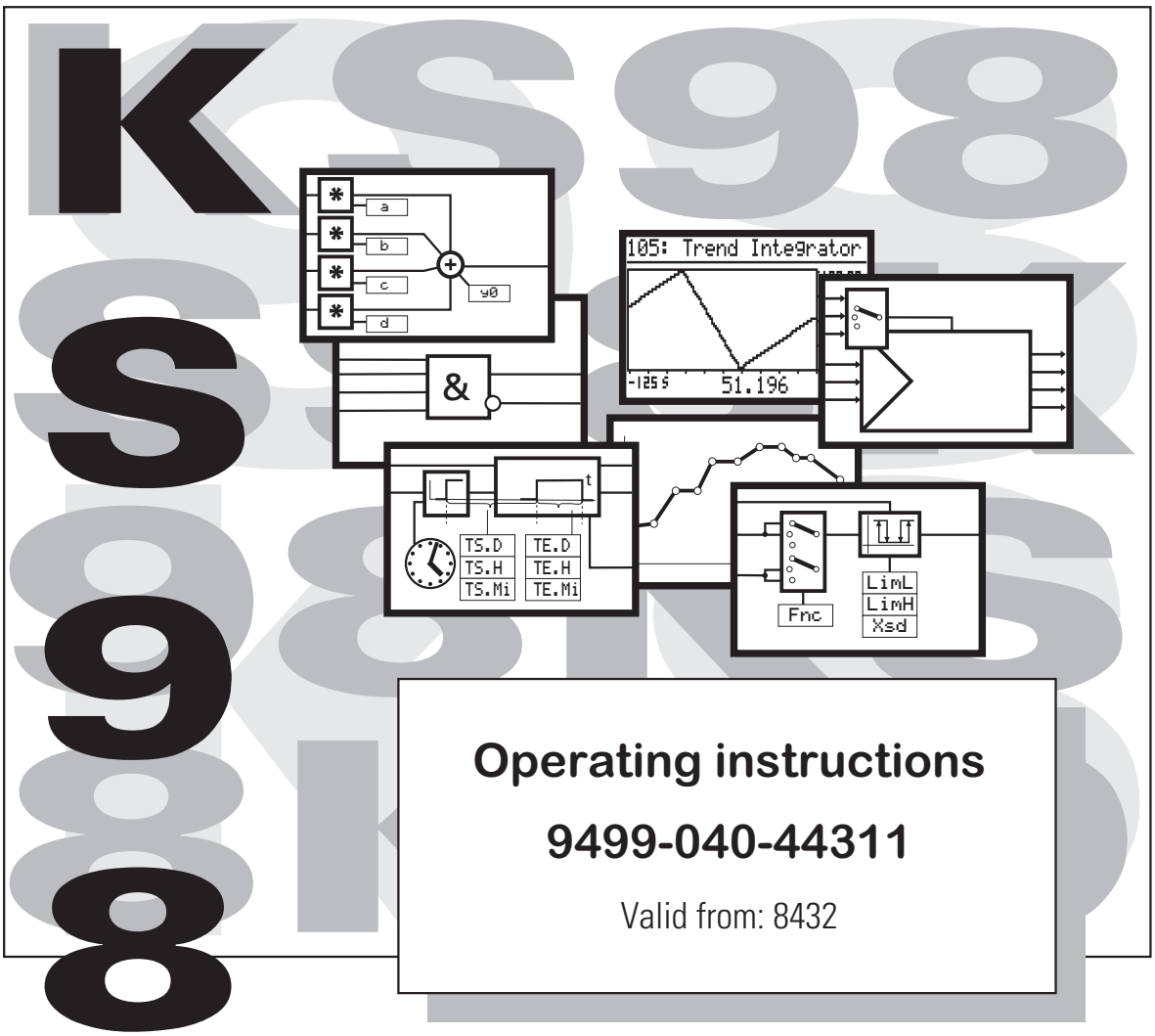
PMA Prozeß- und Maschinen-Automation GmbH

KS 98 and KS98Plus



Operating instructions

9499-040-44311

Valid from: 8432

Content

Symbols used on the device

CE EU conformity mark

⚠ Attention, follow the operating instructions!

A publication of

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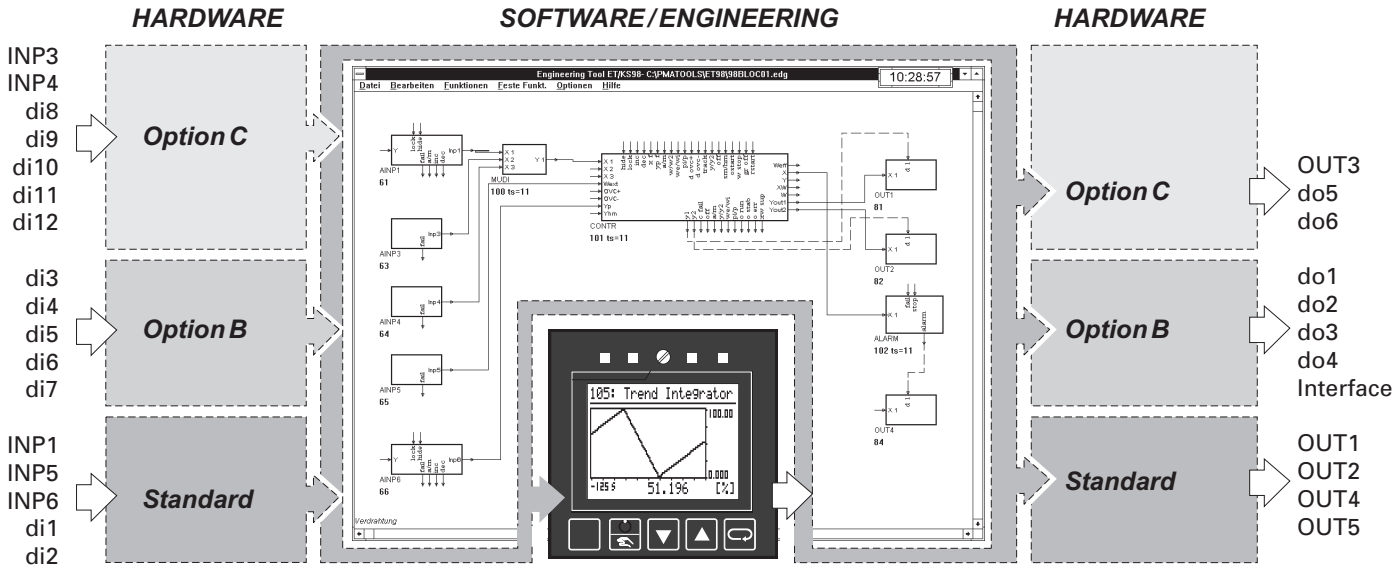
Germany

Change notice!

The Functionblock SOUT has changed since operating version 7. Eventually you must adjust your engineering when updating Soft- or Hardware (see Page 27).

1 Operation

1.1 Description



KS 98 is a freely structurable compact automation unit. Each unit contains a function library from which selection, configuration, parameter setting and combination of up to 450 function blocks is possible by means of an engineering tool. This permits realization of complex mathematical calculations, multi-channel control structures and sequencing in one instrument. Various pages are displayed by means of an LCD (64x128 dots): input and output for analog and digital signals, bargraphs and trends. Communication with other instruments and systems is possible via an optional digital interface.

2 Important technical data

2.1 Analog inputs → sections 6 and 25.1

INP 1: universal input, configurable for thermocouples, resistance thermometers, temperature difference, resistance transducer, DC current and DC voltage
INP 3 (option C): DC current or -50...1300 mV, INP 4 (option C): DC current, INP 5: DC current and DC voltage, INP 6: resistance transducer and DC current

2.2 Digital inputs

Opto-coupler for 24 V DC, current sink to IEC 1131 type1, logic 0 = -3...5 V, logic 1 = 15...30 V, approx. 5 mA di1 and di2: in all versions, di3...di7: in option B, di4...di12: in option C.

2.3 Outputs → section 26.1

Relay contact rating: 500 VA, 250 V, 2 A at 48...62 Hz
OUT1, OUT2, OUT4, OUT5: relay or logic dependent of version, OUT 3 (option C): current

2.4 Control outputs

Opto-coupler, grounded load with common positive control voltage, power 18...32 V DC ≤ 100 mA.
do1...do4: in option B, do5 and do6: in option C

2.5 Supply voltage

90...260V AC, 48...62 Hz, power consumption approx. 10 VA (equipped with all possible options)

For detailed technical data, see data sheet KS98 9498 737 32113
KS98+ 9498 737 37933

3 Versions

Order no. 9407 - 9 _ _ - _ _ 0 _ 1

		Order no.
Basic unit	Standard	9**6**0**0**1
	with integrated supply voltage	9**7**0**0**1
	KS98+ with CANopen I/O	9**8**0**0**1
Power supply and process outputs	90...250 V AC with 4 relays	9**3**0**0**1
	90...250 V AC with 2 relays + 2 current outputs	9**5**0**0**1
	24 V UC with 4 relays	9**7**0**0**1
	24 V UC with 2 relays + 2 current outputs	9**9**0**0**1
Option B	no option B	9**0**0**0**1
	TTL interface + di3...7 / do1...4	9**1**0**0**1
	RS 422 + di3...7 / do1...4 + real-time clock	9**2**0**0**1
	PROFIBUS-DP + di3...7 / do1...4	9**3**0**0**1
	INTERBUS + di3...7 / do1...4	9**4**0**0**1
Option C	no option C	9**0**0**0**1
	INP3 / INP 4 / OUT 3 / di8...12 / do5 / do6	9**0**1**0**1
	INP3 *2) / INP 4 / OUT 3 / di8...12 / do5 / do6	9**0**2**0**1
	Modular option C basic card *1)	9**0**3**0**1
	Modular option C basic card with modules *1)	9**0**4**0**1
Engineering	single-channel controller (basic unit)	9**0**0**0**1
Setting	standard setting	9**0**0**0**1
	setting to specification	9**0**0**9**1

*1) Combination KS98+ (CANopen I/O) **and** modular option C is **not** possible. Either KS98+ or modular option C!

*2) INP3: With Type = 0...20 mA, the input is designed for -50...1300 mV. For further use of the output of INP3 with this scaling, an **x0** of -50 and an **x100** of 1300 must be adjusted.

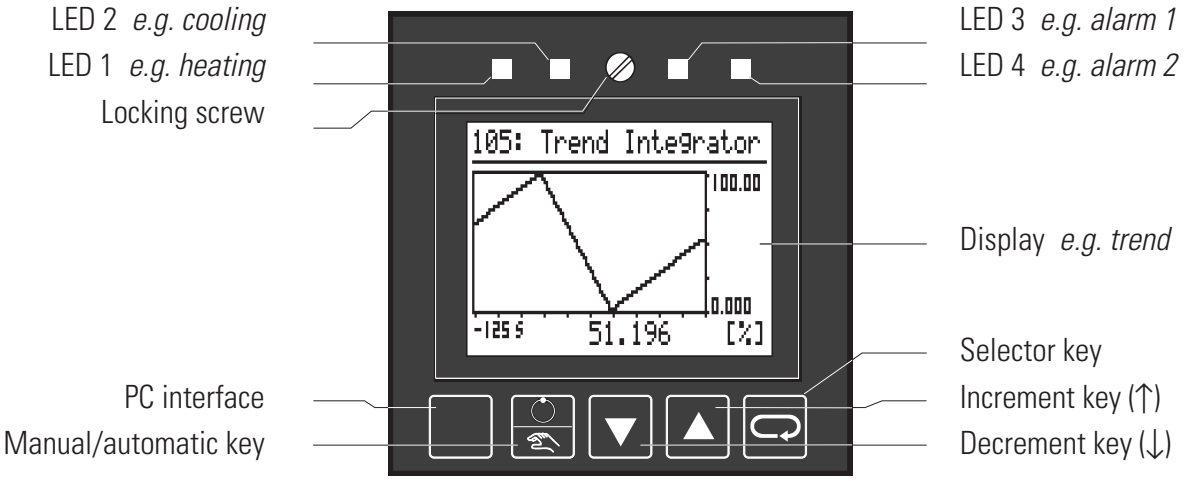
3.1 I/O modules

- for installation in units with modular option C basic card

Order no. 9407 - 998 - 00 _ _ 1

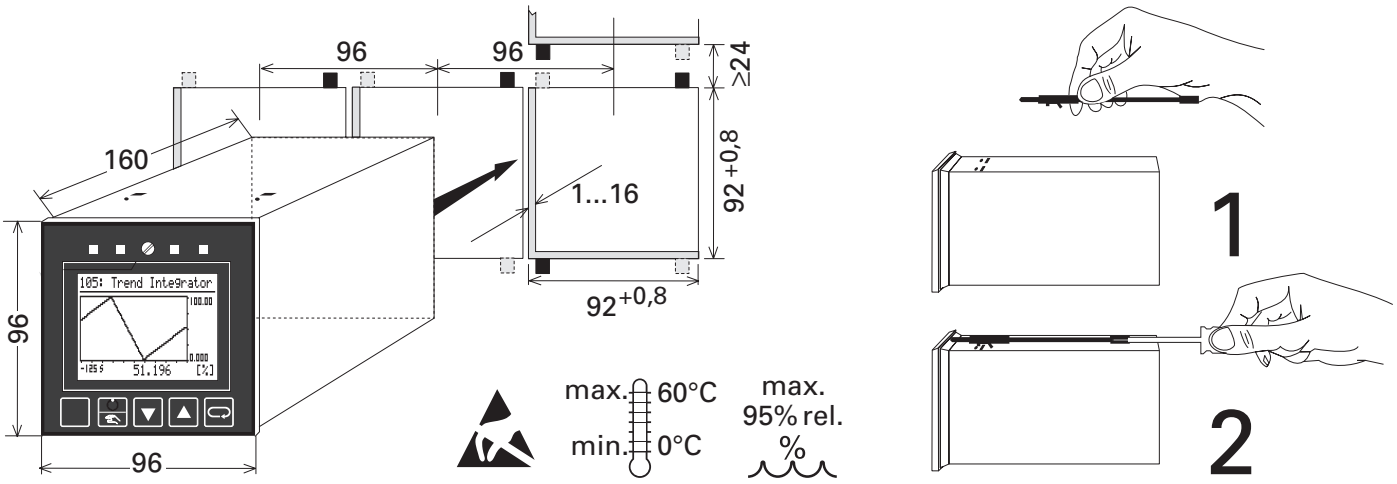
		Order no.
Position	Separate order	9407-998-**0**0**0**1
	Fitted in KS98 socket 1	9407-998-**0**0**1**1
	Fitted in KS98 socket 2	9407-998-**0**0**2**1
	Fitted in KS98 socket 3	9407-998-**0**0**3**1
	Fitted in KS98 socket 4	9407-998-**0**0**4**1
Module type-Analog inputs	Pt100 / 1000, Ni 100 /1000, resistance, potentiometer	9407-998-00**20**1
	Thermocouple, mV, 0/4...20mA	9407-998-00**21**1
	-50...1500mV, 0...10V	9407-998-00**22**1
Module type-Analog outputs	0/2...10V, 0...±10V	9407-998-00**30**1
	0/4...20mA, 0...±20mA	9407-998-00**31**1
Module type-Digital inputs/outputs	Digital I/O (universal)	9407-998-00**40**1
	Frequency/counter input	9407-998-00**41**1

4 Front view



- Locking screw: locks the controller module in the housing.
- LEDs: indicate the statuses of the LED function (→ section 27.1).
- Display: LCD dot matrix with (64x128 dots, back lighting). The relevant display is shown in sections 7 Menus, 17 Visualization, 23 Programmer and 24 Controller.
- Keys [⏻][▼][▲][↵]: The relevant function is described in section 7 Menus.
- PC interface: PC connection for structuring/wiring/configuring/parameter setting/operating with the engineering tool.

5 Mounting

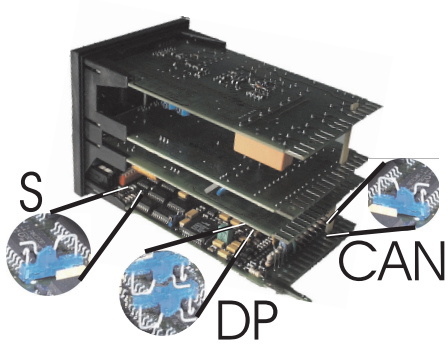


⚠ Mount the unit with min. 2 fixing clamps (diagonally at top and bottom).

⚠ **Protection type IP65:**
Use 4 fixing clamps. Insert the controller module firmly and block it using the locking screw.

Wire-hook switch S: Its switching status is signalled by function STATUS and can be used in the engineering. After delivery, the switch is open.
For closing, release the locking screw, withdraw the controller module from the

housing, close the Wire-hook switch. Insert the unit and lock it with the screw.
Wire-hook switch DP: The bus termination resistor can be activated by 2 S.I.L.
switches (DP) in KS98. Both S.I.L. switches must always be open or closed (terminating resistor active).
Wire-hook switch CAN: for bus terminating resistor → see page36



Ensure tightness!

Caution! The instrument contains electrostatically sensitive components.

6 Electrical connections

6.1 Safety hints

Following the enclosed safety hints 9499 047 07101 is **indispensable**! The instrument insulation meets standard EN 61 010-1 (VDE 0411-1) with contamination degree 2, overvoltage category III, operating voltage range 300 V and protection class I.

With horizontal installation, the following rule is applicable additionally: with the instrument module withdrawn, a facility which prevents conducting parts from dropping into the open housing must be provided.

If the unit is switched to **off-line**, the outputs keep their status from the time of switch-over!!!

6.2 Electromagnetic compatibility

European guide line 89/336/EEC. The following European generic standards are met:
Electromagnetic radiation: EN 50081-2 and Electromagnetic immunity: EN 50082-2. The unit is suitable for use in industrial areas (in residential areas, RF interference may occur). The electromagnetic radiation can be reduced decisively by installing the unit in a grounded metal switch cabinet.

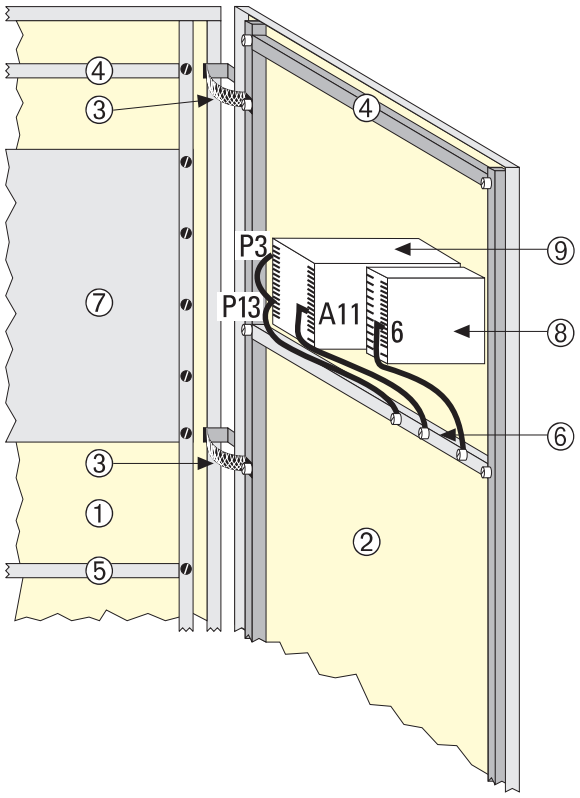
6.3 Measurement earth (for grounding interferences)

If outside interference voltages act on the instrument, functional troubles may be caused (concerns also high-frequency interferences). For grounding the interference voltages and ensuring the electromagnetic immunity, a measurement earth must be connected. Terminal A 11 must be connected to ground potential by means of a short cable (approx. 20 cm, e.g. to switch cabinet ground)! This cable must be kept separate from mains cables.

6.4 Störschutzbeschaltung

Load current free connections between the ground potentials must be realized so that they are suitable both for the low-frequency range (safety of persons, etc.) and the high-frequency range (good EMC values).

The connections must be made with low impedance. All metal grounds of the components installed in the cabinet ① or in the cabinet door ② must be screwed directly to the sheet-metal grounding plate to ensure good and durable contact. In particular, this applies to earthing rails ④, protective earth rail ⑤, mounting



plates for switching units ⑦ and door earthing strips ⑥.Controllers KS40/50/90 ⑧ and KS92/94 ⑨ are shown as an example for earthing. The max. length of connections is 20 cm (see relevant operating instructions).

Generally, the yellow/green protective earth is too long to provide a high-quality ground connection for high-frequency interferences.

Braided copper cables ③ provide a high frequency conducting, low-resistance ground connection, especially for connecting cabinet ① and cabinet door ②.

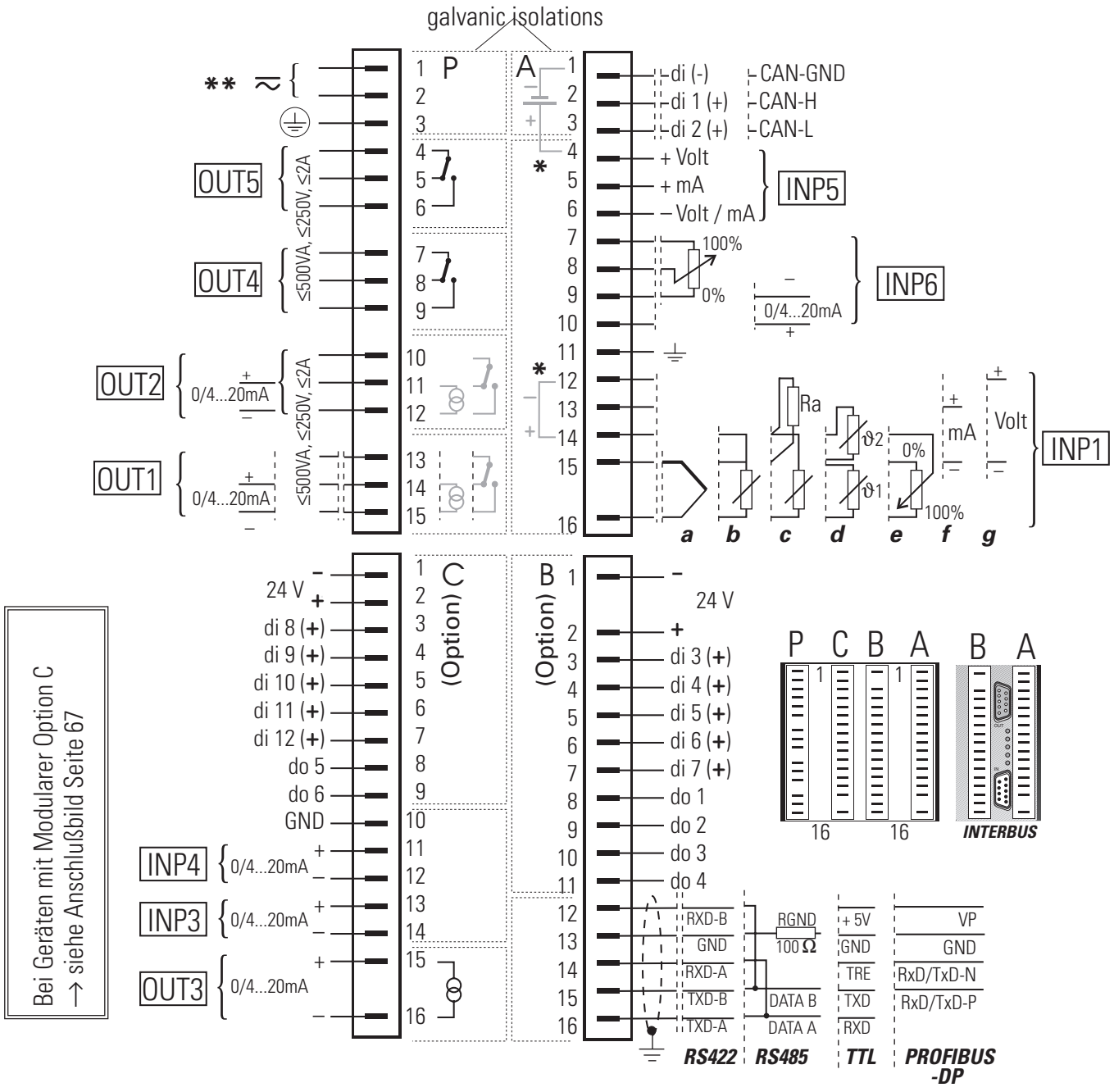
Because of the skin effect, the surface rather than the cross section is decisive for low impedance. All connections must have large surfaces and good contact. Any lacquer on the connecting surfaces must be removed.

Due to better HF properties, zinc-plated mounting plates and compartment walls are more suitable for large-surface grounding than chromated mounting plates.

6.5 Connecting diagram

- Power supply cables must be kept separate from signal and measuring cables.
- Twisted and screened measuring cables have to be used (screening connected with measurement earth).
- Connected final elements must be equipped with protective circuits to manufacturer specifications. This avoids voltage peaks which can cause trouble to the instrument.
- The instruments must be protected additionally by an individual or common fuse for a max. power consumption of 10 VA per unit (standard fuse ratings, min. 1 A)!

⚠ Signal and measurement circuits may carry max. 50 Vr.m.s. against ground, mains circuits may carry max. 250 V r.m.s between terminals.



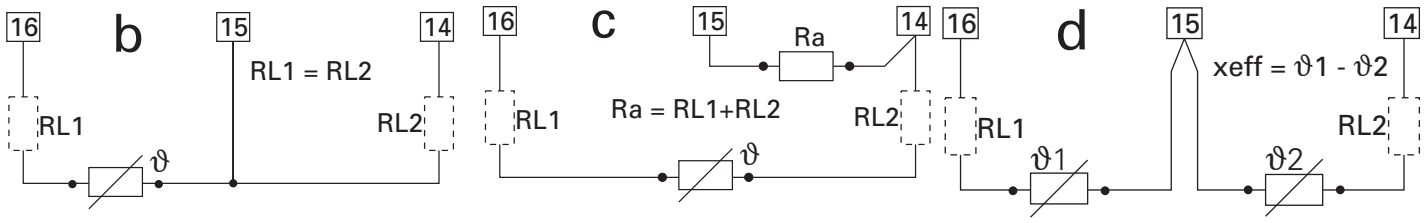
✻ Versions with integrated supply voltage only

✻✻ With 24 V DC or AC, protective earth must also be connected. With 24 DC, the polarity is uncritical.

6.6 Analog inputs (→ connecting diagram)

Thermocouples (a)

No lead resistance adjustment.
Internal temperature compensation: compensating lead up to the instrument terminals. With AINP1, `STK = int.CJC` must be configured.
External temperature compensation: Use separate cold junction reference with fixed reference temperature. Compensating lead is used up to the cold junction reference. Copper lead between reference and instrument. With AINP1, `STK = ext.CJC` and `TKref =` reference temperature must be configured.



Resistance thermometer Pt 100 in 3-wire connection (b)

No lead resistance adjustment is necessary, if RL1 = RL2.

Resistance thermometer Pt 100 in 2-wire connection (c)

Lead resistance adjustment is necessary: Ra must be equal to RL1 + RL2.

Two resistance thermometers Pt100 for difference measurement (d)

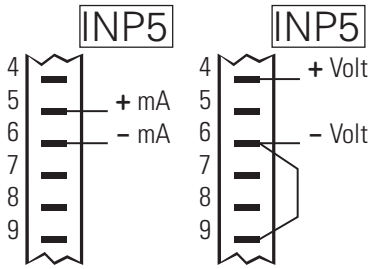
Lead resistance compensation: proceed as described on page13 - 7.7.

Resistance transducer (e)

Measurement calibration: proceed as describedon page13 - 7.7..

Standard voltage signals 0/2...10V (g)

Input resistance: ≥ 100 kΩ, configure scaling and digits behind the decimal point.
INP5 is a difference input, the reference potential of which is connected to terminal A9. With voltage input, A6 must always be connected to A9.



Standard current signals 0/4...20 mA (f)

Input resistance: 50 Ω, configre scaling and digits behind the decimal point.

DC voltage -50...1300 mV

(only for INP3 in instruments with order no. 9407-9xx-x2xx1):
With Type = 0...20 mA, the input is designed for -50...1300 mV. For further use of the output of INP3 with this scaling, an x0 of -50 and an x100 of 1300 must be adjusted.

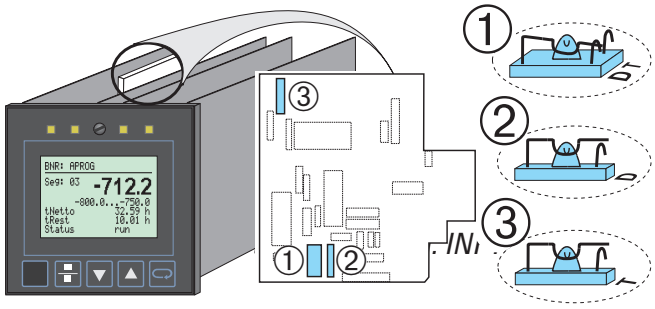
⚠ The inputs INP1 / INP6 are interconnected. This must be taken into account if both inputs must be used for standard current signal. If necessary, galvanic isolation should be used.

6.7 Versions with integrated supply voltage

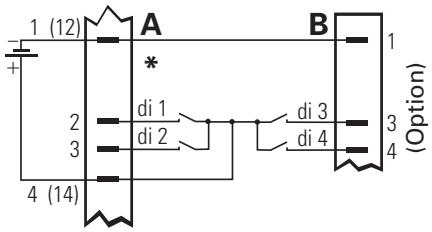
The potential-free supply voltage can energize a 2-wire transmitter or max. 4 control inputs. Its output connectors are selectable by means of 3 S.I.L. switches:

Connectors	①	②	③	Remarks
14 (+) 12 (-)	T	open	closed	Only available with INP1 configured for current or thermocouple
4 (+) 1 (-)	D	closed	open	The voltage input of INP5 is not available

Factory setting: ① = T, ② = open, ③ = closed (T). For changing the switch positions, the instrument must be withdrawn from its housing. The S.I.L switches are accessible on the circuit board indicated below

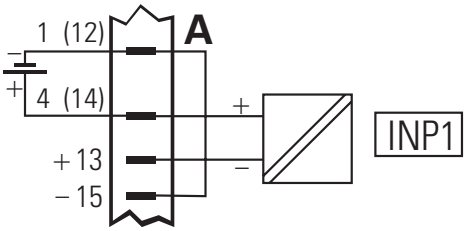


Energizing digital inputs (e.g. di1...di4)



* If A14/A12 is used for di1/di2, A12 muß be linked with A1.

