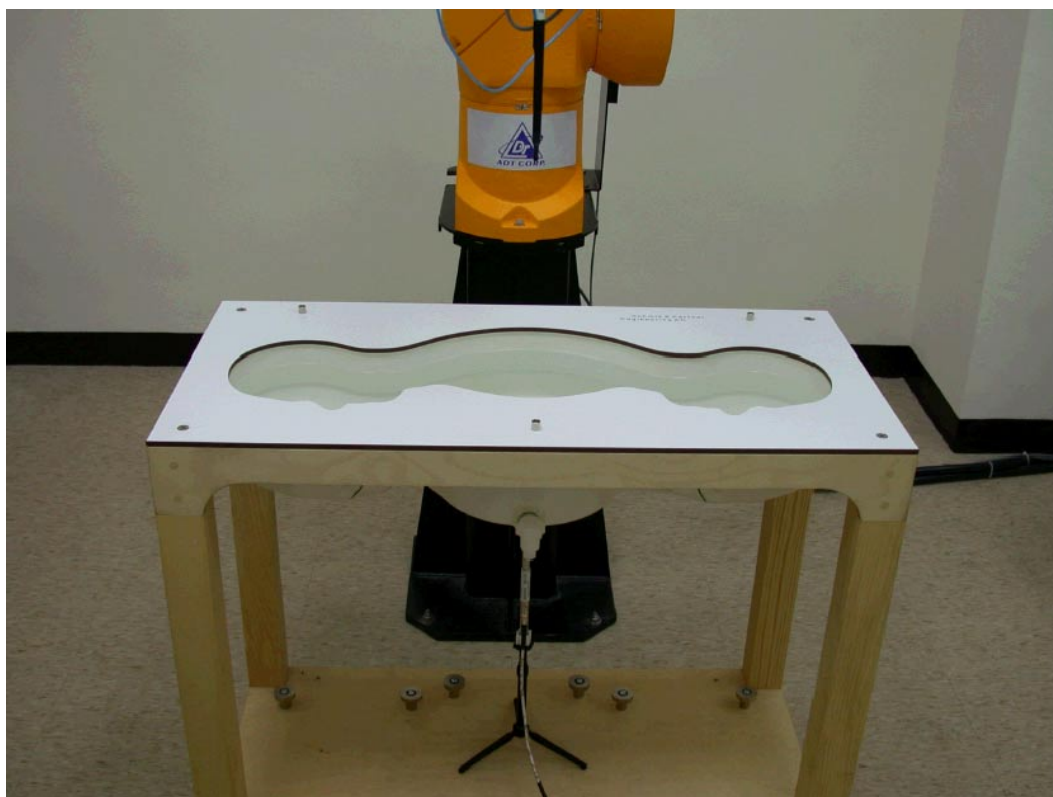


## APPENDIX B: ADT SAR MEASUREMENT SYSTEM



## APPENDIX C: PHOTOGRAPHS OF SYSTEM VALIDATION





## **APPENDIX D: SYSTEM CERTIFICATE & CALIBRATION**

### **D1: SAM PHANTOM**

# Schmid & Partner Engineering AG

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## Certificate of conformity / First Article Inspection

|                       |                                                                          |
|-----------------------|--------------------------------------------------------------------------|
| Item                  | SAM Twin Phantom V4.0                                                    |
| Type No               | QD 000 P40 CA                                                            |
| Series No             | TP-1150 and higher                                                       |
| Manufacturer / Origin | Untersee Composites<br>Hauptstr. 69<br>CH-8559 Fruthwilen<br>Switzerland |

### Tests

The series production process used allows the limitation to test of first articles. Complete tests were made on the pre-series Type No. QD 000 P40 AA, Serial No. TP-1001 and on the series first article Type No. QD 000 P40 BA, Serial No. TP-1006. Certain parameters have been retested using further series units (called samples).

| Test                 | Requirement                                                                             | Details                                                              | Units tested              |
|----------------------|-----------------------------------------------------------------------------------------|----------------------------------------------------------------------|---------------------------|
| Shape                | Compliance with the geometry according to the CAD model.                                | IT'IS CAD File (*)                                                   | First article, Samples    |
| Material thickness   | Compliant with the requirements according to the standards                              | 2mm +/- 0.2mm in specific areas                                      | First article, Samples    |
| Material parameters  | Dielectric parameters for required frequencies                                          | 200 MHz – 3 GHz<br>Relative permittivity < 5<br>Loss tangent < 0.05. | Material sample TP 104-5  |
| Material resistivity | The material has been tested to be compatible with the liquids defined in the standards | Liquid type HSL 1800 and others according to the standard.           | Pre-series, First article |

### Standards

- [1] CENELEC EN 50361
- [2] IEEE P1528-200x draft 6.5
- [3] IEC PT 62209 draft 0.9

(\*) The IT'IS CAD file is derived from [2] and is also within the tolerance requirements of the shapes of [1] and [3].

