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# **HAAKE MARS 40/60 Rheometer**

## **Reference Manual**

(Original Instructions)

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**ThermoFisher**  
S C I E N T I F I C

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Release history:

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## Preface

The highly modular Thermo Scientific™ HAAKE™ MARS™ 40/60 rheometer is designed to meet the most demanding requirements in research and development while remaining open to technical customizations and future developments.

This guide gives additional information on setting up a network connection between the HAAKE™ MARS™ rheometer and the PC on which HAAKE™ RheoWin™ is running, on working with specific parts of the HAAKE RheoWin software and on updating the rheometer firmware.

## Related documentation

In addition to this guide, Thermo Fisher Scientific provides the following documents for use with the HAAKE MARS rheometer:

- HAAKE™ MARS™ 40/60 Rheometer, Instruction Manual.
- HAAKE™ MARS™ Temperature Modules, Instruction Manual.
- HAAKE™ RheoWin™, Installation and 21 CFR Part 11 Configuration, Instruction Manual.
- HAAKE™ RheoWin™, Instruction Manual.

## Safety and special notices

Make sure that you follow the cautions and special notices presented in this guide. Cautions and special notices appear in boxes; those concerning safety or possible damage also have corresponding caution symbols.

This manual uses the following types of cautions and special notices.



**CAUTION** Highlights hazards to humans, property, or the environment. Each CAUTION notice is accompanied by an appropriate CAUTION symbol.

**IMPORTANT** Highlights information necessary to prevent damage to software, loss of data, or invalid test results; or may contain information that is critical for optimal performance of the system.

**Note** Highlights information of general interest and information that can make a task easier.

## Contacting us

Please always first address any questions to the local Thermo Fisher Scientific office or the general agent or partner company who delivered your instrument.

## International Helpdesk

You can also contact our international helpdesk directly. In that case we kindly ask you to use the contact form to which a link is provided below.

### ❖ To contact the international helpdesk

Contact form <https://tfs-3.secure.force.com/materialcharacterization/>

## Technical and Sales Support

### ❖ To contact Technical Support or Sales, Germany and International

Company	Thermo Electron (Karlsruhe) GmbH Part of Thermo Fisher Scientific
Address	Pfannkuchstraße 10 - 12 76185 Karlsruhe, Germany
Phone	+49(0)721 4094 444
Fax	+49(0)721 4094 300
E-mail	<a href="mailto:support.mc.de@thermofisher.com">support.mc.de@thermofisher.com</a>
Internet	<a href="https://www.thermofisher.com/materialcharacterization">https://www.thermofisher.com/materialcharacterization</a>

### ❖ To contact Technical Support or Sales, USA/Canada

Company	Thermo Fisher Scientific
Address	2 Radcliff Road Tewksbury, MA 01876, USA
Phone	+1 603 436 9444
Fax	+1 603 436 8411
E-mail	<a href="mailto:info.mc.us@thermofisher.com">info.mc.us@thermofisher.com</a>

### ❖ To contact Technical Support or Sales, UK

Company	Thermo Fisher Scientific
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Phone +44 (0) 1442 233555  
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❖ **To contact Technical Support or Sales, China**

Company Thermo Fisher Scientific  
 Address Building 6, No. 27  
 XinJinqiao Rd., Shanghai 201206  
 Phone +86(21) 68654588  
 Fax +86(21) 64457830  
 E-mail [info.mc.china@thermofisher.com](mailto:info.mc.china@thermofisher.com)

❖ **To contact Technical Support or Sales, Japan**

Company Thermo Fisher Scientific  
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 Yokohama, 221-022  
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 Fax +81 45 453 9082  
 E-mail [info.mc.jp@thermofisher.com](mailto:info.mc.jp@thermofisher.com)

❖ **To contact Technical Support or Sales, India**

Company Thermo Fisher Scientific  
 Address 403-404, Delphi-B Wing, Hiranandani Business Park  
 Powai, Andheri (E), Mumbai - 400076  
 Phone +91 22 6680 3000  
 Fax +91 22 6680 3001  
 E-mail [info.mc.in@thermofisher.com](mailto:info.mc.in@thermofisher.com)

## Application Support

For questions regarding your rheological application please use the following e-mail address to contact our application specialists. Do not use this e-mail address for any other questions.

❖ **To contact Application Support, Germany and International**

E-mail [support.rheology@thermofisher.com](mailto:support.rheology@thermofisher.com)

## Software and Firmware downloads

The latest HAAKE RheoWin software version and firmware versions for all HAAKE rheometers and viscometers are available as downloads from our dedicated web-site.

❖ **To download software and firmware**

Internet                      [www.rheowin.com](http://www.rheowin.com)

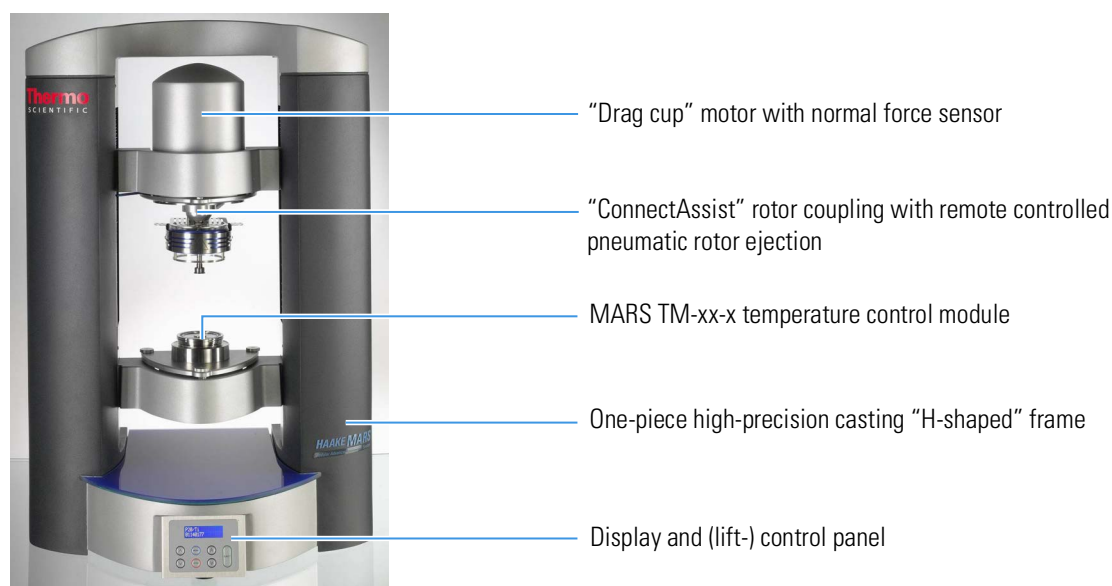


## Instrument Description

The HAAKE MARS modular rheometer platform was designed for the creative rheologist who has to handle her or his instrumentation work quickly and flexibly. The name “MARS” reflects the philosophy of the product: **MARS** stands for “**M**odular **A**dvanced **R**heometer **S**ystem”.

The rheometer platform is designed as a two-column frame and is manufactured as a one-piece high-precision casting that meets the most stringent requirements for dynamics and rigidity. The distinguishing feature of the frame is its optimal force distribution; in contrast to all other “C-shaped” rheometers available on the market, the active forces from the sample and the reactive forces in the “H-shaped” frame act in one plane. This effectively prevents the gap from widening as a result of high normal forces.

**Figure 1.** The HAAKE MARS rheometer (MARS 40 or MARS 60)



The following list sums up the main features of the HAAKE MARS 40 and HAAKE MARS 60.

- Highly dynamic, powerful “Drag cup” motor with CR-mode<sup>1</sup>, CD-mode<sup>2</sup> and CS-mode<sup>3</sup> for both rotational and oscillatory rheometry.
- Normal force sensor for measurement and control of normal forces between -50 N and +50 N.
- Generously proportioned spacious frame manufactured as a high-precision one-piece aluminium casting with an optimal force distribution and unbeatable handling capabilities.

<sup>1</sup> CR-mode: Controlled shear Rate mode

<sup>2</sup> CD-mode: Controlled Deformation mode

<sup>3</sup> CS-mode: Controlled shear Stress mode

- Removable electronic unit for additional free space in the bottom part of the frame for combined measuring methods (available as an option).
- A new dimension in modularity as all application-relevant component groups (including the measuring head and the electronics box) can easily be taken out and replaced.
- Integrated valve-block for liquid and air flow to allow a wide temperature range with one temperature module.
- Ergonomic control panel integrated in the frame with a 6-button keypad, including menu button, for lift control as well as status and error message display.
- High precision “ConnectAssist” rotor quick coupling, with remote controlled pneumatic rotor release, for measuring geometries with automatic recognition including automatic transfer of the relevant geometry parameters.
- Compatibility with HAAE Viscotester™ iQ and HAAKE MARS iQ “ConnectAssist” measuring geometries.
- Compatibility with existing MARS TM-xx-x temperature control modules and other accessories.
- MARS TM-xx-x temperature control modules for temperatures between -150 °C and +600 °C.
- Easy and quick exchange of temperature modules with “ColorAssist” and comfortable access to cable and hose connector sockets.
- Ethernet TCP/IP interface for a fast and reliable point-to-point communication with a PC on which HAAKE RheoWin is running or for integration in a company network.
- Very fast data acquisition rates with data-points being acquired and transferred to the Rheometer software every 2 ms for observing fast material changes.
- Integrated web server for remote monitoring, maintenance and service of the instrument in a network.
- HAAKE RheoWin PC software for,
  - complex measuring and data evaluation routines (Jobs) and interactive data analysis,
  - automatic report export (PDF) and report printout,
  - tools for 21 CFR part 11 compatibility.

