



Homer Help

User's Handbook

S-TEAM

Jul-2026

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INTRODUCTION

This Help/Handbook is Version 5.0.3.0-60. It describes:

- Topics important for understanding, installation, and upgrading of the **Homer** measurement and autotuning systems.
- The use of the ***S-TEAM Homer Windows Visualization and Control Software***, referred to as **HomSoft**.

The **HomSoft** version described in this document has been created for Microsoft Windows 10 and higher operating systems.

The following sections provide essential information about S-TEAM Homer Analyzers and Autotuners.

A basic step-by-step procedure for using the **HomSoft** software is outlined in the [How to Use the Program](#) section.

Notes:

- Many of the program windows and dialog boxes include a  button.
- If **HomSoft** program windows do not display properly on very-high definition monitors (e.g., notebook 4K displays), please reduce the monitor resolution: for instance to 1920 × 1080. You can do this by right-clicking the desktop surface and choosing **Display settings**.

Welcome to Homer

The software described in this document pertains to the following measurement, tuning, and autotuning systems: Homer Analyzer, Homer Mototuner, and Homer Autotuner.

- **Homer Analyzer** is a high-power impedance, power and frequency measurement instrument optimized for different Industrial-Scientific-Medical (ISM) bands and transmission media (waveguide, coaxial), capable of handling various types of signal waveforms and power levels.
- **Homer Mototuner** is a motorized three-stub high-power impedance transformer optimized for different ISM bands and transmission media.
- **Homer Autotuner** is an intelligent system that combines the Homer Analyzer and Homer Mototuner. Autotuner can be a compact one-piece unit, or a two-piece device consisting of separate Analyzer and Mototuner units. The Autotuner combines functionalities of the Analyzer and Mototuner and, more than that, can be used for autonomous or externally controlled automatic impedance matching of time-varying loads.

For the sake of text simplicity, the term **Homer** will be used for all three system categories, having usually the most complex of them, the **Autotuner**, in mind.

An inseparable integral part of Homer is its **firmware**, the most important part of which is the internal program, denoted as **Server**. This internal program should be differentiated from the **HomSoft** Windows Visualisation & Control SW, running in your PC and enabling easy control and monitoring of the Homer. The two programs cooperate via a communication link, which can be

RS232, RS422 or CAN Bus (RS232 and RS422 use the same communication protocol and will be treated as one).

A full-fledged **HomSoft** application can communicate with a Homer device only if the Homer device is provided with the *HomSoft Control* option (please refer to Homer datasheet for Homer options). Without the *HomSoft Control* option, you can still access Server functionalities by writing your own program for PC or PLC, using the published communication protocol (part of Homer documentation). Another alternative is to use a complimentary [reduced-functionality HomSoft](#) application, named **HomTool**.

The Homer Autotuner can also work without any external control as an autonomous unit. In this case, its behavior is controlled by several internal [configuration files](#), available for editing by the user.

Note that both Homer hardware and software are continually evolving; upgraded versions include updated Help.

New Users

For new users of the system and **HomSoft** software, the best approach is to study the User's Handbook or this Help systematically, topic by topic as they appear sequentially in the Table of Contents, or by using the **Next** and **Previous** browsing buttons. This way, the user acquires a global overview and becomes aware of the multitude of capabilities the system offers.

When using the program and pointing at a *menu item*, please observe the brief information appearing in the bottom status bar of the main program window. Also, many of the program windows and dialog boxes have a **Help** button, which opens a related help topic.

For training purposes, the best way is to use the **HoSim.exe** [simulation version](#) of **HomSoft**, which requires nothing more than your computer.

To see "behind the scenes" of Homer communication, you may wish to peruse the Homer Communication Protocol (see below).

Accompanying Literature

- Homer Hot Measurement and Autotuning System: User's Handbook (*HomerHbookxxxx_y.pdf* where *xxxx_y* stands for version number).
- Homer Communication Protocol (*HoComProtoxx_y.pdf* where *xx_y* stands for version number).
- Application Notes (part of **HomSoft** installation or downloadable from <https://s-team.sk/docs>).

Other Sources

- Power Transmission Theory and Calculator (downloadable from <https://s-team.sk/software>).
- Six-Port Measurement Technique: Theory and Applications (downloadable from <https://s-team.sk/docs>).

Reporting Problems

When reporting problems, please adhere to instructions in the [Problem Reporting](#) section.

Key Features

Homer Analyzer and Autotuner

Homer **Analyzer** enables the user to accurately measure under full-power operating conditions of magnetron-based or solid-state microwave generators:

- Magnitude and phase of reflection coefficient.
- Incident, reflected, and absorbed power.
- Signal frequency.

The system can handle the following types of microwave signals:

- Low-ripple continuous wave (**CW** mode of sampling).
- Slowly pulsing signals resulting from powering magnetron with rectified unfiltered power line voltage (**Rectified** mode of sampling).
- Fast pulse-modulated signals with pulse durations down to 100 μs (**Pulsed** mode of sampling).

The system can communicate with an external controller or monitor via

- RS232/RS422 serial interface.
- CAN Bus serial interface. More Homers can be connected to the same bus simultaneously (see [MultiCAN: More Homers on CAN Bus](#)).

Homer **Autotuner** can be used for autonomous or externally-controlled automatic impedance matching of time-varying loads under complex microwave signal conditions.

These features make Homer suitable for effective and easy monitoring and control of process parameters, e.g., in plasma generation, semiconductor fabrication, heating, drying, sintering, coating, chemical reactions, materials processing and many other industrial applications.

Homer, in particular:

- Enables the user to understand the complex impedance (vector reflection coefficient) of microwave loads.
- Provides means for performance tests during the development and production of microwave applicators.
- Can be used to characterize new equipment designs.
- Enables designing, adjusting, or programming of equipment to desired characteristics.
- Maintains design specifications during manufacturing.
- Gives on-line control of microwave processes.

HomSoft Windows Visualization and Control Software

- Provides visualization of measured complex reflection coefficient in various formats,

including:

- Magnitude
- Phase angle
- Return loss
- VSWR
- Polar plot
- Smith charts (impedance and admittance)
- Rieke diagram-type plot
- In the case of Autotuner, the display can be switched between:
 - Input reflection coefficient (includes effect of inserted tuning stubs).
 - Load (deembedded) reflection coefficient, i.e., reflection coefficient that would be measured if the tuning stubs were withdrawn.
 - You can see both of them simultaneously in two separate windows.
- Measurement of incident, reflected and absorbed powers and their display in various formats, including watts, decibels, percentage of incident power.
- Numerical readout of signal frequency, reflection coefficient and powers in various formats.
- Displaying the time evolution of measured quantities.
- Displaying the waveform (envelope) of microwave power in Rectified and Pulsed operation modes.
- Arbitrary shifting of the load reference plane.
- Saving measured data as tables (text files) or pictures (BMP, PNG, GIF and JPG).
- Periodic data logging of all or some of the measured quantities.
- Multiple windows enable the user to observe the same results in different formats simultaneously.
- Wide selection of appearance of displayed curves.
- Storage and retrieval of complete system settings adapted to particular tasks.

Inside Homer

A block diagram of a generic Homer Autotuner is shown in [Fig. 1](#). The Homer Analyzer part of the system is based on the six-port reflectometer (SPR) principle. SPR is suitable for high-power industrial applications due to its capability of precision on-line measurement of

- complex (vector) reflection coefficient of microwave applicators,
- incident, reflected and absorbed powers.

at full working-power conditions of industrial installations. Moreover, the complex reflection coefficient can be used in predictive impedance matching algorithms actuating the Autotuner, enabling thus the design of fast, compact Autotuners.

From voltages obtained by its four amplitude detectors, the SPR computes :

- Complex reflection coefficient Γ of a device under test (DUT), possibly transformed by the

Tuner.

- Incident power P_i

The detector signals are appropriate combinations (determined by the SPR hardware) of the wave incident on and reflected from the measured load Γ , one of the signals (the reference signal) being a sample of predominantly the incident wave. The SPR parameters required for the computations in addition to the detector voltages are obtained in the process of *calibration* where a set of impedance standards are connected in place of DUT.

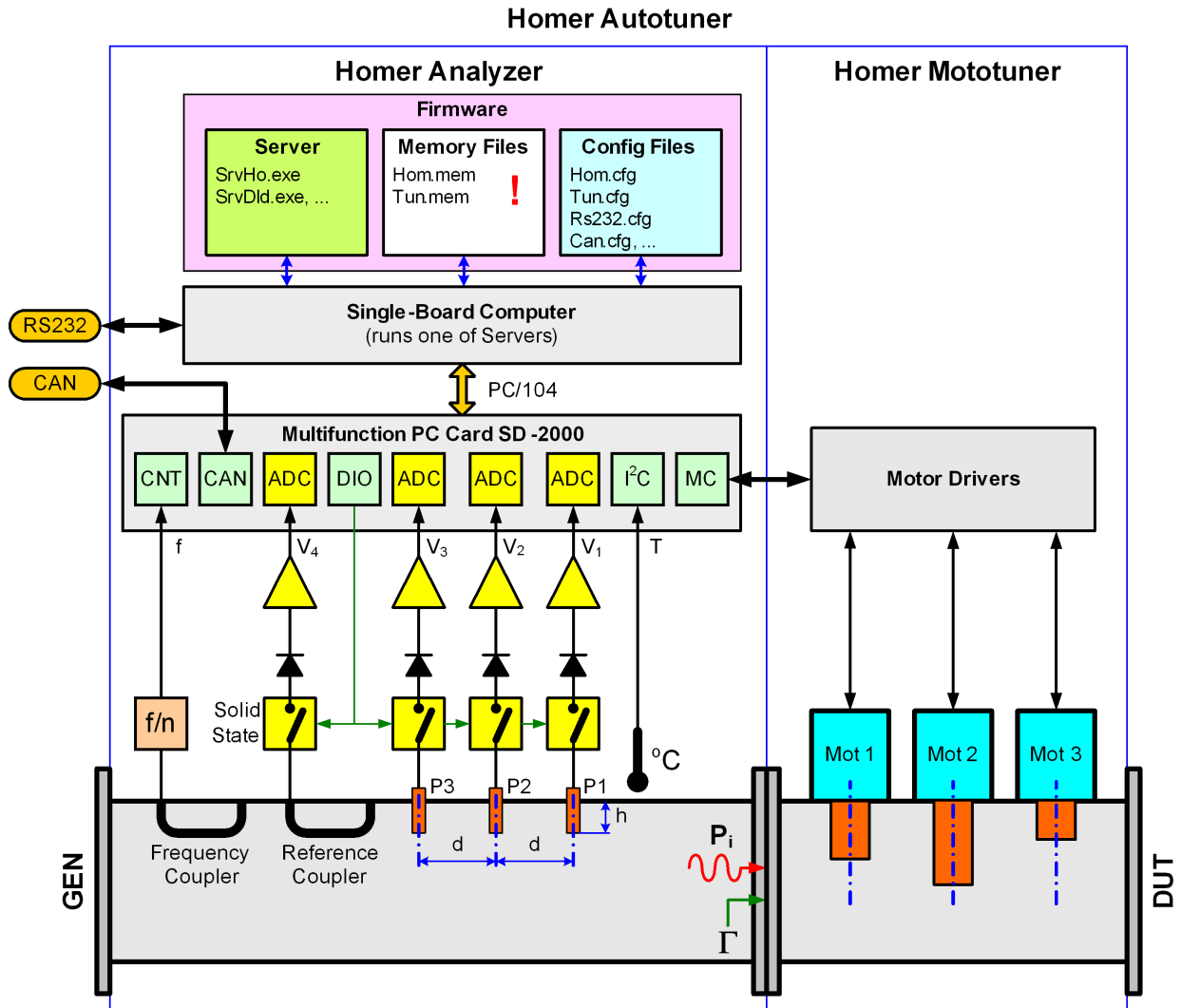


Fig. 1. Homer Autotuner block diagram.

Principal microwave components of the SPR are three *combination* voltage probes (P1, P2, P3) and a *reference* coupler. The voltage probes effectively sample the standing wave pattern, i.e., the magnitude of the vector sum of the incident and reflected waves at three points along the line. An optimum performance is achieved at mutual probe distances $d = \lambda_g/6$ (electrically 60°), with λ_g being the guide wavelength. Insertion depth h of the probes governs the probe coupling factor C hence the nominal working power of the system. For high working powers the probes are in fact recessed.

The reference coupler should ideally, although not necessarily, probe solely the wave incident on the load.

Microwave signals from the combination probes and the reference coupler are converted to DC in amplitude detectors, then amplified and converted to digital in a multifunction PC-card of in-house design (SD-2000), containing 4 separate channels of precision programmable amplifiers (PGA) followed by A/D converters (ADC). Solid-state switches preceding the detectors serve for capturing offsets of the DC circuitry (apparent signals in absence of microwave power), which must be subtracted from the measured voltages V_1 to V_4 . The switches are controlled by a digital input/output (DIO) portion of SD-2000. In a single-board computer (SBC), connected with SD-2000 via PC/104 interface, the digitized voltages undergo a correction routine which eliminates nonlinearity and temperature dependence of the detector transfer characteristics. The inner temperature is measured by a sensor with serial output, connected to SD-2000 by means of I²C bus. The corrected voltages along with signal frequency and stored SPR calibration data are used to compute the reflection coefficient Γ and incident power P_i .

Accurate knowledge of signal frequency is a precondition for accurate measurement. Since magnetrons used in industrial applications are free-running sources with frequency depending on working conditions, frequency is not known in advance but must be measured. A frequency counter is therefore integrated with the system. The counter uses a separate directional coupler (Frequency Coupler) of basically the same design as the reference coupler. The coupled signal frequency is divided in a microwave prescaler down to about 50 – 100 MHz, which is then measured by a 150-MHz counter (CNT) implemented in SD-2000. Gating intervals down to 16 μ s plus the triggering built in the SD-2000 software enable reasonable measurement even of pulsed signals with pulse duration down to about 100 μ s.

The system communicates with an external controller (e.g., a personal computer) via RS232 or CAN Bus interface, the latter being implemented in SD-2000. Another function implemented in SD-2000 is a full control (MC in [Fig. 1](#)) of three stepper motors for the purpose of automatic impedance matching.

Residing inside SBC is Homer *firmware*, which is a system of files that control its operation and behavior. The firmware consists of an assembly of executable files (Servers), memory files (containing individual information, like system identity and calibration data) and auxiliary configuration files, defining the Homer startup behavior. The Server programs run in SBC one at a time, performing all tasks associated with acquiring data, computations of results, receiving commands from PC and sending responses and measurement results. The results include real and imaginary part of measured and load (deembedded) reflection coefficients, power incident on and reflected from DUT, frequency, internal temperature and error byte. In the case of Autotuner, the data include tuning stub positions and motors status. The configuration files, read by Server at its start, contain various Homer power-up settings.

While configuration files can be transferred from one Homer to another to ensure the same startup behavior, memory files are strictly individual. Any attempt to transfer them to a non-native Homer results in a Homer Identity Error and causes the system to refuse to perform, except for some basic operations, such as file transfers.

See more about the firmware in [Homer Internal Files](#).

The Windows **HomSoft** application described in this document enables full Homer control,

receiving of results, converting them to a variety of formats, displaying and storing them, as well as long-term monitoring and data logging.

Learn about Homer Analyzer [measurement accuracy](#).

Homer Versions

Many Homer Analyzer and Autotuner versions exist. They differ by the following main parameters:

- Frequency range (ISM band):
 - 900 MHz (890 – 930 MHz)
 - 2.45 GHz (2425 – 2475 MHz)
 - 5.8 GHz (5725 – 5875 MHz)
- Transmission medium:
 - Waveguide
 - Waveguide type
 - Coaxial
 - Coax dimensions
- RS serial communication interface:
 - RS232
 - RS422
- Maximum input power (as required by customers).
- Type of cooling:
 - Air cooling
 - Water cooling
- Equipment:
 - Presence, type and positioning of connectors
 - Presence and position of **AUTOTUNE** switch
 - Presence and position of **ALL STUBS HOME** button
 - Presence and position of indicator LEDs

This document cannot cover details of every type. The specifics of individual types can be found in the published catalog sheets. In case of any doubt, please contact your vendor or the manufacturer.

Measurement Accuracy

The principal quantity characterizing measurement error of a six-port-based reflectometer is the *uncertainty circle*, drawn in the polar plot around the measured reflection coefficient Γ (see [Fig. 2](#)). Its radius u is such that the actual (true) result lies with a nearly 100% probability somewhere

within this circle. From the radius of the uncertainty circle, all other uncertainty quantities can be derived. The actual radius of the uncertainty circle depends on operating conditions, such as frequency, measured reflection coefficient, input power, or ambient temperature. Therefore, usually a worst-case radius is specified for a defined range of operating conditions, or its typical value.

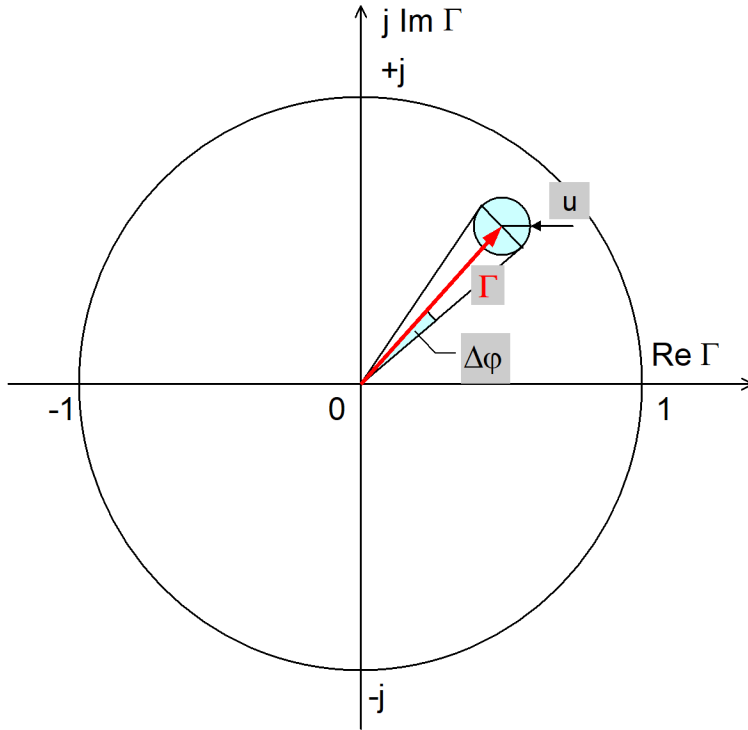


Fig. 2. Reflection coefficient uncertainty circle.

If the radius of the uncertainty circle is u and the measured reflection coefficient is

$$\Gamma = M \exp(j\pi\varphi/180)$$

where M is its modulus (absolute value, magnitude) and φ its phase angle in degrees, then the uncertainty limits for various quantities of interest are as follows:

Reflection coefficient modulus

$$M_{\max} = M + u$$

$$M_{\min} = M - u$$

The formulas assume $M > u$. If $M < u$ then $M_{\min} = 0$.

Reflection coefficient phase angle

$$\varphi_{\max} = \varphi + \Delta\varphi$$

$$\varphi_{\min} = \varphi - \Delta\varphi$$

where

$$\Delta\varphi = \frac{180}{\pi} \frac{u}{M}$$

is phase angle uncertainty in degrees. The formula derivation assumes $M \gg u$. Obviously, given a value of u , the phase angle uncertainty grows when the reflection coefficient magnitude decreases. For $M < u$, the phase angle becomes meaningless.

Return loss R

$$R_{\max} = -20 \log(M_{\min})$$

$$R_{\min} = -20 \log(M_{\max})$$

Voltage standing wave ratio VSWR

$$VSWR_{\max} = (1 + M_{\max}) / (1 - M_{\max})$$

$$VSWR_{\min} = (1 + M_{\min}) / (1 - M_{\min})$$

Effective directivity and test port (source) match

Two independent quantities usually characterize heterodyne network analyzers. These are:

- Effective directivity E_D (critical for the measurement of small reflection coefficients).
- Effective test port (source) match E_S (affecting primarily the measurement of high reflection coefficients).

In the six-port reflectometer, effective directivity can be linked with the uncertainty circle radius u as

$$E_D = -20 \log u$$

Effective test port match is a quantity that cannot be practically defined for this measurement principle.

See also [Deembedded Reflection Coefficient Accuracy Considerations](#).

Measurement Uncertainty Example

An example of return loss uncertainty considerations is depicted in [Fig. 3](#). If, for instance, the uncertainty radius is $u = 0.02$ ($E_D = 34$ dB) and the measured return loss is 20 dB (i.e., $M = 0.1$), then the true value lies somewhere between $R_{\min} = 18.42$ dB and $R_{\max} = 21.94$ dB.

If you wish to be sure that the true return loss is greater than 20 dB, the measured value must be so that $R_{\min}$ is at least 20 dB. The intersection of 20-dB horizontal graticule with the lower blue line (green circle) then shows that the measured return loss must be at least 22 dB.

Mathematically, $R_{\min} = 20$ dB corresponds to $M_{\max} = 0.1$. Because, as stated above,

$$M_{\max} = M + u,$$

the measured reflection coefficient magnitude must not exceed the value

$$M_x = M_{\max} - u = 0.1 - 0.02 = 0.08,$$

hence the measured return loss must be at least

$$R_x = -20 \log(M_x) = -20 \log(0.08) = 21.94 \text{ dB},$$

which is approximately the 22 dB obtained from the graph.

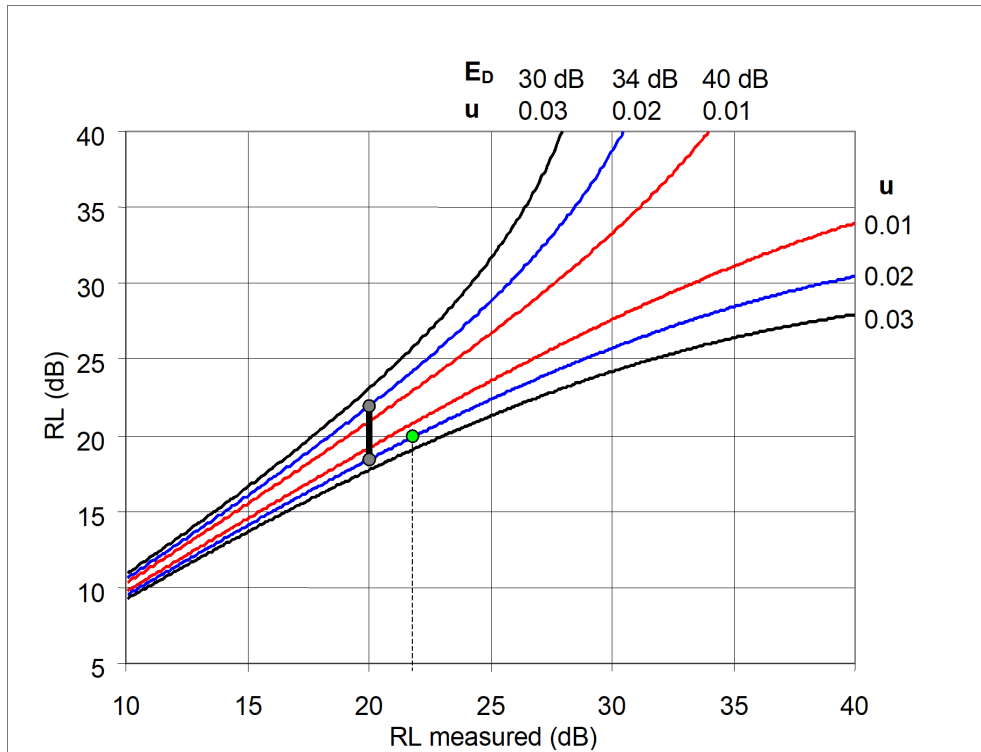


Fig. 3. Uncertainty circle radius and its effect on return loss measurement error.

Input and Load Reflection Coefficients

In the case of Homer Autotuner, two reflection coefficients are provided (in all its various formats):

- Input reflection coefficient Γ_I
- Load reflection coefficient Γ_L

In the case of Homer Analyzer alone, the two quantities are identical and we shall speak only of load reflection coefficient Γ_L .

Reflection coefficient must always be defined at a certain cross-sectional plane along the transmission line.

Input Reflection Coefficient

Input reflection coefficient (Γ_I) is the quantity seen at the tuner input. It is identical with or very close to reflection coefficient Γ_M inherently measured by the Analyzer part of Autotuner. For impedance match, Γ_I must be forced as close to zero as possible.

Input reference plane is fixed at the axis of the tuning stub 1 (the one closest to generator, see [Fig. 4](#)).

Load Reflection Coefficient

Load reflection coefficient (Γ_L) is the reflection coefficient of the object (e.g., an applicator) connected at the tuner output.

Load reference plane can be arbitrarily shifted by the user (see the [Plane Ext](#) item of **Homer Menu**). For zero shift, load reference plane coincides with the output flange of the Homer, be it the Autotuner (see [Fig. 4](#)) or the Analyzer alone.

Transformed Input Reflection Coefficient

Input reflection coefficient (Γ_I) can be, before displaying, subject to a user-defined *bilinear* transform, accounting for instance for a two-port network connected at the Homer input. For details, see [Transforming Input Reflection Coefficient](#) section.

Deembedding

Because the Homer Autotuner includes tuning stubs inserted between the Analyzer part and the actual load, the input reflection coefficient Γ_I generally differs from the load reflection coefficient Γ_L . The effect of the tuning stubs can, however, be accounted for by a mathematical process called *deembedding*. In this way, although the stubs may be extended, you are able to observe what is going on “behind the tuner”, i.e., to see the reflection coefficient Γ_L of your applicator without need of physically retracting the stubs. This is why in the case of Autotuner the load reflection coefficient is alternatively termed *deembedded* reflection coefficient.

In **HomSoft**, you can observe either the input or the load reflection coefficient in each [display window](#) and in [Results windows](#). You may, for instance, open two identically formatted display windows, one showing the input reflection coefficient, the other showing the load reflection coefficient. To switch between the two reflection coefficient displays, proceed as follows:

In Display Windows

- Click into the desired display window to make it active.
- Click the **Trace | Show Load** menu item, *or*
- Activate either the  or the  toolbar button.

In Full-Size (Maxi) Results Window

- Check **Show Load** checkbox.

In Reduced-Size (Mini) Results Window

- Right-click the magnitude display panel (top left) to invoke pop-up menu.
- Check the **Show Load** menu item in the pop-up menu.

Deembedded Accuracy

If tuning stubs of Autotuner are inserted, they can mask the deembedded (load) reflection coefficient Γ_L in the sense that large variations of Γ_L may cause only small variations of the measured input reflection coefficient Γ_I . This is because the main reflection contributor may be the stubs themselves rather than load (see [Fig. 4](#)). The corresponding areas in the Smith chart can easily be 10:1 in size if the stubs are deeply inserted. Deembedding the reflection coefficient

(removing the effect of tuner from Γ_I to arrive at Γ_L) means the opposite process: we try to transform those small variations of Γ_I to large variations of Γ_L . Therefore, even a small error u_I in determining Γ_I will be “blown up” and can cause large error u_L in the determining of Γ_L . If you keep the actual load reflection coefficient constant and move stubs to deeper positions, the displayed deembedded Γ_L should ideally also remain constant. But due to this “blown-up” measurement error, the actually displayed Γ_L will still vary. You can gain a feeling for what you may expect by performing such experiment.

Since autotuning is based on such indirectly obtained Γ_L , tuning of highly mismatched loads is less accurate and may require more than one tuning step. Under very adverse conditions (poor magnetron signal) the tuning stubs may get trapped in the full-extension positions. Invoking [All Stubs Home](#) procedure often helps in such cases, but the only proper solution is to improve your applicator or generator.

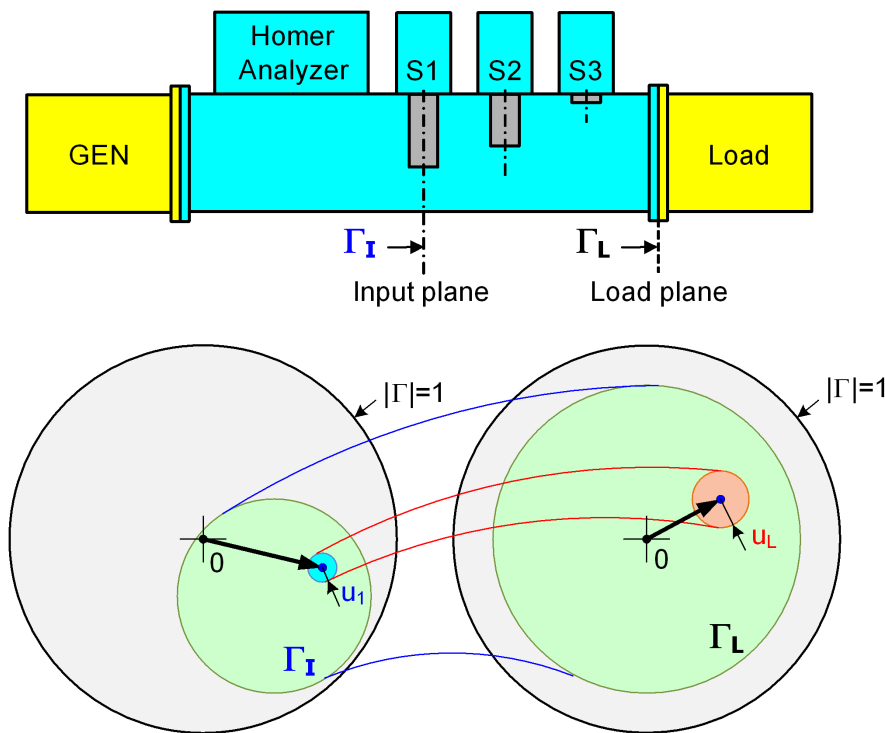


Fig. 4. Load (deembedded) reflection coefficient measurement error u_L .

INSTALLATION

Homer installation consists of the following basic steps:

- Mechanical installation.
- Electrical connection, slightly differing for
 - version with RS232/RS422 Interface
 - version with CAN Bus Interface
- **HomSoft** software installation.
- [Homer start](#).

Mechanical Installation

- Determine the cross-sectional plane in your microwave installation where the Homer should be inserted (Load Plane). For best performance, the Homer should be installed as close to load (applicator) as possible. For more details, see the topic *How Long Is Too Long?* below.
- Separate the microwave system at Load Plane such that the Homer can fit in the space.
- Insert the Homer such that the **DUT** label on its nameplate faces the load (applicator, workspace) and the **GEN** label faces the generator (magnetron).
- Secure the Homer using appropriate screws. Use washers on both sides. Use all screws.
- If your Homer is a water-cooled model, install water-cooling hosepipes.

How Long Is Too Long

Suppose for a moment that an applicator has a constant input reflection coefficient Γ_A . Let the applicator be connected to an Autotuner via a section of essentially loss-free waveguide of length L . The question arises: how long can the waveguide be without adversely affecting the tuning performance?

The reflection coefficient at the connecting waveguide input is

$$\Gamma_L = \Gamma_A \exp j \left(-\frac{4\pi}{\lambda_g} L \right) = \Gamma_A \exp j \left(-\frac{4\pi \sqrt{f^2 - f_c^2}}{c_0} L \right)$$

where f is the generator frequency, f_c is the waveguide cutoff frequency, λ_g is the guide wavelength at f , and c_0 is the speed of light. This is the *load reflection coefficient* Γ_L that the Autotuner perceives at its output and attempts to match.

While the connecting waveguide does not affect the magnitude of the reflection coefficient, i.e., $|\Gamma_L| = |\Gamma_A|$, the phase at the waveguide input varies as

$$\varphi_L = \varphi_A - \frac{4\pi \sqrt{f^2 - f_c^2}}{c_0} L$$

If the frequency of the generator is unstable and fluctuates between $f_{\min}$ and $f_{\max}$, as is often the case with magnetrons, then the phase of Γ_L varies in an interval of width

$$\Delta\varphi_L = \frac{4\pi}{c_0} \left(\sqrt{f_{\max}^2 - f_c^2} - \sqrt{f_{\min}^2 - f_c^2} \right) L$$

The variation is proportional to the waveguide length L . A numerical example for WR975 and WR340 waveguides and the generator frequency instability of $\pm 0.1\%$ is presented in the table below.

Waveguide	WR975	WR340
Nominal frequency	915 MHz	2.45 GHz
Frequency instability	$\pm 0.1\%$	$\pm 0.1\%$
Frequency variation	± 915 kHz	± 2.45 MHz

Waveguide length L	10 m	3 m
Phase variation width $\Delta\varphi_L$	59°	50°

Hence, even if the applicator reflection coefficient Γ_A is constant, the Autotuner perceives a varying reflection coefficient, and hence must keep adjusting the tuning stubs for matching. This may lead to incessant stubs movements or even [stub swapping](#). An additional inconvenience is that if a match has been achieved at a certain instant, this match may be perturbed sooner than the next matching attempt, thus resulting in a reduced overall matching efficiency.

Returning to the title question: the maximal acceptable length L depends on the amount of $\Delta\varphi_L$ you are willing to tolerate. As a rough estimate, $\Delta\varphi$ should not exceed about 30°, but perhaps even 60° may be acceptable.

It is worth noting that this problem is virtually non-existent when using the highly frequency-stable solid state power generators.

Simulation

To simulate this effect, use the [HoSim](#) simulation program. On the [DUT Page](#) of the **Homer Model** window, check **Add Line Length** and set a desired intermediary waveguide length. On the [More](#) page, set a frequency uncertainty. Then you can start measurement without and with autotuning and observe the effect.

RS232 Wiring

This section also applies to the RS422 serial interface.

Equipment

- Homer (equipped by default with RS232, on demand with RS422 interface).
- DC power supply 24 V $\pm$ 10% (see [Power Supply Issues](#)).
- DC power supply cable.
- Personal computer (PC) with Windows 7 or higher operating system (optimally Windows 10 or higher).
- RS232-to-PC or RS422-to-PC adapter (e.g., RS232–USB) if your PC is not equipped with RS232 or RS422 port. Please also read [A Note on USB-RS232 Adapter](#).
- Standard serial RS232 cable (null modem – i.e., with crossed TX-RX wires).

Connection

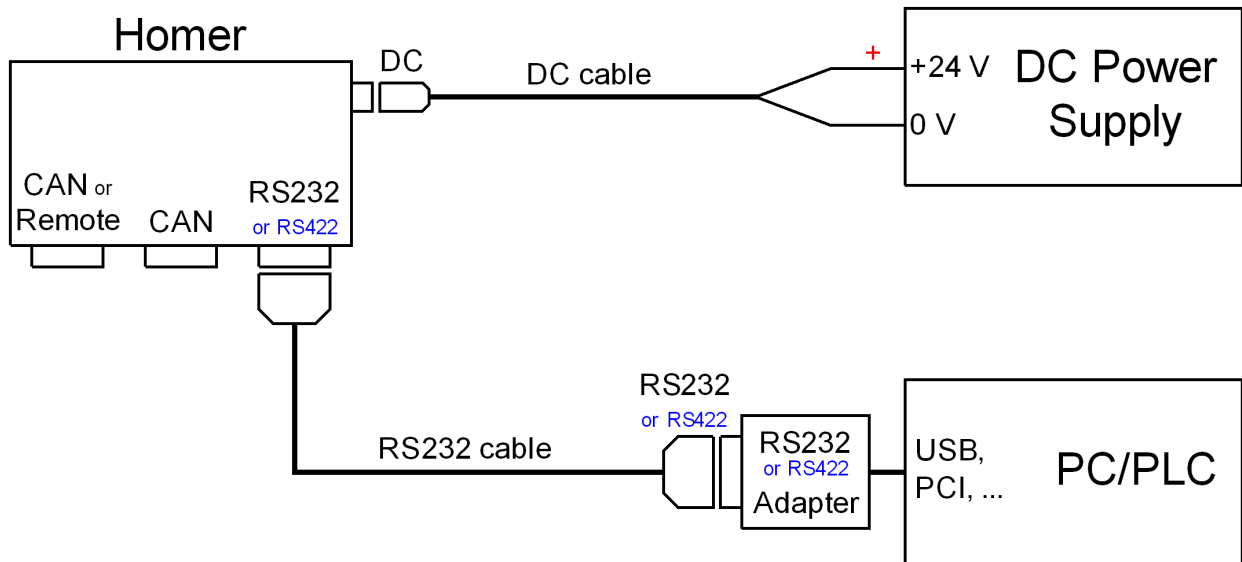


Fig. 5. Homer wiring diagram using RS232/RS422 interface.

Notes

Avoid sharing COM ports in your PC with other devices (modems, network cards) or uninstall such device drivers because they may impair communication with the Homer.

See also

[Establishing Communication.](#)

COM Port Settings

Fixed COM port settings are:

- 8 data bits
- 1 stop bit
- No parity

Variable COM port settings are:

- COM port number
- Baudrate

One should distinguish between COM port settings of

- Homer unit
- Controller (PC, PLC, PAC)

With the exception of COM port number, the settings of Controller must be identical with those of the Homer.

Homer COM Port Settings

You cannot modify Homer COM port **number** because a fixed COM port is used internally. See [Configuring Communication](#) for more details.

PC COM Port Settings

In **HomSoft**, various COM port settings of your PC can be modified in the [COM Port Setting](#) dialog window. The window can be opened by clicking the **Commun | COM Port** menu item.

CAN Bus Wiring

Equipment

- Homer (must be provided with CAN Bus communication option).
- DC power supply 24 V $\pm$ 10% (see [Power Supply Issues](#)).
- DC power supply cable.
- Personal computer (PC) with Windows 95 or higher operating system (optimally Windows 7 or higher).
- CAN Bus adapter. Currently usable adapters are:
 - [Peak PCAN-USB Interface](#)
 - [Sontheim CANfox](#)
 - Sontheim CAN USB Light Dongle (not advertised anymore but available on request)
- Standard CAN Bus cable.

Connection

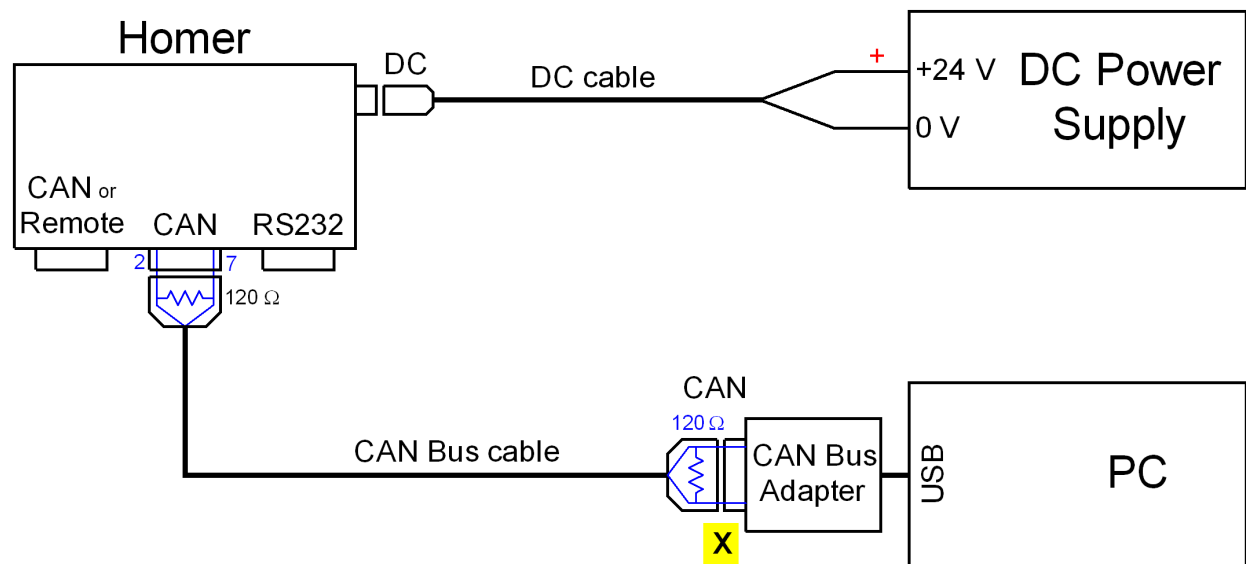


Fig. 6. Homer wiring diagram using CAN Bus interface.

Note on CAN Bus Adapters

Install the CAN Bus adapter device (including SW driver) on your PC according to manufacturer's instructions. **HomSoft** supports the [Peak PCAN-USB Interface](#), [Sontheim CANfox](#) and legacy type Sontheim CAN USB Light Dongle.

If using the Sontheim CAN USB Light Dongle, copy the *CanApi.dll* file from the Dongle installation package available on the manufacturer's web page to any of the following folders:

- Windows central location for shared dlls (something like c:\Windows\System32). This is the best approach, as it covers all **HomSoft** upgrades and all users at once. For Windows 7 and higher you will need administrator rights to do that.
- **HomSoft** Installation folder (something like c:\Program Files\S-Team**HomSoft**\Ver5001). For Windows 7 and higher you will need administrator rights to do that.
- **HomSoft** User Folder (applicable to **HomSoft** versions starting V5.0.0.0). This folder is created automatically when starting **HomSoft** for the first time. It looks something like
c:\Users\<username>\S-Team\HomSoft

HomSoft searches the folders in the same order as listed above.

If using the Peak PCAN-USB Interface, installation of the Windows driver places the **dll** files to appropriate folders and no further action is needed.

Note on CAN Bus Cable Termination

Terminal CAN devices (those at both ends of CAN cabling) should load the CAN cable with a 120-ohm resistor.

The Homer's CAN Bus is not internally terminated (unless you expressly specify it in your order). In case of any doubt, simply measure the resistance between pins 2 and 7 of a Homer CAN connector. If the Homer is not internally terminated and if it should serve as a terminal device, the resistor must be connected externally (many available CAN cable assemblies have switchable resistors at both ends).

CAN Bus adapters may or may not have such resistor connected internally: check the resistance between pins 2 and 7 of its CAN D9 connector.

See also

[Establishing Communication.](#)

Homer Signal Connectors

All signal connectors are of type D-sub DE-9 male ([Fig. 7](#)).

The tables below cover all possible variations of available Homer Analyzer and Homer Autotuner models.

Pins not assigned **Signal** names and **Description** in the tables below are not connected.

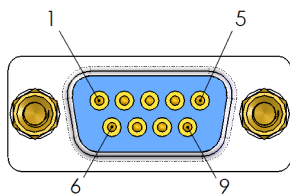
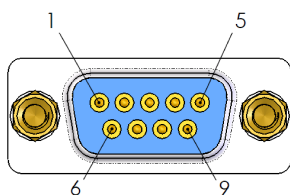


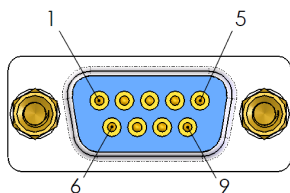
Fig. 7. D-sub DE-9 connector pin numbering (front view).

RS232 Connector



Pin	Signal	Description
1		
2	RX	Received Data
3	TX	Transmitted Data
4		
5	GND	Signal Ground
6		
7		
8		
9		

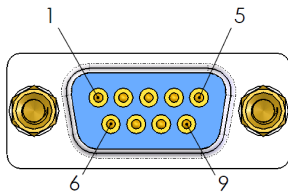
RS422 Connector



Pin	Signal	Description
1		
2		
3		

4		
5		
6	RX+	Received Data +
7	RX-	Received Data -
8	TX-	Transmitted Data -
9	TX+	Transmitted Data +

CAN Bus Connector



Pin	Signal	Description
1		
2	CAN_L	CAN Low
3	CAN_GND	CAN Ground
4		
5		
6	CAN_GND	CAN Ground
7	CAN_H	CAN High
8		
9		

Remote Connector

The presence of the Remote connector and its pinout depend on

- the model of the Homer Autotuner, and
- whether the option **Digital Input for Selected Homer Commands** has been ordered and implemented.

If the Digital Input option is **not** implemented, then

- the Remote connector is present only in the water-cooled Autotuner for 2.45-GHz,
- the Remote connector has *Standard Pinout*.

If the Digital Input option **is** implemented, then

- the Remote connector is present in all Autotuner types,
- the Remote connector has *Special Pinout*,

- only one CAN Bus connector is present.

Via the Remote connector, a remotely controlled action can be triggered. Which action is to be triggered is determined by the **AtSwitchAction** value (referred to as Command Code) in the Homer internal [Tun.cfg](#) configuration file. The default action is swaping the autotuning ON and OFF. This action corresponds to the Command Code = 0, i.e., the line

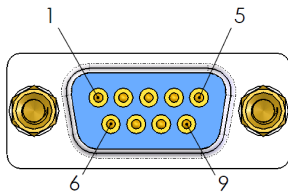
```
AtSwitchAction=0
```

in Tun.cfg. This default action is also triggered when the above line is missing. Two other Command Codes (actions) are implemented:

02 = Single tuning step

69 = All Stubs Home procedure

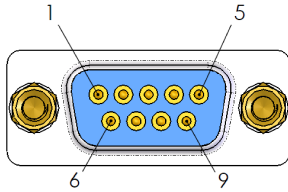
Remote Connector – Standard Pinout



Pin	Signal	Description
1	ASW1	Action Switch 1
2		
3		
4	ASW2	Action Switch 2
5		
6		
7		
8		
9		

In the case of Standard Pinout, the remotely controlled action is triggered by toggling a switch connected between pins 1 and 4.

Remote Connector – Special Pinout



Pin	Signal	Description
1		
2		
3		
4		
5	APLS+	Action Pulse Input +24 V
6		
7		
8		
9	APLS-	Action Pulse Input 0 V

In the case of the optional Special Pinout, the remotely controlled action is triggered by a 24 ± 2 V pulse applied between pins 5 and 9. The pulse width must be between 10 ms and 300 ms. The distance between two consecutive pulses must be at least 1500 ms.

Power Supply Issues

The Homer is powered from a DC supply $24 \text{ V} \pm 10\%$. Be sure that your power supply meets the requirements according to Homer specifications (refer to the datasheet for your particular Homer modification).

Two alternative power supply connector types are used in Homer devices: TRIAD connector and DIN connector.

TRIAD Connector

The Thomas & Betts TRIAD 01 T01-0560-P04 subminiature circular connector (4-pin, male) or an equivalent is used with the following pinout:

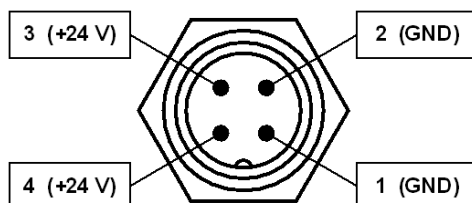


Fig. 8. TRIAD power supply connector (front view).

Pin	Signal	Description
1	GND	Power supply – negative polarity (ground, mass)
2	GND	Connected with 1
3	+24 V	Power supply – positive polarity (voltage relative to GND)
4	+24 V	Connected with 3

The mating cable connector is TRIAD 01 Series T01-0550-S04.

In the cable, the respective pins should also be connected together to relieve the current load of the pins.

DIN Connector

The 3-pin DIN-male power supply connector (DIN 41524) Amphenol T 3262 000 or an equivalent is used with the following pinout:

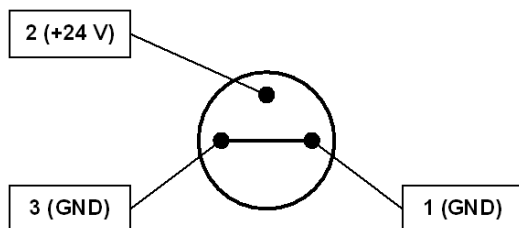


Fig. 9. DIN power supply connector pinout.

Pin	Signal	Description
1	GND	Power supply – negative polarity (ground, mass)
2	+24 V	Power supply – positive polarity (voltage relative to GND)
3	GND	Connected with 1

The mating cable connector is T 3261 001.

It is recommended that the 0 V pins 1 and 3 be connected together also in the cable.

HomSoft Software Installation

To install **HomSoft**, i.e., the Homer Windows Visualization and Control Software, use the installation file downloaded from the web site or copied from another medium, such as USB flash disk. The procedure follows a standard routine for installing Windows programs, as described below.

HomSoft consists of:

- [Homer executables](#): these are the core **HomSoft** components.
- Additional executables (e.g., [Homer simulation](#) **HoSim.exe**, file transfer **Dwnload.exe**).
- Auxiliary files: they define the Homer unit behavior.
- Documentation.

To Install HomSoft from USB Flash Disk

- Insert the USB flash disk into your PC.
- If the installation does not start automatically:
 - Locate the Setup.exe program. It is usually found in a folder such as `HomSoft_5001\Volume\`
 - Run the **Setup.exe** program (e.g., by double-clicking its icon).
- Follow the instructions on your screen (normally respond by clicking **Next** or **Finish**).

To Install HomSoft from Installation Package

Installation software (in particular software upgrades) will be available in the form of a new installation package, which can typically be downloaded from a web site or sent to you via e-mail in the form of a **zip** file. After unzipping, the files are structured the same way as described in the previous section.

To install/upgrade the software, run the installation as described above, you only have to locate the **Setup.exe** program in the unzipped data package and run it.

In case of upgrades, the installer will add new subfolders to the S-TEAM installation folder.

Homer Executables

Homer executables are a group of basic Windows Visualization & Control programs, also referred to as *HomSoft applications*. They can be run one at a time. They fall in two categories:

- Full-fledged programs.
- Reduced-functionality servicing programs.

Full-Fledged HomSoft Applications

In the case of Homer Autotuner, the full-fledged **HomSoft** applications are **Tu_rs.exe** (communication via RS232 or RS422) and **Tu_can.exe** (communication via CAN Bus).

In the case of Homer Analyzer, the full-fledged applications are, respectively, **Ho_rs.exe** and **Ho_can.exe**.

Starting one of these programs will be referred to as *starting HomSoft*.

A full-fledged HomSoft application can communicate with a Homer device only if this Homer device is equipped with the HomSoft option (please refer to Homer datasheet to learn about the Homer options).

Reduced-Functionality Applications

The reduced-functionality **HomSoft** applications are also referred to as **HomTool**. They are complimentary, i.e., they do not need a Homer device to be equipped with the **HomSoft** option.

In the case of Homer Autotuner, the **HomTool** applications are named **TuTool_rs.exe** (communication via RS232 or RS422) and **TuTool_can.exe** (communication via CAN Bus).

In the case of Homer Analyzer, the applications are, respectively, **HoTool_rs.exe** and **HoTool_can.exe**.

If you start **HomTool**, a dialog pops up warning you that this is not a full-fledged **HomSoft** application. You can switch off this dialog by clicking the [Do not Show Again](#) button. (Note: You can reintroduce it only by editing or deleting the line *ShowToolWarning* in the application's [Ini File](#), located in the [User Folder](#).)

Some examples of what **HomTool** can and cannot do are listed below.

What HomTool Can Do

- Display the received (measured) quantities numerically in the [Full-Size Results Window](#).
- Switch signal sampling modes and set sampling parameters (refer to [Homer Sampling Setup Window](#)).
- Upload files to the Homer and download files from the Homer, including the Server program (refer to [Transferring Files](#)).
- Run complete Homer firmware reinstallation and/or reprogramming of Tuner motors (refer to [Homer Firmware Update/Reinstallation](#)). These operations are possible only in **HomTool**.
- Operate the tuner (refer to [Tuner View](#) window), in particular:
 - Switch autotuning ON and OFF.
 - Trigger All Stubs Home and Single Tuning Step procedures.
 - Read actual tuning stubs insertions.

What HomTool Cannot Do

- Display the received (measured) quantities graphically in Display Windows (although such windows can be visible).
- Save results and, hence, perform [waveform determining](#).
- Perform [data logging](#).
- Run tuning stubs scenarios and related operations.
- Run [DDE Server](#).

S-TEAM Installation Folder

The installation or upgrade procedure will copy the files to subfolders of *S-TEAM installation folder*, which may be typically

```
c:\Program Files\S-Team\  
c:\Program Files (x86)\S-Team\
```

HomSoft is installed in a subfolder, also named **HomSoft**, within the S-Team installation folder.

HomSoft Folder

In **HomSoft** folder, a structured subfolder for each particular SW version will be created, containing the basic Windows application files (Tu_rs.exe, Tu_can.exe), Help system files, documentation, and other files. Particularly, the *Server* subfolder contains copies of Homer internal programs (e.g., SrvHo.exe, SrvDld.exe) best matching the given **HomSoft** version. If your Homer is driven by older firmware, you may wish to upload the new servers to the Homer (see section [Transferring Files](#), subsection Upgrading Server Program).

In this way, different **HomSoft** versions are sorted in the **S-TEAM** Installation Folder. The

shortcuts created by the installer will point to the latest installation (regardless of the version).

