

**User's Handbook**

# **Homer Hot Measurement and Tuning System**

**S-TEAM**

This manual was produced using *MadCap<sup>®</sup> Doc-To-Help*.

# Contents

<b>Introduction</b>	<b>1</b>
Welcome to Homer!.....	1
New Users.....	2
Accompanying Literature .....	2
Reporting Problems .....	2
Key Features .....	3
Homer Analyzer and Autotuner.....	3
HomSoft Windows Visualization and Control Software .....	3
Inside Homer .....	4
Homer Versions .....	6
Measurement Accuracy .....	7
Measurement Uncertainty Example.....	8
Input and Load Reflection Coefficients, Deembedding.....	9
Deembedded Reflection Coefficient Accuracy Considerations.....	10
 <b>Installation</b>	 <b>13</b>
Mechanical Installation.....	13
Electrical Installation – RS232/RS422 .....	13
Equipment.....	13
Connection.....	14
COM Port Settings.....	14
Electrical Installation – CAN Bus .....	15
Equipment.....	15
Connection.....	15
HOMER Signal Connectors.....	16
RS232 Connector.....	16
RS422 Connector.....	17
CAN Bus Connector .....	17
Remote Connector – Standard Pinout.....	18
Remote Connector – Special Pinout .....	18
Power Supply Issues .....	18
TRIAD Connector .....	19
DIN Connector.....	19
<i>HomSoft</i> Software Installation .....	19
To Install <i>HomSoft</i> from Compact Disk or USB Flash Disk .....	20
To Install <i>HomSoft</i> from Installation Package .....	20
S-TEAM Installation Folder .....	20
User Folder .....	21

Homer Internal Files .....	21
Server Program (.exe) .....	21
System Memory Files (.mem).....	21
System Configuration Files .....	22
File Transfer Utility (SrvDld.exe) .....	23
Other Files .....	23
Software Upgrades.....	23
<b>Homer Start .....</b>	<b>25</b>
Homer Operation Modes .....	25
Using <i>HomSoft</i> Windows Software .....	25
Autonomous Operation.....	25
Choosing Homer Power-Up Server .....	26
Tera Term: An Alternative to Hyperterminal .....	28
Format of RS232 Results .....	28
Binary Results Format .....	29
ASCII Results Format.....	29
Configuring Communication .....	30
Establishing Communication .....	31
Case of RS232 .....	32
Case of CAN Bus.....	33
Problems with Communication .....	35
Morse Code Messages .....	36
Morse Code Messages Examples .....	36
<b>Software Operation .....</b>	<b>39</b>
Program Windows .....	39
Display Windows.....	40
Display Speed Considerations .....	41
Main Elements of Display Windows .....	41
Display Windows-Related Commands .....	42
Display Window-Related Menu .....	43
Chart Scaling .....	44
Rectangular Displays .....	45
Circular Displays .....	45
Buttons.....	46
Trace Properties .....	46
Trace to Edit Panel.....	47
Line Panel .....	47
Markers Panel .....	47
Other Controls .....	48
Tips for Circular Displays.....	48
Screen Annotation.....	49
Caption.....	49
Date/Time Stamp .....	49

Labels.....	49
Limit Line .....	50
How to Use the Program.....	51
Tuning.....	53
How to Start and Stop Sweeping .....	53
Start Sweeping .....	53
Stop Sweeping .....	53
Homer Error Byte .....	54
<i>Low Signal</i> Warning .....	54
Results Windows .....	55
Full-Size (Maxi) Results Window .....	55
Reduced-Size (Mini) Results Window .....	56
How to Save Measured Results .....	57
Saving Results to a Text File .....	57
Saving Results as a Picture .....	58
Data Logging .....	59
Customizing Homer.....	61
Controlling the Creation of Ini Files.....	61
Backup Setup Files .....	61
Corrupted Ini Files.....	62
User Setups .....	62
Transferring Files.....	62
Sending Files to Homer .....	62
Upgrading Server Program .....	63
Loading Files from Homer .....	63
Homer Resets.....	64
Create CFG .....	65
<b>Signal Waveforms</b> .....	<b>67</b>
Signal Waveforms and Sampling .....	67
Triggering, Free Run, Timeout .....	68
Sample Count, Sampling Rate, Sampling Time .....	68
Accept Level .....	69
Modes of Signal Sampling.....	69
CW Signal Sampling .....	70
Rectified Signal Sampling .....	72
Pulsed Signal Sampling .....	74
Displaying Individual Samples .....	76
Homer Sampling Setup Window .....	76
Mode Stirrer .....	77
<b>Autotuner</b> .....	<b>81</b>
Matchable Area.....	82
Limiting Stub Insertion.....	82
Truncating the Matchable Area .....	83

Studying Matchable Area .....	84
System Info Window .....	86
Homer and Tuner Pages.....	86
Motors.....	86
Autotune .....	86
Sketch .....	89
Tuner View Window .....	89
Stub Movement.....	90
Autotuning Activation .....	91
Reference Planes.....	91
Stubs Motion Scenario.....	91
Creating and Editing Scenarios.....	92
Scenarios realizing sequences of predefined reflection coefficients .....	94
Saving and Loading Scenarios.....	94
Running Scenarios without Measurement .....	94
Running Scenarios with Measurement .....	95
Scenario Output Files .....	95
Hysteresis.....	96
<b>HomSoft Menu</b> .....	<b>101</b>
File Menu.....	101
Homer Menu .....	102
Run/Pause .....	102
Stop Homer.....	102
Finish Sweep.....	102
Show Available.....	102
Sampling Setup.....	103
TX Timing .....	103
Timing Background.....	103
Points per Sweep.....	105
Plane Ext.....	105
Transform .....	105
Counter .....	105
Count Time .....	106
Freq Toler .....	106
Substit Freq.....	106
MultiCAN.....	106
More.....	106
Tuner Menu .....	107
Display, Scale, Trace, Chart Menus.....	108
Window Menu .....	108
Model Menu.....	109
View Menu .....	109
Commun Menu .....	109

Tools Menu .....	109
Help Menu .....	110
<b>Homer Simulation</b>	<b>111</b>
Homer Model Window .....	112
DUT Page .....	112
Chart .....	113
Animation Page .....	115
Freq/Power/Temp Page.....	116
Real Tuner Performance .....	117
To load a Tuner configuration: .....	117
To test the performance of your Tuner: .....	118
Sequences of Predefined Reflection Coefficients .....	118
Example 1: Combined Rectangular-Trajectory Scenario .....	121
Example 2: Simple Circular-Trajectory Scenario .....	121
Example 3: Combined Circular-Trajectory Scenario .....	122
<b>Advanced Topics</b>	<b>123</b>
Homer Analyzer Starting Parameters .....	123
Homer Autotuner Starting Parameters.....	125
Fast Frequency Measurement .....	126
MultiCAN: More Homers on CAN Bus .....	126
Homer.cfg Configuration File.....	127
MultiCAN Menu.....	128
MultiCAN Connection.....	129
Using Windows Virtual Machines.....	130
Power Measurement Calibration Factor .....	130
Single-Shot Commands Window.....	132
HOMER Group.....	133
TUNER Group.....	133
DDE Server.....	134
Homer DDE Results .....	135
Importing to Excel .....	136
Sample DDE Client .....	136
Transforming Input Reflection Coefficient .....	137
Active.....	138
Load .....	138
Clear.....	138
Format of Scattering Parameters Text Files.....	138
Comment Lines.....	139
Info Line .....	139
Header Line .....	139
Frequency Unit .....	139
Data type.....	139
Data Lines.....	140

Homer Firmware Update/Reinstallation .....	140
Reinstall .....	140
Reprogram Motors .....	142
<b>Waveform Determining .....</b>	<b>145</b>
Preparation .....	145
Data Sampling .....	146
Set Measurement Conditions .....	146
Make Measurement .....	147
Save Results .....	147
Repeat .....	147
Save Setup .....	147
Compress and Send Files .....	148
<b>Problem Reporting .....</b>	<b>149</b>
System Identification .....	149
<i>HomSoft</i> Settings Identification .....	149
Try Default Settings .....	150
Download Internal Configuration Files .....	150
Do Data Sampling .....	150
Do Data Logging .....	150
Logging without Autotuning .....	150
Logging with Autotuning .....	151
Test Your System with Defined Loads .....	151
Matched Load .....	151
Flat Short .....	151
Mismatch .....	152
<b>Index .....</b>	<b>153</b>



# Introduction

This Help/Handbook is Version 5010-59. It describes:

- Usage of *S-TEAM Homer Windows Visualization and Control Software*, dubbed *HomSoft*.
- Topics important for understanding, installation, and upgrading of the **Homer** measurement and autotuning systems.

The *HomSoft* version dealt with in this document has been created for Microsoft Windows 7 and higher operating systems. Important differences compared to Windows XP include among others user [working directories](#) (i.e., where the user files are stored). Main differences will be pointed out at appropriate locations in the document.

The following sections provide essential informaton 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:

- You can invoke Help topics related to the majority of the program windows and dialog boxes by pressing **F1** keyboard key. The same is true for some of the main menu items. Also, many of the program windows and dialog boxes contain **Help** button.
- Invoking Help in most cases minimizes the *HomSoft* application. If this is not the case and the Help window is obscured by *HomSoft* windows, please minimize the app (click the title bar "minus" icon on the top right of the main *HomSoft* window or, alternatively, use the shortcut *Windows logo key* + *Down arrow*). After closing the Help window, restore the *HomSoft* app.
- Currently, the *HomSoft* program windows do not appear satisfactorily on very-high definition monitors (e.g., notebook 4K displays). In such cases, please reduce the monitor resolution: for instance to 1920 × 1080. You can do it, among others, by right-clicking the desktop surface and choosing **Display settings**.

---

## Welcome to Homer!

The software described in this document is related to the following measurement, tuning, and autotuning systems:

- Homer Analyzer
- Homer Mototuner
- 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 combining Homer Analyzer and Homer Mototuner. Autotuner can be a compact one-piece unit, or a two-piece device consisting of separate Analyzer and Mototuner. Autotuner combines functionalities of Analyzer and Mototuner and, more than that, can serve for autonomous or externally controlled automatic impedance matching of time-varying loads.

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

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 optional *HomSoft* Windows SW, running in your PC and enabling easy control and monitoring of Homer. The two programs cooperate via a communication link, which can be RS232, RS422 or CAN Bus (communication protocol is the same for RS232 and RS422, hence the two will be treated as one).

Without *HomSoft* option, you still have access to Server functionalities by writing your own program for PC or PLC using the published communication protocol (part of Homer documentation).

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 to you for editing.

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

## New Users

For new users of the system and *HomSoft* software, the best start is to study User's Handbook or this Help systematically, i.e., topic by topic as they appear sequentially in the Table of Contents, or using the **Forward** and **Back** browsing buttons. In this way a global overview will be acquired and you will become 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, some of the dialog boxes have **Help** button, which opens a related help topic.

For training purposes, the best way is to use 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 look into [Homer Communication Protocol](#).

## Accompanying Literature

- Homer Hot Measurement and Autotuning System: User's Handbook (*HomerHbookxxxx\_y.pdf* where *xxxx\_y* stands for version number).
- Homer RS232 and CAN Bus Communication Protocol (*HoComProtoxx\_y.pdf* where *xx\_y* stands for version number).
- Application Notes (part of *HomSoft* installation or downloadable from <https://www.s-team.sk/docs>).

## Other Sources

- *Power Transmission Theory and Calculator* (downloadable from <https://www.s-team.sk/software>).
- *Six-Port Measurement Technique: Theory and Applications* (downloadable from <https://www.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 to accurately measure under full-power operating conditions of magnetron-based microwave generators:

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

The system is capable of handling 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  $\mu$ s (**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 serve 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 controlling 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 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
- Allows designing, adjusting, or programming equipment to desired characteristics
- Maintains design specifications during manufacturing
- Gives on-line control of microwave processes

### HomSoft Windows Visualization and Control Software

- Visualization of measured complex reflection coefficient in various formats, including
  - Magnitude
  - Phase angle
  - Return loss
  - VSWR
  - Polar display
  - Smith charts (impedance and admittance)
  - Rieke-type chart
- In 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 displaying 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, GIF, and JPG)
- Periodic data logging of all or some of the measured quantities
- Multiple windows enable to observe the same results in different formats simultaneously
- Wide selection of appearance of displayed curves
- Storing and retrieving of complete system settings adapted to particular tasks

---

## Inside Homer

A block diagram of a generic Homer Autotuner is shown in [Figure 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 Mototuner, enabling thus the design of fast, compact Autotuners.

SPR computes from voltages obtained by its four amplitude detectors:

- Complex reflection coefficient  $\Gamma$  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  $\Gamma$ , 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.



Figure 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  $60^\circ$ ), with  $\lambda_g$  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 I<sup>2</sup>C bus. The corrected voltages along with signal frequency and stored SPR calibration data are used to compute the reflection coefficient  $\Gamma$  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  $\mu$ s plus the triggering built in the SD-2000 software enable reasonable measurement even of pulsed signals with pulse duration down to about 100  $\mu$ 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 [Figure 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 Homer startup behavior. One of the Server program at a time runs in SBC, 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 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 the configuration files can be transferred from one Homer to another to assure the same startup behavior, the memory files are strictly individual. An attempt to transfer them to a non-native Homer results in raising Homer Identity Error and refusal to perform except some basic operations like file transfers.

More about the firmware see 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 also 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 positioning of indicator LEDs

This document cannot cover details of each type. The particulars of individual types can be found in the published catalog sheets. In case of 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 diagram around the measured reflection coefficient  $\Gamma$  (see [Figure 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. 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/and its typical value.

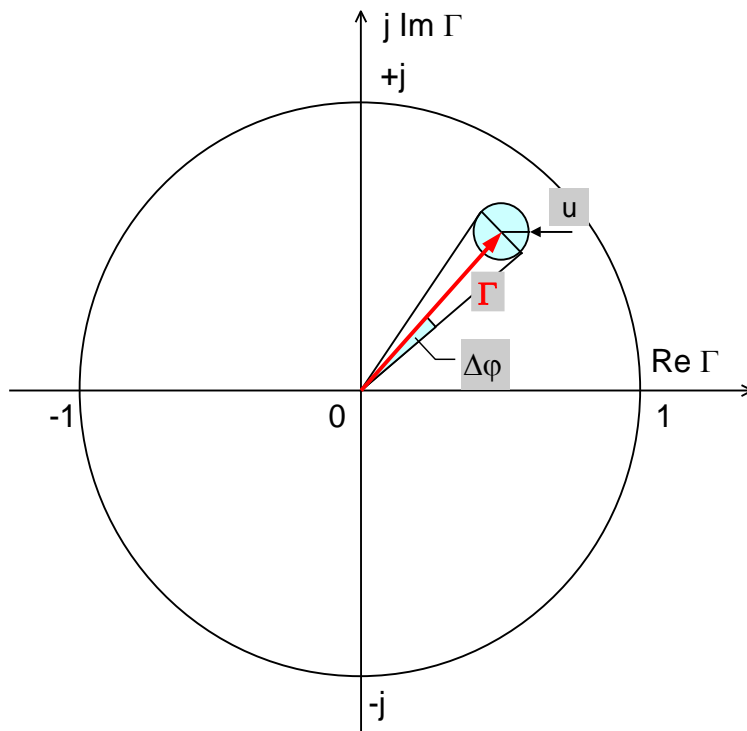


Figure 2. Reflection coefficient uncertainty circle.

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

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

$M$  being its modulus (absolute value, magnitude) and  $\varphi$  the phase angle in degrees, then these are uncertainty limits for various quantities of interest:

### Reflection coefficient modulus

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

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

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

### 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  $M \gg u$ . Clearly, given a value of  $u$ , the phase angle uncertainty grows when the reflection coefficient magnitude decreases. For  $M < u$ , phase angle loses meaning at all.

### Return loss R

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

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

### Voltage standing wave ratio V

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

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

### 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 cannot practically be defined.

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

### Measurement Uncertainty Example

An example of return loss uncertainty considerations is depicted in [Figure 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  $R_x = -20 \log(M_x) = -20 \log(0.08) = 21.94$  dB, which is approximately the 22 dB obtained from the graph.



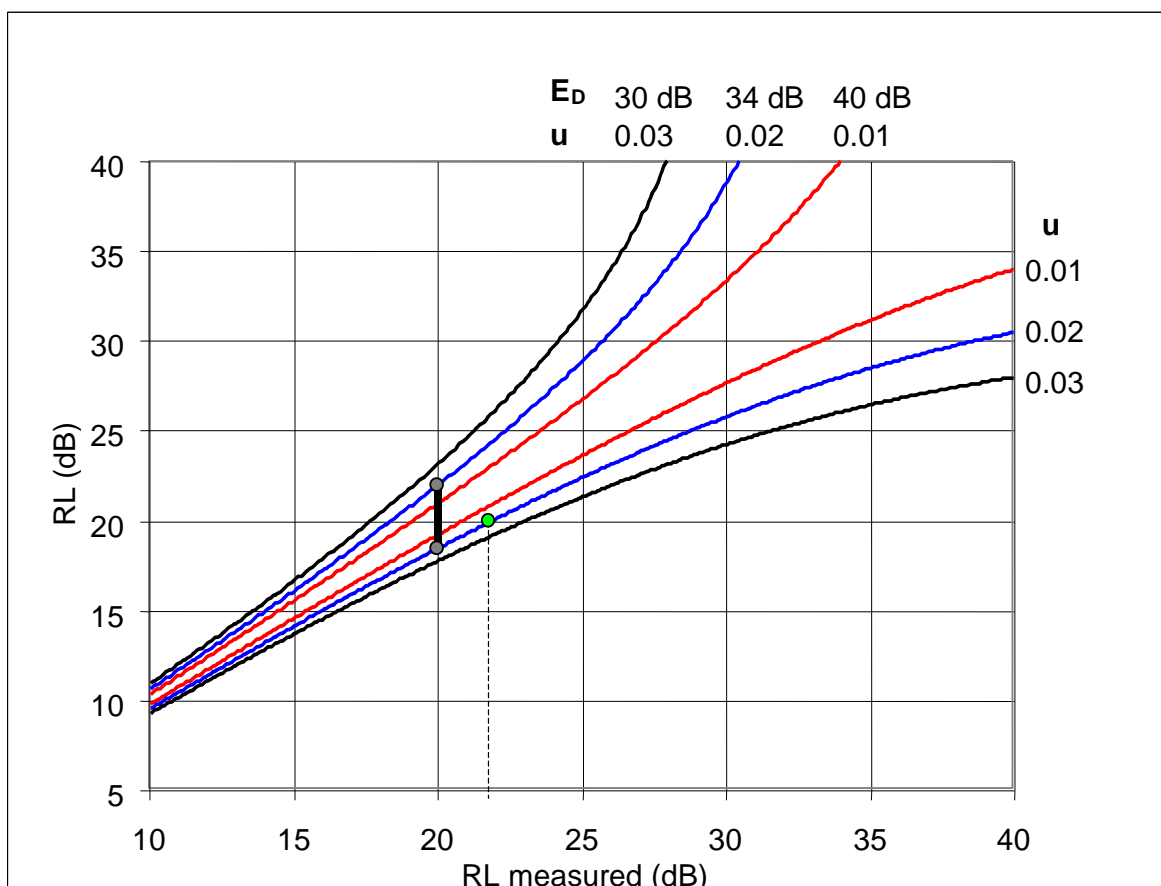


Figure 3. Uncertainty circle radius and its effect on return loss measurement error.

## Input and Load Reflection Coefficients, Deembedding

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

- Input reflection coefficient  $\Gamma_I$
- Load reflection coefficient  $\Gamma_L$

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

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

### Input Reflection Coefficient

**Input** reflection coefficient ( $\Gamma_I$ ) is the quantity seen at the tuner input. It is identical with or very close to reflection coefficient  $\Gamma_M$  inherently measured by the Analyzer part of Autotuner. For impedance match,  $\Gamma_I$  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 [Figure 4](#)).

### Load Reflection Coefficient

**Load** reflection coefficient ( $\Gamma_L$ ) 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 [Plane Ext](#) item of **Homer Menu**). For zero shift, load reference plane coincides with the output flange of Homer, be it the Autotuner (see [Figure 4](#)) or the Analyzer alone.

## Transformed Input Reflection Coefficient



**Input** reflection coefficient ( $\Gamma_I$ ) can be, before displaying, subject to a user-defined *bilinear* transform, accounting for instance for a circuit 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  $\Gamma_I$  generally differs from the load reflection coefficient  $\Gamma_L$ . 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  $\Gamma_L$  of your applicator without need of physically retracting the stubs. This is why in 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 window.
- Click **Trace|Show Load** menu item, *or*
- Depress either  or  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 **Show Load** menu item in the pop-up menu.

## Deembedded Reflection Coefficient Accuracy Considerations

If tuning stubs of Autotuner are inserted, they can mask the deembedded (load) reflection coefficient  $\Gamma_L$  in the sense that large variations of  $\Gamma_L$  may cause only small variations of the measured input reflection coefficient  $\Gamma_I$ . This is because the main reflection contributor may be the stubs themselves rather than load (see [Figure 4](#)). The corresponding areas in the Smith chart can be easily 10:1 in size if the stubs are deeply inserted. Deembedding the reflection coefficient (removing the effect of tuner from  $\Gamma_I$  to arrive at  $\Gamma_L$ ) means the opposite process: we try to transform those small variations of  $\Gamma_I$  to large variations of  $\Gamma_L$ . Therefore, also a small error  $u_I$  in determining  $\Gamma_I$  will be “blown up” and can cause great error  $u_L$  in the determining of  $\Gamma_L$ . If you keep the actual load reflection coefficient constant and move stubs to deeper positions, the displayed deembedded  $\Gamma_L$  should ideally also remain constant. In fact, due to this “blown-up” measurement error the displayed  $\Gamma_L$  will more or less vary. You can gain a feeling for what you may expect by performing such experiment.

Since autotuning is based on such indirectly obtained  $\Gamma_L$ , 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 correct way is improving your applicator or generator.

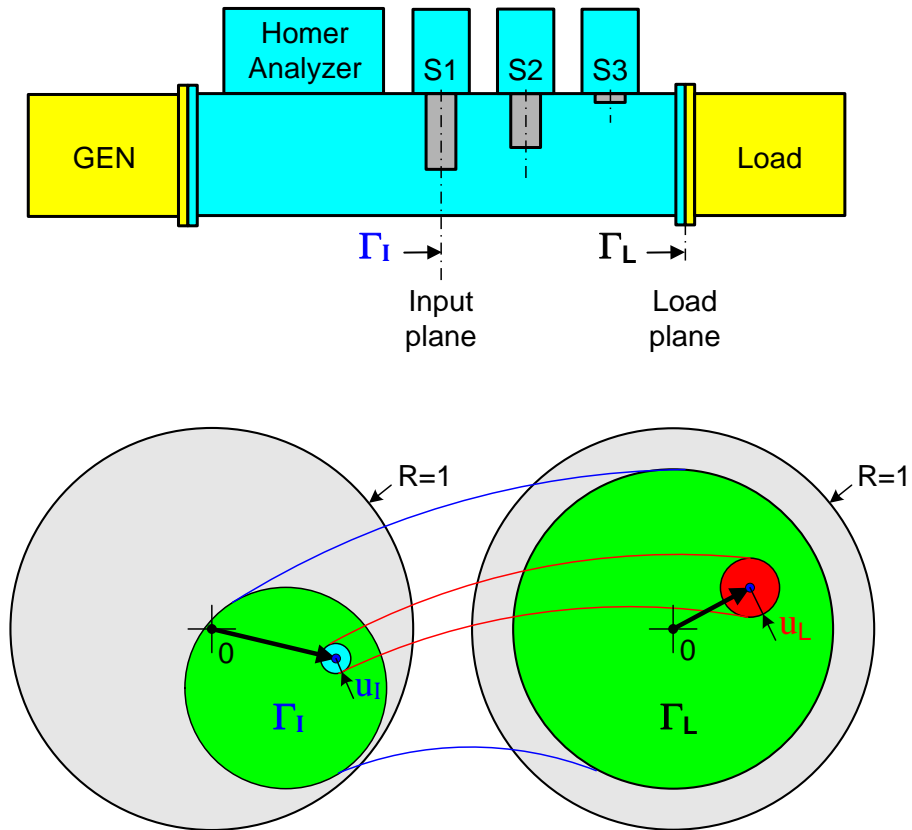


Figure 4. Load (deembedded) reflection coefficient measurement error  $u_L$ .



# Installation

Homer installation consists of the following basic steps:

- ✓ Mechanical installation
- ✓ Electrical installation, 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 Homer should be inserted (Load Plane). **For best performance, Homer should be installed as close to the load (applicator) as possible.**
- Separate the microwave system at Load Plane such that Homer can fit in the space.
- Insert Homer such that the **DUT** label on its nameplate faces the load (applicator, workspace) and the **GEN** label faces the generator (magnetron).
- Fix Homer using appropriate screws. Use washers on both sides. Use all screws.
- If your Homer is a water-cooled model, install water cooling hosepipes.

---

## Electrical Installation – RS232/RS422

### Equipment

- Homer (as a standard equipped 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 95 or higher operating system (optimally Windows 7 or higher).
- RS232- or RS422-to-PC adapter (e.g., RS232–USB) if your PC is not equipped with RS232 or RS422 port. Please read also [A Note on USB-RS232 Adapter](#).
- Standard serial RS232 cable (null modem – i.e., with crossed TX-RX wires).

## Connection

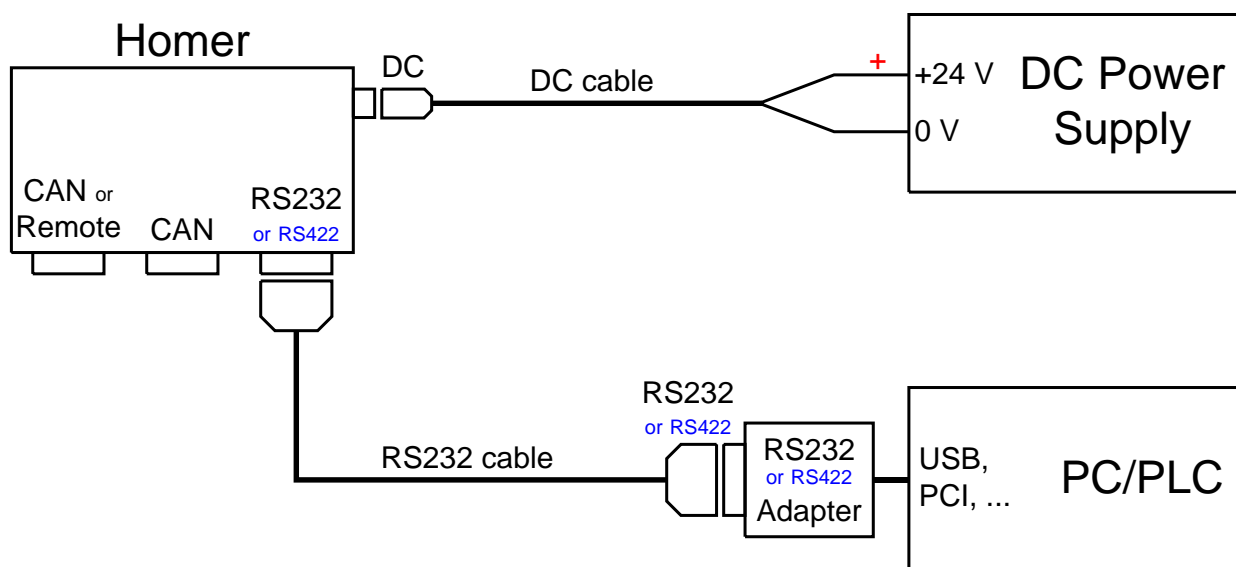


Figure 5. Homer wiring diagram using RS232/RS422 interface.

### Notes

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

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

### Homer COM Port Settings

You cannot influence 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 [Com Port Setting](#) dialog window. The window can be opened by clicking the **Commun|COM Port** menu item.

# Electrical Installation – CAN Bus

## Equipment

- Homer (must be provided with CAN Bus 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 CAN USB Light Dongle](#)
- Standard CAN Bus cable.

## Connection

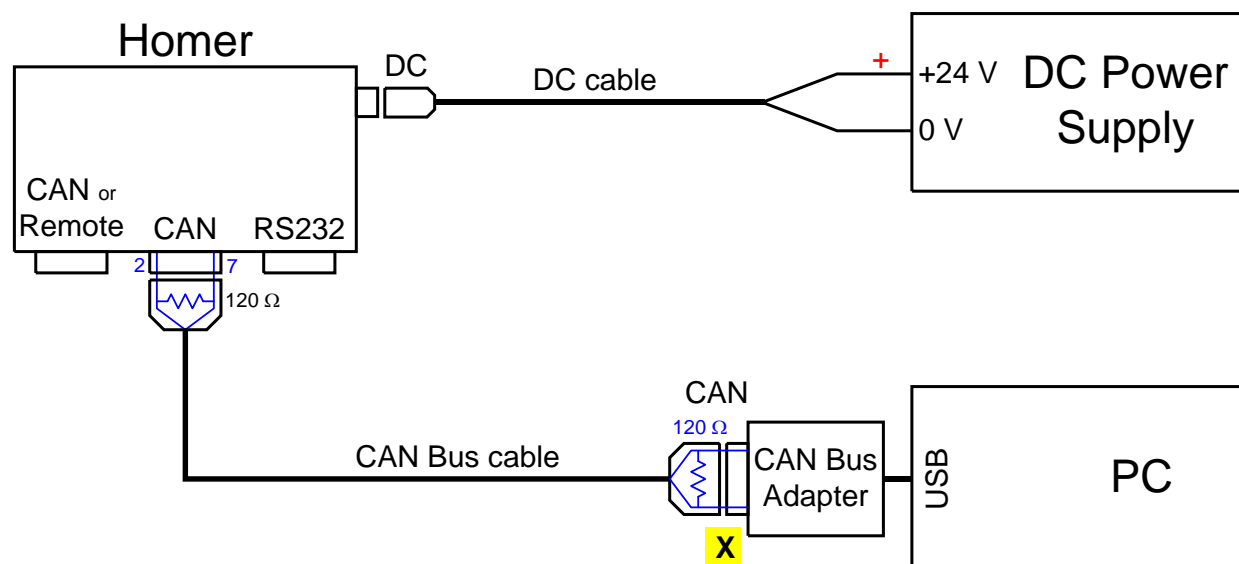


Figure 6. Homer wiring diagram using CAN Bus interface.

## Note on CAN Bus Adapters

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

**If using the Sontheim CAN USB Light Dongle**, copy the **CanApi.dll** file from the Dongle installation CD to any of the following folders:

- Windows central location for shared dlls (something like c:\Windows\System32). This is the best way, covering once for all *HomSoft* upgrades and all users. 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 is something like
 

```
c:\Users\<username>\S-Team\HomSoft (Windows 7 and higher)
c:\Documents and Settings\<username>\S-Team\HomSoft (Windows XP)
```

*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 other action is needed.

### Note on CAN Bus Cable Termination

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

The Homer's CAN Bus is not internally terminated (unless you expressly specify it in your order). In case of doubt, simply measure the resistance between pins 2 and 7 of a Homer CAN connector. If 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).

The CAN USB Light Dongle 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 ([Figure 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.

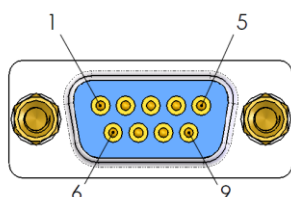
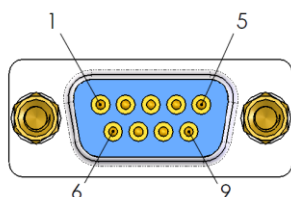


Figure 7. D-sub DE-9 connector pin numbering (front view).

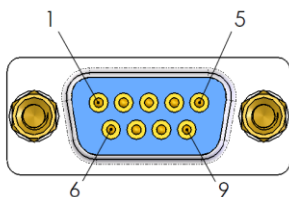
### RS232 Connector



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

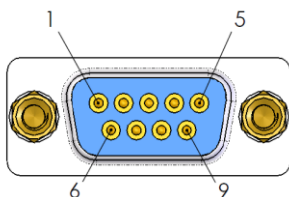


## RS422 Connector



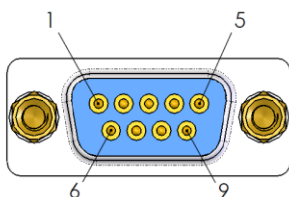
Pin	Signal	Description
1		
2		
3		
4		
5		
6	RX+	Received Data +
7	RX-	Received Data -
8	TX-	Transmitted Data -
9	TX+	Transmitted Data +

## 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		

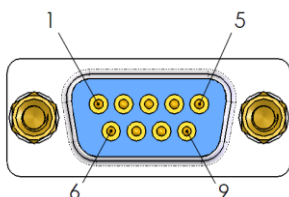
## Remote Connector – Standard Pinout



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

The standard pinout is used when a remotely controlled action is to be controlled by 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

The optional special pinout is used when a remotely controlled action is to be controlled by a voltage (24 V) applied between pins 5 and 9.

---

## Power Supply Issues

Homer is powered from a DC supply 24 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:

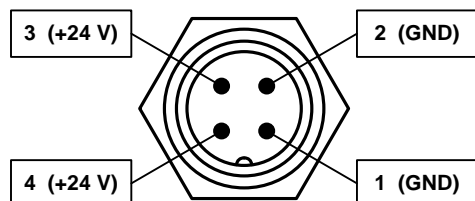


Figure 8. TRIAD power supply connector (front view).

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:

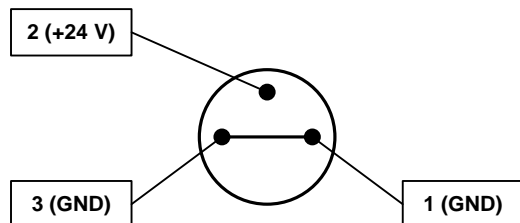


Figure 9. DIN power supply connector pinout.

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 Homer Windows Visualization and Control Software*, use the installation CD or another medium, such as USB flash disk, or an installation file downloaded from a web site. The procedure is a standard routine for installing Windows programs as described below.

*HomSoft* consists of

- Executable Windows Visualization & Control programs **Tu\_rs.exe** (for RS232) and **Tu\_can.exe** (for CAN Bus); these are the main SW components, also referred to as *HomSoft applications*. *Starting one of these programs will be referred to as starting HomSoft.*
- Other executable programs (e.g., demo HoSim.exe, file transfer Dwnload.exe)
- Auxiliary files defining programs operation
- Documentation

## To Install *HomSoft* from Compact Disk or USB Flash Disk

- Insert the compact disk or the USB flash disk into your PC.
- If the installation does not start automatically:
  - Locate the Setup.exe program. It is normally found in a folder like  
`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 be typically downloaded from a web site or sent to you via e-mail. The files are structured as on the compact disk.

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

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

## 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 equally named (*HomSoft*) subfolder of the S-Team installation folder.