In addition to this, Thermo Fisher Scientific great customer proximity and its ability to provide not only rheometers but also plenty of rheological know-how allows the development of application-orientated solutions together with its customers. This situation has given rise to a very wide range of special measuring devices and to a constant improvement of existing devices (see the separate accessories catalogue). Examples of this are several UV curing cells, pressure cells with a wide range of temperature (up to 300 °C) and a wide pressure range (up to 600 bar), the RheoScope module for simultaneous microscopy and rheometry, the SER tool for extensional rheometry, a tribology measuring cell, an electro-rheology measurement system, the unique Rheonaut module which combines FTIR spectroscopy with rheometry and the RheoRaman module.

For a more detailed description of the functionality, installation, operation and specifications, etc. of the HAAKE MARS 40/60, see the HAAKE MARS 40/60 Rheometer instruction manual.

## Network Setup

The communication between the HAAKE MARS and the HAAKE RheoWin rheometer control software uses the TCP and UDP protocols on an IP network connection. This chapter describes how to setup this network connection.

**Note** It is assumed that any hardware network interface used for the communication between the MARS and the PC (with RheoWin) has been properly setup as part of the PC and operating system installation. This manual does not deal with PC hardware installations and/or network problems. In case of problems with the PC hardware or with the network a local IT specialist should be consulted.

**Note** The serial interface on the rear panel of the electronic box is only intended for service purposes, that is not for controlling the instrument.

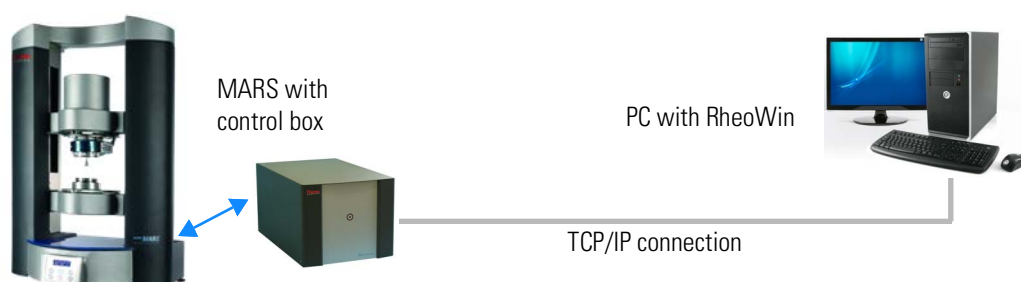
**IMPORTANT** Read this chapter completely before starting the network setup.

## Network considerations

There are two different ways to make the connection between a HAAKE MARS and a PC (with HAAKE RheoWin):

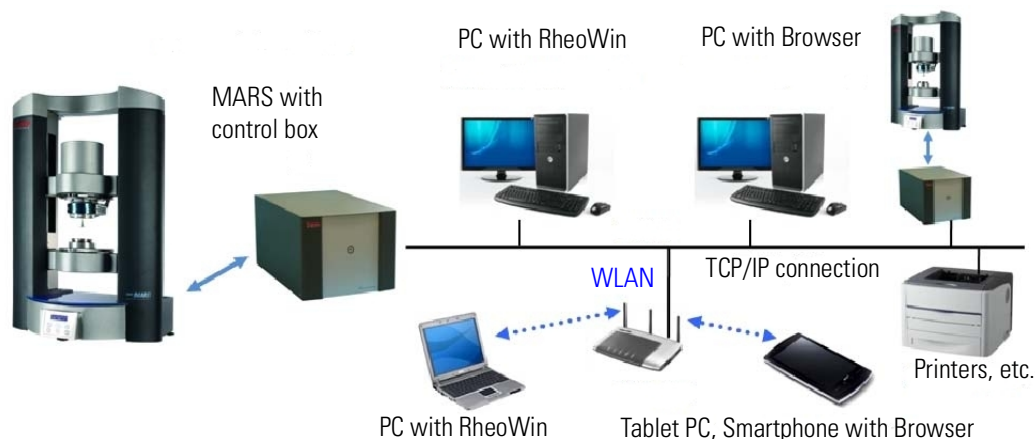
- Point-to-point network  
The HAAKE MARS can be directly connected to a PC (with RheoWin) using a so-called point-to-point network. In such a network there are only two clients and the network connection is only used for the communication between the HAAKE MARS and HAAKE RheoWin (and a browser).

**Figure 2.** HAAKE MARS and PC (with RheoWin) in point-to-point network



- Company or local network (LAN, WAN, Internet)  
The HAAKE MARS can be connect to a network of any size, for example a small dedicated network, a company network (LAN) or a local network with a few or many clients of which the HAAKE MARS and the PC (with HAAKE RheoWin) are just two clients. The connection between the HAAKE MARS and HAAKE RheoWin is just one of many connections in the network.

**Figure 3.** HAAKE MARS and PC (with RheoWin) in LAN



## Point-to-point network

Using a point-to-point network has the following advantages and disadvantages:

- A point-to-point network is easy to setup. An IT network specialist is normally not needed.
- In a point-to-point network the network connection is only used by the communication between the HAAKE MARS and HAAKE RheoWin. Because of this and also due to the intelligent data buffering in the HAAKE MARS firmware the communication can not be interrupted and the highest data acquisition rate of 500 Hz (one data point every 2 ms) can always be achieved when needed.
- The HAAKE MARS can only be accessed from the PC (with HAAKE RheoWin) to which it is connected to by the point-to-point network.
- When the PC (with HAAKE RheoWin) needs to be connected to a company network (and/or the internet) in order to be able to access network directories for exchanging data files etc., the PC needs two hardware network interfaces. One for the HAAKE MARS point-to-point network and the other for the company network (and/ or internet).  
Many PCs only come with one hardware network interface, however it almost always possible to add a second internal or external hardware network interface. Under order number 222-1760 Thermo offers such an USB to Ethernet adapter. For detailed installation instructions and more information on this adapter see the documentation on the CD that comes with the adapter.

## Company or local network

Using a company or local network has the following advantages and disadvantages:

- Integrating the HAAKE MARS and the PC (with HAAKE RheoWin) into a company network normally needs an IT network specialist.

- In a company or local network the network is used by many different services at the same time (accessing network drives, printing, internet connections etc.). Because of that, and even with intelligent data buffering in the HAAKE MARS firmware, it is not possible to guarantee a certain continuous data acquisition-rate for the communication between the HAAKE MARS and HAAKE RheoWin. As a result measurement data may (but certainly must not) show missing data points.
- The HAAKE MARS can be accessed from any PC in the network on which HAAKE RheoWin or a browser is installed. While the HAAKE MARS can of course only be controlled from one instance of HAAKE RheoWin at a time, it is possible to access the HAAKE MARS internal web-server from one or more other PCs at the same time even when HAAKE RheoWin is controlling the HAAKE MARS.
- Only one hardware network interface in the PC (with HAAKE RheoWin) is needed.

## Multiple HAAKE rheometers connected to one PC

One instance of RheoWin running on one PC can *control multiple* HAAKE rheometer (that is multiple MARS 40/60 and/or MARS iQ (Air) and/or VTiQ (Air)) *at the same the time*. In this case separate RheoWin Jobs are running at the same time, each Job controlling a different rheometer.

For this each rheometer can be connected to the PC using an individual point-to-point network, or all rheometers can be connected to a company or local network.

## TCP/IP connection

The TCP/IP connection requirements for the HAAKE MARS are listed in the following sections.

**Note** The TCP/IP connection requirements are all standard specifications and should be fulfilled by any PC network interface.

## Firewall, TCP/IP ports, UDP protocol

**IMPORTANT** Any Firewall (Windows Defender, Symantec, Norton, etc.) installed on the PC on which HAAKE RheoWin is running must be configured in such a way that the TCP ports listed in [Table 1](#) and the UDP protocol are not blocked for RheoWin.

The UDP protocol is used for sending “ConnectAssist” messages (automatic rotor recognition) from the MARS to RheoWin. The automatic recognition by RheoWin will not work when the UDP protocol is blocked.

**Table 1.** TCP/IP ports used used by the MARS and RheoWin

Port	Used for
2010	THMP service protocol for instrument control (measurement, lift)
2000	RheoWin network scan function
80	HTTP service protocol for web-server

## Default IP address

The default IP address of a HAAKE MARS is 192.168.2.140. The current IP address can be viewed in corresponding menu of the display and control panel. See “[The control panel display and menu](#)” on [page 36](#) of the HAAKE MARS 40/60 Instruction Manual on how to operate the display and control panel.

**Figure 4.** Current IP address



## Electronics box settings (DHCP client)

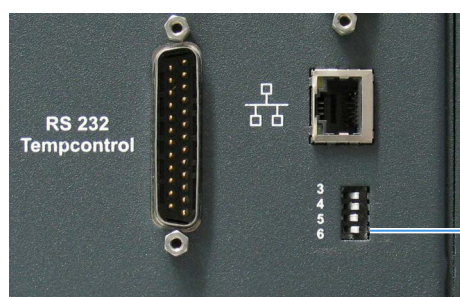
The MARS can be configured as a DHCP client (conforming to RFC-2131). This means that an IP address can be assigned to the instrument by a DHCP server in the network to which the MARS is connected.

By default the DHCP client function of the MARS is deactivated. In a point-to-point network setup, the most commonly used setup for connecting the MARS to a PC, the DHCP client is not needed.

The DHCP client function of the MARS can be activated/de-activated with the DIP switch no. 6 on the rear panel of the MARS electronics box, see [Figure 5](#).

## DIP switch settings

**Figure 5.** DIP switches default setting



DIP switch no. 6 outwards →  
DHCP OFF (default setting)  
DIP switch no. 6 inwards ←  
DHCP ON

## MAC address

The unique MAC address of the MARS electronic box can be found on the small sticker below the DIP switches.

## Control panel status information

When the DHCP client is activated and an IP address was successfully assigned to the MARS by the network DHCP server, the assigned IP address, see [Figure 6](#), can be found in the corresponding menu of the display and control panel. When no IP address was assigned the value 0.0.0.0 will be displayed for the IP address, in this case communication with RheoWin will not be possible.

