10 Diagnostic Functions

SOFTWARE

KR C1

Diagnostic Functions

Release 3.2

PD Interleaf

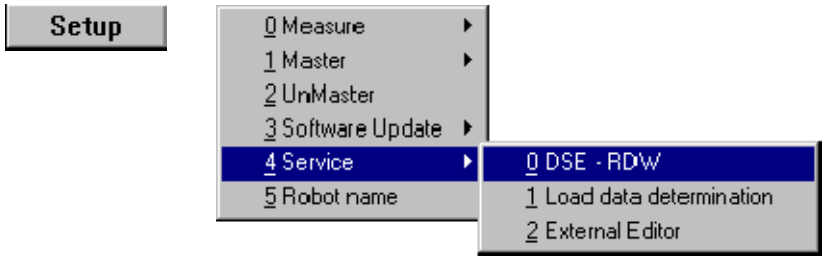
Contents

1 DSE – RDW

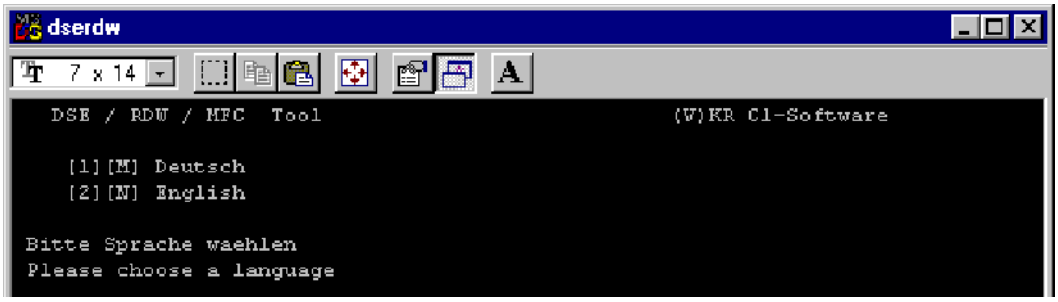
This service option offers you a range of options for displaying states and fault diagnosis as well as for configuring the DSE–RDW part of the robot system.

“DSE” is the abbreviation for “Digital Servo Electronics”, a module fitted on the MFC card (Multi Function Card) in the control cabinet. “RDW” is the German acronym for Resolver–Digital Converter (RDC). This unit is located at the robot base.

Selecting the menu item “Setup – Service – DSE – RDW”

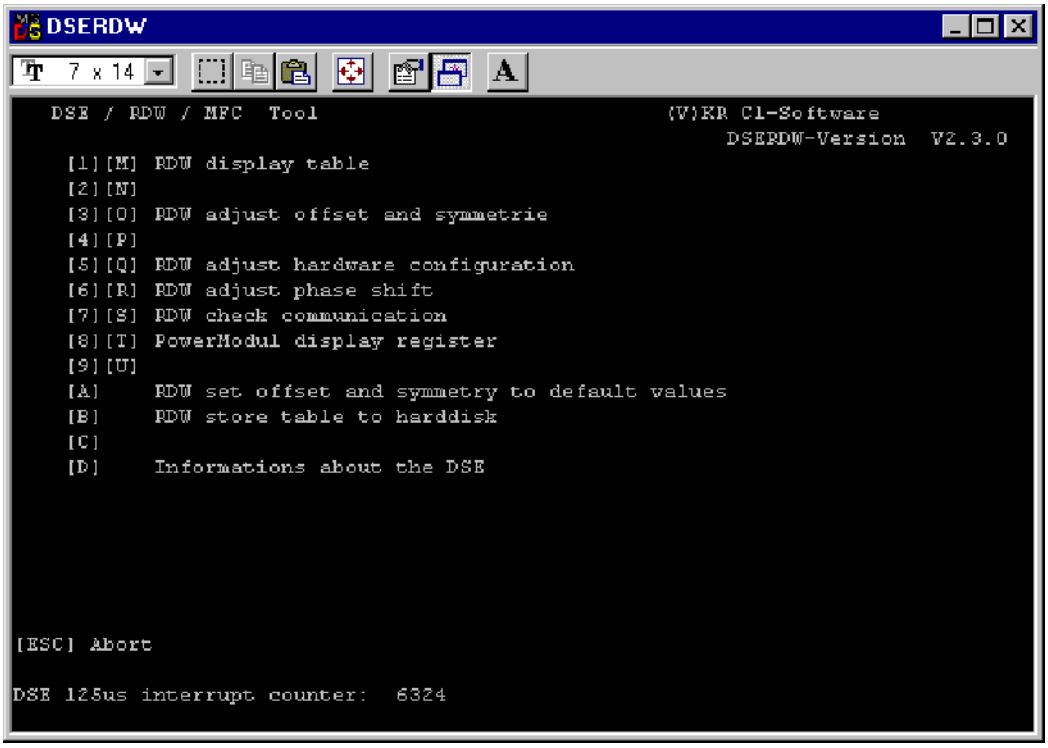


opens this window for language selection:



Briefly press the “N” key on the keyboard to display the following menus in English.

1.1 Main menu



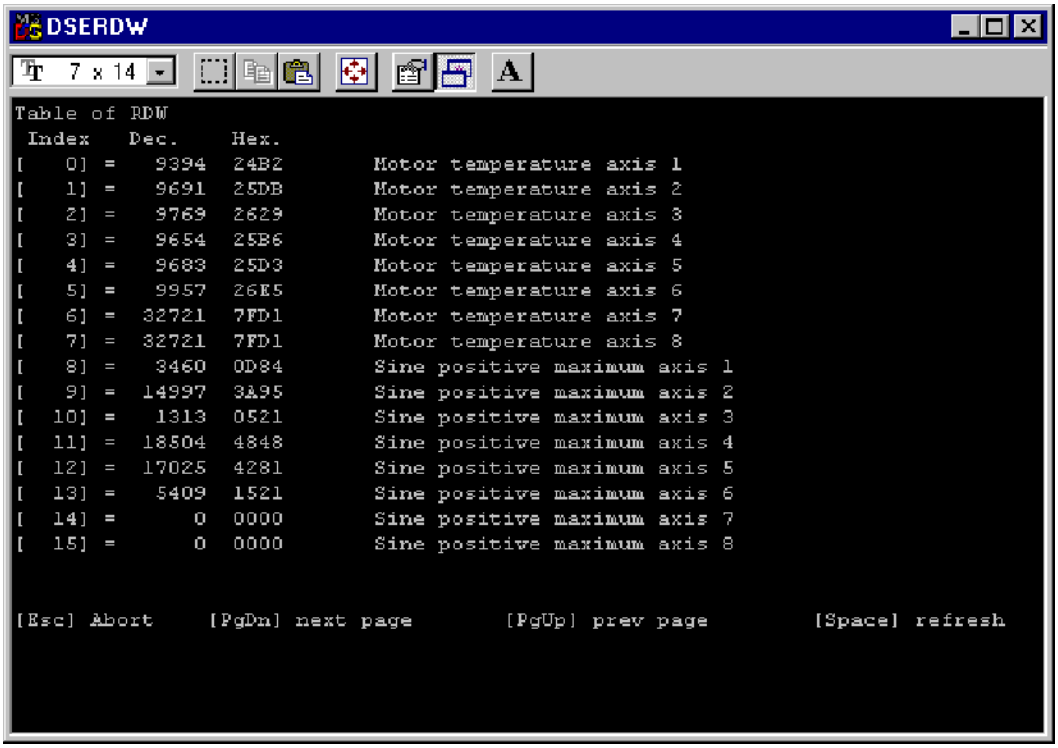
The value of the DSE interrupt counter is displayed in the bottom line. Incrementation of this hexadecimal counter indicates that the DSE control program is running. If the counter stops, the DSE control program is not running correctly.

If you wish to select a submenu, press the preceding figure or letter on the keyboard of your KCP. You can quit the program or selected submenu immediately at any time by pressing the “ESC” key.

The version number of the DSE–RDW diagnostic tool is displayed at the top righthand side of the display.

Only alter the configuration settings if you have adequate knowledge of its function, and of the consequences of the alteration!
The contents of the EEPROM in the RDC unit can be overwritten.
These data cannot be restored simply by booting the system.

1.1.1 RDW display table



If you have selected this option, the contents of the screen illustrated above appear on your display. Measurement and configuration data of the RDW are displayed here.

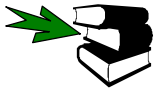
You can increase the size of the DOS window via the keyboard shortcut <Alt> + <Space>.

It is possible to page through the table using the keys “PGUP” and “PGDN”. These functions are available in the numeric keypad. However, this must first be switched to control functions. To do this, press the “NUM” key at the top left of the keypad. So doing, observe the lefthand side of the status line in the display. The word “NUM” must be displayed faded out.

Press the spacebar at the bottom right of the keyboard to refresh the display. You can quit the submenu immediately at any time by pressing the “ESC” key.

In line 88 (index) are data concerning the hardware configuration of the RDW. The frequency set must agree exactly with the processor and processor quartz frequencies, the result otherwise being encoder errors in every axis. If the frequency has not been set correctly, it can be altered using menu item “5”.

1.1.2 RDW adjust offset and symmetry



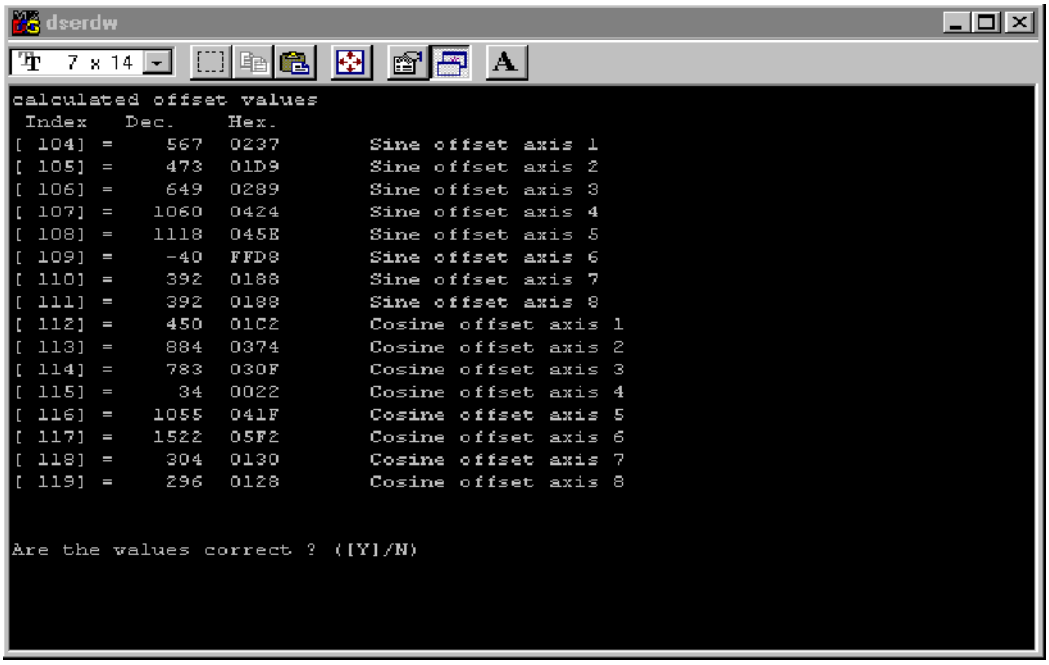
The function “RDW set offset and symmetry to default values” can be used to set the default values. Details can be found in Section 1.1.7.

