

MOVIDYN® Servo Controller

Manual
MD_SCOPE

Edition 01/99



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SEW EURODRIVE

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1 Introduction

Setting the parameter for servo drives is a very demanding task. A frequently employed method to optimise running characteristics of dynamic drives is to analyse the response of the different controller parameters after a speed setpoint change. Therefore, however, the servo controller needs to be equipped with appropriate analog outputs where signals, such as the speed signal, can be output as analog signals. This method often requires storage oscilloscopes and other measuring instruments.

With the MD_SCOPE PC program, the user can perform a machine test (e.g. involving a setpoint change) independently. The response functions are recorded in the servo controller in real time. The information obtained can then be sent to the PC via the serial interface and displayed there. This provides you with up to five traces displayed in different colors on your screen. Similarly to an oscilloscope, both the horizontal and the vertical axes can be stretched and compressed as required.

Functions such as saving, documenting and printing make it easy for you to build up records of setup parameters and transfer functions.

2 Quickstart of a Servo Controller

For more detailed information on the individual steps please refer to the subsequent sections.

Setting up the communications link

- Switch off the servo controller and the PC.
- Connect together the RS-232 interfaces of the two units.
- Switch both units on.

Setting the system parameters with MD_SHELL

- Start the MD_SHELL user interface.
- Select the appropriate PC and servo controller interface and the servo controller address in the "Interfaces" menu.
- Perform the necessary parameter setting procedures.
- Select "*Trigger source: External terminal / PC*" (if "*External terminal*" is selected, assign the "*Ext. Trigger function*" to a binary input on the servo controller using MD_SHELL, and fit an appropriate switch to the unit).

Setting the trace

- Start the MD_SCOPE user interface.
- Select the PC and servo controller interface used as well as the servo controller address with the "*Options/Select interface...*" menu command.
- Select the "*MD_SCOPE/Set Trace...*" menu command. dialog box appears showing the settings for recording measurement data in the servo controller. Select the sampling time and the trigger source.
 - Sampling time [ms]: 1
 - Trigger source: External terminal
- Now start the recording using the on/off switch "*Tracing = Start*".
- The "*TR CE active*" LED indicates that the measured value recording is active.
- After about 2 seconds, the "*Trace overflow*" LED signals that the measurement buffer has been filled with data once. This buffer now continues to be overwritten until the recording is stopped with the selected trigger source. The "*TRIGGER active*" LED indicates whether the measurement termination procedure has been initiated.

Important:

Do not undertake any more settings at present. Close the "*Set TR CE*" dialog box.

Reading in measurement data

- Start the trace data transfer using the "*MD_SCOPE/Read in meas. values*" menu command.
- The "*Trace data transfer*" window appears.
- The percentage indicator provides information about the read-in procedure. It takes about 40 seconds to transfer the entire trace buffer. The data then appear on the display section of the main program window, where they can be processed further. The "*MD_SCOPE/Document...*" menu command displays the recording criteria and MOVIDYN® parameters applicable when the data transfer took place.

For example, you can add your own comments and save the data using "*Environment/Save...*".

Setting the speed controller parameters

- In order to optimize the drive process, the speed controller parameters can be altered using the "*Parameters/Controller parameters*" menu command. After this, a new recording procedure can be started (using *Set Trace...*).

3 Installation

3.1 Hardware requirements

- PC/ T with 80386/80486 CPU (math. co-processor recommended).
- Ideal system configuration: 80486 DX33 or better, 256 KB cache memory.
- Minimum 640 KB main memory (min. 560 KB free user R M)
- 3.5" floppy disk drive (1.44 MB)
- approx. 2 MB free memory capacity on the hard disk
- VG compatible graphics card
- DOS version: ≥ 3.3, recommended: ≥ 5.0
- Minimum one RS-232 serial interface for connecting to MOVIDYN®
- Recommended: serial IBMcompatible mouse.

standard serial interface cable with a maximum length of 6 m (20 ft) is required to connect MOVIDYN® and the PC together (9-pin sub D plug to 9-pin sub D socket).

Pin assignment of the cable, PC side:

9-pin cable assignment Cable side:	RXD	TXD	DTR	Ground
9-pin plug (MOVIDYN® side)	PIN 2	PIN 3	PIN 4	PIN 5
9-pin socket (PC COMx side)	PIN 2	PIN 3	PIN 4	PIN 5

When using 9- to 25-pin adapters:

9/25-pin cable assignment Cable side:	RXD	TXD	DTR	Ground
9-pin plug (MOVIDYN® side)	PIN 2	PIN 3	PIN 4	PIN 5
25-pin socket (PC COMx side)	PIN 3	PIN 2	PIN 20	PIN 7

Important:

Make sure the units are switched off when you connect them together!

3.2 Installing the program

Insert the diskette and start the INST LL.EXE program by entering:

```
a:install
```

Now follow the on-screen instructions displayed by the installation program.

3.3 Starting the program

Change to the directory where the MD_SCOPE files are located. To start the MD_SCOPE program, type MD_SCOPE and confirm by pressing ENTER.

```
Enter: md_scope
```

You may encounter problems with memory-resident programs, because MD_SCOPE takes up a large amount of your main memory (min. 560 KB). To free up as much memory space as possible, avoid starting MD_SCOPE from other programs (i.e. PCSHELL, NC, DOSSHELL, Windows DOS box).

3.4 Communications requirements

All MD_SCOPE windows with a red title bar use the communications link to the MOVIDYN® servo controller. If your PC is not connected to MOVIDYN® or your communications link is faulty, the corresponding buttons in these windows are not activated, they are grayed out. If this is the case, the values displayed are not the actual ones. They are only substitute values which do not reflect the current status of the servo controller. If you have a faulty connection or no connection at all, please check that you have made the following settings and satisfied the following requirements:

PC interface

Make sure that the cable is connected to the correct COMport of your PC.

Interface selection

Check whether the values set for "PC interface" and "MOVIDYN interface" in the "Options/Select interface..." menu item correspond to the connected hardware configuration.

Communications address

If you are using the RS-232 or RS-485 interface of the power supply module (MPx), remember to set the axis module addresses. Make sure that the address set in the "Options/Select interface..." menu item corresponds to the axis module address. Briefly press the S1 pushbutton on the axis module to verify the axis module address. The 7-segment display shows a flashing "A" followed by digits for the tens and the units (e.g. "A" – "1" – "9" = axis module 19). Addresses must not be assigned more than once in a network setup, otherwise there would be a data collision on the transmission line, resulting in a faulty connection.

You will not need to set the axis module address if you use the RS-232 interface (PC connection) of the AIO11 option pcb. The unit can be accessed under any address.

However, you will have to set the communications address if you use any of the other RS-485 and RS-232 interfaces, i. e. those integrated into the basic unit or provided on the FIS31 option pcb.

RS-485 connection

Check whether the RS-485 lines are connected correctly when using the RS-485 interface of the power supply module (MP 50 ..., MPB 51 ..., MPR 51 ...) or of the compact servo controller (MKS 51 ...).