**Figure 6.** DHCP client activated: IP address assigned (left), NO IP address assigned (right)

## Setting up a HAAKE MARS using a point-to-point network

As described above a free hardware network interface on the PC is needed for setting up a point-to-point network between the HAAKE MARS and the PC (with HAAKE RheoWin), see [Figure 2](#).

### Making a hardware connection

#### ❖ To make a hardware connection

1. Connect the RJ45 socket of the PC hardware network interface with the MARS RJ45 socket ((see [Figure 10](#) on [page 8](#) of the HAAKE MARS 40/60 Instruction Manual) using the patch cable (082-2526) which is part of the HAAKE MARS standard delivery.


### PC network interface configuration

#### ❖ To configure the PC network interface in Windows

In Window 7

1. On the Windows taskbar, click the Windows **Start**  button to open the Windows start menu.



In Windows 8 and 8.1

2. On the Windows taskbar, *right* click the Windows **Start**  button to open the Windows start menu.

In Windows 7, 8 and 8.1

3. From the Windows start menu select **Control panel**.
4. In the Windows Control Panel select **Network and sharing center**.

In Windows 10

5. On the Windows taskbar, click the Windows **Start**  button to open the Windows start menu.
6. In the Windows start menu select **Settings**  button to open the (Windows) Settings dialog.
7. In the Windows Settings dialog select **Network & Internet**.

In Windows 7 and Windows 8, 8.1 and 10

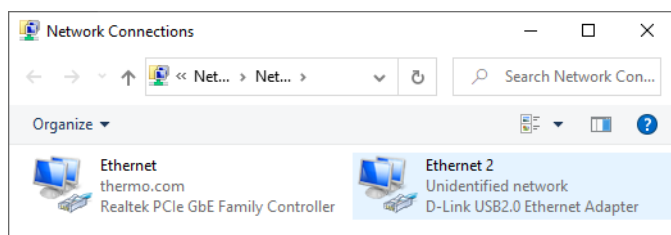
8. Select **Change adapter options** to open the Network connections dialog, see [Figure 7](#).
9. In the **Network Connections** dialog *right* click the network connection that will be used for the HAAKE MARS 40/60 Rheometer, Reference Manual (here Ethernet 2) and then select **Properties** from the context popup-menu to open the networks properties dialog (see [Figure 8](#)).



## 2 Network Setup

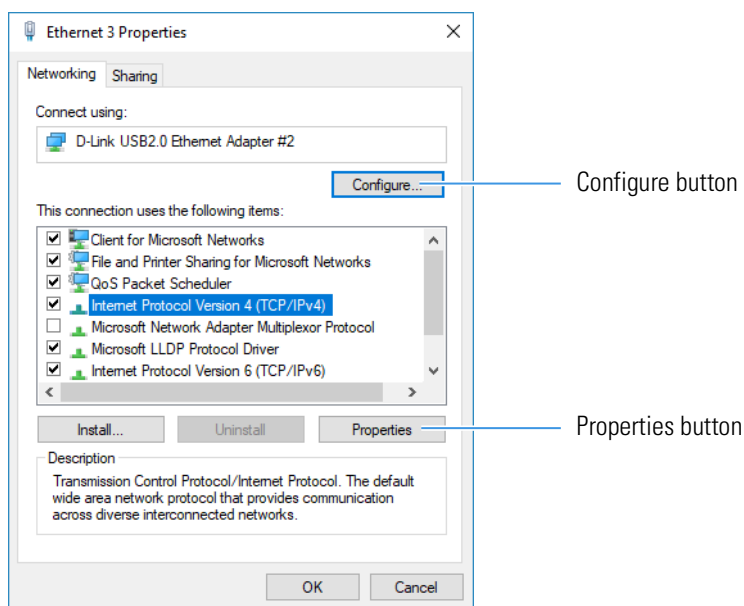
Setting up a HAAKE MARS using a point-to-point network

**Figure 7.** Network Connection dialog with context popup-menu



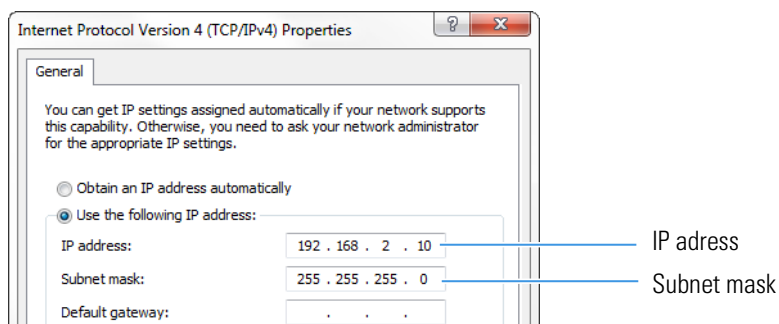
10. In the Network Connection Properties dialog (see [Figure 8](#)) select **Internet Protocol Version (TCP/IPv4)** from the list and then click the **Properties** button.

**Figure 8.** Network Connection Properties dialog



11. In the Internet Protocol Version 4 (TCP/IPv4) Properties dialog (see [Figure 9](#)) select **Use the following IP address** and enter the values 192.168.2.10 for the **IP address** and 255.255.255.0 for the **Subnet mask**.

**Figure 9.** Internet protocol Version 4 (TCP/IPv4) properties



**Note** The last number of the **IP address** (here 10) does not have to be 10, it can be in the range of 0 to 255, but it *must be different* from the last number (15) of the IP address of the HAAKE MARS 40/60 (the default IP address 192.168.2.15).



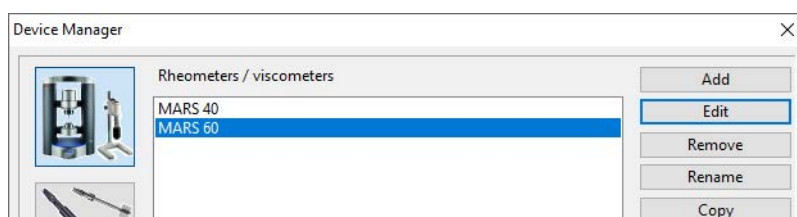
**IMPORTANT** The IP address of the network card in the PC and the IP address of the HAAKE MARS 40/60 Rheometer, Reference Manual *must be different* from each other but they must be in the same subnet range. This means that the first three numbers of the IP addresses (in dotted-decimal notation) must be the same but the last number must be different. For local area network connections it is customary to use IP addresses in the range of 192.168.xx.xx.

## MARS 40/60 configuration in RheoWin

### ❖ To configure the MARS in RheoWin

1. Start **RheoWin JobManager**.
2. Select the **DeviceManager** command from the **Configuration** menu.
3. In the **DeviceManager** dialog select the **MARS 40** or **MARS 60** from the list of **Rheometers / viscometers**.
4. Click the **Edit** button on the right hand side of the list.

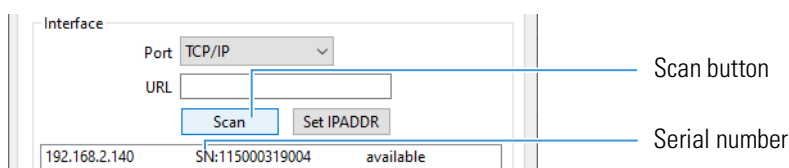
**Figure 10.** RheoWin Device Manager dialog



5. Select the **General** page in the **Properties of 'MARS'** dialog.
6. In the **Interface** box in the **Properties of 'MARS'** dialog click the **Scan** button.

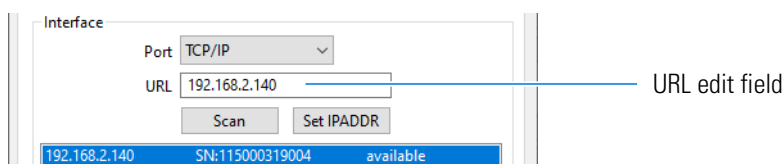
After a short time the serial number of the MARS will appear in the list box below the **Scan** button.

**Figure 11.** IP address of the HAAKE MARS



7. Double click the line containing the serial number of the MARS to transfer the IP address of the MARS to the **URL** edit field. (The IP address can also be entered manually in that field).

**Figure 12.** Transfer the IP address of the HAAKE MARS



8. Click the **Ok** button to close the **Properties of 'MARS'** dialog.
9. In the **DeviceManager** dialog click the **Test** or **Diagnosis** button on the right hand side of the list in order to test the communication between RheoWin and the MARS.

The RheoWin software and the MARS are now ready to be used.

## Setting up a MARS in a company network

In this case the PC (with RheoWin) must already be connected to an existing company network, see [Figure 3](#).

### Making a hardware connection

❖ **To make a hardware connection**

1. Connect the RJ45 socket of the MARS40/60 (see [Figure 10](#) on [page 8](#) of the HAAKE MARS 40/60 Instruction Manual) with a RJ45 (wall) socket of the company network using the patch cable (082-2526) which is part of the HAAKE MARS standard delivery.

### Network without DHCP server

When the network uses the default range of 192.168.xx.xx IP addresses, make sure that the default MARS IP address 192.168.2.140 is not already used in the network. Otherwise change the MARS IP address.

When the network uses IP addresses in a range different from 192.168.xx.xx the IP address of the MARS must be changed.

When multiple MARS instruments are connected to one network the IP address of at least one MARS must be changed, since all network clients must have different IP addresses.

Instructions on how to change the MARS IP address can be found in chapter [“TCP/IP connection”](#) on [page 5](#).

### Network with DHCP server

When the network is equipped with a DHCP server the IP addresses of any client in the network is not set by the client itself but assigned to the client by the DHCP server. In order for a MARS to function in such a network the DHCP client function in the MARS must be activated.

Instructions on how to activate the MARS DHCP client and how to find out which IP address was assigned to the MARS can be found in chapter [“Electronics box settings \(DHCP client\)”](#) on [page 6](#).

## MARS configuration in RheoWin

In RheoWin JobManager open the Properties of 'MARS' dialog as described in [“To configure the MARS in RheoWin”](#) on [page 9](#).

