

Drive Electronics pQ 03



For proportional valves

- Solenoid output current
1600 mA/2400 mA

For servo valves

- Output current 100 mA

Catalog Register
A 17, P 17, H 17

Publication 7501722.06.05.96

OBSOLETE
DOCUMENT

Technical
Reference
Only

Description

Design

The electronic amplifiers pQ 03 are used to control proportional pressure valves, proportional flow control valves and proportional directional control valves. Various amplifiers are available for different applications.

Accessories include potentiometers for adjustment of set points and ramps, set point PCBs, PCB-mounts, transformers, testing devices, control amplifiers, actual value sensors etc.

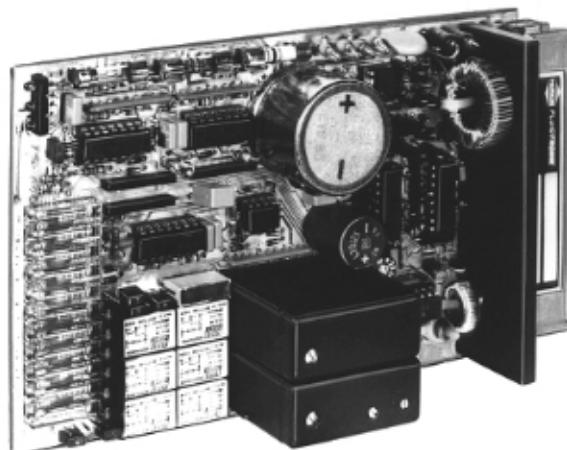
Function

The amplifier supplies a direct current for controlling proportional solenoids. This current is proportional to a set point at the amplifier input. In conjunction with a proportional valve this allows a pressure or a flow to be set to any desired value. In order to improve the hysteresis characteristics, a hum signal (I_{osc}) can be superimposed on the solenoid current. The user can define the operating range of a given valve characteristic in setpoint terms by means of the zeroing function and modulation limitation.

Rise and fall functions can be achieved by means of the ramp shaper. The amplifier card has two module locations. The modular concept makes it possible to implement both standard and customer-specific solutions to problems.

Standard modules are, for example, the following:

- Controller module for position controlling with proportional valves.
- Converter modules for setpoint processing (current inputs, D/A converter for computer control).
- Timer module for ramp adjustment times.
- Controller module for the control of physical variables, e.g. pressure, displacement.



