OPERATING MANUAL
PC Program
VALUEMASTER
Version 2.81 Rev1

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1 ValueMaster $_{base}$ Measurement Module

1.1 Application

1.1.1 What can the VALUEMASTER module do?

The VALUEMASTER module, together with a PC as user interface, is used to measure torque, force, travel and angle of rotation for screwing and measuring, pressing and frictional torque. A variety of ETH sensors can be connected to the VALUEMASTER module.
The VALUEMASTER module is connected to a PC via the LAN interface.
The system is operated from a PC with the VALUEMASTER PC software.

The VALUEMASTER module provides the following functions on the PC:
- Analysis (measuring torque, force, travel, rotational speed and angle of rotation)
- Screwing using various methods
- Measuring frictional torque
- Measuring power

The device output can be +-5V or +-10V.

The VALUEMASTER module is a robust device in an aluminum enclosure with dimensions (LxWxH) 190 x 112 x 51 mm

1.1.2 Connections

The following connections are available on the VALUEMASTER module:

Front panel:

Control I/O	9-pin Dsub socket for digital and analog I/O.
Sensor 1	Socket for active single and double sensors with and without angle of rotation sensor
Sensor 2	Socket for active single sensors without angle of rotation sensor

Rear:

LAN	RJ45 socket for Ethernet connection
12VDC	Voltage supply 12VDC with switch and LED
ON	ON-OFF switch and LED

1.1.3 Initial start-up

1.1.3.1 Switching on

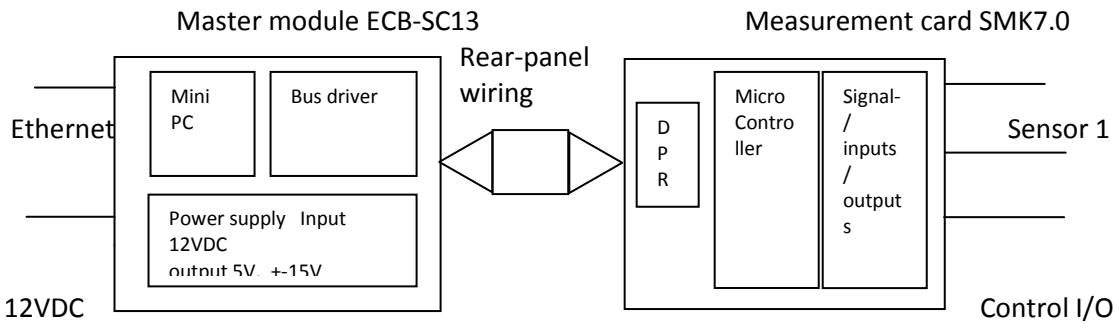
After all sensors have been connected and the VALUEMASTER module is connected with the PC via the network, the VALUEMASTER module can be turned on.

Immediately after turning on, a self-test is performed in the VALUEMASTER module, during which the NOK LED briefly flashes red. If the internal operating voltages (5V +-15V and 12V) are not correct, the NOK LED is permanently red.

In the case of an NOK, the causes can be determined with the test functions in the VALUEMASTER PC program.

1.2 Circuit description

The module consists internally of a pluggable control card **SMK7.0** and a pluggable master module with power supply **ECB-SC123**, which are wired together on the rear panel (also called backplane or bus).



1.2.1 Master module ECB-SC123

The master module consists of a power supply and a mini PC.
The power supply generates +-15V and 5V from the 12VDC, which is supplied via the jack plug.
The mini PC transfers the data between the VALUEMASTER module and a PC, which acts as a user interface. The data exchange is done via a DUAL-PORT-RAM (DPR) with the SMK7.0 measurement card.

1.2.2 Measurement card SMK7.0

The SMK7.0 measurement card (**S**crewing **M**easurement **C**ard) consists of:
- Microcontroller
- High-precision reference: 2.5000 V
- Power supply for the sensors: +12VDC
- Voltage measurement 8 channels 11 bit resolution + sign
- Digital I/O
- Low pass filter
- Angle pulse counter up to 65535 pulses

1.3 Technical data for VALUEMASTER module

1.3.1 Environment

Protection class: IP 52
Storage temperature: -20°C to +70°C
Operating temperature: 0°C to +40°C

1.3.2 Power supply 12V DC

Input voltage tolerance:	10-14VDC
Power consumption at 12V, if all sensors are connected:	700 mA

The power supply input is protected against polarity reversal with a diode in series with the +12V input; it is also secured with a 1.6 A self-resetting fuse (polyswitch).

1.3.3 Interface

1.3.3.1 Control I/O

The control I/O port consists of digital and analog inputs/outputs for a range of control functions.

1.3.3.1.1 Digital input (START)

The digital input is optically isolated and protected against polarity reversal with an anti-parallel diode.

Voltage assignment: 1 = 12V to + 30V
0 = -10V to + 10V

Input current for 24V signal: 10mA

1.3.3.1.2 Digital outputs (OK, NOK, ON)

The digital outputs are optically isolated, short-circuit proof active HIGH outputs.

Max. switching current per output:	500mA
Max. current for all outputs:	1A
Switching voltage:	8 to 30VDC

The power supply for the outputs must come from a 6-to-30VDC external power supply.

1.3.3.1.3 Analog output (speed)

The analog output is used, for example, as speed target voltage
Value range: -10V to +10V

Resolution:	11bit plus sign
Output current:	1 mA
Internal resistance Ri =	100 Ohm

1.3.3.2 Sensor 1

Single sensors and double sensors can be connected at this connection with and without a pulse generator. A 4th order low-pass filter with Butterworth characteristics and 1kHz limit frequency can be connected internally.

CAUTION
The input at sensor 1 pin L is the same as the input at sensor 2 pin C.
This means that if you connect a double sensor to the sensor 1 socket, in order to avoid errors, you should not connect a sensor to the sensor 2 socket.

1.3.3.2.1 Supplying power to the sensors

The power supply is 12VDC and is secured via a self-resetting 200mA fuse (polyswitch).

Input resistance:	Ri = 1 MOhm
Resolution A/D converter:	11 bits and 1 sign bit
Nominal signal:	0 to +-5V (+-10V)*
Range:	0 to +- 6.25V (+-12.5V)*
Accuracy:	0.2% +- 12mV (+-24mV)*
Linearity deviation:	0.1%
Limit frequency (3dB) without filter:	35 kHz
Limit frequency (3dB) with filter:	1 kHz

**The values in parentheses apply to the range +-10V*

1.3.3.2.2 Testing/Calibrating the sensors

By detuning the full bridge strain gauge in the sensor, a 5V (10V) signal is generated that corresponds to the signal for nominal loading.
Calibration signal: Active voltage 12V, Ri 100 Ohm

1.3.3.2.3 Measuring the angle signal

A specific number, e.g., 60 or 360, pulses are generated by the sensor per revolution of the sensor shaft. These pulses can be multiplied by a factor of 4 selectively in the measurement module. For angle measurement, an angle signal A and an angle signal B are generated by the sensor. These angle signals are phase shifted by 90 degrees, based on one period. It is thus possible to detect the direction of rotation of the sensor shaft.

Signal input	Pull up 1.5 k Ohm to + 12V
Frequency range:	0-25kHz for the speed and angle measurement functions.
Signal level assignment:	0 = -0.7V to 2V
	1 = 3 to 12V

For the analyzer, screwing and frictional torque functions, the measurement rate depends on the sampling rate with which the sensor input is recorded in the VALUEMASTER module.

1.3.3.2.4 Sensor chip

A sensor chip is integrated in the new ETH sensors. Calibration and angle sensor data are stored in this chip. The voltage range is 0 – 5V.
The serial data stream is encoded according to the guidelines for the DALLAS OneWire components.

1.3.3.3 Sensor 2

Only single sensors without a pulse generator can be connected to this input.
A 4th order low-pass filter with Butterworth characteristics and 1kHz limit frequency can be connected internally.

CAUTION
The input at sensor 1 pin L is the same as the input at sensor 2 pin C. This means that if you connect a double sensor to the sensor 1 socket, you should not connect a sensor to the sensor 2 socket.

1.3.3.3.1 Supplying power to the sensor

The power supply is 12VDC and is secured via a self-resetting 200mA fuse (polyswitch).

1.3.3.3.2 Signal input

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Resolution A/D converter:	11 bits and 1 sign bit
Nominal signal:	0 to +-5V (+-10V)*
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1.4 Pin assignment for connectors

1.4.1 12V DC power supply

Jack plug

12V DC

1.4.2 LAN port

The VALUEMASTER module is connected with the Ethernet network or with a PC LAN port via the LAN port.

Connector: 8-pin RJ45 socket

Pin no.	Signal designation of printer interface
1	TX+
2	TX-
3	RX+
4	
5	
6	RX-
7	
8	

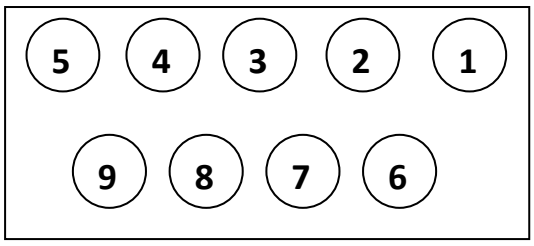
The data rate is maximum 100MBit.

1.4.3 Pin assignment of the control I/O interface

The control I/O interface is a 9-pin Dsub socket. The wires can be used for extra functions: for example, to activate lamps or motor controllers (servos)

Connector: 9-pin Dsub socket

Pin no.	Signal designation of the control I/O interface
1	External 0V
2	START - input (24V signal)
3	GND (for analog signals)
4	Speed output +-10V analog
5	NOK - output (24V signal)
6	External 24V DC power supply
7	OK - output (24V signal)
8	READY - output (24V signal)
9	ON - output (24V signal)



Pin assignment of the 9-pin D-Sub socket (front panel view)

The digital inputs and outputs are optically isolated.
The digital outputs are short-circuit-proof active high outputs with max. 500mA. The sum of the output currents must not exceed 0.5A (restricted by a resettable fuse [polyswitch]).

Note: When using the control I/O interface please connect an external power supply (8 to 30V) to pin 1 and pin 6, otherwise the inputs and outputs will not work. (please see Page 8 Subsection 1.3.3.1.2)

1.4.4 Pin assignment of the sensor 1 interface

The sensor 1 interface is a 12-pin round socket for single and double sensors and angle sensor with the following assignment:

Pin no.	Designation	Signal direction	Reference point and comments
A	NC*		
B	Angle pulse B	Input	Pin E
C	Torque signal 1	Analog input CH1	Pin D
D	Signal GND		
E	GND	For 12V power supply and digital signals	
F	+12V power supply		Pin E
G	Angle pulse A		Pin E
H	CHIP1		Pin E
J	CHIP2		Pin E
K	Test signal 5-12V	Output	Pin E
L	Torque signal 2	Analog input CH2	Pin D
M	Shield		

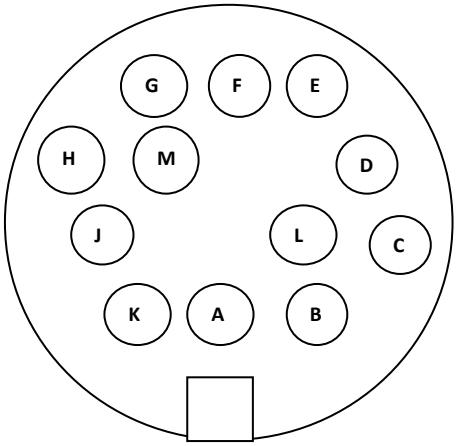
**NC = Nothing to be connected*

1.4.5 Pin assignment of the sensor 2 interface

The sensor 2 interface is a 12-pin round socket for single sensors without an angle sensor with the following assignment:

Pin no.	Designation	Signal direction	Reference point and comments
A	NC*		
B	NC*		
C	Torque signal 2	Analog input CH2	Pin D
D	Signal GND		
E	GND	For 12V power supply and digital signals	
F	+12V power supply		Pin E
G	NC*		
H	CHIP2		Pin E
J	NC*		
K	Test signal 5-12V	Output	Pin E
L	NC*		
M	Shield		

**NC = Nothing to be connected*



1.5 IP addressing

The VALUEMASTER module is delivered with IP address 128.0.0.66.
This IP address is also the default address used by the VALUEMASTER PC software.
The IP address of the PC and/or the IP address of the VALUEMASTER module can be changed if necessary.

1.5.1 General information on IP addressing

The IP address (IP = Internet Protocol) of the VALUEMASTER module can not be dynamically specified by a server. The VALUEMASTER module is not a DHCP client, DHCP=0 in CHIP.INI.

Each device/subscriber (VALUEMASTER module, PC) in a network must have a unique address assigned to it.
This address must only occur once in this network (subnet).

The PC address is displayed with the following PC command sequence:
Start ->Run->cmd↵->ipconfig↵

The IP address and the subnet mask each consist of four decimal numbers which must be separated by decimal points. Each position can have the decimal value 1 to 255.
The subnet mask determines the address space of the subnet.
If the subnet mask has the value 255.255.255.0, the first three address segments are the network address. The 4th segment is the IP address of the VALUEMASTER module.
This means that each device IP address in a local network (subnet), to which the PC and the VALUEMASTER module are connected, must have a unique value in the fourth segment.
The device address should only go from 1-254, the address 255 is reserved for Multicast transmissions. I.e. all devices in the network are addressed if the device address is 255, regardless of which address is set in the device.

Example:

255.255.255. 0 Mask
128. 0. 0. 66
|----------| network address (subnet)
|---| device address

Please contact the network administrator at your company for more information.

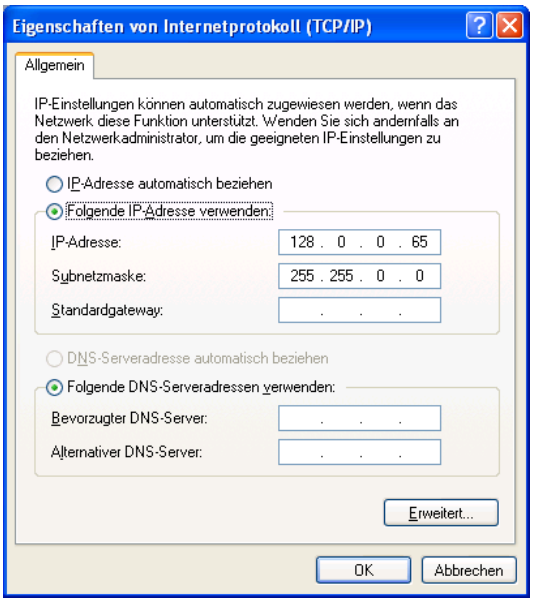
1.5.1.1 Testing the data transfer: PC – VALUEMASTER module

Operator entries on PC:
START -> Run -> cmd ↵
A DOS screen opens on the PC.

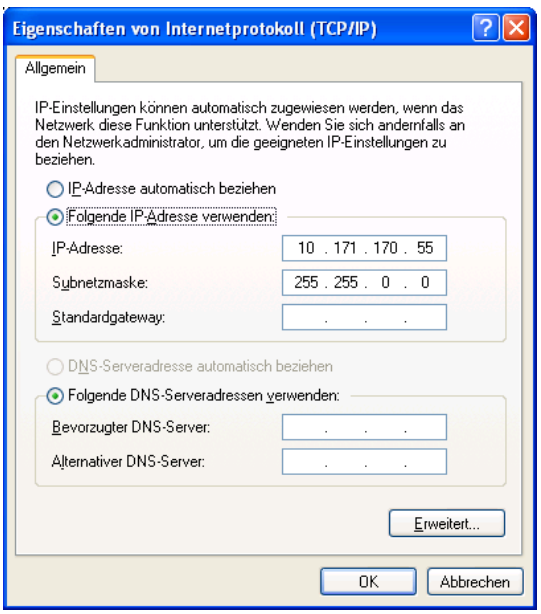
Enter the DOS command
ping 128.0.0.66↵ This is the IP address of the VALUEMASTER module. The data transfer is tested with this command.

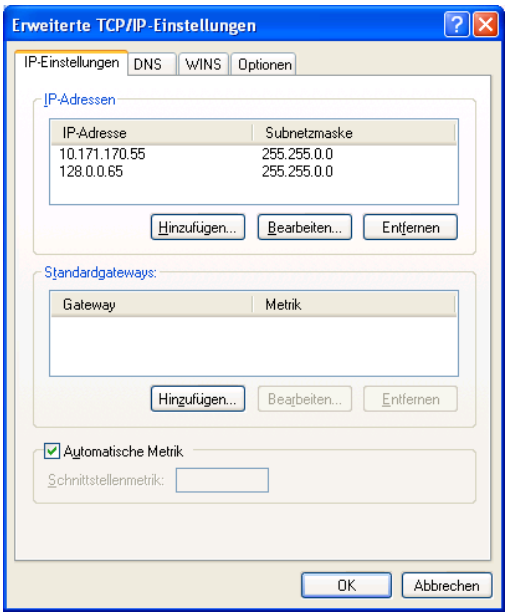
1.5.2 Setting the IP address on the PC with the XP operating system

For the IP communication between a PC with VALUEMASTER software and the VALUEMASTER module, an IP address must be entered in the PC system, e.g., 128.0.0.65.



Address setting connecting PC VALUEMASTER module with a crossover cable.



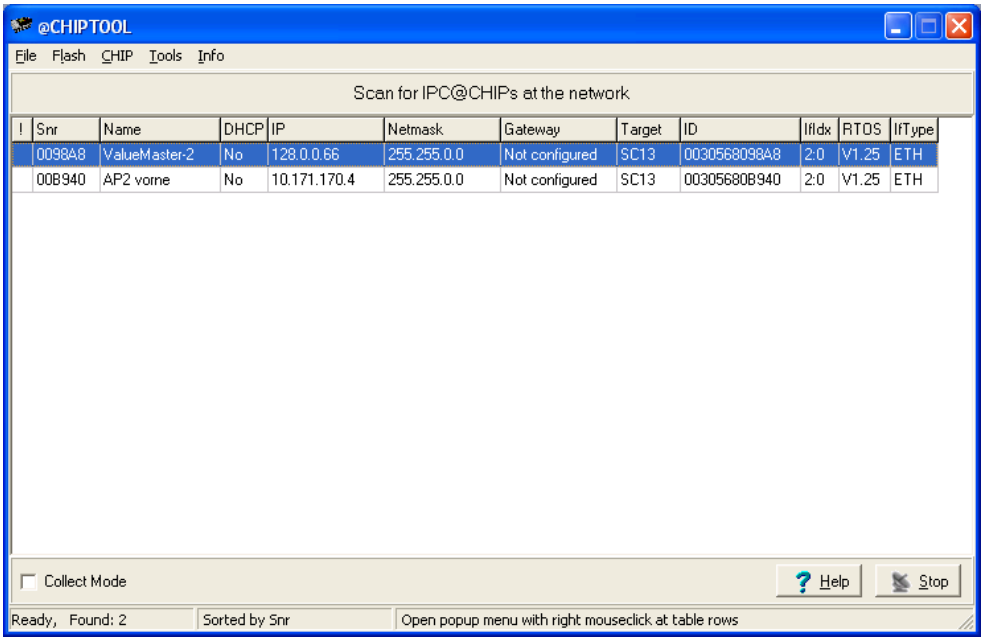


Address setting for VALUEMASTER module and PC in a network. The PC already has an address in the network (10.171.170.55). An additional PC address is assigned (extended by key) (128.0.0.65) for the connection to the VALUEMASTER module.

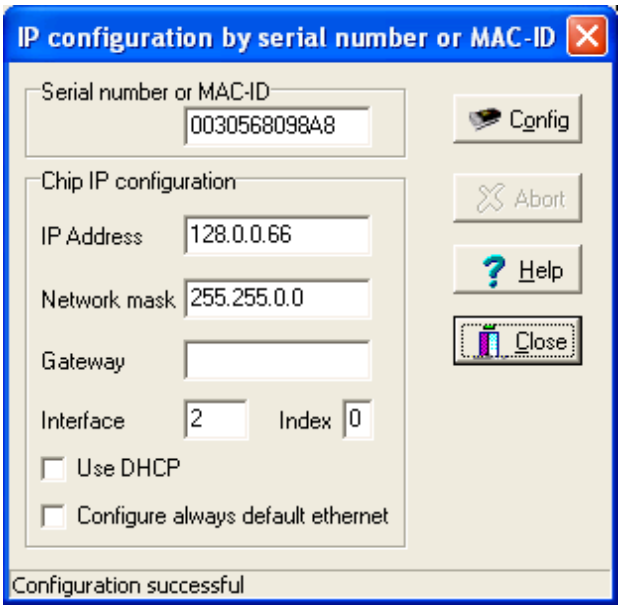
1.5.3 Setting the IP address of the VALUEMASTER module

The IP address of the VALUEMASTER module is set with the CHIPTOOL PC program.
The VALUEMASTER module must be linked to Ethernet for this to happen.
The program on the VALUEMASTER module communicates via the port 700.

When the CHIPTOOL program is started on the PC, a window appears in which all connected modules are listed.



Right click the desired module line to mark it and then select “IP configuration”.



Enter a new IP address and activate the change with the “Config” button.

CAUTION
If the IP address of the VALUEMASTER module is changed, the new IP address must be entered in the PC program in the “Bench constants” menu.

2 PC program VALUEMASTER

With the VALUEMASTER PC program, various measurements can be carried out with a connected ValueMaster (base) measurement module. The data from the module is saved and displayed graphically.

2.1 System setup

The program runs on a PC with the following features:

CPU:	Pentium 4 with 2GHz
Operating system:	Windows XP, Windows VISTA, Windows 7, Windows 8.
Main memory:	2 GByte
Drives	CD-ROM and hard disk with 1GByte free memory
LAN interface:	10 MBit/100 MBit
Color monitor:	Resolution 1024 x 768

2.1.1 ValueMaster firmware

The ValueMaster(base) measurement module must be loaded with the following software versions so that all functions can be performed:

SC123-SW-Version: 1.351/16-02-23
SMK-SW-Version: 4.491/16-02-23

The program versions are monitored.
Non- compatible versions will be a reported.
(see TEST HARDWARE program window at bottom right).

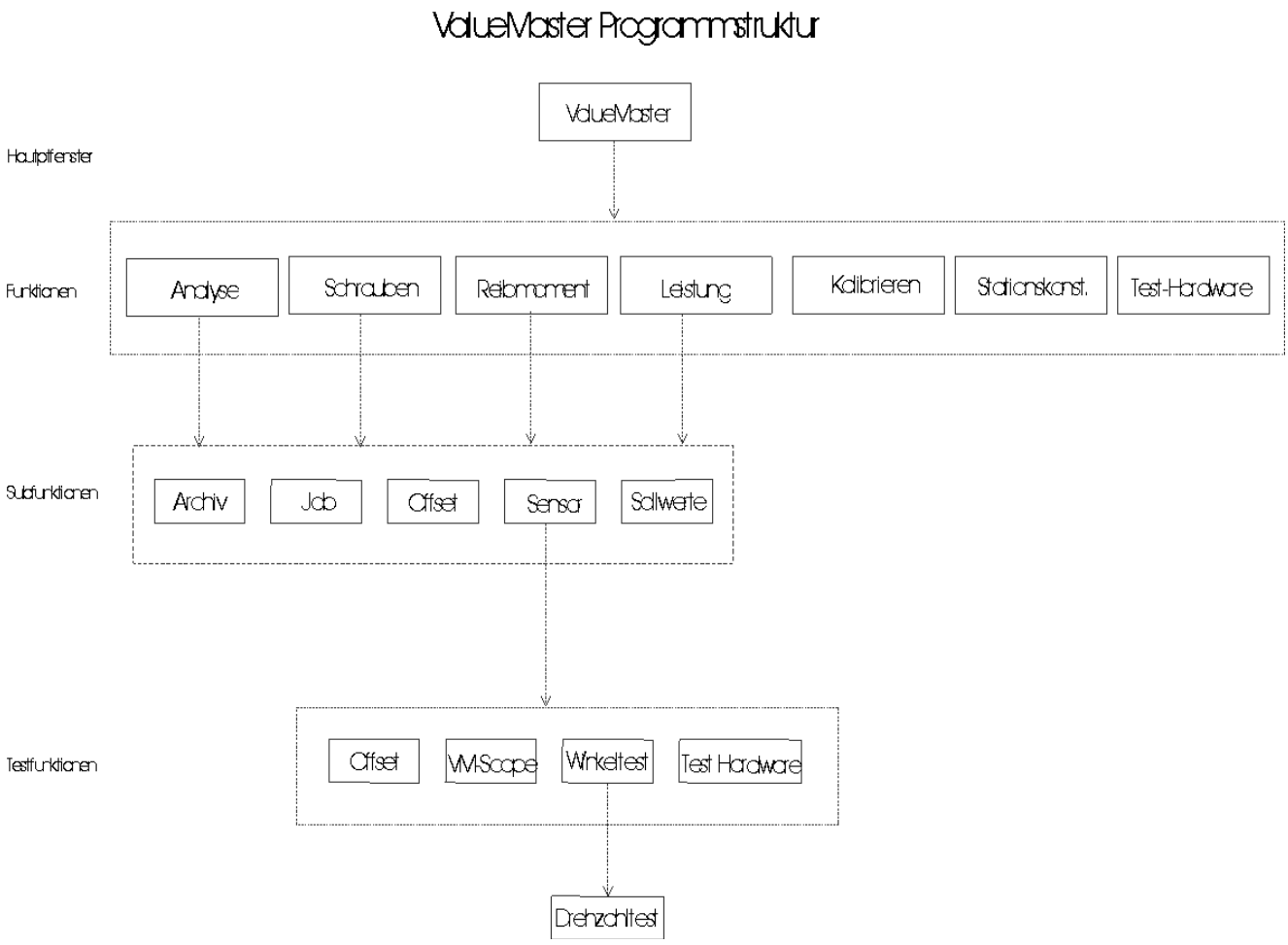
2.2 Program installation

The VALUEMASTER program, this manual and the CHIPTOOL program are shipped on a CD. The installation starts when the program “SETUP” in the folder 'Volume' is called. The VALUEMASTER PC program is installed in the directory C:/Programme/VALUEMASTER Vers. x.xx/. A folder with texts for the language options is created in the drive folder C:/VALUEMASTER/Sprachen.

2.3 **Program structure**

The program structure of the VALUEMASTER PC program is shown in the diagram below. Note that all functions (analysis, screwing, frictional torque, power, calibration) call the same subfunctions.

The following subfunctions are available:
- F4 Evaluate archive
- F5 Taring
- F6 Edit job
- F7 Print window
- F8 Sensor constants and test
- F9 Setpoints



2.4 File structure of the measured values, file names, data format

File structure of the measured values

For each of the functions (analysis, screwing, frictional torque, power), a path/folder is created for the measured values:

Name of drive:	C:/(default value)
Folder name:	ValueMaster_2.80/(default folder)
Data type:	Measured values/(fixed)
Test site name:	Bench/(default value, entered in the bench constants)
Function name:	analysis, screwing, frictional torque, power/
Job name:	Autojob/(default value, entered in the JOB window)
Setpoint record name:	Setpoint record 1/(default value, entered in the setpoints)
File name:	AD_090802_164040.txt (example) and Valuelist.txt

Paths with drive and folder name can be created and selected for each job in the job management. The measured values can thus be saved on a memory stick or a server.

File names

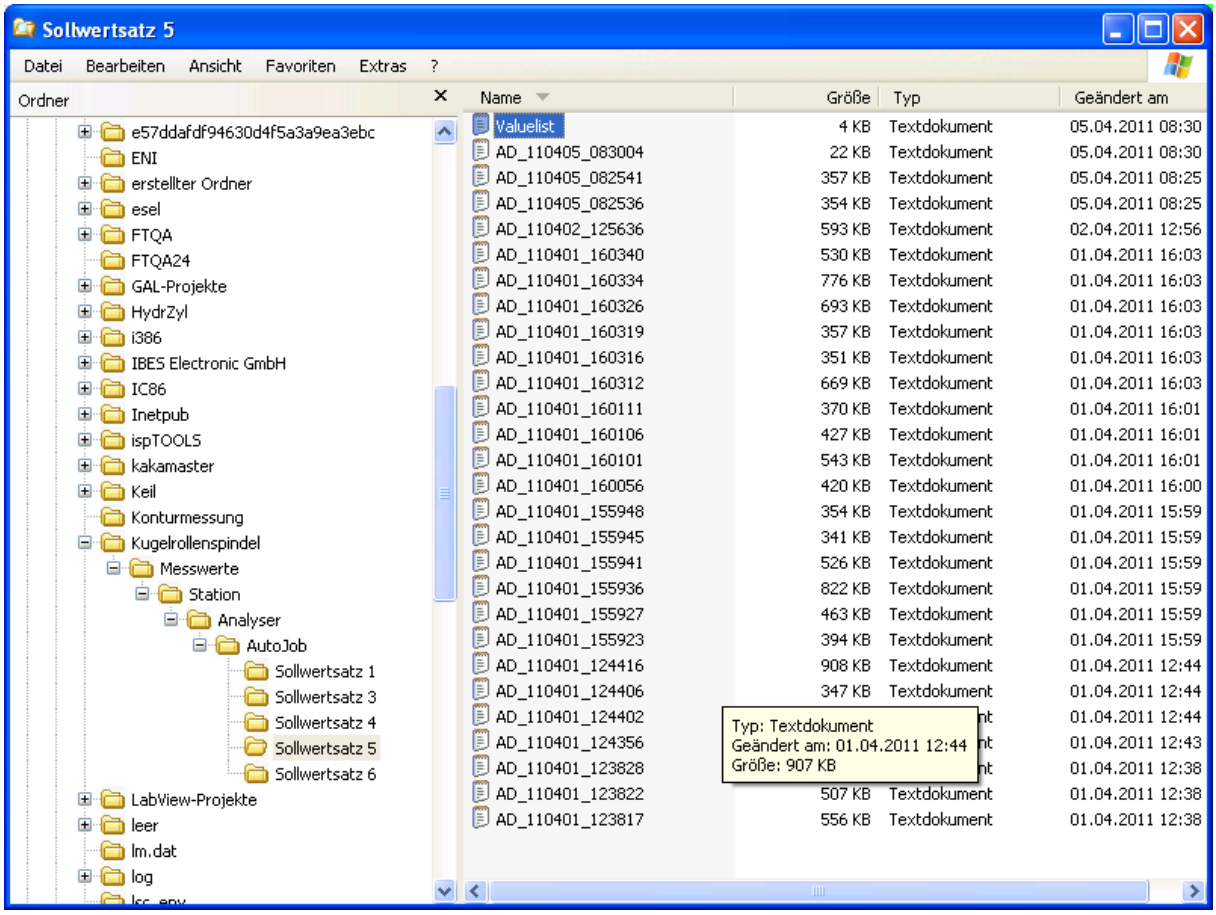
The file names are generated from an abbreviation (AD, TD, FD, PD) plus date and time.

The abbreviations are:

AD = Analyzer Data
TD = Torque Data
FD = Frictional torque Data
PD = Power Data
CD = Calibration Data
AZ = Analyzer Data for sampling loop
TZ = Screw (Torque) Data for sampling loop
FZ = Frictional torque Data for sampling loop
PZ = Power Data for sampling loop

Example:
AD_090802_164040.txt Analyzer data of Aug 2, 2009 16:40 and 40 seconds
PD_091110_132719.txt Power data of Nov 10, 2009 13:27 and 19 seconds

Data from each test run is listed as a table in the file Valuelist.txt.



Windows Explorer shows the data structure

Data format

The data is in text files and can be read with any editor or with EXCEL.
The data is generated when the flag “Archive” ON is set. The data is used in the subfunction “Evaluate archive”, accessed by the F4 function key.
The data elements are separated by a TAB in the file.

2.5 **Parameter structure and parameter input**

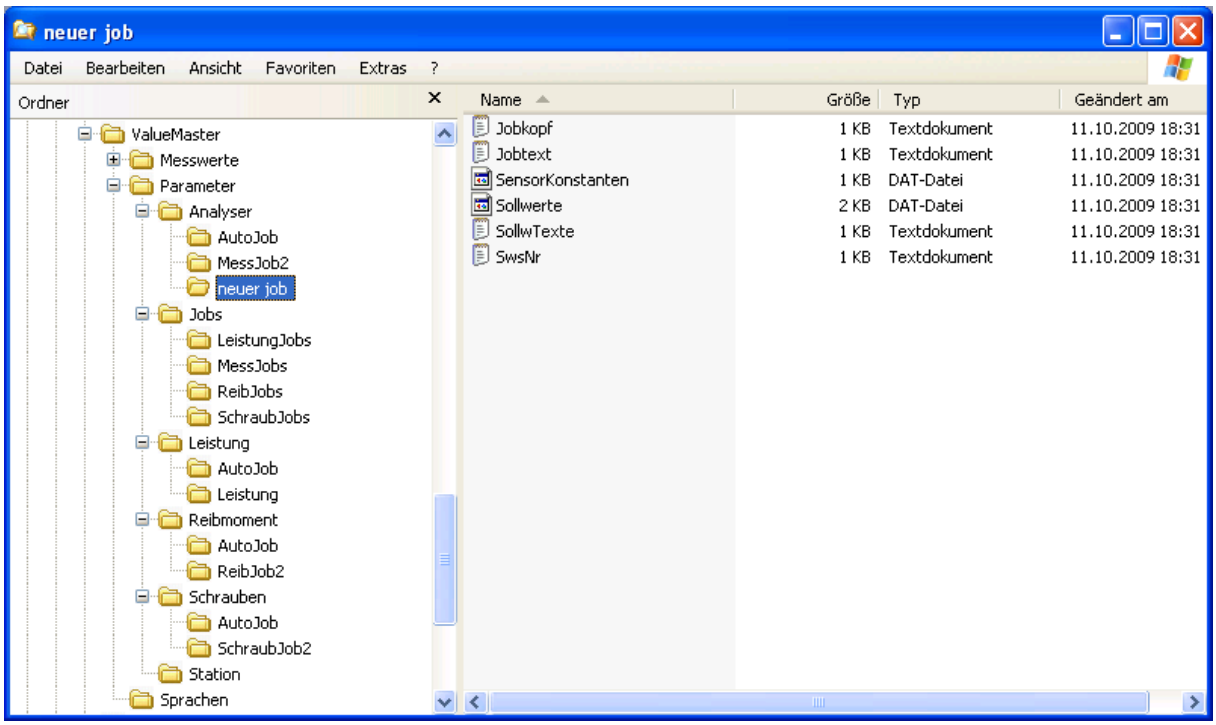
Parameters are calibration values, limit values, cut-off values and various texts, e.g., job entries.

Bench constants are only available once per VALUEMASTER program.

Each of the 5 functions (analysis, screwing, frictional torque, power, calibration) has its own parameter folder and as many job folders as desired can be in this folder.

File folders and parameter data records are set with default values when the VALUEMASTER program is started for the first time and when the functions are called for the first time. This ensures that there are defined values (not arbitrary values) in all sensor data and setpoints.

A job folder called AutoJob is created when each function is first called.



Windows Explorer shows the parameter structure.

The parameters can be displayed and changed.

The parameters can only be changed if a password is entered beforehand.
The **default password** is **1330** after program installation.
After entering the correct password all control elements and input fields are highlighted.
A new password can be entered in the system constants.

2.6 Graphical system functions

This description applies to all plots, etc., in analysis, friction torque, screwing and power test and for their evaluation windows.

2.6.1.1 Scaling

Y-axis factor
The y-axis can be extended with a fixed factor (1, 2, 5, 10).
The factor can be set at the bottom left of the image.
This can only be done before a test is started.

Scaling
If a test is started with F1, the axis can be scaled by moving the cursor to the outside scale value of the x or y-axis and clicking on the value. The new scaling will then be invoked.
The scale is reset when the test is stopped with F2.

Additional functions for plot editing
These additional functions are accessed by moving the cursor into the plot and opening a menu by clicking on the right mouse button. Additional information and functions for the plot can be opened and closed with this menu.