## HomSoft Folder

In *HomSoft* folder, a structured subfolder for each particular SW version is created, containing the basic Windows application files (**Tu\_rs.exe**, **Tu\_can.exe**), 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 Homer (see section [Transferring Files](#), subsection Upgrading Server Program).

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

The shortcuts created by the installer will point at 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).

<b>c:\Program Files\S-Team</b>	
<b>\HomSoft</b>	PC software folder
<b>\Ver4010</b>	Folder for SW Version 4.0.1.0
<b>\Documents</b>	Documentation, sample codes
<b>\Demo</b>	HoSim simulation program and accompanying files
<b>\DDE</b>	Sample DDE client
<b>\Server</b>	Archive for server programs optimal for this HomSoft version
Tu_rs.exe	Windows Visualization & Control Program (RS232)
Tu_can.exe	Windows Visualization & Control Program (CAN Bus)
Dwnload.exe	Windows file transfer program (RS232)
Homer.cfg	MultiCAN configuration file

```

Help system
(Other files)
\Ver5001
...
Folder for SW Version 5.0.0.1

```

## User Folder

The *User Folder* is the default location for reading and writing data by *HomSoft* applications. It was introduced in *HomSoft* version V5.0.0.0, created for Windows 7 operating system.

- Most importantly, the User Folder contains the **Ho0.ini** setup file, to which majority of *HomSoft* settings are automatically stored on its termination. When you start *HomSoft* the next time, the **Ho0.ini** file is loaded back and the program appears in the same state as when you left it.
- 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 (Windows 7 and higher)
c:\Documents and Settings\<username>\S-Team\HomSoft (Windows XP)

```

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

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

```

c:\Users\<username>\S-Team\HoSim (Windows 7 and higher)
c:\Documents and Settings\<username>\S-Team\HoSim (Windows XP)

```

## Note on Earlier HomSoft versions

In *HomSoft* versions earlier than V5.0.0.0, the default location for HomSoft configuration files as well as user-created files (setups, results, log files) was the *HomSoft* installation subfolder where *exe* applications files were stored. A typical path example for *HomSoft* V4.0.6.2 is

```
c:\Program Files\S-Team\HomSoft\Ver4062
```

With introduction of Windows Vista and later this caused problems because files could not be written to this folder without special user privileges. Instead, the files were redirected without warning to a substitute folder, typically

```

c:\Users\<username>\AppData\Local\VirtualStore\Program Files\S-
Team\HomSoft\Ver4062

```

where AppData was normally an invisible folder. So, it was very difficult even for a skilled user to locate the files.

---

## Homer Internal Files

This section describes the structure of the *firmware*, which is a system of files that reside inside 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, Homer is furnished with all the necessary software components and ready to be used. You only have to install *HomSoft* in 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 Homer. For details, see [Transferring Files](#).

Homer Internal Files can be classified as follows:

### Server Program (.exe)

Server program (*Server*) is the basic Homer executable file. The program is automatically started when Homer's DC power supply is switched ON. The server filename is **SrvHo.exe**. The file can be uploaded (sent) to 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 a Homer, including its calibrations and options
- Factory default settings

Server reads these files the first thing after start. The files are not editable; they are produced by the manufacturer. New mem files can be uploaded to Homer, e.g., after a recalibration, adding options or limiting tuning stubs travel distance. The mem files include:

- **Hom.mem**: Homer Analyzer memory file; it contains among others detectors correction data and Homer frequency 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 Server detects a non-native mem file, the Homer Identity Error is raised. Then the following happens:

### Newer Server versions (V54 and more):

If Homer Identity Error occurs, Server announces this by playing [Morse code error message IDE](#), followed by a standard Morse message. Server does not terminate but sets itself in a mode with reduced command set, which does not allow measurement or motor movements, but principally only file transfers so that you are able to remedy the situation.

### Older Server versions (V53 and less):

If 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 files *are text files containing user-definable Homer settings*. Server program reads configuration files *after* reading memory files and copies their settings to its volatile memory. Configuration file settings therefore override the factory defaults and eventually determine Homer power-up behavior. This is important in particular for autonomous Autotuner operation.

The structure of the configuration files is that of Microsoft Windows **ini** files, consisting 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 Homer, modified and sent back (uploaded). In this manner, startup Homer behavior can be altered by the user.

The upload and download can be realized by:

- **HomSoft**
- **HomTool** servicing version of HomSoft. **HomTool** is an automatic, complimentary part of Homer installation.

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 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 needing to be modified.
- **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

A *HomSoft* application (running in a remote PC) has its own settings, stored in **Ho0.ini** setup file in [User Folder](#). When *HomSoft* starts, as the first step it retrieves via communication link actual Homer parameters.

If there is no Ho0.ini file in User Folder, *HomSoft* settings reflect current Homer state (typically its power-up settings).

If Ho0.ini file exists, *HomSoft* continues by the following steps:

- Reads settings from Ho0.ini file
- Overwrites by commands via communication link existing Homer settings by these new settings

You can then further change individual Homer settings manually by *HomSoft* commands.

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

If you want to learn Homer starting parameters without having to resort to downloading and analyzing the cfg files, rename Ho0.ini temporarily, restart Homer, then start *HomSoft* and browse *HomSoft* settings.

## File Transfer Utility (SrvDld.exe)

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

## Other Files

Other auxiliary files of various types serve various purposes, such as managing the startup process and switching between RS232 and CAN Bus communication.

---

## 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 Homer:

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

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





# Homer Start

After completing the installation, Homer can be switched on.

---

## Homer Operation Modes

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

## Using *HomSoft* Windows Software

- Turn on your PC.
- Turn on the Homer DC power supply.
- If your Homer contains **POWER** switch, set it to ON position. The power-up procedure (booting) may last up to 30 seconds. Homer is ready after playing a Morse code. The Morse sequence depends on the used communication interface:
  - RS232:**     **RS**, i.e., | · – · | · · · |.
  - CAN Bus:**   **N**, followed by 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.)
- 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 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 **POWER** switch, set it to ON position. The power-up procedure (booting) may last up to 30 seconds. Homer is ready after playing a Morse code. The Morse sequence depends on the used communication interface:
  - RS232:**     **RS**, i.e., | · – · | · · · |.

**CAN Bus:** **N**, followed by 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.)

- 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.

## Choosing Homer Power-Up Server

Occasionally, you may wish to switch between different 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)
- **SrvDld** 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 of the available Servers (which will then become the new default Server). The easiest way is using 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 Homer playing the startup Morse code, you may not know which interface and communication protocol should be used to establish contact with Homer (or which of the *HomSoft* applications should be employed).
- If you had 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 Homer.

To eliminate the inconveniences, there is a way of taking control of Homer via RS232 right during the power-up process. The procedure described next enables

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

### To Choose Homer Power-up Server:

- Connect your PC and Homer with standard RS232 null modem cable.

- Start in your PC the Hyperterminal (Windows XP) or any other corresponding RS232 monitor, e.g., [Tera Term](#) (Windows 7 and higher).
- Make Hyperterminal COM settings equal to those of Homer (normally 115200 k Bd, 8 data bits, 1 stop bit, no parity; otherwise defined by the internal Rs232.cfg configuration file). Set Flow Control to None. To make the Hyperterminal settings:
  - On the **File** menu of Hyperterminal, click **Properties**.
  - On the **Connect To** tab, select proper COM port.
  - Click **Configure** and enter/check the COM port settings. The result should normally be as in [Figure 10](#).

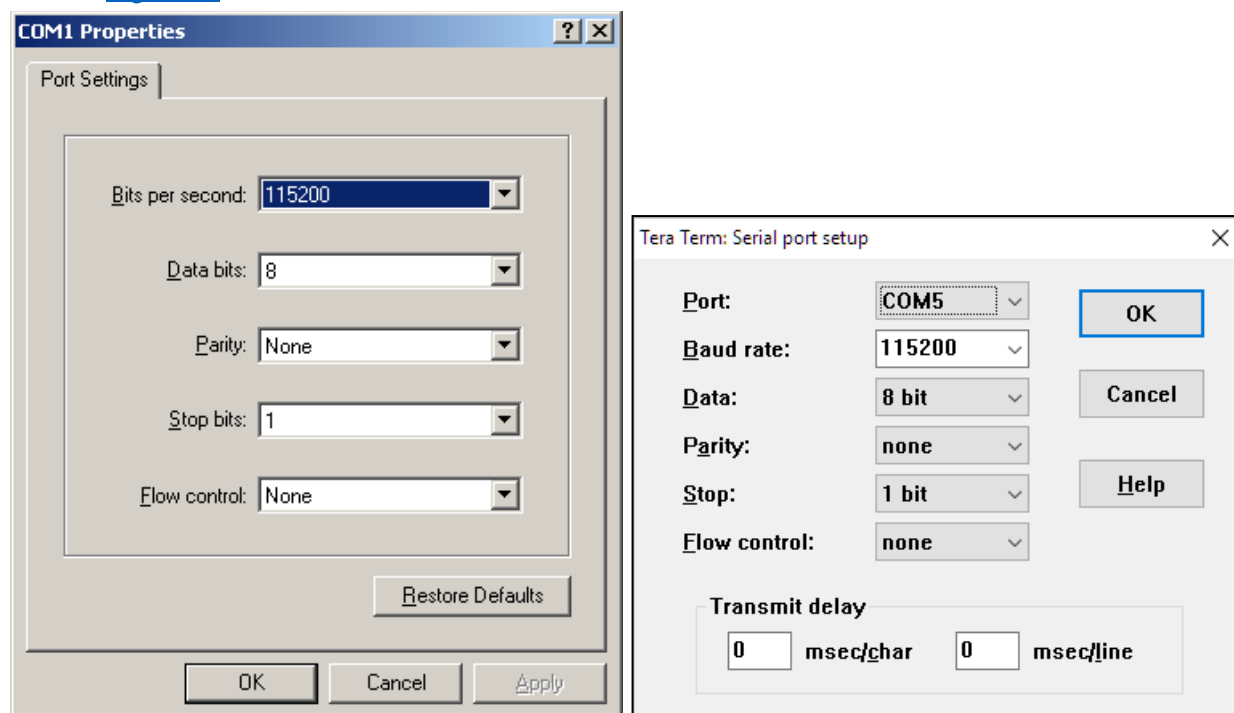


Figure 10. Setting of Windows XP Hyperterminal (left), and of Tera Term (right).

- Switch 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,S=RS232 C=CAN 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 (the letter case does not matter). If, for instance, key **R** or **S** 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:

- To invoke the Server selection menu:

- 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, 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

```
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
```

followed by a prompt instructing you to choose the Server 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 last running Server.

## Tera Term: An Alternative to Hyperterminal

Since Windows 7, Hyperterminal has not been supported. An alternative may be, e.g., **Tera Term**, which is an open-source free terminal emulator. The program can be downloaded from <http://ttssh2.sourceforge.jp/index.html.en>.

---

## Format of RS232 Results

In case of 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 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 in detail described 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 Homer but only wish to receive results without being bothered with decoding binary byte streams, you can choose ASCII results format. Note that this concerns only 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 Homer is configured to measure and transmit data automatically – controlled by **Autorun** line in [Hom.cfg file](#)) your Hyperterminal 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_InvalidStr=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 such 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 for is useful for import to 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 in case when a particular result is invalid or not present (e.g., sometimes only motor positions without Analyzer data are sent). To avoid 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.

### Example

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 red-printed substring from the first example is missing.

## Configuring Communication

Communication between Homer and external computers can be realized either via RS232 (optionally RS422) serial interface or CAN Bus. After power-up, Homer starts its activity depending upon several controlling parameters. Startup settings of the communication interfaces can be defined in Rs232.cfg and Can.cfg configuration files. Homer reads the files as part of its initialization routine.

You can create your own files or download them from Homer, edit them and upload them to back 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. Practically, 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
```

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

---

## Establishing Communication

The first thing after the start, *HomSoft* tries to establish communication between the PC and Homer. Note that you do not need microwave power for establishing this communication. You will not notice anything if all goes well (perhaps a few flashing announcements). In case of problems, a dialog window helping to make the connection shows up.

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

After the connection has been established, *HomSoft* reads all the required information from Homer and verifies correspondence between *HomSoft* version and Server version. In case of disharmony, a dialog box appears informing you and offering 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 [Figure 11](#) may pop up.

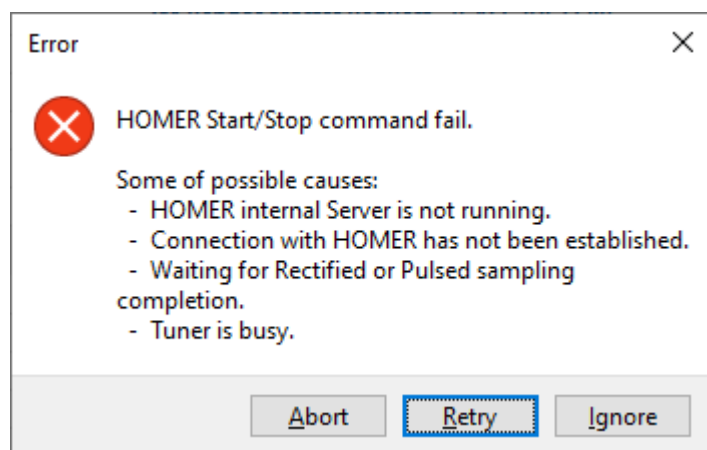


Figure 11. A possible error message at program startup due to missing communication.

If clicking **Retry** button does not help, click the **Ignore** button. This opens a dialog window titled **COM Port Setting** ([Figure 12](#)), displaying error message **COMMUNICATION FAIL**, sometimes with closer error description. A typical problem is incorrect COM port number. Select an appropriate **Port** and **Baud Rate**, then click **Connect**. If the connection has been established, a green message **CONNECTION ESTABLISHED** appears and you can continue by clicking **Continue** button.

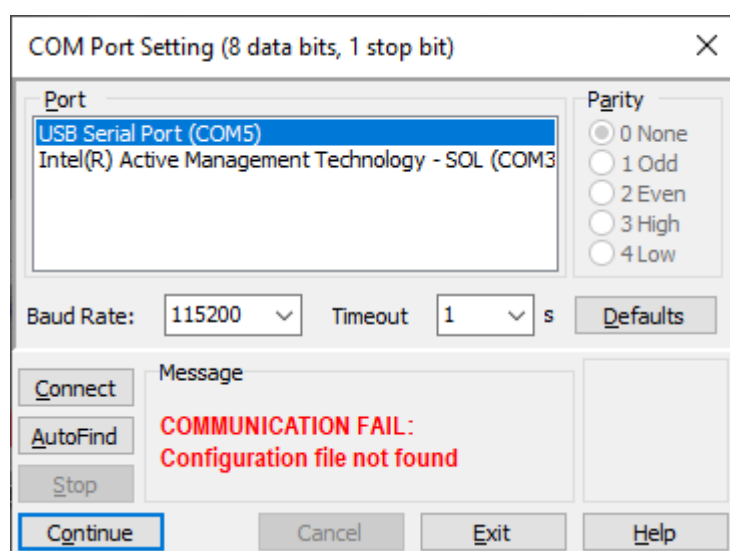


Figure 12. RS232 COM Port Setting dialog.

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

Here are some causes of failed communication and possible remedies:

- Incorrect COM port number 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 Download Server is running. Listen for Morse signal at Homer power-up, or use a Hyperterminal 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 **Connect** button.
  - Verify the integrity of the cable. Fix or replace the cable and click **Connect** button.
- Problem is at the PC end:
  - COM port settings in the *HomSoft* do not agree with those of Homer. In this case you should set the proper port number and baudrate and click **Connect** button. Homer baudrate is normally fixed to 115200 kbits/s. (*HomSoft* is able to find the correct baudrate by clicking **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*.
- Homer is busy:
 

If, after power-up, 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 such case increase **Timeout** in **Com Port Setting** dialog window (edit or choose from the drop-down list) and click **Connect** button.

Once the connection has been established, the green message **CONNECTION ESTABLISHED** appears and you can continue by clicking **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). In case of problems, we recommend the Brainboxes US-101B adapter (supplied worldwide for instance by Farnell).

## Case of CAN Bus

One possible problem at *HomSoft* start is incorrectly installed or recognized CAN Bus adapter. Then an error message like that in [Figure 13](#) may pop up. Sometimes simple disconnecting and reconnecting of the USB adapter plug, and then clicking **Retry** helps. (Clicking **OK** tries using a different adapter type.)

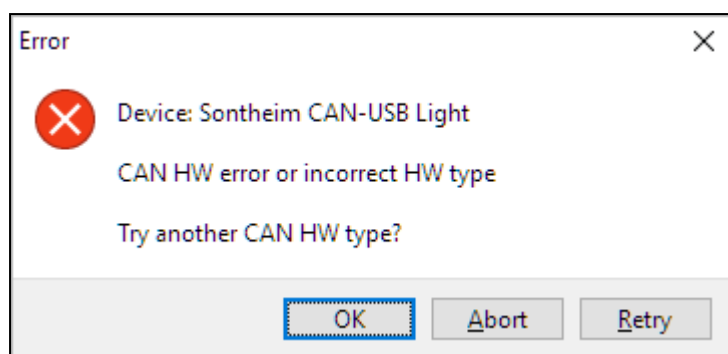


Figure 13. CAN Bus adapter error.

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

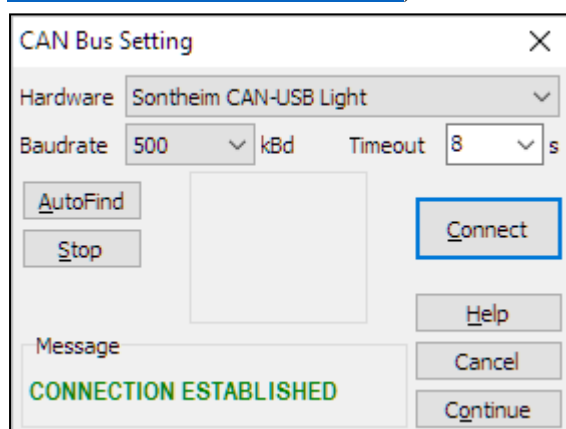


Figure 14. CAN Bus Setting dialog.

### To establish communication manually:

- From **Hardware** drop-down list (Figure 14), select the CAN Bus interface your PC is equipped with.
- Set **Baudrate** and, if your patience has limits, possibly decrease **Timeout** to, say, 2 seconds.
- Click **Connect** and wait for a message.
- If the message is **CONNECTION ESTABLISHED**, reset **Timeout** to the original value and click **Continue** button. If the message is **COMMUNICATION FAIL**, repeat clicking **Connect** 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 Figure 6) but leave your CAN Bus Adapter connected to the USB port of the PC (or pull it out and plug in back). 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 **Hardware** drop-down list, select the CAN Bus interface your PC is equipped with.
- If your patience has limits, decrease **Timeout** to, say, 2 seconds.
- Click **AutoFind** and wait (abort by **Stop**).

- Read the message. If the message is **CONNECTION ESTABLISHED**, reset **Timeout** to the original value and click **Continue** button. If the **COMMUNICATION FAIL** message persists, verify the interconnecting cable integrity or proceed as described in “*Problem is at Homer end*” above and retry.

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 shows 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 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 about 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 goes up 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

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:

Server identifies the first of the errors that occurred by playing the corresponding *error message* (see below), followed by a standard *server identification message*. Server does not terminate but sets itself in a “low-profile” mode with reduced command set, which does not allow measurements or motor movements, but essentially only file transfers so that you are able to remedy the situation that caused the error(s).

## Server Identification Messages

Message	Description
<b>RS</b>	SrvHo.exe Server in RS232 (or RS422) communication mode; results transmitted in <a href="#">binary format</a>
<b>RSA</b>	SrvHo.exe Server in RS232 (or RS422) communication mode; results transmitted in <a href="#">ASCII format</a>
<b>N<sub>xx</sub></b>	SrvHo.exe Server in CAN Bus communication mode; <b>xx</b> , which may be <b>1</b> to <b>20</b> , stands for Homer CAN address (only relevant for <a href="#">MultiCAN</a> )
<b>T</b>	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
<b>DAQ</b>	Data acquisition and Homer control card error
<b>IDE</b>	Homer Identity Error: Hom.mem file from another Homer has been uploaded
<b>HMEM</b>	Hom.mem memory file read error
<b>TMEM</b>	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** SrvDId starting **T** SrvDId 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**

DeviceNet Server SrvDnet, MAC ID = 30, no error

Server starting **30** 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 Homer has been successfully [established](#), the main program window and possibly some additional windows appear on the screen ([Figure 15](#)).

The windows can be classified as:

- Main Window
- Display windows
- Dialog windows

Note that appearance of the windows on your PC will depend on your Microsoft Windows background setting and may differ from illustrations in this document.

### Main Window

The Main Window is the standard Windows program framework. The window includes a menu bar, two toolbars on the top (Standard toolbar, Signal toolbar), and a Status bar in the bottom. Most importantly, Main Window is the container of display windows.

### Display Windows

Display windows are *child* windows of Main Window, i.e., they can be moved only within Main Window borders. 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. Type and format of data to be displayed can be changed for each window. The charts can be scaled manually or automatically. Appearance of the displayed traces (color, width, etc.) can be modified. The windows can be provided by a title (caption), date/time info, editable and moveable labels. For details, see [Display Windows](#) section.

### Dialog Windows

Dialog windows serve for entering data inputs, launching of actions and displaying of information of various kinds. Position of dialog windows is not limited by Main Window borders. Some windows can be present permanently on the screen, some (like Save/Load dialogs) disappear after a corresponding action has been completed. As a matter of example, some important dialog windows are shown in [Figure 15](#) (Maxi Results window, Tuner View window and [System Info](#) window). Various dialog windows will be described where appropriate.

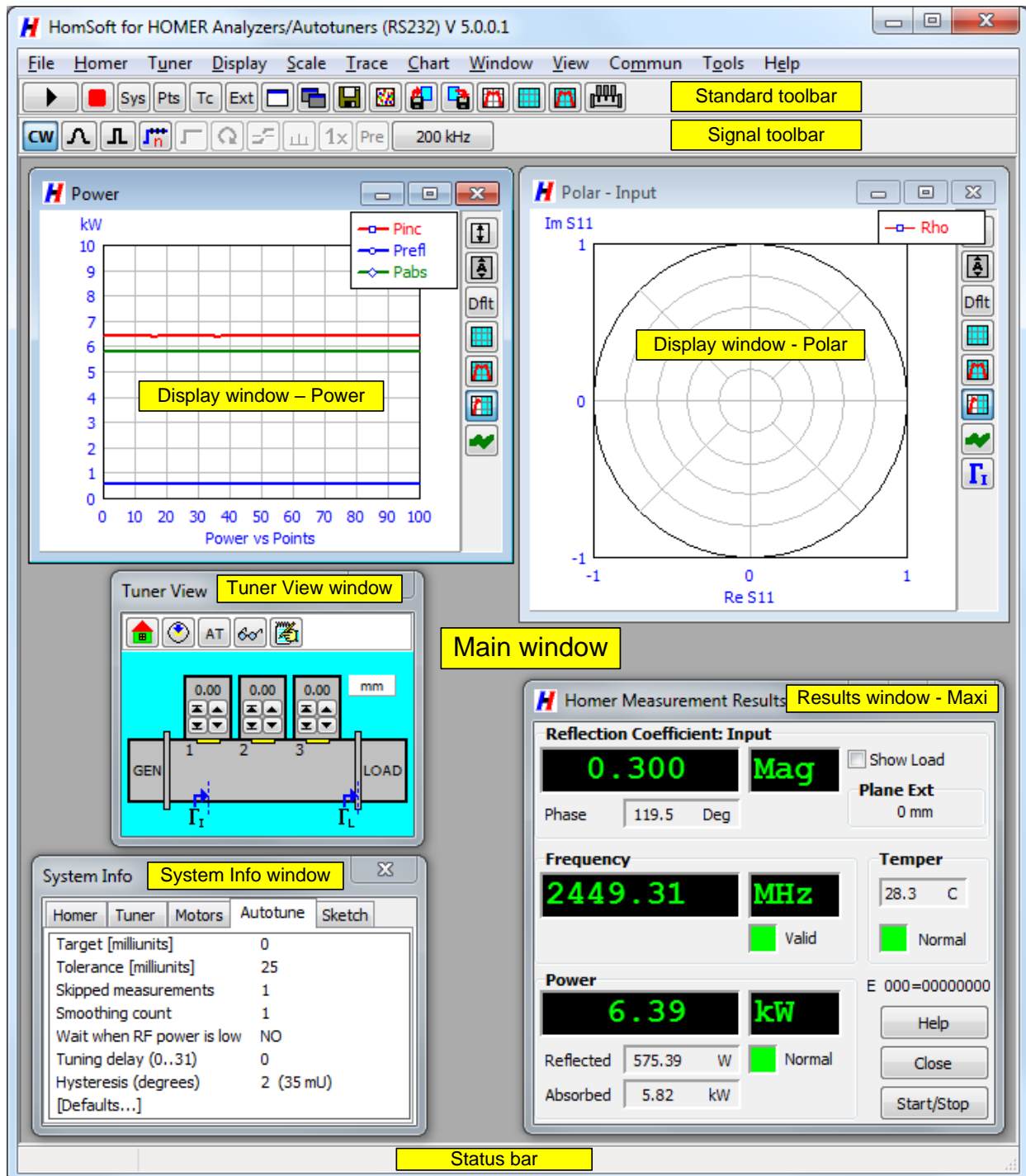


Figure 15. Important HomSoft windows.

## Display Windows

Display windows (Figure 16) are the main agent for presenting measurement results in graphical form (as curves or dots) in selectable formats. Display windows are moveable only within the Main Window frame of the program. 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 relatively long time for this process (this regards also 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.

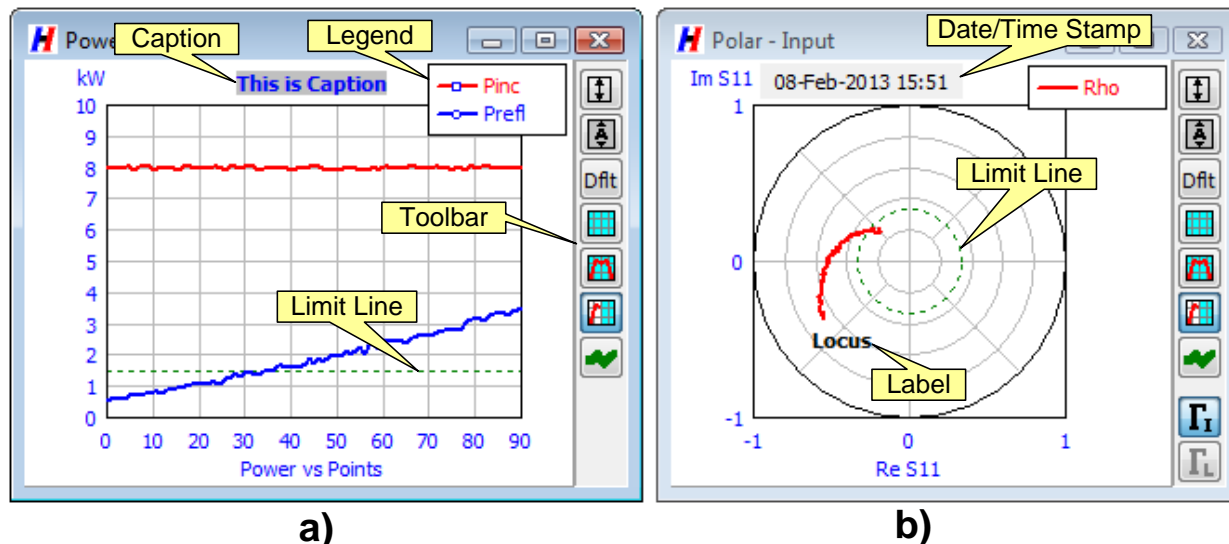


Figure 16. Display windows with (a) rectangular chart and (b) circular chart.

## Main Elements of Display Windows

Main elements of the display window include:

- Chart
- Legend
- Menu
- Toolbar
- Caption
- Date/Time Stamp
- Labels
- Limit Line

### Chart

There are two types of display window charts:

- Rectangular charts (example in [Figure 16a](#))
- Circular charts (example in [Figure 16b](#))

**Rectangular charts** display a scalar measured quantity (e.g., incident power or modulus of reflection coefficient) as a function of number of “Points”, 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 to start from the beginning. Due to this, the measurement process is (not quite correctly) referred to as *sweeping*.

**Circular charts** display complex reflection coefficient in the form of a locus, enabling to simultaneously observe the magnitude and phase. Circular charts include Polar chart (shown in [Figure 16b](#)), impedance Smith chart, admittance Smith chart and Owen diagram.

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

## Legend

Legend is a small rectangle within the display window, showing for each displayed trace its name and drawing attributes (appearance). **Legend** can be freely dragged over the screen or default-positioned by **Chart|Arrange Panels** menu item. To show and hide Legend, click **Chart|Legend** menu item. To change trace appearance, click **Trace|Properties** menu item or right-click the **Legend** box. See details in section [Trace Properties](#).

## 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, Chart**

See details in section [Display Window-Related Menu](#). Settings made in these menu items affect *only the currently active* display window.

## Toolbar

Display window toolbar contains buttons corresponding to frequently used menu commands:

	Set scales
	Autoscale
	Set default scales
	Blank screen
	Redraw last trace
	Blank screen before measurement start
	Persist
	Show Input reflection coefficient (dimmed when not selected)
	Show Load reflection coefficient (dimmed when not selected)

## Caption

Caption is an optional chart title centered above or below the plot area. You can edit its content and modify its font and color.

## Date/Time Stamp

Date/Time Stamp is an optional display of current date and time. The stamp can be moved across the display.

## Labels


Labels are arbitrary text strings that can be added anywhere inside the plot area. They can be edited, dragged to another position, copied, shown/hidden and deleted.

## Limit Line

Limit Line is an optional trace visualizing a predefined value (e.g., tolerance) of the displayed quantity. You can modify its appearance and associated value. Limit Line is a straight line in rectangular charts and a circle in circular charts.

## Display Windows-Related Commands

### To open a new display window:

Click **Window|New Display** menu item or  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, Chart**) affect only the currently active display window.

### To position and resize a display window:

Use standard Windows mouse-dragging techniques.

To position display windows otherwise than dragging them individually, use functions grouped in the submenu of **Window|Arrange** menu item.

**NOTE:** In **HomTool** servicing version of **HomSoft**, clicking the **Window|Arrange|Cascade** menu item or the equivalent  button causes *all* windows to assume a predefined arrangement.

### To close a display window:

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

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

## Display Window-Related Menu

Each display window has its own menu, which is, however, merged with the main program menu. The menu items are

**Display, Scale, Trace, Chart**

Settings using these menus affect only the currently active display window.

### Display

Display menu serves for selecting format and, if applicable, units in which results will be shown.

Available formats are:

- **Mag:** Linear reflection coefficient magnitude  $M = |\Gamma|$ . Available units:
  - **None** Magnitude between zero (perfect match) and 1 (total reflection)
  - **%** Percent: Magnitude between 0% (perfect match) and 100% (total reflection)
  - **mU** Milliunits: Magnitude between 0 mU (perfect match) and 1000 mU (total reflection)
- **LogMag:** Logarithmic reflection coefficient magnitude  $L = 20 \log(M)$  expressed in decibels (dB). Perfect match corresponds to  $L = -\infty$ , total reflection to  $L = 0$  dB.  
Note that *return loss*  $R$  is negative of LogMag:  $R = -L$ .
- **VSWR:** Voltage standing wave ratio  $V = (1+M)/(1-M)$
- **Phase:** Phase of reflection coefficient in degrees
- **Polar:** Polar diagram, 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 diagram, 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

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

**Set Scale, Autoscale, Default**

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

The commands are more comfortably accessible by display window [toolbar buttons](#).

## Trace

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

**Properties, Show Load** (HomSoft starting V5.0.0.0)

**Properties, Deembedded** (HomSoft before V5.0.0.0)

See details in sections [Trace Properties](#) and [Input and Load Reflection Coefficients, Deembedding](#). The commands are more comfortably accessible by display window toolbar buttons.

## Chart

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

**Legend, Limit Line, Caption, Labels, Time, Arrange Panels, Clear and Go, Persist**

For their description, see [Main Elements of Display Windows](#), [Screen Annotation](#), and [Trace Properties](#).

---

# Chart Scaling

Charts can be scaled by means of **Chart Scaling** dialog ([Figure 17](#)). The dialog enables you to control

- Span of axes for the rectangular display types
- Radii of the circular display types

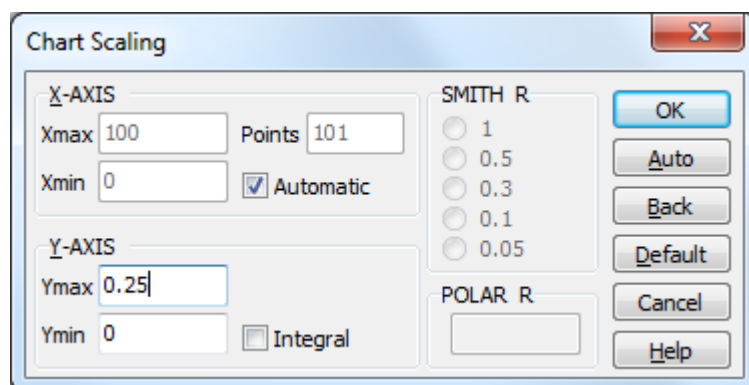


Figure 17. Chart Scaling dialog box.

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

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

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

## Rectangular Displays

### Xmin, Xmax

Selectable 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** or **Pts** toolbar button or **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 division is always automatic.

### Ymin, Ymax

Selectable lower and upper bounds of the y-axis. The values will be accepted after you click **OK** button. The values will be ignored if you click **Autoscale**, **Default** or **Cancel** button.

### Integral

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

When the **Integral** box is unchecked, the chart 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 chart span will be used in a more efficient way.

The y-axis division is always automatic.

## Circular Displays

### Polar Display

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

### Smith Charts, Owen Display

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 **OK** button.

## Buttons

### OK


Accept the settings and close the dialog.

### Auto

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

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

***Circular displays:*** 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 **Scale|Autoscale** menu item, **Ctrl+A** shortcut or  display window button.

### Back

Clicking **Back** button returns scale settings to the most recent manually entered values. The button is useful to reverting autoscale settings. The button does not work with Smith Chart and Oven display types.

### Default

Clicking **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 **Scale|Default** menu item, **Ctrl+D** shortcut or **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

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

A dialog box titled **Trace Properties** shows up ([Figure 18](#)). The dialog contains three panels, titled *Trace to Edit*, *Line*, and *Markers*. The topmost panel also includes a preview box.