**Note** The Scan function can not search beyond the boundaries of the network which are set by the *nearest router* in the network.

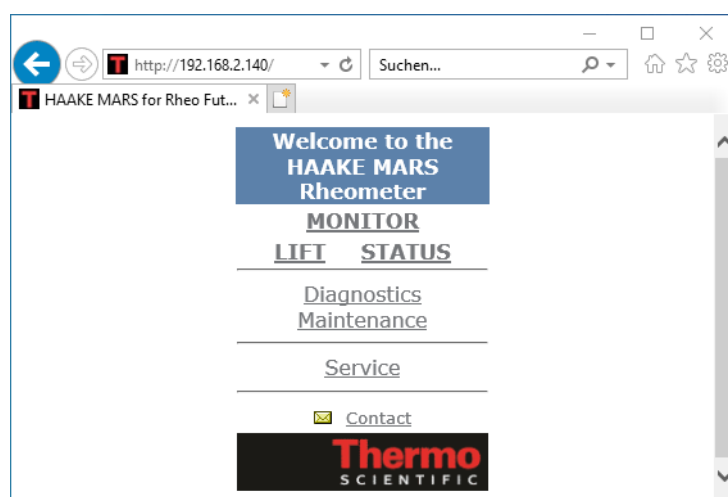
**Note** The *nearest router* restriction only applies to the Scan function, that is not to the ability of RheoWin to communicate with a MARS which is located behind the nearest router. In this case the IP address of the MARS can be manually entered in the URL edit field.

## Connecting with the MARS integrated web-server

The MARS rheometer is equipped with an integrated web-server which can be used for the remote monitoring of a RheoWin measurement (Job) and for displaying status and diagnosis information.

The integrated web-server can be accessed from any device (PC, Smartphone, PDA, iPad, Tablet PC, etc.) that is connected to the network to which the MARS is connected, using any web-browser, by entering the IP address of the MARS in the web-browser's URL edit field.

**Figure 13.** HAAKE MARS web-page in Internet Explorer



The MARS web-pages can be accessed at any time, even when RheoWin is controlling the MARS. Since the RheoWin -MARS connection always has the highest priority, minor delays in refreshing the MARS web-pages in the browser window may occur.



## HAAKE RheoWin Software

This chapter describes how to operate those parts of the HAAKE RheoWin software which are specific for the MARS 40/60. The basic operation of HAAKE RheoWin, which is identical for all HAAKE rheometers and viscometers is described in the HAAKE RheoWin manual.

### Software Version

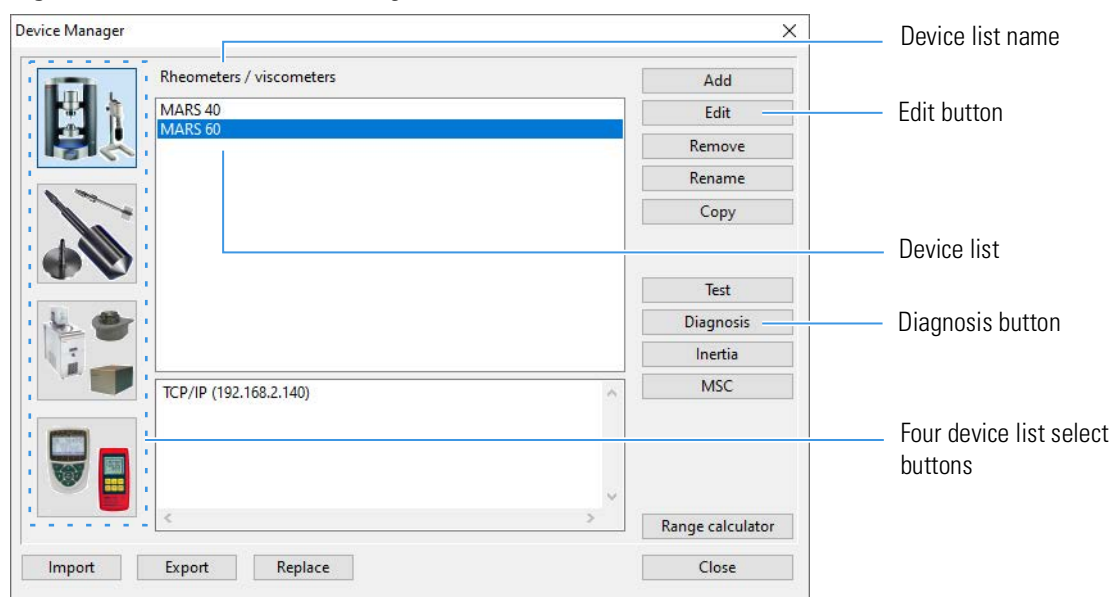
HAAKE RheoWin version 4.60.0000 or higher is needed for operating the HAAKE MARS 40/60.

### RheoWin DeviceManager and Device Drivers

In order to be able to communicate with any rheometer, viscometer, temperature control unit, circulator or auxillary instrument (i.e. any device) RheoWin needs a so-called driver for that device. Such a driver consists of a \*.dll file which is stored in the \RheoWin\Drivers directory. The necessary device drivers are installed automatically during the RheoWin installation process.

In the DeviceManager the devices are sorted into four separate lists, one for the rheometers and viscometers, one for the measuring geometries, one for the temperature control units and circulators and one for the auxillary devices (e.g. pressure sensor, humidity sensor). Each device driver has a user-interface (editor) in which its settings can be modified.

**Figure 14.** RheoWin Device Manager with list of Rheometer devices



❖ **To open a device editor**

1. Click on one of the four buttons on the left hand side of the device list to select the appropriate device list, in this case the list of **Rheometers / viscometers**, see [Figure 14](#).
2. Select the device from the list of devices, in this case the **MARS 60** or **MARS 40**, see [Figure 14](#).
3. Click the **Edit** button on the right hand side of the device list to open the device editor.

The properties of all devices are (automatically) stored in one file, the drivers.flp file, which is stored in the c:\ProgramData\Thermo\RheoWin\drivers directory, for more information on this see the RheoWin manual.

## MARS 40 /60 and MTMC device drivers

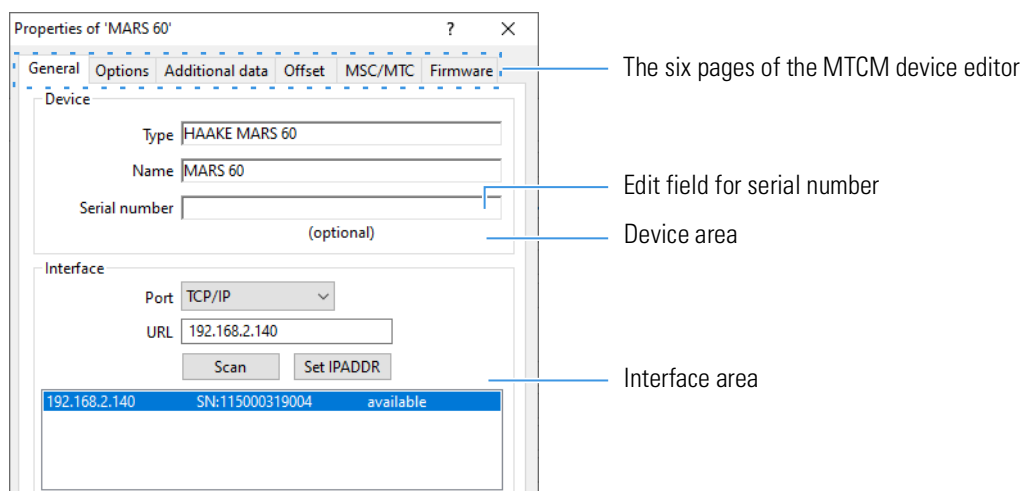
For the MARS 40/60 two device drivers are installed; the MARS40.dll or MARS60.dll driver for the MARS rheometer itself and the MTMC.dll driver for the MARS temperature module controller which is integrated in the MARS instrument.

**Note** The MTMC driver and device editor are described in the HAAKE MARS Temperature Modules Instruction Manual.

## MARS 40/60 Device Editor

The editor for the properties of the MARS 40/60 device consists of 6 pages which are described below.

**Figure 15.** MARS60 device editor with General page



## The General page

On the **General** page, see [Figure 15](#), the device Type, Name and Serial number are shown in the **Device** area. The device **Type** can not be modified. The device **Name** can be modified using the **Rename** button in the DeviceManager dialog (see [Figure 14](#)). The **Serial number** can be edited directly in the edit field.

In the **Interface** area the properties of the communication interface between RheoWin and the MARS are shown.

The value for the **Port** is TCP/IP, and can not be modified, the MARS can only be controlled by RheoWin using a TCP/IP ethernet connection (The RS232 port on the back of the MARS electronics box is for service issues only).

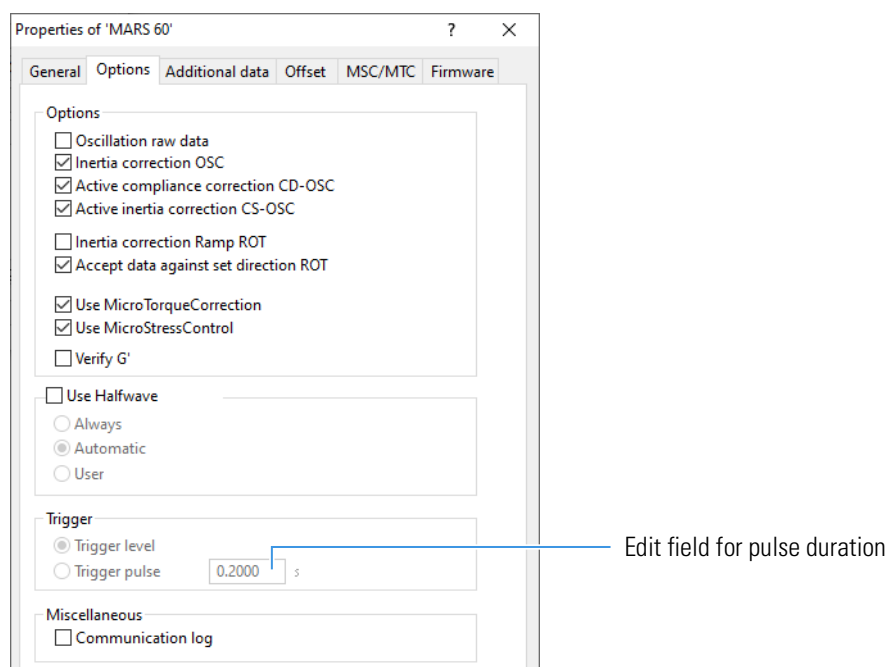
The value for the **URL** can be entered manually but it is recommended to use the Scan button instead, see “MARS 40/60 configuration in RheoWin” on page 9 in Chapter 2, “Network Setup.”