Example

An example of the installation folder structure is shown below (a backslash and bold type denotes a folder).

c:\Program Files\S-Team

\HomSoft (HomSoft software folder)

\Ver5030 (Folder for HomSoft Version 5.0.3.0)

\Documents (Documentation, sample codes)

\Demo (HoSim simulation program and accompanying files)

\DDE Sample DDE client

\HomerHelp (Online Help for Homer)

\Server (Archive for server programs optimal for this HomSoft version)

 u_rs.exe (HomSoft executable file – RS232)

 u_can.exe (HomSoft executable file – CAN)

 uTool_rs.exe (Reduced functionality version of Tu_rs.exe)

 uTool_can.exe (Reduced functionality version of Tu_can.exe)

 Dwnload.exe (File transfer program – RS232 only)

 HomerList.cfg (Sample MultiCAN configuration file)

 (HTML CHM Help system)

 (Some other files)

\Ver5020 (Folder for HomSoft Version 5.0.2.0)

 ...

User Folder

The *User Folder* is the default location for reading and writing data by **HomSoft** applications.

- Most importantly, for each **HomSoft** application type, the User Folder contains its **HomSoft Ini File**, a file to which a majority of **HomSoft** settings is automatically stored on its termination. When you start a **HomSoft** application the next time, its Ini File is loaded back and the program as well as the connected Homer unit appear in the same state as when you left them.
- Also, all user-created files (user setups, results in any form, log files, etc.) are by default written to this directory.

The User Folder is located within a user's domain, typically

 c:\Users\<username>\S-Team\HomSoft

The folder is created automatically when starting **HomSoft** for the first time. To open the folder in Windows Explorer, click the **Files | Open User Folder** menu item.

Analogously, the **HoSim** [Homer simulation](#) user folder is

`c:\Users\<username>\S-Team\HoSim`

Homer Internal Files

This section describes the structure of the *firmware*, which is a system of files that reside inside the Homer's internal single-board computer and control its operation and behavior. The firmware consists of an assembly of executable and auxiliary files.

On delivery, the Homer is furnished with all the necessary software components and is ready to be used. You only have to install **HomSoft** onto your personal computer as described in [HomSoft Software Installation](#).

To upgrade Homer Server programs or modify other firmware components, appropriate files must be uploaded, i.e., sent to the Homer. For details, see [Transferring Files](#).

Homer Internal Files can be classified as follows:

Server Program (.exe)

The server program (**Server**) is the basic Homer executable file. The program is automatically started when the Homer's DC power supply is switched ON. The server filename is **SrvHo.exe**. The file can be uploaded (sent) to the Homer when a newer version is available from the manufacturer.

System Memory Files (.mem)

System memory files are binary files, containing:

- Fixed, **individual** information about each particular Homer unit, including its calibrations and options;
- Factory default settings.

Server reads these files immediately after startup. The files are not editable; they are produced by the manufacturer. New mem files should be, for instance, uploaded to the Homer after a recalibration, when adding software options, or when limiting tuning stubs travel distance is required. There are two mem files:

- **Hom.mem**: Homer Analyzer memory file. It contains, among others, detectors correction data and Homer analyzer calibration constants.
- **Tun.mem**: Mototuner memory file. It contains motors data and tuning stubs characterization.

IMPORTANT NOTE: Because of their individual nature, *.mem files **must not** be exchanged between individual Homers. If a Homer unit firmware (aka Server) detects a non-native mem file, it will raise a *Homer Identity Error*. Then the following happens:

Newer Server versions (V54 and more):

If a Homer Identity Error occurs, the Server announces this by playing [Morse code error message IDE](#), followed by a standard Morse message. Server does not terminate but it switches to a reduced mode, which disables measurement or motor movements, but allows file transfers so that you are able to remedy the situation.

Older Server versions (V53 and less):

If a Homer Identity Error occurs, the Server terminates, playing first a melody (downward musical scale), then [Morse code error message](#) **IDE**. Following this, file transfer server **SrvDId.exe** is started (one long beep – Morse code for **T**).

System Configuration Files

System configuration (*.cfg) files are *text files* containing user-definable Homer Analyzer and Autotuner settings. The Server program reads the configuration files after reading the memory files, then copies these obtained configuration settings to its volatile memory. The **cfg** file settings, therefore, override the factory defaults and, eventually, determine the Homer power-up behavior. This is important in particular for the autonomous Autotuner operation.

The structure of the configuration files is that of Microsoft Windows *.ini files: it consists of lines of the type

Label=Value ;Remark

where **Label** is the name of a variable and **Value** its value. It is the **Value** that is to be changed if needed.

The files are available to the user for editing: they can be downloaded from the Homer, modified, and then sent back (uploaded) to the Homer. In this manner, startup Homer behavior can be controlled by the user.

The upload and download can be carried out by:

- **HomSoft**
- [HomTool](#), which is a complimentary, reduced functionality, servicing version of **HomSoft**.

Basic configuration files include:

- **Hom.cfg**: Basic Homer Analyzer configuration file, defining measurement settings, like expected signal waveform (CW, Rectified, Pulsed), signal sampling parameters (sampling rate, sampling time, triggering method), frequency counting parameters, etc. The file is often modified by users to adapt the Homer behavior to particular tasks. For details, see [Homer Analyzer Starting Parameters](#).
- **Tun.cfg**: Basic Autotuner configuration file, defining autotuning power-up behavior. The file is often modified by users. For details, see [Homer Autotuner Starting Parameters](#).
- **Rs232.cfg**: Defines RS232 baudrate. Rarely needs to be modification.
- **Can.cfg**: Defines CAN Bus baudrate. Sometimes modified by users.
- **Bbox.cfg**: Activates and configures diagnostic internal data logging. The file may not be present.

How HomSoft Affects Configuration Settings

The **HomSoft** application runs in a remote controller, typically your PC. It has its own settings, saved in the HomSoft [Ini File](#) in [User Folder](#).

When **HomSoft** starts, the first thing it does is retrieving current parameters and settings of the connected Homer unit.

If there is no HomSoft Ini File on your PC, the **HomSoft** application settings will match those of

the connected Homer (typically, its power-up settings).

If HomSoft Ini File file exists, the **HomSoft** application continues by the following steps:

- The application reads the desired Homer settings from the ini file.
- Using commands over the communication interface, the application overwrites the existing Homer settings by these desired settings.

From now on, the Homer will operate according to the HomSoft Ini File. Now, it is up to you to adjust any individual Homer setting via **HomSoft** commands.

Be aware that all settings, made either by **HomSoft** or via commands from your own program, are written only to Homer *volatile* memory: they do not overwrite the Homer internal *cfg files*. Therefore, the settings remain valid only until the Homer is reset, e.g., by cycling its DC power. After this, the Homer returns to its power-up (starting) parameters.

If you want to return a Homer to its power-up parameters while starting **HomSoft**:

- Delete or rename the HomSoft Ini File.
- Restart the Homer, e.g., by cycling its DC power.
- Start **HomSoft**.

File Transfer Utility (SrvDId.exe)

SrvDId.exe is a special program handling transfer of files to and from the Homer via RS232 as a last resort when standard SrvHo Server is corrupt. Its counterpart on the PC side is the file transfer application **Dwnload.exe**.

Software Upgrades

HomSoft upgrades are made by the standard method of installing the new version as described in [HomSoft Software Installation](#).

Homer firmware upgrade is accomplished by sending (uploading) to the Homer:

- Executable **Server** files.
- Other system internal files as instructed.

For details, refer to [Transferring Files](#) section.

HOMER START

After completing the installation, the Homer can be switched on.

Homer Operation Modes

The Homer can be operated in several modes.

- The easiest method, in particular for new users, is employing the Microsoft Windows-based

HomSoft software, through which the Homer is controlled from a PC.

- Another option is autonomous operation, which requires nothing more than the Homer itself. To function properly, the Homer must be appropriately configured via its internal [configuration files](#).
- Yet another possibility is integrating the Homer into your own system. It is relatively straightforward if your system is based on LabVIEW. Otherwise, you have to study [Homer Communication Protocol](#) and program the communication with the Homer yourself.

Using HomSoft

- Turn on your PC.
- Turn on the Homer DC power supply.
- If your Homer contains a POWER switch, set it to ON position. The power-up procedure (booting) may last up to 30 seconds. The Homer is ready after playing a Morse code. The Morse sequence depends on the used communication interface:
 - RS232 with transmitting results in binary format: **RS**, i.e., | · - · | · · · |.
 - RS232 with transmitting results in text (ASCII) format: **RSA**, i.e., | · - · | · · · | · - |.
 - CAN: **N**, followed by the Morse code of its CAN Address (e.g., **N1**, i.e., | - · | · - - - - | for CAN Address = 1). The meaning of CAN Address see in [MultiCAN: More Homers on CAN Bus](#). (For Server versions 53 and less, the initial **N** is not played, only the number.)
 - EtherNet/IP: **ETH**, i.e., | · | - | · · · · |.
- If your device contains **AUTOTUNE** switch, set it to OFF position.
- Start a desired **HomSoft** application (i.e., Tu_rs.exe for RS232, Tu_can.exe for CAN Bus).

Autonomous Operation

This mode of operation needs nothing more than the Homer itself. Its behavior is determined by the content of its internal [Hom.cfg](#) and [Tun.cfg](#) configuration files.

- Turn on the Homer DC power supply.
- If your Homer contains a POWER switch, set it to ON position. The power-up procedure (booting) may last up to 30 seconds. The Homer is ready after playing a Morse code. The Morse sequence depends on the used communication interface:
 - RS232 with transmitting results in binary format: **RS**, i.e., | · - · | · · · |.
 - RS232 with transmitting results in text (ASCII) format: **RSA**, i.e., | · - · | · · · | · - |.
 - CAN: **N**, followed by the Morse code of its CAN Address (e.g., **N1**, i.e., | - · | · - - - - | for CAN Address = 1). The meaning of CAN Address see in [MultiCAN: More Homers on CAN Bus](#). (For Server versions 53 and less, the initial **N** is not played, only the number.)
 - EtherNet/IP: **ETH**, i.e., | · | - | · · · · |.
- The startup behavior of the tuning stubs is controlled by the following line in the internal [Tun.cfg](#) configuration file:

```
PowOnAction=2 ;Stubs on PowerUp: 0=Stay in Positions 1=AllHome  
;2=AllHome+Move to Positions
```

Alternatively, or in addition to that, if your device contains **ALL STUBS HOME** button, you

may wish to press it to initialize the tuning stubs.

- The startup autotuning behavior is controlled by the following lines in the internal Tun.cfg configuration file:

```
IsOn=TRUE      ;Activate autotuning (overridden by AUTOTUNE switch)
WaitRF=TRUE    ;Suspend tuning when RF power is absent or too low
```

If the lines are set up as above, Autotuner starts impedance matching as soon as microwave power is present. If your device contains **AUTOTUNE** switch, you can override the IsOn setting by changing the position of the switch.

Note: If Autotuner works autonomously, be sure that its startup settings are appropriate for the actual microwave [signal waveform](#). Refer to [Homer Analyzer Starting Parameters](#) and [Homer Autotuner Starting Parameters](#) on how to change Autotuner startup settings.

Selecting Homer Power-Up Server

Occasionally, you may wish to switch between different SrvHo Servers or methods of communication. The available alternatives are listed below.

- SrvHo Server communicating via RS232/422, transmitting results in:
 - Binary format (default)
 - [ASCII format](#) (for easy monitoring)
- SrvHo Server communicating via CAN Bus (only with CAN Bus option).
- SrvHo Server communicating via EtherNet/IP (only with EtherNet/IP option).
- SrvDId file transfer utility.

After Homer's DC power supply has been switched ON, one of these Server programs will be started, depending on the contents of its internal cfg files. Once a Server is running, the user can send a command via the active communication interface to switch to another available Server (which will then become the new default Server). The easiest way is to use a **HomSoft** application. This approach of switching Servers has some limitations. For instance, you can run into problems in the following situations:

- If you miss the Homer playing the startup Morse code, you may not know which interface and communication protocol should be used to establish contact with the Homer (or which of the **HomSoft** applications should be employed).
- If you have accidentally switched Server to CAN Bus mode and you do not have a CAN Bus hardware to switch back to RS232.
- If you do not use **HomSoft**, you have to be familiar with the communication protocol to be able to assemble and send an appropriate command to the Homer.

To eliminate the inconveniences, there is a way to take control of the Homer via RS232 during the very power-up process. The procedure described below enables the user

- to see the information about Homer HW and options,
- to select which Server to run.

To Choose Homer Power-up Server:

- Connect your PC and the Homer using an RS232 adapter as shown in [Fig. 5](#).
- On your PC, install, configure and start an RS232 monitor, e.g., [Tera Term](#).
- Switch the Homer ON and watch the PC screen with your hand ready at the keyboard.

Newer SrvHo Server versions (starting V55):

To invoke the Server selection menu, you have to hit B key twice as soon as prompted. Do it as follows. When the screen displays the message

```
Press B key twice to select program (waiting 1500 ms...)
```

press B or b key within the time indicated. If you make it, another prompt appears:

```
Waiting 1500 ms for 2nd B...
```

If you succeed to hit B again within the time indicated, the screen displays information about Homer HW, Server and Homer options

```
HW : STHT 2.3/36
SW : V50 SRVHO.EXE 156352 26-Nov-09 11:26:24
COM: RS232 COM1 115200 8N1
OPT: SW=YES Puls=YES CAN=YES Dnet=YES Mism=YES DDE=NO
```

These lines are followed by a prompt instructing you to choose which Server or mode should be started

```
Select:
R=RS232 C=CAN A=ASCII E=EtherNet/IP D=SrvDld (waiting 30 seconds)
30
25
20 ...
```

with the indicated time countdown. In the example above you have 30 seconds to decide and hit a corresponding key (the letter case does not matter). If, for instance, key R was pressed, the message appears

```
Selected: RS232
```

If no such key has been pressed, the message will be

```
Nothing selected - exit code 99
```

meaning that the system will start the default Server. The same happens if you fail to press BB at the beginning.

SrvHo Server versions V54 and older:

- Server version V54:

When the screen displays the message

```
Press B key twice to select program (waiting 1500 ms...)
```

press B or b key within the time indicated. If you make it in time, another prompt appears:

```
Waiting 1500 ms for 2nd B...
```

Hit B or b again within the time indicated.

- Server versions V53 and older:

When the screen displays the message

Press any key to select program (waiting 1500 ms...)

press any key within the time indicated.

If you succeed, the screen displays information about Homer HW, the running selection program (Loader) and Homer options, such as

```
HW : STHT 2.3/36
SW : V50 LOADER.EXE 156352 26-Nov-09 11:26:24
COM: RS232 COM1 115200 8N1
OPT: SW=YES Puls=YES CAN=YES Dnet=YES Mism=YES DDE=NO
```

which is followed by a prompt instructing you to choose which Server is to be started

```
Select:
R,S=RS232 C=CAN N=DevNet D=SrvDld A=ASCII (waiting 30 seconds)
30
25
20 ...
```

with the indicated time countdown. In the example above, you have 30 seconds to decide and hit a corresponding key (letter case does not matter); otherwise the message appears

```
Nothing selected - exit code 99
```

meaning that the system will start the most recently running Server.

Tera Term RS232 Monitor

Since Windows 7, the popular old Hyperterminal has not been supported. As an alternative, one can use **Tera Term**, which is an open-source free terminal emulator. The program can be downloaded/installed from <https://github.com/TeraTermProject/teraterm/releases/tag/v5.2>.

After installation, configure the Tera Term as follows:

After the first start of the application, a window titled *Tera Term: New connection* pops up (accessible from the menu item Edit anytime later).

Select *Serial*, choose an appropriate COM port, and click OK.

Click the menu item **Setup | Serial port** and make COM port settings equal to those of the Homer, as shown in [Fig. 10](#). (The default baudrate is 115200 kBd; otherwise it can be defined by the Homer internal Rs232.cfg configuration file.) To apply the settings, click **New setting**.

To set your preferences, use other **Setup** submenu items, such as **Setup | Window** and **Setup | General**.

Finally, click **Setup | Save setup** to save your settings.

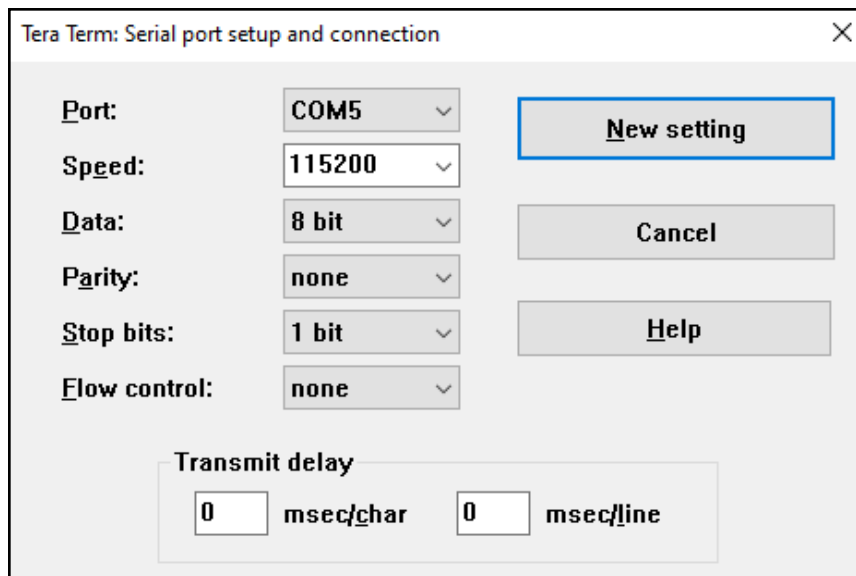


Fig. 10. Settings of Windows Tera Term RS232 monitor.

Format of RS232 Results

In case of the RS232 (or RS422) interface, the SrvHo Server can send results in two formats:

- Binary
- ASCII

There is no need to care about the data format if you use **HomSoft** and do not want to control or monitor the Homer using your own program.

Binary Results Format

Binary format is the standard, compact format for efficient and fast transmission of results, using the smallest possible number of bytes. The format is described in detail in [Homer Communication Protocol](#). A block of bytes containing encoded results of one measurement is termed Measurement Data Object (MDO). To arrive at actual results, you have to decode MDO using a few simple formulas.

ASCII Results Format

If you do not need to send commands to the Homer but only wish to receive results without having to decode binary byte streams, you can choose ASCII results format. Note that this applies only to RS232 (RS422), not CAN Bus. Although slightly slower than binary, the results come in open form of readable ASCII strings.

To start SrvHo running in ASCII mode, proceed as described in topic [Choosing Homer Power-up Server](#) and press **A** when selecting Server.

SrvHo running in ASCII mode announces itself by playing **RSA** Morse code | · – · | · · · | · – | at the start.

Then (if the Homer is configured to measure and transmit data automatically – controlled by **Autorun** line in [Hom.cfg file](#)) your [COM port monitor](#) shows *results strings*, each of which may

include labels:

```
Clk=50736732 HST=20 HER=16 MHz=915 Mag=0.928 Deg=34.127 Mgd=NONE Dgd=NONE Pi=7.376E3  
Pr=6.349E3 T=25.1 M1=5000 M2=5000 M3=0 MS1=119 MS2=0 END
```

or be without labels:

```
50736732 20 16 915 0.928 34.127 NONE NONE 7.376E3 6.349E3 25.1 5000 5000 0 119 0
```

These are results in open, readable form. The first, lengthier form, has the advantage of identifying the particular results by a label (e.g., `Mag=0.928`, which means that magnitude of input reflection coefficient is 0.928). The general form of the string is

```
[Name1=]Value1<Delim>[Name2=]Value2<Delim> ... [NameN=]ValueN<Delim>[END]<CRLF>
```

where

NameN is a label, defining item type

ValueN is corresponding numerical value

<Delim> is delimiter, separating items of the string

<CRLF> is two-byte combination Carriage Return CR + Line Feed LF (bytes 10, 13)

The entities in square brackets are optional.

The string starts with time information

```
[Clk=]MeaFinishTick_ms
```

which is internal computer tick in milliseconds taken at the moment when a measurement finished.

The format of the string is controlled by the following lines in the internal Hom.cfg configuration file:

```
Asc_Delim=32           ;Delimiter of ASCII results: code of delimiting char  
Asc_UseLabels=TRUE     ;Use labels XXX= in ASCII results  
Asc_InvalStr=NONE      ;Padding string to substitute invalid/not present results
```

Asc_Delim: Delimiter

Asc_Delim line defines ASCII code of the delimiting character (0 to 255 with the exceptions below) or the character itself. The rules are as follows:

- If Asc_Delim=10 or 13, the actual delimiter will be the two-byte <CRLF> combination (10, 13).
- The delimiter cannot be:
 - a character used for representation of numbers (0 to 9, +, -, e, E)
 - equality sign (=)
 - semicolon (;)
 - left square bracket ([)

In these cases the default delimiter *space* (ASCII code 32) will be used.

If **Asc_Delim** line is missing in Hom.cfg, the default delimiter *space* (ASCII code 32) is used.

Examples:

```
Asc_Delim=59           ;result=59 (semicolon)
```

```

Asc_Delim=;           ;result=59 (semicolon)
Asc_Delim=13          ;result=13 (CR, actual delimiter will be CR+LF)
Asc_Delim=Newline     ;result=10 (LF, actual delimiter will be CR+LF)
Asc_Delim=Tab         ;result=9 (tab).
Asc_Delim=Ta         ;error: result=32 (space)
Asc_Delim=1236        ;error (more than 255): result=32 (space)
Asc_Delim=+          ;error (numeric char): result=32 (space)
Asc_Delim==          ;error (equality sign): result=32 (space)

```

Asc_UseLabels: Labels

If Asc_UseLabels=TRUE:

- The labels (followed by equality signs) are present in the results string.
- The terminating <CRLF> is preceded by "END" substring.

If Asc_UseLabels=FALSE:

- The results string consists of only numerical data separated by delimiter.
- There is no "END" substring.
- If delimiter is Tab, this form is useful for import to Microsoft Excel (especially by copy and paste method Ctrl+C, Ctrl+V).

If **Asc_UseLabels** line is missing in Hom.cfg, the default TRUE is used.

Asc_InvalStr: Invalid Result Substitution

Asc_InvalStr line defines a padding string (up to 15 characters long) that will be sent when a particular result is invalid or not present (e.g., sometimes only motor positions without Analyzer data are sent). To avoid the shifting of particular results to different positions in the results string, this padding string is used for the missing data. It can be "0", "none", "n.a." etc.

If **Asc_InvalStr** is empty, the invalid or missing results will not be represented in the results string at all.

If **Asc_InvalStr** line is missing, the default "NONE" padding string is used.

Examples:

A case with padding string "X"

```

Asc_InvalStr=X

Clk=0 HST=16 HER=0 MHz=X Mag=X Deg=X Mgd=X Dgd=X Pi=X Pr=X T=X M1=320 M2=320 M3=0 MS1=71
MS2=0 END

```

The same results with empty **Asc_InvalStr**

```

Asc_InvalStr=

Clk=0 HST=16 HER=0 M1=320 M2=320 M3=0 MS1=71 MS2=0 END

```

In the latter case the bold-printed substring from the first example is missing.

Configuring Communication

Communication between the Homer and external computers can be realized either via RS232 (optionally RS422) serial interface or CAN Bus. After power-up, the Homer starts its activity based

on several controlling parameters. Startup settings of the communication interfaces can be defined in Rs232.cfg and Can.cfg configuration files. The Homer reads the files as part of its initialization routine.

You can create your own files or download them from the Homer, edit them and upload them back to the Homer (see [Transferring Files](#) for the download and upload). Examples of Rs232.cfg and Can.cfg configuration files are shown below. The letter case is irrelevant. Text following a semicolon is ignored. To create your own cfg file, you may copy the blue lines below and use them as a template.

For controlling other Homer startup parameters, see [Homer Analyzer Starting Parameters](#) and [Homer Autotuner Starting Parameters](#).

Rs232.cfg

Note that PORTNUM setting is actually ignored (it is a matter of Homer internal wiring). PARITY should always remain set to zero (= no parity).

```
[RS232 configuration]

PORTNUM=0
BAUDRATE=115200
PARITY=0
NTIMEOUT=500000

; This file is not obligatory: use it or only some lines of it when
; values other than defaults are required. If case of missing lines
; or invalid data, the defaults are used. The defaults are as follows:

; PORTNUM=0
; BAUDRATE=115200
; PARITY=0
; NTIMEOUT=500000

; PORTNUM codes: 0=COM1 1=COM2
; BAUDRATE (bits/s) will be rounded up to the closest of these values:
;   50    300    600    1200    2400    4800
;  9600   19200  38400  57600  115200
; PARITY codes:
;   0=None 1=Odd 2=Even
;   3=Mark (fixed high)
;   4=Space (fixed low)
; NTIMEOUT is the max number of RS-232 status-reading cycles when testing
;   for received data presence.
```

The remaining fixed COM port settings are: 8 data bits, 1 stop bit. In practice, you may only wish to change the BAUDRATE if your controller does not support the default rate.

Can.cfg

```
[CAN configuration]

CANBAUD=500

;===== NOTES =====
; This file is not obligatory: Defaults are used in case of absent
```

```
; lines or invalid data. Defaults are as follows:  
  
; CANBAUD=500  
  
; CANBAUD (kbits/s) will be rounded up to the closest of these values:  
; 125, 250, 500
```

In practice, you may wish to change the CANBAUD if your installation is based on a speed different from the default.

Establishing Communication

Immediately after startup, **HomSoft** tries to establish communication between the PC and the Homer. Note that microwave power is not required for establishing this communication. If all goes well, you may not notice anything (perhaps a few flashing announcements). In case of problems, a dialog window will appear in order to assist in making the connection.

Other indications of failed communication are warnings like "*Homer Memory Read Fail*" or meaningless [System Info](#) data.

After the connection is established, **HomSoft** reads all required information from the Homer and verifies correspondence between **HomSoft** version and Server version. If a mismatch is found, a dialog box appears, informing you and offering a Server upgrade.

Case of RS232

If connection via RS232 or RS422 could not be established automatically at **HomSoft** start, an error message like that in [Fig. 11](#) may pop up.

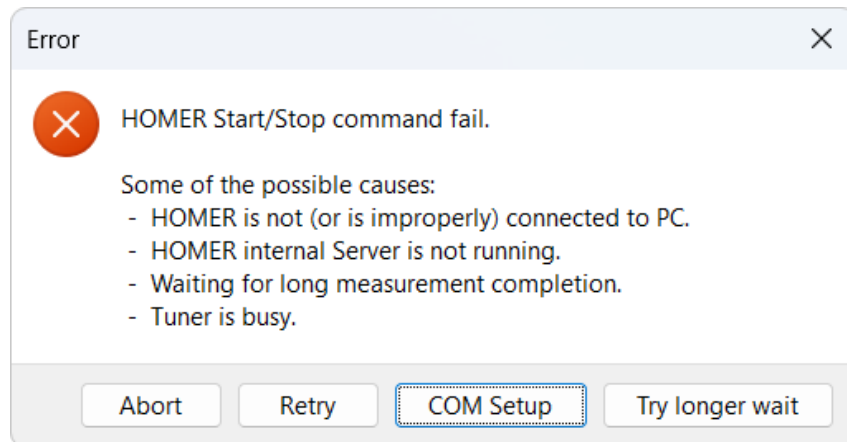


Fig. 11. A possible error message at program startup due to failed communication.

If clicking **Retry** or **Try longer wait** buttons does not help, click the **COM Setup** button. This opens the dialog window titled **COM Port Setting** ([Fig. 12](#)), displaying error message **COMMUNICATION FAIL**, sometimes with a more detailed error description. A typical problem is incorrect COM port settings. Proceed as follows:

- Select the appropriate device from the **Ports** list of the available devices. The list can be

updated by clicking the **Refresh** button.

- Select the appropriate **Baud Rate**, in most cases 115200 kbits/s.
- Click **Connect**.

If the connection is established, a green message **CONNECTION ESTABLISHED** appears and you can continue by clicking the **Return** button. Otherwise, **HomSoft** will terminate.

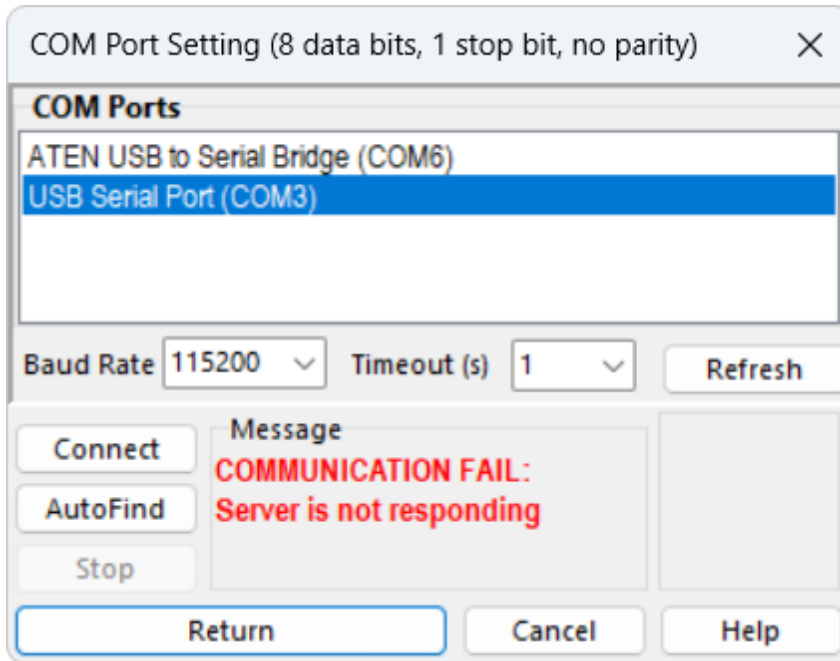


Fig. 12. COM Port Setting dialog.

Fixed COM port settings, that cannot be modified, are: 8 data bits, 1 stop bit, no parity.

Here are some causes of failed communication and possible remedies:

- Incorrect COM port or baudrate.
- Homer internal Server is not running (e.g., the Homer is not switched ON).
- Homer internal Server is running in CAN Bus mode, or the Download Server is running. Listen for Morse signal at Homer power-up, or use a COM port monitor as instructed in [Choosing Homer Power-up Server](#).
- Problem is in interconnection:
 - Verify whether the connecting RS232 cable is *null modem* (crossed TX-RX wires).
 - Verify whether the connecting cable is firmly in its position and click the **Connect** button.
 - Verify the integrity of the cable. Fix or replace the cable and click the **Connect** button.
- Problem is at the PC end:
 - COM port settings in **HomSoft** do not agree with those of theHomer unit. In this case, you should set the proper port number and baudrate and click the **Connect** button. Homer baudrate is normally fixed to 115200 kbits/s. (**HomSoft** is able to find the correct baudrate by clicking the **AutoFind** button.)

- One source of problem in older PCs may be that some SW installed in your PC tries to use the same COM port as **HomSoft**, at least from time to time. It may be a PCMCIA card (e.g., a modem). Try the following:
 - Use another COM port if available.
 - Uninstall PCMCIA cards and observe the effect.
 - Provide your PC with COM port extension card (PCMCIA-to-RS232 adapter) and use another COM port (**HomSoft** supports COM1 to COM99).
 - A usual solution is to use a USB-to-RS232 adapter connected to an USB port in your PC. The **COM Port Setting** window shows which of the available ports correspond to that adapter.
- Problem is at the Homer end:
 - Verify that the Homer DC power supply is on.
 - Terminate **HomSoft**. Switch the Homer DC power supply OFF. Wait for about 10 seconds. Switch the Homer ON again and watch for Morse code to be sure that the Server is running with the correct communication interface.
 - Restart **HomSoft**.
- The Homer is busy: If, after power-up, the Homer is instructed by its internal [Hom.cfg](#) and [Tun.cfg](#) configuration files to start measurement or even tuning automatically, it may respond to commands from your PC with delay. In this case, increase **Timeout** in **COM Port Setting** dialog window (edit or choose from the drop-down list) and click the [Connect](#) button.

Once the connection is established, the green message **CONNECTION ESTABLISHED** appears and you can continue by clicking the [Continue](#) button.

The **COM Port Setting** dialog can be invoked anytime by clicking the **Commun | COM Port** menu item.

A Note on USB-RS232 Adapter

Problems with communication (e.g., when transferring all samples in Rectified and Pulsed modes of sampling) or even PC crash may be experienced with certain brands of USB-RS232 adapters (some contain a fake chip instead of a genuine one). If such problems occur, try another brand of the adapter.

Case of CAN

One possible problem at **HomSoft** start is an incorrectly installed or unrecognized CAN Bus adapter. Then, an error message like that in [Fig. 13](#) may pop up. Clicking [Yes](#) attempts to use a different adapter type. Sometimes, simply disconnecting and reconnecting of the USB adapter plug, and then clicking [Retry](#) resolves the issue. If the problem persists, please read the accompanying CanBusCommProblems.pdf document.

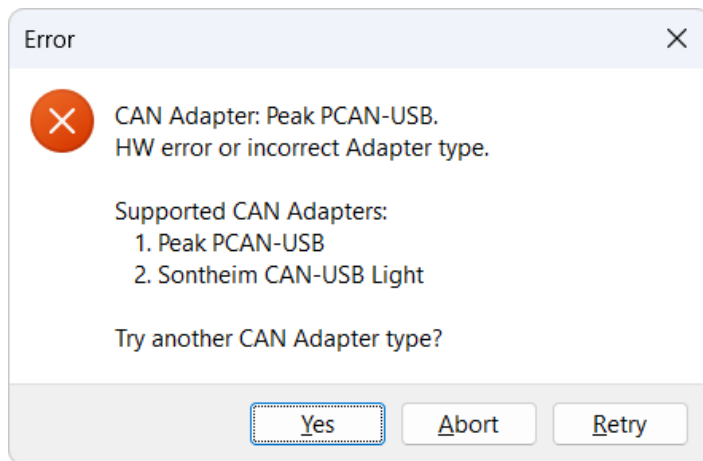


Fig. 13. CAN Bus adapter error.

If the adapter has been recognized but the connection with the Homer still fails, a dialog window titled **CAN Bus Setting** shows up (Fig. 14), displaying the error message **COMMUNICATION FAIL**. The cause may be that the Homer is busy with lengthy measurement and responds with a delay longer than the set timeout (in this case, repeatedly clicking the **Connect** button may help), or there is CAN baudrate discrepancy. This dialog window enables the user to either set CAN baudrate on the PC side manually or detect it automatically. Be sure the CAN cable is properly connected and terminated with a 120-ohm resistor at both end devices (see [Electrical Connection – CAN Bus](#)).

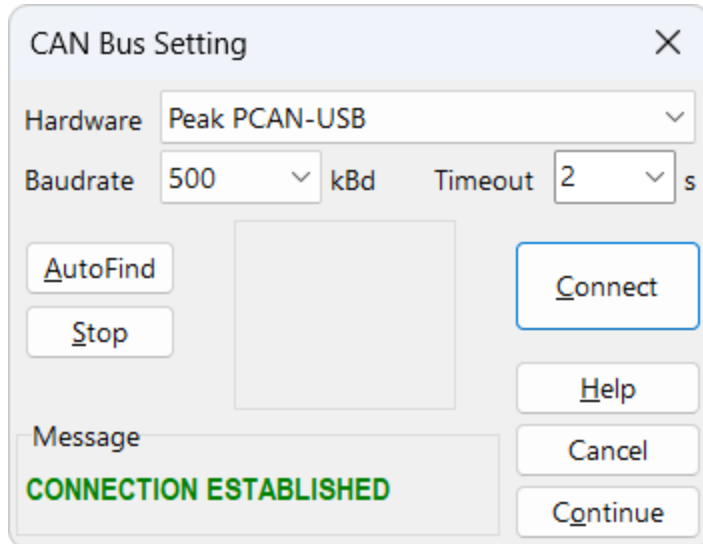


Fig. 14. CAN Bus Setting dialog.

To establish communication manually:

- From the **Hardware** drop-down list (Fig. 14), select the CAN Bus interface your PC is equipped with.
- Set **Baudrate** (you can also try a different **Timeout**).
- Click **Connect** and wait for a message.

- If the message is **CONNECTION ESTABLISHED**, reset **Timeout** to the original value and click the button. If the message is **COMMUNICATION FAIL**, repeat clicking several times, then try another baudrate.
- If the communication fails repeatedly, try disconnecting the CAN Bus cable from the installation (from the Homer device or at the position designated "X" in [Fig. 6](#)) but leave your CAN Bus Adapter connected to the USB port of the PC (or, better yet, pull it out and plug it back in). Then start again with the **Hardware** drop-down list, even if the proper adapter is shown. (The reason is that the CAN Bus adapter should be configured properly prior to connecting it physically to a CAN Bus network, otherwise it may impair the running traffic.)

To establish communication automatically:

- From the **Hardware** drop-down list, select the CAN Bus interface your PC is equipped with.
- Click and wait (abort by).
- Read the message. If the message is **CONNECTION ESTABLISHED**, reset **Timeout** to the original value and click the button. If the **COMMUNICATION FAIL** message persists, proceed as follows:
 - Verify the interconnecting cable integrity.
 - Verify that the Homer DC power supply is on.
 - Terminate **HomSoft**. Switch the Homer DC power supply OFF. Wait for about 10 seconds. Switch the Homer ON again and watch for the Morse code to confirm that the Server is running with the correct communication interface.
 - Restart **HomSoft** and retry establishing communication.

The **CAN Bus Setting** dialog can be invoked anytime by clicking the **Commun | CAN Bus** menu item.

If communication problems arise while measuring, please refer to [Problems with Communication](#) topic.

Problems with Communication

At HomSoft Start

See [Establishing Communication](#) if you encounter problems with communication at **HomSoft** start.

During Measurement

If, while measuring, the communication is interrupted (e. g. the RS232 or CAN Bus cable is unplugged), the data monitoring is suspended (the displays appear frozen) and the following message appears in the left panel of the **HomSoft** bottom Status Bar: **COM Timeout**.

After the communication has been re-established, the measurement will resume.

Sometimes, problems may occur in [Rectified or Pulsed](#) modes of sampling, especially in the case of CAN, because the system cannot "listen" while sampling and processing the samples. As a result, the commands may fail on timeout. You are usually informed of it and prompted to retry the command.

In case of problems, try to stop Homer internal measurement (**Homer | Stop Homer** menu item or *the equivalent*  toolbar button) and wait for the expected timeout (until the top-left **Run-Pause** button returns to the Off state and its icon changes from  to ). Then re-issue the failed command.

After the measurement start (after clicking ), the current timeout (the time **HomSoft** will wait for a response to commands), is displayed in the right-most panel of the **HomSoft** bottom Status Bar.

Morse Code Messages

The Homer produces sounds on Server programs start and termination. The sound may be a melody or a Morse code message.

If there is no error preventing Server from running, a *server identification message* is played in Morse code on Server start. The message identifies the running Server and its communication mode.

On Server termination, a melody (downward musical scale) is played.

In case of error, the message depends on the Server version.

Server versions V53 and less:

In case of error, the startup identification message is **not** played and the Server terminates immediately, playing first the melody, then twice an *error message*, identifying the error due to which the Server is forced to terminate. Following this, file transfer server **SrvDld.exe** is started (one long beep – Morse code for **T**).

Server versions V54 and more:

The Server identifies the first of the errors that occurred in and plays the corresponding *error message* (see below), followed by a standard *server identification message*. Server does not terminate but switches to a reduced mode with a limited command set. In this mode, measurements and motor movements are disabled, but file transfers remain available so that you are able to remedy the situation that caused the error(s).

Server Identification Messages

Message	Description
RS	SrvHo.exe Server in RS232 (or RS422) communication mode; results transmitted in binary format .
RSA	SrvHo.exe Server in RS232 (or RS422) communication mode; results transmitted in ASCII format .
ETH	SrvHo.exe Server in EtherNet/IP communication mode. For this, the Homer unit must be equipped with EtherNet/IP option.

Nxx	SrvHo.exe Server in CAN Bus communication mode; xx , which may be 1 to 20, stands for Homer CAN address (only relevant for MultiCAN). For this, the Homer unit must be equipped with CAN Bus option.
T	SrvDld.exe file transfer Server: only in RS232 (or RS422) communication mode.

Error Messages

Morse codes other than those above represent error messages, forcing Server to either terminate or work in the reduced mode. Error messages are played twice.

Message	Description
DAQ	Data acquisition and Homer control card error
IDE	Homer Identity Error: Hom.mem file from another Homer has been uploaded
HMEM	Hom.mem memory file read error
TMEM	Tun.mem memory file read error

Morse Code Messages Examples

The sounds (Morse codes and melody) are indicated red.

Server versions V53 and less

Server SrvHo in RS232 mode, no error

Server starting **RS** Server running ...

Server terminating **Melody**

Server SrvHo in CAN Bus mode, CAN Address = 1, no error

Server starting **N1** Server running ...

Server terminating **Melody**

DeviceNet Server SrvDnet, MAC ID = 30, no error

Server starting **30** Server running ...

Server terminating **Melody**

Any Server, Homer Identity Error

Server starting Server terminating **Melody IDE IDE** SrvDld starting **T** SrvDld running

Server versions V54 and more

Server SrvHo in RS232 mode, no error

Server starting **RS** Server running ...

Server terminating **Melody**

Server SrvHo in CAN Bus mode, CAN Address = 3, no error

Server starting **N3** Server running ...

Server terminating **Melody**

Server SrvHo in RS232 mode, Homer Identity Error

Server starting **IDE RS** Server running in reduced mode...

Server terminating **Melody**

Server SrvHo in CAN Bus mode, CAN Address = 3, Homer Identity Error

Server starting **IDE N3** Server running in reduced mode...

Server terminating **Melody**

SOFTWARE OPERATION

This section is a guide to

- controlling Homer
- monitoring and visualizing Homer measurement data

using **HomSoft**. A basic step-by-step procedure is outlined in the [How to Use the Program](#) section.

Program Windows

After the communication between your PC and the Homer has been successfully [established](#), the main program window and possibly some additional windows appear on the screen ([Fig. 15](#)).

Note: The appearance of the windows may vary depending on the operating system on your PC.

The windows can be classified as:

- Main Window
- Display windows
- Dialog windows

Please note that the appearance of the windows on your PC may slightly differ from the illustrations in this document, depending on the **HomSoft** version and your Microsoft Windows settings.

Main Window

The Main Window is the standard Windows program framework. The window includes a menu bar, two toolbars at the top (Standard toolbar, Signal toolbar), and a Status bar at the bottom. Most importantly, Main Window is the container (parent) for practically all program windows; these are its *child* windows, i.e., they can be moved only within the Main Window borders.

Display Windows

Display windows show the measured results graphically in a variety of formats (e.g., magnitude or phase of reflection coefficient, VSWR, Smith chart, powers incident on, reflected from and absorbed in the load, etc.). New display windows can be freely added. The type and format of data to be displayed can be changed for each window. The plots can be scaled manually or

automatically. The appearance of the displayed traces (color, width, etc.) can be modified. For details, see section [Display Windows](#).

Dialog Windows

Dialog windows are used for entering data inputs, launching actions and displaying information of various kinds. Examples of some important dialog windows are shown in [Fig. 15](#) (Maxi Results window, Tuner View window and [System Info](#) window).

While some windows (like those shown in [Fig. 15](#)) can be present permanently on the screen, other windows (like Save/Load dialogs) must be closed before any other action is permitted. The position of these *modal* windows is not limited by the Main Window borders.

Various dialog windows will be described where appropriate.

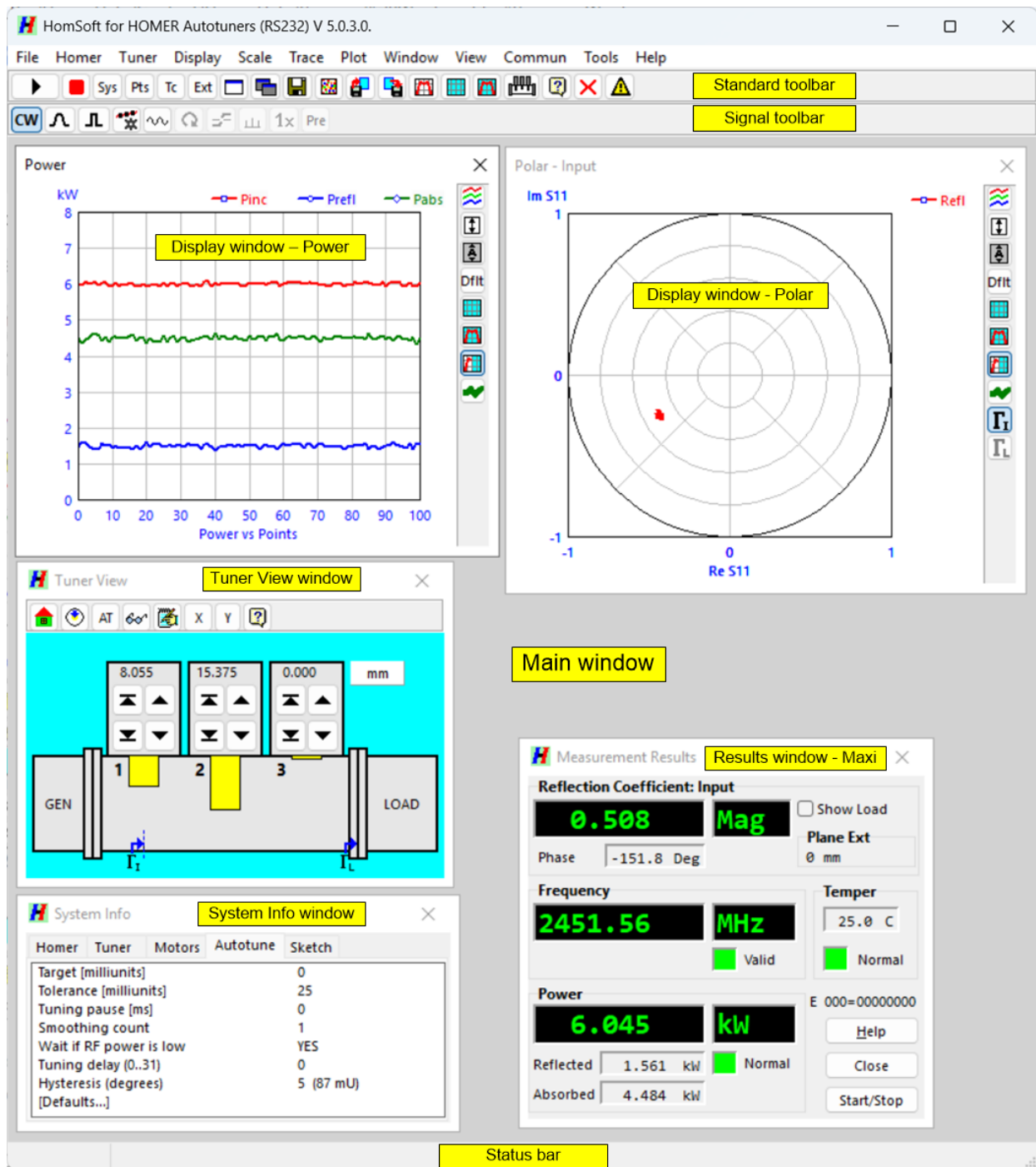


Fig. 15. Important *HomSoft* windows.

Display Windows

Display windows (Fig. 16) are primary means of presenting measurement results graphically (as curves or dots) in selectable formats. When you start measurement, all open display windows will reflect the measured data in their corresponding formats.

Display Speed Considerations

As the measurement progresses, the windows are updated point-by-point. Please be aware that the operating system needs a relatively long time for this process (this also applies to the [Results windows](#)). Therefore, the more windows are open, the slower the process may be. If you observe that the display is lagging behind the actual data, try to open as few windows as possible.

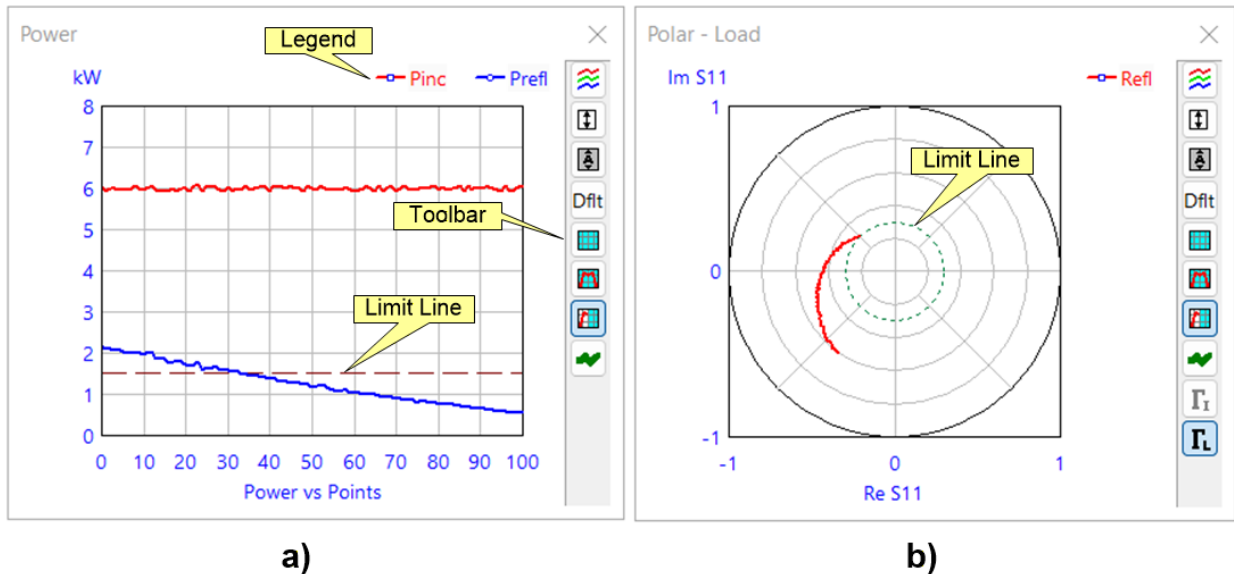


Fig. 16. Display windows with (a) rectangular plot and (b) circular plot.

Main Elements of Display Windows

Main elements of the display window include:

- Plot
- Legend
- Menu
- Toolbar
- Limit Line

Plot

There are two types of display window plots:

- Rectangular plots (example in [Fig. 16a](#))
- Circular plots (example in [Fig. 16b](#))

Rectangular plots display a scalar measured quantity (e.g., incident power or modulus of reflection coefficient) as a function of the "Points" number, i.e., the sequential number of a received measurement data block. The number is related to time although there is no proportionality (measurement start instant and measurement duration may vary widely). The number of displayed points [can be selected](#); on reaching this maximum, the displayed curves retrace and start from the beginning. Due to this, the measurement process is (somewhat inaccurately) referred to as *sweeping*.

Circular plots display the complex reflection coefficient in the form of a locus, enabling the user to observe both magnitude and phase simultaneously. Circular plots include the Polar plot (shown in [Fig. 16b](#)), the impedance Smith chart, the admittance Smith chart and the Owen plot.

The traces in the display windows are updated point by point as the measured data arrive.

Legend

The Legend is a small rectangle within the display window, showing the name and drawing attributes (appearance) for each displayed trace. To show and hide the Legend, click the **Plot | Legend** menu item. To change the appearance of the traces, click the  button or the **Trace | Properties** menu item, or right-click the *Legend* box. See more details in section [Trace Properties](#).

Menu

See section [Display Window-Related Menu](#).

Toolbar

The display window toolbar contains buttons corresponding to frequently used menu commands:



Trace properties



Set scales



Autoscale



Set default scales



Clear screen



Redraw last trace



Clear screen before measurement start (also referred to as Clear and Go)



Persist



Show Input reflection coefficient (dimmed when not selected)



Show Load reflection coefficient (dimmed when not selected)

Limit Line

The [Limit Line](#) (**Plot | Limit Line**) is an optional trace that visualizes a predefined value (e.g., tolerance) of the displayed quantity. You can modify its presence, appearance, and the associated value. The Limit Line is a straight line in rectangular plots and a circle in circular plots.

Display Windows-Related Commands

To open a new display window:

Click the **Window | New Display** menu item or the  button. The window is, apart from its size and screen position, a replica of the currently active display window. Now, you can modify its settings as required.

When you close all display windows and then open a new display window, the new window will be

the replica of the display window that was deleted last.

To activate an open display window:

Click into it. Settings made by menu items associated with display windows (**Display, Scale, Trace, Plot**) affect only the currently active display window.

To position and resize a display window:

Use standard Windows mouse-dragging techniques.

To close a display window:

Click the standard closing button. To close all display windows, click the **Window | Close All Displays** menu item.

When you close all display windows and then terminate the program, a single display window with default settings will open on the program restart.

Display Window-Related Menu

Each display window has its own menu. The menu is, however, merged into the main [HomSoft menu](#). The display menu items (appearing as subitems of the main menu) are

Display, Scale, Trace, Plot

Settings made in these menu items affect *only the currently active* display window.

Display

The Display menu is used for selecting the format and, if applicable, the units in which results will be shown. Available formats are:

- **Mag:** Linear reflection coefficient magnitude $M = |\Gamma|$. For passive loads, magnitude lies between zero (perfect match) and 1 (total reflection).
- **LogMag:** Logarithmic reflection coefficient magnitude $L = 20 \log(M)$ expressed in decibels (dB). A perfect match corresponds to $L = -\infty$; total reflection corresponds to $L = 0$ dB.