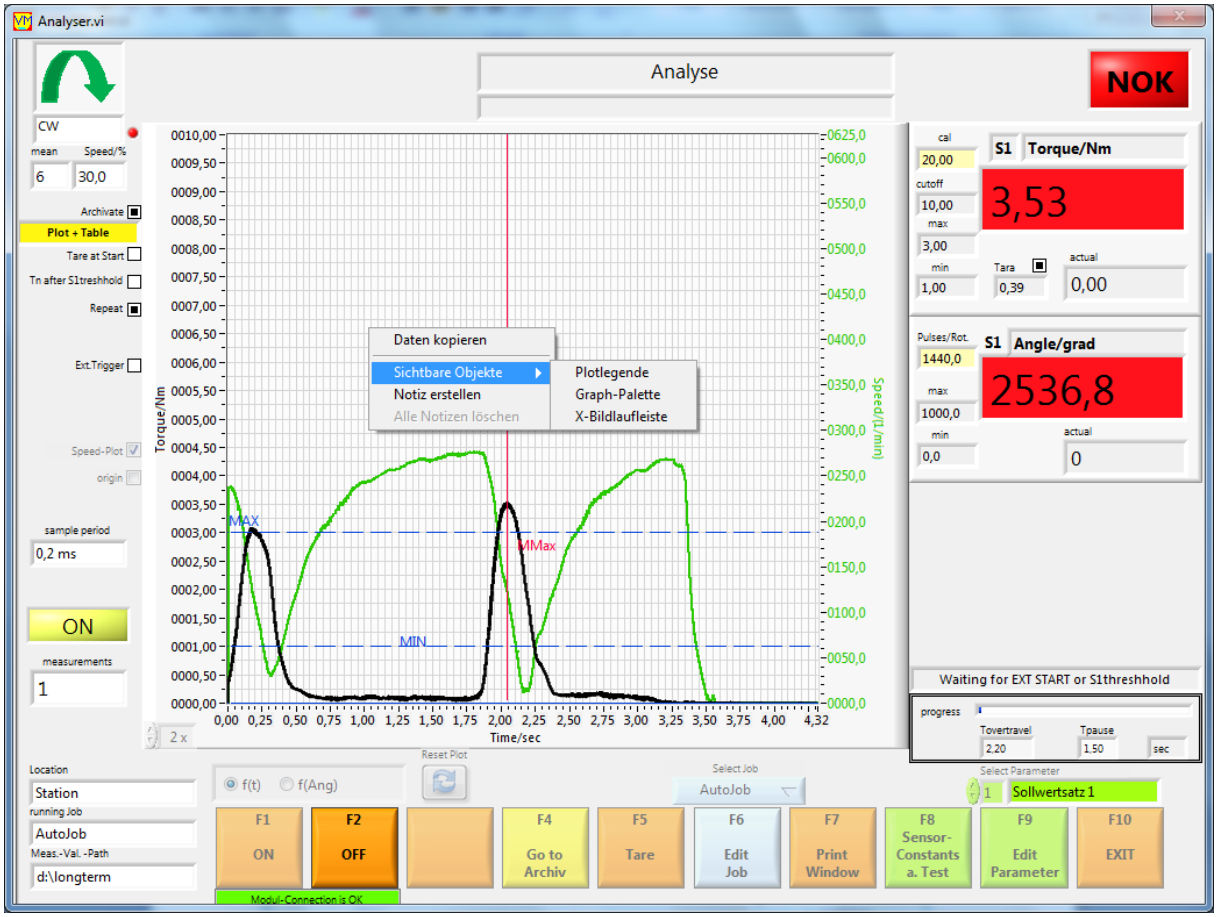
Copying data:
The plot range, not the complete window, is saved in the clipboard.

Visible objects:

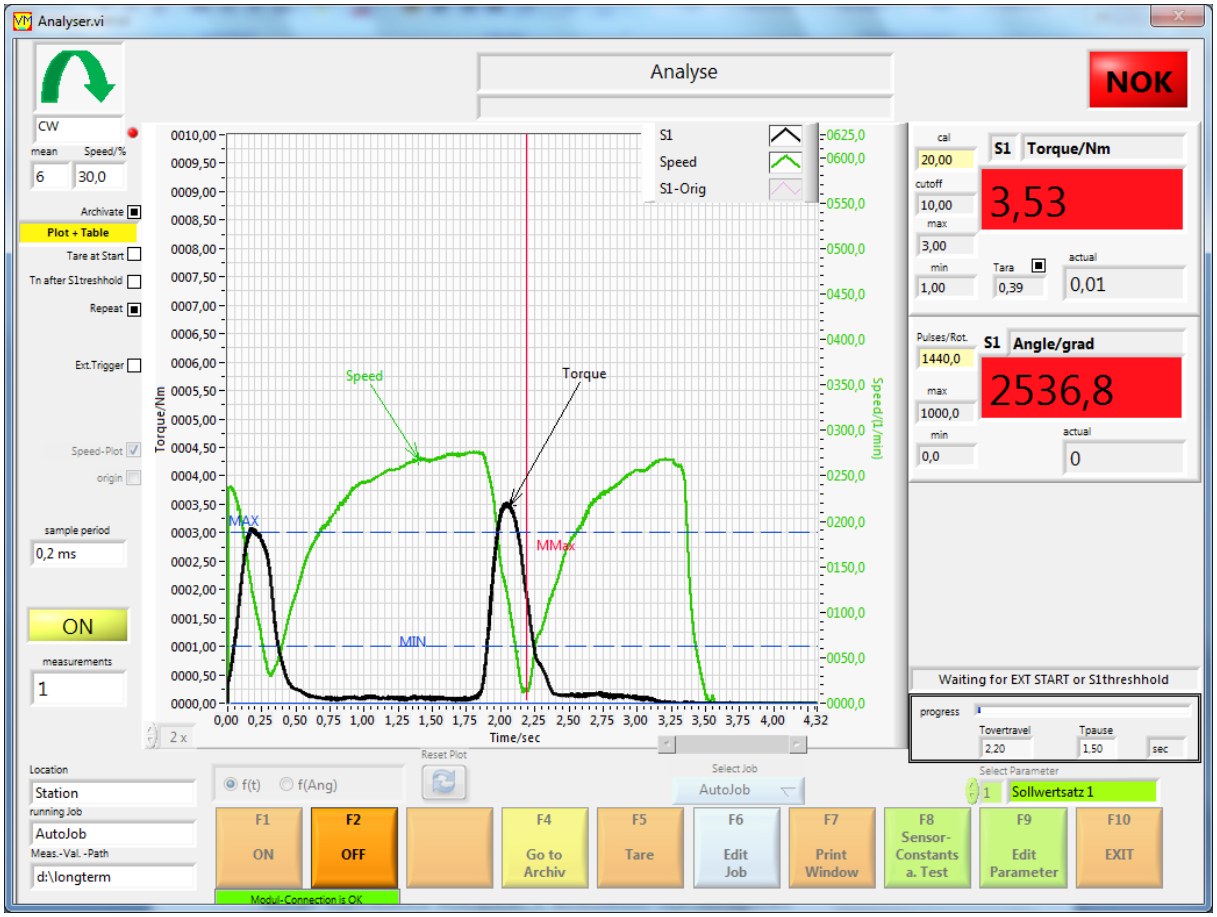
Plot legend:	List of plot colors, plot style and line thickness
Graph pallet:	for editing graphs (enlarging, moving, cursor for positioning)
X scrollbar:	for moving the plot in the x direction

Creating notes:
A note is a cursor in the plot area with arrow and text whose color, cursor shape and style, etc. can be changed.
The cursor can be coupled to a specific plot.
Notes can be attached to several plots.

The cursor must be activated in the graph pallet in order to create notes (no magnifying cursor, no hand cursor)

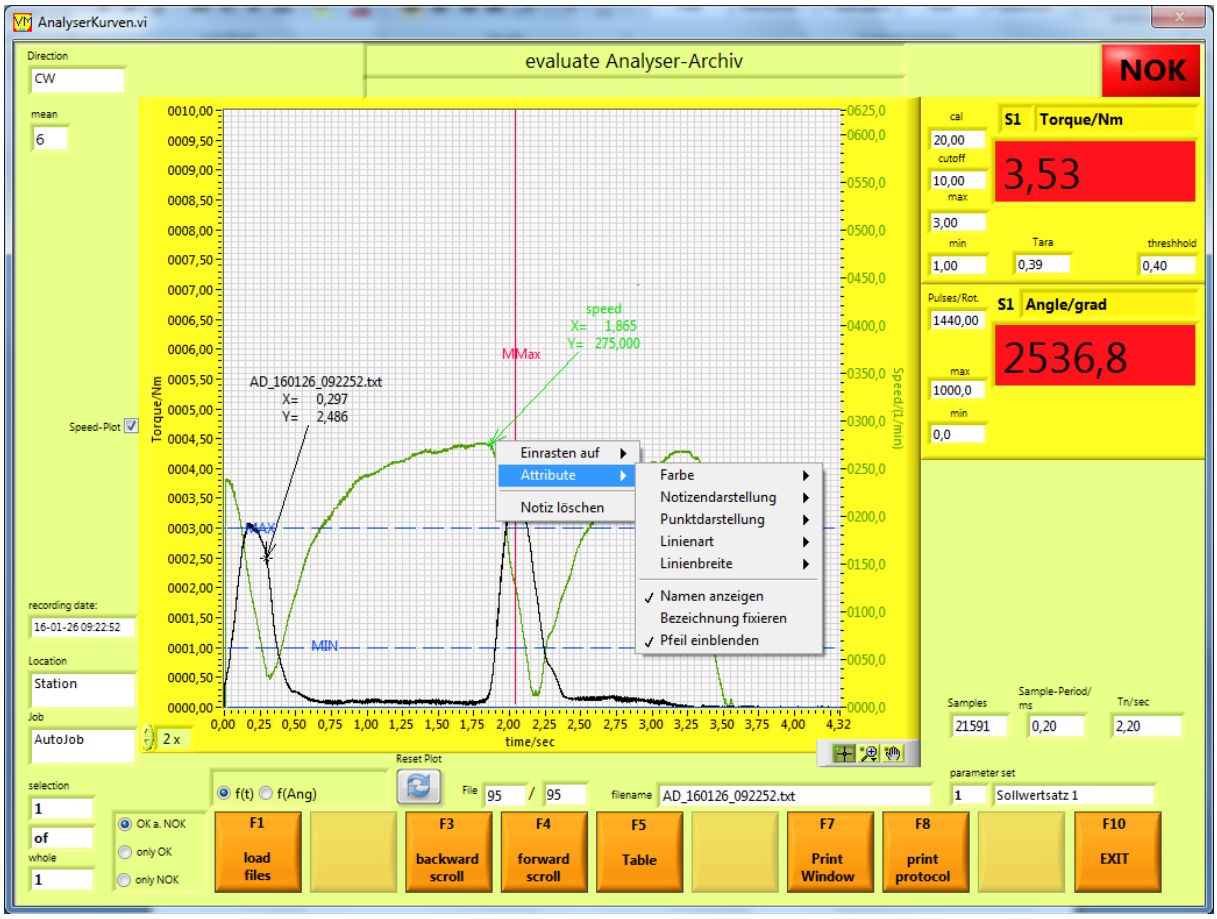


Menu in the plot area with additional functions for the plot area.



Plot with plot legend, x scrollbar and graph pallet switched on.

The cursor must be activated in the graph pallet in order to create notes (no magnifying cursor, no hand cursor)



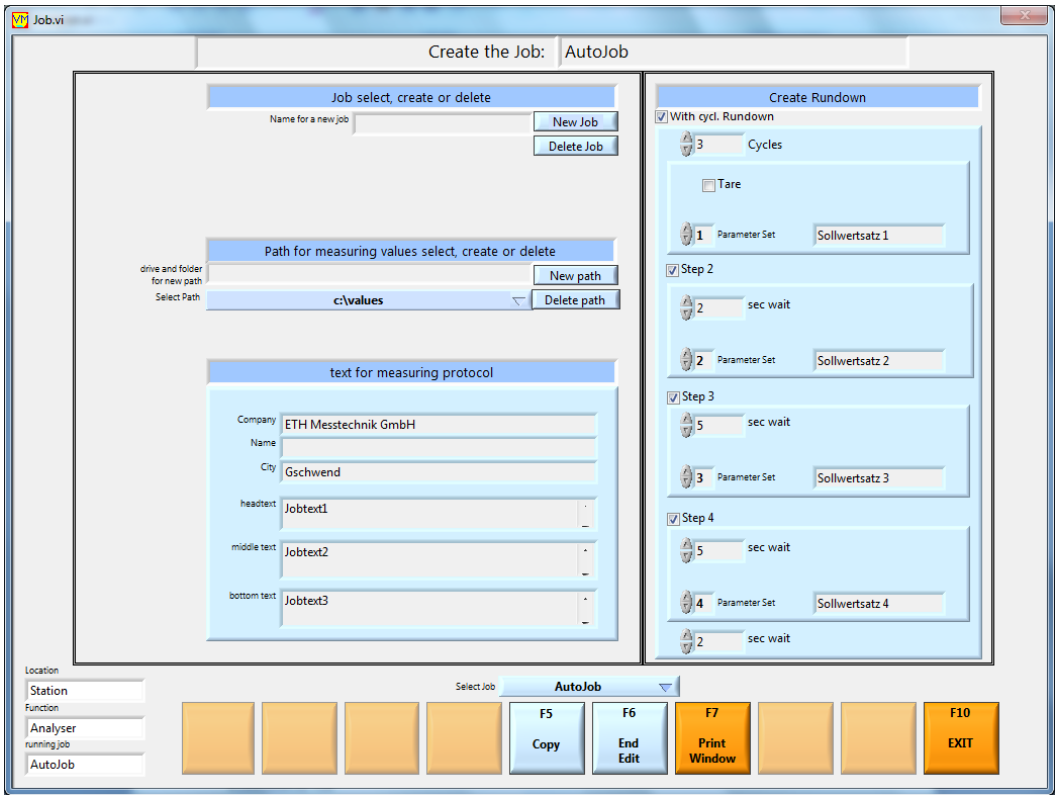
Plot with 2 notes for rotational speed and torque showing measurements

The note properties can be changed by right clicking on the note cursor.

The notes remain the same when a new function is started.

2.7 **Job Management**

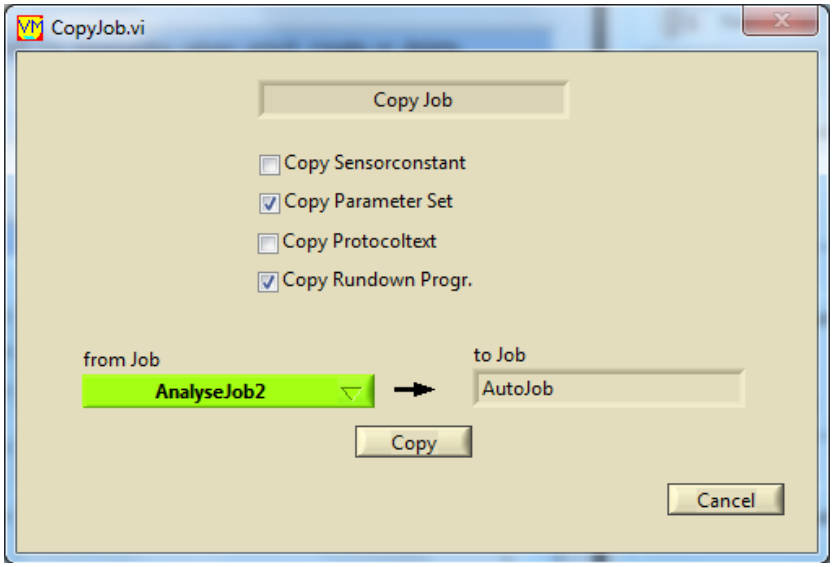
The job subfunction can be called up in any function (analysis, screwing, frictional torque, power, calibration).
The current job is displayed in each of the functions. Parameters (sensor constants, setpoints (record 1 - record 10), job texts and program loop), which should be used for a job, and the path in which the data is saved are assigned to a job. You can set up job for different tests at different locations in job management. These jobs can always be called up again (along with the parameters, data folders and programs associated with it). The Job subfunction is accessed from the functions with the F6 function key. To select a job that is already set up, press the green “Select job” button.



Job subfunction

Select job
The job to be edited can be selected using the green “Select job” button.

Function key F5
After editing is enabled with function key F6, use this button to copy a job. This will copy the parameters from an existing job into the currently set job.



Copy window

Function key F6
Changes and deletions can only be done after pressing the F6 button and entering the password.

Texts in test reports
These are texts that should appear in the report of an archived test. If nothing is entered, the displayed default texts appear in the report.

Select, create or delete path for measured values
A path for saving the measured values can be created or selected for the selected job here. The measured values for this job are archived in this path.
The path name must consist of the drive designation and folder name.
The default path is c:\ValueMaster.

Examples of a path:
c:\Valuemaster (default)
e:\ball screw
\\server name\public\measurement archive

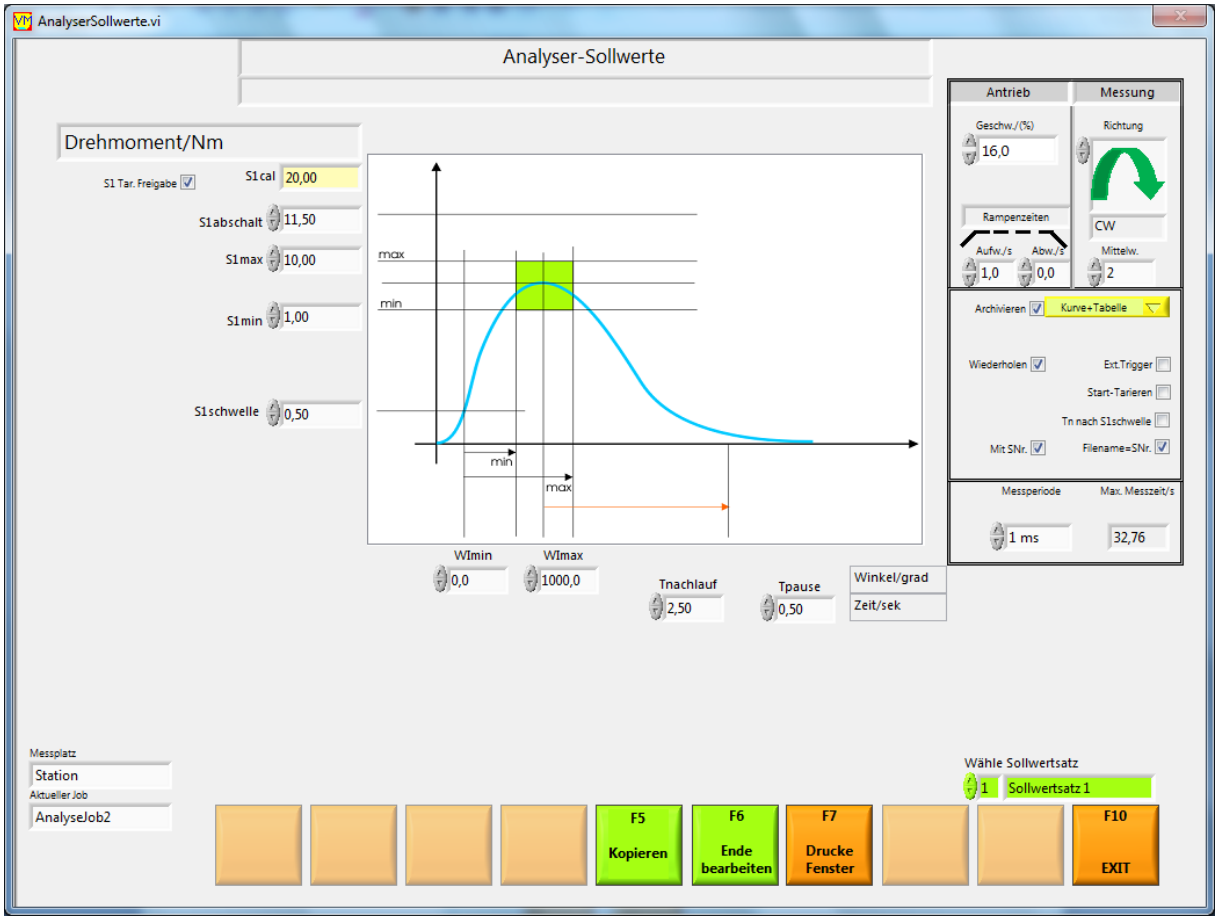
The current paths for storing measurements are displayed in the lower left of the respective screen window in the analysis, frictional torque, screwing, power and calibration functions.

Program loop
You can run up to 4 steps in a function by selecting the program loop. The setpoint record, type of archiving and waiting time can be selected for each program step.

2.8 Enabling serial number input

2.8.1 Enabling serial number input

The serial number entry can be enabled / disabled in the setpoint parameters of the analysis, screws, friction torque, power and calibration functions.
When the serial number entry is enabled, you can select whether the serial number is part of the measurement file name or not.

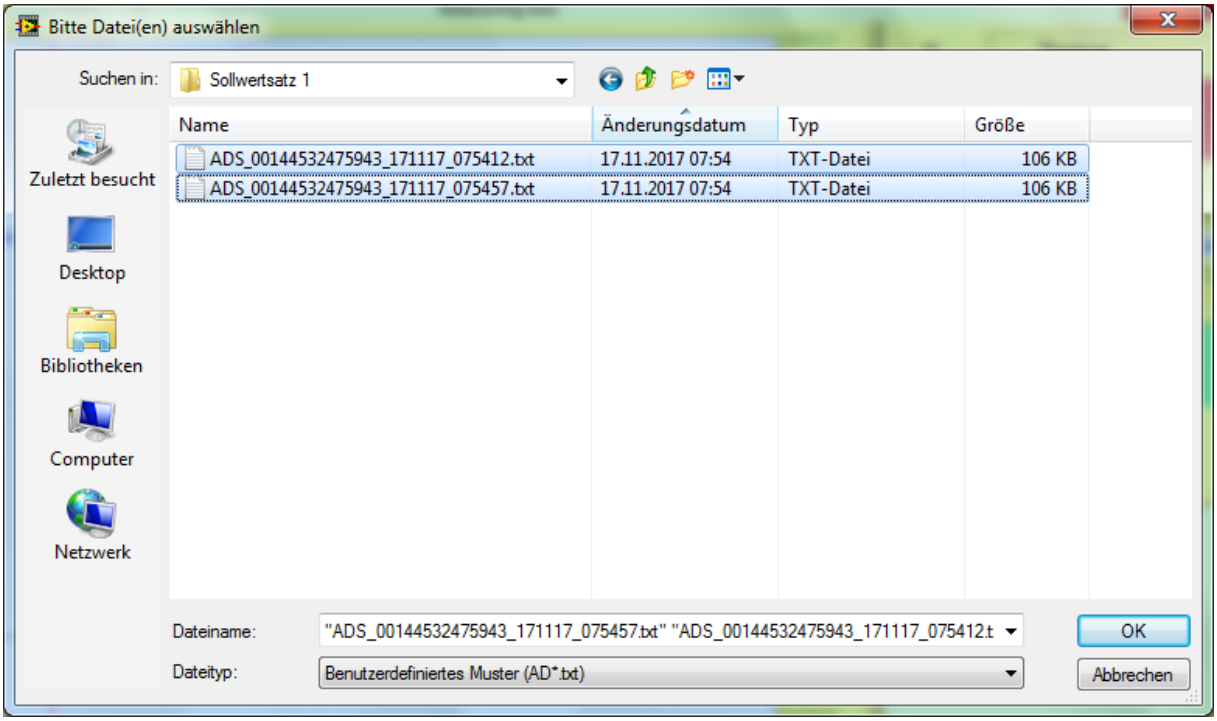


Example: Serial number flags in the analyzer setpoints

If the “**with SNo.**” flag is set, the serial number is output in the test logs and tables.

If the “**Filename = SNo**” flag is set, the serial number becomes part of the test file name.

2.8.2 Serial number as file name

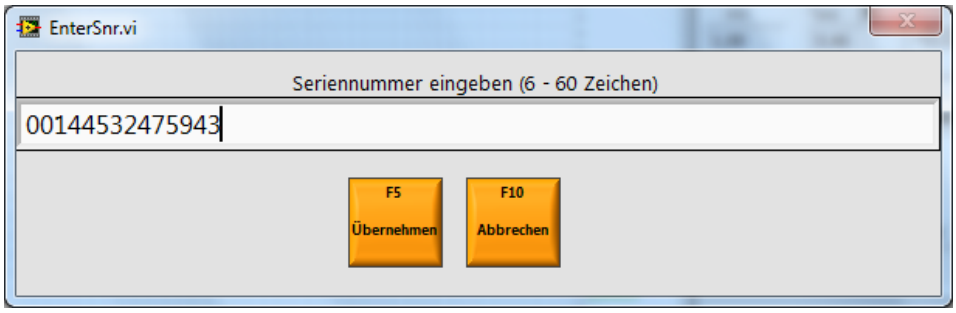


Folder with analyzer measurements records.

The file names with a serial number start with the abbreviation:
ADS_ for Analyzer
TDS_ for Screwing
FDS_ for Friction torque
PDS_ for Power
CDS_ for Calibration
followed by serial number, date and time

2.8.3 Entering the serial number for a test

Entering the serial number is expected in all functions (analysis, screwing, frictional torque, power, calibration) after pressing the function key F1 Start.



The serial number can be entered on the PC keyboard or with a barcode reader. The length of the serial number is 6 to 60 characters.

Save The serial number is saved and the test starts when you press **CR (carriage return)** or function key **F5**.
A barcode terminated with **CR** also starts the test.

You can cancel the entry and the test with the function key F10 Cancel.

The serial number can contain letters, numbers and special characters.

Filenames, however, may not contain any of the following characters:
- asterisk (*)
- vertical line (|)
- backslash (\)
- colon (:)
- double quote (")
- less than (<)
- greater than (>)
- question mark (?)
- slash (/)

Therefore, unauthorized characters in the serial number for the filename are converted by the PC program into an underscore “_”.

2.9 Program quick start

- Call the VALUEMASTER program
- Select function
  - **F1 Analysis**
  - **F2 Screwing**
  - **F3 Friction torque**
  - **F4 Power**
  - **F5 Calibrate**
- Set up a job
  - Enter the **F8 Sensor constants** and the **F9 Setpoints** in the selected function.

Then start the test in the selected function with **F1 On** and stop it with **F2 Off**.

2.10 Program functions

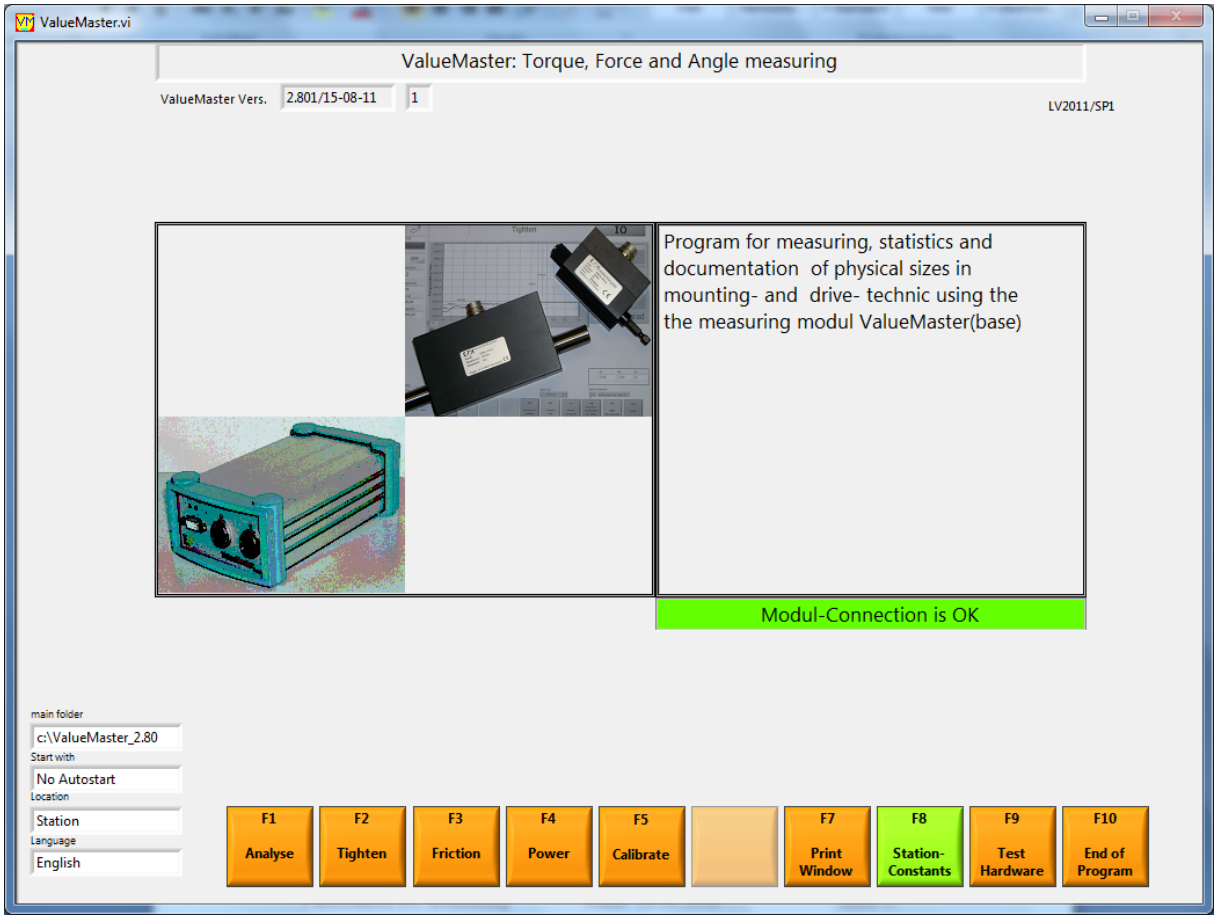
Program functions are: analysis, screwing, frictional torque, power and calibration.

2.10.1 Program start

When the VALUEMASTER program is started, a screen appears with function keys F1 to F10. You can select a function with these keys or with a mouse click.

The functions are:
- F1: Analysis
- F2: Screwing
- F3: Frictional torque
- F4: Power
- F8: Bench constants
- F9: Test hardware

When the program is first started on a PC, parameter files with default values are created in the C:\VALUEMASTER folder. A password is required to change the parameters.
The default password is 1330.



VALUEMASTER start screen

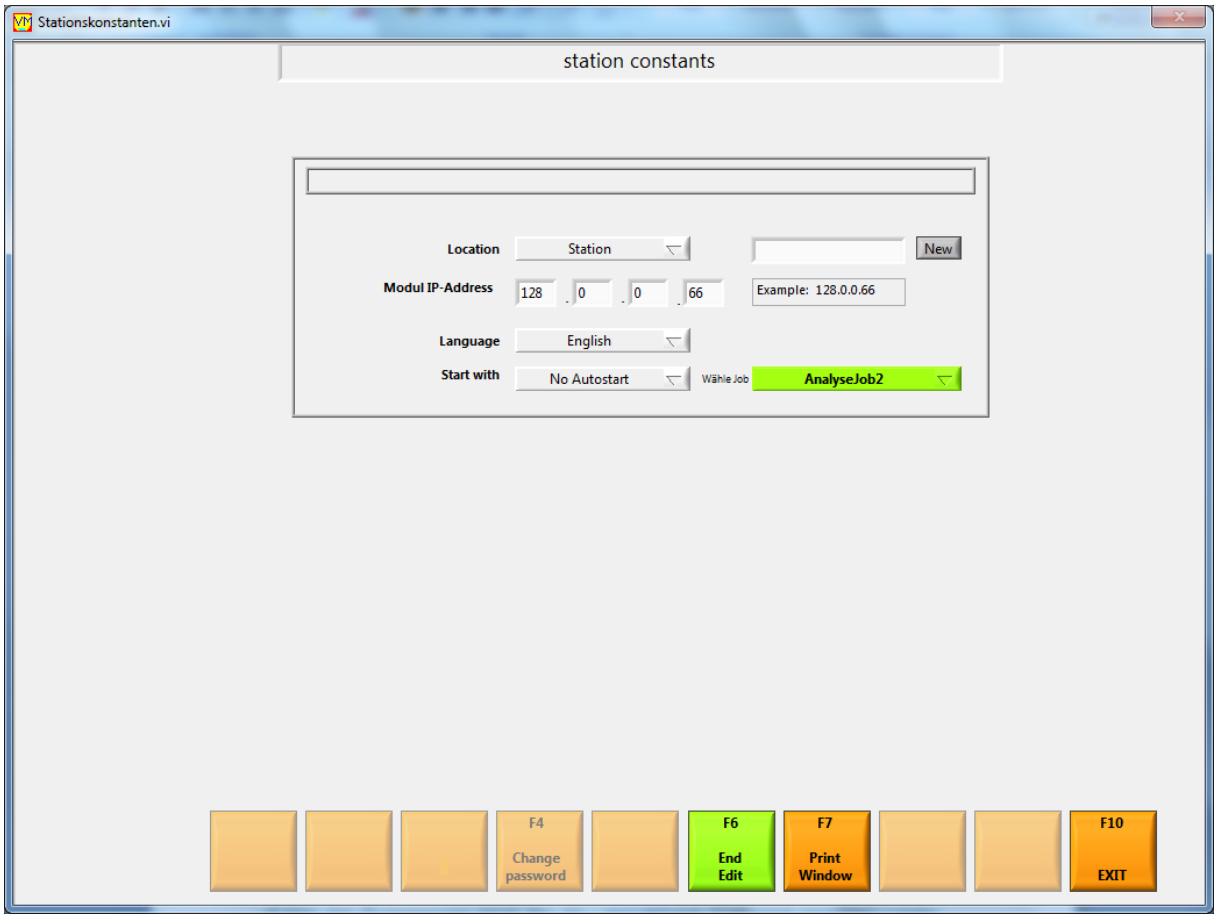
2.10.2 Bench constants

Additional system settings can be made in the bench constants.

Location
In “Location”, the operator specifies the folder where the test data are stored (the default name is “Bench").
You can, for example, create a designated measured-value folder for test purposes.
If there are several identical test sites (identical machines), then the measured values can be assigned to these sites. The sensor settings and jobs are not affected.

Module IP address
The IP address of the Valuemaster module can be entered here.
The default address is 128.0.0.66.

The language for the VALUEMASTER program can be selected here:
German, English, French and AUX. AUX is reserved for a fourth language and can be altered (at the moment it is set to English).



Furthermore, in the bench constants in the line “Start with”, you can specify whether one of the five selectable functions should be performed when the program starts.

With the pull-down menu “**Select Job**”, the job to be executed must also be specified for the automatic start.
A new/own password can be entered in the system constants with the “F4 Change password” button. If an empty password is entered in “Change password”, then no password will be requested during subsequent operations.

2.10.3 Analysis

Torque, force, travel, pressure and speed as a function of time can be measured and displayed in the analysis. The plots can be displayed as a function of time, the angle or the sensor 2 measurement (e.g., displacement). Analysis is in principle a peak-value measurement.

