensor Center	2.7	mm
Surface to Probe Tip	1.7 ± 0.2	mm

Receiving Pattern (ϕ), $\theta = 0°$

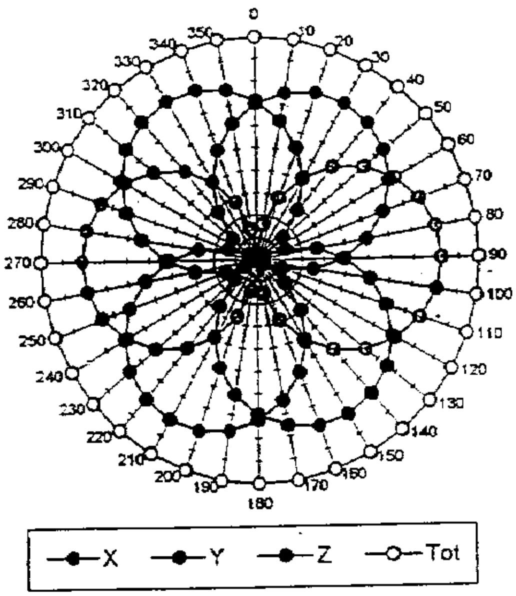
f = 30 MHz, TEM cell ifi110



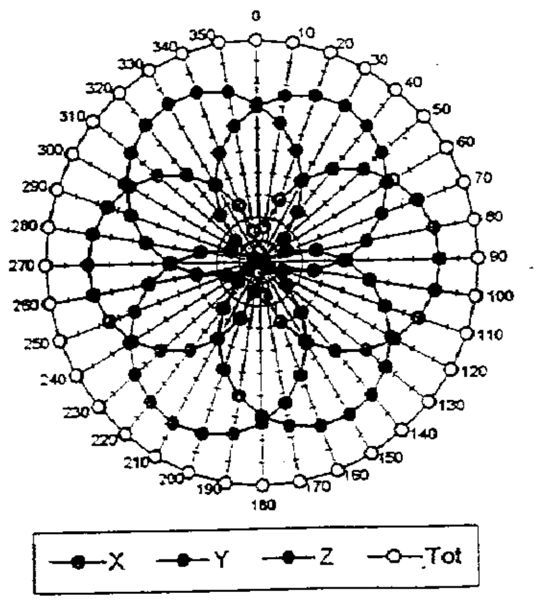
f = 100 MHz, TEM cell ifi110

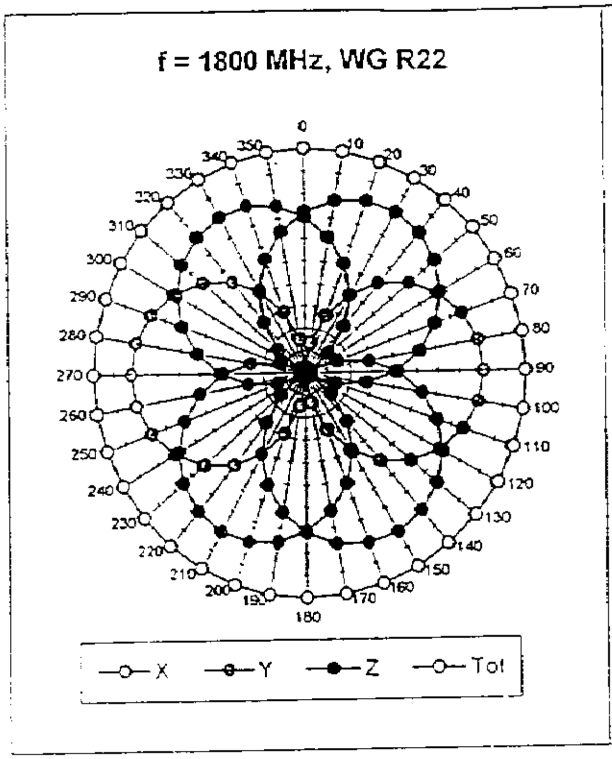


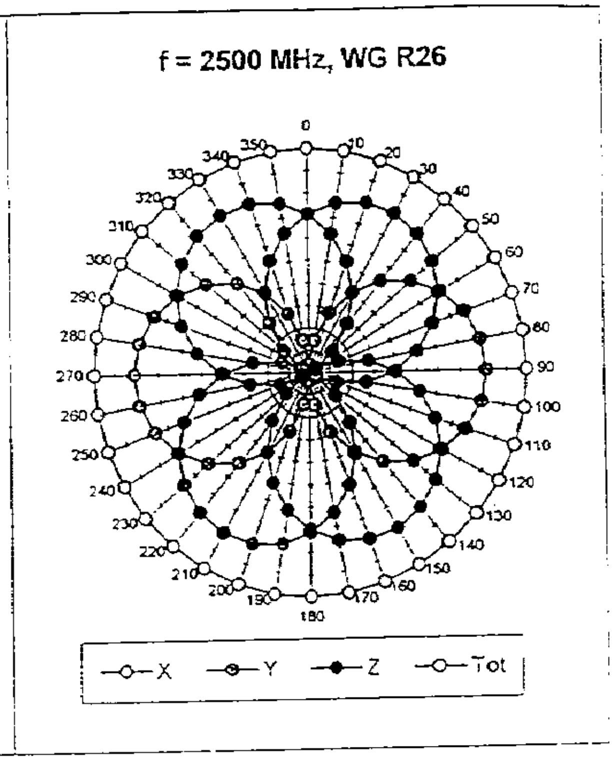
