

# SAR

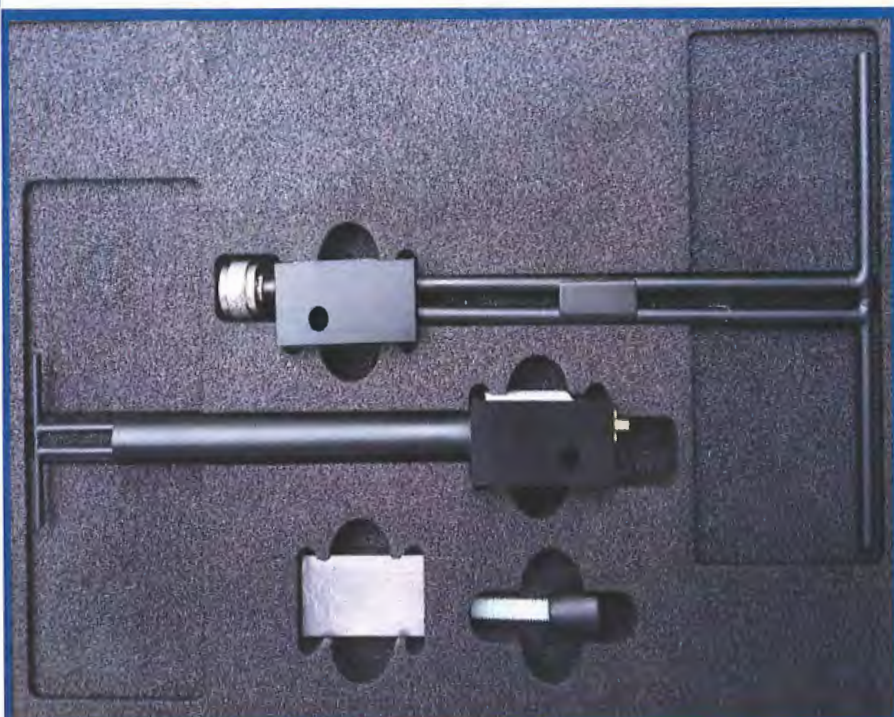
## Dipole & Waveguide

# Performance Measurement Report

ISSUED BY  
Shenzhen BALUN Technology Co., Ltd.



FOR  
Validation Dipoles & Waveguide



Tested by: Zong Liyao  
Zong Liyao  
(Engineer)

Approved by: Liao Jianming  
Liao Jianming  
(Technical Director)

Report No.: LW-SZ2030763  
EUT Type: SAR Validation Dipole and Waveguide  
Model Name: DIP 0G750-446, DIP 0G835-447  
DIP 0G900-448, DIP 1G800-449  
DIP 1G900-450, DIP 2G000-451  
DIP 2G450-452, DIP 2G600-453  
SWG5500-WGA 42

Brand Name: SATIMO  
Test Conclusion: Pass  
Test Date: Mar. 18, 2020 ~ Mar. 20, 2020  
Date of Issue: Mar. 20, 2020

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# 1 GENERAL INFORMATION

## 1.1 Introduction

This document contains a summary of the requirements set forth by the IEEE 1528, FCC KDB 865664 D01 for reference dipoles used for SAR measurement system validations. Instead of the typical annual calibration recommended by measurement standards, the reference dipoles were demonstrated that the SAR target, impedance and return loss have remain stable, so the longer calibration interval is acceptable.

## 1.2 General Description for Equipment under Test (EUT)

| Model            | Frequency | Serial Number             | Product Condition(New/Used) | Last Cal. Date | Last Meas. Date |
|------------------|-----------|---------------------------|-----------------------------|----------------|-----------------|
| <b>Dipole</b>    |           |                           |                             |                |                 |
| DIP 0G750        | 750 MHz   | SN 11/17<br>DIP 0G750-446 | Used                        | 2019/03/20     | 2020/03/18      |
| DIP 0G835        | 835 MHz   | SN 11/17<br>DIP 0G835-447 | Used                        | 2019/03/20     | 2020/03/18      |
| DIP 0G900        | 900 MHz   | SN 11/17<br>DIP 0G900-448 | Used                        | 2019/03/20     | 2020/03/18      |
| DIP 1G800        | 1800 MHz  | SN 11/17<br>DIP 1G900-449 | Used                        | 2019/03/20     | 2020/03/19      |
| DIP 1G900        | 1900 MHz  | SN 11/17<br>DIP 1G900-450 | Used                        | 2019/03/20     | 2020/03/19      |
| DIP 2G000        | 2000 MHz  | SN 11/17<br>DIP 2G000-451 | Used                        | 2019/03/20     | 2020/03/19      |
| DIP 2G450        | 2450 MHz  | SN 11/17<br>DIP 2G450-452 | Used                        | 2019/03/20     | 2020/03/19      |
| DIP 2G600        | 2600 MHz  | SN 11/17<br>DIP 2G600-453 | Used                        | 2019/03/20     | 2020/03/19      |
| <b>Waveguide</b> |           |                           |                             |                |                 |
| SWG5500          | 5GHz-6GHz | SN 49/16<br>WGA42         | Used                        | 2019/03/20     | 2020/03/20      |



### 1.3 Test Equipment List

| Description          | Manufacturer | Model              | Serial No.            | Cal. Date  | Cal. Due   |
|----------------------|--------------|--------------------|-----------------------|------------|------------|
| PC                   | Dell         | N/A                | N/A                   | N/A        | N/A        |
| E-Field Probe        | MVG          | SSE2               | SN 34/15 SSE2 EPGO265 | 2019/05/16 | 2020/05/15 |
| Phantom1             | SATIMO       | SAM                | SN 30/13 SAM103       | N/A        | N/A        |
| Phantom2             | SATIMO       | SAM                | SN 30/13 SAM104       | N/A        | N/A        |
| MultiMeter           | Keithley     | MultiMeter<br>2000 | 4024022               | 2019/06/17 | 2020/06/16 |
| Signal Generator     | R&S          | SMBV100A           | 260592                | 2019/06/13 | 2020/06/12 |
| Power Meter          | R&S          | NRVD-B2            | 7250BJ-0112/2011      | 2019/10/30 | 2020/10/29 |
| Power Sensor         | R&S          | NRV-Z4             | 100381                | 2019/10/30 | 2020/10/29 |
| Power Sensor         | R&S          | NRV-Z2             | 100211                | 2019/10/30 | 2020/10/29 |
| Signal Generator     | R&S          | SMBV100A           | 260592                | 2019/06/13 | 2020/06/12 |
| Thermometer          | Elitech      | RC-4HC             | N/A                   | 2019/11/02 | 2020/11/01 |
| Power Amplifier      | SATIMO       | 6552B              | 22374                 | N/A        | N/A        |
| Dielectric Probe Kit | SATIMO       | SCLMP              | SN 25/13 OCPG56       | N/A        | N/A        |
| Attenuator           | COM-MW       | ZA-S1-31           | 1305003187            | N/A        | N/A        |
| Directional coupler  | AA-MCS       | AAMCS-UDC          | 000272                | N/A        | N/A        |

## 1.4 EUT Photos

DIP 0G750-446



DIP 0G835-447



DIP 0G900-448



DIP 1G800-449



DIP 1G900-450



DIP 2G000-451



DIP 2G450-452



DIP 2G600-453



Waveguide SWG5500





## 2 DIPOLE IMPEDANCE AND RETURN LOSS

The dipoles are designed to have low return loss when presented against a flat phantom at the specified distance. A Vector Network Analyzer was used to perform a return loss measurement on the specific dipole when in the measurement location against the phantom and the distance was specified by the manufacturer with a special, low loss and low relative permittivity spacer.

The impedance was measured at the SMA-connector with the network analyzer.

The measurement of verification with return loss should not deviate by more than 20% and minimum of 20 dB of the return loss, and the impedance (real or imaginary parts) should not deviate by more than 5 Ohms from the previous measurement using network analyzer.

Note:

The "Previous Meas." in the following table refer to dipoles or other equivalent RF sources calibration reports.

