SWR TRUE
Antenna Analyzer

Operators Manual

In partnership with

www.instruments4engineers.com

Edition Notice !

This publication applies to COMM-connect A/S SWR True type 3013 SWR
Analyzer product hardware release "2"and software release 3013 suffix 3M.

Table of Contents

General Safety:

SWR TRUE 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 TRUE instrument is an Antenna Analyzer for analyzing Antennas and feeder cable VSWR or Return loss. The instrument measure the return loss by using a Wheatstone RF bridge, a detector and a RF Generator. The control of the entire instrument is by a microprocessor. The microprocessor is running in a MOP (Micro Operating Program) environment. The MOP schedule and execute all tasks required to handle the LCD Screen, the Key-board, 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 generator 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.

The XML Data option, this option will allow the user to enter specific data into the instrument regarding Operator name, Location of Object, Type of Object. The feature will have an XML file viewer or the data could be used in all PC programs supporting XML data format (Microsoft, LINUX etc.)

Remote Control, this option will allow the instrument to be controlled by the RS232 serial interface. The setup going to the instrument and the measure-ment data coming from the instrument can be a part of a large test system.

INSTRUMENTS 4 ENGINEERS
Stockport Business & Innovation Centre
Broadstone Mill, Broadstone Road
Stockport, Sk5 7DL United Kingdom
Tel: +44 (0) 161 871 7450
Email: info@instruments4engineers.com

4

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, 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 TRUE 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
Programming and RS232
Pin 1 RX Data
Pin 2 TX Data
Pin 3 Pgm Clock
Pin 4 Pgm Data
Pin 5 Pgm Control

USB A Memory Stick
USB B PC Serial Device
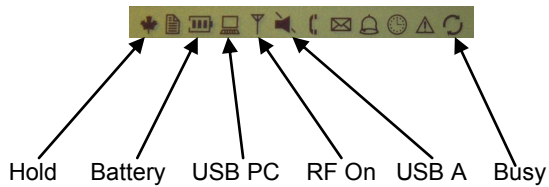DC 7.5 Volt regulated
Charger @ 700 mA + on center pin

Mini DIN   USB A   USB B   DC

Operating

The Front Panel:

Test Connector

Graphic Display

Icon Line

Keys

Charge indicator

Icons

Hold   Battery   USB PC   RF On   USB A   Busy

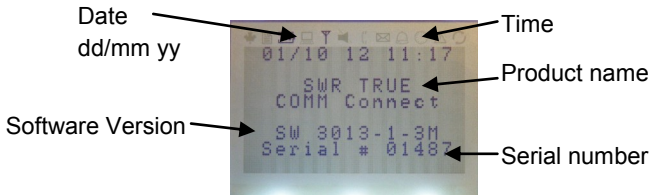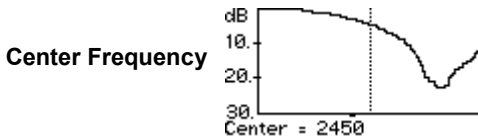**Power On/Off**

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

Date
dd/mm yy   Time

                                            Product name

Software Version

                                            Serial number

The instrument will run for the duration of the AUTO OFF in the menu .

Center Frequency

Pressing the Fc button on the keyboard will give a screen with an entry field Center =   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 center frequency.

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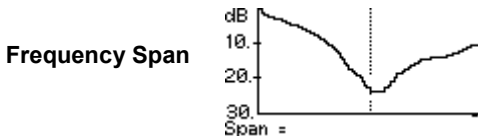
Frequency Span

Pressing the FΔ button on the keyboard will give a screen with an entry field Span =   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.
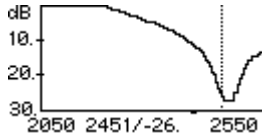
Note that the SWR True automatically adjusts the frequency span so that it fits within the instrument range.

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 center of the screen and adjust the frequency span symmetrical on both side of the new center frequency.

Hold and Copy
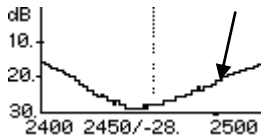
When "HOLD" is pressed, the sweep position indicator stops at the current position and freezes the screen. In "HOLD" mode the frequency sweep is stopped and depending on the setting of Oscillator, the RF is either On or Off. (see menus)

The "COPY" key will write the screen contents to the USB Memory stick. The "COPY" function will create a Directory with the date as directory name YYYYMMDD e.g. 20121001. In the directory the screen files are written as .BMP with the time stamp as file name HHMMSS e.g. 164852.BMP. During write 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 VSWR 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/va
   2 Span Cur/va
   3 Cent Cur/val
   4 Center Span
```

The Horizontal scale can be chosen to have different layout.

1 Start frequency, curser frequency with value and stop frequency.

2 Span Frequency FΔ and curser frequency with value.

3 Center Frequency Fc and curser frequency with value.

4 Center Frequency Fc and Span Frequency FΔ.

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 True is charged and have battery voltage to sustain operation.

9

Menus (cont.)

5 Info:

```
        5   Info
1 Operator   JOHN DOE
2 Address    NEW YORK
3 Device Id  CXL800
4 Device Typ COLLINEA
```

In this menu Data to be used with the XML Feature can be entered; data is 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
```

1. "Power Min" Auto power off time to save battery power. The time to auto 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.