f = 300 MHz, TEM cell ifi110



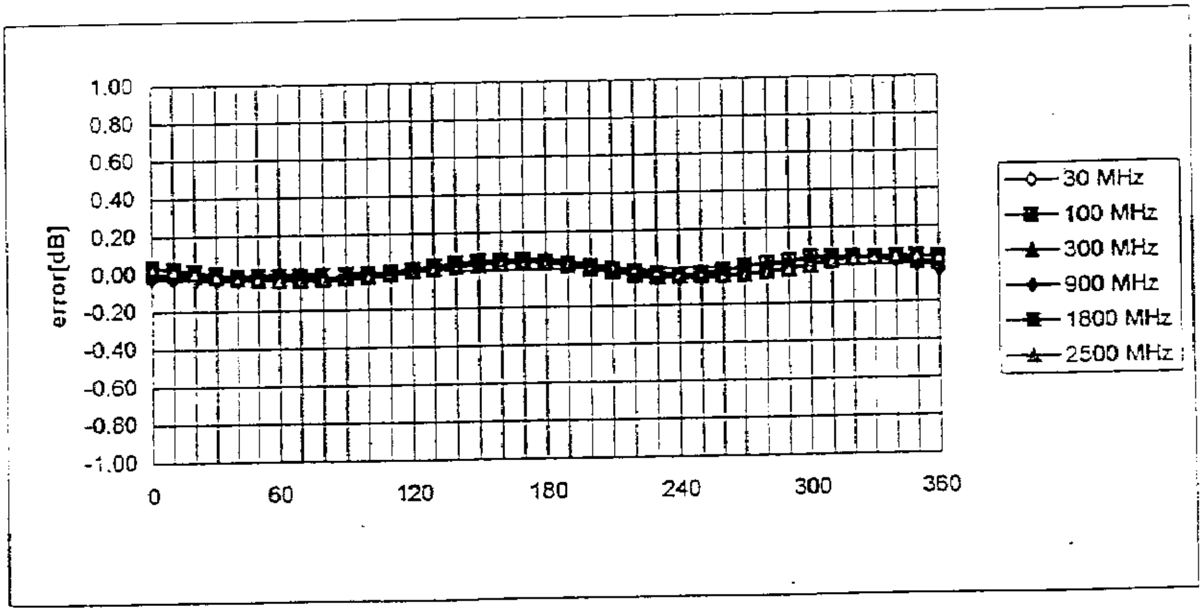
f = 900 MHz, TEM cell ifi110





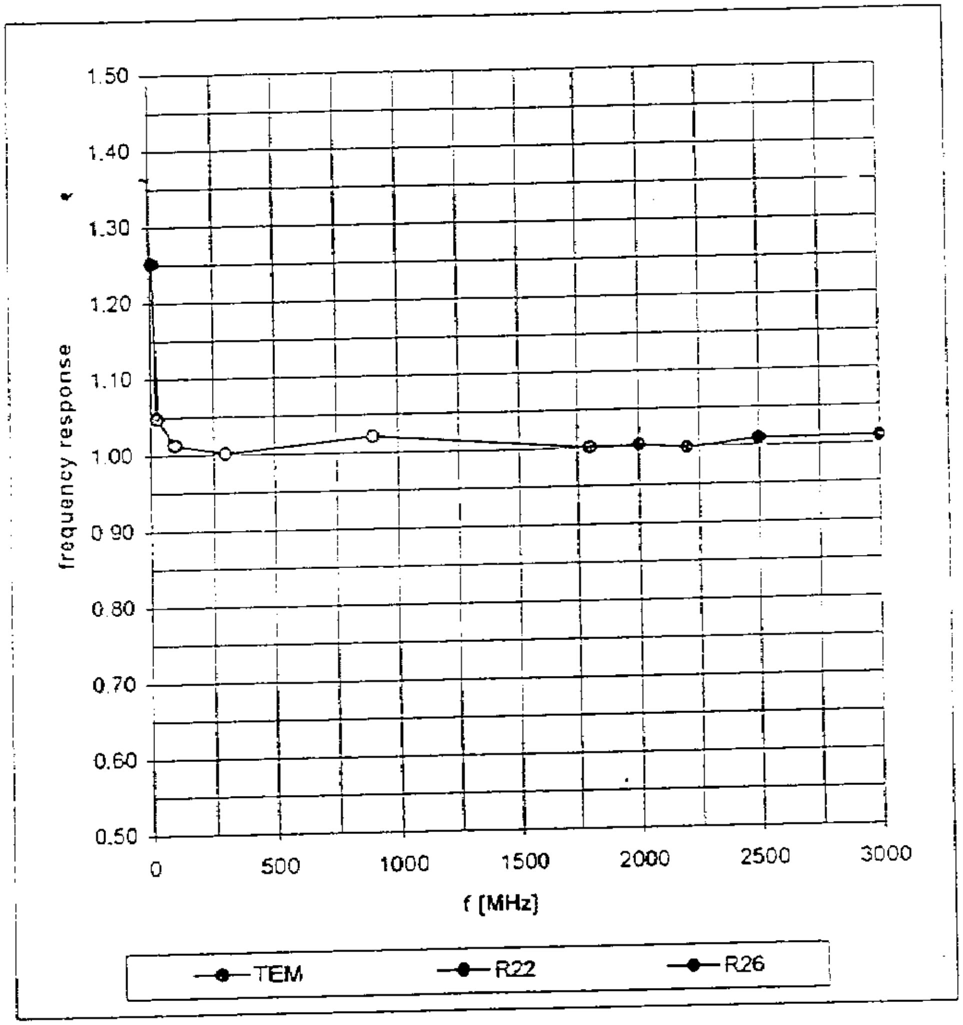


Isotropy Error (ϕ), $\theta = 0°$