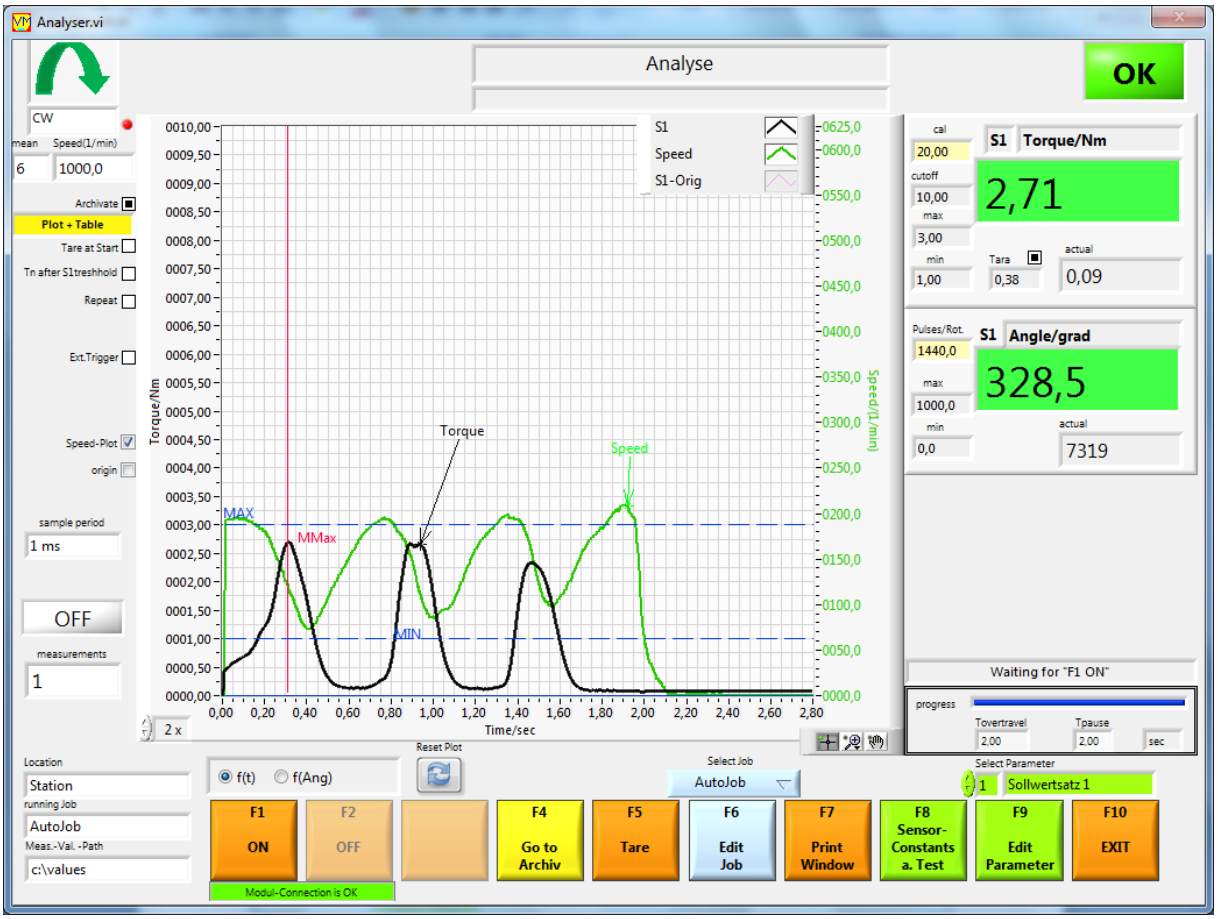
By selecting the subfunction “Job” (accessible with the “F6 Edit job” button), a choice can be made between a standard test routine and a programmable loop.

Before a test run, the sensor constants must be set with F8 and the setpoints with F9 (if none have been entered previously). Before a test, one of ten setpoint records can be selected for the test at the bottom right.

2.10.3.1 Analysis: Standard test sequence with a setpoint record

The standard test is executed with the preset setpoint record. It can be repeated as often as desired: it is started with “F1 ON” and stopped with “F2 OFF”. A test run is started with “F1 On”, and if the bar “LED ON” is on, when S1 threshold is exceeded. The test can also be started, if an external trigger is selected, with the start input at the Dsub socket on the module. The test is terminated when a maximum is reached. When the times Tovertravel (Tn) and Tpause Tp have elapsed and when the measured value has gone below the S1 threshold, a new test can start. If the maximum value increases during time Tn, time Tn is restarted.

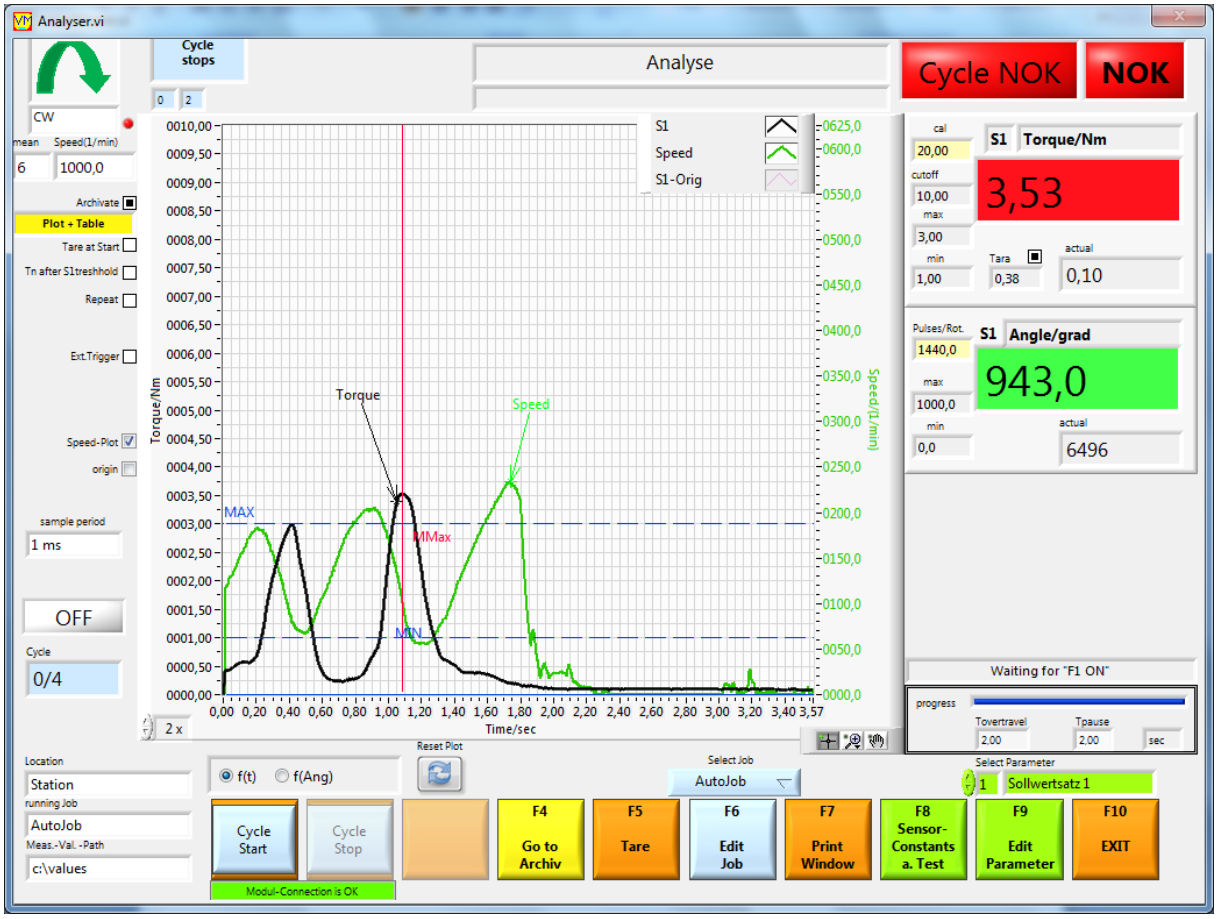
The waveforms can be archived, if “Archiving” is selected in the Setpoints. Archived curves can be displayed with the function “F4 Evaluate analysis” (individually/as a group plus table).



Analysis function window

2.10.3.2 Analysis: Programmable loop

This test is executed according to the programming in the job subfunction. The loop is started with the “Start loop” button and stopped with the “Stop loop” button, or when all loops have executed. Each program step (maximum 4) is executed as a standard test.
The plots and data are archived according to the program preselection in a “Loop” folder. Archived curves can be displayed with the function “F4 Evaluate analysis” (individually/together and in tabular form).



Analysis function window

All loop functions are highlighted in light blue. The program step number (1-4) and the microstep number (within a step) are shown respectively on the left and right under the label “Loop running”.

2.10.3.3 Analysis: Functions and settings

Background tests in the analysis
When using a sensor with a chip, the sensor data is compared to the chip data. An error message is output if there are any anomalies. Furthermore, the setpoints are checked for plausibility and if there is no plausibility, an error message is also output. No test can be started as long as there are errors.

Taring after starting with F1
If Start taring ON is set in the setpoint record, a taring is performed. The taring is complete when the "LED ON" is illuminated yellow. The sensors must not be activated during this taring. This taring ignores the taring which is done with the "F5 Taring" button, but only for this start**.**

Evaluation
The curves are displayed after a test run and the results are displayed and evaluated (within limits?).
The displayed variables are the values at maximum S1 (vertical red line).
The OK/NOK outputs are energized.

Direction indication
The set direction is shown at the top left.
Only variables measured in this direction are recorded.

Torque measurement:

Right rotation (CW=ClockWise)	positive signals.
Left rotation (CCW=CounterClockWise)	negative signals.
Both directions of rotation (CW+CCW)	both signal directions.

Force measurement:

PRESS (pressure)	positive signal
DRAG	negative signal
Both directions (PRESS+DRAG)	both signal directions.

When the bidirectional scenario CW+CCW or PRESS+DRAG is selected, pulses are not evaluated and the positive and negative measured values are shown in the plots.

An "LED" in the direction display lights up RED if more than 15 pulse train errors are detected. (These errors can occur by rotating in the non-specified direction, for example.)

Switching the x-axis
The x-axis variable can be changed with the F(t), f(Wi) and f(S2) buttons.

Other features
The original curve (without mean value calculation) can be displayed additionally as a plot using the check box "Original".
The speed plot can be toggled using the check box "Speed plot".

Taring
A taring is performed with the “F5 Taring” button. The tare value is displayed and saved until the next taring. This tare value is valid for the current job.

Editing Job
The F6 button opens the Job window.
There a new job can be set up or job texts can be entered. A loop sequence can be programmed, as well.
This window is described in the “Job Management” section.

2.10.3.4 Analysis: Inputs/outputs at the control I/O port

The READY, OK, NOK and ON outputs are used (see Valuemaster manual, Pin assignment section)
In addition, a speed setpoint in the form of a voltage in the range -10V to +10V is output (+- 100% of the maximum speed can be set). Since the polarity of the torque setpoint can be selected, the direction of rotation can be set as well.
A screwing test can be started with the input START (set in the setpoints).

- Control I/Os without “External trigger”
The READY output is set if the test is started with F1.
After 100ms, the ON output is energized.
The speed setpoint is output simultaneously.
After reaching the cutoff point, the OK or NOK outputs are set and the ON output is de-energized for approx. 2 sec and then re-energized. The speed setpoint is set to 0% too and after 2 sec. is set to the setpoint value, again. If the test is stopped again with F2, all outputs are de-energized and the speed setpoint is set to 0%.
The OK and NOK outputs are de-energized when the input from sensor 1 has exceeded the S1trigger value.

- Control I/Os with “External trigger”
The “EXTERNAL TRIGGER” field on the left in the analysis window is checked. The READY output is active if the test is started with F1.
The speed setpoint is output simultaneously.
The test/recording is started with the “START” input = “ON”.
The START input must be on for the entire duration of the test. The test is stopped when the START input is de-energized.

When the test is terminated, the test data are transmitted to the PC and the OK or NOK output is energized. The ON output is de-energized and the speed is set to 0%.
A new test is started when the START input is de-energized and then re-energized.

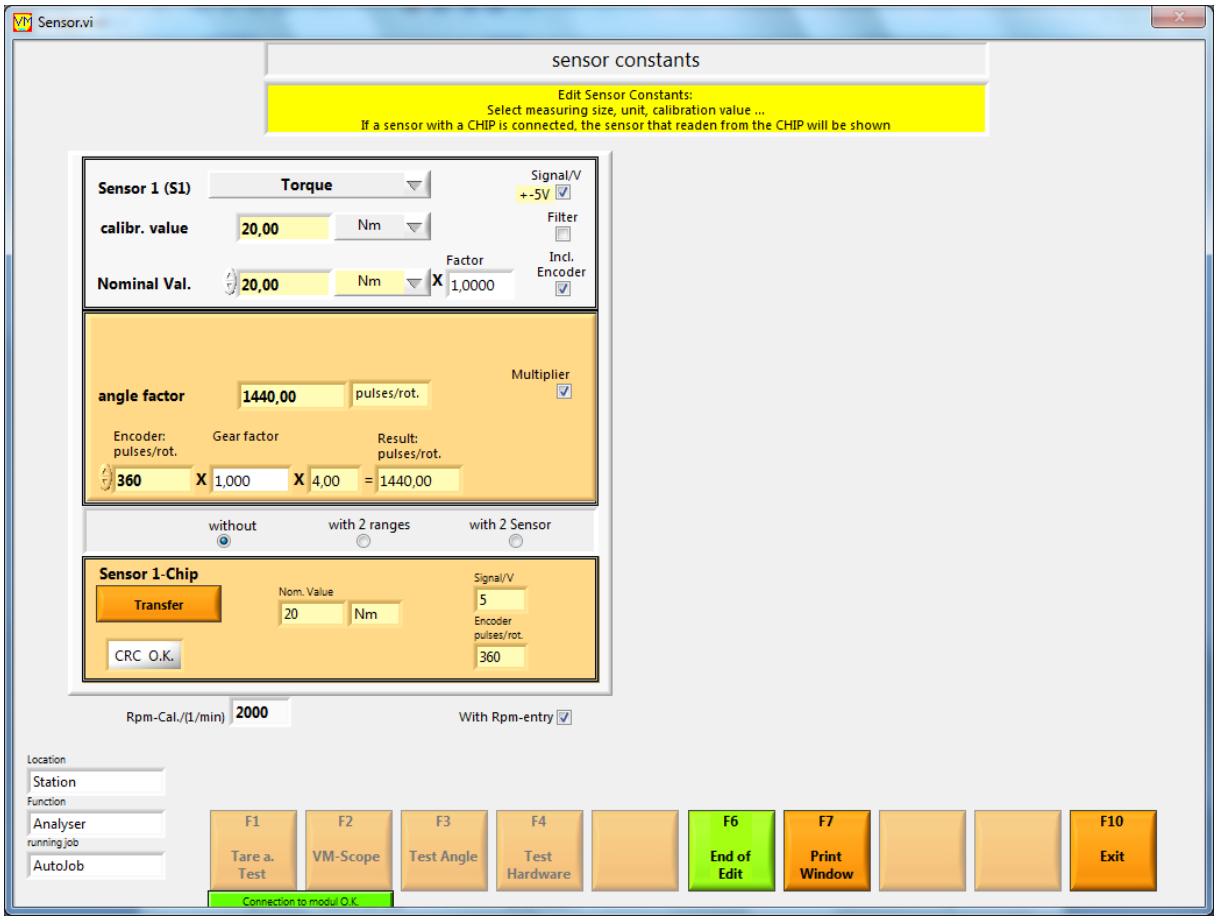
If the test is stopped again with F2, all outputs are de-energized and the speed setpoint goes to 0%.

2.10.3.5 Analysis: Sensor constants and test

The sensor constants (sensor 1 and sensor 2) are set with the “F8 Sensor constants and test” button. If a sensor with chip is connected to the ValueMaster module, the chip data must be scanned, as the chip data are compared with the sensor data. If there is a difference, a test can not be started. Different data flash RED.

The scope of the tests depend on the sensor characteristics selected. This means that tests are always run with sensor 1.
If the pulse generator is on, the angle and speed are also measured.

If sensor 2 is on (2nd parameter or 2nd range), sensor 2 is used in the test, as well.



Window for sensor constants in analysis

Selection of sensor 2:
The selection is done with the following buttons
o without o with 2nd range o with sensor 2
Sensor 2 can thus be switched off, or used for a 2nd range or a 2nd parameter.

Select the **2nd range** if you want a test with 2 sensors having identical physical parameters but different ranges.
Flipping the range must be done in the setpoints.

Select the **2nd sensor** if you want to scan a 2nd parameter.
The 2nd parameter is shown in the function window in the bottom chart.

Inputs for sensor 1 (S1) and sensor 2 (S2):

Calibration value:
If the sensor has a chip, the chip data must be loaded with the "Accept" button or from the PC keyboard. The nominal value is always the value which is on the sensor or stored in the sensor chip.

Calibration value = nominal value x factor

In addition, the calibration value changes depending on the selected engineering unit (Nm, Ncm)

S1 input, S2 input
The maximum voltage of the sensor inputs at nominal value can be 5V or 10V. The operator selects the sensor voltage. For a sensor with sensor chip, this setting is loaded from the chip. The amplifications are changed in the measurement module to suit the selection.

Filter
Each channel in the ValueMaster module has an analog filter with a 1kHz frequency limit. This filter can be turned on/off.

Inputs for sensor 1 (S1)

Only sensor 1 has a pulse generator.

Encoder
Angle and speed measurements can be performed if the sensor has a pulse generator installed. The selection is done with the “Encoder” button.
If “Encoder” is ON, then the sensor chip values for “Encoder pulses/revs” are loaded from the sensor. They can also be entered on the PC keyboard.

Pulses/revs
The “Pulses/revs” value is calculated from several factors.
The “Encoder pulses/revs” are the values given by the sensor manufacturer.
This “Encoder pulses/revs” (e.g., 60 or 360) can be multiplied by a factor (e.g., necessary for gears). A pulse quadrupler is enabled on the ValueMaster module using the Multiplier button. The pulse count is thus electronically quadrupled in the ValueMaster module.

Pulses/revs = Encoder pulse/revs x gear factor x Vvalue

Vvalue = 4 if the pulse quadrupler is enabled
Vvalue = 1 if the pulse quadrupler is disabled

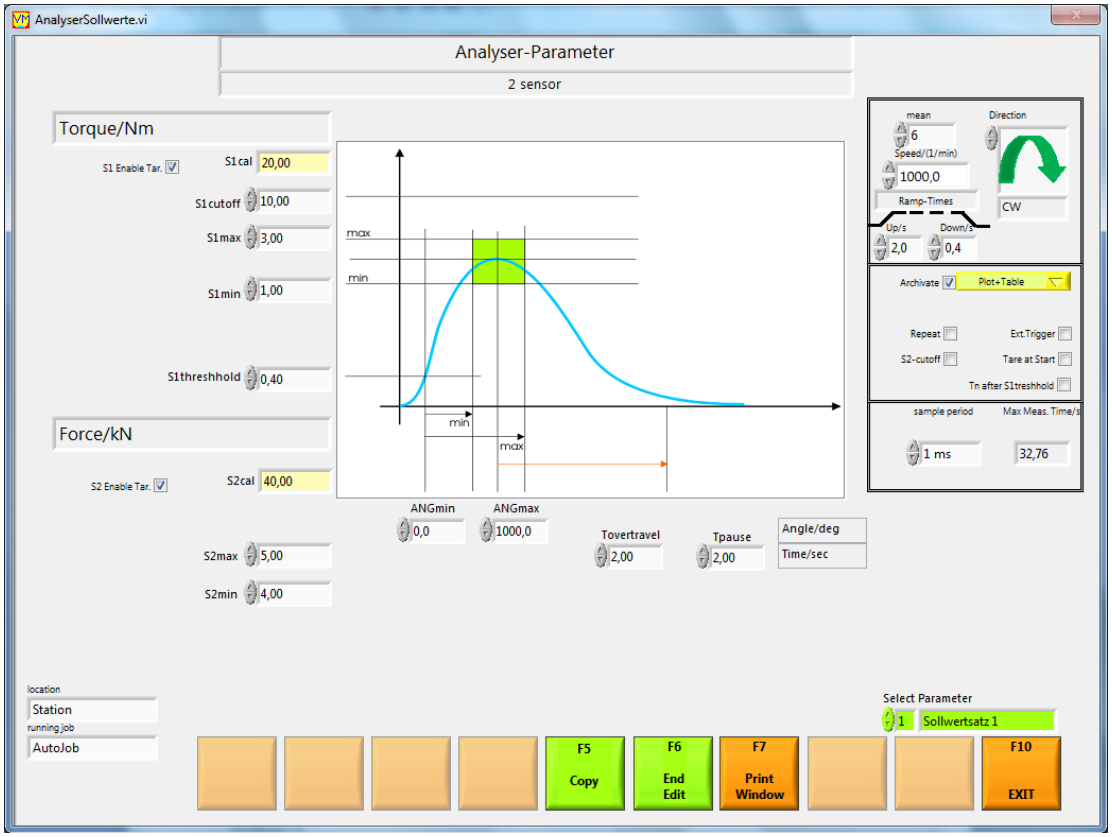
The **test functions**
- F1 Tare and test
- F2 VM-scope
- F3 Angular test
- F4 Test hardware

are identical in all functions and are therefore described in the Test Functions section.

Speed calibration value
Check the “**with RPM entry**” box to select whether the default is percent or speed (rpm) for the speed output in the Setpoints. If the speed default is rpm, the speed calibration values **rpm-cal (1/min)** have to be entered.

2.10.3.6 Analysis: Edit setpoints

The limit values for a test are entered in the “Edit setpoints” window.
Up to 10 setpoint records can be edited.
The setpoint window is structured according to the setting in the sensor constants.
This depends, among other things, on the settings for sensor 2 (2nd parameter or 2nd range) and for the pulse generator (no angle can be measured without the pulse generator).



Window for editing setpoints (Example: Sensor 1 for torque and angle measurement, Sensor 2 for force measurement)

Limit values
Upper and lower limits must be set for torque, force and angle.
If the input values are within limits, then they are correct (OK), otherwise they are incorrect (NOK).

S1 cutoff
If this torque is exceeded, the test is aborted (emergency cutoff)

S2 cutoff
If this cutoff value is exceeded the test is aborted (emergency cutoff)

Switchbox
S1 enable taring and S2 enable taring.
Taring is thereby enabled. It is thus possible to tare with one sensor with the F5 button in Analyzer.

Selecting the setpoint record
The setpoint record to be edited is set at the lower right of the screen. The text next to the setpoint record number describes the setpoint record. It can be changed: for example, to “Stay bolt S10” instead of the default text “Setpoint record x”. This setpoint record designation is also then the name for the folder holding the data files.

Times
j time Tn:
For “Tn after S1 threshold” = OFF (not checked):
The overtravel time Tn is the time after the last recorded sensor 1 peak value.
The test continues during this period. If a value higher than the last measured peak value occurs during the period Tn, then the time Tn is restarted.

With “Tn after S1 threshold” = ON (checked):
The follow-up time Tn is the time after which the threshold has been exceeded.
The test continues to run during this period.

Pause Tpause (Tp):
Another pause period Tp runs after Tn. If Tp = 0, the digital output ON is not de-energized between test runs.

Direction
The direction determines the signal polarity to be scanned.

Torque measurement:

Right rotation (CW=ClockWise)	positive signals.
Left rotation (CCW=CounterClockWise)	negative signals.
Both directions of rotation (CW+CCW)	both signal directions.

Force measurement:

PRESS (pressure)	positive signal
DRAG	negative signal
Both directions (PRESS+DRAG)	both signal directions.

When the bidirectional scenario CW+CCW or PRESS+DRAG is selected, pulses are not evaluated and the positive and negative measured values are shown in the plots.

Mean value
The arithmetic mean is calculated from 2-10 measured values to calculate the mean value of the sensor 1 signal. The mean value is used, among other things, to smooth the plots. The mean value is calculated in the PC.

Speed rpm:
The speed and direction of rotation for a motor controller (servo) is output as an analog voltage to the Dsub socket on the module:
-100% = -10VDC,
+100% = -10VDC.
The speed must be entered in rpm if the speed setpoint is selected in revolutions (rpm) in the sensor constants.

Ramp times
The times for the startup-speed ramp Up/s and the cutoff-speed ramp Down/s can be entered here (0 to 9.9 s.).

Archiving
If the flag is set, archiving is enabled for this setpoint record. If enabled, the archiving method can be chosen (table, plot, table + plot).

External trigger:
A test is started when the external trigger is selected, only if the “START” input is energized on the Dsub socket.

Start taring:
When a test is started with “F1 ON”, taring is performed once.

TN after S1threshold
The time T overtravel (Tn) will be started after the S1 threshold is reached. The evaluation is performed after TN has elapsed.

S2 cutoff
Stopping a test with the sensor 2 input can be enabled or disabled with this flag.

Sampling period
The available sampling periods are 0.2 / 0.5 / 1 / 2 / 5 / 10 ms.
This period determines the sampling rate and the time resolution of the three data streams for sensor 1, sensor 2 and angle.

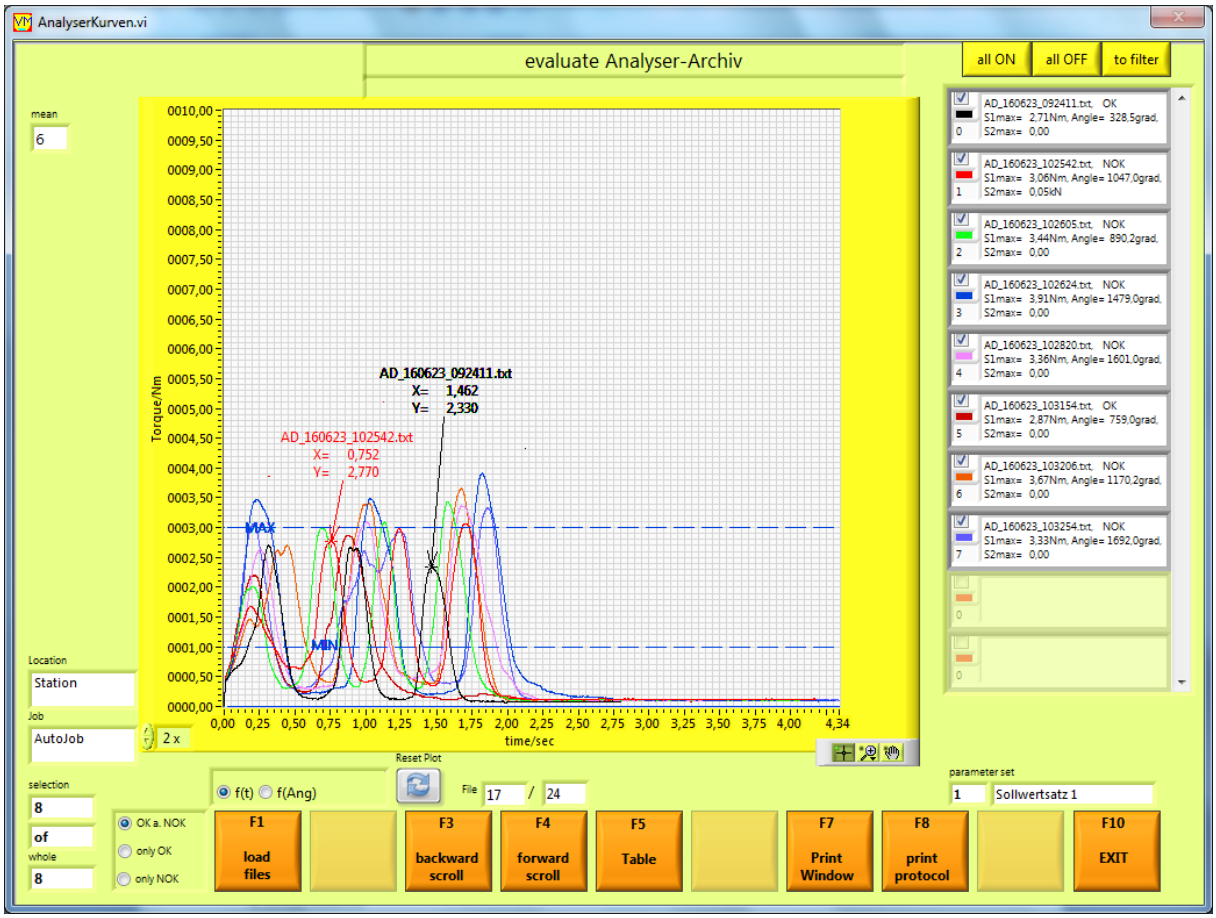
Maximum sampling period:
Please note when selecting the sampling period:
When archiving is enabled, short periods generate large archive files.
Plots are formed slowly and screen changes to the Archive subfuntion are slow.

With SNo.
This flag enables serial number entry.

Filename = SNo
If this flag is set, the serial number becomes part of the test data file name.

2.10.3.7 Analysis: Evaluate archive

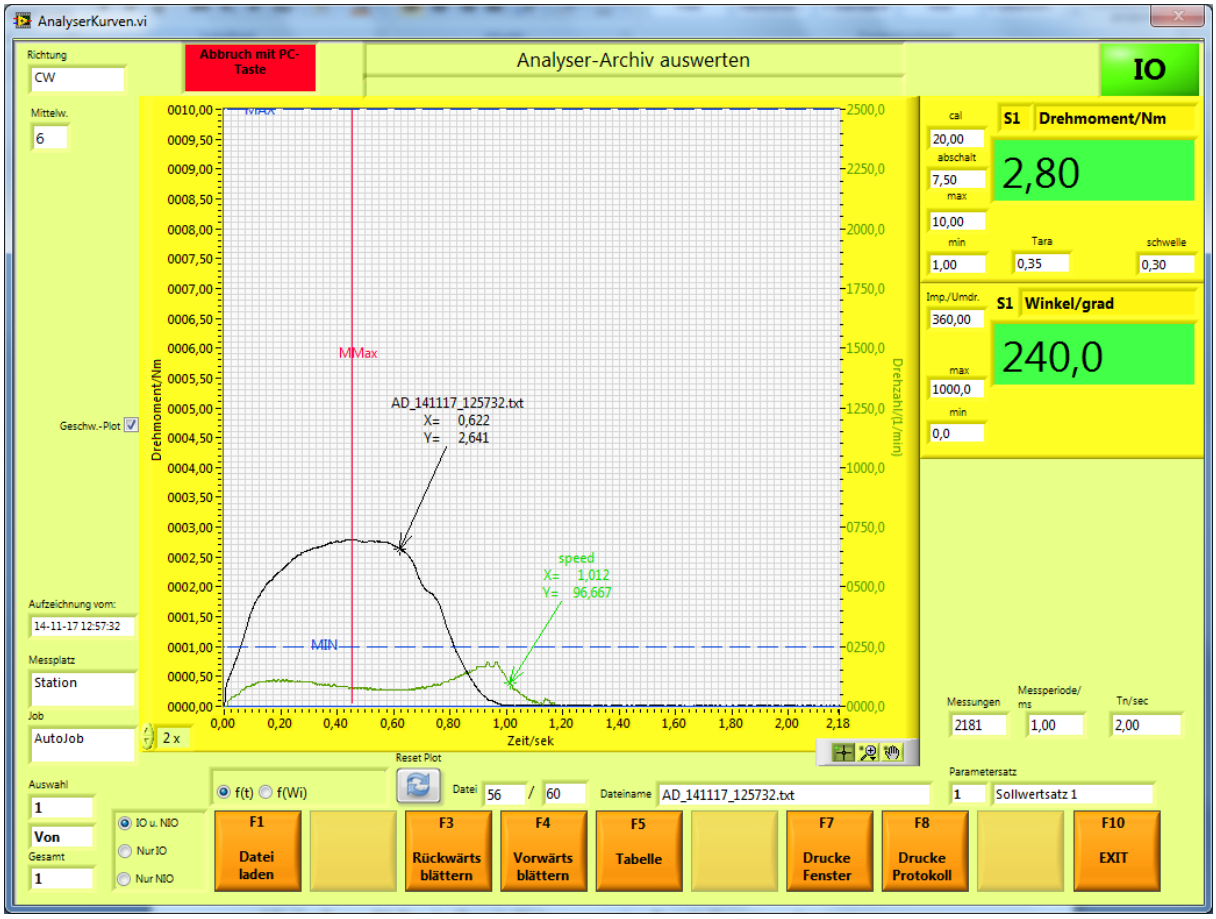
In the “Evaluate archive” subfunction, you can display archived analysis data as a plot and as a table.



Evaluation window for 8 archived torque recordings of the “Analysis” function with plot legend.

You can enable/disable the plots with the checkbox in the plot line in the plot legend. These settings can be saved with the “In filter” button, so that after a “Reset plot” they are loaded when a new screen is output.

You can scroll backwards and forwards, respectively, in the file with the F3 and F4 buttons and show the individual plots.

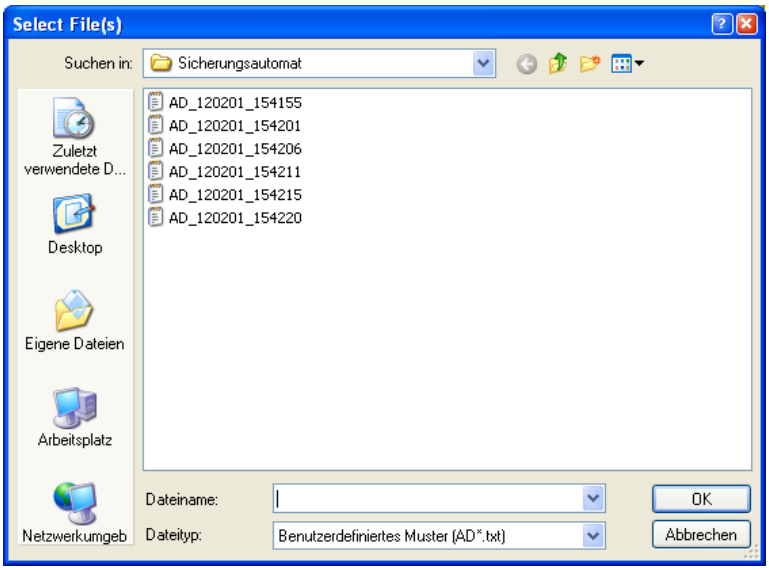


Evaluation window for 1 archived torque recording. If one curve is displayed, the cutoff values are also displayed.

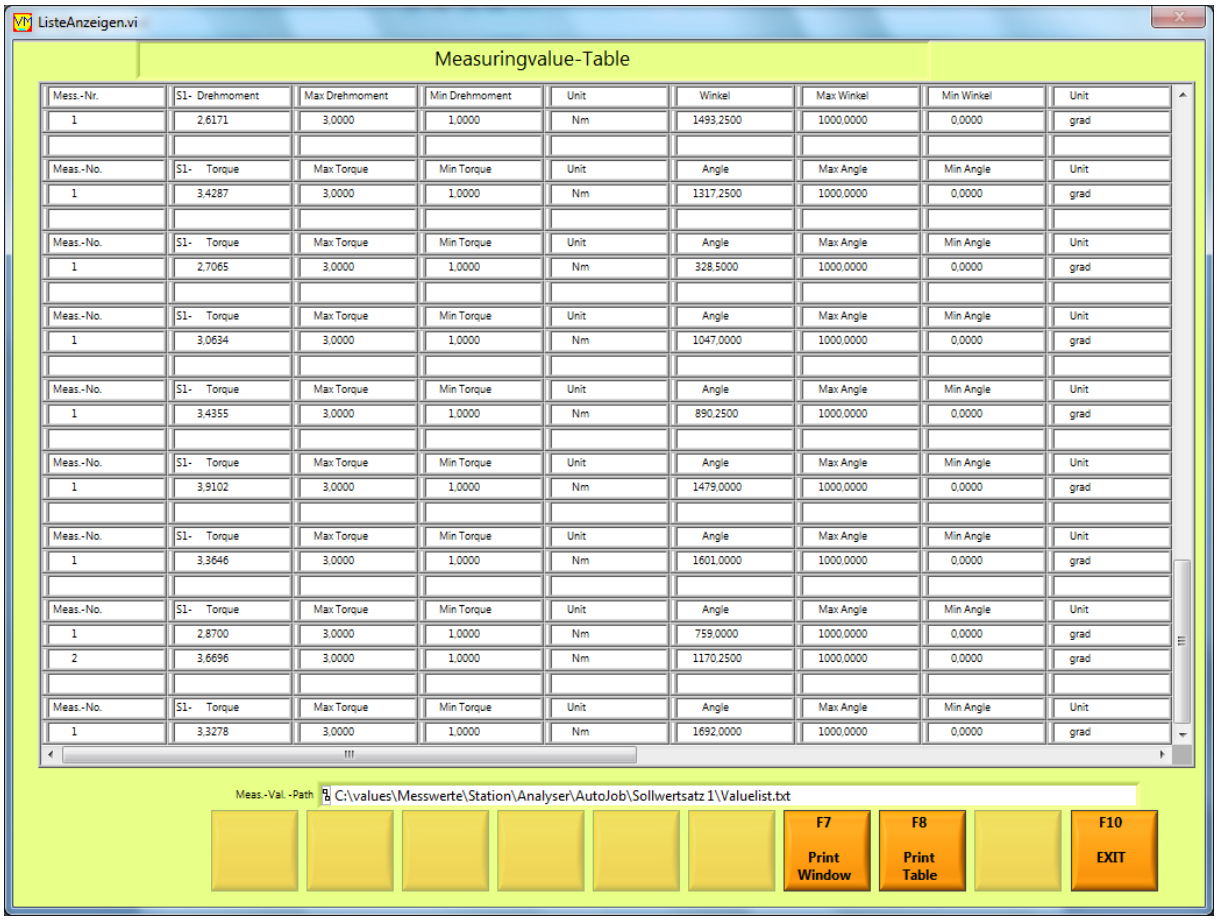
You can initiate a log display or log print with the “F8 Print log” key. First, a window will open where you can enter texts for the log. With the **HTML** button, the log is displayed in the standard internet browser. The **Print** button prints the log to the standard printer.