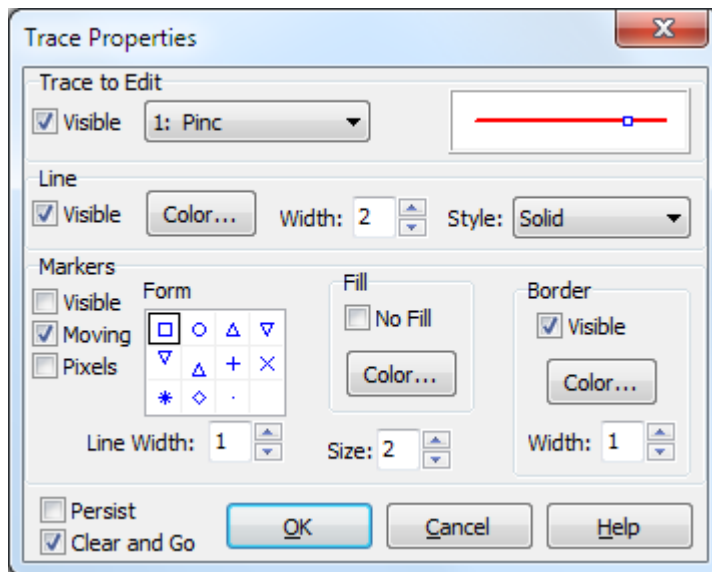


Figure 18. Trace Properties dialog box.

To modify Trace properties, proceed as follows:

## Trace to Edit Panel

In the dropdown control, pick the trace you wish to modify; however, except **Power** and **LogPower** there is only one trace available. **Power** and **LogPower** charts may display up to three traces: incident, reflected, and absorbed power.

Check/uncheck the **Visible** checkbox in order to show or hide a particular trace. Out of the three powers available you may, for instance, wish to display only the incident power.

## Line Panel

Check the **Visible** checkbox if you wish that the measured points 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. It also depends on the **Persist** checkbox state (see below). Now suppose the **Persist** 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 to **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 charts.

## Marker Appearance

The marker appearance and size are defined by the rest of the controls in the *Markers* panel. Best try 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 cumulated traces, leaving only the final sweep.


The **Persist** function is also accessible from **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. Setting of **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 clears all cumulated traces, leaving only the final sweep.

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

## Tips for Circular Displays

Three useful settings for circular displays are:

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

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

**Setting 2** provides a flying marker like in Setting 1 plus a dot (pixel) for each previous point, enabling 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 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** or **Pts** toolbar button or Ctrl+N shortcut.



## Screen Annotation

Several possibilities exist to put additional useful information on screen. These include

- Caption
- Custom Labels
- Date/Time Stamp
- Limit Line.

### Caption

**Caption** is an optional chart title centered above or below the plot area (the later for Smith charts and Oven diagram). You can edit the caption and modify its font and color.

The caption remains unchanged after blanking the screen. It is therefore useful for holding common information for a series of measurements.

Each display type in each particular display window has its own individual caption. Therefore, when you change the display type, the caption generally also changes or disappears.

Captions are stored in setup files so that they reappear after program restart.

#### To show and hide caption:

- Click **Chart|Caption|Visible** menu item.
- If the caption was not visible and it was empty, the prompt appears to enter caption text. Type the desired text and click **OK**.

#### To edit caption:

- Click **Chart|Caption|Text** menu item, *or*
- Click the caption area on the screen (where the mouse cursor switches from arrow to handpoint).
- Type the desired text and click **OK**.

#### To modify caption appearance:

Use **Chart|Caption|Font** and **Chart|Caption|Color** menu items.

### Date/Time Stamp

**Date/Time Stamp** is an optional display of current date and time. The reading is updated each 30 seconds or when you right-click the label.

To show and hide Date/Time Stamp, click **Chart|Time** menu item.

Date/Time Stamp can be freely dragged over the screen or default-positioned by **Chart|Arrange Panels** menu item.

### Labels

**Labels** are temporary text strings that can be added anywhere inside the display window plot area. They can be edited, dragged to another position, copied, shown/hidden and deleted.

The labels are volatile in the sense that they disappear after changing display format. Also, they are not stored in the setup file so that they do not reappear after restarting *HomSoft*.

#### To create a new label:

- Position the mouse cursor where the top left corner of the label should appear. (The label can be dragged later if required.)
- Right-click the screen. A pop-up menu appears.

- On the menu, click **New Label** item. The label with the text “New Label” appears on the screen. You can edit the text now or anytime later. Press **Enter** or click the screen outside of the label.

#### To edit a label:

- Right-click the label. A pop-up menu appears.
- On the menu, click **Edit** item. Edit the label text and press **Enter** or click elsewhere on the screen.

#### To change label font:

- Right-click the label. A pop-up menu appears.
- On the menu, click the **Font** item. *Font* dialog box appears where you can change the text attributes including its color. Press **OK** to confirm the changes or **Cancel** to ignore them.

#### To change label background color:

- Right-click the label. A pop-up menu appears.
- On the menu, click **Color** item. *Color* dialog box appears where you can select the background color of the label. Press **OK** to confirm the changes or **Cancel** to ignore them.

#### To make a label transparent:

- Right-click the label. A pop-up menu appears.
- On the menu, click **Transparent** item. This toggles the label’s transparency.

#### To copy a label:

- Right-click the label. A pop-up menu appears.
- On the menu, click **Copy** item. A copy of the label appears slightly shifted from the original.
- Drag the new label to the desired position.

#### To delete a label:

- Right-click the label. A pop-up menu appears.
- On the menu, click **Delete** item.

#### To move a label:

- Click the label and, holding the left mouse button down, drag it to the destination position. The tip of the cursor arrow shows the position where the top left corner of the label will be moved.

You will not be allowed to drop the label on an existing label.

#### To show and hide all labels:

- Right-click the display window outside of all labels. A pop-up menu appears.
- On the menu, click **Show/Hide Labels** item.

#### To delete all labels:

- Right-click the display window outside of all labels. A pop-up menu appears.
- On the menu, click **Delete All Labels** item.

## Limit Line

**Limit Line** is an optional trace visualizing a predefined *limit value* (e.g., minimal or maximal accepted level) of a measured quantity. A single limit line with a user-defined appearance (color, width and style) can be displayed on the screen. In rectangular charts, the limit line is a straight line parallel with x-axis. In circular charts, 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, including its appearance and value.

An exception is *reflection coefficient in a given display window*, where the limit value is linked with 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  $-20 \text{ dB}$ , 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 equal to 0.1.

Unit of **Mag** format (none, percent, milliunits) is also considered. When you, for instance, define the limit value 0.1 in intrinsic **Mag** format and change the unit from none to milliunits, the limit line appears at the level of 100 mU.

### To show and hide limit line:

Click **Chart|Limit Line|Style** menu item. The dialog box titled **Limit Line Properties** opens. Check or uncheck the **Visible** checkbox. Press **OK**.

### To change limit line value:

Click **Chart|Limit Line|Value** menu item. A dialog box appears where you can define the new limit value.


### To change limit line style:

Click **Chart|Limit Line|Style** menu item. The dialog box titled **Limit Line Properties** opens. Select 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 Installation – RS232/RS422](#) or
  - [Electrical Installation – CAN Bus](#)
- [Start Homer](#)
- Start a *HomSoft* application in your PC (i.e., **Tu\_rs.exe** for RS232, **Tu\_can.exe** for CAN Bus). As the first thing, the application tries to establish communication between PC and Homer. For details, see [Establishing Communication](#) and [Configuring Communication](#).
- After the connection has been established, at least one [display window](#) should appear inside Main Window. If no display window has appeared, click **Window|New Display** menu item or  button.
- After new SW or HW installation or if you are unsure about Homer SW or HW versions, click **Help|About** menu item to open **About** window ([Figure 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:** It is extremely important for accurate measurement and correct tuning to know the *actual*

waveform of your signal and its timing (for details, see [Signal Waveforms](#)). To determine them, do not rely on *anything* but your own measurement. The best way is the sampling as described in [Waveform Determining](#).

- For the chosen sampling mode (also referred to as *Waveform*), choose appropriate sampling parameters and frequency counting time. For more about this, refer to topics [CW Signal Sampling](#), [Rectified Signal Sampling](#), [Pulsed Signal Sampling](#) and [Homer Sampling Setup](#).
- Click **Display** menu item and select the display format of your choice. If applicable (formats Mag, Power, LogPower), select units.
- Click **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 also the Autoscale function will be enabled.
- In the display window, right-click the **Legend** box or, equivalently, click **Trace|Properties** menu item. This opens [Trace Properties](#) dialog window in which you can choose your drawing preferences, such as
  - which of the traces available will be displayed
  - properties of the lines connecting the measured points
  - properties of markers (shape, size, color, etc.)
- If you desire to observe another quantity or the same results in various formats simultaneously, open a new display window by clicking  button or **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 **Chart** 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 **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. 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 measurement results and make your experiments.
- Stop measurement. **In fact, there are two ways which are not equivalent** (see details in [How to Start and Stop Sweeping](#)):
  - If you click **Homer|Run/Pause** menu item or the equivalent  button, you only stop Homer *monitoring*, i.e., receiving and displaying results while Homer *continues* its internal activity: measurement, possibly autotuning, and sending results.
  - If you click **Homer|Stop Homer** menu item or the equivalent  button, you will set Homer to a standstill: Homer will do nothing (no measurement, no autotuning, no results transmission) except waiting for commands. Using the button, the effect is immediate. Using the menu, the effect may be delayed until the current sweep completion, depending on the **Homer|Finish Sweep** menu item status (see details in [How to Start and Stop Sweeping](#)).
- After stopping, last traces will remain on the *HomSoft* screen and in the memory. See [Screen Annotation](#) section if you wish to provide display windows with additional information (caption, date/time, limit line, labels).
- 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 mere picture (you can create picture from text data but not vice versa).

## Tuning

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



## How to Start and Stop Sweeping

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

### Start Sweeping

There are the following alternatives:

#### With Mouse

- Click **Start Homer** button  on the Standard toolbar ([Figure 15](#)). After clicking, the button image changes to a Pause symbol .
- Click **Homer** main menu item, then click **Run/Pause** in the pull-down submenu (shorthand for this is **Homer|Run/Pause**).
- Double-click **Homer** main menu item.

#### Without Mouse


- Press **F9** hot key.
- Press **Spacebar** (only if the main window has focus or any of the graphic display windows within)
- Press **Alt** to get to the menu bar. With cursor keys, step to **Homer** item. Press **Enter**. With cursor keys, step to the **Run/Pause** item. Press **Enter**.
- Press **Alt+H** keys, then press **R** key.

**Start Sweeping** action has two effects:

1. A command is issued to Homer to start repeated measurements, possibly autotuning, and sending results.
2. Your PC starts monitoring Homer, i.e., receiving data messages, processing them, and displaying measurement results either as numbers or graphs or both.


### Stop Sweeping

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

1. You can apply exactly the same methods as for starting the sweeping, typically clicking **Pause** button , pressing **Spacebar** (if main window has focus) or **F9** or clicking **Homer|Run/Pause** menu item. By this, however, your PC only discontinues *monitoring* the Homer, i.e., receiving and displaying results, while 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 **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 end of the plot), then it stops.
2. If you click **Stop Homer** button  or the equivalent **Homer|Stop Homer** menu item, you will (a) suspend Homer *monitoring* but also (b) set Homer to a *standstill*: Homer will do nothing (no measurement, no autotuning, no results transmission) except waiting for commands. This command is executed *immediately*, regardless of **Homer|Finish Sweep** menu item state.

## Homer Error Byte

As part of each block of measured data (Measurement Data Object MDO), Homer sends an *Error Byte*, where various error conditions and warnings are encoded in the bit-wise 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* can be 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 *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 assure accurate data
5	32	Warning	Substitute frequency sent
6	64	Error	Measurement data are (for any reason) invalid
7	128	Reserved	

The value of *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

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

### Low Signal Warning

*Low Signal* condition occurs when the measured *incident power* falls below a predefined threshold. The threshold in watts is defined in [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 [Tun.cfg](#) configuration file. When set to **TRUE**, autotuning is suspended as long as *Low Signal* condition persists.

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

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

## 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](#)**. Updating of the traces is then halted until the condition ceases.

## Results Windows

Results windows serve 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 **View|Results (Maxi)** or **View|Results (Mini)** menu item.

### Full-Size (Maxi) Results Window

Full-size (Maxi) Results window ([Figure 19](#)) displays measured data numerically. Basic results and errors or warnings can be viewed from longer distance. The data are grouped in several boxes.

### Reflection Coefficient Group

*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)

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



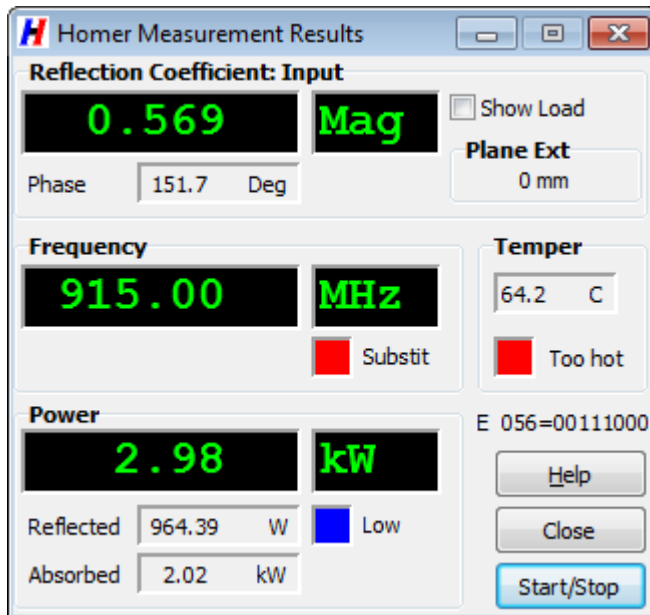


Figure 19. Full-size (Maxi) Results window.

### Frequency Group

*Frequency* group displays measured frequency. If the frequency-measurement counter is disabled or the number provided by the counter is obviously incorrect, a [substitute frequency](#) is displayed instead and the associated LED lamp turns from green to red (as shown in [Figure 19](#)).

### Temper Group

*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 unit 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

*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

[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. Example of one error (temperature too high) and two warnings ([Substitute Frequency](#) and [Low Signal](#)) is shown in [Figure 19](#).

### Start/Stop


Starts and stops sweeping equivalently to **Homer**/[Run/Pause](#) menu item.

## Reduced-Size (Mini) Results Window

Reduced-size (Mini) Results window ([Figure 20](#)) is preferable when the numerical data should 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 *Error Byte*). The letters **I**, **R**, **A** indicate the incident, reflected, and absorbed powers, respectively.



Input				
0.569	Mag	2.98	kW	I
151.7	Deg	964.39	W	R
915.00	MHz	2.02	kW	A

Figure 20. Reduced-size (Mini) Results window.

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

The font color other than black indicates an error/warning condition. The colors correspond to the “LED” colors of 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 (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 the numerical data as a table or for importing the results in 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 point or comma (see *Choosing Decimal Separator* below).


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

The setting will be stored in the Ho0.ini setup 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:

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	<a href="#">Homer Error Byte</a> (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 <a href="#">Homer Communication Protocol</a> .
WinTime	UTC time ( <a href="https://en.wikipedia.org/wiki/Coordinated_Universal_Time">https://en.wikipedia.org/wiki/Coordinated_Universal_Time</a> ) 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 by 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+P**).

#### To Open Results File in Microsoft Excel:

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

### Saving Results as a Picture

A display window contents you see on the screen can be:

- Copied to the clipboard to be subsequently pasted in your document
- Saved as a bitmap (BMP), 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. The file size, unlike the other formats, does not depend on the contents of an image.

The JPG file has acceptable quality, although inferior to the bitmap or GIF. The file size is typically one-third of the bitmap.

The **GIF** file has a very good quality and compression ratio; it is recommended for archiving purposes.

### Before Saving


- Select the desired graphic file format in **File|Picture Type** menu. The choice will persevere, even after *HomSoft* restart, until you make a change.
- Choose which part of the screen should be captured. There are two options selectable in **File|Picture Area** menu item:
  - **Main Window:** Complete inner area of the Main Window, i.e., all open display windows and other windows contained within the *HomSoft* Main Window.
  - **Active Chart:** Only the chart portion (white area) of the 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 persevere, 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](#), [annotating](#) (adding Caption, Labels, Date/Time Stamp and Limit Line)
- If the Picture Area chosen is Main Window:
  - Drag all windows you wish to copy (e.g., a Results window) onto the selected Picture Area.
  - You may wish to click **Window|Main Form Color** to change the background color of Main Window.

### Copying to Clipboard

To copy the selected Picture Area to clipboard, click **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 **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 file name with an extension (bmp, gif, jpg), the picture type will be set accordingly, irrespective of file type filter (**Save as type** edit box). If you type the name without extension or with an invalid extension, the picture type will be set in accordance with Save as type selection.

### Using Window Print Screen Functions

Any active program window (e.g., Results window) can be copied to clipboard as bitmap using the Windows standard **Alt+PrintScreen** key combination. However, you cannot copy individual display windows (e.g., Smith chart) because displays are *child* windows of Main Window. To copy Main Window to clipboard, proceed as follows:

- Size the Main Window and arrange display windows in it according to your wish.
- If needed, drag in other windows (e.g., a Results window).
- Set *focus* to the Main Window, e.g., by clicking into it or on its title bar.
- Press **Alt+PrintScreen**.

---

## 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 the function, click **View|Logging Window** menu item. Following this, **Data Logging** window (Figure 21) appears. The controls are logically organized in three groups: *Timing*, *Log File*, and *Progress*.

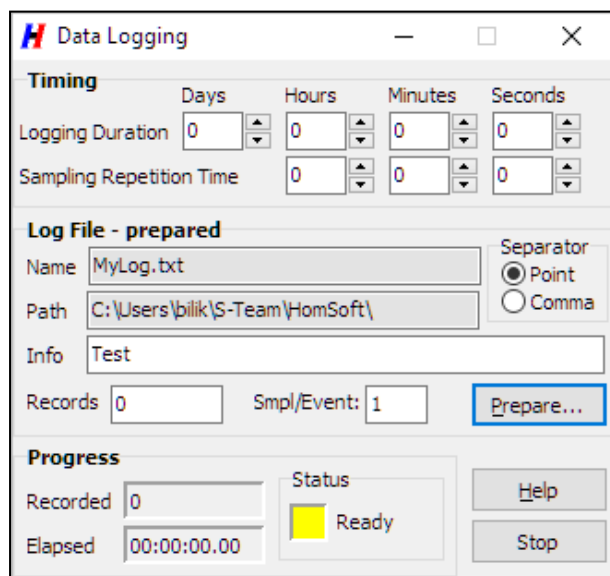


Figure 21. Logging window.

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 *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.
- 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 **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.
- 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).
- In **Smpl/Event** 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 **Smpl/Event** setting is one.

The **Smpl/Event** setting is ignored with continuous logging.

- Select the decimal separator by clicking the **Point** or **Comma** radio button in the **Separator** box.
- In **Info** edit box, type an optional comment: it will be added at the beginning of the log file.
- Click **Prepare** button. The dialog box titled *Prepare Log File* opens where you choose the path and name of the log file. The recommended file extension is *txt*. Click **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*.

- Define measurement conditions, i.e., sampling mode (the waveform type) and sampling parameters, frequency count time, etc. – see [Homer Sampling Setup](#).
- Start measurement.

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 sooner than a stop condition occurs, press **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 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 [Saving Results to a Text File](#) topic.

## Customizing Homer

On *HomSoft* termination, majority of its settings can be automatically stored in **Ho0.ini** setup file, located in the *HomSoft User Folder* (in case of [Homer Simulation](#) program, the file name is **HoSim0.ini**). When you start the program next time, this default **ini** file is loaded back and the system appears in the same state as when you left it. This regards not only *HomSoft* own settings, like position and size of various windows, but also behavior of the connected Homer unit, because, on *HomSoft* start, the app overrides (by means of a series of commands) the internal Homer settings.

### Note:

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

## Controlling the Creation of Ini Files

Sometimes, the changes the user made in *HomSoft* settings prove not desirable and there is a wish to return to the original settings that were before the *HomSoft* start. To enable this, the user can decide whether the “automatic” **ini** file is actually written or not.

Normally, *HomSoft* is terminated by clicking its main window standard closing button (or, alternatively, by **File|Exit** menu item, or **Alt+X** shortcut key). Following this, a confirmation dialog ([Figure 22](#)) appears. When you click **Abort** in this dialog, the **Ho0.ini** file will not be (over)written.

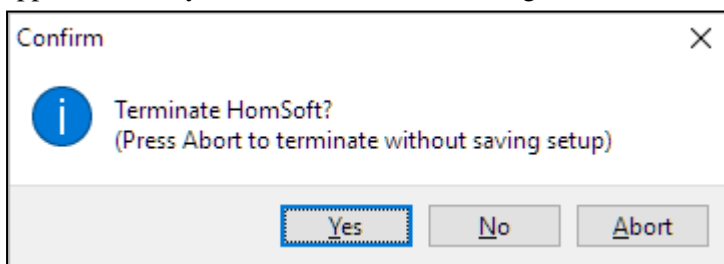


Figure 22. Confirmation dialog when normally terminating *HomSoft*.

If you terminate *HomSoft* by **File|Exit (no setup)** menu item, or **Alt+A** shortcut key, the application is closed immediately, without any dialog, and without writing the **ini** file.

## Backup Setup Files

If you accidentally close *HomSoft* without saving the “automatic” **ini** file, the settings made will still not be lost. It is because they are automatically saved, in the form of user setup files, to the subfolder

**BackupSetups** of the [User Folder](#). The file names have the form

**Ho0\_yymmdd\_hhmmss.stp** or **HoSim0\_yymmdd\_hhmmss.stp**

where **yymmdd** stands for the date and **hhmmss** for time. You can load the 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), odds are that the default **ini** file is corrupted. In such a case, try to delete the **ini** file and restart the app. (A better practice is to move the bad **ini** file to another directory or rename it for further analysis, which helps 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 **File|Save Setup** menu item or the equivalent  toolbar button or use **F2** shortcut.
- When prompted, enter **Comment** text, characterizing the setup.

### To load setup:

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

---

## Transferring Files

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

## Sending Files to Homer

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

- Click **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 wish to update Homer configuration files, pick the item named “*System config files (\*.cfg)*”.
- Browse for the files you wish to send to Homer. For example, if you had downloaded some configuration files from Homer to [User Folder](#) and modified them, they will be found in a folder like  
`c:\Users\Simpson\S-Team\HomSoft` (Windows 7 and higher)  
`c:\Documents and Settings\Simpson\S-Team\HomSoft` (Windows XP)  
 New files may also be delivered to you separately on a CD or via electronic mail.
- Select all files you wish to transfer.
- Click **Open**. Now the files start to be transferred to Homer. After completion, a Pass/Fail report appears.

### Notes:

- The new files will be accepted only after restarting Homer (**HomSoft** too must be restarted to recognize new Homer settings).
- **Tun.mem** file is permitted to be transferred only by **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 mere sending them to Homer is employing the [Reinstall](#) procedure. The latter can ensure that the files will be updated also for the purpose the [Homer Reset](#) procedures. The **FileList.txt** for the Reinstall should contain lines like in the example below:

```
[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 best Server version can be learned after opening the [Help>About](#) window.) If a mismatch is detected, the *HomSoft* will inform you about it and prompt you, depending on the situation, to either install a newer version of *HomSoft*, or to upload to Homer a new version of Server.

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

- Click **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 separately on a CD, a USB flash drive, or via electronic mail.
- Click **Open**. Now the file starts to be transferred to Homer; it may take some 20 seconds. After completion, a Pass/Fail message appears.

The new Server will not be activated until restarting both Homer and *HomSoft*. This will be done automatically after clicking **OK** in the Pass/Fail message dialog. You can switch 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 Homer is employing the [Reinstall](#) procedure. The latter can ensure that the file will be updated also for the purpose the [Homer Reset](#) procedures. The **FileList.txt** for the Reinstall updating for instance also User Reset should contain lines like in the example below:

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

## Loading Files from Homer

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

- Click **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 for the case you want to download one of the predefined files (Hom.cfg, Tun.cfg, Rs232.cfg, Can.cfg, SrvHo.exe), or for the case you want to download any other file you know resides in the Homer device.
  - a) 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.

- b) 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 in your PC to which you wish the downloaded file to be copied. The dialog then may look as in [Figure 23](#).
- Click **Save**. Now the file starts to be downloaded from Homer. After completion, a Pass/Fail report appears.

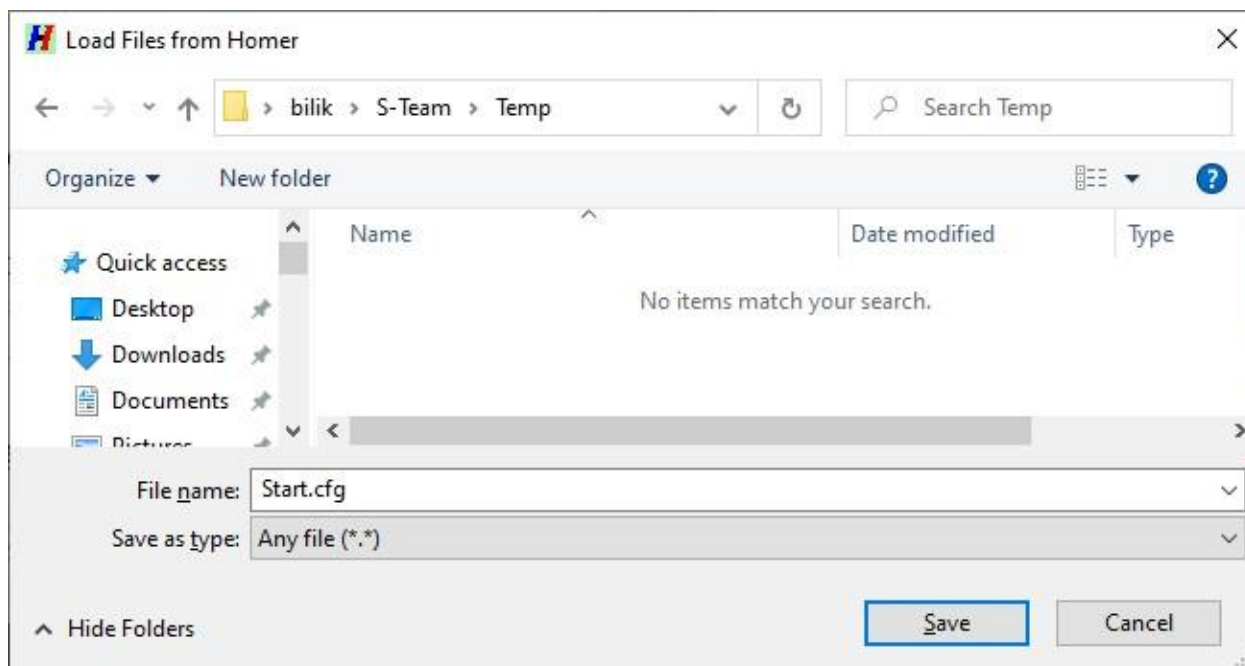


Figure 23. Load Files from Homer dialog.

## Homer Resets

A group of commands under **Tools|Reset** menu item serves for returning Homer to predefined states, including factory (out-of-box) default. The commands are useful when you, for instance, confuse Homer by uploading incorrect firmware files of any kind (the files must not prevent Server from running) and wish to make a remedy.

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

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

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

If some of the files a Reset needs are not available, a warning will occur but otherwise the reset will be executed.

### Restart Server (F7)

Clicking **Restart Server** or pressing **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 Homer|More|[Restart Server](#) menu item.



## Factory

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

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

## User-Defined

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

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

## Make

The **Make** command copies all relevant firmware files from Homer 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 Homer behavior to your application (editing *Hom.cfg*, *Tun.cfg*). **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 Homer volatile memory, not the *cfg* files). If you wish that the newly created user-defined default also reflects settings made via *HomSoft* commands, apply **Create CFG** command before **Make** command.

## Create CFG

After Homer is switched on, its settings are governed by the internal *Hom.cfg* and *Tun.cfg* configuration files, defining thus Homer power-up behavior. If you want to change this behavior, one way is to download these files from Homer, edit them accordingly, then upload them back to Homer. To do the editing, you have to understand the structure of these files (well, it is nothing difficult).

When you start *HomSoft*, the Homer power-up settings are generally overridden first by the values stored in *HomSoft*'s *Ho0.ini* file and then by your various further commands (e.g., switching *Waveform* from **CW** to **Rectified**, etc.). *HomSoft* is actually the most convenient means to adapt Homer settings to your particular application. But all the changes made are temporary: they last only until Homer is restarted. To make your changes permanent you have to modify the *Hom.cfg* and *Tun.cfg* files.

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

After clicking, you are only asked to enter *Autorun* item of *Hom.cfg*, governing Homer activity after power-up, i.e., 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 the newly created *cfg* files to take effect, Homer DC power should be cycled (restarting *HomSoft* is highly recommended, too).

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

**Note:**

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

```
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. A situation often encountered of periodically varying reflection coefficient (for example due to using mode stirrers) is also treated.

---

## Signal Waveforms and Sampling

Amplitude of the microwave power delivered by a magnetron is determined by its high-voltage DC power supply in that 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).

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 consecutively during a certain length of time with a defined sampling rate.

It is essential, especially with autotuning, to configure the timing of the signal sampling such as to arrive at meaningful, steady results; otherwise the supplied data may widely fluctuate, resulting in apparent noise and improper, unstable and seemingly random tuning.

Moreover, with signal power waveforms which drop to zero in parts of their period, an appropriate triggering must also be employed to activate the frequency counter only when the signal is nonzero; otherwise the measured frequency will be meaningless.

The user should be aware of the signal waveform type involved and understand how the sampling works to set up the sampling, triggering and frequency counting appropriately.

A summary of parameters controlling the sampling is shown in [Figure 24](#) and described below. The measured signal (blue and red trace) is sampled at points indicated by the circles.

## Triggering, Free Run, Timeout

- If *Free Run* = TRUE, sampling starts without delay. Repeated sampling bursts generally start at random instants of the signal waveform. This setting of *Free Run* is intended for CW or low-ripple signal waveforms.
- If *Free Run* = FALSE, sampling starts at an instant when the microwave power level, depending on the chosen trigger slope, exceeds or drops below a set triggering level  $L_{trg}$ , which is defined as a percentage of the  $(V_{4\max} - V_{4\min})$  difference, where  $V_4$  is the reference detector output voltage. (Homer determines  $V_{4\min}$  and  $V_{4\max}$  before each sampling burst.) If no triggering event has occurred during a preset timeout interval  $T_{\max}$ , sampling will start automatically.

The same free run/triggering technique is also used for frequency measurement.

### Sample Count, Sampling Rate, Sampling Time

$$T_s = \frac{N_s - 1}{f_s}$$
$$T_s = \Delta t_s (N_s - 1)$$

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 be in principle 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 [Figure 24](#). 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 ripple repetition frequency, number of periods to be covered, and 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 short sampling time in comparison to period  $T_p$ . An example of such a situation is shown as case **A** in [Figure 24](#) (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  $V_{4\text{ min}}$  and  $V_{4\text{ max}}$ . To make the situation worse, if the frequency counting interval ( $T_c$  in [Figure 24](#)) includes periods with near-zero power level, the frequency measurement may be incorrect.

## Accept Level

Some measured quantities, e.g., 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 peak reference detector voltage  $V_{4\text{ max}}$ , below which the samples are regarded invalid and ignored in reflection coefficient and reflected power computations. The invalid region is the grayed area in [Figure 24](#); the invalid samples are indicated by the yellow-filled circles.

Processing of the assembly of the collected samples continues depending on the user-chosen 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.)

A special situation may in addition occur, which can be designated as a **Mode Stirrer** case, when the incident power may be theoretically 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**. 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, and in particular sending individual samples, may take quite a long time (e.g., more than 10 seconds for transfer of 4095 samples).

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

Then, seemingly erratic behavior may result when Homer 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 Problems

- Do not click indiscriminately when encountering no response from Homer: wait a few seconds first, then try to stop Homer internal measurement by clicking  toolbar button or the equivalent **Homer|Stop Homer** menu item.
- Do not **Send Samples** when you wish a faster measurement (uncheck **Send Samples** checkbox in the [Homer Sampling Setup](#) window or deactivate  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. Such type of signal is referred to as **CW** (continuous wave) or **Low-Ripple**. The **CW** mode of sampling is intended for such type of signals.

The parameters governing the **CW** sampling are shown in the table below. Refer to [Figure 24](#) for the left column symbols in parentheses. The middle column shows the settings via the [Homer Sampling Setup](#) window of HomSoft, plus an alternative (mostly a toolbar button), if such 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 <i>Hom.cfg</i>
Sample count ( $N_s$ )	<b>Sample Count</b> edit box or  Signal toolbar <b>button</b> ( <a href="#">Figure 15</a> ). Valid range 1 to 4095. It has the meaning of the voltage averaging number.	<code>Vrpt=201</code> ( $N_s = 201$ )

Sampling rate ( $f_s$ )	<b>Sampling Rate</b> edit box or clicking <b>Sampling Rate</b> display on Signal toolbar. 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 <b>Sampling Time</b> box.	n. a. ( $T_s = 20$ ms)
Sampling step ( $\Delta t_s$ )	Computed internally by Homer; displayed in <b>Sampling Step</b> box.	n. a. ( $\Delta t_s = 100$ $\mu$ s)
Frequency counting time ( $T_c$ )	<b>Count Time</b> edit box or <b>Tc</b> Standard toolbar button (Figure 15). Valid range 16 $\mu$ s to 1 s.	<code>TcountCW_Us=1000</code> ( $T_c = 1$ ms; will be truncated to $n \times 16$ $\mu$ s = 992 $\mu$ s)

In the **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 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 has also 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 CW sampling mode is in contrast 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.


Homer must be told 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 [Homer Sampling Setup](#) window and click **CW** tab. Alternatively, click **CW** Signal toolbar button (Figure 15).

### To set sampling parameters:

In [Homer Sampling Setup](#) window:

- Edit **Sample Count** or click  to set the number of samples  $N_s$  to be collected for one measurement result.
- Edit **Sampling Rate** or click **Sampling Rate** display on Signal toolbar (Figure 15). To set the sampling rate  $f_s$  in Hz.
- Edit **Count Time** or click **Tc** Standard toolbar button (Figure 15) to set the signal frequency counting time  $T_c$  in microseconds.
- Click **Refresh button** to check/correct the entered values and compute the derived parameters (Sampling Time, Sampling Step).
- Click **Apply button** to accept the changes, or click **Cancel button** to ignore all changes. (The **Apply button** automatically performs also 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	$f_r = 12 f_p$

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

The governing parameters of the **Rectified** sampling are shown in the table below. Refer to [Figure 24](#) for the left column symbols in parentheses. The middle column shows the settings via the [Homer Sampling Setup](#) window of HomSoft, plus an alternative (mostly a toolbar button) if such 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 <i>Hom.cfg</i>
Ripple frequency ( $f_r$ )	<b>Ripple Freq</b> edit box. Valid range 1 to 10000 Hz.	<code>Rect_Linfre=50</code> ( $f_r = 50$ Hz)
Number of ripple periods to be covered ( $N_p$ )	<b>Ripple Periods</b> edit box. Valid range 1 to 1000.	<code>Rect_Periods=1</code> ( $N_p = 1$ )
Sample count ( $N_s$ )	<b>Sample Count</b> edit box or  <b>Signal toolbar button</b> ( <a href="#">Figure 15</a> ). 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 <b>Sampling Time</b> box.	n. a. ( $T_s = 20$ ms)
Sampling rate ( $f_s$ )	Computed internally by Homer; displayed in <b>Sampling Rate</b> box.	n. a. ( $f_s = 10$ kHz)
Sampling step ( $\Delta t_s$ )	Computed internally by Homer; displayed in <b>Sampling Step</b> box.	n. a. ( $\Delta t_s = 100$ μs)
Acceptance level ( $L_{acc}$ )	<b>Accept Level</b> 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 ( $T_c$ )	<b>Count Time</b> edit box or <b>Tc</b> Standard toolbar button ( <a href="#">Figure 15</a> ). Valid range 16 μs to 1 s.	<code>Rect_Tcnt_Us=1000</code> ( $T_c = 1$ ms; will be truncated to $n \times 16$ μs = 992 μs)



Triggering level ( $L_{trg}$ )	<b>Trig Level</b> edit box or  Signal toolbar button. Valid range 1 to 99% of the ripple peak-to-peak value.	$TrgLevel=50$ ( $L_{trg} = 50\%$ )
Free Run	<b>Free Run</b> checkbox or  /  Signal toolbar button. Normal setting with high-ripple signals is unchecked. Check the box in <a href="#">Mode Stirrer</a> situation with low-ripple signals.	$TrgMethod=1$ (Free Run = FALSE)

**Notes:**

- 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, frequency counting time  $T_c$  should be shorter than a half of the ripple period. When entering  $T_c$ , via the **Tc** Standard toolbar button ([Figure 15](#)), the software informs about 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 [Figure 25](#)).