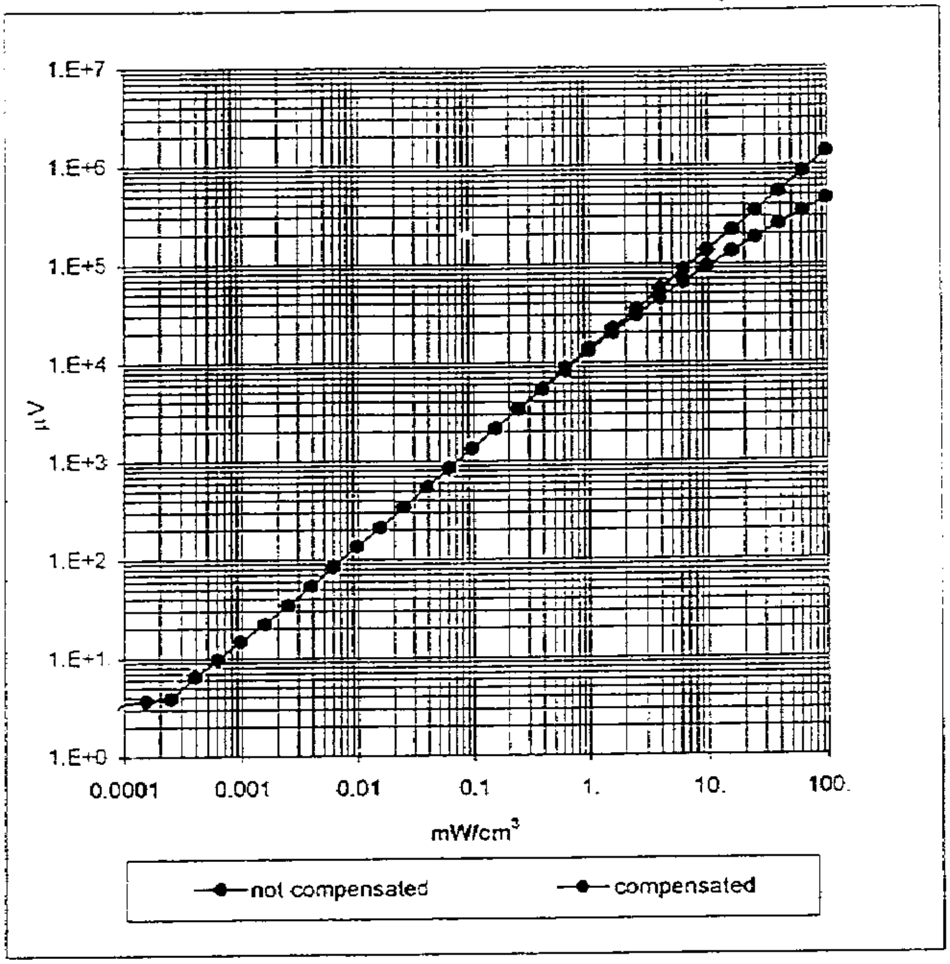
Frequency Response of E-Field

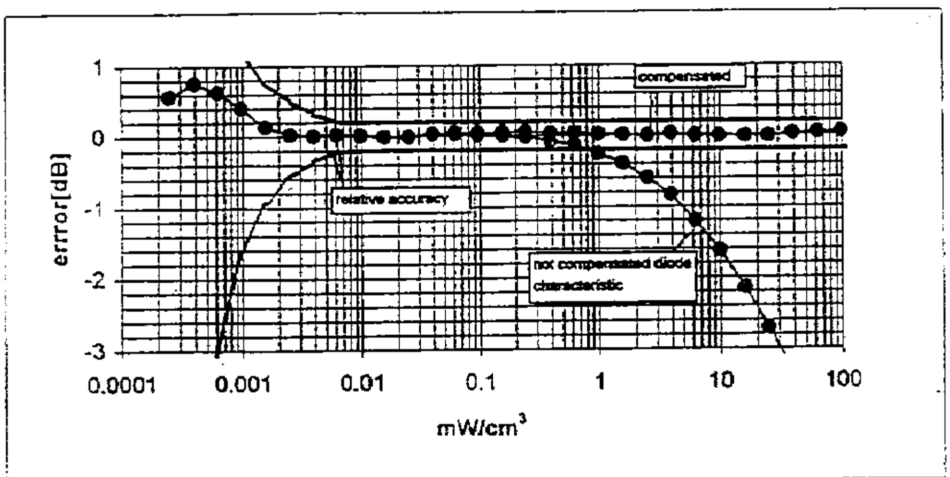
(TEM-Cell:ifi110, Waveguide R22, R26)