### Conformity

Based on the sample tests above, we certify that this item is in compliance with the uncertainty requirements of SAR measurements specified in standard [1] and draft standards [2] and [3].

Date 28.02.2002

Signature / Stamp

*F. Bombault*

**Schmid & Partner  
Engineering AG**

Zeughausstrasse 43, CH-8004 Zurich  
Tel. +41 1 245 97 00, Fax +41 1 245 97 79

*Thomas Kofe*



## **D2: 2450MHZ SYSTEM VALIDATION DIPOLE**

Client Auden > Chunghwa Telecom

## CALIBRATION CERTIFICATE

Object(s) D2450V2 - SN:737

Calibration procedure(s) QA CAL-05.v2  
Calibration procedure for dipole validation kits

Calibration date: August 27, 2003

Condition of the calibrated item In Tolerance (according to the specific calibration document)

This calibration statement documents traceability of M&TE used in the calibration procedures and conformity of the procedures with the ISO/IEC 17025 international standard.

All calibrations have been conducted in the closed laboratory facility: environment temperature 22 +/- 2 degrees Celsius and humidity < 75%.

Calibration Equipment used (M&TE critical for calibration)

| Model Type                | ID #       | Cal Date (Calibrated by, Certificate No.) | Scheduled Calibration  |
|---------------------------|------------|-------------------------------------------|------------------------|
| RF generator R&S SML-03   | 100698     | 27-Mar-2002 (R&S, No. 20-92389)           | In house check: Mar-05 |
| Power sensor HP 8481A     | MY41092317 | 18-Oct-02 (Agilent, No. 20021018)         | Oct-04                 |
| Power sensor HP 8481A     | US37292783 | 30-Oct-02 (METAS, No. 252-0236)           | Oct-03                 |
| Power meter EPM E442      | GB37480704 | 30-Oct-02 (METAS, No. 252-0236)           | Oct-03                 |
| Network Analyzer HP 8753E | US37390585 | 18-Oct-01 (Agilent, No. 24BR1033101)      | In house check: Oct 03 |

|                | Name           | Function            | Signature                                                                             |
|----------------|----------------|---------------------|---------------------------------------------------------------------------------------|
| Calibrated by: | Judith Mueller | Technician          |  |
| Approved by:   | Katja Pokovic  | Laboratory Director |  |

Date issued: August 28, 2003

This calibration certificate is issued as an intermediate solution until the accreditation process (based on ISO/IEC 17025 International Standard) for Calibration Laboratory of Schmid & Partner Engineering AG is completed.

# DASY

## Dipole Validation Kit

Type: D2450V2

Serial: 737

Manufactured: August 26, 2003

Calibrated: August 27, 2003

## **1. Measurement Conditions**

The measurements were performed in the flat section of the SAM twin phantom filled with **head simulating solution** of the following electrical parameters at 2450 MHz:

|                        |                   |           |
|------------------------|-------------------|-----------|
| Relative Dielectricity | <b>38.2</b>       | $\pm 5\%$ |
| Conductivity           | <b>1.89 mho/m</b> | $\pm 5\%$ |

The DASY4 System with a dosimetric E-field probe ES3DV2 (SN:3013, Conversion factor 4.8 at 2450 MHz) was used for the measurements.

The dipole was mounted on the small tripod so that the dipole feedpoint was positioned below the center marking of the flat phantom section and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 10mm from dipole center to the solution surface. Lossless spacer was used during measurements for accurate distance positioning.

The coarse grid with a grid spacing of 15mm was aligned with the dipole. The 7x7x7 fine cube was chosen for cube integration.

The dipole input power (forward power) was  $250\text{mW} \pm 3\%$ . The results are normalized to 1W input power.