RS-232 connection

An on-board RS-232 port is standard on the MP 50 ... and MPB 51 ... power supply modules. The FIS31 option pcb must be used with the MPR 51 ... power supply module and the MKS 51 ... compact servo controller.

3.5 Setting up the printer and graphics card

The default settings for the printer (LPT1 / HP Deskjet / portrait) and for the graphics card (VGA 640 x 480 / 16 colors) can be altered with utility programs (→ Sec. 6).

4 The Main Program Window

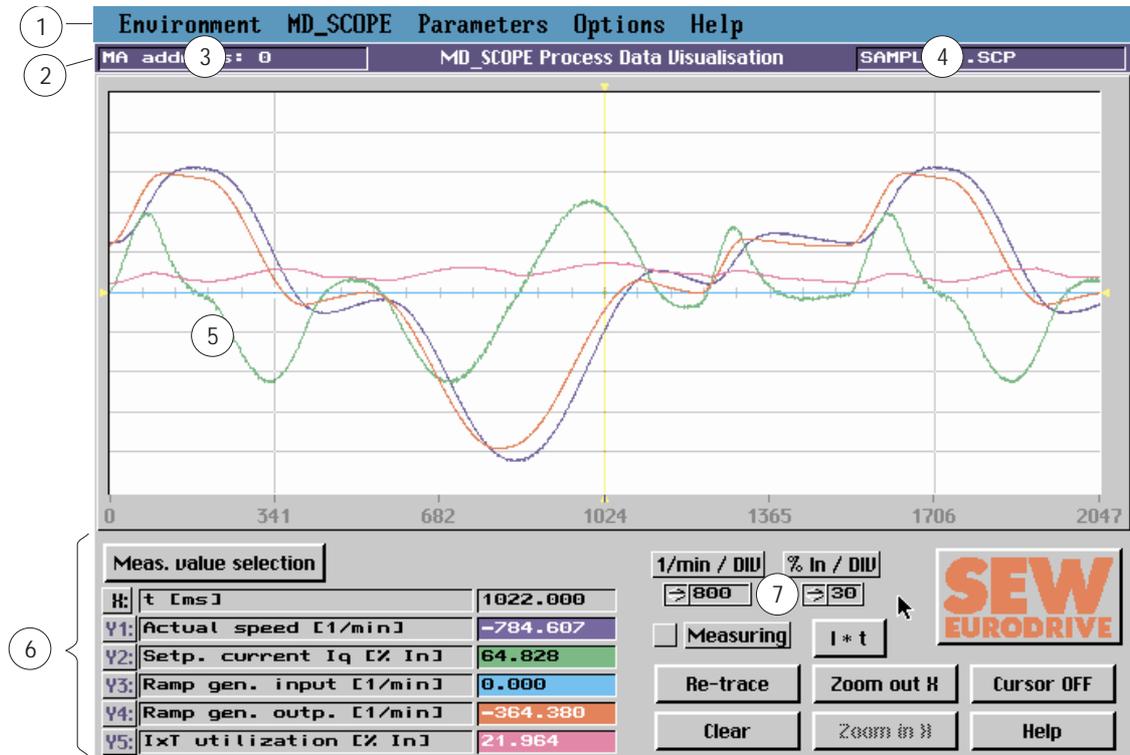


Fig. 1: Main program window

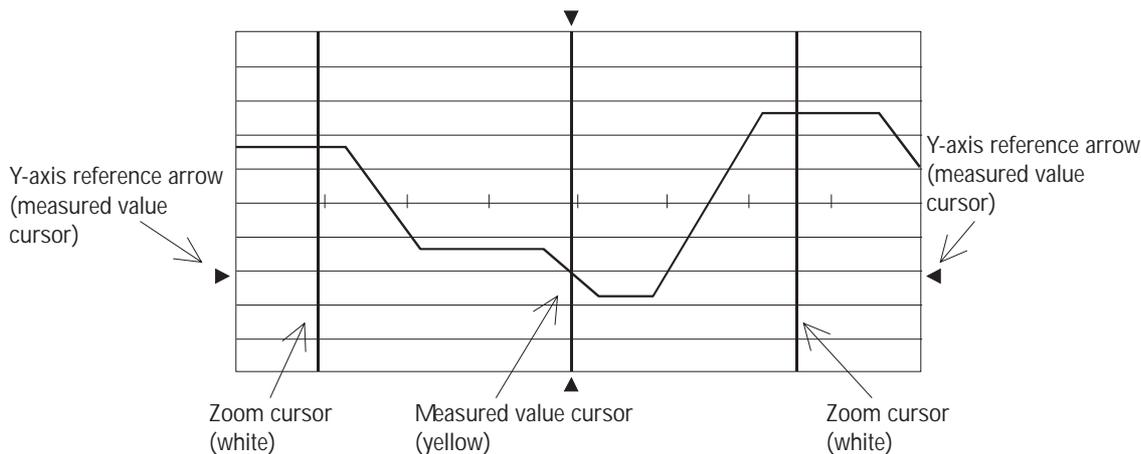
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- 1 Menu bar
- 2 Status bar with
 - 3 MA address: X / Local mode
 - 4 Version number / Current file name
- 5 Oscilloscope display area
- 6 Control and display elements
- 7 Zoom buttons

4.1 Display area

The display area of the main program window is where you can display the recorded measured values as traces for analysis. There are numerous oscilloscope-like functions at your disposal. The display area is divided into 10 horizontal bands. These bars form the basis for the zoom buttons in the main program window. Three cursors are available for the zoom function and for the analysis measurement data. Two white zoom cursors are used for delimiting the section of the display area which is to be enlarged by pressing the "Zoom out X" button. The third cursor is the measured value cursor. Its current x-axis position is displayed on the bottom part of the screen. This reflects the real sampling instant whereas the numbers on the x-axis in the display area only show the cumulative sampling number.

The zoom cursors can be moved anywhere in the entire display area, whereas the measured value cursor always snaps to the nearest sampling point. This means there is always a direct relationship between the measured value and the sampling instant. Each cursor can be selected directly by clicking it with the mouse. If you are using the keyboard, press the PAGE UP key to select the previous cursor and the PAGE DOWN key to select the next cursor.



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Fig. 2: MD_SCOPE display area

The 4 reference arrows at the edge of the display area tell you which cursor is active. The reference arrows of the measured value cursor, which move vertically, snap to the trace that is the reference point for the measured value cursor.

The display area is activated with the mouse by clicking the display area once. If you are using the keyboard, press the TAB or SHIFT + TAB keys.