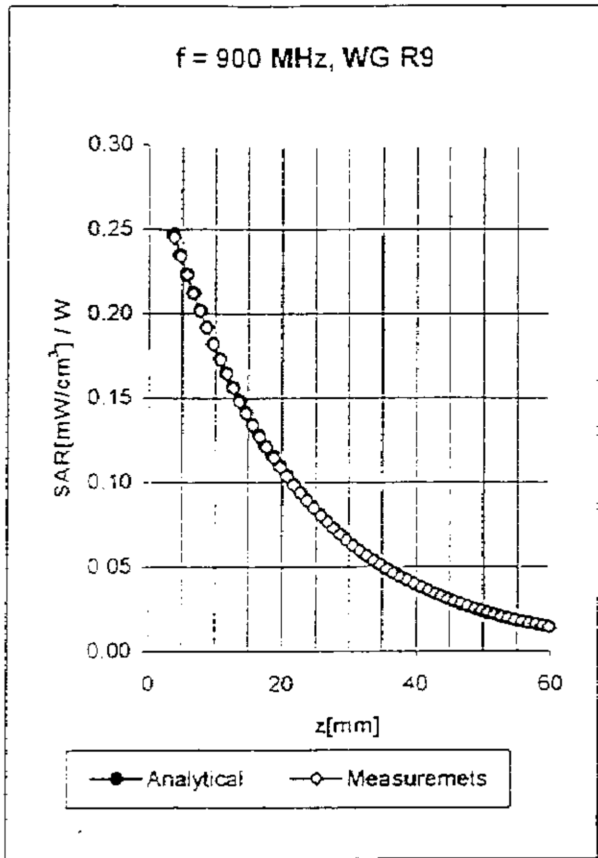
Dynamic Range f(SAR_{brain})

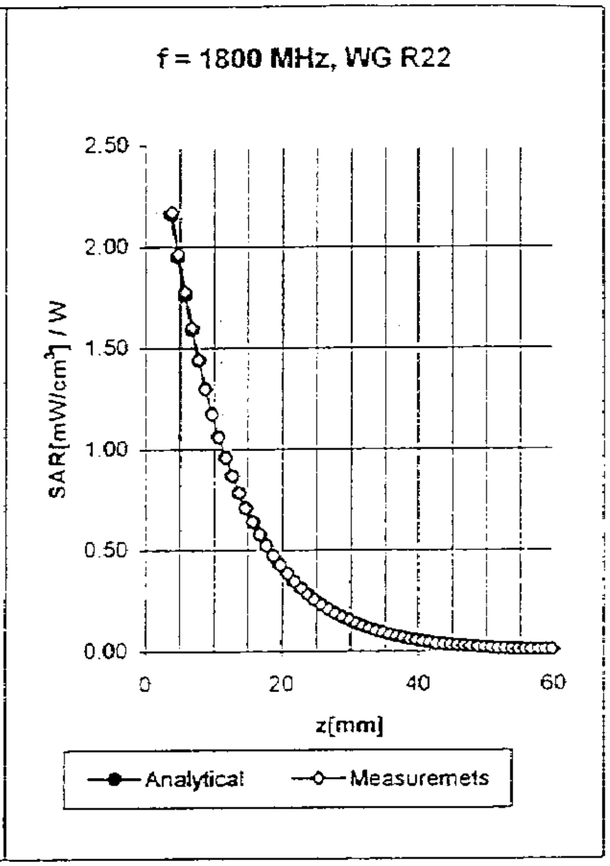
(TEM-Cell:ifi110)