Parameters

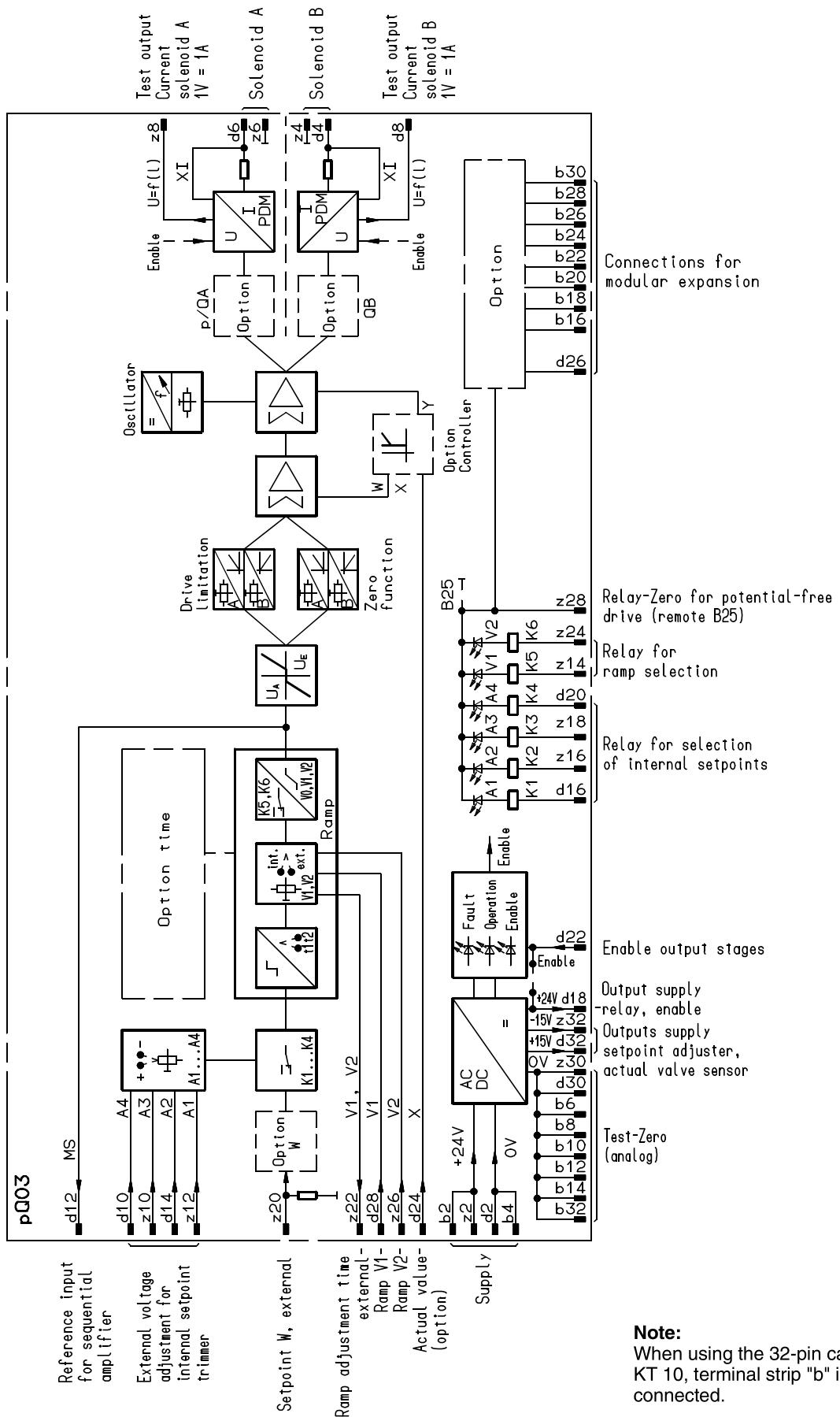
General parameters

Designation	Drive electronics pQ 03		
Design	Amplifier with current regulator PDM		
Mounting position	Vertical, free air circulation must be ensured		
Ambient temperature range	ϑ_U	[°C]	0 ... + 45
Weight		[kg]	0.4
Space requirements if installed in 19" rack		[mm]	European format 100 x 160 x 50 (alternatively 10 TE and 3 HE with front panel)
Terminal strip Type F DIN 41 612	Version		48-pin ¹⁾
Test plug			Terminal strip, two-row, 10-pin (to fit Tester TE 01 and Measuring adapter SA 01)

Technical data

Voltage supply	[V]	24 ± 4 VDC		
Residual ripple	[%]	10		
Current consumption	[A]	1.4	2.3	0.4
Power consumption	[VA]	32.5	55	10
Output current for solenoid	I_A	[mA]	0 ... 1600	0 ... 2400
Solenoid resistance	R_{20}	[Ω]	2.5 ... 7	2.5 ... 4.5
Solenoid lead-in	Cross-section 1.5 mm ²	Length max.	[m]	60
	Cross-section 2.5 mm ²	Length max.	[m]	100
	Cross-section 4 mm ²	Length max.	[m]	160
Outputs for supply of setpoint adjusters, actual-value sensors and internal modules	$I_{max.}$	[V] [mA]	+ 15 ± 0.6 75	
		[V] [mA]	- 15 ± 0.6 50	
Outputs for supply of relays, enable input, etc.	$I_{max.}$	[V] [mA]	24; tolerance + 2, - 8 75	
Zero-point shift		[% $I_{max.}$]	0 ... 40	
Drive limitation		[% $I_{max.}$]	0 ... 100	
Dither (amplitude)		[% $I_{max.}$]	0 ... 30	
Dither frequency		[Hz]	50 or 100 (selectable)	
Adjustment time (ramp) with internal/external adjustment for setpoint jump of $\Delta 10$ V	Range t 1	[s]	0.01 ... 1	
	Range t 2	[s]	0.1 ... 10	
With internal/external switch-over by relay	Nominal relay voltage Relay current	[V] [mA]	24; tolerance + 2, - 8 20	
Setpoint W, external Voltage control:				
– Input resistance	R_i	[kΩ]	200	
– Input voltage for solenoid A		[V]	0 ... + 10	
– Input voltage for solenoid B		[V]	0 ... - 10	
Current control:				
– Input resistance	R_i	[kΩ]	0.5	
– Input current for solenoid A		[mA]	0 ... + 20	
– Input current for solenoid B		[mA]	0 ... - 20	
Option: 4 internal setpoints selectable by relay	Nominal relay voltage Relay current	[V] [mA]	24; tolerance + 2, - 8 20	
Enable signal for output stages Input resistance (enable is signalled by LED)	R_i	[V] [kΩ] Input current	24; tolerance + 2, - 8 2.7 9	

Block diagram



Type list of Drive electronics pQ 03 (standard version for 1 solenoid)

Setpoint input	Internal setpoints	Ramps	Front panel 19" 3HE DIN 41 494	Terminal strip Type F DIN 41 612 Number of pins	Functional modules ²⁾					Current draw of amplifier	Cat. No.
					For description, see Page 8	Position controller	PID controller	D/A-converter	Analog converter		
Qty.	Qty.			RM 10	RM12	UM 01	UM 02	SM 10	[mA]		

For proportional valves with 1 solenoid

Rated current I_N : 0 ... 1600 mA, permissible solenoid resistance R_{20} : 2.5 ... 7 Ω