ALL robot axes must be moved before this menu item is selected, otherwise there is a risk of loss of mastering.

This function is used to adjust the sine, cosine, offset and symmetry of the RDW. Existing A/D converter offsets and resolver asymmetries are eliminated in this way. The adjustment is carried out automatically based on the maximum sine and cosine values measured.

In order to be able to determine the maximum sine and cosine values correctly, every axis must have been moved through several revolutions of the motor.

After adjustment, the determined values are displayed for control purposes:



When the offset and symmetry values are checked, it is only necessary to detect extreme irregularities, e.g. if the axis did not move or a module is defective. Only axes connected to the RDW are relevant.

The values can lie between –2000 ... 2000 for the offset and between 19000 ... 26500 for the symmetry and depend heavily on the built–in A/D converter or multiplexer.

If the values lie outside these ranges, press the “N” key on the keyboard. In this way the RDW is reset to its default values.

If you press any other key, the values are accepted by the RDW and saved in the EEPROM.

1.1.3 RDW adjust hardware configuration

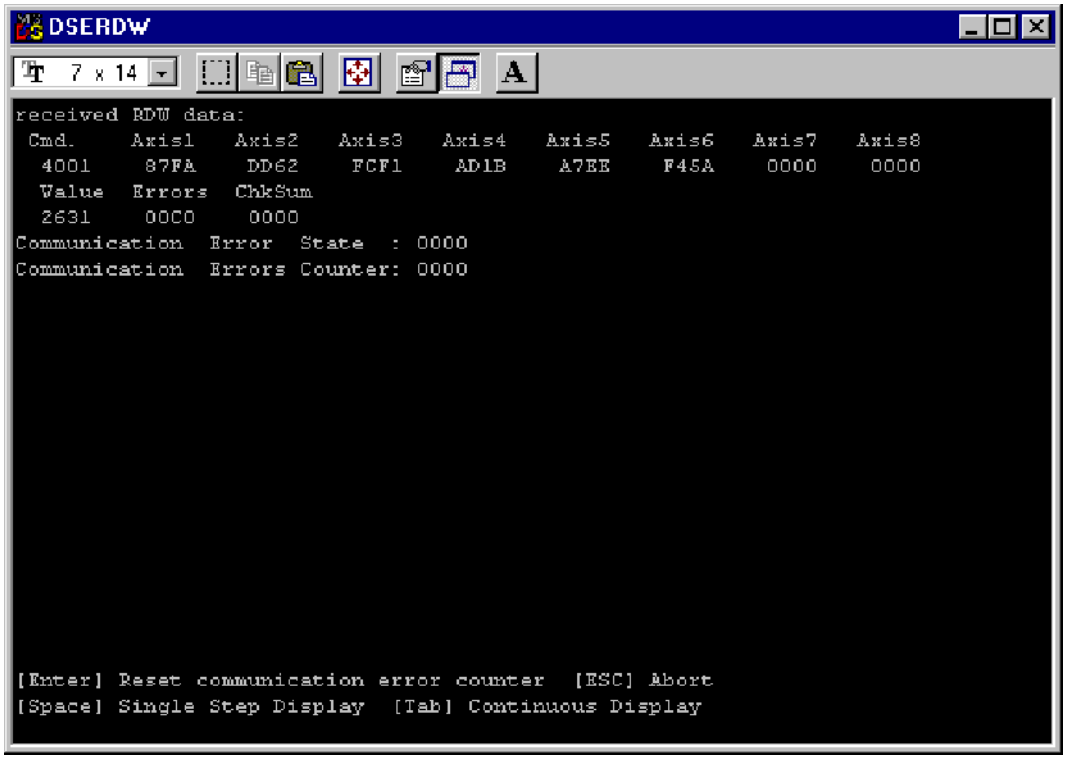
Do not select this menu item; this function is reserved for our service department.

1.1.4 RDW adjust phase shift

Do not select this menu item; this function is reserved for our service department.

1.1.5 RDW check communication

The RDW sends 12 data words to the DSE in a 125 µs cycle. This function can be used to check the communication between the DSE and the RDW. In this function, all values are displayed in hexadecimal.



Command

The last command the DSE has sent to the RDW. The hexadecimal value of this data word is always between 4000 ... 4007. The refresh rate of the KCP's LCD display is not high enough, however, for you to be able to see all the values consecutively.

Axis *nn*

This data word displays the resolver positions of the individual axes. It is normal for the values to vary. If an axis displays the value zero, there is an encoder error.

Value

The motor temperature of axes 1 to 8 requested by the DSE by means of the command.

Error

The encoder error bits and EMT signals are encoded in this data word.

Byte 15	Byte 14	Byte 13	Byte 12	Byte 11	Byte 10	Byte 9	Byte 8	Byte 7	Byte 6	Byte 5	Byte 4	Byte 3	Byte 2	Byte 1	Byte 0
insignificant for diagnosis						EMT signals		Encoder error bits for the robot axes							
								A8	A7	A6	A5	A4	A3	A2	A1

If the bit is "High", an encoder error has occurred.

ChkSum

Check sum for all transferred data.

Communication error state

If more than three data transfers have failed consecutively, this is displayed here. The state then takes the value `0001`.

Press the Enter key to reset the state.

Communication error counter

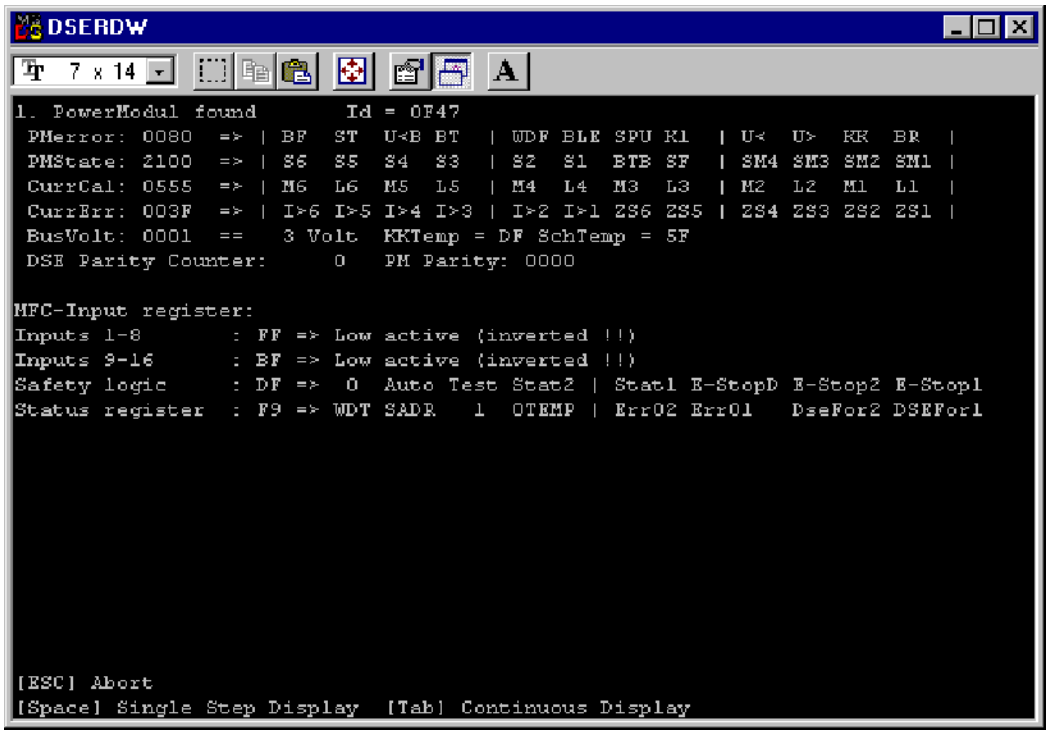
All transfers containing errors are counted here.

The display is frozen by pressing the spacebar at the bottom right of the keyboard and refreshed by pressing it again. Pressing the "TAB" key switches back to the cyclical display. This function is available in the numeric keypad. However, this must first be switched to control functions. To do this, press the "NUM" key at the top left of the keypad. So doing, observe the lefthand side of the status line in the display. The word "NUM" must be displayed faded out.

You can quit the program or selected submenu immediately at any time by pressing the "ESC" key.

1.1.6 PowerModule display register

The display on the screen varies according to the version of the power module.



This function displays the hexadecimal values of the power module and MFC registers. It goes without saying that the power module registers are only displayed if the power module is actually present. After the text *"PowerModul found"* the identification number of the built–in power module is displayed. Using this number, the robot software can distinguish between the various power module versions used.

The identification number has the following format:

Unused	Unused	Manufacturer's release	Version
0	F	0	5

To date, the following identification numbers have been built into our industrial robots:

0FFF	PM6/600
0F47	PM6/600 redesign, release 4
0F05	PM1, PM2
0F15	PM1, PM2 redesign

1.1.6.1 The individual error bits

The power module registers are 12 bits wide. The meaning of each error bit is listed by means of an abbreviation after the hexadecimal value.

PMerror			
Offset	Abbr.	Function, meaning	HIGH level signifies ...
Bit 0	**BR**	Brake error: short–circuit, all axes in idle. There is only one brake driver present for all 6 axes.	Error
Bit 1	**KK**	Heat sink temperature exceeded.	Error
Bit 2	**U >**	Max. intermediate circuit voltage exceeded, overvoltage.	Error
Bit 3	**U <**	Min. auxiliary supply 27 V undershot, undervoltage.	Error
Bit 4	**K1**	Operating state of drive contactor K1.	On
Bit 5	**SPU**	Voltage monitoring for low voltage, power failure.	Power failure
Bit 6	**BLE**	Ballast switch operating state.	Ballast switch ON
Bit 7	**WDF**	Watchdog error.	No error
Bit 8	**BT**	Ballast resistor overtemperature.	Error
Bit 9	**U < B**	Accumulator voltage too low for battery back–up.	Error
Bit 10	**ST**	Cabinet overtemperature, series connection of cabinet temperature sensor and fan sensor over power module.	Error
Bit 11	**BF**	Ballast switch on too long.	Error

PMState			
Offset	Abbr.	Function, meaning	HIGH level signifies ...
Bit 0	**SM1**	Input 1, rapid gauging.	
Bit 1	**SM2**	Input 2, rapid gauging.	
Bit 2	**SM3**	Input 3, rapid gauging.	
Bit 3	**SM4**	Input 4, rapid gauging.	
Bit 4	**SF**	Group error.	Error
Bit 5	**BTB**	Intermediate circuit voltage charge phase ended (system run-up), intermediate circuit voltage over 60 V (switch off: braking with charged intermediate circuit).	Intermediate circuit > 60 V
Bit 6	**S1**	Current controller of axis 1 saturated, without servo enable state is random.	Saturation reached