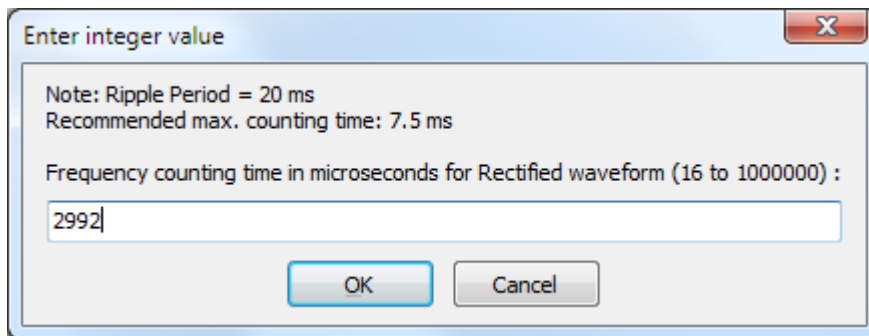


Figure 25. Entering counting time for Rectified sampling.

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 ( $L_{acc}$ ).

Homer must be told 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 [Homer Sampling Setup](#) window and click **Rectified** tab. Alternatively, click  Signal toolbar button ([Figure 15](#)).

### To set sampling parameters:

In [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** or click  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 **Tc** Standard toolbar button (Figure 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 depress  button to display individual samples. To learn more, go to [Displaying Individual Samples](#).
- Click **Refresh button** to check/correct the entered values and compute the derived parameters (Sampling Time, Sampling Rate, Sampling Step).
- Click **Apply button** to accept the changes, or click **Cancel button** to ignore all changes. (The **Apply button automatically performs also 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 20 microseconds. This type of signal is referred to as **Pulsed**. Homer is capable of processing pulsed signals with pulse durations down to 50 microseconds, including autotuning. The Pulsed sampling mode is intended for such types of signal.

The **Pulsed** sampling governing parameters are shown in the table below. Refer to [Figure 24](#) for the left column symbols in parentheses. The middle column shows the settings via the [Homer Sampling Setup](#) window of HomSoft, plus an alternative (mostly a toolbar button) if such exists. The right-hand column shows examples of [Hom.cfg](#) settings for Homer autonomous operation.

Parameter	Setting via HomSoft	Example Setting in <i>Hom.cfg</i>
Sampling time ( $T_s$ )	<b>Sampling Time</b> edit box or  Signal toolbar button (Figure 15). Valid range 10 $\mu$ s to 10 s.	<code>Puls_TsAMPL_Us=2000</code> ( $T_s = 2$ ms)
Sample count ( $N_s$ )	<b>Sample Count</b> edit box or  Signal toolbar button. Valid range 21 to 4095.	<code>Puls_NsAMPL=201</code> ( $N_s = 201$ )
Timeout ( $T_{max}$ )	<b>Max Period</b> 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 ( $L_{acc}$ )	<b>Accept Level</b> edit box. Valid range 0 to 100% of pulse height. A recommended setting is 5 to 20%.	<code>Puls_Acc_Lvl=10</code> ( $L_{acc} = 10\%$ )
Frequency counting time ( $T_c$ )	<b>Count Time</b> edit box or <b>Tc</b> Standard toolbar button (Figure 15). Valid range 16 $\mu$ s to 1 s.	<code>Puls_Tcnt_Us=50</code> ( $T_c = 1$ ms; will be truncated to $n \times 16 \mu$ s = 48 $\mu$ s)
Triggering level ( $L_{trg}$ )	<b>Trig Level</b> 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	<b>Free Run</b> 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 the timeout interval, a sampling is launched automatically.
- 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 [Displaying Individual Samples](#) topic.








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

**To select Pulsed mode of signal sampling:**

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


**To set sampling parameters:**




In [Homer Sampling Setup](#) window:

- Edit **Sampling Time** or click  to set the sampling time  $T_s$  in appropriate units.
- Edit **Sample Count** or click  to set the number of samples  $N_s$  to be collected over 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  Standard toolbar **button** ([Figure 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 depress  button to display individual samples. To learn more, go to [Displaying Individual Samples](#).
- Click **Refresh button** to check/correct the entered values and compute the derived parameters (Sampling Rate, Sampling Step).
- Click **Apply button** to accept the changes, or click **Cancel button** to ignore all changes. (The **Apply button** automatically performs also the **Refresh** action.)

## Displaying Individual Samples

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



To display individual samples, check **Send Samples** checkbox in [Homer Sampling Setup](#) window or depress  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 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 the *Continuous* mode, uncheck the **Single-Shot** checkbox in Homer Sampling Setup window, or set  button into the upper position.
- To set *Single-Shot* mode, check the **Single-Shot** checkbox, or depress  button.
- To disable display of individual samples, uncheck **Send Samples** checkbox, or set  button into the upper position.

### Notes:

1. In **Send Samples** mode of data transmission, [Results windows](#) will still display the averaged results.
2. [Data logging](#) is not allowable in **Send Samples** mode of data transmission.
3. Some quantities, e.g., reflection coefficient, have no meaning 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 annoying 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.
4. Autotuning is based on the averaged results rather than individual samples.
5. Displaying individual samples needs, in the first place, transferring them from Homer to PC. This process may take a considerable time if the sample count is high and the baudrate is slow.

## Triggering

In first experiments, it is advisable to enable **Free Run** () to avoid possible problems with triggering, and to set preliminary sampling parameters. Once you see a nice, 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 go lost so the first pulse of the sampled pulse train may appear thinner.

## Scrolling displayed traces horizontally

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

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

## Homer Sampling Setup Window

Using the Homer Sampling Setup Window ([Figure 26](#)) is the easiest way to select the signal sampling and processing method (*Waveform*) and 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 either by **Homer|Sampling Setup** menu item, or by **Ctrl+Q** shortcut key.

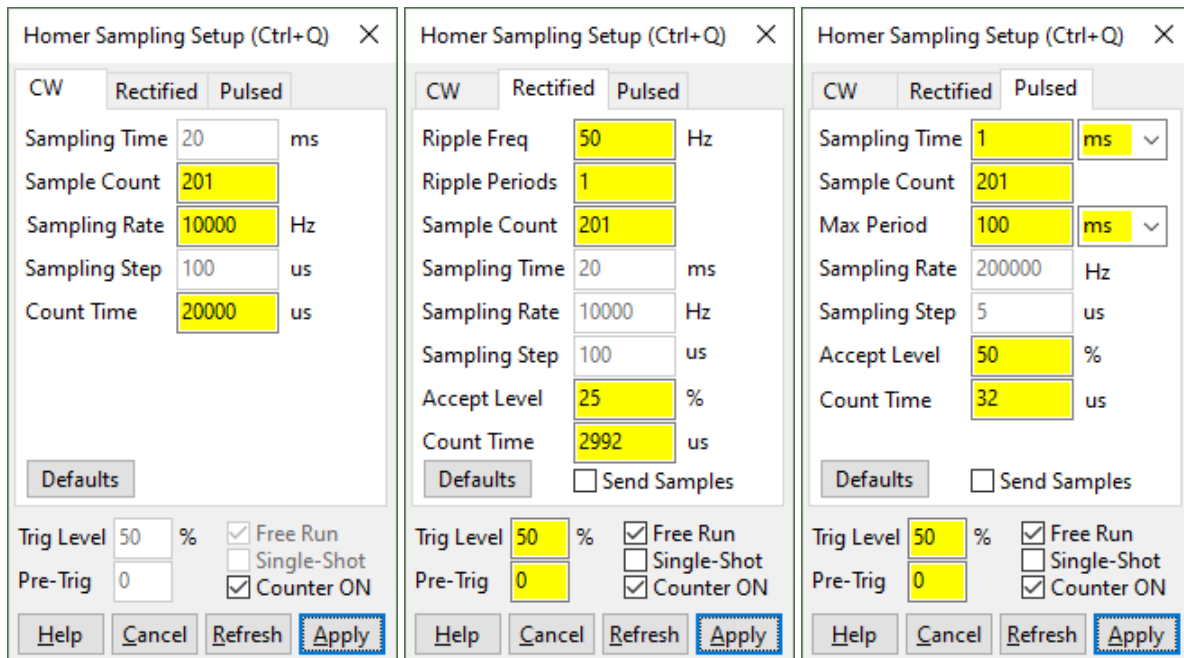


Figure 26. The three tabsheets of Homer Sampling Setup window.

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, serving for information purposes (such as **Sampling Time** in the *CW* tabsheet).

Irrelevant controls will be disabled (such as **Trig Level** if *CW* tabsheet is active).

After entering the desired values, click **Refresh** button. This will resolve errors or inconsistencies in the entered data (and inform you about the details), and compute the grayed values. The Refresh action is automatically called also when clicking the **Apply** button.

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

- 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, all changes that you may have made will be ignored.

## Mode Stirrer

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

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

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

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

As the first thing, an inspection of the signal waveform should be performed. In principle, it can be done by a microwave detector and an oscilloscope. Nevertheless, Homer in **Rectified** mode and with transmission of individual samples is even better for the purpose. First, select the **Rectified** sampling mode, then activate *Free Run* and the transmission of individual samples. Then start measurement and play with sampling parameters to arrive at a meaningful, if jittery, display. To steady the display, disable *Free Run*. The displays may now look like [Figure 27](#). In this example, it 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.

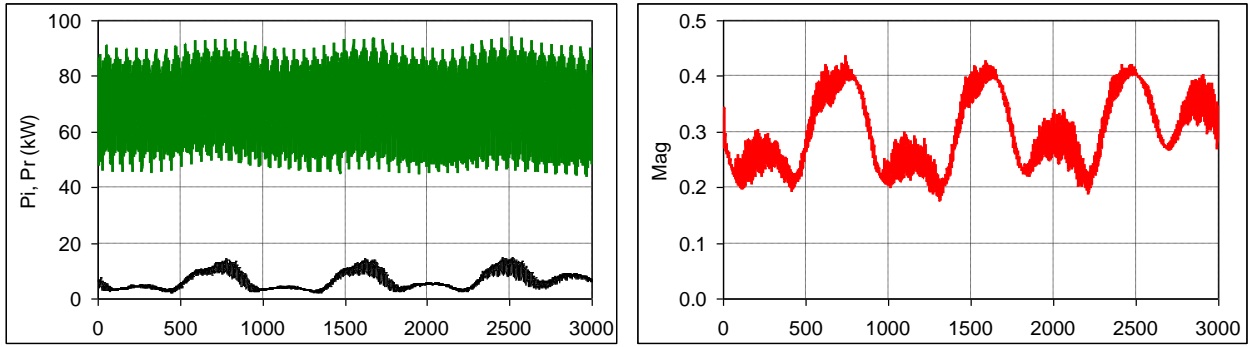


Figure 27. Waveforms of incident power (green), reflected power (black), and reflection coefficient modulus (red). The x-axis is the sample sequential number.

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, 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.

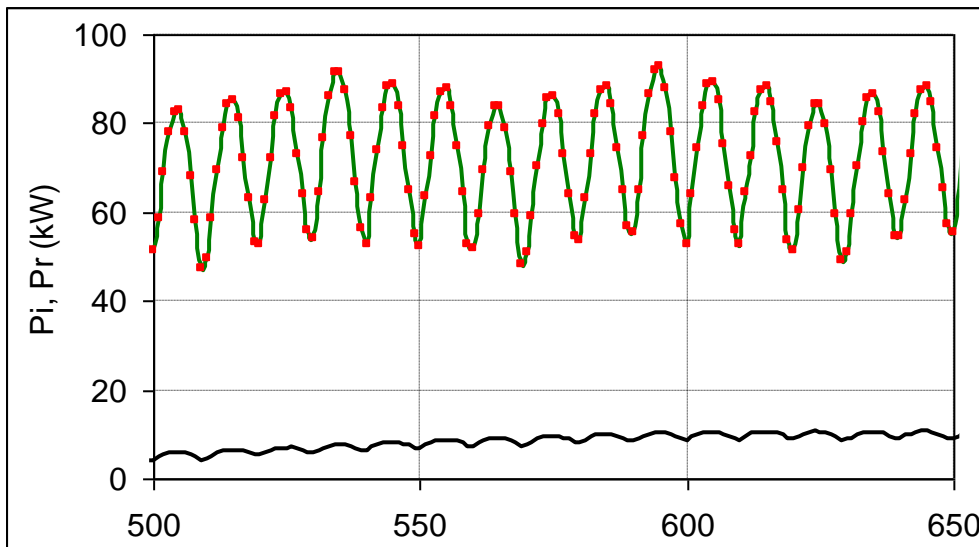



Figure 28. Zoomed waveforms of the incident power (green) and the reflected power (black). The red dots show the actual samples.

The traces also exhibit a fine structure (Figure 28). 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. 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 Figure 28 (six fast ripples). For proper sampling, there is 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 [Figure 28](#). Choosing the sampling time  $T_s = T_1 = 300$  ms calls for the sampling count

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

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 included in  $T_s$ . To obtain the desired  $T_s$ , set  $N_p$  to

$$N_p = T_s f_r$$

In our example  $N_p = 0.3 \times 300 = 90$ .

Since, as seen from [Figure 27](#), all the samples are valid (the incident power never drops close to zero):

- *Free Run* should best be switched on (to handle also very low-ripple signals).
- You can set the Acceptance level  $L_{acc} = 0$ . However, to handle cases where ripple goes as low as to 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 zero) are rejected.

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

**Rule 3:** For tuning, *average* 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 average of 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 [Figure 29](#), showing loci 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 increased, yet this is the best situation. The trace is optically not centered: this is because the samples may be denser in certain locus portions, as the detail on the right reveals, so the “center of mass” of the trace may be offset from an intuitive center.

The importance of **Rule 4** is also evident from [Figure 29](#). It shows that while the *complex* mean value of the reflection coefficient in the tuned state is zero, the mean *magnitude*  $R$  of the reflection coefficient is approximately  $R = 0.07$  (the “radius” of the blue trace). Consequently, the mean reflected power, which is proportional to  $R^2$ , 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 **CW** mode, although it could be configured to take samples exactly as in the **Pulsed** mode, would give false (nearly zero) mean reflected power.

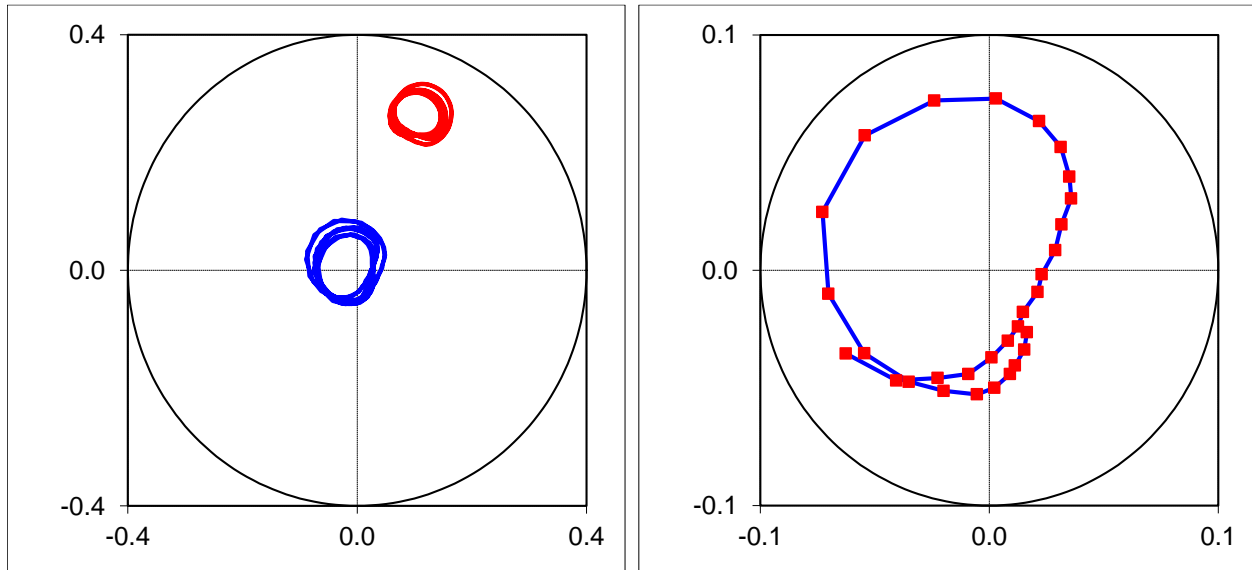


Figure 29. Left: Reflection coefficient locus before tuning (red) and after tuning using mean value (blue). Right: A portion of the blue trace zoomed.

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 ten samples per 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 at intervals close to zero, false frequency readings may be experienced in a case the Free Run, which may result in false reflection coefficient and power outputs. If triggering for some reason does not help, one can disable the counter and set the *Substitute Frequency* in **Homer** menu appropriately.



# Autotuner

The following topics describe aspects of *HomSoft* operation concerning **Homer Autotuner** as an enhancement of Homer Analyzer alone. **The Autotuner** is an intelligent system combining 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 guide wavelength. This arrangement facilitates impedance matching of loads with arbitrary reflection coefficient phase and, depending on construction and maximum power, with VSWR typically up to 10:1.

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

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

Tuner electronics provides for handling of **ALL STUBS HOME** switch and **AUTOTUNE** switch. In most Homer implementations, these switches are accessible to the user. The **ALL STUBS HOME** switch triggers the motor initialization routine; the **AUTOTUNE** switch activates and deactivates automatic impedance matching (autotuning). The actions can be triggered also 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.

## Motor Initialization Routine


Motor initialization routine, also called **Reset Stubs**, **All Stubs Home** or just **All Home** procedure, is a specialized method of setting the tuning stubs to *reference positions* (zero positions). A 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 uncertainty due to possibly lost motor steps.

## Controlling the Autotuner

When starting *HomSoft*, the following happens in addition to the case of Homer Analyzer alone:

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

## Matchable Area

A tuner's primary characteristic of interest is its *matchable area*, i.e., the range of reflection coefficients  $\Gamma_L$  that can be *perfectly* matched by the tuner. The typical matchable area of a three-stub tuner is composed of two subareas (Figure 30), 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.

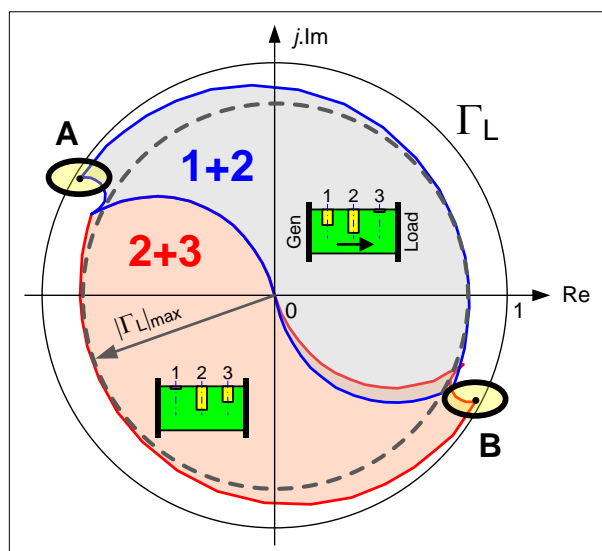


Figure 30. Three-stub tuner matchable area.

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

The radial extension of the matchable area grows with increasing the maximum stub insertion depth  $h_{\max}$ . This defines the maximal 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 in the matchable area with very high reflection coefficients that can still be perfectly matched – by extremely inserted tuning stubs (areas A and B in Figure 30). 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 limits thus severely the maximal 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 of avoiding the described risk is to construct your applicator such that its reflection coefficient never exceeds certain magnitude, e.g.,  $|\Gamma_L| < 0.9$ . This is sometimes challenging. Next, we will discuss other possibilities.

## 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  $h_{\text{abs}}$  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  $h_{\text{abs}}$ , the user can further reduce  $h_{\text{max}}$  by editing the line

```
MaxInsert_mm=22.7
```

in the [Tun.cfg](#) configuration file. For more details on how this can be done, see topic [Homer Internal Files](#).

For studying the effect of varying  $h_{\text{max}}$  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, reducing thus also the useful and safe matchable range. Fortunately, the Homer firmware provides a means of removing only the risky portions of the matchable area by its truncating, as explained next.

## Truncating the Matchable Area

A full matchable area can be software-trimmed to a certain radius  $R_{\text{max}}$  by the following line in the [Tun.cfg](#) configuration file:

```
MaxMag_mU=850
```

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

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

exceeds  $R_{\text{max}}$ , the tuning algorithm uses

$$\Gamma_M = R_{\text{max}} \exp(j\phi_L)$$

for its input instead of  $\Gamma_L$ , as shown in [Figure 31](#). Thus, the critical regions of the matchable area are avoided while maintaining the full tuning performance elsewhere.

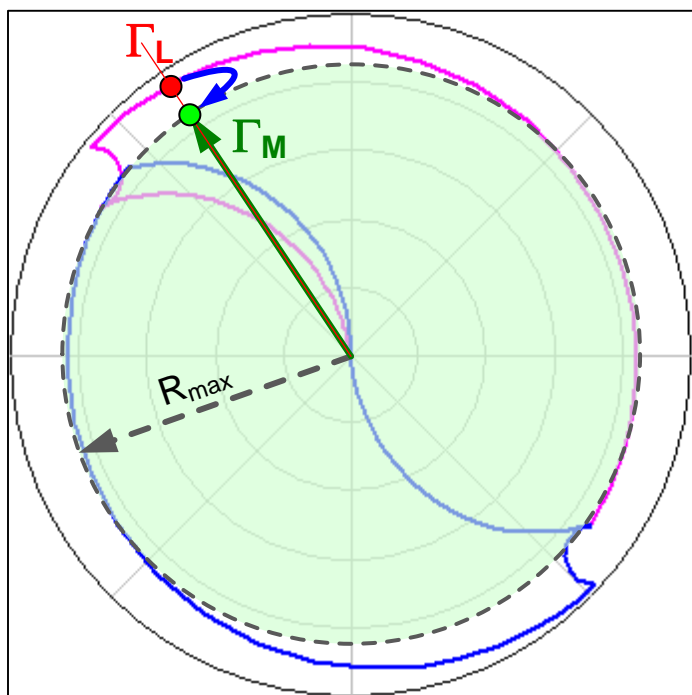


Figure 31. Truncating the matchable area to  $R_{\text{max}}$ .

For studying the effect of truncating the matchable area on your individual autotuner, see topic [Studying Matchable Area](#).

## Studying Matchable Area

The matchable area of your individual autotuner can be varied and studied using the *HoSim* simulation program.

- For customizing *HoSim* to behave as your tuner, see topic [Real Tuner Performance](#).
- For displaying and observing the matchable area, activate [Chart](#) in *DUT* page of Homer Model Window.
- To change the frequency for which the charts are valid, use page *Freq/Power/Temp* of Homer Model Window.

### Studying Effect of Varying $h_{\max}$

The value of  $h_{\max}$  can be changed in [Motors](#) page of **System Info** window after clicking the row *Max Steps/Travel* (this is not enabled in "sharp" HomSoft version). 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.

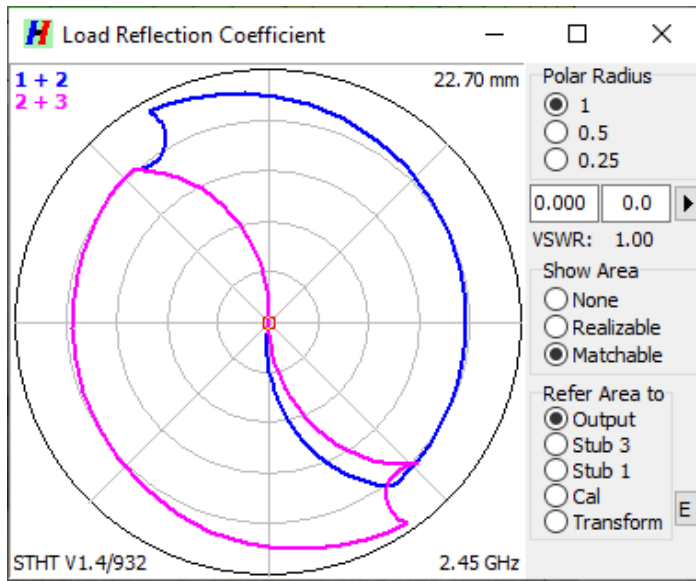
### Studying Effect of Truncating the Matchable Area

The value of  $R_{\max}$  can be changed in [Autotune](#) page of **System Info** window after clicking the row *Max tune Mag [milliunits]* (this row is not visible in "sharp" HomSoft version, as seen in [Figure 35](#) left). The effect is immediately seen if the matchable area is displayed.

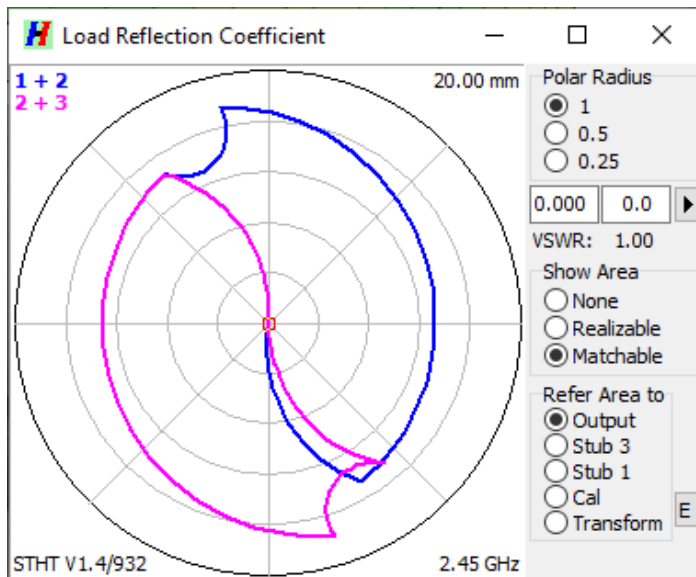
### Examples

Below, in [Figure 32](#), are, as an example, shown matchable areas of the 2450-MHz WR-340 Homer Autotuners for the following cases:

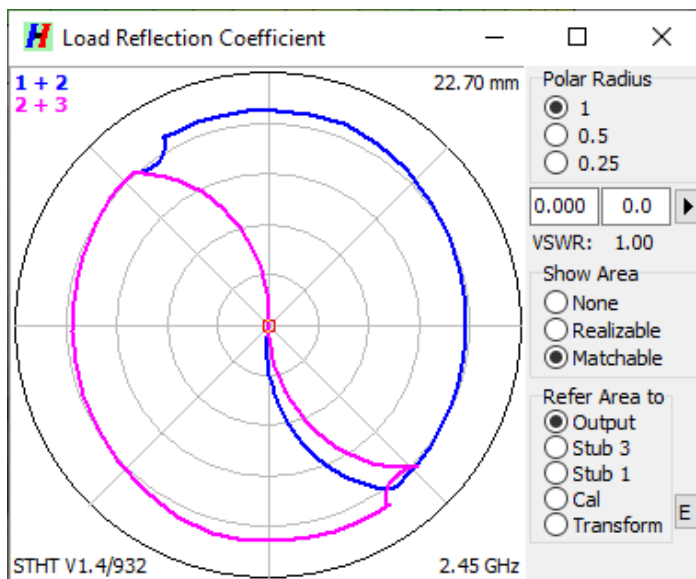
1. Default stub insertion ( $h_{\max} = 22.7$  mm), without truncation ( $R_{\max} = 1000$  mU). For this case  $|\Gamma_L|_{\max} = 0.77$  (VSWR = 7.7).
2. Stub insertions limited to 20 mm, without truncation ( $R_{\max} = 1000$  mU). For this case  $|\Gamma_L|_{\max}$  is only 0.65 (VSWR = 4.7).
3. 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.



$h_{\max} = 22.7 \text{ mm}$ ,  $R_{\max} = 1000 \text{ mU}$



$h_{\max} = 20 \text{ mm}$ ,  $R_{\max} = 1000 \text{ mU}$



$h_{\max} = 22.7 \text{ mm}$ ,  $R_{\max} = 850 \text{ mU}$

Figure 32. Effects of limiting the maximal stub insertions (middle) and of truncating the matchable area (bottom).

## System Info Window

**System Info** window provides basic system information about Homer Analyzer/Autotuner. The window can be opened by clicking **View|System Info** menu item or **Sys** button on Standard toolbar ([Figure 15](#)).

In case of Homer Analyzer, a single-page window opens with the page titled *Homer*; in case of Homer Autotuner, a multipage window opens with pages titled *Homer*, *Tuner*, *Motors*, *Autotune* and *Sketch*. Items shown in *Autotune* page can be clicked and modified (which fact is signified by a hand-shaped mouse cursor when moving over them).

## Homer and Tuner Pages

The *Homer* page ([Figure 33](#)) displays identification, waveguide size and nominal frequency of Homer Analyzer.

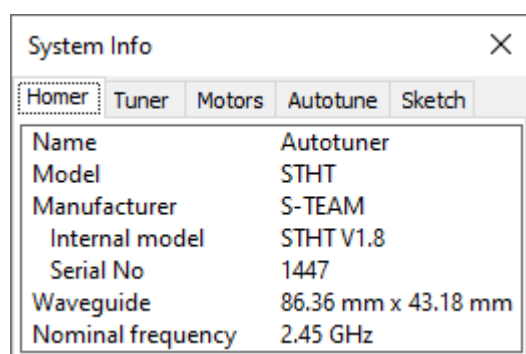


Figure 33. Homer page of System Info window.

The *Tuner* page displays identification, waveguide size and nominal frequency of Homer Mototuner. In case of compact, one-piece Autotuner, the *Tuner* page is identical with *Homer* page except for *Nominal frequency*, which may be different for Analyzer and Tuner.

## Motors

The *Motors* page ([Figure 34](#)) displays basic parameters characterizing tuning stubs (motors) motion. An approximate full travel time is computed as (Max Steps)/(Pull-in rate).

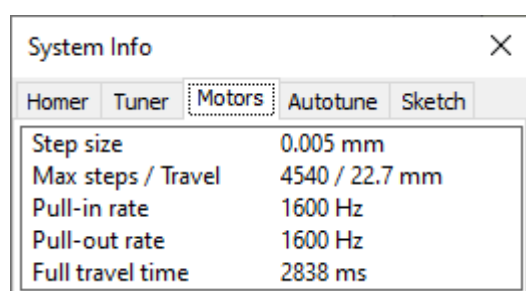


Figure 34. Motors page of System Info window.

## Autotune

Thanks to the fact that Homer Analyzer measures *complex* reflection coefficient, the autotuning process is not an error-and-trial procedure: in contrast, 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 (Figure 35 left) lists those which the user can modify. This is done by simply clicking a corresponding item.

For *HoSim* simulation program (Figure 35 right), the *Autotune* page includes the additional line **Max tune Mag** and the button titled **Load Mem**. For their usage, please refer to [Truncating the Matchable Area](#) and [Real Tuner Performance](#), respectively.

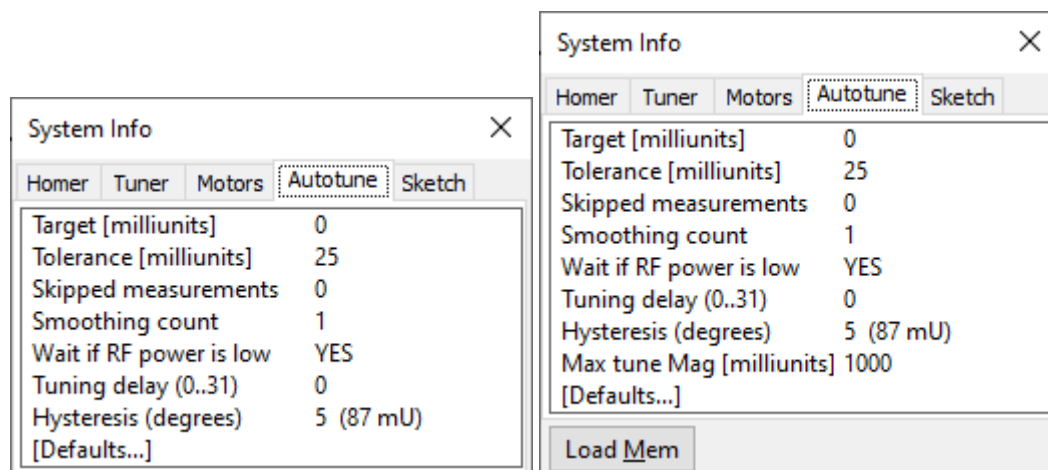


Figure 35. Autotune page of System Info window. Right: The page form in the *HoSim* simulation program.