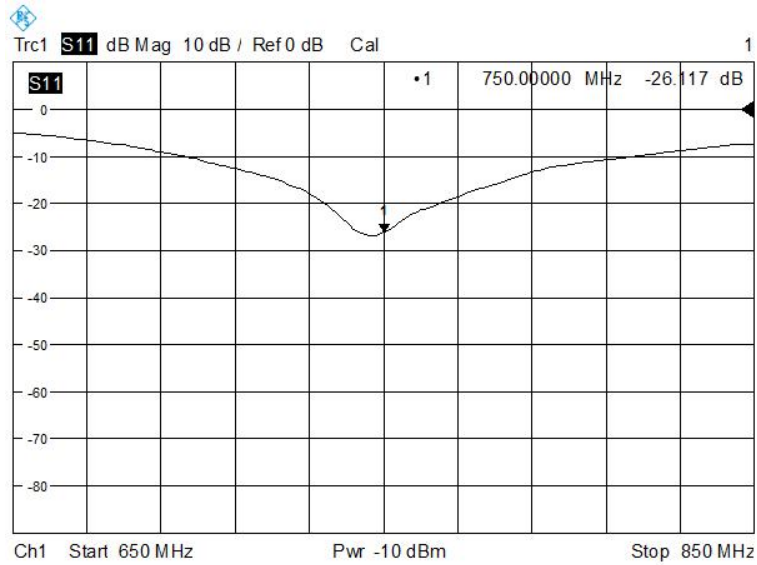


## 2.1 DIP 0G750

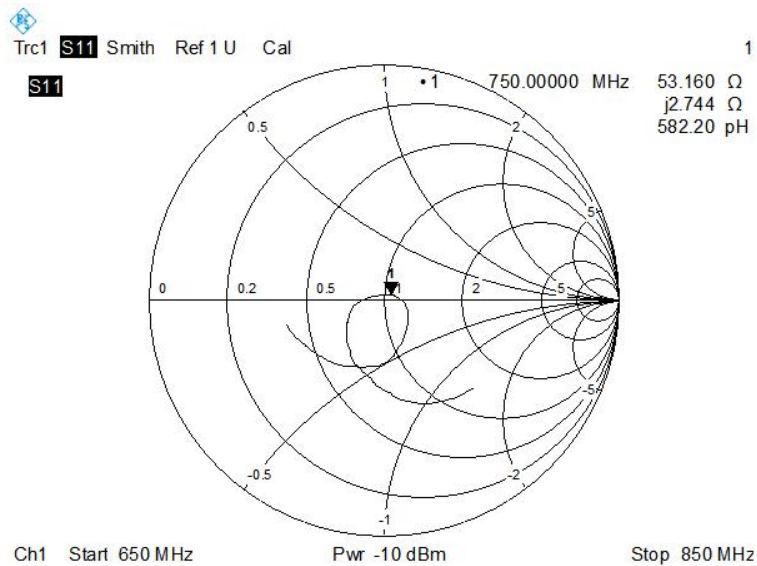
### RETURN LOSS AND IMPEDANCE IN HEAD LIQUID

| Meas. Results   | Current Meas.                 | Previous Meas.                | Max. Deviation                   |
|-----------------|-------------------------------|-------------------------------|----------------------------------|
| Return Loss(dB) | -26.12                        | -32.48                        | 1.1 %                            |
| Impedance       | 53.2 $\Omega$ +2.7 j $\Omega$ | 51.6 $\Omega$ +1.7 j $\Omega$ | 0.8 $\Omega$<br>(Imaginary part) |

#### Return Loss



#### Impedance



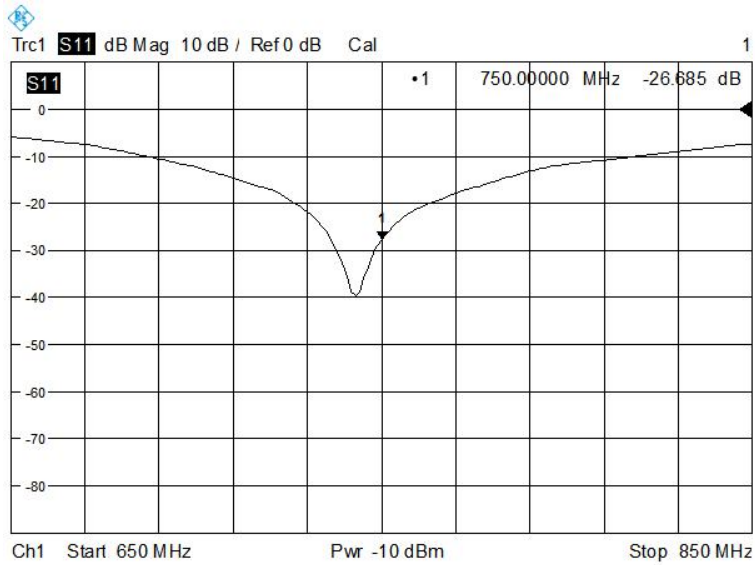




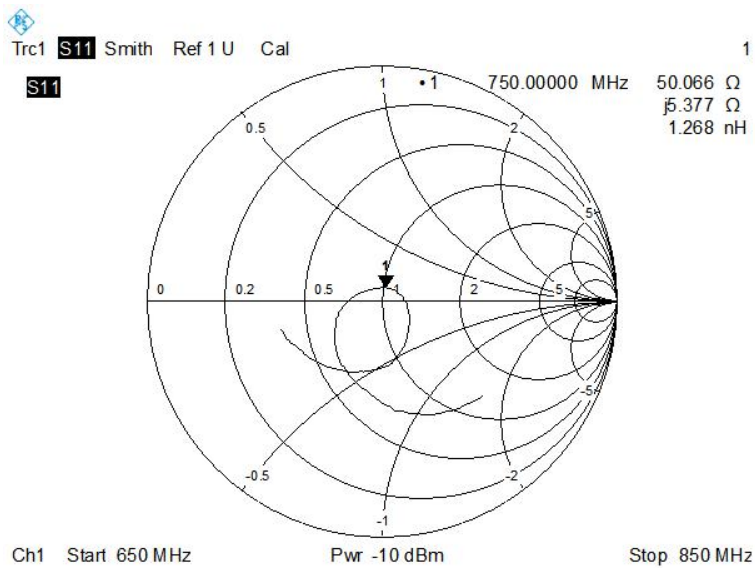
### RETURN LOSS AND IMPEDANCE IN BODY LIQUID

| Meas. Results   | Current Meas.               | Previous Meas.              | Max. Deviation              |
|-----------------|-----------------------------|-----------------------------|-----------------------------|
| Return Loss(dB) | -26.69                      | -23.50                      | 3.8 %                       |
| Impedance       | $50.1 \Omega + 5.4 j\Omega$ | $48.8 \Omega + 6.6 j\Omega$ | $1.0 \Omega$<br>(Real part) |

#### Return Loss



#### Impedance



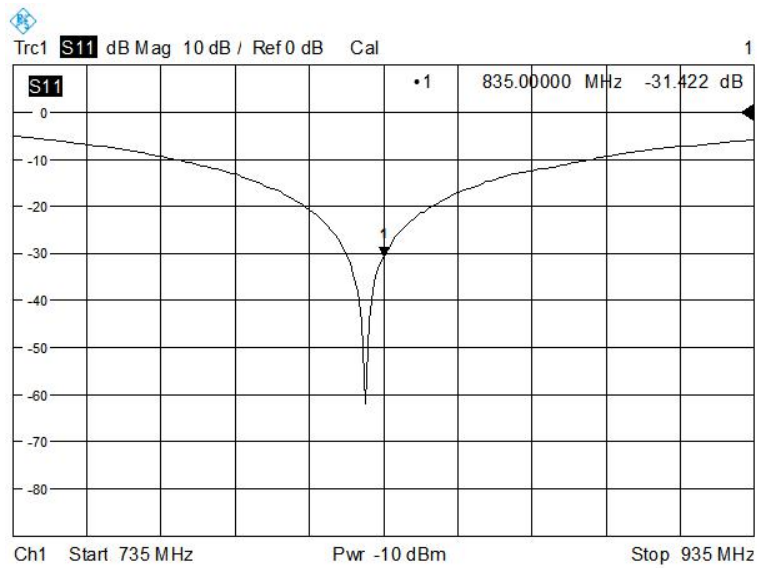


## 2.2 DIP 0G835

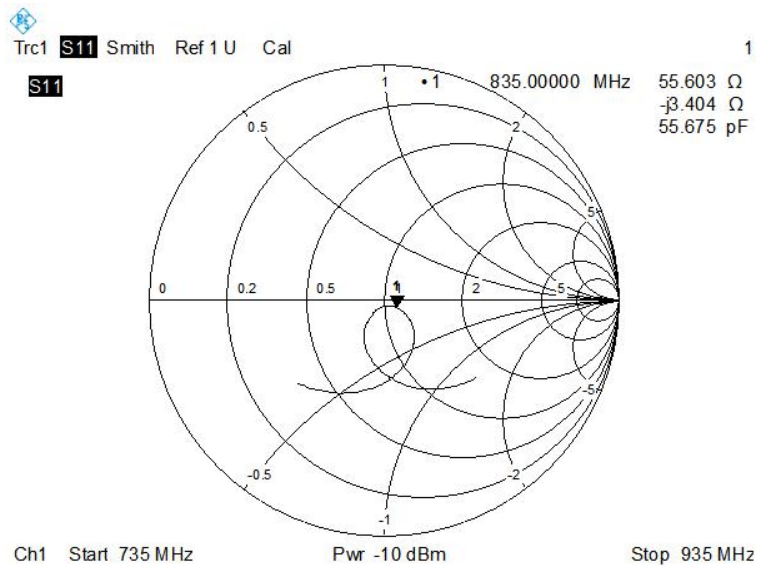
### RETURN LOSS AND IMPEDANCE IN HEAD LIQUID

| Meas. Results   | Current Meas.                 | Previous Meas.                | Max. Deviation                   |
|-----------------|-------------------------------|-------------------------------|----------------------------------|
| Return Loss(dB) | -31.42                        | -34.07                        | 3.1%                             |
| Impedance       | 55.6 $\Omega$ -3.4 j $\Omega$ | 49.3 $\Omega$ +1.8 j $\Omega$ | 2.3 $\Omega$<br>(Imaginary part) |