2. The contrast of the LCD screen can be adjusted, you may adjust from 50 to 99. Factory default is 70.

3. The file system may be selected where 1 is the time/date format and 2 is the XML format. See XML feature on page 14.

4. The choice of having the RF generator stopped or running during "HOLD" mode.

www.instruments4engineers.com

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 adapter. Please observe that the use of adapters 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 the SWR True on 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 VSWR or Return Loss curve. Antennas are usually designed to have a 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 <3 dBd) the influence from nearby objects is small when the objects are more than ½λ away (15 cm at GSM900). When testing high gain antennas (e.g. Yagi's and panel's) 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 manufacturers 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 manufacturers 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)!

<center>**Keep connectors clean and tight!**</center>

Calibration

We recommend the "SWR True" to be recalibrated once every 24 month. On the "Welcome Menu" the "Calibration Due" will appear when the calibration period is exhausted. The calibration message will not affect the functions and measurement of the SWR True.
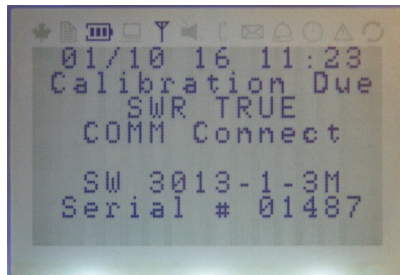
Specifications:

Model	SWR TRUE Type 3013
Application:	Measurement of SWR in 50 Ω transmission lines
Frequency range	30->2700 MHz entered as center and span
Center Frequency	30 to 2700 MHz
Span	0 to 2670 MHz
Frequency stability	±50 ppm
Measurement range	1.0<SWR<9.9, 0<dB<-30 dB
Impedance	Nom. 50 Ω
Generator output	Approx. -4 dBm
Max. input on test terminal	100 mW
Tolerance on SWR reading	30-1000 MHz ± 5%; 1000-1600 MHz ± 10%; and 1600-2700 MHz ±15%
Operating temperature range	0° C-> + 50° C
Storage temperature range	-30° C -> + 50° C
Calibration	Every 24 month recommended.
Connectors	"N"-female RF test connector.
	USB A type for memory key.
	USB B type for serial PC communication.
	Mini DIN for RS232 up to 38400 Baud
Power supply	4 NiMH type AA 1.2 V 1.8 Ah rechargeable batteries
	(Batteries, NiMH rechargeable and 230 VAC/7.5 VDC charger supplied)
Auto Power off	For battery economy, SWR TRUE 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:

In order to use the XML feature this must be installed. When the feature is installed You can take advantage of the info menu 5 where operator, address, device and types can be entered.

```
    5    Info
1 Operator   JOHN DOE
2 Address    BERLIN
3 Device Id  CXL800
4 Device Typ COLINAR
5 SerialNo   01001
```

Also you can choose between the stand-ard .bmp picture copy (File sys 1)or the XML type where all info is copied onto the USB memory stick (File sys 2)

```
    6    Settings
1 Power Min   5
2 Contrast    70
3 File sys    2
4 Hold Osc  OFF
5 Maint       0
```
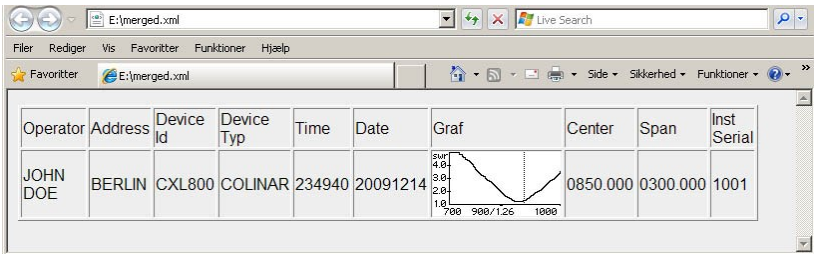
Along with the XML Feature is a USB Memory Stick with program files:
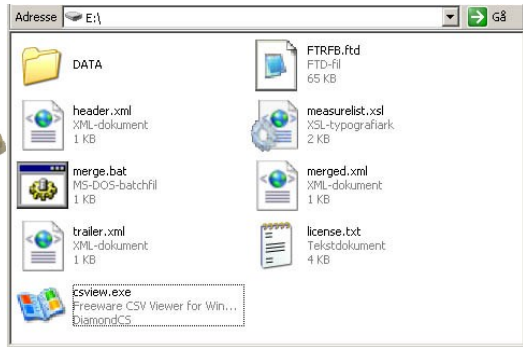
After inserting the USB memory stick into the SWR True and pressing "COPY" the Screen is copied to the USB memory stick along with Info data, time of day, date and table data for each of the 101 data points on screen.

