HOMER Analyzer ISM 2.45 GHz, WR340 Waveguide

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General Description

The HOMER-Series STH 2.45-GHz Analyzer is an automatic impedance and power measurement system based on the WR340 (R26) waveguide. The system works under the full-power operating conditions of magnetron-based and solid-state microwave generators. The Analyzer measures both the magnitude and phase of the reflection coefficient as well as incident, reflected and absorbed power, and frequency. The system is designed forlow-ripple continuous wave (CW), high-ripple (Rectified) and Pulsed sampling modes. The peak working power is set at manufacture time as specified in the customer's order. The unit can be equipped with precision adapters to WR430 or WR284.

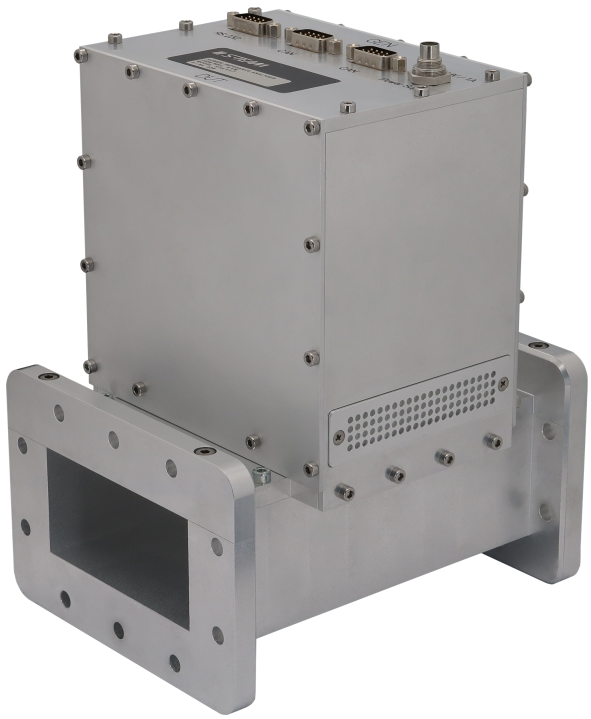

Fig. 1. HOMER Analyzer STH 1.7.

STH can be:

- Controlled from a personal computer or another controller via the following communication interfaces:
  - RS232 or RS422,
  - CAN (Controller Area Network),
  - EtherNet/IP.
- Integrated into a LabVIEW environment.

The system comes with its own firmware (Server) and documentation.

Principle of Operation

The HOMER Analyzer is based on the six-port reflectometer (SPR) principle. Reflectometers of this type are especially suitable for industrial applications where on-line monitoring and control under full working power is required. SPR is capable of measuring not only the complex reflection coefficient of the load but also the incident, reflected and absorbed powers. A frequency counter is also integrated with the system. The conceptual simplicity of SPR facilitates its stable and temperature-independent operation over long periods of time. The system parameters required for the computations are obtained in the process of

factory-made calibration, in which a collection of impedance standards is connected in place of the load. It is recommended for the best performance that the recalibration be performed every two years.

Modes of Sampling

HOMER supports three modes of microwave signal sampling, named *CW*, *Rectified*, and *Pulsed*.

- **CW mode** is applicable to unmodulated signals with output power ripple not exceeding 15% of the peak value.
- **Rectified mode** is designed for slowly pulsing signals (with repetition rates up to several kHz). Such signals are typical for magnetrons powered by economy power supplies which incorporate simple half-wave or full-wave rectifiers.
- **Pulsed mode** (optional) is intended primarily for sampling fast square pulse-modulated microwave signals with pulse widths down to 100 µs.

The *Rectified* and *Pulsed* modes provide both instantaneous and mean values of the reflection coefficient and powers.