Bit 7	**S2**	Current controller of axis 2 saturated, without servo enable state is random.	Saturation reached
Bit 8	**S3**	Current controller of axis 3 saturated, without servo enable state is random.	Saturation reached
Bit 9	**S4**	Current controller of axis 4 saturated, without servo enable state is random.	Saturation reached
Bit 10	**S5**	Current controller of axis 5 saturated, without servo enable state is random.	Saturation reached
Bit 11	**S6**	Current controller of axis 6 saturated, without servo enable state is random.	Saturation reached

Bit 12	From these two bits in the register of the first power module, the software can recognize what power module is connected to the interface. If the power module is present, "*n. PowerModul found*" is shown on the display and the values indicate the current contents of the power module register. If the power module is not present, "*n. PowerModul not found*" is shown in the display and the values are invalid.			
	Bit	12	13	Meaning
Bit 13	Value	0	0	First and second power modules present
		0	1	Only second power module present
		1	0	Only first power module present
		1	1	No power module present

CurrCal			
Offset	Abbr.	Function, meaning	HIGH level signifies ...
If both axis bits are Low, the axis is not connected. If both axis bits are High, a fault has occurred.			
Bit 0	**L1**	Current calibration of axis 1	... set to low current range
Bit 1	**M1**	Current calibration of axis 1	... set to high current range
Bit 2	**L2**	Current calibration of axis 2	... set to low current range
Bit 3	**M2**	Current calibration of axis 2	... set to high current range
Bit 4	**L3**	Current calibration of axis 3	... set to low current range
Bit 5	**M3**	Current calibration of axis 3	... set to high current range
Bit 6	**L4**	Current calibration of axis 4	... set to low current range
Bit 7	**M4**	Current calibration of axis 4	... set to high current range
Bit 8	**L5**	Current calibration of axis 5	... set to low current range
Bit 9	**M5**	Current calibration of axis 5	... set to high current range
Bit 10	**L6**	Current calibration of axis 6	... set to low current range
Bit 11	**M6**	Current calibration of axis 6	... set to high current range

CurrErr			
Offset	Abbr.	Function, meaning	HIGH level signifies ...
External axes can only be enabled here if the power module is fitted with an *external axis enabling board*.			
Bit 0	**ZS1**	Enabling of the external axis	External axis is enabled
Bit 1	**ZS2**	Enabling of the external axis	External axis is enabled
Bit 2	**ZS3**	Enabling of the external axis	External axis is enabled
Bit 3	**ZS4**	Enabling of the external axis	External axis is enabled
Bit 4	**ZS5**	Enabling of the external axis	External axis is enabled
Bit 5	**ZS6**	Enabling of the external axis	External axis is enabled
Bit 6	**I > 1**	Overcurrent in axis 1	Error
Bit 7	**I > 2**	Overcurrent in axis 2	Error
Bit 8	**I > 3**	Overcurrent in axis 3	Error
Bit 9	**I > 4**	Overcurrent in axis 4	Error
Bit 10	**I > 5**	Overcurrent in axis 5	Error
Bit 11	**I > 6**	Overcurrent in axis 6	Error

BusVolt

Hexadecimal value of the intermediate circuit voltage in volts

KKTemp

Hexadecimal value for the heat sink temperature bit

SchTemp

Hexadecimal value for the cabinet temperature bit

DSE Parity Counter

The number of parity errors detected when reading the power module register on the DSE is indicated on this counter. The 16 bit wide counter is displayed in hexadecimal form.

PM Parity

The number of parity errors detected when writing to the power module register on the DSE is indicated on this counter. The 8 bit wide counter is displayed in hexadecimal form. This counter should normally remain unchanged or only increase very, very rarely.

Data bus faults occur more often if the servo enable function is switched on. The counter may then increase more quickly.

1.1.6.2 MFC register

Inputs 1–8, inputs 9–16

These registers show the states of MFC inputs 1 ... 6.

The levels are displayed inverted.

Safety logic			
Offset	Abbr	Function, meaning	LOW level signifies ...
Bit 0	**NotAus1**	Image of Emergency Stop circuit 1	Circuit open
Bit 1	**NotAus2**	Image of Emergency Stop circuit 2	Circuit open
Bit 2	**NotAusD**	EMERGENCY STOP delay	Delay active
Bit 3	**Zust1**	Image of enabling switch circuit 1	Circuit closed
Bit 4	**Zust2**	Image of enabling switch circuit 1	Circuit closed
Bit 5	**Test**	Image of operating mode group “TEST”	Group selected
Bit 6	**Auto**	Image of operating mode group “AUTO”	Group selected
Bit 7	**0**	–	–

Status register			
Offset	Abbr	Function, meaning	LOW level signifies ...
Bit 0	**DSEVor1**	Image of first DSE	Circuit open
Bit 1	**DSEVor2**	Image of second DSE	Circuit open
Bit 2	**Err01**	Monitoring of outputs 1 ... 8	Short–circuit
Bit 3	**Err02**	Monitoring of outputs 9...16	Short–circuit
Bit 4	**OTEMP**	Image of control computer temperature	Overheated
Bit 5	**1**	–	–
Bit 6	**SADR**	MFC base address	h280 [*HI h260*]
Bit 7	**WDT**	MFC watchdog	Tripped

The display is frozen by pressing the spacebar at the bottom right of the keyboard and refreshed by pressing it again. Pressing the “TAB” key switches back to the cyclical display. This function is available in the numeric keypad. However, this must first be switched to control functions. To do this, press the “NUM” key at the top left of the keypad. So doing, observe the lefthand side of the status line in the display. The word “NUM” must be displayed faded out.

You can quit the program or selected submenu immediately at any time by pressing the “ESC” key.

1.1.7 RDW set offset and symmetry to default values

This menu item can be used to reset the offset and symmetry values to the default values. This should always be done before an RDW adjustment is carried out.

RDW adjustment

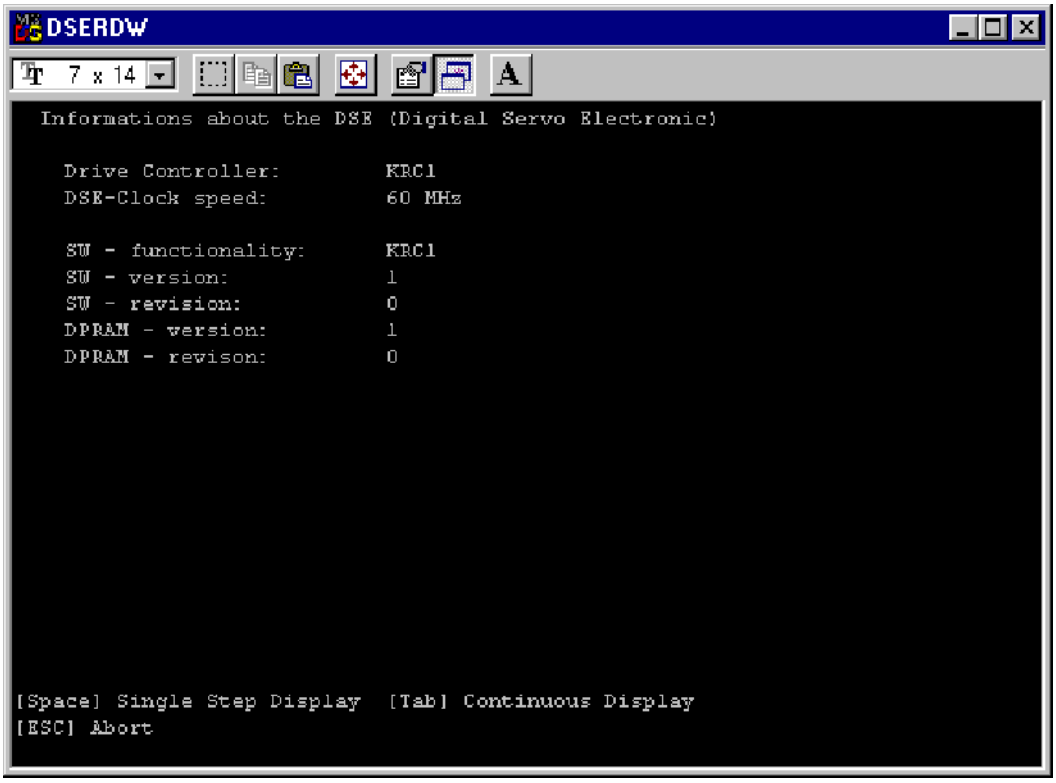
- Set RDW to default values
- Move all axes manually, guide value: min. 10 degrees per axis
- Carry out offset and symmetry adjustment

1.1.8 RDW store table to harddisk

Selecting this option saves the contents of the RDW table to the hard disk.

1.1.9 Information about the DSE

Here you can display information about the DSE:

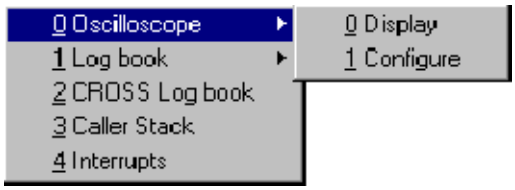


2 Oscilloscope

The submenu “Oscilloscope” contains the two additional menu items “Display” and “Configure”.

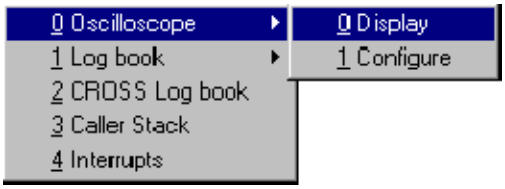
Monitor

Using the menu key “Monitor”, open first the submenu “Diagnosis” and then the menu “Oscilloscope”. The following submenu is displayed:



2.1 Display

Saved traces can be viewed and analyzed with this function.



A window is opened on the display. All of the files which are saved in the directory `C:\PROGRAM FILES\KRC\TRACE` and which have the extension TRC are displayed here.

2.1.1 File selection

The desired file can be selected using the arrow keys. The name of the selected file will be indicated by a color background. Move the cursor to a file having the end digit 1. It contains data from the digital servoelectronics DSE.

Ok

After selecting this file, please press the softkey “Ok”.