### 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 a desired value. The autotuning mathematics (computation of stub positions) proceeds until the magnitude of 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 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 input reflection coefficient magnitude from the desired *Target* value. It can be envisaged as a circle with radius  $r_T$  around the target reflection coefficient (see also 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
```



## Skipped measurements

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. 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

(Applies to HomSoft versions starting 5.0.0.0)

Smoothing is a floating average procedure applied on reflection coefficients (and frequency) in an attempt to reduce the undesirable effect on tuning behavior of glitches (short-lived deviations) in reflection coefficient. Tuning in case of smoothing is based not on the current results but on the mean value of  $N_a$  previous results, where  $N_a$  is *smoothing count*.

Typical examples where increased smoothing count may be beneficial:

- Essentially homogeneous substance moving on conveyor belt, containing from time to time a metallic object.
- A liquid flowing through an applicator, occasionally containing air bubbles.

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 reflection coefficient (and 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 5.0.0.0)

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, value 12 of *Tuning delay* represents the delay  $12 \times 250 \text{ ms} = 3 \text{ seconds}$ .

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.

## [Defaults...]

Click *Defaults* to set all autotuning parameters to their default values.

## Sketch

The *Sketch* page ([Figure 36](#)) displays relevant mechanical dimensions of Autotuner, including Analyzer calibration (CAL) plane location (not important for the user), location of input reflection coefficient reference plane ( $\Gamma_I$ ) and default location of input reflection coefficient reference plane ( $\Gamma_L$ ).

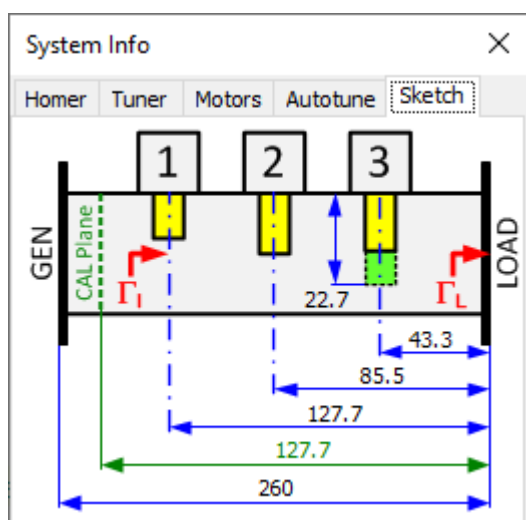



Figure 36. Sketch page of System Info window.

## Tuner View Window

**Tuner View** window ([Figure 37](#)) enables visual, mouse-based Tuner control and monitoring. The window can be opened by clicking **Tuner|View** menu item or  button. If you wish to change the background color, right-click the background.

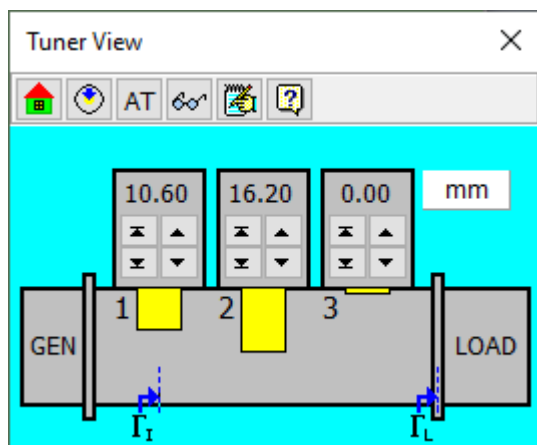




Figure 37. Tuner View window.


## All Stubs Home

All Stubs Home procedure (motors initialization) is activated by clicking **Home** button  or, equivalently, **Tuner|Home** menu item.

## Reading Stub Positions

Clicking **Read** button  (or **Tuner|Read** menu item) commands *HomSoft* to query Homer for the actual position of the tuning stubs. This action is normally not necessary; you may wish to try it in case of doubts about correctness of the displayed stub positions.

## Scenario

Clicking the **Scenario** button  (or **Tuner|Scenario** menu item) opens the [Scenario](#) dialog window enabling to define, save, load and run sequences of predefined stub positions with specified dwell time at each position, or set individual positions of a sequence by a mouse click.





## Stub Movement

### Mouse Dragging

A tuning stub can be moved by gripping the bottom edge of its image by 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 (maximal extension) position.
-  Click once or keep the button depressed to move the stub upwards by small, medium, or large steps.
-  Click once or keep the button depressed to move the stub downwards by small, medium, or large steps.

The step size can be controlled by simultaneous holding a keyboard key as follows:

- Small step      hold **Ctrl** key
- Medium step    do not hold any key
- Large step      hold **Shift** key *or (easier!)* use the **right-hand** mouse button

Numerical indicators attached to the motors show 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 *steps* can be typed in numerically after clicking the numerical indicators. Confirming the value starts the stub motion.

**Note:** In case of CAN Bus, stub dragging as well as stub movement buttons are disabled while the system is measuring or autotuning. The typing via keyboard still works.

## Autotuning Activation

### Single-Step Tuning

While measuring, a single autotuning step can be invoked at any moment by clicking  button.

**Note:** In case of HoSim [Homer Simulation](#), an approximate time in milliseconds the tuning step takes is shown on top left. See subsection **Chart** of Homer Simulation section on how to customize HoSim program to represent a real Autotuner (loading a Tun.mem file).

### Continuous Tuning

Continuous autotuning can be activated or deactivated by clicking **AT** button (or **Tuner|Autotune|Active** menu item).

### Using AUTOTUNE Switch

Autotuning can also be controlled by means of the hardware AUTOTUNE switch (presence of this switch depends on Autotuner model). The switch overrides the software setting at the instant the switch position has been changed. Conversely, a next click on **AT** button overrides the HW switch setting.

## Reference Planes

Tuner View window indicates location of the planes to which input reflection coefficient  $\Gamma_I$  and load (deembedded) reflection coefficient  $\Gamma_L$  are referred.

- Input ( $\Gamma_I$ ) reference plane is located at the axis of the tuning stub 1, closest to the generator.
- Load ( $\Gamma_L$ ) reference plane coincides with the output flange of the tuner.

Details about  $\Gamma_I$  and  $\Gamma_L$  and their reference planes see in [Input and Load Reflection Coefficients, Deembedding](#).

### Plane Extension

The load reference plane (and only the *load* reference plane) can be arbitrarily user-shifted. For details, see [Plane Ext.](#)

If the load reference plane is shifted, the symbol  $\Gamma_L$  in 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 [Figure 37](#).

Plane extension distance is also written in the *Reflection Coefficient* group of the full-size Results Window.


## Stubs Motion Scenario

The **Stubs Motion Scenario** window ([Figure 38](#)) enables the user to:

- Create sequences of predefined stub positions (insertions) by copying actual motor positions.
- Create sequences of stub positions [realizing a desired set of input reflection coefficients](#).
- Save the defined sequences to text files.
- Load sequences of predefined stub positions from text files.
- Set individual positions of a sequence by a mouse click.

- Run once or repeatedly sequences of predefined stub positions with specified resting (dwell) time for each position.
- Run a sequence of predefined stub positions, **making measurement for each position**, and storing the measurements to a text file. This is, for example, a basis for measuring Rieke diagrams of magnetrons.

The window can be opened by

- Clicking the **Scenario** button  on the [Tuner View](#) window, *or*
- Clicking the **Tuner|Scenario** menu item.

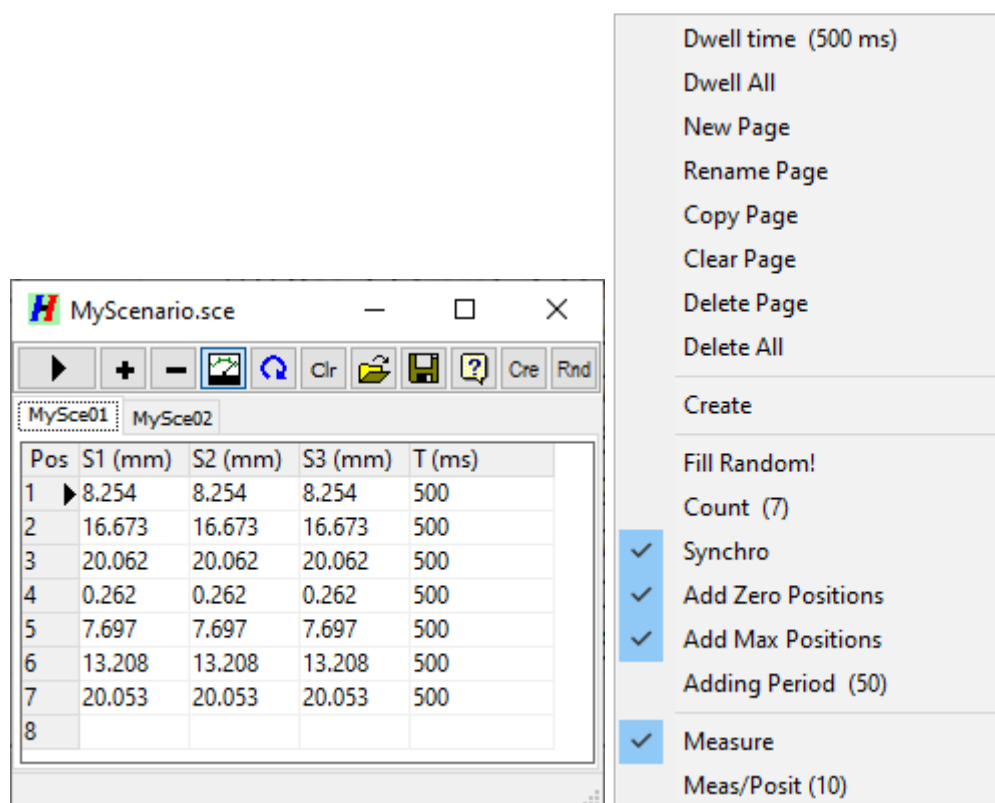


Figure 38. Stubs Motion Scenario window (left) and its context menu (right). **Cre** button is visible only in [HoSim](#) Homer simulation program.


Each combination of stub positions will be referred to as a *triplet*. Each triplet is characterized by three individual stub positions ( $S1$ ,  $S2$ ,  $S3$ ) in millimeters and a dwell time  $T$  in milliseconds. A **scenario** is a sequence of triplets, as listed on one page (table) of the Scenario window. The window can contain more than one page, defining thus multiple scenarios.

### To select a triplet (table row):

- Click the row at its leftmost gray cell (in **Pos** column). An arrowhead appears in this cell (e.g., row 3 is selected in [Figure 38](#)).

## Creating and Editing Scenarios

### To define a scenario:


- If the scenario table is not empty, clear it by clicking **Clr** button.
- Move the tuning stubs to desired positions.
- Click **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 default dwell time, right-click the table to invoke a context menu ([Figure 38](#) right), then click the **Dwell Time** menu item.

- Click the cell in **T (ms)** column and edit individual dwell time for any position triplet.
- Repeat the previous three steps as many times as required.

#### Other possibilities to define scenarios include:

- Saving an existing sequence, then editing the scenario file by an external text editor.
- Creating a text file with the corresponding structure by any text editor or spreadsheet calculator.


#### To insert a new triplet into an existing sequence:

- Move the stubs to desired positions.
- Select a desired sequence (page).
- Select the row before which the new position triplet should be inserted.
- Click **Add** button .
- If required, click the cell in **T (ms)** column to edit the dwell time.

#### To change dwell times for all existing triplets:

- Right-click the table. The context menu pops up ([Figure 38](#) right).
- Click **Dwell All** and enter the desired dwell times.

#### To delete a triplet:

- Select a desired sequence (page).
- Select the row that is to be deleted.
- Click **Delete** button .

#### To create a new scenario page:

- Right-click the table. The context menu pops up ([Figure 38](#) right).
- Click **New Page** to create a new, empty page, *or*
- Click **Copy Page** to create a copy of the current page.

#### To rename a scenario:

- Select a desired sequence (page).
- Right-click the table to open the context menu.
- Click **Rename Page** and enter a new name.

#### To empty a scenario page:

- Select a desired sequence (page).
- Click **Clr** button.
- Alternatively:
  - Right-click the table to open the context menu.
  - Click **Clear Page** menu item.

#### To delete a scenario page:

- Select a desired sequence (page).
- Right-click the table to open the context menu.
- Click **Delete Page** menu item.

*Note:* If there is only one page remaining, this cannot be deleted.

#### To delete a all scenario pages (except one):

- Right-click the table to open the context menu.

- Click **Delete All** menu item.

### To create a random sequence (for testing purposes):

This procedure inserts at a selected position of an existing sequence a predefined number of random triplets with values ranging between zero and maximum stub insertion. If required, zero and the maximum can be inserted regularly into this sequence. Such sequences can be used for testing proper functioning of the tuner. If steps are being lost, terminal switches will be reached after some time, and motor error will be reported.


- Select a desired sequence (page).
- Right-click the table to open the context menu.
- Click **Count** menu item to define how many triplets to create.
- If the table is not empty, select the row before which the new random sequence should appear. If you want a new table, click **Clr** button instead.
- If you want to add zero positions and maximum positions periodically:
  - In the context menu, check either **Add Zero Positions** or **Add Max Positions** or both.
  - In the context menu, click **Adding Period** and enter the periodicity.
- If you want that all stubs move synchronously (equal positions), check **Synchro** in the context menu.
- Click **Rnd** button, or right-click the table and click **Fill Random** menu item.
- Repeated **Rnd** button click adds new series of triplets.

## Scenarios realizing sequences of predefined reflection coefficients

*HoSim* [Homer simulation](#) program enables creating scenarios that realize sequences of predefined reflection coefficients, or even define sequences of reflection coefficients evenly covering portions of the Smith chart. See details in [Sequences of Predefined Reflection Coefficients](#).

## Saving and Loading Scenarios

### To save all scenario sequences to disk:

- Click **Save** button . **Save File** dialog box appears.
- Define a filename and 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 default extension *sce*. Open the file by a text editor to see its structure or to edit it.
- On *HomSoft* termination, the current scenario (provided it is not empty) is saved to *Ho0.sce* file in the [User Folder](#). This file will **not** be automatically loaded after the next *HomSoft* restart, and hence you have to load it manually, as described next.

### To load scenario sequences from disk:

Click **Open** button . **Open File** dialog box appears.





Locate and select the desired scenario file; then click **Open**.

## 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 a desired sequence (page).
- If the **Measure** button  is depressed, release it.
- Select the row for which you wish the motion to start (normally but not necessarily the first row).
- Depress the **Cyclic** button  if you wish the scenario to be cyclically repeated. You can do and undo it anytime, also during motors movement.
- Click **Play** button . The button appearance turns to  and the scenario starts running. The progress is shown in the bottom status bar.
- Click the same button if you wish to abort the scenario.
- When the scenario is completed or aborted, the stubs remain in the last position although the pointer will be reset to the starting 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 each setting has elapsed. The measurement results are written to one or two output files.

### Procedure:

- Select a desired scenario sequence (page).
- Depress the **Measure** button . This will activate the measurements.
- Right-click the table to open the context menu. Click **Meas/Posit** menu item to choose the number *Nrpt* of repeated measurements to be performed at each scenario setting.
- Click **Play** button . The button appearance turns to  and the scenario starts running. The progress is shown in the bottom status bar. (Click the same button if you wish to abort the scenario while running.)
- Before starting the scenario, the dialog titled **Prepare Output Files** opens, prompting you to define the name of the files the measurement results will be written to, and a comment.
  - If *Nrpt* > 1, two output files will be created with the defined name: one with extension **txt**, the other with extension **rkd**.
  - If *Nrpt* = 1, only the **txt** file will be created.
- The scenario then continues automatically, writing the measurement results for each stubs setting to the defined output files.
  - Only a single scenario run will be performed regardless of the **Cyclic** button  status.

## Scenario Output Files

If the number *Nrpt* of measurements per scenario position is greater than 1, two output text files with the same name will be created: one with extension **txt**, the other with 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 as described in [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 MS Windows manner (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 exhibiting 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 the standard deviations of **not** merely magnitudes: they are **uncertainty circle radii** *u*, representing the scatter of the respective reflection coefficients in the complex plane (see topic [Measurement Accuracy](#)). They are computed as

$$dMag = u = \sqrt{s_x^2 + s_y^2}$$

where  $s_x$  and  $s_y$  are, respectively, standard deviations of the real and imaginary parts of the measured reflection coefficient. Thus, for example, if the magnitude of the reflection coefficient is constant and only its phase fluctuates, *u* will still be nonzero.

The *WinTime* is added at the very end of each row.

- If the output files were 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**, the **rkd** file can contain additional columns, representing the desired (scenario) reflection coefficient in polar form (columns **Mag\_sc**, **Dg\_sc**), the rectangular form (**Re\_sc**, **Im\_sc**), and the frequency in MHz, at which they were synthesized with the tuner (**f\_sc**).

---

## Hysteresis

Only two of the three stubs (1+2 or 2+3) are used at a time for matching of any particular load reflection coefficient, each pair covering certain area in the Smith chart ([Figure 39](#)). There is a boundary between these two sub-areas (the thick red line S1 in [Figure 39](#)) where the central stub (Stub 2) is withdrawn and either Stub 1 or Stub 3 protrudes (up to maximum). Varying load reflection coefficient just slightly across this border would force the stubs 1 and 3 to incessantly and mostly uselessly jump up and down. This is for instance the case of reflection coefficients (red dots) designated 1 and 2 in chart (a) and reflection coefficients 4 and 5 in chart (b). Because of this stub switching the boundary can be aptly named “discontinuous boundary”.

Another, less critical, is the “continuous” boundary S2 (thick dark-blue line), where the central stub is inserted and stubs 1 and 3 swap “gracefully” by way of zero extension at S2 boundary. The two cases are illustrated in [Figure 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 at reducing the incidence of such stub swapping. As a measure of hysteresis, *hysteresis distance*  $r_H$  has been introduced. It is the distance in complex plane by which the load reflection coefficient  $\Gamma_L$  must intrude into the other area in order for the system to swap the stubs. The price is somewhat greater mismatch, especially if  $r_H$  is chosen too high. In [Figure 39](#), the hysteresis area around S1 is bounded by the green line and around S2 by the grey line. In chart (a), the swapping will not occur when reflection coefficient variation is **1→2** or **u→v** but it occurs in cases **2→3** or **v→w**. In chart (b) the swapping will not occur in cases **4→5** or **x→y** but it occurs in cases **5→6** or **y→z**.



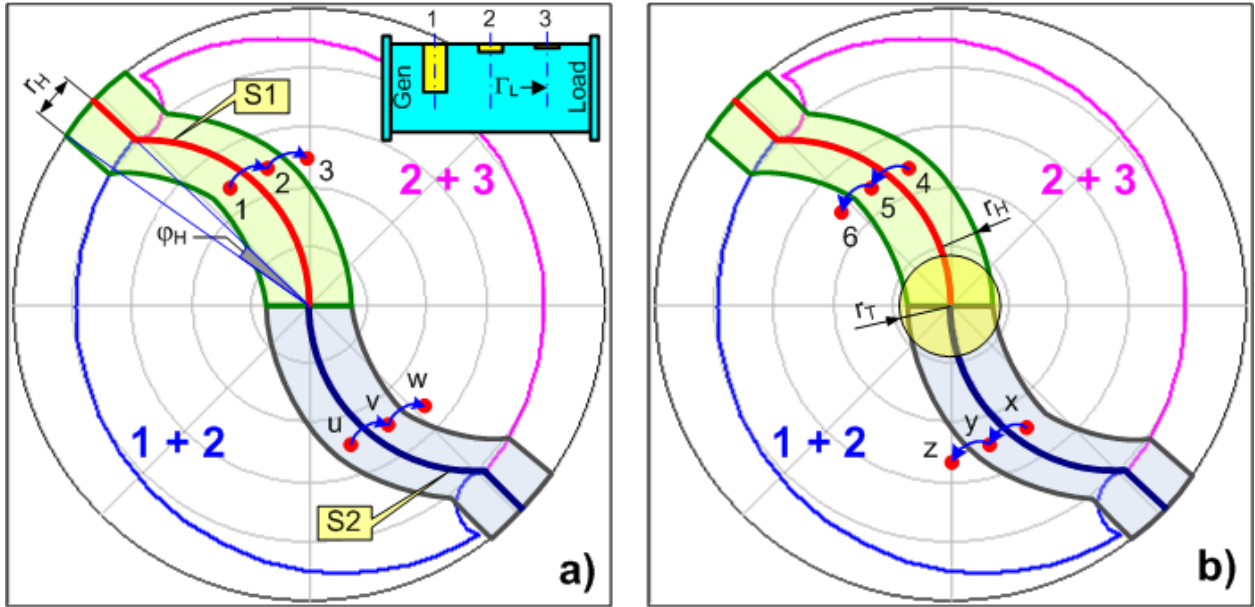


Figure 39. Stub swapping and hysteresis. Tolerance circle with radius  $r_T$  is also shown in (b).

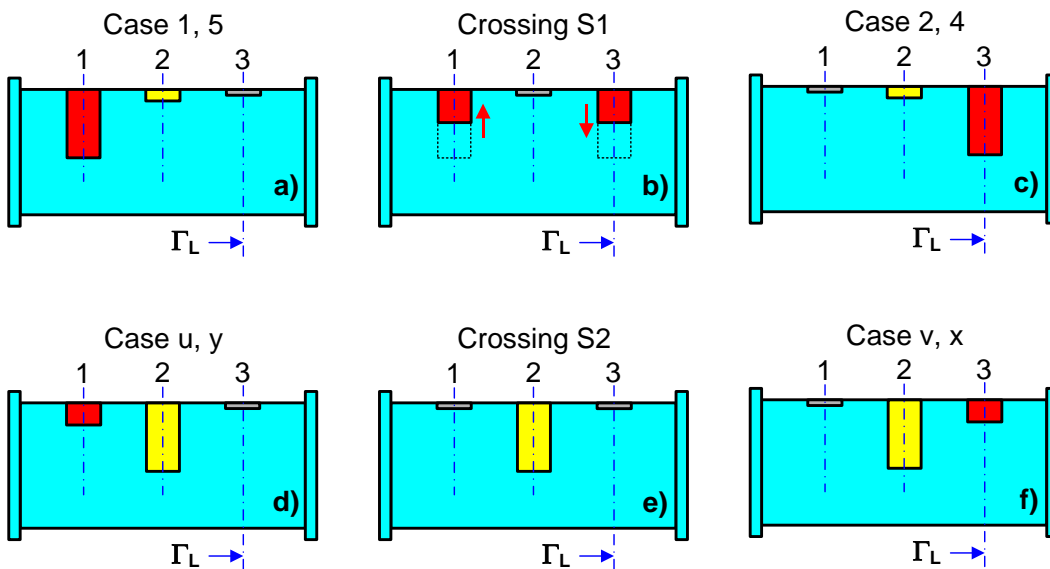


Figure 40. Stub swapping across “discontinuous” boundary  $S1$  (a, b, c), and across “continuous” boundary  $S2$  (d, e, f).

If there is a gap between the two areas or if the areas overlap (Figure 41), the “permissible distance of intrusion”  $r_H$  is measured from the decision curve running in the middle of the gap (or overlap). The gap/overlap can arise only at the discontinuous boundary  $S1$  and its size is a function of electrical distance of the stubs.

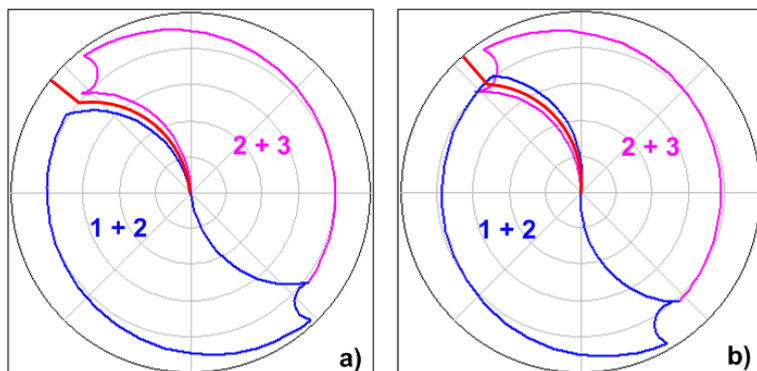


Figure 41. Gap between the matchable subareas (a) and their overlap (b). The decision curve (thick red line) runs in the middle of the gap/overlap.

The value of  $r_H$  is defined indirectly by the hysteresis angle  $\varphi_H$  as follows from [Figure 39](#). If  $\varphi_H$  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) provides  $r_H = 87$  mU; other values (exactly computed) can be obtained from [Figure 42](#). You are not encouraged to modify the default hysteresis value without a good reason.

The **Autotune** page of [System Info](#) window shows the hysteresis distance in parentheses.

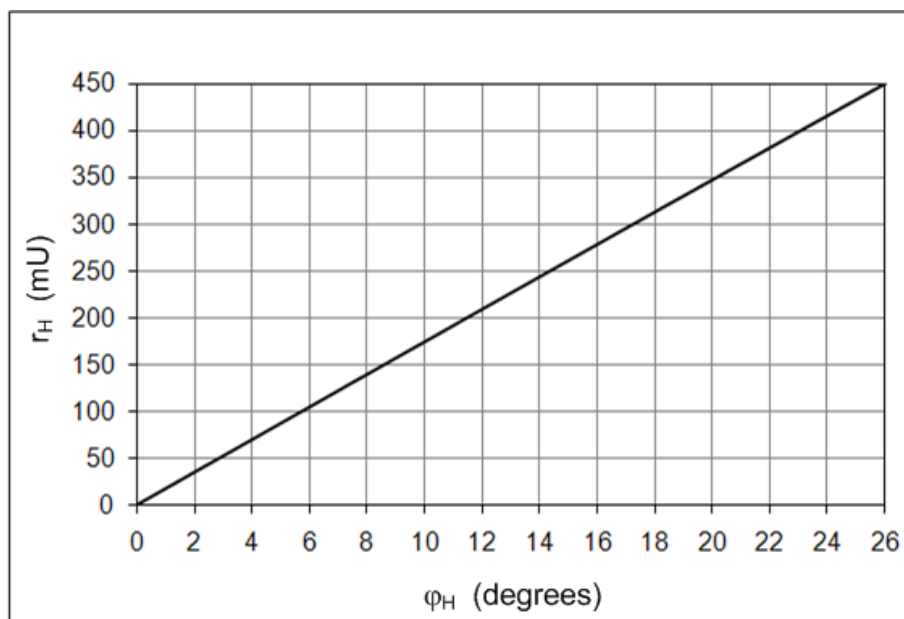


Figure 42. Hysteresis distance  $r_H$  as a function of hysteresis angle  $\varphi_H$ .

Note that **Hysteresis** is combined with **Tolerance** (a circle with radius  $r_T$  around the **Target** (usually zero) reflection coefficient (see [Figure 39b](#)).

When reflection coefficient variations are confined in a relatively small cluster located exactly at one of the swap boundaries (like the reddish area in [Figure 43](#)), the cluster can be moved off by inserting a section of waveguide between Tuner and load. A waveguide with length 1/8 of guide wavelength will rotate the load reflection coefficient by 90 degrees. For R-26 (WR-340) 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.

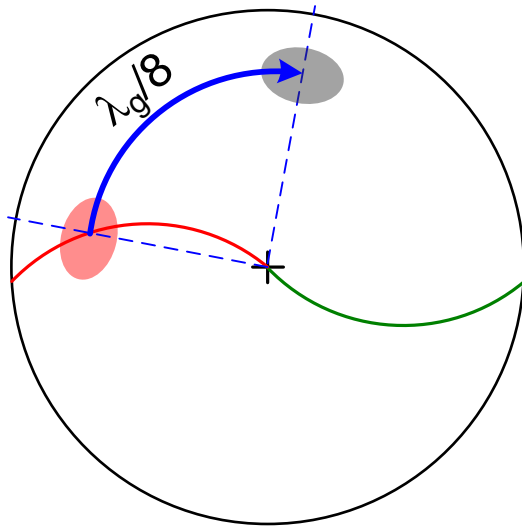


Figure 43. Insertion of a waveguide section can move reflection coefficients off the critical area.



# HomSoft Menu

This section is an overview of *HomSoft* menu commands. Depending on the program and its status, some menu items may be disabled or invisible.

---

## File Menu

**File** Menu groups commands related with file operations. The menu includes program termination command.

### Copy Picture

Copy selected display area to clipboard. For details, see [Saving Results as a Picture](#).

### Save Picture

Save selected display area as a graphic file. For details, see [Saving Results as a Picture](#).

### Picture Area

Choose which part of the screen should be captured for **Copy Picture** and **Save Picture** operations. For details, see [Saving Results as a Picture – Before Saving](#).

### Picture Type

Select the desired graphic file format for **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 [Saving Results to a Text File](#) topic.

### Separator

Select the decimal separator for **Save Results** by clicking either **Point** or **Comma** submenu item. The setting will be stored in the Ho0.ini setup file so that it remains the same after *HomSoft* restart.

### Save Setup

Save complete system setup. For details, see [Customizing Homer](#).

### Load Setup

Load complete system setup. For details, see [Customizing Homer](#).

### Open User Folder

Opens Windows Explorer in *User Folder*, where Ho0.ini files and other *HomSoft* configuration files are stored. This is also the default location for user-created files (setups, results files, log files).

## Exit

Terminate *HomSoft* execution (shortcut Alt+X). For details, see Customizing Homer.


## Exit (no setup)

Terminate *HomSoft* execution without writing the default setup file Ho0.ini (shortcut Alt+A). For details, see Customizing Homer.


# Homer Menu


Homer menu groups functions related mostly to Homer Analyzer.

## Run/Pause


Clicking **Run/Pause** menu item or the equivalent  button has two effects:

1. A command is issued to Homer to start repeated measurements, possibly autotuning, and sending results.
2. PC starts *monitoring* Homer, i.e., receiving data messages, processing them, and displaying measurement results either as numbers or graphs or both.

The button appearance changes to a Pause symbol .

Clicking again the menu item or  button does not stop Homer internal activity, it only stops *monitoring* in the sense that the PC ignores data coming from Homer. The effect may be immediate or delayed until the current sweep completion, depending on the **Homer|Finish Sweep** menu item status (see details in [How to Start and Stop Sweeping](#)).


## Stop Homer

Clicking **Stop Homer** menu item or the equivalent  toolbar button has two effects:

1. A command is issued to Homer to go *idle*, i.e., to stop making internal measurements, autotuning, and sending data. Homer then just waits for further commands.
2. Homer monitoring is discontinued.

The effect is immediate. For details, see [How to Start and Stop Sweeping](#).

## Finish Sweep

Checking or unchecking **Finish Sweep** menu item controls the instant the monitoring is *actually* discontinued after clicking  button or **Spacebar** (provided main window has focus) or **F9** or **Run/Pause** menu item while sweeping (monitoring 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.

## Show Available

The menu item is visible only in case of CAN Bus. A click opens a window listing the detected Homers and their status. The column titled *Running* indicates whether a Homer is measuring and sending data repeatedly. The column *Tuning* shows its autotuning status (effective only if Running=YES). The column *Selected* indicates which of the Homers is selected for control by *HomSoft* (see [MultiCAN: More Homers on CAN Bus](#)).

## 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 ([Figure 44](#)) to define the cadence with which the measurement results will be updated and transmitted via the communication interface.

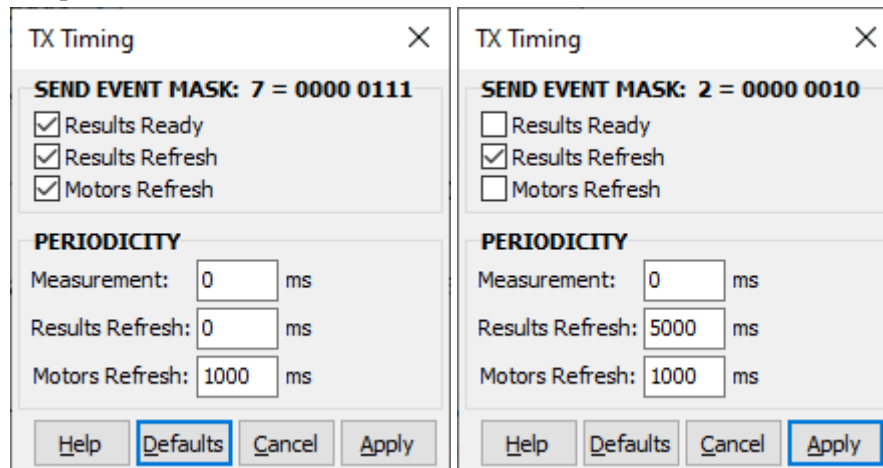


Figure 44. TX Timing window. Left: defaults, right: as in the example below.

The **TX Timing** window must be closed before continuing the program. You can do it using **Apply** button, **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, all changes that you may have made will be ignored.

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

## Timing Background

In each cycle of its main program loop, 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 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] (min=0)
```

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

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

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* sending request (*bit 2 of RTS*) occurs periodically with the period defined by **Motors Refresh** edit box in the *PERIODICITY* panel. A power-up value of is defined by the following line in 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 reduced Measurement Data Object (MDO) containing only motors positions and status 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.
- 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 alternatively be defined in **Tuner|Motors Refresh** menu item.

## Sending Periodicity Example

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

- In *PERIODICITY* panel:
  - Edit **Measurement** edit box to 0 (to ensure full-speed measurement).
  - Edit **Results Refresh** edit box to 5000.
- In *SEND EVENT MASK* panel:
  - Uncheck **Results Ready** checkbox.
  - Check **Results Refresh** checkbox.
  - Uncheck **Motors Refresh** checkbox.
- Now, the **TX Timing** window should look as [Figure 44](#) right. Click **Apply** button.



## Points per Sweep

Points per Sweep menu item (or the corresponding **Pts** toolbar button or Ctrl+N shortcut) defines the count of measurement points displayed on x-axis of rectangular displays (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  $\Gamma_L$  is by default referred to the output flange of Homer. However, this reference plane can be arbitrarily shifted by the user by means of **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 ( $\Gamma_{L0}$ ) and new ( $\Gamma_{L1}$ ) 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 generator to load (outwards of Homer output),  $\Delta x = x_1 - x_0$  and  $\lambda_g$  is the guide wavelength. The formula represents rotation of  $\Gamma_{L0}$  by an angle proportional to the extension  $\Delta x$ . 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  $\Gamma_L$  and its arrow in [Tuner View window](#) are shifted from their default location shown in [Figure 37](#) either to the right (if extension  $\Delta x$  is positive) or to the left (if  $\Delta x$  is negative).

Reference plane shift enables to compensate, e.g., for a section of waveguide connected between Homer output and your applicator.

Reference plane shift does not affect autotuning, for which always input reflection coefficient  $\Gamma_I$  is used. More details about reflection coefficients measured by Homer and their reference planes see in section [Input and Load Reflection Coefficients, Deembedding](#).

## Transform

Submenu items of **Transform** menu launch actions associated with a user-defined *bilinear transform* of **input** reflection coefficient  $\Gamma_I$ . For details, see [Transforming Input Reflection Coefficient](#) section.

## Counter

Since magnetron frequency can easily change by as much as 1% (several tens of MHz at 2.45 GHz) when varying its anode voltage (hence output power level) or load reflection coefficient, Homer contains an internal counter which measures actual frequency and interpolates the system parameters (calibration data) for more accurate measurement. The counter can be enabled and disabled by repeated clicking the **Counter** menu item. When disabled, a substitute frequency  $F_{subst}$  is considered by Homer. The substitute frequency value can be imposed by the user (see [Substit Freq](#) menu item below).

Frequency is displayed with other quantities in [Results windows](#). When the substitute frequency is used, the LED-like frequency indicator of the Maxi Results window turns red; the same happens with the font color of the Mini Results window.

Switching the counter OFF and defining appropriate  $F_{subst}$  may prove useful in situations when 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, **Tc** toolbar button opens a dialog to define the gating interval in microseconds of the frequency-measurement counter. The prompt suggests the minimum count time recommended for good frequency measurement accuracy (quantization error below 40 ppm, i.e., 10 kHz at 2.45 GHz) although a ten times shorter count time is still satisfactory. The prompt also shows the maximum settable value  $T_{max}$  to avoid counter registers overflow. When a greater value is entered, it will be automatically truncated to  $T_{max}$ . Count time is stored in Ho0.ini setup file.