HomSoft Windows Control, Visualization and Data Logging Software

The *HomSoft* control, visualization and data logging software (Fig. 2 on the next page) significantly expands the system capabilities. Its basic features include:

- Microsoft Windows® environment.
- Accurate measurement of complex reflection coefficient and its display in various formats, such as
  - Magnitude
  - Phase
  - Return Loss
  - VSWR
  - Polar Display
  - Smith Charts (Z and Y)
  - Oven diagram (Rieke-type chart)
  - Frequency
- Measurement of incident, reflected, and absorbed powers and their display in various formats, such as watts, decibels, or percentage of incident power.
- Numerical readout of signal frequency, load reflection coefficient and power in various formats.
- Arbitrary shifting of the measurement plane.
- Saving measured data as tables (text files) or pictures (BMP, GIF, JPG).
- Periodic data logging of all measured quantities.
- Multiple windows enabling simultaneous observation of various quantities in different formats.
- Wide selection of appearances of displayed curves.
- Storage and retrieval of complete system settings tailored to particular tasks.
- DDE Server option, enabling other Windows applications to share measurement results.
- Extensive on-line help.

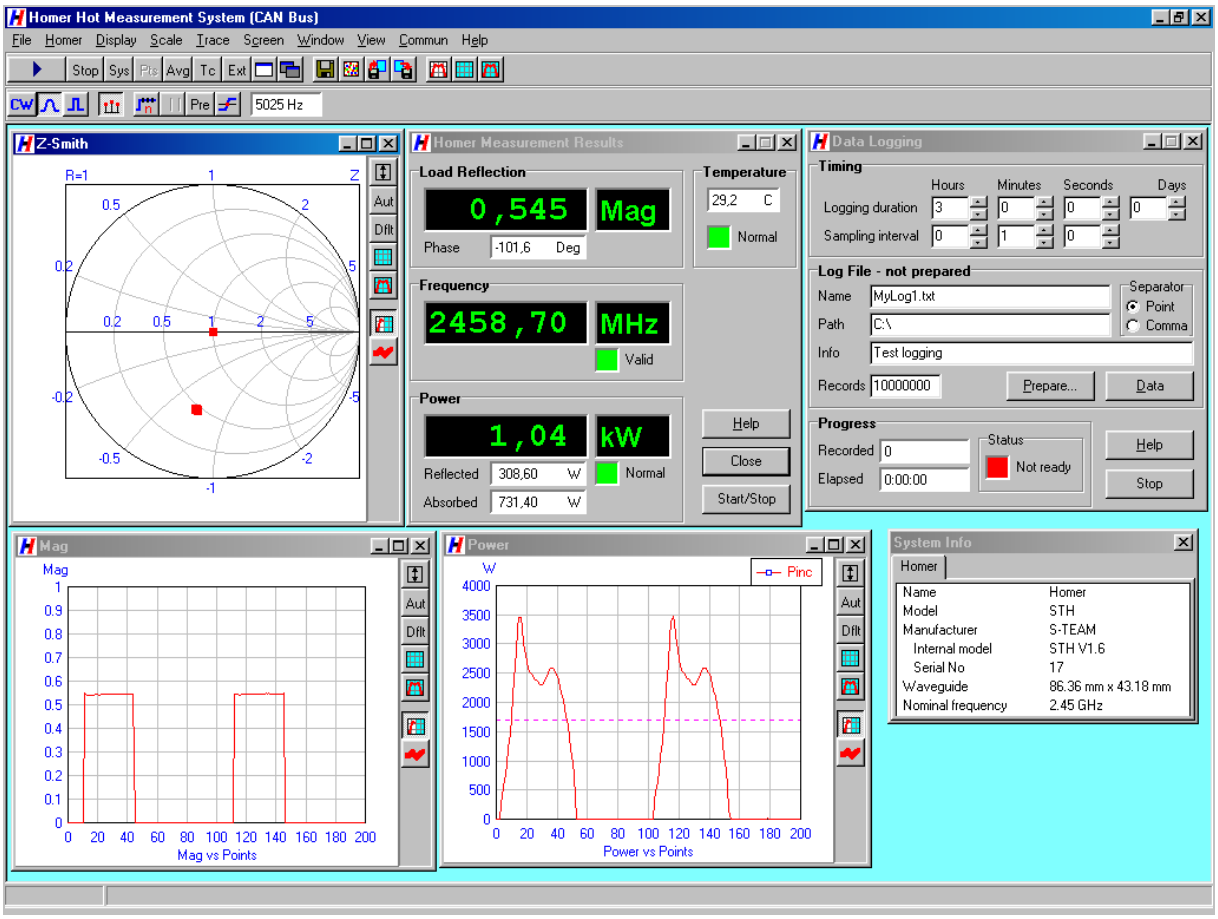

Fig. 2. An example of *HomSoft* graphical user interface.