4.1.1 The zoom cursors

The zoom cursors (white) enable you to delimit a section of the display area and increase it in horizontal direction using the "Zoom out X" button. You can move these cursors with the mouse by clicking one of them directly and dragging it whilst holding the mouse button pressed. If you are using the keyboard, you can move the cursors as follows:

- Arrow keys: Move by 10 pixels
- Shift + Arrow keys: Move by 1 pixel
- Ctrl + Arrow keys: Move to the edge
- Home/End: Move to the top left/bottom right corners

4.1.2 The measured value cursor

The measured value cursor (yellow) enables you to analyze the individual sampling operations. The area at the bottom left of the screen displays information about the current position of the measured value cursor. You can move this cursor with the mouse by directly clicking the cursor and dragging it whilst holding the mouse button pressed. If you are using the keyboard, you can move the cursor as follows:

- Arrow keys: Move by 1 sampling value
- Shift + Arrow keys: Move by 10 sampling values
- Home/End: Move to the first/last visible sampling value

Recommendation:

It is sometimes not possible to position the measured value cursor correctly, i.e. it does not stop on the required sampling value but jumps to a different one. You can prevent this by setting the Y-axis reference point of the measured value cursor on a visible recording channel (by moving the measured value cursor with the mouse and placing the mouse pointer directly onto the trace).

The reference arrows at the right and left-hand edges of the display area then snap to the selected recording channel. If you are using the keyboard, press the SHIFT + PAGE UP / SHIFT + PAGE DOWN keys to select the next/previous recording channel.

4.1.3 The differential measurement cursors

The differential measurement is activated by clicking the button next to "Measuring" in the main program window. The SEW logo is then replaced by a numerical display of the differential measured values and the white zoom cursors change into white reticules. This means the white cursors now serve as differential measurement cursors by means of which delta-x and delta-y differential measurements can be performed.

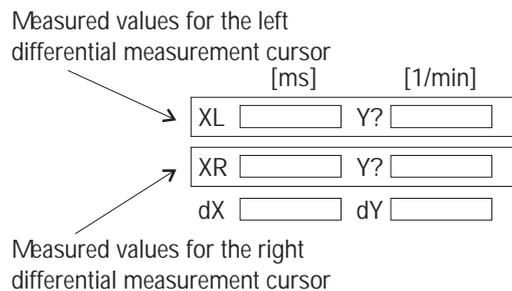


Fig. 3: Numerical display of the differential measured values

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Since the x-axis displays the sampling instants, it is always possible to determine the delta-x value, i.e. the time difference between the two differential measurement cursors. In contrast, a delta-y differential measurement can only be performed between measured quantities in the same measurement unit.

In the area where the y-axis measured values are displayed, the background color of measured values and the designation provide information about the measured parameter. See example below:

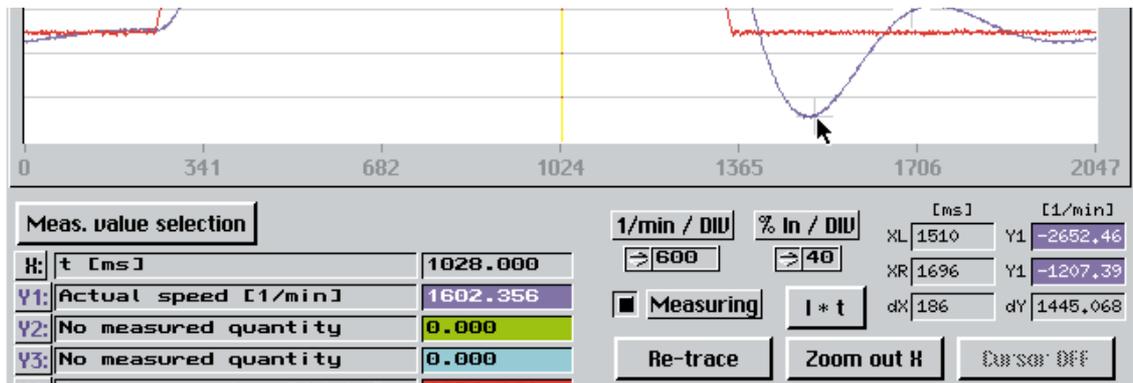


Fig. 4: Section of a window with an active differential measurement

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The left-hand differential measurement cursor is snapped onto the trace for the "Actual speed [1/min]" measured quantity. In the numerical display area, the box for the y-axis measured value of the left-hand cursor is entitled Y1. Its background color is blue. This means it is always possible to assign the measured value to a definite measured quantity.

The following display elements are available for differential measurements:

- XL / XR / dX: X-axis position of the left / right differential measurement cursor / difference between XL and XR
- Yx / Yy / dY Y-axis position of the left / right differential measurement cursor / difference between Yx and Yy

The differential measurement cursors are operated like the measured value cursors.

4.2 Control and display elements

There are various control and display elements at the bottom of the main window. These are required for analyzing the process data.

Element name	Function
1/min / DIV	Scaling factor for speed measured quantities with the unit [1/min]
% In / DIV	Scaling factor for current measured quantities with the unit [% In]

Table 1: Scaling factors

MD_SCOPE's control of these elements includes a plausibility check, i.e. the user can only operate elements of which the operation actually makes sense given the current program status. If no measurement data have been acquired, for example, the "Re-trace" function cannot be activated at all. Tables 1 and 2 give an explanation of the controls listed.

Element name	Function
Help (F1)	Activates the on-line help function
Re-trace (F2)	Trace output of the selected measured quantities (entire buffer)
Clear (F3)	Deletes the displayed traces
Zoom out X (F4)	Increases the size of the area between the white zoom cursors
Zoom in X (F5)	Reverts to the previous zoom area
Cursor OFF / ON (F6)	Switches the zoom cursors off and on
Meas. value selection (F7)	Assigns new measured quantities to measured value channels Y1 – Y5
I*t (F8)	Determines the effective capacity of the axis module
Measuring	Activates the differential measurement (delta-x, delta-y)

Table 2: Buttons in the main window

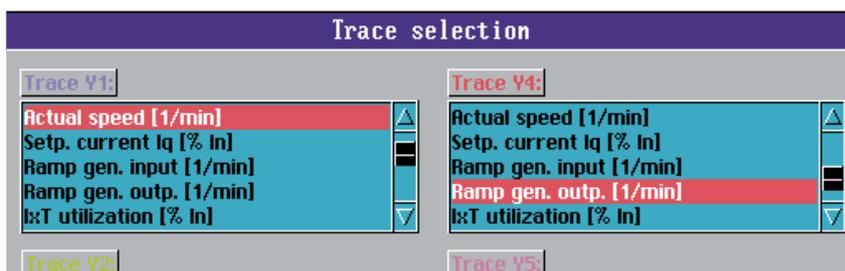
Six display elements provide information about the assignment of measured value channels X and Y1 to Y5. Sampling instants are plotted on the x-axis. While the x-axis legend in the oscilloscope display area indicates the number of data points sampled (i.e. not the actual sampling time!), the measured value display for the x-axis shows the real sampling time in the unit [ms] relative to the sampling instant furthest back.

4.3 Measured value selection

To select measured quantities for trace display, the "Meas. value selection" button. This calls up the "Trace selection" dialog box.

It contains five list boxes where all acquired measured quantities are displayed. You can now assign a different measured quantity to all five measured value channels or switch off the channels (*No measured quantity*).