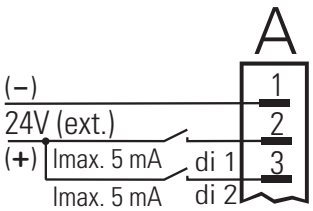
Connection 2-wire-transducer (e.g. INP1)



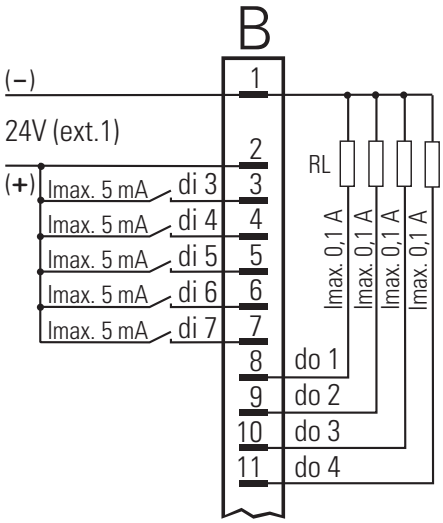
6.8 Digital inputs and outputs (→ connecting diagram)

The digital inputs and outputs must be energized from one or several external 24 V DC sources. Power consumption is 5 mA per input. The max. load is 0,1 A per output. Examples:

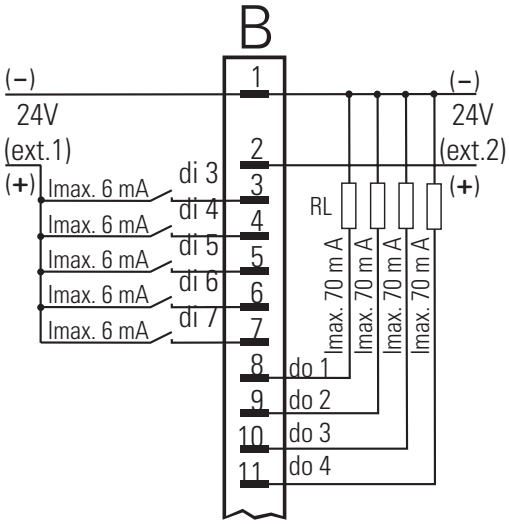
Digital inputs (connector A)



Digital inputs and outputs at one voltage source (e.g. connector B)



Digital inputs and outputs at two voltage sources (e.g. connector B)

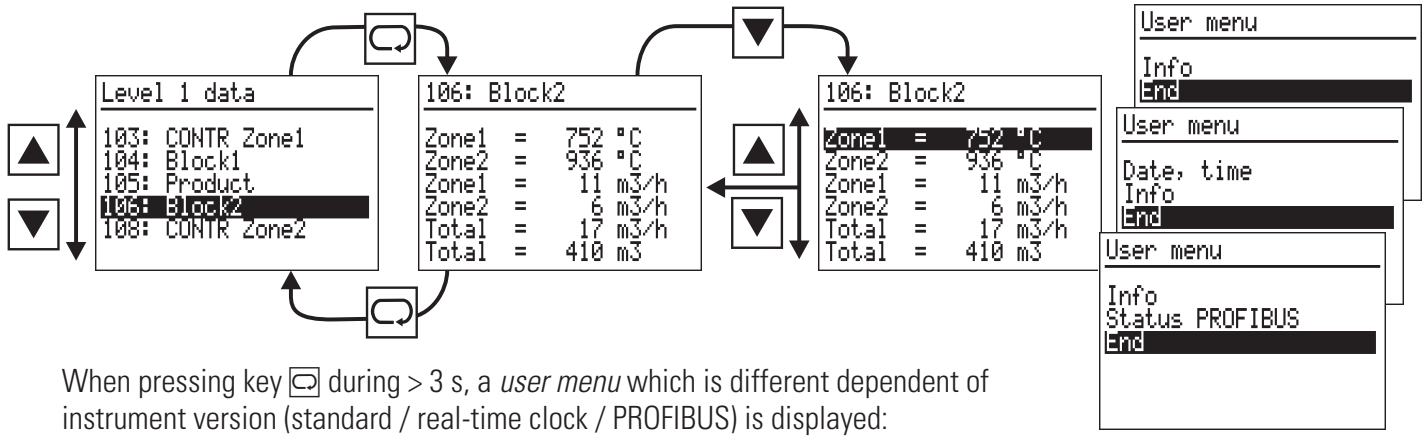


7 Menus

Instrument operation is menu-guided. Distinction of *complete dialog* and *short-form dialog* is made. In the *complete dialog*, the main menu with its sub-menus is displayed, i.e. all permitted settings are selectable. During *short-form dialog*, the main menu is switched off, i.e. unauthorized or accidental access is prevented and only the operating page menu with the permitted operating pages is selectable. The short form dialog is available from operating version 2.

7.1 Short-form dialog

Available from operating version 2. The main menu is switched off via interface (`m-hide`) or function STATUS (`m-hide`). The operating page menu with the permitted operating pages is selectable. Selecting, marking lines and value adjusting are done as described below.



When pressing key ⮌ during > 3 s, a *user menu* which is different dependent of instrument version (standard / real-time clock / PROFIBUS) is displayed:

Line `Info`: hardware order no., software order no., software version and operating version.
Line `Date, time`: display and adjustment of date and time.
Line `Status PROFIBUS`: status of bus access, parameter setting, configuration and data communication.

7.2 Complete dialog

A *main menu* for selecting the five *sub-menus*, using which an application-dependent number of *pages* can be selected.

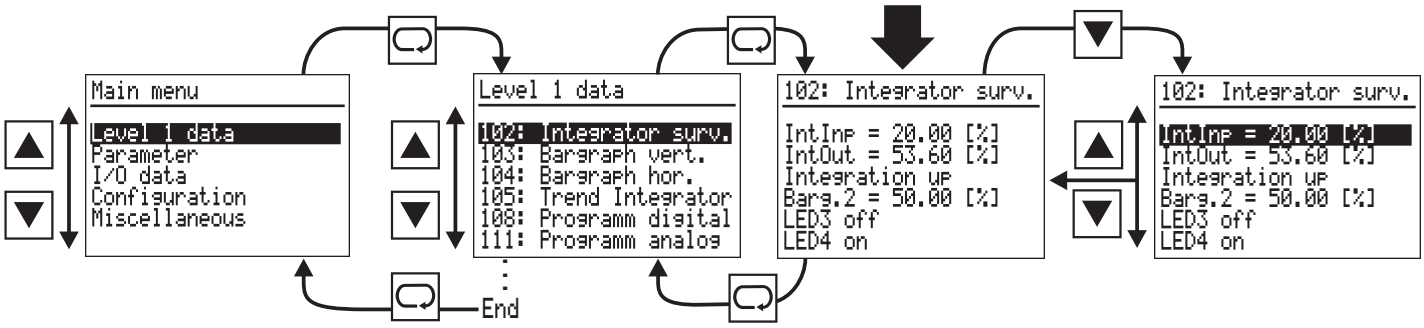
Sub-menu	Contents of *pages*
`Level 1 data`	The operating pages VWERT, VPARA, VBAR, VTREND, APROG, DPROG, CONTR, CONTR+ and PIDMA are displayed: display and adjust the operating values.
`Parameter`	A page is provided for each function used with which parameters are adjustable: display and adjust parameters.
`I/O data`	A page is provided for each function used: display of input and output data
`Configuration`	A page is provided for each function used, which must be configured: display and adjust configurations. For changing the configuration, the instrument must be set to 'Offline' (→ Operating modes).
`Miscellaneous`	Page `Date, time`: display and adjust date and time. ① Page `Device data`: display and adjust interface, mains frequency and language. Page `Online/Offline`: on-line ↔ off-line, cancel configuration. Page `Calibration`: display and calibrate all signals to be calibrated. Page `Info`: display hardware / software order no., software version no. ② Page `Status CAN-BUS`: status of any connected CAN nodes. ③ Page `Status PROFIBUS/INTERBUS`: display status of bus access and data communication. ④

① Only with option B with real time clock
② From operating version 2, the operating version is also displayed.
③ Only with option KS98+ with CAN I/O extension (→ 19 KS98+ I/O extension with CANopen interface)
④ Only with option B with PROFIBUS/INTERBUS

Prior to operating version 2, KS 98: was displayed additionally in the headers of the main menu and the five sub-menus. Example: KS 98: Main menu

7.3 Selection (switching on and operating pages)

After power switch-on, the instrument starts up with a logo and Main menu wait! and then the main menu is displayed during several seconds. Unless a selection is made during this time, the first operating page entered in the sub-menu without marked line is displayed. Pressing keys ▲ / ▼ marks one line at a time (inverse display). When reaching the page without marked line again by means of keys ▲ / ▼, return to the sub-menu is by pressing key ↵. When reaching the End in the sub-menu by pressing keys ▲ / ▼, return to the main menu is possible by pressing the ↵ key.



Keys ▲ / ▼ scroll the marked line up to the start or down to the menu end. When pressing the key again, the marked line changes from the start to the end, or vice versa.

7.4 Language selection

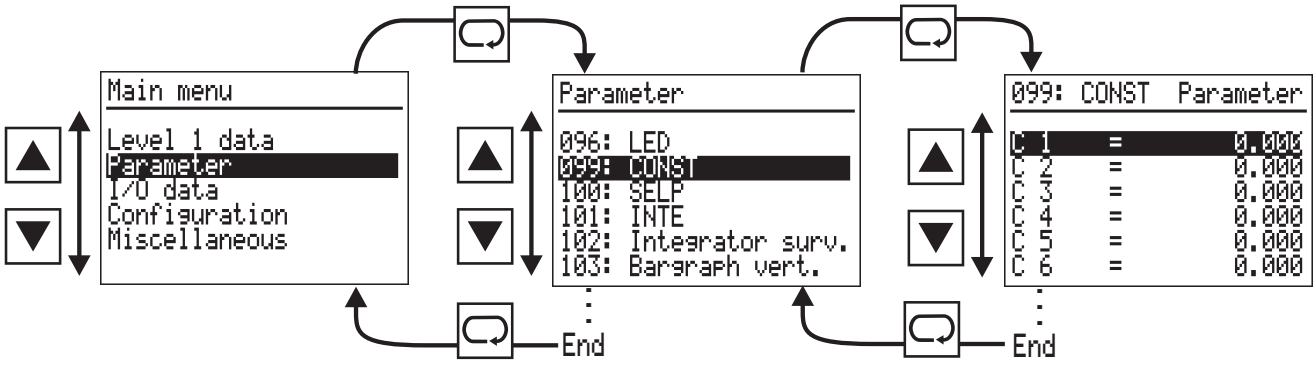
English: Mark Allgemeine Daten → Gerätedaten → Sprach = deutsch.
Press ↵: deutsch blinks. Press ▲: english blinks. Press ↵: Main menu is indicated.

German: Mark Miscellaneous → Device data → Langu. = english.
Press ↵: english blinks. Press ▼: deutsch blinks. Press ↵: Hauptmenü is indicated.

French: Mark Divers → Donn er d´appar. → Langu. = francais.
Press ↵: francais blinks. Press ▼ 2 x: francais blinks. Press ↵: Menu principal is indicated.

7.5 Selection (other pages)

Select sub-menu (inverse display) in the main menu with ▲ ▼ and open it with ↵. Select page with ▲ ▼ and open it with ↵. The first line is marked (inverse, → Adjusting values). When reaching End with ▲ ▼, return to the sub-menu is with ↵. When reaching End in the sub-menu with ▲ ▼, return to the main menu is with ↵.
Example: parameters

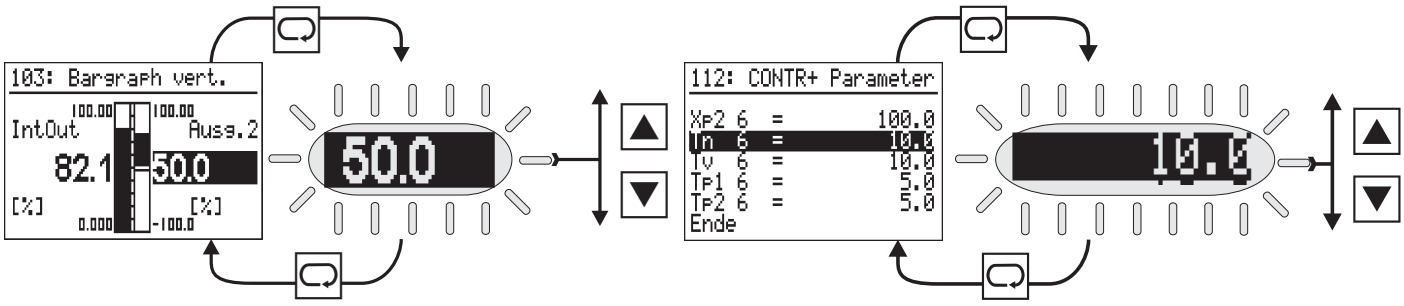


Keys ▲ / ▼ scroll the marked line up to the start or down to the menu end. When pressing the key again, the marked line changes from the start to the end, or vice versa.

7.6 Adjusting values

Values in marked lines of pages can be adjustable. For this, the required line or value is marked with ▲▼ (inverse display). When confirming the value with ↵, it starts blinking and can be adjusted with ▲▼. When reaching the required value, confirm it with ↵. Now, ▲▼ can be pressed to mark another line.

Example: bargraph vertical *Example: parameter CONTR+*



7.7 Calibration

Select (▲▼) item `Calibration` in sub-menu `KS98: Miscellaneous` and open it (↵). Mark the bottommost line (inverse display, e.g. `Quit`) by pressing ▲. Continue as follows:

Transducer input (INP1 or INP6)

Calibration of transducer start and end:

① Set transducer to start (→ section Operating modes)
② Press ↵ → `Quit` blinks *
③ Press ▲ → `Set 0%` blinks
④ Wait until the input has settled (min. 6 s)
⑤ Press ↵ → `0% done` is displayed
⑥ Set transducer to end (→ section Operating modes)
⑦ Press ↵ → `0% done` blinks
⑧ Press ▲ 3x → `Set 100%` blinks
⑨ Wait until the input has settled (min. 6 s)
⑩ Press ↵ → `100% done` is displayed

Calibration is finished. For exit from calibration press ▼ until nothing is marked and then press ↵.

2 resistance thermometers in difference (INP1)

Calibration of lead resistance effect:

① Short-circuit both thermometers in the connecting head
② Press ↵ → `Quit` blinks *
③ Press ▲ → `Set Dif` blinks
④ Wait until the input has settled (min. 6 s)
⑤ Press ↵ → `Cal done` is displayed

Lead resistance adjustment is finished. Remove both short circuits. For exit from calibration press ▼ until nothing is marked and then press ↵.

* if another word blinks, press key ▲ or ▼ as many times as necessary, until the required dialogue blinks.

7.8 Operating modes

❑ *Online/Offline*
For configuration changing, switch the unit to 'Offline' and back to 'Online' (`Miscellaneous`, `Online/Offline`).

❑ *Manual/automatic operation*
When using controllers, automatic or manual operation may be requested by several points. The controller leaves the manual mode, when all control signals request automatic operation.
Example: INP6 is provided for potentiometric transducer and connected accordingly (position feed-back). When it is calibrated, the controller can be switched to manual mode on the calibrating page (by means of ☞, `Man.` is displayed on the bottom left). Line `Y` can be marked by pressing ▲ and ↵ and the actuator can be driven to its limits with ▲ / ▼. After calibration, the manual mode must be switched off on this page (press ☞ again).

8 Maintenance

8.1 Behaviour in case of trouble

The unit needs no maintenance. In case of trouble, check:

- the unit for on-line operation,
- the power supply for correct voltage, correct frequency and correct connection,
- all connections for correctness,
- sensors and final elements for correct function,
- the engineering for correctness,
- the configuration for required operation and
- the adjusted parameters for required effects.

If the unit does not function correctly after these checks, it must be shut down and replaced. A defective unit can be returned to the supplier for repair.

8.2 Shut-down

Disconnect the supply voltage completely and protect the unit against accidental operation. Before switching off, check that other equipment in the same signal loop is not affected. If necessary, appropriate measures must be taken.

8.3 Cleaning

Housing and front panel can be cleaned using a dry, lint-free cloth. No use of solvents or cleansing agents!

8.4 Further information

		Order no.
For a structured single-channel controller	operating instructions	9499-040-51001
For the Engineering-Tool	operating instructions	9499-040-45701
For the digital interface (ISO1745)	interface description	9499-040-45111
For the PROFIBUS	interface description	9499-040-52711
For the INTERBUS	interface description	9499-040-57011
Engineering manual	manual	9499-040-44911

This manual includes the operating instructions 9499-040-45701 for the engineering tool and the manual 9499-040-50611 for KS 98 Multi Function Unit.

Software functions

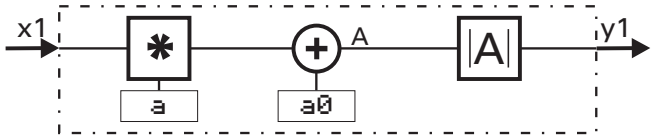
The function blocks are described basically. Analog inputs are described with x, digital inputs with d, analog outputs with y and digital outputs with z. Range "Real" is within -29 999 and 200 000. The max. permissible length of the value is 6 digits (inclusive of minus sign and decimal point), with max. 3 digits behind the decimal point. With time adjustment, negative values are not permissible.

To prevent engineering errors which would result in operating error, we recommend making own engineerings by means of the KS98 engineering tool only. It offers a graphic user interface, manages function blocks and scanning times and permits parameter setting and configuration by means of the relevant short-form descriptions. Text entry is also possible (block title, units and other user-specific texts).

9 Scaling and calculation functions

9.1 ABSV

(absolute value - no. 01)

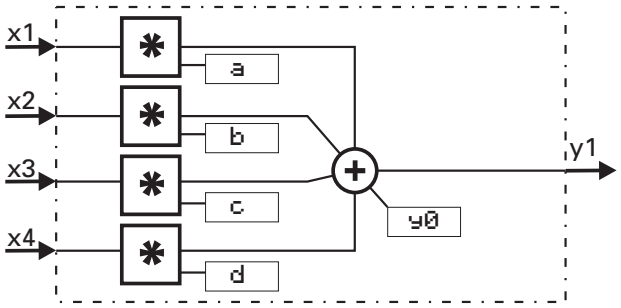


$$y_1 = |a \cdot x_1 + a_0|$$

Parameter	Description	Values	Default
a	Multiplication factor	Real	1
a0	Offset		0

9.2 ADSU

(addition / subtraction - no. 03)

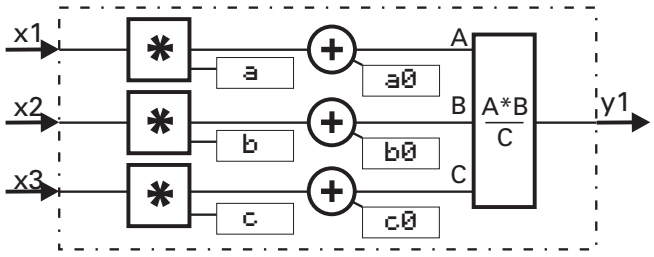


$$y_1 = a \cdot x_1 + b \cdot x_2 + c \cdot x_3 + d \cdot x_4 + y_0$$

Parameter	Description	Values	Default
a...d	Multiplication factor	Real	1
y0	Offset		0

9.3 MUDI

(multiplication / division - no. 05)

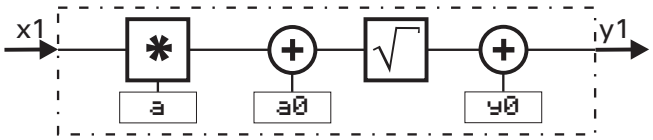


$$y_1 = \frac{A \cdot B}{C} = \frac{(a \cdot x_1 + a_0) \cdot (b \cdot x_2 + b_0)}{c \cdot x_3 + c_0}$$

Parameter	Description	Values	Default
a...c	Multiplication factor	Real	1
a0...c0	Offset		0

9.4 SQRT

(square root function - no. 08)

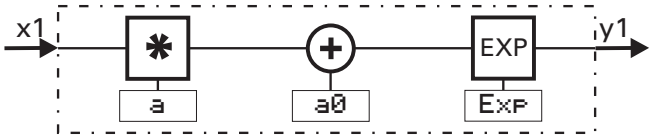


$$y_1 = \sqrt{a \cdot x_1 + a_0} + y_0$$

Parameter	Description	Values	Default
a	Multiplication factor	Real	1
a0	Input offset		0
y0	Output offset		0

9.5 SCAL

(scaling - no. 09)

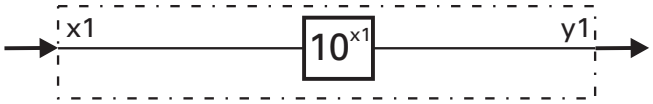


$$y_1 = (a \cdot x_1 + a_0)^{Exp}$$

Parameter	Description	Values	Default
a	Multiplication factor	Real	1
a0	Offset		0
Exp	Exponent	-7...+7	1

9.6 10EXP

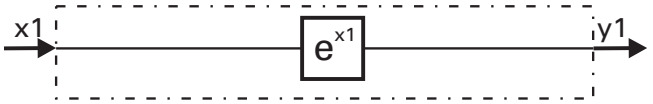
(10s exponent - no. 10)



$$y_1 = 10^{x1}$$

9.7 EEXP

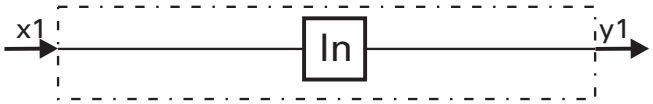
(e function - no. 11)



$$y_1 = e^{x1}$$

9.8 LN

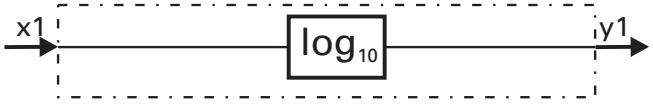
(natural logarithm - no. 12)



$$y_1 = ln(x1)$$

9.9 LG10

(10s logarithm - no. 13)

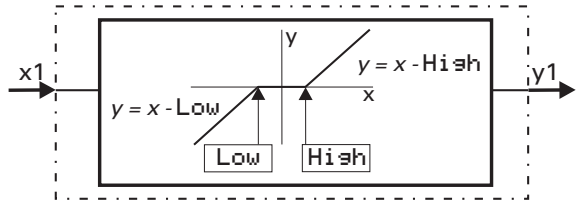


$$y_1 = log(x1)$$

10 Non-linear functions

10.1 GAP

(dead band - no. 20)

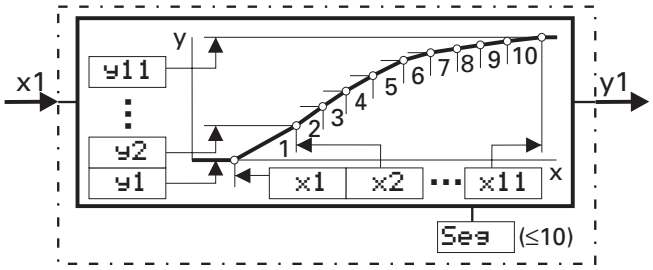


$y_1 = x1 \setminus L$	with x1 < L
$y_1 = 0$	with x1 = L...H
$y_1 = x1 \setminus H$	with x1 > H

Parameter	Description	Values	Default
Low	Lower limit value	Real	0
High	Upper limit value		0

10.2 CHAR

(function generator - no. 21)



With max. 11 value pairs (input / output) non-linear functions are simulated or linearized.

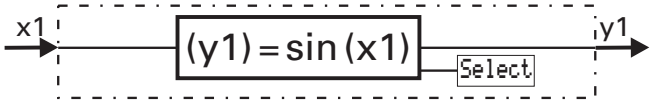
Configuration	Description	Values	Default
Seg	Number of segments	1...10	1
x(1...11)	Input value for curve point	Real	*
y(1...11)	Output value for curve point		0

* 0 for x1, x3...x11 and 1 for x2

11 Trigonometric functions

11.1 SIN

(sinus function - no. 80)

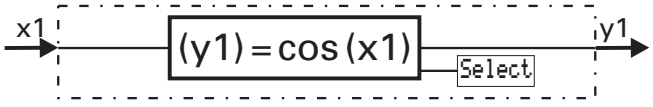


$y_1 = sin(x1)$

Parameter	Description	Values	Default
Select	Unit: degree of angle	0	0
	Unit: arc measure	1	

11.2 COS

(cosinus function - no. 81)

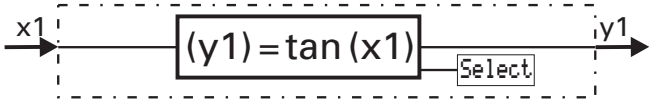


$y_1 = cos(x1)$

Parameter	Description	Values	Default
Select	Unit: degree of angle	0	0
	Unit: arc measure	1	

11.3 TAN

(tangent function - no. 82)

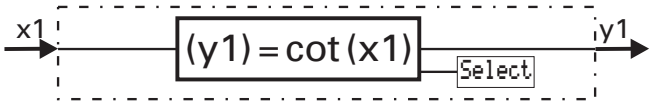


$y_1 = tan(x1)$

Parameter	Description	Values	Default
Select	Unit: degree of angle	0	0
	Unit: arc measure	1	

11.4 COT

(cotangent function - no. 83)

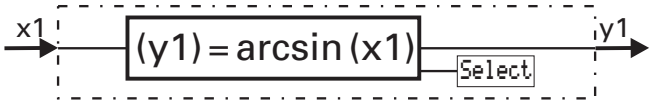


$$y_1 = cot(x1)$$

Parameter	Description	Values	Default
Select	Unit: degree of angle	0	0
	Unit: arc measure	1	

11.5 ARCSIN

(arcus sinus function - no. 84)

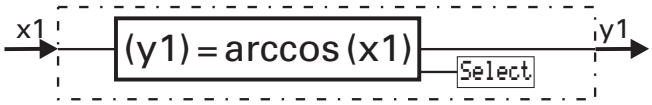


$$y_1 = arcsin(x1)$$

Parameter	Description	Values	Default
Select	Unit: degree of angle	0	0
	Unit: arc measure	1	

11.6 ARCCOS

(arcus cosinus function no. 85)

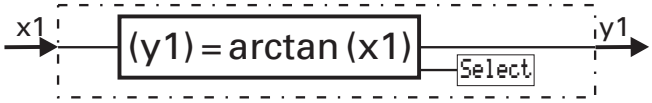


$$y_1 = arccos(x1)$$

Parameter	Description	Values	Default
Select	Unit: degree of angle	0	0
	Unit: arc measure	1	

11.7 ARCTAN

(arcus tangent function - no. 86)

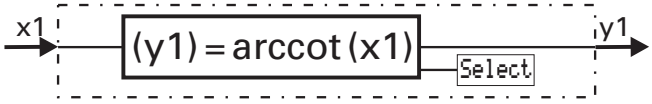


$$y_1 = arctan(x1)$$

Parameter	Description	Values	Default
Select	Unit: degree of angle	0	0
	Unit: arc measure	1	

11.8 ARCCOT

(arcus cotangent function - no. 87)



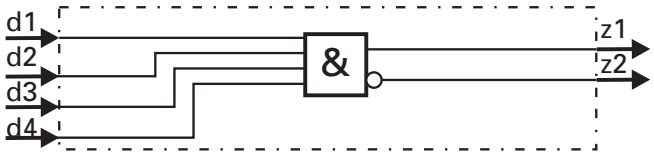
$$y_1 = arccot(x1)$$

Parameter	Description	Values	Default
Select	Unit: degree of angle	0	0
	Unit: arc measure	1	

12 Logic functions

12.1 AND

(AND gate - no. 60)

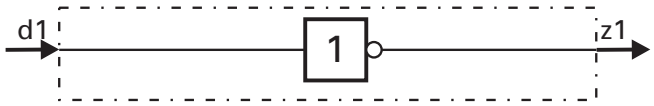


$z_1 = d_1$ AND d_2 AND d_3 AND d_4

$z_2 = \overline{z_1}$

12.2 NOT

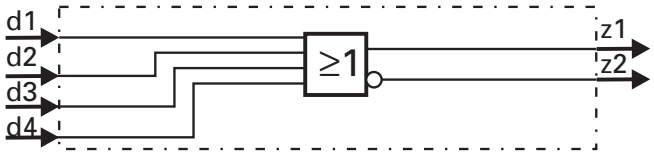
(inverter - no. 61)



$z_1 = \overline{d_1}$

12.3 OR

(OR gate - no. 62)

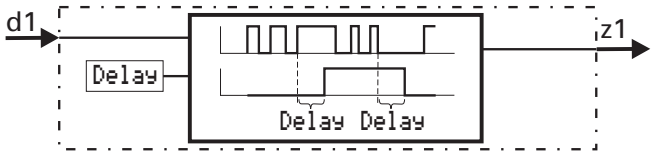


$z_1 = d_1$ OR d_2 OR d_3 OR d_4

$z_2 = \overline{z_1}$

12.4 BOUNCE

(debouncer - no. 63)

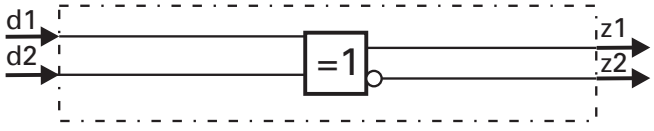


for de-bouncing a logic signal

Parameter	Description	Values	Default
Delay	Switch-on and off delay time [s]	Real	0

12.5 EXOR

(exclusive OR gate - no. 64)

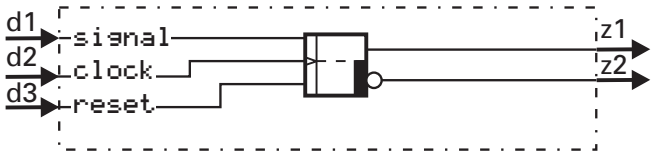


$z_1 = d_1$ EXOR d_2

$z_2 = \overline{z_1}$

12.6 FLIP

(D flipflop - no. 65)



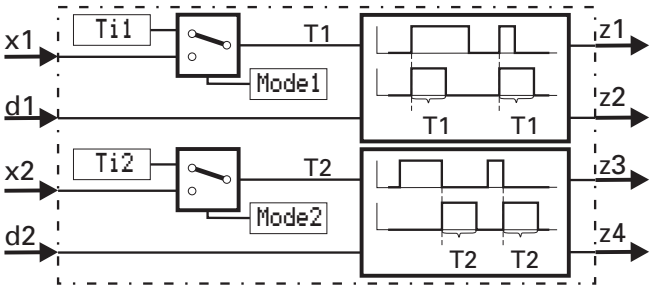
The status of d1 is transferred to z1, when
- d2 changes from 0 to 1 (positive flank) and
- d3 is logic 0.

If d3 is logic 1, z1 is logic 0.

$z_2 = \overline{z_1}$

12.7 MONO

(monoflop - no. 66)



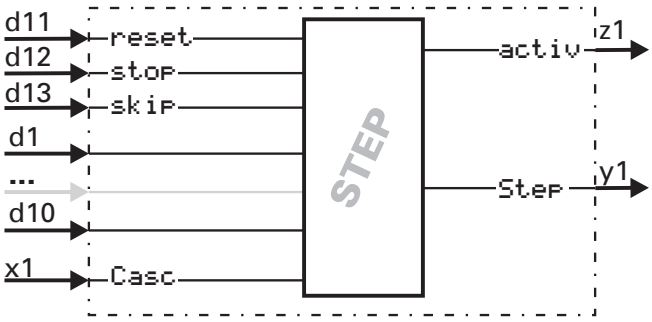
Positive pulse of length T1 at z1, if a positive flank is detected at d1 (0 → 1) and
Positive pulse of length T2, when a negative flank is detected at d2 (1 → 0).

