

# SWR 4000

## Antenna Analyzer



User's manual

Edition Notice!

This publication applies to Amphenol Procom DK  
SWR 4000 SWR Analyzer product hardware release 1A and  
software release 3013 suffix 3J.

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## **General Safety:**

SWR 4000 should only be used for its intended purpose and never be connected to cables carrying hazardous voltages.

When handling NiMh batteries great care should be observed preventing polarity reversal and short circuit as the batteries may explode or catch fire.

## **General Information.**

### Description:

The SWR 4000 instrument is an Antenna Analyzer for analyzing Antennas and feeder cable SWR or Return loss.

The instrument measures the return loss by using a Wheatstone RF bridge, a detector and an RF Generator.

The control of the entire instrument is by a microprocessor.

The microprocessor is running in a MOP (Micro Operating Programme) environment. The MOP schedule executes all tasks required to handle the LCD Screen, the Keyboard, the RF generator, USB interface, serial interface, time of day clock and measurement calculations.

The RF generator covers the frequency range from 30 MHz to 2700 MHz by using two PLL generators covering 650 MHz to 1450 MHz and 1450 MHz to 2700 MHz. The low frequency range from 30 MHz to 650 MHz is covered by mixing the two PLL generators.

The instrument has a built-in time of day clock. This clock is used to identify the output files going to either USB or serial interface.

## Options:

Accessory Kit containing a soft carrying bag, adaptors from the “N”-female on the instrument into “BNC”-female, “TNC”-female, Mini-“UHF”, “FME”-male and a 7.5 Volt regulated Cigarette Lighter Charger.

## Battery and Charging:

The batteries used are NiMh. There are four 1.2 Volt cells. In order to charge the batteries there is a built-in constant current circuit, and the time needed for a full charge is approximately 14 hours. The 7.5 Volt regulated charger supplied will allow the instrument being operated directly from the charger and at the same time charge the batteries when plugged in. Also the cigarette lighter supplied in the accessory kit can run and charge the instrument from your 12 Volt car battery at the same time.

## Warranty:

The SWR 4000 has a 1 year total warranty covering parts and labor as long as the instrument has been used according to the instructions in this manual and has not been subject to any abuse. Warranty will cover the return shipment after repairs.

## Connections:

Mini Din  
RS232 interface for programming  
and calibration (factory use only)



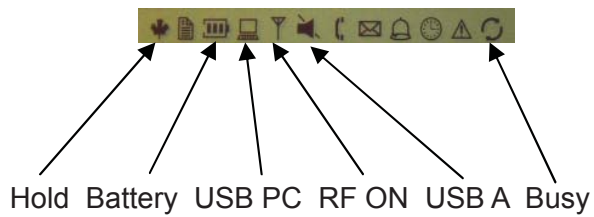
USB A Memory Stick  
USB B PC Serial Device (future use)  
DC 7.5 Volt regulated Charger @ 700mA, + on centre pin

# Operating

## The Front Panel:



## Icons



## Power On/Off

Pressing the ON/OFF button will switch on the instrument. A welcome screen will appear like this:



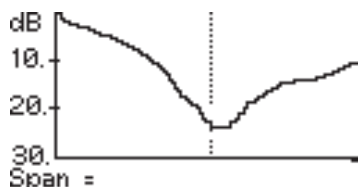
The instrument will run for the duration of the auto power off period.

## Centre Frequency

Pressing the Fc button on the keyboard will give a screen with an entry field "Center =". By pressing the numeric keys you can enter any frequency from 30 MHz to 2700 MHz. To correct entry you can use the arrow keys. Press the enter key to change the centre frequency.

Note that the Centre frequency will have priority over the Frequency span (FΔ) making automatic adjustment to fit inside instrument range.

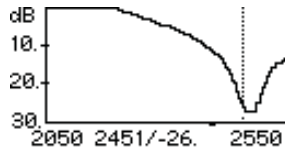
## Frequency Span



Pressing the FΔ button on the keyboard will give a screen with an entry field "Span =". By pressing the numeric keys you can enter any frequency span from 0 MHz to 2670 MHz. To correct entry you can use the arrow keys. Press the enter key to change the frequency span.

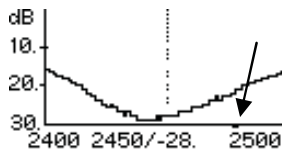
Note that the frequency span will be adjusted automatically to fit within the range boundaries and the actual centre frequency.

## Marker



The marker functions are controlled by the arrow keys when the instrument is in sweep mode. By pressing the left or right arrow the marker line moves across the screen. When the key is held pressed, a mini cursor will be seen moving across the screen and when the key is released, the marker will appear in the new position. The marker will display the frequency and the measured value of the marker position on the bottom line. If you press the “ENTER” key, the marker position will move to the centre of the screen and adjust the frequency span symmetrically on both sides of the new centre frequency.