#### Return Loss



#### Impedance

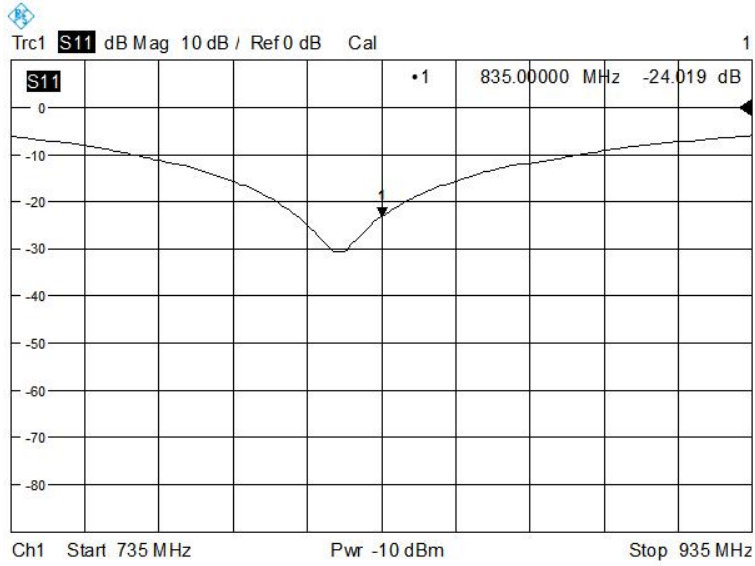




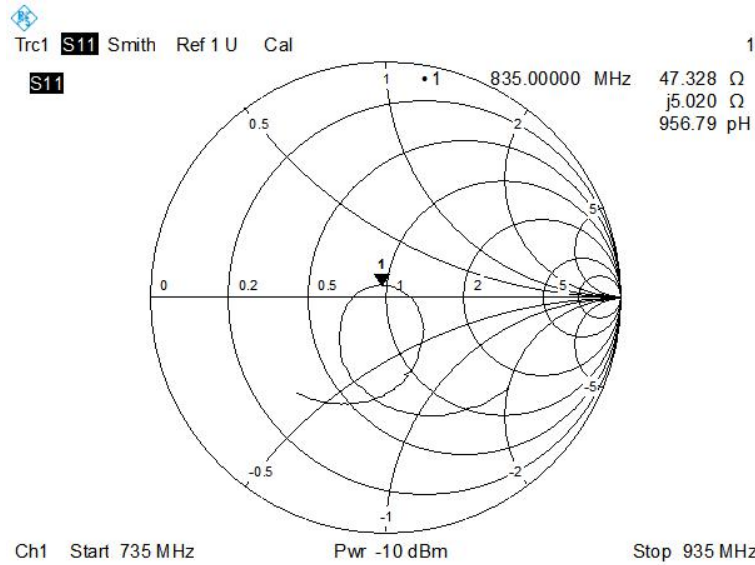
**RETURN LOSS AND IMPEDANCE IN BODY LIQUID**

| Meas. Results   | Current Meas. | Previous Meas. | Max. Deviation       |
|-----------------|---------------|----------------|----------------------|
| Return Loss(dB) | -24.02        | -22.96         | 4.0%                 |
| Impedance       | 47.3Ω+5.0 jΩ  | 45.3Ω+5.3 jΩ   | 0.9 Ω<br>(Real part) |

**Return Loss**



**Impedance**



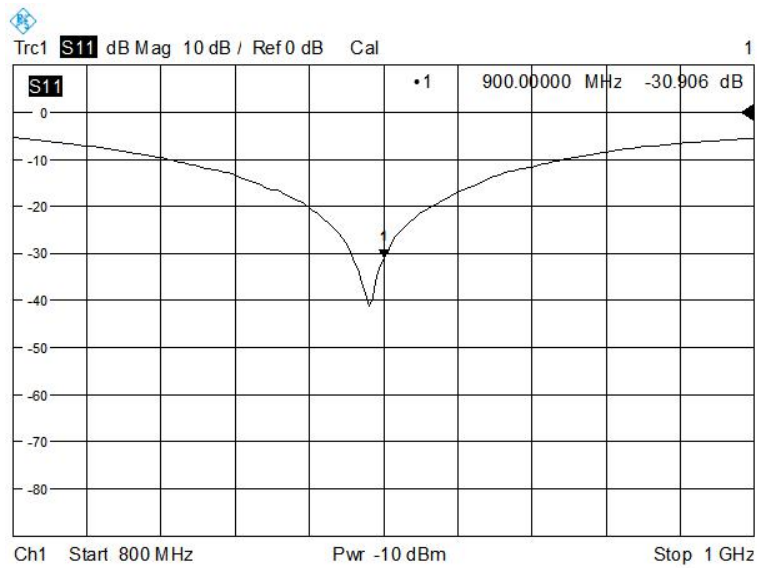


## 2.3 DIP 0G900

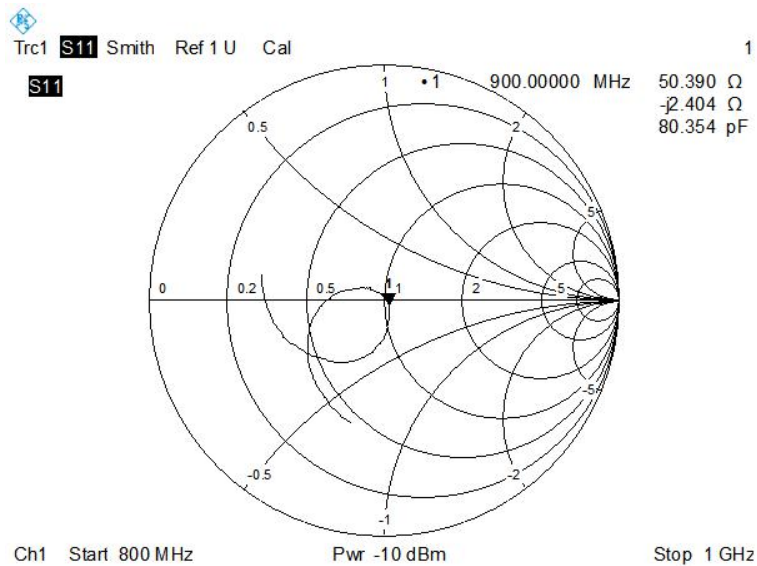
### RETURN LOSS AND IMPEDANCE IN HEAD LIQUID

| Meas. Results   | Current Meas.                   | Previous Meas.                 | Max. Deviation              |
|-----------------|---------------------------------|--------------------------------|-----------------------------|
| Return Loss(dB) | -30.91                          | -30.38                         | 2.0%                        |
| Impedance       | 50.39 $\Omega$ - 2.4 j $\Omega$ | 51.8 $\Omega$ - 2.4 j $\Omega$ | 1.4 $\Omega$<br>(Real part) |