Loading the measurements file

First, one or more file(s) must be selected for display.
Before selecting the files, you can use the buttons to the left of the F1 button to select whether only OK or only NOK evaluations or both should be displayed. The F1 button opens an Explorer window in which the files are listed. There, one or more files are marked and loaded with OK. At this point files can also be deleted.



The data for all tests can be displayed as a table with the function button “F5 Table”.



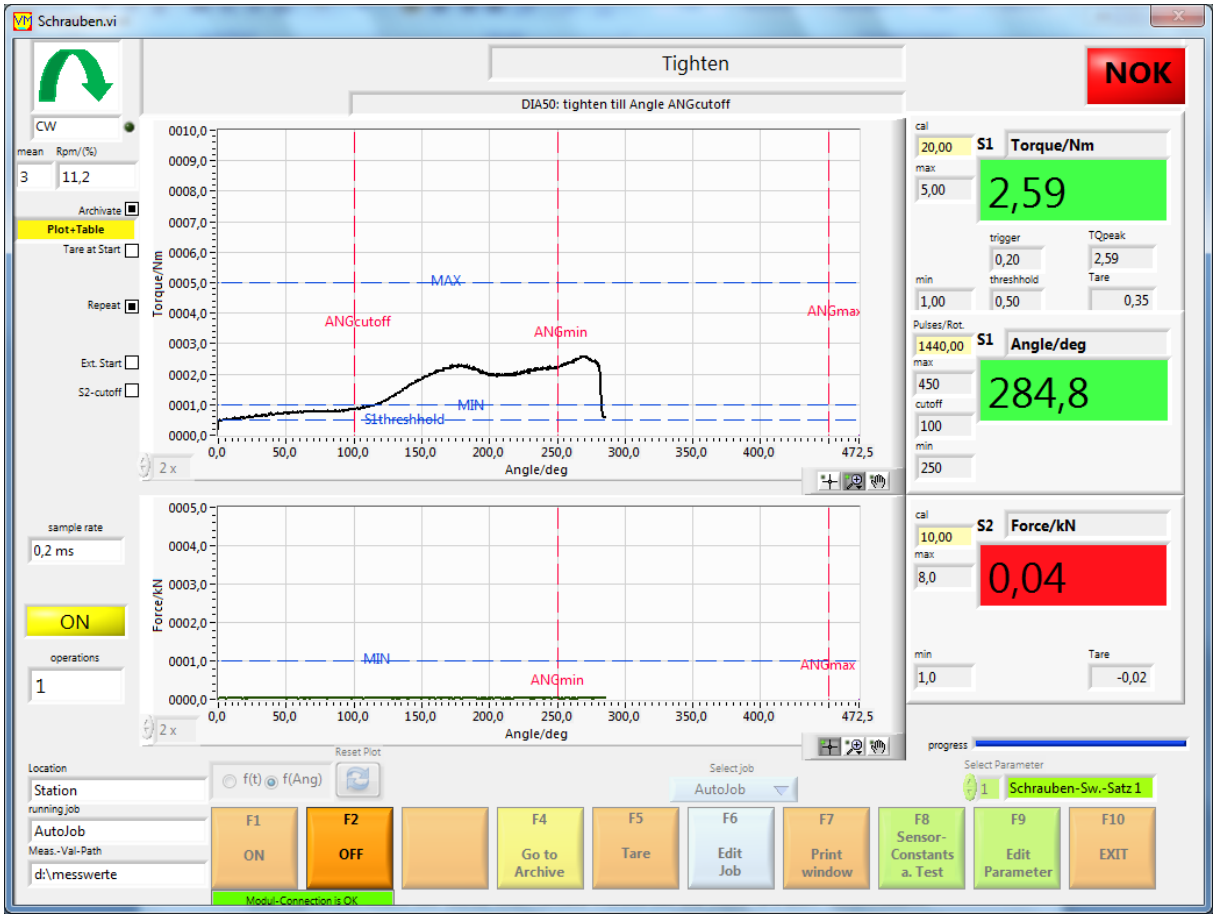
This table is saved in the file Valuelist.txt and can be edited with a text editor or in EXCEL.

2.10.4 Screwing

The screwing function serves to control and monitor a screwing operation. Screwing means to turn a screw/nut to a specified torque or angle. The various types of screwing operations are designated here as diagrams. During screwing, a sensor 1 with a pulse generator is used for the diagrams 30, 35, 40, 50. The torque and angle of rotation are measured with sensor 1.
Force, pressure or travel (e.g., screw-in depth) can be measured with sensor 2.
After reaching one of the cutoff points torque or angle (depending on diagram 20, 30, 35, 40, 50), the data is transferred to the PC and evaluated.
The diagram can be selected in the Setpoints ("F8 Edit setpoints" button).
You can also decide in the Setpoints whether a test should be started with an external start input.

You can also select between a standard test or a loop/programmable test in the "Job" subfunction (accessible with the "F6 Edit job" button).

2.10.4.1 Screwing: Standard test with a setpoint record



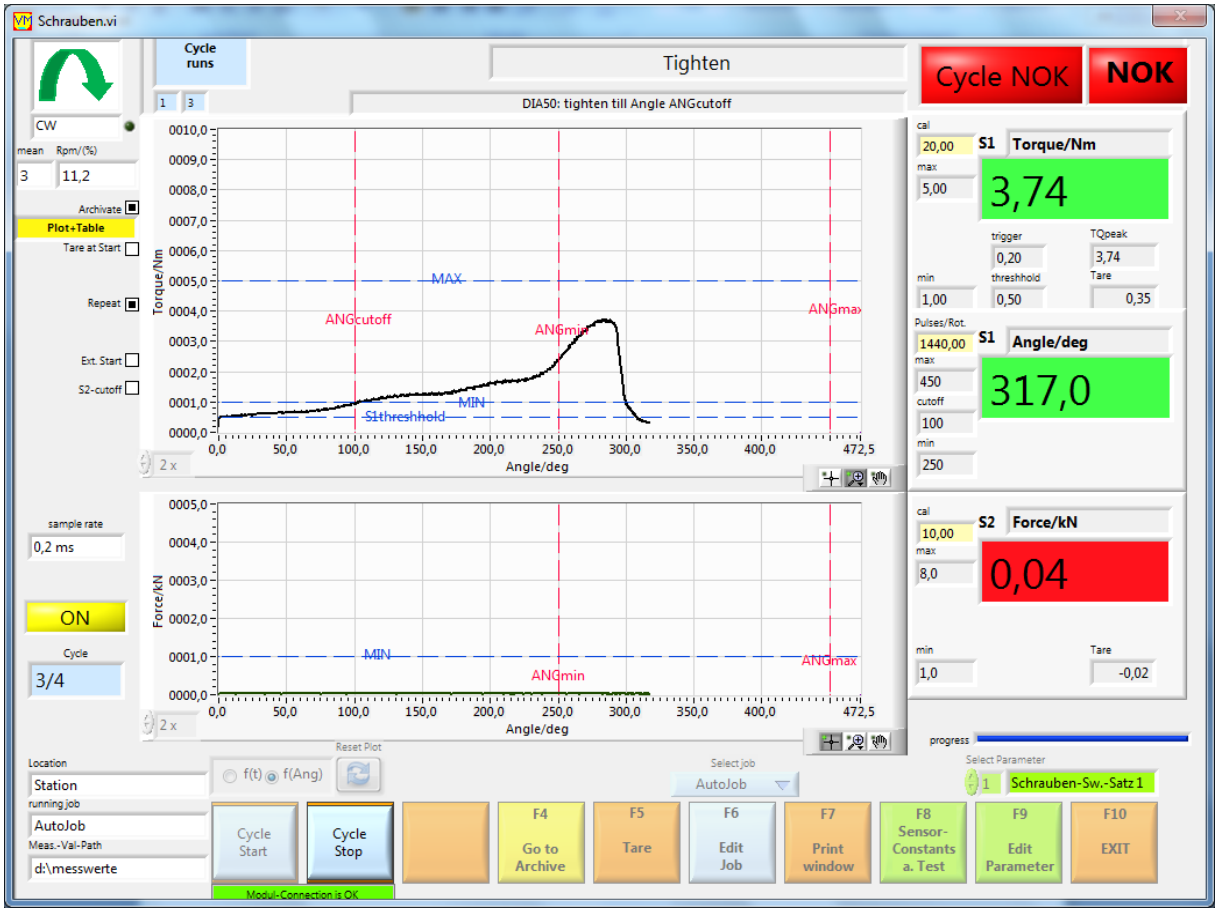
Screwing window – after an NOK screwing operation.

Start the screwing with a setpoint record with the "F1 ON" button.
Any number of screwing operations can be executed with this setpoint record.
The screwing is stopped with the "F2 OFF" button.

2.10.4.2 Screwing: programmable loop

This loop is executed as programmed in the job subfunction. The loop is started with the “Start loop” button and stopped with the “Stop loop” button, or when all loops are complete. Each program step (maximum 4) is executed as a standard test. The loop OK/NOK – the label in the top right-hand corner of the screen shows the overall OK/NOK status of the continuous, running loop. To its right is the OK/NOK state of the processed step.

The plots and data are archived according to the program preselection in a “Loop” folder. Archived curves can be displayed with the function “F4 Evaluate analysis” (individually/together and in tabular form).



2.10.4.3 Screwing: Functions and settings

Archiving
The plots can be archived. Archiving must first be selected in the Setpoints with the pulldown menu: Plot, Table, Plot + table. Archived curves and measurements can be displayed with the function “F4 Evaluate analysis” (individually/together and in tabular form).

Background test in Screwing
When using a sensor with a chip, the sensor data is compared to the chip data. An error message is output if the comparison fails. In addition, the setpoints are checked for plausibility. If the setpoints are not plausible, an error message is also output. No function test can be started as long as there are errors.

Taring after starting with F1
If Start taring ON is set in the setpoint record, a taring is performed. The taring is complete when the “LED ON” is illuminated yellow. The sensors must not be activated during this taring. This taring ignores the taring which is done with the “F5 Taring” button, but only for this start**.**

Evaluation
The curves are displayed after a test run and the data is displayed and assessed (are the measurements within the limits?). The measured values at the cutoff point are displayed.

Direction of rotation indicator
The set direction of rotation is displayed at the top left.
Only measured values generated by this direction of rotation are recorded.
This means that positive signals are recorded for right rotation and negative ones for left rotation.
An “LED” in the direction of rotation indicator lights up RED if more than 15 pulse train errors are detected. (These errors can occur by rotating in the non-specified direction, for example.)

Taring
A taring is performed with the “F5 Taring” button. The tare value is displayed and saved until the next taring. This tare value is valid for the current job.

Edit job
The F6 button opens the Job window.
There a new job can be set up or job texts can be entered and a program loop can be programmed.
This window is described in the “Job Management” section.

2.10.4.4 Screwing: Digital inputs/outputs at the control I/O port

The OK, NOK and ON outputs are used (see Valuemaster manual, Pin assignment section)
In addition, a speed setpoint in the form of a voltage in the range -10V to +10V is output (+- 100% of the maximum speed can be set). Since the polarity of the torque setpoint can be selected, the direction of rotation can be preset.
A Screwing test can be started with the input START (set in the setpoints).

- Control I/Os without "External start"
The READY output is set if the test is started with F1.
The ON output will be energized after 100ms.
The speed setpoint is output at the same time.
After reaching the cutoff point, the OK or NOK outputs are set and the ON output is de-energized for approx. 2 sec and then re-energized. The speed setpoint is set to 0% too and after 2 sec. is set to the setpoint value, again. If the test is stopped again with F2, all outputs are de-energized and the speed setpoint is set to 0%.

- Control I/Os with "External start"
The external trigger flag is set at the left of the Screwing window. The READY output is active if the test is started with F1. The output ON is energized and the speed setpoint is output only after the "START" input = On. The START input must be energized for the entire duration of the screwing operation.
After reaching the cutoff point, the OK or NOK outputs are energized. The ON output is de-energized and the speed is set to 0%.
A new screwing process is started when the START input is de-energized and then re-energized.

If the screwing test is stopped again with F2, all outputs are de-energized and the speed setpoint is set to 0%.
If the START input is de-energized during the screwing process, or if the time Tmax is exceeded, the screwing process is interrupted and a red error message appears in the upper window.

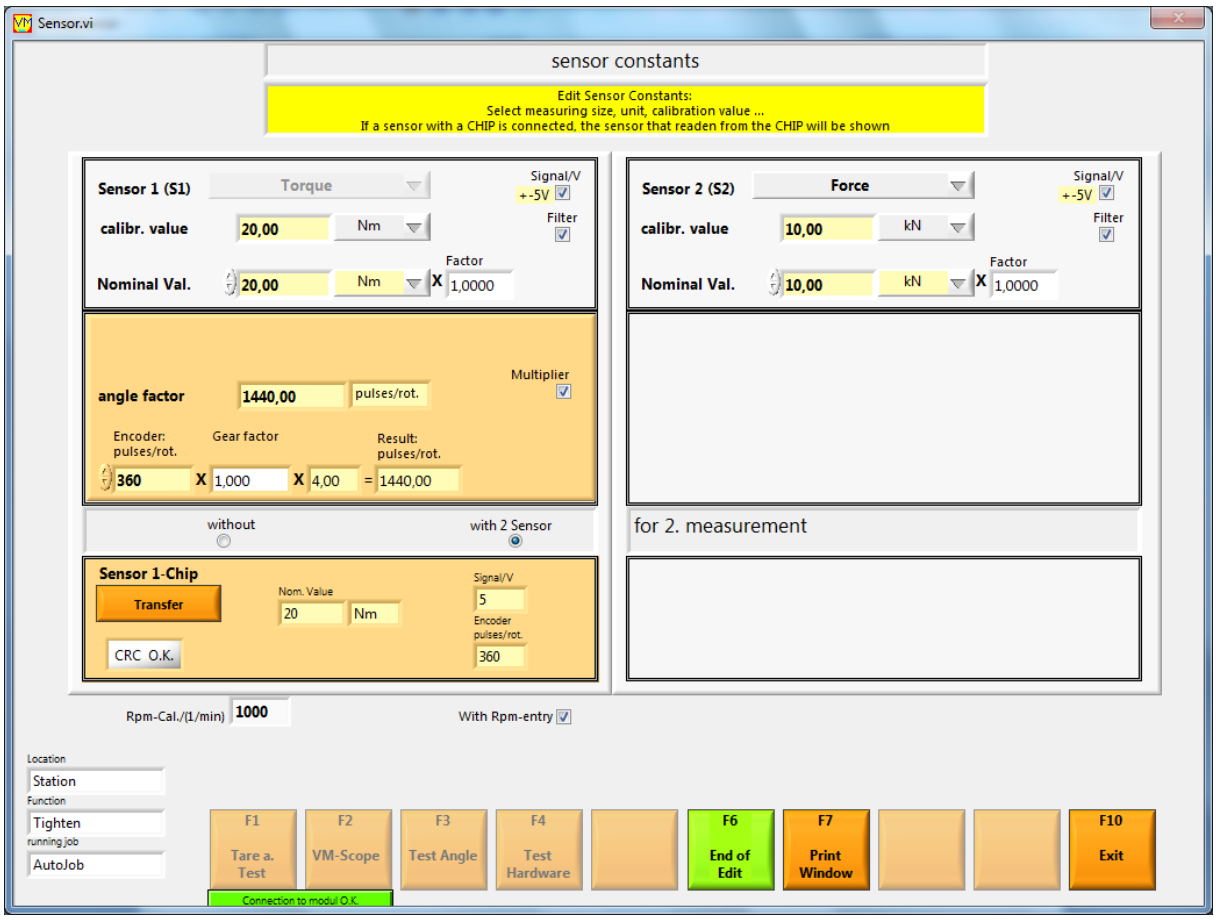
2.10.4.5 Screwing: Sensor constants and test

The sensor constants for sensor 1 and sensor 2 are set with the “F8 Sensor constants and test” button in the “Screwing” function.
If a sensor with chip is connected to the ValueMaster module, the chip data must be loaded, since the chip data is compared with the sensor entries. If there is a difference, no test can be started. Different entries blink RED.

The scope of the test depends on the selection of sensor properties, i.e.:

The test is always run with sensor 1.
The pulse generator is always energized, (however, this is not necessary if screwing is done with graph 20)

If sensor 2 is energized (for the 2nd range only), tests are also run with sensor 2.



Window for the sensor constants in the screwing process

Sensor 2 selection:
Sensor 2 is selected with buttons
o without o with sensor 2
Sensor 2 can thus be disabled, or used for a 2nd parameter.

With Sensor 2 should be used if a 2nd parameter is to be measured.
The 2nd parameter is shown in the bottom graph in the function window.

Inputs for sensor 1 (S1) and sensor 2 (S2):

Calibration value:
If the sensor has a chip, the chip data must be loaded with the "Accept" button or from the PC keyboard. The nominal value is the value which is on the sensor rating plate or is stored in the sensor chip.

Calibration value = nominal value x factor

In addition, the calibration value changes depending on the selected engineering unit (Nm, Ncm …).

S1 input, S2 input
The maximum voltage of the sensor inputs at nominal value can be 5V or 10V. The operator selects the sensor voltage. For a sensor with sensor chip, this setting is loaded from the chip. The amplifications are changed in the measurement module to suit the selection.

Filter
Each channel in the ValueMaster module has an analog filter with a 1kHz frequency limit. This filter can be turned on/off.

Inputs for sensor 1 (S1)

Pulse/revs
The "Pulse/revs" value is calculated from several factors.
The "Encoder pulse/revs" is the value given by the sensor manufacturer.
This "Encoder pulses/revs" (e.g., 60 or 360) can be multiplied by a factor (e.g., necessary for gears). A pulse quadrupler is enabled on the ValueMaster module using the Multiplier button. The pulse count is thus electronically quadrupled in the ValueMaster module.

Pulses/revs = Encoder pulse/revs x gear factor x Vvalue

Vvalue = 4 if the pulse quadrupler is enabled
Vvalue = 1 if the pulse quadrupler is disabled

Speed calibration value
The **"With rpm-entry"** flag allows you to choose if the default for the speed output in the Setpoints must be entered in "%" or in "rpm". If the speed default must be in "rpm", the speed calibration value **rpm-cal (1/min)** must be entered, as well**.**

The **test functions**
- F1 Tare and test
- F2 VM-scope
- F3 Angular test
- F4 Test hardware

are identical in all functions and are therefore described in the Test Functions section.

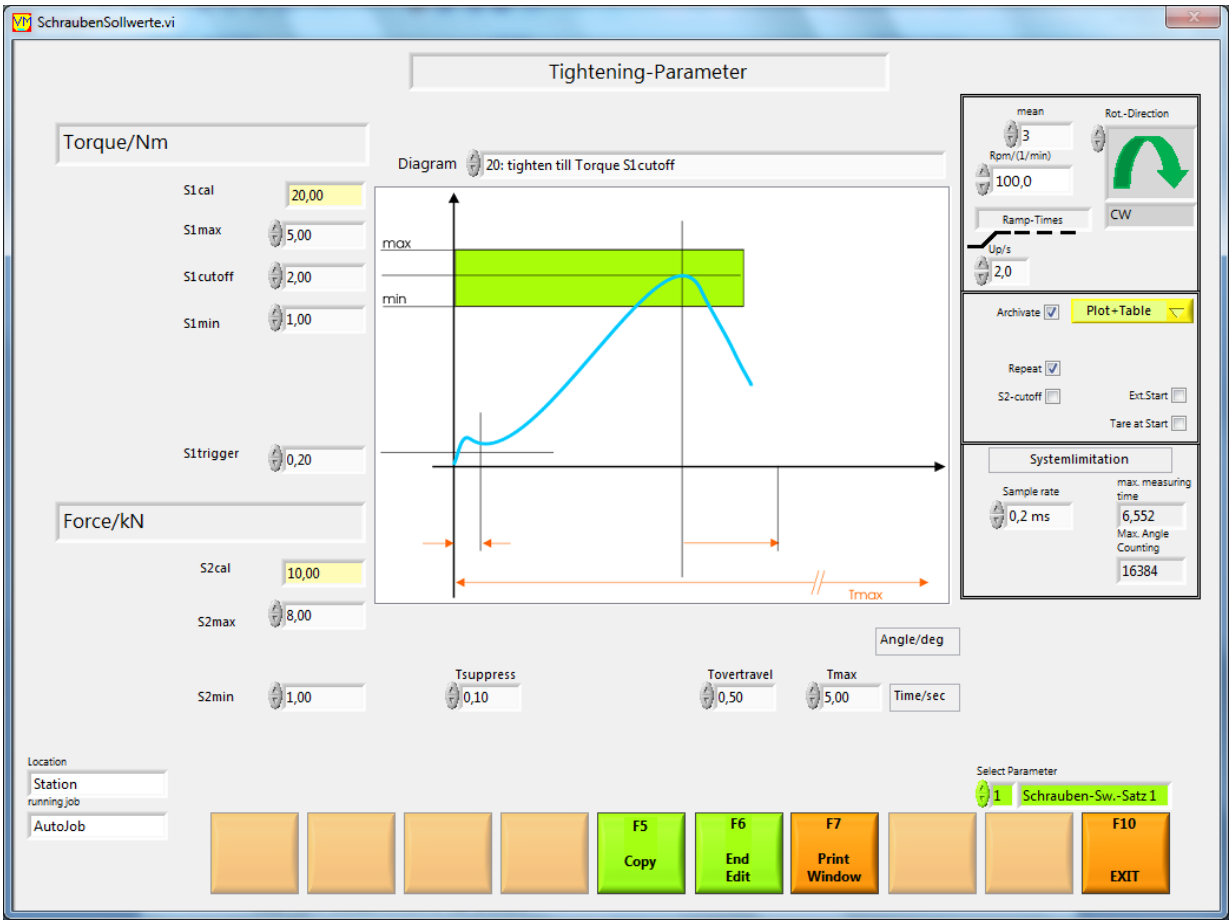
2.10.4.6 Screwing: Edit setpoints

Diagrams (Screwing methods):

Five different diagrams (screwing methods) can be selected. A diagram is selected with the “Diagram” button.
Different diagrams (screwing methods) are used depending on the screwing requirements: Diagram 20, 30, 35, 40 and 50:

Diagram 20:

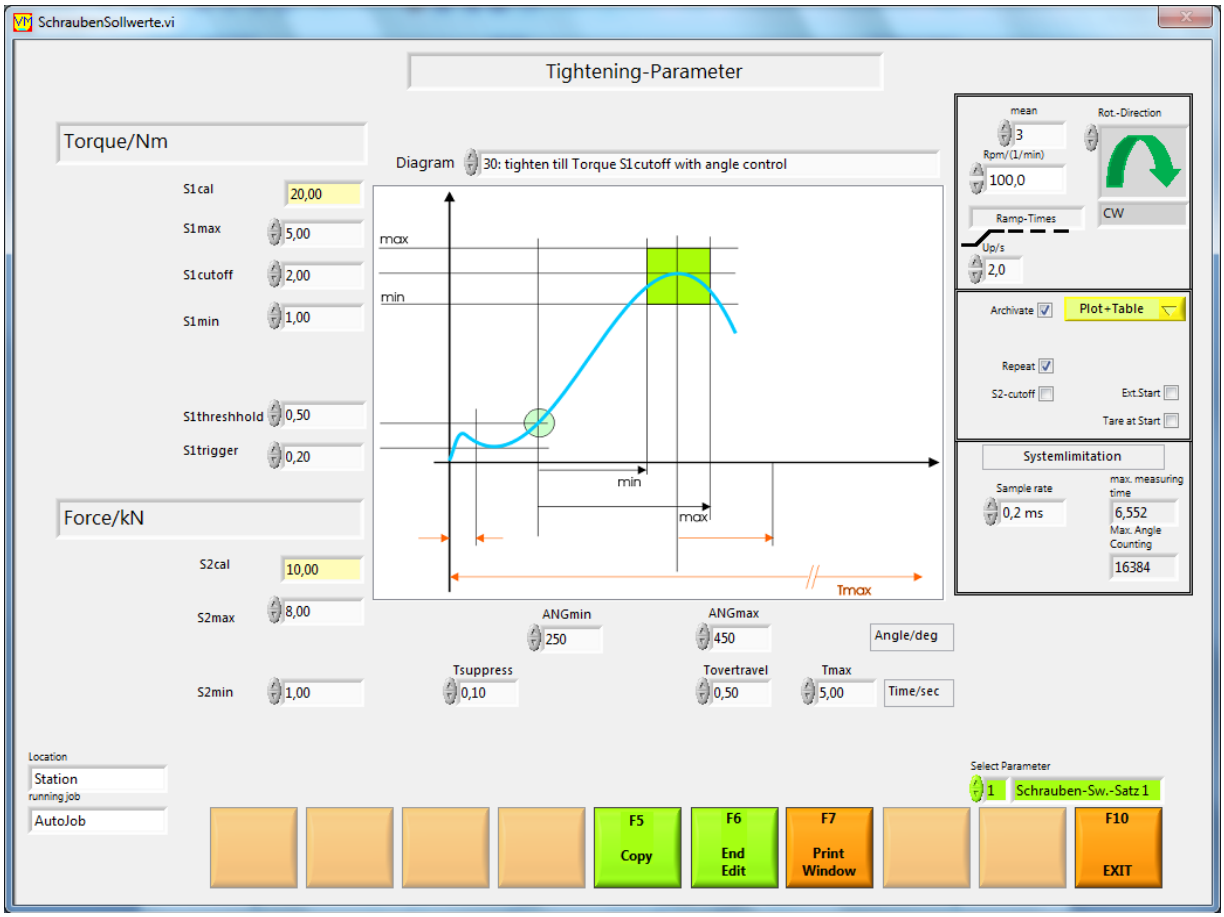
DIA20:
Screwing up to the cutoff torque “S1cutoff”
The torque at the cutoff point must be between S1min and S1max.
When Tmax is reached, the screwing operation stops.



Setpoints entry window for DIA20

Diagram 30:

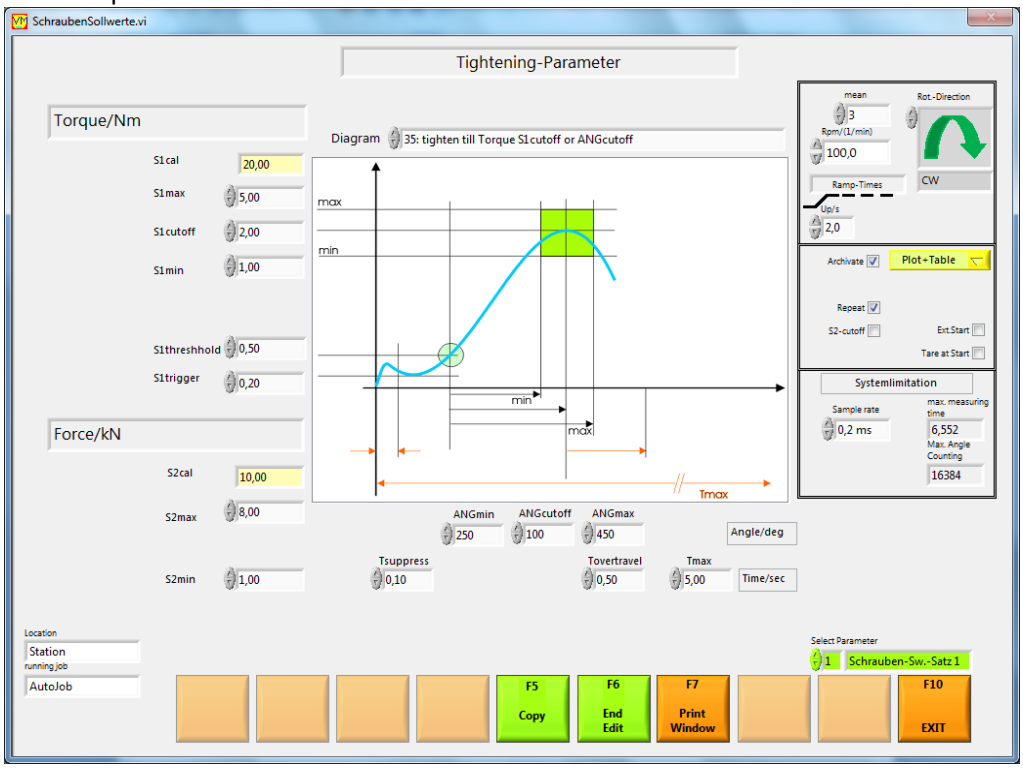
DIA30:
Screws up to the cutoff torque “S1off” or angle ANGmax (as emergency cutoff).
The torque at the cutoff point must be between S1min and S1max.
The angle at the cutoff point must be between ANGmin and ANGmax.
Exceeding Tmax ends the screwing operation.



Setpoints entry window for DIA30

Diagram 35:

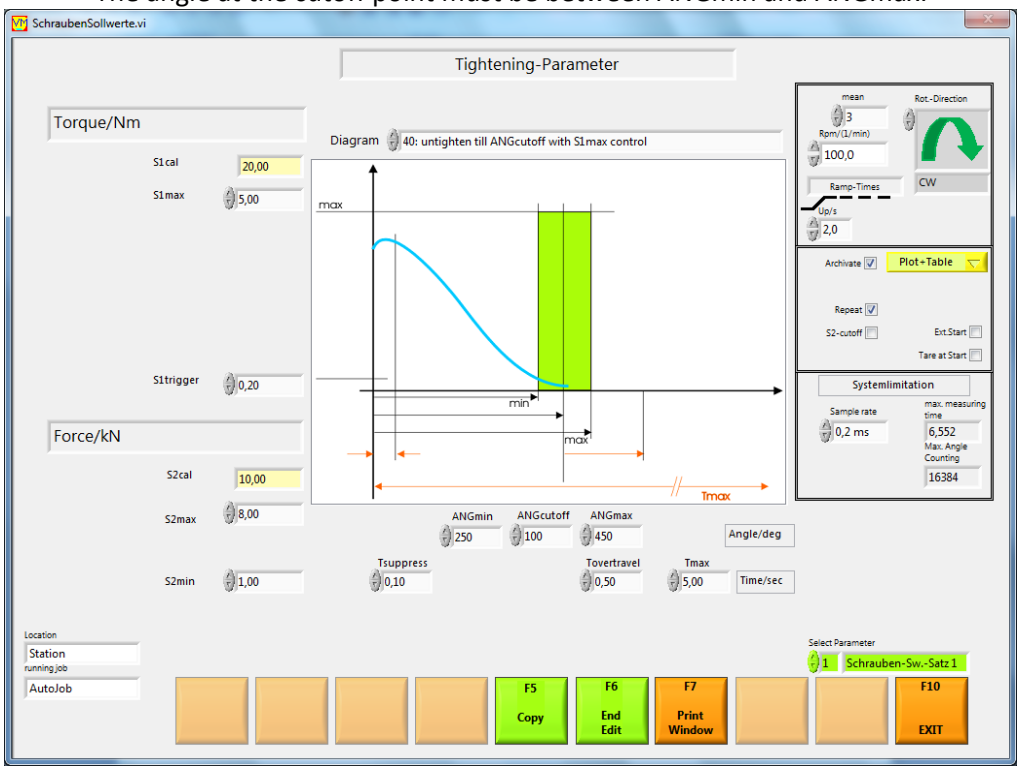
DIA35: Screwing up the cutoff torque “S1cutoff” or angle ANGcutoff (whichever comes first). The torque at the cutoff point must be between S1min and S1max. The angle at the cutoff point must be between ANGmin and ANGmax. Exceeding Tmax terminates the screwing operation.



Setpoints entry window for DIA35

Diagram 40

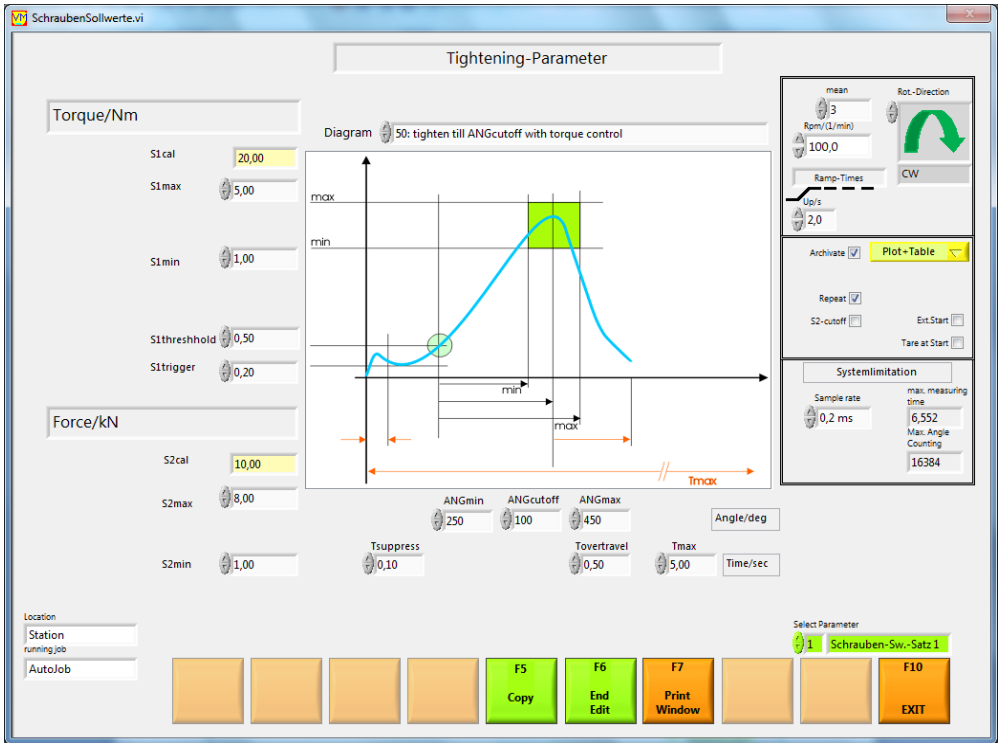
DIA40: Loosening a screwed connection up to the cutoff angle ANGmax or torque S1 max (as emergency cutoff). The peak torque during loosening must be between 0 and S1max. The angle at the cutoff point must be between ANGmin and ANGmax.



Setpoints entry window for DIA40

Diagram 50:

DIA50: Screwing up to the cutoff angle ANGcutoff or torque S1 max (as emergency cutoff).
The torque at the cutoff point must be between S1min and S1max.
The angle at the cutoff point must be between ANGmin and ANGmax.



Setpoints entry window for DIA50

Limit values

Upper and lower limits must be set for torque, force and angle.
If the measured values are within these limits, then they are correct (OK), otherwise they are incorrect (NOK).

Trigger torque and threshold torque:

When screwing in a screw, the torque recording in the VALUEMASTER module is started after the trigger torque S1trigger is exceeded. The angle measurement in the VALUEMASTER module begins after torque S1threshold (threshold torque). If the torque S1cutoff (cutoff torque) or ANGmax is reached, the screwing process has finished.

Times Ta (suppress), Tn(overtravel) and Tmax

If the screwing process has ended, the torque, angle and force are still recorded and measured for a lag time, Tn. Only when Tn has elapsed are the measured values torque, angle and force transferred to the PC. Evaluation is done in the PC.
During Ta a starting pulse is suppressed (measured value peaks do not cause a cutoff). After the time Tmax, screwing is stopped (timeout).

Mean value

The arithmetic mean is calculated from 2-10 measured values to calculate the mean value of the sensor 1 signal. The mean value is used, among other things, to smooth the plots.
The mean is calculated in the ValueMaster module.