0 ... 10 V	—	—	—	48 ³⁾	—	—	—	—	—	1400	5998614
0 ... 10 V	—	—	X	48 ³⁾	—	—	—	—	—	1400	5998780
0 ... 20 mA	—	—	—	48 ³⁾	—	—	—	—	—	1400	5998615
digital, 7 bit ¹⁾	—	—	—	48	—	—	X	—	—	1400	5998616
0 ... 10 V	4	2	—	48 ³⁾	—	—	—	—	—	1400	5998617
0 ... 10 V	4	2	X	48 ³⁾	—	—	—	—	—	1400	5998995
0 ... 10 V	—	—	—	48 ³⁾	—	X	—	—	—	1400	5980030
0 ... 10 V	4	2	—	48 ³⁾	—	X	—	—	—	1400	5980029
0 ... 10 V	4	2	—	48	—	—	—	—	X	1400	5998688
digital, 7 bit ¹⁾	—	—	—	48	—	X	X	—	—	1400	5980084

For proportional valves with 1 solenoid

Rated current I_N : 0 ... 2400 mA, permissible solenoid resistance R_{20} : 2.5 ... 4.5 Ω

0 ... 10 V	—	—	—	48 ³⁾	—	—	—	—	—	2300	5998618
0 ... 10 V	4	2	—	48 ³⁾	—	—	—	—	—	2300	5998620
digital, 7 bit ¹⁾	—	—	—	48	—	—	X	—	—	2300	5998619
0 ... 10 V	—	—	X	48 ³⁾	—	—	—	—	—	2300	5980039
0 ... 10 V	—	—	—	48 ³⁾	—	X	—	—	—	2300	5980043
0 ... 10 V	4	2	—	48 ³⁾	—	X	—	—	—	2300	5980125

Symbol in table: "—" = without "X" = with

¹⁾ and sign reversal

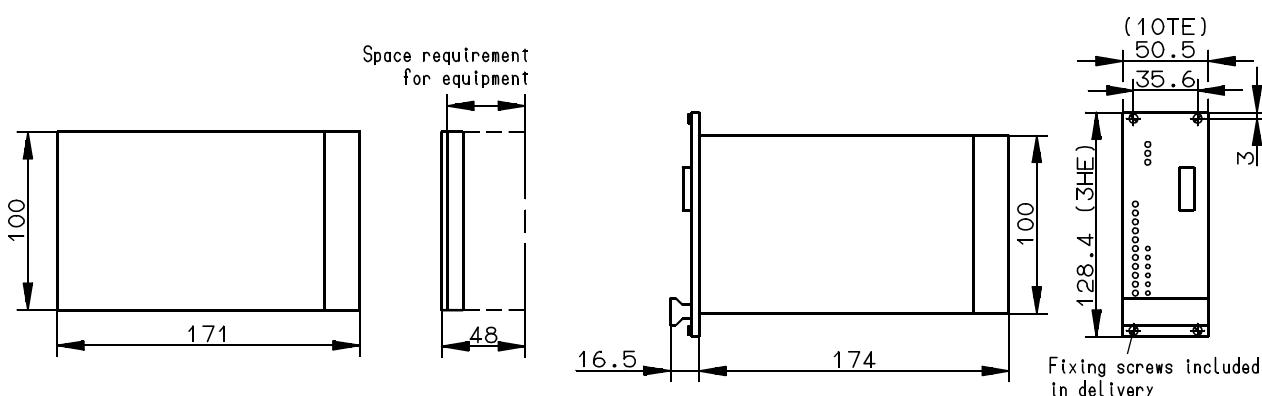
²⁾ module combinations not listed, available on request

³⁾ HERION card rack KT 10 (32-pin) may be used for electrical connection

Dimensional drawings [mm]

Version without front panel

Version with front panel (DIN 41 494)



Accessories for Drive electronics pQ 03

Accessories	Tester TE 01	Setpoint adjuster SE 01 1-turn potentiometer, angle of rotation 270°, for setpoint adjustment	ramp	Setpoint adjuster SE 02 10-turn potentiometer, angle of rotation 3600°, for setpoint adjustment	ramp	Setpoint adjuster SE 03 Digital potentiometer for setpoint adjustment on valves with 1 solenoid	Setpoint adjuster SE 03 Digital potentiometer for setpoint adjustment on valves with 2 solenoids	ramp	Trans-former TR 21 Input 110/220 V Output 24 V DC 3.0 A	Trans-former TR 22 Input 380 V Output 24 V DC 6.0 A	Card rack KT 10 32-pin	Card rack KT 11 48-pin
For technical data see												
Publication	7501788	7501675	7501675	7501782	7501782	7501783	7501783	7501783	7501789	7501789	7501790	7501791

Drive electronics pQ 03	Accessories - Order No.											
Cat. No.	5998639	5998534	5998535	5998536	5998537	5998647	5998542	5998543	5998609	5998611	5998539	5998540
5998614	X	X	—	X	—	X	—	—	X	X	X	X
5998780	X	X	—	X	—	X	—	—	X	X	X	X
5998615	X	—	—	—	—	—	—	—	X	X	X	X
5998616	X	—	—	—	—	—	—	—	X	X	—	X
5998617	X	X	X	X	X	X	—	X	X	X	X	X
5998995	X	X	—	X	—	X	—	—	X	X	X	X
5980030	X	X	—	X	—	X	—	—	X	X	X	X
5980029	X	X	X	X	X	X	—	X	X	X	X	X
5998688	X	X	X	X	X	X	—	X	X	X	—	X
5980084	X	—	—	—	—	—	—	—	X	X	—	X