## Hold and Copy



When “HOLD” is pressed, the sweep position indicator stops at the current position and freezes the screen. In “HOLD” mode the frequency sweep is stopped and depending on the setting of Oscillator, the RF is either On or Off (see menus). The “COPY” key will write the screen contents to the USB Memory stick or to the USB Serial Device. The “COPY” function will create a Directory with the date as directory name YYYYMMDD e.g. 20080826. In the directory the screen files are written as .BMP with the time stamp as file name HHMMSS, e.g. 164852.BMP. During the writing to USB the busy icon is on. When busy goes off, it is safe to remove the USB device.



## Menus:

### Main:

```

Main Menu
1 Light On
2 Y Scale
3 X Scale
4 Date/ Time
5 Info
6 Settings
```

1 Light On will change the setting On/Off of the back light when activated.

### 2 Y Scale:

```

2 Y Scale
1 0-15 dB
2 0-30 dB
3 Auto dB
4 SWR 5-1
5 SWR 9-1
6 SWR Auto
```

The vertical scale can be chosen between return loss in dB and as a numeric SWR value. In each group you may choose the scale that fits your need or the auto scale function.

### 3 X Scale:

```

3 X Scale
1 Ends Cur/val
2 Span Cur/val
3 Cent Cur/val
4 Centre Span
```

The Horizontal scale can be chosen to have a different layout. X1 will have start frequency, cursor frequency with value and stop frequency.

X2 will display  $F\Delta$  and cursor frequency with value.

X3 will display  $F_c$  and cursor frequency with value.

X4 will display  $F_c$  and  $F\Delta$  frequencies.

### 4 Date and Time:

```

4 Date/ Time
1 Day 26
2 Month 8
3 Year 2008
4 Hour 17
5 Minute 13
```

The date and time can be entered and will run real time as long as the SWR 4000 is charged and have battery voltage to sustain operation.

## Menus (cont.)

### 5 Info:

```
5 Info
1 Operator  BILL C
2 Address   W DC
3 Device Id 2400 03
4 Device Typ GP
5 SerialNo   1
```

In this menu Data to be used with the XML Feature can be entered; data are stored with the time stamp and screen copy in XML format.

### 6 Settings:

```
6 Settings
1 Power Min 5
2 Contrast  70
3 File sys  1
4 Hold Osc  OFF
5 Maint     0
```

Settings 1: Time interval in minutes to auto power off. After the set time interval is exceeded, the instrument will switch off and save battery power. The time to power off can be set from 1 to 127 minutes. If the power off time is set to 0, the automatic power save function is disabled.

Settings 2: The contrast of the LCD screen can be adjusted from 50 to 99. Factory default is 70.

Settings 3: The file system may be selected where 1 is the time/date format and 2 is the XML format.

Settings 4: Is the choice of having the RF generator stopped or running during "HOLD" mode.

# Making Measurement

## Connecting antennas:

Observe the utmost care when connecting antennas via cables, as these cables can be connected to transmitters and /or power sources!

Make sure you have chosen the antenna you intend to test!! Connection to transmitters and/or other sources can destroy the instrument or cause hazardous electrical conditions.

When connecting to the “N”-female connector on the instrument, make sure you are using either “N”-male antenna or cable connector.

If antenna or cable is fitted with another type of connector, use appropriate adaptor. Please observe that the use of adaptors and cable connections of poor quality may influence the SWR and give higher readings than the actual antenna SWR. Once the antenna has been connected to the instrument, you switch on the SWR 4000 and select the relevant frequency band by using the Fc and FΔ. By sweeping the frequencies of interest while observing the graphs on the screen, you should see the SWR or Return Loss curve. Antennas are usually designed to have an SWR below a given value within the band for which it is designed. As an example a GSM 900 antenna could have the following specifications: Range 890 - 960 MHz, SWR less than 2.0:1, typical 1.5:1.

## Nearby objects:

When testing SWR on low gain antennas (Gain <3dBd) the influence from nearby objects is small when the objects are more than  $\frac{1}{2} \lambda$  away (15 cm at GSM900). When testing high gain antennas (e.g. Yagi and panel antennas), you should avoid objects in the direction of radiation.

## Strong RF fields:

When testing SWR on antennas located in strong RF fields, the reading you will get on the SWR meter may be incorrect because the strong RF field present will be indicated as reflected power coming from the antenna. If a precise reading is needed, you must switch off the disturbing source of RF or move the antenna under test out of the RF field.

## **Bandwidth:**

Some antennas may need tuning by adjusting the length of an element or by other means in order to cover the entire band of interest. Please refer to antenna manufacturer's instructions for details.

## **Duplex operation:**

When checking antennas to be used for duplex operation, make sure the antenna SWR is adjusted for the lowest possible SWR in both receive and transmit band.

## **General hints:**

Always refer to antenna manufacturer's specification! Antennas may have more than one resonance frequency! A very narrow resonance frequency may indicate resonance of cable instead of antenna resonance (Cable broken or shorted)!