Specifications

Electrical	
Waveguide type[1]	WR340 (R26)
Flange type	IEC
Frequency range	2425 – 2475 MHz
Available maximum working power[2] [3]	100 W – 30 kW
Dynamic range of working power	20 dB
Reflection coefficient measurement error (uncertainty circle radius)	0.05
Incident power measurement error (matched load)	±5 %
Power supply voltage	24 V ±10% DC
Current consumption	0.7 A
Interface	RS232, RS422, CAN, EtherNet/IP
Modes of signal sampling	CW, Rectified, Pulsed
Max acceptable ripple in CW mode	15 % of peak value
Max repetition rate of signal envelope in Rectified mode[4]	10 kHz
Min pulse width in Pulsed mode	100 µs
Mechanical	
Mass	3 kg
Length	174 mm (6.85 in)
Width	138 mm (5.43 in)
Height	226 mm (8.90 in)
Surface finish	E-CLPS 4600
Environmental	
Operating temperature range	+5 to +55 °C
Storage temperature range	-10 to +70 °C
Optimal conditions for long term storage	+5 to +35 °C, humidity < 75%

[1] Stepped or tapered precision transitions to either WR430 (R22) or WR284 (R32) waveguides can be integrated upon request.

[2] The actual maximum working power is hardware-fixed according to customer's order (must be within the Specifications limits). Any changes to the peak working power require hardware modification and partial unit recalibration, and therefore must be done at the factory. The actual minimum working power is 20 dB (= dynamic range) below the actual maximum working power.

[3] In Rectified and Pulsed modes, maximum power means ***peak*** power (not its mean value).

[4] Signal envelope repetition rate (ripple frequency) f_e is determined by power line frequency f_p and the rectification method. Examples: One-phase half-wave rectification $f_e=f_p$; one-phase full-wave rectification $f_e=2f_p$; three-phase half-wave rectification $f_e=3f_p$; three-phase full-wave rectification $f_e=6f_p$; three-phase Y+Δ half-wave rectification $f_e=6f_p$; three-phase Y+Δ full-wave rectification $f_e=12f_p$.

Configurations

Basic Configuration

- STH Basic Unit
- Internal firmware (Server)
- Calibration in 2425 – 2475 MHz band
- RS232 or RS422 serial interface
- CW and Rectified modes of sampling
- Operating handbook (pdf)
- Communication protocol manual (pdf)
- A set of standard cables[5]

Options

1. *HomSoft* control
2. Pulsed mode of sampling
3. n/a
4. CAN Bus communication interface (includes CAN Bus cable)
5. CAN-USB Adapter (to connect a PC to CAN Bus network)
6. LabVIEW HOMER Virtual Instruments Library
7. Dynamic Data Exchange (DDE) server in *HomSoft* Windows SW[6]
8. Technical support in hours
9. n/a
10. n/a
11. EtherNet/IP communication interface

For further details of some of these options, see section Option Descriptions.

Optional Power Supplies

- Traco Power TBL 150-124, 24V/6.25A, DIN rail mountable
- Electro-Automatik EA-PS-524-11T, 24V/10.5A, input 90-264 V, benchtop

[5] The set of standard cables includes DC power supply cable, RS232/RS422 cable, and (in case of CAN Bus) CAN Bus cable.

[6] *HomSoft* control option required.

Option Descriptions

***HomSoft* control.** *HomSoft* is a license-free software package designed for comprehensive monitoring and control of Analyzers thanks to its extensive graphical visualizations. However, *HomSoft* works only with Analyzers that have the "*HomSoft* control" option enabled within the unit. The *HomSoft* control option can be enabled at time of purchase of an Analyzer, or can be purchased later and activated at the customer's site without needing to return the unit to the manufacturer.

For units without the HomSoft control option enabled, the HomSoft installation package includes a limited-feature test software called TuTool. While TuTool provides basic functionality, it lacks graphical visualizations, displaying only numerical data.