5998618	X	X	—	X	—	X	—	—	X	X	X	X
5998620	X	X	X	X	X	X	—	X	X	X	X	X
5998619	X	—	—	—	—	—	—	—	X	X	—	X
5980039	X	X	—	X	—	X	—	—	X	X	X	X
5980043	X	X	—	X	—	X	—	—	X	X	X	X
5980125	X	X	—	X	—	X	—	—	X	X	X	—

Symbol in table: "—" = without "X" = with

Example of order:

Matching accessories for Drive electronics pQ 03, Cat. No. 5998614 (for proportional valves with 1 solenoid, In 0 ... 1600 mA)

- Tester TE 01, Cat. No. 5998639
- Setpoint adjuster SE 01, 1-turn potentiometer, angle of rotation 270°, for setpoint adjustment, Cat. No. 5998534 or
- Setpoint adjuster SE 02, 10-turn potentiometer, angle of rotation 3600°, for setpoint adjustment, Cat. No. 5998536 or
- Setpoint adjuster SE 03, digital potentiometer, for setpoint adjustment of valves with 1 solenoid Cat. No. 5998647
- Transformer TR 21, Cat. No. 5998609 or Transformer TR 22, Cat. No. 5998611
- Card rack KT 10, 32-pin, Cat. No. 5998539

Type list of Drive electronics pQ 03 (standard version for 2 solenoids)

Setpoint input	Internal setpoints	Ramps	Front panel 19" 3HE DIN 41 494	Terminal strip Type F DIN 41 612 Number of pins	Functional modules ²⁾					Current draw of amplifier	Cat. No.
					For description, see Page 8	Position controller	PID controller	D/A-converter	Analog-converter		
Qty.	Qty.			RM 10	RM12	UM 01	UM 02	SM 10	[mA]		

For proportional valves with 2 solenoids , without position control

Rated current I_N : 0 ... 1600 mA, permissible solenoid resistance R_{20} : 2.5 ... 7 Ω

0 ... ± 10 V	—	—	—	48 ³⁾	—	—	—	—	—	1400	5998621
digital, 7 bit ¹⁾	—	—	—	48	—	—	X	—	—	1400	5998622
0 ... ± 10 V	4	2	—	48 ³⁾	—	—	—	—	—	1400	5998624
0 ... ± 10 V	4	2	X	48 ³⁾	—	—	—	—	—	1400	5998626
0 ... ± 10 V	4	2	—	48 ³⁾	—	X	—	—	—	1400	5980057

For proportional valves with 2 solenoids , without position control

Rated current I_N : 0 ... 2400 mA, permissible solenoid resistance R_{20} : 2.5 ... 4,5 Ω

0 ... ± 10 V	—	—	—	48 ³⁾	—	—	—	—	—	2300	5998628
0 ... ± 10 V	4	2	—	48 ³⁾	—	—	—	—	—	2300	5998629
0 ... ± 10 V	4	2	X	48 ³⁾	—	—	—	—	—	2300	5998632

For proportional valves Type S 6 UR ... with 2 solenoids, with position control⁴⁾

0 ... ± 10 V	—	—	—	48 ³⁾	X	—	—	—	—	2300	5998623
0 ... ± 10 V	4	2	—	48 ³⁾	X	—	—	—	—	2300	5998625
0 ... ± 10 V	4	2	X	48 ³⁾	X	—	—	—	—	2300	5998627

For proportional valves Type S 10 UR ... with 2 solenoids, with position control⁵⁾

0 ... ± 10 V	—	—	—	48 ³⁾	X	—	—	—	—	2300	5998630
0 ... ± 10 V	4	2	—	48 ³⁾	X	—	—	—	—	2300	5998631
0 ... ± 10 V	4	2	X	48 ³⁾	X	—	—	—	—	2300	5998633
digital, 7 bit ¹⁾	4	2	—	48	X	—	X	—	—	2300	5998768

For proportional valves Type S 6 UI ... with 2 solenoids, with position control⁶⁾

0 ... ± 10 V	—	—	—	48 ³⁾	X	—	—	—	—	2300	5998781
0 ... ± 10 V	—	—	X	48 ³⁾	X	—	—	—	—	2300	5998797
0 ... ± 10 V	4	2	—	48 ³⁾	X	—	—	—	—	2300	5998782
0 ... ± 10 V	4	2	X	48 ³⁾	X	—	—	—	—	2300	5998798

For proportional valves Type S 10 UI ... with 2 solenoids, with position control⁷⁾

0 ... ± 10 V	—	—	—	48 ³⁾	X	—	—	—	—	2300	5998783
0 ... ± 10 V	—	—	X	48 ³⁾	X	—	—	—	—	2300	5998799
0 ... ± 10 V	4	2	—	48 ³⁾	X	—	—	—	—	2300	5998784
0 ... ± 10 V	4	2	X	48 ³⁾	X	—	—	—	—	2300	5998800