When using the mouse, note that you need to double-click a particular measured quantity in order to select that measured quantity. The mouse pointer briefly changes into a tick to indicate that your selection has been accepted.



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Fig. 5: Section of the "Trace selection" window

4.4 Calculating the effective capacity

You can determine the effective capacity of the axis module using the "Ixt" button. To do this, use the two zoom cursors to select the segment of the current trace for which you wish to determine the effective axis module capacity. If you press the "Ixt" button a display box is called up showing the effective capacity as a percentage of the axis module rated current.

This function is useful for determining how much of the thermal capacity utilisation of the servo drive is being used. After first delimiting a travel cycle with the measurement cursors, you can use the "Ixt" function to calculate the effective capacity of the axis module, according to the following equation:

$$I_{\text{eff}} = \sqrt{\frac{\sum_i I_i^2 \cdot t_i}{\sum_i t_i}}$$

The resultant value is a percentage of the axis module rated current. You can now compare this directly with the rated current of the motor.

Example: DFY71LB motor; $M_0 = 7.5 \text{ Nm}$; $I_0 = 5.5 \text{ A}$; 3000 rpm, operated on MAS 51A-010-503-xx with $I_N = 10 \text{ A}$

The Ixt measurement of a travel cycle is $I_{\text{r.m.s.}} = 45 \% = 4.5 \text{ A}$

Capacity utilization of the motor = $I_{\text{r.m.s.}} = \frac{4.5 \text{ A}}{5.5 \text{ A}} \times 100 = 81.8 \%$

5 The Menu Bar

The menu bar contains five menu item, *“Environment”*, *“MD_SCOPE”*, *“Parameters”*, *“Options”* and *“Help”*. The menu items in the menu bar can be activated using the mouse or with key combinations [ALT + first letter].

5.1 “Environment” menu item

The *“Environment”* menu item provides an interface to the PC environment and includes the commands:

- Information...
- Load meas. value file...
- Save...
- Copy Parameters...
- Print...
- Start MD_SHELL
- Exit

“Information...” menu command

Selecting this menu command displays information about the program (version number, license number) and the service telephone number where you can get further information about the program and MOVIDYN® if required.

“Load meas. value file...” menu command

This menu command allows you to read in measured values from a file, so you can document and edit system data without having a direct connection to a MOVIDYN® servo controller.

When loading the MD_SCOPE measured value file (*.SCP) loading, the program also checks whether a parameter file (*.PAR) of the same name exists which is directly related to the measured value file. If it is, the file will be used for documentation of the parameters at the time the measured values were traced.

This combination of measured value file and parameter file is only supported by MD_SCOPE version 2.0 onwards. Files from an older version can of course still be read in.

“Save...” menu command

This function allows you to save acquired measured values to a file. In addition, the parameter file valid at the time of recording is automatically saved as well.

After you have entered the name of the measured value file you wish to save, MD_SCOPE checks whether a measured value file or parameter file of that name already exists. If it does not, MD_SCOPE will prompt you to enter a system-specific comment in the documentation window.

“Copy Parameters...” menu command

This menu command can only be activated if a communications link with a MOVIDYN® servo controller has been established, i.e. MD_SCOPE is not operating in local mode.

This function allows you to read (upload) parameters from the servo controller and save them in a file, or to copy (download) a parameter file to the controller.

“Print...” menu command

Activating the “Print” menu command opens a new window where you can specify the data to be printed. You can choose between the following aspects:

- Current trace (1 page)
- MD_SCOPE system information
- Calculation parameters for startup (1 page)
- MOVIDYN® parameter set (3 pages)
- MOVIDYN® fault memory (max. 3 pages)

Recommendation:

For better distinction between the measured value traces on the printout, we recommend that you activate the trace attribute function (menu command “Options/Trace attributes...”). This function assigns certain markings to a trace, enabling better distinction.

Printer driver:

Use the HCSELECT.EXE utility to adapt MD_SCOPE to your printer, in particular for trace printouts. It is not possible to adapt the printer from within MD_SCOPE. Please refer to the “Additional utilities” section for more information.

“Start MD_SHELL” menu command

This menu item directly calls up the MD_SHELL user interface. MD_SCOPE is completely exited in order to free sufficient memory capacity. The default setting assumes that the MD_SHELL user interface is located in path “MD_SCOPE disk drive:\MD_SHELL”. You may change this path using the “Options/MD_SHELL-Path...” menu command.

“Exit” menu command

The “Exit” command closes the program.

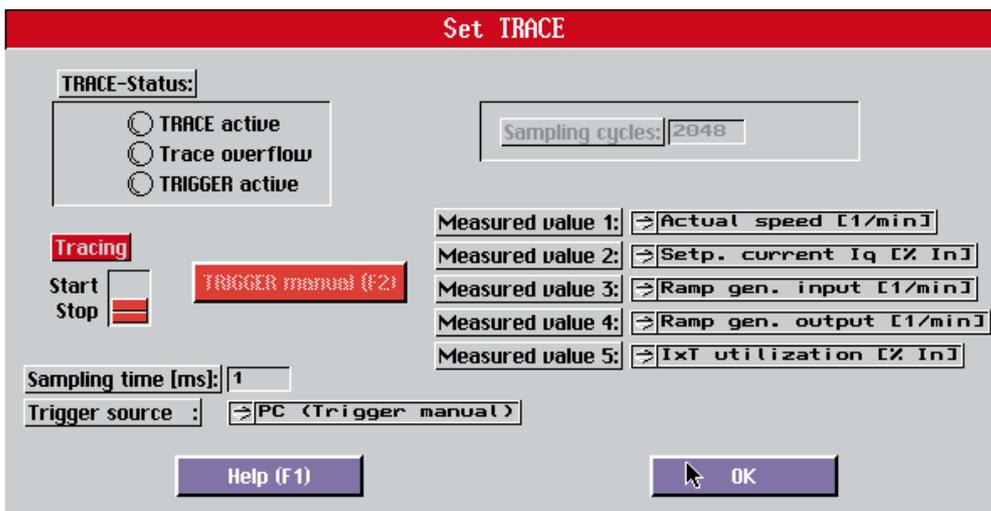
5.2 “MD_SCOPE” menu item

The “MD_SCOPE” menu item contains all the functions required to set and analyze the measured data recording (tracing). It includes the commands:

- Set Trace...
- Read in meas. values
- Document...

5.2.1 “Set Trace...” menu command

There is no reason to activate “Set Trace...” unless a communications link has been established with a MOVIDYN® servo controller, i.e. MD_SCOPE is not operating in local mode.



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Fig. 6: The “Set TRACE” dialog box

The red title bar of the “Set TRACE” dialog box signals that direct communication with the servo controller takes place in this part of the program. The buttons are inoperable in the absence of such a connection, as indicated by their grayed-out status. In this condition, default values are displayed which do not reflect the status of the servo controller.

This window is used for setting all recording criteria. At the same time, status LEDs indicate the current trace status of the MOVIDYN® servo controller. In addition, you can set the values for the sampling time and the trigger source and start or cancel measured data acquisition or stop it by a trigger event.