$z_2 = \overline{z_1}$ and $z_4 = \overline{z_3}$

Parameter	Description	Values	Default
Ti1	Pulse duration in s (d1,**Mode1**=0)	Real	1
Ti2	Pulse duration in s (d2,**Mode2**=0)	Real	1
Mode1	Source of pulse duration T1= **Ti1**	0	0
	Source of pulse duration T1 = x1	1	
Mode2	Source of pulse duration T2= **Ti2**	0	0
	Source of pulse duration T2 = x2	1	

12.8 STEP

(step function for sequencing - no. 68)

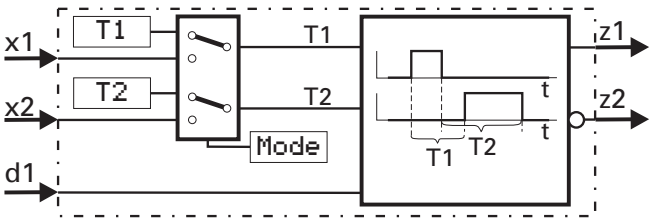


For conditional switch-on or as a ring counter. The STEP function can be cascaded.

d1...d10	Condition inputs for switching on
x1	Input for cascading
d11 = 1	**reset** (y1 is set to 1 or to x1)
d12 = 1	**stop** (y1 and z1 remain unchanged)
d13	**skip** (switch-on with positive flank)
y1	Active step number (or + x1)
z1	1 = STEP function is active or in reset

12.9 TIME1

(timer - no. 69)



The status change of d1 is output with delay at z1. The delay is **T1** or x1 for the positive flank, **T2** or x2 for the negative flank.

$z_2 = \overline{z_1}$

Parameter	Description	Values	Default
T1	Delay time in s (d1=0→1)	Real	0
T2	Delay time in s (d1=1→0)		0

Configuration	Description	Values	Default
Mode	Delay times = **T1**/**T2**	0	0
	Delay times = x1/x2	1	

13 Signal converters

13.1 AOCTET

data type conversion

AOCTET
101 ts=11

Function AOCTET converts an analog value (X1) into the individual bytes (Ooct1-4) of a data type as used e.g. for transmission via the CAN bus (see CPREAD / CPWRIT). In the CAN notation, the bytes are transmitted in Intel format. Unless connected instruments are in compliance with this notation, word or bytewise echange of the bytes may be necessary.

The function works in both directions simultaneously (analog > bytes / bytes > analog) with separate data type adjustment in the parameters.

Analog inputs:

X1	analog input value
Ioct1..4	analog input byte value 1

Analog outputs:

Y 1	analog output value
Ooct1..4	analog output byte value 1

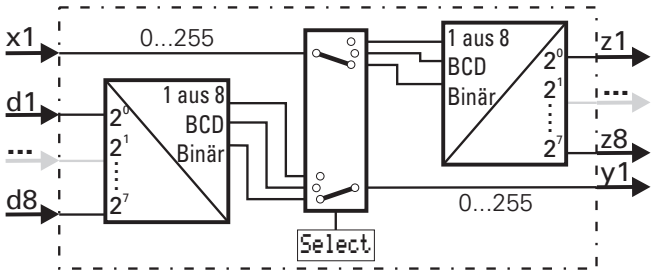
Parameters:

Ioct	data type of analog > byte conversion
Ooct	data type of byte > analog conversion

The following data types are available
0: Uint8
1: Int8
2: Uint16
3: Int16
4: Uint32
5: Int32
6: Float

13.2 ABIN

(analog ↔ binary convertion - no. 71)

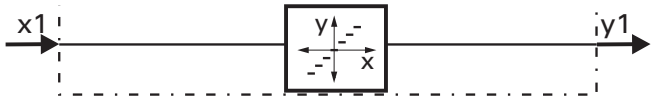


Converts analog value x1 into digital value z1...z8 and converts digital value d1...d8 into analog value y1. Either binary: z1/d1 = LSB or BCD: z1...z4/d1...d4 = LSD, z1/z5/d1/d5 = LSB or 1 of 8: z1/d1 = 1

Configuration	Description	Values	Default
Select	analog → binary and vice versa	0	0
	analog → BCD and vice versa	1	
	analog → 1 of 8 and vice versa	2	

13.3 TRUNC

(integer portion - no. 72)

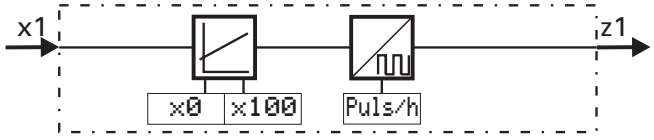


Provides the integer portion of x1 (not rounded!) to y1.

$$y_1 = \mathrm{INT}(x_1)$$

13.4 PULS

(analog-pulse convertion - no. 73)



Value x1 is converted into a number of pulses/h.

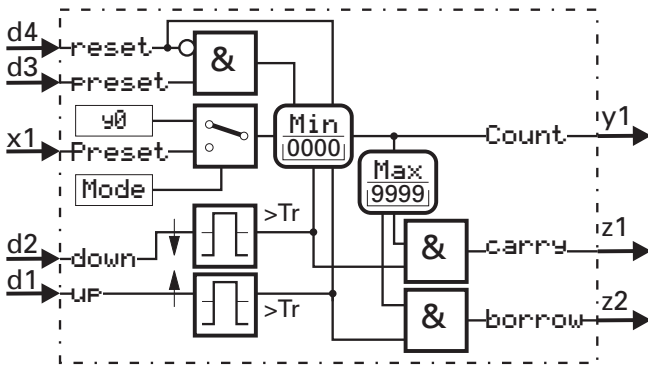
$$n = \mathrm{Puls}/h \cdot \frac{x_1 \setminus x_0}{x_{100} \setminus x_0}$$

Parameter	Description	Values	Default
x0	Start	Real	0
x100	End		1
Puls/h	Pulses/h	0...nmax.	0

$n_{max.}$ = 18 000/h with ts=100 ms
$n_{max.}$ = 9 000/h with ts=200 ms
$n_{max.}$ = 4 500/h with ts=400 ms
nmax. = 2 250/h with ts=800 ms

13.5 COUN

(up/down counter - no. 74)



Count = counter output (counter value)
carry = positive carry
borrow = negative carry

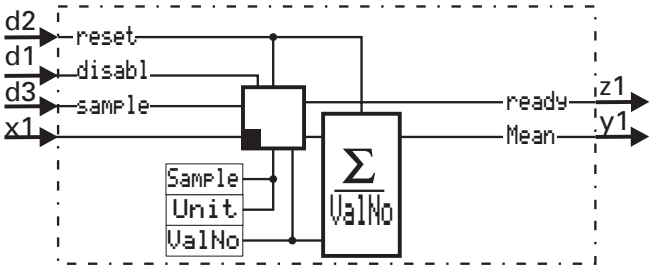
The events (0 → 1) at d1 are counted **up** and the events at d2 are counted **down**. Condition: the non-counting input is not connected, or connected to 1. During carry or borrow, the relevant output is 0.

Parameter	Description	Values	Default
y0	Preset value	Real	0
Max	Max. limit		9999
Min	Min. limit		0
Mode	Source of preset = **y0**	0	0
	Source of preset = x1	1	

reset (di4)	**preset** (di3)	Mode
0	0	GO (Default)
0	1	PRESET
1	0	RESET (first-Run)
1	1	RESET (first-Run)

13.6 MEAN

(mean value formation - no. 75)



After sampling of the required number of values (**ValNo**), z1 goes to 1 during 800 ms. This signal can be used at the **sample** input (d3) of a second MEAN function for cascading.

y1 = arithmetic mean value from the number (**ValNo**) of x1 values sampled last. The interval between the individuel samples is adjustable with **Sample** and **Unit**. Sampling is also possible at a positive flank at d3 (**sample**).
Sampling is interrupted with d1 = 1 (**disabl**),
the mean value is deleted with d2 = 1 (**reset**).

Configuration	Description	Values	Default
Sample	Value for interval	Real	1
ValNo	Number of values to be sampled	1...100	100
Unit	Time unit for interval: s	0	0
	Time unit for interval: min	1	
	Time unit for interval: h	2	

Example 1: Mean value of the last minute with one sample every second.

Sample: 1 **Unit**: 0 → one sample every second.
ValNo: 60 → the mean value is calculated from the last 60 values (1 minute).

Example 2: Mean value of the last day with one sample every hour.

Sample: 1 **Unit**: 2 → one sample every hour.
ValNo: 24 → the mean value is calculated from the last 24 values (1 day).

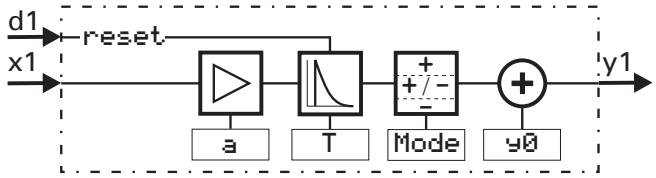
Example 3: Mean value of the last day with one sample every 15 minutes.

Sample: 15 **Unit**: 1 → one sample every 15 minutes.
ValNo: 96 → the mean value is calculated from the last 96 values (1 day).

14 Time functions

14.1 LEAD

(differentiator - no. 50)



reset = reset to start condition

$$y_1(t) = \frac{T}{T + t_s} \cdot [\, y_1(t \setminus t_s) + a \cdot \{\, x_1(t) \setminus x_1(t \setminus t_s) \,\}] + y_0$$

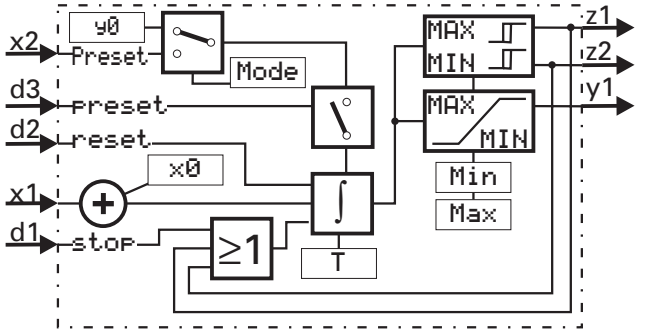
ts	calculation cycle time	x1(t)	instantaneous x1
T	time constant	x1(t-ts)	previous x1
a	gain	y1(t)	instantaneous y1
y0	Output offset	y1(t-ts)	previous y1

Parameter	Description	Values	Default
a	Description	Real	1
y0	Output offset		0
T	Time constant in s		1

Configuration	Description	Values	Default
Mode	Differentiating all changes	0	0
	Differentiating only pos. changes	1	
	Differentiating only neg. changes	2	

14.2 INTE

(integrator - no. 51)



reset (d2 = 1, priority over preset and stop)
preset (d3 = 1, priority over stop)
stop (d1 = 1)
z1 = 1 with max. limiting exceeded
z2 = 1 with min. limiting exceeded

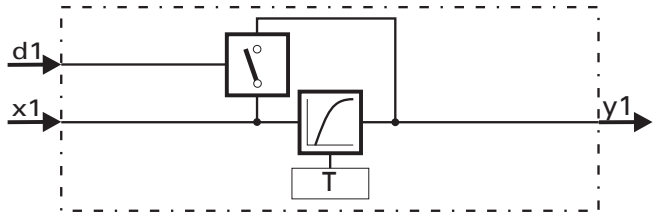
$$y_1(t) = y_1(t \setminus t_s) + \frac{t_s}{T} \cdot [\, x_1(t) + x_0 \,]$$

ts	calculation cycle time	x1(t)	instantaneous x1
T	integration constant	y1(t)	y1 after t = n . ts
n	number of calcul. cycles	y1(t-ts)	previous y1
x0	input offset		

Parameter	Description	Values	Default
T	Time constant in s	Real	60
x0	constant		0
y0	Preset value		0
Min	Min. limiting		-9999
Max	Max. limiting		9999
Mode	Source of Preset = y0	0	0
	Source of Preset = x2	1	

14.3 LAG1

(filter - no. 52)



d1 = 0: delay effective (default)
d1 = 1: delay ineffective

With d1 = 0, x1 is transmitted to y1 with delay after a 1st order e-function (d1 = 1: without delay).

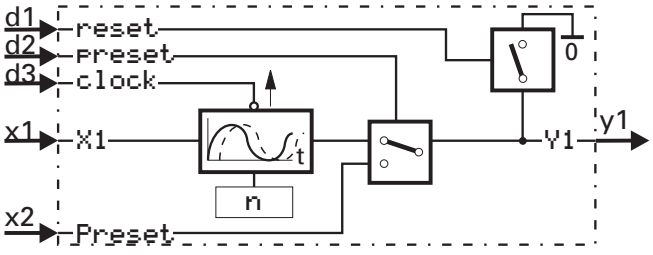
$$y_1(t) = \frac{T}{T + t_s} \cdot y_1(t \setminus t_s) + \frac{t_s}{T + t_s} \cdot x_1(t)$$

ts	calculation cycle time	x1(t)	instantaneous x1
T	time constant	y1(t)	y1 after t = n . ts
n	no. of calculation cycles	y1(t-ts)	previous y1

Parameter	Description	Values	Default
T	Time constant in s	Real	1

14.4 DELA1

(delay time 1 - no. 53)



ts = calculation cycle time

Delay time with TT = **n** · ts (d3 not wired) or shift register of depth **n** (d3: 0 → 1 as clock).

Parameter	Description	Values	Default
n	Delay factor	0/1/...255	0

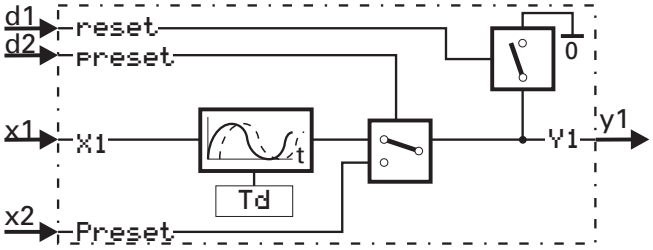
reset (d1 = 1, priority over **preset** and **clock**)

preset (d2 =1, priority over **clock**)

clock (d3, as specified above)

14.5 DELA2

(delay time 2 - no. 54)



Td max =25,5 s with ts=100 ms
Td max =51,0 s with ts=200 ms
Td max =102,0 s with ts=400 ms
Td max =204,0 s with ts=800 ms

Value x1 is output with delay of **Td** (y1).

$$y_1(t) = x_1(t \setminus Td)$$

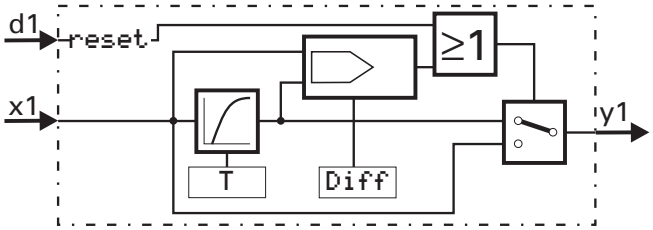
Parameter	Description	Values	Default
Td	Delay in s	Real	0

reset (d1 = 1, priority over **preset**)

preset (d2 = 1, delay (d1 = 0 and d2 = 0)

14.6 FILT

(filter with tolerance band - no. 55)



With the difference between x1 and y1 below **Diff** and d1 = 0, y1 is delayed as follows:

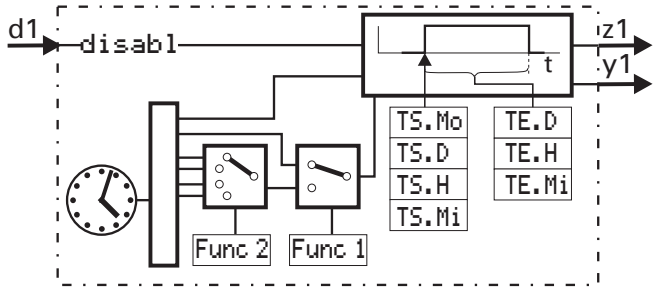
$$y_1(t) = \frac{T}{T + t_s} \cdot y_1(t \setminus t_s) + \frac{t_s}{T + t_s} \cdot x_1(t)$$

Outside the tolerance band or with d1 = 1 the output follows the input directly

Parameter	Description	Values	Default
T	Time constant in s	Real	1
Diff	Tolerance band		1

14.7 TIMER

(time switch 1 - no. 67)



z1 is switched on at absolute time TS (Mo=month, D=day, H=hour, Mi =minute) and switched off again TE later (D=days, H=hours, Mi =minutes). Switching can be done once or cyclically, and suppressed with d1 = 1.
y1 indicates the actual weekday (0...6 ≙ Su...Sa)

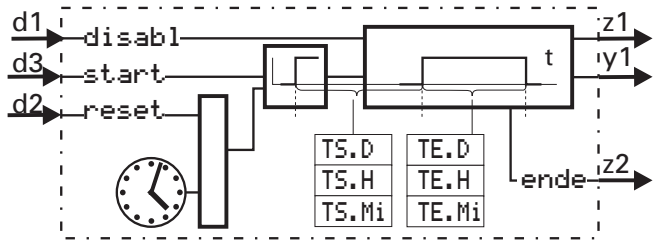
Parameter	Description	Values	Default
TS.Mo	Switch-on time, month	0...12	0
TS.D	Switch-on time, day	0...31	
TS.H	Switch-on time, hour	0...23	
TS.Mi	Switch-on time, minute	0...59	
TE.D	Time duration, days	0...255	
TE.H	Time duration, hours	0...23	
TE.Mi	Time duration, minutes	0...59	

Configuration	Description	Values	Default
Func1	Function runs cyclically	0	0
	Function runs once	1	
Func2	Function runs daily	0	0
	Function runs from Mo...Fr	1	
	Function runs from Mo...Sa	2	
	Function runs weekly	3	

TS.Mo = 0 and TS.D = 0 means 'actual day' When time defined with TS.H / TS.Mi has elapsed, the 1st switching operation occurs on the following day.
With TS.Mo = 0 and TS.D < actual day the 1st switching operation occurs in the following month.
With TS.Mo ≤ actual month and TS.D < act. day the 1st switching operation occurs in the following year.

14.8 TIME2

(time switch 2 - no. 70)



z2 = 1 at switching operation end

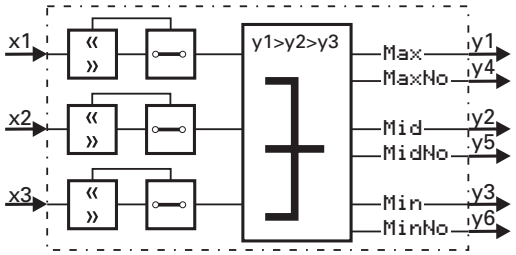
z1 is switched on TS (D=days, H=hours, Mi =minutes) after a positive flank of d3 and switched off again TE later (D=days, H=hours, Mi =minutes). If end is fed back to start, the switching operation is cyclical. The operation is suppressed with d1 = 1, d2 = 1 finishes an instantaneously running switching operation immediately. y1 indicates the actual weekday (0...6 ≙ So...Sa)

Parameter	Description	Values	Default
TS.D	Switch-on delay, days	0...255	0
TS.H	Switch-on delay, hours	0...23	0
TS.Mi	Switch-on delay, minutes	0...59	0
TE.D	Time duration, days	0...255	0
TE.H	Time duration, hours	0...23	0
TE.Mi	Time duration, minutes	0...59	0

15 Selection and storage

15.1 EXTR

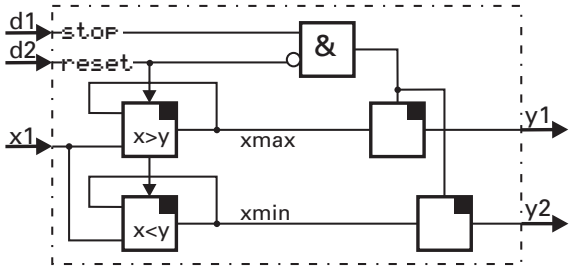
(extreme value selection - no. 30)



The values of x1...x3 are output sorted according to height at y1...y3. y4...y6 indicate the relevant input number. With equality the distribution is at random. If an input is not wired or >0,5 . 10^{37} or <-0,5 . 10^{37}, it is not taken into account during selection.

15.2 PEAK

(peak value memory - no. 31)

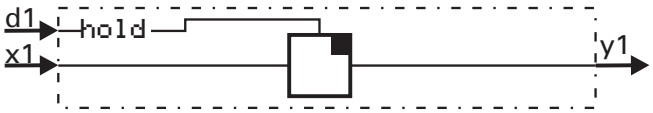


y1 follows the max. and y2 follows the min. value of x1. With stop (d1 = 1, d2 = 0) both values remain stable.

reset (d2 = 1, priority over **stop**): y1 = x1
stop (d1 = 1, d2 = 0): as described above
go (d1 = 0 and d2 = 0): as described above

15.3 TRST

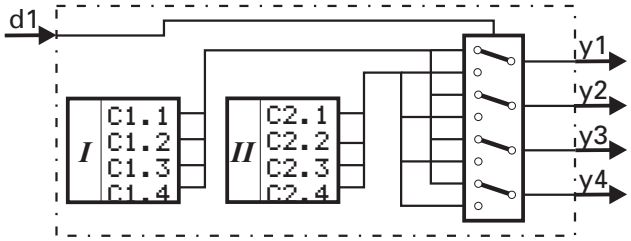
(hold amplifier - no. 32)



y1 follows x1, when d1 = 0.
With d1 = 1 the momentary value of x1 is stored.

15.4 SELC

(constant selection - no. 33)

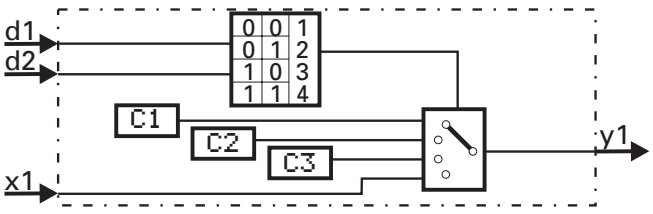


Either parameters C1.1...C1.4 (with d1 = 0) or C2.1...C2.4 (with d1 = 1) are connected with y1...y4.

Parameter	Description	Values	Default
C1.1...4	Constant group1	Real	0
C2.1...4	Constant group2		1

15.5 SELP

(parameter selection - no. 34)

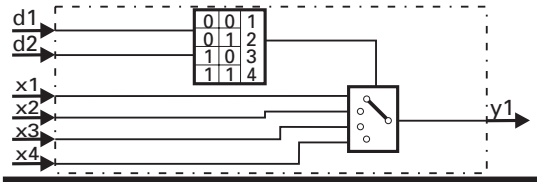


y1 = C1 (d1 = 0, d2 = 0)	y1 = C3 (d1 = 1, d2 = 0)
y1 = C2 (d1 = 0, d2 = 1)	y1 = x1 (d1 = 1, d2 = 1)

Parameter	Description	Values	Default
C1...C3	Constants	Real	0

15.6 SELV1

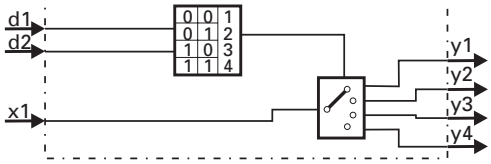
(variable selection - no. 35)



y1 = x1 (d1 = 0, d2 = 0)
y1 = x2 (d1 = 0, d2 = 1)
y1 = x3 (d1 = 1, d2 = 0)
y1 = x4 (d1 = 1, d2 = 1)

15.7 SOUT

(selection of output - no. 36)



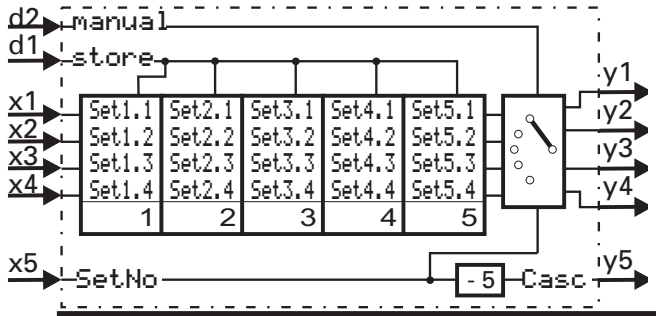
y1 = x1 (d2 = 0, d1 = 0)	y3 = x1 (d2 = 1, d1 = 0)
y2 = x1 (d2 = 0, d1 = 1)	y4 = x1 (d2 = 1, d1 = 1)

This functionblock has changed from operating version 6 to7. Old truthtable:

0	0	1
1	0	2
0	1	3
1	1	4

15.8 REZEPT

(recipe management - no. 37)

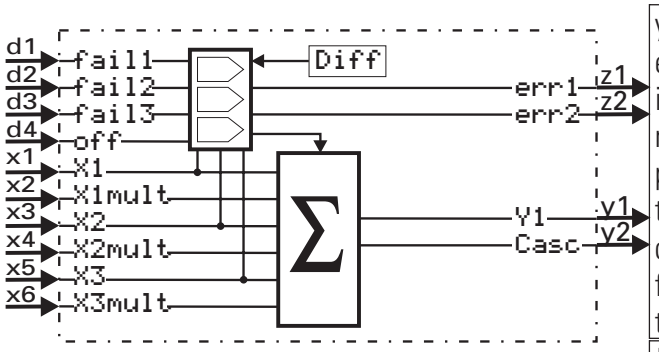


The block contains 5 groups each with 4 parameters. x5 selects, which group is available at y1...y4. With x5 <1 or >5 or with d2 = 1 (**manual**), x1...x4 are through-connected directly to y1...y4. With d1 = 0 → 1 the values at x1...x4 are written to the group selected with x5 (**store**).

manual (d2 = 1): as described above
store (d1 = 0 → 1): as described above

15.9 2OF3

(2-out-of-3 selection with mean value formation - no. 38)

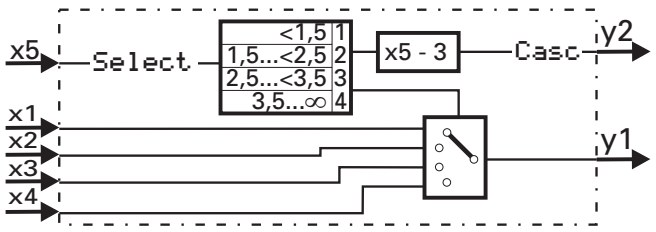


y1 = arithmetic mean value of x1, x3 and x5. y2 = number of values used for mean value formation. The difference of x1, x3 and x5 is formed and compared with Diff. Inputs, the value of which varies by > Diff, are not used for mean value formation. When applying the fail signals of AINP (z1) to d1...d3, faulty inputs are not taken into account either during mean value formation. z1 = 1 indicates, that 1 input has failed and was not used for mean value formation. z2 = 1 indicates, that there was no mean value formation, because min. 2 inputs had failed.

Parameter	Description	Values	Default
Diff	Difference limit value	Real	1

15.10 SELV2

(cascadable selection of variables - no. 39)

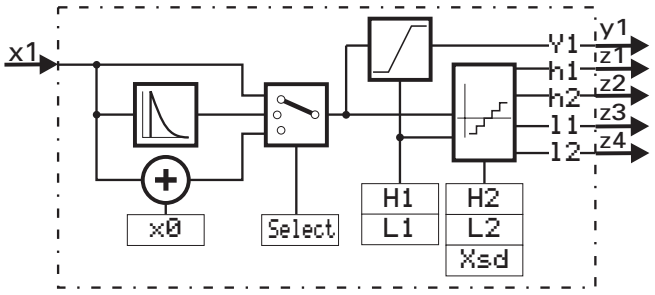


y1 = x1 (x5 < 1,5)
y1 = x2 (x5 = 1,5...<2,5)
y1 = x3 (x5 = 2,5...<3,5)
y1 = x4 (x5 = 3,5...∞)

16 Limit signalling and limiting

16.1 ALLP

(alarm and limiting with fixed limits - no. 40)



y1 = signal limited to L1 and H1
z1 = 1 with signal > H1
z2 = 1 with signal > H2
z3 = 1 with signal < L1
z4 = 1 with signal < L2

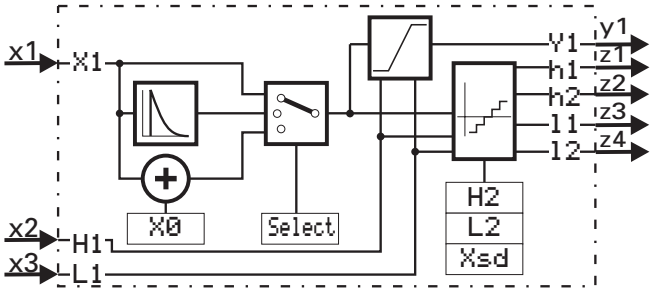
Signal x1 is monitored for 2 low (L1, L2) and 2 high limit values (H1, H2). Additionally min. and max. limiting is applied to the signal (L1, H1). The signal can be x1 or dx1/dt or x1 - x0.

Parameter	Description	Values	Default
H1	Max. alarm 1 or max. limit	Real	9999
L1	Min. alarm 1 or min. limit		-9999
H2	Max. alarm 2		9999
L2	Min. alarm 2		-9999
x0	offset		0
xsd	switching hysteresis		1

Configuration	Description	Values	Default
Select	Monitored variable: x1	0	0
	Monitored var.: dx1/dt [1/s]	1	
	Monitored var.: x1 - x0	2	

16.2 ALLV

(alarm and limiting with variable limits - no. 41)



y1 = signal limited to L1 and H1
z1 = 1 with signal > H1
z2 = 1 with signal > H2
z3 = 1 with signal < L1
z4 = 1 with signal < L2

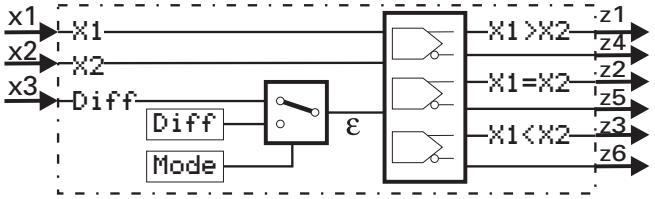
Signal x1 is monitored for 2 low (x2, L2) and 2 high limit values (x3, H2). Additionally min. and max. limiting is applied to the signal (x2, x3). The signal can be x1 or dx1/dt or x1 - x0.

Parameter	Description	Values	Default
H2	Max. alarm 2	Real	9999
L2	Min. alarm 2		-9999
x0	offset		0
xsd	switching hysteresis		1

Configuration	Description	Values	Default
Select	Monitored variable: x1	0	0
	Monitored variable: dx1/dt [1/s]	1	
	Monitored variable: x1 - x0	2	

16.3 EQUAL

(comparison - no. 42)



Checking, whether x1 is smaller, equal or higher than x2 (+/- tolerance Diff).

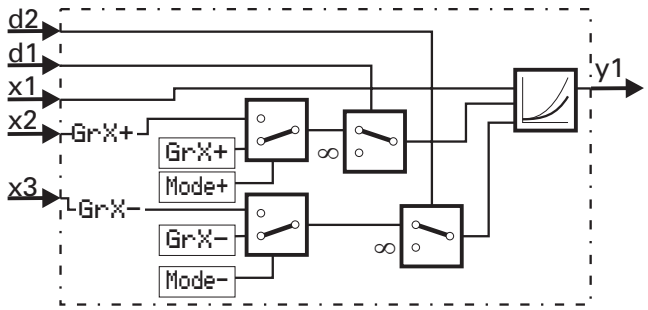
$z_3 = 1$ with $x_1 < x_2 \setminus \varepsilon$
$z_2 = 1$ with $x_1 = (x_2 \setminus \varepsilon) \ldots (x_2 + \varepsilon)$
$z_1 = 1$ with $x_1 > x_2 + \varepsilon$

$z_6 = \overline{z_3}$
$z_5 = \overline{z_2}$
$z_4 = \overline{z_1}$

Parameter	Description	Values	Default
Diff	Tolerance limit	Real	0
Mode	Source tolerance limit: Diff	0	0
	Source of tolerance limit: x3	1	

16.4 VELO

(rate-of-change limiting - no. 43)



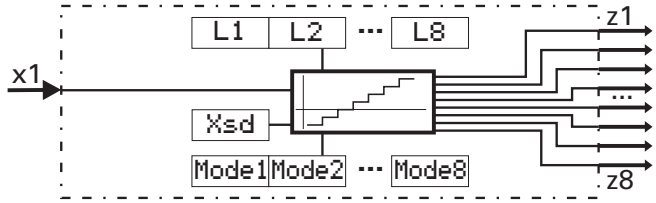
d1 = 0: positive gradient is effective
d2 = 0: negative gradient is effective
d1 / d2 = 1: relevant gradient is ineffective

x1 is passed through to y1, however, its rate of change is limited to a positive and / or a negative maximum value (gradient).