Note that the return loss R is the negative of LogMag: $R = -L$.

- **VSWR:** Voltage standing wave ratio $V = (1+M)/(1-M)$.
- **Phase:** Phase of reflection coefficient in degrees.
- **Polar:** Polar plot, displaying reflection coefficient as a vector in complex plane.
- **Z-Smith:** Impedance Smith chart, mapping complex reflection coefficient to normalized impedance

$$z = (1 + \Gamma)/(1 - \Gamma)$$

- **Y-Smith:** Admittance Smith chart, mapping complex reflection coefficient to normalized admittance

$$y = 1/z = (1 - \Gamma)/(1 + \Gamma)$$

- **Oven:** An alternative form of polar plot, rotated counter-clockwise by 90° and showing circles of constant VSWR. This form is often used for plotting Rieke diagrams of magnetrons.

- **Power:** Incident, reflected and absorbed power in linear scale. Available units:
 - **uW** microwatts
 - **mW** milliwatts
 - **W** watts
 - **kW** kilowatts
- **LogPower:** Incident, reflected and absorbed power in logarithmic scale. Available units:
 - **dBm** decibels relative to $P_0 = 1 \text{ mW}$
 - **dBW** decibels relative to $P_0 = 1 \text{ W}$
 - **dBkW** decibels relative to $P_0 = 1 \text{ kW}$

LogPower (L_p) is related to linear power P by $L_p = 10 \log(P/P_0)$.
- **Freq:** Magnetron frequency in MHz. For correct using of this display type, see topic [Fast Frequency Measurement](#).

Scale

The Scale menu is used for scaling the active display window plot. The menu items are

Set Scale, Autoscale, Default

See [Plot Scaling](#) for more details.

These commands are more comfortably accessible via display window [toolbar buttons](#).

Trace

The Trace menu is used for defining the appearance of traces drawn in the active display window and for switching between the measured and deembedded reflection coefficient. The menu items are

Properties, Show Load

(the **Show Load** menu item appears only for the reflection coefficient-related displays). See details in sections [Trace Properties](#) and [Input and Load Reflection Coefficients](#), subtopic [Deembedding](#). The commands are more comfortably accessible via display window toolbar buttons.

Plot

The Plot menu groups commands associated with the overall plot appearance rather than with individual traces. The menu items are

Legend, Limit Line, Clear, Clear and Go, Persist

For their descriptions, see [Main Elements of Display Windows](#), [Limit Line](#), and [Trace Properties](#).

Plot Scaling

Plots can be scaled by means of **Plot Scaling** dialog ([Fig. 17](#)). The dialog enables you to control:

- The span of the axes for the rectangular plot types.

- Radii of the circular plot types.

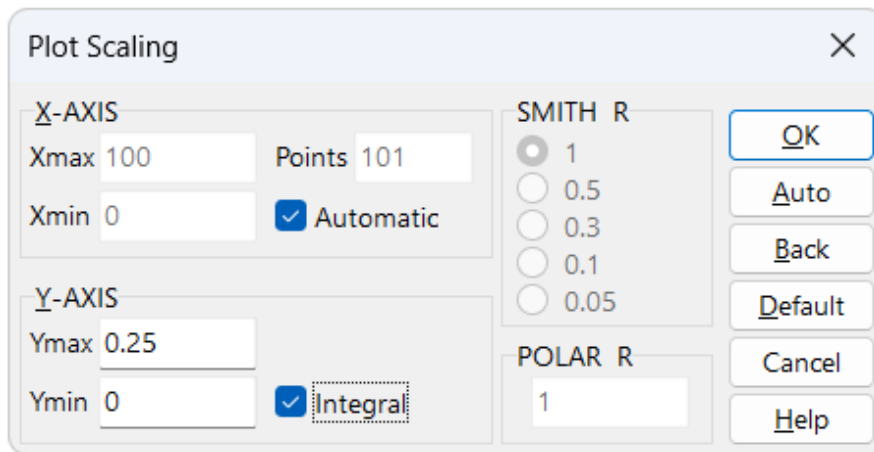


Fig. 17. Plot Scaling dialog box.

Plot Scaling dialog for the active display window can be invoked by any of the following alternatives:

- Click the  button on the display window toolbar.
- Click the **Scale | Set Scale** menu item.
- Double-click the top-level **Scale** menu item.
- Use the **Ctrl+Y** shortcut.

The dialog box contains several panels, of which only those pertinent to the particular display type are accessible.

Rectangular Plots

Xmin, Xmax

User-defined lower and upper bounds of the x-axis. The x-axis is labeled Points and represents the sequential number of a measurement point.

Points

Points is a non-editable information field showing the number of currently selected trace points (points per sweep). Points per sweep can be defined by **Homer | Points per Sweep**, the  toolbar button, or the **Ctrl+N** shortcut.

Automatic

If the *Automatic* checkbox is checked, the span of x-axis is given by points per sweep (N_p). The lower bound is zero, the upper bound is equal to $(N_p - 1)$. The **Xmin**, **Xmax** edits are disabled and their settings ignored. If the box is unchecked, the span of x-axis is given by the **Xmin**, **Xmax** values.

The x-axis grid spacing is always automatic.

Ymin, Ymax

User-defined lower and upper bounds of the y-axis. The values will be accepted after you click the button. The values will be ignored if you click the , or button.

Integral

When the **Integral** checkbox is checked, the y-axis span will be an integral multiple of the axis grid interval. The span encompasses the complete interval Ymin to Ymax. The plot will have a neat appearance but there may be unused portions up to one grid interval at the bottom and top.

When the **Integral** box is unchecked, the plot y-axis bounds will be equal to Ymin, Ymax, or as returned by the autoscaling procedure. The bounds will not be "neat" numbers but the plot span will be used in a more efficient way.

The y-axis grid spacing is always automatic.

Circular Plots

Polar Plot

With Polar plot, only the Polar radius (POLAR R) field is enabled. Here you can enter the desired radius of the polar plot. The choice will be accepted after clicking the button.

Smith Charts, Owen Plot

For these types of displays, only the Smith radius (SMITH R) radio group is enabled. Here you can select from available polar radii one which best accommodates the measured data. Confirm by the button.

Buttons

OK

Accept the settings and close the dialog.

Auto

Autoscaling of the y-axis based on the latest measured data.

Rectangular plots: After clicking the button, the minimum and maximum y-coordinates of all simultaneously displayed traces are computed. Using these values, the y-axis bounds of the plot are automatically set to accommodate all traces. The **Integral** checkbox status is also considered. The values in the Ymin, Ymax fields are modified accordingly.

Circular plots: A similar method is used to compute the polar radius.

The function will only be activated when measured data are available. The function can also be invoked by the **Scale | Autoscale** menu item, **Ctrl+A** shortcut or  display window button.

Back

Clicking the button returns scale settings to the most recent manually entered values. The button is useful for reverting autoscale settings. The button does not work with Smith chart and Owen plot types.

Default

Clicking the **Default** button sets the y-axis span or polar radius to a fixed default value, usually covering the entire possible or practical span of the displayed quantity. Unlike **Auto**, the function can be activated anytime and does not affect the fields of the dialog box.

The function can also be invoked by the **Scale | Default** menu item, **Ctrl+D** shortcut or the **Dflt** display window toolbar button.

Cancel

Ignore new settings and close the dialog.

Trace Properties

Trace properties control the visual appearance of the displayed traces (lines, markers) as they appear on the screen while sweeping and after its completion (the two cases may slightly differ). To start modifying trace properties, you can do any of the following:

- Click the  toolbar button.
- Right-click the **Legend** panel of the display window you wish to modify.
- Click the **Trace | Properties** menu item (this affects the properties of the currently active display window).

A dialog box titled **Trace Properties** appears (Fig. 18). The dialog contains three panels, titled *Visible Traces*, *Line*, and *Markers*. The topmost panel also includes a preview box.

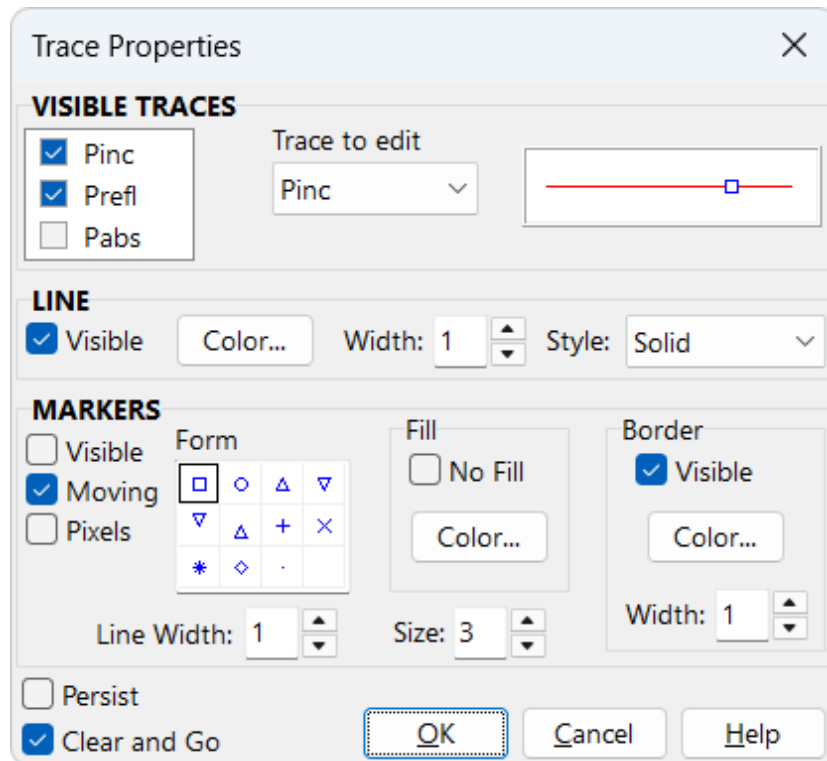


Fig. 18. Trace Properties dialog box.

To modify Trace properties, proceed as follows:

Visible Traces Panel

The **Power** and **LogPower** plots may display up to three traces: incident, reflected, and absorbed power. In the checkbox list on the left, select which traces you want to be visible on the graph, and in the adjacent dropdown menu, select the trace you wish to edit.

For the remaining plots (**Mag**, **Polar**, **VSWR**, etc.), only one trace is available for editing and it is automatically selected.

The right portion of the panel shows the preview of the trace currently being modified.

Line Panel

Check the **Visible** checkbox if you want the measured points to be connected by a straight line. Select the color, width (in pixels), and style of the line. Note that when the width is greater than one, only solid line will be drawn.

Markers Panel

The *Markers* panel defines whether and how the markers (dots) for each measurement point will be displayed during the sweep and afterwards. This also depends on the state of the **Persist** checkbox (see below). For now, suppose the **Persist** box is unchecked.

Visible

The **Visible** checkbox decides whether the markers will be drawn *after* completing the sweeping. For the behavior *while* sweeping, see the description of the **Moving** checkbox.

Moving

When the **Moving** checkbox is checked, a single point is shown on the trace running as the sweep progresses. During sweeping, this happens regardless of the **Visible** checkbox state. After stopping measurement, the trace is updated depending on the **Visible** status as follows:

- If **Visible** is checked, the complete trace is shown, including all markers.
- If **Visible** is unchecked, the markers are not displayed.

When the **Moving** checkbox is unchecked, the trace, both while sweeping and afterwards, is drawn with or without all markers depending on the **Visible** state.

Pixels

When the **Pixels** checkbox is checked, a single dot (pixel) with the color equal to the *Line* color is left behind at each measurement point in addition to anything else. You may wish to combine it with Moving Point in circular plots.

Marker Appearance

The marker appearance and size are defined by the rest of the controls in the *Markers* panel. It is best to try it out and see. **Line Width** affects only the thickness of the following three markers: +

× *.

Other Controls

Persist

When the **Persist** checkbox is checked, the display acts as an oscilloscope with infinite persistence, not erasing previous traces as the new trace is being drawn while sweeping. In this way, glitches, e.g., temporary irregularities, and measurement history can be captured.

Note, however, that this has only a volatile nature: resizing the display window clears all accumulated traces, leaving only the final sweep.

The **Persist** function is also accessible from the **Trace | Persist** menu item or the display window toolbar button .

If the **Persist** is ON the traces are displayed with or without markers depending on the **Visible** checkbox state. The setting of the **Moving** checkbox is irrelevant.

Clear and Go

When **Clear and Go** is checked, the display is cleared before start of each measurement. In this way, only one set of traces at a time is displayed (like an oscilloscope). When the checkbox is unchecked, the contents of the display are left unchanged and new traces are just added. In this way, more curves can be displayed simultaneously and visually compared.

As with **Persist**, this has only a volatile nature: resizing the display window while **Clear and Go** is unchecked clears all accumulated traces, leaving only the final sweep.

The **Clear and Go** function is also accessible from the **Plot | Clear and Go** menu item or the display window button .

Tips for Circular Plots

Three useful settings for circular plots are:

Panel	Control	Setting 1	Setting 2	Setting 3
Line	Visible			ü
Markers	Visible			
Markers	Moving	ü	ü	ü
Markers	Pixels		ü	

Setting 1 provides only one marker “flying” over the plot, corresponding to the current measurement point.

Setting 2 provides a flying marker like in Setting 1 plus a dot (pixel) for each previous point, enabling the user to see the history from the start of a sweep.

Setting 3 provides a comet-like picture: a flying marker like in Setting 1 plus a line tail representing a number of previous points, enabling one to see the recent history. The number of points in the tail is equal to the number of currently selected points per sweep. Points per sweep can be defined by **Homer | Points per Sweep**, the  toolbar button, or the **Ctrl+N** shortcut.

Limit Line

The **Limit Line** (accessed via **Plot | Limit Line**) is an optional trace that visualizes a predefined *limit value* of a measured quantity (e.g., a minimum or maximum accepted value). A single limit line with a user-defined appearance (color, width and style) can be displayed on the screen. In rectangular plots, the limit line is a straight line parallel to the x-axis. In circular plots, the limit line is a circle centered at zero reflection coefficient.

Generally, each display type in each particular display window has its own individual limit line, defined by its presence, appearance and value.

An exception is *the reflection coefficient in a given display window*, where the limit value is linked to the format in which the reflection coefficient is displayed. When changing the display format, both the reflection coefficient *and* the limit value are converted using the same formulas.

The group of display types corresponding to reflection coefficient includes the following:

Mag, LogMag, VSWR, Polar, Z-Smith, Y-Smith, Owen

So, for instance, when you define the limit value 0.1 in **Mag** format and change the display to **LogMag**, the limit line appears at the level of -20 dB, which is $20 \cdot \log(0.1)$. When you switch to **VSWR**, the limit line value becomes 1.222, which is $(1 + 0.1)/(1 - 0.1)$. In circular formats, the limit line appears as a circle with the radius of 0.1.

- To show and hide the limit line, click the **Plot | Limit Line | Visible** menu item.
- To change the limit line value, click the **Plot | Limit Line | Value** menu item and enter a new limit value. This also makes the limit line visible.
- To change the limit line appearance, click the **Plot | Limit Line | Style** menu item. The dialog box titled *Limit Line Properties* opens. Select the desired Color, Width, and pick a Style. Press OK.

How to Use the Program

This section introduces some very basic steps that are needed for performing measurements, [tuning](#) and documenting results. Note that many frequently used functions are accessible not only from the menu but also by clicking corresponding toolbar buttons, or from specific dialog windows.

- Connect the measurement system as described in either
 - [Electrical Connection – RS232/RS422](#) or
 - [Electrical Connection – CAN Bus](#).
- [Start the Homer](#).
- Start a **HomSoft** application on your PC (i.e., **Tu_rs.exe** for RS232, **Tu_can.exe** for CAN Bus). As a first step, the application tries to establish communication between the PC and the Homer. For details, see [Establishing Communication](#) and [Configuring Communication](#).
- After the connection has been established, at least one [display window](#) should appear inside the Main Window. If no display window has appeared, click the **Window | New Display** menu item or the  button.

- After new SW or HW installation or if you are unsure about Homer SW or HW versions, click the **Help | About** menu item to open the **About** window ([Fig. 45](#)). Always copy this window when [reporting problems](#).
- Open [Homer Sampling Setup](#) window and:
 - By selecting a corresponding tabsheet (*CW*, *Rectified* or *Pulsed*), choose the sampling mode appropriate for the microwave power *waveform* delivered by your generator, *and for the periodicity of the load reflection coefficient variations*. (A good idea is to start with *CW* if you are just learning how to use **HomSoft**.)

Note: For accurate measurement and correct tuning, it is extremely important to know the *actual* waveform of your signal and its timing (for details, see [Signal Waveforms](#)). To determine these, do not rely on *anything* but your own measurement. The best way is to sample the waveform as described in [Waveform Determining](#).

 - For the chosen sampling mode (also referred to as *Waveform*), choose appropriate sampling parameters and frequency counting time. For further details, refer to topics [CW Signal Sampling](#), [Rectified Signal Sampling](#), [Pulsed Signal Sampling](#) and [Homer Sampling Setup](#).
- Click the **Display** menu item and select the display format of your choice. If applicable (formats Power, LogPower), the menu includes the option to select units (**Display | Units**).
- Click the **Scale** menu item or the corresponding button  on the display window toolbar to set proper [scales](#) of the display (span of axes, polar radius, etc.). You can do this later, based on a completed measurement, after which the Autoscale function will also be enabled.
- In the display window, right-click the **Legend** box or, equivalently, click the  toolbar button or the **Trace | Properties** menu item. This opens the [Trace Properties](#) dialog window in which you can choose your drawing preferences, such as
 - which of the available traces will be displayed,
 - properties of the lines connecting the measured points,
 - properties of markers (shape, size, color, etc.).
- If you wish to observe another quantity or the same results in various formats simultaneously, open a new display window by clicking the  button or the **Window | New Display** menu item and set its display format, scaling, and trace attributes as described above. You can open any number of display windows. The **Display**, **Scale**, **Trace** and **Plot** menus refer to the currently active display window. To activate a display window, click into it.
- If you wish to observe the measured data also in numerical form, open either a full-size (Maxi) or reduced-size (Mini) [Results windows](#) by clicking **View | Results (Maxi)** or **View | Results (Mini)**, respectively.
- Start measurement by clicking the **Homer | Run-Pause** menu item or the equivalent  button (after clicking, the button turns to ). For more options see [How to Start and Stop Sweeping](#).
- Watch whether an error/warning is not reported. The Homer sends [Error Byte](#) with each Measurement Data Object (MDO), which is then decoded and, based on the results, various

errors or warnings may be announced in [Results windows](#). The Maxi Results window displays the Homer Error Byte value explicitly in decimal and binary form.

- Now you can observe the measurement results and make your experiments.
- Stop measurement. There are two methods, and they are not equivalent (see details in [How to Start and Stop Sweeping](#))
- After stopping, last traces will remain on the **HomSoft** screen and in the memory.
- Save the results in the form of a picture or a text file table (see section [How to Save Measured Results](#)). Be aware that saving results in tabular (text) form is more useful for later data analysis than a mere picture (you can create a picture from text data but not vice versa).

Tuning

- Click the **View | System Info** menu item or the equivalent  button to open the [System Info](#) window. Go to page *Autotune* and set autotuning control parameters. The settings can also be made, although less comfortably, via the **Tuner | Autotune** submenu.
- Click the **Tuner | View** menu item or  button to open the [Tuner View](#) window.
- Set tuning stubs to zero positions ([All Stubs Home](#)) by the **Tuner | Home** menu item or the  button.
- Start measurement.
- To perform a single autotuning step, click the  button.
- To start continuous autotuning, click the  button (stop it by the same method).

How to Start and Stop Sweeping

There are more alternatives for how to start and stop measurement (sweeping).

Start Sweeping

There are the following alternatives:

With a Mouse

- Click the **Start Homer** button  on the Standard toolbar ([Fig. 15](#)). After clicking, the button image changes to a Pause symbol .
- Click the **Homer | Run-Pause** menu item.
- Double-click the **Homer** main menu item.

Without a Mouse

- Press the **F9** hot key.
- Press the **Spacebar** (only if the main window has focus or any of the graphic display windows within)
- Press **Alt+H**, then press the **R** key.

The **Start Sweeping** action has two effects:

- A command is issued to the Homer to start repeated measurements, possibly autotuning, and

sending results.

- Your PC starts monitoring the Homer, i.e., receiving data messages, processing them, and displaying measurement results as numbers, graphs, or both.

Stop Sweeping

There are, in fact, two ways to stop sweeping, **which are not equivalent**:

- You can apply exactly the same methods as for starting the sweeping, typically clicking the **Pause** button , pressing the **Spacebar** (if main window has focus), pressing **F9**, or clicking the **Homer | Run-Pause** menu item. By this, however, your PC only discontinues *monitoring* the Homer, i.e., receiving and displaying results, while the Homer *continues* all its internal activities, such as measurement, possibly autotuning, and sending data.

The instant the monitoring is actually discontinued depends on the state of the **Homer | Finish Sweep** menu item:

- If **Homer | Finish Sweep** is unchecked, the monitoring stops immediately (in the middle of the sweep).
 - If **Homer | Finish Sweep** is checked, the monitoring continues until the current sweep is completed (graphic traces reach the end of the plot), then it stops.
- If you click the **Stop Homer** button  or the equivalent **Homer | Stop Homer** menu item, you will (a) suspend Homer *monitoring* but also (b) set the Homer to a *standstill*: the Homer will do nothing (no measurement, no autotuning, no results transmission) except wait for commands. This command is executed *immediately*, regardless of the **Homer | Finish Sweep** menu item state.

Homer Error Byte

As part of each block of measured data (Measurement Data Object MDO), the Homer sends an *Error Byte*, where various error conditions and warnings are encoded in a bitwise manner. In [Homer Communication Protocol](#) the byte is designated HER (Homer Error Byte). The byte can be decoded and error conditions can be announced (e.g., through LED-like indicators and messages in [Results windows](#)). The Maxi Results window displays the Homer Error Byte value explicitly both in decimal and binary form.

The *Error Byte* is included in the data to be saved or logged (see [How to Save Measured Results](#) and [Data Logging](#)). This enables offline validity check of the saved results.

Bits of the *Error Byte*, if set to 1, signify the following conditions (bit #0 is LSB):

Bit	Weight	Type	Meaning
0	1	Error	Pulsed mode measurement error occurred
1	2	Error	A/D converter overflow in at least one of the four detector channels
2	4	Error	Internal temperature too low (below the calibration interval)
3	8	Error	Internal temperature too high (above the calibration interval)

4	16	Warning	<i>Low Signal</i> : signal level too low to ensure accurate data
5	32	Warning	Substitute frequency sent
6	64	Error	Measurement data are (for any reason) invalid
7	128	Reserved	

The value of the *Error Byte* is the sum of the weights of the individual bits that are set to 1.

Example

Suppose the following conditions occur:

- A/D converter overflow (bit #1, W1=2)
- Internal temperature too high (bit #3, W3=8)
- Substitute frequency sent (bit #5, W5=32)

Then

$Error\ Byte = W1 + W3 + W5 = 2 + 8 + 32 = 042 = 00101010\ bin$

Low Signal Warning

Low Signal condition occurs when the measured *incident power* falls below a predefined threshold. The threshold in watts is defined in the [Hom.cfg](#) configuration file by the line

```
LowPowLvl_W=100;      Incident power threshold for "Low Signal" condition
```

The *Low Signal* flag can be used:

- Internally in Homer Autotuner.
- In **HomSoft**.

Low Signal Use in Homer Autotuner

In Autotuner, the *Low Signal* condition can suspend autotuning (e.g., chaotic tuning when microwave power drops). The default power-up behavior is defined by the line

```
WaitRF=TRUE
```

in the [Tun.cfg](#) configuration file. When set to **TRUE**, autotuning is suspended as long as *Low Signal* condition persists.

HomSoft can override this default by its own setting – see the [System Info](#) window, page *Autotune*, item **Wait if RF power is low**. When set to **YES**, autotuning is suspended as long as the *Low Signal* condition persists.

Setting **NO** may sometimes be useful (noise-based chaotic tuning without microwave power can be used for motors testing purposes).

Low Signal Use in HomSoft

When the *Low Signal* condition occurs, the displaying of the received results can either continue (showing random, noisy data), or can be suspended, depending on the status of **Homer | More | [Suspend on Low Signal](#)** menu item. Updating of the traces is then halted until the condition ceases.

TX Timing Window

Clicking **Homer | TX Timing** opens the **TX Timing** window (Fig. 19) to define the cadence with which the measurement results will be updated and transmitted via the communication interface.

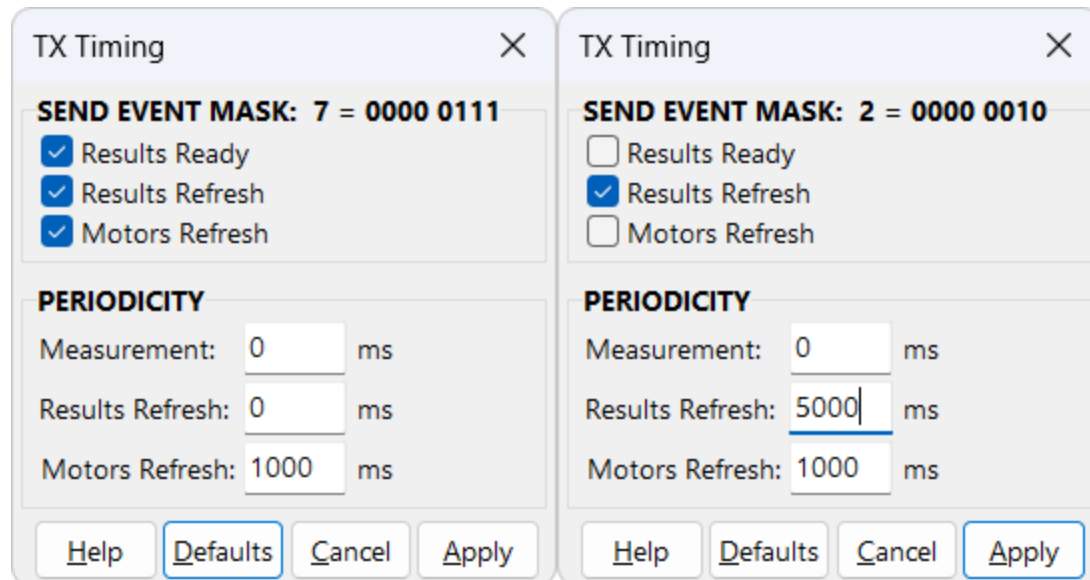


Fig. 19. TX Timing window. Left: defaults, right: as in the example below.

The **TX Timing** window must be closed before continuing the program. You can do it using the **Apply** button, the **Cancel** button or the standard Windows close button (×). To accept your edits, click the **Apply** button. If you click the **Cancel** button or the Windows close button, any changes you have made will be ignored.

To restore default values for all of the settings, click the **Defaults** button.

Note: The value of *Measurement* in the *PERIODICITY* group of the **TX Timing** window is identical to the value of *Period* in the *SIGNAL* group of the [Data Acquisition Setup Window](#).

Timing Background

In each cycle of its main program loop, the Homer checks whether an (internally generated) request to send data has arisen. There are three types of these requests: Results Ready, Results Refresh, and Motors Refresh (see below for their meaning). More than one request type can arise at the same time. The requests are registered in a specialized 8-bit variable (byte) called *Request To Send* register (RTS). Each request type sets a specific bit in this register as follows:

- Results Ready bit 0
- Results Refresh bit 1
- Motors Refresh bit 2

The individual requests are enabled or rejected by comparing the (ever changing) bits of RTS against the corresponding (constant) bits of a similar register called *Send Event Mask* register (SEM). Bits of SEM are user-controlled by the equally named checkboxes in the *SEND EVENT MASK* panel of the **TX Timing** window. The value of SEM byte is displayed in both decimal and

binary form in the header of the *SEND EVENT MASK* panel. The data will be transmitted when at least one of the occurring requests is enabled (mathematically, when $RTS \& SEM > 0$, where $\&$ stands for bitwise AND operation).

The power-up value of SMR is defined by the following line in the internal Hom.cfg configuration file:

```
TxMask=7           ;Homer sending mask (b0=ResReady b1=TxPeriod b2=MotRefr)
```

The value of 7 corresponds to all three checkboxes in *SEND EVENT MASK* panel checked.

Results Ready

The *Results Ready* sending request (*bit 0 of RTS*) occurs after each successful measurement, i.e., normally with the periodicity of signal measurement (**OnPeriod**). Power-up value of **OnPeriod** is defined by the following line in the internal Hom.cfg configuration file:

```
OnPeriod_ms=0      ;Measurement cycle periodicity [ms] (0 to 65535)
```

In the **TX Timing** window, this periodicity can be defined by editing the **Measurement** box in the *PERIODICITY* panel.

The request is enabled by **Results Ready** checkbox.

When **Results Ready** is checked, a Measurement Data Object (MDO) will be sent whenever *Results Ready request* to send occurs. When **Results Ready** is unchecked, the request will be ignored.

Results Refresh

The *Results Refresh* sending request (*bit 1 of RTS*) occurs periodically with the period defined by **Results Refresh** edit box in the *PERIODICITY* panel. Its power-up value is defined by the following line in the Hom.cfg configuration file:

```
TxPeriod_ms=0      ;Homer sending periodicity [ms] (0 to 65535)
```

The request is enabled or rejected depending on the state of the **Results Refresh** checkbox in the *SEND EVENT MASK* panel as follows:

- When the **Results Refresh** checkbox is checked, the last valid Measurement Data Object (MDO) will be sent whenever a *Results Refresh sending request* occurs. On sending, the *Results Refresh* request is cleared and the corresponding internal timer is restarted.
- When the **Results Refresh** checkbox is unchecked, all sending requests of this type will be ignored.

Motors Refresh

The *Motors Refresh* action is meant as a sort of “heartbeat” in a case when the measurement procedure fails for any reason (there are no measurement data to send), or when the measurement cadence is very slow (*Results Ready* period is very long).

The *Motors Refresh* sending request (*bit 2 of RTS*) occurs periodically with the period defined by **Motors Refresh** edit box in the *PERIODICITY* panel. Its power-up value is defined by the following line in the Hom.cfg configuration file:

```
Mot_Refresh=1000    ;Tuner: Interval [ms] between sending motors data
```

The request is enabled or rejected depending on the state of the **Motors Refresh** checkbox in

the *SEND EVENT MASK* panel as follows:

- When the **Motors Refresh** checkbox is checked, a Measurement Data Object (MDO) will be sent whenever a *Motors Refresh* sending request occurs. On sending, the *Motors Refresh* request is cleared and the corresponding internal timer is restarted. The MDO can be of two types:
 - If measurement data are not available at the request instant, a reduced MDO containing only motors positions and status will be sent. Note that these reduced messages will be ignored in [Data Logging](#).
 - If measurement data are available, a complete MDO will be sent.
- When the **Motors Refresh** checkbox is unchecked, all sending requests of this type will be ignored.

The default **Motors Refresh** period is 1000 ms. It is unwise to set it to zero or a low value (below about 100 ms) because the communication bus could get overloaded with motors data messages.

Motors Refresh period can be alternatively defined in the **Tuner | Motors Refresh** menu item.

Sending Periodicity Example

To command the Homer to measure at full speed but send results only once in each 5 seconds:

- In the *PERIODICITY* panel:
 - Edit the **Measurement** edit box to 0 (to ensure full-speed measurement).
 - Edit the **Results Refresh** edit box to 5000.
- In the *SEND EVENT MASK* panel:
 - Uncheck the **Results Ready** checkbox.
 - Check the **Results Refresh** checkbox.
 - Uncheck the **Motors Refresh** checkbox.
- Now, the **TX Timing** window should look like [Fig. 19](#) (right). Click the button.

To make the Homer behave as described on its power-up, edit its internal [Hom.cfg](#) as follows:

```
OnPeriod_ms=0
TxPeriod_ms=5000
TxMask=2
```

Results Windows

Results windows are used for observing measured data numerically. There are two types of Results windows:

- Full-size (Maxi) Results window.
- Reduced-size (Mini) Results window.

To open a Results window, click the **View | Results (Maxi)** or **View | Results (Mini)** menu item.

Full-Size Results Window

The Full-size (Maxi) Results window ([Fig. 20](#)) displays measured data numerically. Basic results and errors or warnings can be read from a longer distance. The data are grouped in several boxes.

Reflection Coefficient Group

The *Reflection Coefficient* group displays:

- Reflection coefficient magnitude in various formats (changed by right-clicking the unit display).
- Reflection coefficient phase.
- Measurement plane extension (only relevant for *Load* reflection coefficient).

The **Show Load** checkbox toggles display between *Input* (Γ_I) and *Load* (Γ_L) reflection coefficients. Details about Γ_I and Γ_L and their reference planes see in [Input and Load Reflection Coefficients, Deembedding](#).

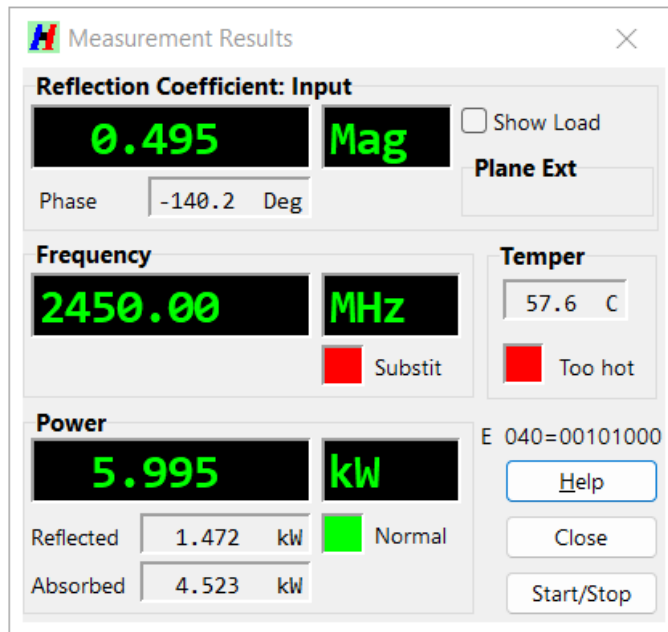


Fig. 20. Full-size (Maxi) Results window.

Frequency Group

The *Frequency* group displays the measured frequency and includes an associated LED lamp indicator.

- If the frequency measurement is valid, the LED lamp is green and its label reads **Valid**.
- If the frequency-measurement counter is disabled (via **Homer | Counter**), a [substitute frequency](#) is displayed instead, the associated LED lamp is blue, and the label reads **Cnt OFF**.
- If the measured frequency falls outside of the [tolerance range](#), a [substitute frequency](#) is displayed instead, the associated LED lamp turns red, and the label reads **Substit** (as shown in [Fig. 20](#)).

Temper Group

The *Temper* group displays temperature measured by the internal temperature sensor. If the temperature falls out of calibration range (typically 5 to 55 Celsius), the associated LED lamp changes color and label.

To toggle between Celsius (C) and Fahrenheit (F), click the temperature display. The conversion is based on the formulas

$$F = 32 + 1.8 * C$$

$$C = (F - 32) / 1.8$$

Power Group

The *Power* group displays measured incident, reflected and absorbed powers in various formats (changed by right-clicking the unit displays). If A/D converter overflows or [Low Signal](#) condition occurs the associated LED lamp changes color and label.

Error Byte

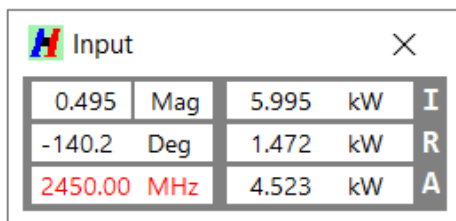
The [Homer Error Byte](#) (HER) is displayed as **E** in decimal and binary format. Based on breakdown of HER, the three rectangular “LED lamps” indicate by their color and adjacent text whether the measurement conditions are normal (green) or whether an error or warning condition has occurred. An example of one error (temperature too high) and two warnings ([Substitute Frequency](#) and [Low Signal](#)) is shown in [Fig. 20](#).

Start/Stop

Starts and stops sweeping equivalently with the **Homer** | [Run-Pause](#) menu item.

Reduced-Size Results Window

The Reduced-size (Mini) Results window ([Fig. 21](#)) is preferable when the numerical data needs to be displayed without occupying much of the screen space. The window provides essentially the same information as the full-size window (it does not show the internal temperature and the *Error Byte*). The letters **I**, **R**, **A** indicate the incident, reflected, and absorbed powers, respectively.



0.495	Mag	5.995 kW	I
-140.2	Deg	1.472 kW	R
2450.00 MHz		4.523 kW	A

Fig. 21. Reduced-size (Mini) Results window.

Similarly to Maxi Results window, you can change the units by right-clicking particular displays and selecting from pop-up menus. The Magnitude display also enables toggling reflection coefficient between Input and Load (deembedded). The display type is identified by the window title.

A font color other than black indicates an error/warning condition. The colors correspond to the

“LED” colors of the Maxi Results window.

How to Save Measured Results

Measured results can be saved in the following basic forms:

- Text file (table of measured data).
- Graphic file:
 - Bitmap copy of the screen or its part (BMP file), **or**
 - Compressed formats (PNG, GIF or JPG files).
- Data Logging (automatic periodic results saving to a text file).

Saving Results to a Text File

This method is suitable for later viewing or printing of the numerical data as a table or for importing the results into another program, typically a spreadsheet calculator, such as Microsoft Excel.

A complete set of the necessary results is recorded, from which all other desired quantities, such as return loss or VSWR, can be computed. The decimal separator can be either a point or a comma (see *Choosing Decimal Separator* below). The number of measurement data rows in the file is determined by the value of the Points per Sweep parameter, which can be specified via the **Homer | Points per Sweep** menu item, the  toolbar button, or the **Ctrl+N** shortcut.

System info is appended to the file, providing information about **HomSoft** version, Homer HW and firmware versions as well as Homer settings. This identifies conditions, under which the measurements were taken.

Choosing Decimal Separator

- Click the **File | Separator** menu item.
- Select the decimal separator by clicking either the **Point** or the **Comma** submenu item.

The setting will be stored in the **HomSoft** [Ini File](#) so that it remains the same after **HomSoft** restart.

Saving Results

- Complete the measurement.
- Click the **File | Save Results** menu item or  toolbar button or use **Ctrl+S** shortcut. A save dialog box opens.
- Choose the file name and location; click **Save** (or an equivalent).
- When prompted, enter an optional comment to be saved along with the data.

The data items in the created text file are separated by Tabs; it is therefore easy to paste them, e.g., into Microsoft Excel.

Recorded Data

The recorded data include the following columns:

Header	Quantity
No	Sequential number
f_MHz	Frequency in MHz
Mag	Input reflection coefficient magnitude
Pha_dg	Input reflection coefficient phase in degrees
Pi_kW	Incident (forward) power in kilowatts
Pr_kW	Reflected (reverse) power in kilowatts
Temp_C	Internal detectors temperature in degrees Celsius
Err	Homer Error Byte (normally 0)
MagL	Load reflection coefficient magnitude
PhaL_dg	Load reflection coefficient phase in degrees
St1_mm	Insertion in mm of tuning stub 1 (closest to generator)
St2_mm	Insertion in mm of tuning stub 2
St3_mm	Insertion in mm of tuning stub 3 (closest to load)
MS1	Motor status byte 1 (normally 119)
MS2	Motor status byte 2 (normally 0). For the meaning of MS1, MS2, please refer to Homer Communication Protocol .
WinTime	UTC time in Windows coding format. The integral part is the number of days that have passed since 30th December 1899. The fractional part is the time of day (e.g., 0.5 means 12 hours).

Using Microsoft Excel

To Paste Saved Results to Microsoft Excel:

- Start Excel.
- Open the results text file in any editor (e.g., by double-clicking its icon or name).
- In the opened file, select all (**Ctrl+A**) and copy to clipboard (**Ctrl+C**).
- In an Excel worksheet, click the cell where the data should start (e.g., top left cell A1).
- Paste the clipboard content (**Ctrl+V**).

To Open Results File in Microsoft Excel:

- Start Excel.
- In Excel, click the Open File icon or the **File | Open** menu item. *File Open* dialog appears.
- In the **Files of Type** dropdown edit, select **Text Files**.
- Find the desired results file, select it and click **Open**. The **Text Import Wizard** appears.
- In the first Wizard screen, click the **Delimited** radio button, then click **Next**.
- In the second screen, check only the **Tab** checkbox in the **Delimiter** group, then click **Next**.
- In the third screen, click the **Finish** button.

Saving Results as a Picture

The main [program window](#) (including its children [display windows](#)), or individual display windows can be:

- Copied to the clipboard to be subsequently pasted into your document.
- Saved as a bitmap (BMP), PNG, GIF, or JPG file.

A bitmap file is a true copy of the screen. For large screens and high color resolution, the file size can be considerable. Unlike the other formats, the file size does not depend on the contents of an image.

The PNG and GIF files have a good quality and compression ratio; they are recommended for archiving purposes.

The JPG file, although a popular format with good compression ratio, has quality inferior to the other formats (altered colors, blurred lines) and is not recommended.

Before Saving

- Select the desired graphic file format in the **File | Picture Type** menu. The choice will persist, even after **HomSoft** restart, until you make a change.
- Choose which part of the screen should be captured. There are two options selectable in the **File | Picture Area** menu item:
 - **Main Window:** Inner area of the **HomSoft** Main Window, including all open display windows. Other, non-display, windows contained within the Main Window area will not be copied.
 - **Active Plot:** Only the plot portion (white area) of the latest active *display* window. The active display window is the one with highlighted (generally darker) Title Bar. To activate a display window, click into it. Be sure the window is not overlaid by another window.
 - The choice will persist, even after **HomSoft** restart, until you make a change.
- Adjust the display window(s) appearance according to your preferences. This includes, e.g., resizing, positioning, [scaling](#), modifying [trace properties](#), adding a [Limit Line](#).
- Click into a desired display window to select it for the operation.

Copying to Clipboard

To copy the selected Picture Area to clipboard, click the **File | Copy Picture** menu item or use **Ctrl+C** shortcut. After copying, you can paste the clipboard contents to your documents.

Saving to a File

- Click the **File | Save Picture** menu item, or the equivalent  button on the toolbar.
- The *Save File* dialog opens: choose a location, enter a file name, and click **Save**.

Note: If you type the file name with an extension (bmp, png, gif, jpg), the picture type will be set accordingly, irrespective of the file type filter (**Save as type** edit box). If you type the name without an extension or with an invalid extension, the picture type will be set in accordance with the Save as type selection.

Using Standard Print Screen Functions

The **HomSoft** window, including all of its child windows, can be copied to the clipboard using the standard Microsoft Windows **Alt+PrintScreen** key combination (key combinations may vary depending on your PC or external keyboard). However, this method does not allow you to copy individual display windows (e.g., a Polar plot).

An alternative is to use the Windows Snipping Tool. Activate it with the **Win+Shift+S** key combination, then choose the snipping mode (this only needs to be set once). If the snipping mode is set to **Window**, clicking the main window will copy it to the clipboard. If the mode is set to **Rectangle**, you can select any portion of the screen for copying, such as an individual display window.

Data Logging

The **Data Logging** function allows the measurement results to be stored periodically and automatically to a text file. This enables later analysis of long-lasting processes.

A complete set of necessary results is recorded, from which all other desired quantities, such as return loss or VSWR, can be computed.

A system info is appended to the log file, providing information about **HomSoft** version, Homer HW and firmware version as well as Homer settings at the moment the logging was stopped. This identifies conditions, under which the measurements were taken.

The log files can be opened and the data processed and plotted using spreadsheet calculators, e.g., Microsoft Excel.

To activate this function, click the **View | Logging Window** menu item. The **Data Logging** window ([Fig. 22](#)) will then appear. The controls are logically organized into three groups: **TIMING**, **LOG FILE**, and **PROGRESS**.

Fig. 22. Logging window.

To activate logging, proceed as follows:

- Choose the maximum extent of data recording by editing *Days*, *Hours*, *Minutes*, and *Seconds* in the **Logging Duration** row of the **TIMING** group. The recording will be terminated after either this time has elapsed or the maximum number of logging events has been recorded (see the **Records** setting below), whichever occurs first.

However, if the logging duration time is set to zero, logging will not be time-limited.

- Choose time spacing between two consecutive data recordings by editing *Hours*, *Minutes* and *Seconds* in the **Sampling Repetition Time** row. If the repetition time is set to zero, continuous logging will take place (all received data will be stored).
- Edit the **Records** field to choose the maximum count of logging records to be stored in the log file. Unless aborted by the user, the recording will be terminated when either the **Records** number or the **Logging Duration** is exceeded, whichever occurs first.

However, if the maximum records count is set to zero, logging will not be record-count-limited.

- In the **Burst Size** edit, type *logging burst size*, i.e., the number of successive samples you wish to be recorded at each logging event. If, for instance, the measurement cadence is 10 measurements/second and you chose Repetition Time = 1 minute and Smpl/Event = 15, then each minute 15 consecutive samples (a burst covering 1.5 seconds) will be recorded. Note that each recorded sample of a given logging burst is assigned the same sequential number. The default and most common **Burst Size** setting is one.

The **Burst Size** setting is ignored with continuous logging, i.e., when the **Sampling**

Repetition Time is set to zero.

- Select the decimal separator by clicking the **Point** or **Comma** radio button in the **Separator** box.
- In the **Info** edit, type an optional comment: it will be added at the beginning of the log file.
- Click the **Prepare** button. The dialog box titled *Prepare Log File* opens where you choose the path and the name of the log file. The recommended file extension is *txt*. Click the **Save** button to close the dialog. The name and path of the chosen file are now displayed in the **Name** and **Path** panels. If the file has been successfully prepared:
 - The group title changes to **LOG FILE - prepared**,
 - the originally red **Status** “lamp” in the **Progress** group turns yellow and its label changes from *Not ready* to *Ready*.
 - The bottom right button **Start** will be enabled.
 - Editing the logging inputs will still be possible but the changes will not be applied until the next click of the **Prepare** button.
- Define Homer measurement conditions, i.e., sampling mode (the waveform type), sampling parameters, frequency count time, etc. – see [Homer Sampling Setup](#).
- Start measurement, then press the **Start** button, or vice versa. The logging will not start until the **Start** button has been pressed. Its caption now changes to **Stop**.

Following this, the yellow **Status** lamp in **PROGRESS** group turns green and its label changes to *Logging*. The progress is shown in increments of **Recorded** and **Elapsed** boxes.

After the stop conditions are met (**Recorded** reaches **Records** or **Elapsed** reaches **Logging Duration**), the **Status** lamp turns blue and its label changes to *Completed*.

To abort data logging anytime before a stop condition occurs, press the **Stop** button. This is the only option when both **Logging Duration** and **Records** are set to zero. The **Status** lamp turns gray and its label will read *Aborted*.

If you pause or stop *measurement* while logging, logging attempts continue: the elapsed time increases in the background but the number of records does not. After restarting the measurement, logging continues normally.

Data items in the created log file are separated by Tabs; it is therefore easy to paste them, e.g., to Microsoft Excel. The procedure is exactly the same as described in topic [Saving Results to a Text File](#).

HomSoft Ini Files

On a **HomSoft** application termination, the majority of its settings is automatically stored in its particular *Ini File*, located in the **HomSoft User Folder**. The next time you start the application, this file is loaded back and both the application and the connected Homer unit appear in the same state as when you left them.

HomSoft Ini File Names

A **HomSoft** Ini File name depends on:

- Type of the application (Autotuner, Analyzer, simulation).
- Communication interface (RS232/RS422, CAN).
- Whether it is a full-fledged program or a [reduced-functionality HomTool](#).

The names overview is shown in the table below.

App Type	RS232 / RS422	CAN	Before V5.0.2.0
Autotuner	Tu_rs.ini	Tu_can.ini	Ho0.ini
Analyzer	Ho_rs.ini	Ho_can.ini	Ho0.ini
Simulation	HoSim.ini	HoSim.ini	HoSim0.ini
Autotuner Tool	TuTool_rs.ini	TuTool_can.ini	Tool0.ini
Analyzer Tool	HoTool_rs.ini	HoTool_can.ini	Tool0.ini

To view the pertinent Ini File name, click the **File | Show Ini File Name** menu item.

After starting an upgraded **HomSoft** for the first time, the older style files (before version 5.0.2.0) will automatically be copied under appropriate new names.

Note: This also happens anytime you delete, remove or rename a new style ini file (e.g., Tu_rs.ini) but the older style file (Ho0.ini) still exists. Thus, instead of expected default settings, including Homer power-up, you will arrive at settings defined by Ho0.ini. To avoid such a surprise, you may wish to delete or rename the old style file.

Customizing Homer Power-Up Behavior

If you want the Homer settings you made using **HomSoft** to become permanent, you have to change Homer's internal [Hom.cfg](#) and [Tun.cfg](#) configuration files (these files define the Homer power-up behavior). You can do that either by downloading, editing, and uploading these files, or by the [Create CFG](#) command.

Controlling Creation of Ini Files

Sometimes, settings made while running **HomSoft** turn out to be undesirable, and the user may wish to return to the original settings before the **HomSoft** start. To enable this, the user can decide whether the "automatic" **ini** file is rewritten or not.

Normally, **HomSoft** is terminated by clicking its main window standard closing button. Alternatively, you can use the **File | Exit** menu item, or the **Alt+X** shortcut key. Following this, a confirmation dialog ([Fig. 23](#)) appears. When you click **Abort** in this dialog, the **HomSoft** Ini File will not be overwritten.

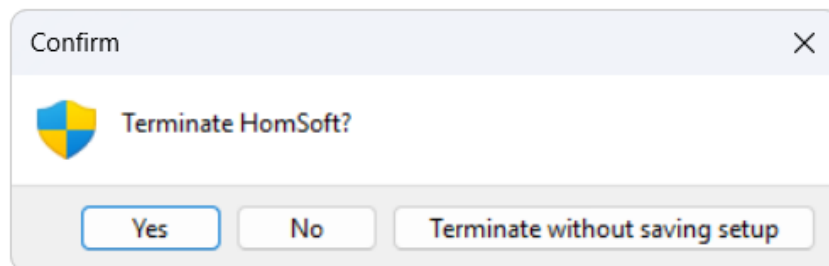


Fig. 23. Confirmation dialog when normally terminating **HomSoft**.

If you terminate **HomSoft** by the **File | Exit (no setup)** menu item or the **Alt+A** shortcut key, the application is closed immediately and quickly, without any dialog, and without writing the **HomSoft Ini File**. The same can be achieved by clicking the  button on the topmost *Standard* toolbar.

Backup Ini Files

If you accidentally and unintentionally terminate **HomSoft** without saving the “automatic” **ini** file, all desired settings you might have made will be lost. To avoid this, check the **File | Backup Ini File** menu item. When checked, the settings will still be written in the background as a **User Setup** file. A penalty is a slightly slower application termination. The file location is the **BackupSetups** subfolder of the **User Folder**. The file name will have the form

OrigName_yymmdd_hhmmss.stp, such as **Tu_rs_250311_132003.stp**

where **OrigName** stands for the original **ini** file name as shown in the table above, **yyymmdd** stands for the date and **hhmmss** for time. You can load these files, and thus restore the settings, as described in the **User Setups** section.

It is a good practice to delete old and unused backup files from time to time.

Corrupted Ini Files

In case of problems at the **HomSoft** start, (stubbornly appearing error messages or missing apparently open windows), odds are that the **HomSoft Ini File** is corrupted. In this case, try to delete the **ini** file and restart the application. An alternative is to move the suspect file to another directory or rename it for further analysis, a procedure that can help find the cause of the faulty behavior.

User Setups

Each **HomSoft** settings collection can also be saved to a custom ***.stp** setup file and loaded anytime later. In this way, you can prepare various measurement scenarios and quickly switch between them.

To save a setup:

- Click the **File | Save Setup** menu item or the equivalent  toolbar button or use **F2** shortcut.
- When prompted, enter **Comment** text, characterizing the setup.

To load a setup:

- Click the **File | Load Setup** menu item, or the equivalent  toolbar button or use **F3** shortcut.

Transferring Files

HomSoft enables you to transfer files between the Homer and the PC, either via RS232 or CAN Bus. The following procedures assume that **HomSoft** is running in your PC and connection between the PC and the Homer has been established.

Sending Files to Homer

To send (upload) files from your PC to the Homer, proceed as follows:

- Click the **Tools | Send to Homer** menu item. A dialog window titled *Send Files to Homer* appears.
- In the **File Type** box, pick the item representing the files you wish to transfer. If, for instance, you want to update Homer configuration files, pick the item named “*System config files (*.cfg)*”.
- Browse for the files you wish to send to the Homer. For example, if you had downloaded some configuration files from the Homer to [User Folder](#) and modified then, they will be found in a folder like

`c:\Users\<username>\S-Team\HomSoft`

New files may also be delivered to you by other means (e.g., e-mail or USB flash drive).

- Select all files you wish to transfer.
- Click **Open**. Now the files start to be transferred to the Homer. After completion, a Pass/Fail report appears.