Normally setting up the interface for the MARS is only done once during the initial installation of the instrument.

## The Options page

On the **Options** page, Figure 16, several options which influence the data-acquisition and communication between RheoWin and the instruments can be set.

**Figure 16.** MARS60 device editor with Options page



### Oscillation raw data

When the option **Oscillation raw data** is activated, the raw angle and torque sine wave data of the last repetition which is used for a data point (in RheoWin) is transferred from the rheometer to RheoWin and displayed in RheoWin during any oscillation measurement. Please note that in order to save this sine wave data to a file (for later use) the option **Save raw data** must be activated in the oscillation measurement elements.

### Inertia corrections OSC

In order for the result of any oscillation measurement to be correct the inertia of the instrument (inertia of motor shaft + inertia of measuring geometry) must be taken into account. This option must always be activated.

## Active compliance correction CD-OSC

When this option is activated the oscillation set angle amplitude is actively corrected for the compliance of the drive motor + rotor shaft, during an oscillation measurement in CD-mode. It is recommended to have this option always activated.

## Active inertia correction CS-OSC

When this option is activated the oscillation set torque amplitude is actively corrected for the inertia of the drive motor + rotor, during an oscillation measurement in CS-mode. It is recommended to have this option always activated.

## Inertia correction Ramp ROT

When this option is activated the measured torque is passively corrected for the inertia of the drive motor + rotor during a ROT CR Ramp measurement and the set torque is actively corrected during a ROT CS Ramp measurement.

This option should only be activated for fast ramps, for example when the angular velocity is ramped up from 0.0 rpm to 1000 rpm in 60 s or less. It is recommended to deactivate this option for normal operation.

## Accept data against set direction ROT

Under certain circumstances the measured shear rate can be negative when the set shear stress is positive or vice versa. This can be caused by residual stresses in the sample caused by sampling loading or by a less than perfect MSC correction when measuring at very low torques, etc. When the option **Accept data against set direction** is set such measured values are accepted and saved, when this option is deactivated these values are set to zero. By default this option is activated.

## Use MicroTorqueCorrection

**MicroTorqueCorrection** (or MTC) is a fine tuning for the torque calibration of the rheometer drive motor. The MTC consists of a table of torque correction values which is stored in the instrument itself. This table is determined for each rheometer drive motor individually during the manufacturing process. This option should always be activated.

## Use MicroStressControl

**MicroStressControl** (or MSC) is a correction for the dependence of the torque on the angular position of the drive motor shaft (rotor) relative to drive motor housing (stator) and is mainly caused by inevitable imperfections in the drive motor air-bearing. The MSC consist of table of torque correction values (torque as a function of angular position) which is stored in the instrument itself. This option should always be activated.

## Verify G'

The option **Verify G'** is a relict from older HAAKE RheoStress instruments and should not be activated.



## Use Halfwave

In order to speed up oscillation measurements at (very) low frequencies the option **Use Halfwave** can be activated. When this option is active only half a sine wave, instead of a complete sine wave, is measured for the calculation of the rheological data. When the option **Always** is selected half sine waves are used for all frequencies. When the option **Automatic** is selected half sine waves are used for frequencies below 5 Hz only. When the option **User** is selected the frequency below which half waves are used can be entered by the user. The default value for this frequency is 0.5 Hz. By default this option is deactivated.

**Note** During oscillation in CD-mode these settings are ignored and the complete sine wave is always used.

## Trigger

When the option **Trigger level** is selected the trigger event is defined by the trigger relays being closed. When the option **Trigger pulse** is selected the trigger event is defined by the trigger relays being closed for a short time only. The value for the duration of the pulse can be edited, see [Figure 16](#).

## Communication log

When the option **Communication log** is activated the RheoWin MARS device driver will create a log file (in ASCII format) which contains all the commands send to the device and all the answers from the device. This log file has the file name `mars60.log` or `mars40.log` and is stored in the folder `c:\ProgramData\Thermo\Rheowin\Drivers`. The log file can be viewed comfortably by using the **Show log file...** command from the JobManager **Help** menu.

When this option is activated RheoWin will show a warning message every time the communication with the device is started, this because the logging may influence the timing of the communication in a negative way.

**Note** The Communication log option should *not* be activated unless it is explicitly needed for service issues, trouble shooting, debugging, etc.

## The Additional data page

On the **Additional data page**, see [Figure 17](#), settings for the acquisition of data from external instruments or sensors, auxiliary devices and cameras can be made.

## External data

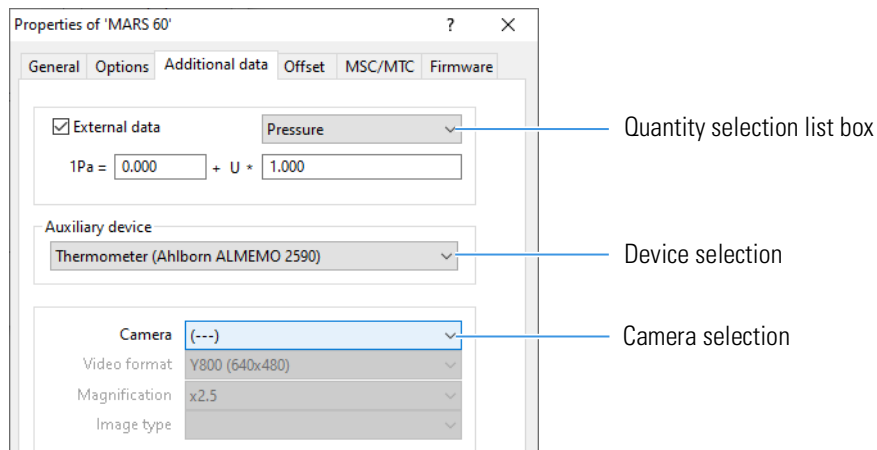
The HAAKE MARS can measure a 0 – 10 Volt external voltage at pins 9 and 1 (ground) of the 15 pin D-sub input/output connector at the back of the electronics box (see [Figure 10](#) on [page 8](#) and Appendix A of the HAAKE MARS 40/60 Instruction Manual).

The measured voltage can be scaled as a physical quantity using the linear equation:

$$\text{quantity-value} = \text{offset-factor} + \text{multiplication-factor} \cdot \text{voltage} \quad (1)$$

The **offset-factor** and **multiplication factor** can be entered by the user in the line below the **External data** checkbox. The quantity as which the measured signal will be measured and stored by RheoWin can be selected from the list-box. The following quantities are available: length, mass, voltage, pressure, electrical field strength and luminous intensity.

**Figure 17.** MARS60 device editor with Additional data page



## Auxiliary device

RheoWin can acquire data from the following auxiliary devices:

- A hygrometer, that is the Ahlborn ALMEMO 2590 (and compatible models) universal measuring device equipped with a special sensor to measure humidity.
- A thermometer, that is the Ahlborn ALMEMO 2590 (and compatible models) universal measuring device equipped with a temperature sensor.
- A manometer, the Greisinger GMH 3110 and GMH 3111 pressure measuring devices. This device can be used with the pressure cells that are available for the MARS.
- A FTIR spectrometer

These devices can be connected to an USB or RS232 port on the PC on which RheoWin is running. The properties of these auxiliary devices must be set in the RheoWin DeviceManager. By selecting one of these auxiliary devices in the list box, the measuring signal delivered by this device will be acquired and stored by RheoWin.

## Camera

RheoWin can acquire images from certain specific USB 3.0 and Firewire (IEEE 1394) cameras or a generic USB camers for which a WDM (Windows Driver Model) compatible driver is installed on the PC on which RheoWin is running. The camera must be selected from the list-box in which any camera for which a WDM driver was installed will appear (at the end of the list).

- By selecting (---) no camera is selected and no images will be acquired.
- By selecting (**Any**) the first camera found when starting a RheoWin Job or the Manual Control Window will be used for acquiring images (searching for a camera name is done in an alphabetical order).

- By selecting (**Smart selection**) the user will be asked (when starting a RheoWin Job or the Manual Control Window) which camera should be used when more than one camera is found, when only one camera is found that camera will be used automatically.
- By selecting (**Select at start**) the user will always be asked which camera should be used when starting a RheoWin Job or the Manual Control Window.

The video format used for the acquisition can be selected from the **Video format** list-box. The video format describes the colour depth and the image size in pixels. Choosing a format with less colours and less pixels will increase the maximum possible image acquisition rate. For the HAAKE RheoScope only, the magnification of the lens used in the RheoScope must be selected from the Magnification list-box.

**Note** The ruler which is displayed on all images is only correct for RheoScope images.

The image type of the acquired images can be selected from the Image type list-box:

- The use of the .BMP format is recommended when achieving the highest possible image acquisition rate is important. Since .BMP images are not compressed this image type does not require PC computing time.
- The use of the .TIF format results in a slightly lower acquisition rate. The .TIF format is supported by many commercially available software packages.
- The use of the .LWF format is recommended when minimizing the RheoWin data file size is an issue. For the .LWF format the image compression rate can be set between 1 and 1000 using the mouse and/or arrow keys on the keyboard. The higher the compression rate the smaller the image size (in byte) and the lower the quality of the image will be, see [Table 2](#).