Parameter	Description	Values	Default
GrX+	Positive gradient (1/s)	Real	∞
GrX-	Negative gradient (1/s)		∞
Mode+	Source of pos. gradient: GrX+	0	0
	Source of pos. gradient:x2	1	
Mode-	Source of neg. gradient: GrX-	0	0
	Source of neg. gradient: x3	1	

16.5 LIMIT

(multiple alarm - no. 44)



z1...z8: 0 = no alarm 1 = alarm

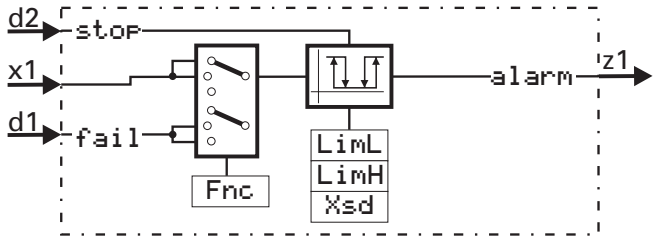
x1 is checked for 8 alarm values. Mode determines the operation of the relevant alarm (max. / min.).

Parameter	Description	Values	Default
L1...L8	Alarm values	Real	0
Xsd	Switching hysteresis		0

Configuration	Description	Values	Default
Mode1... Mode8	Operation: max. alarm	0	0
	Operation: min. alarm	1	

16.6 ALARM

(alarm processing - no. 45)



z1: 0 = no alarm 1 = alarm
d1 can come e.g. from the **fail** output of an AINP

x1 is checked for a low and a high alarm value. Additionally the digital alarm input can be switched to d1. With d2 = 1 the alarms are suppressed. After removal of this signal, suppression is maintained, until the monitored value returns within the limits.

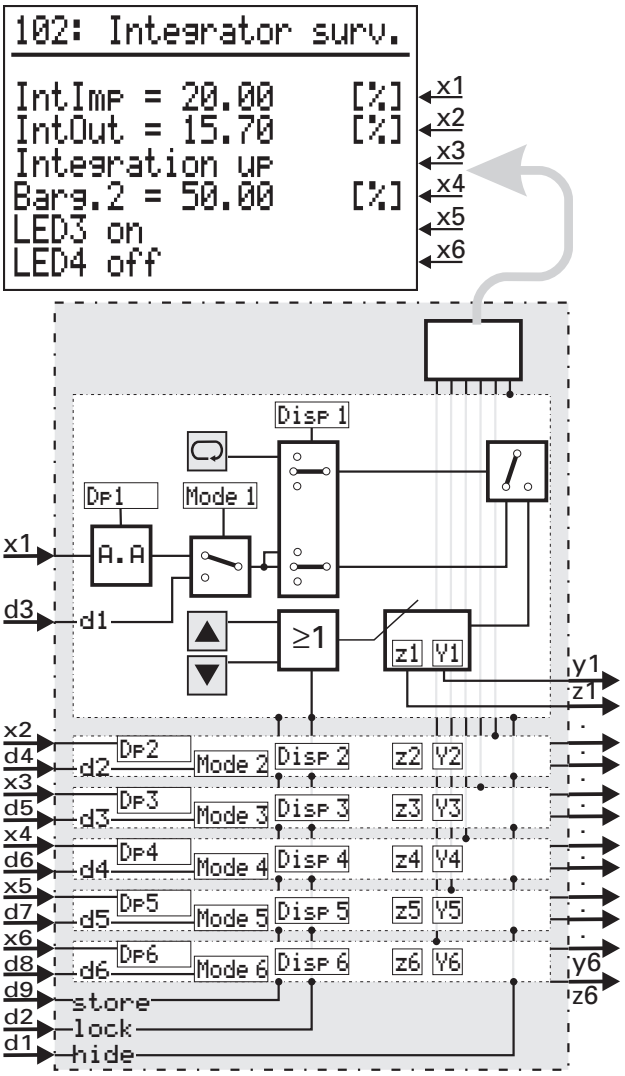
Parameter	Description	Values	Default
LimL	Low alarm value	Real	10
LimH	High alarm value		10
Lxsd	Switching difference		0

Configuration	Description	Values	Default
Fnc	Alarm function: meas. value	0	0
	Alarm function: meas. value + d1	1	
	Alarm function: d1	2	

17 Visualization

17.1 VWERT

(display / definition of process values - no. 96)



The following values or texts are displayed in the lines:

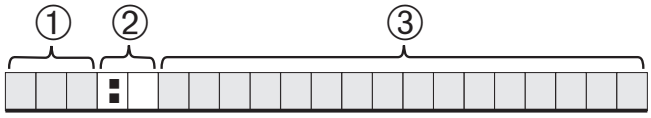
① Block number 3 digits
② Fixed text or space (no access)
③ First 16 characters of 'title''
④ With analog lines: parameter name (dependent of line
the first 6 characters of 'text 1a'...'text 6a')
⑤ With analog lines: value x1...x6 dependent of line
⑥ With analog lines: unit (the first 6 characters of 'text 1b'...'text 6b' dependent of line)
⑦ With digital lines: dependent of signal and line
the first 16 characters of 'text 1a'...'text 6a' (Signal=0)
the first 16 characters of 'text 1b'...'text 6b' (Signal=1)

For display or alteration of 6 analog or digital values in 6 display lines. With d1 = 1 the operating page is not displayed. With d2 = 1 the values are not adjustable by means of keys ▲▼. With a positive flank at d9 (0⟶1) the input values are stored as output values.

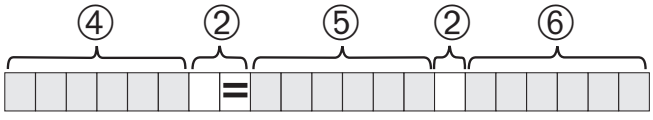
Parameter	Description	Values	Default
z1...z6	Start values digital at power-on	0 / 1	0
Y1...Y6	Start values analog at power-on	Real	0
Configuration			
Disp1 ... Disp6	Display line, value adjustable	0	1
	Only display line	1	
	Line = Empty line	2	
Mode1 ... Mode6	Display line analog	0	0
	Display line digital	1	
Dp1... Dp6	Digits behind dec. point	0...5	0

Text entry is possible only via the engineering tool.

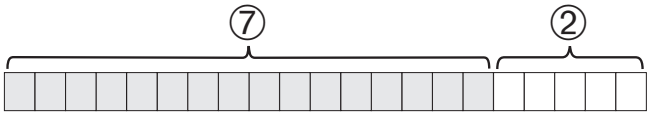
Header



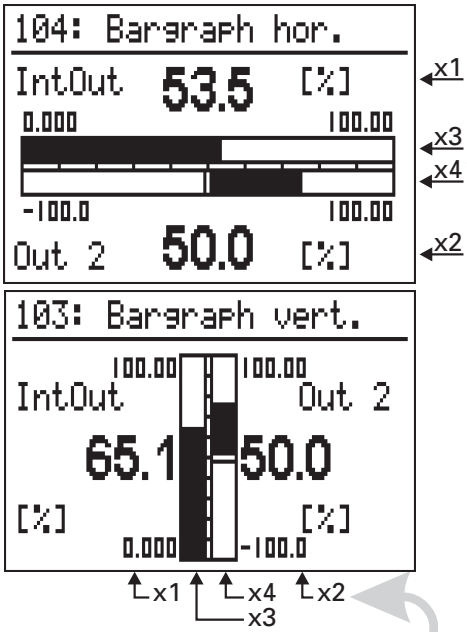
Analog line

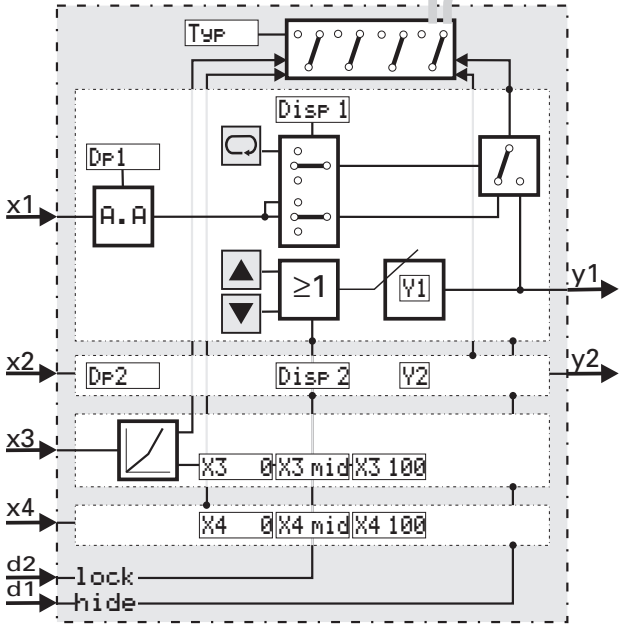


Digital line



17.2 VBAR
(bargraph display - no. 97)





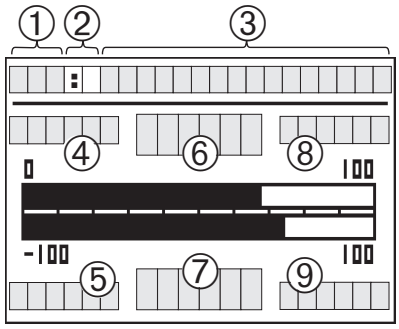
For display of 4 analog values, 2 thereof as bargraphs. The bargraphs can be horizontal or vertical. The values of x1 and x2 can also be altered. With d1 = 1 this operating page is not displayed. With d2 = 1 the values are not adjustable using keys ▲▼.

Parameter	Description	Values	Default
Y1, Y2	display x1 / x2, variable	Real	0

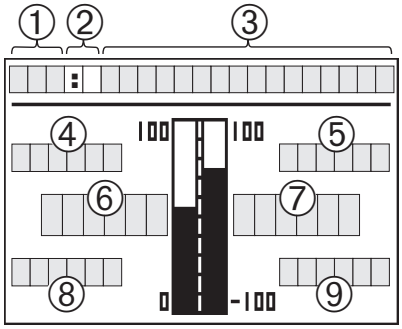
Configuration	Description	Values	Default
Disp 1 Disp 2	display x1 / x2, variable	0	1
	only display x1 / x2	1	
	empty field x1 / x2	2	
Dp1, DP2	Digits behind dec. point	0...3	0
Type	Both bargraphs horizontal	0	0
	Both bargraphs vertical	1	
	Scaling bargraph 1 (x3)		
X3 0	Left or bottom	Real	0
X3 100	Right or top	Real	100
X3 mid	Start value middle	Real	0
	Scaling bargraph 2 (x4)		
X4 0	Left or bottom	Real	0
X4 100	Right or top	Real	100
X4 mid	Start value middle	Real	0

Text entry is possible only via the engineering tool.

Bargraphs horizontal



vertical

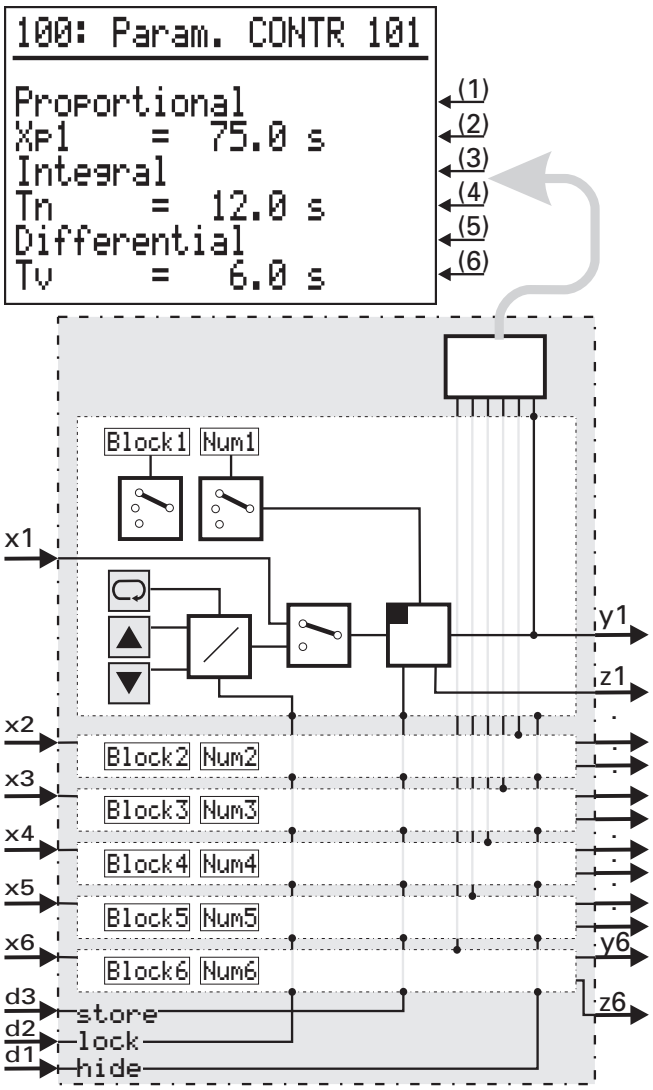


The following values or texts are displayed:

① Block number 3 digits
② Fixed text or space (no access)
③ First 16 characters of 'title'
④ Parameter name for x1 (first 6 characters of 'name 1')
⑤ Parameter name for x2 (first 6 characters of 'name 2')
⑥ Value x1
⑦ Value x2
⑧ Unit for x1 (first 6 characters of 'unit 1')
⑨ Unit for x2 (first 6 characters of 'unit 2')

17.3 VPARA

(parameter operation - no. 98)



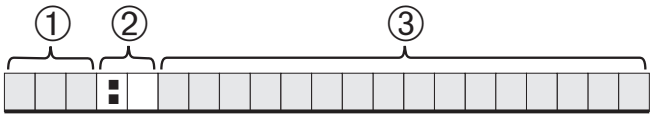
For common display and adjustment of max. 6 parameters of other function blocks on 6 display lines. When value 0 is specified as block number, the corresponding line is a text line. With input (x) connected, keys ▲▼ are without effect but display and output follow the input with positive edge at d3 (0⟶1). With d2 = 1, the values are not adjustable by means of keys ▲▼. With d1 = 1, the operating page is not displayed

Configuration	Description	Values	Default
Block1 ... Block6	Block number of displayed parameter	*	*
Num1 ... Num6	Parameter number	*	*

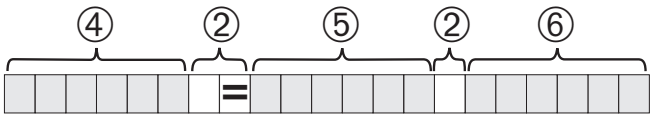
* To prevent confusion and thus operator errors, we recommend adjusting block numbers and parameters exclusively via the engineering tool, which is also used for entry of the parameters with short-form descriptions Text entry is possible only via the engineering tool.

The following values or texts are displayed in the lines:

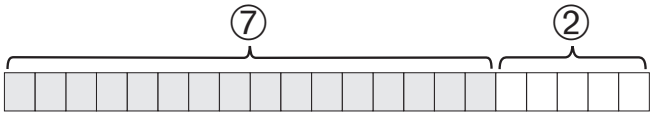
① Block number 3 digits
② Fixed text or space (no access)
③ First 16 characters of 'title'
④ With parameter lines: parameter name (depend. of line the first 6 characters of 'text 1'...'text 6')
⑤ With parameter lines: the parameter value
⑥ With parameter lines: unit (the first 6 characters of 'unit 1'...'unit 6' dependent of line)
⑦ With text lines: the first 16 characters of 'text 1'...'text 6' dependent of line



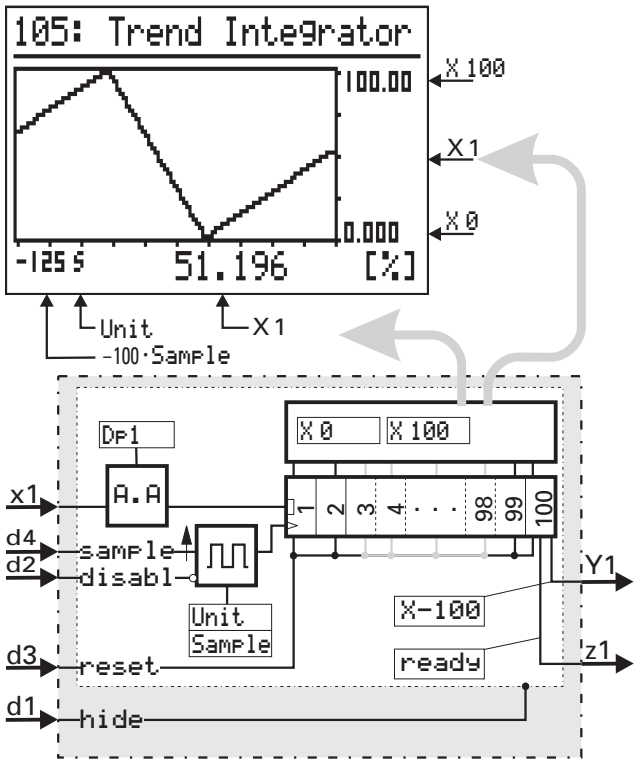
Parameter line



Text line



17.4 VTREND
(trend display - no. 99)



For collection and display of the last 100 analog values of x1. These values are displayed in a trend curve. Sampling interval (`Sample`) and time unit (`Unit`) are adjustable. With d1 = 1 the operating page is not displayed. With d2 = 1 sampling is interrupted. With d3 = 1 trend sampling is reset. Sampling can be done automatically or with a positive pulse at d4.

Configuration	Description	Values	Default
	Unit of sampling interval		
`Unit`	seconds (`s`)	0	0
	Minutes(`m`)	1	
	Hours (`h`)	2	
`Sample`	Value of sampling interval	Real	1
`Dp`	Digits behind decimal point	0...3	0
`X 0`	Display scaling 0%	Real	0
`X 100`	Display scaling 100%		100

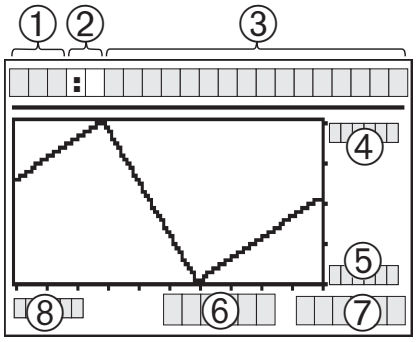
Y1 is the value from 100 samples ago (`X-100`)

z1=1 when buffer memory full (`ready`)

The following values or texts are displayed:

① Block number 3 digits
② Fixed text or space (no access)
③ First 16 characters of 'title'
④ `X 100`
⑤ `X 0`
⑥ Instantaneous value x1
⑦ Unit for x1 (first 6 characters of 'unit')
⑧ -100 * `Sample`, `Unit`

Trend display



Text entry is possible only via the engineering tool.

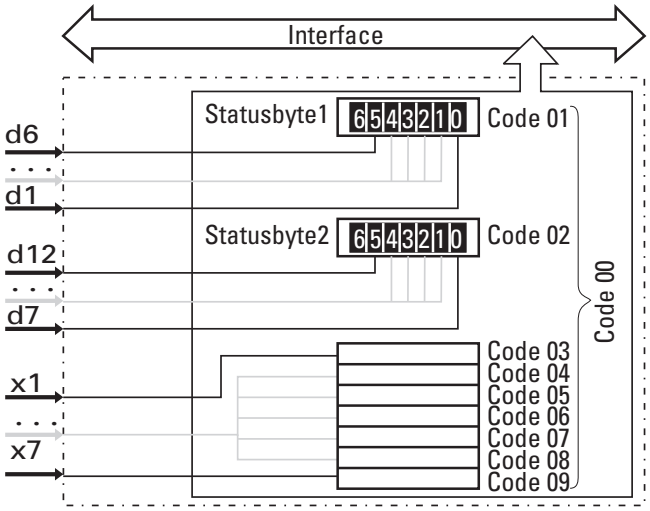
18 Communication

ISO 1745

Max. 20 functions L1READ and L1WRIT are configurable (blocks 1...20), whereby any combination is possible. In the functions, any data can be used.

18.1 L1READ

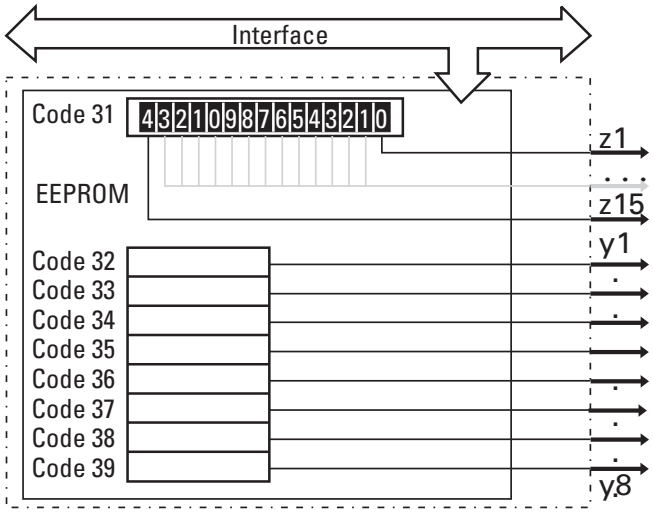
(read level1 data - no. 100)



Any 7 analog process values (x1...x7) and any 12 digital status informations (d1...d12) of the engineering are composed into a data set for the digital interface. With code 00, function number 0, the digital interface can read the data set as overall block or the individual values with codes 01...09, function number 0.

18.2 L1WRIT

(write level1 data - no. 101)



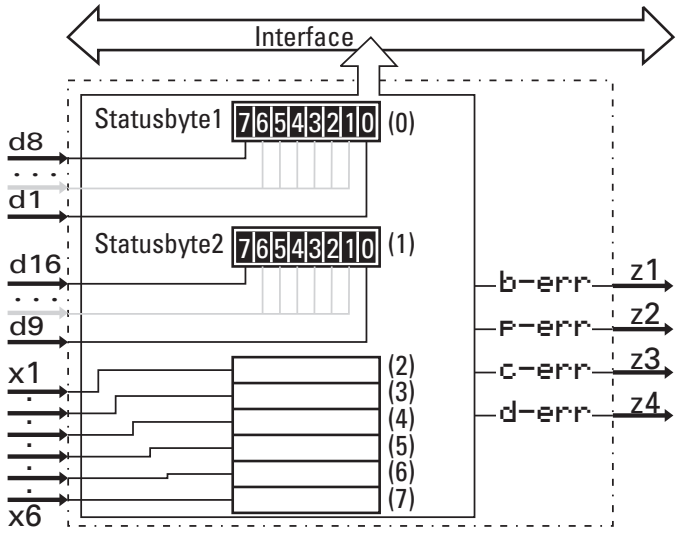
With codes 31...39, function number 0, the digital interface writes into EEPROM cells. The data set comprises 8 analog process values (y1...y8) and 15 digital status informations (z1...z15), which are thereby made available to the engineering.

PROFIBUS **INTERBUS**

Max. 4 functions DPREAD and 4 functions DPWRIT are configurable (blocks 1...4 or 11...14), whereby any combination is possible. In the functions, any data can be used.

18.3 DPREAD

(read level1 data via PROFIBUS / INTERBUS - no. 102)



Block numbers 1...4. Any 6 analog process values (x1...x6) and any 16 digital process values (d1...d16) of the engineering are grouped for reading via a PROFIBUS/INTERBUS data channel. Block number 1 provides the data for channel 1 etc. The PROFIBUS/ INTERBUS module reads the data of two channels at intervals of 100 ms. z1...z4 indicate the PROFIBUS/INTERBUS status.

z1 = bus access not successful

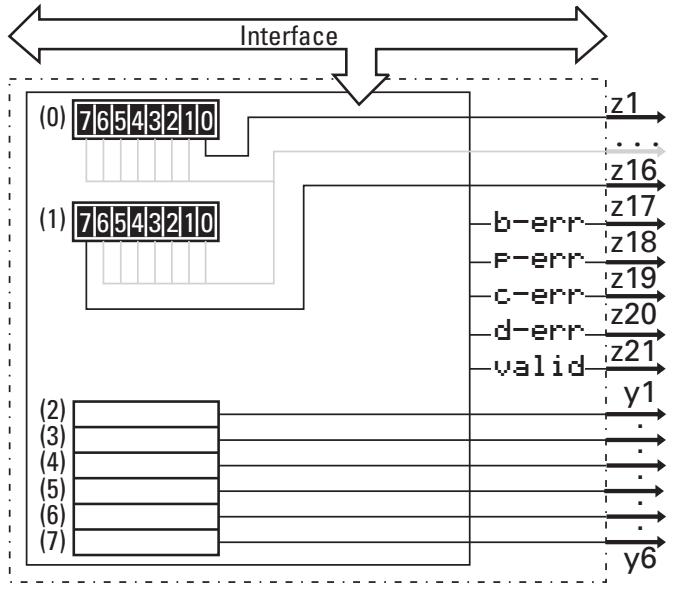
z2 = faulty parameter setting

z3 = faulty configuration

z4 = no data communication

18.4 DPWRIT

(write level1 data via PROFIBUS / INTERBUS - no. 103)



Block numbers 11...14. The data of a PROFIBUS/INTERBUS data channel are transmitted into the memory. Block number 11 transmits the data of channel 1 etc. The PROFIBUS/INTERBUS module writes the data of two channels at intervals of 100 ms. The data set comprises 6 analog process values (y1...y6) and 16 digital status informations (z1...z16), which are available to the engineering. z17...z21 indicate the PROFIBUS/INTERBUS status.

z17 = bus access not successful

z18 = faulty parameter setting

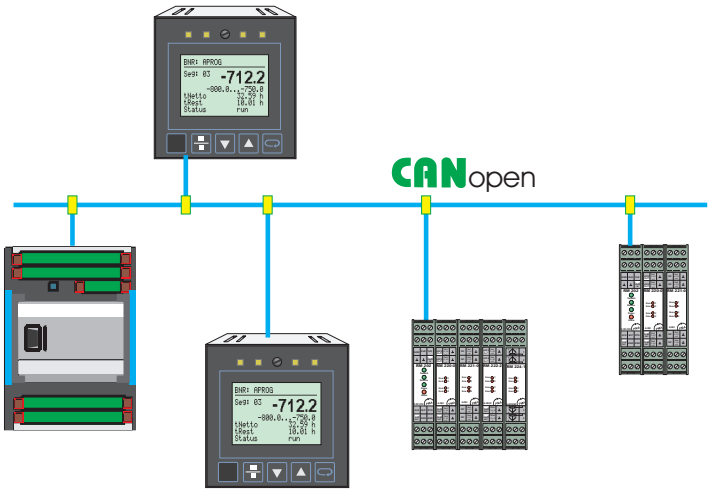
z19 = faulty configuration

z20 = no data communication

z21 = data OK

19 KS98+ I/O extension

with CANopen interface

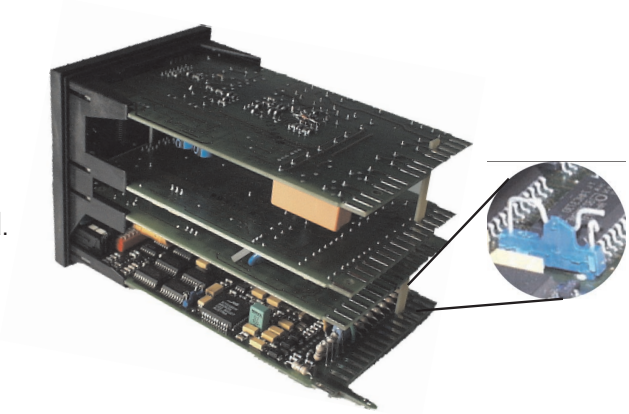


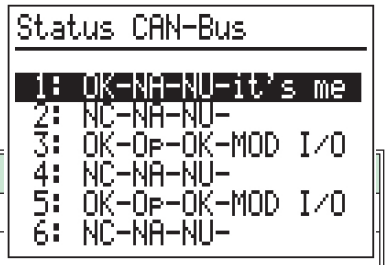
The additional CANopen interface extends the multi-function unit functionality already in the basic version by

- Extension of the number of local I/O by means of the modular PMA RM 200 I/O system
- connection of PMA multi-temperature controllers KS800 / KS 816 with CANopen interface
- on-site data exchange with other KS98+ units (cross crommunication)

⚠ These functions are available only in KS98+ versions from operating version 5.

BUS terminating resistor
Both ends (first and last unit) of the CANopen bus must be fitted with a bus terminating resistor. For this purpose, the bus terminating resistor provided in each KS98+ can be used. With the S.I.L. switch closed, the terminating resistor is connected. By default , the S.I.L. switch is open (see opposite).



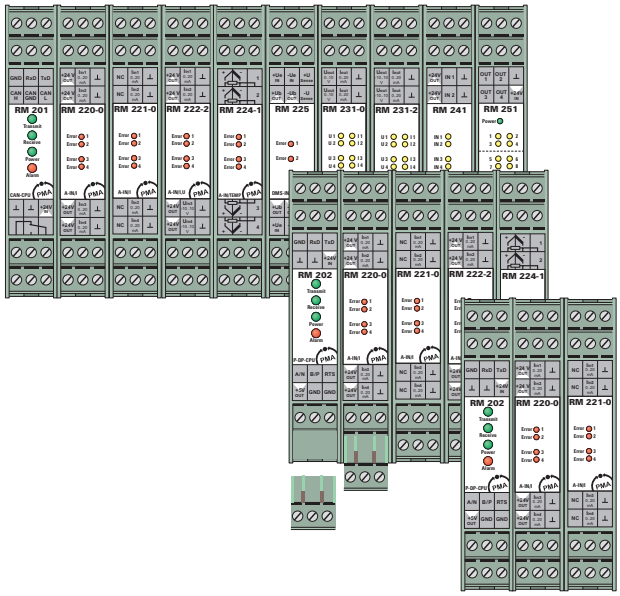


Status display : CAN bus status

Character	Value	Signification
1, 2	1...42	Node number
3, 4	:	Separator
5, 6	NC	NoCheck: Node existence so far unchecked / node not provided.
	Ck	Check: Check for node existence is busy.
	NR	NoResponse: No response from this node. However, node is required.
	OK	Ready: Node has responded and was identified.
	ES	EmStart: Node has output an emergency message.
7, 10, 13	–	Separator
8, 9	NA	NotAvailable: Node status is unknown.
	PO	PreOperation: Node is in status PreOperational.
	Er	Error: Node is in error condition.
	Op	Operational: Node is in operational condition.
11, 12	NU	NotUsed: Node is not required by an own lib function.
	Wa	Waiting: Lib function waits for identification of this node
	Pa	Parameter setting: Lib function is busy setting the node parameters
	OK	Ready: Lib function has finished parameter setting
14...21	String	Determined node name

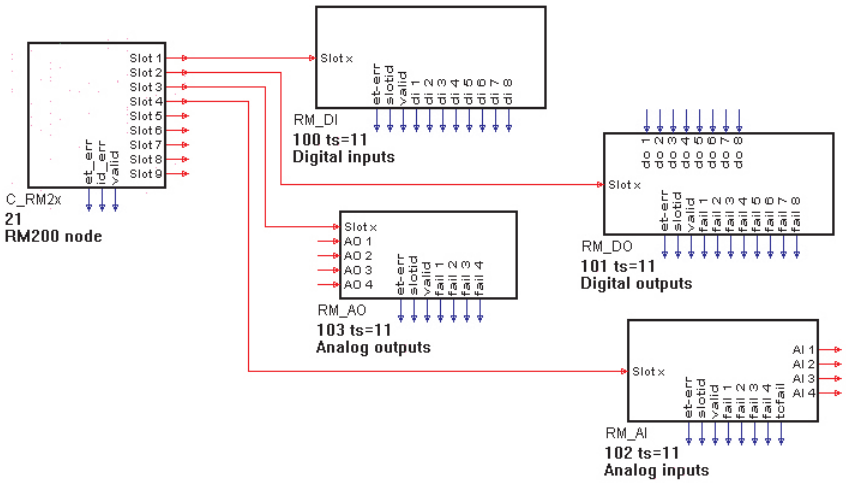
19.1 RM 211, RM212 and RM213 basic modules

An RM 200 system comprises a basic module (housing) for mounting on a snap-on rail with 3, 5 or 10 sockets.
The left socket is generally reserved for bus coupler module CANopen RM 201. Dependent of requirements, I/O modules or dummies are fitted in the other sockets. The modules click into the basic module and can be released for replacement by means of simple tools.