CAN-USB Adapter. To connect your PC with a CAN Bus network (or with the STHT alone), either the Peak PCAN-USB Interface or Sontheim CAN USB Light Dongle adapter is needed. You can order it as an option. Another possibility is to buy the dongle yourself from the manufacturer (visit the links above).

LabVIEW HOMER Virtual Instruments Library enables HOMER monitoring and control from within the National Instruments' LabVIEW environment. The library consists of a collection of virtual instruments (Fig. 3 above) and includes several useful examples. The library enables users to integrate HOMER into their own applications with much less effort than trying to start from scratch by studying HOMER communication protocol and programming the complete communication.

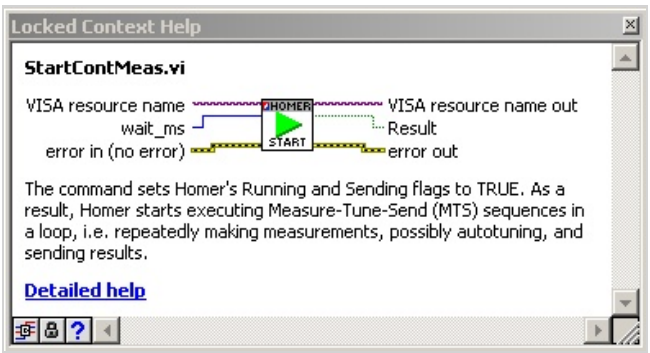

Fig. 3. An example of a LabVIEW virtual instrument block.

DDE Server. DDE Server is a functionality within the *HomSoft* Windows visualization and control SW, and hence it needs the *HomSoft*control option, too. The DDE Server enables another (customer's) Windows program, e.g., Microsoft Excel, to extract measurement results from running *HomSoft*.

Technical support. It often happens that new users, especially in the initial phase, need counsel about issues that are not directly a matter of HOMER itself but of their particular application, or about topics that are in fact described in the accompanying documentation. Four hours of such support are provided free of charge; additional support should be ordered.