For servo valves Type HDSV 2 DI ... and -DIL ... , with 2 coils, rated current I_N 0 ... 100 mA,
Coil resistance 28 Ω ⁸⁾

0 ... ± 10 V	4	2	—	48 ³⁾	—	—	—	—	—	200	5980053
0 ... ± 10 V	4	2	—	48 ³⁾	—	X	—	—	—	200	5980098

Symbol in table: " — " = without " X " = with

¹⁾ and sign reversal

²⁾ Module combinations not listed, available on request

³⁾ HERION card rack KT 10 (32-pin) may be used for electrical connection

⁴⁾ See Publication 7501719, Catalog Register H 12

⁵⁾ See Publication 7502257, Catalog Register H 12

⁶⁾ See Publication 7502264, Catalog Register H 12

⁷⁾ See Publication 7502265, Catalog Register H 12

⁸⁾ See Publication 7501475 and 7502587, Catalog Register H 12

Accessories for Drive electronics pQ 03

Accessories	Tester TE 01	Setpoint adjuster SE 01 1-turn potentiometer, angle of rotation 270°, for setpoint adjustment	ramp	Setpoint adjuster SE 02 10-turn potentiometer, angle of rotation 3600°, for setpoint adjustment	ramp	Setpoint adjuster SE 03 Digital potentiometer for setpoint adjustment on valves with 1 solenoid	Setpoint adjuster SE 03 Digital potentiometer for setpoint adjustment on valves with 2 solenoids	ramp	Trans-former TR 21 Input 110/220 V Output 24 V DC 3.0 A	Trans-former TR 22 Input 380 V Output 24 V DC 6.0 A	Card rack KT 10 32-pin	Card rack KT 11 48-pin
For technical data see Publication	7501788	7501675	7501675	7501782	7501782	7501783	7501783	7501783	7501789	7501789	7501790	7501791
Drive electronics pQ 03	Accessories - Order No.											
Cat. No.	5998639	5998534	5998535	5998536	5998537	5998647	5998542	5998543	5998609	5998611	5998539	5998540
5998621	X	X	-	X	-	-	X	-	X	X	X	X
5998622	X	-	-	-	-	-	-	-	X	X	-	X
5998624	X	X	X	X	X	-	X	X	X	X	X	X
5998626	X	X	X	X	X	-	X	X	X	X	X	X
5980057	X	X	X	X	X	-	X	X	X	X	X	X
5998628	X	X	-	X	-	-	X	-	-	X	X	X
5998629	X	X	X	X	X	-	X	X	X	X	X	X
5998632	X	X	X	X	X	-	X	X	X	X	X	X
5998623	X	X	-	X	-	-	X	-	X	X	X	X
5998625	X	X	X	X	X	-	X	X	X	X	X	X
5998627	X	X	X	X	X	-	X	X	X	X	X	X
5998630	X	X	-	X	-	-	X	-	X	X	X	X
5998631	X	X	X	X	X	-	X	X	X	X	X	X
5998633	X	X	X	X	X	-	X	X	X	X	X	X
5998768	X	X	X	X	X	-	X	X	X	X	-	X
5998781	X	X	-	X	-	-	X	-	X	X	X	X
5998797	X	X	X	X	X	-	X	X	X	X	X	X
5998782	X	X	-	X	-	-	X	-	X	X	X	X
5998798	X	X	X	X	X	-	X	X	X	X	X	X
5998783	X	X	-	X	-	-	X	-	X	X	X	X
5998799	X	X	X	X	X	-	X	X	X	X	X	X
5998784	X	X	-	X	-	-	X	-	X	X	X	X
5998800	X	X	X	X	X	-	X	X	X	X	X	-
5980053	X	X	X	X	X	-	X	X	X	X	X	X
5980098	X	X	X	X	X	-	X	X	X	X	X	X

Symbol in table: " - " = without " X " = with

Example of order:

- Matching accessories for Drive electronics pQ 03, Cat. No. 5998621 (for proportional valves with 2 solenoids, I_N 0 ... 1600 mA)
- Tester TE 01, Cat. No. 5998639
 - Setpoint adjuster SE 01, 1-turn potentiometer, angle of rotation 270°, for setpoint adjustment, Cat. No. 5998534 or
 - Setpoint adjuster SE 02, 10-turn potentiometer, angle of rotation 3600°, for setpoint adjustment, Cat. No. 5998536 or
 - Setpoint adjuster SE 03, digital potentiometer, for setpoint adjustment of valves with 2 solenoids Cat. No. 5998542
 - Transformer TR 21, Cat. No. 5998609 or Transformer TR 22, Cat. No. 5998611
 - Card rack KT 10, 32-pin, Cat. No. 5998539

Function modules

Two module locations situated on the electronic control unit can be equipped at the factory with electronic circuits for additional functions. The electrical connections are made by means of the plug connector of the electronic unit. Adjusting elements such as potentiometers and switches are accessible on the top side of the module.