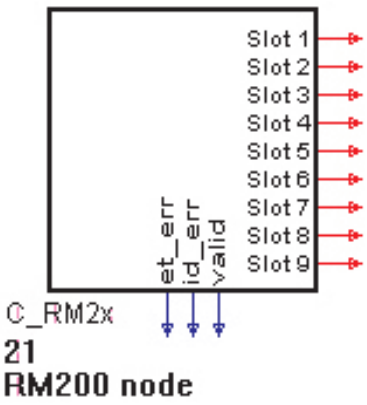
The plug-in cards must not be plugged in or withdrawn with the supply voltage switched on.

Partial engineering for communication with a RM200 node.



19.2 C_RM2x

(CANopen field bus coupler RM 201 - no. 14)



Coupler module RM201 contains the interface to the CAN bus and is plugged into the first socket. The other sockets are provided for various I/O modules, which are read cyclically via an internal bus.

Parameter	Description	Values	Default
NodeId	RM201 node address	2...42	32

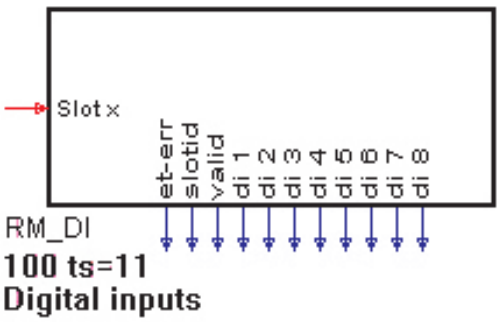
Unlike other KS98 functions, only one data function may be wired at the analog outputs.

Prerequisite for communication between KS98+ multifunction unit and CANopen field bus coupler RM 201 is a matching setting of CANparameters (→ see ET98 → Device → CANparameters).

Outputs:

Slot1...Slot9	Connection of RM modules	RM_DI, RM_DO, RM_AI and RM_AO
et-err	0 = no engineering error	1 = engineering error (change parameter NodeId)
id-err	0 = correct participant Id	1 = faulty participant Id
valid	0 = invalid data	1 = data are valid

19.3 RM_DI
(RM 200 - digital input module - no. 15)



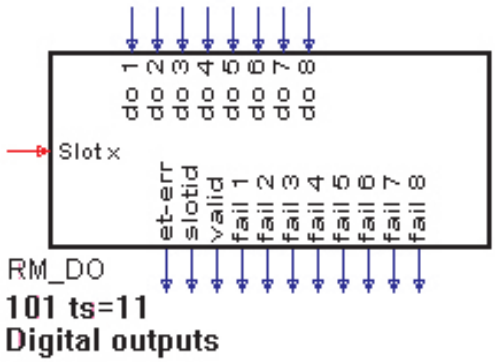
Function RM_DI handles the data of connected digital input modules.

Configuration	Description	Values
MTyP	Module type	0: RM 241 = 4 x 24 VDC 1: RM 242 = 8 x 24 VDC 2: RM 243 = 4 x 230 VAC
Inv 1 ... Inv 8	Direct or inverse output of input signal 1? ... Direct or inverse output of input signal 8?	direct / inverse

Inputs and outputs:

Slot x	Connection of one of the slot outputs of the RM 200 node (C_RM2x)
di 1...di 8	1st to 8th digital input signal
et-err	0 = no engineering error 1 = engineering error (several RM module functions in a slot)
slotid	0 = correct slot allocation 1 = faulty slot allocation (faulty RM module fitted)
valid	0 = no data 1 = data can be received

19.4 RM_DO
(RM 200 - digital output module - no. 16)



Function RM_DO handles the data of connected digital output modules.

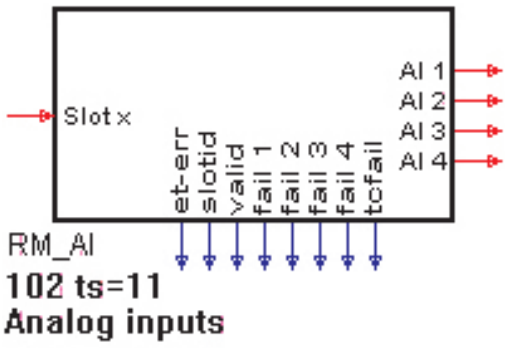
Configuration	Description	Values
MTyP	Module type	0: RM 251 = 8 x 24 VDC, 0,5A 1: RM 252 = 4 x relay (230 VDC) 2A
Inv 1 ... Inv 8	Direct or inverse output of output signal 1? ... Direct or inverse output of output signal 8?	direct / inverse
FStat1 ... FStat8	Output last signal or Fstat in case of communication failure	no / FStat
FStat1 ... FStat8	Output 1 status in case of errror ... Output 8 status in case of error	0/1 ... 0/1

Inputs and outputs:

Slot x	Connection of one of the slot outputs of the RM 200 node (C_RM2x)
do 1...do 8	Set-points for digital outputs 1 to 8
fail 1...fail 8	Output 1...output 8 with failure
et-err	0 = no engineering error 1 = engineering error (several RM module functions in a slot)
slotid	0 = correct slot allocation 1 = faulty slot allocation (faulty RM module fitted)
valid	0 = no data 1 = data could be received

19.5 RM_AI

(RM 200 - analog input module - no. 17)



Inputs and outputs:

Slot x
Connection of one of the slot outputs of the RM 200 node (C_RM2x)

AI 1...AI 4
1st to 4th input signal

et-err
0 = no engineering error
1 = enginee-ring error (several RM module functions in a slot)

slotid
0 = correct slot allocation
1 = faulty slot allocation (faulty RM module fitted)

valid
0 = no data
1 = data could be received

fail 1...fail 4
Measurement error at channel 1 … 4 (e.g. sensor break)

tcfail
Temperature compensation error

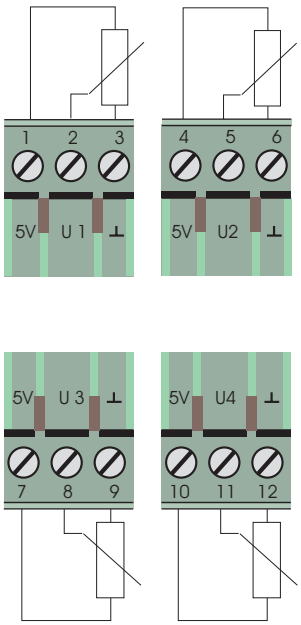
Function **RM_AI** handles the data of connected analog input modules.

Configuration	Description	Values
MTyp	Modultyp	0: RM 221-0 = 4x 0/4...20 mA 1: RM 221-1 = 4x -10/0...10 V 2: RM 221-2 = 2x 0/4...20 mA + 2x -10/0...10 V 3: RM 222-0 = 4x 0/4...20 mA, TPS 4: RM 222-1 = 4x -10/0...10 V, potentiometer, TPS 5: RM 222-2 = 2x 0/4...20 mA + 2x -10/0...10 V, potentiometer, TPS 6: RM224-1 = thermocouple / Pt100 7: RM224-0 = 2 x TC, 16 bits 8: RM224-2 = 1 x -3...3V, 1x TC, 16 bits
STyp 1 ... STyp 4	Input signal	1: type J = -120...1200°C 2: type K = -130...1370°C 3: type L = -120 ... 900°C 4: type E = -130...1000°C 5: type T = -130 ... 400°C 6: type S = 12...1760°C 7: type R = 13...1760°C 8: type B = 50...1820°C 9: type N = -109...1300°C 10: type W = 50...2300°C 30: Pt100 = -200 … 850°C 40: standard signal = 0...10V 41: standard signal = -10...10V 50: standard signal = 4...20mA 51: standard signal = 0...20mA
Unit 1 ... Unit 4	Temperature unit input 1 to 4 (only relevant with thermocouple and Pt100 inputs)	0 : unit = °C 1 : unit = °F 2 : unit = K
Tf 1 ... Tf 4	Filter time constant input 1 … 4 in (s)	0 ... 200 000
x0 1 ... x0 4	Scaling start value input 1 … input 4	-29 999 ... 200 000
x100 1 ... x100 4	Scaling end value input 1 ... input 4	-29 999 ... 200 000

Scaling

19.6 Potentiometer connection and adjustment

only RM222-1



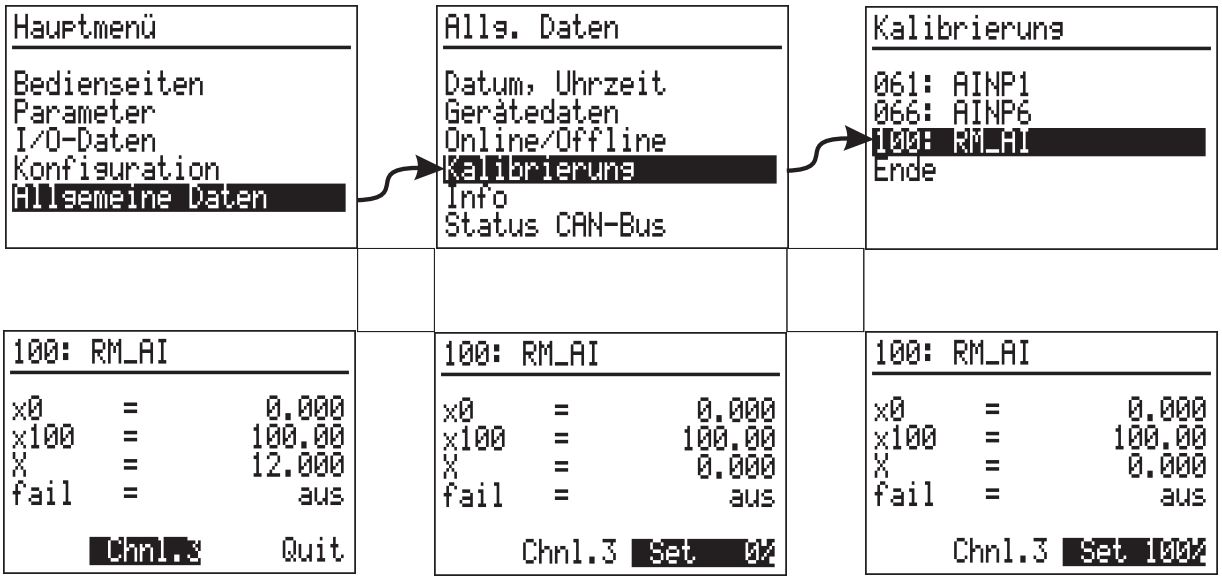
RM222-1
RM222-2

Connection:
Modules RM 222-1 and RM222-2 are also suitable for connection of potentiometers.
Max. two potentiometers can be connected to module RM222-2 and max. four potentiometers can be connected to module RM 222-1.
For potentiometer measurement, a voltage divider circuit is used. The channels designed for voltage can be changed for potentiometer measurement pairwisely (by means of jumpers on the module circuit board)

Uconst: Us = 5V DC (output instead of +24V OUT);
Short circuit proof current limiting: 20mA
Max. load: 4mA/channel; Σ I $\leq$ 20mA (can be distributed to the 4 module channels.
The min. resistance values must be
4 x 1000 Ω , 2 x 500 Ω or 1 x 250 Ω

Calibration:

In order to calibrate the potentiometer inputs, call up menu item Calibration.
For this, leave the operating menu, call up
Main menu → Miscellaneous,
select Calibration, and call up the module you wish to calibrate.



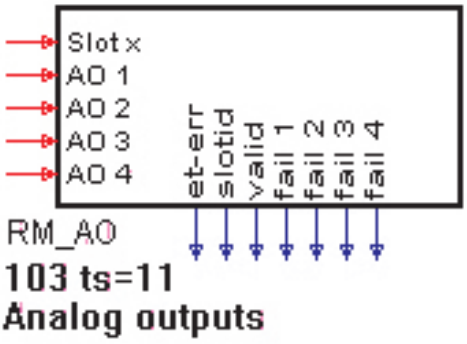
Start by selecting the channel you wish to calibrate.
Press key ▲ to select the channel number (**chnl.1**) and change it after acknowledgement via key ⏎

Subsequently, press **Quit** and change over to **Set 0%** . Press key ⏎. **Set 0%** starts flashing.
Bring the resistance value into the position for X0. The value valid for this channel appears on display **X.** Press key ⏎ again to store this value as **X0.**

Actuate **Set 0%** and change over to **Set 100%.** Press key ⏎. **Set 100%** starts flashing.
Now, bring the resistance value into the position for X100. The value valid for this channel appears on display **X.**
Press key ⏎ again to store this actual value as X100.

19.7 RM_AO

(RM 200 - analog output module - no. 18)



Function RM_AO handles the data of connected analog output modules.

Configuration	Description	Values
MTyP	Modultype	0: RM 231-0 = 4x 0/4...20 mA / 4x 0...10 V 1: RM 231-1 = 4x 0/4...20 mA / 2x 0...10 V / 2x -10...10V 2: RM 231-2 = 4x 0/4...20 mA / 4x -10...10V
OTyP 1 ... OTyP 4	Output signal	10: standard signal= 0...10V 11: standard signal= -10...10V 20: standard signal= 0...20mA 21: standard signal= 4...20mA
x0 1 ... x0 4	Scaling 0% input 1 … input 4	-29 999 ...200 000
x100 1 ... x100 4	Scaling 100% input 1 ... input 4	-29 999 ...200 000

Inputs and outputs:

Slot x

Connection of one of the slot outputs of the RM 200 node (C_RM2x)

AO 1...AO 4

1st to 4th analog output signal

et-err

0 = no engineering error

1 = enginee-ring error
(several RM module functions in one slot)

slotid

0 = correct slot allocation

1 = faulty slot allocation
(faulty RM module fitted)

valid

0 = no data

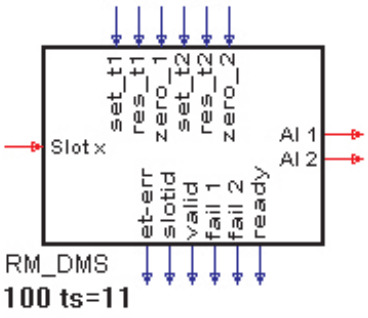
1 = data could be received

fail 1...fail 4

Error channel 1 … 4

19.8 RM_DMS

strain gauge module



Function RM_DMS reads data from a special strain gauge module of KS98+ I/O extension with CANopen. Max. 2 strain gauges can be connected to the module. The measured values are available at outputs AI 1 and AI 2.
The two measurements can be influenced via digital command inputs, e.g. zero setting. Monitoring a new command (positive flank at one of the digital inputs) is restarted only when the "ready" output is "1". The module position in the RM rack is determined by connection of analog input Slotx to the RM2xx node.

Important hint:
A special coupler module (RM201-1) must be used for operation of the strain gauge module. This coupler module cannot be combined with thermocouple modules. Moreover, the limitations as for coupler module RM201 (e.g. max. 4 analog input modules) are applicable.

Digital inputs:

- ❑ set_t1 Set tare strain gauge channel 1. The actual weight is not stored continuously as tare (packaging weight). The following measurements provide the net weight.
- ❑ res_t1 Reset tare strain gauge channel 1. The tare value is set to 0. Gross weight= net weight.
- ❑ zero_1 Zero setting of strain gauge channel 1 measured value. The actual measured value is stored as a zero value in a non-volatile memory.
- ❑ set_t2 Set tare strain gauge channel 2. The actual weight is buffered as tare (packaging weight). The following measurements provide net weight.
- ❑ res_t2 Reset tare strain gauge channel 2. The tare value is set to 0. Gross weight=net weight.
- ❑ zero_2 Zero setting of the strain gauge channel 2 measured value. The actual measured value is stored as zero in the non-volatile memory.

Digital outputs:

- ❑ et-err 0 = no engineering error 1 = engineering error (several module blocks at a slot output). slotx not connected.
- ❑ slotId 0 = correct slot allocation 1 = faulty slot allocation (module type). faulty coupler module
- ❑ valid 0 = no data 1 = data could not be received fail 1 faulty connection or measurement error on channel 1 fail 2 faulty connection or measurement error on channel 2 ready ready message after command handling

Analog inputs:

- ❑ connection of one of the slot outputs of the RM201-1-node block

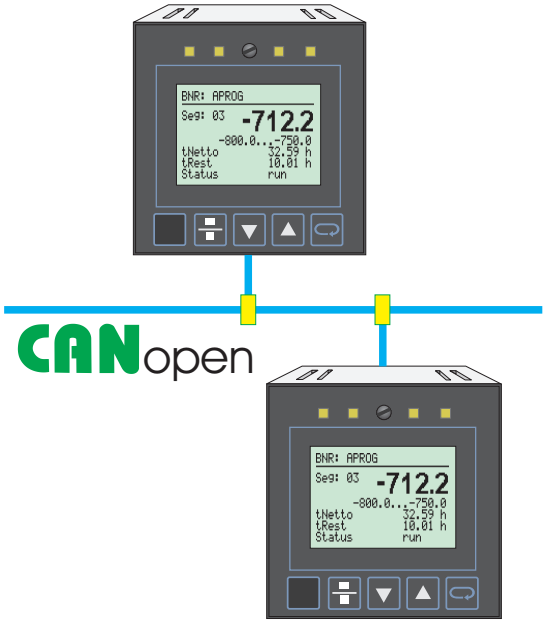
Analog outputs:

- ❑ AI 1st measured value of strain gauge channel 1
- ❑ AI 2nd measured value of strain gauge channel 2

Parameters:

MTyp 1/2	module type 0: RM225 = strain gauge
STyp 1/2	0: -4 +4mV/V
Unit 1/2	mV/V
Tf 1/2	filter time constant input 1 ... 2 in (s) 0 ... 999 999 (0,5)
x0 1/2	scaling start value input 1 ... 2 -29 999 ... 999 999 (0)
x100 1/2	scaling end value input 1 ... 2 -29 999 ... 999 999 (100)
Fail 1/2	signal action in case of sensor error 0:upscale 1:downscale
X1in 1/2	measured value correction input value segment point 1 > input 1...2 -29 999 ... 999 999 (0)
X1out 1/2	measured value correction output value segment point 1 > input 1...2 -29 999 ... 999 999 (0)
X2in 1/2	measured value correction input value segment point 2 > input 1...2 -29 999 ... 999 999 (100)
X2out 1/2	measured value correction output value

20 Cross communication KS 98plus - KS98plus



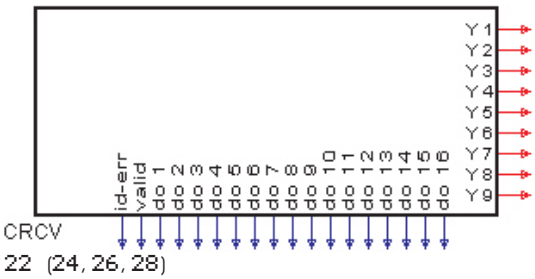
Whilst data exchange between KS 98+ and RM200, KS800 or KS816 must be carried out exclusively via KS98+ as a master, "cross communication" is possible directly. Data exchange between several KS 98+ of a CAN network is via send blocks (CSEND; block numbers 21, 23, 25, 27) and receive blocks (CRCV; block numbers 22, 24, 26, 28).

In each send/receive block, max. 9 analog values and 16 digital statuses from the relevant engineering can be transmitted. The sender sends the data together with his node address and block number. The receiver checks, if the adjusted send address of the messages is correct, and if the block number of the sender is by "1" lower than the own one.

For BUS terminating resistor, see: 36

20.1 CRCV

(receive block numbers 22, 24, 26, 28 - no. 56)



The CRCV function can receive data from another KS98+. The data of the other multifunction unit are made available with the CSEND function. The CSEND block number is by 1 smaller than the CRCV block number.

CRCV no. 22 reads the data of another KS98+ from CSEND no. 21

CRCV no. 24 reads the data of another KS98+ from CSEND no. 23

CRCV no. 26 reads the data of another KS98+ from CSEND no. 25

CRCV no. 28 reads the data of another KS98+ from CSEND no. 27

Configuration	Description	Values
NodeId	Node address of sending KS98+ (The sending KS98plus is adjusted accordingly in window "CANparameters" in the engineering tool, or in the device parameter via the front panel (during off-line mode)	1...24

Outputs:

Y 1 to **Y 9** analog output values 1 to 9

Id-err

0 = correct bus participant Id

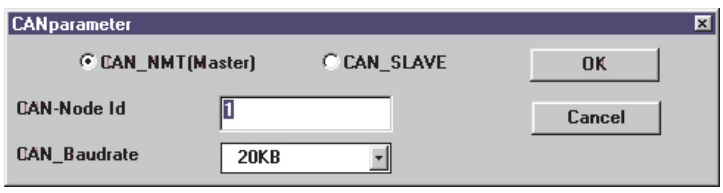
1 = faulty bus participant Id

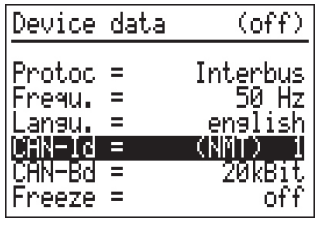
valid

0 = no data

1 = data could be received

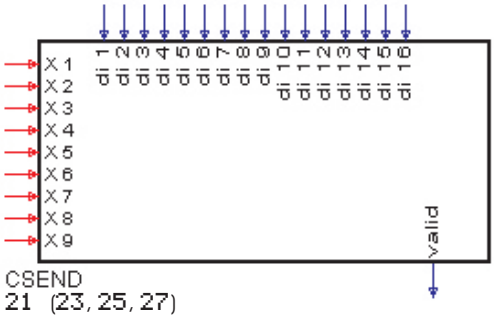
do 1 ... **do 16** = status values 1 to 16





20.2 CSEND

(send block numbers 21, 23, 25, 27 - no. 57)



Function CSEND makes the data for other KS98+ available on the CANopen bus. The data can be read using the CRCV function by the other multifunction units.

Configuration	Description	Values
delta	Change from which a new send operation is started.	0.000...200 000

Inputs and outputs:

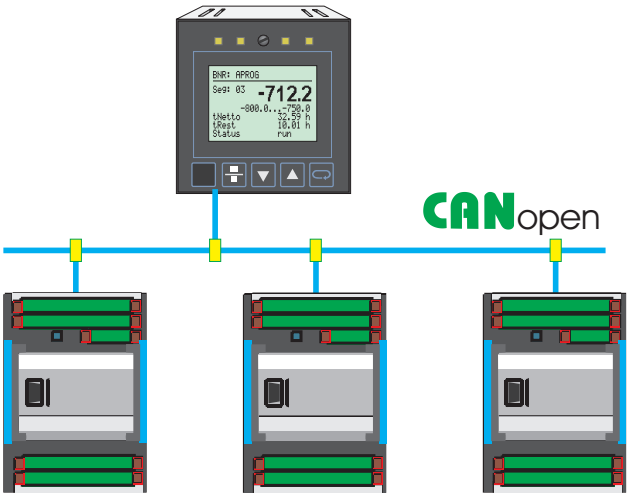
X1...X9
analog values 1 to 9, which are sent.

di 1...di 16
digital values 1 to 16, which are sent.

valid
0 = invalid data (e.g. no KS98+ but only KS98)
1 = data could be received

⚠ Transmission is at intervals of 200ms. Therefore, note that values which are applied only during 100 ms are lost.

21 KS 800 and KS 816 connection

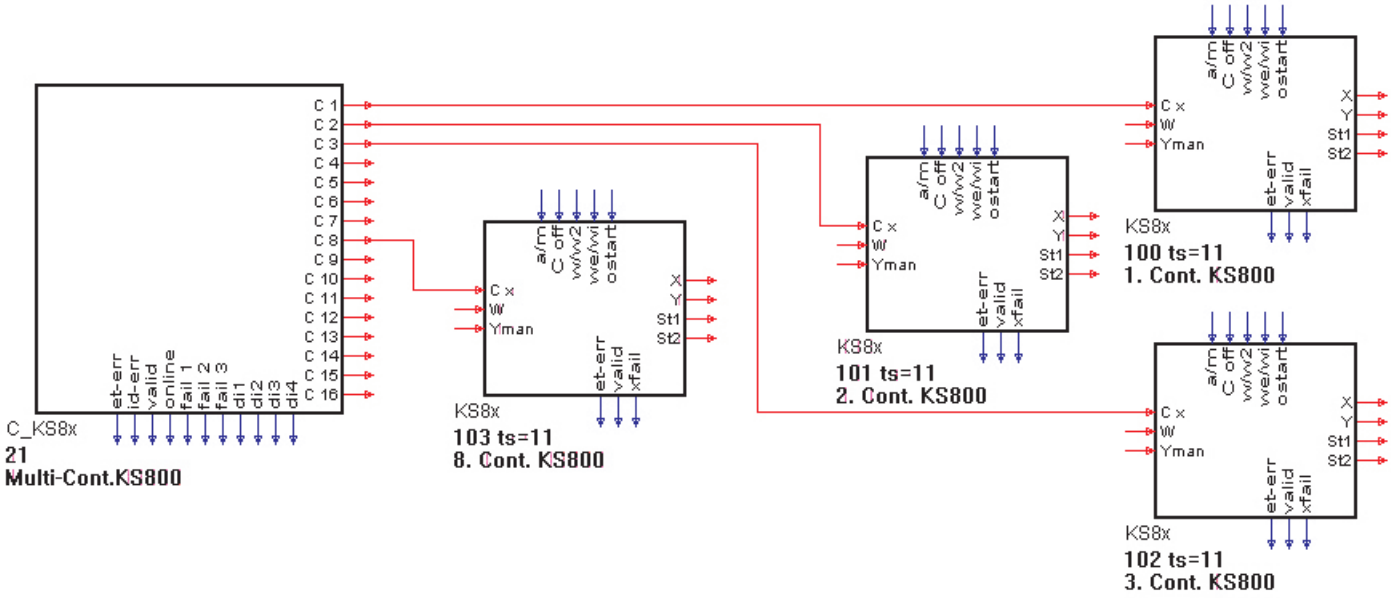


Function blocks C_KS8x and KS8x can be used for communication between multifunction unitKS98+ and multi-temperature controllers KS 800 and KS 816.

Each KS 800 or KS 816 is allocated a node function C_KS8x. The KS8x functions are allocated to the individual controllers of KS 800 (max. 8 controllers) or KS 816 (up to 16 controllers).

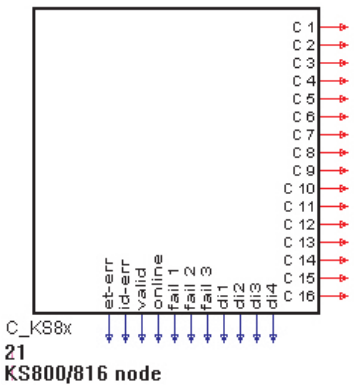
For BUS terminating resistors, see page: 36

Partial engineering for communication with the multi-temperature controllers KS800 and KS816



21.1 C_KS8x

KS800 and KS 816 nodefunction - no. 58



Node function C_KS8x represents the interface to one of the multi-temperature controllers KS 800 or KS 816. Analog outputs C1 ... C16 can be used for connecting the KS8x functions which represent a controller of KS 800 (max. 8) or KS 816 (max. 16).

Parameter	Description	Values	Default
NodeId	Node address of KS800/KS816	2...42	2

Unlike the other KS98 functions, only one data function may be wired at each analog output.

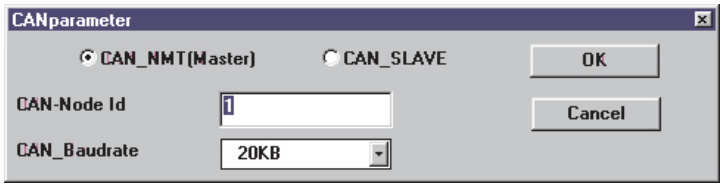
Prerequisite for a communication between the KS98+ multifunction unit and KS800 or KS816 is an identical setting of CANparameters (→ see *1)).

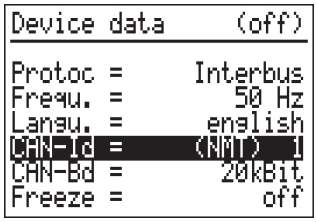
Outputs:

C1...C16	Connection of KS8x functions (individual controller in KS800 / KS816)	
et-err	0 = no engineering error	1 = engineering error (other node functions at equal KS800)
id-err	0 = correct bus participant Id	1 = faulty bus participant Id (no KS800/KS816 with the configured node Id available)
valid	0 = no data	1 = data were received
online	0 = KS800/816 is offline	1 = KS800/816 is online
fail 1	0 = no fail at do1...do12	1 = fail at do1...do12
fail 2	0 = no fail at do13...do16	1 = fail at do13...do16
fail 3	0 = no heating current short circuit	1 = heating current short circuit
di1	0 = di1 = 0	1 = di1 = 1
di2	0 = di2 = 0	1 = di2 = 1
di3	0 = di3 = 0	1 = di3 = 1
di4	0 = di4 = 0	1 = di4 = 1

The data of the individual controllers are read cyclically.
All data are refreshed at the latest at intervals of 1,6 seconds (KS800) or of 3,2 seconds (KS816).

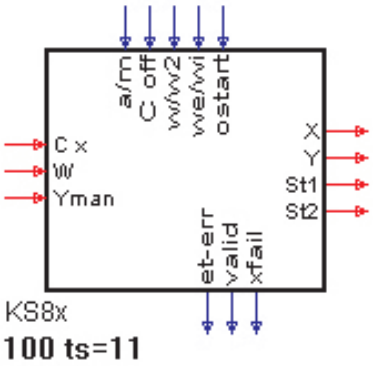
*1) The parameters for the CANopen bus are adjusted in window "CANparameters" in the engineering tool, or in the instrument parameters viat the front panel. ET98 → Device → CANparameters.





21.2 KS8x

(KS 800 and KS 816 controller function - no. 59)



The KS8x functions each handle a controller from KS 800 or KS 816. The analog or digital inputs can be used for sending the signals for control to the controller in KS800/16.

The analog outputs provide the process and controller values.