**Table 2.** Compression rate, image quality and image size

Compression rate	Image quality reduction	Image size reduction
1	none	1.6
10	hardly visible	10
100	clearly visible	100

## The Offset page

On the **Offset** page, see [Figure 18](#), a temperature offset table (or temperature calibration table) for the temperature measured by the MARS itself can be entered. This is the temperature measured by a Pt100 sensor connected to the Pt100 connector on the back of the HAAKE MARS instrument. Normally this connector is used for connecting older type (MARS II and RheoStress xxx compatible) liquid temperature control units.

**Note** This is NOT the temperature measured by any TM-xx-x module and not the CTC temperature. The offsets for these temperatures must be defined in the editors of the device drivers of these units and modules.

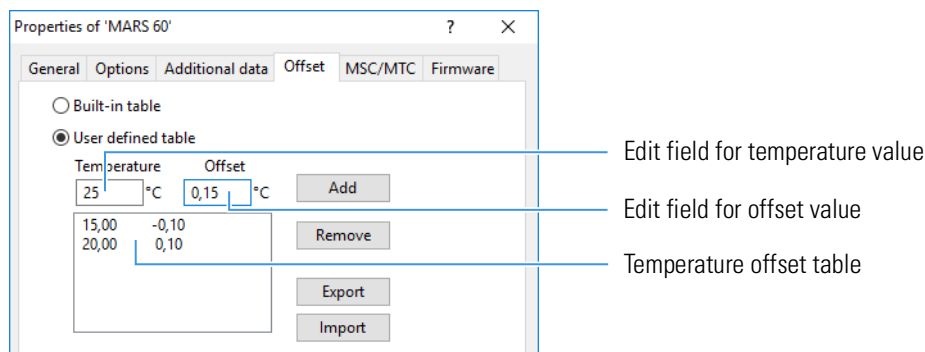
The temperature offset table has space for up to 20 offset values.

For a temperature value that is not directly available in the table, that is basically for any temperature, the temperature offset value is calculated from the two nearest values in the table by means of linear interpolation. Therefore any offset table *must* contain offset values for at least two different temperatures.

The range of temperature values in the table should be slightly wider as the temperature range used for measurements: When temperatures in the range of, for example, 20 °C to 60 °C are measured, the offset table should span the range from 15 °C to 65 °C.

For temperatures for which no interpolated offset can be calculated the offset of the nearest value in the table is used.

**Figure 18.** MARS 60 device editor with Offset page



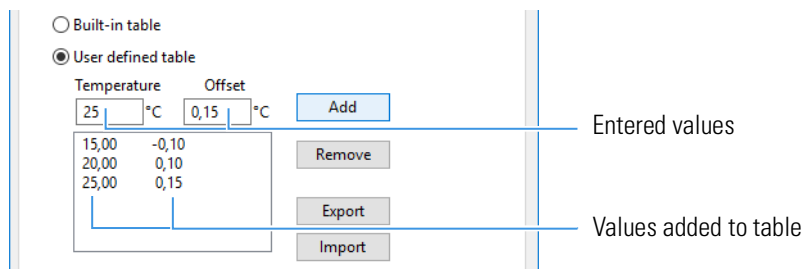
#### ❖ To edit the temperature offset table

1. Select the **User defined table** option.
2. Edit the table by adding, modifying or deleting table rows, see the corresponding procedures below.
3. Transfer the modified table to the instrument, see the corresponding procedure below.

#### ❖ To add an offset value

1. Enter the temperature value for which an offset is to be added in the left edit field above the offset table, see [Figure 19](#).
2. Enter the temperature offset value for that temperature in the right edit field above the offset table.
3. Click the **Insert** button to add the new values to the table, see [Figure 19](#).

**Figure 19.** MARS 60 device editor with Offset page



#### ❖ To modify an offset value

1. Enter a temperature value, which is already in the table, in the left edit field above the offset table.

2. Enter the new temperature offset value for that temperature in the right edit field above the offset table.
3. Click the **Insert** button to modify the existing offset value.

❖ **To delete an offset value**

1. Select the row in the table that is to be deleted.
2. Click the **Remove** button to delete the offset value.

❖ **To transfer the temperature offset table to the instrument**

1. Click the **Apply** button at the bottom of the dialog.
- or
2. Click the **Ok** button at the bottom of the dialog.

This will also close the dialog.

The currently displayed offset table can be exported to and from a file (in ASCII format) with the extension **.tot**. This is useful for making a backup copy of a table, or for transferring a table from one instrument to another.

❖ **To export the temperature offset table**

1. Click the **Export** button to open the file save dialog
2. Enter an appropriate file name in the file save dialog.

❖ **To import a temperature offset table**

1. Click the **Export** button to open the file open dialog.
2. Select the desired **\*.tot** file in the file open dialog.

## The MSC/MTC page

On the **MSC /MTC** page, see [Figure 20](#), the MSC and MTC tables which are stored in the MARS instrument itself are shown. By clicking on the **Load from instrument** button both the MSC and the MTC table are downloaded from the instrument and displayed in the respective tables. The MSC table contains 720 lines, the MTC table 30.

The **Insert** and **Remove** functionality of these tables is the same as that of the temperature offset table (see above) but is normally not used, the determination of the MSC and MTC tables is performed automatically by the corresponding calibration routines in the DeviceManager dialog.

The **Export** and **Import** functionality of the MSC and MTC tables is the same as that of the temperature offset table (see above). By using the **Export** and **Import** buttons the MSC and MTC tables can be exported to and imported from a file (in ASCII format) with the extension **.MSC** and **.MTC** respectively.

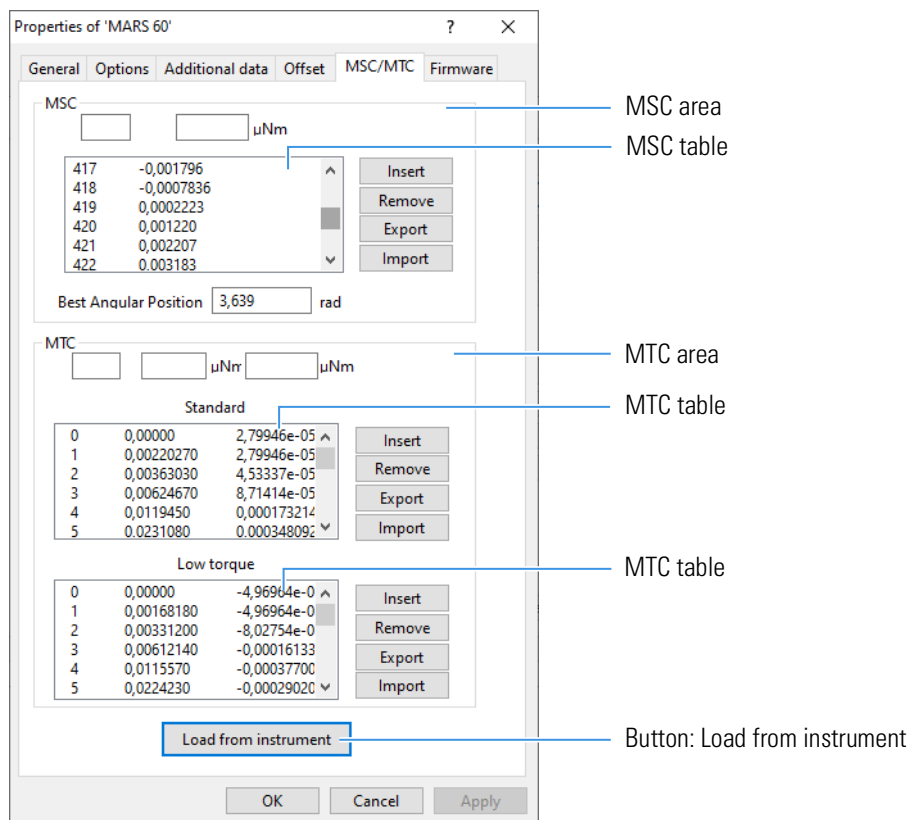
**Note** Exported **\*.MSC** files can be imported by HAAKE RheoWin DataManager, using the **File > Open** command and selecting the **All files (\*.\*)** extension option.

Both the MSC and MTC table are uploaded to the instrument when the **Ok** button at the bottom of the dialog is clicked.

Although the MSC table is determined for each rheometer individually during the manufacturing process it is recommended to run the MSC calibration routine (see “[MSC Calibration](#)” on [page 24](#)) on a regular basis when measuring in the sub-micro-newton-meter torque range.

**IMPORTANT** The MTC table must *not* be modified by the operator. The values in this table are determined for each rheometer individually during the manufacturing process.

**Figure 20.** MARS60 device editor with MSC/MTC page



## The Firmware page

The functionality on the Firmware page, see [Figure 21](#), is used for updating the MARS and MTMC firmware. The MTMC firmware is an integral part of the MARS Stand (M-Box) firmware.

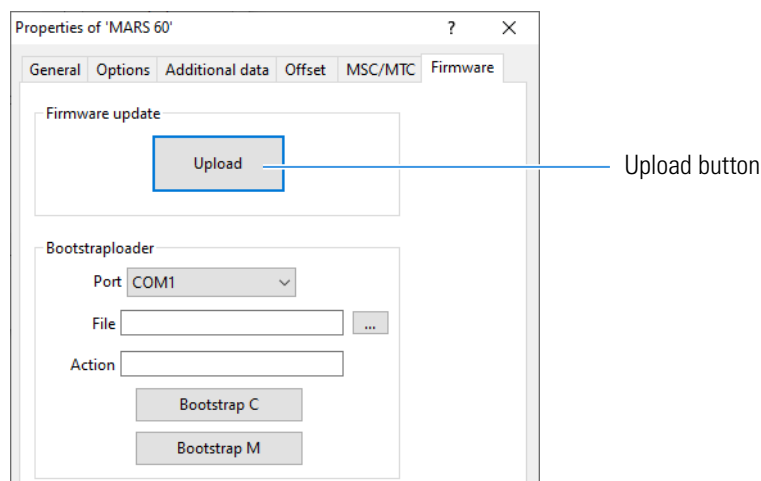
### Firmware update

Although it is generally recommended to have a firmware update performed by a qualified service engineer, updating the firmware can be done by any user after carefully reading the instructions in [Appendix A, “Firmware Update”](#) on [page 29](#).