RM 10 controller module for position control for proportional directional control valves

Description

The RM 10 controller module is used for precision control of the spool in valves with position measuring systems like proportional directional valves, Types S 6 UR, S 6 UI, S 10 UR, S 10 UI and S 10 UN. The controller is permanently set to the optimum value and adapted to the valve type to be controlled. The RM 10 controller module consists of setpoint/actual-value comparator, PID controller and actual-value monitor, which registers a fault and disables the output stage of the amplifier PCB when e.g. actual value feedback is interrupted. The direction of the feedback signal can be altered via a switch on the module, so that a change of direction on the valve can be carried out.¹⁾

Parameters

Function: PID controller, fixed

Symbol:



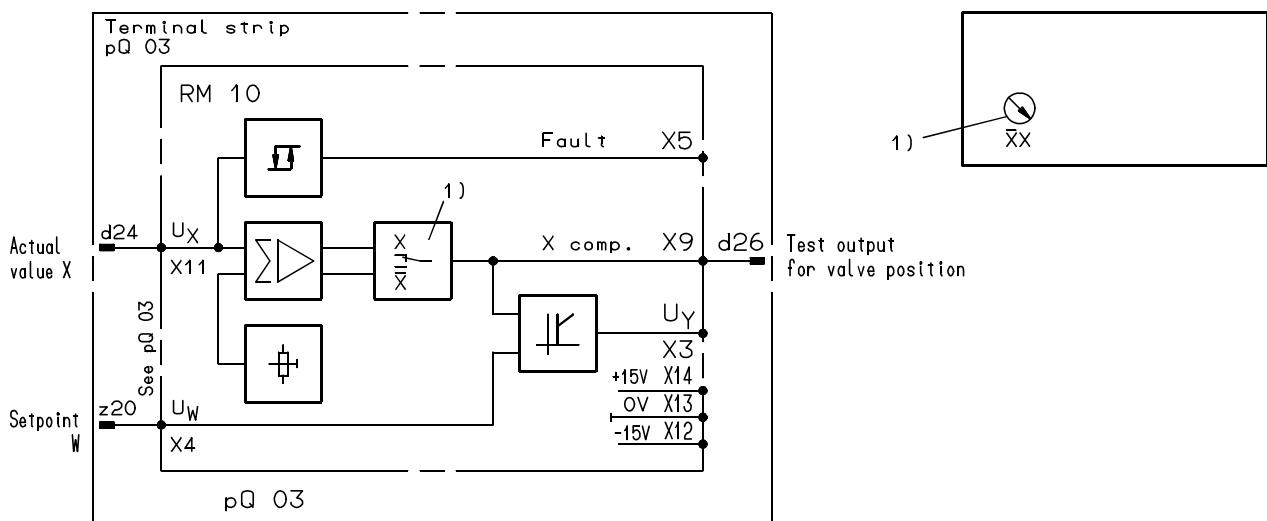
Output X-comp.:
Measurement output for
valve position

Output voltage [V] ± 10
Max. output current [mA] 1

Response characteristic
of controller PID

Block diagram

Top view



PID controller module RM 12 for controlling physical variables

Description

The controller module is suitable for controlling physical variables such as pressure, flow rate, position, speed etc. This variable is to be measured by the user by means of a corresponding sensor with electrical output signal (actual value signal) and applied to the actual value input U_X . The controller compares the actual value variable with the reference variable (setpoint from pQ 03). The deviation $X-W$ is applied to the subsequent PID controller; the controller's output serves as the setpoint for the output stage on the pQ 03 electronic control unit. The controller is enabled with the enabling of the pQ 03 output stage (d 22 input or B 22 jumper). I- and D-controllers can be connected or disconnected via jumpers.

The MR 12 controller module consists of actual-value interface, setpoint/actual-value comparator and adjustable PI controller. The deviation can be measured at output $X-W$ for adjustment of the controller. A threshold value switch is connected to the output side of the controller module. It produces a digital output signal when the deviation is within an adjustable tolerance.

Parameters

Function: PID controller, adjustable by means of a threshold

Symbol:



Input, actual value X

Voltage signal:

Input voltage	[V]	0 ... ± 10
Input resistance R_i	[MΩ]	> 1

Current signal:

Input current:	[mA]	0 (4) ... 20
Input resistance	[Ω]	250

Actual-value interface:

Compensation zero point	[V]	±0.25 ... ±5.5 ¹⁾
Gain factor		0.9 ... 2.7 ¹⁾

P-controller:

Proportional amplifier	[V _p]	0.42 ... 20.8 ¹⁾
Comparative accuracy	[%]	< 1

I-controller:

Control speed of reset time T_N	[V/s]	3.5 ... 110
Limitation I-share	[%]	0 ... 100