Measured values 1–5 have fixed assignments.

5.2.2 “Read in meas. values” menu command

This menu command can only be activated if there is a communications link established with a MOVIDYN® servo controller, i.e. MD_SCOPE is not operating in local mode.

Activating this menu item starts the process of reading the measurement and parameter data into the PC from the MOVIDYN® servo controller.

Important:

All system and parameter values are acquired when the trace buffer is read in. Therefore, the acquired data are only valid if neither the MD_SCOPE system values nor any other parameters were changed between the time when the recording was triggered and the time the trace buffer was read in.

5.2.3 “Document...” menu command

The “*Documentation for current recording*” dialog box allows you to enter your own comments to describe the measured values recorded. The text boxes must contain an entry (e.g.*), otherwise MD_SCOPE displays a corresponding message. Activating the “*Settings*” button opens a new window in which all the system and parameter data valid at the time of the data transfer are automatically documented (only from version 2.0 onwards).

This window is displayed automatically just before each save process, prompting you to document the recorded measured values.

5.3 “Parameters” menu item

The “*Parameters*” menu item serves as a direct interface to the MOVIDYN® servo controller. It includes the following menu commands:

- Controller parameters...
- Test function...
- Commissioning...

The “*Controller parameters...*” and “*Test function...*” menu commands require direct communication with the MOVIDYN® servo controller. Consequently, they can only be activated if a serial communications link has been established, i.e. MD_SCOPE is not operating in local mode.

5.3.1 “Controller parameters...” menu command

When you activate this menu command the “*Controller parameters*” window opens. You can now set the most important controller parameters directly from MD_SCOPE. If you wish to change any other parameters, you will have to start the MD_SHELL user interface with the “*Environment/Start MD_SHELL*” menu command.

200 Gain n-controller:	The speed controller gain increases the P component.
201 Time constant n-controller:	The speed controller time constant is used for setting the I-portion. The I component is inversely proportional to the time constant. Special case: If the time constant = 0, the I component is deactivated.
202 D portion n-controller:	The D component sets the differential component of the speed controller.
203 Threshold feedforward [1/min/ms]:	Acceleration feedforward is active if the filtered setpoint increase is greater than this parameter setting.
204 Gain feedforward:	Sets the acceleration feedforward gain factor.
205 Filter feedforward:	Filter time constant for the digital filter that filters the ramp generator output before it is used by the acceleration feedforward.
206 Filter speed setpoint:	Filter time constant for the digital filter that filters the ramp generator output before it is used as speed setpoint.
207 Filter speed actual value:	Filter time constant for the digital filter that filters the actual speed value before it is used as the actual speed value.
210 Max. speed CW [1/min]:	Limit value for CW direction of rotation.
211 Max. speed CCW [1/min]:	Limit value for CCW direction of rotation.
212 Maximum current [% In]:	Setting the internal current limit as a percentage of the axis module rated current.
220 Gain hold controller:	The hold controller gain increases the P component.
120-123, 130-133 Ramp generators:	The ramp generators are used for setting the ramp values. Acceleration and deceleration ramps are available for both directions of rotation. The ramp times relate to a speed change of 0 – 3000 1/min.

Table 3: MOVIDYN® controller parameters adjustable with MD_SCOPE

MD_SCOPE performs a value range check, i.e. if you enter values outside the valid range, MD_SCOPE changes them to the next higher increment or the minimum/ maximum and transfers them to MOVIDYN®. At the same time, the value read from MOVIDYN® is displayed.

The help function provides further information and descriptions of the speed control parameters. The elements of this window are grayed out if the serial communications link is interrupted. Substitute values are displayed (0.00) which do not reflect the status of the servo controller!

5.3.2 “Test function...” menu command

Selecting the “Test function...” menu command opens a dialog box of the same name where you can set the following parameters:

- 208 7-segmental test indicator
- 209 Controller test function

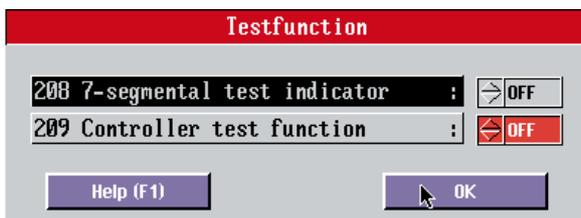


Fig. 7: Parameters of the “Test function...” menu command

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208 7-segmental test indicator:

This parameter switches the 7-segment display of the MOVIDYN® axis module to the acceleration feedforward test display. In this way, the 7-segment display indicates in real time whether the acceleration feedforward is active or not (all segments light up if it is active). This parameter is not saved permanently to the EEPROM. Any of the following actions deactivates the display:

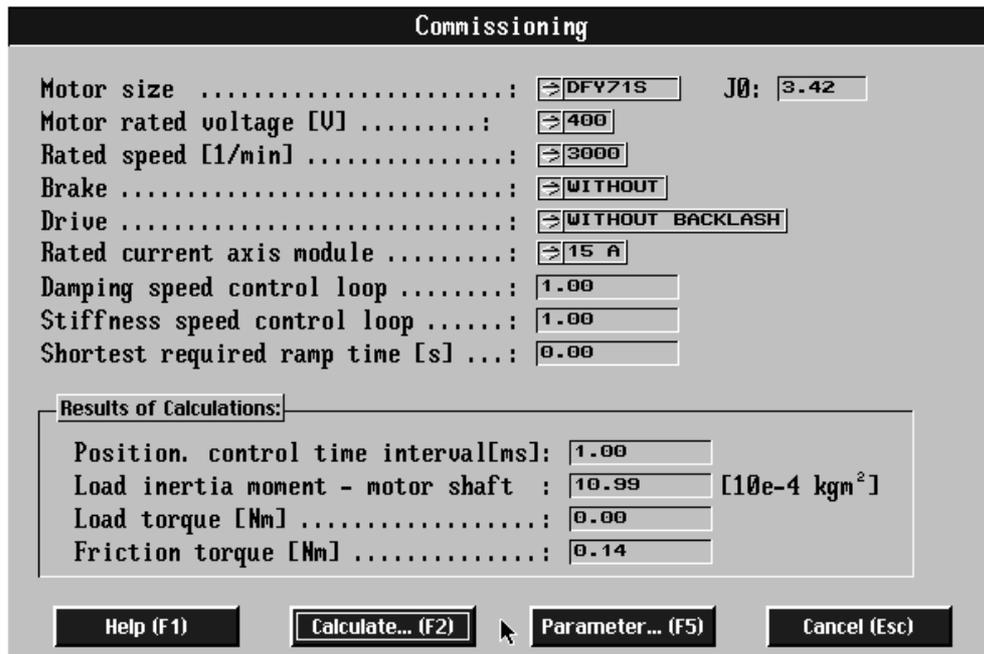
- Resetting the axis module
- Switching off the mains supply
- Parameter setting “NO”
- Pressing the pushbutton on the axis module

209 Controller test function:

The controller test function makes it easy for you to perform a measured value recording by means of which you can automatically calculate system-specific parameters such as load moment of inertia, load and friction torques in the commissioning window. The controller test function negates the setpoint at the ramp generator input in cycles of one second. This function can only be activated when the controller is in the “normal operation” operating mode. The system always uses the setpoint valid at the time the test is carried out.