Direction of rotation
The direction of rotation determines the expected direction of rotation during screwing.
The direction of rotation is transferred to the VALUEMASTER module.
Only torque data that results from the selected direction of rotation are recorded.
Only angles which result from the selected direction of rotation are recorded.
Pulse trains which result from an incorrect direction of rotation are accumulated.
If there are more than 16 false pulse trains, the message “Pulse train error” is displayed (red LED in the respective PC evaluation window).

Rotational speed
The speed and direction of rotation for a motor controller (servo) is output as an analog voltage to the Dsub socket on the module:
-100% = -10VDC,
+100% = -10VDC.
The speed must be entered in rpm if the speed setpoint is selected in revolutions (rpm) in the sensor constants.

Ramp times
You can enter the time for the startup speed ramp here (0 to 9.9 sec).

External start
With no “External start”, a screwing operation is started when “F1 ON” is energized.
With “External start“, a screwing operation is only started if the START input on the control I/O port of the Value Master module is energized.

Start taring:
After starting a screwing operation with “F1 ON”, taring is performed once.

System limits
Since the measured values torque, force and angle data are stored in the VALUEMASTER module and are transferred to the PC when the screwing operation is finished, the system limits are fixed by the RAM size and the counter limits in the VALUEMASTER module.

Archiving
If the flag is set, archiving is enabled for this setpoint record. If enabled, the archiving method can be chosen (table, plot, table + plot).

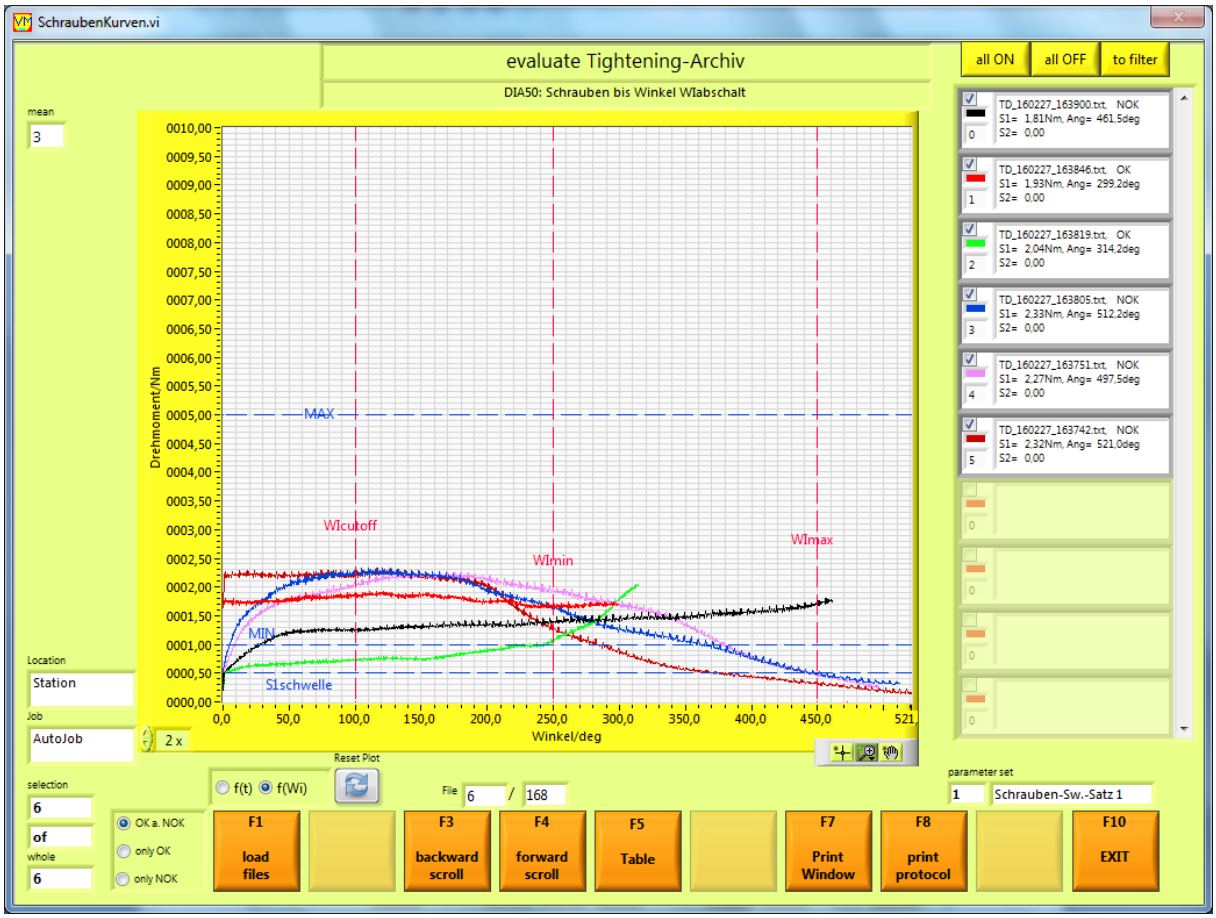
S2 cutoff
Stopping a test with the sensor 2 input can be enabled or disabled with this flag.

With SNo.
This flag enables serial number entry.

Filename = SNo
If this flag is set, the serial number becomes part of the test data file name.

2.10.4.7 Screwing: Evaluate archive

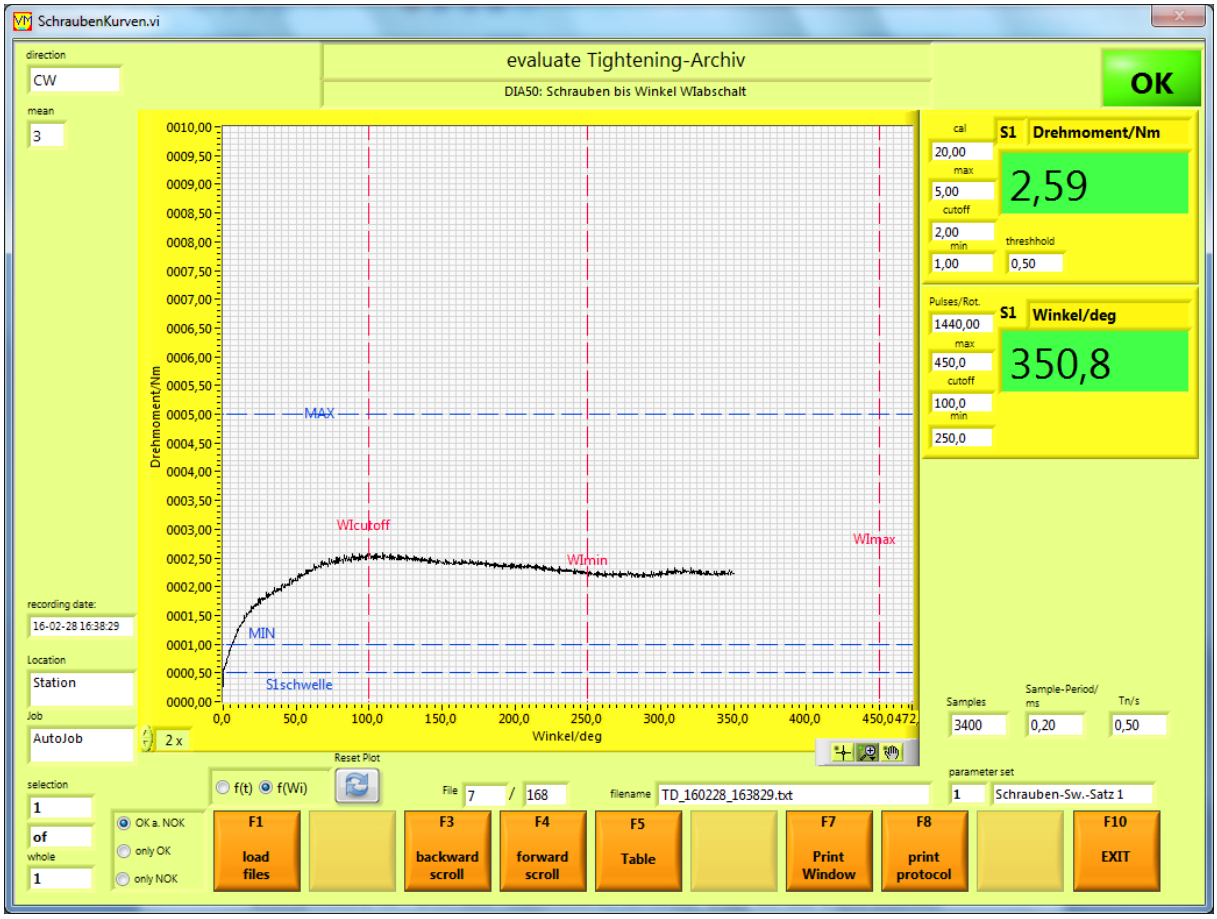
You can display archived measured values from of a screwing operation in the “Screwing archive” subfunction.



Evaluation window for 6 archived torque recordings of the “Screwing” function with plot legend.

In the **plot legend**, you can enable/disable the plots with the checkbox in the plot line. These settings can be saved with the “In filter” button, so that after a “Reset plot” they are loaded when a new screen is output.

You can scroll backwards and forwards, respectively, in the file with the F3 and F4 buttons and show the plot.

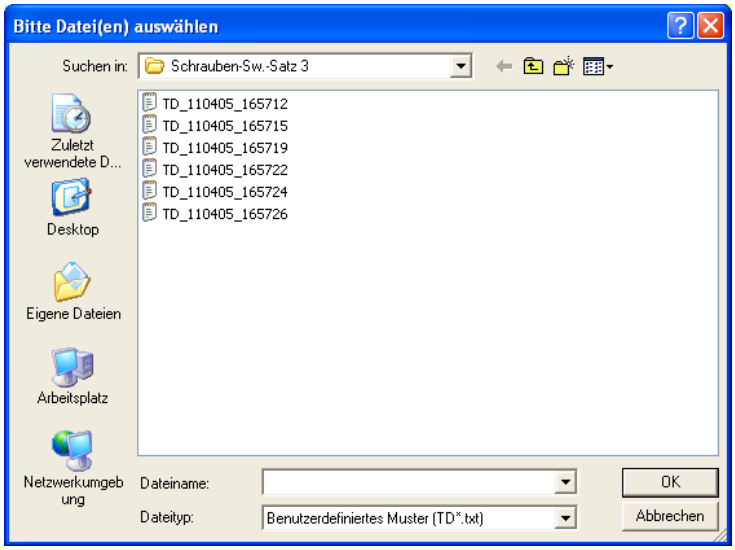


Evaluation window for one archived torque recording. If only one curve is displayed, the cutoff values are also displayed.

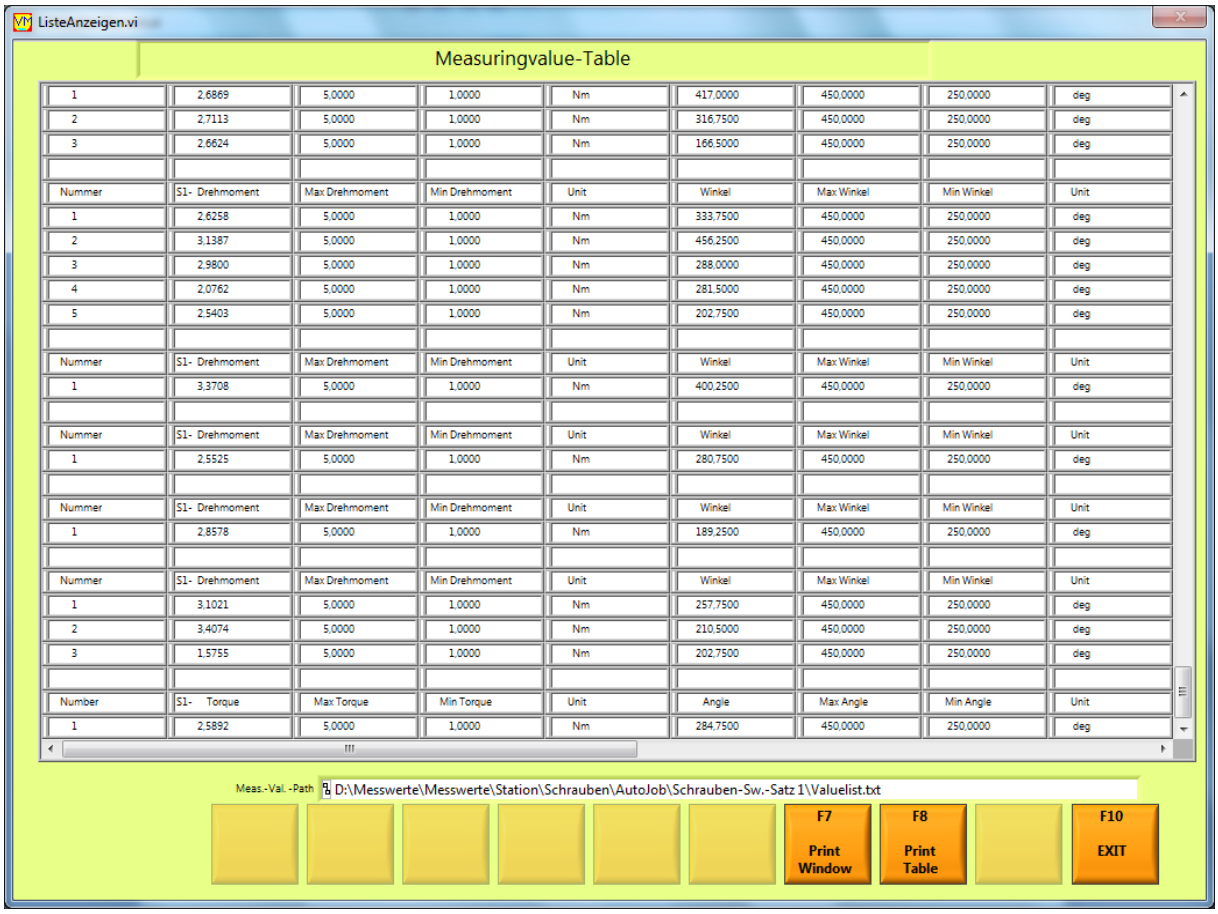
You can display or print a report with the “F8 Print report” button. First, a window is opened in which more text for the report can be entered. The report is displayed in the standard Internet browser with the **HTML** button. The report is printed on the standard printer with the **Print** button.

Loading measurements file

First, one or more file(s) must be selected for display.
Before selecting the files, you can use the buttons to the left of the F1 button to select whether only OK or only NOK evaluations or both should be displayed. The F1 button opens an Explorer window in which the files are listed. There, one or more files are marked and loaded with OK. At this point files can also be deleted.



The data for all Screwing tests can be displayed as a table with the function button “F5 Table”.



1	2,6869	5,0000	1,0000	Nm	417,0000	450,0000	250,0000	deg
2	2,7113	5,0000	1,0000	Nm	316,7500	450,0000	250,0000	deg
3	2,6624	5,0000	1,0000	Nm	166,5000	450,0000	250,0000	deg
Nummer	S1- Drehmoment	Max Drehmoment	Min Drehmoment	Unit	Winkel	Max Winkel	Min Winkel	Unit
1	2,6258	5,0000	1,0000	Nm	333,7500	450,0000	250,0000	deg
2	3,1387	5,0000	1,0000	Nm	456,2500	450,0000	250,0000	deg
3	2,9800	5,0000	1,0000	Nm	288,0000	450,0000	250,0000	deg
4	2,0762	5,0000	1,0000	Nm	281,5000	450,0000	250,0000	deg
5	2,5403	5,0000	1,0000	Nm	202,7500	450,0000	250,0000	deg
Nummer	S1- Drehmoment	Max Drehmoment	Min Drehmoment	Unit	Winkel	Max Winkel	Min Winkel	Unit
1	3,3708	5,0000	1,0000	Nm	400,2500	450,0000	250,0000	deg
Nummer	S1- Drehmoment	Max Drehmoment	Min Drehmoment	Unit	Winkel	Max Winkel	Min Winkel	Unit
1	2,5525	5,0000	1,0000	Nm	280,7500	450,0000	250,0000	deg
Nummer	S1- Drehmoment	Max Drehmoment	Min Drehmoment	Unit	Winkel	Max Winkel	Min Winkel	Unit
1	2,8578	5,0000	1,0000	Nm	189,2500	450,0000	250,0000	deg
Nummer	S1- Drehmoment	Max Drehmoment	Min Drehmoment	Unit	Winkel	Max Winkel	Min Winkel	Unit
1	3,1021	5,0000	1,0000	Nm	257,7500	450,0000	250,0000	deg
2	3,4074	5,0000	1,0000	Nm	210,5000	450,0000	250,0000	deg
3	1,5755	5,0000	1,0000	Nm	202,7500	450,0000	250,0000	deg
Number	S1- Torque	Max Torque	Min Torque	Unit	Angle	Max Angle	Min Angle	Unit
1	2,5892	5,0000	1,0000	Nm	284,7500	450,0000	250,0000	deg

This table is saved in the file Valuelist.txt and can be edited with a text editor or in EXCEL.

2.10.5 Frictional torque

Frictional torque measurements are taken with gears, plain/ball bearings, hinges, window lifts in vehicles, etc., to be able to determine the so-called frictional torque.

Definition:
Since the frictional torque can be recorded and evaluated as a function of time, angle or position (the selection is done in the setpoint parameters). Below, the limits are generally designated as x-start, x-end and x-cutoff. (Replace x with the angle or time.)

Sensor 1 with/without a pulse generator can be used with the “Frictional torque” function.
The torque and angle of rotation are measured with sensor 1.
With the “Frictional torque” function, the torque is recorded periodically in the VALUEMASTER module and after reaching a cutoff value x-cutoff, it is displayed on the PC and evaluated. The test plots can be saved.

Principles of measurement:
When the test piece (e.g., gear shaft) slips and spins, the torque recording in the VALUEMASTER module is started when the trigger torque MDtrigger is exceeded. The angle/time test in the VALUEMASTER module begins after the torque MDthreshold (threshold torque). When x-cutoff is reached, the test is complete. The torque values are transferred to the PC. The evaluation is done in the PC, where only the torques between **x-start and** x-end are included.

You can also select between a standard test or a loop/programmable test in the “Job” subfunction (accessible with the “F6 Edit job” button).

2.10.5.1 Frictional torque: Evaluation methods

All typical measured data are shown after a frictional torque test:

- Highest frictional torque (Hi)
- Mean frictional torque (Me)
- Lowest frictional torque (Lo)
- Breakoff torque (Br)
- Difference torque (Di)

You can select the analysis method in the Setpoints.

Frictional torque evaluation
You can select the evaluation methods for the frictional torque test in the Setpoints.

Mean frictional torque
When the test has terminated, the arithmetic mean calculated from all measured values recorded within the limits x-start and x-end is checked to be within the min. and max. limit values.

Highest and lowest frictional torque
When the test has terminated, the measurements within the limits x-start and x-end will be checked to be within the min. and max. limit values.

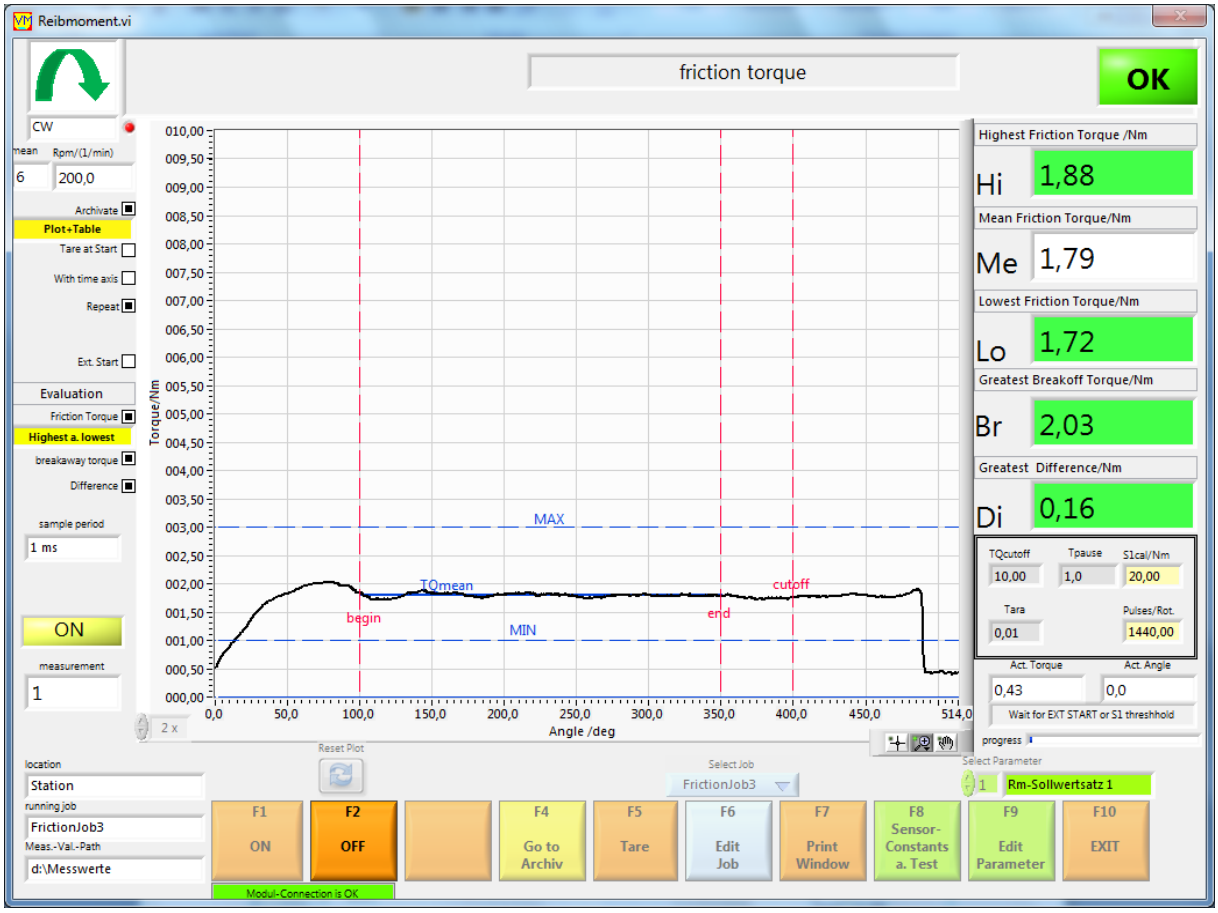
Difference evaluation
The greatest frictional torque difference within the limits x-start and x-end will be assessed.

Breakaway torque evaluation
The greatest frictional torque from the start to the angle ANGstart will be assessed.

Before starting a test, you must select the limit values from setpoint record 1-10. The limit values for torque, angle of rotation, etc. must be specified in the setpoint record. You can enter the limit values with the function key **F9: Edit setpoints**.

2.10.5.2 Frictional torque: Standard test using a setpoint record

A test is started with the F1 ON button. You can run as many tests as you want to with the preset setpoint record.

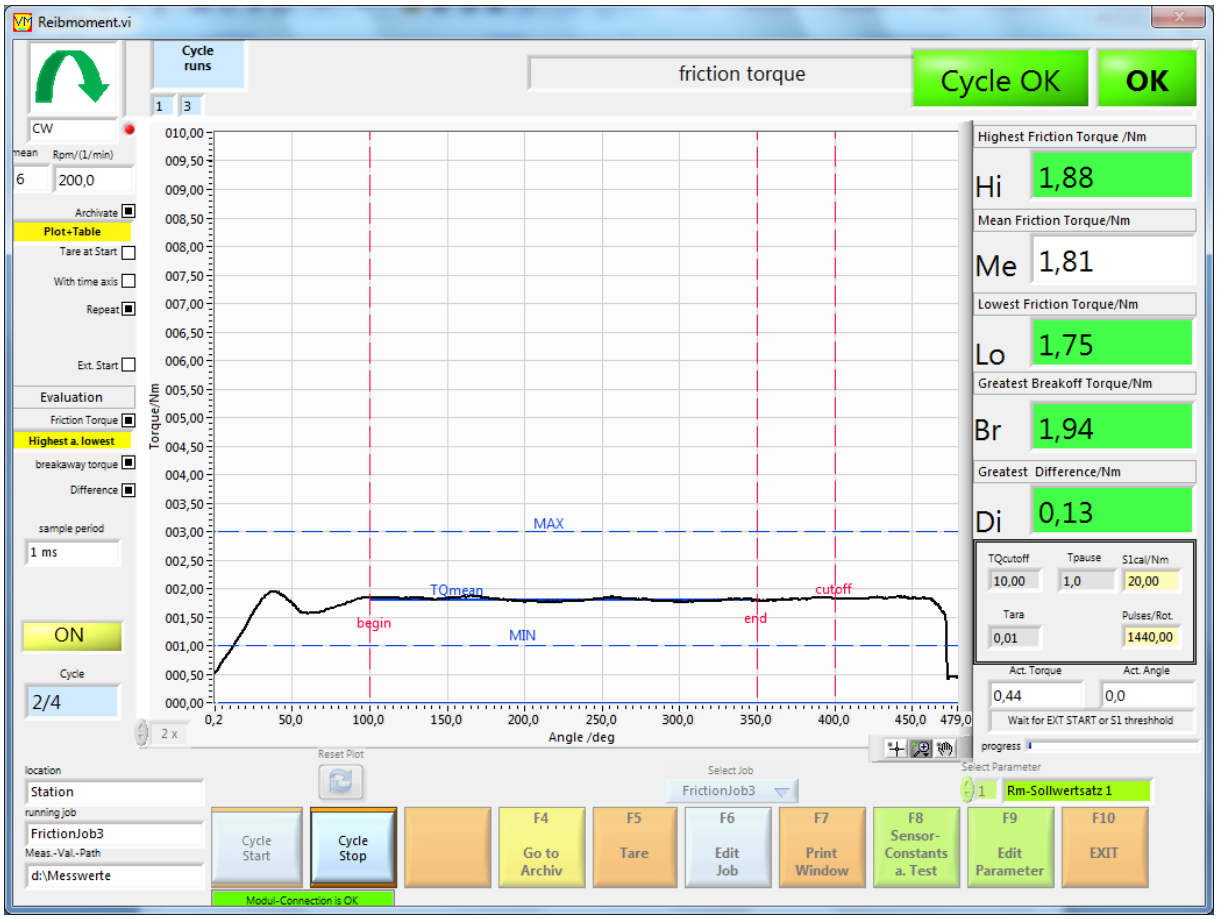


Function “Measure frictional torque” with evaluation angle

2.10.5.3 Frictional torque: Program loop

This test is executed according to the programming in the job subfunction. The loop is started with the “Start loop” button and stopped with the “Stop loop” button, or when all loops have executed. Each program step (maximum 4) is executed as a standard test: The loop OK/NOK – the label in the top right-hand corner of the screen shows the overall OK/NOK status of the continuous loop. To its right is the OK/NOK state of the processed step.

The plots and data are archived according to the program preselection in a “Loop” folder. Archived curves can be displayed with the function “F4 Evaluate analysis” (individually/together and in tabular form).



2.10.5.4 Frictional torque: Functions and settings

Background tests in frictional torque
When using a sensor with a chip, the sensor data is compared to the chip data. An error message is output if there are any anomalies. Furthermore, the setpoints are checked for plausibility and if there is no plausibility, an error message is also output. No test can be started as long as there are errors.

Taring after starting with F1
If Start taring ON is set in the setpoint record, a taring is performed. The taring is complete when the "LED ON" is illuminated yellow. The sensors must not be activated during this taring. This taring ignores the taring which is done with the "F5 Taring" button, but only for this start**.**

Evaluation
The curves are displayed after a test run and the results are displayed and evaluated (are the measured values within the limits?).
The following values are displayed:

- Highest frictional torque (Hi)
- Mean frictional torque (Me)
- Lowest frictional torque (Lo)
- Breakaway torque (Br)
- Difference torque (Di)

Direction of rotation indicator
The set direction of rotation is displayed in the direction of rotation indicator, top left.
Only measured values which result from this direction of rotation are recorded.

Right rotation (CW):	positive signals are recorded
Left rotation (CCW):	negative signals are recorded.
Bidirectional (CW+CCW):	positive and negative signals are recorded.

In the case of CW and CCW, an "LED" in the direction display lights up RED if more than 15 pulse train errors are detected. (These errors can occur by rotating in the non-specified direction, for example.)

Taring
A taring is performed with the "F5 Taring" button. The tare value is displayed and saved until the next taring. This tare value is valid for the current job.

Editing Job
The F6 button opens the Job window.
There a new job can be set up or job texts can be entered. A loop sequence can be programmed, as well.
This window is described in the "Job Management" section.

2.10.5.5 Frictional torque: Inputs/outputs at the control I/O port

Inputs/outputs on the control I/O port
The READY, OK, NOK and ON outputs are used (see Valuemaster manual, Pin assignment section)
In addition, a speed setpoint in the form of a voltage in the range -10V to +10V is output (+- 100% of the maximum speed can be set). Since the polarity of the torque setpoint can be selected, the direction of rotation can be set as well.
A test can be started with the input START (set in the setpoints).

- Control I/Os without "External trigger"
The READY output is active if the test is started with F1.
After 100ms the ON-output is energized.
The speed setpoint is output simultaneously. The angle or time test starts when the threshold torque S1threshold is exceeded.
After reaching the cutoff angle ANGcutoff or the cutoff time Tcutoff, the OK or NOK outputs are set and the ON output is de-energized for approx. 2 sec and then re-energized. The speed setpoint is set to 0% too and after 2 sec. is set to the setpoint value, again.
If the test is stopped again with F2, all outputs are de-energized and the speed setpoint is set to 0%.

- Control I/Os with "External trigger"
The "EXTERNAL TRIGGER" field on the left in the "Frictional torque" window is checked.
The READY output is active if the test is started with F1.
When the "START input" = On, the output ON is energized and the speed setpoint is output.
The START input must be on for the entire duration of the test.
The test is stopped when the START input is de-energized. The OK or NOK output is energized.
The ON output is de-energized and the speed is set to 0%. A new screwing test is started when the START input is de-energized and then re-energized.

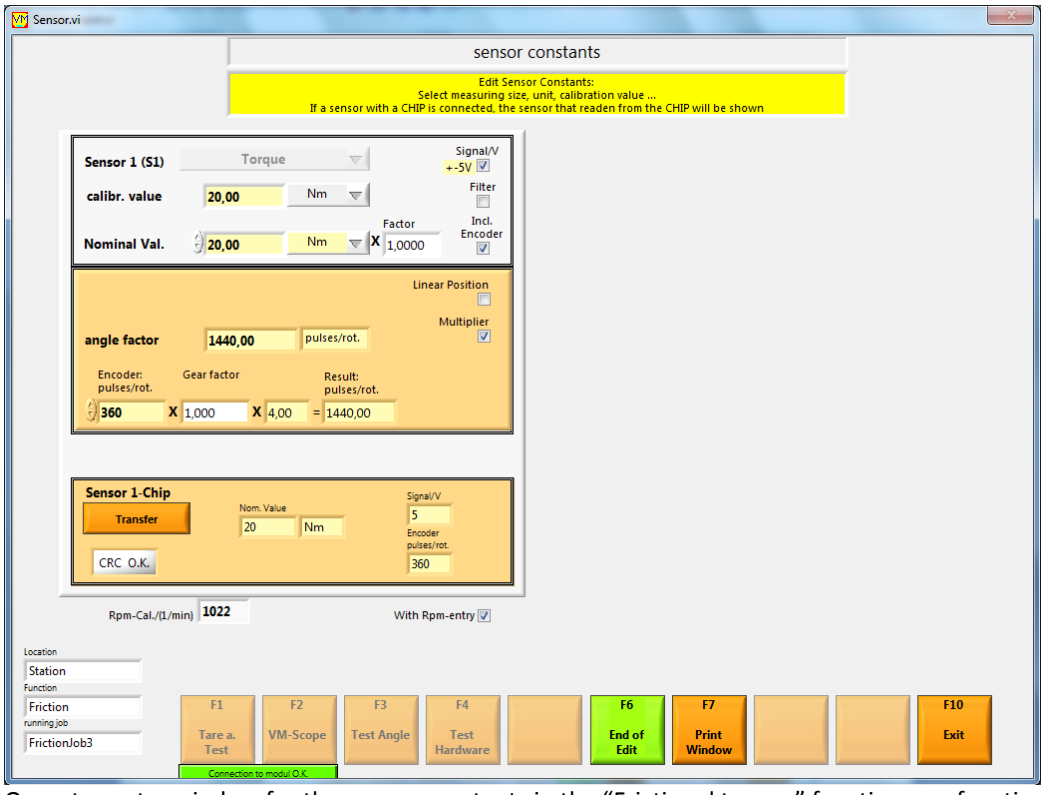
If the test is stopped again with "F2 OFF", all outputs are de-energized and the speed setpoint goes to 0%.

If the START input is de-energized during the test, the test is interrupted and a red error message appears in the upper window.

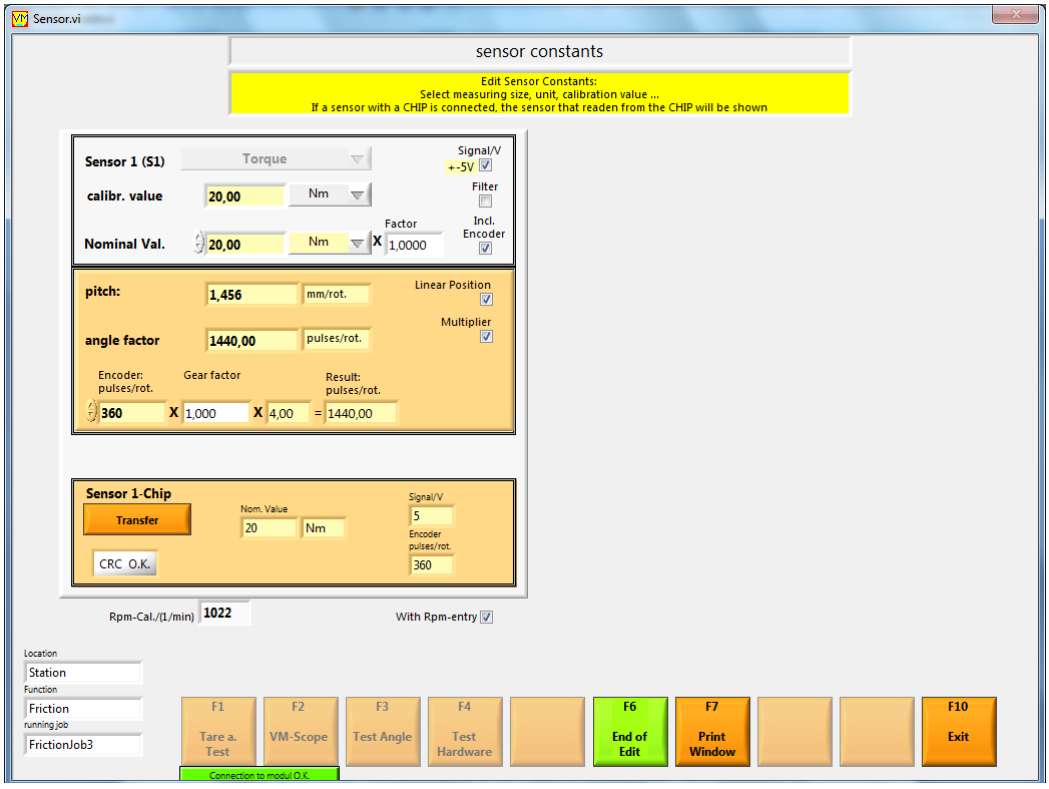
2.10.5.6 Frictional torque: Sensor constants and test

The sensor constants for sensor 1 are set with the “F8 Sensor constants and test” button in the Frictional torque function. If a sensor with chip is connected to the ValueMaster module, the chip data must be loaded, since the chip data is compared with the sensor entries. If there is a difference, no test can be started. Different entries blink RED.

The sensor constants must also be specified before a test is run:



Operator entry window for the sensor constants in the “Frictional torque” function as a function of the angle.