The actual count time will be truncated to the highest multiple of 16  $\mu$ s not exceeding the set value.

Separate count times are used in CW, Rectified, and Pulsed modes of sampling.

The count times can also be set in the [Homer Sampling Setup](#) window.

## Freq Toler

Clicking **Freq Toler** opens a dialog to define frequency tolerance  $F_{toler}$ , which is the maximum allowable deviation of measured frequency ( $F_{meas}$ ) from 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 **Substit Freq** menu item below).

Homer nominal frequency  $F_{nomin}$  is a fixed, intrinsic quantity for each Homer class. It can be learned from [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 substitute frequency is sent by Homer instead of measured frequency when at least one of the following instances occurs:

- Frequency counter is disabled by **Homer|Counter** command.
- Measured frequency falls beyond the permitted tolerance interval (see **Freq Toler** menu item). This can happen when, for instance,
  - magnetron power level is too low;
  - magnetron is pulse-modulated and you do not employ triggering;
  - internal counter is faulty (which, of course, can never happen).

Frequency is displayed along with other quantities in [Results windows](#). When the substitute frequency is used, the LED-like frequency indicator of the Maxi Results window turns red; the same happens with the font color of the Mini Results window.

*Note:* If for some reason the user-defined substitute frequency is invalid, Homer firmware decides what will be sent as  $F_{subst}$ , the last instance being the nominal frequency  $F_{nomin}$ .

## MultiCAN

This menu item and its submenu are available only in case of CAN Bus *and* more than one Homer detected on the bus. See [MultiCAN: More Homers on CAN Bus](#).

## More

**More** menu includes the following items:

### Suspend on Low Signal

When the warning *Low Signal* is reported from Homer, e.g., after you switch off the magnetron power, the graphical display of “measurement” results may become annoyingly noisy. While Homer continues

transmitting these meaningless results, *HomSoft* may decide to ignore them: not to update charts until the power becomes sufficiently high again. The decision is based on the status of **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, which is in fact just cosmetics, should not be confused with [suspending autotuning](#) when Low Signal condition occurs.

For more details on *Low Signal* condition, see [Homer Error Byte](#).

## Pow Cal Factor

Opens dialog to set user-defined Homer power measurement correction factor: see [Power Measurement Calibration Factor](#).

## Halt Server

Clicking **Halt Server** menu item terminates execution of Homer internal server program SrvHo.exe and starts the internal utility SrvDld.exe, enabling transfer of files between Homer and 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 **F7** hot key terminates and immediately restarts the Homer internal server program SrvHo.exe. This causes resetting Homer to default settings without 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 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:

1. To terminate SrvHo.exe and restart it in a new communication mode (RS232 vs. CAN), use **Tools|Switch Server** menu.
2. 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.

# Tuner Menu

Grouped in Tuner menu are functions related to Tuner operation. The menu items include:

## View

Shows/hide [Tuner View](#) window.

## Home


Triggers [motor initialization routine](#).

## Autotune


The **Autotune** submenu enables to:

- Switch autotuning ON and OFF (submenu item **Active**). A more comfortable way is via [Tuner View](#) window.
- Set parameters controlling the autotuning process. The settings can more comfortably be made in the **Autotune** page of [System Info](#) window; this topic also describes the parameters in detail.

## Read

Clicking **Read** menu item (or the equivalent  button in [Tuner View](#) window) commands *HomSoft* to query Homer for the actual position of the tuning stubs.

## Scenario

Clicking **Scenario** menu item (or the equivalent  button in [Tuner View](#) window) opens the [Scenario](#) dialog window. The dialog enables to enter, save, load and run sequences of predefined stub positions with specified dwell time for each position.

## Motors Refresh

Define the minimal interval in milliseconds between two consecutive motor position messages sent by 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, Scale, Trace, Chart Menus

Description see in [Display Window-Related Menu](#).

---

## Window Menu


Window menu groups commands related with display windows.

### New Display

Open a new display window. For details, see [Display Windows-Related Commands](#).

### Arrange

Position display windows automatically in different ways (**Cascade**, **Tile**, etc.) as offered by the submenu of **Arrange** menu item. See hints in the status bar when hovering with mouse over the submenu items.

**NOTE:** In **HomTool** servicing version of *HomSoft*, clicking the **Arrange|Cascade** menu item or the equivalent  button causes all windows (not only display windows) to assume a predefined arrangement.

### 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.

### Main Window Color

Change the background color of [Main Window](#). The same effect is achieved by double-clicking the Main Window background.

### Impress All

On all display windows, redraw the latest measured traces without first blanking the display windows (leaving, e.g., traces cumulated by [Persist](#)).

### Blank All

Clear all display windows.

**Redraw All**

Clear all display windows and redraw the latest measured traces.

**Close All**

Close all display windows.

**Model Menu**

This menu item is only visible in **HoSim.exe** [simulation](#) version of *HomSoft*. Clicking **Model** opens [Homer Model window](#).

**View Menu**

**View** menu enables to open and close several non-display windows as well as to hide/unhide Standard and Signal toolbars ([Figure 15](#)).

**Commun Menu**

**Commun** menu groups commands related with Homer communication issues. For more details, see [Configuring Communication](#) and [Establishing Communication](#).

**COM Port**

**COM Port** menu item opens [RS232 communication configuring dialog](#).

**CAN Bus**

**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 managing file transfers to and from Homer, Server type switching, and commands for resetting Homer to various predefined states. A **HomTool** servicing variant of *HomSoft* adds commands for complete Homer firmware reinstallation and reprogramming stepper motors.

**Send to Homer**

Send (upload) configuration files, memory files, Server program files, or any other firmware files from your computer to Homer. For details, see [Transferring Files](#).

**Load from Homer**

Receive (download) files from Homer to your computer. For details, see [Transferring Files](#).

**Update Server**

A specialized command for uploading a **Server** program file from your computer to Homer.

**Switch Server**

Terminate the Server currently running in Homer and start a Server selected in the submenus of the **Switch Server** command. The available choices are **RS232**, **CAN Bus** and **Download** Servers.

## Reset

Submenu items of this menu enable to set Homer to predefined states, including factory (out-of-box) default and a user-defined state. The menu also enables 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](#).

## Reinstall

The **Reinstall** command starts complete Homer firmware reinstallation. The command is visible only in **HomTool** version of *HomSoft*.

## Reprogram Motors

The command reprograms parameters controlling the stepper motors, including maximum tuning stub insertion depth. The command is visible only in **HomTool** version of *HomSoft*.

Details of the reinstallation and motors reprogramming are described in section [Homer Firmware Update/Reinstallation](#).

# Help Menu

The menu contains the standard Help menu items.

## Contents

Opens Help for Homer.

## About

Opens **About** window ([Figure 45](#)). The window provides basic information on *HomSoft* version, running Server version, Homer HW identification as well as available options. Always copy this window when [reporting problems](#).

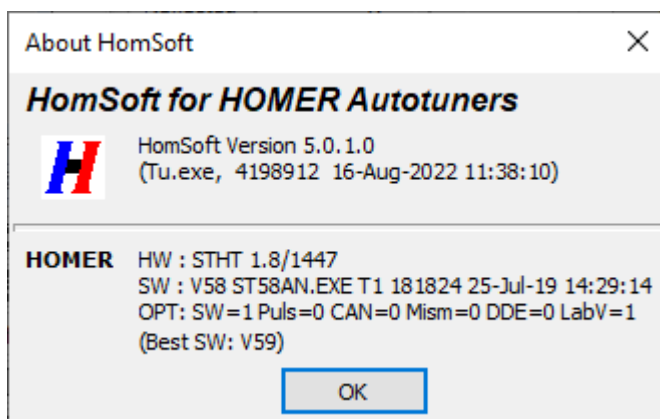



Figure 45. About window example.

# Homer Simulation

For training purposes, **HoSim.exe** simulation version of **HomSoft** is available. HoSim simulates (computes) “measurement” results, based on your inputs. HoSim therefore does not require a real Homer system, it only needs your computer. For versions starting V5.0.0.0 the HoSim user folder is

c:\Users\<username>\S-Team\HoSim (Windows 7 and higher)  
c:\Documents and Settings\<username>\S-Team\HoSim (Windows XP)

To simulate exactly the tuning performance of your unit, HoSim can be [customized](#) by loading 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](#) (Figure 46). The waveforms can be seen when the display of individual samples is chosen. To do that, depress  Signal toolbar **button** (Figure 15), leaving **1x** button in the upper position. Alternatively, open [Homer Sampling Setup](#) window, then check **Send Samples** checkbox and uncheck **Single-Shot** checkbox.

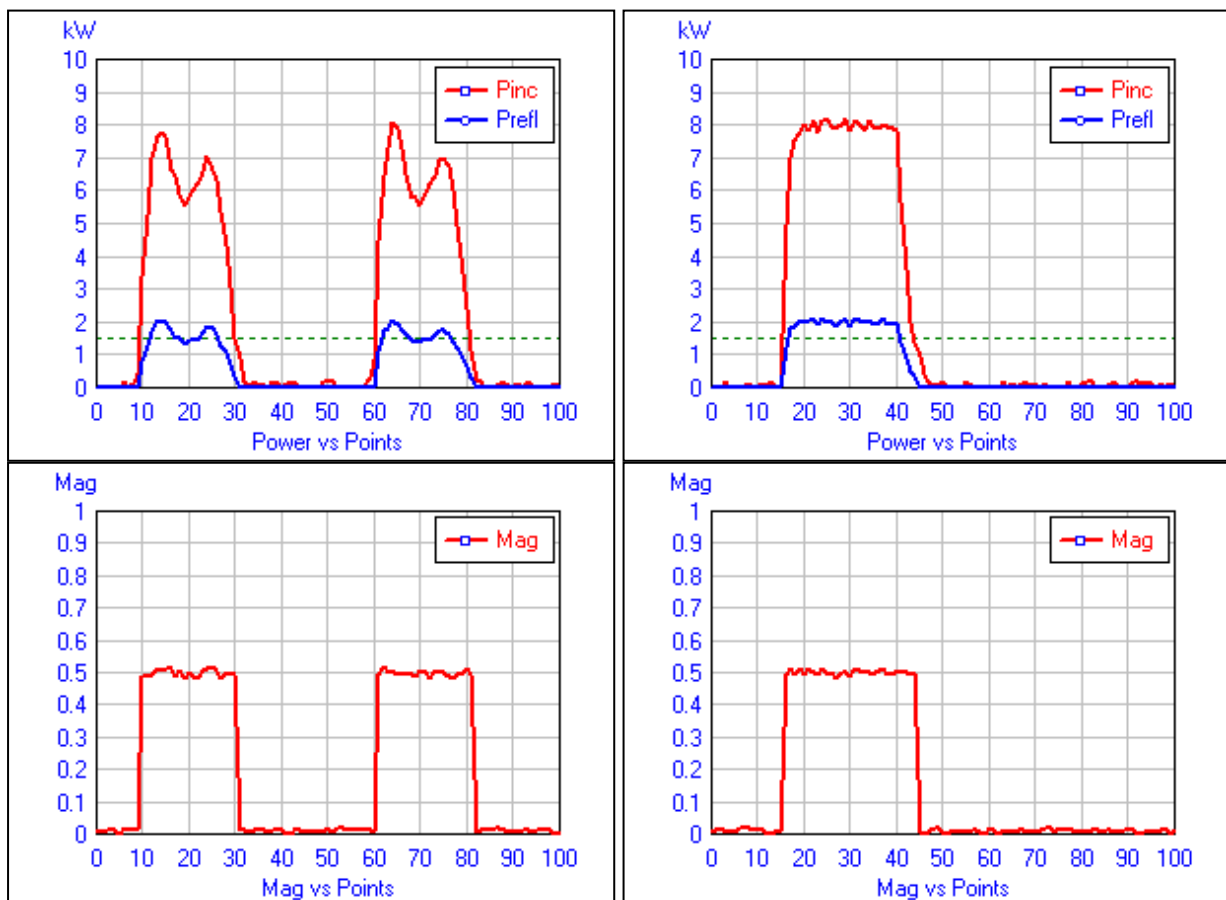


Figure 46. Waveforms simulated in Rectified (left) and Pulsed (right) modes, including noise.

Tuning stub positions are controlled the same way as in the real programs (see [Tuner View](#) window). Unlike real programs, the stubs can be moved also during the simulated measurement.

## Homer Model Window

To control the simulation data, click **Model** menu item. **Homer Model** multipage dialog window appears ([Figure 47](#)). The pages are titled *DUT*, *Animation*, *File*, and *Freq/Power/Temp*. (The *File* page is under development and is not active as of HomSoft Version 5.0.1.0.)

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 measurements. The number does not represent any real time unit and you have to play a little to arrive at a reasonable sweeping speed (to start with 1000 is a good choice).

New settings are not accepted until you click the **Apply** button (the exception is Error Byte in *Errors* page, setting of which has immediate effect).

### DUT Page

The *DUT* page ([Figure 47](#)) controls the reflection coefficient of the simulated load (DUT stands for Device Under Test).

#### IMPORTANT NOTE:

All reflection coefficients discussed here refer 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 [Plane Ext](#) item of **Homer Menu**.

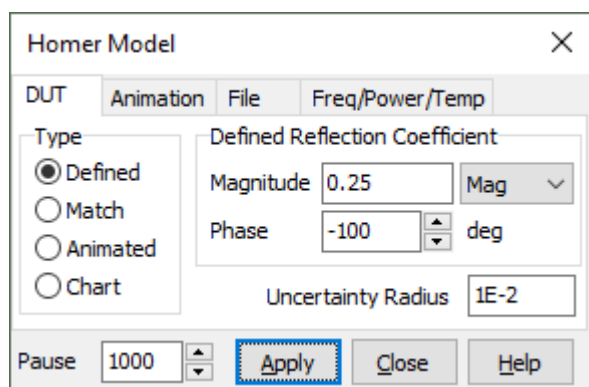


Figure 47. Homer Model window: DUT page.

See topic [Chart](#) for more details about this type of DUT reflection coefficient definition.

### Type of DUT

The **Type** group of radio buttons selects the type of the simulated DUT. The choices are:

- **Defined:** Load reflection coefficient defined by the values of magnitude and phase in the Defined Reflection Coefficient box.
- **Match:** Load reflection coefficient is zero (perfect match).
- **Animated:** Load reflection coefficient magnitude and phase is automatically incremented point-by-point as defined in [Animation](#) page.
- **Chart:** Load reflection coefficient is comfortably generated by mouse clicking and dragging in a polar diagram. See topic [Chart](#) for details.


### Uncertainty Radius

A nonzero value of **Uncertainty Radius** adds a 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 using **Polar** display format. For useful Polar display settings, see *Tips for Circular Displays* in [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 the real measurement. Fluctuations equal exactly to Uncertainty Radius are only observable when the averaging is set to unity. To modify the averaging:

- Set *Waveform* to CW (click **CW** Signal toolbar button ([Figure 15](#)), or use [Homer Sampling Setup](#) window).
- Modify the sample count (averaging) by editing **Sample Count** in *Homer Sampling Setup* window or by clicking  button.

### Case of Rectified and Pulsed modes of sampling

Please note that (unlike real Homer) this CW sample count setting also affects data fluctuations simulated in *Rectified* and *Pulsed* modes.


### Defined Reflection Coefficient

When selecting **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 **Apply** button.

### Chart

When clicking **Chart** radio button in **Type** group, followed by **Apply** button, the window titled **Load Reflection Coefficient** ([Figure 48](#)) will open, containing a polar chart. You are now able to generate the simulated load reflection coefficient by the following methods:

- Clicking into the chart.
- Dragging the cursor over the chart by holding down the left mouse button.
- Editing the **Mag** and **Deg** edits (below Polar Radius panel), then clicking **Apply** button  or hitting *Enter* key on the keyboard. Invalid inputs are ignored and substituted by current values.

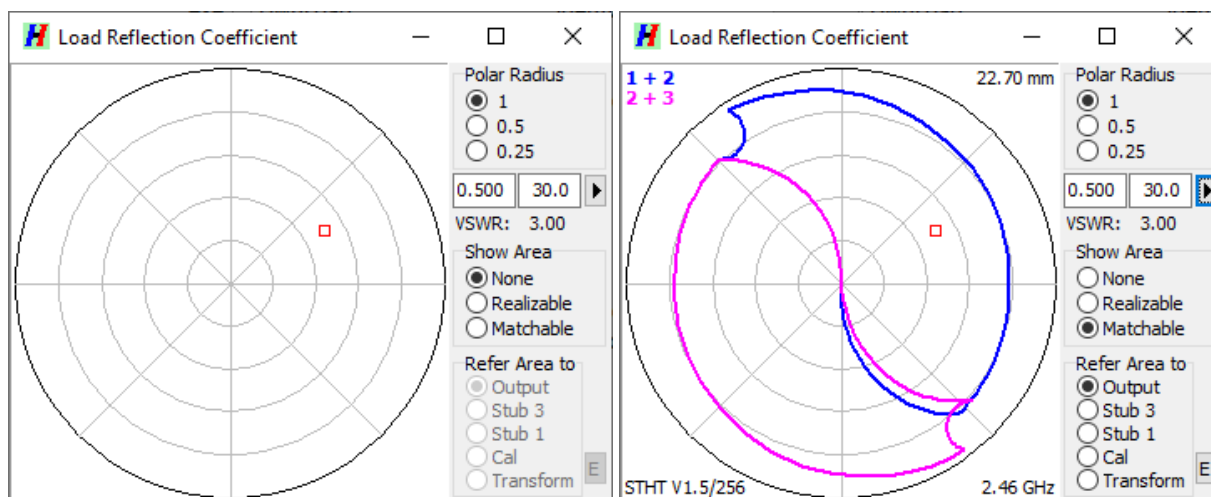


Figure 48. Load Reflection Coefficient window. Right: Matchable area valid for the chosen simulation frequency and maximal stub insertions.

Mouse-generated reflection coefficients are displayed numerically in **Mag** and **Deg** edits. The magnitude is also converted to VSWR.

To change the chart radius (to zoom the chart), click one of the **Polar Radius** radio buttons.

#### Notes:

- If you now select another type of DUT simulation (*Defined*, *Match*, or *Animated*) the chart remains on the screen but the link between the chart-generated and simulated reflection coefficients will be broken.
- All reflection coefficients discussed here refer to Homer's *load reference plane*. By default, this plane coincides with the output flange of the device. See also: [Input and Load Reflection Coefficients](#), [Deembedding](#) and [Plane Ext](#) item of **Homer Menu**.

### Realizable and Matchable Areas

In addition to comfortably generating reflection coefficients, the **Load 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 the 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 Polar diagram 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 diagrams.

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 areas is **Output**, meaning the plane of the tuner output flange. The reference plane can also be set to the axis either of **Stub 3** or **Stub 1**, or to the reflectometer calibration plane (button **Cal**). Plane positions are specified on *Sketch* page (Figure 36) of [System Info](#) window. The most natural choice for the realizable areas is **Stub 1**.

A special choice of the reference is **Transform**. This refers the areas to the input of a *circuit connected at the Homer input*. For details, see [Transforming Input Reflection Coefficient](#) section. The **Transform** choice is meaningful for the *realizable* areas. If the transform is not active, the areas refer to **Stub 1** (no circuit connected).

The [tuner](#) model and frequency for which the areas are pertinent are shown in the bottom of the chart. The maximal stub insertion for which the areas are pertinent is shown in the top right.

You can export the area borders as a contour to a text file. To do so, click **E** button (bottom right).

## Animation Page

The *Animation* page ([Figure 49](#) left) enables 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 will be activated by clicking **Apply** button whenever the *Animation* page of **Homer Model** window is selected. Alternatively, the animation can be activated by clicking **Animated** radio button on the *DUT* page.

An example of two animations is shown in [Figure 49](#).

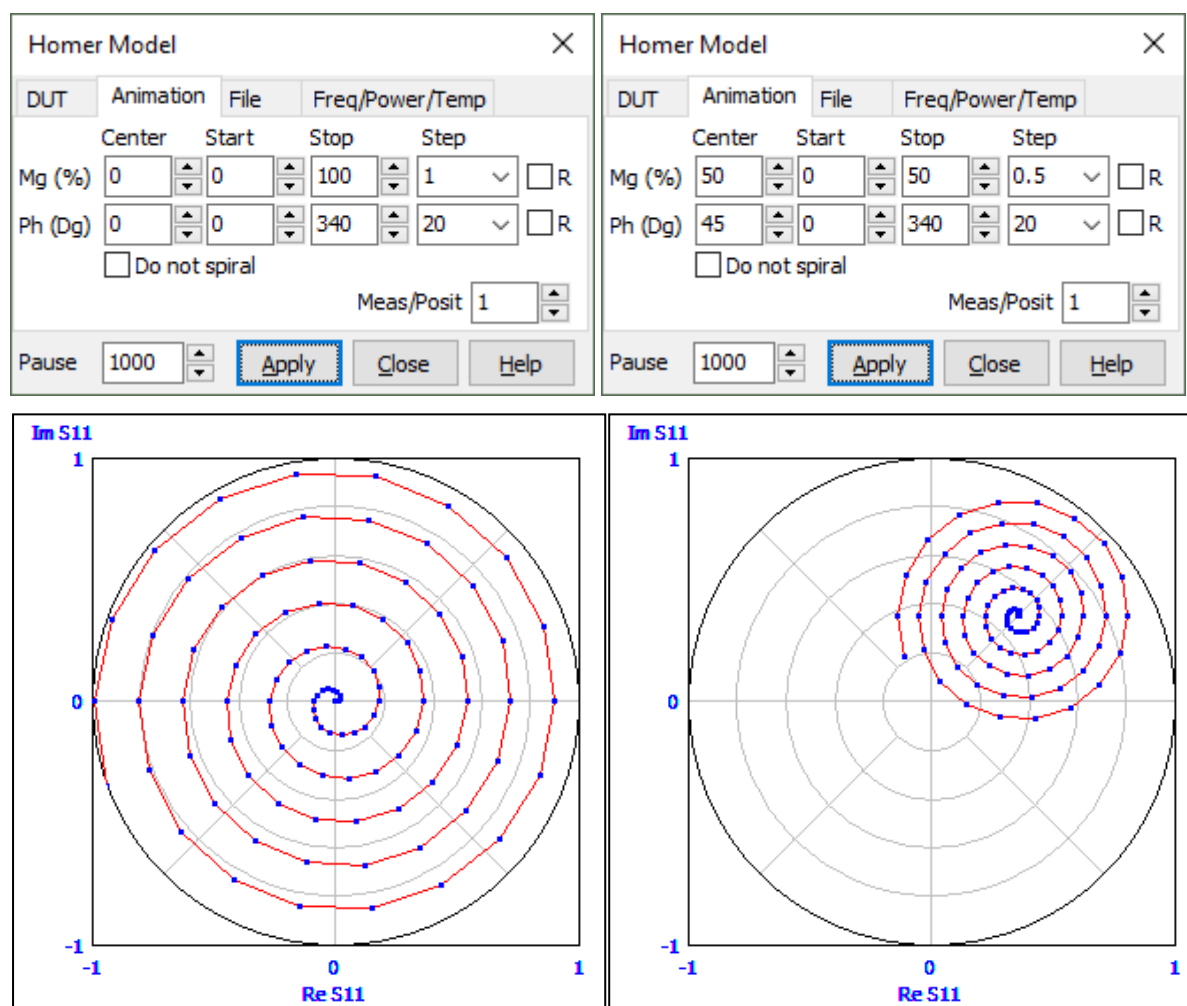


Figure 49. Animation page of **Homer Model** window (top) and the resulting evolution of load reflection coefficients (bottom). To obtain these charts, set **Homer/Points per Sweep** = 101, check **Homer/Finish Sweep**, then start measurement and stop it before the end of the sweep. Autotuning must be switched OFF and the tuning stubs retracted.

- The **Center**, **Start** and **Stop** values for *magnitude* are stepped by 1% (0.01); the **Center**, **Start** and **Stop** values for *phase* are stepped by 1 degree.
- **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 **Apply** button.
- The speed of the stepping 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 a stable, periodically repeated displays, consider this:

Let the magnitude Start, Stop, and Step values are  $M_1$ ,  $M_2$ , and  $\Delta M$ . 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  $\phi_1$ ,  $\phi_2$ , and  $\Delta \phi$ . Then the repetition period of the phase is

$$n_{pha} = 1 + |(\phi_2 - \phi_1)/\Delta \phi|$$

Let the **Homer|Points per Sweep** setting is  $N_{pts}$ .

To obtain stable, periodically repeated displays, 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 [Figure 49](#) do not meet these conditions because  $n_{mag}/n_{pha} = 5.611$ .

## Freq/Power/Temp Page

The *Freq/Power/Temp* page ([Figure 50](#)) controls the simulated signal frequency, generated power, and Homer internal temperature. Power-related bits of Error Byte can also be defined.

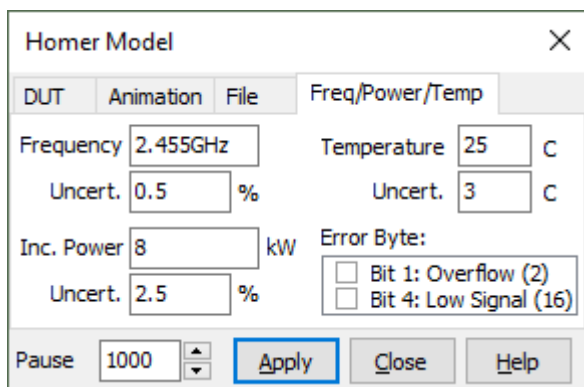


Figure 50. Freq/Power/Temp page of Homer Model window.

### To define simulated frequency:

- In the **Frequency** edit box, type the value in MHz.
- In the **Uncert.** (Uncertainty) edit box, enter the frequency uncertainty (random variation in percent).

- Press **Apply** button.

*Notes:*

- *Substitute Frequency* warning may be raised depending on these settings and **Homer|Freq Toler** setting.
- If an attempt is made to set the simulated frequency too far (more than  $\pm 10\%$ ) from the nominal frequency, the nominal frequency will be used instead.
- Error conditions are best observed by opening 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 in percent).
- Press **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 affects also the fluctuations in the *Rectified* and *Pulsed* sampling modes. More about this see in the [Uncertainty Radius](#) subsection of [DUT Page](#) topic.

### To define simulated temperature:

- Enter the desired Celsius value in the **Temperature** edit box.
- In the **Uncert.** edit box, enter the temperature uncertainty (random variation in Celsius).
- Press **Apply** button.

*Note:* Temperature-related error may be raised depending on these settings (normal range being typically 5 to 55 °C).

### To define power-related bits of Error Byte:

In **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 a possibility to load the real tuner parameters from its **Tun.mem** file. The file must be [downloaded](#) from your Homer first (the default destination is [User Folder](#) but you may wish to change it to the **TunMem** subfolder of the User Folder).

### To load a Tuner configuration:

- Open [System Info](#) window ([Figure 51](#)). In case of HoSim simulation program, the window contains additional button, labeled **Load Mem**.
- Click **Load Mem** button. **Open** dialog pops up.
- Browse for the **Tun.mem** file, then click **Open**.

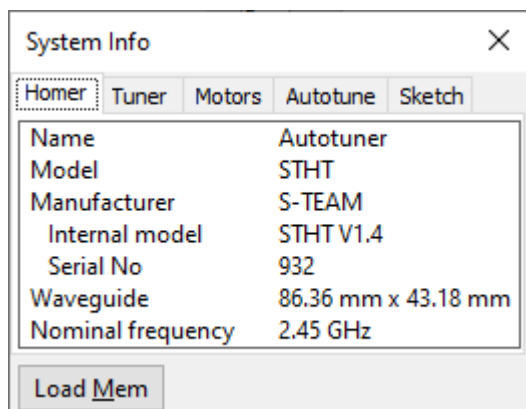





Figure 51. HoSim System Info window includes **Load Mem** button.

## To test the performance of your Tuner:

- Define simulation frequency in *Freq/Power/Temp* page of **Homer Model** window (see below).
- Click **Chart** in *DUT* page of **Homer Model** window, then **Apply** button. **Load Reflection Coefficient** window ([Figure 48](#)) pops up.
- Click **Matchable** radio button in the **Show Area** group of **Load Reflection Coefficient** window.
- Click **Output** radio button in the **Refer Area to** group of **Load Reflection Coefficient** window.
- Open **Tuner View** window ( button or **Tuner|View** menu item); activate autotuning by depressing **AT** button.
- Start measurement by clicking  button (after clicking, the button turns to .
- Drag the mouse over the chart in **Load Reflection Coefficient** window and observe the input reflection coefficient in **Polar** display window and stub positions in **Tuner View** window.

## Sequences of Predefined Reflection Coefficients

*HoSim* enables creating scenarios realizing sequences of predefined reflection coefficients, in particular to automatize creating reflection coefficient sequences to 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  $\Gamma_I$
- Reflection coefficients  $\Gamma_R$  at the input of a two-port circuit 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 **Tun.mem** file available of the Homer with which you wish to realize the reflection coefficients. To load **Tun.mem** from the Homer device, start **HomSoft**, connect with the Homer and download the file using **Tools|Load from Homer** menu item. In Save Dialog:
  - Select the directory in your PC to save the **Tun.mem** to
  - Save as type: Any File
  - File name: **Tun.mem**
- Start **HoSim.exe**.
- In **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 [System Info](#) window:
  - Click **Load Mem** to load **Tun.mem** of the Homer you wish to realize the reflection coefficients with.





- 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 **Create List**. The left-hand text box (memo) will be filled with a list of desired reflection coefficients  $\Gamma_I$  or  $\Gamma_R$  (the latter if the [Transform](#) file has been loaded). The format is as in the following example:

```
#   MHz   Rfl_Re   Rfl_Im
2455  -0.5000  0.0000
2455  -0.4000  -0.3000
2455  -0.4000  -0.2000
2455  -0.4000  -0.1000
2455   0.2000   0.0000
...
2455   0.5000   0.0000
2455   0.0000   0.0000
End
```

The items are separated by tabs; each numerical data row begins with a tab. The list is automatically copied to the clipboard.

- You can edit the list, and then save it to a text file by clicking **Save List** button, or copy it to clipboard by clicking **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 List memo, or you can load such a list from a properly formatted file by clicking **Load List** button. You can use the above example list as a model for your editing.
- Generally, frequency for each individual reflection coefficient can be different.
- *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 **Make Sce** button. A Scenario file will be created in the right-hand text box (Scenario memo). The memo includes the tuning stub positions such as to realize the reflection coefficients in the left List memo.
- If you want to combine scenarios with different settings (e.g., to cover a certain area denser 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 so, you can edit the info lines at the Scenario beginning. In [Figure 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]
```

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 **Scenario** window.

- Click **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 **See to Clipboard** to copy the Scenario to Clipboard. Then you can paste it directly to an Excel file.

### Example 1: Combined Rectangular-Trajectory Scenario

The scenario reflection coefficients shown in [Figure 53](#) have been created by adding three sub-scenarios. The settings were according to the following table:

No.	Trajectory	Start	Stop	Step	Start Angle	Stop Angle	Rot	Clockwise	Segment	Shuttle
1	Rect	0	250	50	n.a.	n.a.	0	n.a.	n	n.a.
2	Rect	250	700	50	-45	45	0	y	y	n.a.
3	Rect	250	700	25	-45	45	0	n	y	n.a.

As a side effect of the combination, 12 of the totally 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, decreasing thus the scenario size to 1012.

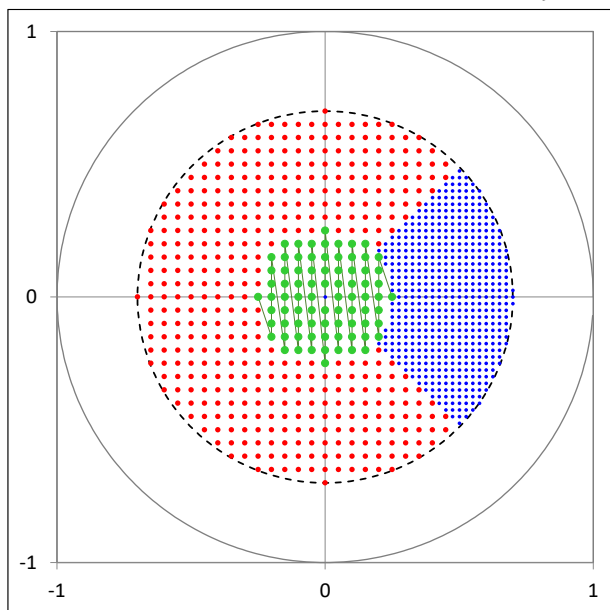


Figure 53. A rectangular-trajectory scenario combined from three sub-scenarios: a circle (green), a segment (red), and a complementary, denser segment (blue). The trajectory is shown only for the circle part.

### Example 2: Simple Circular-Trajectory Scenario

A disadvantage of rectangular-trajectory scenarios is regularly occurring large jumps of the reflection coefficient. To reduce the number and size of these jumps, a circular-trajectory scenario can be used. This is perhaps the most useful scenario.

The reflection coefficients shown in [Figure 54](#) have been created according to the settings in the following table:

Trajectory	Start	Stop	Step	Start Angle	Stop Angle	Rot	Clockwise	Segment	Shuttle
Circ	200	700	100	n.a.	n.a.	0	n	n	n

As seen in [Figure 54](#), only small jumps in the reflection coefficient occur.

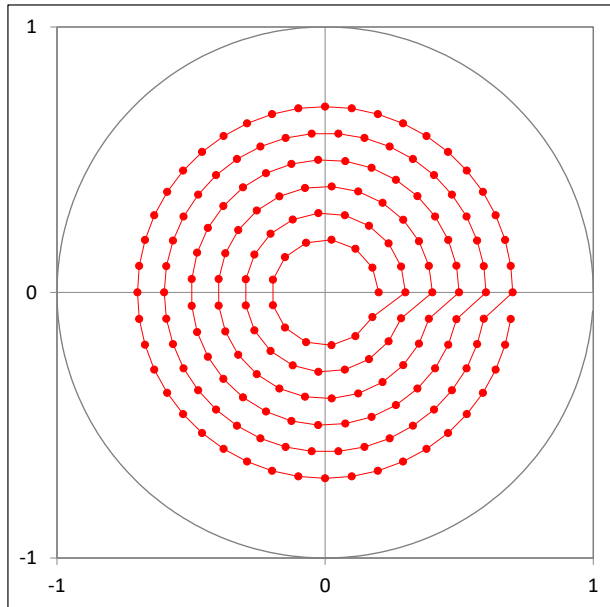


Figure 54. A simple circular-trajectory scenario.

### Example 3: Combined Circular-Trajectory Scenario

The reflection coefficients shown in [Figure 55](#) have been created by adding three sub-scenarios. The settings were according to the following table:

No.	Trajectory	Start	Stop	Step	Start Angle	Stop Angle	Rot	Clockwise	Segment	Shuttle
1	Circ	0	300	100	n.a.	n.a.	0	n	n	n
2	Circ	400	700	100	45	-45	0	n	y	y
3	Circ	700	350	50	45	-45	0	y	y	y

As seen in [Figure 55](#), there are only two moderately large jumps in the reflection coefficient.

Similarly to the rectangular scenarios, some reflection coefficients are duplicate.

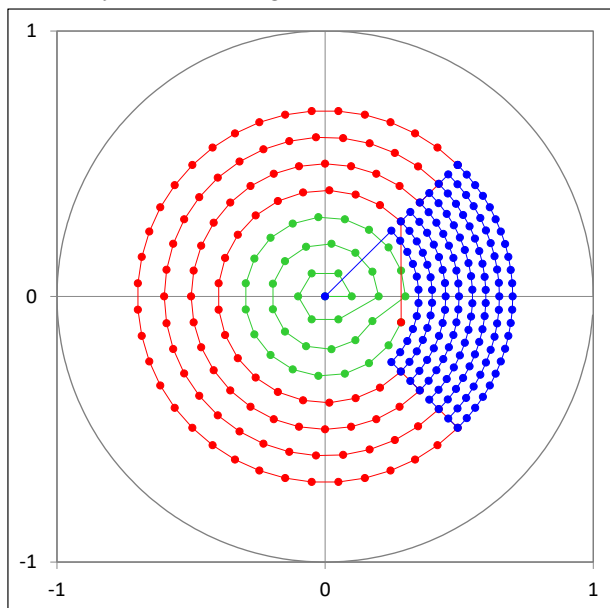


Figure 55. A circular-trajectory scenario combined from three sub-scenarios: a circle (*green*), a segment (*red*), and a complementary, denser segment (*blue*).

# Advanced Topics

This section includes some specialized or less frequently needed topics.

---

## Homer Analyzer Starting Parameters

Homer behavior depends upon several controlling parameters. Most of them are defined in **Hom.cfg** and **Tun.cfg** configuration text files, which Homer Server reads as part of its initialization routine after power-up or Server restart. The files therefore determine Homer behavior in *autonomous* mode (without any external controller, that could change the parameters via commands).

If you want to change Homer power-up behavior, you have to modify these cfg files. There are more ways of how to do it. The best one is using the currently active files as a template and edit what is necessary. The copies of these files can be obtained by downloading them from Homer. After editing, the files must be sent back to Homer and Homer must be restarted. See [Transferring Files](#) for downloading and uploading files.

Another method, which does not involve editing, is creating Hom.cfg and Tun.cfg by means of *HomSoft* (see [Create CFG](#)).

An example Hom.cfg configuration file is listed below. The lines starting with semicolon are ignored. To create your own cfg file, you may copy the colored lines below and use them as a template. For **Tun.cfg**, see [Homer Autotuner Starting Parameters](#). For setting of the communication interface, see [Configuring Communication](#). Meaning of **CAN\_ADDR** parameter see in [MultiCAN: More Homers on CAN Bus](#).

For a more detailed explanation of the parameters controlling the sampling of the detector voltages and frequency measurement (those printed **red** below in Notes section), see topic [Signal Waveforms](#) and its subtopics. The parameters printed **black** depend on the Homer hardware.