Inputs and outputs:

Cx	connection to one of the C1...C16 outputs of node function C_KS8x	
W	controller set-point	
Yman	correcting variable in manual mode	
a/m	0 = controller is in automatic mode	1 = controller is in manual mode
C off	0 = controller is switched on	1 = controller is switched off
W/w2	0 = internal set-point is active	1 = 2nd set-point is active (safety set-point)
we/wi	0 = external set-point is active	1 = internal set-point is active
Ostart	0 = do not start self-tuning	1 = start self-tuning
X	controller process value	
Y	controller correcting variable	

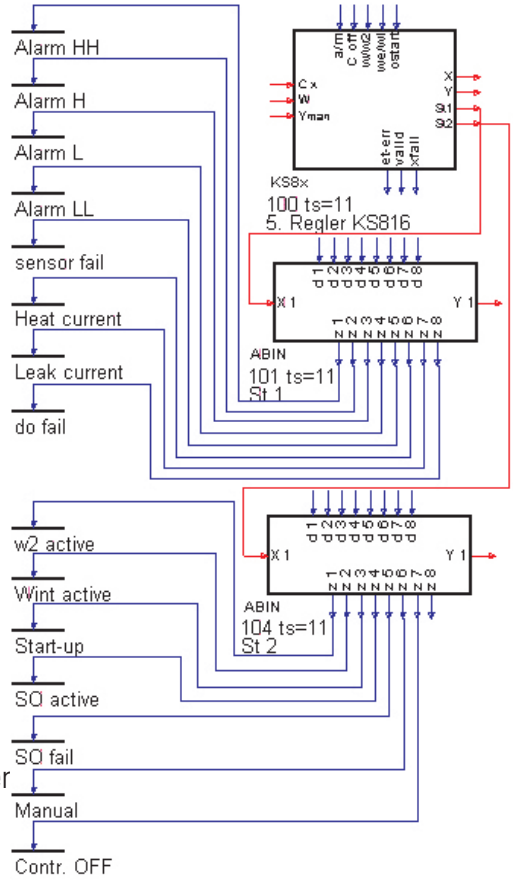
St1 Status byte 1

Bit	Value	Description
0	1	alarmHH
1	2	alarmH
2	4	alarmL
3	8	alarmLL
4	16	sensor fail alarm
5	32	heating current alarm
6	64	leakage current alarm
7	128	alarm DOx

St2 Status byte 2

Bit	Value	Description
0	1	W2 active
1	2	Wint active
2	4	Wstart active
3	8	self-tuning active
4	16	self-tuning error
5	32	controller A / M
6	64	controller switched off
7	128	- - - -

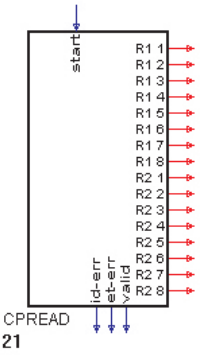
et-err	0 = no engineering error	1 = engineering error (sever channel)
valid	0 = no data	1 = data were received
xfail	0 = no sensor fail	1 = sensor fail



22 Description of KS98 CAN bus extension

22.1 CPREAD

(CAN-PDO read function)



Function CPREAD is used for read access to instrument PDOs. Due to the normal quantity of min. 2 PDOs per instrument, the data quantity of 2 PDOs with 2 COB-IDs was grouped in one block.
Node address and COB-ID (CAN-OBject IDentifier) parameter setting is in the block. Moreover, node guarding for monitoring the CAN communication to the specified node can be switched on.
Data provided by the instrument must be interpreted according to the instrument specification. Groups of 4 transmitted bytes can be converted into different data types. For this purpose, a conversion function for converting and inverting 1 to 4 bytes into a parameterizable data type (see function AOCTET) is available.
Examples: R1+R2 > Int16 / R1+R2+R3+R4 >Long

Important note: The heart beat protocol is not supported. If an instrument can be operated only via “heart beat”, the guarding function must be switched off.

Digital inputs:

`start` The function is active with the input not connected, or if start=1 is connected.

Digital outputs:

`et-err`
0 = no engineering error
1 = no CAN-HW (KS98 type)
multiple node monitoring

`id-err`
0 = correct node id
1 = faulty node id or instrument does not reply
specify own node ID as “NodeId”
no free receive PDOs (RPDO)

`valid` Bit follows node status with the node guarding active
(0=”preoperational”, 1=”operational”)
always 1 with node guarding switched off

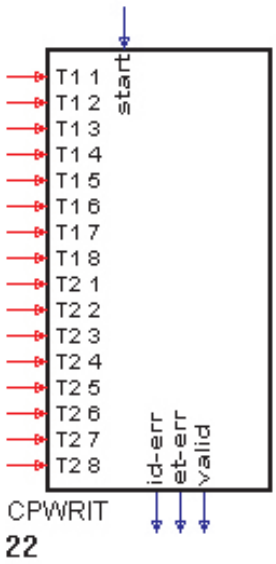
Analog outputs:

`R1 1 ...R1 8` 1st to 8th analog input value in byte format (8-bit) for COB-ID 1
`R2 1 ...R2 8` 1st to 8th analog input value in byte format (8-bit) for COB-ID 2

Configuration parameters (can be changed only during OFFLINE):

NodeId	CAN node address
Guard	node guarding off/on
COBID1	decimal ID of the first CAN object identifier
COBID2	decimal ID of the second CAN object identifier

22.2 CPWRIT
(CAN-PDO write function)



Function CPWRITE is used for write access to instrument PDOs. Because of the normal quantity of min. 2 PDOs per instruments, the data quantity of 2 PDOs with 2 COB-IDs was grouped in a block.
Node address and COB-ID (CAN-OBject IDentifier) parameter setting is in the block. Moreover, node guarding for monitoring the CAN communication to the specified node can be switched on.
Data sent to the instrument must be interpreted according to instrument specification. Groups of 4 transmitted bytes represent different data types.
To provide the bytes according to the required data type, a conversion function for transforming the value in the engineering into 1 to 4 bytes is available (see function AOCTET).

Examples: R1+R2 > Int16 / R1+R2+R3+R4 >Long

Important note: The heart beat protocol is not supported. If an instrument can be operated only via “heart beat”, the guarding function must be switched off.

Digital inputs:

`start` The function is active, unless the input is connected, or if start=1 is connected.

Digital outputs:

`et-err`	0 =	no engineering error
	1 =	no CAN-HW (KS98 type) multiple node monitoring
`id-err`	0 =	correct node id
	1 =	faulty node id or the instrument does not reply own node ID was specified as “NodeId” no free send PDOs (TPDO)
`valid`		bit follows the node status with the node guarding active (0=”preoperational”, 1=”operational”) always 1 with the node guarding switched off

Analog outputs:

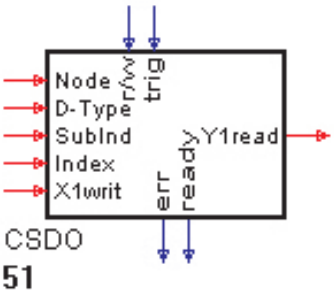
`T1 1 ...T1 8`	1st to 8th output value in byte format (8-bit) for COB-ID 1
`T2 1 ...T2 8`	1st to 8th analog output value in byte format (8-bit) for COB-ID 2

Configuration parameters (can be changed only during OFFLINE):

NodeId	CAN node address
Guard	node guarding off/on
COBID1	decimal ID of the first CAN object identifier
COBID2	decimal ID of the second CAN object identifier

22.3 CSDO

CAN-SDO function



Function CSDO permits access to the CAN bus by means of SDOs (Service Data Objects). SDOs are used for asynchronous data exchange without real-time inquiry. Transmission started by the trigger input is always confirmed by the receiver, possibly during data inquiry along with value transmission. Reception of the confirmation is indicated by a logic 1 at the "ready" output. A new command can be generated via the positive flank at trig only with "1" indicated by the "ready" output.-

Data required for command generation can be adjusted as parameters or connected as values to the inputs. As soon as a connection at an input was made, the relevant parameter looses its function. In this case, the value applied to the input is valid. Data (command) addressing in the connected instrument is done via indexes (index / sub-index), which is described in the CAN instrument documentation.

A value to be transmitted is connected to X1writ (or parameter "value"). A received value is output at Y1read. Y1read is set to 0 after power-on, after an error ("err" = 1) and after a data output.

With RM modules provided in the KS98 engineering, and for addressing the same nodes also via a CSDO block , the trigger should be interlocked with the valid bit of the RM-200 block. During access to RM nodes which are handled already by KS98 in the background, there may be start-up collisions the consequences of which are removed only by restarting KS98.

⚠ Important note: The heart beat protocol is not supported. If an instrument can be operated only via "heart beat", the guarding function must be switched off.

Digital outputs:

`err` 0 = no error 1 = error detected.

Possible errors:

- Faulty KS98 hardware. KS98+ expected.
- The trigger input is not connected.
- No reply or faulty reply from the instrument.
- Instrument replies an inquiry with an error message.
- Min. one parameter or connected value is out of limits.

`ready` 0 = transmission is being handled. So far, no confirmation was received.
1 = transmission completed. Ready for the next command.

Analog outputs:

`T1 1` ...`T1 8` 1st to 8th analog output value in byte format (8-bit) for COB-ID 1
`T2 1` ...`T2 8` 1st to 8th analog output value in byte format (8-bit) for COB-ID 2

Parameters (can be changed during operation):

Access	access mode: 0 = read, 1 = write
NodeId	decimal CAN node address,1..42 (KS98+ forms the CAN Object Identifier according to CiA DS301, node ID + 600H)
D-Type	data type of the connected value, 0..6. The following data types are available 0: Uint8, 1: Int8, 2: Uint16, 3: Int16, 4: Uint32, 5: Int32, 6: Float
SubInd	address in object directory 1..255
Index	address in object directory 1..65535
Wert	data value –29999 ... 999999)

23 Programmer

Valid for DPROG and APROG:

With `P-show` = 1 and `program` in line `Status`, the direct parameter page can be indicated. It shows all times and set-points belonging to a program. The marked line scrolls up and down and the values can be adjusted.

A new `ProgNo` is effective only after reset. After an engineering download `Seg 0` is output (reset). If `run` is not connected, `stop` is used. When sending a faulty recipe number, `Error` is displayed.

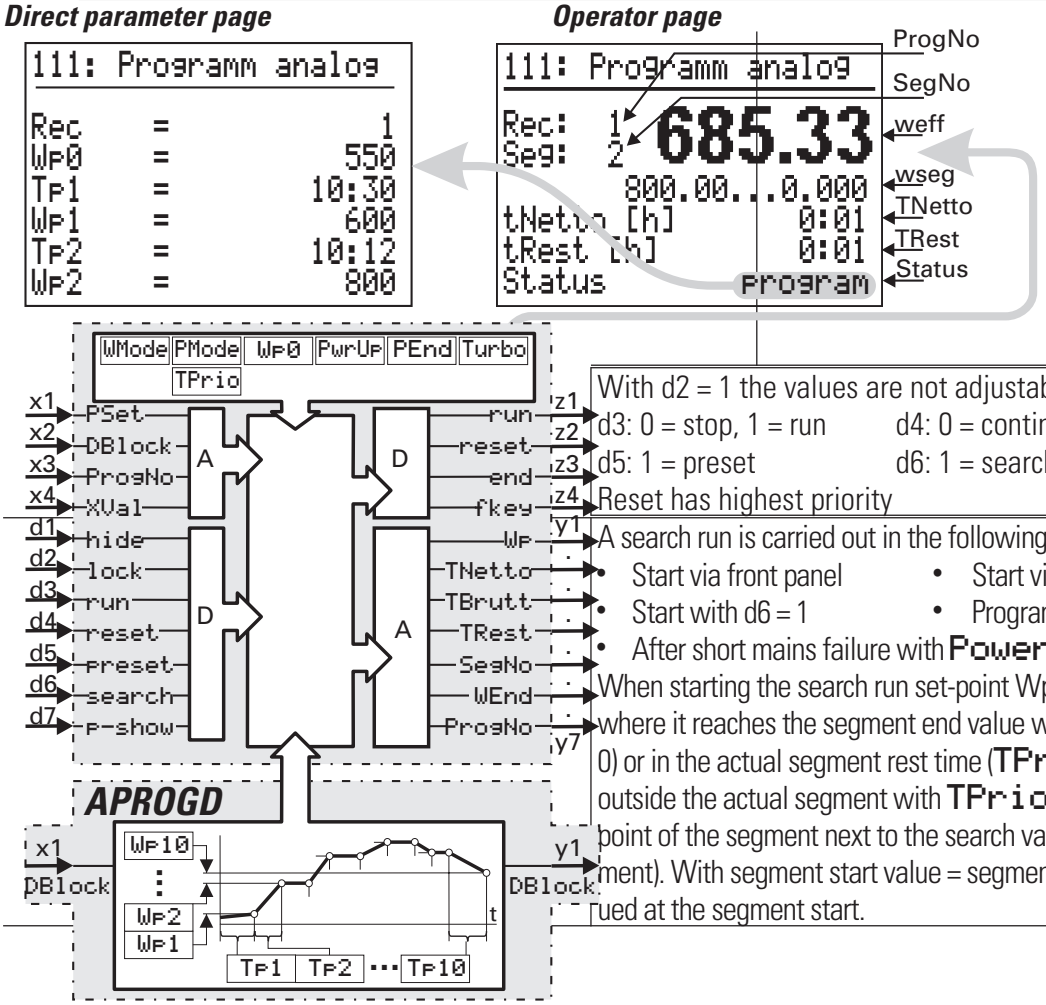
The analog inputs and outputs of DPROG and APROG are determined as follows:

`DBlock`	Input DPROG / APROG: block number of the first data function DPROGD / APROGD Input DPROGD / APROGD: block no. of the cascaded data function DPROGD / APROGD Output DPROGD / APROGD: separate block number
`ProgNo`	Input: required program number; Output: actual program number
`PSet`	Input; preset value for program
`SegNo`	Output; actual segment number
`TBrutt`	Output; program time gross (Σ T*run* + Σ T*stop*)
`TNetto`	Output; program time net (Σ T*run*)
`TRest`	Output; rest time of programmer
`WEnd`	Output; final set-point of actual segment (only APROG)
`Wp`	Output; set-point of programmer (only APROG)
`XVal`	Input; value for search run (only APROG)

23.1 APROG

(analog programmer - no. 24) / APROGD (APROG data - no. 25)

Direct parameter page ***Operator page***



Data are contained in APROGD.
More than 10 segments:
cascade APROGD
several programs (recipes):
select APROGD via SELV2
d1 = 1: the operating page is not displayed. d7 = 1: the direct parameter page is indicated.

With d2 = 1 the values are not adjustable by means of keys ▲▼.
d3: 0 = stop, 1 = run d4: 0 = continue, 1 = reset
d5: 1 = preset d6: 1 = search run
Reset has highest priority

A search run is carried out in the following cases:
- Start via front panel
- Start via interface
- Start with d6 = 1
- Program start after **Reset**
- After short mains failure with **PowerUp** = 1 or 2

When starting the search run set-point Wp is set to the value of Xval, from where it reaches the segment end value with the actual gradient (**TPrio** = 0) or in the actual segment rest time (**TPrio** = 1). With the search value outside the actual segment with **TPrio** = 0, the program is continued at the point of the segment next to the search value (start / end of the actual segment). With segment start value = segment end value the program is continued at the segment start.

z1: 0 = program stop 1 = program running (Run)
z3: 1 = program end reached
z4: pressing key toggles z4 (0 or 1)

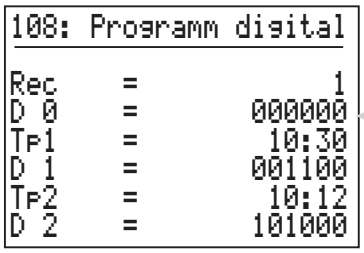
Dependent of **Turbo**, **Tp1**...**Tp10** for APROGD and DPROGD must be specified in minutes or seconds in the engineering tool.

Parameter	Description	Values	Default
WMode	Ramp function	0	0
	Step function	1	
PMode	Preset to segment	0	1
	Preset to time	1	
TPrio	Gradient priority	0	0
	Time priority	1	
Dp	Decimal points for setpoint	0..3	3
RecMax	Max. recipes	1..99	99
Wp0	Program setpoint after reset	W0..W100	W0
W0	Lower setpoint range	-29 999 ...999 999	-29 999
W100	Upper setpoint range	-29 999 ...999 999	999 999
Configuration	Description	Values	Default
PwrUp	Behaviour after mains recovery		
	Continue program	0	0
	Search run in actual segment	1	
	Continue at actual time	2	
PEnd	After program end: stop	0	0
	After program end: reset	1	
Turbo	Time = hours : minutes	0	0
	Time = minutes : seconds	1	

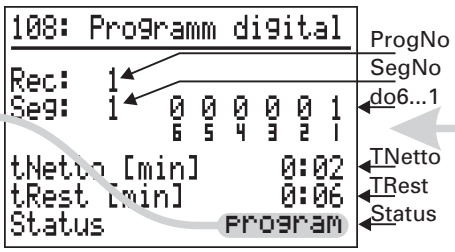
23.2 DPROG

(digital programmer - no. 27) / DPROGD (DPROG data - no. 28)

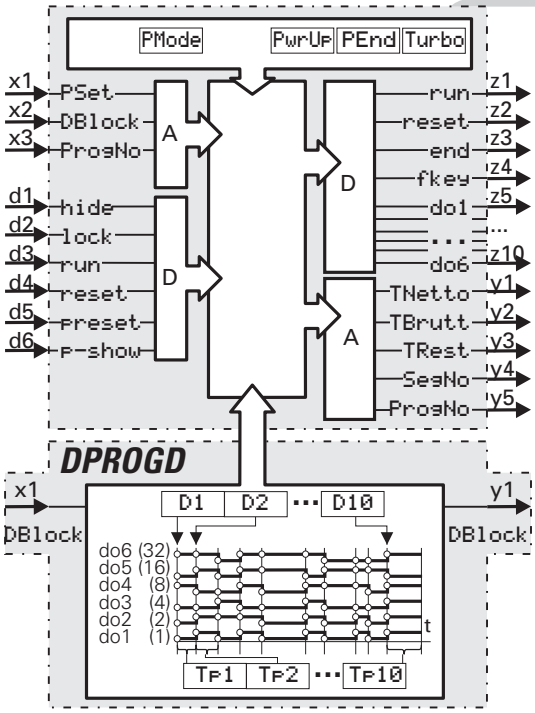
Direct parameter page



Operator page



Data are contained in DPROGD. More than 10 segments: DPROGD must be cascaded, several programs (recipes): select DPROGD via SELV2. d1 = 1: the operating page is not displayed. d6 = 1: the direct parameter page is displayed.



With d2 = 1 the values are not adjustable by means of keys ▲▼.
d3: 0 = Stop, 1= Run d4: 0 = Continue, 1 = Reset d5: 1 = Preset
Reset has highest priority

Parameter	Description	Values	Default
D0	Status of outputs 6...1 after reset	0 / 1	000000
RecMax	Max. recipes	1..99	99
PMode	Preset to segment	0	1
	Preset to time	1	

Configuration	Description	Values	Default
PwrUp	Behaviour after mains recovery		
	Continue program	0	0
	Continue at actual time	2	
PEnd	Stop after program end	0	0
	Reset after program end	1	
Turbo	Time = hours : minutes	0	0
	Time = minutes : seconds	1	

The digital outputs are as follows:
z1: 0 = program stop 1 = program running (Run)
z2: 1 = program reset
z3: 1 = program end reached
z4: pressing key toggles z4 (0 or 1)

D1 ...**D10** for DPROGD must be specified as integer numbers consisting of ones and zeros in the engin. tool.
Ex.: 001101 specified as 1101, 000011 specified as 11.

24 Controllers

The analog inputs and outputs are determined as follows:

OVC+	Input; override control +
OVC–	Input; override control -
ParNo	Only with CONTR+; input: required parameter set; output: effective parameter set
W	Output; internal set-point
Weff	Output; effective set-point
Wext	Input; external set-point
X	Output; effective process value
X1	Input; main variable x1
X2	Input; auxiliary variable x2
X3	Input; auxiliary variable x3
XW	Output; control deviation
Y	Output; effective correcting value
Yadd	Input; additional correcting variable
Yhm	Input; correcting value with hard manual
Yout1	Output; correcting value yout1
Yout2	Output; correcting value yout2
Yp	Input; position feedback

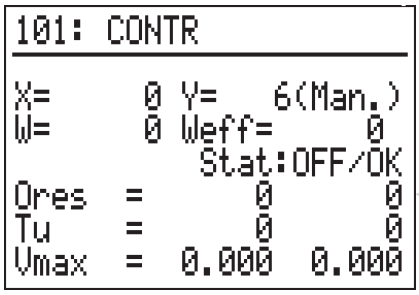
The digital inputs and outputs are determined as follows:

a/m	Input or output; 0 = automatic 1 = manual
c fail	Output; 1 = controller in failure handling
d ovc+	Input; 1 = override control + with 3-point stepping controllers (exept PIDMA)
d ovc–	Input; 1 = override control - with 3-point stepping controllers (exept PIDMA)
dec	Input; 1 = decrement for manual adjustment
gr off	Input; 1 = suppression of set-point gradient
hide	Input; 1 = no display of controller operating page
inc	Input; 1 = increment for manual adjustment
lock	Input; 1 = values can be altered neither with ▲▼ nor with **inc** / **dec**
o err	Output; 1 = error during self-tuning
o run	Output 1; 1 = self-tuning running
o stab	Output: 1 = process at rest (for self-tuning, exept PIDMA)
o–hide	Input; 1 = no display of self-tuning operating page
off	Input or output; 0 = controller switched on 1 = controller switched off
ostart	Input; 1 = self-tuning start
oplock	Input; 1 = Key blocked
Pi/P	Input or output; feedback/integrator 0 = with 1 = without (exept PIDMA)
rstart	Input; 1 = start set-point ramp
sm/hm	Input; 0 = soft manual 1 = hard manual
track	Input; 1 = tracking function on
w stop	Input; 1 = freeze effective set-point
w/w2	Input; 0 = int./ext. set-point 1 = W2
we/wi	Input or output; 0 = external 1 = internal set-point
x f	Input; sensor failure x1...x3
xw sup	Output; 1 = alarm suppression with set-point change
y/y2	Input or output; 0 = correcting value Y 1 = correcting value Y2
y1	Output; status of switching output Y1; 0 = off 1 = on
y2	Output; status of switching output Y2; 0 = off 1 = on
yp f	Input; sensor failure Yp

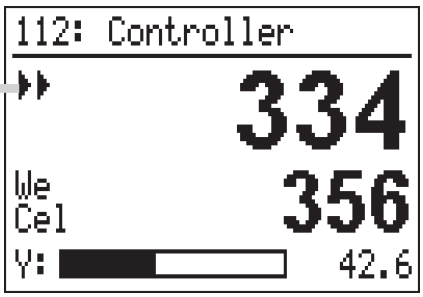
24.1 CONTR

(control function - no. 90)

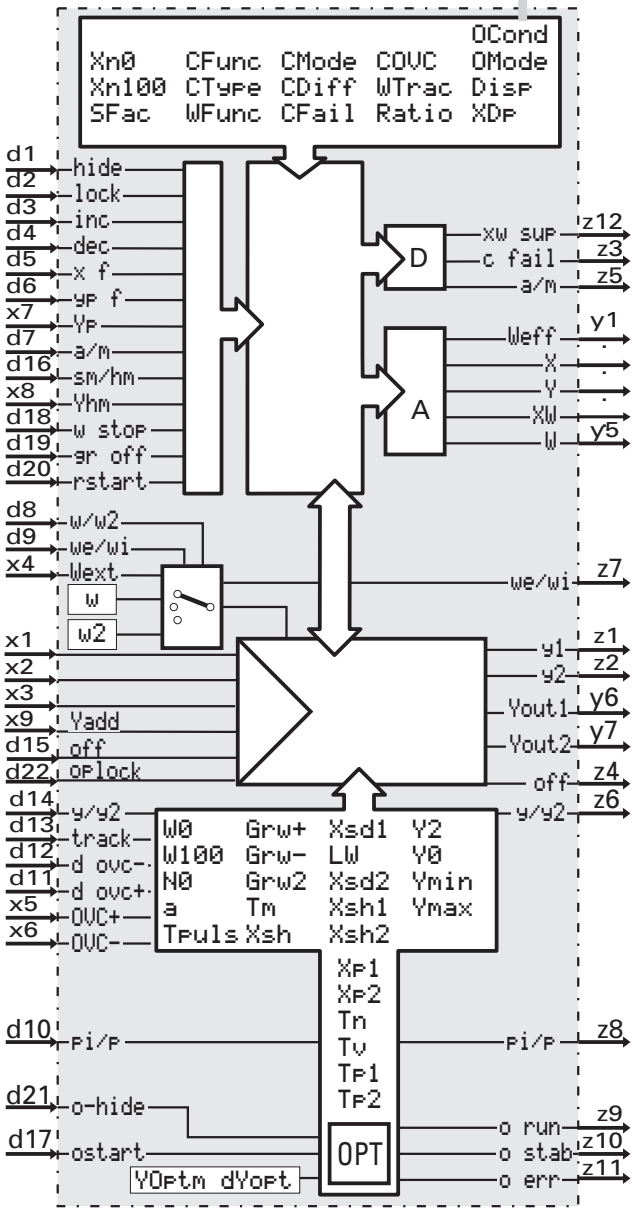
Page for self-tuning



operator page



Controller with one control parameter set. With d1 = 1 the operating page is not displayed. With d2 = 1 the values are adjustable neither with keys ▲▼ nor with d3 (↑) / d4 (↓).



Parameter	Description	Values	Default
W0	Min. set-point limit (Weff)	Real	0
W100	Max. set-point limit (Weff)		100
W2	Additional set-point		100
Grw+	Set-point gradient + (K/min)	Real	- - - -
Grw-	Set-point gradient - (K/min)		- - - -
Grw2	Set-point gradient W2 (K/min)		- - - -
N0	Zero ratio control	Real	0
a	Factor a (3-element control)	Real	1
Xsh	Trigger point separation	Real	0,2
Tpuls	Min.pos.step time		0,3
Tm	Actuator response time		30
Xsd1	Switching difference signaller	Real	1
LW	Trigg.pnt.separ.add.contact		- - - -
Xsd2	Switch.difference add.contact		1
Xsh1	Trigger point separation (PD)	Real	0
Xsh2	Trigger point separation (PD)		0
Y2	Additional correcting value	Real	0
Ymin	Min. correcting variable limit	Real	0
Ymax	Max. correcting variable limit		100
Y0	Controller working point	Real	0
YOptm	Corr.value with proc.at rest		0
dYopt	Step height with self-tuning		100
Xp1	Proportional band 1	Real	100
Xp2	Proportional band 2		100
Tn	Integral time		10
Tv	Derivative time		10
Tp1	Cycle time heating		5
Tp2	Cycle time cooling		5

Configuration	Description	Values	Default
CFunc	Signallers:		9
	1 Output	0	
	2 Outputs	1	
	2-point controller	2	
	3-point controller		
	Heating/cooling switching	3	
	Heat.cont./cool.cont.	4	
	Heat.switch./cool.cont.	5	
	2-point + add. contact *	6	
	3-pnt.stepping controller:		
	Standard	7	
	With position feedback Yp	8	
	Continuous controller:		
	Standard	9	
	With split-range behaviour	10	
	With position feedback Yp	11	
CType	Standard controller	0	0
	Ratio controller	1	
	3-element controller	2	
WFunc	Set-point control	0	0
	Set-point/cascade control	1	
CMode	Output action inverse	0	0
	Output action direct	1	
CDiff	Differentiation Xw	0	0
	Differentiation X	1	
CFail	Behaviour with sensor failure:		1
	Neutral	0	
	Ypid = Ymin (0%)	1	
	Ypid = Ymax (100%)	2	
	Ypid = Y2 (alteration via front not possible)	3	
	Ypid = Y2 (automatic) or Yman (manual mode)	4	
COVC	No override control	0	0
	Override-Control +	1	
	Override-Control -	2	
	Override-Control + / -	3	

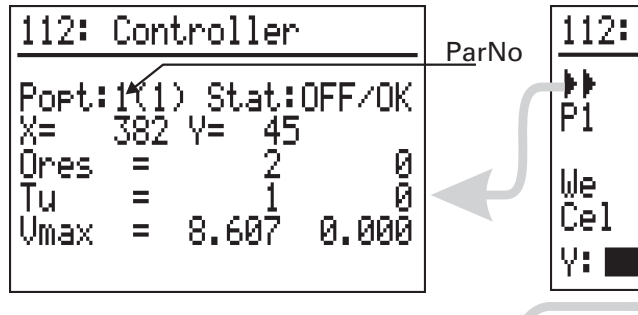
* Used as Δ / Y / OFF controller

Configuration	Description	Values	Default
WTrac	No tracking of Wint	0	0
	Set-point tracking	1	
	Process value tracking	2	
Ratio	Function of ratio controller:		0
	(x1 + N0) / x2	0	
	(x1 + N0) / (x1 + x2)	1	
	(x2 -x1 + N0) / x2	2	
XDp	Digits beh.dec.pnt.(proc.v.)	0...3	0
Disp	Content of bargraph line:		0
	Correcting variable	0	
	Control deviation	1	
	Xeff	2	
OMode	Self-tuning mode:		0
	Standard	0	
OCond	Condition for process at rest:		0
	grad = 0	0	
	grad <0 (controller inv.) grad >0 (controller dir.)	1	
	grad <>0	2	
Xn0	Span start	Real	0
Xn100	Span		100
SFac	Factor stoichiom. ratio	Real	1,00

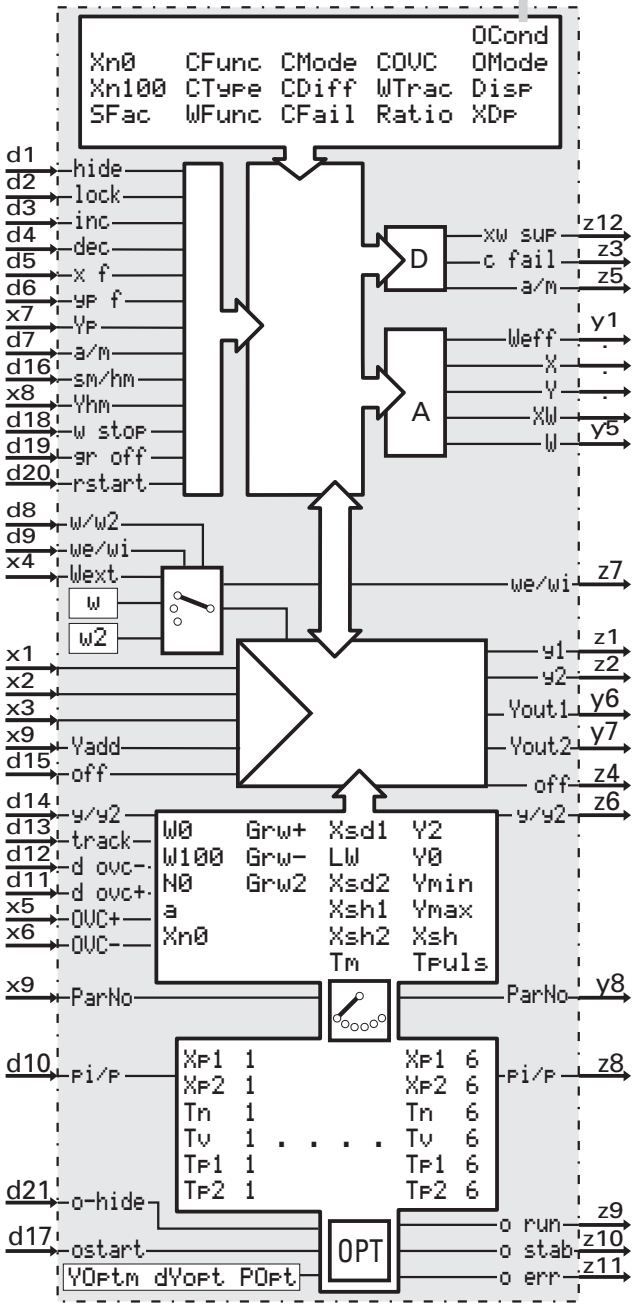
24.2 CONTR+

(extended control function - no. 91)

Page for self-tuning *operator page*



Controller with six control parameter sets. With d1 = 1 the operating page is not displayed. With d2 = 1 the values are alterable neither with keys ▲▼ nor with d3 (↑) / d4 (↓).