Notes:

- The new files will be accepted only after restarting the Homer (**HomSoft** must also be restarted to recognize new Homer settings).
- **Tun.mem** file is permitted to be transferred only by a [reduced-functionality HomTool](#) version of **HomSoft**. This serves as a protection against overwriting Tun.mem by accident. (Valid for SW versions starting 4050–54.)
- **Hom.mem** file, being strictly individual, is declined to be transferred if it belongs to a different Homer device. (Valid for SW versions starting 4050–54.)
- A better procedure for *.mem files than merely sending them to the Homer is employing the [Reinstall](#) procedure. The latter can ensure that the files will be updated for the purpose of the [Homer Reset](#) procedures as well. The **FileList.txt** for the Reinstall should contain lines such as:

```
[Homer Reinstallation Filelist]
HOM.MEM=C:\SRV\HOM.MEM
HOM.MEM=C:\SRV\FACT\HOM.MEM
HOM.MEM=C:\SRV\USER\HOM.MEM
TUN.MEM=C:\SRV\TUN.MEM + MOTORS
TUN.MEM=C:\SRV\FACT\TUN.MEM
TUN.MEM=C:\SRV\USER\TUN.MEM
```

Upgrading Server Program

Each **HomSoft** version is good for control of Homer units with matching internal firmware, notably the version of the Server program SrvHo.exe. (The optimal Server version can be found after opening the [Help|About](#) window.)

If a mismatch is detected, the warning button  appears on the standard toolbar ([Fig. 15](#)). On clicking this button, **HomSoft** will give you details of the mismatch and, depending on the situation, will prompt you to either install a newer version of **HomSoft**, or to upload a new

version of Server to the Homer.

You can also upload a Server manually at any time. To do so, proceed as follows:

- Click the **Tools | Update Server** menu item. A file open dialog box titled *Send Server to Homer* appears.
- Locate the new **SrvHo.exe** file. With **HomSoft** installed, the file may reside in a folder like `c:\Program Files (x86)\S-Team\HomSoft\Ver5004\Server`
A new Server may also be delivered to you by various means (e.g., e-mail, a USB flash drive).
- Click **Open**. Now the file transfer to the Homer begins; it may take some 20 seconds. After completion, a Pass/Fail message appears.

The new Server will not be activated until restarting both the Homer and **HomSoft**. This will be done automatically after clicking **OK** in the Pass/Fail message dialog. You can switch the Homer OFF and ON manually as well.

Notes:

- Alternatively, you can proceed as described in [Sending Files to Homer](#).
- A better procedure for **SrvHo.exe** file than merely sending it to the Homer is employing the [Reinstall](#) procedure. The latter can ensure that the file will be updated for the purpose of the [Homer Reset](#) procedures as well. The **FileList.txt** for the Reinstall procedure (including User Reset) should contain lines such as:

```
[Homer Reinstallation Filelist]
SRVHO.EXE=C:\SRV\SRVHO.EXE
SRVHO.EXE=C:\SRV\USER\SRVHO.EXE
```

Loading Files from Homer

To download files from the Homer to your PC, proceed as follows:

- Click the **Tools | Load from Homer** menu item. A file save dialog box titled *Load Files from Homer* appears.
- In the **Save as type** box, pick the file you wish to transfer. Now, the procedure slightly differs depending on whether you want to download one of the predefined files (Hom.cfg, Tun.cfg, Rs232.cfg, Can.cfg, SrvHo.exe), or any other file that you know resides in the Homer device.
- If, for instance, you wish to download the predefined Homer configuration file:
 - In the **Save as type** box, pick the item "*Homer config (Hom.cfg)*".
 - **Do not** edit the **File name** box.
- If you wish to download any other file that you know resides in the Homer device, and you know its name, for instance the **Start.cfg** file:
 - In the **Save as type** box, pick the item "*Any file (*.*)*".
 - In the **File name** box, type the name of the file you want to download; in our example it is "*Start.cfg*".
- Browse for the folder on your PC to which you wish the downloaded file to be copied. The dialog may look as shown in [Fig. 24](#).

- Click **Save**. Now the file starts to be downloaded from the Homer. After completion, a Pass/Fail report appears.

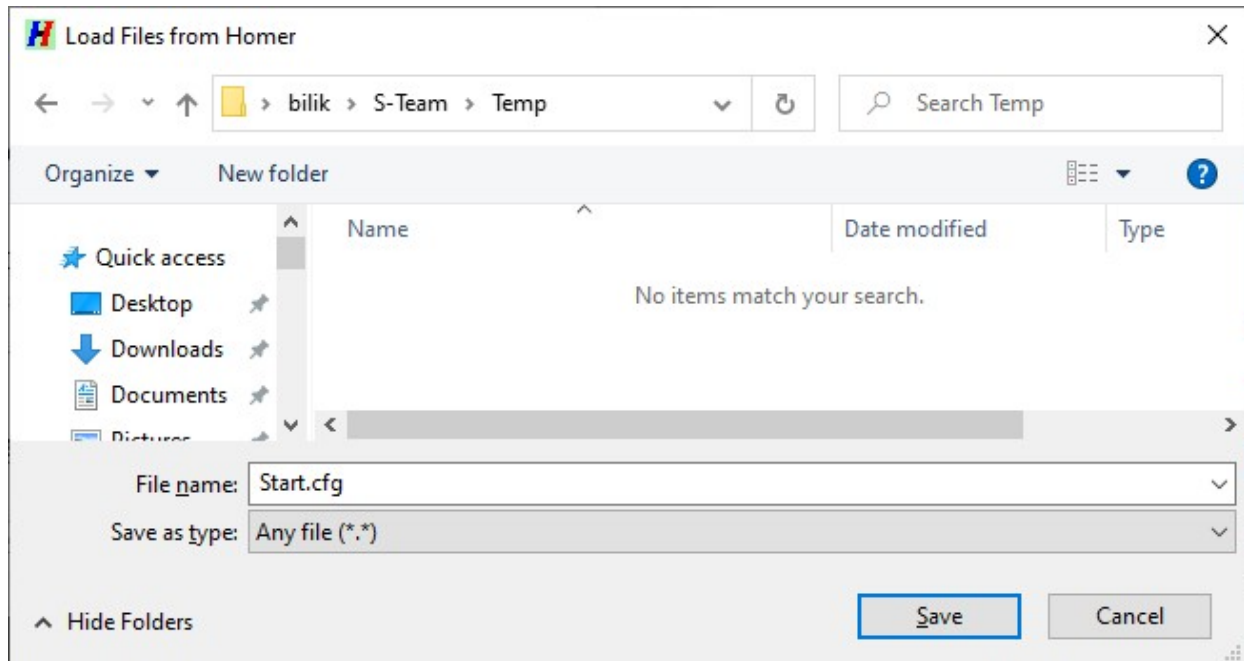


Fig. 24. Load Files from Homer dialog.

Homer Resets

A group of commands under the **Tools | Reset** menu item is used for returning the Homer to predefined states, including the factory (out-of-box) default. The commands are useful if you, for instance, confuse the Homer by uploading incorrect firmware files of any kind (as long as the files do not prevent Server from running) and need to remedy the situation.

The menu also enables one to create a *user default* which can later be used as an alternative to the factory default.

Another reset command enables the user to modify the [Hom.cfg](#) and [Tun.cfg](#) configuration files residing inside the Homer unit without manual editing, i.e., to redefine the Homer power-up behavior so that it corresponds to current settings made by **HomSoft**.

For all these changes to take effect, the DC power supply of the Homer must be switched OFF and ON, and **HomSoft** must be restarted.

If some of the files needed for a Reset are not available, a warning will be issued but otherwise the reset will still be executed.

Restart Server (F7)

Clicking **Restart Server** or pressing the **F7** hot key terminates and immediately restarts the Homer internal server program SrvHo.exe. You should always restart **HomSoft** after a **Restart Server** action. See more details in the description of the **Homer | More | Restart Server** menu item.

Factory

The command returns the Homer device to the state in which it left the factory (out-of-box default) by way of copying the default firmware files from a specific *Factory Default* location to the Homer internal working directory. This helps resolve unwanted confusing situations, e.g., after an accidental upload of improper firmware files. The factory default files can be changed only by the manufacturer.

After performing this type of reset, the DC power of the Homer should be cycled and **HomSoft** restarted.

User-Defined

Similar to the Factory reset, this reset type returns the Homer to the state previously defined by the user using the **Make** command, described next. The corresponding firmware files are copied from a specific *User Default* location.

After performing this type of reset, the DC power of the Homer should be cycled and **HomSoft** restarted.

Make

The **Make** command copies all relevant firmware files from the Homer's internal working directory to a special *User Default* location, making them the source for the **User-Defined** reset. This is useful, e.g., after performing firmware upgrades, buying new options, or adapting the Homer behavior to your application (editing Hom.cfg, Tun.cfg). The **Factory** reset would eradicate all such changes.

Make does not update the internal [Hom.cfg](#) and [Tun.cfg](#) configuration files to reflect changes made by **HomSoft** commands (the **HomSoft** commands affect only the Homer volatile memory, not the cfg files). If you want the newly created user-defined default to also reflect settings made via **HomSoft** commands, apply the **Create CFG** command before the **Make** command.

Create CFG

After the Homer is switched on, its settings are governed by the internal [Hom.cfg](#) and [Tun.cfg](#) configuration files, defining thus the Homer power-up behavior. One way to change this behavior is to download these files from the Homer, edit them accordingly, then upload them back to the Homer. To do the editing, you have to understand the structure of these files (which is not that difficult).

When you start **HomSoft**, the Homer power-up settings are generally overridden first by the values stored in the **HomSoft Ini File**, and then by any subsequent commands (e.g., switching [Waveform](#) from **CW** to **Rectified**, etc.). **HomSoft** is actually the most convenient way to adapt Homer settings to your particular application. But all changes made are temporary: they last only until the Homer is restarted. To make your changes permanent, you have to modify the Hom.cfg and Tun.cfg files.

Now, instead of the above-mentioned direct editing, there is an easier way: click the **Create CFG** menu item. The command instructs the Homer to rewrite Hom.cfg and Tun.cfg based on **HomSoft's** current settings.

After clicking, you are only asked to enter the *Autorun* item of Hom.cfg, governing Homer activity

after power-up, i.e., the values of its *Running* and *Sending* flags. Possible *Autorun* values are summed up in the table below (the factory default is typically 1).

Autorun	Running	Sending	Comment
0	FALSE	FALSE	Homer neither running (continuously measuring & tuning) nor sending results
1	TRUE	FALSE	Homer running but sending no results (default)
2	FALSE	TRUE	Homer not running (hence cannot send results)
3	TRUE	TRUE	Homer running and sending results

For newly created cfg files to take effect, the DC power of the Homer should be cycled (restarting **HomSoft** is highly recommended, too).

After this, you may wish to store not only the two newly created files, but the complete set of firmware, as a User-Defined default. To do so, apply the **Make** command as described above.

Note:

As a protective measure, **HomSoft** cannot alter the *incident power* threshold for the *Low Signal* condition (see also [Low Signal Warning](#)). This can only be changed by editing the following line in Hom.cfg:

```
LowPowLvl_W=100;      Incident power threshold for "Low Signal" condition
```

SIGNAL WAVEFORMS

This section is devoted to methods of handling microwave signals with various waveforms (modulation envelopes), generated as a result of using different types of magnetron power supplies and their modulation. An often-encountered situation of periodically varying reflection coefficient (for example due to using mode stirrers) is also treated.

Signal Waveforms and Sampling

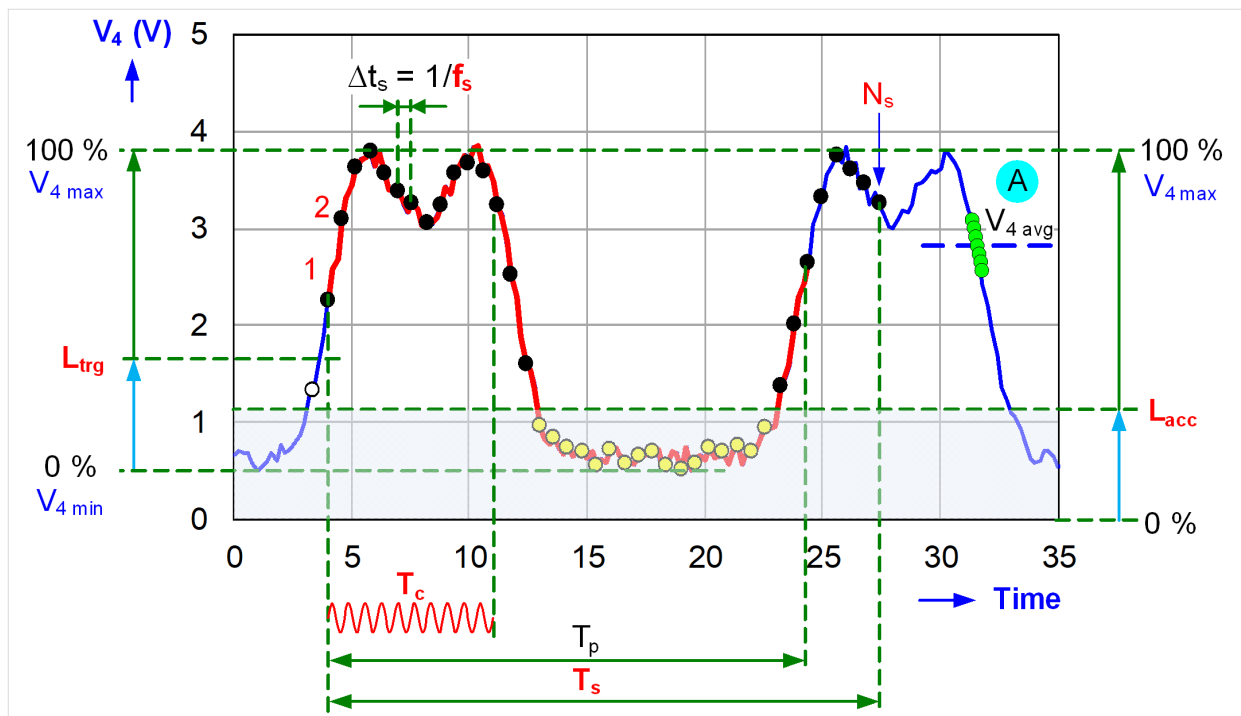
The amplitude of the microwave power delivered by a magnetron is determined by its high-voltage DC power supply, as it essentially follows the waveform of the magnetron anode current. This waveform can range from a low-ripple type (CW) to power-line rectified (high-ripple) to pulse-modulated. Modulated signals of various kinds can also be produced by other generator types.

In addition, all measured quantities may vary periodically for different reasons (e.g., a mode stirrer installed in the microwave cavity, objects moving on a belt in the applicator, or a combination of both).

The Homer collects voltage samples from its four detectors, and can be commanded to compute results either

- based on each individual sample, **or**
- by calculating special averages over a *sampling burst*, which is a collection of samples taken

A summary of parameters controlling the sampling is shown in [Fig. 25](#) and described below. The measured signal (blue and red trace) is sampled at points indicated by the circles.



detector output voltage. (The Homer determines $V_{4 \min}$ and $V_{4 \max}$ before each sampling burst.)

A signal sampling is normally followed by a frequency measurement; the same free run/triggering logic is used.

Waiting for a triggering event continues for a limited timeout interval $T_{\max}$. If no triggering event occurs during this interval, measurement will start automatically on $T_{\max}$ expiration. This may result in slow measurement cadence, fluctuating results and incorrect frequency measurement.

Sampling Parameters

The sampling procedure collects N_s samples (1 to 4095), spaced in time by the sampling step $\Delta t_s = 1/f_s$, where f_s (10 Hz to 200 kHz) is the sampling rate. The whole sampling process takes a time denoted *sampling time* or *sampling duration* T_s , where

$$T_s = \frac{N_s - 1}{f_s}$$

or

$$T_s = \Delta t_s (N_s - 1)$$

Any two of the three parameters involved in the equations can be chosen (subject to their bounds); the third one must be computed using the above formulas.

In case of CW or low-ripple signals, the sampling parameters can, in principle, be arbitrary (of course, subject to the above constraints).

A case of periodic waveforms (resulting, e.g., from using a high-ripple magnetron power supply) is illustrated in [Fig. 25](#). The sampling time T_s in such cases should ideally cover exactly one signal period T_p (thicker red portion of the waveform) or its integral multiples, otherwise the mean power will not be computed accurately. To aid in proper settings, the sampling parameters in **Rectified** mode are defined indirectly in terms of the ripple repetition frequency, the number of periods to be covered, and the total sample count.

A particularly undesirable situation may occur when the user does not recognize that the signal is of high-ripple type and employs **CW** sampling with a short sampling time relative to period T_p . An example of such a situation is shown as case **A** in [Fig. 25](#) (densely packed green circles). The sampling here covers only a small fraction of the ripple period, yielding an average value $V_{4 \text{ avg}}$ which strongly depends on the instant the sampling has started. Since in CW mode the sampling starts at random, the result can fluctuate practically between $V_{4 \min}$ and $V_{4 \max}$. To make the situation worse, if the frequency counting interval (T_c in [Fig. 25](#)) includes periods with near-zero power level, the frequency measurement may be incorrect.

Accept Level

Some measured quantities, e.g., the reflection coefficient, are meaningless during zero-power signal portions. These meaningless values would introduce error into the average reflection coefficient and reflected power computations, and should therefore be discarded. Sample acceptance/rejection is controlled by a parameter named Accept Level (L_{acc}). It is defined as a

percentage of the peak reference detector voltage $V_{4\max}$, below which the samples are considered invalid and are ignored in reflection coefficient and reflected power computations. The invalid region is the grayed area in [Fig. 25](#); the invalid samples are indicated by the yellow-filled circles.

Processing of the assembly of the collected samples continues depending on the user-selected mode of sampling (also referred to as *Waveform*). Three types of signal waveforms (and equally named modes of sampling) are distinguished: **CW**, **Rectified**, and **Pulsed**. All will be described in detail below. (Simulation program [HoSim.exe](#) can “generate” all three types of the waveforms.)

In addition, a special situation may occur, which can be designated as a **Mode Stirrer** case, when the incident power may theoretically be constant, providing no clue for triggering, but the reflection coefficient and the reflected power oscillate periodically. This situation will be treated [separately](#).

Modes of Signal Sampling

There are three signal sampling modes available, named **CW**, **Rectified**, and **Pulsed**. Each of them is suitable for a different microwave signal modulation envelope (waveform).

CW Sampling Mode

The CW sampling mode is suitable for signals essentially constant over time or with a relatively low ripple in it. Such waveforms result for instance when feeding magnetrons by constant or low-ripple anode voltage. This type of signal is referred to as **CW** (continuous wave) or **Low-Ripple**. See more details in [CW Signal Sampling](#).

In the **CW** mode, the detector voltages are sampled over a defined sampling time T_s . After being collected, the mean values of the voltages are calculated. The final results of interest (reflection coefficient, incident power) are computed from these averaged voltages. This is in contrast with the **Rectified** and **Pulsed** modes, where the results are computed for *each* individual sample, and only then averaged.

Rectified Sampling Mode

Many magnetron generators use high voltage which is simply a result of unfiltered rectification of up-transformed one-phase or three-phase power line voltage. Microwave power envelope then pulses with repetition rate f_r equal to power line frequency f_p or its integral multiple (typically 1, 2, 3, 6 or 12). Such type of signal is referred to as **Rectified**. See more details in [Rectified Signal Sampling](#). Rectified-type sampling is also useful to handle the [Mode Stirrer](#) situation.

Pulsed Sampling Mode

In some applications, microwave generators are modulated by fast rectangular pulses with durations in some cases as short as 20 microseconds. This type of signal is referred to as **Pulsed**. The Homer is capable of processing pulsed signals with pulse durations down to 50 microseconds, including autotuning. See details in [Pulsed Signal Sampling](#).

What Is the Difference

In the **CW** mode, the detector voltages are sampled over a defined sampling time T_s . After being collected, the mean values of these voltages are calculated. The final results of interest (reflection

coefficient, incident power) are computed from these *averaged voltages*.

In the **Rectified** and **Pulsed** sampling modes, the detector voltages are also sampled over a specified sampling time T_s , possibly using triggering. After being collected, the samples are, unlike in the **CW** mode, processed *individually* to yield particular results (reflection coefficient, incident power, reflected power) for *each* sample. These particular *results*, not voltages, are then averaged in a special manner to obtain final results. The individual results can also be viewed.

Communication Problems in Rectified/Pulsed Modes

Communication problems may sometimes be experienced in **Rectified** and **Pulsed** modes of sampling. This is because the sampling, in particular the sending of individual samples, may take quite a long time (e.g., more than 10 seconds to transfer 4095 samples).

During this period, the system does not respond to commands from the PC; the commands are either ordered in a queue or may be lost.

As a result, the Homer may exhibit seemingly erratic behavior when it takes the commands from the queue and executes them.

A progress bar on the Signal toolbar shows progress in receiving of the individual samples.

Tips to Avoid Difficulties

- Do not click indiscriminately when encountering no response from the Homer: wait a few seconds first, then try to stop the Homer internal measurement by clicking the  toolbar button or the equivalent **Homer | Stop Homer** menu item.
- Do not **Send Samples** when you want a faster measurement (uncheck **Send Samples** checkbox in the [Homer Sampling Setup](#) window or deactivate the  toolbar button).

CW Signal Sampling

The simplest type of waveform results from the magnetron anode voltage essentially constant over time or with a relatively small ripple in it. It is also typical for solid-state generators. This type of signal is referred to as **CW** (continuous wave) or **Low-Ripple**. The **CW** mode of sampling is intended for this type of signals.

The parameters governing the **CW** sampling are shown in the table below. Refer to [Fig. 25](#) for the symbols in parentheses in the left column. The middle column shows the settings via the [Homer Sampling Setup](#) window (**Homer | Sampling Setup**) of **HomSoft**, plus an alternative (mostly a toolbar button), if one exists. The right-hand column shows examples of [Hom.cfg](#) settings for Homer autonomous operation, resulting in sampling time $T_s = 20$ ms.

Parameter	Setting via HomSoft	Example Setting in Hom.cfg
Sample count (N_s)	Sample Count edit box. Valid range 1 to 4095. It has the meaning of the voltage averaging number.	<code>Vrpt=201</code> ($N_s = 201$)

Sampling rate (f_s)	Sampling Rate edit box. Valid range 10 Hz to 200 kHz.	<code>Fsampler_CW=10000</code> ($f_s = 10$ kHz)
Sampling time (T_s)	Computed internally by Homer; displayed in Sampling Time box.	n. a. ($T_s = 20$ ms)
Sampling step (Δt_s)	Computed internally by Homer; displayed in Sampling Step box.	n. a. ($\Delta t_s = 100$ μ s)
Frequency counting time (T_c)	Count Time edit box or <input type="button" value="Tc"/> Standard toolbar button (Fig. 15). Valid range 16 μ s to 1 s.	<code>TcountCW_Us=1000</code> ($T_c = 1$ ms; will be truncated to $n \times 16$ μ s = 992 μ s)

In **CW** mode, the detector voltages are sampled over the sampling time T_s , collecting N_s samples for each of the four Homer detectors. After being collected, the mean values of these N_s voltage samples are computed. The results of interest (reflection coefficient, incident power) are then computed from these averaged voltages. Hence, in the case of true CW signal (i.e., constant power), N_s has the meaning of *voltage averaging number*, which theoretically decreases white noise floor by

$$D_L = 5 \log(N_s) \text{ [dB]}$$

i.e., 1.5 dB for each doubling of the averaging number. Increasing N_s therefore improves measurement precision at low working power levels. Reducing the generator power level to one-half should be theoretically compensated by four-fold increase of N_s .

Since the sampling takes a definite time T_s , it also has a smoothing effect, and, if appropriately configured, can smooth out power supply ripples. Choosing, for instance, $N_s = 201$ and $f_s = 10$ kHz leads to $T_s = 20$ ms, which is one period of 50-Hz power line voltage. To cover one period of 60-Hz power line voltage, set $f_s = 12$ kHz instead.

Averaging of detector *voltages* in the CW sampling mode contrasts with the **Rectified** and **Pulsed** modes, where particular results (reflection coefficient, incident power, reflected power) are computed for each individual sample, and then these individual *results* are averaged to obtain a final result.

The Homer must be informed of the type of signal waveform it will be confronted with (in this case **CW**). Following this, the corresponding sampling parameters can be modified.

To select CW mode of signal sampling:

Open the [Homer Sampling Setup](#) window and click the **CW** tab. Alternatively, click the Signal toolbar button (Fig. 15).

To set sampling parameters:

In [Homer Sampling Setup](#) window:

- Edit *Sample Count* to set the number of samples N_s to be collected for one measurement result.
- Edit *Sampling Rate* to set the sampling frequency f_s in Hz.
- Edit *Count Time* or click the Standard toolbar button (Fig. 15) to set the signal frequency

counting time T_c in microseconds.

- Click the **Refresh** button to check/correct the entered values and compute the derived parameters (Sampling Time, Sampling Step).
- Click the **Apply** button to accept the changes, or click **Cancel** to ignore all changes. (The **Apply** button also automatically performs the Refresh action.)

Rectified Signal Sampling

Many magnetron generators use high voltage which is simply a result of unfiltered half-wave or full-wave rectification of the up-transformed one-phase or three-phase power line voltage. Microwave power envelope then pulses with repetition rate (ripple frequency) f_r , which is equal to power line frequency f_p or its integral multiple, as shown in the table below:

Rectification Method	Ripple Frequency
One-phase half-wave	$f_r = f_p$
One-phase full-wave	$f_r = 2 f_p$
Three-phase half-wave	$f_r = 3 f_p$
Three-phase full-wave	$f_r = 6 f_p$
Three-phase Y+ Δ half-wave	$f_r = 6 f_p$
Three-phase Y+ Δ full-wave	$f_r = 12 f_p$

This type of signal is referred to as **Rectified**. Rectified sampling mode is intended for these signal types. It is also useful for handling the [Mode Stirrer](#) situation.

The governing parameters of the **Rectified** sampling are shown in the table below. Refer to [Fig. 25](#) for the symbols in parentheses in the left column. The middle column shows the settings via the [Homer Sampling Setup](#) window of **HomSoft**, plus an alternative (mostly a toolbar button) if one exists. The right-hand column shows examples of [Hom.cfg](#) settings for Homer autonomous operation, resulting in sampling time $T_s = 20$ ms.

Parameter	Setting via HomSoft	Example Setting in Hom.cfg
Ripple frequency (f_r)	Ripple Freq edit box. Valid range 1 to 10000 Hz.	<code>Rect_Linfre=50</code> ($f_r = 50$ Hz)
Number of ripple periods to be covered (N_p)	Ripple Periods edit box. Valid range 1 to 1000.	<code>Rect_Periods=1</code> ($N_p = 1$)
Sample count (N_s)	Sample Count edit box. Valid range 21 to 4095. One ripple period is sampled by approximately N_s/N_p samples.	<code>Rect_Nsampl=201</code> ($N_s = 201$)

Sampling time (T_s)	Computed internally by Homer as $T_s = N_p/f_r$; displayed in Sampling Time box.	n. a. ($T_s = 20$ ms)
Sampling rate (f_s)	Computed internally by Homer; displayed in Sampling Rate box.	n. a. ($f_s = 10$ kHz)
Sampling step (Δt_s)	Computed internally by Homer; displayed in Sampling Step box.	n. a. ($\Delta t_s = 100$ μ s)
Acceptance level (L_{acc})	Accept Level edit box. Valid range 0 to 100% of pulse height. In <i>Mode Stirrer</i> situation, 0 to 20% recommended.	<code>Rect_Acc_Lvl=20</code> ($L_{acc} = 20\%$)
Frequency counting time (T_c)	Count Time edit box or  Standard toolbar button (Fig. 15). Valid range 16 μ s to 1 s.	<code>Rect_Tcnt_Us=1000</code> ($T_c = 1$ ms; will be truncated to $n \times 16$ μ s = 992 μ s)
Triggering level (L_{trg})	Trig Level edit box or  Signal toolbar button. Valid range 1 to 99% of the ripple peak-to-peak value.	<code>TrgLevel=50</code> ($L_{trg} = 50\%$)
Free Run	Free Run checkbox or  /  Signal toolbar button. Normal setting with high-ripple signals is unchecked (). Check the box in Mode Stirrer situation with low-ripple signals.	<code>TrgMethod=1</code> (Free Run = FALSE)

Notes:

- If *Free Run* = FALSE, the triggering timeout is equal to the sampling time (T_s). If no triggering event occurs during this interval, measurement will start automatically. Please also refer to the topic [Triggering](#).
- Enabling *Free Run* temporarily instead of triggering may be useful if one wishes to inspect a signal waveform that will not trigger.
- If ripples are such that the power drops to zero, the frequency counting time T_c should be shorter than one half of the ripple period. When entering T_c via the  Standard toolbar button ([Fig. 15](#)), the software reports the ripple period and recommends a counting time not exceeding 75% of the ripple half-period (an example for 50-Hz ripple frequency is in [Fig. 26](#)).

Fig. 26. Entering counting time for Rectified sampling.

Rectified-type signals are thus sampled over one or more periods of the high-voltage ripple. After being collected, the samples are processed *individually* to yield particular results for each sample (reflection coefficient, incident power, reflected power). These particular results are then averaged to yield the final results of interest. The rules for averaging are as follows:

- Incident and reflected powers are averaged over the whole sampling time (i.e., considering *all* samples). This yields the mean power values.
- Reflection coefficient is averaged only over the *accepted* samples. The accepted samples are those with the incident power exceeding the set Accept Level (L_{acc}).

The Homer must be informed of the type of signal waveform it will be confronted with (in this case **Rectified**). Following this, the corresponding sampling parameters can be modified (most importantly the ripple frequency).

To select Rectified mode of signal sampling:

Open the [Homer Sampling Setup](#) window and click the **Rectified** tab. Alternatively, click the  Signal toolbar button ([Fig. 15](#)).

To set sampling parameters:

In the [Homer Sampling Setup](#) window:

- Edit *Ripple Freq* to set the microwave power ripple frequency f_r in Hz.
- Edit *Ripple Periods* to set the number of periods N_p to be sampled.
- Edit *Sample Count* to set the total number of samples N_s to be collected over the sampling time.
- Edit *Accept Level* to set the acceptance level L_{acc} in % of pulse height.
- Edit *Count Time* or click  Standard toolbar button ([Fig. 15](#)) to set the signal frequency counting time T_c in microseconds.
- Edit *Trig Level* or click  to set the trigger level L_{trg} in % of ripple peak-to-peak value.
- Check *Free Run* or click  /  button to enable/disable sampling without triggering.
- Check **Send Samples** or press the  button to display individual samples. To learn more, go to [Displaying Individual Samples](#).
- Click the  button to check/correct the entered values and compute the derived

parameters (Sampling Time, Sampling Rate, Sampling Step).

- Click the **Apply** button to accept the changes, or click **Cancel** to ignore all changes. (The **Apply** button also automatically performs the Refresh action.)

Pulsed Signal Sampling

In some applications, microwave generators are modulated by fast rectangular pulses with durations in some cases as short as tens of microseconds. This type of signal is referred to as **Pulsed**. The Homer is capable of processing pulsed signals with pulse durations down to 50 microseconds. The Pulsed sampling mode is intended for these types of signal.

The parameters governing **Pulsed** sampling are shown in the table below. Refer to [Fig. 25](#) for the symbols in parentheses in the left column. The middle column shows the settings via the [Homer Sampling Setup](#) window of **HomSoft**, plus an alternative (mostly a toolbar button) if one exists. The right-hand column shows examples of [Hom.cfg](#) settings for Homer autonomous operation.

Parameter	Setting via HomSoft	Example Setting in Hom.cfg
Sampling time (T_s)	Sampling Time edit box. Valid range 10 μ s to 10 s.	<code>Puls_Tsampl_Us=2000</code> ($T_s = 2$ ms)
Sample count (N_s)	Sample Count edit box. Valid range 21 to 4095.	<code>Puls_Nsampl=201</code> ($N_s = 201$)
Timeout ($T_{\max}$)	Max Period edit box. Valid range 1 ms to 10 s.	<code>Puls_Tmax_ms=100</code> ($T_{\max} = 100$ ms)
Sampling rate (f_s)	Computed internally by Homer.	n. a. ($f_s = 100$ kHz)
Acceptance level (L_{acc})	Accept Level edit box. Valid range 0 to 100% of pulse height. Recommended setting 5 to 20%.	<code>Puls_Acc_Lvl=10</code> ($L_{acc} = 10\%$)
Frequency counting time (T_c)	Count Time edit box or  Standard toolbar button (Fig. 15). Valid range 16 μ s to 1 s.	<code>Puls_Tcnt_Us=50</code> ($T_c = 1$ ms; will be truncated to $n \times 16 \mu$ s = 48 μ s)
Triggering level (L_{trg})	Trig Level edit box or  Signal toolbar button. Valid range 1 to 99% of the ripple peak-to-peak value.	<code>TrgLevel=50</code> ($L_{trg} = 50\%$)
Free Run	Free Run checkbox or  /  Signal toolbar button. Normal setting is unchecked ().	<code>TrgMethod=1</code> (Free Run = FALSE)

Notes:

- Sampling time has precedence over sample count. If the desired sampling time and the

sample count would lead to a sampling rate higher than 200 kHz, the sampling rate will be set to 200 kHz and the sampling count will be reduced to maintain the desired sampling time.

- Timeout ($T_{\max}$) is the maximum wait time for a triggering event to occur, i.e., the maximal expected pulse repetition period. If no triggering event occurs during this timeout interval, measurement will start automatically on $T_{\max}$ expiration. Please also refer to the topic [Triggering](#).
- Enabling *Free Run* temporarily instead of triggering may be useful if one wishes to inspect a signal waveform that will not trigger.
- Frequency counting time T_c should be shorter than a single pulse duration.

Pulsed signals are thus sampled over a user-defined sampling time T_s . After being collected, the samples are processed *individually* to yield particular results for each sample (reflection coefficient, incident power, reflected power). These particular results are then averaged to yield the final results of interest. The rules for averaging are as follows:

- Incident and reflected powers are, unlike in **Rectified** mode, averaged only over the *accepted* samples. This yields the mean power *in pulse*. For rectangular pulses, this is equal to the peak power.
- Reflection coefficient is averaged only over the *accepted* samples. The accepted samples are those with the incident power exceeding the set Accept Level (L_{acc}).

In addition to the averaged results, the results corresponding to each particular sample can also be viewed. To learn more about this, go to the topic [Displaying Individual Samples](#).

The Homer must be informed of the type of signal waveform it will be confronted with (in this case **Pulsed**). Following this, the corresponding sampling parameters can be modified.

To select Pulsed mode of signal sampling:

Open the [Homer Sampling Setup](#) window and click the **Pulsed** tab. Alternatively, click the  Signal toolbar button ([Fig. 15](#)).

To set sampling parameters:

In the [Homer Sampling Setup](#) window:

- Edit *Sampling Time* to set the sampling time T_s in appropriate units.
- Edit *Sample Count* to set the number of samples N_s to be collected during the sampling time.
- Edit *Max Period* to set the maximal expected pulse repetition period $T_{\max}$.
- Edit *Accept Level* to set the acceptance level L_{acc} in % of pulse height.
- Edit *Count Time* or click the  Standard toolbar button ([Fig. 15](#)) to set the signal frequency counting time T_c in microseconds.
- Edit *Trig Level* or click  to set the trigger level L_{trg} in % of ripple peak-to-peak value.
- Check **Free Run** or click the  /  button to enable/disable sampling without triggering.
- Check **Send Samples** or press the  button to display individual samples. To learn more, go to [Displaying Individual Samples](#).
- Click the  button to check/correct the entered values and compute the derived

parameters (Sampling Rate, Sampling Step).

- Click the **Apply** button to accept the changes, or click **Cancel** to ignore all changes. (The **Apply** button also automatically performs the Refresh action.)

Displaying Individual Samples

In addition to the averaged results, results corresponding to each individual sample in **Rectified** and **Pulsed** sampling modes can also be viewed, displaying, for instance, the time dependence of the generated power similarly to an oscilloscope. This is, in fact, very important for choosing the appropriate [sampling mode](#) for your application.

To display individual samples, check the **Send Samples** checkbox in [Homer Sampling Setup](#) window or press the  button. Two modes are available: *Continuous* and *Single-Shot*. In *Continuous* mode, measurements are repeated indefinitely. In *Single-Shot* mode, a measurement and sending of all samples is made only once, then the Homer is stopped to a standstill. The *Single-Shot* mode is useful if the sample count is large (then the whole process takes long), or if you wish to study (and optionally save) results made at a particular instant.

- To set *Continuous* mode, uncheck the **Single-Shot** checkbox in the Homer Sampling Setup window, or set the  button to the Off (inactive) state.
- To set *Single-Shot* mode, check the **Single-Shot** checkbox, or set the  button to the On (active) state.
- To disable the display of individual samples, uncheck the **Send Samples** checkbox, or set the  button into the Off (inactive) state.

Notes:

- In **Send Samples** mode of data transmission, the [Results windows](#) will still display the averaged results.
- [Data logging](#) is not allowed in **Send Samples** mode of data transmission.
- Some quantities, e.g., reflection coefficient, are meaningless in zero-power signal portions. These extremely noisy samples are rejected by proper choice of *Accept Level* (L_{acc}) when computing the averaged results. To avoid their display in **Send Samples** mode of data transmission, a substitute (the last valid) value of the reflection coefficient is shown in place of these invalid samples.
- Autotuning is based on the averaged results rather than individual samples.
- Displaying individual samples first requires transferring them from the Homer to the PC. This process may take considerable time if the sample count is high and the baudrate is slow.

Triggering

In your initial experiments, it is advisable to enable *Free Run* () to avoid possible problems with triggering, and to set preliminary sampling parameters. Once you see a reasonable, although jittery, trace, you can deactivate *Free Run* () and thus stabilize the trace.

Note: Due to the triggering evaluation time, a few of the first samples may be lost; therefore, the first pulse of the sampled pulse train may appear thinner.

Shifting displayed traces horizontally

To shift the displayed traces horizontally, define the number of samples you wish to see before the triggering event. You can do it in two ways:

- Edit the **Pre-Trig** edit box in the [Homer Sampling Setup](#) window.
- Click the **Pre** Signal toolbar button ([Fig. 15](#)) and enter the desired value.

Sampling Setup Window

Using the Homer Sampling Setup Window ([Fig. 27](#)) is the easiest way to select the signal sampling and processing method (*Waveform*) and to define the corresponding sampling and triggering parameters, as well as the frequency counting time. For details of these settings, please refer to the previous subtopics of this [Signal Waveforms and Sampling](#) section.

The window can be opened by any of the following methods:

- Signal Toolbar button 
- **Homer | Sampling Setup** menu item
- **Ctrl+Q** shortcut key.

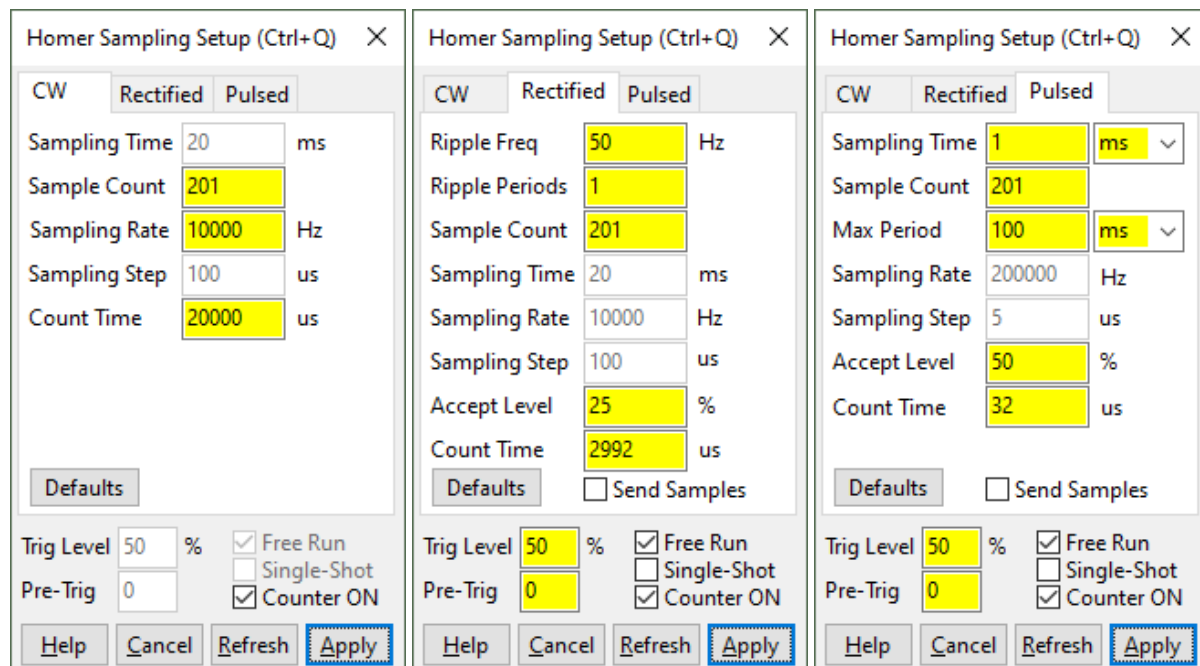


Fig. 27. The three tabsheets of Homer Sampling Setup window.

The window includes three tabsheets, titled *CW*, *Rectified*, and *Pulsed*. In each of them, you can edit the yellow-highlighted edit boxes. The grayed fields are computed values, provided for information purposes (for example, **Sampling Time** in the *CW* tabsheet).

Irrelevant controls will be disabled (for example, **Trig Level** if *CW* tabsheet is active).

After entering the desired values, click the **Refresh** button. This will resolve errors or inconsistencies in the entered data (and inform you of the details), and compute the grayed

values. The Refresh action is automatically also called when clicking the **Apply** button.

Please note that the actual value of **Count Time** will be the highest multiple of 16 μ s that does not exceed the set value.

The window must be closed before continuing the program. You can do it using the **Apply** button, the **Cancel** button or the standard Windows close button (x).

- To accept your edits, click the **Apply** button. The mode and parameters of the signal sampling (*Waveform*) will be set according to the currently active tabsheet.
- If you click the **Cancel** button or the Windows close button, any changes you have made will be ignored.

Mode Stirrer

This section, in the form of an example, discusses a relatively complex situation when

- a high-ripple rectified signal is used for powering the magnetron, **and**
- the applicator (e.g., a heating cavity) comprises a mode stirrer.

The example illustrates how to properly set up the signal sampling parameters for autotuning purposes.

The appropriate sampling mode to handle the situation is **Rectified**.

First, an inspection of the signal waveform should be performed. In principle, this can be done using a microwave detector and an oscilloscope. Nevertheless, Homer in **Rectified** mode and with transmission of individual samples is even better suited for this purpose. First, select the **Rectified** sampling mode, then activate *Free Run* and the transmission of individual samples. Then start measurement and experiment with sampling parameters to arrive at a meaningful, if jittery, display. To steady the display, disable *Free Run*. The displays may now look like [Fig. 28](#). In this example, this was achieved with sampling time $T_s = 1$ s and sample count $N_s = 3001$ (resulting in sampling rate $f_s = 3$ kHz). The horizontal axis is the sample sequential number (proportional to time). Two samples are separated by $\Delta t_s = 1/3000$ Hz = 1/3 ms.

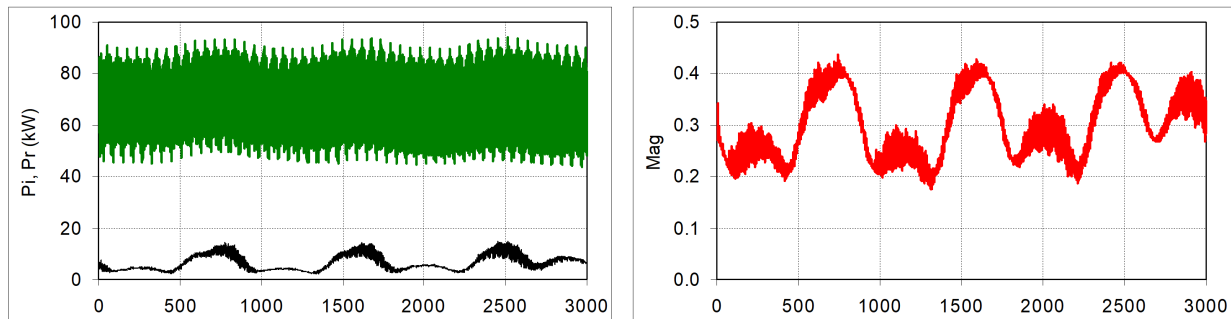


Fig. 28. Waveforms of incident power (green), reflected power (black), and reflection coefficient modulus (red). The x-axis is the sample sequential number.

The slowest periodicity (T_1) the traces exhibit corresponds to about 900 points, i.e., $T_1 = 300$ ms. The repetition rate is $f_1 = 1/T_1 = 3.333$ Hz. The origin of these slow oscillations is the mode stirrer rotation.

Rule 1: To arrive at proper mean values, the sampling time T_s should be an integral multiple of the longest periodicity.

In our example, the longest period is T_1 , hence $T_s = 300$ ms, or 600 ms, or 900 ms, etc.

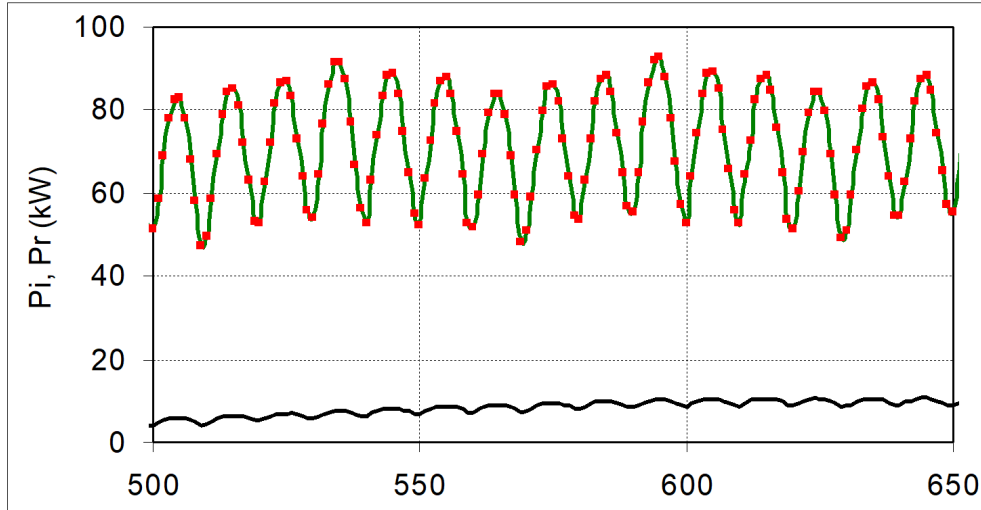


Fig. 29. Zoomed waveforms of the incident power (green) and the reflected power (black). The red dots show the actual samples.

The traces also exhibit a fine structure (Fig. 29). It is visible after zooming (to zoom, click  on the display window, uncheck **Automatic** and set **Xmin, Xmax**). The fastest period (T_2) in our case corresponds to about 10 points (the red dots), i.e., $T_2 = 3.333$ ms. The repetition rate is $f_2 = 1/T_2 = 300$ Hz. The origin of these oscillations is the three-phase full-wave rectification of the up-transformed power line voltage with frequency $f_p = 50$ Hz. A 50-Hz periodicity is also discernible in Fig. 29 (six fast ripples).

For proper sampling, there is an additional rule, concerning the sample count n_2 per the fastest ripple period.

Rule 2: The fastest variations must be well covered by sampling (e.g., $n_2 = 10$ points/period).

Combining **Rule 1** and **Rule 2** leads to the sample count

$$N_s = n_2 \frac{T_s}{T_2} + 1$$

In our example, the shortest period $T_2 = 3.333$ ms is sampled at 10 points, as shown by the red dots in Fig. 29. Choosing the sampling time $T_s = T_1 = 300$ ms calls for the sampling count

$$N_s = 10 \text{ points} \times 300 \text{ ms} / 3.333 \text{ ms} + 1 = 901 \text{ points.}$$

The sampling rate is then

$$f_s = \frac{N_s - 1}{T_s} = 3 \text{ kHz}$$

In **Rectified** mode, the sampling time T_s is not defined directly but in terms of the number N_p of

the ripple periods constituting T_s . To obtain the desired T_s , set N_p to

$$N_p = T_s f_r$$

In our example $N_p = 0.3 \text{ s} \times 300 \text{ Hz} = 90$.

Since, as seen in [Fig. 28](#), all samples are valid (the incident power never drops close to zero):

- It is best to switch *Free Run* on (to also handle very low-ripple signals).
- You can set the Acceptance level $L_{acc} = 0$. However, to handle cases where ripple goes as low as zero (like one-phase half-wave rectification), a better choice is to set a small but nonzero Acceptance level, e.g., $L_{acc} = 10\%$ or 20% . Then meaningless reflection coefficients resulting from noise (when signal level is near-zero) will be disregarded.

There are additional important rules in the *Mode Stirrer* situation:

Rule 3: For tuning, *averaged* reflection coefficient must be used. This is automatically taken care of when selecting **Rectified** or **Pulsed** modes of sampling.

Rule 4: The mean reflected power should not be computed from the mean incident power and the mean reflection coefficient but as the average of the reflected powers for individual samples. This is again automatically taken care of when using **Rectified** or **Pulsed** modes of sampling.

Application of **Rule 3** is illustrated in [Fig. 30](#), showing trajectories of reflection coefficient. The red trace is a reflection coefficient before tuning (tuning stubs completely withdrawn). The oscillations along a deformed circle are caused by the mode stirrer. When tuning based on the mean value is activated, the locus moves closer to the center (blue trace). No individual point is perfectly matched and the size of the pattern has slightly increased, yet this is the a uch better situation. The trace is optically not centered: this is because the samples spacing may be denser in certain locus portions, as the detail on the right reveals. Thus, the “center of mass” of the trace is offset from an intuitive center.

The importance of **Rule 4** is also evident from [Fig. 30](#). It shows that while the mean value of the *complex* reflection coefficient in tuned state is practically zero, the mean *magnitude* M of the reflection coefficient is approximately $M = 0.07$ (the “radius” of the blue trace). Consequently, the mean reflected power, which is proportional to M^2 , is about 0.5% of the incident power. Using the zero mean reflection coefficient for the computation would incorrectly result in *zero* reflected power.

This is the reason why, for instance, the **CW** sampling mode, albeit configured to take samples exactly as in the **Pulsed** mode, would deliver a false (i.e., nearly zero) mean reflected power.

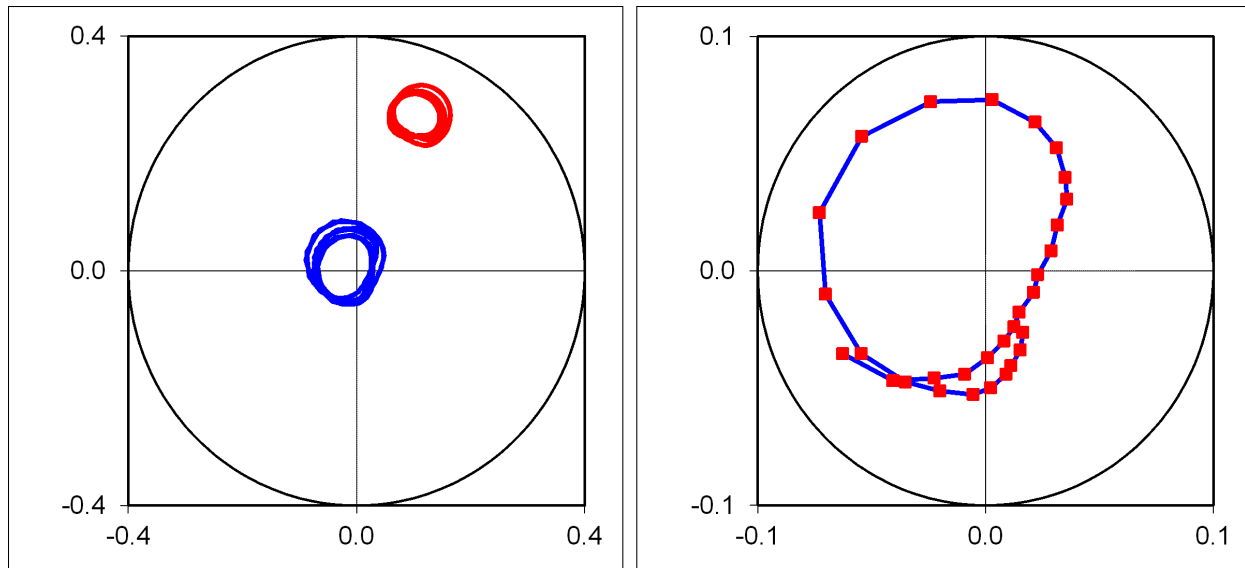


Fig. 30. Left: Reflection coefficient locus before tuning (red) and after tuning using mean value (blue). Right: A portion of the blue trace zoomed.