```
[Homer configuration]
; A comment can be added here

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
TxMask=7

OnPeriod_ms=0
OfsPeriod_s=30
FPeriod_ms=0
TPeriod_s=30
TxPeriod_ms=0
Mot_Refresh=1000

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=100      Incident power threshold for "Low Signal" condition
; IsCntOn=1            Activate frequency counter (1=ON, 0=OFF)
; Fsubst_kHz=2450000   Substitute frequency
; Fdelta_MHz=61        Frequency tolerance interval half-width
; Trpt=8               Temperature measurement averaging (1 to 4095)
; TxMask=7             Homer sending mask (b0=ResReady b1=TxPeriod
b2=MotRefresh)

;Timings
; OnPeriod_ms=0        Measurement cycle periodicity [ms] (min=0)
; OfsPeriod_s=30       Offsets measurement periodicity [s] (min=0)
; FPeriod_ms=0         Frequency measurement periodicity [ms] (min=0)
; TPeriod_s=30         Temperature measurement periodicity [s] (min=0)
; TxPeriod_ms=0        Homer sending periodicity [ms] (min=0)
; Mot_Refresh=1000     Tuner: Interval [ms] between sending motors data

```

```
;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 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 [Homer Analyzer Starting Parameters](#). An example Tun.cfg configuration file is listed below. Lines starting with semicolon are ignored. To create your own cfg file, you may copy the blue lines below and use them as a template. The parameter *MaxInsert\_mm* (printed **black** in Notes section) depends on the Homer hardware.

```
[Tuner Config]
; A comment can be added here

IsOn=FALSE
Targ_mU=0
Toler_mU=25
Skip=1
Smooth=1
WaitRF=TRUE
Delay5b=0
DelayStep_ms=250
HystDg=5
MaxInsert_mm=22.7
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
; Skip=1         Number of skipped measurements
; 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 maximum 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
; GuardSeconds=60 Minimal wait between consecutive AllHome attempts
```

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 control whenever its position has been *changed*. This applies also in case of using an external controller. A feedback to external PC is not provided hence a discrepancy may occur until you issue next Autotune ON/OFF command from PC (to do so, click **Tuner|Autotune|Active** menu item or **AT** button in [Tuner View](#) window).

Meaning of **Targ\_mU**, **Toler\_mU**, **Skip**, **Smooth**, **WaitRF**, **Delay5b**, **DelayStep\_ms** is explained in **Autotune** section of [System Info Window](#) topic. Meaning of **HystDg** is explained in [Hysteresis](#) section. Meaning of **PowOnAction** is explained in [Autonomous Operation](#) section.

By **MaxInsert\_mm** you can limit [maximal stub extension](#) to less than the factory value.

By **MaxMag\_mU** you can [truncate the matchable area](#) to avoid regions with risk of arcing.

**AtSwitchAction** defines the action triggered by toggling the **Autotune** HW switch. The default is, of course, switching autotuning on and off. But the switch can be also used, for instance, for triggering a single autotuning step on each toggling.


**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 a problem of randomly lost motor steps in otherwise correctly working tuner. However, to prevent incessant attempts if 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 Homer (see [Transferring Files](#)) and Homer must be restarted.

For setting of the communication interface, see [Configuring Communication](#).

## Fast Frequency Measurement

Sometimes, it is useful to examine the time dependence of a magnetron's instantaneous frequency. It is, for example, the case of high-ripple signals pulsing with power-line-related ripple frequency. To make such measurement, proceed as follows:

- Select [Freq](#) display.
- Close both [Result Windows](#). This is because updating the windows takes much time, decreasing thus the measurement cadence. For the same reason, you may wish to close all graphical displays except the **Freq** window.
- Set Homer for fast frequency measurement by choosing a small frequency count time, e.g., 100  $\mu$ s or less. To do it, click **Homer|Count Time** menu or **Tc** button. Later, you can experiment with the setting.
- Set **CW** sampling mode.
- Set a sufficient number of measurement points (**Homer|Points per Sweep** menu, Ctrl+N shortcut, or **Pts** button).
- Depress the  button, disabling thus all measurements except 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 frequency (f\_MHz).

## MultiCAN: More Homers on CAN Bus

Theoretically, up to 20 Homers can be connected at the same time to CAN Bus and controlled independently by a single *HomSoft* application. The following conditions must be satisfied:

- All Homers must be of identical model and equipped with the same Server version.
- All Homers must be set to the same CAN baudrate (see **Can.cfg** in [Configuring Communication](#)).

- Each Homer must be assigned a unique number, ranging from 1 to 20, called *CAN Address*. The assignment is made by the following statement in **Hom.cfg** configuration file (the example below assigns a Homer the address 4):

```
CAN_ADDR=4
```

See [Homer Analyzer Starting Parameters](#) for details on Hom.cfg configuration file. Note that Hom.cfg and Can.cfg files reside inside each individual Homer. The files can be transferred from Homer to your PC, edited and sent back to Homer: see [Transferring Files](#).

**Caution!** Be careful to avoid a case of more Homers having the same CAN Address. This would lead to confusion because such Homers cannot be distinguished. Otherwise, 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.

- It is advisable that, except CAN\_ADDR, **Hom.cfg** and **Tun.cfg** files of all Homers be identical.
- A **Homer.cfg** configuration file, containing a list of Homer addresses, must be present in [User Folder](#) of your PC (please do not confuse **Homer.cfg** file in PC with **Hom.cfg** file residing in a Homer device). If **Homer.cfg** file is not present, only one Homer will be searched for: the one with CAN Address = 1.

## Homer.cfg Configuration File

To control a group of Homers by a single running application, a Homer.cfg configuration file, containing a list of addresses of these Homers, must be present in [User Folder](#) of your PC. (Please do not confuse **Homer.cfg** file in PC with **Hom.cfg** file residing in each individual Homer device.) If **Homer.cfg** file is not present, *HomSoft* will search only for one Homer: the one with CAN Address = 1.

A **HOMER\_LIST** statement must be present in **Homer.cfg** file, listing the addresses of Homers the program will search for. An example:

```
HOMER_LIST=2 15 4 1 7
```

The addresses follow the equality sign (=) and must be 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 addresses appearance.

Because detecting of a nonexistent Homer takes about 10 seconds, time can be saved if **HOMER\_LIST** reflects exactly the 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.

A **Homer.cfg** example is given below. Lines starting with semicolon are ignored. To create your own file, you may copy the blue lines below (the first two are sufficient) and use them as a template. Other definitions, like **PCCAN\_BASE**, **LPT\_BASE**, **LPT\_IRQNUM**, **CAN\_HMTXWAIT\_US**, **CAN\_PCTXWAIT\_US** are required only in special cases; you will be notified in such cases.

```
[HomerConfig]
HOMER_LIST=2 15 4 1 7

;===== NOTES =====
; This file is relevant only for CAN bus communication interface.
; Defaults are used in case of absent or invalid lines.
; The defaults are as follows:

; HOMER_LIST=1      Addresses of Homers searched for on CAN bus.
; The address values can be 1 to 20. 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).
```

```

; CAN_HMTXWAIT_US=0  Min pause in microseconds between two messages sent
;   consecutively by Homer. Needed only for slow devices without FIFO.
; CAN_PCTXWAIT_US=0  Min pause in microseconds between two messages sent
;   consecutively by PC. Applicable only for Sontheim CANUSB Dongle.
;   Multiples of 500 us.

```

*HomSoft* tries to establish communication with the Homers, starting with the first address in the list (dialog titled *Establishing Communication*). The first Homer detected is a “flagship”, determining the baudrate. The remaining Homers will be checked only at this baudrate (dialog *Checking Communication*). The detected Homers will be assigned sequence numbers (1, 2, ...).

*HomSoft* can control and show data from only one Homer at a time (we will denote it *Selected Homer*). After the initial search for available Homers, *HomSoft* chooses one of them as *Selected*: either the Homer assigned the sequential number 1 or as read from its **Ho0.ini** setup file. Selected Homer and detected Homer count are shown also in the title bar of the main *HomSoft* window.

## MultiCAN Menu

Commands to control multiple Homers are grouped in **Homer|MultiCAN** submenu. The submenu is visible only in case of CAN Bus and more than one Homer detected.

### Select Homer

By this command decision is made which of the detected Homers will become *Selected Homer*, i.e., one to be controlled and listened to. All Homers are temporarily stopped during the *Selected Homer* switching procedure. After completing the procedure, running status of all Homers will be restored and the program window will be adjusted according to Selected Homer settings.

All settings of each particular Homer are individual. When *HomSoft* is run for the first time, all Homers are set according to their internal **Hom.cfg** and **Tun.cfg** files (see [Homer Analyzer Starting Parameters](#) and [Homer Autotuner Starting Parameters](#)). All settings made during the program run are stored in the **Ho0.ini** setup file on *HomSoft* termination and used again when the program is restarted.

### Stop All

The command stops all Homers detected on the bus. They will neither measure, nor tune, nor send data; they will only listen for commands.

### Start All

The command starts all detected Homers on the bus. They resume measurement, tuning and sending data.

### Copy To All

The command copies the settings of the currently Selected Homer to all detected Homers. In this way you do not have to set each of the Homers individually.

### Stop All Possible

Homers may be active on the CAN Bus without being detected (if you choose not to include them in the **HOMER\_LIST** statement, wishing to work with only some of them and keep the rest idle). The undetected Homers may be overloading CAN Bus with unwanted messages, slowing or impairing thus communication with the detected Homers. One possible way to resolve the problem is to switch off their power supplies.

Another method is using the **Stop All Possible** command, which will stop all potentially available Homers on the bus, without waiting for response. Then, by **Copy To All**, you can activate only the detected (listed) Homers.

### Broadcast

If you issue a command, it will be accepted only by the Selected Homer *unless* **Broadcast** menu item is checked. If you click the **Broadcast** item to check it, the next command (**only one!**) will become a *Broadcast Command*, i.e., one accepted by *all* Homers (even those not detected but connected to CAN



Bus). On transmitting the command, **Broadcast** item will become automatically unchecked, hence you have to check it again to broadcast another command.

Only commands requiring less than 8 data bytes as parameters can be broadcast, otherwise they will be ignored altogether. The commands that cannot be broadcast include moving motors (you can still broadcast-initialize them) or setting autotuning control parameters.

Some broadcast commands are explicitly included in the **MultiCAN** Menu (Stop All, Start All, Stop All Possible).

## MultiCAN Connection

An example of a connection of four Homers to a CAN Bus is shown in [Figure 56](#). 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-Ω 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 Ω). 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 Ω.

A single copy of *HomSoft* is running in the controller (PC), enabling to switch the display between the individual Homers.

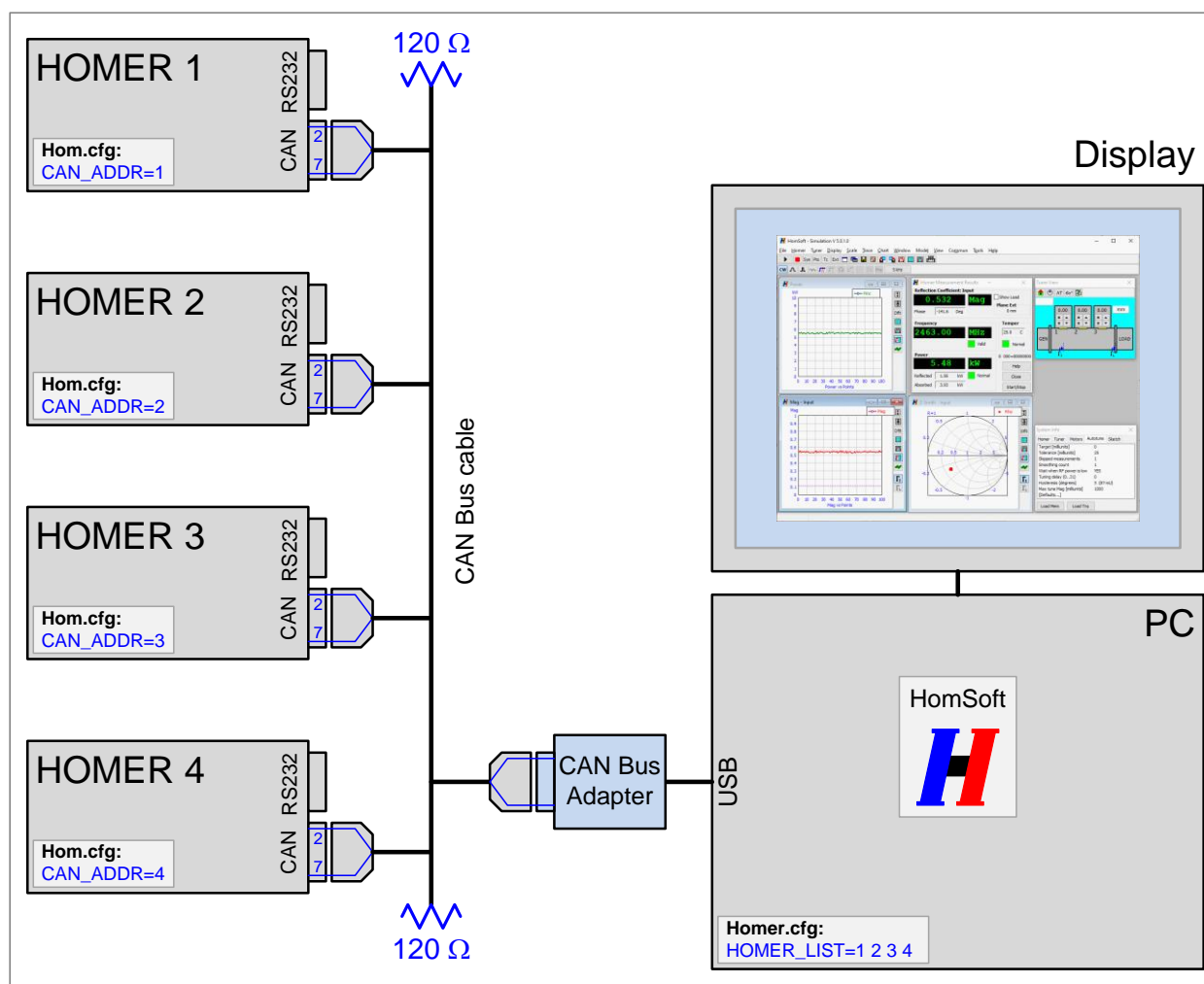


Figure 56. An example of a connection of four Homers to a CAN Bus.

## Using Windows Virtual Machines

Installing a number of Virtual Machines in your PC allows 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 Virtual Machines installed is shown in [Figure 57](#).

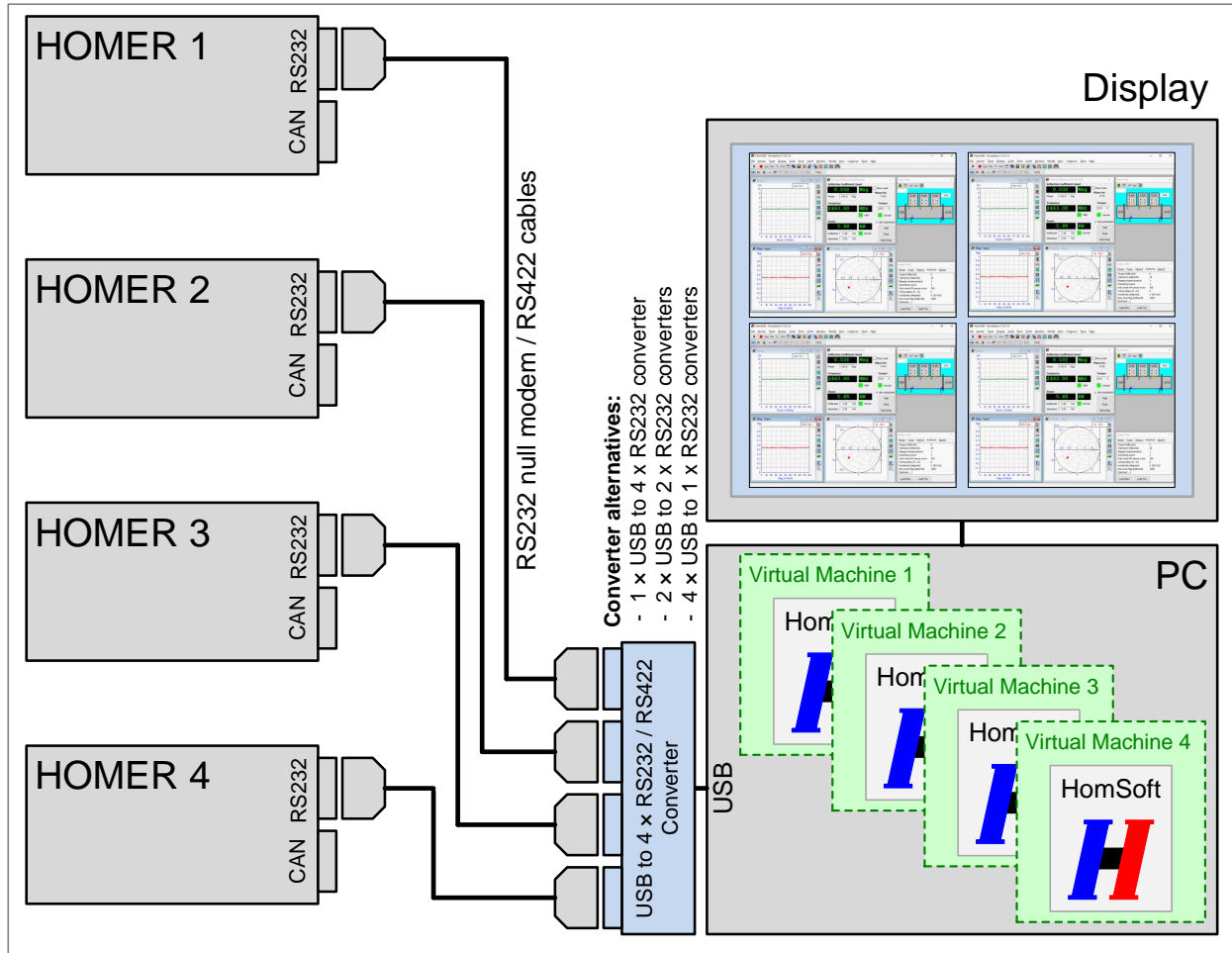


Figure 57. An example of connecting four Homers to a single PC using Virtual Machines.

## Power Measurement Calibration Factor

When measuring power, Homer uses an internal *power calibration factor*  $C$ , stored in its memory. Value of  $C$  is set to unity in factory at the time of 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 *calibration factor multiplier* ( $M$ ). Mathematically,  $M$  multiplies the current power calibration factor to obtain its new value:

$$C_{\text{new}} = C_{\text{current}} * M$$

The bounds on allowable  $M$  depend on the current  $C$  so that their product always remain within the permitted range 0.1 to 10:

$$M_{\text{min}} = 0.1 / C_{\text{current}}$$

$$M_{\text{max}} = 10 / C_{\text{current}}$$

The user can change the current calibration factor or restore it to unity.

To perform the described functions, click **Homer|More|Pow Cal Factor** menu item. Following this, the window titled *Power Measurement Calibration Factor* shows up ([Figure 58](#)).

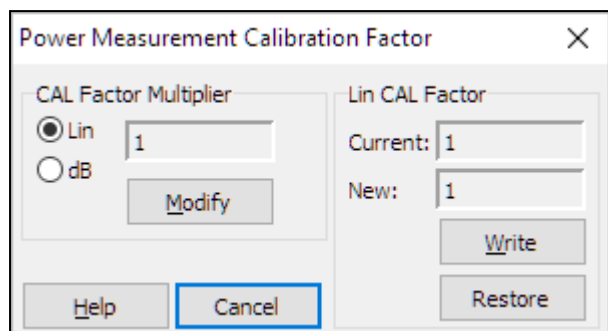


Figure 58. Power Measurement Calibration Factor window.

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 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 **Modify** button opens 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 *Lin CAL Factor* group but will not be accepted until clicking **Write** button (see next). **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*  $C$ . You do not modify it directly but through the setting of  $M$  in the *CAL Factor Multiplier* group.

**New** shows the value of  $C$  which would result from its current value when modified by the multiplier  $M$ .

**Write** button activates the procedure of writing the new calibration factor to Homer memory and closes the dialog window.

**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:* 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:* 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 **Homer|More|Pow Cal Factor** menu item.
- Click **Lin** radio button (in case of Example 1) or **dB** radio button (in case of Example 2).
- Click **Modify** 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 **OK**.
- If you are satisfied, click **Write** button, otherwise click **Cancel** button.
- Verify the modified calibration factor by reopening the dialog via **Homer|More|Pow Cal Factor** menu item.

### To restore power calibration factor to unity:

- Click **Homer**|**More**|**Pow Cal Factor**.
- Click **Restore** button.

## Single-Shot Commands Window

**Single-Shot Commands** window ([Figure 59](#)) can be opened by clicking **View**|**Single-Shots Commands** menu item. The window contains a group of specialized Homer commands, most of which trigger execution of one Measure-Tune-Send sequence (or its part); hence the adjective Single-Shot.

*Note:* These single-shot commands should be not confused with the single-shot sampling (see [Displaying Individual Samples](#) topic).

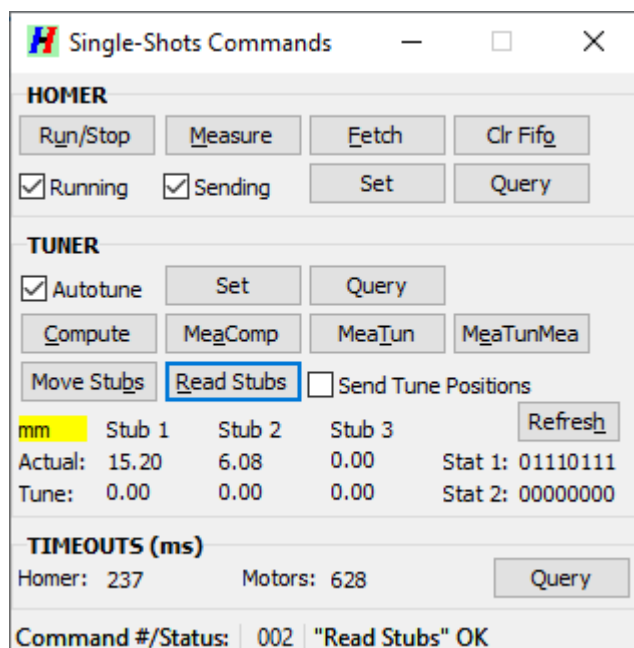


Figure 59. Single-Shot Commands window.

The window is meant chiefly as an aid in developing user's own Homer control programs.


Please refer to [Homer Communication Protocol](#), section *Single-Shot Commands*, where working of the commands and the involved quantities are described in detail. Names of various quantities typed with **this font** are also taken from the Homer Communication Protocol.

Homer measurement results (HMR) received as a response to commands are displayed in [Results windows](#). Motor positions and their status are shown in the TUNER group of the window but also in [Tuner View](#) window.

The **TIMEOUTS** group serves for querying and displaying Homer device internal timeouts in milliseconds when waiting for the analyzer part 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 status of the latest 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 **Send Samples** checkbox in [Homer Sampling Setup](#) window (or  button).
- Phrases in **[square brackets]** below refer to the names of the corresponding commands in the [Homer Communication Protocol](#), where they are described in a more detail.

## HOMER Group

### Run/Stop

If Homer is idle, clicking **Run/Stop** button is equivalent to setting Running and Sending flags to TRUE (see below). It also is similar to clicking **Homer|Run/Pause** [Homer menu](#) item *except* that the action is not accompanied by the PC starting monitoring Homer.

If Homer is running, clicking **Run/Stop** button is equivalent to clicking **Homer|Stop Homer** menu (Homer goes idle). The action is also equivalent to setting Running flag to FALSE.

### Measure

Clicking **Measure** button commands Homer to make one measurement and send Measurement Data Object (MDO). **[Meas]**

### Fetch

Clicking **Fetch** button commands Homer to send the latest available MDO (no measurement is carried out). **[FetchLast]**

### Clr Fifo

Clicking **Clr Fifo** button commands Homer to clear its internal message buffer. As a result, the next incoming command will become the first in the queue. **[ClrFifo]**

### Running

**Running** checkbox sets/clears Homer internal Running flag. If Running = TRUE, Homer repeats the Measure-Tune-Send sequence (or its applicable part) periodically. If Running = FALSE, Homer is idle, only waiting for commands.

### Sending

**Sending** checkbox sets/clears Homer internal Sending flag. If Sending = TRUE and Running = TRUE, Homer sends the data periodically subject to the conditions defined in [TX Timing window](#). If Sending = FALSE, Homer will not transmit results, even if running and tuning.

Note that Running and Sending states affect only periodic (continuous) measurement, not single-shot commands.

The power-up value of 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 **Set** button to apply the settings of Running and Sending checkboxes in Homer. You can verify the Homer actual settings by changing the checkboxes and clicking **Query**.

### Query

Click **Query** button to read from Homer actual settings of Running and Sending flags.

## TUNER Group

The bottom three lines of the TUNER group represent the states of the motors (tuning stubs). The display fields of this group show:

- Actual stub positions in steps, millimeters or inches. To change the unit, click the **yellow** unit label.
- Tune Positions (those needed for achieving impedance match)
- Motor Status Bytes MS1 and MS2 (as **Stat 1** and **Stat 2**, respectively)

The displays can be refreshed to the latest available values (e.g., when autotuning is on) by clicking **Refresh** button.

## Autotune

**Autotune** checkbox activates/deactivates continuous autotuning (i.e., Homer internal Autotune flag).

## Set

Click **Set** button to apply the settings of Autotune checkbox in Homer. You can verify the Homer actual setting by changing the checkbox and clicking **Query**.

## Query

Click **Query** button to read from Homer the actual setting of Autotune flag.

## Compute

Using the latest measurement results and actual tuning stub positions, Homer computes and sends Tune Positions, i.e., new stub positions computed for achieving impedance match of the load. Motors are not moved to these positions. The positions are displayed in *Tune* row. **[CompStubs]**

## MeaComp

Homer makes a measurement and sends results including actual stub positions, then executes the **Compute** procedure as above. Motors are not moved. **[MeaComp]**

## MeaTun

Homer makes one measurement. If successful, it computes Tune Positions and moves motors to these positions. Homer then sends the measurement results and actual positions (which are now equal to Tune Positions). The positions are displayed in both *Actual* and *Tune* rows. Measurement results correspond to tuning stubs in the previous positions. **[MeaTun]**

## MeaTunMea

Homer makes one measurement. If successful, it computes Tune Positions and moves motors to these positions. Then Homer makes new measurement and sends the results and actual positions (which are equal to Tune Positions). The positions are displayed in both *Actual* and *Tune* rows. Measurement results correspond to tuning stubs in the final, sent positions. **[MeaTunMea]**

## Move Stubs

The command instructs Homer to move the stubs to Tune Positions.

## Read Stubs

The command reads the actual stub (motor) positions and status (*Stat 1* and *Stat 2*).

## Send Tune Positions

The checkbox enables to choose whether, during continuous measurement, Homer should compute Tune Positions and send them along with actual motor positions.

# DDE Server

A Dynamic Data Exchange (DDE) server can be activated in *HomSoft* starting with Version V4. Homer must be equipped with DDE option. Obviously, HomSoft option is necessary for this, too. DDE enables another Windows application (DDE client) to receive measurement results from 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. (More about the communication see in [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 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. Homer simulation “*Hosim*” also includes DDE server so you can test your client application before 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 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 has been established, your client can receive Homer measurement results in the form of 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 generator)  
 Stub 2 position in steps  
 Stub 3 position in steps (Stub 3 is closest to load)  
 Motor status byte 1 (MS1)  
 Motor status byte 2 (MS2)

Meaning of HST, MS1, MS2 see in [Homer Communication Protocol](#).

### Possible delimiters are:

**CRLF**: a pair in the given order of bytes with decimal ASCII codes 13, 10 (carriage return + line feed)  
**Tab**: tab character (decimal ASCII code 9)  
**Space**: space character (decimal ASCII code 32)  
**Semicolon**: “;” character (decimal ASCII code 59)

### To make *HomSoft* deliver results:

- Check **Commun|DDE Server** menu item (switch it ON)
- Choose the delimiter by clicking **Commun|Delimiter** menu item
- Choose the minimal period (maximal rate) of generating DDE messages by clicking **Commun|DDE Wait** menu item. This will limit the cadence of DDE messages when Homer produces results too fast. Fast cadence of DDE messages may overload the receive buffer of your DDE client app and even cause it or PC to crash.



## App Speed Considerations

Please be aware that when your DDE client application is running together with *HomSoft*, both apps may get slower under certain circumstances (e.g., when using an older PC). This may be, for example, the case when your client is running in National Instrument's LabVIEW environment. If you in this case experience slowing down of *HomSoft*, **multithreading must be switched off** in your LabVIEW project.

To disable multithreading in LabVIEW versions starting V8.2, you have to manually add the entry `ESys.StdNParallel=0`

into the LabVIEW app *ini* file. In older versions, you can turn off multithreading in LabVIEW menu item **Tools|Options|Performance and Disk|Run with Multiple Threads**.

You will have to restart LabVIEW in order for the changes to take effect. Please refer to National Instrument's support web pages.

## Importing to Excel

To import the data to Microsoft Excel from, e.g., 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 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 ([Figure 60](#)) including commented Delphi source code (Delphi project packed as HmDdeClientSrc.zip), is included in the Homer installation as an aid and inspiration for writing your own client application.

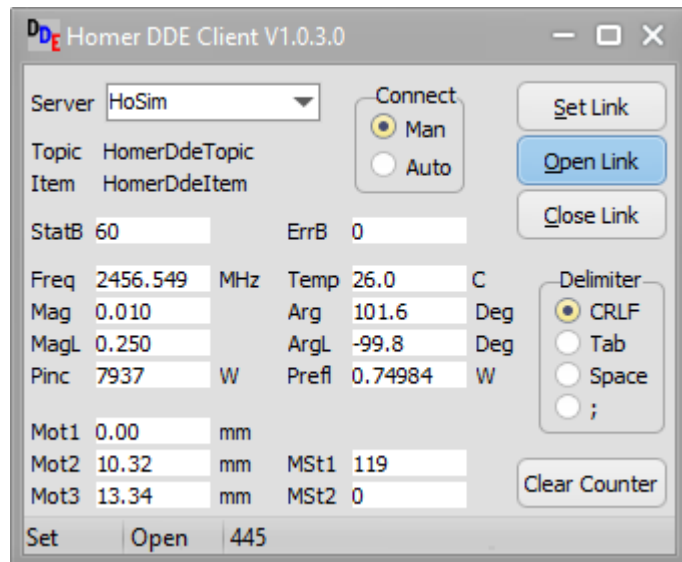


Figure 60. Sample DDE Client program.

To use the client program, proceed as follows:

1. 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.
2. Start the data producing program (e.g., *HoSim.exe*).
  - 2.1. In its **Commun** menu, check **DDE Server** item.
  - 2.2. In **Commun** menu, select **Delimiter**, (e.g., CRLF).
  - 2.3. In **Commun** menu, set **DDE Wait** in milliseconds (e.g., 500).
  - 2.4. Start measurement.



3. Start *HmDdeClient.exe* program (the copy in your user folder).
  - 3.1. Select or type **Server** name (in this example *HoSim*).
  - 3.2. Set **Delimiter** equal to that of the data producing program (in this example CRLF).
  - 3.3. Select **Connect** method (e.g., Man).
4. Observe the bottom status bar, showing the link setting status (Not set, Set) and the link open status (Closed, Open).
5. Click **Open Link**. Watch now the displays being continuously refreshed.
  - 5.1. In case of Connect = Auto, you can alternatively click **Set Link** for the same effect.
  - 5.2. In case of Connect = Man, you can alternatively click **Set Link**, then **Open Link** for the same effect.
6. Observe the bottom status bar, showing the growing count of the received messages.
7. Click **Close Link**. Observe the status bar.
8. In case of frozen displays, click **Close Link**, then **Open Link** again.