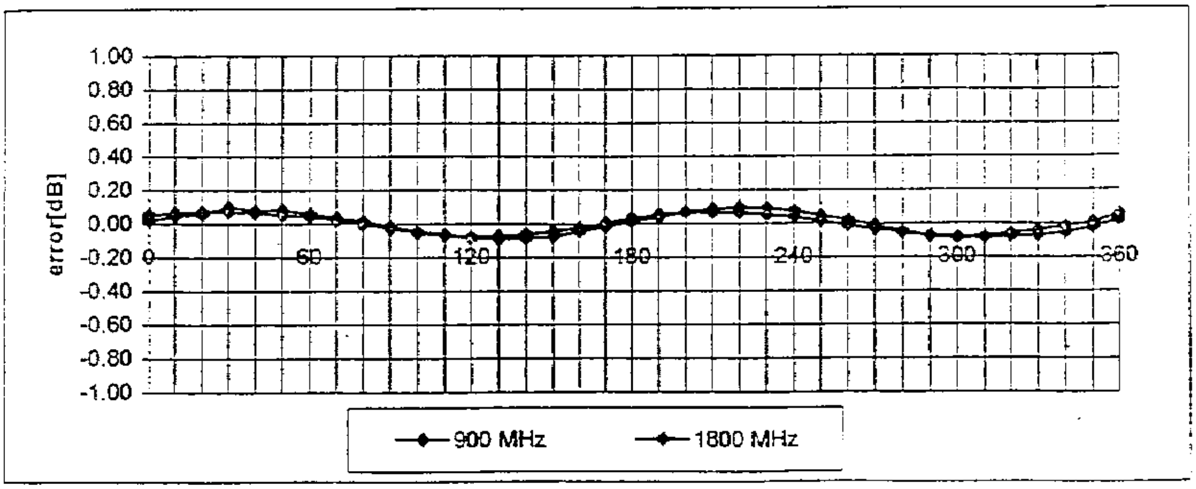
Conversion Factor Assessment





Receiving Pattern (ϕ)

(in brain tissue, z = 5 mm)



8 APPENDIX C - TECHNICAL JUSTIFICATION FROM MANUFACTURER

[X] See separate attachment

GLENAYRE™

Wireless Products
2101 Tasman Drive
Santa Clara, CA 95054 USA
tel 408-653-1555
fax 408-567-1069

Description of the @ctivelink Antenna

The @ctivelink wireless messaging module has an internal antenna only. There is no external antenna, nor any external cable for an external antenna connection. The internal antenna is a resonant monofilar normal-mode helical antenna. The helical antenna is constructed with a copper wire mounted on a molded plastic core. The helical antenna is attached perpendicular to the RF assembly located at the top of the module and positioned a few millimeters inside the plastic. The antenna ground is the electrical ground of the RF Printed Circuit Board. There are no requirements for the module to have an external ground attached to it for its antenna to operate.

GLENAYRE™

Wireless Products
2101 Tasman Drive
Santa Clara, CA 95054 USA
tel 408-653-1555
fax 408-567-1069

Description of the Duty Cycle for the @ctivelink Wireless Messaging Module

The worst case duty cycle for the @ctivelink module transmitter occurs on a collapse of 1 when it is sending messages from the module to the infrastructure. For this calculation, assume infinite messages are queued in the module, each message is the maximum length allowed (2000 characters), and the back channel is running at its slowest speed (800 bps).

The ReFLEX protocol is timed on frames, each of which is 1.875 seconds long. The sequence for transmitting a message from the module is shown in the following table. Also shown are transmitter on times and elapsed time.

Frame	Event	Transmitter on time	Elapsed time
1	Module signals request to transmit to system	0.1705	1.875
2	Request goes to system controller and is scheduled	0	1.875
3	Unusable frame	0	1.875
4	Grant for data unit is sent to Module	0	1.875
5	Module sends first data unit (100 characters) to system	1.875	1.875
6	Data unit goes to system controller and next data unit is scheduled	0	1.875
7	Unusable frame	0	1.875
8	Grant for next data unit is sent to Module	0	1.875
9	Module sends data unit to system	1.875	1.875
10-81	steps 6-9 repeat unit entire message is transmitted (18 more data units for a total of 20)	18 X 1.875	72 X 1.875
82	Last data unit goes to system controller and end of transmission is scheduled	0	1.875
83	Unusable frame	0	1.875
84	End of transmission is sent to module	0	1.875
85	Ack to end of transmission is transmitted from module to system	0.1705	1.875
	Totals	37.841 seconds	159.375 seconds

Thus, the maximum duty cycle for the @ctivelink is 37.841/ 159.375 = 23.74 %

Note this is not achievable in a real system due to delays in computing and traffic delays, and is only a theoretical maximum based on the protocol.