## **2. SAR Measurement with DASY4 System**

Standard SAR-measurements were performed according to the measurement conditions described in section 1. The results (see figure supplied) have been normalized to a dipole input power of 1W (forward power). The resulting averaged SAR-values measured with the dosimetric probe ES3DV2 SN:3013 and applying the advanced extrapolation are:

|                                                  |                                                            |
|--------------------------------------------------|------------------------------------------------------------|
| averaged over $1\text{ cm}^3$ (1 g) of tissue:   | <b>55.2 mW/g <math>\pm 16.8\%</math> (k=2)<sup>1</sup></b> |
| averaged over $10\text{ cm}^3$ (10 g) of tissue: | <b>24.8 mW/g <math>\pm 16.2\%</math> (k=2)<sup>1</sup></b> |

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<sup>1</sup> validation uncertainty

### 3. Dipole Impedance and Return Loss

The impedance was measured at the SMA-connector with a network analyzer and numerically transformed to the dipole feedpoint. The transformation parameters from the SMA-connector to the dipole feedpoint are:

|                      |                 |                                       |
|----------------------|-----------------|---------------------------------------|
| Electrical delay:    | <b>1.162 ns</b> | (one direction)                       |
| Transmission factor: | <b>0.983</b>    | (voltage transmission, one direction) |

The dipole was positioned at the flat phantom sections according to section 1 and the distance spacer was in place during impedance measurements.

|                                  |                                          |
|----------------------------------|------------------------------------------|
| Feedpoint impedance at 2450 MHz: | $\text{Re}\{Z\} = \mathbf{52.5\ \Omega}$ |
|----------------------------------|------------------------------------------|

|  |                                         |
|--|-----------------------------------------|
|  | $\text{Im}\{Z\} = \mathbf{5.4\ \Omega}$ |
|--|-----------------------------------------|

|                         |                 |
|-------------------------|-----------------|
| Return Loss at 2450 MHz | <b>-24.8 dB</b> |
|-------------------------|-----------------|

### 4. Measurement Conditions

The measurements were performed in the flat section of the SAM twin phantom filled with **body simulating solution** of the following electrical parameters at 2450 MHz:

|                        |                   |           |
|------------------------|-------------------|-----------|
| Relative Dielectricity | <b>50.8</b>       | $\pm 5\%$ |
| Conductivity           | <b>2.03 mho/m</b> | $\pm 5\%$ |

The DASY4 System with a dosimetric E-field probe ES3DV2 (SN:3013, Conversion factor 4.2 at 2450 MHz) was used for the measurements.

The dipole was mounted on the small tripod so that the dipole feedpoint was positioned below the center marking of the flat phantom section and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 10mm from dipole center to the solution surface. Lossless spacer was used during measurements for accurate distance positioning.

The coarse grid with a grid spacing of 15mm was aligned with the dipole. The 7x7x7 fine cube was chosen for cube integration.

The dipole input power (forward power) was  $250\text{mW} \pm 3\%$ . The results are normalized to 1W input power.

## **5. SAR Measurement with DASY4 System**

Standard SAR-measurements were performed according to the measurement conditions described in section 4. The results (see figure supplied) have been normalized to a dipole input power of 1W (forward power). The resulting averaged SAR-values measured with the dosimetric probe ES3DV2 SN:3013 and applying the advanced extrapolation are:

averaged over 1 cm<sup>3</sup> (1 g) of tissue:                      **55.2 mW/g ± 16.8 % (k=2)<sup>2</sup>**

averaged over 10 cm<sup>3</sup> (10 g) of tissue:                      **25.4 mW/g ± 16.2 % (k=2)<sup>2</sup>**

## **6. Dipole Impedance and Return Loss**

The dipole was positioned at the flat phantom sections according to section 4 and the distance spacer was in place during impedance measurements.

Feedpoint impedance at 2450 MHz:                      **Re{Z} = 48.5 Ω**

Im {Z} = **6.1 Ω**

Return Loss at 2450 MHz                                      **-23.9 dB**

## **7. Handling**

Do not apply excessive force to the dipole arms, because they might bend. Bending of the dipole arms stresses the soldered connections near the feedpoint leading to a damage of the dipole.

## **8. Design**

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals.