5.3.3 “Commissioning...” menu command

The “Commissioning...” menu command opens a window (Fig. 8) of the same name where you can perform a simplified commissioning and a controller optimization of the MOVIDYN® servo controller. This MD_SCOPE function provides you with a tool which allows you to display and set the drive parameters that are most important for commissioning.



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Fig. 8: MD_SCOPE commissioning window

The window is divided into two sections. The calculation parameters are listed in the upper section of the window, whilst the lower section contains the calculated system-specific values, e.g. the positioning control time interval, the load mass moment of inertia at the motor shaft, the friction torque and the load torque. These results can be used as the basis for calculating a controller setting proposal.

Calculation parameters

The upper section of the commissioning window lists the calculation parameters you need to set in order to calculate the system-specific values and generate a proposal for controller parameterization.

Motor size:	MD_SCOPE provides a list of all SEW servo motors from which you can select the motor used in your system. This list includes a large amount of motor-specific data which are automatically used for calculation when the motor is selected (see rating plate).
Motor rated voltage [V]:	Enter the rated voltage of the motor used (see rating plate).
Rated speed [1/min]:	Enter the rated speed of the motor used (see rating plate).
Brake:	This calculation parameter indicates whether the motor is operated with or without a brake.
Drive:	Enter the type of application (with backlash/without backlash).
Rated current axis module [A]:	The rated current of the MOVIDYN [®] axis module is automatically read in from the unit if a communications link is established. You have to enter the rated current yourself if MD_SCOPE is operating in local mode.
Damping speed control loop:	Damping affects the amount of overshoot and the dying out of the oscillation. The default setting is 1.0. Values less than 1.0 increase the oscillation, values greater than 1.0 reduce the oscillation.
Stiffness speed control loop:	Stiffness is a measure for the speed of response of the speed control loop. The default setting is 1.0. Increasing the stiffness increases the speed of response. The control loop will start oscillating from a critical value on. Decreasing the stiffness slows down the control loop and increases the lag error.
Shortest required ramp time [s]:	The shortest ramp time is required for optimum setting of the ramp generators.

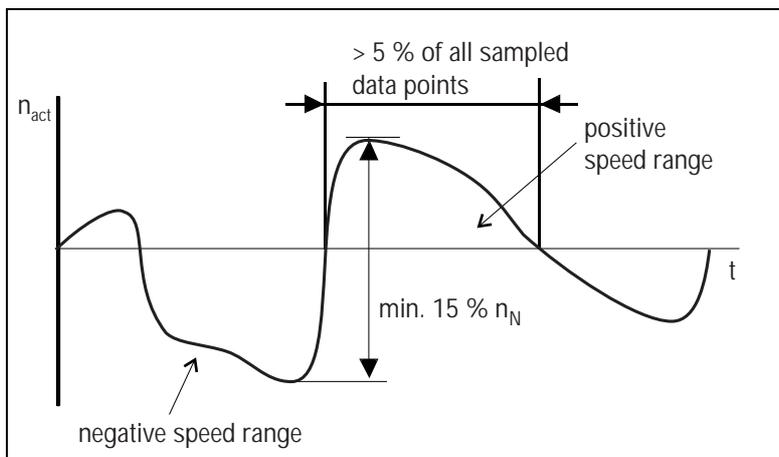
Table 4: Commissioning parameters for calculating the system-specific values

The results of the calculation in the lower section of the commissioning window become invalid when a calculation parameter is changed. Each time you change a parameter, you must perform a new calculation using the "Calculate..." button.

Calculating the load moment of inertia at the motor shaft

Several requirements must be fulfilled to calculate the load moment of inertia at the motor shaft. An easy way of calculation is described below:

- 1) Startup the drive in accordance with the MVIDYN® Installation and Operating Instructions. Use the estimated J_{ext} (design data) as the basis for commissioning.
- 2) Record a trace with the test function ("Parameters/Test function..." menu command, P209 Controller test function = ON). The setpoint entry requires an absolute change of at least 15 % of the rated speed. If the servo controller test function cannot be used for reasons inherent in the system, you can enter a speed setpoint profile that is tailored to your system. However, it is important that you enter an absolute setpoint change of at least 15 % of the motor rated speed. As a rule the calculation algorithm also works with measured values for one direction of rotation, we recommend, however, to use both the positive and the negative speed ranges so as to optimize the calculation result. The load and friction torque can only be determined on the basis of both ranges.
- 3) Check whether at least 5 % of all sampling operations are within one speed range. For example, a minimum of 308 sampling operations must be within one speed range if there are 2048 sampling operations (see also Fig. 9).
- 4) Enter the calculation parameters for your system in the upper section of the commissioning window.



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Fig. 9: Calculating the load moment of inertia

- 5) Press the "Calculate..." button. The "Calculation selection" dialog box appears. Select the load moment of inertia calculation by clicking on the corresponding button with the mouse and then press the "Calculate" button to exit the window. The program now calculates the load moment of inertia at the motor shaft and enters the result in the "Results of Calculations" box in the bottom section of the commissioning window. At the same time, the grayed-out "Parameter..." button becomes active.

An error message is displayed if MD_SCOPE is unable to determine a load moment of inertia from the data specified.

- 6) Pressing the "Parameter..." button automatically activates the calculation of a suggestion of controller parameter settings. A new window entitled "Commissioning/Controller parameters" then appears; it can be identified by the "?" in the top bar. It is the same window that can be activated using the "Controller parameters..." menu command; now, however, a controller parameter suggestion is made (see also the "The Commissioning/Controller parameters window" section).

7) Now repeat the MD_SCOPE recording with the new modified controller parameters. You can influence the calculation of a new parameter suggestion according to your own evaluation by varying the "Stiffness speed control loop" or "Damping speed control loop" calculation parameters.

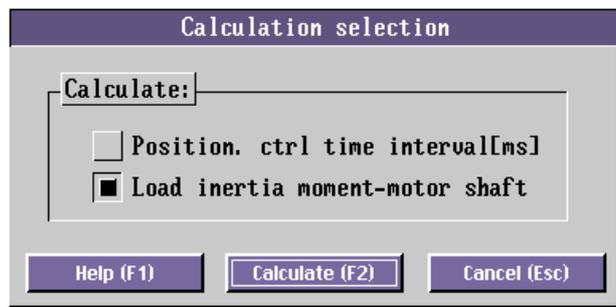


Fig. 10: Dialog box for calculation selection

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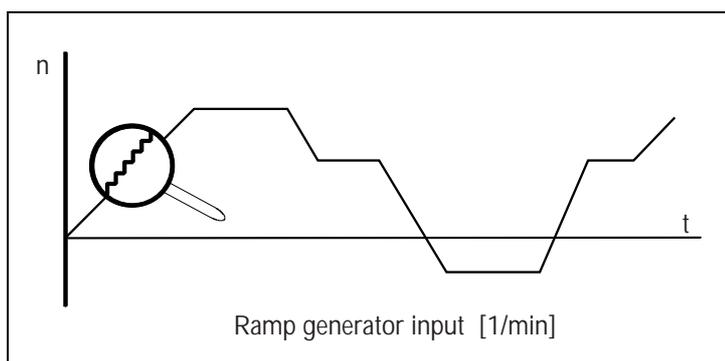
If, after several attempts and using different traces, it is still not possible to determine the load moment of inertia, you can enter an estimated value in the "Results of Calculations" box. The "Parameter..." button will then also become active. If you activate this button, the program makes a controller parameter suggestion based on the load moment of inertia you have entered.