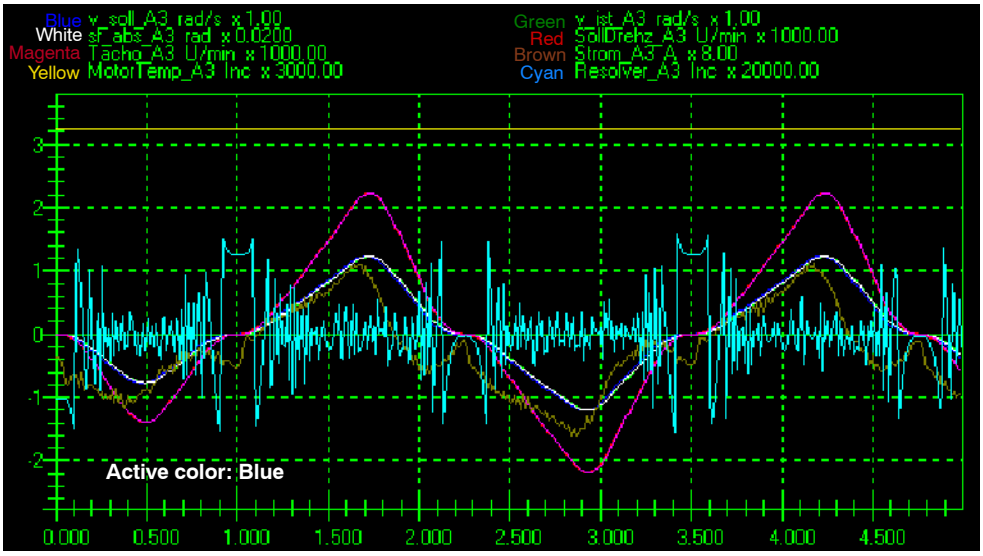
A new window is opened: the oscilloscope display.

2nd file

The softkey “2nd file” is described in more detail in the section **[Superposing traces]**.

2.1.2 The oscilloscope display

The contents of your screen should now look similar to those below. However, you have probably recorded other data with a different configuration. For this reason, the individual curves also have different forms and different colors on your screen.

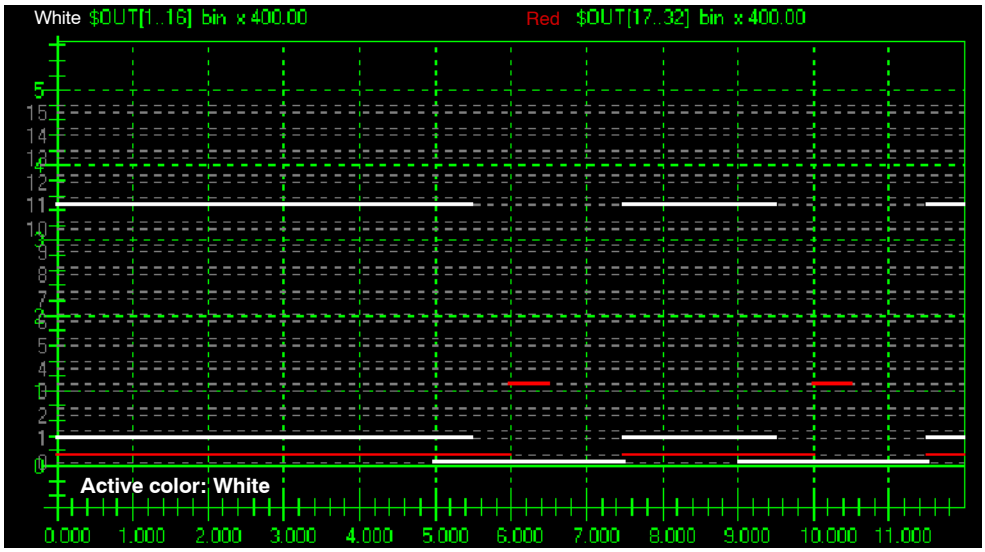


More detailed information about the curves can be found in the upper part of the display. The color, the assigned variable, the unit of measurement and the scale of the display are listed in sequence for each curve.

The left bar (vertical) shows values which, when multiplied by the scale of the display, represent the value of a curve at a point in time that is shown below on the time axis (horizontal).

If signals from the controller's inputs and outputs are displayed, the left bar (vertical) also contains numbers as placeholders for the number of the selected inputs or outputs.

Inputs or outputs are only displayed while they have the value "TRUE" (as long as an input or output has the value "FALSE", you will only see a broken gray line).



The "active" color is permanently displayed at the bottom left of the screen.

You can "move" through the entire trace by using the arrrow keys.

Cancel

You can exit the display function again at any time by pressing the softkey "Cancel".

2.1.3 The information window

Info

Now first press the softkey “Info”. A window is opened displaying further information about the individual curves. The information window appears as follows for the example given above:

No.	File	Channel	Description	Color	Visible
Graph 0	BEW31	Channel 0	Teil-Sollwert_A1	Blue	yes
Graph 1	BEW31	Channel 1	Ist-Drehzahl_A2	Green	yes
Graph 2	BEW31	Channel 2	Schleppfehler_A3	White	yes
Graph 3	BEW31	Channel 3	Soll-Drehzahl_A4	Red	yes
Graph 4	BEW31	Channel 4	Ist-Drehzahl_A5	Magenta	yes
Graph 5	BEW31	Channel 5	Strom_A6	Brown	yes
Graph 6	BEW31	Channel 6	Motortemperatur_A7	Yellow	yes
Graph 7	BEW31	Channel 7	Resolver_A8	Cyan	yes

The color and the number of each curve are displayed in the first column.

The second column specifies the file from which the data for the curve have been read.

You can see the channel to which the curve has been assigned and the variable that it represents in the columns “Channel” and “Name”.

The name of the color of the curve is displayed in the column “Color”.

The last column indicates whether the curve is displayed or not.

Info

Now press the softkey “Info” again. The window is closed. You can switch between the two functions by using this softkey.

2.1.4 The softkey bar

Let us now turn to the softkey bar. It has four levels in the function “Show”.

===>

You can switch between these four levels by using the softkey “===>”.

Blue	Green	White	Red	Info	--->	Cancel
Magenta	Brown	Yellow	Cyan	Info	--->	Cancel
Zoom	Unzoom	Channel	RMS	Print	--->	Cancel
VCursor 1	VCursor 2	HCursor 1	HCursor 2	Filter on/off	--->	Cancel

2.1.5 The color softkeys

To make it as easy as possible to read the display, a maximum of eight different colors (blue, green, white, red, magenta, brown, yellow and cyan) are shown.

Blue	Green	White	Red	Info	--->	Cancel
Magenta	Brown	Yellow	Cyan	Info	--->	Cancel

Curves can be displayed or removed on the basis of their colors with the aid of the color softkeys. This is done quite simply by pressing the appropriate color softkey.

Blue

Please remove the blue curve by pressing the softkey “Blue” once. Then open the information window. Reminder: To do so, press the softkey “Info”.

No.	File	Channel	Description	Color	Visible
Graph 0	BEW31	Channel 0	Teil-Sollwert_A1	No color	no
Graph 1	BEW31	Channel 1	Ist-Drehzahl_A2	Green	yes
Graph 2	BEW31	Channel 2	Schleppfehler_A3	White	yes

Your action has been registered in the last column (far right). “Visible” now has the value “No” for the blue curve.

Now close the information window again and then make the blue curve visible once more. To do so, press the color softkey “Blue” again.

If you press color softkeys while the information window is open, color assignments will be cancelled. The procedure for recovering cancelled color assignments is described in Section 2.1.13.

Certain graphs can also be removed by selecting the desired graph in the information window and pressing the “Enter” key. More detailed information on this can be found in Section 2.1.14.

2.1.6 The zoom function

Press the softkey “===>” repeatedly until the zoom functions appear in the softkey bar.

Zoom

When the softkey “Zoom” is pressed, a white cross about five millimeters high appears in the middle of the window. This can be moved about the entire window using the arrow keys. Move it to the position of your choice and then press the Enter key. The point that is currently selected represents a corner point of the zoom window, which must now be expanded using the arrow keys. Include everything that you want enlarged in this zoom window and then press the Enter key again. The contents of the zoom window will then be enlarged on the display.

Unzoom

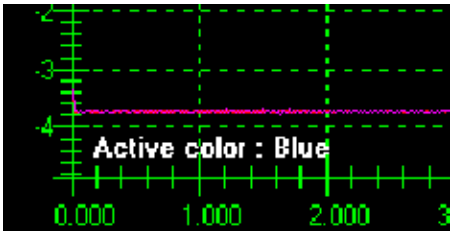
To undo zooming, please press the softkey “Unzoom”.

2.1.7 The scaling function

In the display, you are able to increase or reduce the amplitude of individual curves.

Channel

To do so, press the softkey “Channel” until the color of the desired curve is active. The active color is permanently displayed at the bottom left of the window.



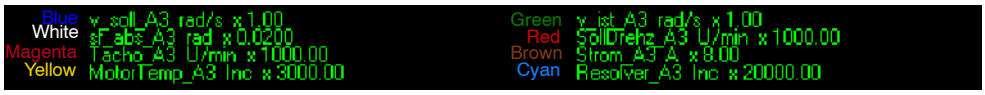
Now observe what changes occur when you press the keys “M” or “N” in the ASCII alphabetic keypad.

N Pressing the key “N” in the ASCII alphabetic keypad gradually <u>increases</u> the amplitude.

M Pressing the key “M” in the ASCII alphabetic keypad gradually <u>decreases</u> the amplitude.

By using this function, it is also possible to clearly display curves which only have a small deflection or which are hidden by other curves.

The current scale is given in the top area of the display.

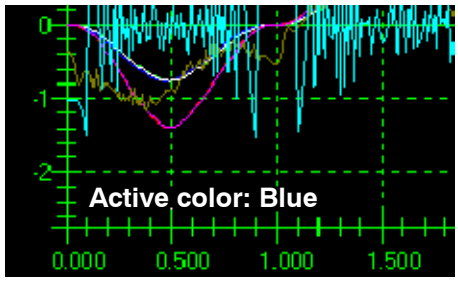


2.1.8 The r.m.s. value function

In order to determine the value that a curve represents during a certain period of time as easily as possible, the r.m.s. value function has been integrated.

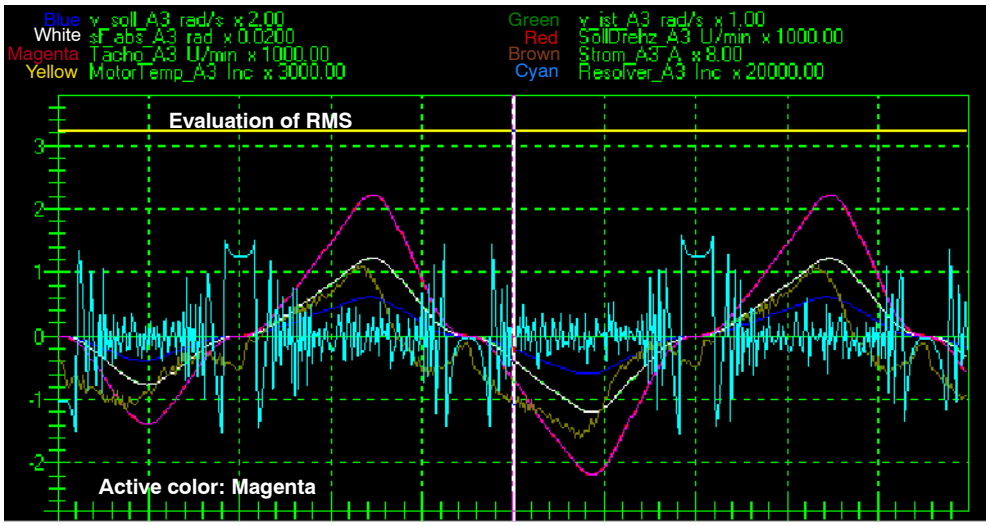
Channel

To determine the r.m.s. value, you must press the softkey “Channel” to select the color used by the curve that is to be evaluated. The active color is permanently displayed at the bottom left of the window.