Small end caps have been added to the dipole arms in order to improve matching when loaded according to the position as explained in Sections 1 and 4. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

## **9. Power Test**

After long term use with 40W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

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<sup>2</sup> validation uncertainty

Test Laboratory: SPEAG, Zurich, Switzerland  
 File Name: SN737\_SN3013\_HSL2450\_270803.da4

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN737**  
**Program: Dipole Calibration**

Communication System: CW-2450; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: HSL 2450 MHz ( $\sigma = 1.89$  mho/m,  $\epsilon_r = 38.19$ ,  $\rho = 1000$  kg/m<sup>3</sup>)

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ES3DV2 - SN3013; ConvF(4.8, 4.8, 4.8); Calibrated: 1/19/2003
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 - SN411; Calibrated: 1/16/2003
- Phantom: SAM with CRP - TP1006; Type: SAM 4.0; Serial: TP:1006
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 115

**Pin = 250 mW; d = 10 mm/Area Scan (81x81x1):** Measurement grid: dx=15mm, dy=15mm

Reference Value = 90.7 V/m

Power Drift = -0.07 dB

Maximum value of SAR = 15.2 mW/g

**Pin = 250 mW; d = 10 mm/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

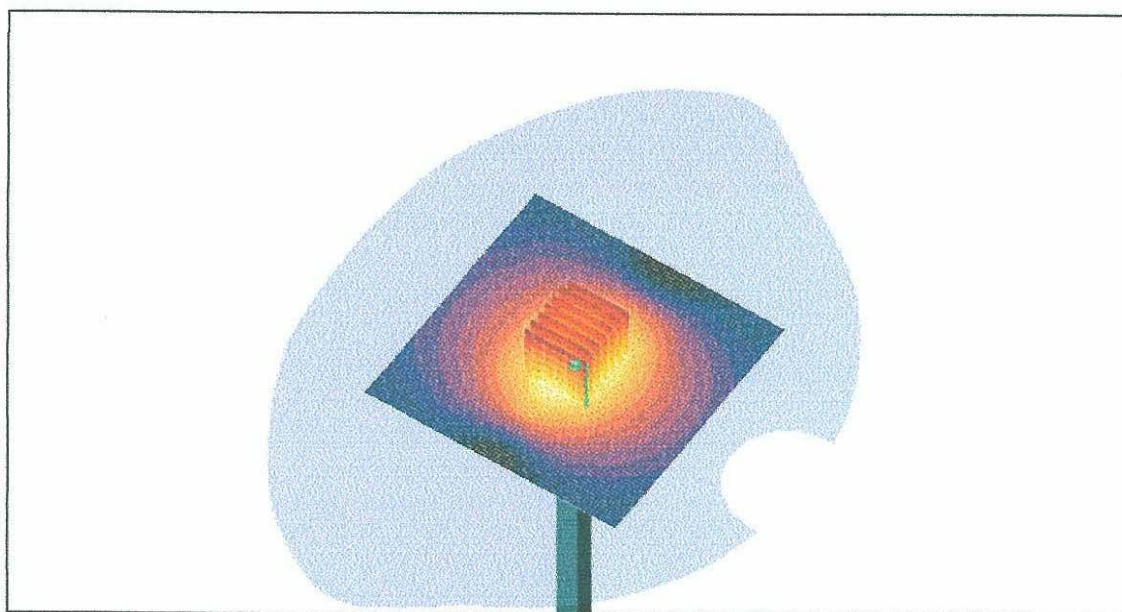
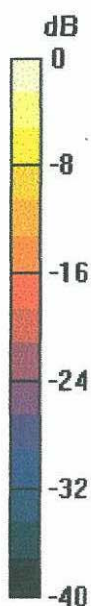
Peak SAR (extrapolated) = 29.6 W/kg

SAR(1 g) = 13.8 mW/g; SAR(10 g) = 6.2 mW/g

Reference Value = 90.7 V/m

Power Drift = -0.07 dB

Maximum value of SAR = 15.1 mW/g



0 dB = 15.1mW/g

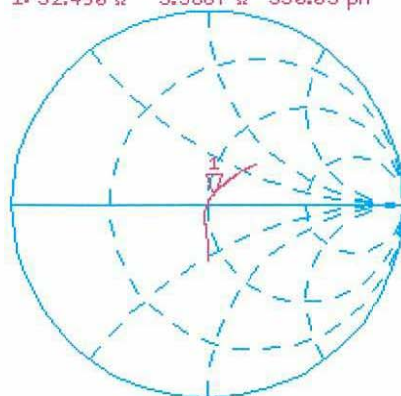
27 Aug 2003 09:59:05  
[CH1] S11 1 U FS 1: 52.490  $\Omega$  5.3887  $\Omega$  350.05  $\mu$ H 2 450.000 000 MHz