### Bootstrloader

**WARNING** The integrated Bootstrloader is for use by qualified service engineers only. Misuse of this function may make the instrument unusable.

**Figure 21.** MARS60 device editor with Firmware page



## Inertia Calibration

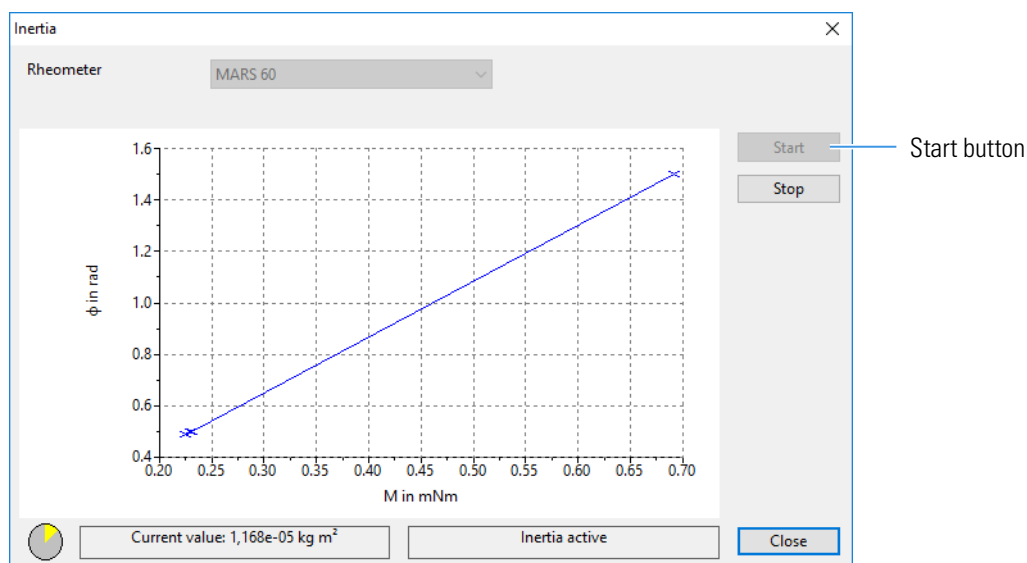
The inertia of the MARS drive motor can be checked using the inertia calibration routine. This routine measures the torque needed for oscillating (in CD-Osc mode) the drive motor at two different angle amplitude values and calculates the inertia value from the measured data.

### ❖ To run the inertia calibration routine for the MARS drive motor

1. Click on one of the four buttons on the left hand side of the device list to select the appropriate device list, in this case the list of **Rheometers /viscometers**, see [Figure 14](#).
2. Select the device from the list of devices, in this case the **MARS 60** or **MARS 40**, see [Figure 14](#).
3. Click the **Inertia** button on the right hand side of the device list to open the Inertia dialog, see [Figure 22](#).

**IMPORTANT** Make sure that no rotor is attached to the drive motor shaft.

**Figure 22.** Inertia calibration dialog



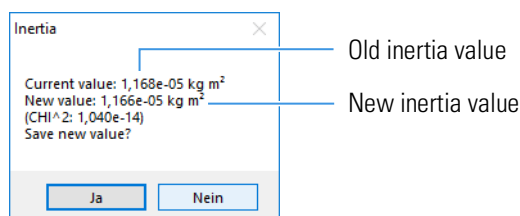
4. Click the **Start** button to start the inertia calibration routine.

The routine takes around 2 minutes and 20 seconds to complete.

When the routine is finished the new and old inertia values are displayed in a confirmation dialog, see [Figure 23](#).

**IMPORTANT** The new inertia value should be in the range of  $0.9 \cdot 10^{-5} \text{ kg m}^2 < I < 1.2 \cdot 10^{-5} \text{ kg m}^2$  and (normally) not differ much from the old value.

**Figure 23.** Inertia save confirmation dialog



5. Click the **Yes** button to save the new inertia value to the rheometer firmware.

## MSC Calibration

The MSC calibration routine is used to establish a torque map (torque as a function of the absolute angle position of the drive motor shaft relative to the motor stator) of the residual torque of the drive motor air-bearing. The resulting torque map is used during any measurement to correct for the residual torque.

**IMPORTANT** Performing a MSC calibration on a regular basis is an important pre-requisite for achieving good measurement results at low torque value ( $M_d < 1 \mu\text{Nm}$ ).

**IMPORTANT** For optimal low torque performance set the air-bearing pressure to 1.8 bar.

For small diameter ( $D < 20 \text{ mm}$ ) measuring geometry rotors, the residual torque is mainly dependent on the air-bearing properties, for larger rotors imperfections in the rotor may have an effect also.

This MSC calibration routine measures the torque as function of the absolute angle needed for rotating the drive motor at a low constant rotational speed (in CR-Rot mode). The measured torque values as a function of the absolute angle values form the torque map, which is saved in the rheometer firmware.

The torque map can be refined (optimized) by running the MSC calibration routine a 2nd or even 3rd time, then with the torque correction activated, using the **Test of calibration** option, see [Figure 25](#).

### ❖ To run the MSC calibration routine

1. Click on one of the four buttons on the left hand side of the device list to select the appropriate device list, in this case the list of **Rheometers / viscometers**, see [Figure 14](#).
2. Select the device from the list of devices, in this case the **MARS 60** or **MARS 40**, see [Figure 14](#).
3. Click the **MSC** button on the right hand side of the device list to open the Inertia dialog, see [Figure 24](#).
4. Select the **Measuring geometry** attached to drive motor shaft.
5. Select the **Calibration** option.



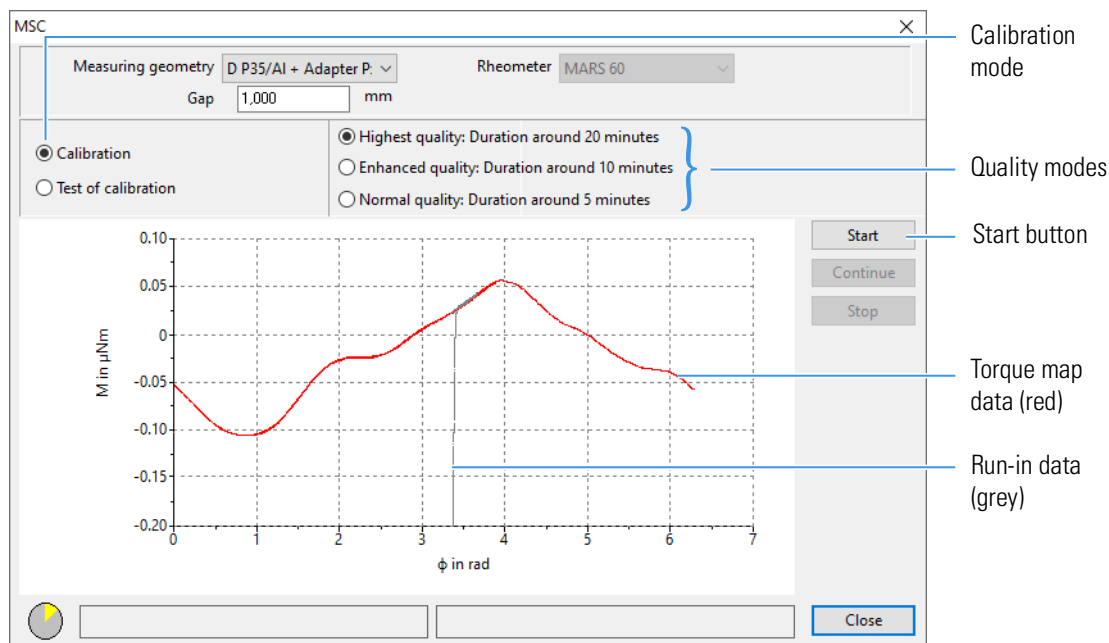
6. Select one of three **Quality** modes.

When time is not critical and the low torque range is used, use the highest quality.

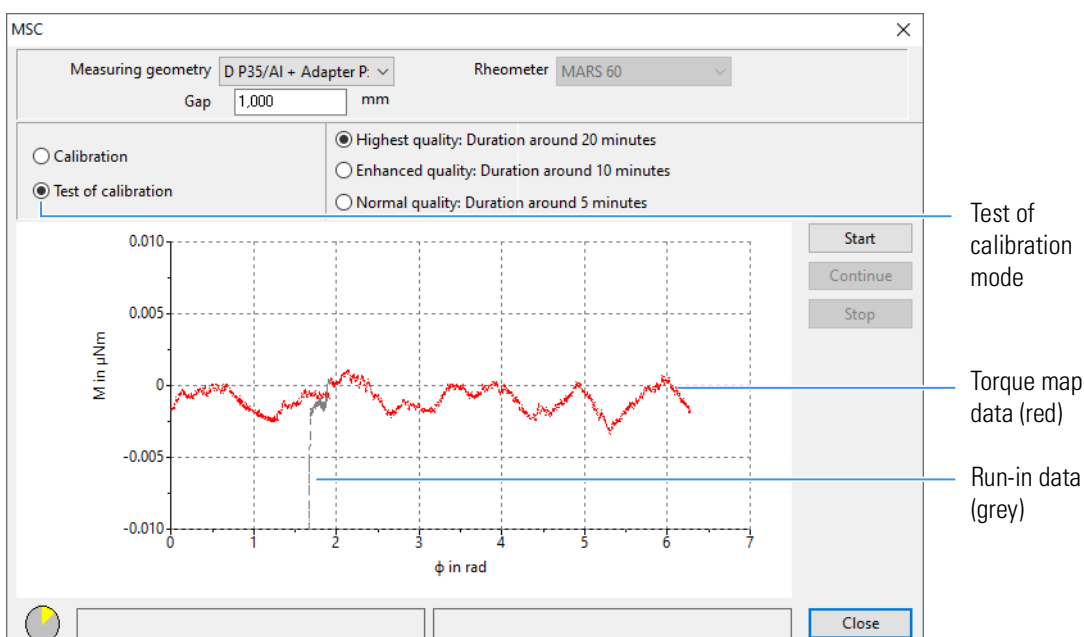
7. Click the **Start** button to start the MSC calibration routine.