Appropriate settings for the *Mode Stirrer* situation in our example are summarized in the following table:

Sampling method (<i>Waveform</i>)	Rectified
Free Run	TRUE
Triggering level	(Irrelevant)
Ripple frequency (f_r)	300 Hz
Number of ripple periods (N_p)	90
Sampling time (T_s)	300 ms: Computed by Homer as N_p/f_r
Sample count (N_s)	901: This results in 10 samples per a ripple period
Sampling rate (f_s)	3 kHz: Computed by Homer
Acceptance level (L_{acc})	0 to 20%
Frequency counting time (T_c)	Arbitrary, e.g., 20 ms (if the power never drops to zero)

If the microwave power ripple drops close to zero during some intervals, false frequency readings may be experienced in the case of Free Run, which may result in incorrect reflection coefficient and power outputs. If triggering for some reason does not help, one can disable the counter and set an appropriate *Substitute Frequency* in the **Homer** menu.

AUTOTUNER

The following topics describe aspects of **HomSoft** operation related to the **Homer Autotuner** as an enhancement to the Homer Analyzer alone. *The Autotuner* is an intelligent system combining the Homer Analyzer and Homer Mototuner (Tuner). The Tuner is a motorized

three-stub high-power impedance transformer, consisting essentially of a waveguide section with three stepper motor-driven metallic posts (tuning stubs) inserted into the waveguide at mutual distances of nominally one quarter of the guide wavelength. This arrangement facilitates impedance matching of loads with arbitrary reflection coefficient phases and, depending on construction and maximum power, with VSWR typically up to 10:1.

Functions related to Tuner operation are grouped in the [Tuner menu](#).

The terms *stub positions/movements* will be used equivalently with the terms *motor positions/movements*.

Most Homer implementations have the **ALL STUBS HOME** and **AUTOTUNE** switches physically present on the hardware. The water-cooled 2.45 GHz Autotuner has the AUTOTUNE switch accessible via [Remote Connector](#) (Action Switch or Action Pulse inputs). The **ALL STUBS HOME** switch triggers the motor initialization routine; the **AUTOTUNE** switch activates and deactivates automatic impedance matching (autotuning). These actions can also be triggered by software commands. Optionally, the **AUTOTUNE** switch can be assigned a different action, as specified by the "AtSwitchAction" line of the internal [Tun.cfg](#) configuration file.

Controlling the Autotuner

When starting **HomSoft** for the Autotuner, the following additional features appear compared to the Homer Analyzer:

- New menu item, named [Tuner](#), appears on the main menu bar.
- A button with Tuner icon  appears on the Standard toolbar ([Fig. 15](#)).
- The [System Info](#) window contains new pages related to the Autotuner.
- Additional windows can be opened:
 - [Tuner View](#) window (shows the Tuner image and enables Autotuner control via mouse clicks and drags).
 - [Scenario](#) window (enables stubs to be moved in a predesigned position-vs-time manner).

All Stubs Home Routine

The motor initialization routine, also called **Reset Stubs**, **All Stubs Home** or just **All Home** procedure, is a specific method of setting the tuning stubs to *reference positions* (zero positions). The reference position represents a fully retracted stub and corresponds to zero-mm setting in motor motion commands.

The stubs are first moved up (retracted) until the top terminal switches are closed reliably. Then, with a minimum speed, the motors are stepped back, until the switches are released. This is the absolute, mechanical zero position. From this position on, the stubs go further down by a certain number of steps, defined for each motor individually. This is then the reference position.

The motor initialization routine therefore resolves any uncertainties or motor errors possibly caused by lost motor steps.

Matchable Area

A tuner's primary characteristic of interest is its *matchable area*, i.e., the range of reflection coefficients Γ_L that can be *perfectly* matched by the tuner. The typical matchable area of a three-stub tuner is composed of two subareas (Fig. 31), one matchable by the combination of stubs 1 and 2, the other by the combination of stubs 2 and 3, stub 1 being the one closest to the generator.

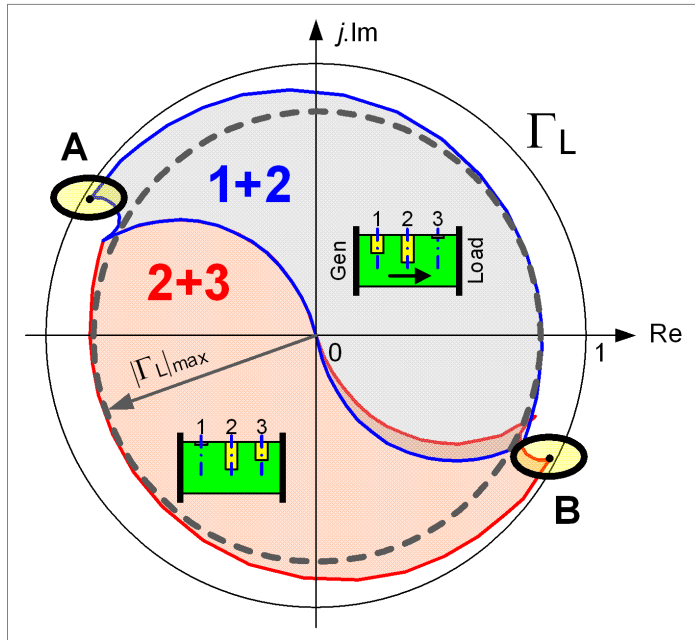


Fig. 31. Three-stub tuner matchable area.

When increasing the frequency, the two subareas can overlap (as shown in the figure), touch, or there may be a gap between them.

The radial extension of the matchable area grows with increasing the maximum stub insertion depth $h_{\max}$. This defines the maximum modulus $|\Gamma_L|_{\max}$ of reflection coefficient that can be perfectly matched irrespective of its phase.

If $h_{\max}$ is high, there may be portions of the matchable area with very high reflection coefficients that can still be perfectly matched – by extremely inserted tuning stubs (areas A and B in Fig. 31). This means that the full generator power is being pumped into a space with nearly no losses, which results in an extreme buildup of the internal field strengths and surface currents. Such a situation thus represents an acute danger of electric breakdown, arcing and tuning stub structure overheating, and thus severely limits the maximum safe working power. For more information about these problems, please refer to the following publication:

V. Bilik and J. Bezek, "High Power Limits of Waveguide Stub Tuners," Journal of Microwave Power and Electromagnetic Energy, vol. 44 (2010), No. 4, pp. 178-186.

The best way to avoid the described risk is to construct your applicator such that its reflection coefficient never exceeds a certain magnitude, e.g., $|\Gamma_L| < 0.9$. This is sometimes challenging. Next, we will discuss other options.

Limiting Stub Insertion

One method of reducing the risk of arcing is limiting the maximum possible stub insertion $h_{\max}$. This can be done in two ways: as a factory setting, or as a user-definable setting.

Factory Setting

The absolute maximum h_{abs} of stub insertions is defined in Homer's **Tun.mem** file. The value can only be changed by the Homer manufacturer. The user, after receiving a modified **Tun.mem** file, has to run the [Reinstall](#) procedure to apply the new settings.

User-Defined Setting

For a given h_{abs} , the user can further reduce $h_{\max}$ by editing the line

```
MaxInsert_mm=22.7
```

in the [Tun.cfg](#) configuration file (for safety, this is the only available method in the live operational **HomSoft** version). For more details on how this can be done, see topic [Homer Internal Files](#).

For studying the effect of varying $h_{\max}$ on your individual Autotuner, see topic [Studying Matchable Area](#).

Unfortunately, as you might have observed, limiting the maximum stub insertion shrinks the whole matchable area, thus also reducing the useful and safe matchable range. Fortunately, the Homer firmware provides a way of removing only the risky portions of the matchable area by its truncating, as explained next.

Truncating Matchable Area

A full matchable area can be software-trimmed to a certain radius $R_{\max}$ by the following line in the [Tun.cfg](#) configuration file (for safety, this is the only available method in the live operational **HomSoft** version):

```
MaxMag_mU=850
```

This defines the maximum magnitude in milliunits (mU) to be used for autotuning. In the above example line, $R_{\max} = 850 \text{ mU} = 0.85$. If the magnitude $|\Gamma_L|$ of the actual load reflection coefficient

$$\Gamma_L = |\Gamma_L| \exp(j\phi_L)$$

exceeds $R_{\max}$, the tuning algorithm uses

$$\Gamma_M = R_{\max} \exp(j\phi_L)$$

for its input instead of Γ_L , as shown in [Fig. 32](#). Thus, the critical regions of the matchable area are avoided while maintaining the full tuning performance elsewhere.

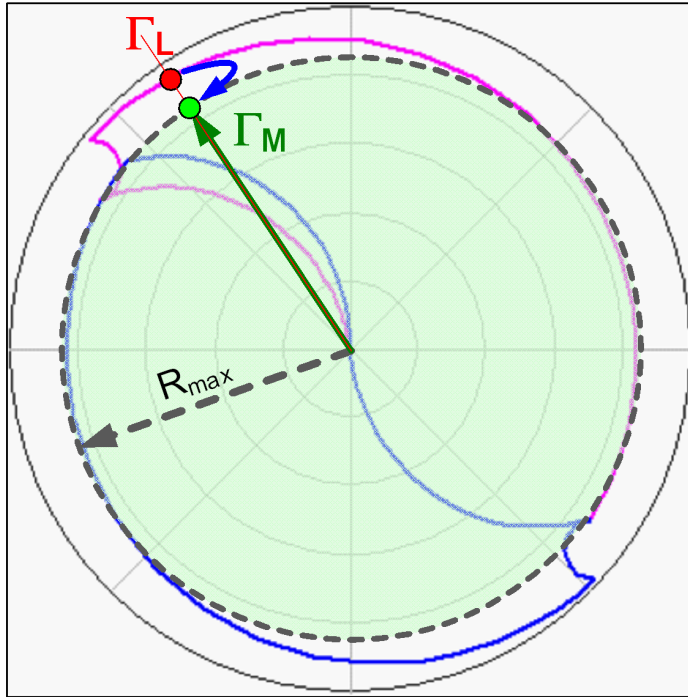


Fig. 32. Truncating the matchable area to $R_{\max}$.

For studying effects of truncating the matchable area of your particular Autotuner, see the topic [Studying Matchable Area](#).

Studying Matchable Area

The matchable area of your particular Autotuner can be varied and studied using the **HoSim** simulation program.

- For customizing **HoSim** to behave as your tuner, see the topic [Real Tuner Performance](#).
- To display and observe the matchable area, activate [Plot](#) in the *DUT* page of the **Homer Model** Window.
- To change the frequency for which the plots are valid, use the page [More](#) of the **Homer Model** Window.

Effect of Limiting Stub Insertion

The value of $h_{\max}$ can be changed on the [Motors](#) page of the **System Info** window by clicking the *Max Steps/Travel* row (this is only available in the **HoSim** simulation). The effect is immediately seen if the matchable area is displayed. You can even set the insertion deeper than is physically possible. To return to default, set zero as the insertion.

Note that this function is disabled in the live operational **HomSoft** version and is available only in the **HoSim** simulation.

Effect of Truncating Matchable Area

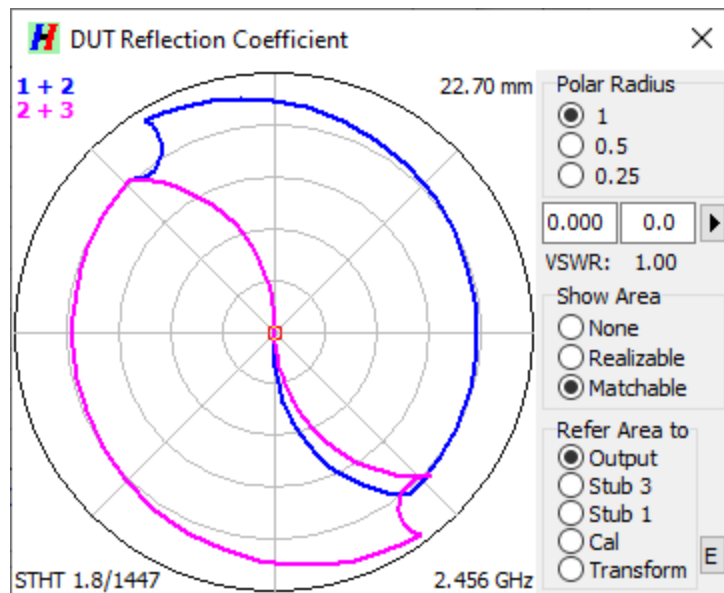
The value of $R_{\max}$ can be changed in the [Autotune](#) page of the **System Info** window by clicking the row *Max tune Mag [milliunits]*. This is only available in the **HoSim** simulation. The effect is

immediately seen if the matchable area is displayed.

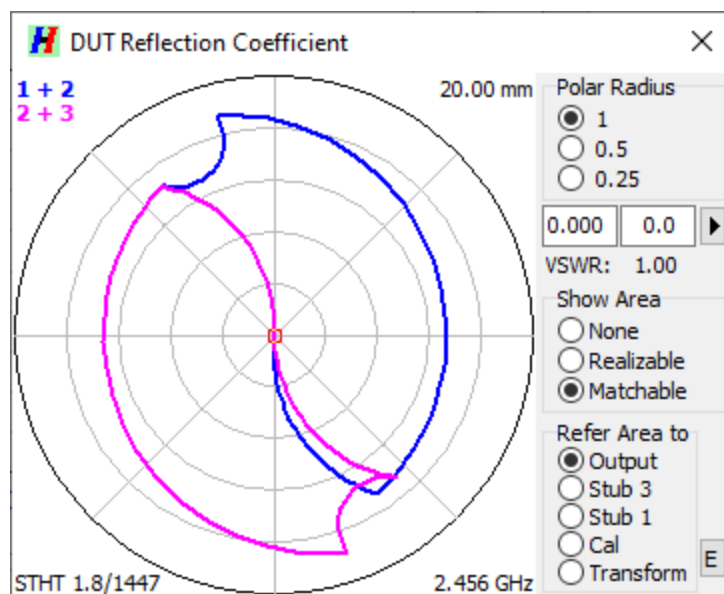
Examples

Below, Fig. 33 shows examples of matchable areas of the 2450-MHz WR340 Homer Autotuners for the following cases:

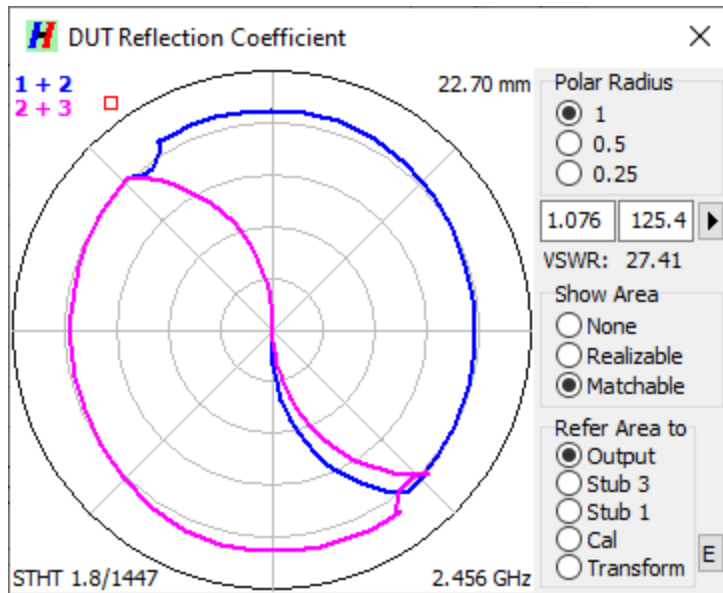
- Default stub insertion ($h_{\max} = 22.7$ mm), without truncation ($R_{\max} = 1000$ mU). For this case $|\Gamma_L|_{\max} = 0.77$ (VSWR = 7.7).
- Stub insertions limited to 20 mm, without truncation ($R_{\max} = 1000$ mU). For this case $|\Gamma_L|_{\max}$ is only 0.65 (VSWR = 4.7).
- Default stub insertion ($h_{\max} = 22.7$ mm), the matchable area truncated to $R_{\max} = 850$ mU. For this case, $|\Gamma_L|_{\max}$ has remained 0.77 as in the default case but the critical regions have been removed.



$h_{\max} = 22.7$ mm, $R_{\max} = 1000$ mU



$h_{\max} = 20$ mm, $R_{\max} = 1000$ mU



$h_{\max} = 22.7 \text{ mm}$, $R_{\max} = 850 \text{ mU}$

Fig. 33. Effects of limiting the maximum stub insertions (middle) and of truncating the matchable area (bottom).

System Info Window

The **System Info** window provides basic system information about the Homer Analyzer/Autotuner. The window can be opened by clicking the **View | System Info** menu item or the **Sys** button on the Standard toolbar (Fig. 15).

In the case of Homer Analyzer, a single-page window opens with the page titled *Homer*; in the case of Homer Autotuner, a multipage window opens with pages titled *Homer*, *Tuner*, *Motors*, *Autotune* and *Sketch*. Items shown in the *Autotune* page can be clicked and modified (a fact indicated by a hand-shaped mouse cursor when hovering over them).

Homer and Tuner Pages

The *Homer* page (Fig. 34) displays identification, waveguide size and nominal frequency of the Homer Analyzer.

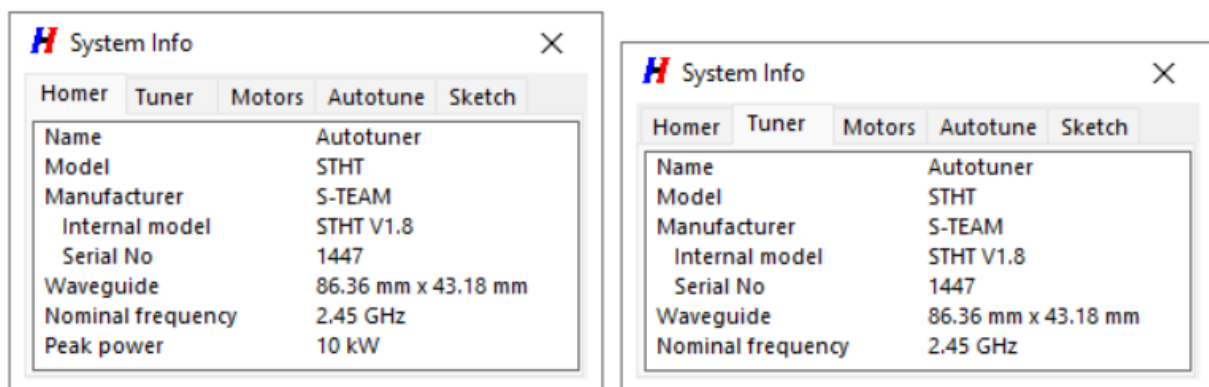


Fig. 34. Homer and Tuner pages of System Info window.

The *Tuner* page displays identification information, waveguide size and nominal frequency of the Homer Mototuner. In the case of the compact, one-piece Autotuner, the *Tuner* page is identical to the *Homer* page except for the missing *Peak power*. Also, *Nominal frequency* may differ for the Analyzer and the Tuner.

Motors Page

The *Motors* page ([Fig. 35](#)) displays basic parameters characterizing tuning stubs (motors) motion. An approximate full travel time is computed as (Max Steps)/(Pull-in rate).

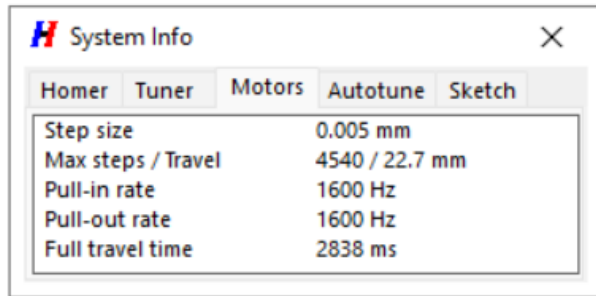


Fig. 35. Motors page of System Info window.

Autotune Page

Thanks to the fact that the Homer Analyzer measures *complex* reflection coefficient, the autotuning process is not a trial-and-error procedure: on the contrary, the process employs a systematic, predictive algorithm which, based on a single measurement performed with arbitrarily inserted tuning stubs, computes new, match-ensuring stub positions. (Due to limited [measurement accuracy](#), sometimes two or three cycles are required.) The computations take a fraction of a second, so the speed of the process depends essentially on the motor speeds.

The autotuning process is controlled by several parameters. The *Autotune* page of the System Info window ([Fig. 36](#) left) lists those which the user can modify. This is done by simply clicking the corresponding item.

For the case of the **HoSim** simulation ([Fig. 36](#) right), please also refer to [Truncating Matchable Area](#) and [Real Tuner Performance](#).

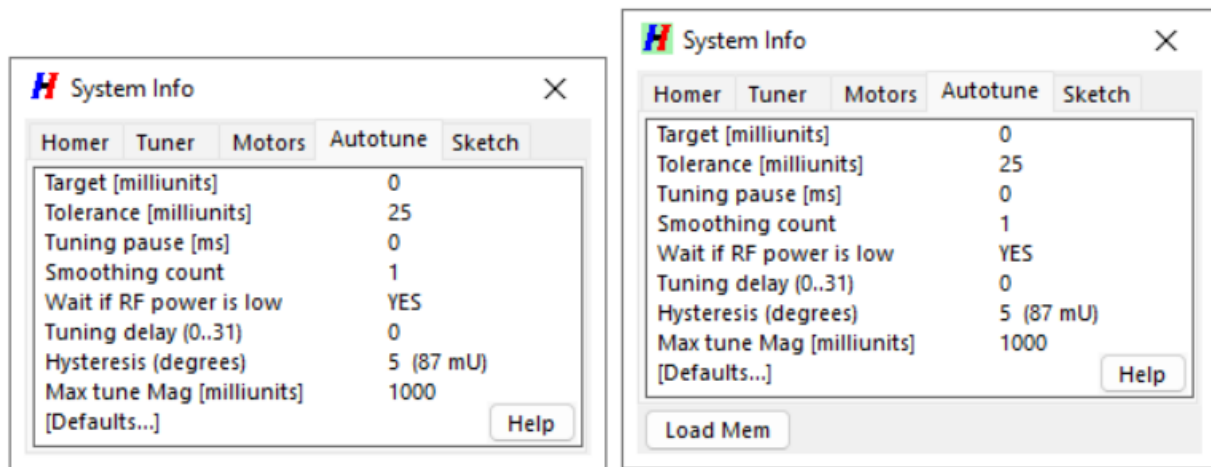


Fig. 36. Left: Autotune page of System Info window. Right: The page appearance in the *HoSim* simulation program.

Target [milliunits]

Target is the desired goal reflection coefficient magnitude to be attained by impedance matching. The *Target* value is to be entered in *milliunits* (1 milliunit = 0.001 in terms of reflection coefficient magnitude).

In most applications, a perfect match is desired. To strive for a perfect match, set *Target* to zero, which is also the default value.

There are, however, microwave installations (notably some plasma applicators) that may work better when autotuning is not aimed at perfect match but at a reflection coefficient with a nonzero magnitude. To achieve it, set *Target* to the desired value. The autotuning mathematics (computation of stub positions) proceeds until the magnitude of the input reflection coefficient differs from the *Target* value by less than the *Tolerance* (described below).

The Autotuner power-up value of *Target* is controlled by the following line in the internal **Tun.cfg** configuration file:

```
Targ_mU=0;      Target [milliunits] for autotuning
```

Mathematically, the tuning algorithm finds the positions of two of the tuning stubs to achieve a perfect match, and then “spoils” this match by the third, unused, stub. The phase angle of the resulting reflection coefficient is not (cannot be) controlled by this method.

If the Homer is not equipped with the *Defined Mismatch Tuning* option, the *Target* value will be ignored (internally set to zero).

Tolerance [milliunits]

Tolerance (r_T) is the maximum acceptable deviation of the input reflection coefficient magnitude from the desired *Target* value. It can be envisaged as a circle with a radius r_T around the target reflection coefficient (also see figures in section [Hysteresis](#)). If the input reflection coefficient is within this circle, the stubs will not move. Set *Tolerance* to a value different from zero if you want to prevent stubs from incessant fine-tuning.

Similarly to *Target*, the *Tolerance* value r_T is to be entered in milliunits. The default value is 25

milliunits.

The Autotuner power-up value of *Tolerance* is controlled by the following line in the internal **Tun.cfg** configuration file:

```
Toler_mU=25;      Tolerance [milliunits] for autotuning
```

Tuning pause [ms]

Sometimes you may wish to introduce a delay between two consecutive autotuning attempts to prevent stubs from frequent movements. This can be done by setting a non-zero *Tuning pause*. The value is entered in milliseconds between zero and 2550; it will be rounded to tens of ms. The default value of *Tuning pause* is zero, which ensures the fastest possible tuning.

The actual delay in milliseconds can be longer depending on how long one measurement and stubs movement takes.

The Autotuner power-up value of *Tuning pause* is controlled by the following line in the internal **Tun.cfg** configuration file:

```
Pause_10ms=20;      Minimal interval n x 10ms between tuning steps
```

In this example the *Tuning pause* will be 200 ms. The value can range from zero to 255.

Starting with **HomSoft** version 5.0.3.0, the *Tuning pause* parameter replaces the deprecated previous *Skipped measurements*.

(Skipped measurements)

Please note that this parameter applies to older **HomSoft** versions (5.0.2.0 and less). In more recent versions, *Skipped measurements* is replaced by the more exact *Tuning pause*.

Here is the original text:

Sometimes you may wish to introduce a delay between two consecutive autotuning attempts. This can be done by making a number of measurements without tuning after each autotuning step. The number can be entered as *Skipped measurements*. The higher the number, the longer the delay. The default value of *Skipped measurements* is 1. The lowest possible value is zero (tuning after each measurement).

The actual delay in milliseconds depends on how long one measurement takes.

The Autotuner power-up value of *Skipped measurements* is controlled by the following line in the internal **Tun.cfg** configuration file:

```
Skip=1;      Number of skipped measurements
```

Smoothing count

Smoothing is a floating average procedure applied to reflection coefficients (and frequency) in an attempt to reduce the undesirable effect of glitches (short-lived deviations) in the reflection coefficient on tuning behavior. Tuning in the case of smoothing is based not on the current results but on the mean value of N_a previous results, where N_a is the *smoothing count*.

Typical examples where increased smoothing count may be beneficial:

- Mostly homogeneous substance moving on a conveyor belt, occasionally containing a metallic

object.

- A liquid flowing through an applicator, occasionally containing air bubbles.

The default value of *smoothing count* is 1.

The Autotuner power-up value of *smoothing count* is controlled by the following line in the internal **Tun.cfg** configuration file:

```
Smooth=1;           Number of averaged measurements taken for one tuning step
```

Smoothing should be applied judiciously and well tested because under certain circumstances it may not work as expected. To smooth out regular oscillations of the reflection coefficient (and the incident power), consider using proper [sampling mode and timing](#) instead.

Wait if RF power is low

When this parameter is set to YES (default), autotuning will be suspended when the incident microwave power is below a predefined *Low Signal* level. As soon as the power increases above that level, autotuning will resume.

When *Wait if RF power is low* is set to NO, autotuning takes place regardless of the microwave power level. This may be useful, e.g., for checking motors without microwave power (tuning based on noise).

The Autotuner power-up value of *Wait if RF power is low* is controlled by the following line in the internal **Tun.cfg** configuration file:

```
WaitRF=TRUE;        Suspend tuning when RF power is absent or too low
```

For details about *Low Signal* level and its setting, see [Low Signal Warning](#) in section [Homer Error Byte](#).

Tuning delay

(Applies to **HomSoft** versions starting 5.0.3.0)

When power supply voltages and currents are applied to a magnetron, the magnetron may need some time to reach stable operational state. During the transient period, tuning may become erratic. To avoid this, the user may postpone the start of tuning by a *Tuning delay*. The delay is measured from the instant the incident power rises above the *Low Signal* level.

The tuning delay is expressed in terms of a 5-bit number (0...31), representing the number of elementary delays applied. The elementary delay is defined in the internal **Tun.cfg** configuration file; the default is 250 ms. For instance, a *Tuning delay* value of 12 represents the delay 12×250 ms = 3 seconds.

The default value of *Tuning delay* is zero.

The Autotuner power-up values of *Tuning delay* and the elementary delay are controlled by the following lines, respectively, in **Tun.cfg**:

```
Delay5b=0;           Tuning delay after power onset in steps DelayStep_ms  
DelayStep_ms=250;    Step of tuning delay after power onset
```

The *Low Signal* level of incident power is controlled by the following line in the internal **Hom.cfg** configuration file:

```
LowPowLvl_W=100;    Incident power threshold for "Low Signal" condition
```

For more details, see [Low Signal Warning](#) in section [Homer Error Byte](#).

Hysteresis

See the [Hysteresis](#) section.

Max tune Mag [milliunits]

This value truncates the matchable area to avoid excessively high-reflecting loads that, when matched by the tuner, could result in arcing.

In the live operational **HomSoft** version, *Max tune Mag* is a read-only quantity. For details, please refer to [Truncating Matchable Area](#). For Homer units with Server versions older than V60, the displayed value is "Unknown".

In the **HoSim** simulation, the value can be edited after clicking the item. For details, please refer to [Studying Matchable Area](#).

[Defaults]

Click *Defaults* to set the autotuning parameters to their default values. In the live operational **HomSoft** version, the *Max tune Mag* will not be affected.

Sketch Page

The *Sketch* page ([Fig. 37](#)) displays relevant mechanical dimensions of the Autotuner, including the Analyzer calibration (CAL) plane location (not important for the user), the location of the input reflection coefficient reference plane (Γ_I) and the default location of the load reflection coefficient reference plane (Γ_L).

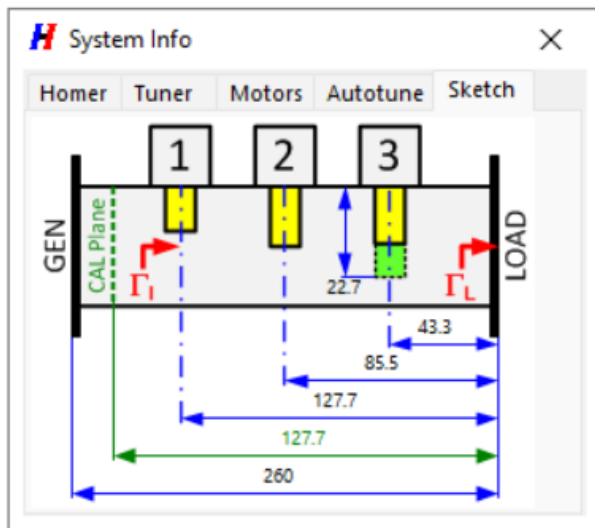


Fig. 37. Sketch page of System Info window.

Tuner View Window

The **Tuner View** window ([Fig. 38](#)) enables visual, mouse-based Tuner control and monitoring. The window can be opened by clicking the **Tuner | View** menu item or the  button.

To enhance visual detail and provide finer control of stub positions via dragging, the window includes two buttons that will open dialogs for scaling the tuner image:

- X scales the overall width of the window while maintaining its aspect ratio.
- Y defines the scaling factor for the waveguide height relative to the motor height, effectively stretching the window vertically.

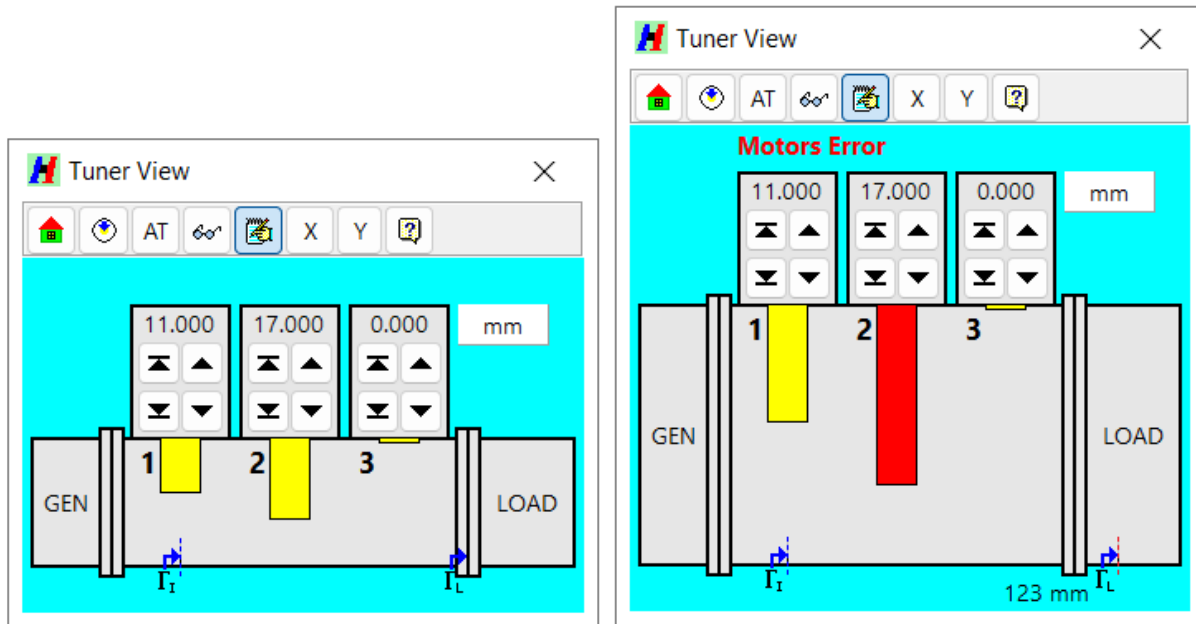


Fig. 38. Tuner View window. Right: A case of Motor 2 error and the load reference plane shifted outward by 123 mm.

All Stubs Home

The [All Stubs Home](#) procedure (motors initialization) is activated by clicking the **Home** button  or, equivalently, the **Tuner | All Home** menu item.

Reading Stub Positions

Clicking the **Read** button  (or the **Tuner | Read** menu item) commands **HomSoft** to query the Homer for the current positions of the tuning stubs. This action is normally not necessary; you may wish to try it in case of doubts about the correctness of the displayed stub positions.

Scenario

Clicking the **Scenario** button  (or the **Tuner | Scenario** menu item) opens the [Scenario](#) dialog window enabling the user to define, save, load and run sequences of predefined stub positions with a specified dwell time at each position, or set individual positions of a sequence by a mouse click.

Stubs Movement

Mouse Dragging

A tuning stub can be moved by gripping the bottom edge of its image with the mouse and

dragging it to a desired insertion. Releasing the mouse starts the stub motion.

Buttons

Each tuning stub can be moved independently by operating its four buttons:

-  Move the stub upwards to zero-mm position.
-  Move the stub downwards to the bottom (maximum extension) position.
-  Click once or hold to move the stub upwards by small, medium, or large steps.
-  Click once or hold to move the stub downwards by small, medium, or large steps.

The step size can be controlled by simultaneously holding a keyboard key as follows:

- Small step: hold the **Ctrl** key.
- Medium step: do not hold any key.
- Large step: hold the **Shift** key *or* use the **right-hand** mouse button.

The numerical indicators attached to the motors show the current stub positions. The positions can be displayed in millimeters, inches, or as motor steps. Toggle the display by clicking the panel showing the unit.

Keyboard

Stub positions (in the displayed units) can be typed in numerically after clicking the numerical indicators. Confirming the value starts the stub motion.

Note: In the case of CAN Bus, stub dragging as well as stub movement buttons are disabled while the system is measuring or autotuning. Typing via keyboard still works.

Autotuning Activation

Single-Step Tuning

While measuring, a single autotuning step can be invoked at any moment by clicking the  button.

Note: In the case of the **HoSim** [Homer Simulation](#), an approximate time in milliseconds the tuning step takes is shown on the top left. See subsection [Plot](#) of the Homer Simulation section on how to customize the **HoSim** program to represent a real Autotuner (loading a Tun.mem file).

Continuous Tuning

Continuous autotuning can be activated or deactivated by clicking the  button (or the **Tuner | Autotune | Active** menu item).

Using AUTOTUNE Switch

Autotuning can also be switched ON and OFF by means of the hardware **AUTOTUNE** switch (the presence of this switch depends on the Autotuner model). The switch overrides the software setting at the instant its position is changed. Conversely, the next click on the  button overrides the HW switch setting. However, starting with Server version V60 and **HomSoft** version V5.0.3.0, the Autotune LED always reflects the actual state of Homer's Autotune flag.

Reference Planes

The **Tuner View** window indicates the location of the planes to which the input reflection coefficient Γ_I and the load (deembedded) reflection coefficient Γ_L are referred.

- The input (Γ_I) reference plane is located at the axis of tuning stub 1, closest to the generator.
- The load (Γ_L) reference plane coincides with the output flange of the tuner.

For further details about Γ_I and Γ_L and their reference planes, see section [Deembedding](#) in [Input and Load Reflection Coefficients](#).

Plane Extension

The load reference plane (and only the *load* reference plane) can be arbitrarily shifted by the user. For details, see [Plane Ext.](#)

If the load reference plane is shifted, the symbol Γ_L in the **Tuner View** window and the associated angled arrow are shifted either to the right (if the extension is positive) or to the left (if the extension is negative) from the default location shown in [Fig. 38](#).

The plane extension distance is also written in the *Reflection Coefficient* group of the full-size Results Window.

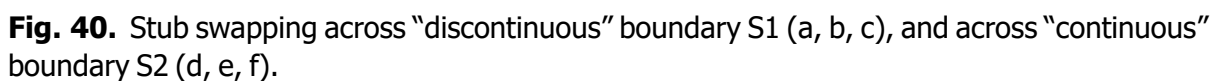
Hysteresis

Only two of the three tuning stubs (1+2 or 2+3) are used at one time for matching any particular load reflection coefficient. Each pair covers a specific area in the Polar plot ([Fig. 39](#)). There is a boundary between these two sub-areas (the thick red line S1 in [Fig. 39](#)), where the central stub (Stub 2) is retracted and either Stub 1 or Stub 3 protrudes (up to the maximum). Slight variations of the load reflection coefficient across this boundary would cause stubs 1 and 3 to move up and down incessantly, without any useful effect. This is, for instance, the case of reflection coefficients (red dots) designated 1 and 2 in plot (a) and reflection coefficients 4 and 5 in plot (b). Because of this "stub swapping", the boundary can be aptly named a "discontinuous boundary".

Another, slightly less critical, is the "continuous" boundary S2 (thick dark-blue line), where the central stub is inserted and stubs 1 and 3 swap smoothly through zero extension at S2 boundary. The two cases are illustrated in [Fig. 40](#).

An additional inconvenience of stub swapping is that this "great reshuffling" may affect the dynamics and energy efficiency of the microwave process being monitored and controlled.

The concept of hysteresis aims to reduce the incidence of such stub swapping. To quantify hysteresis, the *hysteresis distance* r_H is introduced. It is the distance in the complex plane by which the load reflection coefficient Γ_L must intrude into the adjacent area for the system to swap the stubs. The downside is a somewhat greater mismatch, especially if r_H is set too high. In [Fig. 39](#), the hysteresis area around S1 is bounded by the green line and around S2 by the grey line. In plot (a), the swapping does not occur when reflection coefficient variation is **1** → **2** or **u** → **v** but it occurs in cases **2** → **3** or **v** → **w**. In plot (b), the swapping will not occur in cases **4** → **5** or **x** → **y** but it occurs in cases **5** → **6** or **y** → **z**.



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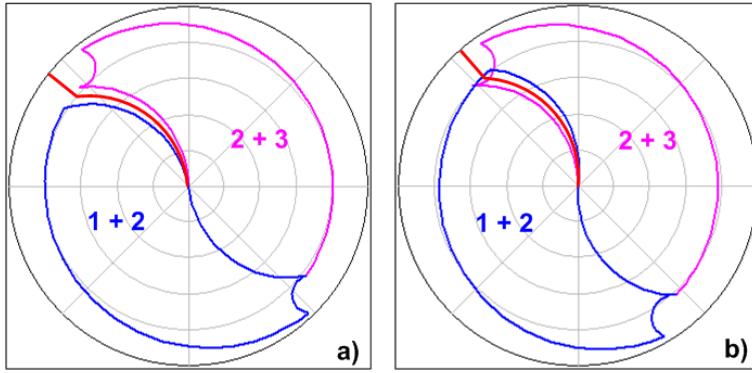


Fig. 41. Gap between the matchable subareas (a) and their overlap (b). The decision curve (thick red line) runs in the middle of the gap/overlap.

The value of r_H is defined indirectly by the hysteresis angle φ_H as follows from [Fig. 39](#). If φ_H is expressed in degrees, then hysteresis distance in milliunits is given approximately by

$$r_H \approx 17.45 \times \varphi_H$$

In [Homer Autotuner Starting Parameters](#) (Tun.cfg internal file), the hysteresis angle in degrees is defined by the line

`HystDg=5 ;Hysteresis in degrees for stubs 1-3 swapping`

The default value (5 degrees) yields $r_H = 87$ mU; other values (computed exactly) can be obtained from [Fig. 42](#). Modifying the default hysteresis value without a good reason is not recommended.

The [Autotune](#) page of System Info window shows the hysteresis distance in parentheses.

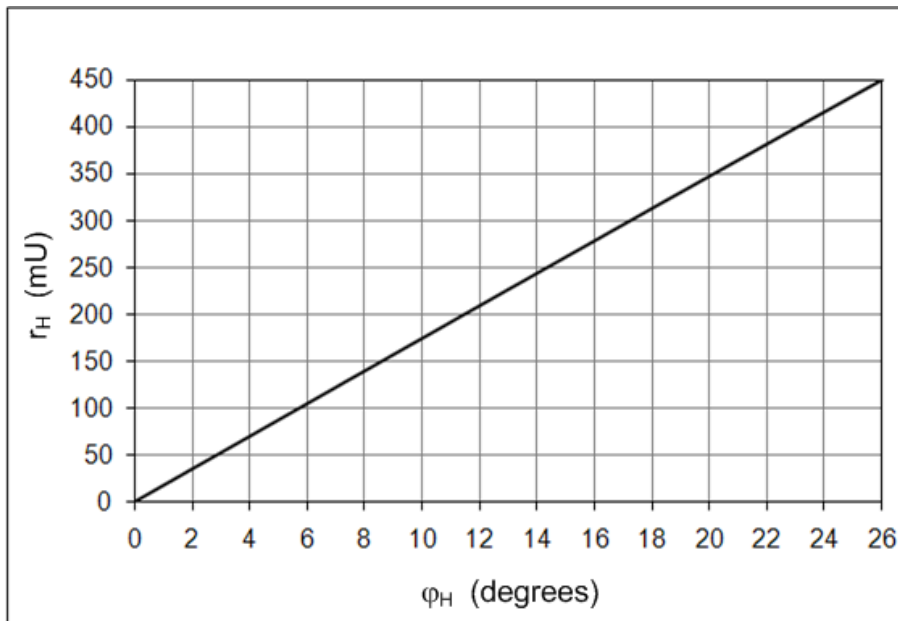


Fig. 42. Hysteresis distance r_H as a function of hysteresis angle φ_H .

Note that **Hysteresis** is combined with **Tolerance** (a circle with radius r_T around the **Target**

(usually zero) reflection coefficient (see [Fig. 39b](#)).

When reflection coefficient variations are confined to a relatively small cluster located exactly at one of the swap boundaries (like the reddish area in [Fig. 43](#)), the cluster can be moved off by inserting a waveguide section between the Tuner and the load. A waveguide with length $1/8$ of the guide wavelength will rotate the load reflection coefficient by 90 degrees. For WR340 waveguide and 2.45 GHz, the required length is about 22 mm; for R-9 (WR-975) waveguide and 915 MHz, the length is about 55 mm.

Using solid-state generators with their exact frequency control, a similar effect can be achieved by changing the operating frequency. The needed frequency shift depends on the distance between the actual load (applicator) and the tuner.

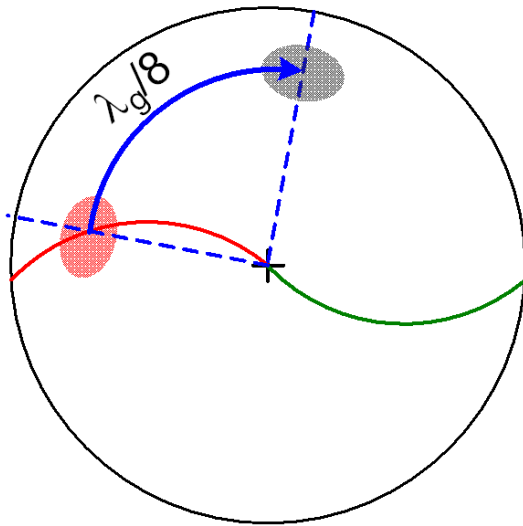


Fig. 43. Insertion of a waveguide section can move reflection coefficients off the critical area.

Motor Errors

After completing each movement action of the tuning stubs, the Autotuner internally records the current positions of the stubs in terms of motor steps, starting from the reference (zero-extension) positions. Occasionally, a discrepancy may arise between the counted steps and the actual positions of the tuning stubs, commonly known as “lost steps.” If left unattended or allowed to accumulate, this discrepancy can negatively impact autotuning accuracy. Moreover, commanding the stubs to go to a zero or a near-zero extension can result in hitting one or more of the terminal switches. In such instances, the Autotuner reports a motor error, causing it to cease responding to motor movement commands. In the [Tuner View window](#), the affected stubs will be highlighted red.

Listed below are several reasons for losing motor steps, along with possible remedies:

- Autotuner turned OFF during stubs movement: Non-fatal. Remedy: Reset the stubs using the [All Stubs Home](#) procedure, either through the corresponding button or a command.
- Autotuner operated at low temperature (below 5°C): Non-fatal. Remedy: Increase the ambient temperature, then reset the stubs using the All Stubs Home procedure.

- Autotuner subjected to strong mechanical vibrations: Non-fatal. Remedy: Isolate the unit from vibrations, then reset the stubs using the All Stubs Home procedure.
- Failure of a stepper motor or its control/driver electronics: Fatal. The affected stubs do not respond to All Stubs Home attempts but otherwise seem intact. Repair in the factory is necessary.
- Damage caused by arcing: Fatal. Repair in the factory is necessary.
- Occasional motor errors without an obvious reason: Run [Tuner Test](#) to assist in making further decisions.

It is good practice to invoke the [All Stubs Home](#) procedure upon Autotuner power-up. This can be achieved by editing the following line in the Homer internal [Tun.cfg](#) file:

```
PowOnAction=1
```

or (the default setting)

```
PowOnAction=2
```

Stubs Motion Scenario

A *stubs motion scenario* is a predefined sequence of tuning stub insertions (positions).

Each combination of the tuning stub insertions will be referred to as a scenario **triplet**. A triplet is characterized by three individual stub positions ($S1$, $S2$, $S3$) in millimeters, plus a dwell time T in milliseconds. The dwell time is the interval that must elapse after setting the stubs before the next action (such as a measurement or another stub movement) can take place.

Thus, a scenario is a sequence of triplets, as listed in the **Stubs Motion Scenario** window ([Fig. 44](#)). This window can be opened by

- clicking the **Scenario** button  on the [Tuner View](#) window, **or**
- clicking the **Tuner | Scenario** menu item.

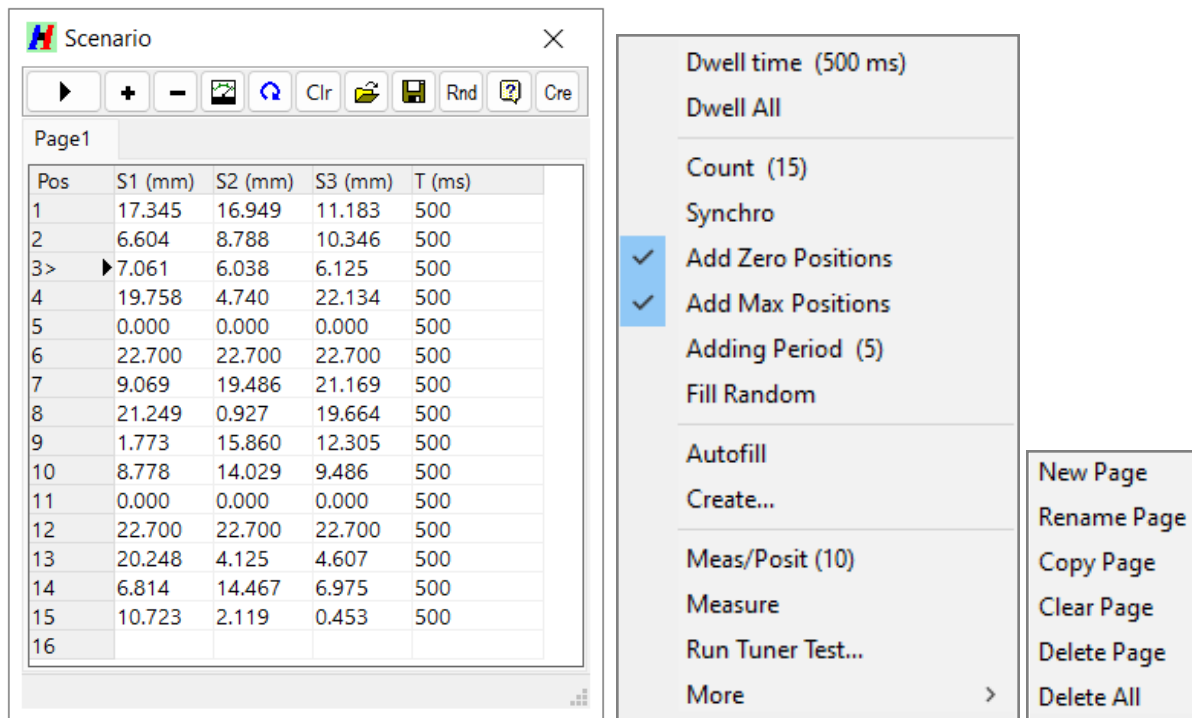


Fig. 44. Stubs Motion Scenario window (left), its context menu (center), and More submenu (right). The **Cre** button is visible only in [HoSim](#) simulation program.

The **Stubs Motion Scenario** window enables the user to:

- Create a scenario by successively copying *actual* motor positions.
- Save a created scenario to a text file.
- Define scenarios in the form of a text file with a [simple structure](#).
- Load scenarios from text files with an appropriate structure.
- Synthesize scenarios that would [realize a desired set of input reflection coefficients](#).
- Set individual positions of a scenario sequence by a mouse click.
- Play a scenario, i.e., iterate the sequence once or repeatedly, considering the dwell time for each position.
- Play a scenario while also making **one or more measurements at each position** and writing the results to an *output* text file. This, for example, is a basis for quick and accurate determination of **Rieke diagrams** of magnetrons.
- Run prolonged **tuner tests**, intercepting and recording potential stepper motors errors.

The **Stubs Motion Scenario** can contain more than one page, thus defining more than one scenario.

Selecting a triplet (table row):

To select a triplet, click the desired table row at its leftmost gray cell (in **Pos** column). A "greater than" sign (>) and a black triangle (arrowhead) will appear in this cell (e.g., row 3 is selected in [Fig. 44](#)).

The > sign marks the starting point for playing this scenario. The arrowhead will show the current

position as the scenario progresses and the whole current row will be shown in red.

Merely selecting a triplet does not move the stubs.

- To move the stubs to *currently* selected positions, double-click anywhere in the columns S1, S2, or S3.
- To select a triplet *and* move the stubs, double-click the leftmost cell of the desired row.

Creating and Editing Scenarios

The most convenient ways to define scenarios, especially large ones, include:

- Creating a text file with an appropriate structure by any text editor or spreadsheet application.
- Saving an existing sequence, then editing the scenario file.
- Using the built-in procedures Fill Random and Autofill for automatic creation of scenarios with random tuning stub insertions.

The following instructions describe how to create and edit short scenarios manually.

To create a new a scenario:

- If the scenario table is not empty, clear it by clicking the **Clr** button.
- In the **Tuner View** window, move the tuning stubs to desired insertions.
- Click the **Add** button **+**. The actual positions will be copied to the first row of the table with a default dwell time shown in the rightmost column. To change the default dwell time, right-click the table to invoke the context menu ([Fig. 44](#)), then click the **Dwell Time** menu item.
- Click the cell in the **T (ms)** column and edit the individual dwell time for any position triplet.
- Repeat the previous three steps as many times as required.

The following procedures operate upon a selected scenario (page).

To insert a new triplet into an existing sequence:

- Move the stubs to desired insertions.
- Select the row before which the new position triplet should be inserted.
- Click **Add** button **+**.
- If required, click the cell in the **T (ms)** column to edit the dwell time.

To change dwell times for all existing triplets:

- Right-click the table to open the context menu ([Fig. 44](#)).
- Click **Dwell All** and enter the desired dwell time.

To delete a triplet:

- Select the row that is to be deleted.
- Click **Delete** button **-**.

To create a new scenario page:

- Right-click the table to open the context menu.

- Click **More | New Page** to create a new, empty page, *or*
- Click **More | Copy Page** to create a copy of the current page.

To rename a scenario:

- Right-click the table to open the context menu.
- Click **More | Rename Page** and enter a new name.

To empty a scenario page:

- Click button. Alternatively:
 - Right-click the table to open the context menu.
 - Click the **More | Clear Page** menu item.