Determining the load and friction torques

The load and friction torques are automatically determined when the load moment of inertia at the motor shaft is calculated. The measured values used for calculating these torques must represent both the positive and the negative speed ranges. Load and friction torques are only of informative nature. They do not affect the calculation of the controller parameters.

Determining the positioning control time interval

The time interval of an external positioning control is only to be taken into account in connection with an external positioning control. A default value of 1.0 ms should be entered if an internal API/ APA positioning pcb is fitted or if no position control is provided. The value specifies the time interval with which the higher-level positioning control enters the analog speed setpoints.



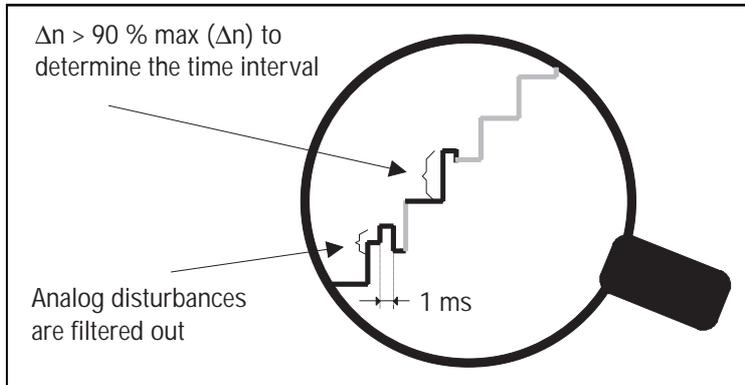
MD0132AE

Fig. 11: "Step function" of the external setpoint entry

You can enter the time interval manually if you know the value. Otherwise, you can have the program calculate the time interval automatically. Proceed as follows:

1. Record a trace (MD_SCOPE sampling time 1 ms) using the analog setpoint entered by the higher-level positioning control. The given setpoint change must be big enough to obtain a clear step function (Fig. 11) for the "Ramp generator input [1/min]" measured quantity. Setpoint ramps steeper than 1 s are required for the calculation!

2. Enter the calculation parameters for your system in the top section of the commissioning window.



MD0133AD

Fig. 12: Peripheral conditions for determining the time interval

3) Press the "Calculate..." button. The "Calculation selection" dialog box opens. With the mouse, click on the button to select the "Position. ctrl time interval [ms]" option. Then close the dialog box by clicking on the "Calculate" button. The calculation is now being performed and the result is entered in the "Results of Calculations" box in the bottom section of the commissioning window. At the same time, the previously grayed-out "Parameter..." button becomes active.

The time interval has no effect on the speed control loop if the sampling time for the external positioning control is shorter than or the same as the MD_SCOPE sampling time. The value only affects the filter time constants if the sampling times are longer.

Error messages

MD_SCOPE stops calculating the load moment of inertia or the time interval and displays an error message if the calculation requirements are not met.

Message	Problem	Remedy
Calculation of the moment of inertia not possible!	<ul style="list-style-type: none"> – Speed change 15 % of the motor rated speed. – No speed range with more than 5 % of all sampling operations available. 	Increase the setpoint input and re-record the measured value.
Not enough user memory! Calculation not possible!	<ul style="list-style-type: none"> – Your PC does not have enough free user memory to perform a calculation. IMPORTANT: MD_SCOPE will become unstable. 	Exit the program and make at least 560 KB of free user memory available.
Time interval of the positioning control cannot be calculated!	<ul style="list-style-type: none"> – Current recording was made with an MD_SCOPE sampling time of more than 1 ms. – The greatest speed difference between two sampling operations is greater than the rated motor speed. 	Set the MD_SCOPE sampling time to 1 ms and re-record the measured value.
Speed changes too small for time interval calculation!	<ul style="list-style-type: none"> – The speed change of the analog setpoint is greater than 1 s. 	Enter a "steeper" setpoint and re-record the measured value.
Not enough differential values to calculate the time interval!	<ul style="list-style-type: none"> – The time interval determined is not representative of the system, as less than 1.5 % of all sampled values are within this time interval! 	Change the setpoint profile and re-record the measured value.

Table 5: Error messages during calculation

The Commissioning/Controller parameters window

You can also activate this window directly via the menu bar using the *"Parameters/Controller parameters..."* menu command. However, the elements for the controller parameter proposal are inactive if you call up the window in this way.

When you call up this window from the commissioning function, the program will automatically present you with a calculated proposal for controller parameter settings. The calculated controller parameters are listed next to the current controller parameters. You can now transfer the proposed controller parameters to the servo controller by clicking the *"Copy"* button.

The program performs a value range check on the individual values when the proposed parameters are being transferred to the servo controller. This may result in minor differences between the parameter value proposed and the one transferred. You can correct the parameters manually if you wish. Refer to the *"Controller parameters... menu command"* section for a more detailed description of the adjustable parameters.

Commissioning/Controller parameters		
	Act. values	Proposal
200 Gain n-controller	0.15	0.15
201 Time constant n-controller [ms]:	300.00	1420.63
202 D-portion n-controller	0.00	0.00
203 Thresholdprecontrol [1/min/ms] :	0.60	0.73
204 Acceleration gain precontrol :	1.68	1.68
205 Filter accel. gain precontrol ..	56.40	56.44
206 Filter speed setpoint	28.20	28.22
207 Filter speed actual value	1.20	1.20
210 Max. speed CW [1/min]	1200.00	1200.00
211 Max. speed CCW [1/min]	1200.00	1200.00
212 Maximum current [% In]	45.00	15.00
220 Gain hold controller	0.10	0.18

Fig. 13: Section of the controller parameters window

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5.4 "Options" menu item

The *"Options"* menu item comprises commands which are required for setting MD_SCOPE program parameters or selecting the type of communications link. Most of the commands are rarely used. The menu includes the following commands:

- Select interface...
- Trace attributes...
- Language...
- MD_SHELL path...