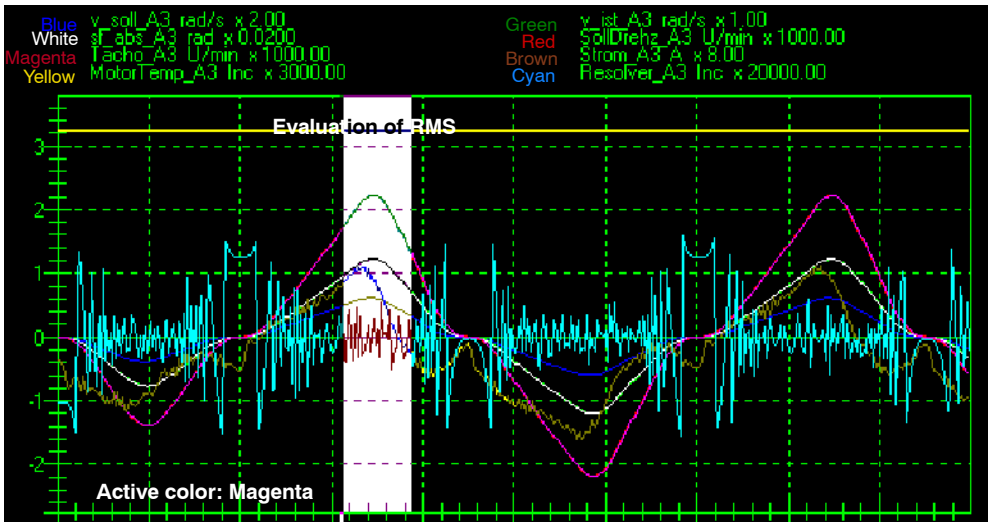
RMS

Then press the softkey “RMS”. A vertical white line with the label “Evaluation of RMS” is displayed in the window.

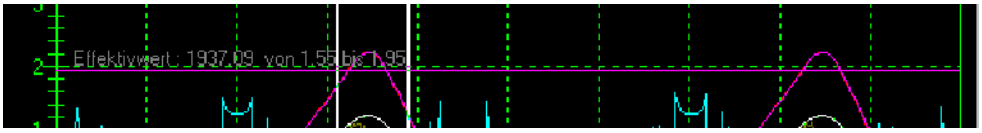


Now move this line to the start point of your r.m.s. value evaluation using the “←” and “→” arrow keys and then press the Enter key.

You can now use the “←” and “→” arrow keys to define a sort of “measuring range”, which is displayed as a white box.



After pressing the Enter key, the result of the evaluation is displayed in the window.



Should the text that is displayed be hidden by other curves and thus cannot be read, simply remove the other curves for the time being. Reminder: To do so, use the color softkeys.

RMS To end the function “RMS”, please press the softkey “RMS” again.

If you press the softkey “Close” instead, the entire display function will be ended.

2.1.9 Printing

Print If you would like to print out the contents of the screen, please press the softkey “Print”.

The screen is printed on the current default printer of the operating system. The printer should be set to “Landscape”.

2.1.10 The cursor functions

Press the softkey “===>” repeatedly until the cursor functions appear in the softkey bar.

VCursor 1	VCursor 2	HCursor 1	HCursor 2	Filter on/off	--->	Cancel

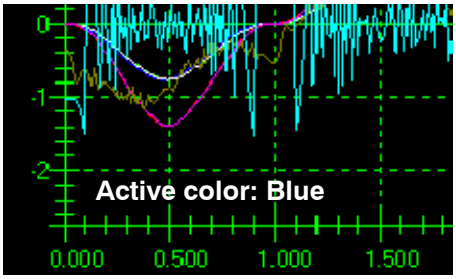
You are able to place two vertical and two horizontal lines (cursors) inside the window with these functions. This enables you to determine the value that a curve represented at a certain time quite easily.

The color of the active curve is permanently displayed at the bottom left of the window. To change it, press the softkey “===>” repeatedly until the following functions appear in the softkey bar.

Zoom	Unzoom	Channel	RMS	Print	--->	Cancel

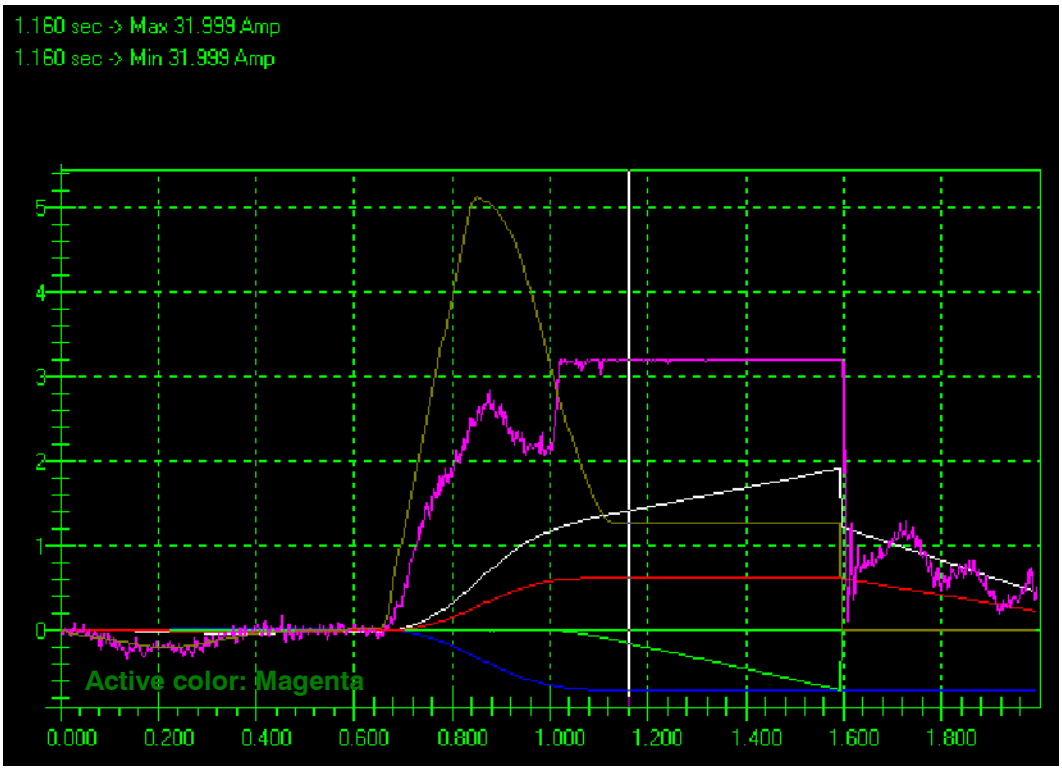
Channel

Press the softkey “Channel” until the color of the desired curve is active.

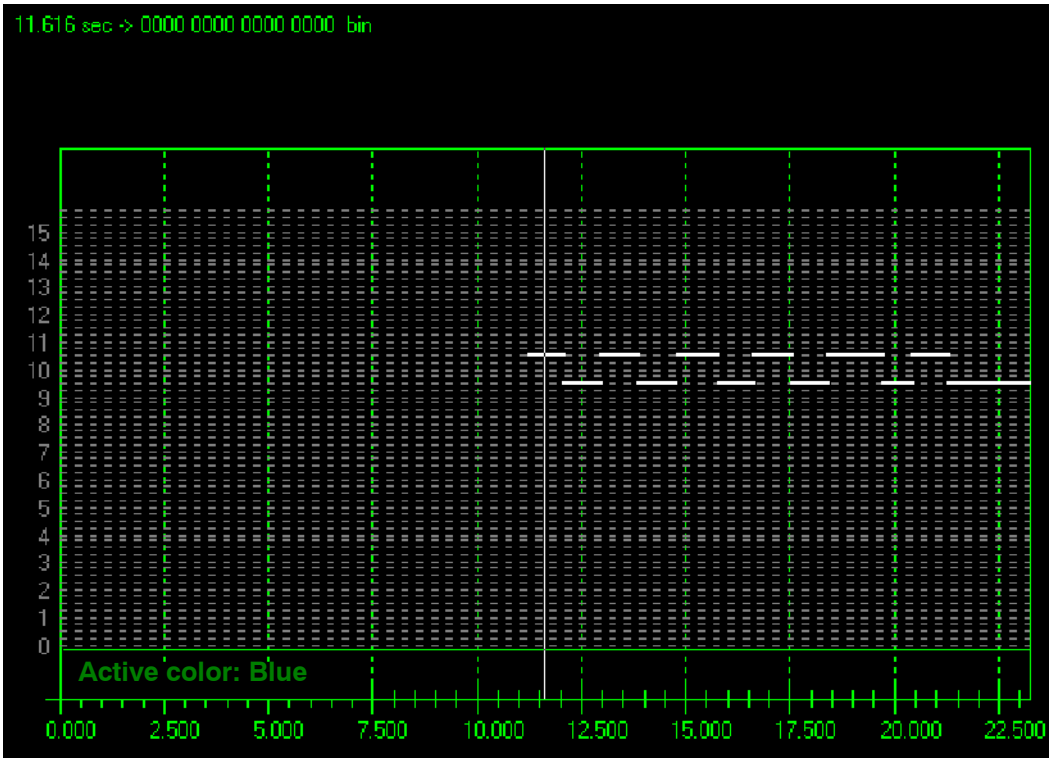


VCursor 1

Change the softkey bar again and then press the softkey “VCursor1”. A vertical white line is displayed in the window.



The value that the selected curve had at the time where the cursor is currently positioned is displayed at the top left of the window (2 values are displayed in this illustration as the softkey “Filter off” has been selected). When inputs or outputs are displayed, the bit pattern of the selected input or output group is shown here.



Now move the cursor using the arrow keys and observe how the top left of the display changes.

VCursor 2

Press the softkey “VCursor2”. A second vertical white line (cursor) is displayed in the window.