Taking the USB memory stick to your PC you can execute the "merge.bat" program which will give you all stored data in the following format:

Operator	Address	Device Id	Device Typ	Time	Date	Graf	Center	Span	Inst Serial
JOHN DOE	BERLIN	CXL800	COLINAR	234940	20091214		0850.000	0300.000	1001

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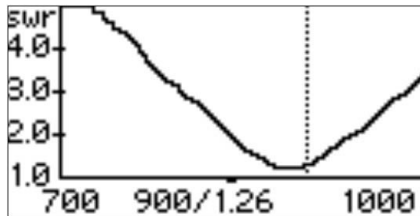
The spread sheet files xxxxyyyy.CSV are files where the name is xxxx Serial of the instrument yyyy is the sequential file number. In the files are the measurement data for each point on the screen separated by commas. Each data entry is the frequency, reflection coefficient RHO, Return loss in dB and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

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

Data in these spread sheets files can be imported and used for making all kind of drawings, statistics and calculations by standard spreadsheet programs.

DiamondCS CSView - E:\DATA\10011009.CSV

File

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.	1.38
911.60	.177	-15.	1.43

Optional accessories Kit:

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

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

N male / FME male

N male / BNC female

N male / TNC female

N male / miniUHF female

Soft canvas case

Nato approved SWR True-MIL : (NSN 6625-22-623-9610)
Ruggedized and Dust proof enhancement.

Nato approved accessory kit SWR-ASS: (NSN 6625-22-623-9614)

Professional carrying case that is water-and airtight. The carrying case
contains 7.5 Volt Auto Charger with Hella connectors that can be used in
vehicles with 12-32 Volts. Furthermore, there is room for 8 pieces N
adaptors, and 1 pc. 7/16 adapter. There is extra space for cables and
instructions, as well as cuts for SafeOne *

Included Adaptors:

N male / UHF female

N male / BNC female

N male / TNC female

N male / SMA female

* SafeOne is a small RF field strength meter that warns the user if the RF
radiation exceeds health authorities' requirements. (WHO ICNIRP) 16

PC Viewer Program Option

In order to run the PC Viewer program with COMM-connect 3013 SWR True perform the following steps:

Install the program on your PC using defaults.

> Make sure .NET Framework version 3.5 is installed on your PC.
> (available online at Micro Soft and requested by this installation)
> Run the "3013 PC Display Install.msi" from the memory stick; follow the default installation.
> After driver installation etc. you should have an Icon on your Desktop:

To use the program:

> Insert memory stick into SWR True.
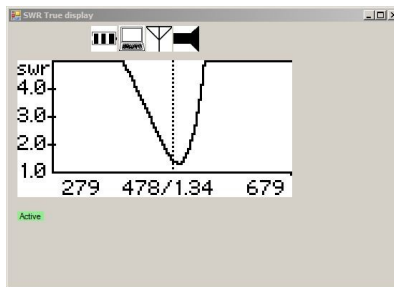> Connect the USB interface cable from SWR True to your PC.
> Power on the SWR True.
> After welcome screen has completed on SWR True press "Copy" and wait for busy to disappear.
> Run the "3013 Display" program.
> In your PC program select the COM port.
> When "Active" is displayed in the bottom of the screen the Viewer is running.

Note: When running under Windows XP the program will terminate unexpected if connection to 3013 SWR True is disconnected before the Viewer program is terminated!

Conversion table:

Return Loss In dB	Reflection Coefficient, r	VSWR
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
PLL	Phase Locked Loop
USB	Universal Serial Bus
RS232	EIA Serial Interface
SMPS	Switched Mode Power Supply
GSM	Global System for Mobile
dBm	deciBell referenced to 1 milli Watt
dBd	deciBell referenced to half wave dipole
ppm	parts per million
LCD	Liquid Crystal Display
AC	Alternating Current
NiMH	Nickel Metal Hydride

Another great product from COMM-connect:

PMR Power Meter

Type 3030

Specifications:

Frequency range: 30MHz - 500MHz
· VSWR: < 1.05:1
· 50Ohms "N" Female connector
· Power Range: 1.5mW to 100W
· Display resolution: 128x64 pixels
· Calibration stored in EEPROM
· USB Serial device (B type)
· Operation time: > 5 hours