Parameter	Description	Values	Default
W0	Min. set-point limit (Weff)		0
W100	Max. set-point limit (Weff)	Real	100
W2	Additional set-point		100
Grw+	Set-point gradient plus		- - - -
Grw-	Set-point gradient minus	Real	- - - -
Grw2	Set-point gradient for W2		- - - -
N0	Zero ratio control	Real	0
a	Factor a (3-element control)	Real	1
Xsh	Trigger point separation		0,2
Tpuls	Min.pos.step time	Real	0,3
Tm	Actuator response time		30
Xsd1	Switching difference signaller		1
LW	Trigg.pnt.sep.add.contact	Real	- - - -
Xsd2	Switch.difference add.contact		1
Xsh1	Trigger point separation (PD)	Real	0
Xsh2	Trigger point separation (PD)		0
Y2	Additional correcting value	Real	0
Ymin	Min. output limiting	Real	0
Ymax	Max. output limiting		100
Y0	Controller working point		0
YOptm	Correct.value w.process at rest	Real	0
dYopt	Self-tuning step height		100
POpt	Parameter set to be optimized	1...6	1
Xp1 1...6	Proportional band 1		100
Xp2 1...6	Proportional band 2		100
Tn 1...6	Integral time set	Real	10
Tv 1...6	Derivative time set		10
Tp1 1...6	Cycle time heating		5
Tp2 1...6	Cycle time cooling		5

Configuration	Description	Values	Default
CFunc	Signaller:		9
	1 Output	0	
	2 Outputs	1	
	2-point controller	2	
	3-point controller:		
	Heating/cooling switching	3	
	Heat. cont./cool. switch.	4	
	Heat. switch./cool. cont.	5	
	2-point + add. contact *	6	
	3-point stepping controller:		
	Standard	7	
	With position feedback. Yp	8	
	Continuous controller:		
	Standard	9	
	With split-range behaviour	10	
	With position feedback Yp	11	
CType	Standard controller	0	0
	Ratio controller	1	
	3-element controller	2	
WFunc	Set-point control	0	0
	Set-point/cascade control	1	
CMode	Output action inverse	0	0
	Output action direct	1	
CDiff	Differentiation Xw	0	0
	Differentiation X	1	
CFail	Behaviour with sensor failure:		1
	Neutral	0	
	Ypid = Ymin (0%)	1	
	Ypid = Ymax (100%)	2	
	Ypid = Y2 (alteration via front not possible)	3	
	Ypid = Y2 (automatic) or Yman (manual)	4	
COVC	No override control	0	0
	Override-Control +	1	
	Override-Control -	2	
	Override-Control + / -	3	

Configuration	Description	Values	Default
WTrac	No tracking of Wint	0	0
	Set-point tracking	1	
	Process value tracking	2	
Ratio	Function of ratio controller:		0
	(x1 + N0) / x2	0	
	(x1 + N0) / (x1 + x2)	1	
	(x2 -x1 + N0) / x2	2	
XDp	Digits beh. dec.pnt.(proc.v.)	0...3	0
Disp	Content of bargraph line:		0
	Correcting variable	0	
	Control deviation	1	
	Xeff	2	
OMode	Self-tuning mode:		0
	Standard	0	
OCond	Condition for process at rest:		0
	grad = 0	0	
	grad <0 (controller inv.) grad >0 (controller dir.)	1	
	grad <>0	2	
Xn0	Span start	Real	0
Xn100	Span		100
SFac	Factor stoichiom. ratio	Real	1,00

* Used as Δ / Y / OFF controller

24.3 PIDMA

(controller function, No.93)

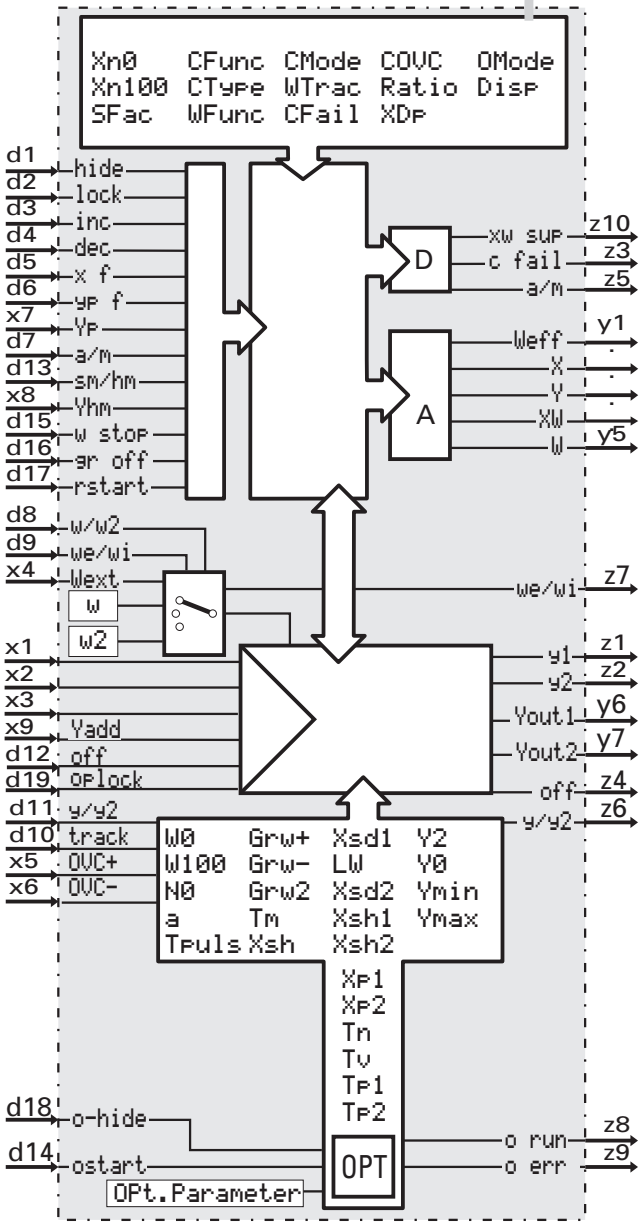
Self optimization page

```
100: PIDMA

X=      0 Y= 100(Man.)
W=     11 Weff=    11
T=      0 Status:OFF/OK
Ores= 0:Kein Fehler
K =     1
Ti=    10  Td=    10
```

operating page

```
112: Controller

        334   <- xeff
We
Cel     356   <- weff(y)
Y:  ######      42.6   <- y(xeff/xw)
```

Controller with one set of control parameters. With d1 = 1 the operating page is not shown. With d2 = 1 the values are neither with ▲▼ keys nor with d3 (↑) / d4 (↓) adjustable.



Parameter	Description	Values	Default
PType	Line type (with/without Compensation)	1/2	1
Drift	Drift compensation on/off	0/1	0
CSpeed	Control dynamic slow/normal/fast	1...3	1
W0	Min. set-point limit (Weff)		0
W100	Max. set-point limit (Weff)	Real	100
W2	Additional set-point		100
Grw+	Set-point gradient + (K/min)		- - - -
Grw-	Set-point gradient - (K/min)	Real	- - - -
Grw2	Set-point gradient for W2 (K/min)		- - - -
N0	Zero ratio control	Real	0
a	Factor a (3-element control)	Real	1
TPause	Min pause duration		0,1
Tpuls	Min.pos.step time	Real	0,3
Tm	Actuator response time		30
thron	Switch-on point of step. output	Real	0.2
throff	Switch-off point of step. output		0.2
Y2	Additional correcting value	Real	0
Ymin	Min. output limiting	Real	0
Ymax	Max. output limiting		100
Y0	Controller working point	Real	0
dYopt	Self-tuning step height		20
Xlimit	Switch-off point for dYopt		10
Tdrift	Drift estimation time	Real	30
Tnoise	Noise estimation time		30
Kp	Control gain		1
Tn	Integral time set		10
Tv	Derivative time set		10
Tp1	Cycle time heating		5
Tp2	Cycle time cooling		5
VD	Derivative gain	Real	4
bW_p	Set-point weighing factor p-part		1
cW_d	Set-point weighing factor d-part		0
Tsat	Time constant "Anti reset wind up"		50
Xsh	Trigger point separation		0

Configuration	Description	Values	Default
CFunc	Controller type-selction:		1
	2-point controller	0	
	Continuous controller		
	Standard	1	
	With position feedback. Yp	8	
	3-point controller:		
	Heating/cooling switching	2	
	Heat. cont./cool. switch.	3	
	Heat. switch./cool. cont.	4	
	Heat. cont./cool. cont.	5	
	3-point stepping controller:		
	Standard	6	
	With position feedback. Yp	7	
CType	Standard controller	0	0
	Ratio controller	1	
	3-element controller	2	
WFunc	Set-point control	0	0
	Set-point/cascade control	1	
CMode	Output action inverse	0	0
	Output action direct	1	
CFail	Neutral	0	
	Ypid = Ymin (0%)	1	
	Ypid = Ymax (100%)	2	
	Ypid = Y2 (alteration via front not possible)	3	
	Ypid = Y2 (automatic) or Yman (manual)	4	
COVC	No override control	0	0
	Override-Control +	1	
	Override-Control -	2	
	Override-Control + / -	3	

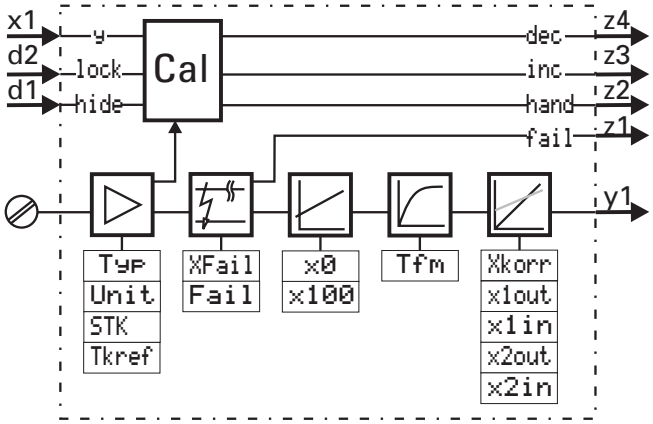
Configuration	Description	Values	Default
WTrack	Tracking-Funktion		0
	No tracking of Wint	0	
	Set-point tracking	1	
	Process value tracking	2	
Ratio	Function of ratio controller:		0
	(x1 + N0) / x2	0	
	(x1 + N0) / (x1 + x2)	1	
	(x2 -x1 + N0) / x2	2	
XDp	Digits beh. dec.pnt.(proc.v.)	0...3	0
Disp	Content of bargraph line:		0
	Correcting variable	0	
	Control deviation	1	
	Xeff	2	
Xn0	Span start	Real	0
Xn100	Span	Real	100
SFac	Factor stoichiom. ratio	Real	0

25 Inputs

25.1 AINP1

(analog input 1 - no. 110)

For direct connection of temp. sensors, for resist. transducers and standard signals



calibration

x1, z2, z3, z4 are used for resistance transducer or line calibration with 2x Pt100 (→ section Menus, Calibration). With d2 = 1 this calibration is disabled, with d1 = 1 the calibration page is not displayed. With `fail` , z1 = 1 (sensor failure).

For INP1 configuration and parameter setting. Block number 61, calculated once per time slot.

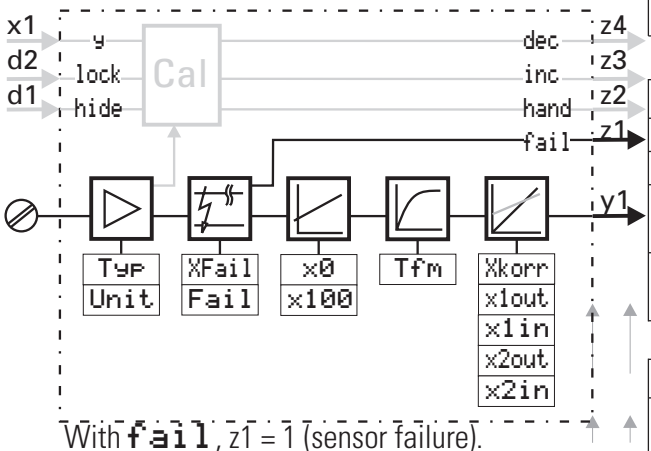
Parameter	Description	Values	Default
x1in	Meas.value correction P1, input	Real	0
x1out	Meas.value correction P1, output		0
x2in	Meas.value correction P2, output		100
x2out	Meas.value correction P2, output		100

Configuration	Description	Values	Default
Typ	Type L -200...900 °C	00	30
	Type J -200...900 °C	01	
	Type K -200...1350 °C	02	
	Type N -200...1300 °C	03	
	Type S -50...1760 °C	04	
	Type R -50...1760 °C	05	
	Type T -200...400 °C	06	
	Type W 0...2300 °C	07	
	Type E -200...900 °C	08	
	Type B 0...1820 °C	09	
	Pt 100 -99,9...850,0 °C	20	
	Pt 100 -99,9...250,0 °C	21	
	2x Pt 100 -99,9...850 °C	25	
	2x Pt 100 -99,9...250,0 °C	26	
	0...20 mA	30	
	4...20 mA	31	
	0...10 V	32	
	2...10 V	33	
	Transducer 0...500 Ω	40	
	Resistance 0...500 Ω linear	45	
	Resistance 0...250 Ω linear	46	
Fail	Fail function off	0	1
	z1 = 1, y1 = x100	1	
	z1 = 1, y1 = x0	2	
	z1 = 1, y1 = XFail	3	
Xkorr	Meas.value correction off	0	0
	Correction adjustable	1	
Unit	Unit = °C	1	1
	Unit = °F	2	
STK	Int. temperature compensation	1	1
	Ext. temperature compensation	2	
x0	Physical value at 0%	Real	0
x100	Physical value at 100%		100
XFail	Substitute value with sensor fail		0
Tfm	Filter time constant [s]		0,5
Tkref	Refer. temperature with STK=2		0

25.2 AINP3...AINP6

(analog inputs 3...6 - no. 112...115)

For connection of standard signals, AINP6 also for resistance transducers, AINP3 also for dc voltage -50...1300 mV (9407-9xx-x2xx1)



With `fail`, z1 = 1 (sensor failure).

x1, z2, z3 and z4 are used for transducer calibration (AINP6, → section Menus, Calibration). With d2 = 1 this calibration is disabled, with d1 = 1 the calibration page is not displayed.

*** 9407-9xx-x2xx1, AINP3:**
With Type = 0...20 mA, the input is designed for -50...1300 mV. For further use of the output of INP3 with this scaling, an x0 of -50 and an x100 of 1300 must be adjusted.

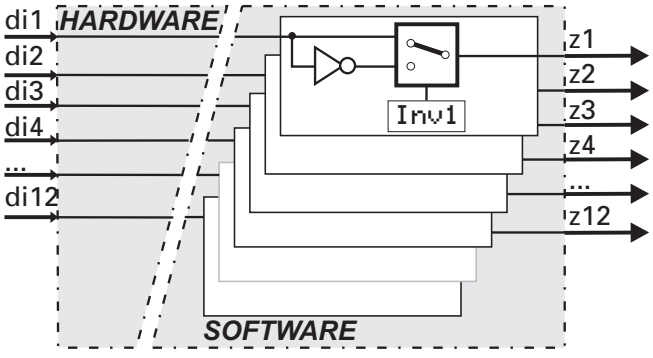
For INP3...INP6 configuration and parameter setting. Block numbers 63...66, calculated once per time slot.

		AINP					
Parameter	Description	3	4	5	6	Values	Def
`x1in`	Correction P1; input	✘	✘	✘	✘	Real	0
`x1out`	Correction P1; output	✘	✘	✘	✘		0
`x2in`	Correction P2; input	✘	✘	✘	✘		100
`x2out`	Correction P2; output	✘	✘	✘	✘		100

		AINP					
Configuration	Description	3	4	5	6	Values	Def
`Typ`	0...20 mA *	✘	✘	✘	✘	30	30
	4...20 mA	✘	✘	✘	✘	31	
	0...10 V	—	—	✘	—	32	
	2...10 V	—	—	✘	—	33	
	Transducer 0..1000 Ω	—	—	—	✘	40	
`Fail`	Fail function off	✘	✘	✘	✘	0	1
	z1 = 1, y1 = `x100`	✘	✘	✘	✘	1	
	z1 = 1, y1 = `x0`	✘	✘	✘	✘	2	
	z1 = 1, y1 = `XFail`	✘	✘	✘	✘	3	
`Xkorr`	Meas.val. correct. off	✘	✘	✘	✘	0	0
	Correction adjustable	✘	✘	✘	✘	1	
`x0`	Phys. value at 0%	✘	✘	✘	✘	Real	0
`x100`	Phys. value at 100%	✘	✘	✘	✘		100
`XFail`	Subst. val. at `fail`	✘	✘	✘	✘		0
`Tfm`	Filter time const. [s]	✘	✘	✘	✘		0,5

25.3 DINPUT

(digital inputs - no. 121)



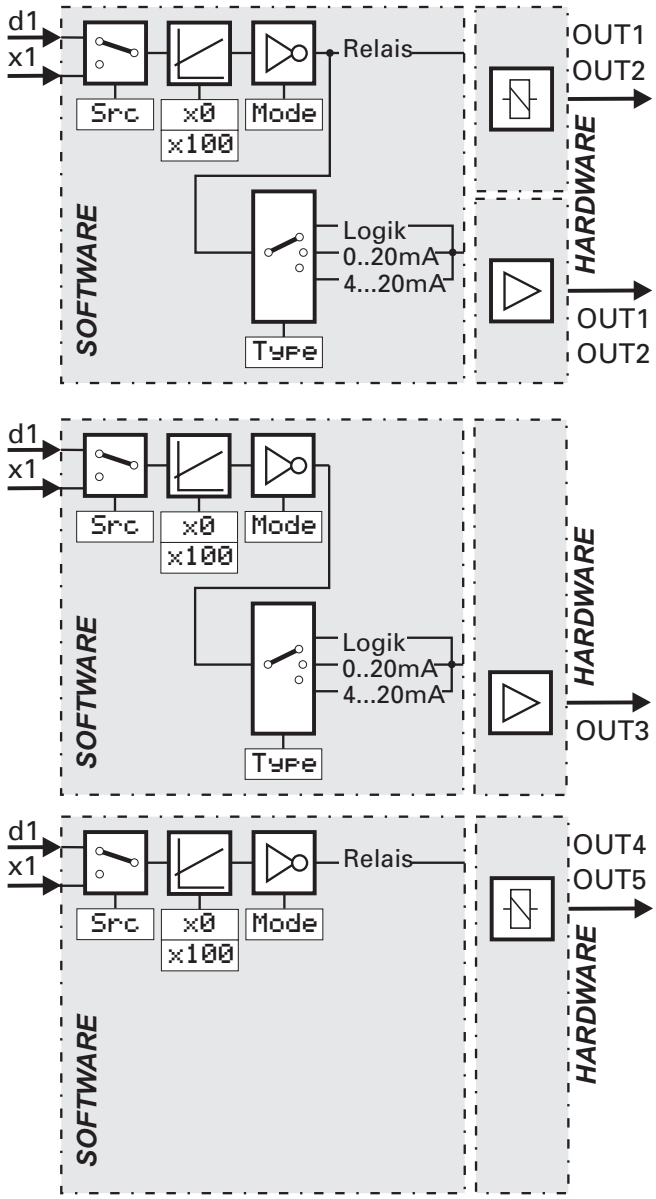
For di1...di12 configuration and parameter setting (di3...di12 are hardware-dependent). Block number 91, calculated once per time slot.

Configuration	Description	Values	Default
`Inv1...`	Output direct (z = di)	0	0
`Inv12`	Output inverse (z = $\overline{di}$)	1	

26 Outputs

26.1 OUT1...OUT5

(process outputs 1...5 - no. 116...120)

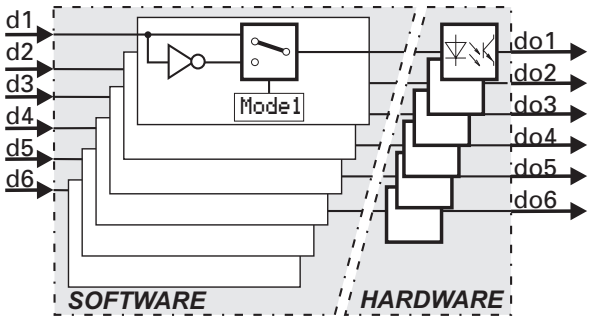


For OUT1...OUT5 configuration and parameter setting. Block numbers 81...85, calculated once per time slot.

Configuration	Description	OUT 1/2	OUT 3	OUT 4/5	Values	Def.
Src	Sign. source: d1 (digital)	✘	✘	✘	0	0
	Sign. source: x1 (analog)	✘	✘	✘	1	
	Operating principle:					
Mode	Direct/norm. open	✘	✘	✘	0	0
	Inverse/norm. closed	✘	✘	✘	1	
	Continuous output:					
Type	Logic 0/20 mA	✘	✘	—	0	1
	0...20 mA	✘	✘	—	1	
	4...20 mA	✘	✘	—	2	
	Input:					
x0	Value of x1 at 0%	✘	✘	✘	Real	0
x100	Value of x1 at 100%	✘	✘	✘		100

26.2 DIGOUT

(digital output - no. 122)



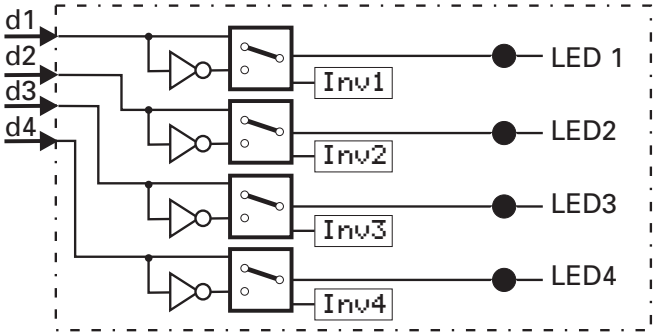
For configuration of DO1...DO6 (dependent of hard- ware). Block number 95, calculated once per time slot.

Configuration	Description	Values	Default
Mode1 ... Mode6	Output direct (do = d)	0	0
	Output inverse (do = $\overline{d}$)	1	

27 Zusatzfunktionen

27.1 LED

(LED display - no. 123)

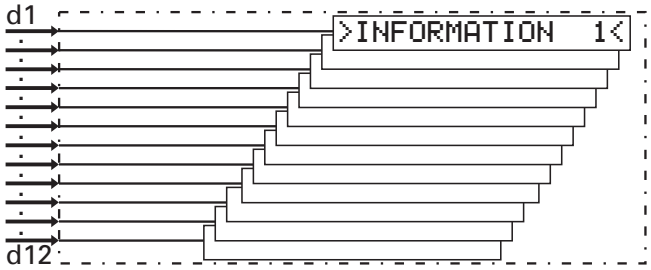


For configuration of the four LEDs.
Block number 96, calculated once per time slot.

Parameter	Description	Values	Default
Inv1... Inv4	No inversion (LED = d)	0	0
	Inversion (LED = $\bar{d}$)	1	

27.2 INFO

(information function - no. 124)

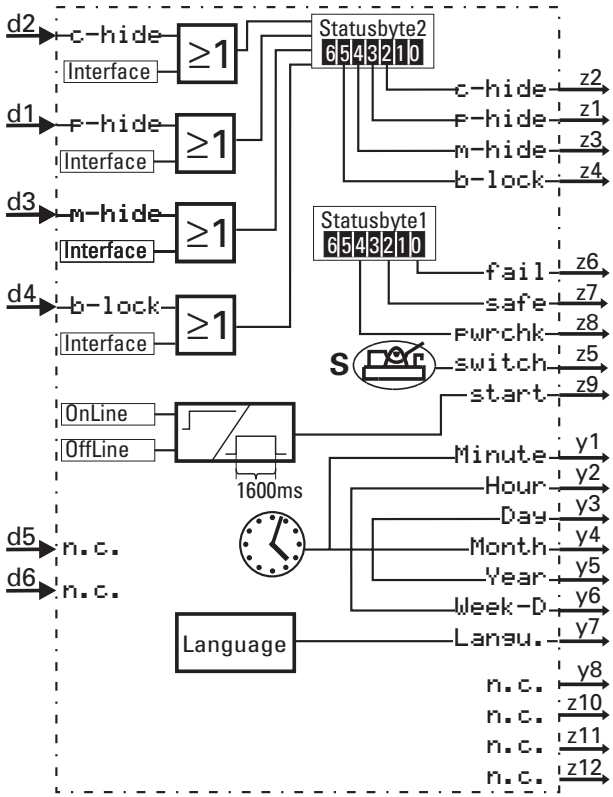


For configuration of 12 user texts each with max. 16 characters.
Block number 97, calculated once per time slot. If the relevant input is 1, the relevant text is displayed.

Parameter	Description
Text1... Text12	User texts each with max. 16 alphanumeric characters. Default: >INFORMATION XX<

27.3 STATUS

(status function - no. 125)

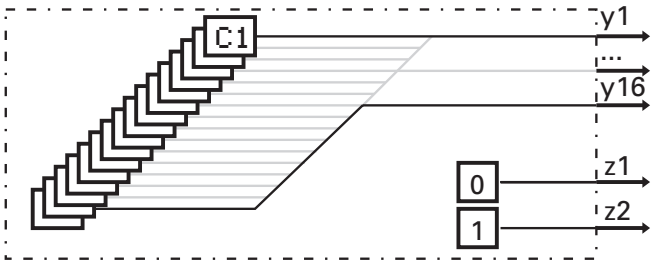


Block number 98, updated once per time slot.

d1=1: parameters/configurations are not displayed
d2=1: configurations are not displayed
d3=1: the main menu is not displayed, only operating pages are displayed during on-line operation
d4=1: the use of the bus interface is blocked
z1...z4:Infos from status byte 2 (signification as d1...d4)
z5=0: S.I.L. switch open, z5=1: switch closed
z6=1: common message sensor failure
z7: safety status, set via interface (code 22, fbno. 0, fctno. 0)
z8: power fail check, z8=0 after power ON
z9: after off-line → on-line to 1 during 1600 ms
Y1...Y6: status of real-time clock (if provided)
Y7=0: language German, Y7=1: language English (selected with Miscellaneous, Device data)

27.4 CONST

(constant function - no. 126)

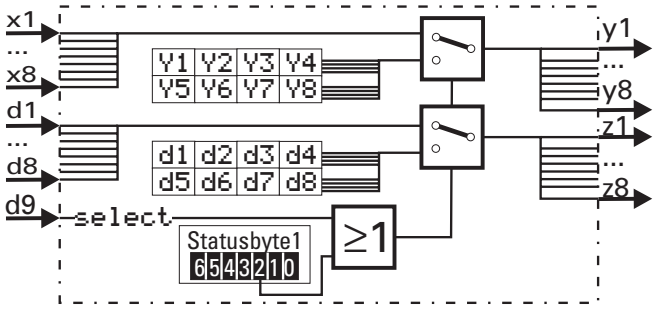


16 analog values and the logic levels 0 and 1 are made available. Block number 99, configured firmly once.

Parameter	Description	Values	Default
C1... C16	Analog constants	Real	0

27.5 SAFE

(safety function - no. 94)



For generation of 8 defined analog output values and digital levels. With d9 = 1 OR bit 2, status byte1 = 1 the configured data z1 ...z8 and Y1 ...Y8, otherwise the data applied to inputs d1...d8 and x1...x8 are output.
Bit 2 can be set via the interface (code 22, fbno. 0, fctno. 0).

Parameter	Description	Values	Default
Y1...Y8	Analog values	Real	0
z1...z8	Digital levels	0/1	

28 KS98 I/O extension modules

For mounting in KS98: 9407 - 9xx - x3xx1 and
9407 - 9xx - x4xx1.

Safety hints

ESD !
contains electrostatically sensitive components
-Original packing protects against electrostatic discharge (ESD).
-Transport only in original packing.
During mounting, rules for ESD protection must be taken into account.

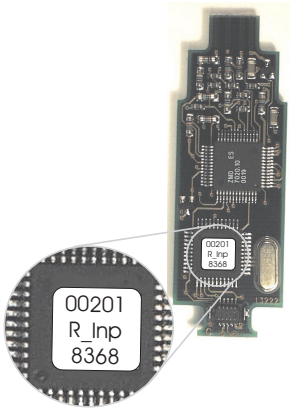
Connection:
-KS98 engineering must be taken into account, because it determines pin allocation and signification of connections.

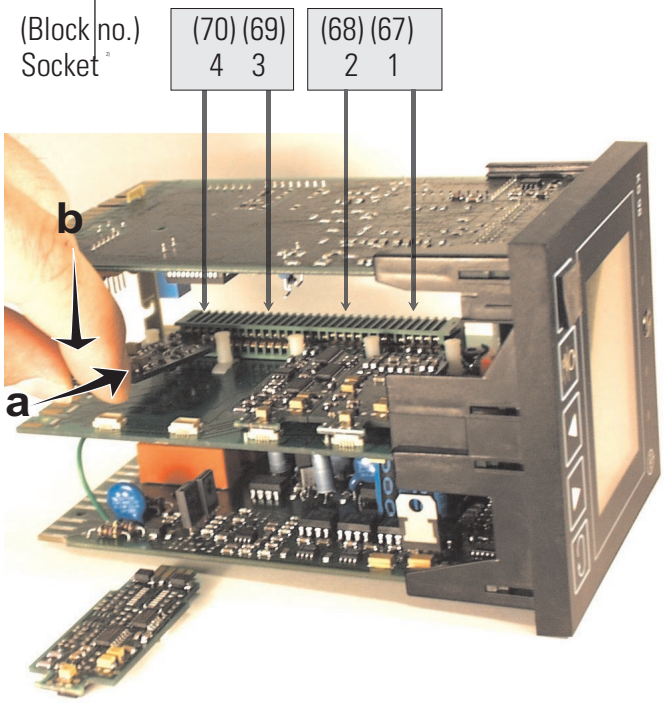
Maintenance:
No particular maintenance is required for the units.

When opening the units, live parts can be exposed. Before work, disconnect the supply voltage. The units contain electrostatically sensitive components.

I/O modules 9 4 0 7 - 9 9 8 - 0 0 x x 1	
Module type:	
Analog inputs:	
Pt 100 / 1000, Ni 100 /1000, Resistance, potentiometer	2 0
Thermocouple, mV, 0/4..20mA	2 1
-50...1500mV, 0...10V	2 2
Analog outputs:[1]	
0/2...10V, 0...±10V	3 0
0/4...20mA, 0...±20mA	3 1
Digital inputs/outputs:	
Digital I/O (universal)	4 0
Frequency/counter input	4 1

The various modules are distinguished by printed label.
The last 5 digits of the ordernumber are given in the upper line.