De1

Cor

Avg  
16

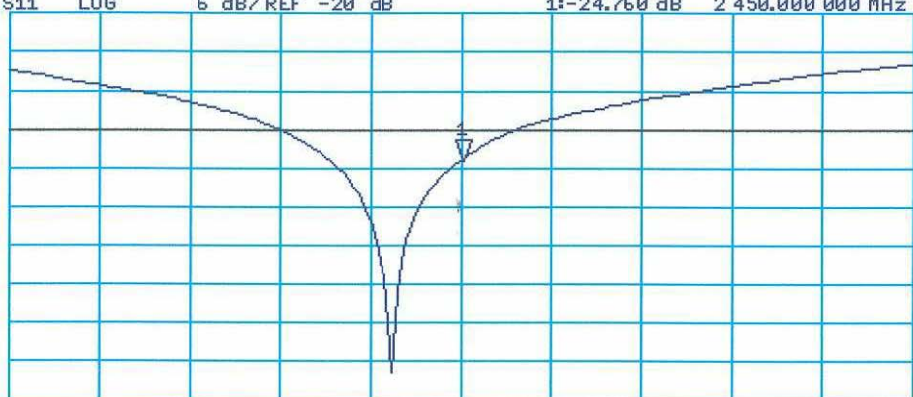
↑



CH2 S11 LOG 6 dB/REF -20 dB 1:-24.760 dB 2 450.000 000 MHz

Cor

↑



CENTER 2 450.000 000 MHz

SPAN 400.000 000 MHz

Test Laboratory: SPEAG, Zurich, Switzerland  
 File Name: SN737\_SN3013\_M2450\_270803.da4

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN737**  
**Program: Dipole Calibration**

Communication System: CW-2450; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium: Muscle 2450 MHz ( $\sigma = 2.03$  mho/m,  $\epsilon_r = 50.75$ ,  $\rho = 1000$  kg/m<sup>3</sup>)

Phantom section: Flat Section

Measurement Standard: DASY4 (High Precision Assessment)

DASY4 Configuration:

- Probe: ES3DV2 - SN3013; ConvF(4.2, 4.2, 4.2); Calibrated: 1/19/2003
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE3 - SN411; Calibrated: 1/16/2003
- Phantom: SAM with CRP - TP1006; Type: SAM 4.0; Serial: TP:1006
- Measurement SW: DASY4, V4.1 Build 47; Postprocessing SW: SEMCAD, V1.6 Build 115