After a short run-in the rheometer will first perform one full rotation clockwise and then one full rotation counter-clockwise. The grey coloured part of the curve, see [Figure 24](#), is the run-in part which is not used for the torque map.

**Figure 24.** MSC dialog, Calibration



**Figure 25.** MSC dialog, Test of calibration



8. When the routine is finished click the **Yes** button in the **Save new values** dialog to save the new torque map in the rheometer firmware.

The rest of this procedure is optional.

To check how well the residual torque is corrected for and at the same time refine (optimize) the torque map, run the routine a 2<sup>nd</sup> time by continuing with the following steps.

9. Select the **Test of calibration** option, to activate the residual torque correction.
10. Click the **Start** button to start the MSC calibration routine.

After a short run-in the rheometer will first perform one full rotation clockwise and then one full rotation counter-clockwise, just as before, but now with the torque being corrected for the residual torque values stored in the torque map. As a result the rest-residual torque values, see [Figure 25](#), are now much smaller.

11. When the routine is finished click the **Yes** button in the **Save new values** dialog to save the new optimized torque map in the rheometer firmware.

Often, performing [step 9](#) to [step 11](#) again, that is running the routine a 3<sup>rd</sup> time, will improve the correction noticeable, but not as much as after the first time.

## Test and Diagnosis

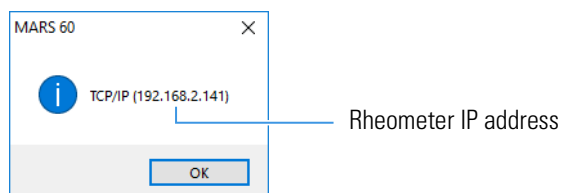
The Test and Diagnosis buttons on the right hand side of the device list, see [Figure 14](#), can be used to test the communication between RheoWin and the rheometer and to read certain device parameters from the rheometer firmware.

### ❖ To run the Test routine

1. Click on one of the four buttons on the left hand side of the device list to select the appropriate device list, in this case the list of **Rheometers / viscometers**, see [Figure 14](#).
2. Select the device from the list of devices, in this case the **MARS 60** or **MARS 40**, see [Figure 14](#).
3. Click the **Test** button, on the right hand side of the device list, to test the communication with rheometer.

When the IP address of the rheometer is displayed correctly, see [Figure 26](#), the communication is working correctly.

**Figure 26.** Test result



### ❖ To run the Diagnosis routine

1. Click on one of the four buttons on the left hand side of the device list to select the appropriate device list, in this case the list of **Rheometers / viscometers**, see [Figure 14](#).
2. Select the device from the list of devices, in this case the **MARS 60** or **MARS 40**, see [Figure 14](#).
3. Click the **Diagnosis** button, on the right hand side of the device list, to read diagnostic information from the rheometer firmware, see [Figure 27](#).
4. Click the **Save** button, to save a MARSxx.di a file in the RheoWin drivers directory.

**Figure 27.** Diagnosis dialog

Diagnose for 'MARS 60'

Device  
MARS60-00112 HS-HT-NF, (118002950003 / 118002616008)

Version  
μP1 50.25.003  
μP2 50.23.435TS11:48:12  
μP3 65.00.012

Motor Constants  
K1 4.412 K21 1.034e-06  
K2 0.4851 K35 1.230e-05  
K3 0.000  
K4 0.000

Service and Calibration  
Next Service 24.04.2020  
Next Calibration 24.04.2020

Lift  
Table Position 48835 (28.73%)  
Current Gap 153.173 mm  
Speed  
Initialize lift  
Reset connect assist

Torque  
Set 0.000  
Current 0.000

Rotation speed  
Set 0.000  
Current 0.000

Temperature  
Sample  
Motor 22.6 °C  
Offset table

Air pressure  
Current 2.010 bar

OK Save

Rheometer serial number

Drive motor serial number

Activated/installed rheometer options

Firmware version numbers

Save button



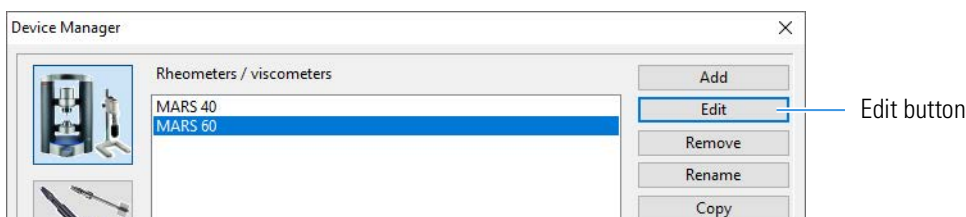
## Firmware Update

This appendix describes how to update the MARS and MTMC firmware.

### ❖ To update the HAAKE MARS firmware

1. Start **RheoWin JobManager**.
2. Select the **DeviceManager** command from the **Configuration** menu.
3. In the **DeviceManager** dialog select the **MARS 40** or **MARS 60** from the list of **Rheometers / viscometers**.
4. Click the **Edit** button on the right hand side of the list, see [Figure 28](#).

**Figure 28.** RheoWin Device Manager dialog



5. Select the **Firmware** page in the **Properties of MARS** dialog, see [Figure 21](#) on [page 23](#).
6. Click the **Upload** button, this will launch the Thermo HAAKE Firmware Updater V2.0.0.03 program (the version number must be 2.0.0.3 or higher), see [Figure 29](#).
7. Click the **Scan** button.

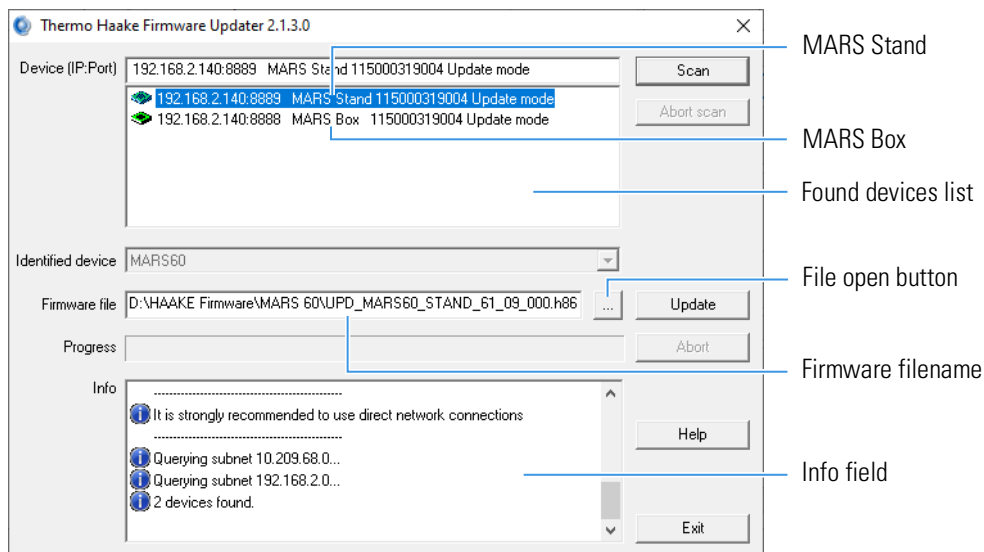
The firmware updater program will now scan any network that the PC on which RheoWin is connected to and search for any available MARS devices.

**Note** The firmware updater can only scan local network segments, i.e. it can not find (and thus not update) devices running in a different network segment. Therefore it is recommend to only use a direct (point-to-point) network connection for updating the firmware.


8. *Right* click on the line which shows the MARS for which the firmware should be updated and then select the command **Switch to Update mode** from the context popup menu.

The MARS device will now be switched into Update Mode, the yellow indicator light on the front of the electronics box will light up and the MARS display will show the text **MARS update Mode...** (in two lines).

**Figure 29.** Firmware Updater dialog



The firmware updater will now automatically scan the network again and show the message **2 devices found** in the info field, there will be 2 devices because in update mode the MARS Stand and the MARS electronic box are treated as two separate devices. When the message **no devices found** is displayed, no device was found. In this case click the **Scan** button again.

9. Select the **MARS Stand** or the **MARS Box** device from the list of found devices.
10. Click the File open  button and browse to and select the corresponding \*.h86 firmware file in the file open dialog.

The files for the MARS Stand and the MARS Box have the following names and format:

- MARS Box: UPD\_MARS\_RCBOX\_FULL\_xx\_xx\_xxx.h86
- MARS Stand: UPD\_MARS3\_MBOXTC\_xx\_xx\_xxx.h86

where xx\_xx\_xxx stands for the version number. The letters FULL are not always part of the MARS Box file name.

11. When the correct firmware file name is shown in the **Firmware file** edit field, click the **Update** button to transfer the \*.h86 file to the device.

The firmware updater will check whether the selected \*.h86 file and the select device match, in case they do not the file will not be transferred. The firmware is completely transferred when the text **Verify ok – Target remains in update mode** is displayed in the Info field.

12. Repeat step 9 until 11 for the other firmware file if necessary.

**Note** It is *not* obligatory to upload both firmware file unless the documentation that comes with the firmware files says so.

13. After finishing uploading the firmware files click with the right mouse button on either the MARS Stand or MARS Box entry in the list and then click on the **Switch to Normal mode** popup menu.

The MARS device will now be switched back into Normal Mode and re-initialized.