---

## Transforming Input Reflection Coefficient

[Input reflection coefficient](#)  $\Gamma_I$  can, before displaying, be subject to a user-defined transformation, accounting, e.g., for a circuit connected at the Homer Autotuner input. A typical example for its use is a magnetron Rieke diagram measurement ([Figure 61a](#)). Rieke diagram is usually defined in a waveguide different from that of 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  $\Gamma_R$  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  $S$ -matrix,  $P_L$  is the power absorbed in the matched load, and  $S_{ij}$  are (frequency-dependent) scattering parameters of the two-port circuit ([Figure 61b](#)) between plane R (where  $\Gamma_R$  is defined) and the tuner Stub 1 axis plane A (where  $\Gamma_I$  is defined). The equation is a conformal mapping, also called a *bilinear transform*.

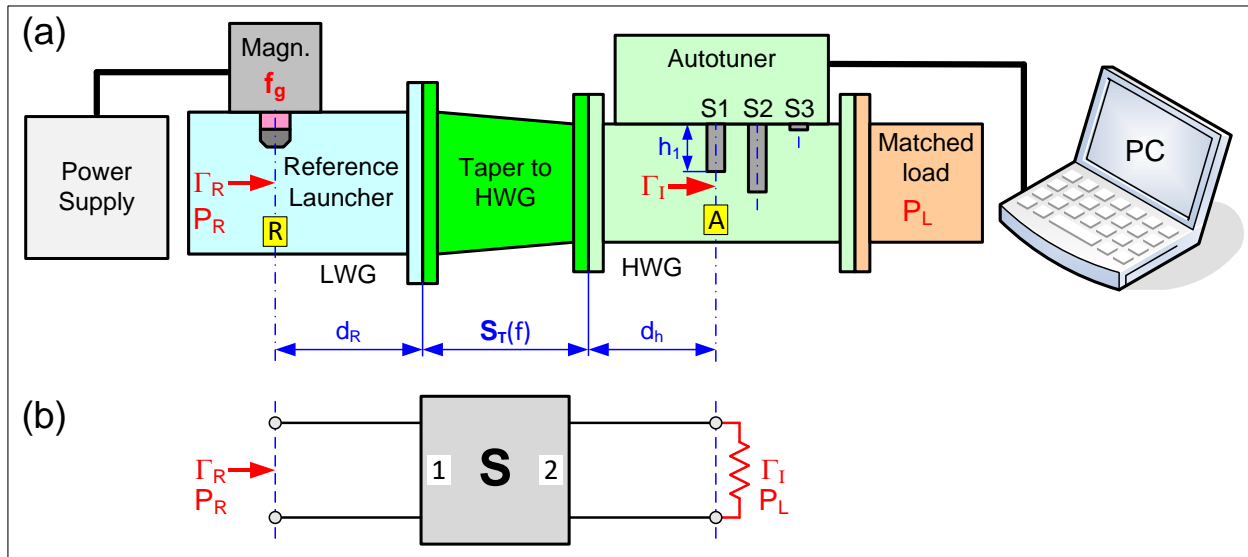


Figure 61. a) Rieke diagram measurement setup example. b) Substitution of the circuit between the  $\Gamma_R$  reference plane  $R$  and the  $\Gamma_I$  measurement plane  $A$  by its scattering matrix  $S$ .

Homer enables this transform to be performed online after first loading a text file with tabulated frequency dependence of  $S_{ij}$ . Corresponding actions can be carried out from the following submenu items of Homer|Transform menu.

### Active

Switching the bilinear transform ON and OFF, assuming the transformation data have been loaded. (otherwise the menu item is disabled).

### Load

Load a text file containing tabulated frequency dependence of the circuit scattering parameters. The parameters are interpolated if the actual frequency is between the tabulated values. For actual frequency below the lowest tabulated frequency, the lowest tabulated frequency values are used. For actual frequency above the highest tabulated frequency, the highest tabulated frequency values are used.

After successful loading, the bilinear transform is both enabled and activated.

### Clear

Disables the transform permanently. It can be enabled again only by new **Load**.

## Format of Scattering 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 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 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

Info line starts with asterisk (**\***). The line is not obligatory. The structure of the info line is

**\* INFO = Text**

**Text** (up to the end of the line) is an arbitrary comment to the file. The asterisk as well as the equality sign can be surrounded by whitespaces, such as Space (ASCII 32) or Tab (ASCII 9).

## Header Line

Header line starts with the **#** character. It can be optionally followed by whitespaces.

One header line must precede data lines.

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 obligatory. Frequency values in data lines (first data line item) are interpreted according to the frequency unit.

## Data type

The form, quantity and arrangement of the data type substrings in the header line give information about the type of data, their format, number and ordering 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. Ordering of the terms indicates the ordering of the corresponding data items in the data lines.

### Rules for Header Substrings

There must be the following data type terms present in the header: **S11**, **S22**, and one or both of **S12**, **S21**. If **S12** or **S21** is missing, the circuit 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., **S11\_RE** & **S11\_IM**)
- magnitude and phase (e.g., **S11\_LOG** & **S11\_DEG**, **S21\_MAG** & **S21\_RAD**, etc.)

Invalid combinations are, for instance, **S22\_RE** & **S22\_DEG**, or **S12\_MAG** & **S12\_IM**.

The substrings can be in arbitrary order, e.g.,

**S11\_MAG S21\_MAG S22\_MAG S11\_DEG S21\_DEG S22\_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 according to the header frequency unit term.

Frequencies must be ordered in ascending order.

## Homer Firmware Update/Reinstallation

The user may be in need of Homer firmware update at the following occasions:

1. Upgrading the SrvHo.exe server program.
2. Acquiring new SW options (such as HomSoft, Defined Mismatch Tuning, etc.).
3. Limiting or extending the absolute maximum of the tuning stub insertions.
4. Complete firmware reinstallation (needed very rarely).

Tasks 1 and 2 can in principle be accomplished by mere transferring (uploading) the relevant files to Homer device. Details of the procedure are described in [Transferring Files](#) section. However, file changes should also be reflected in [Homer Reset](#) files. Otherwise, reverting to say the User Reset may lead to losing newly purchased options.

Tasks 3 and 4 need operations additional to mere file transfers, namely, 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 **HomTool** servicing version of HomSoft. **HomTool** is an automatic, complimentary part of Homer installation. For 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:

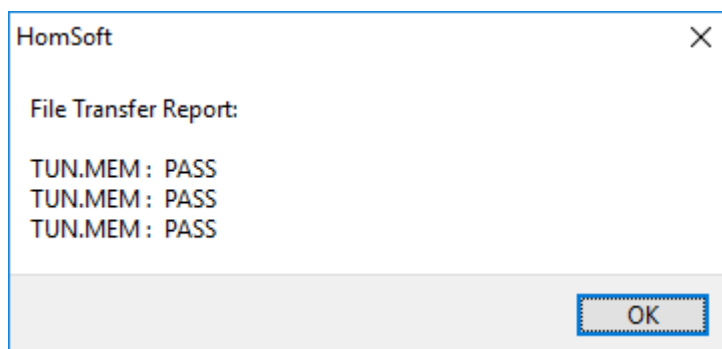
[**Reinstall**] directory, including:

- **FileList.txt** text file, containing instructions for the reinstaller. (The file may be named differently.)
- A collection of files to be transferred to Homer device and processed internally.

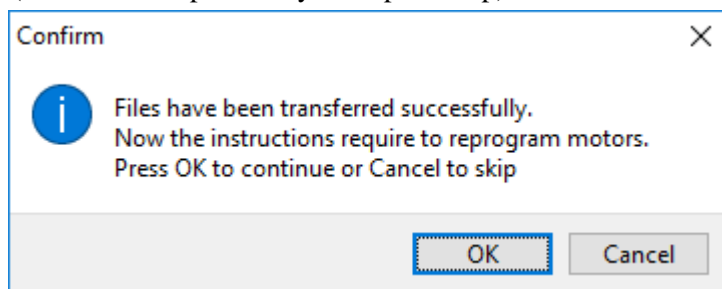
Unzip the package and copy the whole **Reinstall** directory best to **HomSoft User Folder**. You can open the User Folder from within running **HomSoft** by **File|Open User Folder** menu item.

## Procedure

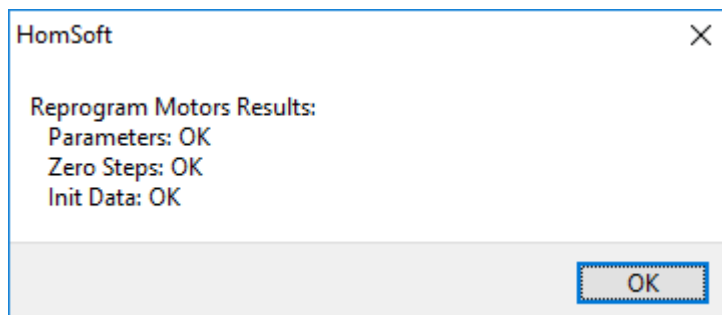
- Connect Homer and your PC with either RS232 or CAN Bus interface cable.
- Restart Homer device so that it operates in the respective communication mode.
- In your PC, start **HomTool** servicing version of HomSoft for the chosen communication interface (**TuTool\_rs.exe** or **TuTool\_can.exe**).
- Click **Tools|Reinstall** menu item.
- After confirming your intention to continue, *File Open* dialog opens. Navigate to **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.
- After completing, a dialog box appears informing about (possibly) successful completion of file transfers.



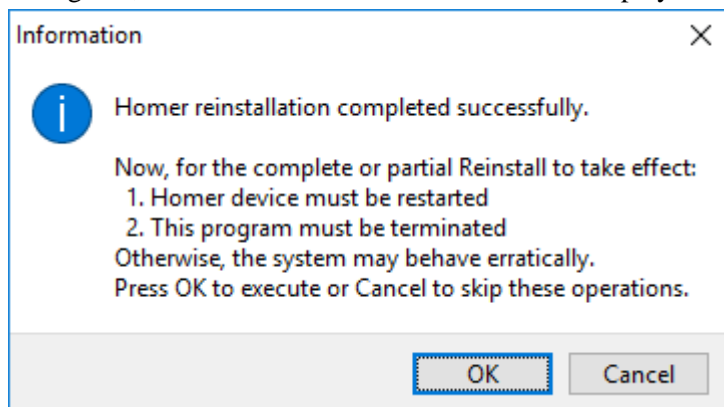
- If the **FileList** included the instruction to reprogram motors controller, the next dialog box informs of this (and offers the possibility to skip the step).



- 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, Homer device will be restarted to accommodate the changes, and **HomTool** will be terminated.

*Note:* in the case the motors have been reprogrammed, please consider also editing the line

`MaxInsert_mm=22.7`

in `Tun.cfg` file because it can limit the maximal stub insertion to a value lower than the absolute maximum having just been programmed.

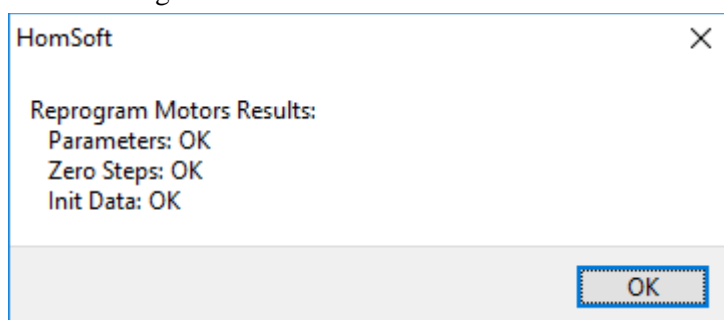
## Reprogram Motors

*Note:* You will only rarely need this routine because it is usually an automatic part of the **Reinstall** procedure.

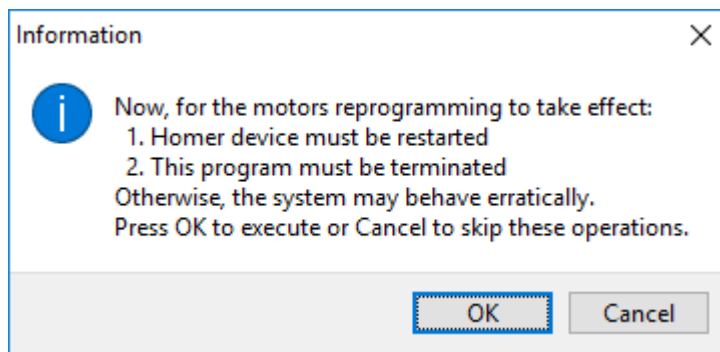
The **Reprogram Motors** takes the relevant motors data from the **Tun.mem** file and reprograms the motors controller accordingly.

### Procedure

- The routine is started by clicking **Tools|Reprogram Motors** menu item in **HomTool** servicing version of HomSoft.
- After confirming your intention to continue, the process begins. After its completion, the outcome is shown in a dialog box.



- Following this, the final reprogramming information will be displayed.



- On pressing OK, Homer device will be restarted to accommodate the changes, and **HomTool** will be terminated.

*Note:* After motors reprogramming, please consider also editing the line

`MaxInsert_mm=22.7`

in [Tun.cfg](#) file because it can limit the maximal stub insertion to a value lower than the absolute maximum having just been programmed.





# Waveform Determining

This section helps determine

- generator signal waveform type and characteristics,
- periodic load reflection coefficient variation (e.g., due to the mode stirrer rotation or similar effects)

using **HomSoft** Windows visualization and control software. This self-contained section supersedes the former Application Note AN1001 (Signal Waveform Determining).

**HomSoft** version V5.0.0.1 or higher is assumed. For older versions, please refer to the earlier editions of AN1001 or upgrade your **HomSoft** and firmware (all upgrades are free of charge).

The information obtained by procedures described here is essential for appropriate Homer setting, e.g., contents of its internal [Hom.cfg](#) configuration file. Improper settings as a rule lead to erroneous and fluctuating measurement results and incorrect (often chaotic) autotuning.


Once you know the waveform characteristics, appropriate Homer settings can be made as described in [Signal Waveforms](#).

Please read also [A Note on USB-RS232 Adapter](#).

The next sections describe a recommended step by step procedure.

---

## Preparation

- Open and scale [standard display](#) windows, like incident and reflected powers, reflection coefficient magnitude.
- Open [Results](#) window by clicking **View|Results (Maxi)**.
- Open [Tuner View](#) window ([Figure 62](#)) by clicking **Tuner|View** menu item or  button.

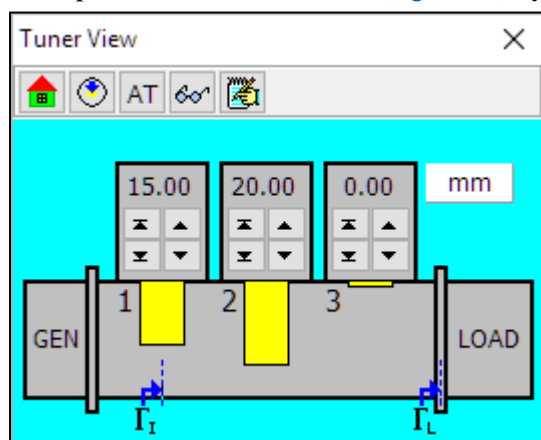



Figure 62. Tuner View window.

- In *Tuner View* window, disable autotuning (set **AT** button to the upper, not depressed position).

- Move the tuning stubs to home position by clicking  button. If your process does not permit fully retracted stubs but requires a pre-tuning, move the stubs to the desired positions.
- Choose Decimal Separator:
  - Click **File|Separator** menu item.
  - Click **Point** submenu item.

This setting is important if you want to report your results to us. The setting will be stored in the Ho0.ini setup file so that it remains the same after the *HomSoft* restart.

## Data Sampling

Each individual block of results that Homer provides is a result of processing a number of samples (Sample Count  $N_s$ , up to 4095). While Homer normally transmits only the final results, this data sampling procedure enables to see and analyze each particular sample. It is this analysis that is essential for appropriate Homer setting. (On the other hand, 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 conditions settings. The settings are summarized in [Figure 63](#). The parameters in parentheses are not settable, they only serve for information.

It is recommendable to make several attempts of 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 goal is to identify the fastest frequency components in the power envelope detectable by Homer. Individual samples are spaced by 5  $\mu$ s sampling step.
- **Medium-speed sampling** covers an interval of 200 ms with slower sampling rate. The purpose is to 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 more.
- **Slow sampling** records a two-second span of the signal. The purpose is to discover slow reflection coefficient swinging caused typically by mechanical movements in the applicator (e.g., mode stirrer rotation or moving objects 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	<b>Tc</b>	16	992	992
Send samples		Send Samples		✓	✓	✓
Triggering level	%	Trig Level		50	50	50
Free Run		Free Run		✓	✓	✓
Single-shot		Single-Shot	<b>1x</b>	✓	✓	✓
Counter		Counter ON		✓	✓	✓



Figure 63. Homer settings for data sampling.

## Set Measurement Conditions

In [Homer Sampling Setup](#) window, make the settings according to [Figure 63](#) (as you can see, some of the settings have a button alternative).

Now, *HomSoft* main window may look like in [Figure 64](#) (only with empty displays).

## Make Measurement

Start measurement by clicking **Homer|Run/Pause** menu item or the corresponding  button (the button changes to ). Be patient because the slow sampling takes some 5 seconds to complete measurement plus 12 to 15 seconds to transfer all 4001 samples. Observe the progress bar on the lower toolbar.

After completing, the **HomSoft** main window may look like in [Figure 64](#).

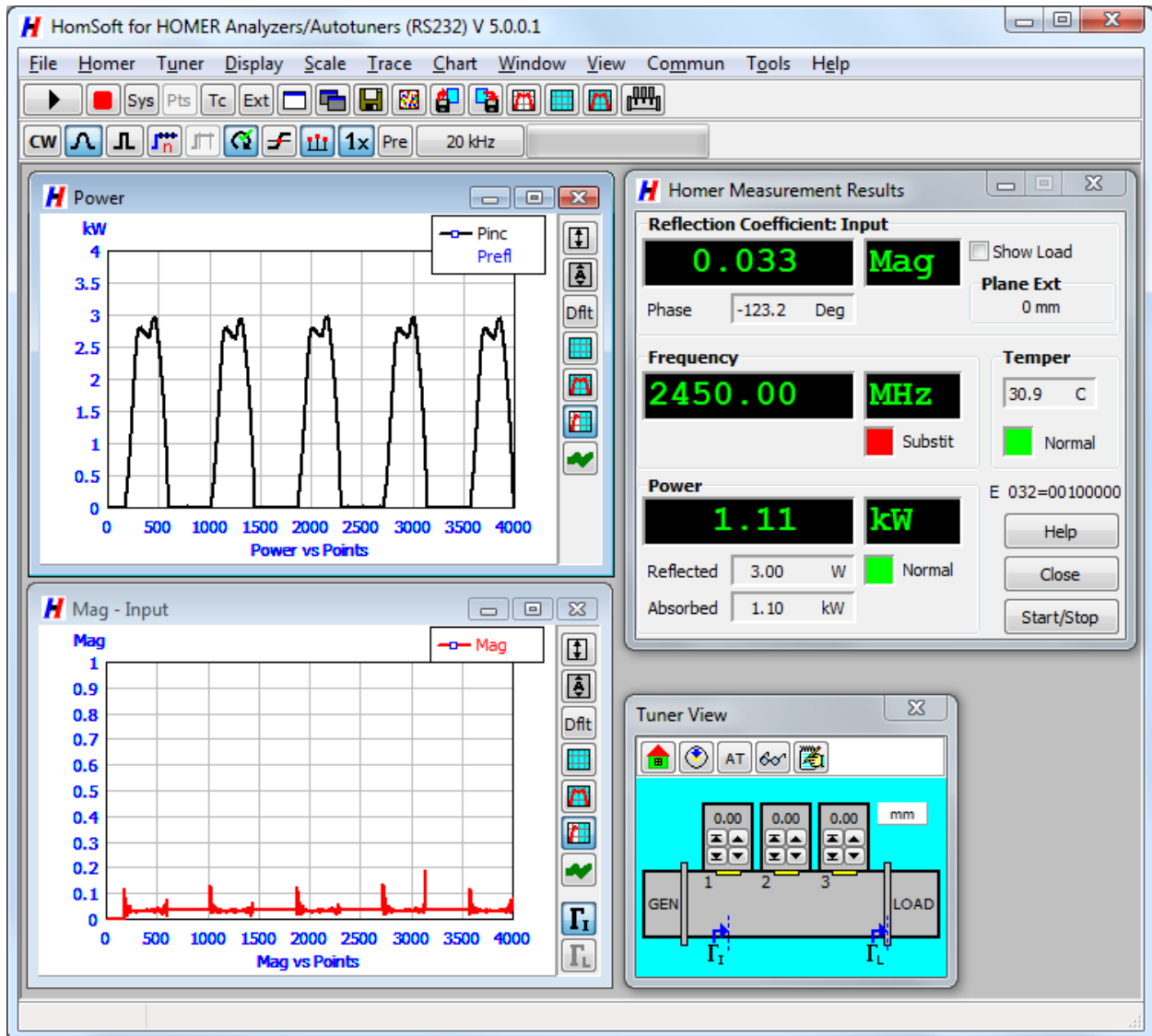



Figure 64. Example of **HomSoft** main window after sampling.

## Save Results

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

## Repeat

You may wish to repeat the sampling and data saving several times or in different situations (e.g., for various generator power levels).

## Save Setup

Save the existing **HomSoft** setup using **File|Save Setup** menu item or  button or **F2** shortcut. The file name may be for instance FastSmpl.stp for fast sampling. Next time you will not need to type the settings

all over again but load the setup file instead (using **File|Load Setup** menu item or  button or **F3** shortcut).

### **Compress and Send Files**

If you wish our support, then, after all measurements as described above, compress (zip) the sampled data text files (to preserve their dates and times) and e-mail them to us for analysis.

# Problem Reporting

For S-TEAM to be able to effectively analyze a Homer problem, additional information to its mere description is important. This self-contained section serves for acquiring and documenting such information using **HomSoft** Windows visualization and control software. This section supersedes the former *AtProblemReporting* document.

**HomSoft** version V5.0.0.1 or higher is assumed. For older versions, please refer to the earlier editions of *AtProblemReporting* or upgrade your **HomSoft** and firmware (all upgrades are free of charge).

The next sections describe a recommended step by step procedure.

---

## System Identification

To identify your system, please do the following:

1. Prepare a document file that will be sent to us, e.g., “MyProblem.doc”.
2. Power up the Autotuner from a 24 V DC power supply. Be sure that the power supply can deliver sufficient current (as specified in your Homer datasheet). You **do not** need microwave power for system identification.
3. Start **HomSoft** (run, e.g., Tu\_rs.exe). Note down and copy to MyProblem any error messages.
4. Click **Help|About** menu item. Make a printscreen of **About** window to clipboard (Alt+PrintScreen).
5. Paste the clipboard to MyProblem file (see example in [Figure 65](#)).

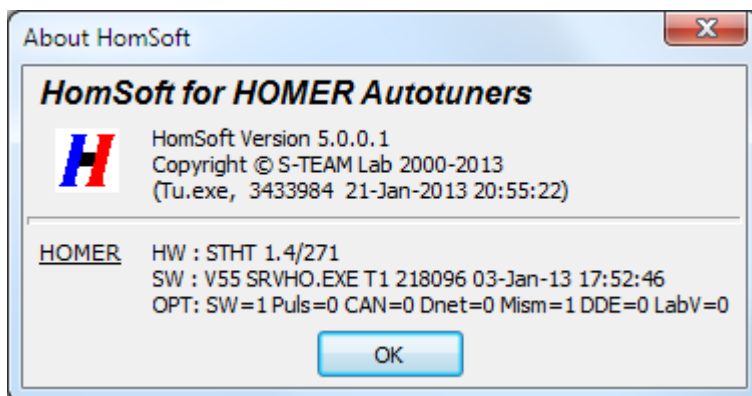


Figure 65. About window example.

---

## HomSoft Settings Identification

Some problems may be caused by inappropriate **HomSoft** settings or corrupted **Ho0.ini** setup file. Analyzing your setup may help us to locate the problem. Please proceed as follows:

1. Exit **HomSoft**. Click **Yes**, not **Abort** in confirmation dialog shown in [Figure 22](#) (in the latter case the Ho0.ini setup file would not be written). Note down and copy to MyProblem file any error messages.

2. Locate the file **Ho0.ini** file in the Homer [User Folder](#), typically  
     `c:\Users\<username>\S-Team\HomSoft` (Windows 7 and higher)  
     `c:\Documents and Settings\<username>\S-Team\HomSoft` (Windows XP)
3. Check the date/time of the file to see whether it is indeed the file just created.
4. Pack this file (e.g., to Ho0.zip). The purpose is to preserve its original date/time.
5. E-mail this file to us along with MyProblem file created above.

## Try Default Settings

Sometimes it may happen that the **Ho0.ini** setup file has not been correctly written on **HomSoft** exit. To eliminate a suspicion of using a corrupted file or a file with illegal data:

1. Exit **HomSoft** if it is running.
2. Delete **Ho0.ini** file in [User Folder](#). Alternately, you can just rename it, e.g., to **Ho0-orig.ini** for further analysis.
3. Restart **HomSoft**. You will have to re-enter all the parameters you wish to change. Observe whether the system behavior has changed (whether it is back to normal).

## Download Internal Configuration Files

Download from Autotuner the internal configuration files **Hom.cfg** and **Tun.cfg**, zip them to preserve their date/time and send us the zip file.

Details of download procedure see in [Transferring Files](#), subtitle *Loading Files from Homer*.

## Do Data Sampling

Even if you suppose your microwave signal is low-ripple continuous wave (CW), it can contain a considerable ripple component causing unstable results and unsatisfactory tuning. In addition, 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 it, please proceed exactly as described in the Data Sampling subsection of the [Waveform Determining](#) topic.


## Do Data Logging

Unlike [data sampling](#), data logging is continuous recording of final measurement results transmitted by Homer.

Make about 5-minute data logging without and with autotuning (the former is more important). For the procedure, refer to [Data Logging](#), with special settings as described below. Zip the log files and send them for analysis.

### Logging without Autotuning

If, based on the previous [data sampling](#) analysis and study of [Signal Waveforms](#) topic, you are able to find acceptable Homer parameters (the most important being those in [Homer Sampling Setup](#) window), adjust Homer accordingly. If case of problems, consult us or leave the default settings. Then proceed as follows:

1. In **Tuner View** window, disable autotuning (set **AT** button to the upper, not depressed position).
2. Move the tuning stubs to home position by clicking  button. If your process does not permit fully retracted stubs but requires a pre-tuning, move the stubs to the desired positions.
3. Open **Data Logging** window (click **View|Logging Window** menu item) and make settings as in [Figure 66](#). Concentrate on the following:
  - **Sampling Repetition Time:** 0 hours, 0 minutes, 0 seconds to perform the fastest sampling possible.
  - **Smpl/Event:** 1.

4. Prepare the rest as described in [Data Logging](#).
5. Run measurement with logging for several minutes to properly cover time span of your process. You may wish to repeat the logging several times or in different situations (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\bilik\S-Team\HomSoft\
  - Info: Test
  - Separator: ☒ Point, ☐ Comma
  - Records: 0, Smpl/Event: 1
  - Buttons: Prepare..., Help, Stop
- Progress:**
  - Recorded: 0
  - Elapsed: 00:00:00.00
  - Status: Ready

Figure 66. Data Logging window and suggested settings.

## Logging with Autotuning

1. In **Tuner View** window, enable autotuning (depress **AT** button).
2. Do the rest 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 accordingly to get stable results (for this, see topic [Signal Waveforms and Sampling](#) and related topics).

### Recording Results

In all of the measurements suggested below, you may employ data logging as described in [Do Data Logging](#), or just save the results using **File|SaveResults** menu item, button or **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. Measured reflection coefficient should be close to zero (depending on waterload quality, reflection coefficient magnitude should not exceed 0.05 to 0.1).
- Switch autotuning ON and watch the stubs moving to positions to improve the match below the set **Tolerance** (settable in [Autotune](#) page of [System Info](#) window).

### Flat Short

- Connect a flat short (a shorting plate).
- Switch autotuning OFF.
- Open [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  $1 \pm 0.05$ ) and the phase should be close to  $180^\circ$  (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 reflection coefficient magnitude about 0.5. It can be, e.g., a waterload preceded by a manual tuner.
- Switch autotuning OFF.
- Start measurement, observe and note the results.
- Switch autotuning ON and watch the stubs moving to positions to improve the match below the set Tolerance.



# Index

## A

- A Note on USB-RS232 Adapter 33
- Accept Level 71
- Accompanying Literature 2
- Advanced Topics 133
- Animation Page 123
- ASCII Results Format 29
- Autonomous Operation 25
- Autotune 91
- Autotuner 85
- Autotuning Activation 96

## B

- Before Saving 59
- Buttons 46

## C

- CAL Factor Multiplier Group 141
- CAN Bus Connector 17
- Caption 49
- Case of CAN Bus 33
- Case of RS232 32
- Chart 122
- Chart Scaling 44
- Choosing Decimal Separator 57
- Choosing Homer Power-Up Server 26
- Circular Displays 45
- COM Port Settings 14
- Comment Lines 149
- Commun Menu 115
- Configuring Communication 30
- Copying to Clipboard 59
- Count Time 112
- Counter 111

- Create CFG 65
- Creating and Editing Scenarios 97
- Customizing Homer 61
- CW Signal Sampling 72

## D

- Data Lines 150
- Data Logging 59
- Data Sampling 156
- Date/Time Stamp 49
- DDE Server 144
- Deembedded Reflection Coefficient Accuracy Considerations 10
- Defined Reflection Coefficient 122
- Display Window-Related Menu 43
- Display Windows 40
- Display Windows-Related Commands 42
- Display, Scale, Trace, Chart Menus 114
- Displaying Individual Samples 78
- Do Data Logging 162
- Do Data Sampling 162
- Download Internal Configuration Files 162
- DUT Page 121

## E

- Electrical Installation – CAN Bus 15
- Electrical Installation – RS232/RS422 13
- Establishing Communication 31
- Example 1: Combined Rectangular-Trajectory Scenario 129
- Example 2: Simple Circular-Trajectory Scenario 130
- Example 3: Combined Circular-Trajectory Scenario 131

## F

- Fast Frequency Measurement 136
- File Menu 107
- Finish Sweep 108
- Format of RS232 Results 28
- Format of Scattering Parameters Text Files 148
- Freq Toler 112
- Freq/Power/Temp Page 125
- Full-Size (Maxi) Results Window 55

**H**

Header Line 149  
 Help Menu 116  
 Homer Analyzer Starting Parameters 133  
 Homer and Tuner Pages 91  
 Homer Autotuner Starting Parameters 135  
 Homer DDE Results 145  
 Homer Error Byte 54  
 Homer Firmware Update/Reinstallation 150  
 HOMER Group 143  
 Homer Internal Files 21  
 Homer Menu 108  
 Homer Model Window 120  
 Homer Operation Modes 25  
 Homer Resets 64  
 Homer Sampling Setup Window 78  
 HOMER Signal Connectors 16  
 Homer Simulation 119  
 Homer Start 25  
 Homer Versions 6  
 Homer.cfg Configuration File 137  
 HomSoft Menu 107  
 HomSoft Settings Identification 161  
 HomSoft Software Installation 19  
 How to Save Measured Results 57  
 How to Start and Stop Sweeping 53  
 How to Use the Program 51  
 Hysteresis 101

**I**

Importing to Excel 146  
 Info Line 149  
 Input and Load Reflection Coefficients,  
   Deembedding 9  
 Inside Homer 4  
 Installation 13  
 Introduction 1

**K**

Key Features 3

**L**

Labels 49  
 Limit Line 50

Limiting Stub Insertion 86  
 Lin CAL Factor Group 141  
 Line Panel 47  
 Loading Files from Homer 63  
 Low Signal Warning 54

**M**

Main Elements of Display Windows 41  
 Make Measurement 157  
 Markers Panel 47  
 Matchable Area 86  
 Measurement Accuracy 7  
 Measurement Uncertainty Example 8  
 Mechanical Installation 13  
 Mode Stirrer 79  
 Model Menu 115  
 Modes of Signal Sampling 71  
 More 112  
 Morse Code Messages 36  
 Morse Code Messages Examples 36  
 Motors 91  
 MultiCAN 112  
 MultiCAN Connection 139  
 MultiCAN Menu 138  
 MultiCAN: More Homers on CAN Bus 136

**N**

New Users 2

**O**

Other Controls 48

**P**

Plane Ext 111  
 Points per Sweep 111  
 Power Measurement Calibration Factor 140  
 Power Supply Issues 18  
 Preparation 155  
 Problem Reporting 161  
 Problems with Communication 35  
 Program Windows 39  
 Pulsed Signal Sampling 76

**R**

Real Tuner Performance 126  
 Recorded Data 58  
 Rectangular Displays 45  
 Rectified Signal Sampling 74  
 Reduced-Size (Mini) Results Window 56  
 Reference Planes 96  
 Reinstall 150  
 Remote Connector – Special Pinout 18  
 Remote Connector – Standard Pinout 18  
 Reporting Problems 2  
 Reprogram Motors 152  
 Results Windows 55  
 RS232 Connector 16  
 RS422 Connector 17  
 Run/Pause 108  
 Running Scenarios with Measurement 100  
 Running Scenarios without Measurement 99

**S**

Sample Count, Sampling Rate, Sampling Time 70  
 Sample DDE Client 146  
 Sampling Setup 109  
 Saving and Loading Scenarios 99  
 Saving Results 57  
 Saving Results as a Picture 58  
 Saving Results to a Text File 57  
 Saving to a File 59  
 Scenario Output Files 100  
 Scenarios realizing sequences of predefined reflection coefficients 99  
 Screen Annotation 49  
 Sending Files to Homer 62  
 Sequences of Predefined Reflection Coefficients 127  
 Show Available 108  
 Signal Waveforms 69  
 Signal Waveforms and Sampling 69  
 Single-Shot Commands Window 142  
 Sketch 94  
 Software Operation 39  
 Software Upgrades 23  
 S-TEAM Installation Folder 20  
 Stop Homer 108

Stub Movement 95  
 Stubs Motion Scenario 96  
 Studying Matchable Area 88  
 Substit Freq 112  
 System Identification 161  
 System Info Window 91

**T**

Tera Term: An Alternative to Hyperterminal 28  
 Test Your System with Defined Loads 163  
 Tips for Circular Displays 48  
 Tools Menu 115  
 Trace Properties 46  
 Trace to Edit Panel 47  
 Transferring Files 62  
 Transform 111  
 Transforming Input Reflection Coefficient 147  
 Triggering, Free Run, Timeout 70  
 Truncating the Matchable Area 87  
 Try Default Settings 162  
 TUNER Group 143  
 Tuner Menu 113  
 Tuner View Window 94  
 Tuning 53  
 TX Timing 109  
 Type of DUT 121

**U**

Uncertainty Radius 121  
 Upgrading Server Program 63  
 User Folder 21  
 User Setups 62  
 Using HomSoft Windows Software 25  
 Using Microsoft Excel 58  
 Using Window Print Screen Functions 59  
 Using Windows Virtual Machines 140

**V**

View Menu 115

**W**

Waveform Determining 155  
 Welcome to Homer! 1  
 Window Menu 114