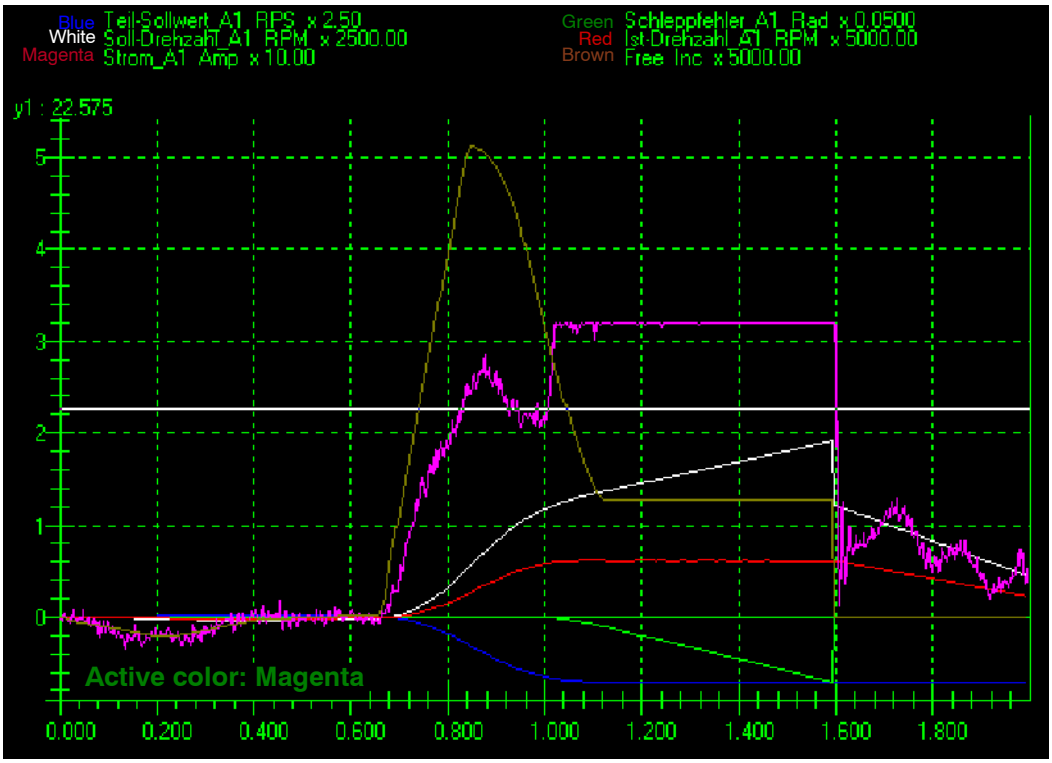
The values for the second cursor now appear to the right of the display for the first cursor (2 values are displayed in this illustration, one below the other, as the softkey “Filter off” has been selected). When inputs or outputs are displayed, the bit pattern of the selected input or output group is also shown here. The time difference between these two cursors is displayed on the lefthand side.

These cursors can be removed again by pressing the softkey “VCursor1” or “VCursor2” once more.

HCursor 1

If the softkey “HCursor1” is pressed, a horizontal white line with the label “Function value cursor” will be displayed in the window.

When inputs and outputs are displayed, the function “HCursor” is not suitable for showing the numbers.



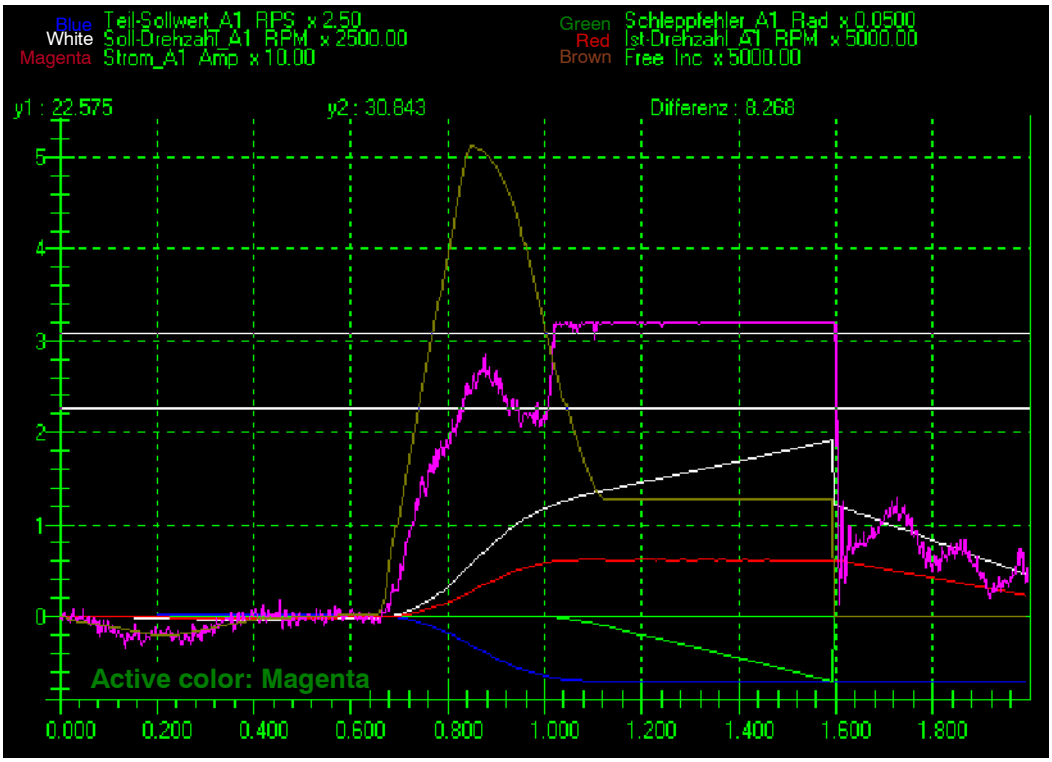
The value where the cursor is currently positioned is displayed at the top left of the window.

Now move the cursor using the arrow keys and observe how the top left of the display changes.

HCursor 2

Press the softkey “HCursor2”. A second horizontal white line is displayed in the window.

When inputs and outputs are displayed, the function “HCursor” is not suitable for showing the numbers.



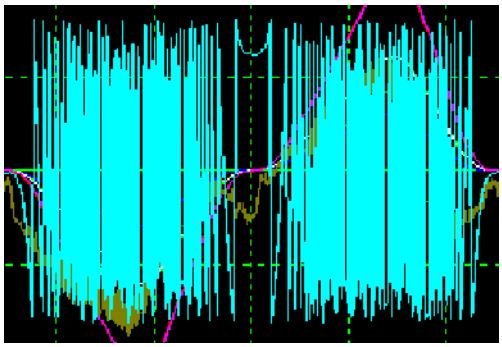
The values for the second cursor now appear to the right of the display for the first cursor. The time difference between these two cursors is displayed on the lefthand side.

These lines can be removed again by pressing the softkeys “HCursor1” or “HCursor2” once more.

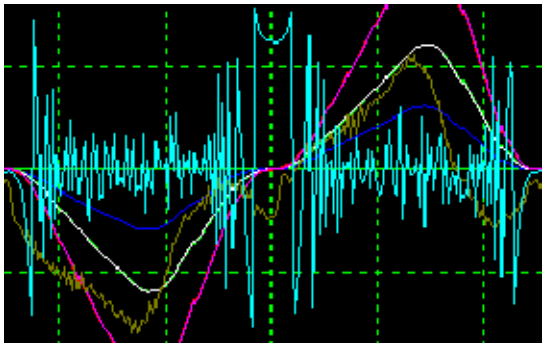
2.1.11 The filter function

Filter on/off

By pressing this softkey, you can switch on a software filter which “smooths” the displayed curves. This filter is switched off again by pressing this softkey once more.



unfiltered

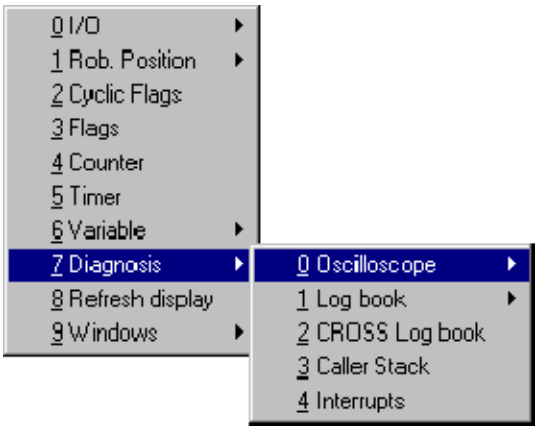


filtered

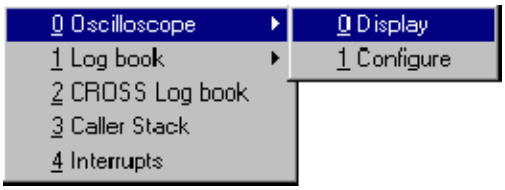
2.1.12 Superposing traces

To allow you to compare data from different traces with each other, the function “TraceFile2” has been integrated.

To use this function, please open the menu by means of the menu key “Monitor”. Then select “Diagnosis”. The following display appears:



As you want to use the oscilloscope function “Display” to view traces that have already been saved, please confirm the offered selection “Oscilloscope”. A further menu is opened, in which you also confirm the offered selection “Display” again.



A window is opened on the display. All of the files which are saved in the directory `C:\PROGRAM FILES\KRC\TRACE` and which have the extension TRC are displayed here.

The desired file can be selected using the arrow keys. The name of the selected file will be indicated by a color background. Move the cursor to a file with, for example, the end digit 3. Data from the controller’s inputs and outputs are recorded in this file.

2nd file

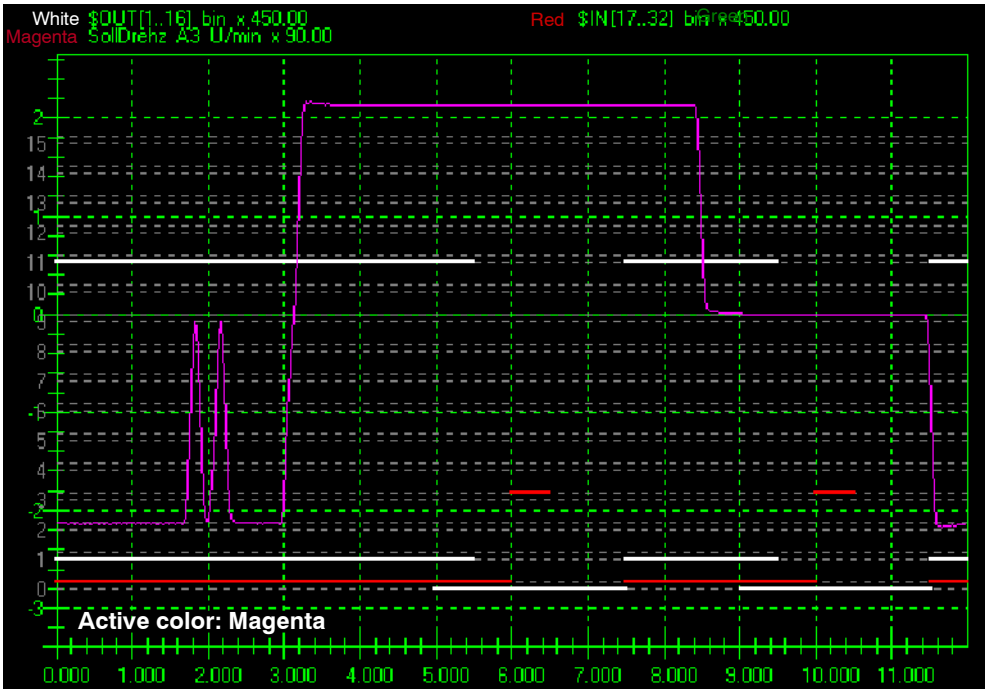
After selecting this file, please press the softkey “2nd file”. Beneath the trace file list appears the message “BEW31.TRC marked for second file, please choose first file and hit “OK”.