#### Return Loss



#### Impedance

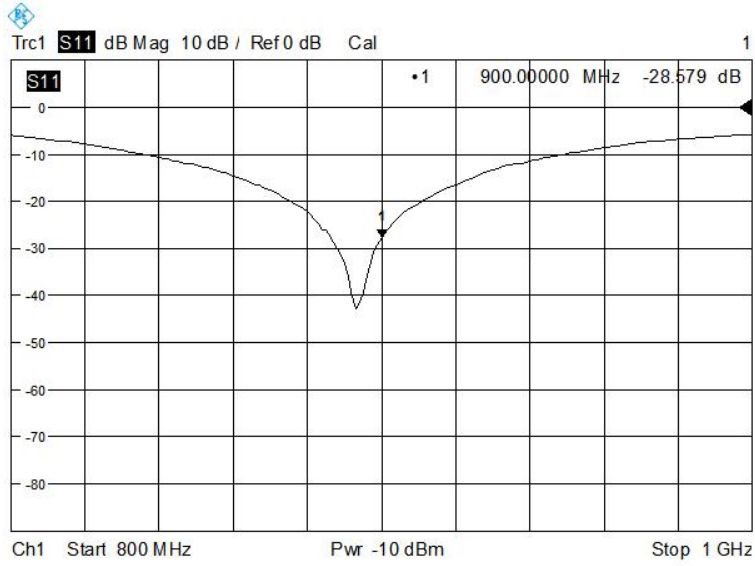




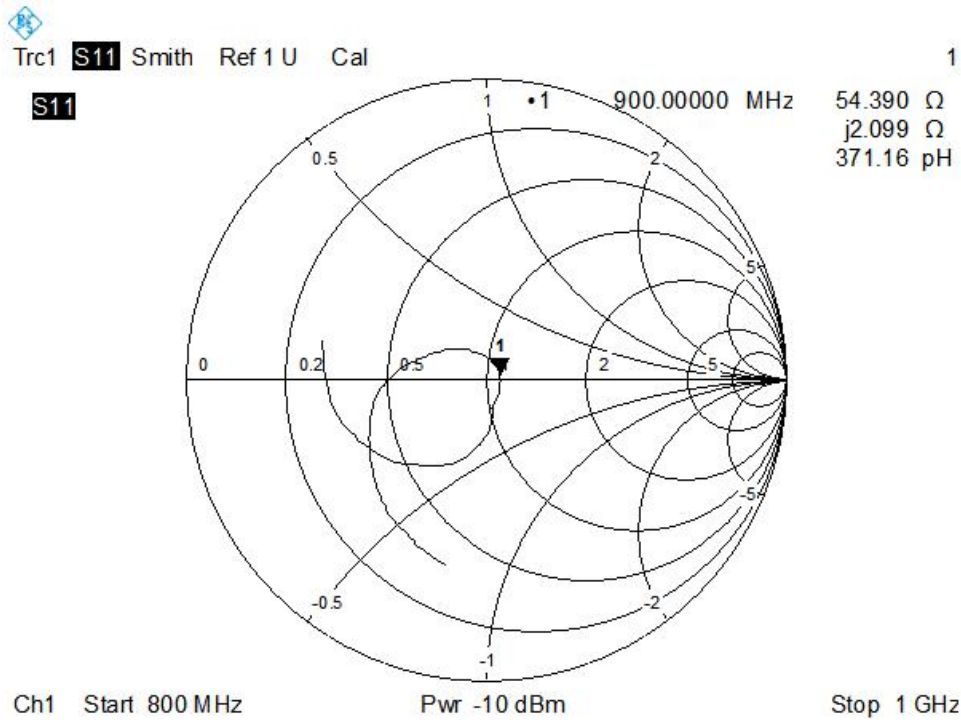
**RETURN LOSS AND IMPEDANCE IN BODY LIQUID**

| Meas. Results   | Current Meas.                 | Previous Meas.                | Max. Deviation              |
|-----------------|-------------------------------|-------------------------------|-----------------------------|
| Return Loss(dB) | -28.58                        | -27.29                        | 3.5%                        |
| Impedance       | 54.4 $\Omega$ +2.1 j $\Omega$ | 53.4 $\Omega$ +2.6 j $\Omega$ | 0.3 $\Omega$<br>(Real part) |

**Return Loss**



**Impedance**



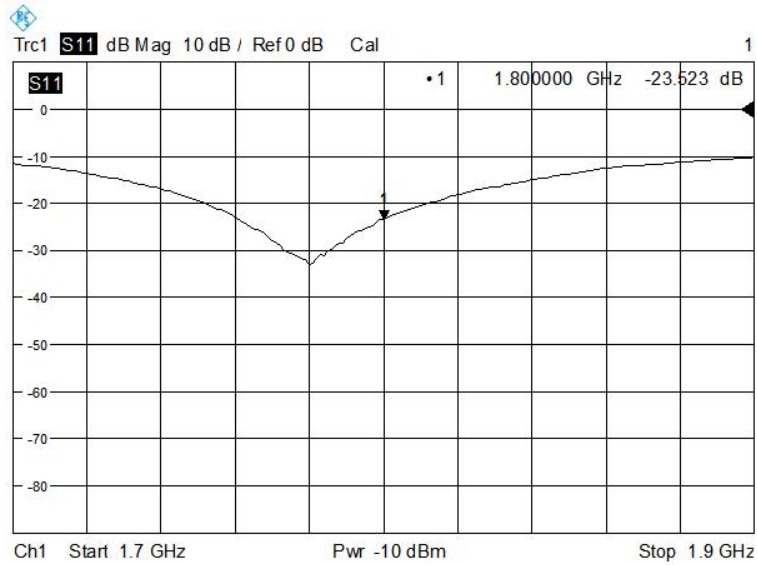


## 2.4 DIP 1G800

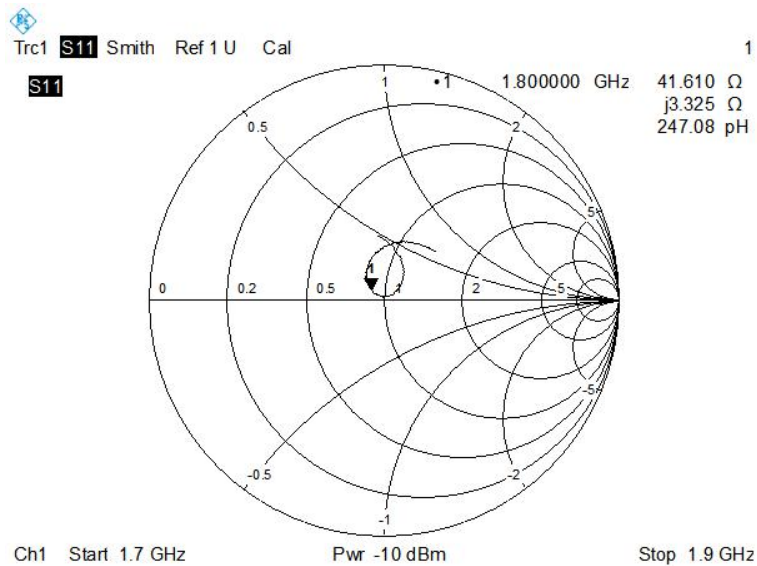
### RETURN LOSS AND IMPEDANCE IN HEAD LIQUID

| Meas. Results   | Current Meas.                     | Previous Meas.                    | Max. Deviation             |
|-----------------|-----------------------------------|-----------------------------------|----------------------------|
| Return Loss(dB) | -23.52                            | -25.49                            | 3.1%                       |
| Impedance       | $41.6\Omega + 3.3\text{ j}\Omega$ | $45.4\Omega + 2.6\text{ j}\Omega$ | $3.2\Omega$<br>(Real part) |

#### Return Loss



#### Impedance

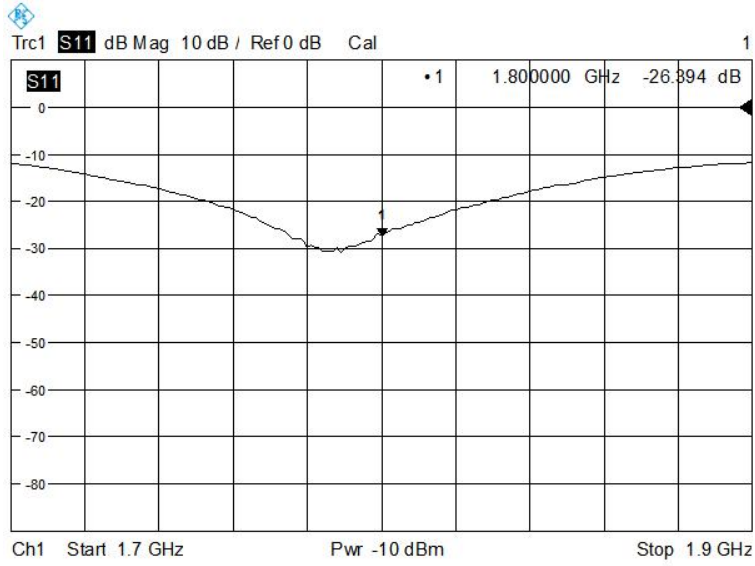




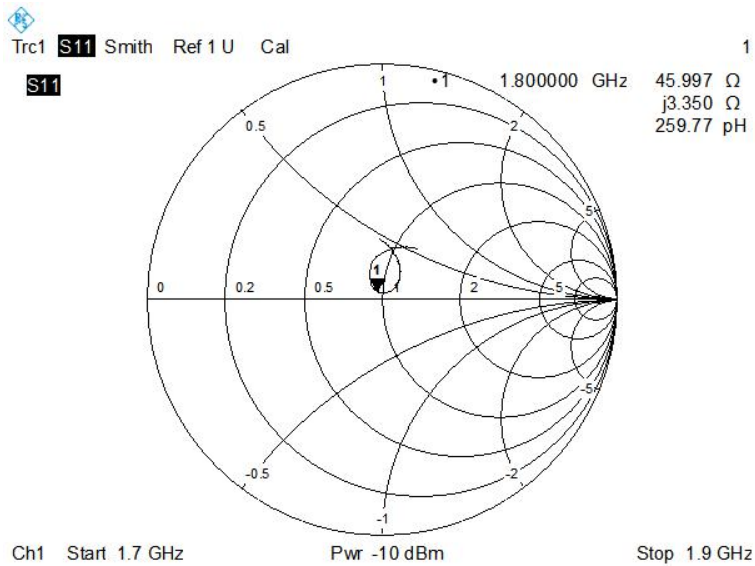
**RETURN LOSS AND IMPEDANCE IN BODY LIQUID**

| Meas. Results   | Current Meas. | Previous Meas. | Max. Deviation       |
|-----------------|---------------|----------------|----------------------|
| Return Loss(dB) | -26.39        | -26.35         | 3.7%                 |
| Impedance       | 46.0Ω +3.4 jΩ | 45.4Ω -1.5 jΩ  | 1.8 Ω<br>(Real part) |