Dimensional Drawing

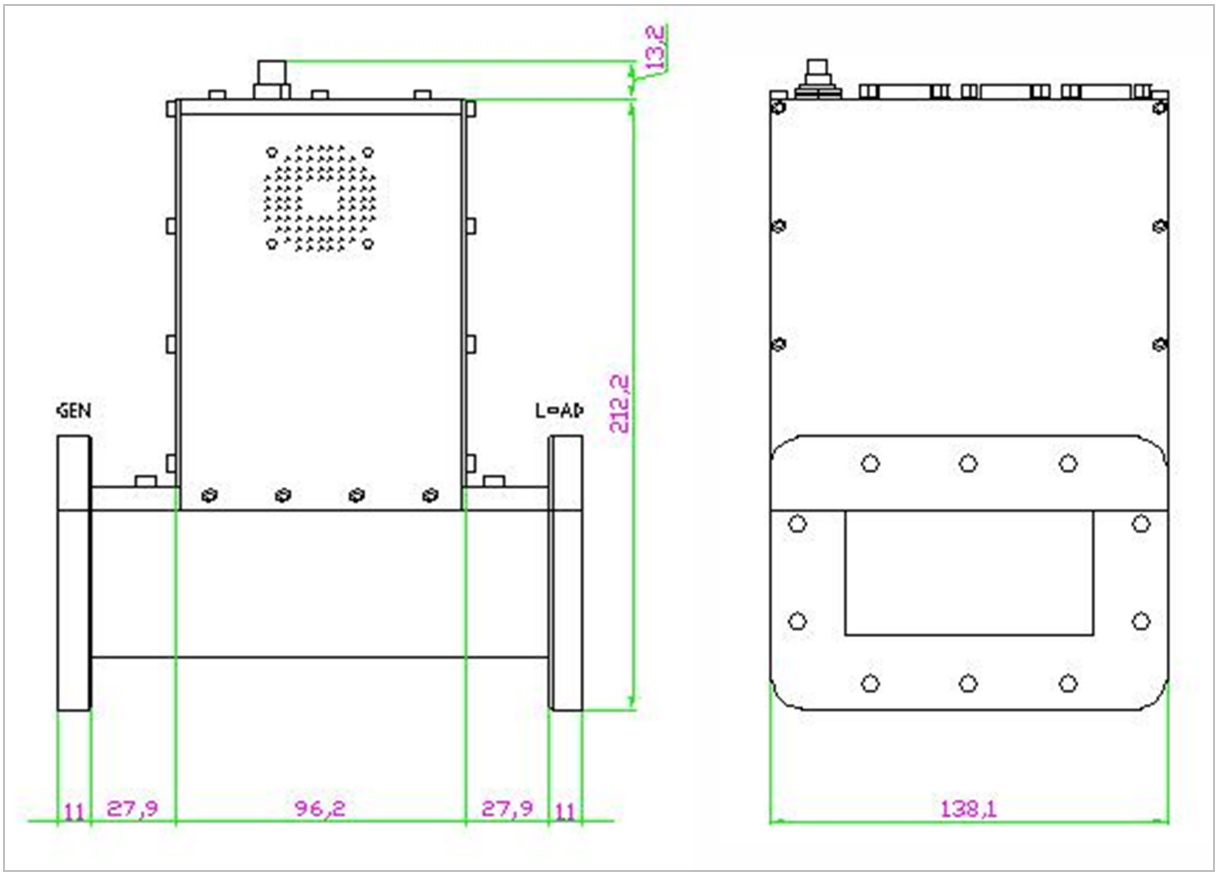

Fig. 4. Basic HOMER Analyzer STH 1.7 dimensions in millimeters.

Modifications

To allow smooth HOMER unit integration into installations with different waveguide sizes or with coaxial transmission lines, a range of precision waveguide transitions and waveguide-to-coax adapters are available:

Model	Port 1	Port 2	Type	Length (mm)
WTS142	WR340	WR430	Step	66.00
WTT141	WR340	WR430	Taper	78.90
WTS151	WR340	WR284	Step	85.00
WTL171	WR340	7/8" EIA	Inline	101.30

Fig. 5 below shows an example of a modified HOMER product: a water-cooled STHT 1.8 with precision WR340-to-WR430 step transitions WTS142 attached at both ends. In this particular case, the length of each transition is 66 mm, increasing the total device length from 260 mm to 392 mm.

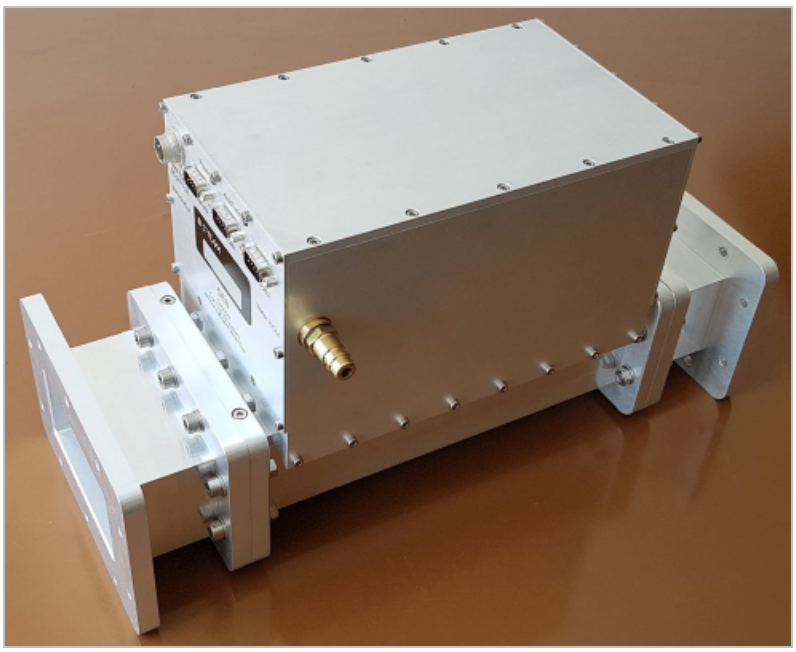

Fig. 5. A water-cooled HOMER Autotuner STHT 1.8 with precision waveguide transitions.