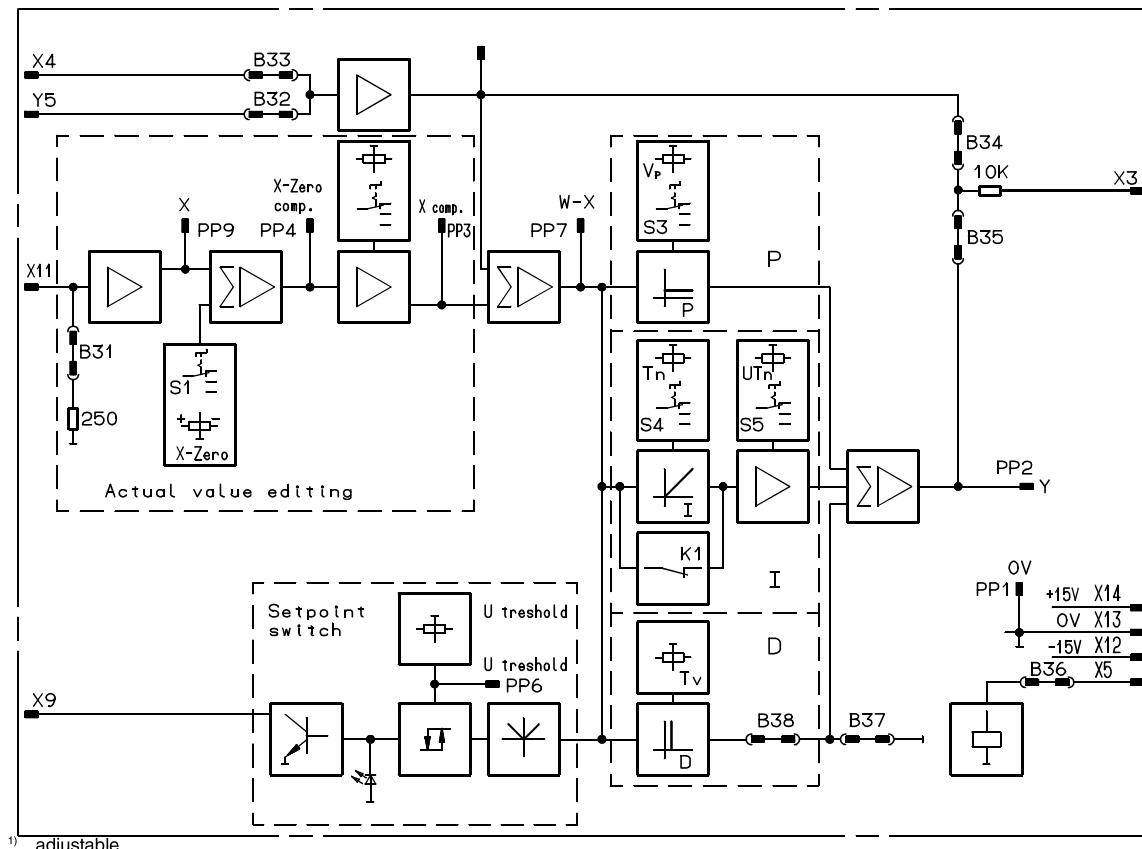
D-controller:

Reset time	[ms]	2 ... 160
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Threshold value switch:

Open collector output		
Max. voltage	[V]	30
Max. current	[mA]	50

Block diagram



UM 01 digital-analog converter module for converting setpoint signals

Description

The UM 01 converter module serves to convert digital 7-bit setpoint signals (e. g. from computers or binary switches), into a standard voltage signal 0 to 10 V, which can be processed by the pQ 03 electronic control unit. An analog setpoint signal can be subtracted from the specified digital setpoint via a separate input. It is possible to reverse the polarity of the setpoint by means of a built-in relay.

Parameters

Function: D/A converter

Symbol:



Input, digital setpoint:

Input voltage

Logic L [V] 0 ... 4

Logic H [V] 15 ... 28

Input resistance R_i [$k\Omega$] 33

Input, analog setpoint:

Input voltage

- maximum [V] ± 15

- nominal [V] 0 ... ± 10

Input resistance R_i [$k\Omega$] ≥ 10

Input, polarity reversal:

Input voltage [V] 24 ± 4

Input resistance R_i [$k\Omega$] 1.44

Response characteristic, D/A converter:

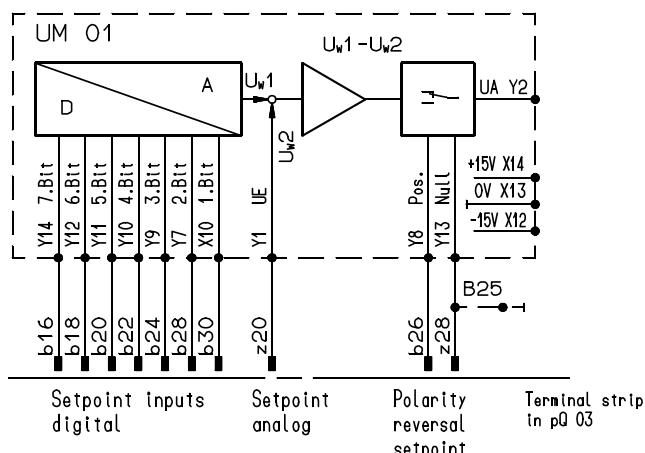
Number of bits 7

Coding binary

Resolution, analog [mA] 78

Accuracy [%] ± 1

Block diagram



Top view



UM 02 analog converter module for adapting analog setpoint signals

Description

The UM 02 converter module serves to adapt analog setpoint signals to the required standard signal 0 to 10 V on the pQ 03 electronic control unit. It is possible to use voltage or current signals as setpoint signals; these signals are within the ranges 0 ... \pm 10 V or 0 ... \pm 20 mA (e.g. 5 ... 8 V or 5 ... 10 mA). The standard interfaces 0 ... 20 mA and 4 ... 10 mA can be called up via selector switches. Differing signals can be adapted to 0 ... 10 V via adjustable potentiometers. It is possible to reverse the polarity of the setpoint signal by means of a built-in relay.