**Return Loss**



**Impedance**

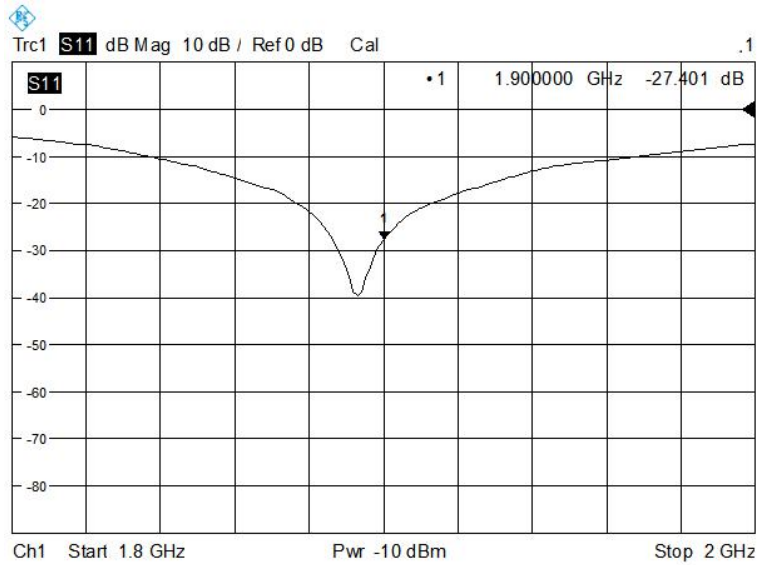


## 2.5 DIP 1G900

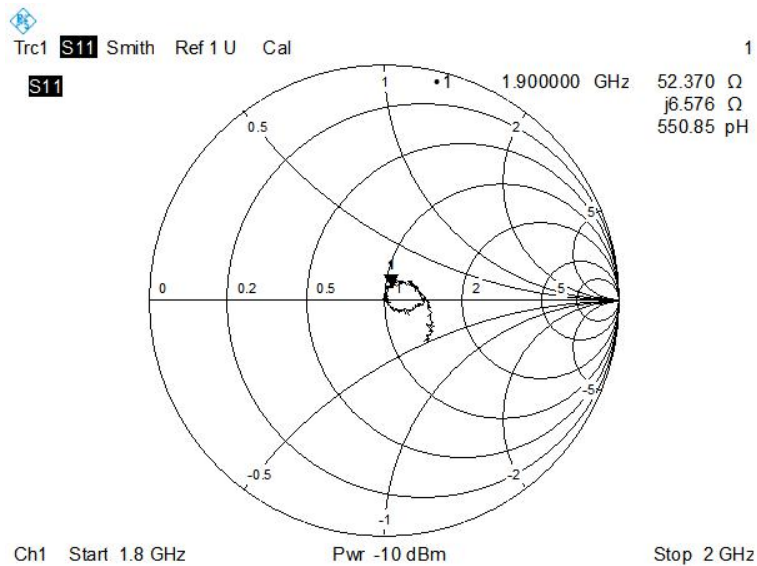
### RETURN LOSS AND IMPEDANCE IN HEAD LIQUID

| Meas. Results   | Current Meas. | Previous Meas. | Max. Deviation            |
|-----------------|---------------|----------------|---------------------------|
| Return Loss(dB) | -27.40        | -24.20         | 16.2 %                    |
| Impedance       | 52.4Ω+6.6 jΩ  | 51.2Ω+6.0 jΩ   | 1.4 Ω<br>(Imaginary part) |

#### Return Loss



#### Impedance



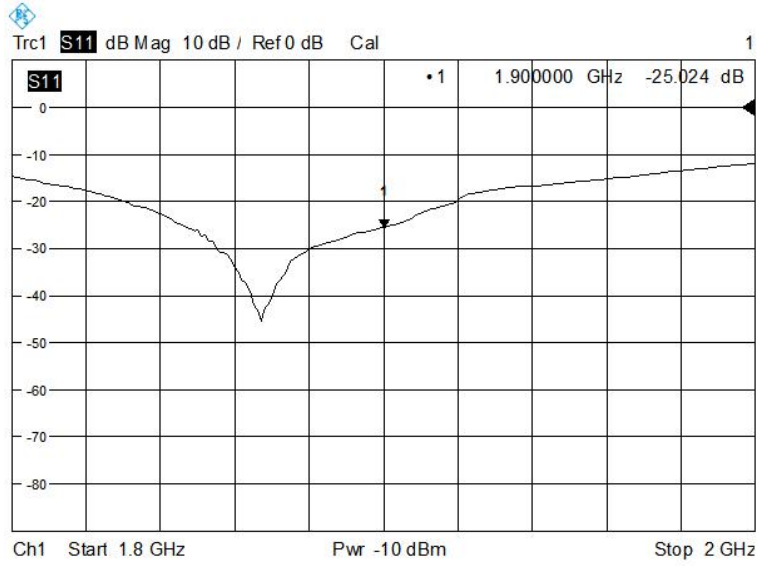




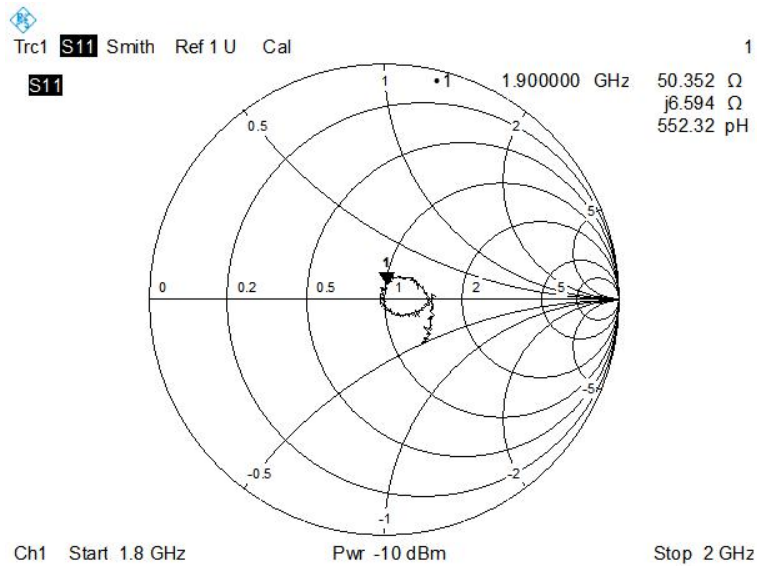
### RETURN LOSS AND IMPEDANCE IN BODY LIQUID

| Meas. Results   | Current Meas.                 | Previous Meas.                | Max. Deviation              |
|-----------------|-------------------------------|-------------------------------|-----------------------------|
| Return Loss(dB) | -25.02                        | -22.45                        | 12.2 %                      |
| Impedance       | 50.4 $\Omega$ +6.6 j $\Omega$ | 46.7 $\Omega$ +6.7 j $\Omega$ | 2.8 $\Omega$<br>(Real part) |