Now use the arrow keys to move the cursor to a file with the end digit 1, for example. DSE data are recorded in this file.

Ok

After selecting this file, please now press the softkey “Ok”.

In the window, you can now see that the contents of these two traces are superposed on each other.



2.1.13 Changing color assignments

Info

The color assignments of the individual curves can be changed at any time. This is necessary, for example, if more than 8 channels are assigned and not all channels can be displayed simultaneously because there are only 8 colors available. To do so, open the information window by pressing the softkey “Info”.

No.	File	Channel	Description	Color	Visible
Graph 0	BEW31	Channel 0	Teil-Sollwert_A1	Blue	yes
Graph 1	BEW31	Channel 1	Ist-Drehzahl_A2	Green	yes
Graph 2	BEW31	Channel 2	Schleppfehler_A3	White	yes
Graph 3	BEW31	Channel 3	Soll-Drehzahl_A4	Red	yes
Graph 4	BEW31	Channel 4	Ist-Drehzahl_A5	Magenta	yes
Graph 5	BEW31	Channel 5	Strom_A6	Brown	yes
Graph 6	BEW31	Channel 6	Motortemperatur_A7	Yellow	yes
Graph 7	BEW31	Channel 7	Resolver_A8	Cyan	yes

As an example, we now want to interchange the color assignments of curves 1 (currently still blue) and 3 (currently still red).

Blue

Press the color softkey “Blue” to deactivate the assignment that is valid for the curve.
Move the highlight to the curve with the number 3.

Blue

Press the color softkey “Blue” again to assign the color blue (which has just become available) to curve 3.
Move the highlight to curve 1, which is currently not assigned a color.

Red

Press the color softkey “Red” here to assign the color red to this curve.

Info

Now close the information window again.

2.1.14 Switching curves on and off

Info

It can sometimes be necessary to completely remove individual curves from the display. To do so, open the information window by pressing the softkey “Info”.

No.	File	Channel	Description	Color	Visible
Graph 0	BEW31	Channel 0	Teil-Sollwert_A1	Blue	yes
Graph 1	BEW31	Channel 1	Ist-Drehzahl_A2	Green	yes
Graph 2	BEW31	Channel 2	Schleppfehler_A3	White	yes
Graph 3	BEW31	Channel 3	Soll-Drehzahl_A4	Red	yes
Graph 4	BEW31	Channel 4	Ist-Drehzahl_A5	Magenta	yes
Graph 5	BEW31	Channel 5	Strom_A6	Brown	yes
Graph 6	BEW31	Channel 6	Motortemperatur_A7	Yellow	yes
Graph 7	BEW31	Channel 7	Resolver_A8	Cyan	yes

Select the curve that you would like to remove from the display. The curve that is currently selected is highlighted by a color background. Now press the Enter key.

No.	File	Channel	Description	Color	Visible
Graph 0	BEW31	Channel 0	Teil-Sollwert_A1	No color	no
Graph 1	BEW31	Channel 1	Ist-Drehzahl_A2	Green	yes
Graph 2	BEW31	Channel 2	Schleppfehler_A3	White	yes

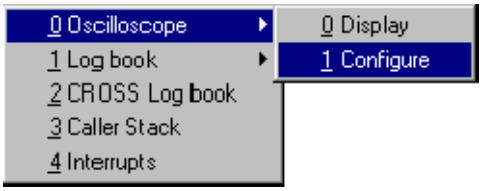
Info

Now close the information window again.

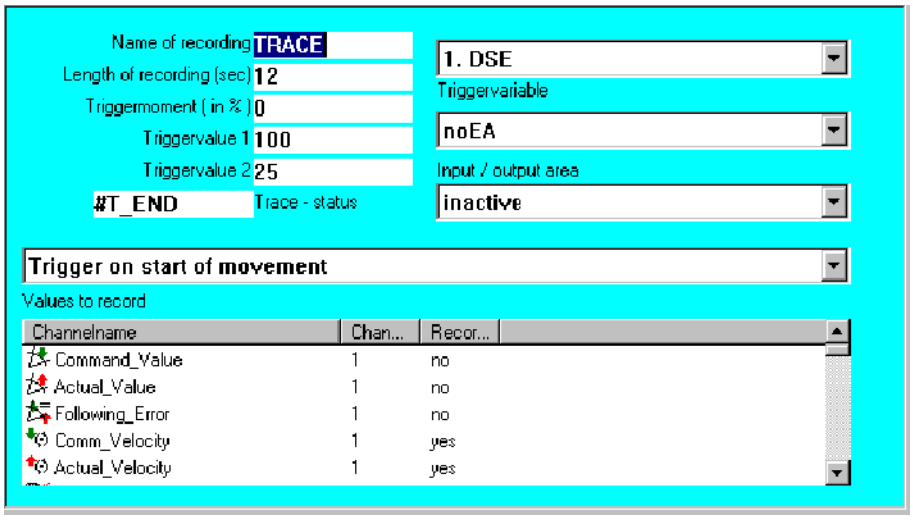
As you can see, your action has been registered. The deactivated curve is now no longer displayed.

2.2 Configure

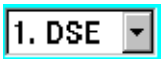
Before you can record something with the oscilloscope, you must first tell it WHAT and HOW it is to record. For this purpose, the oscilloscope function offers a range of configuration options.



A window is opened on the display. Data which characterize the trace in greater detail must be entered here.



The various **input boxes** can be selected using the "↓" and "↑" arrow keys. Then enter the desired values by means of the keyboard or numeric keypad.



Use the "←" and "→" arrow keys in **selection boxes**, which can be identified by the arrow symbol on the right, to select from the options offered.

If the "Values to record" box is activated (dark blue highlight), you can also change the channel name by pressing the "←" and "→" arrow keys. A channel name is activated or deactivated by repeatedly pressing the "Enter" key.

2.2.1 Name of recording

A file name under which the trace will be saved later can be defined here. Do not use more than seven characters because a further digit is added to the file name by the system in order to distinguish different types of trace.

These trace files can be found with the extension TRC in the directory `C:\PROGRAM FILES\KRC\TRACE`.

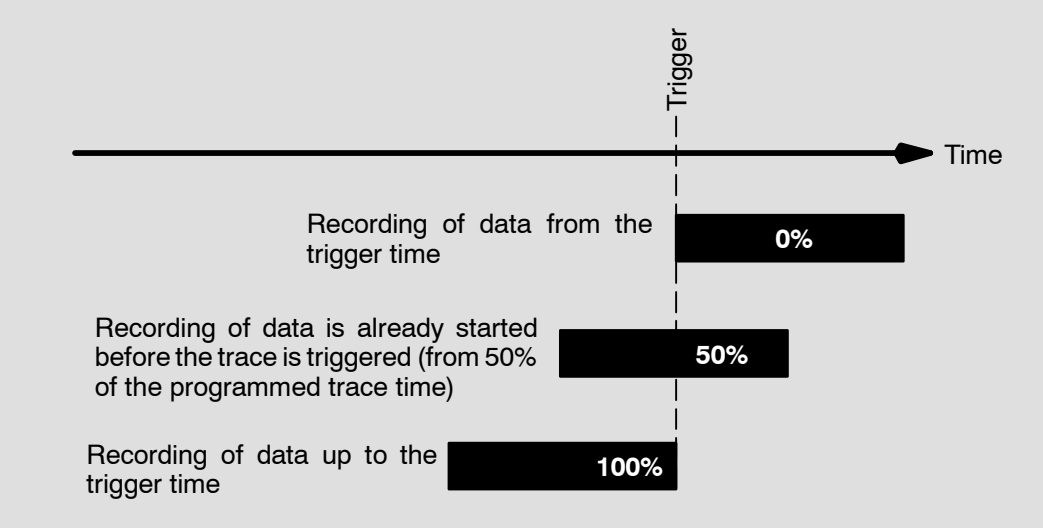
2.2.2 Length of recording

Please enter an integer value here specifying the length of the trace in seconds.

The cycle rate for recording DSE data is 2 ms. 500 data sets are therefore generated in one second. Please take this volume of data into account when programming the length of the trace.

2.2.3 Trigger moment

Specify the position in time of the trace in relation to the trigger time in this field. The value between 0% and 100% that is entered refers to the programmed trace length.



2.2.4 Trigger value1/Trigger value2

The start of the recording can be made dependent on the inputs/outputs (trigger variable) and the trigger conditions (see section **[Trigger condition]** 2.2.9) using Trigger value1 and Trigger value2.
In the boxes “Trigger value1” and “Trigger value2”, enter a value (data type: Integer) that triggers the trace. This trigger value is of the data type DOUBLE.

Several examples can be found in this chapter, section **[Examples of traces]** (2.2.12).

2.2.5 Trace – status

The current working status of the oscilloscope can be seen in this box.

Trace – status	Meaning
#T_WAIT	Trace is started and is waiting for the trigger condition. All of the data before the trace is triggered are recorded.
#TRIGGERED	Trace is triggered and runs for as long as specified in the boxes “Length of recording (sec)” and “Triggermoment”.
#T_END	Trace is finished, the data are saved on the hard disk.

2.2.6 DSE (Digital Servoelectronics)

You can select here whether you want to record data from the first DSE (axes 1–8) or from the second DSE (axes 9–16). If you do not want to record any DSE data and only want to monitor the inputs and outputs of the controller, please select here the option “No DSE data”.

Files containing the traces of DSE data are identified by the end digit “1”.

The cycle rate for recording DSE data is 2 ms. 500 data sets are therefore generated per second.

2.2.7 Trigger variable

If you only want to record DSE data, please select here the option “No I/O”.

Otherwise, you can distinguish the previous selection made under “Input / output area” more clearly here. From the 32 inputs and outputs that you selected previously, you can now have the first or the last 16 inputs or outputs monitored for the occurrence of the trigger condition.

Files containing data about the status of inputs and outputs are identified by the end digit 3.

The cycle rate for recording the activities of inputs and outputs is 12 ms. About 85 data sets are therefore generated per second.

2.2.8 Input / output area

If you only want to record DSE data, please select here the option “inactive”.

The inputs and outputs are each combined into 32–bit groups. You can select here, for example, whether inputs and outputs 1 to 32 or inputs and outputs 33 to 64, etc., are to be recorded.

2.2.9 Trigger condition

In this field, select the condition which, when met, will trigger recording.