5.4.1 "Select interface..." menu command

This menu command calls up the *"Interface selection"* dialog box. This dialog box contains three buttons for setting up the communications link:

- PC interface
- MOVIDYN® interface
- Communication with MA address X

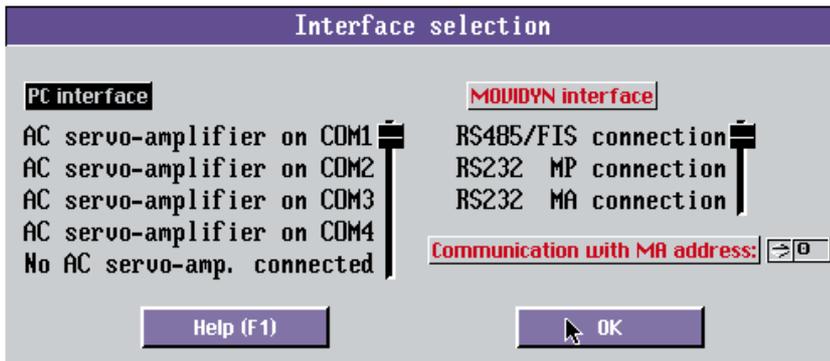


Fig. 14: "Interface selection" dialog box

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5.4.2 "Trace attributes..." menu command

This command calls up the "Trace attributes" dialog box. Since you may not always have a color monitor available when you commission a system, it may often prove difficult or even impossible to discriminate between the different traces. The "Trace attributes" dialog box allows you alter the appearance of each trace by assigning attributes to it. For example, you can mark the traces with different symbols, etc. in order to differentiate between them.

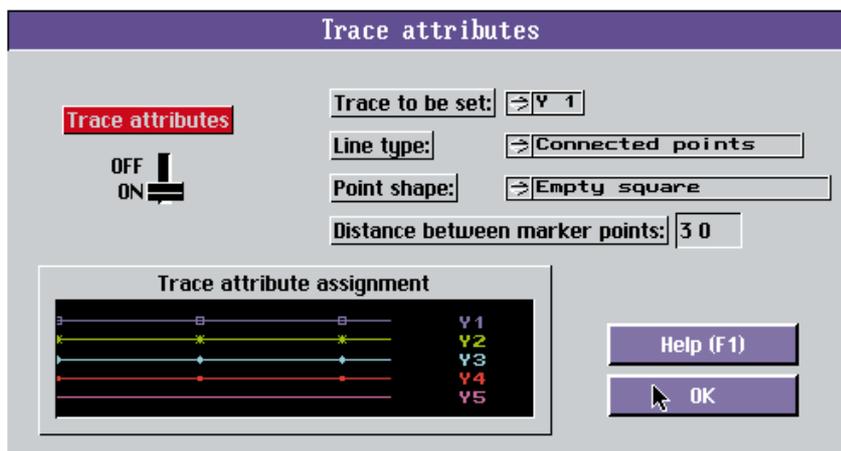


Fig. 15: The "Trace attributes" dialog box

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The trace attribute feature is also of interest for black and white printouts.

Important:

The amount of user memory needed to display the marked traces increases in proportion to the density of the marker points, i.e. if you see the warning "Not enough memory..." after setting the trace attributes, you should increase the distance between marker points.

5.4.3 "Language" menu command

This command calls up the "Language" dialog box where you can select the language you require.

5.4.4 "MD_SHELL-Path" menu command

As not all MOVIDYN® parameters can be set using MD_SCOPE, the "Environment/Start MD_SHELL" menu command enables you to call up the MD_SHELL user interface directly. MD_SCOPE is completely exited and MD_SHELL started.

In the "MD_SHELL path" menu item, you can specify the call path in which the MD_SHELL.EXE file is located.

5.5 "Help" menu item

The "Help" menu provides you with general information about the "Menu structure" and the "Key assignment".

"Menu structure" menu command

This help function provides you with a brief overview of the various features in the individual menus.

"Key assignment" menu command

This help function tells you how to operate MD_SCOPE using the keyboard.

6 Additional Utilities

MD_SCOPE works in graphic mode with a resolution of 640 x 480 pixels and 16 colors. This standard IBMVGA setting is supported by all common VGA-compatible graphics cards, so MD_SCOPE can be started with this default setting. The default printer driver setting is HP DESKJET.

If your PC configuration is different from the above, use the ADAPTER.EXE (to adapt the graphics card settings) and the HCSELECT.EXE utilities (to select/configure the printer driver) in order to modify the settings according to your system. These utility programs (with dialogs in English) are part of the LabWindows® software package of the National Instruments Corporation.

6.1 ADAPTER.EXE

The ADAPTER.EXE utility allows you to adapt MD_SCOPE to the graphics card installed in your PC. When selecting a different graphics card, please keep the resolution at 640 x 480 pixels. A different resolution may result in fault messages and prevent MD_SCOPE from starting.

Start the ADAPTER.EXE utility. The default configuration appears on the screen:

Make:	IBM
Type:	VGA
Resolution:	640x480
Colors:	16
Monitor Type:	color

This standard VGA mode is supported by almost every VGA compatible graphics card. You can now select one of three program functions using the 'y', 'n' or 'q' keys.

Key: Function:

'y' YES: Accepts the selected configuration and exits the program.

'n' NEW: Selects a different configuration.

'q' QUIT: Exits the program without accepting the new configuration.

Graphics drivers marked with an asterisk do not work with MD_SCOPE! The configuration selected with the ADAPTER.EXE utility is saved to the ADAPTER.PRO file. This file is needed to operate MD_SCOPE.

Recommendation:

The 16-color display may cause flickering, in particular on LCD screens (e.g. notebook computers). A 2-color display is often preferred for these applications. To adapt the display select the following configuration:

Make:	IBM
Type:	MCGA
Resolution:	640x480
Colors:	2
Monitor Type:	monochrome

6.2 HCSELECT.EXE

The HCSELECT.EXE utility lets you select a printer driver for use with the *"Print"* menu command and set a scaling. The settings are stored in the corresponding HARDCOPY.PRO file. It is not possible to set these variables from within MD_SCOPE! You need to call up the HCSELECT.EXE to select a printer driver. Start HCSELECT.EXE and select the *"Graphics Printer"* function. The *"Graphics Printer Configuration"* dialog box appears where you can enter your settings. All printer driver settings made with this utility only affect the graphics printout (hardcopy) of the MD_SCOPE screen. The following configuration is preselected:

Destination:	LPT1
Current Graphics Printer:	HP Deskjet 500
Orientation:	Portrait
Image Width:	0.00
Image Length:	0.00
Eject Page:	yes

The printer port should remain LPT1 as all text information is output via LPT1 as a rule. The printer type can be selected from a list of about 170 printer drivers. Printed page orientations are portrait and landscape. Image width and length are specified in inches. The entry 0.00 has a special function; it activates the 1:1 mode, i.e. the best possible print image of the selected printer. As all printouts are screen hardcopies, the 0.00 setting will provide the best possible print quality. The printout, however, will only be in A5 format. A sample printer parameter setting for a hardcopy printout in A4 format is offered below:

Orientation:	Landscape
Image Width:	8.00
Image Length:	10.00

Important:

Graphics printout with a GPIB or RS-232 plotter and output to an HPGL plot file are not supported by MD_SCOPE and may cause the program to crash!

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