**Keep connectors clean and tight!**

## Specifications:

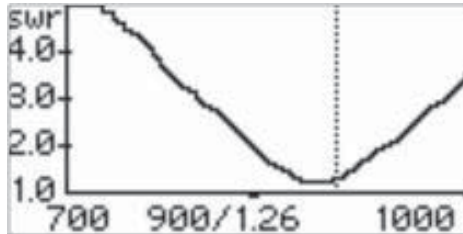
Model	SWR 4000 Type 3013
Application:	Measurement of SWR in 50 $\Omega$ transmission lines
Frequency range	30 to 2700 MHz entered as centre and span
Centre frequency	30 to 2700 MHz
Span	0 to 2670 MHz
Frequency stability	$\pm 50$ ppm
Measurement range	$1.0 < \text{SWR} < 9.9$ , $0 < \text{dB} < -30$ dB
Impedance	Nom. 50 $\Omega$
Generator output	Approx. -4dBm
Max. input on test terminal	100 mW
Tolerance on SWR reading	30 - 1000 MHz $\pm 5\%$ ; 1000 - 1600 MHz $\pm 10\%$ ; and 1600 - 2700 MHz $\pm 15\%$
Operating temperature range	0° C to + 50° C
Storage temperature range	-30° C to + 50° C
Connectors	“N”-female RF test connector.  USB A type for USB memory stick USB B type for serial PC communication (future use) Mini DIN for RS232 (factory use only)
Power supply	4 NiMH type AA 1.2V 1.8Ah rechargeable batteries (Batteries, NiMH rechargeable and 230VAC/7.5VDC charger supplied)
Auto Power off	For battery economy, SWR 4000 automatically turns off after user-defined time
Capacity	Fully charged: More than 6 hours continuously
Colour	Silver/blue
Width	82 mm
Depth	31 mm
Height	165 mm
Weight	500 gram (incl. Batteries)
EMC	Complies with Directive 89/336EEC as amended by 92/31EEC and 93/68/EEC
Standards	Emissions: EN 61000-6-4: 2001 Immunity: EN 61000-6-2: 2005



## XML Feature continued:

On the USB memory stick is a directory called Data, this directory will hold your stored data including spread sheet data and bmp files.

The bmp files can be viewed using any picture viewer and from the viewer it can be zoomed and printed.



The spread sheet files xxxxyyyy.csv are files where the name is xxxx Serial of the instrument yyyy is the sequential file number. In the files are the measurement data for each point on the screen separated by commas. Each data entry is the frequency, reflection coefficient RHO, Return loss in dB and the SWR.

The spread sheet files can be viewed with the programme CSVIEW located onto the memory stick.

Data in these spread sheet files can be imported and used for making all kinds of drawings, statistics and calculations by standard spread sheet programme.

Freq	RHO	RTNLoss	SwR
844.64	.262	-11.	1.71
847.32	.247	-12.	1.65
850.00	.233	-12.	1.60
852.67	.221	-13.	1.56
855.35	.211	-13.	1.53
858.03	.200	-13.	1.50
860.71	.184	-14.	1.45
863.39	.164	-15.	1.39
866.07	.139	-17.	1.32
868.75	.119	-18.	1.27
871.42	.110	-19.	1.24
874.10	.099	-20.	1.22
876.78	.096	-20.	1.21
879.46	.092	-20.	1.20
882.14	.088	-21.	1.19
884.82	.088	-21.	1.19
887.50	.079	-21.	1.17
890.17	.079	-21.	1.17
892.85	.084	-21.	1.18
895.53	.092	-20.	1.20
898.21	.106	-19.	1.23
900.89	.116	-18.	1.26
903.57	.128	-17.	1.29
906.25	.152	-16.	1.35
908.92	.162	-15.	1.36
911.60	.177	-15.	1.43

## **Optional Accessory Kit:**

Automobile cigarette lighter regulated 7.5Volt charger.  
With lighter jack and 5.5 mm DC plug.

Coaxial adaptors to fit "N" at the Test port:

N-male / FME-male

N-male / BNC-female

N-male / TNC-female

N-male / mini UHF-female

Soft canvas case



## Conversion table:

Return Loss In dB	Reflection Coefficient, r	SWR
1	0.891	17.4
2	0.794	8.72
3	0.707	5.85
4	0.631	4.42
5	0.562	3.57
6	0.501	3.01
7	0.447	2.61
8	0.398	2.32
9	0.355	2.10
10	0.316	1.92
12	0.251	1.67
14	0.199	1.50
16	0.158	1.38
18	0.126	1.29
20	0.100	1.22
25	0.056	1.12
30	0.032	1.07
35	0.018	1.04
40	0.010	1.02

### Abbreviations

SWR, VSWR	(Voltage) Standing Wave Ratio
RF	Radio Frequency
MHz	Mega Hertz
GaAs	Gallium Arsenide
MMIC	Monolithic Microwave Integrated Circuit
SMPS	Switched Mode Power Supply
GSM	Global System for Mobile
dBm	decibel referenced to 1 milli Watt
dBd	decibel referenced to half wave dipole
ppm	parts per million
LCD	Liquid Crystal Display
AC	Alternating Current
NiMH	Nickel Metal Hydride



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