Parameters

Function: U/U converter, I/U converter
 Symbol:



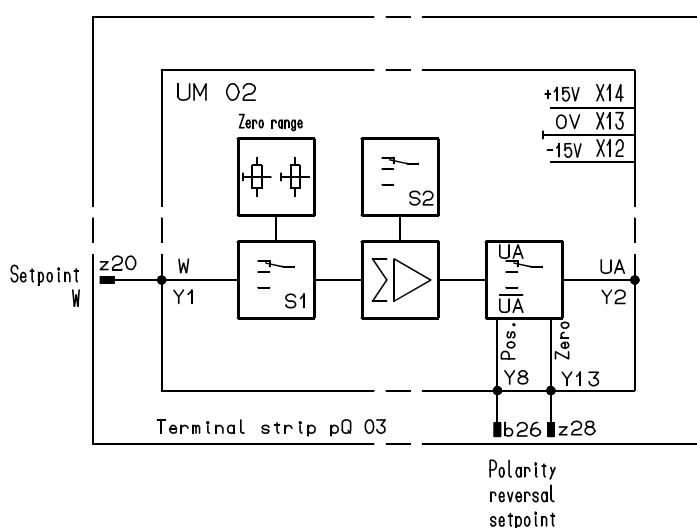
Input, setpoint:	
Voltage signal	min. [V] 0 ... \pm 1
	max. [V] 0 ... \pm 10
Input resistance R_i	[k Ω] 500
Current signal	min. [mA] 0 ... \pm 2
	max. [mA] 0 ... \pm 20
Load impedance	[Ω] 500

Input, polarity reversal:	
Input voltage	[V] 24 \pm 4
Input resistance R_i	[k Ω] 1.44

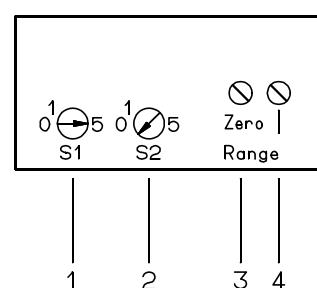
Response characteristic:	
Gain	0 ... 10
Zero shift	[V] 0 ... \pm 9
Linearity	[%] < 1
Symmetry	[%] < 1

Transformation error
 at $U_A = U_E$ [mV] < 20

Block diagram



Top view



- 1 Selector switch
- 2 Selector switch
- 3 Zero shift "Zero"
- 4 Gain "Range"

SM 10 trigger module for recognizing "Ramp on" function

Description

The SM 10 trigger module (threshold-value switch) serves to recognize an operating ramp function on the pQ 03 electronic control unit. The ramp function is operative when the setpoint voltage at the input of the ramp shaping circuit differs from the setpoint voltage at the output of the ramp shaping circuit, i.e. $U_E \neq U_A$. When the ramp is on, the output of the module switches the output signal to „On“. This output signal can be used in an external sequence control to introduce the next operation.

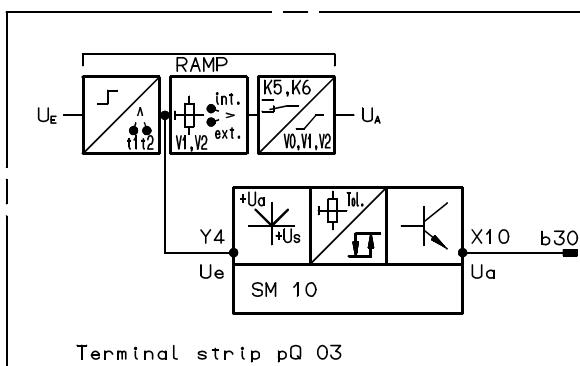
Parameters

Function:	Comparator		
Symbol:			
Output:	Open collector, switching to 0 V		
Voltage	max. [V]	40	
	max. [mA]	50	

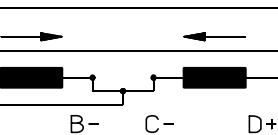
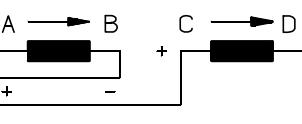
Transfer function:

U_a ON, when ramp of pQ 03 electronic control unit is on

Block diagram



Drive of servo valves, Types HDSV 2 DI and HDSV 2 DIL

Circuit	Connection to pQ 03	Coil connection
Push-pull circuit	d 4 d 6 z 4 z 6	
Single	d 6 z 6 z 4 d 4	

Symbol