#### Return Loss



#### Impedance

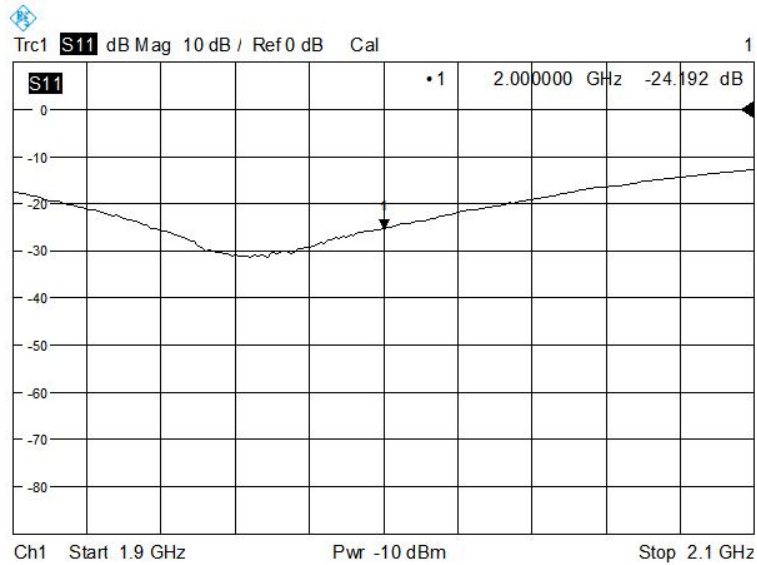


## 2.6 DIP 2G000

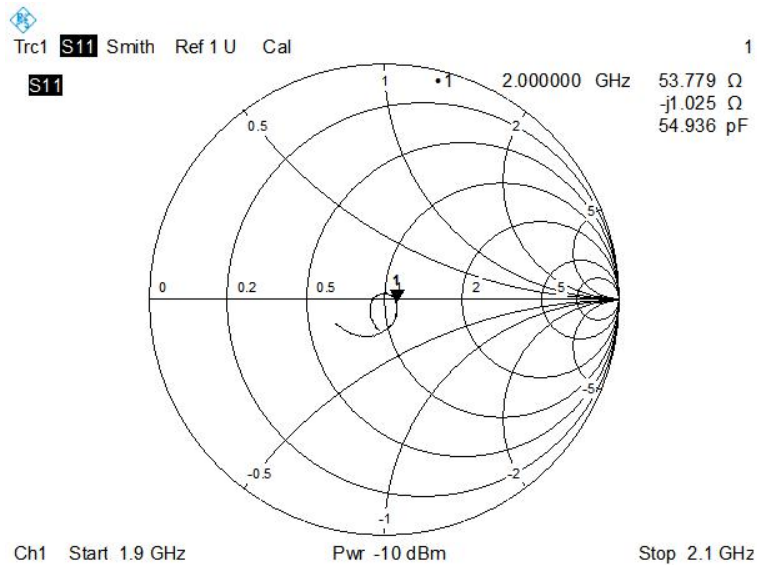
### RETURN LOSS AND IMPEDANCE IN HEAD LIQUID

| Meas. Results   | Current Meas.                     | Previous Meas.                    | Max. Deviation             |
|-----------------|-----------------------------------|-----------------------------------|----------------------------|
| Return Loss(dB) | -24.19                            | -24.61                            | 3.6%                       |
| Impedance       | $53.8\Omega - 1.0\text{ j}\Omega$ | $54.3\Omega - 4.0\text{ j}\Omega$ | $1.9\Omega$<br>(Real part) |

#### Return Loss



#### Impedance

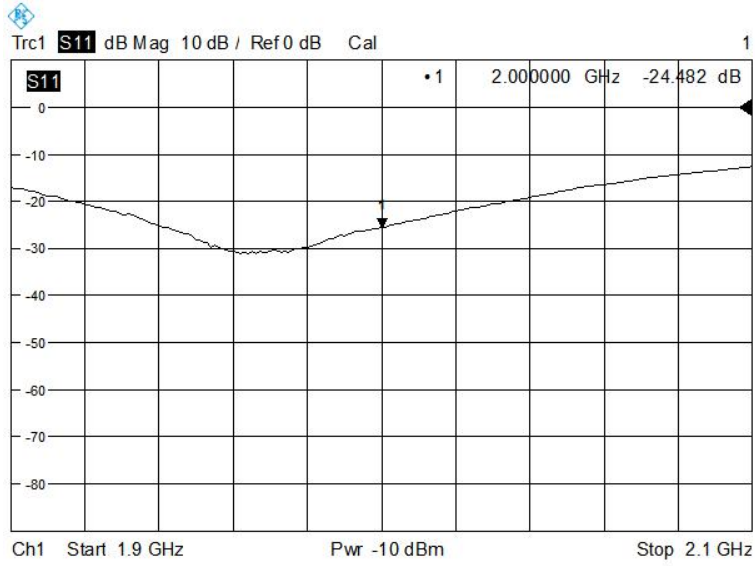




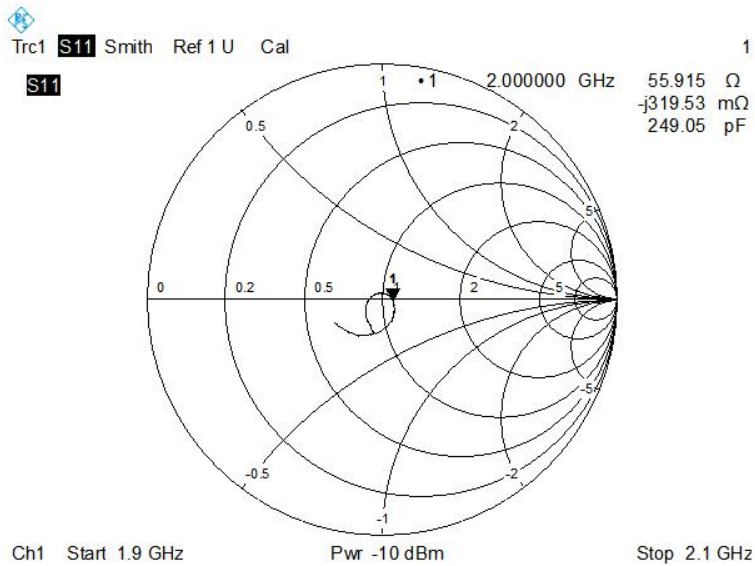
**RETURN LOSS AND IMPEDANCE IN BODY LIQUID**

| Meas. Results   | Current Meas. | Previous Meas. | Max. Deviation       |
|-----------------|---------------|----------------|----------------------|
| Return Loss(dB) | -24.48        | -24.74         | 3.3 %                |
| Impedance       | 55.9Ω-0.3 jΩ  | 55.8Ω-0.3 jΩ   | 1.1 Ω<br>(Real part) |

**Return Loss**



**Impedance**



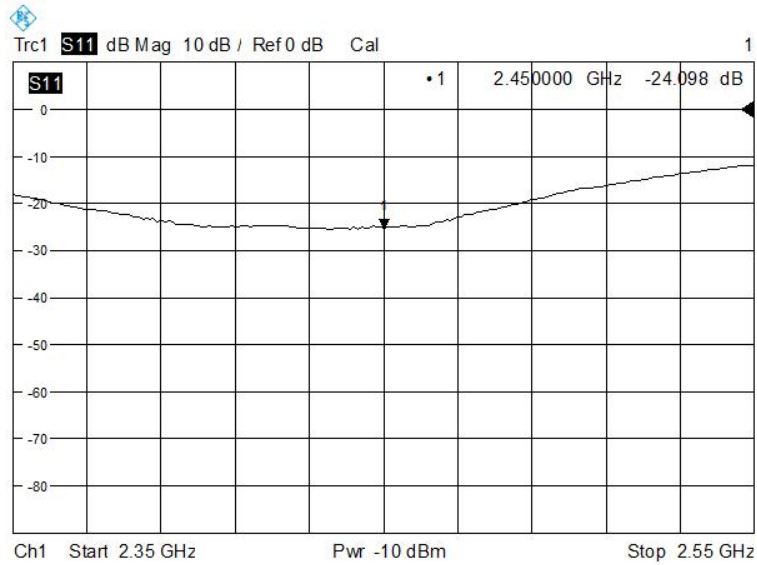


## 2.7 DIP 2G450

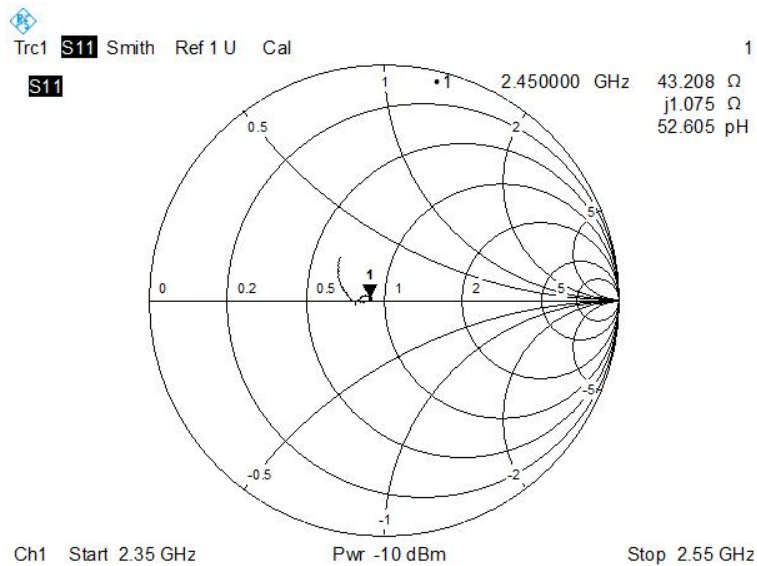
### RETURN LOSS AND IMPEDANCE IN HEAD LIQUID

| Meas. Results   | Current Meas.                  | Previous Meas.                 | Max. Deviation              |
|-----------------|--------------------------------|--------------------------------|-----------------------------|
| Return Loss(dB) | -24.10                         | -24.82                         | 3.8 %                       |
| Impedance       | 43.2 $\Omega$ + 1.1 j $\Omega$ | 44.3 $\Omega$ + 0.2 j $\Omega$ | 1.1 $\Omega$<br>(Real part) |