To delete a scenario page:

- Right-click the table to open the context menu.
- Click the **More | Delete Page** menu item.

Note: If there is only one page remaining, this page cannot be deleted and will remain intact.

To delete all scenario pages:

- Right-click the table to open the context menu.
- Click the **More | Delete All** menu item.

Note: The only thing remaining will be an *empty* scenario page.

Random Scenarios

Scenarios with randomly generated triplets are useful for testing purposes. Two procedures are available:

- The **Fill Random** procedure gives the user, by means of the context menu, some control over the scenario to be created.
- The **Autofill** procedure creates a large, fully automatic scenario suitable for prolonged, comprehensive [tuner tests](#).

Fill Random

The **Fill Random** procedure inserts, at a selected position of an existing sequence, a predefined count of random triplets, with values between zero and maximum stub insertion. Optionally, these two extreme insertions can be injected regularly into this sequence.

To generate a scenario, proceed as follows:

- If the scenario table is not empty, select the row before which the new random sequence should appear. If you want a new table, click the button instead.
- In the context menu (right-click the scenario table to open it), click **Count** to define how many triplets should be generated.
- If you want the stubs to move synchronously (i.e., to have the same insertions), check **Synchro** in the context menu.

- If you want to add zero insertions and/or maximum insertions periodically, then, in the context menu:
 - Check either **Add Zero Positions** or **Add Max Positions** or both.
 - Click **Adding Period** and enter the adding periodicity.
- Click the  button, or right-click the table and click the **Fill Random** menu item.
- Each new  button click adds a new series of triplets.

Autofill

The **Autofill** procedure, accessible from the context menu, clears the active scenario table and fills it with a very large random scenario fully automatically. All three tuning stubs have the same insertions. Zero insertions and maximum insertions are added periodically. **Autofill** is equivalent to the **Fill Random** with the following settings:

Count = 2048

Synchro = TRUE

Add Zero Positions = TRUE

Add Max Positions = TRUE

Adding Period = 50

Sequences of Predefined Loads

The **HoSim** [Homer simulation](#) program incorporates a procedure capable of creating scenarios that realize sequences of predefined reflection coefficients. This procedure can also generate suitable sequences of reflection coefficients that evenly cover desired portions of the Smith chart. For details, refer to [Sequences of Predefined Reflection Coefficients](#).

Saving and Loading Scenarios

To save all scenario sequences to disk:

- Click the **Save** button . The **Save File** dialog box appears.
- Define the filename and the folder and click **Save**.
- When prompted, type in an info text, which characterizes the scenario file.

Notes:

- This procedure saves all sequences (pages) to one text file with the default extension **sce**. Open the file in a text editor to see its structure or to edit it.
- On **HomSoft** termination, the current scenario (if not empty) is automatically saved to **Ho0.sce** file in the [User Folder](#). This file will **not** be automatically loaded after the next **HomSoft** restart; therefore, if desired, you must load it manually.
- In the case of the **HoSim** simulation, the name of the autosave file is **HoSim0.sce**.

To load scenario sequences from disk:

- Click the **Open** button . The **Open File** dialog box appears.

- Locate and select the desired scenario file.
- Click **Open**.

Structure of Scenario Files

An example of a two-page scenario file, with six settings (triplets) on each page, is shown below.

Each **data** line contains, in this order:

- Triplet serial number.
- Equality sign.
- Insertions in millimeters of tuning stubs 1, 2, 3.
- Dwell time in milliseconds.

The items are separated by (any number of) tabs (ASCII #9) or spaces (ASCII #32).

```
[Scenario Info]
SceInfo=Sample Scenario
[MySce01]
1   =   19.377   8.606   18.541   500
2   =   3.580   8.862   5.953   500
3   =   0.000   0.000   0.000   500
4   =   22.700  22.700  22.700  500
5   =   17.304   4.676   13.401  500
6   =   18.776   6.244   11.879  500
[MySce02]
1   =   11.350  11.350  11.350  500
2   =   17.709  17.709  17.709  500
3   =   0.083   0.083   0.083   500
4   =   15.583  15.583  15.583  500
5   =   9.704   9.704   9.704   500
6   =   12.020  12.020  12.020  500
```

A convenient way to prepare such files is Microsoft Excel.

Running Scenarios without Measurement

To set stubs according to a given row in the table:

Double-click the leftmost (gray) cell of the given row.

To move stubs according to a scenario:

- Select the desired sequence (page).
- If the **Measure** button  is in the On (active) state, click it to turn it Off.
- Select the row from which you wish the motion to start (usually, but not necessarily, the first row). The row is selected by clicking the leftmost (gray) cell of the given row.
- Click to activate the **Cyclic** button  if you wish the scenario to be cyclically repeated. You can do and undo it anytime, even during motors movement.
- Click the **Play/Stop** button . The button appearance turns to  and the scenario starts running. The progress is shown in the bottom status bar.
- Click the **Play/Stop** button  again if you wish to stop the scenario.

- When the scenario is stopped, the stubs remain in the latest position. A new **Play/Stop** click continues the scenario from this position.

Running Scenarios with Measurement

When running a scenario, one measurement or a series of repeated measurements can be performed at each stub triplet setting. The measurements will start after the dwell time for this triplet has elapsed. The measurement results are written to one or two output files.

Procedure:

- Select a desired scenario sequence (page).
- Click the **Measure** button  to turn it On. This will activate the measurements.
- Right-click the table to open the context menu. Click the **Meas/Posit** menu item to choose the number *Nrpt* of repeated measurements to be performed at each scenario setting.
- Click the **Play/Stop** button . The button appearance turns to  and the program reminds you of the option to enable the input reflection coefficient transformation (see [Transforming Input Reflection Coefficient](#) section for details). If you choose to continue, all stubs are retracted to home positions.
- Following this, the dialog titled **Prepare Output Files** opens, prompting you to define (a) the name of the files the output measurement files, and (b) a comment.
 - If *Nrpt* > 1, two output files will be created with the defined name: one with an extension **txt**, the other with an extension **rkd**.
 - If *Nrpt* = 1, only the **txt** file will be created.
- The scenario then starts running automatically, writing the measurement results for each stubs setting to the specified output files. The progress is shown in the bottom status bar of the Scenario window. Unlike the case without measurement:
 - The scenario will always start from the topmost table row.
 - Only a single scenario run will be performed, regardless of the **Cyclic** button  status.
- Click the **Play/Stop** button  again if you wish to abort the scenario while running.

Scenario Output Files

If the number *Nrpt* of measurements for each scenario position is greater than 1, two output text files with the same name will be created: one with an extension **txt**, the other with an extension **rkd**. If *Nrpt* = 1, only the **txt** file will be created.

- The **txt** file contains the results of each individual measurement, i.e., there are *Nrpt* data rows for each stub triplet setting. The format of the **txt** file is the same as described in the [Saving Results to a Text File](#) topic. In addition, two columns are included:

Pa_kW: Absorbed power (net power delivered to load).

WinTime: Date/Time coded in Microsoft Windows style (the decimal part is a fraction of one day).

- Each row of the **rkd** file contains the mean values of those *Nrpt* measurements, i.e., there is

only one data row for each stub triplet setting. The format is the same as in the **txt** file. In addition, each row of the **rkd** file includes standard deviations of the measured quantities, enabling you to detect potential problems (e.g., magnetron instability manifesting itself as frequency hopping). The details can then be studied in the associated **txt** file. The names of the deviation columns start with *d*, e.g., *df_MHz* for frequency.

The quantities *dMag* and *dMagL* are standard deviations u , u_L of the input (Γ_I) and load (Γ_L) reflection coefficients, respectively. They are not computed merely from magnitudes: they are **uncertainty circle radii**, representing the scatter of the reflection coefficients in the complex plane (see topic [Measurement Accuracy](#)). They are computed as

$$u = \sqrt{s_x^2 + s_y^2}$$

where s_x and s_y are, respectively, standard deviations of the real and imaginary parts of the respective reflection coefficient. Thus, for example, if the magnitude of the reflection coefficient is constant but its phase fluctuates, u will still be nonzero.

The *WinTime* is added at the very end of each row.

- If the output files have been obtained using a loaded scenario (**sce**) file, and if this **sce** file had been created by the [Create Scenario](#) procedure of the [Homer simulation](#) program **HoSim**, then the **rkd** file can contain additional columns, representing the desired (scenario) reflection coefficient in polar form (columns **Mag_sc**, **Dg_sc**), the same in the rectangular form (**Re_sc**, **Im_sc**), and the frequency in MHz (**f_sc**) for which they were synthesized using the tuner.

Tuner Test

The **Tuner Test** procedure:

- Sets the tuning stubs according to the active Scenario, and for each setting
 - retrieves the measurement results,
 - stores the results to an output text file.
- Repeats the whole cyclis indefinitely until
 - the user stops it, **or**
 - an excessive number of consecutive motor errors occurs.

The output file is created and named automatically. The file name includes the date and time of its creation, having the form **TunerTest_ymmdd_hhmmss.txt**. The file is written to the [User Folder](#). The file structure is as described in [Scenario Output Files](#).

The test should be performed without microwave power. This is partly because only behavior of tuning stubs/stepper motors is of interest. Another reason is that deep stubs insertions could cause problems when microwave power is applied. A typical returned [Homer Error Byte](#) is, therefore, 48 = 16 (Low Signal) + 32 (Substitute Frequency).

To start Tuner Test, proceed as follows:

- In the context menu (right-click the scenario table to open it), click **Autofill** to generate a

scenario.

- Alternatively, you can create a scenario using the **Fill Random** menu item or by [any other method](#) discussed here.
- In the context menu, click **Run Tuner Test** and follow the prompts.
- Without motor errors, the test continues indefinitely.
- To stop the **Tuner Test** immediately, click the top left **Play/Stop** button .
 - Alternatively, to first continue until the **Scenario** end, and then stop the **Tuner Test**, click the **Cyclic** button  to deactivate it.
- When the test is stopped, the program will inform you about the created file and prompt you to open the [User Folder](#).

Handling Motor Errors

The main purpose of the **Tuner Test** is to run long-lasting comprehensive tests with moving stubs, detecting and recording potential faults of the stepper motors or tuning stubs. In order for the test not to be stopped immediately after an error occurs, the motor errors (based on the value of [Motor Status Byte](#) MS2) are handled as follows:

- The remark **MotxyzErr!** is added at the end of the corresponding output file row where **x**, **y**, **z** stand for the numbers of the motors in error. If, for instance motors 1 and 3 are in error, the remark reads **Mot13Err!**. The remark is separated by a tab character (ASCII #9).
- An [All Stubs Home](#) procedure is attempted.
- If the attempt was successful, the **Tuner Test** proceeds.
- If the attempt failed, another All Home attempt is made.
- If the number of successive failed attempts exceeds a defined limit (typically 10), this is an indication of a fatal error. In this case, the **Tuner Test** is aborted.
- If a successful All Home attempt occurs before reaching this limit, the fail count is restored to zero and the **Tuner Test** continues.

HOMSOFT MENU

This section is an overview of the **HomSoft** menu commands. Depending on the program and its status, some menu items may be disabled or invisible.

File Menu

The **File** Menu groups commands related to file operations. The menu includes the program termination command.

Copy Picture

Copy the selected display area to clipboard. For details, see [Saving Results as a Picture](#).

Save Picture

Save selected display area as an image file. For details, see [Saving Results as a Picture](#).

Picture Area

Choose which part of the screen should be captured for the **Copy Picture** and **Save Picture** operations. For details, see Saving Results as a Picture – Before Saving.

Picture Type

Select the desired image file format for the **Save Picture** operation. For details, see Saving Results as a Picture.

Save Results

Save measured results in tabular form as a text file. For details, see the [Saving Results to a Text File](#) topic.

Separator

Select the decimal separator for **Save Results** by clicking either the **Point** or the **Comma** submenu item. The setting will be stored in the **HomSoft** [Ini File](#) so that it remains the same after **HomSoft** restart.

Save Setup

Save complete system setup (see [User Setups](#)).

Load Setup

Load complete system setup (see [User Setups](#)).

Backup Ini File

When this menu item is checked, and you choose to exit **HomSoft** without writing the standard *.ini file [see **Exit (no setup)** below], the current **HomSoft** settings will still be written in the background as a backup *.stp file. For more details, please refer to *Backup Ini Files* subsection of the [HomSoft Ini Files](#) topic.

Please note that for **HomSoft** to remember a changed setting of this menu item, you have to exit the application *with* writing the standard *.ini file.

Open User Folder

Opens Windows Explorer and navigates to [User Folder](#) where **HomSoft** *Ini Files* and other **HomSoft** configuration files are stored. This is also the default location for user-created files (setups, results files, log files).

Show Ini File Name

Displays the pertinent **HomSoft** [Ini File](#) and offers a possibility to open *User Folder*.

Exit

Terminate **HomSoft** execution (shortcut Alt+X).

Exit (no setup)

Terminate **HomSoft** execution without writing the **HomSoft** [Ini File](#) (shortcut Alt+A). This is useful if you choose to discard settings you may have made since the **HomSoft** start, or if you

have not made any changes and wish to exit **HomSoft** quickly. The same effect can be achieved by clicking the  button on the upper Standard toolbar.

Homer Menu

The **Homer** menu primarily groups functions related to the Homer Analyzer.

Run-Pause

Clicking the **Run-Pause** menu item or the equivalent  button has two effects:

- A command is issued to the Homer to start repeated measurements, possibly autotuning, and sending results.
- The PC starts *monitoring* the Homer, i.e., receiving data messages, processing them, and displaying measurement results either as numbers or graphs or both.

The button appearance changes to the Pause symbol .

Clicking the menu item or the  button again does not stop Homer internal activity, it only stops *monitoring* in the sense that the PC ignores data coming from the Homer. The effect may be immediate or delayed until the current sweep completion, depending on the status of the **Homer | Finish Sweep** menu item (see details in [How to Start and Stop Sweeping](#)).

Stop Homer

Clicking the **Stop Homer** menu item or the equivalent  toolbar button has two effects:

- A command is issued to the Homer to go *idle*, i.e., to stop making internal measurements, autotuning, and sending data. The Homer then just waits for further commands.
- Homer monitoring is discontinued.

The effect is immediate. For details, see [How to Start and Stop Sweeping](#).

Finish Sweep

Checking or unchecking the **Finish Sweep** menu item controls the instant the monitoring is *actually* discontinued after clicking the  button or the **Spacebar** (provided main window has focus) or **F9** or the **Run-Pause** menu item while sweeping (monitoring the Homer).

- If **Finish Sweep** is unchecked, the monitoring stops immediately (in the middle of the sweep).
- If **Finish Sweep** is checked, the monitoring continues until the current sweep is completed (graphic traces reach the end of the plots), then it stops.

Sampling Setup

Opens the [Homer Sampling Setup](#) window to select the data sampling and processing mode (*Waveform*) and define the corresponding sampling and triggering parameters as well as the frequency counting time.

An alternative method for opening this window is the shortcut **Ctrl+Q**.

TX Timing

Opens the [TX Timing Window](#) to define the cadence with which the measurement results will be updated and transmitted via the communication interface.

Points per Sweep

The Points per Sweep menu item (or the corresponding **Pts** toolbar button or the **Ctrl+N** shortcut) defines the count of measurement points displayed on the x-axis of rectangular plots (sweep size). At the same time, Points per Sweep is the number of data points used in [Save Results](#) operations.

Plane Ext

Any reflection coefficient must be defined at a certain cross-sectional plane along the transmission line. Load reflection coefficient Γ_L is, by default, referenced to the output flange of the Homer. However, this reference plane can be arbitrarily shifted by the user by means of the **Plane Ext** menu item or the corresponding **Ext** button.

If the original load reference plane is at a location x_0 along the transmission line and this plane is shifted to another location x_1 , the original (Γ_{L0}) and new (Γ_{L1}) reflection coefficients are related by

$$\Gamma_{L1} = \Gamma_{L0} \exp j \left(4\pi \frac{x_1 - x_0}{\lambda_g} \right) = \Gamma_{L0} \exp j \left(4\pi \frac{\Delta x}{\lambda_g} \right)$$

where x increases in the direction from the generator to load (outwards of Homer output), $\Delta x = x_1 - x_0$ and λ_g is the guide wavelength. The formula represents the rotation of Γ_{L0} by an angle proportional to the extension Δx . The rotation direction is counter-clockwise if the plane is shifted towards load ($\Delta x > 0$).

If the load reference plane is shifted, the symbol Γ_L and its arrow in the [Tuner View window](#) are shifted from their default location shown in [Fig. 38](#) either to the right (if extension Δx is positive) or to the left (if Δx is negative).

A reference plane shift enables you to compensate, e.g., for a section of waveguide connected between the Homer output and your applicator.

A reference plane shift does not affect autotuning, for which the input reflection coefficient Γ_I is always used.

For more details about reflection coefficients measured by the Homer and their reference planes, see section [Input and Load Reflection Coefficients, Deembedding](#).

Transform

The submenu items of the **Transform** menu item launch actions associated with a user-defined *bilinear transform* of the input reflection coefficient Γ_I . For details, see [Transforming Input Reflection Coefficient](#) section.

Counter

Since a magnetron frequency can easily change by as much as 1% (several tens of MHz at 2.45 GHz) when varying its anode voltage (and hence the output power level) or the load reflection coefficient, the Homer contains an internal counter which measures the actual frequency and interpolates the system parameters (calibration data) for more accurate measurement. The counter can be enabled and disabled by clicking the **Counter** menu item. When disabled, a substitute frequency F_{subst} is used by the Homer. The substitute frequency value can be specified by the user (see the [Substit Freq](#) menu item below).

Frequency, along with other quantities, is displayed in the [Results windows](#). When the **Counter** is OFF, the LED-like frequency indicator of the Maxi Results window turns blue. For more details, see section [Results windows](#).

Switching the counter OFF and defining an appropriate F_{subst} may prove useful in situations where the counter may provide false or unreliable data (e.g., when power is too low or pulses modulating the magnetron are too short or you wish to measure Rectified or Pulsed signals without triggering).

Count Time

Clicking **Count Time** or, equivalently, the  toolbar button opens a dialog to define the gating interval in microseconds of the frequency-measurement counter. Separate count times are used in CW, Rectified, and Pulsed modes of sampling. All three count times are stored in the **HomSoft** [Ini File](#).

In the case of CW sampling mode, the prompt suggests the minimum count time recommended for accurate frequency measurement (quantization error below 40 ppm, i.e., 10 kHz at 2.45 GHz), although a count time ten times shorter is still satisfactory.

In the case of Rectified sampling mode, the prompt suggests the maximum recommended count time, which is 75% of the ripple half-period. This tentative suggestion assumes that the magnetron anode voltage is obtained using a half-wave single-phase rectification of the power line voltage.

The actual count time will be the highest multiple of 16 μ s that does not exceed the set value.

The count times can also be set in the [Homer Sampling Setup](#) window.

Freq Toler

Clicking **Freq Toler** opens a dialog to define the frequency tolerance F_{toler} , which is the maximum allowed deviation of the measured frequency (F_{meas}) from the Homer *nominal* frequency F_{nomin} . If F_{meas} falls outside of the interval bounded by

$$F_{nomin} \pm F_{toler}$$

then F_{meas} is deemed invalid and will be replaced with a substitute frequency F_{subst} (see the **Substit Freq** menu item below). If this happens, the LED-like frequency indicator of the Maxi Results window turns red (and so does the font of the Mini Results window).

Homer nominal frequency F_{nomin} is a fixed, intrinsic quantity for each class of Homer products. It can be found in the [System Info](#) window, page *Homer*, item **Nominal frequency**.

Substit Freq

Clicking **Substit Freq** opens a dialog to input a user-defined substitute frequency F_{subst} . The Homer will send the substitute frequency instead of the measured frequency when at least one of the following occurs:

- The frequency counter is disabled by **Homer | Counter** command.
- The measured frequency falls outside the permitted tolerance interval (see the **Freq Toler** menu item). This can happen when, for instance,
 - the generator power level is too low;
 - the generator is pulse-modulated and you do not employ triggering;
 - the internal counter is faulty (which, of course, will never happen J).

Frequency, along with other quantities, is displayed in the [Results windows](#). When the substitute frequency is used while the [Counter](#) is ON, i.e., when F_{meas} is outside of the [tolerance range](#), then the LED-like frequency indicator of the Maxi Results window turns red. For more details, see section [Results windows](#).

Note: If, for some reason, the user-defined substitute frequency is invalid, Homer firmware determines what will be sent as F_{subst} , the last resort being the nominal frequency F_{nom} .

MultiCAN

This menu item and its submenu are available only when CAN communication method is used **and** more than one Homer is detected on the CAN Bus. See [MultiCAN: More Homers on CAN Bus](#).

More

The **More** menu includes the following items:

Suspend on Low Signal

When the warning *Low Signal* is reported from the Homer, e.g., after you switch off the magnetron power, the graphical display of “measurement” results may become annoyingly noisy. While the Homer continues transmitting these meaningless results, **HomSoft** may decide to ignore them and not update plots until the power becomes sufficiently high again. The decision is based on the status of the **Suspend on Low Signal** menu item:

- If the item is checked, the sweeping is suspended until the *Low Signal* condition ceases.
- If the item is unchecked, the sweeping (showing random, noisy data) continues regardless of the *Low Signal* status.

In either case, the message “**Low Signal**” appears in the left panel of the Status Bar.

Note: This setting is purely cosmetic and should not be confused with [suspending autotuning](#) when the Low Signal condition occurs.

For more details on the *Low Signal* condition, see [Homer Error Byte](#).

Pow Cal Factor

Opens a dialog to set a user-defined Homer power measurement correction factor. See [Power](#)

[Measurement Calibration Factor.](#)

Halt Server

Clicking the **Halt Server** menu item terminates the execution of Homer internal server program SrvHo.exe and starts the internal utility SrvDld.exe, enabling transfer of files between the Homer and the PC via RS232. A special Windows program (DwnLoad.exe) must be started in your PC for this. For details, see Help to DwnLoad.exe.

Note that transfer of files is normally handled by **HomSoft** itself so this functionality is essentially obsolete.

Restart Server (F7)

Clicking **Restart Server** or pressing the **F7** hot key terminates and immediately restarts the Homer internal server program SrvHo.exe. This causes the Homer to reset to default settings without the need of switching its DC power OFF and ON. This function can be useful in the following situations:

- New or edited configuration and auxiliary files have been uploaded (sent to the Homer). These include for instance:
 - Hom.cfg, Tun.cfg (the most typical operation).
 - Rs232.cfg, Can.cfg (e.g., to change the baudrate).
- New SrvHo.exe has been uploaded (typically, upgrading Server to a newer version).

Notes:

- To terminate SrvHo.exe and restart it in a new communication mode (RS232 vs. CAN), use the **Tools | Switch Server** menu.
- Since **Restart Server** causes discrepancy between the settings of the Homer unit and those of **HomSoft**, you should always restart **HomSoft** after a **Restart Server** action.

DAQ Setup

This menu item opens a window that collects, in concise form, some of the more advanced Homer settings, regarding primarily the measurement of detector voltages as well as measurement timings. You will need it very rarely. For details, please refer to the [Data Acquisition Setup Window](#) topic.

Tuner Menu

The **Tuner** menu groups functions related to the Tuner operation. The menu items include:

View

Shows/hides the [Tuner View](#) window.

All Home

Triggers the [motor initialization routine](#).

Autotune

The **Autotune** submenu enables the user to:

- Switch autotuning ON and OFF (submenu item **Active**). Alternatively, use the [Tuner View](#) window for more convenient access.
- Set the parameters controlling the autotuning process. These settings can be adjusted more conveniently in the **Autotune** page of the [System Info](#) window; that topic also describes each parameter in detail.

Read

Clicking the **Read** menu item (or the equivalent  button in the [Tuner View](#) window) commands **HomSoft** to query the Homer for the current positions of the tuning stubs.

Scenario

Clicking the **Scenario** menu item (or the equivalent  button in [Tuner View](#) window) opens the [Scenario](#) dialog window. The dialog enables the user to enter, save, load and run sequences of predefined stub positions with a specified dwell time for each position.

Motors Refresh

Define the minimum interval in milliseconds between two consecutive motor position messages sent by the Homer Autotuner. Note that in addition to these regular messages, motor positions are sent as part of Homer measurement results encoded in Measurement Data Objects (MDO).

Display-Related Menus

For descriptions of Display, Scale, Trace and Plot Menus, please refer to [Display Window-Related Menu](#).

Window Menu

The **Window** menu groups commands related to display windows.

New Display

Open a new display window. For details, see [Display Windows-Related Commands](#).

Impress All

On all display windows, redraw the latest measured traces without first blanking the display windows (leaving, e.g., traces cumulated by [Persist](#)).

Clear All

Clear all display windows.

Redraw All

Clear all display windows and redraw the latest measured traces.

Close All Displays

Close all display windows.

Main Window Color

Change the background color of [Main Window](#). The same effect is achieved by double-clicking the Main Window background.

Arrange

Cascades all open windows and adjusts the main window size accordingly. This brings all open windows into the visible area of the main window. Please note that some smaller windows may become obscured by larger windows in this process.

Equivalently, the toolbar button  can be used for this purpose.

Note: In [HomTool](#) servicing version of **HomSoft**, clicking the **Arrange** menu item or the equivalent  button causes all open windows to assume a predefined position.

Focus to Display (F8)

Activates (restores focus to) the *display* window that was last active if a non-display window (e.g., Tuner View window) is currently active. With mouse, this function is obsolete.

View Menu

The **View** menu enables the user to open and close several non-display windows as well as to hide/unhide Standard and Signal toolbars ([Fig. 15](#)).

Commun Menu

The **Commun** menu groups commands related to Homer communication issues. For additional details, refer to [Configuring Communication](#) and [Establishing Communication](#).

COM Port

The **COM Port** menu item opens [RS232 communication configuring dialog](#).

Format

The **Format** menu can switch the format of RS232-transmitted results between Binary (default) and ASCII (readable text). For more details, refer to [Format of RS232 Results](#).

CAN Bus

The **CAN Bus** menu item opens [CAN Bus communication configuring dialog](#).

DDE Server, Delimiter, DDE Wait

These menu items are related to the [DDE Server](#) that can be activated in **HomSoft**.

Tools Menu

The **Tools** menu groups commands that manage file transfers to and from the Homer, Server type switching, and commands that reset the Homer to various predefined states. A [reduced-functionality **HomTool**](#) servicing variant of **HomSoft** adds commands for complete Homer firmware reinstallation and reprogramming of the stepper motors.

Send to Homer

Send (upload) configuration files, memory files, Server program files, or any other firmware files from your computer to a Homer unit. For details, see [Transferring Files](#).

Load from Homer

Download files from a Homer unit to your computer. For details, see [Transferring Files](#).

Update Server

A specialized command for uploading a **Server** executable program file from your computer to a Homer unit.

Switch Server

Terminate the Server currently running in the Homer and start a Server selected in the submenus of the **Switch Server** command. The available Servers are **RS232**, **CAN**, **EtherNet/IP** and **Download**.

Reset

The submenu items of the **Reset** menu allow users to set the Homer to predefined states, including factory (out-of-box) default and a user-defined state. The menu also enables users to *create* a user-defined state or, based on the current settings, create corresponding Hom.cfg and Tun.cfg configuration files. For details, see [Homer Resets](#).

Waveform Sampling

Starts the automatic [waveform determining](#) procedure.

Reinstall

The **Reinstall** command starts complete Homer firmware reinstallation. The command is visible only in the [reduced-functionality **HomTool**](#) version of **HomSoft**.

Reprogram Motors

The command reprograms the parameters that control the stepper motors, including the maximum tuning stub insertion depth. The command is visible only in the **HomTool** version of **HomSoft**.

Details of the reinstallation and motors reprogramming are described in section [Homer Firmware Update/Reinstallation](#).

Help Menu

The **Help** menu contains the standard Help menu items.

Contents

Opens Help for Homer. Alternatively, double-click the parent **Help** menu item.

About

Opens the **About** window (Fig. 45). The **About** window displays the current **HomSoft** and Server versions, alongside hardware (HW) and firmware (FW) details. The hardware identification includes the Homer model name and indicates if a STEIPA Ethernet/IP adapter is present (denoted by + ETH). The FW section lists the installed firmware version as well as the recommended version (Best FW) if not installed. Available Homer options are listed under the OPT heading, where the active features are indicated by 1 and the inactive features by 0. For a full list and detailed explanations of Homer options, please refer to the product data sheet. Always include a screenshot of this window when [reporting problems](#).

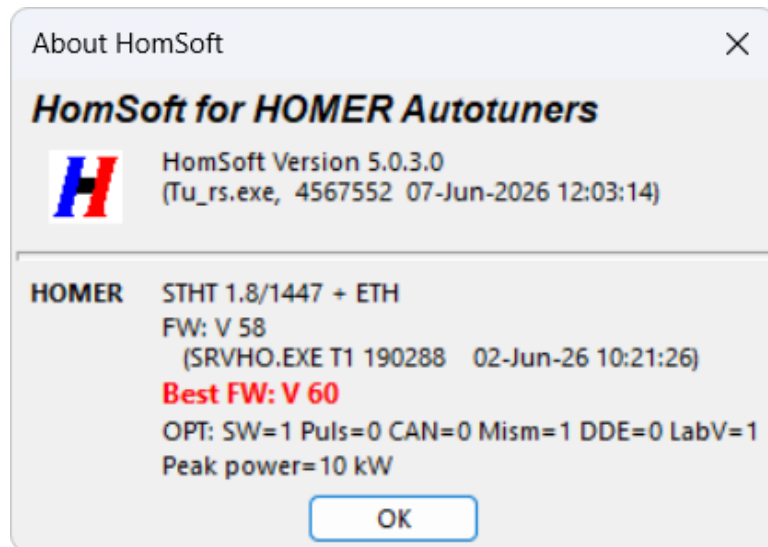


Fig. 45. About window example.

HOMER SIMULATION

For training purposes, **HoSim.exe**, the simulation version of **HomSoft**, is available. **HoSim** simulates (computes) "measurement" results based on your inputs. Therefore, it does not require a physical Homer system, but only a computer. For versions starting V5.0.0.0, the **HoSim** user folder is

`c:\Users\<username>\S-Team\HoSim`

To simulate the tuning performance of your particular unit, **HoSim** can be [customized](#) by loading the Tun.mem file of a real Homer.

If **Rectified** or **Pulsed** mode of sampling is selected, the simulation will generate characteristic rectified- or pulsed-type [waveforms](#) (Fig. 46). The waveforms can be seen when the display of

individual samples is chosen. To do that, activate the  Signal toolbar button (Fig. 15), leaving the **1x** button deactivated. Alternatively, open the [Homer Sampling Setup](#) window, then check the **Send Samples** checkbox and uncheck the **Single-Shot** checkbox.

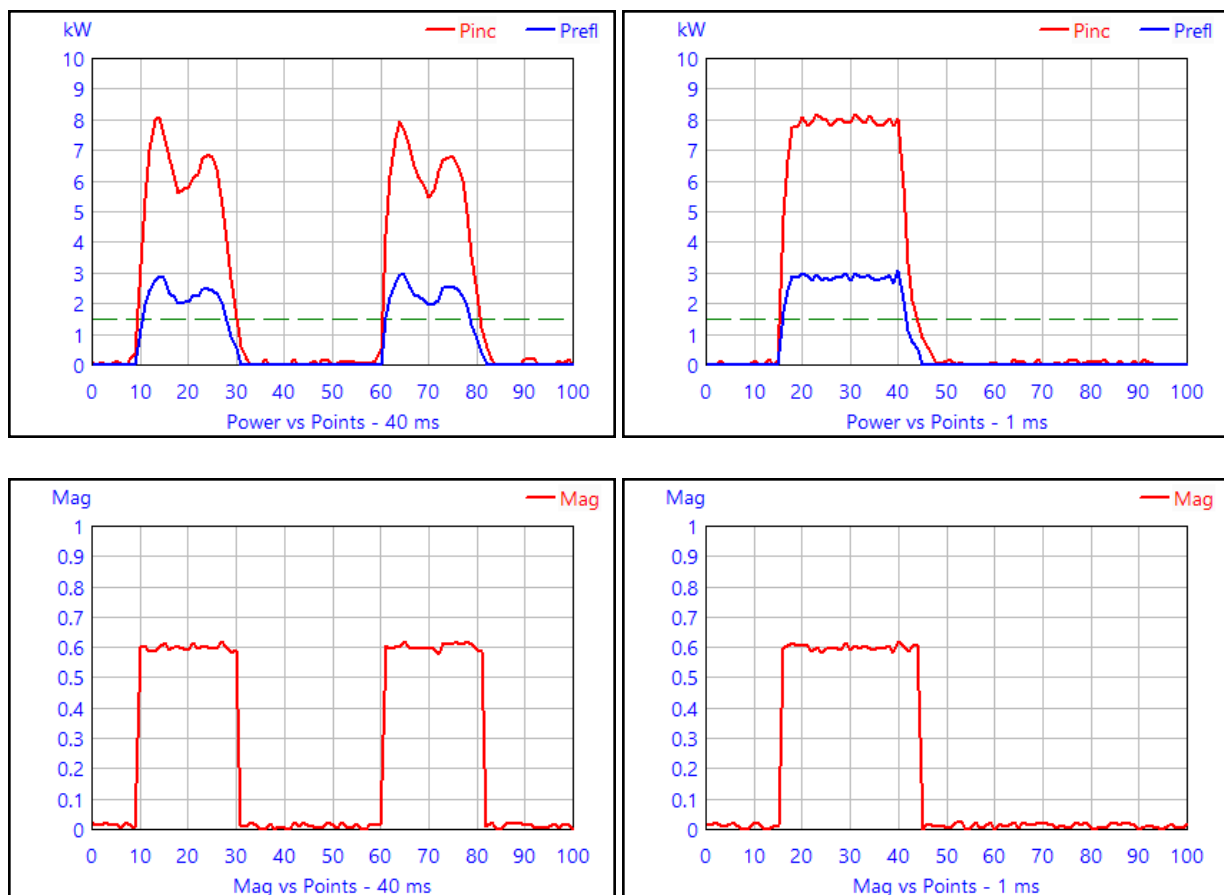


Fig. 46. Waveforms simulated in Rectified (left) and Pulsed (right) modes, including noise. The x-axis title includes the full-scale time span.

Tuning stub positions are controlled the same way as in the live programs (see [Tuner View](#) window). Unlike the live programs, the stubs can also be moved during the simulated measurement.

Homer Model Window

The parameters of the simulation are set in the Homer Model window (Fig. 47), which is always open in the main program window. The window contains three pages (tabs), titled *DUT*, *Animation*, and *More*.

The speed of generation of all simulated “measurements” is controlled via the **Pause** edit in the *Animation* page. A wait period proportional to Pause setting is inserted between each consecutive measurement. The number does not represent any real time unit and you have to experiment to arrive at a reasonable sweeping speed (starting with 1000 is a good choice).

New settings are not accepted until you click the **Apply** button (an exception is the Error Byte

setting on the *Errors* page, which takes effect immediately).

DUT Page

The **DUT page** (Fig. 47) controls the reflection coefficient of the simulated load (DUT stands for Device Under Test).

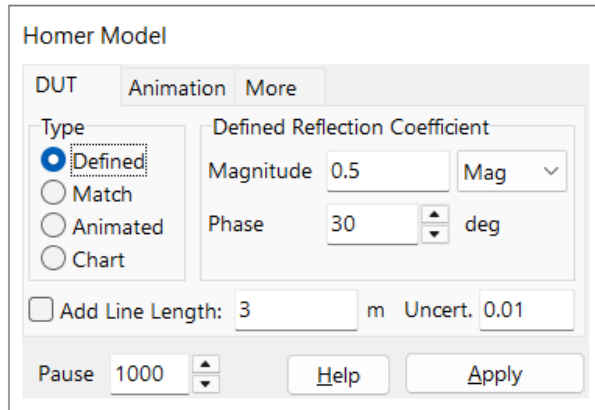


Fig. 47. Homer Model window: DUT page.

Type of DUT

The **Type** group of radio buttons selects the type of the simulated DUT. The choices are:

- **Defined:** The DUT reflection coefficient Γ_A is defined by the values of magnitude and phase in the Defined Reflection Coefficient box.
- **Match:** The DUT reflection coefficient Γ_A is zero (perfect match).
- **Animated:** The DUT reflection coefficient magnitude and phase is automatically incremented point-by-point as defined in [Animation](#) page.
- **Plot:** The DUT reflection coefficient Γ_A is comfortably generated by mouse clicking and dragging in a polar plot. See topic [Plot](#) for details.

Add Line Length

If the **Add Line Length** checkbox is checked, then a waveguide with length L defined in the adjacent edit box is connected between the DUT as defined above and the Autotuner output flange. This allows the user to simulate the influence of such a waveguide on the autotuning performance. For the underlying theory, please refer to the topic [How Long Is Too Long](#). Based on this theory, the load reflection coefficient as seen at the Autotuner output is Γ_L . If the **Add Line Length** checkbox is not checked or $L = 0$, then $\Gamma_L = \Gamma_A$.

A note on load reference plane:

The load reflection coefficient Γ_L discussed here refers to the Homer's *default load reference plane*. This plane coincides with the output flange of the device. See also: [Input and Load Reflection Coefficients](#), [Deembedding](#) and the [Plane Ext](#) item of the **Homer Menu**.

Uncertainty Radius

A nonzero value of the **Uncertainty Radius** adds random noise to the generated reflection

coefficient. The noise is added as a random vector to the simulated complex reflection coefficient. The noise vector is a complex number with arbitrary random phase and a random magnitude not exceeding the Uncertainty Radius. The resulting uncertainty circle is best observable in the **Polar** plot format. For useful Polar plot settings, see *Tips for Circular Plots* in the [Trace Properties](#) section.

If the mode of signal sampling (*Waveform*) is set to [CW](#), increasing the sample count N_s (i.e., the voltage averaging number) decreases the displayed noise level as in real measurement. Fluctuations equal exactly to the Uncertainty Radius are only observable when the averaging is set to unity. To modify the averaging:

- Set *Waveform* to CW (click  Signal toolbar button ([Fig. 15](#)), or use the [Homer Sampling Setup](#) window).
- Modify the sample count (averaging) by editing *Sample Count* in the *Homer Sampling Setup* window or by clicking the  button.

Case of Rectified and Pulsed modes of sampling

Please note that (unlike a real Homer device) this *CW* sample count setting also affects data fluctuations simulated in *Rectified* and *Pulsed* modes.

Defined Reflection Coefficient

When selecting the **Defined** radio button in **Type** group, you can define the simulated reflection coefficient by editing the values in **Magnitude** and **Phase** edit boxes. To define the reflection coefficient:

- Click the arrow to the right of the **Magnitude** edit to open a drop-down list and pick the format in which you wish to define the reflection coefficient magnitude (**Mag**=linear, **dB**=logarithmic in decibels, or **VSWR**=voltage standing wave ratio).
- Type the desired value in the **Magnitude** edit box. Note that when you select a different format, the entered value is automatically converted to the new format so that it represents the same reflection coefficient.
- Type the phase angle value in degrees in the **Phase** edit box or step it by clicking the associated UpDown control.
- Press the  button.

Plot

When clicking the **Plot** radio button in the **Type** group, followed by the  button, the window titled **DUT Reflection Coefficient** ([Fig. 48](#)) will open, containing a polar plot. You are now able to generate the simulated Device Under Test (DUT) reflection coefficient Γ_A by the following methods:

- Clicking into the plot.
- Dragging the cursor over the plot by holding down the left mouse button.
- Typing in the two edits below the Polar Radius panel (left: linear magnitude, right: phase in degrees), then clicking the Apply button  or hitting the **Enter** key on the keyboard. Invalid inputs are ignored and substituted by the previous values.

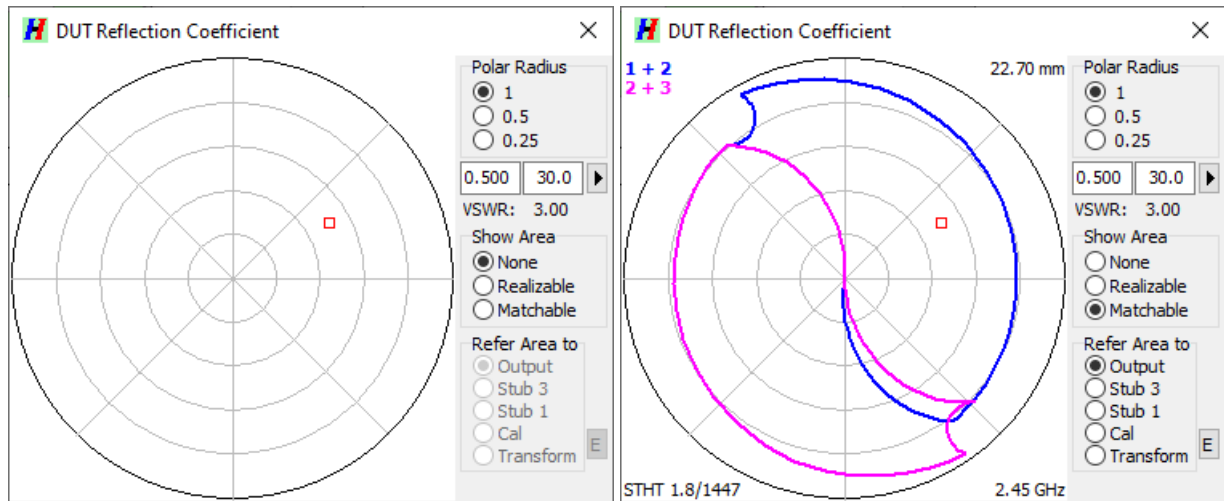


Fig. 48. DUT Reflection Coefficient window. Right: Matchable area valid for the chosen simulation frequency and maximal stub insertions.

Mouse-generated reflection coefficients are displayed numerically in **Mag** and **Deg** edits. The magnitude is also converted to VSWR.

To change the plot radius (to zoom into the plot), click one of the **Polar Radius** radio buttons.

Note: If you now select another type of DUT simulation (*Defined*, *Match*, or *Animated*) the plot disappears.

Realizable and Matchable Areas

In addition to conveniently generating reflection coefficients, the **DUT Reflection Coefficient** window enables you, in the form of an underlying graphic:

- To see the area of reflection coefficients **realizable** by your tuner at the simulation frequency; i.e., the range of the tuner input reflection coefficients that can be obtained by any combination of settings of stubs 1+2 (blue-bordered area) and 2+3 (pink-bordered area) for a tuner terminated by a match (zero reflection coefficient). To show the realizable area, click **Realizable** radio button in the **Show Area** group. You can compare this area with the area obtained in the Polar plot by moving the stubs while “measuring”.
- To see the area of reflection coefficients **matchable** by your tuner at the simulation frequency; i.e., the range of load reflection coefficients that can be matched by proper positioning of stubs 1+2 (blue-bordered area) or 2+3 (pink-bordered area), respectively. To see the area of matchable reflection coefficients, click **Matchable** radio button in the **Show Area** group. You can observe the effect of changing reflection coefficient while “measuring” with autotuning switched on. The best suited display format is **Polar** or other circular plots.

The realizable and matchable areas can be referred to different reference planes, selected in **Refer Area to** group. The most natural choice for the matchable area is **Output**, which means the plane of the tuner output flange. The reference plane can also be shifted to the axis either of **Stub 3** or **Stub 1**, or to the reflectometer calibration plane (**Cal**). The plane positions are specified on the *Sketch* page (Fig. 37) of the [System Info](#) window. The most natural choice for the realizable area is **Stub 1**.

A special choice of the reference plane is **Transform**. This relates the areas to the input of a *two-port network connected at the Homer input*. For details, see section [Transforming Input Reflection Coefficient](#). The **Transform** choice is only meaningful for the *realizable* area. If the transform is not active, the areas refer to **Stub 1** (no network connected).

The [tuner](#) model and frequency for the displayed areas are shown at the bottom of the plot. The associated maximum stub insertion is shown at the top right.

You can export the area borders as a contour to a text file in the user folder. To do so, click the  button (bottom right).

Animation Page

The **Animation page** ([Fig. 49](#) left) allows the reflection coefficient magnitude and phase to be stepped automatically between **Start** and **Stop** values with **Step** increments. The whole pattern can be offset by defining **Center** coordinates.

The animation can be activated by clicking the **Animated** radio button on the **DUT** page or by selecting the **Animation** page, and then clicking the  button.

Two example animations are shown in [Fig. 49](#).

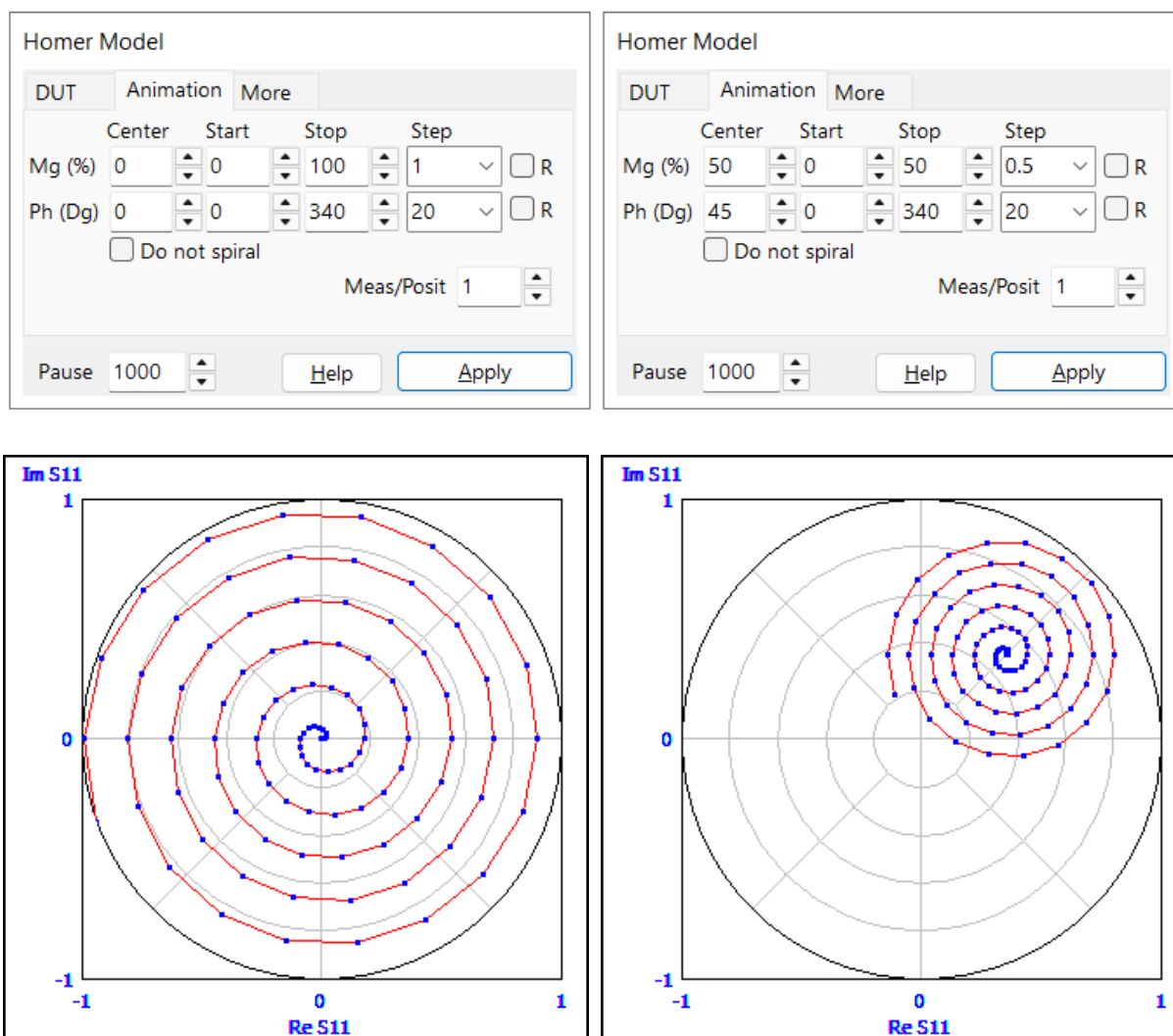


Fig. 49. Animation page of Homer Model window (top) and the resulting evolution of load reflection coefficients (bottom).

To obtain these plots, set **Homer | Points per Sweep** = 101, check **Homer | Finish Sweep**, set **Type** = **Animated** on the **DUT** page, click **Apply**, then start measurement and stop it before the end of the sweep. Autotuning must be switched OFF and the tuning stubs retracted.

- The **Center**, **Start** and **Stop** values for *magnitude* can be adjusted in 1% (0.01) increments via the up-down control; the **Center**, **Start** and **Stop** values for *phase* can be adjusted in 1° increments. They can also be entered manually.
- The **Step** values can be picked from the drop-down lists, or edited arbitrarily; they will be rounded off.
- The **Start** value may be lower than, greater than, or equal to the **Stop** value. If, for instance, **Start** = 360° and **Stop** = 0° for phase, the reflection coefficient will rotate clockwise.
- When the **R** (Reverse) checkbox is *unchecked*, then, on reaching the **Stop** value, the corresponding parameter jumps back to its **Start** value and the process continues.
- When **R** is *checked*, then, on reaching the **Stop** value, the parameter only changes its step

direction and starts stepping back to the **Start** value.

- When the **Do not spiral** checkbox is checked, the magnitude remains constant irrespective of the magnitude **Stop** or **Step** settings. Thus, you can model load reflection coefficients moving along a circle or an arc.
- If the sweep is interrupted, the next sweep continues from the current parameter values. To initialize the animation (also while sweeping), click the **Apply** button.
- The stepping speed is controlled by the **Pause** edit.
- To make more than one “measurement” at each reflection coefficient setting, increase the **Meas/Posit** count.

Note about display periodicity

To obtain stable, periodically repeated plots, consider this:

Let the magnitude Start, Stop, and Step values are M_1 , M_2 , and ΔM . Then the repetition period of the magnitude is

$$n_{mag} = 1 + |(M_2 - M_1)/\Delta M|$$

Let the phase Start, Stop, and Step values are φ_1 , φ_2 , and $\Delta\varphi$. Then the repetition period of the phase is

$$n_{pha} = 1 + |(\varphi_2 - \varphi_1)/\Delta\varphi|$$

Let the **Homer | Points per Sweep** setting is N_{pts} .

To obtain stable, periodically repeated plots, the following conditions must be satisfied:

$$n_{mag} = k_1 n_{pha}$$

$$N_{pts} = k_2 n_{mag}$$

where k_1 and k_2 are integers. (This assumes that $n_{mag} > n_{pha}$ and $N_{pts} > n_{mag}$.)

Note that the settings in [Fig. 49](#) do not meet these conditions because

$$n_{mag}/n_{pha} = 5.611.$$

More Page

The **More page** ([Fig. 50](#)) defines the simulated signal frequency, generated power, and Homer internal temperature. Power-related bits of Error Byte can also be defined.

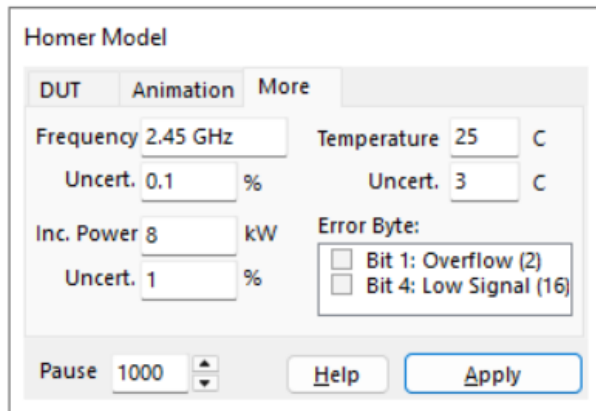


Fig. 50. More page of Homer Model window.

To define simulated frequency:

- In the **Frequency** edit box, type the value in MHz or use appropriate prefixes (e.g., G or g for Giga).
- In the **Uncert.** (Uncertainty) edit box, enter the frequency uncertainty (random variation as a percentage).
- Press the **Apply** button.

Notes:

- A *Substitute Frequency* warning may be triggered, depending on these settings and the **Homer | Freq Toler** setting.
- If the user attempts to set the simulated frequency too far (more than $\pm 10\%$) from the nominal frequency, the nominal frequency will be used instead.
- The error conditions are best observed in the full-size [Results window](#).

To define simulated incident power:

- Enter the value in kilowatts in the **Inc. Power** edit box.
- In the **Uncert.** edit box, enter the incident power uncertainty (random variation as a percentage).
- Press the **Apply** button.

Note: If the mode of signal sampling (*Waveform*) is set to [CW](#), increasing the sample count N_s (i.e., the voltage averaging number) decreases the displayed noise level as in the real measurement. This CW setting also affects the fluctuations in the *Rectified* and *Pulsed* sampling modes. For further details, see the [Uncertainty Radius](#) subsection of the [DUT Page](#) topic.

To define simulated temperature:

- In the **Temperature** edit box, enter the desired value in Celsius.
- In the **Uncert.** edit box, enter the temperature uncertainty (random variation in Celsius).
- Press the **Apply** button.