Operator entry window for the sensor constants in the “Frictional torque” function as a function of the position.

Inputs for sensor 1 (S1):

Calibration value:
If the sensor has a chip, the chip data must be loaded with the "Accept" button or from the PC keyboard. The nominal value is on the sensor rating plate or is entered in the sensor chip.

Calibration value = nominal value x factor

In addition, the calibration value changes depending on the selected engineering unit (Nm, Ncm …).

The maximum voltage of the sensor inputs at nominal value can be 5V or 10V. The operator selects the sensor voltage. For a sensor with sensor chip, this setting is loaded from the chip. The amplification is changed in the ValueMaster measurement module to suit the selection.

Filter
Each channel in the ValueMaster module has an analog filter with a 1kHz frequency limit. This filter can be turned on/off.

Encoder
The encoder (angle sensor) can be turned on/off.

Pulse/revs
The "Pulse/revs" value is calculated from several factors.
The "Encoder pulse/revs" is the value given by the sensor manufacturer.
This "Encoder pulses/revs" (e.g., 60 or 360) can be multiplied by a factor (e.g., necessary for gears). A pulse quadrupler is enabled on the ValueMaster module using the Multiplier button. The pulse count is thus electronically quadrupled in the ValueMaster module.

Pulses/revs = Encoder pulse/revs x gear factor x Vvalue

Vvalue = 4 if the pulse quadrupler is enabled
Vvalue = 1 if the pulse quadrupler is disabled

Linear position
Showing the position on the x-axis.

Slope (mm/* revs*)
The value "*Slope* (mm/revs)" is used to convert the angle to a position.

Position(mm) = slope * angle /360

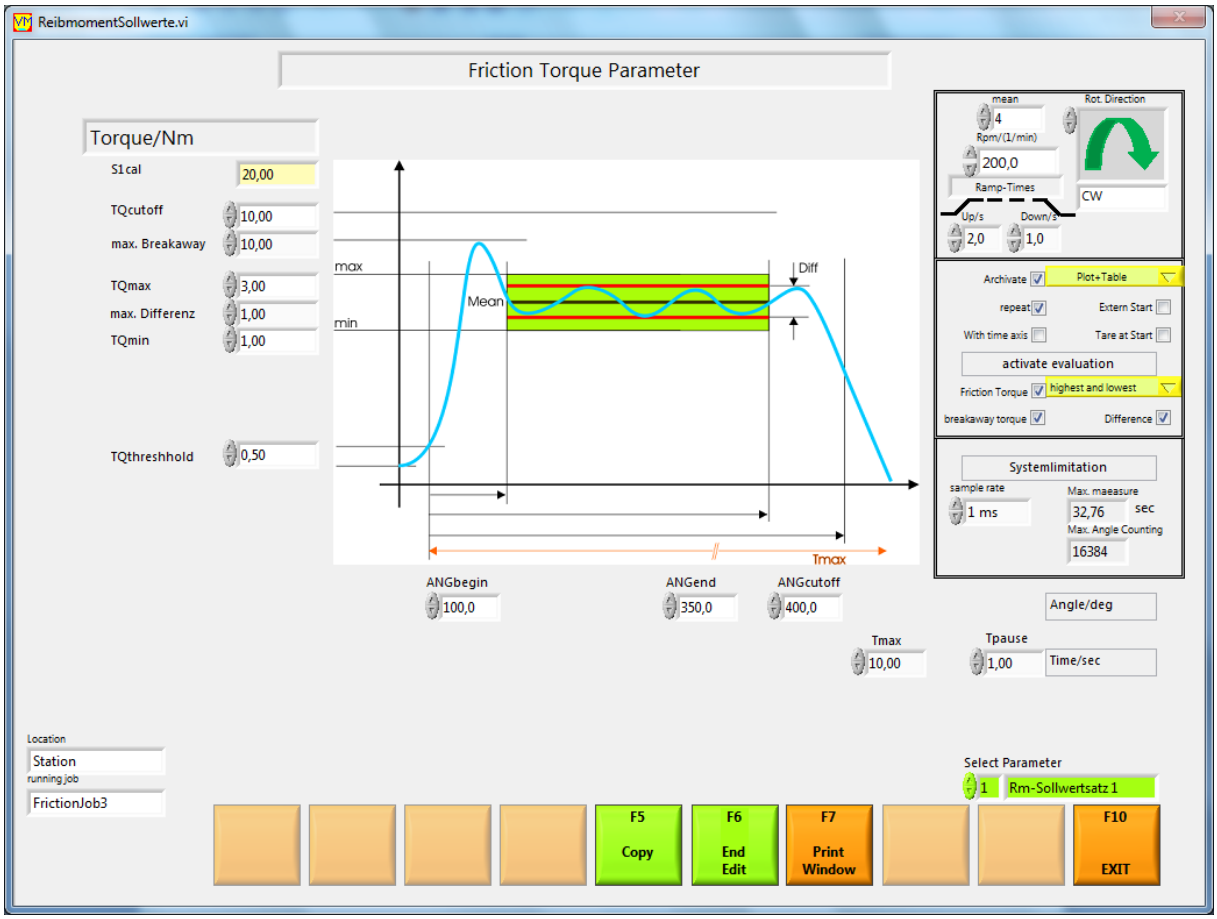
Speed calibration value
The **"With rpm-entry"** flag allows you to choose if the default for the speed output in the Setpoints must be entered in "%" or in "rpm". If the speed default must be in "rpm", the speed calibration value **rpm-cal (1/min)** must be entered, as well**.**

The **test functions**
- F1 Tare and test
- F2 VM-scope
- F3 Angular test
- F4 Test hardware

are identical in all functions and are therefore described in the Test Functions section.

2.10.5.7 Frictional torque: Edit setpoints

When entering the setpoint for the frictional torque test, you can also select the evaluation.



Operator entry window for the setpoints in the “Frictional torque” function.

Limit values
Upper and lower limits must be set for the torque.
If the input values are within these limits, then they are correct (OK), otherwise they are incorrect (NOK).

MDcutoff
If this torque is exceeded, the test is aborted (emergency cutoff)

Trigger torque and threshold torque:
During a test, the torque recording in the VALUEMASTER module is started after the trigger torque MDtrigger is exceeded. The angle measurement in the VALUEMASTER module begins after torque MDthreshold (threshold torque). A test is completed when ANGcutoff is reached.

Mean value
The arithmetic mean is calculated from 2-10 measured values to calculate the mean value of the torque. The mean value is used, among other things, to smooth the plots.
The mean is calculated in the ValueMaster module.

Direction of rotation
The direction of rotation determines the expected direction of rotation during a test. The direction of rotation is transferred to the VALUEMASTER module.
Only torque data that results from the selected direction of rotation are recorded.
Only angles which result from the selected direction of rotation are recorded.
Pulse trains which result from an incorrect direction of rotation are accumulated.
If there are more than 16 false pulse trains, the message “Pulse train error” is displayed (red LED in the respective PC evaluation window).
When the bidirectional directions CW+CCW are selected, no pulse-train evaluation is made and the positive and negative measured values are shown in the plots.

Rotational speed
The speed and direction of rotation for a motor controller (servo) is output as an analog voltage to the Dsub socket on the module:
-100% = -10VDC,
+100% = -10VDC.
The speed must be entered in rpm if the speed setpoint is selected in revolutions (rpm) in the sensor constants.

Ramp times
You can enter the times for the start-up speed ramp **Up/s** and the cutoff speed ramp **Down/s** here (0 to 9.9 sec).

Repeat
If the Repeat flag is set, the function will be repeated. If the Repeat flag is not set, the function will be carried out once and the function window will go back to its initial state (not effective if loop = ON).

External trigger
A test is started immediately without “External trigger”.
With “External trigger”, a test is started only when the START input on the control I/O port of the ValueMaster module is energized. The tests ends when the START input is de-energized.

Start taring
After starting the test with “F1 ON”, taring is performed once.

With time axis
ON: The frictional torque is measured as a function of time and shown in the plot.
OFF: The frictional torque is measured as a function of the angle of rotation and shown in the plot.
This selection option is only displayed if an angle sensor (encoder) is selected in the sensor constants.

Activated evaluation

Frictional torque
If the friction torque flag is set, you can select the evaluation method “Mean frictional torque” or “Greatest lowest frictional torque” in a drop-down-menu.

With “Mean fictional torque”, the arithmetic mean of all torque values within the limits x-start and x-end is calculated and checked that it is within the limits MDmax and MDmin.

With “Greatest lowest fictional torque”, all torque values of within the limits x-start and x-end are checked that they are within the limits MDmax and MDmin.

Breakaway torque
Breakaway torque is the maximum torque between start and x-start.
If the flag is set, the fictional torque is checked for exceeding the parameter “max. breakaway”.

Difference
In the differential test, the difference between the smallest and the largest friction torque, within the x-start and x-end, is calculated.
If the flag is set, the friction torque is checked for exceeding the parameter “max. difference”.

System limits
The system limits are constrained by the counter size and the available RAM in the VALUEMASTER module, as the torque and angle are saved in the VALUEMASTER module and transferred to the PC at the end of the test run.

Pause time Tpause (Tp):
A pause time Tpause runs after the test. If Tpause = 0, the digital output ON is not de-energized between tests.

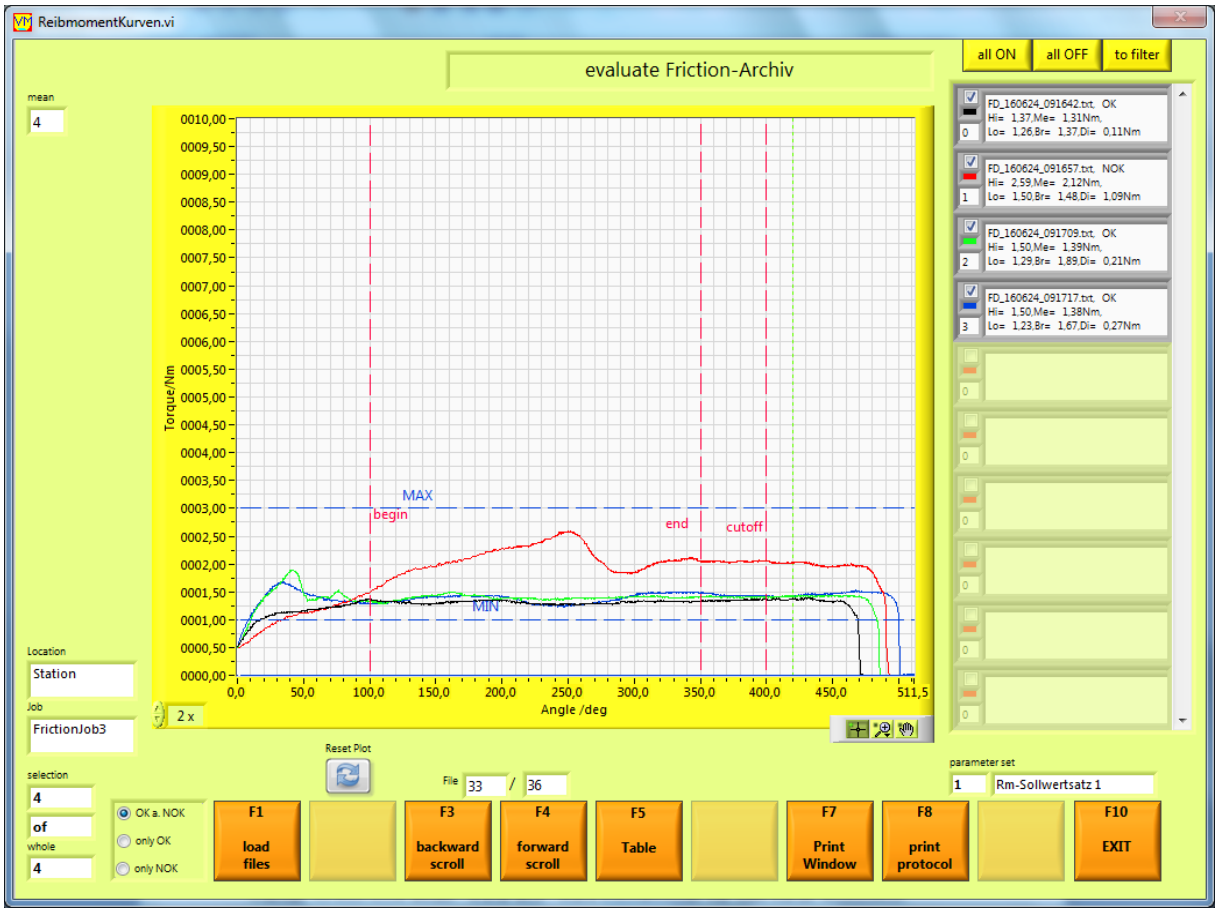
Observe time Tmax:
If TQthreshold is exceeded after the test is started, Tmax is started. If Tmax is exceeded, the test is stopped (effective only “with timeline = OUT”).

With SNo.
This flag enables the serial number entry.

Filename = SNo
If this flag is set, the serial number becomes part of the test data file name.

2.10.5.8 Frictional torque: Evaluate archive

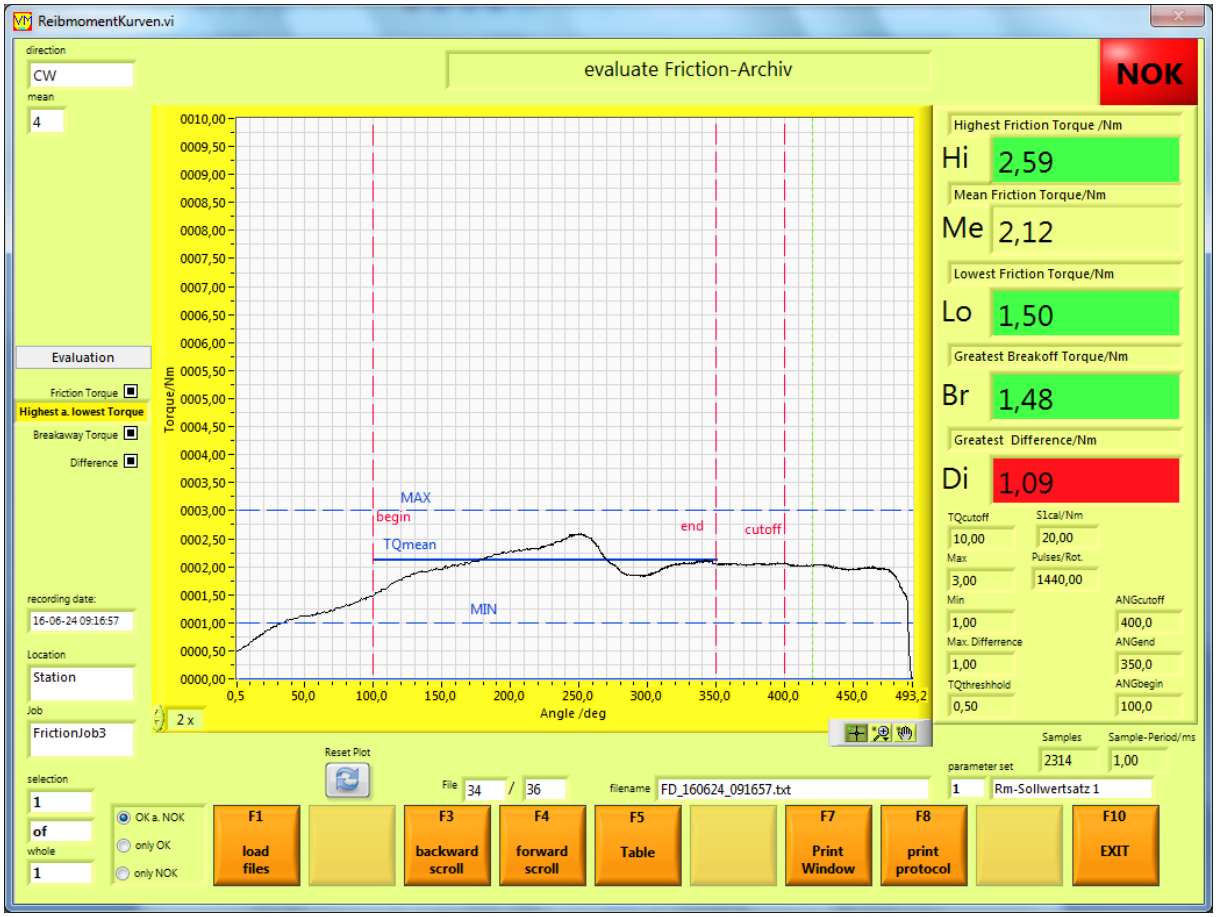
You can plot stored data from a frictional torque test in the “Evaluate frictional torque archive” subfunction.



Evaluation window for 4 archived torque recordings of the “Frictional torque” function with plot legend.

You can enable/disable the plots with the checkbox in the plot line in the **plot legend**. These settings can be saved with the “In filter” button, so that after a “Reset plot” they are loaded when a new screen is output.

You can scroll backwards and forwards, respectively, in the file with the F3 and F4 buttons and show the individual plots.

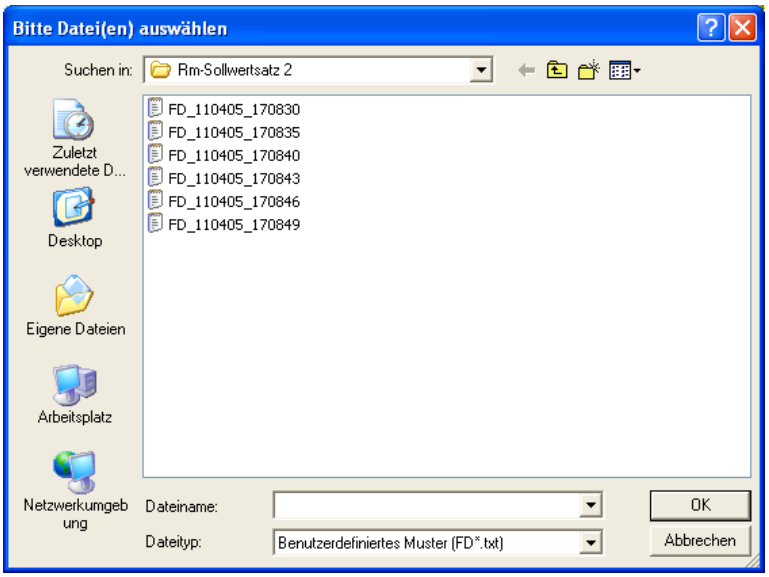


Evaluation window for one archived torque recording. If only one plot is selected, the frictional torque values are displayed.

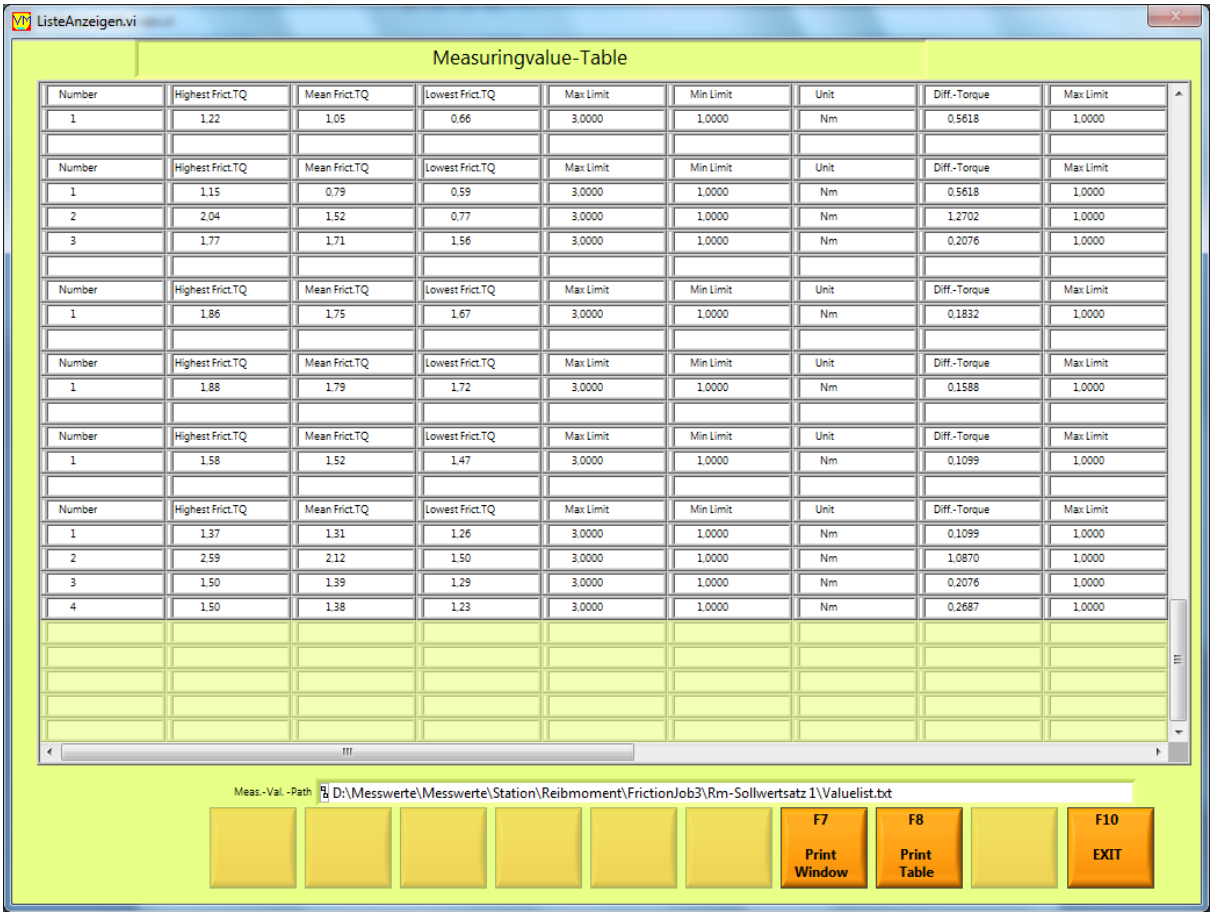
You can initiate a log display or log print with the “F8 Print log” key. First, a window will open where you can enter texts for the log. With the **HTML** button, the log is displayed in the standard internet browser. The **Print** button prints the log to the standard printer.

Loading the measurements file

First, one or more file(s) must be selected for display.
Before selecting the files, you can use the buttons to the left of the F1 button to select whether only OK or only NOK evaluations or both should be displayed. The F1 button opens an Explorer window in which the files are listed. There, one or more files are marked and loaded with OK. At this point files can also be deleted.



The data for all tests can be displayed as a table with the function button “F5 Table”.



Number	Highest Frict.TQ	Mean Frict.TQ	Lowest Frict.TQ	Max Limit	Min Limit	Unit	Diff.-Torque	Max Limit
1	1,22	1,05	0,66	3,0000	1,0000	Nm	0,5618	1,0000
Number	Highest Frict.TQ	Mean Frict.TQ	Lowest Frict.TQ	Max Limit	Min Limit	Unit	Diff.-Torque	Max Limit
1	1,15	0,79	0,59	3,0000	1,0000	Nm	0,5618	1,0000
2	2,04	1,52	0,77	3,0000	1,0000	Nm	1,2702	1,0000
3	1,77	1,71	1,56	3,0000	1,0000	Nm	0,2076	1,0000
Number	Highest Frict.TQ	Mean Frict.TQ	Lowest Frict.TQ	Max Limit	Min Limit	Unit	Diff.-Torque	Max Limit
1	1,86	1,75	1,67	3,0000	1,0000	Nm	0,1832	1,0000
Number	Highest Frict.TQ	Mean Frict.TQ	Lowest Frict.TQ	Max Limit	Min Limit	Unit	Diff.-Torque	Max Limit
1	1,88	1,79	1,72	3,0000	1,0000	Nm	0,1588	1,0000
Number	Highest Frict.TQ	Mean Frict.TQ	Lowest Frict.TQ	Max Limit	Min Limit	Unit	Diff.-Torque	Max Limit
1	1,58	1,52	1,47	3,0000	1,0000	Nm	0,1099	1,0000
Number	Highest Frict.TQ	Mean Frict.TQ	Lowest Frict.TQ	Max Limit	Min Limit	Unit	Diff.-Torque	Max Limit
1	1,37	1,31	1,26	3,0000	1,0000	Nm	0,1099	1,0000
2	2,59	2,12	1,50	3,0000	1,0000	Nm	1,0870	1,0000
3	1,50	1,39	1,29	3,0000	1,0000	Nm	0,2076	1,0000
4	1,50	1,38	1,23	3,0000	1,0000	Nm	0,2687	1,0000

This table is saved in the file Valuelist.txt and can be edited with a text editor or in EXCEL.

2.10.6 Power

Torque, speed and power are plotted as a function of time, or torque and power are plotted as a function of speed in the power function.
The current measurements are displayed large at the right.
At the end of the test, the maximum values that occurred during the test are displayed.

The plots can be saved, if Archiving is selected in the Setpoints. You can display archived plots and measurements with the “F4 Evaluate archive” function, either individually or grouped with a table.

You can also select between a standard test or a loop/programmable test in the “Job” subfunction (accessible with the “F6 Edit job” button).

2.10.6.1 Power: Standard test with a setpoint record

A test is started when switched on with “F1 On”, and when “LED ON” is on, when S1threshold is exceeded: the test ends after the cutoff time Tcutoff, S1cutoff or after the cutoff speed (whichever occurs first). A new test can start when the time Tp has elapsed and the measured value drops below the S1theshold.
The plots can be archived. Fist, archiving must be enabled with the function key “F3 Archive ON”. Archived plots can be displayed with the function “F4 Evaluate analysis” (individually or combined).
The sensor constants must be set with F8 and the setpoints with F9 before a test (if they have not yet been set). Before the test, you can select one of ten setpoint records for the test at the bottom right of the screen.

Power function window: Torque, speed and power as a function of time.

2.10.6.2 Power: Programmable loop

This routine is executed according to the programming in the job subfunction. The loop is started with the “Start loop” button and stopped with the “Stop loop” button, or when all loops have executed. Each program step (maximum 4) is executed as a standard test. The loop OK/NOK – the label in the top right-hand corner of the screen shows the overall OK/NOK status of the continuous, running loop. To its right is the OK/NOK state of the processed step.

The plots and data are archived according to the program preselection in a “Loop” folder. Archived curves can be displayed with the function “F4 Evaluate archive” (individually/together and in tabular form).

2.10.6.3 Power: Functions and settings

Background test in Power
When using a sensor with a chip, the sensor data is compared to the chip data. An error message is output if the comparison fails. In addition, the setpoints are checked for plausibility. If the setpoints are not plausible, an error message is also output. No test can be started as long as there are errors.

Taring after starting with F1
If Start taring ON is set in the setpoint record, a taring is performed. The taring is complete when the "LED ON" is illuminated yellow. The sensors must not be activated during this taring. This taring ignores the taring which is done with the "F5 Taring" button, but only for this start**.**

Evaluation
The curves are displayed after a test run and the data is displayed and assessed (is the torque within limits?). The displayed measured values are the maximum measured values.

Switching the X axis
The X-axis variable can be changed with the f(t) and f(v) buttons.

More properties
The speed plot can be turned on/off using the check box "Plot speed".
The power plot can be turned on/off using the check box "Plot power".

Taring
A taring is performed with the "F5 Taring" button. The tare value is displayed and saved until the next taring. This tare value is valid for the current job.

Edit job
The F6 button opens the Job window.
There a new job can be set up or job texts can be entered and a program loop can be programmed.
This window is described in the "Job Management" section.

Window width/sec
Only one time section is displayed graphically during the test. This time section is dependent on the sampling period set in the setpoints.

Progress
This progress bar informs the operator about the test progress.

2.10.6.4 Power: Digital inputs/outputs on the control I/O port

Inputs/outputs on the control I/O port

The OK, NOK and ON outputs are used (see Valuemaster manual, Pin assignment section).
In addition, a speed setpoint in the form of a voltage in the range -10V to +10V is output (+- 100% of the maximum speed can be set). Since the polarity of the torque setpoint can be selected, the direction of rotation can be preset.
A test can be started with the input START (set in the setpoints).

- Control I/Os without "External trigger"

The READY output is active if the test is started with F1.
The ON output will be energized after 100ms.
The speed setpoint is output at the same time. The angle or time test starts when the threshold torque S1threshold is exceeded.
After reaching the cutoff angle ANGcutoff or the cutoff time Tcutoff, the OK or NOK outputs are set and the ON output is de-energized and then re-energized after the time Tpause. The speed setpoint is set to 0% too, and is set to the setpoint value again after the time Tpause.
If the test is stopped again with "F2 OFF", all outputs are de-energized and the speed setpoint is set to 0%.

- Control I/Os with "External trigger"

The external trigger flag is set at the left of the "Power" window. The READY output is active if the test is started with F1. The output ON is energized and the speed setpoint is output after the "START" input = On. The START input can be released for the rest of the test. The end of the test is determined by the cutoff time. When the test is terminated, the OK or NOK outputs are energized.
The ON output is de-energized and the speed is set to 0%.

If the test is stopped again with "F2 OFF", all outputs are de-energized and the speed setpoint is set to 0%.

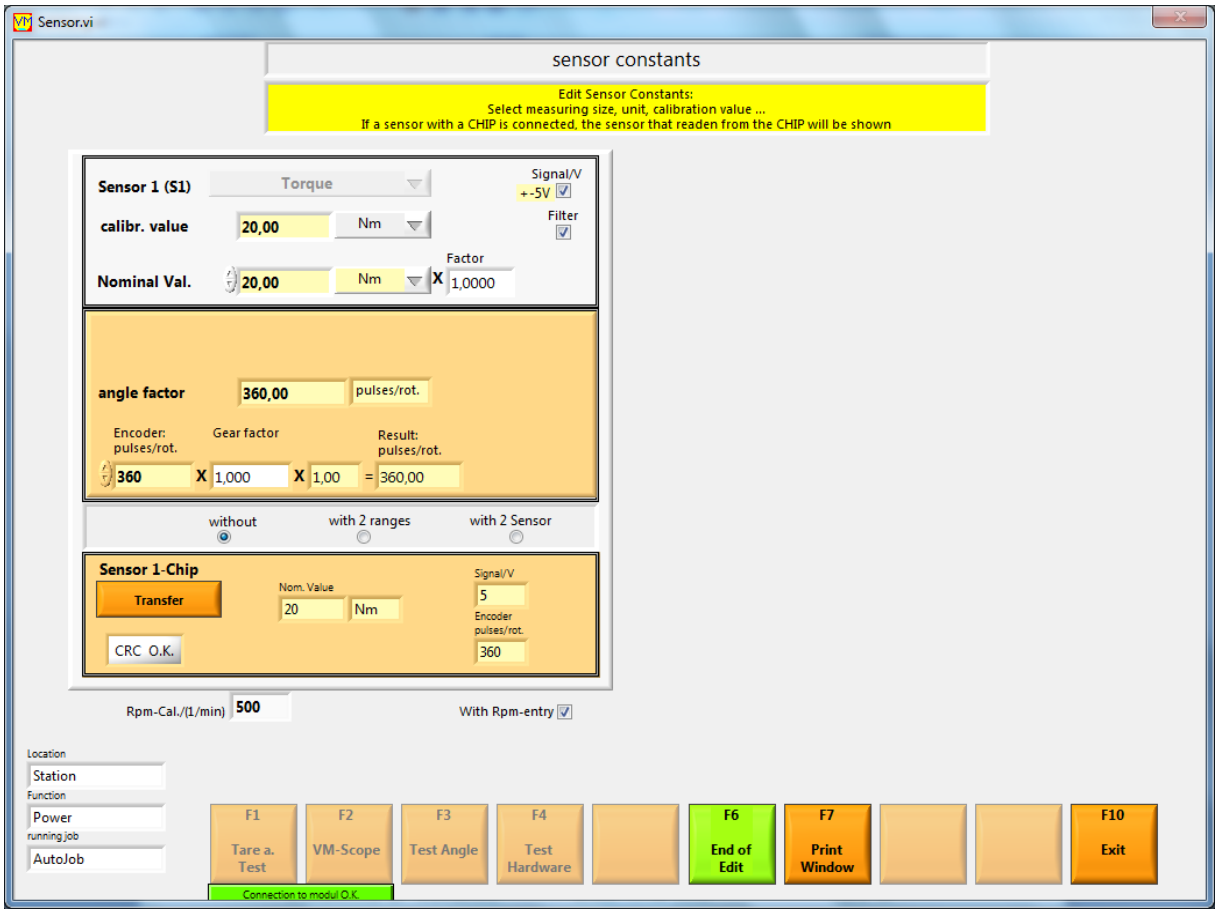
2.10.6.5 Power: Sensor constants and test

A sensor 1 with a pulse generator (encoder) is required for the “Power” function.
Torque and rotation speed are measured with sensor 1.
The sensor constants (sensor 1 and sensor 2) are set with the “F8 Sensor constants and test” button.
If a sensor with chip is connected to the ValueMaster module, the chip data must be loaded, since the chip data is compared with the sensor entries. If there is a difference, no test can be started. Different entries blink RED.

The scope of the tests depends on the sensor properties that are selected, i.e.:

Sensor 1 is always used for the test.

If sensor 2 is on (2nd variable or 2nd range), it will also be used in the test.



Window for the sensor constants in Power

Sensor 2 selection:
The selection is done with buttons
o without o with 2nd range o with sensor 2
Sensor 2 can thus be disabled or used for a 2nd range or a 2nd parameter.

2nd range should be selected if you want to run a test with 2 sensors having identical parameters but different ranges.
The range is changed over in the setpoints.

2nd sensor should be selected if you want to test a 2nd parameter.
The 2nd parameter is shown in the function window in the bottom chart.

Inputs for sensor 1 (S1) and sensor 2 (S2):

Calibration value:
If the sensor has a chip, the chip data must be loaded with the "Accept" button or from the PC keyboard. The nominal value is on the sensor rating plate or is stored in the sensor chip.

Calibration value = nominal value x factor

In addition, the calibration value changes depending on the selected engineering unit (Nm, Ncm …).

S1 input, S2 input
The maximum voltage of the sensor inputs at nominal value can be 5V or 10V. The operator selects the sensor voltage. For a sensor with sensor chip, this setting is loaded from the chip. The amplifications are changed in the measurement module to suit the selection.

Filter
Each channel in the ValueMaster module has an analog filter with a 1kHz frequency limit. This filter can be turned on/off.

Inputs for sensor 1 (S1)

Only sensor 1 has a pulse generator.

Pulse/revs
The “Pulse/revs” value is calculated from several factors.
The “Encoder pulse/revs” is the value given by the sensor manufacturer.
This “Encoder pulses/revs” (e.g., 60 or 360) can be multiplied by a factor (e.g., necessary for gears). A pulse quadrupler is enabled on the ValueMaster module using the Multiplier button.