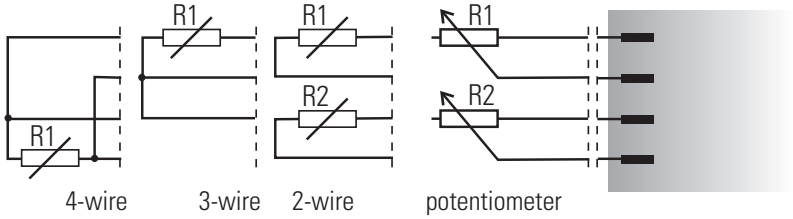




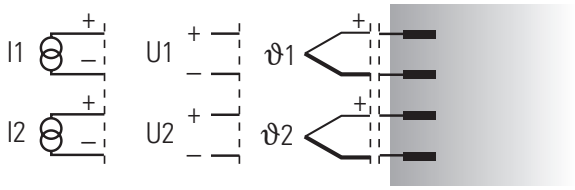
Mounting
After releasing the locking screw, withdraw the KS98 module from the housing. (a) - Insert the module into the required socket with the printed label pointing downwards into the green connector and click it in position in the small, white contact (b) at the top.

1)PERFORMANCE LIMITS
For reasons of maximum permissible self-heating, the number of possible analog output modules per basic card is limited: Max. one current output module! Max. one voltage output module, if a current output module is already provided (but in different galvanically isolated module groups)! The sum of performance factors (P factor, → Technical data) must not exceed 100%! If 100% are exceeded, a message is output in the Engineering Tool. Unless a current output module is used, modules of any type can be fitted on all sockets. Max. 1 current output module (any socket)! Max. 1 current and max. 1 voltage output module, but on galvanically isolated sockets!
Example: Current output module in socket 1 or 2 and voltage output module in sockets 3 or 4. The sum of P factors is 95%. 1 more resistance or 1 TC/mV/mA module can be fitted.2)
Galvanic isolation: sockets 1-2 are galvanically isolated from 3-4.

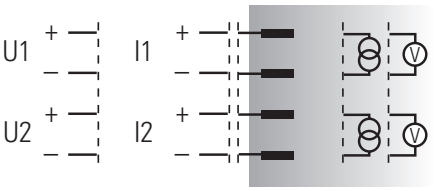
28.1 Electrical connections of modular option C



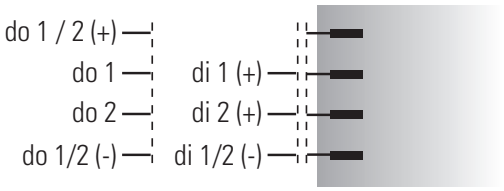
Resistive input
(9407-998-0x201)



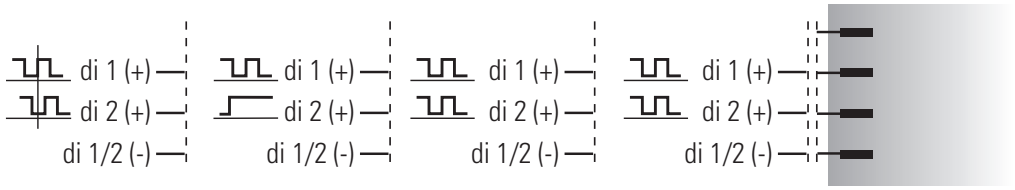
TC, mV, mA / V inputs
(9407-998-0x211) /
(9407-998-0x221)



Voltage /
current outputs
(9407-998-0x301) /
(9407-998-0x311)



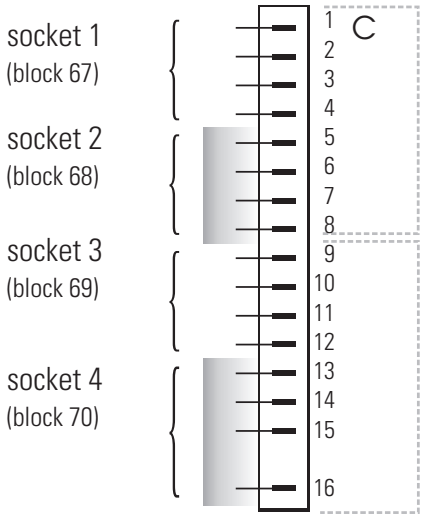
Combined digital inputs/
outputs
(9407-998-0x401)

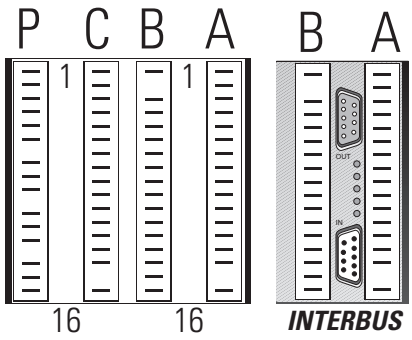


Frequency/
Counter inputs
(9407-998-0x241)

Quadruple counter up/down counter 2 x counter and 2 x frequency

Connect acc. to engineering!
(print-out with ET/KS 98plus)





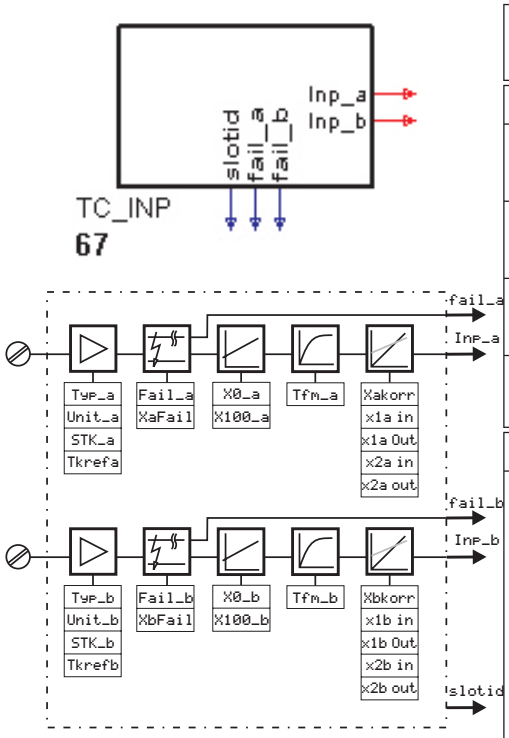
Connection of
basic unit

29 Modular I/O extension modules

29.1 TC_INP

(analog input card TC, mV, mA, No. 46)

Analog input, plugs into modular option card C



Digital outputs:

slotid
0 = correct module fitted
1 = faulty module fitted
e.g. sensor break

fail_a
0 = no measurement error on channel a detected
1 = measurement error on channel a detected
e.g. sensor break

fail_b
0 = no measurement error on channel b detected
1 = measurement error on channel b detected
e.g. sensor break

Analog outputs:

Inp_a → channel a measurement value
Inp_b → channel b measurement value

For configuration and parameter setting of analog inputs **R_INP**. The inputs are invariably calculated once per time slot.

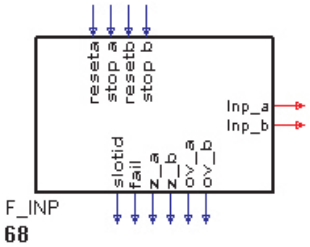
Parameter	Description	Values	Default
x1a in	Measured value correction Inp_a, P1 Input value	Real	0
x1aOut	Measured value correction Inp_a, P1 Output value		0
x2a in	Measured value correction Inp_a, P2 Input value		100
x2aOut	Measured value correction Inp_a, P2 Output value		100
x1b in	Measured value correction Inp_b, P1 Input value		0
x1bOut	Measured value correction Inp_b, P1 Output value		0
x2b in	Measured value correction Inp_b, P2 Input value		100
x2bOut	Measured value correction Inp_b, P2 Output value		100

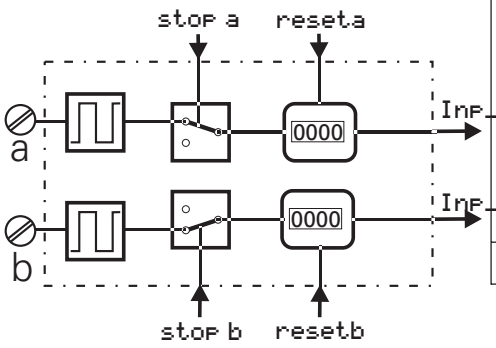
Configuration	Description	Values	Default
Typ_a Typ_b	Type L -200...900 °C	00	30
	Type J -200...900 °C	01	
	Type K -200...1350 °C	02	
	Type N -200...1300 °C	03	
	Type S -50...1760 °C	04	
	Type R -50...1760 °C	05	
	Type T -200...400 °C	06	
	Type W(C) 0...2300 °C	07	
	Type E -200...900 °C	08	
	Type B 0...1820 °C	09	
	Type D 0...2300 °C	10	
	Voltage 0...30mV	27	
	Voltage 0...100mV	28	
	Voltage 0...300mV	29	
	Standard signal 0...20mA	30	
	Standard signal 4...20mA	31	
Fail_a Fail_b	Switched off	0	1
	Upscale, Inp_a (Inp_b) = x100_a (x100_b)	1	
	Downscale, Inp_a (Inp_b) = x0_a (x0_b)	2	
	Substitute value, Inp_a (Inp_b) = XaFail (XbFail)	3	
Xakorr Xbkorr	Measured value correction Inp_a (b) switched off	0	0
	Measured value correction Inp_a (b) adjustable	1	
Unit_a Unit_b	Unit of measured value of Inp_a (b) = °C	1	1
	Unit of measured value of Inp_a (b) = °F	2	
STK_a STK_b	External temperature compensation	1	1
	External temperature compensation	2	
x0_a(b)	Physical value Inp_a (Inp_b) at 0%	Real	0
x100_a(b)	Physical value Inp_a (Inp_b) at 100%	Real	100
Xa(b)Fail	Substitute value at Inp_a(b)	Real	0
Tfm_a(b)	Filter time constant of Inp_a (Inp_b) in s	Real	0,5
Tkrefa(b)	Reference temperature Inp_a(b) at STK_a(b)	Real	0

29.2 F_INP

(frequency/counter input, No. 76)

The frequency/counter input plugs into modular options card C .





For input **F_INP** configuration and parameter setting.
The input is calculated once per time slot.

Configuration	Description	Values	Default
Func_a	DigInput →control input	0	1
	Count_1 →up counter	1	
	Count_2 → up/down counter	2	
	Count_3 → up/down counter with direction signal	3	
	Count_4 →quadruple counter	4	
	Count_5 →frequency counter	5	
Func_b	DigInput →control input	0	1
	Count_1→ up counter	1	
	Count_5 →frequency measurement	5	
Time	Time unit for frequency measurement in s	0,1...20	10

Digital inputs:

reseta → 1 = the value for **Inp_a** is reset to 0.
stop a → 1 = the instantaneous value for **Inp_a** remains unchanged.
resetb → 1 = the value for **Inp_b** is reset to 0.
stop b → 1 = the instantaneous value for **Inp_b** remains unchanged.

Digital outputs:

slotid → 0 = correct module fitted 1 = faulty module fitted
fail → 1 = fitted module is detected, but communication with module is not possible.
z_a → signal status of HW input a
z_b → signal status of HW input b
ov_a → 1 = frequency at HW input a is higher than the maximum permitted 20 kHz
ov_b → 1 = frequency at HW input b is higher than the maximum permitted 20 kHz

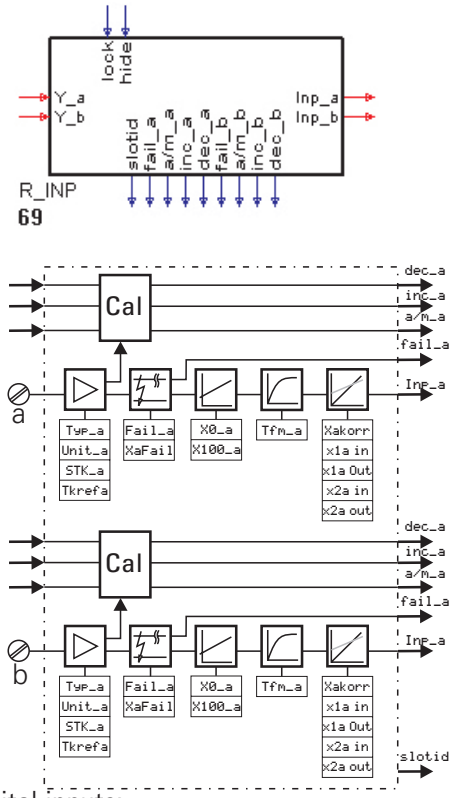
Analog outputs:

Inp_a → output value for channel a
Inp_b → output value for channel b

29.3 R_Inp

(analog input card Pt100/1000, Ni 100/1000, resistance, potentiometer, No. 77)

Analog input, plugs into modular options card C



Digital inputs:

lock =1 → disable calibration

hide =1 → calibration hidden

Digital outputs:

slotid

0 = correct module fitted

1 = faulty module fitted

fail_a(b)

0 = no measurement error detected on channel a (b)

1 = measurement error detected on channel a (b) E.g. sensor break

a/m_a(b)

Status of auto/manal key → 0 = automatic

Status of auto/manual key → 1 = manual

inc_a(b) =1 → ▲ key pressed

dec_a(b) =1 → ▼ key pressed

Analog inputs:

Y_a(b) → position feedback

Analog output:

Inp_a → measured value a

Inp_b → measured value b

For analog input **R_INP** configuration and parameter setting. The inputs are calculated invariably once per time slot.

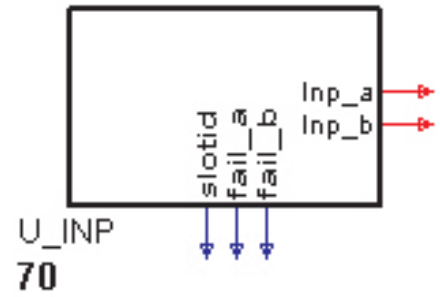
Parameter	Description	Values	Default
x1a in	Measured value correction Inp_a, P1 input value	Real	0
x1aOut	Measured value correction Inp_a, P1 output value		0
x2a in	Measured value correction Inp_a, P2 input value		100
x2aOut	Measured value correction Inp_a, P2 output value		100
x1b in	Measured value correction Inp_b, P1 input value		0
x1bOut	Measured value correction Inp_b, P1 output value		0
x2b in	Measured value correction Inp_b, P2 input value		100
x2bOut	Measured value correction Inp_b, P2 output value		100

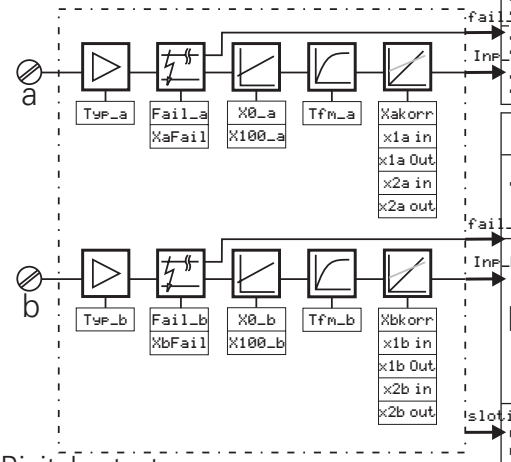
Configuration	Description	Values	Default
Typ_a Typ_b	Pt100 (850) -200 ... 850 °C	00	0
	Pt100 (100) -200 ... 100 °C	01	
	Pt1000 (-1) -200 ... 850 °C	02	
	Pt1000 (-2) -200 ... 100 °C	03	
	Ni100 -60 ... 180 °C	04	
	Ni1000 -60 ... 180 °C	05	
	R160 resistance 0 ... 160 Ohm	06	
	R450 resistance 0 ... 450 Ohm	07	
	R1600 resistance 0 ... 1600 Ohm	08	
	R4500 resistance 0 ... 4500 Ohm	09	
	Poti 160 potentiometer 0 ... 160 Ohm	10	
	Poti 450 potentiometer 0 ... 450 Ohm	11	
	Poti 1600 potentiometer 0 ... 1600 Ohm	12	
	Poti 4500 potentiometer 0 ... 4500 Ohm	13	
Fail_a Fail_b	Switched off	0	1
	Upscale, Inp_a (Inp_b) = x100_a (x100_b)	1	
	Downscale, Inp_a (Inp_b) = x0_a (x0_b)	2	
	Substitute value, Inp_a (Inp_b) = XaFail (XbFail)	3	
Xakorr Xbkorr	Measured value correction Inp_a (b) switched off	0	0
	Measured value correction Inp_a (b) switched off	1	
Unit_a Unit_b	Unit of measured value Inp_a (b) = °C	1	1
	Unit of measured value Inp_a (b) = °F	2	
Mode	Inp_a and Inp_b: 2-wire connection	0	0
	Inp_a: 3-wire connection no Inp_b	1	
	Inp_a: 4-wire connection no Inp_b	2	
x0_a(b)	Physical value Inp_a (Inp_b) at 0%	Real	0
x100_a(b)	Physical value Inp_a (Inp_b) at 100%	Real	100
Xa(b)Fail	Substitute value with sensor error at Inp_a(b)	Real	0
Tfm_a(b)	Filter time constant Inp_a (Inp_b) in s	Real	0,5
Kal_1a(b)	1st calibration value Inp_a(b) (read only)	Real	0
Kal_2a(b)	2nd calibration value Inp_a(b) (read only)	Real	100

29.4 U_INP

(analog input card -50...1500mV, 0...10V, no. 78)

Analog input, plugs into modular options card





For analog input **U_INP** configuration and parameter setting. The input is calculated invariably once per time slot.

Parameter	Description	Values	Default
x1a in	Measured value correction Inp_a, P1 Input value	Real	0
x1aOut	Measured value correction Inp_a, P1 Output value		0
x2a in	Measured value correction Inp_a, P2 Input value		100
x2aOut	Measured value correction Inp_a, P2 Output value		100
x1b in	Measured value correction Inp_b, P1 Input value		0
x1bOut	Measured value correction Inp_b, P1 Output value		0
x2b in	Measured value correction Inp_b, P2 Input value		100
x2bOut	Measured value correction Inp_b, P2 Output value		100

Configuration	Description	Values	Default
Typ_a	Voltage 0...10V	0	0
	Voltage -50...1500mV	1	
Fail_a	Switched off	0	1
	Upscale, Inp_a = x100_a	1	
	Downscale, Inp_a = x0_a	2	
	Substitute value, Inp_a = XaFail	3	
Xakorr	Measured value correction Inp_a switched off	0	0
	Measured value correction Inp_a adjustable	1	
Typ_b	Voltage 0...10V	0	0
	Voltage -50...1500mV	1	
Fail_b	Switched off	0	1
	Upscale, Inp_b = x100_b	1	
	Downscale, Inp_b = x0_b	2	
	Substitute value, Inp_b = XbFail	3	
Xbkorr	Measured value correction Inp_b switched off	0	0
	Measured value correction Inp_b adjustable	1	
x0_a	Physical value Inp_a at 0%	Real	0
x100_a	Physical value Inp_a at 100%	Real	100
XaFail	Substitute value with sensor fail at Inp_a	Real	0
Tfm_a	Filter time constant of Inp_a in s	Real	0,5
x0_b	Physical value Inp_b at 0%	Real	0
x100_b	Physical value Inp_b at 100%	Real	100
XbFail	Substitute value with sensor fail at Inp_b	Real	0
Tfm_b	Filter time constant of Inp_b in s	Real	0,5

Digital outputs:

slotid

0 = correct module fitted

1 = faulty module fitted

fail_a

0 = no measurement error at channel a detected

1 = Measurement error at channel a detected (e.g. sensor break)

fail_b

0 = no measurement error at channel b detected

1 = measurement error at channel b detected (e.g. sensor break)

Analog outputs:

Inp_a

Measured value channel a

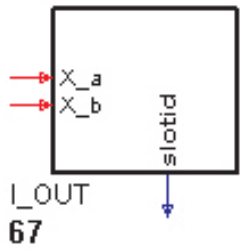
Inp_b

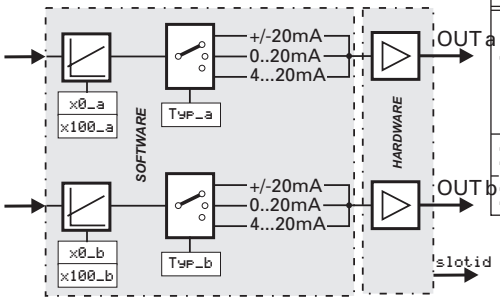
Measured value channel b

29.5 I_OUT

(analog output card 0/4...20mA, +/-20mA, No. 47)

Analog output, for inserting into modular options card C





For analog output **I_OUT** configuration and parameter setting. The output is calculated invariably once per time slot.

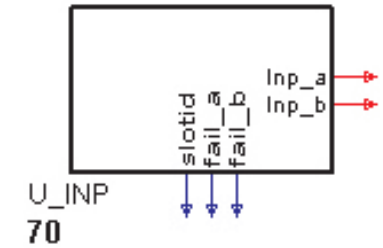
Configuration	Description	Values	Default
Typ_a	0...20mA	0	0
	4...20mA	1	
	+/-20mA	2	
x0_a	Physical value X_a at 0%	Real	0
x100_a	Physical value X_a at 100%	Real	100
Typ_b	0...20mA	0	0
	4...20mA	1	
	+/-20mA	2	
x0_b	Physical value X_b at 0%	Real	0
x100_b	Physical value X_a at 100%	Real	100

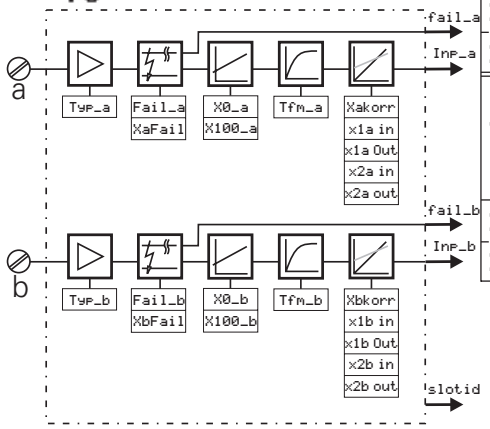
Digital output: slotid → 0 = correct module fitted 1 = faulty module fitted
Analog inputs: X_a → output value for channel a
X_b → output value for channel b

29.6 U_OUT

(analog output card 0/2...10V, +/-10V, No. 48)

Analog output, plugs into modular options card C





For analog output **U_OUT** configuration and parameter setting. The output is calculated invariably once per time slot.

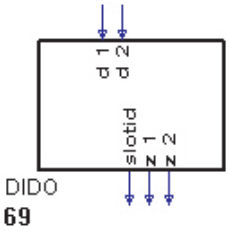
Configuration	Description	Values	Default
Typ_a	0...10V	0	0
	2...10V	1	
	+/-10V	2	
x0_a	Physical value X_a at 0%	Real	0
x100_a	Physical value X_a at 100%	Real	100
Typ_b	0...10V	0	0
	2...10V	1	
	+/-10V	2	
x0_b	Physical value X_b at 0%	Real	0
x100_b	Physical value X_a at 100%	Real	100

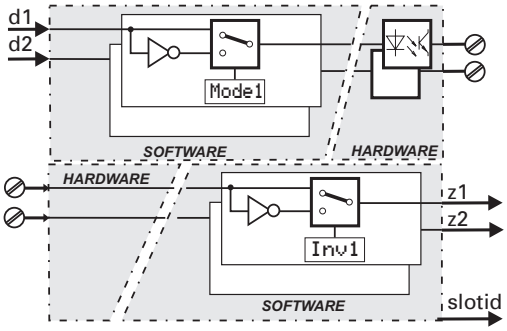
Digital output: slotid → 0 = correct module inserted 1 = faulty module fitted
Analog inputs: X_a → output value for channel a X_b → output value for channel b

29.7 DIDO

(digital input/output card, No. 44)

Digital input/output card, plugs into modular options card C





For digital input/output **DIDO** configuration and parameter setting. The function block is calculated invariably once per time slot.

Configuration	Description	Values	Default
Inv_Ia	direct - HW input di1 direct at z1	0	0
	inverse - HW input di1 inverted at z1	1	
Inv_Ib	direct - HW input di2 direct at z2	0	0
	inverse - HW input di2 invertd at z2	1	
Inv_Oa	direct - d1 direct on HW output do1	0	0
	inverse - d1 inverted on HW output do1	1	
Inv_Ob	direct - d1 direct on HW output do1	0	0
	inverse - d2 inverted on HW output do2	1	
Mode_a	Input - only HW input d1 at z1	0	0
	Output - d1 at HW output do1 with feedback at z1	1	
Mode_b	Input - only HW input d2 at z2	0	0
	Output - d2 at HW output do2 with feedback at z2	1	

Digital inputs:

d1 → if configured as an output: hardware output a
d2 → of configured as an output: hardware output b

Digital outputs:

slotid → 0 = correct module fitted 1 = faulty module fitted
z1 → status of hardware input a; if the channel was configured as an output, z1 is the fed back output value.
z2 → status of hardware input b; if the channel was configured as an output, z2 is the fed back output value.

30 Function management

Max. 350 function blocks can be used. Each function requires a defined portion of the working memory and a defined calculation time.

30.1 Memory requirement and calculation time

Function	Time %	Memory %
Scaling and calculation functions		
ABSV	0,4	0,2
ADSU	0,9	0,3
MUDI	0,9	0,3
SQRT	1,3	0,2
SCAL	3,2	0,2
10EXP	3,0	0,2
EEXP	1,6	0,2
LN	1,6	0,2
LG10	1,6	0,2
Non-linear functions		
GAP	0,3	0,2
CHAR	0,9	0,5
Trigonometric functions		
SIN	1,4	0,2
COS	2,0	0,2
TAN	1,4	0,2
COT	2,9	0,2
ARCSIN	2,4	0,2
ARCCOS	2,4	0,2
ARCTAN	1,8	0,2
ARCCOT	1,9	0,2
Logic functions		
AND	0,2	0,2
NOT	0,2	0,2
OR	0,2	0,2
EXOR	0,2	0,2
BOUNCE	0,3	0,2
FLIP	0,2	0,2
MONO	1,0	0,3
STEP	0,8	0,3
TIME1	1,2	0,3
Signal converters		
AOCTET	1,0	0,2
ABIN	1,5	0,3
TRUNC	0,3	0,2
PULS	0,9	0,2
COUN	0,4	0,3
MEAN	0,9	0,9
Controller		
CONTR	10,0	3,1
CONTR+	10,0	3,5
PIDMA	5,8	4,6

Function	Time %	Memory %
Time functions		
LEAD	0,7	0,3
INTE	0,6	0,3
LAG1	0,5	0,2
DELA1	0,9	1,9
DELA2	0,9	1,9
FILT	0,6	0,2
TIMER	0,5	0,2
TIME2	0,5	0,2
Selection and storage		
EXTR	0,5	0,2
PEAK	0,3	0,2
TRST	0,3	0,2
SELC	0,3	0,3
SELP	0,3	0,3
SELV1	0,3	0,2
SOUT	0,3	0,2
REZEPT	0,7	0,5
2OF3	1,4	0,3
SELV2	0,4	0,2
Limit signalling /limiting		
ALLP	0,8	0,3
ALLV	0,8	0,3
EQUAL	0,6	0,2
VELO	0,5	0,3
LIMIT	1,4	0,4
ALARM	0,4	0,3
Inputs		
AINP1	0,5	0,5
AINP3	0,4	0,3
AINP4	0,4	0,3
AINP5	0,4	0,3
AINP6	0,5	0,5
DINPUT	0,3	0,3
Outputs		
OUT1	0,9	0,3
OUT2	0,9	0,3
OUT3	0,9	0,3
OUT4	0,9	0,2
OUT5	0,9	0,2
DIGOUT	0,2	0,3

Function	Time %	Memory %
Additional functions		
LED	0,2	0,2
INFO	0,2	0,9
STATUS	0,4	0,3
CONST	0,2	0,4
SAFE	0,3	0,5
Visualization		
VWERT	0,4	1,7
VBAR	0,3	0,7
VPARA	2,5	1,1
VTREND	0,8	1,2
Communication		
L1READ	0,3	0,4
L1WRIT	0,3	0,4
DPREAD	0,5	0,4
DPWRIT	0,5	0,2
Programmer		
APROG	3,6	3,2
APROGD	0,9	0,5
DPROG	3,6	3,0
DPROGD	0,9	0,5
KS98+ CANopen		
C_RM2x	3,0	1,0
RM_DI	0,5	0,3
RM_DO	0,5	0,5
RM_AI	0,5	0,7
RM_AO	0,5	0,5
RM_DMS	1,0	0,8
CRCV	4,0	0,3
CSEND	5,0	0,5
C_KJS8x	3,0	0,8
KS8x	0,3	0,3
CPREAD	1,5	0,4
CPWRIT	0,8	0,4
CSDO	1,5	0,3
Modular option c		
TC_Imp	0,5	0,5
F_Imp	0,9	0,2
R_Imp	0,9	0,7
U_Imp	0,9	0,4
I_Out	0,5	0,2
U_Out	0,5	0,2
DIDO	0,5	0,2

30.2 Sampling intervals

The sampling intervals for conversion of input signals into internal values and conversion of internal values into output signals (hardware conversion) are given in the table opposite.

The sampling interval for software calculation of function blocks AINP1, AINP3...AINP6, DINPUT, STATUS, CONST, LED, INFO, OUT1...OUT5 and DIGOUT is 100 ms.

Input or output	Interval
INP1	200 ms
INP3 / INP4	100 ms
INP5	800 ms
INP6	400 ms
di1...di12	100 ms
OUT1...OUT5 / do1...do6	100 ms

Calculation of the other function blocks is at equal intervals according to their allocation to the 8 time slots of 100 ms. Allocation of a block to one or several time slots (100, 200, 400 or 800 ms) is in the engineering. The engineering defines an identification for each block (ts), which can be used for determining the allocation from the table opposite.

The sum of calculation times of all required function blocks must be < 100 % per time slot.

	Time slot								
ts	1	2	3	4	5	6	7	8	Interval
11	✘	✘	✘	✘	✘	✘	✘	✘	100 ms
21	✘	-	✘	-	✘	-	✘	-	200 ms
22	-	✘	-	✘	-	✘	-	✘	200 ms
31	✘	-	-	-	✘	-	-	-	400 ms
32	-	✘	-	-	-	✘	-	-	400 ms
33	-	-	✘	-	-	-	✘	-	400 ms
34	-	-	-	✘	-	-	-	✘	400 ms
41	✘	-	-	-	-	-	-	-	800 ms
42	-	✘	-	-	-	-	-	-	800 ms
43	-	-	✘	-	-	-	-	-	800 ms
44	-	-	-	✘	-	-	-	-	800 ms
45	-	-	-	-	✘	-	-	-	800 ms
46	-	-	-	-	-	✘	-	-	800 ms
47	-	-	-	-	-	-	✘	-	800 ms
48	-	-	-	-	-	-	-	✘	800 ms

30.3 Daten im EEPROM

Data are stored in non-volatile EEPROM. The manufacturers specify approx. 100 000 permissible write/read cycles per EEPROM address. In practice, however, this value can be exceeded mostly by a multiple. When changing parameters and configurations only manually, exceeding the max. number of write/read cycles is almost precluded. With digital interface or automatic parameter changes, however, taking the maximum number of write/read cycles into account is indispensable, and measures to prevent excessively frequent parameter writing must be taken.

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