Note: A temperature-related error may be triggered by these settings (normal range being typically 5 to 55 °C).

To define power-related bits of Error Byte:

In the **Error Byte** box, check or uncheck one of the checkboxes (Overflow or Low Signal). Only one box at a time can be checked. The errors are set independently of the actual incident power value.

Real Tuner Performance

To see the behavior of a *real* tuner rather than that of the default dummy tuner, you have an option to load the real tuner parameters from its **Tun.mem** file. The file must be [downloaded](#) from your Homer first (the default destination is the [User Folder](#) but you may wish to change it to the **TunMem** subfolder of the User Folder).

To load a Tuner configuration:

- Open the [System Info](#) window ([Fig. 51](#)). For the **HoSim** simulation program, the window contains an additional button, labeled **Load Mem**.
- Click the **Load Mem** button. An **Open** dialog pops up.
- Browse for the **Tun.mem** file, then click **Open**.

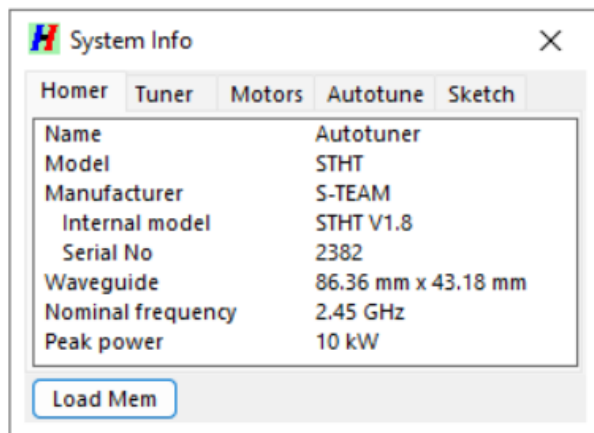


Fig. 51. **HoSim** System Info window includes the **Load Mem** button.

To test the performance of your Tuner:

- Define the simulation frequency in the [More](#) page of the **Homer Model** window (see below).
- Click **Plot** in the *DUT page* of the **Homer Model** window, then click **Apply**. The **DUT Reflection Coefficient** window ([Fig. 48](#)) appears.
- Click the **Matchable** radio button in the **Show Area** group of the **DUT Reflection Coefficient** window.
- Click the **Output** radio button in the *Refer Area to* group of the **DUT Reflection Coefficient** window.
- Open the **Tuner View** window (the  button or the **Tuner | View** menu item); turn on autotuning by activating the **AT** button.
- Start measurement by clicking the  button (after clicking, the button turns to .

- Drag the mouse over the plot in the **DUT Reflection Coefficient** window and observe the input reflection coefficient in the **Polar** plot window and stub positions in the **Tuner View** window.

Creating Scenarios of Predefined Loads

HoSim allows users to create scenarios that realize sequences of predefined reflection coefficients. This is particularly useful for automating the generation of reflection coefficient sequences that evenly cover portions of the Smith chart. Such scenarios are useful, for example, for measuring Rieke diagrams of magnetrons.

The predefined reflection coefficients can be:

- Tuner input reflection coefficients Γ_I .
- Reflection coefficients Γ_R at the input of a two-port network with known S-parameters, connected at the tuner input (see topic [Transforming Input Reflection Coefficient](#) for details).

The procedure is as follows:

- A prerequisite (one time only): Have the **Tun.mem** file available for the Homer with which you wish to realize the reflection coefficients. To load the **Tun.mem** from the Homer device, start **HomSoft**, connect to the Homer and download the file using the **Tools | Load from Homer** menu item. In the **Save** Dialog:
 - Select the target directory on your PC to save the **Tun.mem**.
 - Save as type: Any File
 - File name: **Tun.mem**.
- Start **HoSim**.
- In the **Homer Model** window, set the frequency that you expect to be generated by your magnetron under test. As a first guess, it can be the nominal frequency of this magnetron (e.g., 2460 MHz for 2M244).
- In the [System Info](#) window:
 - Click the **Load Mem** button to load the **Tun.mem** of the Homer for which you wish to realize the reflection coefficients.
 - In the *Homer* or *Tuner* tab, verify that the model matches your Homer.
- If you want to predefine reflection coefficients Γ_R at the input of a two-port network with known S-parameters, load a file of such S-parameters and keep it activated using the items of the **Homer | Transform** menu.
- In the **Tuner View** window, click the  button to open the [Scenario](#) window.
- In the **Scenario** window, click the **Cre** button or right-click the table area and select **Create** in the context menu to open the **Create Scenario** window. Please note that this button and this menu item are visible only in the **HoSim** simulation program. Following the click, the **Create Scenario** window will open (an example is shown in [Fig. 52](#)). The bottom text windows (memos) will initially be empty.

Create Scenario (Not Transformed)

Start (mU): 0 Start Angle (dg): 30 ☐ Segment Create List Make Sce

Stop (mU): 400 Stop Angle (dg): 90 ☐ Clockwise Load List Add Sce

Step (mU): 200 Rot (dg): 0 ☐ Shuttle Save List Save Sce

Trajectory Dwell (ms): 2000 ☒ Add Match List to Clipb Sce to Clipb

☐ Rect ☒ Circ ☒ Skip Matches Clr List Clr Sce

Input File: No file

# No	MHz	Rfl_Re	Rfl_Im
1	2450.000	0.0000	0.0000
2	2450.000	0.2000	0.0000
3	2450.000	0.1000	0.1732
4	2450.000	-0.1000	0.1732
5	2450.000	-0.2000	0.0000
6	2450.000	-0.1000	-0.1732
7	2450.000	0.1000	-0.1732
8	2450.000	0.4000	0.0000
9	2450.000	0.3542	0.1859
10	2450.000	0.2272	0.3292
11	2450.000	0.0482	0.3971
12	2450.000	-0.1418	0.3740
13	2450.000	-0.2994	0.2652
14	2450.000	-0.3884	0.0957
15	2450.000	-0.3884	-0.0957
16	2450.000	-0.2994	-0.2652
17	2450.000	-0.1418	-0.3740
18	2450.000	0.0482	-0.3971
19	2450.000	0.2272	-0.3292
20	2450.000	0.3542	-0.1859
21	2450.000	0.0000	0.0000

End

[Scenario Info]
SceInfo = STHT V1.8/0. Transf=NO. 0 to 400 step 200 mU. Rot=0 dg.
[Page1]

1	=	0.000	0.000	0.000	2000	0.000	0.00	2450.000	0.0000	0.0000
2	=	10.405	12.485	0.000	2000	0.200	0.00	2450.000	0.2000	0.0000
3	=	5.110	10.690	0.000	2000	0.200	60.00	2450.000	0.1000	0.1732
4	=	0.000	12.580	10.710	2000	0.200	120.00	2450.000	-0.1000	0.1732
5	=	0.000	10.595	12.485	2000	0.200	180.00	2450.000	-0.2000	0.0000
6	=	0.000	5.865	10.970	2000	0.200	-120.00	2450.000	-0.1000	-0.1732
7	=	12.485	10.970	0.000	2000	0.200	-60.00	2450.000	0.1000	-0.1732
8	=	10.780	15.795	0.000	2000	0.400	0.00	2450.000	0.4000	0.0000
9	=	8.325	15.510	0.000	2000	0.400	27.69	2450.000	0.3542	0.1859
10	=	4.540	14.375	0.000	2000	0.400	55.39	2450.000	0.2272	0.3292
11	=	0.000	15.700	9.270	2000	0.400	83.08	2450.000	0.0482	0.3971
12	=	0.000	15.320	13.240	2000	0.400	110.76	2450.000	-0.1418	0.3740
13	=	0.000	13.855	14.945	2000	0.400	138.47	2450.000	-0.2994	0.2652
14	=	0.000	12.105	15.700	2000	0.400	166.16	2450.000	-0.3884	0.0957
15	=	0.000	10.025	15.795	2000	0.400	-166.16	2450.000	-0.3884	-0.0957
16	=	0.000	7.380	15.230	2000	0.400	-138.47	2450.000	-0.2994	-0.2652
17	=	0.000	2.650	13.810	2000	0.400	-110.76	2450.000	-0.1418	-0.3740
18	=	15.605	12.295	0.000	2000	0.400	-83.08	2450.000	0.0482	-0.3971
19	=	14.375	14.470	0.000	2000	0.400	-55.39	2450.000	0.2272	-0.3292
20	=	12.770	15.510	0.000	2000	0.400	-27.69	2450.000	0.3542	-0.1859
21	=	0.000	0.000	0.000	2000	0.000	0.00	2450.000	0.0000	0.0000

Fig. 52. Create Scenario window.

- Select the *Trajectory*. This setting controls whether the generated reflection coefficients will “move” along the rectangular axes (*Rect*) or along circles with increasing or decreasing radii (*Circ*).
- Set the inputs determining the generation of the list of the desired reflection coefficients:

Start, Stop, Step (magnitudes),

Start Angle, Stop Angle, Rot, Clockwise, Segment, Shuttle,

Add Match.

Notes:

- All numeric values must be integers.
- Settings that do not apply to the selected *Trajectory* will be disabled.
- Depending on these inputs, the list will represent a rectangular or circular (polar) grid in the shape of a circle, a ring, a circle segment, or a ring segment.
- *Stop* magnitude can be higher than *Start*, lower than *Start*, or equal to *Start*.
- *Step* must be a positive integer.
- If $|Stop - Start| < Step$, then only *Start* will be considered.
- Only for *Circ* trajectory: When *Shuttle* is checked, the trajectory will change direction at the end of each generated circle or arc.

- The whole pattern can be rotated by Rot degrees (e.g., counter-clockwise by 30° if $Rot = 30$).
- If *Add Match* is checked, a zero reflection coefficient will be appended at the end of the list.
- A warning will be issued if some of the inputs are illegal; such inputs will be automatically set to their default values.
- Click the **Create List** button. The left-hand text box (Input memo) will be filled with a list of desired reflection coefficients that will be interpreted as Γ_I or Γ_R (the latter if the [Transform](#) file has been loaded). The format is as in the following example:

```
# No  MHz      Rfl_Re  Rfl_Im
1    2455.000  -0.5000  0.0000
2    2455.000  -0.4000  -0.3000
3    2455.000  -0.4000  -0.2000
4    2455.000  -0.4000  -0.1000
5    2455.000  -0.4000  0.0000
...
81   2455.000   0.5000  0.0000
82   2455.000   0.0000  0.0000
End
```

- Each numerical data row begins with a serial number (although the numbers will be, in the end, ignored).
- The items are separated by one or more tabs or spaces.

The list will be automatically copied to the clipboard.

- You can edit the list, and then save it to a text file by clicking the **Save List** button, or copy it to the clipboard by clicking the **List to Clipb** button.
- Alternatively, you can create a list of arbitrary reflection coefficients with the above format by any text editor or Excel, and paste it to the left-hand Input Memo, or you can load such a list from a properly formatted file by clicking the **Load List** button. You can use the above example list as a model for your editing.
- Generally, the frequencies for each individual reflection coefficient can differ.
- *Dwell* defines the time the stubs will remain in a set position before any other action is started (e.g., a measurement or stepping to a next position).
- Check *Skip Matches* if all zero reflection coefficients except the one at the very end of the list should be ignored when creating the scenario from the list.
- Click the **Make Sce** button. A Scenario file will be created in the right-hand text box (Scenario Memo). The Scenario Memo includes the tuning stub positions needed for realizing the reflection coefficients in the Input Memo.
- If you want to combine scenarios with different settings (e.g., to cover a certain area more densely than the others):
 - Change the inputs as required.
 - Click **Create List**.
 - Click **Add Sce** button.

The new scenario will be appended to the existing one in the Scenario Memo.

You can combine more of such sub-scenarios.

- If you wish, you can edit the info lines at the beginning of the Scenario . In [Fig. 52](#), for instance, the original lines are:

```
[Scenario Info]
SceInfo = STHT V1.4/310. Transf=NO. 0 to 400 step 200 mU. Rot=0 dg.
[Page1]
```

After editing, they may become, for example:

```
[Scenario Info]
SceInfo = STHT V1.4/310. Transf=NO. 0 to 400 step 200 mU. For testing only.
[Testing]
```

In the above example, the edited text is shown in **green**. The first line (**red**) must remain unchanged. The third line text will be shown as the sheet title after loading the scenario in the **Scenario** window.

- Click the **Save Sce** button to write the Scenario contents to a text file. The default extension is **sce** but you can change it to, say, **txt**.
- Alternatively, click **Sce to Clipb** to copy the Scenario to Clipboard. Then you can paste it directly to an Excel file.

Creating Scenario Examples

Example 1: Combined Rectangular-Trajectory Scenario

The scenario reflection coefficients shown in [Fig. 53](#) were created by adding three sub-scenarios. The settings used are shown in the following table:

No.	1	2	3
Trajectory	Rect	Rect	Rect
Start	0	250	250
Stop	250	700	700
Step	50	50	25
Segment	n	y	y
Start Angle	n.a.	-45	-45
Stop Angle	n.a.	45	45
Clockwise	n.a.	y	n
Shuttle	n.a.	n.a.	n.a.
Rot	0	0	0
Add Match	y	y	y
Skip Matches	y	y	y

As a side effect of this combination, 12 of the total 1024 reflection coefficients are duplicate. This may not matter if the scenario is used, for instance, for Rieke diagram measurement. If necessary, the duplicate reflection coefficients can be deleted manually, thus decreasing the scenario size to 1012.

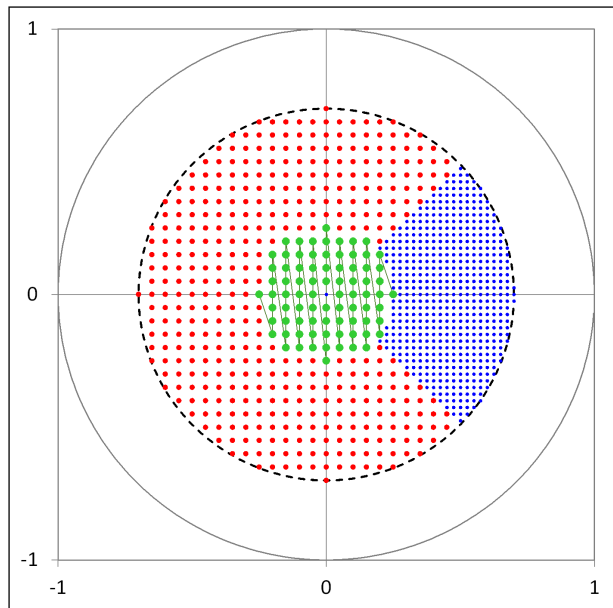


Fig. 53. A rectangular-trajectory scenario composed of three sub-scenarios: a circle (green), a segment (red), and a complementary, denser segment (blue). The trajectory is shown only for the circle part.

Example 2: Simple Circular-Trajectory Scenario

A disadvantage of rectangular-trajectory scenarios is the regular occurrence of large jumps of the reflection coefficient. To reduce the number and size of these jumps, a circular-trajectory scenario is a better choice. This is perhaps the most useful scenario.

The reflection coefficients shown in [Fig. 54](#) were created according to the settings in the following table:

Trajectory	Circ
Start	200
Stop	700
Step	100
Segment	n
Start Angle	n.a.
Stop Angle	n.a.
Clockwise	n
Shuttle	n
Rot	0
Add Match	n
Skip Matches	y

As seen in [Fig. 54](#), only small jumps in the reflection coefficient occur.

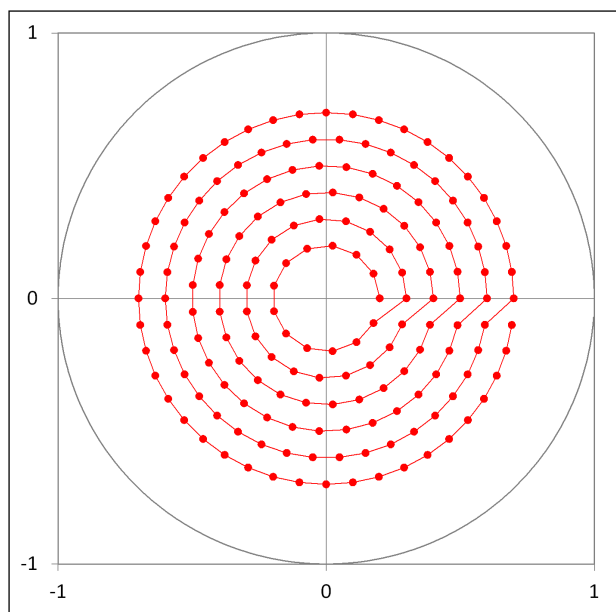


Fig. 54. A simple circular-trajectory scenario.

Example 3: Combined Circular-Trajectory Scenario

The reflection coefficients shown in [Fig. 55](#) were created by adding three sub-scenarios. The settings used are shown in the following table:

No.	1	2	3
Trajectory	Circ	Circ	Circ
Start	0	400	700
Stop	300	700	350
Step	100	100	50
Segment	n	y	y
Start Angle	n.a.	45	45
Stop Angle	n.a.	-45	-45
Clockwise	n	n	y
Shuttle	n	y	y
Rot	0	0	0
Add Match	n	n	y
Skip Matches	y	y	y

As seen in [Fig. 55](#), there are only two moderately large jumps in the reflection coefficient. Similarly to the rectangular scenarios, some reflection coefficients are duplicate.

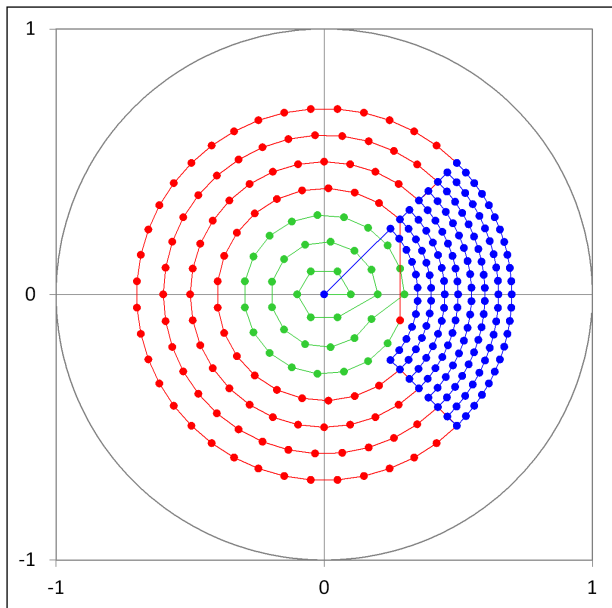


Fig. 55. A circular-trajectory scenario composed of three sub-scenarios: a circle (green), a segment (red), and a complementary, denser, segment (blue).

ADVANCED TOPICS

This section includes some specialized or less frequently needed topics.

Homer Analyzer Starting Parameters

The Homer behavior depends on several controlling parameters. Most of them are defined in the **Hom.cfg** and **Tun.cfg** configuration text files, which the Homer Server reads as part of its initialization routine after a power-up or a Server restart. The files therefore determine the Homer behavior in *autonomous* mode (without any external controller that could change the parameters via commands).

To change the Homer power-up behavior, you must modify these cfg files. There are several ways to do this. The best one is to use the currently active files as a template and manually edit the necessary parameters. The copies of these files can be downloaded from the Homer. After editing, the files must be sent back to the Homer and the unit must be restarted. See [Transferring Files](#) for instructions on downloading and uploading files.

Another method, which does not involve manual editing, is to create Hom.cfg and Tun.cfg using **HomSoft** (see [Create CFG](#)).

An example Hom.cfg configuration file is listed below. Lines starting with a semicolon are ignored. To create your own cfg file, you can copy the code block below and use it as a template. For **Tun.cfg**, see [Homer Autotuner Starting Parameters](#). To configure the communication interface, see [Configuring Communication](#). For the meaning of the **CAN_ADDR** parameter, see [MultiCAN: More Homers on CAN Bus](#).

For a more detailed explanation of the parameters controlling the sampling of the detector

voltages and frequency measurement (printed in **red** in the Notes section below), see topic [Signal Waveforms](#) and its subtopics. Some of the parameters (Fsubst_kHz, Fdelta_MHz, LowPowLvl_W) are related to Homer hardware.

```
[Homer Configuration]
```

```
Waveform=0
Autorun=1
Can_Addr=1
```

```
Fsampl_CW=10000
Vrpt=201
TcountCW_Us=20000
```

```
Rect_Linfre=50
Rect_Periods=1
Rect_Nsampl=201
Rect_Tcnt_Us=2992
Rect_Acc_Lvl=25
```

```
Puls_Tsampl_Us=1000
Puls_Nsampl=201
Puls_Tcnt_Us=32
Puls_Tmax_ms=100
Puls_Acc_Lvl=50
```

```
TrgMethod=0
TrgLevel=50
LowPowLvl_W=100
IsCntOn=1
Fsubst_kHz=2450000
Fdelta_MHz=61
Trpt=8
```

```
OnPeriod_ms=0
OfsPeriod_s=30
FPeriod_ms=0
TPeriod_s=30
TxPeriod_ms=0
Mot_Refresh=1000
TxMask=7
```

```
OnRnge=-1
OfsRnge=2
OfsEqualOn=TRUE
```

```
Asc_Delim=32
Asc_UseLabels=TRUE
Asc_InvalidStr=NONE
```

```
;===== NOTES =====
;This file is not obligatory: Defaults below are used in case of absent
;lines or invalid data (some defaults are HW-specific).
```

```
; Waveform=0      Input signal type (0=CW 1=Rectified 2=Puls)
; Autorun=1      AutoStart after power-up: Run (b0=1), Send (b1=1)
; Can_Addr=1     Address (1 to 20) for more Homers on CAN bus
```

```

;The following settings apply when Waveform=0
; Fsampl_CW=10000      CW signal sampling rate [Hz] (1 to 200000)
; Vrpt=201             Voltage measurement averaging (1 to 4095)
; TcountCW_Us=20000    CW signal frequency counting interval [microseconds]

;The following settings apply when Waveform=1
; Rect_Linfr=50         Microwave power ripple frequency
; Rect_Periods=1        Number of periods to be sampled
; Rect_Nsampl=201       Number of samples to take
; Rect_Tcnt_Us=2992     Frequency counting interval [microseconds]
; Rect_Acc_Lvl=25       Only samples higher than this % of peak value
;                       will be taken for refl. coef. computation

;The following settings apply when Waveform=2
; Puls_Tsampl_Us=1000   Sampling duration [microseconds]
; Puls_Nsampl=201       Number of samples to take
; Puls_Tcnt_Us=32       Frequency counting interval [microseconds]
; Puls_Tmax_ms=100      Max expected pulse repetition period [milliseconds]
; Puls_Acc_Lvl=50       Only samples higher than this % of peak value
;                       will be taken for refl. coef. computation

;Other settings
; TrgMethod=0           Triggering for non-CW sampling (0=free run 1=triggered)
; TrgLevel=50           Triggering level [%] for non-CW signal sampling
; LowPowLvl_W=0         Incident power threshold for "Low Signal" condition
; IsCntOn=1             Activate frequency counter (1=ON, 0=OFF)
; Fsubst_kHz=245000*    Substitute frequency (*HW-dependent)
; Fdelta_MHz=61*        Frequency tolerance interval half-width (*HW-dependent)
; Trpt=8                Temperature measurement averaging (1 to 16)

;Timings
; OnPeriod_ms=0         Measurement cycle periodicity [ms] (0 to 65535)
; OfPeriod_s=30         Offsets measurement periodicity [s] (0 to 120)
; TxPeriod_ms=0         Homer sending periodicity [ms] (0 to 65535)
; FPeriod_ms=0          Frequency measurement periodicity [ms] (0 to 65535)
; TPeriod_s=30          Temperature measurement periodicity [s] (0 to 120)
; Mot_Refresh=1000      Tuner: Interval [ms] between sending motors data
; TxMask=7              Homer sending mask (b0=RsltsReady b1=TxPeriod b2=MotRefresh)

;A/D converters ranges: do not change unless absolutely necessary
; OnRnge=-1             Signal measurement range (-1=auto 1=50mV 2=500mV 3=5V)
; OfRnge=2              Offset measurement range (-1=auto 1=50mV 2=500mV 3=5V)
; OfEqualOn=TRUE        Make OfRnge=OnRnge when OfPeriod_s=0

;Settings for results in ASCII format
; Asc_Delim=32          Delimiter of ASCII results: code of delimiting char
; Asc_UseLabels=TRUE    Use labels XXX= in ASCII results
; Asc_InvalidStr=NONE   Padding string to substitute invalid/not present results

```

Homer Autotuner Starting Parameters

For autonomous use of the Homer Autotuner, you do not need an external PC. In this case the automatic impedance matching is controlled by

- **Autotuner Starting Parameters**, contained in the **Tun.cfg** configuration file, *and*

- **AUTOTUNE** switch setting (if such a switch is provided).

The Autotuner starting parameters can be modified by treating the Tun.cfg file similarly to the [Homer Analyzer Starting Parameters](#). An example Tun.cfg configuration file is listed below. Lines starting with a semicolon are ignored. To create your own cfg file, you can copy the code block below and use it as a template. The parameter MaxInsert_mm is related to Homer hardware.

```
[Tuner Configuration]

IsOn=FALSE
Targ_mU=0
Toler_mU=25
Pause_10ms=0
Smooth=1
WaitRF=TRUE
Delay5b=0
DelayStep_ms=250
HystDg=5
MaxMag_mU=1000
PowOnAction=2
AtSwitchAction=0
MotErrAction=0
MaxAttempts=10
GuardSeconds=60

;===== NOTES =====
;This file is not obligatory: Defaults below are used in case of absent
;lines or invalid data (some defaults are HW-specific).

; IsOn=FALSE           Activate autotuning
; Targ_mU=0            Target [milliunits] for autotuning
; Toler_mU=25          Tolerance [milliunits] for autotuning
; Pause_10ms=0         Minimal interval n x 10ms between tuning steps
; Smooth=1             Number of averaged measurements taken for one tuning step
; WaitRF=TRUE          Suspend tuning when RF power is absent or too low
; Delay5b=0            Tuning delay after power onset in steps DelayStep_ms
; DelayStep_ms=250     Step of power onset tuning delay
; HystDg=5             Hysteresis in degrees for stubs 1-3 swapping
; MaxInsert_mm=22.7    Limits maximal stubs insertion depth
;                     This default is HW-specific
; MaxMag_mU=1000       Max load magnitude [milliunits] for autotuning
; PowOnAction=2        Stubs on PowerUp: 0=Stay in Positions 1=AllHome
;                     2=AllHome+Move to Positions
; AtSwitchAction=0     Command to execute on changing Autotune switch state:
;                     0=Autotune on/off else Command Code
;                     Allowed codes: 2=Single Tune, 69=All Home
; MotErrAction=0       Action on hitting a terminal switch: 0=Nothing 1=AllHome
; MaxAttempts=10       How many unsuccessful AllHome attempts are allowed (1 to 1000)
; GuardSeconds=60     Minimal wait between consecutive AllHome attempts (0 to 3600)
```

The **IsOn** item activates or deactivates the autotuning at the system power-up *irrespective* of the **AUTOTUNE** switch setting. When set to TRUE, the autotuning will be active.

The **AUTOTUNE** switch takes priority whenever its position is *changed*. This also applies when using an external controller. Because status feedback is not sent to an external PC, a discrepancy

may occur until the next Autotune ON/OFF command is issued from the PC. To do so, click the **Tuner | Autotune | Active** menu item or the **AT** button in the [Tuner View](#) window.

The meaning of **Targ_mU**, **Toler_mU**, **Skip**, **Smooth**, **WaitRF**, **Delay5b**, **DelayStep_ms** is explained in the **Autotune** section of the [System Info Window](#) topic. The meaning of **HystDg** is explained in the [Hysteresis](#) section. the meaning of **PowOnAction** is explained in the [Autonomous Operation](#) section.

By **MaxInsert_mm** you can limit the [maximum stub extension](#) to a value lower than the factory default.

By **MaxMag_mU** you can [truncate the matchable area](#) to avoid regions with a risk of arcing.

AtSwitchAction defines the action triggered by toggling the **Autotune** HW switch. The default (when the line is missing) is switching autotuning on and off. Depending on the **AtSwitchAction** value, the switch can also be used to perform a single autotuning step, or to activate the [All Stubs Home](#) procedure. All these actions can also be triggered via the [Remote connector](#).

MotErrAction defines what action should be taken if any of the motors hits its terminal switch. If **MotErrAction** = 1, an attempt will be made to invoke the [All Stubs Home](#) procedure. This can resolve the problem of randomly lost motor steps in an otherwise correctly working tuner. However, to prevent incessant attempts when the tuner is indeed damaged (e.g., mechanically stuck stubs), only **MaxAttempts** number of attempts will be made: not all of them at the same time but mutually separated by **GuardSeconds** seconds.

After editing, the Tun.cfg file must be sent to the Homer (see [Transferring Files](#)) and the unit must be restarted.

For the communication interface settings, see [Configuring Communication](#).

Power Measurement Calibration Factor

When measuring power, the Homer uses an internal *power calibration factor* C , stored in its memory. The value of C is set to unity in the factory at the time of the Homer calibration.

The user can modify C to be anywhere within the range 0.1 to 10 (-10 dB to +10 dB).

However, rather than entering C directly, it is more natural to enter a number which should multiply the currently displayed power to obtain the desired power reading. This number is called the *calibration factor multiplier* (M). Mathematically, M multiplies the current power calibration factor to obtain its new value:

$$C_{new} = C_{current} * M$$

The bounds on allowable M depend on the current value of C , such that their product always remains within the permitted range of 0.1 to 10:

$$M_{min} = 0.1 / C_{current}$$

$$M_{max} = 10 / C_{current}$$

The user can change the current calibration factor or restore it to unity.

To perform the described actions, click the **Homer | More | Pow Cal Factor** menu item. Following this, the window titled *Power Measurement Calibration Factor* appears ([Fig. 56](#)).

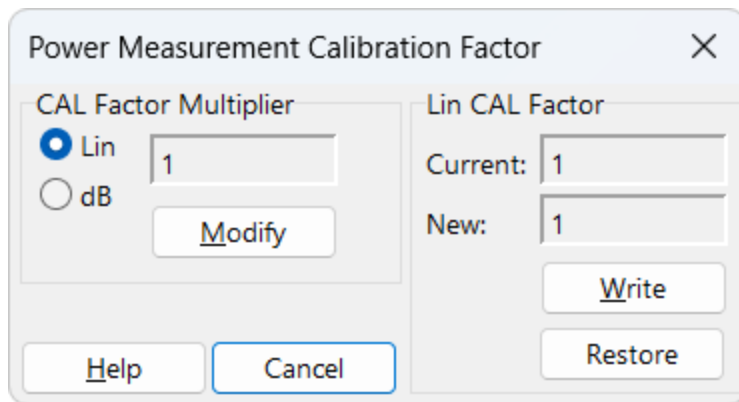


Fig. 56. Power Measurement Calibration Factor window.

The controls and displays are organized in two groups, *CAL Factor Multiplier* and *Lin CAL Factor*.

CAL Factor Multiplier Group

The group displays the current *calibration factor multiplier* M and enables the user to modify it. The radio buttons **Lin** or **dB** determine whether M is displayed and will be entered in linear format or in decibels. The conversion is via the formula $M_{dB} = 10 \cdot \log(M_{lin})$. After opening the dialog window, the starting value of M is always 1 (0 dB).

Clicking the **Modify** button opens a dialog for editing the multiplier M . The permissible bounds on the new value are automatically computed and the user is not allowed to exceed them.

The changes made are reflected in the *Lin CAL Factor* group, but they will not be accepted until the **Write** button is clicked (see the next section). The **Cancel** button discards the modifications made, leaves the current calibration factor unchanged and closes the dialog window.

Lin CAL Factor Group

Current shows the currently valid *power calibration factor* C . This value cannot be modified directly; instead, it is updated by adjusting M in the *CAL Factor Multiplier* group.

New previews the value of C which would result from applying the multiplier M to the current value.

The **Write** button activates the procedure of writing the new calibration factor to the Homer memory and closes the dialog window.

The **Restore** button returns the *power calibration factor* to its original factory setting $C = 1$ and closes the window.

To change the power calibration factor:

- Determine the calibration factor multiplier M .

Example 1: The Homer reads 985 W and you wish the reading to be 1000 W. The required multiplier in linear format is $M = 1000/985 = 1.0152$.

Example 2: The Homer reads 59.93 dBm and you wish the reading to be 60 dBm. The required multiplier in decibel format is $M = 60 - 59.93 = 0.07$ dB.

- Click the **Homer | More | Pow Cal Factor** menu item.
- Click the **Lin** radio button (in the case of Example 1) or **dB** radio button (in the case of Example 2).
- Click the button. A dialog for entering a value opens. Type in the *required M* (1.052 for Example 1 or 0.07 for Example 2); then click .
- If you are satisfied, click the button, otherwise click .
- Verify the modified calibration factor. You can do so by checking the value in parentheses of the **Homer | More | Pow Cal Factor** menu item, or by reopening the dialog via the **Homer | More | Pow Cal Factor** menu item.

To restore power calibration factor to unity:

- Click **Homer | More | Pow Cal Factor**.
- Click the button.

MultiCAN or More Homers on CAN Bus

Theoretically, up to 20 Homers can be connected simultaneously to the CAN Bus and controlled independently by a single **HomSoft** application. The following conditions must be satisfied:

- All Homers must be set to the same CAN baudrate (see **Can.cfg** in [Configuring Communication](#)).
- Each Homer must be assigned a unique number, called a *CAN Address*, ranging from 1 to 20. The assignment is made by the following statement in its internal [Hom.cfg](#) configuration file (the example below assigns the Homer a CAN Address 4):

```
CAN_ADDR=4
```

Note that the [Hom.cfg](#) and [Can.cfg](#) files reside inside each Homer. The files can be transferred from a Homer to your PC, edited, and sent back to the Homer: please refer to [Transferring Files](#) for details.

Caution! You must ensure that no two Homers are assigned the same CAN Address. This would lead to unpredictable behavior because such Homers cannot be distinguished. Aside from being unique, the addresses may be arbitrary. Example: If $N = 4$ Homers are on the bus, the addresses may be, e.g., 7, 11, 2, 4, or 1, 2, 5, 6, or 1, 2, 3, 4, etc.

- A [HomerList.cfg](#) configuration file, containing a list of Homer CAN Addresses, must be present in the [User Folder](#) on your PC (please do not confuse the **HomerList.cfg** file on your PC with the **Hom.cfg** file residing inside a Homer device).

HomerList Configuration File

To control a group of Homers by a single **HomSoft** application, a **HomerList.cfg** configuration file, containing a list of CAN Addresses of these Homers, must be present in [User Folder](#) on your PC. (Please do not confuse the **HomerList.cfg** file in the PC with the **Hom.cfg** file residing inside of each individual Homer device.) If the **HomerList.cfg** file is absent, **HomSoft** will search for only one Homer: the one with CAN Address = 1.

A **HOMER_LIST** statement must be present in the **HomerList.cfg** file, listing the addresses of

Homers the program will search for. For example:

```
HOMER_LIST=2 15 4 1 7
```

The CAN Address numbers follow the equality sign (=) and must be mutually separated by one or more spaces or Tab characters. The valid addresses are numbers ranging from **1** to **20**; they may appear in any order.

The search will be performed in the order of appearance of the addresses.

Because an attempt to detect a nonexistent Homer takes about 10 seconds, time can be saved if **HOMER_LIST** exactly reflects the CAN Addresses of the Homers on the bus.

A special statement form **HOMER_LIST=ALL** is equivalent to making a complete list consisting of all possible addresses (**1** through **20**). The search procedure is lengthy but it will find all available Homers.

An example of a **HomerList.cfg** is given below. Lines starting with a semicolon are ignored. To create your own file, you may copy the code block below (the first two lines are sufficient) and use it as a template.

```
[HomerList]

HOMER_LIST=1 4

; ===== NOTES =====
; This file is relevant only for CAN bus communication interface.
; Default is used in case of absent or invalid lines.
; The default is as follows:

; HOMER_LIST=1      Addresses of Homers searched for on CAN bus.

; The address values can be 1 to 20, separated by spaces or tabs.
; Example: HOMER_LIST=2 15 4 1
; To save time at program start, set the list to reflect exactly
; the Homers available on the CAN bus.
; HOMER_LIST=ALL launches search for all possible Homers (1 to 20).
```

HomSoft tries to establish communication with all listed Homers one by one, starting with the first address in the list (a transient message titled *Establishing Communication* appears). The first Homer detected is a “flagship”, determining the baudrate. The remaining Homers will be checked only at this baudrate (a transient message *Checking Communication*).

The detected Homers will be assigned sequence numbers (1, 2, ...).

HomSoft can control and show data for only one Homer at a time (we will refer to it as the *Selected Homer*). After the initial search for available Homers, **HomSoft** designates one of them as the *Selected*: either the Homer assigned the sequential number 1, or the one specified in the [Ini File](#). The *Selected Homer* will be identified in the title bar of the main **HomSoft** window. For example:

HomSoft for HOMER Autotuners (CAN) V5.0.2.0. HOMER #1 of 2, Addr=4

MultiCAN Window

Commands related to MultiCAN are grouped in the **MultiCAN** window ([Fig. 57](#)). The window can

be opened by clicking the **Homer | MultiCAN** menu item. This menu item is only visible when the CAN Bus is used and more than one Homer is detected.

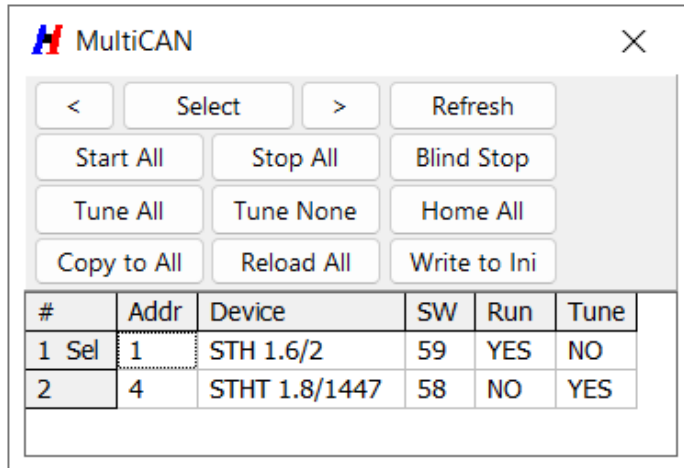


Fig. 57. An example of MultiCAN window with two Homers connected. Homer CAN Addresses are 1 and 4, respectively.

At the bottom of the **MultiCAN** window is a table listing all recognized Homers, including their CAN Addresses (column Addr), identities (Device), internal firmware versions (SW), *Running* state (Run), and Autotuning state (Tune). Note that *Tune* is effective only if *Run* = YES. The currently selected Homer is labeled "Sel" in the leftmost column.

The top of the **MultiCAN** window comprises buttons related to MultiCAN operations.

Selecting a Homer

There are several options to decide which of the detected Homers will become the *Selected Homer*, i.e., the one to be controlled and monitored by **HomSoft**:

- Double-clicking the leftmost column of the row corresponding to the desired Homer.
- Clicking the **Select** button opens a dialog to choose the number (column #) of the *Selected Homer*.
- Clicking the **<** button decrements the *Selected Homer*.
- Clicking the **>** button increments the *Selected Homer*.

All Homers will be temporarily stopped during the switching procedure. After the procedure is complete, all program windows will be adjusted according to the new *Selected Homer* settings. The *Running* and *Sending* states of all Homers will then be restored.

Settings for each particular Homer can be configured individually. If the **HomSoft Ini File** does not exist (e.g., **HomSoft** is run for the very first time), all Homers are set according to their individual internal **Hom.cfg** and **Tun.cfg** files (see [Homer Analyzer Starting Parameters](#) and [Homer Autotuner Starting Parameters](#)). On **HomSoft** termination, settings of all Homers (possibly changed while running the program) will be stored in the **HomSoft Ini File** and will be used again when the program is restarted.

Refresh

This button refreshes the table *Run* and *Tune* settings for all detected (i.e., listed) Homers.

Start All

This button starts all detected Homers (setting *Run* to YES). They resume measurement, data transmission, and, if *Tune* = YES, autotuning.

Stop All

This button stops all detected Homers. Stopped Homers will not measure, tune, or send data; they will only listen for commands.

Blind Stop

This button sends stop commands to all potentially possible Homers (i.e., CAN Addresses 1 to 20) without waiting for responses.

Homers may be active on the CAN Bus without being detected by **HomSoft** (if you choose not to include them in the **HOMER_LIST** statement of the **HomerList.cfg** file. For instance, you may wish to work with only some of them and keep the rest idle. The undetected Homers may be overloading the CAN Bus with unwanted messages, thus slowing or impairing the communication with the detected Homers. Obviously, an effective way to resolve this problem is to switch off their power supplies or to disconnect them from the CAN Bus. But this may sometimes not be practical.

Tune All

This button sets *Tune* = YES to all detected Homers, i.e., starts autotuning for all of them (effective only if *Run* = YES).

Tune None

This button sets *Tune* = NO to all detected Homers, i.e., stops autotuning for all of them.

Home All

This button commands all detected Homers to execute the [All Stubs Home](#) procedure.

Copy To All

This button copies the settings of the currently *Selected Homer* to all detected Homers. This way, you do not have to configure each Homer individually.

Reload All

This button blind-stops all Homers, then re-reads the scratch settings of all detected Homers (and sets the Homers accordingly). The procedure consists of two steps:

- Reading Homer power-up settings (to learn more about Homer power-up behavior, please refer to *System Configuration Files* section of [Homer Internal Files](#)).
- Reading the **HomSoft** [Ini File](#).

Write to Ini

This button writes current *Run* and *Tune* settings to the **HomSoft** [Ini File](#).

MultiCAN Connection

An example of a connection of four Homers to a CAN Bus is shown in [Fig. 58](#). The individual devices are wired to the main cable by simple Tee-connected branches. The branches should be as short as possible. The main cable is terminated at each of its extreme ends by a $120\text{-}\Omega$ resistor. In this case, none of the connected devices must load the bus (please check by an ohm-meter that their inputs are high-resistance, not $120\text{ }\Omega$). Alternatively, a main cable end can be connected to one of the devices (in our example, for instance, to HOMER 1). In this case, the device must also load the bus by $120\text{ }\Omega$.

A single copy of **HomSoft** is running on the controller (PC), enabling the user to switch the display between the individual Homers.

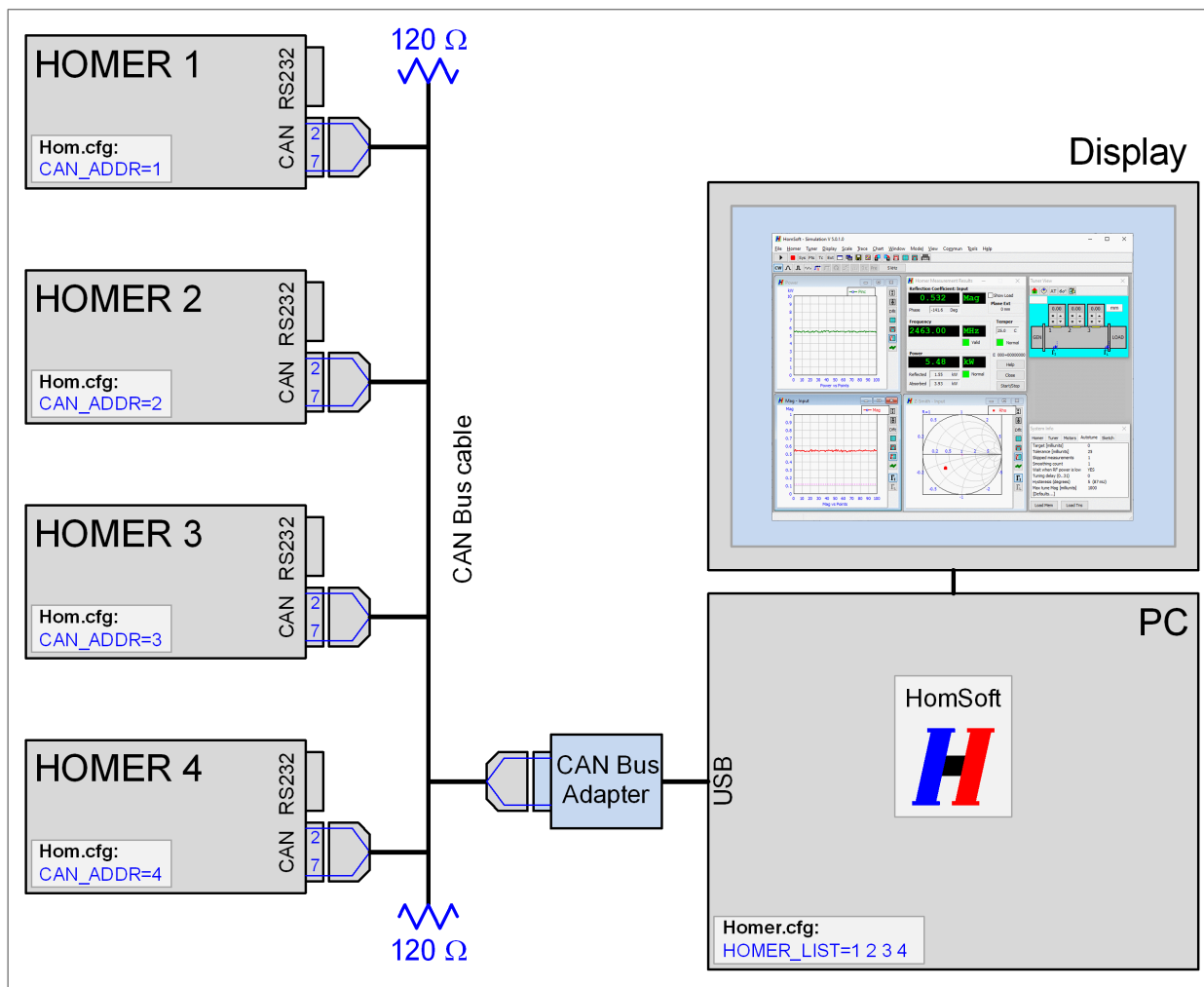


Fig. 58. An example of a connection of four Homers to a CAN Bus.

Using Windows Virtual Machines

Installing a number of Virtual Machines on your PC allows you to control more Homers using a dedicated **HomSoft** application for each of the Homers. An example of connecting four Homers

to a single PC with four installed Virtual Machines is shown in [Fig. 59](#).

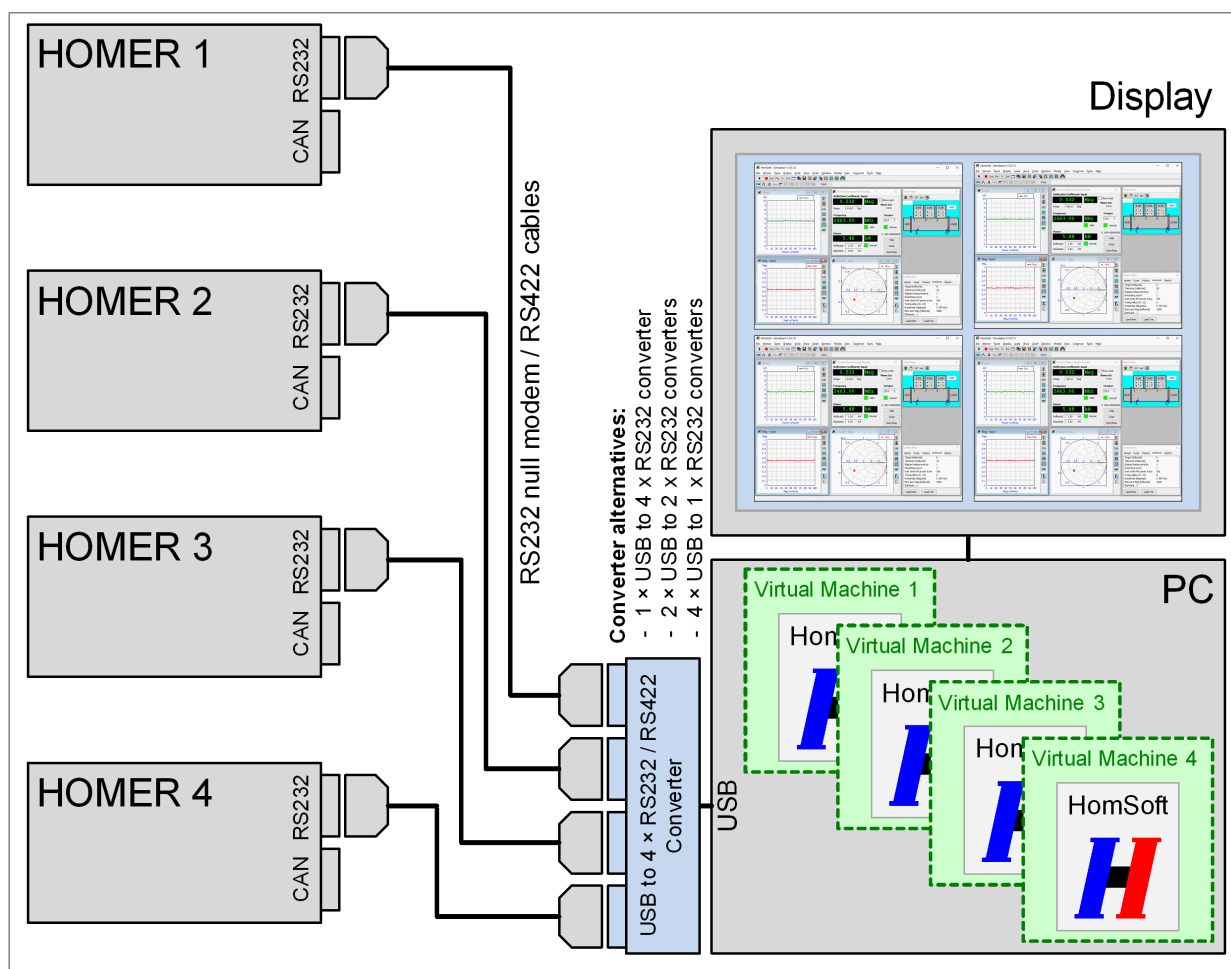


Fig. 59. An example of connecting four Homers to a single PC using Virtual Machines.

Fast Frequency Measurement

Sometimes, it is useful to examine the time dependence of a magnetron's instantaneous frequency. This is the case, for example, with high-ripple signals pulsing at power-line-related ripple frequency. To make such measurement, proceed as follows:

- Select the [Freq](#) display.
- Close both [Result Windows](#). Updating the windows is time-consuming, and thus decreases the measurement cadence. For the same reason, you may wish to close all graphical displays except the **Freq** window.
- Set the Homer for fast frequency measurement by choosing a small frequency count time, e.g., 100 μ s or less. To do this, click the **Homer | Count Time** menu or the **Tc** button. Later, you can experiment with this setting.
- Select **CW** sampling mode.
- Set a sufficient number of measurement points (via the **Homer | Points per Sweep** menu,

the **Ctrl+N** shortcut, or the **Pts** button).

- Activate the  button, thus disabling all measurements except the frequency measurement.
- Start measurement.

After completing the measurement, you may wish to [save the results](#). Please note that:

- The x-axis is the measurement count and does not represent exact time.
- The only relevant data column in the file is the frequency (f_MHz).

Single-Shot Commands Window

The *Single-Shot Commands* window ([Fig. 60](#)) can be opened by clicking the **View | Single-Shot Commands** menu item. The window contains a group of specialized Homer commands, most of which trigger the execution of a single Measure-Tune-Send sequence (or its part); hence the adjective Single-Shot.

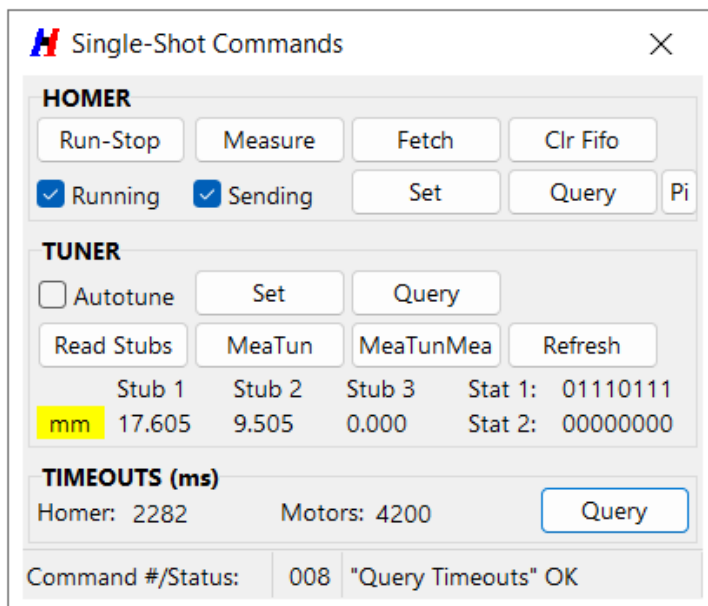


Fig. 60. Single-Shot Commands window.