#### Return Loss



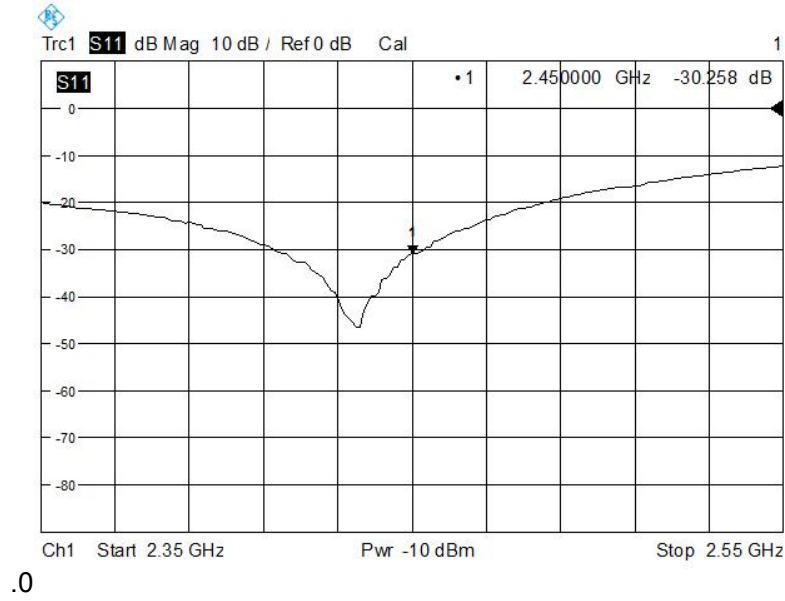
#### Impedance



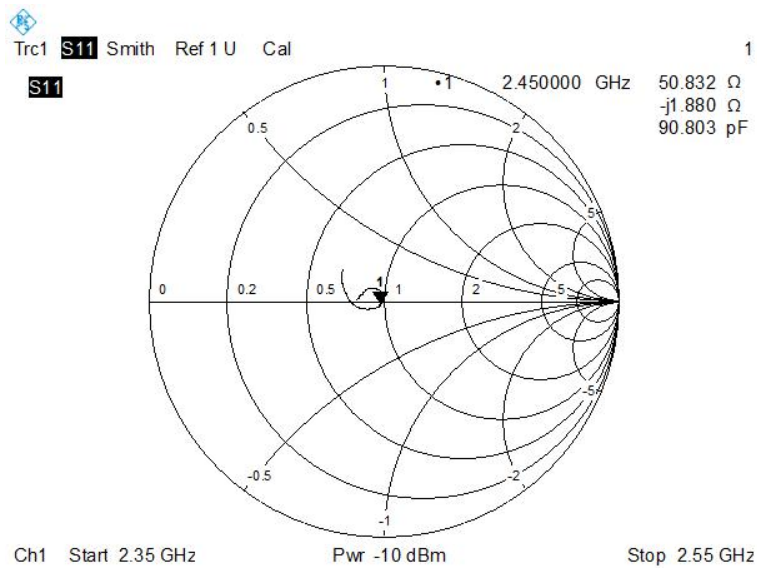
**RETURN LOSS AND IMPEDANCE IN BODY LIQUID**

| Meas. Results   | Current Meas.                  | Previous Meas.                 | Max. Deviation              |
|-----------------|--------------------------------|--------------------------------|-----------------------------|
| Return Loss(dB) | -30.26                         | -31.92                         | 2.5%                        |
| Impedance       | 50.8 $\Omega$ - 1.9 j $\Omega$ | 47.5 $\Omega$ - 0.4 j $\Omega$ | 2.1 $\Omega$<br>(Real part) |

**Return Loss**



**Impedance**

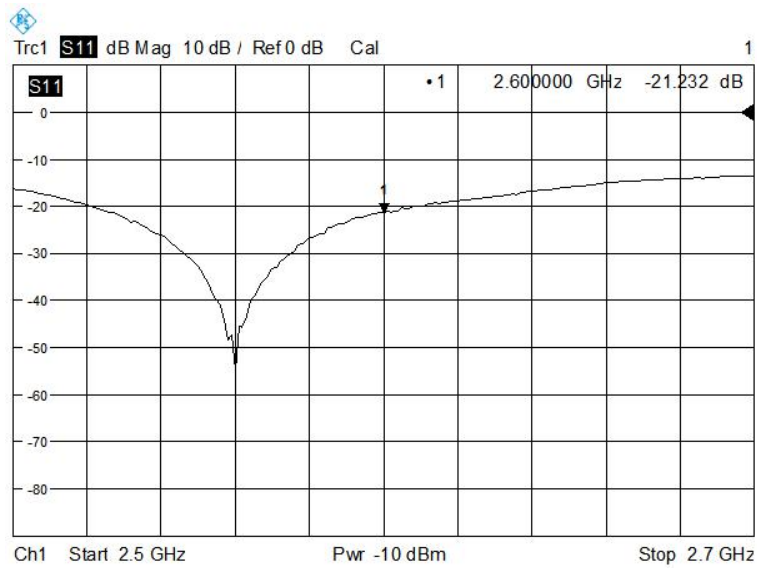


## 2.8 DIP 2G600

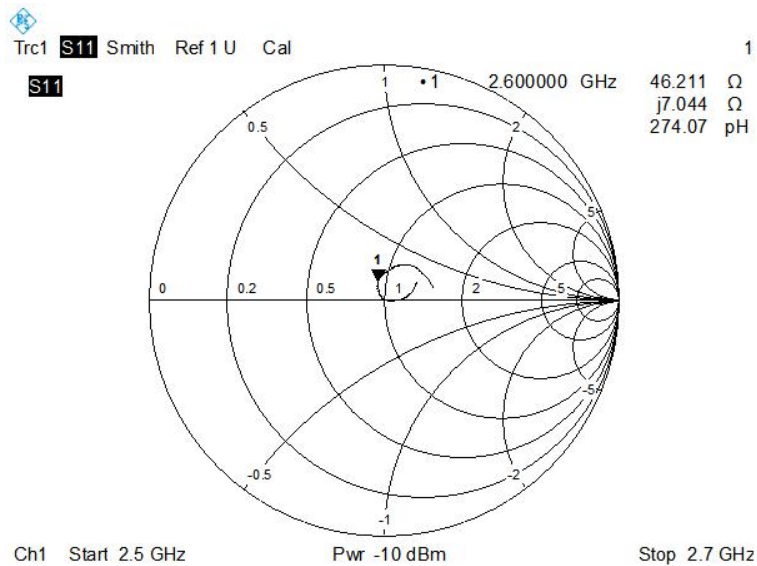
### RETURN LOSS AND IMPEDANCE IN HEAD LIQUID

| Meas. Results   | Current Meas.                 | Previous Meas.                | Max. Deviation                   |
|-----------------|-------------------------------|-------------------------------|----------------------------------|
| Return Loss(dB) | -21.23                        | -21.53                        | 4.8%                             |
| Impedance       | 46.2 $\Omega$ +7.0 j $\Omega$ | 46.1 $\Omega$ +7.4 j $\Omega$ | 0.8 $\Omega$<br>(Imaginary part) |