Pulses/revs = Encoder pulse/revs x gear factor x Vvalue

Vvalue = 1 (This is a permanent constant since the pulse quadrupler can not be enabled)

Speed calibration value
The **“With rpm-entry”** flag allows you to choose if the default for the speed output in the Setpoints must be entered in “%” or in “rpm”. If the speed default must be in “rpm”, the speed calibration value **rpm-cal (1/min)** must be entered, as well**.**

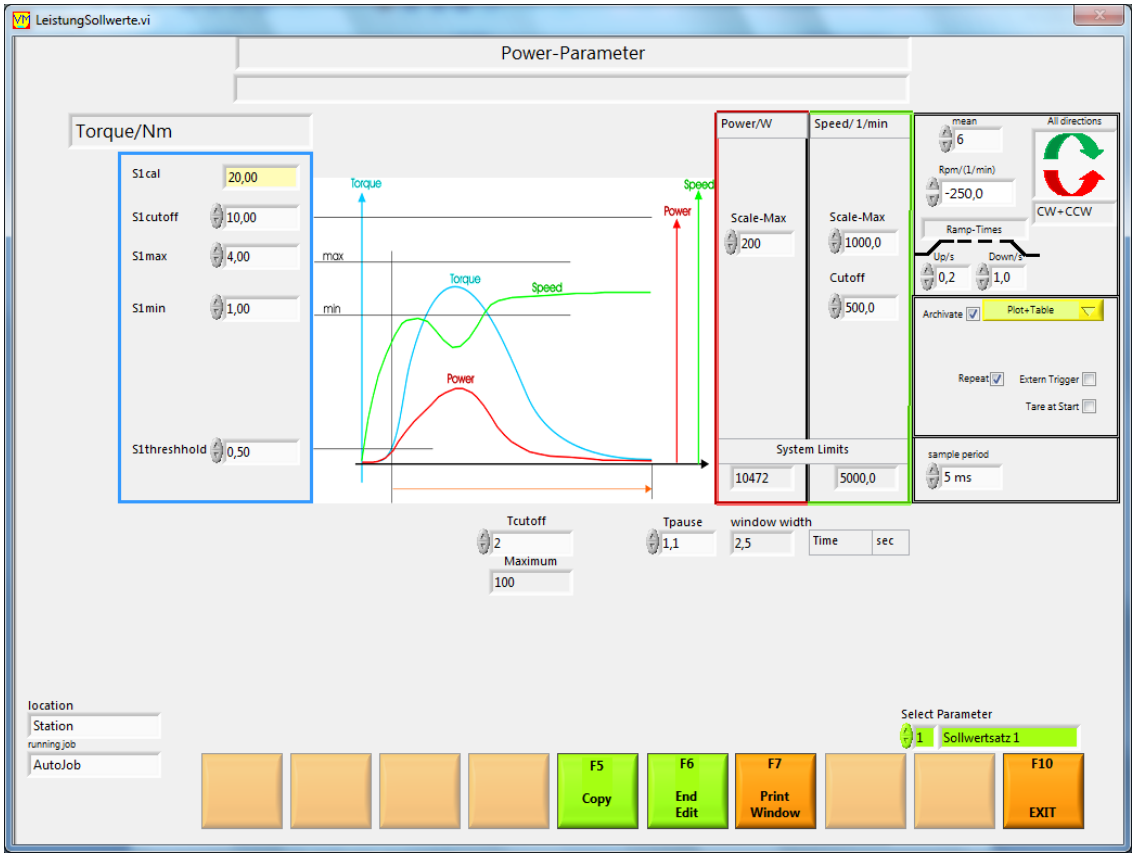
The **test functions**

F1 Tare and test
F2 VM-scope
F3 Angular test
F4 Test hardware

are identical in all functions and are therefore described in the Test Functions section.

2.10.6.6 Power: Edit setpoints

The limit values for a test are entered in the Edit setpoints window.
Up to 10 setpoint records can be edited.
The setpoint window is structured depending on the setting in the sensor constants.
Among other things, this depends on the settings for sensor 2 (2nd parameter or 2nd range).



Window for editing setpoints

Limit values
Upper and lower limits must be set for the torque.
If the input values are within limits, then they are correct (OK), otherwise they are incorrect (NOK).

Selecting the setpoint record
The setpoint record to be edited is set at the lower right of the screen. The text next to the setpoint record number describes the setpoint record. It can be changed: for example, to “MAXON EC22” instead of the default text “Setpoint record x”. This setpoint record designation is also then the name for the folder holding the data files.

Times
The time Tcutoff is the test time. The test ends and is evaluated when the Tcutoff time has elapsed. The Tcutoff time depends on the selected test period and can be up to 20000 seconds. When the test has ended, a pause time Tpause (Tp) elapses.

Mean value
The arithmetic mean is calculated from 2-10 measured values to calculate the mean value of the torque. The mean value is used, among other things, to smooth the plots.

Speed rpm:
The speed and direction of rotation for a motor controller (servo) is output as an analog voltage to the Dsub socket on the module:
-100% = -10VDC,
+100% = -10VDC.
The speed must be entered in rpm if the speed setpoint is selected in revolutions (rpm) in the sensor constants.

Ramp times
The times for the startup-speed ramp Up/s and the cutoff-speed ramp Down/s can be entered here (0 to 9.9 s.).

External trigger:
A test is started when the external trigger is selected, only if the "START" input is energized on the Dsub socket.

Start taring:
When a test is started with "F1 ON", taring is performed once.

Sampling period
The available sampling periods are 1, 2, 5, 10, 20, 50, 100, 500 and 1000 ms.
Please observe the following when selecting the sampling period:
Small sampling periods generate large archive files when archiving is enabled.
Displaying the plots and switching windows to the Archive subfunction are slowed down.

Sampling period in ms	*Measurements /data block*	*Time per data block*	*Fixed average for speed calculation*	*Recommended max. average for torque*	*Maximum scanning time in seconds*
1000	2	2000	1	1	20000
500	3	1500	1	2	10000
200	5	1000	1	4	4000
100	10	1000	1	8	2000
50	20	1000	1	10	1000
20	30	600	5	10	400
10	30	300	5	10	200
5	30	150	5	10	100
2	30	60	5	10	40
1	30	30	5	10	20

Rotation speed:
The system limit for the speed measurement depends on "Pulse/revs" for the sensor.
The Scale-Max value determines the scaling of the speed axis (green).
The cutoff value is the speed at which the power test is ended.

Power:
The system limit for the power test is calculated with the system limit of the speed and the torque calibration value.
The Scale-Max value determines the scaling for the power axis (red).

With SNo.
This flag enables serial number entry.

Filename = SNo
If this flag is set, the serial number becomes part of the test data file name.

2.10.6.7 Power: Evaluate archive

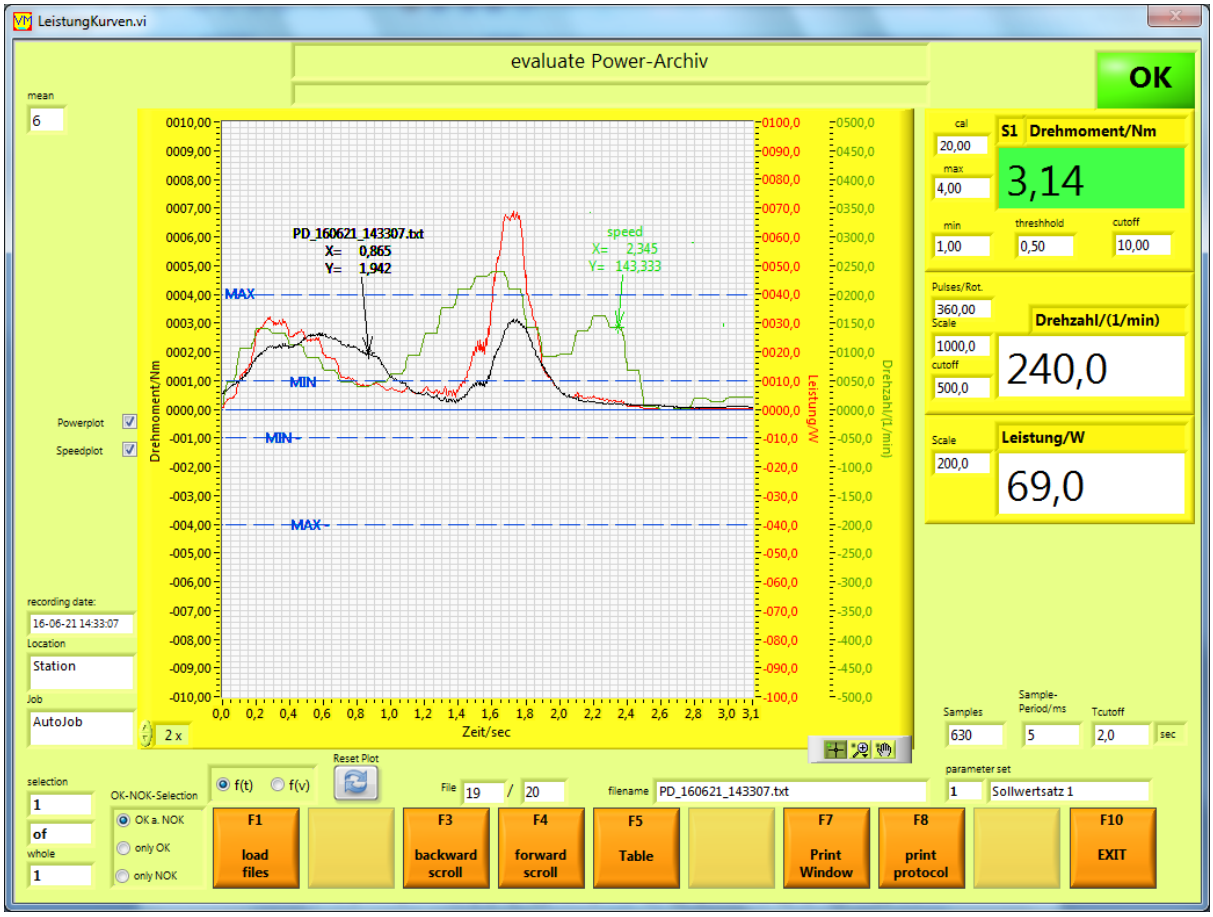
In the “Evaluate archive” subfunction, you can display archived power test data as a plot.

Evaluation window for 3 archived torque recordings of the “Power” function with plot legend.

You can select which plot you want to show in the plot selection on the left of the screen.

You can enable/disable the plots with the checkbox in the plot line in the **plot legend**. These settings can be saved with the “In filter” button, so that after a reset with F2 they are loaded when a new screen is output.

You can scroll backwards and forwards, respectively, in the file with the F3 and F4 buttons and show the plot.



Evaluation window for 1 archived power test recording. If one plot is displayed, the maximum values for torque, speed and power are also displayed.

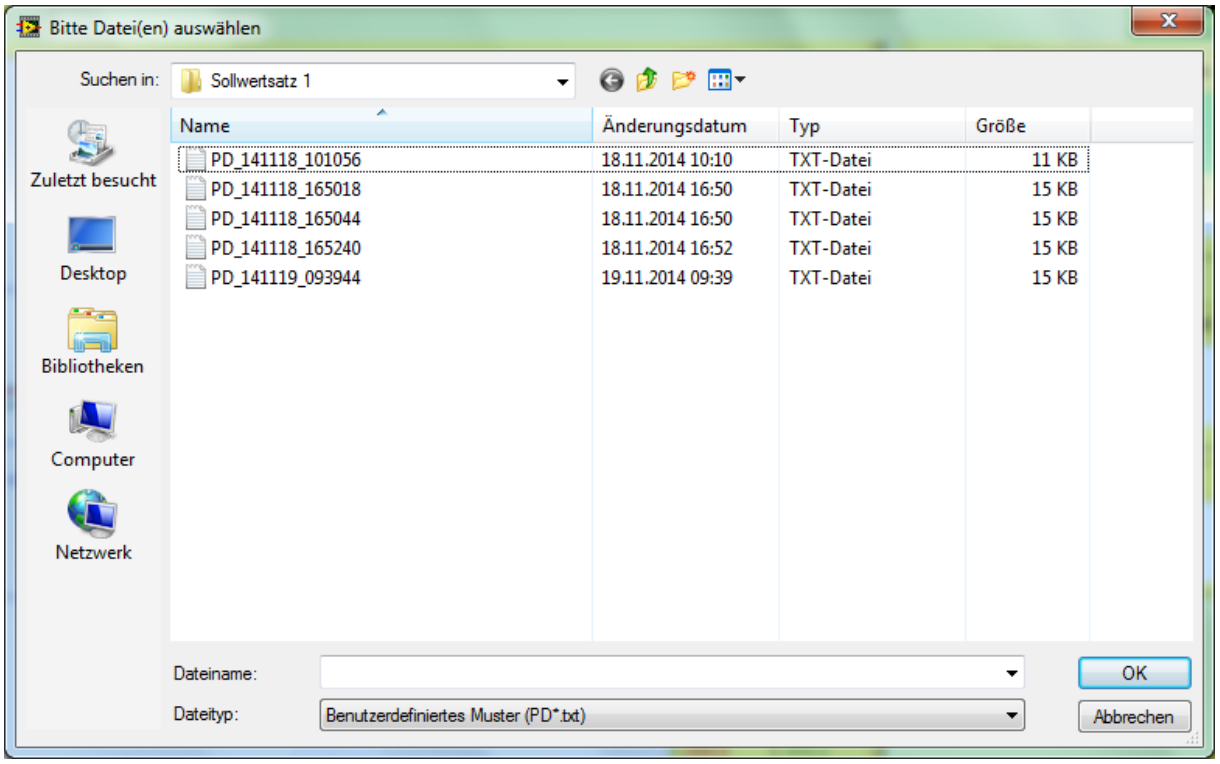
You can initiate a log display or log print with the “F8 Print log” key. First, a window will open where you can enter texts for the log. With the **HTML** button, the log is displayed in the standard internet browser. The **Print** button prints the log to the standard printer.

Switching the X-axis
The X-axis variable can be changed with the f(t) and f(v) buttons.

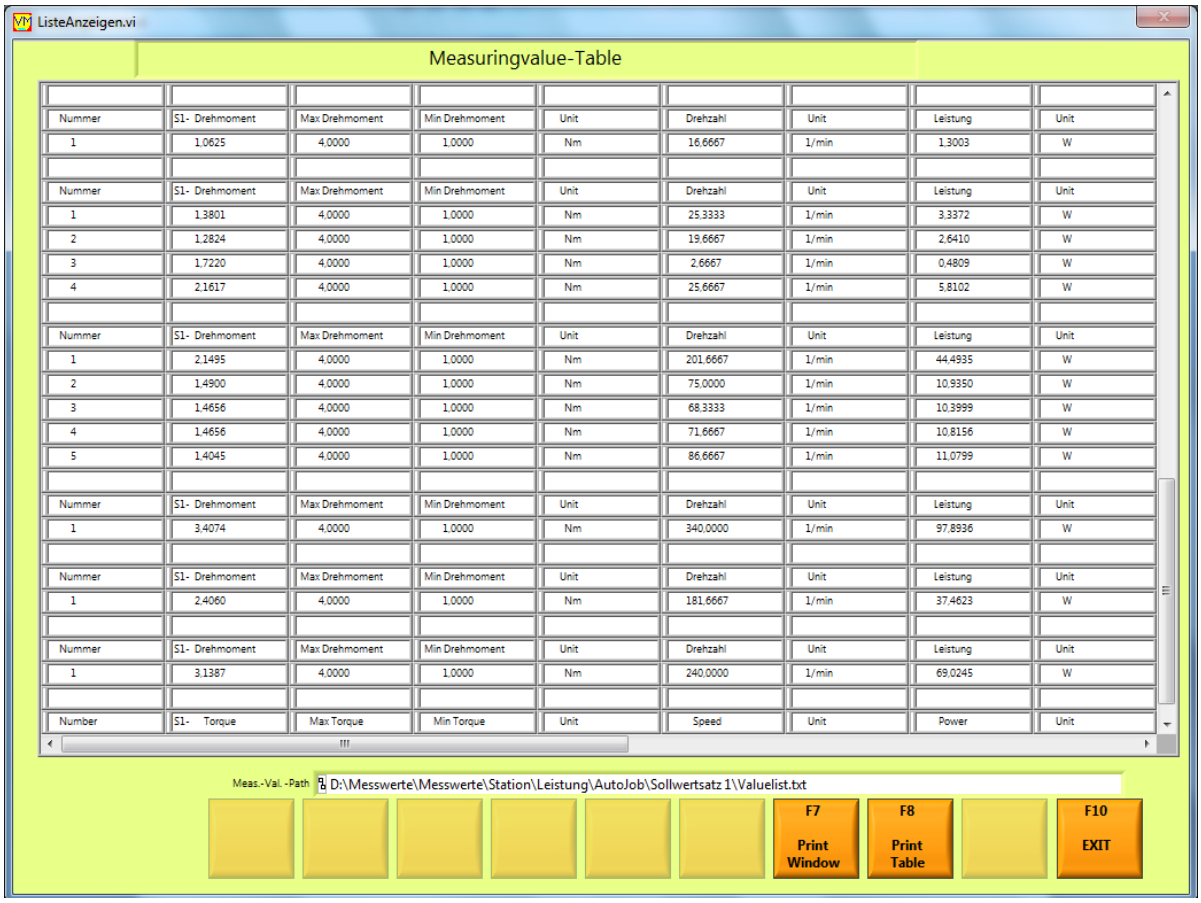
More properties
The speed plot can be turned on/off using the check box “Plot speed”.
The power plot can be turned on/off using the check box “Plot power”.

Loading the measurements file

First, one or more file(s) must be selected for display.
Before selecting the files, you can use the buttons to the left of the F1 button to select whether only OK or only NOK evaluations or both should be displayed. The F1 button opens an Explorer window in which the files are listed. There, one or more files are marked and loaded with OK. At this point files can also be deleted.



The data for all tests can be displayed as a table with the function button “F5 Table”.



This table is saved in the file Valuelist.txt and can be edited with a text editor or in EXCEL.

2.10.7 Calibrating

The S1 input is the dependent variable and the S2 input the control variable with the Calibrate function. Instead of an S2 input, the control variable can also be input as a numerical value on the PC keyboard. The control variable is selected in the sensor constants.
S1 and S2 variables are torque, force, travel and pressure.

Before a calibration, the sensor constants must be set with F8 and the setpoints with F9 (if none have been entered previously). Before a test, one of ten setpoint records can be selected for the test at the bottom right.

Serial number, model number and additional text can be entered for the record.

2.10.7.1 Calibrating: Standard routine with a setpoint record

The device is calibrated with the set setpoint record.

Start with “F1 ON”.

Enter serial number, model no. and additional text.

Set control variable (S2 input or keyboard data entry)

Dependent variable S1 follows the control variable.

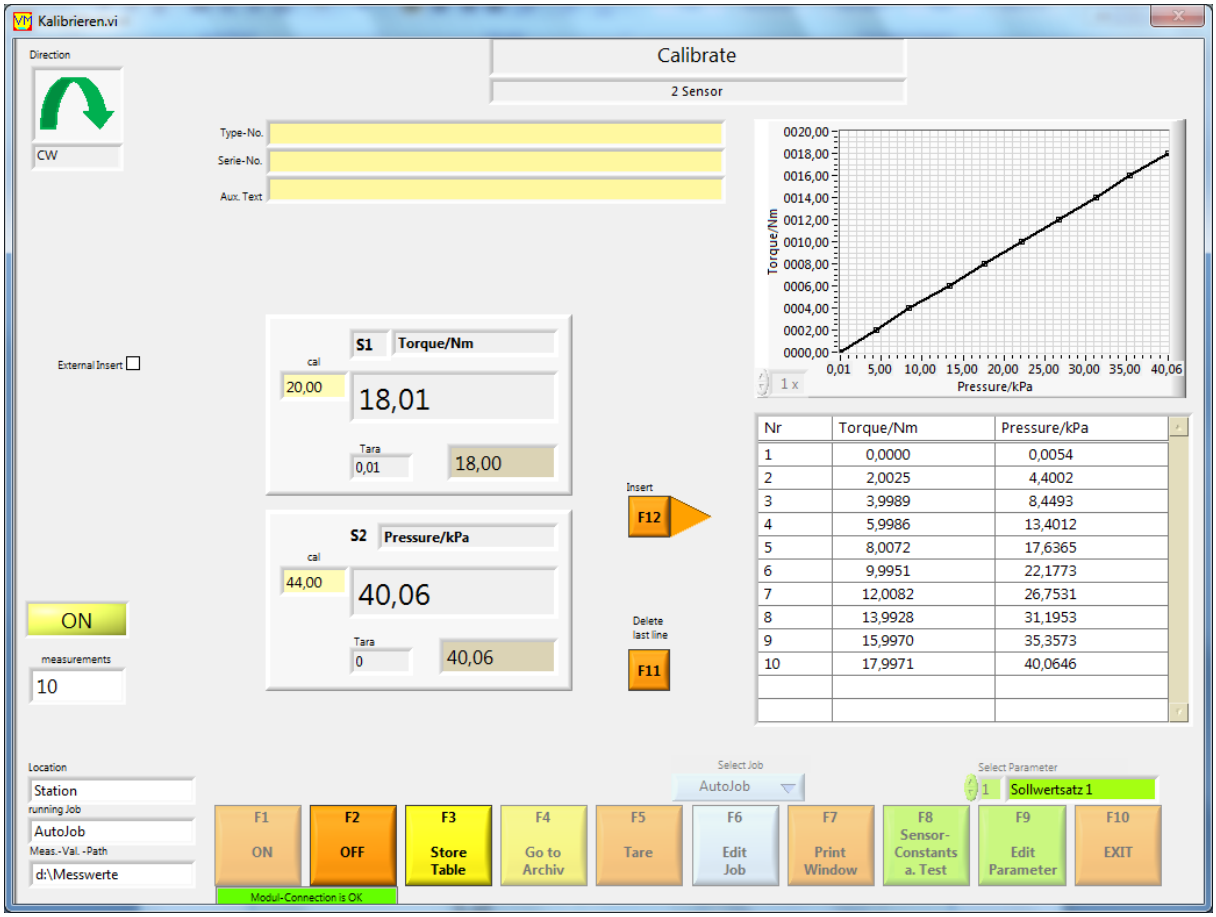
Enter the control variable and dependent variable S1 in the table using the F12 key (mouse or F12 function key) or an external key on the ValueMaster module.

You can always delete the last entered line appended to the table with the F11 key (mouse or F11 function key).

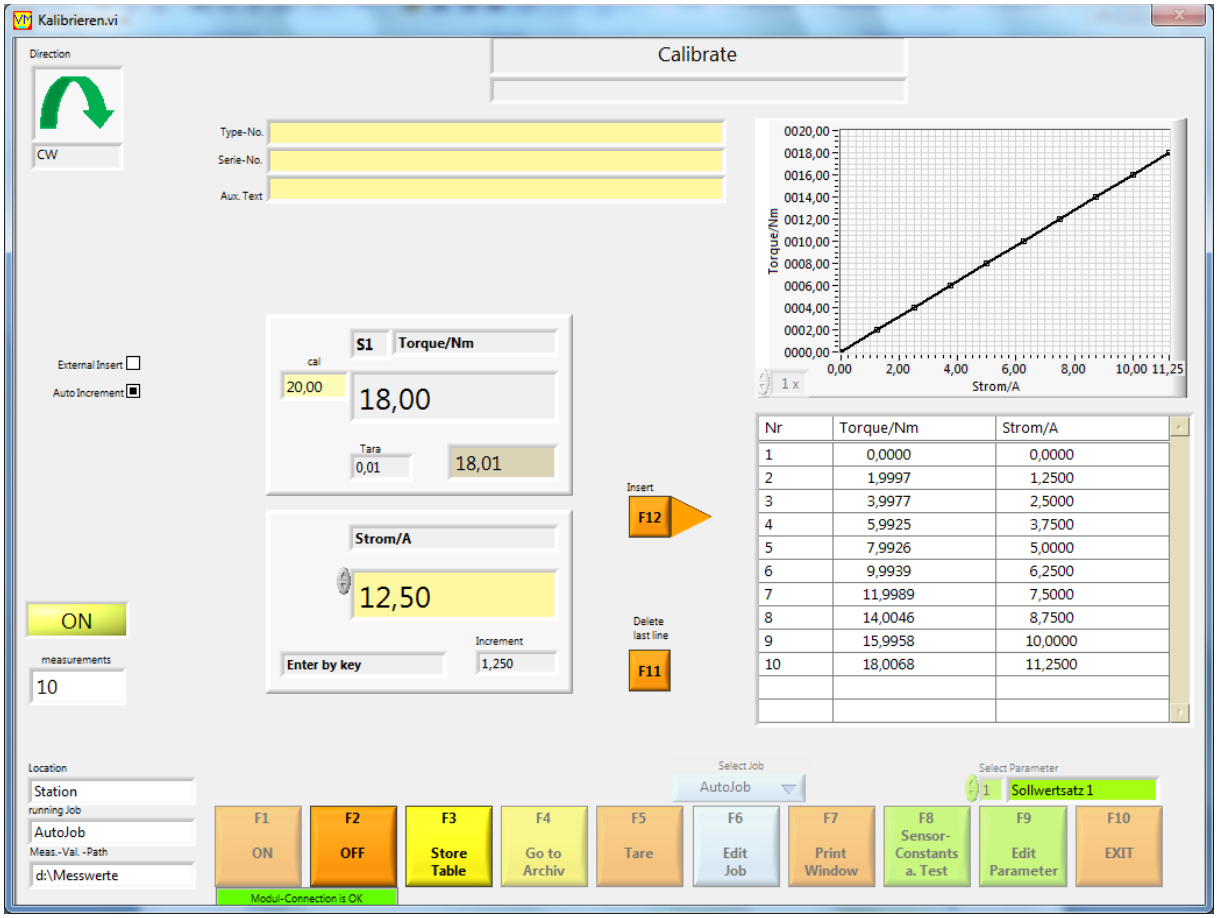
The table is saved using the “F3 Store table” key.

End the calibration with the “F2 OFF” key

You can display and print saved tables with the “F4 Go to Archive” key.



Calibration function window: Control variable S2 (pressure) dependent variable S1 (torque)



Calibration function window: Control variable manual entry (current) dependent variable S1 (torque)

2.10.7.2 Calibrating: Functions and settings

Background tests in calibrate
When using a sensor with a chip, the sensor data is compared to the chip data. An error message is output if the comparison fails.

Direction display
The set direction is shown at the top left.
Only variables measured in this direction are recorded.

For torque measurement:

Right rotation (CW=ClockWise)	positive signals.
Left rotation (CCW=CounterClockWise)	negative signals.
Both directions of rotation (CW+CCW)	both signal directions.

For force measurement:

PRESS (pressure)	positive signal
DRAG	negative signal
Both directions (PRESS+DRAG)	both signal directions.

Store table F3
The table with the values entered up to that point are saved in the archive.

Evaluate archive F4
The saved tables can be visualized, printed out or displayed as HTML files in a browser.

Taring F5
A taring is performed with the “F5 Taring” button. The tare value is displayed and saved until the next taring. This tare value is valid for the current job.

Editing Job F6
The F6 button opens the Job window.
There a new job can be set up or job texts can be entered This window is described in the “Job Management” section.

2.10.7.3 Calibrating: Inputs/outputs on control I/O port

Only the output ON is used (see Valuemaster manual, Pin assignment section).
In addition, a speed setpoint in the form of a voltage in the range -10V to +10V is output (+- 100% of the maximum speed can be set). Since the polarity of the torque setpoint can be selected, the direction of rotation can be set as well.
A measurement entry in the table can be executed with the START input, (set in the Setpoints).

- Control I/Os without "External trigger"
The ON output is set if the calibration was started with F1.
The speed setpoint is output simultaneously.
If the calibration is stopped again with F2, all outputs are de-energized and the speed setpoint is set to 0%.

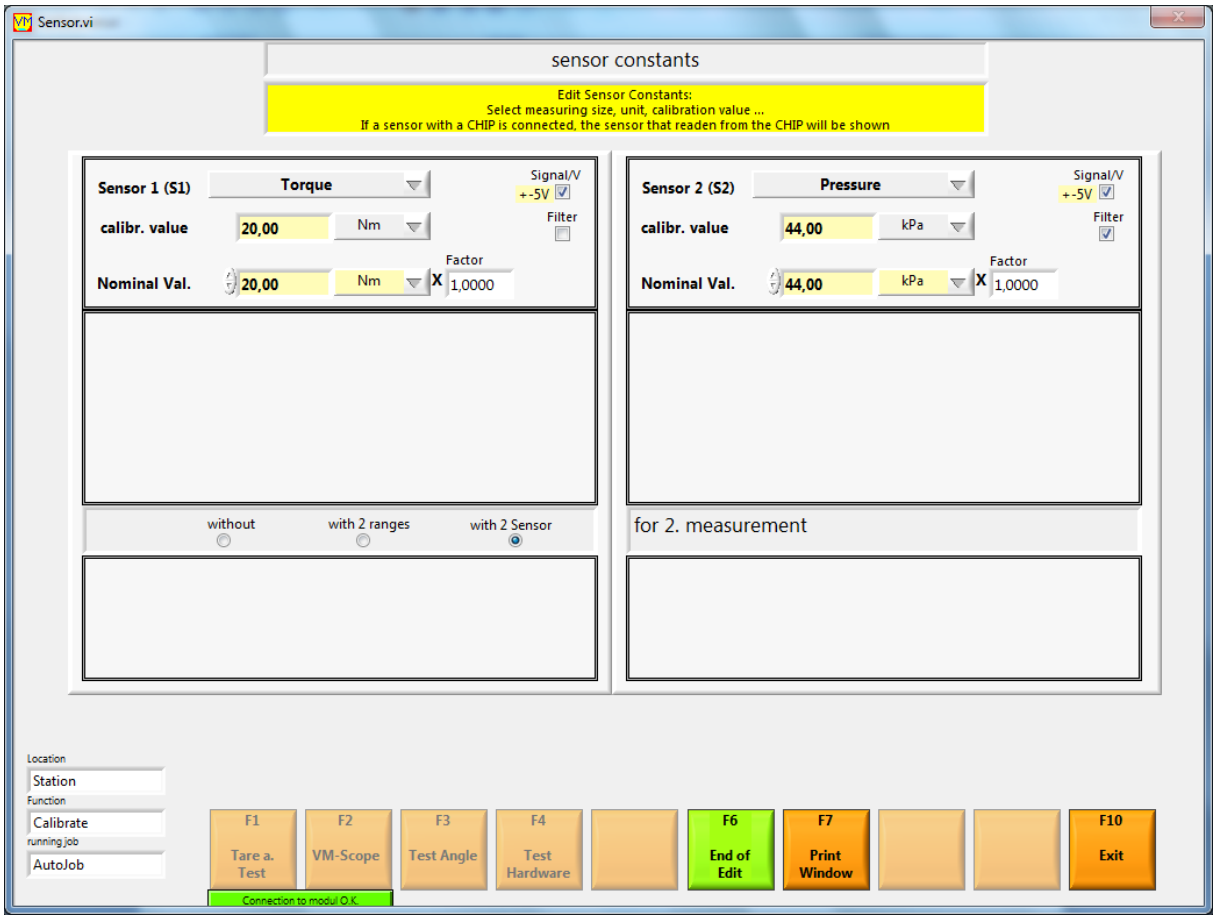
- Control I/Os with "External input"
A yellow field with
"WITH EXTERNAL INPUT" appears at the top of the Calibrate window.
The ON output is energized if the calibration was started with F1.
The speed setpoint is output at the same time.
A measurement entry in the table is executed when the START input is energized.
If the calibration is stopped again with F2, all outputs are de-energized and the speed setpoint goes to 0%.

2.10.7.4 Calibrating: Sensor constants and test

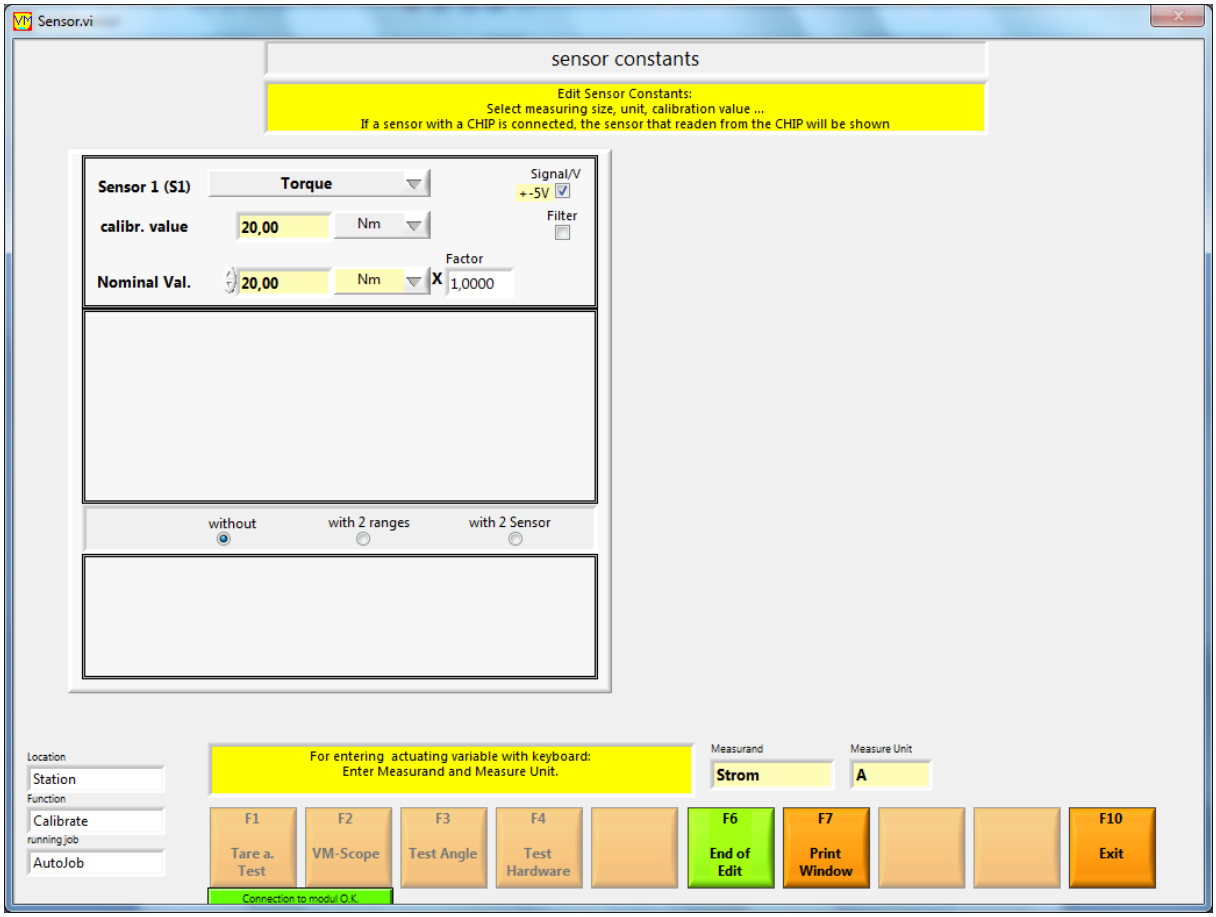
The sensor constants (sensor 1 and sensor 2) are set with the “F8 Sensor constants and test” button. If a sensor with chip is connected to the ValueMaster module, the chip data must be scanned, as the chip data are compared with the sensor data. If there is a difference, a calibration cannot be started. Different entries blink RED.

The scope of the calibration depends on the selection of sensor settings:

The dependent variable is always measured with sensor 1.
No pulse generator is required in sensor 1.
If sensor 2 is on (2nd parameter or 2nd range), sensor 2 is also used for testing.



Window for the sensor constants in Calibrate. Sensor 2 inputs the control variable and sensor 1 the dependent variable.



Window for the sensor constants in Calibrate. In this window the control variable is entered from the keyboard (in addition, the dependent variable and unit must be edited as text).

The dependent variable is scanned with sensor 1 or sensor 2 if two ranges are selected.

Selection of sensor 2:
The selection is done with buttons
o without o with 2nd range o with sensor 2
Sensor 2 can thus be switched off, or used for a 2nd range or a 2nd parameter.

"**without**" must be selected, if a 2nd sensor is not connected.
Control variables are entered from the keyboard.

Select the **2nd range** if you want a test with 2 sensors having identical physical parameters but different ranges.
Flipping the range must be done in the setpoints.
Control variables are entered from the keyboard.

Select **2nd sensor** if you want to test a 2nd dependent variable as a control variable.

Inputs for sensor 1 (S1) and sensor 2 (S2):

Calibration value:
If the sensor has a chip, the chip data must be loaded with the “Accept” button or from the PC keyboard. The nominal value is always the value which is on the sensor or stored in the sensor chip.

Calibration value = nominal value x factor

In addition, the calibration value changes depending on the selected engineering unit (Nm, Ncm, etc.).

S1 input, S2 input
The maximum voltage of the sensor inputs at nominal value can be 5V or 10V. The operator selects the sensor voltage. For a sensor with sensor chip, this setting is loaded from the chip. The amplifications are changed in the measurement module to suit the selection.