The window is meant chiefly as an aid in developing user's own Homer control programs.

Please refer to the [Homer Communication Protocol](#), section *Single-Shot Commands*, where the commands and the associated quantities are described in detail.

Homer measurement results (HMR) received as a response to measurement commands are displayed in [Results windows](#). Motor positions and their status are shown in the TUNER group of the window but also in the [Tuner View](#) window.

The **TIMEOUTS** group is used to query and display **HomSoft** timeouts in milliseconds when waiting for the analyzer to complete a measurement (Homer), and for the tuner to complete motors movement (Motors).

The status bar at the bottom of the window shows the sequential number and the status of the

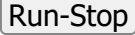
most recent attempted command.

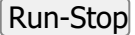
Notes:

- If used in [Rectified](#) and [Pulsed](#) modes of sampling, single-shot commands never send individual samples, only averaged results, regardless of your setting of the **Send Samples** checkbox setting in the [Homer Sampling Setup](#) window (or the state of the corresponding toolbar button ).
- Expressions in **[square brackets]** in the following related subtopics refer to the names of corresponding commands in the [Homer Communication Protocol](#), where they are described in more detail.
- With a few exceptions, the commands described below will not work in the **HoSim** simulation version of HomSoft.

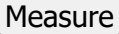
HOMER Group

Run-Stop

If the Homer is idle, clicking the  button is equivalent to setting the Running and Sending flags to TRUE (see below). This is also similar to clicking the **Homer | Run-Pause** [Homer menu](#) item (or the equivalent  toolbar button) *except* that clicking the  button does not initiate the PC monitoring of the Homer.

If the Homer is running, clicking the  button is equivalent to clicking the **Homer | Stop Homer** menu item or the equivalent  toolbar button (the Homer goes idle). The action is also equivalent to setting the Running flag to FALSE.

Measure

Clicking the  button commands the Homer to make a single measurement and send the Measurement Data Object (MDO). **[Meas]**

Fetch

Clicking the  button commands the Homer to send the latest available MDO (but no measurement is carried out). **[FetchLast]**

Clr Fifo

Clicking the  button commands the Homer to clear its internal message buffer. As a result, the next incoming command will become the first in the queue. **[ClrFifo]**

Running

The **Running** checkbox sets/clears the Homer internal Running flag. If Running = TRUE, the Homer repeats the Measure-Tune-Send sequence (or its applicable part) periodically. If Running = FALSE, the Homer is idle, only waiting for commands.

Sending

The **Sending** checkbox sets/clears the Homer internal Sending flag. If Sending = TRUE and Running = TRUE, the Homer sends the data periodically, subject to the conditions defined in the

[TX Timing window](#). If Sending = FALSE, the Homer will not transmit results, even when running and tuning.

Note that the Running and Sending states only affect periodic (continuous) measurement, not the single-shot commands.

The power-up value of the Running and Sending flags is defined by the following line in the internal Hom.cfg configuration file:

```
AUTORUN=3 ;AutoStart after power-up: Run (b0=1), Send (b1=1)
```

Set

Click the button to apply the settings of the Running and Sending checkboxes in the Homer. You can verify the actual Homer settings by changing the checkboxes and clicking **Query**.

Query

Click the button to read from the Homer the actual settings of the Running and Sending flags.

TUNER Group

The bottom two lines of the TUNER group represent the state of the motors (tuning stubs). The display fields of this group show:

- Stub positions in steps, millimeters or inches. To change the unit, click the yellow unit label.
- Motor Status Bytes MS1 and MS2 (as **Stat 1** and **Stat 2**, respectively).

Autotune

The **Autotune** checkbox activates/deactivates continuous autotuning (i.e., the Homer internal Autotune flag).

Set

Click the button to apply the setting of the **Autotune** checkbox to the Homer unit. You can verify the actual Homer setting by changing the checkbox setting and clicking .

Query

Click the button to read from the Homer the actual setting of its Autotune flag.

Read Stubs

The command reads the actual stub (motor) positions and the status (*Stat 1* and *Stat 2*).

MeaTun

The Homer makes a single measurement. If successful, it computes new tuning stub positions and moves the motors to these positions. The Homer then sends the measurement results and the current positions, which are then displayed. Please note that the measurement results correspond to tuning stubs in their *previous* positions. **[MeaTun]**

MeaTunMea

The Homer makes a single measurement. If successful, it computes new tuning stub positions

and moves the motors to these positions. Following this, the Homer makes a *new* measurement and sends these new results and the current positions, which are then displayed. The measurement results now correspond to tuning stubs in their *current* positions. **[MeaTunMea]**

Refresh

All numeric displays, including the [Results windows](#), will be updated to the latest available results (this includes measurement data, not only stub positions).

Data Acquisition Setup

The **Data Acquisition Setup** window ([Fig. 61](#)) contains a collection of some more advanced Homer settings, regarding primarily:

- Measurement of the detector voltages.
- Measurement timings.

You will need it very rarely. To open the window, click the **Homer | More | DAQ Setup** menu item.

Modified values will not be accepted until the **Apply** button is clicked. Invalid entries will be either truncated or replaced by defaults.

To set all values to defaults, click the **Defaults** button, then click the **Apply** button. [Fig. 61](#) shows the defaults.

The screenshot shows the 'Data Acquisition Setup' dialog box. It is organized into three columns. The first column, labeled 'SIGNAL', contains a 'Period' input set to '0' with a 'ms' unit, and a 'Range' section with four radio button options: 'Auto' (which is selected), '50 mV', '500 mV', and '5 V'. The second column, labeled 'OFFSET', contains a 'Period' input set to '30' with a 's' unit, and a 'Range' section with four radio button options: 'Auto', '50 mV', '500 mV' (which is selected), and '5 V'. Below the 'Range' section in the 'OFFSET' column is a checked checkbox labeled 'Range as Signal'. The third column, labeled 'FREQUENCY', contains a 'Period' input set to '0' with a 'ms' unit. Below the 'FREQUENCY' section is a 'TEMPERATURE' section with a 'Period' input set to '30' with a 's' unit, and an 'Avrg' input set to '8'. At the bottom of the dialog are four buttons: 'Help', 'Defaults', 'Close', and 'Apply'.

Fig. 61. Data Acquisition Setup window.

SIGNAL Group

The **SIGNAL** group sets:

- Periodicity of the signal measurement.
- Ranges of Analog-to-Digital Converters (ADC) used for signal measurement.

These settings apply to all **Waveform** modes.

Period

Period defines the Signal Measurement Period in milliseconds. When set to zero (default), there is no delay between two consecutive Measure-Tune-Send (MTS) sequences; otherwise two consecutive measurements are spaced by at least **Period** milliseconds.

The power-up **Period** value is defined by the following line in the internal [Hom.cfg](#) configuration file:

```
OnPeriod_ms=0           ;Measurement cycle periodicity [ms] (0 to 65535)
```

Note: The value in the **Period** edit box of the **SIGNAL** group is the same as the value in the **Measurement** edit box of the **PERIODICITY** group in the [TX Timing window](#).

Range

Range defines ADC voltage measurement ranges when signal (microwave power) is applied to Homer detectors. The default is *Auto* (autoranging). Fixed ranges increase measurement speed but also the chance of ADC overflow or an inadequately high range.

The power-up *Range* value is defined by the following line in the internal Hom.cfg configuration file:

```
OnRnge=-1               ;Signal measurement range (-1=auto 1=50mV 2=500mV 3=5V)
```

OFFSET Group

The **OFFSET** group sets the periodicity and ADC range for the measurement of DC offsets of Homer detectors. Offsets are the output voltages of the detector channels in the absence of input microwave power. To enable offset measurements, microwave signal is blocked from reaching the detectors by solid-state switches ([Fig. 1](#)). The settings apply to all **Waveform** modes.

Period

Period defines the offsets measurement period in seconds. When set to zero, the offsets are measured anytime the signal voltages are measured; otherwise, two consecutive offset measurements are spaced by at least **Period** seconds. The default is 30 s.

The power-up offset measurement **Period** is defined by the following line in the internal [Hom.cfg](#) configuration file:

```
OfsPeriod_s=30          ;Offsets measurement periodicity [s] (0 to 120)
```

Range

Range defines the offset voltages measurement range. However, there is one exception: When

- offsets are measured each time the signal voltages are measured (`OfsPeriod_s=0`), **and**
- **Range as Signal** checkbox is checked (the default),

then the **OFFSET Range** setting is ignored and the offset measurement ranges are the same as the **SIGNAL** measurement ranges.

The power-up offset measurement range is defined by the following two lines in the internal Hom.cfg configuration file:

```
OfsRnge=2               ;Offset measurement range (-1=auto 1=50mV 2=500mV 3=5V)
OfsEqualOn=TRUE         ;Make OfsRnge=OnRnge when OfsPeriod_s=0
```

FREQUENCY Group

The **Period** value in the **FREQUENCY** group defines the frequency measurement repetition period in milliseconds. When set to zero (default), frequency measurement takes place each time the signal voltage is measured; otherwise two consecutive frequency measurements are spaced by at least **Period** milliseconds.

The power-up frequency measurement **Period** is defined by the following line in the internal [Hom.cfg](#) configuration file:

```
FPeriod_ms=0 ;Frequency measurement periodicity [ms] (0 to 65535)
```

TEMPERATURE Group

The **TEMPERATURE** group sets the periodicity and averaging number of Homer internal temperature measurement.

Period

Period defines temperature measurement period in seconds. When set to zero, temperature measurement takes place each time the signal voltage is measured; otherwise, two consecutive temperature measurements are spaced by at least **Period** seconds. The default is 30 s.

The power-up temperature measurement period is defined by the following line in the internal [Hom.cfg](#) configuration file:

```
TPeriod_s=30 ; Temperature measurement periodicity [s] (0 to 120)
```

Avrg

Avrg defines the number of temperature samples taken and averaged to compute the resulting temperature reading. The default is 8.

The power-up temperature averaging number is defined by the following line in the internal [Hom.cfg](#) configuration file:

```
Trpt=8 ;Temperature measurement averaging (1 to 16)
```

DDE Server

A Dynamic Data Exchange (DDE) server can be activated in **HomSoft** starting with Version V4. Homer must be equipped with the DDE option. Obviously, the **HomSoft** option is necessary for this, too. DDE enables another Windows application (DDE client) to receive measurement results from the Homer in the form of an ASCII string. The advantage is that you do not have to:

- Write your own procedures for the data bytes reception, which may be a tricky task. (For more about communication, see the [Homer Communication Protocol](#).)
- Decode the received bytes, i.e., the Measurement Data Objects (MDO) to usable results (like incident power, reflection coefficient, frequency, tuning stub positions, etc.).

Generally, DDE transfer is defined by the names of three entities:

- **DDE Server** is the DDE data producer name without the "EXE" extension. It may be, e.g., "Tu_rs", "Tu_can", or whatever you rename a **HomSoft** application to. The Homer

simulation **HoSim** also includes a DDE server so you can test your client application before making the final decision to procure the DDE option.

- **DDE Topic** is fixed to "*HomerDdeTopic*".
- **DDE Item** is fixed to "*HomerDdeItem*".

Using these three names, DDE conversation can be established between your client application and the Homer Windows Software. For more information about DDE, refer to your particular programming environment. For an overview, please visit [http://msdn.microsoft.com/en-us/library/ms648711\(VS.85\).aspx](http://msdn.microsoft.com/en-us/library/ms648711(VS.85).aspx) .

Homer DDE Results

After the connection is established, your client can receive Homer measurement results in the form of an ASCII string, consisting of individual result items separated by a delimiter.

The results appear in the following order:

Homer Status Byte (HST)

[Homer Error Byte](#) (HER)

Frequency in MHz

Magnitude of input reflection coefficient

Phase of input reflection coefficient

Magnitude of load (deembedded) reflection coefficient

Phase of load (deembedded) reflection coefficient

Incident power in watts

Reflected power in watts

Internal temperature in Celsius

Stub 1 position in steps (Stub 1 is closest to the generator)

Stub 2 position in steps

Stub 3 position in steps (Stub 3 is closest to the load)

Motor status byte 1 (MS1)

Motor status byte 2 (MS2)

For the meaning of HST, MS1, MS2, see the [Homer Communication Protocol](#).

Possible delimiters are:

CRLF: a pair of bytes in the given order with decimal ASCII codes 13, 10 (carriage return + line feed).

Tab: the tab character (decimal ASCII code 9).

Space: the space character (decimal ASCII code 32).

Semicolon: the ";" character (decimal ASCII code 59).

To make HomSoft deliver results:

- Check the **Commun | DDE Server** menu item (switch it ON).
- Choose the delimiter by clicking the **Commun | Delimiter** menu item.
- Choose the minimum period (maximum rate) of generating DDE messages by clicking the **Commun | DDE Wait** menu item. This will limit the cadence of DDE messages when the Homer produces results too fast. Fast cadence of DDE messages may overload the receive buffer of your DDE client application and even cause it or the PC to crash.

Application Speed Considerations

Please be aware that when your DDE client application is running together with **HomSoft**, both applications may get slower under certain circumstances (e.g., when using an older PC). This may be the case, for example, when your client is running in National Instrument's LabVIEW environment. If, in this case, you experience a slowdown of **HomSoft**, **multithreading must be switched off** in your LabVIEW project.

To disable multithreading in LabVIEW versions starting V8.2, you must manually add the entry

```
ESys.StdNParallel=0
```

into the LabVIEW application *ini* file. In older versions, you can turn off multithreading in the LabVIEW menu item **Tools | Options | Performance and Disk | Run with Multiple Threads**.

You will have to restart LabVIEW for the changes to take effect. Please refer to National Instrument's support web pages.

Importing to Excel

To import data to Microsoft Excel from, e.g., the simulation program **HoSim.exe**, enter the following function to a chosen cell:

```
=HOSIM|HomerDdeTopic!HomerDdeItem
```

Unfortunately, our experience is that Microsoft Excel does not receive data separated by CRLF or Tab (only the first result item, which is the Homer Status Byte HST). Therefore, you have to choose another delimiter (Space, Semicolon) and break up the received string yourself.

Sample DDE Client

A sample DDE client ([Fig. 62](#)) including the commented Delphi source code (a Delphi project packed as HmDdeClientSrc.zip), is included in the Homer installation as an aid and inspiration for writing your own client application.

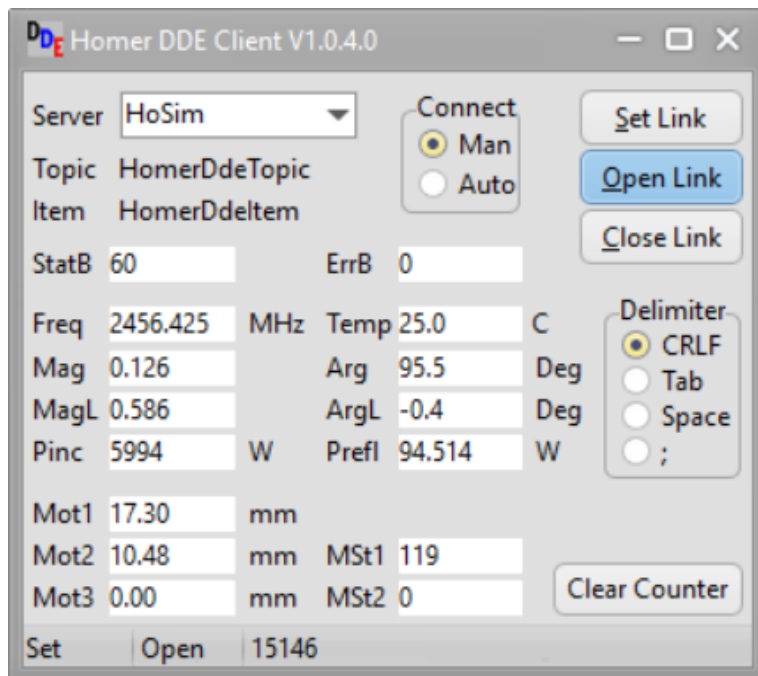


Fig. 62. Sample DDE Client program.

To use the client program, proceed as follows:

- Localize the DDE folder in your **HomSoft** [installation folder](#) and copy the whole DDE folder to some place in your user folder. Next, use only the files in this DDE copy.
- Start the data producing program (e.g., **HoSim.exe**).
 - In its **Commun** menu, check the **DDE Server** item.
 - In the **Commun** menu, select the **Delimiter**, (e.g., CRLF).
 - In the **Commun** menu, set the **DDE Wait** in milliseconds (e.g., 500).
 - Start measurement.
- Start *HmDdeClient.exe* program (the copy in your user folder).
 - Select or type the **Server** name (in this example, *HoSim*).
 - Set the **Delimiter** equal to that of the data producing program (in this example, CRLF).
 - Select the **Connect** method (e.g., Man).
- Observe the bottom status bar, showing the link setting status (Not set, Set) and the link open status (Closed, Open).
- Click **Open Link**. Now watch the displays being continuously refreshed.
 - If Connect = Auto, you can alternatively click **Set Link** for the same effect.
 - If Connect = Man, you can alternatively click **Set Link**, then **Open Link** for the same effect.
- Observe the bottom status bar, showing the increasing count of received messages.
- Click **Close Link**. Observe the status bar.
- If the displays are frozen, click **Close Link**, then **Open Link** again.

Transforming Input Reflection Coefficient

The Input reflection coefficient Γ_I can, before displaying, be subject to a user-defined transformation, accounting, e.g., for a two-port network connected at the Homer Autotuner input. A typical example for its use is a magnetron Rieke diagram measurement (Fig. 63a). A Rieke diagram is usually defined for a waveguide different from that of the Homer. In such situation, we need an adapter between the launcher waveguide (LWG) and the Homer waveguide (HWG). To arrive at the Rieke diagram-related reflection coefficient Γ_R and the net power P_R delivered by the magnetron we need to use the formulas

$$\Gamma_R = S_{11} + \frac{S_{12}S_{21}\Gamma_I}{1 - S_{22}\Gamma_I} = \frac{S_{11} - D\Gamma_I}{1 - S_{22}\Gamma_I}$$

$$P_R = P_L \frac{|1 - S_{22}\Gamma_I|^2 - |S_{11} - D\Gamma_I|^2}{|S_{21}|^2 (1 - |\Gamma_I|^2)}$$

where $D = S_{11}S_{22} - S_{12}S_{21}$ is the determinant of the $\mathbf{S}$ -matrix, P_L is the power absorbed in the matched load, and S_{ij} are (frequency-dependent) scattering parameters of the two-port network (Fig. 63b) between plane R (where Γ_R is defined) and the tuner Stub 1 axis plane A (where Γ_I is defined). The equation is a conformal mapping, also called a *bilinear transform*.

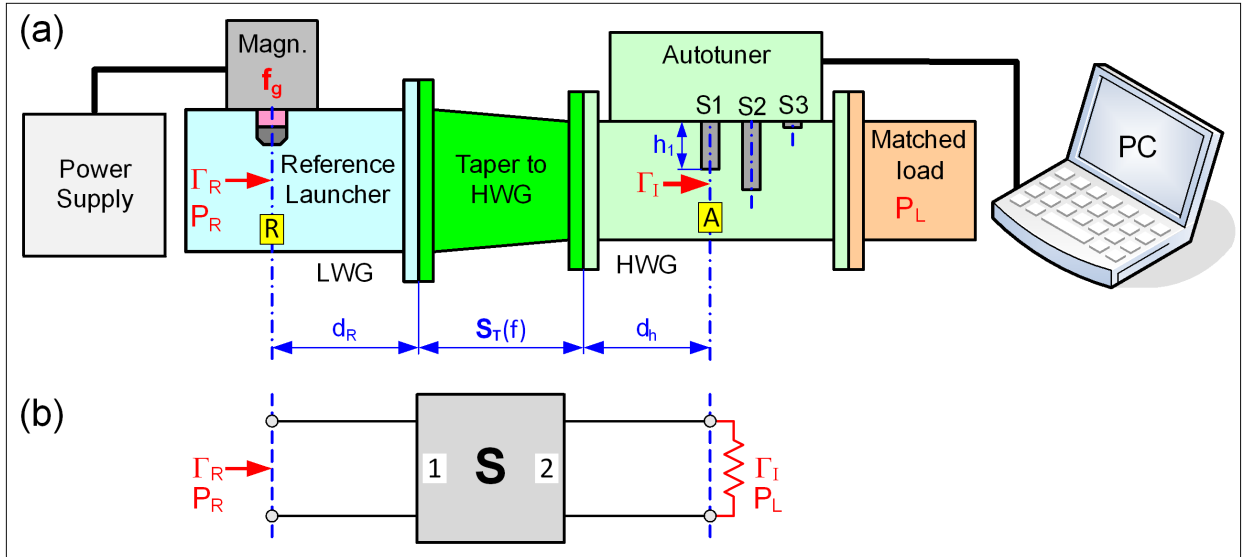


Fig. 63. a) Rieke diagram measurement setup example. b) Substitution of the two-port network between the Γ_R reference plane R and the Γ_I measurement plane A by its scattering matrix $\mathbf{S}$.

The Homer can perform this transform in real-time, after an appropriate text file with tabulated frequency dependence of S_{ij} is loaded. The necessary actions can be carried out via the following submenu items of the **Homer | Transform** menu.

Active

Switching the bilinear transform ON (YES) and OFF (NO), provided that the transformation data have been loaded. (otherwise, the menu item is disabled).

Load

Load a text file containing the tabulated frequency dependence of the network scattering parameters. The parameters are interpolated if the actual frequency is between the tabulated values. For an actual frequency below the lowest tabulated frequency, the lowest tabulated frequency values are used. For an actual frequency above the highest tabulated frequency, the highest tabulated frequency values are used.

Once the file is successfully loaded, the bilinear transform is both enabled and activated.

Clear

Disables the transform permanently. It can be enabled again only by a new **Load**.

Format of S-Parameters Text Files

An example of a scattering parameters text file is shown below:

```
! Lines starting with exclamation mark are ignored
{ Lines between braces are ignored.
Empty lines are also ignored }
* Info = This is a comment associated with the file
# MHz S11_Re S11_Im S21_Mag S21_Deg S22_Log S22_Rad
2420 0.2 -0.3 0.8 50 -20 1.7453
2425 0.21 -0.25 0.79 40 -21 1.3963
2430 0.22 -0.2 0.78 30 -22 1.0472
2435 0.23 -0.15 0.77 20 -23 0.6981
2440 0.24 -0.1 0.76 10 -24 0.3491
2445 0.25 -0.05 0.75 0 -25 0.0000
2450 0.26 0 0.74 -10 -23 -0.3491
2455 0.27 0.05 0.73 -20 -21 -0.6981
2460 0.28 0.1 0.72 -30 -19 -1.0472
2465 0.29 0.15 0.71 -40 -17 -1.3963
2470 0.3 0.2 0.7 -50 -15 -1.7453
2475 0.31 0.25 0.69 -60 -13 -2.0944
End
```

The file is terminated by a line containing the string `END`.

The files are case-insensitive.

Four line types are distinguished:

- Comments and blank lines.
- Info line.
- Header line.
- Data lines.

Comment Lines

Comment lines are those starting with the exclamation mark (`!`). They can appear anywhere in the text and will be ignored.

If a line starts with the left brace (`{`), this line and all following lines will be ignored until the right brace (`}`) is found. (The line with the right brace will also be ignored.)

Empty lines will also be ignored.

Info Line

The Info line starts with an asterisk (*). The line is not mandatory. The structure of the Info line is

* INFO = <Text>

<Text> symbolizes an arbitrary comment (up to the end of the line). The asterisk as well as the equality sign can be surrounded by whitespaces, such as Space (ASCII 32) or Tab (ASCII 9).

Header Line

The Header line starts with the # character. It can be optionally followed by whitespaces.

Exactly one Header line must precede the Data lines.

The Header line consists of substrings, mutually separated by at least one Space (ASCII 32) or Tab character (ASCII 9). The substrings are of two types:

- Frequency unit substring.
- Data type substrings.

Frequency Unit

Accepted frequency unit substrings are (the letter case is irrelevant)

Hz, kHz, MHz, GHz

The substring is mandatory and must be the first item in the Header line. The frequency values in Data lines (the first item in each line) are interpreted according to the specified frequency unit.

Data type

The form, quantity and arrangement of the data type substrings in the header line provide information about the type of data, their format, number and order in the data lines.

Each substring consists of two parts, separated by the underscore character (e.g., S11_RE).

The first part identifies the data type: it can be S11, S12, S21, or S22.

The second part denotes the data *format*:

RE: real part

IM: imaginary part

MAG: linear magnitude

LOG: logarithmic magnitude (dB)

SWR: standing wave ratio

DEG: phase angle in degrees

RAD: phase angle in radians

The existence of a header term indicates the existence of the corresponding data item in the data lines.

The order of the terms indicates the order of the corresponding data items in the data lines.

Rules for Header Substrings

The following data type terms must be present in the header: S11, S22, and one or both of S12, S21.

If S_{12} or S_{21} is missing, the two-port network is considered reciprocal, i.e., $S_{12} = S_{21}$.

Each scattering parameter must have two components, which can be:

- Real and imaginary parts (e.g., S_{11_RE} & S_{11_IM}).
- Magnitude and phase (e.g., S_{11_LOG} & S_{11_DEG} , S_{21_MAG} & S_{21_RAD} , etc.).

Invalid combinations are, for instance, S_{22_RE} & S_{22_DEG} , or S_{12_MAG} & S_{12_IM} .

The substrings can be in arbitrary order, e.g.,

S_{11_MAG} S_{21_MAG} S_{22_MAG} S_{11_DEG} S_{21_DEG} S_{22_DEG}

Data Lines

Data lines follow the Header line. There must be at least one Data line.

A Data line consists of numeric terms separated by at least one Space (ASCII 32) or Tab character (ASCII 9).

The first data item is frequency in units specified in the header frequency unit term.

The frequencies must be ordered in ascending order.

Firmware Update and Reinstallation

A Homer firmware update may be required when:

1. Upgrading the SrvHo.exe server program.
2. Acquiring new SW options (such as *HomSoft Control*, *Defined Mismatch Tuning*, etc.).
3. Limiting or extending the absolute maximum of the tuning stub insertions.
4. Complete firmware reinstallation.

Task 1 and **Task 2** can in principle be accomplished by merely transferring (uploading) the relevant files to the Homer device. The details of the procedure are described in the [Transferring Files](#) section. However, file changes should also be reflected in the [Homer Reset](#) files. Otherwise, reverting to a state such as the User Reset may result in a loss of newly purchased options.

Task 3 and **Task 4** need additional operations beyond mere file transfers; specifically, the reprogramming of the internal motors controller.

All these tasks can be accomplished by the **Tools | Reinstall** procedure, or its combination with **Tools | Reprogram Motors**. Both menu items are only available in a [reduced-functionality HomTool](#) servicing version of **HomSoft**. **HomTool** is an automatic, complimentary part of the Homer installation. For the Homer Autotuner, the executable files are typically named **TuTool_rs.exe** (RS232 version) and **TuTool_can.exe** (CAN Bus version).

The details of the **Reinstall** and **Reprogram Motors** procedures are described next.

Reinstall

Before Start

You will obtain the reinstallation package from your distributor or S-TEAM as a zipped file. The content is typically organized as follows:

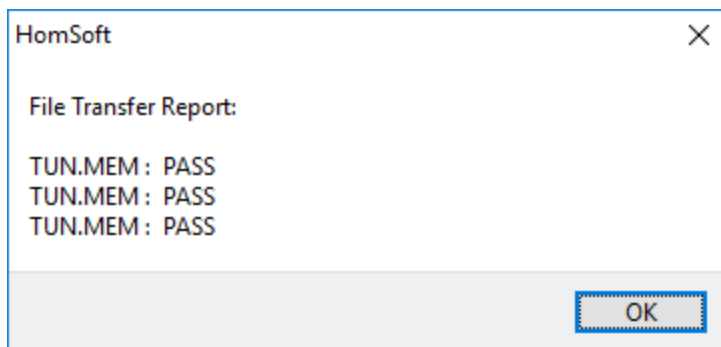
[Reinstall] directory, including:

- **FileList.txt** text file, containing instructions for the reinstaller. (The file may be named differently.)
- A collection of files to be transferred to the Homer device and processed internally.

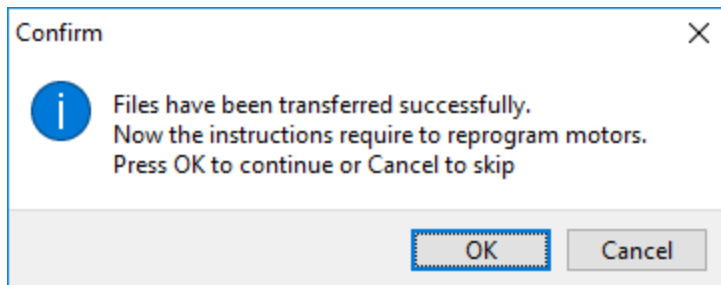
Unzip the package and copy the whole **Reinstall** directory, ideally, to the **HomSoft** [User Folder](#). You can open the User Folder from within a running **HomSoft** by the **File | Open User Folder** menu item.

Procedure

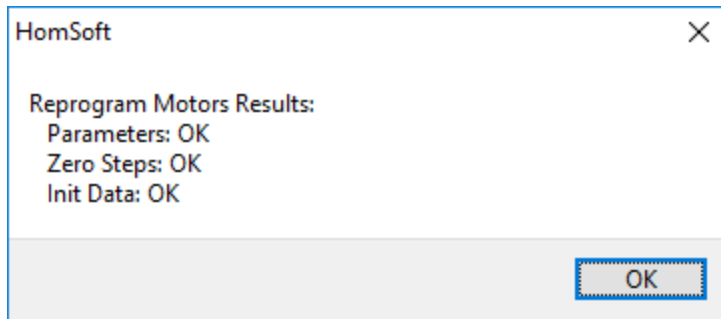
- Connect the Homer and your PC with either RS232 or CAN Bus interface cable.
- Restart the Homer device so that it operates in the respective communication mode.
- On your PC, start the [HomTool](#) servicing version of **HomSoft** for the chosen communication interface (**TuTool_rs.exe** or **TuTool_can.exe**).
- Click the **Tools | Reinstall** menu item.
- After confirming your intention to continue, a *File Open* dialog opens. Navigate to the **Reinstall** directory, select the **FileList.txt** (or otherwise named) file, then click **Open**. The file transfer begins, with the progress shown in a dialog box. Some file names may appear up to three times, being transferred to different locations in the Homer device.
- Upon completion, a dialog box appears, reporting a (possibly) successful completion of file transfers.



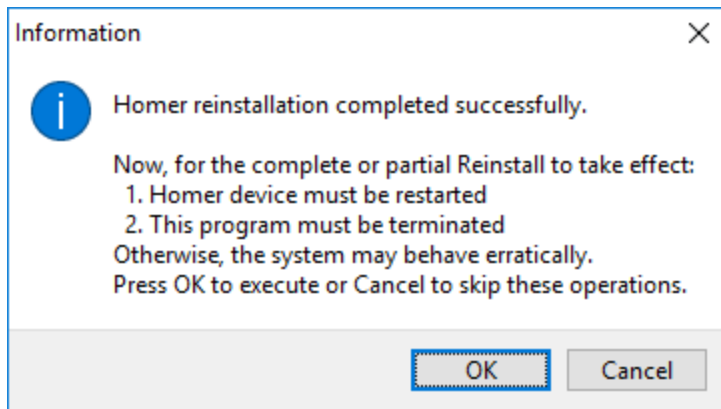
- If the **FileList** included the instruction to reprogram the motors controller, the next dialog box reports this (and offers the possibility to skip the step).



- Pressing OK starts the [Reprogram Motors](#) routine. After its completion, the outcome is shown in an information box.



- Following this, the final reinstall information will be displayed.



- On pressing OK, the Homer device will be restarted to accommodate the changes, and **HomTool** will be terminated.

Note: If the motors have been reprogrammed, please also consider editing the line

`MaxInsert_mm=22.7`

in the [Tun.cfg](#) file because it can limit the maximum stub insertion to a value lower than the absolute maximum that was just programmed.

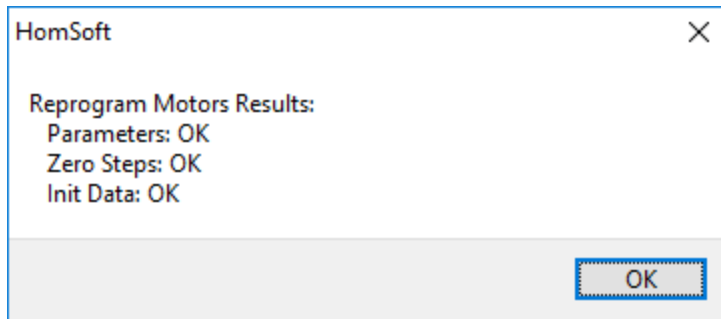
Reprogram Motors

Note: This routine is rarely required, as it is usually an automatic part of the **Reinstall** procedure.

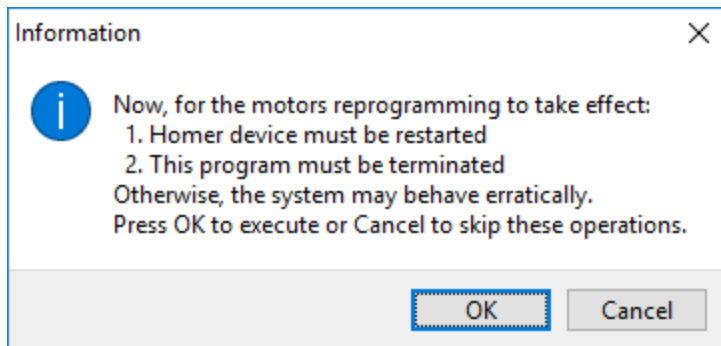
The **Reprogram Motors** takes the relevant motors data from the **Tun.mem** file and reprograms the motors controller accordingly.

Procedure

- The routine is started by clicking the **Tools | Reprogram Motors** menu item in a [reduced-functionality HomTool](#) servicing version of **HomSoft**.
- After confirming your intention to continue, the process begins. Upon its completion, the outcome is shown in a dialog box.



- Following this, the final reprogramming information will be displayed.



- On pressing OK, the Homer device will be restarted to accommodate the changes, and **HomTool** will be terminated.

Note: After reprogramming motors, please also consider editing the line

`MaxInsert_mm=22.7`

in the [Tun.cfg](#) file because it can limit the maximum stub insertion to a value lower than the absolute maximum that was just programmed.

WAVEFORM DETERMINING

This section describes procedures to determine:

- Generator signal waveform type (CW, high-ripple, pulsed) and its characteristics.
- Slow periodic variations in the load reflection coefficient (e.g., due to the mode stirrer rotation or similar effects).

For **HomSoft** versions V5.0.2.0 or higher, use the new, fully [automatic procedure](#).

For **HomSoft** versions older than V5.0.2.0 (down to V5.0.0.1), follow the instructions for a [manual procedure](#). The steps outlined can also be followed in the newer **HomSoft** versions; we recommend reading them to understand the process involved in the automatic procedure.

An analysis of the files created by either method is essential for appropriate Homer configuration, in particular, for the contents of the Homer internal [Hom.cfg](#) configuration file. Improper settings can lead to erroneous and fluctuating measurement results and incorrect (often chaotic) autotuning.

Once you know the waveform characteristics, the appropriate Homer settings can be made as

described in the [Signal Waveforms](#) subtopics.

Please also read [A Note on USB-RS232 Adapter](#).

Automatic Waveform Determining

This automatic procedure creates and zips the three files required for waveform determining. The procedure is detailed in the next topic for reference.

Before starting, set the tuning stubs to desired positions (usually All Home).

To run the procedure, click the **Tools | Waveform Sampling** menu item and follow the prompts.

The name of the generated zip file includes the date and time, having the form **WForm_yymmdd_hhmmss.zip**. The file is located in the [User Folder](#).

Once the zip file is generated, you can analyze the three included files or, if you need our support, e-mail the zip file to your vendor or to us.

Manual Waveform Determining

Preparation

- Open and scale the [standard display](#) windows, like incident and reflected powers, or reflection coefficient magnitude.
- Open the [Results](#) window by clicking **View | Results (Maxi)**.
- Open the [Tuner View](#) window ([Fig. 64](#)) by clicking the **Tuner | View** menu item or the  button.

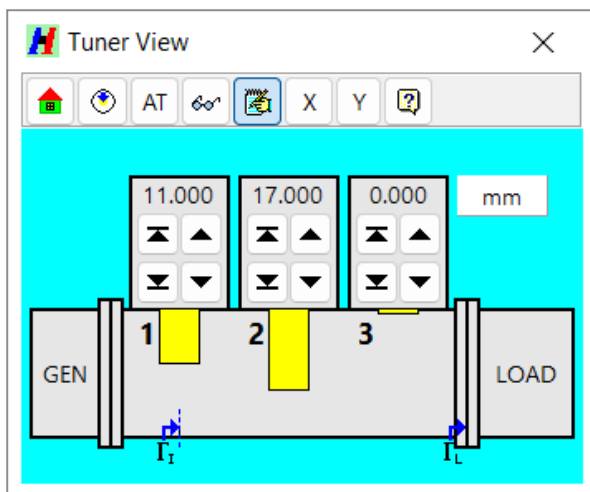


Fig. 64. Tuner View window.

- In the *Tuner View* window, disable autotuning (set the **AT** button to the inactive position).
- Retract the tuning stubs by clicking the  button. If your process does not permit fully retracted stubs but requires a pre-tuning instead, move the stubs to the desired positions.

- Choose the Decimal Separator: Click the **File | Separator** menu item and select your preferred separator in the submenu. (Please select **Point** if you want to report your results to us.)

The Separator will be stored in the **HomSoft** [Ini File](#) so that it remains the same after a **HomSoft** restart.

Data Sampling

Each individual set of results that the Homer produces is a result of processing a number of samples (Sample Count N_s , up to 4095). While the Homer normally transmits only the final results, the data sampling procedure described here enables you to view and analyze each particular sample. This analysis is essential for appropriate Homer configuration. (Please note that a continuous recording of *final* results is called [data logging](#).)

Make a fast, medium-speed and slow sampling as described below. The procedure is always the same; the difference is only in Homer measurement settings. The settings are summarized in [Fig. 65](#). The parameters in parentheses cannot be modified directly; they are provided for reference only.

It is good practice to make several attempts for each sampling type, if possible, at various generator power levels.

- **Fast sampling** records a 20-ms signal section with the highest sampling rate possible (200 kHz). The purpose is to identify the fastest frequency components in the power envelope detectable by the Homer. Individual samples are spaced by 5 μ s sampling steps. This setting will detect any frequency components derived from the power line frequency f_p (50 or 60 Hz) and its multiples, which typically reach $6 \times f_p$ or even $12 \times f_p$.
- **Medium-speed sampling** covers an interval of 200 ms with a slower sampling rate.
- **Slow sampling** records a two-second span of the signal. The purpose is to discover slow reflection coefficient variations, typically caused by mechanical movements in the applicator, such as a mode stirrer rotation or objects moving on a conveyor belt.

Parameter	Unit	Homer Sampling Setup window	Button	Fast	Medium	Slow
Waveform		Select tabsheet <i>Rectified</i>		Rectified		
Ripple frequency	Hz	Ripple Freq		50	50	50
No. of ripples to sample		Ripple Periods		1	10	100
Sample count		Sample Count		4001	4001	4001
(Sampling time)	ms	(Sampling Time)		20	200	2000
(Sampling rate)	Hz	(Sampling Rate)		200000	20000	2000
(Sampling step)	us	(Sampling Step)		5	50	500
Accept level	%	Accept Level		5	5	5
Frequency counting time	us	Count Time	Tc	16	992	992
Send samples		Send Samples		✓	✓	✓
Triggering level	%	Trig Level		50	50	50
Free Run		Free Run		✓	✓	✓
Single-shot		Single-Shot	1x	✓	✓	✓
Counter		Counter ON		✓	✓	✓

Fig. 65. Homer settings for data sampling.

Set Measurement Conditions

In the [Homer Sampling Setup](#) window, set the parameters according to [Fig. 65](#) (some parameters can be set via a corresponding button shortcut).

Now, the **HomSoft** main window may look like that in [Fig. 66](#) (only with empty displays).

Make Measurement

Start measurement by clicking the **Homer | Run-Pause** menu item or the corresponding  button (the button changes to ). Note that the slow sampling process requires approximately 5 seconds to complete measurement and an additional 15 seconds to transfer all 4001 samples. Observe the progress bar on the lower toolbar.

Upon completion, the **HomSoft** main window may look like that in [Fig. 66](#).

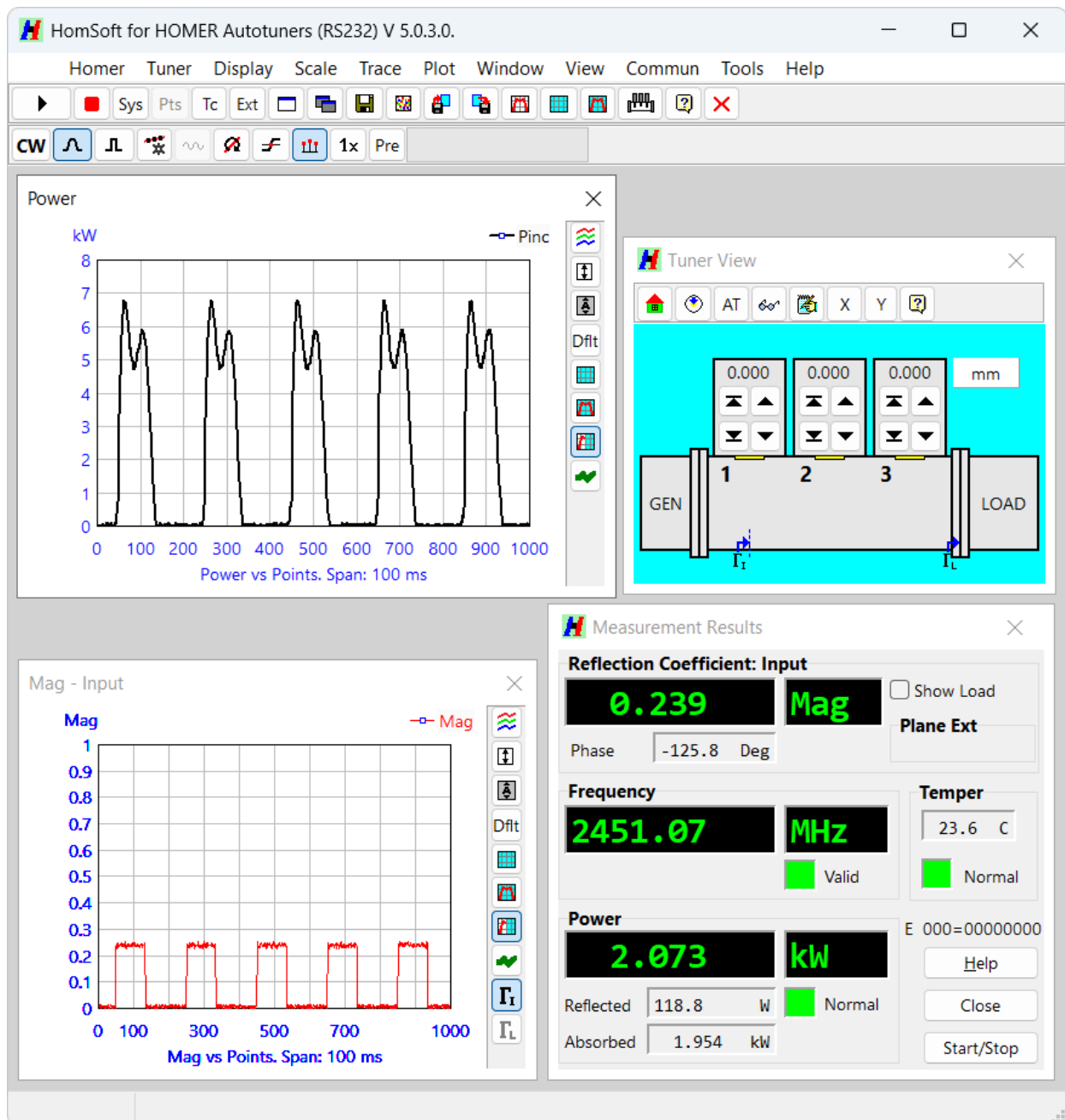


Fig. 66. Example of HomSoft main window after sampling.

Save Results

- Click the **File | Save Results** menu item or the  button, or use the **Ctrl+S** shortcut. A save dialog box opens.
- Choose the file name and location, then click **Save**.
- When prompted, enter an optional comment to be saved along with the data.

Repeat

You may wish to repeat the sampling and data saving process several times or in different

conditions (e.g., for various generator power levels).

Save Setup

As a useful option, save the existing **HomSoft** setup using the **File | Save Setup** menu item, the  button, or the **F2** shortcut. The file name may be, for instance, FastSmpl.stp for fast sampling. Next time, instead of setting each parameter manually, you can just load the setup file (using the **File | Load Setup** menu item, the  button, or the **F3** shortcut).

Compress and Send Files

If you need our support, complete all measurements as described above, compress (zip) the created text files and e-mail the zip file to us for analysis. (Zipping the files preserves their dates and times.)

PROBLEM REPORTING

To effectively analyze a Homer problem, S-TEAM requires additional information beyond a mere problem description. This self-contained section describes how to acquire and document such information using the **HomSoft** Windows visualization and control software.

The following sections describe a recommended step-by-step procedure.

System Identification

To identify your system, please do the following:

- Prepare a document file that will be sent to us, e.g., "MyProblem.docx".
- Power up the Autotuner from a 24 V DC power supply. Make sure that the power supply can deliver sufficient current (as specified in your Homer datasheet). You **do not** need microwave power for system identification.
- Start **HomSoft** (run, e.g., Tu_rs.exe). Copy any error messages to MyProblem.docx.
- Click the **Help | About** menu item. Make a printscreen of the **About** window to clipboard (**Win+Shift+S**).
- Paste the clipboard to MyProblem.docx (see the example in [Fig. 67](#)).

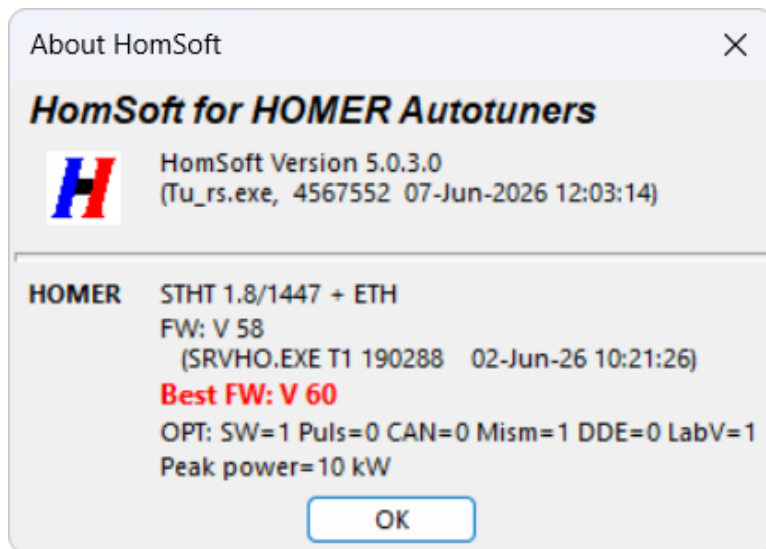


Fig. 67. About window example.

HomSoft Settings Identification

Some problems may be caused by inappropriate **HomSoft** settings or a corrupted **HomSoft Ini File**. Analyzing your setup can help us to locate the problem. Please proceed as follows:

- Exit **HomSoft**. Click **Yes**, not Abort in the confirmation dialog shown in [Fig. 23](#) (otherwise a **HomSoft Ini File** would not be written). Copy any error messages to the MyProblem.docx file.
- Locate the appropriate **HomSoft Ini File** in the Homer [User Folder](#), typically `c:\Users\<username>\S-Team\HomSoft`
- Check the timestamp of the file to verify that it is indeed the file just created.
- Pack this file (e.g., to IniFile.zip). The purpose is to preserve its original timestamp.
- E-mail this file to us along with the MyProblem.docx file created above.

Try Default Settings

Sometimes it may happen that the **HomSoft Ini File** has not been correctly written on **HomSoft** exit. To rule out the possibility that issues were caused by a corrupted file or a file with illegal data:

- Exit **HomSoft** if it is running.
- Delete the appropriate **HomSoft Ini File** in the [User Folder](#). Alternatively, you can just rename it, e.g., to **Orig.ini** for further analysis.
- Restart **HomSoft**. You will have to re-enter all parameters you wish to change. Observe whether the system behavior has returned to normal.

Download Internal Configuration Files

- Download the internal configuration files **Hom.cfg** and **Tun.cfg** from the Autotuner.
- Pack (zip) them to preserve their timestamps.

- Mail the zip file to us.

For details of the download procedure, refer to topic [Transferring Files](#), subsection [Loading Files from Homer](#).

Do Data Sampling

Even if you assume that your microwave signal is low-ripple continuous wave (CW), it can contain a considerable ripple component causing unstable results and unsatisfactory tuning. In addition, the load reflection coefficient often oscillates with periods of the order of 1 s. To investigate these effects, data sampling ought to be made. To do this, please proceed exactly as described in the [Data Sampling](#) subsection of the [Waveform Determining](#) topic.

Do Data Logging

Unlike [data sampling](#), data logging is the continuous recording of final measurement results transmitted by the Homer.

Perform data logging for about 5-minutes, both without and with autotuning (the former is more important). For the procedure, refer to section [Data Logging](#), applying the special settings as described below. Zip the log files and send them for analysis.

Logging without Autotuning

If, based on previous [data sampling](#) analysis and study of the [Signal Waveforms](#) topic, you are able to find acceptable Homer parameters (the most important being those in the [Homer Sampling Setup](#) window), adjust the Homer accordingly. In case of problems, consult us or leave the default settings. Then proceed as follows:

- In the **Tuner View** window, disable autotuning (set the  button to the inactive position).
- Move the tuning stubs to the home position by clicking the  button. If your process does not permit fully retracted stubs but requires a pre-tuning, move the stubs to the desired positions.
- Open the **Data Logging** window (click the **View | Logging Window** menu item) and adjust the settings as shown in [Fig. 68](#). Pay particular attention to the following parameters:
 - **Sampling Repetition Time:** 0 hours, 0 minutes, 0 seconds to perform the fastest sampling possible.
 - **Smpl/Event:** 1.
- Proceed with the remaining setup as described in [Data Logging](#).
- Run the measurement with logging for several minutes to properly cover the time span of your process.

You may wish to repeat the logging several times or in different conditions (e.g., for various generator power levels).

The screenshot shows the 'Data Logging' window with the following settings:

- TIMING:**
 - Logging Duration: 0 Days, 0 Hours, 0 Minutes, 0 Seconds
 - Sampling Repetition Time: 0
- LOG FILE - prepared:**
 - Name: MyLog.txt
 - Path: C:\Users\VBilik\S-Team\HomSoft\
 - Info: My test logging
 - Records: 0
 - Burst Size: 1
 - Separator: ☒ Point, ☐ Comma
 - Buttons: Prepare...
- PROGRESS:**
 - Recorded: 0
 - Elapsed: 00:00:00.00
 - Status: Ready
 - Buttons: Help, Start

Fig. 68. Data Logging window and suggested settings.

Logging with Autotuning

- In the **Tuner View** window, enable autotuning (activate the **AT** button).
- Proceed with the remaining steps exactly as described in Logging without Autotuning.

Test Your System with Defined Loads

If possible, connect several well-defined, stable loads at the Autotuner output flange and test the system with them. If the signal is not CW, set the sampling mode (*Waveform*) and sampling parameters appropriately to get stable results (see topic [Signal Waveforms and Sampling](#) and related topics).

Recording Results

In all measurements suggested below, you may employ data logging as described in [Do Data Logging](#), or just save the results using the **File | SaveResults** menu item, the  button, or the **Ctrl+S** shortcut key.

Matched Load

- Connect a matched load (waterload).
- Switch autotuning OFF and retract the tuning stubs.
- Start measurement, observe and note the results. The measured reflection coefficient should be close to zero (depending on the waterload quality, the reflection coefficient magnitude should not exceed 0.05 to 0.1).

- Switch autotuning ON and watch the stubs move to positions to improve the match below the set **Tolerance** (settable in the [Autotune](#) page of the [System Info](#) window).

Flat Short

- Connect a flat short (a shorting plate).
- Switch autotuning OFF.
- Open the [full-size Results Window](#) and check *Show Load*.
- Start measurement, observe and note the results. The measured load reflection coefficient magnitude should be close to unity (typically 1 ± 0.05) and the phase should be close to 180° (within a few degrees).
- Do not attempt to start autotuning with such high-reflection loads.

Mismatch

- If possible, set up a stable mismatched load with the reflection coefficient magnitude of about 0.5. For example, it can be a waterload preceded by a manual tuner.
- Switch autotuning OFF.
- Start measurement, observe and note the results.

Switch autotuning ON and watch the stubs move to positions to improve the match below the set **Tolerance**.