#### Return Loss



#### Impedance

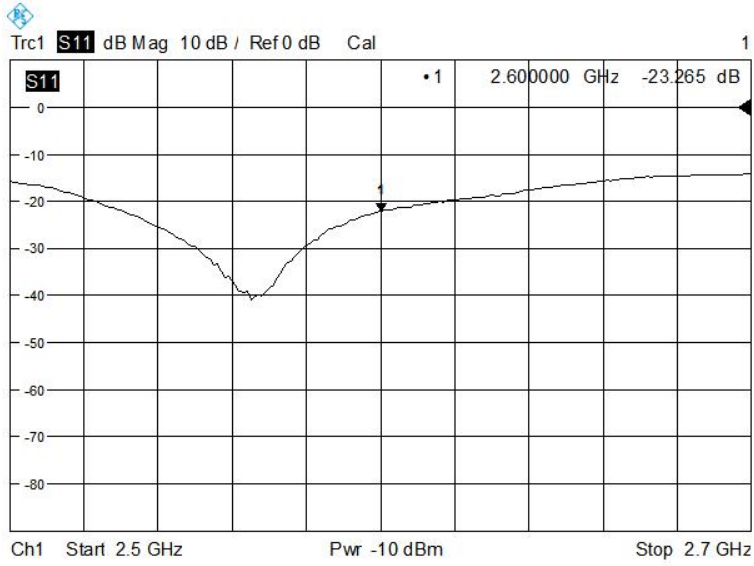




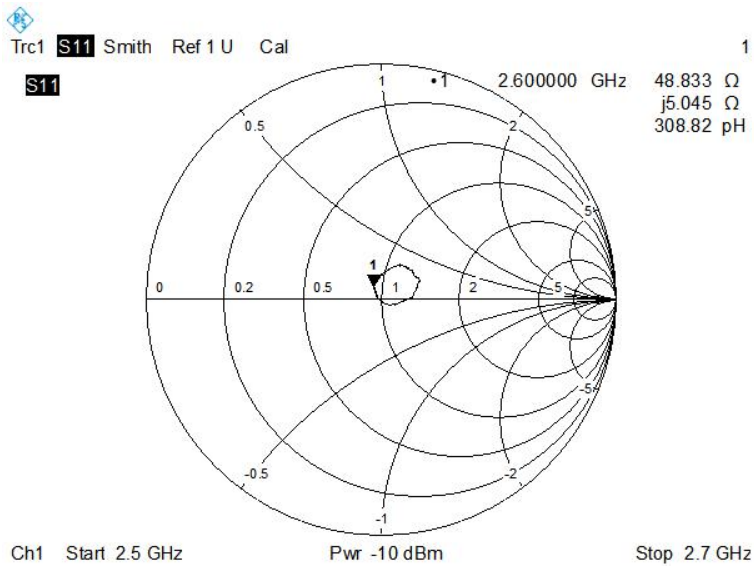
**RETURN LOSS AND IMPEDANCE IN BODY LIQUID**

| Meas. Results   | Current Meas. | Previous Meas. | Max. Deviation       |
|-----------------|---------------|----------------|----------------------|
| Return Loss(dB) | -23.27        | -21.76         | 4.0 %                |
| Impedance       | 48.8Ω +5.0 jΩ | 44.2Ω +5.7 jΩ  | 2.7 Ω<br>(Real part) |

**Return Loss**



**Impedance**



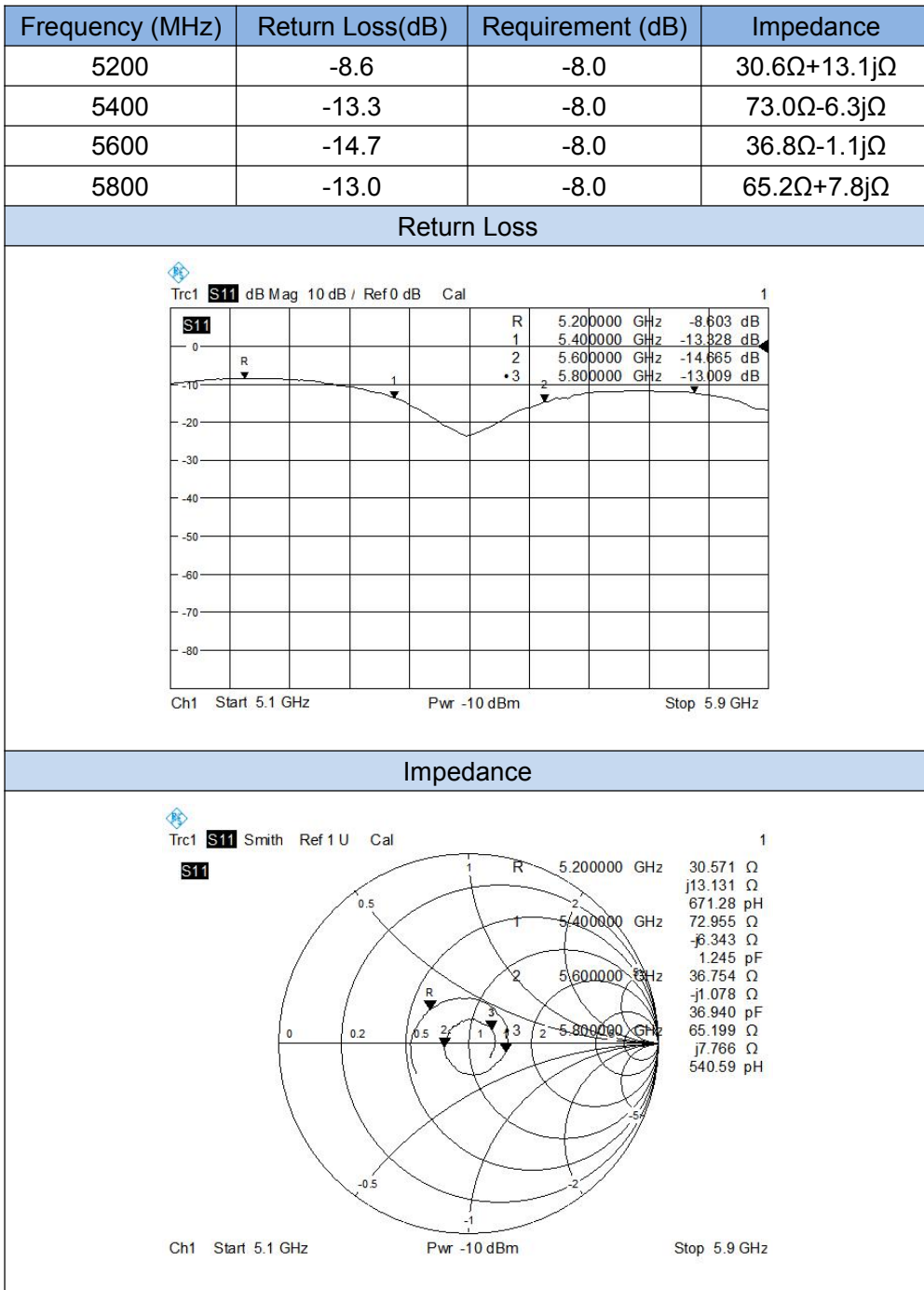
### 3 WAVEGUIDE IMPEDANCE AND RETURN LOSS

The waveguide are designed to have low return loss when presented against a flat phantom at the specified distance. A Vector Network Analyzer was used to perform a return loss measurement on the specific waveguide when in the measurement location against the phantom and the distance was specified by the manufacturer with a special, low loss and low relative permittivity spacer.

The impedance was measured at the SMA-connector with the network analyzer.

#### 3.1 SWG5500

##### RETURN LOSS AND IMPEDANCE IN HEAD LIQUID



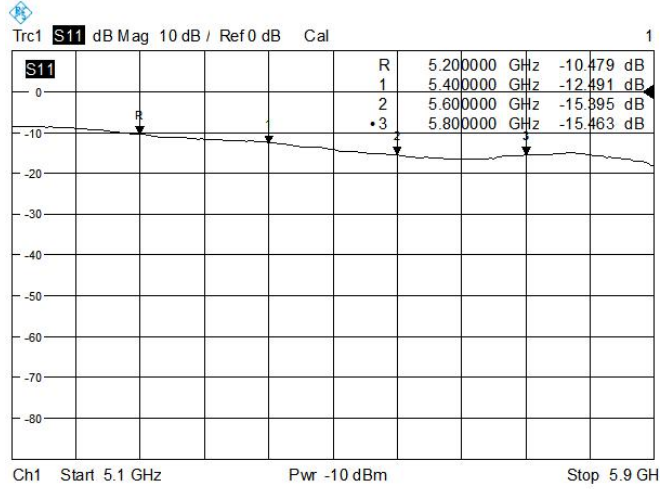




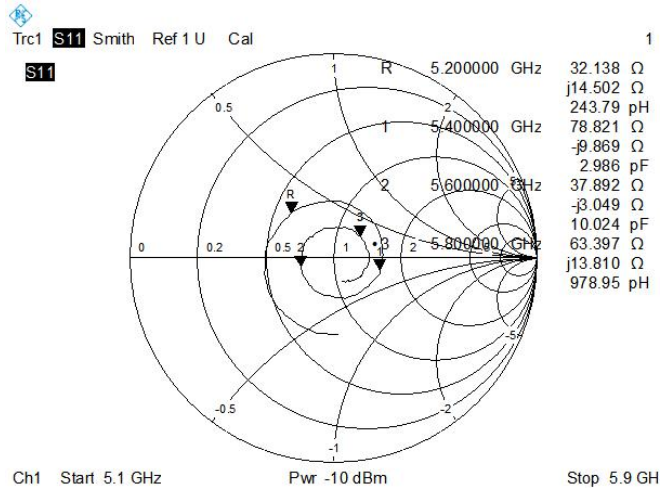
**RETURN LOSS AND IMPEDANCE IN BODY LIQUID**

| Frequency (MHz) | Return Loss(dB) | Requirement (dB) | Impedance    |
|-----------------|-----------------|------------------|--------------|
| 5200            | -10.5           | -8.0             | 32.1Ω+14.5jΩ |
| 5400            | -12.5           | -8.0             | 78.8Ω-9.9jΩ  |
| 5600            | -15.4           | -8.0             | 37.9Ω-3.0jΩ  |
| 5800            | -15.5           | -8.0             | 63.4Ω+13.8jΩ |

**Return Loss**



**Impedance**



--END OF REPORT--