Start by user, recording until buffer is full
The recording must be intitiated manually with the softkey “Start”. It continues until the set recording length has been reached.
Cyclic recording, until user stops
Recording is carried out for the time specified in “Length of recording” before termination with the softkey “Stop” is recorded.
Trigger on appearance of error
Recording is carried out for the time specified in “Length of recording” around the appearance of an error that stops the robot system. The location of this period of time depends on the value set as the trigger moment.
Trigger on start of movement
The recording starts whenever the beginning of a motion instruction is reached or a motion instruction is being executed. It continues until the set recording length has been reached. The location of this recording time depends on the value set as the trigger moment.
Trigger on signal <> value 1
The recording starts as soon as the value of the selected trigger variable is not equal to the value specified as trigger value 1. It continues until the set recording length has been reached. The location of this recording time depends on the value set as the trigger moment.
Trigger on trigger variable = trigger value 1
The recording starts as soon as the value of the selected trigger variable is equal to the value specified as trigger value 1. It continues until the set recording length has been reached. The location of this recording time depends on the value set as the trigger moment.
Trigger on trigger variable < trigger value 1
The recording starts as soon as the value of the selected trigger variable is less than the value specified as trigger value 1. It continues until the set recording length has been reached. The location of this recording time depends on the value set as the trigger moment.
Trigger on trigger variable > trigger value 1
The recording starts as soon as the value of the selected trigger variable is greater than the value specified as trigger value 1. It continues until the set recording length has been reached. The location of this recording time depends on the value set as the trigger moment.
Trigger on trigger value 1 < trigger variable < trigger value 2
The recording starts as soon as the value of the selected trigger variable is greater than the value specified as trigger value 1 and less than the value specified as trigger value 2. It continues until the set recording length has been reached. The location of this recording time depends on the value set as the trigger moment.
Trigger on clearing filter
This option is intended for our service personnel only.
Trigger variable AND trigger value 1 = trigger value 2

	The recording starts as soon as the result of the logical ANDing of the two operands trigger variable / trigger value 1 is equal to trigger value 2. It continues until the set recording length has been reached. The location of this recording time depends on the value set as the trigger moment.
Trigger on DSE error	
	In this instance, recording is carried out for the time specified in “Length of recording” around the appearance of a hardware error that is signalled by the digital servo-electronics (e.g. “Command value out of range”, “Cabinet temperature too high”). The location of this period of time depends on the value set as the trigger moment.

2.2.10 Values to record

The data from the DSE that are to be recorded are defined in this selection box.

Values to record	Meaning
Command Value *1)	Command value from the interpolator per position control cycle
Actual Value *1)	Actual value per position control cycle
Following Error *1)	Difference between command position and actual position
Command Velocity *1)	At the position controller output
Actual Velocity *1)	Motor speed
Current *1)	At the speed controller output
Motor temperature *1)	In increments
Resolver *1)	Encoder position
Test_IN_1	This option is intended for our service personnel only.
Test_IN_2	This option is intended for our service personnel only.
Bus_Voltage–PM 1	Power module 1
Bus_Voltage–PM2	Power module 2
*1) For each of the channels 1...8	

After selecting the variable that is to be recorded, the trace can be selected or deselected by repeatedly pressing the Enter key.

2.2.11 Softkeys

The current configuration is saved by pressing the softkey “Save”. It is then available for every further recording process.

Recording is started by pressing the softkey “Start”. It begins as soon as the selected trigger condition is met.

Recording is started manually irrespective of the selected trigger condition by pressing the softkey “Trigger”.

Recording is stopped by pressing the softkey “Stop”. All of the data that have been recorded thus far are saved.

The softkey “Monitor” has the same function as the menu key “Monitor” followed by the submenu “Diagnosis” and the option “Display”. Further information can be found in Section 2.1.

The window for configuring the oscilloscope is closed by pressing the softkey “Cancel”. The entered values will not be saved.

2.2.12 Examples of traces

As the oscilloscope function with all the configuration and display options is somewhat complex, we want to introduce you to the use of this tool with the aid of a small example.

Example 1

The:

command speed of the drive of axis 1,

actual speed of the drive of axis 1,

torque of the drive of axis 1, and

status of outputs 1 to 16

are to be monitored.

Create a motion program which, amongst other things, moves axis 1 and operates outputs 1 to 16.

Press the menu key “Monitor” and select the option “Diagnosis”. In the submenu which opens, please confirm the selection “Oscilloscope”. Now select “Configure”.

Please leave the default name “TRACE” as it is.

Enter the value “12” in the field “Length of recording (sec)”.

Enter the value “0” in the field “Trigger moment”.

Also enter the value “0” in the fields “Trigger value1” and “Trigger value2”.

Select the first DSE.

In the next selection window “Trigger variable”, select $IN[x..x+15]

Select “$IN[1..32], $OUT[1..32]” in the field “Input / output area”.

Specify “Trigger on start of movement” as the trigger condition.

Switch on the trace for “Command velocity channel 1”, “Actual velocity channel 1” and “Torque channel 1” in the field “Values to record”.

Press the softkey “Save”.

Now start the motion program and then press the softkey “Start”.

The command speed, the actual speed and the torque of the drive of axis 1 and the statuses of inputs 1 to 32 will now be recorded and saved until the data buffer is full and the trace status changes to #T–END. The files are called TRACE1.trc and TRACE3.trc.

Example 2

The signals of inputs and outputs 1 to 32 are to be recorded as soon as input 3 takes on the state “TRUE”.

- Enter a concise name of your choice under “Name of recording”. Make sure that the length of this name does not exceed seven characters because a digit will later be added by the system in order to distinguish different types of trace.
- Enter the value 12 in the box “Length of recording”. The recording length will then be 12 seconds.
- Enter the value 0 in the box “Triggermoment”. The data will then be recorded from the moment input 3 takes on the state “TRUE”.
- Enter the value 4 for input 3 in the boxes “Triggervalue 1” and “Triggervalue 2”.

Why the value 4?

Input	5	4	3	2	1
Signal			X		
Bit	4	3	2	1	0
Binary	0	0	1	0	0

The binary value 100 corresponds to the decimal value 4.

The decimal value corresponding to an output or input is determined by raising the bit number to the power of 2.

Select “Trigger variable AND trigger value 1 = trigger value 2” as the trigger condition.

Why this trigger condition?

Input	5	4	3	2	1
Signal	X		X	X	
Bit	4	3	2	1	0
Binary	1	0	1	1	0

Binary	1	0	1	1	0	Value of the trigger variable; inputs 2, 3 and 5 set

Logical ANDing with

Binary	0	0	1	0	0	Trigger value 1, decimal: 4

Result of logical operation:

Binary	0	0	1	0	0	Trigger value 2, decimal: 4

- Select “No DSE data” in the DSE data box.
- Select the first input group ($IN[x..x+15]) as the trigger variable.
- Select the first 32–bit group ($IN[1..32], $OUT[1..32]) in the box “Input / output area”.
- Now save the configuration by pressing the softkey “Save”, then activate the data recording process by means of the softkey “Start”.

Input 3 will now be monitored for occurrence of the trigger condition. The message “#T_WAIT” is displayed in the box “Trace – status”. This message changes to “#TRIGGERED” as soon as the trigger condition is fulfilled. The signals of inputs and outputs 1 to 32 will be recorded for 12 seconds from this moment onwards.

Example 3

A robot program branches to various subprograms depending on how the PLC sets specific signals. In a certain, unknown situation, the program branches to the subprogram “SP55.SRC”, which is not desired in this configuration, however.

For the purpose of checking the I/O communication of the robot program with the PLC in this situation, an unassigned output (e.g. output 32) can be set in the subprogram SP55 and reset again on quitting the subprogram.

A trace can now be triggered at this output and the recorded sequence of events saved.

- Enter a concise name of your choice under “Name of recording”. Make sure that the length of this name does not exceed seven characters because a digit will later be added by the system in order to distinguish different types of trace.
- Enter the value 10 in the box “Length of recording”. The recording length will then be 10 seconds.
- Enter the value 90 in the box “Triggermoment” as it is primarily the pre–event history that is of interest here. Recording of the data will then already start 90% of the recording length (9 seconds in this example) before the trigger moment. The recording will overlap the trigger moment by 1 second in this instance.
- Enter the value 32768 for input 32 in the boxes “Triggervalue 1” and “Triggervalue 2”.

Why the value 32768?

Input	34	33	32	31	30	...	19	18	17	16	15	14	...	3	2	1
Signal			X			...							...			

Data word	3	2	1

Bit	1	0	15	14	13	...	2	1	0	15	14	13	...	2	1	0
Binary	0	0	1	0	0	...	0	0	0	0	0	0	...	0	0	0

The binary value I000 0000 0000 0000 of data word 2 corresponds to the decimal value 32768.

The decimal value corresponding to an output or input is determined by raising the bit number to the power of 2.

Select “Trigger variable AND trigger value 1 = trigger value 2” as the trigger condition.

Why this trigger condition?

Input	34	33	32	31	30	...	19	18	17	16	15	14	...	3	2	1
Signal			X			...							...			
Bit	1	0	15	14	13	...	2	1	0	15	14	13	...	2	1	0
Binary	0	0	1	0	0	...	0	0	0	0	0	0	...	0	0	0

Binary	0	0	1	0	0	...	Value of trigger variable; inputs 2, 3 and 32 set

Logical ANDing with

Binary	0	0	1	0	0	...	Trigger value 1, decimal: 32768

Result of logical operation:

Binary	0	0	1	0	0	...	Trigger value 2, decimal: 32768

- Select “No DSE data” in the DSE data box.
- Then select the last output group ($OUT[x+16..x+31]) as the trigger variable.
- Select the first 32–bit group ($IN[1..32], $OUT[1..32]) in the box “Input / output area”.
- Now save the configuration by pressing the softkey “Save”, then activate the data recording process by means of the softkey “Start”.

Output “17” will now be monitored with regard to this trigger condition. The message “#T_WAIT” is displayed in the box “Trace–status”. This message changes to “#TRIGGERED” when the trigger condition is fulfilled. The signals of inputs and outputs 1 to 32 will be recorded for 10 seconds from this moment onwards.

Example 4

You discover that a robot program always stops at night because an error occurs in the I/O communication with the PLC. It cannot be determined whether this error is caused by the PLC program or the robot program since nothing is known about the incorrect communication at this point.

It is possible for the oscilloscope function to be started in the KRL robot program before this situation and to be ended after it. The data are overwritten every time the program is correctly executed. If the motion program is interrupted by an error message, however, the last trace is saved and the error can be analyzed with the aid of the recorded data.

- Enter a concise name of your choice under “Name of recording”. Make sure that the length of this name does not exceed seven characters.
- Enter a value in the box “Length of recording” taking into account the time for communication between the robot and the PLC.
- Enter the value 0 in the boxes “Triggermoment”, “Triggervalue 1” and “Triggervalue 2”.
- Select the option ”Start by user, recording until buffer is full” as the trigger condition.
- Select “No DSE data” in the DSE data box.
- Then select “No I/O” as the trigger variable.
- Select the first 32–bit group ($IN[1..32], $OUT[1..32]) in the box “Input / output area”.
- Now save the configuration by means of the softkey “Save”, and quit the oscilloscope function by pressing the softkey “Cancel”.
- Insert the following lines into the KRL program before the selected program section in order to start the trace:

```
$TRACE.MODE=#T_START
REPEAT
UNTIL $TRACE.STATE == #T_WAIT
```

Insert the following lines into the KRL program after the selected program section in order to stop the trace:

```
$TRACE.MODE=#T_END
REPEAT
UNTIL $TRACE.STATE == #T_END
```

These changes can only be made at the expert level.

As soon as the error has been located, these instructions must be removed from the program again.

Symbols

Numbers

C

D

E

H

I

L

M

N

P

R

S

T