**Pin = 250 mW; d = 10 mm/Area Scan (81x81x1): Measurement grid: dx=15mm, dy=15mm**

Reference Value = 90.4 V/m

Power Drift = -0.03 dB

Maximum value of SAR = 15.7 mW/g

**Pin = 250 mW; d = 10 mm/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm**

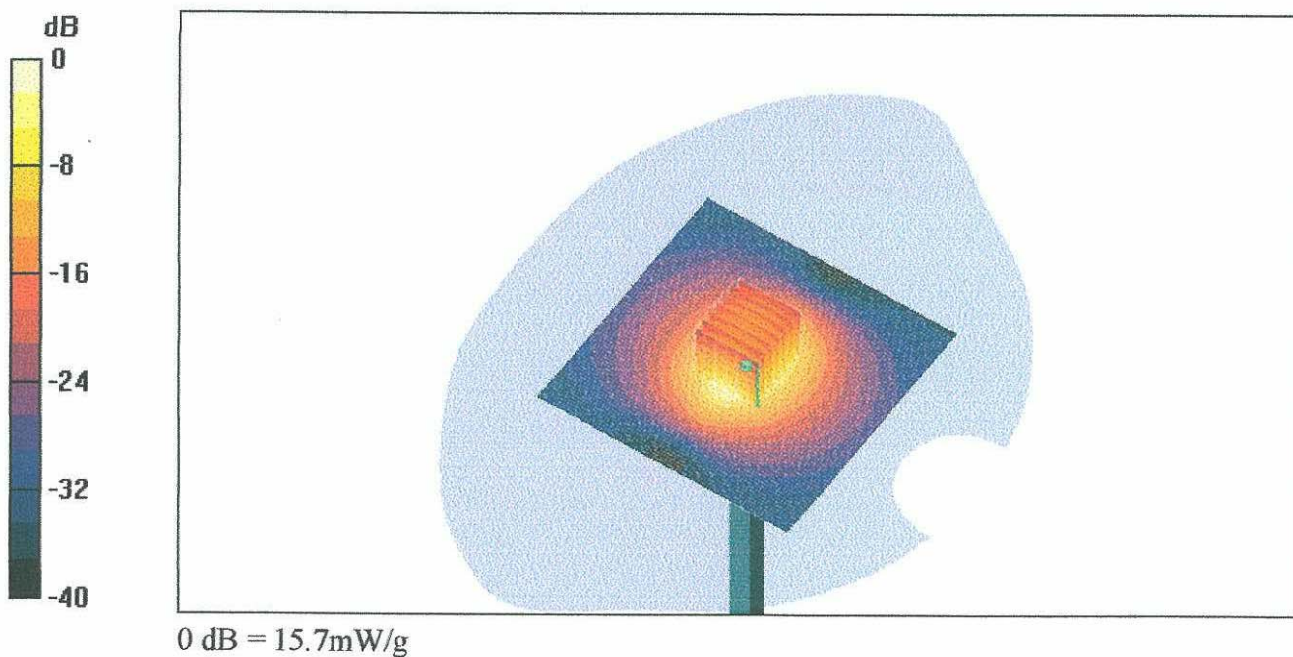
Peak SAR (extrapolated) = 27.3 W/kg

SAR(1 g) = 13.8 mW/g; SAR(10 g) = 6.36 mW/g

Reference Value = 90.4 V/m

Power Drift = -0.03 dB

Maximum value of SAR = 15.7 mW/g



737  
Body

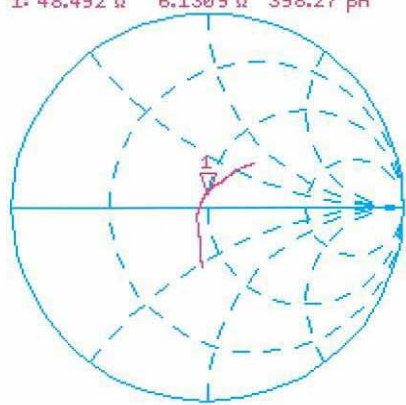
27 Aug 2003 13:31:47  
CH1 S11 1 U FS 1: 48.492  $\Omega$  6.1309  $\Omega$  398.27 pF 2 450.000 000 MHz

De1

Cor

Avg  
15

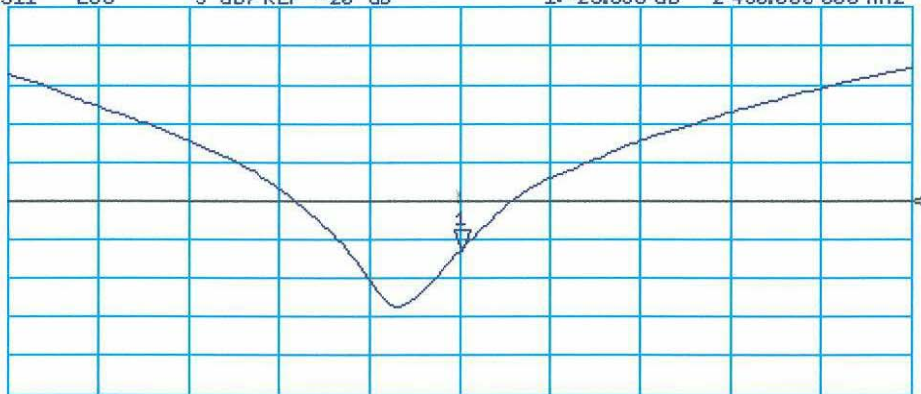
↑



CH2 S11 LOG 3 dB/REF -20 dB 1:-23.855 dB 2 450.000 000 MHz

Cor

↑



CENTER 2 450.000 000 MHz

SPAN 400.000 000 MHz