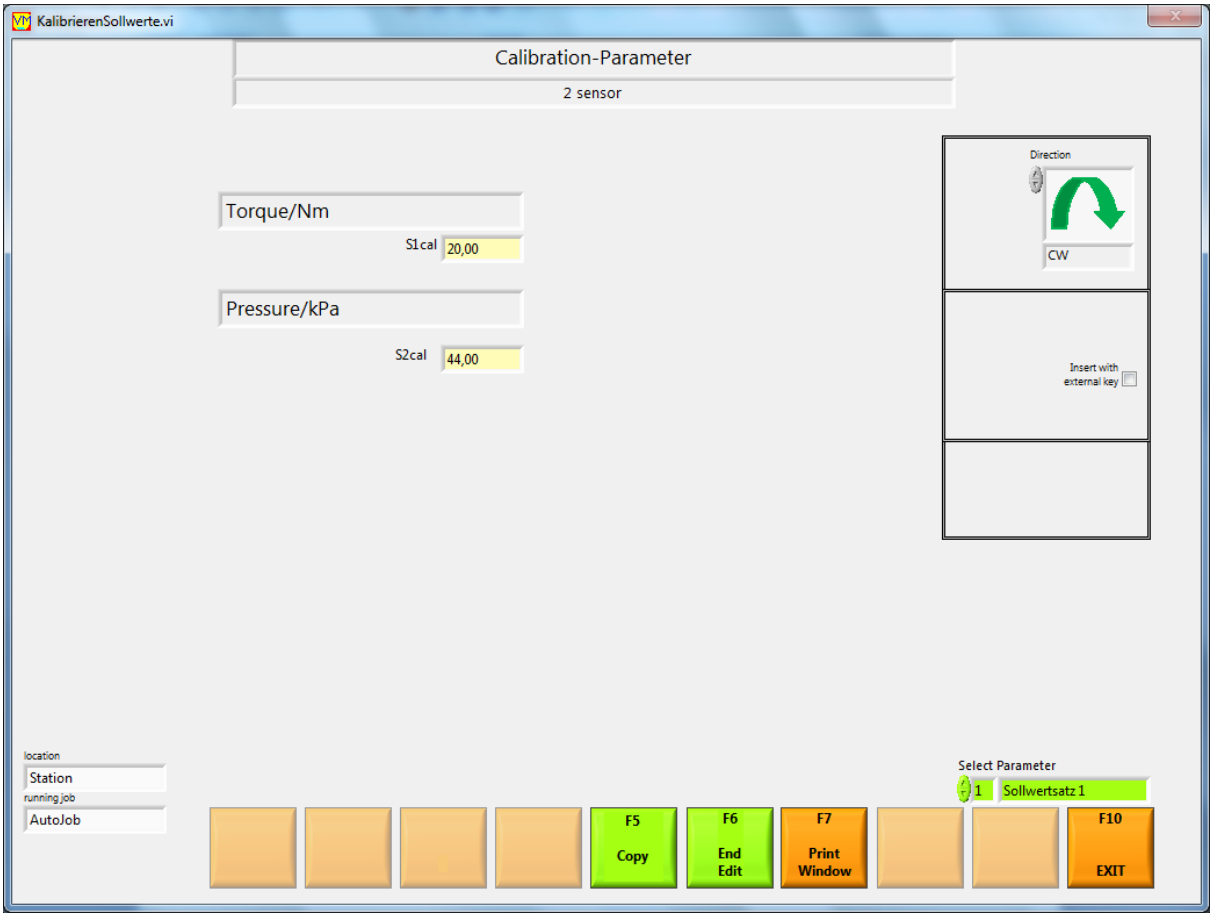
Filter
Each channel in the ValueMaster module has an analog filter with a 1kHz frequency limit. This filter can be turned on/off.

The **test functions**
- F1 Tare and test
- F2 VM-scope
- F3 Angular test (deactivated for calibration)
- F4 Test hardware

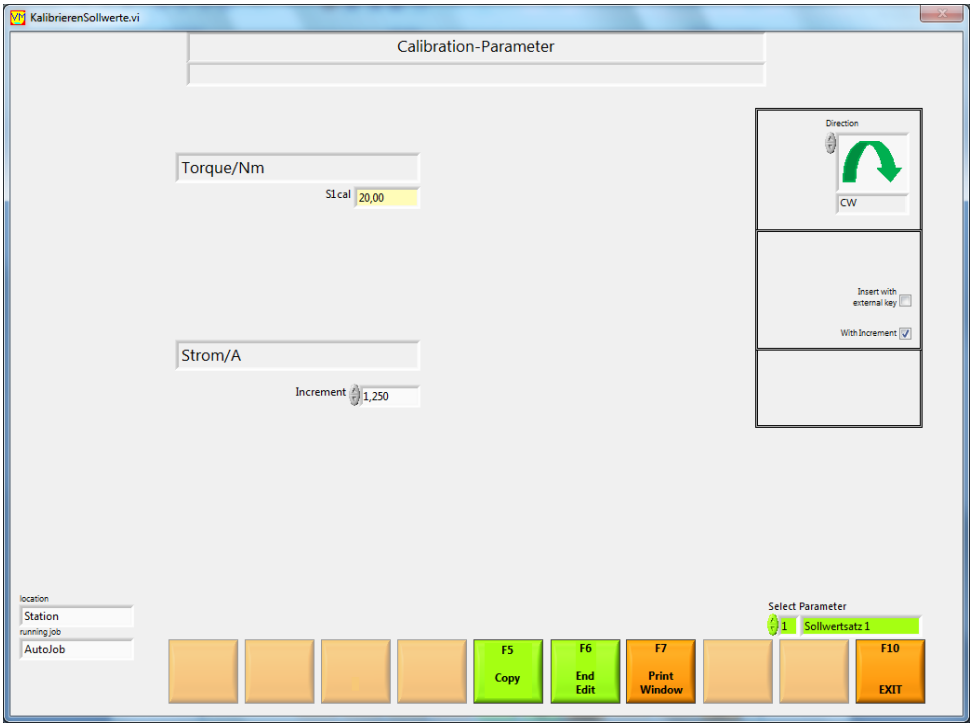
are identical in all functions and are therefore described in the Test Functions section.

2.10.7.5 Calibrating: Edit setpoints

More adjustment values for a calibration are entered in the “Edit setpoints” window. Up to 10 setpoint records can be edited.
The setpoint window is structured according to the setting in the sensor constants.
This depends, among other things, on the settings for sensor 2 (2nd parameter or 2nd range).



Window for editing setpoints
Sensor 1 for torque measurement; sensor 2 for force as control variable



Window for editing setpoints
Sensor 1 for torque measurement; sensor 2 for 2nd range, current as control variable for entry using keyboard.

Selecting the setpoint record
The setpoint record to be edited is set at the lower right of the screen. The text next to the setpoint record number describes the setpoint record. It can be changed: for example, to “Stay bolt S10” instead of the default text “Setpoint record x”. This setpoint record designation is also then the name for the folder holding the data files.

Direction
The direction determines the signal polarity to be scanned.

<u>For torque measurement:</u>

Right rotation (CW=ClockWise)	positive signals.
Left rotation (CCW=CounterClockWise)	negative signals.
Both directions of rotation (CW+CCW)	both signal directions.

<u>For force measurement:</u>

PRESS (pressure)	positive signal
DRAG	negative signal
Both directions (PRESS+DRAG)	both signal directions.

When the bidirectional scenario CW+CCW or PRESS+DRAG is selected, pulses are not evaluated and the positive and negative measured values are shown in the plots.

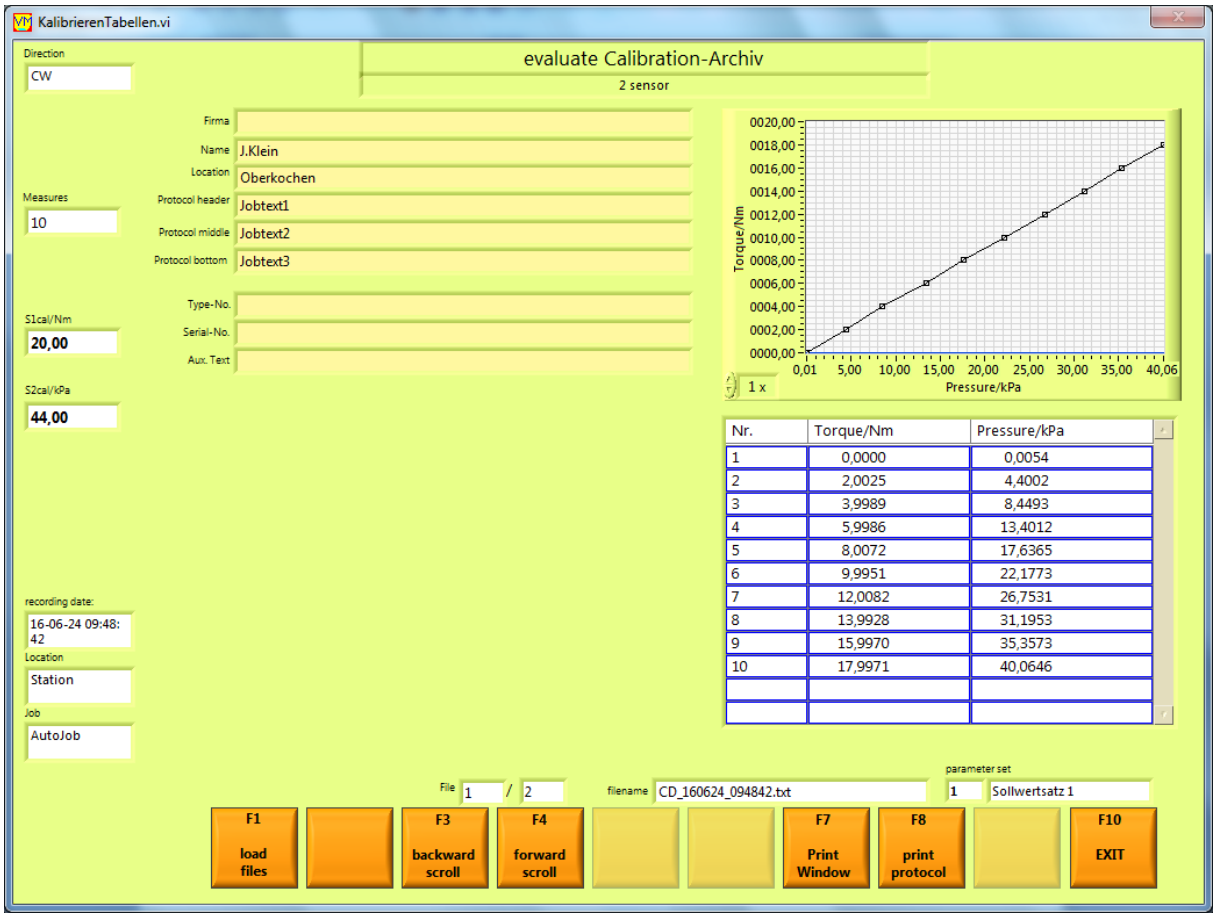
Data entry via external key:
Test data can be entered in the table with a key on the signal input “START” of the ValueMaster module

With increment:
When entering a control variable with the keyboard, the control variable is automatically increased by the increment value.

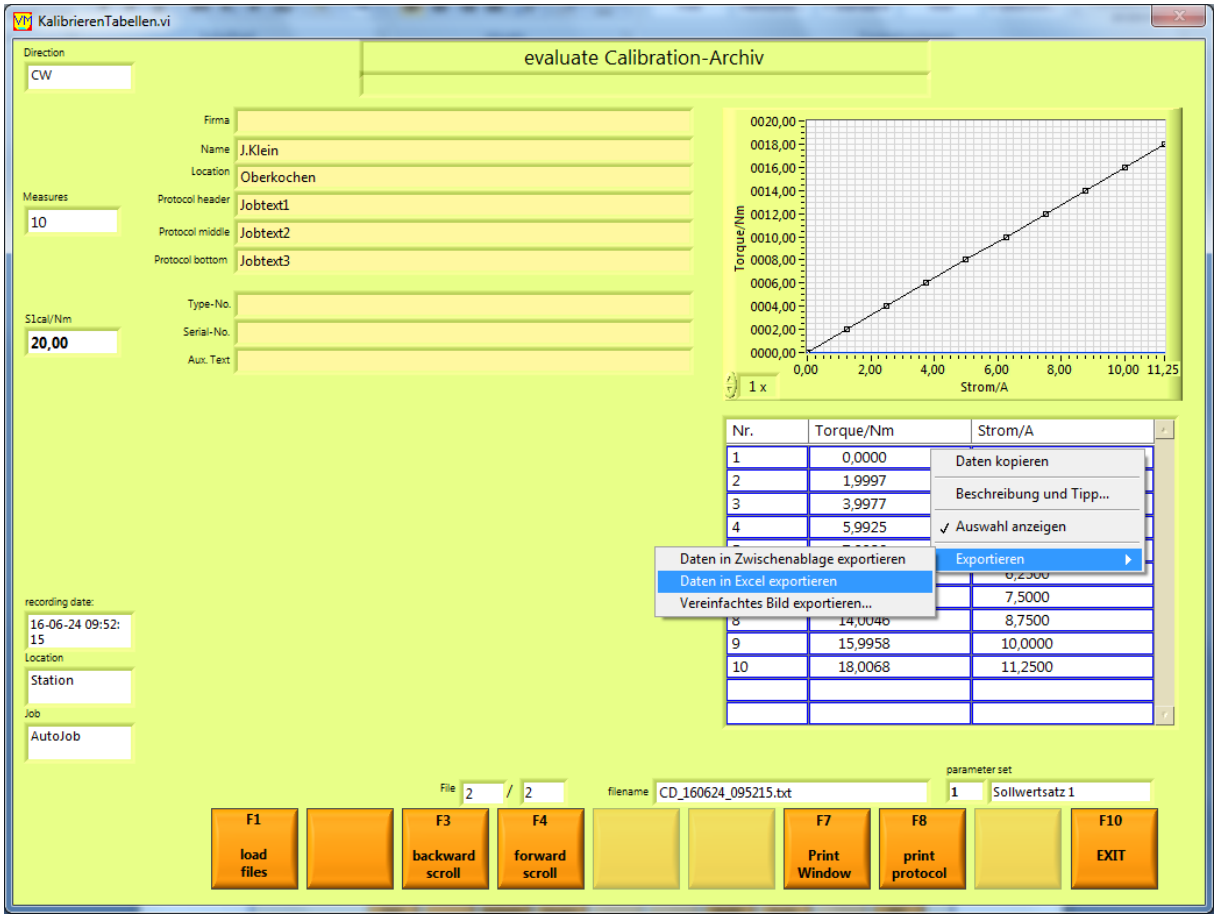
With SNo.
This flag enables serial number entry.
Filename = SNo
If this flag is set, the serial number becomes part of the test data file name.

2.10.7.6 Calibrating: Evaluate archive

In the “Evaluate calibration archive” subfunction, saved calibration data can be displayed as a chart and as a table.



Evaluation window for the “Calibrate” function
Sensor 1 for torque measurement; sensor 2 for force as control variable



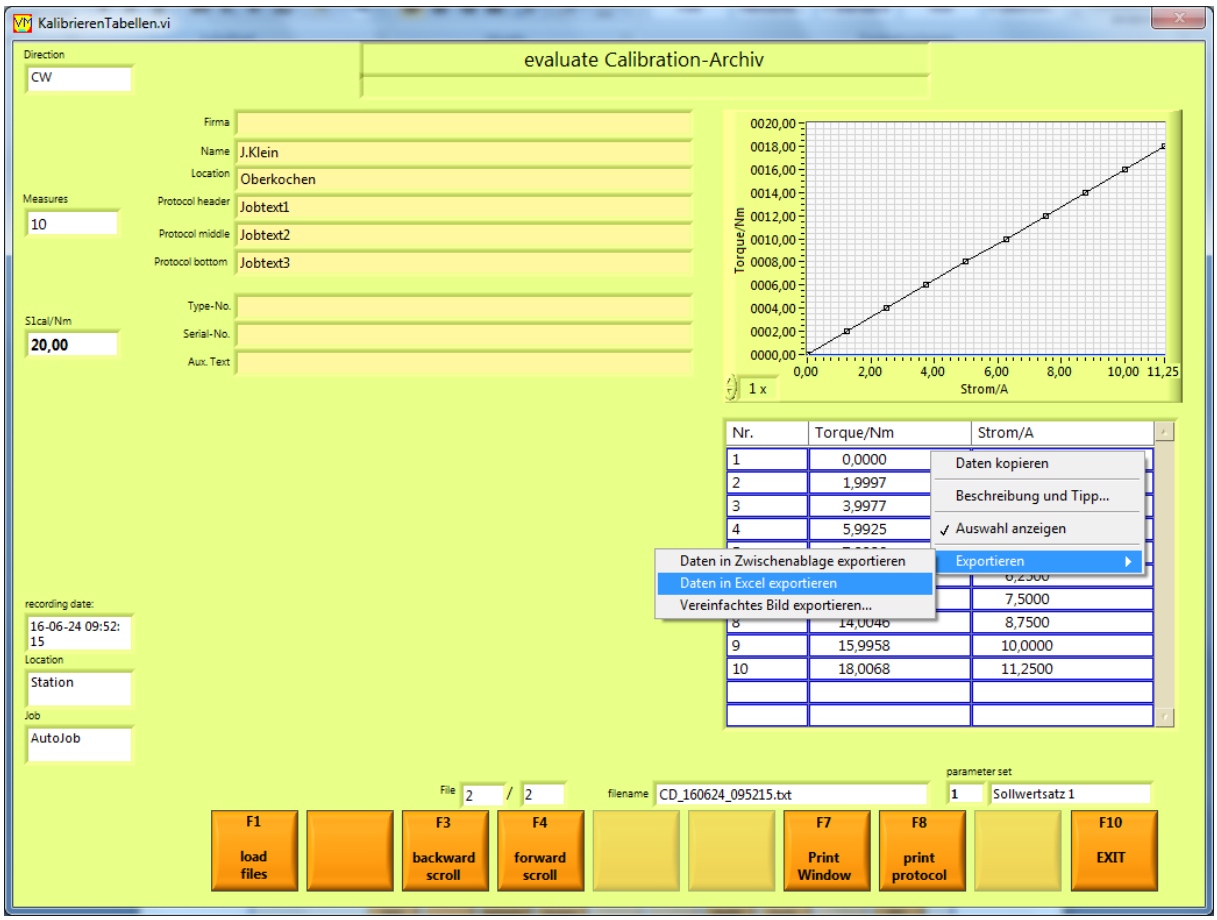
Evaluation window for 1 archived table.
Sensor 1 for torque measurement, current as the control variable when entering using the keyboard.

You can scroll backwards and forwards, respectively, in the file with the F3 and F4 buttons and show the individual plots.

You can initiate a log display or log print with the “F8 Print log” key. First, a window will open where you can enter texts for the log. With the **HTML** button, the log is displayed in the standard internet browser. The **Print** button prints the log to the standard printer.

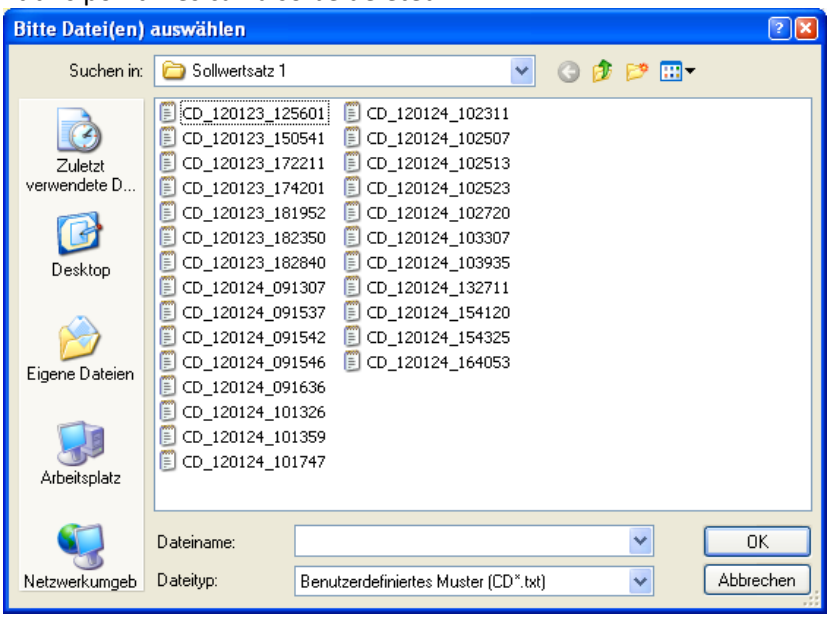
Exporting a table

- Mark all elements in the table.
- Right click with the mouse on the marked fields
- Select function from the menu



Loading the measurements file

First, a file must be selected for display.
The F1 button opens an Explorer window in which the files are listed. There, a file must be marked and loaded with OK.
At this point files can also be deleted.



2.11 Test functions

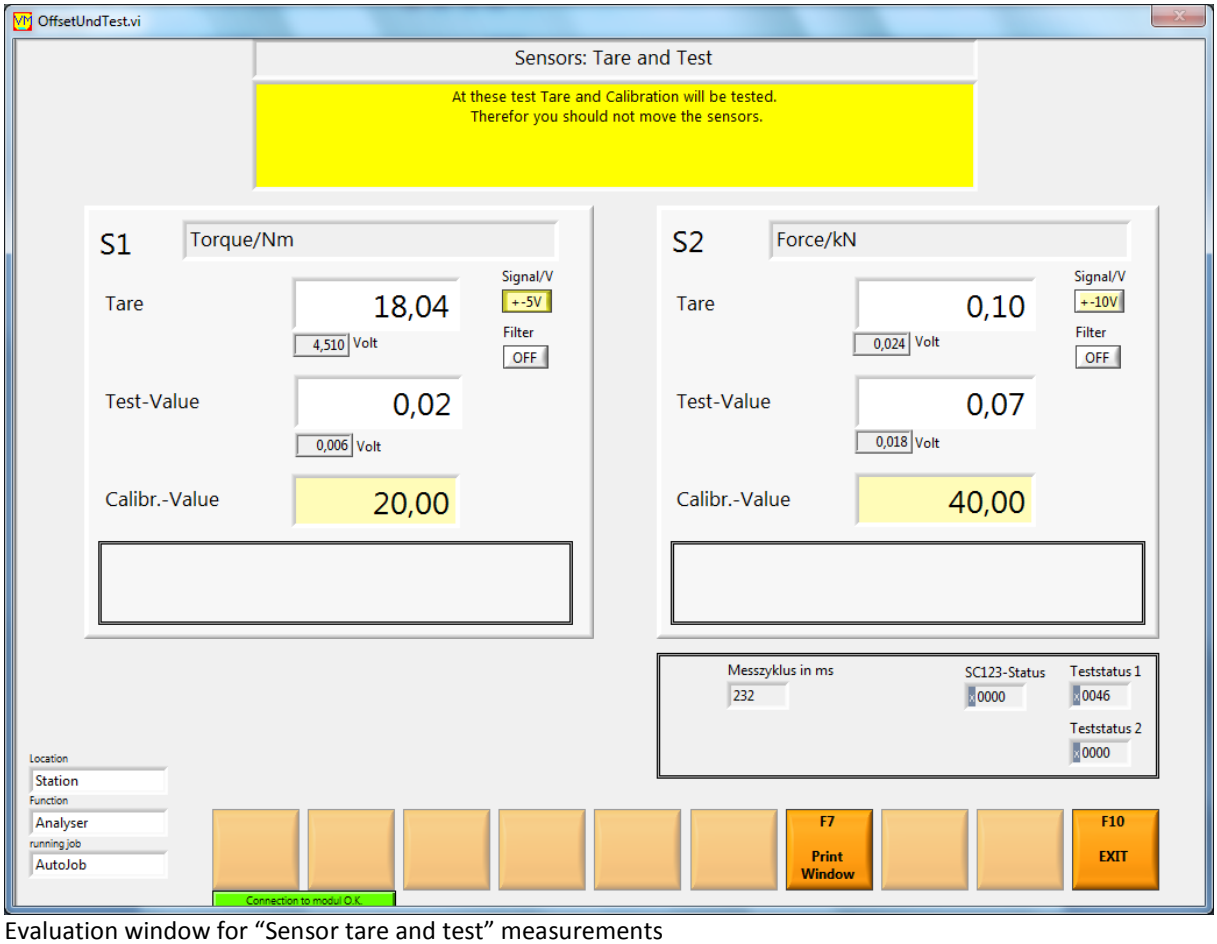
The test functions can be called up in the sensor constants.

2.11.1 Tare and test

During the sensor test, the sensors must not be activated!
The tare value, test value and calibration value of sensor 1 and sensor 2 are measured and displayed in the sensor test window. These values are defined as:

- **Tare** is the zero drift when the sensor is not activated.
- **Test value** is the measured value in the event of electrical detuning (internal resistance is enabled) minus the tare value (the subtraction is done on the device board).
- **Calibration value** is the same as the calibration value entered in the sensor constants.

You can calibrate the sensors or check the calibration with the sensor test. The goal of the calibration is:
Tare value = 0
Test value = calibration value.



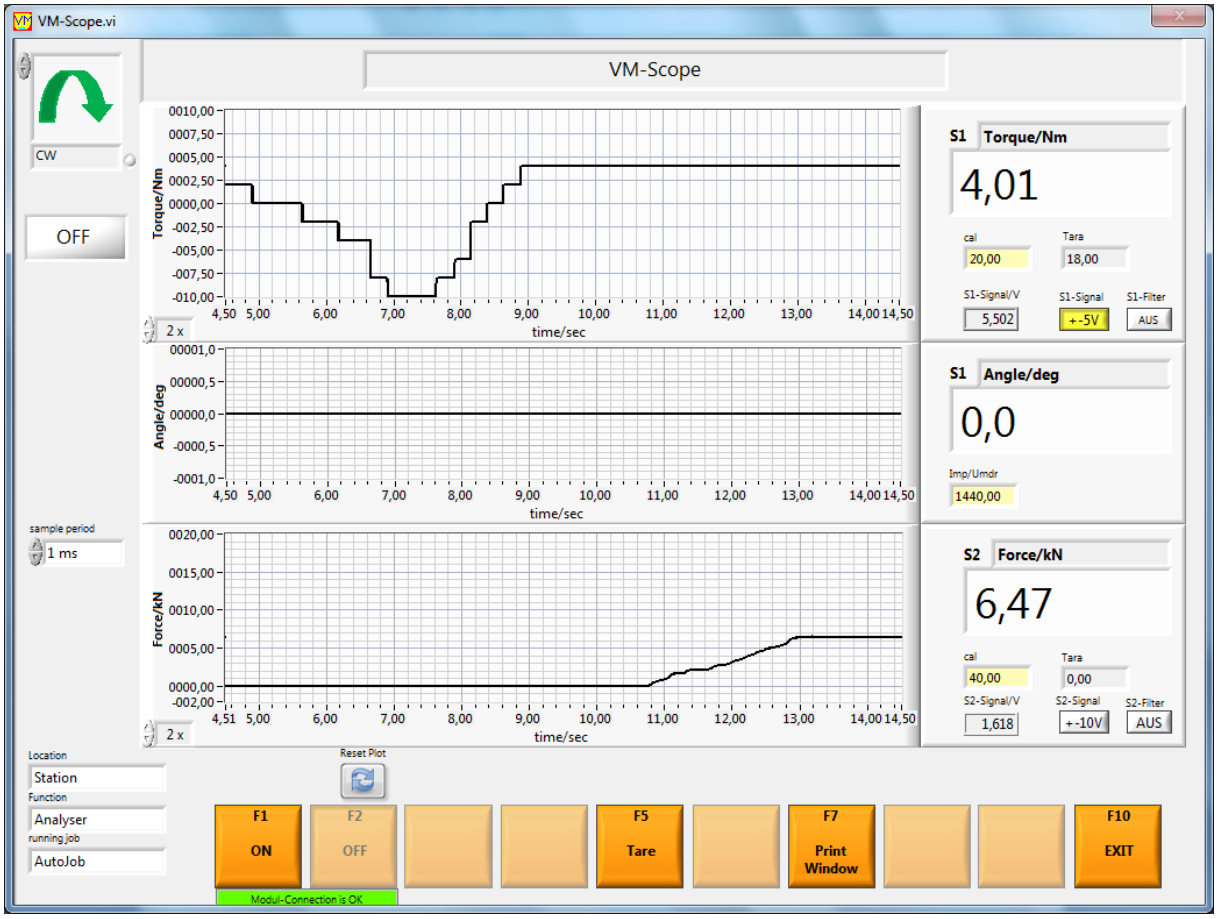
Evaluation window for “Sensor tare and test” measurements

2.11.2 VM scope

Sensor 1, sensor 2 and angle sensor inputs are plotted as on an oscilloscope.

The charts and the number of windows depends on the selection in the sensor constants.

Select the sampling period and the Y-axis scale before starting.



2.11.3 Angular test

2.11.3.1 360 degree test

You can test the pulse generator in sensor 1 with the 360 degree test. The angle factor is displayed at the top left in pulses/360 degrees. This is loaded from the sensor constants and can be changed for the test.
Test routine:

- Mark the shaft of the torque-angle sensor with a felt pen, so that you can see by how many degrees the shaft has turned.
- With F1 key: START - Start test, the RUN LED on the VALUEMASTER module goes green.
- Turn the sensor shaft by hand slowly only in the preset direction of rotation and observe the RUN LED.
- When the RUN LED goes out, stop turning.
- Check the angle on the PC. It should be 360 degrees +- 5 degrees (response error, etc.).

If the shaft is also turned by 360 degrees (the mark is at the same place as at start), then the angle factor is correct.

Evaluation window for sensor 1 angle test

2.11.4 Speed test

The speed and torque (excluding the tare value) of sensor 1 are measured in the rotational speed test.

Evaluation window for sensor 1 speed test

2.11.5 Test hardware

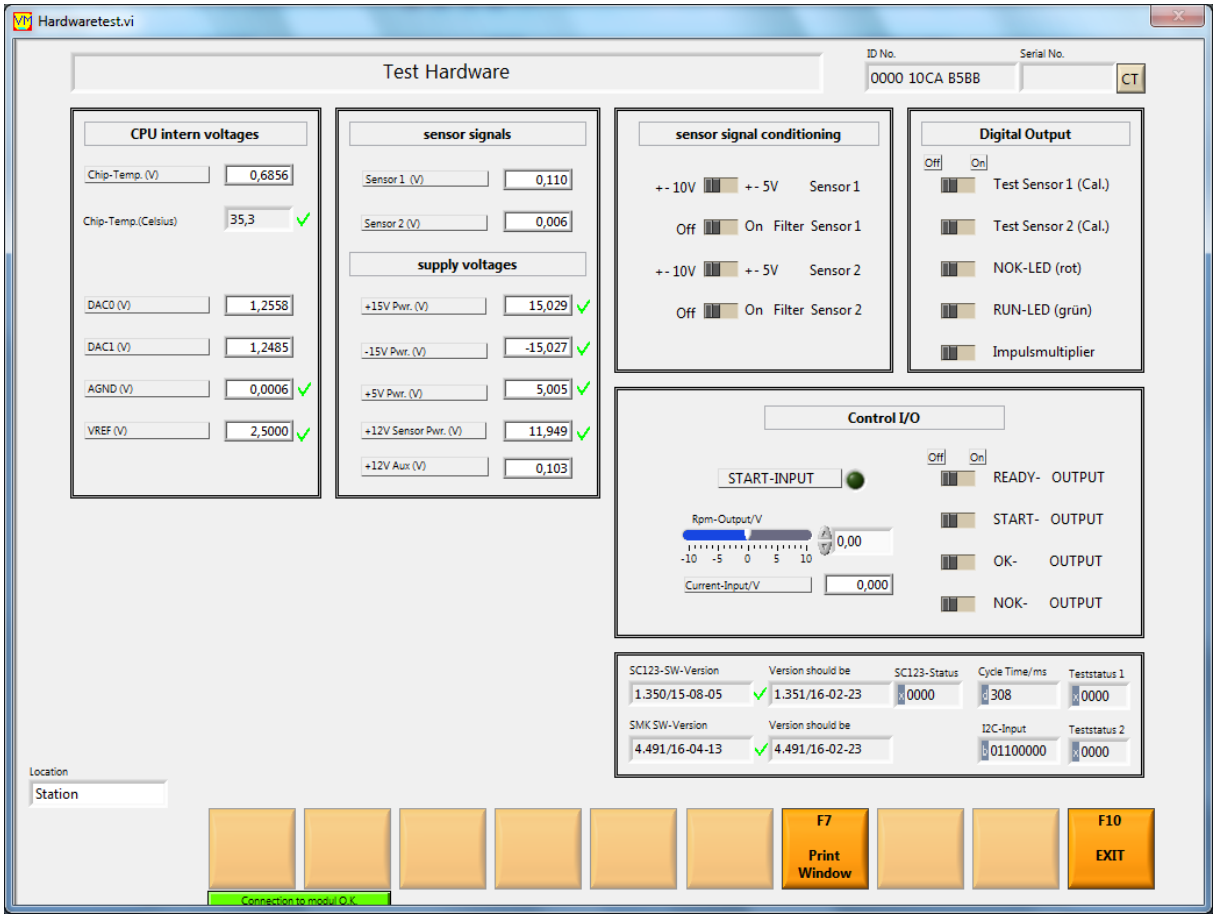
The operating voltages +5V and +-15V and 12V and the voltage values of the sensor inputs are displayed in the “Test Hardware” window.
The version numbers of the module firmware are displayed at the bottom left.
The serial number of the measurement module is at the top right.
A range of functions is available in the measurement module for individual tests. You can start the functions with the switches:

For sensor 1 and sensor 2:
- Input voltage 5V or 10V
- Filter on/off:
- Test sensor on/off

On the front panel:
- NOK LED on/off
- RUN LED on/off

Pulse multiplier in the measurement module on/off

The control I/Os can also be selected /de-selected and displayed.



Evaluation window for Hardware test

3 Software Versions:

03.08.2009	New edition / it
22.09.2009	Revised / it
06.10.2009	Recent screenshots / es
23.11.2009	Completion / it
25.11.2009	Proofreading /bs
15.03.2010	NEW: Power test: time-optimized, test period in seconds, sampling period 1-1000ms Analyzer: time-optimized, test period in seconds
06.06.2010	NEW: Frictional torque test with optional torque difference evaluation. The job window has been revised. NEW: The path for saving the test data can be selected in the job window.
3.2.2011	Power test revised Direction of rotation default and check removed. Cutoff with F2 key works. Emergency cutoff also at excessive torque (S1cutoff)
5.4.2011	The test data file names are generated in the format yy.mm.dd HH.MM.SS. Thus, the visualization over monthly boundaries is in the right order. The type of archiving can now be selected in all functions: plot, table, plot + table. The table is saved as file Valuelist.txt. Power test: a number of successive tests now work, speed peaks intercepted.
24.8.2011	New software version 2.65 Reason: ETH wish list of May 30, 2011, program loop, etc. Servo control in analysis and power function. Bidirectional plots in analysis and power function. Name of the default folder for test data and parameters includes version number New diagrams 20 and 35 in Screwing. In Frictional torque: torque as a function of time or angle.
23.01.2012	Software version 2.70 New dependent variable Pressure, new calibration function, copying jobs and setpoints, friction torque with breakaway torque, no password query with length = 0

21.03.2012	Software version 2.71 In frictional torque and analysis: At Tp = 0 dig. ON output not de-energized. Repeat ON / OFF switchable. In Frictional torque: Messages during the test.
11.06.2012	Software version 2.712 Loop OK / NOK label in the function window top right. Loop data tables. Sensor unit with chip is now also included in the calibration value.
18.11.2014	Version 2.80 Friction torque test: all friction data is displayed. The evaluation can be switched on / off. Notes in the archive evaluations with data display. Cutoff with sensor 2 in Analyze, Screwing and Power. Software version monitoring Archive On / Off in the setpoints.
23.02.2016	Version 2.802 Speed setpoints selectable in percent or rpm in sensor constants. Adjustable speed ramps in the setpoints. Speed setpoint more precise (error approx. 0.2%)
20.10.2017	Version 2.81 Serial number input
17.11.2017	Version 2.81 Rev1 Changed serial number input

This operator manual is not a quality agreement or durability guarantee as set out in Section 443 of the German Civil Code.

Specification changes, typing and printing errors reserved.

Version 2.81 Rev1
No 177e
October 17th, 2018